Repair instructions

ROTINA 35 / 35 R

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Abbreviations

CP	Control panel
FC	Frequency converter
SB	Supply board
CB	Cooling board
CC	Control cable
LL	Lid locking
BC	Braking chopper
BR	Brake resistor
MR	Mains reset, mains switch OFF - ON
EC	Error cause
ES	Error consequence
ER	Error remedy
M	Measurements
ECR	Error-code reset

1. Introduction

- Repairs must only be carried out by personnel authorised to do so by the manufacturer.

> ⚠ Interventions and modifications at centrifuges, which have been conducted by persons not authorized by the HETTICH company, are at their own risk and entail the loss off all guarantee and liability claims. In such an event any guarantee claim or liability claim against the HETTICH company expire.

- Only original spare parts and original accessories licensed by the Hettich company are allowed to be utilised.

> ⚠ If no original spare parts or no original accessories are used, any guarantee claim or liability claim against the HETTICH company ceases to exist.

- Information about the operation of the centrifuge please see operating instructions.
- We reserve all rights for these technical documents.

2. Description of the new Hettich centrifuges

2.1 Functional structure of the ROTINA 35 / 35 R

These microprocessor-controlled centrifuges are comprised of the following electrical components:

- Control panel (CP), microprocessor-controlled
- Supply board (SB)
- Frequency converter (FC, motor control), microprocessor-controlled
- Motor with speed sensor (speedometer)
- Braking chopper (BC) with brake resistor (BR)
- Lid locking (LL)
- Cooling board (CB), only Rotina 35 R

2.2 Control panel (CP)

The CP is the ”brain” or ”master” of the centrifuge.
Via a serial data bus system, the MASTER controls its SLAVE, the component:

  – frequency converter (FC)

The individual tasks of the CP are:

- Management of operator inputs and control of LCD display.
- Storage of 3 run programs.
- Control of components:
  - FC via the enabling circuit and via the serial interface.
  - cooling and fan.
- Evaluation of the speed sensor (speedometer).
- Evaluation of the imbalance switch.
- Evaluation of the FC fault alarm circuit.
- Evaluation of the LL open/closed signalling circuit.
- Control of the relay for the LL solenoid at rotor standstill
- Temperature measurement and sensor evaluation of the temperature sensor in centrifuge chamber (only refrigerated centrifuge).
- Routine for input, storage and transfer of temperature offset values.
- Format of the serial interface:

- 5 Volt interface with 3 conductors.
- (16-pole control cable, pole 6, 8 and 11).

- The CP is powered from the SB via the control cable:

  + 10...15 Volt pole 1,2
  GND pole 15,16

2.3 Supply board (SB)

The SB performs the following individual functions:

- 12 V DC and 5 V DC supply for the SB.
- 12 V DC supply for the CP.
- 12 V DC supply for the CB (only Rotina 35 R).
- Plugging station X5 for mains power supply, LL magnet and transmission of the signalling circuit for LL-switch (open/closed over opto-coupler to the CP).
- Power supply for speed sensor (speedometer).
- Plugging station X4 for speed sensor cable an0d transmission to the CP and FC.
- Control of the relay for the LL solenoid at rotor standstill
- Plugging station X3 for the imbalance switch and direct transmission of the imbalance signal to the CP.
- The 5 Volt interface with 3 conductors is converted to an RS 485 interface with 2 conductors:

- Interface to FC: RS 485-interface via 2 conductors.

- Transfer of primary enabling (=Hardware STOP) CP $\Rightarrow$ FC
- Transfer of fault circuit (FC-ERROR) FC $\Rightarrow$ CP

2.4 Frequency converter (FC)

The FC performs the following individual functions:

- Generation of the motor power supply.
  (3-phase AC current of variable frequency and voltage)
  Mode of operation: The mains supply is rectified, smoothed and chopped in three bridge elements to give a pulse-duration modulated supply.
- Monitoring of the motor current.
- Evaluation of the overtemperature switch in the motor (only version 115V, AC).
- Slave behaviour (handling of interrogations and commands from the CP via the serial interface):
  RS 485-interface with 2 conductors
  (10-pole control cable, pole 3 and 5).
- Evaluation of the primary enabling (Hardware STOP) for the FC
  (10-pole control cable, pole 7).
- Evaluation of potential faults and monitoring of the fault circuit (FC-ERROR)
  (10-pole control cable, pole 4).
- The electrical power, which resulted from braking, will be conducted to the BR. The braking chopper switches at a voltage:
  - from approximately 390V (230V series).
  - from approximately 200V (115V series).
- The BR is protected by an overtemperature switch. At a short circuit on the BC, which is located on the FC, the BR overheats because of high current. The overtemperature switch cuts off the voltage supply from the FC. After cooling down at the BR the voltage supply is switched on again.

- The CP issues the following via the serial interface:
  - Speed
  - Starting and braking levels
  - Control commands START, BRAKE, STOP
- State display by LED´s:

In standby mode	the green LED is on
In running mode	the green LED is on
In fault mode	the green LED flashes

If the FC processor detects a fault, it shuts down itself automatically and triggers the fault circuit (FC-ERROR). The CP then interrogates the type of fault via the serial interface.

2.5 Special features

- Multiprocessor concept:

  Although one microprocessor will fail, the other one will continue to monitor its assigned area.
  If the CP fails, the drive will be shut down automatically by the FC when no interrogations have been received via the interface for more than 30 seconds.
- Interface concept:

  Transmission of data is monitored by an extra check sum.
- Hardware concept:

  All switches with a safety relevant function are of the NC-contact type, which means that loose contacts and open-circuit faults can also be detected.

2.6 Motor / Tacho system

- The motor is a 3 phase asynchronous motor with 2 pairs of poles.
- A speed sensor (speedometer) attached to the motor receives the following from the transmitter attached to the rotor,
  - rotor code information (see section "8") and
  - speed data (6 pulses per revolution)
- The ACTUAL speed is monitored and controlled via the CP
  - Double safety: The FC is also programmed that no value of speed in excess of the maximum permitted rotor speed can be selected. The FC monitors the speed and switches off at excess speed with error code “ERROR 84”.
- Rotor standstill is monitored via the CP.
  - The lid can only be opened when the CP has detected standstill.

2.7 Imbalance switch

- A switch detects any imbalance.
- Imbalance can only be detected in running mode (starting, centrifuging and braking).
- If any imbalance is detected, the drive is changed over to braking.

2.8 Interlocking

- Opening of the LL is prevented by a latch. The LL can only be opened when the relay on the SB is energized by the CP. This occurs when the rotor is at standstill and mains power is applied. A solenoid is energized and releases the latch.
- The centrifuge can only be started when the lid is closed. A microswitch on the LL detects the position of the LL.

2.9 Cooling

- **Temperature behaviour:**
  - When rotor is at standstill and the lid is locked, the cooling is operating.
  - When rotor is at standstill and the lid is unlocked, there is no cooling.

2.9.1 Temperature sensor B1, in the centrifuge chamber

- This temperature is processed in the CP.
- The housing of the temperature sensor B1 also contains an overtemperature switch. In refrigerated centrifuges this switch cuts off the drive at > 60°C.

2.9.2 Function of the cooling board (CB) A3

- Plugging station (X3) for the temperature sensor and the overtemperature switch in the centrifuge chamber.
- The voltage of the temperature sensor in the centrifuge chamber plug X4 being transmitted over a 10-pole CC to the CP plug X101.
- The signal of the overtemperature switch in the centrifuge chamber plug X4 being onward transmitted over a 10-pole CC to the CP plug X101.
- Plugging station (X2) for the overheating protection B2 at the condenser.
- Relay circuit for the compressor and the fan. The overheating protection B2 at the condenser is series connected to the relay voltage.
- Plugging station (X1) for the compressor and the fan.

2.10 Fan

- The fans cool down the refrigerant flowing through the condenser.
- The fans are parallel-connected to the compressor.

2.11 Offset calibration

- Offset calibration is performed in order to equalize the tolerances of the temperature sensor and the electronics.

Perform Offset calibration when replacing:	Where/How
– the temperature sensor	calibrate the temperature sensor.
– the CP	calibrate temperature sensor and read out the old offset values and put them in the new CP.
– the CP-EPROM	Read out the old offset values and put them in the new CP.

2.12 Protection

Mains power input	⇒	Mains input with overvoltage protection
Mains switch	⇒	Thermal overload protection (fuse)
FC	⇒	Electronic protection
Motor	⇒	Overtemperature cutout > 135°C (only 115 V version).
Cooling	⇒	Overtemperature switch in centrifuge chamber and at condenser.

3. Troubleshooting procedures

- Fuses in installation in which centrifuge is installed are intact.
- Supply voltage present at (see circuit diagram):
  - Connecting cable
  - Appliance plug
  - Overvoltage protection (F1)
  - Mains switch (Q1)
  - Supply board, plug X5 (PIN 1, PIN 5).
- Look for the displayed error code in the chapter "Error messages".
- Remedy the error according to the instructions.
- Carry out a functional check after every repair and whenever a component is replaced, see chapter "Functional check after a repair".

4. Error messages

4.1 Brief description

- Error messages in: ROTINA 35
  ROTINA 35 R

Error designation	No.	Brief description		Page
TACHO-ERROR	01	Speedometer pulses break down during rotation		16
TACHO-ERROR	02	No speedometer pulses after start command		16
IMBALANCE		Imbalance on motor axle		17
CONTROL-ERROR	04	LL error, lid opened without recognizing that motor had stopped		17
N > MAX	05	Excessive speed error, 250 RPM above n-max of rotor		17
ROTORCODE	10	Invalid rotor code		18
MAINS INTERRUPT		Mains interruption		18
VERSION-ERROR	12	Error in initialization		18
N < MIN	13	Speed error, slippage is too great		19
CONTROL-ERROR	21	CP - error:	speed	19
CONTROL-ERROR	22	CP - error:	I²C bus	19
CONTROL-ERROR	23	CP - error:	display memory	19
CONTROL-ERROR	24	CP - error:	clock timeout	19
CONTROL-ERROR	25	CP - error:	EEPROM	19
CONTROL-ERROR	26	CP - error:	driver defective	19
N > ROTOR MAX	---	CP - error:	nominal speed is higher than permitted rotor speed or nominal RCF is higher than permitted rotor RCF	19
SER I/O-ERROR	30	No connection between CP and serial interface		19
SER I/O-ERROR	31	No connection between FC and serial interface		19
SER I/O-ERROR	33	Subassembly data incorrectly transmitted		20
SER I/O-ERROR	34	Data incorrectly transmitted between CP and FC		20
SER I/O-ERROR	36	No acknowledgement (NAK) from FC to CP		20

Error designation	No.	Brief description		Page
No cooling (No error displayed)		Overtemperature at condenser		20
°C / *-ERROR	52	Overtemperature in centrifuge chamber		21
°C / *-ERROR	53	Temperature sensor in centrifuge chamber is defective		21
FU/CCI-ERROR	60	Faulty release signal to FC		21
FU/CCI-ERROR	61	FC - error:	computing section	22
FU/CCI-ERROR	62	FC - error:	undervoltage	22
FU/CCI-ERROR	63	FC - error:	overcurrent	22
FU/CCI-ERROR	64	FC - error:	overvoltage	22
FU/CCI-ERROR	67	FC - error:	overtemperature in motor (only 115V)	23
FU/CCI-ERROR	68	FC - error:	overtemperature in FC	23
FU/CCI-ERROR	69	FC - error:	EEPROM	23
FU/CCI-ERROR	84	FC - error:	FC recognizes excess speed	23
FU/CCI-ERROR	85	FC - error:	“Watchdog” in FC had triggered	23

4.2 Description and elimination of errors

TACHO - ERROR 01

EC During centrifugation the speedometer pulses are interrupted.

ES The rotor slows down until it stops.
After the rotor stops, there is a DC braking for 30 sec.
An MR during slowing-down causes a DC braking for 3 min.
After the DC braking, the ”open the lid” release takes place.
Further cooling to NOMINAL temperature.

ER
- Speed sensor (speedometer) defective or loose contact on plug.
  Measure speedometer pulses on plug X4 / SB (pin 4 - pin 2).
- CC to CP, or CC to FC is defective.
- SB or CP or FC is defective.

M Also see at SB-X4 and CP-X1 (PIN 14) and FC S501 (PIN 8)

ECR Open the lid. Turn the rotor by hand and perform an MR while the rotor is turning.

TACHO - ERROR 02

EC There are no speedometer pulses on the CP after startup.

ES The rotor slows down until it stops.
After the rotor stops, there is a DC braking for 30 sec.
An MR during slowing-down causes a DC braking for 3 min.
After the DC braking, the ”open the lid” release takes place.
Further cooling to NOMINAL temperature.

ER
- Startup took place without the rotor.
- Motor not connected.
- Motor is defective.
- Speed sensor (speedometer) defective, or loose contact on plug.
  Measure speedometer pulses on plug X4 / SB (pin 4 - pin 2).
- CC to CP, or CC to FC is defective.
- No release signal to FC.
- SB or CP or FC is defective.

M Also see at SB-X4 and CP-X1 (PIN 14) and FC S501 (PIN 8)

ECR Open the lid. Turn the rotor by hand and perform an MR while the rotor is turning.

IMBALANCE

EC Imbalance on motor axle.

ES The centrifuge slows down until the “open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- Weight difference in rotor components.
- Supporting lugs not lubricated.
- False IMBALANCE MODE is set (see chapter "Imbalance Mode").
- Imbalance switch not connencted.
- Imbalance switch is defective.
- Loose contact in cable or plug.
- CC to CP is defective.
- CP or SB is defective.

M Also see at SB-X3 and CP-X1 (PIN 12)

ECR Perform an MR.

CONTROL - ERROR 04

EC LL is open during centrifugation.

ES Slowing down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- LL is defective and can be opened during centrifugation.
- Loose contact in cable or in plug.
- CC to CP is defective.
- CP or SB is defective.

M Also see at SB-X5 (PIN 2 and PIN 6) and CP-X1 (PIN 5)

ECR Perform an MR.

N > MAX 05

EC Excess speed. The speed recognized by the speed sensor (speedometer) is 250 RPM greater than the n-max speed of the rotor.

ES The centrifuge slows down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- Insulation of speed sensor (speedometer) cable is defective.
- Loose contact on speed sensor (speedometer) cable.
- Speed sensor (speedometer) is defective.
- CC to CP is defective.
- CP or FC or SB is defective.

ECR Perform an MR.

ROTORCODE 10

EC An invalid rotor code was read during startup.

ES The centrifuge slows down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- Magnetic coding on rotor is defective.
- Speedometer system is defective.
- Loose contact on speed sensor (speedometer) plug
- The rotation of the rotor (direction) is incorrect.

M Also see section 10.

ECR Open the lid or perform an MR.

MAINS INTERRUPT

EC Interruption of mains supply during centrifugation.

ES The centrifuge slows down until the ”open the lid” release occurs.
- Switching on at the mains during centrifugation causes slowing-down until the ”open the lid” release occurs.
- Switching on at the mains when the rotor has stopped brings about the ”open the lid” release.

ER
- Power supply has failed.
- Loose contact in electrical connections.
- CC to CP is defective.

ECR Open the lid and press the START key.

This error **cannot** be reset by an MR

VERSION - ERROR 12

EC Differences in the initialization from CP (EPROM) or FC.

ES No further user operation is possible.

ER
- An incorrect EPROM has been plugged into CP.

M Also see initialization section 5.2

ECR Perform an MR.

N < MIN 13

EC Insufficient speed; the slippage of the motor is too great.
The centrifuge regulation can adjust the speed by 5% max (the limit of adjustment).
The error is indicated if the ACTUAL speed is lower than the NOMINAL speed minus 5%.

ES The centrifuge slows down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached

ER
- Motor is labouring (damage to bearings).
- Motor has a short-circuited coil (coil is defective).
- Loose contact in the electrical connections.
- FC is defective.
  Release signal to FC was interrupted during centrifugation.

ECR Open the LL. Perform an MR.

CONTROL - ERROR 21 - 26

EC Internal error in CP.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CP is defective.

ECR Perform an MR.

N > ROTOR MAX

EC Error in the entered program

ES Further operation is not possible.

ER SET speed or SET RCF is higher than the permissible rotor speed or permissible rotor RCF.

ECR Open the lid.
Reduce the speed or RCF in the entered program to the permissible rotor speed or permissible rotor RCF.

SER I/O - ERROR 30 and ERROR 31

EC CP has no connection to the component FC via serial interface.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CC to FC is defective.
- There is no voltage on FC.
- F2 overtemperature switch on brake resistor has opened or is not connected.
- CP or FC is defective.
- Cable on plug S102 is not or wrong plugged

ECR Perform an MR.

SER I/O - ERROR 33

EC CP is not receiving correct data from FC.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CC to FC is defective.
- CP or FC is defective.

ECR Perform an MR.

SER I/O - ERROR 34

EC CP is not receiving correct data from FC.

ES The centrifuge slows down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached.

ER
- CC to FC is defective.
- CP or FC is defective.

ECR Perform an MR.

SER I/O - ERROR 36

EC FC sends signal NAK to the CP after receiving an unknown command.
NAK (not acknowledged).

ES The centrifuge slows down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached.

ER
- CC to FC is defective.
- FC is defective.
- CP is defective.

ECR Perform an MR.

°C / * - NO COOLING

EC No cooling in centrifuge chamber. Overtemperature at condenser, temperature > 60°C.

ES Cooling switches off.
Continuance of centrifugation until temperature switch in the centrifuge chamber triggers and “ERROR 52” appears.
The centrifuge slows down until the “open the lid” release occurs.

ER
- Condenser soiled.
- Loose contact in plug.
- SB is defective.
- Fan is defective.
- Sensor cable B2 is defective.

M Also see at CB-X2

ECR Perform an MR.

°C / * - ERROR 52

EC Overtemperature in centrifuge chamber.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- Sensor cable B1 is defective.
- Loose contact in plug.
- CP is defective.
- CB is defective.

M Also see at CB-X3 (PIN 1 and PIN 2) and CP-X101 (PIN 4)

ECR Perform an MR.

°C / * - ERROR 53

EC Temperature sensor in centrifuge chamber has a short circuit or a discontinuity.

ES The centrifuge slows down until the ”open the lid” release occurs. Cooling switches off.

ER
- Temperature sensor is defective.
- Sensor cable B1 is defective.
- Loose contact in plug.
- CP is defective.
- CB is defective.

M Also see at CB-X3 (PIN 5 and PIN 4), CP-X101 (PIN 8)

ECR Perform an MR.

FU / CCI - ERROR 60

EC The release signal was not correctly transmitted to FC.
The evaluation of the release signal only occurs once after MR.

ES No further user operation is possible.

ER
- CC to FC is defective.
- CC to CP is defective.
- SB is defective.

M Also see at CP-X1 (PIN 4) and FC-S501 (PIN 7).

General Notice for FU / CCI - ERROR 61 to FU / CCI - ERROR 69

ES
- FC switches independently.
- The rotor freewheels, coasting.
- No further user operation is possible.
- Cooling continues until nominal value is attained

ECR
- Mains switch is OFF.
- Switch mains switch to ON after 1 min.

M
- Also see at FC-S501 (PIN 4) and CP-X1 (PIN 13).

FU / CCI - ERROR 61

EC Error in computing section.

ER
- CC is defective.
- FC is defective.

FU / CCI - ERROR 62

EC Undervoltage. Mains voltage less than 20% as nominal voltage.

ER
- Supply voltage too low, see chapter "Short the mains choke coil".
- CC is defective.
- FC is defective.

M Also see at FC, U_{DC}.

FU / CCI - ERROR 63

EC Overcurrent.

ER
- Short circuit in motor.
- Motor impedance is too low.
- CC is defective.
- FC is defective.

FU / CCI - ERROR 64

EC Voltage in intermediate circuit:
>410 V DC at 230 V
>205 V DC at 115 V
This error normally only occurs when the drive is being braked.

ER
- BR is defective.
- CC is defective.
- FC is defective.

M Also see at FC, $U_{DC.}$

FU / CCI - ERROR 67

EC Only centrifuges with 115 V.
Overtemperature in the motor. The cable “overtemperature” in the motor has high impedance.

ER
- Overtemperature switch opens because of overtemperature in the motor
- CC is defective.
- FC is defective.
- Motor is defective

M Also see at FC, remove plug S2 and measure at the plug
Switch closed: $\approx 0\ \Omega$
- opened: $\infty\ \Omega$

FU / CCI - ERROR 68

EC Overtemperature in FC.

ER
- Insufficient heat abduction from FC to centrifuge housing. There is no, or not enough, heat-conducting paste between FC and housing.
- Full-load operation and an ambient temperature > 45°C.
- CC is defective.
- FC is defective.

FU / CCI - ERROR 69

EC EEPROM in FC is defective.

ER
- CC is defective.
- FC is defective

FU / CCI - ERROR 84

EC FC recognizes excess speed.
During rotation the speedometer pulses (6 per revolution) are controlled by the FC.
The FC switches the centrifuge off, when the maximum speed of the rotor is exeeded more than 500 rpm.

ER
- CCis defective.
- FC is defective.

M Also see at SB-X4 and FC S501 (PIN 8).

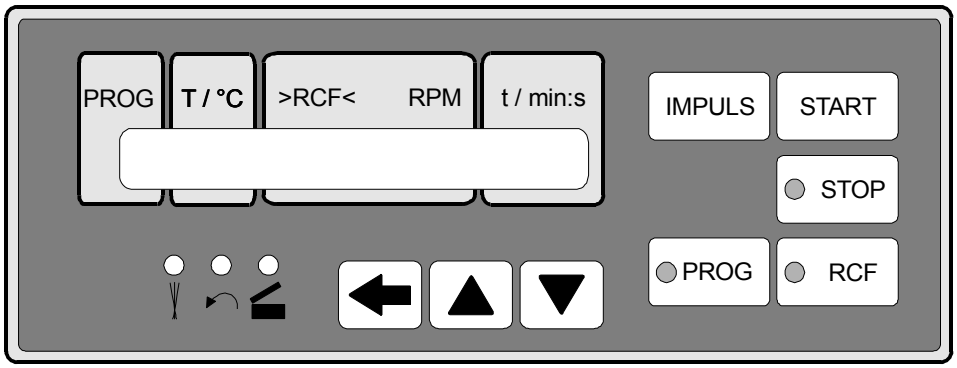
FU / CCI - ERROR 85

EC “Watchdog” in FC
Discrepancy in program procedure

ER
- CC is defective.
- FC is defective.

5. Settings and interrogations

5.1 Control panel



> The EPROM of the CP must, in all circumstances, correspond to the machine version and the cooling version.

5.2 Procedure for initialization

An initialization must be carried out:

- after replacing the FC.

The frequency converter must be adjusted to the centrifuge.

Requirement:

1. Rotor has stopped.
2. LL is open.
3. Mains switch is OFF.
4. Plug on coding strip X3 on the CP has a a jumper in slot 3 and in slot 4 (initialization position).

- Mains switch is ON → Display: **INIT - MODE**
- Press ⇦ key → Display: **VERS 15 °C / * 01**

  machine version

  Cooling version (01 = with cooling, 00 = without cooling)
- Press the ⇦ key → Display: **IMBALANCE MODE 2**
- Press the ▲ or ▼ key to set IMBALANCE MODE 1 or IMBALANCE MODE 2. Now press the START key to save this setting. Information about IMBALANCE MODE see chapter "Imbalance Mode".
- Press ⇦ key → Display: **PARAM - INIT 0000**

  machine version

  Number of initializations

CP : control panel, FC : frequency converter, SB : supply board, CB : cooling board, CC : control cable, LL : lid locking, BC : braking chopper, BR : brake resistor, MR : mains reset, EC : error cause, ES : error consequence, ER : error remedy, M : measurements, ECR : error-code reset

- Press START key → Display: ***** OK *****
  and then: **PARAM - INIT F001**
  ↑ ↑
  machine version |
  Number of initializations

- Mains switch is OFF.
- Remove both jumpers from slot 3 and slot 4 on coding strip X3 on the CP.

> ⚠ Put a jumper on slot zero at the plug on coding strip X3 on the CP. (Service position, “Watchdog”)

An initialization is **always necessary** after a replacement of the FC.

5.3 Imbalance Mode

From programme version 3.00 it is necessary to set the imbalance mode during the initialization.
Depending on the SB version IMBALANCE MODE 1 or IMBALANCE MODE 2 must be selected.

> ⚠ If the incorrect imbalance mode is selected, the display shows error "IMBALANCE" permanently !

5.4 OFFSET alignment

An OFFSET alignment is performed to align the temperature sensor and the CP electronics with one another. An alignment must be performed in any event:

- 1. Replacement of the temperature sensor at the centrifuge chamber.
- 2. Replacement of the CP or the EPROM at the CP.

The OFFSET alignment for the temperature sensor is carried out in the CP.

To carry out an offset compensation, measure the temperature directly on the temperature sensor with a temperature measuring device. Then enter the measured value in the display and save it.

> ⚠ Each correction must be confirmed by the START key.

Requirements:
1. Rotor has stopped.
2. LL is open.
3. Mains switch is OFF.
4. Plug on coding strip X3 at the CP the jumper from slot 0 to slot 3 (OFFSET position).

5.4.1 OFFSET value

The OFFSET value is the difference between the actual temperature and the sensor temperature.

Example:	Actual temperature	-	Sensor temperature	=	OFFSET value
	25.5 °C	-	27.0 °C	=	-1.5 °C

5.4.2 Procedure for performing an OFFSET alignment

1. Mains switch is ON → Display: *** OFFSET – MODE ***
2. Press ⇦ key → Display: T1: 27,0 °C → 25,5 °C

   ↑ ↑

   Sensor temperature | Actual temperature
3. The sensor temperature measured is to be adjusted with the ▼, ▲ keys to make it agree with the actual temperature.
4. Press the START key → Display: ***** OK *****

   If the temperature settings are not confirmed by pressing the START key, the old settings will be maintained.
5. Mains switch is OFF.
6. Remove jumper from slot 3 on coding strip X3 on the CP.

> ⚠ Put the jumper on slot zero at the plug on coding strip X3 on the CP (Service position, “Watchdog”).

5.4.3 Note for temperature sensor in centrifuge chamber

If the temperature in the sample deviates from the nominal value (Display), the offset alignment can be altered as follows:

- Actual temperature is lower than nominal temperature:
  Set the offset temperature of T1 lower by the amount of the deviation (the corrected value is lower).
- Actual temperature is higher than nominal temperature:
  Set the offset temperature of T1 higher by the amount of the deviation.

5.5 Parameter interrogation

Requirements: 1. Rotor is stopped.
2. Mains switch is ON.

Keep ◄ key pressed down until (after about 8 sec) the following appears in the display:

1. **SOUND / BELL ON1** or **OFF** (acoustic signal)

Press ◄ key. Every time the ◄ key is pressed, the display alters as follows:

2. **CONTROL XXXXX h** Hours of operation
3. **VERS XX °C / * XX** Machine version, cooling version
4. **FU / CCI - 1000** FC type
5. **FU / CCI - S. 00.XX** FC software

If nothing more is keyed in for 8 sec, the CP switches over to normal mode. Only Nos. 1. and 2. of the function retrievals listed here can be altered.

5.6 Acoustic signal

The acoustic signal sounds:

- Upon the appearance of a disturbance in 2 second intervals.
- After completion of a centrifugation run and rotor standstill in 30 second intervals.

The acoustic signal is stopped by opening the lid or pressing any key.

The signal can be activated or deactivated after completion of the centrifugation run (if the rotor is at standstill) in the following manner:

- Hold down the key ◄ for 8 seconds.
  After 8 seconds, **SOUND / BELL XXX** appears in the display.
- Set **OFF** or **ON1** with the key ▲ or ▼ .
- Press the key START in order to store the setting.
  As confirmation, ***** ok ***** will be displayed for a short period.

5.7 Hours of operation

You can check and change the working hours only if the rotor is at standstill.

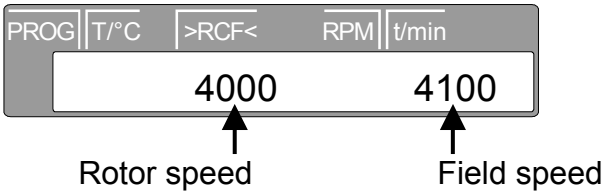
- Keep the ◄ key pressed for 8 seconds.
  After 8 seconds, **SOUND / BELL XXX** will be displayed.
- Press the ◄ key again.
  The working hours (**CONTROL:**) of the centrifuge will be displayed.
- To exit the working hours check screen, press the ▲ or ▼ key.
  Press the ○ RCF key to set the working hours.
- Set the working hours with the ▲ and ▼ keys.
- Press the START key to save the setting.
  ***** ok ***** is displayed for a short time to confirm that the setting has been saved.

5.8 Checking the motor slippage

The centrifuge control can readjust the speed depending on the rotor.
The error (N < MIN 13) is displayed if the rotor speed (ACTUAL speed) is lower than the permitted range of control.

It is only possible to check the slippage during a centrifugation run.

- Start a centrifugation run and wait until the set speed is achieved.
- Keep the ◄ key pressed for 8 seconds. After 8 seconds the following appears in the display:



  Slippage = (field speed) - (rotor speed)
- Press the ◄ key to exit the slippage display.

5.9 Setting display contrast on control panel

The display contrast has been preset at the factory, but can be readjusted.

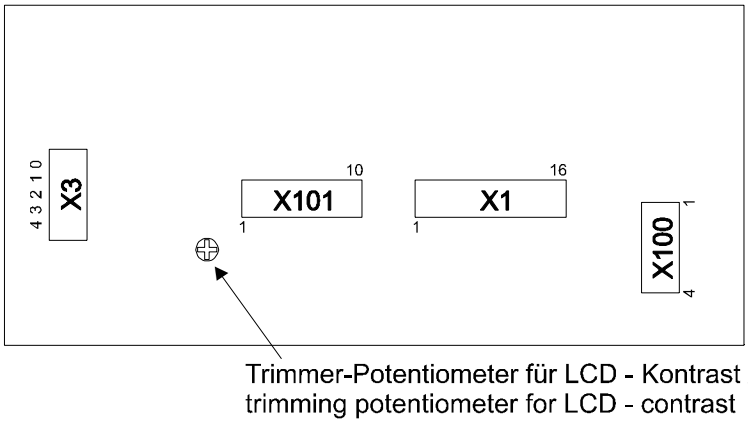
Requirements: The control panel is at room temperature (20 ... 25°C).

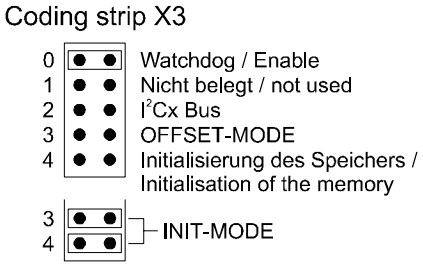
The contrast must be adjusted so that the background pixels are not visible.

Adjustment:

Using a screwdriver, adjust the contrast on the trimming potentiometer on the rear side of the control section (see diagram).

Rear side of control panel:





5.10 Imbalance switch-off

The permissible imbalance is specified for rotor 1724 by the indication of the difference in weight of opposite rotor positions.

When having a difference in weight within the range of 15g to 30g during run-up, the drive has to switch off before reaching 1500 RPM.

The imbalance switch-off is adjusted by changing the distance of the imbalance switch.

With a test run with the indicated differences in weight the imbalance switch-off will be checked.

Adjusting the imbalance switch:

- Loosen both screws at the angle bracket of the imbalance switch on the outer part of the housing floor until you can shift it.
- Set the permissible imbalance by shifting the angle bracket.
- Tighten both screws at the angle bracket of the imbalance switch again.
- Check the imbalance switch-off with a test run.

6. Functional check after a repair

After a repair a functional check of the unit must be carried out.
For functional check a test run with the loaded rotor must be performed.

During the test run the followings must be checked:

- Function of the keys, the display and the LEDs.
- Run-up and slow-down time, max. speed of the rotor. Values see operating instructions chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories".
- Sample temperature. Values see operating instructions chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories".
- Imbalance switch-off. Values see repair instructions chapter "Imbalance switch-off".
- Current consumption. Values see repair instructions chapter "Technical specifications".

After the test run a safety test must be carried out. Check the following values:

• Insulation resistance	> 2	MΩ
• Protective conductor resistance	< 0.2	Ω
• Leakage current	< 3.5	mA *
	* limit according to EN 61010	

A laboratory centrifuge do not belong to those medical appliances which may be tested according to the regulation IEC 601 or corresponding national medical electronic standards. Laboratory centrifuges are classified as laboratory equipment.
The regulations applying to laboratory equipment are IEC 1010 or European standard EN 61010.

7. Assembling and disassembling components

Before assembling or disassembling components, the working processes in Tabelle 7-B for ROTINA 35 and ROTINA 35 R must first be carried out to reach the components and make a note of the plug numbers.

The components are assembled in reverse order !

The further procedure is described on the following pages.

In Tabelle 7-A the components are ordered in the following sequence:

Column 1: Abreviation
Column 2: Components
Column 3: Abreviations in the circuit diagrams
Column 4: Plug connections
Column 5: Connections at the electronic-panels
Column 6: Described in capture.

Tabelle 7-A

1	2	3	4	5	6
A	Speed sensor (speedometer)	B3	X4	A1	7.1
B	Motor	M1	S101	A2	7.2
C	Vibration damper				7.2
D	FC (frequency converter)			A2	7.3
E	EPROM (on FC)			A2	7.3
F	SB (supply board)			A1	7.4
G	CB (cooling board)			A3	7.5
H	CP (control panel)			A4	7.6
I	EPROM (on CP)			A4	7.7
J	Mains choke coil			-	7.12
K	CC (control cables) - 16 conductors		A4-A1		7.8
	- 10 conductors		A1-A2		
	- 10 conductors		A4-A3		
L	LL (lid locking)	Y1	X5	A1	7.9
M	BR (brake resistor)	R1	P10-P1	A2	7.10
N	Radio interference suppression filter	Z1	X5-Q1	A1	7.11
O	Mains switch ON / OFF	Q1	Z1-F1		7.13
P	Appliance plug	B4	F1		7.14
Q	Overvoltage protection	F1	B4-Q1		7.14
R	Imbalance switch	S1	X3	A1	7.15
S	Fan for motor	M5	X6	A1	7.16
T	Temperature sensor (centrifuge chamber)	B1	X3	A3	7.17
U	Temperature sensor (condenser)	B2	X2	A3	7.18
V	Fan (compressor)	M3	X1	A3	7.19
W	Compressor	M2	X1	A3	7.20
X	Gas-filled damper				7.21

Tabelle 7-B

Working processes		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1.	Open lid	X	X	X								X						X		X			X	X
2.	Set mains switch to OFF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X
3.	Disconnect centrifuge from mains voltage	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X
4.	Disassemble rotor	X	X	X														X		X			X	
5.	Remove motor covering in centrifuge chamber	X	X	X														X		X			X	
6.	Take rubber sleeve under motor covering out		X	X														X		X			X	
7.	Detach front screen		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	
8.	Pull of theControl cable from the CP		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	
9.	Remove front screen	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			X	
10.	Detach rear covering																				X	X	X	X

Example: Disassembling appliance plug

1. Definite the abreviaton of the appliance plug in Tabelle 7-A, column 1. Appliance plug = P
2. See Tabelle 7-B column P and carry out the working processes in numeric order.
3. Definite in Tabelle 7-A the corresponding abreviaton, for the example line P and pick out in column 6 the especially capture (9.13), where the disassembly is discribed.

7.1 Speed sensor B3 (speedometer)

- Unscrew speed sensor (speedometer) from upper end plate of motor.
- Unplug plug number X4 from Supply board A1.
- Replace speed sensor (speedometer).

7.2 Motor M1 / Vibration damper

- Unscrew speed sensor (speedometer) from upper end plate of motor, and place it in centrifuge chamber.
- Pull out the 3 cables from plug S101 at the FC (BU/BN/BK).
- Use a socket spanner to loosen and remove the three fastening nuts on lower end plate of motor.
- Lift motor upwards out of centrifuge. Unplug the earth lead.
- Before motor is installed, the three vibration dampers must be checked for possible wear or cracks, and if necessary replaced.
- Replace the motor.
- Care must be taken of the anti-twist device when the vibration dampers are being installed.

7.3 FC (frequency converter)

- Pull all plugs out of FC.
- Unscrew from below the four fastening screws of FC.
- Unscrew the screws on the connecting clips and pull the cables out.
- Replace FC
- Before installation, it must be noted that there is a heat-conducting paste between FC and centrifuge housing floor.

Heat conducting from FC to centrifuge housing floor must be ensured.

7.4 SB (supply board)

- All plugs on the SB must be pulled out.
- Unscrew the four screws, and take SB out of centrifuge.
- Replace SB

7.5 CB A3 (cooling board) only ROTINA 35 R

- All plugs on the CB must be pulled out.
- Unplug the two cables (RD and BK) at the SB.
- Unscrew the four fastening screws at the CB.
- Replace the CB.

7.6 CP A4 (control panel)

- Detach the two holding frames at the CP.
- Lift out the CP on the opening at the front screen.
- Replace the CP.

7.7 EPROM at CP

- Pull the EPROM carefully out of IC-socket.
- Pay attention to the polarity of the EPROM when installing.
- Do not bend the IC-pins.

Before touching the EPROM ensure that your own static electricity is discharged.

- Replace the EPROM.

7.8 CC (control cables)

- Unplug the corresponding control cable from the boards.
- Replace the control cable.

7.9 LL (Y1) (lid locking)

- Remove the front panel.
- Unplug all cable from the lid lock.
- Loosen the to fastening screws on the to of the housing.
- Exchange the lid lock.

7.10 BR R1 (brake resistor)

- From below loosen the two fastening screws of the BR at the floor.
- Unplug the cables at the BR and the FC.
- Loosen cable of overtemperature switch on the BR at FC (clip S102, position U1).
- Replace BR.

7.11 Radio interference suppression filter Z1

- From below unscrew the two fastening screws of the radio interference suppression filter.
- Remove the plugs from the radio interference suppression filter.
- Replace the radio interference suppression filter.

7.12 Mains choke coil (L1)

7.12.1 Assembly and disassembly

- Pull both plugs from the mains choke coil.
- Undo the fastening screws of the mains choke coil.
- Replace the mains choke coil.

7.12.2 Short the mains choke coil

> In countries, in which the European standard EN 61000-3-2 applies it is not allowed to short the mains choke coil.
>
> The mains choke coil reduces the mains input current below the limit values stated in the above mentioned European standard.

If the centrifuge is run with undervoltage, that is mains frequency 50 Hz with a voltage < 205 V or mains frequency 60 Hz with a voltage < 210 V the voltage drop of the mains choke coil can cause the error FU / CCI - ERROR 62.
The short of the mains choke coil will increase the supply voltage of the frequency converter.

- Pull both plugs (A) from the mains choke coil, see Figure 1.
- Cut off both plugs and connect the ends of both cables together with a luster terminal (B), see Figure 2.

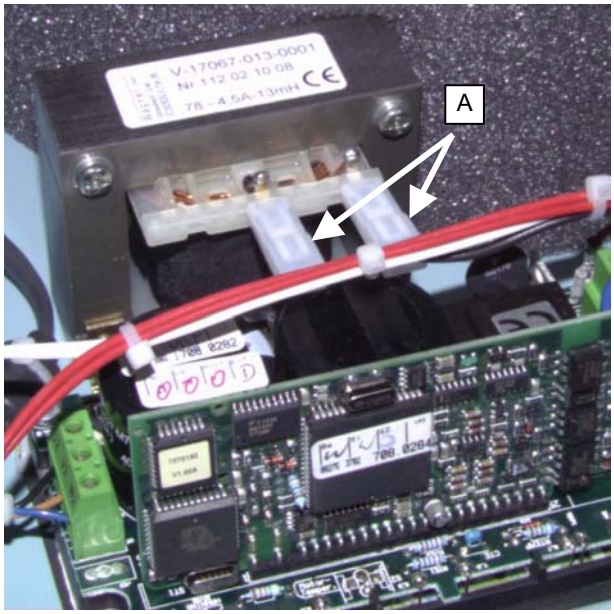


Figure 1

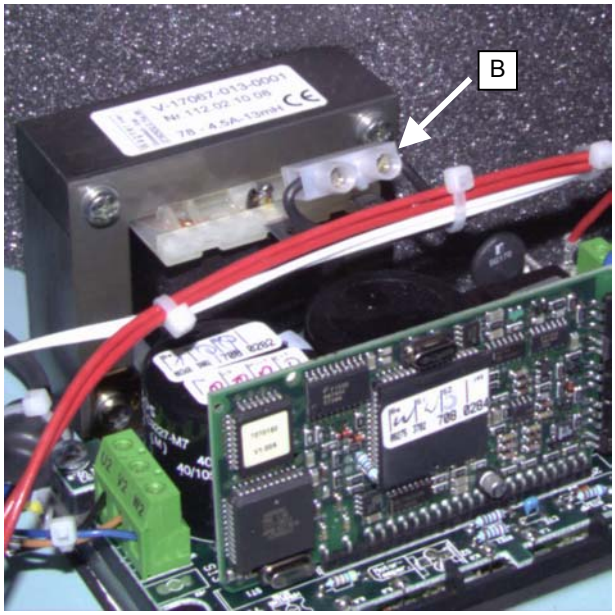


Figure 2

7.13 Mains switch Q1

- Press mains switch out of lower part of housing.
- Remove all plugs at mains switch.
- Replace mains switch.

7.14 Appliance plug B1, overvoltage protection F1

- Remove mains switch, see chapter 7.13.
- Unscrew the two fastening screws at the appliance plug.
- Pull the appliance plug out of the opening.
- Remove the overvoltage protection from the appliance plug.
- Replace appliance plug.
- Unplug the cables at the overvoltage protection.
- Replace overvoltage protection.

7.15 Imbalance switch

- Remove plug from position X3 at the SB.
- From below loosen the two fastening screws of the imbalance switch.
- Loosen the fastening nuts from the motor. Lift up the motor and pick up the imbalance switch through the opening at the centrifuge chamber.
- Replace imbalance switch.
- To mount the imbalance switch, carry out these steps in opposite order.
  After the installation the imbalance cutoff must be checked, see chapter "Imbalance switch-off".

7.16 Fan M5 for the motor (only ROTINA 35 R)

- Remove the FC (see chapter 7.3).
- Remove plug number X6 from the SB.
- From below loosen the two fastening screws of the fan.
- Replace fan.

7.17 Temperature sensor B1 in centrifuge chamber

- Remove plug from position X3 at the CB.
- Remove the four bushes in the plug (unlock the bushes with appropiate tools at the front of the plug). Then press out the four bushes.
- Press out the temperature sensor in the centrifuge chamber.
- Replace temperature sensor.

7.18 Temperature sensor B2 at condenser

- Remove plug number X2 at the CB.
- Unscrew the temperature sensor (one screw).
- Replace temperature sensor.

7.19 Fan M3 and M4

- Remove both plugs at the defective ventilator.
- Unscrew the two fastening screws of the defective fan (through the ventilating louvres).
- Detach fan.
- Replace fan.

7.20 Compressor (M2)

- Loosen the fastening screws at the two hinge blocks.
- Lift up the lid with the hinge blocks out of the upper housing part.
- Remove both lockings from the upper housing part.
- Loosen the fastening screws of the upper housing part (8 screws) through the housing floor of the centrifuge and place them aside.
- Unscrew both fans through the ventilating louvres at the upper housing part.
- Pull the upper housing part to the front until the compressor is accesible.
- Repair or replace the compressor.

7.21 Gas filled damper

- Loosen gas filled damper at the lid.
- Press out both retaining rings at the damper.
- Press the bolt out of the fixing strap.
- Remove gas filled damper with appropiate tools (turn off the damper from the fork-head).
- Remove bolt-spring from damper-rod.
- Replace the gas filled damper.

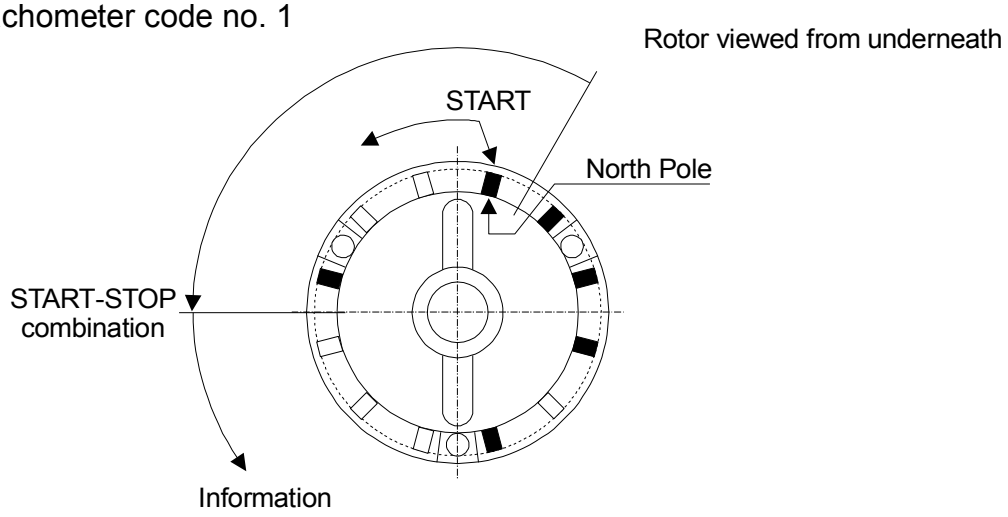
<u>If it`s not possible to turn off the damper from the fork-head:</u>

- Remove the fan first (see chapter 7.19)

8. Speedometer-code-position of the rotors

ROTINA 35 / 35 R		
Speedo-meter-code-No.	Position occupied	Rotor
0	1001 0000 1111	
1	1001 0001 0111	1722, 1725, 1726, 1740, 1748
2	1001 0001 1011	1717, 1724
3	1001 0001 1101	1720, 1720A
4	1001 0001 1110	1718
5	1001 0100 0111	
6	1001 0101 0101	1714
7	1001 0101 0110	
8	1001 0101 1010	
9	1001 0110 0011	
10	1001 0111 0001	E1094
11	1001 1000 0111	
12	1001 1000 1011	1711
13	10011000 1101	
14	1001 1010 0011	
15	1001 1100 0011	

Example: tachometer code no. 1



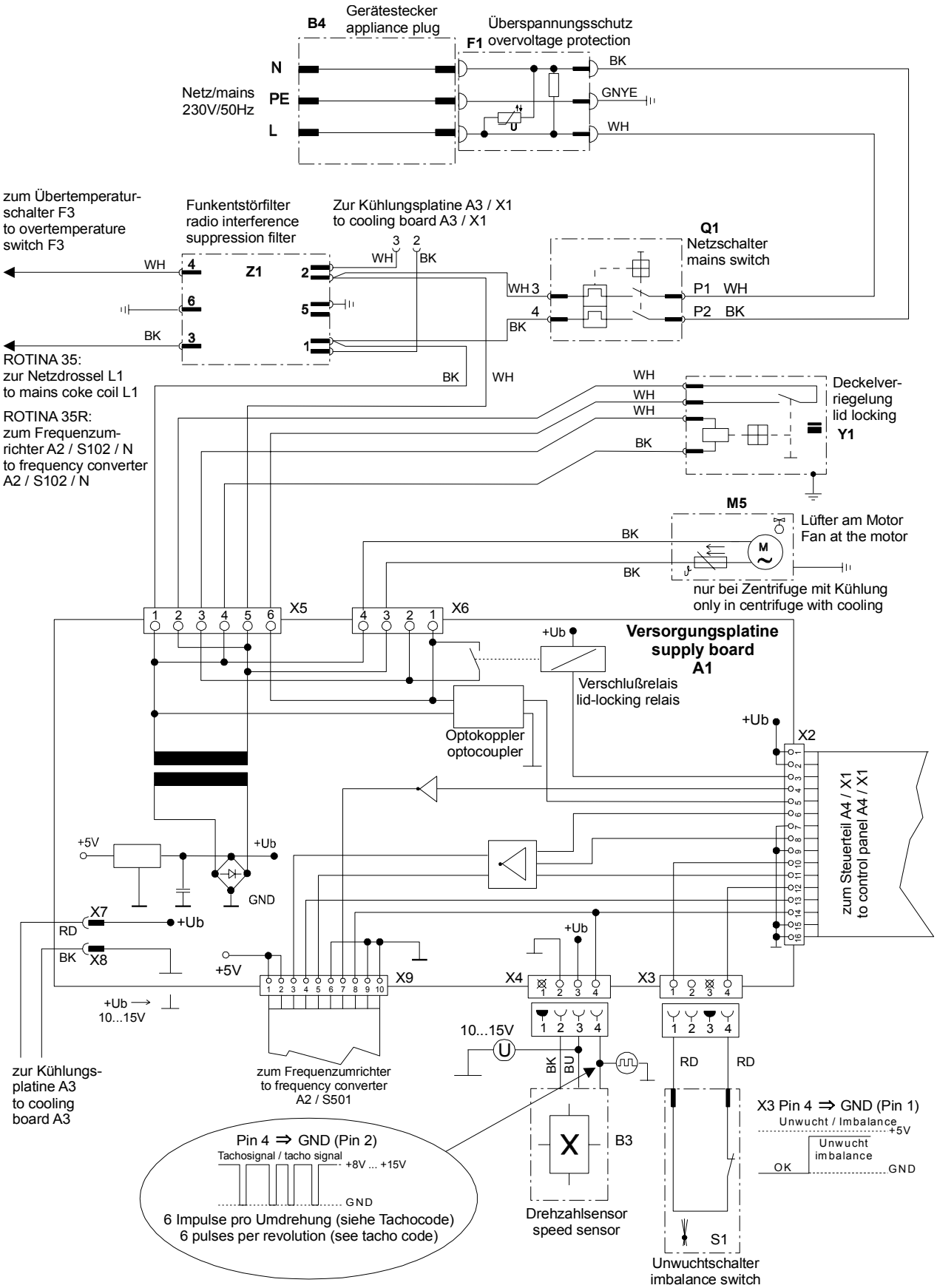
tachometer code determines: 1. maximum speed of rotor
2. run up and braking ramps
3. control response of electronics

Used cable colours and their abbreviations:

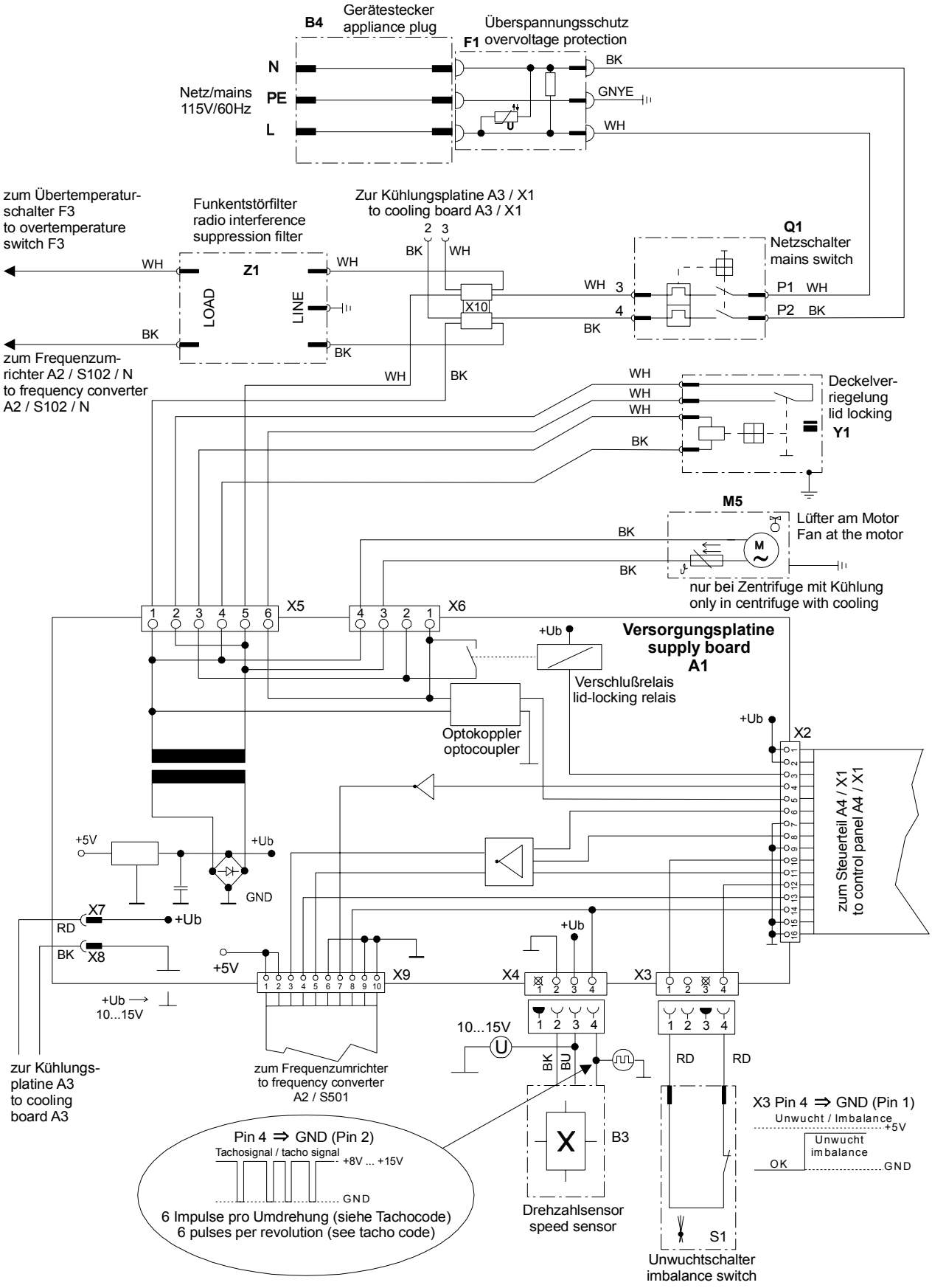
Abbreviation	Colour
BK	black
BN	brown
BU	blue
GD	gold
GN	green
GNYE	green-yellow
GY	grey
OG	orange
PK	pink
RD	red
SR	silver
TQ	turquoise
Transp.	transparent
VT	violet
WH	white
YE	yellow

9. Circuit diagrams

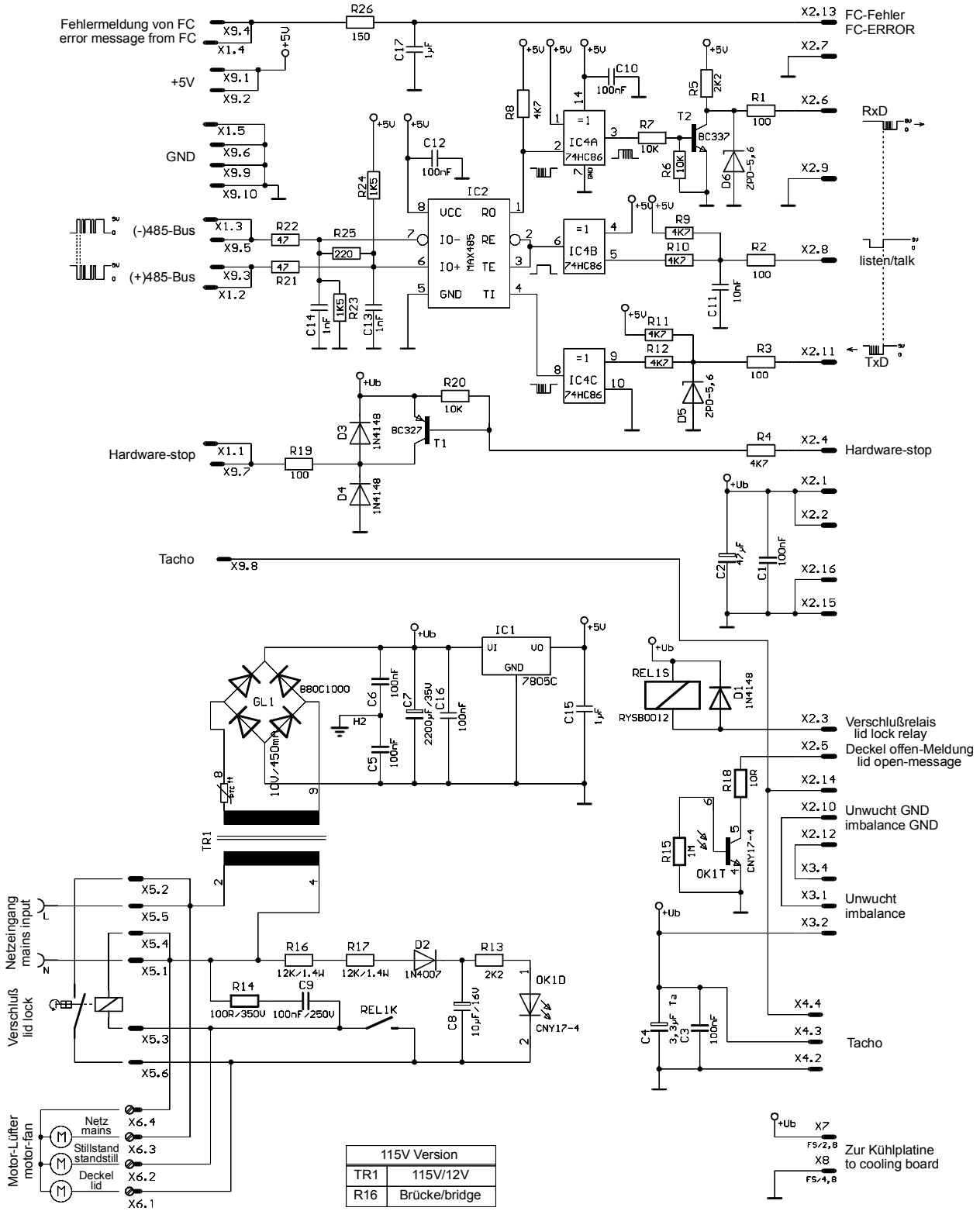
9.1 Mains supply with supply board (SB) 230 V



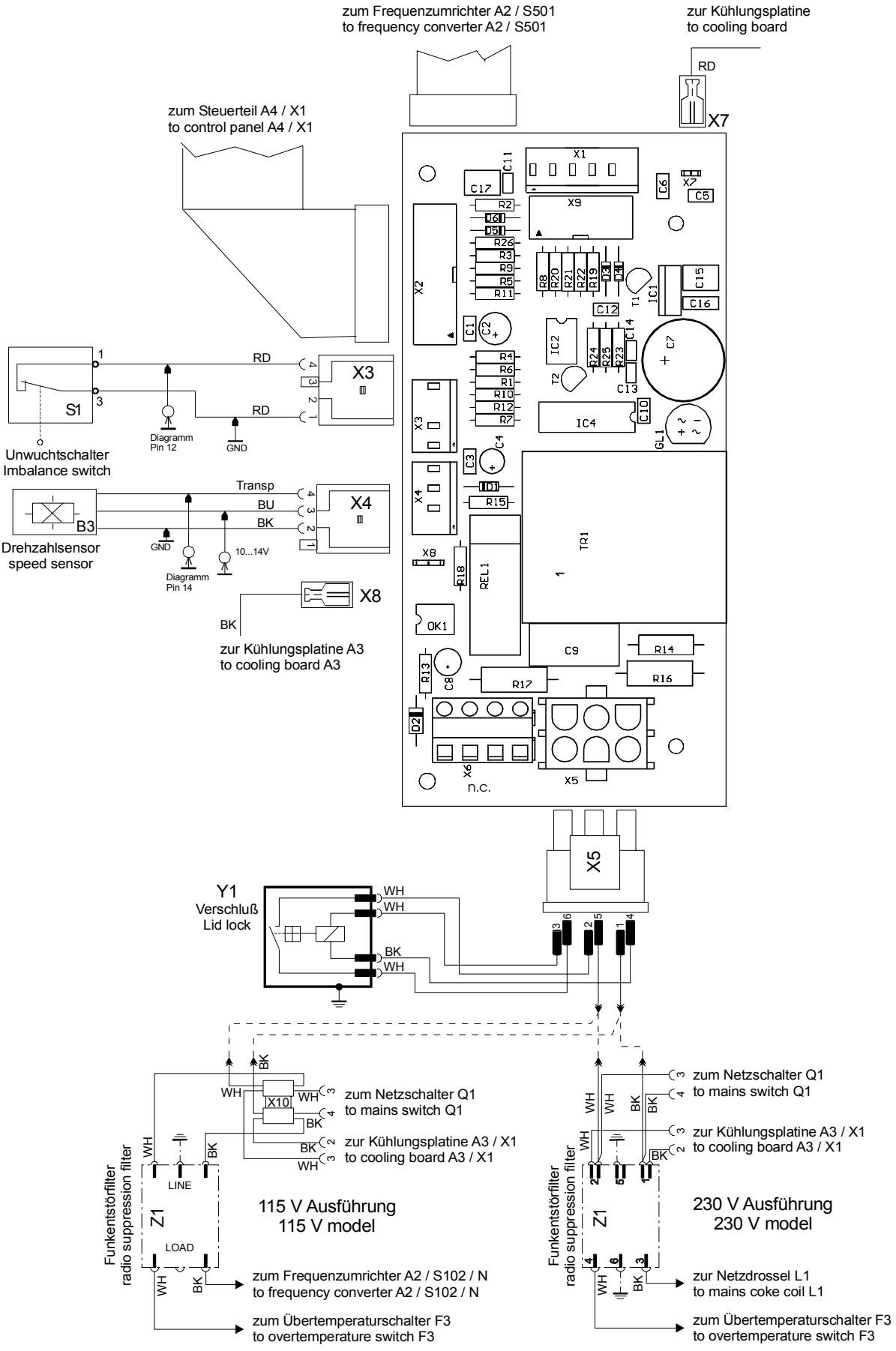
9.2 Mains supply with supply board (SB) 115 V



9.3 Circuit diagram supply board (SB)

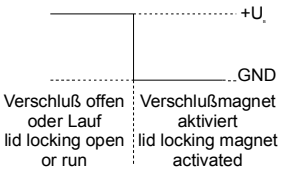


9.4 Connecting diagram and component layout supply board (SB)

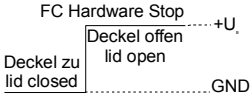


9.5 Signals at control cable (between CP-SB)

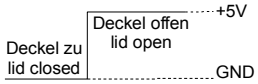
X1 Pin 3 ⇒ GND

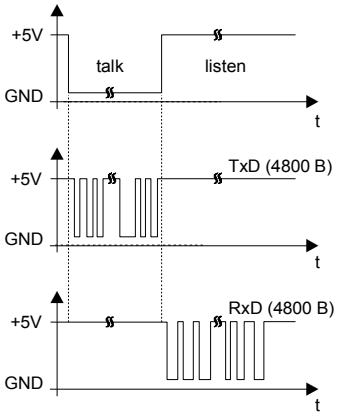


X1 Pin 4 ⇒ GND



X1 Pin 5 ⇒ GND





X1 Pin 8 ⇒ GND
ser. Schnittstelle vom CP
ser. interface from CP

X1 Pin 11 ⇒ GND
ser. Schnittstelle vom CP
ser. interface from CP

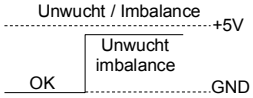
X1 Pin 6 ⇒ GND
ser. Schnittstelle zum CP
ser. interface to CP

X1 Pin 7 ⇒ GND : 0V

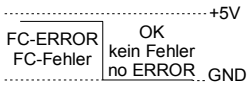
X1 Pin 9 ⇒ GND : 0V

X1 Pin 10 ⇒ GND : 0V

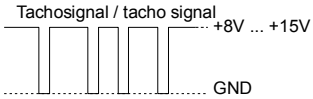
X1 Pin 12 ⇒ GND



X1 Pin 13 ⇒ GND



X1 Pin 14 ⇒ GND



6 Impulse pro Umdrehung
siehe Tachocode
6 pulses per revolution
see tachocode

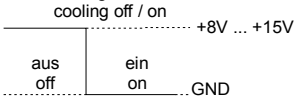
nur bei Zentrifuge mit Kühlung
only centrifuge with cooling

X101 Pin 8 ⇒ GND

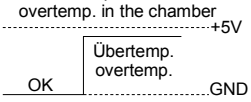
Spannung vom Temperaturfühler
voltage from temperature sensor

25°C = 2.98V
Unterschied / difference 1°K = 10mV

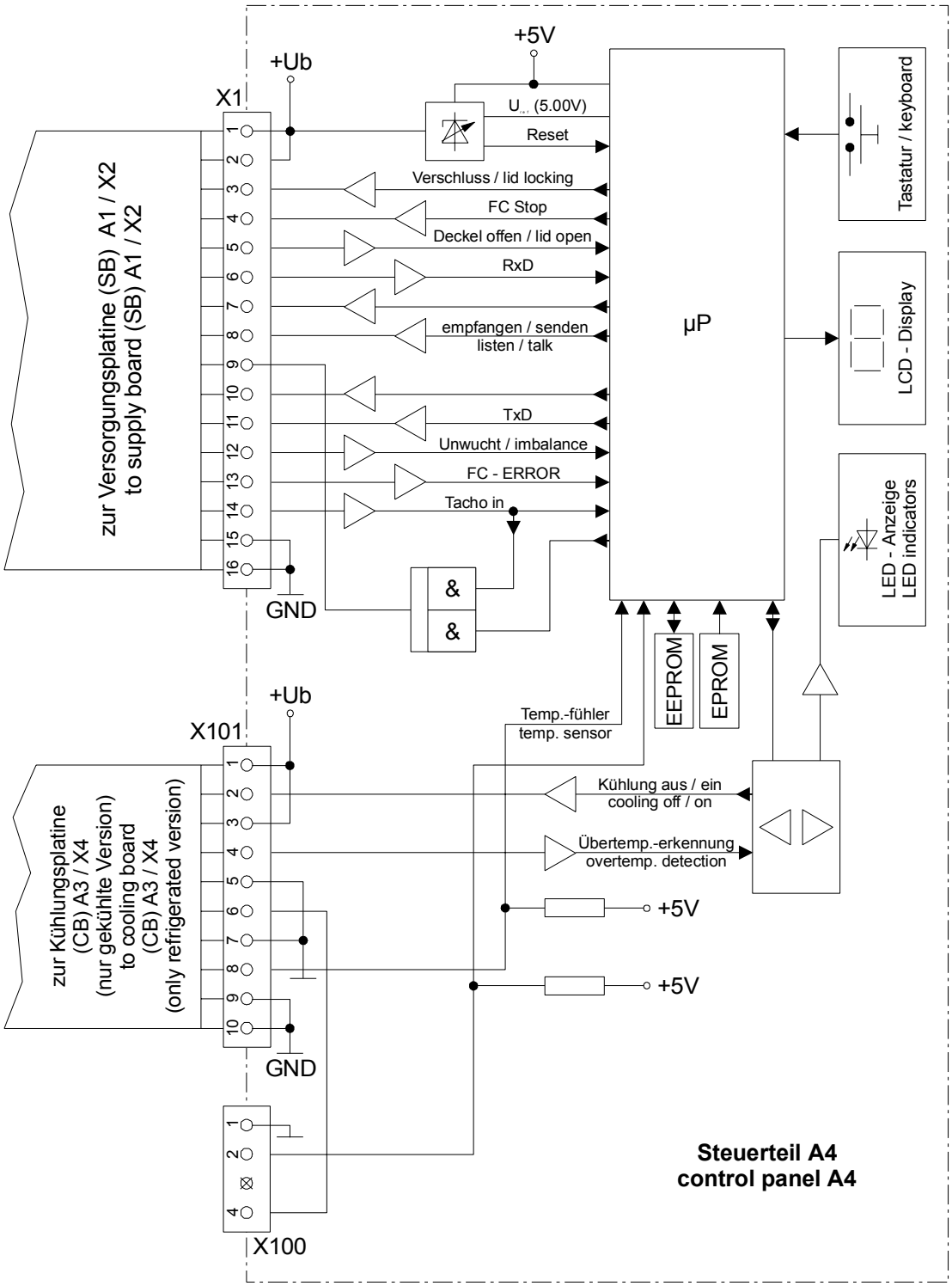
X101 Pin 2 ⇒ GND



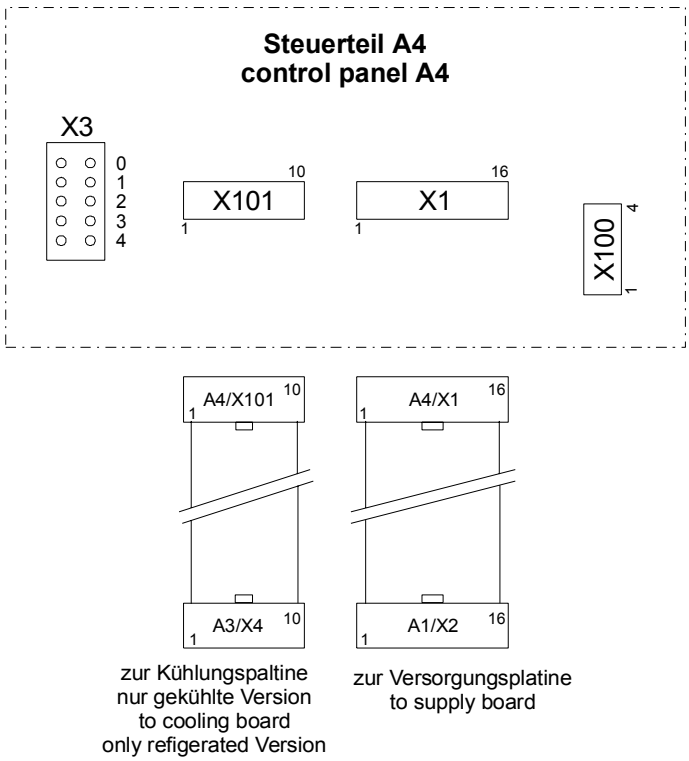
X101 Pin 4 ⇒ GND



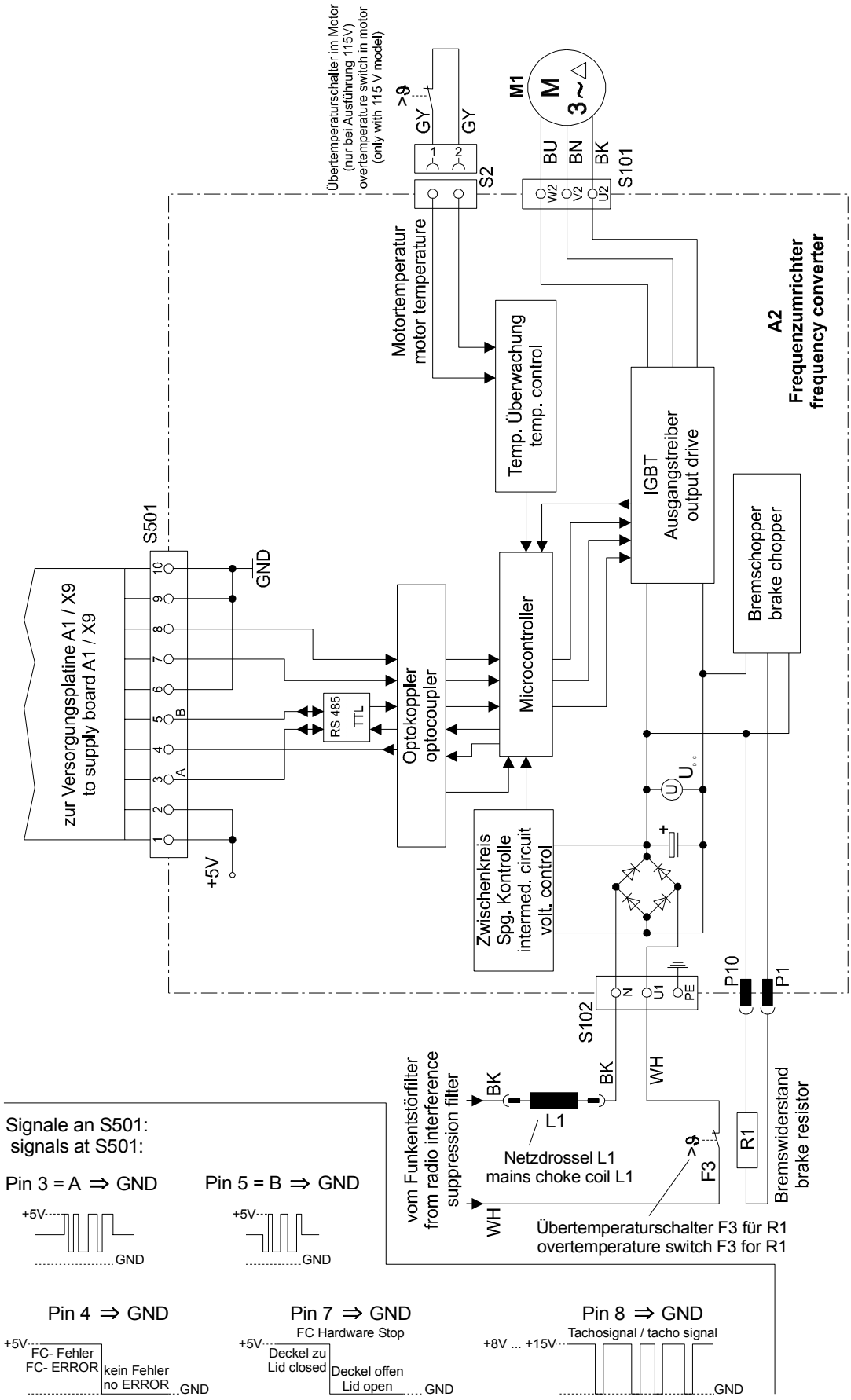
9.6 Block diagram control panel (CP)



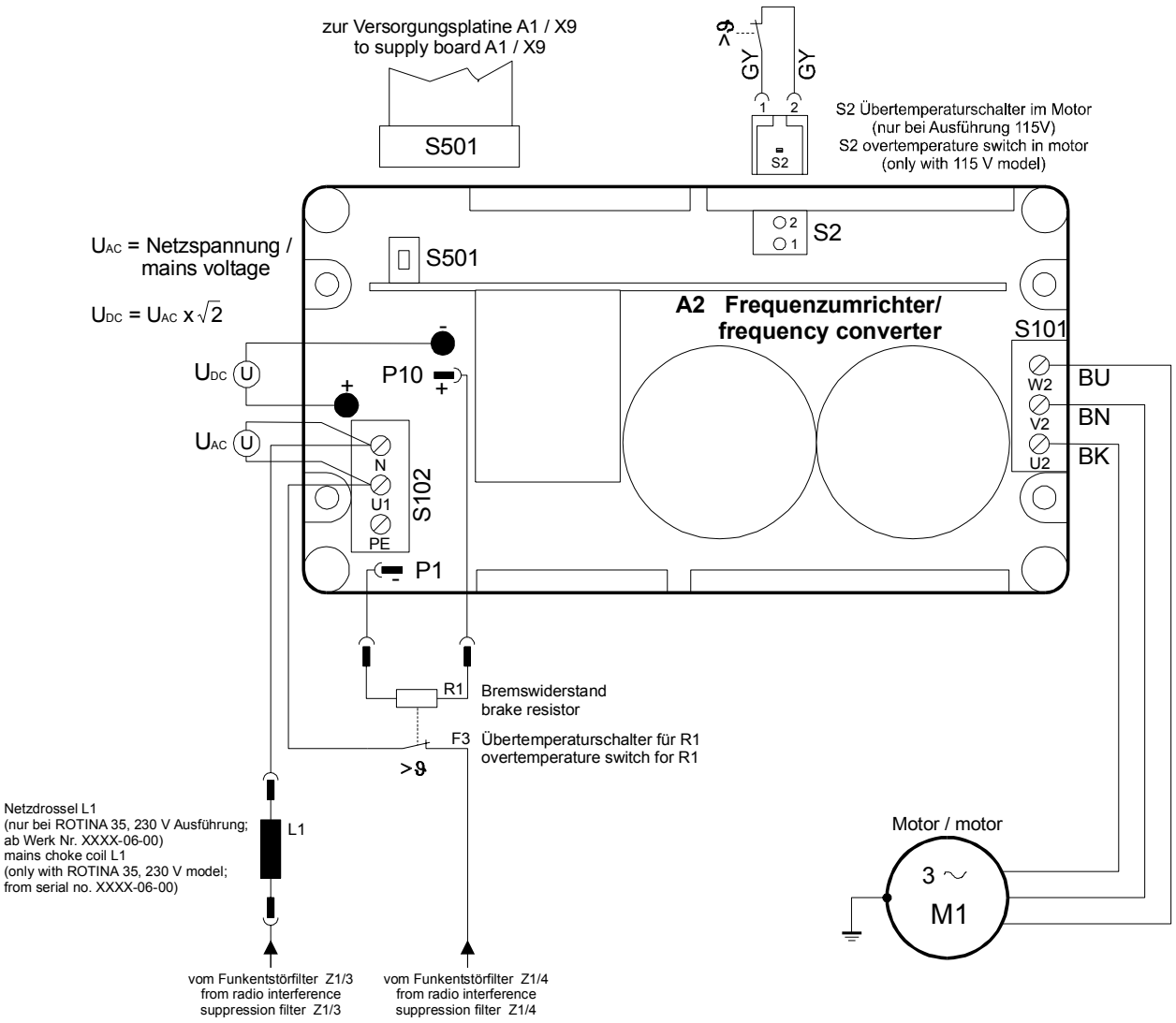
9.7 Connecting diagram Control board (CP)



9.8 Block diagram and control panel signals at FC



9.9 Connecting diagram frequency converter (FC)

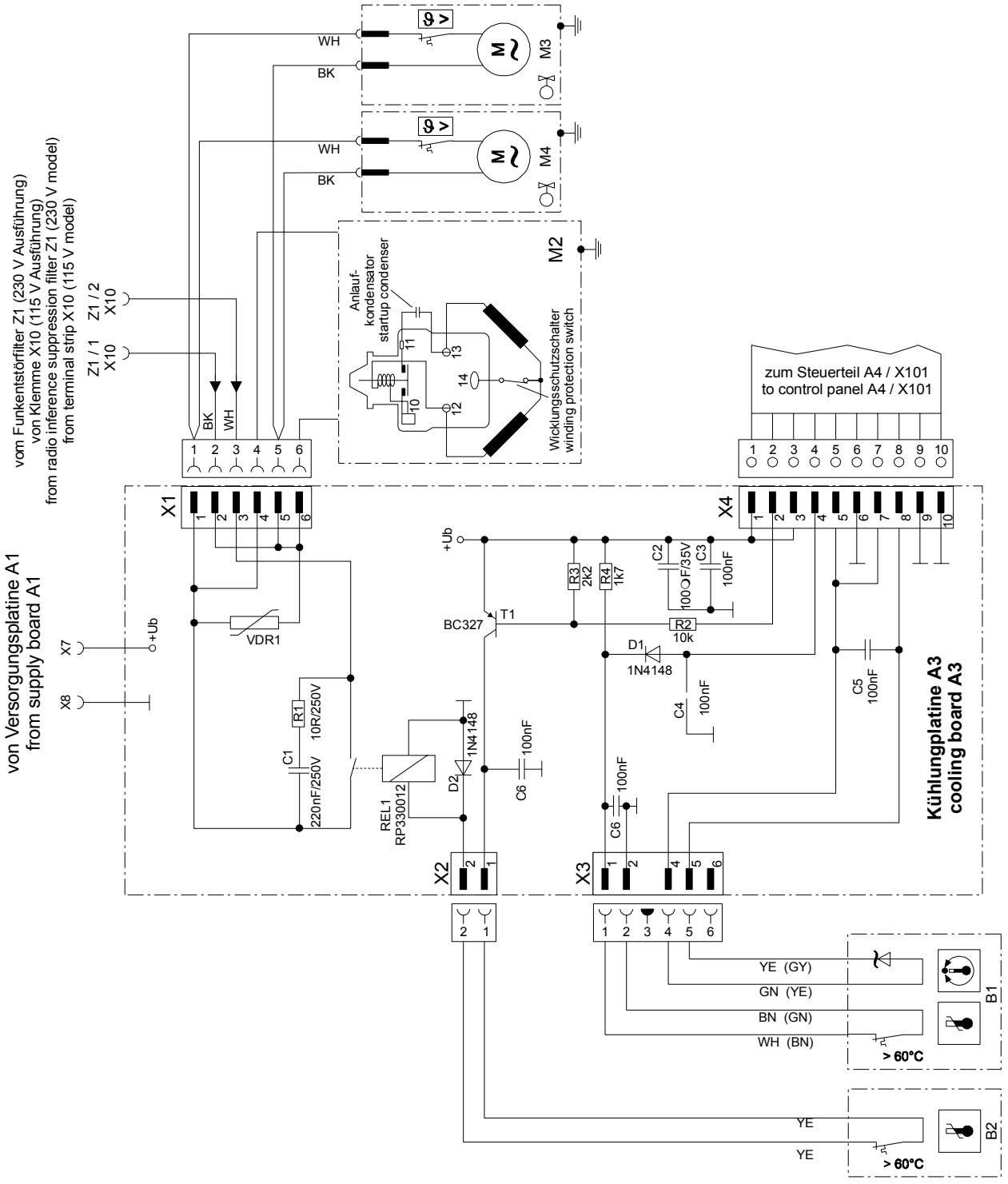


Bremswiderstand	230 V Ausführung:	160 Ω
Brake resistor	115 V Version:	70 Ω

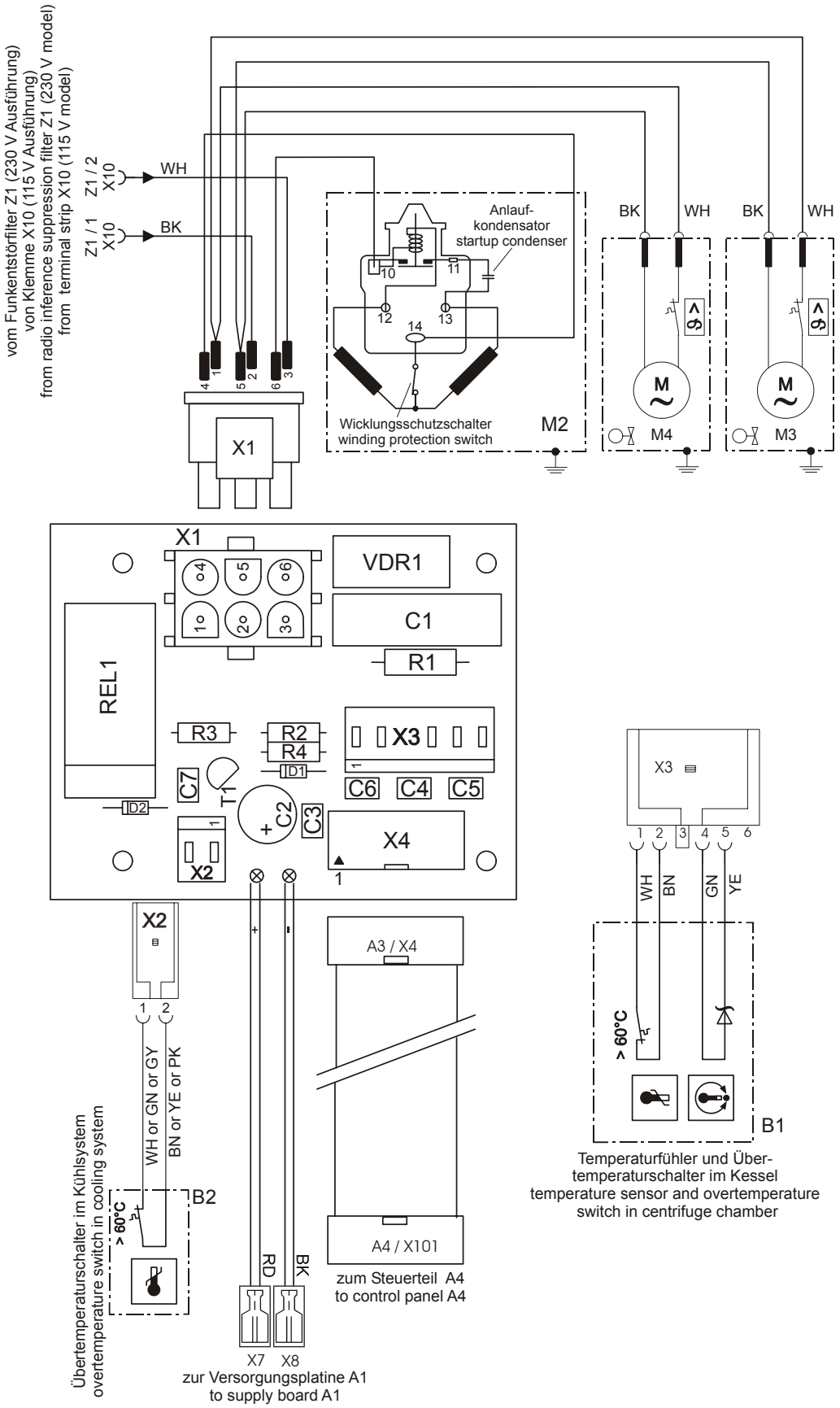
Motorwiderstand (kalter Motor, zwischen je 2 Leitungen)
Motor resistance value (cold motor, between 2 wires)

230 V Ausführung:	4,3 Ω
115 V Version:	0.7 Ω

9.10 Circuit diagram cooling board



9.11 Connecting diagram and component layout cooling board



10. Technical specifications

Manufacturer	Hettich Zentrifugen D-78532 Tuttlingen			
Model	ROTINA 35		ROTINA 35 R	
Product no.	1705	1705-01	1710, 1710-20	1710-01
Mains voltage (± 10%)	220-240 V 1~	110-127 V 1~	208-240 V 1~	110-127 V 1~
Mains frequency	50-60 Hz	50-60 Hz	50 Hz	60 Hz
Connected load	880 VA	760 VA	1300 VA	1500 VA
Current consumption	4.2 A	7.8 A	6.5 A	13.5 A
Power consumption	600 W	620 W	1100 W	1200 W
Refrigerant	-----		R 404A	
Max. capacity	52 x 15 ml			
Max. density	1.2 kg/dm^3			
Speed RPM	15000			
Force RCF	23 646			
Kinetic energy	18500 Nm		22000 Nm	
Obligatory inspection	yes			
Environment – Ambient temperature – Relative humidity	5°C up to 40°C max. 80% up to 31°C, descending in a linear pattern down to 50% at 40°C			
Sample overtemp.	≤ 15 K		-----	
Class of protection	I			
EMC	ISM (Industrial Science Medicine)			
– Emission (Radio interference suppression)	EN 55011 Class B	FCC Class B	EN 55011 Class B	FCC Class B
– Immunity	according to EN 50082-2			
Noise level (dependent on rotor)	52 bis 66 dB(A)		46 bis 66 dB(A)	
Dimensions				
• Width	468 mm		468 mm	
• Depth	540 mm		695 mm	
• Height	380 mm		380 mm	
Weight approx.	43,1 kg		70 kg	