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ALLEGRA X-22 & 22R

Centrifuge Service Manual

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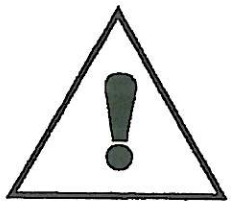
SAFETY REMINDERS

The following pages summarize cautionary information basic to the safe operation of this instrument. However, it is strongly recommended that the user read the entire manual carefully before attempting to service the instrument. In addition, be sure to heed all **NOTES, CAUTIONS**, and **WARNINGS**, which are specifically defined as follows:



NOTE: Used to make a procedure easier or clearer. To disregard it may cause inconvenience, but not mechanical damage or personal injury.

CAUTION: Used to prevent equipment damage. To disregard the caution may cause mechanical damage, however, personal injury is not likely.

WARNING: Used whenever an action or circumstance may potentially cause personal injury or loss of life. Mechanical damage may also result.

MECHANICAL SAFETY

Good mechanical safety practices are more important than ever now that microprocessors are taking control of mechanical devices. Yet, the area of mechanical safety is often overlooked during instrument servicing. We may be able to change this situation if you heed the following safety tips:

1. Remember to keep clothing and fingers away from rotating or moving components. It is easy to slip, lose a tie, or get cut while working near one of these devices.

2. Unless it is absolutely essential, never run mechanical components without the protective guards in place.

3. Always use the tools specifically recommended for the job. This not only reduces the chances of injury, it minimizes damage to the instrument.

4. Although not always possible, it is recommended that mechanical devices be adjusted or calibrated with the power turned OFF. This is especially important if you are working with a microprocessor-controlled instrument, which can start running without notice or user intervention.

5. After the mechanical repairs have been completed, always check that all mounting hardware and safety shields are in place and secure. By doing so, you will not only ensure safe operation of the instrument, but may reduce callbacks.

As you can appreciate, all it takes is good common sense, plus good safety techniques that are basic and easy to remember. With this is mind, you should have no trouble servicing mechanical devices safely.

ELECTROSTATIC DISCHARGE

Static electricity is an electrical charge which can damage circuitry and components. Listed below are important **E**lectrostatic **D**ischarge guidelines for handling electronic components. Following these guidelines will avoid needless damage to circuit cards and components on them.

- Keep paper, non-conductive plastic, plastic foams or cardboard away from circuit boards and components and static-free work areas.
- Keep hand creams and food away from the conductive work surfaces. If spilled on the bench top, these materials contaminate and increase the resistivity of the work area.
- Be especially careful when using soldering guns around conductive work surfaces. Solder spills and heat from the gun may melt and damage the conductive mat.
- Check the grounding connections on wrist strap and static mats. (Mat must have proper ground.) Make certain they fit snugly before starting work with the components and printed circuit cards.
- Touch the conductive work surfaces before starting work.
- Know the ESD caution symbols.
- Do not allow anyone not grounded to touch ESD sensitive components in the work area. To be grounded, they must be standing on the conductive floor mat and must touch the conductive bench top mat before touching the components or printed circuit cards.
- Do not place ESD-sensitive components on work areas that are not grounded properly.
- Do not touch the component by the pins or leads since the most damage is done at these points by ESD. Handle the components by the cap edges or body and the printed circuit cards by the edges.
- Do not handle components or printed circuit cards during transport between work stations. Components or cards must not be directly handled by anyone not grounded.
- Do not use Refrigerant or other chlorinated cleaners at the work area. Use conductive or anti-static bags and containers for storage and transportation of components or circuit boards.

REFRIGERATION SYSTEM SAFETY

Working with refrigeration systems requires special equipment and training. If you are not familiar with the operational theory for refrigeration systems and the special requirements for performing service on a system, do **NOT** attempt it. Use the following precautions for working with refrigeration systems in Beckman instruments.

1. Always use protective glasses and clothing.

2. Do **NOT** inhale refrigerant. It has an intoxicating effect and is harmful to your health.

3. Refrigerant can easily cause "frostbite". Be especially careful with liquid refrigerant.

4. Use caution when replacing a burnt out compressor. The oil in the compressor may be very caustic or acidic. Use protective gloves.

5. Charge refrigeration systems with gas from the low side only. High side charging may damage the compressor.

6. Do **NOT** run a compressor without refrigerant in the system. Compressors are cooled by the refrigerant and will burn out if there is no cooling.

CUSTOMER OPERATING INSTRUCTIONS

The instruction manual is shipped as part of the instrument and is not included in this service manual. Additional copies of the "instruction manual" may be ordered from Technical Publications Department, 1050 Page Mill Road, Palo Alto, California 94304.

It is strongly recommended that you read the entire instruction manual carefully before attempting to operate the instrument.

Safety Reminder

Centrifuges are not designed for use with materials capable of developing flammable or explosive vapors. Such materials should not be handled or stored near the instrument.

- Spills may generate aerosols. Pathogenic, toxic, or radioactive materials should not be used in this instrument unless all necessary safety precautions are taken.
- Only trained, qualified personnel should perform maintenance other than that contained in this manual.
- **Turn the power OFF** and disconnect the instrument from the main power source before performing any maintenance that requires the removal of an instrument panel.
- Do not place containers holding liquid on or near the chamber door. If they spill, liquid may get into the instrument and damage electrical or mechanical components.
- Under no circumstances should you try to slow or stop the rotor by hand.

ALLEGRA X22 & 22R

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SECTION 1

INTRODUCTION

1.1 Allegra X 22 Specification

Only values with tolerances or limits are guaranteed data. Values without tolerances are informative data, without guarantee.

Speed	
Set speed	0 to 14500 rpm (in 100-rpm increments) or equivalent RCF
Time	
Set time	to 9 hr 59 min or continuous
Time display	time remaining in run (timed run) or hold and elapsed time (continuous run)
Acceleration	10 acceleration profiles
Deceleration	10 deceleration profiles
Dimensions	
Width	46 cm (18.1in.)
Depth	55 cm (21.7in.)
Height, door closed	35.5cm(14 in.)
Height, door open	78.7 cm (31in)
Weight	48 kg (106 lb)
Clearances (sides and rear)	7.6 cm (3.0 in.)
Electrical requirements	60 Hz, 120 Vac, 4.5A: 50 Hz, 230 Vac 2.4 A 50/60 Hz, 100VAC, 5.5A
Maximum heat dissipation into room under steady-state conditions	1638 Btu/h (0.48 kW)
Noise level 0.91 m (3 ft) in front of instrument	$\underline{<70}$ dBA

1.2 Allegra X 22R Specification

Only values with tolerances or limits are guaranteed data. Values without tolerances are informative data, without guarantee.

Speed	
Set speed	0 to 15 500 rpm (in 100-rpm increments) or equivalent RCF
Time	
Set time	to 9 hr 59 min or continuous
Time display	time remaining in run (timed run) or hold and elapsed time (continuous run)
Temperature	
Temperature setting	-20 to +40°C (in 1°C increments)
Operating range	2 to 40°C
Ambient temperature range	10 to 35°C
Humidity restrictions	<80% (non condensing)
Acceleration	10 acceleration profiles
Deceleration	10 deceleration profiles
Dimensions	
Width	46 cm (18.1 in.)
Depth	70.7cm (27.8 in.)
Height, door closed	37 cm (14.6 in.)
Height, door open	81.3 cm (32 in)
Weight	78kg (172 lb)
Clearances (sides and rear)	7.6 cm (3.0 in.)
Electrical requirements	60 Hz, 120 Vac, 10.5 A: 50 Hz, 230 Vac 5.5A 50/60 Hz, 100VAC, 12.6A
Motor	1010 W
Maximum heat dissipation into room under steady-state conditions	3311Btu/h (0.97 kW)
Noise level 0.91 m (3 ft) in front of instrument	≤64 dBA

1.3 Allegra X 22/R System General Description

Allegra X 22 and 22R are tabletop centrifuges designed for laboratory use. The Allegra X 22R is the refrigerated version and the Allegra X 22 is the non-refrigerated version. These laboratory centrifuges are microprocessor controlled. Complete operating instructions are found in the Users Manual.

1.3.1 Rotors and Rotor Chamber

Make sure that only flawless rotors are permitted for use with the specific centrifuge. Insure that the rotor chamber and seals are not damaged.

Rotor Chamber

The rotor chamber must be clean and free of foreign particles. It is advisable when using the refrigerated centrifuges to open the lid after centrifuging in order to allow frost and ice to melt and vaporize.

After glass breakage, considerable contamination can occur. In this case the rotor must be removed and carefully cleaned. Glass splinters must be removed entirely. Otherwise, the sealing and rotor chamber surface may be damaged. After a short period of operation with glass splinters present a black metallic abrasive dust is produced, contaminating the centrifuge.

Glass splinters can damage the rotor surface so heavily that the protective anodizing layer is removed and corrosion sets in.

Rotors showing signs of corrosion may no longer be used!

In order to avoid such damage remove all traces of glass breakage. Larger splinters can be removed by hand with special protection (gloves, tweezers, etc.). Smaller glass particles can easily be removed by applying vacuum grease or a similar substance to a palm-sized area and then run the centrifuge at medium speed. Afterwards wipe off the vacuum grease with the stuck-on splinters. If required, repeat this procedure.
Check the state of the seals and grommets. Also check the boot between the drive and rotor chamber as these are of great importance for error free centrifuge operation.

Seals also play an important part in the rotor function. An uncontrolled air flow above the rotor could destabilize the system and cause damage.

Refrigeration performance may be severely limited by foreign air flows, which can cause considerable frost and ice formation.

NOTE: Perform regular maintenance on seals and grommets, replace damaged seals.

Drive Shaft

The customer should dismantle the rotors for cleaning at least once a month, or more frequently if required. After cleaning, grease the pins of swinging bucket rotors and the shaft using a high quality grease. (P/N 879049, 335148, etc.)

Caution! Never run the drive without a rotor installed. There is the danger of the split shaft being bent apart. Never tighten the rotor fixing screw on the shaft without the rotor installed. The shaft would be spread and permanently deformed.

Rotors

Damaged rotors may no longer be used. If in doubt, return damaged rotors to SPINCO Rotor Repair Center where they are checked for possible further use. Cracks in the material or corrosion damage always render rotors useless. Corrosion damage is often difficult to judge, because small surface damage may continue deep into the rotor and cause severe damage inside the material.
Make sure that the rotor coding is working, i.e. that all boreholes below the rotor contain magnets. Missing or malfunctioning magnets may lead to the detection of an incorrect rotor.
Sterilizing of aluminum rotors and buckets may take place in an autoclave for a maximum of 20 minutes at max. 130°C. Higher temperatures or durations alter the physical properties of the material and may lead to rotor breakage.

Fixed Angle Rotors

The most frequent damage to fixed angle rotors is corrosion starting inside the boreholes. The frequency depends on the operation mode and on the substances centrifuged. Alkaline substances foster corrosion. Operating with a contaminated centrifuge or high humidity in the boreholes leads to corrosion.

Swinging Bucket Rotors

The same measures and criteria for fixed angle rotors must be applied for swinging bucket rotors. **Additionally, the joint bolt for the buckets must be greased.** Make sure the buckets swing out evenly.

Caution: The joint bolts must be attached correctly and greased sufficiently. Their surface must be flawless. The buckets must be able to swing out evenly and entirely. Often uneven swinging of the buckets causes imbalance effects.

The rotor cross must also be greased, especially in the acceptance borehole and at the cone. Look out for cracks, especially near the joint bolts.

NOTE: The previous information is very important to the user. Train the customer on rotor maintenance as required.

1.5 System Operating Specification

For use by Field Service to certify performance.

Speed Control	Actual rotor speed will be within 50 RPM of set speed
Low Speed Check	2000 RPM
High Speed Check	Maximum speed of selected rotor

For Refrigerated Models (Allegra X 22R)

Temperature Control Range	2°C to 40°C Actual temperature obtainable is dependent on rotor selected and speed.
Low Temperature Check	5°C
High Temperature Check	15°C
Temperature Control	+ or - 2°C of set temperature at ambient temperature of 20°C.
For Non-Refrigerated Models	The normal temperature rise is dependent on rotor selected and speed as well as time between cycles to set speed and brake to stop. The maximum temperature rise should not exceed 15°C above ambient.

SECTION 2

SYSTEM INSTALLATION

2.1 General Safety Requirements and Regulations

The user is required to take comprehensive safety measures detailed in the corresponding operating instructions. In principle, these also apply to the service personnel.
It is obvious that not all safety precautions to be observed by users can always be adhered to by the service personnel such as functional test with open lid.

Observe the following:

First read the safety regulations in the operating instructions.

Apply valid (official) accident prevention rules.

Make sure that no safety-relevant modifications were made to the centrifuge.

Avoid long loose hair, loose clothing and jewelry (danger of being sucked in).

Extreme caution must be paid when performing functional test with open lid. Apart from the obvious danger of injury caused by the moving rotor there are secondary dangers such as breaking glass etc.

When working at the centrifuge, unplug the main cable and take precautions against accidental reconnection by placing a warning sigh **"DO NOT CONNECT POWER".**

When working on live components, have a second person present in order to remove the main power in cases of emergency.

Make sure that rotor and accessories are in flawless condition (no corrosion etc.).

Run centrifuge only within the permitted maximum rotation speed.

If the centrifuge density exceeds **1.2 g/cm^3**, reduce maximum rotation speed.

2.1.1 Safe Centrifuge Operation

A number of conditions must be met for the operation of a centrifuge. The safety of the service personnel and the performance of the service tasks depend on these conditions.

The conditions are listed below.

A secure footing of the centrifuge is ensured.

The rotors used in the centrifuge are approved and in a flawless state (no corrosion damage, no cracks, etc.)

Drive shaft and cone are in flawless state; the rotor is securely fixed to the shaft and can turn freely.

There are no foreign particles inside the rotor chamber.

The lid locks close properly; the lid seal is in working order.

No flammable or volatile substances are stored in the immediate vicinity of the centrifuge.

2.2 Installation Requirements

This Instrument is supposed to be Customer installed

Positioning The Instrument

WARNING: Do not place the instrument near areas containing flammable reagents or combustible fluids. Vapors from these materials could enter the instrument's air system and be ignited by the motor.

WARNING: Maintain a 30-cm (1 ft) "clearance envelope" around the centrifuge while it is running. No persons or any hazardous materials should be within this clearance boundary while the centrifuge is operating.

- Position the centrifuge on a level surface, such as a sturdy table or laboratory bench that is able to support the weight of the centrifuge (refer to SPECIFICATIONS) and resist vibration.
- Centrifuges must be located in areas with sufficient ventilation to allow for heat dissipation.
- Check that there are **7.6 cm (3 in.)** clearances at the sides and back of the instrument to ensure sufficient air circulation.
- Ambient temperatures during operation should not be lower than **4°C** or higher than **40°C**. Relative humidity should not exceed **80%** (non condensing).

NOTE: During transport between areas with varying temperatures, condensation may occur inside the centrifuge. Allow sufficient drying time before running the centrifuge.

Make sure the voltage imprinted on the name rating plate affixed to the back of the instrument agrees with the line voltage of the outlet used. Plug in both ends of the centrifuge power cord. If there is any question about voltage, have a qualified service person measure it under load while the drive is operating.

WARNING: To reduce the risk of electrical shock, this equipment uses a three-wire electrical cord and plug to connect the instrument to earth-ground. To preserve this safety feature:

- Make sure that the matching wall outlet receptacle is properly wired and earth-grounded. Check that the line voltage agrees with the voltage listed on the name rating plate affixed to the instrument.
- Never use a three-to-two wire plug adapter.
- Never use a two-wire extension cord or a two-wire non-grounding type of multiple-outlet receptacle strip.

NOTE: A ground lug is provided near the main plug. A separate ground wire can be connected to the lug to ground any non hazardous leakage current.

NOTE: Remove stabilizing foam from the chamber

Test Run

NOTE: The instrument must be plugged in and the power switch turned to on position (1) before the door can be opened.

We recommend that you make a test run to ensure that the instrument is in proper operating condition following shipment.

2.2.1 Rotor Attachment

It is extremely important for a safe centrifuge operation that the rotor attachment to the drive shaft is free of play. Otherwise shifts between drive and rotor can develop. Consequences of this are bent shafts as well as damage to rotors, rotor chamber, etc.

Allegra X 22 &22R centrifuges avoid this by using a conical seat and an additional expanding connection at the drive shaft. The conical seat is located above the bearing plate, and the cross-slit end of the shaft with inner cone is the expanding connection. The counterpart is the boring of the rotor, which is conical at the bottom end.

The **"collet screw"** belongs to the rotor attachment. This is a screw of model-specific dimensions equipped with a packet of spring washers and an expanding cone. **(P/N 361367)**

The rotor is placed onto the drive shaft and the screw is tightened into the shaft. When tightening the screw, the spring washers packet is compressed as far as physically possible. The resulting tension load forces the rotor onto the cone and thus ensures that the bottom end of the rotor boring is free of play. When tightening the collet screw further, the cone at the screw spreads the upper end of the cross-slit shaft apart and thus also presses it against the upper end of the rotor boring.

The hexagonal head of the collet screw has an inside thread into which the fixing screw of a cover can be affixed.

Caution: First safely attach the rotor using the collet screw: then screw on the lid.

Make sure the drive shaft and rotor boring are free of dirt and foreign particles. To prevent the rotor from sticking to the shaft, swab the inside of the rotor drive hole with Anti-Seize or equivelent product. (P/N 961660, 306812, etc.)

Also make sure that the collet screw is not tightened into the shaft with no rotor installed. The spreading cone would spread the shaft too far and deform it permanently. The rotor would afterwards jam on the shaft and thus not be pressed onto the cone with the required force. If, however, the permanent deformation has occurred, the ends of the slit shaft can be carefully bent back into place using smooth, ungrooved pliers. Be very careful not to damage the shaft surface. Replace the drive if the damage cannot be repaired.

Be sure to inform the user of the importance of a secure seating of the rotor and the principle of the attachment.

Caution: Warn the user against possible handling errors and their consequences!

2.3 Customer Training and Instrument Demo

The following check list is useful when customer training is required.

Prior to installation, contact the customer to ensure electrical requirements have been completed (GS-30TB-008A). Adjust your, training to the customer's needs.

Refer to User's Manual for all of the following:

Explain:

Rotors
Warranty
Maintenance
Responsibility
Cautions

Descriptions of instrument
Functions
Controls
Indicators
Rotor chamber
Temperatures sensing and control
Drive
Safety features
Name rating plate, serial number

Run the instrument

Help the customer do a simple run.

Explain:

Troubleshooting

Customer maintenance items

Beckman Coulter Field Service, service agreements, etc.

Accessories and options that are available for the instrument

How to get applications support from Beckman

SECTION 3

SERVICE PROCEDURES

3.1 Mechanical Systems

CAUTION !

Prior to working on the centrifuge disconnect mains power plug and make sure it cannot be reconnected by mistake (e.g. by means of a warning sign)!

3.1.1 Removing Front and Back Panels

Front and back panels of centrifuge must be removed completely to gain access to the electronic and mechanical components and refrigeration system.

Remove Plastic cover on top front panel and unscrew the screws at the top and bottom on the front when lid is open and pull out the front panel.
If the panel needs to be removed completely, mark the connecting plugs to the display control board prior to disconnecting. This helps to prevent wrong re-connections at a later stage.

After its removal the front panel can be slided underneath the base plate.
It is now possible to work on the front part of the centrifuge and it is no longer necessary to disconnect the cables. It is important to ensure that the front panel rests on a firm surface (the distance between the front lower edge of the centrifuge and the edge of the table should be at least 10 cm.

The back panel can be removed by unscrewing the 4 screws that ties it to the frame.

CAUTION!
Release the lid lock only if the rotor does not turn and any possible danger to other persons can be excluded!

3.1.2 Lid Lock

The Allegra X-22R has a mechanical lid lock. There is no special adjustment necessary.

3.1.2.1 Lid Emergency Release

It may be required to manually release the lid locks.

See Allegra X-22R Instruction Manuals for Emergency Access Procedures

3.1.2.2 Removal of Lid Locks

Open lid

Caution! Disconnect main power plug!

- Remove front panel
- Disconnect power connector X4 from the power board
- Loosen screws from the top
- Pull out lock downwards
- Activate emergency release, if necessary.

To assemble proceed in reverse order. Do not forget to adjust the lock!

- All movable parts of the lock and the lid hooks must be greased sufficiently to prevent increased wear and stiffness!

Note: If it is necessary to carry out an operational test of the centrifuge with the lid open, block the lock from above by inserting a separate lid hook into the rectangular opening in the lock.

CAUTION!
There is considerable danger for people in the vicinity of the centrifuge if the centrifuge is operated with the lid open!

3.1.3 Lid Gasket

3.1.3.1 Replacement of Lid Gasket

- Put the lid gasket on the centrifuge table plate starting from the front.?
- Glue joint of gasket with a rubber glue (e.g.Sicomet 8400).?
- Knock gasket firmly into place using a rubber mallet and seal off the joint on the edge of the chamber with silicon.
- From outside punch a hole of approx. 2mm ?into the rubber gasket approx. 1 cm from the joint (ventilation hole for rubber gasket).

3.1.4 Gas Pressure Springs

Gas pressure springs are used in the Allegra X-22R to relieve the lid. The lower fastening point is a metal bracket at the bottom plate of the centrifuge.

Removing spring:

- Remove back panel of centrifuge
- Open lid completely and support it firmly
- Secure lid
- Open clamping device on the fastening point of the pressure spring manually.

3.2 Drive Assembly

The drive is located at the geometric center of the rotor chamber.

Motors are taken out upward through the rotor chamber and also reinstalled from the top in a Allegra X-22R.

The drive also comprises vibration dampers and a rubber boot forming the motor suspension.

The respective rotor is attached to the drive shaft in the rotor chamber. The motor itself is suspended in an oscillatory manner.

A rubber boot encloses the motor and seals the armored chamber bottom. The rubber boot is attached to the motor via a round cover plate.

Protection against operation at a too high imbalance is ensured by the imbalance switch located at the bottom of the motor.

3.2.1 Motor Suspension

The motor is suspended via 3 rubber mounts, same as Allegra 21, GS15. The motor also has a rubber boot to seal the rotor chamber.

3.2.2 Rubber Boot

In all models, there is a rubber boot at the top of the motor. It is attached to the motor with a cover plate. The rubber boot seals the rotor chamber against the motor. It is positioned into the opening in the bottom of the rotor chamber.
The connector cable for the rotor detector runs through the rubber boot.

3.2.3 Vibration Mounting System

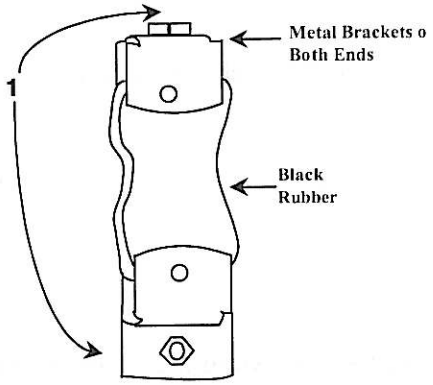
Centrifuges are operated at more or less significant imbalances. The drive must be suspended in order to allow the rotor to rotate around its axis and through its center of gravity, instead of around its geometrical axis. The drive attached to the rotor is thus suspended with elastic elements (rubber mounts).

This constitutes a physical spring-mass system which oscillates in itself. This oscillation tendency depends on the elasticity constant and mass properties; it can be so strong that the centrifuge becomes unstable and insufficient dampening could lead to destruction. Such dangerous operation states can be avoided using vertical and horizontal vibration dampers. Special care must be taken with respect to the dampers during maintenance.

Rubber Vibration Mounts

Rubber mounts consist of a stable rubber piece with a sheet metal yoke and a threaded pin at either end. The metal parts are greased with silicone oil in order to reduce friction within the yokes. Inspect the oil film during maintenance and repair. Exchange cracked rubber mounts. Take care that the rubber mounts are not twisted during installation. The base plate of the motor is suspended beneath the chamber. In the Allegra X-22/R this connection is dampened with rubber dampers.

REPLACE AS ASSEMBLY



For removal of Rubber Vibration Mounts proceed as follows:

- Loosen fixing nuts at the bottom of the chamber.
- Remove 2 hexagonal screws of the damper (1).
- Take out rubber damper from support angle.
- Reinstallation proceeds in the reverse order.

3.2.4 Suspension Maintenance

- Check the listed components visually:
- Check rubber components for cracks and holes; exchange if necessary.
- Check rubber grommets for holes and cracks; exchange if necessary

3.2.5 Motor Removal

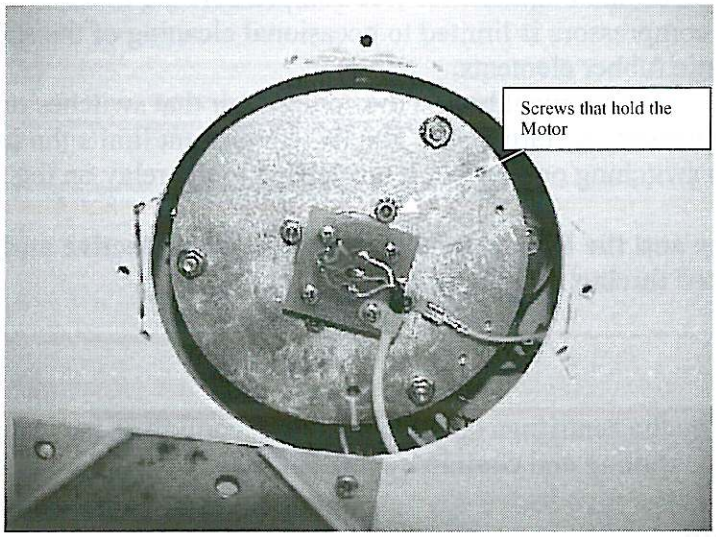
The motor is removed as follows:

Caution! ***Prior to start of removal always disconnect the main power plug and prevent accidental reconnecting by placing a warning sign:***

"DO NOT CONNECT TO POWER!".

Proceed as follows:

- Remove front covers and open lid.
- Loosen rotor attachment and remove rotor.
- Unscrew square cover on the bottom opening.



- Unplug motor and tachometer cables from power and display control boards.
- Unscrew 4 screws from the motor cover inside the rotor chamber.
- Remove motor cover with rotor detection device(P/N-365752). Do not damage cable and plug in the process!
- Remove rubber boot (P/N-364206).
- Unscrew 4 fixing screws of the motor.
- Remove motor carefully through the chamber.

CAUTION!
Disconnect main power plug and make sure it cannot be reconnected by mistake (e.g. by means of a warning sign)!

3.2.5 Motor Installation

Install motor in reverse order to removal.

It is advisable to check that the seams of the rubber elements are vertical. If this is not the case, it is dangerous to operate the centrifuge.

- After installation the imbalance sensor has to be checked.

3.3 Cooling

If temperatures below room temperature are to be achieved, a refrigeration unit must be used for cooling.

3.3.1 Compressor

Only hermetically sealed and maintenance-free compressors are used. The maintenance of the compressors is limited to occasional cleaning of the surface and checking of the elastic rubber elements.
There is a start relay in the terminal box of the compressor that switches on an auxiliary winding in the compressor for starting-up. The RC component limits the inductive voltage peaks when switching on and off. It is attached to the relay on the compressor.

Both the start relay and the RC component may become defective and must therefore be checked during maintenance work.

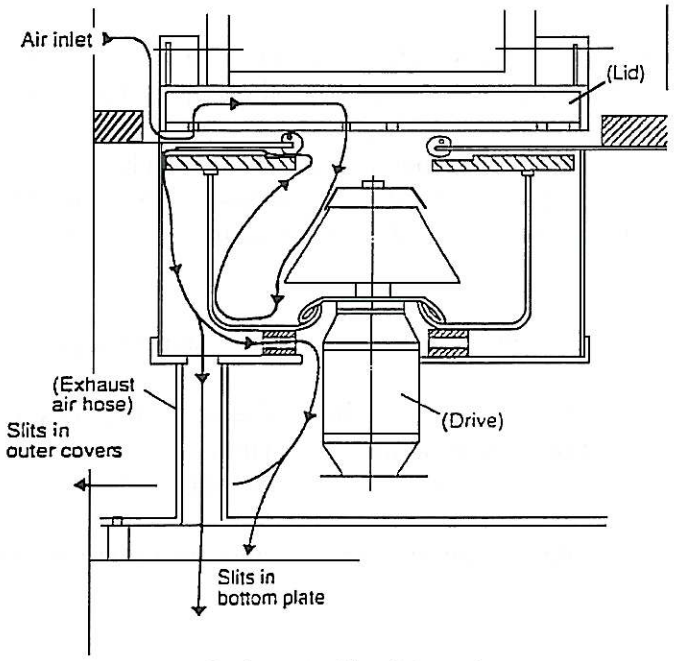
3.3 Cooling

The heat generated by the centrifuge operation requires cooling of the instrument. Two methods are used, air cooling and cooling by refrigeration.

3.3.1 Air Cooling

An air flow must pass through the rotor chamber in order to dispose of the heat generated by the rotor. For this purpose, the lid is not hermetically sealed as in the refrigerated centrifuges. The air-cooled centrifuge is designed to allow air flow through the system.

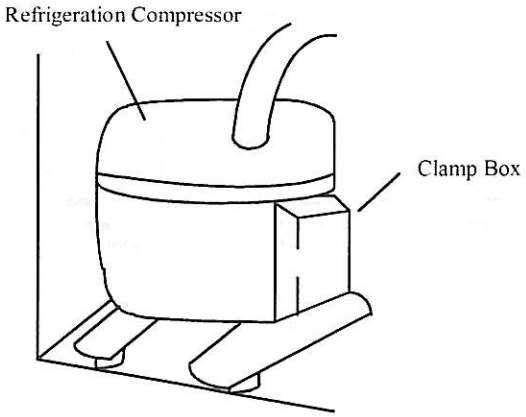
The room air used for cooling is drawn in at the rear of the lid and exits through the center of the lid openings into the rotor chamber and past the rotor. The air flow is then directed over the top edge of the rotor chamber and continues outside through the slit between rotor chamber and armored chamber downward. Via gaps in the lower intermediate ring the cooling air flows across the drive and cools its surface. Temperatures below ambient are thus unobtainable, as opposed to temperatures above ambient. The pressure gradient necessary for generating the air flow originates from the rotor movement.



Air Cooling - Air Flow Schematic

3.3.2 Refrigeration Cooling

In laboratory centrifuges, the drive energy (apart from acceleration and deceleration phases) is converted to heat. In order to prevent the rotor from excessive heating, this heat must be disposed of in a suitable manner. This can be done with an air flow through the rotor chamber (as for the air cooled centrifuges). If temperatures below the ambient are required, refrigeration must be used.



Compressor with Clamp Box

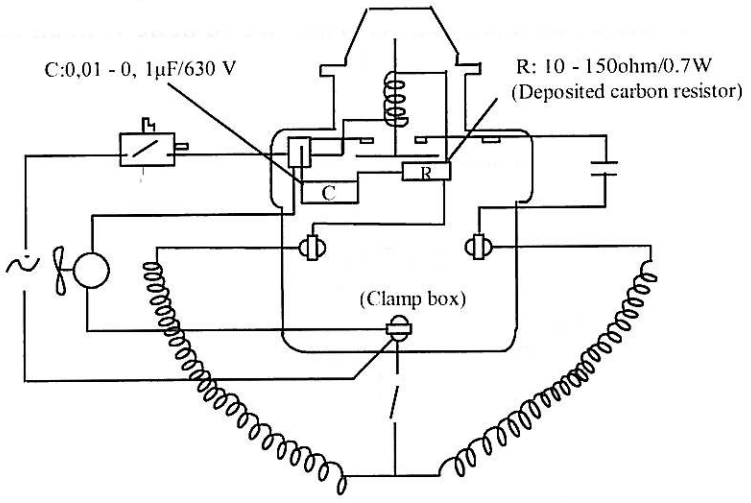
Refrigeration Compressor

The compressor is the core of the refrigeration system. The compressor draws off the cooling gas charged with the rotor heat energy from the evaporator (cooling coil around the rotor chamber) and compresses it. During this compression the heat contained in the cooling gas is "elevated" to a higher temperature (compression heat).
Only hermetically sealed and maintenance-free compressors are used. Maintenance of these compressors is confined to occasional cleaning of the surface and a check of the elastic mounts.

The electrical equipment of the compressors consists of a startup capacitor and also of an operation capacitor.
A start-up relay is located inside the clamping box. The relay switches on an additional auxiliary winding in the compressor as an aid for starting up. The R-C circuit also located inside the clamping box limits the inductive voltage peaks caused by the switching.
The start-up relay as well as the R-C circuit may fail and must therefore be checked during maintenance.

Configuration

Inside the clamping box of the compressor, the circuit must be configured according to the circuit diagram above.
The clamp box is fixed to the compressor by means of a clamp. Remove the clamp using a pointed tool such as a screwdriver.



Condenser

The condenser consists of a coiled tube inside a finned body. A fan is installed behind the condenser, drawing in cool ambient air through the grill (finned body) of the condenser.

Dust from the ambient air can be caught in the finned body of the condenser, hindering the heat transfer to the cooling air and infringing on the performance of the cooling device. It is necessary to clean the grill (fins) at regular intervals (at least on the occasion of the annual maintenance).
Use a brush or compressed-air for cleaning.
Wash out greasy and sticky dust layers using suitable detergents.
The grill can be bent by mechanical force. The air flow can be hindered by parts of the grill being bent. When this happens realign the grill.
Realign the grill using slim adjustment (needlenose) pliers. The grill spacing is 5 fins per 1 cm. (12 fins per inch)

Expansion Device

Expansion valves or capillary tubes are used as expansion devices. In principle, this is a throttling section, where the pressure gradient generated by the compressor is decreased, and the fluid cooling agent expands.
Capillary tube injections are used in this case. The cooling agent existing from the expansion device into the evaporator is called "injection".
The capillary tube may become clogged due to impurities in the cooling circuit. In this case replace the capillary tube.

Evaporator

After the cooling agent has left the expansion device, it is injected into the vaporizer, expands and changes its state of aggregation by vaporizing. Heat is extracted from the ambient (in this case the rotor chamber) during this procedure; thus the rotor chamber is cooled. At the evaporator output the cooling gas loaded with the heat energy is drawn in again by the compressor.
The evaporator consists of a copper tube wound around the rotor chamber in tight turns and soldered to the chamber for better heat conductivity. The evaporator is thermally shielded against the ambient air by means of an insulation layer. Therefore only the heat generated in the chamber is reduced.

3.3.3 Repairing the Refrigeration System

Cooling circuit repairs may only be performed by a trained refrigeration technician.

3.3.4 Filling Capacities: (1 gram = 0.03527 ounce)

8.11 oz or 0.230 kg R134a

3.3.5 Cooling System Performance

In a refrigerated centrifuge the heat caused by air friction is eliminated by using cooling. The temperature is measured inside the rotor chamber and then regulated to the value preset by the user via the microprocessor.
This mechanism can only work as long as the compressor can cope with the heat to be eliminated.

Compressor performance is determined by its capacity and influenced by outer conditions. High ambient temperature or contamination of the cooling agent condenser can reduce the performance significantly.

Compressor performance depends on the temperature range in which it is functioning. At lower centrifugation temperatures less heat has to be eliminated than at higher temperatures.

The amount of heat to be eliminated from the rotor chamber is determined by the rotors used, by the operation speed, and the preset temperature.

At normal operation conditions and at maximum speed the lowest temperature of +4° can be reached.

However, if lower temperatures than the obtainable ones are required, reduce the rotational speed.

No general rules or values for the reduction of maximum speeds can be given. Determine experimentally, at which speed the desired lower temperature is obtained.

The maximum rotational speed may only be reduced as far as to ensure that the air flow generated by the rotor is still sufficient to transport the heat energy from the rotor to the cooler rotor chamber. This can be especially true for fixed angle rotors.

3.3.6 Calibration of the R134a Refrigeration System

Test the Charge

After charging the system you should check the performance to insure proper charge.

First make temperature offset zero in the service mode.
(This is to test the charge)

Turn the centrifuge on, but no rotor turning. (0 RPM)
Set temperature to -20°C.
Wait 1 hour.

After 1 hour the indicated temperature should be -2°C or lower. If not -2°C or lower adjust the freon charge. (i.e. add more refrigerant)

Next set speed to 4,800 rpm, time hold and temperature to +5°C. The temperature should be able to reach 5°C.

Test for pressure while under heat load.

CAUTION: ***Cover backside of power receptacle (P/N961827) with electrical tape when servicing the rear of the instrument to protect against shock hazard.***

To check the filling capacity with a refrigeration manifold gauge set:

Ambient temperature should be 22-27°C.

Put low side gauge on service value of refrigeration compressor.
Set for maximum cooling (0°C)
Set rotor for maximum speed, set time for hold.
Run rotor at maximum speed.
After 30 minutes the low side gauge should read :

With instrument off (unplugged), after 30 minutes the gauge should read 41 psig.

3.3.7 Temperature Sensor

Rotor Chamber

The temperature sensor is monitored for short-circuit or failure by the micro controller; ERROR 87, 90 is displayed if required.

In case of malfunction the sensor (which is poured into a metal jacket and fixed to the bottom plate of the centrifuge) must be exchanged. Malfunctions of the wiring and the connectors are also possible and must be repaired. After the circuit board is exchanged take care to correct the offset values in the EEPROM. To replace the Rotor Chamber Temperature Sensor, first remove the RTV from the bottom (outside) of chamber bowl. Then the sensor is pressed down from the inside of the chamber out through the bottom.

Heat Sinks

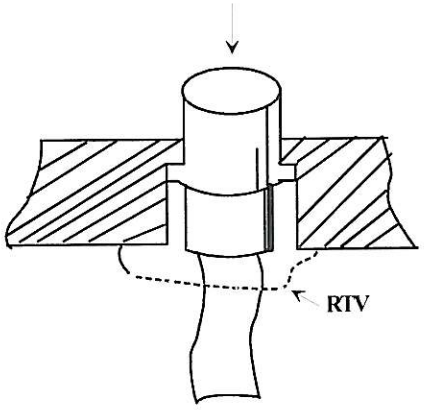
Temperature sensor B1 is located at the heat sink of the power board. This is set to overtemp at 70°C. (B1 is located on the left side of the heat sink)

The heat sink temperature is monitored, because overload and too high ambient temperature threaten the power transistors. The same sensor is used as for the rotor chamber. It is installed at the left side of the heat sink.

The sensor is connected to pin 17 of the 40-pin cable to the power board and then on to the analog input AN5 = pin 15 of IC12 (80535). Sensor response is signalized by the micro controller with ERROR 88.
For exchanging the sensor; first remove the power board, then exchange sensor and reinstall the power board.

Tempterature Sensor

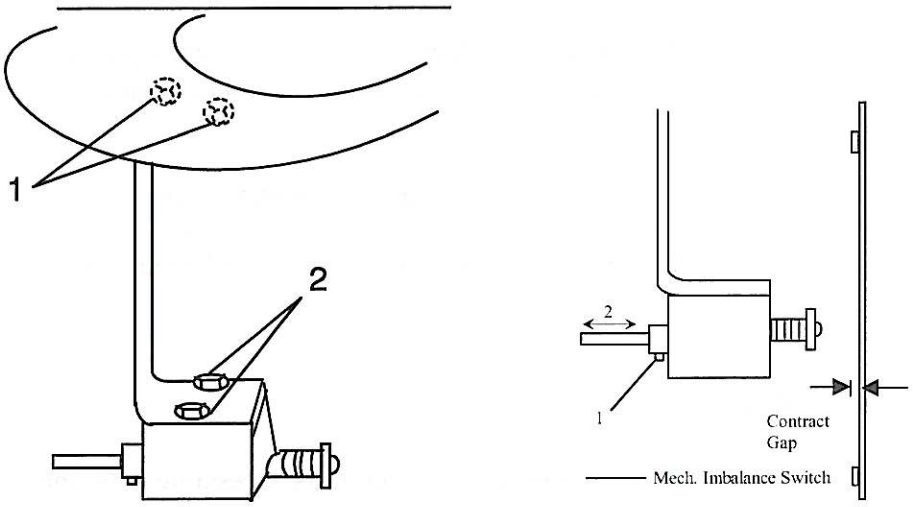
Remove sensor by pressing down
after removing RTV from bottom



3.4 Electronics

3.4.1 Imbalance

Allegra X-22R uses a mechanical imbalance switch. It is located at a support angle beneath the motor.
In case of imbalance the mechanical imbalance switch is pressed against the imbalance switch plate mounted on the tachometer board.



For removal proceed as follows:
Unplug connection cable to the power board (flat cable).
Unscrew 2 fixing screws of the support angle (1).
Unscrew 2 fixing screws of the imbalance switch at the support angle (2).
Replace imbalance switch.
For reinstallation proceed in reverse order.

After installation adjust the contact gap as follows.
Loosen slit screw at the contact (1).
Slide the contact at the rear of the imbalance switch in such a way that the contact gap is 1.0 ± 0.1mm (2).
Tighten slit screw.
After installation operate the centrifuge with an imbalance of 6 grams. It should not fail. Use decel value of three when testing the imbalance at 6 grams.
With a swinging bucket rotor the imbalance switch must fail at **15** grams imbalance. The imbalance LED will come on and the drive will brake fast. Otherwise repeat the adjustment. The centrifuge should operate with up to **6** grams of imbalance and not fail. With a fixed angle rotor it should pass at **10** grams and fail at **20** grams.

Note: 1 milliliter of water equals 1 gram.

3.4.3 Electronic Tests

For checking the rotational speed sensor and the rotor detection. The rotor can be rotated by hand (with open lid). The speed sensor LED must light-up six times per revolution. The rotor detection LED must light up according to the rotor code, where one coding magnet switches it off again. Spin the rotor by hand and confirm the LED lights up.

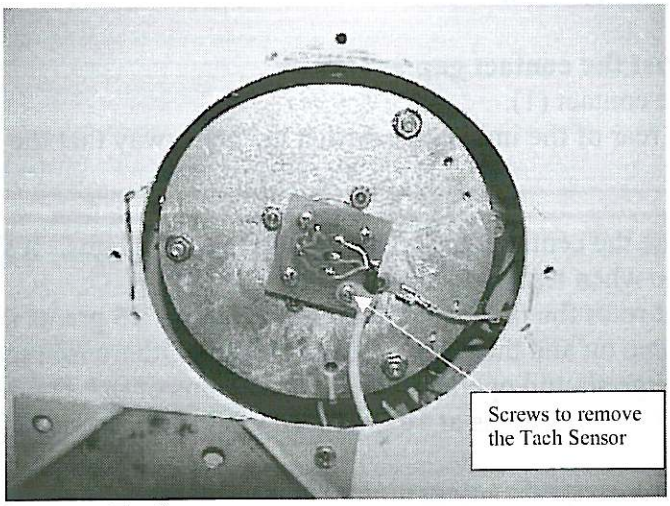
3.4.4 Speed Sensor

The speed sensor consists of a bistable Hall sensor which is placed on a small circuit board attache to the bottom of the motor. This unit can not be repaired but must be replaced as a whole.

A magnet segment with 6 pairs of poles rotates **1±0.5 mm** away from the sensor. A north pole in front of the Hall sensor switches the output to H = 5 V, whereas a south pole switches to L = O V. Therefore 6 H/L transfers must occur per rotor revolution. This is 3 highs and 3 lows.

For removal proceed as follows:

Tilt the centrifuge to the right side in such a way that the bottom is accessible from the outside.
Remove bottom plate.
Unplug cables.
Unscrew 4 phillips screws from the board .
Remove board and replace it if required.
Reinstallation proceeds in reverse order.



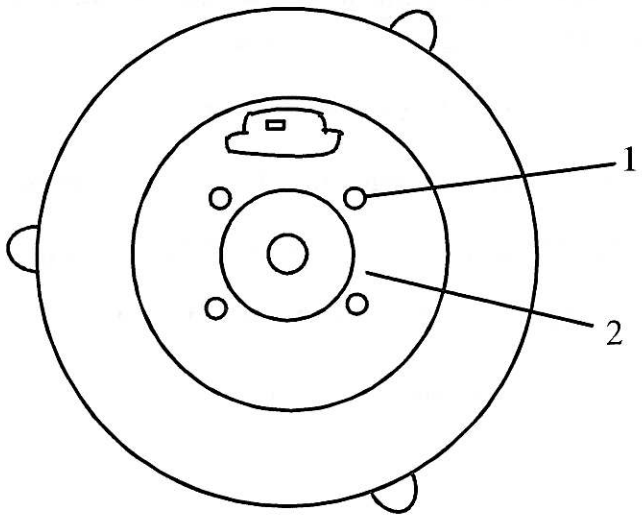
Speed Sensor - Exchange

3.4.5 Rotor Indentification

The same Hall sensor as described previously is used. It is mounted on the motor cover - inside the rotor chamber. A 4-pin cable leads alongside the motor down to the speed sensor board.
Small bar magnets of changing polarity are located in the rotor at a distance of 0.8...2mm in front of the Hall sensor. Between 2 and 12 magnets are located on a circle divided in 30° sectors. The number is always even. Angular position and number of magnets form the rotor code.

For removal proceed as follows:

Unscrew the 4 fixing screws of the rotor cover (1).
Lift cover with mounted sensor carefully approx. 10 cm .4 inch (2).
Unscrew 2 fixing screws beneath the cover.
Unplug the connection plug on the speed sensor board.
Exchange sensor.
For reinstallation proceed in reverse order.



Rotor Code Sensor - Exchange

3.4.6 Top and Lid of the Centrifuge

This section describes all components of the centrifuge accessible from the top.

Micro Controller Board

Dismantling and Installation: The micro controller board is located behind the front cover. The board is removed and installed together with the touch panel.

Caution! **Prior to start of work always disconnect the main plug and prevent accidental reconnecting by placing a warning sign "DO NOT CONNECT TO POWER".**

NOTE: ***The micro controller board contains static-sensitive CMOS components (i.e. damage may be caused by touching with your fingers). "Use anti static mat, grounding straps and other anti static devices."***

3.4.7 Sealing Ring of Armored Chamber - Replacement

A rubber sealing ring is located at the top edge of the armored chamber. Replacement is required if the installed sealing is damaged or gets brittle.

Press defective sealing inward towards the central chamber axis.

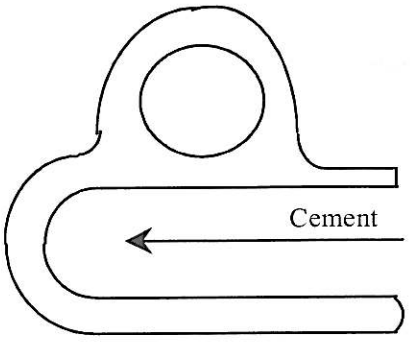
Pull off the sealing ring from the chamber edge towards the center and remove it.

Apply silicone (RTV **P/N 342778**) cement to the groove of the new sealing.

Starting with the seam, place the new sealing onto the chamber edge.

Smooth the remaining bulge outward using a rubber mallet.

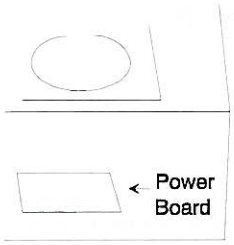
Wipe off the excess cement.

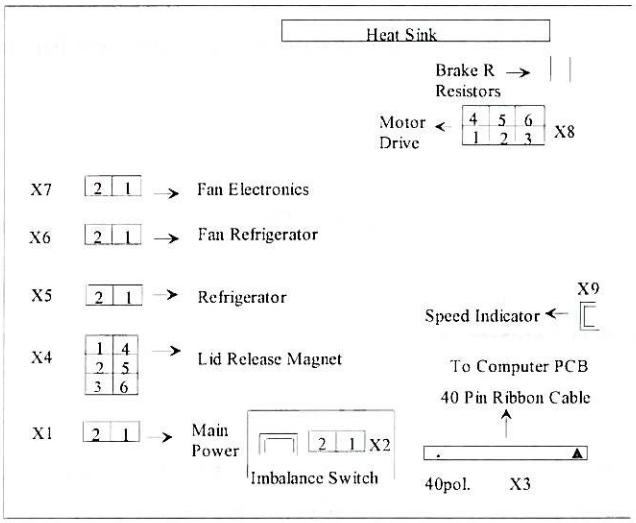


3.4.8 Power Board

Position, Dismantling and Installation

The power board is located at the front, bottom inside the centrifuge. Mark and then disconnect all cables leading to the power board.
Take out the power board attached to the heatsink. Do not detach the power board from the heatsink, the IGBT might be destroyed.
For reinstallation proceed in reverse order.





3.4.9 Maintenance Requirements

PMC Procedures

To properly maintain Beckman centrifuges regular maintenance should be performed on a periodic basis.

Contamination

Insure that the instrument is safe to work on. No pathogenic, radioactive, or biohazardous material can be present. Ask the operator to clean the instrument and rotors prior to doing a preventative maintenance.

Safe Positioning

Check and insure the centrifuge is located properly and firmly. Insure the proper clearances from the walls and sides as specified in the installation instructions. Insure that the table the centrifuge is placed on is steady, and that the proper air flow paths are clear. Check the refrigeration system if applicable. Insure airflow is clear and fans are operational. Condensing fins should be free of dust in order to function properly.

Centrifuge Identification

The indentification label with serial number and etc. must be legible. The rotation direction arrow must be present.

Rotors and Accessories

The required indentification labels must be present and legible on all rotors and accessories. Visually inspect rotors for signs of corrosion. Rotors that are not properly maintained and show cracks, damage or corrosion may no longer be used.
If the customer or yourself is unsure of a rotor's condition, the rotor can be scheduled for a FRIP inspection or returned to the SPINCO Rotor Center. The Rotor Center can inspect and repair if possible. Make sure that only good rotors are permitted for use.

Test Operation

Perform a test run and check the instruments operation. Note any problems. Disconnect the instrument power by unplugging the main power cord. Post a sign on the centrifuge :

"DO NOT CONNECT TO MAIN POWER OR ATTEMPT TO OPERATE THIS INSTRUMENT, IT IS BEING SERVICED".

Inspect the Instrument

Inspect and correct all instrument problems such as loose hardware chaffing wires, burnt wires, pitted relay contacts, cracked hinges, etc. Insure all vibration devices, motor mounts and etc. are in working order. Correct any problems found in the test run also.

Safety Barrier

Inspect the chambers, safety barriers and other body and enclose parts for damage, loose bolts etc. Correct all descrepencies found.

Protective Door

Insure the centrifuge door and associated safety latches are functional and not damaged.

Calibration

Power on the instrument, perform instrument calibration. Check imbalance detector operation and calibration.

Final Checks and Test Run

Reassemble instrument and make a final test run. Check all operational settings.

Safe Braking

Insure the effectiveness of the braking system for the centrifuge both at full and slow decels.

Accessories, Updates and Options

Inspect all accessories for damage. Insure all accessories are operational and safe. Insure the centrifuge has all safety updates, current version of firmware and is in general maintained to the current revision. Safety interlocks and devices must not be bypassed or deleted.
After the PMC is complete explain the service performed to the customer. Make recommendations as to proper rotor and instrument maintenance. Review all commitments and thank the customer before you leave.

3.5 Service Mode Zent 3 Version Electronics

3.5.1 Service Mode

To activate the service mode:

Press Cursor Up key
Press Enter three times, holding down the key the third time until the Service Mode appears in the time display = 'Ser'

The program and speed fields display the following parameters:

program	speed	description
0	ver	software version and centrifuge type
1	sen	sensor status
2	imbal	imbalance calibration
3	error	error table
4	eep--	erase EEPROM or Door Lockout Timer
5	imbw	static imbalance
6	imbf	dynamic imbalance
7	led888	LED test
8	zeit	accumulated run time
9	zykl	cycle mode
10	temp	temperature offset

Select the program using the ↑ and ↓ keys.
To exit any service program press STOP.

0 Software Version and Centrifuge Type

Press ENTER to activate.
The time and speed fields display the following parameters:

time = Software Version
speed = Centrifuge Type

1 Sensor Status

Press ENTER to activate.
The program, time and speed fields display the following parameters:

ACC/DEC =
digit 1, i.e. left = 1 inverter bus charged, 0 inverter bus discharged

digit 2, = 1 inverter enabled, 0 inverter not enabled

TIME =
digit 1, i.e. left =1 door closed, 0 door not closed
digit 2 = n/a
digit 3 = 1 chamber overtemperature (O/T), 0 no chamber O/T

SPEED =
digit 1, i.e. left = 1 no inverter O/T, 0 inverter O/T
digit 2 = 1 imbalance, 0 no imbalance
digit 3 = 1/0 rotor ID sensor output
digit 4 = 1/0 tach sensor output
digit 5 = 1 rotor turning, 0 rotor stopped at least 2 seconds

2 Dynamic Imbalance N/A

3 Error Table

Press ENTER to activate.
The 14 most recent errors are stored in the error table. Pressing the ↑ and ↓ keys scrolls through the list of errors. Pressing RPM deletes the error from the list. The time and speed fields display the following parameters:

time = sequence number
speed = error number

4 Erase EEPROM or Door Lockout Timer

Press ENTER to activate.
The speed field displays 'ERASE'. Two options are available by pressing the following keys:

ENTER = deletes the error table; exits Service Mode
not effected: elapsed run time, cycle counter, temperature offset, imbalance thresholds

RPM = deletes error table, run time, temperature offset, imbalance thresholds
not effected: elapsed run time, cycle counter; exits Service Mode
The accumulated run time and cycle counter values can be deleted in programs 8 and 9, respectively. The temperature offset and imbalance thresholds revert to their default values.

5 Static Imbalance N/A
6 Imbalance Cutoff N/A

7 LED test
Press ENTER to activate.
Every discrete LED and seven segment LED digit is turned ON.

8 Accumulated Run Time
Press ENTER to activate.
The speed and time fields display the following parameters:

speed = time =
hhh & hh-mm
A maximum of 99999 hours and 59 minutes can be displayed, about 11 years.
Pressing RPM clears the stored elapsed time in the EEPROM.
Pressing STOP or ENTER exits the program.

9 Cycle Mode

Press ENTER to activate.
The centrifuge can be programmed to cycle automatically. The time and speed fields display the following parameters:

time = wait time (minutes)
speed = cycle counter

The following keys are used to program the cycle mode parameters:

↑ and ↓ = wait time (1minute increments)
RPM = clear the cycle counter
START = begin cycling and start the centrifuge
FSTOP = end cycling and stop the centrifuge
STOP or ENTER = exit the program

10 Temperature Offset Mode

Press ENTER to activate.
A temperature offset can be programmed to be added or subtracted from the temperature display to match the temperature measured with a dunk test.
The speed, time, and temp fields display the following parameters:

speed = temperature including offset
time = temperature offset
temp = temperature without offset
↑ and ↓ = offset (+/- 0.1C increments)
STOP or ENTER = exit the program

3.5.2 Error listing for Zent 3

No.	Type	Description	Service Procedure
	System CPU:		
1	fail	CPU test after power up failure	change EPROM, change Control Board
2	stack	stack overflow	same as error #1
3	CPU RAM	CPU RAM failure	same as error #1
4	RAM	external RAM failure	same as error #1
5	EPROM	checksum invalid	same as error #1
6	comm	communication fault	same as error #1
7	comm	Control to Display communication error	√ connection, change Control and/or Display Board
8	watchdog	frequent tripping	√ +5volt power supply on Control Board, change EPROM, change Control Board
9	status	disallowed SW traps	change EPROM, change Control Board
10			
	Motor CPU:		
11	fail	CPU test after power up failure	change EPROM, change Control Board
12	stack	stack overflow	same as error #11
13	CPU RAM	CPU RAM failure	same as error #11
14	RAM	external RAM failure	same as error #11
15	EPROM	checksum invalid	same as error #11
16	comm	communication fault	same as error #11
17	reset	Motor CPU reset	same as error #11
18	watchdog	frequent tripping	√ +5volt power supply on Control Board, change EPROM, change Control Board
19	status	disallowed SW traps	change EPROM, change Control Board
	Tach, System CPU:		
20	unstable	interrupt faulty	√ tach sensor to Control Board connection, √ tach sensor cable grounding, √ tach sensor/magnet ring gap, change tach sensor
21	overspeed	RPM exceeds limit	same as error #20

No.	Type	Description	Service Procedure
22	unstable	noisy or jittery	same as error #20
23	compare	inconsistent reading between motor and system CPUs	same as error #20
24	control	final speed not reached	√ AC input voltage, √ how easily the rotor turns, change Power Board, change drive
25	drive	inverter problem	√ AC input voltage, change Power Board
26	monoflop	no indication of rotor turning even though tach O.K.	change EPROM, change Control Board
27	PWM check	PWM signal or feedback signal absent	same as error #26
28	no tach	start without tach	same as error #20 lid lockout requires power to be left on for 12-13 minutes, or can be cleared in the service mode
29	no tach	lose tach during run	same as error #28
30	compare	inconsistent overspeed limit between motor and system CPUs	same as error #26
	Tach, Motor CPU:		
31	overspeed	RPM exceeds limit	same as error #20
32	unstable	noisy or jittery	same as error #20
33	compare	inconsistent tach reading between motor and system CPUs	same as error #20
34	control	final speed not reached	same as error #24
5	drive	inverter problem	same as error #25
36	monoflop	no indication of rotor turning even though tach O.K.	change EPROM, change Control Board
37	PWM check	PWM signal or feedback signal absent	same as error #26
38	no rotor	start without rotor	same as error #20
39	no tach	no tach indication	same as error #20
40	overspeed	hardware overspeed test failure	√ overspeed jumper settings, change Control Board
41	overspeed	hardware overspeed detection, at max rotor speed	same as error #40

No.	Type	Description	Service Procedure
42	imbalance	hardware imbalance test failure	√ imbalance sensor and Control Board connection, √ imbalance sensor position, change imbalance sensor
43	imbalance offset	DC offset not in range	same as error #42
44	n/a		
50	status	floating point operation error, overflow	change EPROM, change Control Board
51	status	floating point operation error, overflow	same as error #50
52	status	floating point operation error, underflow	same as error #50
53	n/a		
	EEPROM:		
69	type	not compatible	EEPROM loose, same as error #20
70	type	version not compatible with SW version	same as error #69
71	hardware	not responding	same as error #69
72	verify	not responding	same as error #69
73	checksum	program data not valid	same as error #69
74	checksum	free area not valid	same as error #69
75	checksum	imbalance not valid	same as error #69
76	checksum	offset not valid	same as error #69
77	checksum	program variables not valid	same as error #69
	Door:		
78	close failure	not closed after door relay active	n/a, motorized latch only
79	hook difference	time difference between hooks too large	n/a, motorized latch only
80	transistor	transistor failure	change Power Board
81	monoflop	rotor turning with door open	turning rotor by hand with the door open, √ door contacts, √ tach sensor
82	test	door lock test signal failure	√ door latch to Power Board connection, change Power Board, change Control Board
83	open failure	door won't open	same as error #82

No.	Type	Description	Service Procedure
84	O/T	chamber O/T	√ refrigeration system including Power Board, relay, √ O/T sensor to Control Board connection, change O/T sensor
85	O/T	Rotor exceeds 50C	√ refrigeration system including Power Board, relay
86			
87	temperature	temperature signal out of range	√ temperature sensor to Control Board connection, change temperature sensor, change Control Board
88	O/T	Power Board heatsink exceeds 70C	√ airflow, √ O/T sensor and cable
89			
90	temperature	temperature sensor failure	same as error #87
91	n/a		
94	imbalance	static imbalance sensor failure	same as error #42
95	imbalance	dynamic imbalance sensor failure	change EPROM, change Control Board
96	n/a		
98	rotor ID	invalid rotor ID	√ rotor ID sensor to rotor gap, rotor missing magnets, √ rotor ID sensor and cable
99	rotor ID	invalid rotor ID	wrong rotor ID keyed in by user, same as error #98

SECTION 4

SCHEMATICS

4.1. Circuit Description

4.1.1 Power Board

The power board comprises relay operation control, power supply for the micro controller board, intermediate circuit, the star-delta switch proper, brake chopper, over voltage monitoring, transistor temperature monitoring, and possibly the imbalance switch.

4.4.2 Electronic Speed Regulations for Centrifuge Drives

All laboratory centrifuges require drive systems with variable rotational speed. Universal motors were used for this purpose, where the commutation takes place by carbon brushes and collectors. By means of a speed control, a specific rotational speed could be adjusted and regulated within an adjustment range. Sometimes regulating transformers were used as speed adjustment circuits.

Universal motors have system-inherent disadvantages. For example, brushes and communators wear out quickly causing frequent maintenance and shortening the life. The brush dust causes contamination, interfering with laboratory work. Undesired carbon dust deposits in the centrifuge may occur.

An alternative to the universal motor is the three-phase asynchronous motor, characterized by its simple structure. In the industrial drive technology for fixed speeds it is by far the motor type most widely used. If driven with AC current they provide high torque and are less noisy. With brushes no longer in use, the only life cycle-significant elements are the bearings. This is of secondary importance. The asynchronous motor can be regarded as maintenance free.

In order to operate an asynchronous motor at varying speeds it must be driven with three-phase current of variable current or variable frequency. For this purpose a three-phase converter is required, driven by a DC voltage source (the intermediate circuit).

The power transistors are digital switches, because they can only be switched on or off. The speed sensor is also digital. Thus the entire speed regulation system can be designed digitally if a microprocessor is used. As compared to analog systems the advantage is greater stability and simple integration. Adjustment is not required. Remaining functions the microprocessor cannot handle due to its limited operation speed, are integrated into its own gate array. The result is a system with economic component use and high flexibility.

Intermediate Circuit (Bus Current)

The intermediate circuit drives the converter. It consists of a main rectifier and one or more storage capacitors.

The generated DC voltage is the basis for generating the three-phase current for driving the motor. In order to attenuate the switch-on current peaks of the electronic capacitors, the main voltage is connected first via resistors. After approximately 0.5 sec. the resistors are short-circuited via K4.

Main Input

For the main input function see the machine-specific circuit diagram "Main Input".
The main voltage is supplied to the power board via plugs x3/1 and x3/2.
It connects lid release magnet via relay K1,2 and lid switch to voltage. If the lid switches are closed, the following components are connected to the input.

The opto-coupler U2 (tells the micro controller that the lid is closed)

The relay K3 (can switch on the compressor)

The relays K2 (can switch on the fans)

The relays K4 (can switch on the intermediate circuit)

Relay Control

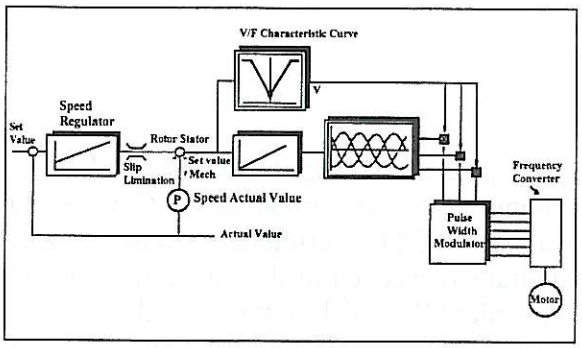
The relays are switched by the micro controller output ports via the relay driver D7.
Relay K4 is time-delayed by Rx and Cx with respect to PWM signed presence.

The thermistor temperature sensor measures the heat sink temperature.

The opto-coupler Ux LED is connected to the voltage after the lid is closed. Ux thus signals to the micro controller that the lid is closed.

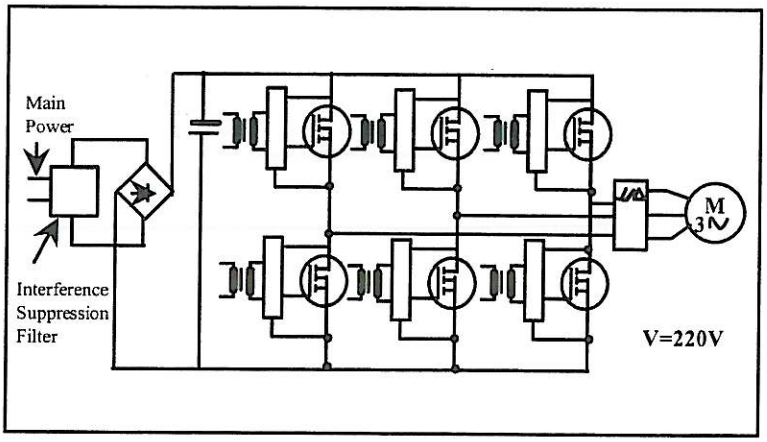
The exact sine valuation of the motor voltage generated in the converter allows an even rotation of the motor at or above only approx. 30 RPM. Density gradient centrifugations can thus be performed very well with these centrifuges.

Acceleration and braking follows selectable curves. They contain a time function together with the max. slip speed for the motor. The slip is dominant; i.e.. if the preset acceleration time is shorter than physically possible, acceleration does not follow the time but the max. slip speed. This is always the case for curve 9. Here the desired times are so short that they can never be achieved. Acceleration/braking in this case follows max. slip speed and is thus achieved in the shortest possible time.



Frequency Converter

The converter consists of a power transistor module with corresponding drivers and the current monitoring. Two transistors with their drivers are wired as a semi-bridge. Only one transistor per semi-bridge is conductive at any one time. If uncomfortable voltage peaks accidentally cause 2 transistors of one semi-bridge to become conductive at the same time, they are usually destroyed. Often the CMOS circuits in the driver stages are damaged as well, causing another failure in the future. As such damage is undetectable, do not exchange transistors but the entire board.



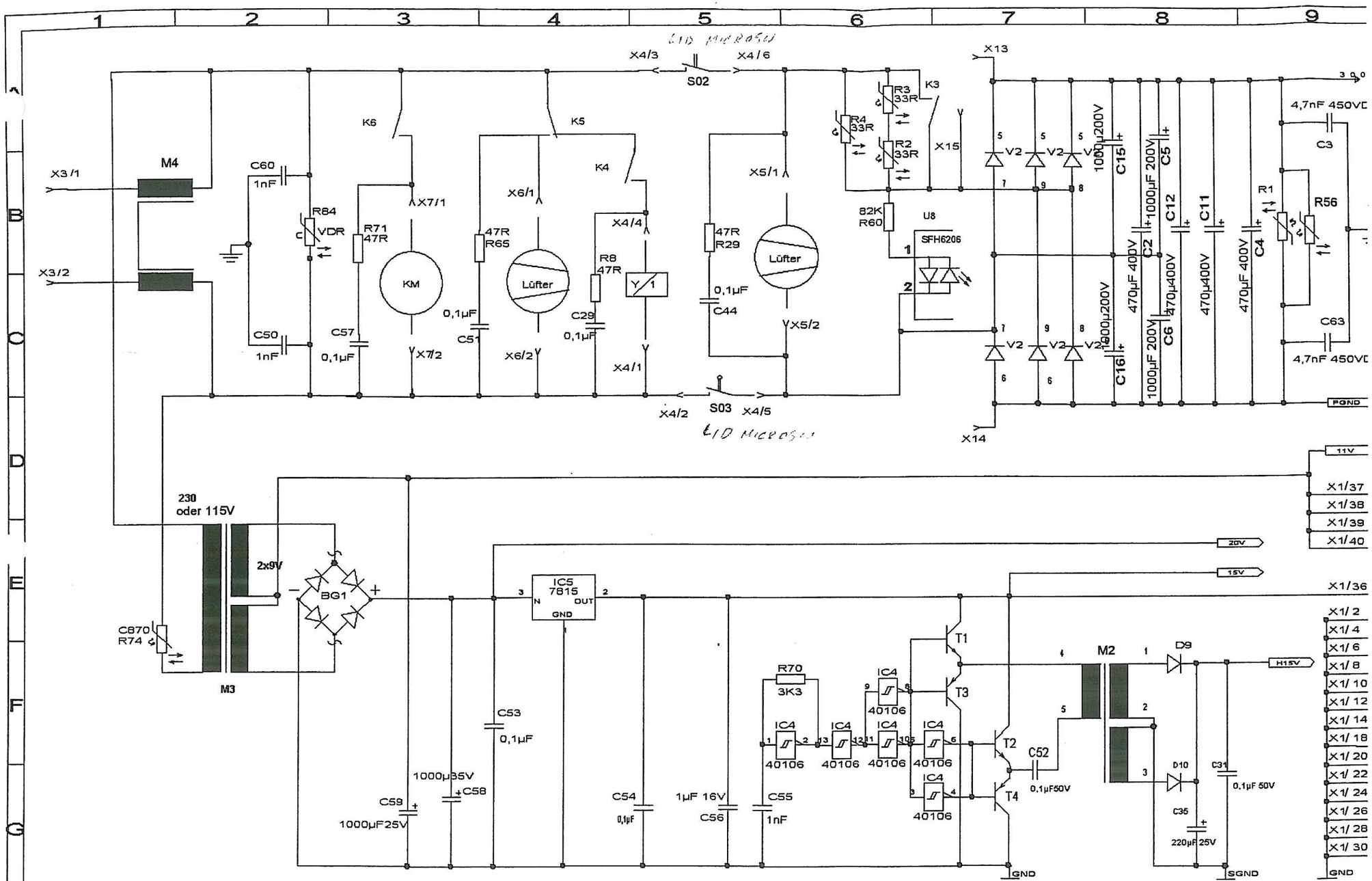
NOTE: Consider in general that trying to repair within the converter (transistors and drivers) should be avoided, because extensive experience and quite expensive measuring equipment is required.

Brake Chopper

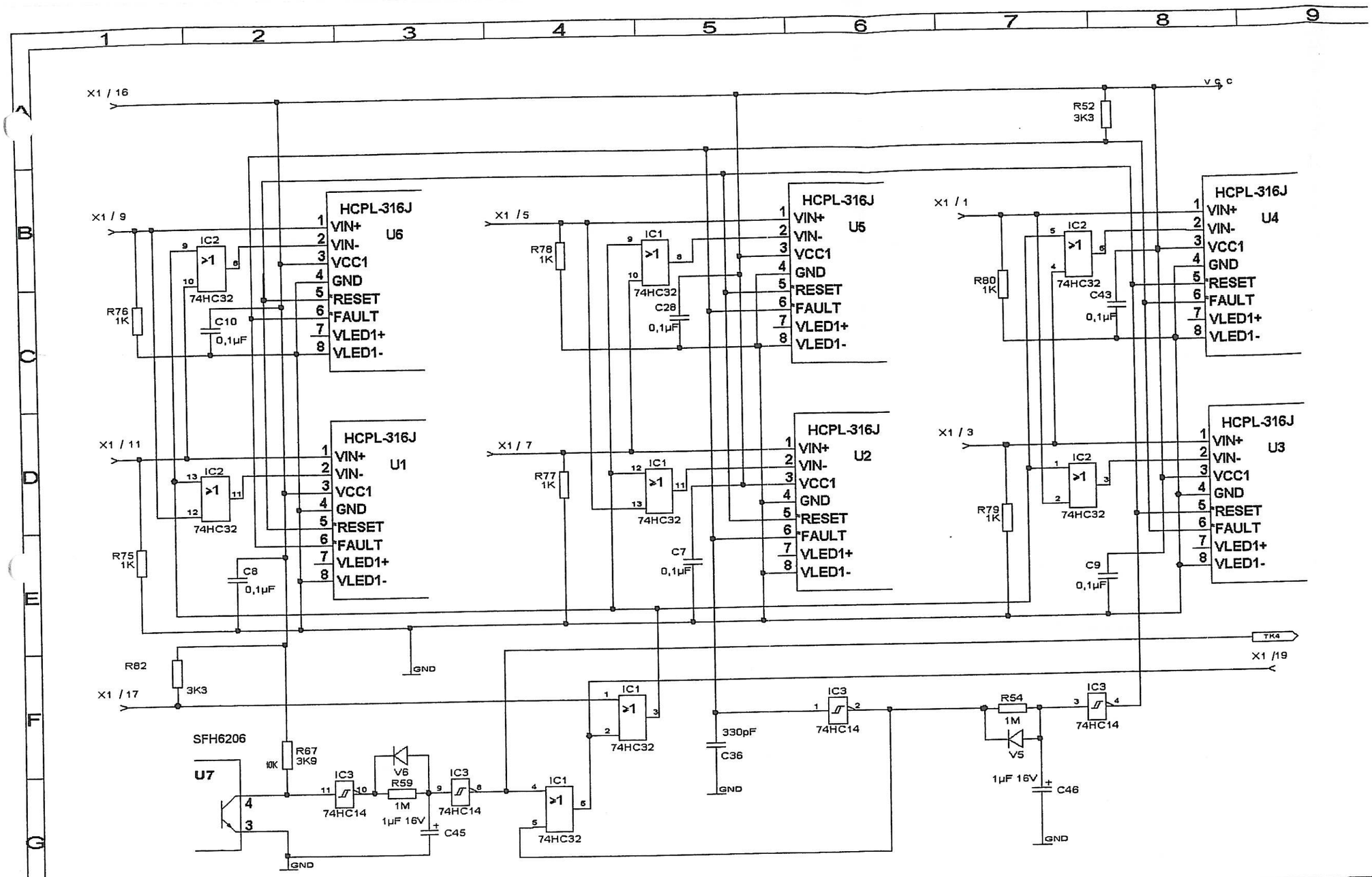
The voltage regulator TL431 N3 generates the operating voltage for the brake chopper via R37 and R38. The reference voltage is connected to the comparator N2C pin 8 and 9 and switches on transistor V38 and thus resistor R87 if the intermediate circuit voltage exceeds approx. 360 V. If the intermediate voltage rises even further, at approx. 390V the second comparator switches on the opto-coupler U1, which in turn signals over voltage to the micro controller. Error message 25 or 35 appears and the drive slows down freely.

Power Supply

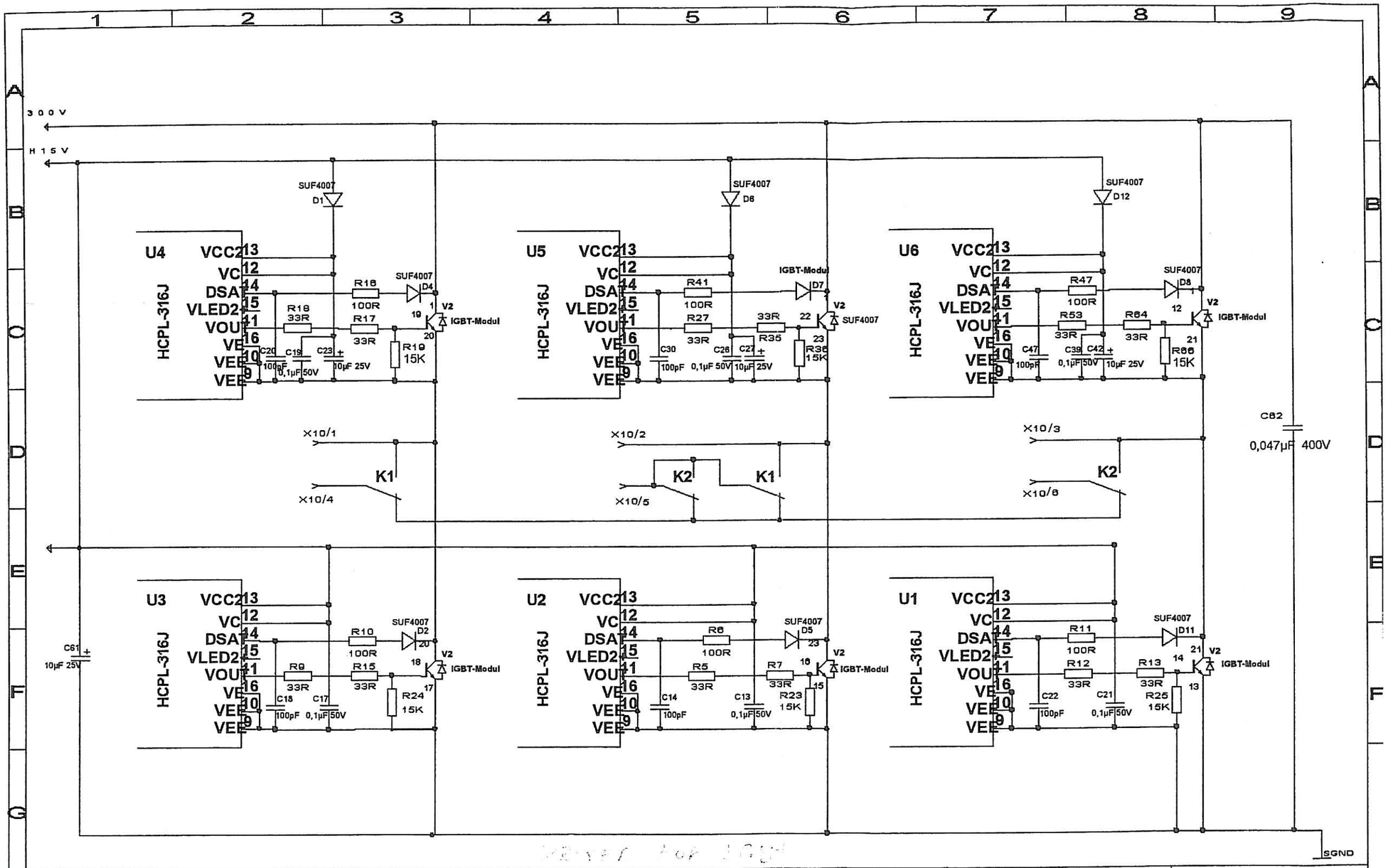
Capacitor C1 and diode V39 form a voltage doubler with approx. 25 V at its output, stabilized by N4 to 15 Volt. The unstabilized 25 VDC voltage supplies the switching relays.



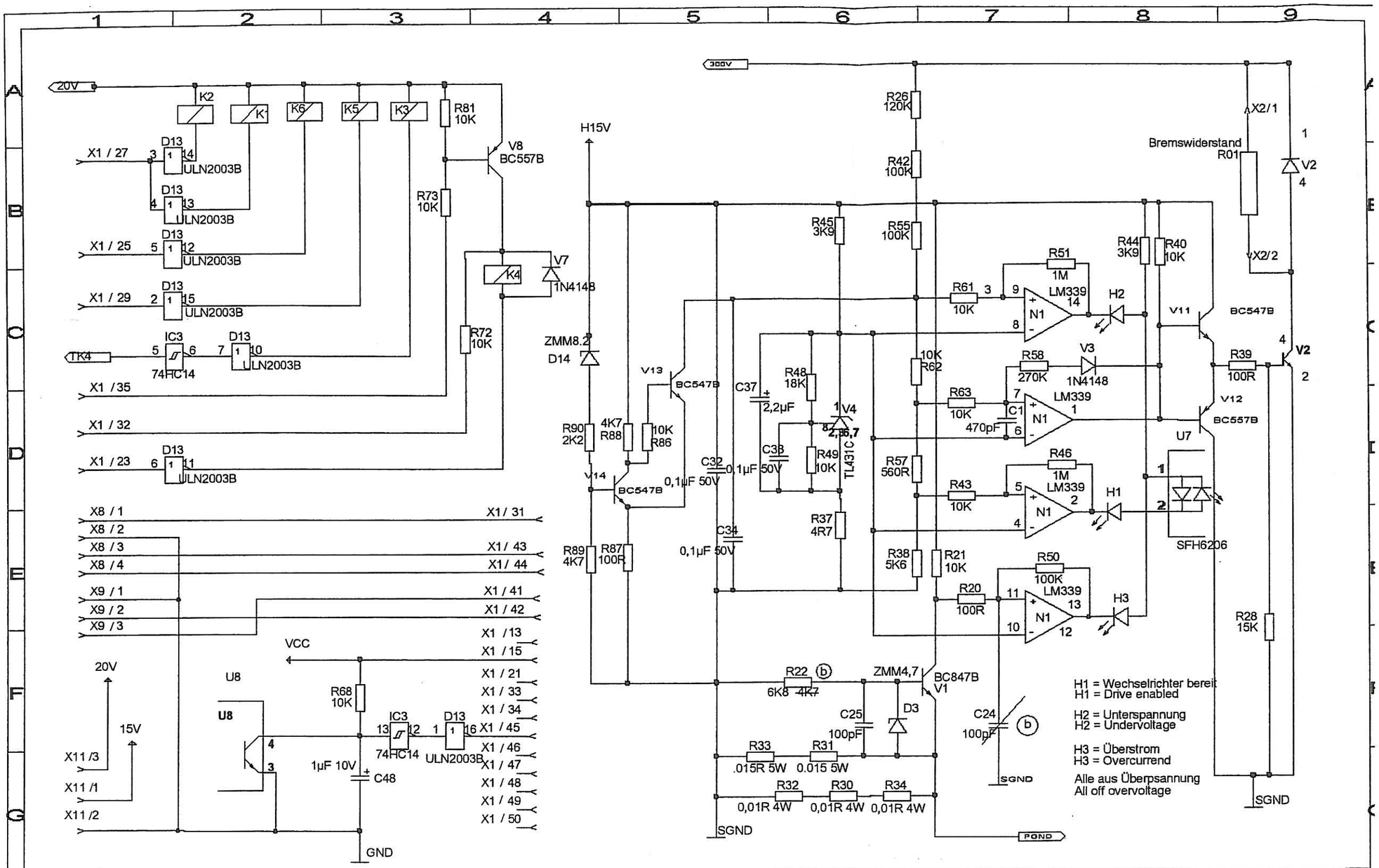
			Datum	08.07.2002	70792 230V 8A C2, C4 R1, R2, R3, R56 70793 120V 4A (C15 u. C16) oder (C5 u. C6), C3, C63, R1, R2, R3 70794 230V 4A C2, R1, R4,	SIGMA Laborzentrifugen GmbH 37520 Osterode Harz	Bezeichnung Schaltbild für Leistungsplatte Zent 3
			Bearb.	Gärtner			Zeichnungsnummer 25293
a	0208	02.05.2002	gepr.				Platte 25291/21
	Mitteilung	Datum	Norm			Auftrags Nr.:	Blätter 4 Blatt:



			Datum	08.07.2002	SIGMA Laborzentrifugen GmbH 37520 Osterode Harz	Bezeichnung **Schaltbild für Leistungsplatte Zent 3**	Zeichnungsnummer **25293**
			Bearb.	Gärtner			
a	0208	02.05.2002	gepr.				
	Mitteilung	Datum	Norm		Auftrags Nr.TEXT	Platte 25291/21	Blätter: 4 Blatt:



			Datum	08.07.2002	SIGMA Laborzentrifugen GmbH	Bezeichnung Schaltbild für	Zeichnungsnummer
			Bearb.	Gärtner	37520 Osterode Harz	Leistungsplatte Zent 3	25293
a	0208	02.05.2002	gepr.		Auftrags Nr.:	Platte 25291/21	Blätter: 4 Blatt: 3
	Mitteilung	Datum	Norm				



			Datum	08.07.2002	Alternativ: R31 und R33 oder R30, R32, R34	SIGMA Laborzentrifugen GmbH 37520 Osterode Harz	Bezeichnung: Schaltbild für Leistungsplatte Zent 3
b	C24 gestr., R22 geänder	07.08.2002	Bearb.	Gärtner			Zeichnungsnummer: 25293
a	0208	02.05.2002	gepr.				
	Mitteilung	Datum	Norm			Auftrags Nr.:	Platte 25291/21

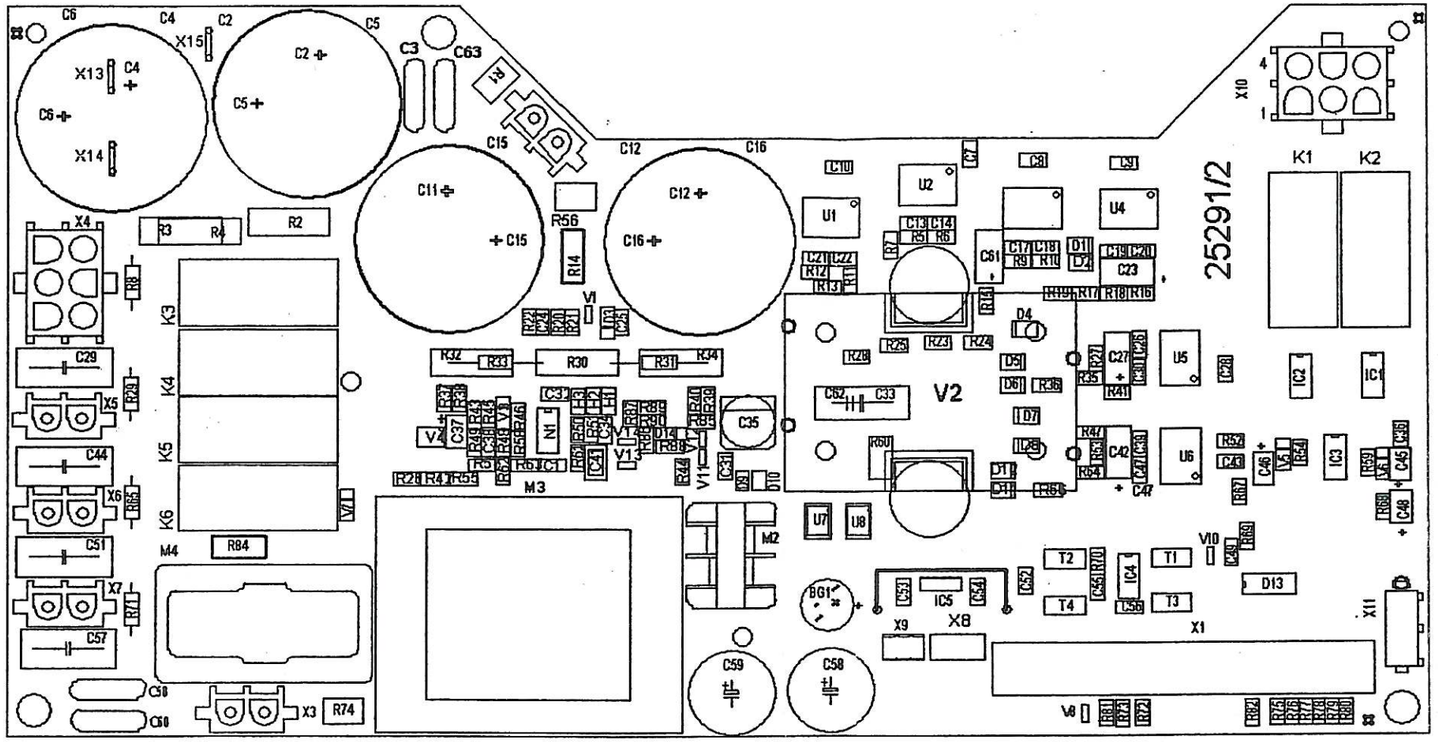
Blätter: 4 Blatt: 4

H1 = Wechselrichter bereit
H1 = Drive enabled

H2 =Unterspannung
H2 =Undervoltage

H3 = Überstrom
H3 = Overcurrend

Alle aus Überspannung
All off overvoltage



Version 25291/2

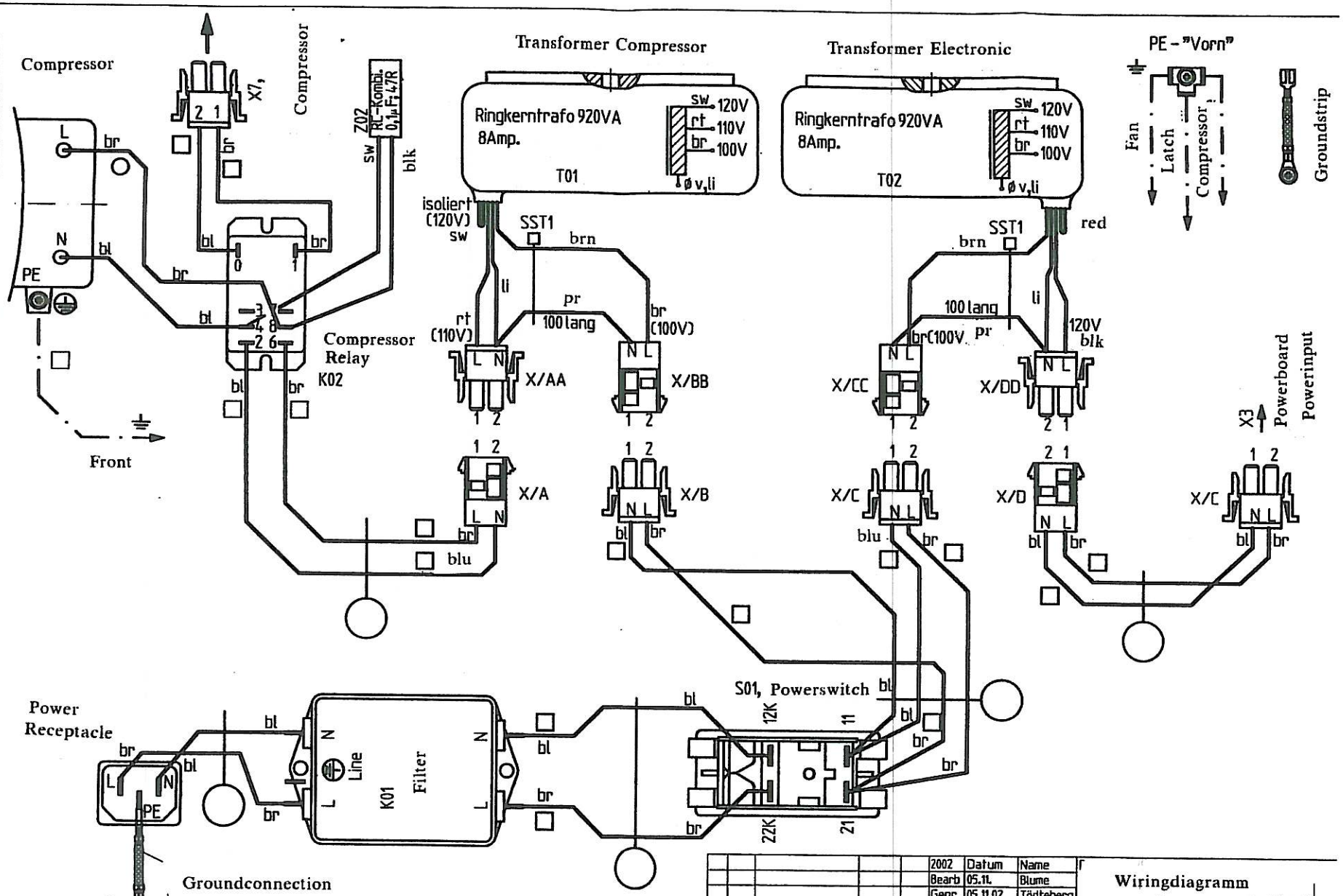
Alternativ: (R30, R32, R34) oder (R31 und R33)

Nicht bestückt werden: Not assembled:
C3, C33, C40, C41, C49, C63, C24
R14, R69, R85, V10
X13, X14, X15

Version:

70792 C2 und C4 je 470µF 400V; R2 und R3
70793 (C5 und C6) oder (C15 und C16) je 1000µF 200V Durchmesser max 30mm; R2 und R3
70794 C2 470µF 400V; R4
70695 (C5, C6, C15, C16) je 1000µF 200V Durchmesser max 30mm oder (C5 und C6) je 2200µF 200V; R2 und R3

			Datum	02.05.2002	SIGMA Laborzentrifugen GmbH	Bezeichnung Bestückungsplan	Zeichnungsnummer
b	C24 not assembled	07.08.2002	Bearb.	Gärtner	37520 Osterode Harz	für Leistungsplatte Zent 3	25292
a	0208	02.05.2002	gepr.				
	Mitteilung	Datum	Norm		Auftrags Nr.:	Leistungsplatte 25291/21	Blatter 1 Bla



Schutzvermerk nach DIN 34 beachten

					2002	Datum	Name	Wiringdiagramm	
					Bearb	05.11.	Blume	Allegra X - 22 R, 100 V	
					Gepr.	05.11.02	Tödteberg		
					Norm				
					sigma			Japan - Version 100 V; 50/60 Hz	Zeichnungs-Nr. 70853 / Blatt 1 von 1
Ind	ÄM	Änderung	Datum	Name	37520 Osterode / Harz			Stoff-Nr.:	Stückliste Nr.: 70853

SECTION 5

PARTS

5.1.1 Electrical

365738	Board Assembly, Zent3 Power, 120V/ 5A
368950	Board Assembly, Zent3 Power, 230V/ 5A
392235	Display/Control Assembly Allegra X-22
392218	EPROM, Allegra X-22
392209	Display/Control Assembly Allegra X-22R
392205	50 pin Ribbon cable
392216	EPROM, Allegra X-22R
365753	Tach Generator Board
365754	Cable, Tach
365752	Rotor ID Plate Assembly
365787	Imbalance Sensor Assembly
392211	Latch Assembly
365757	Temperature Sensor (includes cable)
365758	Cable, Heat sink O/T Assembly
365705	Cable, Ribbon, 50 Pin
392239	Fan, 120V
365980	Fan, 230V
	Power switch with integrated Fuse:
392236	120V X-22, 230V X-22R
392237	230V X-22
392238	120V X-22R
365757	Temperature Sensor (O/T) on Heat-sink (B1)
361349	Tach Generator Board
392198	Imbalance Detector Assembly
392223	Motor Assembly
392226	Power Receptacle
368870	Filter Kit, 100V/120V
365825	Filter Kit 230V
392219	Ground Filter

5.1.2 Mechanical

P/N	Description
392201	Lid rubber Seal
361328	Motor Shaft Cone, 9/16 in. ID
364206	Boot, Rubber Seal, Motor Cover
961803	Vibration Damper, Motor Suspension
361329	Cover, Disc (plastic for motor)
361330	Cap for Motor Cover
392224	Button front panel
392196	Chamber Spacer
368230	Hinge, Lid
392213	Gas Damper
365838	Foot, Rubber,

5.1.3 Refrigeration

P/N	Description
893332	Compressor, 50/60 Hz
392220	Compressor, 60Hz
365973	Relay, Power 230V
392193	Condenser
367815	Snubber, E1

5.1.5 Tools and Supplies

P/N	Description
883371	Tri-Flow Lubricant
964429	4 Weight Set (2,6,9,10g)
961660	Anti-Seize (961660)
964432	Metric Hex Key Set
267356	Drive Tester
306812	SPINKOTE Lubricant
335148	Silicone Vacuum Grease
339555	Solution 555
964371	Teflon Grease
361367	Rotor Tie-Down Bolt Assembly
361371	Spanner Wrench, T Handle, 10mm
347998	Arrow Label
339379	Rotor Cleaning Brush
339558	Rotor Cleaning Kit

SECTION 6

ACCESSORIES & MISCELLANEOUS

NO MATERIAL AVAILABLE AT THIS TIME

SECTION 7

APPLICATIONS

NO MATERIAL AVAILABLE AT THIS TIME

SECTION 8

SERVICE MEMOS

ISSUED DURING TRAINING CLASS