ADVANCED ENERGY®

THYRO-P

THYRISTOR-LEISTUNGSSTELLER / THYRISTOR POWER CONTROLLER

KOMMUNIKATIONSFÄHIG / COMMUNICATION CAPABLE

October 2014 8000003232 DE/EN - V9

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 assembly, installation and commissioning of Thyro-P by those persons working with or on Thyro-P.
These operating instructions are part of the Power Controller Thyro-P.
The operator of this device is obliged to provide these operating instructions to all persons transporting, commissioning, maintaining or performing other work on the Thyro-P without any restrictions.
In accordance with the Product Liability Act, the manufacturer of a product has an obligation to provide explanations and warnings as regards:

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

The information given below must be understood in this respect. It is to warn 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 in industrial alternating current or 3-phase networks.
- The Thyristor Power Controller may at maximum 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.
- 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 (for instance electrical shock, burns) and hazards for systems (for instance overload) may be caused.

RESIDUAL HAZARDS OF THE PRODUCT

- Even in case of proper use, in case of fault, 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 (for instance breakdown 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 physical dimensions of the overall power circuit. It must be ensured by system design that no uncontrolled large currents, voltages or power results. It is not possible to totally exclude that during operation of Thyristor power controllers other loads show abnormal behavior. The physically determined network reactions, depending on the operating mode, must be considered.

DANGER OF ELECTRIC SHOCKS

Even if the Thyristor Power Controller is not triggered, the load circuit is not disconnected from the mains.
It is possible to safely disconnect the Thyristor Power Controller as under IEC 60950

CAUTION

Hazard of electrical shock. Even after disconnection from the mains voltage, capacitors may still contain a dangerously high power level.

CAUTION

Hazard of electrical shock. 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 in place using exact torques. For safety reasons, power components repairs must be performed by Advanced Energy Industries GmbH.

SAFETY REGULATIONS

IMPORTANT INSTRUCTIONS AND EXPLANATIONS

Operation and maintenance according to regulation as well as observance of the listed safety regulations is required for protection of the staff and to preserve readiness to operate. Personnel installing/uninstalling the devices, commissioning them, operating them, maintaining them must know and observe these safety regulations. All work may only be performed by specialist personnel trained for this purpose using the tools, devices, test instruments and consumables provided for this purpose and in good shape.
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 shows work and operating procedures to be observed exactly to exclude hazards for persons.

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

REMARK
This is where remarks about technical requirements and additional information is given, which the user has to observe.

ACCIDENT PREVENTION RULES

The accident prevention rules of the application country and the generally applicable safety regulations must be observed in any case.

CAUTION
Before starting any work on Thyro-P, the following safety regulations must be observed:
- switch voltage-free,
- secure against switching on,
- determine if it is voltage-free,
- ground and short-circuit it,
- cover or block neighboring parts under voltage.

QUALIFIED PERSONNEL

Thyro-P 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. The specialist personnel must be authorized for the work required by the person responsible for the safety of the system.
Specialists are persons who
- have received training and have experience in the respective field of work,
- know the respective applicable standards, regulations, terms and accident prevention rules,
- have been familiarized with the function and operating conditions of Thyro-P,
- are able to detect and avoid hazards.

- objection,
- duration of use,
- ambient conditions,
- operating mode.

GUIDELINES

The devices of the type range Thyro-P conform to the currently applicable EN 50178 and EN 60146-1-1.

The CE mark on the device confirms observation of the general EG guidelines for 2006/95/EC (LVD) – low voltage and for 2004/108/EC (EMC) – electromagnet compatibility, if the instructions on installation and commissioning described in the operating instructions are observed.

Regulations and definitions for qualified personnel are contained in DIN 57105/VDE 0105 Part 1.

Safe isolation to VDE 0160 (EN 50178 Chapter 3)

in writing by Advanced Energy Industries; or if the defect arises because of the fitting of the goods to unsuitable equipment.
Advanced Energy Industries will cancel all possible obligations incurred by Advanced Energy Industries and its dealers, such as warranty commitments, service agreements, etc., without prior notice if other than original AEI spare parts or spare parts purchased from Advanced Energy Industries are used for maintenance or repair.

CONTACT

TECHNICAL QUERIES
If you have any technical queries regarding the subjects dealt with in these operating instructions, please get in touch with our team for power controllers:
Phone: +49 (0) 2902 763 -520 or
Phone: +49 (0) 2902 763 -290
powercontroller@aei.com

COMMERCIAL QUERIES
If you have any commercial queries on power controllers, please get in touch with:
Phone: +49 (0) 2902 763 -558
powercontroller@aei.com

ADDRESS

Advanced Energy Industries GmbH
Branch office Warstein-Belecke
Emil-Siepmann-Straße 32
D-59581 Warstein
Phone: +49 (0) 2902 763-0

INTERNET

Further information on our company or our products can be found on the internet under www.advanced-energy.com

COPYRIGHT

Passing on, duplication and/or takeover of these operating instructions using electronic or mechanical means, even in excerpts, is subject to express prior written approval of Advanced Energy Industries.

COPYRIGHT NOTICE
Thyro-P is an internationally registered trademark of Advanced Energy Industries.
Windows and Windows NT are registered trademarks of Microsoft Corporation.
All other company and product names are (registered) trademarks of their respective owners.

- Measured values are given at analog outputs
- 4 set point channels incl. motor potentiometer to set parameters

The specific characteristics especially include the following options:

- LBA-2 local touch display with integrated process data recorder of up to 6 channels
- LBA-2 is downward compatible with LBA and can replace it.
- Cabinet installation kit (SEK) for LBA-2 with touch display. The SEK allows the installation of LBA-2 in cabinet doors. It comes with wiring and installation frame.
- Bus connection via bus adaptor cards to plug into the Thyro-P Power Controller, coupling to different bus systems, for instance Profibus, other bus systems upon enquiry.
- The PC-Software Thyro-Tool Family for effective commissioning and simple visualization tasks. Functions are for instance loading, storing, modification, comparing and printing of parameters, set points and actual value processing, line diagrams of process data (including printing and storing option), bar diagrams, simultaneous display of process data from different power controllers, simultaneous connection of up to 998 Thyro-P Power Controllers.
- Patented ASM procedure for dynamic mains load optimization. The ASM procedure (automated synchronization of multiple power controller applications) is used for dynamic mains load optimization. It reacts to changes in load and set point, minimizes mains load peaks and associated mains feedback. Minimizing of mains load peaks means cost savings in operating and investment cost.
- For new systems it is recommended to use the high performance dASM instead of ASM.

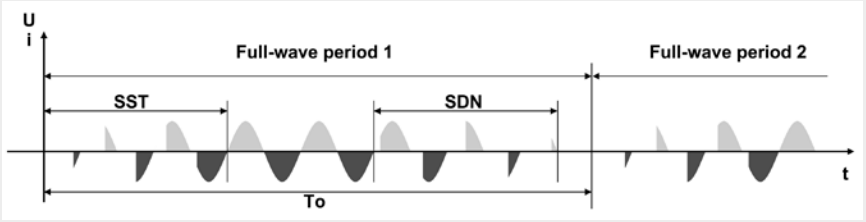
NOTE:
After purchasing Thyro-Tool Family software updates (if available) can be downloaded for free from our homepage.

1.3 TYPE DESIGNATION

The type designation of the thyristor power controllers are derived from the construction of its power section:

TYPE RANGE	DESIGNATION	FEATURES
Thyro-P	1P	1-phase power section, for single phase operation
	2P	2-phase power section 3-phase economy circuit (not for phase-angle firing VAR)
	3P	3-phase power section, for three phase operation
	.P400	Type voltage 230-400 Volt, 45-65 Hz
	.P500	Type voltage 500 Volt, 45-65 Hz
	.P690	Type voltage 690 Volt, 45-65 Hz
	.P ...-0037	Type current 37A (Typecurrent range 5A-2900 A)
	.. ...-.... . H	Integrated semi-conductor fuse (all Thyro-P)
	.. ...-.... . F	Forced air cooling with integrated ventilators
	The complete type range can be found in the TYPE OVERVIEW in chapter 10.	

SOFT-START-SOFT-DOWN (SSSD)
The operating mode SSSD operated similar to operating mode TAKT. However, it can be used especially advantageous in operation of large single loads to reduce pulse-shaped mains loads and therefore to reduce voltage variations. Switching on and off of turn on-time Ts occurs by applying periods with phase-angle firing (VAR). Please see following diagram.



Key parameters are

TAKT cycle period T_0	[sec]
Soft-Start SST	[msec]
Soft-Down SDN	[msec]

MOSI operation for 1P and 3P
MOSI is a sub-operating mode of the operating modes TAKT and VAR for sensitive heating materials with a high R_{hot}/R_{cold} ratio, for instance molybdenum disilicide. The Power Controller always starts with phase-angle maximum value and actual value to avoid high current amplitudes during the heating-up phase and then automatically switches to the set operating mode.

For the sub-operating mode MOSI, the key parameters are:

MOSI:	RAMP/ STELL
Rate of angular displacement 1	[°el/s]
Rate of angular displacement 2	[°el/s]
Peak current	
I max	[A]

MAINS LOAD OPTIMIZATION (WITH dASM OR OPTIONAL ASM PROCESS)
For systems in which several power controllers are employed in full wave switch mode TAKT, it is possible that individual power controllers are synchronized so that a regular mains load is achieved by defined switching of the individual power controller. This avoids load peaks by random simultaneous switching of many power controllers and load troughs are filled up. The upstream transformer and/or the upstream feed point may be designed for a lower load. Besides savings in investment and operating costs it also results in considerable lower system perturbations.

For new installations the dASM process is recommended due to its quicker and easier handling (see chapter 6.1).

2.2 SET POINT CONTROL CHARACTERISTIC

The set point control characteristic of Thyro-P may be easily adapted for the control output signal of the 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. Inverted operation (ending value is smaller than the starting value in voltage or current) is also possible.
The effective set point is the total set point. It is formed by adding the four set points as shown in fig. 2.
In the simplest case all the set point values are added algebraically. The prerequisite for a set point to influence the total set point value is that it must be enabled by the set point Enable Register.
• Set point 1 (X5.2.10 - X5.1.13 ground) 0-20mA default

SET POINT CONTROL CHARACTERISTICS

The set point control characteristic (Fig. 1) of Thyro-P may be easily adapted for the control output signal of the 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. Inverted operation (ending value is smaller than the starting value in voltage or current) is also possible.

- Set point 3:

Set point of the superordinate system or PC via RS232 or fiber optic connection (standard) X30, X31 or via the optional bus interface.

- Set point 4:

Set point input (motor potentiometer function) settings as for set point 3 but additionally via LBA-2. Set point 4 is stored in case of mains failure.

EFFECTIVE TOTAL SET POINT VALUE

The algebraic addition of the results of set point (1,2) to set point 3 and 4 gives the (effective) total set point value for the set point control characteristic as shown in the following figure.

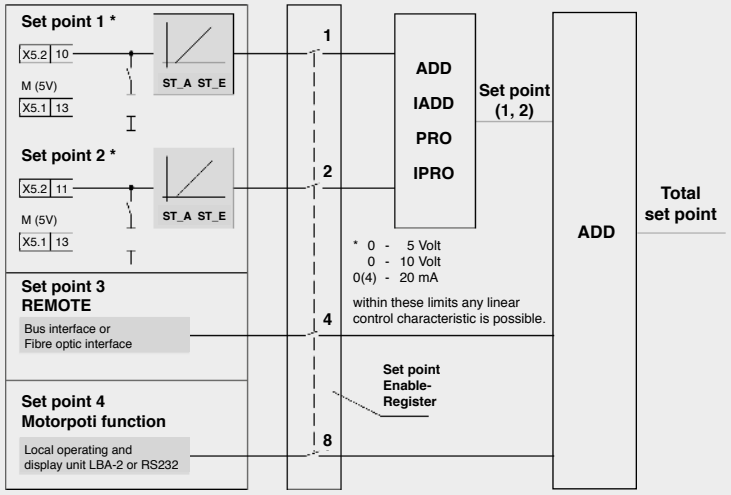


FIG. 2
TOTAL
SET POINT

The prerequisite for a set point to influence the total set point value is that it must be enabled by the set point Enable Register. Set point 1 and 2 can be linked using the following functions. The result of this link is called set point (1,2).

Set point link

ADD Set point (1,2) = Set point 1 + Set point 2

IADD Set point (1,2) = Set point 1 - Set point 2

_Pro $\text{Set point (1,2)} = \text{Set point 1} * \frac{\text{Set point 2 [\%]}}{100\%}$

_IPro $\text{Set point (1,2)} = \text{Set point 1} * \left(1 - \frac{\text{Set point 2 [\%]}}{100\%}\right)$

VALUE RANGE OF SET POINT (1,2)

For the link result of set point (1,2) the following value range applies:

$0 \leq$ Set point (1,2) $\leq$ Set point max (U_{max}, I_{max}, P_{max}).

CONTROLLER RESPONSE

If the load resistance changes, for instance due to temperature effect, ageing or load fault, then the values (depending on control type) effective on the load change as follows:

CONTROL TYPE	LIMIT	LOAD RESISTANCE DECREASES P	U_{LOAD}	I_{LOAD}	LOAD RESISTANCE INCREASES P	U_{LOAD}	I_{LOAD}	EFFECTIVE* LIMITATIONS	
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	=	larger	larger	=	$U_{rms\ max}$	P_{max}
I^2 (IxI)	$I_{rms\ max}$	smaller	smaller	=	larger	larger	=	$U_{rms\ max}$	P_{max}
P	P_{max}	=	smaller	larger	=	larger	smaller	$U_{rms\ max}$	$I_{rms\ max}$
without control		larger	=	larger	smaller	=	smaller	$U_{rms\ max}$ P_{max}	$I_{rms\ max}$
General modulation limit								$T_s=T_{s\ max}$ $\alpha=\alpha_{max}$	

* If one of the limits is exceeded, then the signaling relay K2 and the LED Limit react (default values of parameter settings).

TAB. 1 BEHAVIOR IN CASE OF LOAD CHANGE

2.4 INDICATIONS

2.4.1 LED INDICATIONS

The LEDs on the front side signal the following states:

• ON	green: operating indication, power supply controller board red: RESET active
• CONTROL	modulation percentage indication, flashing*
• LIMIT	limitation is active, relay K2 switches*
• PULSE LOCK	Controller Lock active, but load control is continued at pulse limits (default value = 0)*
• FAULT	fault present*
• OVERHEAT	overheating of power section (in case of ..HF types, check ventilator)*

* Default setting

Activation of the integrated semiconductor fuse may be signaled using the fault indicating relay K1 rest current, contactor, otherwise separate supply of the control device required). In case of power controllers from model current 495A, additional signaling is performed via an indicator at the semiconductor fuse.

2.4.2 RELAY INDICATIONS K1-K2-K3

The Thyro-P power controller is fitted with three relays. Each of these relays has a change over contact, in principle a value has been allocated in the event register. The default values for parameter settings are listed in chapter 3.5 ERROR ACKNOWLEDGEMENT / DATA LOGGER. The connection terminals are specified in chapter 4 EXTERNAL CONNECTIONS.

ALARM RELAY K1

The relay K1 is activated if a fault is detected in the system. The effective direction, whether it should close or open in case of fault, may be set using the parameter Relay ON at message or Relay OFF at message by using LBA-2 or Thyro-Tool Family. Which indications lead to switching of the relay may also be set.

Recommendation: keep the default setting.

2.5.2. LOAD MONITORING

It is possible to monitor load by absolute monitoring of heating elements with $R_{hot}/R_{cold} \approx 1$ and relative monitoring of heating elements with $R_{hot}/R_{cold} \neq 1$.

2.5.2.1 ABSOLUTE VALUE MONITORING CURRENT

This function allows monitoring of a freely selectable absolute current limit. The parameters for the value may be set in ampere.

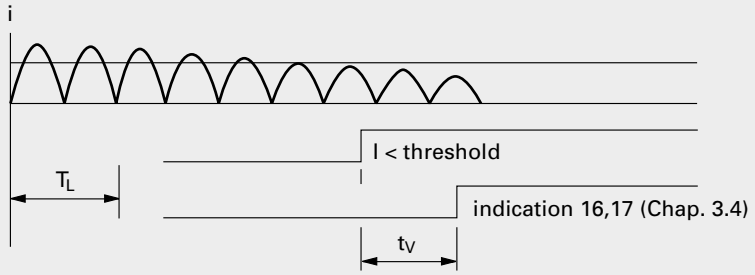


FIG. 4: ABSOLUTE VALUE MONITORING

This absolute value monitoring lends itself to one or more load resistances organized in parallel or in series. Generally, the effective current value measured is continuously compared with a preset-table absolute current limit for undercurrent or overcurrent. If these limits are undercut or exceeded an indication occurs after Tv =10 mains periods. In case of resistor elements organized in parallel, it is therefore possible, using the lower current limit, to detect a partial load interruption. Using the upper current limit, in case of resistors switched in series, short-circuiting of an element may be detected.

2.5.2.2 RELATIVE MONITORING

This monitoring is sensible if the resistance value of the load slowly changes. Changes in resistance may for instance be caused by temperature changes or by ageing. The current (b) of the Power Controller is regarded as 100% load current (current in fault-free state) after activation of the RESET or CONTROLLER LOCK. The RESET is automatically activated after each startup, restart or after mains outage. In case of relatively slow changes of the current, due to characteristics of the above mentioned heating elements, automatic adjustment of the internal reference value to 100% is performed (b').

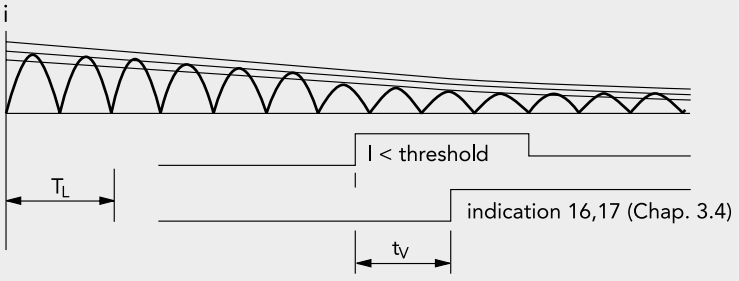
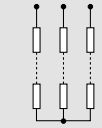
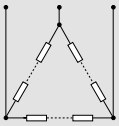


FIG. 5: RELATIVE MONITORING

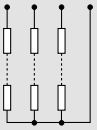
Quick current changes, which may for instance occur in case of partial short-circuit, may be detected by overcurrent monitoring (max., a – a').
Quick current changes, which may for instance occur in case of load breakdown may be detected by undercurrent monitoring (min., c – c').



Star connection
without neutral conductor



Delta connection



Star connection
with neutral conductor

HEATING ELEMENTS IN SERIES FOR EACH STRAND	**1P**	**2P* / 3P**		**3P**
		STAR CONNECTION WITHOUT CONNECTED NEUTRAL CONDUCTOR	DELTA CONNECTION	STAR CONNECTION WITH CONNECTED NEUTRAL CONDUCTOR
6	10%	7%	6%	10%
5	13%	8%	7%	13%
4	17%	10%	9%	17%
3	25%	14%	13%	25%
2	50%	25%	26%	50%

TAB. 3 PARTIAL SHORT-CIRCUIT WITH HEATING ELEMENTS SWITCHED IN SERIES, OVERCURRENT, RELATIVE MONITORING

* for Thyro-P 2P: additional external converters in phase L2 are possible.

Thyro-P determines the load conductance separately for each phase. These values are available from LBA-2, Thyro-Tool Family and the Bus interface. The current resistance can be determined by reading out and converting from the conductance.

2.5.4 FAN MONITORING

The separately ventilated power controllers (-...HF) are fitted with thermal monitoring. The temperature is measured on the heat sink. In case of a temperature overrange, a fault indication is issued: Unit excess temp.

As a standard the device will be switched off and LED Overheat will be lit.

ATTENTION

When using the device under UL conditions, this feature has to be switched on.

3.1.2 SETTINGS LBA-2

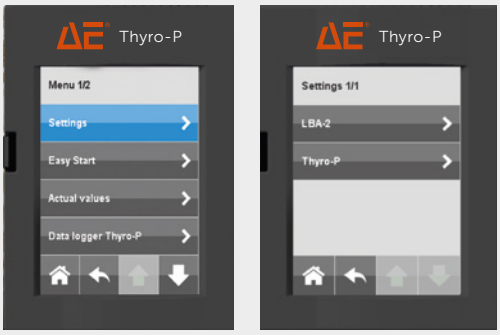


FIG. 7: MAIN MENU LBA-2 (SAMPLE)

To change anything on LBA-2, the button SETTINGS in the main menu has to be pressed. By using the button LBA-2 the following menus will be available:

Settings for LBA-2
- Operation display, bar chart, and line chart settings
- Display settings
- Startscreen
- Languages
- Bluetooth
- Authorization and passwords
- Information about the device
- Address
- Reset to factory settings

3.1.3 SETTINGS THYRO-P

To change anything on Thyro-P, the button SETTINGS in the main menu has to be pressed.
By using the button Thyro-P the following menus will be available:

Settings for Thyro-P
- Operating mode
- Control mode
- Control parameters
- Limits
- Analog outputs
- Setpoint inputs
- Relays / LED / pulse inhibit
- Address
- Hardware
- Monitoring
- Temperature
- Data logger Thyro-P

Additional parameter sets and configurations can be stored permanently in the EEProm of the LBA-2.

3.1.7 BLUETOOTH

This option is only available with model no 2.000.000.409. It can be switched on and off in the submenu of the LBA-2.

It offers a wireless operation of Thyro-P
- Via Thyro-App* (by Android smartphone or tablet PC)
- Thyro-Tool Family (e.g. by laptop and Bluetooth)

*free download from www.advanced-energy.com

As soon as the LBA-2 is connected via Bluetooth using the Thyro-App to a Smartphone or Tablet PC, or to a PC via the Thyro-Tool Family, the display of the LBA-2 shows a Bluetooth symbol and all other functions of the LBA-2 will be automatically deactivated. Therefore operations via display and via Bluetooth are not possible at the same time. Once the Bluetooth connection has ended, the display of the LBA-2 is active again.

NOTE
When using the Bluetooth feature, all other functions are deactivate except the BLUETOOTH ACTIV SYMBOL – this also applies to the PROCESS DATA recorder.

3.1.8 PASSWORDS / AUTHORIZATION

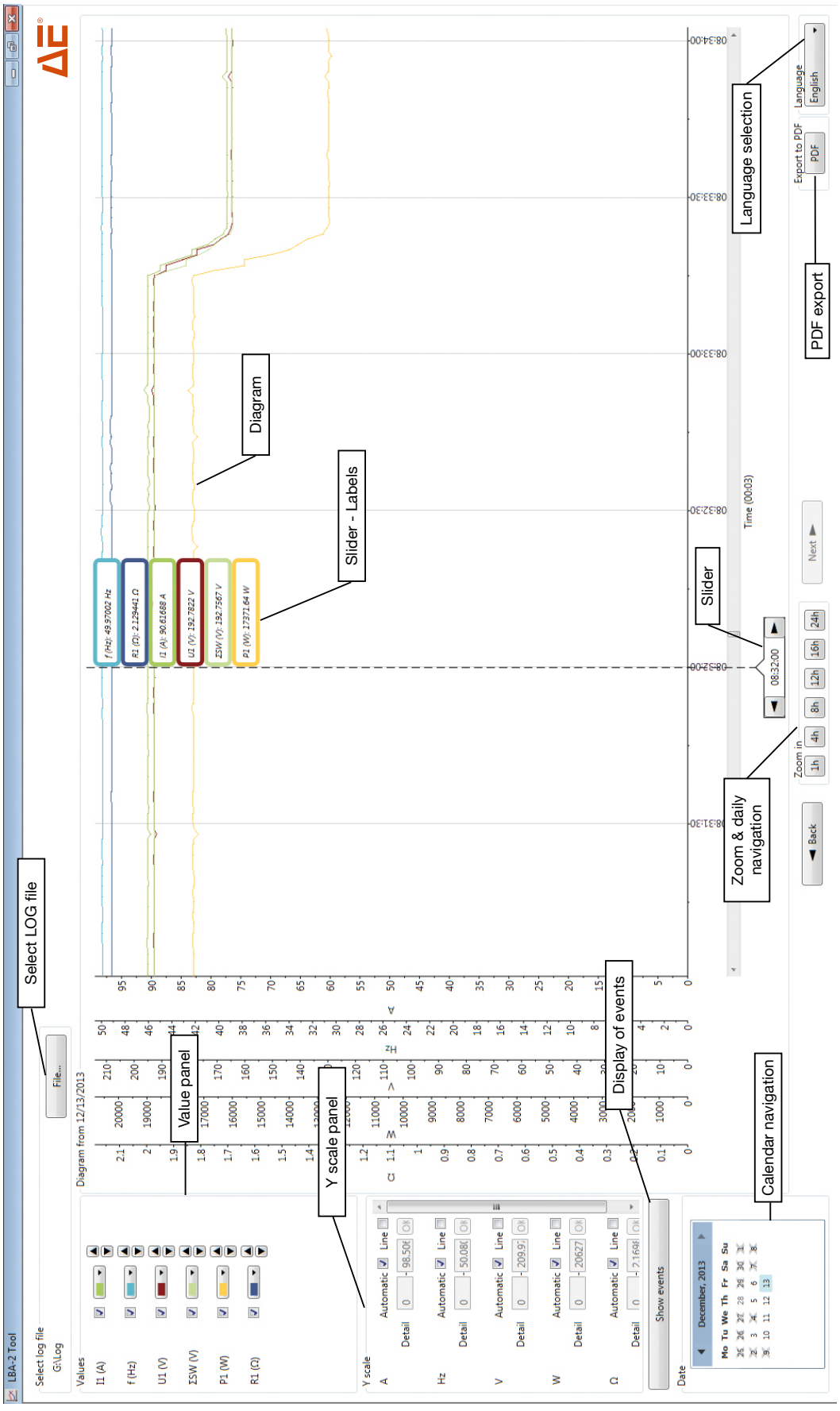
FIG. 9: ACCESS LEVELS

Password Level 1: 160387
Access to parameter settings or EasyStart function

Password Level 2: 311263
Access to detailed parameter settings of the power controller

CAUTION
To avoid unauthorized access, change your password settings the first time you use the LBA-2. Only 6-digit numerical password combinations are possible!

3.2.1 OVERVIEW



3.2.5 TIME AXIS

STANDARD ZOOM

Once the program has been turned on, each diagram will be displayed with the 24h zoom setting. This corresponds to the data stored in the log file. By clicking on the other zoom settings, the data view will be reduced accordingly. With the aid of the displayed scrollbar under the diagram, the data view can be shifted horizontally along the time axis.
The buttons Back and Next, next to the standard zoom, direct to the previous or following day of an saved LOG file.

FIG. 14: STANDARD ZOOM KEYS

DETAILED ZOOM

By sliding the mouse horizontally on the diagram, a new X axis view can be selected. Thus you can zoom in to a one-minute section. The detailed view that is then displayed can be magnified again only after entering a standard zoom setting.

3.2.6 VALUE AXES

With the Y scaling panel, the axes can be changed for the units (up to 6 values) that appear in the diagram. By deactivating the AUTO checkbox, the part of the axis that is automatically calculated can be set by the user. Therefore the displayed area and the resolution of measured signal might be optimized. The horizontal lines for the main section of an axis can be displayed in the diagram by the checkbox line.

The settings for the Y axes will be maintained during navigation.

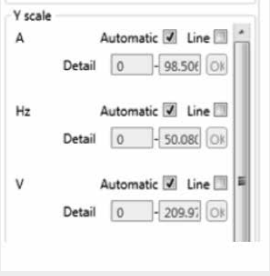


FIG. 15:
Y SCALING PANEL

The modification is relevant for all Y axes having the same unit. Several axes with the same unit can be created, e.g. when two currents are displayed.

The slider can be used to read values on specific points in the diagram. The slider of the time axis (X axis) can be set to any position by using the mouse. By clicking with the left side of mouse directly on the slider, it can be moved to another position. When the slider is released, the slider labels show the values of line chart (color like selected in the relating line chart) and their according units. With both buttons the slider can be moved either one second to the right or left. Is the slider on the leftmost or rightmost of the diagram (parking position), then no labels are be shown.

While zooming, the slider maintains its position on the X axis. If, however, the slider is located at a position on the X axis, which is not a part of the zoomed section, then it will be put into parking position on the left or right depending on where it was previously located.

3.3 CABINET INSTALLATION KIT (SEK)

The cabinet installation kit (optional: model 2.000.000.405) enables the LBA-2 to be mounted on a cabinet door with a thickness of up to 4mm. It consists of one 96x72mm adapter frame (cut-out dimensions 92x68mm) and a cable. The LBA-2 is connected to the RS232 interface of the Thyro-P via the cable. The LBA-2 clicks into the adapter frame and can only be removed when the cabinet door is open. In this way the technician can set the parameters (e.g. adjustments to retooling) and manual setpoint setting (motor potentiometer) as well as reading of the actual values without opening the door.
The SEK offers an operation of Thyro-P with closed cabinet doors.

If the LBA-2 is connected to the power controller via a long cable and cannot be operated, it can be provided by increase of supply voltage (by opening the R155 wire jumper in the control unit).

WARNING

When the R155 wire jumper is open, the LBA-2 should not be connected to the power controller without cables (risk of damage). The position of the wire jumper can be seen on the layout diagram of circuit board of the control unit (see chapter 4).

3.4 THYRO-TOOL FAMILY

Thyro-Tool Family is optional software for commissioning and visualization under Windows 95/98/NT 4.0/XP and higher. It includes all functions of Thyro-Tool P and it is connected to Thyro-P via RS232 interface.
Thyro-Tool Family may be employed as an alternative to LBA-2 and as already stated above has the following functions, for which several windows may be opened simultaneously:

- set point and actual value processing with overview display for 22 set point/actual value input options for motor potentiometer and total set points.
- loading, storing, modification and printing of parameters
- comparison of parameters

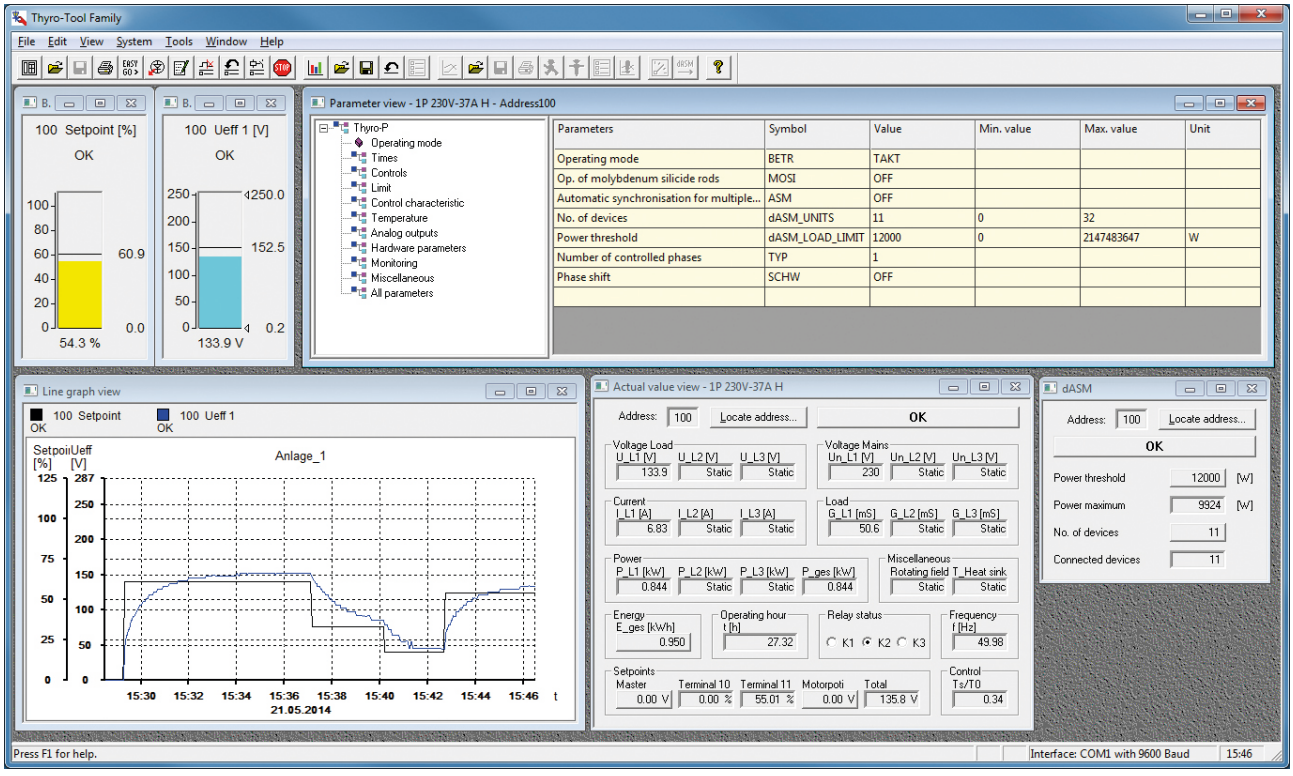
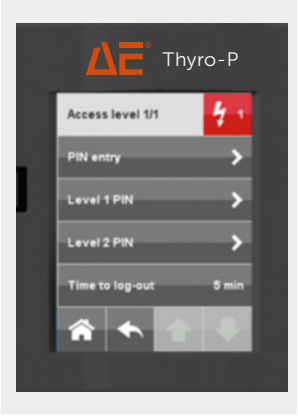


FIG. 19: EXAMPLE FOR USER INTERFACE THYRO-TOOL FAMILY



3.5.1 LBA-2

DISPLAY OF ERROR MESSAGES

If there are status messages, a red or yellow reference will appear in the LBA-2 status line (see illustration).

Yellow:	Status messages / Warnings
Red:	Error messages
	Incl. further status messages

By pressing the status field, individual events can be displayed on the LBA-2 in the data logger view. Then previous events can also be seen. Occurring messages, which are recorded by the data logger, are also secured just like the process data of line chart and are therefore documented. The number of saved messages is nearly unlimited which can be used for analyzing purposes.
The data logger can also be set up as start screen.

NOTE

If the SD card is removed for analyzing purposes, it is required to shut down the LBA-2 by using the OFF button.

ACKNOWLEDGE ERROR MESSAGES

Error messages and warning can be reset in the LBA-2 menu (page 2/2: ACKNOWLEDGE ERRORS).

ACTIVATE MESSAGES FOR DATA LOGGER

To activate messages in Thyro-P data logger, they have to be parameterized. This has to done by the LBA-2 menu:

After selecting menu SETTINGS / THYRO-P (page 3/3) / DATA LOGGER, the messages are shown in order and can be selected.

3.5.2 THYRO-TOOL FAMILY

Using the Thyro-Tool Family and active line chart, errors and messages that occur will be displayed in a window and stored on the hard drive as per the line chart. Via a bus interface option (e.g., Profibus DPV1, Profinet, Modbus TCP, EthernetIP, Modbus RTU, DeviceNet), a message will be communicated automatically. As already mentioned, the status messages generated from the Thyro-P (errors, warnings, messages) refer either to the load or the power controller in the Thyro-Tool Family. Depending on the application, either warnings or status messages will be displayed.

As a deviation from the default factory setting, all messages can be switched on the data logger, on the relays and on the LEDs. The default factory settings are as follows:

3.6 LBA-2 MENU STRUCTURE

Menu	Submenu		Access level	Default value	Remarks
Settings					
LBA-2					
Operation display					Max. 6 channels available; ON / OFF per channel, choosing variable
Bar chart					Max. 4 channels available; ON / OFF per channel, choosing variable and color
Line chart					Max. 6 channels available; ON / OFF per channel, choosing variable and color
Display					
	Operating brightness				Display brightness during active usage
	Brightness after standby				Display brightness of standby mode
	Time until standby				Selection of duration till when the brightness will turn down to the value set above; constant level of brightness by setting 0
	Calibrating display				
Start screen					Selection of graphic shown on the display
	Operation display				Data shown as numerical values on the display
	Bar chart			X	Data shown as bar chart on the display
	Line chart				Data shown as line chart on the display
	Data logger Thyro-P				
	Time until activation				Selection of duration till when the start screen will appear automatically; No automatically setting back to start screen by setting 0
Language					
	Deutsch				German
	English			X	English
	Français				French
	Čeština				Czech
	Español				Spanish
	Türkçe				Turkish
	Italiano				Italian
	中文				Chinese
	Svenska				Swedish
Bluetooth					Turn on / off Bluetooth feature (only type 2.000.000.409) Shows demanded PIN, device name and address
Access levels					Enabling of password functions
	PIN entry				Enabling of additional settings
	Level 1 PIN		X-2		Changing level 1 PIN
	Level 2 PIN		X-2		Changing level 2 PIN
	Time to log-out		X-2		Setting period of validity
Information					Serial and version number of LBA-2 software
Address					Search and settings of communication address for multiple controllers
Reset to factory settings					Setting back to LBA-2 configuration default values
Thyro-P					
Operating mode					
	TAKT		X-1		
		1st phase angle	X-1	60°el	60°el for Thyro-P 1P, otherwise 90°el., default value for transformers
		Softstart	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time up
		Softdown	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time down
		TAKT cycle period T0	X-1	1.000	Display / default of TAKT cycle period T_0
		Turn on-time Ts max	X-1		Display of on-time T_s
		Turn on-time Ts min	X-1		Display of on-time T_s
		Synchronal delay	X-1		Turn on-time delay at resumption of power supply
		MOSI	X-1		RAMP or STELL; Rate of angular displacement 1 and 2 (Access level 2)
		Min. break	X-1	60ms	Depends on transformer
		ASM			Display of ASM process; Setting time constant, waiting period, threshold, tolerance
		dASM	X-1		Display of dASM process; Setting of no. of devices and power threshold
	VAR				
		Softstart	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time up
		Softdown	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time down
		MOSI	X-1		RAMP or STELL; Rate of angular displacement 1 and 2 (Access level 2)
		Front pulse limit position	X-1		
		Back pulse limit position	X-1		
	SSSD				
		Softstart	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time up
		Softdown	X-1	0.3	0 to (T_0 -20ms), default value 300ms, ramp time down

	Setpoint 1 (terminal 10)				Display setpoint 1
	Setpoint 2 (terminal 11)				Display setpoint 2
	Master (Bus)		X-1		Setting setpoint 3
	Total				Display total setpoint
	Settings of setpoint inputs		X-1		
		Setpoint 4 mopo	X-1		
		Setpoint 1 analog (10)	X-1		
		Signal type	X-1		Selection between 0…5 V, 0…10 V and 0…20 mA **NOTE:** For signal range 0…5 V / 0…10 V: Please open jumper X221. For signal range 0…20 mA: Please close jumper X221.
		Control start	X-1	0,3 mA	
		Control end	X-1	20,0 mA	
		Setpoint 2 analog (11)	X-1		
		Signal type	X-1		Selection between 0…5 V, 0…10 V and 0…20 mA **NOTE:** For signal range 0…5 V / 0…10 V: Please open jumper X221. For signal range 0…20 mA: Please close jumper X221.
		Control start	X-1	0,7 V	
		Control end	X-1	5,0 V	
		Setpoint 3 remote	X-1		
	Setpoint link		X-1		Selection between Addition (SW1+SW2), Subtraction (SW1-SW2), Multiplication (SW1*SW2%/100%), Inverse Multiplication (SW1*(1-SW2%/100%))
Relay / LED / pulse inhibit					
	K1		X-1		
		Select event *	X-1		See chapter Error acknowledgement / Daten logger
		Mode	X-1		Selection between switch, static, Monoflop, blink, alpha PWM, switch delayed, cyclic Monoflop, static inverse
		Error acknowledge of controller inhibit	X-1		On / Off of error acknowledge with controller inhibit
		Error acknowledge of input X5.2.19	X-1		On / Off of error acknowledge with input X5.2.19
		Delay time	X-1		Selection of 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min
		Functionality	X-1		Setting relay On or Off at message
	K2		X-1		
		Select event *	X-1		See chapter Error acknowledgement / Daten logger
		Mode	X-1		Selection between switch, static, Monoflop, blink, alpha PWM, switch delayed, cyclic Monoflop, static inverse
		Delay time	X-1		Selection of 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min
		Functionality	X-1		Setting relay On or Off at message
	K3		X-1		
		Select event *	X-1		See chapter Error acknowledgement / Daten logger
		Mode	X-1		Selection between switch, static, Monoflop, blink, alpha PWM, switch delayed, cyclic Monoflop, static inverse
		Error acknowledge of controller inhibit	X-1		On / Off of error acknowledge with controller inhibit
		Error acknowledge of input X5.2.19	X-1		On / Off of error acknowledge with input X5.2.19
		Delay time	X-1		Selection of 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min
		Functionality	X-1		Setting relay On or Off at message
	LED Control		X-1		
		Select event *	X-1		See chapter Error acknowledgement / Daten logger
		Mode	X-1		Selection between switch, static, Monoflop, blink, alpha PWM, switch delayed, cyclic Monoflop, static inverse
		Delay time	X-1		Selection of 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min
		Functionality	X-1		Setting relay ON or OFF at message
	LED Limit		X-1		
		Select event *	X-1		See chapter 12. Error acknowledgement / Daten logger
		Mode	X-1		Selection between switch, static, Monoflop, blink, alpha PWM, switch delayed, cyclic Monoflop, static inverse
		Delay time	X-1		Selection of 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min

		Overcurrent monitoring	X-1	OFF	Turing feature On or Off
		Min. load break	X-1	0	Depending on selection above in % or A; Prior activation of undercurrent monitoring
		Max. load break	X-1	0	Depending on selection above in % or A; Prior activation of overcurrent monitoring
		Monitoring L2 Enable	X-2	OFF	
		Monitoring L3 Enable	X-2	OFF	
		i^2t fast current monitoring	X-2		Setting of fast current monitoring for L1, L2 and L3
Temperature			X-2		Details only turn up when a temperature controller (PT100, PT1000 or NTC) is selected
	PT100		X-2		Used temperature sensor
		Characteristic no.	X-2	Type	Depends on type
		Level wire breakage	X-2		
		Level sensor short circuit	X-2		
	PT1000		X-2		Used temperature sensor
		Characteristic no.	X-2	Type	Depends on type
		Level wire breakage	X-2		
		Level sensor short circuit	X-2		
	NTC		X-2		Used temperature sensor
		Characteristic no.	X-2	Type	Depends on type
		Level wire breakage	X-2		
		Level sensor short circuit	X-2		
Data logger Thyro-P			X-1		Select message *
EasyStart			X-1		Please confirm the request to start EasyStart configuration
Operating mode Load type Dynamic Control mode Control end value Conclusion					Selection between TAKT, VAR or SSSD Selection between R-Last and RL-Last Selection between Slow (T0=1s) and Fast (T0=0,1S) Selection between U^2. U. I^2. I. P or Off Default depends on Thyro-P type Display of above selection; When confirming the selection, the previously selected parameters will be implemented immediately into Thyro-P
Actual values					Display of Thyro-P actual values
Data logger Thyro-P					Current display of data logger entries
Line chart					Display of line chart in historical course; Turning On and Off of channels and settings of values displayed
Load / save data					
Load LBA-2 configuration to SD card					Load line charts or LBA-2 configuration which have been saved on SD card
Save LBA-2 configuration from SD card					Save LBA-2 settings and line charts on SD card
Save Thyro-P parameters from SD card					Save a copy of Thyro-P parameterization on SD card
Load Thyro-P parameters from SD card					Load parameterization to Thyro-P which has been saved on SD card
Save Thyro-P parameters to EEProm					Permanently save Thyro-P parameterization from RAM to EEProm
Acknowledge errors					Acknowledge of errors and warnings

X-1	Password level 1
X-2	Password level 2
X-AEI	AEI password protected parameter

TAB. 6 LBA-2 MENU STRUCTURE

CAUTION
The pulled plug has mains voltage of the load circuit! The new connecting lines must be fused according to the applicable regulations (for applicable plug, see chapter 13).

4.3 POWER SUPPLY FOR THE VENTILATOR

With Thyro-P Thyristor Power Controllers furnished with integrated ventilators (HF types), the ventilator must be supplied with a voltage of 230V 50/60Hz according to the connecting plans and the dimensional drawings. The ventilator's power consumption is given in chapter 11 TECHNICAL DATA.

ATTENTION
The ventilator must run when the Power Controller is switched on.

4.4 RESET

The input RESET (terminals X5.2.12-X5.1.14) is separated from the remaining system by an opto-electronic coupler. By opening the RESET jumper the Thyristor Power Controller is locked (load: 24V/20mA), i.e. the power sections are no longer triggered. On activating RESET, LED "ON" lights up red.

Functional procedure:

TERMINALS	FUNCTION
X5.12-14 closed	Enables the device
X5.12-14 open	Device is out of operation, communication via interfaces not possible

TAB. 8 RESET

The hardware RESET must be applied when synchronizing the software of several Power Controllers (chapter 6.3 SOFTWARE SYNCHRONIZATION). If the Power Controller is equipped with a Bus option, a Bus RESET also ensues from the hardware RESET. Apart from opening the jumper terminal X5.2.12-X5.1.14, the hardware RESET is also activated by supply voltage OFF or by reducing the supply voltage at the Power Controller (A70-X1) to below 160V.

4.5 CONTROLLER INHIBIT

The input controller lock (terminals X5.2.15 and X5.1.14) is electrically identical to the input RESET (electrical data as under 4.4.).

ATTENTION
When activating controller lock, the LED „PULSE LOCK" is lit and the control device remains completely in operation. The total set point is therefore without effect, but the min. limiting values (TS-MIN, HIME) remain active. This enables securing a certain quantity of electrical energy at the load.

TERMINALS	FUNCTION
X5.15-14 closed	power controller operating
X5.15-14 open	control pulses OFF (default value) or pulse limit

TAB. 9 CONTROLLER LOCK

All other functions of the power controller remain in operation. The state of the signalling relay does not change (parameter-dependent) and communications remains active. After closing the controller lock jumper, the controller is back in operation.

4.6 QUIT

The input acknowledge (Quit, X5.2.19) has a circuit identical with the input RESET. It must be

tions, limiting and the influence of operating modes with SSSD and MOSI) give the actual value signals dynamic rations which can be smoothed with a smoothing stage. The MEAN (VALUE) parameter is applied here. The following setting is recommended: MEAN(VALUE) = 25.

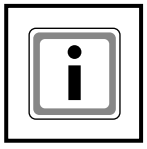
4.11 CURRENT TRANSFORMER

By standard, each power section of the power controller has a current transformer. When using external current transformers, for instance on the secondary side of a transformer, these must be connected to the terminals X7.1 and X7.2 and terminated using a load resistor.
Each external voltage transformer must be connected with an load resistor.

CAUTION
Danger of electric shocks.
Current transformers must not be used without load resistors (secondary side), otherwise high voltages can occur at the terminals.

ATTENTION
Danger of damaging Thyro-P.
Current transformers must not be used without load resistors (secondary side), otherwise high voltages can occur at the terminals.
The load resistor must be designed so that at nominal current a voltage drop of 0.9 - 1.1Vrms occurs at the burden resistance.

The value of the used load resistor has to be entered with Thyro-Tool Family or LBA-2 in parameter U_Load resistor.



REMARK
The internal current transformers of Thyro-P, which are not needed when using external current current transformers, are jumpered by load resistor R40 on the control boards.

If load current monitoring of the phase 2 (not controlled) is desired for Thyro-P 2P,
then an external current transformer and an external voltage transformer must be provided for this purpose.

CURRENT TRANSFORMER	TERMINAL X7.2	TERMINAL X7.1
phase L1	.11(k)	.12(l)
phase L2	.21(k)	.22(l)
phase L3	.31(k)	.32(l)

TAB. 11 CURRENT TRANSFORMER

The following parameters must be checked or adjusted:

HARDWARE-PARAMETER	
Current transformer ratio ü:1, e.g. at 100A/5A transformer is ü=20	UE_I
Type current in A (Primary current of transformer, e.g. 100A)	I_TYP
U_load resistor in V	U_load resistor (Voltage at load resistor)

LIMITATIONS		
Ieff max	xxxx	A IEMA

This is conform to voltage at load resistor at nominal current of transformer.

Example 2 Thyro-P 3P400-110 H
- the power controller is a 3-phase power controller of Thyro-P 3P 400-110H with 110A type current
- three similar current transformers with transformation ratio of tr = 100:1

The calculation and selection of the three similar load resistor has to be done according to example 1.
After selecting the resistors, which value must be between 0,818 Ω and 1 Ω, the the value has to be entered with Thyro-Tool Family or LBA-2 in parameter U_Load resistor.

4.12 VOLTAGE TRANSFORMER

As standard, each power section is fitted with a voltage transformer for recording the load voltage. It is possible to measure voltages of up to 690V. The voltage transformers are wired to the control device A70 by the works.

LOAD VOLTAGE	TERMINAL X7.2	TERMINAL X7.1
phase L1	.15	.16
phase L2	.25	.26
phase L3	.35	.36

TAB. 12 VOLTAGE TRANSFORMER

In case of the power controller Thyro-P 2P, the voltage transformers output the voltages L1-L2 and L3-L1. To achieve a good resolution of the voltage measurement, 3 measuring ranges are provided. Selection of the ranges is performed by means of 4-pin bars, which have been set to the Power Controller type voltage by the works. The pin bars are found on the control device A70 above the terminal X7.

MAINS VOLTAGE	JUMPERS X501, X502, X503	MAX. MEASURING
230V	1 - 2	253V
400V	2 - 3	440V
500V respectively 690V	3 - 4	760V

TAB. 13 VOLTAGE MEASUREMENT JUMPER

If the jumpers are changed, then a change of parameters is required.

Hardware parameters	
Type voltage	U_TYP
U rms max	UEMA
X501-3,1-2,2-3,3-4	TYP-BEREICH
Mains voltage	U_NETZ_ANW (Thyro-Tool Family)

Voltage readings of Thyro-P is equipped with 3 measurement ranges:
1. range: max. 15V (with internal transformer 230V)
2. range: max. 28V (with internal transformer 400V)
3. range: max. 45V (with internal transformer 500V / 690V)

The correct input voltage range (jumper) has to be selected when using an external voltage transformer.
The chosen input voltage range has to be set by Thyro-Tool Family or LBA-2 (Parameter: Voltage range).

13	ground 5V	10	set point 1
13	ground 5V	11	set point 2
13	ground 5V	32	analog output 1
13	ground 5V	33	analog output 2
13	ground 5V	34	analog output 3
13	ground 5V	16	ASM input
21	+3,3V	17	GSE input
14	ground 24V	12	RESET
14	ground 24V	15	controller lock
14	ground 24V	18	SYT9 connection
14	ground 24V	19	QUIT
20	+24V*	20	+24V*
* Loading: $I_{X5.1.20} + I_{X5.2.20} + I_{X21.9} \leq$ max. 80mA			

TAB. 15 TERMINAL STRIP X5 IN THE CONTROL DEVICE

Terminal strip X6 in the control device

At the terminal strip X6, wiring between the control device A70 and the control cards A1, A3 and A5 of the power section is performed by the works. Allocation of the terminal strip is as follows:

X6	Name
11	thyristor L1 neg.
12	+5V
13	thyristor L1 pos.
21	thyristor L2 neg.
22	+5V
23	thyristor L2 pos.
31	thyristor L3 neg.
32	+5V
33	thyristor L3 pos.
41	input temperature sensor
42	ground temperature sensor

TAB. 16 TERMINAL STRIP X6

Each thyristor is controlled by 20mA current supply switching to ground.
The ventilator monitor is connected to the terminals X6.41 and X6.42 in separately ventilated devices (..HF). The temperature of the power section is monitored using a PT 1000 temperature sensor. In case of overheating of the power section, for instance caused by outage of the ventilator, a fault indication is generated and the alarm relay is activated (default values). The temperature may be enquired by the interfaces.

4.14 SYNCHRONIZATION

By standard, each power section is fitted with a transformer for an input voltage of up to 690V.

4.15 COMPONENT MOUNTING DIAGRAM CONTROL DEVICE

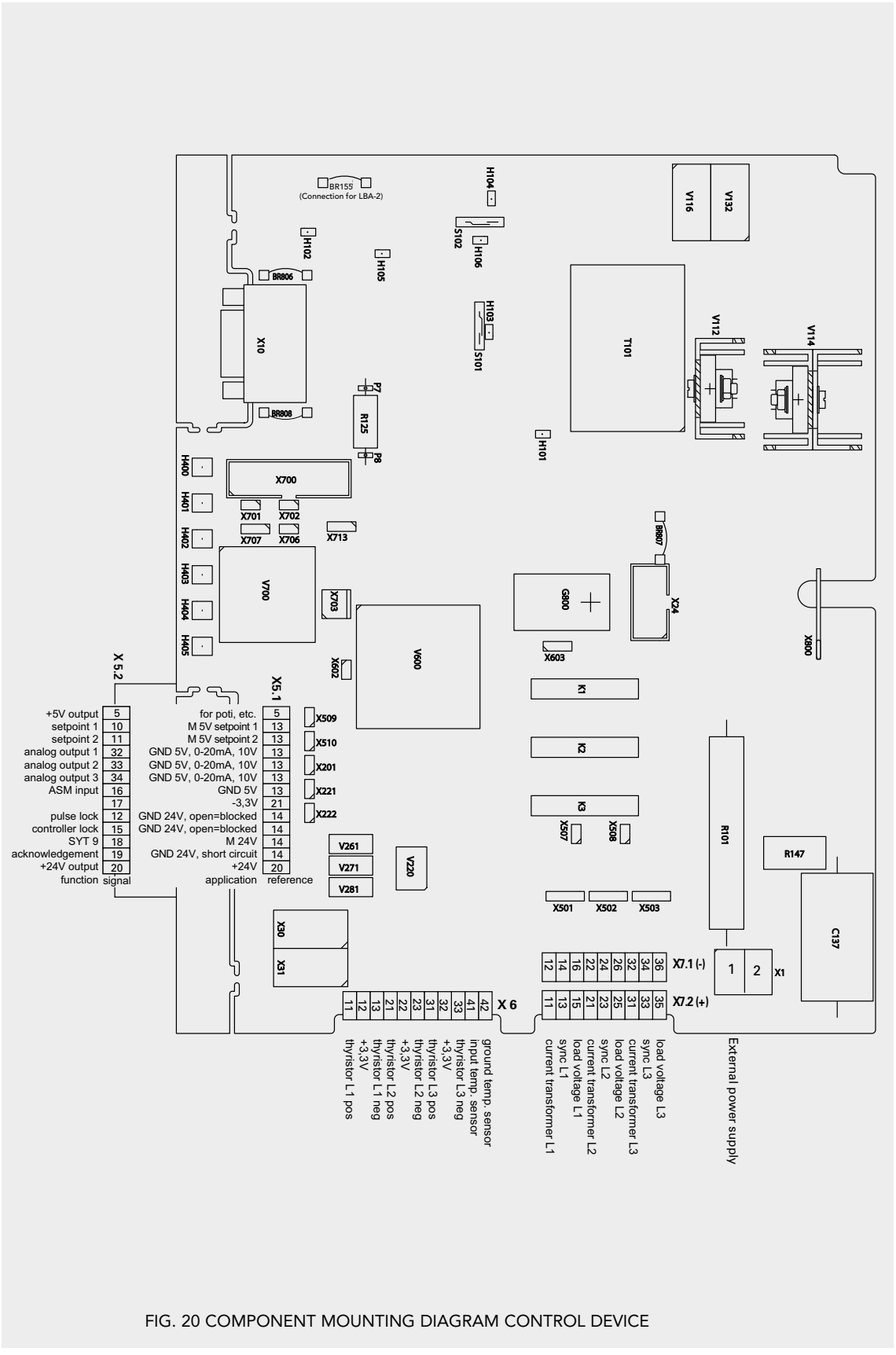


FIG. 20 COMPONENT MOUNTING DIAGRAM CONTROL DEVICE

With the power controller Thyro-P, the following interfaces may be used for this (see also fig. 11 on previous page):
• X10, RS232 (optional with Bluetooth adapter or LBA-2)
• X30, fibre optic receiver
• X31, fibre optic transmitter

as well as optional interfaces, for instance
• X20, bus interface, e.g. for Profibus DPV1, Profinet, DeviceNet, Ethernet IP, Modbus RTU or Modbus TCP
• X40 dASM input
• X41 dASM output

All internally processed data like current, voltage, power, set point value, limitations, etc. may be enquired, processed and modified during operation (online operation) in master-slave process. Under assistance of corresponding automation technology, it is possible to do without connection of process controls, potentiometers, instruments, LBA-2, etc.
The existing interfaces may operate simultaneously, so that for instance the following system configuration would be possible: a stored-program control via Profibus supplies the set points, a PC visualizes (fibre optic interface/Thyro-Tool Family) the data and on location the device status and selected operating values are displayed via LBA-2 (using the RS232).
Therefore, the power controller Thyro-P is transparent to all levels of production and the process may therefore be securely handled.

5.1 RS232 INTERFACE

The isolated RS232 interface is provided for direct connection of an LBA-2 (with cabinet installation kit also indirect via cable) or a PC. Setting of parameters of the interface is performed using Thyro-Tool Familiy or LBA-2. The default baud rate is set to 9600 baud, no parity, 8 data bits, 1 stop bit.

The following illustration shows connection of a Thyro-P to a PC using the RS232 interface (also possible via fiber optic or Profibus).

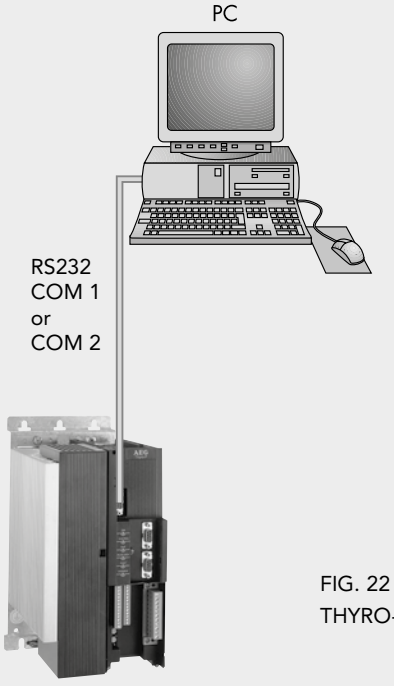


FIG. 22 CONNECTION OF A PC TO THYRO-P VIA RS232

For connecting the PC, an RS232 cable is required. On the Thyro-P side, a 9-pin sub-D plug and on the PC side a 9-pin sub-D socket must be available.

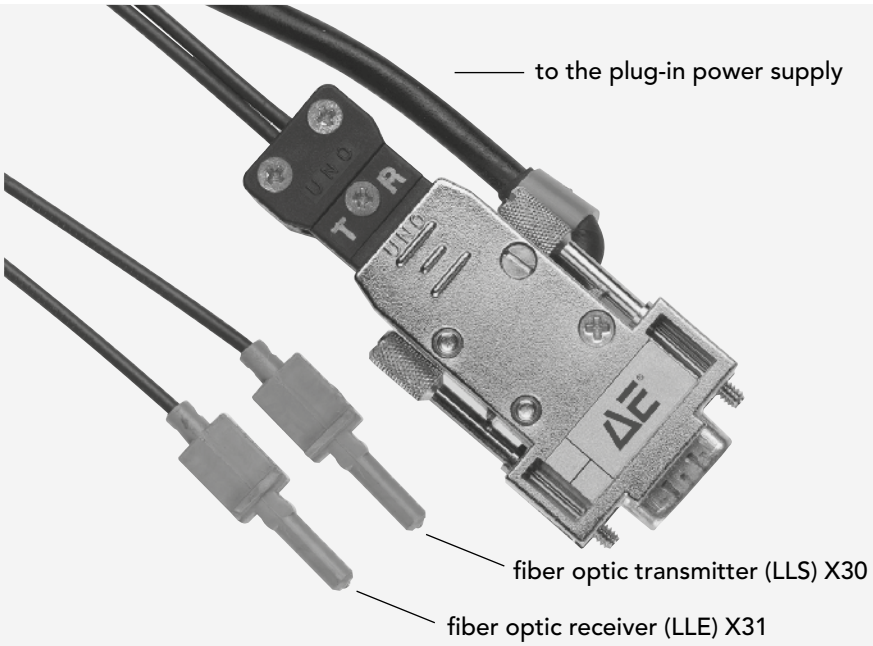


FIG. 24 SIGNAL CONVERTER RS232/FIBER OPTIC

LLV.V

The fiber optic distributor supply LLV.V is the basic component for the fiber optic system. It serves to connect star distributors and to amplify the light signals received. Its power supply is sufficient for supply of five fiber optic distribution components of the type LLV.4.

The amplification of LLV.V in the fiber optic data path is sufficient for increasing the distance for each LLV.V by about 50 m, so that overall longer transmission paths are possible then.

LLV.4

The fiber optic distributor LLV.4 is connected to the base component LLV.V. It is able to distribute the optical signal to respectively receive from four connections and therefore multiplies the signal from the computer to Thyro-P by four units each. The maximum distance from LLV.4 to Thyro-P should not exceed about 25 m.

In case of optimum installation conditions (number of bends, connection mounting, etc.), the distances stated in the following table may be realized:

DEVICE	PC	LLV.V	LLV.4	THYRO-P
PC	– –	50 m	– –	25 m
LLV.V	50 m	50 m	– –	25 m
LLV.4	– –	50 m	– –	25 m
Thyro-P	25 m	25 m	25 m	– –

TAB. 19 FIBER OPTIC DISTANCES

5.3 BUS INTERFACES (OPTIONAL)

The control device of Thyro-P may be optionally fitted with interface cards, e.g.
- Profibus DPV1
- Profinet
- DeviceNet
- Ethernet IP
- Modbus RTU
- Modbus TCP

All available interface cars support the usage of motor potentiometer feature for set point processing.

If the motor potentiometer feature is not used, signals can be transmitted on three inputs (Input 0, Input 1 and Input 2) of the bus interface via bus to the higher control system.
Further information are available in the corresponding operating manuals.

Further interface cards are available on request.

Installation of the dASM control cables
With regards to the dASM procedure there are a few simple rules which need to be adhered to when installing the control devices:

- For 1 and 3 phase loads separate dASM groups must be wired up.
- Power controllers and loads of a dASM group must be connected to the same grid in phase.
- The connection of of the RJ45 patch cables (Ethernet CAT 5 8-pole) is made on the underside of the control device in accordance with the following illustration to connectors X41 (output) and X40 (input):

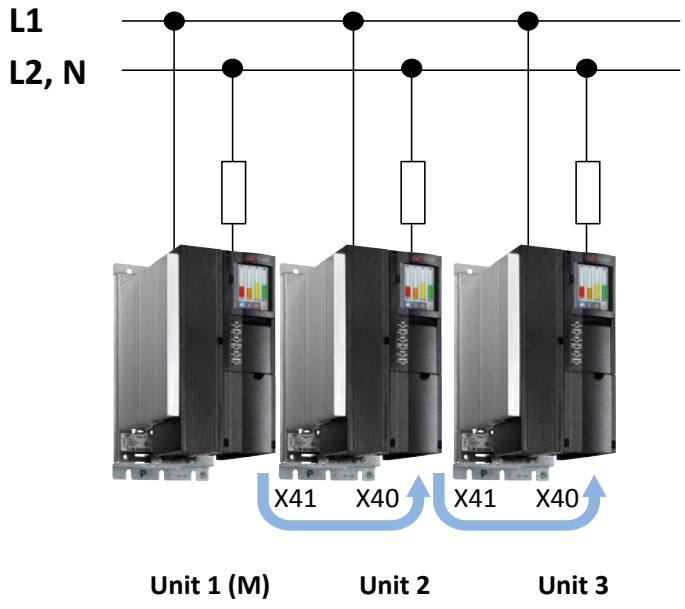


FIG. 26 WIRING OF THE dASM SIGNAL CABLES

The 4 LEDs on the RJ45 connectors serve to check the RJ45 wiring as well as that the dASM data transmissions via the dASM control cables are running smoothly.

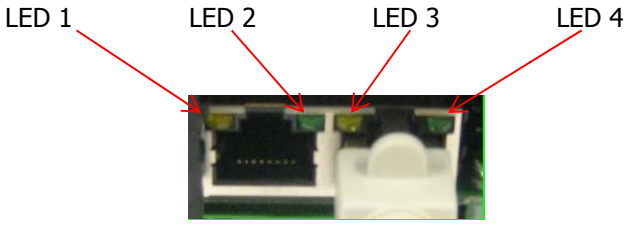
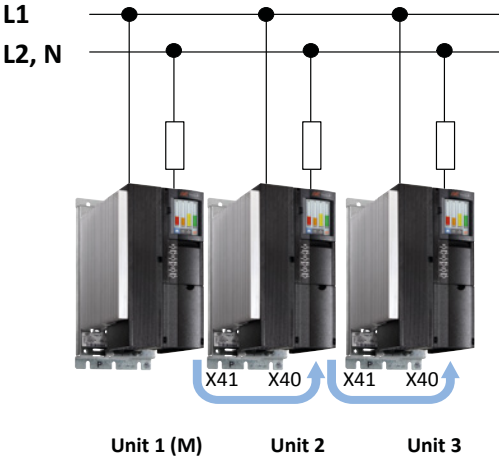


FIG. 27 LEDS ON THE RJ45 CONNECTORS

Installation of the power units for dASM operation
Amongst other things the following points are important for successful installation of dASM grid load optimization

- Power/grid connection of all power controllers to be executed in phase (see the diagrams of the following examples 1, 2, 3).
- dASM control cable connection (RJ45 patch cable) running from dASM master to the final Thyro-P unit (see the diagrams of the following examples 1, 2, 3)



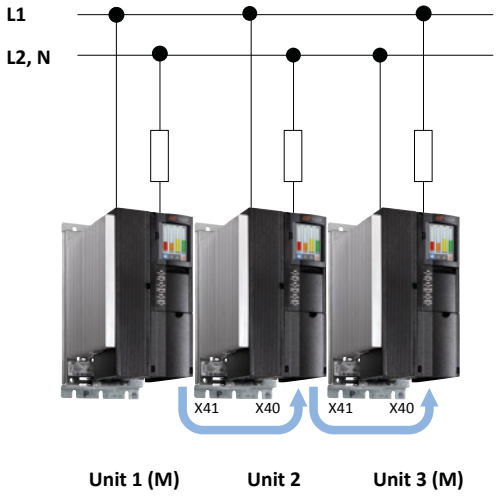
Installations examples

Example 1

This diagram shows 3 one phase Thyro-P power controllers with in phase grid connection, connected to 2 phases of a three-phase network or a single-phase network, along with dASM wiring. The dASM grid load optimization is operating on the example with all connected and switched on Thyro-P units 1-3.

dASM group of unit 1 (M): 3 x Thyro-P

The device labelled unit 1 is operating in this configuration as the dASM master of dASM group 1. In total the dASM group can consist of up to 32 Thyro-P devices. Additional dASM groups of up to 32 Thyro-P devices operating independently of one another group can be connected to the same grid so the number of Thyro-P devices which can be operated with dASM grid load optimization can, in principle, be as large as desired.
Alongside the dASM control cable connection (RJ45 patch cable), which is required for all units, the power/grid connection, in each case in phase, is a prerequisite for the formation of a dASM group.



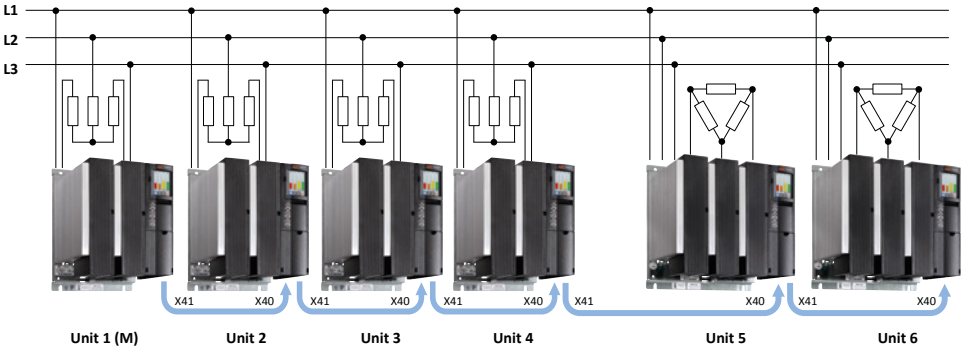
Example 1a

This diagram shows 3 single-phase Thyro-P power controllers with a grid connection which is not in phase, connected to 2 phases of an three-phase network, or a single-phase network, also with dASM wiring.
Due to the connection of unit 3 not being in phase with regards to the preceding unit 2, unit 3 autonomously forms a new master (however operates independently from units 1 and 2). This is why the grid load optimization in this example only operates with units 1 and 2, which means that, as a result of the connection not being in phase, the switching here, in comparison with the switching in example 1, does not lead to optimal grid load optimization.

dASM group from unit 1 (M): 2 x Thyro-P
dASM group from unit 3 (M): 1 x Thyro-P

Example 3
The following illustration shows a total of 6 power controllers with symmetrical load distribution in a three-phase network:
4 Thyro-P 2P power controllers
2 Thyro-P 3P power controllers

All ThyroP units in the following diagram are set up with an in phase grid connection.



The device labelled unit 1 operates in this configuration as a dASM master for all units, as units 5 and 6 are connected in phase with units 1 to 4.

dASM commissioning

To ensure optimal functionality of the dASM grid load optimization the following must be adhered to when commissioning:
- Check Thyro-P for in phase grid connection
- Check wiring of patch cable
- Select operating mode TAKT (with same TAKT cycle period) for all Thyro-P devices
- Parameterization of the master units:
  - o dASM NO. OF DEVICES
  - o dASM POWER THRESHOLD [W]
- Start up of the dASM group (=>switch-on)

dASM notification

The dASM grid load optimization generates the following notifications in the master unit should errors arise:
- dASM device number is incorrect:
  check patch cable connections/parameter dASM device number
- dASM power limit has been exceeded: reduce set points of the assembly as appropriate

The notifications generated can be reported via:
- data logger,
- LED,
- Relay,
- LBA-2 (in preparation) or
- Thyro-Tool Family

ERRORS IN dASM COMMUNICATION

Should the dASM communication become interrupted (for example, an interruption between unit 6 and unit 7) during operation of the assembly e.g. as the result of a cable break or similar, then a new master is automatically generated in the system beyond the point of interruption during operation – the dASM system continues to run and unit 1 now operates only as a master for units 1-6 and displays that only 6 units are present in the dASM network. Notification: “dASM device number is incorrect”.

6.4 ASM PROCEDURE (PATENTED)

In systems, in which several equal power controllers are operated in the operating mode TAKT, the ASM process may be sensibly used for dynamic and automatic mains load optimization in multiple Power Controller applications. This patented world premiere independently minimizes mains load peaks and therefore mains reaction shares during the current process. In case of the ASM process (automated synchronization of multiple controller applications), changes in set point and load (for instance due to temperature-dependent load) are included in mains load optimization online. Especially when using heating elements with a large aging effect, which during new operation have high current amplitudes with short startup time, lower investment cost may be achieved. For the ASM process the controller requires an ASM control device. An additional burden resistor is used for all controllers. Schematic wiring of power controllers for the ASM process can be seen in the following illustration:

When using the ASM option, the analog output 2 (X5.2.33 against ground X5.1.13) becomes an output proportionate to the current during the on-period T_s. All power controllers connected to synchronization work on the same external burden. The burden resistor is calculated approximately as

R_{burden} [kΩ] = 10V / (n x 20mA) n = number of power controller

The burden voltage is measured at the ASM input. The Power Controller searches within the clock control the place with the lowest mains load.

Due to this automated, independent procedure, the process chain is ensured through the temperature control circuit and the power controller without effects; negative effects like flicker and subharmonics of the mains frequency are balanced out during a current dynamic process. In this case, unfavorable short-term overlapping may occur, for instance after set point jumps or voltage swing. The application document ASM-procedure gives further information on this.

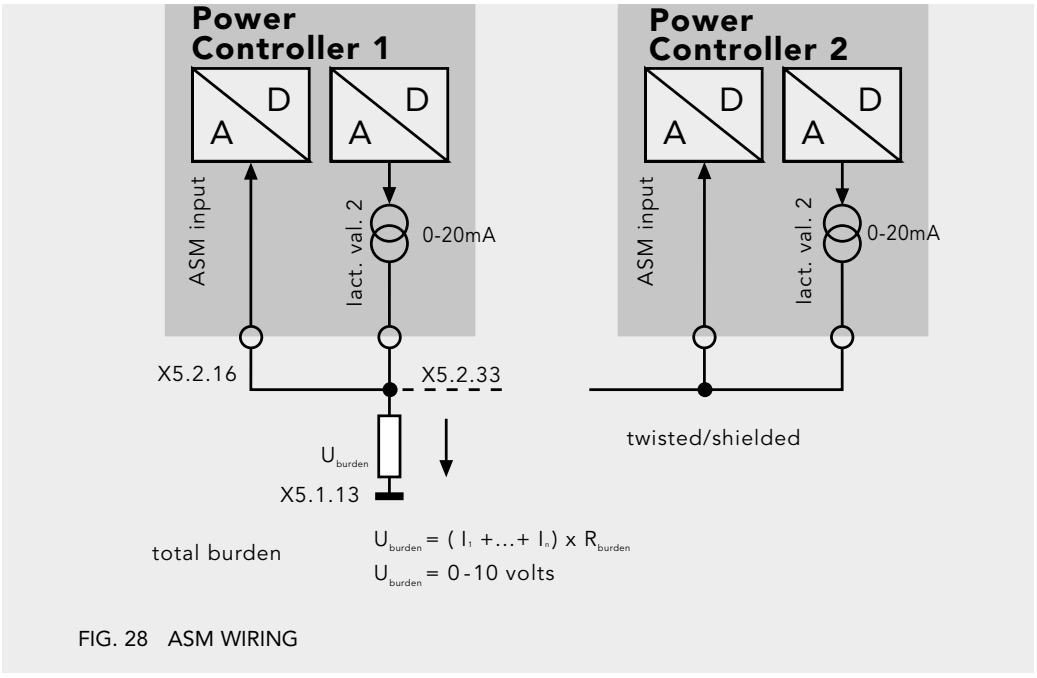


FIG. 28 ASM WIRING

OTHER FEATURES

If load monitoring is required with the VSC connection then external converters are needed on the secondary side.
The wiring required by the type series Thyro-P…VSC is different with regards to both the power and control connections when compared with standard power controllers from the type series Thyro-P.

OPERATING WITH LBA-2

To operate the VSC power controllers you need software for the LBA-2 version V1.2. or higher.
If you only have older versions then you can get a free update for the LBA-2 from our support team.

OPERATING WITH THE THYRO-TOOL FAMILY

The Thyro-Tool Family from version 4.06 can be used to operate the VSC power controllers.
If you have already purchased an older version of the Thyro-Tool Family software you can upgrade the software with a free update from our home page.

OPERATING MODES

The power controllers in the series Thyro-P 1P..VSC only have one operating mode: VSC_VAR

REGULATION MODES

All regulation modes of the Thyro-P are available as regulation modes: U, U^2, I, I^2, P.
In primary VSC regulation mode U and U^2 are less suited.

LOAD MONITORING

For the application of load monitoring external converters are needed for L1 on the secondary side (also see the Thyro-P VSC connecting diagrams in chapter 8 as well as chapters 4.10 and 4.11 of operating instructions). The parameters for this can be configured with the Thyro-Tool Family or LBA-2.

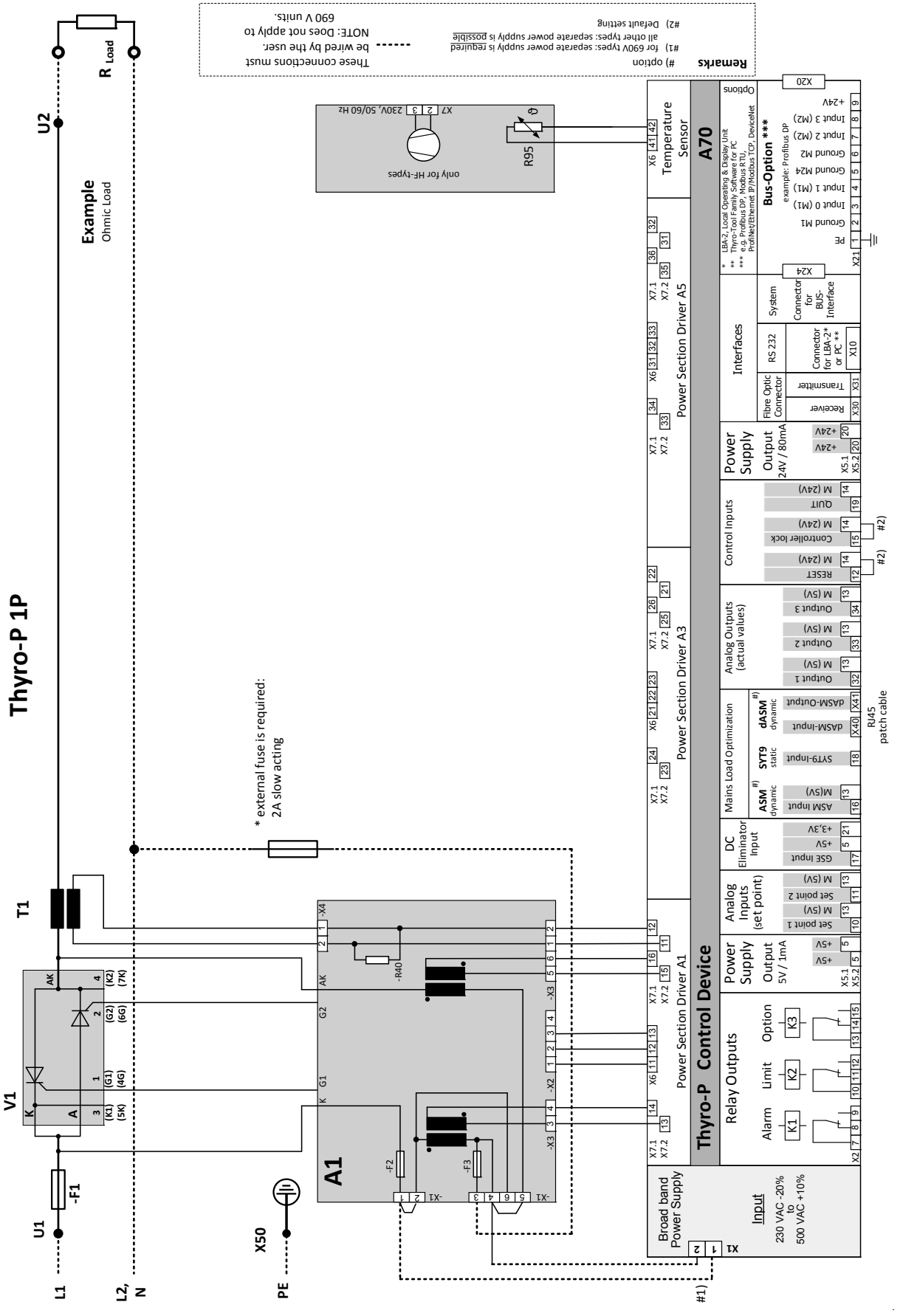
Parameterization:
- Operating mode
- Number of VSC stages
- External converters
- Overlapping*

* Using overlapping parameters

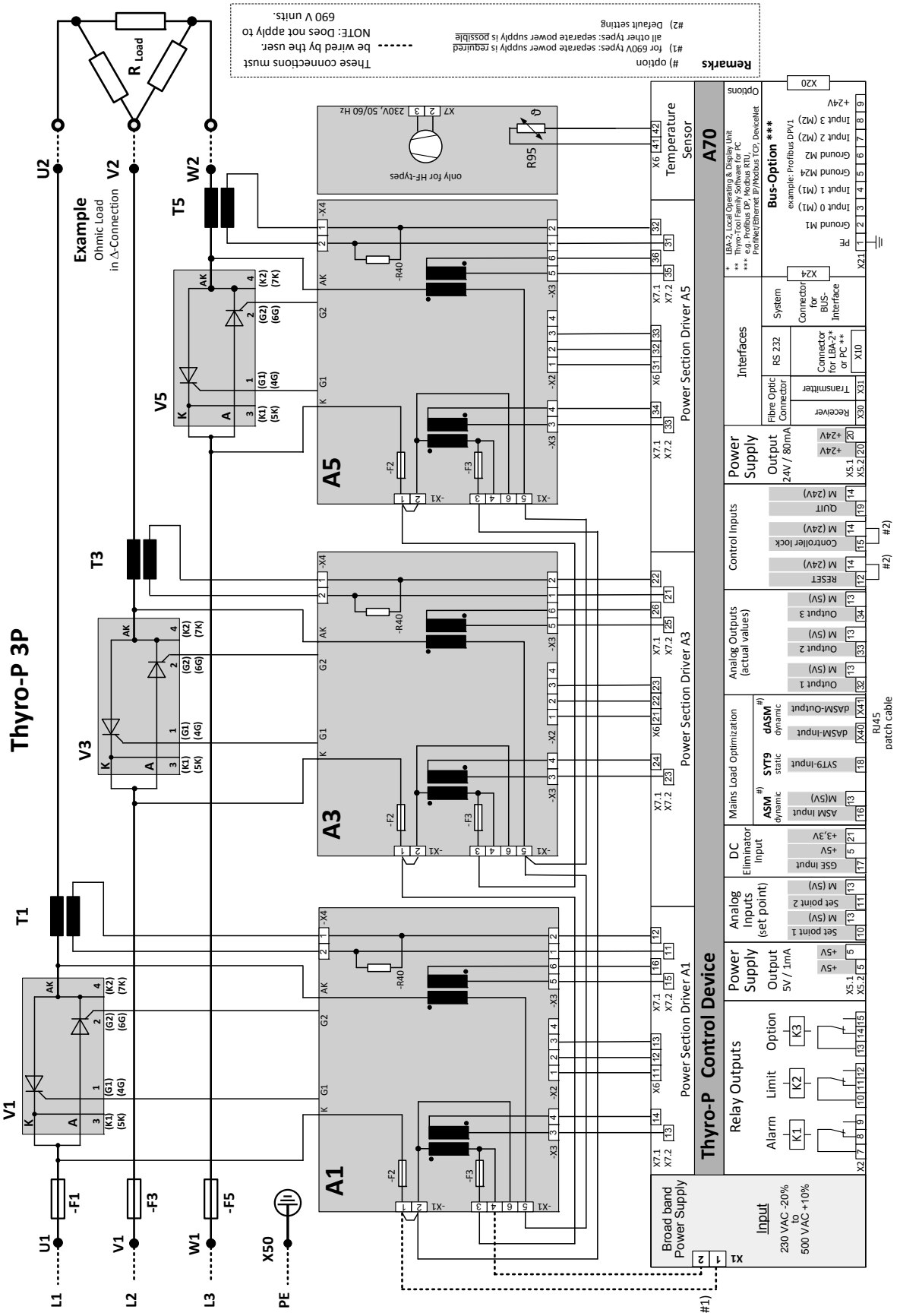
The overlapping process is for linearization of the control characteristic line and can be used on request. In this case the next higher step will already be activated before full conducting the small step. The change is only marginal regarding cos phi.

Within a half wave cycle up to 3 thyristor stages can be activated, however, in reality only one is ever switched on. As such, the advantages of a very good level of efficiency in terms of the thyristor controllers is retained in full.

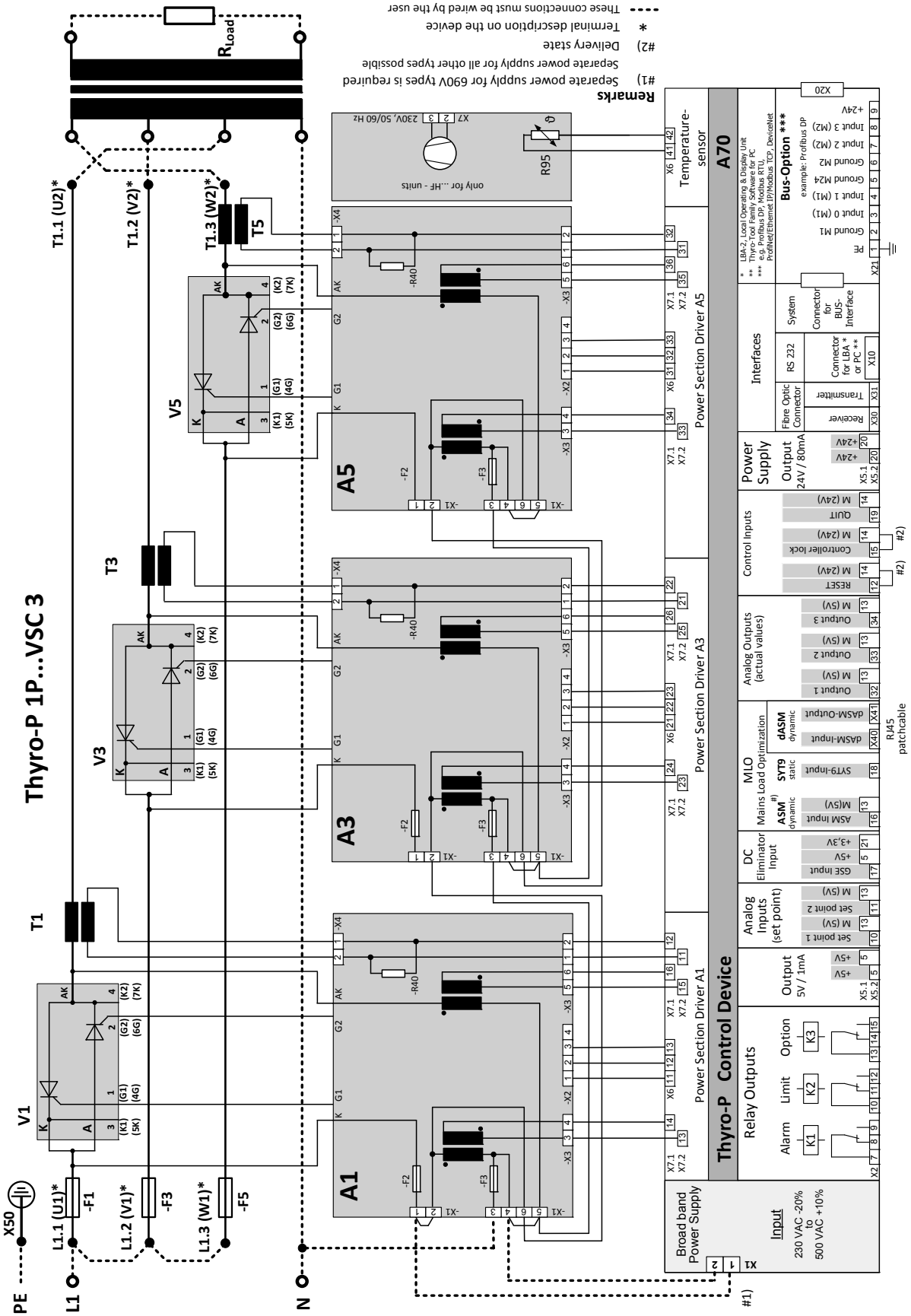
8.1 THYRO-P 1P 1-PHASE POWER CONTROLLER



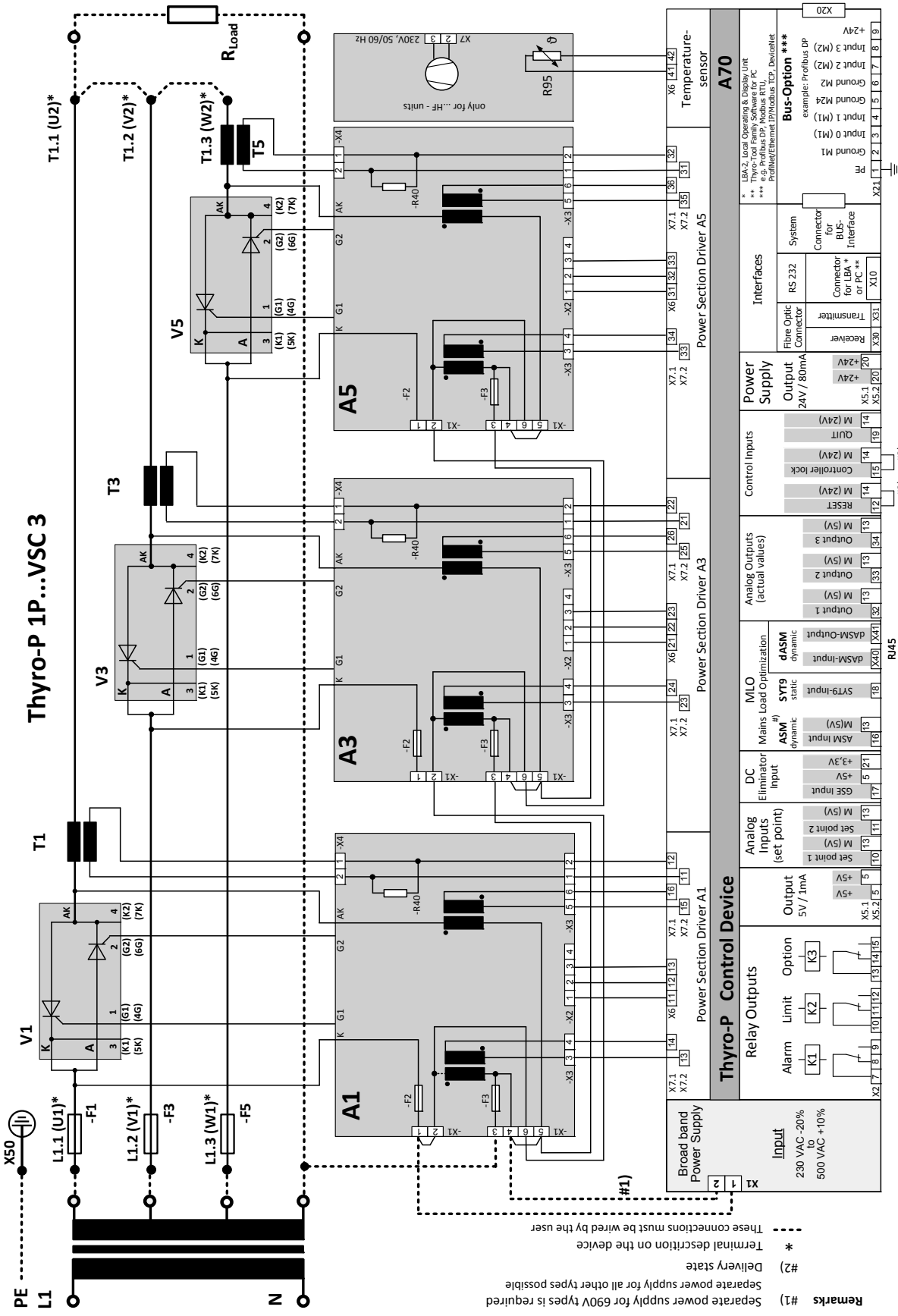
8.3 THYRO-P 3P 3-PHASE POWER CONTROLLER



8.5 THYRO-P VSC 3 3-STEP PRIMARY VSC



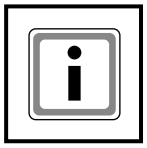
8.7 THYRO-P VSC 3 3-STEP SECONDARY VSC



Afterwards safe gaps (according to IP20) have to be cut into the covers.
Please be consider that an adequate IP20 protection has to be secured.
Then the according coverages have to be fixed again on the device.

9.3 COMMISSIONING

The device must be connected to the mains and the associated load according to the wiring diagrams.



REMARK

If the units Thyro-P 1P (or Thyro-P 3P in „open delta“) and/or Thyro-P 2P are operated at over 600 V and without load at the output side, voltages can occur above input voltage at the connection points U2,V2 and W2. In this case, additional 690V snubber boards are to be used (see chapter 13 ACCESSORIES AND OPTIONS).
Depending on connection system of the load (star, delta, etc.), it must be ensured that the load voltage transformers in the power sections are wired correctly (terminal strip X1 of the power section). The correct terminals may be found in the connecting diagrams.

On delivery, the device is parameterized adjusted to the respective power section. The operating mode TAKT (Thyro-P 1P / Thyro-P 2P) is set. If a different operating mode is desired, then the user must set this using the LBA-2, PC, etc. Generally, the standard parameters (see menu list) should be reviewed and adjusted to the respective conditions for use by the user (for instance operating mode, control mode, limitations, monitoring, times, characteristics, actual value outputs, fault indications, relays, time and date, etc.).

Besides the load, some control signals must be connected as well (refer to chapter 4). The following signals are always required for operation of the device:

Set point	(terminal 10 or 11/or via interfaces)
RESET	(on ground, on terminal 12, jumper set as standard)
Regular inhibit	(on ground, on terminal 15, jumper set as standard)

If the RESET is not connected, then the device is in reset state and is not operating (LED „ON“ shows red light), i.e. no communications is possible via interface. Further details of the RESET are described in chapter 4.4. If the regulator inhibit is not connected, then the device is fully operable, but the power section is only controlled using the values of the minimal limitations (LED „PULSE LOCK“ is on). Further details on the regulator inhibit may be found in the chapter 4.5 of the same name.

ATTENTION

The controller lock may also be set via the interfaces!

ATTENTION

The control device is to be operated only with casing.

9.4 SERVICE

The devices delivered have been tested according to the state of the art and have been produced to a high quality standard (DIN EN ISO 9001). In the event of any faults or problems despite such controls, please contact our technical support team (see page 12 CONTACT).

9.5 CHECKLIST

No frontside LED is on:

- for 690V devices, the power supply for the control device A70 to be provided by the customer is missing. (Attention, maximum nominal input voltage 500V)

10. TYPE OVERVIEW

10.1 TYPE RANGE 400 VOLT

TYPE VOLTAGE 230-400 VOLTS

TYPE CURRENT (A)	TYPE POWER (KVA)		DISSIPATION (W)	DIMENSIONS (MM) W	H	D	WEIGHT (NET ABOUT KG)	DIM. DRAW. (NO.)	TEMP. CHARACTERISTIC (NO.)	CURRENT TRANSF. T1	BURDEN RESISTOR R40 (Ω)	SEMICONDUCTOR FUSE* F1 (A)	508
THYRO-P 1P													
5 H		2	58	150	320	229	6	260	1	400/1	82.5	50	
16 H	3.6	6	71	150	320	229	6	260	1	400/1	27.4	50	
25 H		10	83	150	320	229	6	260	1	400/1	15.4	50	
37 H	8	15	105	150	320	229	6	260	1	100/1	2.70	50	
75 H	17	30	130	150	320	229	6	260	1	100/1	1.30	100	
110 H	25	44	175	150	320	229	6	260	2	100/1	0.91	180	
130 H	30	52	190	200	320	229	8	263	2	150/1	1.10	200	
170 H	39	68	220	200	320	229	8	266	2	200/1	1.10	315	
280 HF	64	112	365	200	370	229	9	265	2	300/1	1.00	350	
495 HF	114	198	595	175	502	340	15	266	3	500/1	1.00	630	
650 HF	149	260	750	175	502	340	15	266	3	700/1	1.00	900	
1000 HF	230	400	1450	242	762	505	35	268	4	1000/1	1.00	2x1000	
1500 HF	345	600	1775	242	762	505	35	285	5	1500/1	1.00	4x900	
2100 HF	483	840	2600	521	577	445	50	270	6	2000/1	0.91	4x1000	
2900 HF	667	1160	3400	603	577	470	62	271	7	3000/1	1.00	4x1500	
THYRO-P 2P													
16 H	6	11	107	225	320	229	10	272	1	400/1	27.4	50	
37 H	15	25	175	225	320	229	10	272	1	100/1	2.70	50	
75 H	30	52	220	225	320	229	10	272	1	100/1	1.30	100	
110 H	44	76	310	225	320	229	10	272	2	100/1	0.91	180	
130 H	52	90	350	325	320	229	12	275	2	150/1	1.10	200	
170 H	68	118	410	325	320	229	12	275	2	200/1	1.10	315	
280 HF	111	194	700	325	404	229	15	277	2	300/1	1.00	350	
495 HF	197	343	1150	261	502	340	22	278	3	500/1	1.00	630	
650 HF	259	450	1465	261	502	340	22	278	3	700/1	1.00	900	
1000 HF	398	693	2865	410	762	505	54	280	4	1000/1	1.00	2x1000	
1500 HF	597	1039	3510	410	762	505	54	280	5	1500/1	1.00	4x900	
2000 HF		1385	4800	526	837	445	84	282	6	2000/1	1.00	4x1000	
2100 HF	796		4800	526	837	445	84	282	6	2000/1	1.00	4x1000	
2750 HF		1905	6200	603	837	470	107	283	7	3000/1	1.00	4x1500	
2900 HF	1905		6200	603	837	470	107	283	7	3000/1	1.00	4x1500	
THYRO-P 3P													
16 H	6	11	228	300	320	229	14	284	1	400/1	27.4	50	
37 H	15	25	330	300	320	229	14	284	1	100/1	2.70	50	
75 H	30	52	400	300	320	229	14	284	1	100/1	1.30	100	
110 H	44	76	540	300	320	229	14	284	2	100/1	0.91	180	
130 H	52	90	560	450	320	229	17	287	2	150/1	1.10	200	
170 H	68	118	650	450	320	229	17	287	2	200/1	1.10	315	
280 HF	111	194	1070	450	404	229	20	289	2	300/1	1.00	350	
495 HF	197	343	1800	348	527	340	30	290	3	500/1	1.00	630	
650 HF	259	450	2265	348	527	340	30	290	3	700/1	1.00	900	
1000 HF	398	693	4370	575	762	505	74	292	4	1000/1	1.00	2x1000	
1500 HF	597	1039	5335	575	762	505	74		5	1500/1	1.00	4x900	
1850 HF	736	1281	6900	526	1094	445	119	294	6	2000/1	1.00	4x1000	
2600 HF	1035	1801	8700	603	1094	470	152	295	7	3000/1	1.10	4x1500	

* number of fuses per path of power section, built in

TYPE VOLTAGE 500 VOLTS

TYPE CURRENT (A)	TYPE POWER (KVA)	DISSIPATION (W)	DIMENSIONS (MM) W	H	D	WEIGHT (NET ABOUT KG)	DIM. DRAW. (NO.)	TEMP. CHARACTERISTIC (NO.)	CURRENT TRANSF. T1	BURDEN RESISTOR R40 (Ω)	SEMICONDUCTOR FUSE* F1 (A)	
THYRO-P 1P...VSC2												
16 H	8	70	225	320	229	10	272	1	100/1	2.70	40	
37 H	18	105	225	320	229	10		1	100/1	2.70	50	
75 H	38	130	225	320	229	10		1	100/1	1.30	100	
110 H	55	175	225	320	229	10		2	100/1	0.91	180	c UL us
130 H	65	190	325	320	229	12	275	2	150/1	1.10	200	
170 H	85	220	325	320	229	12		2	200/1	1.10	315	
280 HF	140	365	325	404	229	15	277	2	300/1	1.00	350	
495 HF	248	595	261	502	340	22	278	3	500/1	1.00	630	
650 HF	325	750	261	502	340	22		3	700/1	1.00	900	c UL us
1000 HF	500	1450	410	762	505	54	280	4	1000/1	1.00	2 x 1000	
1500 HF	750	1775	410	762	505	54		5	1500/1	1.00	4 x 900	
2000 HF	1050	2600	526	837	445	84	282	6	2000/1	0.91	4 x 1000	
2750 HF	1450	3400	603	837	470	107	283	7	3000/1	1.00	4 x 1500	
THYRO-P 1P...VSC3												
16 H	8	70	300	320	229	14	284	1	100/1	2.7	40	
37 H	18	105	300	320	229	14		1	100/1	2.7	50	
75 H	38	130	300	320	229	14		1	100/1	1.3	100	
110 H	55	175	300	320	229	14		2	100/1	0.91	180	c UL us
130 H	65	190	450	320	229	17	287	2	150/1	1.1	200	
170 H	85	220	450	320	229	17		2	200/1	1.1	315	
280 HF	140	365	450	404	229	20	289	2	300/1	1	350	
495 HF	248	595	348	527	340	30	290	3	500/1	1	630	
650 HF	325	750	348	527	340	30		3	700/1	1	900	c UL us
1000 HF	500	1450	575	762	505	74	292	4	1000/1	1	2 x 1000	
1500 HF	750	1775	575	762	505	74		5	1500/1	1	4 x 900	
1850 HF	1050	2600	549	1094	445	119	294	6	2000/1	0.91	4 x 1000	
2600 HF	1450	3400	603	1094	470	152	295	7	3000/1	1	4 x 1500	

* number of fuses per path of power section, built in

11. TECHNICAL DATA

TYPE VOLTAGE	...P400...	230 volts -20%	to	400 volts +10%
	...P500...	230 volts -20%	to	500 volts +10%
	...P690...	500 volts -20%	to	690 volts +10%

MAINS FREQUENCY	all models	45Hz	to	65Hz

LOAD DESCRIPTION	ohmic load (minimum 100W) ohmic load R_{hot}/R_{cold} ratio up to 20 (MOSI operation) transformer load
TRANSFORMER	The induction of the load side transformer should not exceed 1.45T in case of mains overvoltage when using grain-oriented, cold-rolled plates. This corresponds to a nominal induction of approx. 1.3T.
OPERATING MODES	TAKT = full oscillation clock = default setting for the models 1P, 2P and 3P VAR = phase-angle firing = only for the models 1P and 3P SSSD = soft-start-soft-down; a combination of „VAR“ and „TAKT“, for the models 1P, 2P and 3P, i.e. reduced mains surge load VSC_VAR = phase-angle firing in voltage sequence control
SET POINT INPUTS	The power controller Thyro-P has 4 set point inputs. The set point inputs are indirectly connected to the mains (SELV, PELV). Set points 1, 2: external set point input signal ranges: 0(4) - 20 mA Ri = ca. 250 Ω / max. 24mA* 0 - 5 V Ri = ca. 8,8 kΩ / max. 12V 0 - 10 V Ri = ca. 5 kΩ / max. 12V * refer to “ATTENTION” in chapter 2.2 Set point 3: connection for fiber optic (LL) from the super-ordinate PC or automation system Set point 4: set point assignment via RS232 (for instance LBA-2)
ANALOG OUTPUTS	3 outputs: signal level 0-10 V, 0-20mA or 4-20mA. The maximum burden voltage is 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 at will. Every controller (for instance temperature controller), whose output signal is in the range of 0-20mA/0-5V/0-10V may be easily adapted to the power controller.

CONTROL TYPES	Voltage control U_{rms} Voltage control U^2_{rms} = default setting Current control I_{rms} Current control I^2_{rms}

TABLE TERMINAL SCREWS	THYRO-P 1P, 2P, 3P	CONNECTOR	EARTHING SCREW
			U1, V1, W1, U2, V2, W2
	37H, 75H	M 6	M 6
	80H	M 8	M 10
	110H	M 6	M 6
	130H, 170H	M 8	M 10
	200HF, 280HF, 300HF 495HF, 500HF, 650HF	M 10	M 10
	780HF, 1000HF, 1400HF, 1500HF, 1700HF, 1850HF, 2000HF, 2100HF, 2200HF, 2400HF, 2600HF, 2750HF, 2900HF	M 12	M 12

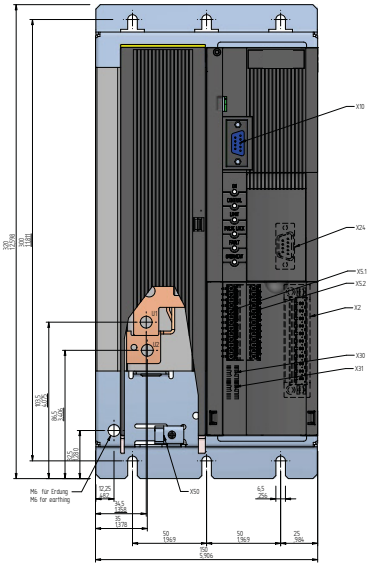
WITH UL APPLICATIONS	POWER CONNECTION	USE ONLY 60°/75°C COPPER CONDUCTORS (UL SPECIFICATION)		
STUD TORQUE FOR	SCREW	MIN	RATED	MAX
TABLE TERMINAL SCREWS	M 2	0.2	0.25	0.3
[Nm]	M 6	3.0	4.4	5.9
	M 8	11.5	17.0	22.5
	M 10	22.0	33.0	44
	M 12	38.0	56.0	75
[Pound inches]	SCREW	MIN	RATED	MAX
	M 2	1.9	2.2	2.5
	M 6	26.1	38.9	52.2
	M 8	101.8	150.5	199.1
	M 10	194.7	292.1	389.4
	M 12	336.3	495.6	663.8

FAN 230 V 50-60 HZ	THYRO-P (HF-TYPES)	TYPE CURRENT 50HZ I [A]	60HZ I [A]	AIR VOLUME [m^3/h]	SOUND PRESS. IN 1 m DIST. [ca. dbA]
	1P				
	200HF, 280HF	0.22	0.22	120	53
	300HF, 495HF, 500HF, 650HF	0.50	0.38	150	67
	780HF, 1000HF, 1400HF, 1500HF	0.55	0.60	580	75
	2000HF, 2100HF, 2600HF, 2900HF	1.00	1.20	2200	81
	2P / 1P...VSC 2				
	200HF, 280HF	0.50	0.38	200	67
	300HF, 495HF, 500HF, 650HF	0.50	0.38	230	67
	780HF, 1000HF, 1400HF, 1500HF	1.00	1.20	1200	81
	1850HF, 2000HF, 2400HF, 2750HF	1.00	1.20	2100	81
	3P / 1P...VSC 3				
	200HF, 280HF	0.50	0.38	260	67
	300HF, 495HF, 500HF, 650HF	0.29	0.35	450	72
	780HF, 1000HF, 1400HF, 1500HF	1.00	1.20	1600	81
	1700HF, 1850HF, 2200HF, 2600HF	1.00	1.20	2000	81

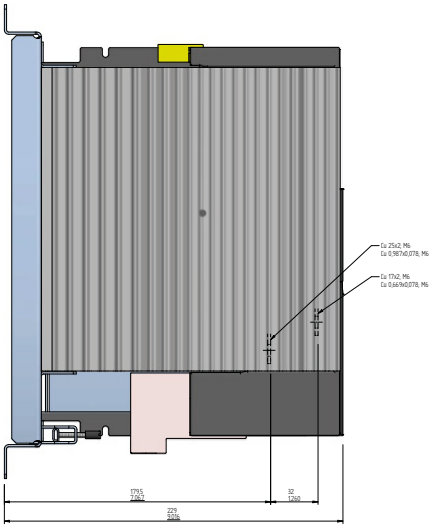
Fans (for HF types) must be running when Thyro-P is operating. Connection according to connecting diagrams in chapter 8.
When operating conditions are below +10°C, a longer start-up time of the fan has to be considered. Therefore the adjustable range should amount at least double of the specified continuous current.

12. DIMENSIONAL DRAWINGS

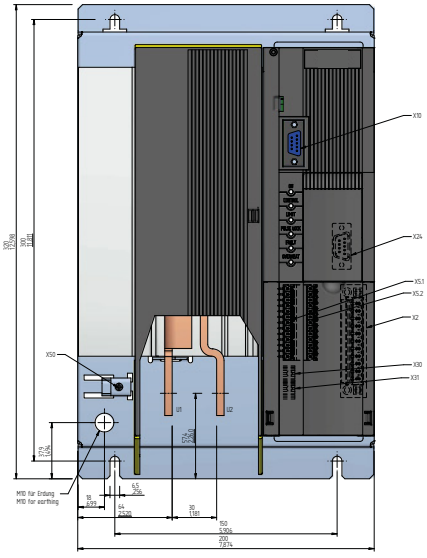
Vorderansicht / front view



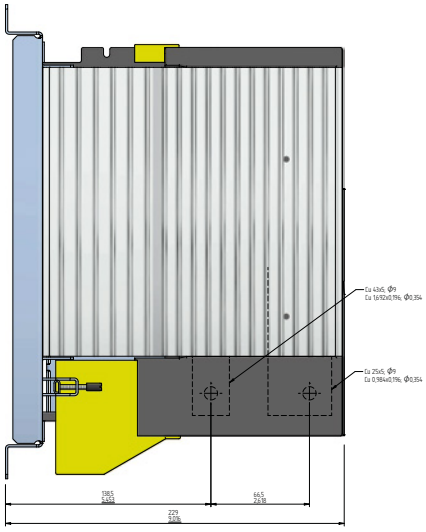
Seitenansicht / siede view



Vorderansicht / front view

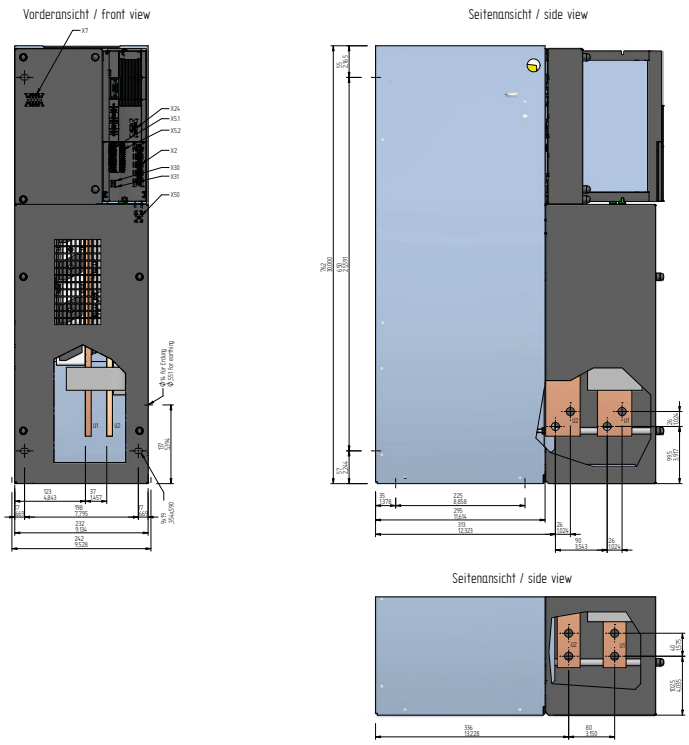


Seitenansicht / side view

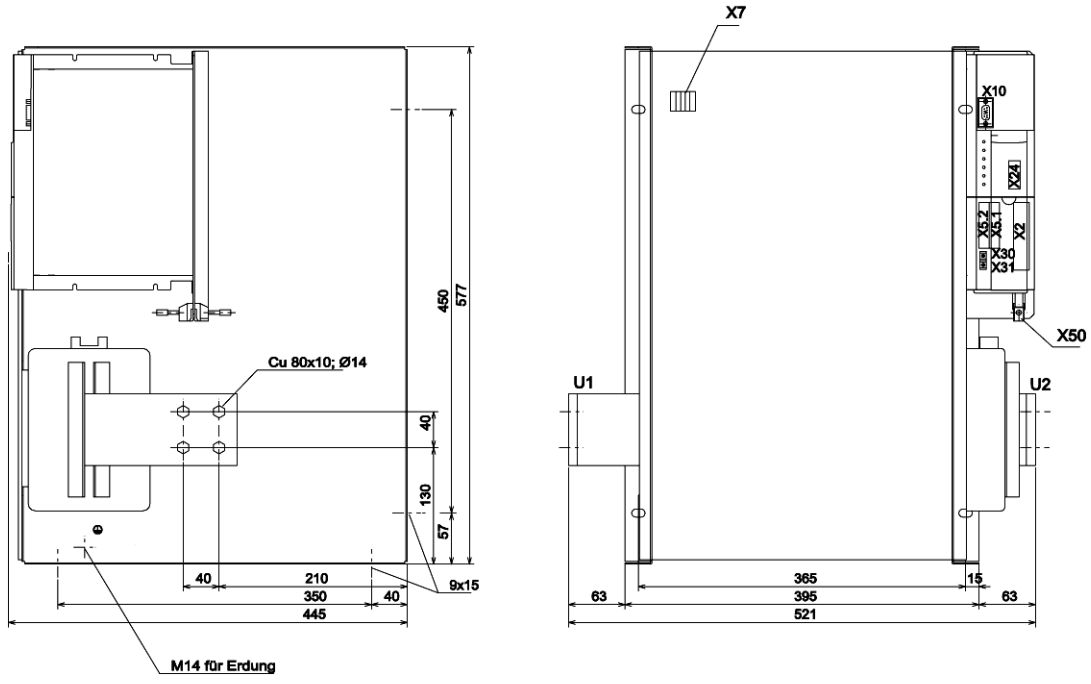


Thyro-P 1P (80 H, 130 H, 170 H)

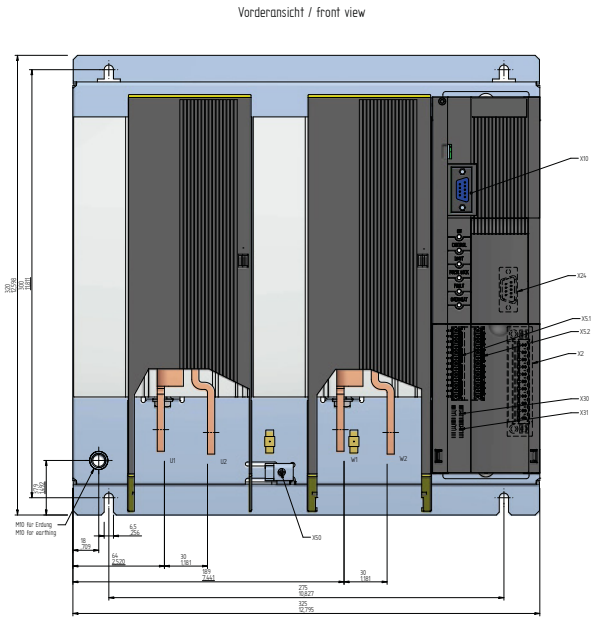
Dimensional Drawing 263

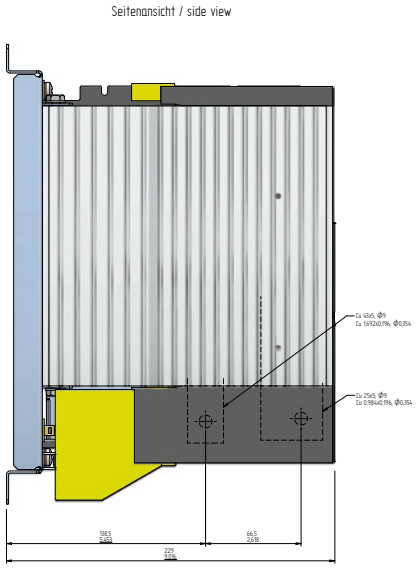


Thyro-P 1P (780 HF, 1000 HF, 1400 HF, 1500 HF) Dimensional Drawing 268



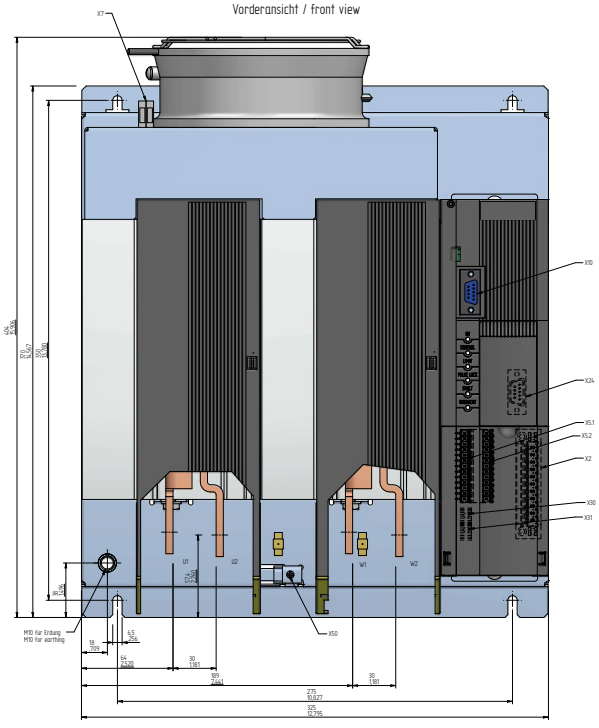
Thyro-P 1P (2000 HF, 2100 HF) Dimensional Drawing 270

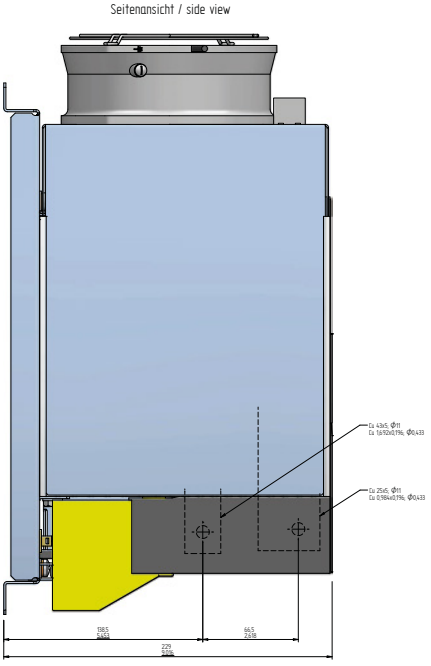




Thyro-P 2P (80 H, 130 H, 170 H)

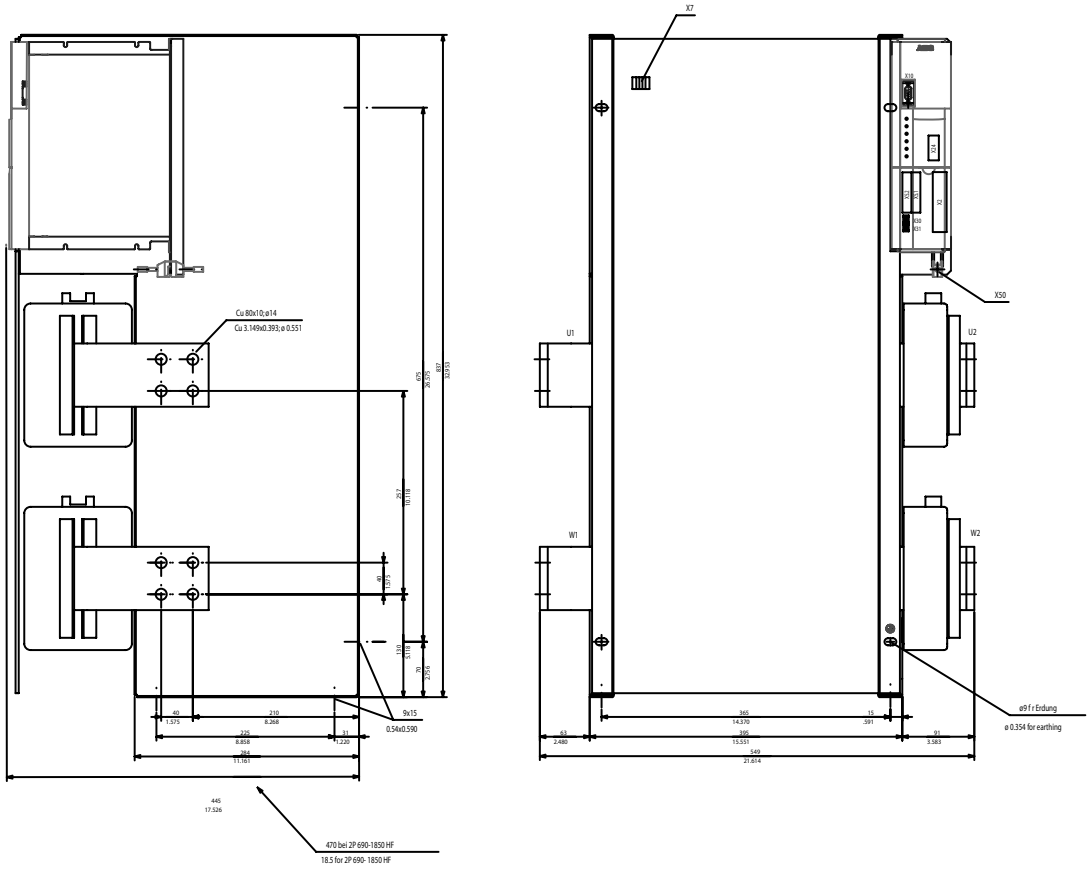
Dimensional Drawing 275





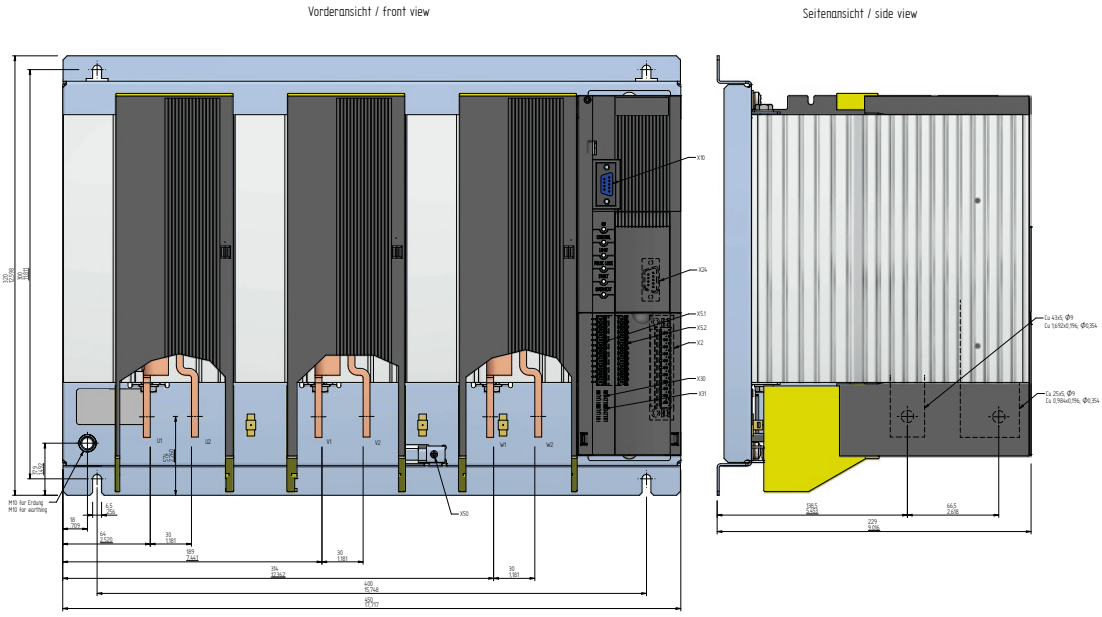
Thyro-P 2P (200 HF, 280 HF)

Dimensional Drawing 277

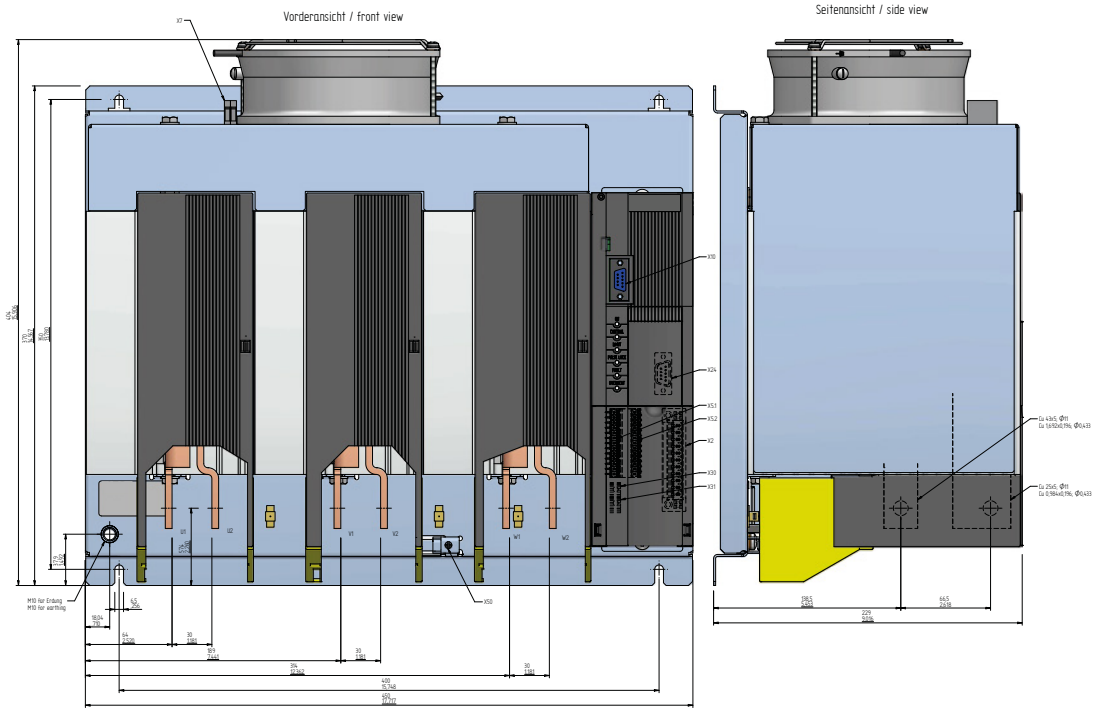


Thyro-P 2P (1850 HF, 2000 HF)

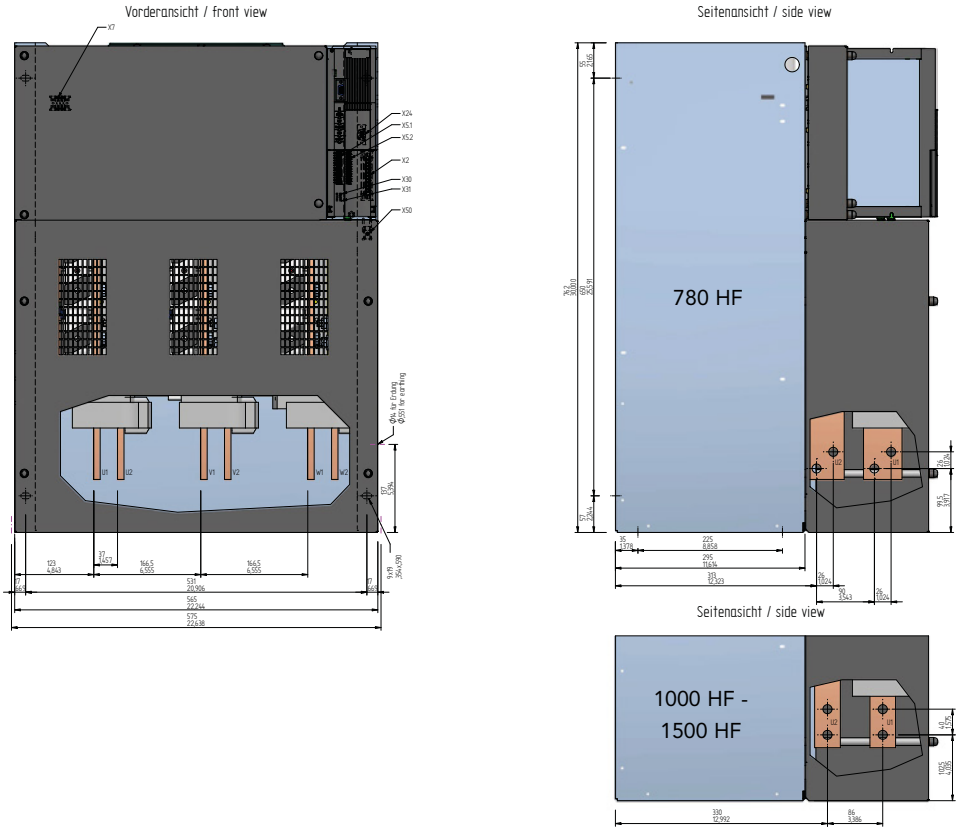
Dimensional Drawing 282



Thyro-P 3P (80 H, 130 H, 170 H) Dimensional Drawing 287

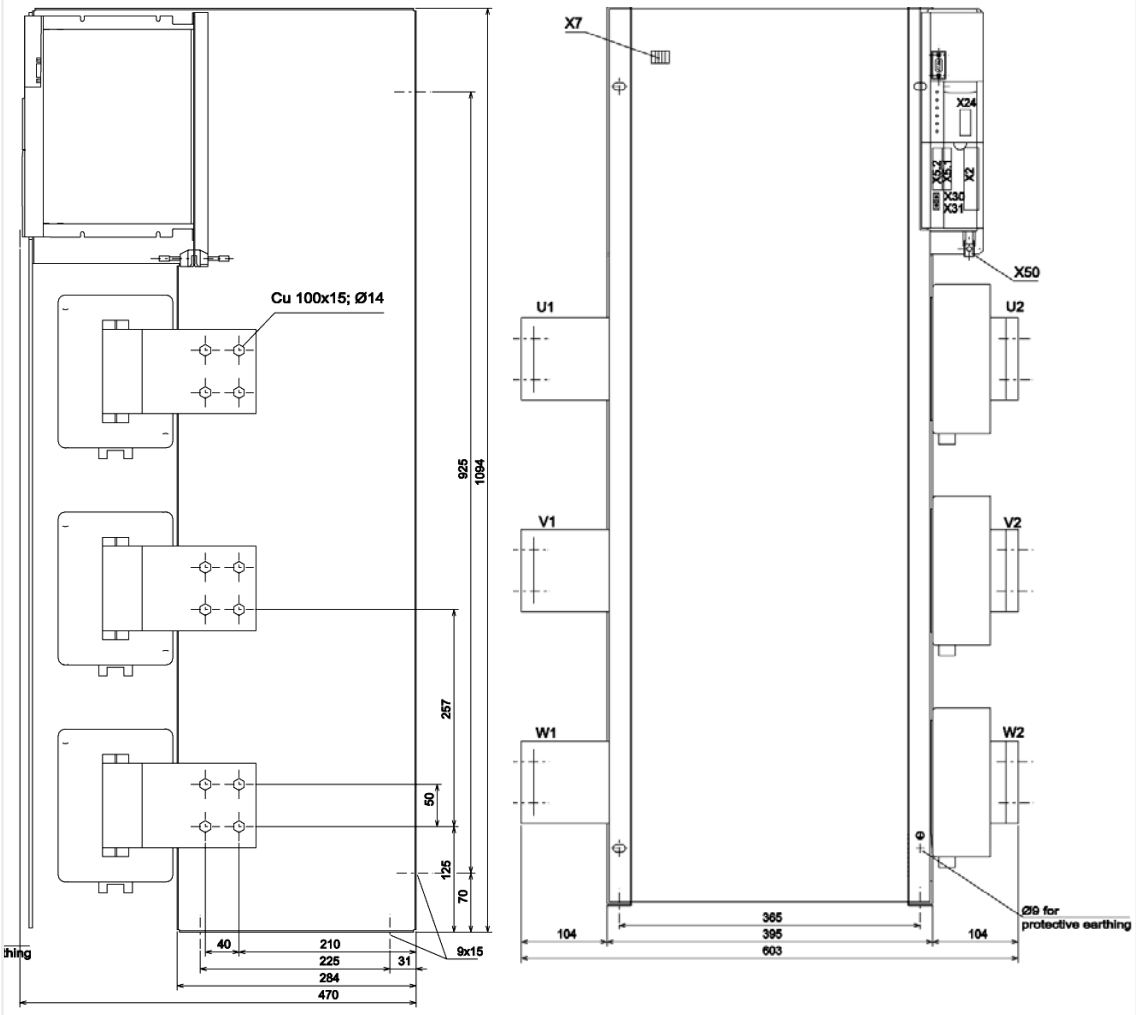


Thyro-P 3P (200 HF, 280 HF) Dimensional Drawing 289



Thyro-P 3P (780 HF, 1000 HF, 1400 HF, 1500 HF)

Dimensional Drawing 292



Thyro-P 3P (2200 HF, 2600 HF) Dimensional Drawing 295

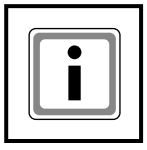
14. APPROVALS AND CONFORMITIES

Due to European harmonization and international reconciliation, the standards will be subject to years of adjustment and renumbering. The detailed schedule therefore contains the current standards as well, even if the date for their expiry has already been set. There is no product norm for Thyristor Power Controllers, so that a sensible norm structure must be created from the corresponding basic norms, which ensures safe application and opportunity for comparison.

CAUTION

Thyristor Power Controllers are non-valid devices for disconnection and may therefore be operated only in connection with a suitable mains isolating device (for instance switch) connected on line side.
Approvals and conformities are available for Thyro-P:

- Quality standard according to ISO 9001
- Registration in acc. to UL 508, file no. E 135074
  Investigated under consideration to Canadian National Standard C22.2 No. 14-95
- UL Markings:
  · Field wiring terminal markings (see chapter 4 EXTERNAL CONNECTIONS)
  · Use 60/75°C Copper Conductors only
  · Tightening torque (pound inches) see chapter 11 TECHNICAL DATA
  · Devices are suitable for the following short circuit current ratings:
  Devices rated 300A
  „Suitable For Use On A Circuit Capable Of Delivering Not More Than 100kA rms Symmetrical Amperes, xxx Volts Maximum, When Protected by RK5 Class Fuses, sized max. 600A / 600V“
  Devices rated 495A and 695A:
  „Suitable For Use On A Circuit Capable Of Delivering Not More Than 100kA rms Symmetrical Amperes, xxx Volts Maximum“



NOTE:

xxx = max. allowable voltage depending upon rating of the device

- „Branch circuit protection must be provided and sized according National Electrical Code and any additional local codes“

- CE conformity
  Low Voltage Directive 73/23 EEC;
  EMV Directive 89/336 EEC;
  Marking Directive 93/68 EEC
- Interference suppression
  The RegTP confirms the compliance with the interference suppression regulations for the power control device

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Power Conditioning ***category:***

Click to view products by Advanced Energy ***manufacturer:***

Other Similar products are found below :

63236258 STFE100-24L A2D130HW STFE050-24L STFE030-24L Thyro-S 1S 400-100 H3 Thyro-AX 3A 600-100 HF RLP2 2000000405 CSB-02 Thyro-PX 2PX 500-280 HF 2000190002 Thyro-A 2A 500-30 HRL3 Thyro-S 1S 230-100 HRLP3 Thyro-A 1A 230-170 HRL3 Thyro-A 1A 230-100 HRL3 Thyro-S 1S 500-60 HRLP3 Thyro-S 1S 230-60 HRLP3 Thyro-S 1S 500-30 HRLP3 Thyro-A 1A 230-45 HRLP3 C09 Thyro-A 2A 400-60 H3 Thyro-A 2A 400-30 H3 3C33991FT0CG DBUF20-24 DBUF40-24 STFE10010N STV100K10Y LC1200 STFE030-10N STFE200-24L STFE050-10N PDA-SURGE Thyro-A 1A 230-30 HRL3 Thyro-A 2A 500-100 HRL3 63-23-210-C8 23-23-210-8 23-23-220-8 23-23-230-8 63-23-175-8 63-23-220-8 23-13-030-2 23-13-060-2 23-22-112-2 23-23-125-8 23-23-150-8 63-13-125-6 63-23-112-4 63-23-150-8 63-23-650-8 STV25K-10S LC2400