Viscosity Processor
9601

V2.6.1

User Manual

Original version
Ref.: 237/5

IMPORTANT

THE <u>OFFSET ADJUSTMENT IN THE AIR</u> MUST BE THE FIRST TASK COMPLETED.

Offset adjustment procedure is detailed in § 5.1

1. CLEAN AND DRY THE SENSOR ROD.

2. BE SURE THE PROCESS IS EMPTY. THE ROD MUST BE VIBRATING IN THE AIR.

3. INSTALL THE SENSOR ON THE PROCESS AND FIX IT WITH ITS 4 SCREWS.

4. REACH THE OFFSET ADJUSTMENT FUNCTION BY ENTERING INTO THE MENU AND CHOOSING THE FUNCTION NUMBER 1 (OFFSET). PRESS "OK".

5. FOLLOW THE INSTRUCTIONS DISPLAYED ON THE ELECTRONICS SCREEN.

6. PRESS "OK" TO ADJUST THE OFFSET. IT MEANS THE RAW SIGNAL IS SHIFTED TO THE VOLTAGE REFERENCE DEFINED IN THE FACTORY CALIBRATION STAGE.
A MESSAGE SAYING THE OPERATION WAS SUCCESSFUL APPEARS.

PRACTICAL ADVICES AND IMPORTANT WARNINGS ARE ALSO LISTED IN THE **9601** TECHNICAL MANUAL IN **§ 1.6** AND **§ 3.12.**

TABLE OF CONTENT

1 Generalities

Before any use, read carefully the technical manual in order to ensure the good installation of the unit.
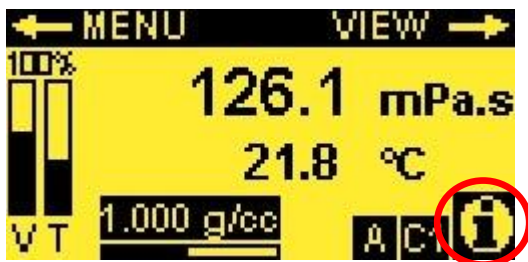
1.1 Navigation

ESC : Press on this key enables to return to the previous level.

🏠 : Press on this key enables to return to the "Bargraphs" view (see § 2.1).

1.2 Diagnosis

When an anomaly is detected by the processor, the symbol ⓘ appears on the main "Bargraphs" view.

Press F6 and the details about the anomaly appear.

Type of anomaly:
- *Out of range: Viscosity.*
  We consider that the sensor is out of range when viscosity exceeds 110 % of full scale range.
- *Out of range: Offset.*
  An offset setting is needed. It means that Vbrut needs to be shift to the reference 9000mV.
  It is necessary to respect the method of Offset setting described on § 5.1 "Set the Offset".
- *Out of range: Compensation table.*
  The referenced temperature, that can be set on "Compensated viscosity" view (see § 2.2) or the instantaneous temperature is out of the table.
- *Alarms.*
  Message that appears at the reach of the low or high threshold for viscosity, temperature or density.
- *Rupture.*
  Message that appears when there is a rupture (viscosity, temperature or density) generally related to a connexion problem.

1.3 Security codes

4 security codes, CODE 0 to CODE 3, are defined.
Refer to:
- Technical manual : §7 – Specific notes and manufacturing parameters
- User manual : §6.4 – Modify security codes

2 Utilisation Mode

The Utilisation mode enables to visualize viscosity, temperature and density values in various forms.

Information related to the sensor identification is gathered in a view accessible since this mode.

The Utilisation mode enables the access to the Adaptation mode.

2.1 "Bargraphs" view

"Bargraphs" view is the principal view.

The following data are displayed:

⚒ Viscosity, temperature and density bargraphs.

⚒ Instantaneous viscosity, temperature according to the selected unit and density (coefficient or densimeter).

2.2 "Compensated viscosity" view
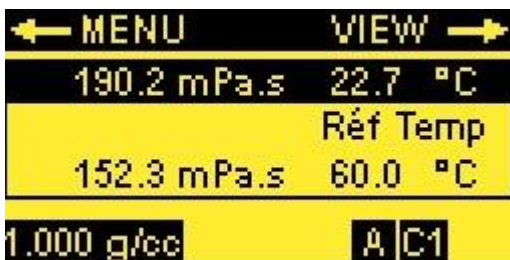
The viscosity at referenced temperature calculation requires knowing the viscosity evolution in function of temperature.

All the reference curve points are saved in the compensation table of the "Parameters" block.

The reference temperature can be modified starting from this view as following:

⚒ Using the keyboard, enter the new value of the reference temperature.

⚒ Press OK: the modification is done and the viscosity is re-calculated according to this new value of reference temperature.

2.3 "Acquisition graph" view
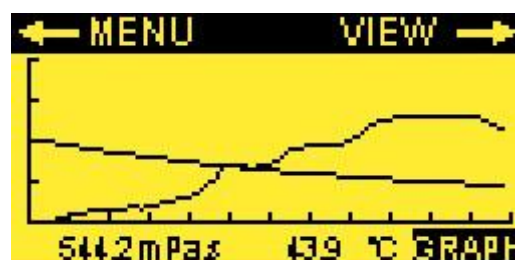
The acquisition graph represents viscosity and temperature.
One graph represents 120 values and the acquisition time can be set in the "Settings" block.

For example:
For an acquisition time setting at 30s, the graph will represent an acquisition of 1 hour.

A first pressing on F6 enables to display the viscosity graph, with the same time scale of the graph for viscosity and temperature.
A second pressing enables to display the temperature graph.

2.4   Information – version
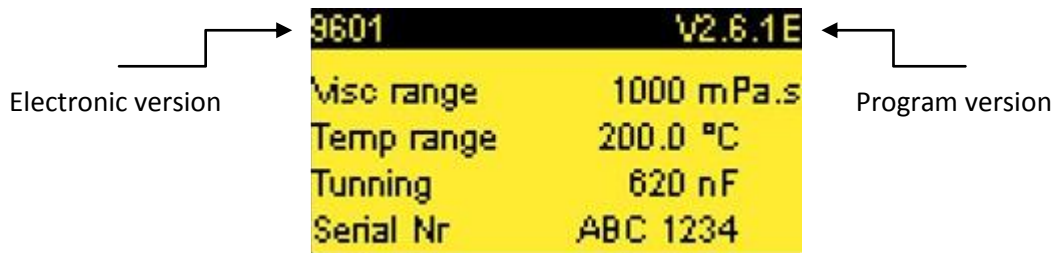
The information view is accessible starting from the main view by pressing on ⌂.

2.5 Synoptic

Navigation between the three views "Bargraphs", "Compensated viscosity" and "Acquisition graph" is possible by pressing on the key F4.

Starting from all these views, pressing on the key F1 enables to reach to the Adaptation mode main menu.
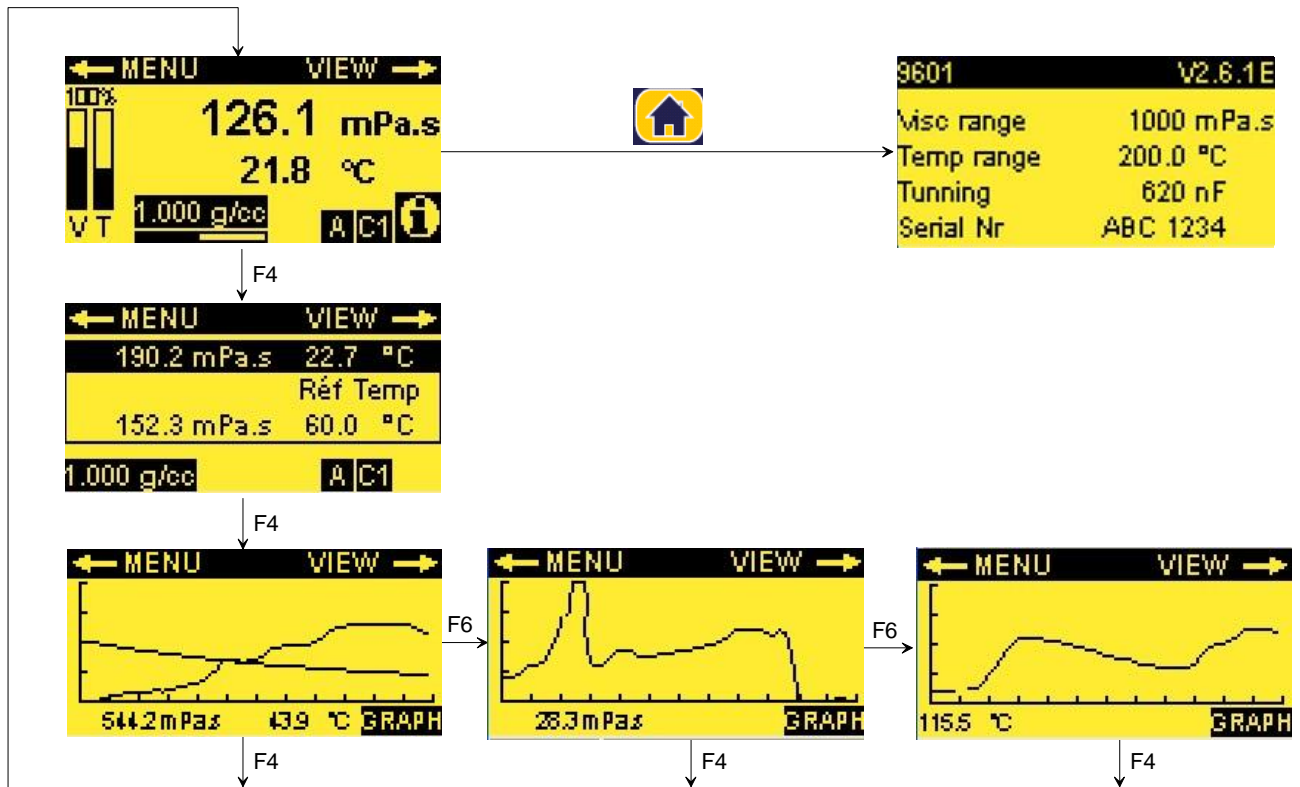
3 Adaptation Mode

The Adaptation mode enables to adapt parameters, settings and configuration of the processor according to the using conditions.

The Menu is accessible, starting from all the Utilisation Mode views, by pressing on the F1 key.

The Menu enables to reach the various block of the Adaptation Mode.

To select the block you want to reach, use the arrows ▲▼ and press "OK".

Displays: see § 4
Settings: see § 5
Parameters: see § 6
Configurations: see § 7

4 Block "Displays"

4.1   Menu of the block "Displays"

Use the arrows to select the function you wish and press "OK".

4.2   Choose the Viscosity Unit

The security code 3 is needed.
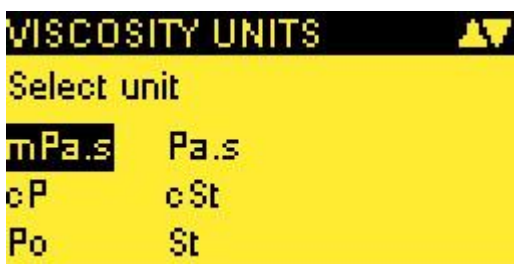
To choose the new viscosity unit, it is enough to select it with the arrows and to press "OK". The change is automatically done.

4.3   Choose the Temperature Unit

The security code 3 is needed.

To choose the new temperature unit, it is enough to select it with the arrows and to press "OK". The change is automatically done.

4.4   Activate viscosity correction

The security code 3 is needed.
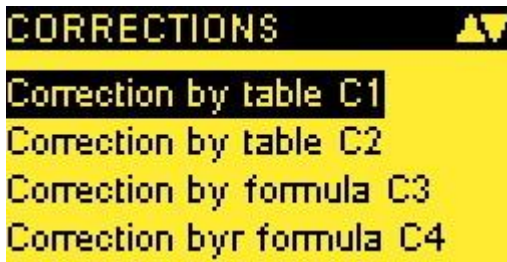
Select the correction you want to apply using the arrows, for example table C1.

If it is indicated "OFF": the correction is activated and if you press on F3, it will disable the correction.

If it is indicated "ON": the correction is disabled and if you press on F3, it will activate the correction.

Only one correction can be enabled.
If you activate a new correction, it will automatically deactivate the previous one.

The correction, which is activated, is displayed on the "Bargraphs" view.
For example:
Correction C1 is activated.

4.5 Status

This function enables to reach:

- Status of current outputs
- Status of relays
- Raw data

The data visualized starting from this block is not modifiable.
Select the function you want to reach by using the arrows.

4.5.1 Current outputs status

It makes it possible to visualize the instantaneous values of current outputs corresponding to the viscosity, the compensated viscosity, the temperature and the density.

The setting of current outputs is made starting from the block "Settings".

CURRENT OUTPUTS

Viscosity	4.0 mA
Comp viscosity	4.0 mA
Temperature	4.3 mA
Density	5.6 mA

4.5.2 Relays status

It makes it possible to visualize the status of the relays allocated to viscosity, compensated viscosity, temperature and density alarms.

Relays are NO type.
Under normal functioning, the coils of the relay are under tension and the contact is closed.
In anomaly, the coils are not under tension and the contact is opened: measurements out of set point, processor power supply is turn off…

The setting of High and Low thresholds is made starting from the block "Settings".

ALARMS RELAY OUTPUT

Viscosity	—◦—◦—	
Temperature	—◦╱◦—	Low
Comp viscosity	—◦—◦—	
Density	—◦╱◦—	Low

In this example:

Temperature and Density are under their Low thresholds.
This is an anomaly so contacts are opened.

4.5.3 Raw data

DATA

Calibration parameters
- Y0 9001.8238
- A -17.5691
- B 0.3563

Frequency ← Hz 294

Coil	8012	→ Coil value (mV)
V in	1251	
Offset	2356	
V brut	3607	

Vin = Initial viscosity - not corrected
Vbrut = Viscosity corrected in offset : Vbrut = Vin + Offset

This view is intended for SOFRASER after sales service.
In the case of a special calibration, this window can change and display more parameters (2 pages).

4.6 Synoptic of Block "Display"

5 Block "Settings"

5.1 Set the offset

Air is used as reference fluid in order to adjust the raw signals during the installation.
The offset adjustment must be done:

⚠ At each new installation of the sensor on the process
⚠ At each observation of the signal drift **in the air** (§ 4.5.3).
⚠ Each time the information is indicated on the "Diagnosis" view.

The stages to follow to proceed to the offset adjustment are describes below:

Step 1	Enter in the "Settings" block
Step 2	Enter the security CODE 2 and choose the function "Offset".
Step 3	Clean the sensor rod and make sure that it is clean and dry.
Step 4	Make sure that the process is empty so that the sensor is vibrating in the air during the adjustment, i.e. that the rod is not immersed.
Step 5	Install the sensor using the fastening screws.
Step 6	Adjust the assembly offset in the air to fix Vbrut to the reference of 9000 mV by pressing on the F3 key "Shift".
Step 7	Press on OK to take into account the offset adjustment.
Step 8	Confirmation of the adjustment validity :

	The offset adjustment is successful : Press on	*The offset adjustment has failed :* Start again : press on OK Ignore : press on ESC

Consequences of a failed offset adjustment:

Viscosity is calculated starting from the amplitude corrected with offset.
So, if the offset is not adjusted correctly, the viscosity value will be false.

5.2 Set the alarms

It makes it possible to set LOW and HIGH thresholds and hysteresis of viscosity, compensated viscosity, temperature and density alarms.

Pressing OK does the navigation from one threshold to another.

The modification of a value is done using the keyboard. Pressing on OK will immediately take the value modified into consideration and will make it possible to skip to the following threshold.

Low threshold of temperature alarm ⟶ Low   0.0

Hysteresis of low threshold ⟶ Hyst   0.0

Example:

Alarm 1 = alarm corresponding to the viscosity LOW threshold *Alarm 2 = alarm corresponding to the viscosity HIGH threshold* *Viscosity unit = cP*	
LOW threshold = 15 Hysteresis = 5	Alarm 1 is activated when the viscosity reaches 10 cP. It stays active as long as viscosity does not reach the set point 15 cP. The relay associated is opened as long as Alarm 1 is activated.
HIGH threshold = 100 Hysteresis = 10	Alarm 2 is activated when the viscosity reaches 110 cP. It stays active as long as viscosity does not reach the set point 100 cP. The relay associated is opened as long as Alarm 2 is activated.

Low threshold - Viscosity

High threshold - Viscosity
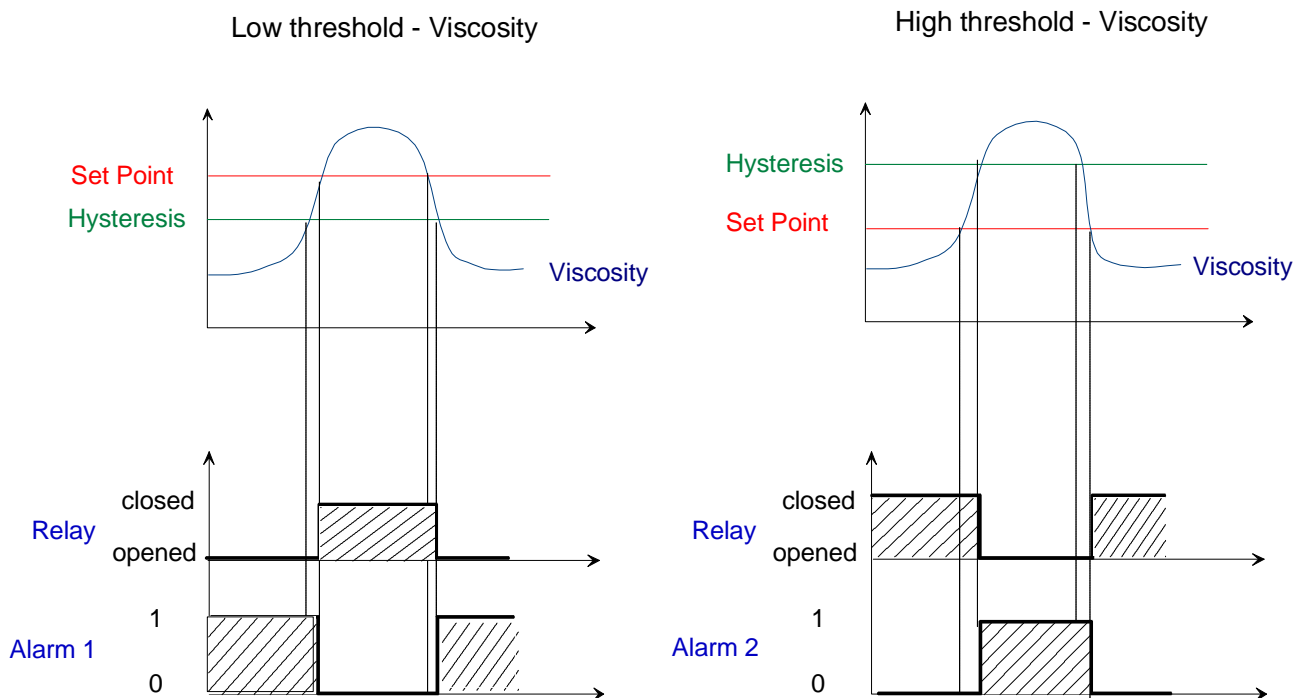
5.3 Set and test the current outputs

5.3.1 Set the current outputs

It makes it possible to set viscosity, compensated viscosity, temperature and density current outputs.

VISCOSITY CURRENT

	Viscosity	Current
Low	0.0	4 mA
High	1000.0	20 mA
Burn		4 mA

Minimal physical viscosity value: 0.0 cP
Value of the current output for the minimal physical value: 4mA

Maximum physical viscosity value: 1000.0 cP
Value of the current output for the maximum physical value: 20mA

Burn: Value of the current output in the event of rupture of the measurement signal.
Pressing on OK does the navigation from one value to another.

The modification of a value is done using the keyboard. Pressing on OK key will immediately take the value modified into consideration and will make it possible to skip to the following threshold.

5.3.2 Test the current outputs

Code 1 is needed to access this testing function.
This function permits to SOFRASER after-sales service to test current outputs by generating a current.

<u>To test an output :</u>

For the output you want to test, define a current on this view:

CURRENT GENERATOR

Viscosity	4 mA
Comp viscosity	4 mA
Temperature	4 mA
Density	4 mA

Measure the signal on the appropriate connector on the back module of the equipment. The measured signal should be equal to the defined testing current.
You have to stay on the view "current generator" to proceed to the test.

COM + AOUT 0: viscosity current output
COM + AOUT 1: temperature current output
COM + AOUT 2: compensated viscosity current output
COM + AOUT 3: density current output

5.4 Choose the method of kinematic viscosity calculation

It is possible to calculate the kinematic viscosity in 2 ways:

⚖ Starting from the density measured by a densimeter (in option):
When the 9601 processor is delivered with a densimeter, the density input configuration (4/20 mA) is the following one:

4 mA → 0,4 g/cc

20 mA → 2 g/cc

⚖ By considering that the density is constant.

The choice of the calculation method is done by selecting it with the arrows.

Caution: if the user chooses to work with kinematic viscosity values, the viscosity unit (§ 4.2) must be " cSt " in order to activate the conversion.

5.5 Set the bargraphs

Bargraphs are displayed on the main view, which is accessible by pressing on .

The bargraphs scales require to be modified during a change of viscosity or temperature unit in order to remain in coherence with the range of the physical units.
Only high thresholds of bargraphs can be modified.

The modification of a value is done using the keyboard. Pressing on OK key will immediately take the value modified into consideration and will make it possible to skip to the following threshold.

5.6 Set the graph scales

It makes it possible, for the user, to set the working range to visualize on the acquisition graph: minimum and maximum of the scales and acquisition frequency.

Scale minimum	Always equal to 0
Acquisition frequency	Minimum : 1s
	Maximum : 120s
Number of points	120 points

By default:

⚖ Scale maximum: equal to the maximum of viscosity and temperature range.

⚖ Acquisition period: 30s.

The scales must be verified and adjusted following:

⚖ Modification of the viscosity unit (§ 4.1)

⚖ Modification of the temperature unit (§ 4.2)

Example:

Acquisition time:
A point will be recorded and traced every seconds. The graph will represents 2 minutes of acquisition.

5.7   Activate the Pt100

⚖   *With Pt100:* makes it possible to activate all displays and functions related to the temperature.

⚖   *Without Pt100:* when the temperature measurement is not available or when the user prefers to work without temperature indication.
It will cancel all displays (bargraphs, graphs, instantaneous measurements) and will block the access to all the functions related to the temperature (te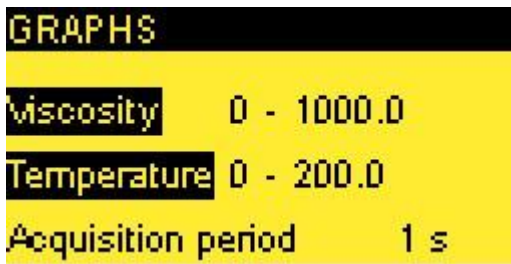mperature unit, temperature and viscosity compensated alarms, temperature and viscosity compensated current outputs, compensation table…)

5.8   Define the filter

This function permits to activate and define parameters of the viscosity filter.
Two parameters need to be defined by the user :

⚖   Samples number: number of values that are used to calculate the averaged viscosity.
Four possibilities are proposed (4, 8, 12 or 16 values) and the user can deactivate the filter by choosing "no filter".

⚖   Sampling period : this period corresponds to the new viscosity value acquisition period. At each period, a new value enters in the table and the oldest is getting out. The filtered viscosity is updated.
Four periods are proposed (50, 100, 200, 400 ms) and the user can define an other period from 50 ms to 36000 ms.

SAMPLING PERIOD

50 ms   200 ms   Other
100 ms   400 ms

OK to confirm

SAMPLING PERIOD

50 ms
(50 to 36000 ms)

OK to confirm
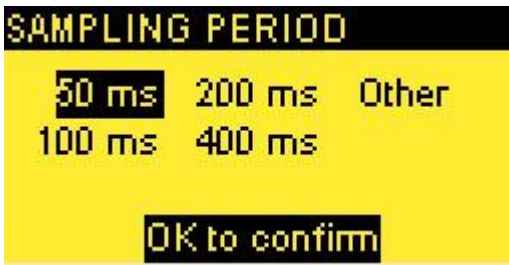
The first filtered viscosity value is calculated (samples number * sampling period) after the starting of the sensor.

For example:

Samples number = 12 – Sampling period = 100ms
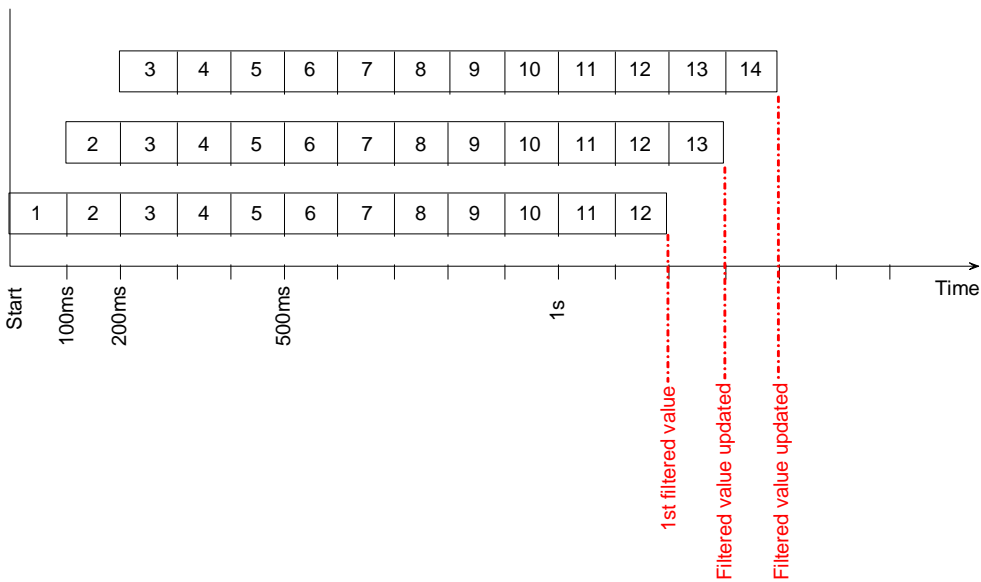
5.9   Synoptic of Block "Settings"

SECURITY

Enter code 2

* * * *

OK to confirm

SETTINGS   ▲▼

Offset	Bargraphs
Alarms	Graphs
Current outputs	PT 100
Density choice	Filter

DENSITY CHOICE

Kinematic viscosity
calculation by :

Densimeter   Coefficient

OK to confirm

SAMPLES NUMBER

No filter   4 values   12 values
8 values   16 values

OK to confirm

CURRENT OUTPUTS   ▲▼

Viscosity	Generator
Comp viscosity	
Temperature	
Density	

SAMPLING PERIOD

50 ms   200 ms   Other
100 ms   400 ms

OK to confirm

If "Other" is selected

VISCOSITY CURRENT

	Viscosity	Current
Low	0.0	4 mA
High	1000.0	20 mA
Burn		4 mA

CURRENT GENERATOR

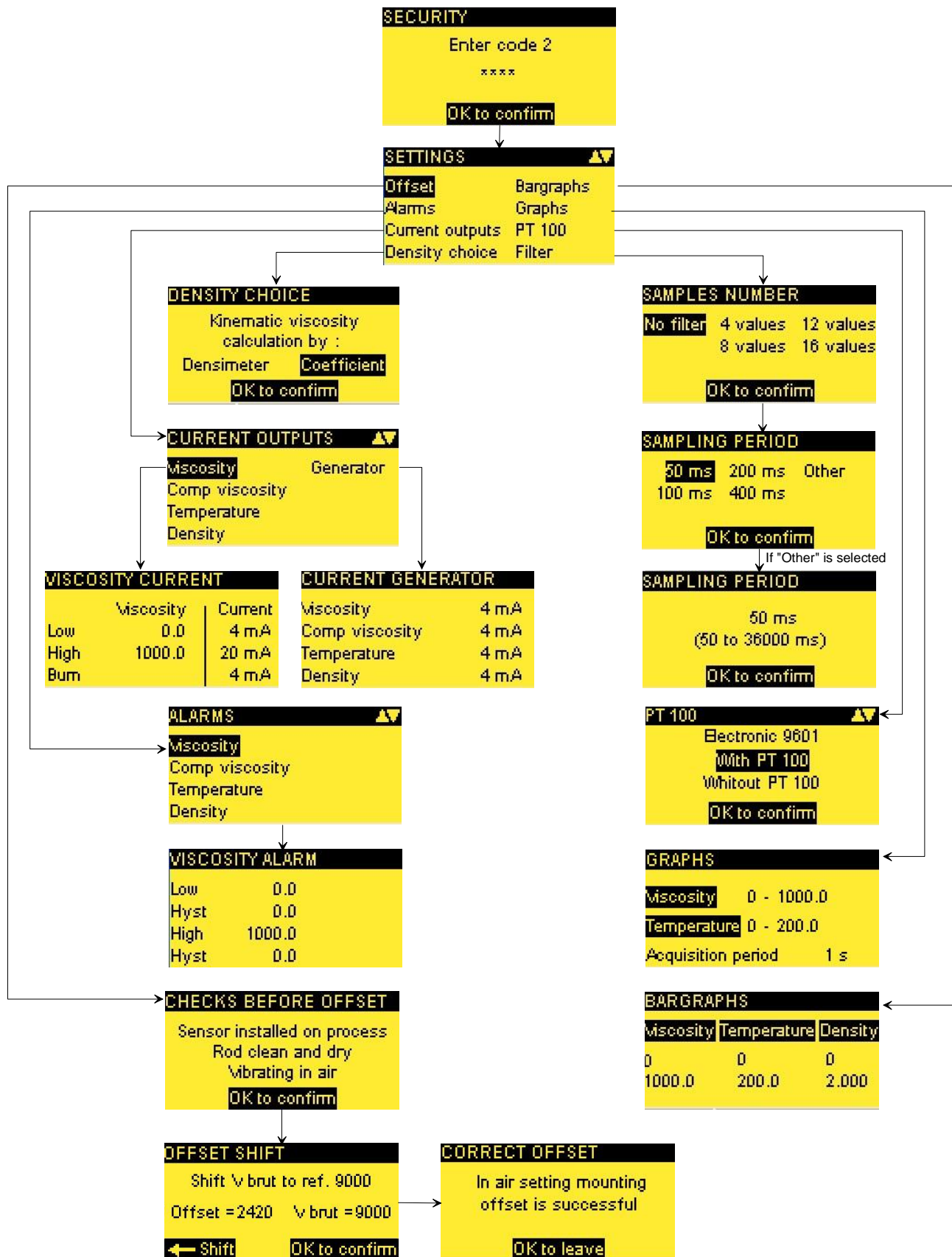| Viscosity | 4 mA |
Comp viscosity	4 mA
Temperature	4 mA
Density	4 mA

SAMPLING PERIOD

50 ms
(50 to 36000 ms)

OK to confirm

ALARMS   ▲▼

Viscosity
Comp viscosity
Temperature
Density

PT 100   ▲▼

Electronic 9601
With PT 100
Whitout PT 100

OK to confirm

VISCOSITY ALARM

Low	0.0
Hyst	0.0
High	1000.0
Hyst	0.0

GRAPHS

Viscosity	0 - 1000.0
Temperature	0 - 200.0
Acquisition period	1 s

CHECKS BEFORE OFFSET

Sensor installed on process
Rod clean and dry
Vibrating in air

OK to confirm

BARGRAPHS

Viscosity	Temperature	Density
0	0	0
1000.0	200.0	2.000

OFFSET SHIFT

Shift V brut to ref. 9000

Offset = 2420   V brut = 9000

← Shift   OK to confirm

CORRECT OFFSET

In air setting mounting
offset is successful

OK to leave

6 Block "Parameters"

6.1   Viscosity corrections

This function can be used in two ways:
- ⚖ define a correlation
- ⚖ define new viscosity unit

Correlation:

The selection of a viscosity correction makes it possible to correlate the measured viscosity (in cP), starting from the manufacturing calibration data, to the expected viscosity of a product. This correlation is done by table or by equation of second order.

This function enables to take into account the effects of non-Newtonian behaviour.

Example for correction by an equation:

$y = 0,003x^2 + 0,8489x + 5,1402$
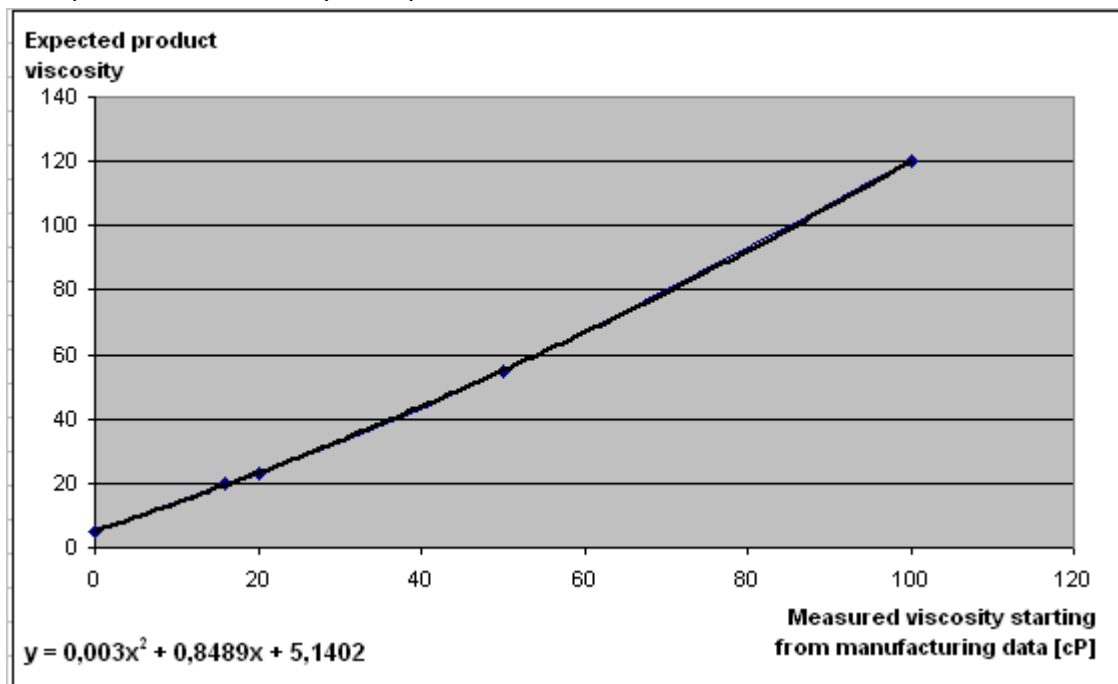
In our example, the user have to define parameters as follows :

A = 0.003
B = 0.8489
C = 5.1402

Viscosity unit:

The viscosity units, which are defined, are the following ones: mPa.s, cP, Po, Pa.s, cSt.
It is possible to define other viscosity units using this function.

The activation of the correction is made in the block "Display" (§ 4.4).

NOTES : It is not possible to give a name to these corrections.

6.2   Compensation table

This function enables to read and to modify the temperature compensation table.
The compensation table contains 7 couples of points (Temperature, Viscosity).

Note: take care to the coherence between the unit of the table points and the temperature and viscosity units chosen to display. Any change of viscosity or temperature unit requires the modification of the table points: conversion of the value into the selected unit.

6.2.1   Reading of the compensation table

The reading is simply made after selecting the function "Compensation table" starting from the "Parameters" block.
The direction arrows are used to skip from a table line to the next one.

6.2.2   Modification of the compensation table

To modify the table points, follow the steps below:

Step 1	Position using the arrows ▲▼ on the table line to be modified.
Step 2	Press on OK to have access to the modification.
Step 3	Modify the X value - temperature: using the keyboard and press on OK to validate.
Step 4	Modify the Y value – viscosity: using the keyboard and press on OK to validate.
Step 5	Pressing on OK, at the time of the validation of the Y point, will close the modification window. The 2 modified points are taken into account and the reading window becomes active again.

6.3   Define the density coefficient

If the kinematic viscosity is calculated with a constant density, the user has to define this constant by this function.
The coefficient must be programmed in [g/cc].

DENSITY COEFFICIENT

Enter coefficient value
1.000 g/cc

OK to confirm

6.4   Modify the security codes

The security codes make it possible to protect data and to limit the access to some functions of the processor.

CODE 3	Code 3 = 1111 – Modifiable. This code gives access to the functions of Viscosity and Temperature units choice and of viscosity corrections activation (§ 4.2, § 4.3 and § 4.4).
CODE 2	Code 2 = 1111 – Modifiable. This code gives access to the blocks "Settings" and "Parameters".
CODE 1	Not modifiable and reserved to SOFRASER after-sales service.
CODE 0	Not communicated and not modifiable. This code gives access to the parameterized manufacturing data: calibration data and thermal drift table.

To modify a security code, it is enough to enter it using the keyboard and to press on OK to record it.

6.5   Synoptic of Block "Parameters"
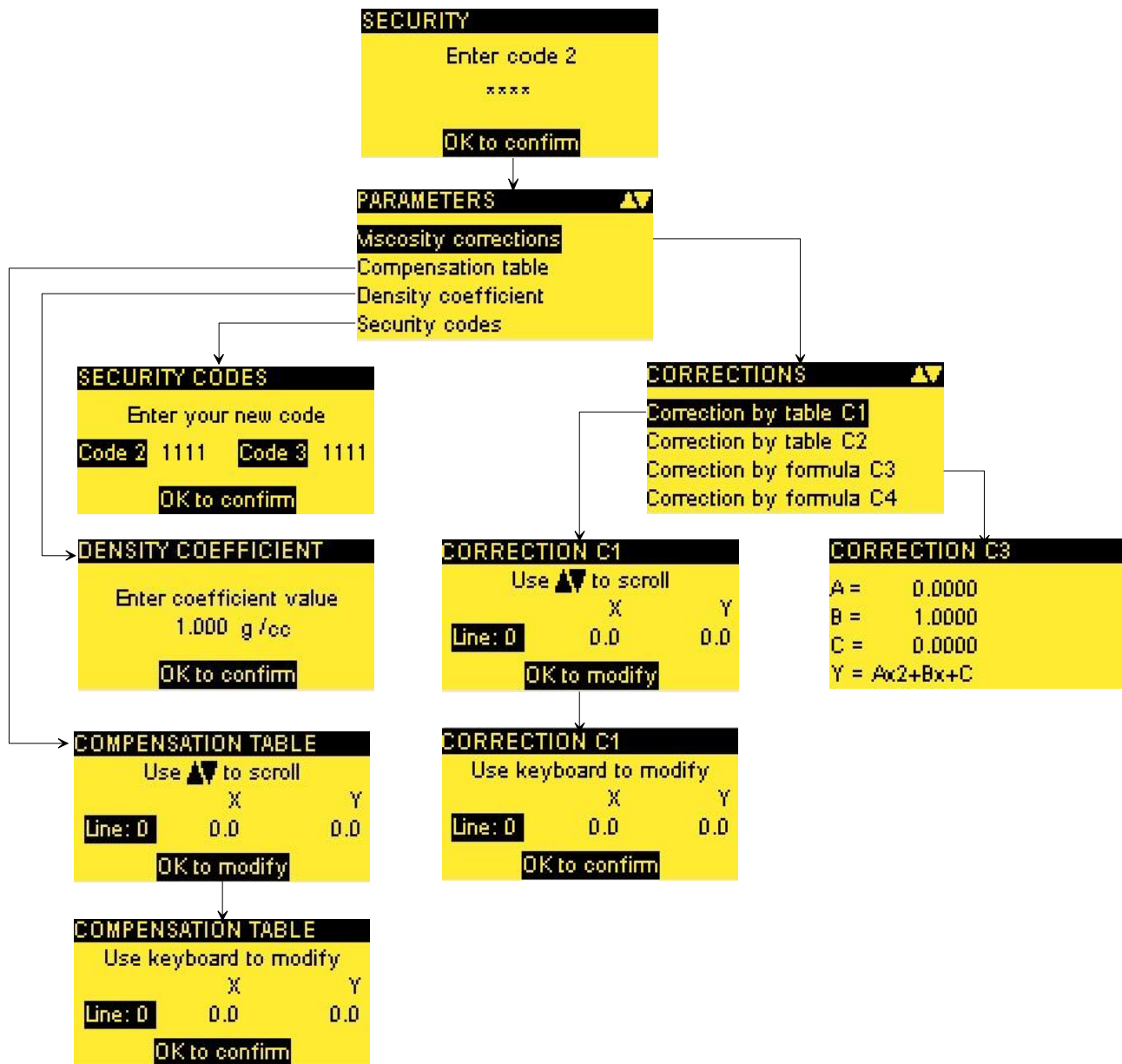
7 Block "Configuration"

These data are reserved at the SOFRASER workshop and at the after-sales service.

7.1   Define the thermal drift table and the calibration data
The security code 0 is required to have access to these functions.
These manufacturing data should not be modified.

Nevertheless, it is possible to visualize the calibration data starting from 2 different views:

Accessible starting from the block "Display".

Accessible starting from the main view "Bar-graphs" by pressing .

7.2   Define the filter inputs
The filter inputs are defined by the SOFRASER workshop for the most common cases, however, it is possible for the distributor to adapt them to the process needs. To do so, after entering the security code 1, you must either modify the desired values and validate with OK either keep and move to the next value by pressing OK.

The higher the value is, the longer the measurement response time will be.

7.3   Define the adjustment data
The adjustment function makes it possible for the distributor to do a re-calibration in order to make correspond the measured viscosity to the awaited viscosity.
The adjustment of the measured viscosity is done with equation as follows:

$y = ax + b$
x = measured viscosity
y = adjusted viscosity

If "Adjustment indication" is selected as "YES", it means that the activation will be represented on the main view "Bargraphs" with an "A".

If "Adjustment indication" is selected as "NO", it means that the activation will not be represented on the main view "Bargraphs". The adjustment is still activated.

To deactivate the adjustment, parameters must be recorded as follows:
A = 1   B = 0

For a new calibration, the sensor must be returned to SOFRASER.

7.4 Synoptic of Block "Configuration"