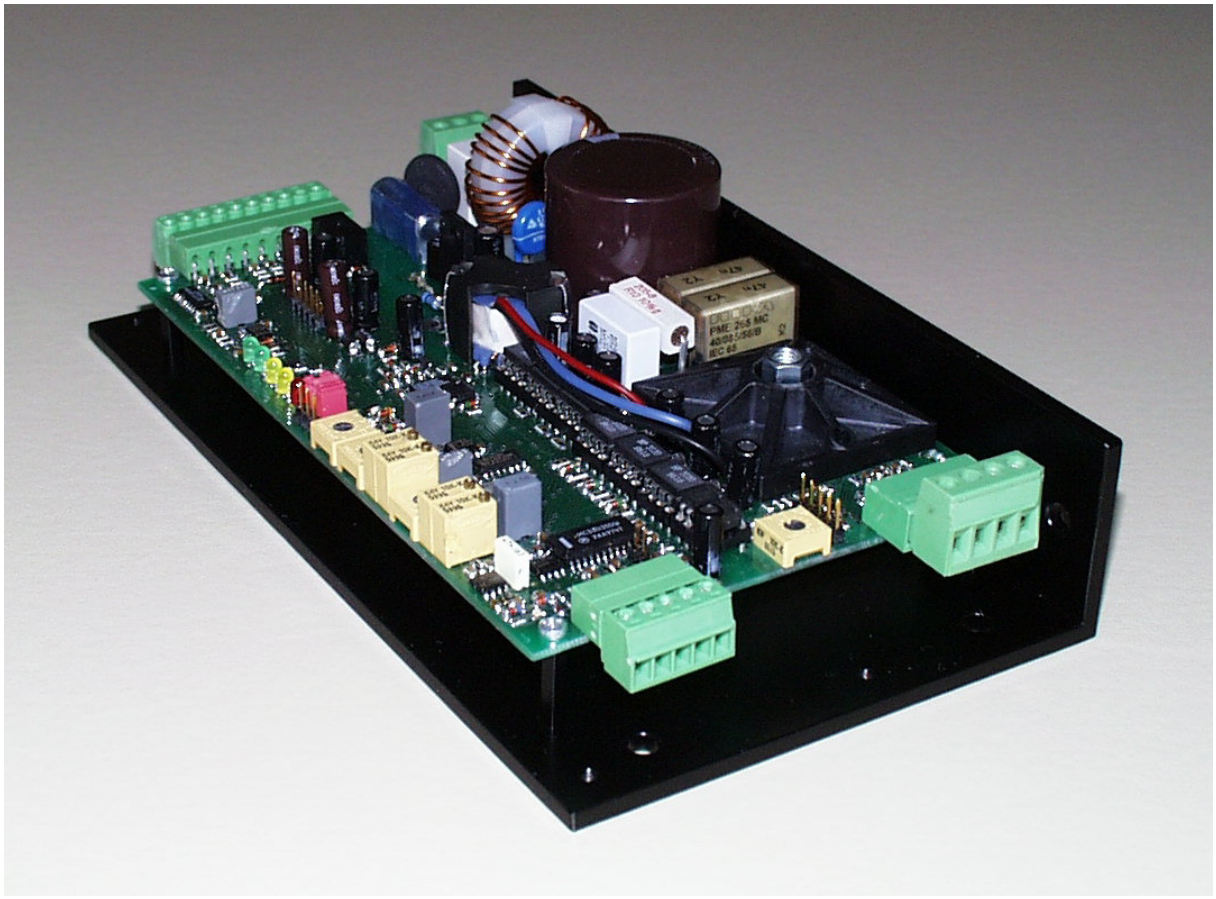
ANTEK
ANTRIEBE & ELEKTRONIK

Technical Documentation

for

1Q–Drive regulator ECE 3 AP

for Permanent-excited Three-phase Synchronous Motors and Brushless Direct-current motors up to 0,7 kVA



Technical Documentation	1Q-Drive regulator ECE3AP
Document	R0045JGB.doc
Version	03/04

Contents:

The text at hand is a translation which, before use, is to be examined by a professional engineer of the company using it for its technical accuracy and agreement.

1. General Information

1.1 Manufacturer

ANTEK GmbH
Im Köchersgrund 1
71717 Beilstein

☎ +49 7062 94060
+49 7062 940620
info@antek-online.de
www.antek-online.de

1.2 Shipping Contents

The following are shipped with the unit:

- 1 Drive Regulator ECE3AP
- 1 Operating Manual
- all necessary connectors

Upon receipt, examine the contents for completeness. The manufacturer, ANTEK – Antriebstechnik GmbH, assumes no liability for later shortage claims.

1.3 EC - Advantages

The prominent advantages of permanent-excited, three-phase synchronous motors (EC-Motors, brushless DC motors), especially in the lower power range, such as:

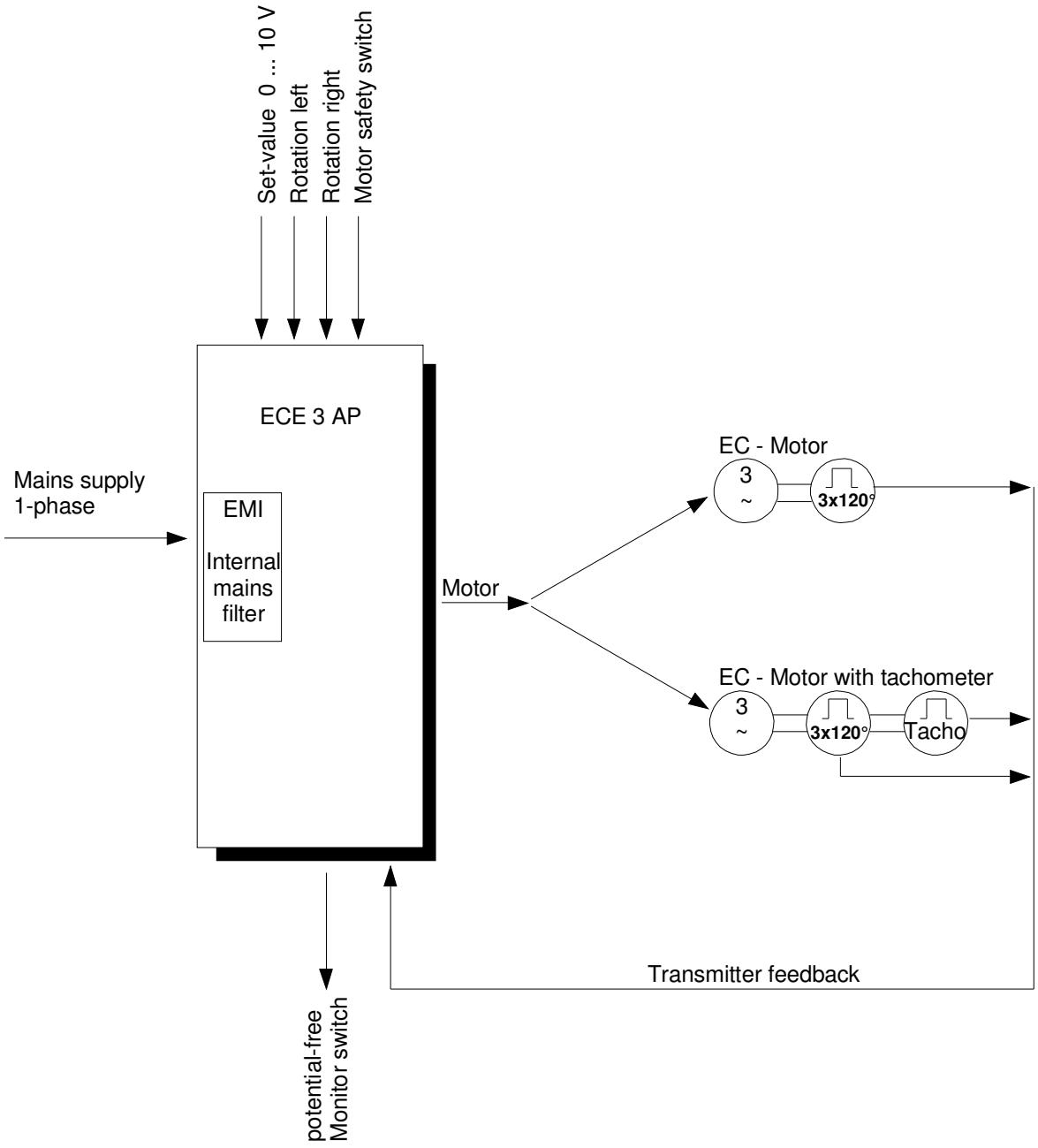
- high power density
- high durability / long-life due to wear-free commutation
- high efficiency for economical operation
- broad speed-range and excellent control-behavior at full motor power
- high torque consistency
- highly dynamic
- vibration-free, practically silent operation

compared to conventional DC- or AC drives, have replaced these in many areas, or first allowed for complex and intelligent drive solutions.

Our compact 1-Quadrant Drive-regulator ECE3AP supports the above advantages. The signals from the rotor position transmitter are fed back to the drive as actual values so that a sufficient RPM accuracy can be achieved without an additional tachometer.

1.4 Description

- 1Q Drive-regulator
- Power-range: max. 0,7 kVA
- Multiple-voltage input
- all internal voltages generated by the secondary-circuit
- integrated secondary-circuit charging connection
- Space-saving, economical construction on mounting bracket / heat-sink
- Also available with integrated EMI-Filter for compliance with EMI-standards N 50011-B



1.5 Proper use

- The electronic drive regulator ECE3AP is for controlling and regulating variable-speed permanent-excited, three-phase synchronous motors.
- The drive regulator ECE3AP is an electrical device for use in industrial systems. The drive is intended for installation in switching cupboards or cabinets for drive systems.
- Voltage-converters meet the EG safety standards for low-voltage.
- Drive systems incorporating the regulator ECE3AP comply with EG-standards for EMI when installed per the directives for CE-typical drive systems.
- The CE-typical drive systems with these voltage changers are intended for
  – operation on public and non-public networks.
  – use in the industrial area as well as in residential and business areas.
- CE-typical drive systems are not compatible with IT-networks (networks without reference to earth-ground) due to the earth-ground reference of the radio-interference filter.
- The converters may not be operated on networks with a grounded phase.
- The converters are not household devices, they are intended for the construction of drive systems for commercial use.
- The converters are not machines according to the EG-directives for machines.

The converter is only to be operated under the operating conditions stated in this operation manual. Before installing the device, read this manual from beginning to end and . follow the directions stated herein:
Store this manual near the converter for future reference.

1.6 Disclaimer

Liability
The information, data and instructions stated in this operating manual were up-to-date as of the date of print. No claims can be made against previously delivered converters based upon statements, illustrations/photos or descriptions contained in this operating manual.

The process-specific instructions and circuit extracts contained in this manual are recommendations. Their applicability for the task at hand must first be verified.
The firm ANTEK – Antriebstechnik GmbH assumes no liability for the suitability of the described processes and circuit suggestions contained herein.

No liability will be assumed for damages or malfunctions caused by:

- disregard of this operating manual
- unauthorized modifications made to the converter
- operator errors
- improper working on and with the converter

Guarantee
Guarantee claims are to be made to the manufacturer as soon as a fault / defect is discovered. The guarantee will be voided by:

- improper use of the converter
- improper working on and with the converter

1.7 Definitions

Qualified Personnel
Qualified personnel are persons who, due to their training, experience and instructions, as well as their knowledge of relevant standards and directives, safety-regulations, company policies, and entitled by those responsible for the safety of the system, are justified to carry out necessary tasks and recognize and avoid possible dangers.
(Definition for qualified employees per IEC 364)

Operator
An operator is any natural person or legal entity who operates the converter, or in whose name the converter is operated.

Drive regulator
The term drive regulator will be used in the following to describe the converter ECE3AP.

2. Safety

2.1 General Safety Information

The drive regulator was state-of-the-art at the time of delivery and is considered principally safe to operate. The drive regulator may present certain dangers to personnel, the drive regulator or other assets of the operator when:

- non-qualified personnel work on or with the device,
- Operation of the regulator in other mountings or connections, other than described in this manual.

Then exists danger for:

- Persons
- The drive regulator
- Other real value of the operator

The drive regulator must be considered in the planning to ensure that the devices safely fulfill their intended purpose when correctly installed and operated. This also applies in combination with the complete system.
Take precautions to ensure that no damage may occur in the event of a malfunction of the drive regulator through the use of:

- additional devices to override the function of the regulator
- electrical or mechanical safety devices
- complete system measures

Ensure that no material damages may occur in the event of a regulator fault by implementing the proper safety measures.

2.2 Operating Manual

This operating manual contains safety instructions for correct operation on and of the drive regulator, they are to be followed.

In addition to the general safety instructions contained in this chapter, the instructions contained in the manual text must also be followed.
No claim is made that the safety instructions are complete. Please contact the manufacturer in the event of questions or problems.

This manual must be available to all persons who work on or with the drive regulator and must remain in good, readable condition.

2.3 Operator Responsibilities

Responsibilities of the operator or safety officer:

- to ensure adherence to all relevant directives, instructions and laws,
- to ensure that only qualified personnel operate on or with the drive regulator,
- to ensure that the operating manual is available to all personnel.

2.4 Personnel

Only qualified personnel may work on or with the converter.

2.5 Drive Regulator

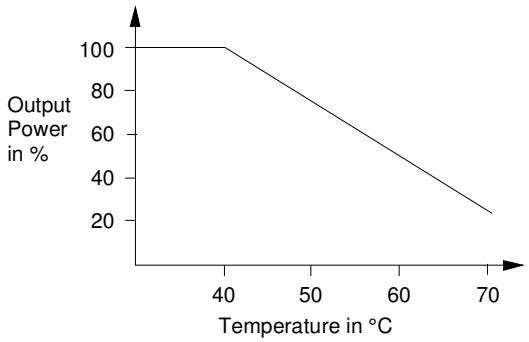
Only operate the drive regulator in faultless condition. The authorized operating conditions and power limits are to be adhered to.

Retrofitting, modification or conversion of the drive regulator is prohibited. Any of these must first be discussed with the manufacturer. The drive regulator is a device for use in industrial, high-voltage systems. All covers must be in place during operation to prevent the possibility of electrical shock.

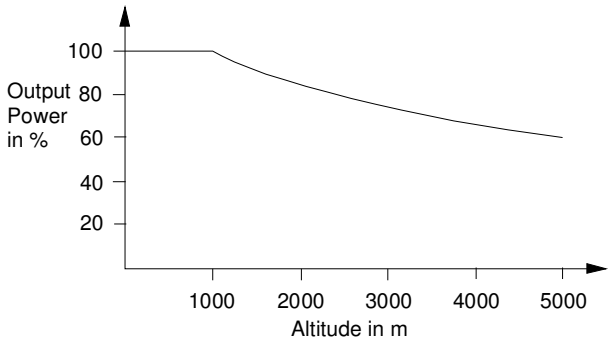
3. Technical Data

3.1 General Data / Operating Conditions

Temperature range: 0°C ... +40°C without power-loss
40°C ... +70°C with power-loss



Altitude tolerance: under 1000m without power-loss
over 1000m with power-loss



Humidity tolerance: Humidity class F without condensation (average relative humidity 85%)

Degree of soiling: VDE 0110 Part 2 level 2

Interference emission: EN 50081-2, EN 50082-1 requirements
Class B limits per EN 55011 (residential)

Interference immunity: Meets standards without mains filter.
Requirements per EN 50082-2

Requirement	*Norm*	*Intensity*
Burst	EN 61000-4-4	4kV
ESD	EN 61000-4-2	Enclosure 8KV Connectors 4kV
Voltage drops	EN 61000-4-11	
High frequency	EN 50141	10V/m
Voltage surge	EN 61000-4-5	Class 1

Insulation: Over-voltage category II per VDE 0100

Protection class: IP 00

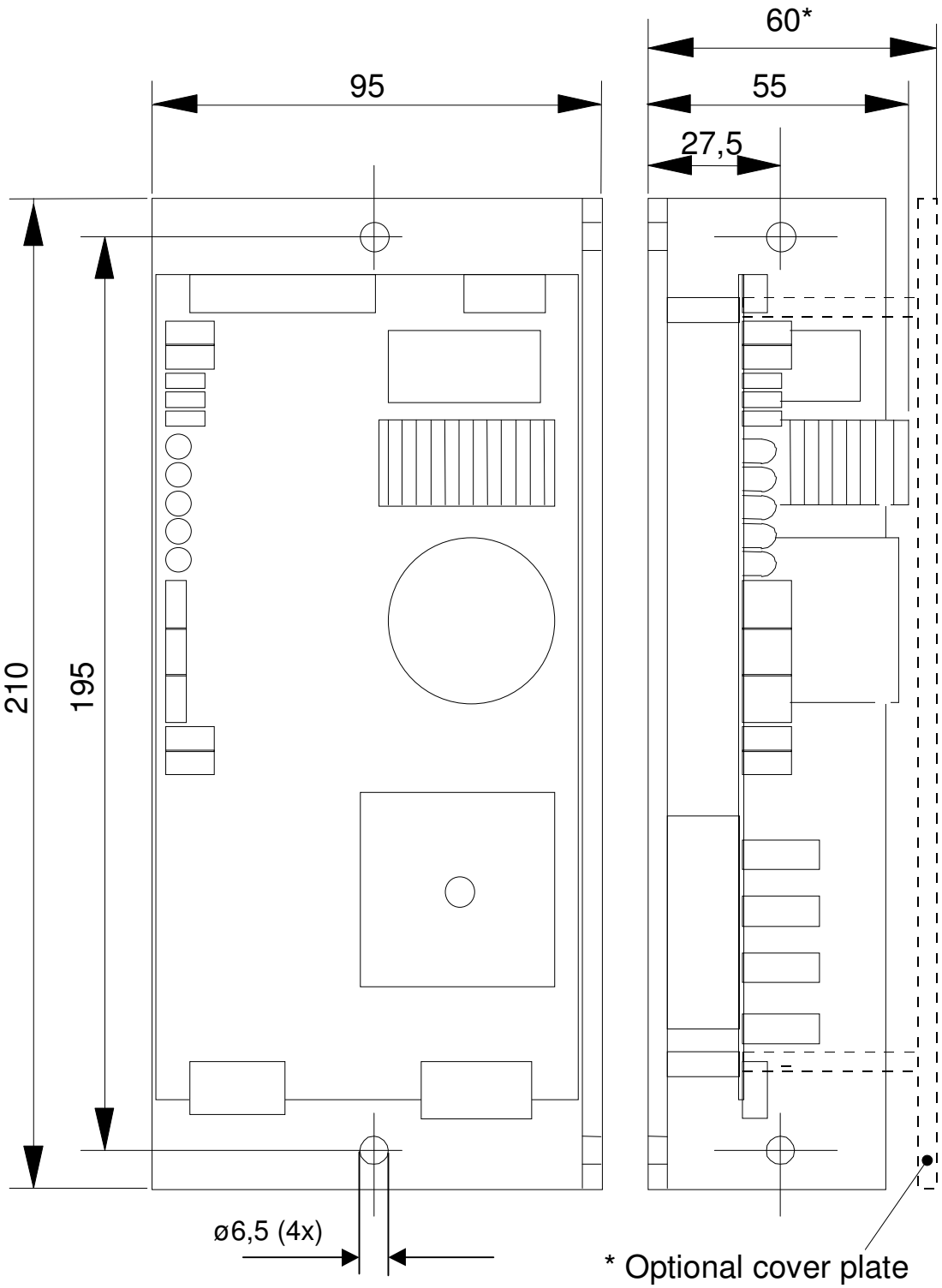
Mounting position: vertical

3.2 Ratings ECE3AP

Mains supply voltage:	U_N	90 ... 250 VAC, 45 ... 66 Hz
Nominal supply current:	I_N	3 AAC
Internal fuse:		6,3 AT
Output voltage:	U_M	0 ... 90% UZK
Max. Output current:	I_{Mmax}	6 A / Phase
Continuous current:	I_M	3 A / Phase
Nominal output power[1]:	S_N	0,7 kVA
Efficiency:	η	approx. 95%
Amplifier frequency:	f_M	16 kHz
Power dissipation no-load[2]:	P_{V0}	ca. 18
Power dissipation full-load:	P_V	ca. 40 W
Max. heat-sink temperature:	ϑ	ca. 80 °C
Control range:	1 : 40	(with rotor position transmitter)
	1 : 500	(with incremental tachometer ≥ 500 Imp/Rev.)
Weight:	580 g	

[1] Based on mains voltage of 230 VAC
[2] Dissipation at 3A phase-current and 16 kHz oscillator frequency

3.3 Dimensions



4. Installation

4.1 Mechanical Installation

- The drive regulator may be mounted vertically or horizontally.
- Allow a distance of 50 mm above and below the drive regulator for air-circulation
- Ensure the unobstructed circulation of exhaust air
- When the cooling air is contaminated by dust, lint, aggressive gases and greases, which could impair the functioning of the drive regulator, sufficient countermeasures must be taken, e.g. separate air ducts, installation of filters, regular cleaning etc.
- Do not exceed the permitted operating temperature range.
- If the drive regulator is exposed to vibrations or tremors, vibration damping is required.

4.2 Electrical Installation

- The regulator contains components sensitive to electrostatics. Before installation and service work in the terminal clamp area, the staff must free itself of electrostatic electricity. The discharging can be achieved by touching a grounded metal surface beforehand.
- Due to the discharge currents of the drive regulator (>3,5 mA) via the protective conductor (PE), the input diameter of the protective conductor must be at least 10 mm² Cu according to DIN VDE 0160, or a second protective conductor must be laid, electrically parallel. With greater connection powers, the minimum diameter of the protective conductor must correspond to the diameter of the external conductors.
  (see DIN 57100 Part 540)
- The regulations for the minimum diameter of PE conductors must be observed.
  The diameter of the PE conductors must be at least as large as the diameter of the conductor connections.
- The drive regulator can only be safely switched using a mains contactor in the input.
- To protect the power supply cables, the recommended cable protection fuse is required
- We recommended conducting the temperature monitoring of the motor using a thermal protection switch and the monitor switching, which is integrated in the converter.
- Control wiring and power cables must always be spatially separated from each other.
- Set-value inputs, analog control inputs and measurement outputs must be shielded.
- Conductor diameters for power supply and motor wiring must be at least 1,5 mm²!
- Observe the current local safety regulations.

4.3 Information on EMC

In order to guarantee electromagnetic compatibility (EMC) in your switch cabinets in an electrically raw environment, the following EMC rules are to be observed during construction and set-up:

- All metallic parts of the switch cabinet are to be connected flatly and in a well-conducting manner (not lacquer on lacquer!). If necessary, use contact or scraper wafers. The cabinet door is to be connected with as short a circuit as possible via the metal powder tapes (upper, middle, lower).

- Signal lines and power cables are to be laid separated from each other in order to avoid coupling intervals. Minimum distance: 20 cm:

- Signal lines should be led to the cabinet from only one level, if possible.
  Unshielded lines from the same electrical circuit (outgoing and return circuit) are to be transposed, if possible.

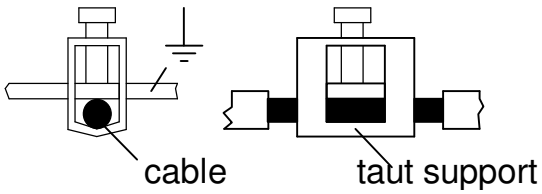
- Contactors, relays and magnetic valves in the switch cabinet, if necessary in the adjacent cabinets, are to be wired with suppressor combinations, e.g. with RC elements, varistors or diodes.

- The braiding from signal lines are to be laid two-way (source and target), large-area and well-conducting to a ground[1]. In case of poor potential equalization between shielded connections, an additional balancing network of at least 10 mm² must be laid parallel to the braiding to reduce the current.

- Wiring is not to be laid freely in the cabinet, but should rather lead as tightly as possible to the cabinet frame or to installation plates. This also applies to reserve cables. At least one end of them must lie grounded, but preferably both (additional shield effect).

- Unnecessary wire lengths are to be avoided. Coupling capacities and coupling inductance's are thereby kept small.

- The braiding from leads, such as resolver or incremental tachometer cables, must be laid to the frame grounding. Approximately 2 cm of the insulation is to be removed in the area where the cable is to be led into the frame in order to expose the braided cable. The braided cable may not be damaged while removing the insulation. The cable is to be led at the position where the insulation has been removed by grounded terminals or taut supports.

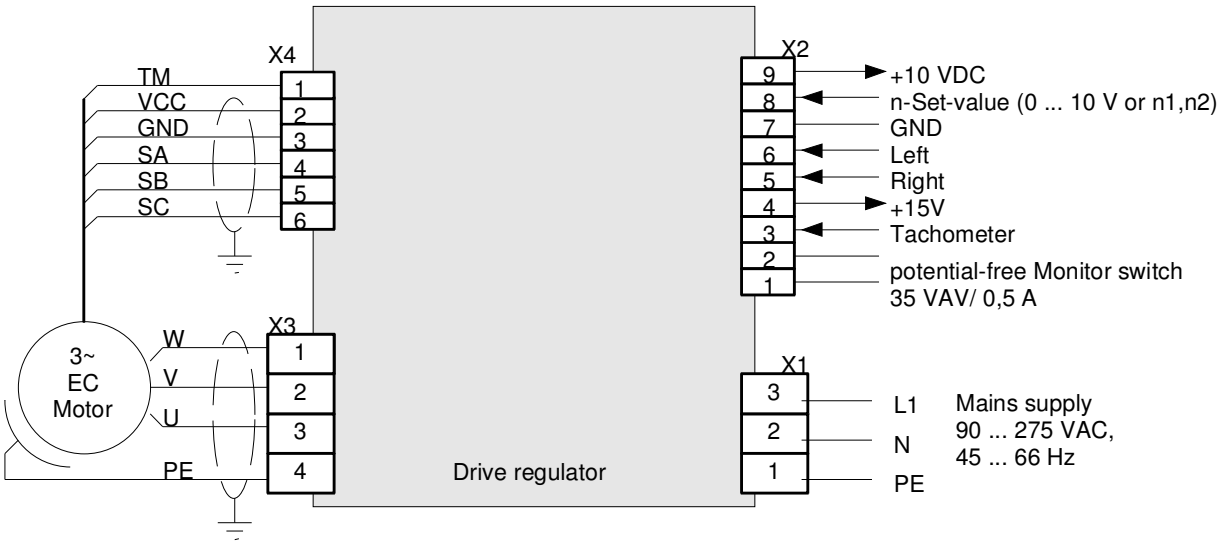


[1]Generally all metallic conducting parts which can be connected to a protective conductor, such as cabinet frames, motor frames, foundation grounding, etc. are designated as a ground.

4.4 Connections

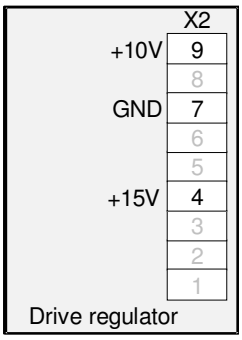
4.4.1 Power and motor connection

- Minimum. wiring diameter for power and motor winding connections 1,5 mm²
- Power wiring to the plug-in connecting terminals X1
  Connect N, L1, PE
  (Starting torque: 0,5 - 0,6 Nm)
- Motor wiring to the connecting terminals X3
  Connect PE, W, V, U
  (Starting torque: 0,5 - 0,6 Nm)
- Rotor position transmitter to the connecting terminals X4
  Connect VCC, GND, SA, SB, SC
  Sensor wiring must be shielded.
- Shield must be correctly mounted according to EMC - compatible wiring (see chapter 4.3)



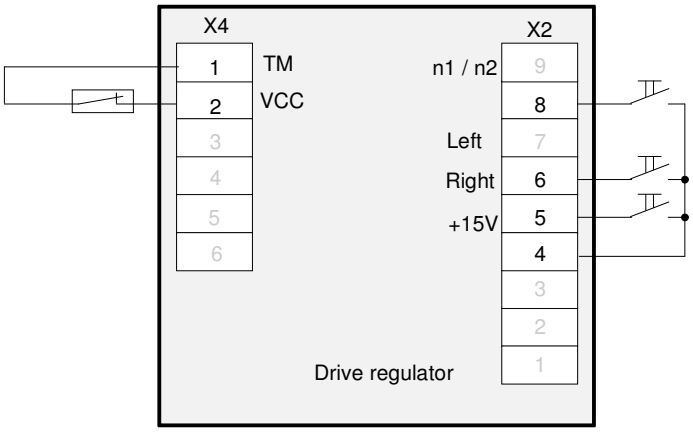
4.4.2 Control connections

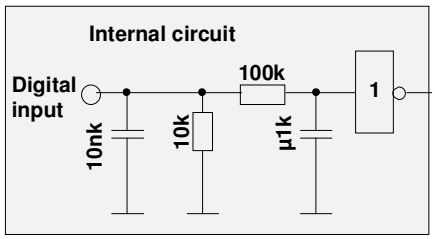
4.4.2.1 Auxiliary voltages



+10V (X2-9) max. load 3 mA
+15V (X2-4) (13…17V) max. load 50 mA
GND (X2-7)

4.4.2.2 Connection of digital signals





Level definition

HIGH = +12 ... +35 VDC
LOW = 0 ... +2 VDC or open
Reference potential: GND
Input resistance: Ri = 10kOhm

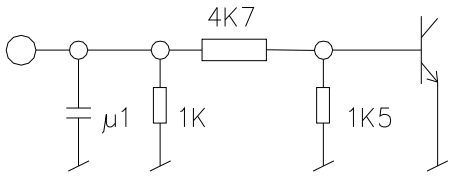
Ensure common reference potential when controlling via peripheral devices!

n1 / **n2** (X2-8) The fixed speeds function can be selected with the jumper STB3 „Set value source„ (see chapter 5.3).
HIGH = Selection fixed speed n2
LOW = Selection fixed speed n1

Right (X2-5) HIGH = Selection of direction of rotation by connecting the corresponding control voltage.

Left (X2-6) If both direction of rotation inputs are selected, the power amplifier remains cut-off..
LOW = power amplifier cut-off

TM (X4-1)



Input level: Low = Motor to hot = < 2V

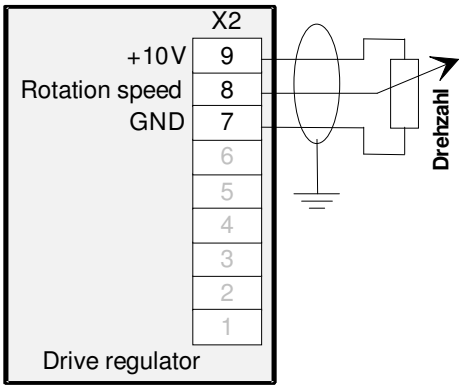
High = Motor O.K. = > 4V

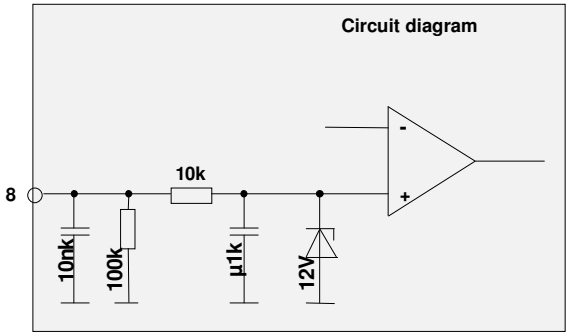
From the boards index A442d is dispenses the downward compatibility to previous versions.

Connection for the thermal circuit breaker (Break contact)
HIGH = Motor temperature in the work area, the LED „ϑ-MOTOR“ is lit up to indicate the input.
LOW = Motor on excess temperature, stand-by signal contact is (see chapter 4.4.2.4).

Note: If the motor does not have temperature monitoring via a thermal circuit breaker, the connecting terminal X4-1 must be installed to HIGH-Potential e.g. +15 V

4.4.2.3 Connection of the analog speed-set value

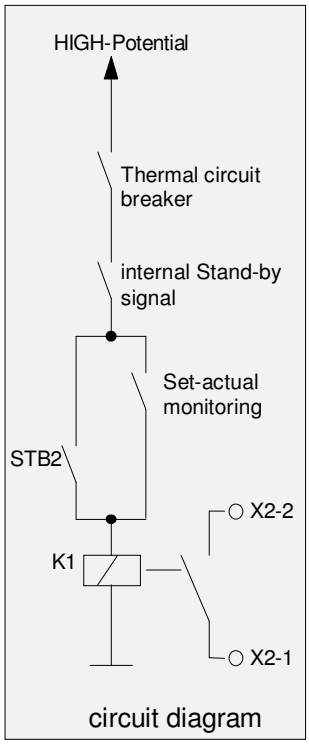




Analogue set-value wiring must be shielded.

Speed (X2-8) Unipolar input for the manual speed-set value specification. This function can be selected with the jumper STB3 „set value source„ (see chapter 5.3).
Input voltage: 0 ... +10 VDC
Input resistance: Ri = 100 kΩ
Reference potential: GND

4.4.2.4 Monitor output switch



floating relay contact
max. load capacity
35 VAC; 0,5A

(X2-1/2) The signal output connects several functions to each other and trips when a failure occurs. The connection is clearly shown in the circuit diagram.

Monitoring functions:
- Temperature monitoring via Thermal circuit breaker in the motor
- internal stand-by signal monitors
  a) the intermediary circuit voltage (95V < UZK <420) and
  b) the heat sink temperature < 80°C
- Optionally the function set value / actual value monitoring can be connected with plug bridge STB2.

If the regulator is cut-off when the stand-by signal is tripped, it must be connected externally!

Monitor output: terminal X2-1
terminal X2-2

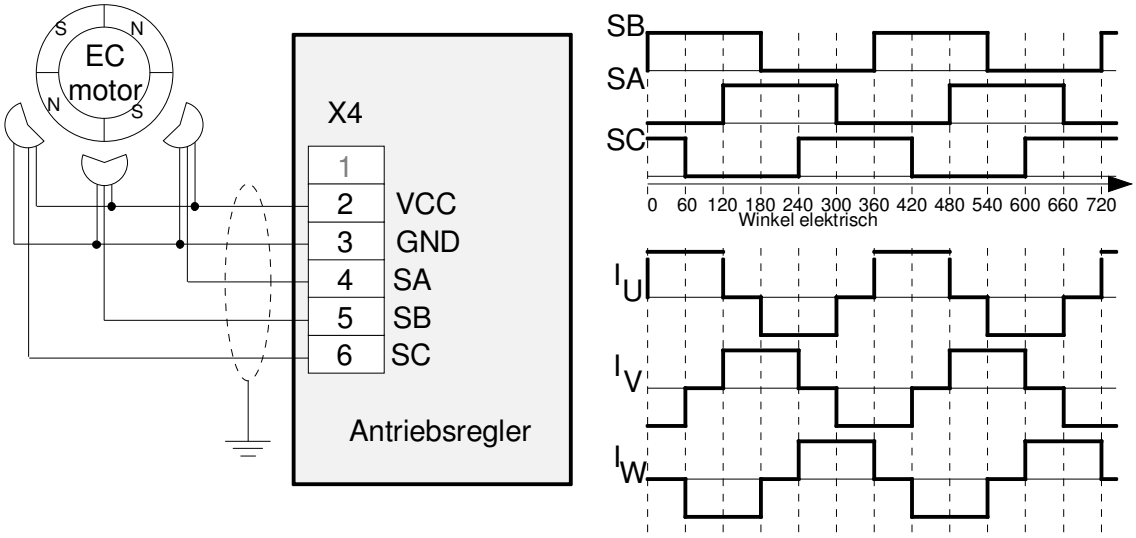
From the boards index A442d is dispenses the downward compatibility to previous versions.

4.4.3 Rotor position transmitter

The signals of the rotor position transmitters (3x120° staggered commutation sensors) are used for the commutation control of the motor phases. The actual speed is also recorded with the rotor position transmitter signals. With standard equipment a control range of 1:40 can be achieved.

The commutation sensors must be connected to the drive regulator according to the following diagram. The sensor wiring must be shielded.

VCC (X4-2)	Sensor power supply (Standard 15VDC; Optional 5/10/12VDC)
GND (X4-3)	Reference potential
SA (X4-4)	Rotor position transmitter with internal
SB (X4-5)	Pull-up resistances 1 kΩ, 6 V Reference voltage
SC (X4-6)	HIGH at input signal > 4 V
	LOW at input signal < 1 V



Speed gauging via rotor position transmitter

The speed is proportional to the signal frequency of the commutation sensors installed in the motor. If the frequency is gauged at a sensor input, the following applies:

$$n = \frac{f \times 60}{p}$$

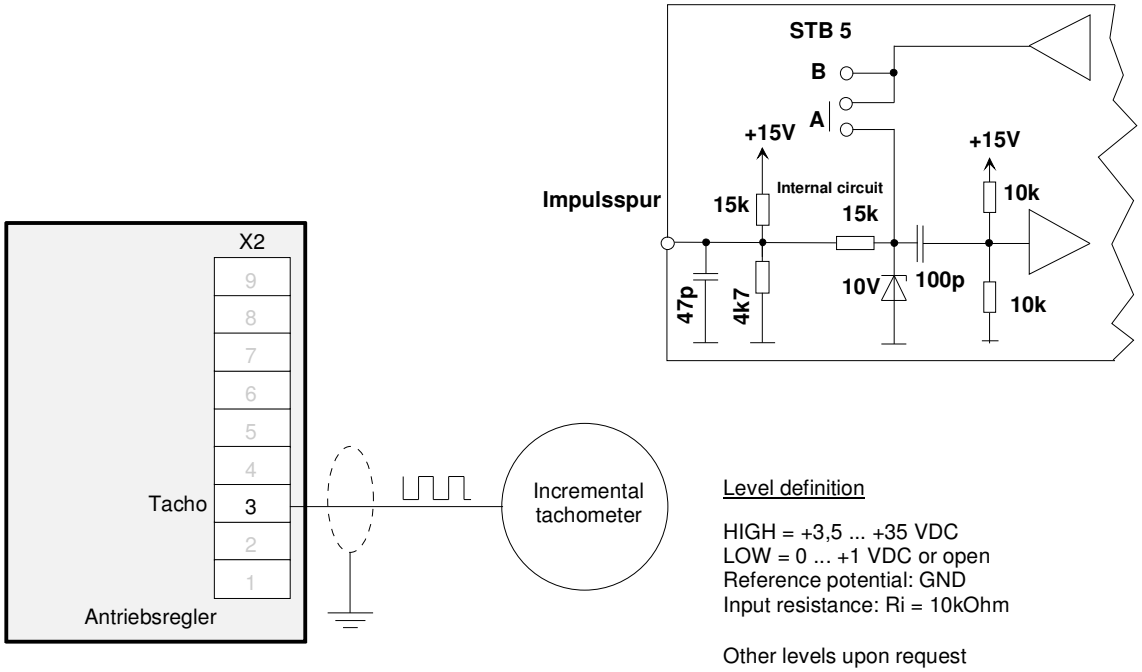
f ... Signal frequency [Hz]
p ... number of pole pairs
n ... Synchronous speed [r.p.m.]

4.4.4 Incremental tachometer

When an additional incremental tachometer with min. 500 Imp./Rev. is connected, a control range of 1:500 can be reached.

The commutation control is achieved by reading the rotor position. The higher control accuracy is reached due to the fact that the impulses from the tachometer have a higher resolution, and are fed-back as the regulating variable.

The sensor wiring must be shielded.



Tacho (X2-3) Pulse-train from incremental tachometer

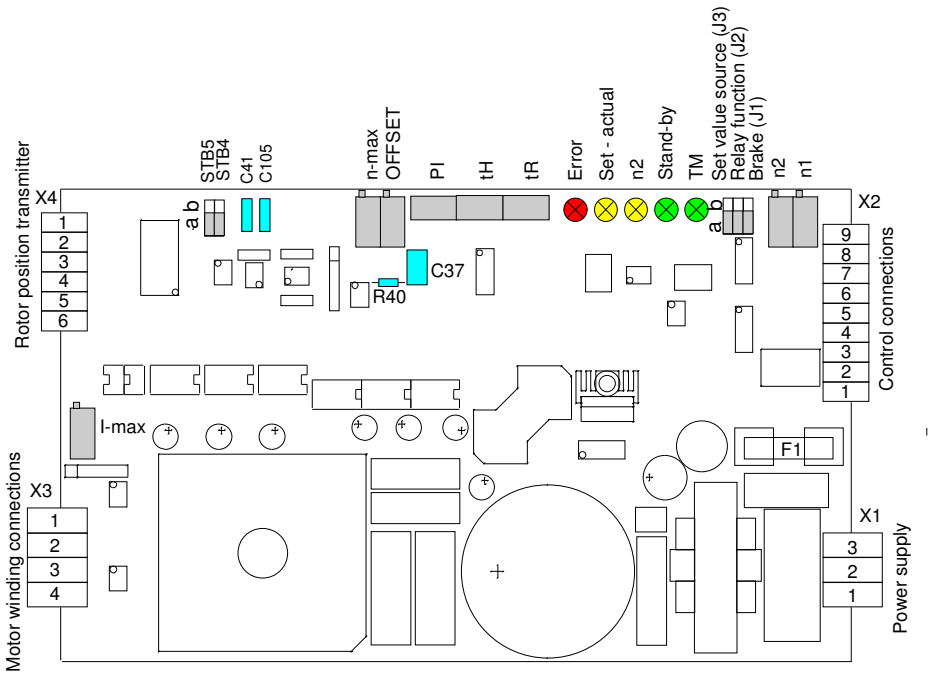
With STB 4+5 the operation of the control unit could be transliterated on acknowledge of rotation-operation by pulse generator.

STB 4/5 (plug by pairs) in Position A = Actual value by rotor position sensor.
Position B = incremental transducer.

Standard equipment 512 Imp./Motor rotations (conforming by ANTEK, if needed)
Attention! On position A, terminal 3 is an output for OR`d commutation-sensors.
On position B input incremental transducer .

From the boards index A442d is dispenses the downward compatibility to previous versions.

5. Service – Information



5.1 Indicators

Stand-by indicators: green (GN)
Error indicator: red (RD)
Status indicators: yellow (YE)

Error (RD) Excess current or inadmissible rotor position sensor condition

n2 (YE) Fixed speed n2 was selected

SET-ACTUAL (YE) The difference between set to actual speed is less than 20% of the currently specified set value speed. In the lower speed range (< 0,25 n-max.) this threshold increases.
The monitoring function is time-delayed.
With deviation 1% above/below threshold approx. 10 sec.
With deviation 100% above/below threshold approx. 0,5 sec.

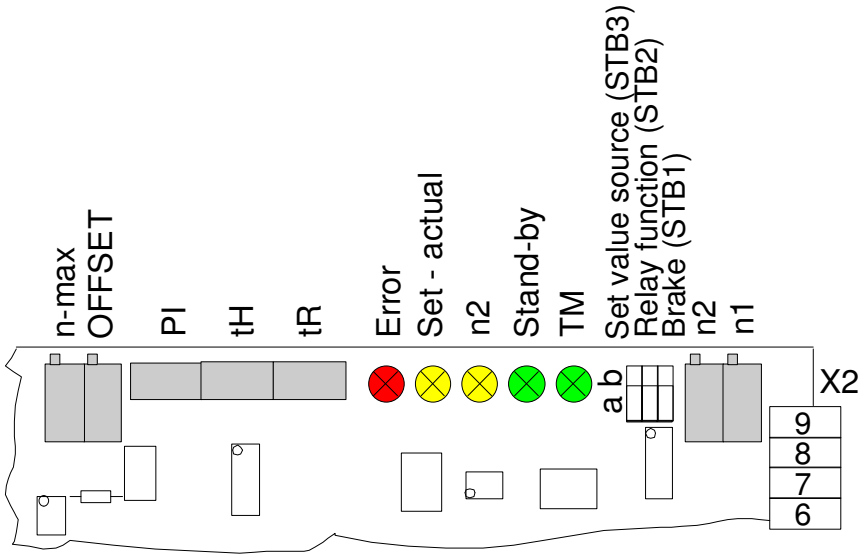
Stand-by (GN) ON = Control device ready for operation
OFF= Control device collective failure
- Intermediate circuit voltage > 420 V
- Intermediate circuit voltage < 95 V
- Heat sink temperature > 80°C

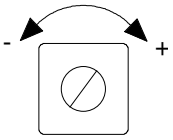
If there is a fault, the power amplifier is immediately cut-off. The fault signal remains active until it is acknowledged. It is acknowledged by removing the regulator release (Left or Right).

TM (GN) Input thermal circuit breaker motor is on High-Potential.

5.2 Trimmers

All of the trimmers required for the adjustment of the drive regulator to the respective application are located on the unit boards. All of the trimmers are pre-set to the standard parameters and/or the customer commissions so that the customer normally does not have to re-adjust the trimmers.





Adjustment right = value increases
Adjustment left = value decreases

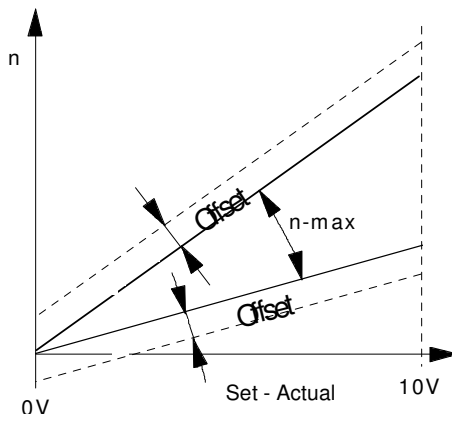
n-max

Setting of the maximum speed
1. Specify maximum set value voltage (10V).
2. Set the desired max. speed on the trimmer „n-max„ (see diagram at trimmer OFFSET and Chapter 4.4.3 Rotor position)

Setting range: 4-pol. Motor 2000 to 4500 r.p.m.^{1}
6-pol. Motor 1350 to 3500 r.p.m.$^{-1}$

OFFSET

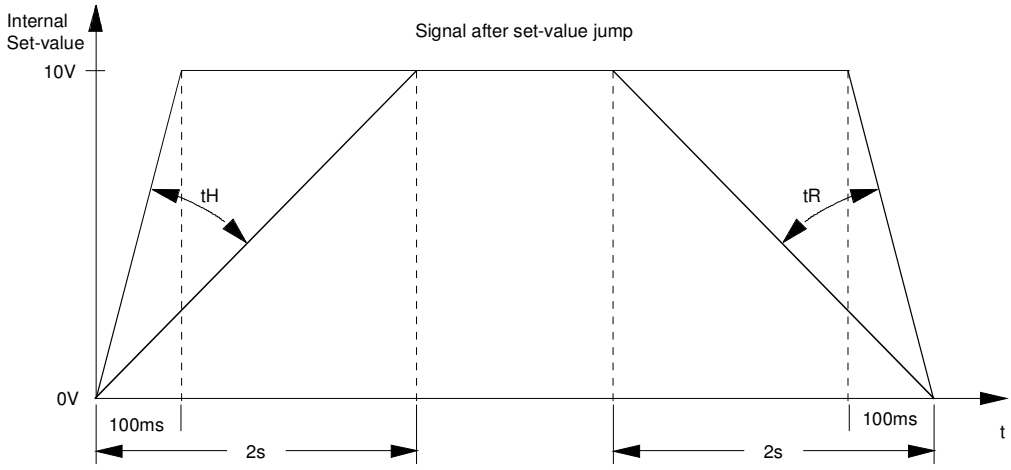
Speed offset adjustment
Set speed control to „0“ and select left or right rotation.
Adjust trimmer „OFFSET“ until Motor comes to a standstill.



I-max Factory adjustment, may not be altered.

tH Rise-time of the set value integrator
tR Fall-time of the set value integrator
Setting the set value slope

Specify set value jump (0 → 10 V) at the set value input and set the desired speed slope with trimmer „tH„ and/or „tR„.
Setting range: 300 ms ... 3 sec.
Other ramp times available upon request.

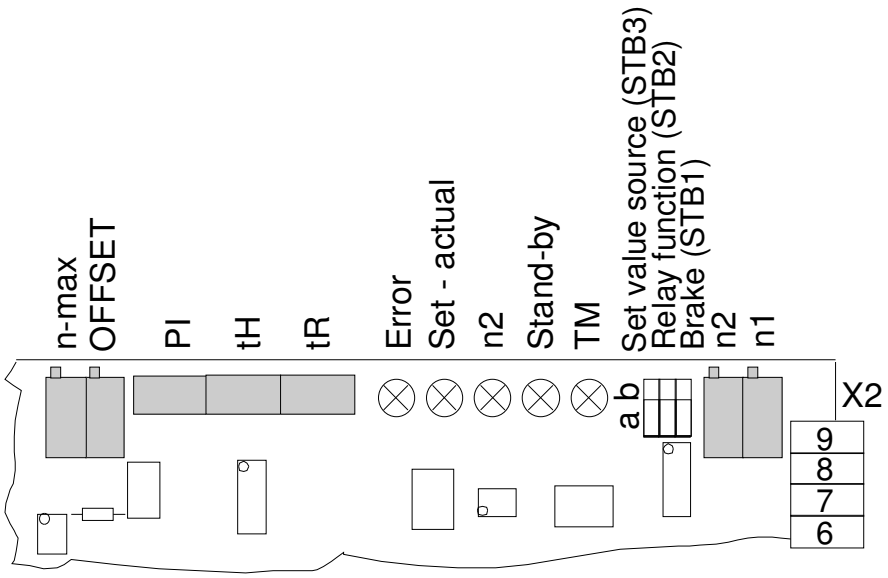


PI Setting of the speed control behavior. When necessary, adjust to the respective application. Clockwise rotation increases the proportional amplification.

Incorrectly set control behavior leads to vibrations of the drive which can destroy the motor or other components connected down-line (gears etc.).
The manufacturer assumes no liability for damages caused by incorrect parameterization.

C37, R40 The coarse adjustment of the speed control behavior can be adapted to a particular task with capacitor C37 and resistor R40. The manufacturer is solely responsible for determining the values for these components.

5.3 Jumpers



STB1
Brake function

Jumper position a
A cut-off of the control voltage on connecting terminal 2-5 and/or X2-6 causes the motor to come to a standstill. This is the normal operation mode of the control device..

Jumper position b with brake function for positioning
After the cut-off of the control voltage on connecting terminal X2-5 ad/or X2-6, the motor winding is short-circuited. The current is dependant upon the braking energy and must not exceed 8 A, otherwise the motor or the control device could be destroyed. If the jumper is plugged in Position a, the manufacturer is not liable for damages to the motor or the control device.

STB2
Relay function

Jumper position a
The function set-actual monitoring has an effect upon the stand-by signal output, the function result is an AND-operation.

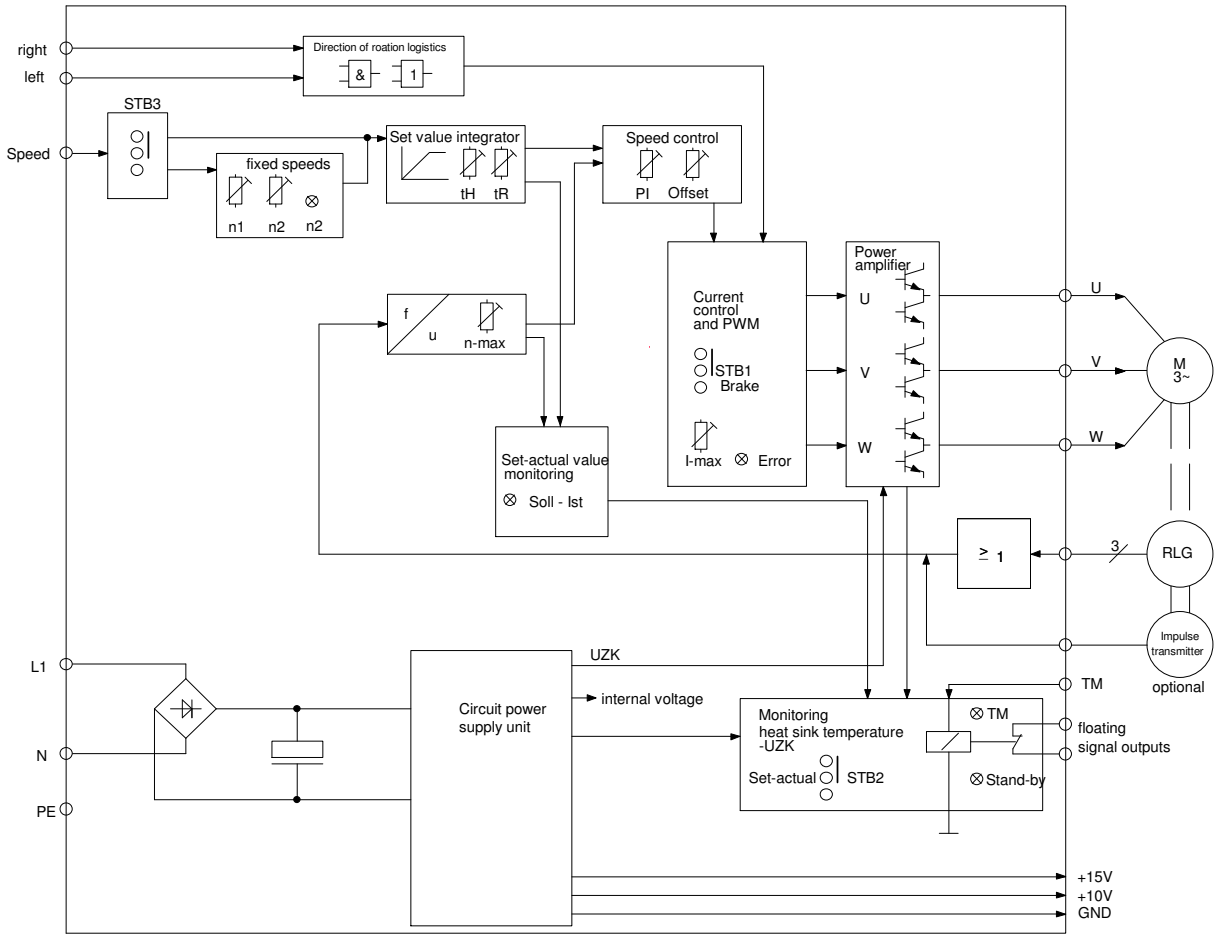
Jumper position b
The function set-actual monitoring has no effect upon the stand-by signal output.

STB3
Set value source

Jumper position a
The function fixed speeds is selected. Selection of the fixed speed via connecting terminal X2-8.
HIGH = Selection fixed speed n2
LOW = Selection fixed speed n1

Jumper position b
The function analog set value is selected.
Speed set value 0 ... 10 V to connecting terminal X2-8.

5.4 Block circuit diagram



6. Manufacturer's declaration

The manufacturer, ANTEK GmbH, herewith declares that the drive regulator ECE3AP must be used as a component of the control equipment for variable speed motors to be installed in a machine or to be used for the construction of a machine together with other components. The drive regulators are not machines as defined in the machine guideline 89/392/EWG.

Notes and recommendations for the installation and proper operation are included in this technical documentation.

The start-up of the machine is prohibited until it has been determined that the protection and safety requirements of the machine guideline 89/392/EWG including revisions 68/EWG are fulfilled.

In this technical documentation, the measures are described with which the drive regulator complies with the EMC-limiting values. The electromagnetic compatibility of the machine is based on the method and thoroughness of the conducted installation. The User is responsible for the compliance of the EMC guideline 89/336/EWG including the revisions 92/31/EWG during operation of the machine.

Norms and regulations observed

- Installation of high-voltage current plants with electrical operating equipment: DIN VDE 0160
- Regulations for the set-up of high-voltage current plants: DIN VDE 0100
- IP-protection systems: EN 60529
- Basis material for printed circuits: DIN IEC 249 Part 1
- Printed circuits, circuits boards: DIN IEC 326 Part 1
- Regulation of air and flow routes: DIN VDE 0110 Part 1-2
- De-charging of statically electricity (ESD): EN 50082-2
- Rapid transient interference factors (Burst): EN 50082-2
- Radio shielding of electrical operating equipment and plants: EN 50081-2, EN 55011