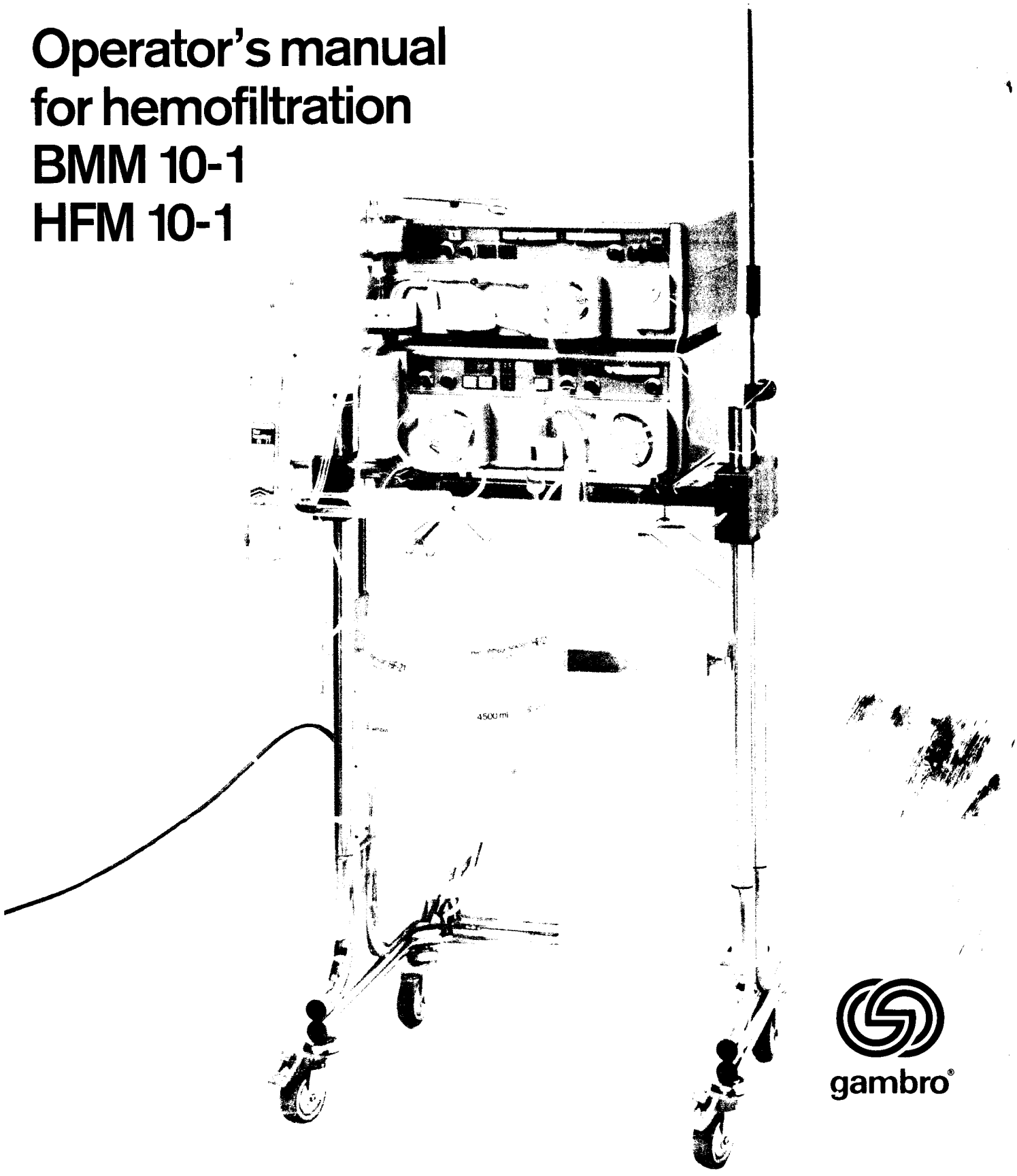
Hemofiltration

AK-10 System

Operator's manual for hemofiltration BMM 10-1 HFM 10-1



gambro®

The AK-10 system for hemofiltration.

Introduction

The AK-10 system for hemofiltration is designed around two basic building blocks, the **Blood Monitor** and the **Fluid Monitor.** The system can easily be expanded or modified by adding or interchanging monitors to meet a variety of needs and treatment techniques.

This manual describes the operation of two of the monitors in the AK-10 system. The BMM 10-1 is the standard blood monitor for extracorporeal circulation. It controls and monitors the blood circulation in the extracorporeal system. The HFM 10-1 is the hemofiltration fluid monitor for standard hemofiltration. It controls and monitors the amount of filtrate drawn from the patient and the amount of infusion solution given to the patient during the treatment.

Note: The AK-10 hemofiltration machine may only be operated by persons trained in hemofiltration and who are familiar with the operation procedure given in this manual.

When unpacking, check equipment for damage. If equipment is damaged proper operation cannot be assured.

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The Blood Monitor

The BMM 10-1 monitor can be conveniently divided into a number of functional groups which work together to control and monitor the extracorporeal blood circuit. As the other monitors in the AK-10 system, the BMM is designed so that **mode selection** is made with **white** buttons and **operational settings** with **knobs. Alarm indication** and **alarm handling buttons** are always **red.** On this monitor, certain selector buttons have two positions, *"in" (light on)* and *"out" (light off)*. For these buttons the instructions *"depress"* and *"release"* are used to designate the action of pushing in and letting out the buttons.

1 The **MAIN SWITCH** powers both the blood monitor and the hemofiltration fluid monitor. The **MUTE button** lights up on alarm and is used to temporarily silence the audible alarm. Pressing the button silences the buzzer for 30 seconds. A power failure will cause the **MUTE** button to blink and an intermittent alarm to sound.

2 The **heparin-protamine pump** and its **flow rate control knob.** The knob is graduated in ml/h increments.

3 The **blood pump, flow meter** and its **flow rate control knob.** The blood flow meter indicates the flow rate in ml/min. In the event of a power failure, the blood can be returned to the patient by pulling out the white handle on the blood pump and turning the pump in the direction indicated by the arrows.

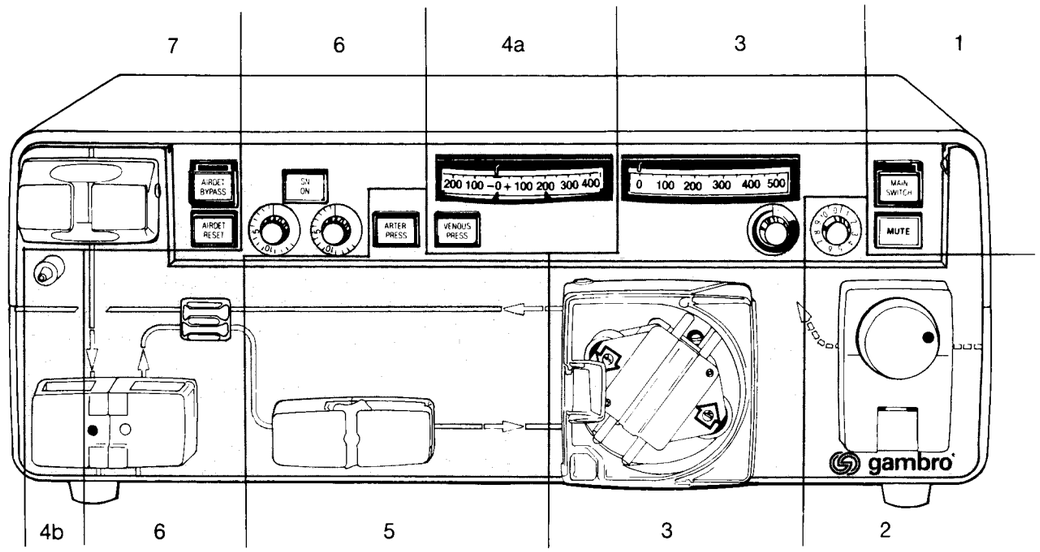
4a The **venous pressure meter** with **adjustable alarm limits** and the **venous pressure alarm button (VENOUS PRESS.).**

4b The **venous pressure connector (male).**

5 The **arterial pressure sensor and the arterial pressure alarm indicator (ARTER.PRESS.).** The arterial pressure sensor can be bypassed by pulling out the sensor plate. The sensitivity can be adjusted by rotating the pressure plate.

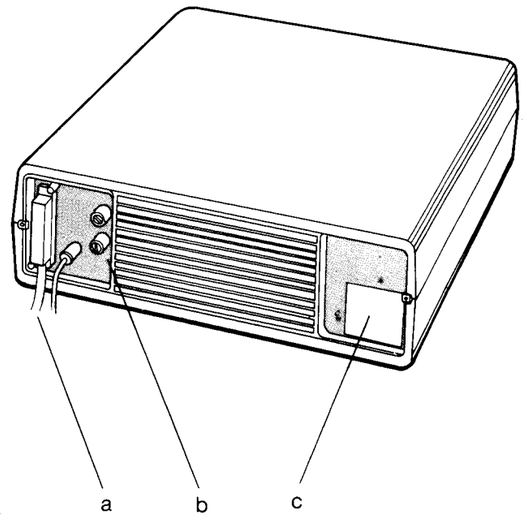
6 The **arterial and venous line clamps.** The solenoid clamps clamp the arterial and venous lines in certain alarm situations.
The **single needle mode selector button (SN ON)** and the **arterial and venous time-setting knobs.** Owing to the high blood flow rate needed in hemofiltration, the use of a double-pump blood monitor, such as the AK-10 BMM 10-4, is recommended for single needle mode.

7 The **air detector,** the **air detector bypass button (AIRDET.BYPASS)** and the **air detector reset button (AIRDET.RESET).** The air detector head is adjustable to accommodate most drip chambers of 18–30 mm diameter. The ultrasonic air detector will detect at least 0.2 ml air/min at blood flows below 300 ml/min and give an alarm.



The back of the machine

a) The **interface cable.**
b) The **mains fuse(s).**
c) The **monitor type label with serial number.**
Note that the serial number for the hemofiltration and blood monitor may be different.



The Hemofiltration Fluid Monitor

The HFM 10-1 monitor consists of a number of functional groups which control and monitor the filtrate and infusion circuits.

Mode selection is made with **white** control buttons, while **alarms** are indicated and dealt with using **red** indicators and buttons.

1 The **filtrate scale** (maximum load: 35 kg).

2 The **filtrate pump** and its **flow rate control knob.**

3 The **transmembrane pressure meter** with adjustable alarm limits, **alarm indicator (TMP ALARM), TMP control knob** and **filtrate pressure connector.**

The monitor indicates the TMP as the difference between the venous pressure and the pressure caused by the filtrate pump. The selected TMP is automatically held constant by the monitor. The TMP is shown on the transmembrane pressure meter.

4 The **blood leak detector,** the **blood leak alarm button (BLOOD LEAK)** and its **sensitivity control knob.**

5 The **infusion scale** (maximum load: 35 kg).

6 The **infusion pump** and its **flow rate control knob.**

7 The **infusion heater** with **temperature control knob** and **temperature alarm indicator (TEMP. ALARM).** Internal alarm limits are normally set at 34°C and 42°C.

The heater is not activated until the AUTO mode is entered.

8 The automatic treatment is monitored and controlled with:

a) The **automatic treatment selector button (AUTO).**

b) The **weight loss selector (kg DIFF).** The desired weight loss is selected with the **thumb wheel selectors.**

c) The **infusion quantity selector (kg INF).** The desired infusion quantity is selected with the **thumb wheel selectors.**

d) The **display.** The accumulated weight loss in kg (max 9.9 kg) is continuously shown. (Blinking display indicates that the patient is gaining weight).

e) The **filtrate flow rate button (UF RATE).** When the button is pressed the display will indicate the filtrate flow rate in l/min (UF rate).

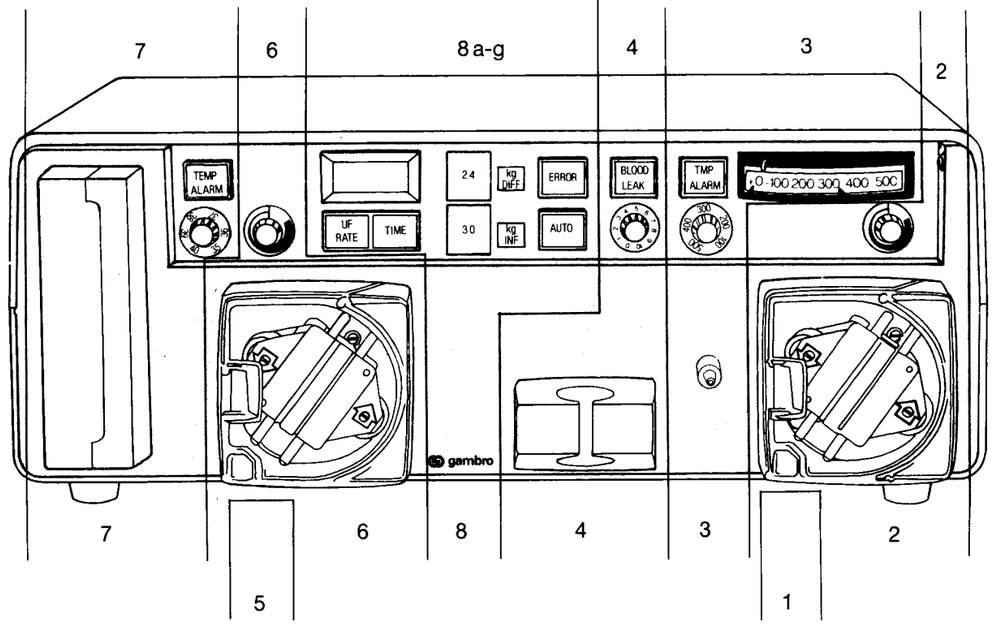
f) The **time button (TIME).** When the button is pressed the display will indicate the calculated remaining treatment time in hours and tens of minutes *(3.5 means 3 hours and 50 minutes)*. During the last hour of treatment the remaining time is shown in minutes.

When the **UF RATE** and **TIME** button are pressed simultaneously the display will show the accumulated infusion volume infused into the patient.

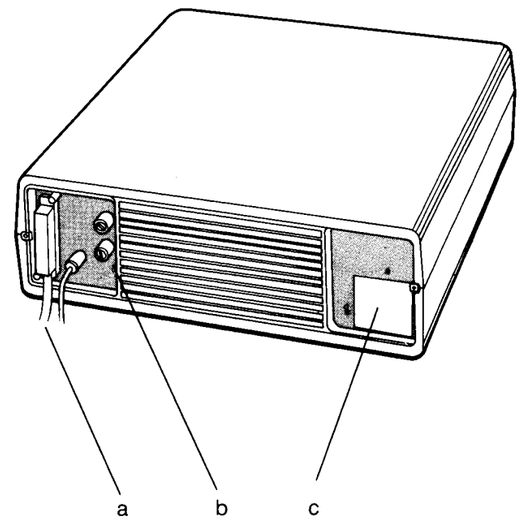
During the first 10 minutes of the treatment, before the treatment parameters have been adjusted to the patient and type of hemofilter used, the indicator is not very accurate.

g) The **error indicator (ERROR)** indicates either operating fault *(steady red light)* or technical fault *(blinking red light)*. When the **UF RATE** and **TIME buttons** are pressed simultaneously the display will indicate an **error code.** For error codes see page 20.

The **ERROR** *indicator will be steadily lit until the AUTO mode is activated. This is to notify the operator of the manual mode.*



The back of the machine



a) The **interface cable.**
b) The **mains fuse(s).**
c) The **monitor type label with serial numer.**
Note that the serial numer for the hemofiltration and blood monitor may be different.

Hemofiltration preparations

First check

- that the mains cables are connected to power. A power failure alarm will result if the mains cables are not connected.
- that the interface cable between the blood monitor (BMM) and the hemofiltration fluid monitor (HFM) is correctly placed. An alarm will result if the cable is not connected. If improperly connected the monitors will not operate.

Setting up

1 Hang up **container/bags** with sufficient infusion solution for the treatment on the infusion scale.

2 Hang up empty **container/bags** on the filtrate scale. Make sure that the **container/bags** have the capacity to contain the selected quantity of filtrate i.e. the volume of the infusion solution plus the patient's weight loss.

Note: *The container/bags must hang free so as to guarantee the accuracy of the scale during the treatment. They must not be removed or touched during treatment.*

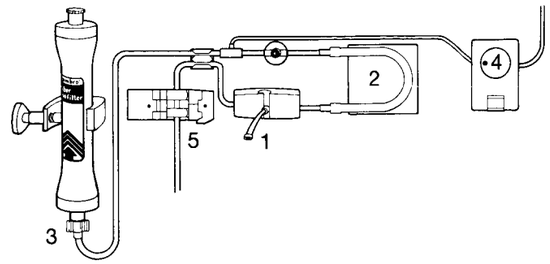
3 Place the **hemofilter** in the holder in a vertical position with the arterial end at the bottom.

Note: *It is important that the hemofilter remains in this position throughout the priming and rinsing procedure as well as during treatment.*

4 Place the blood lines and the fluid lines on the machine and connect to the hemofilter according to the schematic diagram on page 9. Take care to maintain the sterility of all connectors.

Attaching the blood and fluid lines

Arterial blood line



1 **Arterial pressure sensor** – Place the pillow in the arterial pressure sensor. Secure the blood line on both sides of the pillow by adjusting it into the line holders.

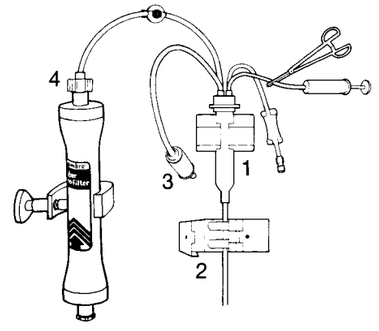
2 **Blood pump** – Thread the pump segment into the blood pump. When the pump segment is in place, close the blood pump door.

3 **Hemofilter blood port** – Attach the hemofilter connector to the blood port at the bottom of the hemofilter.

4 **Heparin-protamine pump** – Open the pump by pulling down the housing. Place the heparin line into one of the two grooves. Push the housing up to lock the line into place.

5 **Arterial line clamp** – Place the pre-pump arterial line into the line clamp colour-coded with the red dot.

Venous blood line



1 **Air detector** – Place the venous drip chamber halfway down into the air detector.

2 **Venous line clamp** – Place the post-drip chamber venous line into the line clamp colour-coded with the blue dot.

3 **Venous pressure connector** – Attach the venous pressure transducer protector to the venous pressure connector.

4 **Hemofilter blood port** – Attach the hemofilter connector to the blood port on the top of the hemofilter.

Infusion line

1 **The heater** – Pull out and open the heater. Fasten the heating bag to the vertical bar at the back. Press the soft part of the lines into the line holders and pull the lines out of the heater so that the bag is correctly placed in the heater. Close and push in the heater.

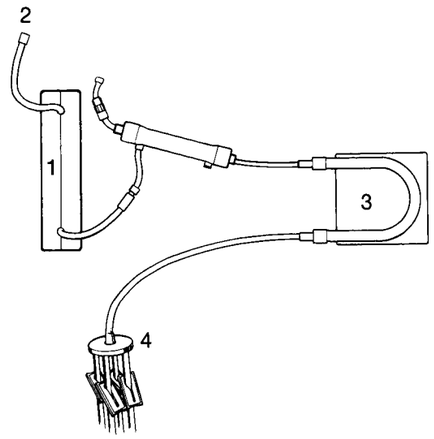
Note: *The lines must not be kinked or twisted in the heater. The heater, infusion pump and filtrate pump will not function if the heater is not properly inserted.*

2 **The venous drip chamber** – Connect the infusion line (coming out from the upper part of the heater) to the non-return valve connector at the venous drip chamber.

3 **The infusion pump** – Thread the pump segment into the infusion pump.

4 **Container/bags** – Clamp all multiconnector lines before attaching to the infusion container/bags.

If a pyrogen filter is used in the infusion line please follow separate instructions for this device.



Filtrate line

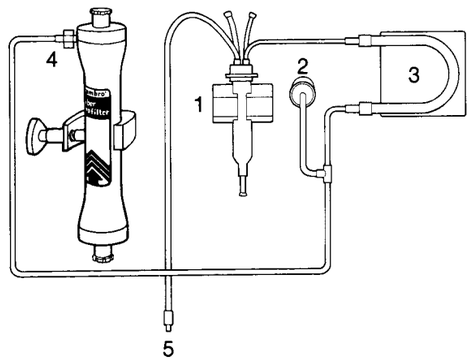
1 **The blood leak detector** – Place the filtrate chamber half-way down into the blood leak detector. (Otherwise turbulence might cause false alarms).

2 **The filtrate pressure connector** – Attach the filtrate pressure transducer protector to the filtrate pressure connector.

3 **The filtrate pump** – Thread the pump segment into the filtrate pump.

4 **The hemofilter filtrate port** – Connect the filtrate line to the filtrate port of the hemofilter.

5 **The drain line** – Remove the protection cap at the end of the drain line and place the line into the filtrate container.



Before starting the machine

1 Place clamps on the lines according to the procedure followed in the unit. (The filtrate line should be clamped close to the hemofilter).

2 Connect a physiological solution (2000 ml) to the arterial blood line for priming and rinsing the lines and hemofilter. Place the free end of the venous line into an empty bottle.

3 If the heparin line is to be used, connect it to the heparin solution (bag or syringe).

Starting the machine

4 Depress **MAIN SWITCH** *(light on)*.
Wait until the count-down on the display has ended (0–9 + error code symbols). Several alarm lights should now be lit, since the machine is not yet ready for hemofiltration.

5 If the buzzer sounds continuously:

- pull out the **arterial pressure sensor plate.**
- depress **AIRDET. BYPASS** *(light on)*.
- move the adjustable **alarm limits** on the **venous pressure meter** apart.
- release **AUTO** *(light off)*.
- depress **BLOOD LEAK** *(light off)* and turn the **sensitivity control knob** to 10.
- move the adjustable **alarm limits** on the **transmembrane pressure meter** apart.

If the **AUTO** *mode is not activated within 10 minutes after having started the machine there will be an* **AUTO** *alarm. The buzzer will sound and* **MUTE** *is lit. If the machine is not yet ready for the hemofiltration treatment press* **MAIN SWITCH** *twice to reset the alarm function for another 10 minutes.*

The **TEMP. ALARM** *and* **ERROR** *buttons will be lit until* **AUTO** *is pressed.*

Priming and rinsing procedure

General

For priming and rinsing of the Gambro Fiber Hemofilters continue with the procedure on this page. For priming and rinsing of other hemofilters, the procedure recommended by the manufacturer should be followed. The instructions in steps 1–5 below should be incorporated into this procedure.

Check safety functions

1 **Arterial pressure sensor** – Clamp the line just before the arterial pressure pillow. The arterial pressure alarm will be activated: **ARTER. PRESS.** *(light on)*. Blood, heparin, infusion and filtrate pumps stop and the buzzer sounds. To reactivate the alarm, remove the clamp and adjust the sensor plate if necessary.

2 **Air detector** – Release **AIRDET. BYPASS** *(light off)*; **AIRDET. RESET** *(light on)*. The air detector alarm will be activated: All pumps stop, the buzzer sounds. The arterial and venous solenoid clamps close*. To reactivate the alarm, press **AIRDET. RESET** *(light off)*. If necessary, adjust the fluid to the correct level in the venous drip chamber using a syringe.

3 **Venous pressure** – Move the adjustable alarm limits to simulate a decrease and an increase of the venous pressure. The venous pressure alarm will be activated: **VENOUS PRESS** *(light on)*. All pumps stop, the buzzer sounds. The arterial and venous clamps close*. To reactivate the alarm, set the alarm limits at +10 and +200 mmHg.

4 **Blood leak** – Turn the sensitivity control knob down until **BLOOD LEAK** lights up. The blood leak alarm will be activated: All pumps stop, the buzzer sounds and the arterial and venous clamps close. To reactivate the alarm, depress the **BLOOD LEAK** button and turn the sensitivity control knob up two degrees *(light off)*.

5 **Transmembrane pressure:**

a) Move the lower adjustable alarm limit to simulate a decrease in TMP: **TMP** *(light on)*, the buzzer will sound.

b) Move the upper adjustable alarm limit to simulate an increase in TMP: **TMP** *(light on)*, the buzzer sounds and the filtrate pump stops.
To reactivate the alarm, set the adjustable alarm limits at 0 and 200 mmHg. Set the TMP control knob at 100 mmHg. **TMP** *(light off)*.

**) Not on all models*

Gambro® Fiber Hemofilters

Approximately 500 ml of infusion solution is used to prime the infusion circuit. If a pyrogen filter is included in the infusion line the procedure recommended by the manufacturer for priming and rinsing should be followed.

An additional 2000 ml of priming solution will be required to rinse and prime the rest of the system. At least half of this volume should pass through the membrane to the filtrate compartment.

1 Remove any obstructing clamps and start the infusion pump to rinse and prime the infusion circuit.

2 When 500 ml of infusion solution has been used, stop the infusion pump and clamp the infusion line at the venous drip chamber.

3 Remove any obstructing clamps and start the blood pump at 150 ml/min to rinse and prime the blood circuit.

4 Prime with 500 ml of priming solution and remove air from the blood compartment in the hemofilter by gently tapping the upper header with the hand.

5 Unclamp the filtrate line *(the filtrate pump segment should not be in position in the filtrate pump)* and clamp the venous line at the top of the hemofilter.

6 Rinse and prime the filtrate compartment with 1000 ml of priming solution.

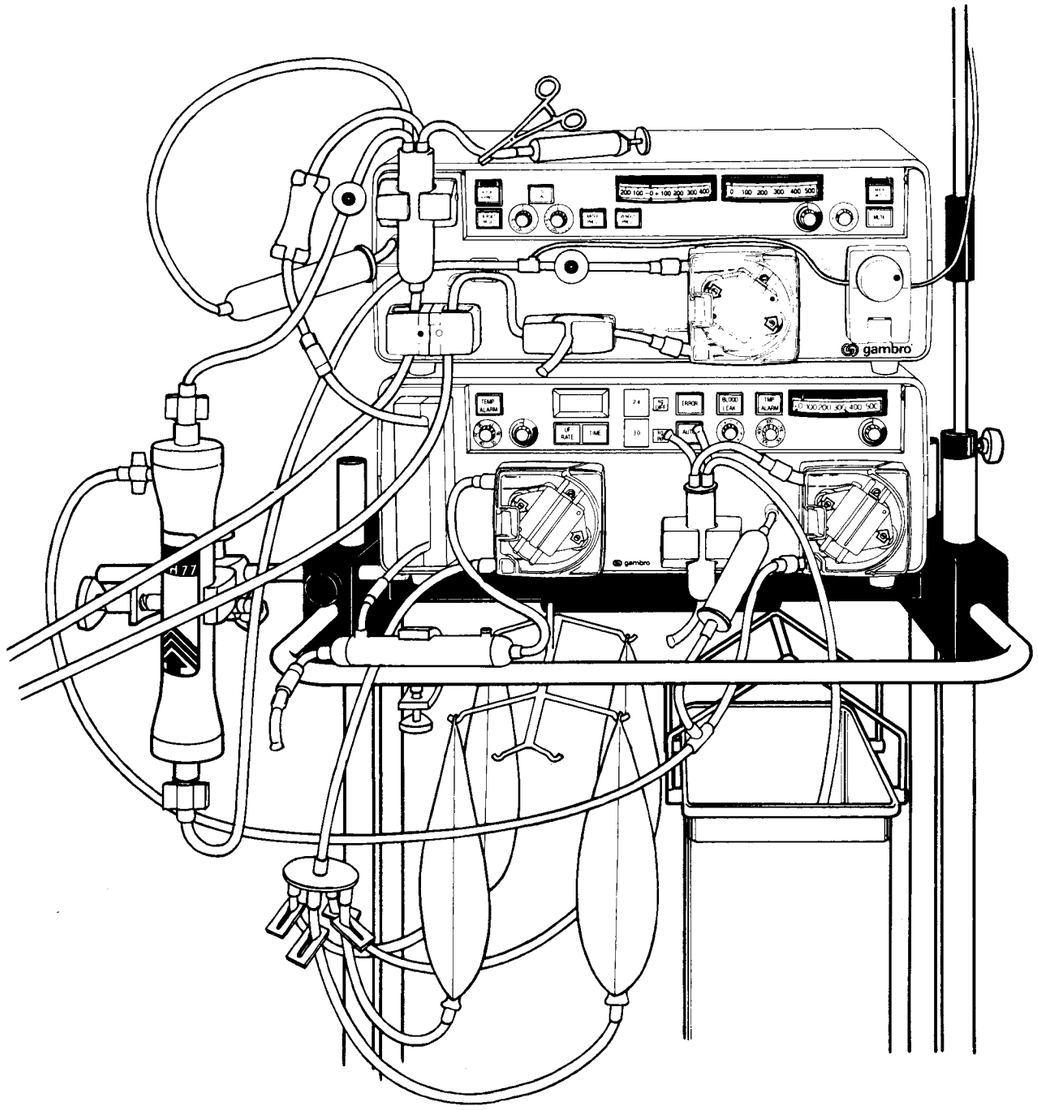
7 Unclamp the venous line and clamp the filtrate line again. Rinse and prime with the remaining 500 ml of priming solution.

8 Just before the 2000 ml of priming solution has been used remove any remaining air from the blood circuit. Adjust the amount of fluid in the venous drip chamber with a syringe until the level is at least 1 cm (10 mm) below the top of the drip chamber.

9 Turn off the blood pump and clamp the arterial and venous lines.

10 Insert the filtrate pump segment into the filtrate pump and unclamp the infusion and filtrate lines.

The hemofilter is now ready for use.



Initiating hemofiltration

Select initial settings

1 Set the desired weight loss **(kg DIFF)** in kg and hundreds of grams *(1.5 = 1 kg 500 g)*

2 Set the desired quantity of infusion solution **(kg INF)** always in whole kg *(litres)*.

To prevent air from coming into the infusion circuit, there must always be 1 litre of infusion solution in excess of the desired amount infused:
Ex: *If the total volume of the container/bags is 20 litres, the desired amount of infusion solution should never exceed 19 litres.*

Start the blood circulation

1 Connect the arterial blood line to the patient.

2 Remove the clamps from the arterial line and the cannula.

3 Start the blood pump at a low initial flow rate (100 ml/min).

4 Start the heparin pump, if required, and set the correct flow rate.

5 Remove the clamp from the venous line when the venous pressure is +100 mmHg and let the priming solution flush out.

6 Stop the blood pump when the blood reaches the venous drip chamber.

7 Make sure that all air has been removed from the venous line, and then clamp it.

8 Connect the venous line to the patient.

9 Remove the clamps from the venous line and the cannula.

10 Start the blood pump and set the required blood flow rate.

Start hemofiltration

11 Start the infusion pump. Turn the knob to max flow rate *(otherwise the buzzer will sound and the heater will not be activated when entering* **AUTO).** *The pump speed will automatically be controlled when* **AUTO** *is depressed.*

12 Start the filtrate pump. Turn the knob to max flow rate. The pump speed will automatically be controlled by the selected TMP when **AUTO** is depressed.

Warning: There is no control of the infusion and filtrate flow rates in the manual mode. It is therefore recommended to start the infusion and filtrate pumps at max flow rate to avoid deviation of the two flow rates and consequent weight gain or loss before entering the **AUTO** mode.

13 Depress **AUTO** *(light on)* – **ERROR** *(light off)*. During the first 15 seconds the display will indicate the selected weight loss and selected quantity of infusion solution.

Note: *Check that the data on the display and the selected settings correspond. If not, the patient data selector is malfunctioning. Discontinue the treatment according to the procedure on page 16 and call for technical service.*

Select the operating values

14 Check that the blood flow rate is at the required value.

15 Set the venous pressure alarm limits just above and below the patient's stabilized venous pressure.

Warning: The lower alarm limit should never be set below 0 mmHg.

16 Set the required TMP and set the alarm limits accordingly. It is important to have sufficient blood flow rate before the TMP is set to the desired value in order to prevent hemoconcentration.

17 Recheck all connections in the blood and fluid circuits, as the material can expand due to the contact with warm infusion solution and blood.

Warning: No red lights should be lit when the treatment is initiated.

Note: *It is of the utmost importance that* **MAIN SWITCH** *is not touched during treatment. If this happens the programme will be reset and the machine will restart the treatment without counting the weight loss already obtained. To reset see* **restart and weighing procedure.**

If a mains power failure occurs during treatment the actual treatment data are stored for 10 minutes. After 10 minutes it is necessary to reprogram the treatment data.

Changing the weight loss

During the treatment it is possible to change the selected weight loss.

1 Release **AUTO** *(light off)* – **ERROR** *(light on)*.

2 Set the new weight loss desired. The weight loss should not be set below the weight loss already achieved, otherwise the patient will get reinfused.

3 Depress **AUTO** *(light on)* – **ERROR** *(light off)*. During the first 15 seconds the display will indicate the new selected weight loss and the quantity of infusion solution. The buzzer will sound for 5 seconds.

Check that the display corresponds with the selected data on the thumb wheels.

As a safety precaution the buzzer will sound and the infusion and filtrate pumps stop if **AUTO** *is not reactivated within 1 minute.*
During this manual mode the infusion and filtrate flow rates are registered and included in the treatment data. The display will continuously show the accumulated weight loss.

If the infusion and filtrate pumps are turned off there is a 10 minutes delay before the **AUTO** *alarm will be activated.*

Changing the quantity of infusion solution

It is also possible to change the selected quantity of infusion solution during the treatment following the procedure above.

Restart and weighing procedure

1 Read and record the weight loss on the display.
2 Switch off the machine by releasing **MAIN SWITCH** *(light off)*.
3 Release **AUTO** and turn off the infusion and filtrate pumps.
4 Remove the infusion container/bags from the infusion scale, do not touch the filtrate container.
5 Switch on the machine by depressing **MAIN SWITCH** *(light on)* and reset any alarm which may occur.
6 Wait until the count-down on the display *(0–9 and error code symbols)* has ended.
7 Press the **TIME** button *(light on)*: 0.0 is now shown on the display.
8 Hang up the infusion container/bags on the infusion scale.
9 The display will now indicate the quantity of infusion solution.
10 Reprogram **Kg INF** and **Kg DIFF** (with respect to the patient's weight loss).
11 Turn on the infusion and filtrate pumps.
12 Depress **AUTO** *(light on)*.

Discontinuing hemofiltration

1 If the heparin-protamine pump has been used, stop the pump at the prescribed time before finishing the treatment.
When the desired weight loss and infusion volume have been obtained, the treatment should be terminated. This is indicated by the following:
- **AUTO** blinks
- the buzzer sounds
- the infusion pump stops
- the filtrate pump stops.

Note: *The treatment is considered finished, when the preset infusion volume has been attained.*

2 Turn off the filtrate pump. Set **TMP** at 100mmHg and clamp the filtrate line coming out of the hemofilter.

3 Turn off the infusion pump and clamp the infusion line leading to the venous drip chamber.

4 Release **AUTO** *(light blinks)* – **ERROR** *(light on)*. Move the alarm limits on the transmembrane pressure meter apart.

5 Adjust the lower venous pressure alarm limit to 0 mmHg.

6 Turn off the blood pump.

Return the blood

7 Clamp the arterial blood line and the cannula and remove it from the patient.

8 Connect the arterial blood line to at least 100 ml of physiologic solution.

9 Invert the hemofilter to facilitate the rinse-back of blood.

10 Start the blood pump and set the desired rinse-back flow rate to remove the blood from the extracorporeal circuit.

11 Clamp the venous line repeatedly to facilitate adequate emptying of the hemofilter.

12 When the required amount of blood has been returned to the patient, stop the blood pump, clamp the venous line and cannula and disconnect it from the patient.

13 When the blood lines are disconnected from the patient, depress **AIRDET. BYPASS** *(light on)*.

14 Release **MAIN SWITCH** *(light off)*. This is necessary to reset the programme even if a new treatment is to be started immediately.

15 Remove and discard the hemofilter, blood lines and fluid lines. Disarm the arterial pressure alarm by pulling out the sensor plate.

16 Remove the infusion and the filtrate containers/bags.

Alarms

General

The AK-10 monitors are designed to detect and indicate three conditions – clinical alarms, technical alarms and operational faults.

Clinical alarms, caused for example by blood leaks or air detection, will result in an audible alarm, the **MUTE** button and the indicator for the specific alarm being steadily lit. If a deviation occurs in the weighing system the **ERROR** indicator will be lit and at least one error code will be displayed to signal the possible need for operator assistance.

The hemofiltration monitor can indicate **technical alarms.** The machine continuously tests its own function. If a malfunction is detected, there will be an audible alarm, simultaneously the **MUTE** button will be lit and the **ERROR** indicator will blink. An error code will be displayed and the service staff should be informed of this.

A slowly blinking indicator on the hemofiltration monitor signifies that the **operator** should take some action.

Clinical Alarms

ALARM LIGHT / REACTION	BUZZER SOUNDS	BLOOD PUMP STOPS	HEPARIN PUMP STOPS	INFUSION PUMP STOPS	FILTRATE PUMP STOPS	A-V CLAMPS CLOSE	HEATER TURNS OFF
AIRDET. RESET	×	×	×	×	×	×	×
ARTER. PRESS.	×	×	×	×	×		×
VENOUS PRESS.	×	×	×	×	×	×*	×
BLOOD LEAK	×	×	×	×	×	×	×
TEMP. (high)	×			×	×		×
TEMP. (low)							
TMP (high)	×				×		
TMP (low)	×						
ERROR	×						
FLASHING AUTO	×			×	×		×

*Not on all models

Blood Monitor alarms

In an alarm situation, **first check the connections to the patient before taking any other steps.** Then press **MUTE** to silence the buzzer. The buzzer will sound again if the fault is not rectified within approximately 30 seconds.

Take the following steps according to which alarm light is lit.

1 **AIRDET. RESET** *(red light on)*. **All pumps stop. The clamps close on the arterial and venous blood lines.** *The alarm is activated if there is too much air or foam in the venous drip chamber.* After rectifying the fault, remove the air from the venous drip chamber using a syringe. Press **AIRDET. RESET** until the light goes off.

2 **ARTER. PRESS** *(red light on)*. **All pumps stop. The clamps close on the arterial and venous blood lines*.** *The alarm is activated by an increased negative pressure between the patient and the blood pump.* This may be caused by a fall in the patient's blood pressure, altered position of the arterial needle, or a kink in the arterial line between the patient and the arterial pressure pillow.

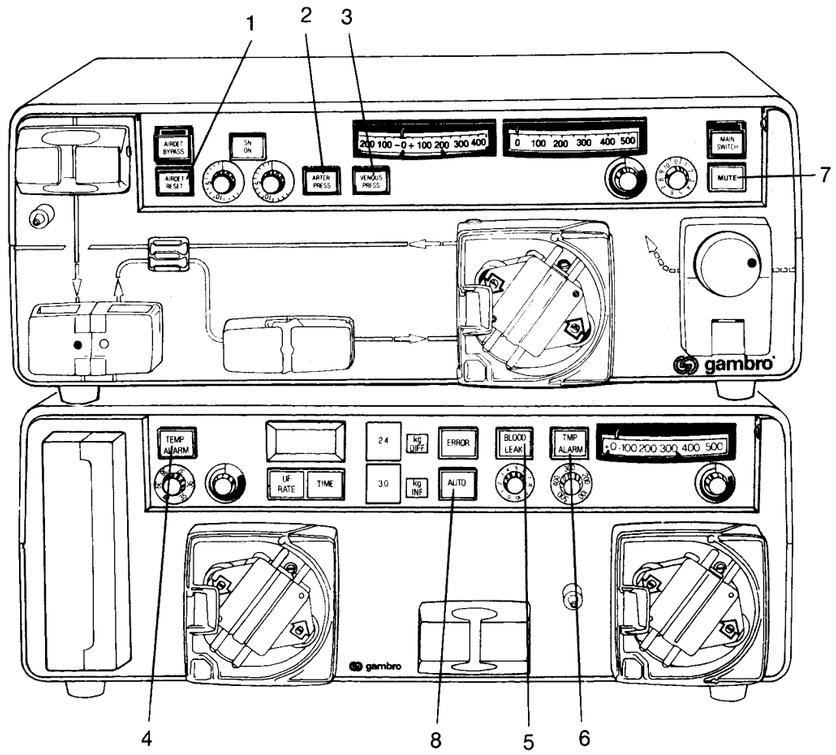
3 **VENOUS PRESS** *(red light on)*.

a) **Too high. All pumps stop.** *The alarm is activated by an increase of the venous pressure above the upper adjustable alarm limit.* This may be caused by an obstruction of the venous line after the drip chamber or a change in the patient's position.

b) **Too low. All pumps stop. The clamps close on the arterial and venous blood lines*.** *The alarm is activated by a decrease in the venous pressure below the lower adjustable alarm limit.* This may be caused by a leaking or separated line, an obstruction before the venous drip chamber, a fall in the patient's blood pressure or a change in the patient's position.

By pressing **VENOUS PRESS.** the blood pump can be forced to run so as to determine why the alarm has occured.

*Not on all models



Hemofiltration monitor alarms

4 **TEMP. ALARM** *(red light on)*.

a) **Too high. The infusion and filtrate pumps stop, the heater is turned off.** (To rectify the alarm condition, both pumps will run intermittently until the temperature in the heater is correct). *The alarm might be activated by a kinked infusion line, a temporary stop of the infusion pump or a malfunction in the heater.* If the alarm is still given after 15 minutes carry out "Discontinuing hemofiltration" and call for technical service.

b) **Too low** *(no buzzer)*. **No reaction except red light on.**
- The heater is turned on when the AUTO-mode is activated. The low temp alarm will then disappear.
- Low temp alarm when AUTO is activated indicates too low temperature of incoming infusion solution or heater malfunction. A medical decision must be made whether the treatment should be continued or not.

5 **BLOOD LEAK** *(red light on)*. **All pumps stop and clamps close on the arterial and venous blood lines.** If the leak is not immediately visible, verify the presence of blood with a separate test.

a) **Small leaks:** Turn up the sensitivity knob to position 10 and press **BLOOD LEAK** *(light off)*. By decreasing the transmembrane pressure and blood flow rate the leak usually seals itself within approx. 5 minutes.

Remember to turn the sensitivity knob back to the original position, increase the blood flow rate and the transmembrane pressure.

b) **Major leaks:** It is important to consider the possible risk of contamination from the filtrate compartment. At this point a medical decision must be made whether or not to return the blood to the patient.
If the blood is to be returned to the patient proceed with "Discontinuing hemofiltration" on page 16, instructions 1–13.
It may be necessary to remove the drip chamber from the blood leak detector in order to start the pumps *(if the light does not go off when* **BLOOD LEAK** *is pressed and the sensitivity control knob is set at position 10)*.

If the blood is not to be returned to the patient proceed with "Discontinuing hemofiltration" on page 16, instructions 1–6.
Change the hemofilter and if required, blood lines and filtrate line. The infusion circuit is not to be removed.
Make sure to use an aseptic technique when handling the venous drip chamber connection.
Carry out "Priming procedure" and "Initiating hemofiltration" on page 14, following the appropriate instructions.

Note: *The machine should not be switched off during this procedure as the patient's treatment parameters are banked in the memory.*
If the machine is switched off follow "Restart and weighing procedure" on page 15, instructions 1–12.

6 **TMP ALARM** *(red light on)*.

a) **Too high. The filtrate pump stops.** *The alarm is activated by an increase in the transmembrane pressure above the upper adjustable alarm limit.* This may be caused by a blockage before the filtrate pump.

b) **Too low. No reaction except the TMP ALARM and MUTE buttons are lit and the buzzer sounds.** *The alarm is activated by a decrease in the transmembrane pressure below the lower adjustable alarm limit.* This may be caused by an air leak before the filtrate pump, or the filtrate pressure transducer protector not being properly connected to the pressure connector.

7 **MUTE** *(red light on, the buzzer sounds)*.

a) *The infusion rate control knob is not turned on or is in min position when the* **AUTO** *mode is activated.* Reset by turning the rate control knob to max position.

b) *The* **AUTO** *mode is not activated within 10 mintes after having started the machine.*
Activate the **AUTO** *mode or press* **MAIN SWITCH** *twice to reset the alarm.*

c) *The microprocessor in the hemofiltration monitor has stopped.* Note the **error code** if possible and carry out "Discontinuing hemofiltration". Call for technical service.

8 **AUTO** *(blinking, the buzzer sounds)*. **The infusion and filtrate pumps stop.** The treatment has finished. Carry out "Discontinuing hemofiltration".

Error alarms

General

MUTE is lit, the buzzer sounds and the **ERROR** indicator is blinking or steadily lit.

a) *Steadily lit* **ERROR**
The alarm indicates a fault in the gravimetric weighing system which may be caused by a handling mistake.
Note the **error code:** By pressing the **UF RATE** and **TIME** buttons simultaneously the **error code** is displayed on the hemofiltration monitor.

b) *Blinking* **ERROR**
The alarm indicates a technical fault.
Note the **error code** as mentioned in point a).
Carry out "Discontinuing hemofiltration" and call for technical service.

Caution

After having rectified the fault caused by wrong handling the alarm condition will automatically be corrected within approx. 5 minutes *(buzzer off, lights off)*. However, whilst the alarm is maintained, the patient must be carefully supervised. If the alarm (30 or 03) does not stop within 45 minutes, carry out "Discontinuing hemofiltration".

Operation action table

Error code Alarm condition	Reason	Action
3C	**1** Running in manual mode	If ready to initiate the treatment press **AUTO** to activate the **AUTO** mode. If not ready press **MAIN SWITCH** twice to reset the alarm function for another 10 minutes.
U1 The amount of infusion solution infused into the patient has not been within the 30–300 ml/min limits during the last 160 sec.	**1** The infusion line is kinked.	Check all the lines in the infusion circuit and straighten out the kink.
	2 No infusion solution in the container/bags	Discontinue hemofiltration. Contact physician with regard to whether a new treatment should be performed on the same day.
	3 The infusion pump is not running.	Check that the pump is switched on, that the pump segment is correctly inserted and that there is no kink. If necessary, call for technical service to exchange the infusion pump.
	4 The container/bags are not hanging free.	Make sure that the container/bags are hanging free.
U2 The filtrate flow rate has not been within the 30–300 ml/min limits during the last 160 sec.	**1** The filtrate line is kinked.	Straighten out the kink.
	2 The filtrate drain line is not placed in the filtrate container.	Place the drain line in the filtrate container. Note how much filtrate was lost and if necessary reprogram the patient's weight loss (amount of lost filtrate = decrease of the patient's weight loss).
	3 The filtrate pump is not running.	Check the preset TMP value. At TMP=0 the UF rate is less than 30 ml/min. Check that the pump is switched on, that the pump segment is correctly inserted and that there is no kink. If necessary, call for technical service to exchange the filtrate pump.
	4 The container is not hanging free.	Make sure that the container is hanging free.

Error code Alarm condition	Reason	Action
 **Linearity alarm** **a)** The patient's weight loss is more than calculated value plus 10% of selected value. *If the selected weight loss is less than 2.0 kg, the alarm limit is set at calculated value plus 200 g.* **b)** The patient's weight loss is more than 500 g/15 min. for the first hour. **c)** The patient's weight loss is more than selected **kg DIFF** plus 0.5 kg.	**1** The infusion line is kinked. **2** The infusion pump is not running. **3** The filtrate pressure transducer protector is not connected to the filtrate pressure connector on the HFM.	Straighten out the kink. see **Action** on page 21 Connect the filtrate pressure transducer protector to the filtrate pressure connector. *When the fault is rectified the HFM will automatically correct the alarm condition and compensate for the patient's excess weight loss by having a higher flow rate in the infusion pump than in the filtrate pump.* Supervise the patient during the alarm condition. Do not reprogram. If necessary IV solution can be given to the patient.
 **Linearity alarm** **a)** The patient's weight loss is less than calculated value minus 10% of selected value. *If the selected weight loss is less than 2.0 kg, the alarm limit is set at calculated value minus 200 g.* **b)** The patient has gained more than 300 g within the first hour. **c)** The patient's weight gain exceeds 0.5 kg/15 min during the first hour after a reprogramming.	**1** The filtrate line is kinked but the filtrate flow rate is more than 30 ml/min. **2** The filtrate drain line is not placed into the filtrate container **3** The filtrate pump is not running.	Straighten out the kink. *When the fault is rectified the HFM will automatically correct the alarm condition and compensate for the patient's excess weight gain by having a higher flow rate in the filtrate pump than in the infusion pump.* Supervise the patient during the alarm condition. Do not reprogram. Place the filtrate drain line into the filtrate container. In this case it may be necessary to reprogramme for less weight loss. see  **Action** on page 21

Error code Alarm condition	Reason	Action
 **Total amount alarm** **a)** A weight increase of more than 100 g on the infusion scale compared to the tared value.	**1** Extra infusion solution has been added to the infusion scale after **AUTO** was activated.	Reprogram the amount of **kg INF** and if necessary the amount of **kg DIFF.**
b) A weight decrease on the infusion scale, compared to the tared value, of more than the programmed amount of **kg INF** + 200 g.	**1** The infusion container/bags have been removed after **AUTO** was activated.	Hang up the infusion container/bags again. After having rectified the fault the alarm condition will be automatically corrected.
 **Total amount alarm** **a)** A weight decrease of more than 100 g on the filtrate scale compared to the tared value.	**1** The filtrate container has been removed after **AUTO** was activated.	Hang up the filtrate container again.
b) A weight increase of more than the programmed amount of **kg INF + kg DIFF** + 200 g on the filtrate scale compared to the tared value.	**1** Something has been placed on the filtrate container after **AUTO** was activated.	Remove the offending article and make sure never to place anything on the filtrate container during treatment. After having rectified the fault the alarm condition will be automatically corrected.

Technical error codes

Indicated by a blinking **ERROR** indicator, **MUTE** is lit and the buzzer sounds. By pressing the **UF RATE** and **TIME** buttons simultaneously the **error code** will be shown on the display.

Caution

The problem needs to be corrected by a technician. Carry out "Discontinuing hemofiltration" and call for technical service.

Error code	Explanation of alarm condition
c 3	Microprocessor failure/error
ɔ 3	Loss of TARE values
u 3	Microprocessor failure/error
c c	Microprocessor failure/error
ɔ ɔ	Microprocessor failure/error
u u	Microprocessor failure/error
t 3	Microprocessor failure/error
53	Microprocessor failure/error
55	Weighing function failure/error

Cleaning

Clean when necessary

Wipe the outside with a cloth moistened with disinfectant.

Do not use alcohol or iodine-based disinfectant. These solvents will dry and crack most polymers. Always keep the heater closed and inserted while cleaning to protect the heating plates and sensors.

Blood, infusion and filtrate pumps

Pull out the pump handle, turn, the roller will disengage from the shaft. The roller assembly can be disinfected in almost any solution and can also be autoclaved. To replace the roller assembly, place it on the shaft, turn, and the first lock will engage. Continue to turn while applying pressure to the locking handle and the second lock will engage.

Heparin-protamine pump

Unscrew the knob *(turn to the left)* and remove the roller. The housing and shaft can now be cleaned easily.

Technical data BMM 10-1

Operating principle
Double-needle or single-needle blood circulation using time regulated clamps

Blood pump
Self-threading roller pump
adjustable occlusion

Flow regulation
50–500 ml/min indicated on flow instrument

Heparin pump
Roller pump for two lines (heparin and when required protamine)

Flow regulation
0–10 ml/h indicated on regulating knob

Pressures

Arterial pressure
Pressure sensor plate with microswitch
Alarm limits: adjustable −50 to −500 mmHg

Venous pressure
Measured in dripchamber
Instrument: −200 to + 400 mmHg ± 10% mmHg
Alarm limits: adjustable on instrument

Air detector
Ultrasonic detection at dripchamber
Sensitivity: max. 0.2 ml air/min at blood flow below 300 ml/min

Power supply

Mains voltage
240, 220, 130, 110 V ±10%; 50 or 60 Hz
(Mains frequency must be specified for running-time meter)

Power
Max. 100 W

Cable length
Approx. 3 m

Mains socket
Standard earthed socket; DIN specifications for 220 V; ASA for 110 V

Fuses
220 V: 2*×0.63 ATT; DIN 5×20
110 V: 2*×1.25 ATT; ASA 6.3×22
* For some countries 1×0.63 ATT; 1.25 ATT

The monitor is protected against electric shock according to IEC 601-1, Classification B.

Leakage current
30 μA

Dimensions
Depth: 400 mm
(with front components 450 mm)
Width: 510 mm
Height: 190 mm

Weight
13 kg

Technical data HFM 10-1

Operating principle
Electronic feed-back control

Fluid balancing

Pumps
Infusion: self-threading roller pump
Flow rate: 0/approx. 20–200 ml/min with tube 6×1.5 dia.

Ultrafiltrate: self-threading roller pump
Flow rate: 0/approx. 20–200 ml/min with tube 6×1.5 dia.

Infusion and ultrafiltrate scales
Weighing range: 0–35 kg (including weighing arms and containers)
Overload protection: mechanical
Weighing arms: different types available to suit most types of containers

Selectors
kg DIFF: weight loss
kg INF: quantity of infusion solution

Pressure/TMP

Regulation
0 to 500 mmHg (0 to 66 kPa)
± 10% or ± 10 mmHg (1.3 kPa)

Instrument
+ 50 to −500 mmHg (+7 to −66 kPa)

Alarm limits
Adjustable; set with two indicators

Temperature
Incoming infusion solution: min. 15°C
Heated infusion solution: 35–40°C±1°C

Blood leak detector
Transillumination of the ultrafiltrate towards infrared phototransistor
Sensitivity: adjustable; 10 steps; least sensitive position 10

Power supply

Mains voltage
240, 220, 130, 110 V ±10%; 50 or 60 Hz
(Mains frequency must be specified for running-time meter)

Power
Approx. 400 W

Mains socket
Standard earthed socket; DIN specifications for 220 V; ASA for 110 V

Fuses
220 V: 2*×0.63 ATT and 1.6 AF;
DIN 5×20
110 V: 2*×1.25 ATT and 3.0 AF;
ASA 6.3×32
* For some countries 1×0.63 ATT; 1.25 ATT

The monitor is protected against electric shock according to IEC 601-1, Classification B.

Cable length
Approx. 3 m

Dimensions
Depth: 400 mm
(with front components 450 mm)
Width: 510 mm
Height: 190 mm

Weight
23.5 kg

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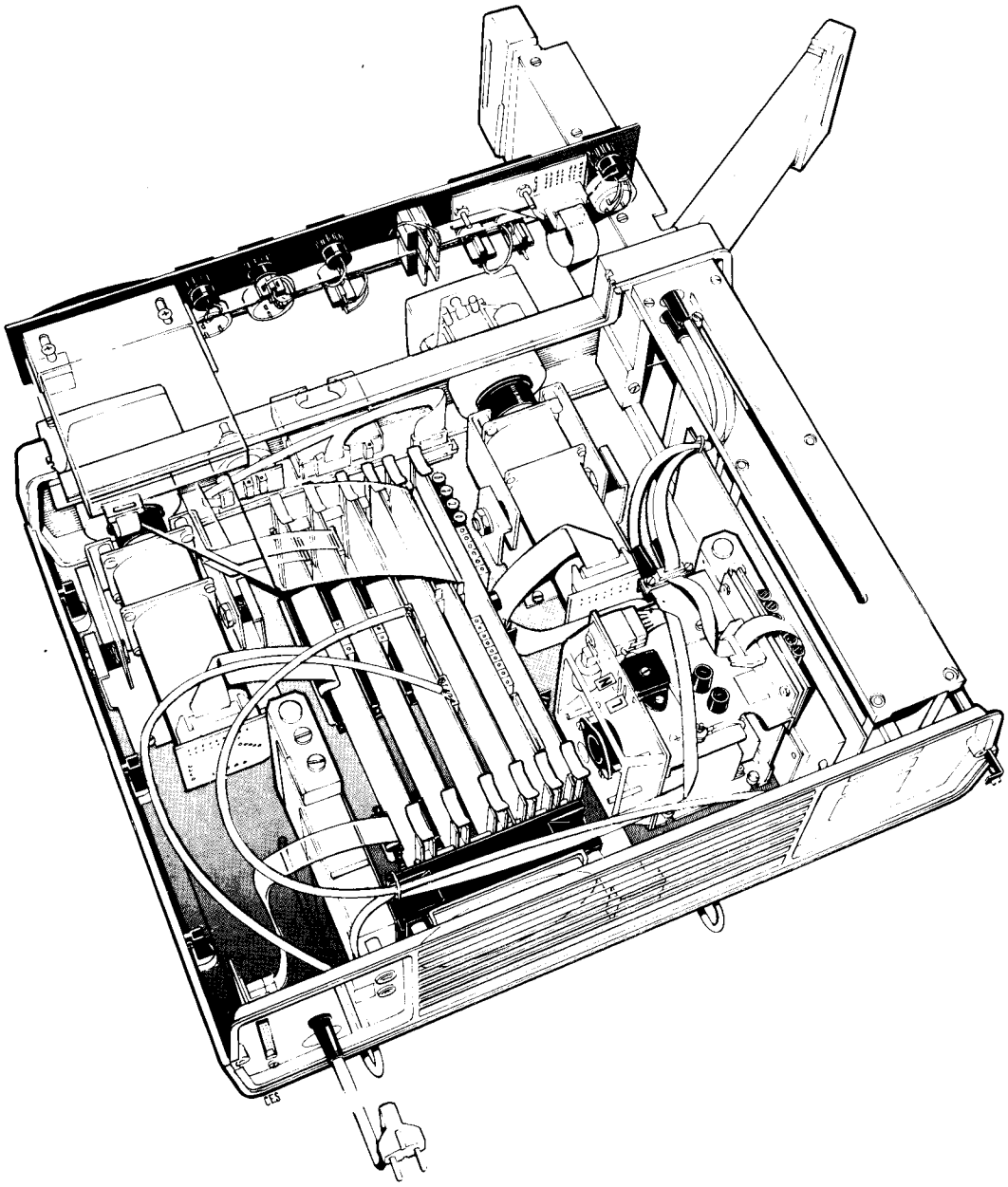
AK-10 System

Hemofiltration monitor HFM 10-1

Service manual



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General description

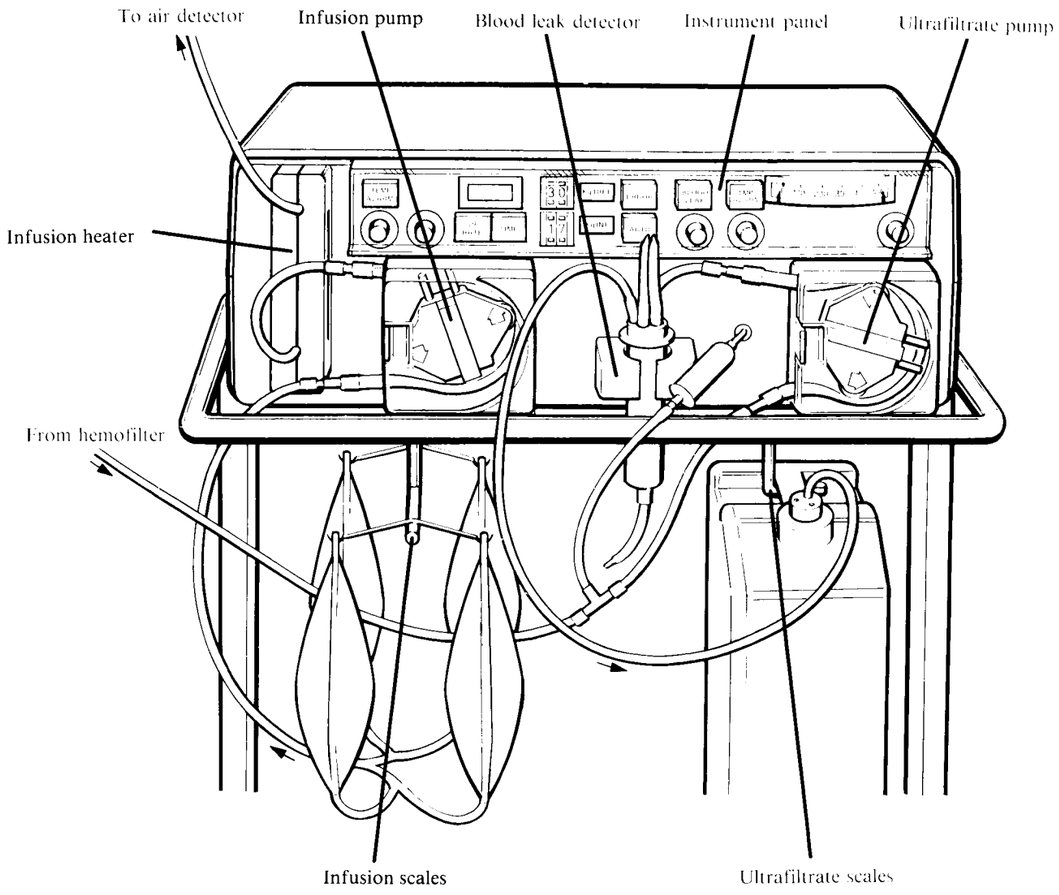
The function of the hemofiltration monitor is to control and monitor the infusion flow to the blood stream returning to the patient at hemofiltration and to control and monitor the ultrafiltrate drawn from the patient through the hemofilter.

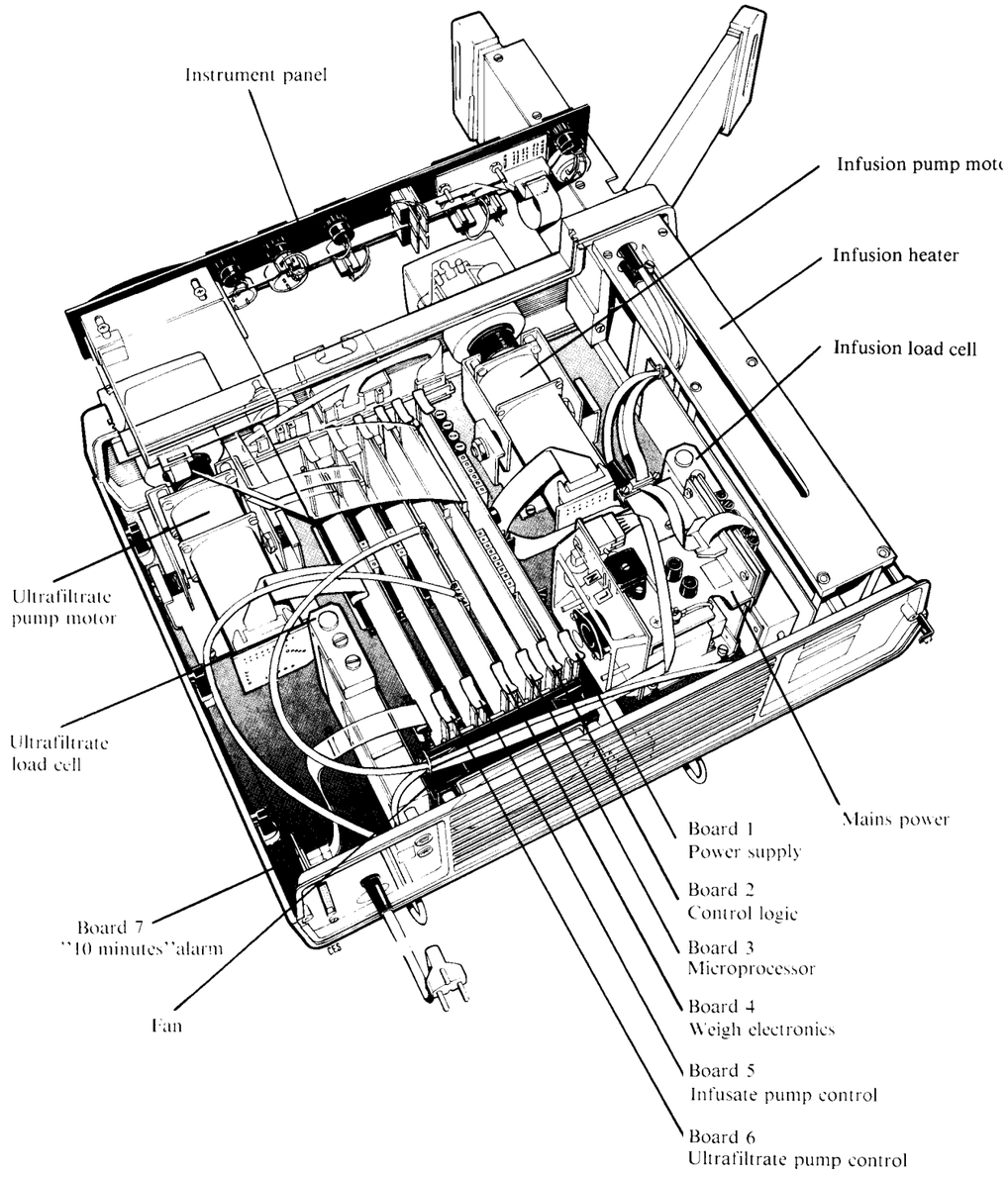
The infusion is heated before it is added to the blood stream.

Treatment is automatic after setting of weight loss and infusion quantity values and selection of AUTO. The weight loss is continuosly shown on a display. The display can also be switched over to show calculated remaining treatment time or ultrafiltration rate.

The transmembrane pressure (TMP) across the hemofilter is monitored and maintained at a settable level. Both lower and upper alarm limits can be set. Alarm is also given at overtemperature and undertemperature in the heater, blood leakage in the hemofilter and certain weighing and microprocessor operating errors.

The operating function is made clear in the operator's manual.





Temperature control and alarm

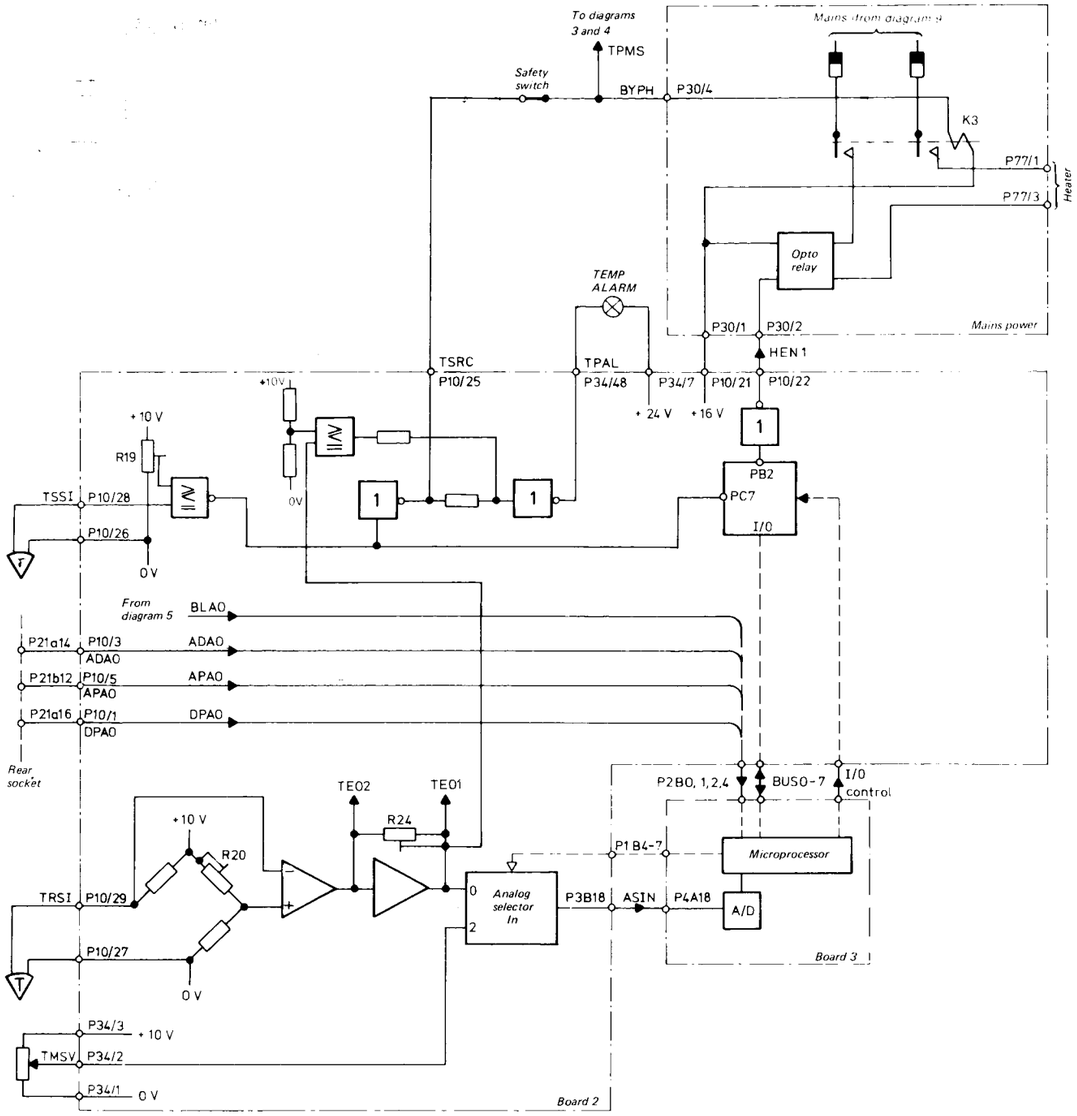


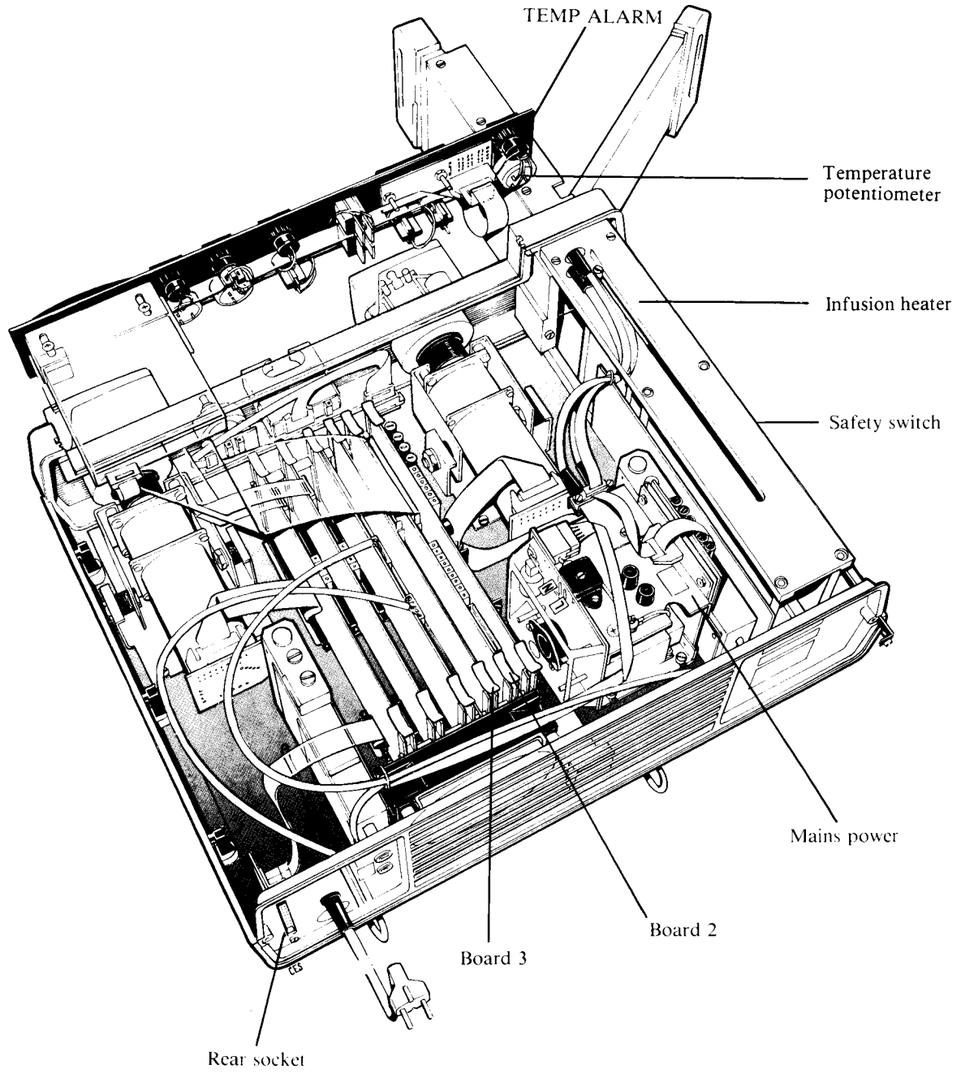
Diagram 1

There are two types of temperature transducers. An alarm transducer and a regulating transducer.

The regulating transducer in the heater-handle is connected to a bridge board (TR S1). The bridge is zeroed by R20. The output from the bridge is amplified and fed through an analog selector on board 2 and an analog-digital converter on board 3 to the microprocessor. The range is set by R24. From the temperature potentiometer on the front panel, TMSV is fed in the same way to the microprocessor. The analog selector is selected by P1B4 (zero) and addressed by P1B5-7 from the microprocessor.

The microprocessor compares the two values and issues signal HEN1 through the I/O circuit on board 2 to the opto relay in the mains power. The opto relay connects the mains voltage to the heater in series with the normally activated relay K3. HEN1 is pulsed to turn the heater on for longer or shorter intervals depending on the temperature deviation. The pulsing of HEN1 is also controlled by infusion flow information in the microprocessor (speed control signal MCVI, see Infusion pump control).

If the infusion potentiometer is not turned far enough (clockwise) from a zero position then in **manaul mode** the heater is switched off and in **AUTO mode** the heater is switched off and the buzzer sounds.



There are two types of alarms:
1. Software alarms.
The microprocessor turns the heater off at five different alarms: blood lead (BLAO), air in blood circuit (ADAO), arterial pressure too low (APAO), venous pressure out of limits (DPAO), or a sensed temperature by the regulating transducer exceeds 42°C. In the last case (temp more than 42°C) the microprocessor turns PC7 to be an outport and deactivates relay K3, lights up the TEMP ALARM lamp, switches on the buzzer, makes HEN1 high, stops pump. After the temperature goes below 42°C the infusion pump rotates at least 5 × 1/2 rev. (with intervals) until the temperature goes below 37°C. When the pump rotates, the microprocessor turns PC7 to be an outport.

2. Hardware alarms.
The alarm transducer is placed adjacent to the handle in the heater and connected to a comparator on board 2 (TS S1). The second input to the comparator is set to the equivalent of 42°C by potentiometer R19. If the sensed temperature exceeds this value, the comparator issues a zero, which deactivates the relay K3 lights the TEMP ALARM lamp, stops pumps. After the temperature goes below 42°C, the infusion pump works as described above (1).

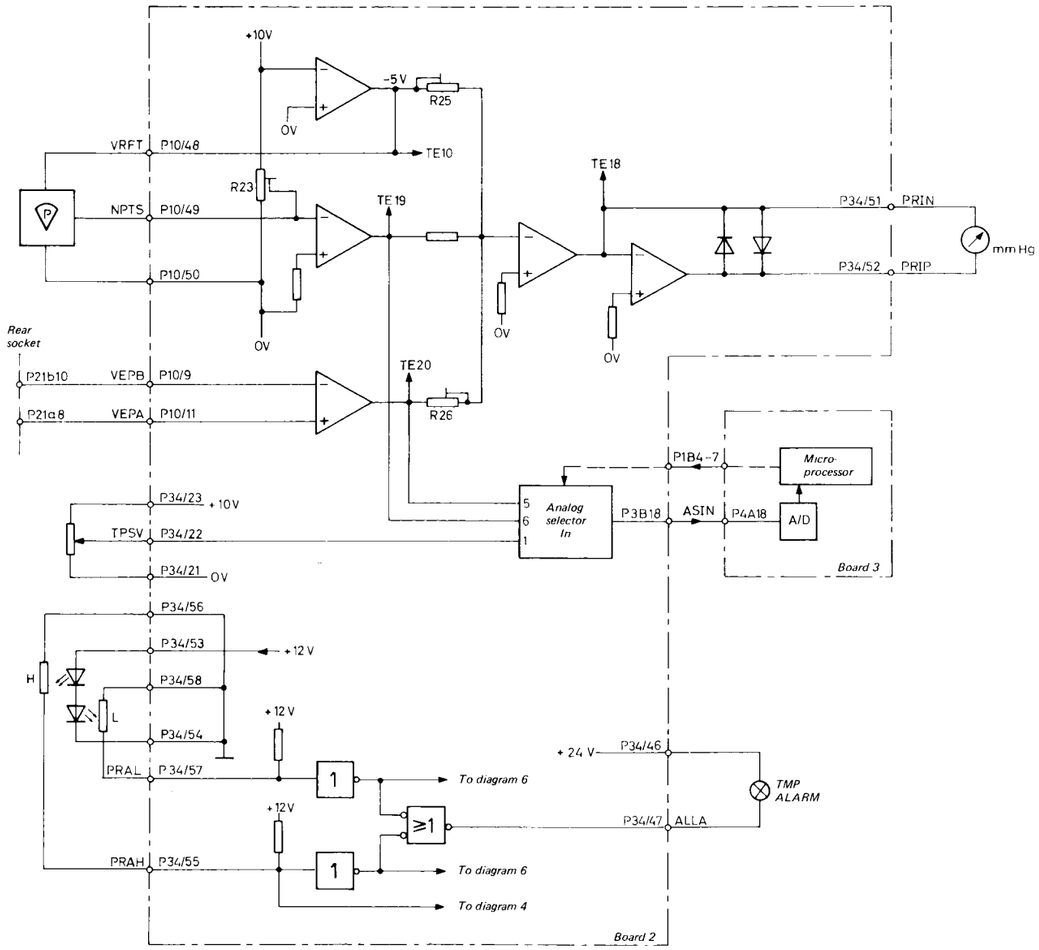
The output from the comparator is also input to the microprocessor through the I/O circuit.

The regulating transducer circuit also issues the low temperature alarm signal in case the temperature goes below 34°C. the signal is amplified and fed to the comparator lighting up the TEMP ALARM lamp.

the relay is also deactivated when the heater is pulled out and the safety switch opens. The open safety switch stops the infusion and ultrafiltrate pumps (see diagram 3 and 4).

The heater is divided up in two elements, which are connected in series for 220 V or in paralell for 110 V. Each element has an overheating guard which breaks the supply circuit at 75°C and automatically resets when the element has cooled down.

Pressure monitoring and control



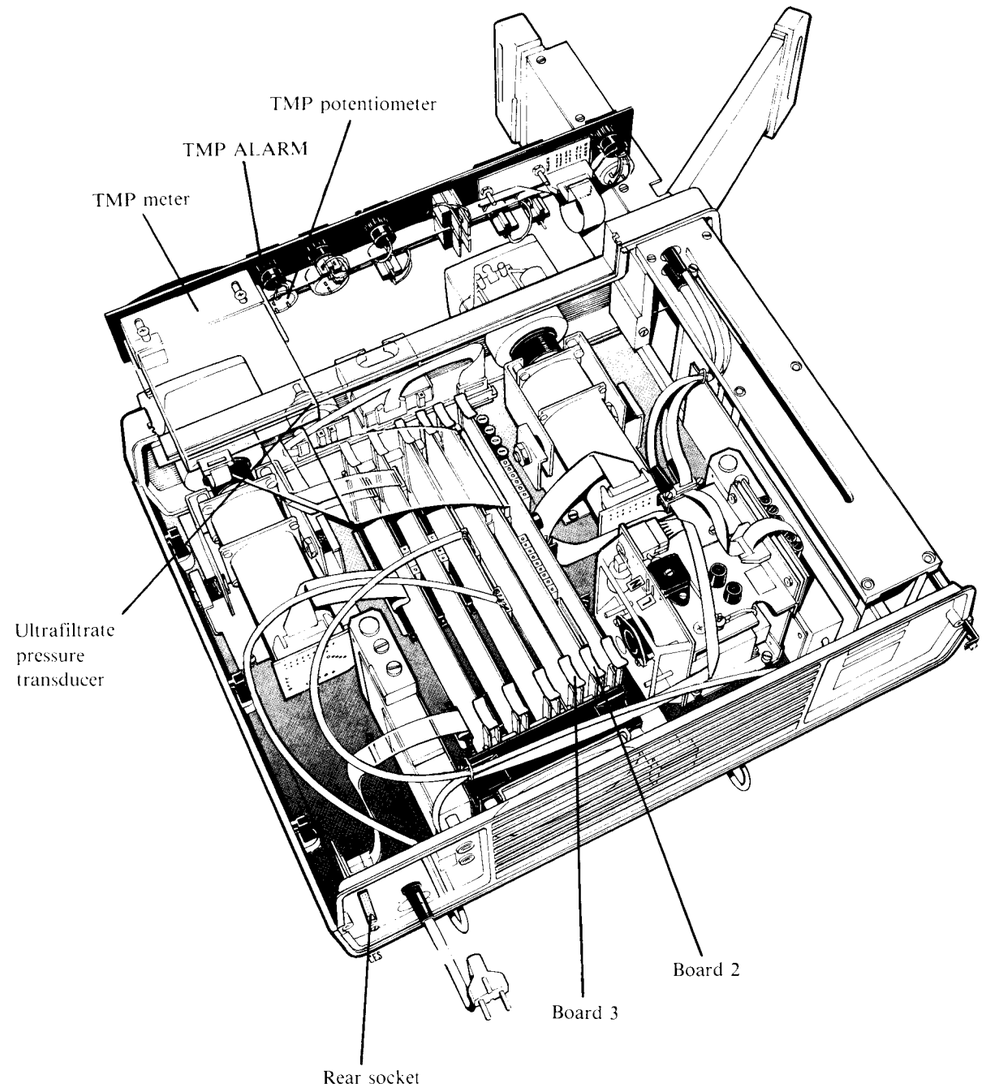


Diagram 2

The ultrafiltrate pressure transducer is fed with -5 V from an amplifier serving as a + 10 V/ -5 V dc converter. The output from the transducer, NPTS is amplified and fed to a summing point, where it is added to a zero-setting voltage from the -5 V converter and a venous pressure signal VEPA/VEPB.

Trimmer R23 is used to set the output of the NPTS amplifier at 0 mm Hg ultrafiltrate pressure. Trimmer R26 is used to adjust the venous pressure signal

R25 is used to adjust the instrument at the 0 mmHg venous pressure

The summed voltages are amplified further and fed to the TMP meter.

The ultrafiltrate and venous pressure signals are also fed to the microprocessor through the in analog selector and the analog-digital converter. In the same way TPSV is fed from the TMP potentiometer on the front panel to the microprocessor. The in selector is selected by P1B4 and addressed by P1B5-7. The microprocessor will compare set and actual values and control the ultrafiltrate pump to keep the TMP at the set value irrespective of changes in the venous pressure.

On the meter there are two alarm limit indicators with opto-electronic sensors, one giving PRAH when TMP (trans membrane pressure) is too high, the other PRAL when TMP is too low. The signals are inverted and fed to the TMP ALARM lamp through an OR gate and to the buzzer alarm circuits (diagram 6).

The upper limit signal is also fed to the stop circuit for the ultrafiltrate pump (diagram 4).

Infusion pump control

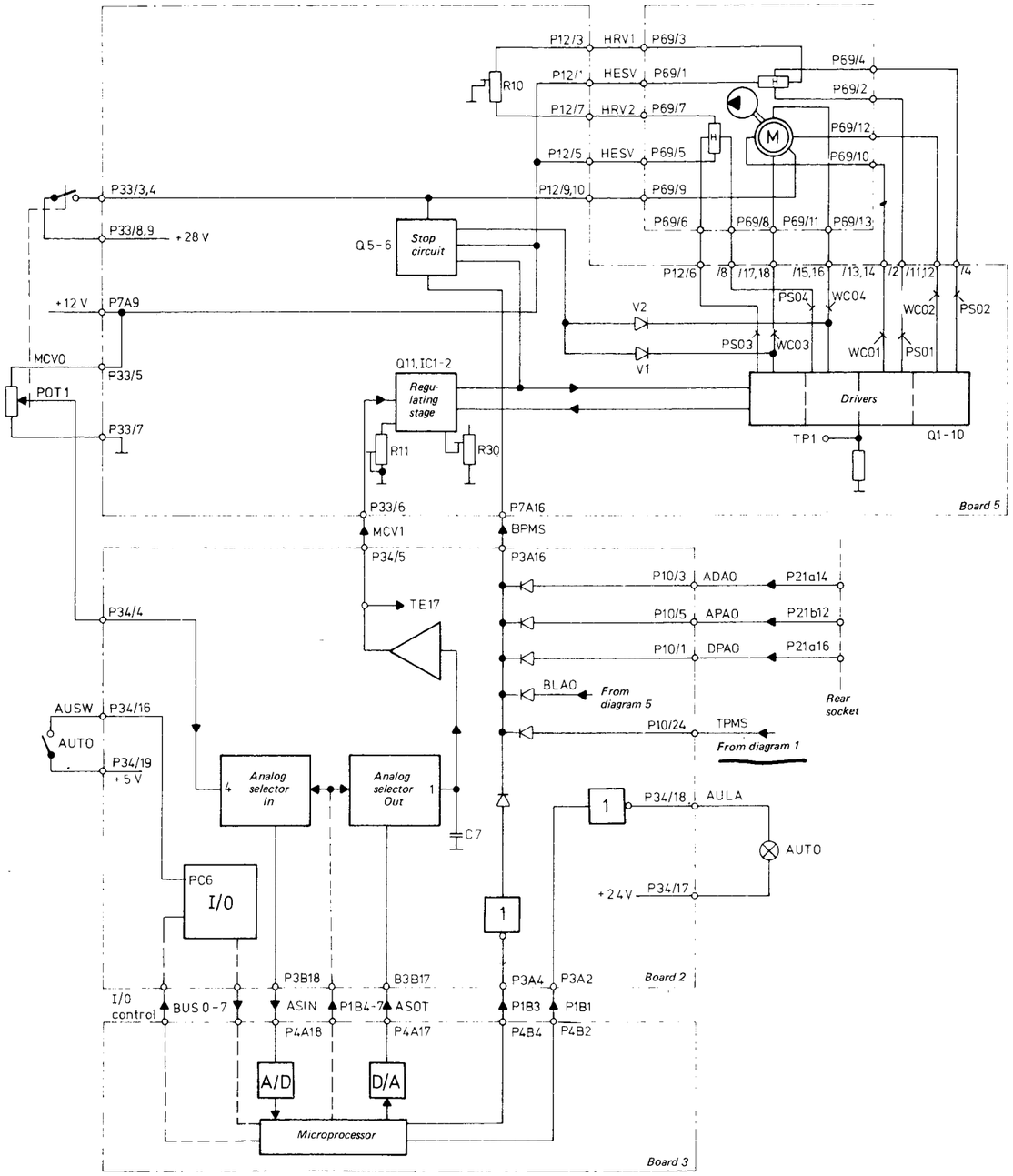
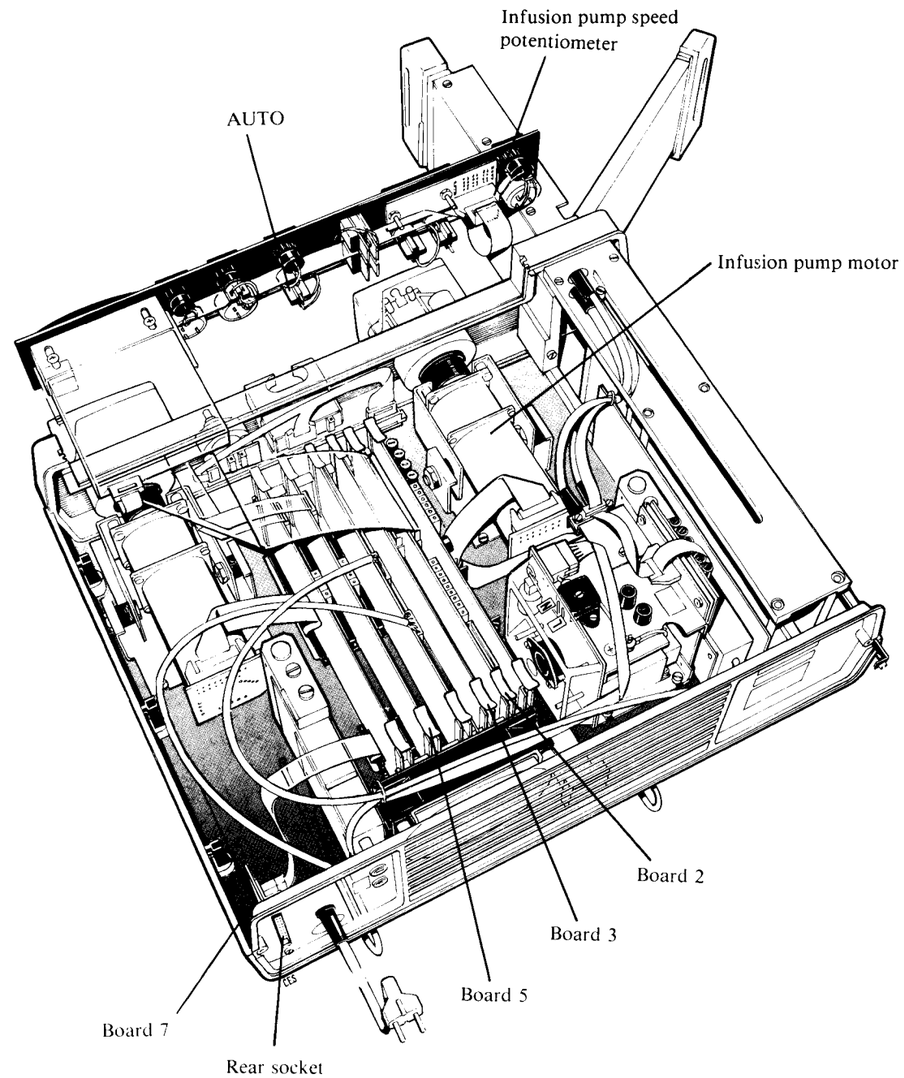


Diagram 3

When the infusion pump speed potentiometer is turned from the zero position, a switch connects +28 V to one end of the four windings of the infusion pump motor. The other ends of the windings are each connected to their own driver.

The motor has no mechanical commutator. It is controlled instead by Hall elements which sense the position of the rotor. The Hall elements are fed with +12 V (HESV) and balanced with R10. PS01-04 from the Hall elements control the drivers.



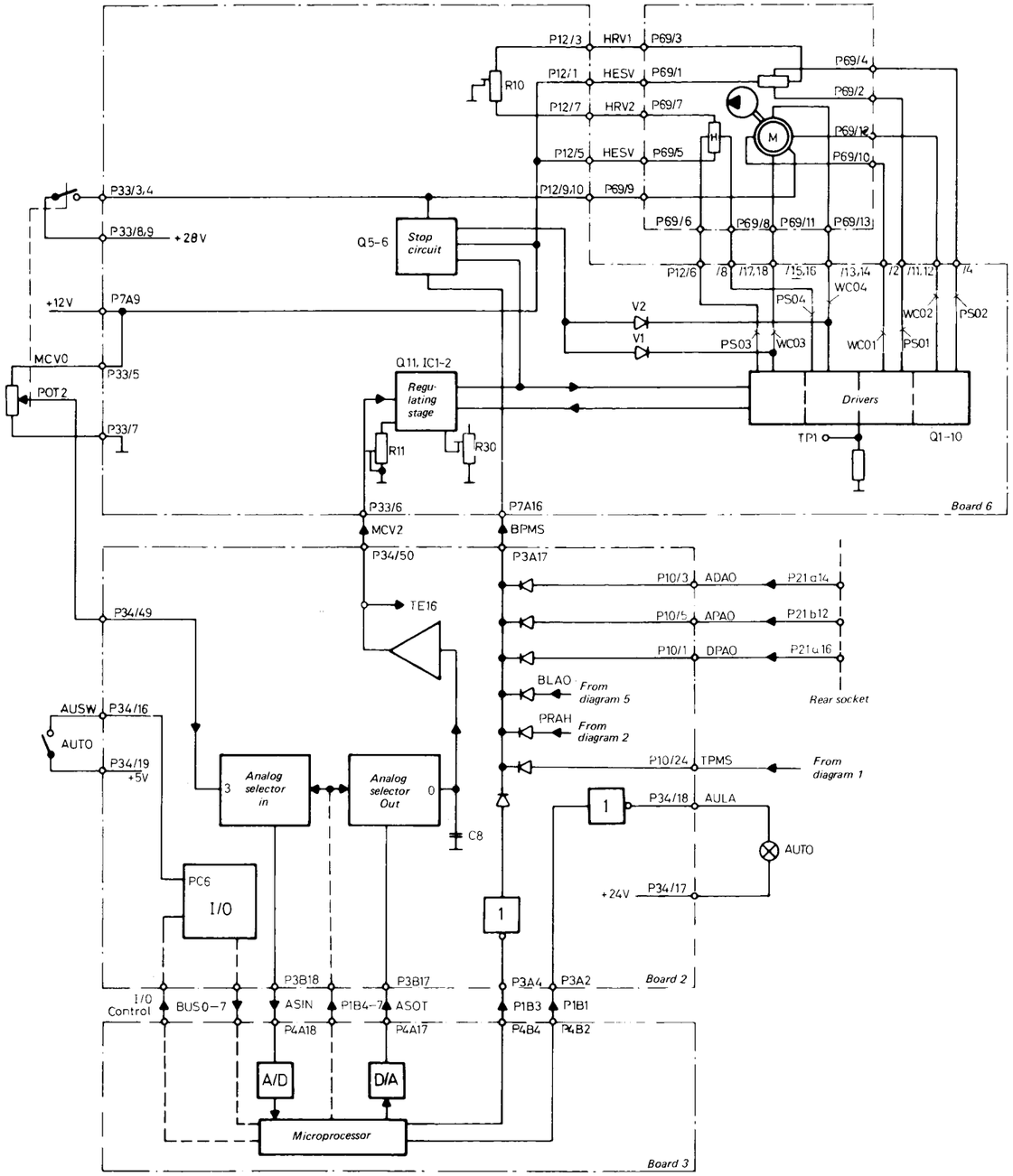
The motor can be stopped at any time by the BPMS signal, which is received either from the microprocessor when treatment is completed or at air detection (ADAO), insufficient arterial pressure (APAO), venous pressure out of limits (DPAO), blood leakage (BLAO) and infusion temperature above 42°C or heater pulled out (TPMS). The signal enters a stop circuit which acts on the drivers. For a quick stop this results in short-circuiting of two of the motor windings through the diodes V1 and V2. When BPMS ceases, the stop circuit are current limitation in the drivers so that the motor does not start in a rush.

The speed of the motor- i.e indirectly the flow- is regulated by the signal MCVI. The signal is fed to a regulating circuit, which acts on the drivers. The regulating circuit also senses the current through the drivers. In case of momentary overloading it limits the current. In case of prolonged overloading it stops the motor but automatically makes repeated attempts at starting.

When AUTO is selected, signal AUSW is fed through the I/O circuit to the microprocessor to select automatic control if the infusion potentiometer is not turned far enough (clockwise) from a zero position in AUTO mode then the heater is switched off and the buzzer sounds. The microprocessor lights the AUTO lamp. Signal MCVI is then derived from the microprocessor through a digital-analog converter on board 3 and the out analog selector on board 2. The out analog selector is selected by P1B4 (one) and addressed by P1B5-7 from the microprocessor. When treatment is completed the microprocessor will cause the lamp to blink.

In manual mode the POT1 signal is fed to analog selector in-A/D converter- microprocessor. The microprocessor is only copying POT1, and transfering it to the regulating stage as MCVI. When the heater is on the microprocessor filtrates POT1 to prevent MCVI from quick changes. If the infusion potentiometer is not turned far enough (clockwise) from a zero position in manual mode then the heater is switched off.
Signal AULA is also fed to the "10 minutes" alarm board (diagram 8).

Ultrafiltrate pump control



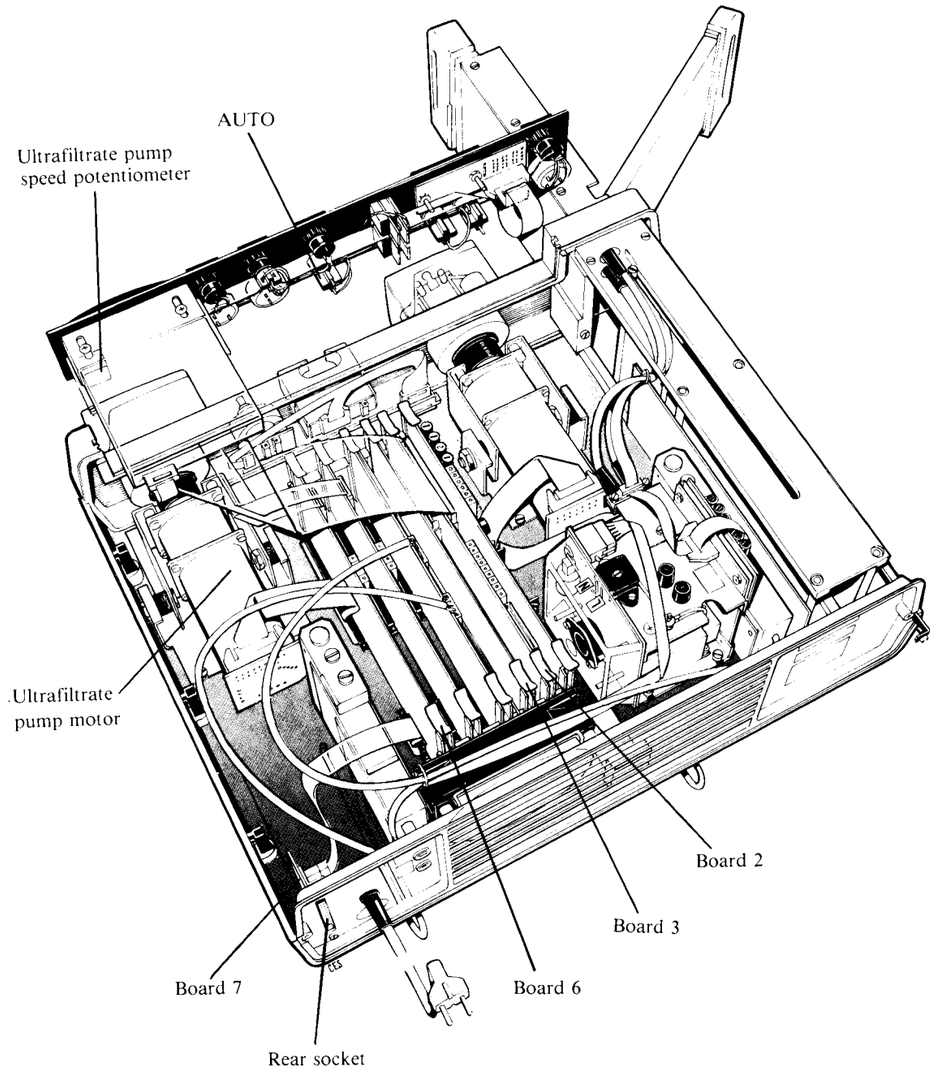


Diagram 4

The ultrafiltrate pump control circuits are similar to those for infusion pump control. The motor is however also stopped at too high TMP (PRAH). There is no filtration of the POT2 signal

Blood leak detection

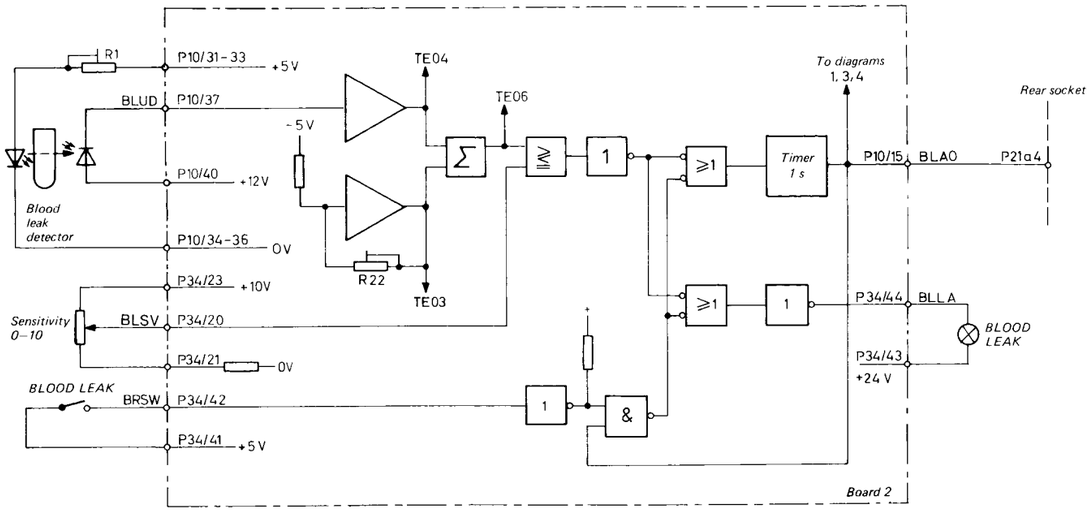


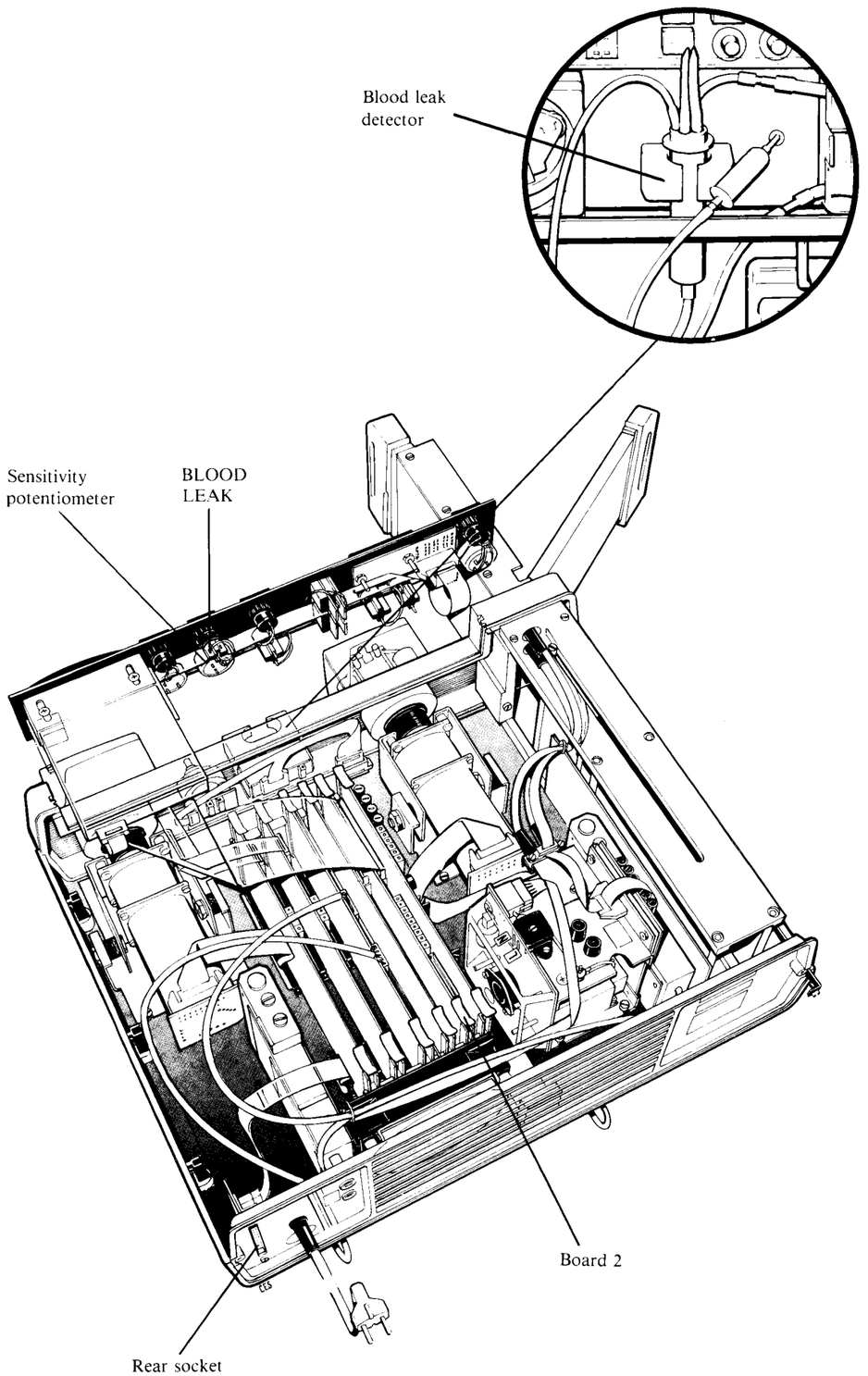
Diagram 5

Blood in the dialysis fluid causes a lower signal level BLUD. The signal is amplified on board 2 and fed to a comparator, which compares it with signal BLSV from the sensitivity potentiometer. If a blood leak occurs the comparator output gets high and the BLOOD LEAK lamp is lit.

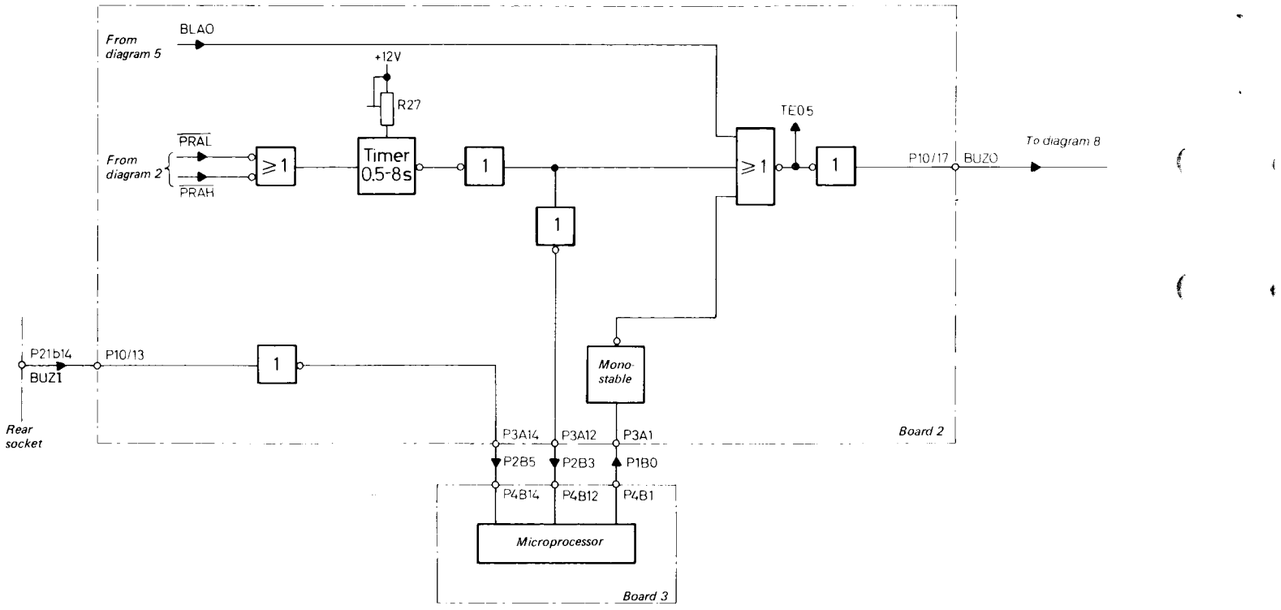
After one second the timer output gets high, i.e the timer issues BLAO to the microprocessor for heater switch-off (diagram 1), to the motor stop circuits (diagrams 3 and 4) and to the blood unit for blood pump stop and arterial and venous line clamping.

The timer is locked by its own output acting through a NAND gate. This gate also keeps the BLOOD LEAK lamp lit.

The timer is reset and the lamp extinguished by depressing the BLOOD LEAK button.



Buzzer alarm



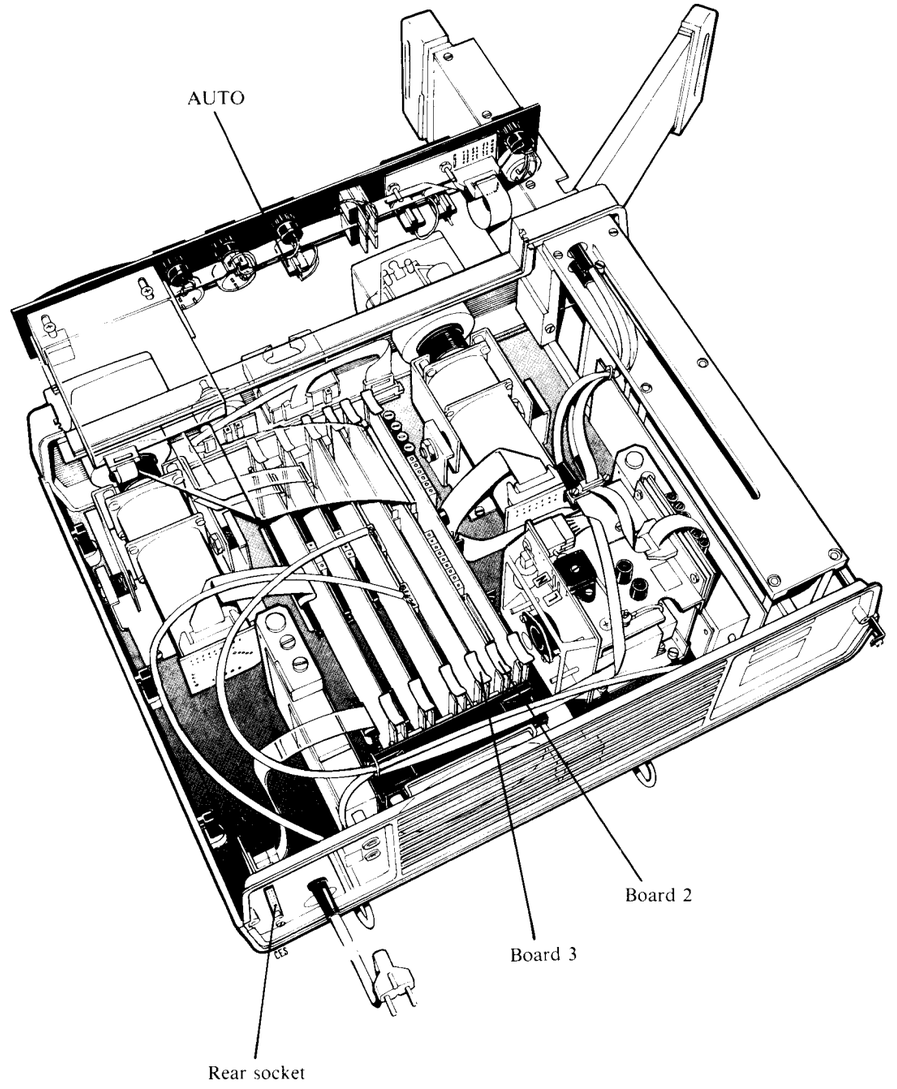


Diagram 6

The buzzer alarm signal BUZO is initiated in three instances.

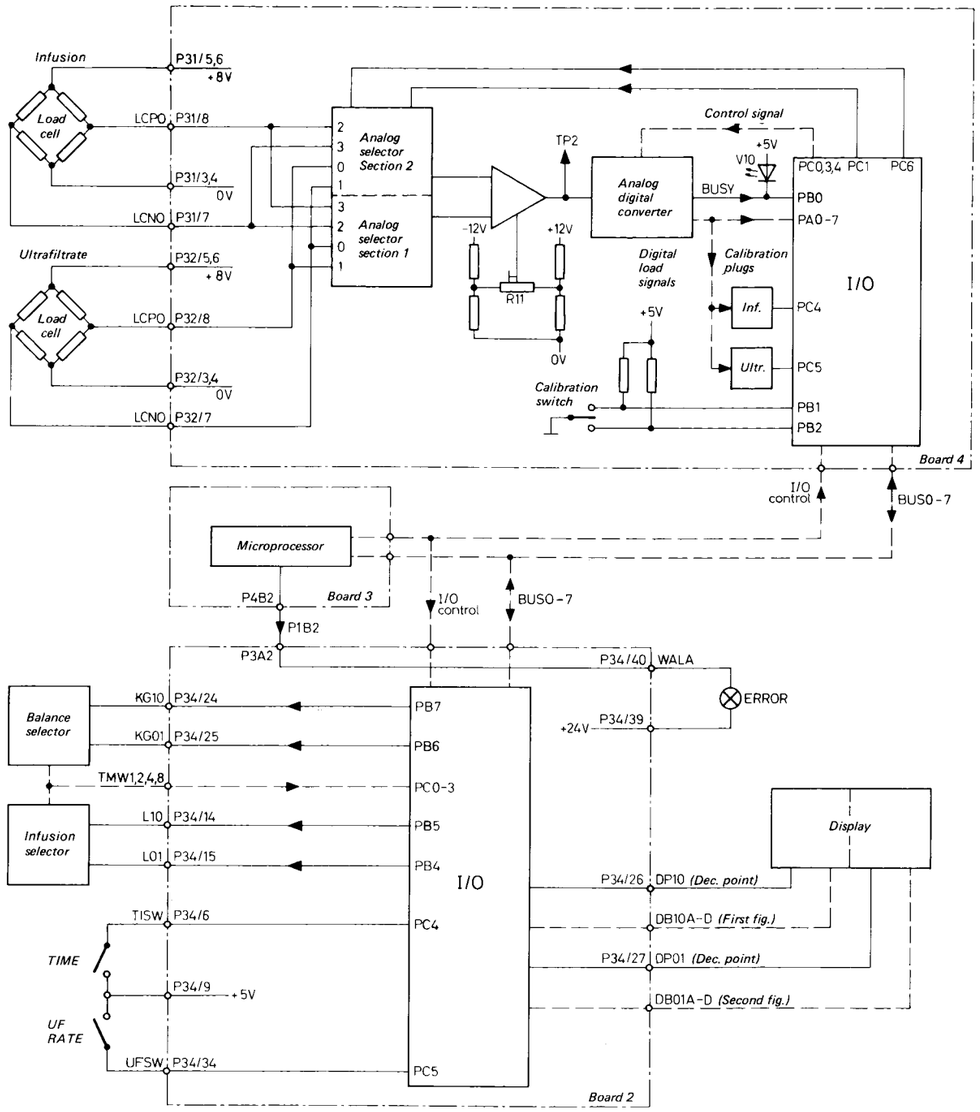
At blood leakage, i.e at BLAO, BUZO will at once be issued to the blood unit.

At TMP out of limits, BUZO will be issued after a delay which can be set by R27.

From the microprocessor, a square wave P1B0 is fed out to a monostable on board 2. The monostable will then give out a continous zero. If the microcomputer fails or issues an alarm(stops a square wave) the monostable output will go high and BUZO will be issued. When treatment is finished, P4B1 will be inhibited intentionally to initiate the alarm and alert the operator. After the AUTOswitch is released the microprocessor continues generating of a square wave.

The general alarm signal BUZI from the blood unit is input to the microprocessor for later use at connection of a central alarm system.

Weighing system



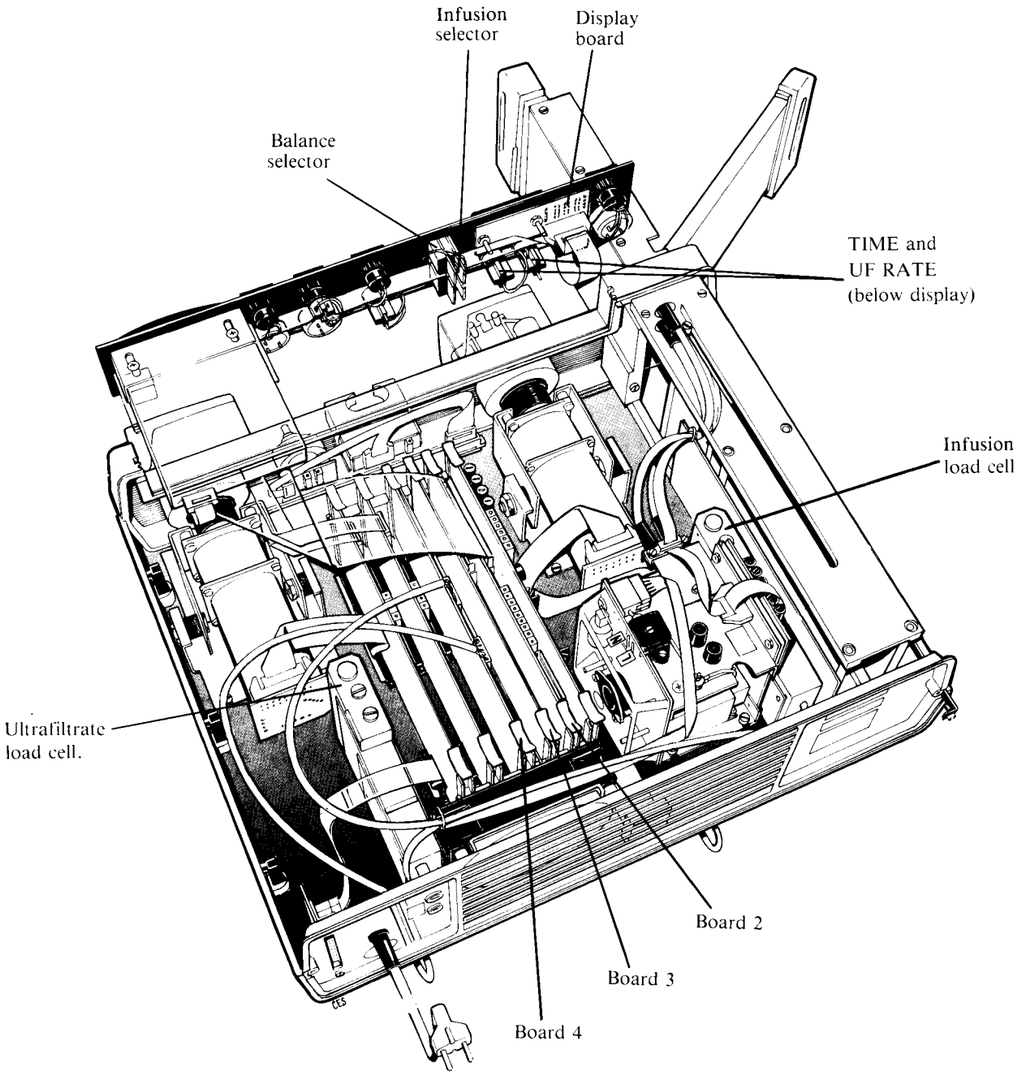


Diagram 7

The load cells consist of strain sensors, arranged in bridges and powered by +8 V. The outputs are input to an analog selector, which is controlled from the microprocessor through an I/O circuit. The selector first passes the output from one load cell and then its inverted version to an amplifier. The output from the amplifier is analog to digital converted and fed to the microprocessor where the mean value is calculated. The microprocessor eventually uses the mean value at four such mean values for the control. In this way any drift in the amplifier is compensated. The output from the other load cell is treated in the same way. The load cell range is limited to 35 kg by stop screws in the bottom plate below the load cells.

The analog-digital converter signals BUSY to the microprocessor during conversion to indicate when no values are available. LED on the board is then extinguished.

The load cells are individually calibrated by selector plugs inserted in sockets on board 4 when exchanging the cells. The calibration switch is for selecting the I/O circuit for display of calibration factor for infusion or ultrafiltrate scales (see service).

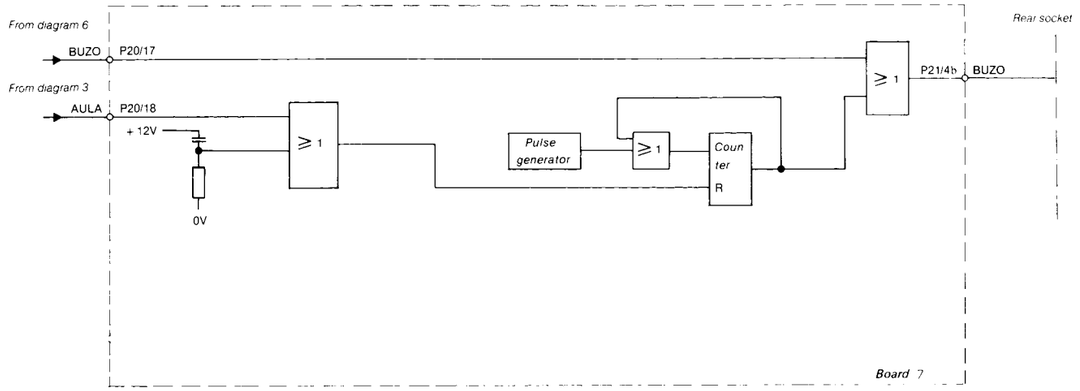
The values set on the infusion and balance selectors ar also input to the microprocessor. When AUTO is selected (see infusion pump control and Ultrafiltrate pump control) the pump motor speeds are controlled to obtain the selected values.

Normally, the weight loss (up to 9,9 kg) is indicated on the display (steady light - patient weight loss, blinking light - patient weight gain). If button TIME is depressed, the indicator will show calculated remaining treatment time in hours and tens of minutes. During the last hour the remaining time will be shown in minutes.

If button UF RATE is depressed, the indicator will show the ultrafiltration rate in fractions of litre/min.

The ERROR lamp is lit at weighing errors, which the operator can often correct, or blinks at other errors, which concern the operation of the microprocessor. The display will show codes for these errors if the UF RATE and TIME buttons are depressed simultaneously (see service).

”10 minutes” alarm board.



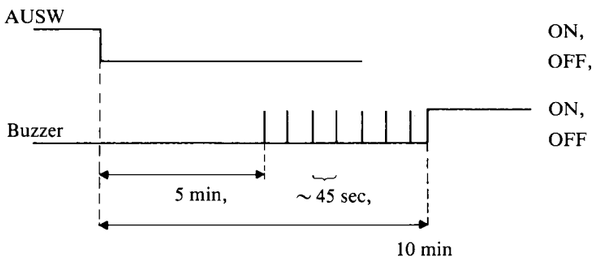


Fig.1.

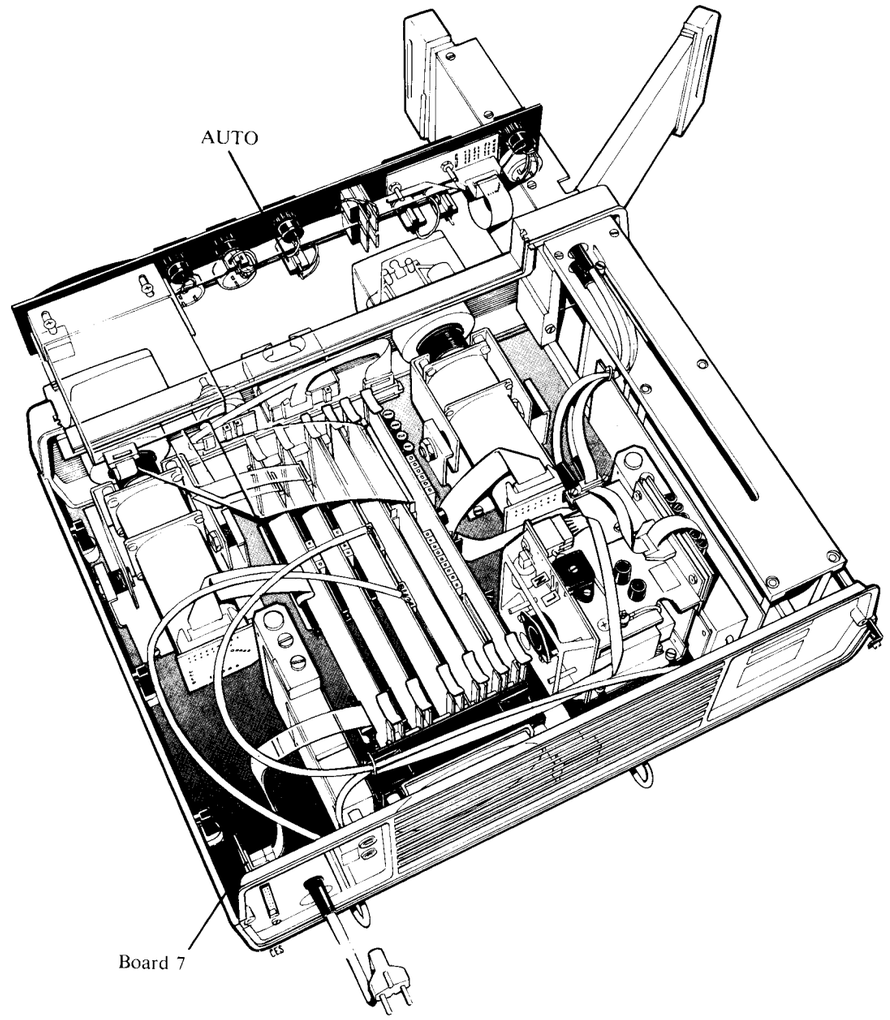


Diagram 8

The function of the board is to monitor that the AUTO lamp is on.

The AULA signal is fed from board 2. As long as the AUTO lamp is on the counter is reset. If the AUTO lamp is switched off the counter starts counting.
Clock pulses are fed from the pulse generator. After 10 minutes the output from the counter goes high and the BUZO signal is issued the counter is stopped. In practice this means that after 10 minutes in the manual mode (AUTO switch is not on) the buzzer is on.
This alarm is also included in a software and is activated by releasing AUTO (see Fig.1)

Power supply

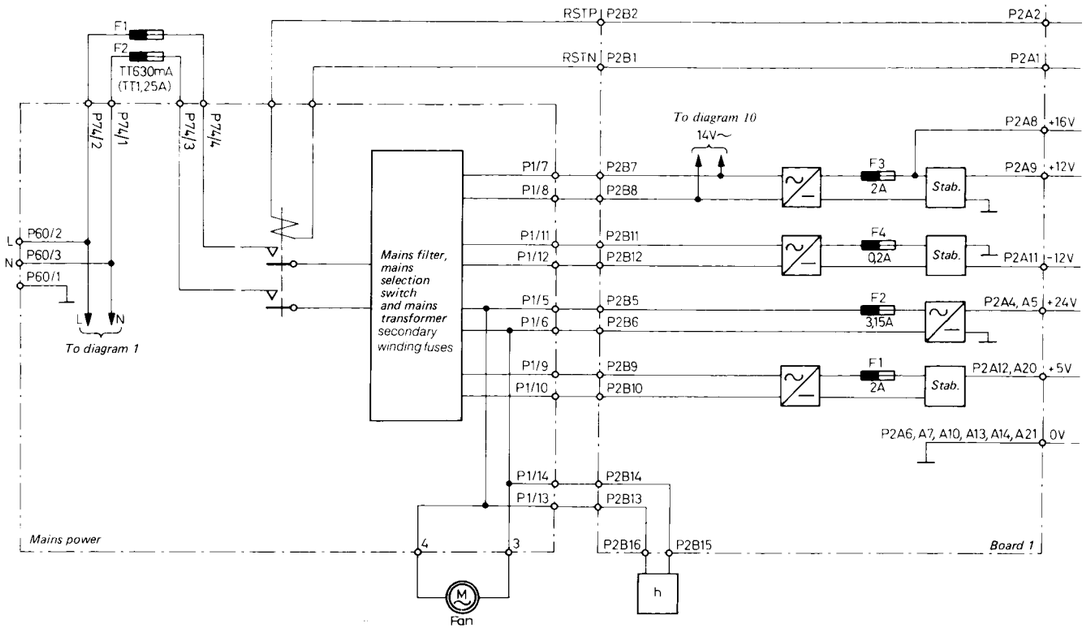


Diagram 9

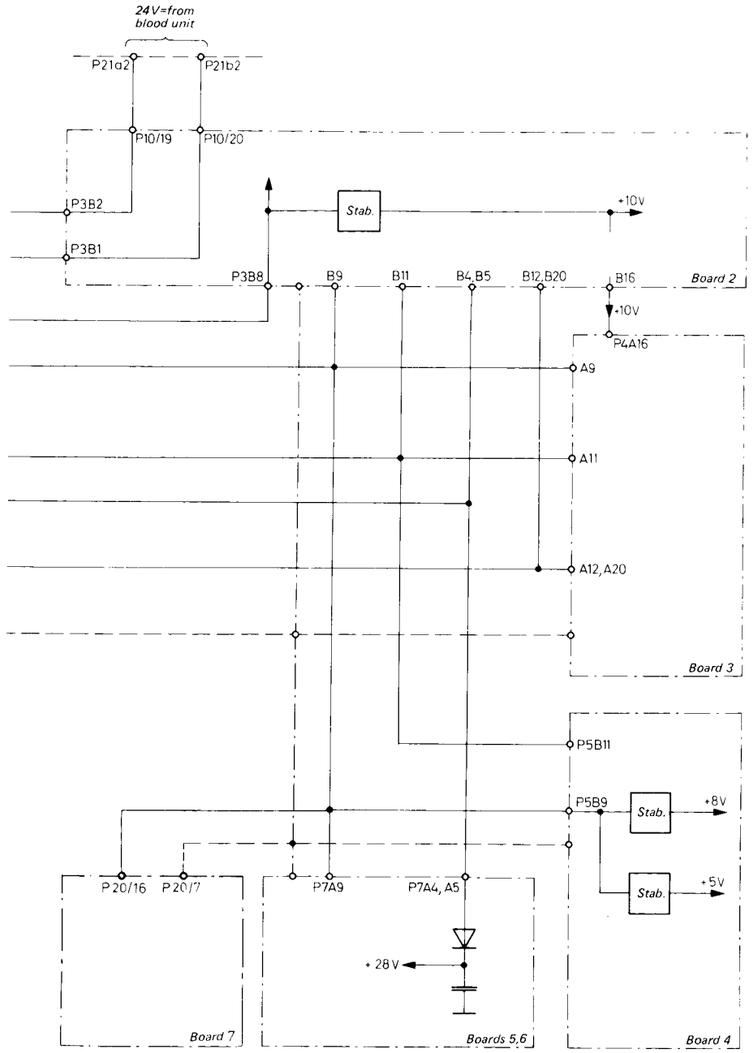
The hemofiltration unit receives its electrical supply from the mains power and board 1.

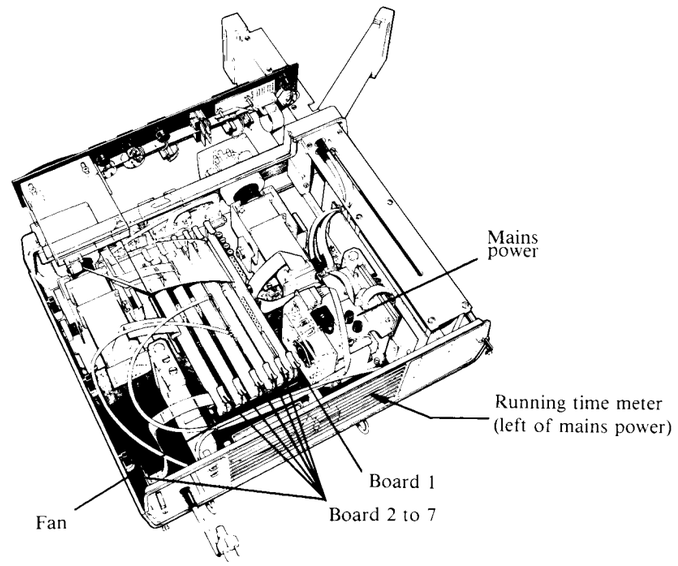
The unit is connected directly to the mains by a mains relay in the mains power. The mains relay receives its operating voltage from the blood unit when this has been switched on. Mains voltage is tapped off, before the main fuses, for the heater (see diagram 1).

The mains power also contains mains filter, voltage selection for 110, 130, 220 and 240 V, as well as +/- 10 V, and mains transformer.

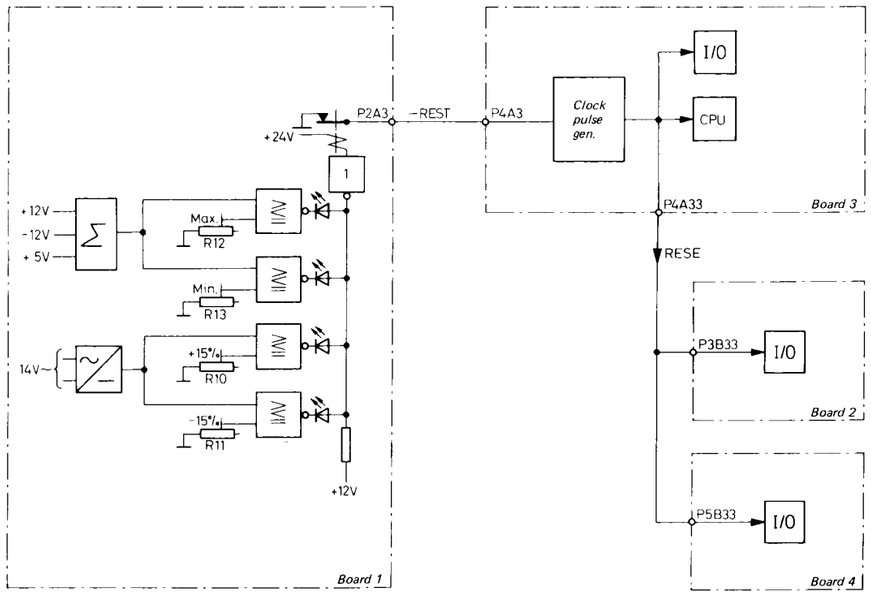
Board 1 contains rectifiers and stabilizers for a range of voltages distributed to boards 2-7. Stabilizers are also placed on boards 2 and 4.

Board 1 also contains resetting circuits (see diagram 10).





Resetting circuits



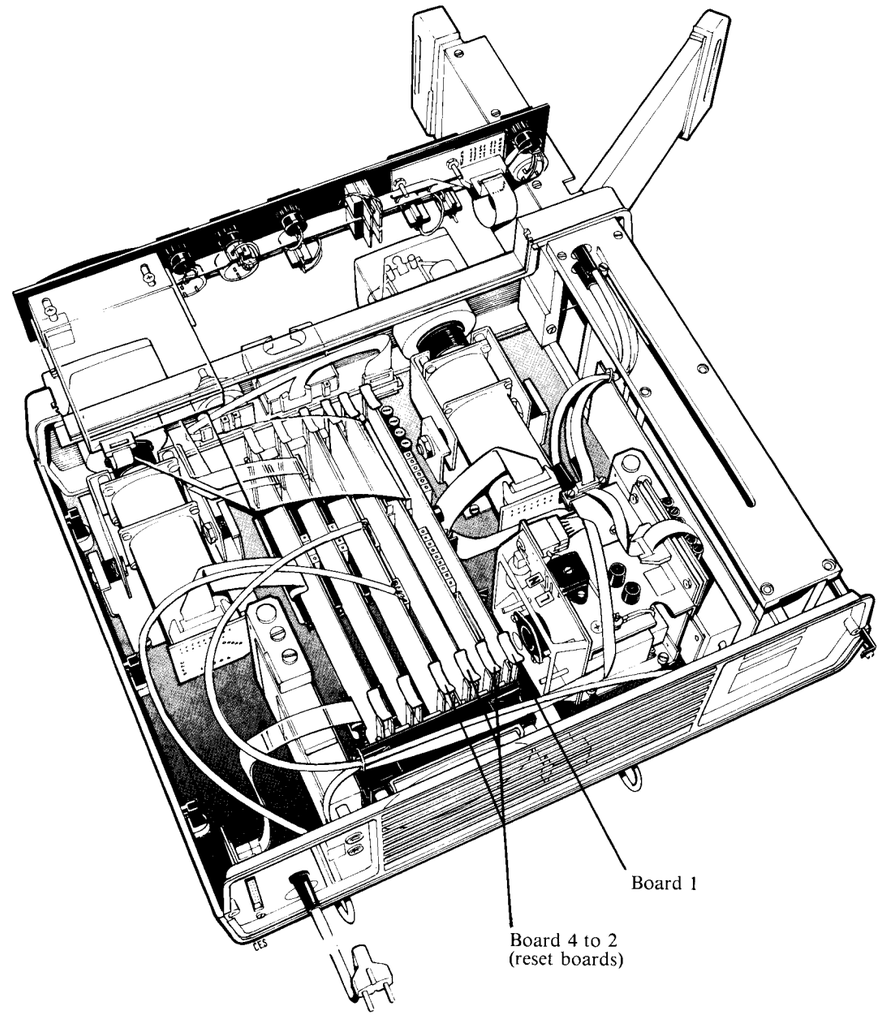


Diagram 10

If deviation is too great on the + 12 V, -12 V or + 5 V voltages or more than 15% deviation in the mains voltage, a relay feeds -REST to the clock pulse generator on the microprocessor board. The clock pulse generator issues RESE, which is used to reset the CPU and the I/O circuit on the microprocessor board as well as the I/O circuits on the control logic and weigh electronics boards. Consequently the circuits are reset at switch-off.

Alarm list

Source of alarm \ Affected devices	Heater off	TEMP ALARM lamp	TMP ALARM lamp	Buzzer (from blood unit)	Infusion pump stop	Ultrafiltrate pump stop	BLOOD LEAK lamp	ERROR lamp blinking	ERROR lamp steady
Alarm temperature transducer	○	○		○	○	○			
Regulating temperature transducer (high temp)	○	○		○	○	○			
Regulating temperature transducer (low temp)		○							
Blood leak detector	○			○	○	○	○		
Air detector (from blood unit)	○			○	○	○			
Arterial pressure transducer (from blood unit)	○			○	○	○			
Venous pressure transducer (from blood unit)	○			○	○	○			
Safety switch	○				○	○			
TMP meter (too low TMP)			○	○					
TMP meter (too high TMP)			○	○		○			
AUTO switch (not pressed)				○					
Treatment faults				○					○
Electronics				○				○	
Infusion pump potentiometer (in manual mode)	○								
Infusion pump potentiometer (in auto mode)	○			○					

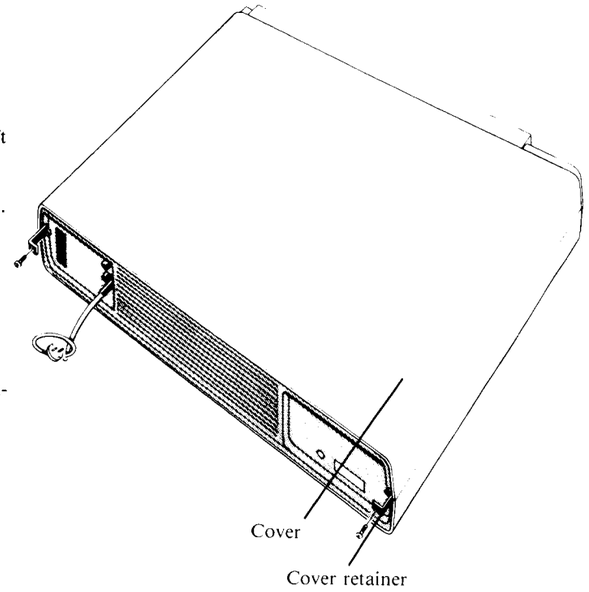
Field service

Removing the cover

Disconnect the machine from the mains.

Loosen the locking screw and withdraw the cover retainers. Lift the cover straight up.

Before replacing, check that the cover retainers are pulled out. Insert the cover retainers carefully while depressing the cover.

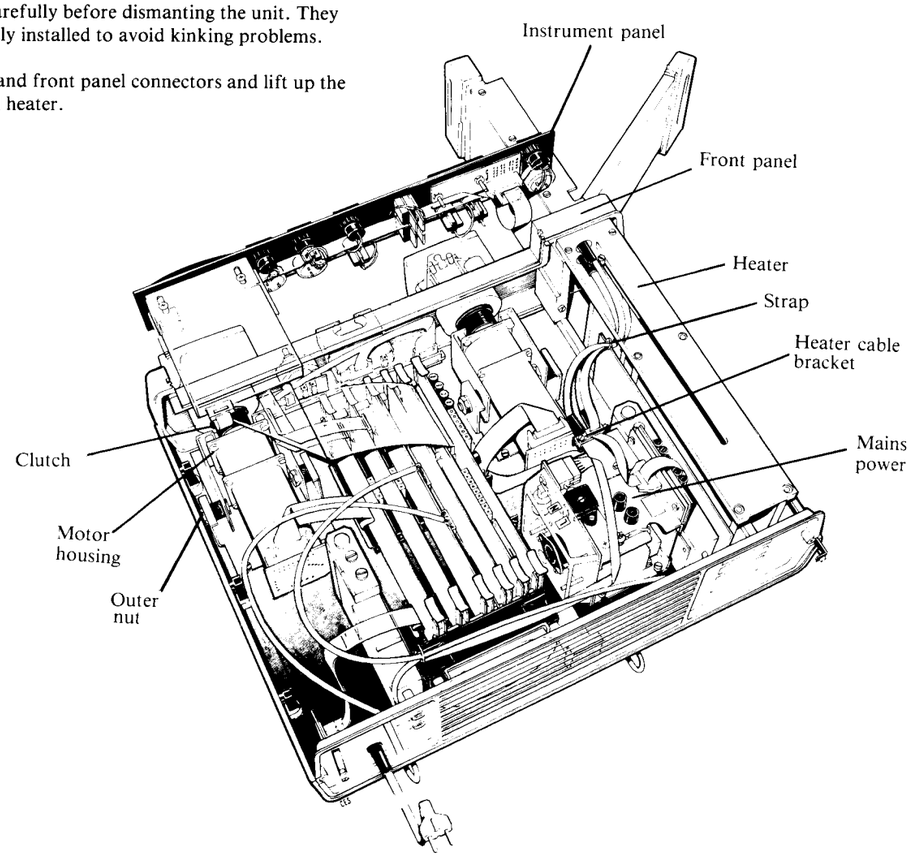


Removing the instrument panel.

The instrument panel can be lifted away with all connections intact. First disconnect the machine from the mains.

Removing the front panel.

1. Undo the outer nuts on the pump motor housing.
2. Push the motors back so that the clutches disengage.
3. Loosen the bracket for the heater cables from the power supply.
4. Cut the strap holding the heater cable. Note: Study the heater cables carefully before dismanting the unit. They must be correctly installed to avoid kinking problems.
5. Unplug heater and front panel connectors and lift up the front panel and heater.

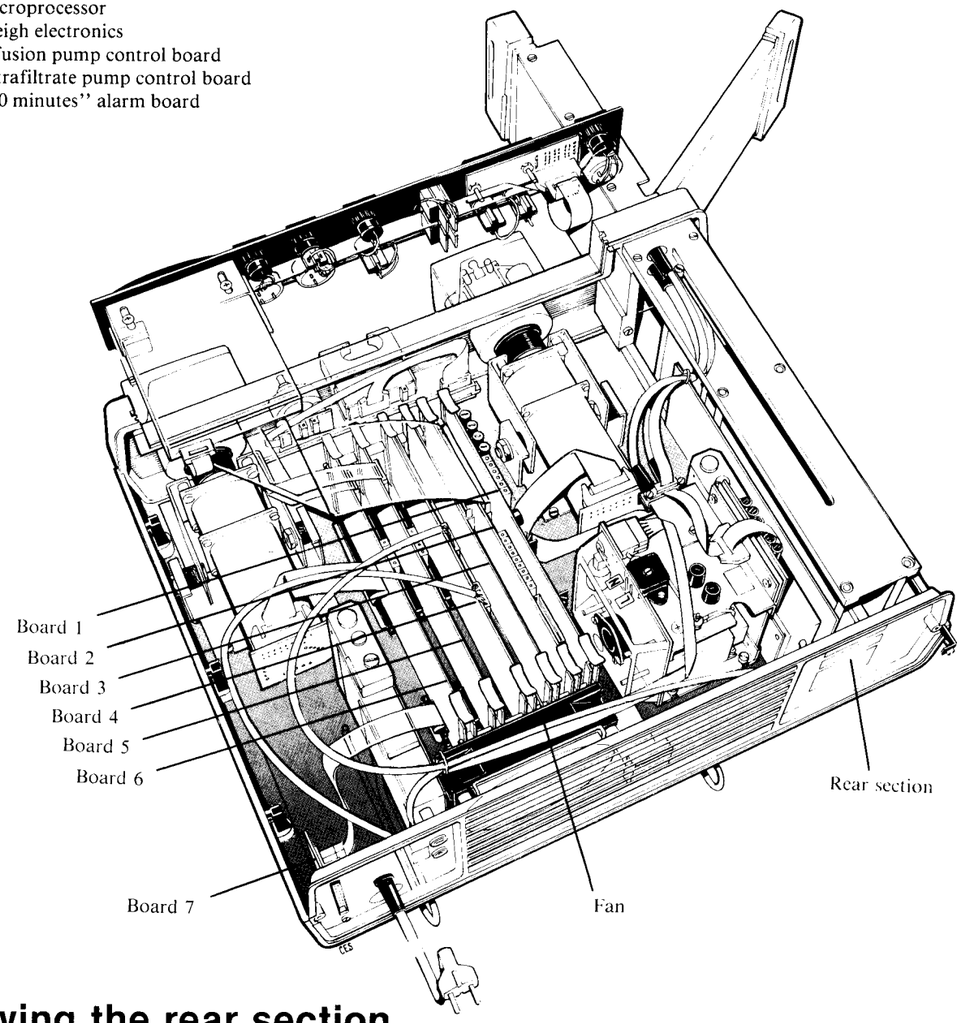


Changing the printed circuit boards

Fold the lifting arms outwards.

When replacing the boards, note that there is a key arrangement whereby each board only fits one position. Board 1 is the one adjacent to the power supply.

Board 1: Power supply board
Board 2: Control logic
Board 3: Microprocessor
Board 4: Weigh electronics
Board 5: Infusion pump control board
Board 6: Ultrafiltrate pump control board
Board 7: ''10 minutes'' alarm board



Removing the rear section

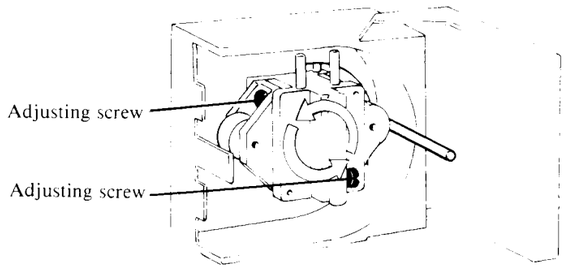
Just lift the section up.

Changing the fan.

Lift away the rear section to expose the fan.

Adjusting the pumps

Insert the gauge pin between one of the pressure rollers and the pump path without using force. Check that the holder of the roller just starts to move inwards. If it does not, rotate the rotor through 180°, turn the adjusting screw and check again.



Changing the pump motors

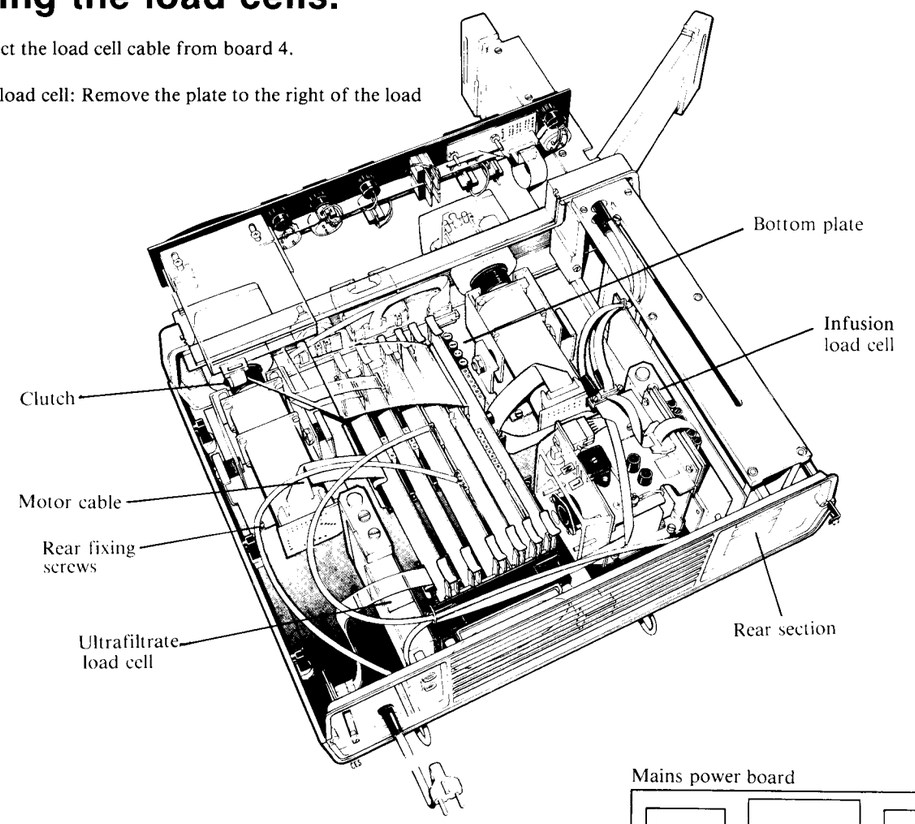
1. Remove the two rear screws in the bottom plate of the motor and loosen the front screw.
2. Unplug the cable.
3. Pull the motor to the rear so that the two halves of the clutch slide apart and lift out the motor.

Changing the load cells.

1. Disconnect the load cell cable from board 4.
2. Infusion load cell: Remove the plate to the right of the load cell.

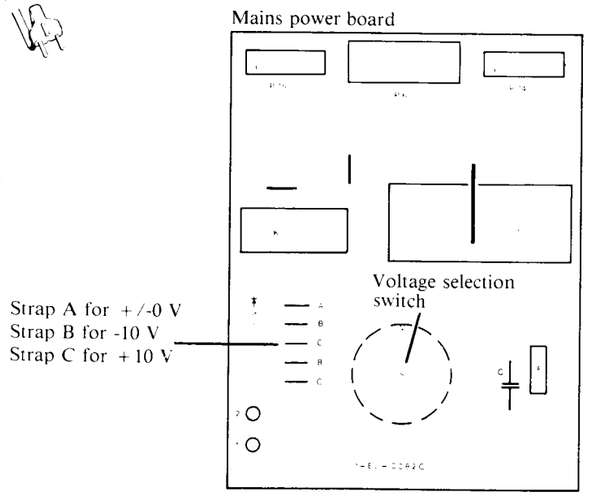
Ultrafiltrate cell. Remove the rear section.

3. Remove the two screws in the T-bracket holding the load cell to the bottom plate (one screw on each side of the load cell, at the rear end).
4. Move the T-bracket to the new load cell.
5. Reassemble.
6. Adjust the load limits (See Special adjustments).



Changing the voltage

The switch under the transparent cover on the power supply can be set for 110, 130, 220 and 240 V. By means of strapping it is also possible to select a 0 V, + 10 or -10 V deviation from these values.



Changing the signal lamps

Remove the text cap with the special tool or by inserting a screwdriver in the slot on the top and twisting. Remove the lamp by pulling it straight out with the removing tool.

All lamps are 36 V, 30 mA.

Special adjustments

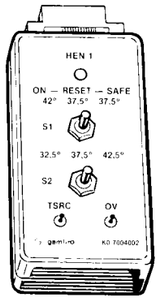
Technical aids

The following instructions are based on the availability of four special technical aids:

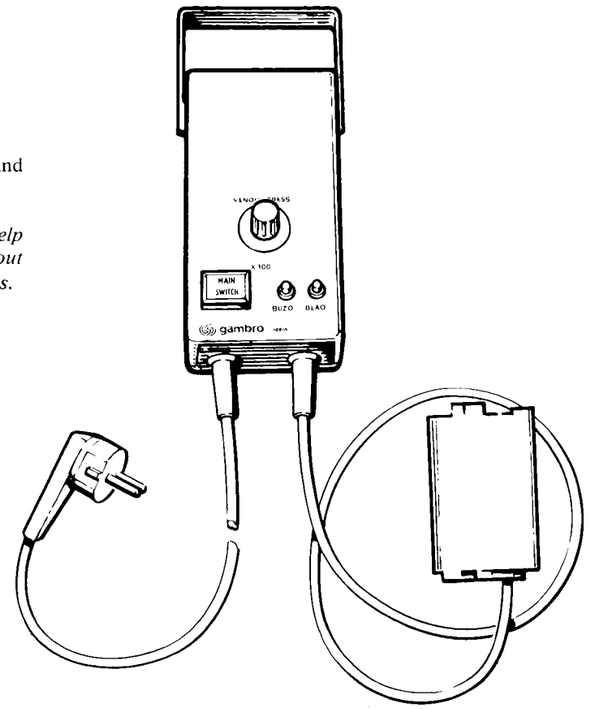
Startbox K0 6934 003 220 V
K0 6934 004 110 V
Temperature simulator K0 7004 002
Trim adaptor K0 6952 002
Extension cable K0 6944 001

In addition you will need a feeler gauge K0 7050 or 0.9 mm and an approved reference weight of 10 kg.

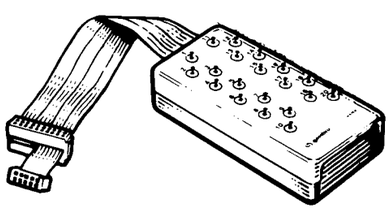
The special technical aids will simplify the adjusments and help provide more accuracy. Instructions on how to adjust without these aids will eventulally be inserted on all circuit diagrams.



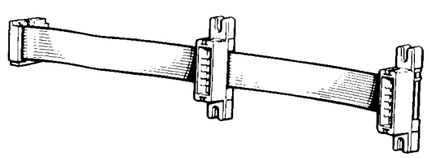
Temperature simulator K0 7004 002



Startbox K0 6934 003 220 V
K0 6934 004 110 V



Trim adaptor K0 6952 002



Extension cable K0 6944 001

Connections

Connect the Gambro startbox K0 6934 003/4 to the rear socket on the hemofiltration unit. Set the startbox knob to zero venous pressure and switch on the main switch.

If a Gambro startbox is not available, use the BMM 10 blood unit.

Checking the voltages, board 1

1. Check that the voltages from the stabilizers are +12 V +/-0.5 V (TP Z12P), -12 V +/-0.5 V (TP Z12VN) and 5 V +/-0.25 V (TPZ25V).

2. Check the 10 V reference voltages is 10 V +/-50 mV (TP Z10P). If neseccary, adjust R14 (second potentiometer from front end).

3. Mains voltage monitoring:

   a. Connect the fluid unit mains input to a variable transformer.
   b. Set the nominal value minus 15%.
   c. Adjust R11 so that V16 lights up.
   d. Repeat for plus 15%. Adjust R10 on Board 1 so that V17 lights up.
   e. Vary the voltage +/-15% from nominal value and check that V16 and V17 light up respectively.
   f. Revert to normal line voltage.

4. DC voltage monitoring:

   a. Remove Z0V from R35, put in the R32-module.
   b. Readjust R35, now to 4.500 V at TP5VP.
   c. Adjust R13 so that V15 lights up.
   d. Readjust R35 to obtain 5.500 V at TP Z5VZP.
   e. Adjust R12 so that V14 lights up.
   f. Seal all adjusted potentiometers with red sealing paint.
   g. Remove the R32-module.
   h. Connect R35 to Z0V.
   i. Adjust R35 to 5.2 V +/-0.025 V.

Adjusting the temperature control circuit

1. Connect temperature simulator K0 7004 002 to P76 on the mains power and trim adaptor K0 6952 002 to P35 on board 2.

2. Check first the 10 V reference voltage at P35:8 w.r.t P35:13. If necessary adjust R21 (third potentiometer from rear end) to 10 V +/-20 mV. Check that the voltage at p35:10 is -5 V +/-20 mV w.r.t P35:13.

3. Set switch 2 on simulator K0 7004 002 to 42.5°C (2938 ohms).
4. Set switch 1 to RESET.
5. Adjust R20 (second potentiometer from rear end) to 0 V +/-20 mV at P35:2 w.r.t P35:13.
6. Set switch 2 to 32.5°C (4417 ohms).
7. Adjust R24 to +10 V +/-20 mV at P35:1 w.r.t P35:13.

Adjusting the temperature alarm circuit

NOTE: the calibration switch on board 4 must be in one of its outer (calibration) positions during adjustment of the temperature transducer curcuit.

1. Connect temperature simulator K0 7004 002 to P76 on the mains power.

2. Set switch 2 to 37.5°C.

3. Set switch 1 to ON (42°C).

4. Connect the DVM to the two test pins on simulator K0 7004 002.

5. Adjust R19 (first potentiometer from rear end) to obtain high signal, approx 16 V.

6. Check with switch 1, that the safety relay on the mains power is working, position SAFE.

Adjusting the pressure transducer

NOTE: Because of interaction these adjustments must always be carried out in full.

1. Connect a reference gauge and a syringe to the angular nipple in the NPTS pressure transducer house. Connect the extension cable between socket P66 on the NPTS pressure transducer board and the corresponding plug. Connect trim adaptor K0 6952 002 to the extension cable. Measure at the adaptor pins.

2. Measure -5.000 V at pin 8 w.r.t pin 10.

3. Adjust R1 to -3.500 V +/-5 mV at pin 9 w.r.t pin 10. NOTE: Zero pressure.

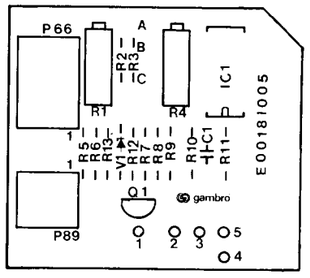
4. Apply a negative pressure of -400 mm Hg with the syringe and measure -3.900 V. If necessary adjust R4. Then repeat point 3 if further adjustment is necessary, repeat point 4 etc.

Pressure and corresponding voltages

mm Hg	V	
+100	—3.400	
0	—3.500	(Adjust at zero pressure)
—100	—3.600	
—200	—3.700	
—300	—3.800	
—400	—3.900	(Adjust at —400 mm Hg)
—500	—4.000	
—600	—4.100	

Tolerance +/-5 mm Hg and +/-5 mV.

5. Seal all adjusted potentiometers with red sealing paint.



Adjusting the pressure monitoring circuits

Always check the pressure transducer before attempting to adjust the pressure monitoring circuits.

1. Adjust R23 (fifth potentiometer from the front end of board 2) at zero pressure to +1.020 V +/-20 mV at P35:19 w.r.t. P35:13.

2. At zero venous pressure adjust R25 (third potentiometer from front end) for 0V +/-20 mV at P35:18 w.r.t. P35:13.

3. Set the startbox knob to 400 mm Hg and adjust R26 (second potentiometer from front end) for -4 V +/-20 mV at P35:18 w.r.t. P35:13. The instrument on the instrument panel should now show -400 mm Hg.

Adjusting the TMP alarm delay

1. Move one of the alarm limit indicators on the TMP instrument to obtain an alarm condition.

2. Check that the time between alarm initiation and buzzer sounding is about 8 seconds. Adjust on R27 if necessary (first potentiometer from the front end of board 2).

Adjusting the blood leak detector

1. See that the blood leak detector is filled with clear fluid.

2. Check that the current in the BLUD wire is 1 mA by measuring -560 mV on TE04 (w.r.t. TE13). Adjust if necessary with R1 on the blood leak detector (accessible through a hole in the lower edge of the front panel).

3. Adjust R22 (fourth potentiometer from the rear on board 2) for 6 V on TE06 (w.r.t. TE13).

4. By covering the sensor in the blood leak housing (right side) check that the voltage on TE06 drops below 1 V.

Zeroing the weighing amplifier

1. Start the machine and wait 30 seconds.

2. Check the +5 V on board 4 (weigh electronics). The voltage must be +5 V +/-0.025 V, -0.000 V at TP4 w.r.t. TP5. If necessary adjustR1 (rear potentiometer). (Note that the +5 V is not allowed to drop below +5 V).

3. Set the calibration switch to the infusate position (to the rear).

4. Load the infusate scale with 10 kg +/-0.005 kg.

5. Depress TIME, keep it depressed and adjust R11 until ERROR lamp is off and 00+/-08 is obtained on the display.

6. Remove the load. Put the calibration switch back in midposition.

7. Turn of the machine in order to clear the memory

Calibrating the weighing system.

Note: Check zeroing of the weighing amplifier.

1. Switch on the machine and wait for at least 30 seconds.

2. See that there is no load on the scales. Depress TIME. The display should show 00.

3. Set the calibration switch to the INF POS. (to the rear).

4. Set the infusion quantity selector to 10 kg.

5. Load the infusion scales with 10 kg +/-0.005 kg.

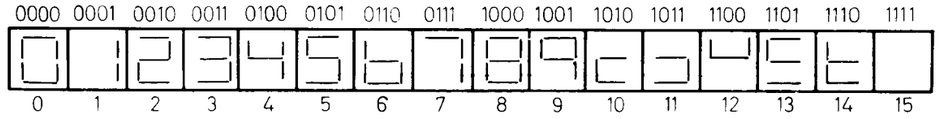
6. The display will show the calibration factor bits in hexadecimal form. If the display is steady, proceed to point 7, if the display is blinking: Depress UF RATE to obtain the difference between the actual calibration factor and the setting of the calibration plug. If the difference is more than +/-2 bits a new calibration plug must be inserted. The infusion plug is the rear plug (IC7). Convert the digits to digital form and set the new plug to the calibration factor by cutting straps to represent ones. NOTE: The plug must be viewed from above.

7. Set the calibration switch to the ultrafiltrate position (to the front).

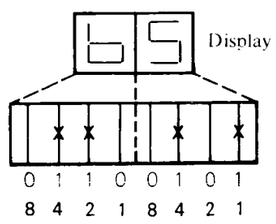
8. Load the ultrafiltrate scales with 10 kg +/-0.005 kg.

9. Repeat as in point 6 for plug IC8 (front plug).

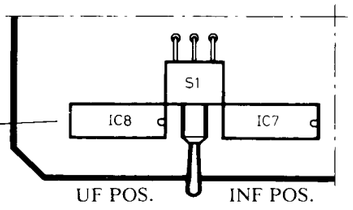
10. Set the calibration switch to its neutral (middle) position.



Conversion table



Example (x = cut)



Calibration switch

Adjusting the load limits

1. Unscrew the stop screws for the load cells (the screws are accessible through holes in the bottom cover) and apply a thin layer of Loctite 222 on the threads.

2. Reinsert the stop screws. Use feeler gauge K0 7050 to set the distance between screw and load cell to 0.9 mm.

3. Switch on the machine, wait 30 sec.

4. Depress TIME.

5. Load the infusate scales with approx. 35 kg. (Use a container filled with water.) The load should be positioned as far out as possible on the load hook. Check that the display indicates the weight.

6. Remove the load and wait until the display indicates 00.

7. Take out the heater

8. Depress AUTO.

9. Load the ultrafiltrate scales with approx. 35 kg. The load should be positioned as far out as possible on the load hook. Check that the display indicates the weight.

Adjusting the pump motor circuits

1. Connect an oscilloscope to TP1 on Board 5 (6) and adjust the sweep rate so that at least four pulses are shown on the oscilloscope.

2. Balance the Hall elements by adjusting R10 on Board 5 (6) for as equal pulse length as possible.

3. Set the pump potentiometer at maximum.

4. Connect the oscilloscope to the collector of one of the transistors Q1, Q3, Q7 or Q9 on Board 5 (6).

5. Adjust R11 On Board 5 (6) so that the maximum rotor speed is about 37 rpm (t = approx, 25 ms on the collector).

6. Connect a voltmeter to the wiper on R30. Minus to TP2.

7. Adjust R30 on Board 5 (6) to about +1.5 V on the voltmeter.

8. Run the pump slowly, stop it by grasping the pump handle, check that driving stops after 2-3 seconds (stopping time) and that restart is obtained after about 20 seconds.

Error codes

Depress UF RATE and TIME buttons simultaneously for the display to show error codes when ERROR is lit or blinking.

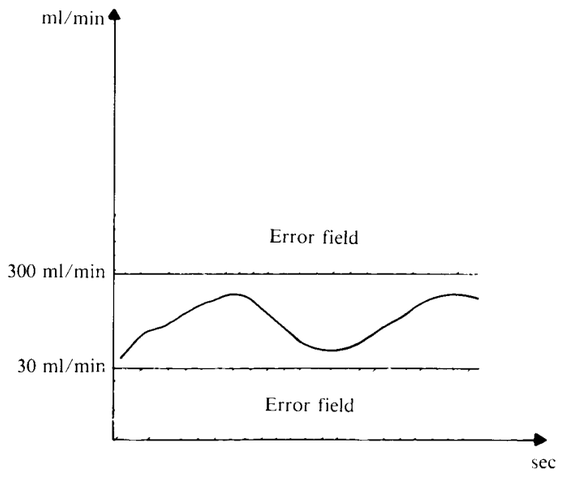
ERROR lamp lit (code figure 1 refers to the infusate side, 2 to the ultrafiltrate side).

Steady light (treatment fault)

U1, U2

Linearity of infusion consumption (1) or ultrafiltrate output (2) not within 30-300 ml/min for the last 160 seconds.

Infusion or ultrafiltrate flow during the last 160 sec.



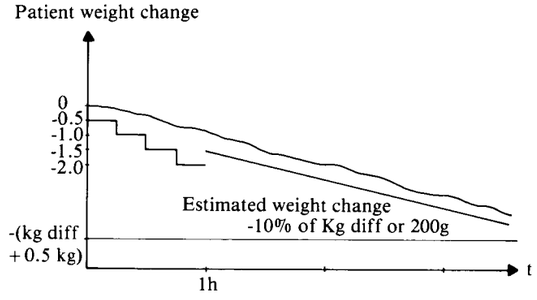
J0

Linearity alarm indicates:

a) patient weight loss is more than estimated value + 10% of selected value. If the selected weight loss is less than 2.0 kg the alarm limit is set at estimated value + 200 g. However, during the first hour after start or reprogramming of set values before a linearity alarm curve has been established the alarm is set to that the patient weight loss will exceed 500 g/15 min.

b) patient weight loss is more than Kg diff + 0,5 kg.

The linearity alarm curve is provided every 42 min. If an alarm occurs the buzzer will only be active 1,5 min out of every 42 min. period.



J1

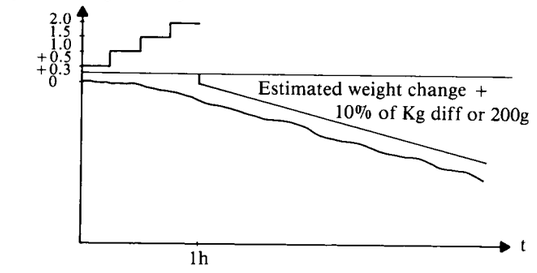
Linearity alarm indicates:

a) patient weight loss is less than estimated value -10% of selected value. If the selected weight loss is less than 2.0 kg the alarm limit is set at estimated value -200g.

b) patient weight gain from the start of treatment exceeds 0.3 kg. This is the alarm limit during the first hour.

c) patient weight gain exceeds 0.5 kg/15 min during the first hour after a reprogramming.

patient weight change



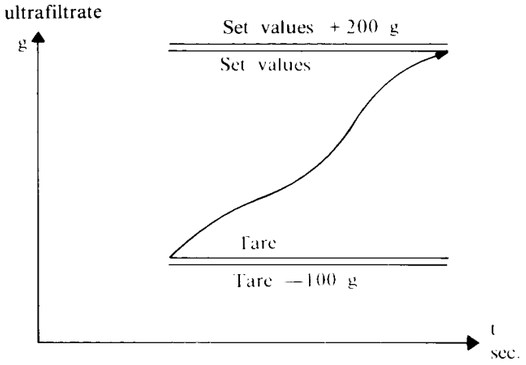
C1, C2

Total amount alarm

1. A weight increase of more than 100 g on the infusion scale compared to the tarated value.
   A weight decrease on infusion scale of more than the programmed amount of Kg INF + 200 g.

2. A weight decrease of more than 100 g on the UF scale compared to the tarated value. A weight increase of more than programmed amount of Kg INF + Kg DIFF + 200 g on UF scale.

Infusion or ultrafiltrate



Blinking light (technical fault)

C3 — Calculations not correct when carried out with simulated values.

J3 — The tare value is placed in two memories when the AUTO button is depressed. The code indicates that these values are no longer equal.

U3 — The microprocessor reads out critical values written into a RAM and compares it with the value which was written in. The code indicates that descrepancies occur.

CC — Register storing not functioning correctly at starting up (Button AUTO can not be lit).

JJ — At starting up first ones, then zeros are automatically written into all RAMs. The code indicates that this is not possible (Button AUTO can not be lit).

UU — The sum of the contents in the PROMs has changed at starting-up (Button AUTO cannot be lit).

E3 — Program memory test during treatment wrong.

53 — Microprocessor interrupt, not correct.

55 — Function of weighing electronic board, not correct.
a/ A/D stopped
b/ A/D overranged
c/ Amplifier offset

Signal list

ASIN	Analog	Signal	Input	
ASOT	Analog	Signal	Output	
AULA	Auto	Lamp		
AUSW	Auto	Switch		
BDCR	Blood	Detector	Current	Reference
BLAO	Blood	Leak	Alarm	Out
BLLA	Blood	Leak	Lamp	
BLSV	Blood	Leak	Set	Voltage
BLUD	Blood	Detector		
BRSW	Blood	Leak	Reset	Switch
BPMS	Blood	Pump	Motor	Stop
BUZI	Buzzer	Input		
BUZO	Buzzer	On		
CAMD	Central	Alarm	Monitor	Digital
D01-A...D		Display × 1 kg		
D10-A...D		Display × 10 kg		
DP01	Decimal	Point × 1 kg		
DP10	Decimal	Point × 10 kg		
EALA	Error	Alarm	Lamp	
FIVN	Flow	Instrument	Negative	
FIVP	Flow	Instrument	Positive	
HEN1	Heating	Element	Number 1	
KG01	Kilo × 1			
KG10	Kilo × 10			
LCNO	Load	Cell	Negative	Out
LCPO	Load	Cell	Positive	Out
LI01	Liter × 1			
LI10	Liter × 10			
MCV1	Motor	Control	Voltage 1	
MCV2	Motor	Control	Voltage 2	
MCV0	Speed potentiometer ground conn.			
MSWB	Main	Switch	Battery	
NPTS	neg.	Pressure	Transducer	Signal
PRAH	Pressure	Alarm	High	
PRAL	Pressure	Alarm	Low	
PRIN	Pressure	Instrument	Negative	
PRIP	Pressure	Instrument	Positive	
POT1	Speed pot for infusion pump			
POT2	Speed pot for ultrafiltrate pump			
REDD	Red	Detector		
REST	Reset (Active: low)			
TALA	TMP	Alarm	Lamp	
TISW	Time	Switch		
TMSW	Temp	Set	Value	
TMW1, 2, 4, 8		Thumb	Wheel	Switch
TPAL	Temp	Alarm	Lamp	
TPMS	Temp	Pump	Motor	Stop
TPSV	TMP	Set	Value	
TRSI	Temp	Regulation	Signal	Input
TSRC	Temp	Safety	Relay	Current
TSSI	Temp	Sensor	Signal	Input
UFSW	Ultra	Filtrate	Switch	
VEPA	Venous	Pressure	"A"	
VAPB	Venous	Pressure	"B"	
VRFT	Voltage	Reference	For	Transducer

Technical data

Type designation	HFM 10-1
Infusion pump	
Design	Self-threading roller pump
Flow regulation	0/approx 22-225 ml/min with tube Ø 6.35 × 1.6
Ultrafiltrate pump	
Design	Self-threading roller pump
Flow regulation	0/approx 22-225 ml/min with tube Ø 6.35 × 1.6
Temperature	
Incoming infusion	Min 15°C (59°F)
Heated infusion	35-40°C (95-104°F +/-1.8°F)
Infusion ultrafiltrate scales	
Weighing range	0-35 kg (77.2 lbs, including weight of weighing arms and containers)
Overload protection	Mechanical
Weighing arms	Different types available to suit most types of containers
Selectors	
Kg DIFF	Weight loss
Kg INF	Infusion quantity
Indicator	
Normal indication	Weight loss
TIME depressed	Remaining treatment time
UF RATE depressed	Ultrafiltration rate
Both buttons depressed	Error code
TMP	
Regulation	0 to 500 mm Hg (0 to 66 kPa) +/-10% or +/-10 mm Hg (1.3 kPa)
Instrument	+50 to -500 mm Hg (+7 to -66 kPa)
Alarm limits	Adjustable set with two alarm limit indicators
Blood leak detector	
Design	Transillumination of the ultrafiltrate towards infrared phototransistor
Sensitivity	Adjustable
Power supply	
Mains voltage	240, 220, 130, 110 V +/-10%, 50 or 60 Hz (Supply frequency must be specified for elapsed time meter)
Power consumption	Approx. 400 W
Length of cable	Approx. 3 m
Supply socket	Earthed standard socket. DIN model for 220 V, ASA for 110 V
Fuses	220 V: 0.63 A TT and 1.6 A F, DIN 5 × 20 110 V: 1.25 A TT and 3.0 A F, ASA 6.3 × 32
Dimensions	Depth 400 mm (450 mm including front components) Widht 520 mm Height 190 mm (15.7 × 291 × 7.5 in)
Weight	23.5 kg (51.8 lbs)

HC E-6911, Rev. 02.1985

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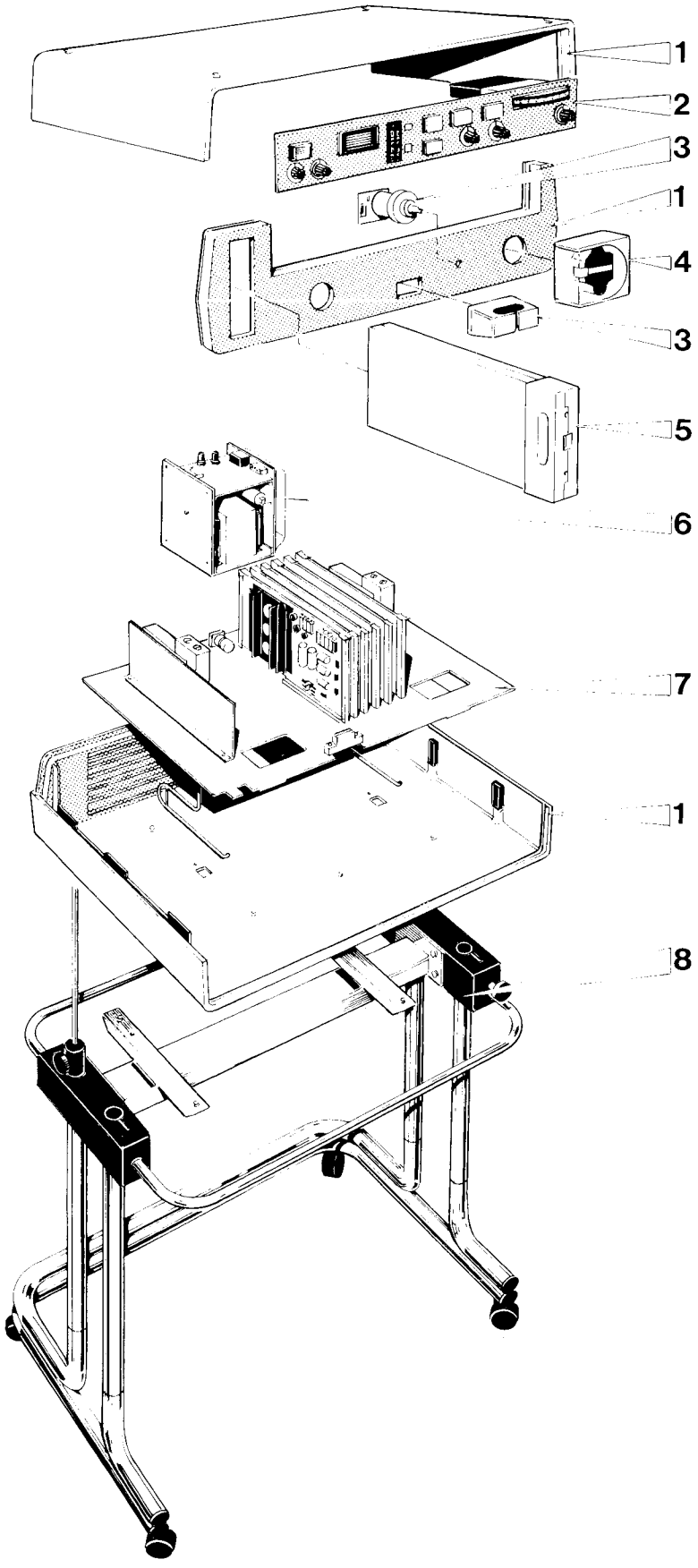
AK-10 System

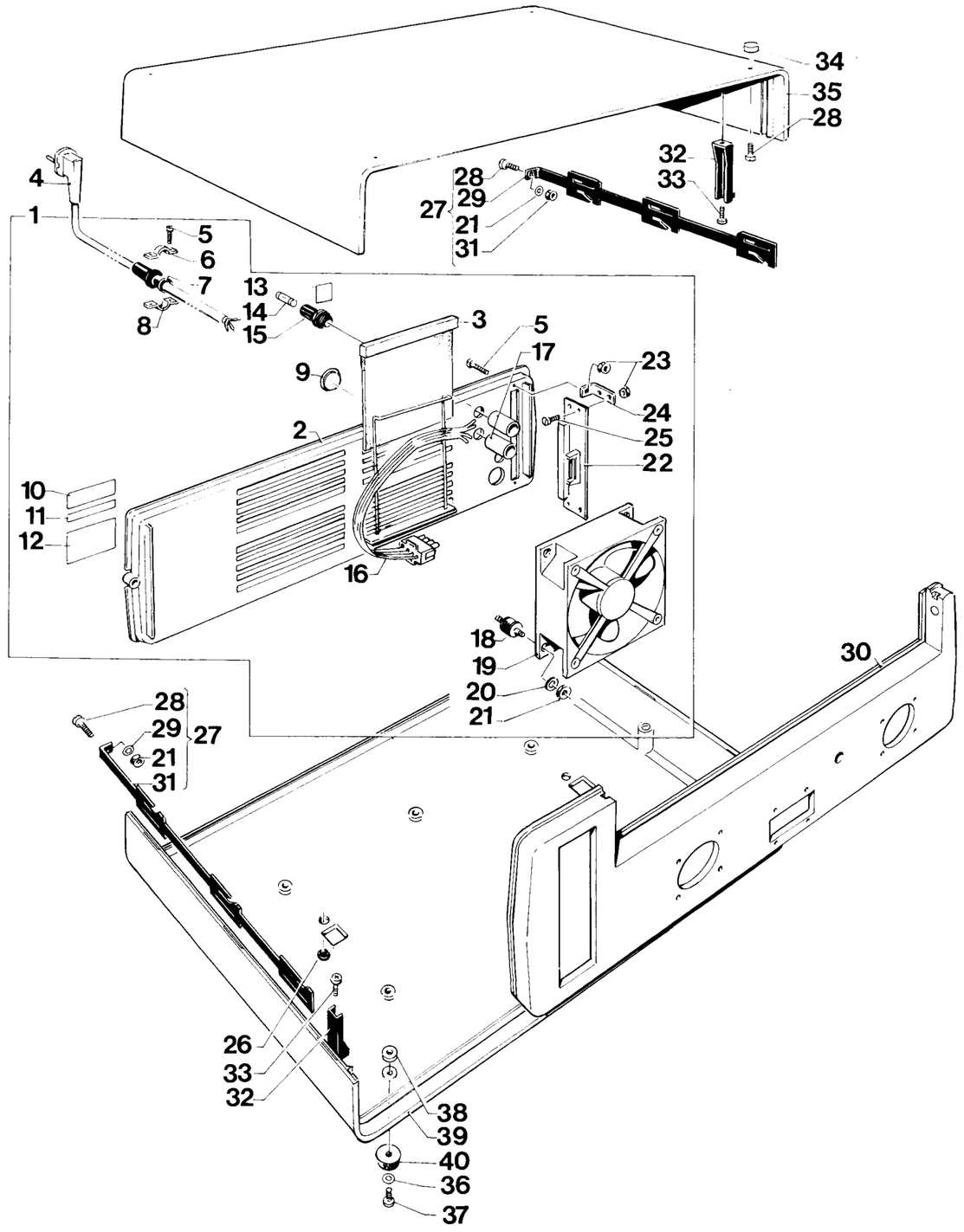
Hemofiltration monitor HFM 10-1



Spare part list

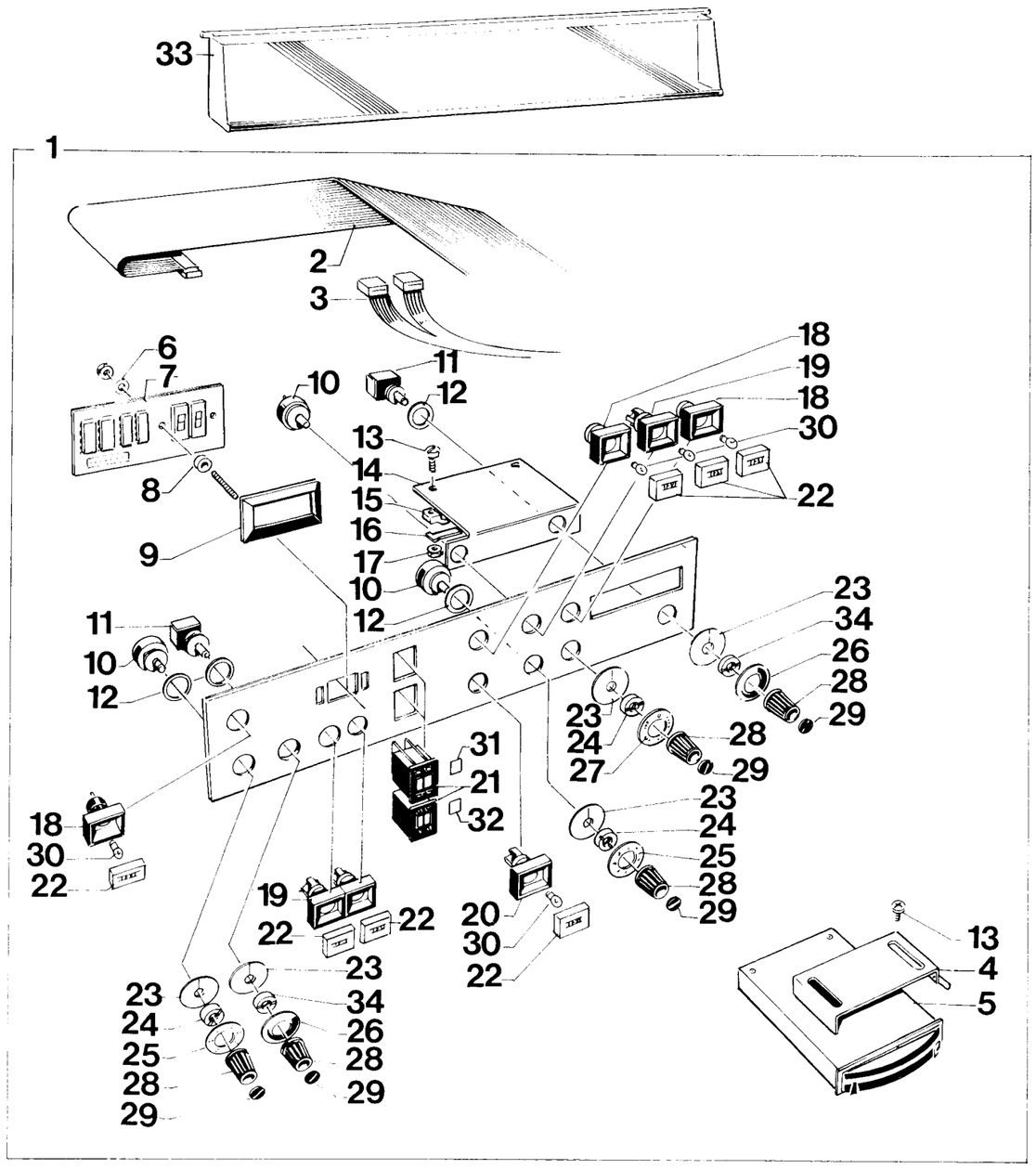
1. Casing and panels.

Item	Denomination	Order no.	Remarks
1	Rear panel	K0 5772 A	220 V, 2 fuses
1	Rear panel	K0 5772 B	220 V, 1 fuse
1	Rear panel	K0 5772 C	110 V, 2 fuses
1	Rear panel	K0 5772 D	100 V, 1 fuse
2	Rear panel	K0 4670 E	
3	Air filter	K0 4749 A	
4	Mains cable	100 220 051	220 V
4	Mains cable	K0 4926 A	110 V
5	Screw	100 370 312	
6	Cable clamp	100 314 050	
7	Flexing guard	100 314 080	
8	Cable clamp	100 314 051	
9	Grommet	100 334 047	
10	Plate USA	K0 5099 001	
11	Patent plate	K0 5098 001	
12	Type designation plate	K0 5152	
13	Fuse plate	K0 5151 001	220 V, 630 mAT
13	Fuse plate	K0 5151 002	110 V, 1.25 AT
14	Fuse	100 213 042	630 mAT
14	Fuse	100 213 043	1.25 AT
15	Fuse holder	100 212 001	220 V
15	Fuse holder	100 212 002	110 V
16	Cable	K0 6166 A	220 V, 2 fuses
16	Cable	K0 6166 B	220 V, 1 fuse
16	Cable	K0 6166 C	110 V, 2 fuses
16	Cable	K0 6166 D	110 V, 1 fuse
17	Shrink tube	K0 5191 003	
18	Flexible mounting	K0 2691 001	
19	Fan	100 328 013	
20	Washer	100 392 902	
21	Nut	100 390 400	
22	Alarm board	K0 8613 001	
23	Nut	100 390 300	
24	Mounting plate	K0 6292 001	
25	Screw	100 370 306	
26	Grommet	100 307 011	
27	Locking slide assy	K0 4387 A	
28	Screw	100 370 412	
29	Washer	100 392 902	
30	Front panel	K0 6124 A	
31	Locking slide	K0 4275 001	
32	Retaining catch	K0 6200 001	
33	Screw MRX 4 x 12	100 378 412	
34	Button	K0 3028 001	
35	Cover	K0 5493	
36	Washer	K0 6180 001	
37	Screw	100 316 085	
38	Washer	K0 5472 001	
39	Bottom cover	K0 5492	
40	Rubber foot	100 307 012	



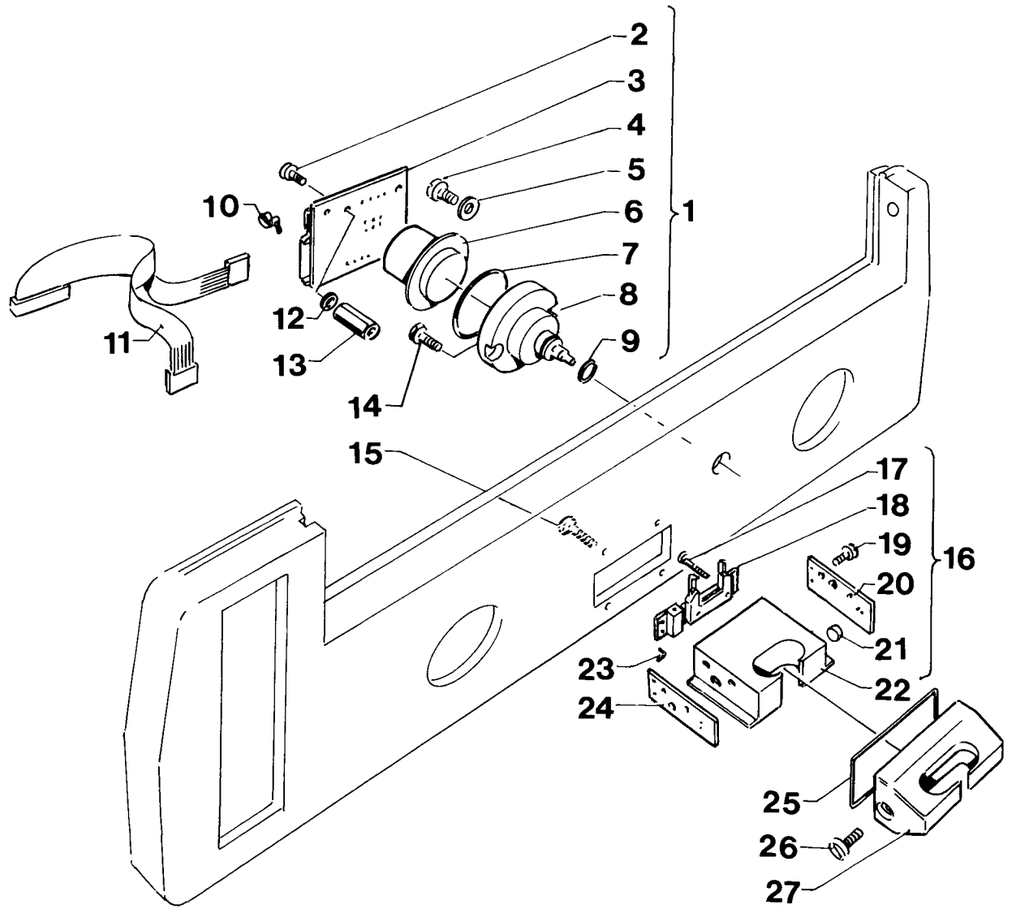
2. Instrument panel.

Item	Denomination	Order no.	Remarks
1	Instrument panel assy	K0 5775 A	mm Hg
1	Instrument panel assy	K0 5775 B	kPa
2	Cable	K0 5718 A	
3	Cable	K0 5744 A	
4	Mounting plate	K0 6723 A	
5	Instrument	K0 5136 001	mm Hg
5	Instrument	K0 6286 001	kPa
6	Washer	100 322 013	
7	Display board	K0 5702 A	
8	Spacer	K0 6142 001	
9	Filter	100 007 001	
10	Potentiometer	100 106 028	
11	Potentiometer	K0 4970 001	
12	Washer	100 322 009	
13	Screw	100 378 510	
14	Mounting bracket	K0 5073 001	
15	Flat cable mounting	100 314 066,67	
16	Strap	100 314 068	
17	Nut	100 390 400	
18	Signal lamp holder	100 210 010	
19	Push button switch	100 208 015	
20	Signal switch	100 208 016	
21	Code switch assy	K0 5989	
22	Lamp lens kit	K0 6154	
23	Stator	100 301 006	
24	Nut	100 301 004	
25	Scale	K0 4706 001	
26	Scale	100 301 002	
27	Scale	K0 5198 001	mm Hg
27	Scale	K0 6288 001	kPa
28	Knob	100 300 017	
29	Cover	100 301 012	
30	Lamp	100 222 017	
31	Sign plate	K0 6144 001	
32	Sign plate	K0 6143 001	
33	Cover	K0 4274 001	
34	Nut	100 301 011	



3. Blood leak detector. Pressure transducer.

Item	Denomination	Order no.	Remarks
1	Transducer assy	K0 7261 001	
2	Screw	100 316 068	
3	Pressure transducer board	K0 6170 A	
4	Screw	100 370 408	
5	Washer	K0 6180 001	
6	Pressure transducer	K0 6269 001	
7	O-ring	100 319 007	
8	Transducer housing	K0 7224 001	
9	O-ring	100 318 053	
10	Strap	100 314 016	
11	Cable harness	K0 5722 A	
12	Washer	100 322 012	
13	Spacer	100 316 074	
14	Screw	100 382 416	
15	Screw	100 372 619	
16	Blood leak detector assy	K0 6162 B	
17	Screw	100 370 214	
18	Contact board	K0 7120 001	
19	Screw	100 370 304	
20	Receiver board	K0 7118 001	
21	Filter	K0 6165 001	
22	Detector housing	K0 6098 001	
23	Wire	K0 5138 001	
24	Transmitter board	K0 7116 001	
25	O-ring	100 318 054	
26	Screw	100 316 068	
27	Cover	K0 4514 001	



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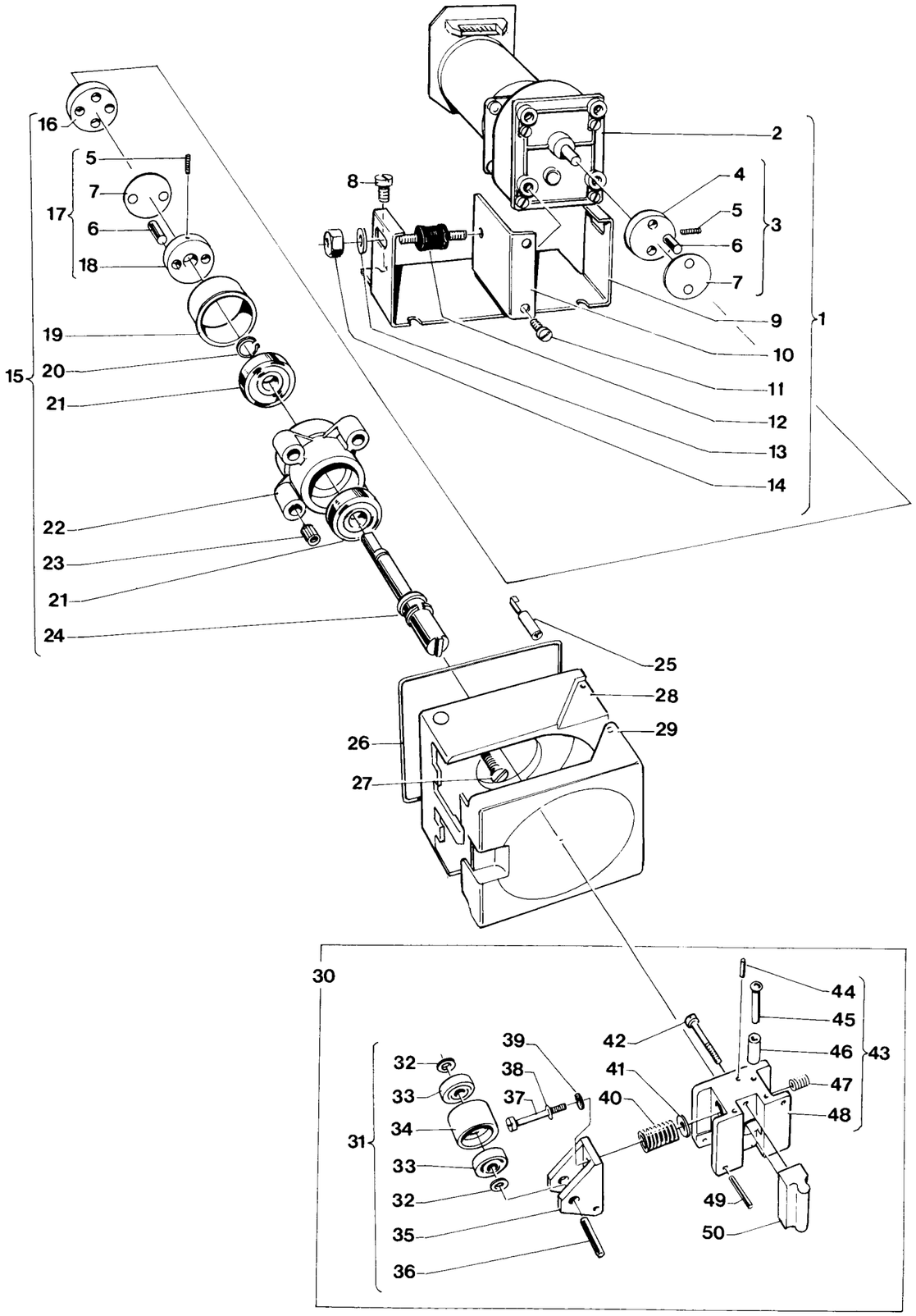
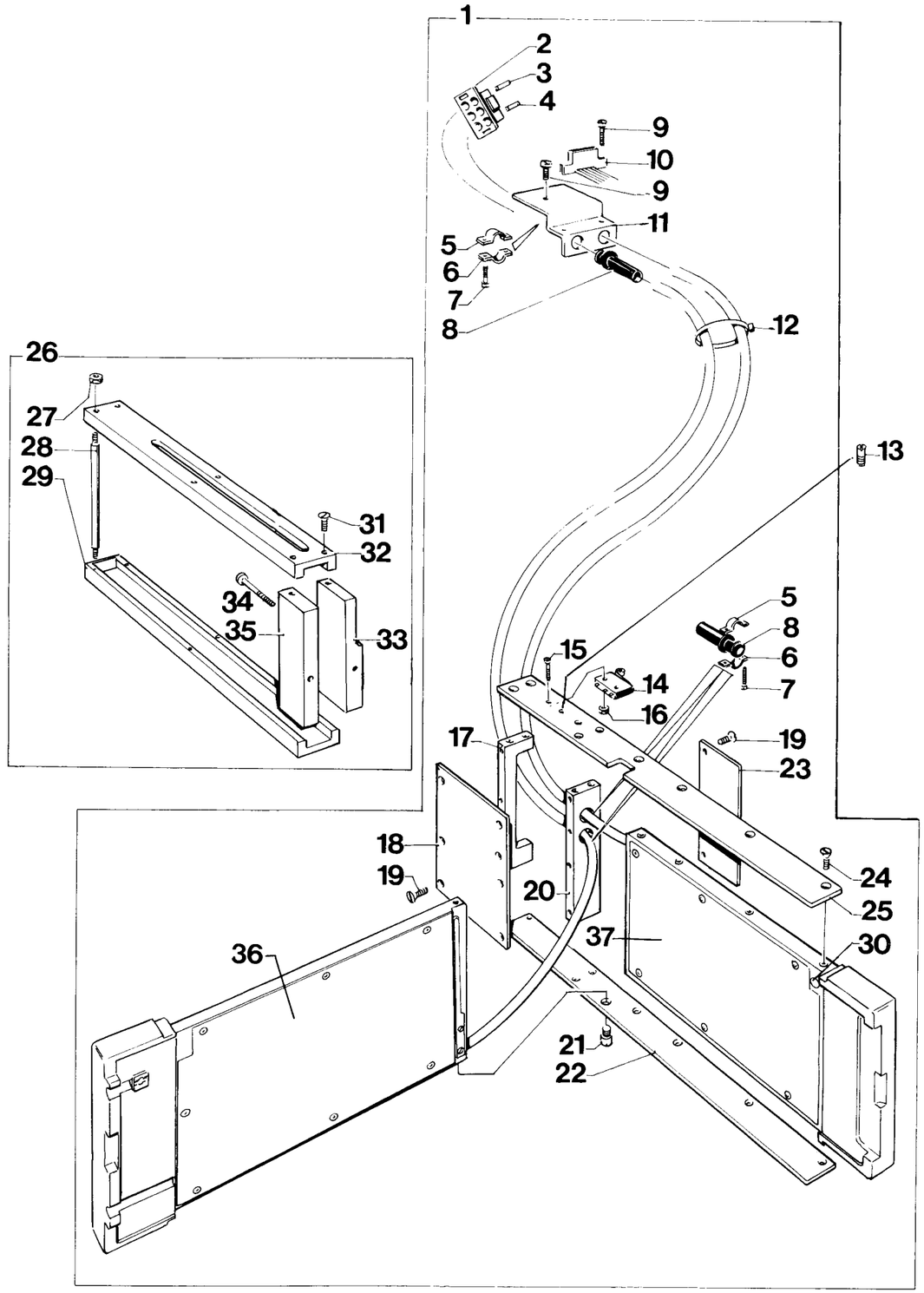
4. Infusate pump, ultrafiltrate pump.

Item	Denomination	Order no.	Remarks
1	Motor unit	K0 4566 A	
2	Motor	K0 4721 A	
3	Clutch half assembly	K0 4898 A	
4	Clutch half	K0 4899 001	
5	Set screw, MSK6SS 5 x 8	100 380 508	
6	Dog	100 320 027	
7	Insulation washer	K0 4902 001	
8	Screw, MCS 4 x 6	100 370 406	
9	Motor cradle	K0 4708 001	
10	Angle piece	K0 4709 001	
11	Screw, MCS 4 x 14	100 370 414	
12	Flexible mounting	K0 4817 001	
13	Washer, BRB 8.4 x 16	100 392 904	
14	Nut, M6M8	100 390 800	
15	Bearing unit	B0 0224 A	
16	Clutch insert	K0 4901 001	
17	Clutch half assembly	K0 4898 B	
18	Clutch half	K0 4899 002	
19	Casing	K0 4904 A	
20	Retaining ring	100 330 003	
21	Ball bearing	100 326 003	
22	Bearing house	K0 7724 001	
23	Thread insert	100 316 022	
24	Pump shaft	B0 0223 001	
25	Magnetic sensor	K0 8424 A	
26	O-ring, 96.6 x 1.6	100 318 056	
27	Screw, MCS 5 x 20	100 370 520	
28	Pump housing	B0 0260 001	
29	Cover	K0 8325 A	
30	Pump rotor assembly	B0 0248 A	
31	Roll holder	B0 0236 A	
32	Spacer	B0 0154 006	
33	Ball bearing	100 326 001	
34	Roller	B0 0228 001	
35	Roll holder	B0 0239 001	
36	Shaft	B0 0237 001	
37	Screw, MCS 4 x 25	100 370 425	
38	Washer, BRB 4.3 x 8	100 392 902	
39	Washer	K0 7316 001	
40	Spring	K0 7315 001	
41	Plastic washer, 4.3 x 12 x 1.5	100 322 007	
42	Screw, MCS 5 x 8	100 370 508	
43	Rotor	B0 0247 A	
44	Pin	100 320 037	
45	Pin	B0 0234 001	
46	Guide roller	B0 0235 001	
47	Thread insert	100 316 024	
48	Hub	B0 0246 001	
49	Shaft	B0 0256 001	
50	Grip	B0 0229 001	



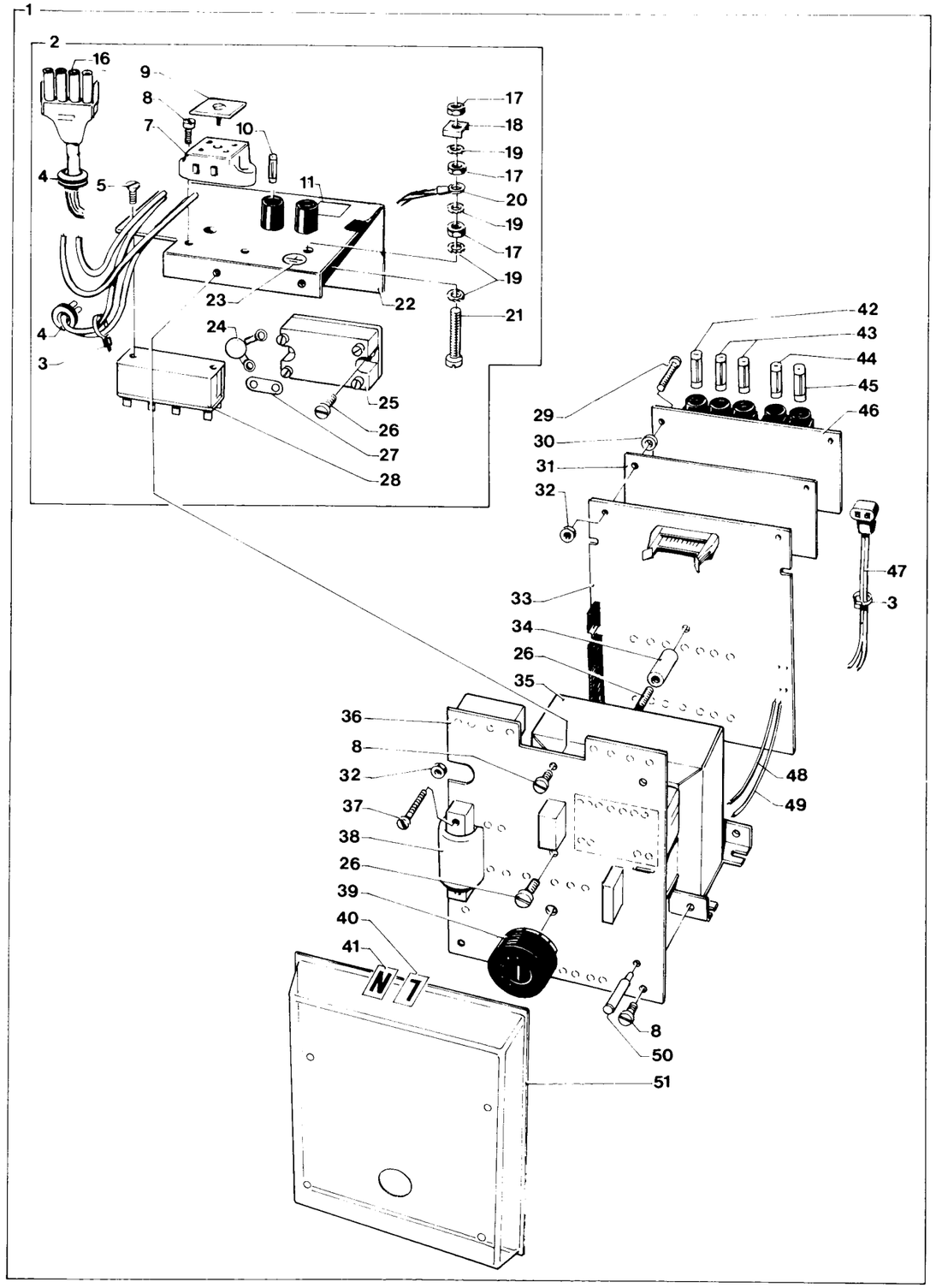
5. Heater.

Item	Denomination	Order no.	Remarks
1	Heater	K0 5610 A	220 V
1	Heater	K0 5610 B	110 V
2	Connector house	100 202 123	
3	Pin	100 203 050	
4	Pin	100 203 067	
5	Cable clamp	100 314 051	
6	Cable clamp	100 314 050	
7	Screw	100 370 310	
8	Flexing guard	100 314 080	
9	Screw	100 370 308	
10	Connector	100 202 067	
11	Cable bearer	K0 6122 001	
12	Strap	100 314 015	
13	Strap screw	K0 6068 001	
14	Micro switch	100 228 009	
15	Screw	100 370 212	
16	Nut	100 390 200	
17	Support	K0 6115 A	
18	Cover plate	K0 6064 001	
19	Screw	100 374 306	
20	Support	K0 6114 A	
21	Screw	K0 6069 001	
22	Guide	K0 6062 001	
23	Cover plate	L0 6063 001	
24	Screw	100 374 410	
25	Guide	K0 6061 001	
26	Guide bar	K0 6726	
27	Nut	100 390 400	
28	Stud	K0 5462 001	
29	Guide	K0 5464 001	
30	Temperature transducer	K0 6155 001	
31	Screw	100 370 420	
32	Guide	K0 5463 001	
33	Block	K0 6117 A	
34	Screw	100 370 440	
35	Block	K0 6116 A	
36	Heater plate	K0 6101 A	220 V
36	Heater plate	K0 6101 B	110 V
37	Heater plate	K0 6102 A	220 V
37	Heater plate	K0 6102 B	110 V



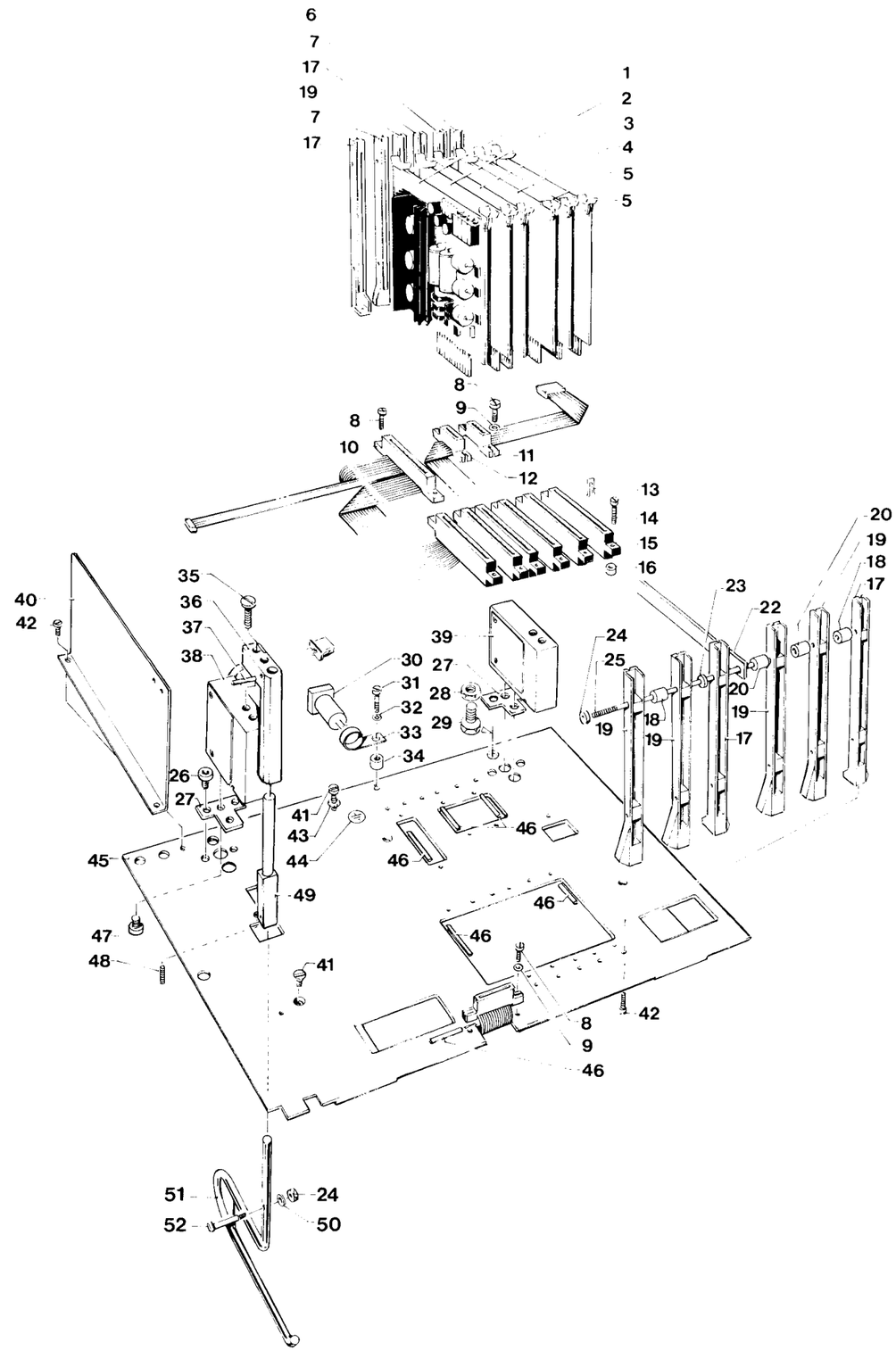
6. Power supply.

Item	Denomination	Order no.	Remarks
1	Mains power complete	K0 8348 001	220 V
1	Mains power complete	K0 8348 002	110 V, 1 fuse
1	Mains power complete	K0 8348 003	110 V, 2 fuses
2	Distance plate complete	K0 8345 001	220 V
2	Distance plate complete	K0 8345 002	110 V, 1 fuse
2	Distance plate complete	K0 8345 003	110 V, 2 fuses
3	Strap	100 314 015	
4	Rubber bush	100 314 078	
5	Screw MFS 4 x 8	100 374 408	
7	Connector plint	100 204 014	
8	Screw MCS 3 x 4	100 370 304	
9	Cover	100 205 042	
10	Fuse 10 A	100 213 052	220 V
10	Fuse 12,5 A	100 213 053	110 V
11	Label	K0 9468 001	
16	Cable	K0 8403 001	220 V, 110 V
17	Nut, M6M 4	100 390 400	
18	Lock washer	100 322 005	
19	Washer, Az 3.2	100 322 011	
20	Earth cable	K0 9837 002	
21	Screw, MCS 4 x 20	100 370 420	
22	Distance plate	K0 7056 001	
23	Earth label	100 340 001	
24	Transient protector	K0 5788 001	
25	Relay	100 200 038	
26	Screw, MCS 4 x 6	100 370 406	
27	Connector plate	K0 8037 001	
28	Relay	100 200 046	
29	Screw, MCS 3 x 10	100 370 310	
30	Washer	100 322 012	
31	Distance plate	K0 8038 001	
32	Nut, M6M 3	100 390 300	
33	Secondary board	K0 7428 001	
34	Spacing sleeve	100 316 092	
35	Transformer	K0 7123 001	
36	Primary board	K0 7761 001	
37	Screw, MCS 3 x 14	100 370 314	
38	Coil	K0 7760 001	
39	Voltage switch	100 206 010	
40	Marking letter, "L"	100 340 002	
41	Marking letter, "N"	100 340 003	
42	Fuse, 315mA	100 213 010	
43	Fuse, 2.5A	100 213 057	
44	Fuse, 4.0A	100 213 015	
45	Fuse, 125mA	100 213 055	
46	Fuse board	K0 7427 001	
47	Cable	100 220 059	
48	Cable, red	K0 5142 010	
49	Cable, black	K0 5140 010	
50	Spacer	100 316 030	
51	Cover	K0 4884 001	



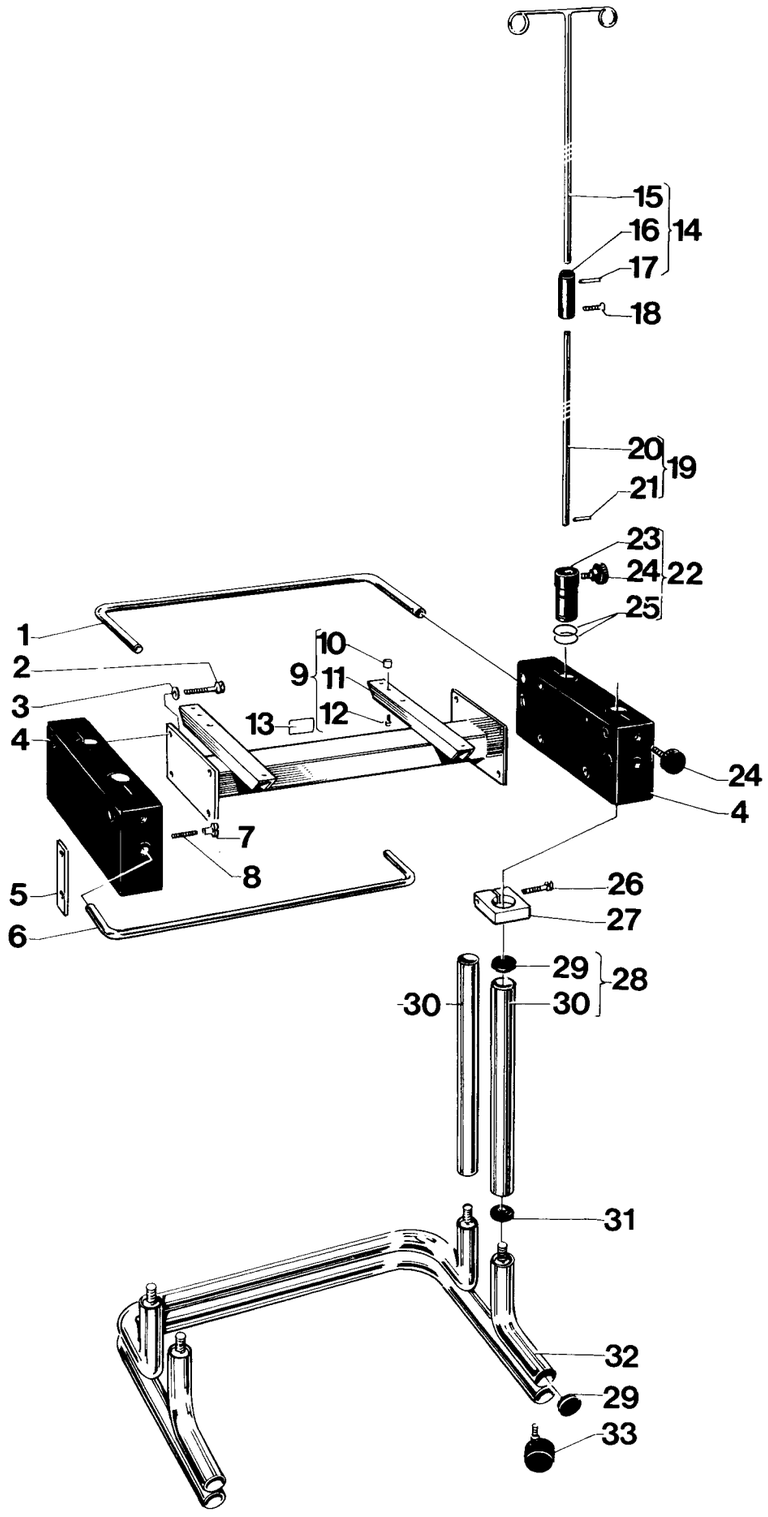
7. Bottom plate.

Item	Denomination	Order no.	Remarks
1	Power supply board	K0 4538 G	
2	Control logic board	K0 5710 002	
3	Microprocessor board	K0 7257 001	
4	Weight board	K0 5706 A	
5	Motor control board	K0 4475 C	
6	Board guide	K0 5459 002	
7	Board guide	K0 5459 001	
8	Screw	100 370 308	
9	Washer	100 392 901	
10	Cable harness	K0 5721 A	
11	Cable harness	K0 5720 A	
12	Cable harness	K0 5719 A	
13	Keying plug	100 203 068	
14	Screw	100 370 312	
15	Bus cable harness	K0 7101 001	
16	Spacer	100 316 015	
17	Board guide	K0 4846 001	
18	Spacer	100 316 018	
19	Board guide	K0 4846 002	
20	Spacer	100 316 057	
21	Spacer	100 316 056	
22	Strip	K0 5461 001	
23	Spacer	100 316 055	
24	Nut	100 390 400	
25	Stud	K0 4816 003	
26	Screw	100 388 612	
27	Mounting plate	K0 6799 001	
28	Nut	100 316 061	
29	Screw	100 316 060	
30	Time meter	K0 6297 001	50 Hz
30	Time meter	K0 6297 002	60 Hz
31	Screw	100 370 422	
32	Washer	100 390 902	
33	Clamp	100 314 071	
34	Spacer	K0 4980 001	
35	Screw	100 316 105	
36	Holder	K0 7016 001	
37	Expanding plug	100 320 032	
38	Weight transducer, left	K0 6153 A	Transd.K05729001
38	Weight transducer, left	K0 8468 001	Transd.K08456001
39	Weight transducer, right	K0 6153 B	Transd.K05729001
39	Weight transducer, right	K0 8468 002	Transd.K08456001
40	Plate	K0 5470 001	
41	Screw	100 374 408	
42	Screw	100 370 408	
43	Washer	100 322 008	
44	Earth sign	100 340 001	
45	Bottom plate	K0 5454 A	
46	Edge strip	100 312 029	
47	Screw	100 316 104	
48	Screw	100 380 612	
49	Bush	K0 7017 001	
50	Washer	100 392 902	
51	Hook, acc to individual spec.	See "Accesories catalogue" HCE 6442	
52	Screw	K0 6091 001	



8. Stand.

Item	Denomination	Order no.	Remarks
1	Rear bumper	K0 6248 001	
2	Screw	K0 6651 001	
3	Washer	100 392 003	
4	Mounting plate	K0 5156 A	
5	Spacer plate	K0 6112 001	
6	Front bumper	K0 6247 001	
7	Screw	100 316 042	
8	Stud	100 394 640	
9	Frame	K0 5364 A	
10	Button	K0 3028 001	
11	Upper part	K0 5158 A	
12	Screw	100 370 406	
13	Type destignation plate	K0 5478 026	
14	Infusion stand assy	K0 5000 A	
15	Infusion stand, upper part	K0 4861 A	
16	Coupling	K0 4990 001	
17	Pin	100 320 004	
18	Screw	100 376 420	
19	Infusion stand, lower part	K0 5377 A	
20	Infusion stand, rod	K0 4862 001	
21	Pin	100 320 001	
22	Bushing assy	K0 6250 A	
23	Bushing	K0 6249 001	
24	Knob	100 300 021	
25	O-ring	100 318 020	
26	Screw	100 382 635	
27	Clamp	K0 6540 001	
28	Rod, assy	K0 6650 A	
29	Plug	100 316 049	
30	Rod	K0 6246 001	
31	Spacer	K0 6814 001	
32	Bottom frame	K0 6251 001	
33	Wheel	100 304 054	



HC E-6913, Rev. 03.1984

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Head office

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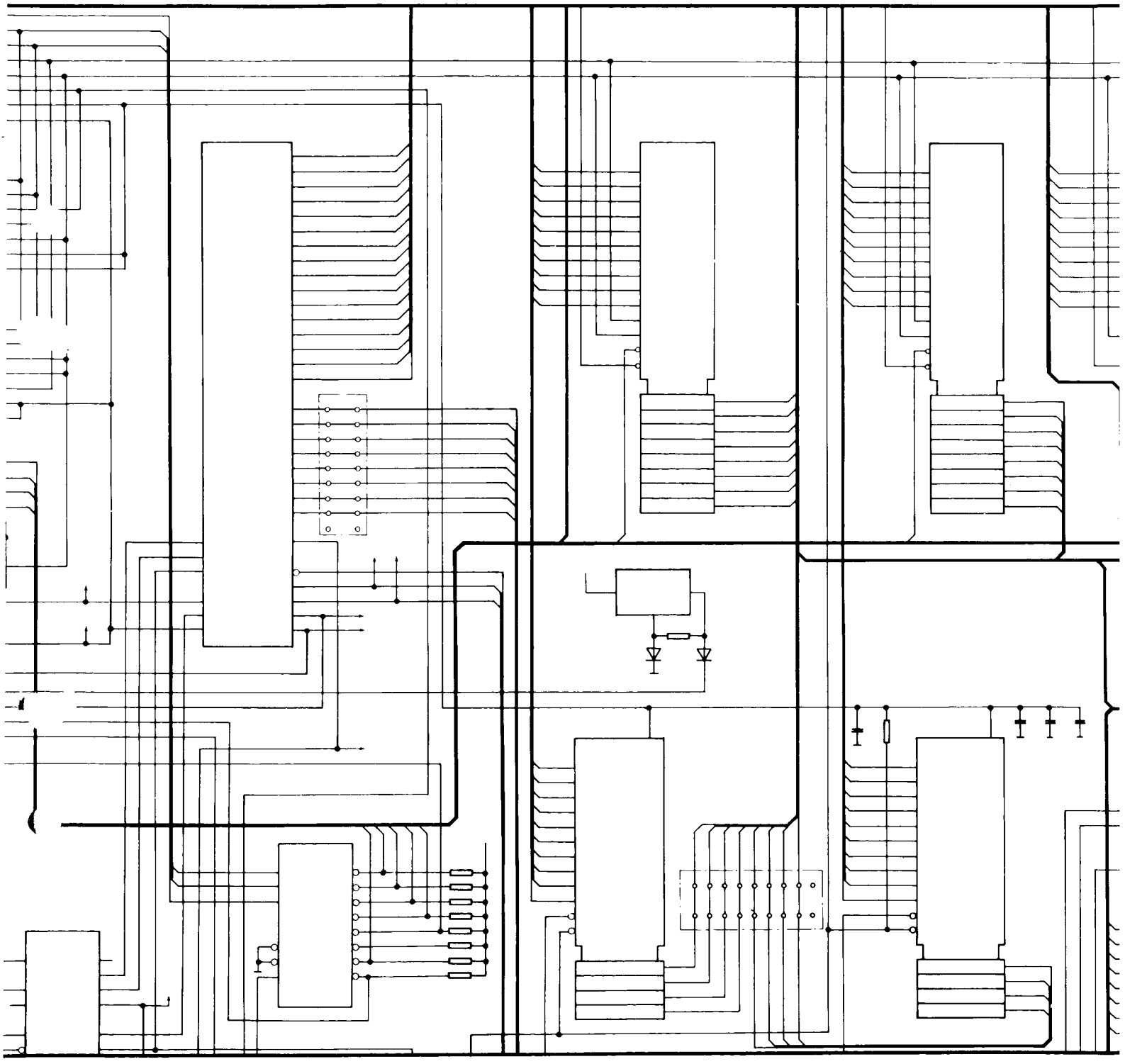
S-220 10 Lund
Sweden

AK-10 System

Hemofiltration monitor HFM 10-1



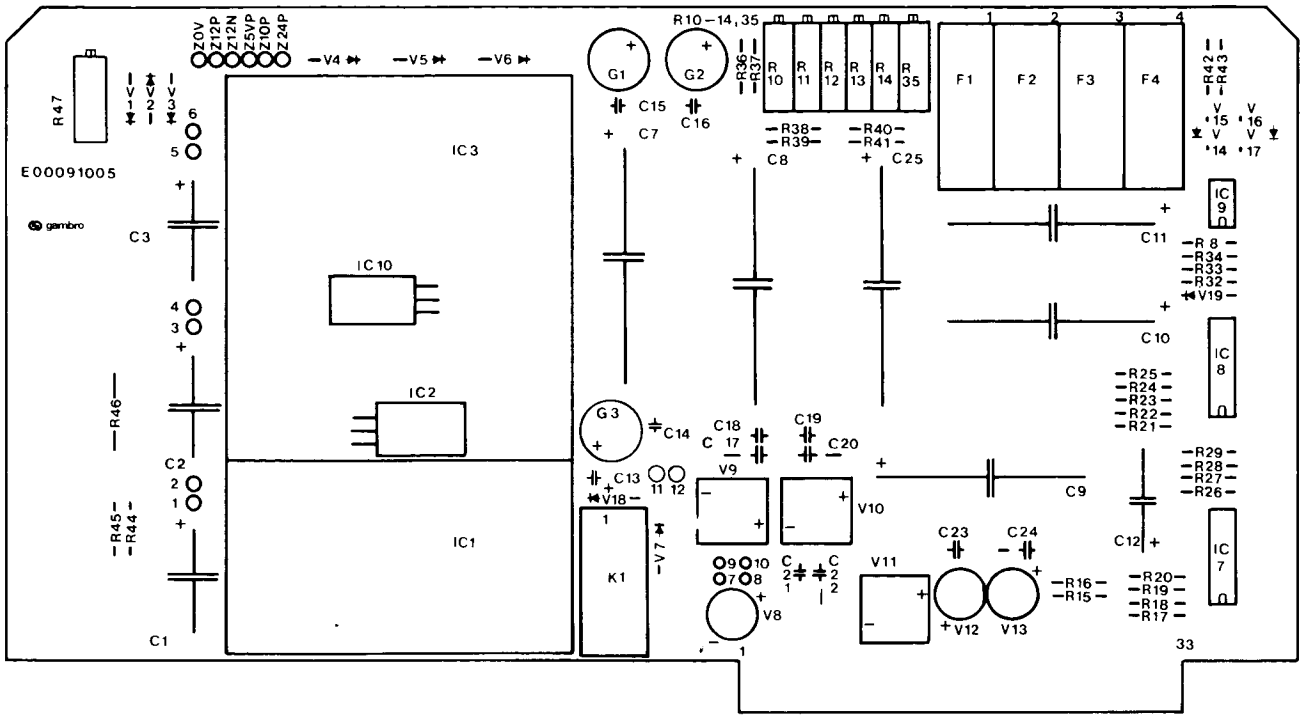
Electrical diagrams

gambro

Contents

		Ordering No	Drawing
Power supply	1	K0 4538 G	K0 4539
Control logic	2	K1 0824 001	K1 0283
Micro processor	3	K1 0140 001	K1 0141
Weight electr	4	K0 5706 A	K0 5707
Motor controller	5	K0 4475 C	K0 4477
Mains power	6	K0 8348 001	K0 8346
Primary board	6	K0 7761 001	K0 8346
Secondary board	6	K0 7428 001	K0 8346
Fuse board	6	K0 7427 001	K0 8346
Display card	7	K0 5702 A	K0 5703
Instrument panel	8	K0 5775 A	K0 5716
Blood leak	9	K0 6162 B	K0 6076
Transmitter board	9	K0 7116 001	K0 6076
Receiver board	9	K0 7118 001	K0 6076
Contact board	9	K0 7120 001	K0 6076
Alarm board	10	K0 8613 002	K0 8614
Press trans board	11	K0 6170 B	K0 6171
Wiring diagram	12		K0 5723
Progr interconn. unit	13	K0 6009 E	K0 6217

Power supply 1



R46	100 102 067
R44	100 104 031
R8, 33	100 104 038
R41	100 104 047
R37	100 104 048
R39, 40	100 104 050
R15	100 104 054
R21, 22, 23, 24, 25	100 104 060
R26, 27, 28, 29	100 104 061
R16	100 104 062
R20	100 104 064
R19	100 104 069
R17	100 104 075
R18	100 104 084
R34	100 105 040
R45	100 105 041
R38	100 105 050
R36	100 105 051
R43	100 105 060
R42	100 105 061
R14	100 106 010
R10, 11, 12, 13	100 106 014
R35, 47	100 106 022
C14, 15, 16, 18, 19	
21, 23	100 110 061
C1, 2, 3	100 114 008
C9, 10, 11	100 114 019
C7, 8, 25	100 114 020
C12	100 114 029
C17, 20, 22, 24	100 116 030
IC8	100 010 035
IC7	100 010 053
IC9	100 010 073
IC9 socket	100 011 007
IC1	100 010 063
IC3	100 010 057
IC2, 10	100 010 088
V1, 2, 3, 4, 5, 6, 7	
18	100 002 004
V19	100 002 006
V12, 13	100 002 019
V9, 10, 11	100 002 026
V14, 15, 16, 17	100 006 005
PIN 1-12, Z0V	
Z12P, Z12N, Z5VP	
Z10P, Z24P	100 202 094
F1	100 212 004
Fuse	100 213 008
Fuse label	K0 5941 005
F2	100 212 004
Fuse	100 213 009
Fuse label	K0 5941 001
F3	100 212 004
Fuse	100 213 008
Fuse label	K0 5941 004
F4	100 212 004
Fuse	100 213 004
Fuse label	K0 5941 002
G1	100 010 060
G2, 3	100 010 061
Cooling flange (IC1)	100 302 010
Cooling flange	
(IC2, 3, 10)	K0 7053 001
Cooling flange	
(V9, 10, 11)	K0 8658 001
K1	100 200 035

Ordering no:	K0 4538 G
Drawing:	K0 4539
Layout:	E0 0087 006
Comp.print:	E0 0091 005
Change order:	4753

Smst - intn	
K04538	S

ONLY K04538 G,K

K04538 G,H,K

P2 — 9B — 10B — 33B — 12A — 20A — 21A — 10A — 13A — 14A — 32B — 7B — 8B — 8A — 31B — 9A

Z10A — Z10B — Z5VP — Z0VL — Z0VL — Z0VL — Z0VR — Z14A — Z14B — Z16P — Z12P

C20 0µ1 — C19 0µ01 — V10 — F1 2A — IC3 5V — G1 U>6V2 — C25 — C7 — C8 4700µF x 3 — C15 0µ01 — C3 15µ — Z5VP → Z0VL Z0VP Z0VR

C22 0µ1 — C21 0µ01 — V11 — F3 2A — IC1 12V — C10 2200µF — C11 2200µF — G2 U>14V — C1 15µF — C16 0µ01 — V1 — Z16V — V6 — Z12P → Z12P — Z0V

Z24P — V18 — V7 — K1

R22 10k — Z5VP — R25 10k — R23 10k — Z12P — R24 10k — Z12N — R21 10k

Z10P — R42 13K — R12 1K — R40 2K7 — R43 11K — R13 1K (LOW) — R41 1K5

R18 560k — R26 12k — R27 12k — R17 100k — IC7 — IC8 — V14 — V15

R19 56k (82k) — R29 12k — R28 12k — R20 22k (47k) — V16 — V17 — V19 5V1 — Z16V — R34 750R

R37 1K8 — R10 1K — R38 3K — R36 3K6 — R11 1K (LOW) — R39 2K7

Z5VP — R33 470R — R35 (1k) 200R — (R32) (470R) — Z12N

V12 — C9 2200µF — F4 0,2A — ADJ IC10 — R46 3R9 — ADJ IC2 12V — R45 910R — R47 200R — R44 120R — C2 15µ — G3 U>14V — C14 0µ01 — V2 — Z12N

C24 0µ1 — C23 0µ01 — V5

short-circuit mod. to be used toghether with transformer K04591002-004

V13 — R16 15k — C12 47µF — R15 5k6

Z12P — R8 470R — Z10P — IC9 — Z16V — R14 5k

ONLY K04538 H,K

V8 — V9 — F2 3,15A — Z24P → Z24P — C17 0µ1 — C18 0µ01 — Z0VP

P2 — 4B — 1B — 2B — 1A — 2A — 15A — 3B — 11B — 12B — 5B — 6A — 7A — 6B — 4A — 5A — 13B — 14B — 15B — 16B — 11A — 3A

Z0VL — RSTN — RSTP — RSTN — RSTP — Z24A — Z14C — Z14D — Z24C — Z0VP — Z24D — Z24B — Z24D — Z24C — Z14N — REST

ADJUSTMENT

1 R 14 Z10P TO 10,0V ± 0,050V

2 R 47 Z12N TO -12V - 0,2V + 0V

3 R 10 NOM. NETVOLTAGE + 15 % ← ALARM UNDER NORMAL LOAD

4 R 11 NOM. NETVOLTAGE - 15 % ← ALARM UNDER NORMAL LOAD

5 R 12 ALARM WHEN Z5VP ADJUSTED TO 5,5V } REMOVE Z0VL FROM R35. PUT IN R32-MODULE. DO ADJ. THEN REASSEMBLE.

6 R 13 ALARM WHEN Z5VP ADJUSTED TO 4,5V }

7 R 35 Z5VP TO 5,2V ± 0,025V

	Z0VL	Z12P
IC7	12	3
8	8	

5	94 11 07		6	AM 4753	930316		
3	AM		4				
1	ÄM.nr. 2586		2	ÄM.nr.			
Not	Ändring	Dat.	Inf.	Not	Ändring	Dat.	Inf.

Då icke annat anges avser mättuppgift på ytbelagd detalj mättet före ytbeläggning

Tol. för icke direkt toleransatta mått enl. SMS 715 medel

Nom mått	över	t.o.m	Tol
	(3)	6	0,1
	(6)	30	0,2
	(30)	100	0,3
	(100)	300	0,5
	(300)	1000	0,8
	(1000)	2000	1,2
	(2000)	4000	2
	(4000)	8000	3

E 00087006

C	B	A	Pos.	Benämning	Material el. beteckning	Anmärkning
Antal			Dat. 800114	Rit. OLL	Kontr.	Godk.	Skala	Ytjämnh

gambro instrumenta Lund Sweden

CIRCUIT DIAGRAM POWER SUPPLY

K04539 — 2

Power supply

Calibrating/Adjusting

1. R14 Z10P to 10,0V +/-0,050V.

2. R47 Z12N to -12V -0,2V/+0V.

3. R10 Nom. netvoltage +15% - alarm under normal load.

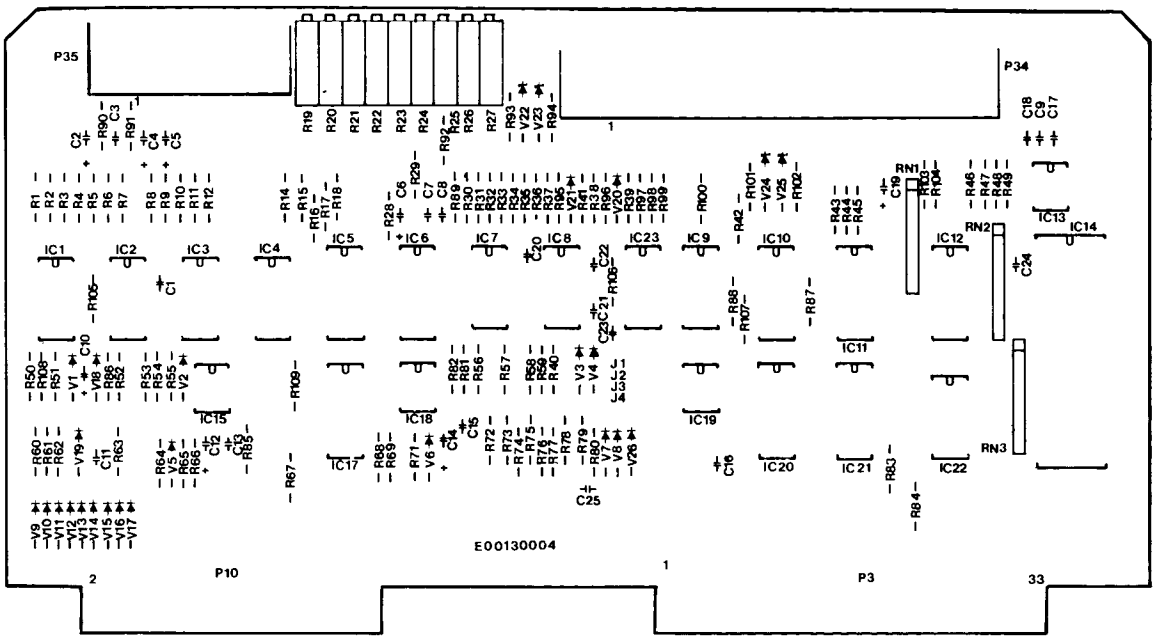
4. R11 Nom. netvoltage -15% - alarm under normal load.

5. R12 Alarm when Z5VP adjusted to 5,5V.
6. R13 Alarm when Z5VP adjusted to 4,5V.

} Remove Z0VL from R35. Put ing R32-module. Do adj. Then reassemble.

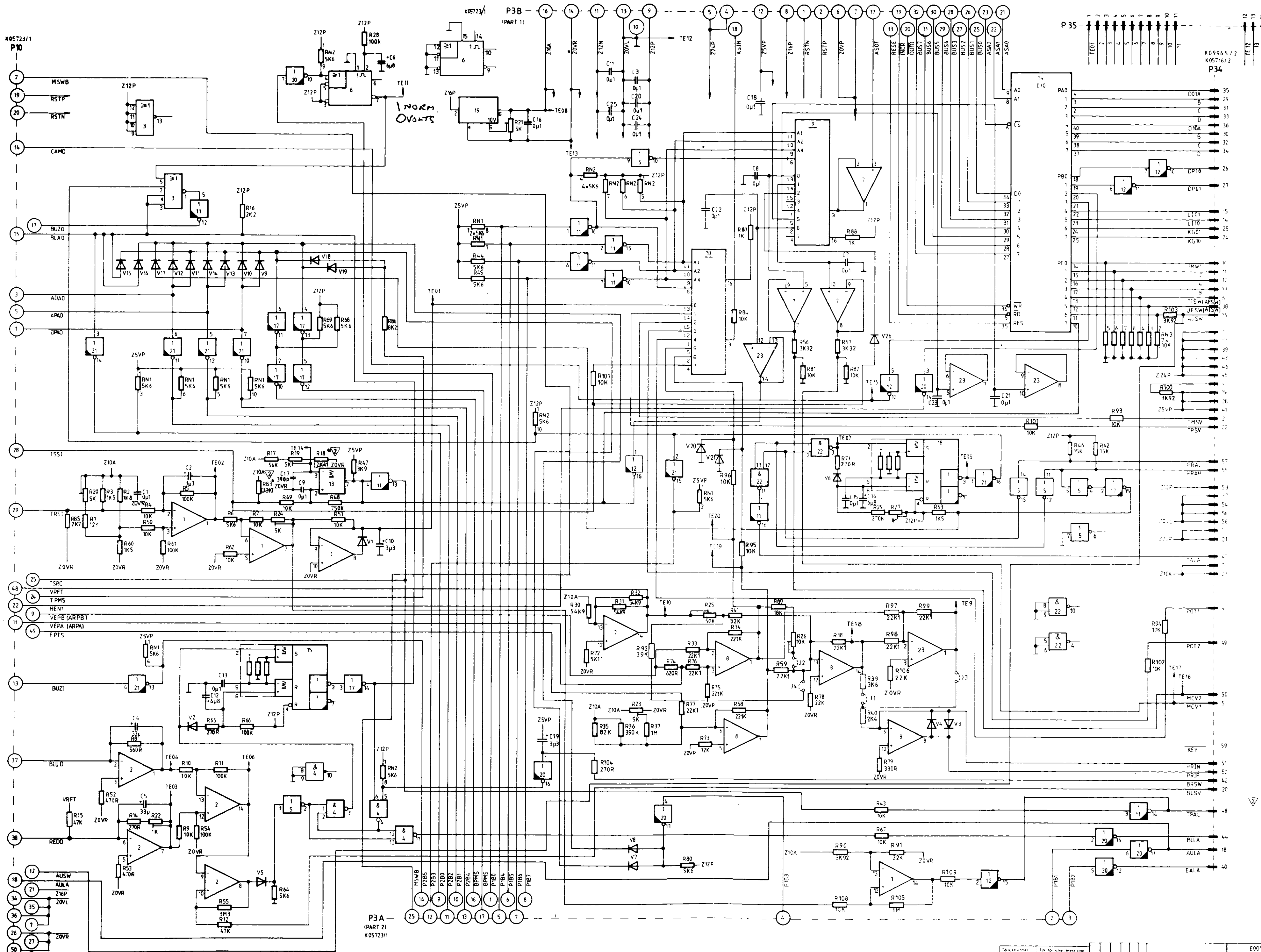
7. R35 Z5VP to 5,2V +/-0.025V.

Control logic 2



R14, 65, 71, 104	100 104 035
R79	100 104 036
R52, 53	100 104 038
R8	100 104 039
R87, 88	100 104 045
R3, 60, 63	100 104 047
R2	100 104 048
R16	100 104 049
R83, 85	100 104 050
R56, 57	100 104 051
R47, 90, 100, 103	100 104 052
R6, 44, 45, 64, 68, 69, 80	100 104 054
R86	100 104 056
R4, 7, 9, 10, 43, 49 50, 51, 62, 67, 81, 82, 84, 93, 94, 96, 101, 102, 107, 108, 109	100 104 060
R1, 73	100 104 061
R42, 46	100 104 062
R89	100 104 063
R76, 78, 91, 106	100 104 064
R92	100 104 067
R12, 15	100 104 068
R17	100 104 069
R35, 41	100 104 071
R5, 11, 28, 54, 61, 66	100 104 075
R29	100 104 080
R36	100 104 082
R37, 105	100 104 090
R55	100 104 090
R74	100 105 039
R39	100 105 051
R72	100 105 051
R48	100 105 053
R19-21, 23, 24	100 106 010
R25	100 106 013
R22	100 106 014
R27	100 106 021
R26	100 106 025
R33, 38, 59, 77, 97, 98, 99	100 150 064
R30, 31, 32	100 150 069
R34, 58, 75	100 150 079
R40	100 151 049
R18	100 151 068
RN1, 2	100 108 024
RN3	100 108 025
C17	100 110 037
C2, 10, 19	100 114 010
C6, 12, 14	100 114 022
C4, 5	100 114 024
C1, 3, 7, 8, 9, 11, 13, 15, 16, 18, 20, 21, 22, 23, 24, 25	100 116 030
IC13	100 010 001
IC15, 18	100 010 019
IC11, 12, 20	100 010 035
IC17, 21	100 010 036
IC3	100 010 039
IC4, 22	100 010 040
IC5	100 010 043
IC14	100 010 050
Socket	100 011 004
IC1, 2, 7, 8, 23	100 010 072
IC19	100 010 073
IC9, 10	100 010 074
IC6	100 010 089
V1-19, 26	100 002 005
V20, 21	100 002 048
P35	100 202 081
P34, Key: pos. 59	100 202 114
J1-4	100 202 166
J1, 2	100 202 167

Ordering no:	K1 0824 001
Drawing:	K1 0283
Layout:	E0 0129 006
Comp. print:	E0 0130 004
Change order:	6778



Gen. ass. draw	
K10335	S
K10824	S

	Z12N	Z0VR	Z0VL	Z0VP	Z5VP	Z12P
IC 12	11					4
3			7			14
4			7			14
5			8			1
6			8 15			16
7 8	11					4
9 10			8			
[illegible]				8		
12			8			
[illegible]		[illegible]				8
[illegible]					2 6	
[illegible]						8
[illegible]			8			
[illegible]						8
[illegible]			8			
[illegible]			[illegible]			
22						14
23	11					4

	J1	J2	J3	J4
HFM	x	x		
PFM			x	x

x = STRAP

CALIBRATING, ADJUSTING

NOTE ALL VOLTAGES MEASURED AGAINST Z0VR P35/[illegible]

R21 ADJ TO 10V ± 20mV MEASURE AT P35/6

R19 CONN [illegible] Ω [illegible] BETWEEN P10/28 AND P10/26. ADJ TO THE SWITCH-POINT TO GET HIGH LEVEL (Z16P) MEASURE ON P10/25

R20 CONN 2938 Ω [illegible] BETWEEN P10/29 AND P10/26. ADJ TO 0V ± 20mV MEASURE ON P35/2

R24 CHANGE TO [illegible] Ω (32.5 °C). ADJ TO 10V ± 100mV MEASURE ON P35/1

R23 ZERO PRESSURE IN, ADJ TO 1,02V FOR HFM AND 2,00 V FOR PFM. MEASURE ON P35/19.

R25 ZERO THE INSTRUMENT ELECTRICALLY

R26 CONN A CURRENT GENERATOR WHICH GIVES 0,666mA BETWEEN P10/[illegible] (POSITIVE) AND P10/9 (NEG.). ADJ TO 400mmHg ON THE INSTRUMENT (HFM ONLY)

R27 ALARM DELAY TMP. ADJ TO 8 SEC

R22 CONN A CURRENT GENERATOR WHICH GIVES 1,000 mA BETWEEN P10/37 (POSITIVE) AND P10/26 (NEG.). ADJ TO 6V ± 125 mV. MEASURE ON P35/6.

2

(*)	R18	R83
HFM	62k	2k7
PFM	2k4	33k

No	Revision	Dft	Chk	Appd	No	Revision	Dft	Chk	Appd
1	[illegible]				2	6778 841105	[illegible]	[illegible]	[illegible]

A B C Item No	Title	Material or title: E00129006	Note: PFM, HFM	
Quantity	Date 83[illegible]30	Drn. by [illegible]	Chk. by [illegible]	Auth. by [illegible]

Scale | Finish

gambro® Lund Sweden

CONTROL LOGIC CIRCUIT DIAGR.

K10283-1

Control logic

Adjustment

Note: All voltages measured against Z0VR, P35/13.

R21: Adj to 10 V +/-20 mV. Measure at P35/8.

R19: Conn. 2997 (42°C) between P10/28 and P10/26 adj. to the switch-point to get high level (Z16P) measure on P10/25.

R20: Conn. 2938 (42.5°C) between P10/29 and P10/26 adj. to 0 V +/-20 mV measure on P35/2.

R24: Change to 4417 (32.5°C) adj. TP 10 V +/-100 mV, measure on P35/1.

R23: Zero pressure in adj. to 1,02V measure on P35/19.

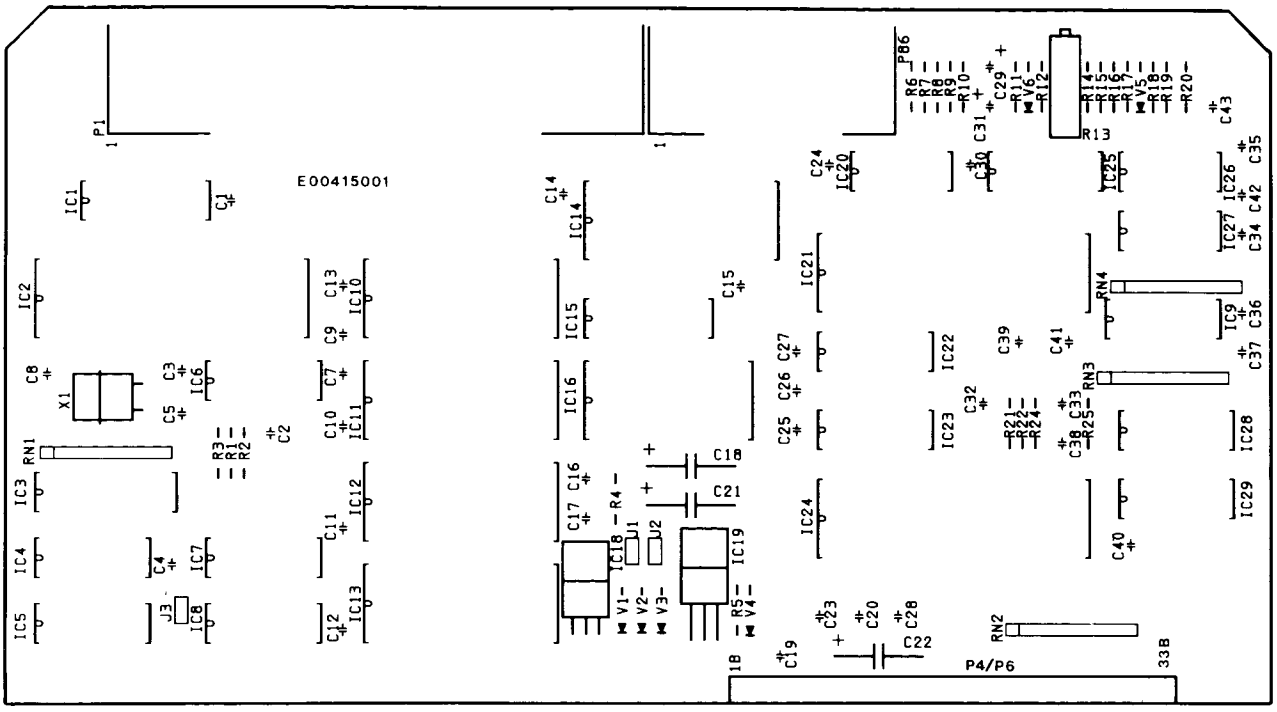
R25: Zero the instrument electrically.

R26: Conn. a current generator which gives 0,666mA between P10/11 (positive) and P10/9 (neg) adj to 400 mmHg on the instrument.

R27: Alarm delay TMP, adj. to 8 s.

R22: Conn. a current generator which gives 1.000 mA between P10/37 (positive) and P10/26 (neg) adj. to 6 V +/-125 mV measure on P35/6.

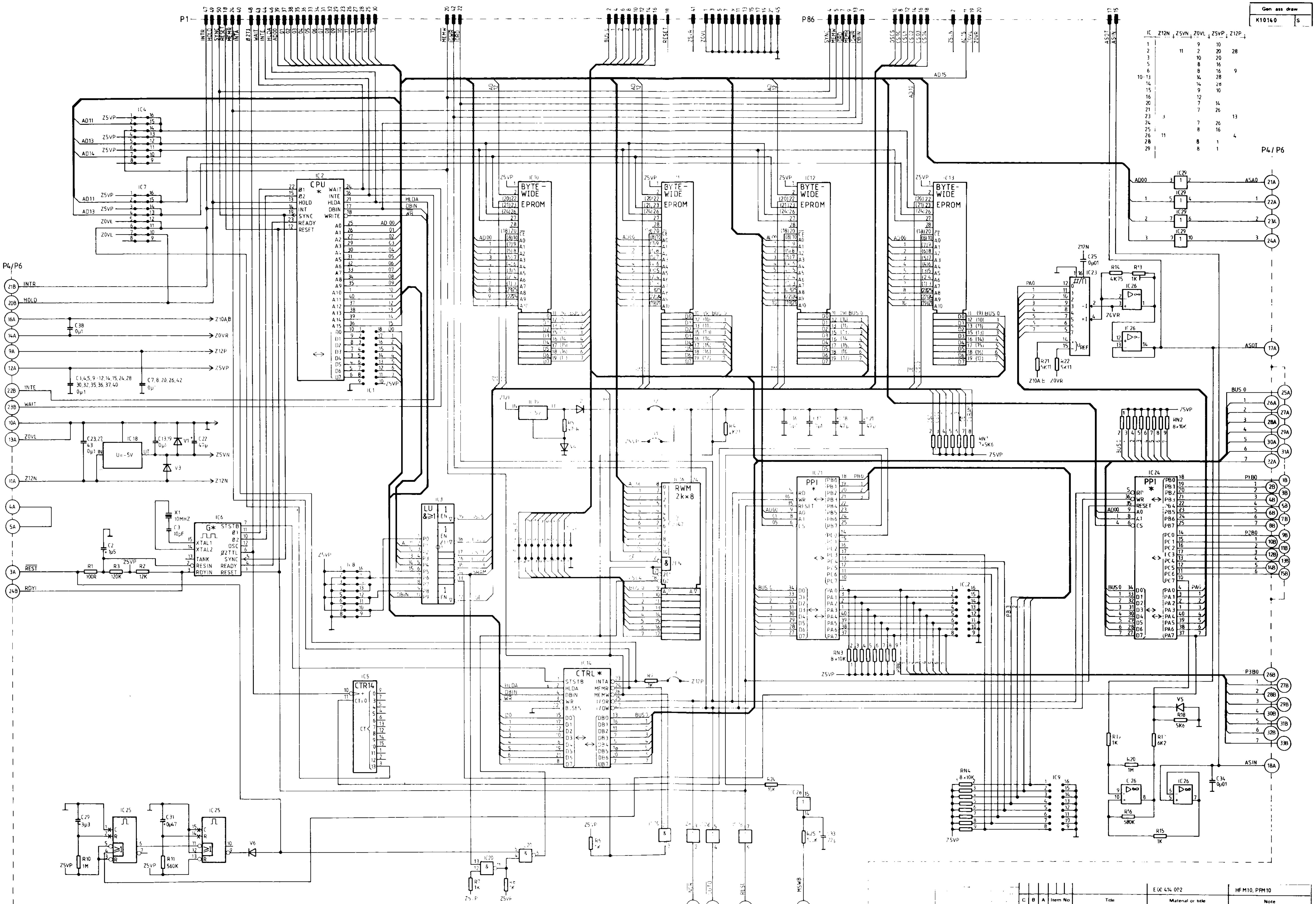
Microprocessor 3



R1	100 104 030
R5	100 104 038
R6-9, 15, 19	100 104 045
R4	100 104 049
R14	100 104 053
R18	100 104 054
R24	100 104 060
R2	100 104 061
R25	100 104 075
R3	100 104 076
R11	100 104 084
R16	100 104 085
R10, 20	100 104 090
R21, 22	100 105 053
R17	100 105 054
R13	100 106 014
RN1	100 108 024
RN2, 3, 4	100 108 025
C3	100 110 015
C25, 34	100 110 061
C31	100 114 009
C29	100 114 029
C18, 21, 22	100 114 013
C2	100 114 016
C33	100 114 016
C1, 4, 5, 7-17, 19, 20 23, 24, 26, 27, 28, 30 32, 35-38, 40, 42, 43	100 116 030
IC3	K1 0307 001
IC28, 29	100 010 044
IC14	100 010 048
IC6	100 010 051
IC23	100 010 062
IC5	100 010 067

IC26	100 010 072
IC25	100 010 089
IC20	100 010 092
IC16	100 010 112
IC2, Socket	100 011 004
IC2	100 010 046
IC21, 24, Socket	100 011 004
IC21, 24	100 010 050
IC19	100 010 056
IC18	100 010 058
IC4, 7, 8, Socket	100 011 002
IC4, 7, 8	100 206 004
IC10-13	100 011 012
IC1, 15, Socket	100 011 006
IC1, 15	100 206 004
IC9, 22, Socket	100 011 002
V1, 2, 3	100 002 004
V4, 5, 6	100 002 005
X1	100 130 003
P86	100 202 111
J1	100 202 260
J2, 3	100 202 260
J2, 3, Jumper	100 202 262

Ordering no:	K1 0140 001
Drawing:	K1 0141
Layout:	E0 0414 002
Comp. print:	E0 0415 001
Change order:	6304



UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS.
2. ALL CAPACITANCE VALUES IN FARADS.

C	B	A	Item No	Title	Material or title	Note
					E 00 414 002	HF M10, PFM10

Quantity | Date 84 01 31 | Drn by RDA | Chk by | Auth by | Scale | Finish

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Lund Sweden

MICROPROCESSOR CIRCUIT DIAGR.

K10141 1

No	Revision	Sign and date Dft	Chk	Appd	No	Revision	Sign and date Dft	Chk	Appd
1					2				

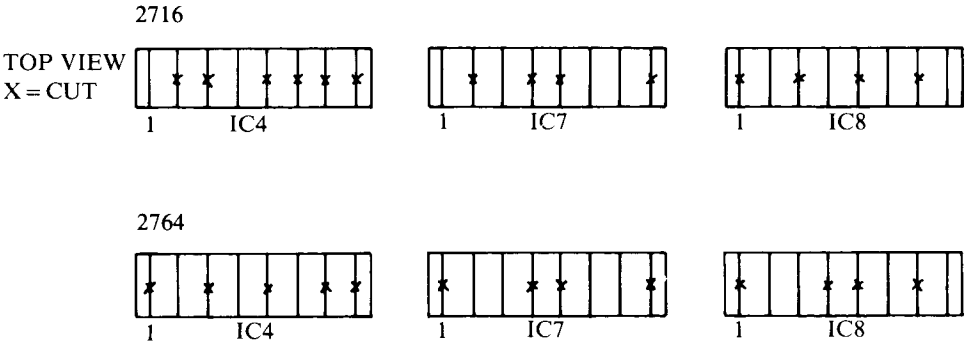
Microprocessor

Adjusting

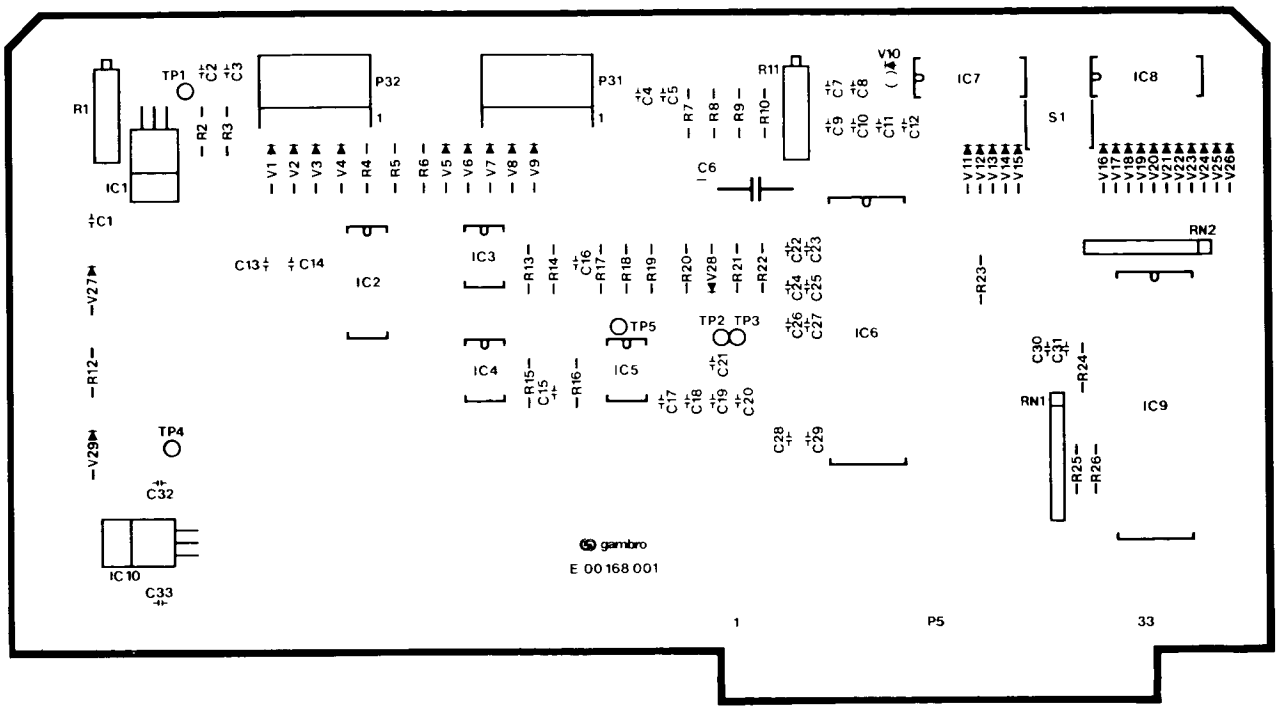
R13: Remove IC24 adjust ASOT (P86 17) to 10.00 V +/-20 mV.

Programming for diff. type of memory.

1 PROM 2716
CMOS RAM "LIKE" 2114 with back up insert programming plugs as below.

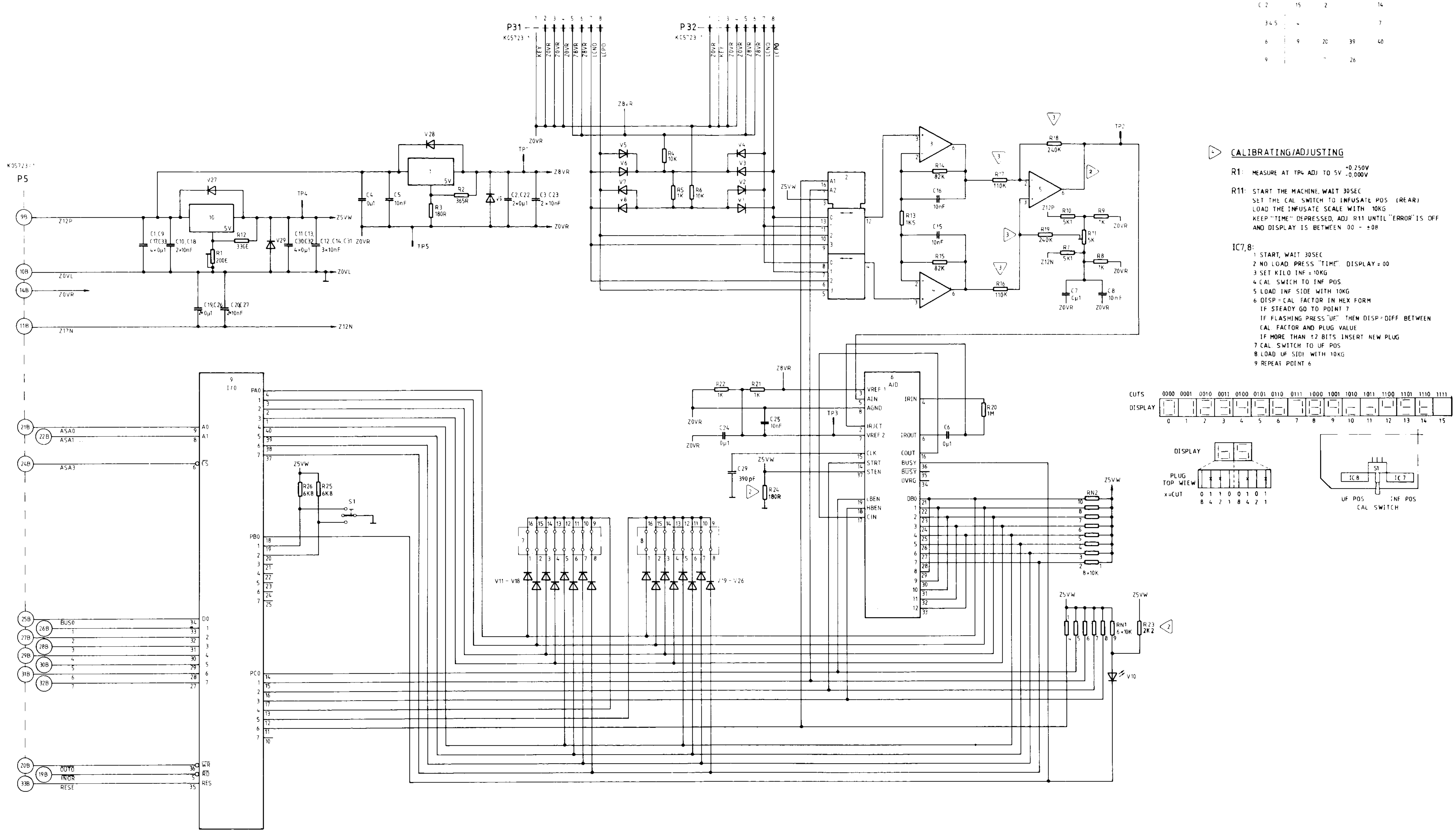


Weighing board



R25, 26	100 100 055
R3, 24	100 104 033
R12	100 104 036
R5, 8, 9, 21, 22	100 104 045
R13	100 104 047
R23	100 104 049
R4, 6	100 104 060
R14, 15	100 104 071
R20	100 104 090
R2	100 105 036
R7, 10	100 105 053
R16, 17	100 104 075
R18, 19	100 105 079
R11	100 106 010
R1	100 106 022
RN1, RN2	100 108 025
C29	100 110 037
C3, 5, 8, 10, 12, 14, 15, 16, 18, 20, 23, 25, 27, 31	100 110 061
C1, 2, 4, 7, 9, 11, 13, 17, 19, 22, 24, 26, 30, 32, 33	100 116 030
C6	100 118 030
IC9	100 010 050
IC9 socket	100 011 004
IC1, 10	100 010 056
IC3, 4, 5	100 010 084
IC6	100 010 081
IC6 socket	100 011 004
IC2	100 010 082
IC7, 8	100 206 004
IC7, 8 socket	100 011 002
V9, 27, 28, 29	100 002 004
V1-8, 11-26	100 002 005
V10	100 006 005
TP1, 2, 3, 4, 5	100 202 031
P31, Key: pos 1	100 202 121
P32, Key; pos 2	100 202 121
S1	100 208 019

Ordering no:	K0 5706 A
Drawing:	K0 5707
Layout:	E0 0116 003, 004
Comp.print:	E0 0168 001
Change order:	5489



CALIBRATING/ADJUSTING

R1: MEASURE AT TP4 ADJ TO 5V $^{+0.250V}_{-0.000V}$

R11: START THE MACHINE, WAIT 30SEC
SET THE CAL SWITCH TO INFUSATE POS (REAR)
LOAD THE INFUSATE SCALE WITH 10KG
KEEP "TIME" DEPRESSED, ADJ R11 UNTIL "ERROR" IS OFF
AND DISPLAY IS BETWEEN 00 - ±08

IC7,8:
1 START, WAIT 30SEC
2 NO LOAD. PRESS "TIME". DISPLAY = 00
3 SET KILO INF = 10KG
4 CAL SWICH TO INF POS.
5 LOAD INF SIDE WITH 10KG
6 DISP = CAL FACTOR IN HEX FORM
IF STEADY GO TO POINT 7
IF FLASHING PRESS "UF" THEN DISP = DIFF BETWEEN
CAL. FACTOR AND PLUG VALUE
IF MORE THAN ±2 BITS INSERT NEW PLUG
7 CAL. SWITCH TO UF POS
8 LOAD UF SIDE WITH 10KG
9 REPEAT POINT 6

Gen ass drew	
K05706	S

gambro
Lund Sweden

Title: WEIGH ELECTR CIRCUIT DIAGR
K05707 1
Date 1979-01-26 · Drn by RDA
E 00 116 003 4 · HFM

Weight electr.

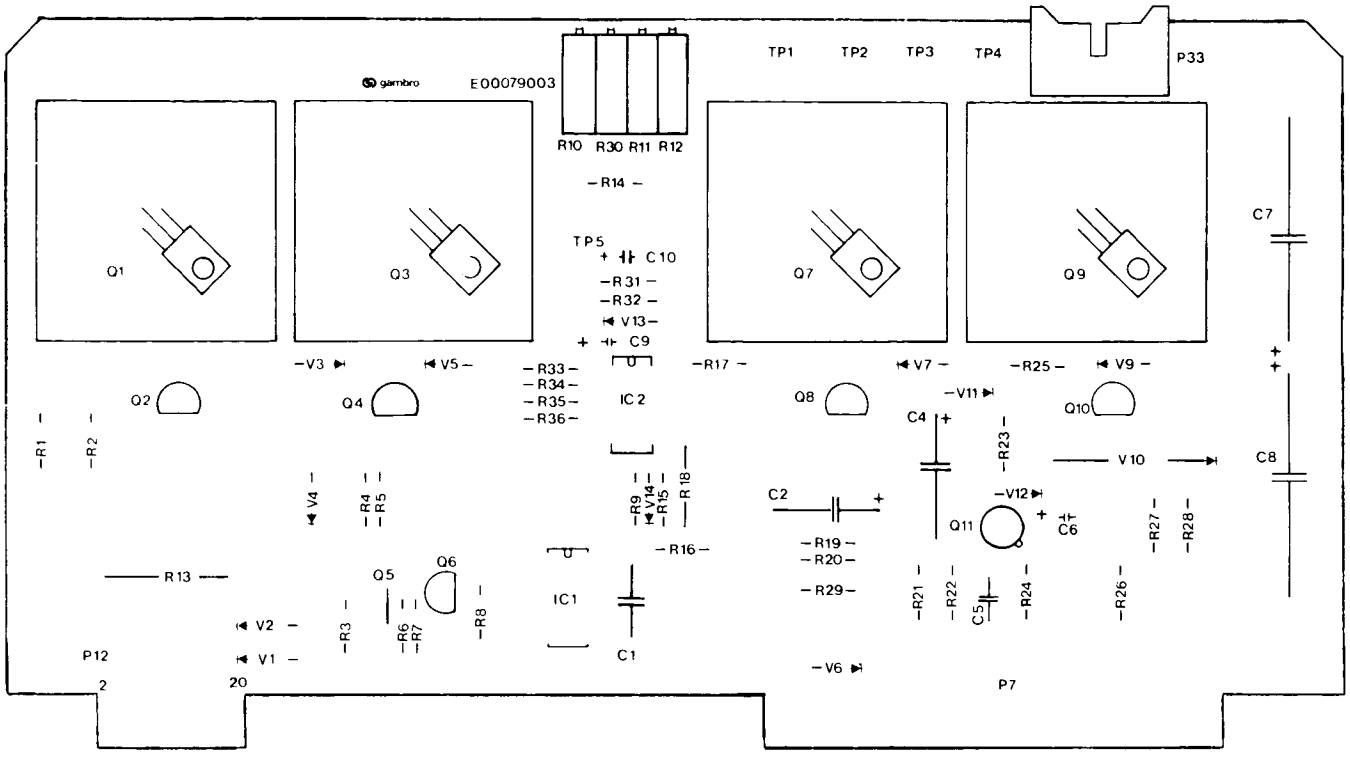
Calibrating/Adjusting

R1: Measure at TP4 adj. to 5V +0,250V/-0,000V.

R11: Start the machine, wait 30 sec.
Set the cal. switch to infusate pos. (rear).
Load the infusate scale with 10 Kg.
Keep "TIME" depressed adj. R11 until "ERROR" is off and display this between 00- + /-08.

IC7, 8:1. Start, wait 30 sec.
2. No load, press "TIME", display = 00.
3. Set kilo inf. = 10Kg.
4. Cal. switch to inf. pos.
5. Load inf. side with 10 Kg.
6. Disp = Cal. factor in hex form.
If steady go to point 7.
If flashing press "UF", then disp = diff between cal. factor and plug value.
If more than + /-2 bits insert new plug.
7. Cal. switch to "UF" pos.
8. Load "UF" side with 10 Kg.
9. Repeat point 6.

Motor controller

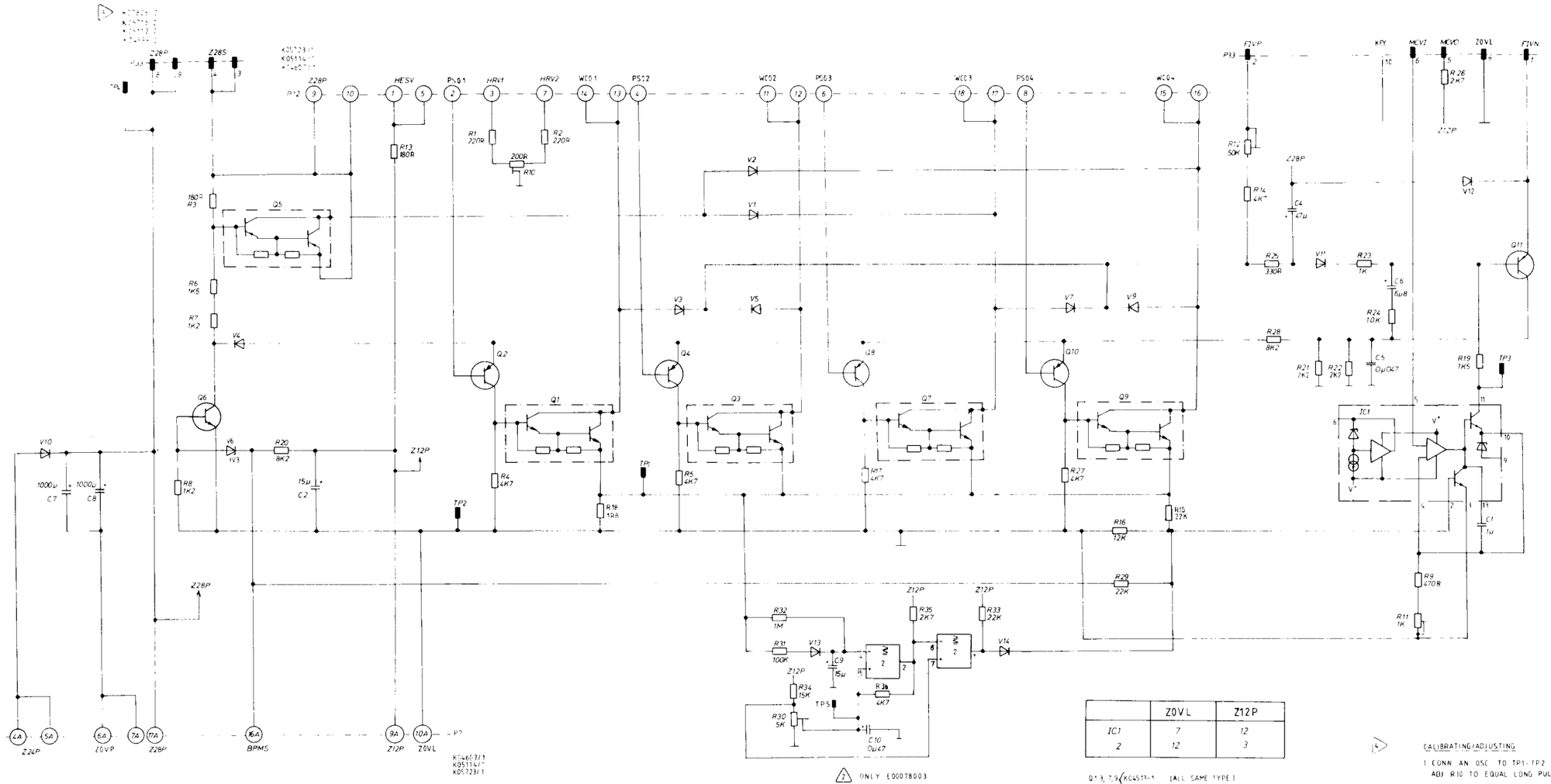


R13	100 102 023
R18	100 102 063
R3	100 104 033
R1, 2	100 104 034
R25	100 104 036
R9	100 104 038
R23	100 104 045
R7, 8	100 104 046
R6, 19	100 104 047
R21, 22	100 104 049
R26, 35	100 104 050
R4, 5, 14, 17, 27, 36	100 104 053
R20, 28	100 104 056
R24	100 104 060
R16	100 104 061
R34	100 104 062
R15, 29, 33	100 104 064
R31	100 104 075
R32	100 104 090
R30	100 106 010
R12	100 106 013
R11	100 106 014
R10	100 106 022
C5	100 112 023
C1	100 112 045
C7, 8	100 114 006
C2	100 114 008
C10	100 114 009
C9	100 114 023
C4	100 114 029
C6	100 114 034
V3, 4, 5, 7, 9, 11, 12	100 002 004
V13, 14	100 002 005
V6	100 002 008
V1, 2	100 002 009
V10	100 002 025

IC1	100 010 032
IC2	100 010 053
Q6	100 000 003
Q2, 4, 8, 10	100 000 004
Q5	100 000 010
Q11	100 000 011
Q1-3, 7, 9	K0 4513 001
TP1-5	100 202 031
P33, Key: pos 10	100 202 064
Cooling flange	100 302 012

Ordering no:	K0 4475 C
Drawing:	K0 4477
Layout:	E0078003
Comp.print:	E0 0079 003
Change order:	4419
In prod. from machine no:	11058

Ämnet - rätn
K04475



	Z0VL	Z12P
IC1	7	12
2	12	3

CALIBRATING/ADJUSTING

1 CONN AN OSC TO TP1-TP2
ADJ R10 TO EQUAL LONG PULSES

2 ADJ R11 TO CORRECT MAX SPEED
FOR BMM 56 RPM
FOR HFM 37 RPM

3 FOR BMM ADJ R12 TO CORRECT MOTOR READING

4 ADJ R30 TO 1.5V BETWEEN TP5-TP2
HOLD MOTOR ADJ R30 TO 2-3 SEC STOP TIME

													E00788 003		
											C	B	A	Pos	Benämning	Material el beteckning	Anmärkning
											Antal	Dat		Rit ACA	Kontr	Godk	Skala	Ytjämnh
3	50 nr 2997			4	HM 1098						gambro instrumenta Lund Sweden	CIRCUIT DIAGRAM MOTORCONTROLLER BMM10		K04477	1
1	HM 1250		11/8	2											
Not	Ändring	Dat	Inf	Not	Ändring	Dat	Inf								

Motor controller

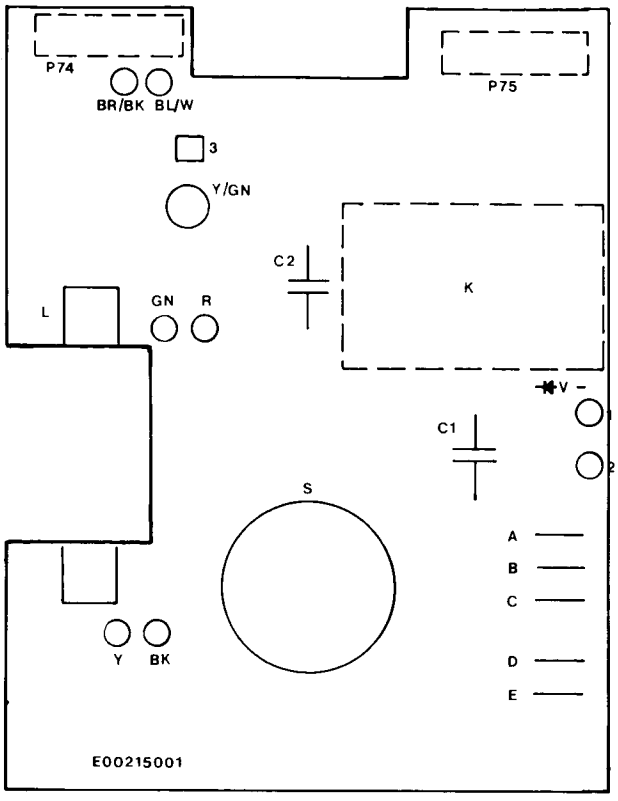
Calibrating/Adjusting

1. Conn. an osc. to TP1-TP2.
   Adj. R10 to equal long pulses.

2. Adj. R11 to correct max speed.
   For HFM: 37 rpm.

3. Adj. R30 to 1.5V between TP5-TP2.
   Hold motor. Adj. R30 to 2-3 sec. stop time.

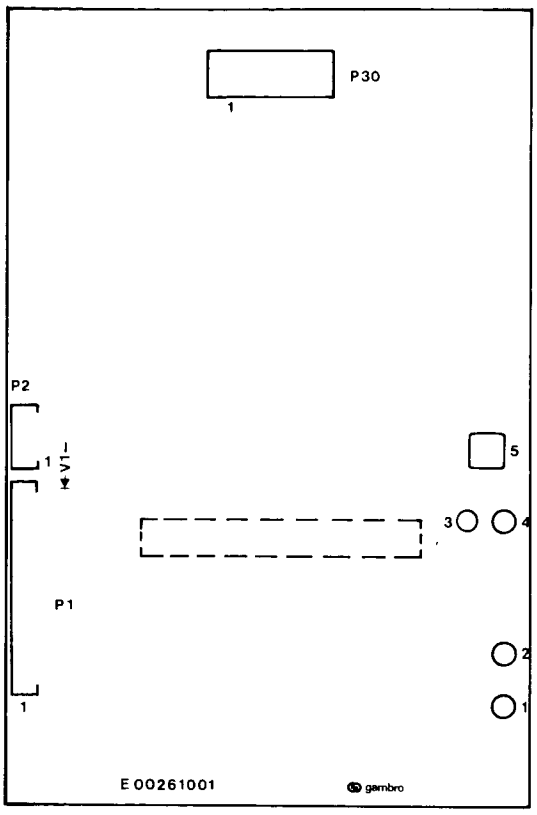
Mains power 6



Primary board

C1	100 120 002
C2	100 120 013
V	100 002 004
P74	100 202 076
K	100 200 042
S	100 206 010

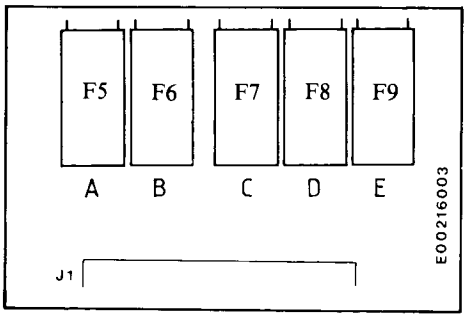
Ordering no:	K0 7761 001
Drawing:	K0 8346
Layout:	E0 0188 004
Comp.print:	E0 0215 001
Change order:	5303



Secondary board

V1	100 002 004
P2	100 202 0083
P30, Key pos: 9	100 202 115
P1	100 202 124

Ordering no:	K0 7428 001
Drawing:	K0 8346
Layout:	E0 0145 004
Comp.print:	E0 0021 03
Change order:	5303

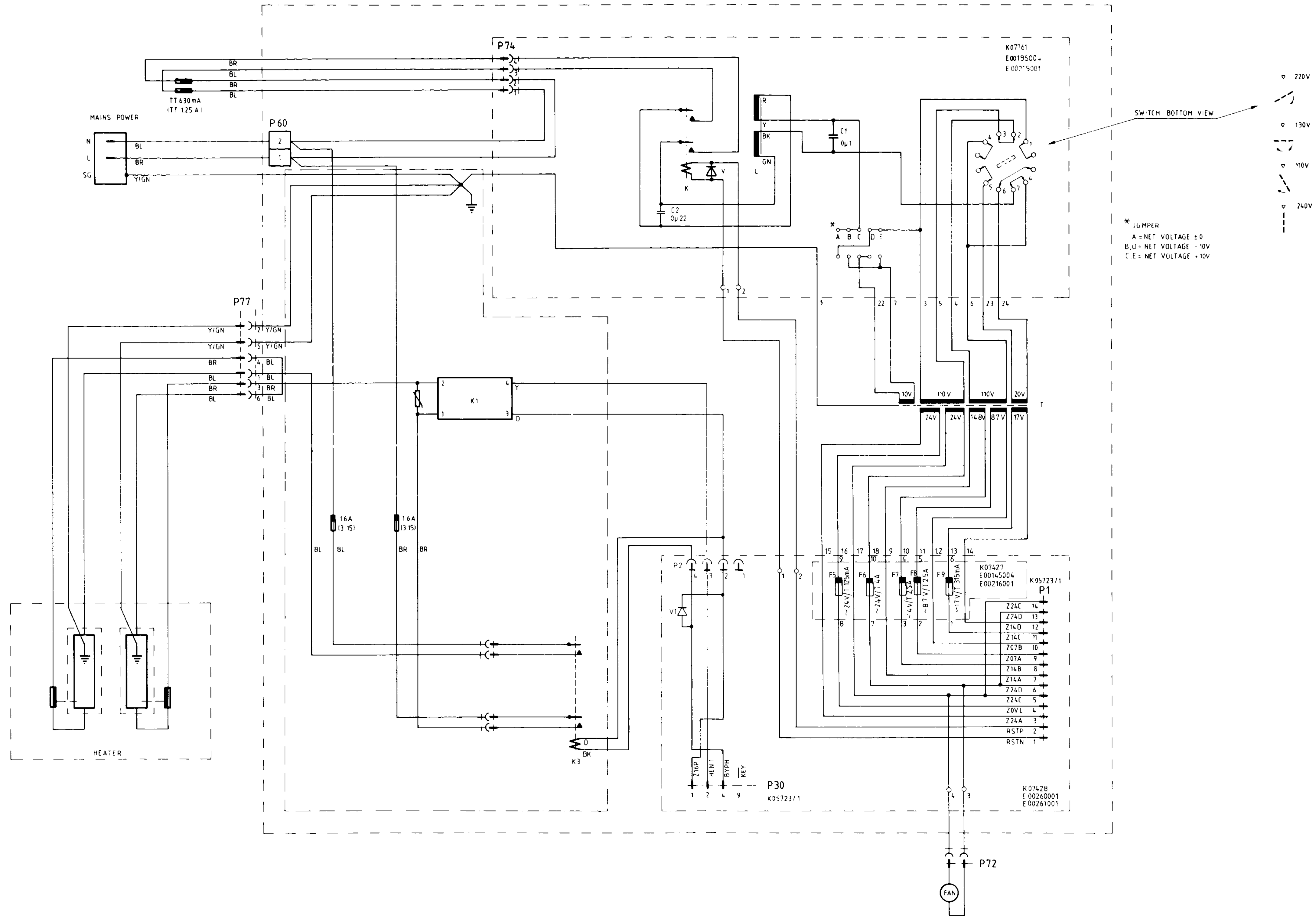


Fuse board

A, B, C, D, E	100 212 004
J1	100 220 081
Fuse 5	100 213 055
Fuse 6	100 213 015
Fuse 7, 8	100 213 057
Fuse 9	100 213 010

Ordering no:	K0 7427 001
Drawing:	K0 8346
Layout:	E0 0145 004
Comp.print:	E0 0216 003
Change order:	5303

Gen see drew	
	S



1	AH 4373	82								
No	Revision	Dft	Chk	Appd	No	Revision	Dft	Chk	Appd	

A B C	Item No	Title	Material or title	HFM Note
Quantity	Date 1982 03 18	Drn by BO/B	Chk by	Auth by	Scale	Finish

gambro Lund Sweden

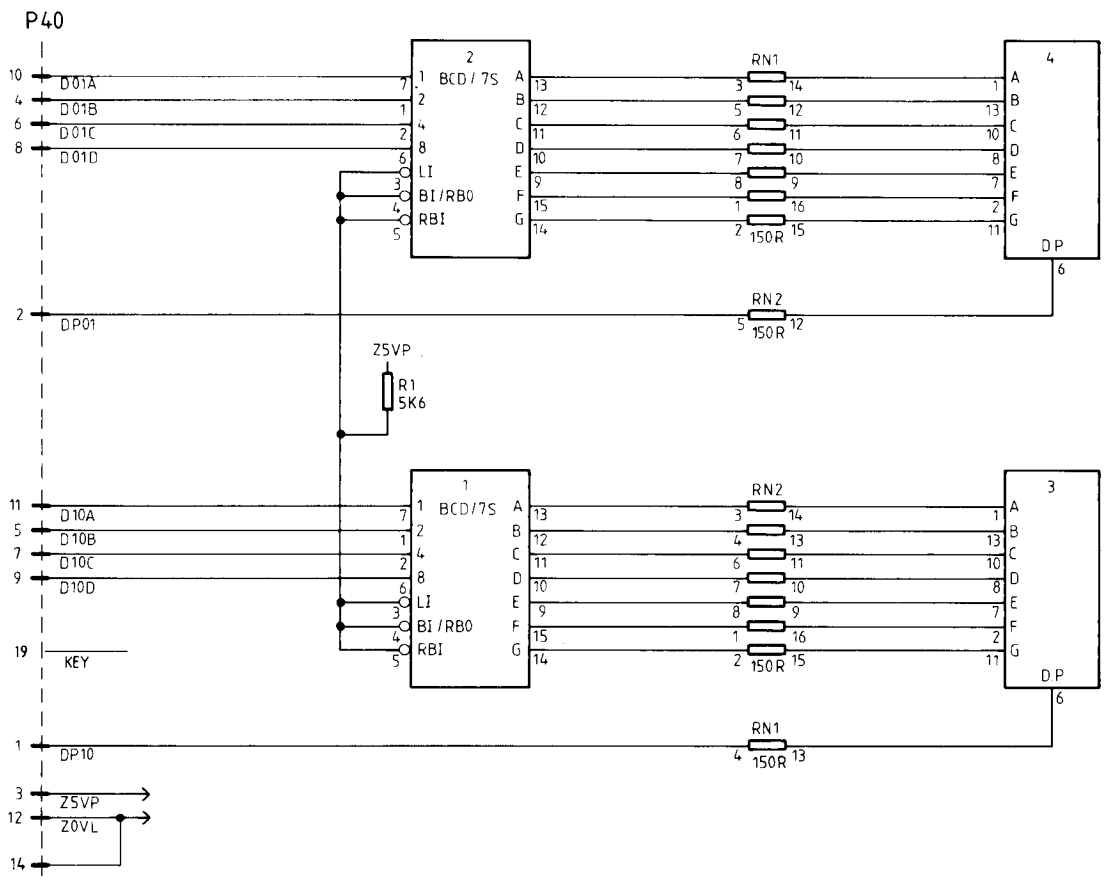
MAINS POWER CIRCUIT DIAGR

K08346 1

Gen. ass. draw	
K 05702	S

	Z0VL	Z5VP
IC 1,2	8	16
3,4		3,14

K05711/1



Display card

7

No	Revision	Sign and date Dft	Chk	Appd	No	Revision	Sign and date Dft	Chk	Appd
1	"AH 1990 9/4 79				2				

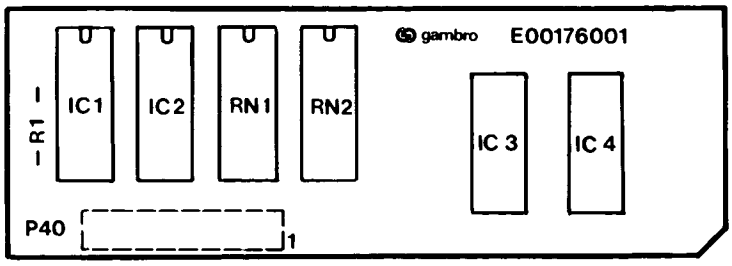
C	B	A	Item No	Title	E 00115 002 Material or title	HFM 10 Note
Quantity			Date 1979 01.10	Drn. by RDA	Chk. by	Auth. by Scale	Finish

gambro Lund Sweden

DISPLAY CARD CIRCUIT DIAGR.

K 0 5 7 0 3 3

Display card



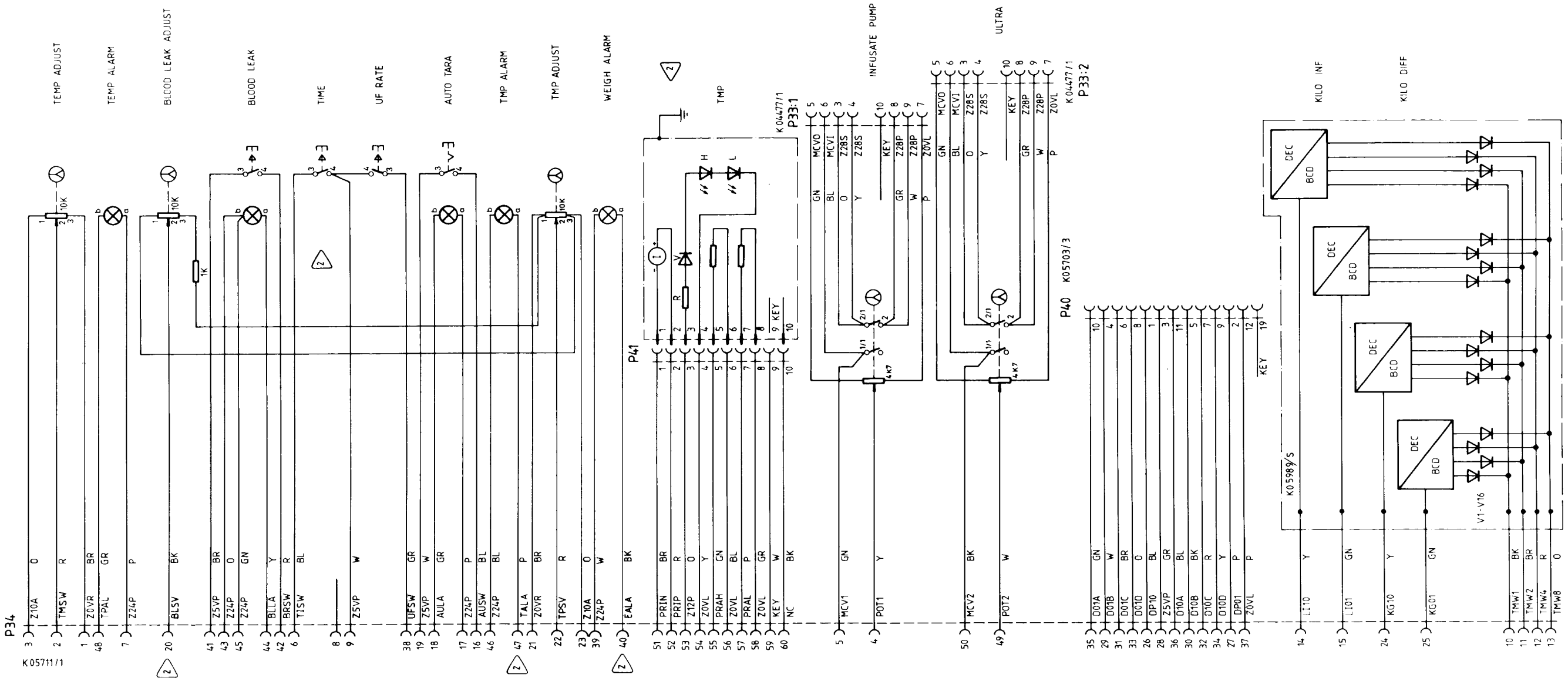
R1	100 100 054
RN1, RN2	100 108 027
IC3, 4	100 106 011
IC1, 2	100 010 083
P40 Key, pos:19	100 202 116

Ordering no:	K0 5702 A
Drawing:	K0 5703
Layout:	E0 0115 002
Comp.print:	E0 0176 001
Change order:	1990

Instrument panel 8

Ordering no:	K0 5775 A
Drawing:	K0 5716
Change order:	2661

Gen ass. draw	
K05775	S



No	Revision	Dft	Sign and date Chk	Appd
1	ÄM 1990 7/5 89			
2	ÄM 2661 3/6-90	BO/B		

Då icke annat anges avser måttuppgift på ytbelagd detalj måttet före ytbelaggning

Tol för icke direkt toleransatta mått enl SMS 715 medel

Nom mått över	t o m	Tol ±
(1)	6	0.1
(6)	30	0.2
(30)	100	0.3
(100)	300	0.5
(300)	1000	0.8
(1000)	2000	1.2
(2000)	4000	2
(4000)	8000	3

C	B	A	Item No	Title	Material or title	HFM / Note
Quantity	Date 790117	Drn. by RDA	Chk by	Auth. by	Scale	Finish

gambro Lund Sweden

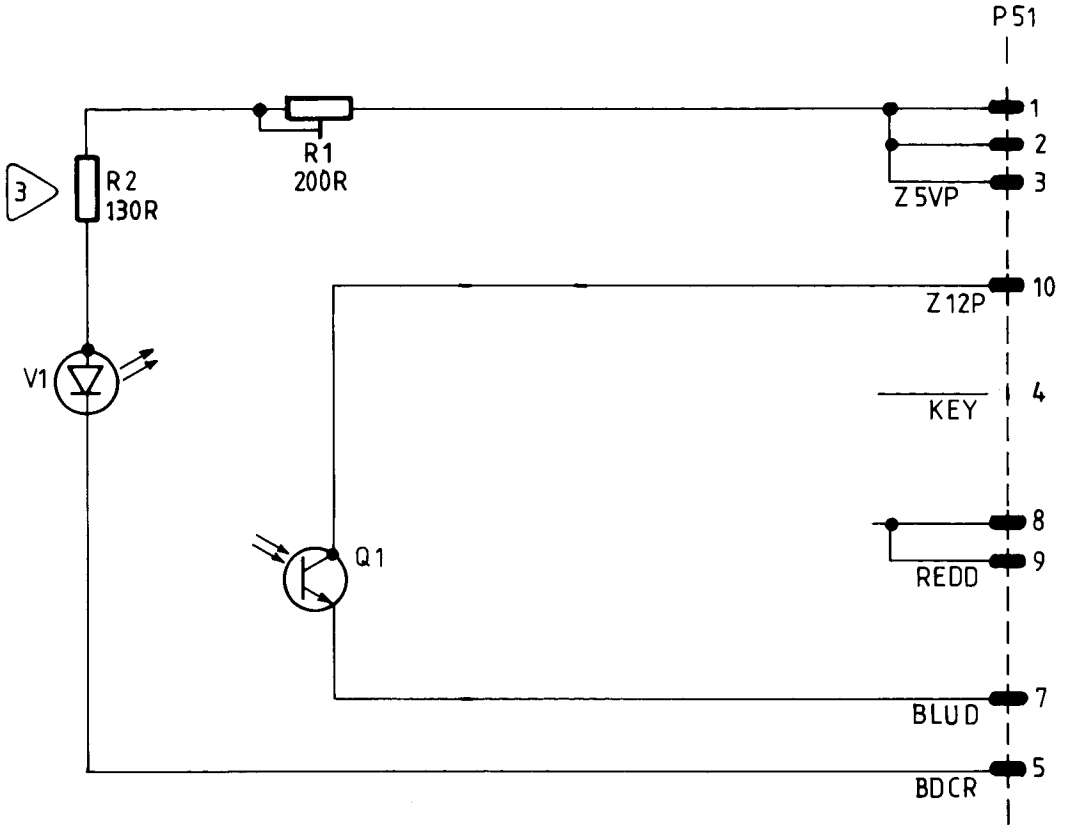
PANEL WIRING DIAGRAM

K 0 5 7 1 6 — 2

Blood leak detector

No	Revision	Sign and date Dft	Chk	Appd	No	Revision	Sign and date Dft	Chk	Appd	Gen. ass. draw.	
1	HM. 1990 9/4 79				2	AM2060 22/5 79				K06162	S
3	AM2134 29/8 79	du	lo		4	HM. 2647 2/5 80		den			

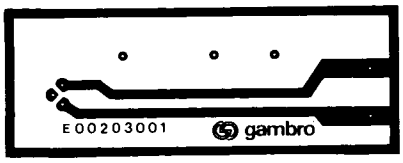
K05723/1



						HFM 10		E00203001, E00204001 E00205001			
A	B	C	Item No			Title		Material or title		Note	
Quantity			Date 79 - 03 - 22			Drn.by Len	Chk.by Len	Auth.by		Scale	Finish
gambro® Lund Sweden						BLOOD LEAK CIRCUIT DIAGR.				K 0 6 0 7 6	4

Blood leak

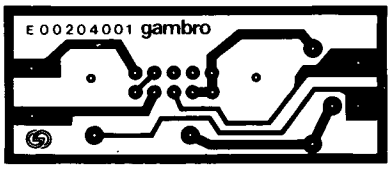
Receiver board



Ordering no:	K0 7118 001
Drawing:	K0 6076
Layout:	E0 0220 001
Comp.print:	
Change order:	2647

Q1	100 006 013

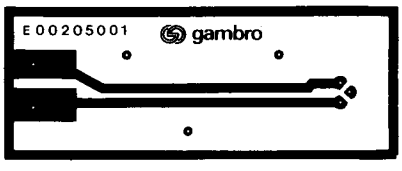
Contact board



Ordering no:	K0 7120 001
Drawing;	K0 6076
Layout:	ze0 0204 001
Comp.print:	K0 7122
Change order:	2647

R2	100 105 031
R1	100 106 022
P51, Key pos: 4	100 202 110

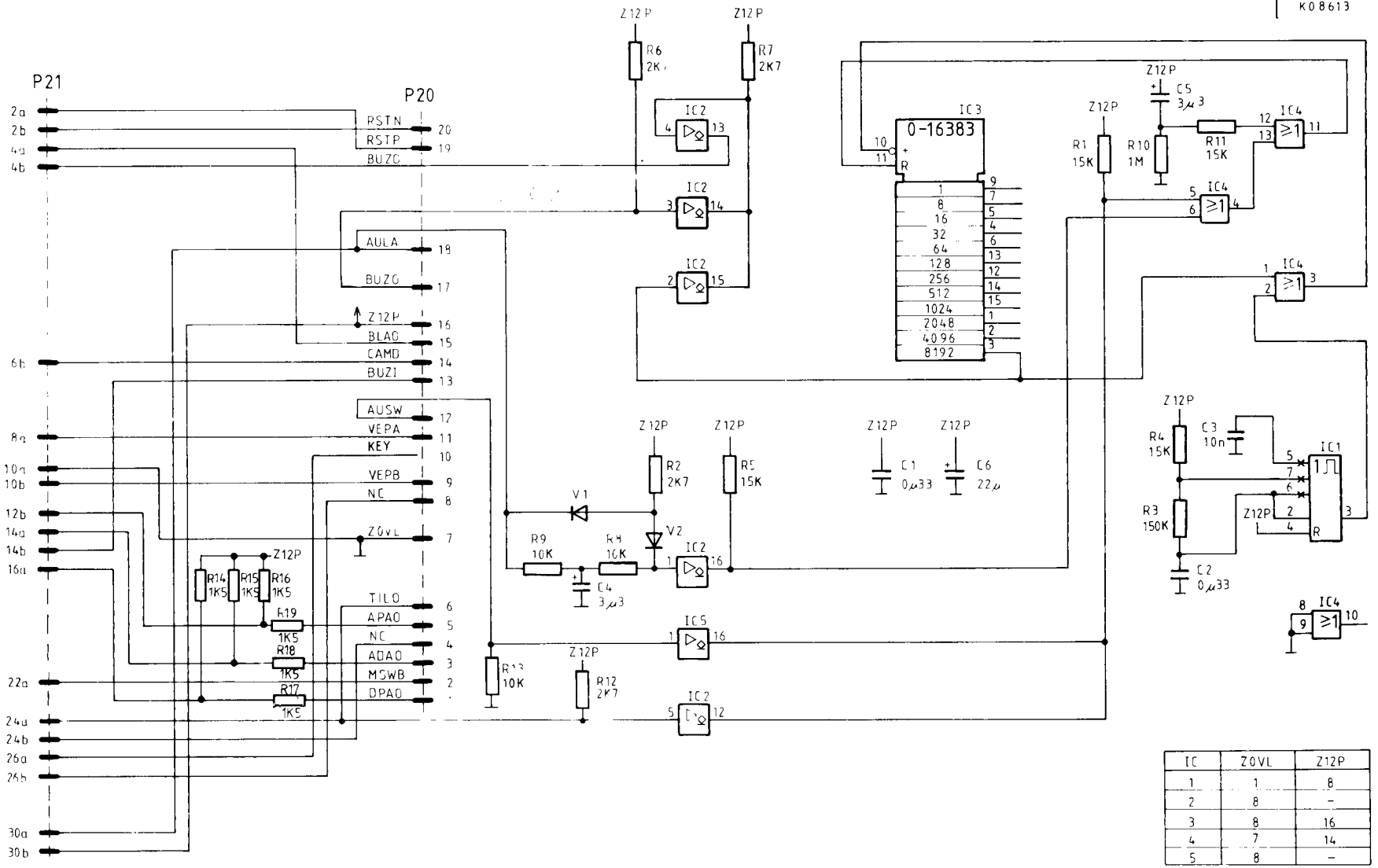
Transmitter board



Ordering no:	K0 7116 001
Drawing:	K0 6076
Layout:	E0 0205 001
Comp.print:	
Change order:	2647

V1	100 006 012

Gen ass draw	
K08613	S



IC	Z0VL	Z12P
1	1	8
2	8	–
3	8	16
4	7	14
5	8	–

NOTES UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS
2. ALL CAPACITANCE VALUES IN FARADS

No	Revision	Sign and date Dft	Chk	Appd	No	Revision	Sign and date Dft	Chk	Appd
1					2				

C	B	A	Item No	Title	E0011300[illegible]5 Material or title	HFM 10 Note
Quantity			Date 840217	Drn by	Chk by	Auth by	Scale	Finish

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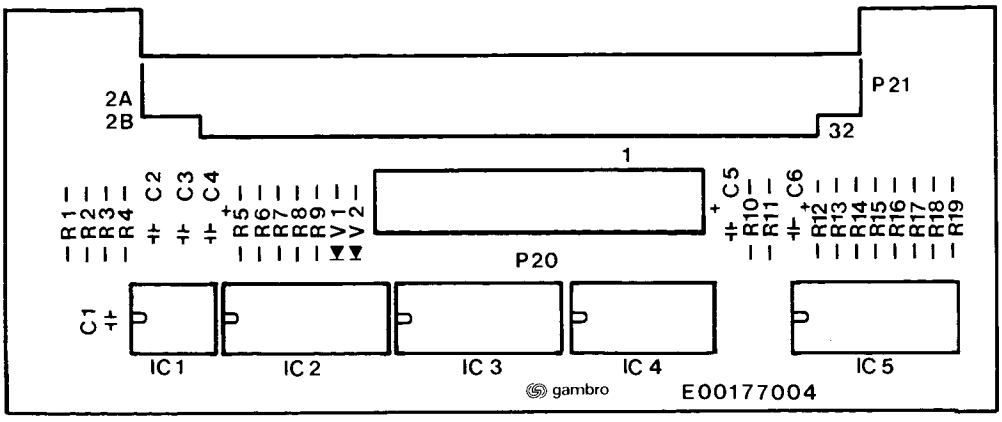
Lund Sweden

ALARMBOARD
CIRCUIT DIAGR.

K 0 8 6 1 4 3

Alarm board

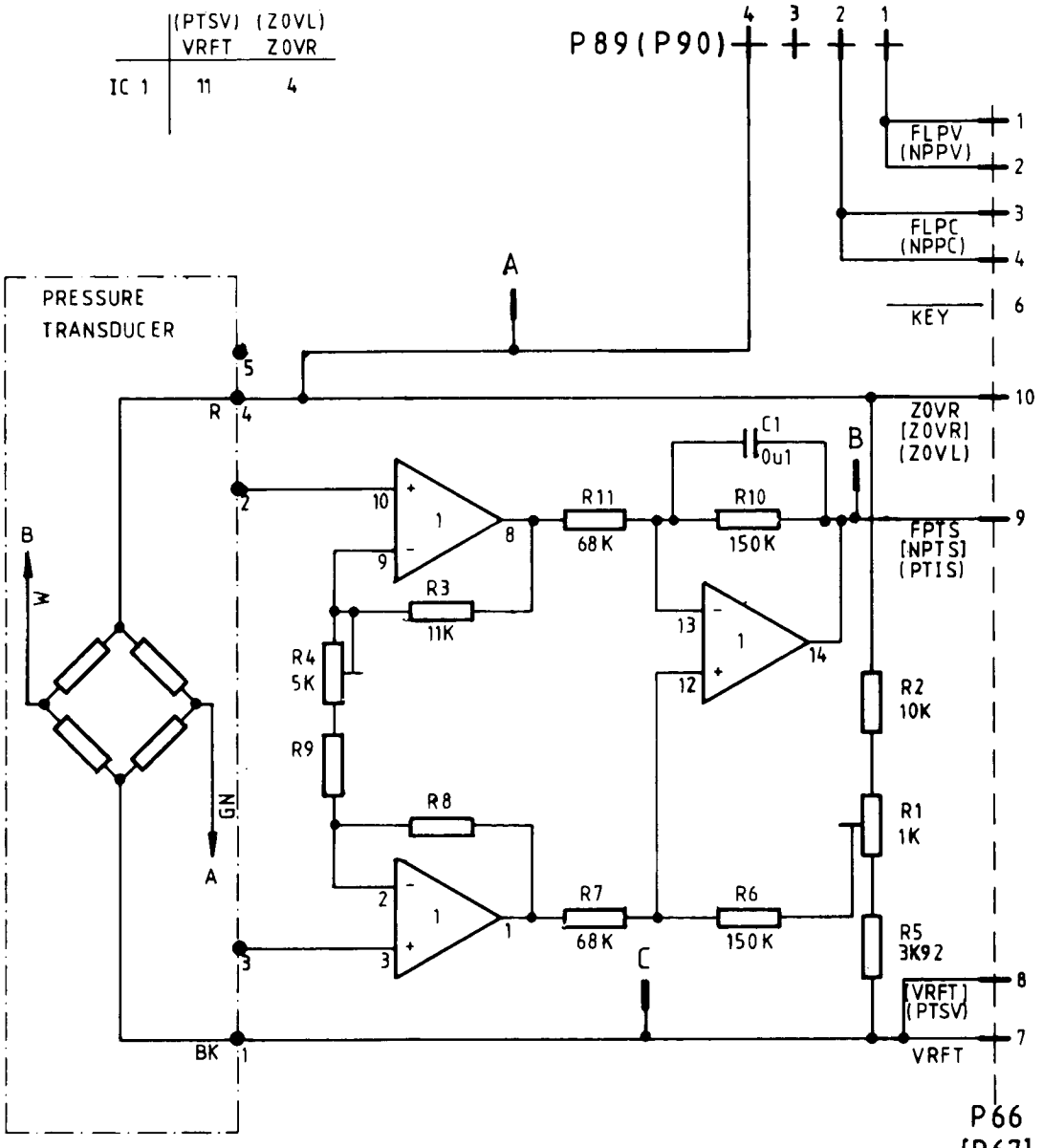


R14-19	100 104 047
R2, 6, 7, 12	100 104 050
R8, 9, 13	100 104 060
R1, 4, 5, 11	100 104 062
R3	100 104 077
R10	100 104 090
C3	100 110 060
C1, 2	100 116 036
C4, 5	100 114 010
C6	100 114 016
IC1	100 010 019
IC5	100 010 035
IC2	100 010 036
IC4	100 010 064
IC3	100 010 067
V1, 2	100 002 005
P21	100 202 088
P20, Key: pos 10	100 202 116

Ordering no:	K0 8613 002
Drawing:	K0 8614
Layout:	E0 0113 005
Comp.print:	E0 0177 004
Change order:	6581

No	Revision	Sign and date Dft	Chk	Appd	No	Revision	Sign and date Dft	Chk	Appd	Gen. ass. draw.	
1	AM4401 82 11 22				2	AM5418 83-9-9	LKE	HWk		K06170	S
3					4						

	(PTSV) VRFT	(ZOVL) ZOVR
IC 1	11	4

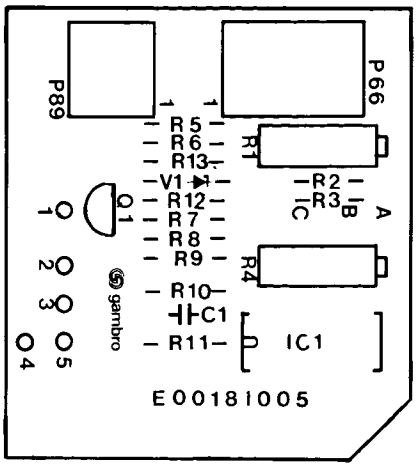


FOR K06513001,K06510001 : A—3,B—2
R1 Adjust -3,5V ± 8mV P66:9 at 0mmHg
R4 " -3,9V " " " -400mmHg

FOR K06513002 : A—2,B—3
R1 Adjust -3,5V ± 8mV P66:9 at 0mmHg
R4 " -3,9V " " " +400mmHg

						E00180005			
A	B	C	Item No	Title		Material or title		Note	
Quantity		Date 82.11.11	Drn.by HRO	Chk.by	Auth.by	Scale		Finish	
gambro® Lund Sweden			PRESS. TRANS. BOARD DATA INS. CIRCUIT DIAGR.			K 0 6 1 7 1		- 4	

Press. transducer board



R5	100 104 052
R2	100 104 060
R7, 11	100 104 070
R6, 10	100 104 077
R9	100 105 048
R3, 8	100 105 060
R4	100 106 010
R1	100 106 014
C1	100 116 030
IC1	100 010 037
P66, Key: pos 6	100 202 064
P89	100 202 089
Feeler pin A, B, C	100 202 230

Adjustment

For K0 6513 001, K0 6510 001: A-3, B-2.

R1 Adjust -3,5V +/-8mV, P66:9 at 0 mmHg.
R4 Adjust -3,9V +/-8mV, P66 at -400 mmHg.

For K0 6513 002: A-2, B-3.

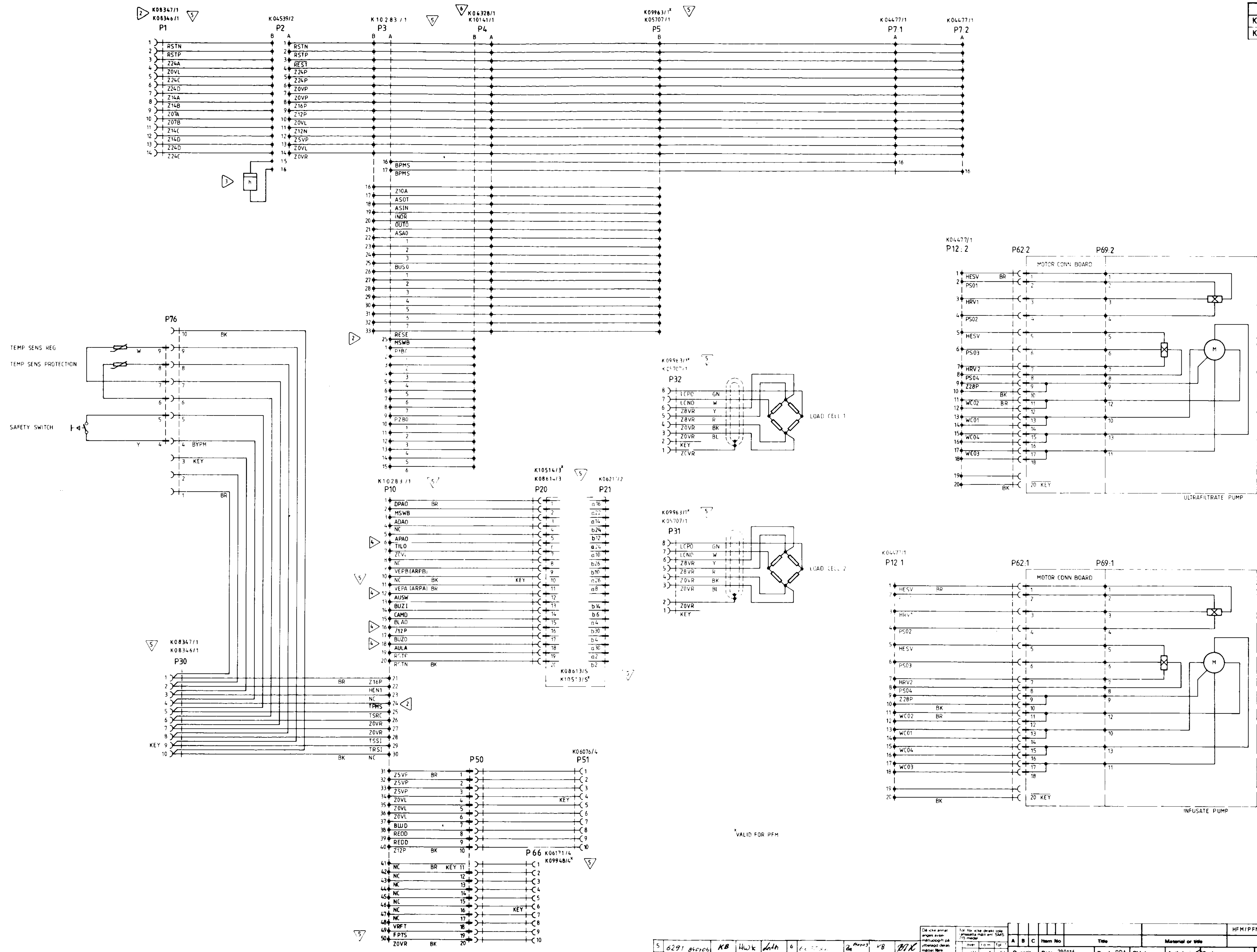
R1 Adjust -3,5V +/-8mV, P66:9 at 0 mmHg.
R4 Adjust -3,9V +/-8mV, P66:9 at -400 mmHg.

Ordering no:	K0 6170 B
Drawing:	K0 6171
Layout:	E0 0180 005
Comp.print:	E0 0181 005
Change order:	4401

Wiring diagram 12

Drawing: K0 5723
Change order: 6635

Gen see drw	
K06141	S
K10537	S-



HFM/PFM10

Item No | Title | Material or title | Note

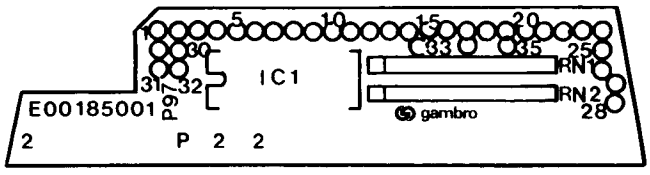
Quantity | Date 790116 | Drn. by RDA | Chk. by | Auth. by | Scale | Finish

gambro | Lund Sweden

WIRING DIAGR

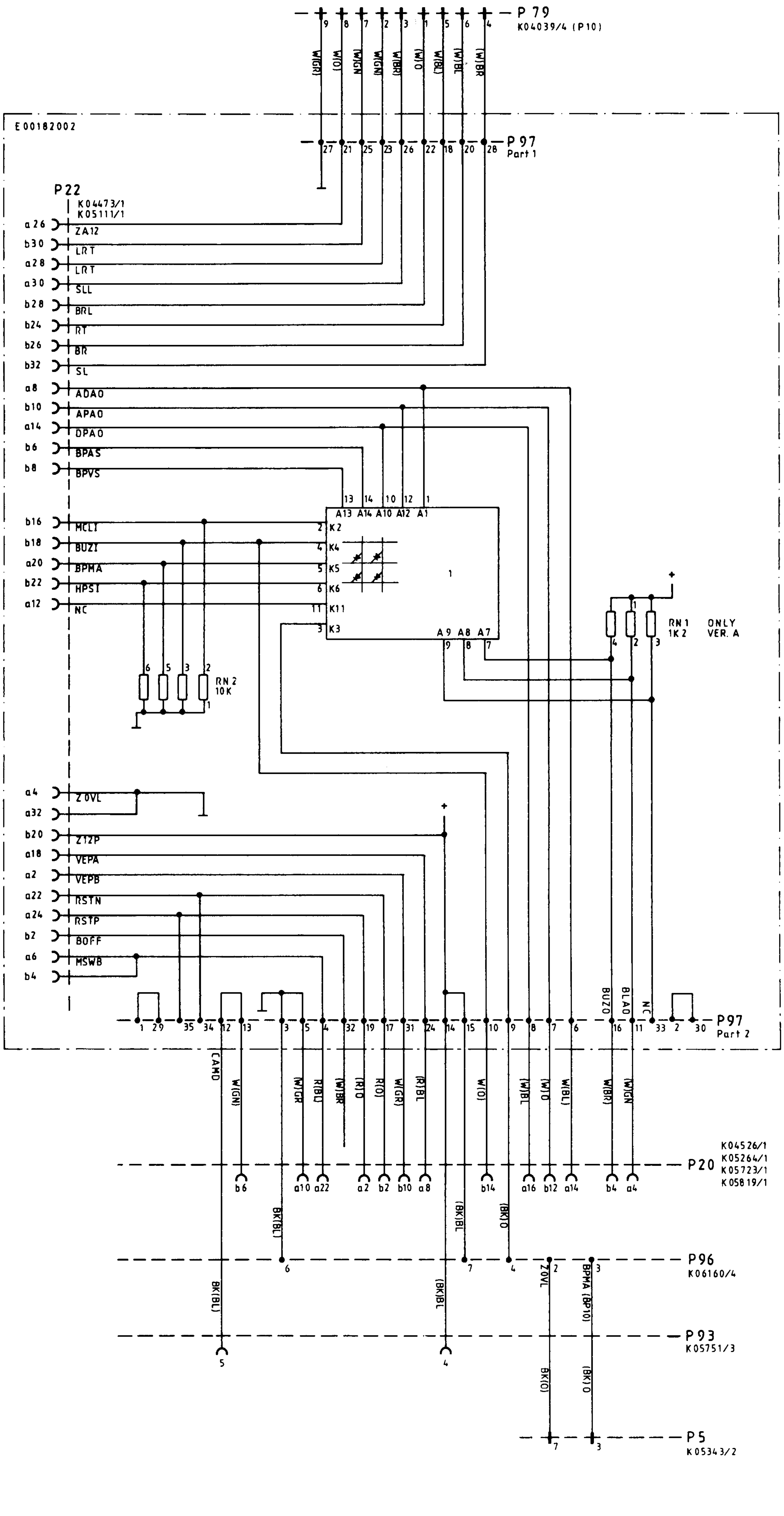
K05723 1

Program interconn. unit 13



RN1	100 108 022	
RN2	100 108 025	
IC1	K0 6219 001	Intermittent BP
IC1	K0 6219 003	Continuous BP
IC1	K0 6219 004	Intermittent BP/USA
IC1	K0 6219 006	Continuous BP/USA
IC, socket	100 011 010	
P22	100 202 087	

Ordering no:	K0 6216 A
Drawing:	K0 6217
Layout:	E0 0182 002
Comp.print:	E0 0185 001
Change order:	2479



No	Revision	Dft	Sign and date Chk	Appd
1	79-04-19			
2				

Då icke annat anges avser måttuppgift på ytbelagd detalj måttet före ytbeläggning

Tol för icke direkt toleransatta mått enl SMS 715 medel

Nom mått över	t o m	Tol ±
(1)	6	0.1
(6)	30	0.2
(30)	100	0.3
(100)	300	0.5
(300)	1000	0.8
(1000)	2000	1.2
(2000)	4000	2
(4000)	8000	3

gambro®
Lund Sweden

Quantity	Item No	Title	Material or title	Note
				BMM 10

Date 79 04 26 | Drn.by GO | Chk.by | Auth.by | Scale | Finish

PROGR.INTERCONN.UNIT
CIRCUIT DIAGR.

K 0 6 2 1 7 2

Gen ass draw	
K06009	S
K06223	S
K06224	S
K06225	S
K06226	S

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