- Power controller

THYRITOP 30

MODELE 3A ----- H1 / HRLP

ENGLISH

User's Manual

CHAUVIN ARNOUX

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> List of illustrations and tables

Contact

Technical queries

Do you have any technical queries regarding the subjects dealt with in these operating instructions?
If so, please get in touch with our team for power controllers:
Tel : + 33(0)472 14 15 40

Commercial queries

Do you have any commercial queries on power controllers?
If so, please get in touch with our team for power controllers.
Tel : + 33(0)472 14 15 40

Service-Hotline

Our team is at your service on the following hotline:
PYRO-CONTROLE
6 bis Avenue du Docteur Schweitzer
69881 MEYZIEU Cedex FRANCE
Tel : + 33(0)472 14 15 40 Fax : + 33(0)472 14 15 41
http://www.pyro-controle.com

Copyright

Further information on copyright

> 1. General

The Thyritop 30 3A is a communication-capable thyristor power controller. It can be used wherever alternating voltages, alternating currents or outputs in thermal process technology need to be controlled. The Thyritop 30 3A has several different control and regulation modes, can easily be connected to process and automation technology, has a high degree of control accuracy and is simple to handle.

These operating instructions describe the configuration and functions of the Thyritop 30 3A and are designed to enable qualified personnel to perform the following work:

- Planning
- Start-up
- Maintenance and repair

Information and notes for personnel not qualified to perform the work, and for use other than in industrial plants, are not included in these operating instructions.

1.1 Type designations / Validity

These operating instructions describe the Thyritop 30 3A series versions ...H 1, H RL1 and ...H RLP. Product characteristics that are only provided by the Thyritop 30 ...H RL1 and ...H RLP series are marked in the text.

These operating instructions comply with the current technical specifications of the device at the time of publication. The contents do not constitute a subject matter of the contract, but serve for information purposes only.

We reserve the right to alter any specifications given in these operating instructions, especially with regard to technical data, operation, weights and dimensions. PYRO-CONTROLE reserves the right to make modifications with regard to the content and technical data in these operating instructions.

Type code

The type designation of the thyristor-power controller is derived from the configuration of the power section as well as from other features.

Designation (Example)	Characteristics	Different versions of the power controller
Thyritop30	Three-phase power controller with 3-phase power section	
...400-	with 400V type voltage	230V, 400V, 500V
...280	with 280A type current	16 ... 350A
H	with integrated semiconductor fuse	
F	with fan (from 280A types)	*
R	with signalling relay	*
L	with load monitoring	*
P	with additional output control (H RLP)	*
1	Identification Thyritop 30, series	*
Example: Thyritop 30 3A...H1		

* Device-specific

Thyritop 30 3A...H1

Thyristor power controller with three-phase circuit with integrated semiconductor fuse, system bus interface, TAKT and VAR operating modes, synchronisation option (in TAKT operating mode with option SYT9) and control modes U, U^2. Suitable for 3-phase operation in 3-phase circuit. Suitable for visualisation and start-up software from the Thyro-Tool Family.

Thyritop 30 3A...HRL1

Thyristor power controller in 3-phase switch with integrated semi conductor fuse, system bus interface, additional 24 DC/AC electronic power supply, alarm relay, load monitoring and analogue output, channel separation, with operating modes TAKT and VAR, synchronisation option (in operating mode TAKT with SYT9), control systems U, U2, I ,I2. Suitable for the visualisation and commissioning software Thyro-Tool.

Thyritop 30 3A...H RLP

Thyristor power controller with three-phase circuit with integrated semiconductor fuse, system bus interface, additional 24 VDC/AC electronic supply feed, signalling relay, load current monitoring and analog output, channel separation, with TAKT and VAR operating modes, synchronisation option (in TAKT operating mode with option SYT9) and control modes U, U^2, I, I^2 and P. Suitable for visualisation and start-up software from the Thyro-Tool Family.

1.2 Abbreviations

AEG PSS	AEG Power Supply Systems GmbH
AN1	Phase angle of the 1st half-wave
SST	Soft start time
SYT	Synchro cycle
T_0	Cycle period
T_S	Switch-on time

1.3 Special Features

- Integrated semiconductor fuse
- Additional supply for electronics, therefore also operation with mains voltages up to 0.43 x U_{nom} possible (only ...HRL 1 und ...H RLP)
- Ohmic load and transformer load, as well as load with high R_{warm} /R_{cold} ($\leq$ 6) peak current limitation of 3 x I_{nom} (only ...H RL1 and ...H RLP)
- Soft start function for transformer load
- Channel separation, necessary with reverse voltage
- Load current monitoring (only ...H RL1 and ...H RLP)
- Signalling relay (only ...H RL1 and ...H RLP)
- Analog output (only ...H RL1 and ...H RLP)
- Control modes U, U^2; with ...H RL1 also I, I^2, with ...H RLP also P
- Operating modes TAKT, VAR
- Synchronisation option (for TAKT: with SYT9 or with software)
- Addressing with analog set value or optional bus adapter
- System interface standard
- Safe isolation in acc. with EN 50178 Ch. 3
- UL rating

Options:

- Connection to various bus systems, e.g. Profibus DP, Modbus RTU, DeviceNet, CANopen, other bus systems on request.
- PC-Interface and THYRO-TOOL (Visualisation and start-up software)

1.4 Warranty

In the event of any claims in connection with the Thyritop 30, please contact us quoting:

- Type designation
- Works number / Serial number
- Reason for the complaint
- Environmental conditions of the device
- Operating mode
- Period of use

Goods and services are subject to the general conditions of supply for products of the electrical industry, and our general sales conditions. Claims in connection with supplied goods must be submitted within one week of receipt, along with the delivery note. PYRO-CONTROLE will rescind all obligations such as warranty agreements, service contracts, etc. entered into by PYRO-CONTROLE or its representatives without prior notice if maintenance and repair work is carried out using anything other than original PYRO-CONTROLE spare parts or spare parts purchased from PYRO-CONTROLE.

> 2. Safety

2.1 Identification in the operating instructions

In these operating instructions, there are warnings before dangerous actions. These warnings are divided into the following danger categories:

DANGER

Dangers that can lead to serious injuries or fatal injuries.

WARNING

Dangers that can lead to serious injuries or considerable damage to property.

CAUTION

Dangers that can lead to injuries and damage to property.

CAUTION

Dangers that can lead to minor damage to property.

The warnings can also be supplemented with a special danger symbol (e.g. "Electric current" or "Hot parts") , e.g.

 risk of electric current or

 risk of burns.

In addition to the warnings, there is also a general note for useful information.

NOTE

Content of note

2.2 General danger information

⚠ DANGER

Electric current

Risk of injury from live parts

There is a danger:

- In the case of devices not controlled, since the load circuit cannot be disconnected from the power supply network by the power contoller.
- After disconnection from the power supply network, since the capacitors can still carry a dangerous residual voltage. Wait approx. 1 minute until the residual voltage has dissipated.

⚠ DANGER

Electric current

Risk of injury from live parts

- Never operate the device without the cover.

⚠ DANGER

Hot parts

Risk of burns from heat sinks and neighbouring plastic parts (> 70°C possible)

- Do not touch the hot parts of the device.
- Affix the "Risk of burns" warning symbol in the immediate vicinity of the device.

2.3 Operator requirements

The operator must ensure the following:

- That the safety regulations of the operating instructions are observed.
- That the accident prevention regulations valid in the respective country of use and the general safety regulations are observed.
- That all safety devices (covers, warning signs etc.) are present, in perfect condition and are used correctly.
- That national and regional safety regulations are observed.
- That the personnel has access to the operating instructions and safety regulations at all times.
- That operating conditions and restrictions resulting from the technical data are observed.
- That, should abnormal voltages, noises, increased temperatures, vibration or similar occur, the device is immediately put out of operation and the maintenance personnel is informed.

2.4 Personnel requirements

- Only qualified electro-technical personnel who are familiar with the pertinent safety and installation regulations may perform the following:
  - Transport
  - Installation
  - Connection
  - Startup
  - Maintenance
  - Testing
  - Operation.

These operating instructions must be read carefully by all persons working with or on the equipment prior to installation and initial start-up.

2.5 Intended purpose

The device may only be used for the pupose for which it was intended, as persons may otherwise be exposed to dangers (e.g. electric shock, burns) and plants also (e. g. overload). The user must therefore observe the following points:

- It is not permitted to make any unauthorised modifications to the unit or to use any spare parts or replacement parts not approved by AEG PSS, or to use the unit for any other purpose.
- The warranty obligations of the manufacturer are only applicable if these operating instructions are observed and complied with.
- The device may only be used for control and regulation of electrical power.
- The device is a component that cannot function alone.
- Project planning must account for the proper use of the device.
- Never exceed the maximum permitted connection values as given on the nameplate.
- The device may only be operated in conjunction with an upstream mains disconnect device (e.g. switch, VDE 0105 P1).
- It must be guaranteed that in the event of a fault, no uncontrolled currents, voltages or power may occur in the circuit.
- Despite proper use, it is possible in the event of a fault, that the device will not control the currents, voltages and power in the load circuit. (Example: if the power components are destroyed (broken down or high-resistance), the following reactions are possible: current interrupted, half wave operation, permanent flow of power).

2.6 Use of the device

2.6.1 Operation

- Only switch on the mains voltage at the machine when there is no danger to persons, system or load.
- Protect the device against dust and damp.
- Ensure that the ventilation openings are not blocked.

2.6.2 Prior to installation / start-up

- If stored in a cold environment: ensure that the device is absolutely dry. (Allow the device a period of at least two hours to acclimatise before start-up)
- Check that the voltage data on the nameplate matches the mains voltage.
- Only install the device in an upright position.
- Ensure sufficient ventilation of the cubicle if mounted in a cubicle.
- Observe minimum spacing (Clearance: 150 mm above, 100 mm below). The devices can be installed next to each other without spacing between.
- Ensure that the device cannot be heated up by heat sources below it. (The power loss is given in the type overview table, see page 141, Technical data).
- Ground the device in accordance with local regulations.
- Connect the device to the mains and the corresponding load in accordance with the connection diagram.
- The device is parameterised when delivered. The parameters are adapted to the particular power section. (Default: operating mode VAR without N-conductor). Check default settings and adjust to application conditions if necessary (e.g. operating mode, control type, restrictions, monitoring, control characteristic curves, actual value output, fault messages etc.)

NOTE

Connecting the control signals

The following control signals are absolutely necessary for operating the devices:

- Setpoint (terminal X2.4 or via bus option)
- Pulse blocking (to ground, on terminal 2.1, X2.2; bridge present)

> Use shielded control conductors to connect the control signals.

If the pulse blocking bridge is not connected, the device is blocked and is not operating. Communication is still possible via the interface (see page 130, Connecting pulse blocking).

2.6.3 Maintenance, service, faults

In order to avoid injuries and damage, the user must observe the following:

- Before all work:
  > Disconnect the device from all external voltage sources.
  > Secure the device against accidentally being switched back on.
  > Use suitable measuring instruments and check that there is no voltage present.
  > Ground and short circuit the device.
  > Provide protection by covers or barriers for any neighbouring live parts.
- The device may only be serviced and repaired by trained electro-technical personnel.
- There is a risk of damage when carrying out repair work on the power section. Various components of the power section are screwed tight with a precise torque.
  > Have repairs to power sections carried out by PYRO-CONTROLE.
- see also contact on page 81

2.6.4 Transport

- Only transport the device in the original packaging.
- Protect the device against damage, caused by jolts, knocks and contamination, for instance.

> 3. Functions

In order for the Thyritop 30 to be adapted as best possible to the required application, it has numerous functions. These functions are described in this chapter.

NOTE

Ideal adaption of the Thyritop 30 to the load

Choose the operating or control mode to adapt the Thyritop 30 to best match the load.

NOTE

Times given

The times given (duration), e.g. T_0 or SST are based on a 50 Hz mains freqency. With a mains frequency of 60 Hz, the times go down to 5/6 of the indicated value.

3.1 Operating modes

The user selects the operating mode most suitable to adapt the Thyritop 30 to the various applications and manufacturing processes, as well as to different electrical loads.

3.1.1 Full oscillation cycle mode TAKT

In this operating mode, the mains voltage is switched periodically, relative to the defined setpoint. Multiples of the mains periods are switched to avoid any direct current. The full oscillation cycle mode TAKT is particularly suited for loads with thermal intertia. The most important settings for this operating mode are the cycle time (T_0) and the transformer load (see page 117, Setting the transformer load).

The use of this function achieves the lowest system disturbances. Any system disturbances that are still present (e.g. flicker) can be reduced to an insignificant amount using system load optimisation (see page 107, Mains load optimisation).

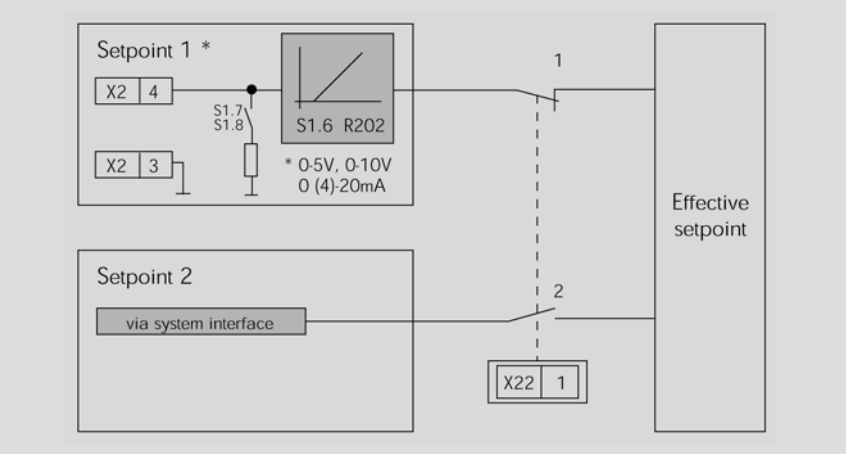
3.1.2 Phase angle principal VAR

In this operating mode, the sinus wave of the mains voltage is shifted. The shift depends on the setpoint value. Characteristic of this operating mode are the high control dynamics.

When phase angle control VAR is used, harmonics of the mains voltage form. These can be compensated for with various types of circuit.

3.2 Setpoint processing

Fig. 1 Setpoint inputs and total set point



The user can adapt the setpoint signal to process controllers or to the automation system (see page 114, Live zero and setpoint input range). This is done by altering the starting and finishing points of the control characteristic curve. All common signals can be used.

As soon as the power controller reaches a limit value (U_{max}, I_{max}, P_{max}), this is indicated by LEDs (see page 101, LED messages).

The power controller has two setpoint inputs that are electrically isolated from the mains and of which only one is ever active.

- Setpoint 1: Analog signal X2.4 (+); X2.3 (ground)
- Setpoint 2: Via system interface (bus module, THYRO-TOOL...)

The effective setpoint is the value when connected through.

The setpoint input to be used is defined by configuring terminal X22.1 (see page 101, Settings and operation).

3.3 Control types

The power controller has various different control types.

Control types ...H1	
Control type	**Control variable**
U, U^2	highest conductor voltage

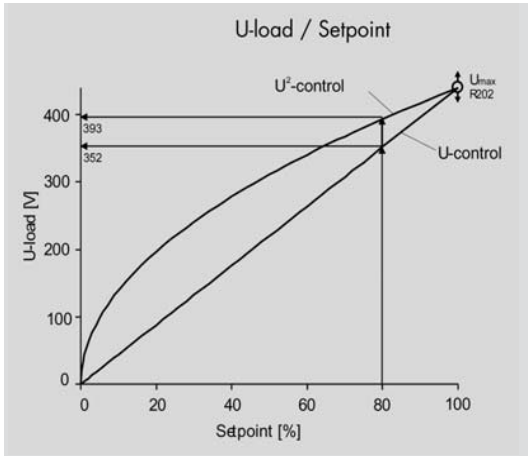
Control types ...H RL1	
Control type	**Control variable**
U, U^2	highest conductor voltage
I, I^2	highest phase current

Control types ...H RLP	
Control type	**Control variable**
U, U^2	highest conductor voltage
I, I^2	highest phase current
P	total effective power

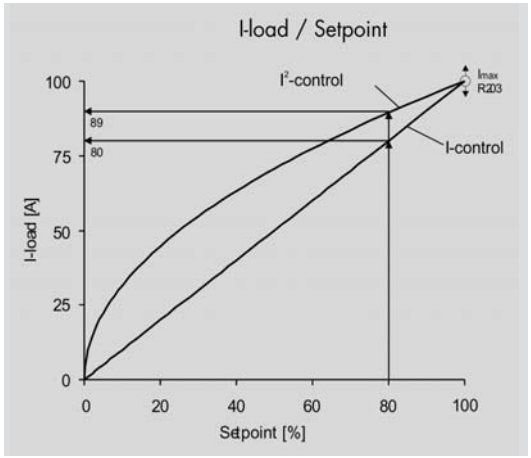
Fluctuations in mains voltage or changes in load are compensated directly by bypassing the inert temperature control circuit. This method is therefore particularly fast (secondary control).

Control characteristic curve and control variable

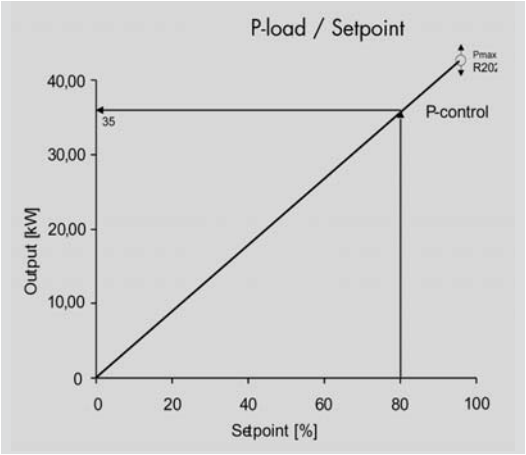
The control variable influencing the load is proportional to the effective setpoint in the case of control types U, I, P. In control types U^2, I^2, the control variable influencing the load is a square of the effective setpoint.



U	Output voltage, U_{eff}
U^2	Output voltage, U^2_{eff}



I	Output current, I_{eff}
I^2	Output current, I^2_{eff}



P	Output power (only for ...H RLP)

If the load resistance changes, e.g. due to temperature, ageing or load breakage, the variables influencing the load change.

Tab. 1 Effects of a change in the load resistance

Control type	Load resistance becomes smaller			Load resistance becomes greater		
	P	U_{Last}	I_{Last}	P	U_{Last}	I_{Last}
U	greater	=	greater	smaller	=	smaller
U^2	greater	=	greater	smaller	=	smaller
I*[1]	smaller	smaller	=	greater	greater	=
I^2*[1]	smaller	smaller	=	greater	greater	=
P*[2]	=	smaller	greater	=	greater	smaller

(*[1] for ...H RL1 and ...H RLP, *[2] only for ...H RLP)

3.4 Limits

In addition to setting the control type, it is also possible to set limits for the following variables:

- Voltage (U)
- Current (I) (only for ...H RL1 und ...H RLP)
- Power (P) (only for ...H RLP)

Tab. 2 Effective limits

Secondary control	End value of the controller	Limits
U	$U_{eff\ max}$	$I_{eff\ max}$[1] P_{max}[1]
U^2	$U_{eff\ max}$	$I_{eff\ max}$[1] P_{max}[1]
I*[1]	$I_{eff\ max}$	$U_{eff\ max}$[1] P_{max}[1]
I^2*[1]	$I_{eff\ max}$	$U_{eff\ max}$[1] P_{max}[1]
P*[2]	P_{max}	$I_{eff\ max}$[1] $U_{eff\ max}$

(*[1] for ...H RL1 and H RLP, *[2] only for ...H RLP)

The Thyritop 30 3A ... H RL1 und ...H RLP also has peak current limiting (î=3 x I_{nom}).

3.5 Pulse blocking

Certain errors trigger pulse blocking (depending on the configuration). When pulse blocking is active (terminal X1.1 opens after X1.2), the power section is no longer addressed and LED PULSE INHIBIT lights up.

3.6 Current or voltage transformer (only for ...H RL1 and ...H RLP)

The power controller has three current transformers that are wired internally in the device. The loads voltage is measured with the measuring signal of the mains voltage.

3.7 Display via analog output (only for ...H RL1 and ...H RLP)

The following variables are output at the analog output (e.g. when an external measuring instrument is connected):

- Load current (highest phase current from L1, L2, L3)
- Load voltage (highest conductor voltage)
- Effective power (total power) (only with ...H RLP)
- Additional variables (can be selected via PC/bus, e.g. mains voltage, setpoint etc.)

The user must configure which variable is to be output at the analog output, (see page 113, Control mode / Analog output). The analog output can also be used as a setting aid for potentiometer settings (see page 115, Potentiometer).

3.8 Error and status Messages

The Thyritop 30 3A has internal error and status messages. The THYRO-TOOL can be used to configure the consequences. The user can define what the reactions are to be in the event of a particular message. Possible reactions that can be set are blocking the load current (pulse blocking) and an output at fault signalling relay K1 (only for ...H RL1 and ...H RLP). The working principle can also be set at fault signalling relay K1. Basic error messages that make operation of the machine impossible always result in pulse blocking being actuated or fault signalling relay K1.

Error messages	Pulse blocking		Fault signalling relay K1	
	fixed	configu-rable	fixed	configu-rable
Frequency error	x			x
SYNC error	x			x
Device overtemperature		x		x
Undercurrent in load circuit		x		x
Flash values invalid	x		x	
Master / Slave error	x			x
Error rotating field / phase	x			x

Error messages	Pulse switch-off		Fault signalling relay K1	
	fixed	configu-rable	fixed	configu-rable
Undervoltage in mains		x		x
Overvoltage in mains		x		x
Pulse switch-off	x			x
U limit		x		x
I limit		x		x
P limit		x		x

Fault signalling relay K1		
	No message	Message
Closed-circuit current principle	picked up	dropped out
Active current principle	dropped out	picked up

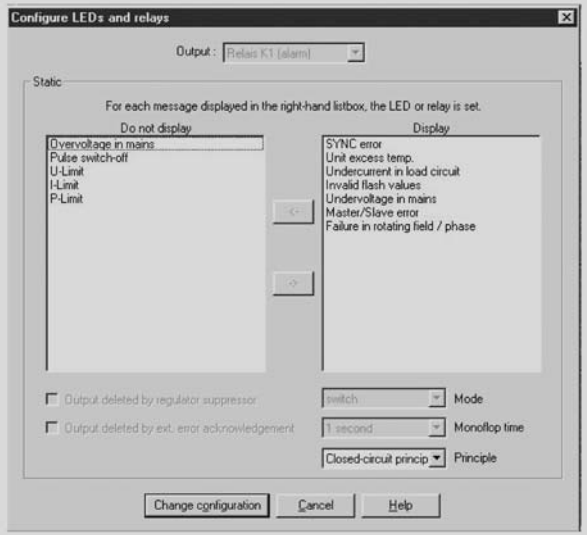
Please refer also to: LED messages (see page 101) and Fault signalling relay K1 (see page 103)

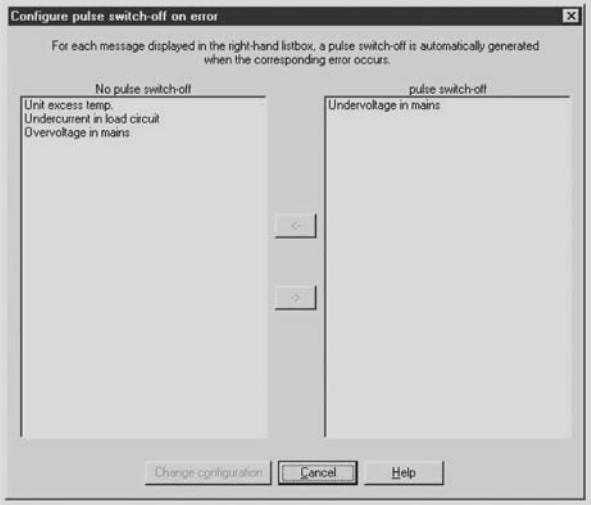
Default settings		
Error message	Pulse blocking	Fault signalling relay K1
Frequency error	x	x
SYNC error	x	x
Device overtemperature		x
Undercurrent in load circuit		x
Flash values invalid	x	x
Master / Slave error	x	x
Error rotating field / phase	x	x

Default settings		
Status message	Pulse blocking	Fault signalling relay K1
Undervoltage in mains	x	x
Overvoltage in mains		
Pulse switch-off	x	
U limit		
I limit		
P limit		

Default settings	
Fault signalling relay K1	Closed-circuit current principle

Possible settings in THYRO-TOOL





3.8.1 LED messages

1	LED ON (green) Master
2	LED PULSE INHIBIT (red)
3	LED LOAD FAULT (red)
4	Internal LED (green) Master
5	LED ON (green) Slave1
6	Internal LED (green) Slave1
7	LED ON (green) Slave2
8	Interne LED (green) Slave2

LED messages

Message	LED ON (green)	LED PULSE INHIBIT (red)	LED LOAD FAULT (red)	Interne LED am Master (green)	Interne LED am Slave 1 (green)	Interne LED am Slave 2 (green)	Description
Device without voltage supply	OFF	OFF	OFF	OFF	-	-	Device not operating
Voltage supply present	ON	-	-	-	-	-	Voltage supply present
Control display	ON	OFF	-	Flash*1	Flash*1	Flash*1	Depending on the control, the internal LEDs flash at different speeds, from completely OFF to completely ON
Setting aid on analog output	ON	Flash fast	Flash fast	OFF	-	-	The analog output outputs a potentiometer value 30 secs. after the last potentiometer change: Normal mode, alternating flashing
Frequency error	ON	Flash slow	OFF	OFF	-	-	Frequency outside 47 Hz to 63 Hz
SYNC error	ON	Flash slow	OFF	OFF	-	-	Zero crossing of mains voltage faulty
Device over-temperature	ON	OFF	Flash slow	OFF	-	-	Overtemperature 90°/95°C internal/external
Undercurrent in load circuit	ON	OFF	ON	OFF	-	-	Undercurrent limit exceeded
Flash values invalid	ON	Flash*1 fast	Flash*1 fast	OFF	-	-	Parameters (in flash) faulty or deleted
Undervoltage in mains	ON	ON	ON	ON	-	-	Mains voltage < than undervoltage limit (-57%)
Pulse switch-off	ON	ON	OFF	OFF	-	-	Bridge X22.1 - X22.2 open or set via bus
U limit I limit P limit	ON	Flash slow	Flash slow	OFF	-	-	U, I, or P limit reached, flash alternately
No communication with the slaves	ON	OFF	OFF	Flash slow	Flash fast	Flash fast	No communication with the slave
Error rotating field / phase	ON	Flash*1 slow	OFF	Flash*1 slow	Flash fast	Flash fast	Left rotating field or phase missing

OFF	LED not lit	Flash slow	LED flashes slowly (1 Hz or 3.3 Hz)
ON	LED permanently lit	Flash fast	LED flashes fast or flickers (14.7 Hz)
-	Any other state of the LED	*1	LEDs flash simultaneously

When the semiconductor fuse is triggered, this causes a voltage failure at the power controller. The device therefore switches off. This causes a frequency error.

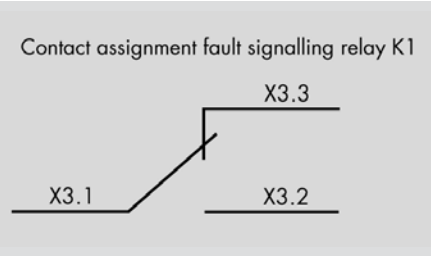
If the power controller is supplied from an external 24 V source at the extra electronics supply input (see page 129, Connecting additional electronics supply), the device sends a frequency error message but does not switch off.

3.8.2 Fault signalling relay K1 (only for ...H RL1 and ...H RLP)

NOTE

Default setting

The function explained here is described in the default state. This setting can be changed with a bus module or with THYRO-TOOL



X3.1	Root
X3.2	N/O contact
X3.3	N/C contact

Fault signalling relay K1 has a changeover contact. Messages that cause the fault signalling relay to switch can be set with THYRO-TOOL
In the default state, fault signalling relay K1 functions on the closed-circuit current principle.

In the event of the following errors, the fault signalling relay drops out and the power controller switches off:

- SYNC error
- Internal error
- Undervoltage in the mains
- Master/Slave error
- Error rotating field / phase

In the event of the following errors, the fault signalling relay drops out, the power controller remains on and a message is sent (LED):

- Overtemperature
- Undercurrent in the load circuit

3.9 Monitoring

Power controller and load circuit are monitored for malfunctions. Messages are sent via LED (see page 101, LED messages), by bus or by fault signalling relay K1 (see page 103, Fault signalling relay K1).

3.9.1 Monitoring the mains voltage

NOTE

Limit values for voltage monitoring
The following limit values apply for voltage monitoring:
- Undervoltage monitoring: -57% of type voltage
- Overvoltage monitoring: +10% of type voltage

This results in absolute limit values for the monitoring of the main voltage.

Tab. 3 Limit values for mains voltage monitoring

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

Only for ...H RL1 and ...H RLP

In the event of more than 15% below the type voltage, the devices can only be operated right up to the undervoltage limit if the electronics are supplied from an external 24 V source.

For ...H1, ...H RL1 and ...H RLP

In default state, pulse blocking is switched internally when the undervoltage limit is exceeded, and fault signalling relay K1 drops out (both can be set with THYRO-TOOL.

3.9.2 Load monitoring (only for ...H RL1 and ...H RLP)

The load can consist of one or more resistors connected in parallel or in parallel-series. It can be monitored up to a freely selectable absolute undercurrent limit value. The measured current is constantly compared with a settable undercurrent limit value. The device can thus detect an increase in load resistance. If the undercurrent limit value is exceeded, a message is sent. Where resistance elements are connected in parallel, a partial load interruption can be selected if the undercurrent limit value is set accordingly (see page 122, Setting load monitoring).

3.9.3 Device temperature monitoring

NOTE

Default setting
The function explained here is described in the default state. This setting can be changed with a bus module or with THYRO-TOOL

The Thyritop 30 has temperature monitoring.

If the temperature is exceeded, a message is sent via LED (see page 101, LED messages), via the bus module, or via fault signalling relay K1 (see page 103, Fault signalling relay K1). Pulse blocking is not actuated.

3.9.4 Fan monitoring (for ...F...)

The externally ventilated thyristor power controllers have temperature monitoring for the heat sink. The fan is thus indirectly monitored.

3.10 Extended functions (with bus module / THYRO-TOOL)

Certain functions cannot be set via DIP switch or potentiometer. A bus module (e. g. Profibus DP, DeviceNet, Modbus RTU, CANopen) or a PC can be connected at the system interface X22. This makes it possible to access further parameters, setpoints, actual values and error messages.

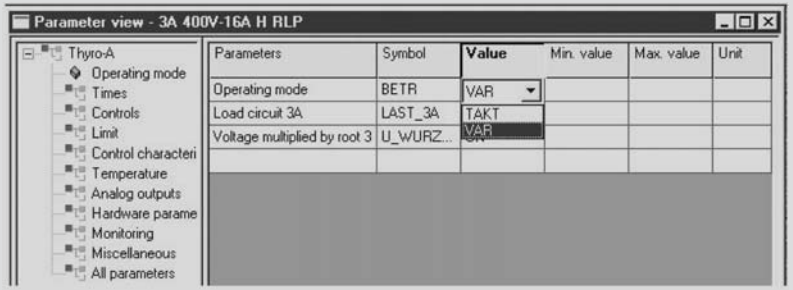
A few examples of extended functions are set out on the following pages.

3.10.1 Extended operating modes / circuit types

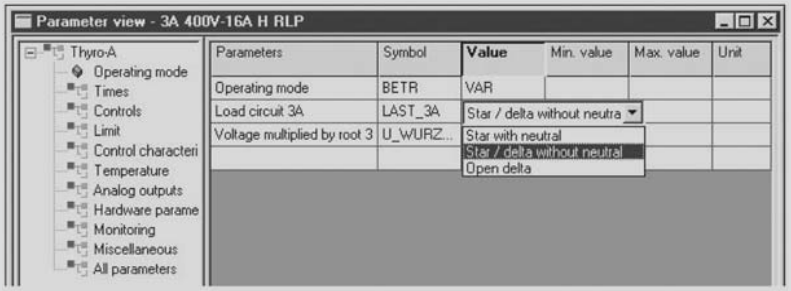
With the aid of THYRO-TOOL it is possible to set the operating mode and circuit type independently of one another. Combinations are thus possible which cannot be set with DIP switch S1.1 and S1.2.

Operating modes	TAKT, VAR
Load circuits	Star with neutral conductor, delta or star without neutral conductor, open delta

Possible settings in THYRO-TOOL (operating mode)



Possible settings in THYRO-TOOL (circuit type)



3.10.2 Averaging for the analog output

In order to attain a finer line thickness for line recorders, for example, the output signal can be smoothened if needed to suit the application.

MEAN	100	Mains periods (default setting)

3.10.3 Control limits

For operating modes TAKT and VAR, it is possible to set control limits (end position limits).

For TAKT

$T_{s\ max}$	Maximum switch-on period
$T_{s\ min}$	Minimum switch-on period

For VAR

V_IE	Front pulse end position
H_IE	Rear pulse end position

3.10.4 Controller parameters

The parameters of the controller can be adapted to the path if needed.

Parameters

T_I	20	Controller I share
K_P	60	Controller P share
K_R	5	Controller amplification

* Default setting

3.10.5 Mains load optimisation

The time for software synchronisation can be set (see page 134, Mains load optimisation).

(50Hz) =>	Delay period after mains returns 10ms * 100 = 1000 ms
(60Hz) =>	Delay period after mains returns 8.33ms * 100 = 833 ms (Default setting: 100)

> 4. Settings and operation

DANGER

Dangers involved in settings and operation

Risk of injury / Risk of damage to the device or plant

• Observe all safety regulations in the chapter on safety.

Setting and operating the thyristor power controller is described in this chapter.

There are three ways of setting the power controller:

• on DIP switches and potentiometers (on device)
• via bus system (when operated in a bus system)
• via PC interface and THYRO-TOOL

Certain settings can only be made on the device (DIP switch S1.7, S1.8 and S1.10), e.g. setting the analog input and output.

In the case of certain configurations / connection types, setting on the device itself is no longer possible:

• Operation with bus module
  - Ground to X22.1: Setpoint comes from bus. DIP switch and potentiometer are read in once more after being switched on and the setting can then be changed with the bus module.
  - No ground to X22.1: DIP switch and potentiometer are always read in. Setpoint is read via the analog input.
• Operation with THYRO-TOOL
  - Device in Thyro-Tool mode: DIP switch and potentiometer are ignored. Settings are read out of the memory and can only be changed via the PC.
  - Device not in Thyro-Tool mode: DIP switch and potentiometer are read in. Further settings can be changed via the PC. All parameters are visualised on the PC.

NOTE

Described settings

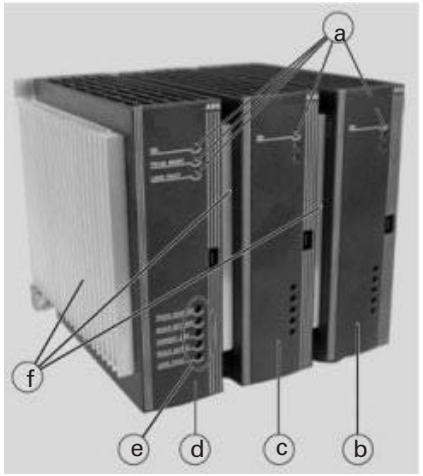
Settings made on the device itself are described in this chapter. Where reference is made to settings with a bus module or with the PC, this is indicated.

4.1 Device overview

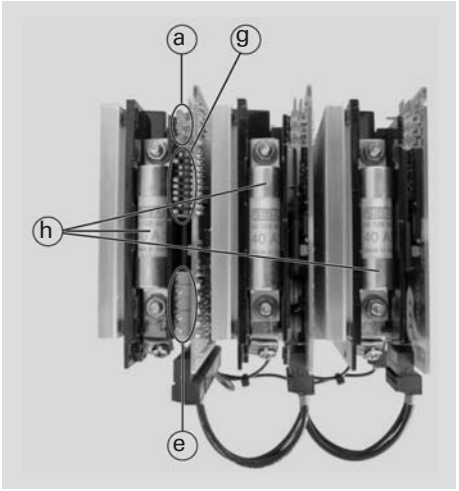
NOTE

Illustrations

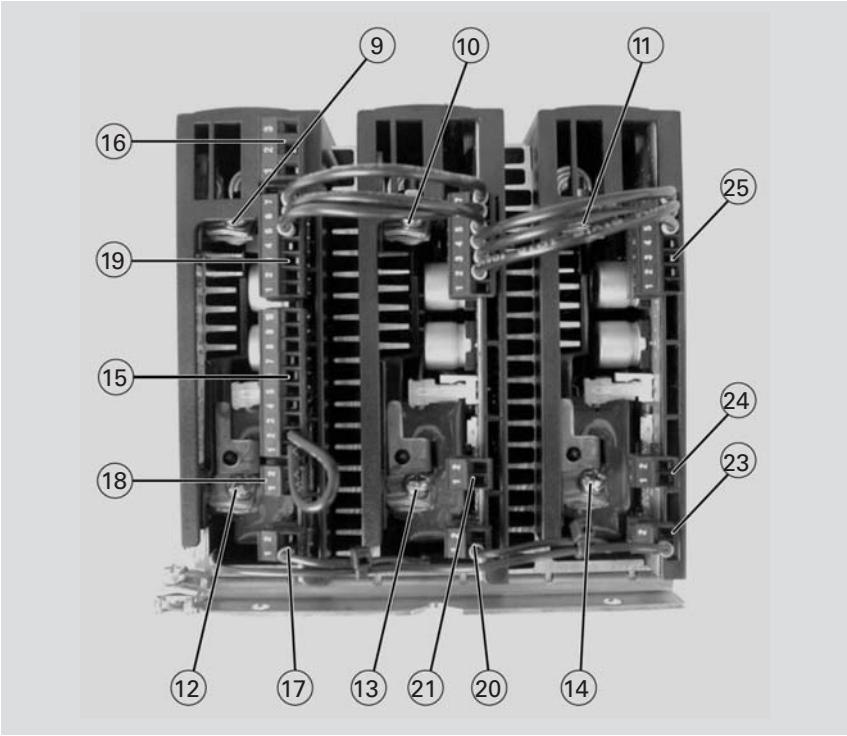
Only one size of the Thyritop 30 is depicted in the operating instructions (16 A/30 A). The operation and display elements and terminals are arranged the same in all sizes (see page 145, Dimensional drawings).



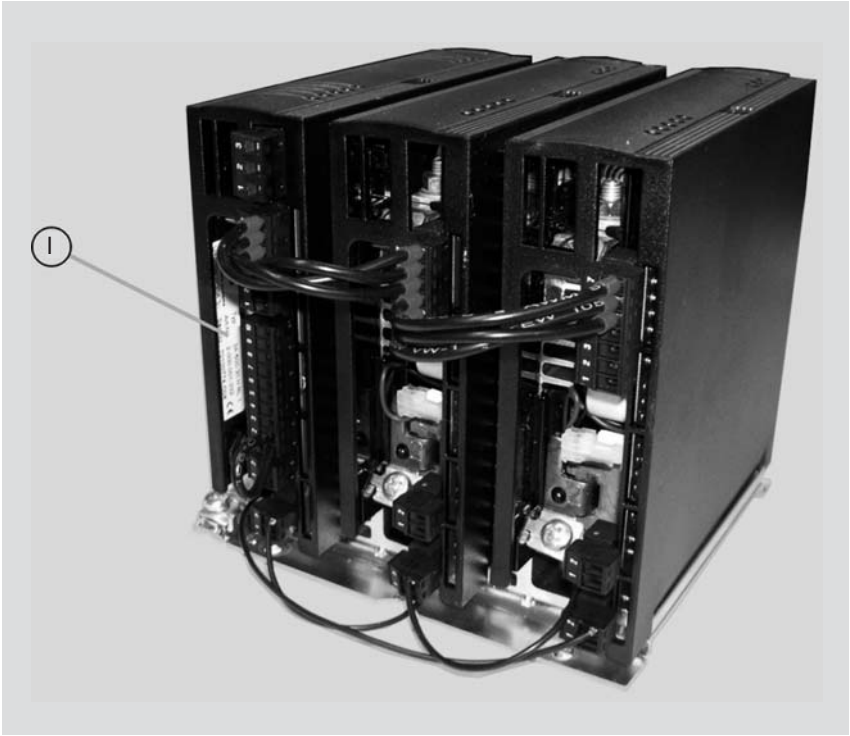
a	LEDs
b	Power section Slave2
c	Power section Slave1
d	Power section Master
e	Potentiometer
f	Heat sink



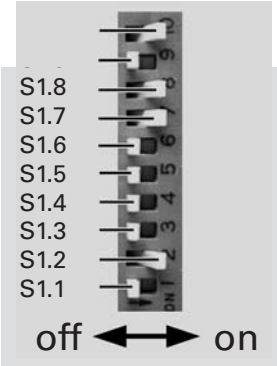
a	LEDs
g	DIP switch S1
e	Potentiometer
h	Fuse



9	Connection terminal U1
10	Connection terminal V1
11	Connection terminal W1
12	Connection terminal U2
13	Connection terminal V2
14	Connection terminal W2
15	Terminal X2
16	Terminal X3
17	Terminal X1 Master
18	Terminal X11 Master
19	Terminal X22 Master
20	Terminal X1 Slave1
21	Terminal X11 Slave1
22	Terminal X22 Slave1
23	Terminal X1 Slave2
24	Terminal X11 Slave2
25	Terminal X22 Slave2



I	Type plate



DIP switch S1

Switch	Function	Default setting	
S1.10	Analog output 10V / 20mA*	ON	0-10V
S1.9	Live zero analog output*	OFF	
S1.8	Setpoint input	ON	0-20mA
S1.7		ON	
S1.6	Live zero setpoint	OFF	0mA
S1.5	Control type / Thyro-Tool mode	OFF	U^2
S1.4		OFF	
S1.3		OFF	
S1.2	Operating mode	ON	VAR
S1.1		OFF	

* only for ...H RL1 and ...H RLP

For device configuration, there is a 10-pin DIP switch behind the cover of the master power section. The DIP switch is only read in once by the controller at switch-on or when the mains returns. Before start-up, the DIP switch must be set to suit the application.

- Switch off mains supply and secure against accidentally being switched back on.
- Remove the cover of the master power section.
- Set configuration on the DIP switch.

The settings that can be made with the individual switches are described in the following chapters.

ON	OFF	TAKT, with delta or star without neutral conductor
OFF*	ON*	VAR, with delta or star without neutral conductor
ON	ON	VAR, with star with neutral conductor
Can be set with THYRO-TOOL		TAKT, with delta or star with neutral conductor
		TAKT, with open delta

* Default setting

4.2.2 Control mode / Analog output

The highest value of the load voltage or load current is always used for control and display. The total power is used for power control. If a bus module or PC is connected, control mode and analog output can be set separately, e.g. U control with I display.

Control mode for ...H RL1 and ...H RLP

S1.3	S1.4	S1.5	Control mode	Analog output	Function R202
OFF*	OFF*	OFF*	U^2	U_{Load}	$U_{Load\ max}$
ON	OFF	OFF	U	U_{Load}	$U_{Load\ max}$
OFF	ON	OFF	I^2	I_{Load}	$U_{Load\ max}$
ON	ON	OFF	I	I_{Load}	$U_{Load\ max}$
OFF	OFF	ON	I	U_{Load}	$U_{Load\ max}$
ON	OFF	ON	P*[1]	P_{Load}	$P_{Load\ max}$
OFF	ON	ON	P*[1]	I_{Load}	$P_{Load\ max}$
ON	ON	ON	Can be configured with THYRO-TOOL	Can be configured with THYRO-TOOL	None, since in THYRO-TOOL mode

* Default setting

*[1] only for ...H RLP

Control mode for ...H1				
S1.3	**S1.4**	**S1.5**	**Control mode**	**Function R201**
OFF*	OFF*	OFF*	U^2	Transformer load (Phase angle 1st half wave)
OFF	OFF	ON	U^2	$U_{Load\ max}$
ON	OFF	OFF	U	Transformer load
ON	OFF	ON	U	Control characteristic
ON	ON	ON	Can be set with THYRO-TOOL	None, since THYRO-TOOL mode

* Default setting

4.2.3 Live zero and setpoint input range

Live zero and setpoint input range				
S1.6	**S1.7**	**S1.8**	**Signal level**	**Input resistance**
OFF	OFF	OFF	0-10V	88kΩ
OFF	OFF	ON	0-5V	44kΩ (e. g. for set-point potentiometer)
OFF*	ON*	ON*	0-20mA	250Ω
ON	OFF	OFF	2-10V	88kΩ
ON	OFF	ON	1-5V	44kΩ (e. g. for set-point potentiometer)
ON	ON	ON	4-20mA	250Ω

* Default setting

The analog input can be adapted to the various process controllers with the setpoint and live zero switches. The following signal ranges can be set:

0(4)-20 mA (R_i = approx. 250Ω), 0-5 V (R_i = approx. 44 kΩ),
0-10 V (R_i = approx. 88 kΩ).
+5 V supply voltage can be taken from terminal X2.8 for a setpoint potentiometer. (5 kΩ ≤ R_{Poti} ≤ 10 kΩ)

4.2.4 Analog output (only for ...H RL1 and ...H RLP)

The analog output allows the r.m.s. values U_{Load}, I_{Load} or P to be displayed. The output signal level can be set.

Analog output		
S1.9	**S1.10**	**Output signal level**
OFF*	ON*	0 - 10V
ON	ON	2 - 10V
OFF	OFF	0 - 20mA
ON	OFF	4 - 20mA

* Default setting

4.3 Potentiometer

There are five potentiometers below the LEDs with approx. 18 turns for the setting range.

Function	
• Turn potentiometer to the right.	> Value is increased.
• Turn potentiometer to the left.	> Value is decreased.

Potentiometer				
Pos.-No.	Potentio-meter	Designation	Function	Default setting
26	R201	TRAFO ADAPTION	Phase angle 1st half wave for transformer load	90°el.
27	R202*	SCALE SETPOINT	Control end	U control: U_{Type} + 10% P control: P_{Type} + 10%
28	R203*	CURRENT LIMIT	Current limit	I_{Type}
29	R204*	SCALE OUTPUT	Amplifi-cation	U_{Type}, I_{Typ}, U_{Type} depen-ding on output variable of analog output
30	R205*	LOAD FAULT	Load monitoring	OFF (left stop pos.)

* only for ...H RL1 and ...H RLP

Setting aid for ...H RL1 and ...H RLP

There is a setting aid for the potentiometers.

- Connect the measuring device to the analog output (X2.9 (+) to X2.5 ground).
  > If a potentiometer is altered, the set value of the potentiometer is output at the analog output and not the actual value.
  > The red LEDs flicker for the duration.
  > If the potentiometer is not greatly altered for 30 secs., the device automatically switches back to output of the selected actual value.

Since the analog output is designed for 0-20 mA / 10 V, 10 mA (or 5 V) correspond to 100%. This means that the set values can be read off directly or in percentages of the nominal value.

Analog output (setting aid)	
20.0mA or 10V	200%
10.0mA or 5V	100% or 100°el.
5.0mA or 2,5V	50% or 50°el
2.5mA or 1,25V	25% etc.

Setting aid for ...H1, ...H RL1 and for ...H RLP

There are two setting options:

- Count the no. of turns of the potentiometer. The potentiometers have a setting range of 18 turns. (The setting range is not guaranteed and may deviate. If accurate settings are required, the potentiometer must be checked using a different method.)
- Visualise the setting with PC and THYRO-TOOL.

4.3.1 Setting the transformer load (AN1, SST, T_0)

The settings described are relevant in operating mode TAKT.

- Set transformer load and SST on potentiometer R201 TRAFO ADAPTION setting: 90° el.).

In order to minimise the rush current for transformers, it is possible to angle of the first half wave on potentiometer R201 TRAFO ADAPTION.

Only for ...H1

Before adapting the transformer load:

- Switch DIP switch S1.5 to OFF.

4.3.2 Setting ohmic load

- Recommendation: Set potentiometer R201 TRAFO ADAPTION to left stop.
  > T_0 = 100ms
  > Faster TAKT period is set.
  > No phase angle of first half wave is set.
  > Soft start time (SST) set to "0".

Soft start time SST

The SST is set at the same time. This also applies to operating mode VAR. The soft start time depends on AN1 and has the following values:

Soft start time SSST			
AN1[°el]	SST [per]	SST [ms/50Hz]	Turns
<60	0	0	9½
<63.7	6	120	10¼
≥63.7	7	140	10¼
≥71.2	8	160	11
≥78.8	9	180	12
≥86.2	10	200	13
≥91.5	11	220	13¾
≥94.5	13	260	14¼
≥97.4	15	300	14½
≥100.5	20	400	15
≥103.5	30	600*	15½

* For a soft start time SST of 30 periods or 600 ms, the power controller remains in the SST ramp until setting time (T_s) is greater than 600 ms. The power controller then pulses without SST ramp, even if t_s is less than 600 ms. As soon as the power controller reaches the setpoint, the SST becomes smaller and the ramp is always crossed once fully.

NOTE

Setting AN1, SST and T_0 independently

When a bus module or Thyro-Tool are used, parameters AN1, SST and T_0 can be set independently of one another.

- Setting potentiometer TRAFO ADAPTION R201 to left stop.

  > At <30°el the device automatically switches to a faster cycle operation with T_0 = 5 periods without SST. Then terminal X2.7 can be used as control input for switch operation.

Analog output (setting aid)	
10.0mA / 5V	100°el
9.0mA / 4,5V	90°el (default)
3.0mA / 1,5V	30°el
2.5mA / 1,25V	0°el

4.3.3 Setting maximum load value with control end U, U² and P control

For ...H RL1 and ...H RLP

With potentiometer R202 SCALE SETPOINT, the maximum voltage (for U, U² control) or the maximum power (for P control) is set on the load, depending on the control mode *[1]. If no P control is set, the potentiometer works as voltage limiter. The end value of the control characteristic curve is adapted accordingly (see following table).

*[1] only for ...H RLP

Tab. 4 Maximum load value at control end

Setting	$U_{Load\ max}$ Potentiometer R202 SCALE SETPOINT	$P^{*1}_{Load\ max}$ Potentiometer R202 SCALE SETPOINT
Potentiometer turns (from left stop)	$9 * U_{Load\ max} / U_{type}$	$5.2 * P_{Load\ max} / P_{type}$
Setting aid, analog output in mA (Switch S1.10 = „OFF“)	$10mA * U_{Load\ max} / U_{type}$	$5.77mA * P_{Load\ max} / /P_{type}$
Setting aid, analog output in volts (Switch S1.10 = „ON“)	$5V * U_{Load\ max} / U_{type}$	$2.89V * P_{Load\ max} / P_{type}$

Analog output: X2.9 (+); X2.5 (ground)

*[1] only for ...H RLP

- Set maximum load value (of U or P) at control end on potentiometer R202 SCALE SETPOINT.

For ...H1

When DIP switch S1.5 is at „ON“, the maximum load voltage (with U/U² control) can be defined on potentiometer R201 TRAFO ADAPTION. The control characteristic curve is adapted in accordance with the following equation:

$U_{Load\ max}$ = (No. of returns R201 : 9) * U_{type}

4.3.4 Setting maximum load current (only for ...H RL1 and ...H RLP)

The maximum load current is limited with potentiometer R203 CURRENT LIMIT, irrespective of the control mode. If there is no I control, the potentiometer works as current limiter.

At reduced ambient temperatures, the power controller can only be operated with up to 110% of its nominal current (r.m.s. value) (see page 141, Technical Data).

Tab. 5 Maximum load current

Setting	$I_{Load\ max.}$ Potentiometer R203 CURRENT LIMIT
Potentiometer turns (from left stop)	9 * $I_{Load\ max}$ / I_{type}
Setting aid, analog output in mA (Switch S1.10 = „OFF“)	10mA * $I_{Load\ max}$ / I_{type}
Setting aid, analog output in volts (Switch S1.10 = „ON“)	5V * $I_{Load\ max}$ / I_{type}

Analog output: X2.9 (+); X2.5 (ground)

When the limit is reached, the red LEDs flash alternately approx. once a second. (Same LED display with peak current limiting)

• Set maximum load current at potentiometer R203 CURRENT LIMIT.

4.3.5 Setting example for maximum load value at control end / maximum load current

Example for maximum load value / Maximum load current

Thyritop 30 3A 400-30 H RLP (U_{type} =400V I_{type} =30A P_{type} =20.7kW)
- Power control with limit to 15 kW
- Current limit to 25 A
- Setpoint 4.20 mA

		Setting aid
P_{max} setting R202:	7.8 * (15kW/20.7kW)	5.65 turns (from left stop)
Setting aid in mA:	8.66mA * (15kW/20.7kW)	6.25mA
Setting aid in volts:	4.33V * (15kW/20.7kW)	3.13V
I_{max} setting R203:	9 * (25A/30A)	**Setting aid** 7.5 turns (from left stop)
Setting aid in mA:	10mA * (25A/30A)	8.33mA
Setting aid in volts:	5V * (25A/30A)	4.16V

4.3.6 Adapting analog output (scale) (only for ...H RL1 and ...H RLP)

The scale of the analog output is adapted with potentiometer R204 SCALE OUTPUT, if, for example, the scale of the display does not correspond to the nominal data (see page 115, Analog output).

Tab. 6 Analog output (scale)

Setting (Default = 0-20mA, corresponds to type value (current/voltage/power)	U, I display Potentiometer R204 SCALE OUTPUT	P-display*[1] Potentiometer R204 SCALE OUTPUT
Potentiometer turns (from left stop)	3.6 turns * (type value power controller/scale end value)	6.24 turns * ($P_{type\ power\ controller}$ / scale end value)
Setting aid analog output in mA (Switch S1.10 = „OFF“)	4mA * (type value power controller/scale end value)	6.93mA * ($P_{type\ power\ controller}$ / scale end value)
Setting aid analog output in volts (Switch S1.10 = „ON“)	2V * (type value power controller/scale end value)	3.46V * ($P_{type\ power\ controller}$ / scale end value)

Analog output: X2.9 (+); X2.5 (ground)
*[1] only ...H RLP

Example, adaptation of the analog output

Thyritop 30 3A 400-30 H RLP (U_{type}=400V, I_{type}=30A, P_{type}=20.7kW)
Measuring instrument for 4-20 mA with scale 20 kW

		Setting aid
Setting R204:	6.24 * (20,7kW/20kW)	6.5 turns (from left stop)
Setting in mA:	6.93mA * (20.7kW/20kW)	7.17mA
Setting in V:	3.40V * (20.7kW/20kW)	3.58V

4.3.7 Setting load monitoring (undercurrent monitoring) (only for ...H RL1 and ...H RLP)

• Set load monitoring on the potentiometer R205 LOAD FAULT.

The default setting for this monitoring is OFF (= left stop of potentiometer R205).

A measuring instrument connected to the analog output can be used as setting aid (see page 115, Potentiometer).

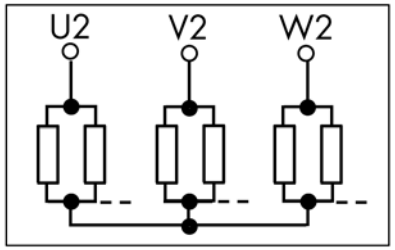
> If the set value is fallen below, a message is sent (LED, by bus and fault signalling relay K1).

NOTE

Notes on settings / tables

- Settings over 90% and under 10% are not sensible. If the load currents are considerably less than the nominal currents of the power controller, consider using a smaller power controller.
- In operating mode VAR, monitoring is blocked for large control angles (for load with neutral conductor $\alpha > 140°$el., for load without neutral conductor $\alpha > 117°$el.)
- The signalling delays can be up to 15 secs. in operating mode VAR and up to 30 secs. in operating mode TAKT.
- Convert deviating values as a percentage. The set monitoring value should always be an average of the value for load nominal current and the value after failure.

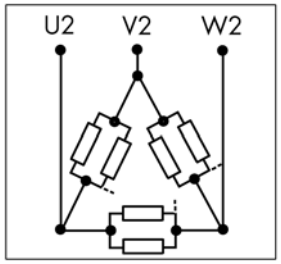
Load with common star point without neutral conductor



Tab. 7 Load with common star point without neutral conductor

No. of parallel load resistors	$I_{Load\ nom.}$ / $I_{type\ contr.}$ in %	Current at failure in %	Recommended setting for pot. R205 in %	Setting aid at actual value output X2.9 in mA	Setting aid at actual value output X2.9 in volts	No. of potentiometer turns from left stop
1	100	0	50	5	2.5	7.8
	80		40	4	2	6.6
	60		30	3	1.5	5.4
	40		20	2	1	4.2
	20		10	1	0.5	2.9
2	100	60	80	8	4	11.4
	80		64	6.4	3.2	9.5
	60		48	4.8	2.4	7.5
	40		32	3.2	1.6	5.7
	20		16	1.6	0.8	3.7
3	100	75	87.5	8.75	4.375	12.3
	80		70	7	3.5	10.3
4	100	82	91	9.1	4.55	12.8

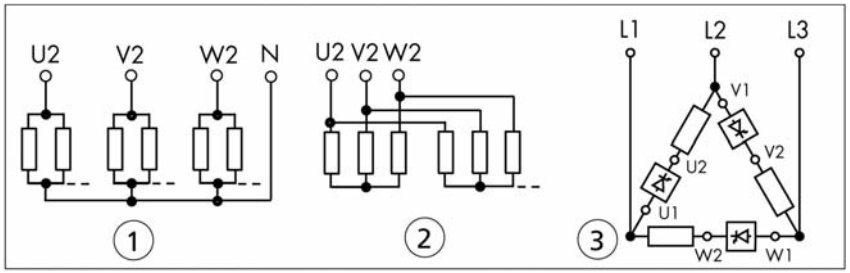
Load in delta circuit



Tab. 8 Load in delta circuit

No. of parallel load resistors	$I_{Load\ nom.}$ / $I_{type\ contr.}$ in %	Current at failure in %	Recommended setting for pot. R205 in %	Setting aid at actual value output X2.9 in mA	Setting aid at actual value output X2.9 in volts	No. of potentiometer turns from left stop
1	100	57	78.5	7.85	3.925	11.3
	80		62.8	6.28	3.14	9.4
	60		47.1	4.71	2.355	7.5
	40		31.4	3.14	1.57	5.6
	20		15.7	1.57	0.785	3.7
2	100	76	88	8.8	4.4	4.0
	80		70.4	7.04	3.52	10.3

Load with common star point with neutral conductor (1)
Load with separate star point without neutral conductor (2)
Load in open delta circuit (3)



Tab. 9 Other possibilities of load monitoring

No. of parallel load resistors	$I_{Load\ nom.}$ / $I_{type\ contr.}$ in %	Current at failure in %	Recommended setting for pot. R205 in %	Setting aid at actual value output X2.9 in mA	Setting aid at actual value output X2.9 in volts	No. of potentiometer turns from left stop
1	100	0	50	5	2.5	7.8
	80		40	4	2	6.7
	60		30	3	1.5	5.4
	40		20	2	1	4.2
	20		10	1	0.5	3.0
2	100	50	75	7.5	3.75	10.9
	80		60	6	3	9.0
	60		45	4.5	2.25	7.2
	40		30	3	1.5	5.4
	20		15	1.5	0.75	3.6
3	100	66	83	8.3	4.15	11.8
	80		66.4	6.64	3.32	9.8
	60		49.8	4.98	2.49	7.8
	40		33.2	3.32	1.66	5.9
	20		16.6	1.66	0.83	3.8
4	100	75	87.5	8.75	4.375	12.3
	80		70	7	3.5	10.3
	60		52.5	5.25	2.625	8.1
	40		35	3.5	1.75	6.0
	20		17.5	1.75	0.875	3.9
5	100	80	90	9	4.5	12.7

> 5. Installation

DANGER

Dangers during Installation

Risk of injury / Risk of damage to the device or plant

> Observe all safety regulations in the safety chapter.

⚠ DANGER

Unsafe system due to incorrect installation

The plant cannot be operated safely and poses a threat to persons.

> Only install the device in an upright position.

> Ensure sufficient ventilation of the cubicle if mounted in a cubicle.

> Observe minimum spacing (Clearance: 150 mm above, 100 mm below). The devices can be installed next to each other without spacing between.

> Ensure that the device cannot be heated up by heat sources below it. (The power loss is given in the type overview table , see page 141, Technical data)

> Ground the device in accordance with local regulations. (grounding screw / nut for protective conductor connection to fixing adapter). Grounding also serves for EMC means (Y capacitor 4.7 nF).

⚠ CAUTION

Use of incorrect connection cables

Incorrect connection cables can lead to malfunctions.

> Use shielded control conductors to connect the control signals.

> For use in UL conditions: Only use 60°C or 75°C copper conductors for power connections (as indicated in Technical Data).

NOTE

Connecting the control signals

The following control signals are necessary for operating the devices:

- Setpoint (terminal X2.4 or via bus option)
- Pulse blocking (to ground, on terminal X2.1, X2.2; bridge present)

If the pulse blocking bridge is not connected, the device is blocked and is not operating. Communication is still possible via the interface (see page 130, Connecting pulse blocking).

The device is parameterised when delivered. The parameters are adapted to the particular power section.

Default setting:

- Operating mode VAR (S1.1 and S1.2)
- Transformer load R201 90°el.

Other default settings are listed in the chapter Operation and Settings (DIP switches (see page 112, DIP switch S1) and potentiometers (see page 115, Potentiometer).

> Check default settings and adjust to application conditions if necessary (e.g. operating mode, control type, restrictions, monitoring, analog output, fault messages etc.)

The devices can be installed next to each other without spacing between. Observe minimum spacing (Clearance: 150 mm above, 100 mm below).

5.1 Connection terminals (Overview)

Tab. 10 Connection terminals (Overview)

Terminal		Description	Pitch size
X3*	**.3**	N/C contact, closed when there is a fault	5.08
	.2	N/O contact, open when there is a fault (closed-circuit current principle)	
	.1	Root, common connection	
X22	**.7**	Control ground	3.5
	.6	Connection to slave	
	.5	Connection to slave	
	.4	Control ground	
	.3	RxD / Connection to bus module	
	.2	TxD / Connection to bus module	
	.1	Bus module detection / Setpoint selection	
X2	**.10**	Ground potential, maybe shield control conductor	3.5
	.9	Analog output 0-10 V or 0(4)-20 mA	
	.8	+ 5V output e.g. for a setpoint potentiometer ($5k\Omega \leq R_{Poti} \leq 10k\Omega$)	
	.7	Sync. In (SYT-9)	
	.6	Sync. Out	
	.5	Control ground	
	.4	Analog - setpoint input max. 10V, max. 20mA	
	.3	Control ground	
	.2	Pulse blocking (PULSE INHIBIT)	
	.1	Control ground	
X11*	**.2**	24V extra electronics supply AC or - DC	3.5
	.1	24V extra electronics supply AC oder + DC	
X1	**.2**	**Works connection (do not alter!)**	
	.1		

* only for ...H RL1 and ...H RLP

5.2 Connecting power supply

The power supply is connected in accordance with the technical data and must be connected to a right rotating field in the power circuit.

- Switch off mains supply and secure against accidentally being switched back on.
- Remove the cover.
- Ground the power controller
- Connect the load to connection terminals U2, V2, W2.
- Connect terminals U1, V1, W1 to the isolating switch.
- Make any other necessary connections.

The electronics of the control unit are supplied directly from the power section. Exception: When an additional electronics supply is connected.

5.3 Connecting additional electronics supply (only for ...H RL1 and ...H RLP)

There are only two cases in which an additional electronics supply must be connected for the control unit:

- Mains voltage at ≤ 85% of the power controller nominal voltage
- Operation of a bus module (no error message "Bus error")

> Switch off mains supply and secure against accidentally being switched back on.

> Provide 24 V (AC/DC; with at least 6 W/15 VA; SELV; earth-free; without connection to control ground) and secure in accordance with the valid regulations.

> Switch off 24 V current supply.

> Connect 24 V current supply to terminals X11.1 and X11.2 of each power section.

5.4 Connecting pulse blocking

Certain errors (see page 98, Error and status messages) trigger pulse blocking internally. Triggering of pulse blocking can be configured.

Preparing to use pulse blocking

- Switch off mains supply and secure against accidentally being switched back on.
- Replace bridge from X2.1 to X2.2 with a switching contact (low-current contact)

Activating pulse blocking (with device switched on)

- Open switching contact.
  > Pulse blocking is activated.
  > Power section is no longer addressed.
  > LED PULSE INHIBIT lights up red.

5.5 Connecting analog setpoint input

- Switch off mains supply and secure against accidentally being switched back on.
- Configure analog setpoint input (see page 114, Live zero and setpoint input range).
- Connect process controller (output signals of 0(4)-20 mA, 0-5 V, 0-10 V) to terminal X2.3 (ground) and X2.4 (+).

5.6 Connecting control input for switch operation

Where there is a purely ohmic resistor load, terminal X2.7 can be used as control input for switch operation.

- Switch off mains supply and secure against accidentally being switched back on.
- Configure operating mode TAKT (see page 113, Operating mode and load type).
- Turn potentiometer R201 TRAFO ADAPTION to left stop (see page 115, Potentiometer).
- Connect signal generator (e.g. 2-point controller) to terminal X2.7.
  > The device switches on at a signal level of > 3 V.

5.7 Connecting the bus module

The way in which the bus module is connected to the power controller decides the type of setpoint processing (see page 93, Setpoint processing). Terminal X22.1 controls the processes (we recommend the use of preassembled connection cable 2000 000 848 / 849).

Setpoint of the anlog control terminal only

- Do not make any connections to terminal X22.1.
  > Only the analog signal (X2.4 (+); X2.3 (ground)) is used as setpoint.

Setpoint of bus module only

- Connect ground to terminal X22.1.
  > Only the value of the bus module is used as setpoint.

Defined setpoint for bus failure

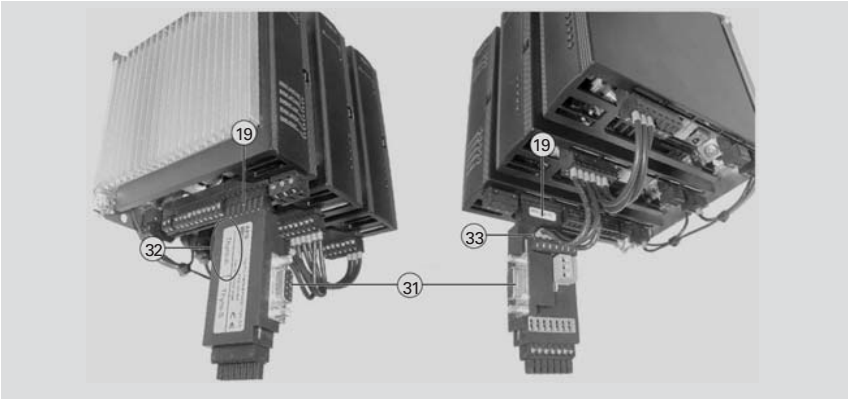
There are two possibilities:

- Connect terminal X22.1 on the master of the power controller to terminals X1.1 ... X8.1 of the bus module.
  > Cable to X22.1 is switched in the event of a malfunction.
  > In the event of malfunctions along the bus line, the system automatically switches to the analog setpoint at the control terminals of the power controller.
- Connect terminal X22.1 on the master of the power controller to terminals X1.5 ... X8.5 of the bus module.
  > Cable to X22.1 is switched in the event of a malfunction.
  > Depending on the settings on the bus module:
  In the event of malfunctions along the bus line, the system automatically switches to the analog setpoint at the control terminals of the power controller.
  or:
  The last setpoint is maintained.
  In addition to this, each device connected to the bus module can be enabled individually via the bus on "Hand" (see bus module instructions).

5.8 Using the analog output (only for ...H RL1 and ...H RLP)

- Switch off mains supply and secure against accidentally being switched back on.
- Connect terminals X2.9 (+) and X2.5 (ground) to a display device. Ensure the correct polarity!
- Configure the signal level (see page 115, Analog output).
- Adapt the signal level to the scale (see page 121, Adapting analog output).

5.9 Using the THYRO-TOOL



19	Terminal X22
31	Serial interface (COM) RS232
32	PC-Interface RS232
33	Connector (Connection to slave)

- Switch off mains supply and secure against accidentally being switched back on.
- Remove connector (connection to slave) of terminal X22.
- Plug PC interface RS232 with the "Thyritop 30" side into terminal X22.
- Plug connector (connection to slave) in at PC interface RS232.
- Connect serial interface (COM) to PC using RS232 data cable (Order no.: 0048764; not crossed; connections 2,3,5,4 and 7 used).
  > The device can be operated with the THYRO-TOOL. Measured values and parameters are displayed in the software. Extended functions can be set (see page 105, Extended functions).
  > Only for operation of the device in Thyro-Tool mode (S1.3 to S1.5 to ON): All parameters can be set with the THYRO-TOOL.

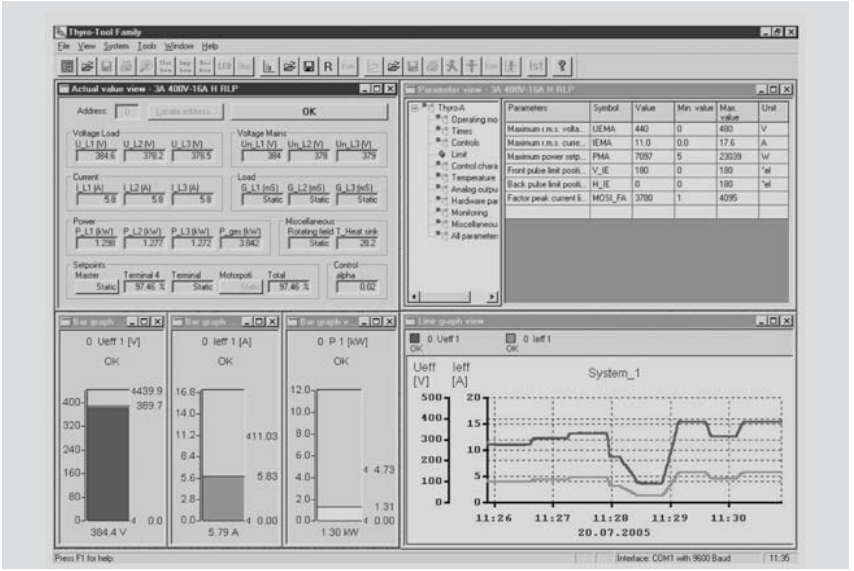
NOTE

Switching over devined setpoint on the PC interface

A switch can be connected to terminals X1.2 and X1.3 of the PC interface RS232 to switch over the defined setpoint.

- For contact X1.2 with X1.3: Digital defining of setpoint with THYRO-TOOL
- For no contact X1.2 with X1.3: Analog defining of setpoint with terminal X2.4 (see page 93, Setpoint processing)

Fig. 2 User surface Thyro-Tool



Power controllers of the Thyritop 30 series can be operated conveniently with the PC software THYRO-TOOL and settings can be made. The prerequisite for working with the THYRO-TOOL is that there is a connection between the PC and power controller. This means that measured values can be visualised and parameters displayed. If the Thyritop 30 is not operated in Thyro-Tool mode, certain parameters can be altered. In Thyro-Tool mode, almost all parameters can be altered.

In order to switch over the setpoint, a switch can be connected to PC-INTERFACE RS232 X1.2 and X1.3. When these terminals are connected, the digital setpoint of the THYRO-TOOL is active. If the terminals are open, the analog setpoint at X2.4 is used.

> 6. Mains load optimisation

DANGER

Danger when making adjustments

Risk of injury / Risk of damage to the device or plant

> Observe all safety regulations in the safety chapter.

Mains load optimisation offers considerable advantages, e.g. reducing mains load peaks and system disturbances. Mains load optimisation is possible under the following conditions:

- When more than one power controller is used
- Operating mode TAKT

The mains load is optimised by cascading the switching on of the individual devices. There are two different processes for doing so.

6.1 Synchronisation with SYNCHRONISATION ASSEMBLY SYT-9

SYT-9 is a procedure for static mains load optimisation using synchronisation. This procedure requires the optional SYNCHRONISATION ASSEMBLY SYT-9.

Characteristics:

- Minimises mains load peaks and the associated system disturbances.
- Alterations to setpoint and load do not automatically affect the mains load optimisation.
- Can be used with existing AEG power controllers.
- Connect the pulse of SYNCHRONISATION ASSEMBLY SYT-9 to terminal X2.7.
- Connect the +5 V current supply of X2.8 to the SYNCHRONISATION ASSEMBLY SYT-9.
- Set the cycle period T_0 to the same value for all power controllers (recommended: T_0=1 sec.).
- Set SYNCHRONISATION ASSEMBLY SYT-9 correspondingly.
  > Input X2.7 defines when the power controller switches on.
  > The SYNCHRONISATION ASSEMBLY SYT-9 controls the connected power controller with pulses.

6.2 Software synchronisation (operating mode TAKT)

Software synchronisation is a method of mains load optimisation where an optional bus module is used or the THYRO-TOOL. The software synchronisation set by entering a parameter (Parameter 36).

- Set the cycle period T_0 to the same value for all power controllers (recommended: T_0=1 sec.).

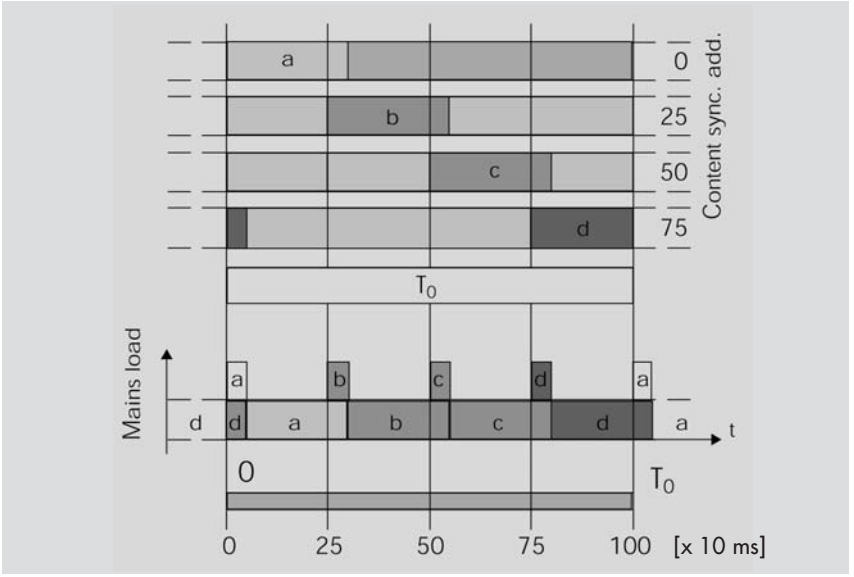
When setting with the bus module:

- Enter value via INDEX 38.

When setting with THYRO-TOOL:

- Enter SYNC value "Synchro cycle address". Select a different value for each power controller.
  > A delay period up to the first switching on is set. The value is multiplied by 10 ms.
  > The length of time up to the first switching on is different for each power controller.

This procedure allows the load to be connected slowly, e.g. with a slow cycle time of 1 sec.. Values at intervals of 100 lead to a switch on delayed by a cycle period T_0 (group formation). This function allows an auxiliary power generator to be connected, for example.



> 7. Connection diagram

Fig. 3 Connection diagram Thyritop 30 3A ...H1

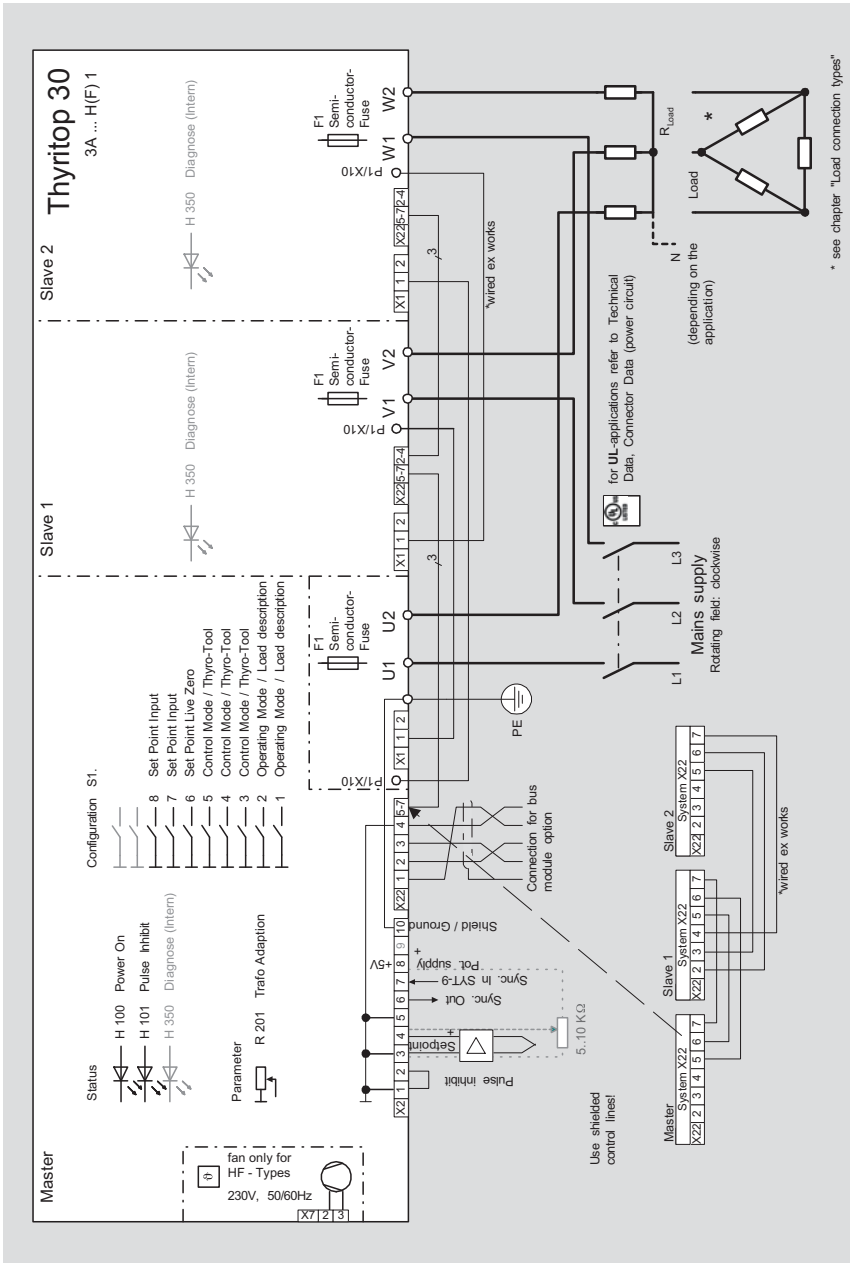


Fig. 4 Connection diagram Thyritop 30 3A ...H RL1, ...H RLP

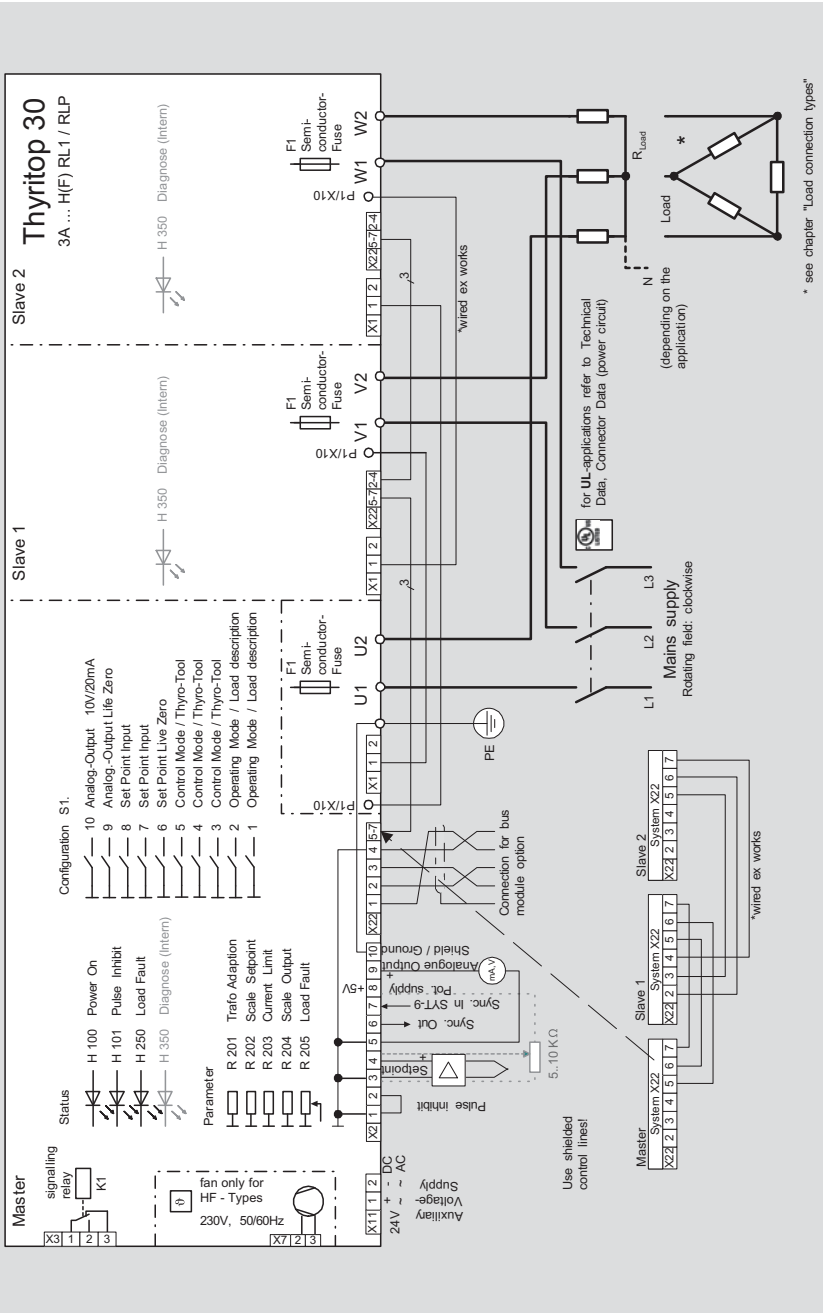
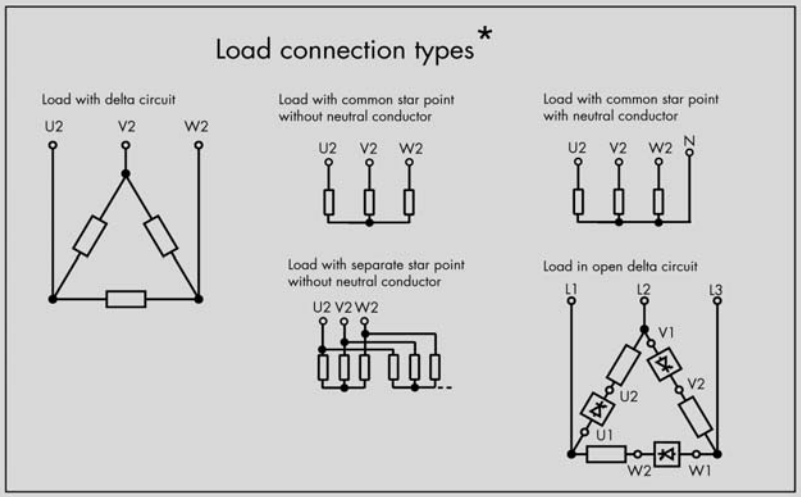


Fig. 5 Load connection types



* Pay attention to switch position (S1.1 and S1.2)

Fig. 6 Additional electronics supply and connection with optional bus module

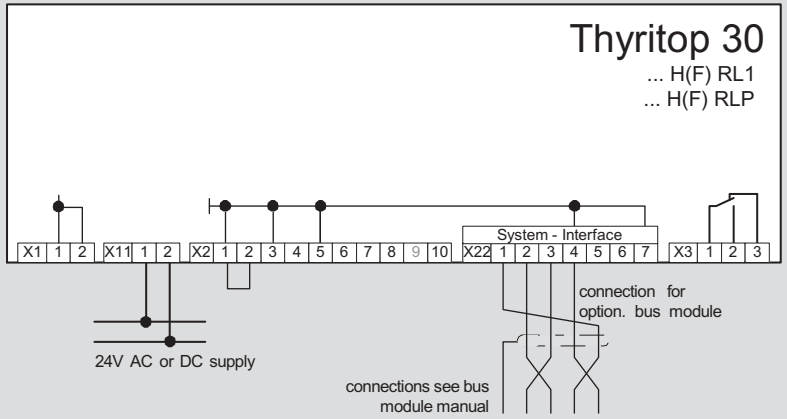
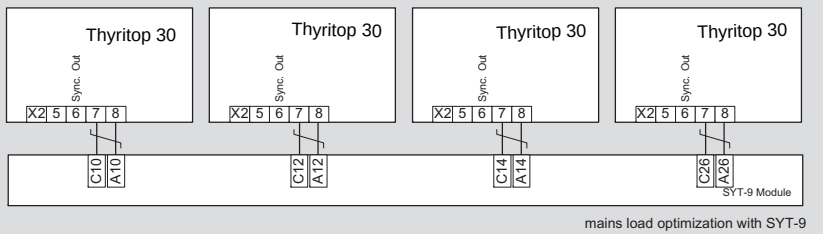
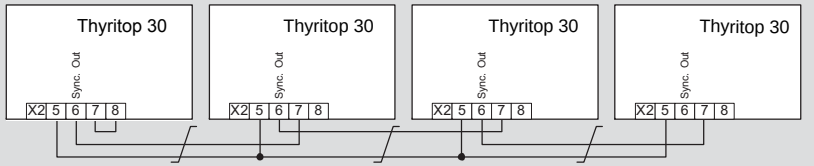


Fig. 7 Wiring diagram for mains load optimisation with SYT-9



mains load optimization with SYT-9

Fig. 8 Connecting diagram mains load optimization with TAKT



integrated mains load optimization for TAKT

> 8. Help in the event of problems

The devices delivered correspond to quality standard ISO 9001. Should you experience any malfunctions or other problems, please contact our service hotline (Tel : + 33(0)472 14 15 40.

We have listed a few tips below for troubleshooting:

LED ON green does not light up

- Check fuses for controller 500 V 1.6A, and check external wiring if faulty. This applies also to faults in any external fuse.
- Check the fuse of the power section: If the fuse is faulty, check the load and wiring to the load.
- Check that there is synchronisation voltage at X1.1 mains (load) voltage. (Must also be present for any 24 V current supply).
- For transformer load, check the setting phase angle first half wave (potentiometer R201 TRAFO ADAPTION): fuse can trigger due to rush current if R201is set incorrectly.
- Check load at X2.8 and mains voltage (R_{min} = 5kΩ).

Supply present but no load current

- Check whether pulse blocking is enabled (bridged), terminal X2.1, X2.2.
- Check setpoint.
- Check for load interruption.
- Check LED messages (see page 101, LED messages).

Load current does not have the expected value

- Check setpoint: terminal X2.4 (+) to X2.3 (ground) or bus setpoint (with optional bus module).
- Setpoint/control value, max. values parameterised (R203).
- Check current flow of all parallel load resistors.
- Check that control end is set correctly.

Load current flows without being addressed

- Check that current transformer I / I^2 control is connected correctly (X4 internal).
- Check that the limiting values are set correctly.
- Check control characteristic curve adaption (U, I, live zero).
- In rare cases, there may be a thyristor short circuit.

> 9. Technical data

Type voltage ...H1

230V -57%* +10% > 99V
400V -57%* +10% > 172V
500V -57%* +10% > 215V

* The 5 V voltage (for possible setpoint potentiometer supply) on terminal X2.8 only works correctly in the -15% to + 10% range of the type voltage.

Type voltage ...H RL1 and ...H RLP

230V -15% +10%
400V -15% +10%
500V -15% +10%

Type voltage ...H RL1 and ...H RLP with add. supply

230V -57% +10% > 99V
400V -57% +10% > 172V
500V -57% +10% > 215V

Additional electronics supply

The additional control voltage infeed can be AC or
(6 W per device / 15 VA / not grounded).
24VAC +10% /-20%
24VDC +18V to +32V

Mains frequency

All types 47 Hz to 63 Hz;
Max. frequency change 5% per half oscillation

Load type

Ohmic load
Ohmic load with R_{hot}/R_{cold} ratio up to 6, peak curre
(for ...H RLP)
Transformer load

CAUTION

If grain oriented, cold rolled sheet me
tance of the down-stream transforme
T for mains overvoltage = 1.2 T nomin

Operating modes

TAKT = Full oscillation cycle
VAR = Phase angle

Setpoint inputs

2 setpoint inputs (SELV, PELV), isolated from the system.

- Setpoint 1: Analog setpoint input
  Signal ranges:
  0(4) - 20mA R_i = approx. 250Ω
  0(1) - 5V R_i = approx. 44kΩ
  0(2) - 10V R_i = approx. 88kΩ
- Setpoint 2: Optional bus interface, connection of higher level PC or automation system.

Control characteristic curve

Each controller (e.g. temperature controller), with an output signal in the range of 0-20 mA / 0-5 V / 0-10 V, can be adapted to the power controller.

Control input for switching mode

Maximum switching frequency 5Hz
$t_{on\ min}$=100ms
$t_{off\ min}$=100ms

Analog output (only for ...H RL1 and ...H RLP)

Signal level 0-10 V, 2-10 V 0-20 mA, 4-20 mA
Maximum load voltage10 V

Control modes

...H1 (without current transformer):	Voltage control U_{rms}, U^2_{rms}
...H RL1 (with current transformer):	Voltage control U_{rms}, U^2_{rms}
	Current control Ieff, I^2_{rms}
...H RLP (with power control):	Voltage control U_{rms}, U^2_{rms}
	Current control Ieff, I^2_{rms}
	Power control P

Accuracy of control

Voltage ± 3%* * In the -15% to +10% range of the type voltage.
Current ± 1.5%
Always based on the end value

Limits

Current limit I_{rms}
Voltage limit U_{rms}
Power limit P
Peak current limit to $\hat{i}=3xI_{nom}$

Relay outputs (only for ...H RL1 and ...H RLP)

Changeover contact, contact material: $AgSnO_2$ / Au plated
The relay can be used for low load circuits (> 5V 20 mA), provided it has not been preloaded with 230 VAC.
Max. values: 250 V, 6 A, 180 W, 1500 VA
Insulation resistance 4 kV / 8 mm

Ambient temperature

35°C at ...F... (with external cooling)
Other models: 45°C
If the maximum ambient temperature is reduced, the maximum load current can be increased to up to 110% of the nominal current. The following applies: 1% more current requires a temperature reduction of 1°C.

The maximum ambient temperature can be increased to a maximum of 55°C if the maximum load current is reduced. The following applies: 1°C more ambient temperature requires a current reduction of 2%.

Connection data, power connection

Grounding screw / nut for connecting the protective conductor to the fixing adapter. Grounding also serves for EMC means (Y capacitor 4.7 nF).

	Connection U1, V1, W1, U2, V2, W2	Grounding screw	Conductor cross section
16 / 30A	Lug / M4	Lug / M4	max. 6 mm²
45A*	M 6	M 6	max. 50 mm²
60* / 100A*	M 6	M 6	max. 50 mm²
130 / 170A	M 8	M 10	95 / 120 mm²
280 A	M 10	M 10	150 / 185 mm²
350 A	M 10	M 10	150 / 185 mm²

In UL applications, use only 60°C or 60°C/75°C copper conductors (except for control lines).
* In UL applications, use only 75°C copper conductors (except for control lines)

Torques in Nm

Screw	Min. value	Nom. value	Max. value
M 2	0.22	0.25	0.28 (Phoenix terminals)
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

Fan data

230V, 50-60Hz

Thyritop 30	Type current 50Hz	Type current 60Hz	Air vol.	Noise level
3A...280 F	0,38A	0,38A	260 m³/h	70dB(A)
3A...350 F	0,50A	0,38A	260m³/h	70dB(A)

The fans must run when the device is on, connection to X7.

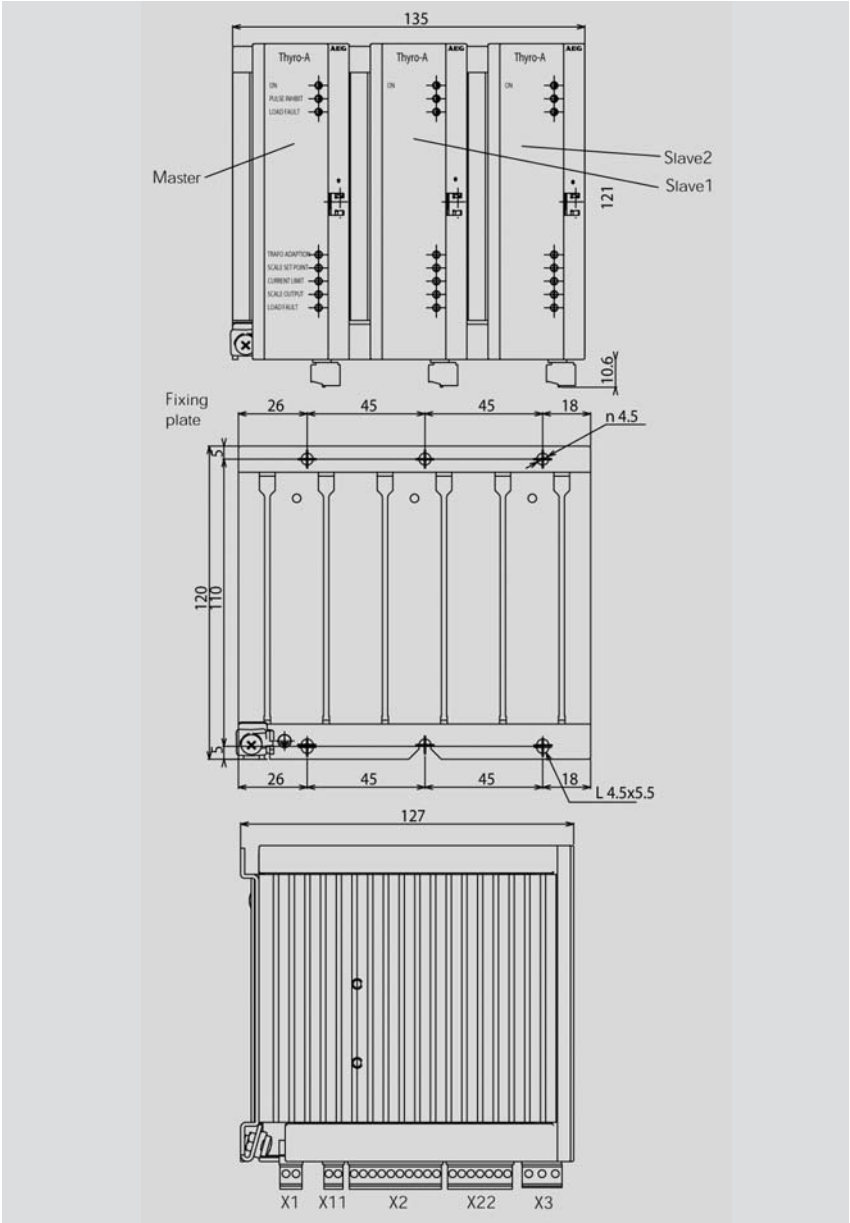
Type overview

	Type power [kW]			Dimensions				Fuse F1 [A]
Curr. [A]	400V	500V	Power loss [W]	W [mm]	H [mm]	D [mm]	Weight [kg]	Per power section
16	11	14	90	135	131.6	127	2.1	20
30	21	26	141	135	131.6	127	2.1	40
45	31	39	144	156	190	182	5.1	63
60	42	52	240	156	190	182	5.1	80
100	69	87	315	225	190	190	5.7	200
130	90	112	450	375	320	241	12	200
170	118	147	630	375	320	241	12	315
280	194	242	990	375	397	241	15	350
350	242	303	1170	375	430	261	25,5	500

> 10. Dimensional drawings

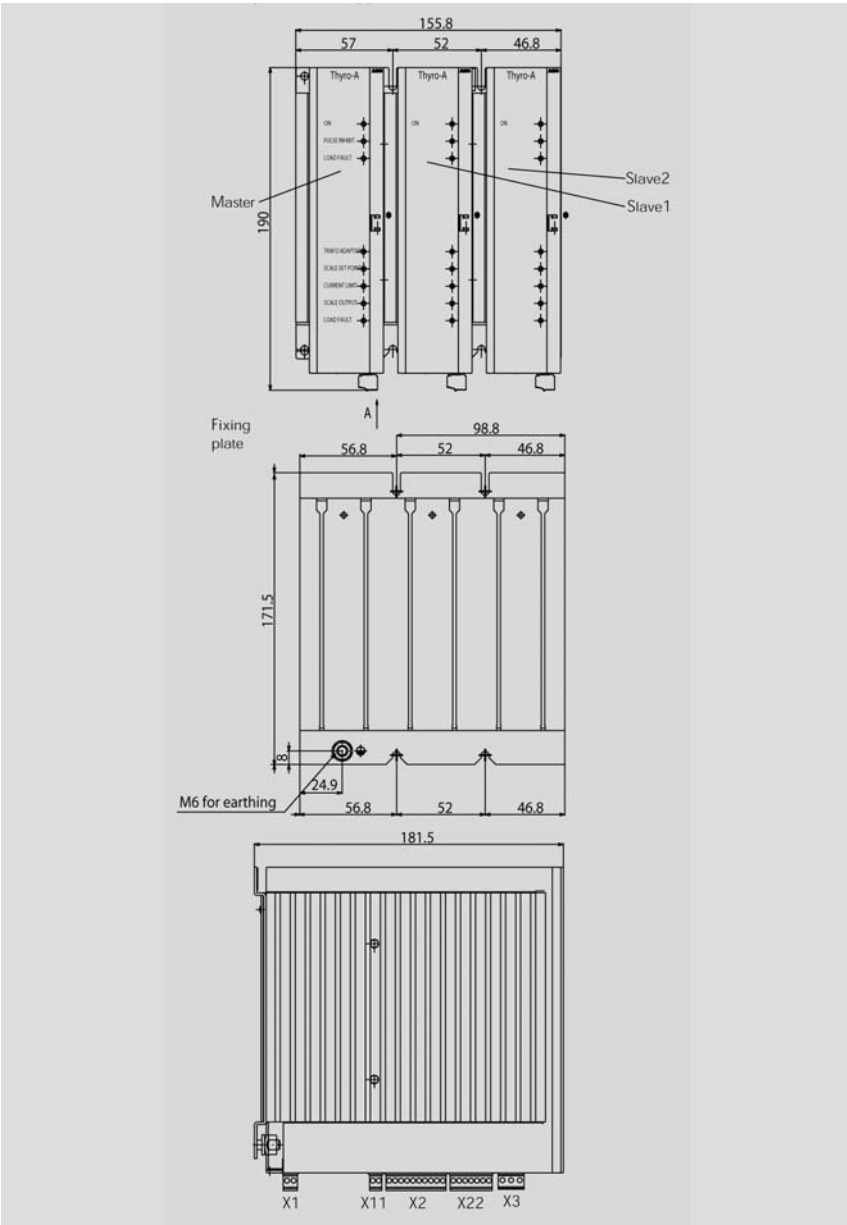
Dimensional drawing Thyritop 30 3A with 16A/30A

The dimensional drawings are for type ...H RLP.



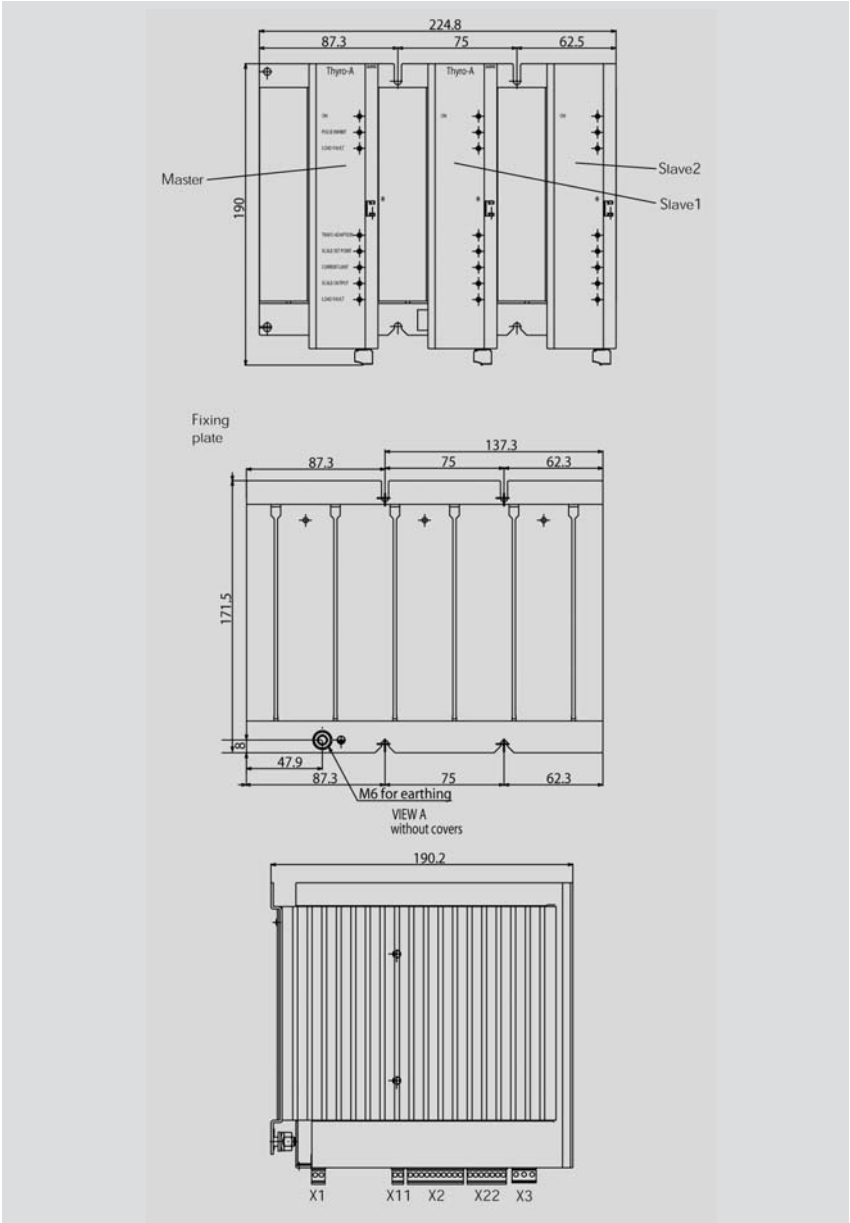
Dimensional drawing Thyritop 30 3A with 45A / 60A

The dimensional drawings are for type ...H RLP.



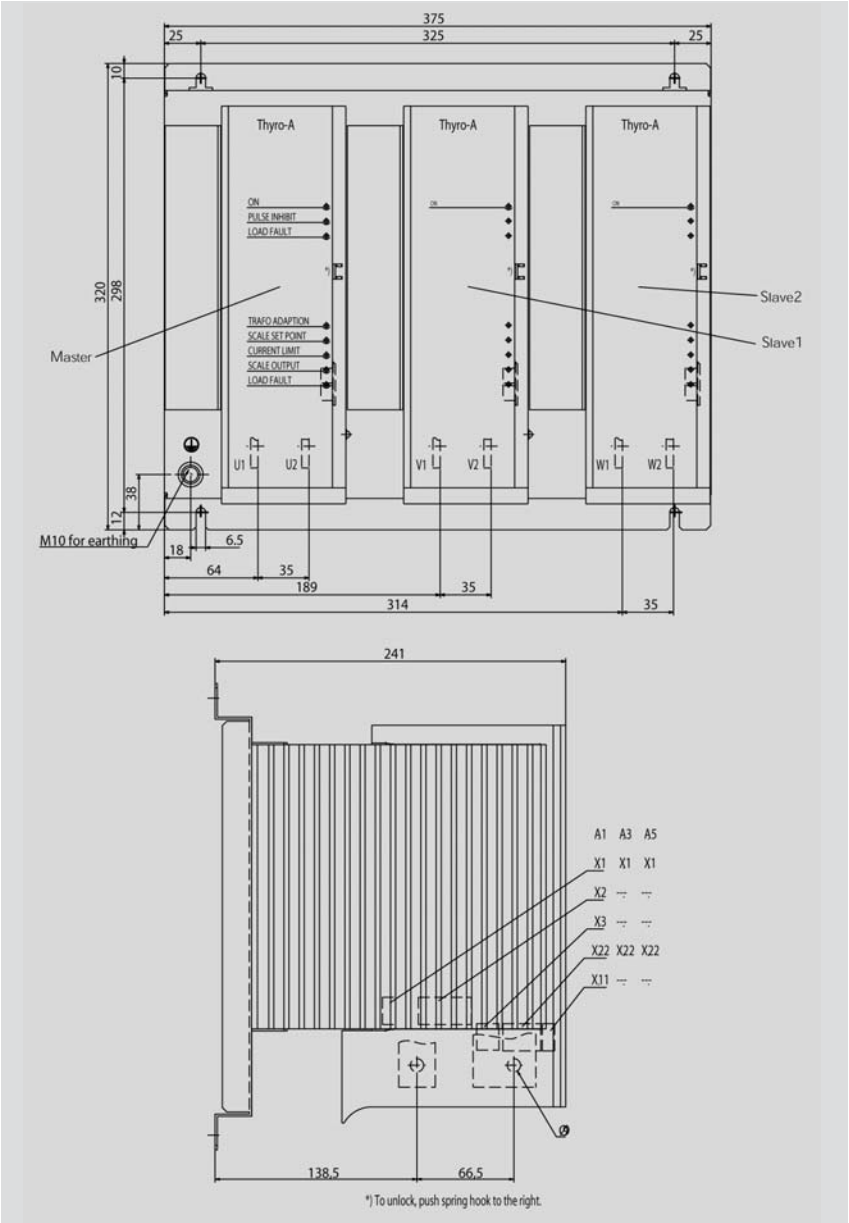
Dimensional drawing Thyritop 30 3A with 100A

The dimensional drawings are for type ...H RLP.



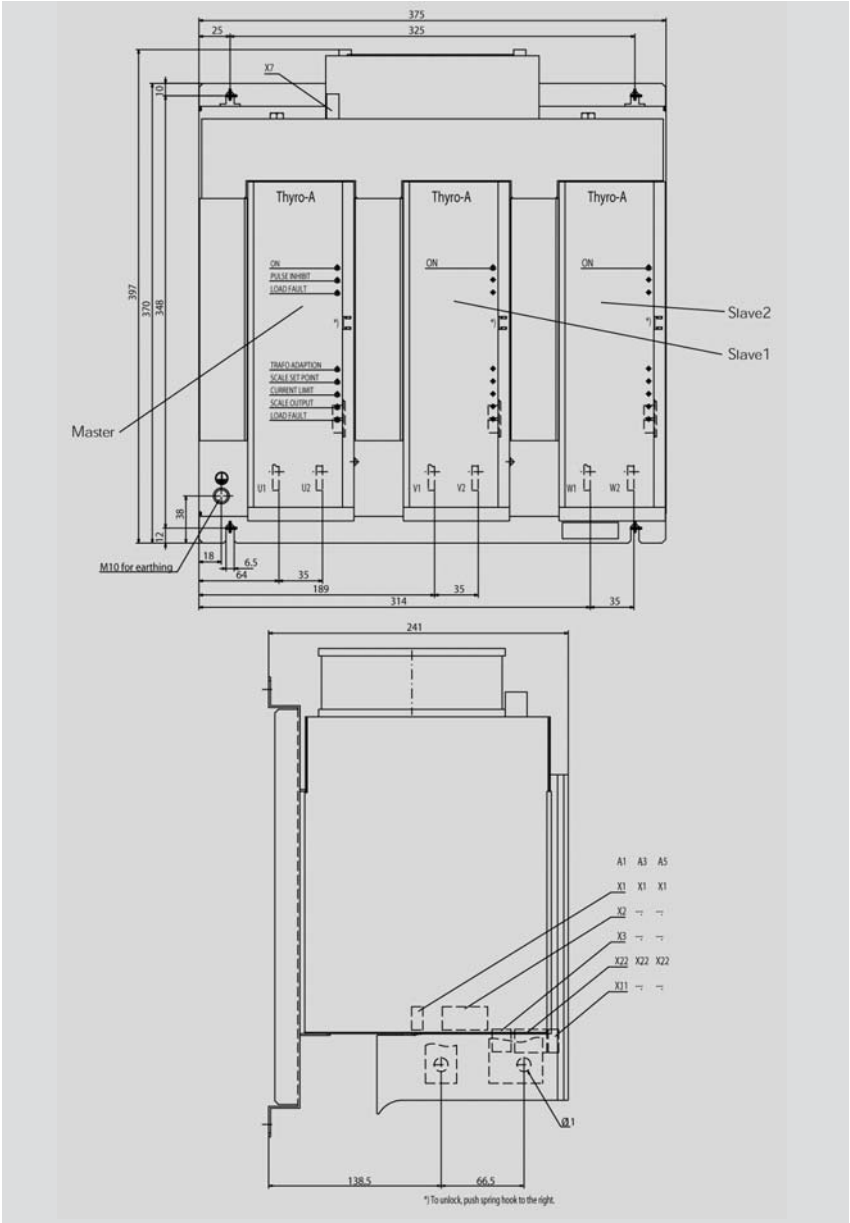
Dimensional drawing Thyritop 30 3A with 130A / 170A

The dimensional drawings are for type ...H RLP.



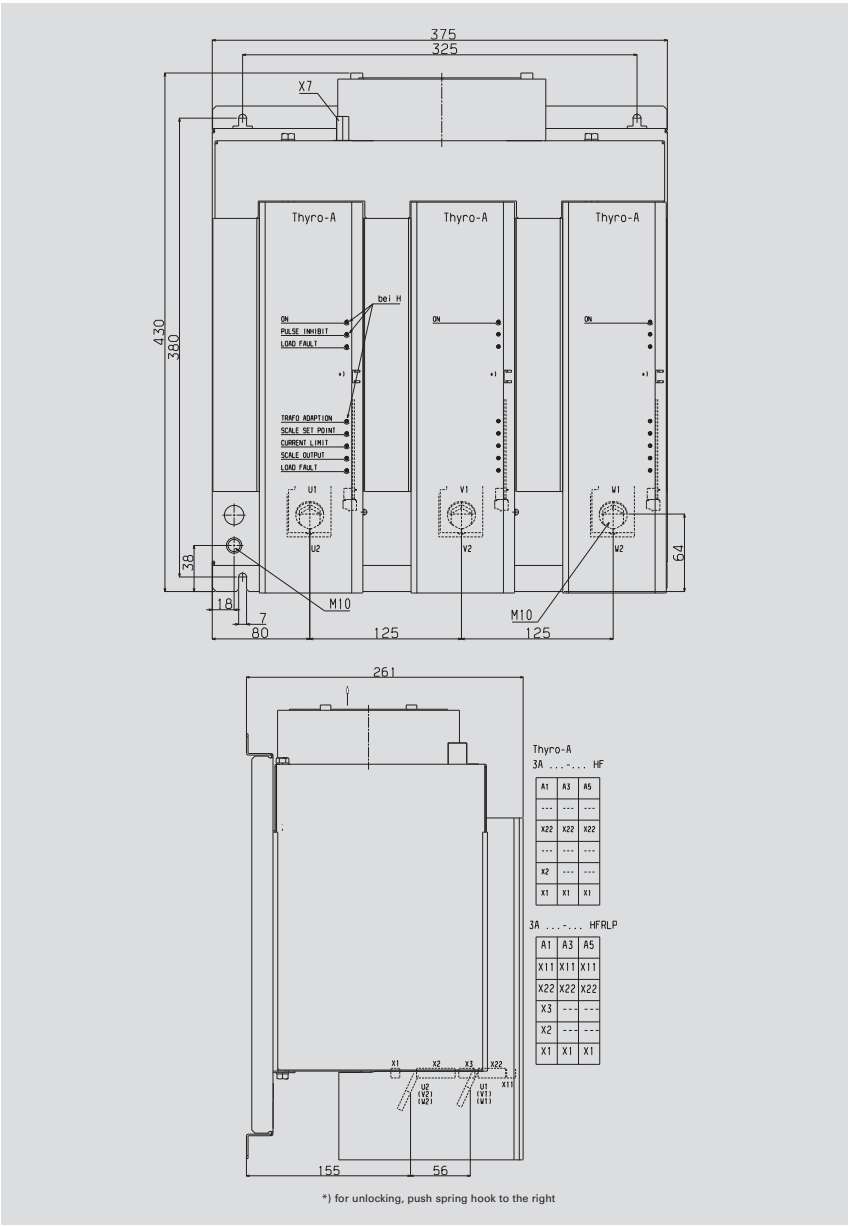
Dimensional drawing Thyritop 30 3A with 280A

The dimensional drawings are for type ...H RLP.



Dimensional drawing Thyritop 30 3A with 350A

The dimensional drawings are for type ...H RLP.



*) for unlocking, push spring hook to the right

> 11. Accessories and options

Order no. 2000 000 841	Bus module Profibus-DP
Order no. 2000 000 842	Bus module Modbus RTU
Order no. 2000 000 843	Bus module CANopen
Order no. 2000 000 844	Busmodul DeviceNet
Order no. 2000 000 848	Bus module connection cable for 4 controllers, 2.5 m long
Order no. 2000 000 849	Bus module connection cable for 4 controllers, 1.5 m long
Order no. 2000 000 380	PC software THYRO-TOOL
Order no. 2000 000 845	PC interface RS-232
Order no. 0048764	Data cable to PC (RS-232) 9-pos. SUB-D 5.0 m
Order no. 37294004	Synchrotakt SYT9
Best.-Nr. 8.000.019.086	Adapterkabel USB 1.1 auf RS232

> 12. Approvals and Conformity

The Thyritop 30 has the following approvals and conformities:

- Quality standard in acc. with DIN EN ISO 9001
- UL- rating, file No. E 135074, taking into account the Canadian
- National Standard C 22.2 No. 14-95, under preparation
- CE conformity
- Low voltage directive 73/23 EEC
- EMC directive 89/336 EEC; 92/31 EEC
- Marking directive 93/68 EEC
- RoHS (RoHS compliant 5/6)

Directives

The CE mark on the device confirms compliance with the EC directives 72/23 EEC for low voltage and 89/339 EEC for electromagnetic compatibility if the instructions on installation and start-up described in the operating instructions are followed. There is no product standard for thyristor power controllers, so it is necessary to build up a sensible framework of standards from the corresponding basic standards to guarantee safe application and possibilities for comparison.

CAUTION

Thyristor power controllers are not seen as devices for disconnection as described in DIN VDE 0105 P1 and may therefore only be operated together with a suitable upstream mains isolating device (e.g. switch, isolator etc.).

In addition to the standards mentioned, further standards are also complied with, e.g. Voltage drops in acc. with 61000-4-11:8.94 are ignored by the control unit or registered by the monitoring being triggered. There is always an automatic start after the mains returns within the tolerances.

In detail

Device application conditions		
Integrated device (VDE0160)		DIN EN 50 178
General requirements		DIN EN 60146-1-1:12.97
Design, vertical installation		
Operating conditions		DIN EN 60 146-1-1; ch. 2.5
Area of application, industrial		CISPR 6
Temperature behaviour		DIN EN 60 146-1-1; ch. 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 ventilation (from 280 A) -10°C - +45°C with air self cooling -10°C - +55°C with reduced type-current -2%/°C
Load category	1	DIN EN 60 146-1-1 P.2
Humidity class	B	DIN EN 50 178 Tab. 7 (EN 60 721)
Surge category	III	DIN EN 50 178 Tab. 3 (849V)
Degree of contamination	2	DIN EN 50 178 Tab. 2
Air pressure		900 mbar * 1000 m above m. sea level
Index of protection	IP00	DIN EN 69 529
Protection class	I	DIN EN 50178 chap. 3
Safe isolation up to 500V mains voltage:		DIN EN 50 178 chap. 3

Air and creepage distances		Housing / mains potential > 5.5 mm Housing / Control pot. > 1 mm Mains volt. / Control pot. ≥ 10 mm Mains volt. among each other 2.5 mm
Mechanical jolt		DIN EN 50 178 chap. 6.2.1
Test voltage		DIN EN 50 178 Tab. 18
Tests in acc. with		DIN EN 60 146-1-1 4.
EMC emitted interference		EN 61000-6-4
Radio interference suppression control unit	Class A	DIN EN 55011:3.91 CISPR 11
EMC resistance		EN 61000-6-2
Compatibility level	Class 3	EN 61000-2-4:7.95
ESD	8kV (A)	EN 61000-4-2:3.96
Electromagnetic fields	10V/m	EN 61000-4-3:3.95
Burst mains lines	2kV (A)	EN 61000-4-4:.95
control lines	2kV (A)	
Surge mains lines	2kV asym.	EN 61000-4-5:.95
	1kV sym.	EN 61000-4-5:.95
control lines	0,5 kV	
Conductor-bound		EN 61000-4-6

PYRO®
CONTROLE
CHAUVIN ARNOUX GROUP

11-09
code 692970A00 NF THYRITOP 30 3A GB - Ed. 1

6 bis avenue Dr SCHWEITZER 69881 MEYZIEU
Cedex - France
tél : (33) 04 72 14 15 40 Fax : (33) 04 72 14 15 41
www.pyro-controle.tm.fr