AEG

SVS POWER SUPPLY SYSTEMS

THYRO-A

THYRISTOR-LEISTUNGSSTELLER
THYRO-A 1A...H RL1, 2A...H RL1
THYRO-A 1A...H RLP, 2A...H RLP

THYRISTOR POWER CONTROLLER
THYRO-A 1A...H RL1, 2A...H RL1
THYRO-A 1A...H RLP, 2A...H RLP

Betriebsanleitung
Operating Instructions

SAFETY INSTRUCTIONS

The safety instructions and operating manual are to be carefully read prior to installation and commissioning

Obligation to give instructions

The following safety and operating instructions must be carefully read before initial assembly, installation and commissioning of Thyro-A by those persons working with or on Thyro-A.

These operating instructions are part of the Power Controller Thyro-A.

The operator of this device is obliged to provide, without restriction, these operating instructions to all persons transporting, commissioning, maintaining or performing other work on this device.

In accordance with the Product Liability Act, the manufacturer of a product has an obligation to provide explanations and warnings as follows:

· the use of the product other than for the intended use,
· the residual product risk,
· operating error and its consequences.

The information given below must be understood in this respect. It is to advise the product user and protect him and his systems.

Proper use

- The Thyristor Power Controller is a component which may only be used for control and regulation of electrical energy.

- The Thyristor Power Controller may at most be operated using the maximum admissible connected load according to information on the type plate.

- The Thyristor Power Controller may only be operated in connection with a suitable and series connected power supply disconnecting device (e.g. switch, VDE 0150 T1).

- As a component, the Thyristor Power Controller is unable to operate alone and must be projected for its intended use to minimize residual risks.

The Thyristor Power Controller may only be operated in the sense of its intended use; otherwise personal hazards, (e.g. electric shocks, burns) and hazards for systems (e.g. system overload) may arise.

Residual hazards of the product

- Even in proper use, should a fault occur, it is possible that control of currents, voltages and power is no longer performed in the load circuit by the Thyristor Power Controller.

In case of destruction of the power components (e.g. break-down or high resistance), the following situations are possible: power interruption, half-wave operation, continuous power flow.

If such a situation occurs, then load voltages and currents are produced from the power circuit. It must be ensured by system design that no uncontrolled large currents, voltages or power occur.

Malfunction and the results

With malfunction it is possible that power, voltage or flow levels which are higher than planned reach the Thyristor Power Controller or load. In principle, this can lead to the Power Controller or load being damaged.

Transport

Thyristor Power Controllers are only to be transported in their original packaging (protection against damage e.g. due to jolting, knocking, soiling).

Installation

If the Thyristor Power Controller is brought into the operation room from a cold environment, moisture due to condensation can occur. Prior to it being commissioned, the Thyristor Power Controller must be absolutely dry. Therefore, wait for a minimum of two hours before commissioning.

Connection

Prior to connection, it must be ensured that the voltage information on the type plate corresponds with the mains voltage.

- The electrical connection is carried out at the designated points with the required cross section cable and the appropriate screw cross sections.

Operation

The Thyristor Power Controller may only be connected to the mains voltage if it has been ensured that any hazard to people and system, especially in the load section, has been eliminated.

- Protect the device from dust and moisture

- Do not block vents.

Maintenance, service, malfunctions

CAUTION
For maintenance and repair work the Power Controller must be disconnected from all external voltage sources and protected against restarting. The voltage-free state is to be determined by means of suitable measuring instruments. This work is only to be carried out by a skilled electrician. The electrical regulations which are locally valid are to be adhered to.

CAUTION
The Thyristor Power Controller contains dangerous voltages. Repairs may only be carried out by qualified and trained maintenance personnel.

CAUTION
Danger of electric shocks. Even after disconnection from the mains voltage, capacitors may still contain a dangerously high power level.

CAUTION
Danger of electric shocks. Even when the Thyristor Power Controller is not triggered, the load circuit is not disconnected from the mains.

ATTENTION
Different components in the power section are screwed into place using exact torques. For safety reasons, power component repairs must be performed by AEG SVS Power Supply Systems GmbH.

CONTENTS

List of illustrations and tables

Safety regulations

Important instructions and explanations

Operation and maintenance according to regulations, as well as observance of the listed safety regulations is required for the protection of the staff and to maintain readiness to operate. Personnel assembling/disassembling the devices, commissioning them, operating them and maintaining them must know and observe these safety operations.
In the present operating instructions important instructions are marked using the terms **"CAUTION"**, **"ATTENTION"** and **"REMARK"** as well as using the icons explained below.

CAUTION
This instruction indicates work and operating procedures to be observed exactly to exclude hazards to persons.

ATTENTION
This instruction refers to work and operating procedures to be observed exactly to avoid damage or destruction of Thyro-A or parts thereof.

NOTE
This is where remarks on technical requirements and additional information is given which the user must observe.

Accident prevention rules

It is imperative that the accident prevention rules of the country of application and the generally applicable safety regulations are observed.

CAUTION
Before starting any work on Thyro-A, the following safety regulations must be observed:
- switch voltage-free
- secure against switching on
- determine voltage-free state
- ground and short-circuit device
- cover or block neighbouring parts under voltage

Qualified personnel

Thyro-A may only be transported, installed, connected, commissioned, maintained and operated by specialists in command of the respective applicable safety and installation regulations. All work must be monitored by the responsible specialist personnel.

Intended use

CAUTION
The Thyristor Power Controller may only be employed in the sense of its purpose of use (see the section of the chapter on safety instructions under the same name), otherwise hazards to persons (e.g. electric shocks, burns) and systems (e.g. overload) may occur.

Any unauthorized reconstruction and modification of Thyro-A, use of spare and exchange parts not approved by AEG SVS as well as any other use of Thyro-A is not permitted.
The person responsible for the system must ensure that:
- safety and operating instructions are available and observed,
- operating conditions and specifications are observed,
- protective installations are used,
- maintenance personnel are immediately notified or Thyro-A is immediately put out of commission if abnormal voltages or noises, higher temperatures, vibrations or similar occur to determine the causes.

These operating instructions contain all information required by specialists for the use of Thyro-A. Additional information and notes for unqualified persons and for the use of Thyro-A outside of industrial installations are not contained in these operating instructions.
The warranty obligation of the manufacturer applies only if these operating instructions are observed.

Warranty

No liability is assumed when using Thyro-A for applications not provided for by the manufacturer. The responsibility for the necessary measures to avoid hazards to persons and property is borne by the operator or the user. In case of complaints on Thyro-A, please notify us immediately stating:
Type name, production number, complaint, ambient conditions, operating mode, duration of use.

Remarks on the present operating instructions and Thyro-A

Validity

The following operating instructions describe the type range Thyro-A of models ...H RL and H RLP. Product characteristics which are only available for the type range Thyro-A...H RLP are marked with (H RLP).
These operating instructions correspond to the technical state of Thyro-A at the time of publication. The contents are not subject matter of the contract, but serve only as information. Modification of information contained in these operating instructions, especially technical data, operation, dimensions and weights, remain reserved at any time. AEG SVS reserves the right to content modifications and technical changes within the present operating instructions without obligation of notification. AEG SVS is not obliged to update these operating instructions constantly.

Handling

These operating instructions for Thyro-A are set out so that all work required for commissioning, maintenance and repair may be performed by corresponding specialist personnel.

Abbreviations

In this description the following specific abbreviations are used:

AEG SVS	= AEG SVS Power Supply Systems GmbH
SYT	= synchronized clock
TAKT	= full wave switch mode Thyrotakt®
VAR	= phase-angle mode Thyrovar®

Loss of warranty

Our supplies and services are subject to the general terms and conditions of delivery of the electrical industry as well as our general sales conditions. Any complaints on goods delivered are to be submitted, together with the delivery note, within eight days of receipt.
All guarantees made by AEG SVS and its dealers will be cancelled without prior notice if other than original AEG SVS spare parts or spare parts purchased by AEG SVS are used for maintenance and repair.

Copyright

Further Copyright advice

1. Introduction

Thyro-A has been conceived to meet the demands for simple assembly, speedier commissioning and safer operation.
For transport, assembly, installation, commissioning, operation and decommissioning, it is essential that the safety instructions included in these operating instructions are observed and made available to all persons handling this product.
In case of uncertainties or missing information, please contact your supplier.
The described operating mode QTM is in preparation.

1.1 General

Thyro-A is a Thyristor Power Controller with the ability to communicate. It will also simply be referred to as Power Controller or Controller. It can be used wherever voltages or currents need to be controlled or regulated in processing technology.
Thyro-A's distinguishing features are its several operating and control modes, good coupling ability to process and automation technology, high control precision and simple handling through a 16-Bit processor.

1.2 Specific characteristics

Thyro-A has a wide range of distinguishing features, for instance:

- ➜ easy handling
- ➜ type range 230-500V, 8-280A, single and double phase with additional 24V
  24V control voltage power supply also for mains voltages $\geqslant 0.43 \times U_{nom}$
- ➜ ohmic load and transformer load, as well as load with large R_{hot}/R_{cold} ($\leqslant 6$)
  peak current limit to $3 \times I_{nom}$
- ➜ soft start function for transformer load
- ➜ channel separation, required with countervoltage
- ➜ load circuit monitoring
- ➜ relay indication
- ➜ control modes U, U^2, I, I^2 as well as P-control with H RLP)
- ➜ operating modes TAKT, as well as VAR and QTM with Thyro-A 1A
- ➜ control with analog set points and / or via optional bus adapter
- ➜ series system interface
- ➜ electrical separation according to EN 50178 chapt. 3

Options:

- ➜ bus connections via bus adapter.
  Coupling to different bus systems, e.g. Profibus DP, Modbus RTU, other bus systems on request.

1.3 Type designation

The type designation of the Thyristor Power Controllers is derived from the construction of its power section:

Thyro-A 1A	Thyristor controller with single phase power section suited for single phase loads
Thyro-A 2A	Thyristor controller with double phase power section suited for symmetrical loads in three phase operation in three phase saver circuit

Example

Thyro-A 1A	Thyristor controller with single phase power section
...400-	with 400 Volt type voltage
...280	with 280 Ampere type current
H	with integrated semi-conductor fuse
F	with ventilator (only 280 Ampere types)
R	with indication relay
L	with load monitoring
P	with additional power control
1	designation Thyro-A, 2002 series

The complete type range can be found in chapter 9, TYPE OVERVIEW.

2. Functions

To enable Thyro-A to adjust optimally to the desired application, it is equipped with a wide range of functions. These are described below. Further functions are possible by applying Thyro-A within a bus system. See also chapter 5 INTERFACES.

2.1 Operating modes

For optimum adjustment to different applications and production processes, as well as different electrical loads, the most favourable operating mode can be set.

Full wave switch TAKT (for 1A, 2A)
Depending on the prescribed set point, the mains voltage is periodically switched. In this operating mode almost no harmonics are created. Whole multiples of the mains periods are switched, thus avoiding d.c. components. The full wave switch mode is especially suited for loads with thermal inertia. Depending on the function angle 1. half wave, the phase frequency is adjusted independently to 5 or 50 mains periods = T_0.

The TAKT operating mode creates minimal mains reactions. Should there be a flicker, this can be minimized with the aid of the mains load optimization.

Phase-angle principle VAR (for 1A)
Depending on the prescribed set point, the sine oscillation of the mains voltage is gated using a larger or smaller control angle α. This operating mode is characterized by high control dynamics. With phase-angle control harmonics of the mains voltage occur. It is possible to compensate these by using circuit variants.

Half-wave switch mode QTM (Quick-Takt-Mode for 1A)
QTM is the patented fast operating mode which works on the half wave switch principle. Depending on the prescribed set point, mains half waves are switched. D.c. components are avoided for the phase duration. The fast phase control is particularly suited for IR beams as an alternative to phase-angle control. When using several controllers it is possible, by synchronisation, to keep the mains reactions small.

2.2 Set point control characteristic

The set point control characteristic of Thyro-A can easily be adapted to the control output signal of an upstream process controller or automation system. All signals customary on the market may be used. The adaption is made by changing the starting and ending points of the control characteristic.

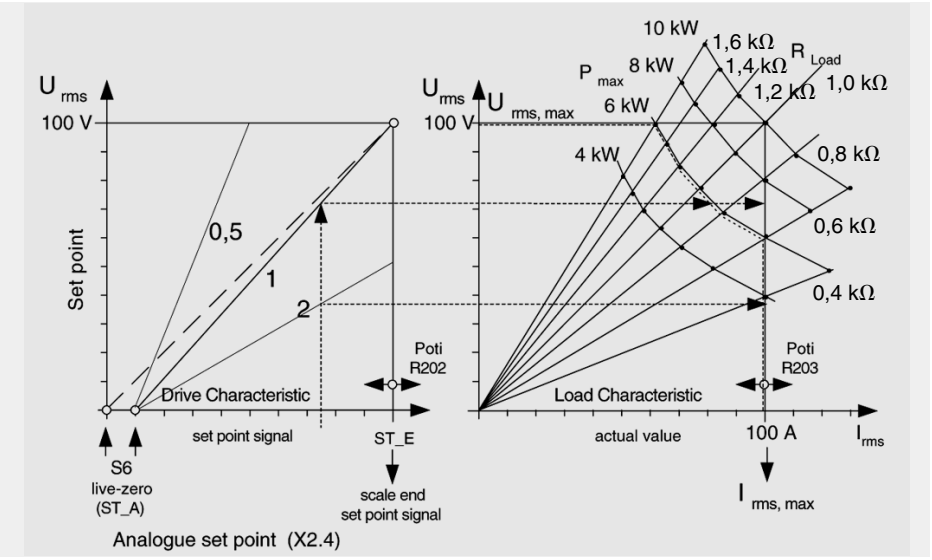


Fig. 1 Control characteristic

If the controller is within a limit (U_{max}, I_{max}, P_{max}), both LED PULSE INHIBIT and LOAD FAULT blink alternatively in second intervals (chapt. 3.3).

Input set points

The Power Controller Thyro-A is equipped with two input set points which are isolated from the mains, of which only one is always active.

- Set point 1 analog (X2.4 – X2.3 ground)
- Set point 2 via bus module

The analog input can be adapted to the various process controllers by means of the set point and live zero switches as well as the potentiometer controlling set point input. The following signal ranges can be set:
0(4)-20 mA (R_i = ca. 250 Ω), 0-5 V (R_i = ca. 44 kΩ), 0-10 V (R_i = ca. 88 kΩ).
+5V supply voltage can be taken for a set point potentiometer from terminal X2.8.
(5 kΩ ⩽ R_{Poti} ⩽ 10 kΩ)
The effective set point is the patched through set point. Within the stated input ranges these values with the control characteristic may be adjusted to any common signal characteristic.

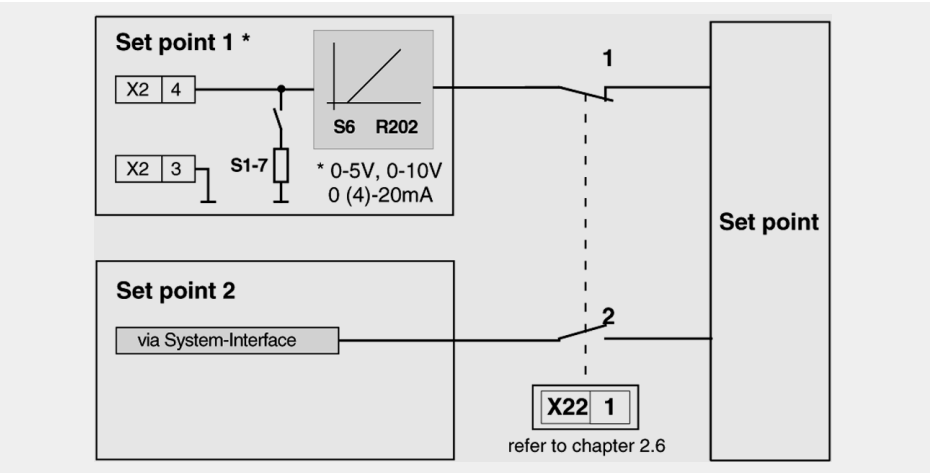


Fig. 2 Set point inputs and total set point

2.3 Control types

Thyro-A has four control types Thyro-A...H RLP with additional P-control). Mains voltage variations and load changes are directly and quickly adjusted by bypassing the sluggish temperature control system.
Before commissioning the Power Controller and selecting a control mode, familiarisation with the operating procedure and the effect upon the application is important.

2.3.1 Controlled value

The controlled value effective on the load is proportionate to the total set point, depending on the control type:

Control type	Control value (proportionate to the total set point)
U	Voltage output, U_{rms}
U^2	Voltage output, U^2_{rms}
I	Current output, I_{rms}
I^2	Current output, I^2_{rms}
P	Power output (only with H RLP type)

2.3.2 Limitations

Independent of the voltage output control, limiting current values can additionally be set (chapt. 3.2.3).

2.3.3 Controller response

If the load resistance changes, e.g. due to temperature effect, ageing or load break, the values effective on the load change as follows:

Underlying		Load resistance decreases			Load resistance increases			Effective limitations
control	limit	P	U_{Load}	I_{Load}	P	U_{Load}	I_{Load}	
U	$U_{rms\ max}$	larger	=	larger	smaller	=	smaller	$I_{rms\ max}$ P_{max}*
U^2 (UxU)	$U_{rms\ max}$	larger	=	larger	smaller	=	smaller	$I_{rms\ max}$ P_{max}*
I	$I_{rms\ max}$	smaller	smaller	=	smaller	larger	=	$U_{rms\ max}$ P_{max}*
I^2 (IxI)	$I_{rms\ max}$	smaller	smaller	=	smaller	larger	=	$U_{rms\ max}$ P_{max}*
P *	P_{max}	=	smaller	larger	=	larger	smaller	$I_{rms\ max}$ $U_{rms\ max}$

Tab. 1 Behaviour with load change * (H RLP)

2.4 Indications

2.4.1 LED indications

The LEDs on the front signal the following states:

• **ON**	green	operating indication, power supply for controller device
• **PULSE INHIBIT**	red	pulse lock active
• **LOAD FAULT**	red	fault present

Blinking indications are described in chapter 3.3.
Activation of the integrated semiconductor fuse can be signalled using the K1 fault indicating relay (undercurrent detection).

2.4.2 Alarm relay K1

The relay K1 is deactivated if a fault is detected in the system (Chapt. 3.3).
This has a relay. The following table shows the configuration of the corresponding terminals.

	Root	Closer	Opener
Alarm relay K1	X3.1	X3.2	X3.3

2.5 Monitoring

Faults occurring in the Power Controller and the load circuit are signalled. Signalling ensues via LED (LOAD FAULT) and via the K1 relay.

2.5.1 Monitoring of load and mains voltage

The limiting values of the voltage are -57% of the type voltage for undervoltage monitoring and +10% of the type voltage for overvoltage monitoring. This produces the following absolute limiting values:

Type	Undervoltage	Overvoltage
230V	99V	253V
400V	172V	440V
500V	215V	550V

NOTE
When operating below the type voltage (-15%), the devices may only be operated down to the undervoltage limit if the electronics are supplied by an ext. 24V voltage. If the undervoltage limit is undercut, the pulse lock is activated internally and relay K1 is released.

2.5.2 Absolute value monitoring current

This function allows monitoring of a freely selectable absolute current limit. The value is set by potentiometer R205. During the setting procedure an instrument connected to the analog output indicates the monitoring value. (Chapt 3.2) This absolute value monitoring lends itself to one or more load resistances arranged in parallel. Generally, the effective current value measured is continuously compared with a presettable absolute current limit for undercurrent. If this limit is undercut, an indication shows. In the case of resistance elements arranged in parallel, it is possible to select a partial load interruption by setting the undercurrent limit accordingly. (Chapt 3.2.5).

2.5.3 Equipment temperature monitoring

The control board is equipped with a temperature monitor.

If a fault occurs the LED LOAD FAULT blinks and the alarm relay K1 is released.

2.5.4 Ventilator monitoring

The separately ventilated Power Controllers (..F..) are fitted with thermal monitoring. The temperature of the heat sink is measured. In case of a temperature overrange a fault indication ensues and relay K1 switches default settings.

2.6 Set point processing when employing a bus module

The set point processing depends on how the bus module is connected to the Power Controller. Different variations can be realized depending on the requirements. The circuit of Thyro-A's terminal X22.1 controls the procedures (Chap. 2.2, fig. 2).

- **No connection to X22.1**

The bus module is fully functional, the set point value is, however, only accepted at the controller via the control terminal as analog signal.

- **Connection to X22.1 with ground potential**

The setpoint value is only accepted by the bus module. The controller's terminal X22.1 can be directly connected to earth if an alternative operation is excluded.

- **Connection to X22.1 is switched**
  - Thyro-A's circuit X22.1 is connected to one of the terminals X1.1 to X8.1 of the bus module (Fig. 2). In case of malfunctions on the bus line, the set point value will be taken automatically from the Power Controller analog input (2 000 000 848 / 849).

  - Thyro-A's circuit X22.1 is connected to one of the terminals X1.5 to X8.5 of the bus module (Fig. 2). In case of malfunctions on the bus line, the set point value will be taken automatically from the Power Controller analog input, as indicated in Chapter 3.2, or the last set point value is held.
    Additionally, every controller connected to the bus module can be released by "hand" (Chapter 3.2 "set output data=0").

2.7 Additional functions for Thyro-A

Applying the bus module provides access to further data on the controller (e.g. parameters, actual values). It is thus possible to perform additional application functions. The data, which can be accessed via the bus module, is specified in the corresponding bus module operating instructions.

Examples:
In order to achieve a narrower line width with a line recorder the output signal can be smoothed as required.

Sliding mean value for the analog output

MEAN	100

(Default setting: with VAR mains periods, with TAKT 100 pulse periods)

For the operating modes TAKT and VAR control limits (final position limit) can be set:

Control limits

Ts max, Ts min	with TAKT
V_IE, H_IE	with VAR

If required the controller's parameters can be adjusted to the route:

Control parameters

TI	20	(default value)
KP	60	(default value)

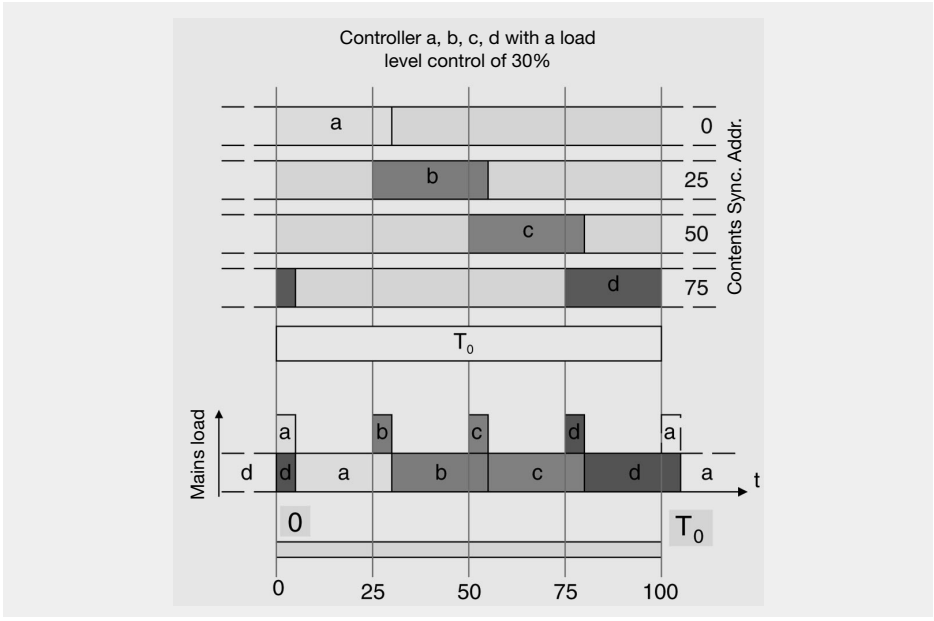
A function of Thyro-A which is often used in the TAKT operating mode is the software synchronization (mains load optimization). A numerical value can be entered via INDEX 38 (SYNC_ADR) which is multiplied by 10ms or 8.33ms (duration of a mains half wave) and results in a delay time up to the first connection.

Mains load optimization with SYNC_ADR

(50Hz) => delay time after mains recovery 10ms * 100 = 1000ms
(60Hz) => delay time after mains recovery 8.33ms * 100 = 833ms
(Default setting: 100)

Controller parameters							R/W			
Index	**Addr.**	**Symbol**	**Name**	**Value Range**	**Combo-Opt.**	**Unit**	**S**	**A**	**Default**	**Remark**
38	36	SYNC_ADR	Synchrotakt address	0...		period/2		r/w	100	

Thye SYNC address contents of the individual controllers then contain different values. As a result, the time up to the initial switch-on varies. This makes staggered switching possible, particularly with the slow pulse time of 1 sec. Values with an interval of 100 mean a delayed switch-on by one pulse period T_0 (group formation). This function also allows switch-on to, for instance, an emergency power generator (step-by-step switch-on of the load).



Example: 4 controllers e.g. with 100 A, load level control ca. 30%
contents of Sync_Adr: 0 (100), 25, 50, 75

NOTE
The mains load optimizations with SYT9 and QTM are not dependent on connection of a controller to a bus module.

3. Operation

This chapter describes the operating elements of Thyro-A. For default settings see chapter 8.2.

3.1 Configuration switch S1

A 10-pole DIP switch is situated at the front behind the hood. The individual switches are marked from 1-10 starting from the bottom and must be set before operation according to application. They are only read in by the Power Controller once when switched on or with mains recovery. For safety reasons further operation is carried out with the hood closed. (3.2).

3.1.1 Operating mode

S1-	1	2	Operating mode
	0	0	none
	1	0	TAKT - full wave switch operation
	0	1	VAR - phase-angle operation
	1	1	QTM - Quick takt operation

3.1.2 Control types / analog output

S1-	3	4	5		Control types	Analog output	
	0	0	0	U^2	(UxU) Control	U - Display	
	1	0	0	U	(U) Control	U - Display	
	0	1	0	I^2	(IxI) Control	I - Display	
	1	1	0	I	(I) Control	I - Display	
	0	0	1	I	(I) Control	U - Display	
	1	0	1	P	P Control	P - Display	(H RLP)
	0	1	1	P	P Control	I - Display	(H RLP)
	1	1	1		configurable with Thyro-Tool	configurable with Thyro-Tool	

With 2-phase devices the highest value of phase voltage or phase current is used for control and display. All values are available through the bus module.

3.1.3 Live zero set point

S1-	6	Signal level
	0	0 - (20) mA
	1	4 - (20) mA

3.1.4 Analog input

S1-	7	8	Signal level	Input resistance
	0	0	0 - 10V	88kΩ
	1	0	undefined	undefined
	0	1	0 - 5V	44kΩ 44 (e.g for set point potentiometer)
	1	1	0 - 20mA	250Ω

3.1.5 Analog output

The analog output allows the display of U_{rms} or P (H RLP) as in 3.1.2

S1-	9	10	Output signal level
	0	1	0 - 10V
	1	1	2 - 10V
	0	0	0 - 20mA
	1	0	4 - 20mA

3.2 Potentiometer

The description of the settings proceeds from the upper (R201) to the lower (R205) potentiometer. A 19 mm potis with 20 revolutions is being referred to.
A setting guide exists for all potentiometers via the analog output (X2:9 against X2:5 ground). If a poti is changed, this is recognised by the Thyro-A. It then switches the analog output over so that instead of the actual value, the poti value is read out. During the setting procedure the red LEDs flicker. As the analog output is designed for 0-20mA / 10V, 10mA (=5V) = 100% is set. This allows the set points to be read directly or in a percentage of the nominal value:

Analog output (setting guide)					
10	V or	20.0mA =	200%		
5	V or	10.0mA =	100%	or	100°el.
2.5	V or	5.0mA =	50%	or	50°el.
1.25	V or	2.5mA =	25%	etc.	

If the poti is not substantially changed within 30 seconds, the Thyro-A automatically switches back to the output of the chosen actual value.

3.2.1 Phase angle 1. half wave operation TAKT

Potentiometer R201 serves to set the transformer load. At works it is set at 60° el with Thyro-A 1A and at 90° el with Thyro-A 2A.
Transformer loads with a nominal induction > 1.2 T, as well as wound core and toroidal core transformers optimization is necessary. With Thyro-A 1A generally 80°el turn (to the right), with Thyro-A 2A turn at smaller angles (to the left). An optimal setting is achieved when the rush current is minimal.

The soft start time SST is set at the same time. The also applies to the operating mode VAR. Depending on AN1 the soft start time has the following value:

AN [1°el]	<30	<33.7	>=33.7	>=41.2	>=48.7	>=56.2	>=61.5	>=64.5	>=67.4	>=70.5	>=73.5
SST [ms]	0	120	140	160	180	200	220	260	300	400	600

With an ohmic resistance load the poti can be turned to the left limit stop, at > 30°el Thyro-A independently switches to a faster pulse operation with T_0 = 5 periods without SST.

NOTE
In this configuration the terminal X2.7 can be used as an additional digital "set point value" (24V d.c.). This also enables the controller to be driven, for example, by a two-position controller.

Analog output (setting guide)
5 V / 10.0mA = 100 °el (Maximum value)
3 V / 6.0mA = 60 °el
1.5V / 3.0mA = 30 °el
1.25V / 2.5mA = 0 °el

3.2.2 Control end set point input

Potentiometer R202 allows the control characteristic to be adapted to the operation. In central position the factor is = 1, right-hand stop = 2, left-hand stop = 0. Default setting.
With set point full modulation (20mA, 10V, 5V see 3.1.4) wird $U_{rms\ max}$, i.e. nominal voltage + 10% or $I_{rms\ max}$, i.e. nominal current is reached, depending on the type of underlying control.

Analog output (setting guide)

				Factor	Control end		
10 V	or	20.0mA	=	2	20 V	or	40mA (theor.)
5 V	or.	10.0mA	=	1	10 V	or	20mA
2.5 V	or.	5.0mA	=	0.5	5 V	or	10mA
1.25V	or	2.5mA	=	0.25	2.5V	or	5mA

Factors > 1 result in a shallower characteristic. Full modulation can no longer be reached. See also Fig. 1 Control characteristic.

3.2.3 Current limitations

Potentiometer R203 enables the load current to be limited to a given value. Default setting: nominal current as on type plate.
At reduced ambient temperature the controller can be operated with up to 110% of its nominal current (effective value).

Analog output (setting guide)

5,5 V / 11.0mA = 200% - values > 110% are limited to 110%
5 V / 10.0mA = 100%
2.5 V / 5.0mA = 50%
1.25V / 2.5mA = 25%

The permissible peak currents are derived from the fuse layout.
See type table and text: definitions and dimensions of Thyristor Power Controllers.
If the limit has been reached, the red LEDs blink in 1 sec. intervals.

3.2.4 Increased analog output

The analog output is adjusted to 0-20mA. 20mA corresponds to the actual r.m.s. current which corresponds to the maximum permissible current of the Power Controller.
It is possible to adapt with potentiometer R204, e.g. if the scaling does not correspond to the nominal data or the output is set to voltage reading. The increase can be set to between 0 and 2.

Analog output (setting guide)

		Factor	Remark
10 V /	20.0mA =	2	e.g. for 50A scale of a 100A device
5 V or	10.0mA =	1	see previous table
2.0V or	4.0mA =	0.4	e.g. for 100A scale of a 40A device

With voltage display the factor 1 corresponds to 110% of the type nominal voltage.
With output display (H RLP) with Thyro-A 1A the analog output signal corresponds to U_{type} * I_{type} * 1.2.
With output display (H RLP) with Thyro-A 2A the analog output signal corresponds to the total output of both power paths: Type power * 2 (type power according to Table 9.1).

NOTE
Control characteristic and limitation P_{max} work with U_{type} * I_{type} * √3 (enlarged by a factor of 1.2 to permit full drive at 10% overvoltage).

3.2.5 Load monitoring (undercurrent monitoring)

Thyro-A is suited for monitoring loads which consist of one or several resistors in parallel or in series parallel connection.
Thyro-A recognises an increase in load resistance. The load monitor works as an undercurrent monitor and is suitable for application in all operating and control modes. Load monitoring is delivered with the default setting OFF = left stop R205.
For all other settings the following applies:
If the load current undercuts the set level, the fault relay is released. The incident is indicated through a bus system which can optionally be installed.

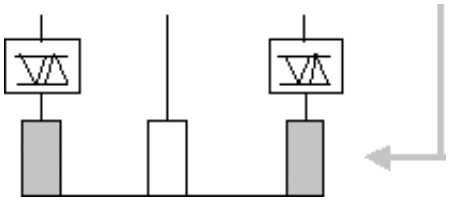
For Thyro-A 1A and Thyro-A 2A (load with separate neutral point without N) a setting for load monitoring can be made according to the table below:

		Thyro-A 1A **Thyro-A 2A** load with separate neutral point without N				
e.g. parallel load resistances	$I_{load\ nom.}$ / $I_{type\ contr.}$	Resistance increase in case of fault	Recommended setting for poti R205	X2.9 [V]	X2.9 [0-20mA]	ca. Revo-lutions
Number						
1	100%	Infinite	50.0%	5.0	10.0	8.5
1	80%		40.0%	4.0	8.0	7.0
1	60%		30.0%	3.0	6.0	6.0
1	40%		20.0%	2.0	4.0	4.5
1	20%		10.0%	1.0	2.0	2.5
2	100%	100%	75.0%	7.5	15.0	12.0
2	80%		60.0%	6.0	12.0	9.5
2	60%		45.0%	4.5	9.0	7.5
2	40%		30.0%	3.0	6.0	6.0
2	20%		15.0%	1.5	3.0	3.5
3	100%	50%	83.3%	8.3	16.7	13.0
3	80%		66.7%	6.7	13.3	10.5
3	60%		50.0%	5.0	10.0	8.5
3	40%		33.3%	3.3	6.7	6.0
4	100%	33%	87.5%	8.8	17.5	13.5
4	80%		70.0%	7.0	14.0	11.5
4	60%		52.5%	5.3	10.5	9.0
4	40%		35.0%	3.5	7.0	6.0
5	100%	25%	90.0%	9.0	18.0	14.0
5	80%		72.0%	7.2	14.4	11.5
5	60%		54.0%	5.4	10.8	9.0
5	40%		36.0%	3.6	7.2	6.5

Tab. 2a Load monitoring

For Thyro-A 2A (load with joint neutral point without N-conductor) a setting for load monitoring can be made according to the table below:

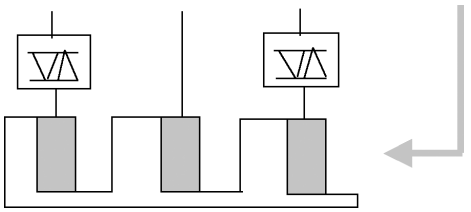
		Thyro-A 2A load with joint neutral point without N				
e.g. parallel load resistances	$I_{load\ nom.}$ / $I_{type\ contr.}$	Resistance increase in case of fault (L1,L3)	Recommended setting for poti R205	X2.9 [V]	X2.9 [0-20mA]	ca. Revo-lutions
Number						
1	100%	Infinite	50.0%	5.0	10.0	8.5
1	80%		40.0%	4.0	8.0	7.0
1	60%		30.0%	3.0	6.0	6.0
1	40%		20.0%	2.0	4.0	4.5
1	20%		10.0%	1.0	2.0	2.5
2	100%	67%	80.0%	8.0	16.0	12.0
2	80%		63.0%	6.3	12.6	10.0
2	60%		48.0%	4.8	9.6	8.0
2	40%		32.0%	3.2	6.4	5.5
2	20%		16.0%	1.6	3.2	3.5
3	100%	33%	87.0%	8.7	17.4	13.5
3	80%		70.0%	7.0	14.0	11.5
3	60%		52.0%	5.2	10.4	8.5
3	40%		35.0%	3.5	7.0	6.0
4	100%	22%	90.0%	9.0	18.0	14.0
4	80%		72.0%	7.2	14.4	11.5
4	60%		(54%)	5.4	10.8	9.0
4	40%		-			.



Tab. 2b Load monitoring

For Thyro-A 2A (wih load in delta connection) a setting for load monitoring can be made according to the table below:

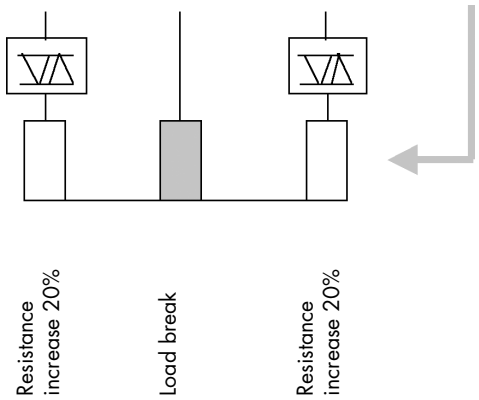
		Thyro-A 2A load in delta connection				
e.g. parallel load resistances	$I_{load\ nom.}$ / $I_{type\ contr.}$	Resistance increase in case of fault (L1,L2L3)	Recommended setting for poti R205	X2.9 [V]	X2.9 [0-20mA]	ca. Revo-lutions
Number						
1	100%		79.0%	7.9	15.8	12.0
1	80%		63.0%	6.3	12.6	10.0
1	60%	73%	48.0%	4.8	9.6	8.0
1	40%		32.0%	3.2	6.4	5.5
1	20%		16.0%	1.6	3.2	3.5
2	100%		88.0%	8.8	17.6	13.5
2	80%		66.0%	6.6	13.2	10.5
2	60%	31%	50.0%	5.0	10.0	8.5
2	40%		33.0%	3.3	6.6	6.0
2	20%		17.0%	1.7	3.4	4.0
3	100%		90.0%	9.0	18.0	14.0
3	80%	20%	72.0%	7.2	14.4	11.5
3	60%		(54%)	5.4	10.8	9.0
-	-		-	-	-	-
-	-		-	-	-	-
-	-	-	-	-	-	-
-	-		-	-	-	-
-	-		-	-	-	-



Tab. 2c Load monitoring

For Thyro-A 2A (load with joint neutral point without N conductor) the setting for load monitoring can be made according to the table below:

		Thyro-A 2A load with joint neutral point without N				
e.g. parallel load resistances	$I_{load\ nom.}$ / $I_{type\ contr.}$	Resistance increase in case of fault (L2)	Recommended setting for poti R205	X2.9 [V]	X2.9 [0-20mA]	ca. Revo-lutions
Number						
1	100%		90.0%	9.0	18.0	14.0
1	80%		72.0%	7.2	14.4	11.5
1	60%		(54%)	5.4	10.8	9.0
	-		-	-	-	-
	-		-	-	-	-



Tab. 2d Load monitoring

Value deviations can be converted by percentage. The set monitoring value must lie "in the middle" between the nominal load current value and the value after outage.

NOTE

Settings above 90% and below 10% are not practical. If low load currents are required, check if a controller with a lower type current can be used.

In the VAR operating mode monitoring with large trigger delay angles $\alpha > 140°$el. is locked.

3.3 Diagnosis / status indications

Faults can occur in the load circuit and in the controller itself or from the mains. Diagnosis of unexpected operating behaviour is performed by LEDs on the front panel of the control device.

Description	LEDs	Relay K1	Description
Frequency fault	PULSE INHIBIT blinks	open	Outside 47Hz to 63 Hz when switching on or
SYNC fault	PULSE INHIBIT blinks	open	Zero crossing outside permissible tolerance range in operation
Temperature monitoring	LOAD FAULT blinks	open	Temp. monitoring responded (control board or control section)
Load fault	LOAD FAULT on	open	Load fault: none or under current
Flash values invalid	2 red LEDs	open	Controller fault
Correction values invalid	synchron. blinks		
Undervoltage		open	Mains fault
Overvoltage		–	Mains fault
Pulse lock active	PULSE INHIBIT	closed	Bridge X2: 1.2 opened
U-limitation	2 red LEDs blink slowly, alternatively	none	U limit value exceeded
I-limitation	2 red LEDs blink slowly, alternatively	none	I limit value exceeded
P-limitation (H RLP)	2 red LEDs blink slowly, alternatively	none	P limit value exceeded

Tab 3 Allocation of message register

4. External connections

4.1 Power supply for Thyro-A

Connecting the power supply is carried out as shown in the figures and technical data. With Thyro-A 2A a right rotational field in the power circuit is required.

4.2 Power supply for the control device

The control device is supplied directly from the power section (terminals U1, X1.1 and X1.2). This voltage also serves as mains synchronization. The mains connection is equipped for input voltages of U_{Nnom} -15% to +10% and nominal frequencies of 47Hz to 63Hz. Both terminals (X1.1 and X1.2 1.5mm² grid 3.81) are internally bridged. If a phase is connected to X1, a fused connection is necessary (figs. 3,7).

4.3 Additional control voltage input

The Thyristor Power Controller Thyro-A is equipped with an additional 24V a.c./d.c. power supply input (X11.1 and X11.2 1. 5mm^2 grid 3.5).
If required, the control device can additionally be supplied with 24V a.c. or d.c., when operating with bus, for instance, or with voltages below the tolerance (e.g. with undervoltage of a 440V supply with a 500V Thyro-A).
When in operation with SELV, the 24V supply must be ungrounded. For EMV reasons a connection with the control ground is not permitted. Several Thyro-A devices can be operated from a 24V supply. The input is reverse protected. The connection output for the control device is ca. 2W (5VA) with Thyro-A 1A or 4W (10VA) with Thyro-A 2A per controller.
The 24V connecting lines must be fuse protected under valid regulations. A soldered 1A fuse protects the device should internal short circuits occur.

4.4 Pulse lock

The pulse lock (PULSE INHIBIT; terminals X2.1 - X2.2 1.5mm^2, grid 3.5) is activated by opening the pulse-lock bridge, i.e. the power section is no longer triggered. If the pulse lock is activated the LED “PULSE INHIBIT” lights up red. A mains outage sets off the pulse lock internally.
It is imperative to use the pulse lock with transformer load in order to activate the Soft Start function. It may only then be released when there is a voltage supply to the power section. With Thyro-A 2A the pulse lock is only wired to the master (L1, left).

NOTE
The contact for actuating the pulse lock must be light-duty contact.

4.5 Analog set point value input

The set point value input (terminal X2: 3 ground - X2:4 + 1.5mm^2 grid 3.5) is suitable for process controllers with output signals of 0(4) - 20mA, 0-5V, 0-10V.

4.6 Digital set point value input

Under particular conditions terminal X2.7 can be used as additional digital “set point value input” (24V d.c.) so that, for instance, Thyro-A can be triggered by a 2-point regulator. Further information is available on this in chapter 3.2.1.

4.7 Analog output

The electrical values for current and voltage at the load are recorded by the Thyro-A Power Controller and can be displayed using an external measuring device or a graph recorder. Connection to terminals X2:9 (+), against X2:5 ground 1.5mm² grid 3.5. The selectable signal levels are 0-10V, 0-20mA, 4-20mA. The analog output is updated in every supply period (refer to 3.2.4).
The following values may be given:

- load voltage
- load current
- Actual output

4.8 Current transformer

All Thyro-A types have one current transformer per path in their power section.
The current transformer only has local mode wiring.

4.9 Voltage transformer

The load voltage is recorded by the measuring signal given by the supply voltage. This value is linked with the control angle α or the pulse ratio
$U_{rms} = U_{mains} * \sqrt{(T_S/T_0)}$. The voltage transformer only has local mode wiring.

4.10 Block connection diagram

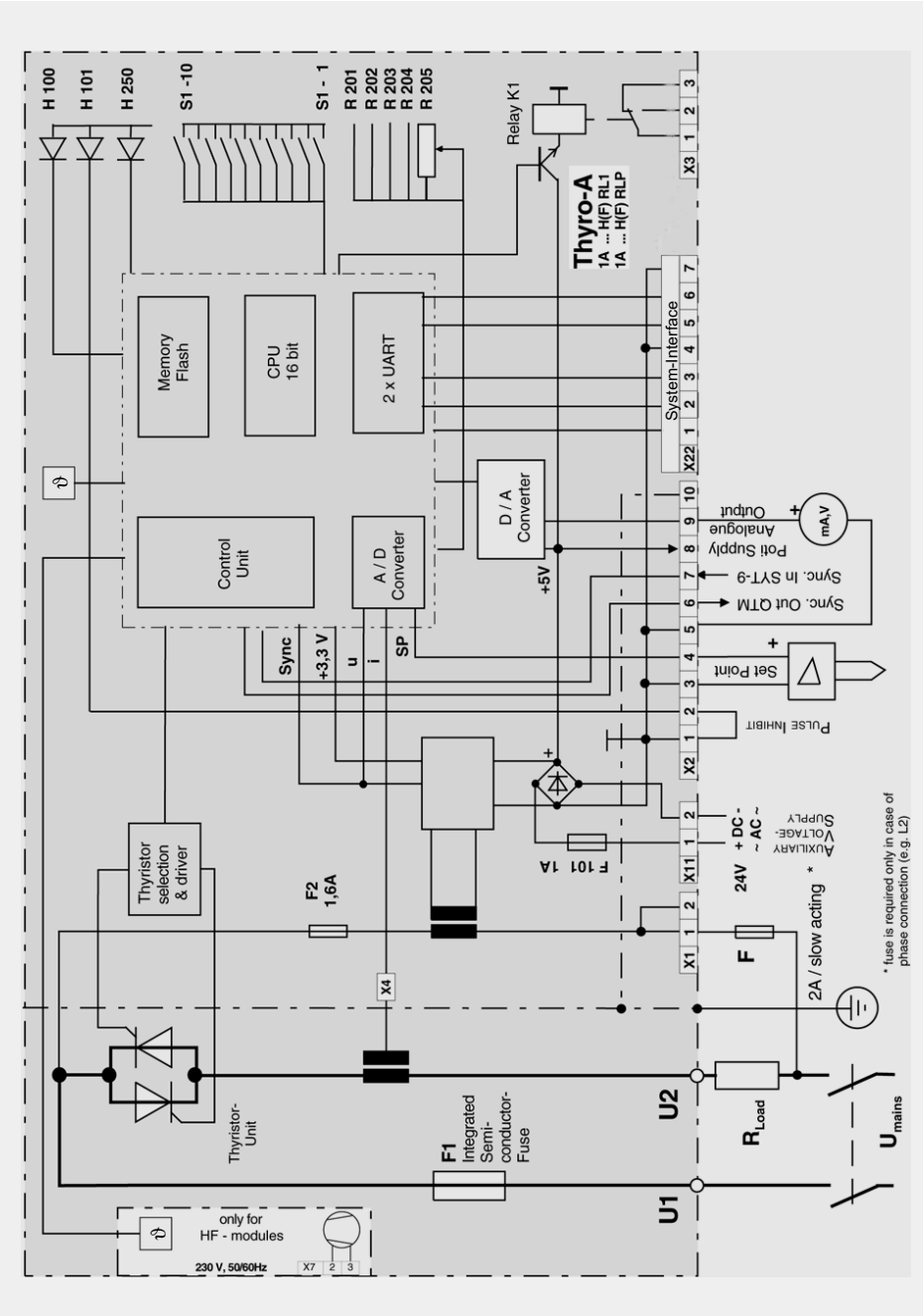
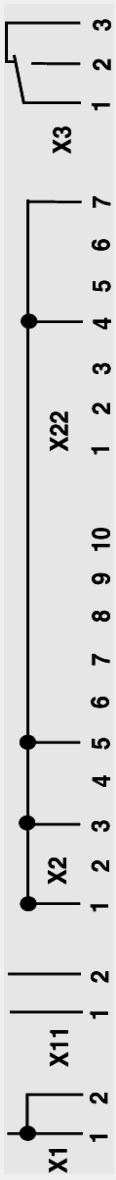


Fig. 3 Block connecting diagram

The above block connection diagram shows the essential functions of Thyro-A.

4.11 Operating elements and terminal strips

This chapter describes all terminal strips and connectors.



(K1)	Opener, in case of fault closed	RM 5.08
	Closer, in case of fault open	
	Root, common connection	
	System interface	
	Control ground	RM 3.5
	Connection to slave with 2A	
	Connection to slave with 2A	
	Control ground	
	RxD / connection to bus module	
	TXD / connection to bus module	
	Bus module recognition	
	Earth potential or if necessary screen tripping device	RM 3.5
	Analog output 0-10V or 0(4)-20mA	
	+ 5V output e.g. for an actual value poti ($5k\Omega \leqslant R_{Poti} \leqslant 10k\Omega$)	
	Sync. In (SYT-9 / QTM, see also chapt. 4.4)	
	Sync. Out (QTM)	
	Control ground	
	Analog set point input max. 10V, max. 20mA	
	Control ground	
	Pulse lock (PULSE INHIBIT)	
	Control ground	
	24V additional voltage supply a.c. or d.c.	RM 3.5
	24V additonal voltage supply a.c. or d.c.	
	L2/N supply connection - synchr. voltage supply freq.	RM 3.81
	L2/N supply connection . synchr. voltage supply freq.	RM 3.81
	X4 internal current transformer connection	
	X350 test jumper	
	X2 is not applicable with the slave components of Thyro-A 2A	

Fig. 4 Terminal plan

H 100	LED	gn	ON	
H 101	LED	rt	PULSE INHIBIT	
H 250	LED	rt	LOAD FAULT	
	Analog output 10V / 20 mA			Chap. 3.1.5
S1-10	Live zero analog output			
S1- 9	Set point value input			Chap. 3.1.4
S1- 8	Set point value input			
S1- 7	Live zero set point			Chap. 3.1.3
S1- 6	Control type			Chap. 3.1.2
S1- 5	Control type			
S1- 4	Control type			
S1- 3	Operation mode			Chap. 3.1.1
S1- 2	Operation mode			
S1- 1				
R 201	Phase angle		TRAFO ADAPTION	Chap. 3.2.1
R 202	Control ende		SCALE SETPOINT	Chap. 3.2.2
R 203	Current limit		CURRENT LIMIT	Chap. 3.2.3
R 204	Increase		SCALE OUTPUT	Chap. 3.2.4
R 205	Load monitoring		LOAD FAULT	Chap. 3.2.5

Fig. 5 Operating elements

5. Interfaces

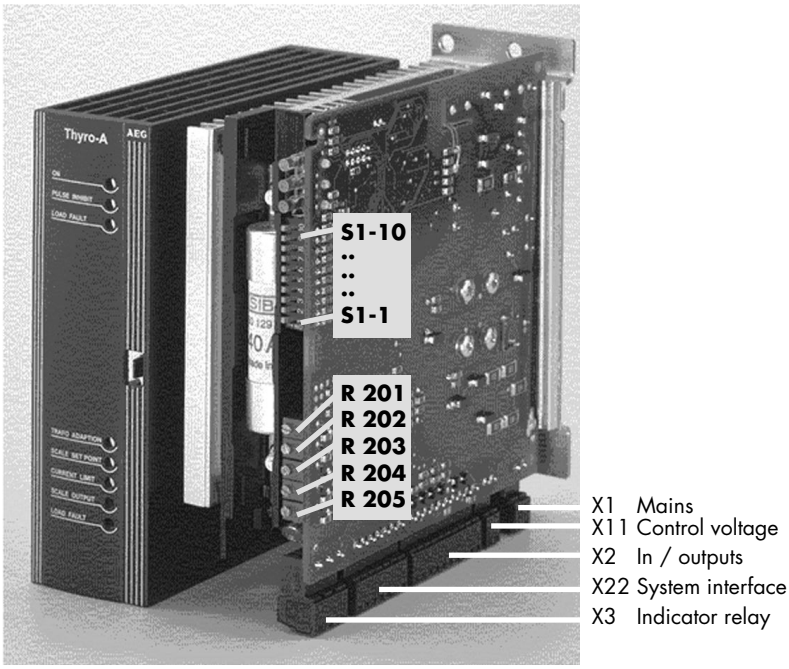


Fig 6 Thyro-A...HRL 1, ...H RLP

With its system interface terminal strip X22 the Power Controller Thyro-A can be connected via an optional bus module to, for example, Profibus DP or Modbus RTU (other bus modules available on request). Description and connections can be taken from the instructions of the respective components.

NOTE
The access to set value, actual values and parameters made possible through bus provides further useful functions for application (see chap. 2.6).

6. Mains load optimization

The application of mains load optimization offers substantial advantages, e.g. reduction of mains load peaks and mains reactions.
Mains load optimization is possible in multiple controller applications in which either the operating mode TAKT (slow pulse at AN_1 = > 30°el) or operating mode QTM is applied.

6.1 Synchronization SYT-9 (operating mode TAKT)

SYT-9 is a process for static load optimization. It minimizes main load peaks and associated mains reaction shares. Set points and load changes are not automatically included in mains load optimization.
The SYT-9 process requires an additional component. It can also be employed in connection with controllers already installed of type Thyro-P. Then the pulse must be connected to terminal X2.7 and the +5V for the SYT-9 card must be connected to X2.8.
The operating mode TAKT contains a high pulse frequency (AN1 $<$ 30°el for ohmic load, T_0 = 5 supply periods) as well as a low pulse frequency (T_0 = 50 supply periods).
The low pulse frequency is also suitable for switching transformers and is activated independently at phase angle $>$ 30°el.
Only in this operating mode is the input X2:7 scanned. Is a pulse recognised, the Power Controller switches onand the pulse time T_0 applies from here.
The impulse is switched by the Synchrotakt component via an optoelectronic coupler. Energy comes from its own controller X2.8.
Please observe the operating instructions of the SYT-9 component.

6.2 Synchronization in operating mode QTM (1A)

In the QTM operating mode a synchronization of 2-12 controllers is possible.

The operating mode QTM works in rapid half-wave frequency with a pattern of switched and locked half waves at particular intervals $<$ 1 sec, also designated as T_0.
T_0 achieve a balance in supply from the outset (not after T_0) the individual controllers synchronize themselves by staggering by one supply period. With the first connected controller the SYT input X2.7 is jumped to +5V X2.8.
The following controllers receive their impulses at X2.7 from sync. output X2.6 of the previous controller. With the last controller X2.6 remains free (series connection).
This synchronization method is only possible with Thyro-A (refer to Fig. 9).

6.3 Software synchronization (operating mode TAKT)

The application of an optional bus module activates the software synchronization.

7. Connecting diagrams

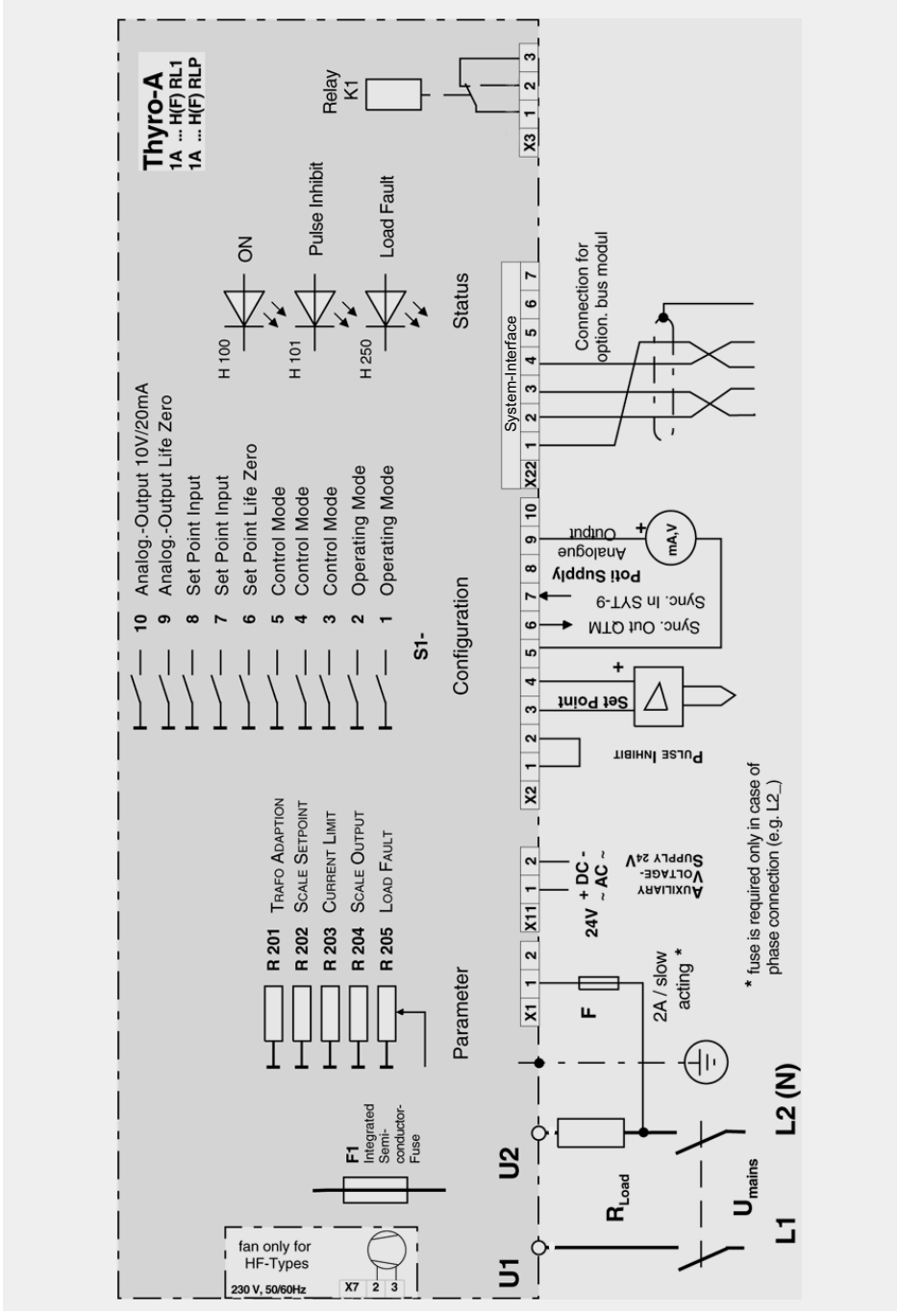


Fig. 7 Connecting diagram 1A

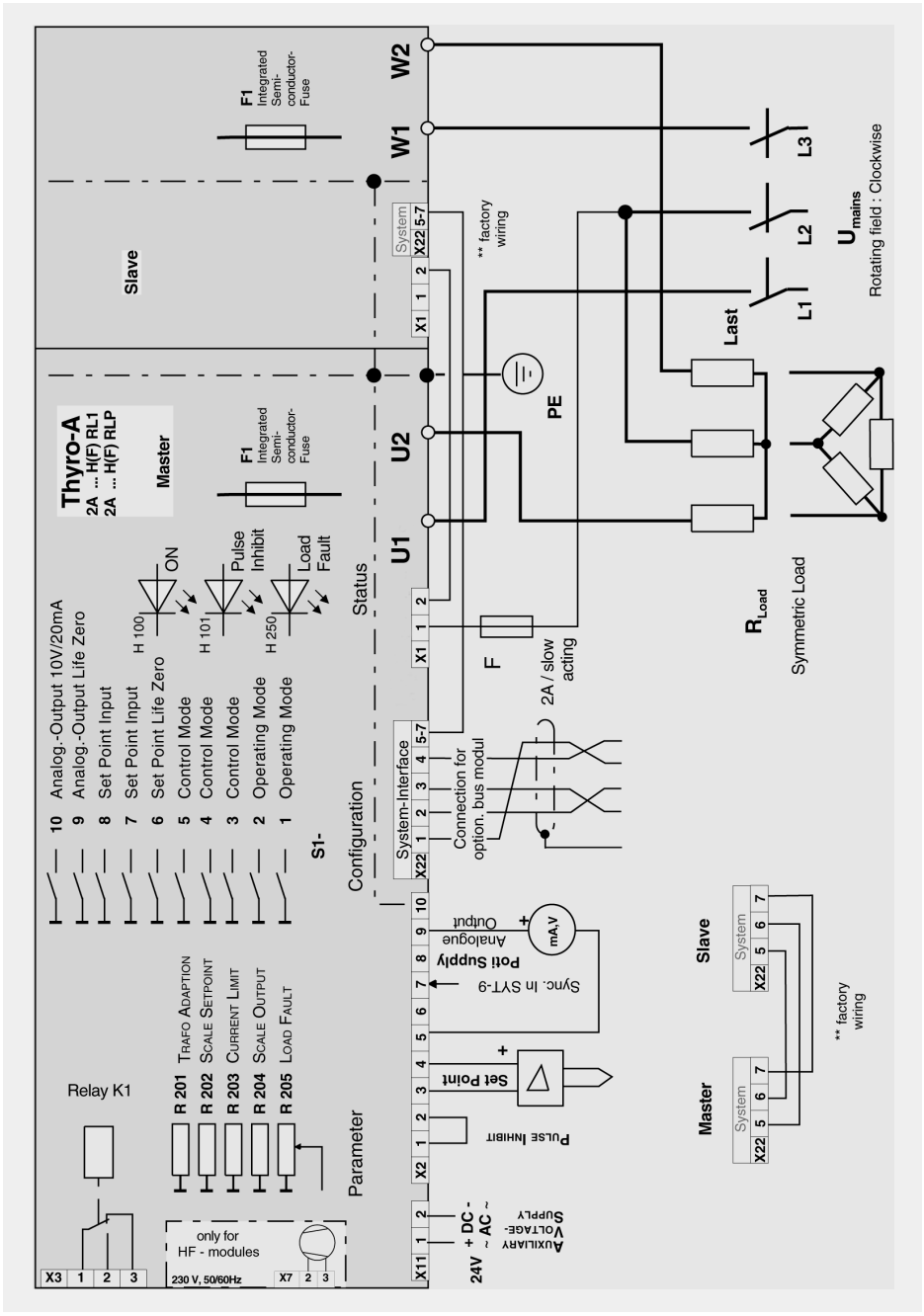


Fig. 8 Connecting diagram 2A

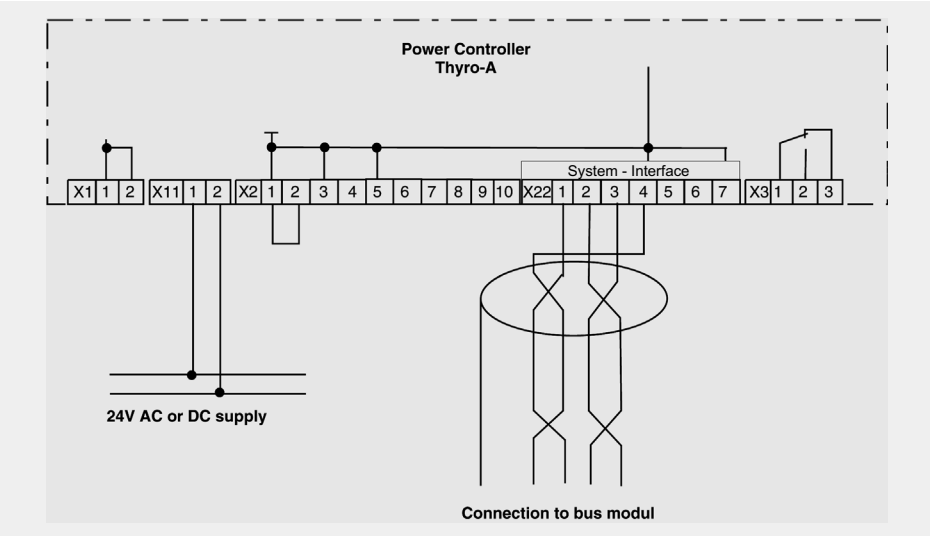


Fig. 9 Connecting diagram for auxiliary supply and connection to bus module

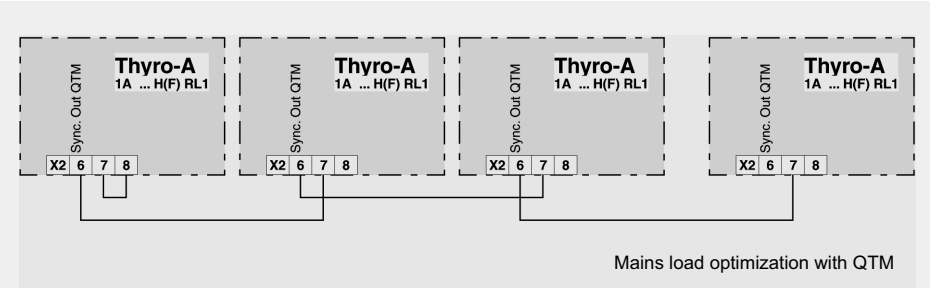


Fig. 10 Connecting diagram for QTM

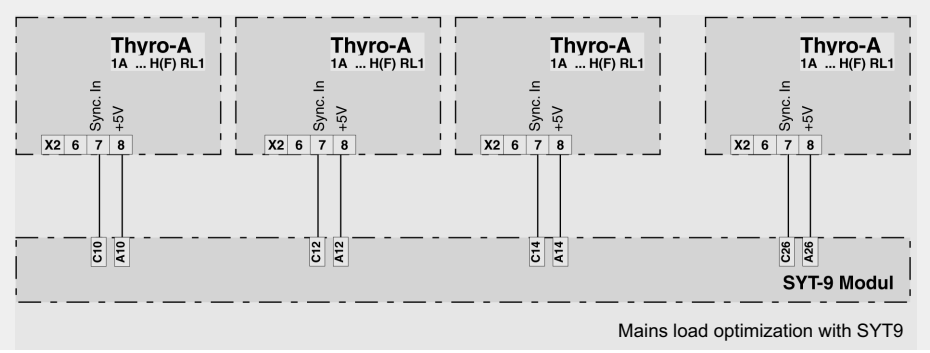


Abb. 11 Connecting diagram for SYT9

8. Special remarks

8.1 Installation

Thyro-A requires a vertical fitting position. With cabinet mounting sufficient ventilation of the cabinet must be ensured. The distance between the Power Controller and the cabinet ceiling or other mountings should be at least 150mm. The distance below the Power Controller should be at least 100mm. Heating up of the device by heat sources must be avoided. The dissipation of the Power Controller is stated in the Type overview table.

ATTENTION
Grounding must be carried out according to local regulations! (a grounding screw is provided for protective conductor connection on fastening adapter). The grounding also serves EMV devices (Y capacitor 4.7 nF).
For single-phase devices with type currents 8, 16 or 30A an adapter can be delivered for the 35mm top-hat rail assembly.

8.2 Commissioning

The device must be connected to the mains and the associated load according to the corresponding connecting plans.
On delivery the device is parameterized and adjusted to the respective power section. The operating mode TAKT (S1-1, S1-2) for transformer load (R201) is set. If a different operating mode is desired, then it must be set by the user. The following table shows the default settings of the DIP switch.

Analog output		Default	Setting act. Setting	Chapter No.
S1-10 S1-9	Signal level	0-10mA		3.1.5
Set point value				
S1-8 S1-7	Signal level	0-20mA		3.1.4
S1-6	Live Zero	0mA		3.1.3
Control mode				
S1-5 S1-4 S1-3	Control mode	U^2		3.1.2
Operating mode				
S1-2 S1-1	Oper. Mode	TAKT		3.1.1

Tab. 4 Default values DIP switch S1

The default settings of the potentiometer can be taken from the following table.

Phase angle 1. half wave		Setting Default	act. Setting	Chapter No.
R201		Thyro-A 1A: 60°el Thyro-A 2A: 90°el		3.2.1
Set point value input control end				
R202		U-Control: U_{Type} +10%		3.2.2
Current limit				
R203		I_{Type}		3.2.3
Load monitoring				
R205		OFF		3.2.5

Tab 5 Default values potentiometer

All standard settings should be checked by the user as a matter of course and adjusted to the operating conditions (e.g. operating mode, control mode, limits, monitoring, control characteristics, actual value output, fault indications etc.)

ATTENTION

Apart from the load and current supply to X1.1, certain control signals must be connected too. The following signals are essential for operating the device:

- Set point (terminal 4 or by bus option)
- Pulse lock (on ground, on terminal 1,2; jumper)

If the pulse lock jumper is not connected, the device is in a locked state and will not operate. Communication via interface is still possible. Further details on the pulse lock are described in the chapter of the same name.

ATTENTION

Heat sinks and neighbouring plastic parts are hot during operation!

8.3 Service

The devices delivered have been produced under quality standard ISO 9001. Should nevertheless faults or problems occur, our 24-hour service hotline is at your service: Tel. +49(0)2902 / 763-100.

8.4 Checklist

• LED ON green does not light up

- Check fuse control 500V 1.6A, if defective check external wiring, also applies to faults of external fusing, check Power Controller fusing.
- If fuse is defective then check load and wiring to load. Synchronization voltage is supplied to X1.1 supply(load) voltage must also be supplied by 24V current supply.
- With transformer load, check phase angle 1 (TRAFO ADAPTION) - fuse release caused by rush current is possible if setting is incorrect.
- Check 5V to X2.8. If this voltage is absent or too low, there is a defective component.

• Supply available but no load current

- Check that pulse lock is cleared (jumpered) terminal X2.1,2
- Check set point
- Check for load interruption
- Check blinking LED indications (chapt. 3.3))

• Load current does not have expected value

- Check set point Terminal X2.4 against X2.3 ground or
  Bus set point (with optional bus module)
- Set point/controller value, max. value correctly parameterized (Poti R203)
- Check all parallel load resistances for current conduction
- Checkthat end control setting is correct

• Load current flows without triggering

- Check that current transformer is correctly connected with I / I^2 control (X4)
- Check limit values for correct setting
- Check control characteristic adjustment (U, I, live-zero)
- Check control end for correct setting

9. Type overview

The type key comprises from left to right:

Type range	Thyro-A
Number of controlled phases	1A, 2A
Mains supply voltage	230, 400, 500 (V)
Type current	30 ... 280 (A)

and designations for incorporated semiconductor (H), with ventilator (F), indication relay (R), load current recording (L), power recording (P) and characteristic 1 for "series 2002".

9.1 Thyro-A 1A...H RL1, ...H RLP

Thyristor controller with integrated semiconductor fuse, system bus interface, additional 24VDC/AC control voltage supply, relay indication, load current monitoring and analog output, channel separation, synchronization option (for TAKT: with SYT9 for QTM integrated), with operating modes TAKT, VAR, Quick-Takt Mode and the control types U - U^2 - I - I^2 as well as P control with (H RLP).

		Type power [kW]				Dimensions in mm/kg						
Thyro-A 1A	Current [A]	230 V	400 V	500 V	Dissipation [W]	W	H	D	Weight	Dim. draw.	Current transf.	Fuse F1
	8	1.8	3.2	4	14	40	121	127	0.5	910	12	12.5
	16	3.7	6.4	8	30	45	121	127	0.7	911	40	20
	30	6.9	12	15	47	45	121	127	0.7	911	40	40
	45	10	18	22.5	48	52	190	182	1.7	943	100	63
	60	14	24	30	80	52	190	182	1.7	944	100	100
	100	23	40	50	105	75	190	190	1.9	944	100	200
	130	30	52	65	150	125	320	237	4	946	150	200
	170	39	68	85	210	125	320	237	4	946	200	315
	280	64	112	140	330	125	370	237	5	947	300	350

9.2 Thyro-A 2A...H RL1, ...H RLP

Thyristor controller with integrated semiconductor fuse, system bus interface, additional 24VDC/AC control voltage supply, relay indication, load current monitoring and analog output, channel separation, synchronization option (for TAKT: with SYT9). Suitable for 3-phase operation in rotary current saver circuit with operating mode TAKT (T) and the control types U - U^2 - I - I^2 as well as P control with (H RLP).

		Type power [kW]				Dimensions in mm/kg						
Thyro-A 2A	Current [A]		400 V	500 V	Dissipation [W]	W	H	D	Weight	Dim. draw.	Current transf.	Fuse F1
	8		5.5	7	28	85	121	127	1	000	12	12.5
	16		11	14	60	90	121	127	1.4	001	40	20
	30		21	26	94	90	121	127	1.4	001	40	40
	45		31	39	96	104	190	182	3.4	002	100	63
	60		42	52	160	104	190	182	3.4	003	100	100
	100		69	87	210	150	190	190	3.8	003	100	200
	130		90	112	300	250	320	237	8	004	150	200
	170		118	147	420	250	320	237	8	004	200	315
	280		194	242	660	250	393	237	11	005	300	350

10. Technical data

Type voltage
230V -15% +10% > 99V with addit. 24V supply
400V -15% +10% > 172V with addit. 24V supply
500V -15% +10% > 200V with addit. 24V supply

Additional gate voltage input
The additional gate voltage supply can take place with a.c. or d.c.
24VAC +10% / -20%
24VDC +18V to +32V

Mains frequency
all models 47Hz to 63Hz;
max. frequency change 5% per half wave

Load description
ohmic load
ohmic load with R_{hot} / R_{cold} ratio up to 6,
limit to $\hat{i} = 3 \times I_{nom}$
transformer load
Thyro-A 2A: symmetrical load

ATTENTION
The induction of the load side transformer should not exceed 1.45T in case of mains overvoltage when using grain-oriented, cold-rolled plates = 1.2T nominal induction.

Betriebsarten
TAKT = full wave pulse = default (T_0: 0.1 sec / 1.0 sec)
VAR = phase-angle control (only for types 1A)
QTM = fast half wave pulse (only for types 1A)

Set point inputs
The Power Controller Thyro-A has 2 set point inputs. The set point inputs are indirectly connected to the mains (SELV, PELV).
Set point 1: External set point input signal ranges:
0(4) - 20mA R_i = ca. 250kΩ
0 - 5V R_i = ca. 44kΩ
0 - 10V R_i = ca. 88kΩ
Set point 2: Optional bus interface, connection from superset PC or automation system.

Analogue output
Output: Signal level 0-10V, 0-20mA, 4-20mA
Maximum burden voltage 10V

Control characteristic
The control characteristic is established by the maximum value of the dimensions to be controlled and the key values of the set point. Using these key values, the linear control characteristic may be set as desired.
Each controller (e.g. temperature controller) whose output signal lies within the range 0-20mA / 0-5V / 0-10V, can easily be adapted to the Power Controller.

Control types
Voltage control U_{rms}, U^2_{rms} = standard setting
Current control I_{rms}, I^2_{rms}

Precision of control
Voltage ± 3 %
Current ± 1,5%
both with reference to the end value

Limitations

Current limitation	I_{rms}	Thyro-Tool	Bus	R203
Voltage limit	U_{rms}	Thyro-Tool	Bus	
Power limit	P (H RLP)	Thyro-Tool	Bus	

Relay outputs
Change-over contact, contactor material: AgSn02 / Au plated
The relay can be used for weak load circuits (> 5V 20mA),
but not after a prior load with 230V a.c.
Max. values: 250V 6A 180W, 1500VA
Insulation strength 4kV / 8mm

Ambient temperature
35°C external cooling (F model with integrated ventilator)
45°C self air cooling
At higher temperatures it is possible to operate with reduced type current:
Temperature range up to 55°C: type current -2% / °C

Connector data

	Connector U1,W1,U2,W2	Earthing screw	Conductor cross sect.
8A	Screw plug-in terminal	Bracket / M4	max. 4mm²
16 / 30A	Bracket / M4	Bracket / M4	max. 6mm²
45A	M 6	M 6	max. 50mm²
60 / 100A	M 6	M 6	max. 50mm²
130 / 170A	M 8	M 10	95 / 120mm²
280A	M 10	M 10	150 / 185mm²

With UL applications only use 60°/75° copper conductors!

Torques in Nm

Screw	Min	Rated	Max
M 2	0.22	0.25	0.28 (Phönix Screws)
M 4	0.85	1.3	1.7
M 6	2.95	4.4	5.9
M 8	11,5	17	22.5
M 10	22	33	44

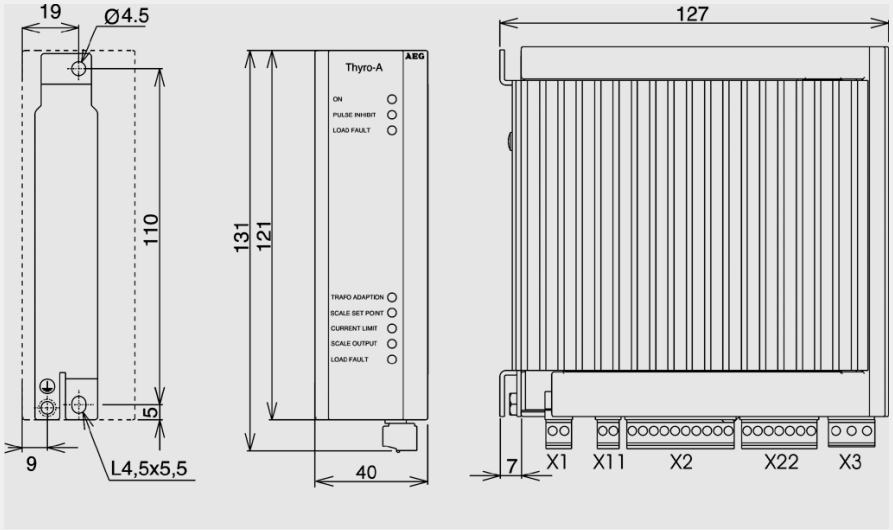
Ventilation data

230V, 50-60Hz

Thyro-A	Type current 50Hz	Type current 60Hz	Air volume
1A 280 F	0.13A	0.13A	120m^3/h
2A 280 F	0.25A	0.26A	200m^3/h

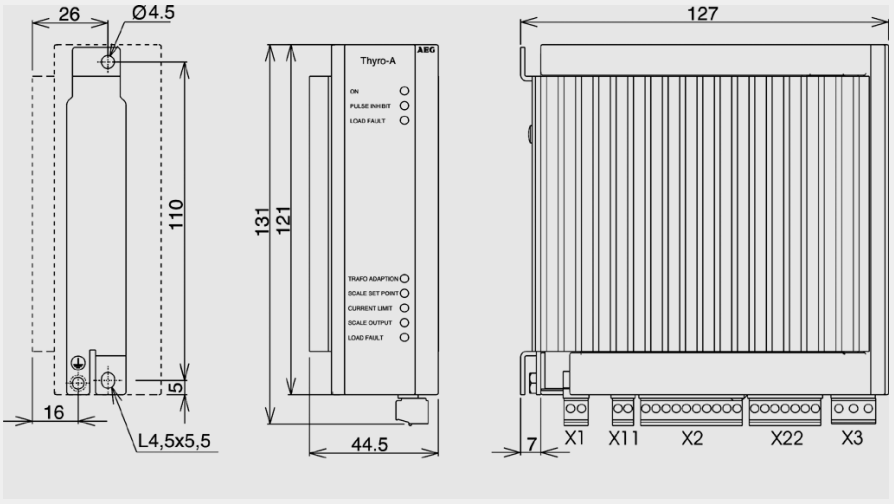
The ventilators must run with Thyro-A switched on, connection to X7

11. Dimensional drawings



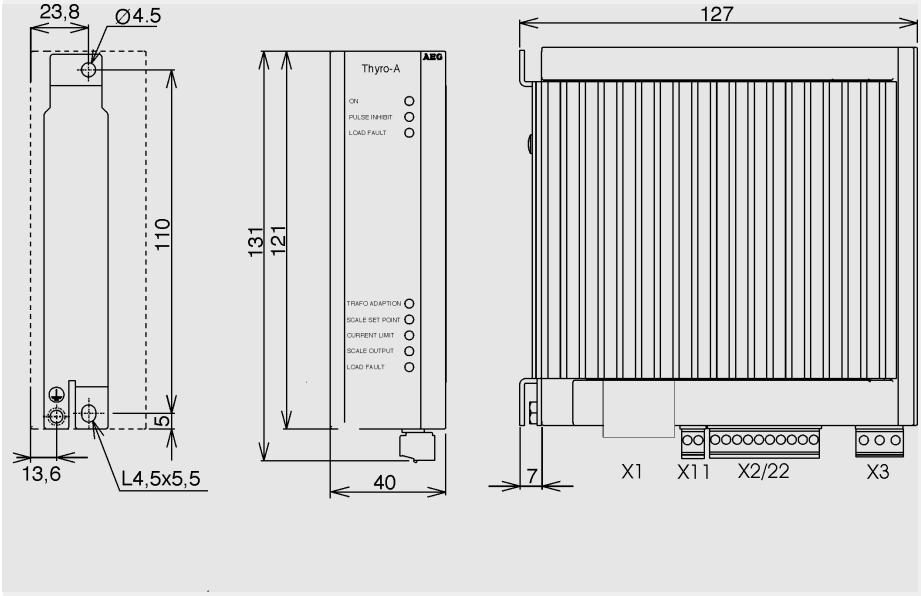
Thyro-A 1A (8 H)

Dimensional drawing 910



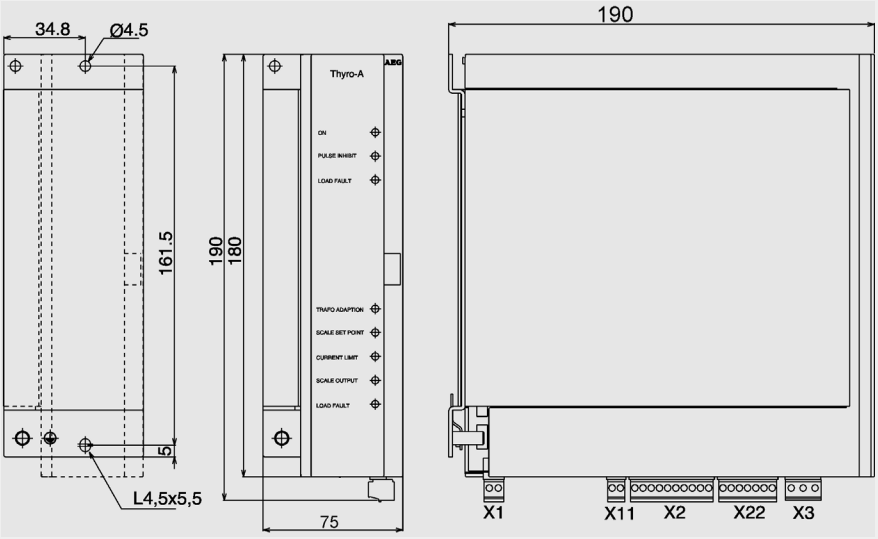
Thyro-A 1A (16 H, 30 H)

Dimensional drawing 911



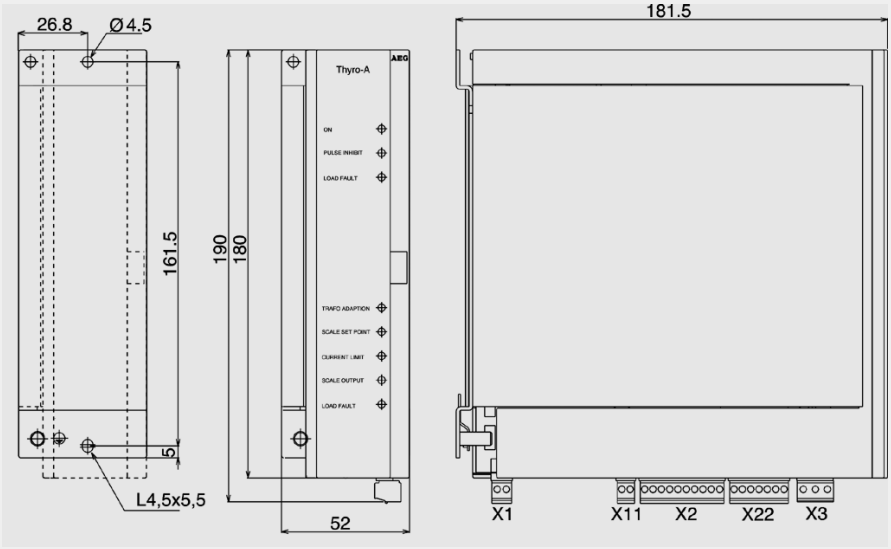
Thyro-A 1A (45 H, 60H)

Dimensional drawing 943



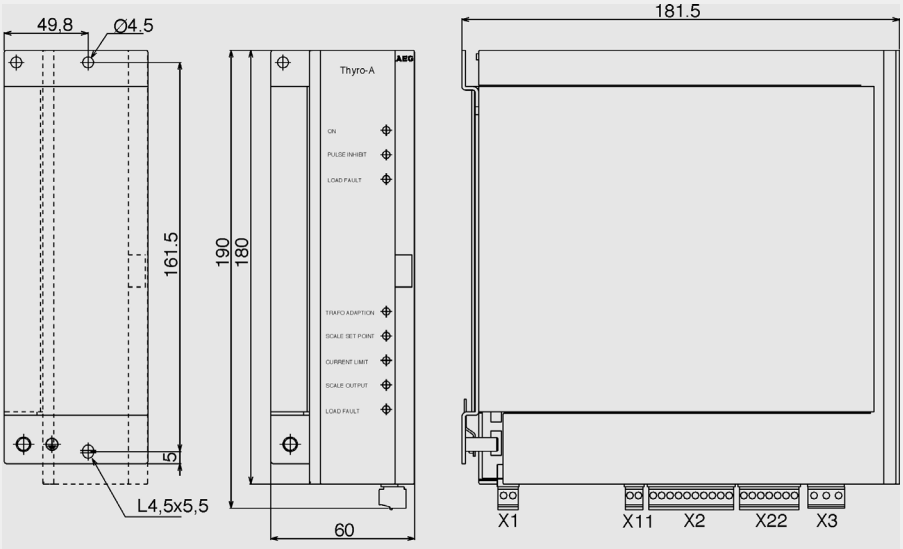
Thyro-A 1A (100 H)

Dimensional drawing 944



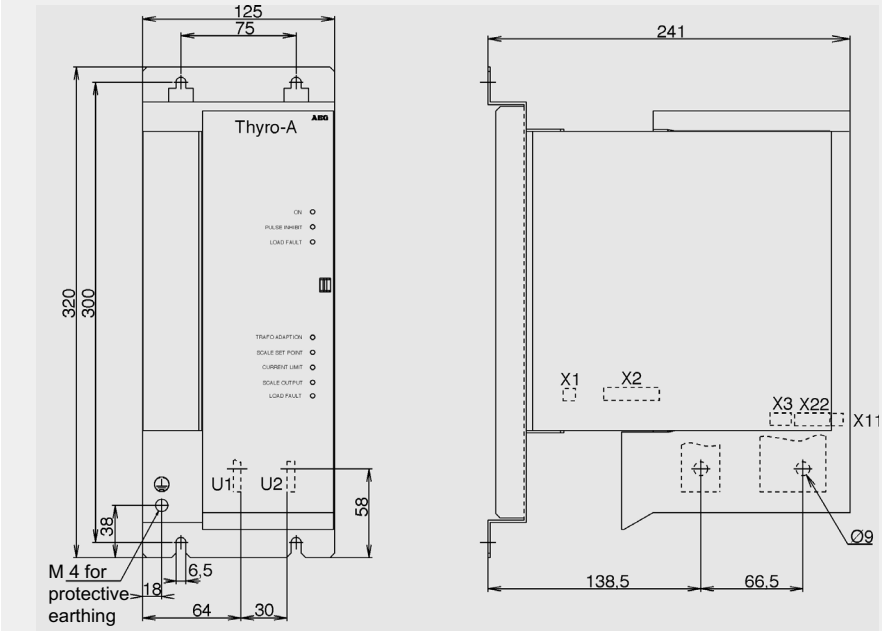
Thyro-A 1A (130 H, 170 H)

Dimensional drawing 946



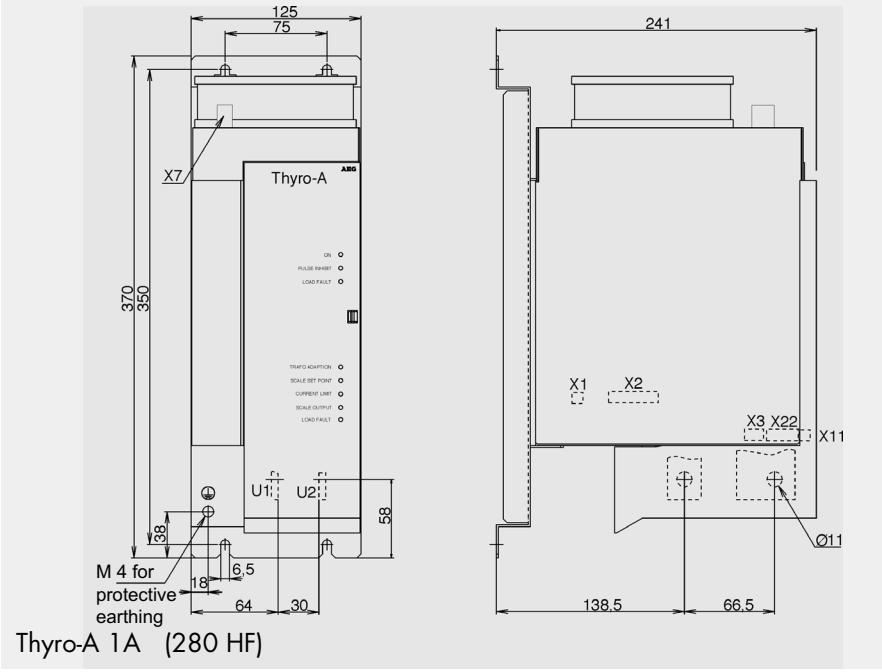
Thyro-A 1A (280 HF)

Dimensional drawing 948



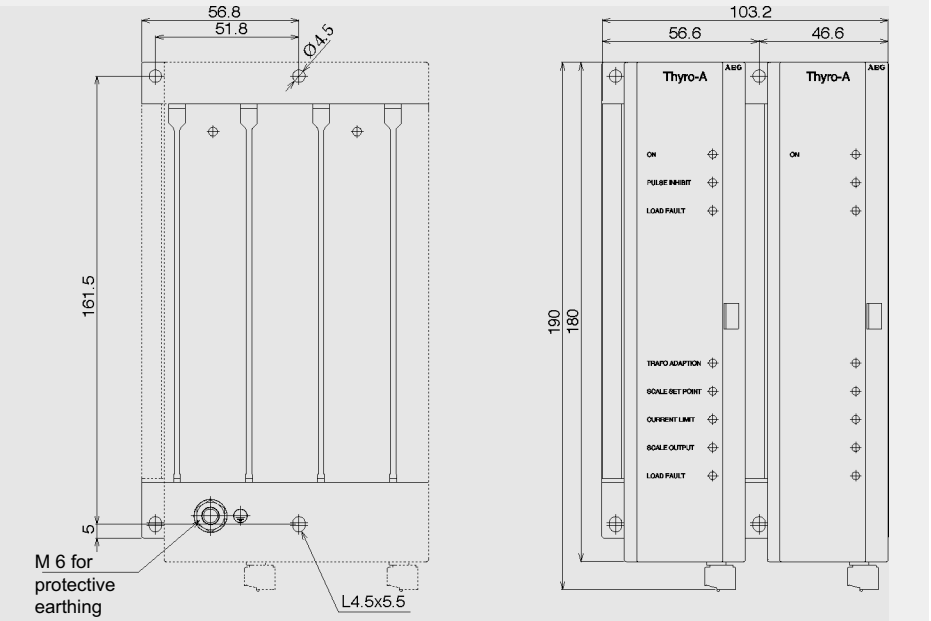
Thyro-A 1A (130 H, 170 H)

Dimensional drawing 000



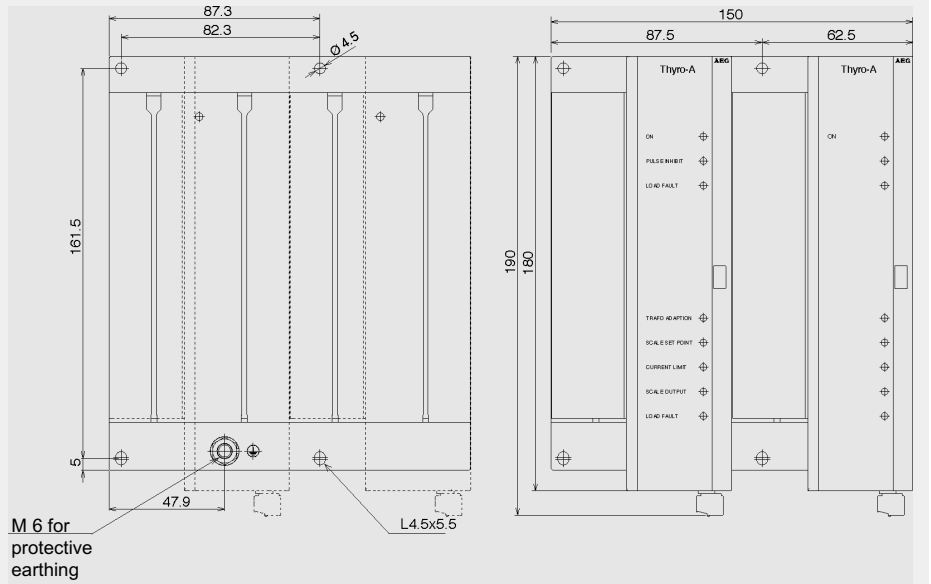
Thyro-A 1A (280 HF)

Dimensional drawing 001



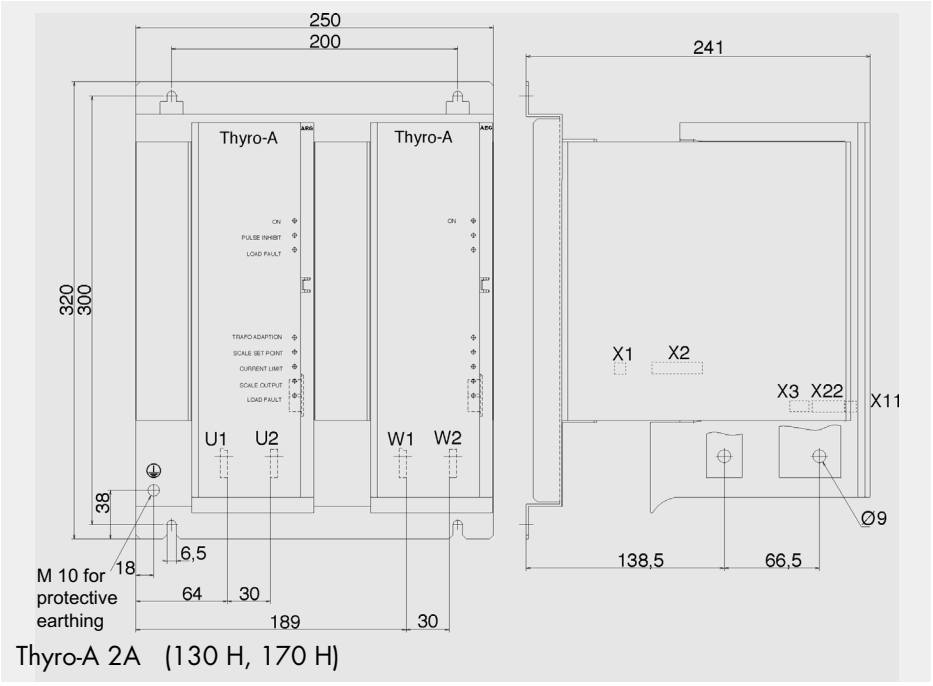
Thyro-A 2A (45 H, 60H)

Dimensional drawing 003



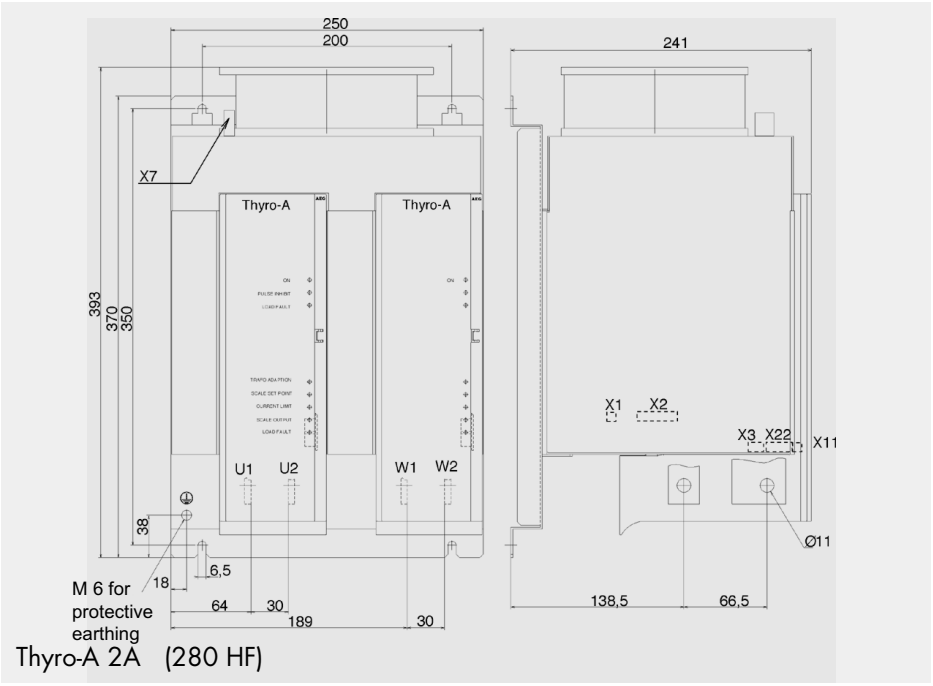
Thyro-A 2A (100 H)

Dimensional drawing 004



Thyro-A 2A (130 H, 170 H)

Dimensional drawing 006



Thyro-A 2A (280 HF)

Dimensional drawing 008

12. Accessories and options

Order no. 8000 006 763 Support for 35mm snap-on assembly for 8A, 16A and 30A

Order no. 8000 010 791 Support for 35mm snap-on assembly for 45A and 60A

Order no. 2000 000 841 Bus module Profibus DP

Order no. 2000 000 842 Bus module Modbus RTU

Order no. 2000 000 848 Bus module connector cable for 4 conntrollers, 2.5m long

Order no. 2000 000 849 Bus module connector cable for 4 conntrollers, 1.5m long

13. Approvals and conformities

The following approvals and conformities are available for Thyro-A
- Quality standard according to DIN EN ISO 9001
- UL registration, file no. E 135074, under preparation, with consideration to Canadian National Standard, project no. 02ME08043
- CE conformity
- Low voltage directive 73/23 EEC
- EMV directive 89/336 EEC; 92/31 EEC
- Marking directive 93/68 EEC

Guidelines

The CE mark on the device confirms observation of the EC general guidelines for 72/23 EEC - low voltage and for 89/339 EEC electromagnetic compatibility if the instructions on installation and commissioning set out in the operating instructions are observed.
There is no product norm for Thyristor Power Controllers so that a sensible norm structure must be set up which ensures safe application and opportunity for comparison.

CAUTION
Thyristor Power Controllers are not devices for disconnection in the sense of DIN VDE 0105 T1 and may therefore be operated only in connection with a suitable mains isolating device (e.g. switch, isolating link).

Additional to the following table further norms are adhered to, e.g. voltage dips according to 61000-4-11:8.94 are ignored by the control device or registered by triggering off monitoring. Generally an automatic start is made after the mains returns within the tolerances.

In detail

Conditions for use		
Built-in unit (VDE 0160)		DIN EN 50 178
General requirements		DIN EN 60146-1-1:12.97
Design, vertical installation		
Operating conditions		DIN EN 60 146-1-1; K. 2.5
Operating location, industry sector		CISPR 6
Temperature behaviour		DIN EN 60 146-1-1; K 2.2
Storage temperature D		-25°C - +55°C
Transport temperature E		-25°C - +70°C
Operating temperature better B		-10°C - +35°C with external cooling (280A) -10°C - +45°C for self air cooling -10°C - +55°C with reduced type current -2%/°C
Load class	1	DIN EN 60 146-1-1 T.2
Humidity class	B	DIN EN 50 178 Tab. 7 (EN 60 721)
Overvoltage category	III	DIN EN 50 178 Tab. 3 (849V)
Degree of pollution	2	DIN EN 50 178 Tab. 2
Air pressure		900 mbar * 1000m above NN
Protection class	I	DIN EN 50178 Chap. 3
Safe isolation		
Up to 500 V mains voltage		DIN EN 50 178 Chap. 3
Air and creeping distances		casing / mains potential > 5.5 mm casing / control potential > 1 mm mains voltage /contr. potent. ≥ 10 mm mains volt. interactive 2.5 mm
Mechanical impact		DIN EN 50 178 Chap. 6.2.1
Test voltage		DIN EN 50 178 Tab. 18
Tests according to		DIN EN 60 146-1-1 4.
EMV noise emission		EN 61000-6-4
Noise suppr. control device	Class A	DIN EN 55011:3.91 CISPR 11
EMV noise resistance		EN 61000-6-2
Compatibility level	Class 3	EN 61000-2-4:7.95
ESD	8 kV (A)	EN 61000-4-2:3.96
Electromagnetic fields	10 V/m	EN 61000-4-3:3.95
Burst mains lines	2 kV (A)	EN 61000-4-4:.95
control lines	2 kV (A)	
Surge mains lines	2 kV unsym.	EN 61000-4-5:.95
	1 kV sym.	EN 61000-4-5:.95
control lines	0.5 kV	
Line-conducted		EN 61000-4-6

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POWER SYSTEMS

Printed in Germany · Änderungen vorbehalten · Druckerei Hecker, Inh. Andrea Koerdt · Bitlon
D 8000007116 02/2003