SATRON®

LUMINA™ VC Optical Transmitters

VCT – Total Consistency
VCA – Ash Content
VCB – Brightness
VCF – Freeness
VCK – Kappa

INSTALLATION AND OPERATION INSTRUCTIONS MANUAL

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1. INTRODUCTION

1.1 VCT & VC MULTICHANNEL TRANSMITTER

The VC family of transmitters utilize the latest LED based strobe techniques using multi-frequency light measurement.
The **VCT** measures Consistency from 0 to 12% CS range.
The **VC** multichannel measures Consistency on channel one and one of the following measurements on channel two: Ash, Brightness, Freeness, Kappa, Fiber Length or Shives Content.

The Remote Display Unit (RDU) provides a local display of the measured values and serves also as a simple menu-driven calibration and troubleshooting interface.

The RDU includes two analog 4-20 mA outputs, 3 dry contact binary inputs and 3 contact outputs.

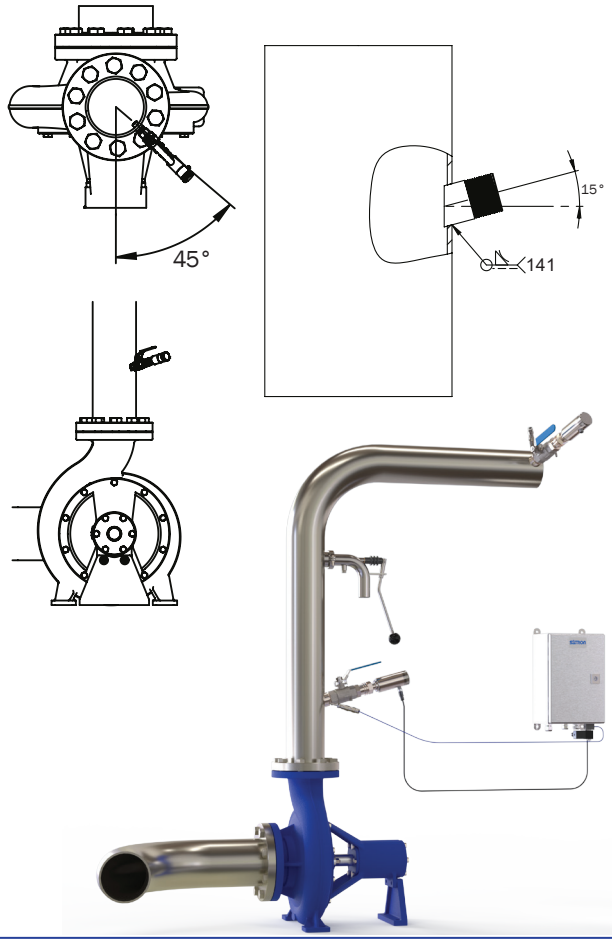
1.2 PROCESS MEASUREMENT TECHNIQUES

The VC family of transmitters measures process parameters by transmitting multichannel strobes of light into the pulp and measuring the backscatter characteristics. These measurement values are calibrated by sampling and laboratory analysis of process and the measurement accuracy is determined by the accuracy of the laboratory analysis results.

Since the calibration is dependent on sampling and analysis, it is imperative that the sampling techniques described in the Calibration section are carefully followed.

2. INSTALLATION

2.1 TRANSMITTER INSTALLATION



For total consistency, VCT
The location of the transmitter should be on the high-pressure discharge of the pump in the turbulent flow. The optimal location is on a 45-degree angle off the centre line of the discharge.

For multichannel, VCx
The location of the transmitter should be in a laminar flow condition in a horizontal pipe section.
Drill a 34 mm diameter hole at 15°angle into the pipe so that the nipple inserts through the pipe wall. After welding, ensure that nothing (welding slag) obstructs the insertion path through the pipe.

Attach the isolation ball valve to the coupling. Once this is complete and the valve closed, the process can be restarted.

Important: while the process is down, attach the ball valve and check that the transmitter will insert fully into the pipe and can be locked in the place with the locking nut.

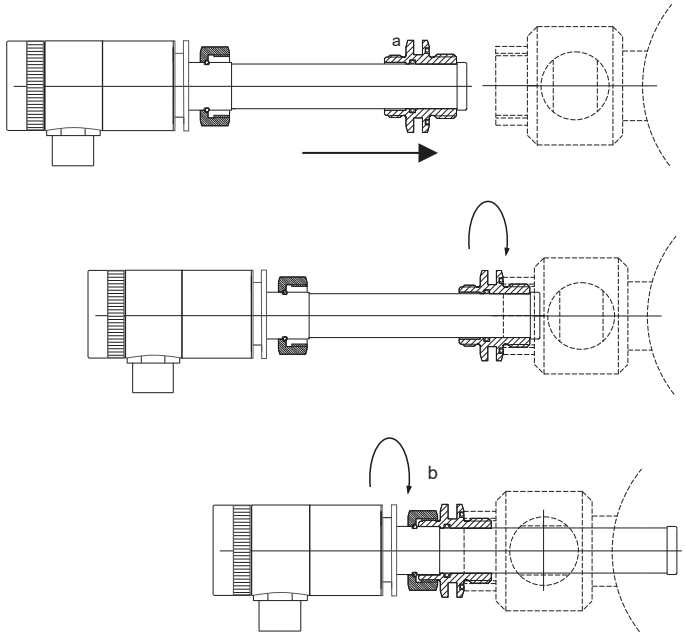
2.2 MOUNTING THE TRANSMITTER

To mount the transmitter, ensure O-ring seal is between the screw fitting and ball valve. Insert the screw fitting on the end of the transmitter into the ball valve and tighten the screw fitting (a).

Open the ball valve and push the transmitter through the valve and lock in place with the locking nut (b). In some cases, under higher pressure applications, the insertion tool may be required.
Insertion and removal tool is optional and is not included with the purchase of the transmitter (code: M1050140).

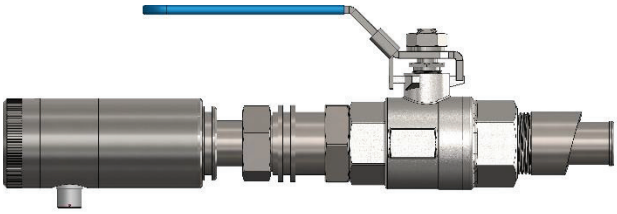
To remove the transmitter, reverse the above steps.

Warning: When removing the transmitter, do not loosen screw fitting (a) unless the ball valve is closed!

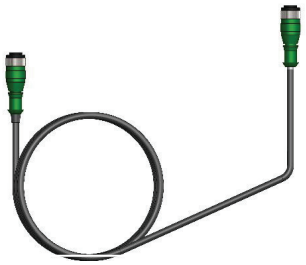


2.3 VC COMPONENTS

The figures below show a combination of many of the components of the VC family. An order will contain a combination of these components along with any additional components associated with special orders.

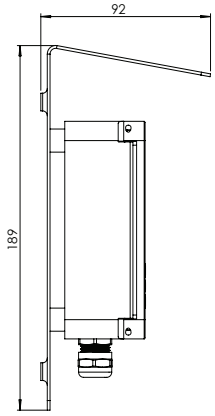


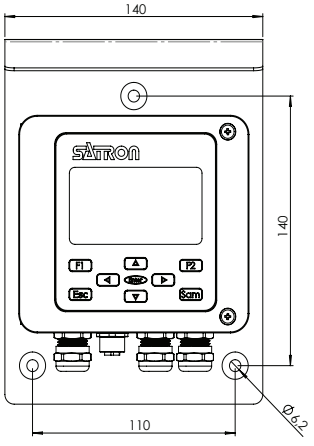
VC transmitter + ball valve + coupling

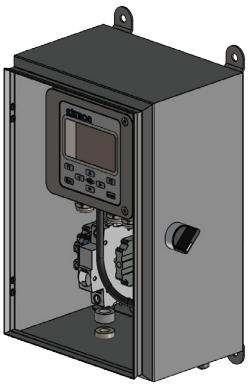


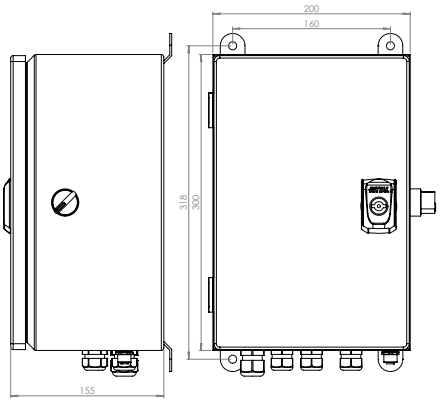
Connection cable for RDU (15m)

Remote Display Unit (RDU)



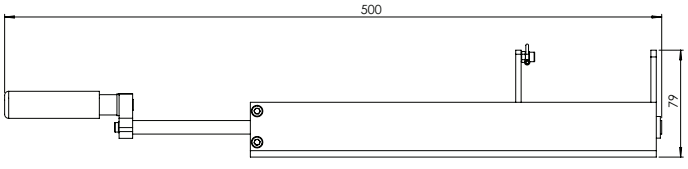


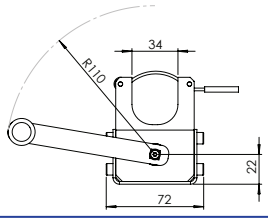




Connection box (K)

Insertion and removal tool





2.4 ELECTRICAL CONNECTIONS

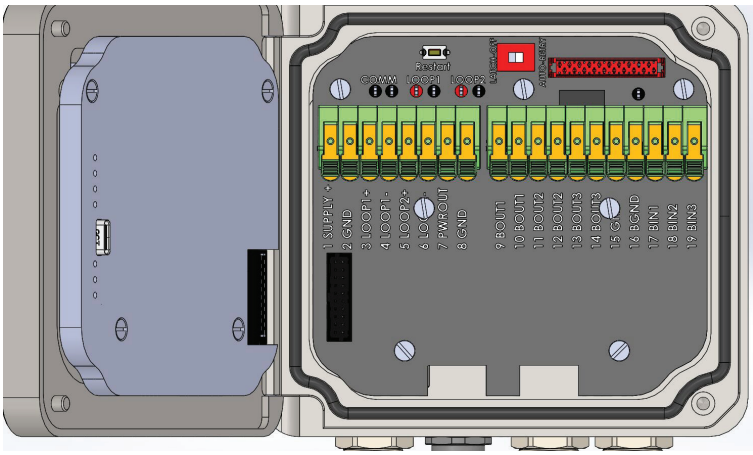
Supply voltage to the transmitter is 24 Vdc and requires up to 200 mA current. It is recommended that a shielded twisted-pair cable is used as a signal cable. The signal cable should not be installed near high voltage cables, large motors or frequency converters.

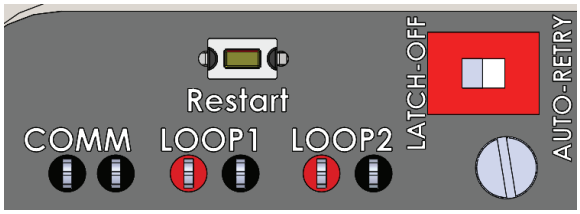
The shield of the cable should be grounded at the end of the power supply or in accordance with the recommendations of the manufacturer of the control system used and the regional electrical code. At the RDU end there's a dedicated screw for connecting the cable shield (1).

The Satron VC transmitter remote display unit (RDU) can be provided with a wall box which can have a 10/15 meters cable between the transmitter and the sensor unit. Inside the RDU, there are terminals for up to 3 binary inputs (BIN1, BIN2, BIN3), 3 relay outputs (BOUT1, BOUT2, BOUT3) and 2 analog 4-20 mA output signals (LOOP1, LOOP2).

⚠ Do not connect or disconnect signal cable of the RDU while the device is powered up.

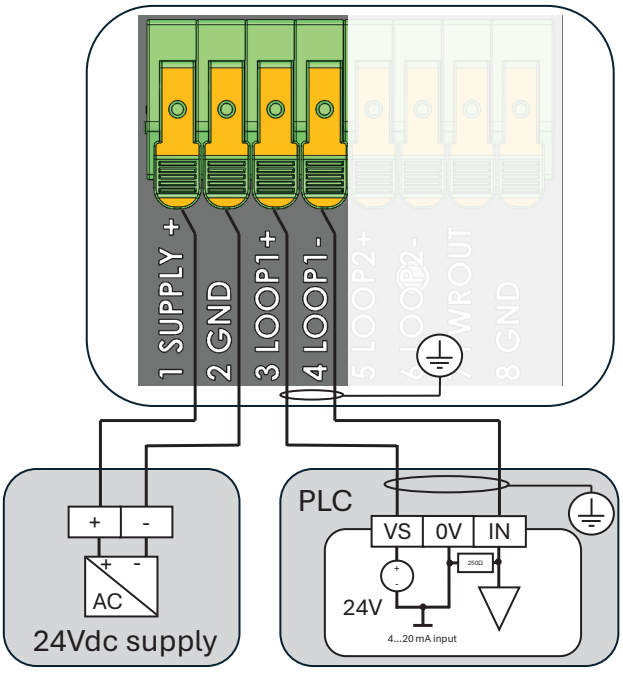
⚠ Do not connect older generation M1/M2 sensors or RDU to new M3 generation devices.



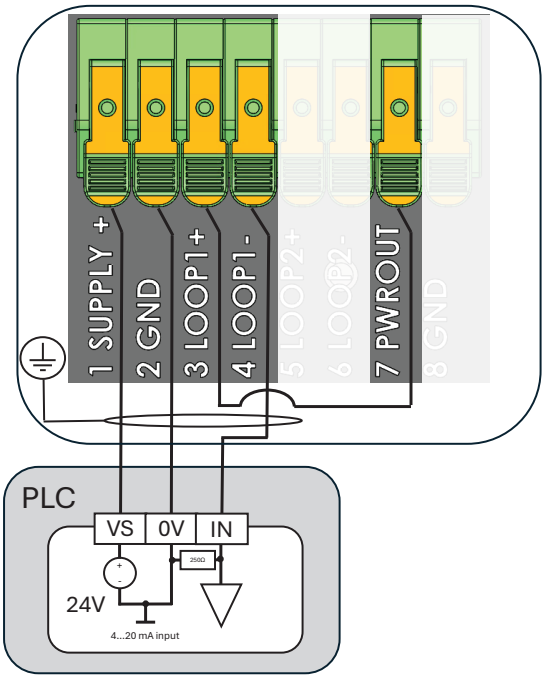


Protection fuse function selection:
LATCH-OFF after the fuse has triggered, device will be kept off until Restart is pressed
AUTO-RETRY device will try to automatically reset the fuse after it has been triggered
COMM Hart® communication terminals
LOOP1 mA loop 1 test terminals
LOOP2 mA loop 2 test terminals

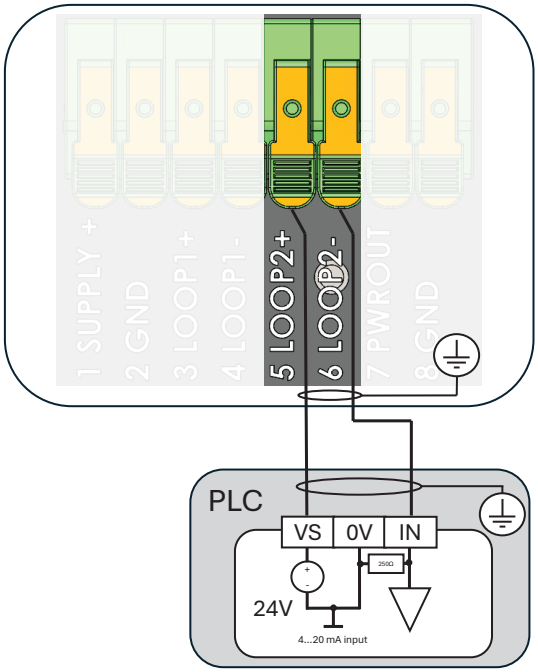
First mA loop (LOOP1) connection with external power supply, isolated mA loop. Preffered mode.



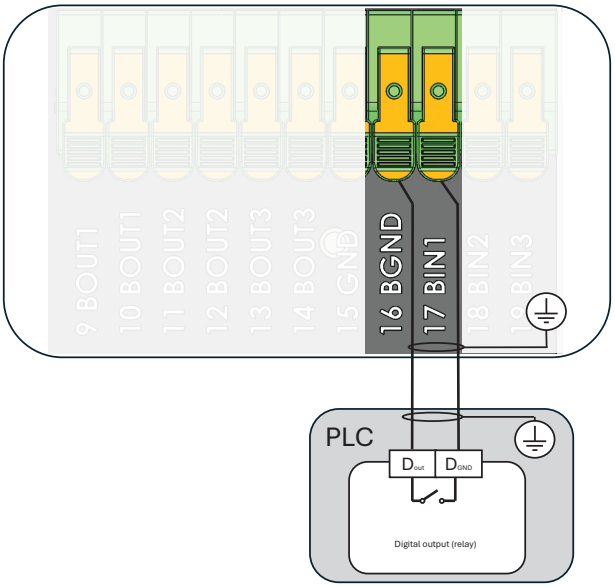
First mA loop (LOOP1) connection (3-wire), non isolated mA loop.



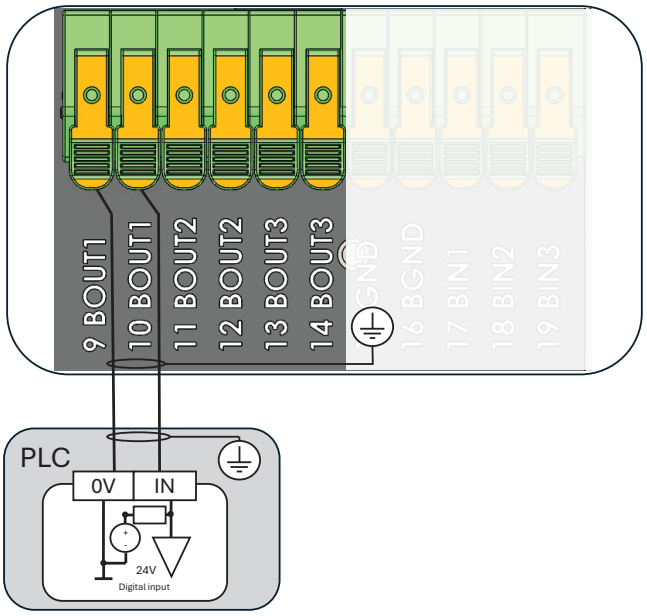
Second mA loop (LOOP2) loop connection (2-wire)



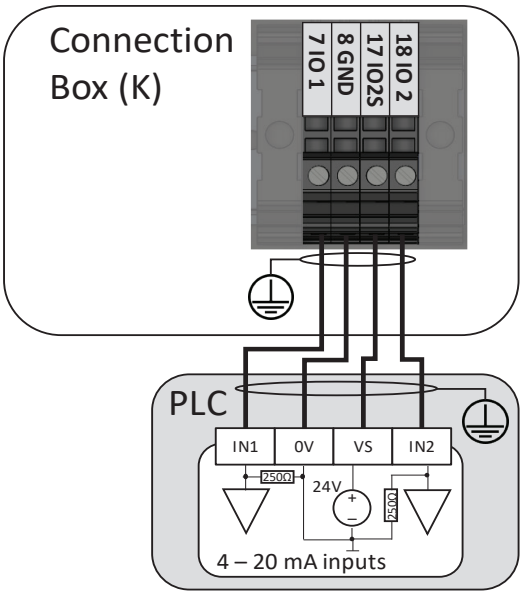
Digital input



Digital output



Device enclosure (K) connection to PLC



2.5 ELECTRICAL REQUIREMENTS

I/O Connections

Current output 1

Range (Namur NE 043)	3.5...23 mA
Maximum load	600 Ω
Factory setting	4...20 mA

Switch outputs (up to 3 available)

Solid state relay	Grounding contact
Maximum voltage	35 V
Maximum current	50 mA
Max leakage current	10 µA

Switch inputs (up to 3 available)

NC (no connection)	OFF
0...2 V	ON
Minimum values for switch in use	
Voltage	16 V
Current	4 mA
Leakage current	1 mA

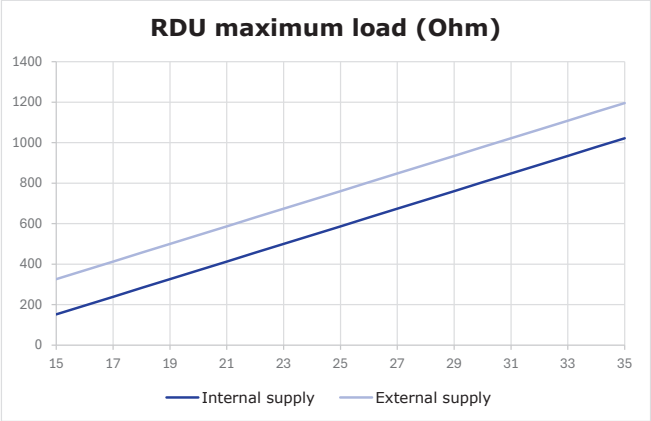
Current output 2

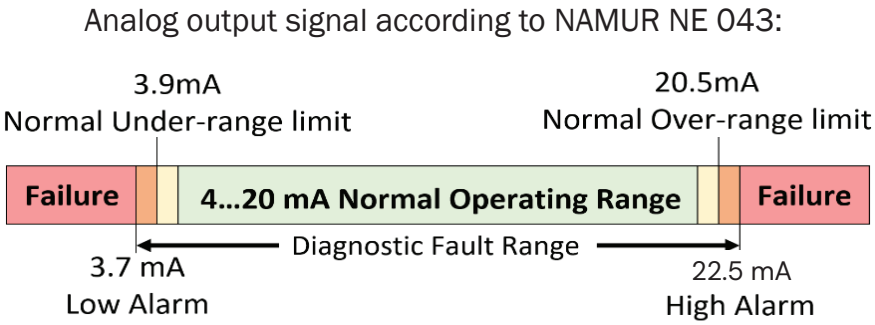
Internal power supply
Current output 2 has the same ground as binary IO

Maximum load	400 Ω
Range	3.5...23 mA
Factory setting	4...20 mA

External power supply
Current output 2 is galvanically isolated

Maximum supply voltage	35 VDC
Range	3.5...23 mA
Factory setting	4...20 mA
Max isolation voltage	100 VDC





3. INITIAL SET-UP

Ensure that the sensor's electrical connections are correct and the cable is securely connected to the RDU. Otherwise, the following error screen will appear.

The RDU can display live operating conditions, perform diagnostic tests, view device information and set configuration parameters for proper operation. The Satron RDU is the local interface and consists of operating keys:

- Press **ESC** to go the main menu, move back towards the top of the main menu or to cancel the current action.
- Press **ENTER** to move to a lower menu level, to accept a configuration/command or enter a setting or parameter value into the transmitter memory.
- Use the **LEFT [←]** arrow key to move left on the current menu level.
- Use the **RIGHT [→]** arrow key to move right on the current menu level.
- Use the **UP [↑]** arrow to increase a parameter value.
- Use the **DOWN [↓]** arrow to decrease a parameter value.
- Press **SAM** to take a sample.
- Function button 1, **F1**
- Function button 2, **F2**

The main menu has 5 submenus: **Configuration, New Sample, Calibration, Diagnostics,** and **Advanced.** When the transmitter is powered up it will show the main display, i.e. Process Value.

The initial set-up consists of three steps.

1. Set the Date and Time
2. Set the operating range for Consistency (IO1).
3. Depending on the need and transmitter type, set the operating range for IO2.

3.1 SETTING THE DATE AND TIME

It is very important to set the correct date and time in the transmitter. The date and time are used to time stamp the samples extracted from the process and to mark the diagnostic events that may occur during transmitter operation.
The time and date values are set through the **Configuration** menu -> **System Configuration** submenu.

1.06 %CS	Starting at the default PV display value; Press the **ESC** button.
CONFIGUR	Press the **ENTER** button to enter the **Configuration** submenu. Use the **LEFT/RIGHT** arrows to move within the **Configuration** submenus.
SYSTCONF	When the **System Configuration** submenu appears in the display, press the **ENTER** button.
RTC	When the **RTC** submenu appears in the display, press the **ENTER** button.
SET	When the **Set** menu item appears in the display, press the **ENTER** button.
01012024	The date submenu will appear first and is in the format of **DDMMYYYY**. Use the **UP/DOWN** arrows to set the day. then press **RIGHT** to move to the month. Use the **UP/DOWN** arrows to set the month, then press **RIGHT** to move to the year. Use the **UP/DOWN** arrows to set the year. Press **ENTER** to move to the Time.
00-00-00	The time submenu will appear in the format **HH-MM-SS**. Use the **UP/DOWN** arrows to set the hour, then press **RIGHT** to move to the minutes. Use the **UP/DOWN** arrows to set the minutes, then press **RIGHT** to move to the seconds. Use the **UP/DOWN** arrows to set the seconds if desired and press **ENTER** or simply press **ENTER** to accept the seconds as they appear.
RTC	The **RTC** submenu will appear in the display. Press the **ESC** button until the PV reading in the main menu is displayed.
1.06 %CS	

3.2 SETTING THE RANGE FOR IO1

By default. the factory setting for the range is 4 mA = 0%CS and 20 mA = 7%Cs. However, this is configurable to match the operating range of the specific application for this example, the range will be changed to 2%CS to 4%CS.

1.06 %CS	Starting at the default PV display value; Press the **ESC** button
CONFIGUR	Press the **ENTER** button to enter the **Configuration** submenu. Use the **LEFT/RIGHT** arrows to move within the Configuration submenus.
MAOUTPUT	When the **MA Output** submenu appears, press the **ENTER** key and ***"MA 1 ?"*** text will appear in the display.
MA 1 ?	Select **MA 1** pressing **ENTER** key and lower range value (**LRV**) menu item will appear.
LRV	Press the **ENTER** button to display the current **LRV**.
0.0000000 2.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number. If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.
LRV	Use the **RIGHT** arrow to move to the upper range value (**URV**).
URV	Press the **ENTER** button to display the current **URV**
7.0000000 4.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number. If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.
URV	Press the **ESC** button until the **PV** reading in the main menu is displayed.
1.06 %CS	

3.3 SETTING THE RANGE FOR IO2 (VCT)

1.06 %CS	Starting at the default **PV** display value; Press the **ESC** button
CONFIGUR	Press the **ENTER** button to enter the **Configuration** submenu. Use the **LEFT/RIGHT** arrows to move within the Configuration submenus.
I/O CONF	When the **I/O CONF** submenu appears, press the **ENTER** key to enter the submenu. Use the **LEFT/RIGHT** arrows to move within the **I/O CONF** submenu.
IO2 SRC	When **IO2** menu item appears, press **ENTER** key and **IO2** source (**IO2 SRC**) menu item will appear, press **ENTER**.
MA	Use **LEFT/RIGHT** arrows to select source for **IO2**, when item **MA** appears, press **ENTER** to select.
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.
IO2 LRV	Within **I/O CONF** menu use **LEFT/RIGHT** arrows to find **IO2** lower range setting. When **IO2 LRV** menu item appears, press **ENTER**.
0.0000000 4.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the **IO2 LRV** mA value to the low range mA value (default 4.0000000 mA). If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving. After pressing **ENTER** you will return to **I/O CONF** submenu.
IO2 URV	Within **I/O CONF** menu use **LEFT/RIGHT** arrows to find **IO2** upper range setting. When **IO2 URV** menu item appears, press **ENTER**.
7.0000000 20.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the the **IO2 URV** mA value to the upper range mA value (default 20.0000 mA). If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.
IO2 URV	Press the **ESC** button until the **PV** reading in the main menu is displayed.
1.06 %CS	

3.4 SETTING THE RANGE FOR IO2 (VC MULTICHANNEL)

0.00 %CS

Starting at the default **PV** display value; Press the **ESC** button

CONFIGUR

Press the **ENTER** button to enter the **Configuration** submenu. Use the **LEFT/RIGHT** arrows to move within the Configuration submenu.

MAOUTPUT

When the **MA Output** submenu appears, press the **ENTER** key and "***MA 1*** ?" text will appear in the display. Use the **LEFT/ RIGHT** arrows to move within the **MAOUTPUT** submenu.

MA 2 ?

When **MA 2 ?** menu item appears, press **ENTER** key and lower range value (**LRV**) menu item will appear.

LRV

Press the **ENTER** button to display the current **LRV**

0.0000000

Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number. If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.

SAVE ?

When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.

LRV

Use the **RIGHT** arrow to move to the upper range value (**URV**).

URV

Press the **ENTER** button to display the current **URV**

10.0000000

Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number. If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.

SAVE ?

When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.

URV

0.00 %CS

Press the **ESC** button until the **PV** reading in the main menu is displayed. The **PV2** displayed unit can be configured in the **CONFIGUR – SYSTCONF – PV2 UNIT.** The **CUSTOM** selection allows the user to configure any letters as the displayed as the unit such as %ASH, SCAN, CSF etc.

4. SAMPLE DATA COLLECTION

The key to a good regression analysis is the correct time correlation of the transmitter measurement values and the lab sample. To ensure an accurate time correlation, one of two procedures needs to be followed:

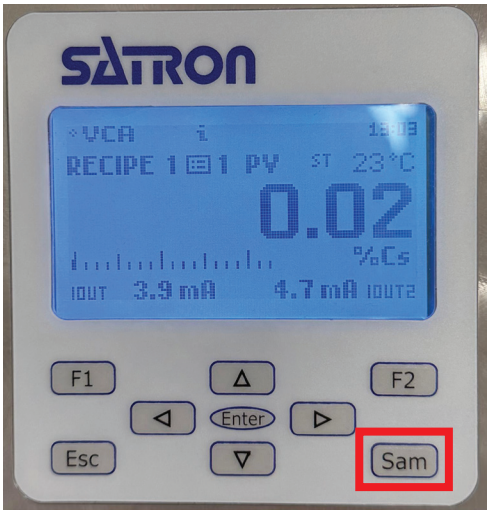
1. Sample data collection at the RDU
2. Sample data collection using a Sample Toggle Switch

4.1 SAMPLE DATA COLLECTION AT THE RDU

To ensure an accurate time correlation, use the following procedure using the Remote Display Unit (**RDU**):

1.06 %CS	Starting at the default PV display value; Press the **ESC** button
NEW SAMP	Use the **UP/DOWN** arrows to move to the **New Sample** submenu and press **ENTER**.
START ?	The **START?** appears in the display. When you are ready to collect the sample press the **ENTER** Key.
SAMPLING	The display will blink the **Sampling** message during the sampling period. Collect the sample as quickly as possible and after the sample is complete, press the **ENTER** key to save or **ESC** to cancel. The sample time stamp, average, min and max values will scroll across the display.
SAVE	Press the **ENTER** button to display the current **LRV.**
OK	An **OK** message and the **Sample number** will appear. Record the **sample number, time stamp and average value** as a reference. Internally the sample number is automatically incremented by the transmitter each time a new sample is saved.
NEW SAMP	The display will automatically return to the **New Sample** submenu. Press the **ESC** key until the PV reading in the main menu is displayed. After the lab testing is completed, record the lab data with the appropriate sample number and time stamp in an Excel spreadsheet.
1.06 %CS	

Alternatively, directly press the sample **(Sam)** button in the RDU, the display will blink the Sampling message during the sampling period. Continue as previously instructed.



4.2 SAMPLE DATA COLLECTION USING A SAMPLING SWITCH (K BOX)

This is best performed by two people. When the sample person is ready to take a sample, the other person activates the switch by moving it to the sampling position. The Remote Display Unit (**RDU**) inside the enclosure will flash "**SAMPLING**". The person operating the sample valve then extracts the sample from the process into a container. After the sample has filled the container the switch person turns the switch immediately back to its original position trying to time the switch movement with the close of the sample valve. The **RDU** will display the sample number (**SAMPL 01**) and a message that the sample was "**OK**".

It is important to assure that the sensor was measuring the pulp in the very moment it was sampled as the transmitter is averaging all the readings while the switch is activated. Take pipe curvature and delay between the sensor location and the sampling valve into consideration. After the sample is complete, mark with the date/time and the sample number that appears to the **RDU** window. Also mark the primary reason for the sample.

Consider setting up a spreadsheet for recording the lab values. The key is recording the correct time for the sample. When the sample data is extracted from the .sif file (see Creating a .sif File section) the samples numbers do not appear, therefore the date and time are used to correlate the lab data to the internally stored averages.

In some cases, the same sample may be used for consistency and a complex variable. Enter both lab values with the same time stamp in the Excel spreadsheet.

This spreadsheet along with the sif-file that is extracted from the transmitter should be sent to Satron for analysis. Satron will send back the calibration coefficients to insert into the **VC** multichannel for this application.

4.3 SAMPLING FOR VC MULTICHANNEL: AN ADVANCED CALIBRATION

Unlike consistency, the best calibration of the VC multichannel requires much more complex analysis and close coordination of transmitter information to the exact time that the sample is extracted from the process. There are two output channels in the VC multichannel, one for Consistency of the stock and the other for the specific parameter being measured. Kappa, Ash, Freeness. Brightness etc. must be carefully determined in the laboratory and the results correlated to the transmitters measured variables. The result is that the parameters measured and displayed on the second channel are non-linear in nature and the calibration is significantly more complex to accomplish. Therefore, more process analysis data is needed to complete these calibrations. It is recommended that twenty-five to thirty samples and lab analyses must be collected for the calibration purposes.

The same range of operation applies; the samples need to cover at least fifty percent of the operating range of the variable. The same two-person data collection procedure should be followed. The key to accurate results is to correctly record the date and time stamp when the sample is taken. The external sampling switch helps to improve the accuracy of the sampling and time stamping that is necessary for good results. Once the data is collected, a multi-variable polynomial regression analysis is performed to determine the unique calibration curve for each application. The transmitter uses a linear equation in three variables as the calibration curve for the application.

5. CALIBRATION VIA RDU

The mill's standard for collecting consistency samples should be enough. The **TAPPI T 240** standard is a good reference. Note: The sample extraction location should be located as close as possible to the transmitter for the best results. Normally located 0,5 meters downstream of the transmitter.

The first component to accurately calibrate the transmitter is to employ consistent sampling and laboratory techniques. It is valuable if the sampling can be scheduled so that the same person collects and tests the samples during the data gathering period (**consistency**). This minimizes sample variability.

The second component to successful data collection is the accurate time correlation between when the sample is taken, and the internal raw readings made by the transmitter. It is recommended that two people work together to collect the samples. One person is the sampler/tester that will physically collect the sample and the second person is at the **RDU** (or Sampling switch) to initiate the transmitter data collection period and time stamp the sampling and meter readings made while the sample is extracted.

5.1 CONSISTENCY CALIBRATION

There is a standard methods to perform a successful consistency calibration via RDU (which automatically store new consistency parameters to current recipe): Two-point calibratioon method for calculating offset and gain.
Multipoint calibration is possible with SiLogAdvisor consistency calibration simulator.

5.2 ENTERING LABORATORY VALUES TO THE TRANSMITTER

In order to utilize calibration functions in the transmitter, the corresponding laboratory values for samples need to be entered into the transmitter. Use the following procedure to enter the laboratory values:

1.06 %CS	Starting at the default PV display value; Press the **ESC** button
CALIBRATION	Use the **LEFT/RIGHT** arrows to move to the **Calibration** submenu and press **ENTER**.
SAMPLES	Use the **LEFT/RIGHT** arrows to move to the **Samples** submenu and press **ENTER.**
SAMPL 01	Use the **LEFT/RIGHT** arrows to move to the corresponding sample and press **ENTER.**
LAB PV	The **LAB PV** will appear in the display. Press the **ENTER** key to enter the laboratory values for the consistency.
0.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number. If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save.
2.0000000	
OK	An **OK** message will appear in and the display will automatically return to the **Sample** submenu. Press the **ESC** key until the **PV** reading in the main menu is displayed
SAMPL 01	
1.06 %CS	

5.3 TWO-POINT CALIBRATION METHOD FOR OFFSET AND GAIN CALCULATION

Use the following procedure to calibrate the consistency measurement with two sample points (you can also use the water point stored in the transmitter as the first sample point):

1.06 %CS	Starting at the default PV display value; Press the **ESC** button
CALIBRATION	Use the **LEFT/RIGHT** arrows to move to the **Calibration** submenu and press **ENTER**.
CALIBRATE	Use the **LEFT/RIGHT** arrows to move to the **Calibrate** submenu and press **ENTER**.
SAMPL 01	Transmitter asks you to select first calibration data point, press **ENTER**. Use the **LEFT/RIGHT** arrows to move to the corresponding sample and press **ENTER**. You can also use the water point stored inside the transmitter as the first calibration point (**SAMPH2O**)
SAMPH2O	
OK	An **OK** message shortly appears in the display followed by the request to select next data point and next sample item will appear in the display. Use **LEFT/RIGHT** arrows to select second calibration point and press **ENTER.**
SAMPL 02	
SAVE ?	When **SAVE?** appears in the display, press **ENTER** to accept or **ESC** to exit without saving.
OK	An **OK** message will appear in and the display will automatically return to the **Calibrate** submenu.
CALIBRATE	
CALIB HISTORY	Press **RIGHT** to **Calib History** and press **ENTER** to see Calibrations information with gain and offset.
0.99 %CS	Press the **ESC** key until the **PV** reading in the main menu is displayed.

5.4 ENTERING CONSISTENCY CALIBRATION PARAMETERS

Once the gain and offset parameters are known, enter them into the transmitter at the **RDU** panel as shown below:

1.06 %CS	Starting at the default PV display value; Press the **ESC** button
CALIBRATION	Use the **LEFT/RIGHT** arrows to move to the **Calibration** submenu and press **ENTER** and the **RECIPE** submenu will appear.
RECIPE	Press **ENTER** to enter the submenu.
MA 1 ?	The **MA 1?** menu item will appear Press **ENTER** and the **OFFSET** submenu will appear.
OFFSET	Press **ENTER** to enter the **OFFSET** submenu.
0.0000000	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. Note: the first digit on the left can be set to a (-) sign so remember to account for this when entering the decimal. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save. The **SAVE?** item will appear.
2.0000000	
SAVE ?	Press **ENTER** to save the value or **ESC** to cancel out of the operation. The **OFFSET** submenu item will reappear.
OFFSET	Press the **RIGHT** arrow to move down the menu to the **GAIN** submenu and press **ENTER** to enter the **GAIN** submenu.
GAIN	Use the **LEFT/RIGHT** arrows to place the decimal point in the proper location and press **ENTER**. Note: the first digit on the left can be set to a (-) sign so remember to account for this when entering the decimal. A cursor will appear to indicate the digit that will be modified. Use the **UP/DOWN** arrows to change the number If more change is needed, move **RIGHT** and the cursor will move to the right position. Press **ENTER** to save. The **SAVE?** item will appear.
0.0000000	
2.0000000	
SAVE ?	Press **ENTER** to save the value or Esc to cancel out of the operation. The **GAIN** submenu Item will reappear.
GAIN	Press the **ESC** key until the **PV** reading in the main menu is displayed.
1.06 %CS	

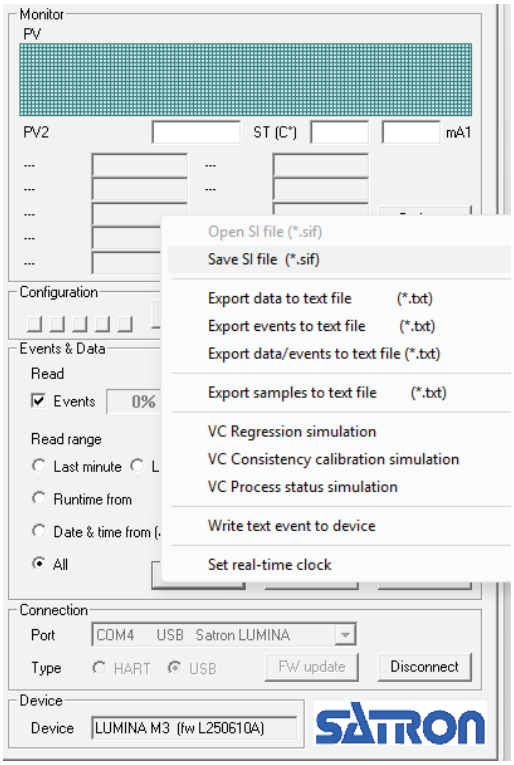
6. CREATING THE .SIF – FILE

• The **SILogAdvisor** software provided by Satron Instruments is used to create the **sif file (Satron Information File).** This software is downloaded from the Satron website (Contact -> Support and Service) and installed on a laptop that can be connected to the USB-C port inside the transmitter cap (1) or the RDU (2). See the instructions in the Satron Operating Manual to locate, download and install this software. The manual also includes instructions for using all features of the software.

• Connect a USB-C cable (this cable is not provided with the transmitter) to the port under the transmitter cap (1), or the RDU (2) to an USB port on the laptop. The USB-C port on the sensor is faster than the one in the RDU.

• Start the **SILogAdvisor** application on the laptop.

• After the opening window appears, verify the port connection.
If the **Port** window appears blank, click the DOWN arrow and select the COMx-port that is connected to the Satron transmitter.
Click the **CONNECT** button in the Connection dialog.



• A connection will be established to the transmitter and the buttons in the **Events & Data** dialog box will become active.

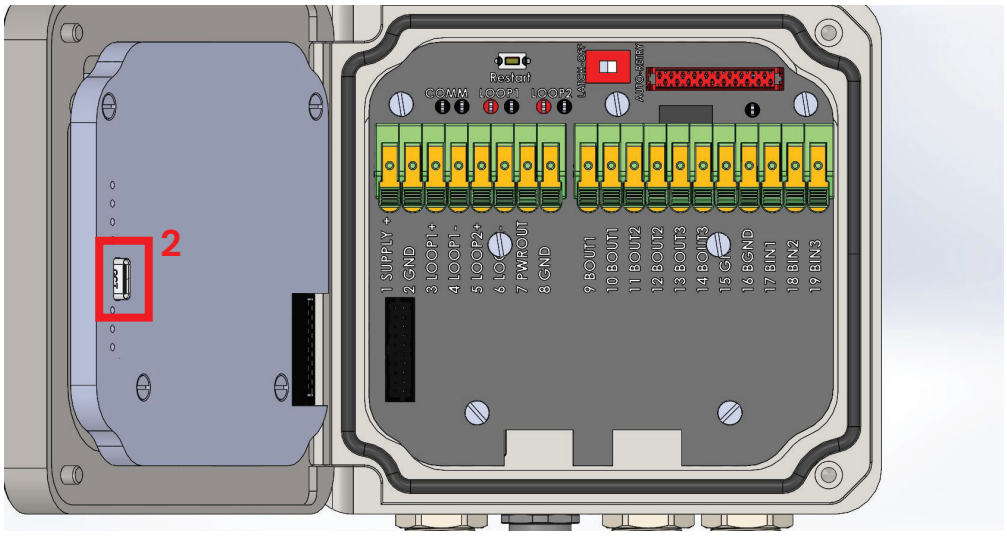
• Select the **All** option button and click the **Read** button.

• The data will be downloaded from the transmitter to the **SILogAdvisor.** This may take some time. While data is being read, the **File and Erase data** buttons are deactivated and the **Read** button changes to **Cancel**. When the data download is complete, the **File and Erase data** buttons will become active again and the **Read** button will replace the **Cancel** button. This is the indication that the download is complete.

• Click the **File** button and select the **"Save SI file (*.sif)"**. Give the file a name and select a location on the laptop to save the data.

• This file along with any other related data files (i.e. lab data results) are essential information for technical support of the VC product.

• After data extraction, remove the USB-C cable and reinstall the transmitter cap. Ensure that the cap is fully sealed.



7. CALIBRATION VIA SILOGADVISOR

There are separate methods for entering tuning constants. Tuning **PV** for consistency (**IO1**) are entered using the **RDU**. Tuning for the second variable (**PV2**) is recommended to enter using the **SILogAdvisor** laptop Interface.

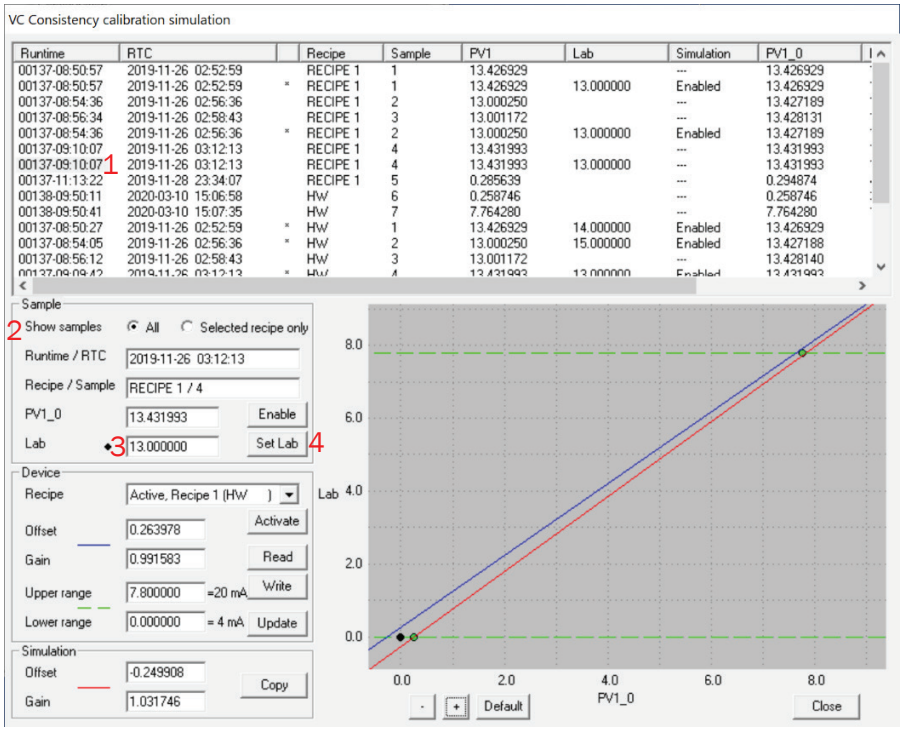
7.1 ENTERING LAB DATA AND CALCULATING CONSISTENCY PARAMETERS WITH SILOGADVISOR

First attach the laptop to the transmitter, start the **SILogAdvisor** software and connect as directed previously.
Read event data from the transmitter as described in the chapter "**Creating the .sif – File**". You may skip this step if you have only few sample points in the transmitter: 9 latest samples plus SAMPLEH20 are stored in the **EEPROM** memory of transmitter, and those are automatically retrieved on the next step.

Enter "**VC Consistency calibration simulation**" window from "**File**" drop down menu (see previous chapter).

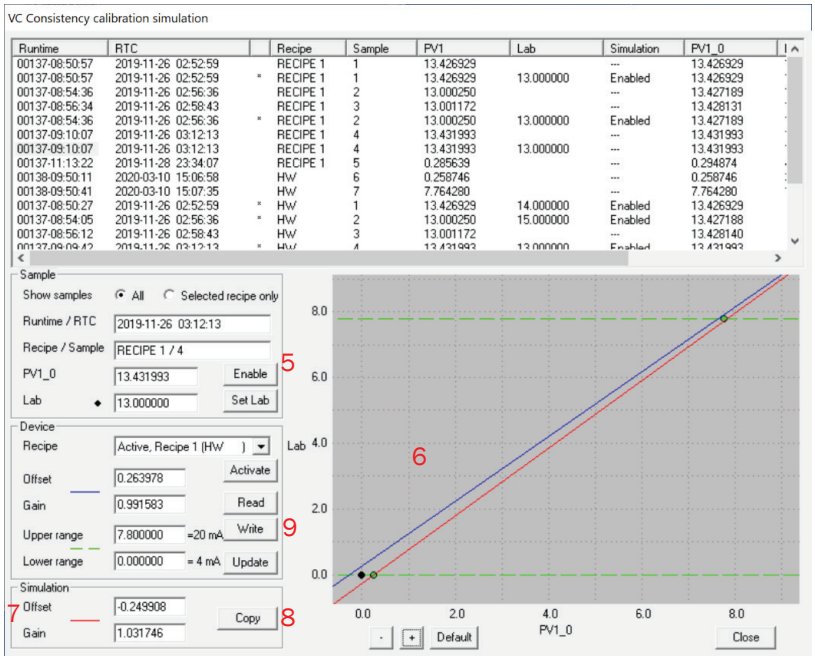
Entering Lab Data

To enter laboratory value, click first column (**Runtime**) (**1**) on the sample line you want to edit. Information of the sample will appear on the "**Sample**" section of the window (**2**). Type in the laboratory value into the "**Lab**" input window (**3**) and press "**Set Lab**" button (**4**). If the selected sample is in the **EEPROM** memory of the transmitter, software will automatically ask if you want to store the value to the transmitter. If you click "**Yes**", lab value will be stored into the transmitter and pressing "**No**" will use the value only in the **SILogAdvisor** software. If the sample is in the Event memory of the transmitter, lab value is only used in the software and storing it into the transmitter is not possible.



7.2 CALCULATING CONSISTENCY PARAMETERS WITH SILOGADVISOR

After the laboratory value is assigned to a sample, click "**Enable**" (5) to include the sample in the calculation of consistency parameters. With same button you can also remove sample from calculation (text on the button will change to "**Disable**" when sample is enabled). On the graph (**6**) you can see all the samples which have lab value: green ones are enabled for the calculation and black ones disabled. The blue line is the line defined by the current consistency parameters on the selected recipe and red line is the fitted line for the selected sample points. Corresponding consistency parameters (**Offset** and **Gain**) are visible on the "**Simulation**" section of the window (**7**). If you want to store these values to transmitter, press "**Copy**" button (**8**), check that correct recipe is selected and click "**Write**" button (**9**). A write warning will appear and simply click "**Yes**".



7.3 ENTERING CONSISTENCY CALIBRATION AND RANGE PARAMETERS WITH SILOGADVISOR

It is also possible to enter the consistency tuning parameter to the transmitter using the **SILogAdvisor** software.

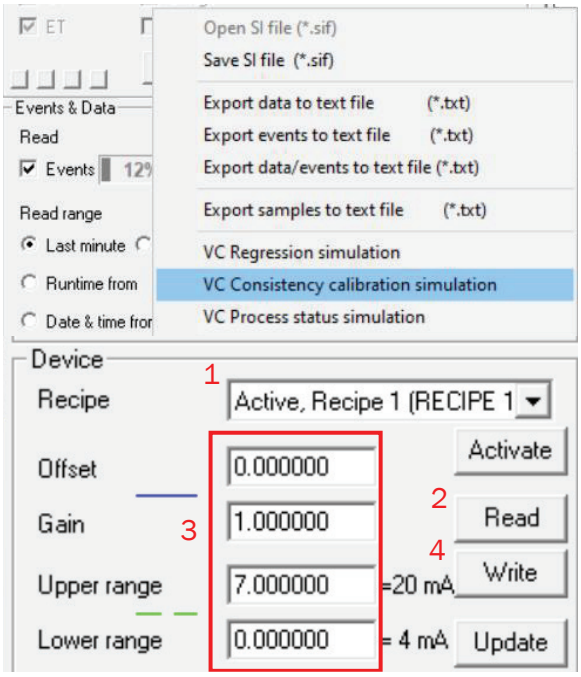
First attach the laptop to the transmitter, start the **SILogAdvisor** software and connect as directed previously.

Click the **File** - drop down button and select "**VC Consistency calibration simulation**" from the menu.

On the device section of the **VC Consistency calibration simulation** window, you can select recipe to edited from drop down menu (**1**) and retrieve the current gain and offset values from the transmitter by clicking the **"Read"** button (**2**). Values for the **Gain** and **Offset** together with **URV** and **LRV** values can be typed into the corresponding input windows (**3**). Values will be stored into the transmitter by clicking the "**Write**" button (**4**).

A write warning will appear and simply click "**Yes**".

After the operation is complete, a successful write message will appear. Click "**OK**".



7.4 ENTERING THE SECOND CHANNEL CALIBRATION VALUES WITH SILOGADVISOR

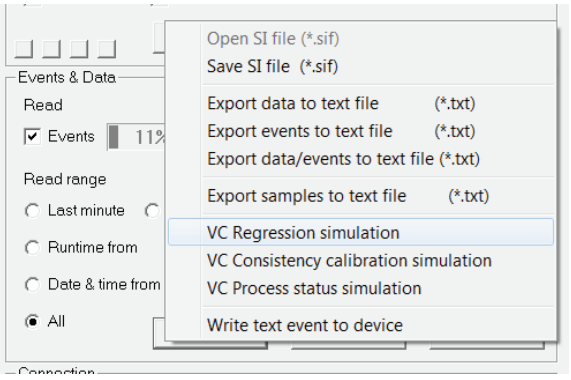
The calibration constants for the second channel form a linear equation in three variables. Rather than entering the constants individually at the **RDU**, they can be entered all at once using the **SILogAdvisor** software.

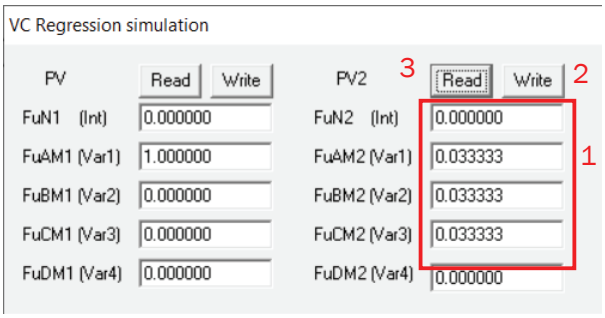
Attach the laptop to the transmitter and connect as directed previously.

Click the "**File**" drop down button and select "**VC Regression Simulation**" at the bottom of the menu.

The **VC Regression simulation** window will open. There are three channels for entering parameters. **PV** is for channel one (**IO1**). Note: it is only active when channel one has been configured as a second variable. When **IO1** is consistency, these parameters should not be changed - the gain and offset must be entered from the RDU or using **SILogAdvisor** as described in previous chapter.

PV2 is channel two (**IO2**) and **FTV3** is reserved for a future channel and is presently inactive. Also in **PV** and **PV2**, the variables with a "**D**" in the name are associated with the future capability and are currently inactive.

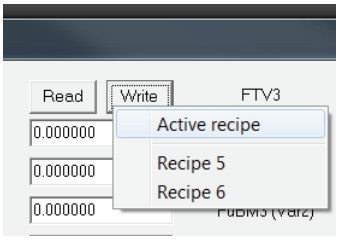




The constants are typed into the windows associated with **FuN2** (intercept) and the three measurement components (**FuAM2, FuBM2** and **FuCM2**) (**1**). Once the values are entered in the input windows, click the "**Write**" button (**2**) above the **PV2** column and select the recipe to store coefficients.
A write warning will appear and simply click "**Yes**".

After the operation is complete, a successful write message will appear. Click "**OK**".

If you wish to verify that the values were written, click the "**Disconnect**" button and then reconnect to the transmitter, reopen the **VC regression simulation** window click on the "**Read**" button (**3**) above the **PV2** column and the values stored in the transmitter will be displayed in the window.



8. DISPLAY SETUP

Under the menu there are 5 submenus: **CONFIGURATION, NEW SAMPLE, CALIBRATION, DIAGNOSTICS** and **ADVANCED.** The menu is entered by pressing **ESC** and the menu is navigated with the arrow keys. The submenu is accessed by pressing the **ENTER** button.

8.1 CONFIGURATION

8.1.1 RCP SEL

RCP SEL

The active recipe is selected by choosing the desired recipe with the **LEFT/RIGHT** keys and saved by pressed **ENTER** twice.

RECIPE 1...4

Recipes 1...4 are available for the consistency measurement (**PV**).

RECIPE 5-6

Recipes 5 and 6 are available for the multichannel measurement (**PV2**).

I/O SEL

I/O SEL allow the recipe change to be controlled externally via the digital inputs.

8.1.2 MAOUTPUT

MAOUTPUT

Select the **MA 1** or **MA 2** loop for configuration. **MA 1** is used as a default for the Consistency measurement **PV** in all Satron VC transmitters. **MA 2** is used as a default for multichannel measurement such as the VCA (Ash%), VCB (SCAN or ISO brightness), VCK (KAPPA or Fiber Length) or VCF (CSF or °SR freeness) .

LRV

Select the lower range value for the mA output.

URV

Select the upper range value for the mA output.

DAMPING

Adjust the damping value of the mA output. The damping is adjusted according to the application requirements.
In a turbulent flow condition, a good starting point for the damping value is to increase the damping value until the last digit (0.01%Cs) displayed on the main view is changing on the display once in 2 seconds. Increasing the damping will introduce additional delay to the automation control loop.

ALARMTYP

Select the alarm current for the mA loop. 3.7 mA and 22.5 mA can be selected. Default is 3.7 mA.

FREEZE

mA signal can be frozen to the current value by selecting FRZ HOLD. mA signal can be frozen to 4 mA by selecting the option FRZ 4 MA.

8.1.3 SYSTCONF

SYSTCONF

Configure parameters that have an effect on the system like tag and date.

TAG

Tag code. You can enter free-format text one character at a time. When you select this option with **ENTER** the cursor will be at the left. Select characters with **ENTER** (to the right) and **ESC** (to the left). You can view the selectable characters one character at a time with the **UP/DOWN** keys until the desired character is found. When the cursor is at the right edge you can go back to the **SYSTCONF** menu either by accepting the new tag code with **ENTER** or by pressing exiting without changing the tag code by pressing the **ESC** key when asked to accept your entry. Apostrophe indicates the cursor position; at point, however, the cursor will disappear. A great deal of special characters are available besides letters and numbers.

RTC

Set Real Time Clock.

HART

Select this function with the **LEFT/RIGHT** keys. In menus 1-3 you select the content of the burst message. You can view the available selections with the **LEFT/RIGHT** keys.
Available options:
In menu 1 (PV): Transmitter sends process value PV to system.
I**n menu 2 (PERCEN%)**: Transmitter sends process variable's value in per cent of specified measuring range to master.
In menu 3 (PVS/CURR): Transmitter sends all process variables and current signal's value.
In menu 5 (POLL ADR): Select the transmitter's Hart® address. The address can be set between 0 and 15. The transmitter enters Multidrop mode when the polling address is set between 1 and 15. When the address is set to 0 (Default) the unit resumes in the normal live mA loop.
In menu 6 (BURST ON/OFF): Select the Burst mode. First define the process variable sent by the transmitter from menus 1-3. The procedure is the same as described above.

DISPLAY

MODE: select the **PV** for only showing the %Cs measurement on the display. Select **PV PV2** option to show both the consistency measurement and the multichannel measurement alternating with a short delay on the display.

PASSWORD

From this menu you can set a password (0...999) for the transmitter. If a password has been specified, you cannot set any parameters or make any other settings on the transmitter unless you enter the correct ID number in this menu. Password is not in use when **PASSWORD** is 000 after reset. You enter the **PASSWORD** in the same way as TAG. **PASSWORD** will be on when you define a value between 1 and 999. If you forget password get in contact with Satron Instruments Inc.

LANGUAGE

English language available by default

T UNIT

Select transmitter's universal temperature unit. Available units are **°C** and **°F.**

PV UNIT

Configure parameters that have an effect on the measurement.

LED CURR

LED operating current %. Cannot be adjusted via the menu.

8.1.4 INFO

INFO

MANUFCTR

Manufacturer's name (**SATRON**). Cannot be changed.

DEV TYPE

Product type code. Cannot be changed.

VERSION

Version numbers of the transmitter's electronics and software. Press **ENTER** to select this item. Press **ESC** to exit. With the **LEFT/RIGHT** keys you can select either **CPU HW, CPU FW, ADC HW, or I/O HW** from this submenu.

ASSM NUM

The transmitter's assembly number. Cannot be changed.

SER NUM

Serial number. Cannot be changed.

OP TIME

HH : MM : SS when the value of counter is <100 hours
HHHH : MM when the value of counter is <100000 hours
HHHHHHHH when the value of counter is ≥100000 hours

AC HZ

Local line voltage frequency. Used for optimizing noise cancellation. This parameter is only changeable by Satron.

8.1.5 I/O CONF

I/O CONF

Configuration of the available digital I/O.

DI1

Select the digital input **DI1...DI3** for configuration.

FUNCTION
DI1...DI3 digital input function is selected.

NONE: No function.
HOLD: MA signal is put on FRZ HOLD.
OFT ACKN: Overfeed timer reset.
RECIPE+1: Change the active recipe by +1 increment (for example RECIPE 1 -> RECIPE 2).
RECIPE+2: Change the active recipe by +2 increment. (for example RECIPE 1 -> RECIPE 3).
DATALOG: Enables/disables data logging. (DIAGNOSTICS - LOG - DATA LOG - DIG I/O).
FLSH ON: External flushing control activation.
FLSH OFF: External flushing control deactivation.
FRZ 4 MA: mA signal is frozen to 4mA.
SAMPLE: Initiates a new sample. Sample is taken by the average of the measurement during the sample switch has been activated.

SWITCH
DI1...DI3 digital input can be direct or reversed when activated.

DO1

Select the digital output **DO1...DO3** for configuration.

FUNCTION
DO1...DO3 digital output function is selected.

NONE: No function.
HI LIMIT: Source value reached HI value.
LO LIMIT: Source value reached LO value.
HILO LIMIT: Source value reached HI or LO value.
ERROR AL: Transmitter error active.
WARNG AL: Transmitter warning active.
ERWNG AL: Transmitter error or alarm active.
FLSH OUT: Flushing control for external relay controlling a flushing valve.

SOURCE
DO1...DO3 digital output function source is selected.

PV: Process value.
MA: MA loop current.
ST: Sensor temperature.
RANGE-%: Calculated percents of the configured range.
MA2: MA2 loop current.

SWITCH
DO1...DO3 digital output can be direct or reversed when activated.

HI VALUE
Configure the **HI** value for the source.

LO VALUE
Configure the **LO** value for the source.

DEADBAND
Configure the deadband for the **HI** or **LO** value.

ON DELAY
Configure delay duration for the output to stay on once triggered. Range 0...300s.

OFF DELAY
Configure delay duration for the output to stay off before it is possible to be triggered again. Range 0...300s.

OF TIMER
Overfeed timer. Configure the limit of how long digital output can be continuously in ON state. Range 1...60 000s.

IO2

Configuration of the **IO2** output (second mA loop)

IO2 SRC
Select the source controlling IO2

NONE: No source selected.
PV: Process value.
%-RANGE: Percent of configured range.
MA: MA signal loop (first mA loop)
ST: Sensor temperature.
ET: Electronics temperature.
AV: Averaged value.
CV: Compensated value.
FV: Factory trimmed value.
UTV: User trimmed value.
ET2: Electronics temperature 2.
IO1: IO1 value
PV2: Process value 2 (default for multichannel transmitters)

IO2 LRV
Lower range value for the **IO2** (default 0.00000 for multichannel)

IO2 URV
Upper range value for the **IO2** (default 100.000 for multichannel)

IO2 DAMP
Damping value for the **IO2**. The damping is adjusted according to the application requirements. Increasing the damping will introduce additional delay to the automation control loop.

8.2 NEW SAMPLE

START?

A new process sample is started by pressing **ENTER**. The sampling is stopped by pressing **ENTER** and saved by pressing **ENTER** once more. Sampling can be cancelled by pressing **ESC** at any point and the result will not be stored. The sample is stored to the active recipe.

8.3 CALIBRATION

8.3.1 RECIPE

RECIPE

Configure the active recipe parameters. Select the correct milliamp output for configuration (**MA 1** or **MA 2**) when asked if the **IO2** is active for **PV2** on a multichannel transmitter. Offset and gain will be automatically adjusted when the sample calibration method is used for the consistency calibration and no manual adjustment is necessary.

OFFSET

Adjust the offset correction of the measurement (default 0.00000).

GAIN

Adjust the measurement gain (default 1.00000).

USER.PNTS

Amount of user points (default 2). No need to change.

USER.MODE

Lin interpolation or spline interpolation between the user points. Default: Lin Interpolation. No need to change.

TEXT

Freely selectable text to describe the recipe.

8.3.2 SAMPLES

SAMPLES

Table of taken process samples for the currently active recipe.

SAMP 01... SAMP 09 stored process samples can be scrolled by the arrow keys.
SAMP H20 is the stored water sample value.

SAMP 01
Selecting the sample with **ENTER** key allows to input the corresponding laboratory value for the Consistency (**LAB PV**) and the multichannel parameter (**LAB PV2**).

8.3.3 CALIBRATE

CALIBRATE

Calibrate the transmitter according to the chapter 5 instructions.

8.3.4 CALIB HISTORY

CALIB HISTORY

The previous calibrations can be found in this view.

8.4 DIAGNOSTICS

This submenu allows you to examine the transmitter's internal errors and faults, to set the transmitter to give out a fixed current, and to calibrate the transmitter's mA loop and sensor temperature.

STATUS

Here you can display and reset accumulated errors one at a time. The text **OK** will be displayed if there are no errors. Possible error messages (alarm means a serious fault/error that also puts the current signal in fault status and makes the display blink).

LOOPTEST

The transmitter can be set to give out a fixed current signal for testing the mA output. The first **ENTER** will switch the transmitter off from normal mode (**AUTO OFF**), the second **ENTER** will set it for 4 mA output, and the third **ENTER** for 20 mA output. The next **ENTER** after that will give default value 12 mA, which can be changed as desired with the **UP/DOWN** keys. The last **ENTER** will switch the transmitter back to normal mode (**AUTO ON**). The purpose of this test is to test the accuracy of the transmitter's current output with a reference meter.

ST TRIM

Sensor Temperature Trim. Here you are able to calibrate the temperature probe which is placed in the head of the analyzer. (Maximum by 10 degrees).

LOOPCAL

Here you can calibrate the current signal given by the transmitter. The first **ENTER** will switch the transmitter off from normal mode (**AUTO OFF**). The next **ENTER** will make the transmitter give out a signal which it assumes to be 4 mA. Use the **UP/DOWN** keys to change this value in accordance with the reading on the reference meter. Then press **ENTER** for 20 mA output, which you must also set in accordance with the reference meter. Press **ENTER** to accept the new reading. Note: Use a sufficiently accurate reference meter.

I/O TEST

Allows user to monitor the functionality of set I/O functions.

HARDWARE

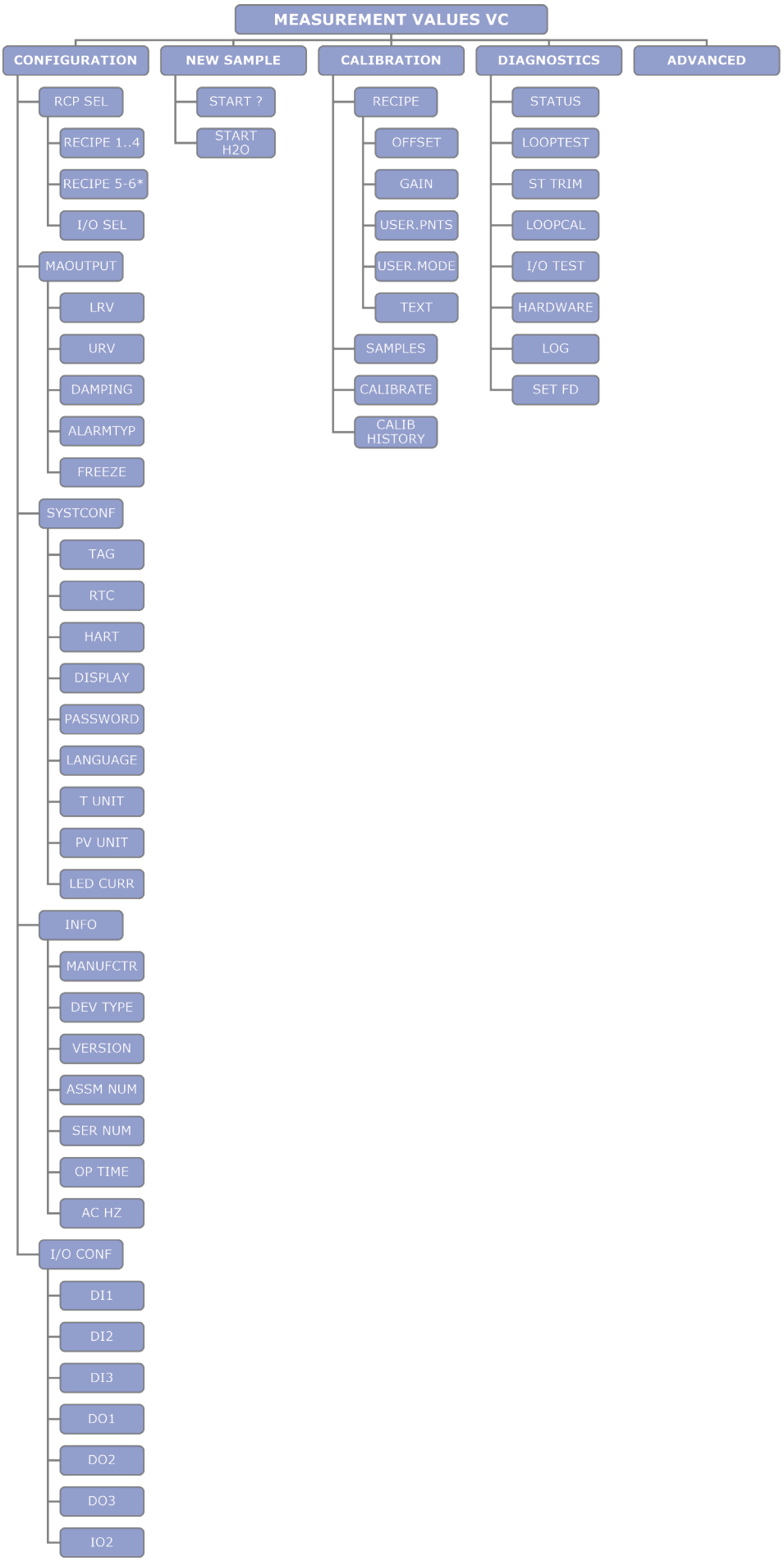
Submenu **VOLTAGES** displays transmitter's inner voltage levels. Submenu **DISPLAY** performs display and button test. Submenu **IOUT1 NC ALARM** chooses if the alarm is displayed when the IOUT1 is not connected. By default this alarm is on.

LOG

Submenu **ADD TEXT** allows user to create and save a notification text to transmitter's data log with time stamp. This can be used later for example to separate different process phases when analyzing the data log. Edit the text and accept it with **ENTER** or press **ESC** if you do not want to change the value. Submenu **DATA LOG** enables user to select between **CYCLIC** data logging (cycle time is determined in submenu **INTERVAL**) or **DIG I/O. DIG I/O** enables user to control data logging via digital input. The factory default setting is **CYCLIC** and its **INTERVAL** setting depends on the transmitter type.

SET FD

SET FD restores the default factory settings.
All calibrations will be lost.


MEASUREMENT VALUES VC
CONFIGURATION
NEW SAMPLE
CALIBRATION
DIAGNOSTICS
ADVANCED
RCP SEL
RECIPE 1..4
RECIPE 5-6*
I/O SEL
MAOUTPUT
LRV
URV
DAMPING
ALARMTYP
FREEZE
SYSTCONF
TAG
RTC
HART
DISPLAY
PASSWORD
LANGUAGE
T UNIT
PV UNIT
LED CURR
INFO
MANUFCTR
DEV TYPE
VERSION
ASSM NUM
SER NUM
OP TIME
AC HZ
I/O CONF
DI1
DI2
DI3
DO1
DO2
DO3
IO2
START ?
START H2O
RECIPE
OFFSET
GAIN
USER.PNTS
USER.MODE
TEXT
SAMPLES
CALIBRATE
CALIB HISTORY
STATUS
LOOPTEST
ST TRIM
LOOPCAL
I/O TEST
HARDWARE
LOG
SET FD

ERROR WORDS

The content of error words 1…12.

EW number	EW bit	EW name (function)	Description
01	00	**EW1**	Turbidity / Consistency error (TU ER/CS ER)
〃	01	〃	Sensor temperature error (ST ER)
〃	02	〃	Electronics temperature error (ET ER)
〃	03	〃	Output under -10 % or over 110 % (RANGE ER)
〃	04	〃	Output current saturated (OUTSA WA)
〃	05	〃	ADC runtime error (ADCR ER)
〃	08	〃	ADC startup error (ADCS ER)
〃	09	〃	EEPROM read error (EERPR ER)
〃	10	〃	EEPROM write error (EEPRW ER)
〃	11	〃	EEPROM calibration error (EECAL ER)
〃	12	〃	HART error (HART ER)
〃	13	〃	System error (INTRN ER)
02	02	**EW2**	Overfeed timer (OFTMR ER)
〃	04	〃	ADCA error
〃	05	〃	ADCB error
〃	06	〃	DACA error
〃	07	〃	DACB error
〃	08	〃	DISP error
〃	09	〃	EEPR error
〃	10	〃	HARA error
〃	11	〃	HARB error
〃	12	〃	SYSA error
〃	13	〃	SYSB error
03	00	**ADCA** (A/D, LEDs)	ADC not found
〃	01	〃	Comm error
〃	02	〃	Invalid channel
〃	03	〃	Irpt timeout
〃	04	〃	Gain comm error
〃	08	〃	AINM undervoltage
〃	09	〃	AINM overvoltage
〃	10	〃	AINP undervoltage
〃	11	〃	AINP overvoltage
〃	12	〃	ADC saturation
〃	13	〃	ADC conversion error
〃	14	〃	Miscellaneous error
04	08	**ADCB** (〃)	LED comm1 error
〃	09	〃	LED comm2 error
〃	10	〃	LED short error
〃	11	〃	LED open error
05	00	**DACA** (D/A, I/O)	IOUT not connected
〃	01	〃	Comm timeout
〃	02	〃	Frame error
〃	04	〃	VLoop 12V
〃	05	〃	VLoop 6V
〃	06	〃	Temp 100C
〃	07	〃	Temp 140C
〃	08	〃	ILoop under
〃	09	〃	ILoop over

〃	12	〃	Loop error
〃	13	〃	I/O comm error
06	00	**DACB** (〃)	IOUT2 not connected
〃	01	〃	I2 Comm timeout
〃	02	〃	I2 Frame error
〃	04	〃	I2 VLoop 12V
〃	05	〃	I2 VLoop 6V
〃	06	〃	I2 Temp 100C
〃	07	〃	I2 Temp 140C
〃	08	〃	I2 ILoop under
〃	09	〃	I2 ILoop over
〃	12	〃	I2 Loop error
〃	13	〃	I/O comm2 error
07	00	**DISP** (Display, RDU)	Keyb error
〃	01	〃	Disp error
〃	08	〃	No reply
〃	09	〃	Frame error
〃	10	〃	Checksum error
〃	12	〃	Keyb error (R)
〃	13	〃	Timeout error (R)
〃	14	〃	Frame error (R)
〃	15	〃	Checksum error (R)
08	00	**EEPR** (EEPROM, Flash)	Checksum error
〃	01	〃	Calibration error
〃	08	〃	CPU r/w error
〃	09	〃	Log r/w error
〃	10	〃	ADC r/w error
〃	11	〃	I/O r/w error
〃	12	〃	CON r/w error (R)
09	00	**HARA** (HART, USB, IO-Link)	Preamble error
〃	01	〃	Frame error
〃	02	〃	Too few chars
〃	03	〃	Checksum error
〃	08	〃	Timeout error (IOL)
〃	09	〃	Overflow error (IOL)
〃	10	〃	Checksum error (IOL)
10	00	**HARB** (〃)	RC2 Invalid selection
〃	01	〃	RC3 Passed parameter too large
〃	02	〃	RC4 Passed parameter too small
〃	03	〃	RC5 Too few data bytes received
〃	04	〃	RC6 Device specific command error
〃	05	〃	RC7 In write protect mode
〃	06	〃	RC16 Access restricted
〃	07	〃	RC18 Invalid units code
〃	08	〃	RC32 Device is busy
〃	09	〃	RC64 Command not implemented
〃	10	〃	RCxx Other single definition response code
〃	11	〃	RCxx Command-specific response code
11	00	**SYSA** (System)	WD reset
〃	01	〃	Invalid reset
〃	02	〃	Stack error
〃	03	〃	Hard fault

〃	07	〃	Fuse blow error
〃	08	〃	AVDD error
〃	09	〃	IOVDD error
〃	10	〃	ALDO error
〃	11	〃	DLDO error
〃	12	〃	20mV error
〃	14	〃	V6V error
〃	15	〃	V24V error
12	00	**SYSB** (〃)	WD reset (R)
〃	01	〃	Invalid reset (R)
〃	02	〃	Stack error (R)
〃	03	〃	Hard fault (R)
〃	08	〃	V24V error (R)
〃	09	〃	Vana error (R)
〃	10	〃	Vdig error (R)
〃	11	〃	I error (R)
〃	12	〃	Fuse blow error (R)
〃	13	〃	Vcc error (R,IOL)
〃	14	〃	Vdd error (R,IOL)

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