

# MANUAL

## Thyristor - motor controller

### Classic

C2.2 - 230/180 - 12f  
potential-free



Hans-Paul-Kaysser-Straße 1  
71397 Leutenbach - Nellmersbach

Tel.: 07195 / 92 83 - 0  
[contact@unitek.eu](mailto:contact@unitek.eu)  
[www.unitek.eu](http://www.unitek.eu)

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## Table of contents

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Basic information</b> .....              | <b>2</b>  |
|          | Safety regulations.....                     | 2         |
|          | Regulations and guidelines.....             | 2         |
|          | General and properties .....                | 4         |
|          | Technical data .....                        | 5         |
| <b>2</b> | <b>Mechanical installation</b> .....        | <b>6</b>  |
|          | Dimension drawing.....                      | 6         |
| <b>3</b> | <b>Electrical installation</b> .....        | <b>7</b>  |
|          | Connection diagrams.....                    | 7         |
|          | Circuit diagram .....                       | 8         |
|          | Component overview .....                    | 9         |
| <b>4</b> | <b>Settings</b> .....                       | <b>10</b> |
|          | Setting functions .....                     | 10        |
|          | Set point / actual value .....              | 11        |
|          | Armature voltage control.....               | 12        |
|          | Current / speed controller.....             | 13        |
|          | Adjustment without measuring equipment..... | 15        |

## 1 Basic information

### Safety regulations

Electronic devices are fundamentally not fail-safe!

## Attention high voltage

**AC 230 V $\sim$ , DC 320 V $=$**

**Danger of shock! / Danger to life!**



This manual must be carefully read and understood by qualified personnel before installation or commissioning. If anything is unclear, contact the manufacturer or dealer.

The devices are electrical equipment (EB) of the power electronics for the regulation of the energy flow in power installations.

**Protection class IP00.**

**Control and power connections can be  
Carry voltages without the drive  
working!**



### Regulations and guidelines

The units and the associated components must be installed and connected in accordance with the local legal and technical regulations.

|  |  |
|--|--|
| EC Directive   | 2004/108/EC, 2006/95/EC, 2006/42/EC<br>EN60204-1, EN292, EN50178, EN60439-1,<br>EN 61800-3, ECE-R100<br>ISO 6469, ISO 26262, ISO 16750, ISO 20653, ISO 12100 |
| IEC/UL   | IEC 61508, IEC364, IEC664, UL508C, UL840   |
| VDE/TÜV regulations  | VDE100, VDE110, VDE160   |
| Regulations of the<br>employers' liability<br>insurance association: | VGB40  |

## **The user must ensure:**

- that after a failure of the unit
- In the event of incorrect operation
- in case of failure of the regulation and control unit, etc.

the drive is guided into a safe operating state.



Machines, plants and vehicles are also equipped with  
The unit must be equipped with monitoring and safety devices  
that are independent of the unit.

Non-grounded systems (e.g. vehicles) must be equipped with  
independent insulation monitors.



There must be no danger to people or property!!!

### **Assembly work**

- Only in the de-energised state
- Only by trained electrical specialists

### **Installation work**

- Only in the de-energised state
- Only by trained electrical specialists
- Observe safety regulations

### **Setting and programming work**

- only by qualified personnel with knowledge of electronic drives and software
- Observe programming instructions
- Observe safety regulations

### **CE**

When installed in machines, systems and vehicles, the device may not be used for its intended purpose until it has been determined that the machine, system or vehicle complies with the provisions of the EC Machinery Directive 2006/42/EC, the EMC Directive 2004/108/EC and ECE-R100.

The EC Directive 2004/108/EC with the EMC standards EN61000-2 and EN61000-4 is complied with under the specified installation and test conditions (see chapter CE notes).

A manufacturer's declaration can be requested.

Compliance with the limit values required by EMC legislation is the responsibility of the manufacturer of the vehicle, system or machine.

### **QS**

The units are archived by their serial number with the test data at the manufacturer for 5 years. The test records can be requested.

## General and properties

### Thyristor controller

- for inductive and ohmic loads

### Main application

- Switch cabinet installation units
- according to VDE, DIN and EC directives
- plug-in terminal connection
- fully insulated power semiconductor
- Field rectifier

### Galvanic separation between

- power unit and housing
- power unit and control electronics


The clearance and creepage distances comply with VDE.

### To be used:

- fully insulated thyristor bridge, generously dimensioned
- only commercially available components in the industry standard
- Light-emitting diode displays
- Precision trim pot for fine adjustment
- DIP switch for system settings

### Properties

- Speed control of DC motors
- 1Q operation, drive
- Power up to 2160 watts
- Speedometer control
- Armature voltage control with IxR compensation
- Torque control
- Cascade control speed-current
- Current-voltage characteristic is a rectangle
- On and off logic
- Mains connection directly switchable

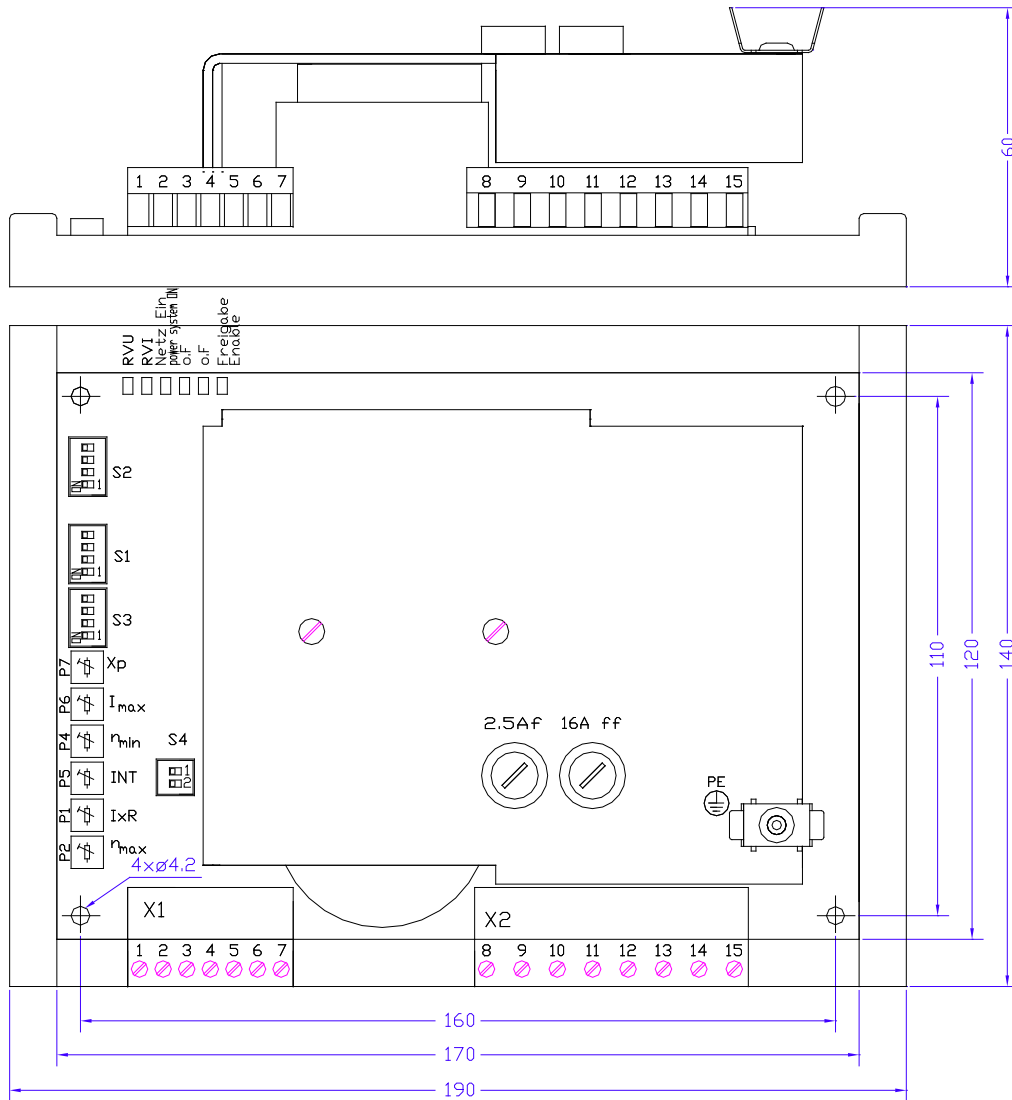
|   |     |                                    |   |
|---|-----|------------------------------------|---|
| <b>Attention:</b>                                   |     |                                    |  |
| <b>Speedometer control:</b><br>Control unit has     | >>> | Potential separation               |   |
| <b>Armature voltage control</b><br>Control unit has | >>> | High-impedance<br>mains connection |   |
| Circuit zero (terminal 5) must not be earthed.      |     |                                    |   |

## Technical data

|                       |                              |                          |
|-----------------------|------------------------------|--------------------------|
| <b>Limit values</b>   |                              |                          |
| Supply voltage        |                              | 230 V $\sim$ +10 %/-15 % |
| Output voltage        | max.                         | 180 V=                   |
| Type current          | max.                         | 12 A=                    |
| Input current         | max.                         | 13,2 A $\sim$            |
| Power (electrical)    | max.                         | 2160 W                   |
| Field voltage         |                              | 210 V=                   |
| Field current         | max.                         | 1 A=                     |
| <b>Working data</b>   |                              |                          |
| Control range         | (DC tachometer)              | 1:300                    |
| Accuracy              | (without actual value error) | 0,1 %                    |
| <b>Working data</b>   |                              |                          |
| Control range         | (armature voltage)           | 1:50                     |
| Accuracy              |                              | 3 %                      |
| <b>Working data</b>   |                              |                          |
| Control range         | (Torque control)             | 1:50                     |
| Accuracy              |                              | 3 %                      |
| <b>Working data</b>   |                              |                          |
| Setpoint supply       |                              | 12 V=, 10 mA             |
| External setpoint     | max.                         | 12 V=                    |
| Actual value          | max.                         | -180 V=                  |
| Switch-on logic       | type-safe                    | Release time 100 mS      |
| <b>Built-in fuses</b> |                              |                          |
|                       | F1                           | 2.5 Af                   |
|                       | F2                           | 16 Aff                   |
| <b>Accessories</b>    |                              |                          |
| Mains choke           |                              | K78-16 F                 |
| Isolating transformer |                              | TE 17/3 F                |
| Smoothing choke       |                              | EI 135 A-12              |

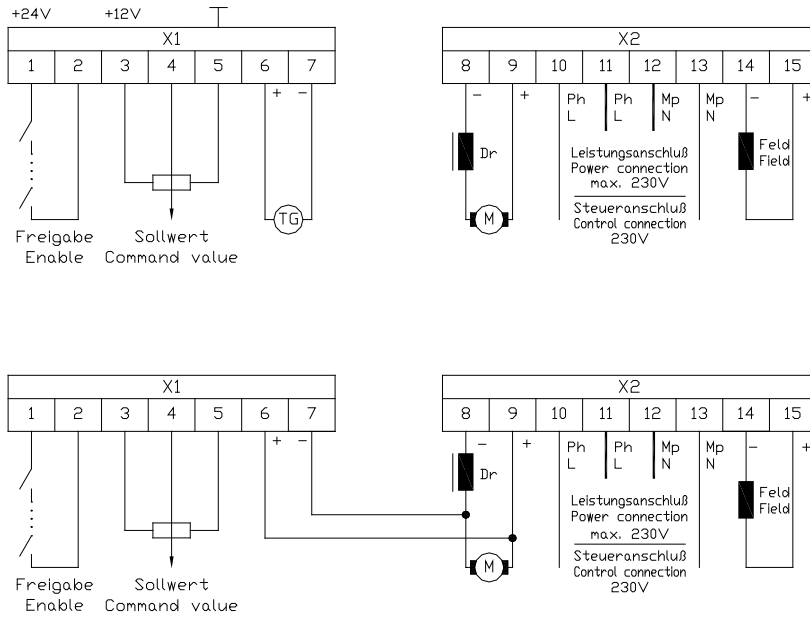
## 2 Mechanical installation

### Dimension drawing



## 3 Electrical installation

### Connection diagrams



### Mains connection

#### Direct mains connection

|             |   |         |       |
|-------------|---|---------|-------|
| Phase       | L | Clamp   | X2:11 |
| Zero        | N | Clamp   | X2:12 |
| Mains choke |   | K78-16F |       |

#### Connection with isolating transformer

|                             |           |
|-----------------------------|-----------|
| Secondary voltages          | 230 V~    |
| Transformer type            | TE 16/3 F |
| Transformer fuse protection | 16 A ff   |

### Motor connection

#### Engine - Anchor

|          |               |
|----------|---------------|
| positive | Terminal X2:9 |
| negative | Terminal X2:8 |

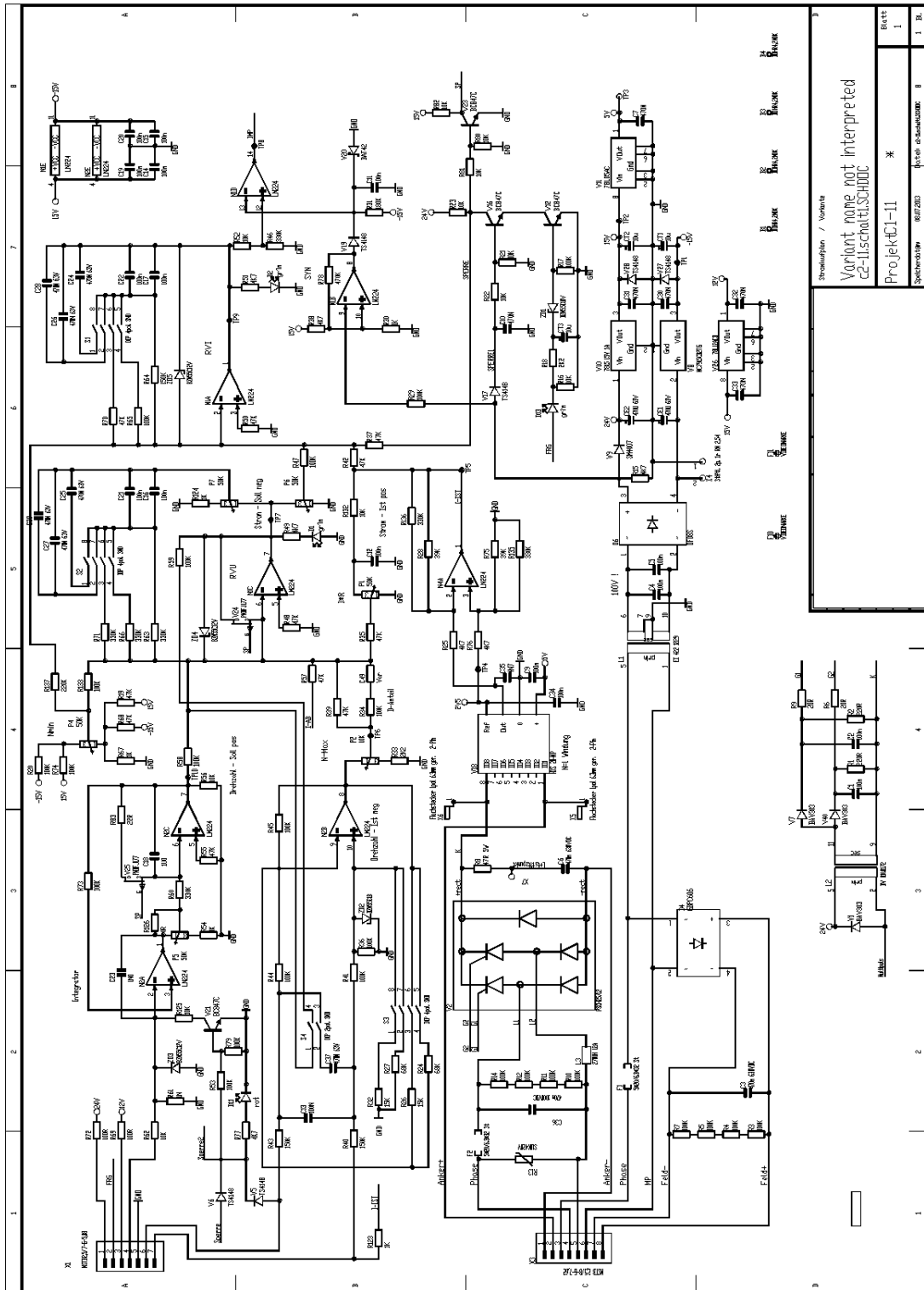
#### Motor field

|          |                |
|----------|----------------|
| positive | Terminal X2:15 |
| negative | Terminal X2:14 |

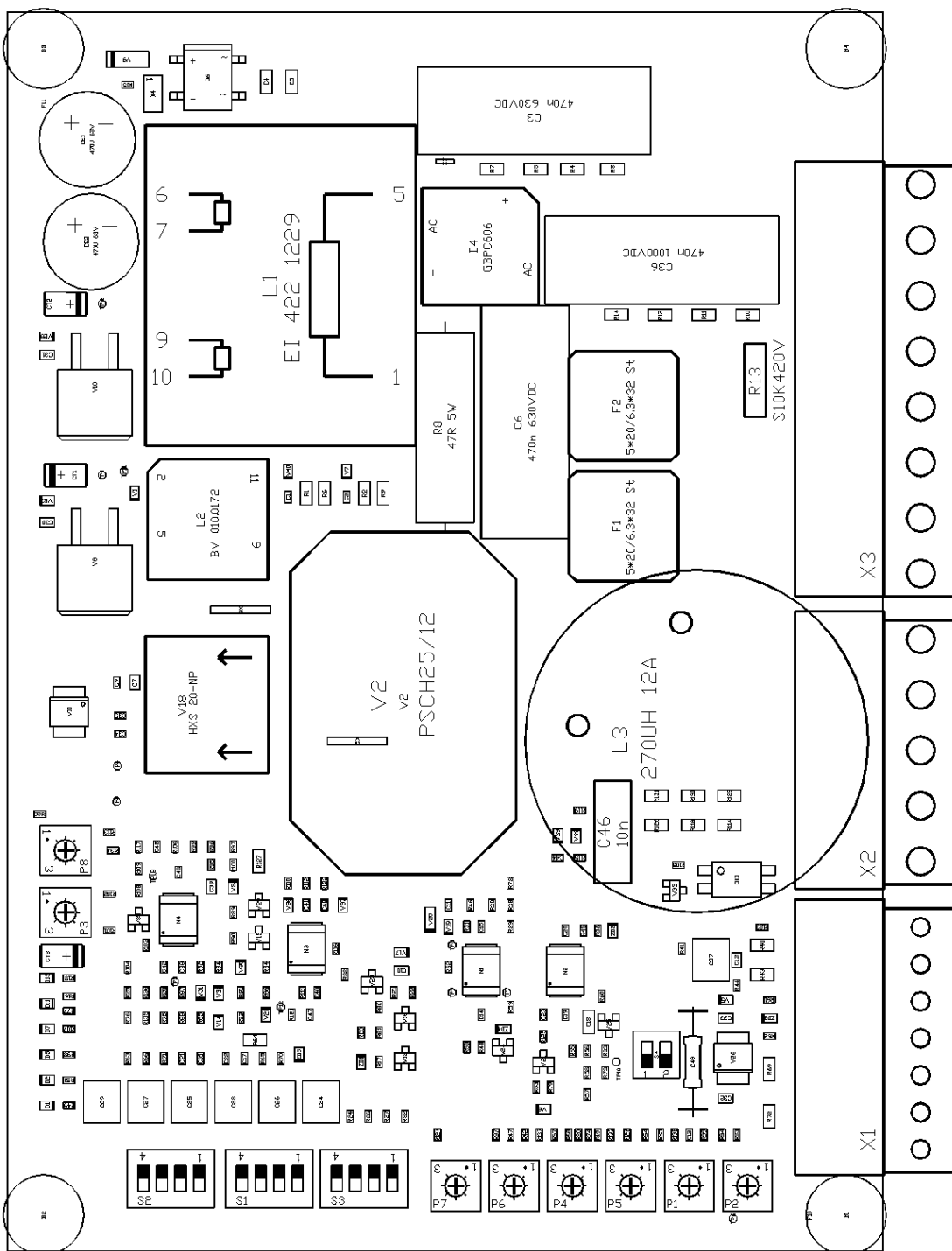
|                      |             |
|----------------------|-------------|
| Smoothing choke type | EI 135 A-12 |
|----------------------|-------------|



## Circuit diagram



## Component overview



## 4 Settings

### Setting functions

| Adjustment potentiometer |                  |   |                 |
|--------------------------|------------------|---|-----------------|
| No.                      | Abbreviation     | Function  | Area            |
| P1                       | IxR              | Speed compensation for Armature voltage control | 0 ... 40 %      |
| P2                       | nmax             | Fine tuning maximum speed                       | 80 ... 120 %    |
| P5                       | INT              | Integration time slope limiter                  | 0.08 ... 5 sec. |
| P4                       | nmin             | Minimum speed                                   | -0,2 ... +2 V   |
| P6                       | I <sub>max</sub> | Current limit                                   | 0 ... 100 %     |
| P7                       | XP               | Reinforcement                                   | 3 ... ∞         |

| Setting switch |                   |                               |
|----------------|-------------------|-------------------------------|
| No.            | Contact           | Function                      |
|                | Current regulator |                               |
| S1             | 1,2               | Integral component            |
| S1             | 3,4               | Proportional amplification    |
|                | Speed controller  |                               |
| S2             | 1,2               | Integral component            |
| S2             | 3,4               | Proportional amplification    |
|                |                   |                               |
| S3             | 1 ... 4           | Speedometer coarse adjustment |
| S4             | 2                 | Speedo smoothing              |

### Basic settings

#### Speedometer control

Switch in ON position: S1-1, S1-4, S2-1, S2-3, S3-1 to S3-4

#### Armature voltage control 180V=

Switch in ON position: S1-1, S1-4, S2-1, S2-3, S3-1 to S3-4

#### Torque control

Switch in ON position: S1-1, S1-4, S4-1

**All other switches in OFF position!**

## Set point / actual value

### Set point

#### Setpoint voltage

Setpoint potentiometer Resistance >1 kΩ (2.5 ... 10 kΩ)  
 Input resistance 50 kΩ  
 Input voltage 0 ... max. +12 V=

#### Setpoint from current source

External terminating resistor 12 V / 20 mA = 0.6 kΩ

### Integrator

#### Setting

Potentiometer INT P5 Area  
 clockwise longer time 0.08 to 5 sec.

## Actual value

### Speedometer control

DC tachometer  
 Alternating current or three-phase tachometer with rectification  
 Speedometer voltage maximum -180 V=  
 IxR potentiometer P1 Left stop!

### Speedometer - Coarse adjustment - Switch positions

| Speedometer voltage | S3-1 | S3-2 | S3-3 | S3-4 |
|---------------------|------|------|------|------|
| 90 ... 180 V        | ON   | ON   | ON   | ON   |
| 60 ... 140 V        | ON   | OFF  | ON   | OFF  |
| 20 ... 60 V         | OFF  | ON   | OFF  | ON   |
| 11 ... 20 V         | OFF  | OFF  | OFF  | OFF  |

## Speed - fine adjustment

### Setting

Potentiometer nminP4 Area  
 Potentiometer nmaxP2 -0.2 ... 2 V Setpoint value  
 clockwise higher speed 50 % of the coarse setting

**Attention:** First adjust nmin then nmax



## Armature voltage control

| Armature voltage control |      |      |      |      |
|--------------------------|------|------|------|------|
| Setting switch S3        |      |      |      |      |
| Armature voltage         | S3-1 | S3-2 | S3-3 | S3-4 |
| 90 ... 180 V             | ON   | ON   | ON   | ON   |
| 60 ... 140 V             | ON   | OFF  | ON   | OFF  |
| 20 ... 60 V              | OFF  | ON   | OFF  | ON   |
| 11 ... 20 V              | OFF  | OFF  | OFF  | OFF  |

## Speed fine tuning

### Setting

Potentiometer nmin P4  
Potentiometer nmax P2  
clockwise higher speed

### Area

-0.2 ... 2 V Setpoint value  
50 % of the coarse setting



**Attention:** First adjust nmin then nmax

## IxR compensation

- Voltage drop at the internal resistance of the motor
- Compensation through current-proportional speed increase

### Setting

Potentiometer IxR P1  
clockwise greater compensation

### Area

0 ... 40 %

- at 10 % speed
- Increase load up to 100
- Increase compensation
- load speed >>> idle speed



### Attention:

With armature voltage regulation, the Device zero connected with high impedance to the mains potential.

## Torque control

- Speed controller wired with amplification -1. Switch S4-1 closed
- Switch S2 all contacts OFF
- no tachometer, no armature voltage feedback
- Switch S1-1, S1-4 closed

## Current / speed controller

### Power

#### Current limit

##### Setting

Potentiometer I<sub>max</sub> P6  
clockwise higher current limit  
Measure current

##### Area

0 ... 100 %

>>> Ammeter in the armature circuit

#### PI circuit Current controller

Setting with DIP switch S1

##### P values

150 KΩ  
60 KΩ  
35 KΩ  
26 KΩ

##### Reinforcement

0,68  
0,27  
0,16  
0,12

##### S1-3

OFF  
OFF  
ON  
ON

##### S1-4

OFF  
ON  
OFF  
ON

##### I-values

0,22 μF  
0,8 μF  
1,2 μF  
1,8 μF

##### S1-1

OFF  
ON  
OFF  
ON

##### S1-2

OFF  
OFF  
ON  
ON

Integral time constant = I value x P value x 4

## Speed controller

#### PI circuit Speed controller

Setting with DIP switch S2

##### P values

330 KΩ  
165 KΩ  
110 KΩ

##### Reinforcement

3,3  
1,65  
1,1

##### S3

OFF  
ON  
ON

##### S4

OFF  
OFF  
ON

##### I-values

0,22 μF  
0,69 μF  
1,20 μF  
1,69 μF

##### S1

OFF  
ON  
OFF  
ON

##### S2

OFF  
OFF  
ON  
ON

Integral time constant = I value x P value x 4

##### Setting

Potentiometer  
clockwise greater amplification

##### Reinforcement

XP P7

##### Area

3 ... ∞

Enable open, setpoint zero

## Switch on the mains.

The motor must stand still without torque.

## Close release switch

The release LED must light up.

Slowly turn up the setpoint potentiometer.

The motor must accelerate according to the setpoint voltage.

(If the motor immediately runs at full speed or full voltage is immediately applied, the actual value connection terminal 6-7 must be replaced).

## Speed setting

Use the selector switch S3 to carry out the actual value coarse adjustment.

At 1 V setpoint, set the speed to 10 % with potentiometer nmax (P2).

Set the minimum speed with potentiometer nmin (P4).

Increase the setpoint to 10 V and set the maximum speed with potentiometer nmax (P2).

## Current setting

Ammeter in the armature circuit.

Set potentiometer I<sub>max</sub> to the left stop.

Motor blocked (disconnect field).

Set the permissible motor current by turning the potentiometer I<sub>max</sub> (P6) clockwise.

## Gain speed controller

|                  |                 |            |             |
|------------------|-----------------|------------|-------------|
| Default setting: | P-amplification | S2 -3 = ON | S2 -4 = OFF |
|                  | I share         | S2 -1 = ON | S2 -2 = OFF |

With large flywheel masses, S2 -2 must be closed and S2 -3 can be opened.

With predominantly frictional load, S2 -2, S2 -4 can be closed and S2 -1, S2 -2 can be opened.

become.  
The fine adjustment is done with the potentiometer XP (P7).

LED Turn the potentiometer to the right until the LED RVU flickers, then turn it to the left until the lights up evenly or is dark.

The brightness of the LED indicates the current requirement of the drive.

# Settings

## Adjustment without measuring equipment

Connect the motor,

Set point=10 %  
 XP =50 %  
 Switch S2 -3=Position ON  
 Switch S2 -4=Position OFF

Enable controller

Turn potentiometer Xp clockwise until the drive oscillates.  
 LED D1 (RVU) flickers.

### No vibration is achieved:

- Set switch S2 -3 to OFF position
- Set to oscillate with XP potentiometer
- LED D1 (RVU) flickers
- Turn potentiometer XP anticlockwise until the oscillation subsides
- LED D1 (RVU) lights up evenly
- Turn the XP potentiometer 2 positions further to the left.

Set switches S2 -1 and S2 -2 so that the drive runs smoothly after approx. two oscillations at a setpoint jump of 50 %.

### Drive behaviour:

Gain too small

Gain too large

long-wave vibrations 1...0, 1Hz  
 long overshoots

short oscillations 30 ... 200 Hz  
 shakes >when accelerating



## Notes on the EC Directives 89/336/EEC

The EN61000-2 and EN61000-4 standards are complied with under the following conditions.

### Speedometer control

Unit, mains choke or transformer, armature choke on mounting plate  
500 x 500 x 2 mounted.  
Motor interference suppressed by collector capacitors.  
Mounting plate connected to PE via 10 mm<sup>2</sup>.  
Motor housing connected to PE via 10 mm<sup>2</sup>.  
Terminal 5 via 2.5 mm<sup>2</sup> to PE.

### Connection via mains choke

Mains choke with filter Type K 78-16 F  
Line length throttle unit 200 mm  
Armature choke type EI 135 A- 12  
Line length throttle unit 200 mm

### Connection via isolating transformer

Transformer with filter type TE 17/3 F  
Cable length transformer unit 200 mm  
Armature choke type EI 135 A- 12  
Line length throttle unit 200 mm

### Control line connection

All cables twisted <1.5 m. No shielding.