Manual
CS-800 Carbon / Sulfur Determinator

Original

ELTRA
ELEMENTAL ANALYSERS

1 Notes on the Service Manual

DANGER

G0001

Mortal danger from electric shock

Exposed power contacts - High Voltage

- An electric shock can cause injuries in the form of burns and cardiac arrhythmia, respiratory arrest or cardiac arrest.

• **Disconnect the mains power plug before opening the analyzer's cabinet.**

NOTICE

In this service manual, no information is repeated from the operation manual, as it may be appreciated.

Service should only be done by persons who have mastered the servicing and maintenance of this device, as well as having further qualifications, especially in the areas of electronics and physics.

We ask the users of this service manual bring to our attention any possible mistakes. We would also appreciate any suggestions for supplements and improvements to this service manual.

2 Modification overview

2.1 Up to S/N 0766xxxxxx

The CS-800 analyzers are equipped with a flow sensor with optical elements and with the corresponding board HF-3 and HF-4.

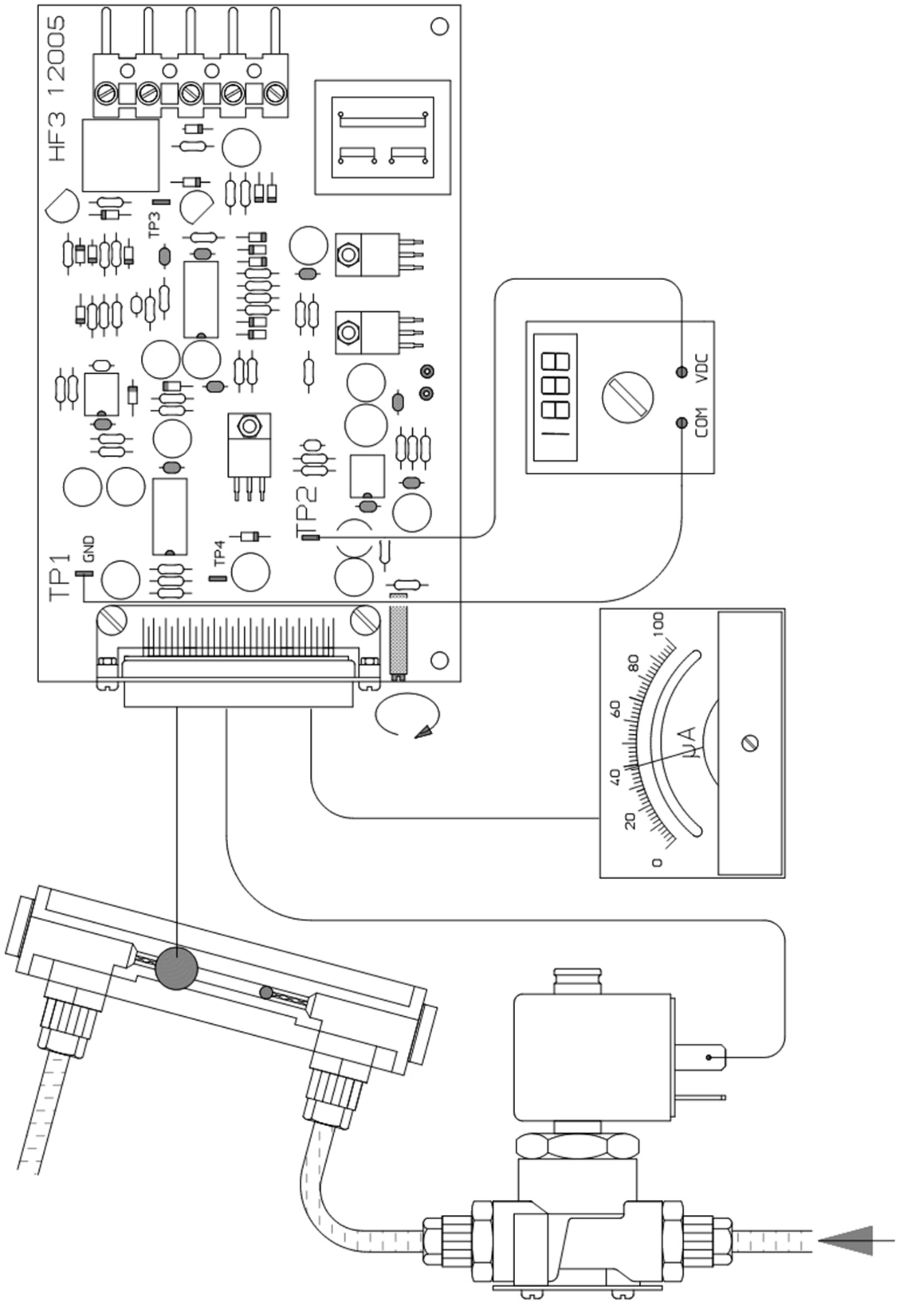


Fig. 1: Draft flow sensor and HF-3

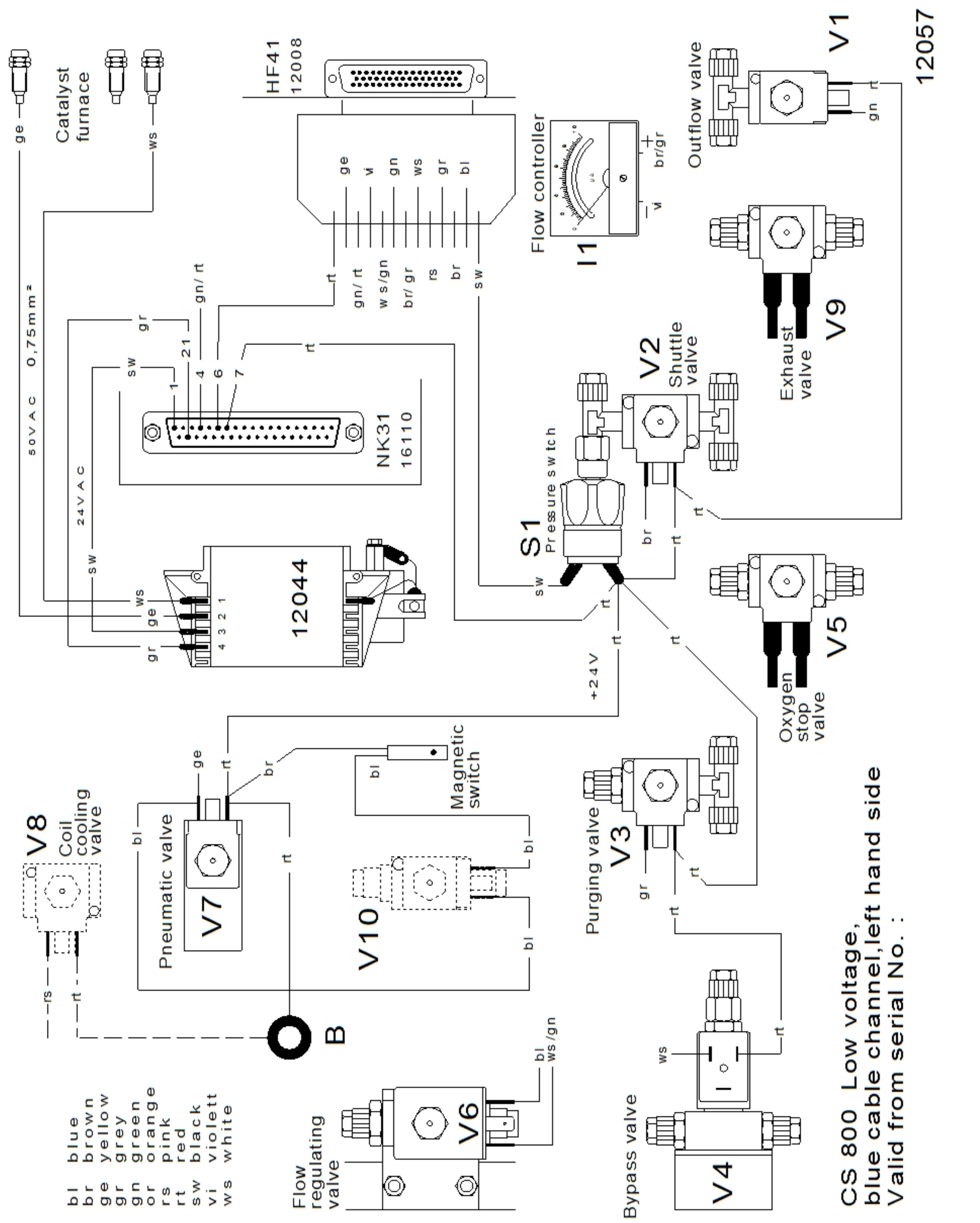


Fig. 2: Draft 12057

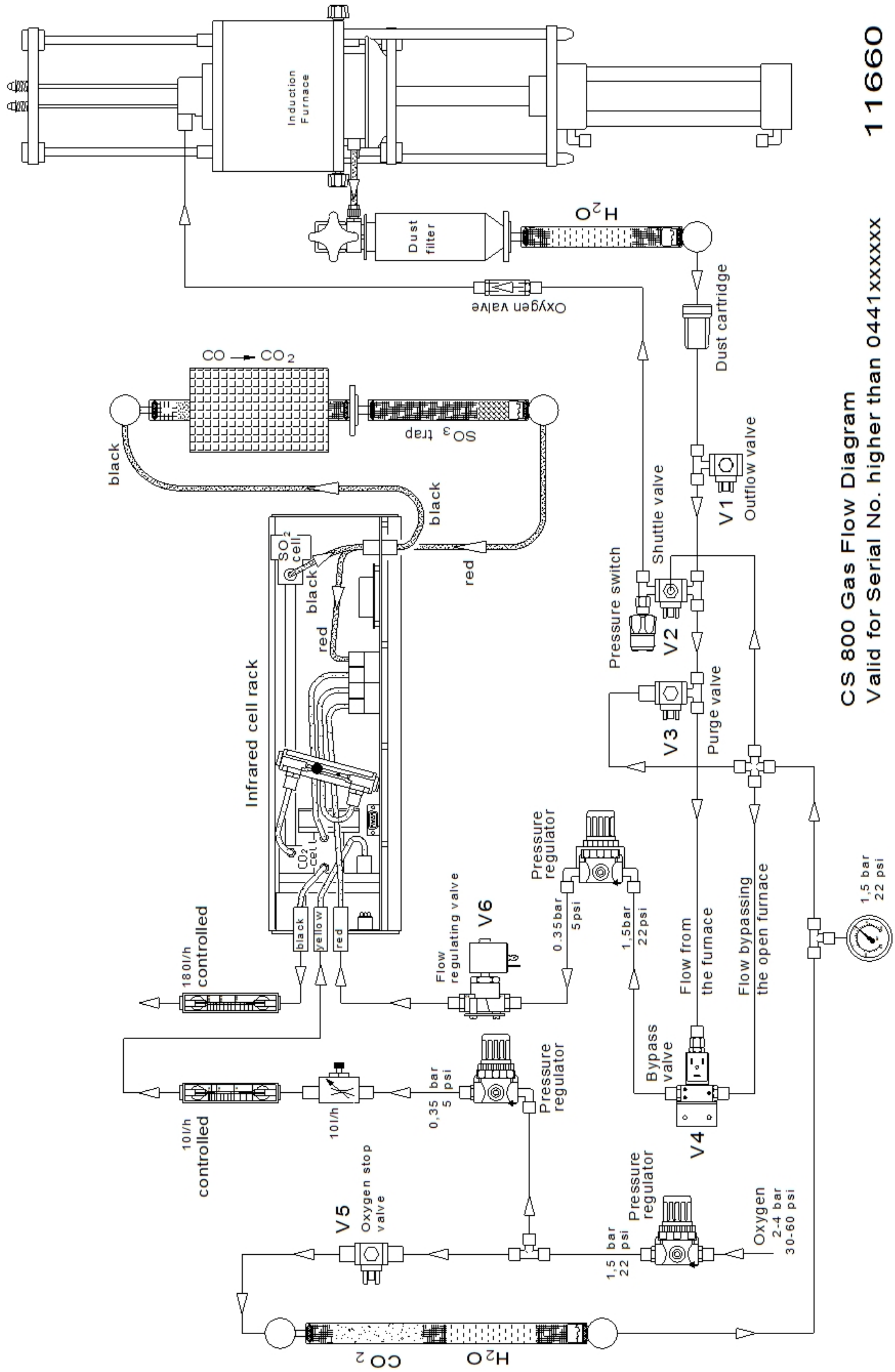


Fig. 3: Draft 11660

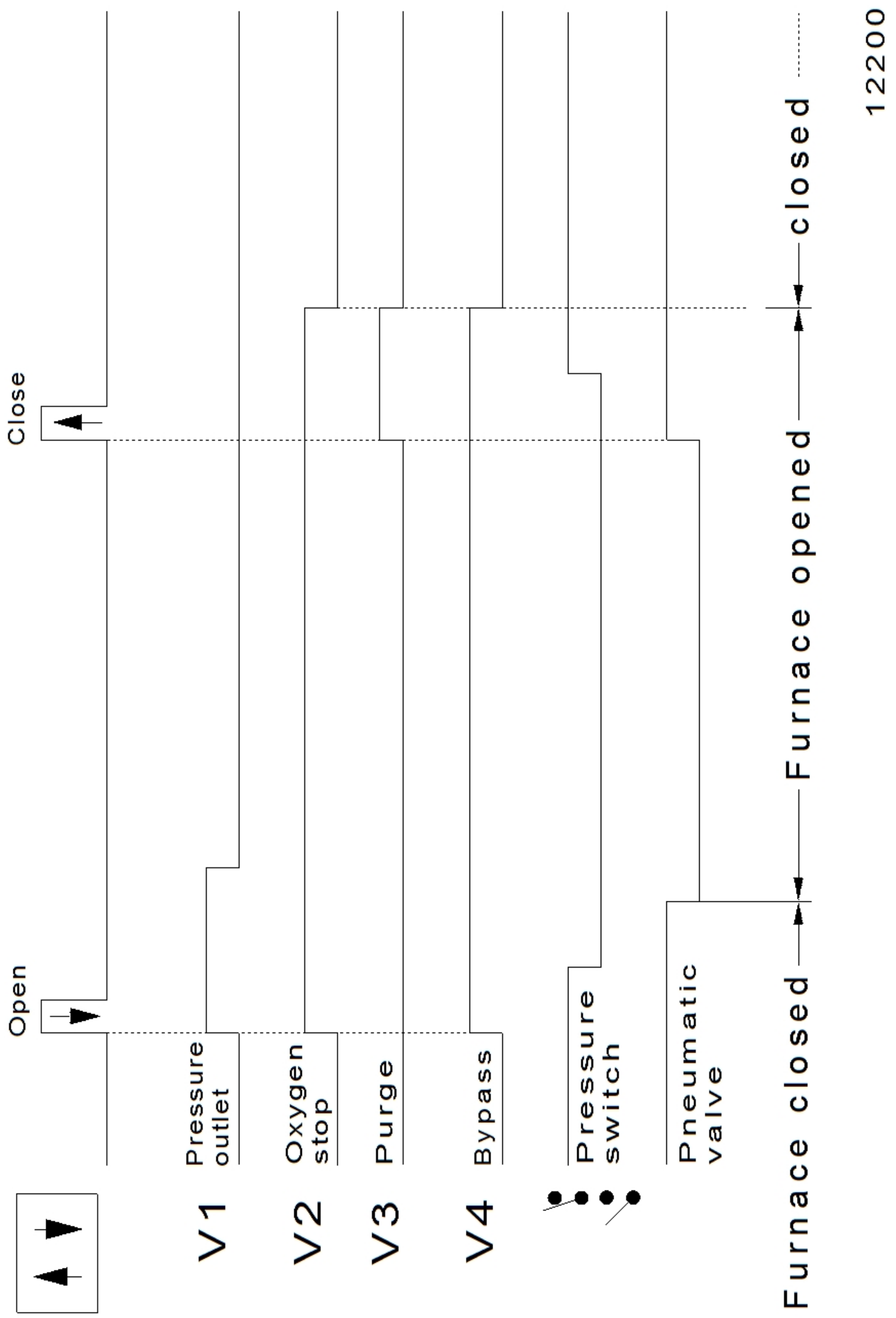


Fig. 4: Draft 12200

2.2 From S/N 0767xxxxxx to 0950xxxxxx

The CS-800 is equipped with a flow sensor employing a pressure transducer, and with the corresponding boards HF-41 and later the HF-42.

These boards also offer:

- Current limit for the induction furnace (on board HF 41/42 adjustment)
- Oxygen flow only during combustion (on board jumper)
- Gas saving mode by controlling the oxygen flow (start / stop) by the software

This function has been included later in the software, from SN / 1080xxxx

Analyzers from SN / 0767 to SN / 1079 can be upgraded with this function.

For description see corresponding service manual.

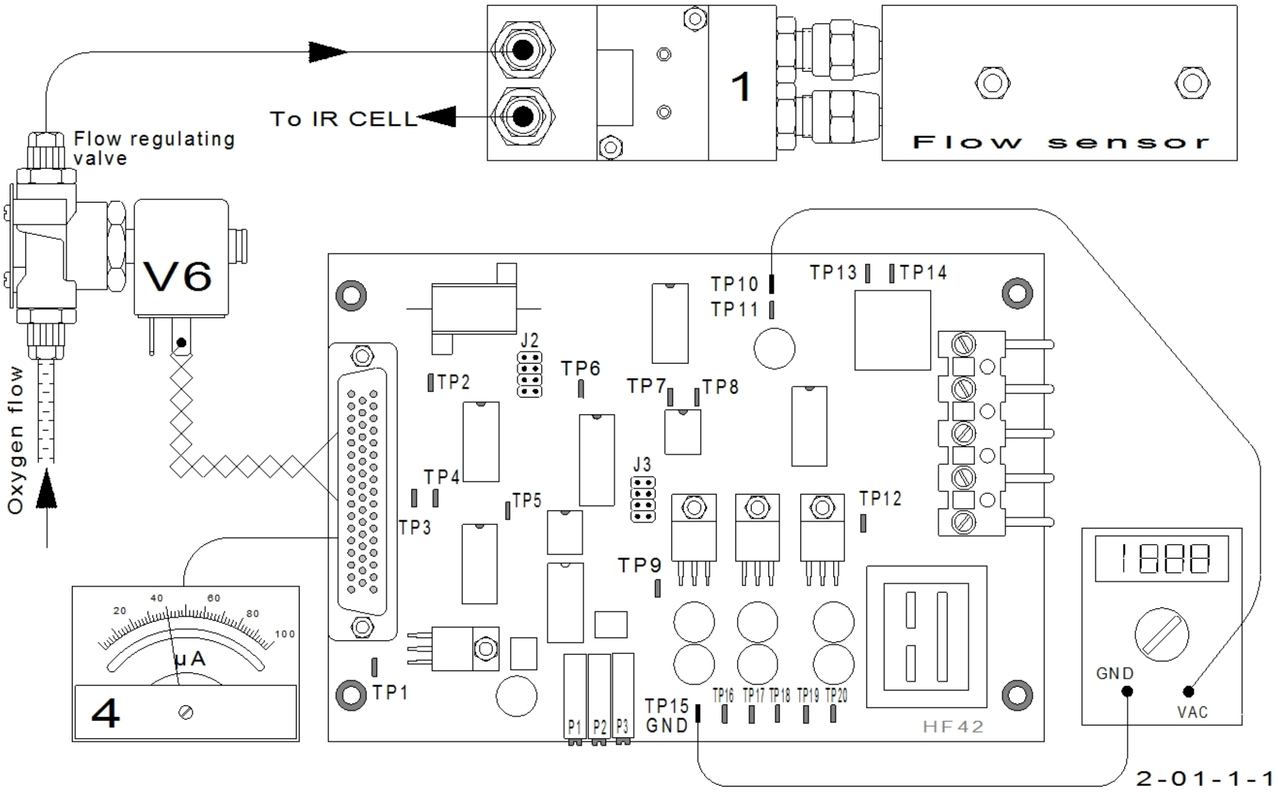


Fig. 5: Draft 2-01-1-1 (pressure transducer)

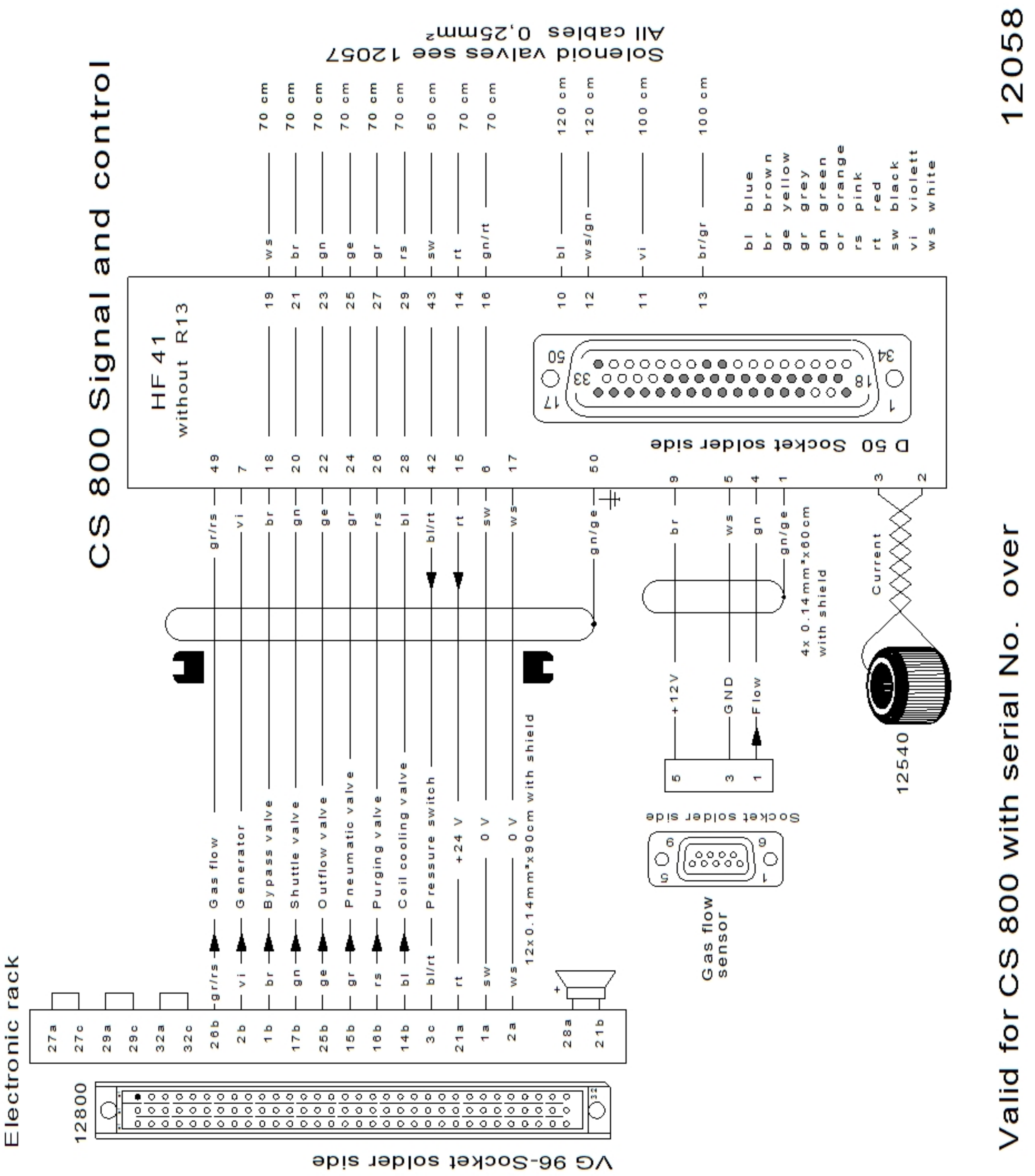


Fig. 6: Draft 12058 (Signal and control)

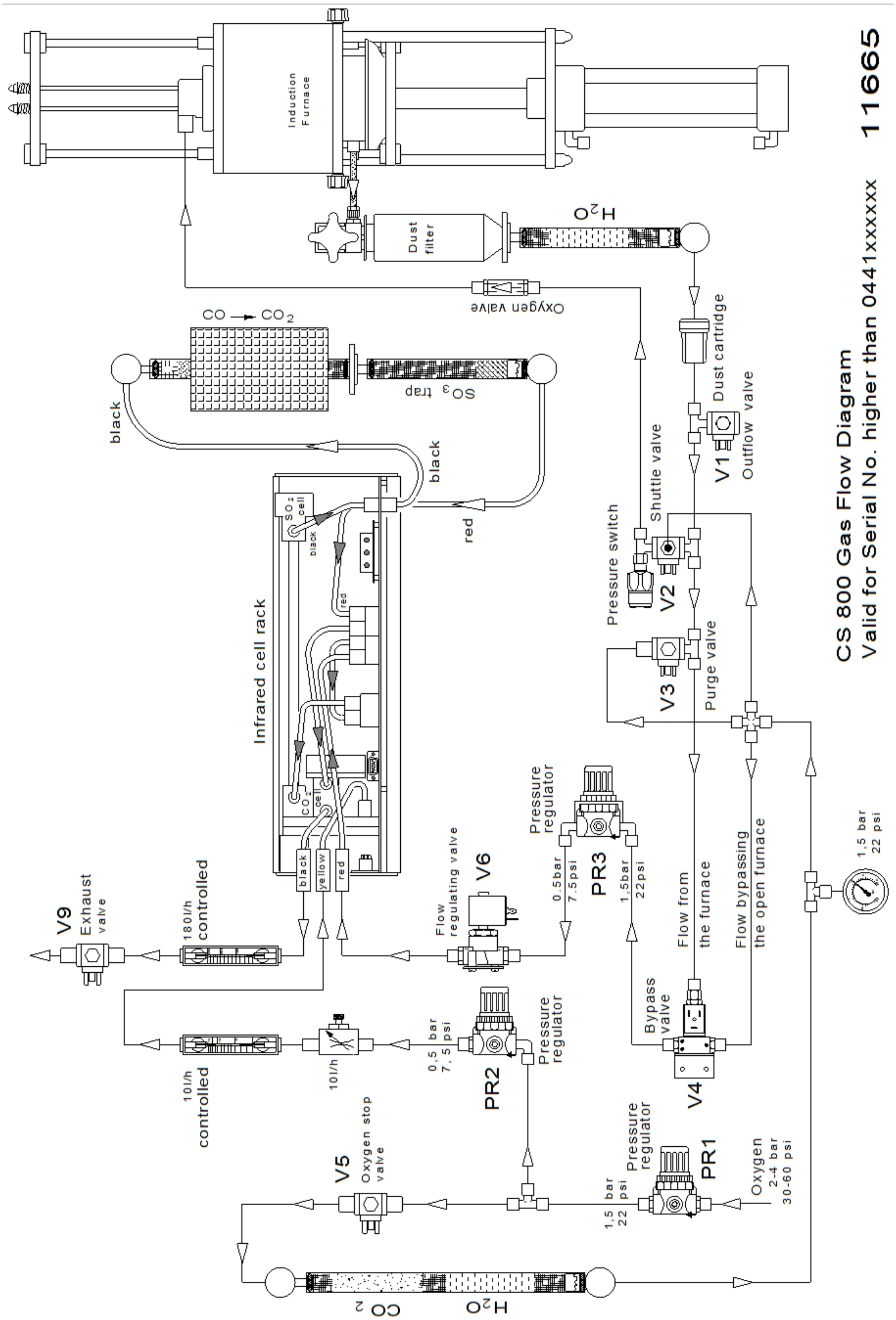


Fig. 7: Draft 11665 (Gas flow diagram)

2.3 From S/N 0951xxxxxx to 1079xxxxxx

The CS-800 has an additional purging inlet on top of the combustion chamber.

- The position of the solenoid valves is rearranged and their controlling software is modified accordingly. Therefore, a very good care has to be taken when changing the EPROMS.
- The wiring has also changed. It has been modified to be used with the IR-4, and the four IR-cell rack. As the 4-cell software was not available, the CS-800 was equipped with the still available with the 3-range IR-cell using an adapter and the 3-cell software up to SN / 1079xxxx.

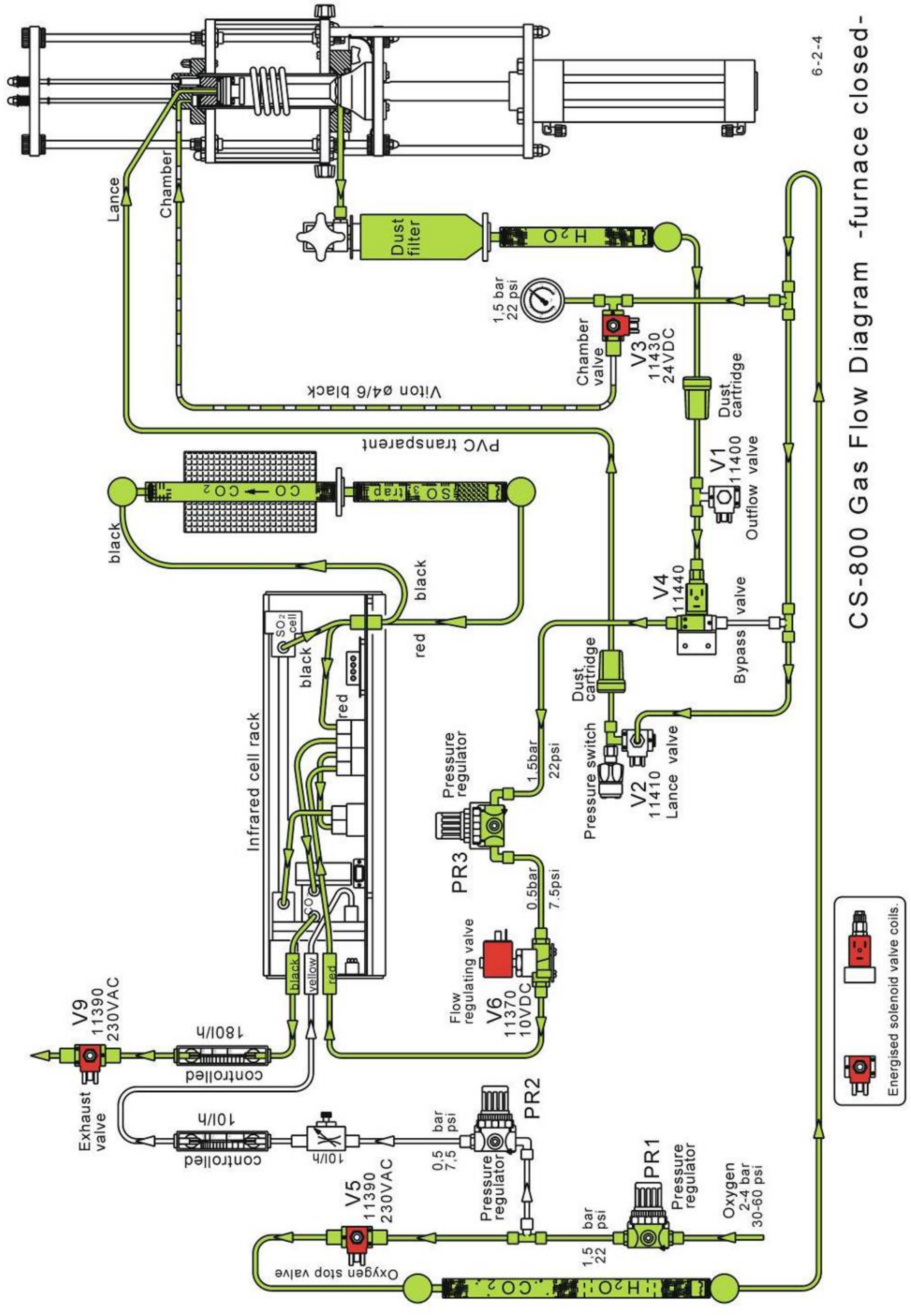


Fig. 8: Draft 6-2-4 (Gas flow diagram furnace closed)

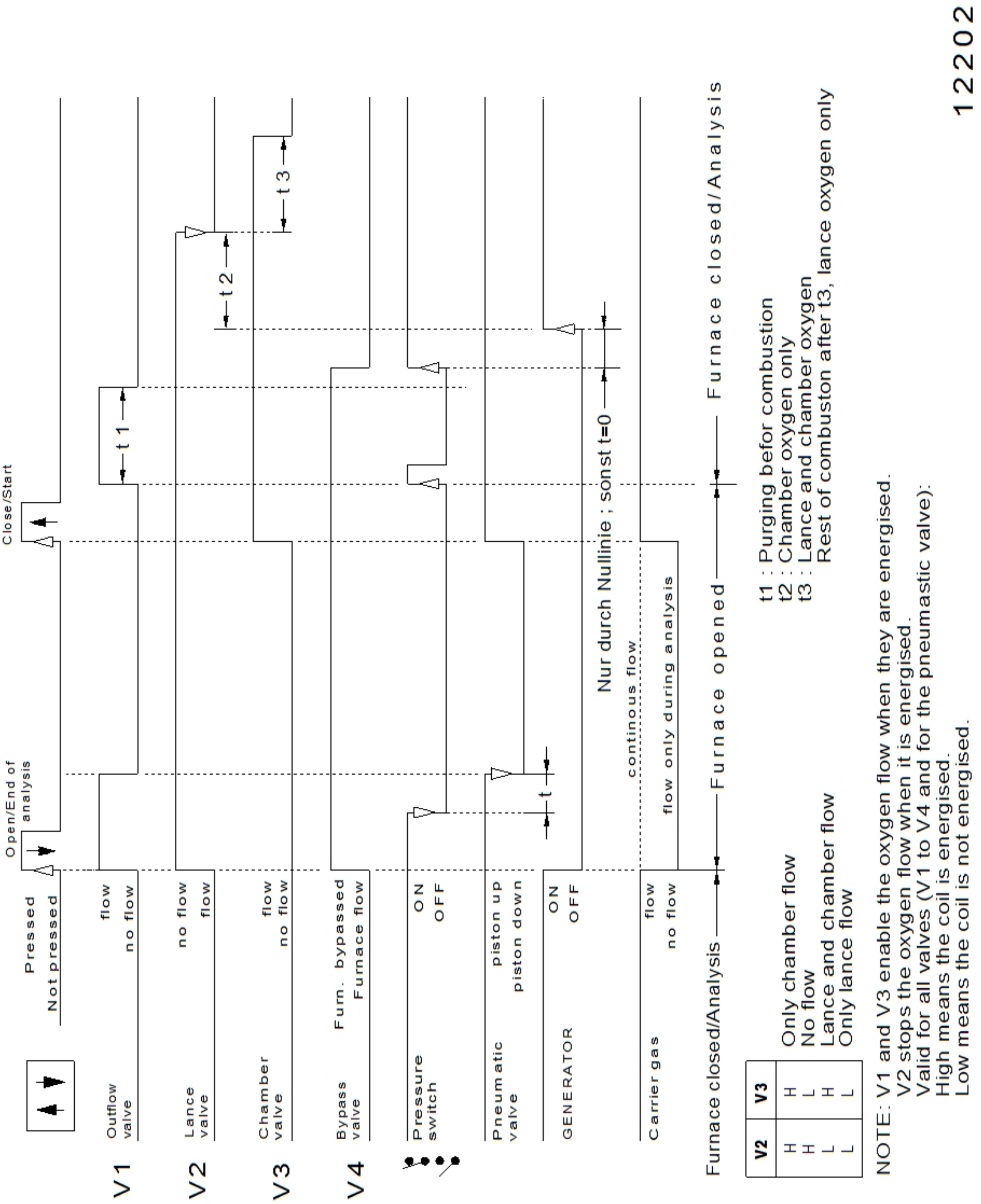


Fig. 9: Oxygen flow schematically

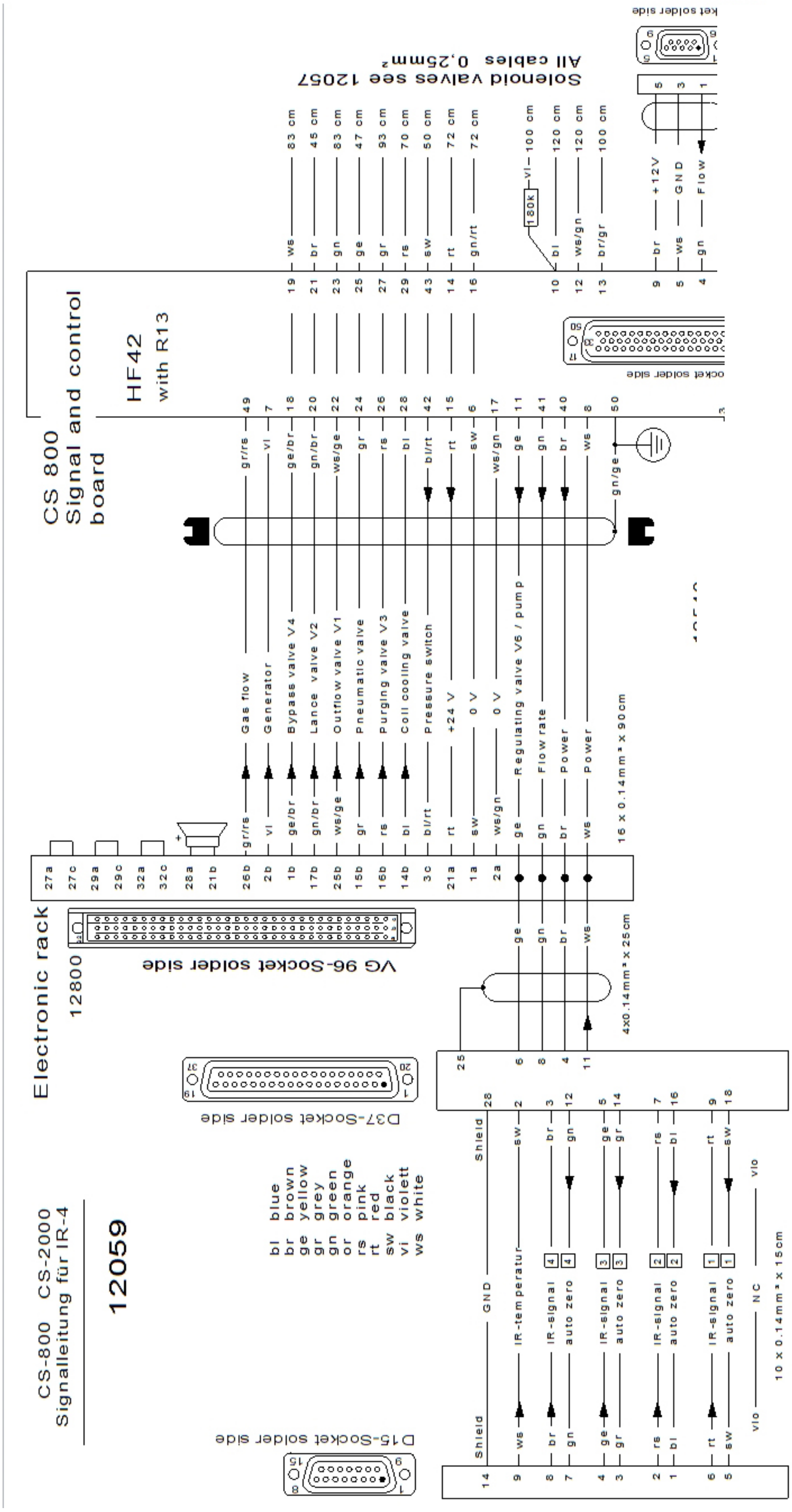
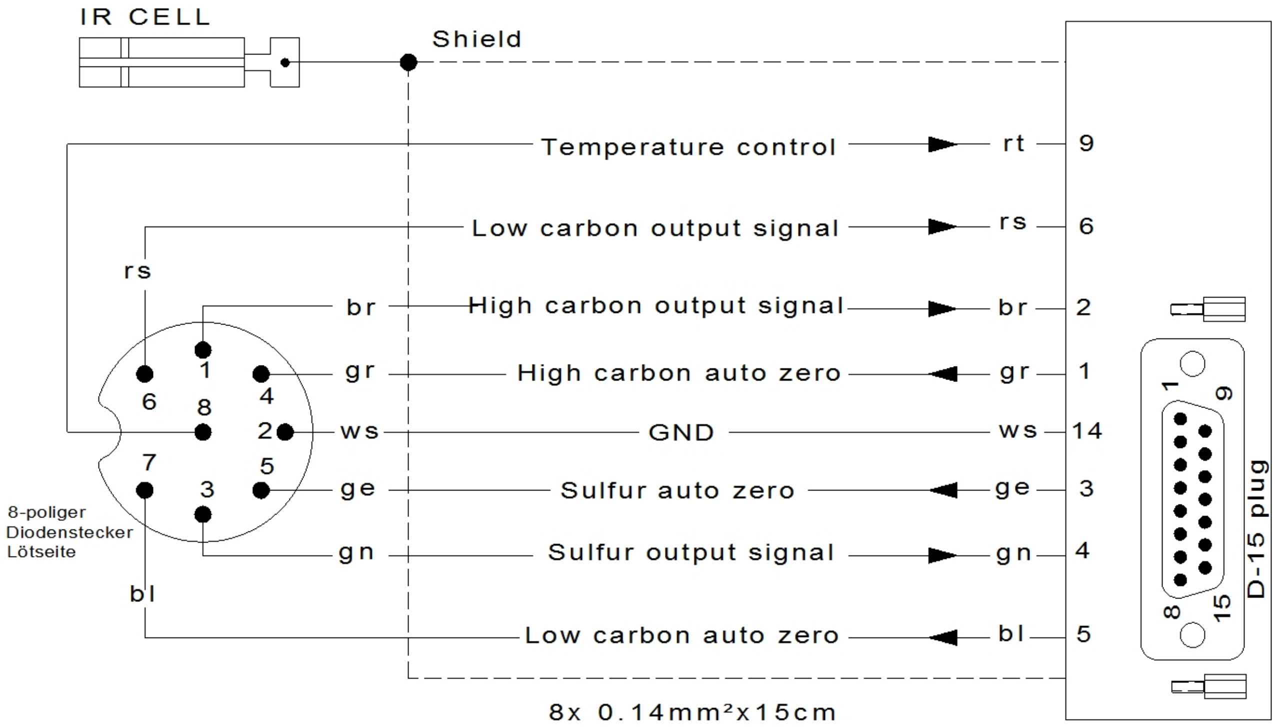


Fig. 10: Draft 12059 (signal and control board)



bl	blue
br	brown
ge	yellow
gr	grey
gn	green
or	orange
rs	pink
rt	red
sw	black
vi	violett
ws	white

Fig. 11: Draft connector pin assignmen

2.4 From S/N 1080 xxxx to 1556xxxxx

The CS-800 is equipped with the four IR-cell racks. All electronic boards as well as the chopper motor are different to those of the previous 3-range IR-cell.

NOTICE

The software version changed to the four IR-ranges!

The gas saving mode is available and selectable in the PC software PLOTCS.

When an analysis has not been carried out for a period of time, the analyzer will automatically switch to “Gas Conservation Mode“. This effectively means the carrier gas flow rate is reduced to a minimum, only < allowing a small amount of oxygen to circulate through the IR-cell etc. The period of time before the Gas Conservation is activated, can be modified via the PC Software. It is also possible to have carrier gas flow only during combustion.

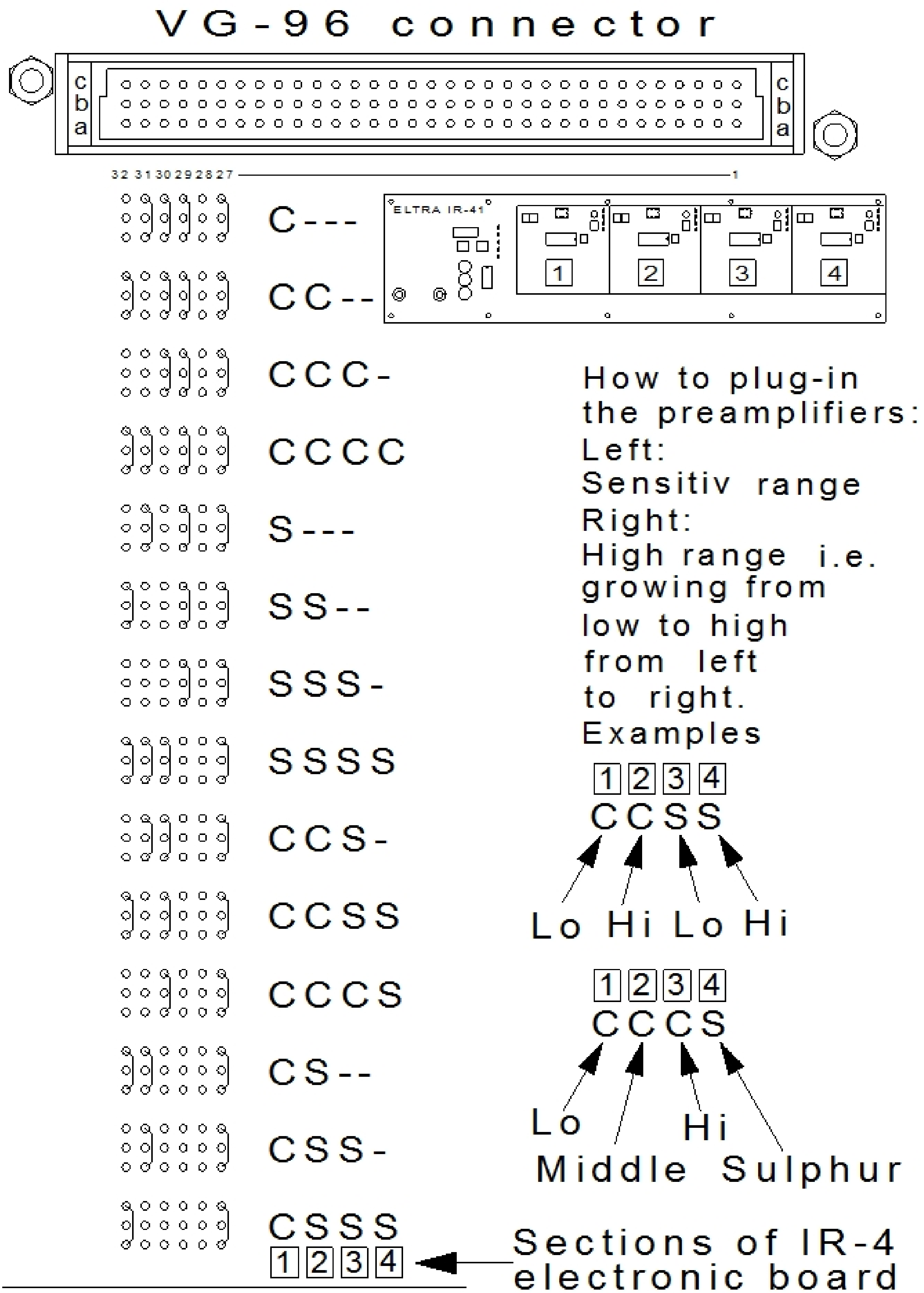


Fig. 12: Draft VG-96 connector

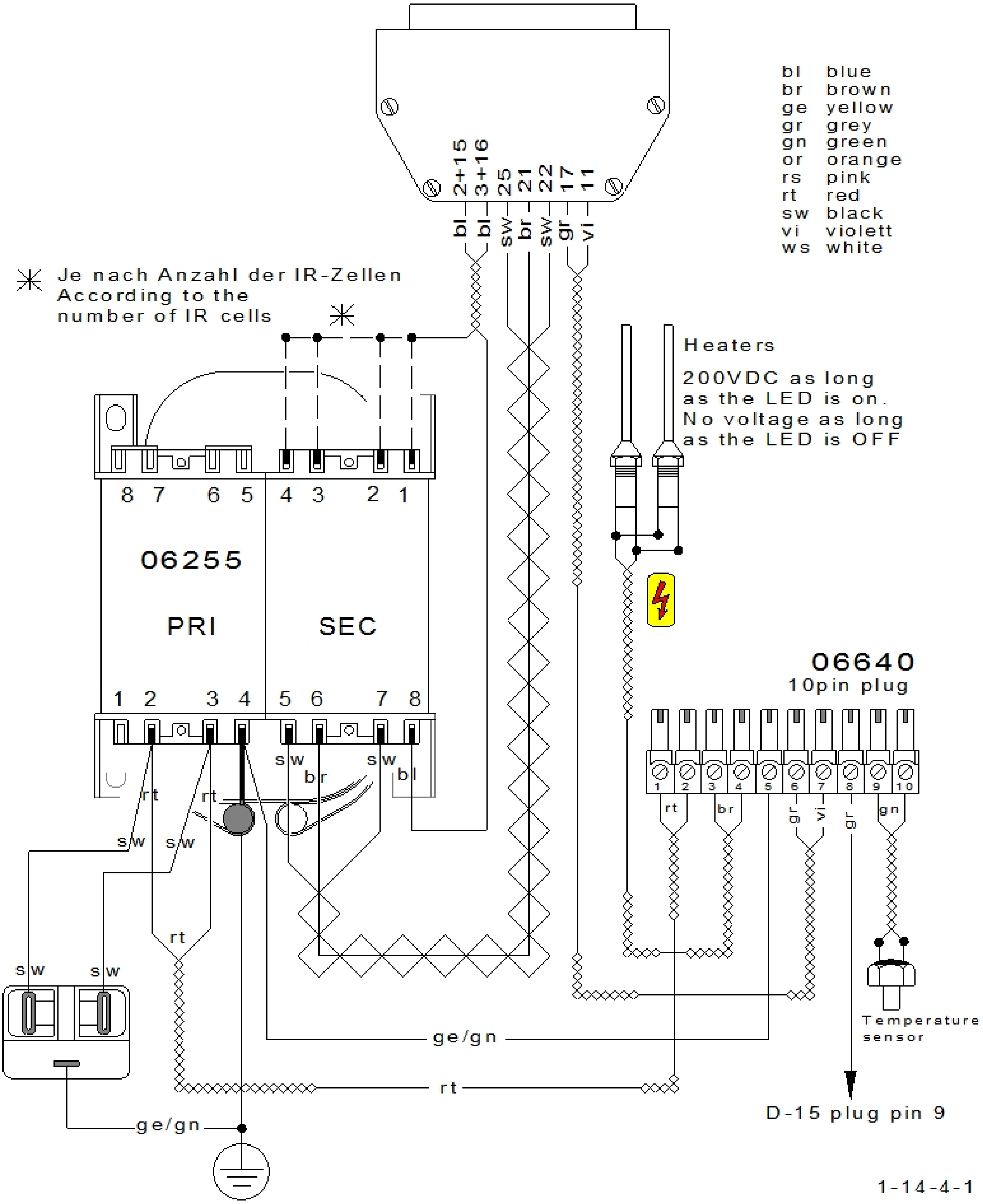


Fig. 13: Draft 1-14-4-1

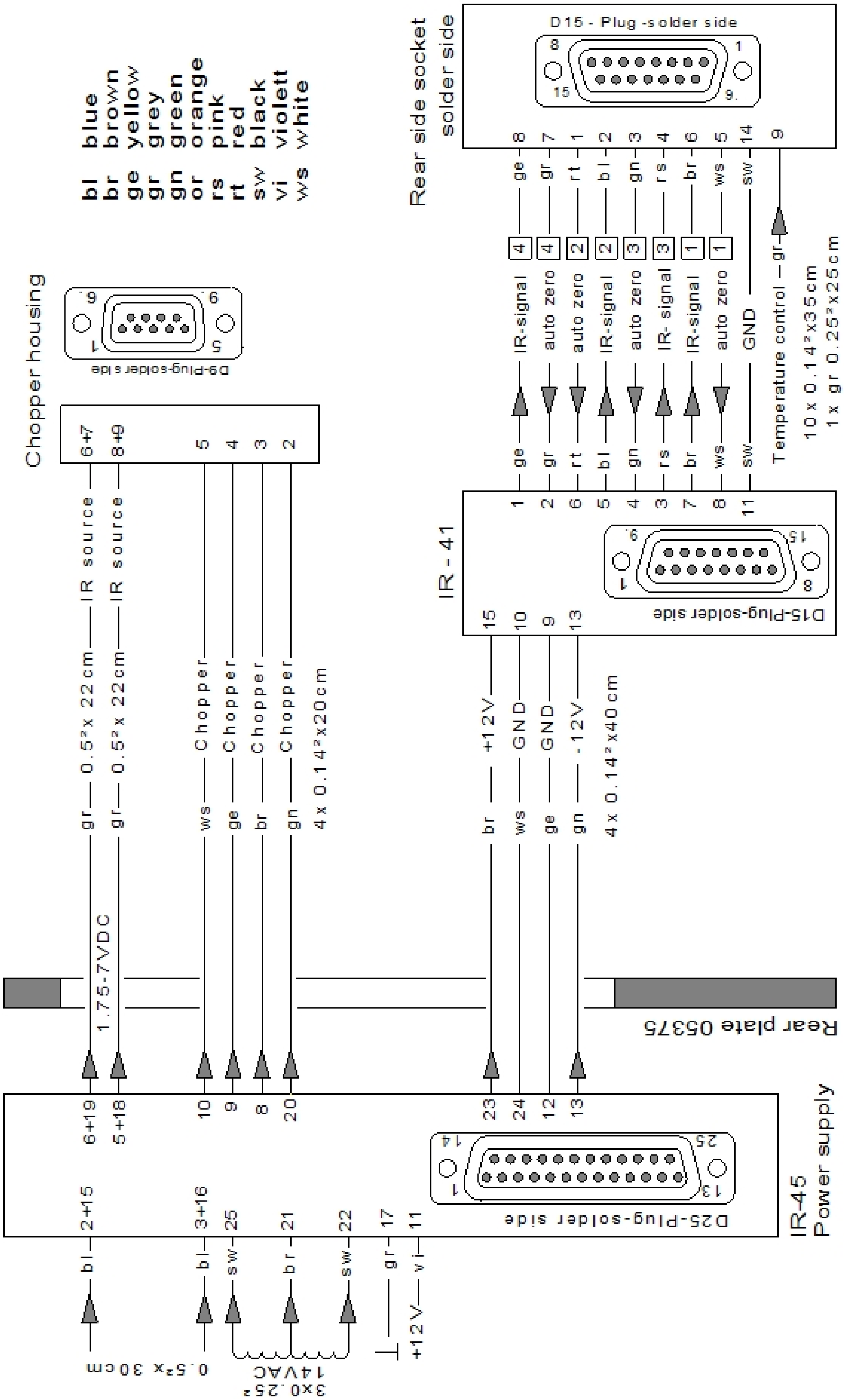


Fig. 14: Draft IR-45 power supply

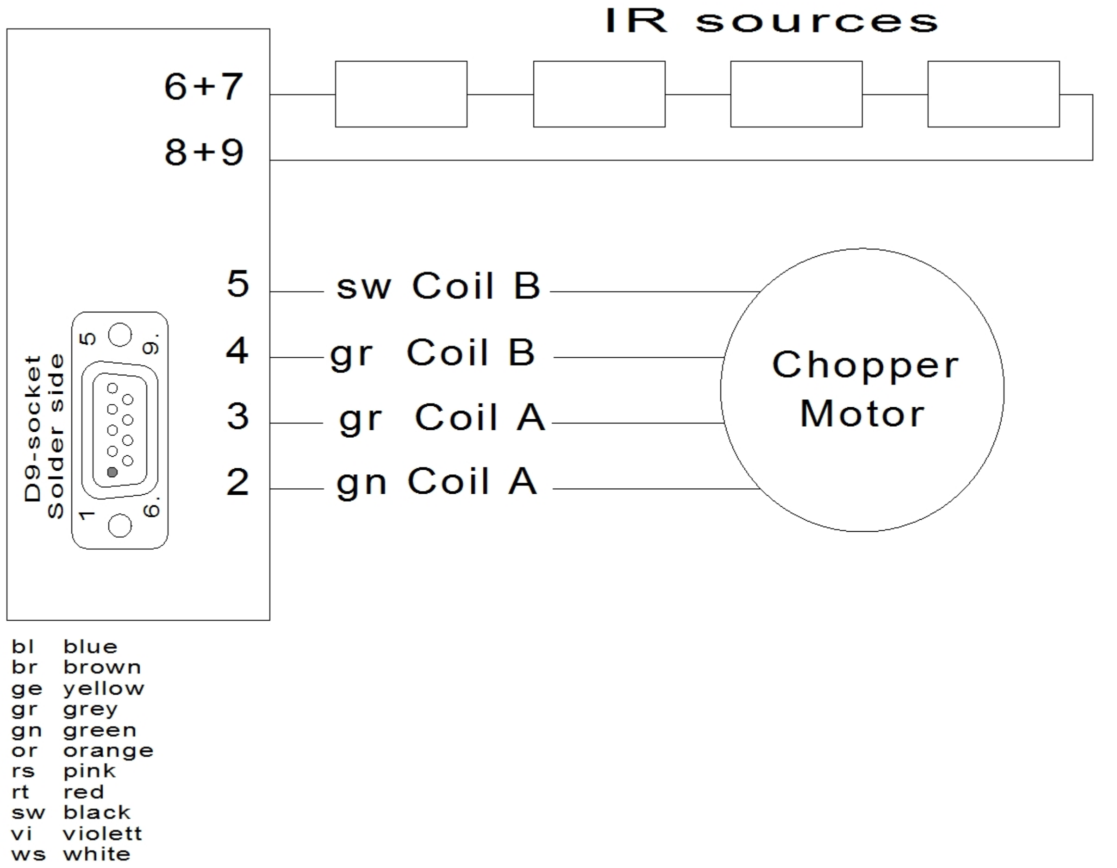


Fig. 15: Draft IR-sources

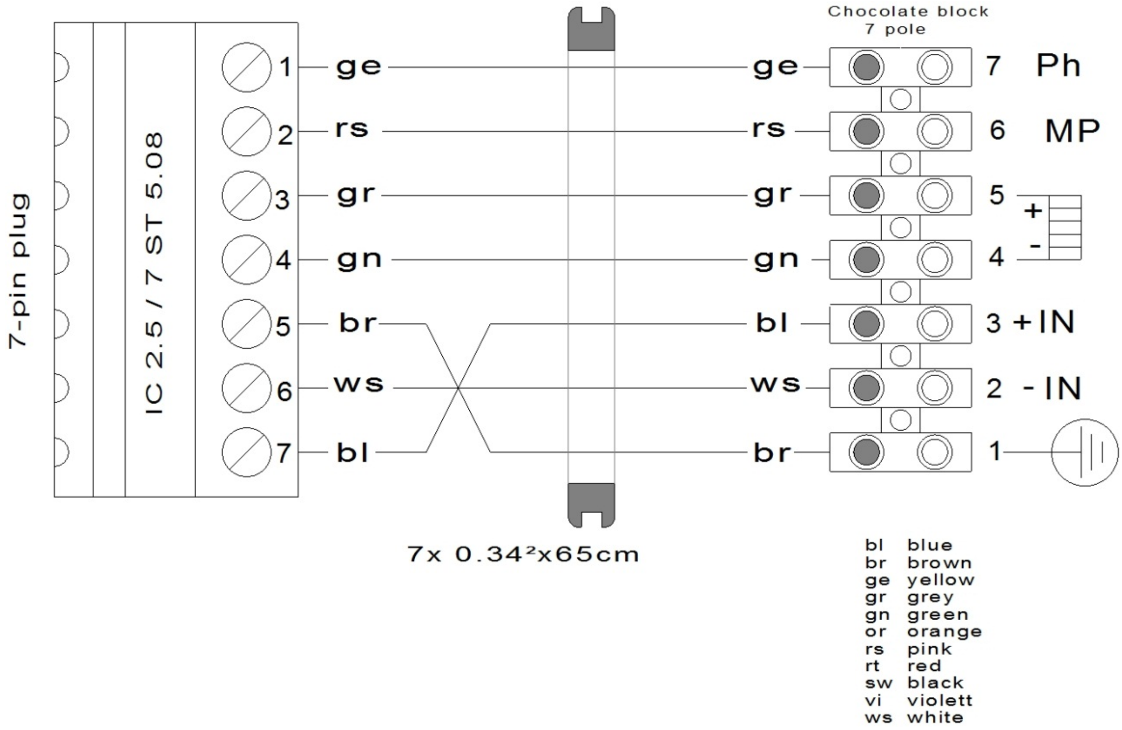


Fig. 16: Draft 7-pin plug

2.5 From S/N 1557xxxxxx

The electronic unit is replaced by the board UNI 1.3 and the electronic rack is removed. The corresponding wiring diagram is 12061.

The modification took place in the second half of 2004.

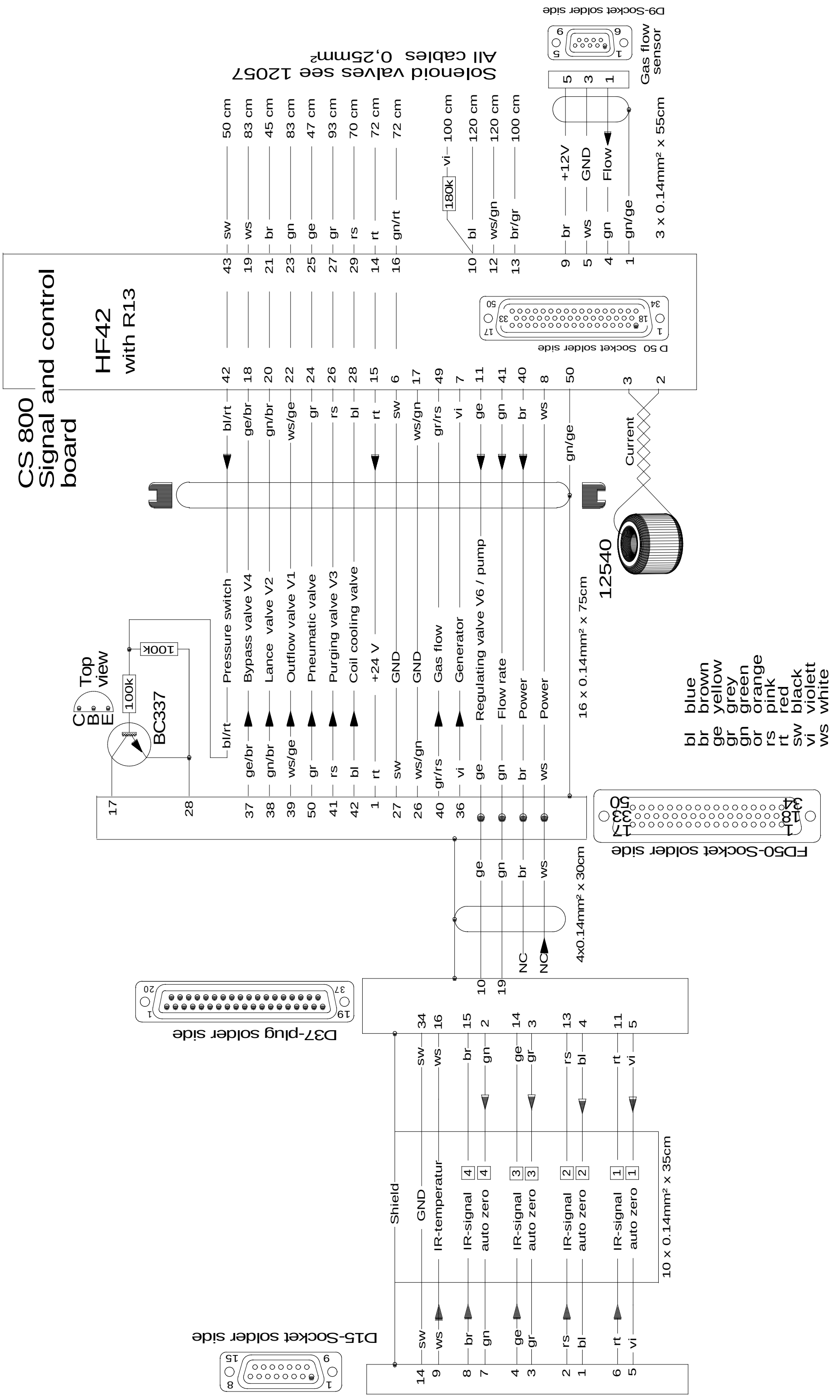


Fig. 17: Draft 12061 (signal and control board)

2.6 new pneumatics (from end 2007)

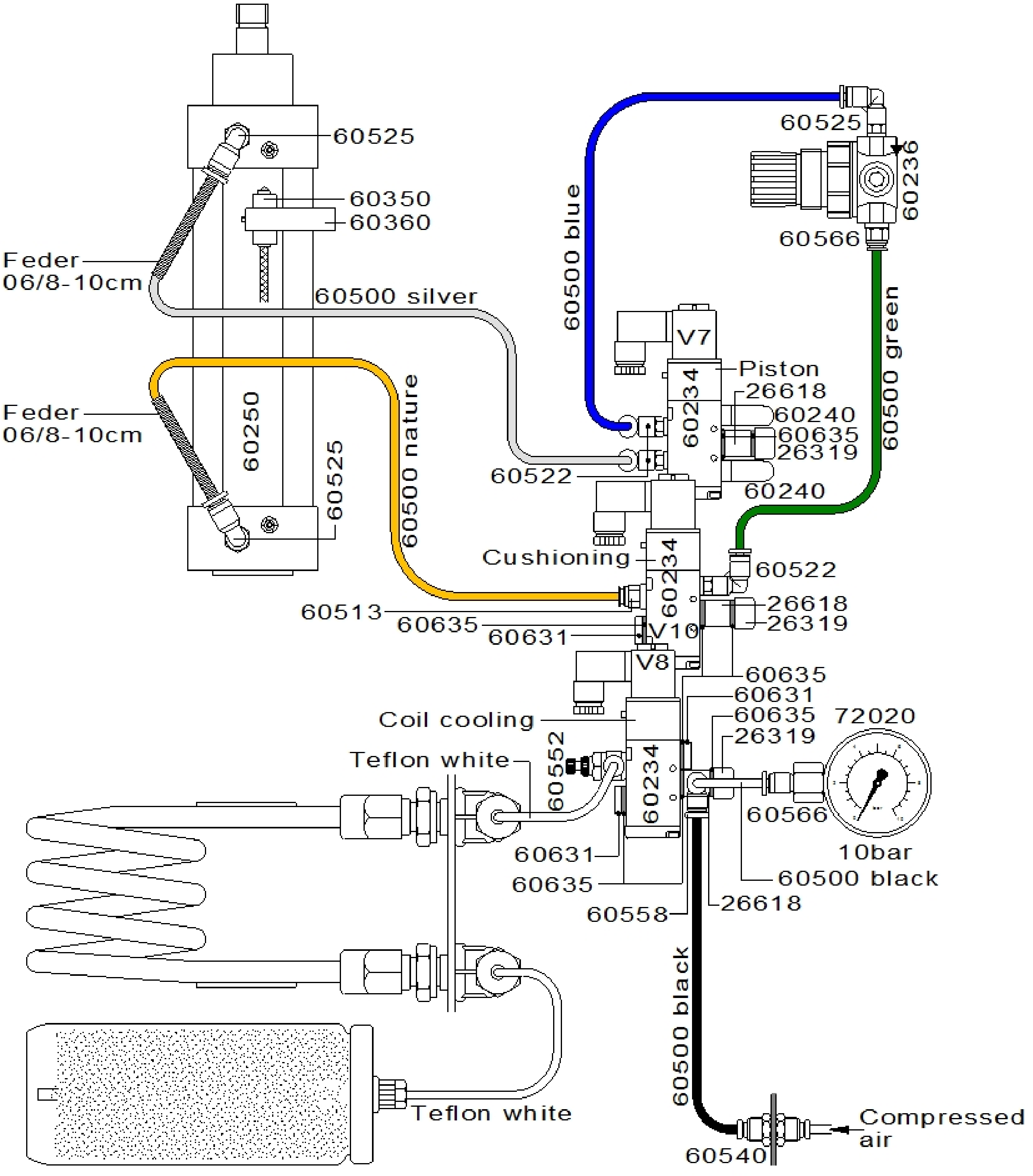


Fig. 18: Draft new pneumatics (from end 2007)

3 Fault messages

3.1 Check base lines

When this message appears on the PC screen, at least one of the base lines is either over +9.5Volts or below -9.5 Volts.

In order to read the base line voltages of all IR cells available, click on “base lines”

Fig. 1: Base lines

A window appears at the right upper end of the screen showing the base lines moving from the left to the right (time coordinate). In the middle of the right end of this base lines window, there is a small button. After clicking on it, a new window appears, displaying the base line voltages, described as “Inputs” and their “Averages”.

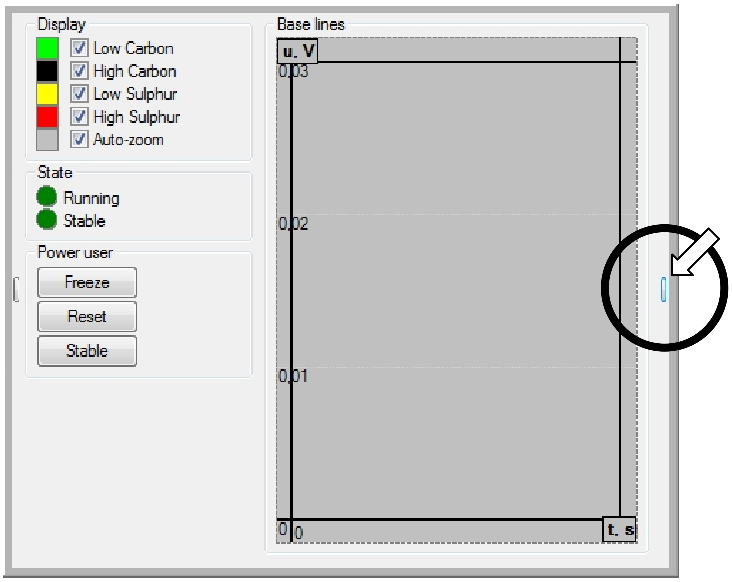


Fig. 2: Activating Inputs and Averages Window

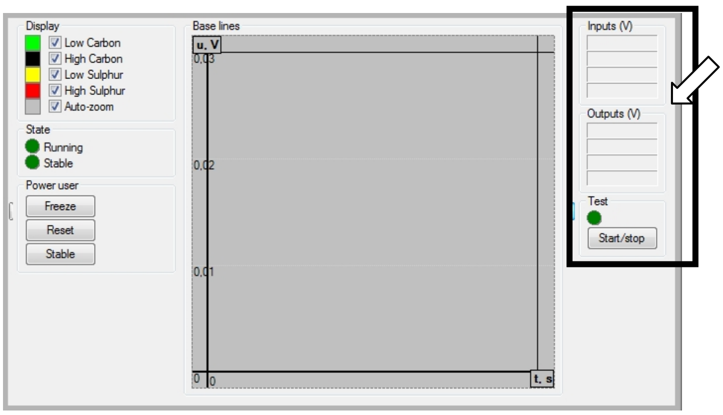


Fig. 3: Inputs and Averages Window

If any of the “Inputs” or “Averages” is over 9.5V, adjust a voltage of about 6 to 7V.

The adjustment is preferably made when having carrier gas flow thru the cells.

Note:

The IR cells have normally base lines adjusted to about 8V and the peak comes down during analysis, respectively during IR absorption by the measuring gas.

In case of golden paths, although we intensively clean them with solvents and heated up to over 500°C for one day or more, in the first couple of months after being in operation, the base line may goes up, which means that the paths become more reflective during this period. Therefore, the base lines of golden paths should be initially set rather at 5 or 6 volts instead of 8 volts. In the first couple of months the base lines go up, but the growing slows down and growing contamination finally causes the base line to start coming down.

The initial base line adjustment at 5 to 6 volts, prevents the maximum base line value from reaching 9.5V, where the error message “Check base line” appears. Note that this message is just a warning. The analyzer is not prevented from carrying out further analyses. As long as the base line remains below 10V, the results are correct.

If a base line is below -9.5V an adjustment should be done as advised above. If this is not possible, then most probably there is a fault or a very strong contamination. In case of contamination, all cells available should have very low voltages, even negative ones.

If all available cells are below -9.5V there is most probably a fault like no rotating chopper motor or a faulty infrared source.

3.2 Fluctuating gas flow

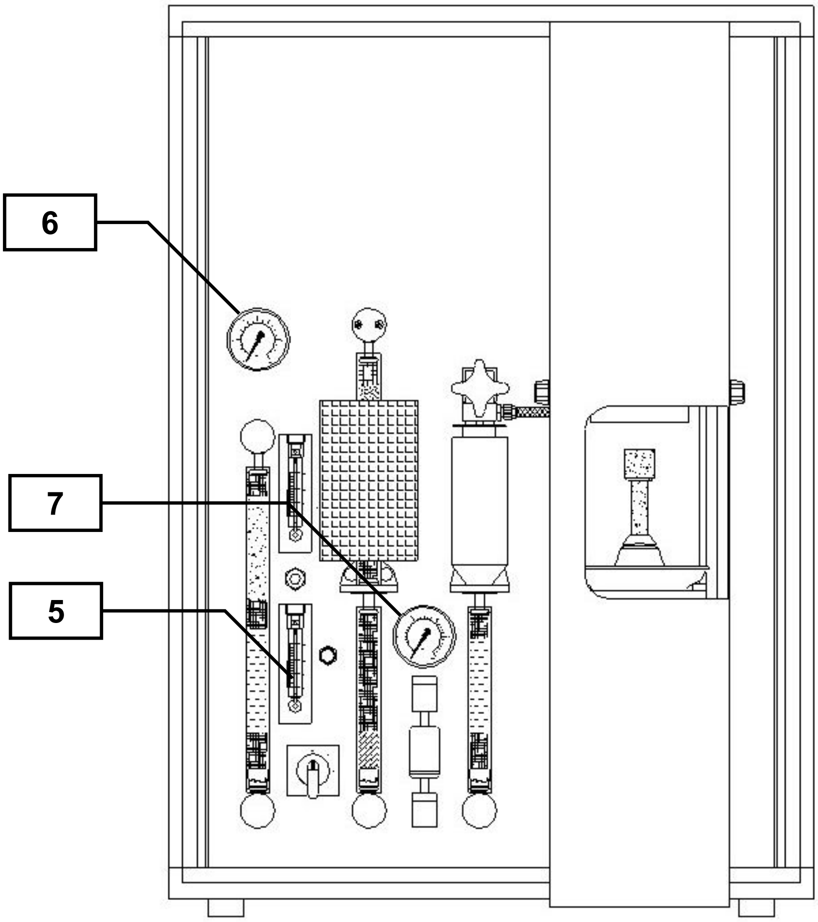


Fig. 4: Fluctuating gas flow

The flow rate is electronically controlled; therefore there should be no significant variation from the set value.

In case of a fault however, a control of the flow rate is no longer possible and the gas flow fluctuates. This can be caused, for example, by an excessive obstruction of the gas flow system or by a faulty component that needs to be replaced.

See the next pages of this chapter and chapter Gas flow controller adjustment and jumper settings

Mostly, the problem lies in the saturation of the dust trap or of the chemicals.

In case the flow becomes lower and the regulating valve voltage goes higher during combustion, it is obvious that the flow regulator is working. Therefore the problem must be a restricted oxygen supply. When the accelerators start burning they take a lot of oxygen, so that the pressure in the furnace goes down, and as a result for this the flow may also go down.

List of fault reasons in order of probability:
(Details to the above points)

- Blocked metal dust filter
- Blocked chemicals
- Blocked paper filters
- Blocked lance hole over the crucible.
- Blocked hole of the ceramic heat shield
- Blocked furnace outlet
- Too low oxygen pressure
- The outlet tap of the oxygen regulator is not properly open
- Faulty oxygen regulator
- Contaminated or corroded solenoid valve
- Bent plastic tube of oxygen supply
- A heavy item is placed on the plastic tube of the oxygen supply
- Twisted plastic tube inside the analyzer
- The oxygen supply is interchanged with the compressed air supply
- Blocked dust filter cartridge
- Blocked fittings
- Blocked flow sensor assembly
- Electronic problem

3.2.1 Blocked metal dust filter

Clean the metal dust filter according to the operation manual.

Caution: Even if the filter may be brushed and cleaned in ultrasonic cleaner, someday will not be able to be cleaned any more. The filter doesn't last forever.

Check by removing the filter with the dust filter housing. See chapter: High carbon results are erratic

Don’t remove the filter from its housing.

Turn the filter housing upside down and try to blow air through the small whole (about 16mm diameter) of the filter housing.

If you feel a remarkable restriction, replace it by a new one. With a new filter the air should pass practically free without any restriction.

3.2.2 Blocked chemicals

The grains of magnesium perchlorate as well as of sodium hydroxide have to move when knocking on their glass tube. If they are cloggy, they are completely depleted and they have to be replaced. When the glass tube is turned upside down, the grains should fall off. If a screw driver is needed to stab the grains free, the chemicals had to be replaced much earlier.

3.2.3 Blocked paper filters

The paper filters are small so that they are frequently forgotten or neglected, although they can block the flow when they are not replaced for long.

3.2.4 Blocked lance hole over the crucible

The hole in the ceramic heat shield over the crucible can be restricted or blocked.

Clean by using the brass brush as described in the operation manual. If this may not be enough then clean the hole by using a piece of wire or a pipe cleaner.

3.2.5 Blocked furnace outlet

Unscrew the cap-nut at the furnace outlet and remove the plastic tube. Pass thru the fitting a pipe cleaner. Open the furnace in order to be sure that the pipe cleaner has passed thru the fitting reaching the furnace area.

Completely remove the plastic tube by unscrewing the left hand cap-nut on the dust filter assembly. Clean this fitting the same way like before. If necessary clean the plastic tube as well.

3.2.6 Too low oxygen pressure

Check the oxygen gauge. The reading should be 1.5 bar (22.5psi). If the pressure is too low, it can be adjusted by pulling and turning clockwise the knob of the pressure regulator on the rear panel of the analyzer. It is placed on the right hand side close to the generator blower and the knob is accessible from inside the analyzer. An adjustment is possible provided that there is sufficient pressure at the input of this pressure regulator.

If the input pressure is too low, check the (external) pressure gauge of the oxygen supply (cylinder). The input oxygen pressure to the analyzer should be between 4 and 6 bar (60 to 90 psi).

3.2.7 Outlet tap of the oxygen regulator is not properly open

It is not necessarily enough to have sufficient oxygen flow if only the right pressure is adjusted on the oxygen regulator of the bottle/cylinder. It is equally important to properly open the small tap at the outlet of the pressure regulator. If this outlet tap of the regulator is not properly open, you may have enough pressure at the analyzer when there is no or little oxygen demand. But when the oxygen demand grows, for example at the beginning of combustion when the sample needs a lot of oxygen to burn, the pressure may drop to a very low level if not enough oxygen can be supplied to the analyzer at the moment of high oxygen demand. The same problem will appear during furnace purging before or after the analysis, depending on the actual settings in the software.

3.2.8 Contaminated or corroded solenoid valve

In case of steel analysis it is very unlikely to have problems with valves. In case of exceptional materials like ores, solenoid valves can be contaminated up to the extent of failing. This depends mainly on the amount of sulfur and moisture in the sample. The most affected valves are the outflow valve V1 and the bypass valve V4. The valves can be cleaned. If cleaning may not help, they should be replaced. For extremely contaminating resp. corroding samples, we have currently valves under evaluation, where the carrier gas does not get in contact with any metal parts but only with chemically resistant plastic.

3.2.9 Faulty oxygen regulator

A faulty oxygen regulator can of course cause a similar problem when it does not keep the pressure level at moments of higher oxygen consumption.

3.2.10 Bent plastic tube of oxygen supply

When the plastic tube supplying oxygen from the bottle to the analyzer is bent, there will be the same problem like described in the above two subjects. There will be too low oxygen pressure in the analyzer, especially at moments of high oxygen consumption, like when burning samples or purging the furnace.

3.2.11 Heavy item is placed on the plastic tube of the oxygen supply

Years of experience have shown that not only bent plastic tubes can be a reason for insufficient oxygen supply, but also that a foot of the analyzer's cabinet was placed on the tube, squeezing it and restricting the oxygen flow. In one case, the customer prolonged the tube using a fitting with too small inner diameter causing the same effect like bending or squeezing the tube.

3.2.12 Twisted plastic tube inside the analyzer

It happened that, when fixing cap nuts of the black plastic tube inside the analyzer but also at the furnace outlet, the tube was turned with the nut and twisted, badly restricting the oxygen flow.

3.2.13 Oxygen supply is interchanged with the compressed air supply

In case of reported bad combustion, we experienced in a number of cases, that the tubes of oxygen and compressed air supplies were interchanged. Compressed air in the induction furnace will provide combustion but a bad one, because of only 20% of oxygen existing in the air. Therefore the peaks are low and long, consisting of more than one peak, looking like mountains.

CAUTION: Oxygen in the pneumatic cylinder can lead to its explosion.

3.2.14 Blocked dust filter cartridge

The dust filter cartridge is on the front panel so that contamination is visible for the operator. In the gas flow circuit, this dust cartridge is connected after the metal filter and its following glass tube with magnesium perchlorate, so that the carrier gas passing thru the cartridge is already filtered. The cartridge is used as an additional safety to ensure that the carrier gas passing thru the IR cell and the flow sensor, are as clean as possible. Therefore it takes long until the cartridge is contaminated, so that its ranking is almost at the end of the list.

3.2.15 Blocked fittings

This case is extremely unlikely to happen in case of an induction furnace analyzer, because the analyzed materials in question are inorganic materials like metals and ceramics, so that they don't create fumes, volatiles and moisture. Even cement analysis is not as critical as organics analysis. Anyway, this information is included in this list in order to have it complete.

In case of analysis of materials causing major contamination, the fittings of the IR cells can be blocked so that they have to be cleaned.

Also fittings elsewhere can be blocked, like the fittings for plastic tubes on the reagent glass-tube holders.

3.2.16 Blocked flow sensor assembly

If the flow sensor is blocked, it should normally be replaced.

For those who may decide to clean them - please read the description about cleaning.

3.2.17 Electronic problem

The flow controller consists of 3 components:

1. The flow sensor
2. The board HF-42 (The lower half of the board only).
3. The proportional valve V6.

The electronic devices involved in the flow regulation are the board HF-42 and the flow sensor. The only influence of the PC and of the microcontroller on the flow, is the start/stop of the flow in case of gas saving mode.

For chasing flow problems, there is a possibility to avoid any involvement of the PC and of the microcontroller, by setting a jumper on the HF-42. To do this, move the jumper of J3 from A1-A2 to B3-B4.

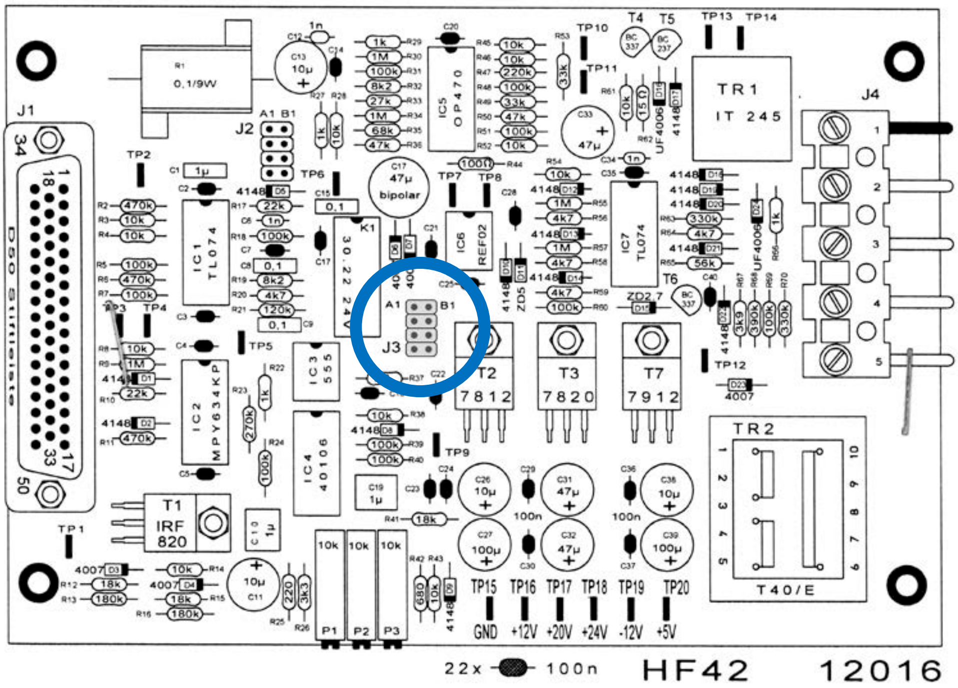


Fig. 5: HF-42

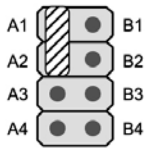


Fig. 6: Jumper position for gas saving mode

Remember to set the jumper back if gas saving operation is required.

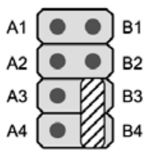


Fig. 7: Jumper position for continuous flow

In this case there is continuous flow when the mains power switch is on Position 2.

3.3 High carbon results are erratic

Even if the filter may be brushed and cleaned in ultrasonic cleaner, someday will not be able to be cleaned any more. Filters don't last forever.

Check by removing the filter housing with the dust filter in it.

Don't remove the filter from its housing.

Turn the filter housing upside down and try to blow air through the small 16mm hole (about 16mm diameter) of the filter housing.

If you feel a remarkable restriction, replace it by a new one. With a new filter the air should pass practically free without restriction.

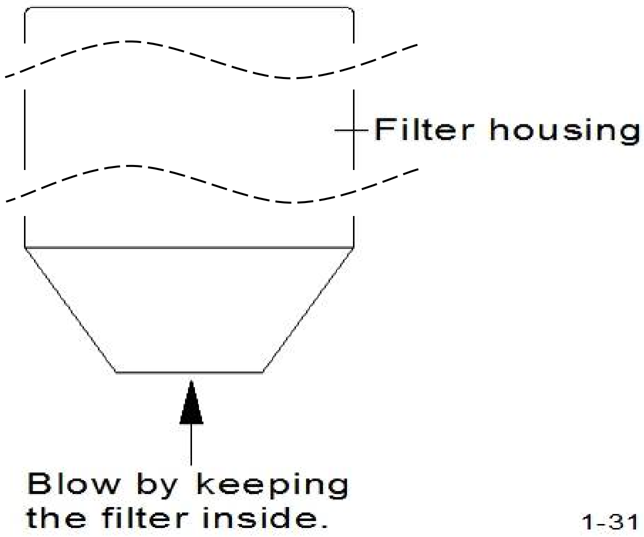


Fig. 8: air blow through filter housing

3.4 No combustion

DANGER

G0001

Mortal danger from electric shock

Exposed power contacts - High Voltage

- An electric shock can cause injuries in the form of burns and cardiac arrhythmia, respiratory arrest or cardiac arrest.

• **Disconnect the mains power plug before opening the analyzer’s cabinet.**

After clicking START of analysis or pressing F5 but the sample doesn’t burn, check the reports in the “status window” on the pc screen.

The following describes how to proceed depending on the displayed message:

3.4.1 No oxygen pressure

If this message permanently remains in the “status window”, then

– Check the oxygen gauge on the analyzer’s front panel.

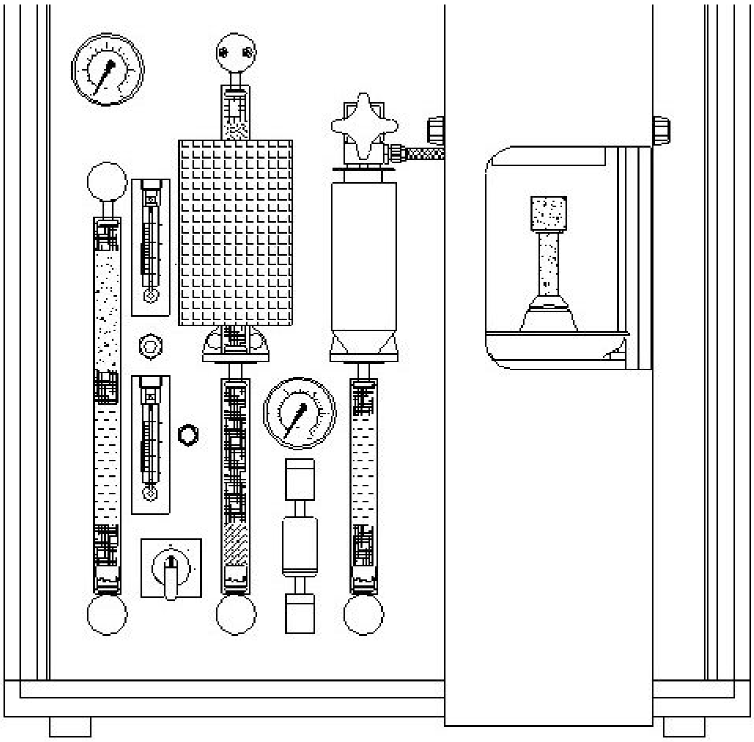


Fig. 9: oxygen gauge

If the pressure is remarkably lower than 1.5 bar (22 psi) then

- Check the pressure of the oxygen bottle.
- Check the pressure regulator of the oxygen bottle
- Do leakage check. See chapter Leak Checking

3.4.2 No flow

If this message permanently remains in the “status window”, check the flow on the lower flow meter (Rotameter). The ball has to be in the range of 180 L/h. If it is in this range, then click on the “device state” window icon.

Fig. 10: device state window icon

Check the graph for L/h. (See software helps). If the vertical bar is not in the middle of the base line then calibrate the flow in the software as follows.

3.4.3 Pre-purging

If this message permanently remains in the “status window”, click the icon of the “configuration window”.

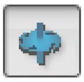


Fig. 11: icon configuration window

The duration of pre-purging is possibly entered much too long. Reasonable values are between 1 and 5 seconds, maximum 10 sec for very low carbon analysis.

3.4.4 Waiting for stability

If this message permanently remains in the “status window”, the infrared cell base lines are not stable or out of range.Click the Base line Icon and check.

Fig. 12: Icon Base line

3.4.5 Integration delay

The message “Integration delay” appears for as many seconds as entered in the “configuration window”. Reasonable range is something between zero and 5 seconds. When the integration delay starts, the induction generator starts at the same time. In other words, the software starts the integration delay and the generator at the same time. This is valid also when the integration delay is set to zero seconds. In this case, the generator is started but “Integration delay does not appear in the status window. The status window displays then the next message of its sequence, which is “Analyzing”.

3.4.6 Analyzing

When “Analyzing” appears in the status window, it means that definitely the command for starting combustion is given by the software, so that if still there is no combustion, there must be probably a hardware reason for this fault.

NOTICE

As a matter of fact, it happened several times that we received requests for help in cases of no combustion, from people who tried to test the functionality of the generator by using empty crucibles!!!!!

After starting analysis, the word “Analyzing” appears in the configuration window.

3.4.7 The command from the microcontroller to start the generator is not received

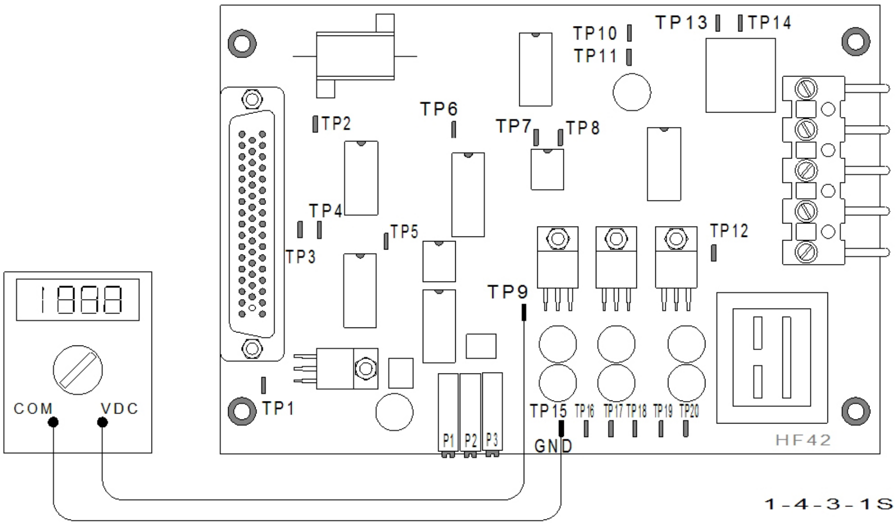


Fig. 13: Measurements on TP9

3.4.7.1 Measurements on TP9:

– a signal of about 0.5 V should turn the generator on,

– a signal of about 12 V should turn the generator off.

If 12 V are measured, despite "Analyzing" appearing on the display, then the microcontroller board is defective or the connection from the HF 42 circuit board, pin 7 is loose.

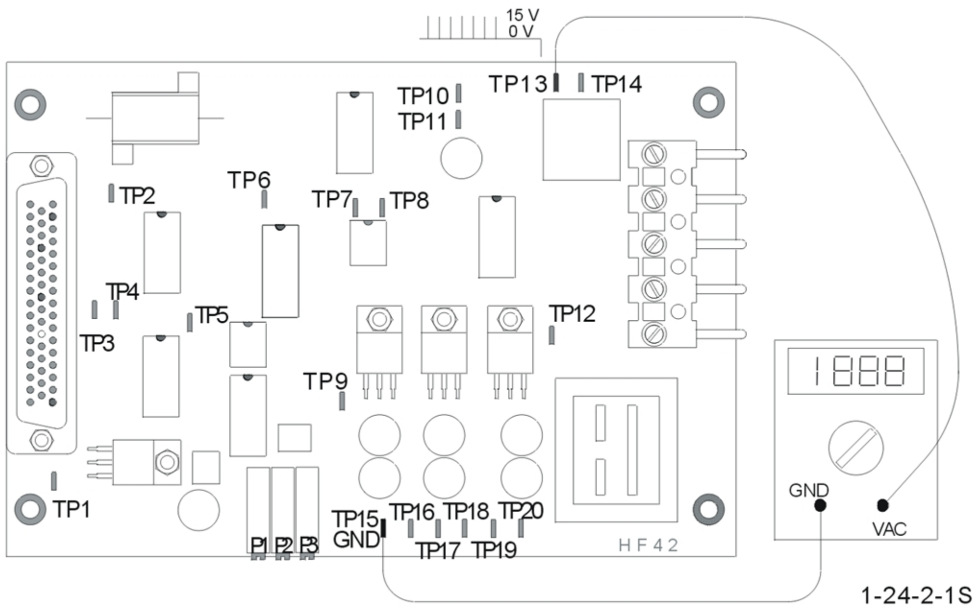


Fig. 14: TP13 test point

When the command for the generator is received (0.5 V DC), the triac triggering pulses must appear on the TP13 test point. If there is no oscilloscope available you can test this with a digital voltmeter. The displayed value depends on what type of digital voltmeter you have. There must be a voltage increase on TP13, once the word "Analyzing" has appeared on the display, or once 0.5 V are present on TP9. When no voltage increase occurs on TP13, despite having 0.5 V on TP9; the HF 42 circuit board is defective.

NOTICE

After replacing the HF 42 board, make sure that the 50 pin plug is properly inserted. It takes a lot of force to push in 50 pins at once. 50 pin plugs that haven't been properly inserted are a frequent problem. Tighten the screws of the plug properly, to ensure a proper connection to the board.

3.4.7.2 Checking the generator tube

Ensure that the power switch is at position 2.

Check if the filament of the generator tube glows:

This can be easily checked:

Through the air vent holes of the furnace, the reflected light of the glowing filaments (heater of the cathode) should be visible.

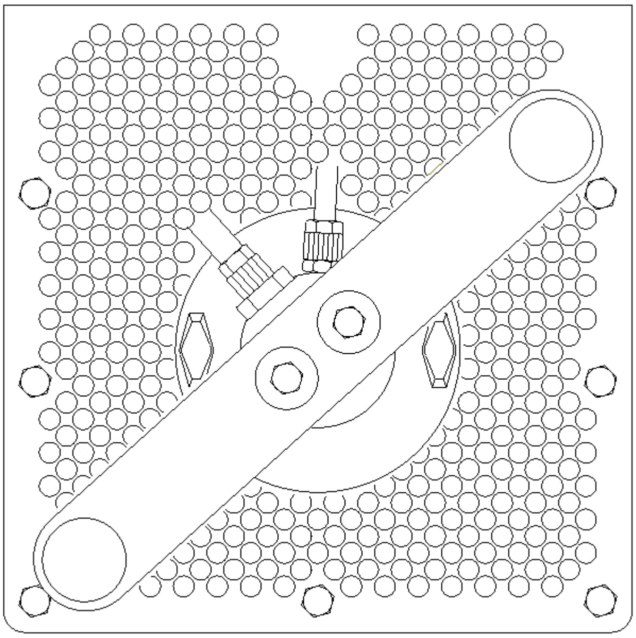


Fig. 15: Air vent holes of the furnace

DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

If the light from the filament is not visible, then remove the cover from the generator section, in order to see the tube.

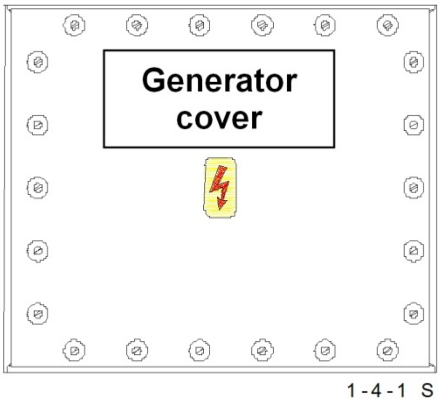


Fig. 16: Generator Cover

3.4.7.3 If the filament of the generator tube doesn't glow

Check the voltage of the filament, on the transformer, there should be 10 V AC on the secondary. If not, then measure 220 V AC on the primary, leads 2-3.

NOTICE

Set the power switch to pos. 1 before removing the tube, although it would be best to completely turn off the device and unplug the power cord.

DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

Before touching any components or wiring, make sure the capacitors are discharged.

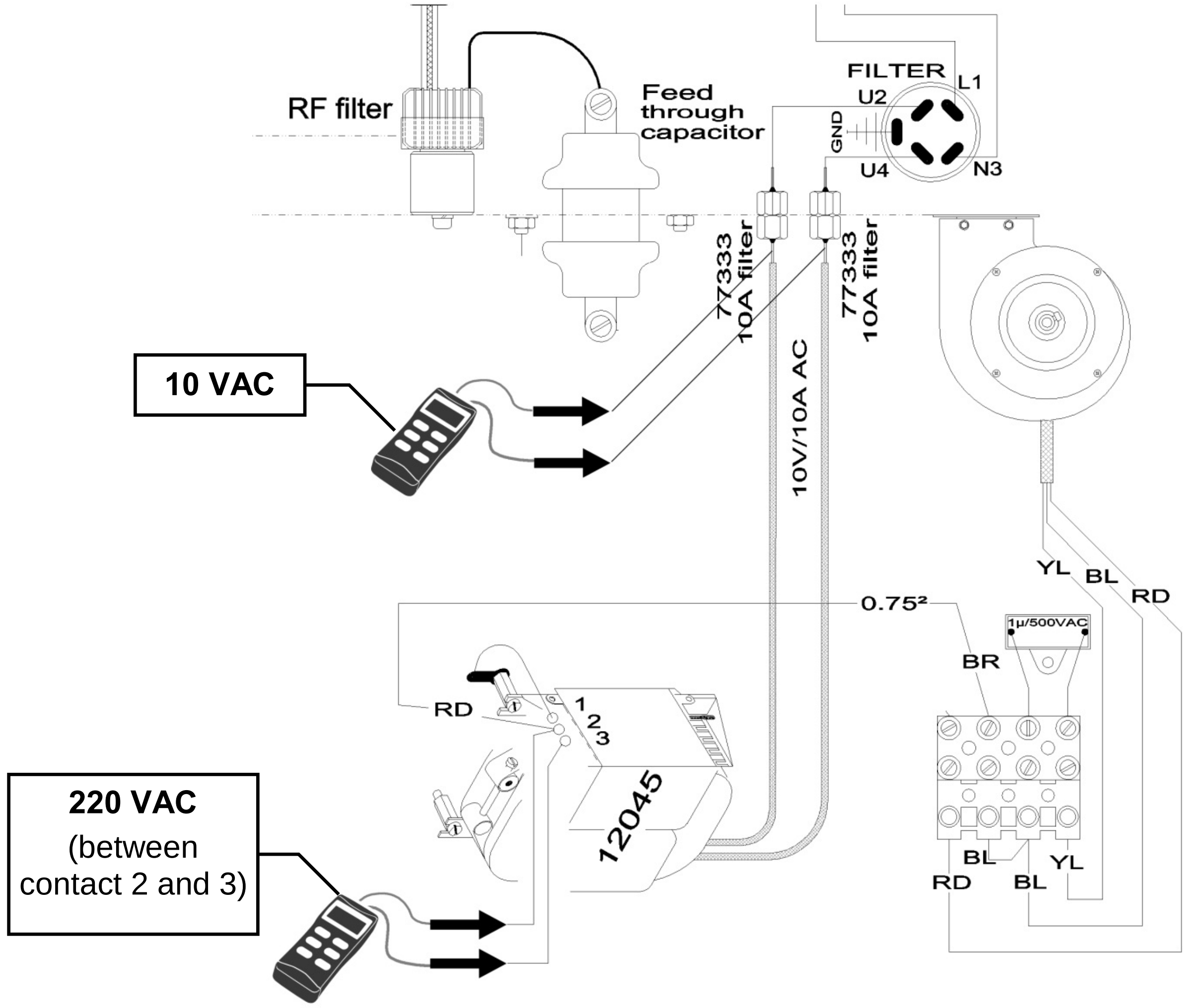


Fig. 17: Measurements

Check whether the filament is faulty, at the filament connections, only 1 Ohm must be measured. A very high or unmeasured resistance means that the filament is burnt through and the tube needs to be replaced.

3.4.7.4 Checking the primary voltage on the high voltage transformer:

DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

When checking for induction power, always keep the furnace closed!

On the primary side of the high voltage transformer, you should be able to measure about 210 V AC; if not, the triac is possibly defective.

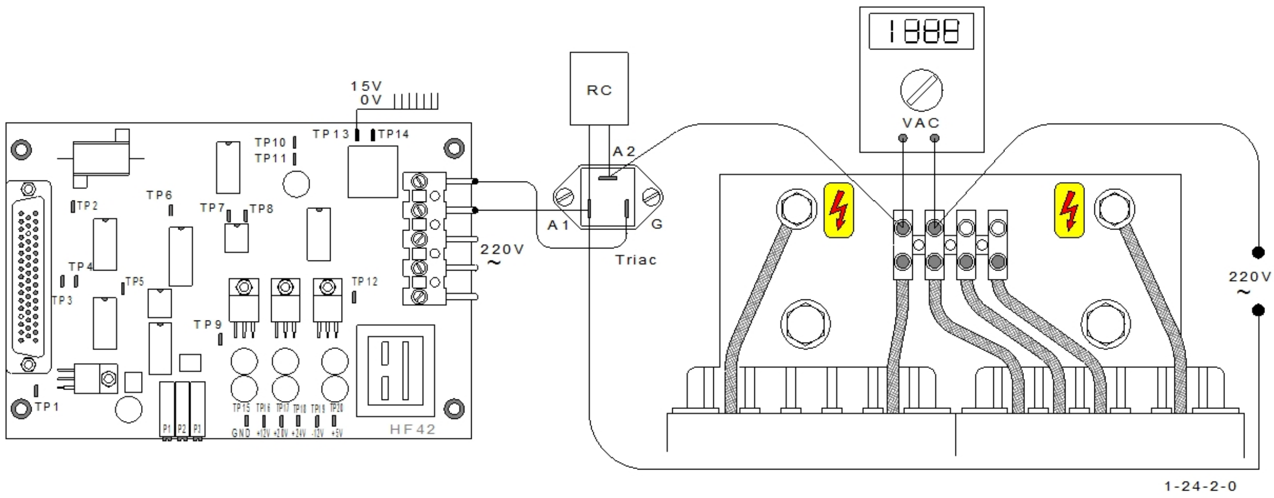


Fig. 18: Measurements - high voltage transformer

Once there is voltage on the transformer the triac must be OK. A relatively low voltage on the transformer could be a result of too high current so that the HF-42 board reduces the phase angle. IF so there is most probably a faulty component in the oscillator circuit preventing it from oscillating so that the oscillator tube takes a high DC current.

NOTICE

This can damage the tube. Therefore when you start for testing whether there is combustion keep your finger on the STOP button. If the sample does not start burning about 3 seconds after the generator starts, then immediately stop the analysis.

One thing that will give further evidence is the current taken by the analyzer from the mains power.

If the current goes up to a level of about 10A, then a faulty component prevents oscillations so that the tube takes all this power causing overheating of the tube within several seconds.

If the current does not increase, it means that the generator does not take power, for example due to a broken grid resistor.

In case the transformer has 210 V AC on the primary coil and there is still no combustion, check the windings of the transformer as follows:

- Switch off the analyzer and disconnect the main power plug.
- Measure the resistance of the primary coil.
  – It must be extremely low, about 0.8 Ohms between the screws labeled 0 and 270.
- Measure the resistance of the secondary coil between the two screws on the ceramic insulators where the wires of the rectifier are connected.
  – The resistance is approximately 322 Ohms.

3.4.7.5 The rectifier could also be faulty

Checking the high frequency generator

⚠ DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

Never try to measure the voltage here!

Due to high voltage in the range of 7000 Volts (amplitude), there should be no measurement on the rectifier under power. If no spare rectifier available to exchange, then test by using a scope according to the following drawing.

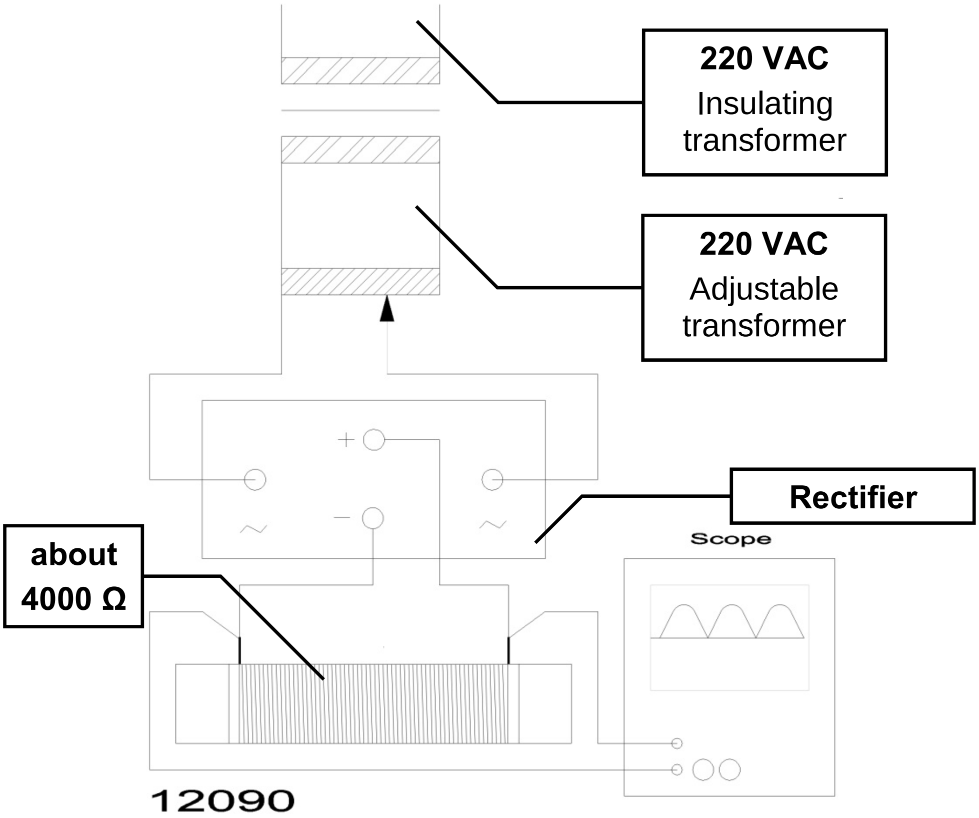


Fig. 19: Rectifier

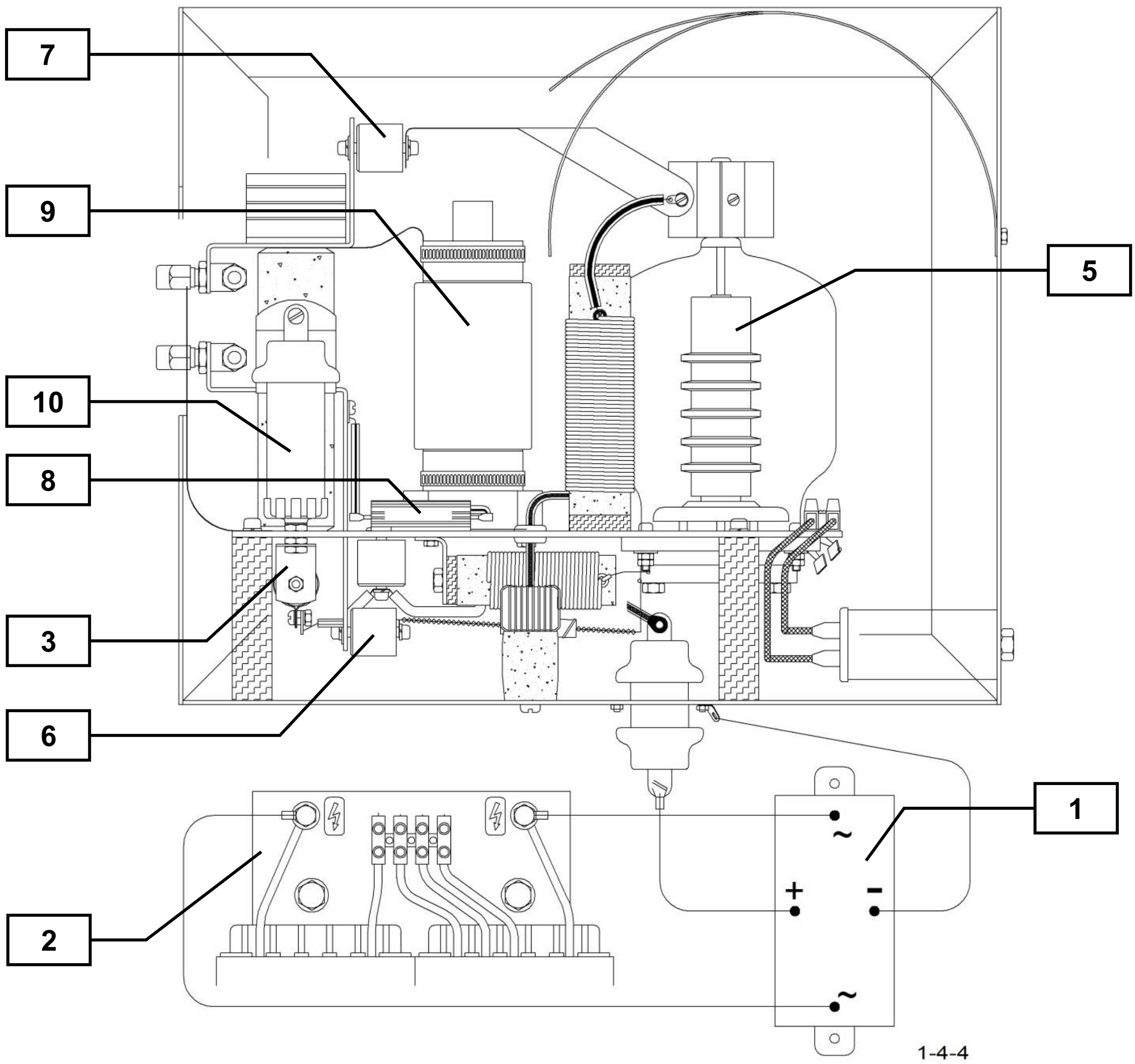


Fig. 20 Draft high frequency generator (1-4-4 + 1-4-5S)

As there is high voltage (5000V) and high frequency (19.2MHz) present, a measurement would be very difficult and, above all, very dangerous. Before the generator cover plate is unscrewed, the device should be turned off or, better, the power plug pulled out.

⚠ DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

Before touching any components or wiring, make sure the capacitors are discharged.

You should check the connections in the oscillator circuit to ensure all screws are turned tightly, especially all the cap screws on the combustion coil.

The electrical connections and resistors should be checked with an ohmmeter. If the resistor 2.7K / 100W (3) is open circuit, then there is no oscillation, but also no power consumption.

The tube doesn't take any current at all. The parts e.g. tube and rectifier should be replaced one by one.

3.4.7.6 Loud buzzing sound when the generator turns on

If during integration (combustion period) the high voltage transformer is making exceptionally loud buzzing sound when the generator turns on, also when running the furnace empty still the loud buzzing appears, this means that obviously for some reason, the triggering of the triac has changed.

If you are sure that the noise appears only during integration period (combustion period) then the problem could be in the generator. The unusually loud noise could be due to current limitation by phase angle control.

The oscillator tube may not be oscillating due to a tube fault so that it takes a very high DC current causing the current limit circuit to reduce the phase angle. Replace the tube. This is also the easiest thing to try so that it can be done by the customer.

NOTICE

The oscillator tube can be damaged due to overheating if for some other reason the new tube may not be able to oscillate. For testing after installing the new tube, put crucible with sample and accelerators into the furnace like you use to do with every normal analysis. After starting analysis watch carefully the furnace to see the light of the burning sample/accelerators. If a couple of seconds after generator start (transformer noise, base lines for peak on the PC screen) there is no combustion to see in the furnace then STOP the generator by clicking STOP on the screen.

NOTICE

When testing for induction power, always test with closed furnace.

NOTICE

When looking to find out whether there is combustion or not, STOP the analysis cycle about 3 seconds after it started. If there are oscillations, after 3 seconds the sample (steel or iron chips) will have visible signs of starting burning. But if you wait up to the end of the analysis cycle in order to check whether there was combustion, it could be already too late for the tube due to overheating.

When there are no oscillations, the tube takes a high DC current, so that after several seconds, the anode of the tube starts glowing from the lower end. This can be visible when the environment is not bright or it is dark.

It is practically not possible to do any measurements on the generator due to very high voltage and due to high frequency in the oscillator (in case of functioning). So we have to solve the problems by looking and trying.

One reason could be the resistor (8) having a short circuit. Normally its resistance has the value of 200K.

One more possibility is a faulty capacitor. Check the capacitors, mainly the one on top (7) of the oscillator circuit which is connecting the anode of the tube with the oscillator circuit. Check also the grid capacitor (6) which is placed underneath the oscillator chassis. Try to find out whether they are broken by applying a reasonable force on them to see whether they are still in one piece. If the analyzer is relatively old and these capacitors are in silicon sleeves, the chance that one of them is faulty, is relatively high. If these capacitors are in brown plastic, it is less likely that they are faulty, according to our experience.

Check also the other, bigger capacitors (9), (10) and (11) however if one of them was faulty, most probably the fuses would blow.

3.5 Bad combustion

In most cases the reasons for bad combustion are:

- Problems with the flow
- The Generator (oscillator) tube is not powerful enough anymore. Normally, this does not occur suddenly. It is rather a long process.
  (Part number 77210)

Some more hints:

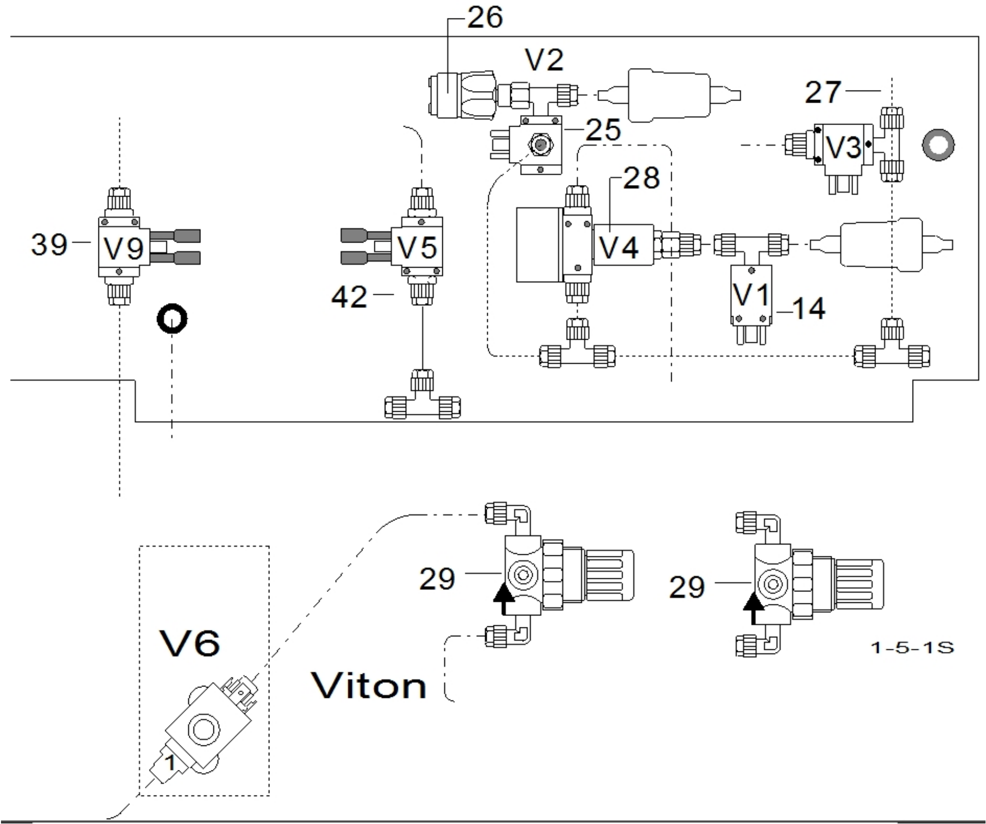


Fig. 21: bypass valves

The bypass valve V4 (28) is either falsely activated during combustion, or the plunger jams. In this case, the oxygen flows through the bypass valve into the IR-cell and not through the furnace. The furnace remains nonetheless under oxygen pressure.

- Measure the voltage to the bypass valve V4 (28)

24 Volts DC while the furnace is open is normal.

Zero volts when the furnace is closed is normal.

Other false controls from the electronics:

- Clean the valves
- Replace inadequate contact points in the oscillating circuit

3.6 Electronic- drivers malfunctioning

IC 15 and 16 are electronic driver integrated circuits, found on the mother Microcontroller board.

Their Type No. of the driver chips is ULN 2803 or TD 62083.

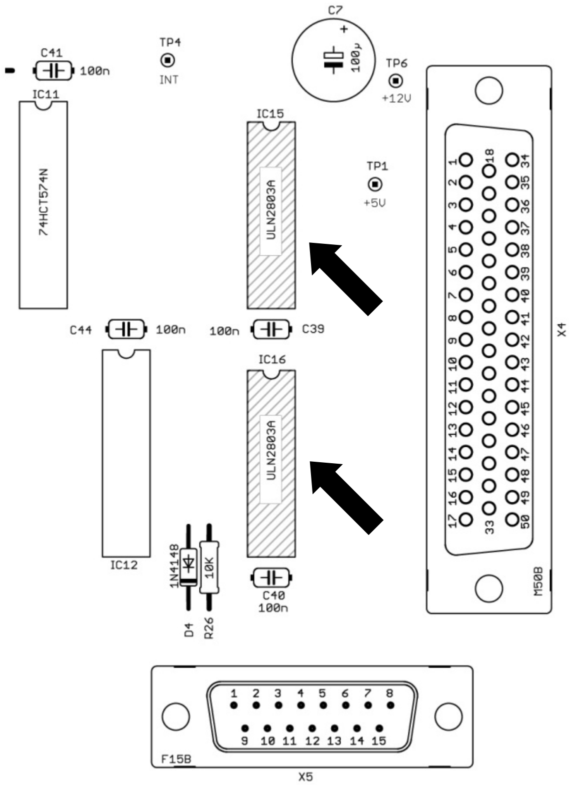


Fig. 22: Partial image of the mother microcontroller board

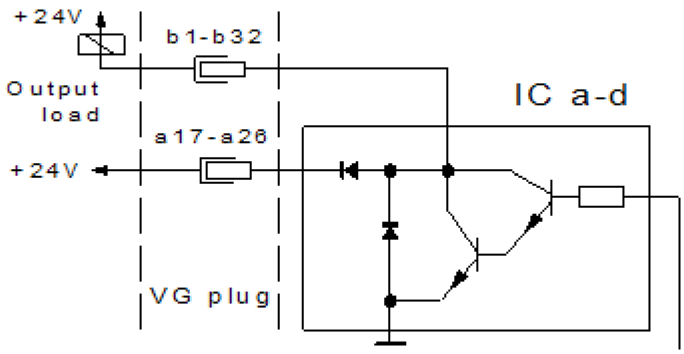


Fig. 19: Circuit diagram

These IC's act as a power switch in order to energize solenoid valves inside the analyzer or to send control signals.

These drivers are designed for continuous current of 500mA each output, so that the 200mA taken by the valves are far below their specified current.

Therefore they are very reliable. In fact they never fail with 200mA load. We only have reports of failure when somebody tries to measure the valve voltages, accidentally causing a short circuit.

In case of short circuit, the drivers are immediately destroyed.

Therefore it is practically not possible to realize the short circuit. It is however not a coincident when drivers working for lots of years in an analyzer, fail just in the moment when somebody tries to measure the voltages of the valves. Therefore we strongly suggest to only measure the valve voltages after all other instructions of this manual are carefully followed, but without solving the problems.

3.7 Furnace does not close

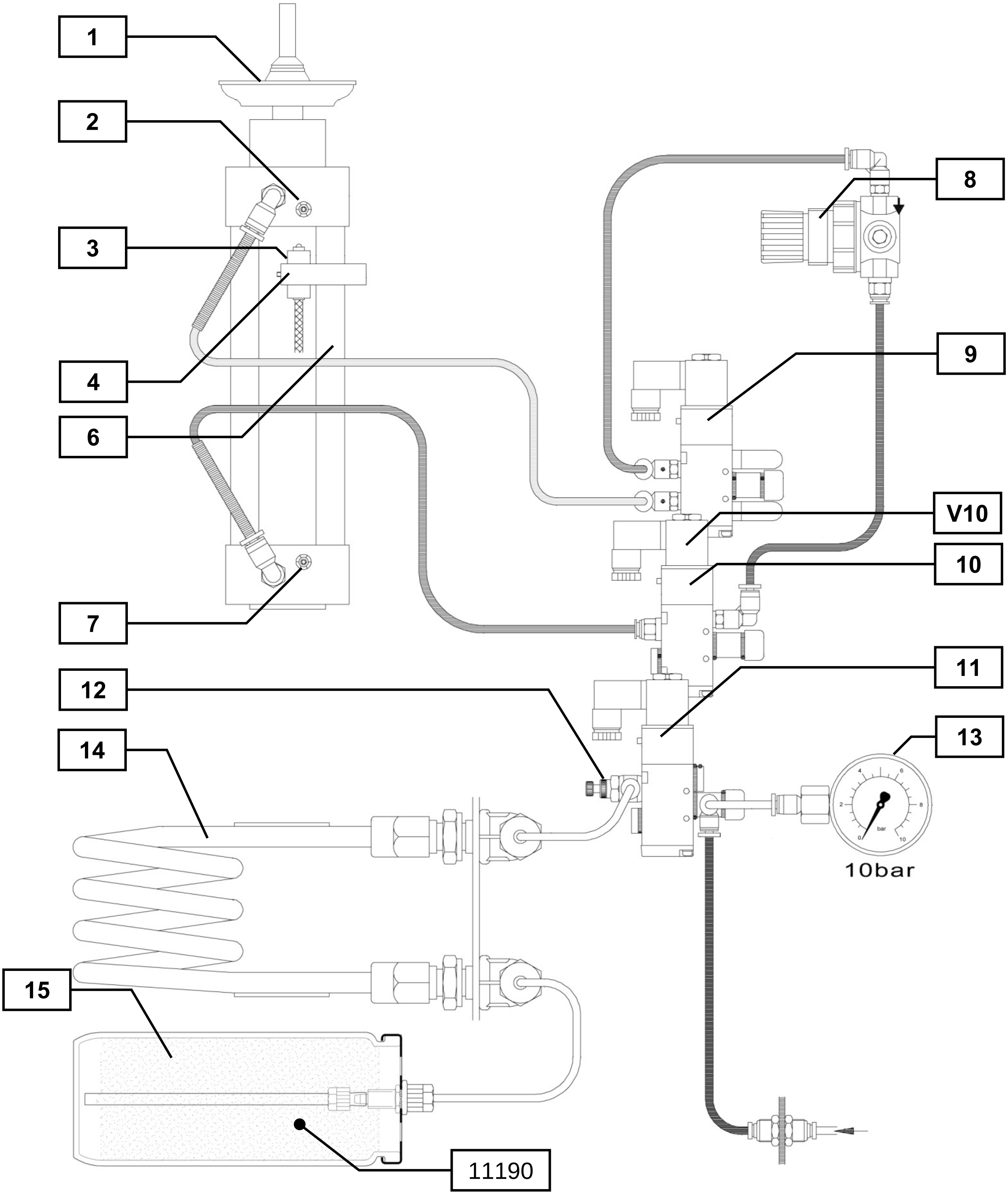


Fig. 23: Pneumatics (schematically)

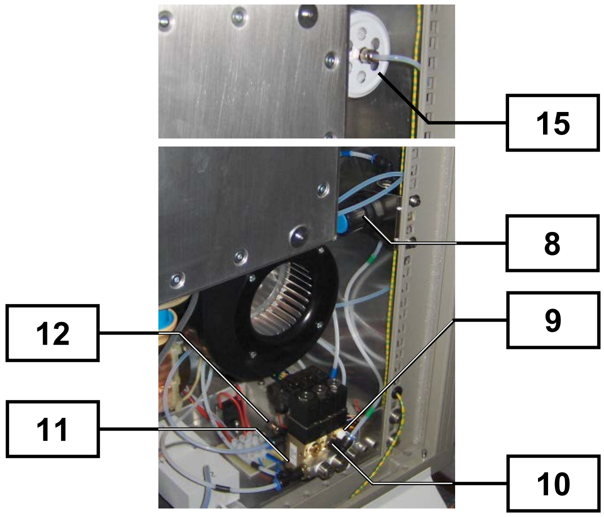


Fig. 24: Pneumatics (photo)

Little or no compressed air pressure, the furnace cannot close.

This pressure is shown on gauge (13), on the front-side of the analyzer.

It must be between 4 to 6 bar (60 to 90psi).

The screw (2) must be turned counter-clockwise, as much as possible.

Adjust regulator (8), so that the furnace floor can rise completely, without shaking; while a person still can stop the moving furnace floor with only one hand.

This is a safety precaution.

Repeat above instruction, until the adjustment is completed. Now, the upward speed is fast enough, yet safe for the operator. The pressure regulator (8) is found on the inside, on the right-side section of the analyzer, installed on the rear panel.

One of the pneumatic valves (V7) or (V10) (or both) is malfunctioning.

The magnetic coil of the pneumatic valve (V7) or (V10) is not powered. The furnace floor goes up, when valve (V10) receives 24 VDC.

The 24 V DC comes from the microcontroller board; if not, replace the electronic drivers.

3.8 Analysis takes too long

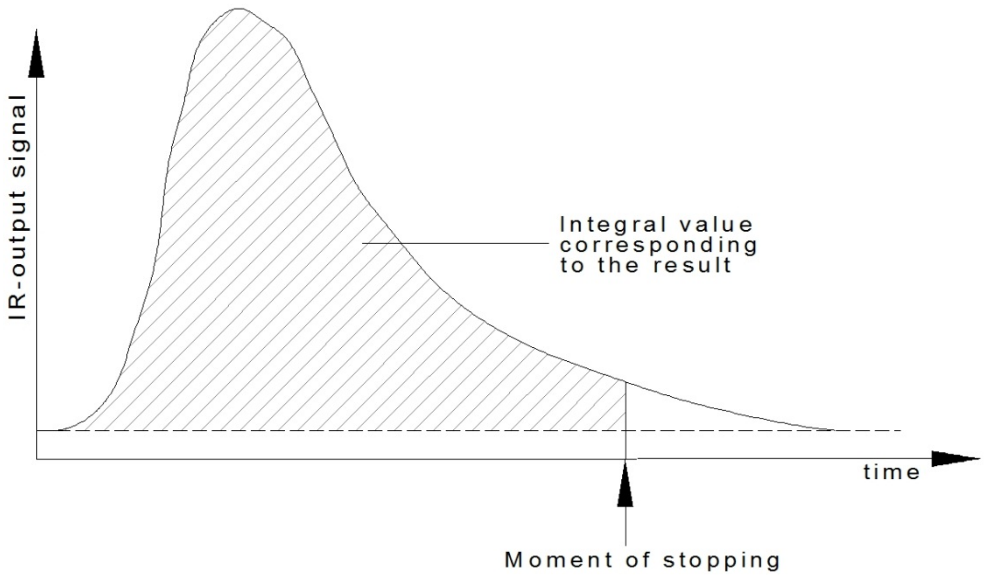


Fig. 25: Analysis time

The analysis respectively the combustion, takes normally a maximum of 100 seconds. At the beginning of combustion, the IR-cells signals start going up on the computer screen, reaching a peak maximum depending on the C resp. S concentrations in the sample. When the signal comes down, the analysis will be terminated when the signal has reached a comparator level. The value of this comparator level is entered in the configuration window of the software.

If, for some reason, the signal may not come down to the comparator level, the analysis is terminated when the maximum analysis time expires. This time is also entered in the configuration window.

The analysis stops also when the maximum analysis time expires before the signal comes down to the comparator level.

The meaning of setting a maximum analysis time is to protect the induction generator from overheating, in case the signal may not come down to the comparator level. One reason why the signal not to come down to the comparator level is that Hydrocarbons from the oxygen burn on the hot crucible, preventing the IR-signal from coming down to zero resp. down to the comparator level. One more reason is a too low comparator level, so that a small positive drift of the base line during analysis makes the base line higher than the comparator level at the end of the combustion. In such cases, the comparator level should be set higher.

The comparator level value entered into the configuration window is a minimum value which increases according to the peak maximum of each analysis. During combustion, the software takes the peak maximum to add to the entered comparator value an additional amount depending on the actual peak maximum.

3.8.1 Additional reasons for excessive analysis duration could be:

- Dirty dust trap,
- Saturated chemicals
- Cotton, glass or quartz wool is pressed too tightly
- The oxygen is not pure, or the catalyst furnace is faulty or is cold, or the copper oxide is used up
- The temperature of the infrared cell is not yet stable. Either it is not yet operational for at least 1 to 2 hours, or the oxygen flow has not yet been running for 10 to 15 minutes (power switch on setting 2),
- The thermostatic control of the infrared cell is defective
- Excessive combustion temperature, causing the crucible to emit CO_2.

3.8.1.1 One of the IR-sources is unstable:

Small resistance changes of one or more IR-sources can cause the current to vary, thus affecting the intensity of the IR-radiation.

This problem will effect all IR-cells, due to the fact that the IR-sources are all connected in series.

In order to establish whether this problem is present or not, an analysis cycle should be run without a sample or a crucible. The baselines of the IR-cells can then be monitored on the PC screen.

The baselines should be quite stable and should run between 0.100 V and - 0.100 V on the screen.

It would be very difficult, in case of a problem, to establish which IR-source is faulty and it is therefore easier to replace them all.

A window of an IR-path is not gastight. The measuring gases pass through the leakage, either into the chopper housing or to the IR-sensor.

Perform a leakage test of the IR-paths. Replace the faulty IR-path.

Check the base line on the PC screen, by starting analysis without sample. Zoom to get the scale of 10mV steps.

The base line should remain within 10mV, 50 seconds after START.

If the drift is larger, then check the IR-source voltage.

RF-interference on the IR-cell, or on the electronic units:

If the generator's high frequency disrupts the electronic units or the infrared cell, then the base line on the PC monitor appears jerky.

DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

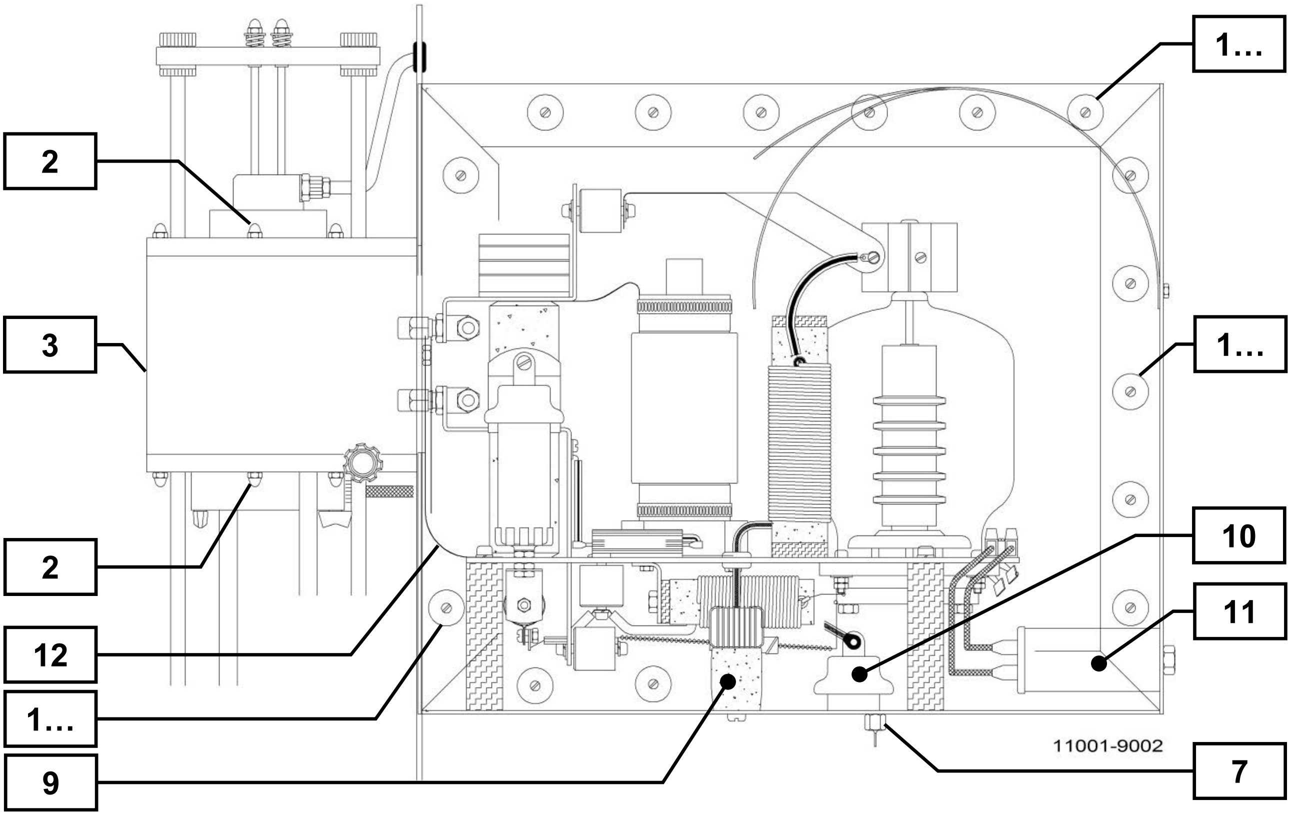


Fig. 20: Draft high frequency generator (1-4-4 + 1-4-5S)

The causes:

– The screws (**1**) are not tightened properly, or not all 22 of them are screwed in.
– The cap nuts (**2**) are not tightened properly or not all 14 are in place.
– The cover (**3**) does not seal tightly with the plates (**4**) and (5) or with the contract straps behind it, on the front panel (**6**)
– One or both filters (**7**) are not OK
– The filter (**11**) can also be damaged in this way.
– When the ground strip (**12**) is not connected after removal or replacement of the oscillator the filters (**7**) will defect.
– The capacitor (**9**) is out of order
– The capacitor (**10**) is out of order. This is however less likely.
In case of failure of this capacitor, most probably the fuses blow.

3.9 Development of dust when closing the furnace

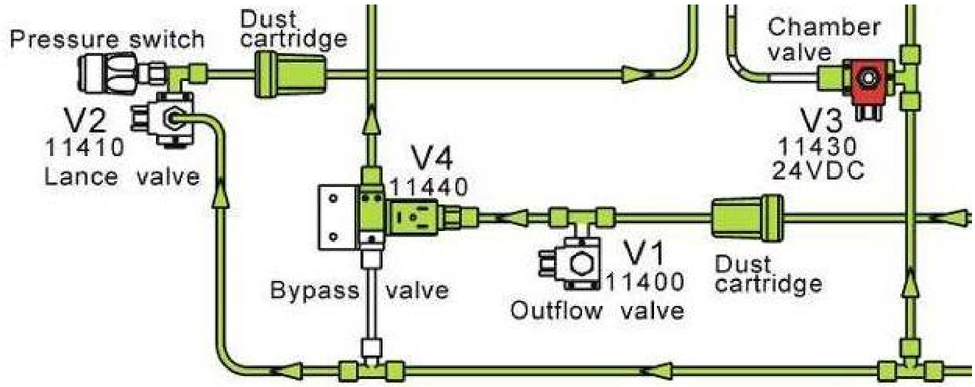


Fig. 26: Gas-flow diagram - furnace closed

This happens when there is no restrictor in the left hand fitting of the valve V3 or the internal diameter of the restrictor is too large. This can easily be checked when removing the connected tube.

The restrictor should have an internal diameter of 1 mm.

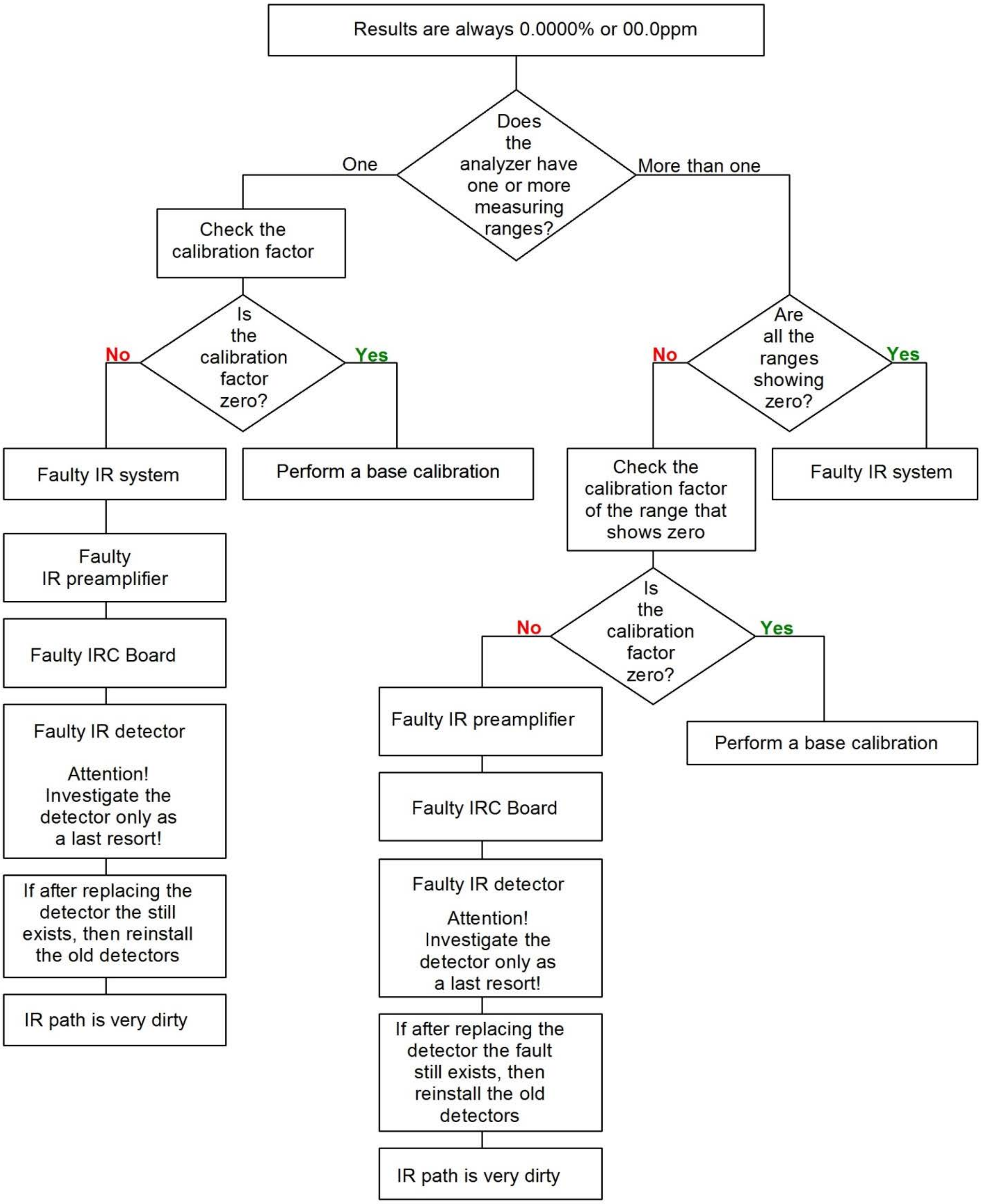
See draft “Gas-flow diagram - furnace closed”
in the chapter Modification Overview .

3.10 Irregular results

There are a lot of different reasons for this:

- Saturated chemicals or clogged dust filter
- Heterogeneous samples
- Leakage
- Flow problems
- The electronic noise or drift of the infrared signal
- It can happen quite often that the combustion start is delayed and the analysis time is too long
- You will see that the message "waiting for stability" is displayed in the status window
- Incomplete or bad combustion
- Too high blank value for the crucible and tungsten. This will be especially noticeable, mostly though, in the low carbon channel
- Widely different weights of the sample and the accelerator (tungsten)

3.11 The results are always 0.0000% or 00.0ppm:



3.12 Combustion tube - life time is too short

Possible reasons for that:

– The sample weight or the weight of the accelerator is too high.

– Don't use copper as accelerator.
– The combustion tube is too long, i.e. longer than 145 mm. In this case, after fixing the four wing nuts (3) and (9), the combustion tube is pressed between the upper furnace closing part (17) and the lower part (10)

  In this case, when the combustion tube heats up during combustion, it may break.

  Check the length of the combustion tubes to be not longer than 145 mm.
– The upper furnace closing part (17) does not provide enough space for the combustion tube. To check this, install a combustion tube as usually but without the O-rings (11) and (12). After fixing the wing nuts (3) and (9), move the tube up and down. If the tube does not move at least 0,5 to 1 mm, replace the part (17) or make room for the combustion tube by machining the upper furnace closure on a lathe.

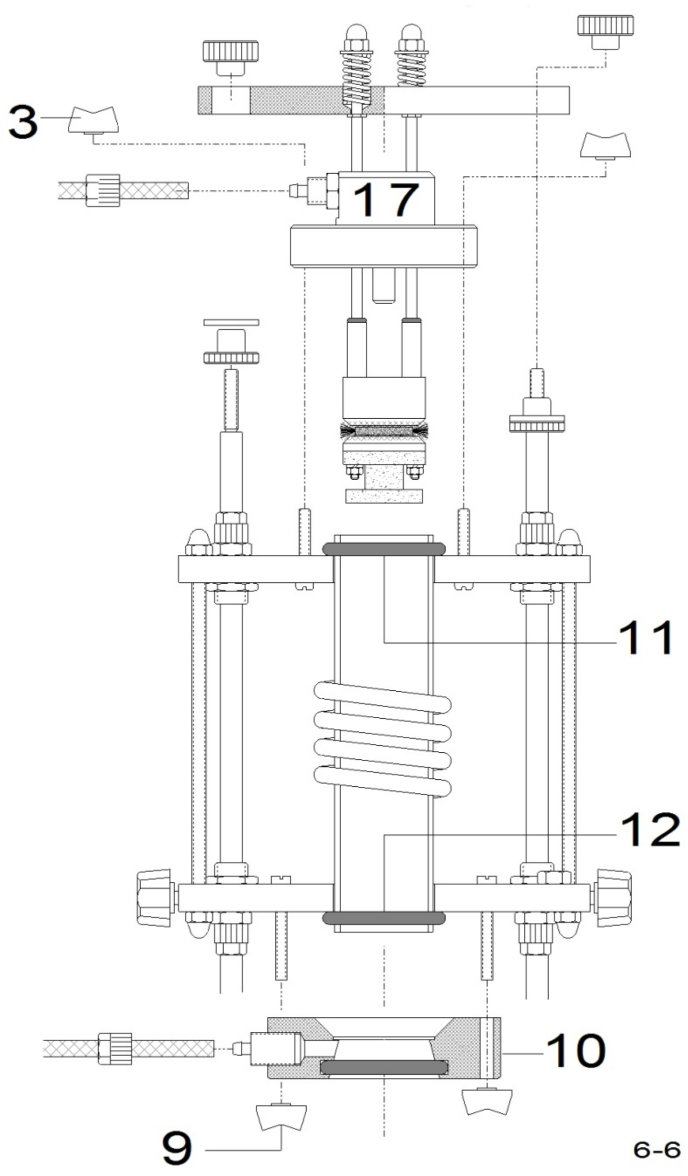


Fig. 27: Draft combustion tubes

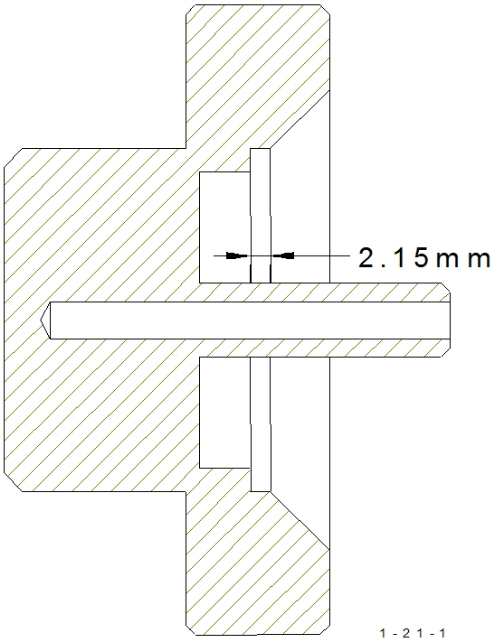


Fig. 28: Draft 1-21-1

3.13 IR-cell temperature control is out of range

If in the device state the graphs of IR-temperature °C or %IR-power are not in the green area, adjust the temperature. See chapter IR-cell temperature control.

Device state

IR Temperature
IR °C
IR %Power

3.14 Breaker turns off at the beginning of combustion

If the circuit breaker turns off at the beginning of combustion then:

– Unplug the analyzer mains power plug.
– Switch on the breaker.

DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

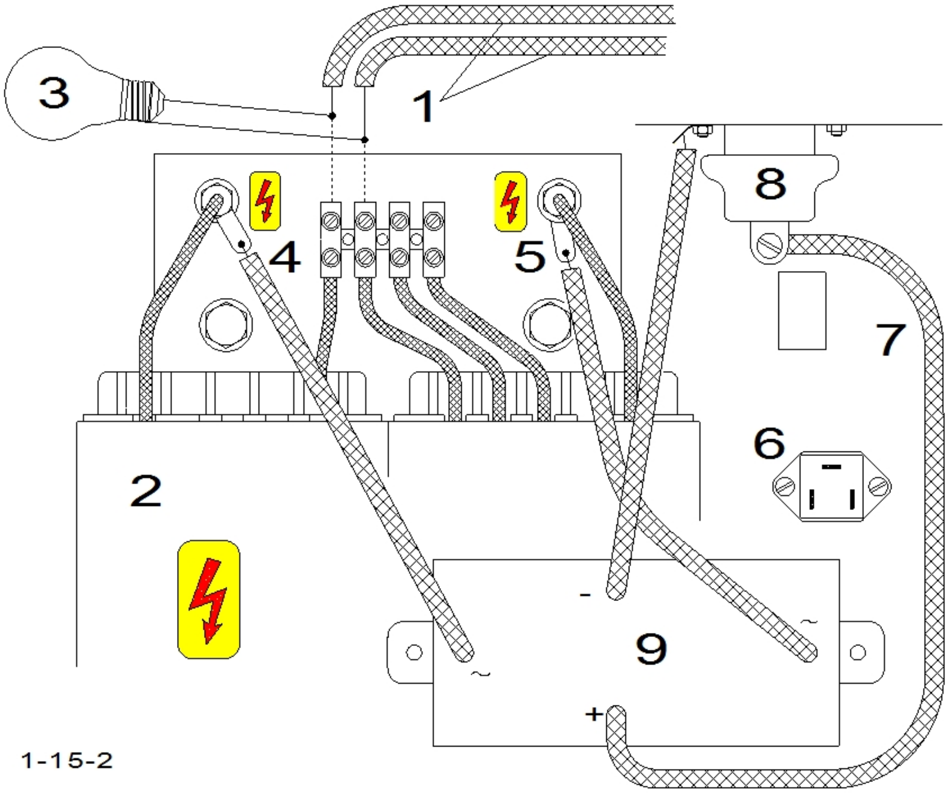


Fig. 29: Transformer

- Disconnect the cables (1) from the primary side of the transformer (2) and connect the cables (1) to a 220 V light bulb (3) which is inserted to a socket.

An ordinary desk lamp can serve for this purpose. In case only 110 V light bulbs are available, connect two of them in series.

NOTE

Be careful that no short circuit occurs!

After the cables (1) have been connected, plug the analyzer to the mains power again.

- Set the power switch to pos. 2.
- Enter a weight manually (for example, 500 mg).
- Press START

– The word "Analyzing" should appear in the status window.

If not, but "Waiting for stability" appears instead, the reason is that after restarting the device and the oxygen flow, the infrared base line could drift. In order to save time, there is a possibility to start without waiting for stability.

- Quit by pressing STOP
- Go to the "power user" level and click on the button "Stable".

– The analysis cycle starts then without waiting for base line stability of the cells.

When "Analyzing" appears on the status window, the light bulb should glow; this does not happen suddenly, but gradually.

Within a few seconds, the light bulb will gradually change from dark to fully bright.

If not, but the lamp becomes immediately bright, replace the board HF-42.

If the light is not fully bright but dim and flickering, replace the triac (6).

If yes (O.K.), unplug the mains power plug and reconnect the power cables (1) to the transformer (2).

Unplug the power plug and reconnect the cables (1).

When reconnecting the power cables (1), do not let these wires approach the connectors for the cables (4) and (5). Otherwise the high voltage can create sparks.

The cables (4) and (5) should be unscrewed from the transformer and placed away from it.

⚠ DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage
After the generator starts the cable carries a voltage of about 7000 Volts!

- Plug in the mains power plug to power the analyzer.

A new analysis should be started. When "Analyzing" appears and the fuse is not damaged as well as the mains power current didn't exceed 10 A (RMS), then the transformer is functioning properly.

Otherwise, replace the transformer. The cables (4) and (5) are then reconnected.

If the problem still remains:

- Unplug the analyzer from the mains power.
- The cable (7) is unscrewed and removed from the capacitor (8)

After the generator starts (Analyzing) the cable (7) carries a voltage of about 7000 Volts! The cable (7) therefore should be laid so that its end is at least 10 cm away from the nearest object!

If, after pressing START and after "Analyzing" appears, the breaker turns off, then replace the rectifier (9).

3.14.1 Further causes could be found in the oscillator circuit

Because of the high voltage (7000 volts) and the high frequency (19.5 MHz), it is difficult to make measurements without any special measuring instruments.

Thus, the analyzer needs to be turned off, and the power plug disconnected.

⚠ DANGER

Mortal danger from electric shock

Exposed power contacts - High Voltage

Make sure all capacitors are discharged

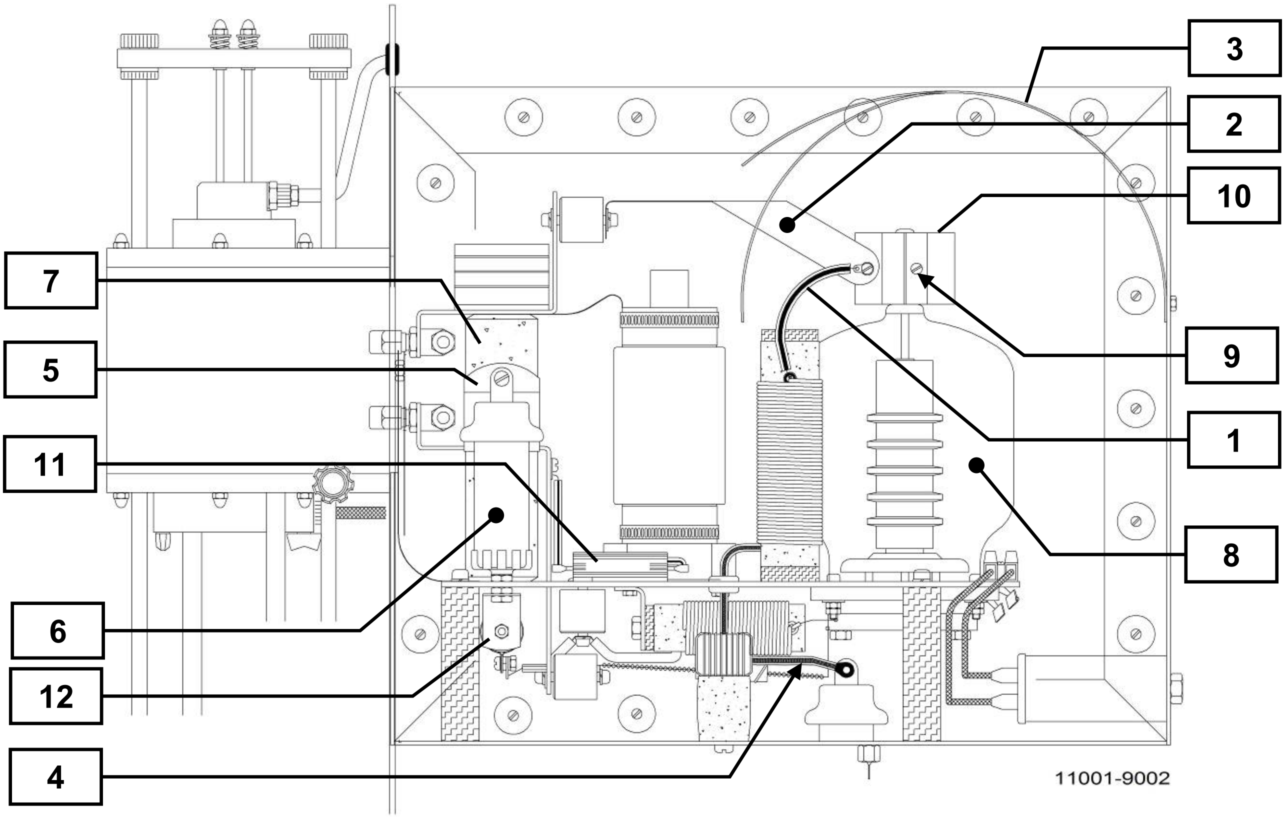


Fig. 21: Draft 11001-9002 (1-15-3-1S)

- Check that all the screws and soldering connections have a good contact.
- – If the resistor 200 K (11) is a short circuit, then the fuse will blow when starting the combustion.
- Check that all power conductors and copper bands are placed far enough away, from any nearby objects!

The wire (1) and the copper band (2), for example, should be placed far away from the plate (3).

The power cable (4) should have a maximum distance from any surrounding object.

The copper band (5) should be placed as far as possible away, from the capacitor (6)!

This is why the copper band (5) should always be bent around the insulator (7).

- If the tube (8) needs to be replaced loosen the screw (9), pull out the heat sink (10) upwards ! Pull out the tube (8) upwards!

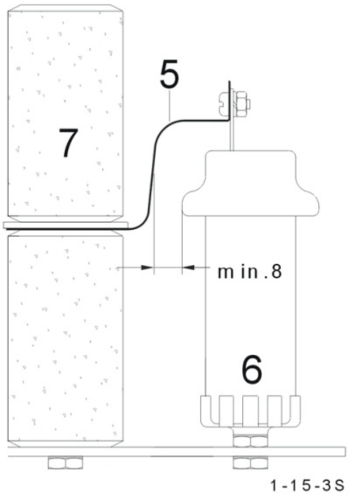


Fig. 30: Capacitor and insulator

3.15 Breaker turns off at the end of the analysis

Causes:

The triac is malfunctioning.

The so-called Latch-up effect causes the triac to remain conductive in one direction after triggering. The transformer is then acting as a short circuit because it is fed with a DC voltage!

- Replace the TRIAC.

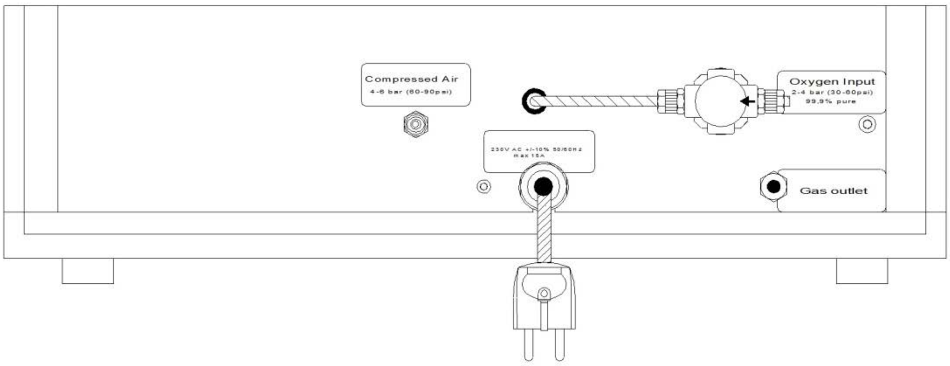


Fig. 31: Backside

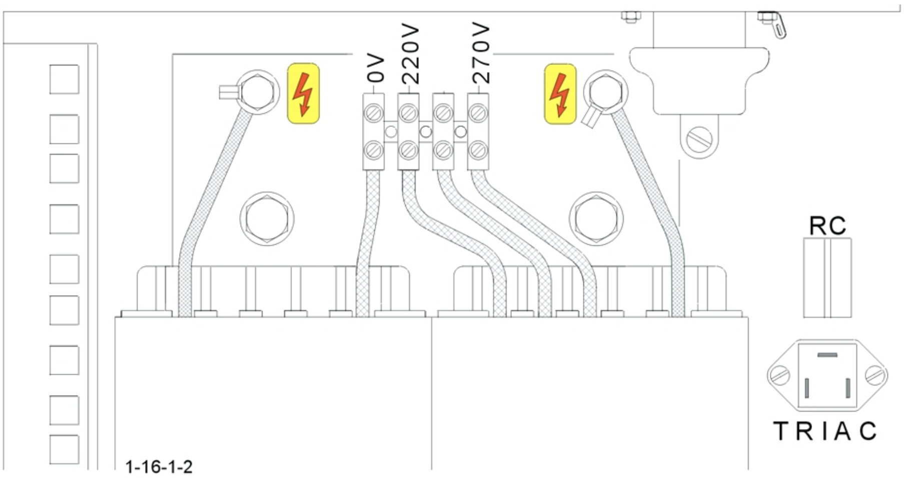


Fig. 32: TRIAC

3.16 Furnace - large collection of dust when opening

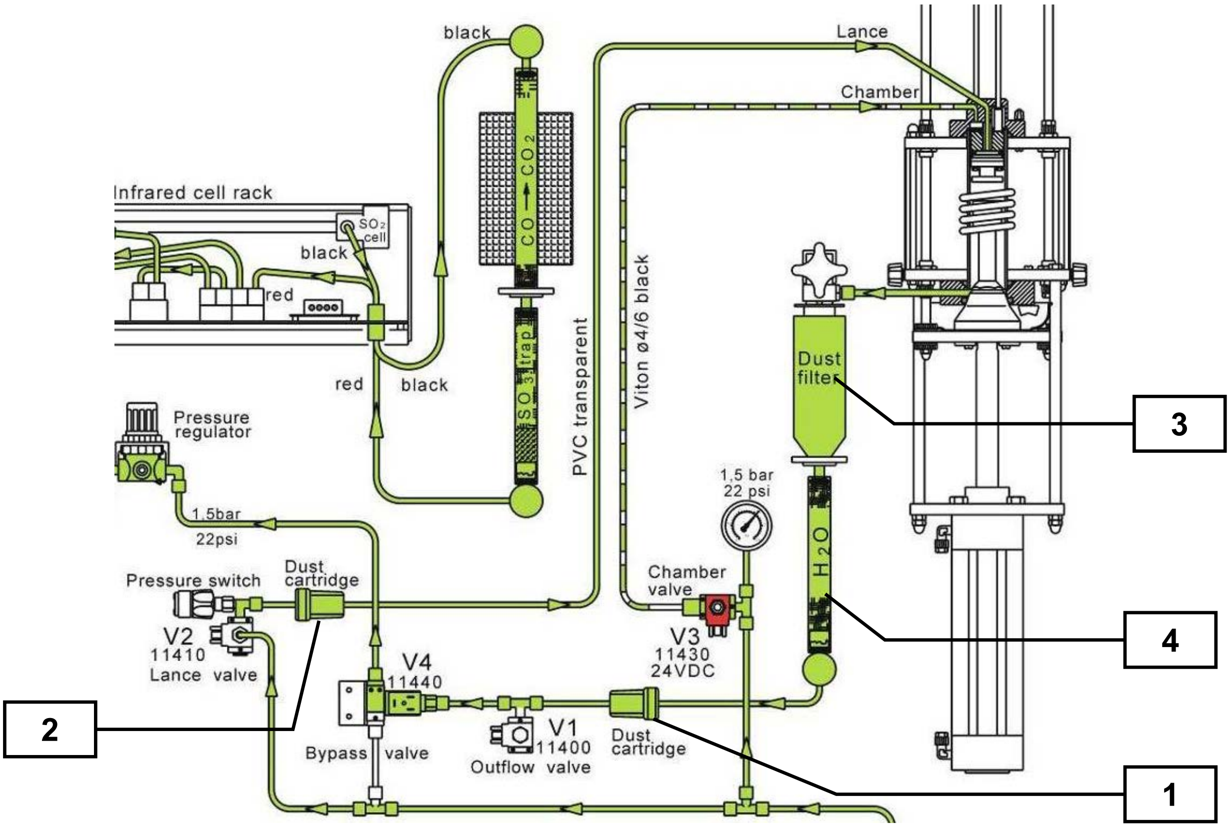


Fig. 22: Fig. 33: Valves

After pressing the key to open the furnace, the valves (V1) and (V2) are energized. This means that they have across their coils 24V DC coming from the electronic unit.

Valve (V2) closes the oxygen supply to the furnace.

Valve (V1) opens, releasing the pressure from the furnace through the dust trap (3), through the moisture trap (4) and through the filter cartridge (1) into the open air (in the direction of the arrow).

Following this, the pneumatic valve shuts and the furnace opens (lift downwards). When dust comes out of the furnace after this process this will cause, that the pressure in the furnace is not sufficiently reduced.

The causes:

- Too much dust in the dust trap (3),
  (a few hundred analyses without cleaning)
- Saturated moisture trap (4)
- Clogged paper filter in the moisture trap (4)
- Clogged filter cartridge (1 and 2) (this would be unlikely though)
- One of the valves (V1) or (V2) receives no power (24V DC)

NOTE

The valve (V1) will only be supplied with voltage (24V DC) until the lift has reached the bottom position, then it will be switched off.

The 24V on the coil of this valve can be measured with a digital voltmeter, or with a light bulb of 24V / 20mA.

One of the valves (V1) or (V2) is jumps, most likely valve (V1)

- Clean the valves.

3.17 No or low oxygen pressure

After pressing the START button, the following message appears:
"no oxygen pressure"

3.17.1 Possible faults on the front panel of the analyzer

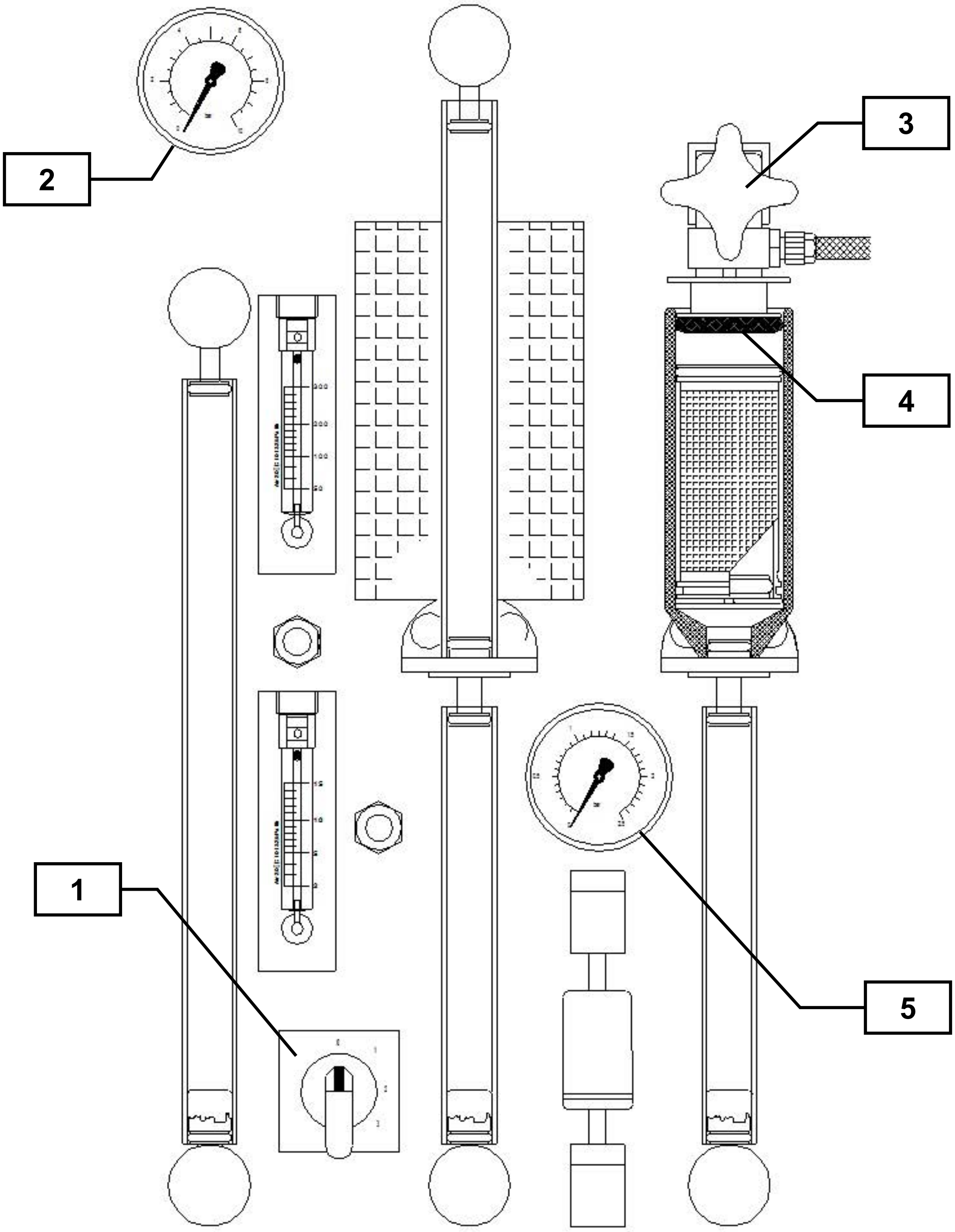


Fig. 34: Front side panel

- Is the power switch (1) set on position 2?
- The pressure on the oxygen gauge (2) may be too low. 1.5bar is normal (22psi). The pressure remains constant when the furnace is closed, and it sinks during the upward movement of the furnace floor.
- Check the oxygen pressure in the supply line or tank. 4 to 6 bar (60 to 90psi) showing on the pressure gauge is normal.

- – Check if the pressure gauge for compressed air (5) shows 4 to 6 bar (60 to 90 psi).
- – Check if the cock (3) is properly shut, or else the O-ring (4) will not seal. Check if the O-ring (4) is in a good condition.
- – Check if the combustion tube is broken or cracked.
- – Check for gas leakage.
- – Check if the chemicals are saturated and have become hard.
- – The paper filter could also be the cause. For changing the paper filter, read the operating manual.

3.17.2 On the rear-side of the analyzer:

The contents of the gas cleaning furnace could be worn out and clogged.

3.17.3 Inside the analyzer:

3.17.3.1 Oxygen solenoid valve (V5) may be defective

- Open the left-side panel of the analyzer.
- Unscrew the upper tube (1). The oxygen should rush out when the power switch is set to pos. 2.

If not:

- – There may be no oxygen supplied.

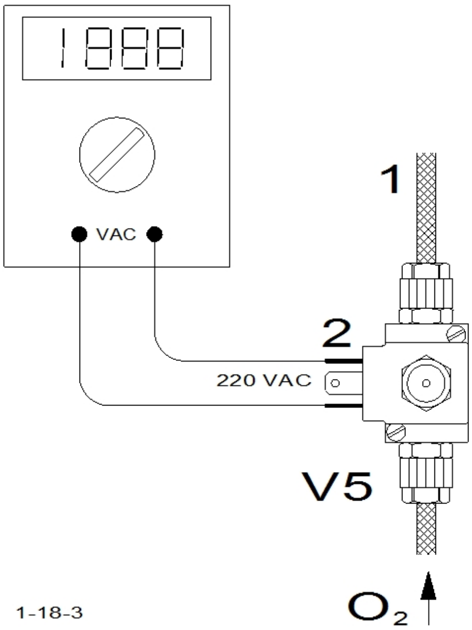


Fig. 35: terminal of the solenoid coil

- – 220V AC is not measured on the terminal (2) of the solenoid coil.
- – The solenoid valve is clogged.
- Clean the solenoid valve.

If the fault is still present, then:

- Switch off the power, (set the power switch to position 0)
- Pull out the socket (2) from the coil and measure the coil resistance. 3.3K is normal.

3.17.3.2 Outflow valve does not close

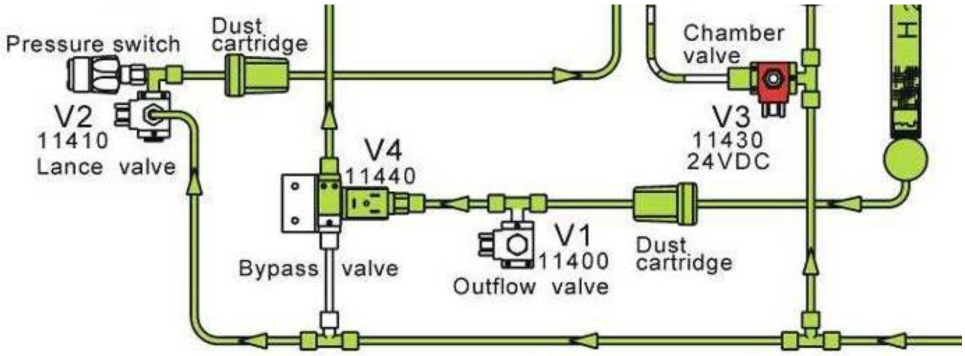


Fig. 36: Outflow valve

Open the left-side panel of the analyzer. When the furnace is closed (the lift is up), no oxygen should be flowing out of the lower (free) opening of the valve V1.

This can be checked by putting your finger under the lower opening of the valve.

If the valve does not close correctly, you will feel a strong oxygen pressure. The power supply to the valve V1 should be 0 Volt. If this is the case, then the outflow valve V1 should be cleaned or replaced.

3.17.3.3 If the voltage on the outflow valve is constantly at 24 V, then:

- Switch off the analyzer, exit the software and restart.
- Replace the electronic driver. See chapter Electronic driver malfunctioning

3.17.4 Other faults

– The screw for the upper furnace cushioning is too tight.
– The pressure switch does not close.
– The furnace closes too slowly.
• Adjust the furnace according to the related chapter.
– The furnace does not close.
– Saved data are lost.

3.18 No oxygen flow

Possible reasons:

- No oxygen pressure. See corresponding chapter.
- The software is in the gas saving mode. If this is the case, the flow will be restored when the mouse is moved or when a key is pressed like F4 for entering the sample weight or F2 for opening and closing the furnace.
- Bent plastic tube. See chapter “Fluctuating gas flow”.
- Faulty flow sensor, flow control board or valve. See chapter “Gas flow controller adjustment…”

3.19 Status window message: "Waiting for stability"

When this message appears in the status window after starting analysis, it means that the base lines are not within the "Deviation" window set in the "configuration" window. A usual value is 10mV and the set time is 20 seconds.

By setting the voltage and the time, both criteria for base line stability are considered, the noise and the drift.

3.19.1 Reasons for instability:

3.19.1.1 Too low deviation value

One reason for the above message is that the deviation value in the configuration window is too low, so that a higher value should be entered. The levels of noise of all cells are not necessarily identical. Longer cells have normally higher noise than shorter ones and the sensors themselves have noise level deviations between exemplars.

3.19.1.2 Too high noise

One more reason could be exceptionally high noise. The base lines and the level of their noise can be seen on the screen when clicking on the base lines icon (with three waves).

The most common reasons for too high noise are:

– The infrared sensor.
– The pre-amplifier,
– A fault on the circuit board IRC-1.x where x can be 1,2, or 3.
– At least one IR source is defective.
– The microcontroller board.
– The power supply fluctuates.

In case of a module (rack) of more than one IR-cell, mostly only one of the base lines has too high noise while the others have noise in normal range. In order to localize whether the noise is created by the sensor, preamplifier or the corresponding section of the IRC board, interchange the preamp connector of the noisy range with another one on the IRC board. If the noise moves to the other range on the PC screen (base line color), this means that the noise is created by the sensor or preamplifier.

In this case replace first the sensor as the more probable reason and if this doesn't help, replace the preamplifier.

NOTE

Don't forget to connect the interchanged connectors to the original position again.

- If the noise is created by the IRC board, change it.

Remark: In such case, theoretically, the noise could be created by the corresponding analog input of the microcontroller board however this possibility is very unlike.

3.19.1.3 Too high drift

Another reason for report of instability is a too high drift of at least one cell, so that the signal of one cell reaches the end of the set window (mV).

A drift can be due to temperature changes of the IR cell. It happens when the cell temperature is still not stable after switching on the power. When switching on the power after long break so that the cell is cold, allow the cell at least 30 minutes to stabilize the temperature. This has to be taken into consideration when checking the base line stability.

When starting the oxygen flow (power switch on position 2), the cell takes about 5 minutes to stabilize when restarting the oxygen flow after long time without flow (but with uninterrupted power).

3.20 Furnace opens with delay after the end of analysis

There can be two different reasons for this.

1. One reason is that this delay is set in the software. The software provides the possibility to set a time to delay the furnace opening after the end of analysis. This is occasionally required for samples creating harmful oxides or

for refineries where the crucible has to be below 60°C when the furnace opens. So check the configuration file.

2. One other reason is a badly blocked metal filter, perchlorate, copper oxide or paper filter, so that it takes long for the pressure to escape from the furnace and consequently, the pressure switch reports with delay low furnace pressure to the software for opening the furnace.

Furnace does not open

Possible reasons:

- See first chapter Furnace opens with delay.
- The outflow valve jams. See chapter Gas flow regulation and see chapter Solenoid valves cleaning.
- The pressure switch is faulty. See chapter Pressure switch.
- Electronic problem.

When the furnace does not open at the end of analysis, or a closed furnace doesn't open by pressing F2, there are the following possible reasons for the fault.

The valve V1 cannot open to release the oxygen pressure

In order to verify that, turn the twist grip on top of the dust filter to enable the oxygen pressure to escape. If then the furnace opens, it is obvious that the pressure could not be released after the end of analysis resp. after pressing F4.

The valve V1 is energized for releasing the pressure out of the furnace area. See diagram 12202. When the pressure comes down below 1 bar, the pressure switch opens, reporting low pressure to the electronics. After a short delay, the pneumatic valve is deenergized and the furnace piston moves down opening the furnace.

In such case, mostly the plunger of the valve V1 cannot move due to particles trapped in the valve or due to corrosion. Open and clean the valve or replace it.

The metal dust filter is installed upside down in the metal filter housing.

One more reason could be a completely blocked filter or fully depleted chemicals. This is however quite unlike to get filters so badly blocked to completely seal the furnace area, especially from one analysis to the next. In case of very dusty filters or depleted reagents, the furnace opens with delay.

3.21 Oxygen pressure falls when the furnace opens

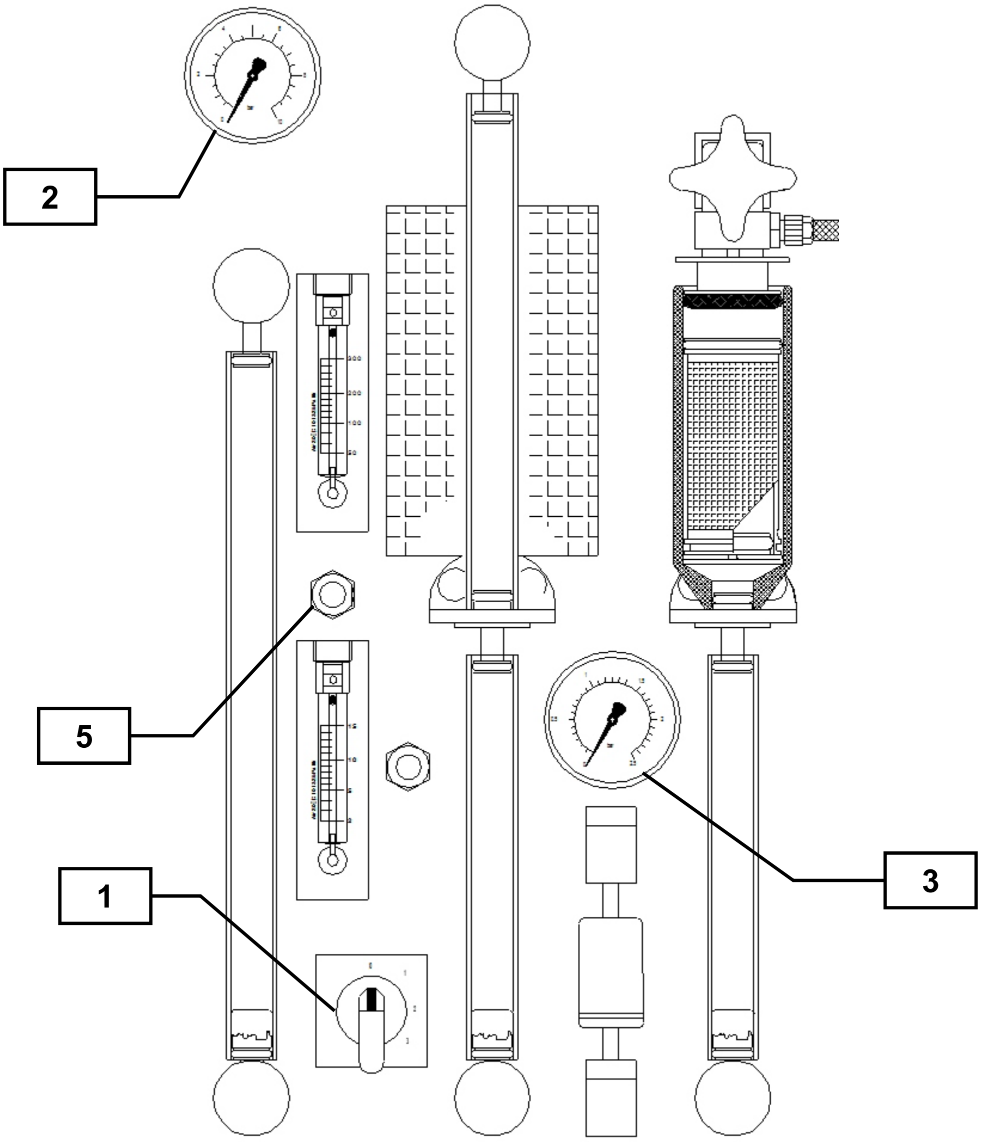


Fig. 37: Front panel

Regardless of whether the furnace is opened or closed, the oxygen pressure shown on the pressure gauge (2) must remain 1.5 bar (22.5psi) constant.

If, however, the oxygen pressure falls when the furnace is open, then either the valve (V2) is defective or its control is incorrect.

When the furnace is open, the valve (V2) should have 23 V DC on its magnetic coil. When the furnace is closed, the voltage should be at zero volts.

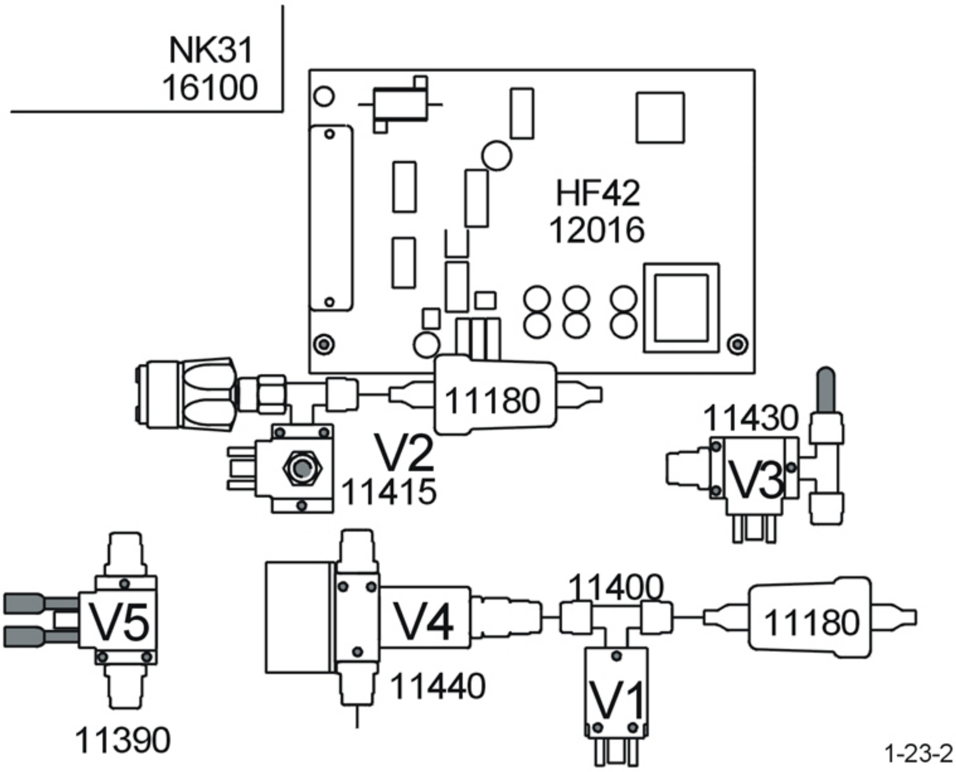


Fig. 23: Valves

If the voltage on the valve (V2) remains at 23 V DC, no matter whether the furnace is opened or closed, then the electronics are defective.

If the valve voltage always stays at zero, then either the wire of the valve to the microcontroller board is broken or the valve driver is defective.

If the voltage on the valve (V2) is correct, then the valve itself is defective.

3.22 Combustion without starting analysis

In this case, the combustion of the sample begins immediately after the sample enters the furnace area and before having pressed F5 to start analysis.

Should the combustion start just after closing the furnace then there is a serious fault.

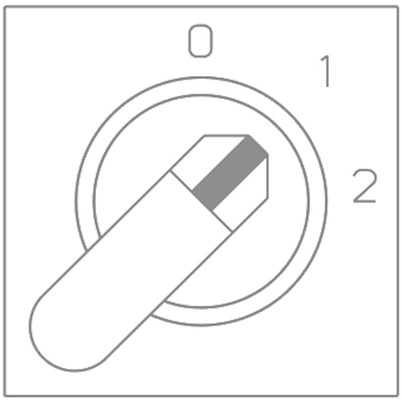


Fig. 38: Main switch

The power switch should be set immediately to pos. 1, in order to avoid any overheating of the generator.

NOTE

Always keep the furnace closed while testing availability of induction power.

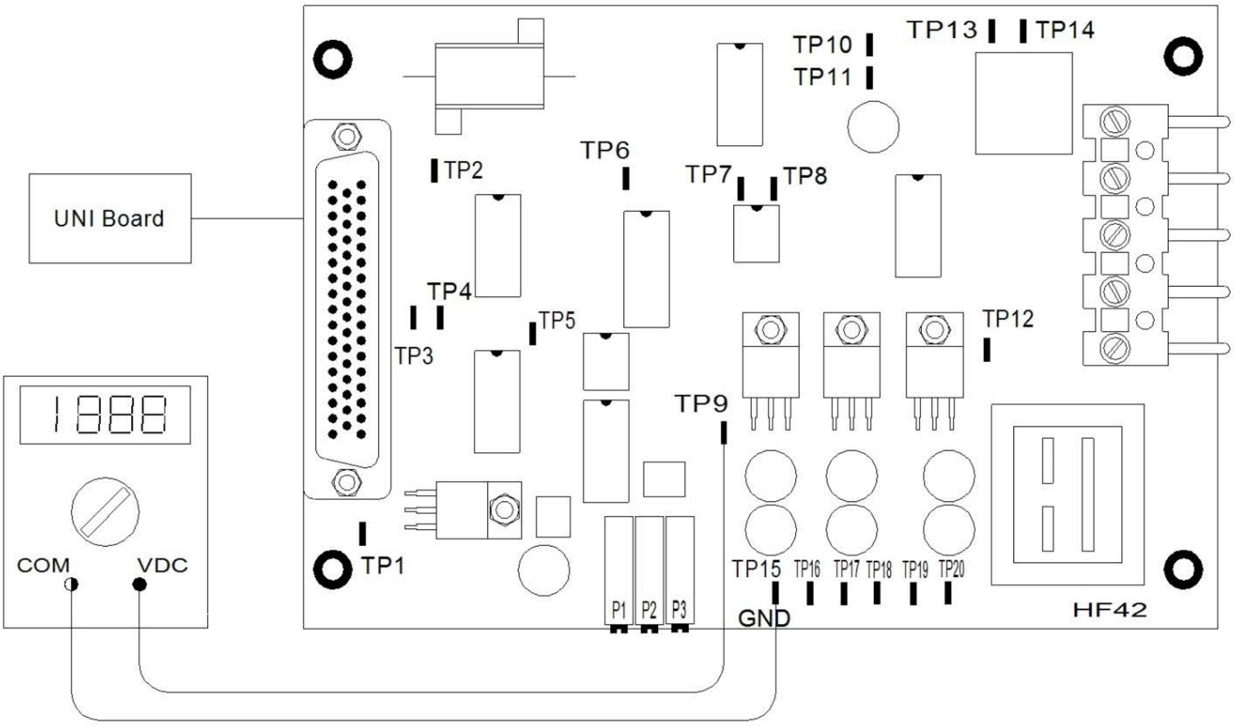


Fig. 39: microcontroller board

The drivers of the microcontroller board are out of order, when the combustion starts without pressing F5 or clicking START and without "Analyzing" on the screen, there is only 0,5V DC on TP9 (instead of 1 2V DC). Replace the electronic drivers.

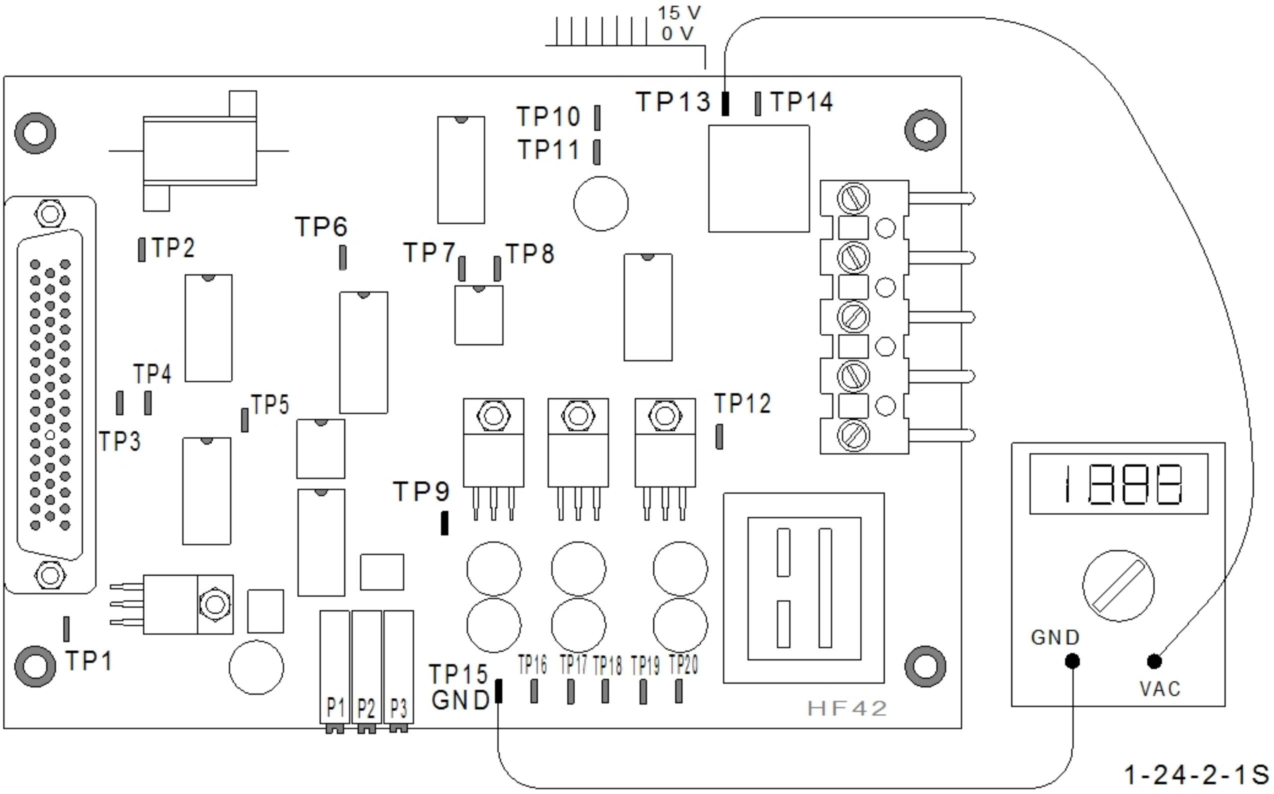


Fig. 40: microcontroller board

When the pulses at TP13 are present without pressing "START" and with 15 V DC at TP9, then the circuit board HF 42 is out of order.

If no scope is available, the pulses can be detected by using a voltmeter.

Normal values are about 0 V AC without pulses, and about 1 V AC with pulses.

This indicated value can be different, depending on the type of the voltmeter used.

Possible reason:

The triac is faulty (short circuit), and has to be replaced.

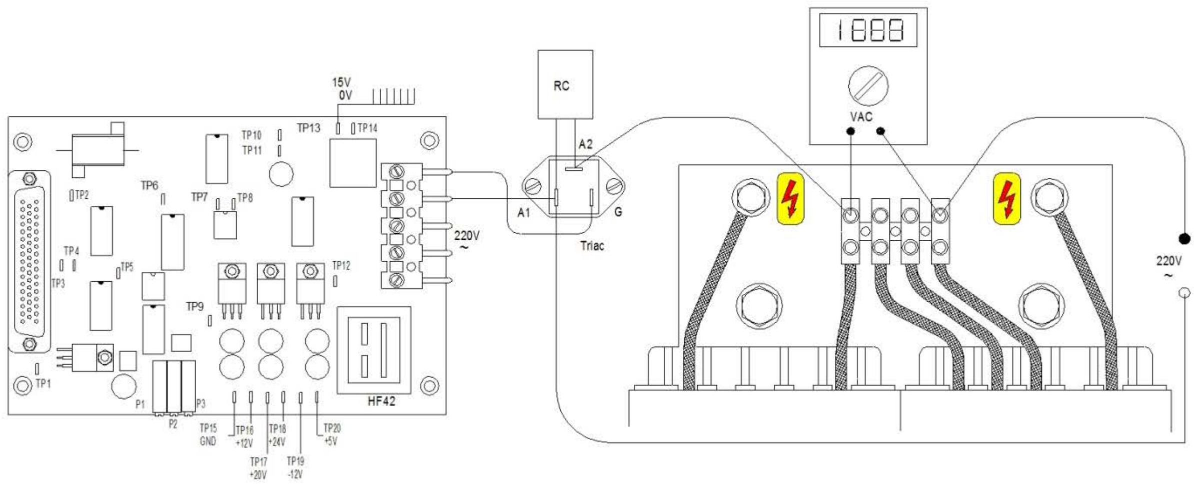


Fig. 41: circuit board HF 42

3.23 Crucible cracks or melts

One reason could be that:

The quality of the crucible is bad. Use a better quality.

Another reason could be that:

The furnace temperature is too high, due to:

– Excessive main voltage.
– Excessive sample and / or accelerator weight.
– The use of a "sample or accelerator" that requires lower generator power. In this case reduce the generator power.

3.24 Analysis doesn't start / no peak on screen

When the analysis cycle is carried out normally and the sample is burned but no peak on the screen, possible reasons are the following:

- The IR cell could be faulty. Check the base lines.
  See chapters “Check base lines” and “Infrared cell adjustments”.

  If the base lines are as described, the IR cell can be regarded as ruled out. If the base lines are practically at zero volts, the cell is faulty or without power. (24VDC). See chapter Bad combustion.

3.25 Vibrations on setting 2

If the Analyzer vibrates when the main power switch is turned to position 2, the reason is dust accumulation on the blades of the oscillator's blower. The vibrations are caused by dust on the blades causing eccentrical rotations.

⚠ **DANGER**

Mortal danger from electric shock

Exposed power contacts - High Voltage

Disconnect the power before removing the oscillator lid.

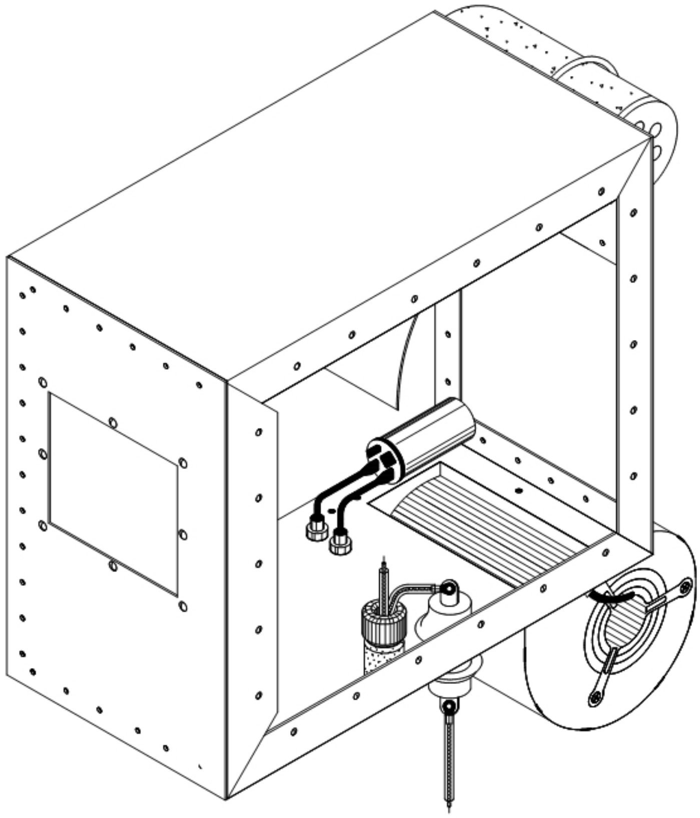


Abb. 42: **Oscillator**

Blow the dust away with compressed air. Blow from the inside to the outside, otherwise the dust will be blown into the oscillator. Take care of the rotary speed of the blower to remain within the operation limits. When blowing compressed air, the rotary speed of the blower can exceed the limit of operation causing damage to the bearings and to the shaft.

3.26 Analysis cycle stops before the peak begins

Reasons:

The minimum analysis time is set too short in the configuration window, so that the analysis time expires before the peak starts. Normally the peak starts about 6 to 8 seconds after the start of combustion. If the minimum analysis time is set for example to 4 seconds, the analysis may be terminated before the peak starts. If the minimum analysis time is set far over 8 seconds, the peak starts before the minimum time expires. Due to the IR signal being then higher than the comparator level, the analysis continues until the IR signal comes down to the comparator level, unless the maximum analysis time expires earlier. If so, it is advisable to increase the maximum analysis time in order to integrate the whole peak.

If after prolongation of the minimum analysis time to a reasonable value, a peak still doesn't appear, possible reasons for the fault are:

- No combustion.
- There is no gas flow.
- There is gas flow, but bypassing the furnace, so that there is gas flow shown on the flow meter and by the flow sensor on the screen but no gas flow thru the furnace. In this case the bypass valve V4 jams, keeping the oxygen flow bypassing the furnace like in case of open furnace. The furnace has though oxygen pressure but without having oxygen flow. Due to oxygen being present, the metal sample and accelerator(s) burn, because there is

availability of oxygen in the furnace, coming thru the chamber valve V3 and/or thru the lance valve V2. In case of metal analysis, the burned sample in the crucible looks like normally combusted sample. If so, check the bypass valve V4.

– The IR call is faulty.

3.27 Chopper motor doesn‘t rotate

The rotation of the chopper motor needs to be checked in case of problems only, like when there are no combustion peaks on the screen or the IR signals are minus -10V (take care, minus) displayed on the PC screen in the window “inputs”.

In order to check whether the chopper motor is rotating, the easiest way is to remove an IR path.

See chapter IR-Paths cleaning and replacing.

Mostly, the easiest path to remove is the shortest one. Then, the chopper blade can be seen thru the hole of the chopper housing, which becomes free (open) after removing the path.

The reason of failure can be a faulty motor but also the controlling electronics of the motor may have become defective. If so, the motor or the IRC board has to be replaced. Before replacing, check at least the voltages on the board, mainly the supply voltage of 24VDC.

See chapter Infrared base line adjustments.

For replacing the chopper see chapter Chopper.

3.28 Sample burns but no peak on the screen

There is gas flow, but bypassing the furnace, so that there is gas flow shown on the flow meter and by the flow sensor on the screen but no gas flow thru the furnace.
In this case the bypass valve V4 jams, causing the oxygen flow to bypass the furnace like in case of open furnace.
See chapter “Gas flow regulation.
The furnace has though oxygen pressure but without having oxygen flow. Due to oxygen being present, the metal sample and accelerator(s) burn, because there is availability of oxygen in the furnace, coming thru the chamber valve V3 and/or thru the lance valve V2. In case of metal analysis, the burned sample in the crucible looks like normally combusted sample. If so, check the bypass valve V4.

3.29 IR signal does not come down to the base line at the end of analysis

There are several different reasons for this effect:

3.29.1 Too long combustion of a very low carbon sample

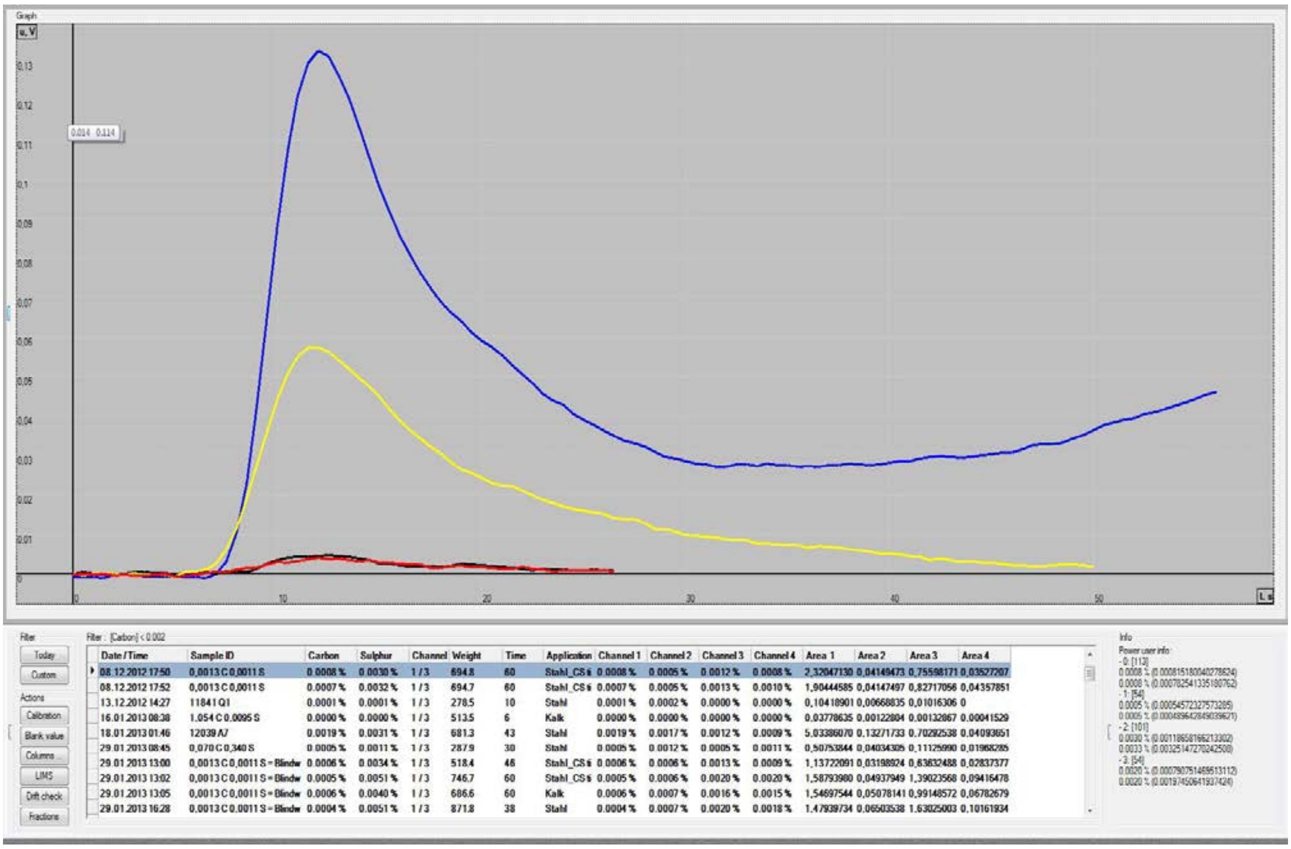


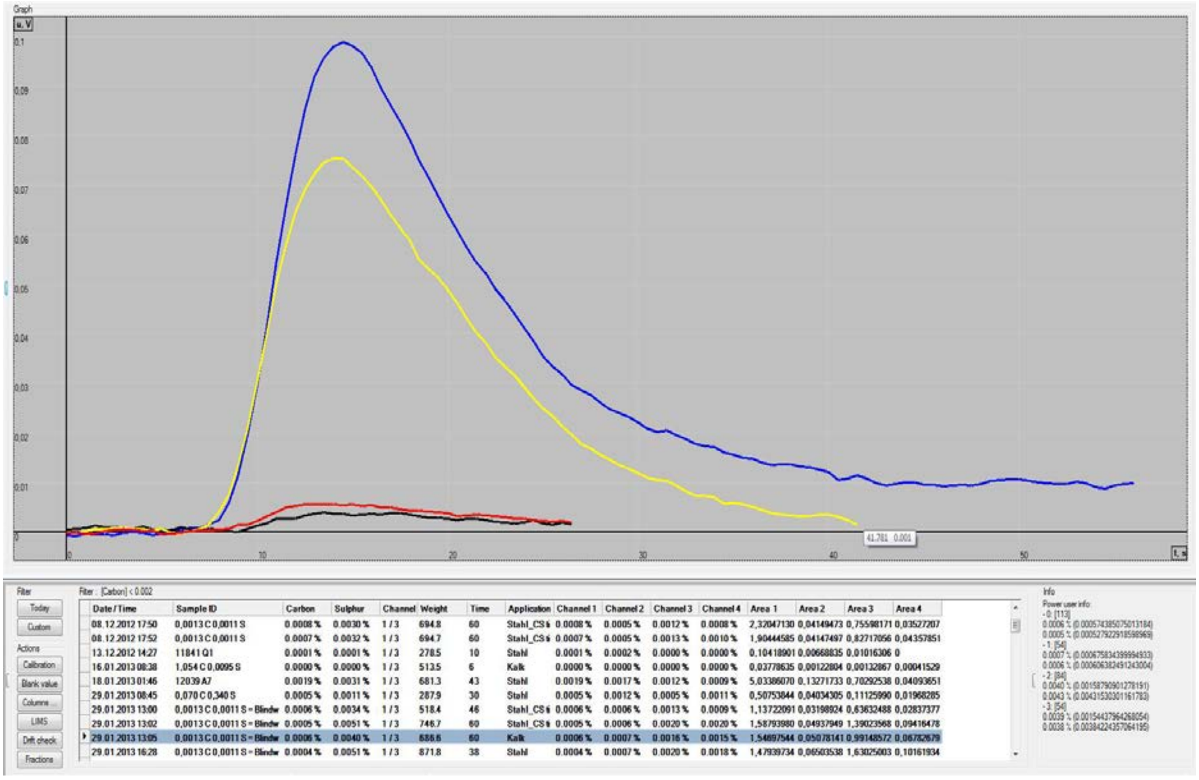
Fig. 24: Programm screenshot (graph example 1)

It appears like a long tailing at the end of the peak. It appears in the low carbon range only and the distance to the base line is in the range of 10 to 50mV. Depending on the blanks of the crucibles and on the oxygen purity, the level of the tailing can be as high as 100mV. When the burning is extremely long, the level of the low carbon tailing even starts to grow.

Possible solutions:

- Reduce the analysis time
- Increase the comparator level of the low carbon range,
- Reduce the generator time.

3.29.2 Copper oxide has a bad quality



Date / Time	Sample ID	Carbon	Sulphur	Channel	Weight	Time	Application	Channel 1	Channel 2	Channel 3	Channel 4	Area 1	Area 2	Area 3	Area 4
08.12.2012 17:50	0,0013 C 0,0011 S	0.0008 %	0.0030 %	1 / 3	694.8	60	Stahl_CS	0.0008 %	0.0005 %	0.0012 %	0.0008 %	2,32047130	0,04149473	0,75598171	0,03527207
08.12.2012 17:52	0,0013 C 0,0011 S	0.0007 %	0.0032 %	1 / 3	694.7	60	Stahl_CS	0.0007 %	0.0005 %	0.0013 %	0.0010 %	1,90444585	0,04147497	0,82717056	0,04357851
13.12.2012 14:27	11841 Q1	0.0001 %	0.0001 %	1 / 3	278.5	10	Stahl	0.0001 %	0.0002 %	0.0000 %	0.0000 %	0,10418901	0,00668835	0,01016306	0
16.01.2013 08:38	1,054 C 0,0095 S	0.0000 %	0.0000 %	1 / 3	513.5	6	Kalk	0.0000 %	0.0000 %	0.0000 %	0.0000 %	0,03778635	0,00122804	0,00132867	0,00041529
18.01.2013 01:46	12039 A7	0.0019 %	0.0031 %	1 / 3	681.3	43	Stahl	0.0019 %	0.0017 %	0.0012 %	0.0009 %	5,03386070	0,13271733	0,70292538	0,04093651
29.01.2013 08:45	0,070 C 0,340 S	0.0005 %	0.0011 %	1 / 3	287.9	30	Stahl	0.0005 %	0.0012 %	0.0005 %	0.0011 %	0,50753844	0,04034305	0,11125990	0,01968285
29.01.2013 13:00	0,0013 C 0,0011 S - Blindw	0.0006 %	0.0034 %	1 / 3	518.4	46	Stahl_CS	0.0006 %	0.0006 %	0.0013 %	0.0009 %	1,13722091	0,03198924	0,63632488	0,02837377
29.01.2013 13:02	0,0013 C 0,0011 S - Blindw	0.0005 %	0.0051 %	1 / 3	746.7	60	Stahl_CS	0.0005 %	0.0006 %	0.0020 %	0.0020 %	1,58793980	0,04937949	1,39023568	0,09416478
29.01.2013 13:05	0,0013 C 0,0011 S - Blindw	0.0006 %	0.0040 %	1 / 3	688.6	60	Kalk	0.0006 %	0.0007 %	0.0016 %	0.0015 %	1,54897544	0,05078141	0,99148572	0,06782679
29.01.2013 16:28	0,0013 C 0,0011 S - Blindw	0.0004 %	0.0051 %	1 / 3	871.8	38	Stahl	0.0004 %	0.0007 %	0.0020 %	0.0018 %	1,47939734	0,06503538	1,63025003	0,10161934

Fig. 25: Programm screenshot (graph example 2)

Memory effects of the copper oxide can cause tailing of the low carbon range in the level of 10 to 50 mV. However the tailing level does not grow due to faulty copper oxide.

Possible solution:

-Replace the copper oxide

3.29.3 Path window is not sealed or it is broken

If the faulty window is on the chopper housing side, all available cells have a tailing due to combustion gases entering the chopper housing causing permanent IR absorption for all cells available.

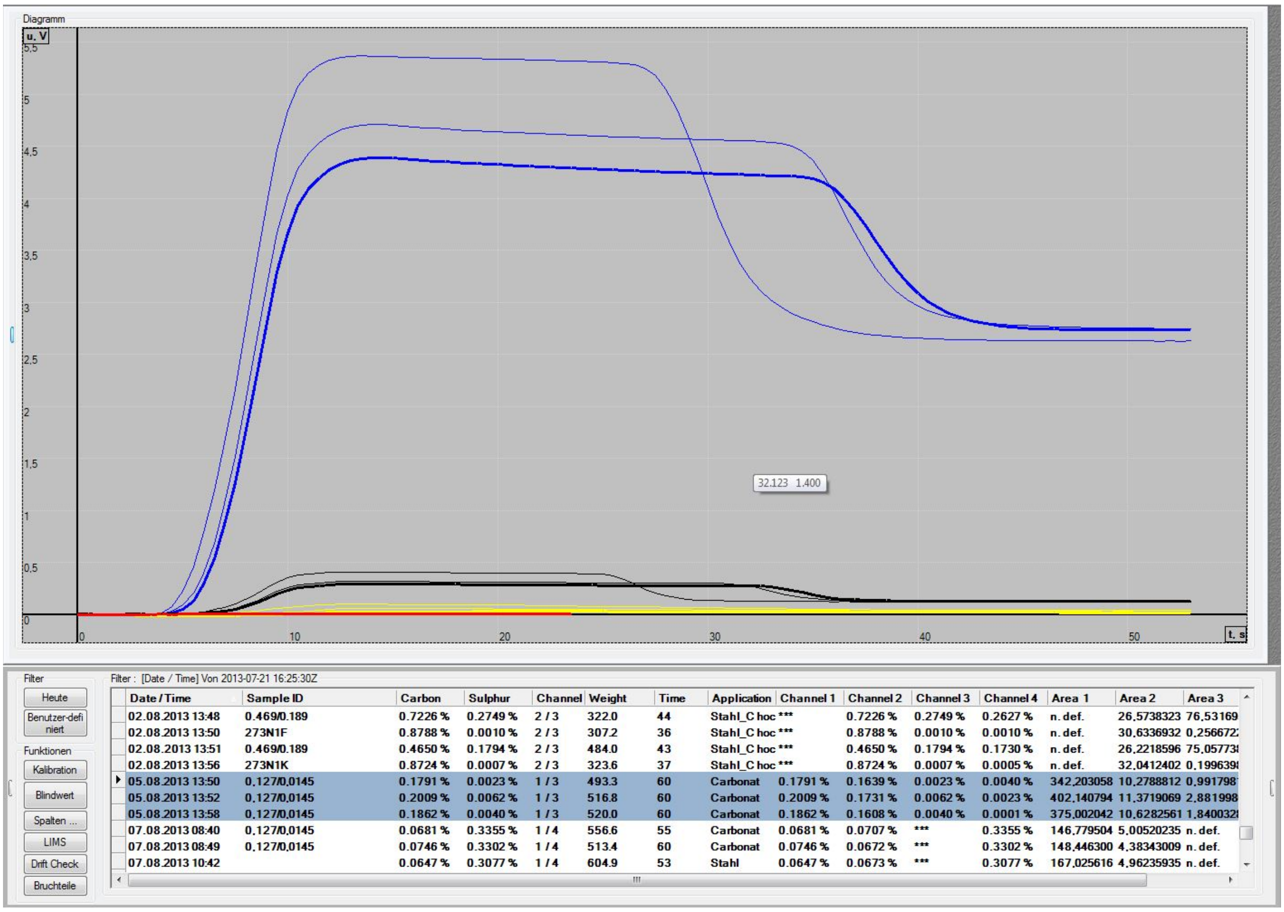
If the faulty window is on the IR sensor side, there is tailing of the damaged cell only.

Solution:

-Replace the part having the faulty window.

Replacing the window only, is rather tricky because the window should be available, the faulty window must be removed, the surface for gluing new window must be cleaned from old glue and rests of the broken window, there must be glue available being suitable to glue windows (two components glue) and time should also be available to wait until the glue is solid.

3.29.4 Flow stops during analysis



Date / Time	Sample ID	Carbon	Sulphur	Channel	Weight	Time	Application	Channel 1	Channel 2	Channel 3	Channel 4	Area 1	Area 2	Area 3
02.08.2013 13:48	0.469/0.189	0.7226 %	0.2749 %	2 / 3	322.0	44	Stahl_C hoc	***	0.7226 %	0.2749 %	0.2627 %	n. def.	26,5738323	76,53169
02.08.2013 13:50	273N1F	0.8788 %	0.0010 %	2 / 3	307.2	36	Stahl_C hoc	***	0.8788 %	0.0010 %	0.0010 %	n. def.	30,6336932	0,256672
02.08.2013 13:51	0.469/0.189	0.4650 %	0.1794 %	2 / 3	484.0	43	Stahl_C hoc	***	0.4650 %	0.1794 %	0.1730 %	n. def.	26,2218596	75,05773
02.08.2013 13:56	273N1K	0.8724 %	0.0007 %	2 / 3	323.6	37	Stahl_C hoc	***	0.8724 %	0.0007 %	0.0005 %	n. def.	32,0412402	0,199639
05.08.2013 13:50	0,127/0,0145	0.1791 %	0.0023 %	1 / 3	493.3	60	Carbonat	0.1791 %	0.1639 %	0.0023 %	0.0040 %	342,203058	10,2788812	0,991798
05.08.2013 13:52	0,127/0,0145	0.2009 %	0.0062 %	1 / 3	516.8	60	Carbonat	0.2009 %	0.1731 %	0.0062 %	0.0023 %	402,140794	11,3719069	2,881998
05.08.2013 13:58	0,127/0,0145	0.1862 %	0.0040 %	1 / 3	520.0	60	Carbonat	0.1862 %	0.1608 %	0.0040 %	0.0001 %	375,002042	10,6282561	1,840032
07.08.2013 08:40	0,127/0,0145	0.0681 %	0.3355 %	1 / 4	556.6	55	Carbonat	0.0681 %	0.0707 %	***	0.3355 %	146,779504	5,00520235	n. def.
07.08.2013 08:49	0,127/0,0145	0.0746 %	0.3302 %	1 / 4	513.4	60	Carbonat	0.0746 %	0.0672 %	***	0.3302 %	148,446300	4,38343009	n. def.
07.08.2013 10:42		0.0647 %	0.3077 %	1 / 4	604.9	53	Stahl	0.0647 %	0.0673 %	***	0.3077 %	167,025616	4,96235935	n. def.

Fig. 26: Programm screenshot (graph example 3)

In such case all base lines remain high, keeping their level which they had at the moment the flow stops. Therefore the voltages of the flat continuation of the base lines can be high, depending on the voltage level of each peak at the moment the flow stopped.

Possible reasons why the flow may stop during combustion:

– The lance valve V2 jams.

At the beginning of analysis, the oxygen is supplied to the furnace by the chamber valve V3 during T2 and T3 for the time (seconds) set in the software (configuration window). After expiring of T2 and T3, V3 closes the oxygen to normally continue being supplied by the lance valve V2 until the end of analysis. But if V2 blocks there is no flow any more so that the combustion gases remain in the IR paths constantly absorbing IR Radiation.

In this case the shape of the IR signals is repeatable as long as T2 and T3 remain unchanged, unless V2 sometimes jams occasionally.

– Loose wire connection to the flow regulating valve V6.

In this case it is not likely to have repeatable shape of the IR signal.

– The 50-pin connector of the HF-42 is not properly connected.

Fix the connector's screws.

– The flow control board HF-42 is faulty.

– For some reason the software goes to the gas saving mode

4 Adjustments, tests and working instructions

4.1 Gas flow controller adjustment and jumper settings

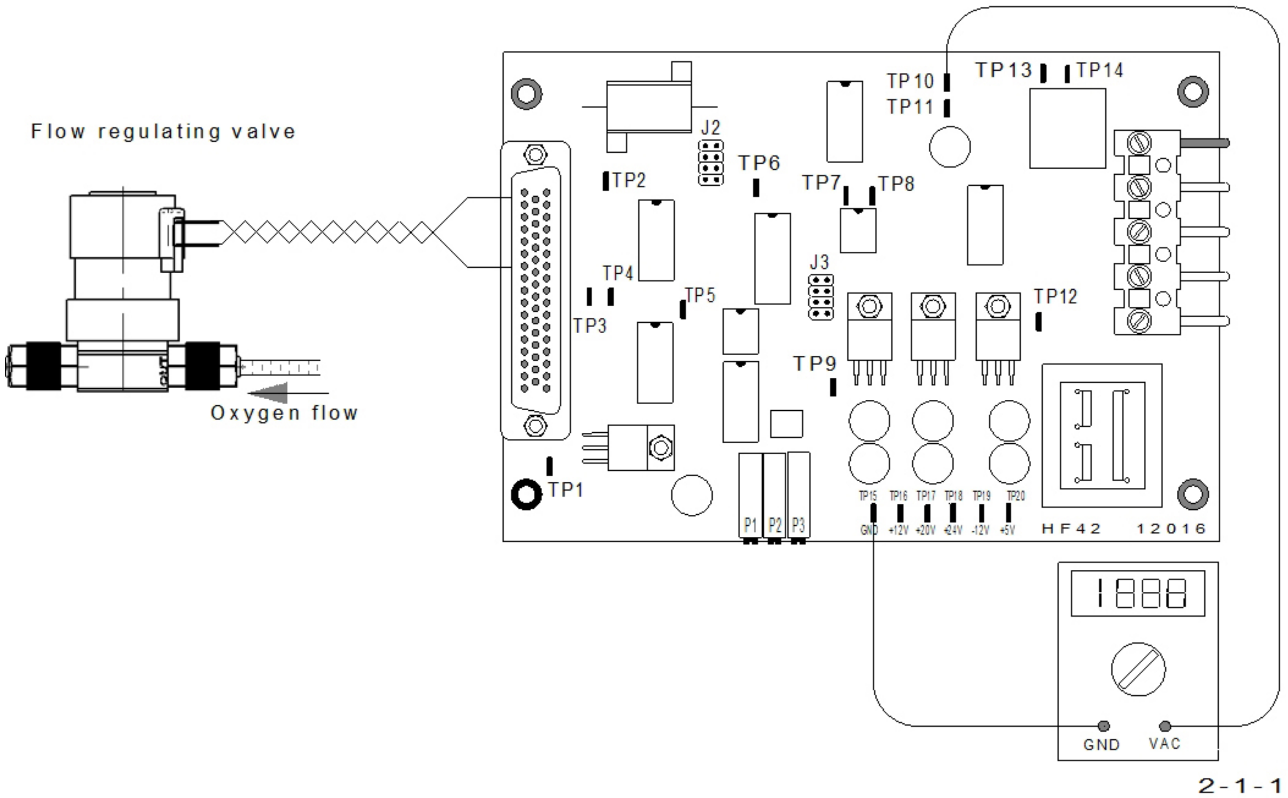


Abb. 43: Gas flow controller

- Set the flow rate with P1 of the HF 42, to about 180 l/h. Observe the flow rate on the lower flow meter of the analyzer. Wait until the value is stable.

The output of the flow sensor is found on TP10 of the HF 42 board; TP15 is GND. With a flow of 180 l/h, the voltage is about 2.5 - 3V.

Please note: without flow, the output voltage of the sensor is not 0V but about 0.6V.

- Adjust with P3 until the voltage on TP7 is 5V.

On TP8, the activity of the pulse width modulator can be checked.

The output voltage to the gas flow regulation valve can be measured on TP3.

With a constant flow of about 180 l/h, it should be between 5 and 15 volts.

- Check and if necessary readjust the pressure regulator (PR3) in front of the flow regulating valve.

4.1.1 Jumper settings

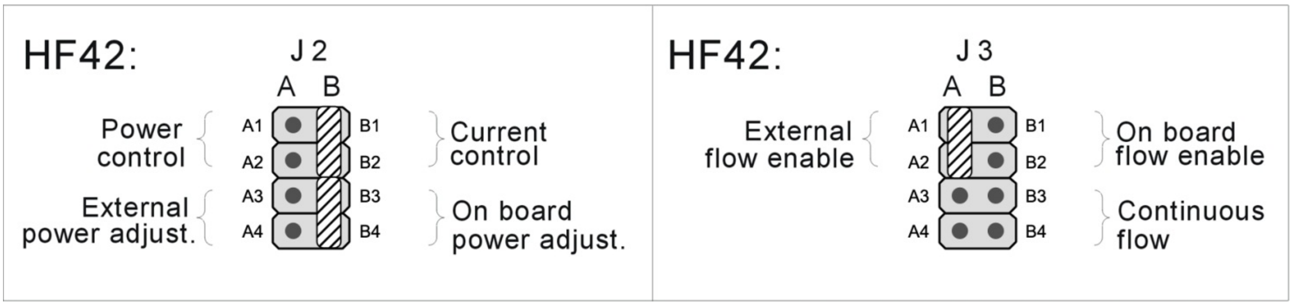


Abb. 44: Jumper settings

The connector J1 is for selecting different options for the induction generator control. By default, one jumper is set in the factory at the position “current control” connecting the pins B1-B2 and a second jumper is set to connect B3-B4 for “On board power adjustment”.

The connector J3 is for selecting options for the oxygen flow. The factory setting of the jumper is for “External flow enable”, by connecting the pins A1-A2. In this case, the microcontroller board can start and stop the flow enabling gas saving mode.

When moving the jumper to B1-B2 for “On board flow enable”, the flow will start and stop with the analysis begin and the analysis end, in other words, there is flow only during analysis. This can be interesting for older analyzers without gas saving function in their software, when they are used in automations running analyses only once in a while with long and regular idling period between analyses, for example 15 minutes.

At position “Continuous flow” when the jumper connects B3-B4, there is continuous flow as long as the mains power switch is set to position 2. The continuous flow position is useful in case of looking to solve flow problems, because the flow is always enabled.

4.1.2 Gas flow regulation

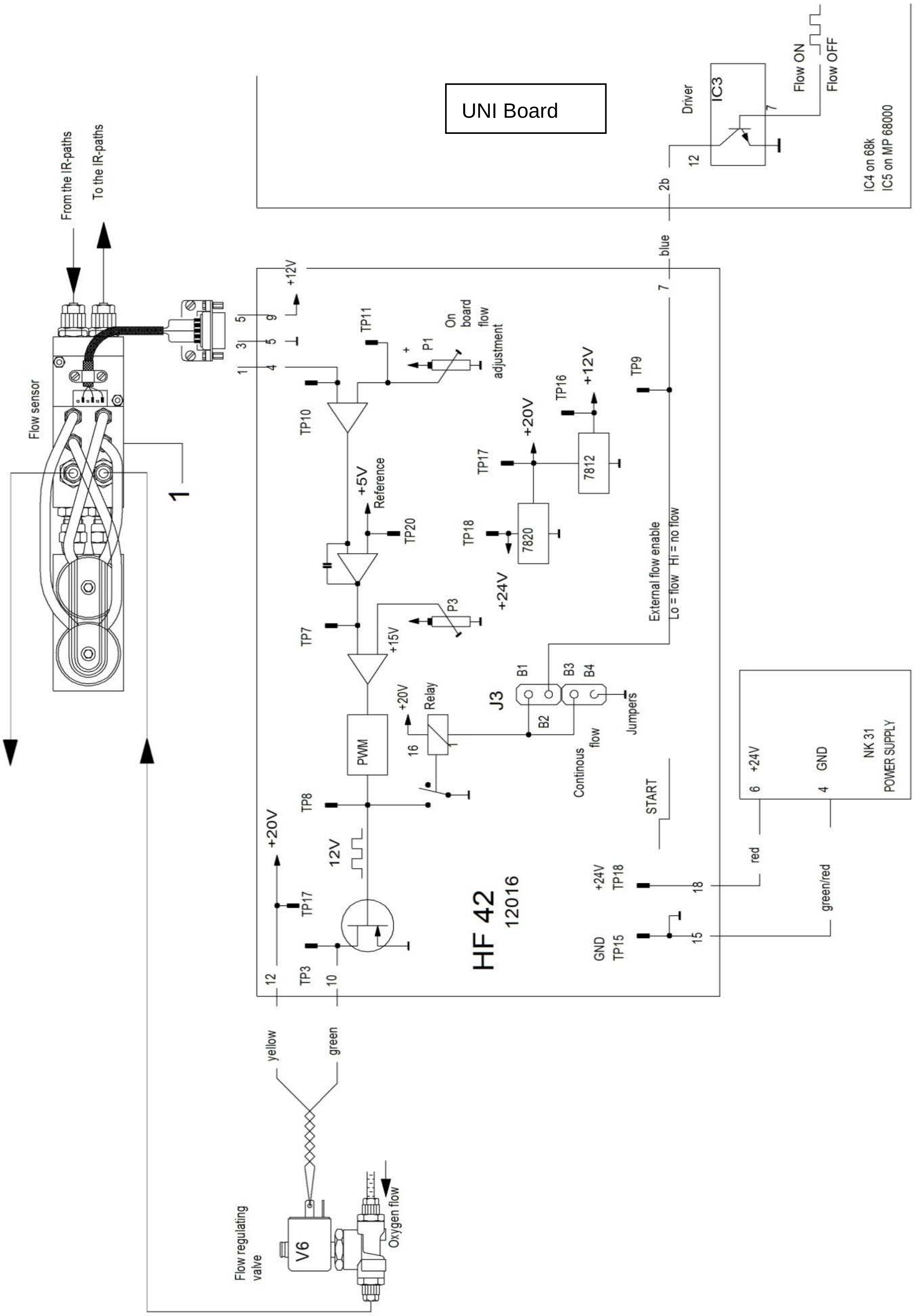


Fig. 27: gas flow regulation

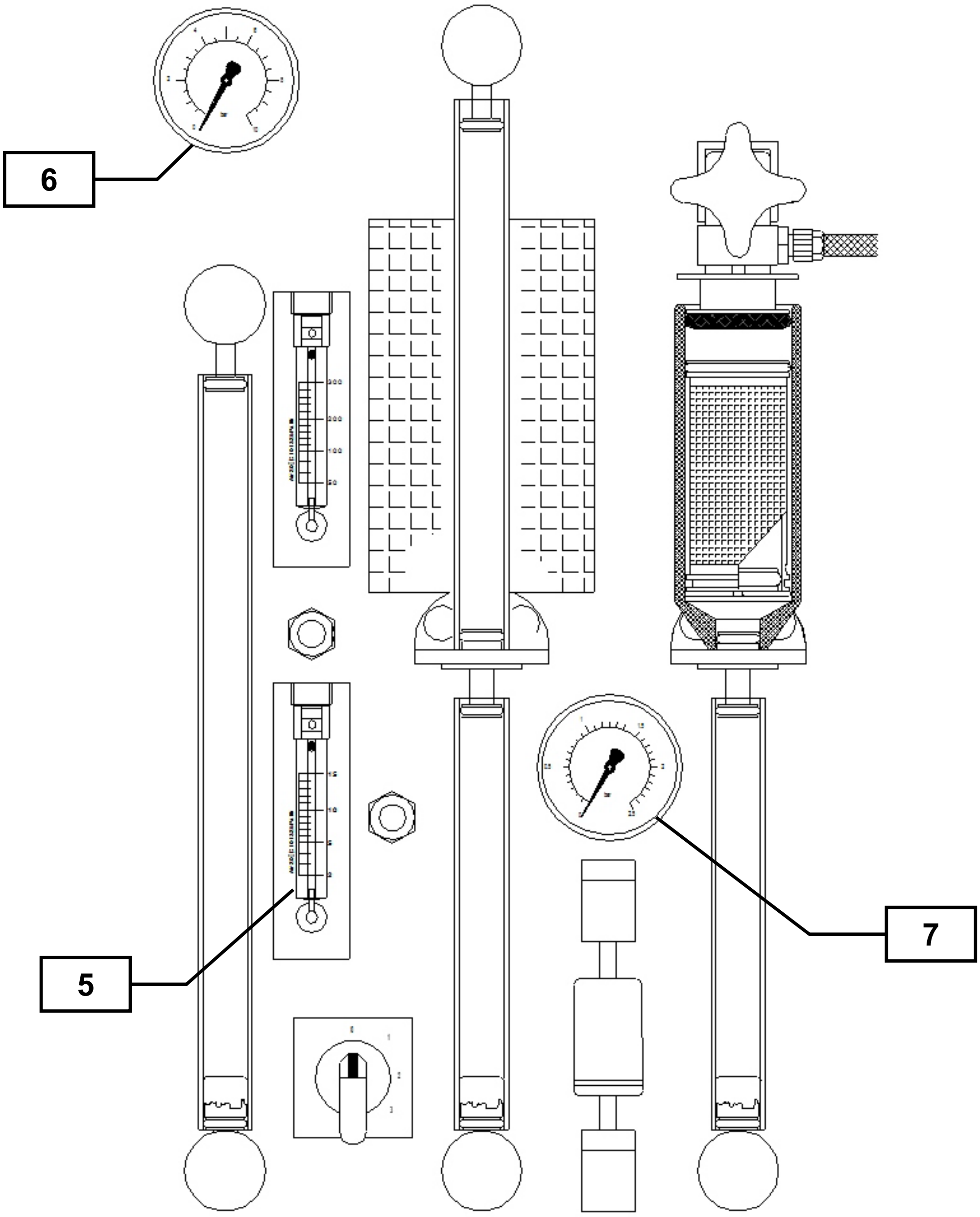


Abb. 45: Front panel

The flow controller mainly consists of the following components:

– The flow sensor (1)
– The flow regulating valve (V6)
– The flow control board HF 42

The flow sensor measures the gas flow, and converts its flow rate into an electrical signal (DC voltage).

The HF 42 board compares this flow value with the flow set point value.

The signal resulting from the comparator controls a pulse width modulator.

Its output can be seen on TP 8. TP 15 is GND.

The pulse width modulated signal runs a power transistor, which in turn, supplies the output signal to the flow regulating valve.

The duty cycle of the output signal determines its DC voltage, which, with a flow of about 180 l/h and with clean chemicals, measures around 9V (on TP 3).

The HF 42 board drives the flow regulating valve (V6) in such way, to provide a constant and accurate gas flow.

Remark:

Due to a few failures of the flow sensors, almost exclusively on the CS-800 at customers who regularly treat their samples with acid, we concluded that the reason of the failures should be of chemical nature i.e. acids and Schutze`s Reagent damage the sensor.

The solution is to prevent the analysis gases to get in contact with the sensors. Therefore the sensor ports are connected with long tubes to the gas flow system. There is no gas flow through the sensor tubes but only the pressure is sensed by the sensor.
In case of failure of a previous version sensor, it is advisable to replace it by the new version. In this case the part numbers of the complete assemblies should be used for ordering. In case the analyzer has already the new version sensor, the order should include the spare part number. See attached drawings.

The new flow sensor cannot be used as a replacement for the older flow sensor consisting of a rotameter and a optical element.

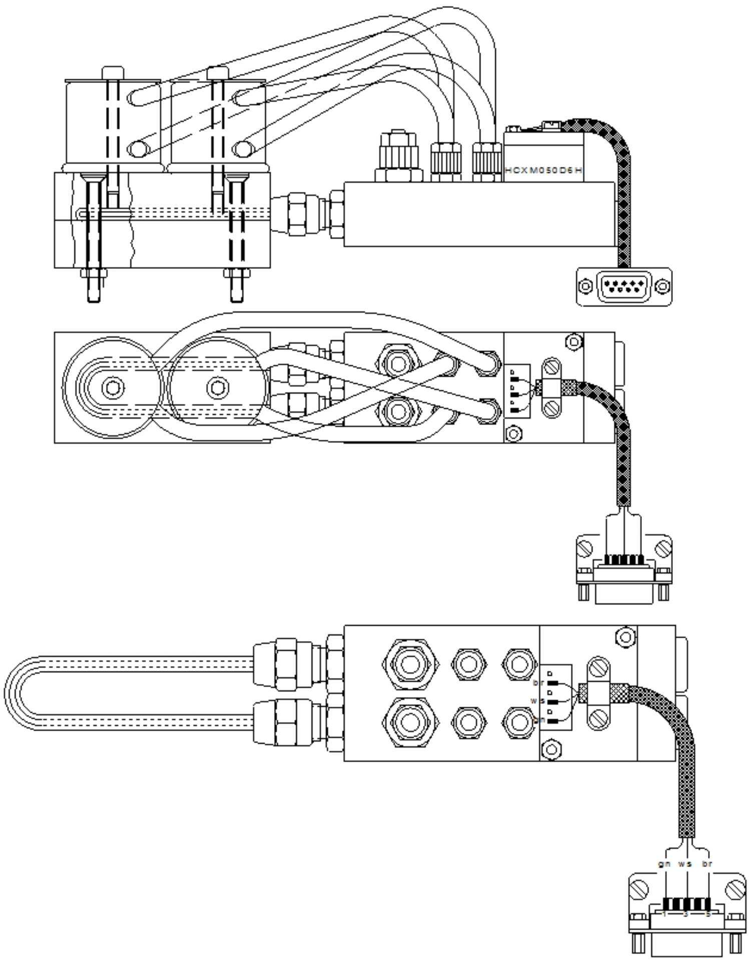


Fig. 28: Flow sensor

4.2 Infrared base line adjustments

4.2.1 Infrared cell modification - general information

Eltra has changed the IR cell design. This modification makes the cells less susceptible to contamination problems and makes the calibration more stable. The changes are:

The IR-4 board is modified so that now the output voltage of the cell is adjusted at 8V instead of zero as it was till now.

The voltage of each source remains unchanged at 1.75 volts as it used to be.

After this modification the peaks you see on the screen and the output voltage of the IR cell are two different things.

The Peaks on the screen look the same way like they used to look before starting from zero (base line) and going up positive.

The outputs of the IR cells (IR base lines) are factory set at 8V when the paths are new and clean. The peaks come down starting from 8V coming down to a minimum voltage (at the peak maximum) and they go back to the 8V baseline after completion of combustion. The 8V IR-base line is obtained through preamplifier adjustment only. The fine adjustment pots are not available in the cell box anymore because they are now not necessary.

In real operation, with growing contamination resulting in gradually weakened radiation reaching the detector, the IR cell output base lines will move down to levels below 8V depending on the grade of contamination. The (negative output) peaks of the cell will also change to smaller amplitude.

The base line is not regulated any more.

Due to a recalculation formula, the base lines on the screen are always zero volts, the peaks are positive and they are always of equal amplitude and surface (for same sample and same weight) regardless the path contamination, regardless the cell base line level, and regardless the cell output peak amplitude. Consequently the integrated value (of the peak on the screen) remains the same and of course also the analyses results remain constant at any grade of contamination.

- When loading the UNI software select from now on "New cell" mode.

NOTICE

Due to the fact that the cell base line is not regulated, the microcontroller UNI boards don’t contain the D/A converter any more, therefore they will not work in case you may install such UNI boards in previous analyzers having IR cells which need their base line to be automatically set to zero.

For testing the functionality of this system the source voltage was gradually reduced from normal 1.75V down to 0.5V during an experiment in order to simulate radiation reduction like it happens due to path contamination during real lab operation. When gradually reducing the IR source voltage from 1.75V down to 0.5V the cell base line came from +8V down to minus 3V and the peak amplitudes became smaller. In all stages of the IR source voltage, the results of the same samples remained stable and linear. On the PC screen was no difference to see. All peaks started from zero going up to the same maximum and come back to zero again. Therefore all results were equal regardless how low the source voltage was.

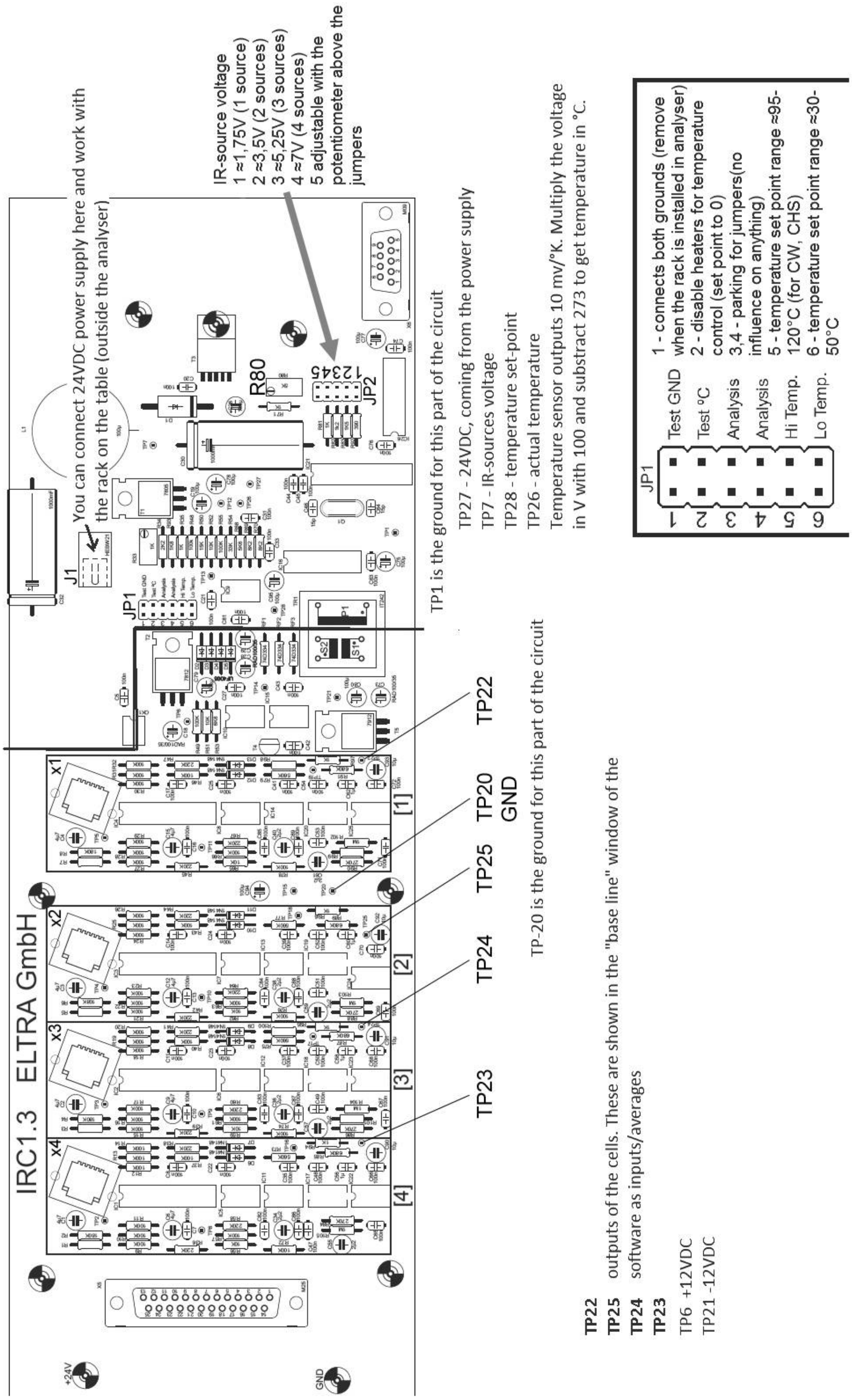

IRC1.3 ELTRA GmbH
You can connect 24VDC power supply here and work with the rack on the table (outside the analyser)
J1
JP1
IR-source voltage
1 ≈1,75V (1 source)
2 ≈3,5V (2 sources)
3 ≈5,25V (3 sources)
4 ≈7V (4 sources)
5 adjustable with the potentiometer above the jumpers
R80
12345
JP2
TP1 is the ground for this part of the circuit
TP27 - 24VDC, coming from the power supply
TP7 - IR-sources voltage
TP28 - temperature set-point
TP26 - actual temperature
Temperature sensor outputs 10 mv/°K. Multiply the voltage in V with 100 and substract 273 to get temperature in °C.
JP1
1 Test GND
2 Test °C
3 Analysis
4 Analysis
5 Hi Temp.
6 Lo Temp.
1 - connects both grounds (remove when the rack is installed in analyser)
2 - disable heaters for temperature control (set point to 0)
3,4 - parking for jumpers(no influence on anything)
5 - temperature set point range ≈95-120°C (for CW, CHS)
6 - temperature set point range ≈30-50°C
x1
x2
x3
x4
[1]
[2]
[3]
[4]
TP22
TP20 GND
TP25
TP24
TP23
TP-20 is the ground for this part of the circuit
+24V
GND
TP22
TP25 outputs of the cells. These are shown in the "base line" window of the
TP24 software as inputs/averages
TP23
TP6 +12VDC
TP21 -12VDC

Abb. 46: IRC 1.3

4.2.2 General test points

4.2.2.1 Supply voltages and thermostatic control circuit

TP 1:	GND
TP 7:	IR source voltage
TP 12:	+ 5V supply
TP 13:	Heating transistors control voltage
TP 26:	IR temperature actual value
TP 27:	+24V supply
TP 28:	IR temperature set point

4.2.2.2 Supply voltages for IR signal processing circuit

TP 6:	+12V
TP 21:	-12V

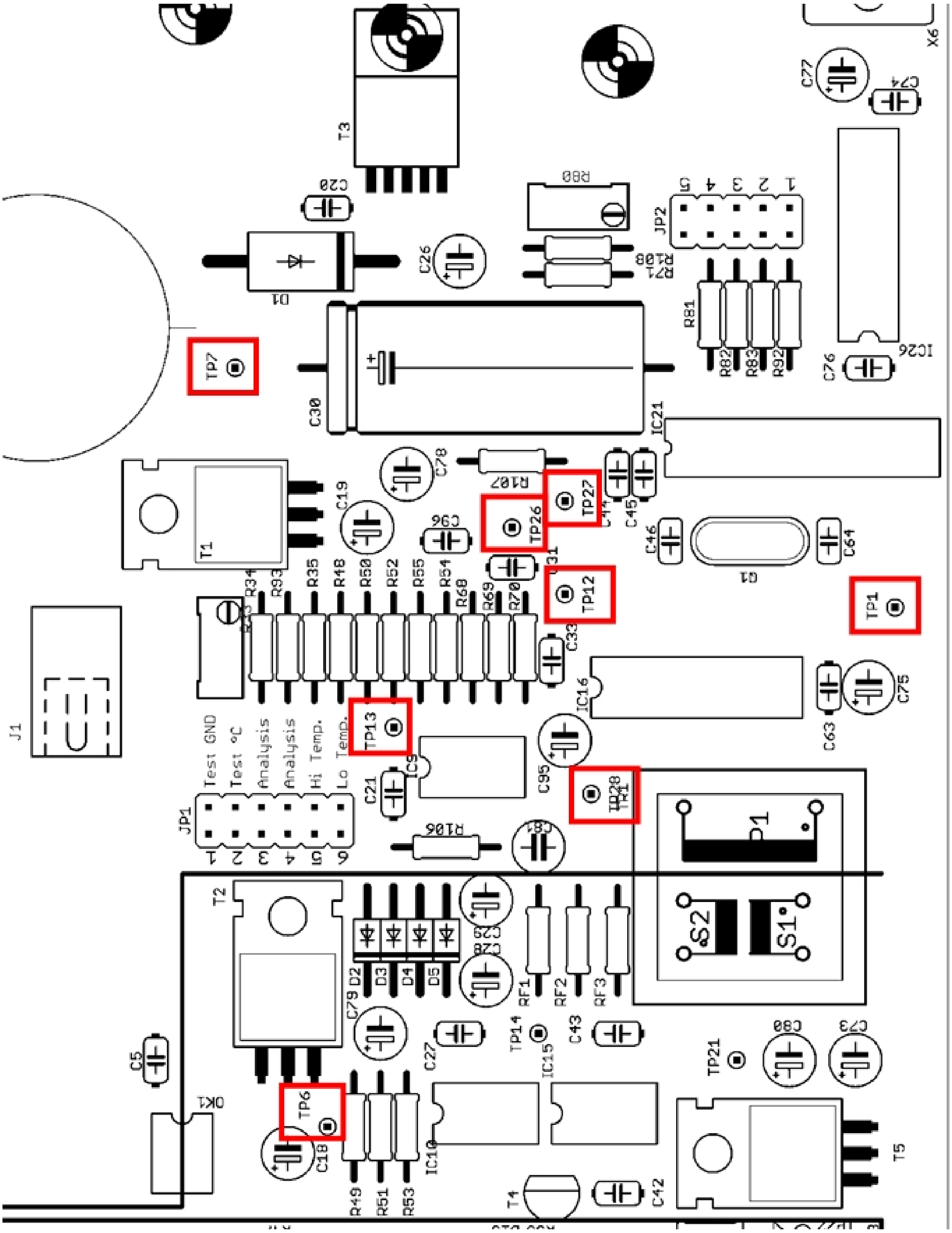


Fig. 29: Mainboard (Cut-out) IR-Cell – general test points

4.2.3 Test points IR-ranges

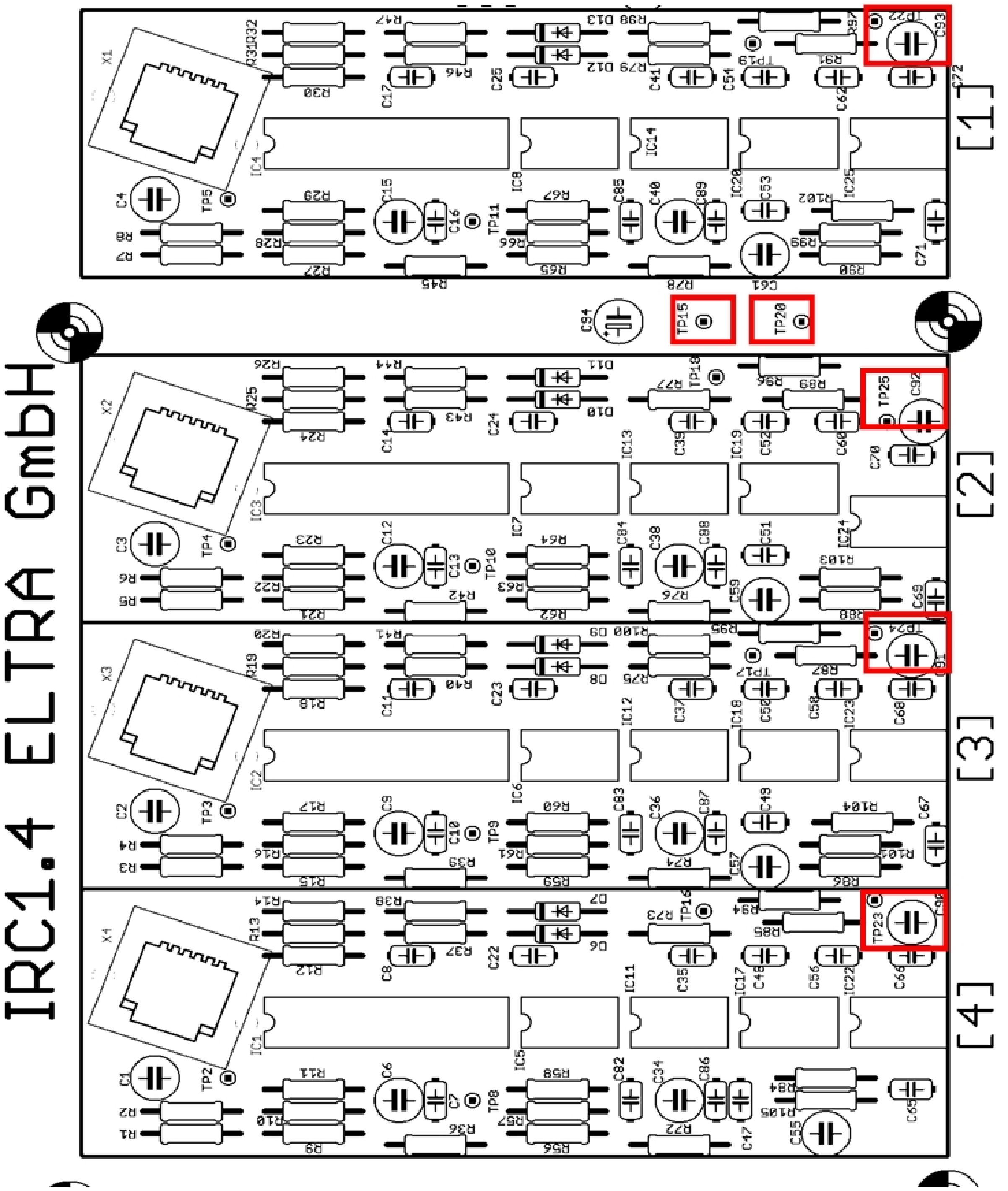


Fig. 30: Test points IR-ranges

4.2.3.1 Supply voltages for IR signal processing circuit

TP 15:	+5V reference
TP 20:	Analog GND

4.2.3.2 Outputs (base lines about 8VDC. For golden paths adjust 6VDC)

TP 22:	Output section [1]
TP 25:	Output section [2]
TP 24:	Output section [3]

TP 23: Output section [4]

4.2.4 Base line adjustments

When the IR module (rack) is removed from the analyzer, it can be powered on the desk by a 24VDC power supply connected to J1 of the IRC board. The power supply should normally be capable to supply a current of 5A.

If a lower current power supply available, in order to prevent the temperature control from taking high current from the power supply, set a jumper to position 2 of the connector J1. In this case a 24V / 1A power supply will be enough.

NOTICE

Remember to remove the jumper from position 2 before reinstalling the IR module into the analyzer, otherwise the thermostatic control will not work.

4.2.5 Infrared cell board IRC1.x sections assignment

board sections	[4]	[3]	[2]	[1]
4 cells IR module	Hi S	Lo S	Hi C	Lo C
3 cells IR module		S	Hi C	Lo C
3 cells IR module		Hi S	Lo S	C
2 cells IR module			S	C
2 cells IR module			C	C
2 cells IR module			S	S
1 cell IR module				C
1 cell IR module				S

4.2.5.1 Explanations

- Lo C: Low carbon range (long C path)
- Hi C: High carbon range (short C path)
- Lo S: Low sulfur range (long S path)
- Hi S: High sulfur range (short S path)
- C: single carbon range (single C path)
- S: single sulfur range (single S path)

The preamplifier connectors of the cells are of course connected to the corresponding sections according to the above assignment list. (4-pin module connectors).

4.2.5.2 Example

A three cell module with a low carbon, a high carbon and a sulfur cell has

- the low carbon signal on section [1], the LoC preamp is on X1
- the high carbon signal on section [2], the HiC preamp is on X2
- the Sulfur cell signal on section [3], the S preamp is on X3

The base line adjustments are done by adjusting the gain of the preamplifier of each IR cell in the IR module (rack). The gain adjustment is done by turning the trimmer which is inside of each preamplifier. The base line voltages can be measured on the following test points:

Outputs (base lines about 8VDC)

TP 22: Output section [1]

TP 25: Output section [2]

TP 24: Output section [3]

TP 23: Output section [4]

TP 20: Analog GND

NOTICE

Use a very thin screwdriver. With a big screwdriver, the trimmer can be mechanically destroyed before you feel it. The screwdriver should never get in touch with the hole resp. the housing of the preamp, otherwise the trimmer may be mechanically stressed and break.

4.2.6 Voltage of a base line is too high (higher than 9.5V)

The optimal value for the base lines of the IR-paths is about 8V. Golden paths have the effect to become more reflective in the first few months of their operation. To compensate this effect, the original value of the golden paths base line should be adjusted at 5 V. In case of a long golden paths (300mm) having sensors including on-chip preamplifier, the cell output sometimes cannot be adjusted down to the required 5 to 6V by turning counter clockwise the trimmer in the preamplifier. (Outputs: TP22 to TP25 against AGND = TP20).

In this case the IR sources voltage has to be reduced until you get a base line of the troubled golden cell down to about 5 to 6V. You will then need to increase the gain of the other cells preamps to get their base lines back to the range of 8V.

4.2.6.1 Source voltage – reducing

1. Take the IR cell out of the analyser.
2. Power the cell by an external 24VDC power supply connected to J1 of the IRC board.
3. If the external power supply cannot supply 5A then set a jumper on position 2 (Test °C) of JP1 in order to switch off the temperature control so that a power supply of 1A is adequate. If a jumper is available on position 3 or 4 (Analysis), this jumper can be moved to position 2. The positions 3 and 4 are simply parking positions for jumpers to simply be available when needed. There are no tracks connected on the pins of the (Analysis) positions 3 and 4 of JP1.
4. Make sure that the gain of the preamplifier in question is adjusted to a minimum gain. To do this, turn its trimmer counter clockwise up to the end of trimmer range. These trimmers have a maximum of 20 turns. When the end of range has been reached, you can hear a gently silent click with each turn. It is not possible to feel any mechanical resistance on the screw driver.
5. Measure the actual source voltage between on TP7 against GND=TP1 and note the value.
6. Turn the potentiometer R80 of the IRC board counter clockwise up to the end of its range. (Maximum gear range = 20 turns).
7. Switch off resp. disconnect the power supply.
8. Move the jumper of JP2 to position 5.
9. Connect the 24V power again.
10. Connect the multimeter to the cell output which has to be adjusted.
11. Wait for the sources to warm up until the output voltage will almost reach its maximum value.
12. Turn the trimmer R80 slowly clockwise until the base line of the cell in question has reached 8V. In case of a clean golden path, adjust between 5V and 6V instead of 8V.
13. Adjust the outputs of other cells (not golden paths) to have between 7 to 8V by adjusting the gains of their preamplifiers.
14. Set the jumper of the JP1 from position 2 (Test °C) to Position 3 (Analysis).

15. Install the IR module into the analyzer.
16. . Allow sufficient time for the base lines to stabilize.

NOTICE

It is necessary to turn slowly in order for the IR sources to stabilize their temperature with increasing IR source voltage.

- Adjust the other cells of the module (if any) at 8V baselines or 5V to 6V in case of clean golden paths.
- Install the IR module into the analyzer. Allow sufficient time for the base lines to stabilize.
- Start gas flow and check the base lines again. If any of them is significantly over 8V then readjust.

4.2.6.2 Drift too large

- Check the temperature regulation.
- Unstable power supply.
- Defective IR-source.

NOTICE

If it is shown on the display that the infrared cell's output voltage is over 10 volts then there is a serious defect.

4.2.7 IR source voltage setting

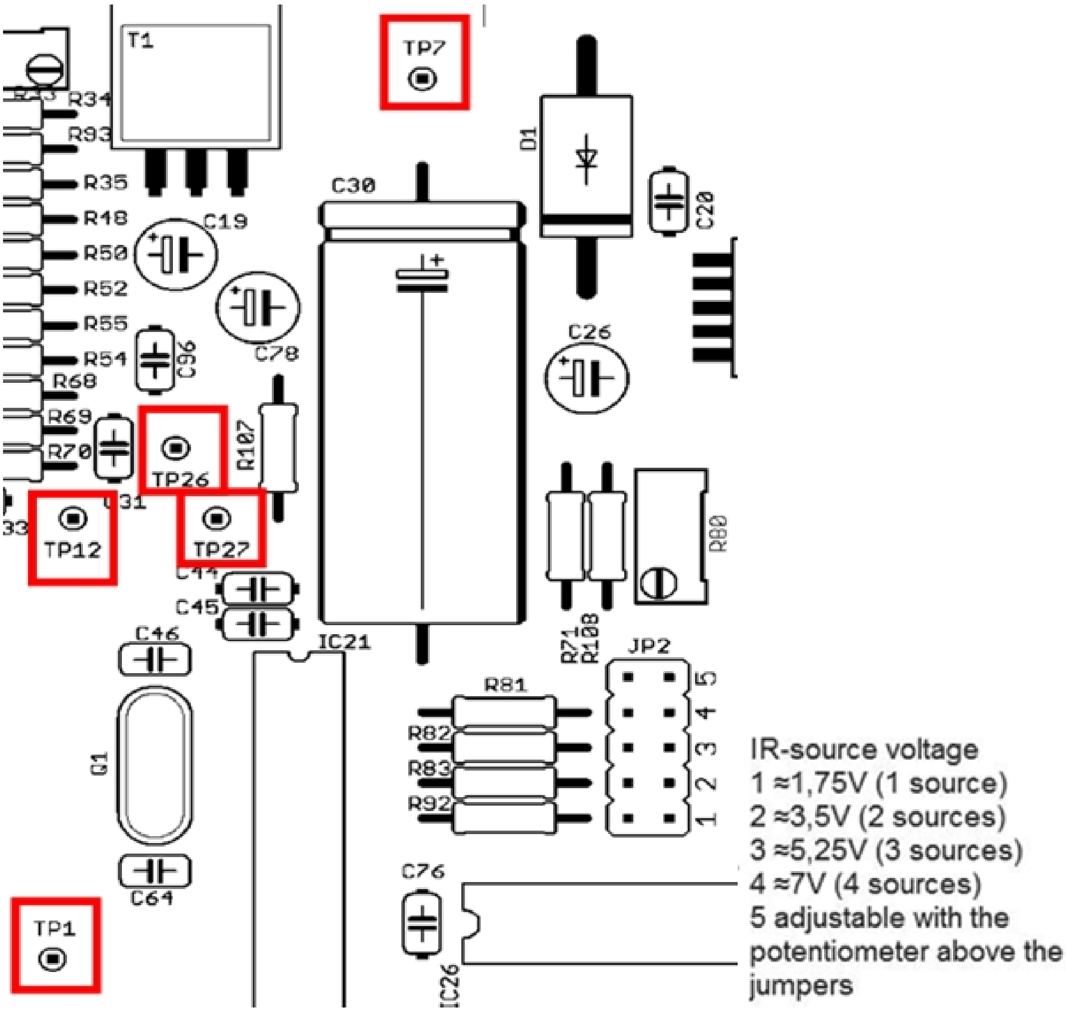


Fig. 31: IR source voltage setting

The jumper JP2 is for setting voltages of the IR sources. All available sources in an IR cell are connected in series. Normally the voltage of each source is 1.75 VDC. The total voltage of all available cells can be measured on test point TP7 against TP1=GND.

Caution: In case of adjusting resp. changing the IR source voltage, the base lines take a few minutes to stabilize at a new level.

In case of problems with adjusting the base line see chapters “Infrared cell adjustments” and “Infrared power supply”.

4.2.8 IR cell temperature control

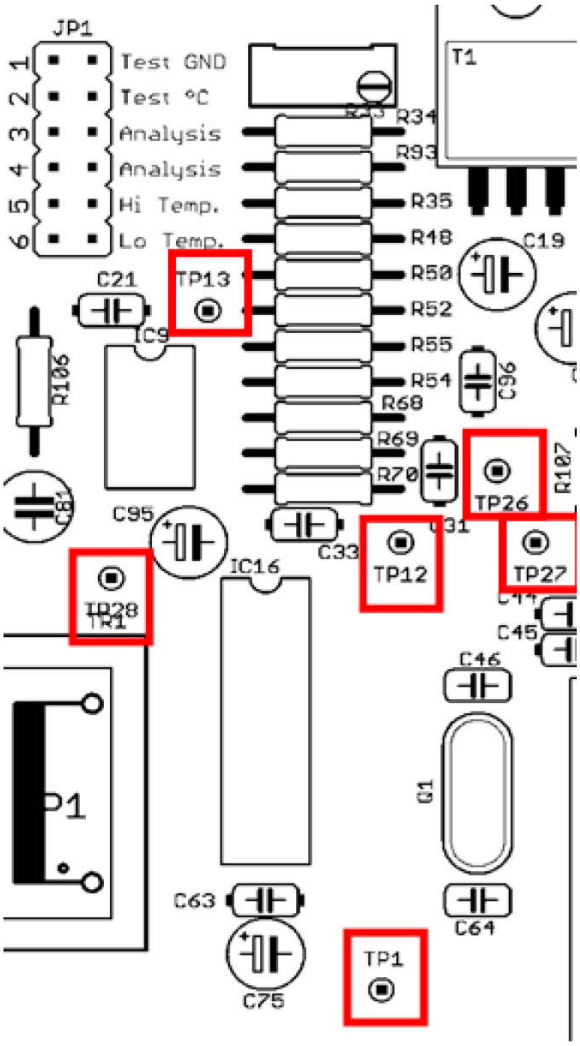


Fig. 32: IR cell temperature control

TP28 is the test point for measuring the set point of the IR temperature against TP1=GND.

At 3000 mV the temperature is 27°C growing with 10 mv /°C.

4.2.8.1 Examples

3.10V → 37°C

3.30V → 57°C

This is the adjustable temperature range of the cell in normal cases. This temperature range is adjustable when there is a jumper set on position 6-Lo temperature of JP1 and mainly there is no jumper on position 5-Hi Temp of JP1. In other words, when no jumper is set, this temperature range is already by default. A jumper in position 6-Lo Temp will keep this range, so there is no difference, but the jumper will be available when a jumper is elsewhere really needed.

3.73V → 100°C

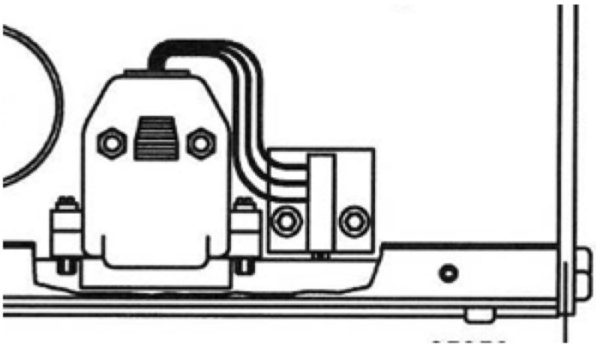
3.98V → 125°C

This temperature range is available for heated paths only. They are the paths for measuring water resp. hydrogen in the analyzers CW and CHS and possibly later in CHNS analyzers. In order to have the temperature adjustable in the above range, a jumper has to be set on position 5-Hi Temp. of JP1.

The temperature is set by turning the pot and measuring the set value on

The actual value of the temperature is measured on TP26.

Caution: After changing the temperature set point, it takes some time until the actual temperature value is stabilized at the new set level.



This is the trimmer in the IR cell module for adjusting the cell temperature. It is accessible with a screw driver from outside the cell. There is no need to remove the cell block module from the analyzer's cabinet in order to adjust the temperature.

4.2.8.2 Modifications for higher sensitivity (gain) in the low sulphur range

For LS: R101=47k R100 = 3M

4.1 x Standard gain

Recalculation factor = 92.664

For double the normal sensitivity: R101=180k

1.92 x standard gain

Recalculation factor = 39.5

For standard gain.

Recalculation factor = 20.59

4.2.8.3 IRC board and cross-talk

For non-soldered sections, at place of the capacitors C90 to C93, jumpers must be soldered (short pieces of wire) to connect not used IR outputs to GND.

There is a peak to see on the screen if not available IR cells are selected in the PC software. For example if an analyzer has one carbon cell only, but the operator selects the configuration of one C and one S ranges in the PC software, he will see a sulfur peak on the screen giving also sulfur results although there is no sulfur cell existing in the IR rack. The reason is cross-talk in the signal cable and in the multiplexer also due to the high input impedance of the UNI board.

In order to avoid this, the outputs of not existing IR ranges have to be connected to GND on the IRC board, so that there will be no peak on the corresponding UNI input and on the PC screen.

4.3 Pneumatics

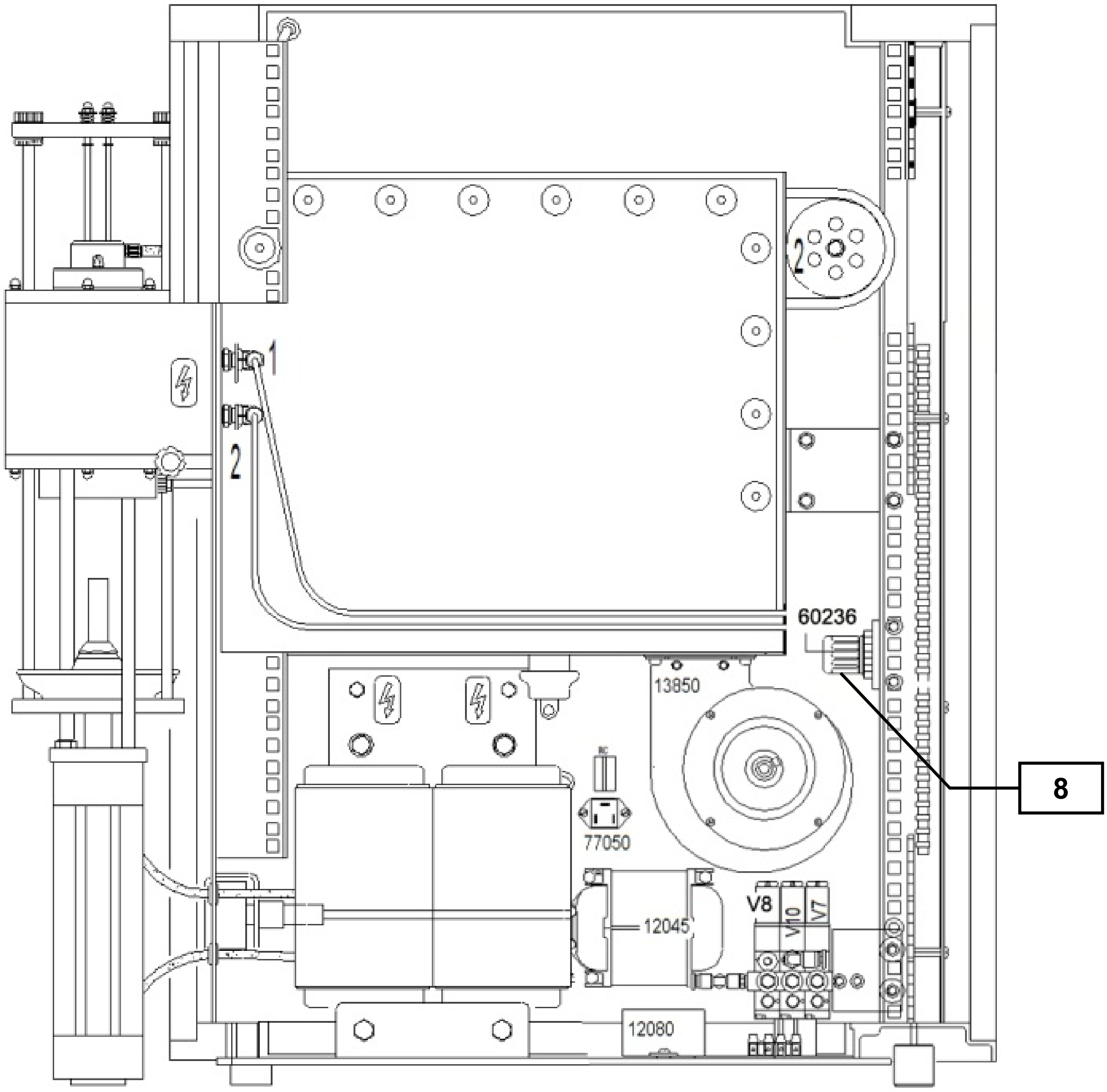


Fig. 33: Pneumatics parts

Pneumatics parts showing the location of the pneumatic valves V7, V8 and V10 as well as the position of the pressure regulator 8

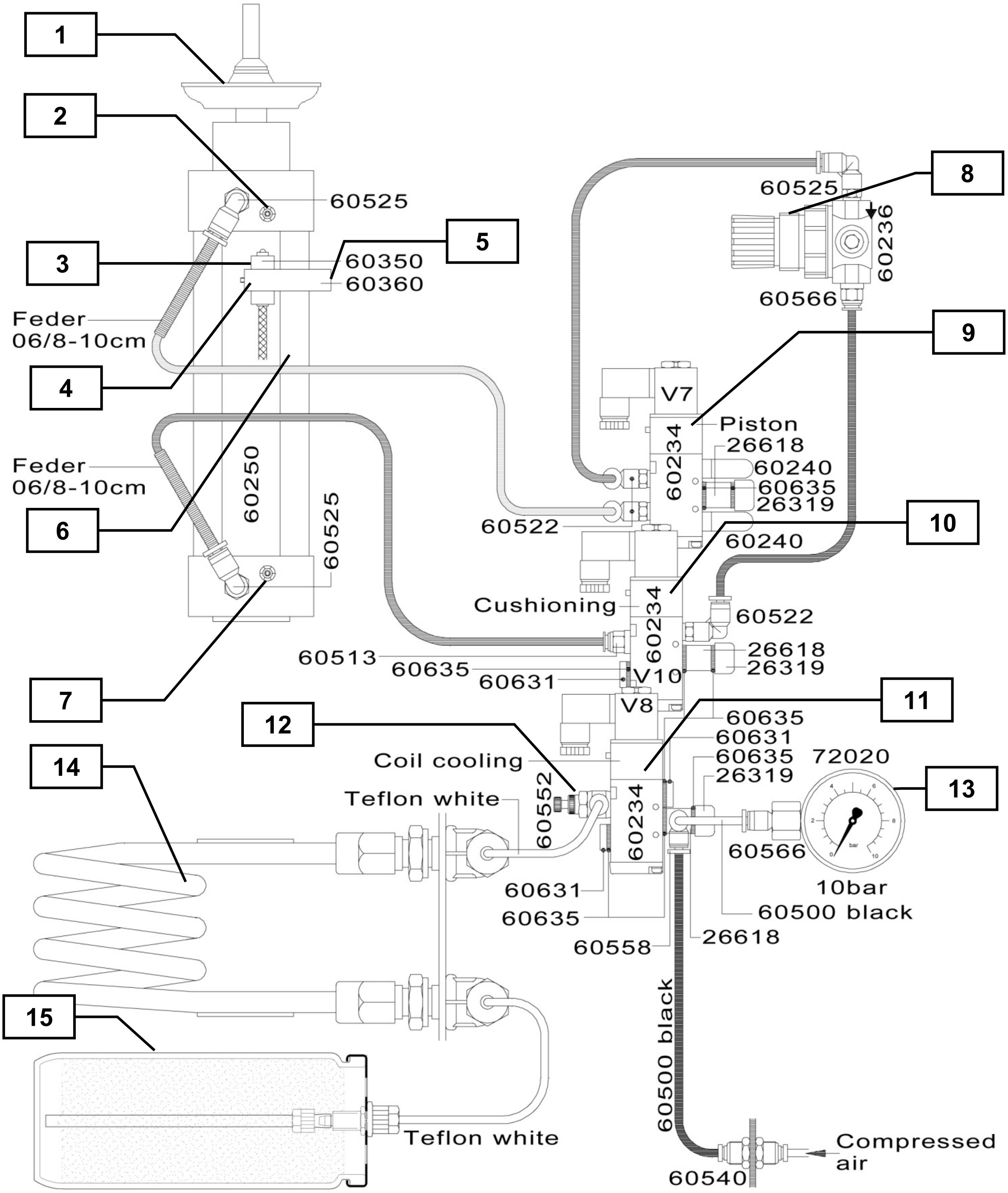


Abb. 47: Pneumatics parts

1	Furnace closing cone
2	Upper cushioning
3	Magnetic switch
4	Magnetic switch holder
5	Adjusting screw
6	Pneumatic cylinder
7	Lower cushioning
8	Pressure regulator
9	Piston valve
10	Cushioning valve
11	Coil cooling valve
12	Coil cooling adjustment
13	Pressure gauge
14	Combustion coil
15	Muffler

4.3.1 Pneumatics adjusting for correct furnace movement

When closing the furnace, the piston moves

Open the right side panel of the analyzer to find the pneumatic valves (9 / V7), (10 / V10) and (11 / V8) as well as the pressure regulator (8).

- Turn the restrictor (12) clockwise up to the end for complete restriction.
- Check the pressure on gauge (13) to be between 4-6 bar (60-85psi).
- Press F2 to open the furnace.
- Pull to unlock and then rotate the knob of the pressure regulator (8) counter clockwise for minimum pressure (zero pressure).
- Turn the screw (5) counter clockwise until the magnetic switch support (4) is free to move up and down on the cylinder (6).
- Shift the magnetic switch upwards up to the end of its adjusting range.
- Press F2 for closing the furnace. The furnace closing cone (1) won't yet move or move very slowly.
- Turn clockwise the knob of the pressure regulator (8) until the closing cone (1) can rise smoothly (without shaking) up to the upper end of its stroke. To do this, open and close the furnace (F2) as often as needed. Take software delays into account.
- The pressure should be only as high as necessary and low enough for a person to be able to stop by hand the cone from rising.
- Push the knob to lock the pressure regulator (8).
- When the furnace is closed, slowly shift the magnetic switch (3) with its support (4) downwards until it just switches on. This can be recognized due to the clicking of a pneumatic valve (10/V10) and the piston moving then slightly higher.
- Make a marking on the cylinder (6) at the upper end of the magnetic switch holder (4).

- Shift the switch with holder downwards until the magnetic switch is off (A valve clicks and the piston slightly moves downwards).
- Make a second marking on the cylinder (6) at the upper end of the switch holder (4).
- Adjust the switch holder (4) to have the upper end in the middle of the two markings.
- Open the furnace and then close it again (F2) to verify the correctness of the adjustment.
- Adjust the lower cushioning (7), so that the furnace opens without the piston banging at the bottom.
- Click on “Communication test”-“Digital outputs”, on the 9th button counting from the left, to energize the coil cooling valve (11/V8), or start analysis cycle.
- Turn the restrictor (12) counter clockwise until the pressure on the gauge (13) is reduced by about 0.2 to 0.3 bar (3 to 4 psi) when the coil cooling valve (11/V8) is open.
- Fix the locknut of the restrictor (12).

Remark:

In case of using valuable gas for operating the pneumatics, the restrictor (12) should be adjusted for lower flow by turning it clockwise. It can even be completely closed by turning it clockwise up to the end of its range.

The flow adjusted with this restrictor is for cooling the combustion coil to ensure very long service life. According to our experience, the combustion coils of our analyzers don’t need replacement, even after years of operation.

4.4 Pressure regulation

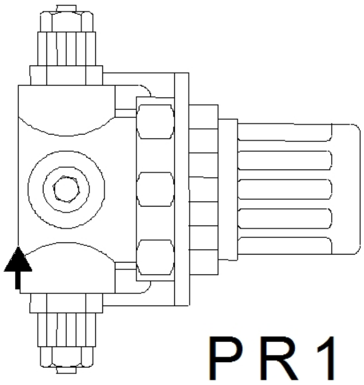


Fig. 48: PR1

PR1 is the inlet oxygen regulator, and is situated inside the analyzer, on the rear panel.

The outlet pressure needs to be set to 1.5bar (22.5psi).

- Pull and rotate the knob of the regulator, until the pressure gauge (6) shows the correct value.
- Ensure that the flow shown on the flow meter (5) shows between 180 and 200l/h; if not, adjust according to the related chapter.

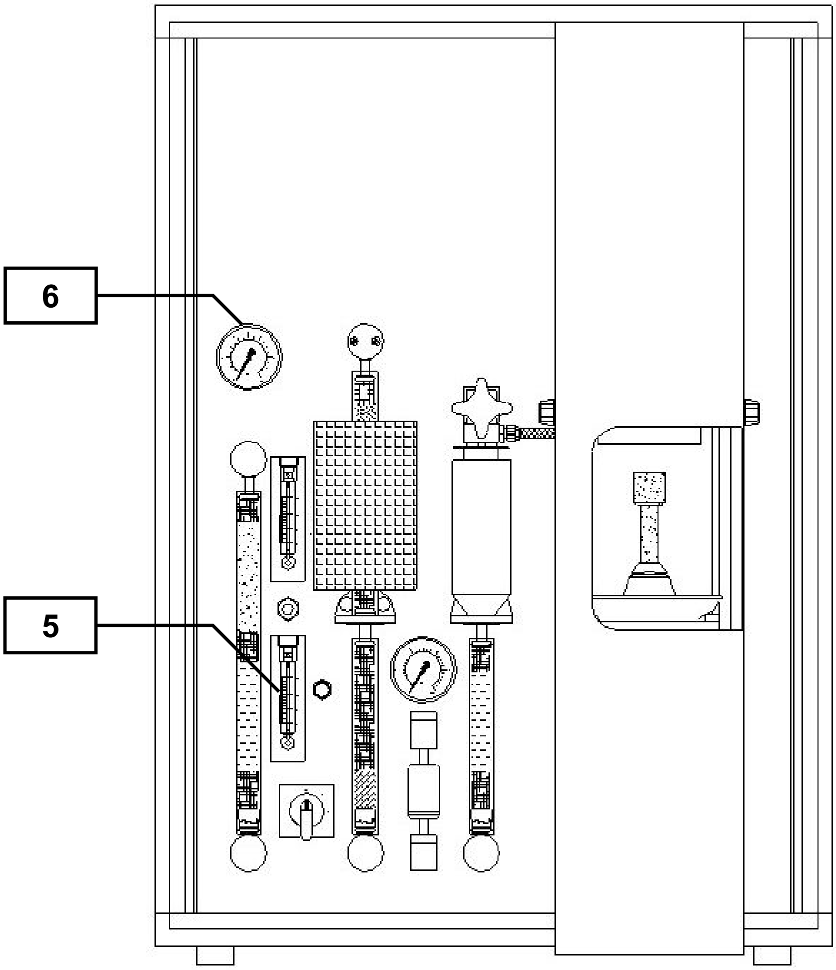


Fig. 49: Front side

4.5 Purge pressure

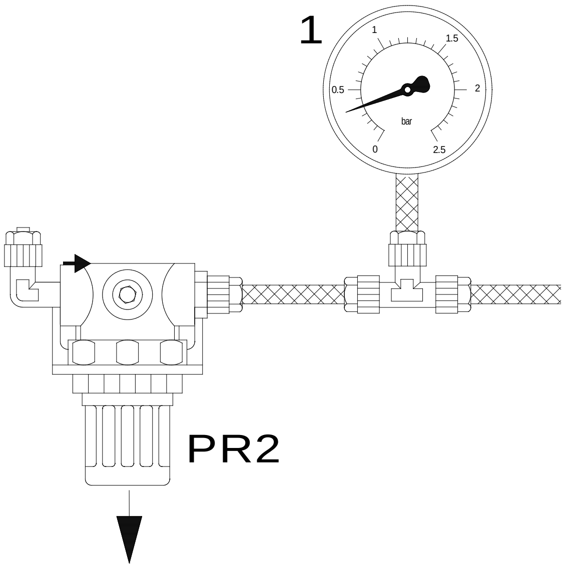


Fig. 50: PR2

PR2 is the pressure regulator for the purging system of the IR-cell and it is situated inside the analyzer, just behind the left-side of the panel. It is positioned horizontally.

– The oxygen pressure at the outlet of the PR2 should be 0.35 bar (5psi).

The pressure can be checked by applying a T-piece on the outlet of the pressure regulator, and connecting a pressure gauge (1), as indicated above.

- Pull and rotate the knob of the pressure regulator (PR2), until the correct pressure is shown on the gauge.

4.6 Closing cone adjustment

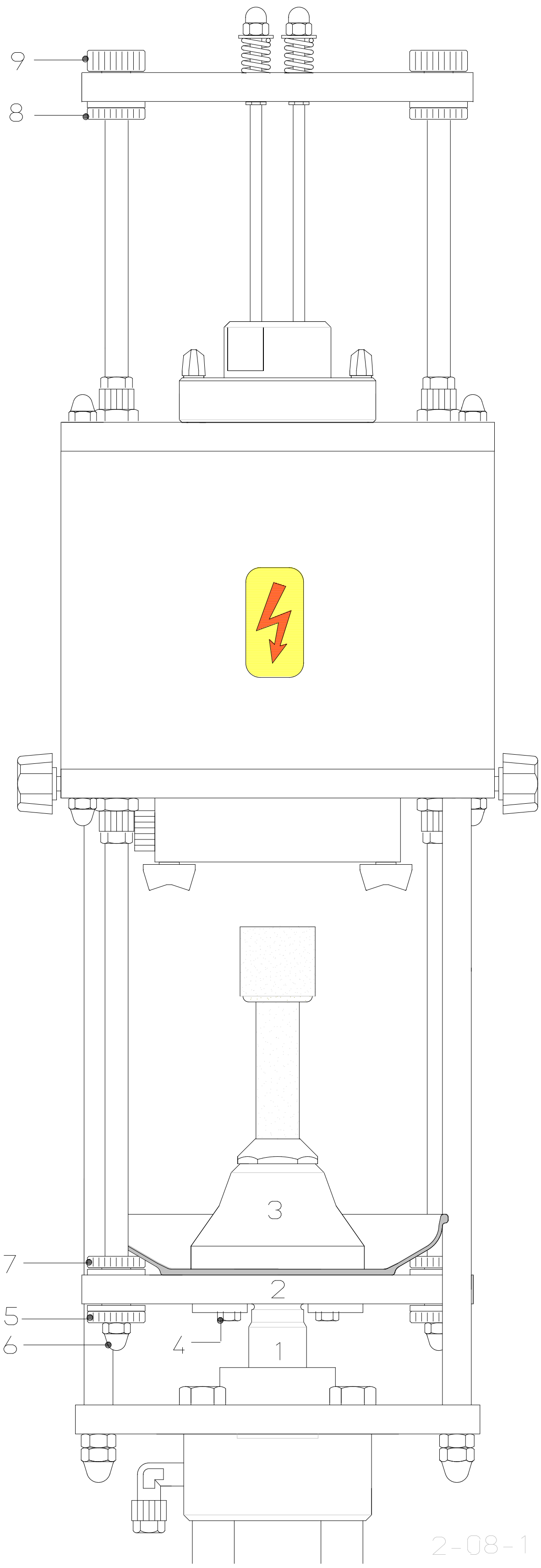


Fig. 51: Furnace

- You should ensure that the shaft (1) is securely fastened to the base (2).
- – If not, hold the base (2) securely and tighten the shaft (1) (engineers wrench size 17).

In order to adjust the cone, the screws (4) should be loosened so that the cone (3) moves horizontally on the base (2).

- Close the furnace (with the lift upwards).
- Tighten the screws (4).
- – The cone is now positioned correctly.
- The screws (7), (5), (6), must now be well tightened in this order.
- The screws (8) should be properly fastened (with a wrench).
- The screws (9) should only be tightened by hand.

4.7 Linearisation

See software helps.

4.8 Balance programming

Basic settings for all types of balances:

- – 9600 Baud
- – No parity
- – Send continuously

4.9 Induction generator control

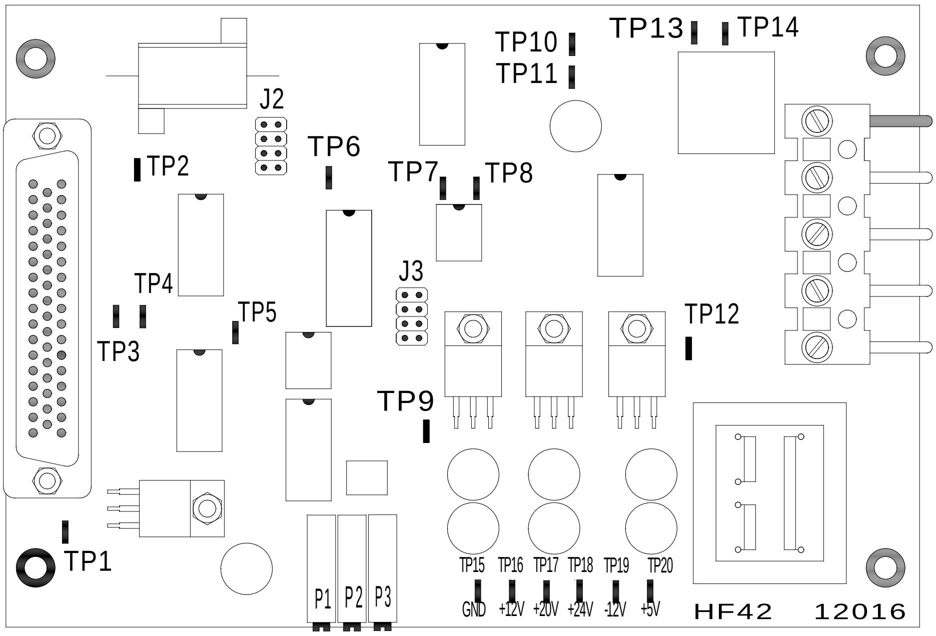


Fig. 52: HF42

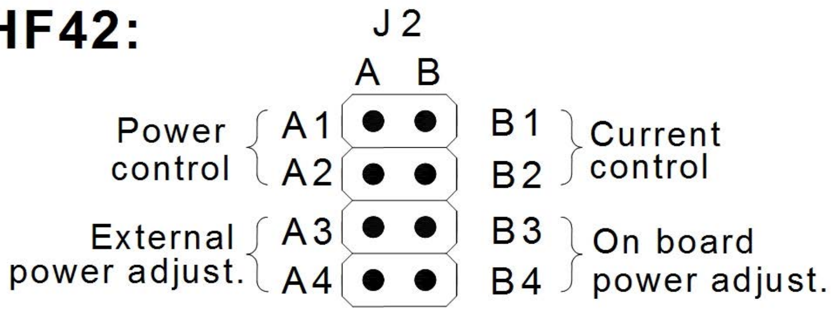


Fig. 53: Jumper setting

– Current control:

  The current control provides a safer and more accurate control of the furnace intensity.

- Set the jumper J2 to B1-B2.
- Connect a digital multi meter on TP1 (TP15 is GND).

  Adjust only, while the furnace is active:

- Start the analysis, adjusting P2 until 6.3V DC is reached on TP1 (for copper analysis adjust 1.2V DC).

The following diagrams show the relationship between the set value (adjustment with P2 on the HF 42 board) and the generator parameters.

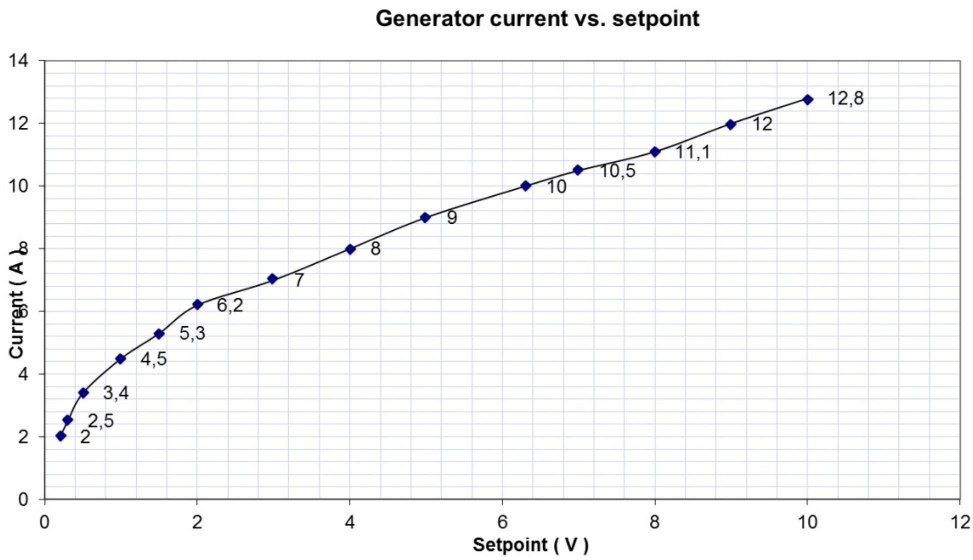


Fig. 54: Diagramm generator current vs. setpoint

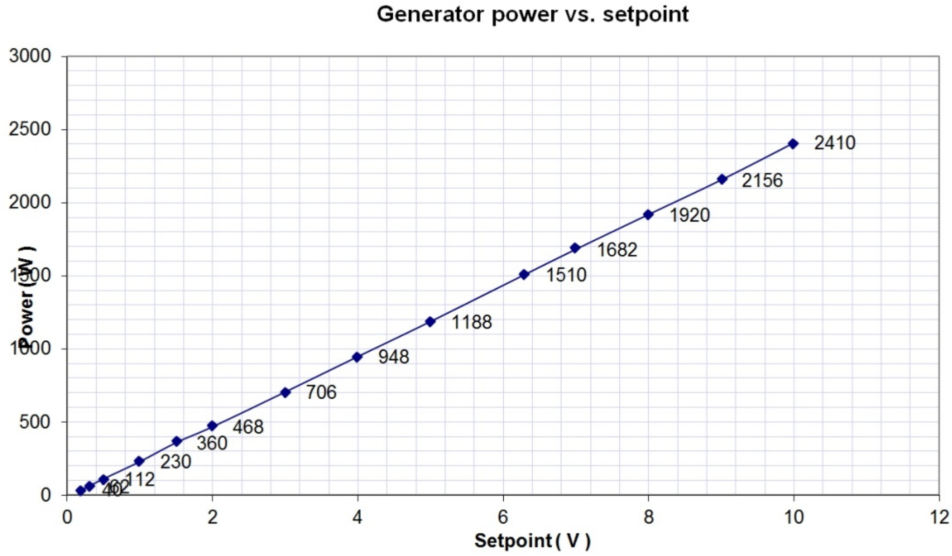


Fig. 55: Diagramm generator power vs. setpoint

5 Service

5.1 IR-paths, cleaning and replacing

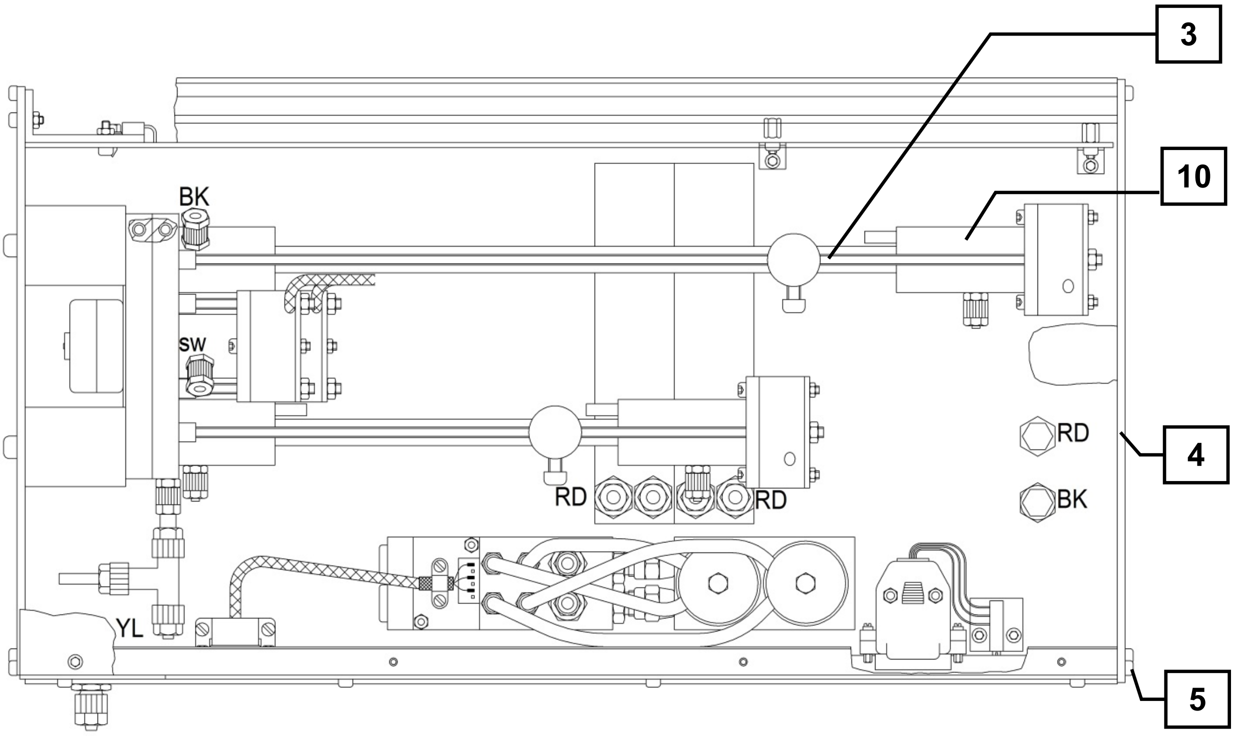


Fig. 34: IR-paths (3-1-1S)

- Unscrew and remove the tubes from the IR-paths.
- Remove the nuts (2) (Size 7); in doing this, the threaded rods (3) should be held tight to prevent them from turning with the nut.
- To be able to remove the nut (2) from the maximum length IR-path (10), remove the plate (4) by unscrewing the four screws (5).
- Take out the pre-amplifiers (6) together with the spacers (7).
- Clean the paths with a cleaning solvent, e.g., ethanol.
- – With a three part path, such as (B) and (C), the windows can be cleaned on the inside using a cotton swab.
- In case of a single part path, such as (A), the path is filled with ethanol and, after a few minutes, oxygen is blown in, to clean and dry out the path.

Soiling, which can accumulate from the analysis of materials that contains a lot of sulphur and moisture or hydrogen, can be very difficult to clean. In such cases, the paths should be replaced.

- – Before reassembling the paths, the threaded rods (3) should be screwed in by hand, in order to ensure that they are firmly installed.
- – Assembly of the paths follows in the reverse order.
- Reconnect the plugs (17) of the preamplifiers (6), in case they were removed.
- \- Readjust the base lines.

See chapter Infrared power supply and chapter Infrared baseline adjustments

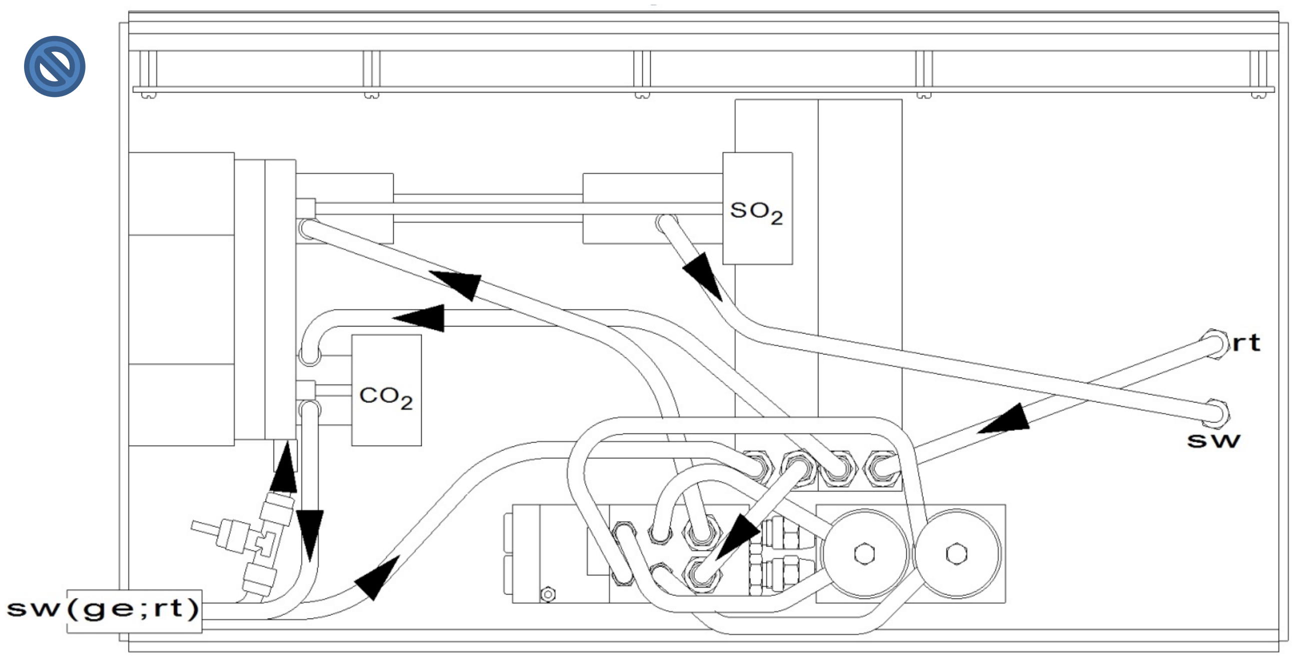


Fig. 56: Infrared cell

By reinstalling the infrared cell unit in the analyzer, you must pay attention to the color markings of the tubes and their connections.

1 black marked tube connection

2 yellow marked tube connection

3 red marked tube connection

5.1.1 Available infrared paths

Path length	% C	Material/ Sample weight	% S	Material/Sample weight
1 mm				
3 mm	6	Metals / 500 mg		
6 mm	5	Metals / 500 mg		
10 mm			40	Non Metals / 200 mg
20 mm			20	Non Metals / 200 mg
30 mm				
40 mm				
50 mm				
100 mm			4	Non Metals / 200 mg
120 mm	0,2	Metals / 500 mg		
140 mm				
170 mm				
200 mm	0,1	Metals / 500 mg		
275 mm				
300 mm			0,3	Metals / 500 mg

Comments:

1,5 g Tungsten accelerator are needed when analyzing Metals.

Above sample weights for metals and alloys are just guidelines. For more accurate information read the operation manual.

The following materials are used as non metals: cement, stone, soils, etc.

5.2 Infrared electronics

See chapter Infrared power supply and chapter Infrared baseline adjustments

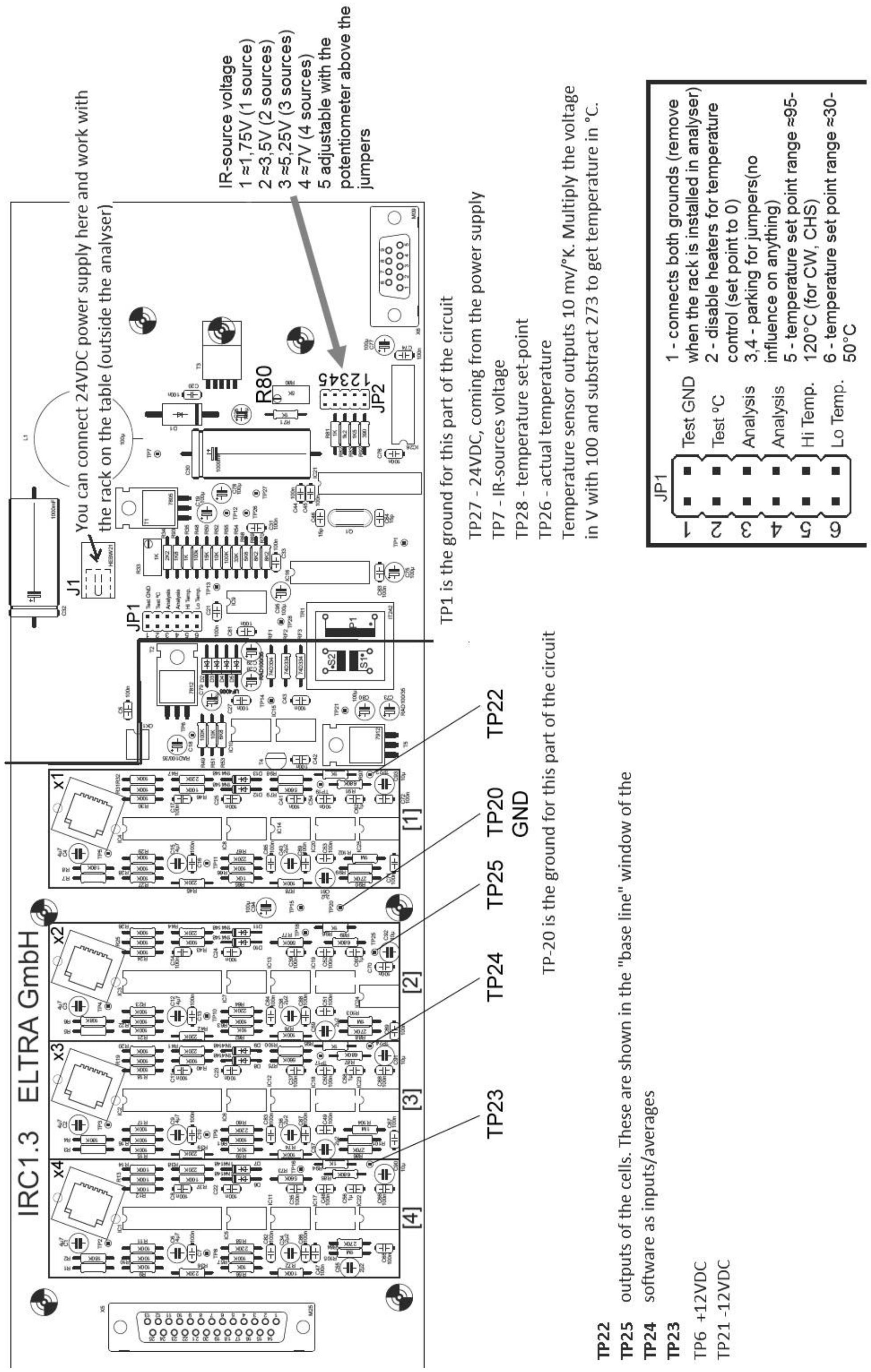


Fig. 57: Circuit board IRC1.3

5.3 General test points

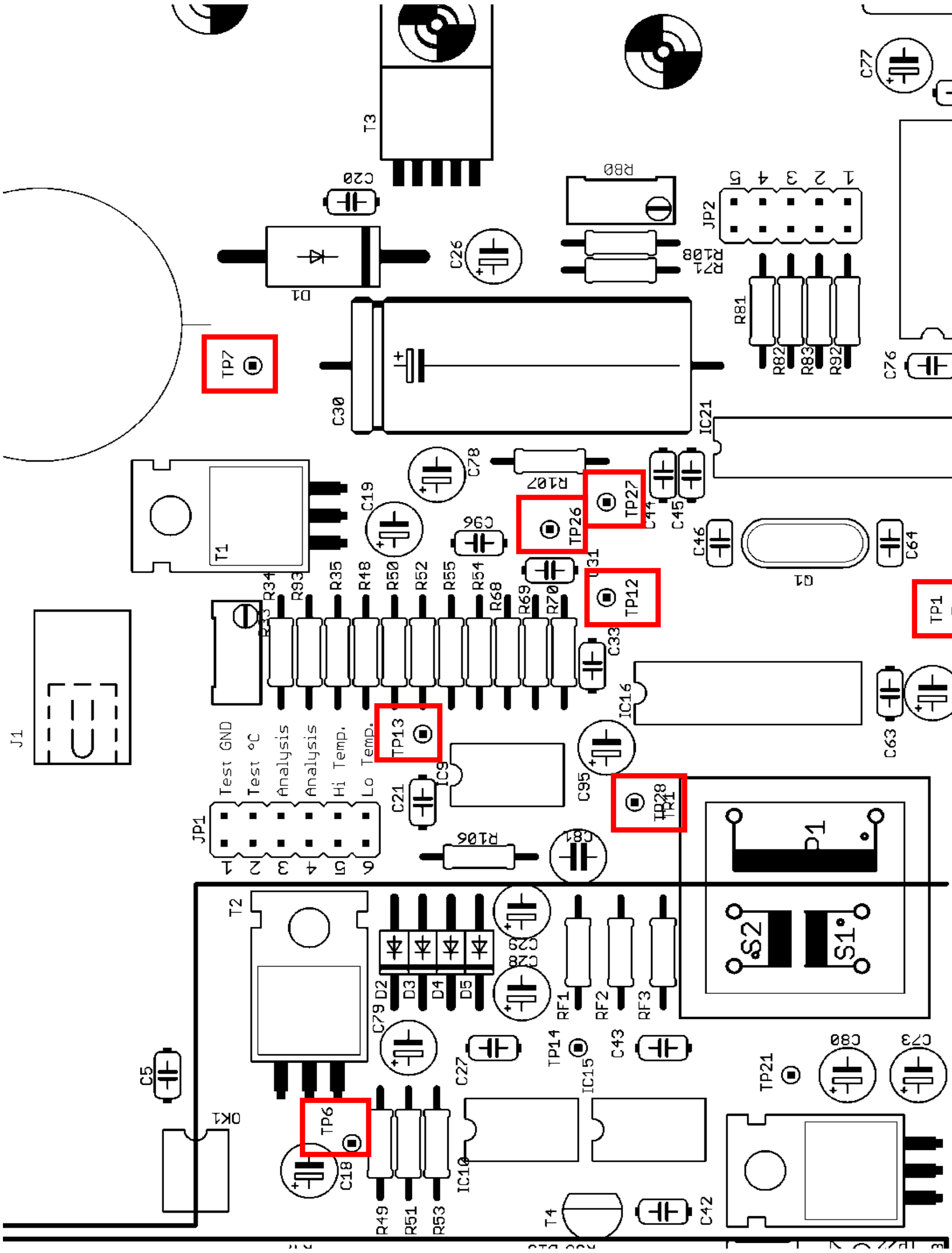


Fig. 35: Mainboard (Cut-out) IR-cell – general test points)

5.3.1 Supply voltages and thermostatic control circuit

TP 1:	GND
TP 7:	IR source voltage
TP 12:	+ 5V supply
TP 13:	Heating transistors control voltage
TP 26:	IR temperature actual value
TP 27:	+24V supply
TP 28:	IR temperature set point

5.3.2 Supply voltages for IR signal processing circuit

TP 6:	+12V

TP 21: -12V

5.4 IR-Channels test points

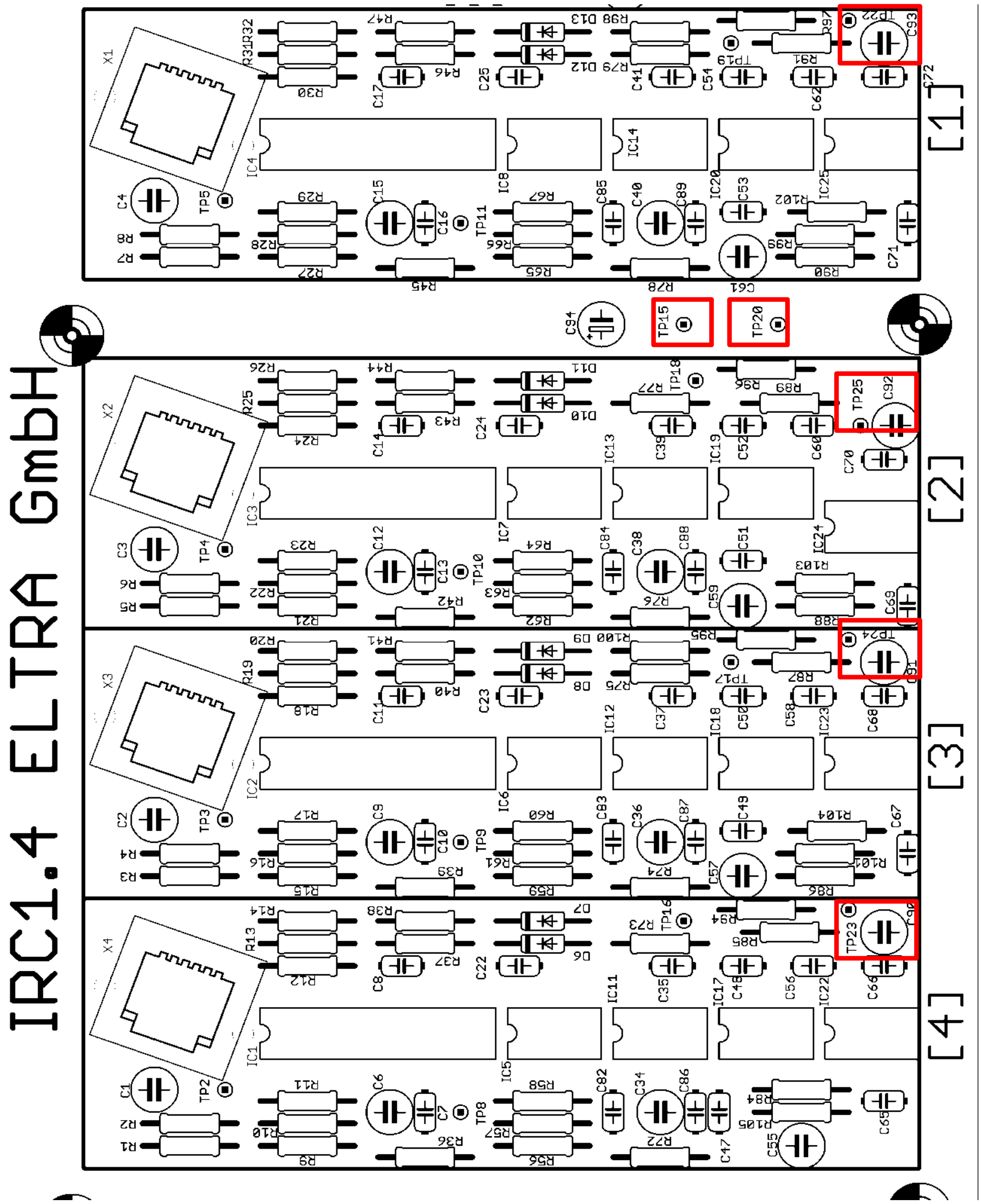


Fig. 36: Mainboard (Detail) IR-cell – test points IR-channels

5.4.1 Supply voltages for IR signal processing circuit

TP 15: +5V reference

TP 20: Analog GND

5.4.2 Outputs (base lines about 8VDC. Less no problem)

TP 22: Output section [1]

TP 25: Output section [2]

TP 24: Output section [3]

TP 23: Output section [4]

For the range assignment of the infrared cell board IRC1.x see the correspondent chapter Infrared cell board IRC1.x sections assignment.

5.5 Infrared power supply

The IRC module is powered by a 24VDC power supply which is specified with 5A.

Depending on the quantity and on the kind of IR cells in a module (rack), the maximum current at the moment of switching ON from cold, can be as high as 3.5A.

If the temperature control is deactivated, the module can be operated with a power supply of 24V / 1A.

In case of servicing an IR cell, the IR cell module has to be taken out of the analyzer's cabinet and be operated on a desk using an external power supply. The 24V power can then be connected on the connector J1 of the IRC board. See graphic below.

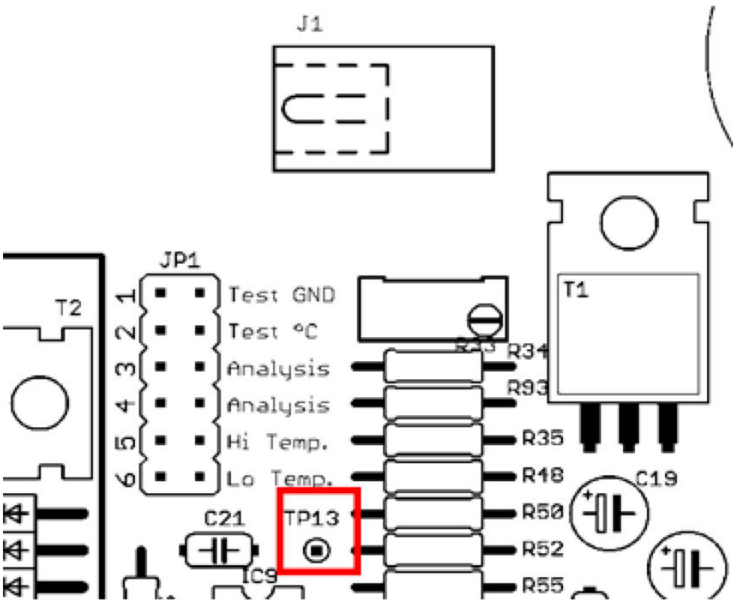


Fig. 58: IR power supply

If there is no power supply 24VDC / 5A, the IR module can be operated by using a power supply of 24VDC / 1A by setting a jumper on 2-Test°C of the JP1. However 1A is the absolute minimum current required. If the power supply can supply more than 1A, a proper operation is more secure.

A jumper is possibly available on JP1 on the positions 3-Analysis or 4-Analysis. A jumper on any of these two positions doesn't have any functionality. These two positions are simply for "parking" jumpers in order to have them available in case they are needed.

NOTICE

Don't forget to remove the jumper from position 2-Test°C before reinstalling the IR module into the Analyzer.

5.6 IR-source

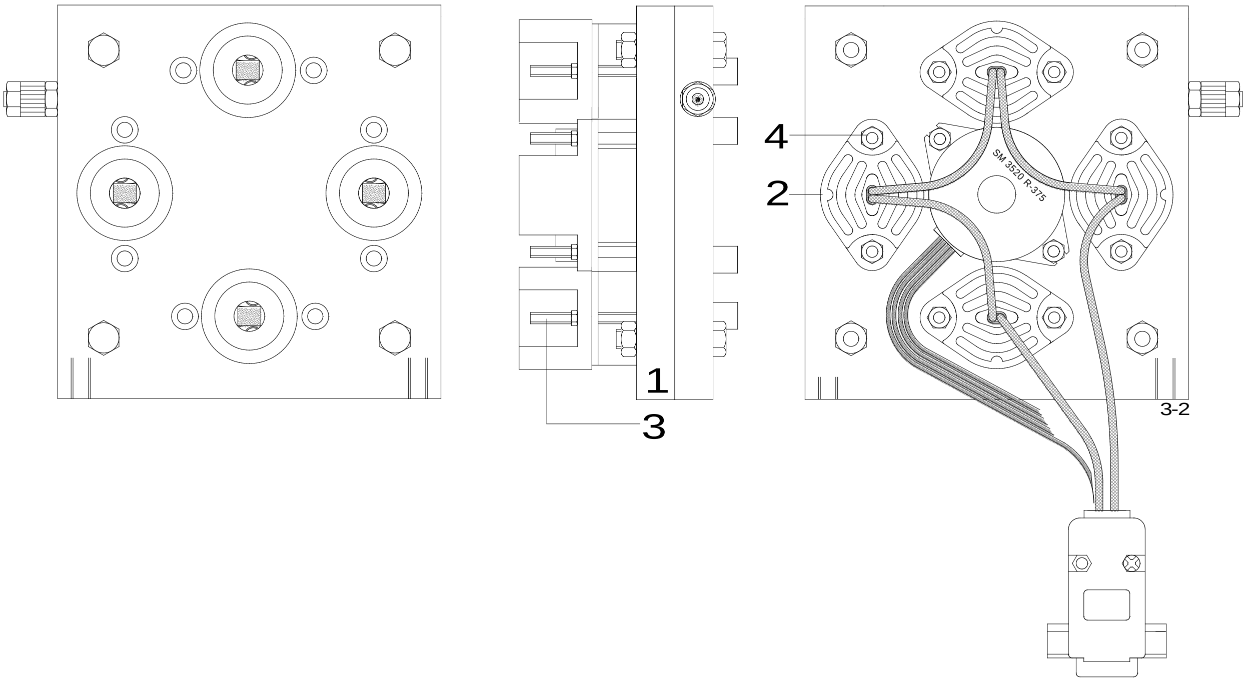


Fig. 37: Infrared source

– The IR sources (2) are fastened with the screws (3)

• To install or removing the IR-source (2), the complete chopper motor assembly (1), together with the mounted paths and pre-amplifier, should be removed from the infrared unit.
See chapter IR paths cleaning and replacing

– The chopper motor housing (1) does not need to be unscrewed. Either by removing or installing the IR-source.

• In order to remove the IR-source, unscrew the nuts (4) with a (5.5 mm wrench) and counter the screws (3) at the same time.

NOTICE

The position of the IR sources in their housing has to be as shown in the graphics A and B.

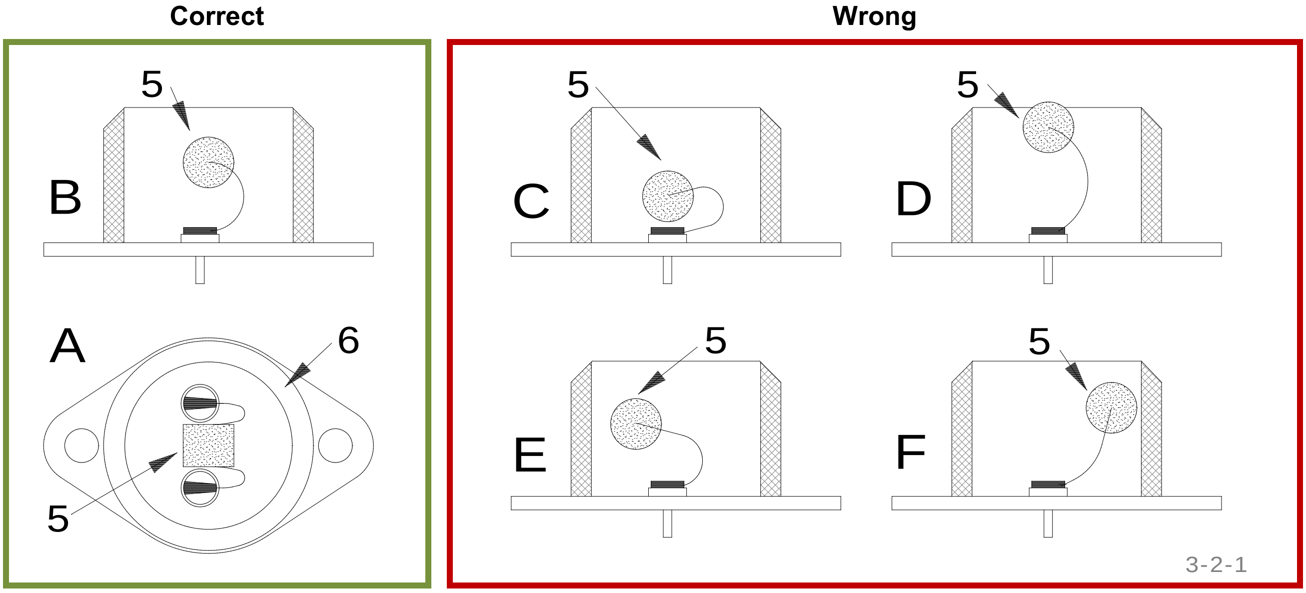


Fig. 38: IR sources in their housing

If the position of a source is wrong, the radiation reaching the IR sensor is lower than when the source is in the right position. It may happen that after transportation due to a strong shock that the base lines are not in the right level due to the sources being not in the right position any more. For correct base lines see chapter “Infrared cell adjustments”.

(Take care in case of previous IR cell models having a base line around zero volts.)

For correcting the position of bent IR sources use a thin forceps or carefully push them to the right central position by using a thin screw driver. Take care not to bend the wires too far. They are quite hard so that when bending back and forth they may break.

In case of changing a source, the wires must be very properly soldered because the resistance of a source is below one Ohm.

All IR sources for all available cells in a module are connected in series.
For adjusting the IR source voltage see chapter IR-source voltage setting.

5.7 Leak checking

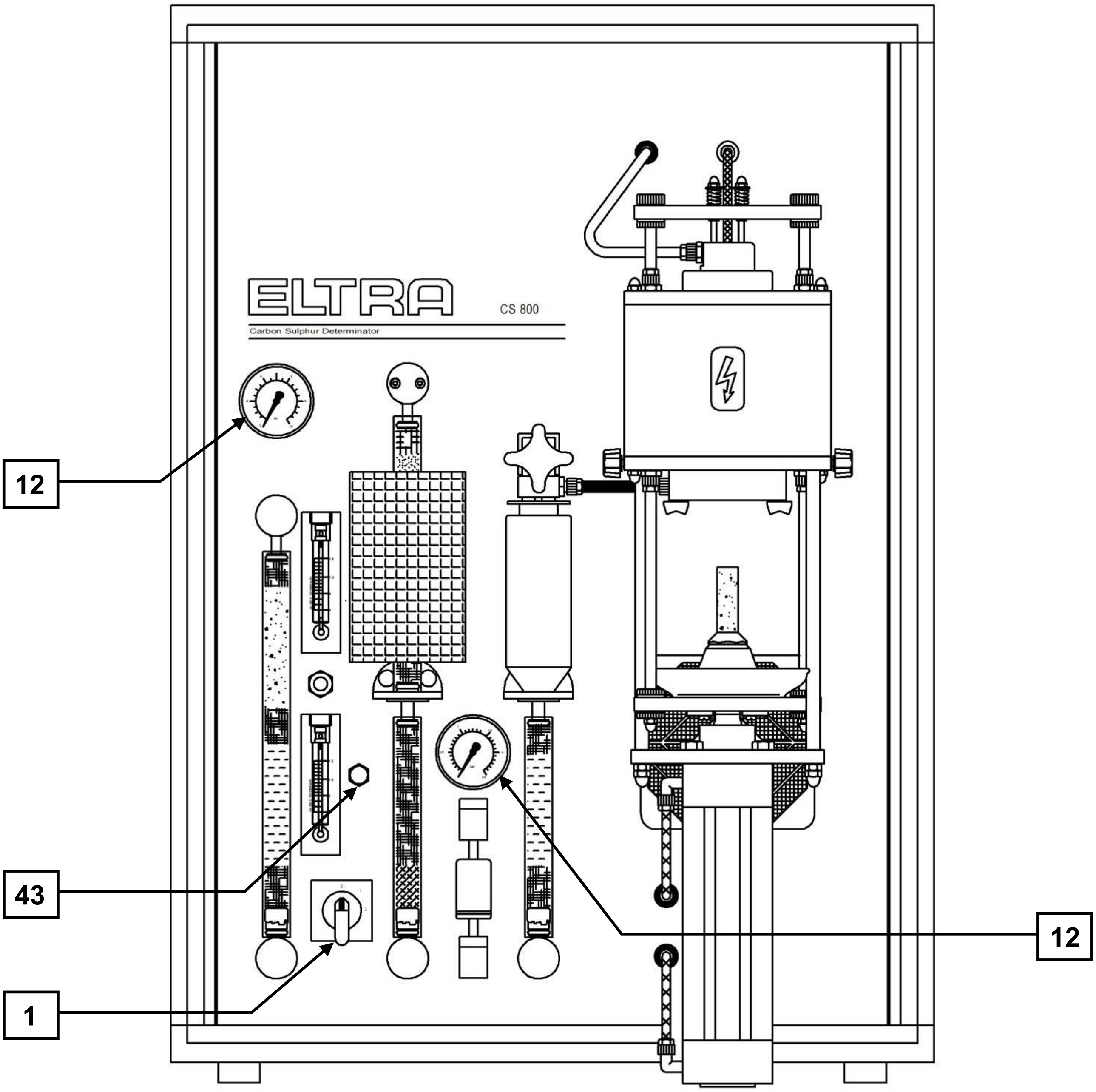


Fig. 59: Front side (without cover)

- Set the power switch (1) to pos. 2.
- Close the furnace.
- Press and hold the button (43).
- – The entire system will be checked for leaks.

The leakage test is completed when the initial pressure drops (about 5 seconds) on gauge (12) and then remains constant, the gas system is ok.

- Should there be a continuous pressure drop, then release the button (43), open the furnace, press and hold the button (43) again.
- – If the pressure is stable then the leakage will found in the furnace.
- – If the pressure still decreases, then the leakage is to found inside the analyzer.

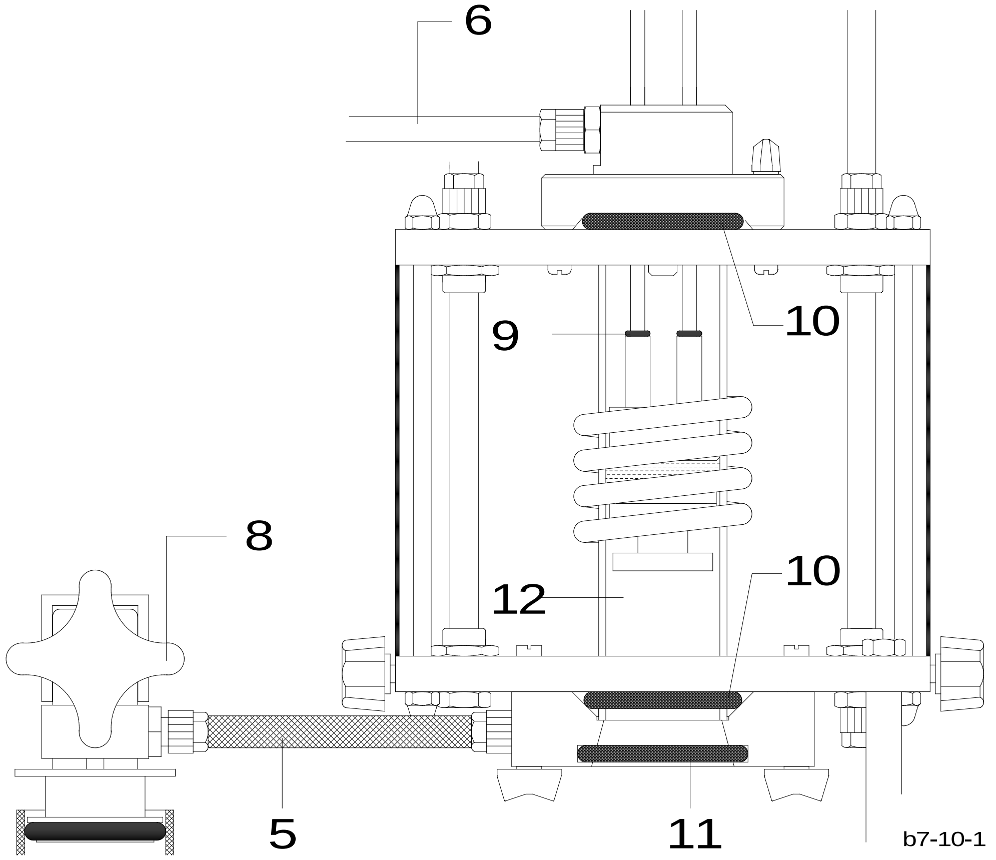
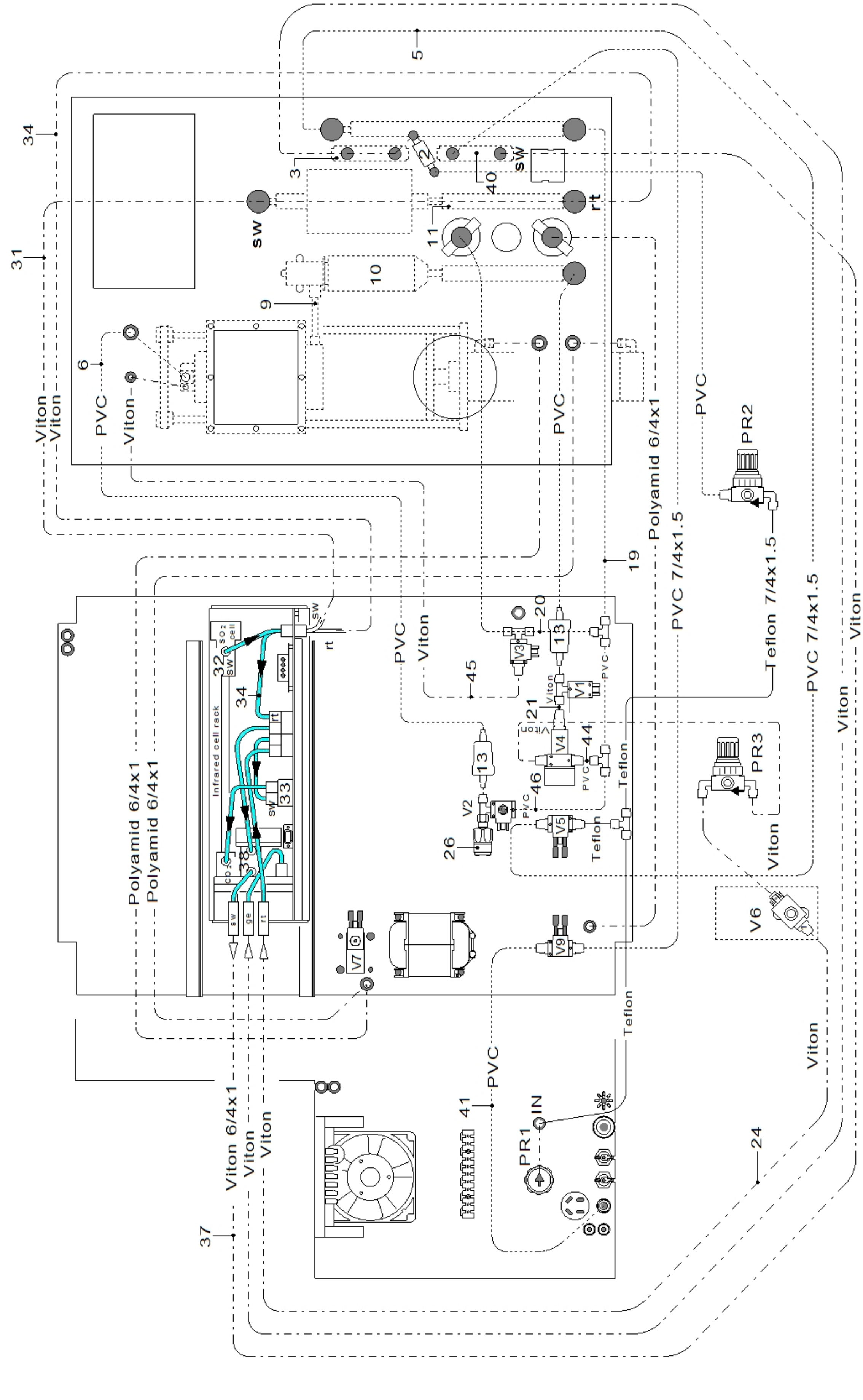


Fig. 60: (b7-10-1)


34
31
Viton
Viton
PVC
6
Viton
sw
9
10
11
3
2
40
sw
rt
5
PVC
Polyamid 6/4x1
PVC 7/4x1.5
19
PR2
Teflon 7/4x1.5
PVC 7/4x1.5
Viton
Viton
PR3
Viton
V6
20
V3
13
V1
45
21
V4
44
46
13
V2
V5
26
Teflon
Teflon
PVC
Viton
Polyamid 6/4x1
Polyamid 6/4x1
Infrared cell rack
32
34
33
38
sw
ge
rt
V7
V9
Teflon
PVC
41
IN
PR1
Viton
24
Viton 6/4x1
Viton
Viton
37

- Release the push button (43).
- Close the furnace, squeeze the tube (6) tightly and press and hold the button (43).

If the pressure on gauge (12) remains constant, then the furnace has to be checked for leaks.

If the pressure shown on gauge (12) drops then the leakage has to be found somewhere along the furnace inlet system.

5.7.1 Furnace inlet system - leaks

- After following the above instructions, check for gas leakage between inlet tube (6) and reverse valve (V2).

5.7.1.1 Leaks in the furnace

After following the above instructions, close the furnace, squeeze tube (9) tightly, press and hold the button (43), observe the pressure gauge (12).

If the pressure drops, then the furnace is leaking.

- Check whether the O-rings (16), (17) and (18) are soiled or defective see Operation Manual.
- Check whether the combustion tube (15) is broken or cracked.

– If the pressure remains constant, then the furnace outlet system is leaking.

5.7.1.2 Leaks in the furnace outlet system

- After following the instructions in the section "Leaks in the furnace", check if the handle (8) is properly shut, or else there will be a major gas leak from the dust filter.
- Check the following components for leakage, by squeezing the following tubes, while pressing and holding the button (43):

Tube to squeeze	Leak location
19	dust trap (10) glass tube (11) dust filter cartridge (13) outflow valve (V1)

5.7.1.3 Leaks inside the analyzer

When pressing the button (43), the gauge (12) shows a pressure drop while the furnace is open then locate the leakage, according to the sequence below.

- Keep the furnace opened.
- Squeeze the following tubes tightly, while pressing and holding the button (43):

Tube to squeeze	Leak location
4	Exhaust valve (V9)
37	Flow meter (40)
34	CO2-Paths (38)
31	SO3-Trap (35) or oxidizing furnace tube (36)
24	SO2-Path (32) or flow sensor (33)
23	Regulator valve (V6)
22	Pressure regulator (PR3)
44	Bypass valve (V4), check for 24 VDC on input pins

45	Purging valve (V3), check for 0 VDC on input pins
46	Reverse valve (V2), check for 24 VDC on input pins

NOTICE

Do not cause a short circuit while measuring!

- If the voltages on V2, V3, or V4 are wrong replace the electronic drivers.

5.8 Solenoid valves cleaning

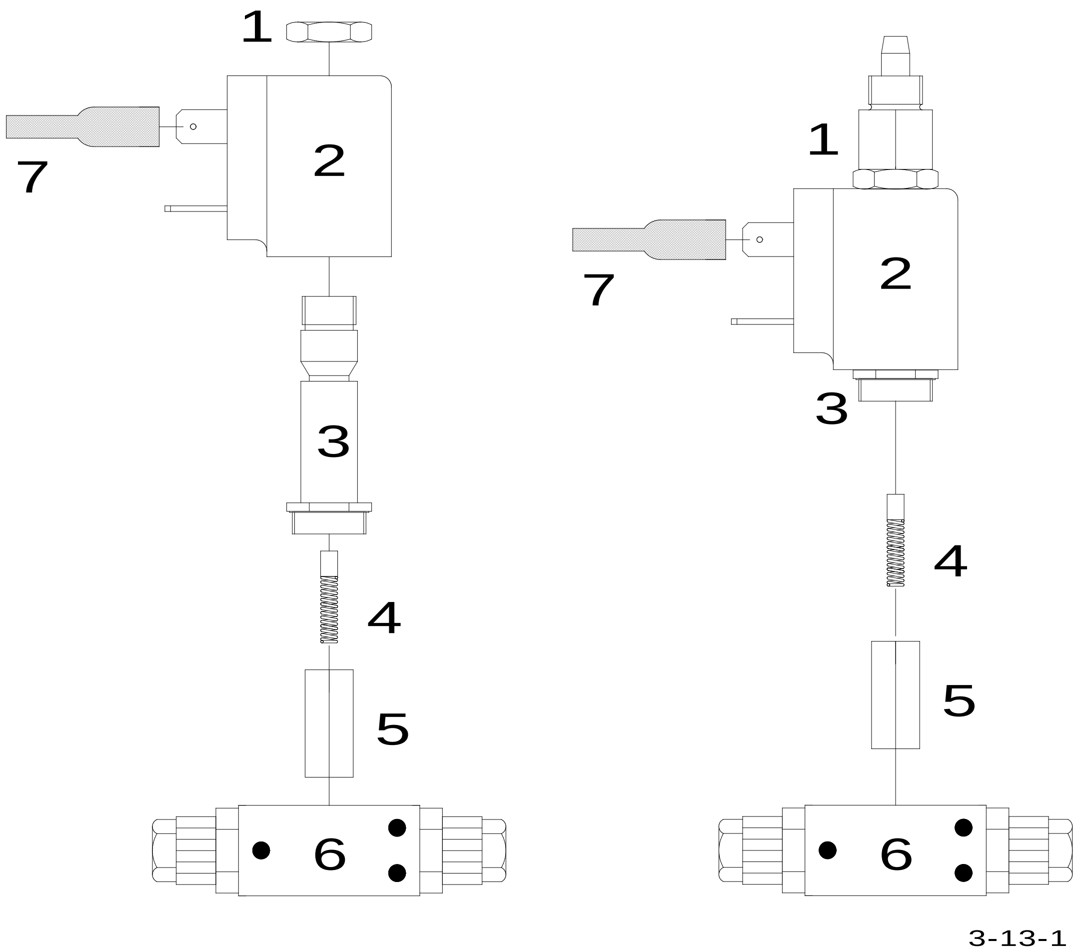


Fig. 61: Solenoid valves (3-13-1)

- Turn the power switch to pos.0
- Unplug the main power plug as well
- Remove the connector (7)
- Unscrew the nut (1)
- Remove the coil (2) (only with the 2/2 valve)
- Unscrew counter-clockwise the hexagon screw on the armature housing.
- Remove the armature (5) (only with the 2/2 valve)

NOTICE

Do not lose the spring (4).

– With oxygen pressure or compressed air, clean the inside of the armature housing (3), as well as the armature (5) and re-assemble the solenoid valve.

- With the furnace closed and renewed oxygen pressure, check to ensure that the solenoid valve is sealed.

5.9 Flow sensor - replacing / cleaning

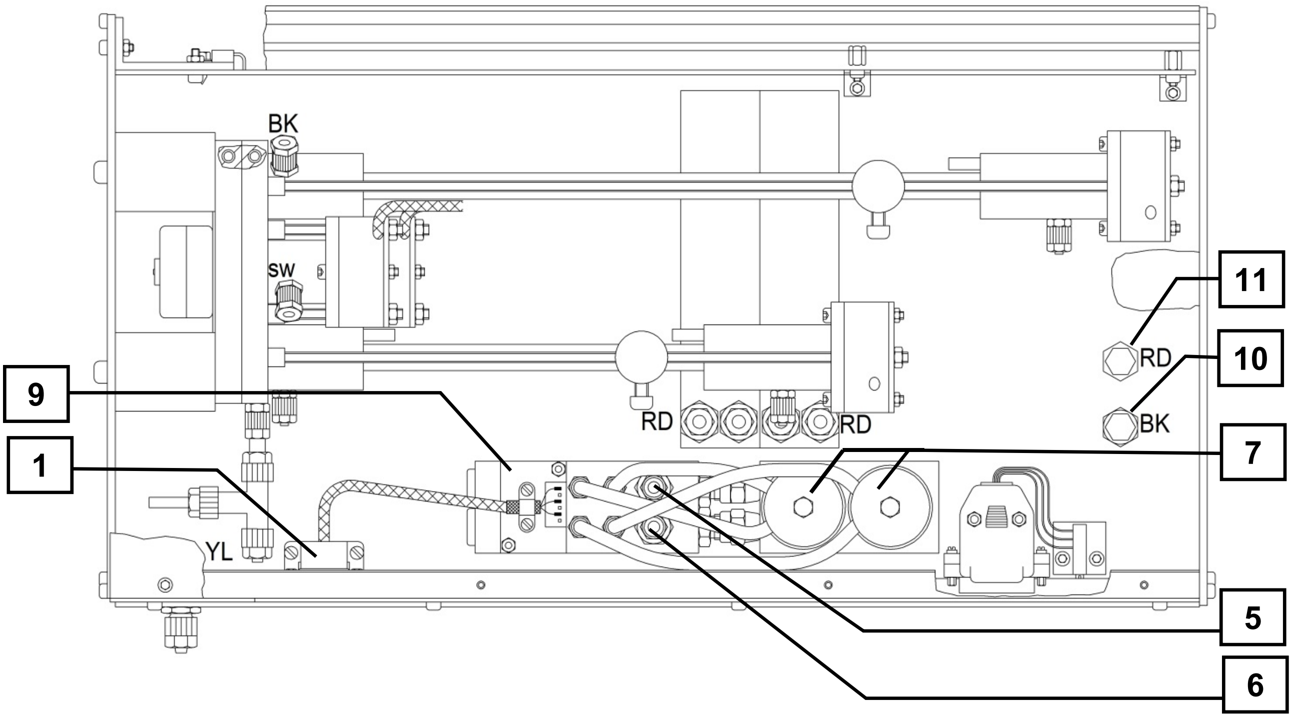
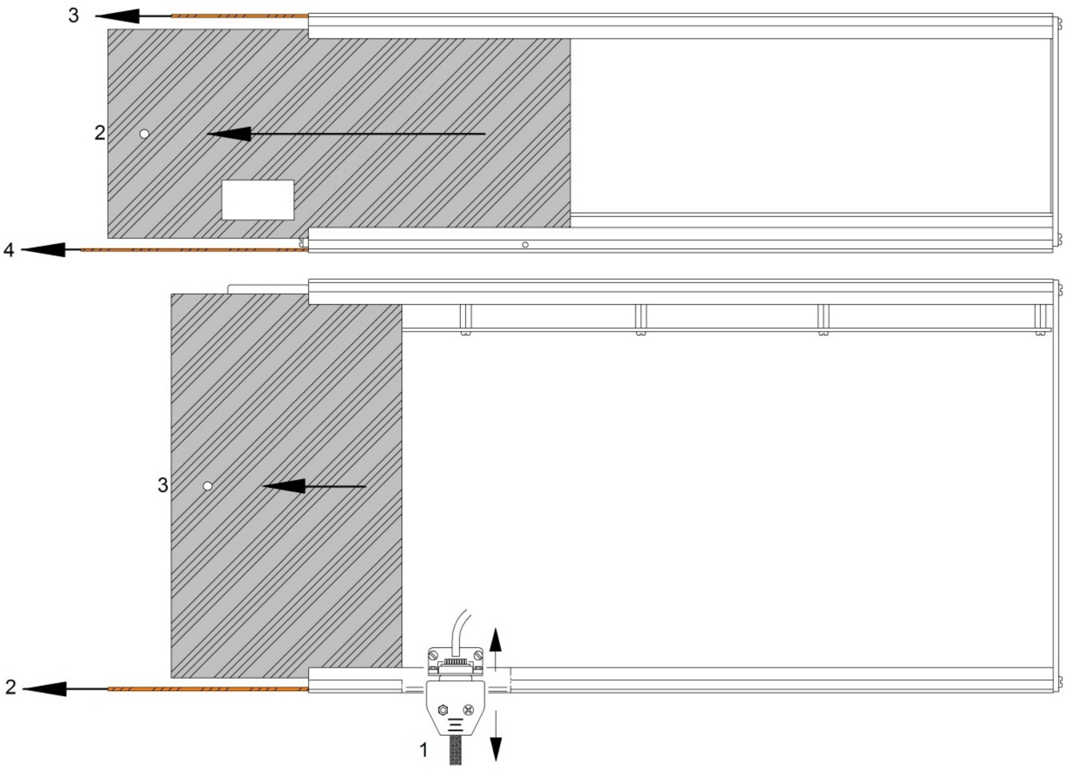


Fig. 39: Flow sensor (3-14)



5.9.1 Flow sensor replacing

- Set the power switch to pos. 0.
- Remove the left side panel of the analyzer
- Unplug the two cables at the rear-side of the infrared rack

- Remove the tubes (10) and (11) at the bottom-side of the infrared rack
- Unplug the plug (1)
- Pull out the infrared rack from the analyzer
- Remove the left side cover (2), the top cover (3) and the bottom cover (4) of the infrared rack
- Remove the two tubes (5) and (6) from the flow sensor (9)
- Remove the two screws (7) underneath the flow sensor.
- Remove the old flow meter, install the new one.
- Reassemble the infrared rack in reverse order.
- – Pay particular attention to the position of the tubes (5), (6), (10) and (11).
- Adjust the flow sensor.

5.10 Furnace pneumatics - additional safety features (optional)

The furnace doesn't change position in case of a power failure.

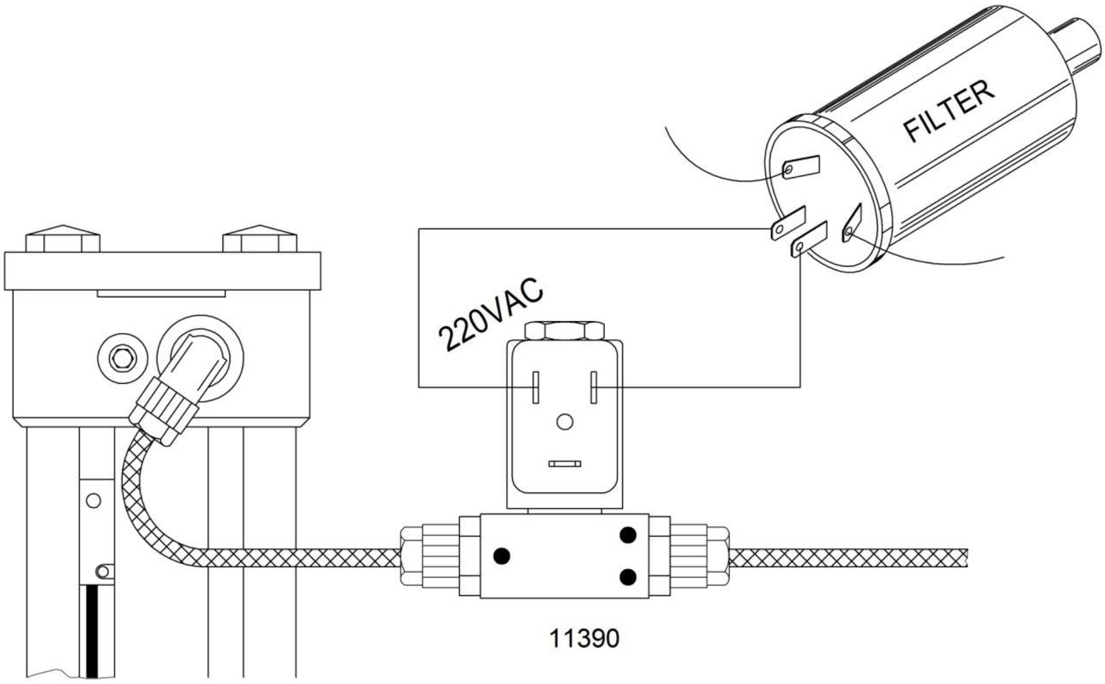


Fig. 62: Furnace power failure

By adding a solenoid valve (8) and connecting the coil directly to 220V AC, the piston won't change position in case of a power failure. If the piston was down, it will remain down; if it was up, it will remain up.

5.11 Halogen trap - installing

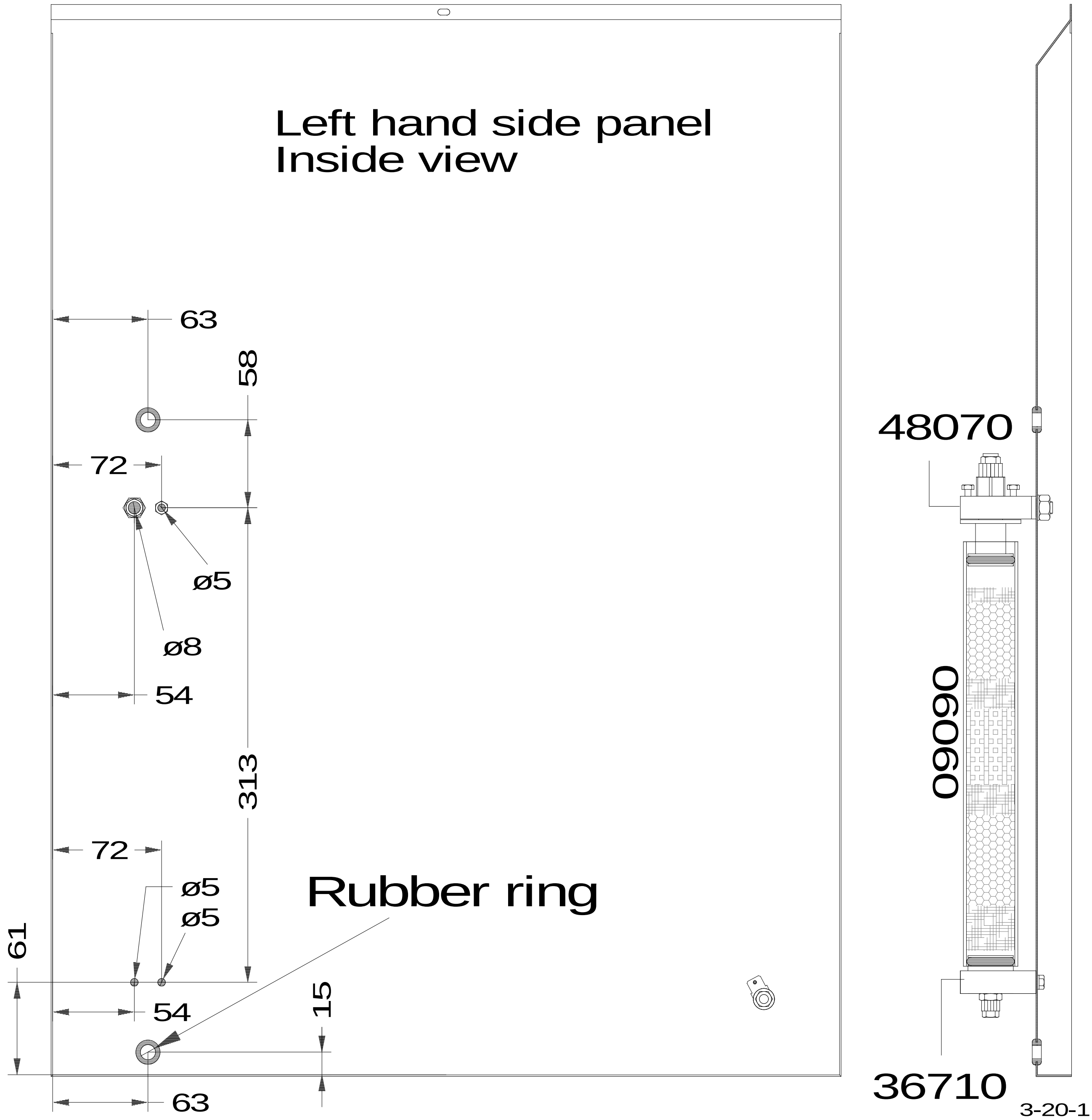


Fig. 63: Halogen trap installation (3-20-1)

5.12 Gas saving mode

NOTICE

This option is functional with EPROMS and PC software versions, later than June 2001.

If the analyzer has the HF41 board:

- Set the jumper setting to A1 with A2 on J2

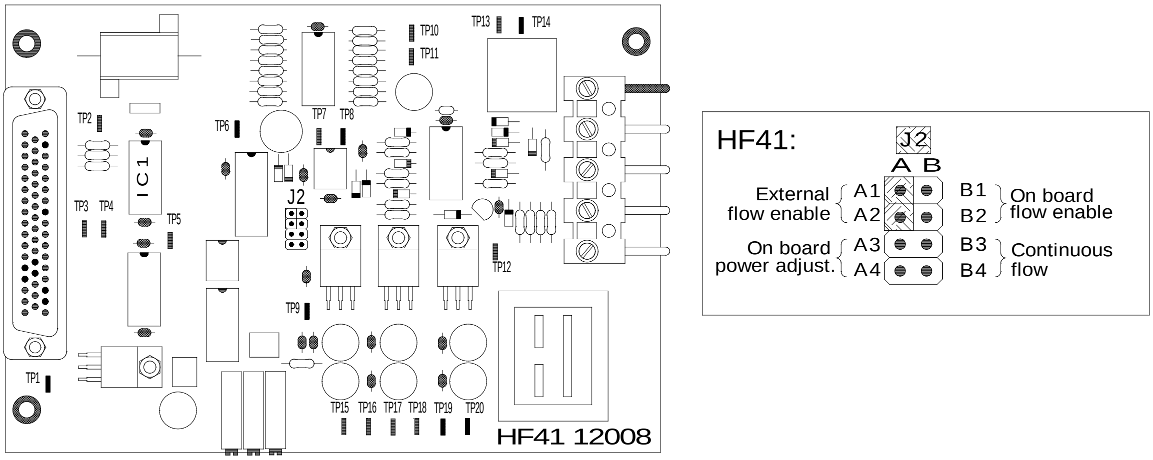


Fig. 64: HF41 board jumper setting for gas saving mode

If the analyzer has the HF42 board:

Set the jumper setting to connect A1 with A2 on J3

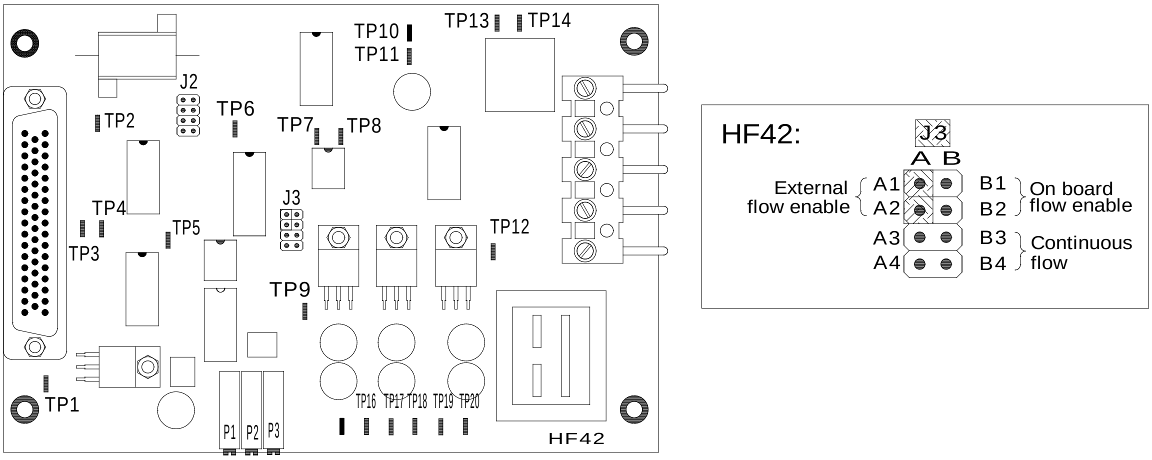


Fig. 65: HF42 board jumper setting for gas saving mode

See chapter Gas flow controller and jumper settings.

6 Miscellaneous

6.1 Ordering numbers

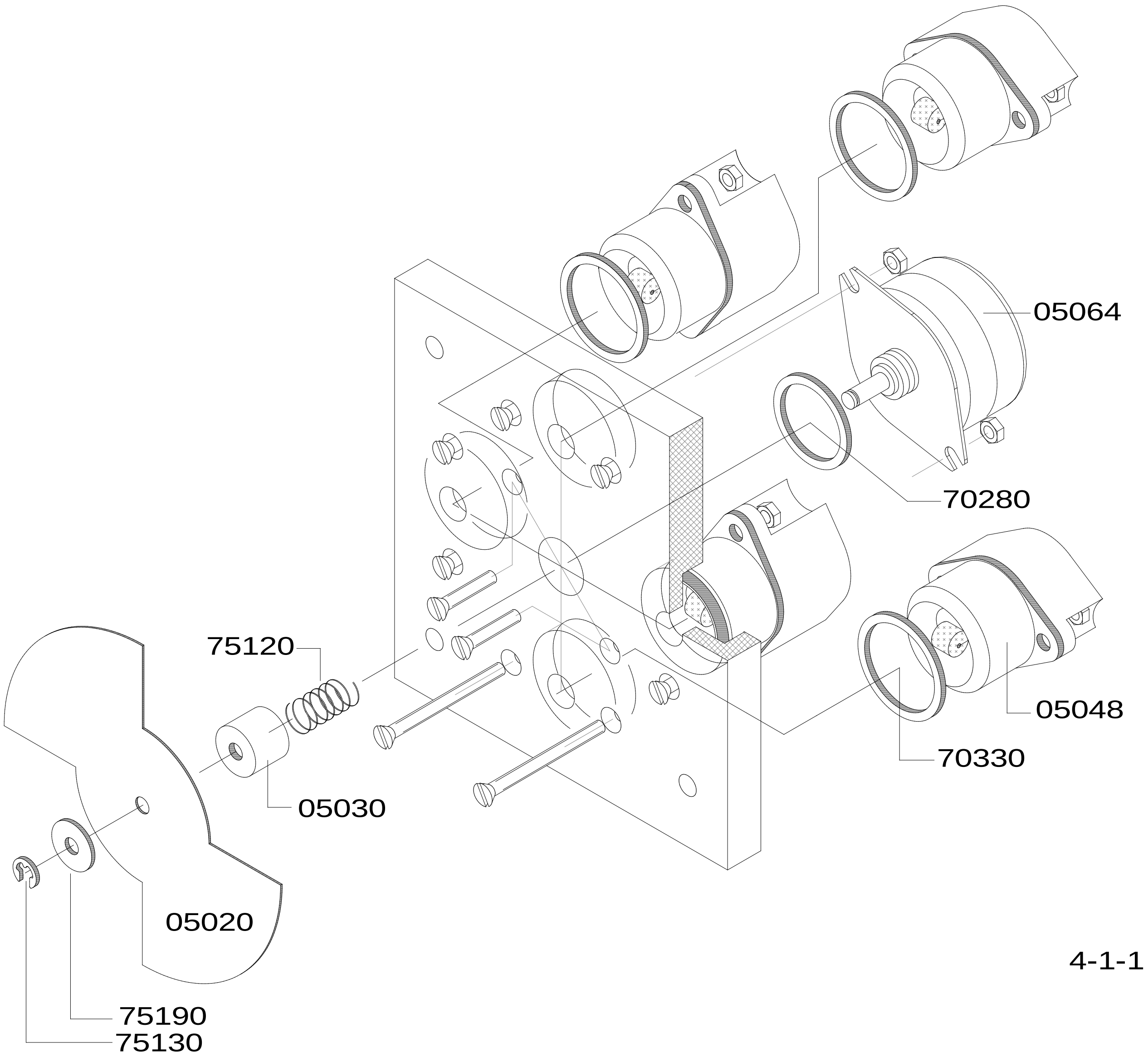
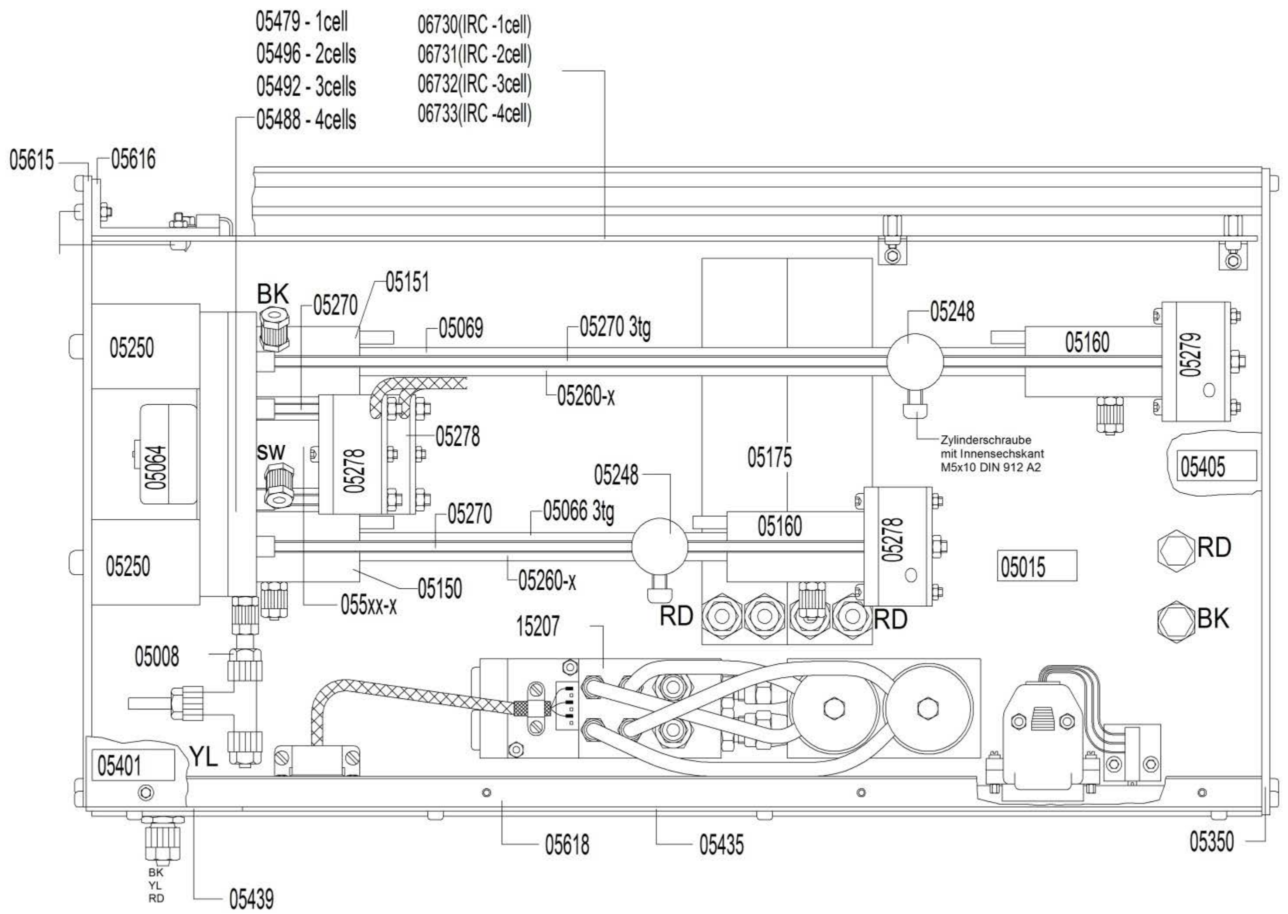


Fig. 40: 4-1-1

05020	Chopper blade
05030	Chopper blade holder
05064	Chopper motor
05048	Infrared source (emitter)
70280	O-ring
70330	O-ring
75120	Spring
75130	Retaining washer

75190 Washer

6.1.1 Infrared cells



05060	Reflector
05067	IR-path for high carbon
05150	IR-path connector with window source side
05160	IR-path connector with window detector side
05170	Gas conditioner
05244	IR 4 chopper
05260	IR-path tube (advice the length)
05270	Threaded rod (advice the length)
05275	Infrared preamplifier
06210	IR-cable
06670	IR-zero adjustment board
06733	Infrared electronics board
15207	Gas flow sensor
70180	O-ring
70330	O-ring

77510 Heaters for IR-cell

6.1.2 Front side

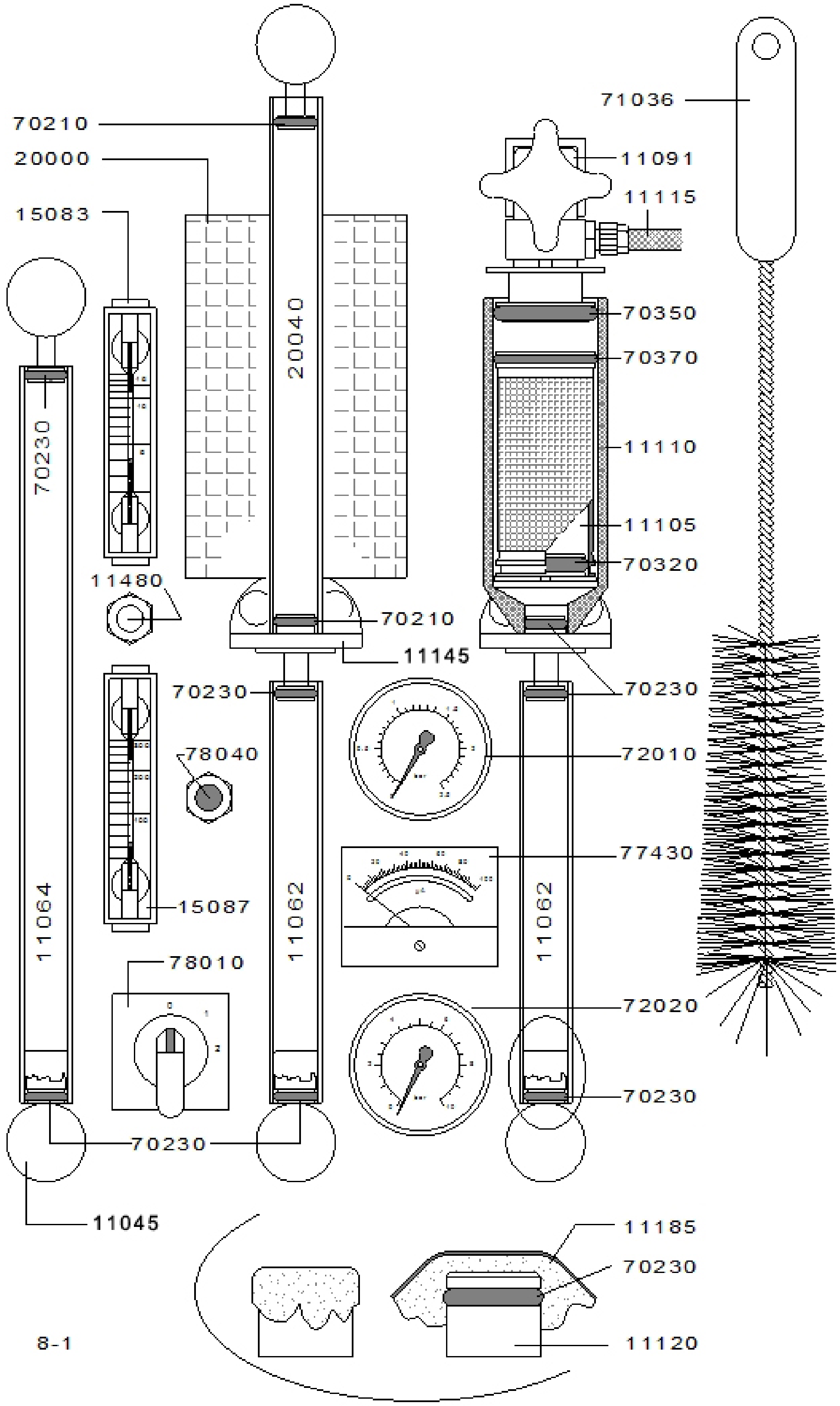


Fig. 41: Front side

05000	IR-cell
11180	Dust cartridge
11390	Oxygen solenoid valve
11400	Pressure outlet solenoid valve
11415	Oxygen stop solenoid valve
11430	Purge solenoid valve
11440	Bypass solenoid valve
11492	Pressure regulator
11492	Inlet pressure regulator
11495	Purge pressure regulator
12016	Gas flow and furnace control board HF 42
12044	Transformer
16100	Power supply board NK 31
18467	Microcontroller board UNI

6.1.3 Right side:

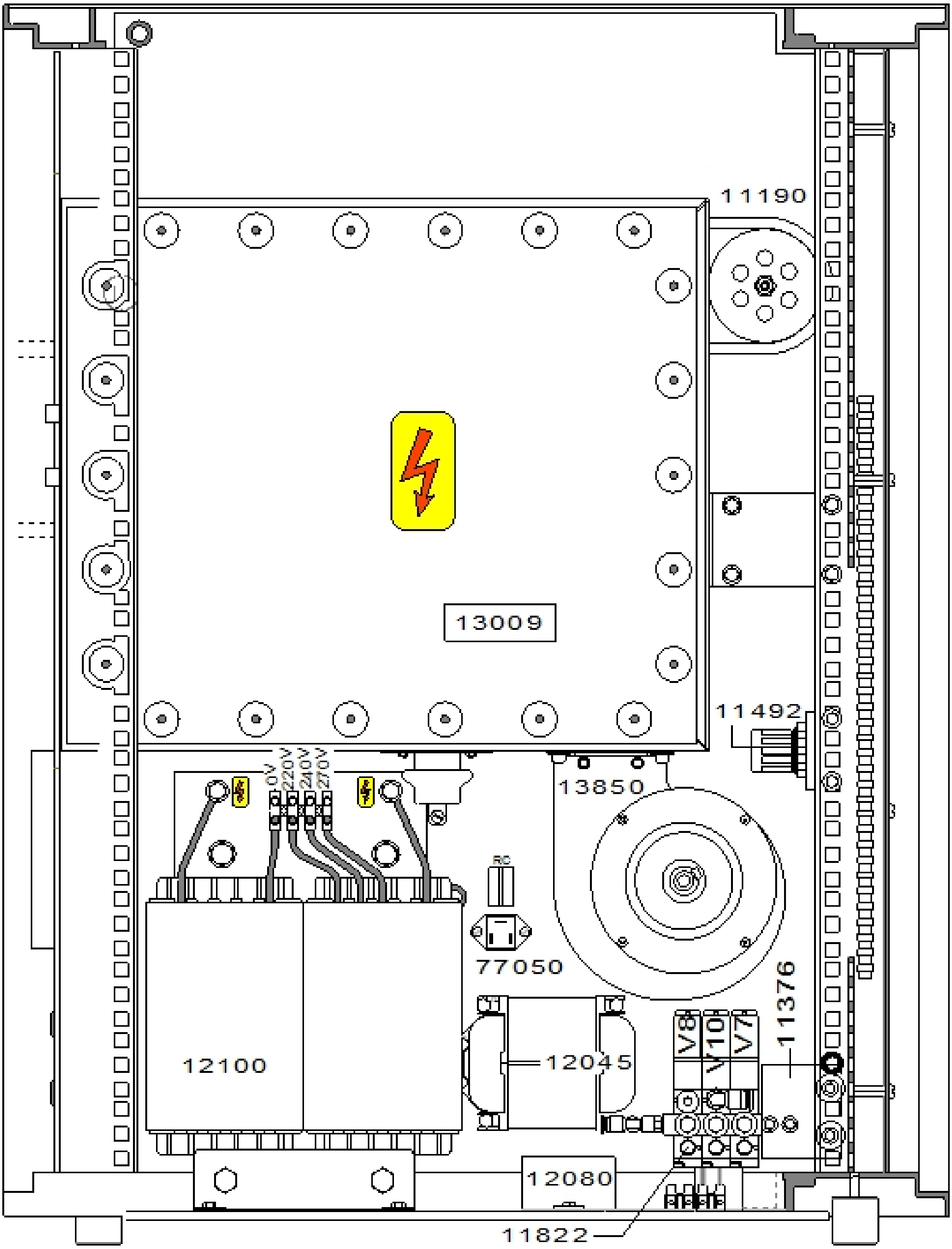


Fig. 42: Right side

11190	Exhaust muffler
13850	Centrifugal blower
11376	Fixing plate for 11822
77050	TRIAC
11492	Pressure regulator
77135	Capacitor
11822	Pnematic valve block
12045	Transformer
12080	Rectifier
12100	Transformer

6.1.4 Pneumatics

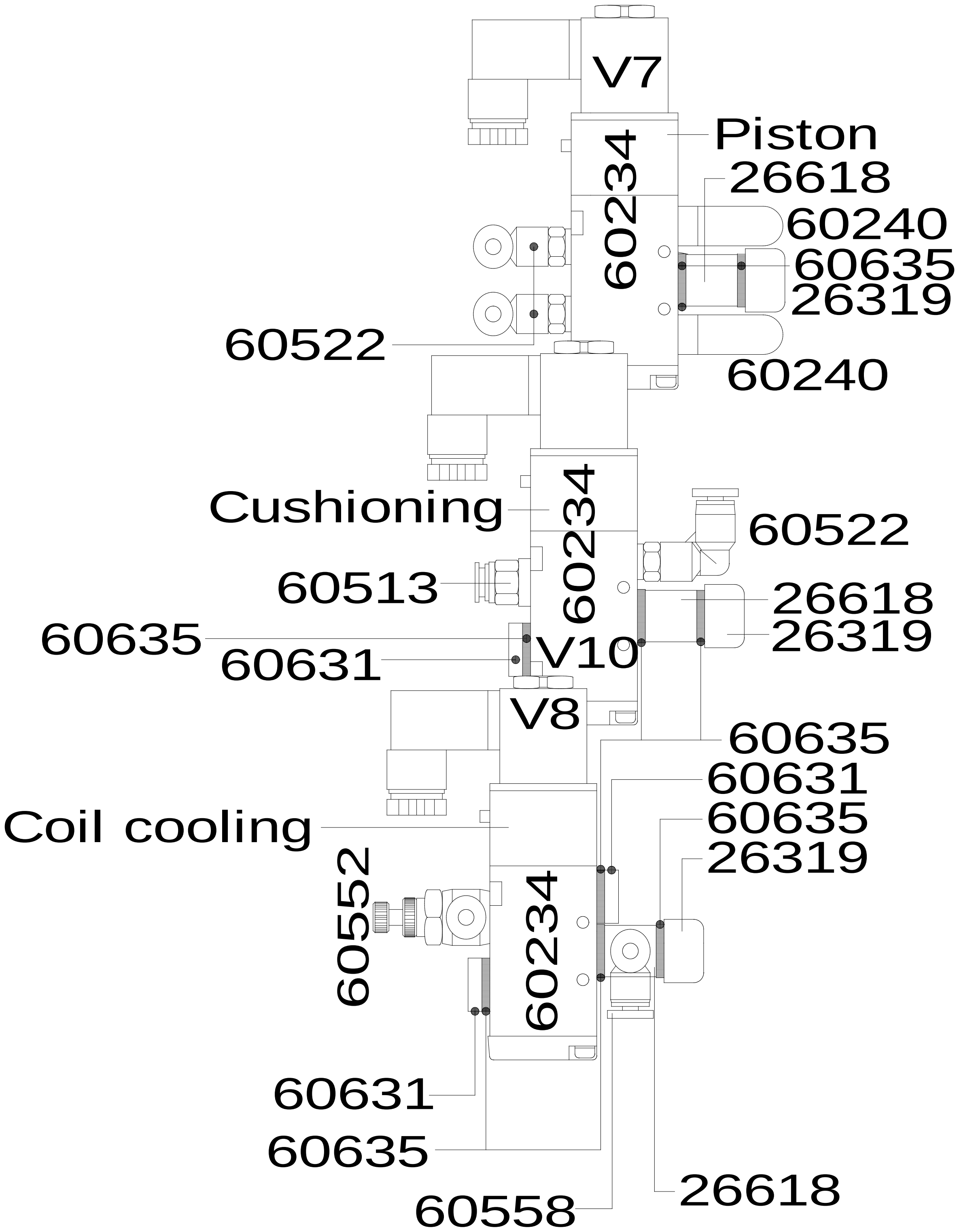


Fig. 43: Pneumatics

26319	Hollow screw
26618	Valve block
60234	Pneumatic valve
60240	Silencer
60513	Fiting
60522	Fiting
60631	Closure
60635	Seal

6.1.5 Oscillating circuit

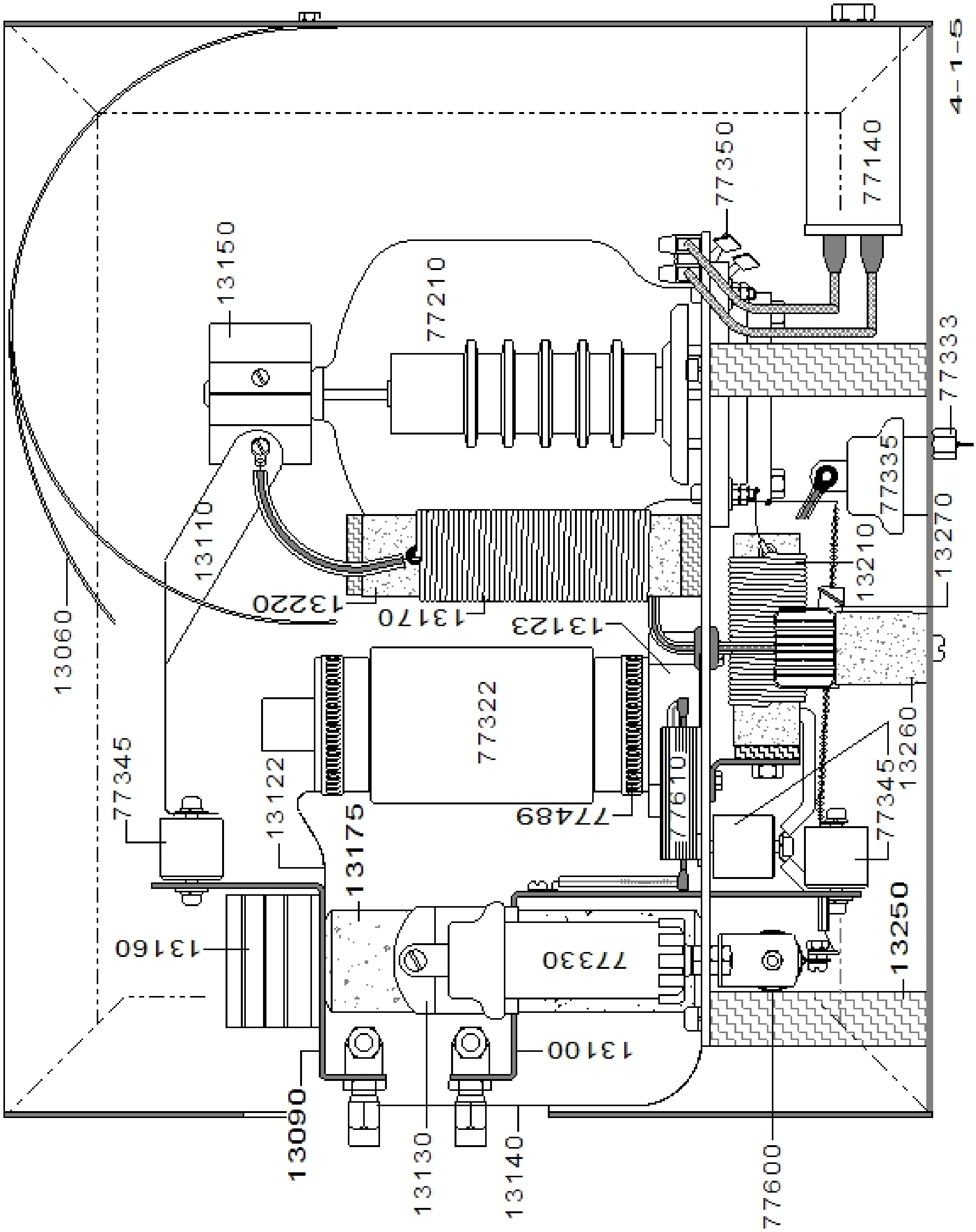


Fig. 44: Oscillating circuit

13060	Protection sheet
13081	Capacitor support
13090	Upper coil connector
13100	Lower coil connector
13110	Anode connector
13122	Capacitor connector
13130	Capacitor connector
13140	Ground connector
13150	Anode heat sink
13160	Coil heat sink
13170	Radiation shield
13175	Insulator
13210	Grid choke
13220	Anode choke
13250	Chassis support
13260	High voltage filter
13270	Resistor
77140	HF-filter
77210	Oscillator tube
77322	Capacitorr
77330	Capacitor
77335	Capacitor
77333	Filter
77345	(13261; 13262; 77340; 77341; 77342) Capacitor
77350	Capacitor 100 nF
77489	Bracket
77600	Resistor
77610	Resistor

6.1.6 Furnace

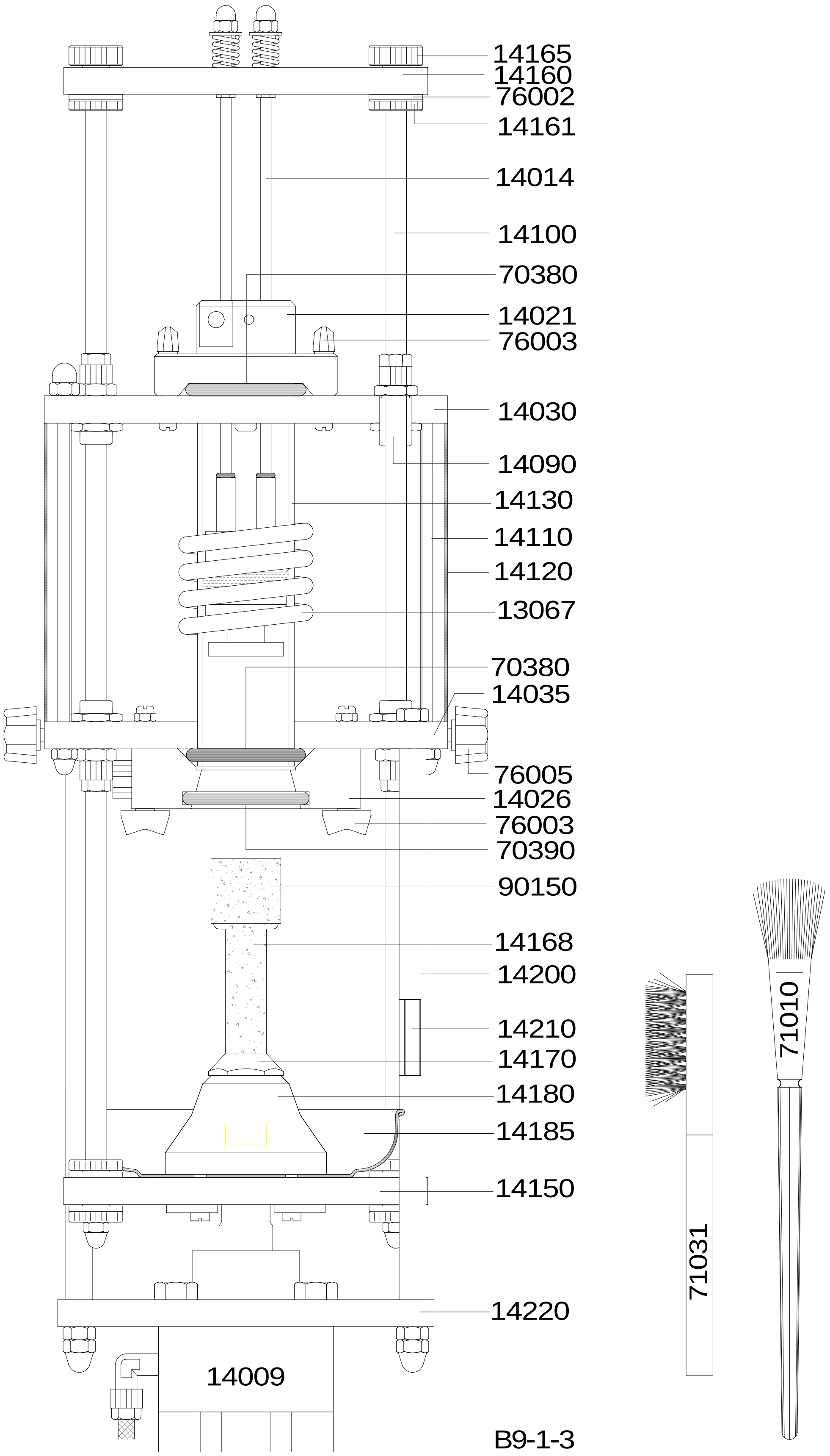
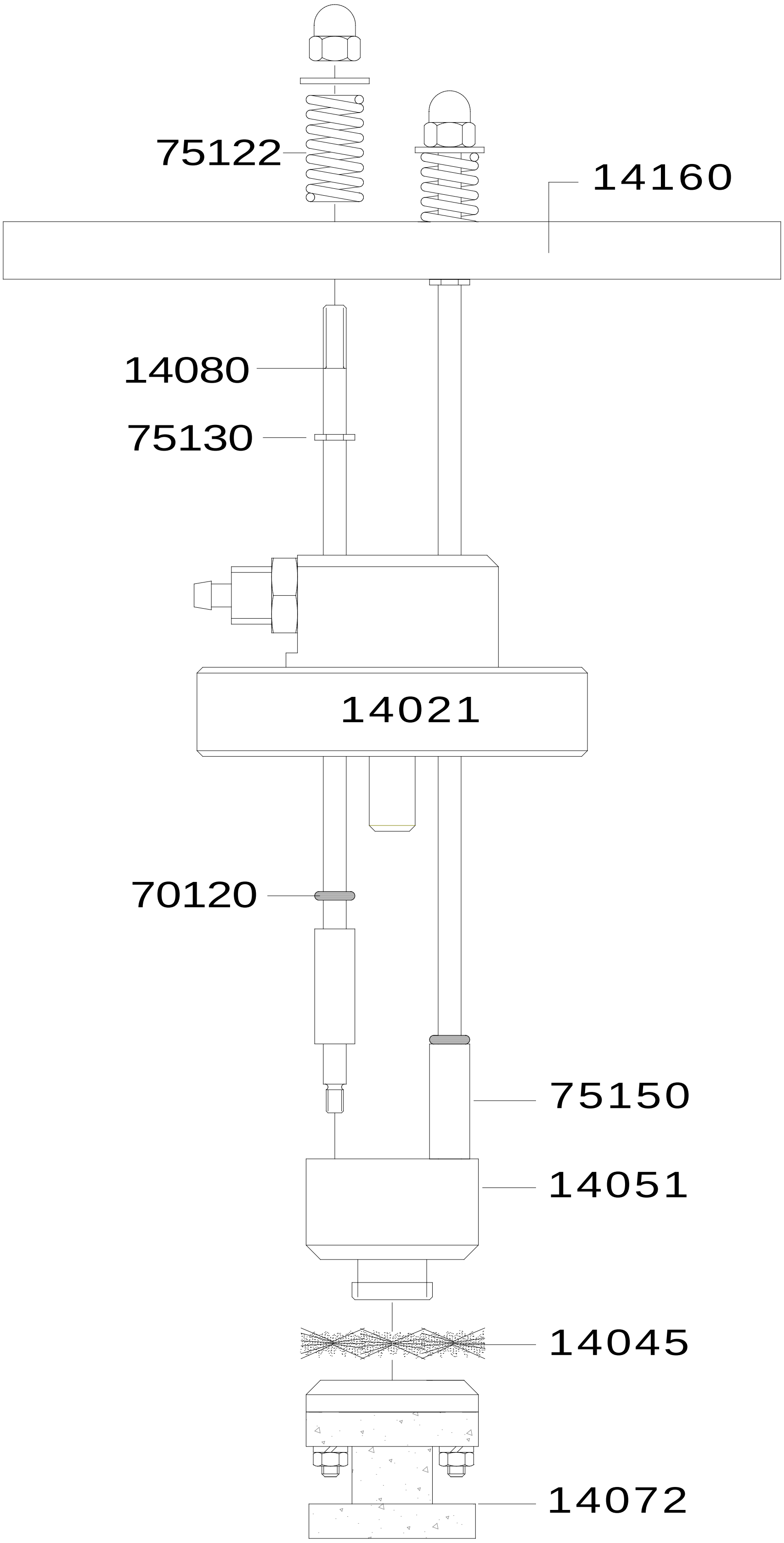

14165
14160
76002
14161
14014
14100
70380
14021
76003
14030
14090
14130
14110
14120
13067
70380
14035
76005
14026
76003
70390
90150
14168
14200
14210
14170
14180
14185
14150
14220
14009
71010
71031
B9-1-3

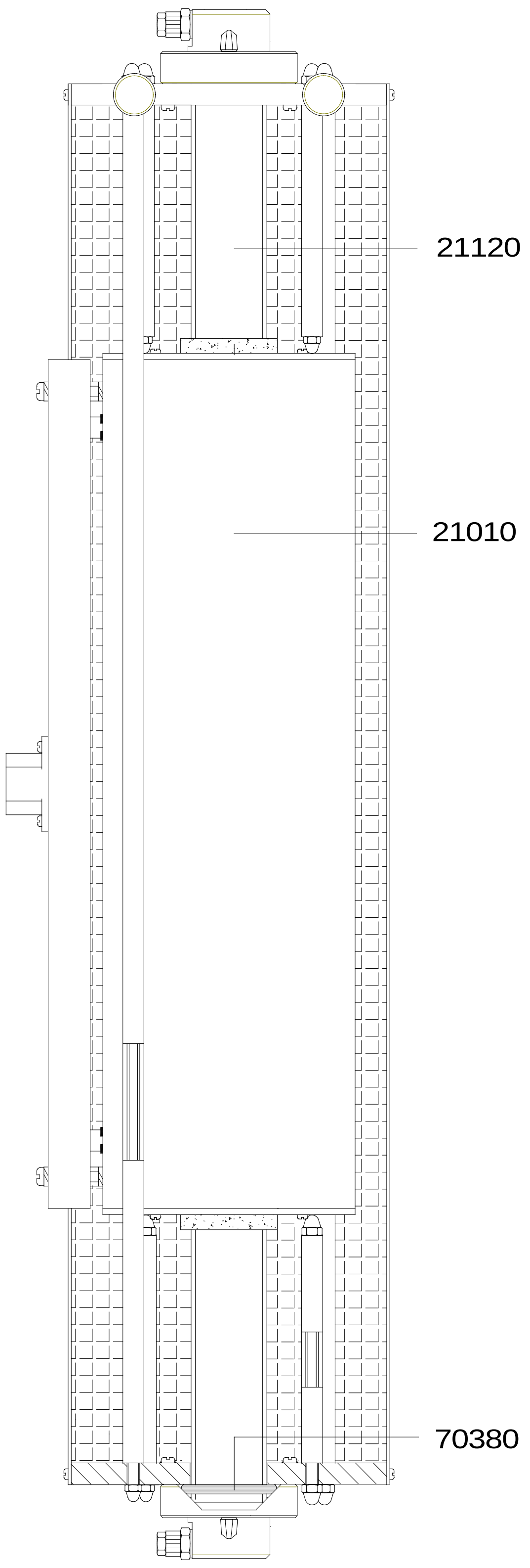
Fig. 45: Furnace

13067	Combustion coil
14009	Pneumatic cylinder for furnace lift
14021	Upper furnace lock
14026	Lower furnace lock
14030	Upper furnace plate
14035	Lower furnace plate
14090	Bearing
14100	Mounting rod
14110	Threaded rod
14120	Furnace cover
14130	Combustion tube
14150	Lower log
14160	Upper log
14161	Lower knurled nut
14165	Upper knurled nut
14168	Pedestal
14170	Pedestal mount
14180	Furnace closure
14185	Tray
14200	Metal tube
14210	Threaded rod
14220	Cylinder support
70380	O-ring
70390	O-ring
71010	Cleaning brush for pedestal
71031	Cleaning brush for radiation shield
76002	Washer
76003	Wing nut
76005	Knurled nut
90150	Crucibles

6.1.7 Furnace cleaning



14014	Complete furnace cleaning assembly unit:
14021	Upper furnace lock
14045	Cleaning brush for combustion tube
14051	Brush holder
14072	Ceramic heat shield for brush
14080	Cleaning mechanism Rod
14160	Upper log
70120	O-ring
75122	Spring
75130	Safety spring
75150	Metal tube



21010	Heather section
21120	Quartz tube
70380	O-Ring

6.2 Wiring (I)

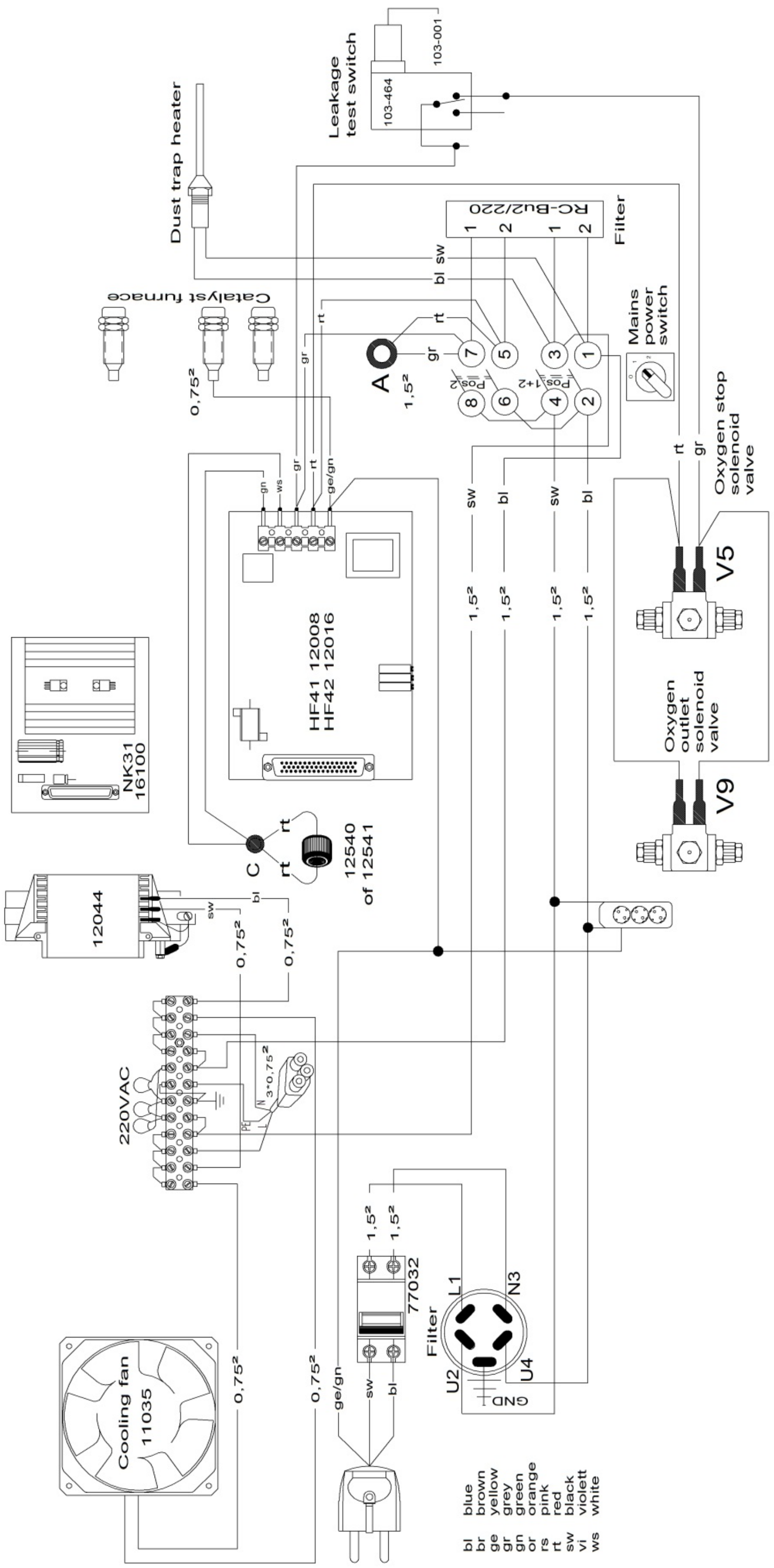


Fig. 46: 12056-6001

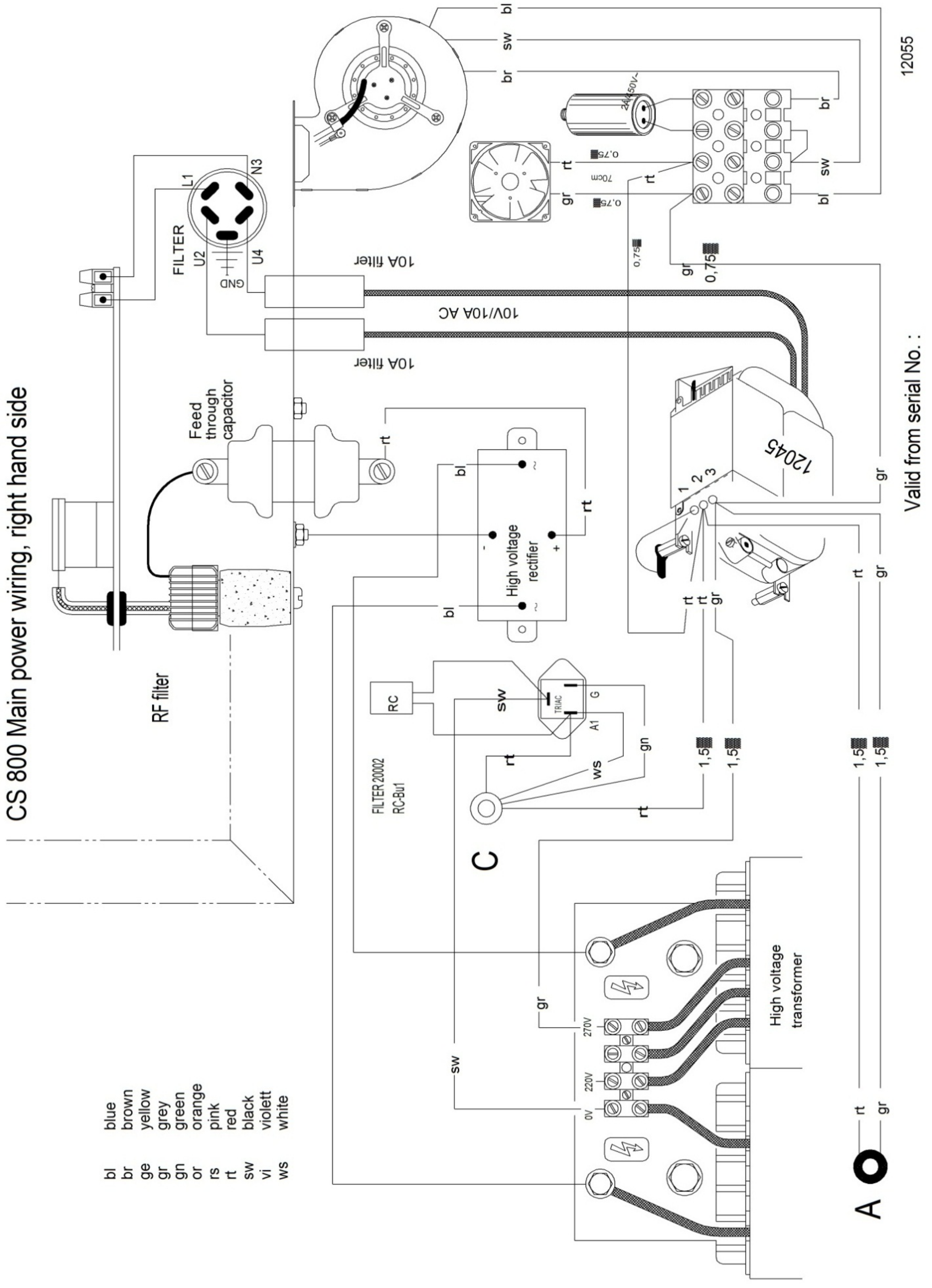


Fig. 47: 12055 (I)

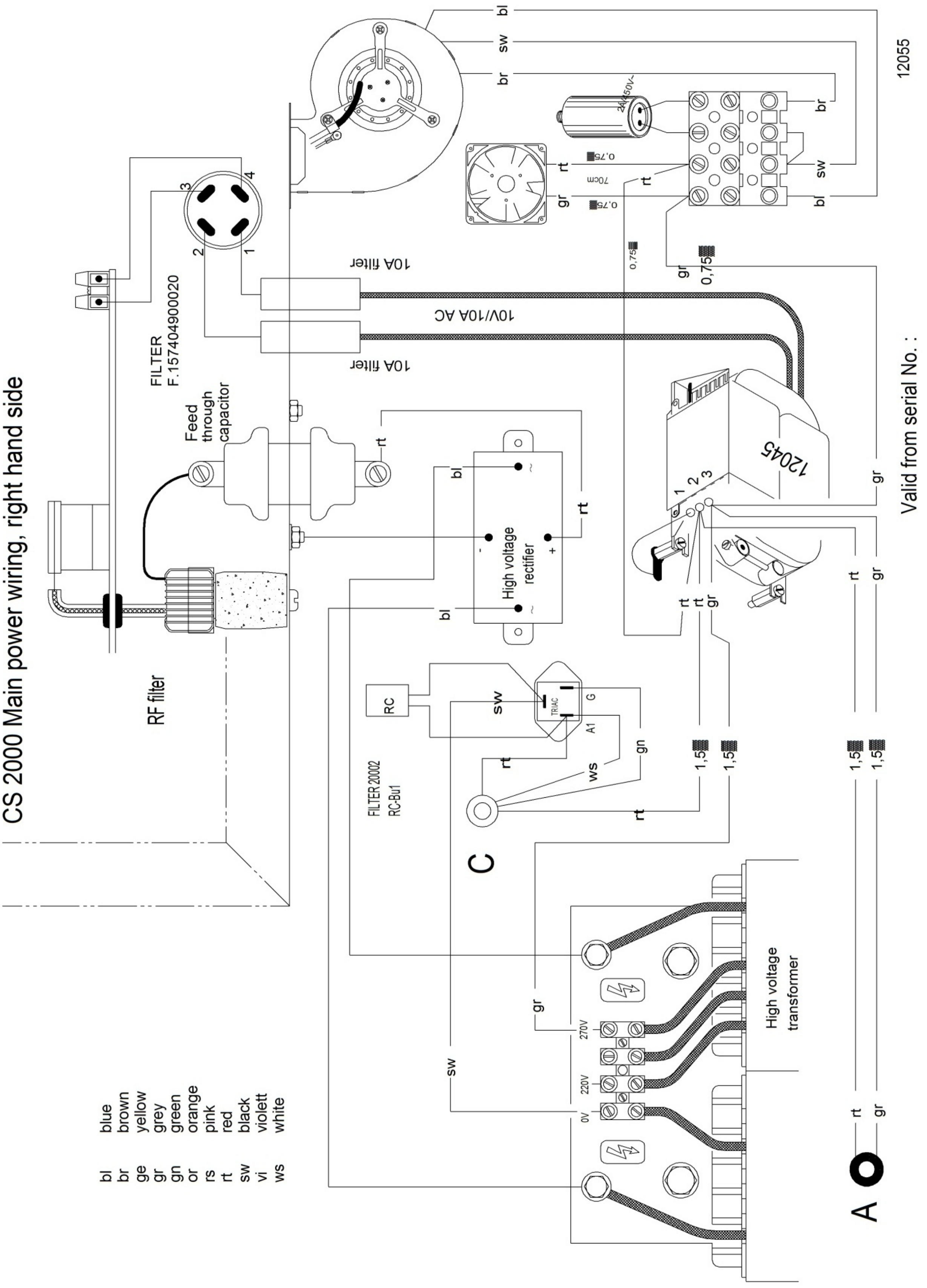


Fig. 48: 12055 (II)

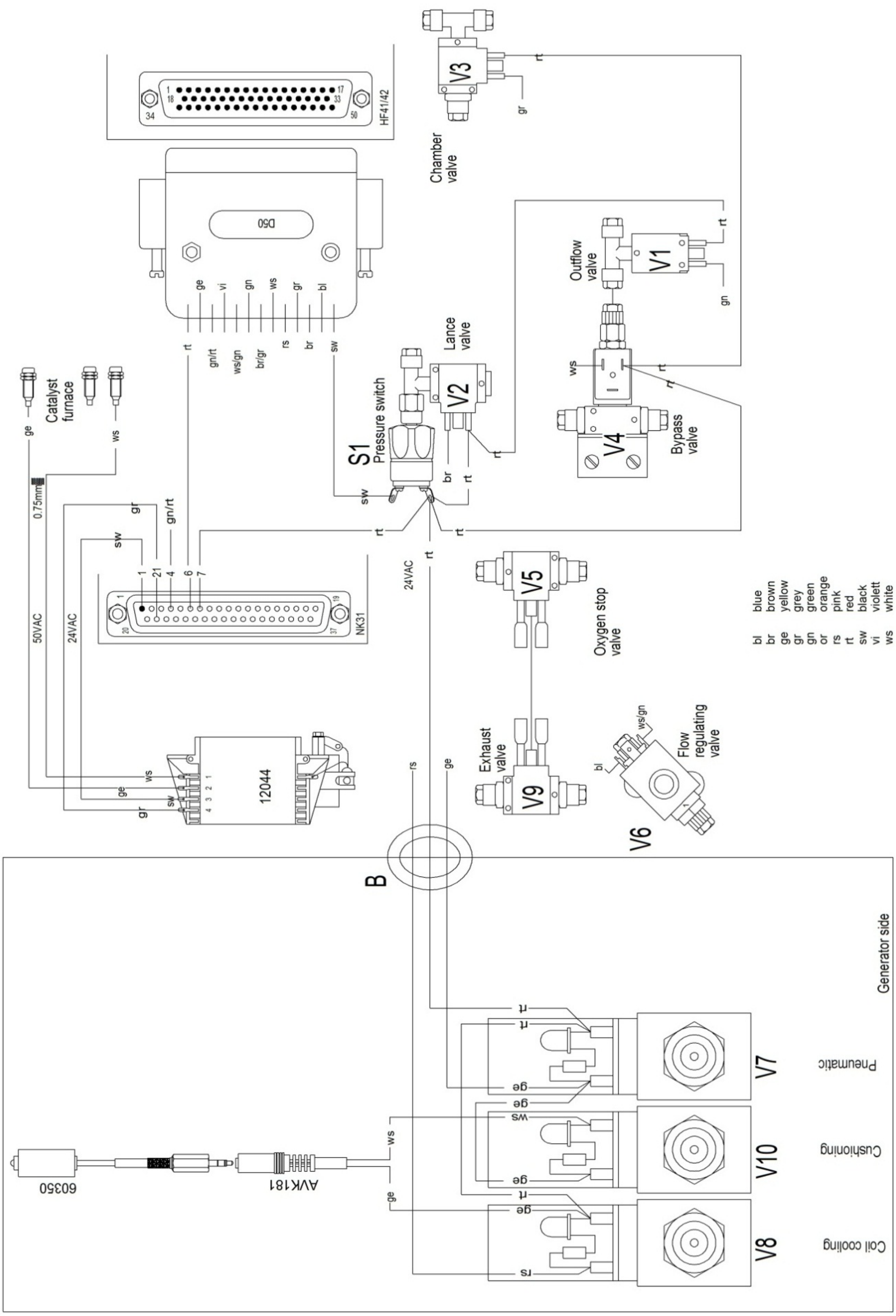

HF41/42
D50
Chamber valve
V3
Outflow valve
V1
Lance valve
V2
Pressure switch
S1
Bypass valve
V4
Catalyst furnace
0.75mm
50VAC
24VAC
NK31
12044
Oxygen stop valve
V5
Exhaust valve
V9
Flow regulating valve
V6
B
Generator side
V7
Pneumatic
V10
Cushioning
V8
Coil cooling
AVK181
60350
bl blue
br brown
ge yellow
gr grey
gn green
or orange
rs pink
rt red
sw black
vi violett
ws white

Fig. 49: 12072

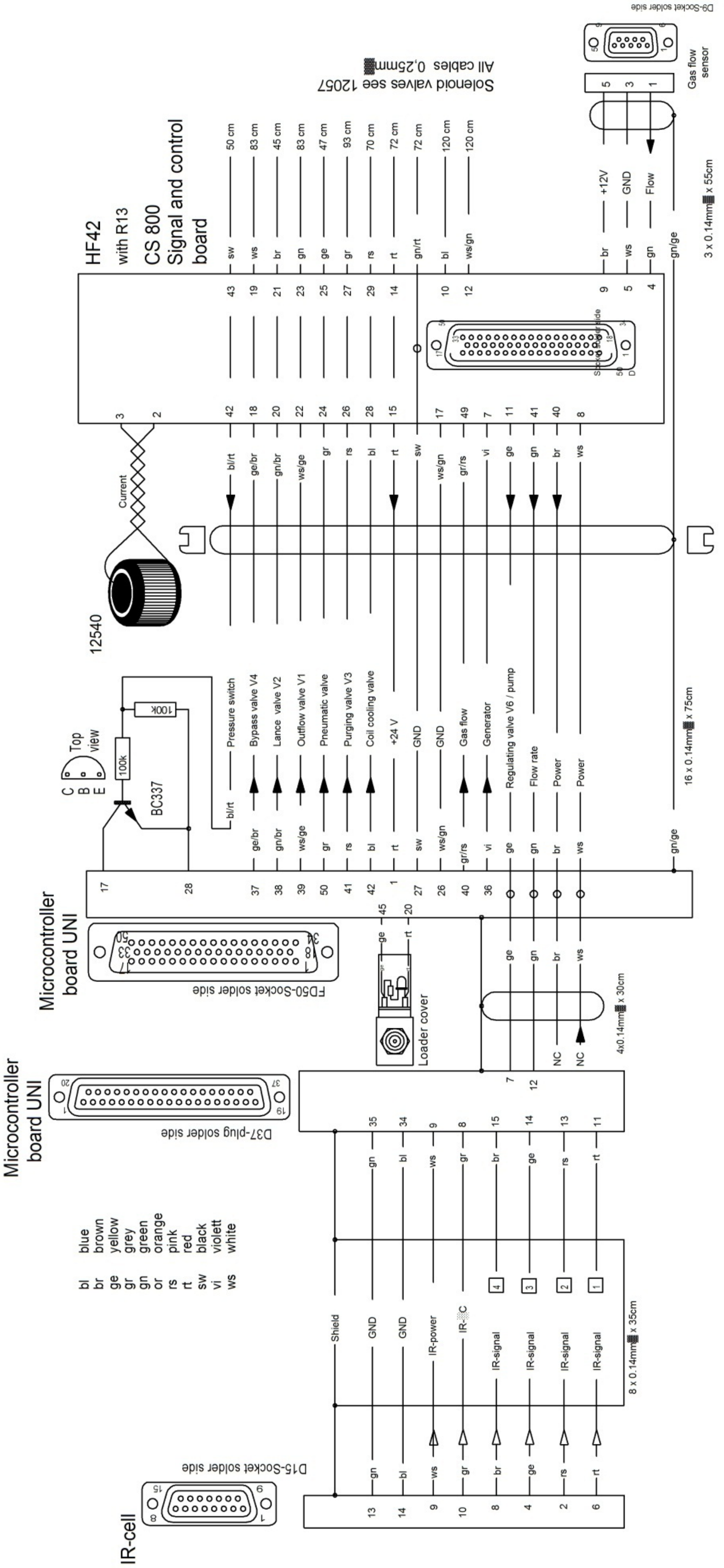

HF42
with R13
CS 800
Signal and control
board
Solenoid valves see 12057
All cables 0,25mm²
D9-Socket solder side
Gas flow sensor
12540
Current
Microcontroller board UNI
FD50-Socket solder side
Loader cover
Microcontroller board UNI
D37-plug solder side
IR-cell
D15-Socket solder side
BC337
Top view
Pressure switch
Bypass valve V4
Lance valve V2
Outflow valve V1
Pneumatic valve
Purging valve V3
Coil cooling valve
+24 V
GND
GND
Gas flow
Generator
Regulating valve V6 / pump
Flow rate
Power
Power
16 x 0.14mm² x 75cm
3 x 0.14mm² x 55cm
4x0.14mm² x 30cm
8 x 0.14mm² x 35cm
Shield
GND
GND
IR-power
IR-signal
bl blue
br brown
ge yellow
gr grey
gn green
or orange
rs pink
rt red
sw black
vi violett
ws white

Fig. 50: 12064

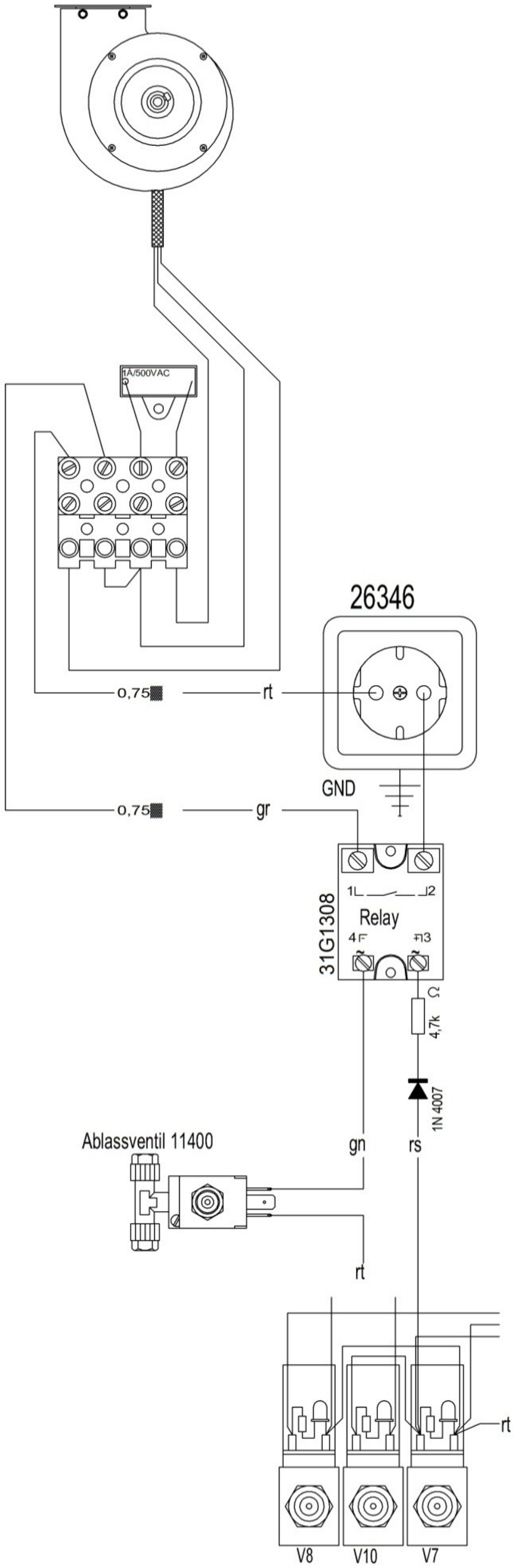


Fig. 51: 12550 Vacuum cleaner

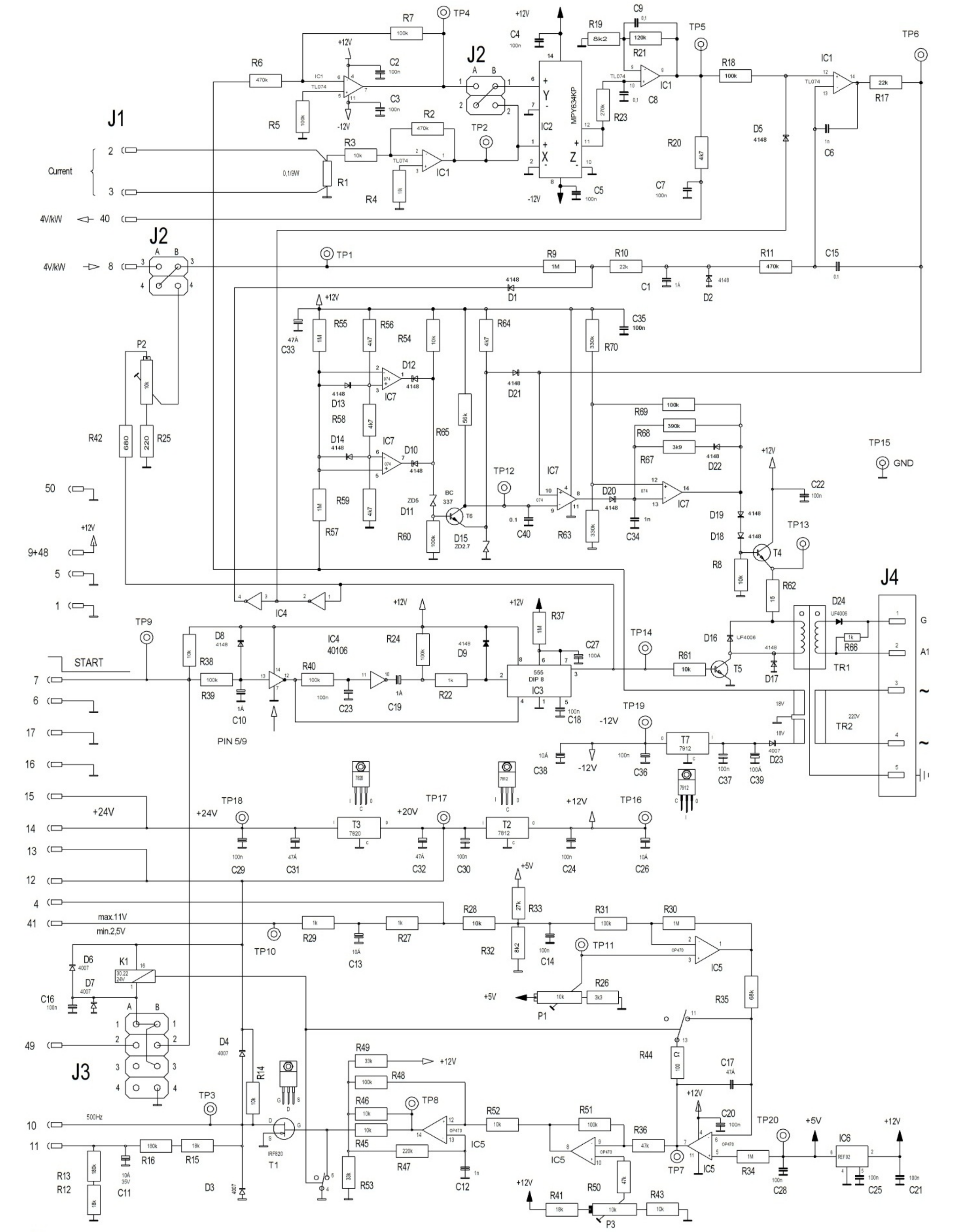


Fig. 52: 12015 (I)

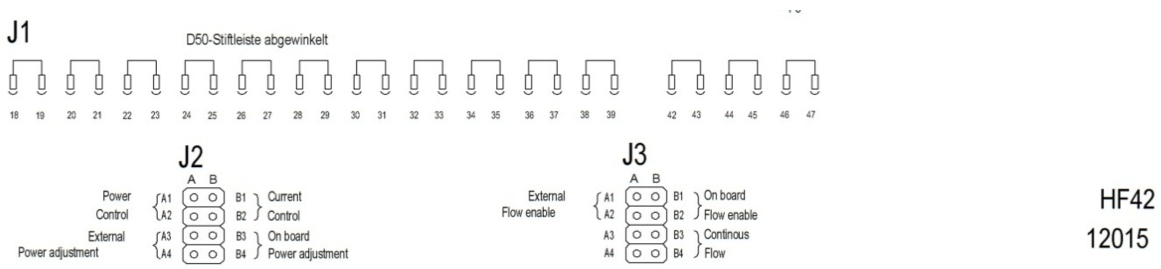


Fig. 53: 12015 (II)

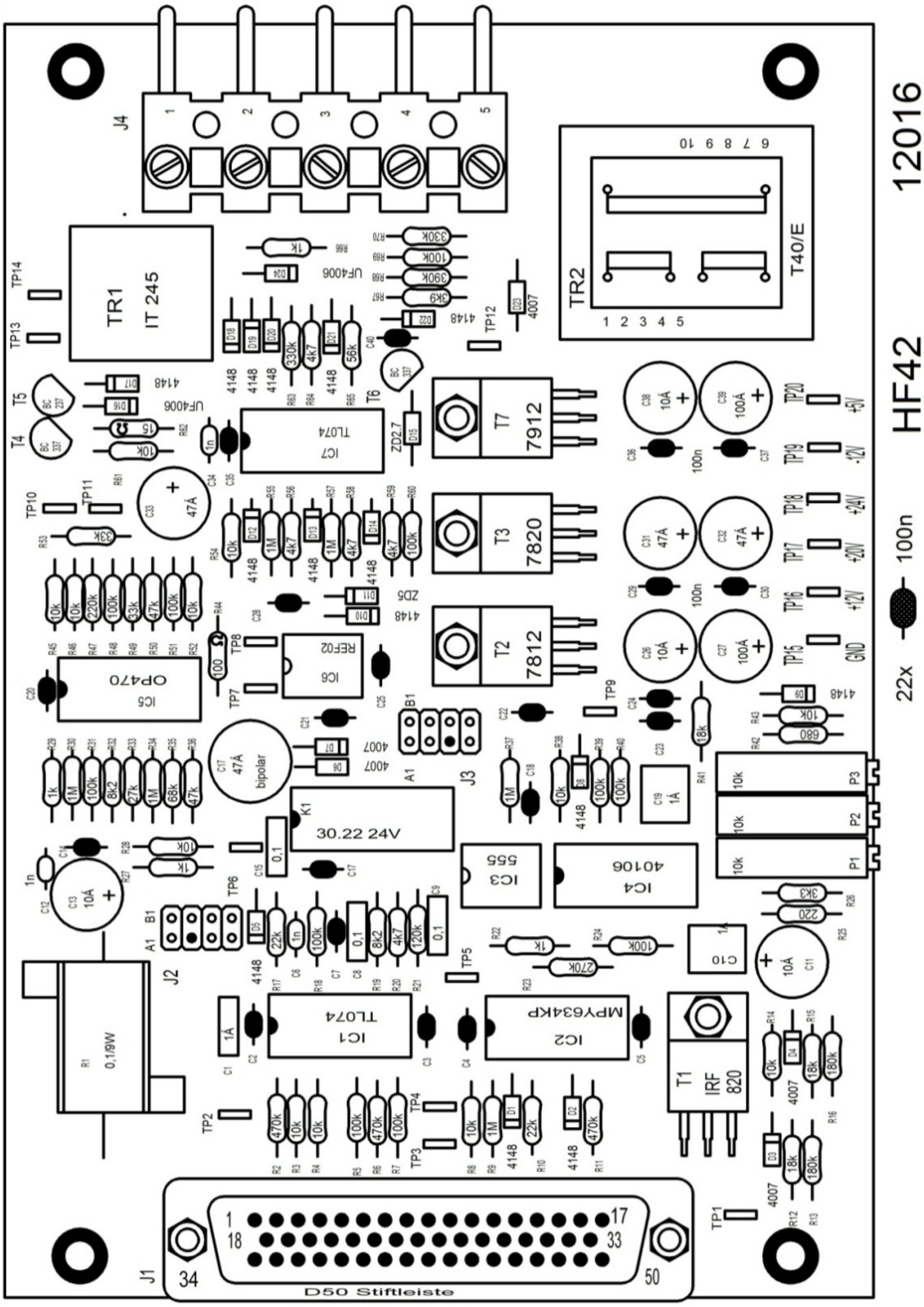
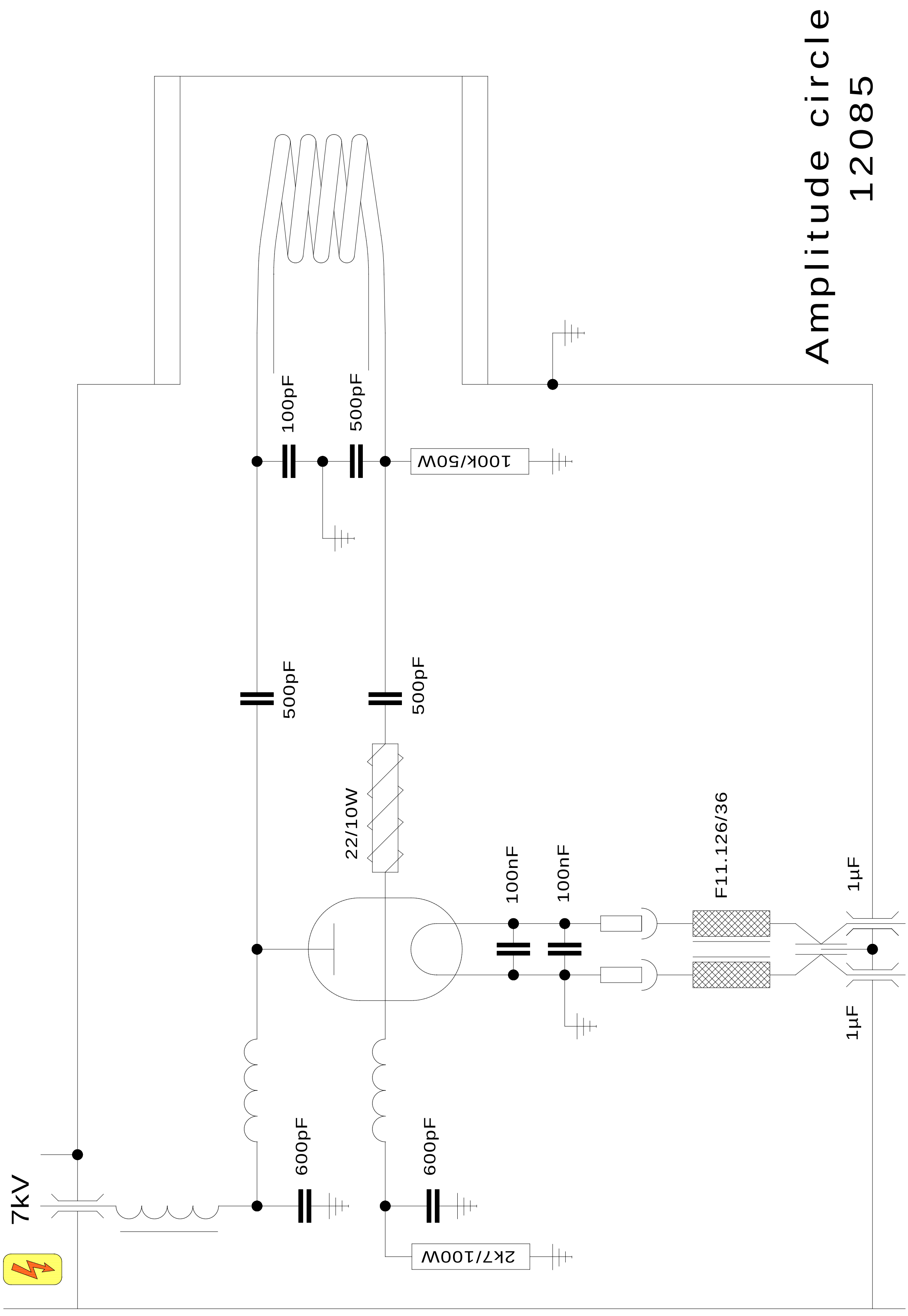
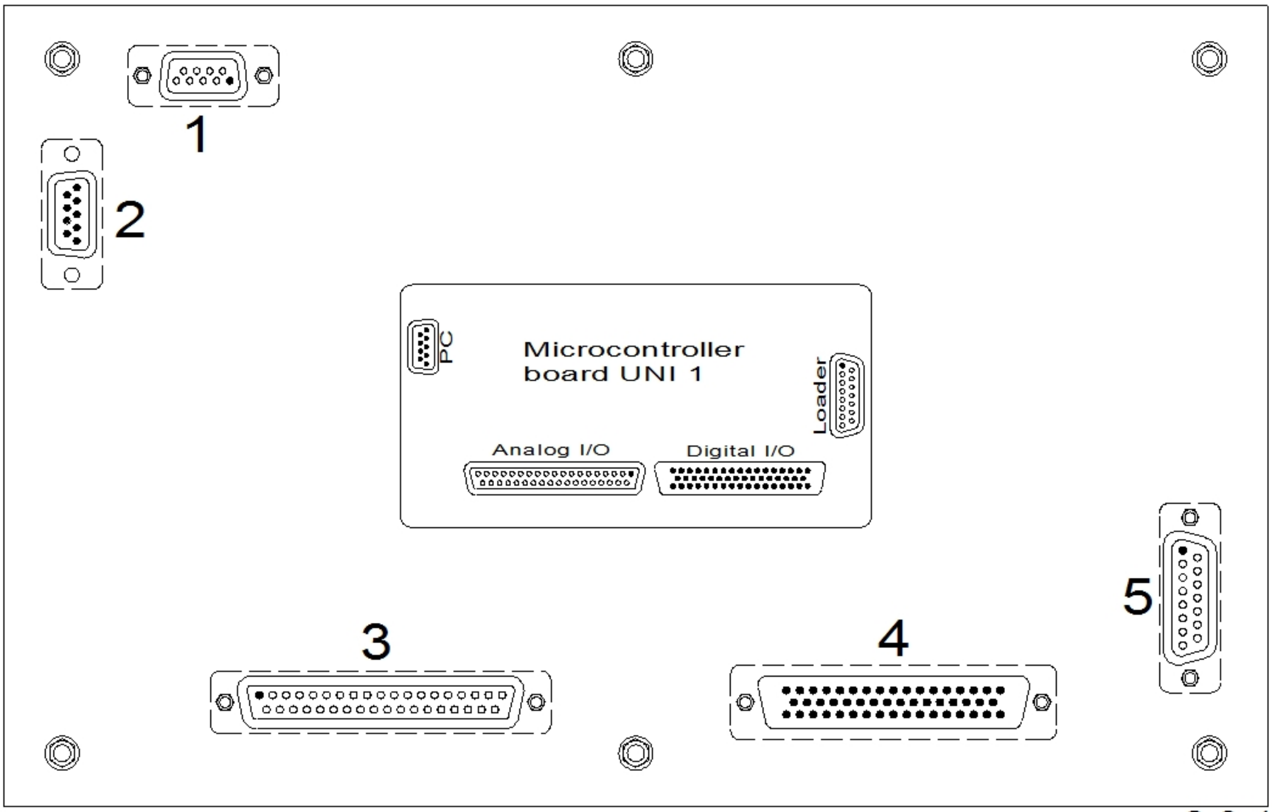


Fig. 54: 12016

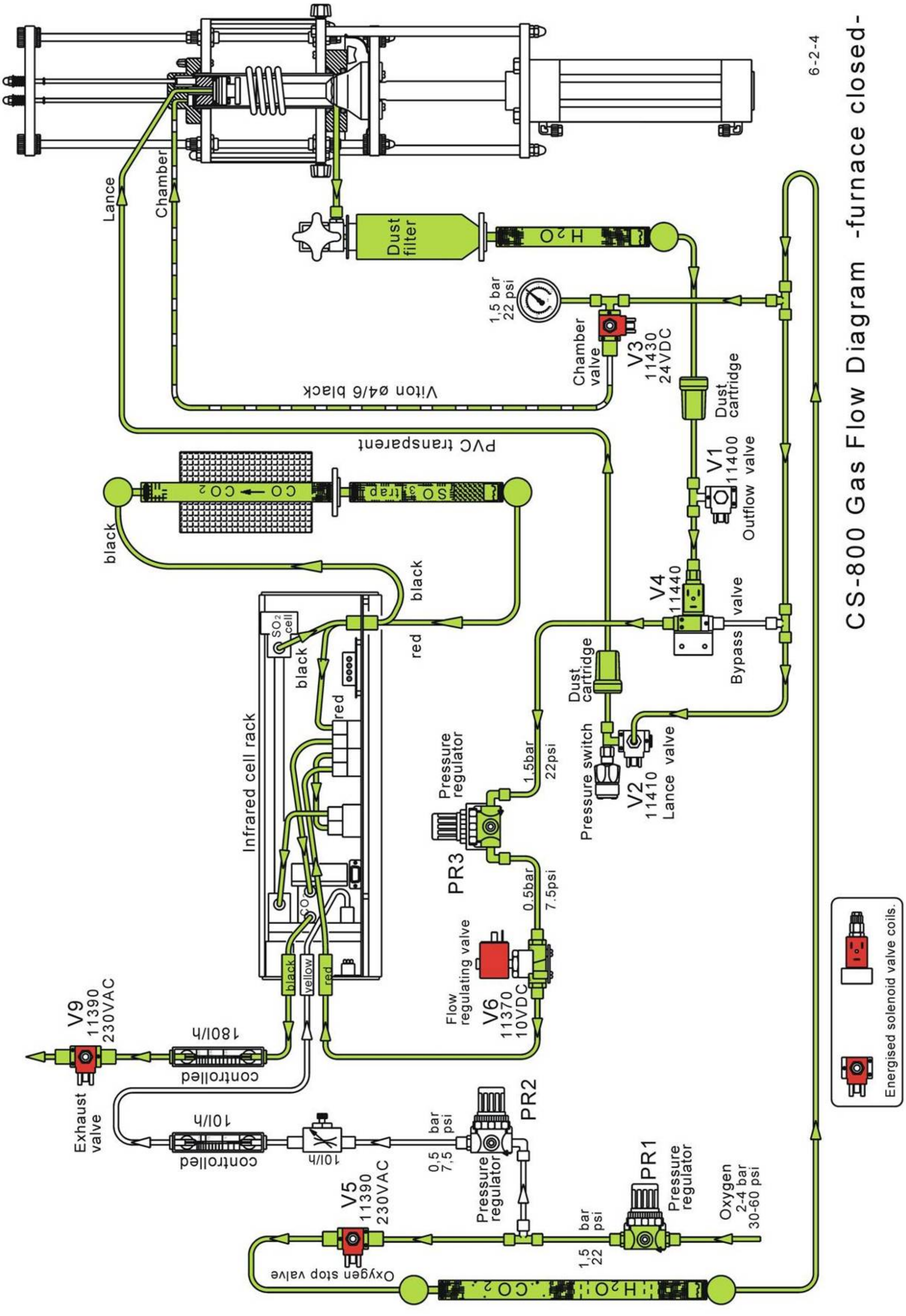

Amplitude circle
12085
100pF
500pF
100K/50W
500pF
500pF
22/10W
100nF
100nF
F11.126/36
1µF
1µF
600pF
600pF
7kV
2k7/100W

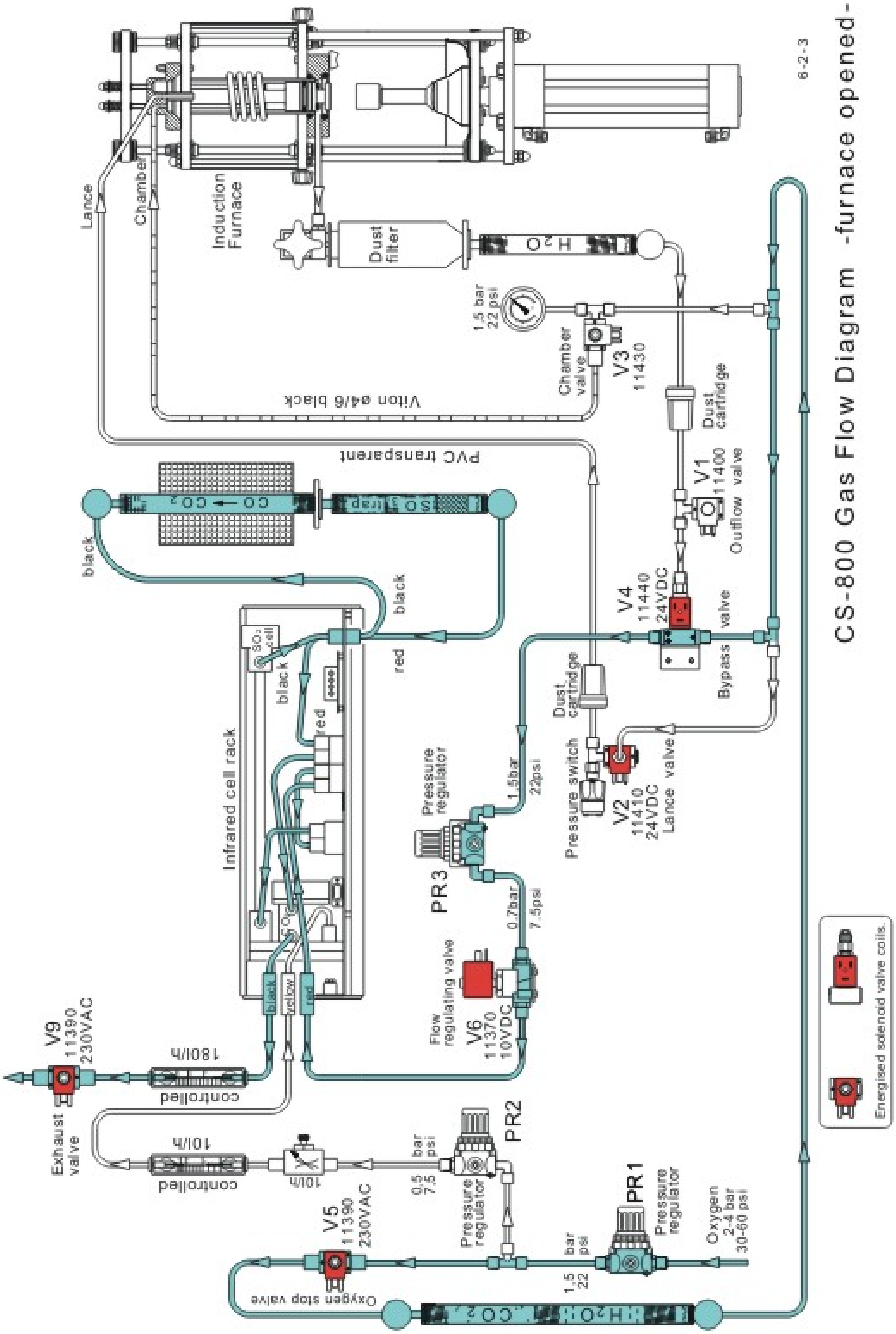
6.2.1 UNI 1


1
2
PC
Microcontroller
board UNI 1
Loader
Analog I/O
Digital I/O
3
4
5

2-3-1

6.2.2 Gas flow system




CS-800 Gas Flow Diagram -furnace opened-
6-2-3
Lance
Chamber
Induction Furnace
Dust filter
H_2O
1,5 bar 22 psi
Chamber valve
V3 11430
Viton ø4/6 black
Dust cartridge
V1 11400 Outflow valve
PVC transparent
SO_3 trap
CO → CO_2
black
red
V4 11440 24VDC
Bypass valve
Infrared cell rack
SO_2 cell
yellow
Dust cartridge
Pressure switch
V2 11410 24VDC Lance valve
Pressure regulator
PR3
1,5bar 22psi
0.7bar 7.5psi
Flow regulating valve
V6 11370 10VDC
V9 11390 230VAC
Exhaust valve
180l/h
controlled
10l/h
0,5 bar 7,5 psi
Pressure regulator
PR2
V5 11390 230VAC
Oxygen stop valve
1,5 bar 22 psi
PR1
Pressure regulator
Oxygen 2-4 bar 30-60 psi
H_2O CO_2
Energised solenoid valve coils.

6.2.3 Valve controlling

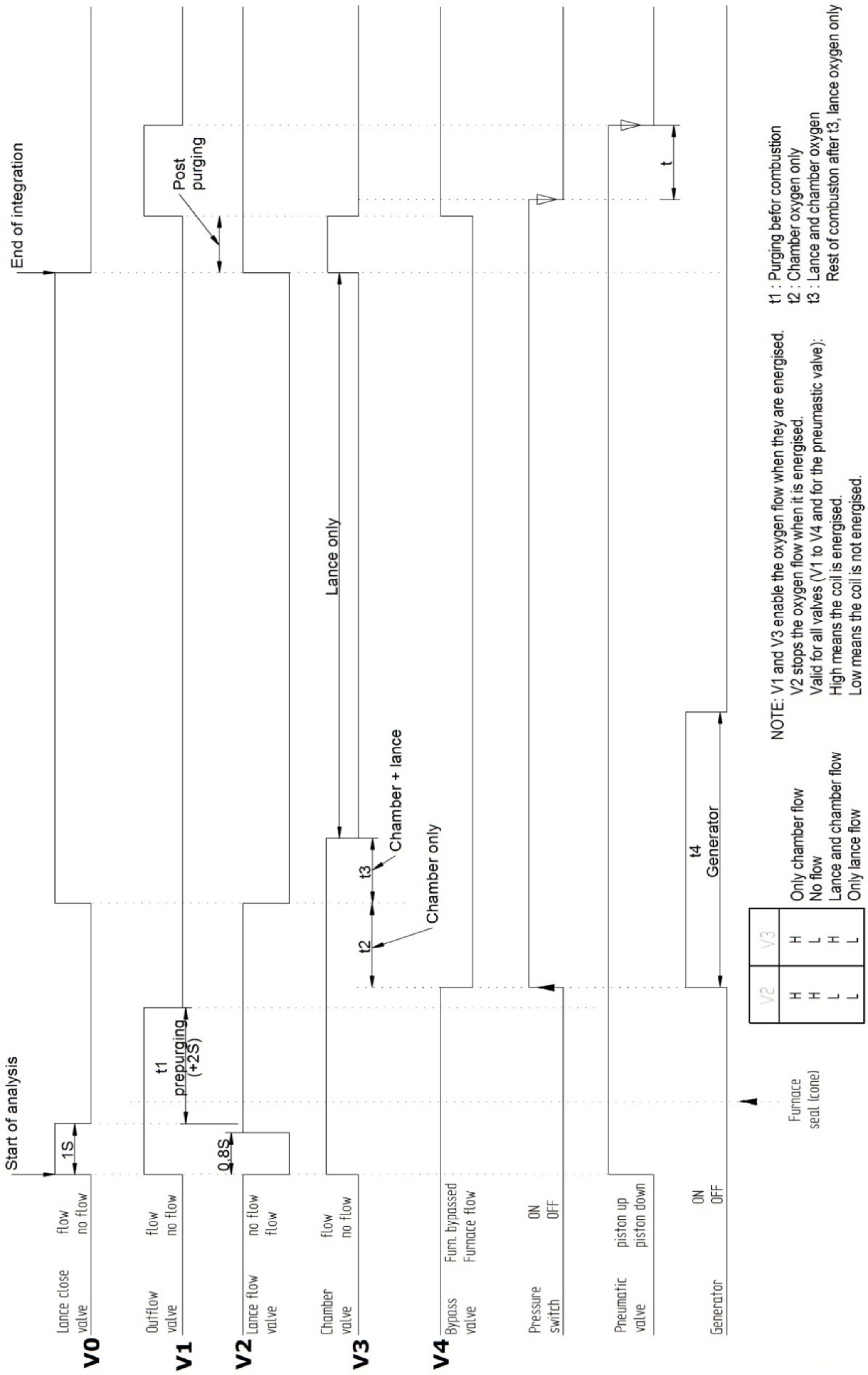


Fig. 55: Valve controlling (I) 11001-6001

Low = de-energized (Zero volts on the coil)
High = energized (24 V DC on the coil)

Opening and closing of the furnace, sequence:

6.2.3.1 Opening the furnace:

At the moment when the key is pressed to open the furnace,

V1, V2 and V4 are energized.

V1 releases the oxygen out of the furnace.

V2 stops the oxygen supply to the furnace.

V4 keeps the oxygen flow to the IR-cell, bypassing the furnace.

About one second later, the pressure in the furnace drops lower than one bar (15 psi) so that the pressure switch opens (no contact any more)

resp. 24V DC between its two leads.

After a short delay produced by the software, thus allowing sufficient time for the oxygen pressure in the furnace to fall practically to zero, the pneumatic valve is de-energized, causing the piston to move down, opening the furnace.

6.2.3.2 Closing the furnace:

By pressing the key to close the furnace, the pneumatic valve is energized and the piston moves up. At the same time V3 is also energized, letting oxygen into the furnace area from the top and from the bottom (through the dust filter).

Before the furnace closing cone reaches the O-ring to seal, the oxygen which enters the furnace area escapes, purging the air out of the furnace. After the cone seals the furnace, the incoming oxygen leads to a growing pressure in the furnace.

When this pressure reaches approx. one bar (15 psi) the pressure switch will close (zero volts between its two leads).

After a short delay by the software, V2, V3 and V4 will be de-energized.

The closed furnace condition is now reached.

6.3 Spare parts kits

6.3.1 Common spare parts kit for all analysers

Part Number	description	quantity
05048	Infrared source (emitter)	1
05060	Reflector	1
05064	Chopper motor	1
05067	IR path for high carbon	1
05068	IR path for sulphur	1
05150	IR path connector with window source side	1
05160	IR path connector with window detector side	1
05260	IR path tube (80 to 320 mm)	1

05278	Infrared preamplifier for 3 pins	1
05279	Infrared preamplifier for 4 pins	
06032	Infrared detector with CO2 filter	1
06034	Infrared detector with SO2 filter	1
06058	IR Temperature control board TH61	1
06421	Infrared power supply assembly IR13	1
06630	IR Temperature control board TH62	1
06733	IRC board for 4 channels	1
11035	Cooling fan	1
11062	Reagent tubes 160 x 16mm	2
11064	Reagent tubes 280mm x 16mm	2
11380	Pneumatic valve	1
11390	Oxygen solenoid valve	1
11408	Pressure switch	1
11480	Adjustable flow restrictor	1
11492	Inlet pressure regulator	1
15037	IR Temperature regulation board NR32	1
15063	Gasflow sensor 300 l/h	1
15083	Gas flow meter 15 l/h	1
15087	Gasflow meter 300 l/h	1
15095	Gasflow meter 600 l/h	1
15098	Gas flow control board FC 21	1
16110	Power supply board NK 32	1
16114	Power supply 24V 5A	
18173	PC-cable	1
18454	Balance cable	1
21120	Quartz tube for purification furnace	1
35310	Pressure switch	1
70120	O-ring 3.4 x 1.9 VT furnace cleaning rods (CS 800) and for furnace platform	1
70150	O-ring 6 x 2.5 VT	1
70210	O-ring 8 x 3.5 VT for catalyst tube (CS 800) and for reagent tube (OH/ON 900)	1
70230	O-ring 9 x 3 VT for reagent tubes and dust filter	1
70280	O-ring 18 x 2 VT for chopper motor	2
70285	O-ring 19 x 3 VT for furnace ON/OH 900 (top)	1
70320	O-ring 20 x 5 VT for dust filter (CS 800) and for furnace glass tube (CS 500)	1
70330	O-ring 21 x 2 VT for infrared source	6

70350	O-ring 29 x 5 VT for dust filter (CS 800)	1
70370	O ring 34 x 3 VT for dust filter (CS 800)	1
70380	O-ring 35 x 5 VT for combustion tube (CS 800) and for furnace internal (CS 500)	1
70390	O-ring 38 x 5 VT for furnace (CS 800)	1
70405	O-ring 47.2x 5.7 VT for furnace closure ON/OH	1
70410	O-ring 48 x 3 VT for furnace internal (CS 500)	1
70415	O-ring 62 x 3 VT for furnace ON/OH 900 (centre)	1
70425	O-ring 90 x 2.5 VT for furnace ON/OH (bottom)	1
72010	Pressure gauge 2,5 bar (37.5 psi)	1
72020	Gauge 10 bar/140 psi	1
73020	Tube transparent	5m
73030	Tube black id = 4 od = 5	5m
73040	Tube black id = 6 od = 9	1m
75120	Spring	1
75130	Retaining washer	1
75190	Washer	1
77140	HF-filter 250 V	1
78010	Mains power switch	1
90290	Copper oxide	100g
92610	Tube of grease	1

6.3.2 Spare parts kit for CS-800

Part Number	description	quantity
11105	Metal dust filter	1
11115	Plastic tube	75mm
11120	Paper filter holder	1
11180	Dust filter cartridge	1
11185	Paper filters	10
11370-2001	Gasflow regulating valve	1
11400	Pressure outlet solenoid valve	1
11410	Oxygen stop solenoid valve	1
11430	Purge solenoid valve	1
11440	Bypass solenoid valve	1
11470	One way valve	1
11490	Pressure regulator	1

12005	Gasflow and furnace control board HF3	1
12016	Gasflow and furnace control board HF42	1
12080	Rectifier	1
13067	Combustion coil	1
13175	Insulator	1
13260	High voltage filter	1
13262	Capacitor 700 pF/40KV	1
13270	Resistor	1
14045	Cleaning brush for combustion tube	1
14072	Ceramic heat shield for brush	1
14080	Cleaning mechanism rod	1
14130	Combustion tube l=145 id=32 od=36 mm	2
14168	Pedestal	1
15207	Gas flow sensor	1
20000	Catalyst furnace	1
20040	Catalyst tube 200 x 16mm	1
75122	Spring	1
75130	Safety ring	1
77050	Triac	1
77135	Capacitor 2µF for blower (at the generator unit)	1
77210	Oscillator tube	1
77322	Capacitor 100 pF/30KVA	1
77333	10V/10A filter	2
77350	Capacitor 1µF/50V	2
77600	Grid resistor	1
77610	Resistor	1
80925	Sets of fuses	3
90220	Tungsten	2500g
90260	Iron chips	908g
92400	Steel standards (advice %C and %S)	100g

7 Maintenance

– Check the IR cell base lines.
See chapter Check base lines

– Clean the paths if necessary.
See chapter IR paths cleaning and replacing. If so, readjust.
See chapter Infrared base line adjustments.

– Check the metal dust filter. Clean it or if necessary, replace it.
See chapter Fluctuating gas flow,
See chapter High carbon results are erratic and
See chapter Furrnace – large collection of dust when opening.

– Check the flow.
See chapter Gas flow controller.

– Carry out leakage test.

– Check the chopper purging. The flow rate should be around 10 L/h.

– Test the power of the induction furnace by burning samples. If the combustion and the fusion in the crucible show weak combustion, then replace the oscillator tube.
See also chapter Induction generator control.

– Test the pneumatics and if necessary readjust.
See Chapter Pneumatics.

8 Index

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