SIMMS

Solid Insulation Moisture Measurement System

Portable Online Transformer Diagnostic System

Operational Manual

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Contents

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1. Introduction

One oil sample per year collected in a glass bottle or syringe, processed in a lab, with a high degree of variability due to the process and lack of controls, and only one (one-shot) measurement of transformer temperature cannot provide the data and accuracy necessary for the competent failure risk management and to manage appropriate insulation treatment program of the transformer.

ARS-Altmann released therefore the **SIMMS** Version 2007.1**,** a miniaturized portable oil sample and temperature diagnostic system.

SIMMS is under normal operational conditions connected to the transformer via :

- the oil sampling point (s)
- the two temperature sensors which are installed on its the upper and bottom part

From the start of the operation the sample oil is in no case exposed to the atmosphere. After the instalation is at first evacuated the hydraulic connection between the transformer and the SIMMS and then checked its tightness.
The oil then flows from the transformer through SIMMS (its water content and temperature is measured by internal moisture transmitter) and return to the transformer. Simultaneously, the upper and bottom temperatures of the transformer and the outputs are measured. The outputs of both temperature sensors and the oil humidity sensor are processed by PCD AMIT. All time-related data are continuously loaded in the AMIT memory and are available at any time for additional processing by laptop.

A good accurate snapshot can be made within ca 30 - 60mins, more accurate than while using the traditional method. In order to assess accurately the oil moisture and both temperatures of the oil cellulose system as well as their migratory patterns in seeking the equilibrium, more time is recommended to produce the snapshot. This is a simple, accurate and cost effective means for determining the level of water in the paper.

SIMMS gives us then the desired overall time-related profile - water content in oil Cw = Cw (t) and both temperatures Tu = Tu (t), Tb = Tb (t) – upper / bottom transformer temperatures, auxiliary temperature level of moisture transmitter TV = TV(t) and mean temperature level of transformer TTS = TTS (t).

After checking the proper equilibrium state of the measured transformer by means of an interconnected lap–top, the averaged (main) Cw and TTS values can be immediately used by the TRACONAL to calculate the water content in the cellulose Cp and temperature loading curve (TLC) of the given transformer

SIMMS is basically used for two reading procedures of the transformer :

SIMMS – 1P (single point oil connection)

SIMMS - 1P is usually connected to one of the oil access point (See Fig.3) e.g. mid way up the main tank. At first, SIMMS evacuates the connecting hose. Then, SIMMS periodically draws the oil sample down, analyses it and returns it to the transformer. This ensures that the sample is always representing the pattern of the oil inventory. It is very convenient for smaller transformers, or larger transformers **where the oil sample access is directly connected to the oil in the main**

tank without internal piping (if there are any doubts, always use the **2P Procedure** !!). Temperature sensors are connected to the bottom and top sleeves connecting the main tank with radiators allowing an average (main) temperature to be established. Alternatively, it can be connected to the top or bottom oil points, with great care of the analysis on the “average” level of the water content in the oil inventory.

SIMMS -1P is mostly used for quick online snapshots of water in the oil and temperature profiles.

1.2 **SIMMS – 2P** (two point connection)

SIMMS –2P is connected to two oil sample taps, one at the top, one at the bottom. Then, both connecting hoses are emptied of the air/ air-emptied to avoid the contamination by air-moisture. Afterwards, the oil is drawn (**D**own – **U**p or **U**p – **D**own, See Fig.4) continuously through the SIMMS unit and passed back to the transformer. Independent temperature sensors are fitted to the identified top and bottom positions. Once SIMMS –2P is installed, connected and started up, the transformer top and bottom temperatures and water content in the oil (ppm) are recorded on a time based log. Within ca 40 - 60 minutes accurate snapshot decision info is made by the laptop connected to SIMMS.

1.3 **Transformer Equilibrium Check**

The primary question after carrying out the measurement is : Are the adequate equilibrium conditions (approximately constant temperature TTS and water content in oil Cw) in the transformer reached or not ?

This evaluation is made (after the measurement by SIMMS is finished) by the laptop cable-connected to the SIMMS.

If **YES**, all the necessary calculations (water content Cp, Temperature Loading Curve - TLC …) can be made immediately by the laptop (and TRACONAL Program).

If **NO**, the on-line measurement for a twenty-four-hour period (or a complete load cycle period) is usually necessary. That allows to reach the desired accuracy in determining water levels in the solid insulation, and the temperature related to the temperature-related movement and time lag of the water movement between the paper and the oil.

The dielectric strength and load risk at peak load can be estimated and/or determined immediately and accurately.

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2. SIMMS Specification

2.1 Technical data

Power supply voltage	80 – 250 VAC
Power supply frequency	50 - 60 Hz
Power consumption:	max 80W
Oil throughput	0.02 m^3 per hour
Measuring range	
Water content in the oil	5 – 100 ppm (diluted water)
Temperature	0 – 100 C
Outlet /inlet filtering grade of preliminary filter	40 µm
Weight – inclusive alu transport box and accessories	26 kg
Dry weight of the measuring unit only (without oil)	5 kg
Hydraulical connection	2 x flexible hose
Communication:	lap-top connector

2.2 Operational conditions

The SIMMS is focused at the **quick and precise reading** of the three basic time-related values of a transformer:

- o Water content in the oil
- o Upper (operational) temperature of the transformer
- o Bottom (operational) temperature of the transformer

The subsequent evaluation of :

- o Desired equilibrium condition of a transformer
- o An averaged water content in cellulose materials of a transformer

is then in situ provided by the lap-top.

Please never forget

SIMMS is designed for a quick reading and evaluation of a transformer in situ

long-term reading of a transformer by SIMMS is basically useless and moreover customer has to get results in hours

The recommended reading period of a transformer should not exceed

1 – 2 hours, in a extreme situation ca 24 hours.

3. Transportations

SIMMS 2005.1 is always transported, inlusive all accessories in:

- stress resistant fly-by alu-box
- high resistant box intended for all-day operation under very heavy conditions

Check the SIMMS funcionality before your departure to a consumer.

4. Installation

Preparation of a SIMMS measuring (at home)

All possible connection points at the transformer(s) suitable for the SIMMS installation should be properly checked before the SIMMS measuring trip.

Call the customer first and check all possible connection alternatives to its transformer(s).

At any transformer exist at least one of three kinds of connection points:

- sampling cock (s)
- filter press valves
- drain valve (s)

4.1 Sampling cock(s)

The best SIMMS connection points are of course sampling cocks e.g. DIN 42568 connected to the bottom and upper part of the oil filling of a transformer. That enables very easy installation and the most precise measuring by means of the 2-P installation.

4.2 Filter press valves

The same opportunity offer “bottom” and “upper” filter press valves.

Attention - both valves (usually slide valves) are under a normal operational conditions sealedby blind flanges. For an easy connection of hoses is necessary to provide both blind flanges with a ½ “ internal thread, or to select other suitable connection e.g. sleeves provided by the 1”, ¾” , ½ “ or 3/8” internal or external thread.

Call your customer first – an above mentioned adjustment of both flanges made e.g. by the local crew saves signifcantly your time.

Do not forget:

1. ***internal space of a filter press valve – the volume between a closing element and the blind flange must be properly evacuated before the begining of any SIMMS mesuring to prevent the ingress of air to the oil inventory of a transformer.***
2. ***if is your measuring finished and the filter press valve is closed again , the internal space of the valve must be sealed against the surrounding, by means of a suitable blind flange, cap or screw.***

4.3 Drain valve

At any transformer bottom exists always al least one drain valve which can be used for a SIMMS measuring procedure.

The connection of SIMMS to the standard drain & sampling point (DIN 4255) at German or Gerrman-made transformers can be easy performed by means of the ARS-adapter See Fig. 1.

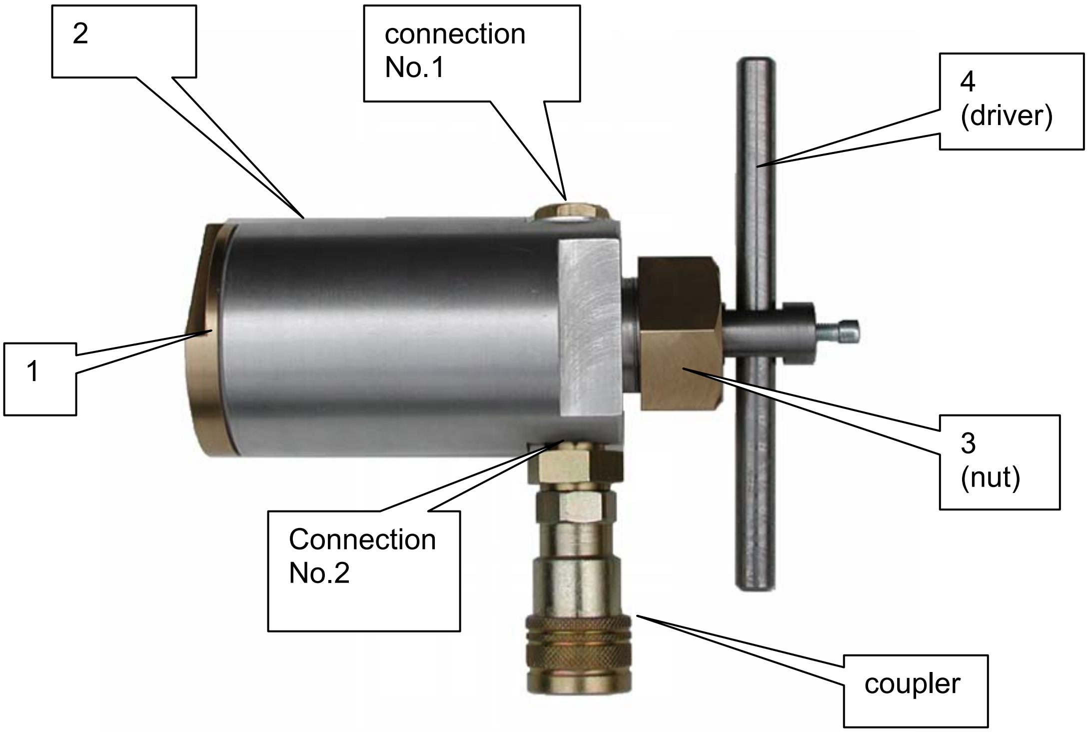

Fig. 1 The ARS – sampling adapter (only at the special order) for the DIN4255 drain& sampling valve

The installation of the adapter at the transformer:

- disassemble cap of the drain & sampling valve
- check the dimension of the drain valve thread and select the proper thread of the adapter. For threads M33 x 1.5 and M32 x 1.5 use the reduction (1), for the M48 x 2 you can directly use the internal thread in the body (2) of the adapter
- loose the nut (3) of the sealing of the adapter and push out the driver(4)
- screw the adapter on the thread of the drain valve and put the and tight it up

Preparation of the instalation of the SIMMS in situ

Hydraulic connection of a transformer and the SIMMS

- o if sampling points are directly connected to the oil inventory of the transformer use simplified procedures 3.4 or 3.5
- o is sampling points are not directly connected to the oil inventory (between the sampling point and the oil inventory exists a detrimental space corresponding e.g. space between the slider and the blind flange of the filter press valve – See Fig. 3 - alwyas use full procedure 3.4 or 3.5, which allows the evacuation of the corresponding detrimental space.

Measuring od transformer temperatures

For a precise evaluation of the equlibruim conditions of the transformer and consequently a precise evaluation of the averaged water content its cellulose materials, is necessary a " long-term " reading of:

- o upper temperature of the transformer
- o bottom temperature of the transformer

Both temperatures are measured by means of enclosed cylindrical temperature sensors RAWET PT30, Ni 1000.

The optimal location of sensors is:

- upper tube (sleeve) of the radiator, which feeds the hottest oil representing the temperature of the upper part of the windings into a radiator.
- bottom tube (sleeve) of the radiator, which feeds the cold oil from the radiator into the bottom part of transformer and therefore satisfactorily represents a temperature of the bottom part of the windings.

The reading of both sensors is inevitably indirect, because sensors read not the oil temperature directly, but the temperature of surfaces of tubes which lead the oil in/out the radiator.

It is always necessary not only perform the proper mechanical fixation of a sensor at the given tubing, but the sensor and the tube on its both sides should be termally insulated as well.

The standard solution is that the temperature sensor is fixed at the tube by enclosed rubber band.

The pre-loaded rubber band safisfactorily fixes the sensor at the tube and simultaneously acts as a sufficient thermal barrier, which effectively eliminates the temperature difference between the throughflowing oil and the outer surface of the tube (and the sensor).

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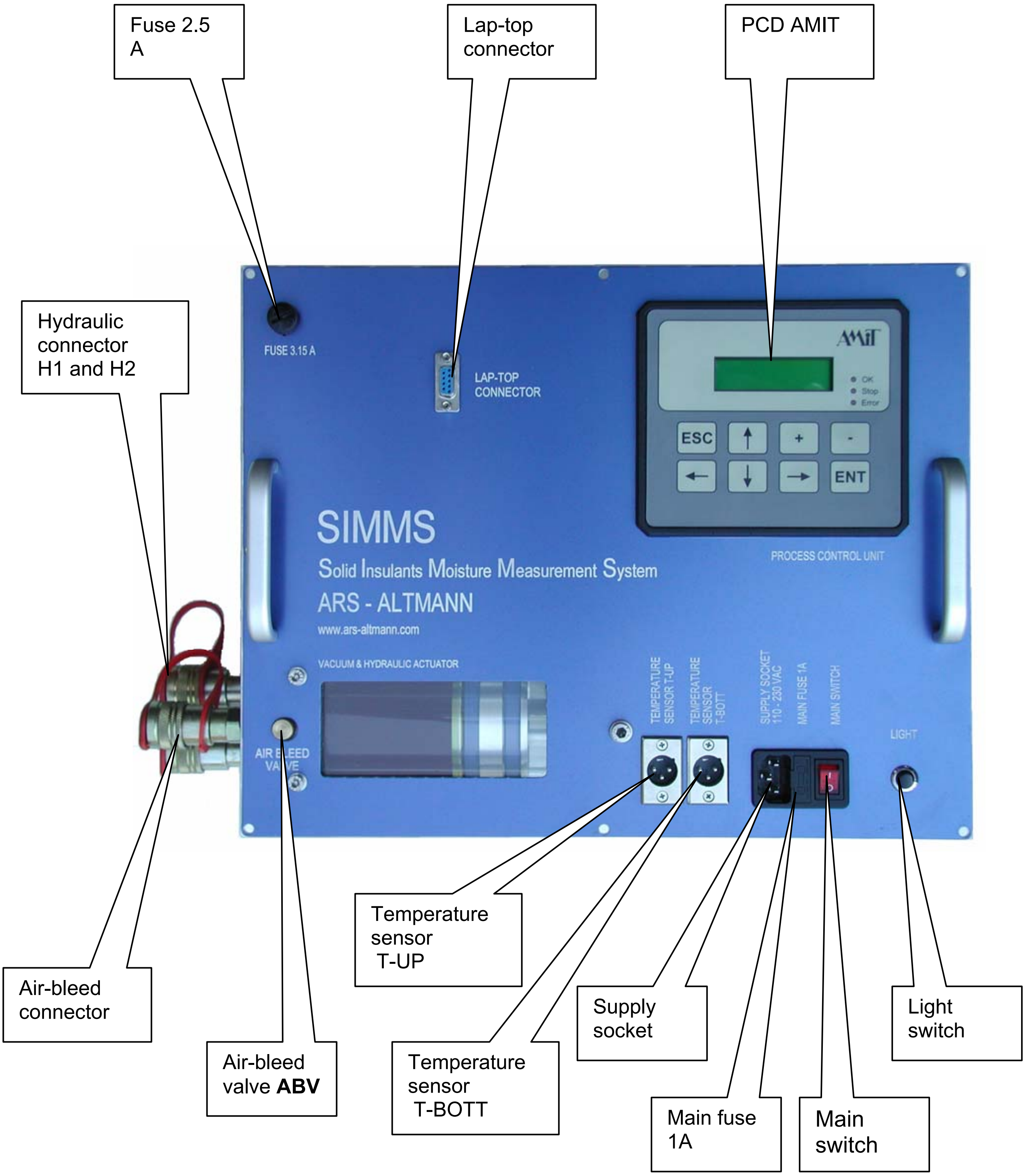

Fig.2 Face plate of the SIMMS 2007

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ATTENTION

- **existing valve or cock at the transformer which directly communicate with its oil filling is thereinafter called the main cock**
- **detrimental space is the space between the main cock and the sampling cock which is installed due to the SIMMS measuring**
- **detrimental space is fulfilled with the air and must be evacuated before the the main cock is open to prevent the ingress of the air into the transformer**

4.4 SIMMS – 1P (one-point Installation) - See Fig.3

- attach the **sampling** cock to the blind flange of the **main** cock, join the hose **H1** at **the sampling** cock and the opposite end of **H1** join at the **preliminary filter** of the hydraulic connector situated at the left side of the SIMMS .

Attention !!

never operate SIMMS without the preliminary filter

- join hose H3 at the air bleeding valve connector **ABV** and place the opposite end of the H3 vertically into the sampling flask.
- Install the first temperature sensor on the upper tubing (hot inlet) of the radiators and connect the sensor to the connector **T-UP**.
- Install the second temperature sensor on the bottom tubing (cold outlet) of the radiators, connect the sensor to the connector **T-BOTT**.
- Check the correct level of supply voltage (required 110 - 230 VAC, 50 –60 Hz).
- Connect **SIMMS** to the power supply by the **SUPP** connector.
- Connect SIMMS to the lap-top

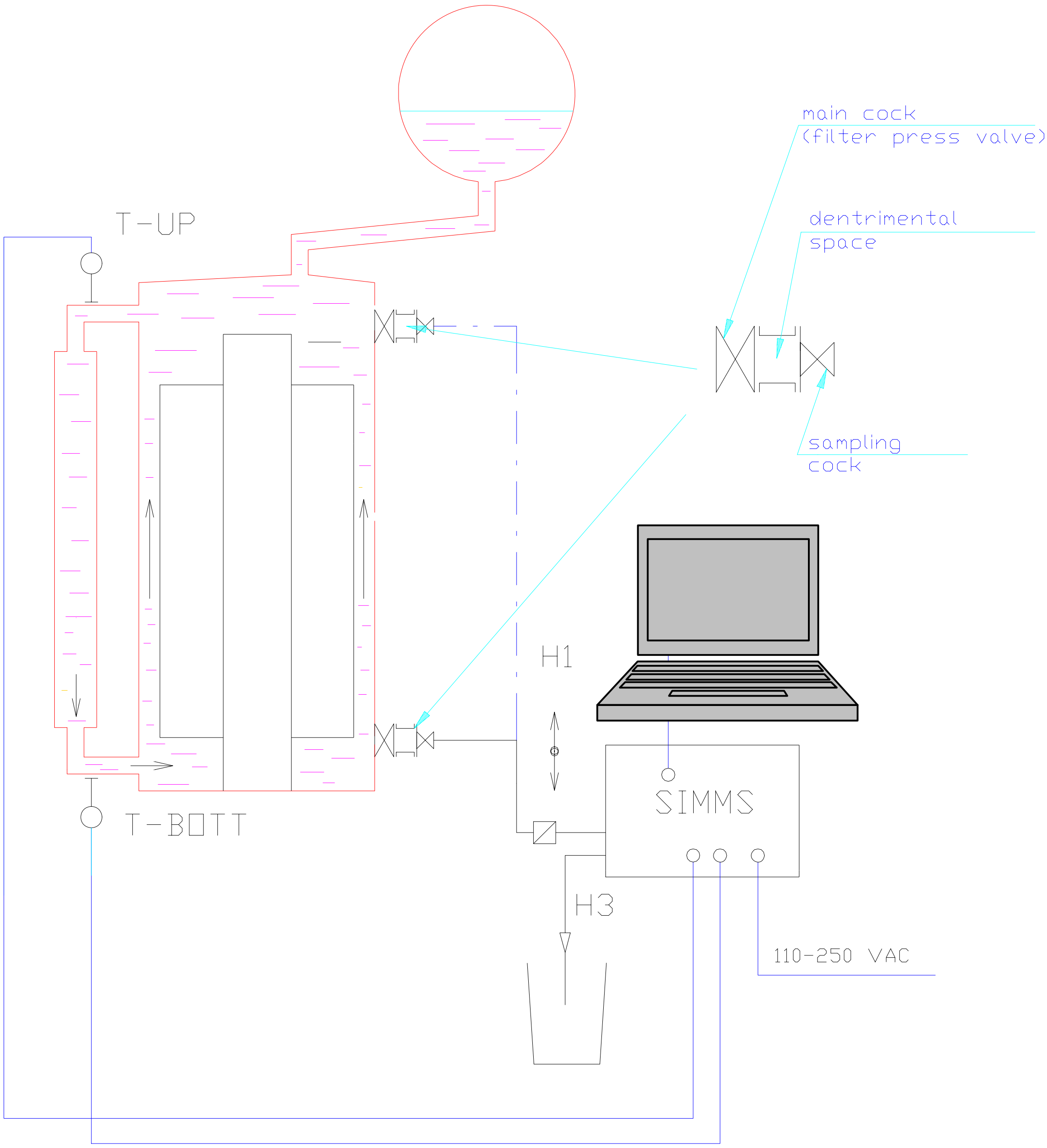

Fig. 3 Connection Diagram **SIMMS 1P**

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4.5 SIMMS – 2P(two-point Installation) – Up-Down,

- Attach the **Valve2** at the first **main cock** (e.g. upper filter press valve or upper sampling cock See Fi.4) of the transformer and connect it with hose H2, the opposite end of hose H2 connect at the preliminary **filter** of the first hydraulic connector of the SIMMS unit.
- Attach the **Valve1** at the second **main cock** (e.g. bottom filter press valve or bottom oil sample cock) of the transformer and connect it with hose H1, the opposite end of hose H12 connect at the preliminary **filter** and the second hydraulic connector of the SIMMS unit.

Attention !!

never operate SIMMS without particle filters

- Connect the bleeding valve hose **H3** onto the air bleeding valve connector **ABV** and place the opposite end vertically into the sampling flask.
- Install the first temperature sensor on the upper tubing (hot inlet) of the radiators and connect the sensor to the connector **T-UP**.
- Install the second temperature sensor on the bottom tubing (cold outlet) of the radiators and connect the sensor to the connector **T-BOTT**.
- Connect SIMMS to the power supply 110-230 VAC, 50-60 Hz by connector
- Connect the SIMMS to the lap-top (see Fig.4).

Rem. For precise and long-term measurement the status **SIMMS 2P UD** is mostly used.

Rem . The installation procedure is the same for status **SIMMS 2P DU** (oil flow direction **D**own **–U**p**)** and the status **SIMMS 2P UD** (oil flow direction **U**p **– D**own) - with the exception of the settings of the both Valves 1 and 2 - See Fig.4.

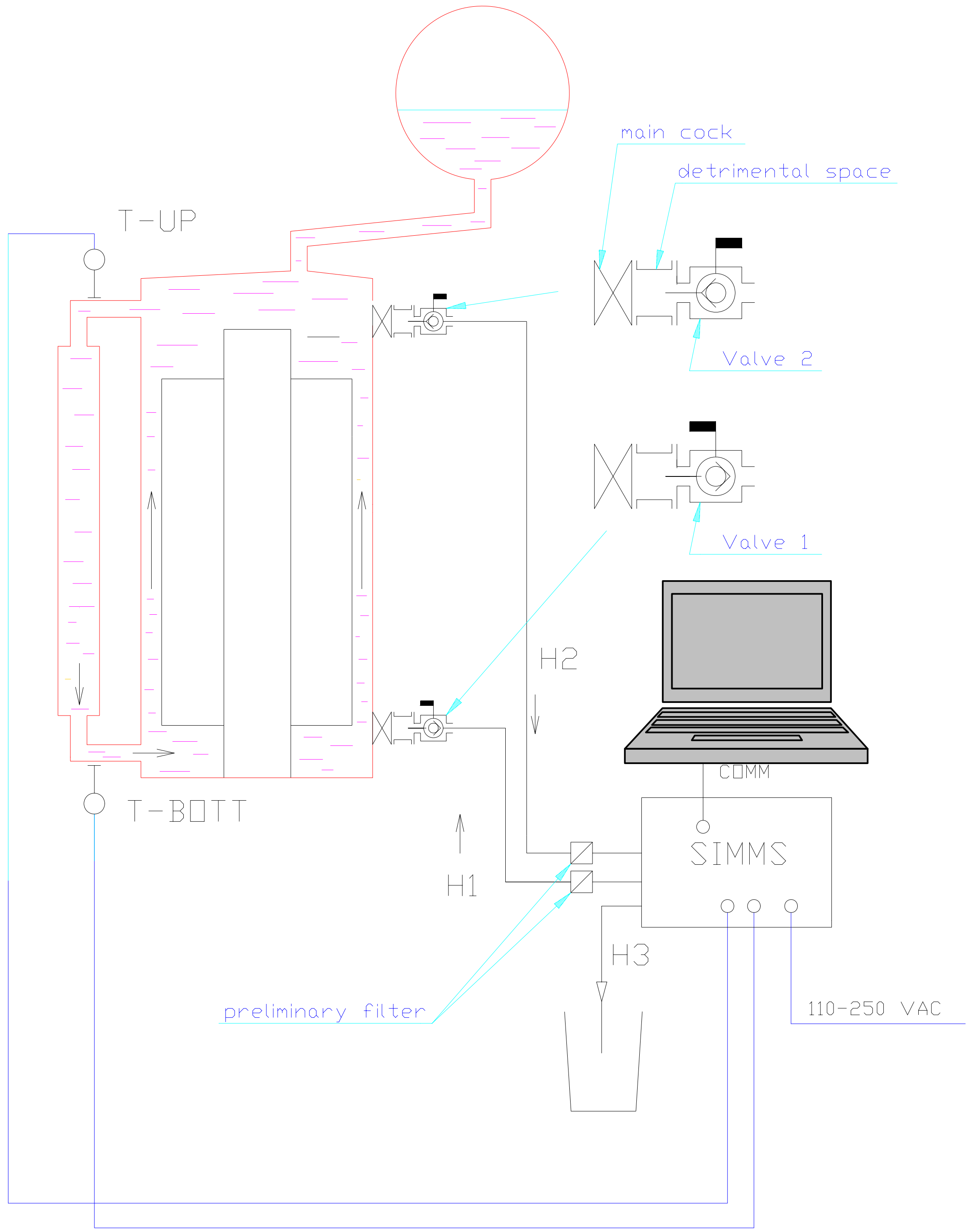

Fig.4 Connection Diagram **SIMMS 2P UD** – oil flow direction **U**p-**D**own

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4. Start-Up

To start the SIMMS, switch the main switch QM1 on the position I (ON).

Attention – all measuring procedures should be properly finished – it means that the measuring should be finished unaffected way until the preprogramed parameter TD(Test Duration) expires.

The corresponding data packet should be then downloaded in the lap-top .

In the case that the last measuring is interupted – e.g. we don´t want wait till the TD parameter (Test Duration) expires, the SIMMS always evaluates the switching OFF/ON as a supply outage / supply recovery only and after 60 sec will try to continue the last measuring.

This "automatic restart" can be easy interrupted by the click on an arbitrary button in the beginning of a new job of the SIMMS.

The old data remains in the SIMMS can be then downloaded in the lap-top.

The "old" data remains in the SIMMS till a new On-line Measurement of Transformer begins – See Section 4.

The PSD AMIT asks at first for the decision

MANUAL = +
AUTOMAT = -

By pushing (**+**) SIMMS proceeds to the manual control regime, where the piston movement is governed by pushing (←) - the piston moves to the left-, or (→) - the piston moves to the right.

By click on the (-) or (+) is automatically interrupted the "automatic restart" of the SIMMS and the data of the last job are erased.

By pushing (**-**) SIMMS proceeds to the full automatic control regime and the SIMMS ask for **TD** (**T**est **D**uration) parameter, the display shows the preset parameter TD = 60 (min):

TD = (min)
+/- PUSH ENTER

This parameter can be altered by pushing (+) / (-) buttons in step of 10 min. (min. duration of the test is 20min, max. 1550 min.

But do not forget – your SIMMS is the apparatus for the quick estimation not for the quasi-on-line measurement !

By pushing ENTER, SIMMS proceeds to the Menu procedure and the display shows :

1P REGIME = +
2P REGIME = -

By pushing (**+**) status **SIMMS 1P** is selected**,** Menu procedure is finished and SIMMS goes forward directly in the procedure **START-UP 1P** (See Section 3.1).

By pushing (**-**) the **SIMMS 2P** status is selected (See Section 3.2)

Rem. Should anything malfunction during the Menu procedure, simply shut-down SIMMS by the main switch QM1 and restart the whole menu operation.

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5.1 STARTUP 1P Procedure

Immediately after the pushing (+) starts the evacuation of the SIMMS and the connected hose H1.
The SIMMS at first check the internal pressure in the glas cylinder (and in the hose H1) and the position of the piston.
When the piston is not in the left position, the glas cylinder is probably fulfiled with the air which must be removed.
The piston automatically therefore goes in the left position and gradually compress the air:

- If the internal pressure in the cylinder is lower as 100 kPa , following message is displayed :

WAIT PLEASE
P = xxx kPa

- if the internal pressure is higher as 100 kP and increase we can follow the pressure at the display and SIMMS demands

PUSH BLEED VALVE
P = xxx kPa

- if the pressure exceeds an allowed pre-programmed level (See Pvyfmax in the Parameter Table -), the piston stops and SIMMS asks if the air-bleeding was performed:

:

IS BLEED VALVE
OPENED ?

By pushing of ABV is the air expelled from the glass cylinder and escapes outside via hose H3. The gas discharge decreases the pressure in the glas cylinder (and in the H1) and automatically starts a new motin of piston is the left direction again.

ATTENTION – if this procedure is more than 3-time repeated, increase the parameter **Pvyfmax** over 150 kPa in the Parameter Table – the Table is any time easy accesible by pushing of key ← at the AMIT keyboard. By pusching of the key → goes the SIMMS back in the main window.

When the piston reach the left terminal position and the pressure is higher as 100 kPa(atmospheric pressure) the last gas removal via ABV is asked

PUSH BLEED VALVE
P = xxx kPa

and the evacuation procedure begins.

The display reads:

VACUUM BUILDING
ON P= xxx kPa

The piston is moving to the right now and sinking pressure P is measured and displayed.

When the piston stops at the right terminal position and max. vacuum level is reached, vacuum (tightness) check begins.

The SIMMS compares the reached absolute pressure level with the desired pre-programmed parameter (See **Pminvac** in the Parameter Table):

- when **P > Pminnvac**, the whole hydraulic system of SIMMS is probably leaking,

VACUUM ALARM
P= xxx kPa

which necessitates checking all hydraulic connections at first.

The SIMMS must be switched off, the leak must be repaired and a new evacuation procedure must be performed..

.

- when **P ≤ Pminvac**, the system is considered tight and the display reads

OPEN SAMPLING
COCK, PUSH ENTER

Opening of the **sampling cock** (See Fig.3) interconnects the SIMMS with the potential **detrimental space** between the **main cock** and the **sampling cock .**

……………………………………………………………………………………………………

ATTENTION - when is the SIMMS connected at the cock which directly comunicates with the oil filling (the detrimental space does not exist), a simplified procedure should be used:

OPEN SAMPLING
COCK, PUSH ENTER

And immediately after

OPEN MAIN COCK
PUSH ENTER

…………………………………………………………………………………………………..

The detrimental space must be always and orderly evacuated and SIMMS therefore at first reads a new pressure level in the system:

- when P > Pminvac a detrimental space is probably too large (the P-level is corespondingly too high) / or the detrimental space is untight.

We get therefore a display:

VACUUM TOO LOW
P= xxx kPa

and after cca 10 sec

CLOSE SAMP. COCK
PUSH ENTER

This manner si closed partially evacuated detrimental space and after ENTER the piston moves to the left position again to compress and then expell the gas from this space into the atmosphere.

The gas expelling sequence is the same as above

WAIT PLEASE
PUSH ENTER

PUSH BLEED VALVE
P = xxx kPa

and if needed

IS BLEED VALVE
OPENED ?

The whole procedure must be repeated till the desired pressure level is reached.

In principle any detrimental space can be evacuated this way, but for a very large detrimental spaces is more suitable to use the vacuum pump connected to the SIMMS via the hose **H3**. During following evacuation must the ABV be pushed down.

The desired vacuum conditions in the whole measuring system signalizes display:

OPEN MAIN COCK

At first, the glass cylinder is filled with the oil and gas bubbles mixture.

Then, the display reads again

PUSH AIR BLEED
VALVE

The piston is moving from the right terminal position to the left. The mixture of oil and bubbles is expelled via hose H3 into the sampling flask and through the opened ABV valve (See Fig.3).

When the piston achieves the left terminal position, the measurement procedure begins (See Section 4).

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5.2 STARTUP 2P DU Procedure

The start 2P DU procedure is a litlle bit more complicated because we have to evacuate two potential detrimental spaces.

The initial evacuation of the both hoses H1 and H2 is the same as before

PUSH AIR BLEED
VALVE

When the left terminal position is reached, ABV is closed and the vacuation procedure begins.

The display shows

VACUUM
BUILDING ON

When the piston achieves the right terminal position, the vacuum check of the connection SIMMS – Valve 1begins.

The SIMMS compares the reached absolute pressure level with the desired pre-programmed parameter (See **Pminvac** in the Parameter Table):

- when **P > Pminnvac**, the whole hydraulic system of SIMMS is probably leaking,

VACUUM ALARM
P= xxx kPa

which necessitates checking all hydraulic connections at first.

The SIMMS must be switched off, the leak must be repaired and a new evacuation procedure must be performed..

.

- when **P ≤ Pminvac**, the system is considered tight and the display reads

TURN VALVE 1 IN 1
PUSH ENTER

Turning the **Valve 1** in the **Position 1** (See Fig.4 - at Fig. 4 is Valve 1 in the Position 2 and must be turned in the Position 1) interconnects the SIMMS with the potential bottom **detrimental space** between the **main cock** and the **Valve 1 .**

The Valve 1 is provided by the non-return valve which is in the Position 1 opened and the gas is discharged into SIMMS.

The display offers the standard tightness check:

The bottom detrimental space must be always and orderly evacuated and SIMMS therefore at first reads a new pressure level in the system:

- when P > Pminvac a detrimental space is probably too large or untight (the P-level is corespondingly too high)

We get therefore a display:

VACUUM TOO LOW
P= xxx kPa

and after cca 10 sec

CLOSE SAMP. COCK
PUSH ENTER

This manner si closed partially evacuated detrimental space and after ENTER the piston moves to the left position again to compress and then expell the gas from this space into the atmosphere.

The gas expelling sequence is the same as above

WAIT PLEASE
PUSH ENTER

PUSH BLEED VALVE
P = xxx kPa

and if needed

IS BLEED VALVE
OPENED ?

The whole procedure must be repeated till the desired pressure level is reached.

In principle any detrimental space can be evacuated this way, but for a very large detrimental spaces is more suitable to use the vacuum pump connected to the SIMMS via the hose H1. During following evacuation must the ABV be pushed down.

The desired vacuum conditions in the whole measuring system signalizes display:

OPEN BOTTOM COCK
PUSH ENTER

At first, the glass cylinder is filled with the oil and gas bubbles mixture and the piston moves automatically in the left.

Then, the display reads again

WAIT PLEASE
P = xxx kPa

PUSH BLEED VALVE
P = xxx kPa

and if needed

IS BLEED VALVE
OPENED ?

The backwash operation of the bottom detrimental space and the hose H2 is finished and begins the evacuation of the upper hydraulic parts and joints.

CLOSE VALVE 1
PUSH ENTER

By the turning of the Valve 1 in the position 2 is hydraulically closed the “botom connection” and automatically pre-prepared the following measuring procedure. Valve 1 in the Position 2 closes previously desired throughflow of oil from the transformer into SIMMS, but opens **the oil throughflow from the SIMMS back into the transformer.**

The evacuation of the upper connection begins with the display

VACUUM BUILDING
ON - P = xxx **kPa**

And the same procedure as before begins:

TURN VALVE 2 IN 1
PUSH ENTER

And the whole procedure constinues

OPEN UPPER COCK
PUSH ENTER

and finished by the display

WAIT PLEASE
P = xxx **kPa**

If the whole system is properůly degassed and/or under the vacuum asks SIMMS what 2-P measuring procedure will be used:

DOWN – UP = +
UP- DOWN = -

As mentioned before, by using of the DOWN – UP procedure is the oil sampled from the bottom part of a transformer and forced by the SIMMS into the upper part.

The second procedure UP-DOWN is used most frequent.

The following displays then inform a user in what position should be VALVE1 and VALVE2 fo preform the desired procedure and continues to the ON-LINE Measurement.

6. ON-LINE Measurement of Transformer

At present the piston is moving continuously between both terminal positions and our on-line measurement can begin.

The pressure in the SIMMS is continously measured to avoid a potential damage induced by the not-allowed overpressure.

When the P > Pmax (250 kPa) the display shows it as warning:

OVERPRESSURE
P = xxxx kPa

and the motor-actuator is immediately switched off.

When a source of the overpressure is identified and removed, the SIMMS continues automatically .

The Pmax level is predefined at 250 kPa, but can be any time changed in the Parameter Table by pushing →, overwriting the number by using of +/- and by pushing ←.

When the piston achieves the right terminal position, values Cw, TV, TU, TB are always loaded in the PCD AMIT memory and actual values appear on the display.

Display shows

I = ...
t = ... (min)

where:	I	….	Number of Sample
	t	….	sampling time

In order to read other data gained from Vaisala transmitter, the display is rolled down by ↓

CW = ... (ppm)
TV = ... (C)

where:	CW	….	water content in oil (at time t)
	TV	….	temperature of oil on sonde

The remaining data are available by another ↓

TU = … TB = …. (C)
TTS =

where:	TU	….	upper temperature of transformer at time t
	TB	….	bottom temperature of transformer dtto
	TTS	….	main temperature of transformer dtto

All measured data from the beginning are available at any time by means of laptop, which can be connected to the serial connector of SIMMS.

The end of our procedure is reported by

MEASURE FINISHED
PUSH ENTER

The following display demands the connection to the laptop. This connection is realized by a normal serial cable. The first connector is joined to the serial port of SIMMS and the second one is attached to the serial port of the laptop.

CONNECT LAP-TOP
PUSH ENTER

SIMMS demands the final operation to download the measured data to the laptop memory.

LAPTOP CLICK ON
SIMMS ICON

6. Transformer Equlibrium Check

However, for proper data evaluation, e.g. by TRACONAL (or only by Nielsen Diagram for example), the equilibrium operating environment of the transformer must meet the necessary criteria.

In practice, this means the following :

- time variation of the mean temperature of the transformer

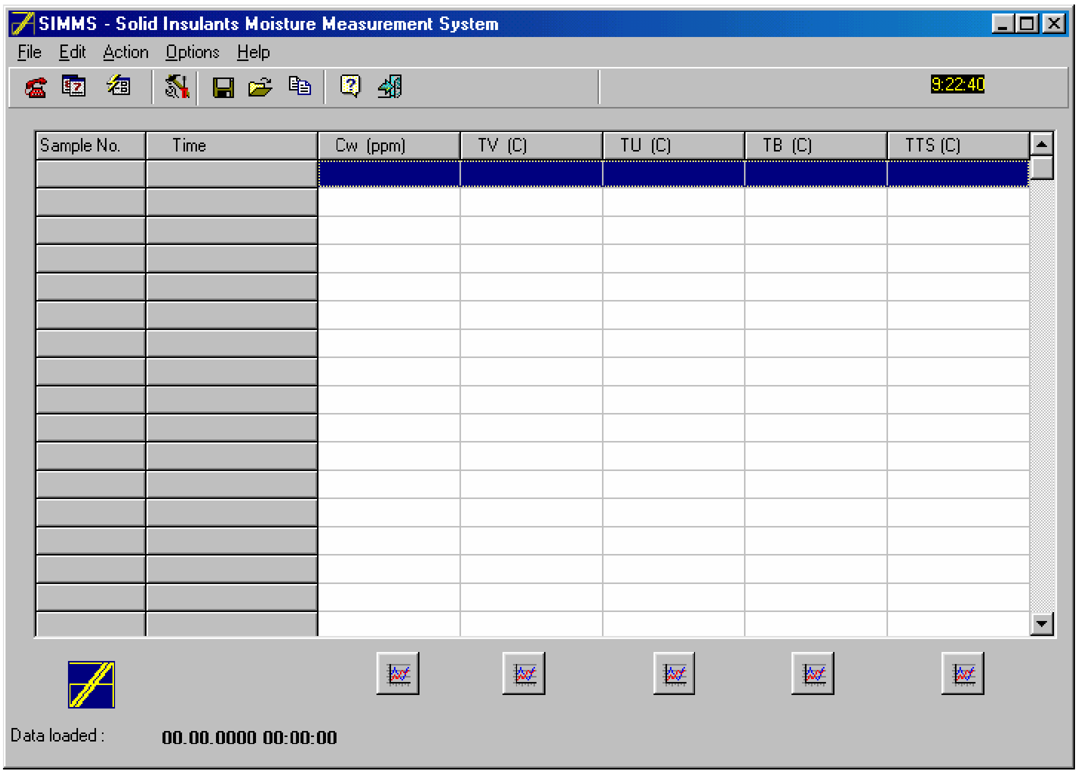
and

- time variation of the water content in the oil

must be simultaneously lower then predefined limits.

The SIMMS software solves the problem in the following steps:

- the program is started by clicking on the SIMMS icon and we get the first window



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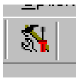
At first, define:

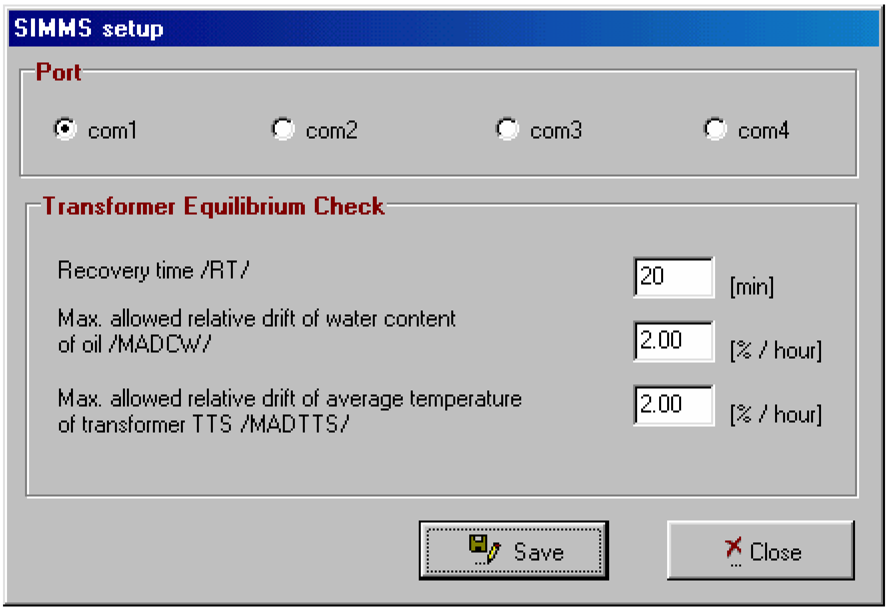
- the connection between SIMMS and laptop
- the basic features for evaluation.

This is achieved by clicking on Settings: 

Then, chose :

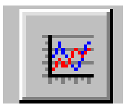
- what com of the laptop will be used for communication
- what **R**ecovery **T**ime will be used for data evaluation (in this way, we can “cut out” the undesired dynamical variation of the initial data, which can be caused by SIMMS alone)
- what **M**aximal **A**llowed **D**rift:
    - MADCW – for water content in the oil Cw (%/hod)
    - MADTTS – for main transformer temperature TTS (%/hod)

By clicking on Connection 



all data from SIMMS are then dow-loaded to the laptop

the first rough evaluation of our data from the numeric side is carried out. In order to achieve the graphical form, click on.



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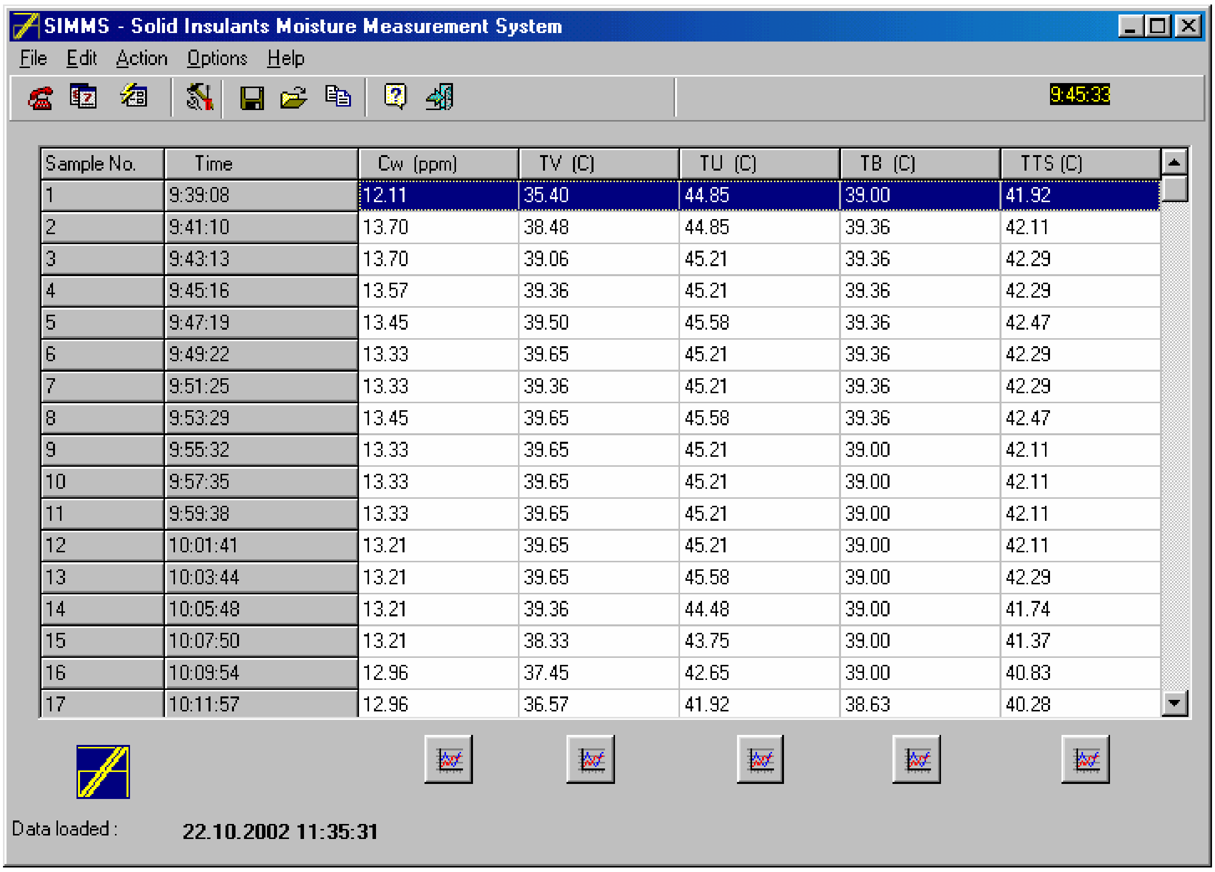
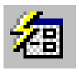


Sample No.	Time	Cw (ppm)	TV (C)	TU (C)	TB (C)	TTS (C)
1	9:39:08	12.11	35.40	44.85	39.00	41.92
2	9:41:10	13.70	38.48	44.85	39.36	42.11
3	9:43:13	13.70	39.06	45.21	39.36	42.29
4	9:45:16	13.57	39.36	45.21	39.36	42.29
5	9:47:19	13.45	39.50	45.58	39.36	42.47
6	9:49:22	13.33	39.65	45.21	39.36	42.29
7	9:51:25	13.33	39.36	45.21	39.36	42.29
8	9:53:29	13.45	39.65	45.58	39.36	42.47
9	9:55:32	13.33	39.65	45.21	39.00	42.11
10	9:57:35	13.33	39.65	45.21	39.00	42.11
11	9:59:38	13.33	39.65	45.21	39.00	42.11
12	10:01:41	13.21	39.65	45.21	39.00	42.11
13	10:03:44	13.21	39.65	45.58	39.00	42.29
14	10:05:48	13.21	39.36	44.48	39.00	41.74
15	10:07:50	13.21	38.33	43.75	39.00	41.37
16	10:09:54	12.96	37.45	42.65	39.00	40.83
17	10:11:57	12.96	36.57	41.92	38.63	40.28

However, this technique is inadequate for proper and precise quantitative time-log analysis. Thus, a better technique must be used.
The linear regression for both time trends Cw = Cw(t) and TTS = TTS(t) is actually the best method.

The procedure is launched by clicking on icon 

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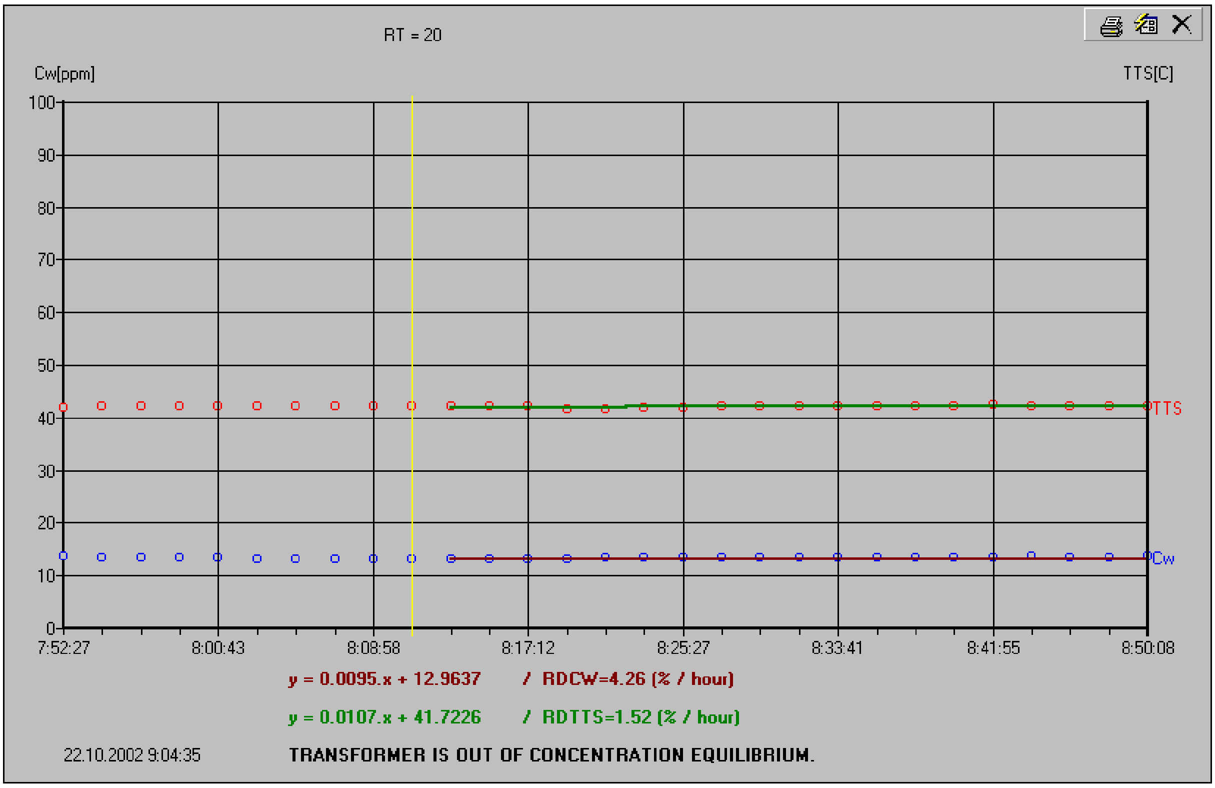
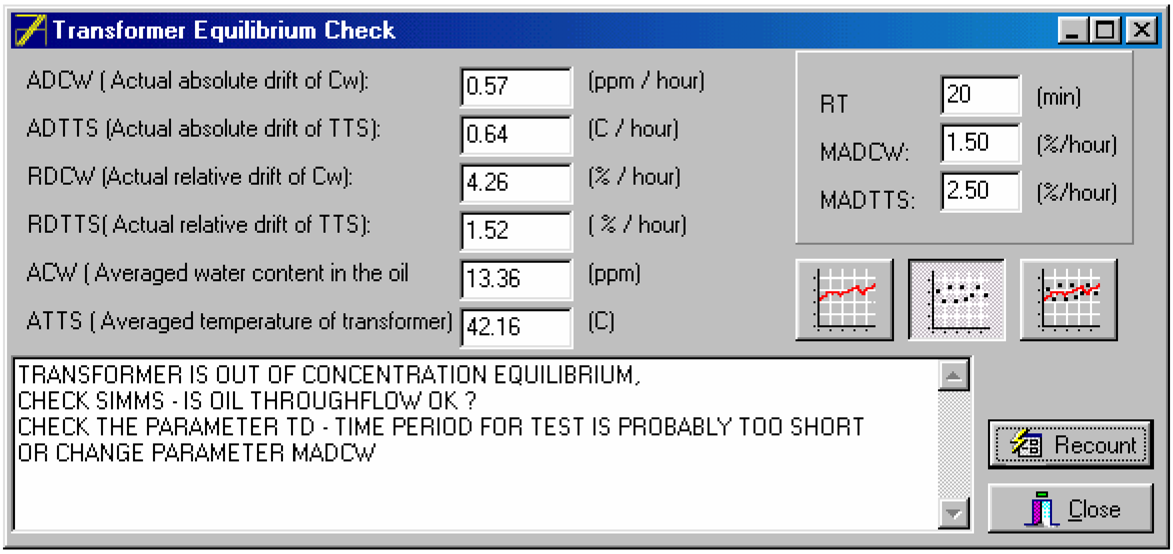


At the same time the Transformer Equilibrium Check appears



The value of the relative concentration drift of Cw (RDCW = 4.26%/hour) looks high. Therefore computer evaluates this state as : TRANSFORMER IS OUT OF CONCENTRATION EQUILIBRIUM and subsequently offers : CHECK SIMMS ………

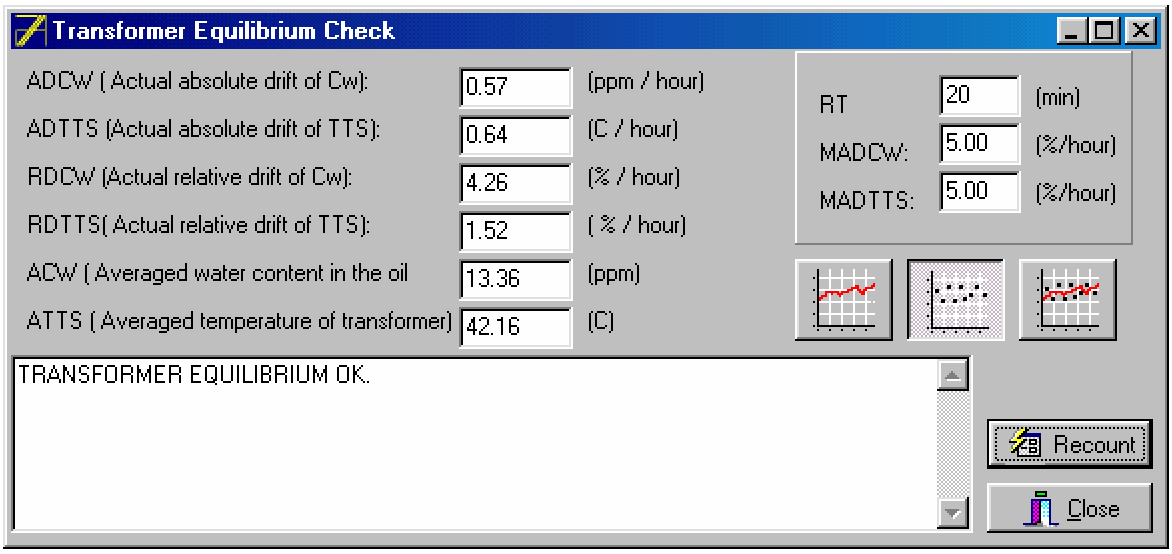
Yet, when considering the relative temperature drift (RDTTS = 1.52 %/hour) the transformer is in the acceptable quasi-equilibrium.

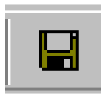
This slightly diverges from the overall equilibrium of the transformer, but the absolute value of Cw, as well as the absolute drift ADCW = 0.57 ppm/hod are relatively very low and near the calibration precision of the Vaisala transmitter. Thus, both ACW and ATTS values can be accepted for the following TRACONAL evaluation.

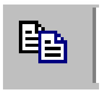
The conclusion is simple - the MADCW and MADTTS values were set too low – acceptable quasi-equilibrium MADCW value ranges between 3-5 % /hour. On the other hand, the preset MADTTS values should never exceed 5% /hour. Therefore we will set both values on 5%/hour and

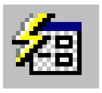
then, by click on icon 

we get a new evaluation of the current state of the transformer



All measured data can be properly named and sent, either to Archive by clicking on 

or sent to the clip-board for reprocessing 

The data can be re-opened by clicking on and evaluated under different TR and MAD-limits. 

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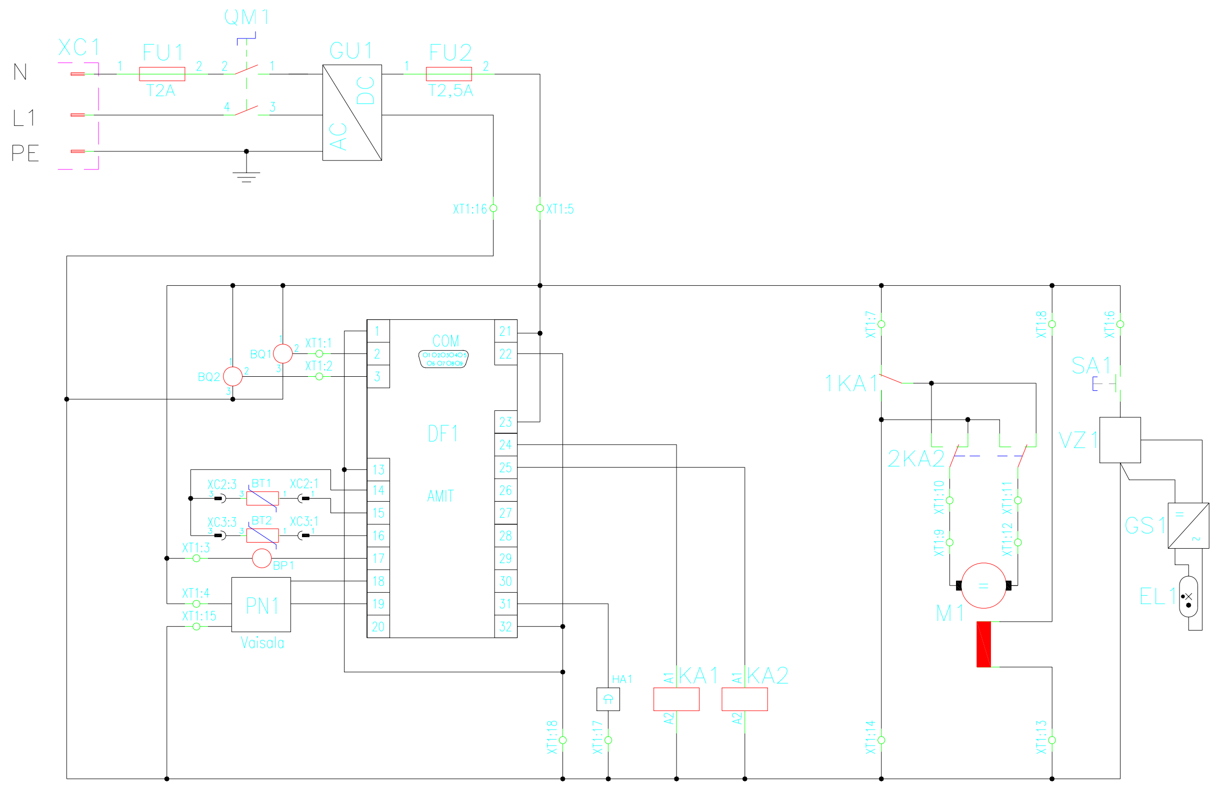
7 . Electrical circuits

Power Circuit diagram is shown on Fig. 5, components location is shown on Fig.6



Name	Function	Designation	Qty.	Producer
QM1	Main switch 10A, 240V	Best.Nr. 501638	1	Conrad
XC1	Power supply connector	Best.Nr. 501638	1	Conrad
GU1	Power supply	TXL 070-24S	1	Traco Power
FU1	230 (110)VAC T 2A tube fuse	FST01	1	GES Electronics
FU2	24 VAC T 2,5A tube fuse	FST02	1	GES Electronics
DF1	Proces Control Unit	ART 267 A	1	AMiT
BQ1, BQ2	Position sensor	TCST 2103	2	GES Electronics
BT1, BT2	Temperature sensor	PT30, Ni 1000	2	Rawet
BP1	Pressure sensor	DMP 331, 0-6bar	1	BD Sensors
PN1	Humidity sensor	HMP 228	1	Vaisala
HA1	Buzzer	PEB 457	1	GES Electronics
KA1	Relay 24V DC	40.61	1	Finder
KA2	Relay 24V DC	40.52	1	Finder
M1	Servodrive 24DVC , 45 rev/min	K7A3	1	ATAS
SA1	Push button switch	B 1383	1	GES Electronics
GS1	Converter	Best.Nr. 581770	1	Conrad
EL1	Fluorescent tube		1	Conrad

Fig. 5 Circuit diagram

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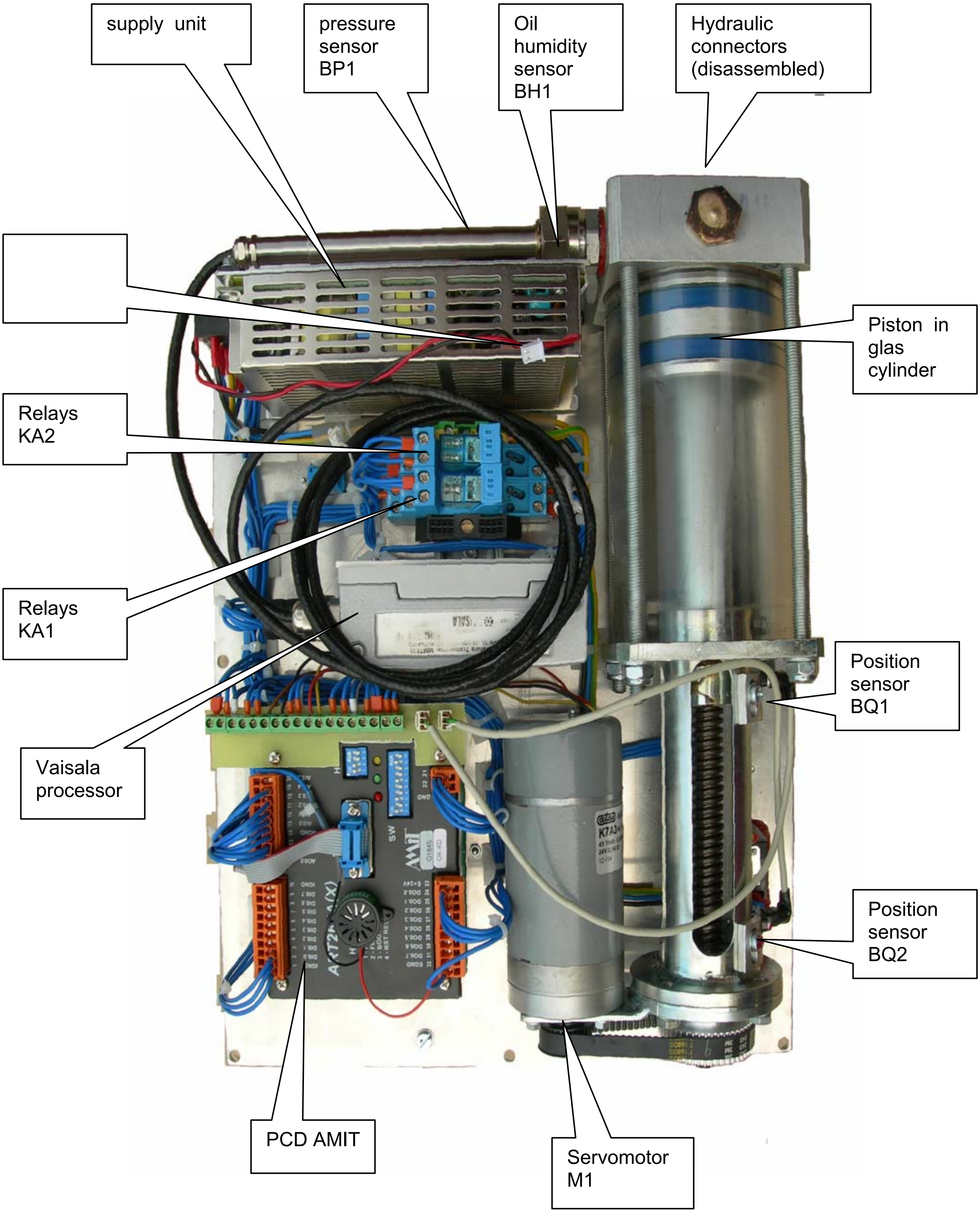
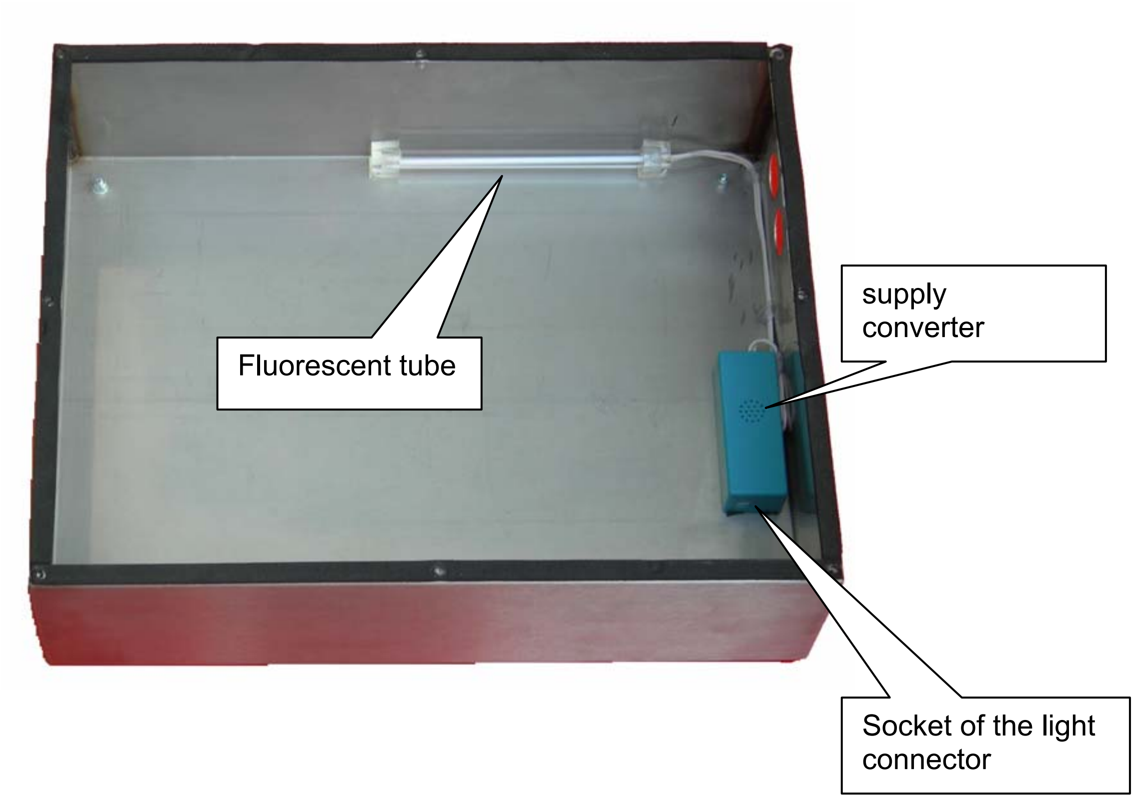


Fig. 6 Components location



ATTENTION !

disconnect the lighting connector
before the final lifting of the face panel of the SIMMS

Fig. 7 The case of the SIMMS