Dok nr 00920-01

SERVICE MANUAL

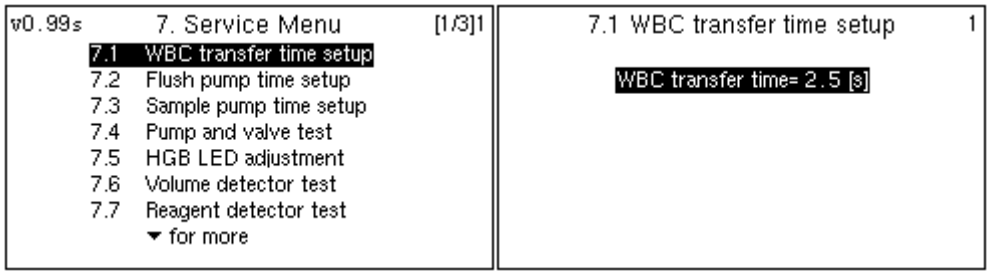
AC920 / AC970EO+

1. Service menu (v 01)

1.1 WBC transfer time setup

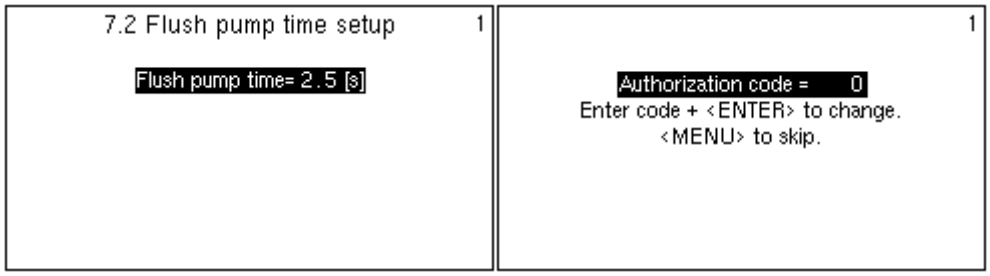
This function is used to adjust the volume of WBC/HGB dilution to be transferred from the mixing beaker 2 to the counting beaker. The time shall be adjusted to give a small remaining volume of the dilution in mixing beaker 2. The rest volume goes to waste through MV 1. This is to prevent air going into the counting beaker.

Select Service menu and pos. 7.1. Press enter and adjust the time by the + and – keys. The normal time is between 2 – 3 sec.
Note ! If the time is out of range check the air pressure and adjust the air valve if necessary.



1.2 Flush pump time setup

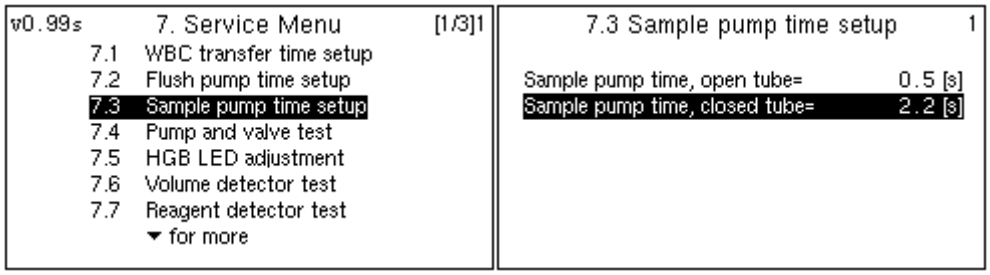
This function is used to check and adjust the last flush volume of diluid into the counting beaker. The liquid level should be approx. 15 mm from the upper edge of the counting beaker. Select Service menu and pos. 7.2. Press enter and adjust the time by the + and – **keys.The normal time is between 1,5 – 3 sec.**
Note ! To introduce a new value an authorisation code is required. **Enter the code 1809** and the new time will be set.



1.3 Sample pump time setup

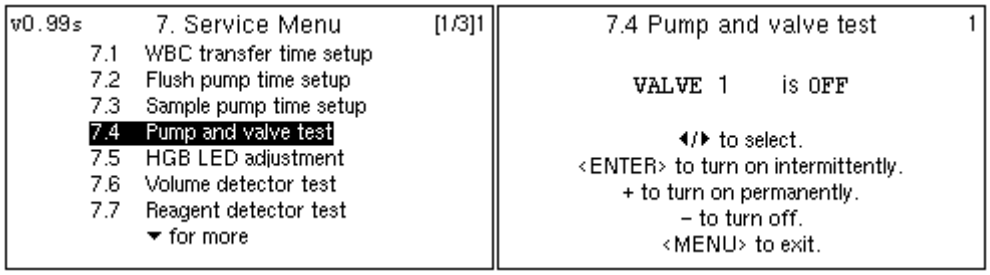
This function is used to set the sample pump time of the second blood aspiration. When cap piercer is used the time is adjusted so the end of the blood column stops just before the MV13.

Select Service menu and pos. 7.3. Press enter and set the time using the + and – keys. The time for Closed tube should be between 2 – 3 sec. The time for Open tube should be 0,5 sec.



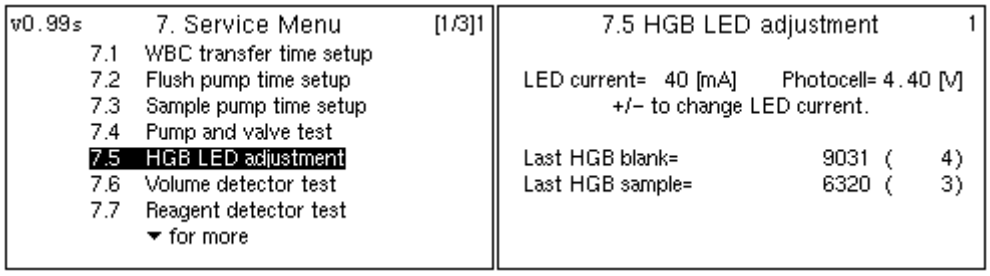
1.4 Pump and valve test

This function is used for testing of all MV:s and pumps. Enter pos. 7.4 and select item by the → and ← key. Switch on and off by + and – keys or momentary by the Enter key.



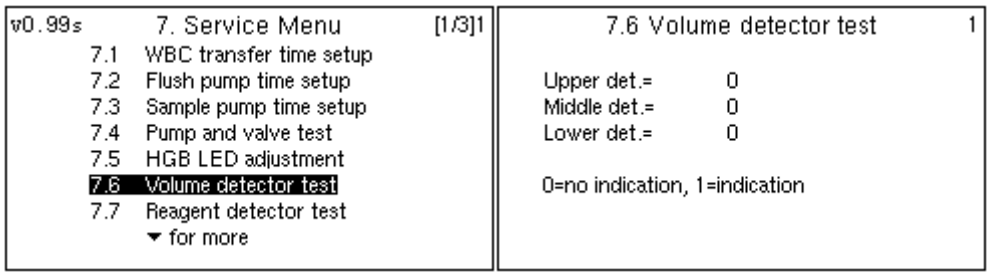
1.5 HGB LED adjustments

Using this function it's possible to check the absorbance of the HGB cuvette in the lower part of the counting beaker.
The green LED diod current is factory set to 40 mA - max.60mA. The voltage should by between 4,00 – 4,4V with clean diluid in the beaker. It`s possible to adjust the current by the + and – key. If necessary, adjust the HGB gain by the potentiometer R50 on the analogue board to fit the photocell voltage 4,2V
Note! Enter the code 1809 and the new current will be set.



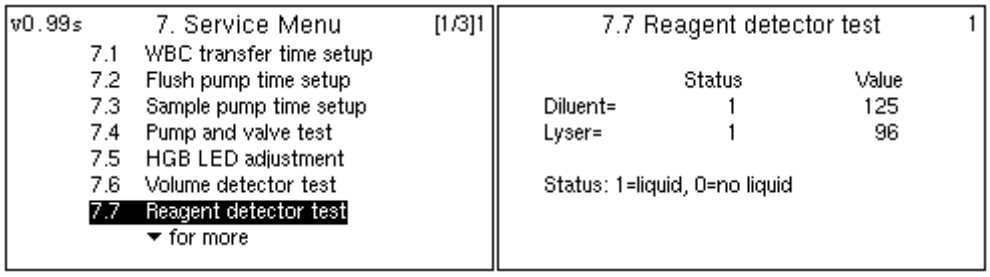
1.6 Volume detector test

Using this function it`s possible to check the function of the optical detectors on the volume board.. Connect a syringe to the measuring tube and aspirate diluid slowly from the counting beaker. When the meniscus passes the sensors 1 (0) will appear in each sensor.



1.7 Reagent detector test

This function is used to control the reagent sensors. Enter pos.7.7 and lift up one of the sensors. Indication should change from 1 to 0. The value should be approx. 100 with reagent sensor placed in the container.
< 160 = reagent in the container. > 220 alarm= emty reagents ”low reagent” will appear. The value has to be lower than 160 to reset the alarm.

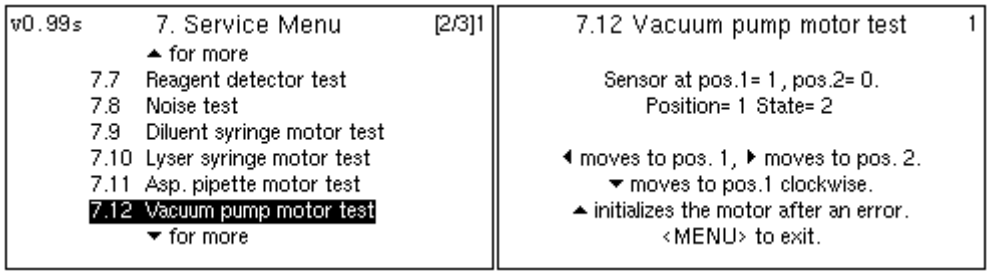


1.8 Diluent Syringe motor test

With this test it`s possible to run the dilutermotor and the syringe unit.
The motor has two sensors (switches)to control the positions
Enter pos.7.9 and run the motor with the → and ← keys. Sensor at pos.1= 1, means that the motor is in home position i.e. Sensor 1 is active. Zero (0) means non active sensor. Pos.2 refers to sensor 2.

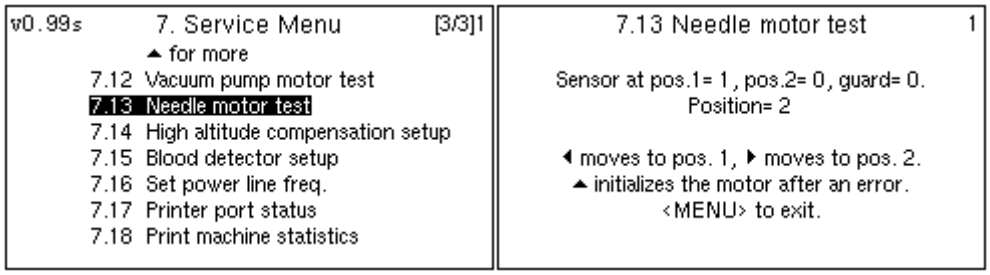
1.9 Vacuum pump motor test

With this test is possible to run the vacuum pump and check the upper and lower optical sensors. Upper sensor is pos.1, lower sensor is pos.2. Use the right → key and the left ← key to run the motor.
Pos.1 = 1 = upper sensor is blocked by the metallic flag, home position.
Pos.2 = 0 = lower sensor is open, 1 = blocked = vacuum position.



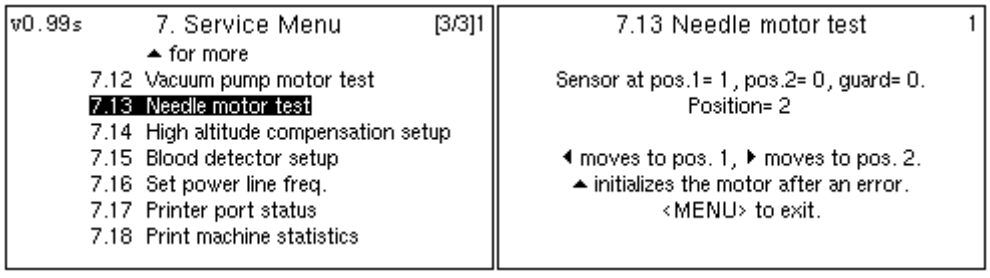
1.10 Needle motor test AC920EO+

This function is to test the cap piercer needle motor and to check the two optical sensors.
Pos.1 = 1 =lower sensor is in home position. The sensor is blocked. Position = 1
Pos.2 = 0 = upper sensor is open.



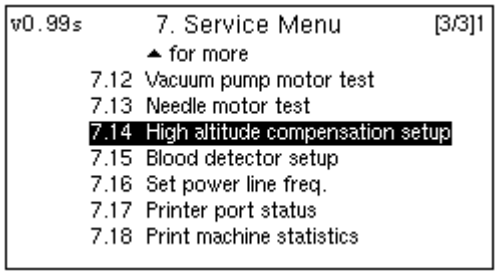
1.11 Needle motor test AC970EO+

This function is for testing the cap piercer together with function control of the three optical sensors. The test is similar as in AC920EO+ except for the guard sensor. The guard sensor is used to prevent damaging of the needle in case the sampler plate is in incorrect position. The guard sensor is connected to the wash cup which is moving up upon aspiration and down after aspiration.
Sensor at pos.1 = 1 pos.2 = 0 guard = 1 = lower (home) position of the needle.
Sensor at pos.1 = 0 pos.2 = 1 guard = 0 = upper position of the needle
Pos.1 = lower sensor
Pos.2 = middle sensor
Guard =upper sensor Position 1 = Home position, Position 2 = Upper pos.



1.12 High altitude compensation setup

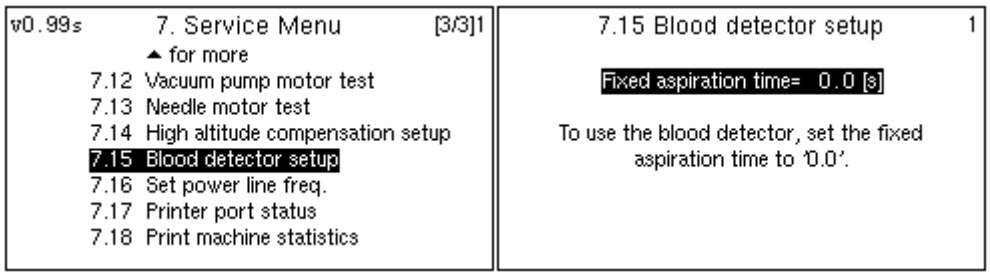
This function is not used



1.13 Blood detector setup

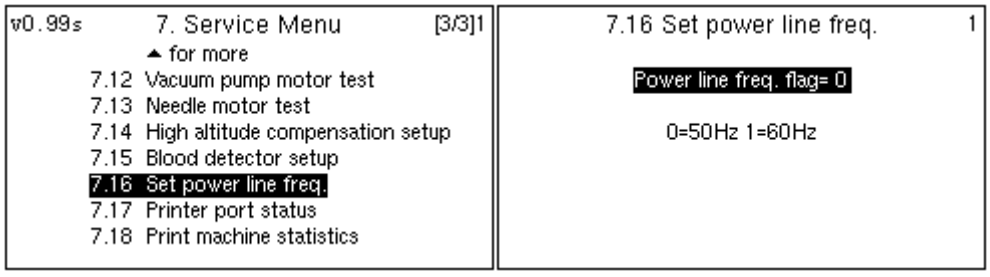
This is a setup menu for the optical blood detector in AC920/970EO+.
0.0 = The blood detector is active and controls the running time of the sample pump. 2,0 means the pump will aspirate during 2 sec. independent of the sensor setting. Normal setting for whole blood is =0.0. If the sample material is more or less colour less the setting 2 sec should be used.

Note! Authorization code is 1809



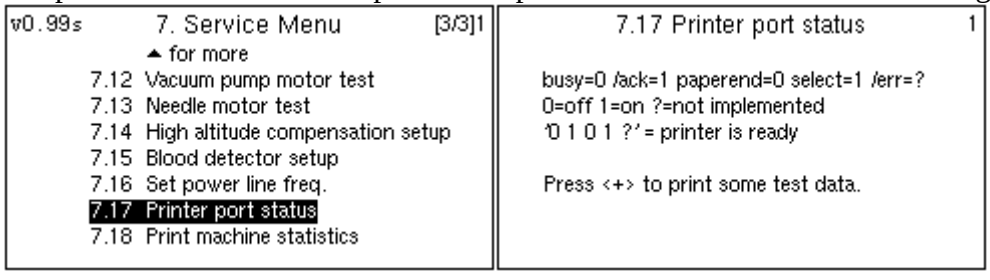
1.14 Set power line frequency

Option to choose 50 or 60 power line frequency. **Authorization code is 1809**



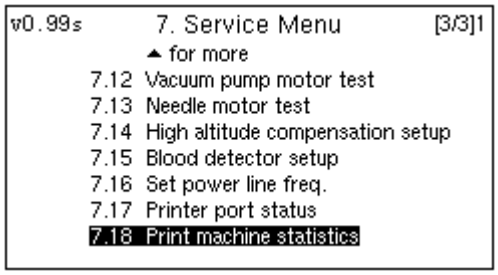
1.15 Printer port status

If a problem occurs with the printer it`s possible to check the status of the signals



1.16 Print machine statistics

This print out gives information on the status of the AutoCounter.
AC version
ID or serial number
Serial number of the CPU board (# xxxxx)
Power ON, date and time
Error indication number, date and time
Calibration status, date and time
Sample counter
WBC transfer time
Flush pump time
Sample pump time, open and closed tube
HGB led. current
Power line frequency
Blood detector time
Last RBC and WBC count time
Last HGB blank value. Last HGB sample value



NOTE! The Volumboard have been upgraded from the CPU program version 164008.
It's a new position in the Service menu. 7.18. Set new volumedetector.
Print machine statistics have now the pos. 7.19.
When ordering volumeboard art.no. 1120013 for sparepart, it will be the upgraded board.
If the CPU program is from 164008, Enter pos.7.18 and Enter 1. 1=New volume board.
If the CPU program is below 164008 ignore above text.
If any reason, it's a new program in the instrument, but the volumeboard is the old model, the setting of the position 7.18 should always be 0.
The different of the boards is: Capacitor C2 and C3 have been change from 330nF to 1µF. This is to prevent frequently NC error problem.

2. Flow system (v 01)

2.1 Flow sequence

1. After starting a measurement for closed tube, the sample pump start to aspirate blood through MV13 to the blood sensor via the rotary valve. When the blood reaches the blood sensor, the pump stops and MV13 changes and releases the under-pressure between the MV 13 and the sample pump through the open pipette. When the needle is in the lower position , the sample pump starts again and aspirates the blood from the needle through the MV13 and the rotary valve and fill the inside of the valve with 20 µL blood. The blood pump will stop by the pre-set sample pump time.
   (0,5sek.for open tube and approx 2sek.for the closed tubes.)
   The end of the blood column from the needle should stop just in front of the MV13.
   During this sequence the counting beaker is cleaned by diluid from the flush pump.

2. The syringe motor starts and moves the rotary valve into position 2. The diluid syringe dispenses 4 ml diluid through the rotary valve, pos.2 and bring the 20 µL blood to MIX 1 (dilution ratio 1/200). The pressure pump starts and MV8 operates in sequences and produces air for the mixing of the primarily dilution 1:200. The lyse syringe dispense 1,5 ml lyse to MIX2.
   The detergent pump start to fill up the wash cup with detergent.

3. The syringe pistons moves down and are filled with new reagent through the MV6 and MV16. The rotary valve changes to position 3. The sample pump aspirates 1 ml of the primarily dilution from MIX 1 and fill through pos.3 the rotary valve with 20 µL. The pressure pump starts and apply pressure to MIX 1 for the transfer of the remaining primarily dilution through MV9 to MIX 2. In MIX 2 the dilution is mixed with lyse reagent and the haemolysing of the red blood cells starts.

4. The syringes moves upwards and the rotary valve change to position 4. The diluid, from the diluid syringe and MV6, transfer the 20 µL (1/200 dilution) through pos.4 of the rotary valve to the counting beaker. The RBC/PLT dilution ratio in the counting beaker is now 1/40 000. MV10 opens sequentially and produces air mixing in the counting beaker. Lyse from the lyse syringe is directly transferred, via MV16, to MIX 2 for the finally WBC/HGB dilution of 1:400. The syringes moves down and are filled by new reagents. The rotary valve change to position 1 and the sample pump starts to aspirate the mixed blood/detergent from the inlet pipette, needle and tubings,to the waste.

5. Before counting, the MV3 is active and the sample pump start and pressurise the silicon tubing between the outer left pos. of the pump tubing to the outer part of the MV3. This is for create air mixing of the MIX 2.

6. The vacuum pump starts to apply vacuum through the MV12 to the measuring tube, the RBC/PLT dilution in the counting beaker is aspirated through the capillary orifice and the RBC/PLT start the counts in the transducer when the meniscus reached the lower optical sensor. When the meniscus have reached the middle sensor, a volume of 200uL have been counted, the vacuum pump stops and the photometer read the HGB blank value. MV12 changes two times and the rest of the vacuum in the pump is released from the vented air. The vacuum pumps starts again, now to apply pressure through the MV12 to the measuring tube. The meniscus is pressed down and the liquid is pressed out through the bypass channel MV11 directly to the counting beaker. The MV12 and MV11 changes when the meniscus reached the lower sensor and it stop just below the lower sensor. The MV12 changes two times to release the rest of the pressure in the pump.

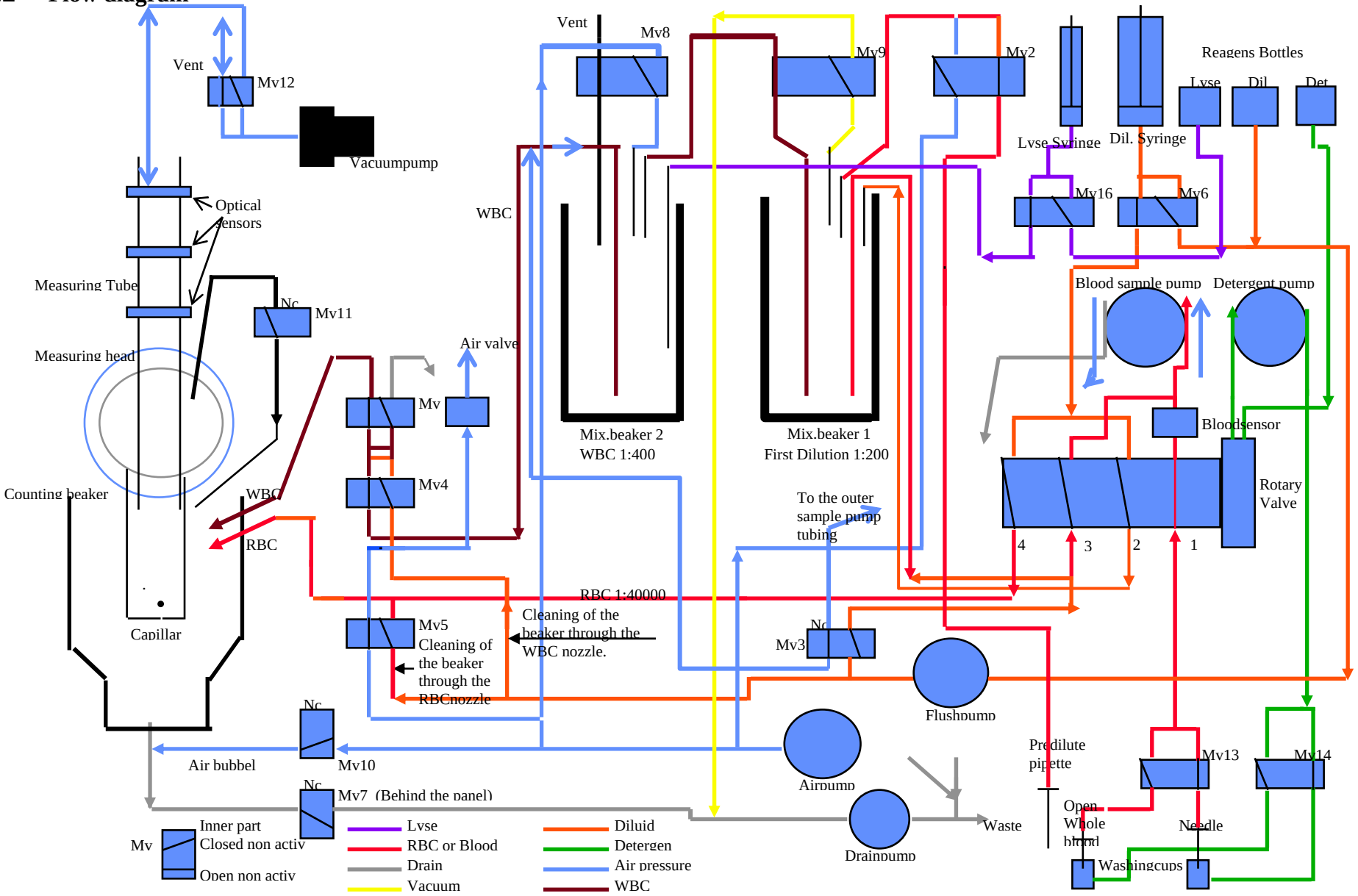
7. The sample pump stops and the MV3 release and give an air mixing into the MIX 2. The drain pump starts to drain the counting beaker from the RBC/PLT dilution.

8. The pressure pump starts and apply pressure through MV8 and MV2 to MIX 2. The WBC/HGB dilution is transferred to the counting beaker through MV1 and MV4. The pressure is regulated by the air valve. The transfer time is adjusted so the last part of the WBC/HGB dilution is transferred to waste through MV1 to prevent air bubbles in the counting beaker. The transfer time (air pressure) is pre-adjusted by the air valve and fine adjusted by the soft-ware, WBC transfer time. The vacuum pump starts again and the WBC is counted between the lower and the middle sensor of the volume board.

9. During counting of the WBC , the MIX 1 and MIX 2 is cleaned by diluid from the flush pump and MV3 and the pressure from the MV2 and MV8 transfer the liquid to the waste through the MV4 and MV1.
   After counting of the WBC, the measurement of the HGB is performed by the photometer.
   A capillary cleaning is performed just before the drain pump drains the WBC/HGB dilution to waste through MV7. The counting beaker is cleaned by diluid through MV1, MV4, MV5, the WBC nozzle and the RBC nozzle. Finally the counting beaker is filled to a specific level by the soft-ware adjusted Flush pump time.

10. The sample pump stops after drying the inlet pipette, needle and tubing’s.

2.2 Flow diagram



3. Mechanical Units (v 01)

3.1 Air pump

The air pump is mounted on the rear panel by 3 O-rings to prevent vibrations . For transportation it's possible to lock the pump by a transport screw from outside.

The function of the air pump is to produce air pressure to the mixing beaker 1 and 2 for transfer of the liquid between the mixing beakers and from the mixing beaker 2 to the counting beaker. Pressure for air mixing in mixing beaker 1 and the counting beaker is also delivered by the air pump.

The pump is supplied by 24V unregulated AC current. The pressure is regulated by an air valve mounted between the mixing beaker 1 and 2 on the flow panel.

Note!! A small variation of the pressure can occur, depending of variation of the inlet voltage. (200 – 240V, 100 – 130V)

An air filter 0,45µ is mounted on the outlet of the air pump to prevent dust in the system.

3.2 Adjustment of the air valve

The volume of WBC/HGB dilution transferred from the mixing beaker 2 to the counting beaker is adjustable by regulated air pressure (Air valve) and fine adjustable by timing of the MV 1. Service program 7.1 WBC Transfer time, normal range 2-3 sec.

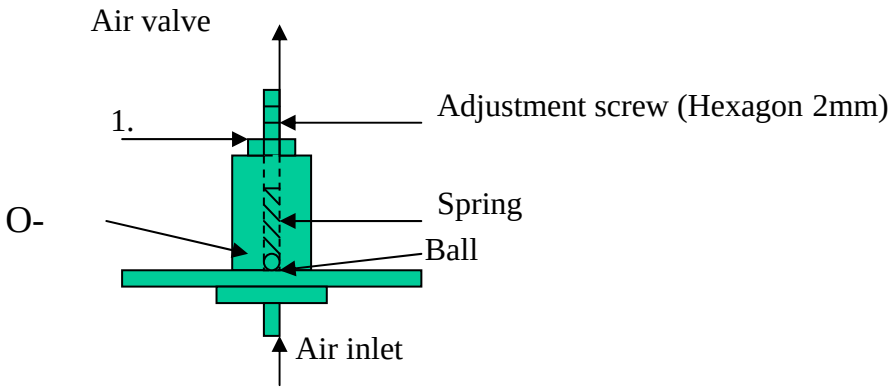
Adjustment.

Set the transferee time to 2,5 sec. Adjust the pressure by the air valve so a small volume in the mixing beaker, approx. 0,5 ml, will go to waste through the MV1. Increasing of the pressure, by turning the adjustment screw clockwise, will give higher dilution volume in the counting beaker .If the pressure is too high, it will cause a spray effect into the counting beaker with a lot of air bubbles. The results of the WBC can be erratic.

Note!! The adjustment of the valve is very sensitive. Normally adjustment is only a few millimetres turning.

It's possible to measure the pressure in serial with the inlet tube to the air valve. The normal adjusted pressure should be approximately 70 to 90 mbar. (Factory set)

Fig.



3.3 Exchange of the air filter.

To prevent malfunction of the air pressure, it's recommended to exchange the air filter once a year. (the frequency of exchanging the filter is depending on the cleanness of the environment) The air filter is mounted on the outlet tubing from the pump and it's connected by bayonet holder on each side. Note!! The yellow part towards the pump.

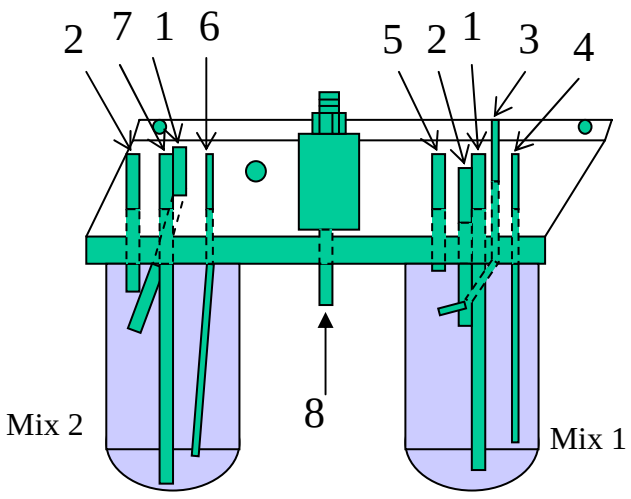
3.4 Mixing beaker Mix1 and Mix2

The mixing beakers are used for mixing of the diluted blood. The mixing beaker 1, Mix 1, is used for the primary dilution from the rotary valve. The diluted blood is transferred through the Teflon tubing, (Fig. pos.3). The mixing beaker 2, Mix.2, is pressurised sequentially 5 times from MV 8 through tubing (2), the pressure is transferred through the tubing (1) in to the Mix.1 and the diluted blood will be air mixed.

The tube (4) aspirates approx. 1 ml through the rotary valve, for the secondary dilution (RBC/PLT) by the sample pump. The rest, approx. 3 ml, of the diluted blood is transferred to Mix 2 through the tubing (1) by pressure through tubing (2) from Mv2. This dilution will be mixed with the lyse which is transferred two times from the lyse syringe through tubing (6) to the Mix. 2. The hemolysing process starts. This dilution is used for counting of WBC and measurement HGB by the photometer in the bottom part of the counting beaker. The dilution is transferred into the counting beaker through the tube (7) by pressure from the inner slot of the MV 8 through the tube (2).

The pressure into the Mix.1 and Mix.2, is regulated by the air valve, the tube (8) is connected to the outer slot of the MV 5, then to the air pump. When the MV 5 is non- active, there is regulated pressure into the beakers.

For aspiration of prediluted blood from the pipette, the tube (5) is connected through the inner slot of the MV 9 to the drain pump, which create vacuum into the Mix. 1. The predilute pipette is connected to the tube (2) through the outer slot of the MV 2.



3.5 Blood sensor

The blood sensor is located to the right of the rotary valve. It's an optical sensor which gives an analogue high signal (approx. 5V) when blood is entering the sensor. The sensor is connected to the diluter board by the connector P 210.

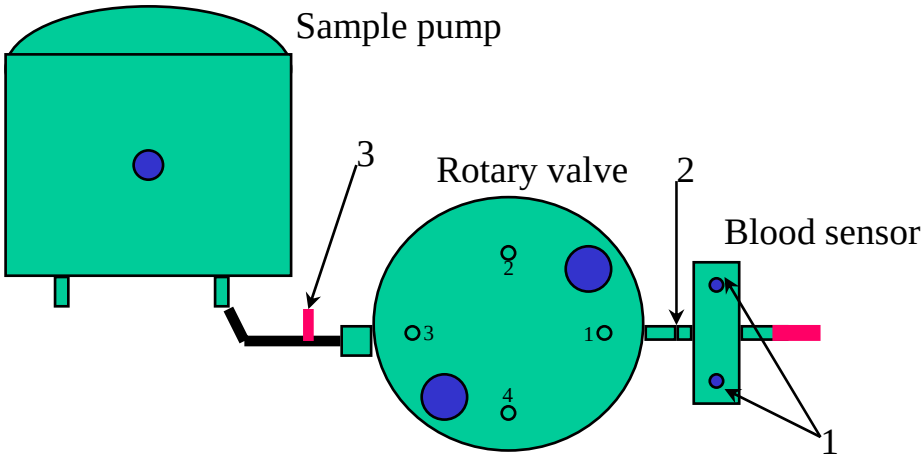
The function of the blood sensor is to stop the sample pump in correct position after aspiration of the blood from the pipette or the cap piercer through the rotary valve. The aspirated volume of blood is approximately 200µl from the pipette and approx. 350 µl from the cap piercer. This is indicated by red lamp on the keyboard.

3.6 Exchange of the blood sensor.

Remove the two screws (Fig. pos 1) which are holding the sensor. Remove the short tygon (2) tubing from the rotary valve. Remove the tygon (3) tubing from the T-connector between the rotary valve and the sample pump, remove connector P210 from the diluter board. Lift out the sensor including the tygon tubing. Remove the short tygon tubing (2) from the glass tube and remove the glass tube including the longer tygon tubing from the sensor.

Assemble the glass tube into the new sensor and mount a new short tygon tubing to the other end of the glass tube for fixing the position of the glass tube. Enter carefully the tygon tubing to the metallic tube of the rotary valve so the position of the fixing holes of the sensor will fit to the holes in the panel. Replace and tighten the two screws which are holding the sensor. Replace the longer tygon tubing to the T-connector between the rotary valve and the sample pump.

Fig.



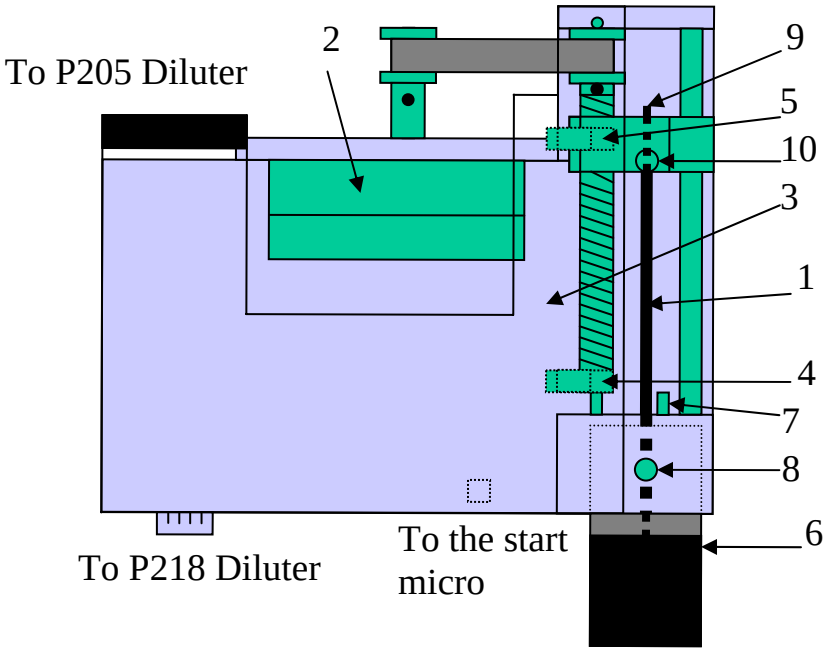
3.7 Electric control of the blood sensor

Refer to chapter 9.1.1 Test of the blood sensor.

3.8 Cap piercer AC920EO+

The needle (Fig. pos.1) in the cap piercer is moved up and down by a motor (2)which is controlled from the diluter board through a sensor board (3), which is mounted inside the cap piercer unit. There are two cables from the sensor board, which is connected to the diluter- board. P205 for the optical needle position sensor (upper and lower position) and P218 for the motor, 24V AC current. Inside of the upper sample tube holder there is a micro switch mounted for automatic start of the measurement. When a blood sample tube is placed in the cap piercer the micro switch is activated and the needle motor starts to move up and will be stopped by the upper optical sensor (4). The sample pump starts to aspirate the blood up into the blood sensor. The pump stops and the needle starts to move down to the lower optical sensor (5). MV13 is released for a short moment and air will be aspirated through the open pipette into the tubing between the MV13 and the sample pump. This will restore the vacuum to atmospheric pressure. The second aspiration starts and the blood between the needle and MV13 is transport into the rotary valve and through the blood sensor. The second aspiration of blood is controlled by timing of the sample pump. 7.1 Service menu, 7.3 Sample pump time setup. Approx. 2,2 sec. The syringe unit rinses out and dilutes the 20 µl blood in the rotary valve. The detergent pump starts to fill up the washing cup (6) with detergent for cleaning of the needle.

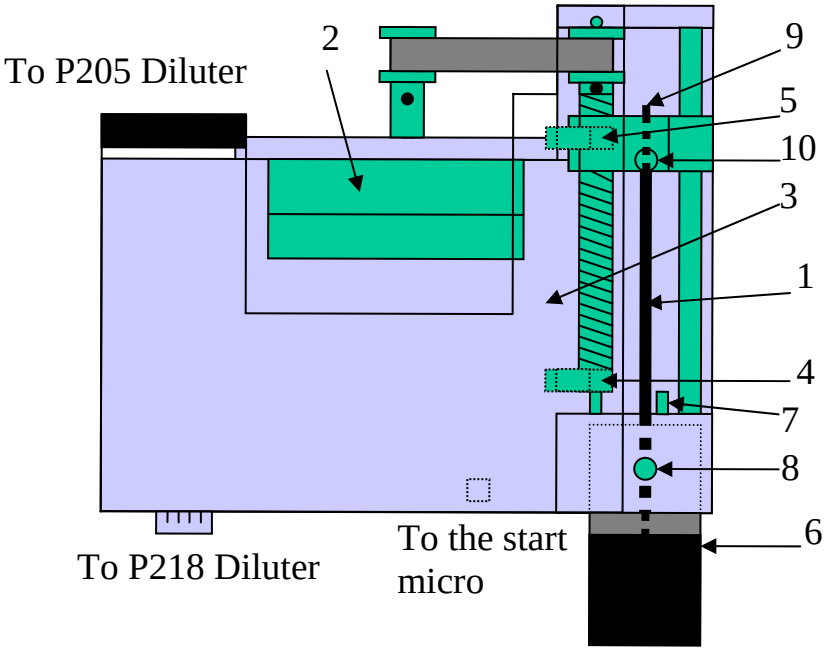
After one turn of the rotary valve the sample pump starts again to empty the needle house and needle of detergent/blood. During counting of WBC and the cleaning of mixing beaker 1 and 2 the needle moves up approximately 3mm to dry. At the end of the measurement cycle the needle moves down to the home position.



3.9 Exchange of the needle.

1. Release the locking screw of the inner door and pull it forward.
2. Remove the detergent tubing (7) from the wash cup. Release the locking screw (8) which holds the wash cup (6), hexagon key 1,5mm. Pull up and remove the wash cup.
3. Remove the blood tubing from the needle (9). Release the locking screw (10) which hold the needle, hexagon key 1,5mm. Use a pincer and pull out the needle. Insert the new needle and push it to the end stop and lock the hexagon screw. Connect the blood tubing.
4. Connect the wash cup and adjust it to correct position (align the detergent tubing to fit the hole). Lock the hexagon screw. connect the detergent tubing.
5. Replace the inner door and lock the screw.
6. Enter pos.7 Service menu. Enter pos. 7.13 Needle motor test. Run the needle motor up and down and check that the needle moves smoothly.

Fig.



3.10 Cap piercer AC970EO+

The sequence of the aspiration is equal to AC920EO++, but the mechanics and the electronics are different.

The movement of the needle is controlled by 3 optical sensors (Fig. pos1). Lower sensor for needle home position. Middle sensor for upper (blood aspiration) position. The upper sensor is a safety sensor to prevent destruction of the needle in case the blood sample tube or the sample plate is in incorrect position.

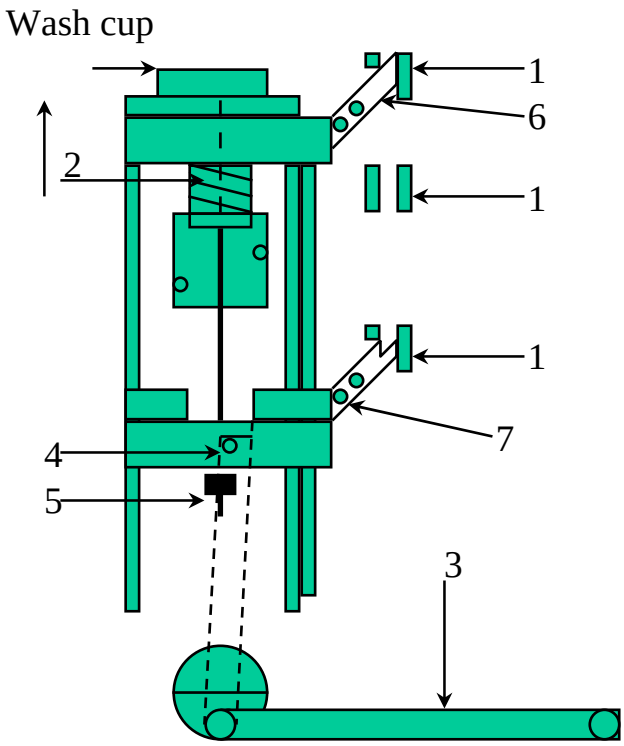
Under the wash cup there is a spring (2) which will press the wash cup up during aspiration. In home position the motor arm keeps the wash cup in down position.

After start of measurement using the cap piercer the arm from the motor moves up the block (4) in which the needle is mounted. The upper sensor plate (6) including the wash cup leaves the upper sensor and just thereafter the lower sensor plate (7) leaves the lower sensor.

When the needle is in top position the lower sensor plate covers the middle sensor and the movement by the motor stops.

If the wash cup is blocked due to incorrect position of the sample plate the wash cup can not move up and the upper sensor plate will not leave the upper optical sensor. The motor stops and reverses and the needle moves to home position.

Fig.



3.11 Exchange of the needle in AC970EO+

Remove the 4 screws on the right hand side of the cap piercer cover.

Remove the screw (4) which holds the motor arm (3) to the needle block.

NOTE!! There is a brass washer between the arm and the block.

Remove the blood tubing from the end of the needle (5). Using a key turn the needle counter clockwise and remove it.

Replace the needle. Do not tighten the screw too hard (plastic). Connect the tubing and place the arm in correct position by pressing the needle block down., so the hole with the screw shall align to the block. Don't forget the **washer between the arm and the block**. Don't tighten the screw too hard to prevent damage of the plastic groove. Replace the cover.

Run the needle motor up and down and check that the rubber seal of the wash house is in correct position.

3.12 Exchange of the sealing for the needle house

Remove the 2 screws on the metallic plate on the upper part of the cap pierce cover. Remove the plate and replace the rubber seal.

Replace the metallic plate. Run the needle motor by the service program and align the seal to the wash cup. See chapter 3.13

3.13 Adjustment of the sensor plate for the optical sensor.

Enter pos. 7 service menu from main menu, enter pos. 7.13 Needle motor test.

Run a complete cycle.

1. Lower sensor plate: Adjust the position of the plate so the motor arm is in a straight vertical position after a complete sequence of the cap pierce.
2. Upper sensor plate: Adjust the position of the plate to straight horizontal position.

A. Check that the needle moves up and down when the sample plate is installed and in correct position.

B. Stop the up movement of the wash house and check that the needle motor reverses and moves to the home position.

Electronic checkpoints.

Measure the voltage on IC U32 on the diluter board.

Needle home position.

Lower sensor pin 7: High level (5V) Sensor is covered.

Middle sensor pin 8: Low level Sensor is open.

Upper sensor pin 9: High level Sensor is covered.

Needle upper position.

Lower sensor pin 7: Low level, Sensor is open.

Middle sensor pin 8: High level, Sensor is covered.

Upper sensor pin 9: Low level, Sensor is open.

3.14 Flush and Drain pump

The flush pump is used for cleaning of the counting-beaker with diluid and also used for cleaning of the mixing beaker 1 and 2.

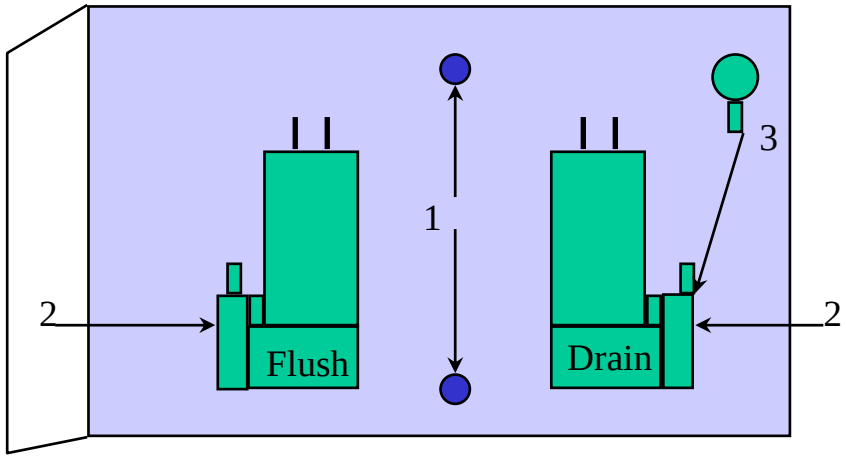
The drain pump is used for draining of liquid in the counting-beaker.
The flush pump is used to create vacuum in the mixing-beaker 2 for aspiration of prediluted blood.

Both of the pumps are mounted on a metallic panel inside the instrument together with the drain valve MV 7. The pumps have a motor which is moving a teflon membrane inside the pump-house (2). The pump house contains two small rubber membranes (3) which allow the liquid to flow only in one direction. The connectors of the pump house are marked with arrows to show the directions of the flow. It's possible to open and clean the pump house.

The pumps are controlled by regulated DC current from the diluter board. The drain-pump is supplied by regulated 18 – 19VDC.

The flush-pump is supplied by an adjustable regulated current. It is adjusted to approximately 13V DC by the factory. (Potentiometer R43, diluter board).

Fig.



3.15 Exchange of the pumps, cleaning of the pump house.

Refer to Fig. 3.14

Release the two screws (Fig. pos 1) on the metallic panel located between the pumps. Lift up and pull down the unit. On the rear there are two screws holding each pump. Remove the tubing, connectors and screws of the defective pump. Install a new pump and connect the tubing, connectors and the panel.

If the motor is running but the flush or the draining is bad probably there is a malfunction of the pump house.

Remove the four screws which are holding the pump house (2). Remove the house and separate the two plastic parts to the opposite of the labelled end. Clean the house including the two small rubber membrane (3**). NOTE the position of the membrane**. Exchange the membrane if necessary. Replace the pump-house.

Check the function of the pump by enter 7. Service menu. Enter 7.4 Pump and valve test. Step by the right arrow→ to Flush pump or Drain pump. Press ON
to activate the pump. Check the flow of diluid and the draining of the counting beaker. When the flush pump is running, both of the pumps are activated to prevent overflow in the counting beaker. The level in the beaker should not increase only a whirlpool in the bottom should be seen.

3.16 Adjustment of the flush-pump.

Turn on the flush-pump in service menu. Check the voltage on TP2 to the ground on the diluter-board. It should be approximately 13V DC.
Adjust R43 if necessary.

Run a priming or a blank measurement. Check that the level in the counting-beaker at the end of the cycle is 3 – 5mm below the inlet nozzles.

Enter 7. Service menu. Enter 7.2 Flush pump time setup.

Adjust if necessary the time to 1,5 – 3 sec. Longer time will increase the level.

3.17 Magnetic valves (MV)

The MV contains a magnetic coil made for 24V DC. The resistance is approximately 75 ohm. One part of the pinch valve is mounted inside the coil. When a current is supplied to the coil, a magnetic field will move the pinch-valve which squeezes the silicon tubing. When a double valve is used the inner tubing is squeezed and the outer tubing is released.

All MV:s are controlled by the diluter board from two power integrated circuits.

When the MV is activated a high voltage, approx. 32V DC, controls the MV for 200 ms. This creates a high pressure onto the tubing. After the 200ms the voltage drops to approx. 22V . The tubing remains squeezed but with a lower pressure.

3.18 Exchange of magnetic valves

Exchange of a magnetic coil: Open the cover of the instrument. Locate the defective magnetic coil. Remove the connector to the coil. Remove the washer on the rear part of the coil. Pull out the coil from the valve part. Note! Do not remove the distance washer between the valve and the coil. Install a new coil, replace the locking washer. Replace the connector.

Exchange of a magnetic coil on a MV circuit board. Remove the connector and all the locking washers. Pull out the MV unit from the valve part. Unsolder and remove the defective coil. Mount a new coil and make sure to have a correct distance between the coil and the board. Solder the coil. Replace the MV circuit board with the washer.

Exchange of a pinch -valve. Remove the coil as above, remove the tubing from the valve. Remove one of the screw on the front panel which is holding the valve lock plate. Release the other screw. Turn the plate making it possible to pull out the valve from inside of the front panel. Note the position of the valve. Install a new valve and lock the valve by the plate with the screw. Replace the MV circuit board. Lock the coils with the washer. Be carefully not to damage the tubing near the magnetic coil. Replace the silicon tubing in the valve.

3.19 Test of the magnetic valves

Refer to chapter 1.2 Pump and valve test.

3.20 Measuring tube

The measuring tube is used to control the measuring volume during counting.

The volume aspirated from the counting-beaker through the transducer is approximately 200 µl. The counting time is determined by the vacuum created by vacuum pump. The counting time is factory set to approximately 12,5 sec.

The measuring tube is connected to the transducer via the measuring head. The measuring tube assembled onto an electric sensor board, the volume board. The board have 3 optical sensors. The distance between each sensor corresponds to approx. 200µl. The sensor will give a signal to the processor board when the meniscus of the aspirated liquid passes one of the sensor. The computer measures the time it takes for the meniscus to travel between two sensors. In the EO+ instrument only the two lower sensors are used.

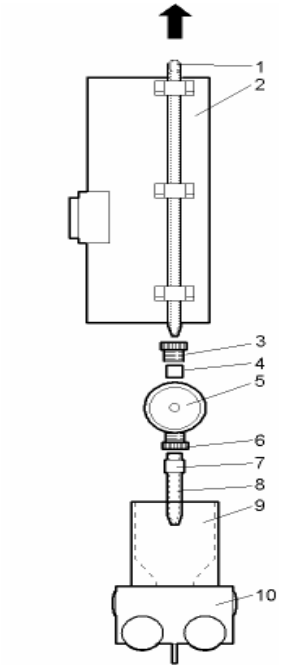
3.21 Exchange or cleaning of the measuring tube

Remove the cover of the volume-board.

Remove the silicon tubing in the top of the measuring tube (glass tube),(1) or from the connector in the panel.

Release the plastic screw (4) completely by turning it counter clockwise. Lift up the glass tube including the plastic screw. Remove the silicon seal (3) carefully from the end of the glass tube. Lift up the glass tube through the optical sensors.

Clean or exchange the glass tube. Insert the glass tube through the sensors. Place the plastic screw at the end of the tube. Make a new seal of silicon-tubing art.no 1140252, 5mm length and place the seal at the end of the measuring-tube. Turn the plastic screw clockwise and tighten.

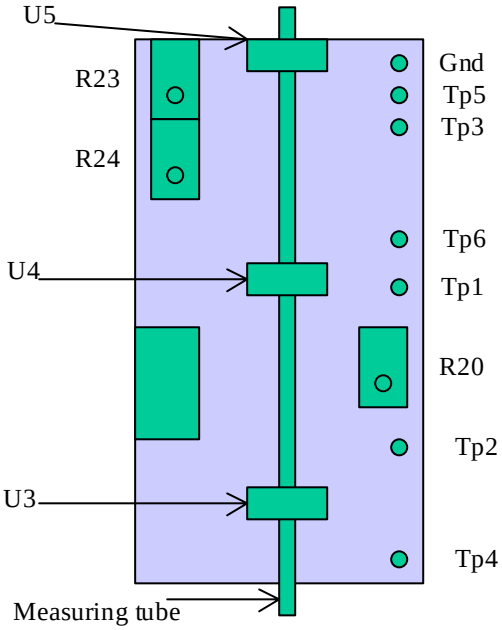


3.22 Adjustments of the measuring board

It’s necessary to check or adjust the optical sensors after cleaning or exchange of the measuring tube.

Refer to chapter 12.1. Adjustment of the optical sensors.

Fig.



3.23 Transducer

The transducer (8) is used for counting and sizing of the blood cells suspended in the dilutions which are aspirated through the small(70µ) orifice.(9). Inside the transducer there is a platinum electrode and outside in the counting beaker there is an outer electrode. Both electrodes are connected to the measuring head (5) and from the head to the analogue board via a coaxial cable. An electric current is applied to the electrodes.
When a blood cell passes the orifice the resistance will increase. This in turn increases the voltage across the electrodes. Each passing cell creates a voltage pulse which is proportional to the volume of the cell. The number of pulses correspond to the number of cells.

3.24 Exchange or cleaning of the transducer

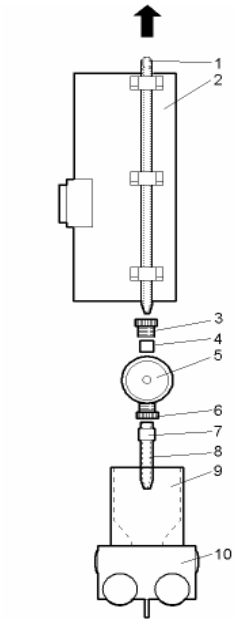
Remove the two screws which are holding the photometer(10) and the counting-beaker(9). Pull carefully down the beaker to reach the transducer(8).

Remove the plastic screw(6) by turning counter clockwise. Pull down the transducer including the screw. Clean the transducer inside using cleaning solution (ProClean Plus or sodium hypochlorit 0.5%) or exchange the transducer including the silicon seal, 5mm length of silicon-tubing art.no. 1140410.

Fill the transducer with clean diluid. Enter the inner electrode into the transducer and push the transducer into the measuring head together with the plastic screw. Turn the screw clockwise and tighten. Check that the end of the inner electrode is located approximately 5 mm above the orifice.

Replace the photometer including the counting-beaker. Make sure that the silicon tubing of MV1 and MV10 is in correct slots of the valve.

Enter 8. Maintenance menu 8.1 Prime cycle. Run a prime cycle to fill the transducer and the measuring tube.



3.25 Peristaltic pumps

Two peristaltic pumps are used the detergent pump and the sample pump. The detergent pump is used for cleaning and lubrication of the rotary valve, cleaning of the pipette and cap piercer needle. The detergent pump transfers the detergent from the container through the rotary valve to the wash cups. The sample pump removes the detergent via the pipette and needle.

The sample pump is used for aspiration of the blood from the pipette and needle into and through the rotary valve and as mentioned above also used for aspiration of detergent.

The sample pump has two pump tubing. The inner tubing is used for aspiration and the outer tube is used to create air mixing via MV3 in mixing beaker 2.

The pumps are controlled by the diluter board. The detergent pump uses 24V AC current and the sample pump uses a stepper motor for 24V unregulated DC current. (approx. 32V).

3.26 Exchange of pump tubing

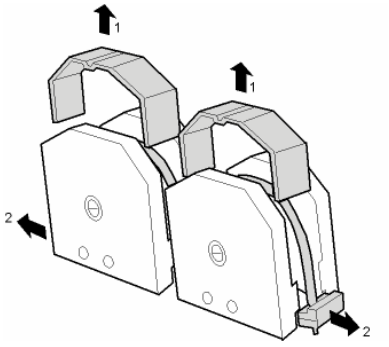
Press two fingers onto the both sides at the lower part of the pump cover(1). The cover will come lose. Lift up and remove the cover. Pull out the tubing connectors on both sides(2). Remove the pump tubing. Install new pump tubing into the connectors. Install the connectors including the tubing into the pump house. Reinstall the cover into the slots of the pump house. Finally press a finger on the top of the cover to snap it into place.Art.no. pumptubing 90mm is 1090799 3pcs.

Art.no for unspecified lenght is 1140271

3.27 Adjustment of the sample pump time

Check the aspiration of the blood after exchange of the sample pump tubing. Run a blood measurement using both the pipette and the cap piercer. Check that the blood is aspirated smoothly through the tubing into the rotary valve and to the blood sensor. After the second aspiration using the cap piercer check that the end of the blood column has stopped just before the MV13.

Adjust the blood sample pump time if necessary. Enter 7 Service menu, 7.3 Sample pump time set up. Closed tube = approx. 2,2 sec. Open tube = 0,5 sec.



3.28 Vacuum pump

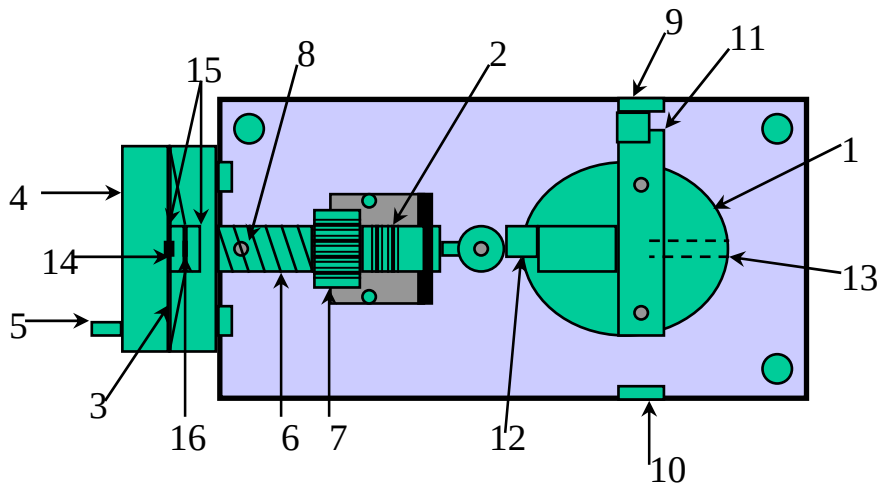
The vacuum pump is connected to the measuring tube in the volume board by a tubing though MV 12. The vacuum from the pump aspirates the dilution in the counting beaker into the transducer and up and through the measuring tube. Three optical sensors are attached to the tube.The distance between the sensors represents a volume of 200µl which is the volume aspirated and counted. To empty the tube after counting the vacuum pump produces an air pressure.

The pump is driven by a 24V AC current motor which is controlled by the processor board. The gearbox of the motor is connected to an eccentric wheel Fig. Pos1) This wheel moves a piston (2) forward and backward. At the end of the piston there is a membrane(3) inside a plastic house (pump-house) (4). The tygon tubing to the measuring tube is connected to a metallic tube(5) of the pump-house. The backward piston movement (vacuum) is controlled by a pressured spring (6), adjustable by turning the adjustment ring (7). The adjustment ring is unlocked and locked by a hexagon 1,5mm screw (8).

The movement of the eccentric wheel is controlled by two optical sensors, upper sensor (9), lower sensor (10) The eccentric wheel have a metallic part with two sensor-plates (11, 12). Upper sensor(9) controls the stop (home) position after the pump has created pressure. Lower sensor(10) controls the stop position after the pump has created vacuum.

The signals from the optical sensors are read by the computer from connector P102, pin 8, pin9. Pin 8 is the upper sensor and Pin 9 is the lower sensor. The signal is logic high level when one of the sensor plates cover the sensor. The eccentric wheel is locked by a hexagon screw, 1,5mm (13)..

Fig



3.29 Exchange of the membrane in the vacuum pump

Remove the tygon tubing from the metallic tube of the pump house (Fig.Pos.4) Remove the two screws which are holding the pump house. Use a short screw- driver. Open the house and remove the screw (14) holding the membrane. Note the position of the two washers (15). Remove the membrane and the small o-ring (16) on the screw.

Turn the eccentric wheel counter clockwise by hand to the vacuum position. (The piston moves to the right). Install the new membrane including the o-ring**. Don't tighten the screw too hard this will damage the o-ring.** Reinstall the pump house.

3.30 Adjustments of the counting time

Before the adjustment check that the transducer is clean. Run a blank measurement.

Enter 8. Maintenance menu, Enter 8.6 Single count test. Press enter to start. The counting time RBC-CT should be in the range 11,5 –13 sec. Adjust if necessary by the adjustment ring (7). Clockwise turning will increase the vacuum and shorten the counting time. Lock the adjustment ring with the hexagon locking screw (8).

Note! If the counting time is too long, > 15, the message LT(long time) will be reported on the screen. If the counting time is too short, < 11, the message ST (short time)will be reported.

3.31 Rotary valve

The rotary valve determines the blood volume used in the first dilution, 20 ul blood in 4ml diluent (1:200) and the volume of blood dilution in the second dilution, 20 ul (1:200) dilution in 4 ml diluent (1:40 000). The dilution for determination of WBC and HGB is prepared by mixing 3 ml 1:200 dilution with 3 ml lyse reagent which gives a dilution of 1:400.

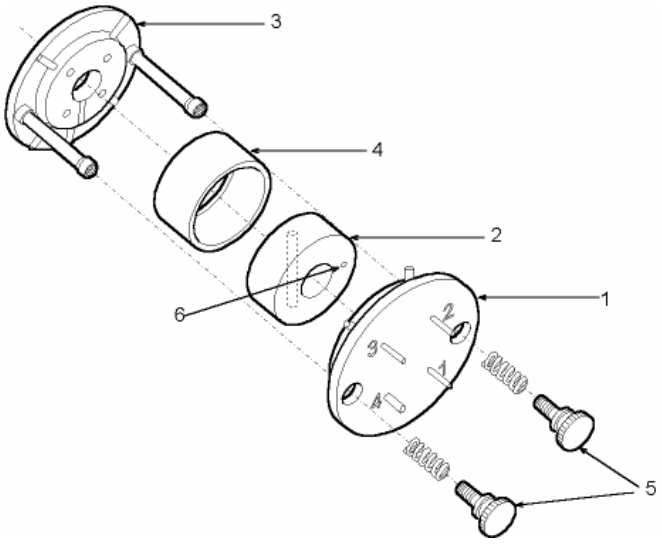
The rotary valve has three main parts: the outer metallic part (Fig.pos.1). The plastic valve-tap (2) and the rear metallic part (3). The two metallic parts are pressed together with the valve-tap using two spring-loaded screws (5). The screws are tighten to the final stop. **The pressure on the valve-tap will have the pressure of the spring.** The valve tap has a small drilled channel(6) having a volume of 20µl. This channel determines the blood and blood dilution volumes.

A motor with a gearbox which drives the syringes and controls the movement of the valve tap by a big wheel having two taps. These two taps move a four bladed plastic wheel. The wheel is mounted on an axis which is connected to the valve tap. When the wheel with the taps moves two turns the plastic wheel moves one turn. The position of the plastic wheel is locked by an arrow shaped screw.

The plastic wheel is factory adjusted to position the channel of the valve tap in line with the four channels of the two metallic parts of the rotary valve.

The position is factory adjusted so the volume hole in the valve-tap correspond to the four different position in the two metallic parts.

Surrounding the valve tap is a rubber seal(4) (rubber stocking) mounted to prevent leakage of the detergent circulation around the rotary valve.



3.32 Exchange/cleaning of the rotary valve, rubber stocking

Exchange of rubber stocking and cleaning of the valve.

1. Tilt down the cover plate in front of the syringes. Remove the tygon tubing from position 1 (Fig.B) in the front metallic part of the rotary valve. Remove the two screws including springs. Remove carefully the front metallic part from the rubber stocking. Carefully hang the front metallic part onto one of the bars supporting the rotary valve. Remove the rubber stocking together with the valve tap (2). Clean the surfaces of the rear and front metallic parts and the valve tap. Use a soft paper or a cotton pin and cleaning solution.

2. Before re-installation wet all surfaces with distilled water. Wet the rubber stocking and place it into the slot of the rear metallic part. Then insert the valve tap into the rubber stocking. Position the channel to the right. Push the valve tap, without touching the surfaces, into the axis. Insert the front metallic part and push it towards the back so the rubber stocking snaps into the slot of the front metallic part. Tighten the rotary valve by the two spring-loaded screws. Reconnect the tygon tubing(Pos. 1).

Exchange the complete valve.

Remove the tubing of the front part.(Fig.B.) Use a small screwdriver and carefully bend away the two teflon tubing (1). Remove the top connector of the 5 ml syringe. Remove the front part and the valve-tap including the rubber-stocking. Remove the two screws of the blood-sensor (Fig.A pos.3) Remove the blood-sensor tygon tubing (4) from the inner metallic part. Remove the other tygon tubing. Pull out the inner metallic part.

Reassemble the new inner valve part and connect the tubing in correct position(Fig A). Reassemble the other parts including the tubing as above.

Fig.A

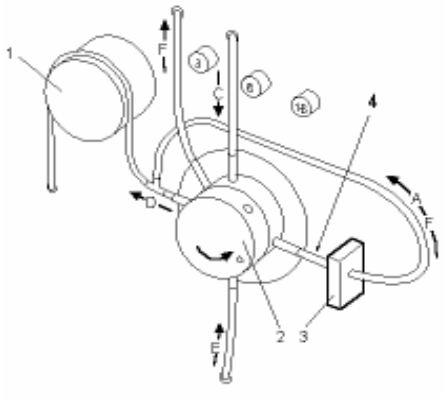
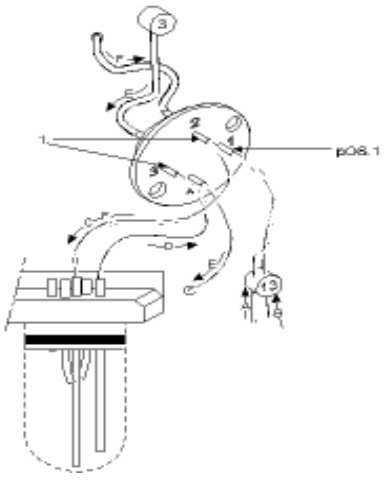


Fig.B



3.33 Syringes

Two 5ml syringes are used for dilution and hemolysing of the blood. The left syringe dilutes the blood with isotonic diluent and the right syringe adds and hemolysing reagents to the WBC/HGB dilution.

The syringes are driven an AC current motor with a gearbox. A wheel (Fig A, pos.1) is connected to the axis of the gearbox. The wheel is locked by a 2,5 mm, (2) hexagon screw. The wheel has two metallic taps (3) which move the four bladed wheel (4) in four steps. The wheel is mounted on the same axis as the rotary valve. The position of the axis is controlled by the black cam-wheel and the upper micro switch (7). An arm with a bearing and a plastic cylinder is mounted on the wheel (5).The other end of the arm is mounted on a plate with four springs (8). The plastic cylinder activates the lower micro switch (6).When both of the switches are active (pressed)the rotary valve and the syringes are in home position.) The plate (8)is mounted on two vertical shafts (9). The syringes are mounted on two shafts of the plate (10). The function of the spring is to give correct end position of the syringes at the mechanical stop position. On the shaft of each syringe are two metallic rings (Fig.B,pos.1,2) mounted and locked by 2 mm hexagon screws. The lower ring (1) is used for volume adjustment. The upper ring (2) is used for adjustment of the mechanical upper stop position to prevent the damage of the syringe top. At the top end of the shaft is a teflon piston (3), with an o-ring.

Fig. A

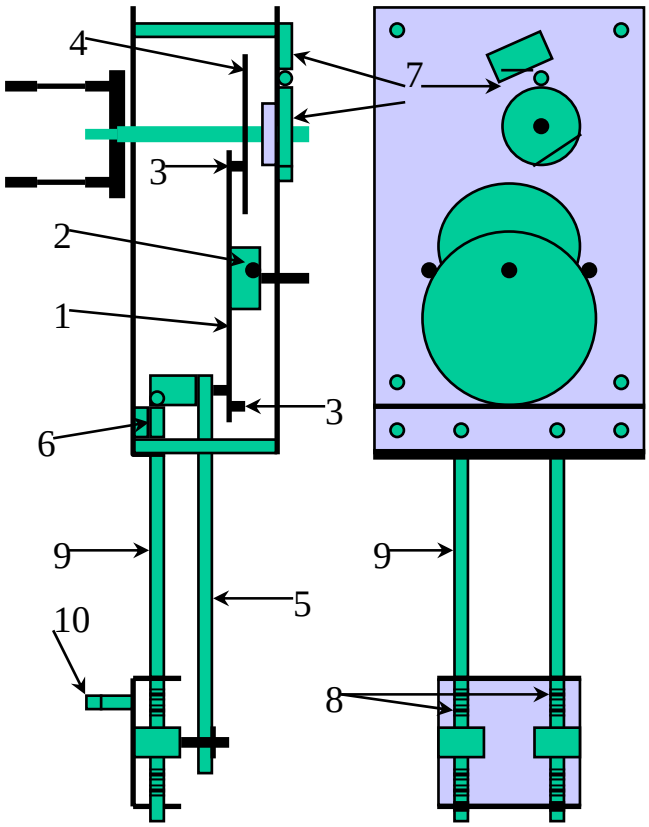
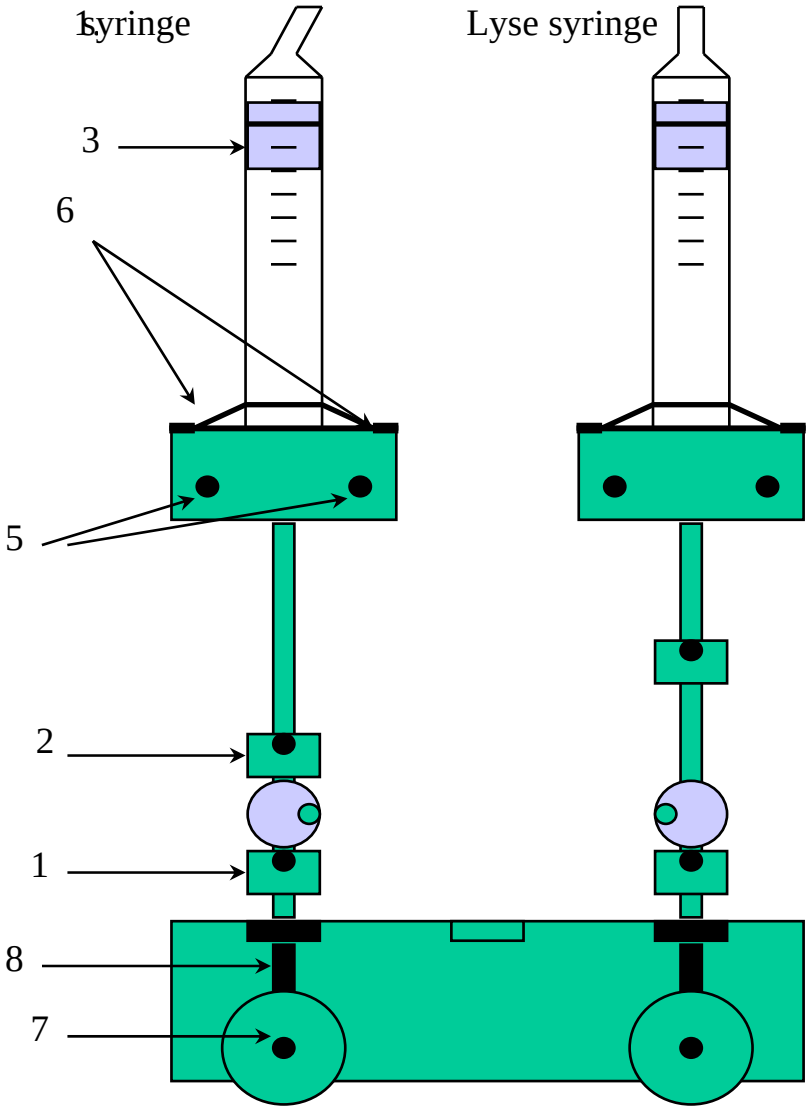


Fig.B



3.34 Exchange of pistons and cylinders

Release the locking screw (Fig B, pos.4). Remove the shaft from the slot(4). Remove the top connector from the syringe. Remove the two screws in the holder (5). Remove the complete syringe. Pull out the shaft with the piston from the glass cylinder. Use a tool and bend away the old piston. Save the washer. Clean the glass-cylinder.

Place the new teflon piston upside down on the table. Insert the new o-ring into the piston. Press by hand the shaft with the washer (Fig.C, 2) into the piston. Finally use a hammer to lock the piston. Wet the piston and enter it into the cylinder. Replace the complete syringe and tighten the screws (5). Enter the shaft into the slot and lock the screw (4). Make sure that the shaft is in vertically position into the cylinder.

Art.no piston 1 pcs is1020331. Set of 5 pcs incl. O-ring, washer is 1090258

Exchange of the cylinder.

Remove the syringe as above. Pull out the shaft from the cylinder. Remove the four screws (6) of the metallic cover of the holder. Remove the old cylinder (note the position of the O-ring) and place a new cylinder in the same position. Replace the cover with the four screws. Replace the syringe as above.

3.35 Adjustments of the volume and the upper end position.

Volume adjustment.

Release the two hexagon, 2mm, locking screws of the lower ring (Fig.B pos.1) Hold you finger on the upper ring and turn the lower ring. Clockwise turning gives higher volume and counter clockwise turning gives lower volume. After adjustments, lock the hexagon screws. The factory settings are approx. 3,8ml for the diluid syringe and 1.5 ml for the lyse syringe on cylinder scale.

Upper end position adjustments.

Enter 7. Service menu. Enter 7.9 Diluent syringe motor test. Press right arrow, > key. The syringes move to the top position and stay in that position.

Release the hexagon 2 mm screw of the upper ring and adjust the position so the space between the slot (Fig B, pos. 4) and the upper ring is approx. 0,1mm. Make the same adjustments of both syringes. Lock the hexagon screw.

Press left arrow < key. The syringes will move to the home position.

3.36 Drain valve MV7

The drain valve is a membrane valve and used for draining of the solutions to waste. The valve is activated by 22 V DC current from the diluter board.

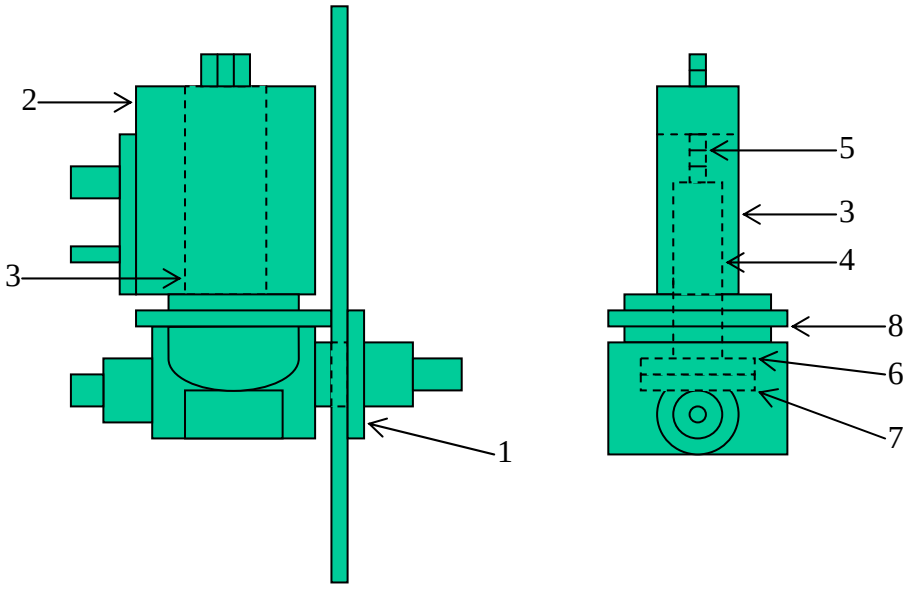
The valve is located on the panel as the flush and drain pumps. The valve is attached to the panel by a brass nut. (fig.pos.1)

The valve contains a magnetic coil (2) which is locked by a nut in the top and a house with a magnet in the top (3). Inside the house there is a shaft (4) of magnetic material . A spring in the top (5) will press down the shaft. At the end of the shaft there is a plastic washer (6) attached to a rubber membrane (7).

The valve is normally closed without current.

3.37 Exchange of the membrane or valve and cleaning of the valve.

Remove the tubing of the valve. Remove the brass nut (1). Remove the electric connectors and the complete valve. Remove the nut in the top of the coil. Lift up and remove the coil. Remove the plastic screw (8) and lift out the house (3). Note! Do not lose the spring in the top (5). Lift out the shaft (4) including the washer and the membrane. Note the position of the plastic washer (6).The phased part should be in the position against the membrane. The membrane is pressed in to the end of the shaft. Replace the membrane. Clean the valve house and the other details. Reinstall the parts.



4. Analog board (v 01)

4.1 Adjustments of the analog board

4.1.1 Adjustments of the capillary voltage

Connect a voltmeter between TP2, gnd and TP7. Analog board. Run a blank measurement and check the voltage during RBC counting. **The voltage should be 15V +/- 0,5V.**
NOTE ! The voltage is not adjustable.

4.1.2 Capillary cleaning voltage

Connect an oscilloscope to TP2 and the upper part of the resistor R66. Analog board. Enter 8. Maintenance menu, 8.5 Start capillary cleaning. Press Enter to start the cleaning. Check that the relays are clicking. **The pulse amplitude should be approx. 250p-p 30mS.**

4.1.3 Offset adjustments

Run a blank measurment

Offset 2. Connect a voltmeter between TP2 and TP9 or pin1, U2. Adjust by **R27 to 0,000V +/- 5mV.**
Offset 1. Connect a voltmeter between TP2 and TP3. Adjust **by R33 to- 0,02V (-20mV) +/- 5 mV.**

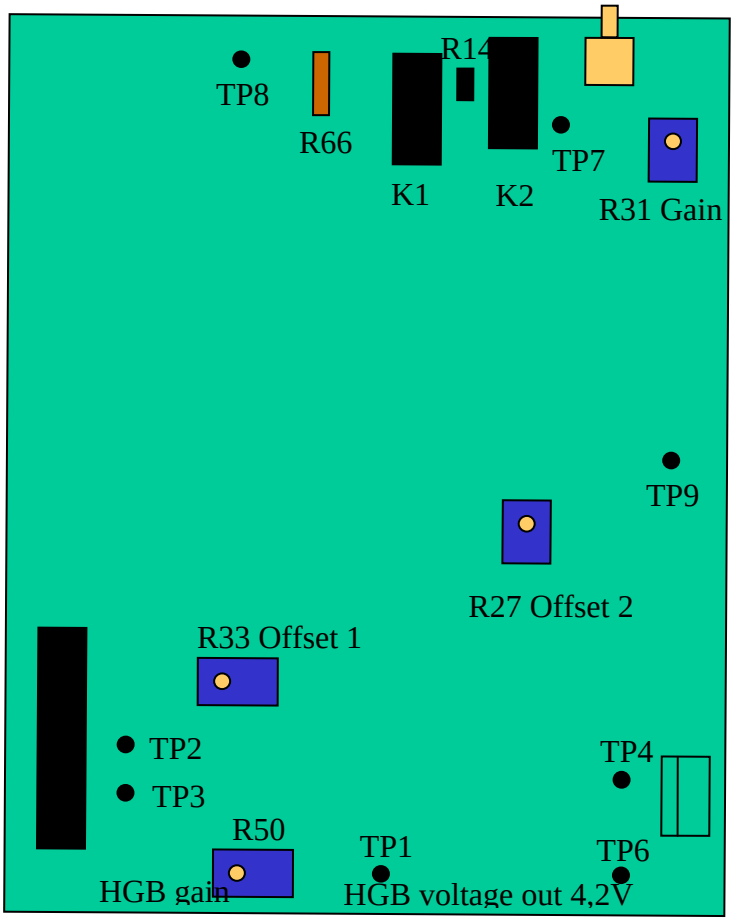
4.1.4 Gain adjustments

Run a calibrator or an equal blood with well known MCV value. Enter 5. Cal. QC menu. Adjust the % value for MCV to 0 %. Run the blood again and check the value. Adjust R 31, clockwise increasing the MCV. Counter clockwise decreasing the MCV. Run and adjust in steps until the MCV value is acceptable.
After adjustments, run the blood 5 times and make a calibration.

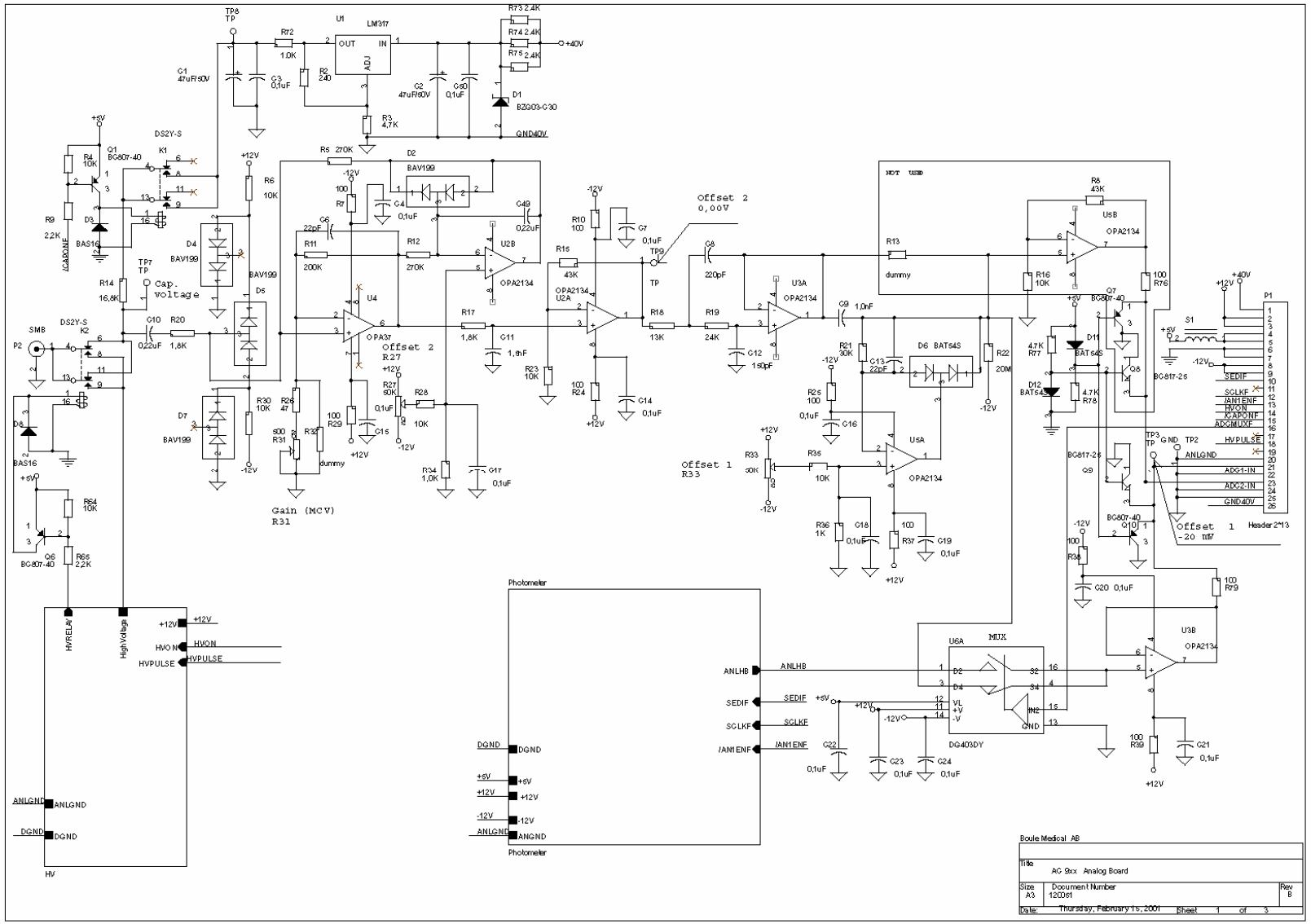
4.1.5 HGB photometer adjustments

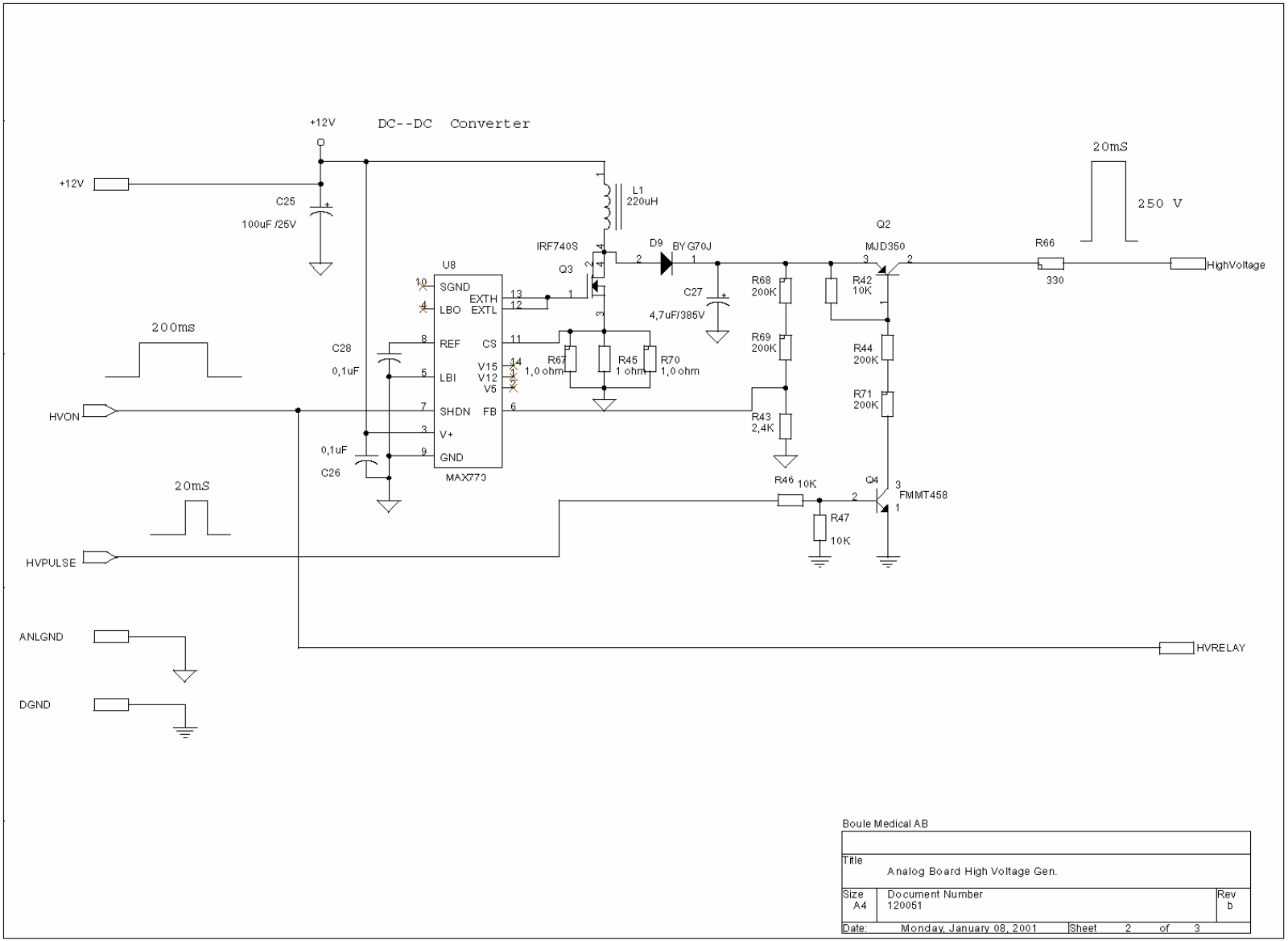
NOTE ! Be sure that the counting beaker is clean before adjustments. Run a blank measurement before adjustments. **Note! Autorization code 1809**
Enter 7. Service menu, pos. 7.5 HGB led adjustments. Check that the led. current is40– 60mA. Adjust by +/- keys. The photocell voltage should be 4,2V +/- 0,2V. If necessary, adjust the voltage by R50, Analog board.

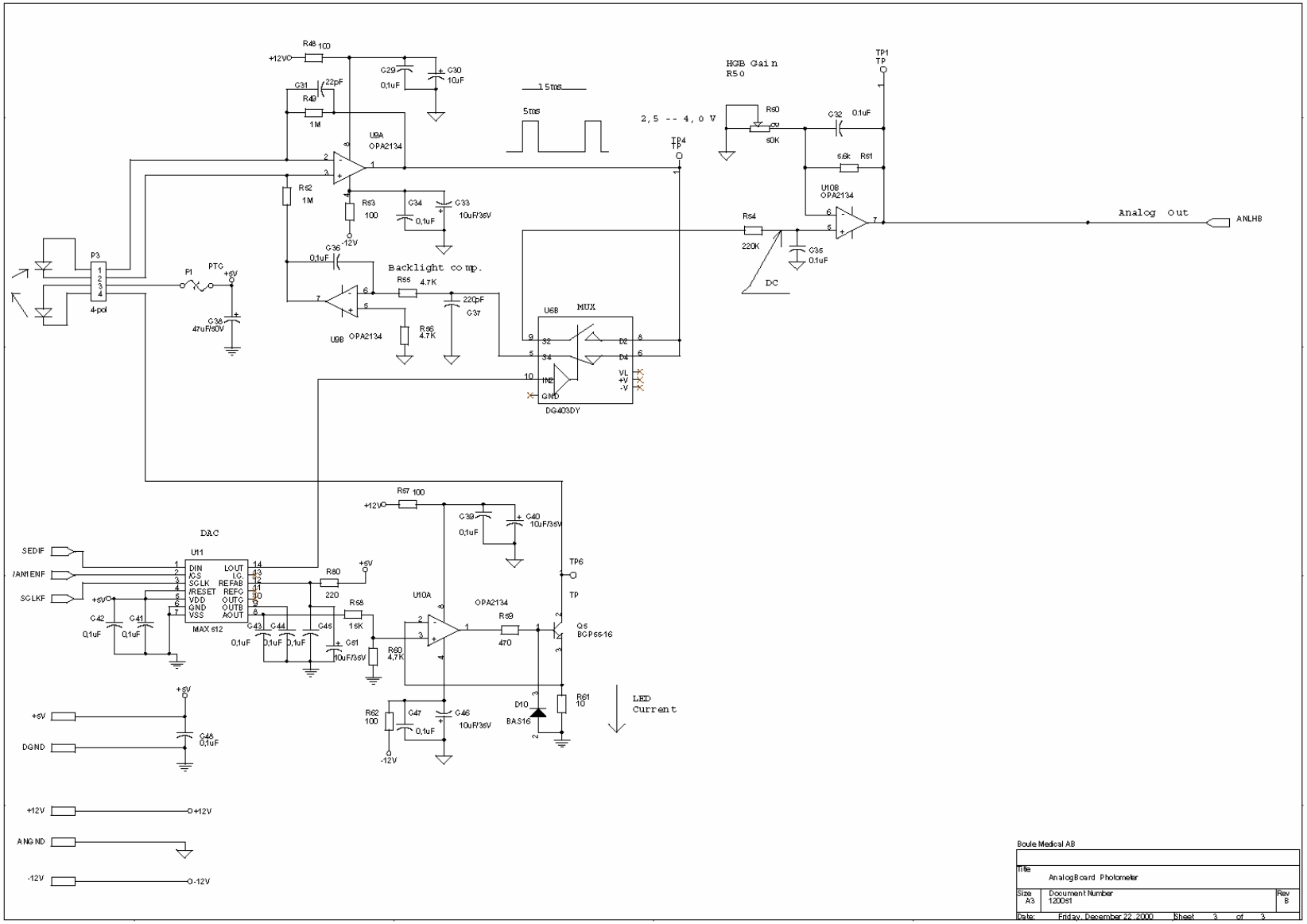
4.1.6 Analog board layout



4.1.7 Analog board diagram

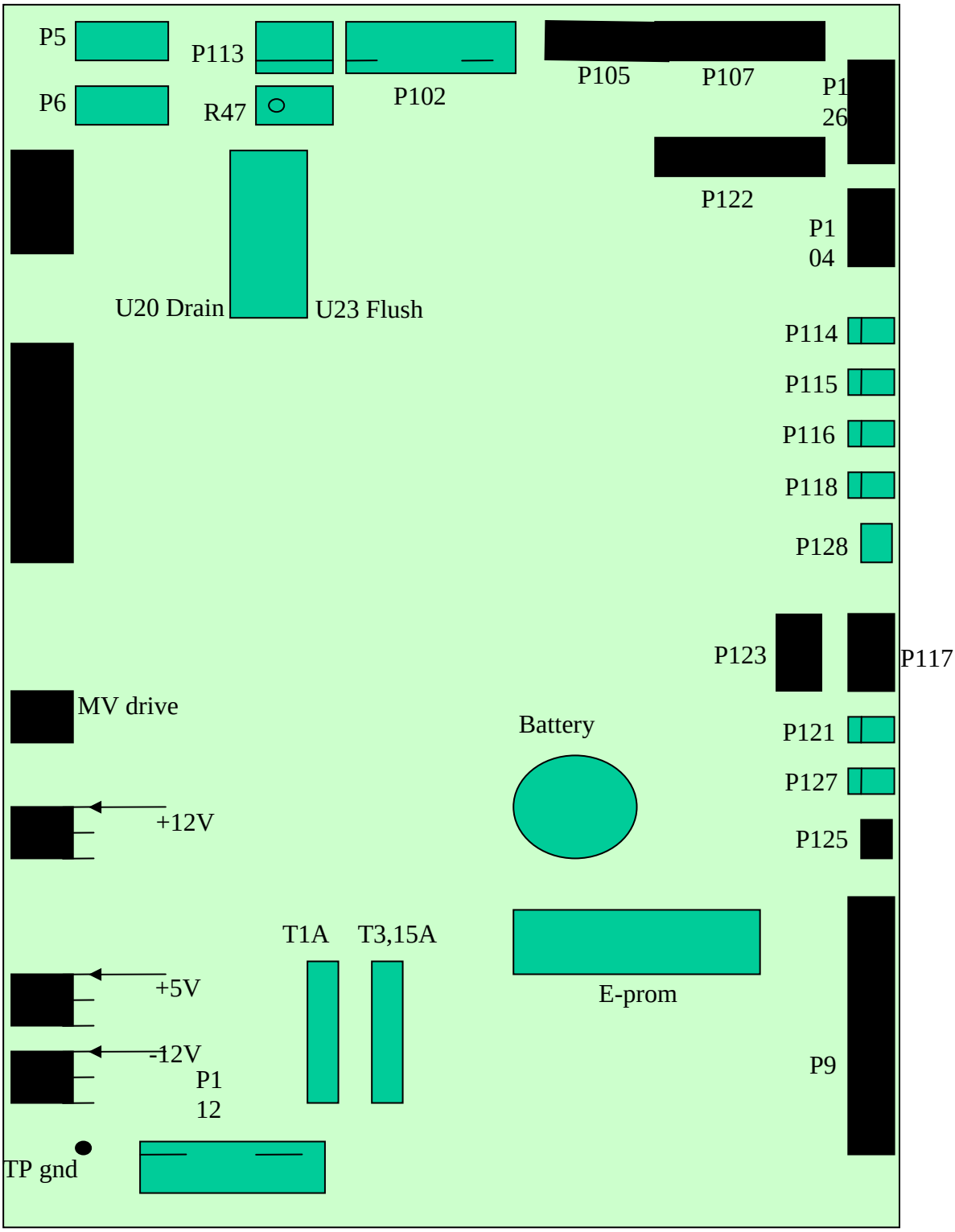

Offset 2
0,00V
Offset 2
R27
Offset 1
R33
Gain (MCV)
R31
Cap. voltage
Offset 1
- 20 mV
Header 2*13
Photometer
Boule Medical AB
AG 9xx Analog Board
Document Number
120081
Thursday, February 15, 2001
Sheet 1 of 3


DC--DC Converter
+12V
C25
100uF /25V
L1
220uH
IRF740S
Q3
D9
BYG70J
C27
4,7uF/385V
U8
SGND
LBO
REF
LBI
SHDN
V+
GND
EXTH
EXTL
CS
V15
V12
V5
FB
MAX770
C28
0,1uF
C26
0,1uF
R67
1,0 ohm
R45
1 ohm
R70
1,0 ohm
R68
200K
R69
200K
R43
2,4K
Q2
MJD350
R42
10K
R44
200K
R71
200K
R66
330
20mS
250 V
HighVoltage
200ms
HVON
20mS
HVPULSE
R46
10K
Q4
FMMT458
R47
10K
ANLGND
DGND
HVRELAY
Boule Medical AB
Title
Analog Board High Voltage Gen.
Size
A4
Document Number
120051
Rev
b
Date:
Monday, January 08, 2001
Sheet
2
of
3

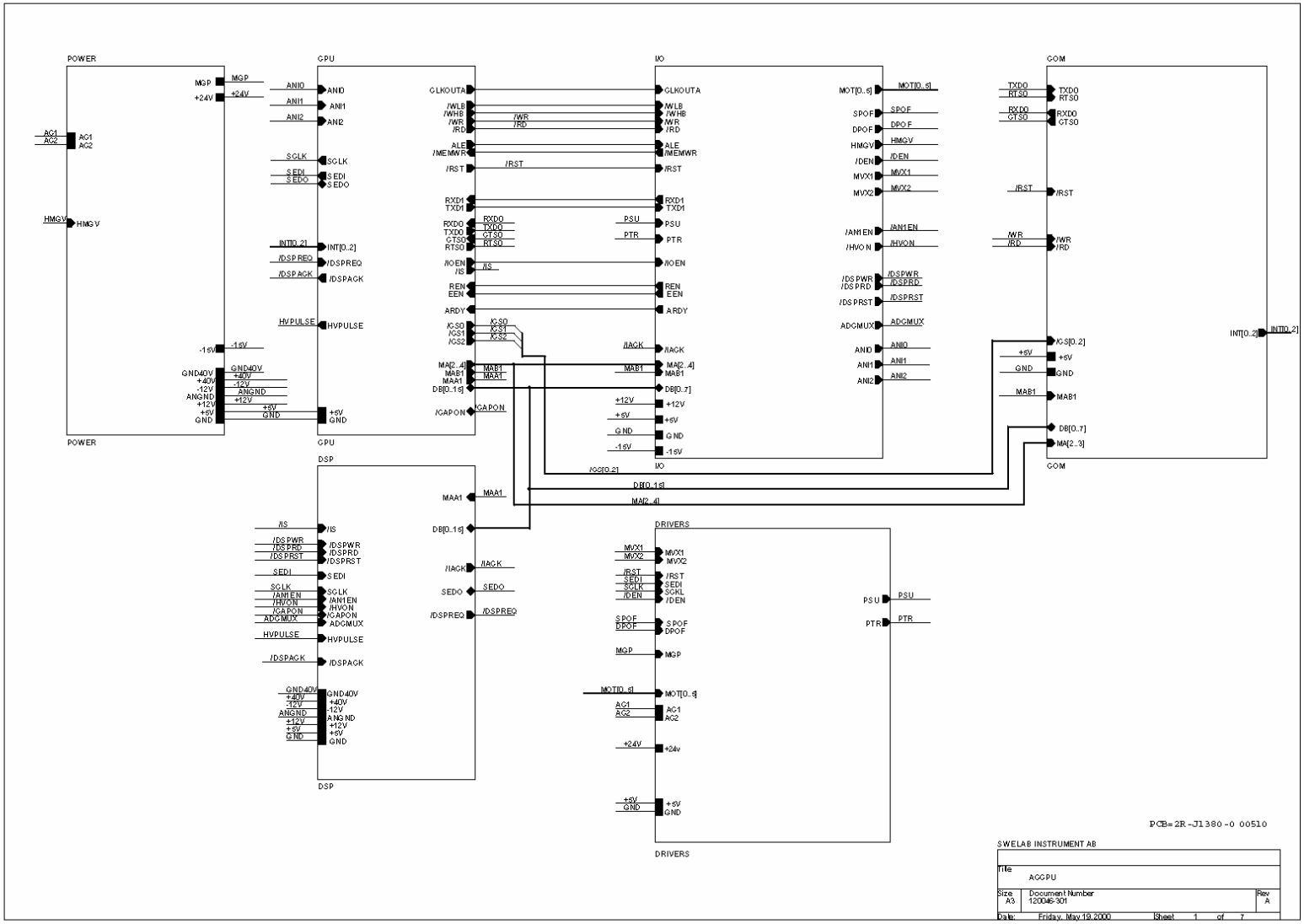

HGB Gain
R50
2,5 -- 4,0 V
Analog Out
ANLHB
Backlight comp.
MUX
DG403DY
OPA2134
DAC
MAX 512
SEDIF
/ANTENF
SCLKF
DGND
-12V
LED
Current
BAS16
BCPss-16
Boule Medical AB
Analog Board Photometer
Friday, December 22, 2000

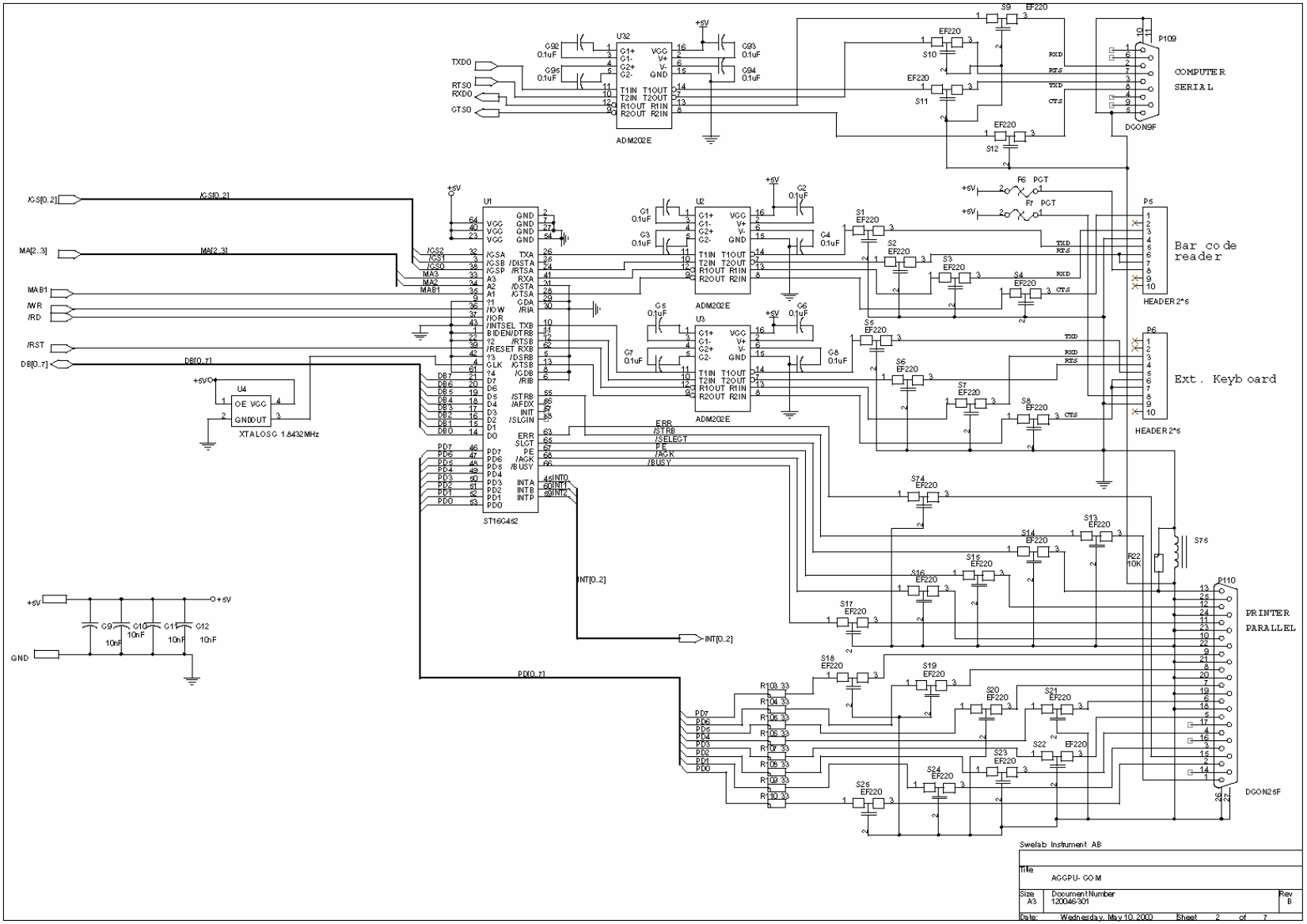
5. Processor board (v 01)

5.1 Processor board



5.2 Processor board diagram

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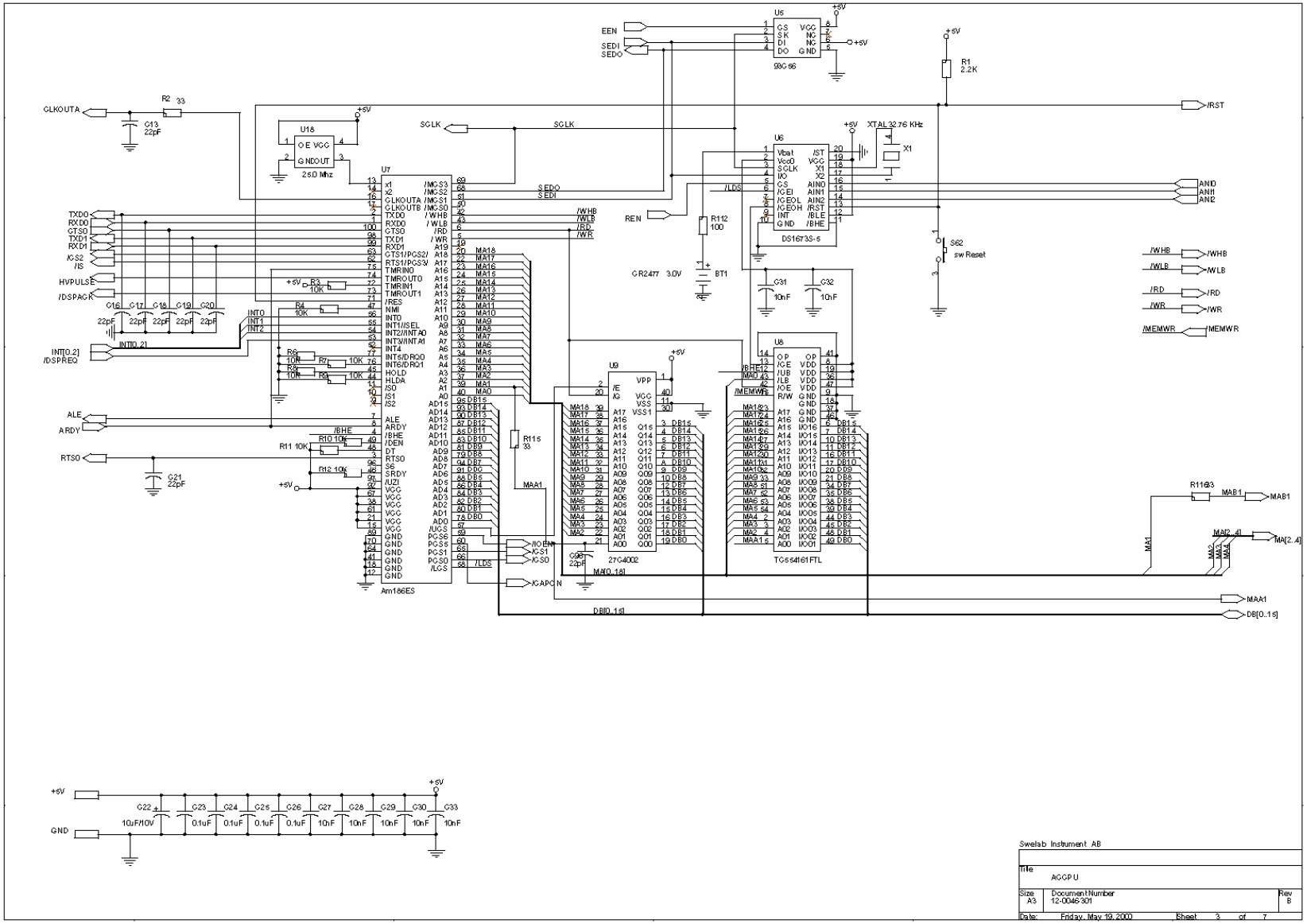
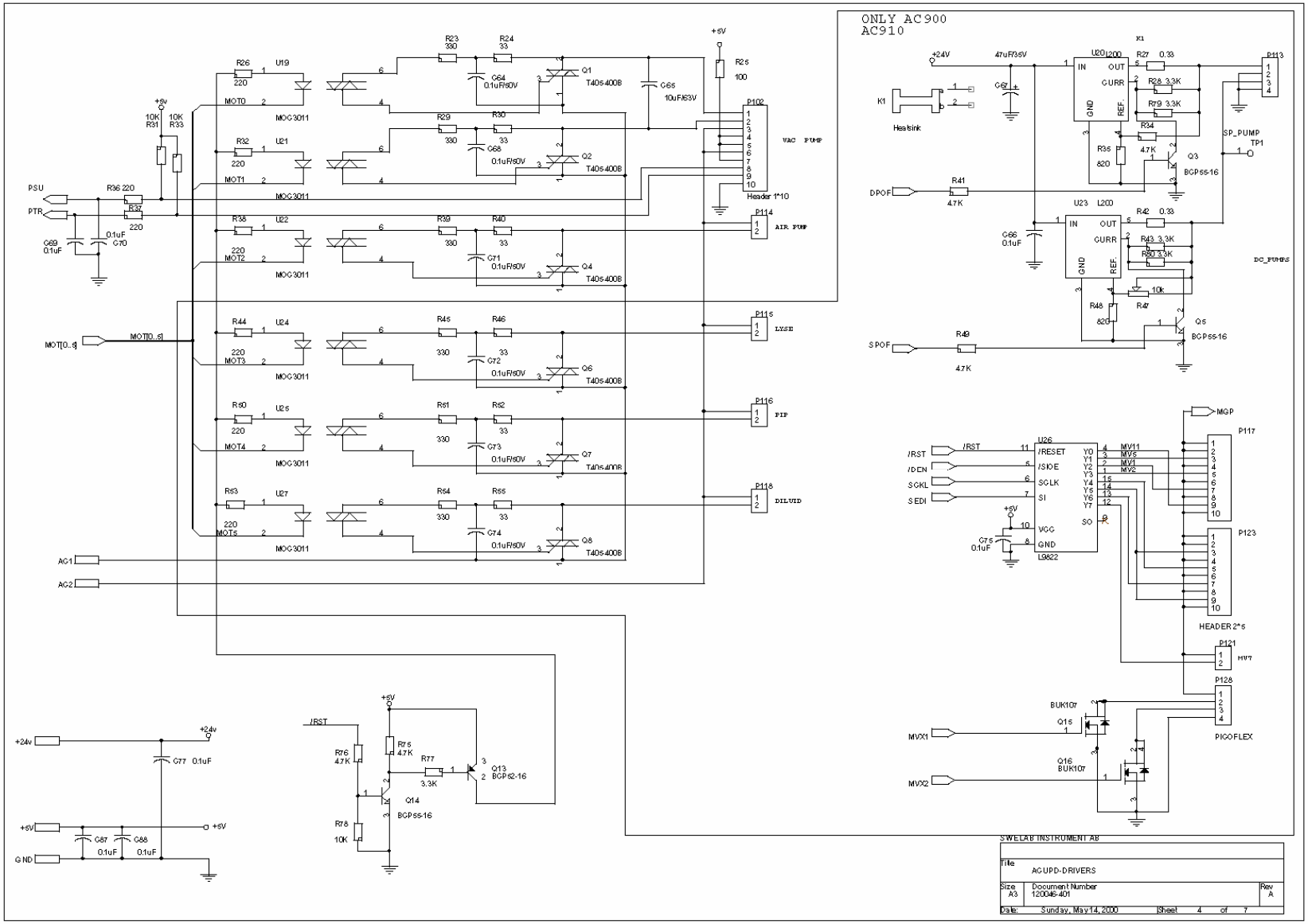
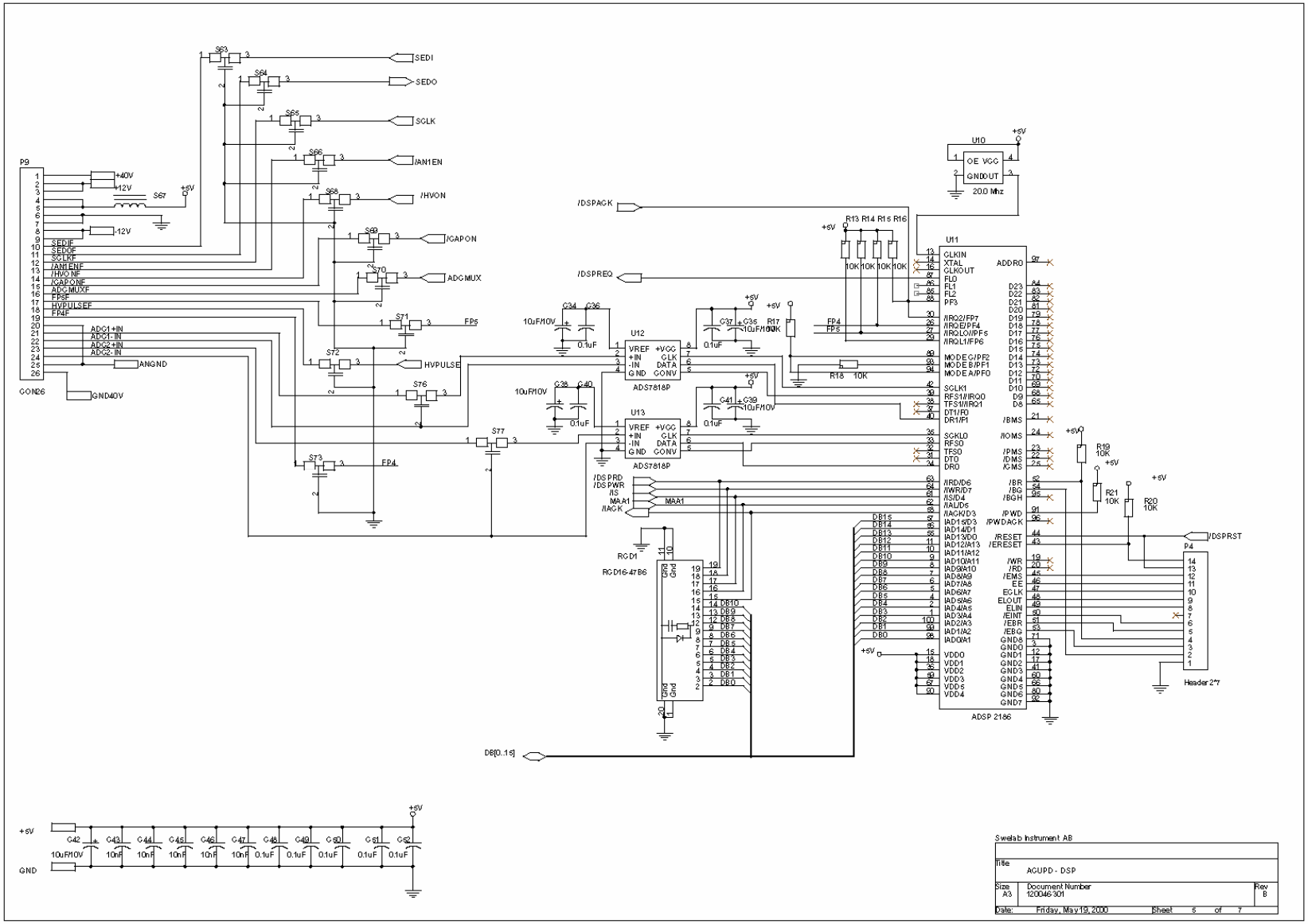
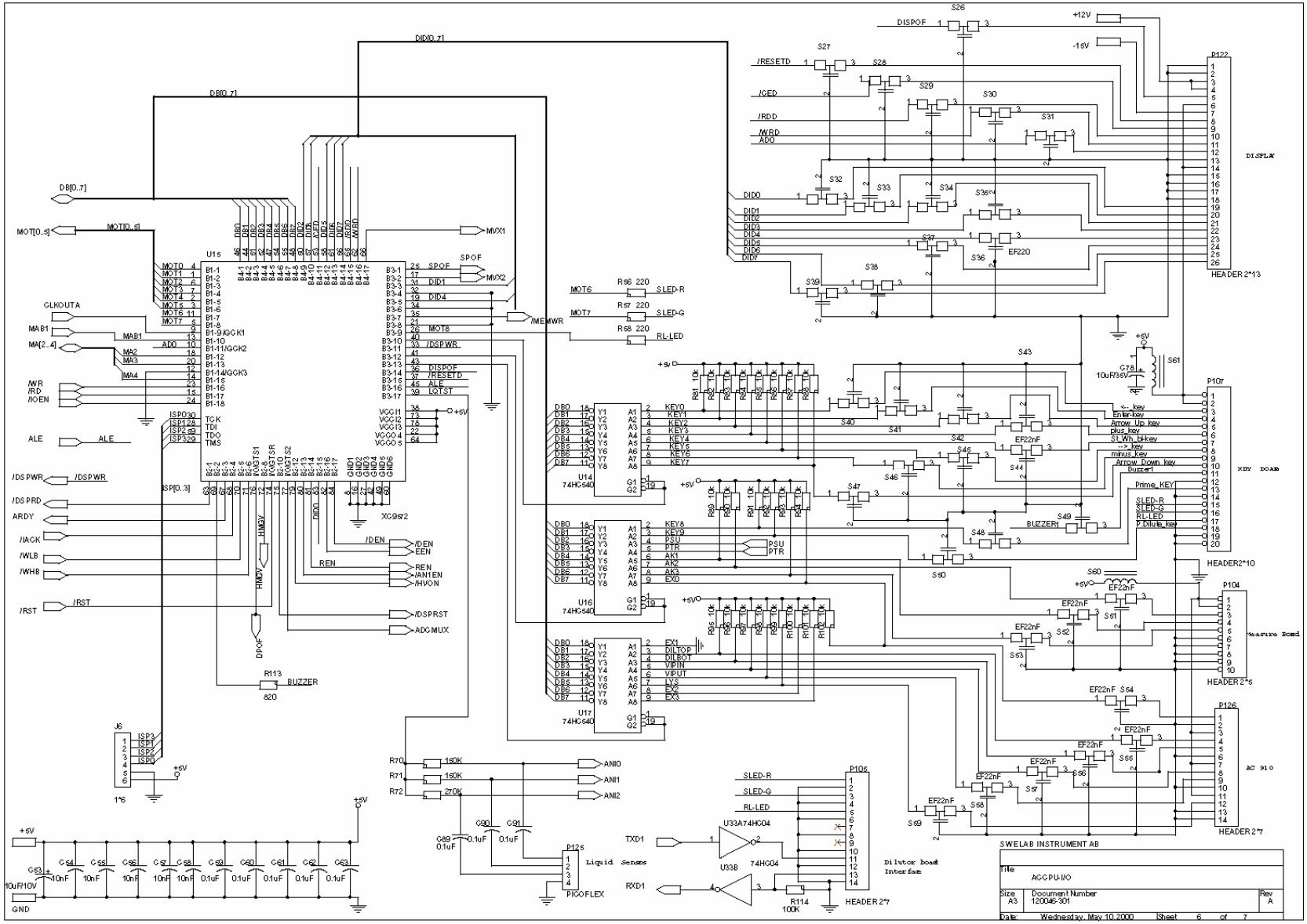
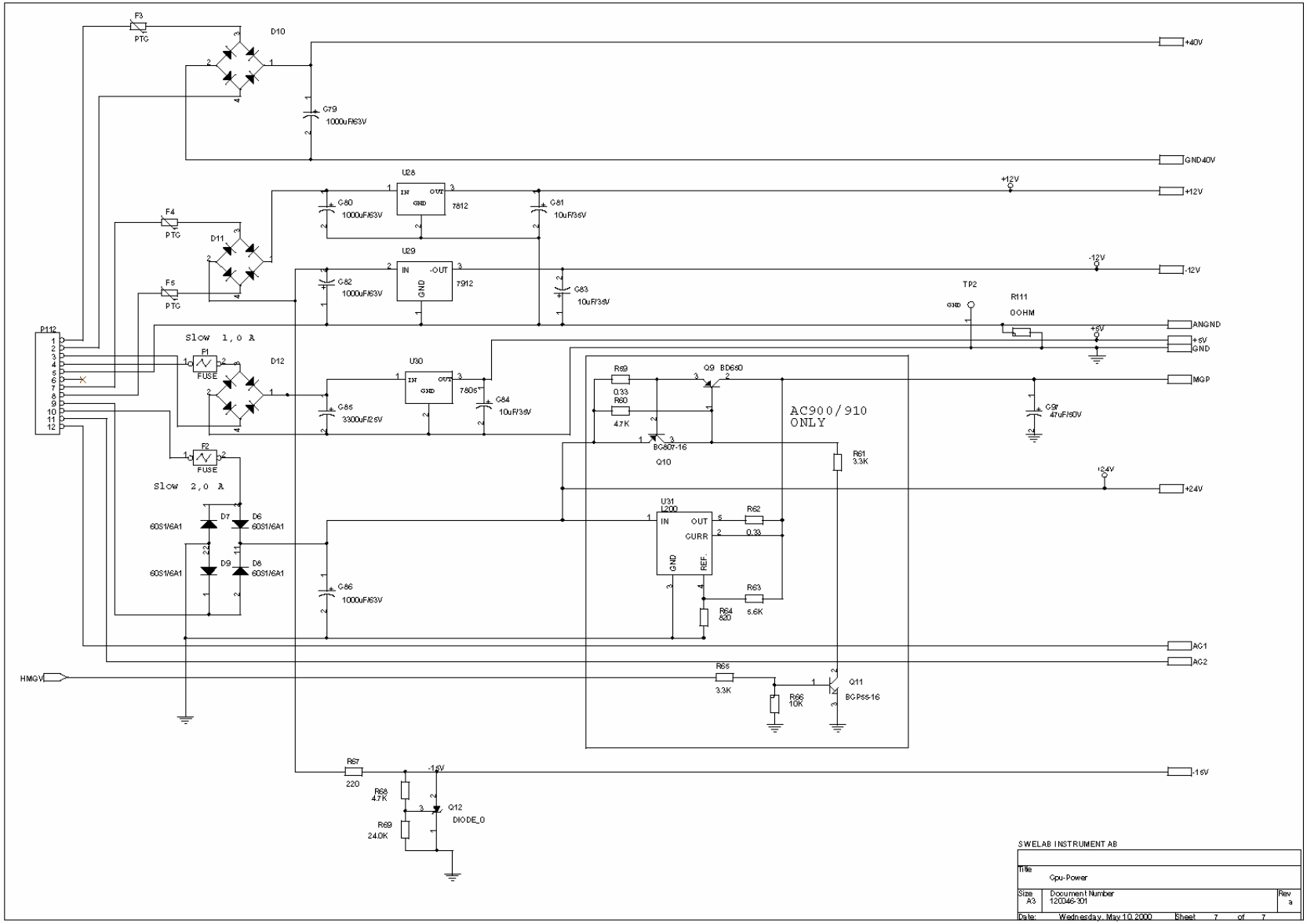
Bar code reader
Ext. Keyboard
PRINTER PARALLEL
HEADER 2*5
XTALOSC 1.8432MHz
ADM202E
ST16C452
Swelab Instrument AB
AGGPU- COM
Wednesday, May 10, 2000


Swelab Instrument AB
Title
AGCPU
Size A3
Document Number 12-0046301
Rev B
Date: Friday, May 19, 2000
Sheet 3 of 7
Am186ES
27C4002
TC554161FTL
DS1673S-5
XTAL 32.76 KHz
25.0 Mhz
+5V
GND
/IRST
/WHB
/WLB
/RD
/WR
/MEMWR
SCLK
SEDO
SEDI
/LDS
REN
/IO-EN
/CS1
/CS0
/C-APCN
MAA1
MAB1
MA[2..4]
MA[0..18]
DB[0..15]
INT[0..2]
/DSPREQ
/DSPACK
HVPULSE
ALE
ARDY
/BHE
/DEN
RTS0
TXD0
RXD0
CTS0
TXD1
RXD1
/CS2
/IS
SW Reset
BT1
GR2477 3.0V


ONLY AC900
AC910
VAC PUMP
AIR PUMP
LYSE
FIP
DILUVID
DC_PUMPS
SP_PUMP
Heatsink
HEADER 2*5
PICOFLEX
SWELAB INSTRUMENT AB
Title
AC UPD-DRIVERS
Size A3
Document Number 120046-401
Rev A
Date: Sunday, May 14, 2000
Sheet 4 of 7


P9
CON26
+40V
+12V
-12V
GND40V
ANGND
SEDIF
SEDOF
SCLKF
/AN1ENF
/HVONF
/CAPONF
ADCMUXF
FP5F
HVPULSEF
FP4F
ADC1+IN
ADC1-IN
ADC2+IN
ADC2-IN
S63
S64
S65
S66
S67
S68
S69
S70
S71
S72
S73
S76
S77
SEDI
SEDO
SCLK
/AN1EN
/HVON
/CAPON
ADCMUX
FP5
HVPULSE
FP4
/DSPACK
/DSPREQ
U10
20.0 Mhz
U11
ADSP 2186
U12
U13
ADS7818P
R13 R14 R15 R16
10K
R17
R18
R19
R20
R21
/DSPRST
P4
Header 2*7
/DS PRD
/DS PWR
/IS
MAA1
/IACK
RCD1
RCD16-47B6
DB[0..15]
C34 C36
C35 C37
C38 C40
C39 C41
10uF/10V
0.1uF
C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52
10nF
0.1uF
Swelab Instrument AB
Title
AGUPD - DSP
Size
A3
Document Number
120046-301
Rev
B
Date: Friday, May 19, 2000
Sheet 5 of 7


DISPLAY
HEADER 2*13
KEY BOARD
HEADER2*10
Measure Board
HEADER 2*5
AC 910
HEADER 2*7
Liquid Sensor
PICOFLEX
Dilutor board Interface
HEADER 2*7
SWELAB INSTRUMENT AB
Title
AC-CPU-I/O
Size A3
Document Number 120046-301
Rev A
Date: Wednesday, May 10, 2000
Sheet 6 of 7


F3
PTC
D10
C79
1000uF/63V
+40V
GND40V
U28
7812
C80
1000uF/63V
C81
10uF/35V
+12V
F4
PTC
D11
F5
PTC
U29
7912
C82
1000uF/63V
C83
10uF/35V
-12V
TP2
R111
0OHM
ANGND
+5V
GND
P112
Slow 1,0 A
P1
FUSE
D12
U30
78S05
C85
3300uF/25V
C84
10uF/35V
R59
0.33
R60
4.7K
Q9 BD680
Q10
BC807-16
AC900/910
ONLY
C87
47uF/50V
MGP
R61
3.3K
+24V
F2
FUSE
Slow 2,0 A
D7
60S1/6A1
D6
60S1/6A1
D9
60S1/6A1
D8
60S1/6A1
U31
L200
IN
OUT
CURR
GND
REF.
R62
0.33
R63
5.6K
R64
820
C86
1000uF/63V
AC1
AC2
HMGV
R65
3.3K
R66
10K
Q11
BCP55-16
R67
220
R68
4.7K
R69
24.0K
Q12
DIODE_0
-15V
SWELAB INSTRUMENT AB
Title
Cpu-Power
Size
A3
Document Number
120046-301
Rev
a
Date:
Wednesday, May 10, 2000
Sheet
7
of
7

6. Measuring Board, Volume Board (v 01)

6.1 Adjustments of the optical sensors

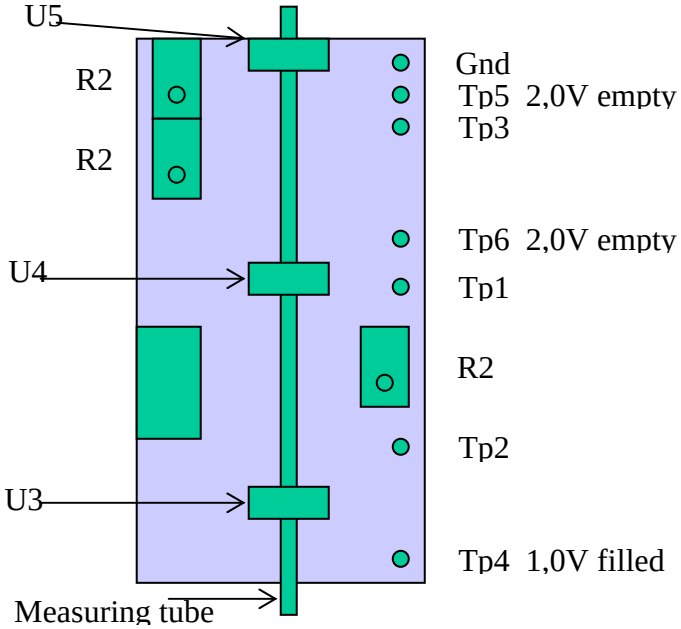
Connect a syringe to the silicon tubing from the top of the measuring tube. Connect a voltmeter to TP 4. Aspirate carefully with the syringe until the meniscues pass the lower sensor U3. Adjust R20 to 1.0V +/- 0,2V.

Connect the voltmeter to TP6, adjust the middle sensor U4 by R24 to 2.0V +/- 0.2V (**when the tube is empty**)

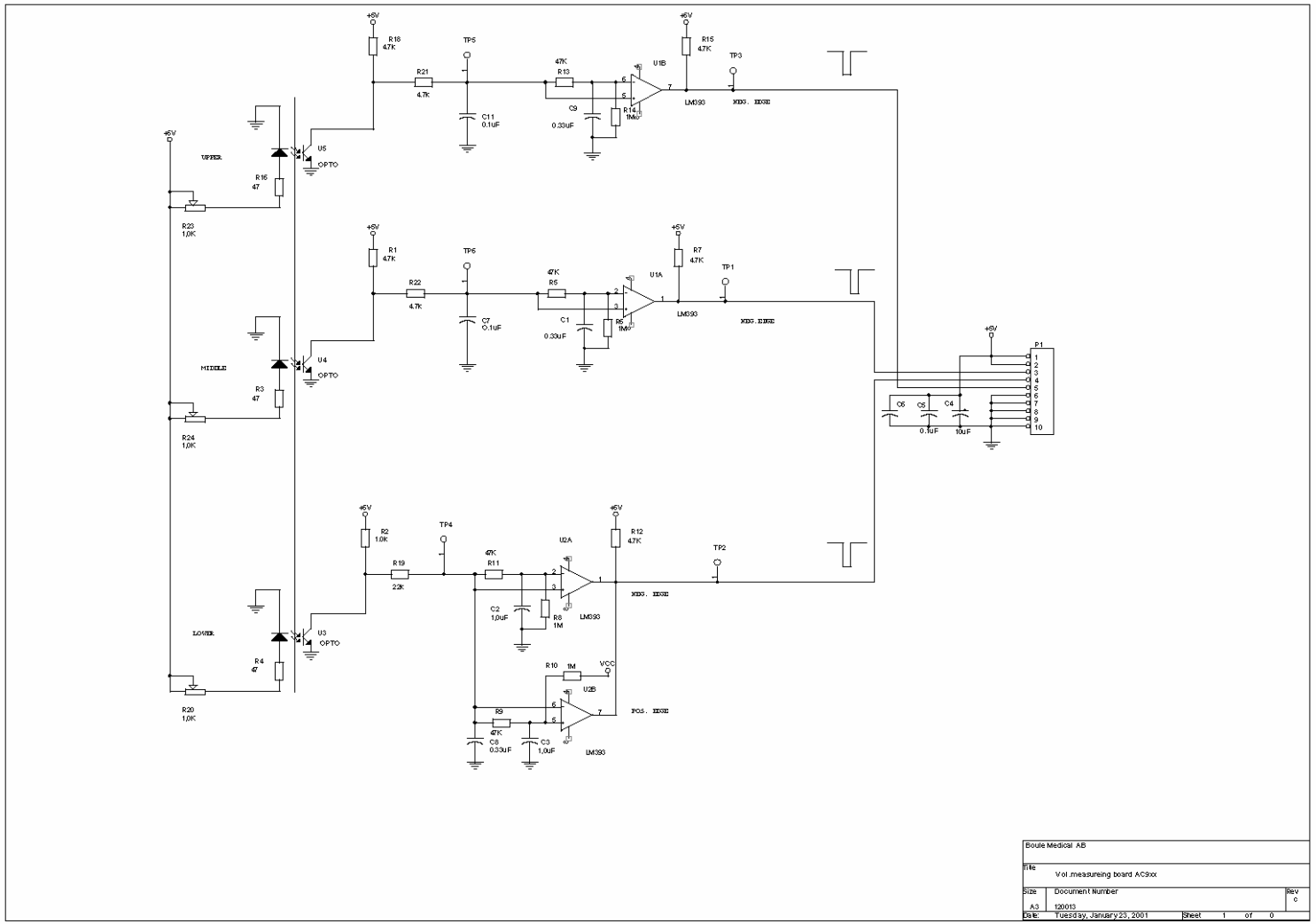
Connect the voltmeter to TP5, adjust the upper sensor U5 by R23 to 2,0V +/- 0,2V (**when the tube is empty)**

Check the voltage when the tube is **filled.** TP5 and TP6 should be lower than 0,5V.

Check the voltage at TP 4 when the tube is **empty in the lower sensor** U3. The voltage should be 3.5V +/- 0,5V.

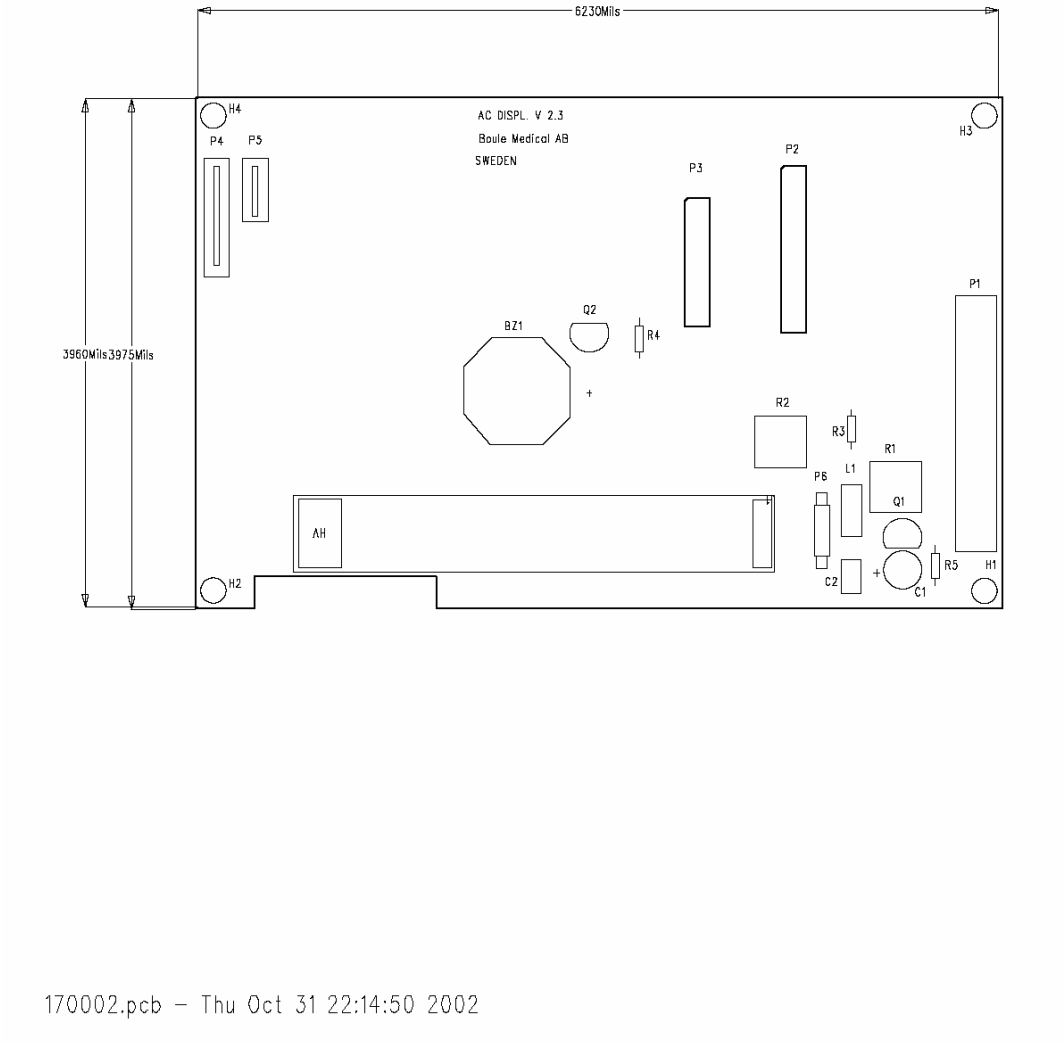


6.2 Measuring board Diagram

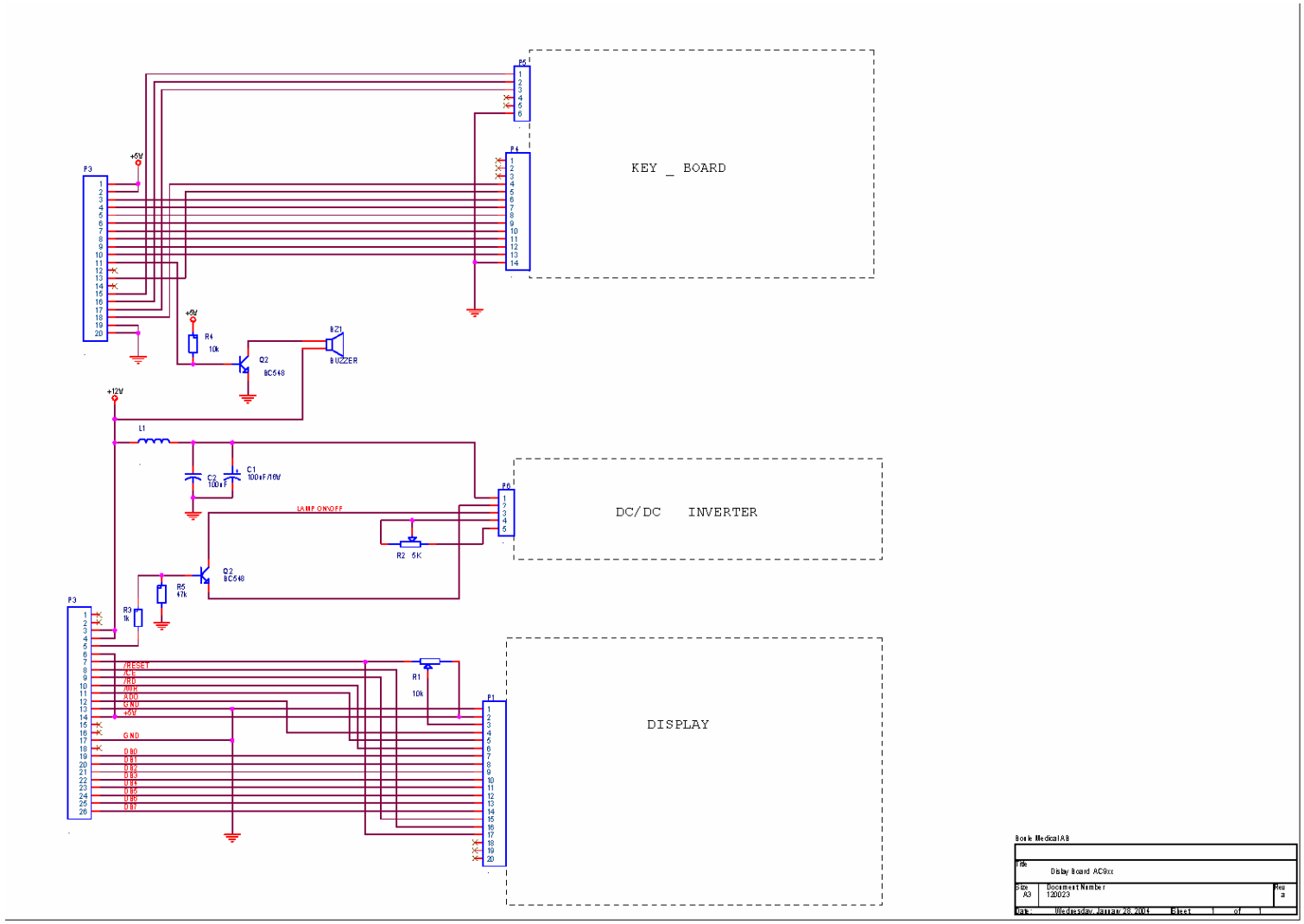


7. Display (v 01)

7.1 Display layout



7.2 Display Diagram



8. Diluter board (v 01)

8.1 Adjustments of the Diluterboard

8.1.1 Test of the bloodsensor

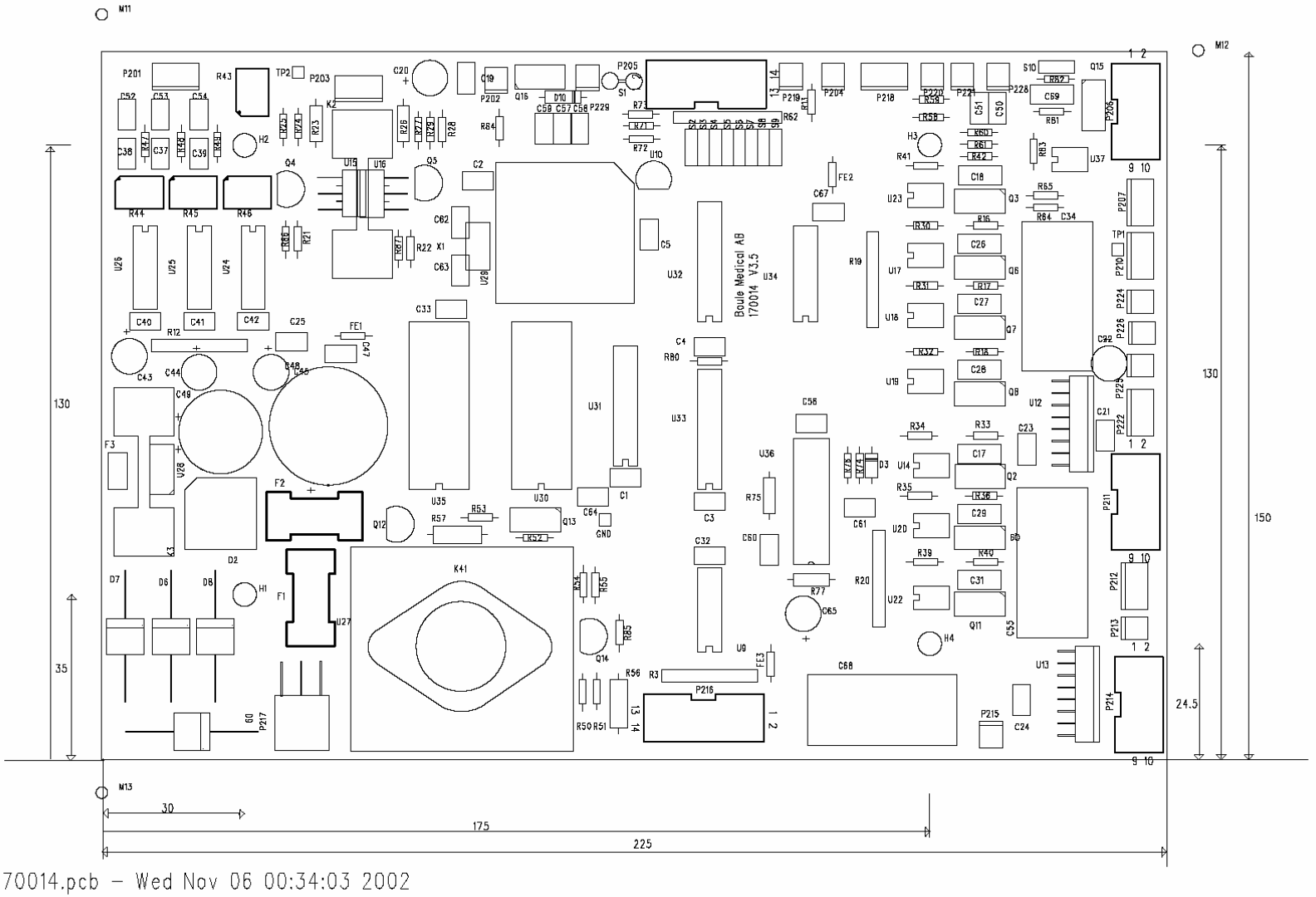
1. Connect a voltmeter between TP gnd and TP1. Diluter board.
   The voltage should be < 0,5V when the bloodsensor is empty
2. Enter 7.Service menu , pos.7.4 Pump and valve test. Step to Sample pump. Press + key and aspirate blood from the open pipette until the blood pass the blood sensor. Turn of the samlepump with the – key and remove the blood tube. **The voltage should increase to 4 – 5V**.
3. Fill the wash cup for the open pipette with clean diluid or detergent. Press + key again and aspirate until the blood sensor is clean and empty. Measure the voltage at TP1. **The voltage should be < 0,5V**

8.1.2 Adjustment of the flushpump

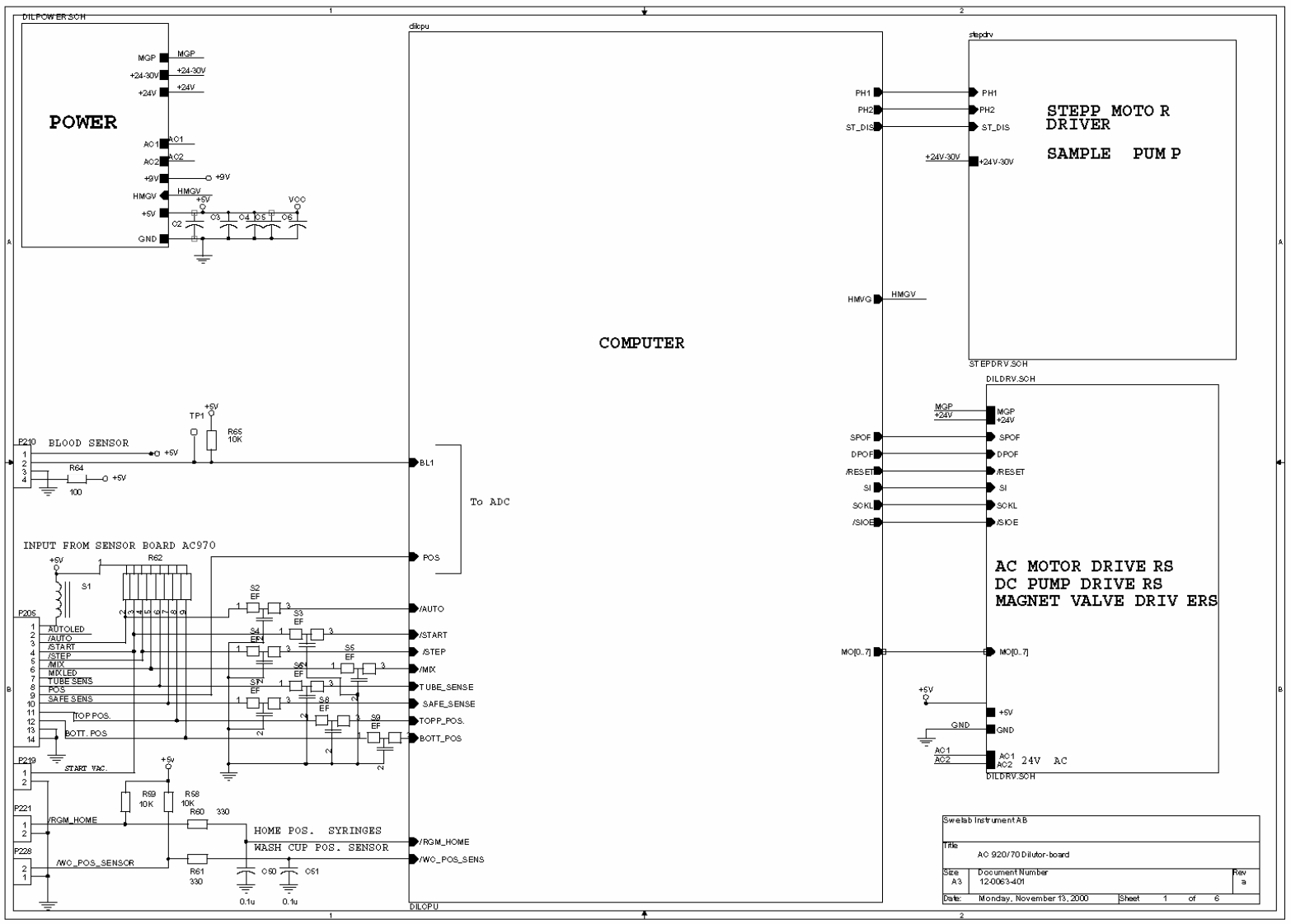
1. Connect a voltmeter between TP gnd and TP 2. Diluter board.
2. Enter 7.Service menu, pos. 7.4 Pump and valve test. Step to Flush pump.

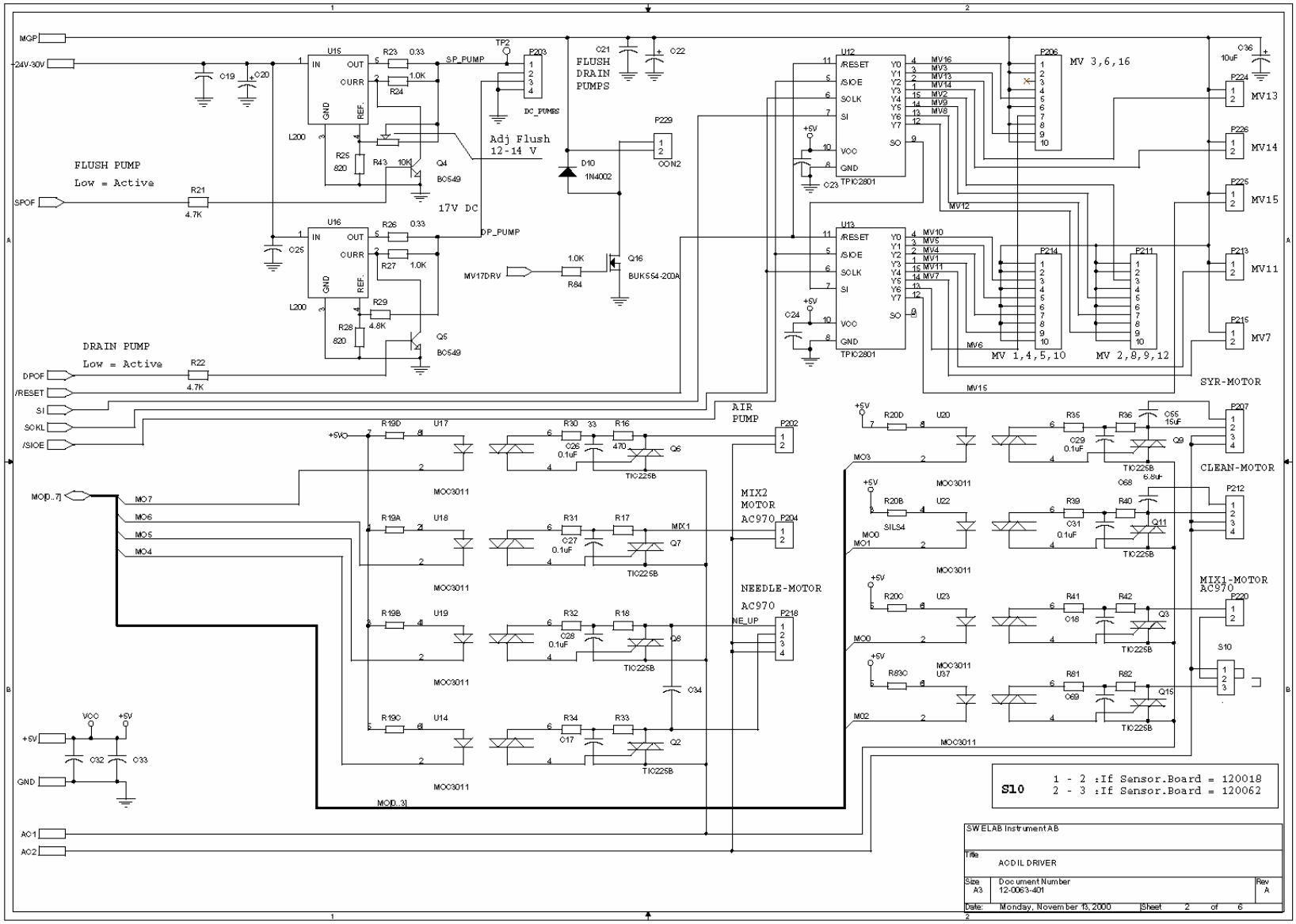
   Press + key. **Adjust with R43 the voltage to 13V +/- 0,5V.**
3. Run a blank measurement. Check the level into the counting beaker after the final cleaning. The level should be approx. 15 mm under the upper edge of the beaker. If the level is incorrect, enter 7. Service pos. 7.2 Flush pump time setup. The factory settings is approx. 2 – 3 sec. (longer time will increase the level **) NOTE! After new setting value, Enter the code 1809.**

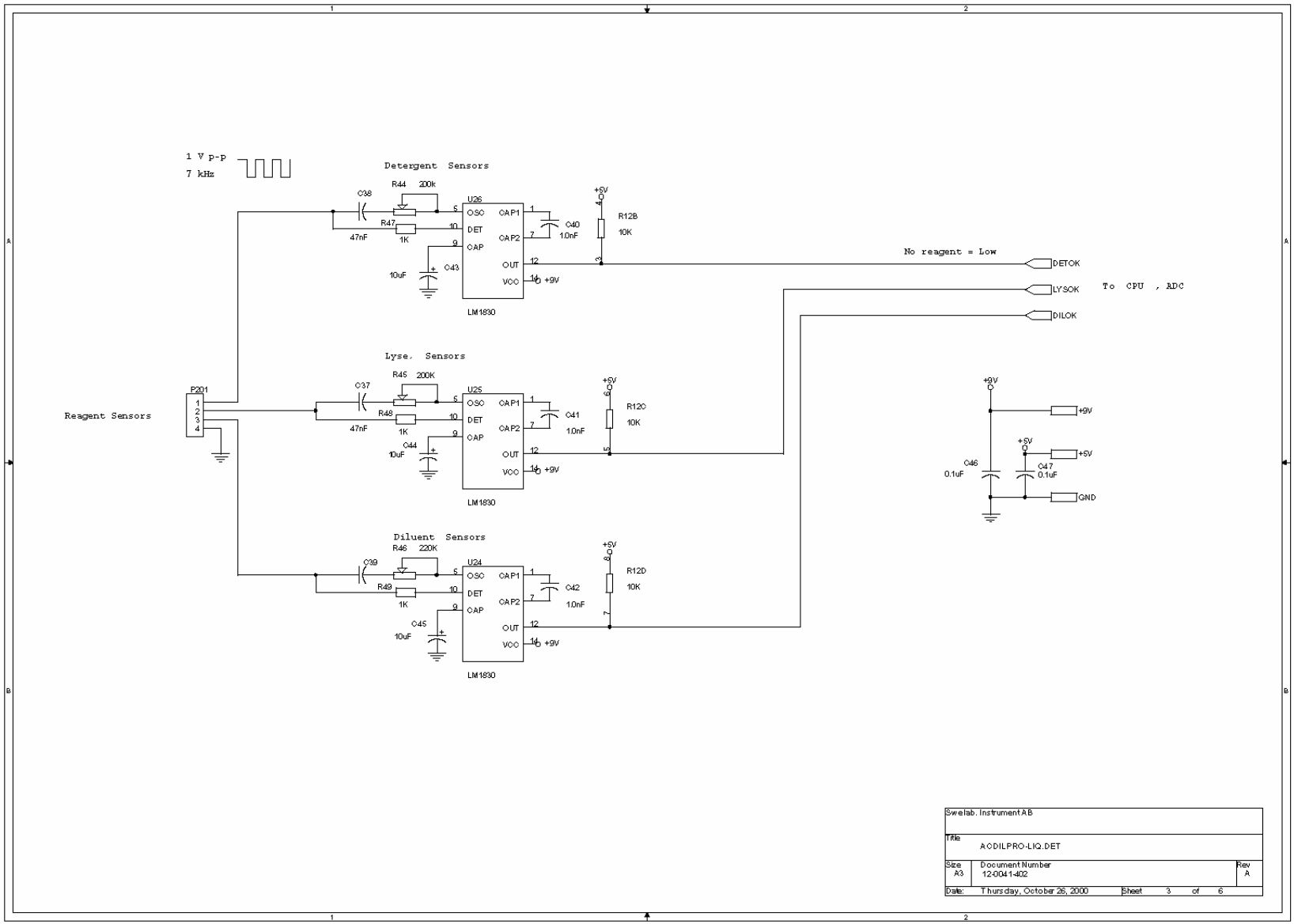
8.2 Diluter board layout

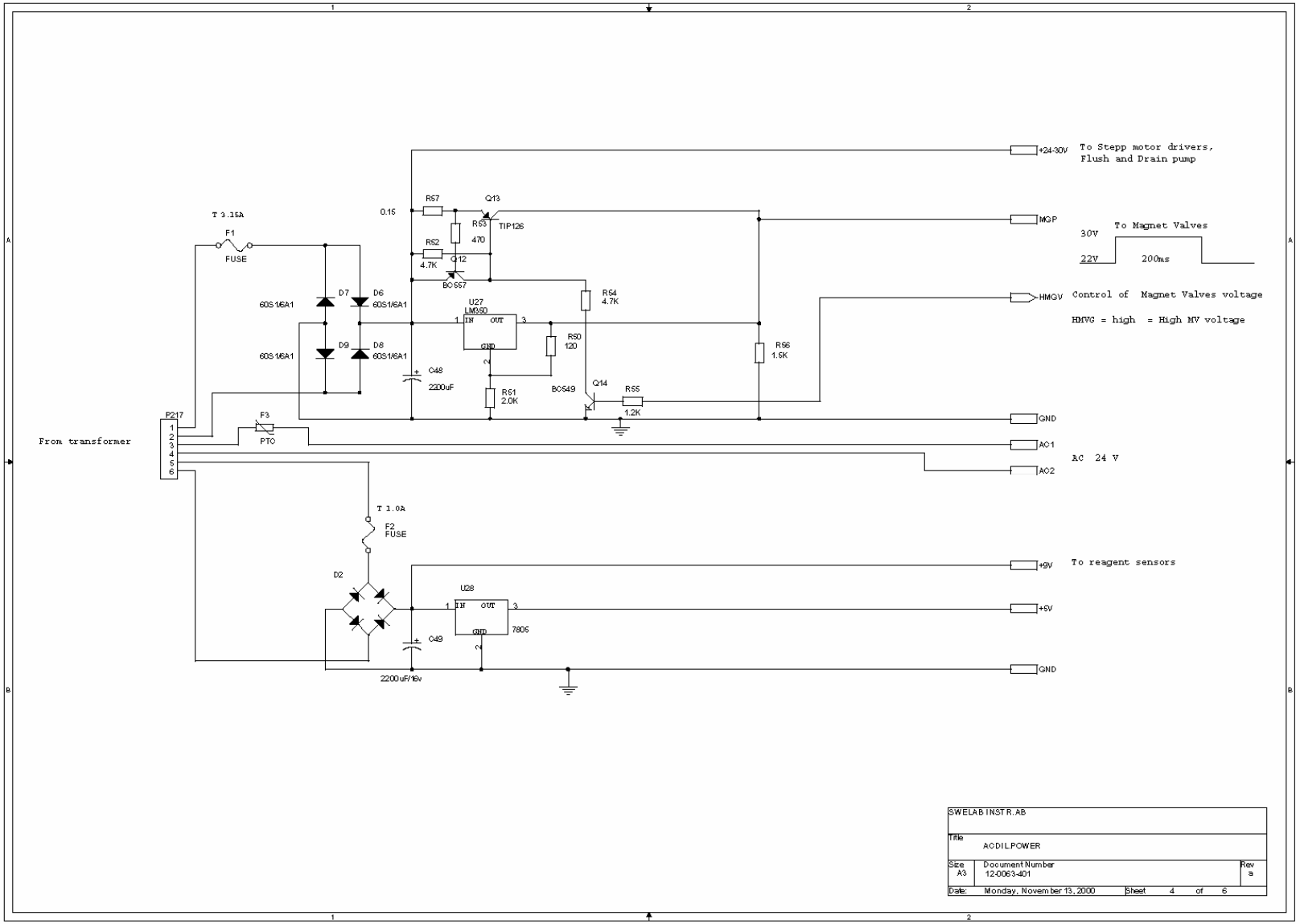

Boule Medical AB
170014 V3.5
130
35
150
24.5
30
175
225
170014.pcb – Wed Nov 06 00:34:03 2002

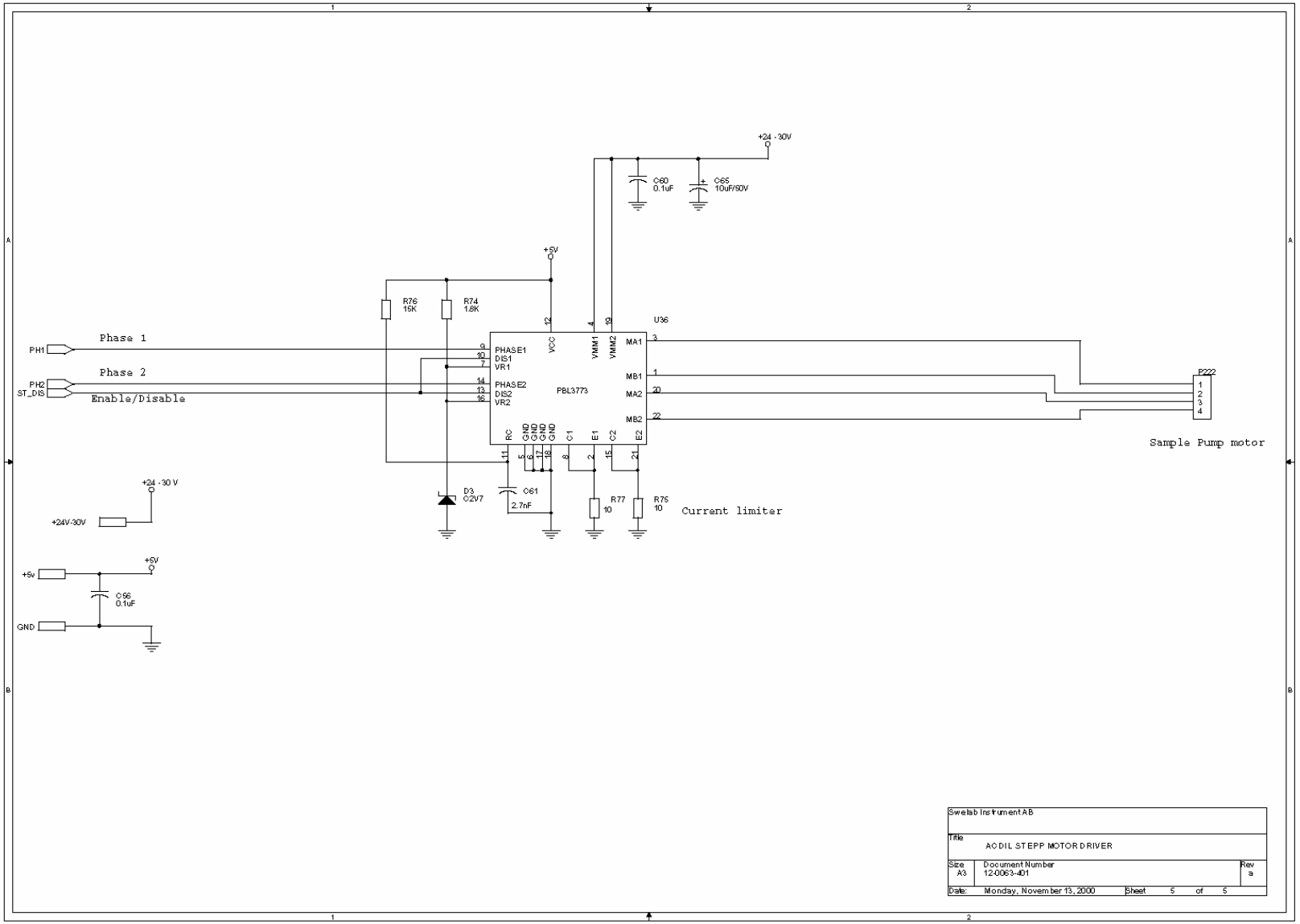
8.3 Diluter board Diagram

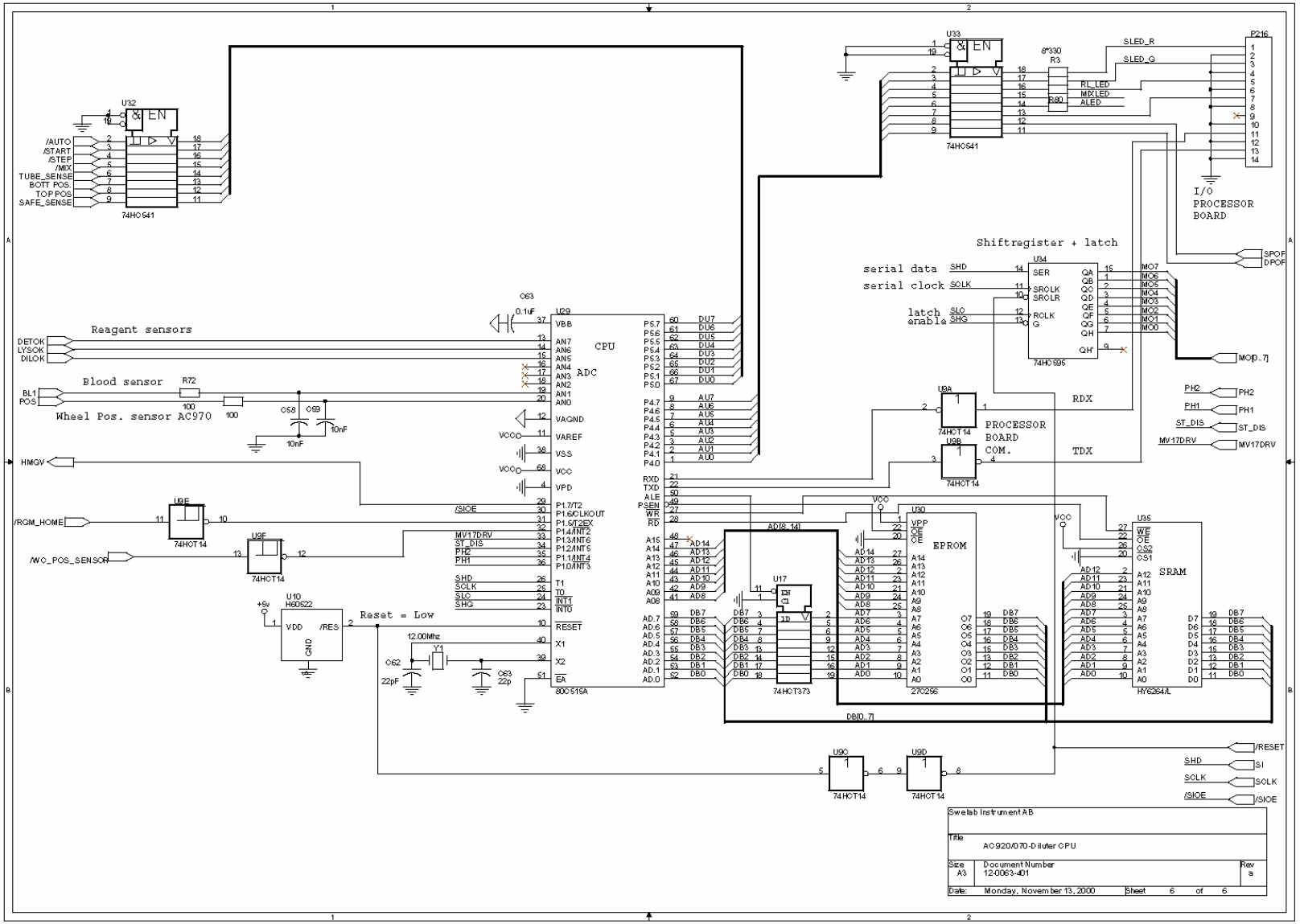



FLUSH PUMP
Low = Active
DRAIN PUMP
Low = Active
Adj Flush
12-14 V
17V DC
FLUSH
DRAIN
PUMPS
AIR
PUMP
MIX2
MOTOR
AC970 P204
NEEDLE-MOTOR
AC970
SYR-MOTOR
CLEAN-MOTOR
MIX1-MOTOR
AC970
MV 3,6,16
MV 1,4,5,10
MV 2,8,9,12
S10 1 - 2 :If Sensor.Board = 120018
2 - 3 :If Sensor.Board = 120062
SWELAB Instrument AB
ACDIL DRIVER
Document Number 12-0063-401
Monday, November 13, 2000


1 V p-p
7 kHz
Detergent Sensors
R44 200k
C38
R47
1K
47nF
U26
OSC
DET
CAP
CAP1
CAP2
OUT
VCC
C40
1.0nF
C43
10uF
+9V
LM1830
+5V
R12B
10K
No reagent = Low
DETOK
LYSOK
DILOK
To CPU , ADC
Lyse. Sensors
R45 200K
C37
R48
1K
47nF
U25
C41
1.0nF
C44
10uF
R12C
10K
P201
Reagent Sensors
+9V
+5V
C46
0.1uF
C47
0.1uF
GND
Diluent Sensors
R46 220K
C39
R49
1K
U24
C42
1.0nF
C45
10uF
R12D
10K
Swelab. Instrument AB
Title
ACDILPRO-LIQ.DET
Size
A3
Document Number
12-0041-402
Rev
A
Date: Thursday, October 26, 2000
Sheet 3 of 6


T 3.15A
F1
FUSE
D7
D6
D9
D8
60S1/6A1
RS7
0.1R
Q13
TIP126
RS3
470
RS2
4.7K
Q12
BC557
U27
LM390
IN
OUT
GND
RS4
4.7K
RS0
120
RS1
2.0K
BC549
Q14
RS5
1.2K
RS6
1.5K
C48
2200uF
P217
From transformer
F3
PTC
T 1.0A
F2
FUSE
D2
U28
7805
C49
2200uF/16v
+24-30V
To Stepp motor drivers,
Flush and Drain pump
MGP
30V
22V
200ms
To Magnet Valves
HMGV
Control of Magnet Valves voltage
HMVG = high = High MV voltage
GND
AC1
AC2
AC 24 V
+9V
To reagent sensors
+5V
GND
SWELAB INSTR.AB
Title
ACDILPOWER
Size
A3
Document Number
12-0063-401
Rev
a
Date:
Monday, November 13, 2000
Sheet
4
of
6


+24 -30V
C60
0.1uF
C65
10uF/50V
+5V
R76
15K
R74
1.8K
U36
Phase 1
PH1
Phase 2
PH2
ST_DIS
Enable/Disable
PHASE1
DIS1
VR1
PHASE2
DIS2
VR2
PBL3773
VCC
VMM1
VMM2
MA1
MB1
MA2
MB2
RC
GND
GND
GND
GND
C1
E1
C2
E2
P222
Sample Pump motor
+24 -30 V
+24V-30V
D3
C2V7
C61
2.7nF
R77
10
R75
10
Current limiter
+5V
+5v
C66
0.1uF
GND
Swelab Instrument AB
Title
AC DIL STEPP MOTOR DRIVER
Size
A3
Document Number
12-0063-401
Rev
a
Date:
Monday, November 13, 2000
Sheet
5
of
5


Reagent sensors
DETOK
LYSOK
DILOK
Blood sensor
BL1
POS
Wheel Pos. sensor AC970
CPU
ADC
HMGV
/RGM_HOME
/WC_POS_SENSOR
Reset = Low
12.00Mhz
74HC541
74HCT14
74HCT373
80C515A
27C256
HY6264/L
EPROM
SRAM
Shiftregister + latch
serial data
serial clock
latch enable
74HC595
I/O PROCESSOR BOARD
PROCESSOR BOARD COM.
RDX
TDX
Swelab Instrument AB
AC920/070-Diluter CPU
12-0063-401
Monday, November 13, 2000

9. Sensor board (v 01)

9.1 Adjustments of the Sensorboard AC970EO+

9.1.1 Adjustment of the needle-sensor plate for the optical sensor

Enter pos. 7 service menu from main menu, enter pos. 7.13 Needle motor test.

Run a complete cycle

1. Lower sensor plate: Adjust the position of the plate so the motor arm is in a straight vertical position after a complete sequence of the cap pierce.
2. Upper sensor plate: Adjust the position of the plate to straight horizontal position.

A. Check that the needle moves up and down when the sample plate is installed and in correct position.

B. Stop the up movement of the wash house and check that the needle motor reverses and moves to the home position.

Electronic checkpoints.
Measure the voltage on IC U32 on the diluter board.

Needle home position.

Lower sensor pin 7: High level (5V) Sensor is covered.

Middle sensor pin 8: Low level Sensor is open.

Upper sensor pin 9: High level Sensor is covered.

Needle upper position.

Lower sensor pin 7: Low level, Sensor is open.

Middle sensor pin 8: High level, Sensor is covered.

Upper sensor pin 9: Low level, Sensor is open.

9.1.2 Adjustments of the Sampler position sensor

9.1.2.1 Connect a voltmeter to TP1 and TP gnd on the sensorboard. Turn the sampler wheel by hand in the position with the wide black position, Fig1 (pos. 1) stripe in front of the position sensor. Turn the wheel slowly to the max. reading voltage at the voltmeter.

9.1.2.2 Adjust the LED-current with R9 to 3,8V +/- 0,2V. Turn the wheel to reach the min. voltage. The level should be 1V +/- 0,2V.

3. Connect an oscilloscope to TP1 and gnd. Check the pulswith. Fig2
   Pos. 1 (21): > 150 mS
   Pos. 2 – 20 (22 – 40): 75 – 100mS

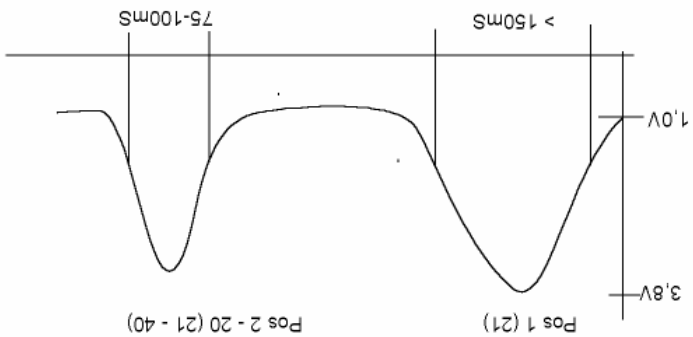


Fig 2

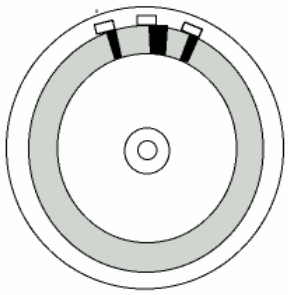


Fig 1

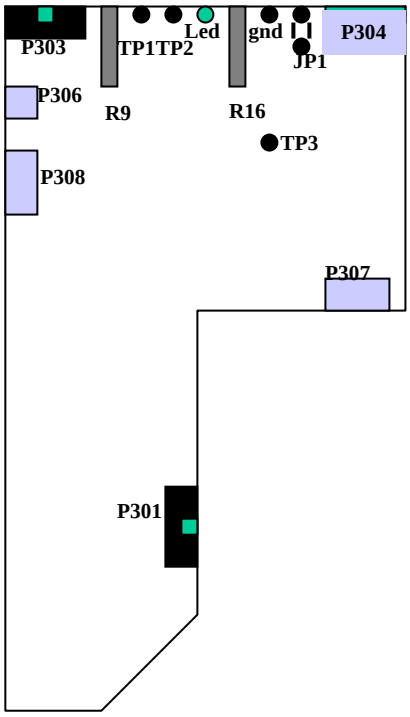
9.1.3 Adjustments of the Sampler tube sensor

Adjustments of the tube sensor (Refer to Fig**)**

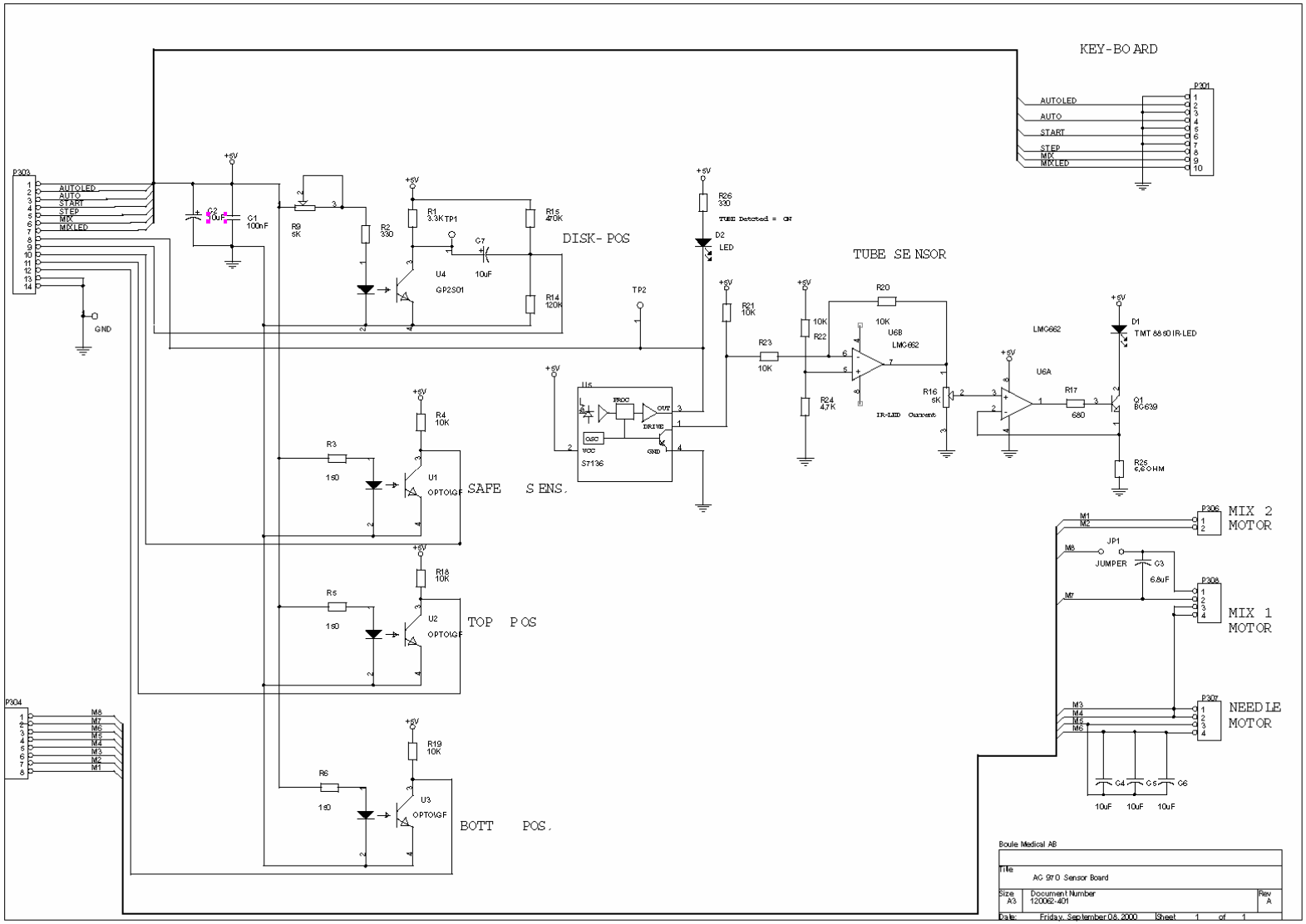
1. Load a blood sample tube into one of the position of the sample wheel.
   Turn the wheel until the sample tube is in front of the tube sensor (just above the needle, wash house).
2. Adjust the trim potentiometer R16 maximum counter clockwise or until the green Led is OFF. Turn the potentiometer clockwise until the green Led is ON. Then continue with 1 turn clockwise.
3. Rotate the wheel one complete turn and check that **the green Led is OFF** in empty positions.
4. Change the position of the sample tube or use another sample tubes into diagonal and 45° positions and check that the **Led is ON** in these positions.

   Note! The jumper JP1 is used together with Diluter board, art.no 1120063

Fig.



9.2 Sensor board Diagram


KEY-BOARD
P301
AUTOLED
AUTO
START
STEP
MIX
MIXLED
P303
GND
DISK- POS
TUBE SENSOR
TUBE Detected = ON
LED
TP2
U4
GP2S01
U5
S7136
U6B
LMC662
U6A
D1
TMT8860IR-LED
Q1
BC639
IR-LED Current
SAFE SENS.
U1
OPTOIGF
TOP POS
U2
BOTT POS.
U3
P304
P306
MIX 2
MOTOR
JUMPER
P308
MIX 1
MOTOR
P307
NEEDLE
MOTOR
Boule Medical AB
AC 970 Sensor Board
Document Number
120062-401
Friday, September 08, 2000

10. Serial Computer (v 01)

10.1 Serial Computer Data Format

The data format is of such an extent that the connected computer system also can trace abnormalities in samples or instrument.
Below an example is given of a typical sample. Note that the parameter transmission is *independent* of language settings. The data transmission is always in English. Use a computer in terminal mode to visualise the output as shown below.

```
 +++++
INSTR= AC920-1875
DATE=   2000/6/6-15:58
MODE= OT-B0-A1-U2-P1-D002
DISC= 15-30-30/095-120
ID= 1234567890
SEQ=   44
RBC=     4.77   O-OK-O
MCV=    102.3   O-OK-H
HCT=     48.8   O-OK-H
PLT=      224   O-OK-O
MPV=     12.5   O-OK-H
WBC=      4.3   O-OK-O
HGB=      148   O-OK-O
MCH=     31.0   O-OK-O
MCHC=     303   O-OK-L
TRBC=    11.7   O-OK-O
TWBC=    11.7   O-OK-O
LYMF=     1.5   O-OK-O
GRAN=     2.1   O-OK-O
MID=      0.7   O-OK-O
LPR=     34.4   O-OK-O
GPR=     49.9   O-OK-O
MPR=     15.7   O-OK-H
RDWR=    30.9   O-OK-H
PDW=     17.8   O-OK-O
PCT=     0.30   O-OK-O
CRBC=
:04:0B:14:1A:1B:18:13:0F
:0B:09:07:06:05:06:07:08
:09:0C:13:1E:32:4E:74:A0
:C9:E9:FA:FF:F6:E2:C8:AB
:94:7E:6A:59:4F:49:47:46
:46:47:49:4A:4A:48:46:43
:3E:37:2F:28:22:1D:18:12
:0E:0B:09:07:05:04:04:04
:03:02:02:02:01:01:01:02
:02:01:01:01:01:01:02:04
CPLT=
:00:00:00:00:00:01:01:02
:03:03:04:05:06:06:07:07
:08:08:09:09:0A:0A:0B:0B
:0B:0C:0C:0C:0B:0B:0B:0A
:0A:09:09:08:08:08:08:08
:08:08:08:08:08:07:07:07
:06:06:06:06:06:05:05:05
:04:04:04:04:04:04:04:04
:03:03:03:03:03:03:03:03
```

```
:03:03:03:03:03:03:03:03
CWBC=

:00:00:00:00:00:00:04:0F
:19:1C:1C:1B:19:17:15:13
:12:13:13:13:14:16:17:17
:17:17:15:14:15:15:14:13
:12:11:11:10:0E:0E:0E:0D
:0B:08:07:07:07:07:06:05
:06:05:04:04:03:02:02:02
:02:02:01:01:01:01:00:00
:00:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
#####
CRC-16
```

An explanation of the above transmission format follows below:

+++++
Five + signs are given to indicate a start of transmission

INSTR= AC920-1875
The instrument identification is transmitted. The first part is a string of characters indicating the type of instrument, followed by a dash and a user selectable 5-digit number. The user selectable number is chosen in the SETUP-MENU, and is only used in the serial output format. Study section 6.12 in the user manual for further details.

DATE= 2000/6/6-15:58
The date and time when the sample was analysed. Note that the date is *always* in the format YYYY/MM/DD (YEAR/MONTH/DAY) and the time in 00-24 hours

MODE= OT-B0-A1-U2-P1-D002
The MODE is expressed as AA-BB-CC-DD-EE-FFFF and represents the following:

AA= How the sample was measured
OT= open tube
PD= pre-diluted sample
CT= cap piercing device

BB= Bottle status
B0= All bottles (containers) OK
B4= Haemolyzer container empty
B2= Diluent container empty
B1= Detergent container empty
B3= Diluent AND detergent container empty
B5= Detergent AND haemolyser container empty
B6= Diluent AND haemolyser container empty
B7= All bottles (containers) empty

CC=Aspiration status
A0= No blood detected
A1= Blood detected

DD= Used parameter units
U=0 Corresponds to the user manual section 6.8; selection 1
U=1 Corresponds to the user manual section 6.8; selection 2
U=2 Corresponds to the user manual section 6.8; selection 3
U=3 Corresponds to the user manual section 6.8; selection 4

EE= P1
For future expansion. Currently it is **P1** when an ordinary sample is analysed, and **PA** when an EOS sample is analysed.

FFFF= D002
For future expansion.

DISC= 15-30-30/095-120
The discriminator settings. The first group of three numbers (to the left of the slash-character) shows the discriminator settings between the platelets and the red blood cell's as follows: the first digits represent the MIN level, the second the ACTUAL setting and the third the MAX setting. In this case the minimum level of the RBC discriminator was at 15 fl, the actual setting of the floating discriminator was at 30 fl and the MAX discriminator level was at 30 fl. See section 6.6 in the user manual.

The last group of two numbers (to the right of the slash-character) shows the discriminator settings
for the white blood cell's. The first number is the discriminator level between the LYM region and the MID region, and the second number is the discriminator level between the MID region and the GRA region. Study section III and section 6.7 in the user manual for further details.

ID= 1234567890
This is the sample identification string and it is entered by the user at the time of sample aspiration. It is a variable length string of 0-15 alphanumeric characters. Numeric characters are entered from the built-in or optional keyboard, but alphanumeric characters can only be entered by the use of a barcode reader.

SEQ= 44
The sequential number of the sample. It is automatically incremented for every sample.

RBC= 4.75 O-SE-O
The parameter values has a field width of 5 digits, right justified and a line has a total width of 40 characters
The flagging system is in the format X-YY-Z

X= Value status
O= OK digit value is available
N= N/A No value available, transmitted as zero (0.00 for RBC)
L= LOW under range
H= HIGH over range

YY= Sample flags

See section **VI** in the user manual for details.

OK= OK , no sample errors
LT= Long time
NC= No count
ST= Short time
TB= Tube bubbles
DE= Distribution error
FD= Floating discr. warning
LO= Blanking error HGB photometer
HI= Blanking error HGB photometer
NG= Negative HGB error
SE= Statistical error

Z= Sample abnormalities
O= OK , sample value within parameter limits
L= Sample value LOW
H= Sample value HIGH

TRBC and TWBC
These 2 'parameters' are the actual counting times for the RBC and the WBC process.

CRBC=
:04:0B: etc..
Here the size distribution curves are transmitted. 80 numerical HEXADECIMAL values are given. Note that the size distribution curve for the RBC values ALSO includes the PLT curve. As the total scale is 250 fl ; each 'channel' represents a value of 250/80 =3.1 fl

CPLT=
See CRBC above. Note that 80 'channels' are transmitted and that the maximum channel represents 30fl. Each channel represents therefore 30/80 fl

CWBC=
See CRBC above. For WBC the maximum scale is 400 fl. As 80 'channels' are transmitted, this corresponds to 400/80 = 5 fl / 'channel'. In case of a 2-part diff.; CWBCL and CWBCG are transmitted which are the LYMF and GRAN curves. In case of a 3-part differential, the CWBCM (MID) curve is also transmitted.

The cell differential curves, like the other curves, always have a max. channel value of 400fl. This means that each channel always represents 400/80 = 5 fl.

NOTE that in all cases, the first transmitted channel represents channel number 0 !
The channel values are always in HEXADECIMAL form proceeded with a ':' sign

#####
The end of a transmission is always marked with 5 '#' signs, followed by a CR and LF

CRC-16
A CRC16 containing four hexadecimal digits. It is calculated on all data between the +++++ and ##### marks, excluding all CR and LF.

EOS sample
For an EOS-sample data is transmitted in a similar way as described above. There are a few differences however which are listed below the sample printout.

```
+++++
INSTR= AC920-1875
DATE=   2000/6/6-16:42
MODE= PD-B0-A1-U2-PA-D002
DISC= 00-00-00/070-200
ID=
SEQ=   46
EOS=     0.02   O-OK-O
TEOS=    23.7   O-OK-O
CEOS=
:00:00:00:00:00:00:00:00
:00:00:00:00:00:01:02:03
:02:01:00:01:01:01:01:02
:01:01:00:00:00:00:01:01
:01:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
:00:00:00:00:00:00:00:00
#####
CRC-16
```

MODE= PD-B0-A1-U2-PA-D002
The fifth element in the "mode"-string is set to **PA** when an EOS sample is analyzed.

DISC= 00-00-00/070-200
The last group of two numbers (to the right of the slash-character) shows the discriminator settings
for the eosinophil white bloodcell's. The EOS value presented is the counted number of cell's between these two limits. Note that the figures DO NOT correspond to cell volume (due to several reasons).

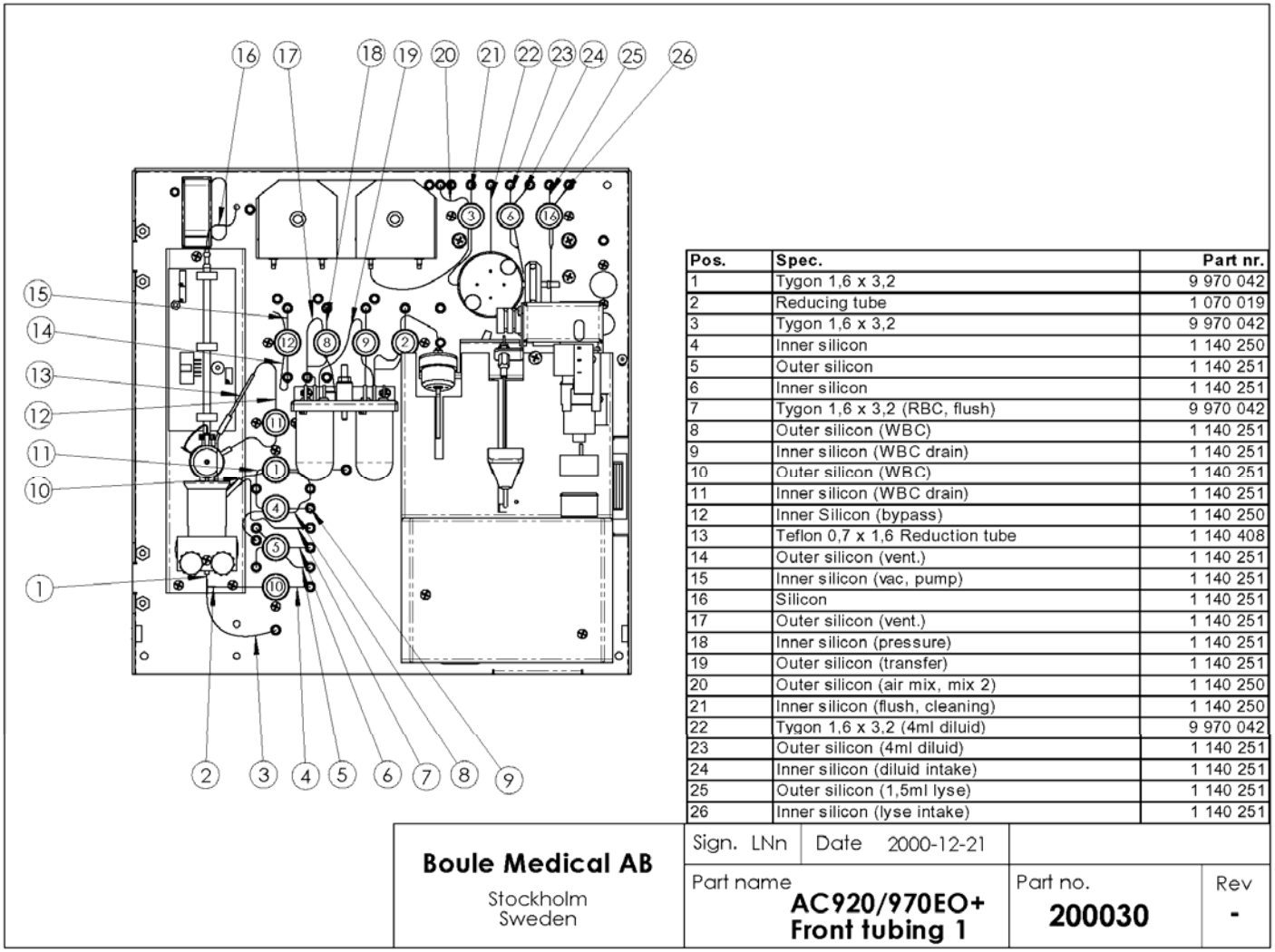
EOS= 0.02 O-OK-O
This is the EOS-parameter and it is formatted as described above.

TEOS= 23.7 O-OK-O
This is the countingtime in seconds for the eosinophil bloodcell's. It is about twice as long compared to the RBC and WBC countingtime, because a larger volume of specimen is analyzed.

CEOS=
:00:00: etc...
See CRBC above. This is the eosinophil cell size distribution histogram. Note that the x-axis (or size) has no reference value (the eosinophil cellsize is not related to any kind of reference).

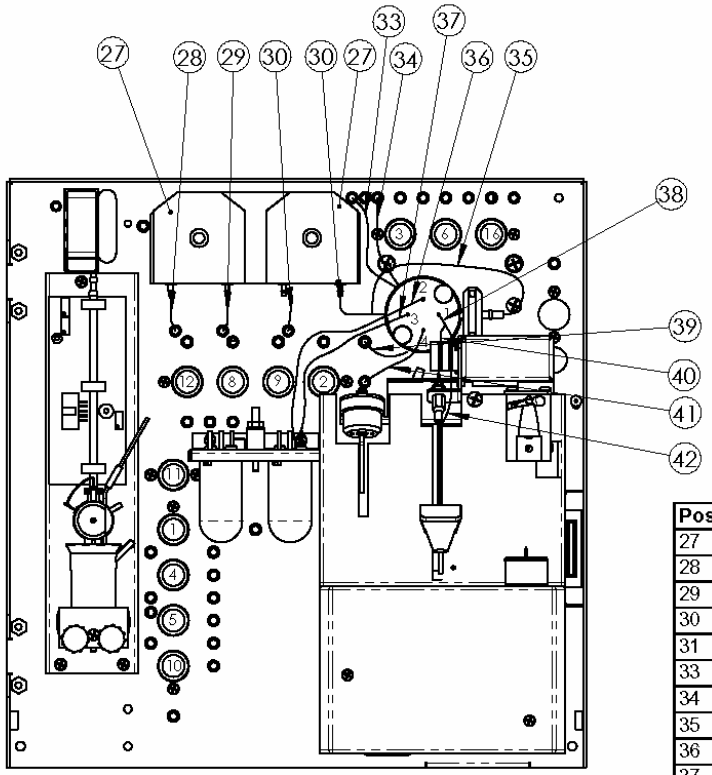
11. Spareparts (v 01)

11.1 Sparepart drawings



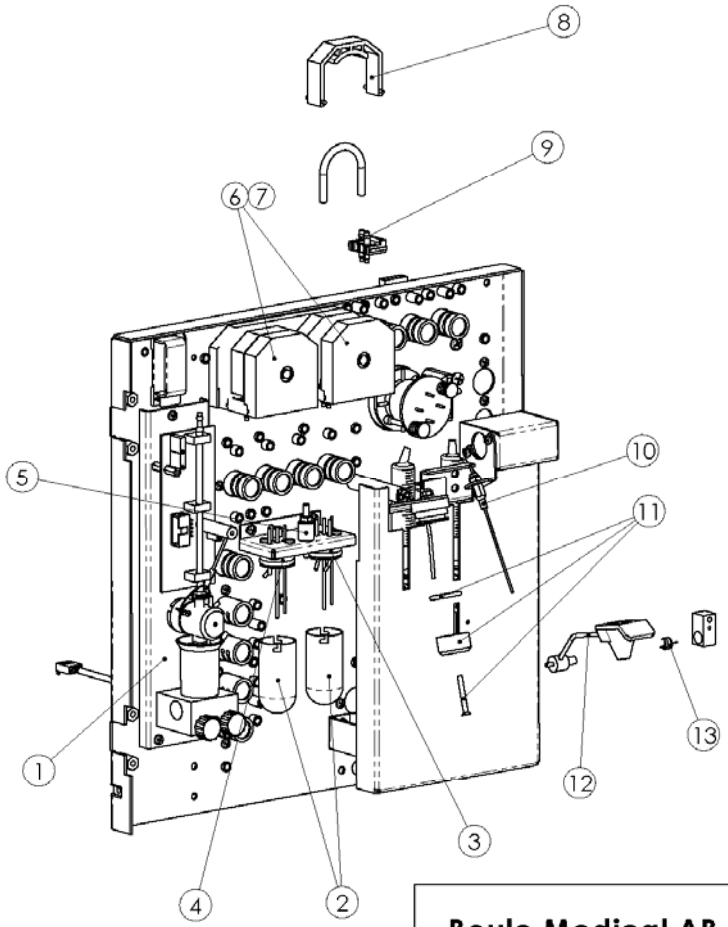
Pos.	Spec.	Part nr.
1	Tygon 1,6 x 3,2	9 970 042
2	Reducing tube	1 070 019
3	Tygon 1,6 x 3,2	9 970 042
4	Inner silicon	1 140 250
5	Outer silicon	1 140 251
6	Inner silicon	1 140 251
7	Tygon 1,6 x 3,2 (RBC, flush)	9 970 042
8	Outer silicon (WBC)	1 140 251
9	Inner silicon (WBC drain)	1 140 251
10	Outer silicon (WBC)	1 140 251
11	Inner silicon (WBC drain)	1 140 251
12	Inner Silicon (bypass)	1 140 250
13	Teflon 0,7 x 1,6 Reduction tube	1 140 408
14	Outer silicon (vent.)	1 140 251
15	Inner silicon (vac, pump)	1 140 251
16	Silicon	1 140 251
17	Outer silicon (vent.)	1 140 251
18	Inner silicon (pressure)	1 140 251
19	Outer silicon (transfer)	1 140 251
20	Outer silicon (air mix, mix 2)	1 140 250
21	Inner silicon (flush, cleaning)	1 140 250
22	Tygon 1,6 x 3,2 (4ml diluid)	9 970 042
23	Outer silicon (4ml diluid)	1 140 251
24	Inner silicon (diluid intake)	1 140 251
25	Outer silicon (1,5ml lyse)	1 140 251
26	Inner silicon (lyse intake)	1 140 251

Boule Medical AB Stockholm Sweden	Sign. LNn	Date 2000-12-21	
Part name **AC920/970EO+** **Front tubing 1**	Part no. **200030**	Rev **-**	



Pos.	Spec.	Part nr.
27	Pumptubing, incl, conn. 6 pcs	1 140 271
28	Tygon 1,6 x 3,2 (det, inlet)	9 970 042
29	Tygon 1,6 x 3,2 (det, outlet)	9 970 042
30	Tygon 1,6 x 3,2 (smp, drain)	9 970 042
31	Tygon 1,6 x 3,2 smp, inlet)	9 970 042
33	Tygon 1,6 x 3,2 (det, inlet)	9 970 042
34	Tygon 1,6 x 3,2 (det, outlet)	9 970 042
35	Tygon 1,6 x 3,4 (smp, outlet)	9 970 042
36	Teflon 1,0 x 2,0 (smp, outlet)	1 140 263
37	Teflon 1,0 x 2,0 (1:200 inlet)	1 140 263
38	Tygon 0,8 x 2,4 (blood inlet)	9 970 041
39	Tygon 1,6 x 3,2 (4ml diluid)	9 970 042
40	Outer silicon 1,0 x 2,8 (pipette)	1 140 250
41	Tygon 1,6 x 3,2 (RBC outlet)	9 970 042
42	inner silicon 1,0 x 2,8 (needle)	1 140 250

Boule Medical AB Stockholm Sweden	Sign. LNn	Date 2000-12-22	
	Part name **AC920/970EO+ Front, tubing2**	Part no. **200031**	Rev **-**



Pos.	Spec.	Part nr.
1	Measuring unit complete exl.	1 090 097
	counting beaker, photometer	
2	Mixing beaker 2 pcs	1 080 020
3	Top cover Mix 1	1 090 087
4	Top cover Mix 2	1 090 086
5	Air valve complete	1 090 085
6	Peristaltic pump, sample, detergent	1 140 488
7	Rotor for peristaltic pump	1 140 547
8	Clamp for peristaltic pump	1 140 544
9	Tube connector, peristaltic pump	1 140 490
10	Pipette, whole blood	1 090 253
11	Top cover, predilute	1 090 772
12	Wash cup complete	1 090 273
13	Spring to wash cup set of 5 pcs	1 090 416

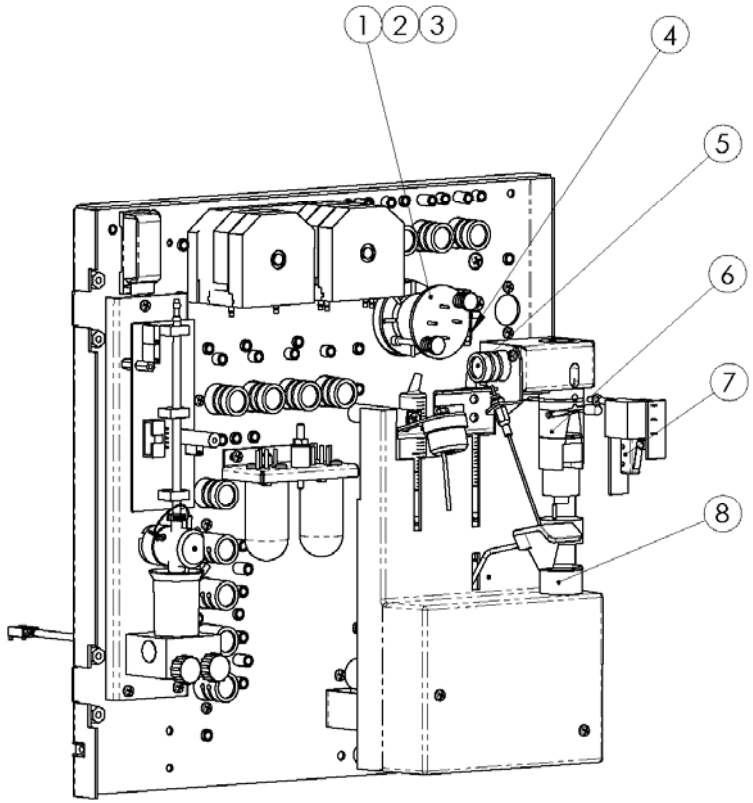
Boule Medical AB
Stockholm
Sweden

Sign. LNn Date 2000-09-25

Part name **AC920/970EO+ Front Mechanical units 1**

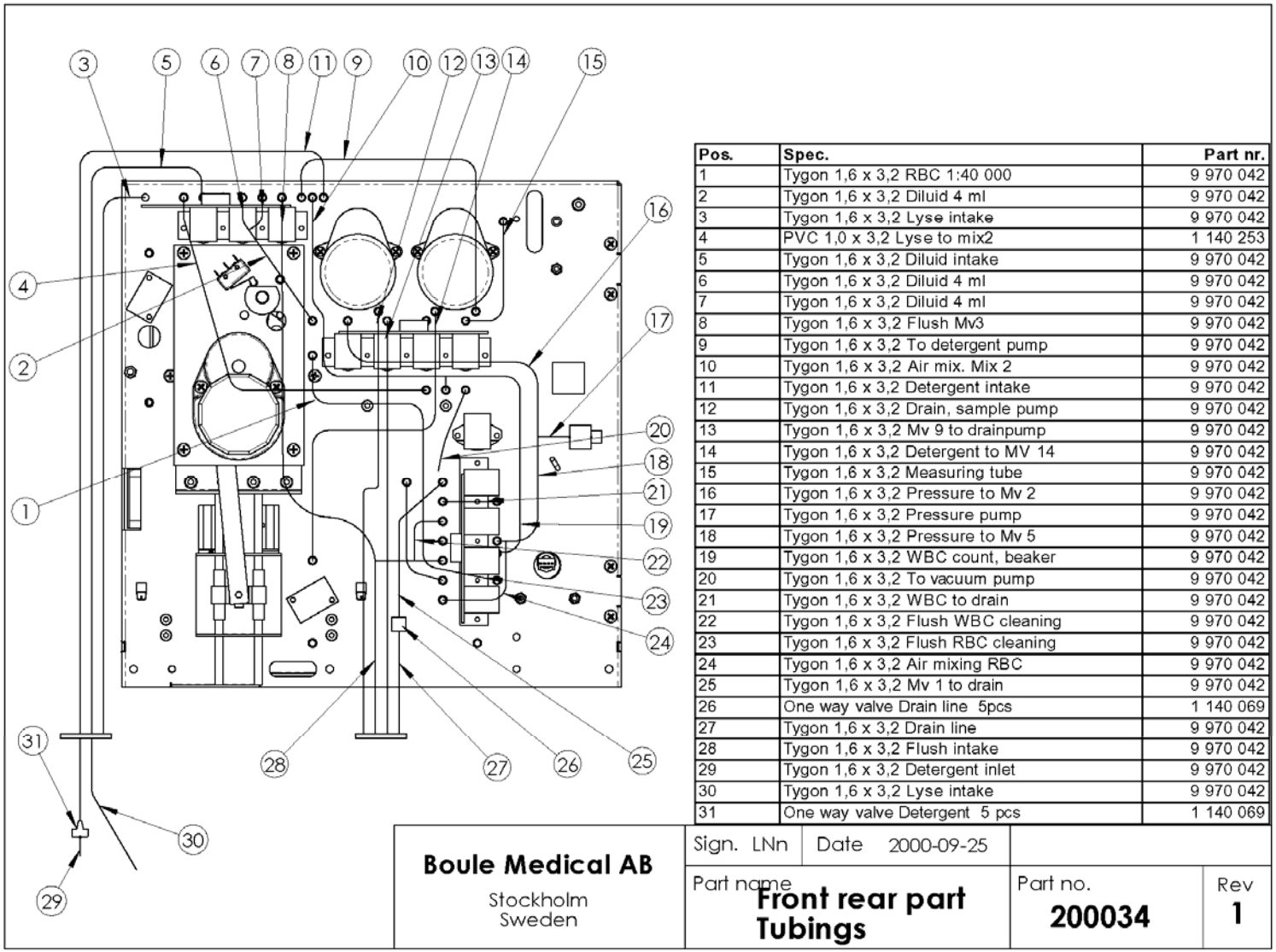
Part no. **200032**

Rev **1**



Pos.	Spec.	Part nr.
1	Rotary valve, complete	1 090 065
2	Rubber stocking 5 pcs	1 060 012
3	Plastic valve tap, complete	1 090 069
4	Blood sensor incl. Glass tube	1 090 205
5	MV complete	1 090 079
6	Upper adj, stop, cap-piercer	1 090 773
7	Start switch for closed system	1 120 048
	Cable for start switch	1 030 087
8	Cover for wash cup	1 020 338

Boule Medical AB Stockholm Sweden	Sign. LNn Date 2000-12-22		
	Part name **Front part, mech units 2**	Part no. **200033**	Rev **1**



Pos.	Spec.	Part nr.
1	Tygon 1,6 x 3,2 RBC 1:40 000	9 970 042
2	Tygon 1,6 x 3,2 Diluid 4 ml	9 970 042
3	Tygon 1,6 x 3,2 Lyse intake	9 970 042
4	PVC 1,0 x 3,2 Lyse to mix2	1 140 253
5	Tygon 1,6 x 3,2 Diluid intake	9 970 042
6	Tygon 1,6 x 3,2 Diluid 4 ml	9 970 042
7	Tygon 1,6 x 3,2 Diluid 4 ml	9 970 042
8	Tygon 1,6 x 3,2 Flush Mv3	9 970 042
9	Tygon 1,6 x 3,2 To detergent pump	9 970 042
10	Tygon 1,6 x 3,2 Air mix. Mix 2	9 970 042
11	Tygon 1,6 x 3,2 Detergent intake	9 970 042
12	Tygon 1,6 x 3,2 Drain, sample pump	9 970 042
13	Tygon 1,6 x 3,2 Mv 9 to drainpump	9 970 042
14	Tygon 1,6 x 3,2 Detergent to MV 14	9 970 042
15	Tygon 1,6 x 3,2 Measuring tube	9 970 042
16	Tygon 1,6 x 3,2 Pressure to Mv 2	9 970 042
17	Tygon 1,6 x 3,2 Pressure pump	9 970 042
18	Tygon 1,6 x 3,2 Pressure to Mv 5	9 970 042
19	Tygon 1,6 x 3,2 WBC count, beaker	9 970 042
20	Tygon 1,6 x 3,2 To vacuum pump	9 970 042
21	Tygon 1,6 x 3,2 WBC to drain	9 970 042
22	Tygon 1,6 x 3,2 Flush WBC cleaning	9 970 042
23	Tygon 1,6 x 3,2 Flush RBC cleaning	9 970 042
24	Tygon 1,6 x 3,2 Air mixing RBC	9 970 042
25	Tygon 1,6 x 3,2 Mv 1 to drain	9 970 042
26	One way valve Drain line 5pcs	1 140 069
27	Tygon 1,6 x 3,2 Drain line	9 970 042
28	Tygon 1,6 x 3,2 Flush intake	9 970 042
29	Tygon 1,6 x 3,2 Detergent inlet	9 970 042
30	Tygon 1,6 x 3,2 Lyse intake	9 970 042
31	One way valve Detergent 5 pcs	1 140 069

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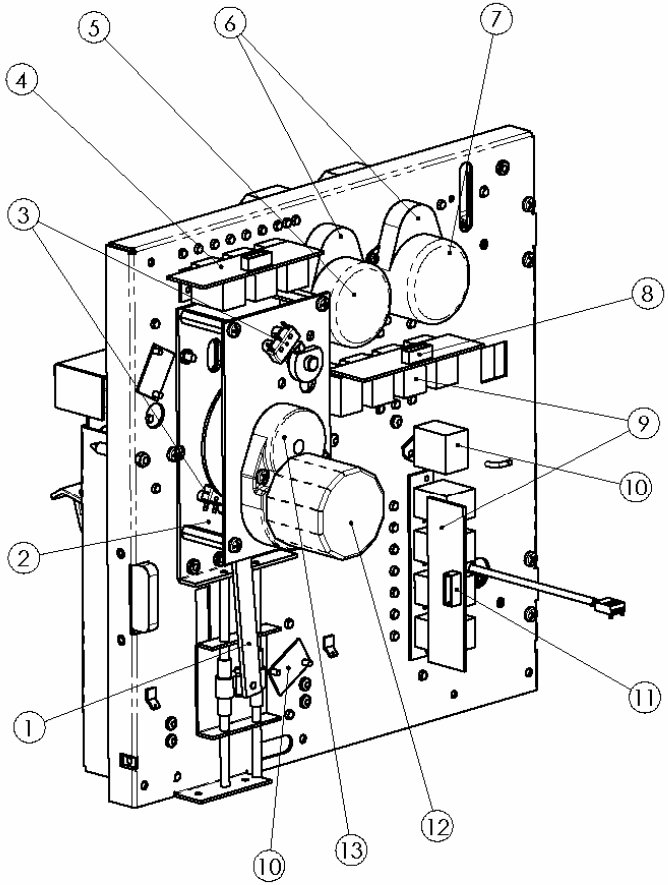
Sign. LNn Date 2000-09-25

Part name **Front rear part Tubings**

Part no. **200034**

Rev **1**



Pos.	Spec.	Part nr.
1	Crank shaft, complete	1 090 771
2	Syring drive unit, complete 50Hz	1 090 074
	Syring drive unit, complete 60Hz	1 090 323
3	Microswitch 5 pcs	1 140 038
4	Circuit board MV, complete	1 120 058
5	Motor sample pump	1 090 318
6	Gearbox for sample and detergent pump	1 140 224
	Motor incl, gearbox sample	1 140 390
7	Motor detergent pump	1 090 301
	Motor incl, gearbox	1 140 391
8	Cable MV P211 MV 2,9,8,12	1 030 091
9	Circuit board MV, complete	1 120 058
10	MV complete	1 090 079
11	Cable MV P214 MV 1,4,5,10	1 030 014
12	Syringe Motor	1 090 303
13	Syringe gearbox 50 Hz	1 140 058
	Syringe gearbox 60 Hz	1 140 073
	Motor incl, gearbox 50 Hz	1 140 055
	Motor incl, gearbox 60 Hz	1 140 074

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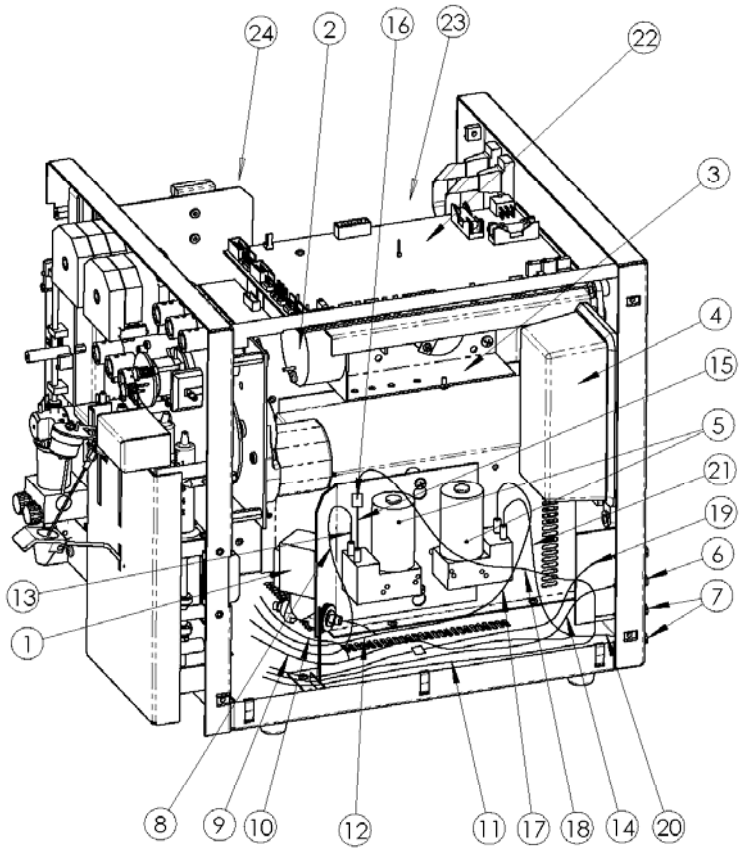
Stockholm
Sweden

Sign. LNn | Date 2000-09-25

Part name: **AC920/970EO+ Front rear part, mechanical unit**

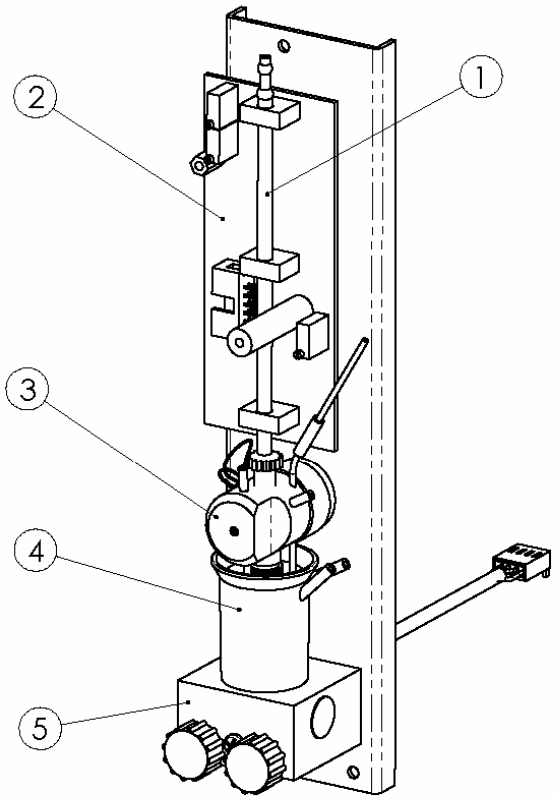
Part no.: **200035**

Rev: **-**



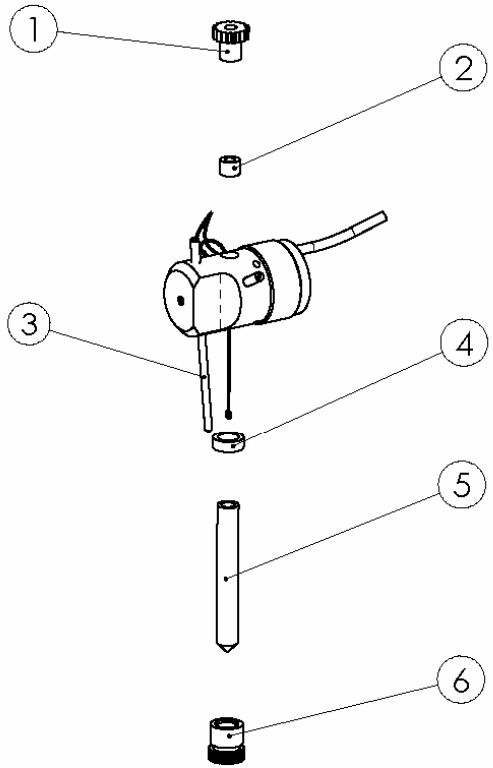
Pos.	Spec.	Part nr.
1	MV 7, drainvalve complete	1 140 037
	Rubber membrane, drain valve	1 140 400
2	Membrane incl, O-ring vacuum pump 5pcs	1 090 261
3	Vacuum pump 50 Hz	1 090 033
	Vacuum pump 60 Hz	1 090 257
4	Air pump 50 Hz	1 090 090
	O-ring, set of 6 pcs	1 090 260
	Air filter 5 pcs	1 140 068
5	Flush/drain pump	1 140 102
	Pumphead, repairkit	1 140 524
6	Connectors complete green/white Kit 10 pcs	1 090 262
7	Connectors complete red/black Kit 10 pcs	1 090 263
	Reagent sensor Green	1 090 151
	Reagent sensor White	1 090 152
	Reagent sensor Red	1 090 068
8	Tygon 1,6 x 3,2 Flush out	9 970 042
9	PVC 4,0 x 6,0	1 140 259
10	Tygon 1,6 x 3,2 Drain from MV 1	9 970 042
11	Tygon 1,6 x 3,2 Diluid intake	9 970 042
12	Tygon 1,6 x 3,2 Mv 9 predilute drain	9 970 042
13	Tygon 3,2 x 6,4	1 140 261
14	Tygon 1,6 x 3,2 Lyse intake	9 970 042
15	Tygon 2,4 x 5,6	1 140 256
16	One way valve 5pcs	1 140 069
17	Tygon 3,0 x 6,0	1 140 261
18	Tygon 1,6 x 3,2	9 970 042
19	Tygon 1,6 x 3,2	9 970 042
20	PVC 4,0 x 6,0	1 140 259
21	Tygon 3,2 x 6,4 drain out	1 140 261
22	Dilutor board	1 120 063
23	Processor board	1 120 052
24	Analog board	1 120 051

Boule Medical AB Stockholm Sweden	Sign. LNn Date 2000-09-25		
	Part name **AC920/970EO+innerpart Tubings, mechanical**	Part no. **200036**	Rev **1**



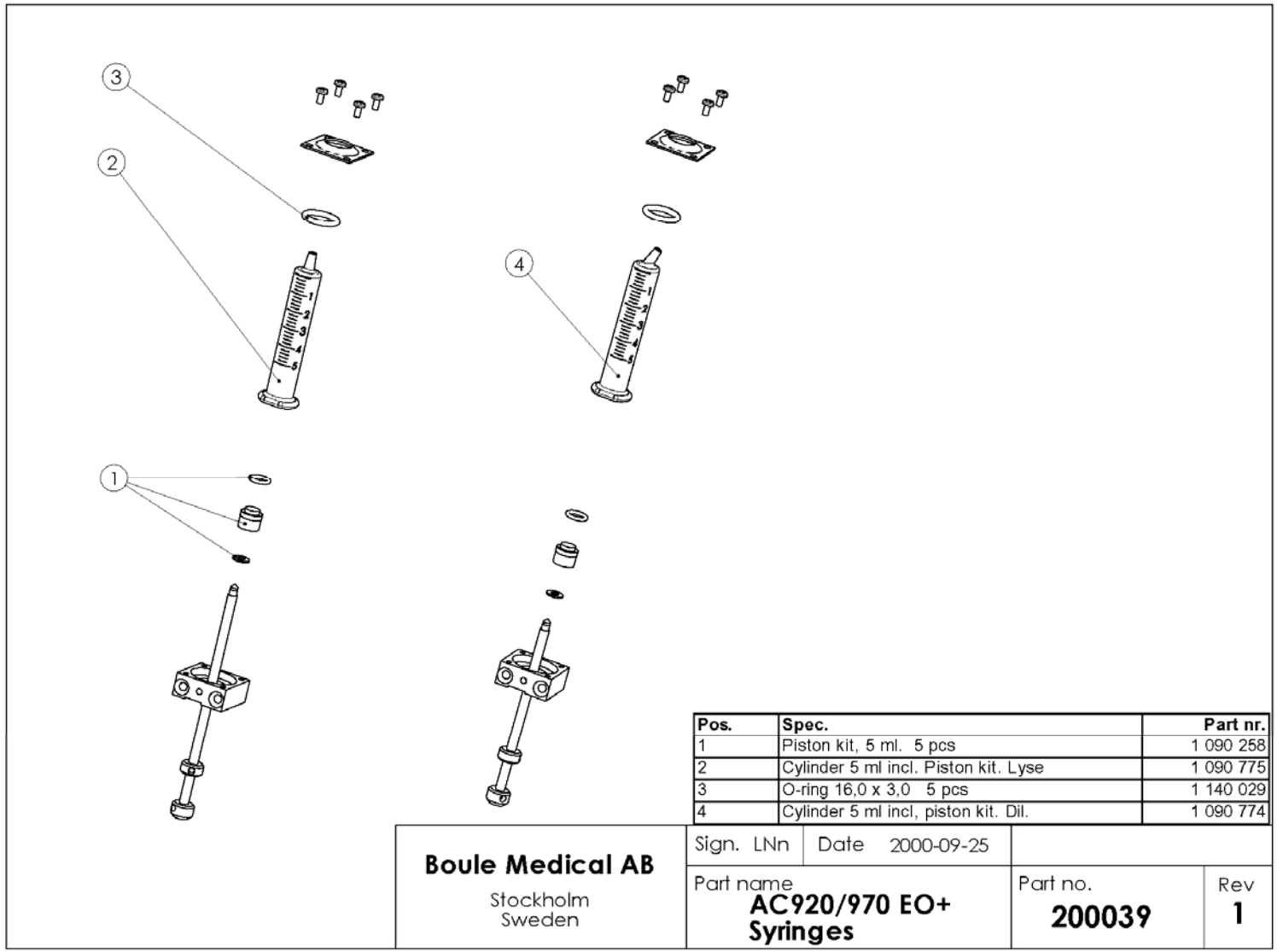
Pos.	Spec.	Part nr.
1	Measuring tube incl, seal 5 pcs	1 090 080
2	Volume board	1 120 013
3	Measuring head incl, electrodes	1 090 096
4	Counting beaker	1 080 025
5	Photometer	1 090 504

Boule Medical AB Stockholm Sweden	Sign. LNn Date 2000-09-25		
	Part name **AC920/970EO+ Measuring units**	Part no. **200037**	Rev **-**



Pos.	Spec.	Part nr.
1	Locking screw for measuring tube	1 020 054
2	Silicon sealing. 10 pcs	1 060 031
3	External electrode	1 020 016
4	Seal for transducer 10 pcs	1 070 046
5	Transducer kit incl. Pos 4, 6 + meas, tube	1 090 756
6	Locking screw to transducer	1 020 515

Boule Medical AB Stockholm Sweden	Sign. LNn Date 2000-09-25		
	Part name **AC920/970EO+ Measuring head**	Part no. **200038**	Rev **-**



Pos.	Spec.	Part nr.
1	Piston kit, 5 ml. 5 pcs	1 090 258
2	Cylinder 5 ml incl. Piston kit. Lyse	1 090 775
3	O-ring 16,0 x 3,0 5 pcs	1 140 029
4	Cylinder 5 ml incl, piston kit. Dil.	1 090 774

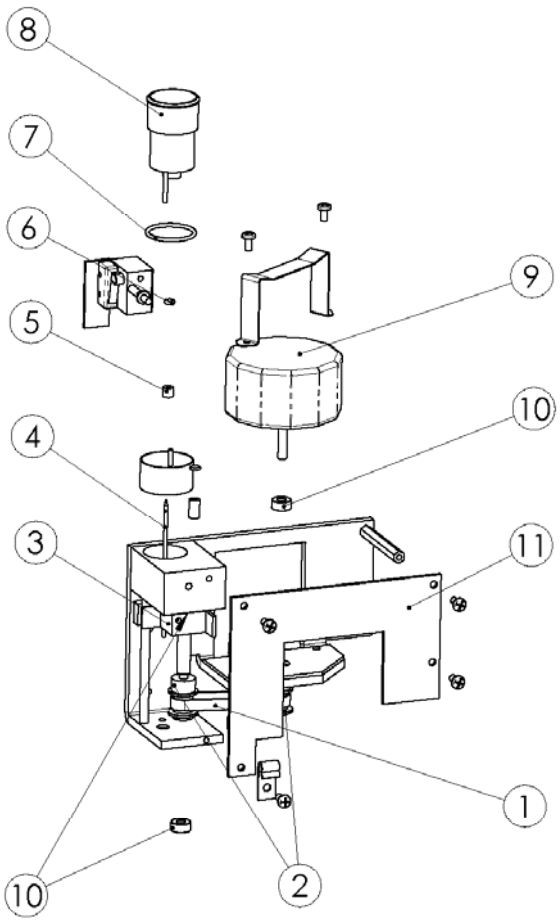
Boule Medical AB
Stockholm
Sweden

Sign. LNn Date 2000-09-25

Part name **AC920/970 EO+ Syringes**

Part no. **200039**

Rev **1**



Pos.	Spec.	Part nr.
1	Motor drive belt	1 080 022
2	Belt wheel 2 pcs	1 020 284
3	Needle guide	1 020 280
4	Needle	1 020 279
5	Plug	1 020 332
6	O-ring 1,4 x 1,8 10 pcs	1 140 036
7	O-ring 20,0 x 1,0 5 pcs	1 140 525
8	Needle wash house	1 020 278
9	Motor	1 090 436
10	Bearing	1 140 474
11	Electronic board PCB	1 120 047

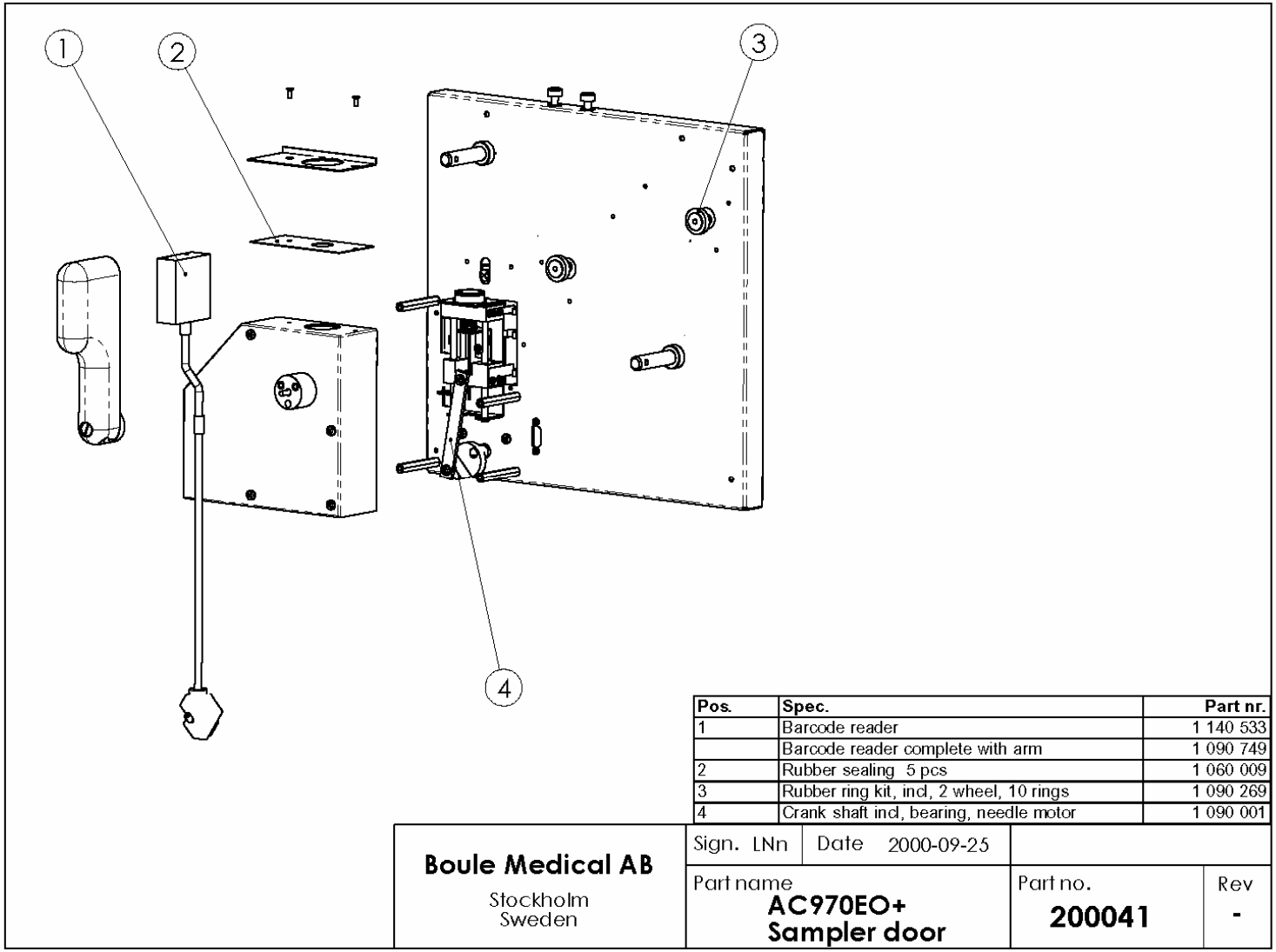
Boule Medical AB
Stockholm
Sweden

Sign. LNn Date 2000-09-25

Part name **AC920EO+ Closed tube unit**

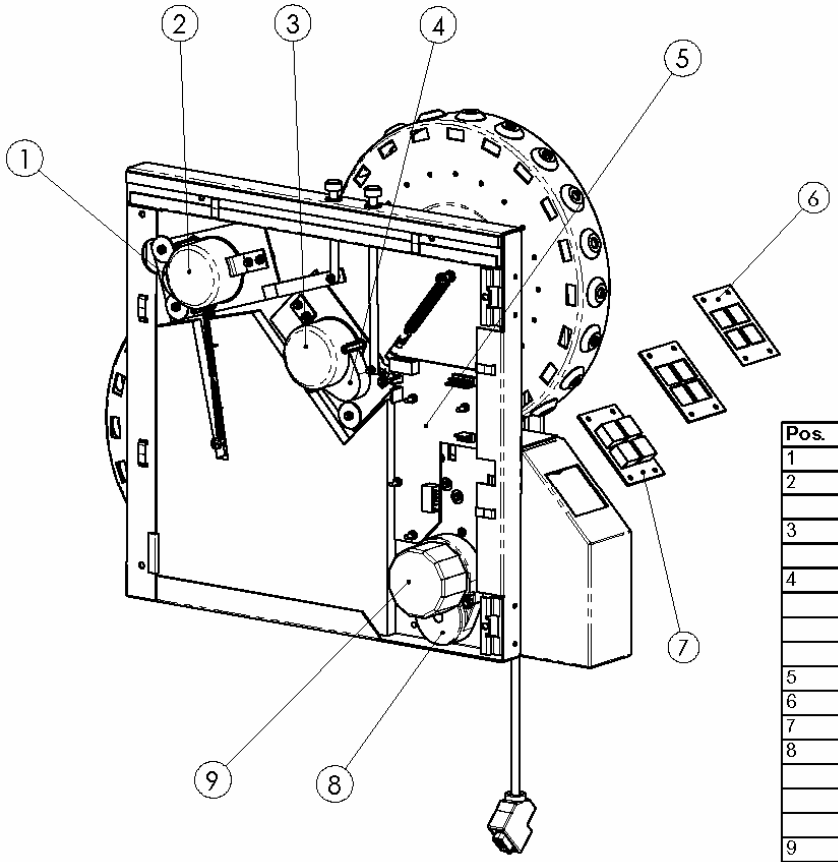
Part no. **200040**

Rev **1**



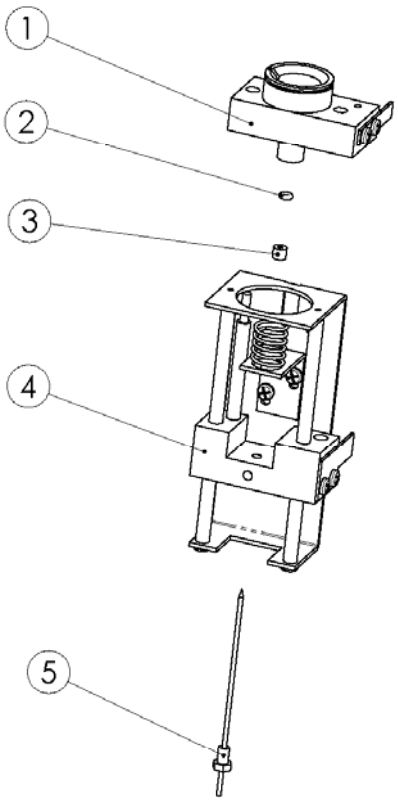
Pos.	Spec.	Part nr.
1	Barcode reader	1 140 533
	Barcode reader complete with arm	1 090 749
2	Rubber sealing 5 pcs	1 060 009
3	Rubber ring kit, incl, 2 wheel, 10 rings	1 090 269
4	Crank shaft incl, bearing, needle motor	1 090 001

Boule Medical AB Stockholm Sweden	Sign. LNn Date 2000-09-25		
	Part name **AC970EO+ Sampler door**	Part no. **200041**	Rev -



Pos.	Spec.	Part nr.
1	Gear box mixing plate	1 140 220
2	Motor mixing plate	1 090 307
	Motor incl, gearbox	1 140 071
3	Motor sample plate 50 Hz	1 090 306
	Motor sample plate 60 Hz	1 090 326
4	Gear box sample plate 50 Hz	1 140 237
	Gear box sample plate 60 Hz	1 140 370
	Motor incl, gearbox 50 Hz	1 140 070
	Motor incl, gearbox 60 Hz	1 140 437
5	Sensor circuit board	1 120 018
6	Folie keyboard	1 050 026
7	Keyboard, circuit board	1 120 014
8	Needle gearbox 50 Hz	1 140 058
	Needle gearbox 60 Hz	1 140 073
	Needle motor incl, gearbox 50 Hz	1 140 055
	Needle motor incl, gearbox 60 Hz	1 140 074
9	Needle motor	1 090 303
10	Tygon tubing 0,8 x 2,4	9 970 041

Boule Medical AB Stockholm Sweden	Sign. LNn	Date 2000-09-25	
	Part name **AC970EO+Sampler door mechanical unit**	Part no. **200042**	Rev **-**



Pos.	Spec.	Part nr.
1	Wash cup, complete	1 020 060
2	O-ring 10 pcs	1 140 036
3	Plug	1 020 077
4	Needle guide	1 020 061
5	Needle 2 pcs	1 020 275

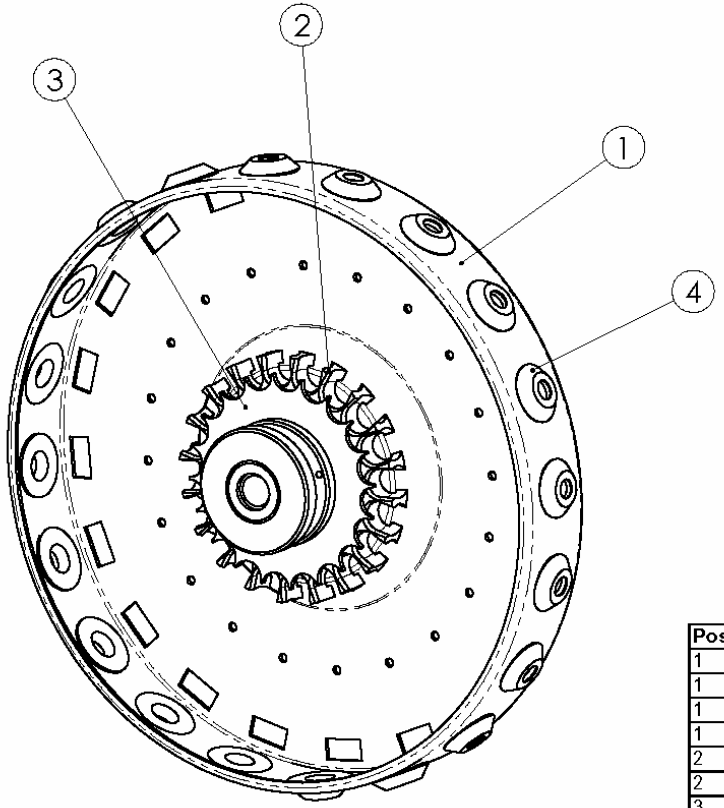
Boule Medical AB
Stockholm
Sweden

Sign. LNn Date 2000-09-25

Part name
AC970EO+
Needle drive unit

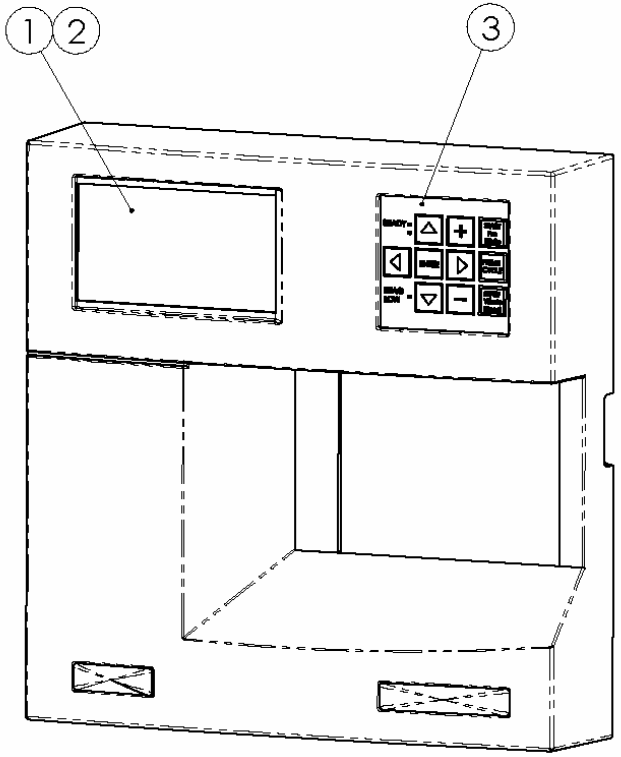
Part no.
200043

Rev
1



Pos.	Spec.	Part nr.
1	Sample plate 1, BD, Greiner, Terumo	1 090 037
1	Sample plate 2, BD, Greiner, Terumo	1 090 674
1	Sample plate 1, Sarstedt	1 090 266
1	Sample plate 2, Sarstedt	1 090 675
2	Sample ring, BD, Greiner, Terumo	1 020 141
2	Sample ring, Sarstedt	1 020 248
3	Center complete, BD, Greiner, Terumo	1 090 039
3	Center complete, Sarstedt	1 090 274
4	Socket, BD, Greiner, Terumo 20 pcs	1 020 067
4	Socket, Sarstedt 20 pcs	1 020 069

Boule Medical AB Stockholm Sweden	Sign. LNn	Date 2000-09-25	
	Part name **AC970EO+ Sample plate**	Part no. **200044**	Rev **-**



Pos.	Spec.	Part nr.
1	Displayboard complete	1090203
2	Backlight lamp	1140434
3	Keyboard AC910 EO+	1050107
	Keyboard AC920/ 970 EO+	1050061

Boule Medical AB
Stockholm
Sweden

Sign. LNn Date 2000-09-25

Part name **Front door**

Part no. **200056**

Rev **-**

11.2 Sparepartlist

11.2 Sparepartlist AC 920/970EO+

Year 2004

Spare part Description	Min.quantity	Part nr.
Air filter		1 140 068
Air pump 50 Hz, AC920/970		1 090 090
Air valve complete		1 090 085
Analog board		1 120 051
Barcode reader		1 140 533
Barcode reader complete with arm		1 090 749
Bearing, vac.unit AC920EO+		1 140 474
Belt wheel,cap-piercer AC920EO+		1 020 284
Blood sensor incl. glass tube		1 090 205
Cable for start switch, cap-piercer AC920EO+		1 030 087
Cable MV1,4,5,10 P214		1 030 014
Cable MV2,9,8,12 P211		1 030 091
Center complete, BD, Greiner, Terumo		1 090 039
Center complete, Sarstedt		1 090 274
Circuit board MV, complete,MV1,4,5,10		1 120 058
Circuit board, Cap-piercer AC920EO+		1 120 047
Circuit board,volume board		1 120 013
Clamp for peristaltic pump		1 140 544
Connectors complete green/white	Kit 10pcs	1 090 263
Connectors complete red/black	Kit 10pcs	1 090 262
Connectors, different models 21pcs		1 140 064
Contact spring-plate cover grounding		1 040 017
Counting beaker		1 080 025
Cover for wash cup,AC920EO+		1 020 338
Crank shaft,complete, needle motor AC970		1 090 001
Crank shaft,Complete,needle motor AC970		1 090 771
Cylinder kit, 5 ml, dil.syringe AC920/970		1 090 774
Cylinder kit, 5 ml, lyse syringe AC920/970		1 090 775
Diluter board		1 120 063
Displayboard, complete		1 090 203
E-prom, latest version, diluterboard		9 990 217
E-prom, latest version, processorboard		9 991 026
External electrode		1 020 016
Flush/drain pump		1 140 102
Folie keyboard AC970, sampler		1 050 026
Gear box sample plate 60 Hz		1 140 370
Gear box, mixing plate		1 140 220
Gear box, sample plate 50 Hz		1 140 237
Gearbox 50 Hz,Syringe,needleAC970		1 140 058
Gearbox,sample and detergent pump,EO/EO+		1 140 224
Gearbox,syringe 60 Hz		1 140 073
Keyboard		1 050 061
Keyboard, circuit board,sampler,970EO,EO+		1 120 014
Keyboard kit AC920/970EO		1 090 758
Lamp, backlight, display		1 140 434
Locking ring, BD, Greiner, Terumo		1 020 141

Spare part Description	Min.quantity	Part nr.
Locking ring, Sarstedt		1 020 248
Locking screw for measuring tube		1 020 054
Locking screw to transducer, EO+		1 020 515
Measuring head, AC920/970,complete		1 090 096
Measuring tube incl, seal		1 090 080
Measuring unit complete exlusive		1 090 097
Membrane kit, vacuum pump		1 090 261
Microswitch		1 140 038
Mixing beaker	2pcs	1 080 020
Motor detergent pump		1 090 301
Motor drive belt,vac. AC920EO+,		1 080 022
Motor mixing plate		1 090 307
Motor sample plate 50 Hz		1 090 306
Motor sample plate 60 Hz		1 090 326
Motor sample pump		1 090 318
Motor,vac. AC920EO+		1 090 436
Motor/gearbox mixing plate		1 140 071
Motor/gearbox 50 Hz, sample plate		1 140 070
Motor/gearbox 50 Hz,Syringe, needleAC970		1 140 055
Motor/gearbox detergent Pump EO/EO+		1 140 391
Motor/gearbox sample pump EO/EO+		1 140 390
Motor/gearbox,sample plate,60Hz		1 140 437
Motor/gearbox;Syringe/ Needle;AC970 60Hz		1 140 074
MV 7, drainvalve complete		1 140 037
MV complete		1 090 079
Needle AC920EO+		1 020 279
Needle AC970, 1 hole		1 020 275
Needle guide AC920EO+		1 020 280
Needle guide, AC970		1 020 061
One way valve,check valve		1 140 069
O-ring 20,0x1,0 closed tube adapter	5pcs	1 140 525
O-ring air pump		1 090 260
O-ring mixing beaker 16,3*2.4 mm	5 pcs	9 990 400
O-ring, 1,4x1,8 closed tube adapter	10pcs	1 140 036
O-ring, 16,0x3,0 cylinder 5 ml	10pcs	1 140 029
Peristaltic pump, sample, detergent pump		1 140 488
Photometer, AC, EO+		1 090 504
Pipette, whole blood		1 090 253
Piston kit, 5ml	set of 5 pcs	1 090 258
Plastic valve tap, complete		1 090 069
Plug		1 020 077
Plug,cap-piercer, AC920EO+		1 020 332
Processor board Tested		1 120 031
Pump tubing set, peristaltic,incl.conn.	Set of 3 pcs	1 090 799
Pumphead repairkit, flush/drain pump		1 140 524
PVC tubing 1,0 x 2,0	per metre	1 140 253
PVC tubing 4,0 x 6,0	per metre	1 140 259
Reagent sensor, diluid (Red)		1 090 801
Reagent sensor, lyse (White)		1 090 803
Reagent sensor,detergent (Green)		1 090 802
Reducing tube		1 070 019
Rotary valve, complete		1 090 065
Rotor for peristaltic pump		1 140 547
Rubber membrane, drain valve		1 140 400
Rubber ring kit,smp, incl.2 wheel+10 rings		1 090 269
Rubber sheeting, AC970		1 060 009
Rubber stocking		1 060 012
Sample plate 1, BD, Greiner, Terumo		1 090 037

Spare part Description	Min.quantity	Part nr.
Sample plate 1, Sarstedt		1 090 266
Sample plate 2, BD, Greiner, Terumo		1 090 674
Sample plate 2, Sarstedt		1 090 675
Seal for transducer	10pcs	1 070 046
Sensor board, AC970EO,EO+		1 120 018
Sensor board, AC970EO+fr.ser.no.0308		1 120 062
Silicon sealing,measuring tube	10pcs	1 060 031
Silicon tubing 1,0x2,8	per metre	1 140 250
Silicon tubing 1,5x3,0	15m	9 970 002
Silicon tubing, old pump tubing,	per metre	1 140 252
Socket,smp, BD, Greiner, Terumo	20pcs	1 020 067
Socket,smp,Sarstedt	20pcs	1 020 069
Spring to wash cup	set of 5 pcs	1 090 416
Start switch,cap-piercer incl.pcb board		1 120 048
Syringe Motor		1 090 303
Teflon tubing 0,7x1,6	per metre	9 970 022
Teflon tubing 1,0 x 2,0	per metre	1 140 263
Top cover Mix 1		1 090 087
Top cover Mix 2		1 090 086
Top cover, predilute		1 090 772
Trancducer EO+ 70u		1 100 024
Transducer kit, incl.measur.tube		1 090 756
Tygon tubing 0,8 x 2,4	1 m	9 970 041
Tygon tubing 1,6 x 3,2	5 m	9 970 042
Tygon tubing 2,4 x 5,6	per metre	1 140 256
Tygon tubing 3,2 x 6,4	per metre	1 140 261
Upper adj.stop, Cap-piercer		1 090 773
Vacuum pump 50 Hz,		1 090 033
Vacuum pump 60 Hz		1 090 257
Wash cup complete		1 090 273
Wash cup, cap-piercer AC920EO+		1 020 278
Wash cup, complete AC970		1 020 060

11.3 Recommended Spareparts
AC920/970EO+
Year 2004

Spec.	Rec. quantity	Part number
Air filter	2pcs	1 140 068
Air pump		1 090 090
Air valve complete		1 090 085
Analog board		1 120 051
Connectors different models, 21pcs/pac.		1 140 064
Counting beaker		1 080 025
Cylinder, diluent syringe, 5ml		1 100 007
Cylinder, lyse syringe, 5ml		1 100 006
Diluter board, compatible to 920/970EO		1 120 063
Displayboard, complete		1 090 203
Flush/drain pump		1 140 102
Keyboard		1 050 061
Keyboard label for AC920/970EO		1 050 043
Measuring head, AC920/970,complete		1 090 096
Measuring tube incl, seal		1 090 080
Membrane kit, vacuum pump		1 090 261
MV 7, drainvalve complete		1 140 037
MV complete		1 090 079
Needle AC920EO+ with closed tube adapter		1 020 279
One way valve,check valve		1 140 069
O-ring Mixing beaker 16,3x2,4mm	5pcs	9 990 400
Photometer, AC, EO+		1 090 504
Piston kit, 5ml	set of 5 pcs	1 090 258
Plastiv valve tap,rotary valve,complete		1 090 069
Processor board Tested		1 120 031
Pump tubing set, peristaltic,incl.conn.	3pcs	1 090 799
PVC tubing 1,0 x 2,0	1m	1 140 253
Rubber membrane, drain valve		1 140 400
Rubber stocking, rotary valve	2pcs	1 060 012
Silicon tubing 1,0x2,8	5m	1 140 250
Silicon tubing 1,5x3,0	15m	9 970 002
Silicon tubing 2,0x4,0 Old pumptubing	1m	1 140 252
Spring to wash cup	set of 5 pcs	1 090 416
Transducer kit, incl.measur.tube		1 090 756
Tygon tubing 0,8 x 2,4	1m	9 970 041
Tygon tubing 1,6 x 3,2	5m	9 970 042
Volume, measuring board		1 120 013
AC970EO+		
Needle AC970, 1 hole		1 020 275
Rubber sheeting, AC970		1 060 009
Rubber ring kit,smp, incl.2 wheel+10 rings		1 090 269
Sensorboard		1 120 062

12. Spareparts for yearly maintenance (v 01)

12.1 Spareparts for yearly maintenance (approx. 50 samples per day)

AC920EO+

Qty	Art no	Denomination		*For use on*
1,5 m	9970002	Silicon tubing	1,5x3,0mm	*Magnetic valves- general*
0,5m	1140250	Silicon tubing	1,0x2,8mm	*Magnetic valves - no 3,10,11,13*
3x 90mm	1090799	Alipren tubing		*Peristaltic pumps*
1 m	9970042	Tygon tubing	1,6x3,2mm	*Transfer tubing etc.*
*2	1020331	Piston 5 ml		*5ml syringes*
*2	1140030	O-ring 5 ml		*5ml syringes*
1	1060012	Rubber stocking, rotary valve		*Rotary valve*
*	1090258	Kit of Piston/O-ring set of 5 pcs		

AC970EO+

Qty	Art no	Denomination		*For use on*
1,5 m	9970002	Silicon tubing	1,5x3,0mm	*Magnetic valves- general*
0,5m	1140250	Silicon tubing	1,0x2,8mm	*Magnetic valves - no 3,10,11,13*
3x 90mm	1090799	Alipren tubing		*Peristaltic pumps*
1 m	9970042	Tygon tubing	1,6x3,2mm	*Transfer tubing etc.*
*2	1020331	Piston 5 ml		*5ml syringes*
*2	1140030	O-ring 5 ml		*5ml syringes*
1	1060012	Rubber stocking		*Rotary valve*
*	1090258	Kit of Piston/O-ring set of 5 pcs		

12.2 Instruction for yearly maintenance AC920/970eo+

Instrument: AC920/970EO+ Serial no:_____

Performed by:_____ Signature:_____

Hospital/Lab: _____ Date: _____

12.2.1 General

1. Run a blank sample and have the result printed.

2. Use a fresh blood sample and run it in open and closed mode. Print out and compare the results.

3. Check the transferring between mixing beaker 2 and the counting beaker**. Service manual 1.1**

4. a, print the calibration data. **6.Set up menu, 6.14 Print all settings**
   b, note the blood sample pump time: open_____ closed_____**7. Service menu, 7.3 Sample pump time. Service Manual 1.3** and **3.26**

5. Enter the **6. Set up menu, 6.6 Floating discr. RBC/PLT 6.6 WBC discr.**
   a, check the setting of the discriminators.
   RBC/PLT **15 – 30** WBC **95 – 120** EOS **70 - 200**

6. Drain the counting beaker.**7.Service menu 7.4 Pump and Valve test, Drain pump ON.**
   Switch of the instrument. Remove the cover. Front panel. Cleaning, replacement of tubing.

7. Replace all silicon tubing in the magnetic valves.

8. Replace one at a time. Remove the tub, measure the length and replace the new one.
   Silicon tube inner ∅ 1,5 mm, outer ∅ 3,0 mm art.no 9970002 Valves 1, 2, 4, 5, 6, 8, 9, 12, 14, 16
   Silicon tube inner ∅ 1,0 mm, outer ∅ 2,8 mm art.no 1140250 Valves 3, 10, 11, 13

9. Replace the tygon-tubing on the T-connection between mixing beaker 1 and valve 2, and between mixing beaker 2 and valve 8. Art.no. 9970042

10. Clean the two mixing beakers.
    Check so the metallic transferring tube does not touch the bottom of the mixing beaker

11. Clean the peristaltic pump rotor and replace the tubing. Length **90mm.** Art.no. 3pcs 1090799

12. Replace the piston and the O-rings in the syringes**. Service manual 3.34**

13. Check the T-connection and the reducing metallic tube inside the T-connector.Replace if necessary the upper tygon tube. Art.no 9970042 Dismount the Hgb-photometer and the counting beaker. Lift up and wrench loose the counting beaker.
    Clean the Hgb-photometer and the counting beaker.

14. Clean the transducer and the measuring tube**. Service manual 3.24 and 3.21** Check the sealing of the transducer. Art.no 1140410, 5mm length. Sealing for measuring tube, Art.no 1140252 5mm length. Clean the measuring head with distilled water. Fill the transducer with diluid or distilled water and remount. Assemble the counting beaker and the Hgb photometer.

15. Check the tygon tubing to the closed and open aspiration system.
    Clean the needle and the washing cup in the closed tube system**. Service manual 3.9 or 3.11**

16. Rotary valve. **Service manual 3.31 and 3.32**
    (Only if there is a problem with RBC or Plt blanks, or if there is leakage around the rubber stocking).
    Unscrew the two spring loaded screws on the front of the rotary valve.
    Remove the front part from the rubber stocking.
    Note! Do not scratch all contacting surfaces.
    Remove the rubber stocking.
    Clean the surface of the rotary valve unit as well as both halves of the valve body.
    Replace the rubber stocking. Art.no. 1060012
    Assemble the details again.

12.2.2 Rear panel Inspection

1. Inspect all tubing and connections.
   Replace tubing and T-connections if necessary.

2. Inspect tube connections to the Flush- and the Drain-pump. Check for any leakage.

3. Inspect the **tubing** to the vacuum pump**. Service manual 3.28**
   If dirty, unscrew the two screws fasten to the pump house and inspect. Clean if necessary.
   Inspect the membrane and the O-ring. Replace if necessary.

4. Check the suspension of the air pump. (O-rings). Replace if necessary.

5. Check all electrical connections and fasteners for all electronic boards.

12.2.3 Electronic control and adjustment

12.2.3.1 Turn on the instrument.

12.2.3.2 Run ”Fill system” until the syringes are filled up. Run a blank measurementuntil the values are accepted.

12.2.3.3 Check the top position of the syringes. **Service manual 3.35**

Analog board.

4. Check the voltage between TP2 (gnd) and TP9 (Offset 2) 0,000V +/-5mV, Adjust with R27

5. Connect the voltmeter between **TP2** and **TP3** (Offset 1) **-20 mV, Adjust with R33**

6. Connect a voltmeter between **TP2 and TP7** (capillary voltage) Run a blank measurement and read the voltage during counting of the RBC. Should be **15 V +/- 0,5V**

7. Check the blank value and the stability of the Hgb-photometer. **(note! Authorization code: 1809) Service manual 4.1.5**
   Run a blank. Enter the **7. Service menu, 7.5. HGB led adjustments**, check / adjust the led current to 40-60mA, adjust by the +/- key until the voltage is: 4,2V+/- 0,2V, If necessary, adjust with the R50 analog board.

8. Check the capillary cleaning.
   a. Enter the **8. Maintenance menu, 8.5 Start capillary cleaning**.
      Press Enter to start the cleaning. You will hear a clicking sound from the relay.
   b. If there is a problem with ”clog”.
      Check with an oscilloscope that **ca 250 V pp, 20 ms pulse** are found between **TP2, gnd** and **R66 analog board.**

12.2.4 Measurement

1. Check that the ”Reag.Low” led.lamp does not flash.
   If flashing, run a priming. If still flashing, **Enter 7 Service Menu, 7.7 Reagent detector test.**
   Check the value on the display, **Service manual 1.7**. Check the reagent connectors etc.

2. Enter the **8. Maintenance Menu, 8.6 Single count test**.
   Press **Enter** to start the single count test..
   If you get ”LT”, ”ST” or ”TB” repeat the procedure until results are obtained.
   Check the counting time **11,5-14,5 sec**
   If not adjust the vacuum pump. **Service manual 3.28 - 3.30**

3. Enter the ”Measurement menu”.
   Run a blank sample until acceptable values are obtained. During the analyse sequence check
   The transferring of liquid between the mixing beakers.
   Air mixing in the mixing beaker 1 and in the counting beaker.
   The transferring of liquid between the mixing beaker 2 and the counting beaker according to **Service manual, 3.2**
   7.1 Service menu If necessary adjust the air valve and the **WBC transfer time**, **Servicemanual 1.1 and 3.2**
   Check that mixing beaker 1 and 2 is completely empty after the last rinsing cycle.
   Check that the syringes is complete filled.
   Check the liquid level in the counting beaker., approx. 15 mm under the upper edge of the counting beaker. **Service menu 7.2 Flush pump time setup. Service manual 3.16**

4. Run the same blood sample in both the closed and the open mode.

a. During the analyse sequence check that the right pump stops when the blood reaches the blood sensor.
The end of the blood column stops shortly after MV13 after the second pump sequence.
For adjustment. Enter the **7. Service Menu, 7.3 Sample Pump Time setup. Service manual 3.25 – 3.27**

12.2.5 Run a sample in the Predilute mode. Check the aspiration from the prediluted pipette. Final blood testing

1. Run the same blood sample as in the beginning, page 1, "General" 2.
Check that the same values are obtained.
If not, run a calibrator or equal and recalibrate the instrument

2. Check the RBC-, the Plt- and the WBC- histogram
If not correct, check or make a more accurate electronic adjustment.
Service manual 4.1
Remount the cover.

3. Run a blood sample 5 to 10 times. Check the precision (CV) by enter the 4. Sample memory menu. Enter the sequence no. Fr: and To: for the measured 5 to 10 blood samples. Enter 4.2 Statistical calculations. Note or print out the CV results and compare by below listed specifications.

<u>Precision for a normal blood</u>

RBC	<2%
MCV	<2%
HGB	<2%
PLT	<5%
WBC	<3%

MCHC
320 – 360
With fresh
normal
blood
sample

13. Trouble shooting (v 01)

13.1 Trouble shooting guide

Problem	Check
RBC/HGB Unstable	Mixing of the blood sample
AC920/970	Sample pump, pump tubing, sample pump time
	Blood sensor, Blood sensor setup
	Air mixing in the Mix 1
	Remaining detergent in the wash cups
	Function of the MV 13
	Clog in the pipette or the needle
	Diluent syringe, check for leakage
	Function MV 6
	Draining of the counting beaker, Emptying of the Mixing beakers after complete cycle
RBC/PLT low, high and/or unstable	Air mixing in the counting beaker- silicon tubing in the MV 10
AC920/970	Aspiration via the sample pump from the Mix 1 to the rotary valve (pos 3)
RBC/PLT very low HGB and WBC quit OK	Check if the reagent tubing's for Diluent and Lyse are shifted
PLT unstable, high and very sharp beginning of the histogram curve Indication DE(AC+), even high blank	Check and clean the measuring head, the plastic screw for the transducer from salted crystallation. Check the condition of the outer electrode, contamination. Check the grounding of the electrode. Coaxial cable to the Analog board, contamination under the silicon sealing where the grounding cable is entering into the measuring head. Check the grounding of the Analog board and Diluter board.
PLT blank too high	If the histogram curve is a round shape, check for micro bubbles in the flow system. Diluent syringe, Diluent inlet tubings. Exchange the resistor R14 (produce noise) on the Analog board (only EO+ versions) (located between the relays). Replace to a metallic resistor 15-16 kOhm on the folieside of the board. Contaminated diluent.
ST, TB indications (Air and bubbles)	MV11 and MV12 and the silicon tubing's
	Too low level into the counting beaker during counting. Check the transfer from the Mix1 to the Mix2. The transfer from the Mix2 to the counting beaker.
	Air pump and the air valve, transfer time settings (EO+).
	Vacuum pump
	Leakage in the measuring head, measuring tube. Silicon sealing.
LT indication (clog)	Contamination of the transducer Check or clean
	Check the capillary cleaning
	Check and clean the measuring tube
	MV12 function, silicone tube
	Check

Problem	
Low/high MCV, unstable	Incorrect diluent
	Transducer Capillary voltage
High HGB blank Indication HI or LO	Contaminated counting beaker, cleaning Scratches in the photometer reading area
	Adjustment of the photocell voltages, LED current
HGB unstable	Air bubble in the counting beaker after air mixing
	Air mixing in the Mix2 (Only EO+ version)
	Photometer malfunction
	Analog board
WBC / HGB unstable	Transfer from the Mix2 to the counting beaker Air valve, transfer time settings (AC+)
	The air filter, air pump
	Transfer from Mix1 to Mix2 MV2 and MV8, tubing's
	Lyse in the Mix2 from the lyse syringe Lyse volume Check the O-ring in the Sample pump.
Max or High PLT, low RBC and low HGB Only AC920/970 instruments	Transfer from the Mix 2 to the counting beaker
	Check in stand by that the Mix2 is empty
	Cleaning of the transfer tubing and the metallic tube into the Mix2
	Air valve adjustments, Transfer time settings (AC+)
	MV1, MV4, MV8 and MV2 and silicon tubing's
High RBC blank, Unstable RBC/HGB	Clean and inspect the two metallic parts of the rotary valve from blood smear. Exchange if necessary.
	Cleaning by the detergent, rubber stocking
	The final cleaning of the Mix1 and the Mix2 via the flush pump and the MV3
MCHC too high frequently	Check or calibrate all parameters which are involved in the calculation of the MCHC (RBC, MCV and HGB) MCHC = HGB/RBC x MCV = HGB/HCT
MCHC decreases	Check the RBC blank after repeated blood measurement
No result for WBC, RBC and PLT Only old AC models	Check discriminator settings
Error indication 20X Only AC920/970EO+ version	Communication error between CPU and diluter board. Check the cable P105_P216, grounding of the diluter board (4 screws)
All parameters very low results or similar blank values	Check the Sample pump, tubing
	Blood sensor, check at TP1 diluterboard that the voltage is < 0,3V without blood and > 4,5V with blood in the sensor.
AC 920eo+ -1 –3	Check the wash-up, magnetic sensor, connector P228 Diluter board. Remove the connector and check with Ohm-meter In the upper position approx. 0 Ohm, In the lower pos. > 1 Mohm. If not correct, adjust the position of the sensor.

13.2 Error indications

Indication numbers are displayed when a system failure occurs.
The AutoCounters will stop and will not continue with the process until the indication failure has been deleted.

Indication numbers in the AutoCounter can occur when it has been a main power and/or memory failure.

All indication numbers must be deleted by the Menu key. Then by turning off/on the instrument, the autocounter will be restored and units which not are failed will be restored to the home position. Each indication number have a specific indication source.

AC type	Indication numbers	Message	Suggested solutions General: Delete the errors with Menu key
All Auto-Counters	1	Date and time not set	Set date and time in the “6 Setup menu” “6.4 Set date and time”
All AC AC910 All AC AC910 Old AC910 Old AC920/970 AC920/970	101 111 – 112 121 – 122 131 – 132 141 – 142 151 - 152	Unspecified motor failure Pipette motor failed Diluter motor failed Lyse syringe motor failed Vacuum pump failed Cap piercer/needle motor failed	Turn off and restart the AutoCounter. If the errors still occur, check the specified unit etc. by enter the Service program Check home switches, refer to the displayed indication of the Service menu Check for high friction of the moving parts Check motors and gearboxes
AC920/970	200 - 209	Internal communication error between the processorboard and diluterboard	Replace/check the cable between Dil. and CPU board, P216 – P105 Grounding of the diluterboard Exchange the Diluterboard or Processorboard
All Auto Counters	230 - 255	Internal failure in the software	
AC920 AC970	351 352 353 354 355 356 357 – 358 359 360 – 365 366 367	Power on cycle failed Prime cycle failed Cleaning cycle failed Fill cycle failed Empty Cycle failed Capillary Cleaning cycle failed Autoprime cycle failed Exit-standby cycle failed Measurement cycle failed Autosampler cycle failed Service Cycle failed	These errors occur after a previous 100 – 200 error Press Menu key and restart the AutoCounter
	901 – 905 911 921 931 941 951 999	Configuration failure Machine statistics lost Stored samples lost Normal ranges lost Calibration raw data lost X – bar lost Battery low	Press Menu key and restart the AutoCounter If not OK, exchange the processorboard
	2000 - 2235	Hardware or software failure	Press Menu key and restart the AutoCounter If not OK, exchange the processorboard
	2500	DSP failure	Press Menu key and restart the AutoCounter If not OK, exchange the processorboard
	3000	Internal failure in the software	Press Menu key and restart the AutoCounter If not OK, exchange the processorboard

13.3 Warning flags

Warning flags	Description	Suggested solution
*	A * (star) will be presented when the results is outside the specified reference range	Check the settings in the Setup menu, Set Reference Range
####	This will occur when the result is outside the measurement range When a electric disturbance during PLT counting and the PLT results is more than 2000.	When blood measurement, dilute the blood by Add 10µl blood to 4ml diluent. Rerun the sample and multiply the results by 2.
LT Long time	This error might be displayed on RBC, PLT, and/or WBC when the counting time is more than 15 sec.	Check / cleaning for clog in the transducer Check the function of the Automatic capillary cleaning in the Maintenance menu Check the vacuum pump
NC No count	This error might be displayed on RBC, PLT, and/or WBC when the meniscus in the measuring tube do not reach the lower optical sensor of the volume board.	Check / cleaning for clog in the transducer. Check the vacuum pump Run single count test
ST Short time	This error might be displayed on RBC, PLT, and/or WBC when the counting time is too short, lower than 11 sec.	Check for the level of the dilution RBC/PLT or WBC during counting. Air bubbles at the end of the counting. Check for air in the measuring tube, Leakage, tubing's, transducer Run single count test
TB Tube bubbles	Bubbles in the measuring tube during counting	Check for air in the measuring tube, Leakage, tubing's, transducer Run single count test Run a prime cycle
DE Distribution error	Errors from abnormal RBC/PLT and WBC histogram curve	Reanalyse the samples Check for electric disturbance Check for micro bubbles in the dilution Check the offset voltage of the analog board Check electric connectors to the analog board, transducer. Check grounding of the instrument and analog board
FD Floating Discriminator	No acceptable minimum found between the population of the PLT and RBC histogram curve	Check if the blood sample is too old Check the settings of the floating discr. Normal settings is 15 / 30 fl
LO Low blank level HGB	The HGB blank level below 3,5V (Photocell voltage)	Cleaning of the counting beaker Broken beaker,0123 Adjustment of the photometer
HI High blank level HGB	The HGB blank level is above 4,6V (Photocell voltage)	Check/Adjust the photometer
NG Negative HGB	The blank value of the HGB is lower than the HGB measured value	Occur only during blank measurement Check/clean the counting beaker
SE Statistical error HGB	The measured pulses from the photometer is too unstable	Check/cleaning of the counting beaker and photometer