

# MANUAL

## Classic P1 1 Quadranten Thyristor - Drive

<b>Part 1</b>	<b>Thyristor Drive</b>	<b>P1</b>
<b>Part 2</b>	<b>Analogue Control Electronics</b>	<b>REG-xx</b>



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2 Basic - Informationen

2.1 History

Version	Modification	Date
04/2016	Complete revision / Word-Version / Drawings	15.04.2016

2.2 Safety advice

Electronic equipment is not fault proof.

**Attention – High voltage**  
**AC250/440V~ - DC 180/300V=**  
**Shock hazard / Danger of life!!**



Before installation or commissioning begins, this manual must be thoroughly read and understood by the technical staff involved.  
 The devices are electrical equipment (EB) to the power electronics for the control of power flow in electrical power systems.  
**Protection rating IP00.**

**Control and power connections can  
 voltage lead, works without the drive!**

**Measured before disassembly voltage!**



## 2.3 Standards and guidelines:

The device and its associated components can only be installed and switched on where the local regulations and technical standards have been strictly adhered to:

EU Guidelines:	2004/108/EG, 2006/95/EG, 2006/42/EG EN 60204-1, EN292, EN50178, EN60439-1, EN61800-3, ECE-R100 ISO 6469, ISO 26262, ISO 16750, ISO 20653, ISO12100
IEC/UL:	IEC 61508, IEC364, IEC664, UL508C, UL840
VDE Regulations:	VDE100, VDE110, VDE160
Trade body guidelines:	VGB4

### The user must ensure that in the event of:

- device failure
- incorrect operation
- loss of regulation or control

the axis will be safely de-activated.



It must be ensured that the machines, equipment or vehicles are fitted with device independent monitoring and safety feature.

Non-earthed systems (e.g. vehicles) need to be secured isolation monitors.



There must be no danger to persons and property arising!

#### Assembly

- should only be carried out when all voltages have been removed and the units are secured
- should only be carried out by suitably trained personnel

#### Installation

- should only be carried out when all voltages have been removed and the units are secured
- should only be carried out by suitably trained personnel for electricians
- should only be carried in accordance with health and safety guidelines

#### Adjustments and programming

- should only be carried out by suitable trained personnel with knowledge in electronic drives and their software
- should only be carried out in accordance with the programming advice
- should only be carried in accordance with health and safety guidelines

## CE

When mounting the units into machines and installations the proper operating of the units may not be started until it is ensured that the machine, the installation, or the vehicle comply with the regulations of the EC machinery directive 2006/42/EG and the EMC guideline 2004/108/EG.

On the installation and test conditions described in the chapter CE-advice it is adhered to the EC guideline 2004/108/EG including the EMC standards EN61000-2 and EN61000-4.

A manufacturer's declaration can be requested.

The manufacturer of the machine or installation is responsible for observing the threshold values demanded by the EMC laws.

## QS

The devices are archived with serial number and the test data from the manufacturer for 5 years. The inspection reports may be requested.

## 2.4 General and features

**This manual describes the basic unit and is only in connection with the manual of the control electronics (e.g. REGxx) valid.**



### Manual use in connection with:

- an analogue control                      REGxx
- options

### **Build**

- switch cabinet mounting a
- according to the VDE, DIN and EU regulations
- standard control electronics REG
- intrinsically safe power section with current control loop
- optional units

### Galvanic isolation between

- the power section and the housing
- the power section and the control electronics

The distance of air gaps and leakage paths adhere to the VDE standards (>8mm).

### Components

- fully insulated thyristor modules, comfortably over-dimensioned
- only components customary in trade and industrially standardized are used
- LED displays
- DIP-switches for the PI-adjustment of the current control loop
- precision potentiometers for fine adjustments
- plug-in jumpers for the system set-up

### Characteristics

- Series Classic P1
- Thyristor drive for dc motors
- Power range 2,7kW to 12 kW
- Drive in the first quadrant
- Fast analogue current control
- 26-pin interface
- Features of the control electronics
- See manual REGxx or third-party product documentation
- Optional units

## 2.5 Technical Data

### P1 230/180-x

Power connection: 200 ... 250V~  
 Auxiliary voltage connection: 200 ... 250V~  
 Output voltage: max. +180V=  
 Cooling: self

P1 230/180-x			15	25	40
Input current		A~	16,5	27,5	44
Output current	- peak 5s	A=	30	50	80
	- continuous	A=	15	25	40
El. power		kW	2,7	4,5	7,2
Input fuses	input	ff	20	30	50
Main choke		Type	K78-16	K84-25	K84-50
		mH	1,2	0,7	0,5
Armature chokes		Type	EI135A-16	EI135B-24	EI150B-35
		mH	33	16	8
Dimension W x H x D		mm	200x160x112	200x160x120	200x160x120
Weight		kg	2,10	3,10	3,50

### P1 400/300-x

Power connection: 360 ... 440V~  
 Auxiliary voltage connection: 360 ... 440V~  
 Output voltage: max. +300V=  
 Cooling: self

P1 400/300-x			15	25	40
Input current		A~	16,5	27,5	44
Output current	- peak 5s	A=	30	50	80
	- continuous	A=	15	25	40
El. power		kW	4,5	7,5	12
Input fuse	input	ff	20	30	50
Main choke		Type	K78-16	K84-25	K84-50
		mH	1,2	0,7	0,5
Armature chokes		Type	EI135A-16	EI135B-24	EI150B-35
		mH	33	16	8
Dimension W x H x D		mm	200x160x112	200x160x120	200x160x120
Weight		kg			3,50

## 2.6 Specification

### Specification

Mains frequency	50 or 60Hz $\pm 5\%$
Protection rating	IP 00
Format	VDE 0100 groupe C, VDE 0160
Humidity rating	class F acc. to DIN 40040
Site of installation	< 1000m above sea level
Operating temperature range	0 ... 45°C
Extended operating temp. range	up to 60°C reduced 2%/°C
Storage temperature range	-30°C to + 80°C

### Current control loop circuit

Amplification	
- input signal	0... + 10V=
- output signal	0... + 200% type current
Enable	+10V
Control precision	$\pm 2\%$
Control range	>1:50
Speed control loop circuit (with REG)	
Control precision (without actual value error)	$\pm 0.1\%$
Control range	> 1:200

## 2.7 Interface

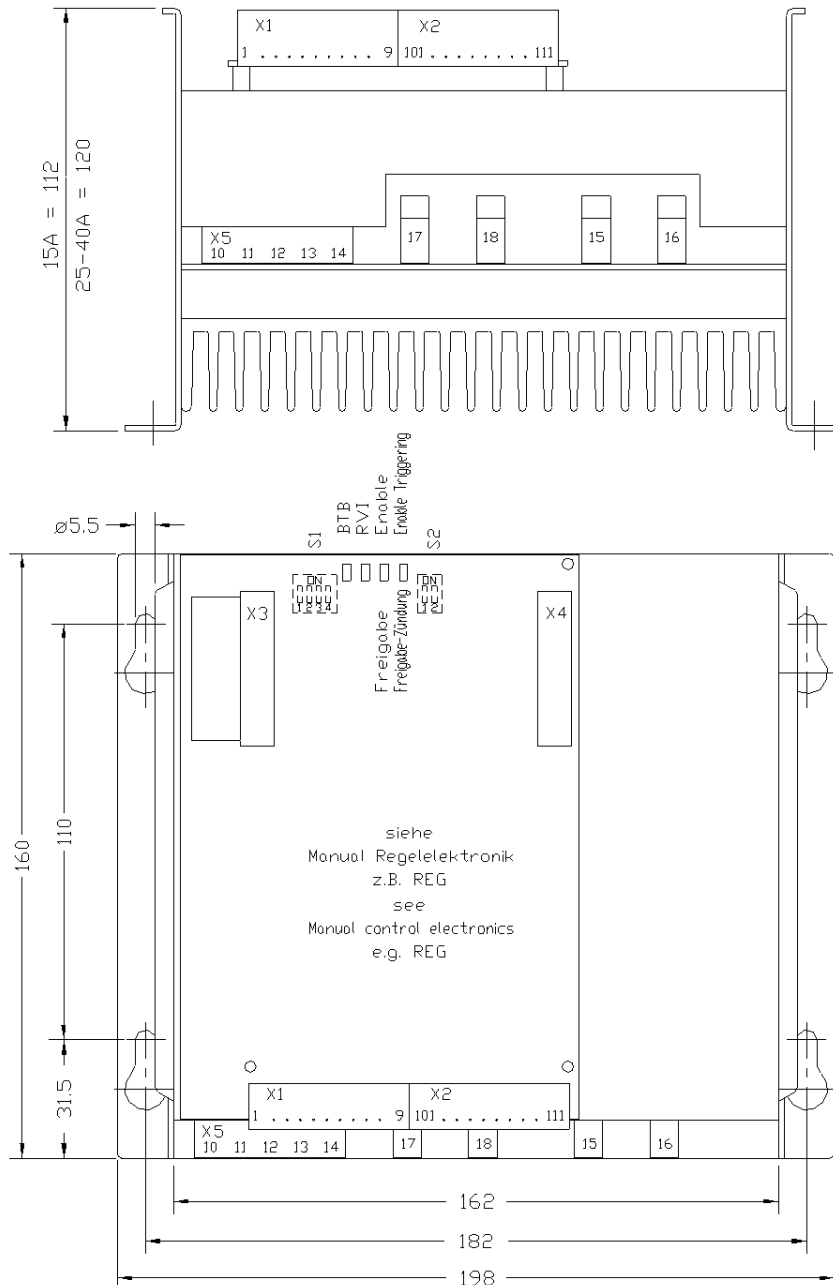
### Interface control electronics X3

Function		Connector no
+ 24V	$\pm 10\%$	X3: 1 and 2
+ 15V	$\pm 2\%$	X3: 3 and 4
- 24V	$\pm 10\%$	X3: 5 and 6
- 15V	$\pm 2\%$	X3: 7 and 8
Device GND	0	X3: 9, 10, 11, 12, 13, 14
I command value (GND)	0	X3: 15
I command value (Signal)	+10V=	X3: 16
Current controller enable	+10V=	X3: 17
Drive disable 1	+10V=	X3: 18
Drive disable 2	+10V=	X3: 19
n (speed) actual	+5V=	X3: 20
I – (current) actual	+5V=	X3: 21
Over current power section	n.B. (not occupied)	X3: 22
Trigger angle 1	+10V=	X3: 23
Trigger angle 2	+10V=	X3: 24
Drive ready BTB	+10V=	X3: 25
not assigned	n.a.	X3: 26



## 3 Mechanical installation

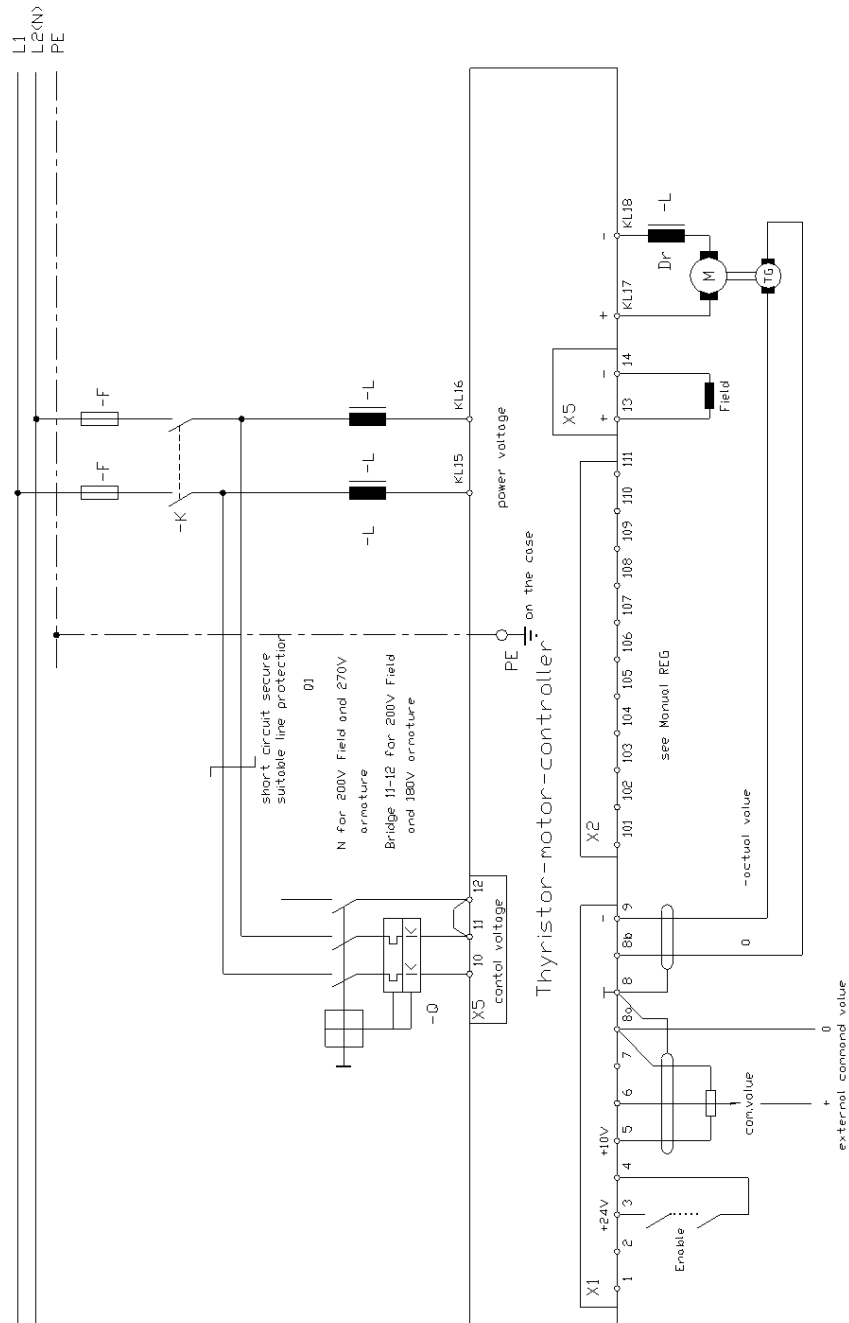
### 3.1 Mounting / Dimensions



P1-Mass-1

4 Electrical installation

4.1 Connections/ Connection diagram



P1-A020

## 4.2 CE – Advice

The devices adhere to the EU guidelines 89/336/EWG and the technical standards EN61000-2 and 61000-4 provided that the following conditions are observed:

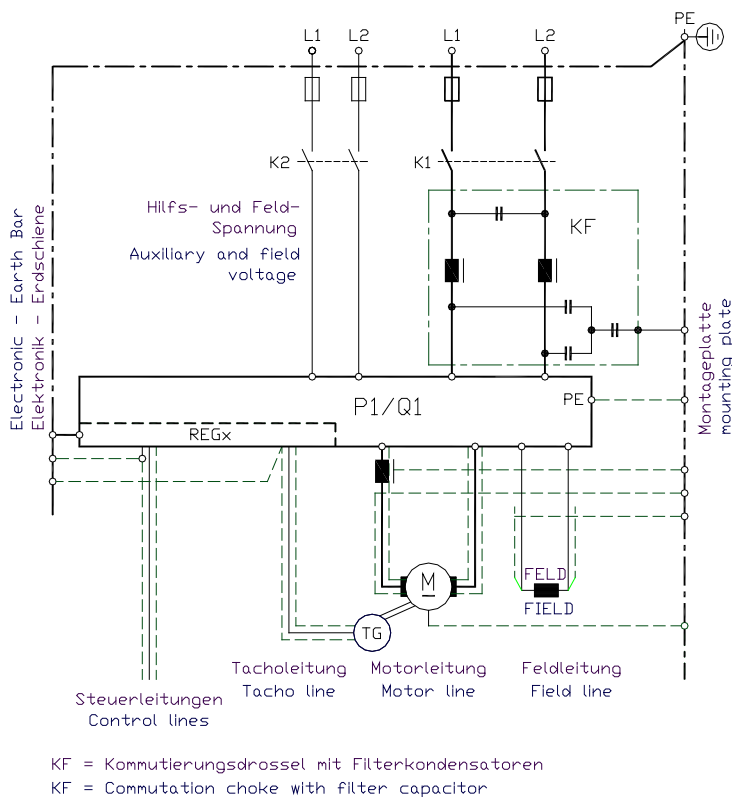
- the device, the power choke and the filter capacitors are mounted on a 500x500x2 mm mounting plate.
- The mounting plate must be connected to ground using a 10mm<sup>2</sup> wire.
- The motor housing must be connected to ground using a 10mm<sup>2</sup> wire.
- The device ground X1:8 must be connected to the mounting plate using a 2,5mm<sup>2</sup> wire.
- Device PE screw be connected to the mounting plate using a 4mm<sup>2</sup> wire , l = 50mm

### Connection:

Power choke type: see technical data  
 Filter capacitors: 0.5µF/600V~ 2 x 1µF (x) + 1 x 0,5µF (y)  
 Conductor length between the device and the power choke <250mm

### Motor connection:

Motor conductors l = 1.5m, shielded  
 Tacho and all control lines l = 1.5m, shielded  
 Shielding connected to PE



P1-Q1-Aufbau-EMV-1266

The connection instructions are for general information and are not binding.

**Attention:**

The order of the connections to the connector numbers or screw terminals is obligatory. All further advice is non-obligatory.

The input and output conductors may be altered or supplemented in accordance with the electrical standards.

**Note:**

- Connection and operating instructions
- Local regulations
- EG-guideline 89/392/EWG, 84/528/EWG, 86/663/EWEG
- VDE, TÜV regulations and Trade body guidelines
- CE advice, EMC



Connection				
Conductor minimal cross - section				
Type current	A	15	25	40
<b>ac power supply</b> Cross sectional minimal	mm <sup>2</sup>	1,0	2,5	4
<b>Motor line</b> Cross sectional minimal	mm <sup>2</sup>	1,0	2,5	4
<b>Auxiliary voltage</b> Cross sectional minimal	mm <sup>2</sup>	0,5	0,5	0,5

## 4.3 Power supply

**Switch on:** the auxiliary voltage and the supply voltage simultaneously.

**Switch off:** the supply voltage after the auxiliary voltage.

**Input filter:** see CE-advice (Capital Electrical Installation)  
Short conductor length to be used between the input filter and the device  
Operation with 60Hz: switch S3 / contact 1 in position ON

### Auxiliary voltage connection:

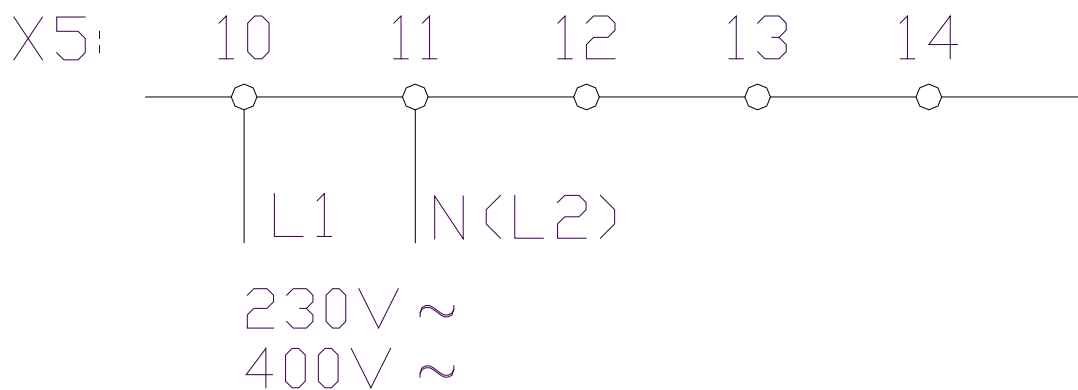
Connection: terminal X5:10, X5:11

Power supply: 230V~ or 400V~

Input current: 0,1 A

Phase position: regardless

Internal fuses: 2,5 Af



P1-Hilfssp-1

**Attention:**  
note typelabel / control voltage xxx

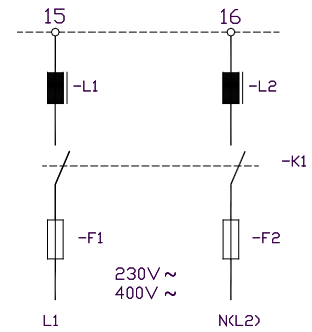


## 4.4 Direct power connection/ with transformer

Direct power connection:

**Connection:**

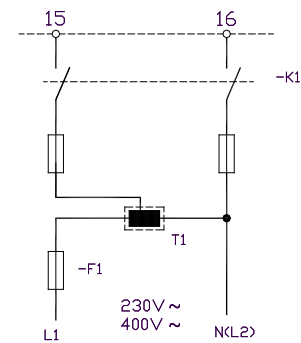
Phase L1	terminal X10:15
Phase L2 (N)	terminal X10:16
<b>Input fuse</b>	super fast acting fuse
<b>Power choke</b>	inductance >200μH



P1-Netz-1

Power connection with a transformer:

<b>Transformer performance:</b>	1,1 x continuous motor power
<b>Secondary voltage:</b>	1,35 x motor power
<b>Trafosicherung:</b>	slow acting
<b>Eingangssicherung:</b>	super fast acting fuse



P1-Netz-2

**Attention:**

- If the secondary voltage produced by the transformer are inferior to 60% of the rated device voltage, the voltage watchdog has to be adapted.
- these modifications may only be effected in the factory
- the transformer secondary voltage has to be indicated on order.

Internal watchdog for fuse failures.



## 4.5 Motor connection

### Connection

Motor- terminal X10:18  
 Motor+ terminal X10:17

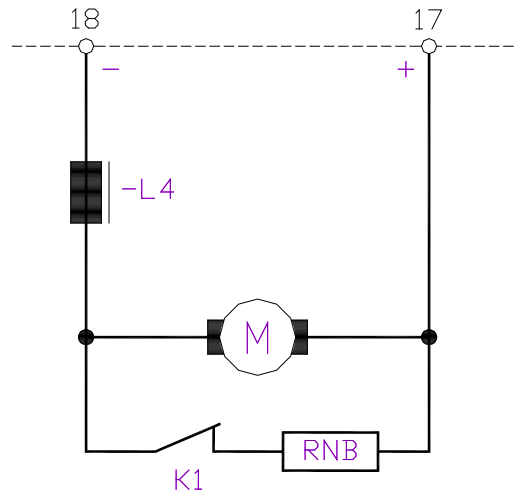
### Armature choke

Inductance  $L4 \text{ (mH)} = \frac{-UA}{IA} \times 2,4$

An armature choke should always be used with a P1 devices

### Turn in the armature circuit:

- DC circuit energized
- Release locked



P1-Motor-1

### Warning:

Faulty switching will create arcing across the switch contacts.



### Power supply failure – brake resistor

- Break contact of the mains contactor K1
- in parallel to the motor armature
- without separation from the device

### Attention:

Power lines have to be shielded and routed separately from control lines!

For electro-magnetic interferences please refer to the CE advice.

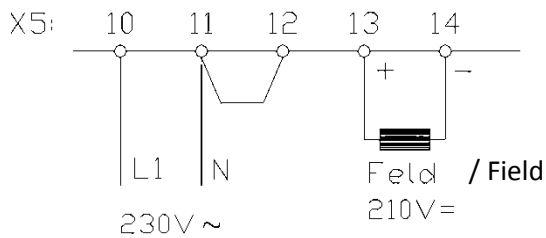


## 4.6 Field connection

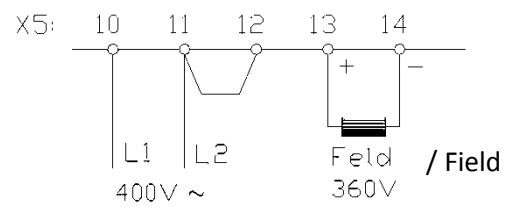
### Connection

Input		Terminal
Field	negative	X5:10, X5:12
Field	positive	X5:13

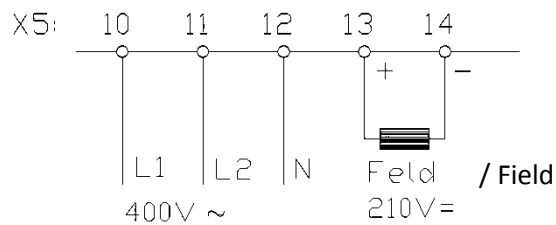
### Field voltage



P1-Feld-1



P1-Feld-2



P1-Feld-3

### Power voltage

230V~  
400V~  
400V~ with N

Field current  
Fusing  
Control

### Field voltage

210V=  
360V=  
210V=

max. 1,5A  
2,5 Af  
deleted



## 4.7 Actual value connection

### Tacho

Suitable actual value encoders:

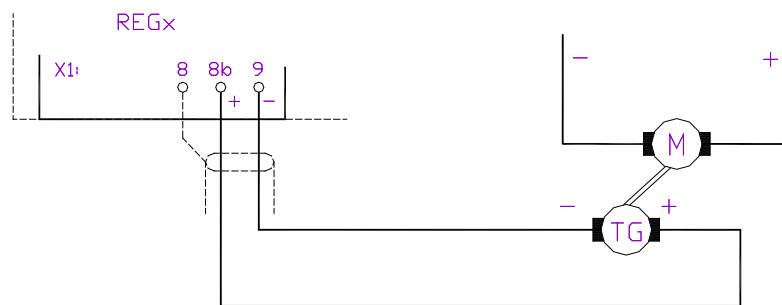
- DC tacho generator
- Brushless tacho generator with evaluation electronics
- Incremental encoders with evaluation electronics
- SC or three-phase tacho with rectification

### Connection

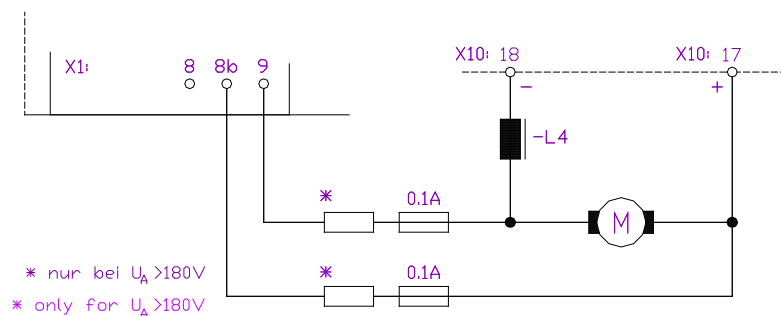
Control electronics (see MANUAL REGxx)

- in case of a positive command value
- Tacho positive                   X1:8b
- Tacho negative                 X1:9
- Shield                             X1:8

P1-Tacho-1



### Armature voltage



P1-Ankersp-1

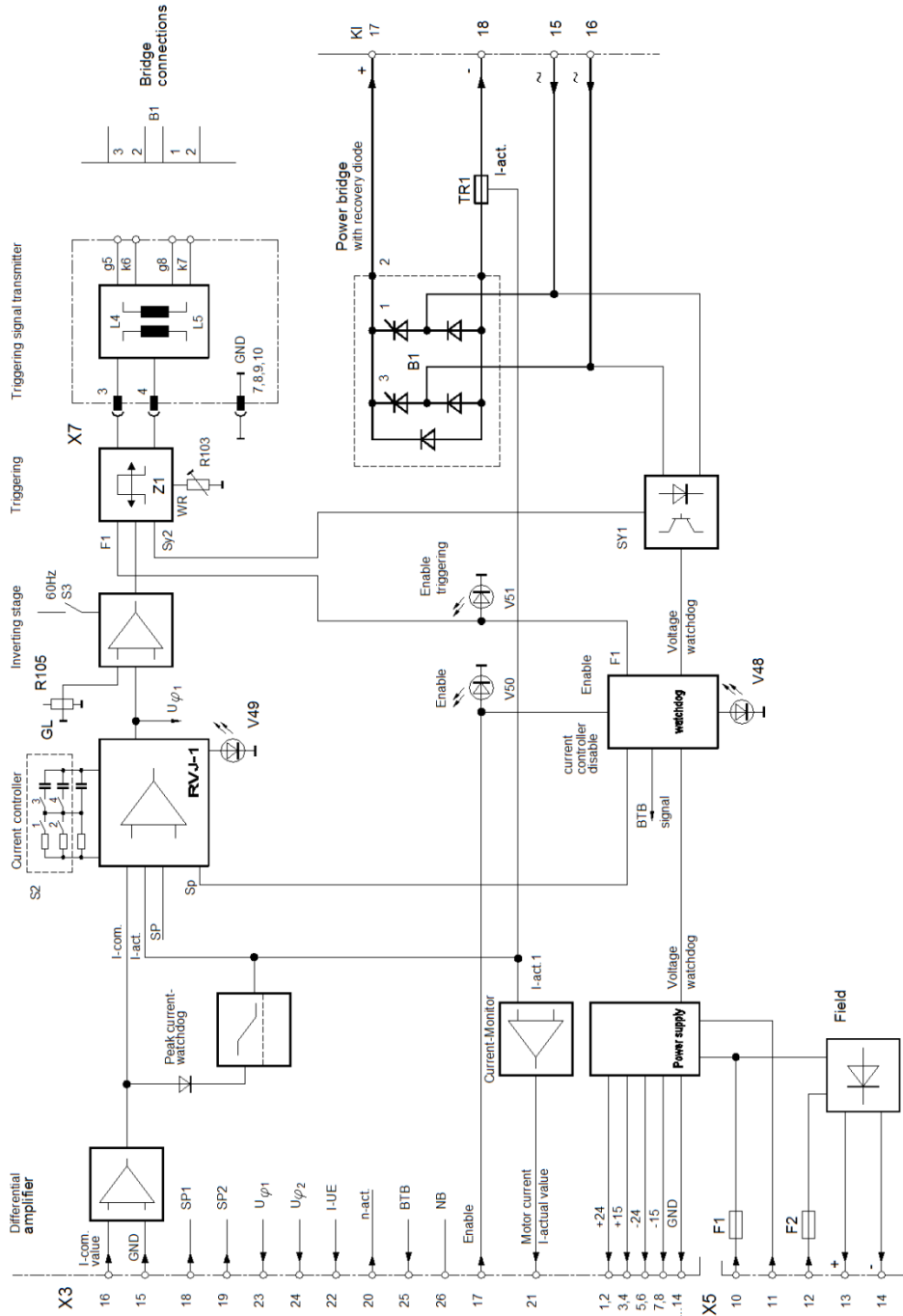
### Ground referenced actual value

- fuses                                 2 x 0,1A/500V                   directly in the armature circuit
- for armature voltage             >180V                                 additional resistors are required
- Use unit                             EXZU-UA1 (Manufacturer)

# Adjustment

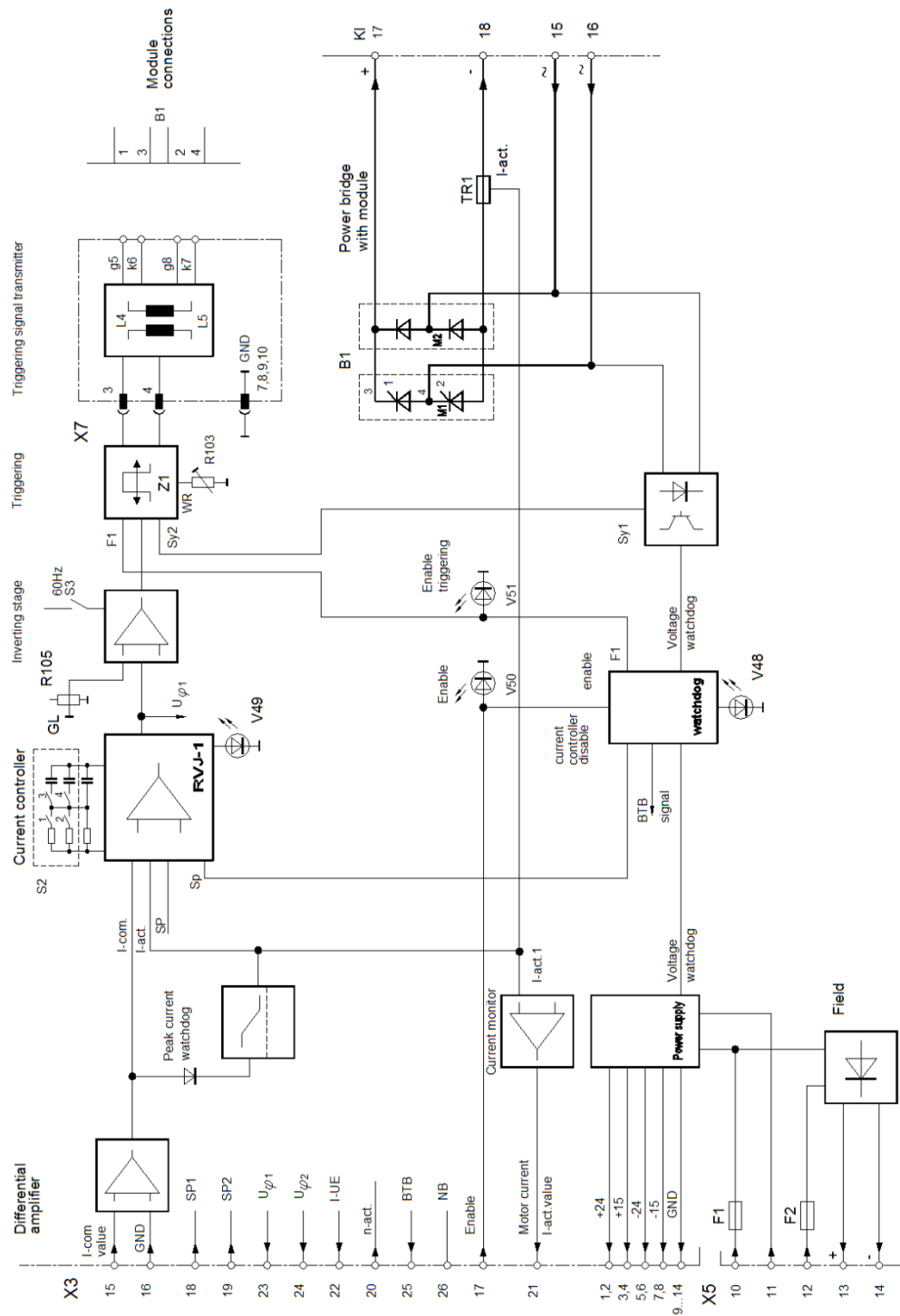
## 5 Adjustment

### 5.1 Circuit diagramms



E-P1-S072

## Circuit diagram

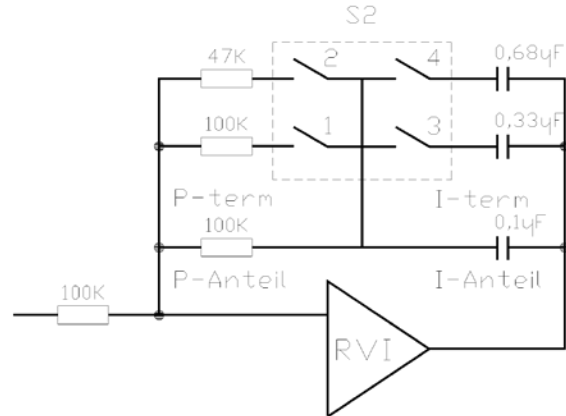
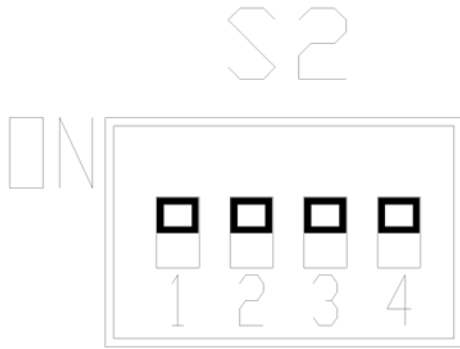


E-P1-S082

## 5.2 Current controller

PI loop circuit

Adjustments with the DIOP switch S2



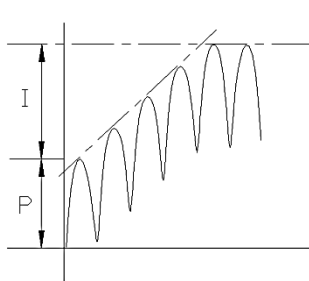
P1-S2

P1-Strompara-1

### Optimization of the current controller

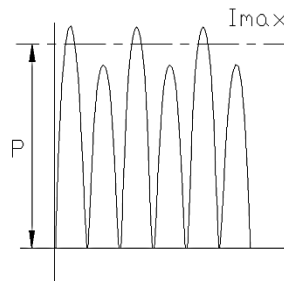
- Connect an oscilloscope across the current actual value X3:21
- Current command value step-change 1V X3:16
- Increase the current command value by 1V steps to 10V
- Alter the P-amplification by means of the DIP switches S2:1 and S2:2
- Optimal adjustment (see fig. 1)
- Not permissible adjustment (see fig. 2)
- Alter in integral part by means of the DIP switches S2:3 and S2:4

### Oscilloscope – Current adjustment

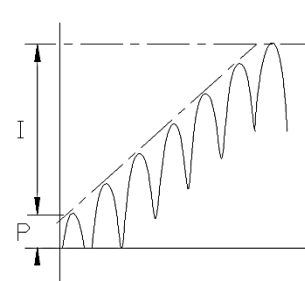


ZchnG.Classic/Classic-Strom-PI-1

Grafic 1:  
setting optimal



Grafic 2:  
amplifier too high



Grafic 3:  
P-amplifier small

## 5.3 Displays

Some important functions are indicated by LEDs:

Display	LED
Drive ready	BTB
Current controller enable	enable
Triggering enabled	enable triggering
Current command value direction	RVI-1
The green LEDs indicate the active states!	

### BTB-signal – Drive ready

BTB-signal	X3:25	>+10V
Error	X3:25	<+2V

### Error

Auxiliary voltage supply	+24V, +15V, -15V
Power supply:	
Fuse failure	
Under-voltage	

In case of errors or failure the power section is internally disabled without delay.

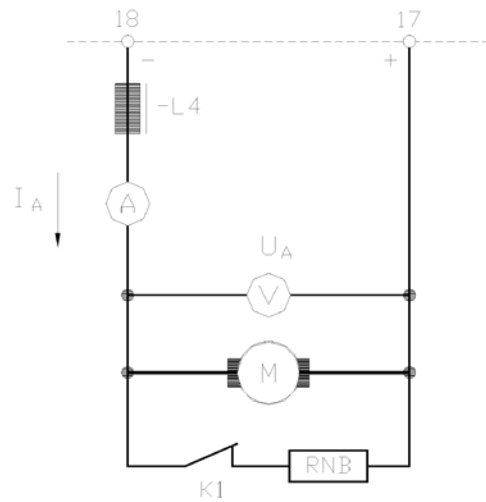
### Measurements:

Measure instruments: multi meter for current and voltage

ammeter

Measure faults: mean value >> actual value

acc. to the form factor approx. 1 bis 5 %



### Measured values

with a positive command value

Voltage X10:18 negative / X10:17 positive  
max. 0,75 x power supply

Current Ammeter in the motor circuit

### Measured values across REG

Speed	X2:109	-5V (10V)	for ±100% speed
Current	X2:111	+5V (10V)f	for ±200% current
GND	X2:104		

## 6 Commissioning

### 6.1 Commissioning

#### Connection advice

Connect the drive in accordance with the P1 manual and the control electronics manual (e.g. REG).

#### Attention:

Check the power supply voltage with that specified on the type plate.  
 Insert correct fuses according to the technical data.  
 Check the field voltage connection and the motor and tacho connections.  
 For 60 Hz applications set the DIP switch S3, contact 1 to ON

#### Commissioning

Basic connections – Mains supply, field, tacho or armature feedback, drive enable, command value.

For armature voltage control the tacho watchdog must be switched off.

#### Drive enable switch open or drive enable voltage 0V:

Command value	0 V
Switch S9	adjust to tacho voltage
For armature voltage control	adjust to 0
Switch S4	position 2
Switch S5	position 6
I <sub>max1</sub> - Potentiometer	left full scale
I <sub>max2</sub> - Potentiometer	adjust to approx. 10 % of full scale
Potentiometer X <sub>p</sub>	adjust to 50 %
Potentiometer I <sub>d</sub> .	= 100 %
Potentiometer I <sub>xR</sub>	= left full scale
Potentiometer n <sub>max</sub> .	= left full scale
Potentiometer INT	= left full scale

#### Apply the voltage:

LED L3 (BTB) and LED L7 (stationary) **must** light.  
 All other LEDs are off.

#### Close the switch drive enable or apply a drive enable voltage of 10V:

LED L1 and L2 must also light.  
 The drive must be at a standstill or turn slowly (offset, n<sub>min</sub>).  
 If the drive accelerates in the correct direction, the polarity of the tacho voltage and the armature voltage feedback must be changed.  
 If the drive accelerates in the wrong direction, the polarity of the armature of the field must be changed.

#### Increase the command value voltage to approx. 10%:

The drive must accelerate to approx. 10% of the speed. If the rotation direction is wrong, change the polarity of the **tacho and the field** or the polarity of the **tacho and the armature**.

### **Current controller amplification:**

(Switch S2 on the power section)

The current amplification is adjustment to a low armature circuit inductance (all switch „on“). High inductance values can lead to motor oscillation which cannot be influenced by means of the speed controller. In this case, first set switch S2-2 to “off”.

If the drive still does not run smoothly, set the switch S2-1 to “off”.

The current response can be measured by means of an oscilloscope across the test point X4:20.

### **Speed controller amplification:**

Adjust on the REG board.

Adjust the P-term to the lowest possible setting from 1 to 5 (switch S4).

Adjust the I-term to match the axis momentum (switch S5).

large axis momentum - high adjustment value

small axis momentum - low adjustment value

With the command value set to 10% speed, increase the amplification by turning the potentiometer Xp clockwise. When the drive begins to oscillate, reduce the amplification by turning the potentiometer anti-clockwise by approximately 10%.

For the fine adjustment of the amplification the control response should be measured by means of an oscilloscope across the test point X4:15.

### **Further adjustment:**

**Such as speed, peak current, continuous current, etc.** (rf. to the manual REG).

### **Switch OFF:**

If the switch „drive enable“ is opened, or the drive enable voltage is switched to 0V, LED L1 and L2 will extinguish and the drive will be disabled.


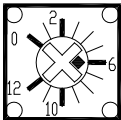
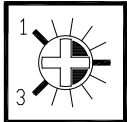
DS1:K4 in position OFF.

After approx. 2s the thyristor triggering circuit is disabled.

### **Commissioning adjustment:**

The adjustment should be documented in the protocol and the adjustment potentiometer should be sealed with a suitable lacquer.

## 6.2 Protocol (commissioning)

<b>Customer</b>				<b>Machine No.I</b>				
<b>Device</b>				<b>Series No.</b>				
<b>Control voltage</b>		[V~]						
<b>Power voltage</b>		[V~]						
<b>Field voltage</b>		[V=]						
<b>Input REGxx</b>								
Enable	Contact ?	Voltage [V=]						
Nominal value	Type	Voltage [V=]						
Auxiliary nom. value	Type	Voltage [V=]						
Current nom. value	I <sub>max1</sub> extern	Voltage [V=]		<b>no function</b>				
Current nom. value	I <sub>max2</sub> extern	Voltage [V=]						
Speed controll settings REGxx								
<b>Switches</b>								
Tacho-adjustment		S9	Position	 <small>REG5 - Schotax</small>				
P-term		S4	Position					
I-term		S5	Position					
D-term		S8	Position					
<b>Poti-Stellungen</b>								
Speed	n <sub>max</sub>	P4	Position	 <small>REG5 - Poti 1</small>				
Peak current	I <sub>max1</sub>	P5	Position					<b>no function</b>
Peak current	I <sub>max2</sub>	P6	Position					
Continuous current	I <sub>D</sub>	P7	Position					
Integrator	INT	P1	Position	 <small>REG5 - Poti 2</small>				
Amplification	X <sub>p</sub>	P3	Position					
I <sub>xR</sub> Compensation	I <sub>xR</sub>	P2	Position					
<b>DIP Switches</b>								
ON	No.							
OFF	No.							



Commissioning P1xx with REGxx

<b>Setting-Current controller</b>			
Switch setting			
Switch S2	open	(off)	
	closed	(on)	
Switch S3 / Contact 1	60Hz	ON	
	50Hz	OFF	
<b>Measuring value</b>			
Armature voltage	max.	[V=]	
Armature current	peak	[A=]	
Armature current	steady	[A=]	
Tachometer voltage	max.	[V=]	
Acceleration	X4:16	[V/ms]	
Integrator	X4:14	[V/ms]	
<b>Motor data</b>			
Identification / name plate specifications			
Producer:			
Type		Serien-Nr.	
Motor voltage [V=]		Motor current [A=]	
Field voltage [V=]		Field current [A=]	
Tacho voltage [V/min <sup>-1</sup> ]		Tachometer type	
Brake [V]		Fan [V]	
Nominal speed [U/min]			

7 Faults

7.1 Error diagnosis

Error diagnosis	
Malfunction	Causes
Motor does not run	<ul style="list-style-type: none"> <li>-Wrong power supply and motor connections</li> <li>-Activated fuses</li> <li>-Missing enable or command value</li> <li>-Current limit too low</li> <li>-Missing BTB</li> </ul>
Motor speeds up	<ul style="list-style-type: none"> <li>-Wrong polarity of the actual value (Tacho armature voltage)</li> <li>-Values of the tacho switch S9 too low</li> <li>-Command value too high</li> </ul> <p>For armature voltage control</p> <ul style="list-style-type: none"> <li>-Field current too low</li> <li>-Fuses, armature voltage feedback activated</li> </ul>
Motor runs unsteadily	<ul style="list-style-type: none"> <li>-Mechanical defect of the tacho</li> <li>-Tacho malfunction</li> <li>-Amplification on the speed controller too low or too high</li> <li>-Wrong PID parameter</li> <li>-Command value errors</li> <li>-Amplification of the current controller too low or too high</li> </ul>
No motor torque	<ul style="list-style-type: none"> <li>-Current limits too low</li> <li>-Field current too low</li> <li>-Mechanical overload of the axis</li> </ul>

## 8 Warranty

### 8.1 Warranty

**UNITEK** warrants that the device is free from material and production defects. Test results are recorded and archived with the serial number.

The warranty time begins from the time the device is shipped, and lasts two years.

**UNITEK** undertakes no warranties for devices which have been modified for special applications.

During the warranty period, **UNITEK** will, at its option, either repair or replace products that prove to be defective, this includes guaranteed functional attributes. **UNITEK** specifically disclaims the implied warranties or merchantability and fitness for a particular purpose. For warranty service or repair, this product must be returned to a service facility designated by **UNITEK**.

For products returned to **UNITEK** for warranty service, the buyer shall prepay shipping charges to **UNITEK** and **UNITEK** shall pay shipping charges to return the product to the buyer.

However, the buyer shall pay all shipping charges, duties and taxes for products returned to **UNITEK** from another country.

The foregoing warranty shall not apply to defects resulting from:

- improper or inadequate repairs effected by the buyer or a third party,
- non-observance of the manual which is included in all consignments,
- non-observance of the electrical standards and regulations,
- improper maintenance
- acts of nature.

All further claims on transformation, diminution and replacement of any kind of damage, especially damage, which does not affect the **UNITEK** device, cannot be considered. Follow-on damage within the machine or system, which may arise due to malfunction or defect in the device cannot be claimed. This limitation does not affect the product liability laws as applied in the place of manufacture (i.e. Germany).

**UNITEK** reserves the right to change any information included this **MANUAL**.

All connection circuitry described is meant for general information purposes and is not mandatory.

The local legal regulations, and those of the standards authorities have to be adhered to. **UNITEK** does not assume any liability, expressly or inherently, for the information contained in this **MANUAL**, for the functioning of the device or its suitability for any specific application.

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**UNITEK's** products are not authorised for use as critical components in the life support devices or systems without express written approval.

The onus is on the reader to verify that the information here is current