VAF INSTRUMENTS

Technical Manual

Instructions for installation, operation and maintenance

771
ELECTRONIC FUEL VISCOSITY CONTROLLER

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CONTENTS

1 PREFACE

The electronic controller is available as an 1 channel and 2 channel controller.
This manual is based on a 2 channel controller with an analog output, since this type of controller is the most comprehensive.
This does not mean that this manual is not applicable for the other type of controller.

1.1 GENERAL

This manual contains instructions for installation, operation and maintenance (IOM) of the electronic controller supplied with a VAF ViscoSense® viscosity sensor and supplements the IOM instructions for the viscosity sensor as referred to in the Technical Information Bulletin (TIB) supplied with the sensor.

These TIB's also include a functional description of viscosity control systems with ViscoSense® viscosity sensor.

The electronic controller is also compatible with a VAF Viscotherm® viscosity sensor.
Installation, operation and maintenance instructions for the electronic controller in conjunction with a Viscotherm® will be supplied separately.

For IOM information of the control valve for steam or thermal oil supplied with your control system, refer to the separate manual supplied with the valve.

CAUTION:
TO ENSURE SAFE AND CORRECT INSTALLATION AND HANDELING, OPERATION AND MAINTAINING, READ THIS MANUAL COMPLETELY BEFORE INSTALLING THE EQUIPMENT AND STARTING OPERATIONS.

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Or your local authorized VAF dealer.
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1.2 SYMBOLS

The following symbols are used to call attention to specific types of information.

A WARNING TO USE CAUTION!
IN SOME INSTANCES, PERSONAL INJURY OR DAMAGE TO THE CONTROLLER MAY RESULT IF THESE INSTRUCTIONS ARE NOT FOLLOWED PROPERLY.

AN EXPLANATION OR INFORMATION OF INTEREST.

1.3 COPYRIGHT

While every precaution has been taken in the preparation of this manual, no responsibility for errors or omissions is assumed. Neither is any liability assumed for damages resulting from the use of the information contained herein. Specifications can be changed without notice.

ViscoSense®, ViscoSense®2, ViscoSense®3, ViscoSense®3D and Viscotherm® are registered trademarks of VAF Instruments B.V.

2 PRODUCT DESCRIPTION

2.1 RECORDING NAMEPLATE DATA

Before installing a VAF viscosity control system, record all type and serial numbers as stamped on the viscosity sensor, controller and other system components.

ALWAYS QUOTE THE INSTRUMENT SERIAL NUMBER AND THE VARIANT NUMBER WHEN CONTACTING THE FACTORY OR LOCAL SERVICE REPRESENTATIVE.

The VAF electronic controller may be part of a complete VAF viscosity control system. For information and instructions covering the other components of this system, refer to the separate Technical Information Bulletins as supplied with these components.

For identification purposes it is recommended to record nameplate data of all viscosity control system components here.

Component Nameplate data

_____

_____

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2.2 SYSTEM DESCRIPTION

VAF viscosity control systems are, besides other applications, intended for use in fuel oil treatment systems to obtain a correct measurement and control of the fuel oil viscosity.

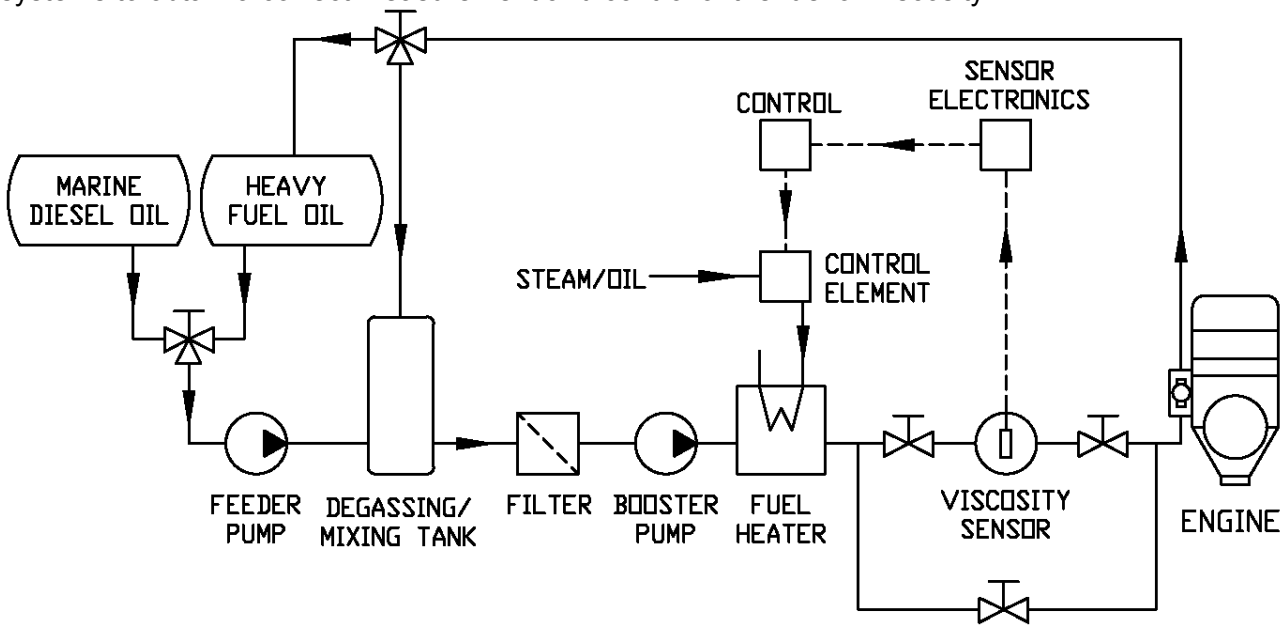


Figure 1 Recommended fuel viscosity control system installation
Typical example of an automatic control system using steam or thermal oil heater.

Figure 1 shows a typical fuel treatment system with return line from the engine. In this configuration, the degassing/mixing tank operates as a fuel buffer, ensuring gradual changes of viscosity which results in a more stable control of the viscosity. The viscosity sensor is used to measure the actual viscosity of the fuel oil. The signal from the sensor is compared to the setpoint of a viscosity controller, which regulates the output of the fuel heater via a control element (steam or thermal oil valve, or electric heater cabinet).

2.3 SYSTEM COMPONENTS

The VAF viscosity control system consists of:

- Viscosity measuring sensor
- Temperature measuring sensor, standard for ViscoSense®
- Electronic viscosity signal converter, standard interface box for ViscoSense®
- Electronic viscosity controller
- Control valve for steam or thermal liquid (optional)

2.3.1 Viscosity measuring sensor

For operation information on your viscosity sensor refer to the TIB supplied with the sensor.

These TIB's also include a functional description of viscosity control systems with ViscoSense® viscosity sensor.

2.3.2 Electronic viscosity controller

The viscosity controller is a microprocessor-based instrument with a proportional and integrating control action. It is available in two types (1 channel or 2 channels) to match the specific requirements for different viscosity control systems.

Channels	Controller type	Controller output	Retransmission	
			Viscosity	Temperature
1	Viscosity	4-20 mA	yes	-
1	Viscosity	relay	yes	yes
2	Viscosity/temperature	4-20 mA	yes	-
2	Viscosity/temperature	relay	yes	yes

Input signals for viscosity and temperature are normally 4-20 mA.
PT100 temperature input is optional.

2.3.2.1 One channel input, current output.

Inputs for the controller are the signals for viscosity and temperature from the viscosity sensor electronics.
The control action is based on the viscosity setpoint. The temperature value is only displayed.
The controller opens or closes the valve in the steam or thermal liquid line through an active 4-20 mA control signal.
The viscosity value is retransmitted as an isolated active 4-20 mA output.

2.3.2.2 One channel input, relay output.

Inputs for the controller are the signals for viscosity and temperature from the viscosity sensor electronics.
The control action is based on the viscosity setpoint. The temperature value is only displayed.
The controller opens or closes the valve in the steam or thermal liquid line through two relay contacts.
Both viscosity and temperature values are retransmitted as isolated active 4-20 mA outputs.

2.3.2.3 Two channel input, current output.
Inputs for the controller are the signals for viscosity and temperature from the viscosity sensor electronics.
The control action is based on the viscosity or temperature setpoint.
The controller opens or closes the valve in the steam or thermal liquid line through an isolated active 4-20 mA control signal.
The viscosity value is retransmitted as an isolated active 4-20 mA output.

2.3.2.4 Two channel input, relay output.
Inputs for the controller are the signals for viscosity and temperature from the viscosity sensor electronics.
The control action is based on the viscosity or temperature setpoint.
The controller opens or closes the valve in the steam or thermal liquid line through two relay contacts.
Both viscosity and temperature values are retransmitted as active 4-20 mA outputs.

2.3.3 Control valve for steam or thermal liquid
The control valve regulates the flow of steam or thermal liquid to the fuel heater. The valve actuator is driven by a bi-directional electric motor.
In the event of an electric power failure the control valve remains in its last obtained position, thus enabling the system to remain on H.F.O., while maintaining the possibility of controlling the valve by means of the manual override.
For IOM information of the control valve for steam or thermal oil supplied with your control system, refer to the separate manual supplied with the valve.

3 TECHNICAL SPECIFICATION

3.1 CONTROLLER

3.1.1 Operation

Display:	Color 1/4 VGA TFT, liquid crystal display (LCD) with built-in backlight
Operator keypad:	6 Tactile membrane keys

3.1.2 Physical

Size:	97 x 97 x 141 mm
Weight:	0.5 kg approx. (unpacked)
Panel cutout:	92 x 92 mm
Case material:	Glass-filled polycarbonate

3.1.3 Environmental

Operating temperature range:	0 to 55 °C
Operating humidity range:	5 to 95 %RH (non-condensing)
Storage temperature range:	-20 to 70 °C
Enclosure sealing :	Front face IP66 / NEMA 4X Rest of enclosure IP20
Vibration:	Conforms to EN60068-2-6

3.1.4 Electrical

Supply ranges:	100 to 240 V AC ±10 % (90 V min. to 265 V max.) 50 / 60 Hz
Power consumption:	10 W max.
Power interruption protection:	No effect for interrupts of up to 60 ms

3.1.5 EMC

Emissions & immunity:	Meets requirements of IEC61326

3.1.6 Safety

Approvals and certifications:	EN61010-1 cULus
General safety:	Pollution category 2 Insulation category 2

3.1.7 Input

Universal process inputs

Number:	2
Type:	Current 3-wire PT100 (optional)
Update rate:	125 ms
Common mode noise rejection:	>120 dB at 50 / 60 Hz with 300 W imbalance resistance
Normal (series) mode noise rejection:	>60 dB at 50 / 60 Hz
CJC rejection ratio:	0.050 °C / °C change in ambient temperature
Temperature stability:	0.02 % / °C or 2 µV / °C (1 µV / °F)
Long term (input) drift:	<0.1 % of reading or 10 µV annually
Input impedance:	>10 MW (millivolts input) 10 W (mA input)

RTD	Maximum Range	Accuracy (% of reading)
Pt100	-200 to 600 °C	0.1 % or ±0.5 °C

Linear Inputs	Standard Analog Input	Accuracy (% of reading)
Milliamps	0 to 50 mA	0.2 % or ±4 µA

3.1.8 Outputs

Controls / retransmission outputs

Number:	2
Isolation:	Galvanically isolated from the rest of the circuitry, 500 V for 1 minute
Analog range:	4 to 20 mA
Load :	750 Ω Max.
Accuracy :	0.25 % of output or ± 10 µVA

Relays

Number:	3
Type:	Controller output relays: NO Alarm relay: standard with changeover contacts.
Contact ratings:	5 A, 240 V
Update rate:	125 ms

3.1.9 2-Wire transmitter power supply (optional)

Voltage:	24 V DC
Number:	1
Drive:	2 Loops for each transmitter PSU, 45 mA max.

4 SAFETY INSTRUCTIONS

4.1 SAFETY PRECAUTIONS

All precautions have been taken to ensure, in so far as reasonable practical that the equipment has been designed and constructed to be safe and without risk to health or the environment when properly used.
Provided that the recommendations contained in this manual are carefully adhered to, no circumstances are foreseen where the equipment will present a health or safety hazard.

To ensure the safety of personnel, equipment and the environment:

- Always follow the safety, installation, repair and maintenance recommendations in this manual.
- Always observe warning labels on containers and packages.
- All personnel who installs, operates, repairs or maintains the equipment should read this manual completely and make themselves acquainted with the equipment before installing, operating, repairing or maintaining the equipment.
- Make sure that all safety requirements are met before installing, operating, repairing or maintaining the equipment.
- Always use personal protective means when necessary.
- Always use the right tools for the job.
- Make sure that all equipment is isolated from the electrical supplies before installing, repairing or maintaining the equipment.
- Never assemble or disassemble electrical equipment or remove or install printed circuit boards with power switched ON.
- Always handle printed circuit boards with CMOS components according to the correct procedures for such components, to prevent any damage due to electrostatic discharges.
- Only use cleaning solvents in a well ventilated area.
- Avoid breathing fumes.
- Keep away from open fire.
- Do not use solvents on plastic components or parts.

4.2 ELECTRICAL SAFETY

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.
If the equipment is used in a manner NOT specified by VAF, the protection provided by the equipment may be impaired.

4.3 SYMBOLS

One or more of the following symbols may appear on the equipment labelling:

	**Warning** – Refer to the manual for instructions
	**Caution** – Risk of electric shock
	Functional earth (ground) terminal
	Protective earth (ground) terminal

	Direct current supply only
	Alternating current supply only
	Both direct and alternating current supply
	The equipment is protected through double insulation

5 UNPACKING

Let the equipment acclimatize inside the closed box for at least one hour at the location where the controller will be installed.
When the controller is taken out of the box, please leave the special protection supplied with the equipment as long as possible in place to avoid any damage.
Disposal of the packing material should be done according to local laws or regulations, or according to the rules that are applicable on the vessel.

Details of the controller:

Controller

Weight: 0.5 kg approx. (unpacked)
Dimensions: 97 mm x 97 mm x 141 mm (W x H x D)

Figure 2 Controller

6 INSTALLATION

CAUTION:
SELECT A LOCATION AWAY FROM STRONG ELECTRICAL AND MAGNETIC FIELDS. IF THESE CANNOT BE AVOIDED, CONNECT USING SCREENED CABLES WITHIN GROUNDED METAL CONDUIT.

6.1 SITING

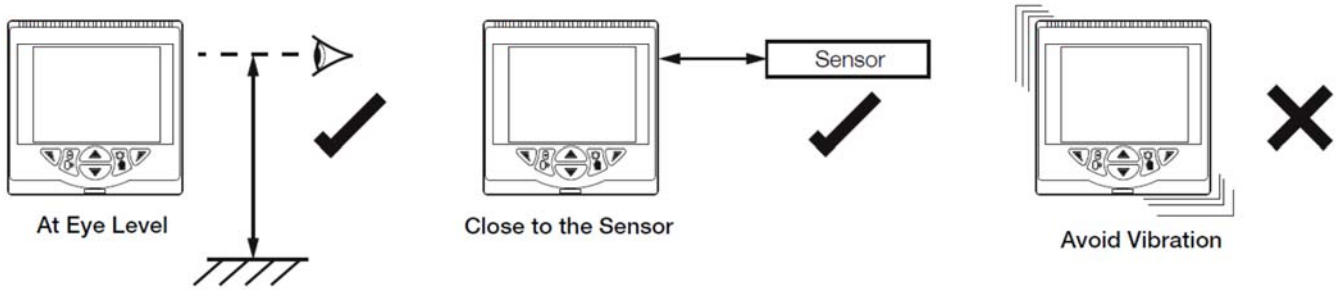


Figure 3 Siting

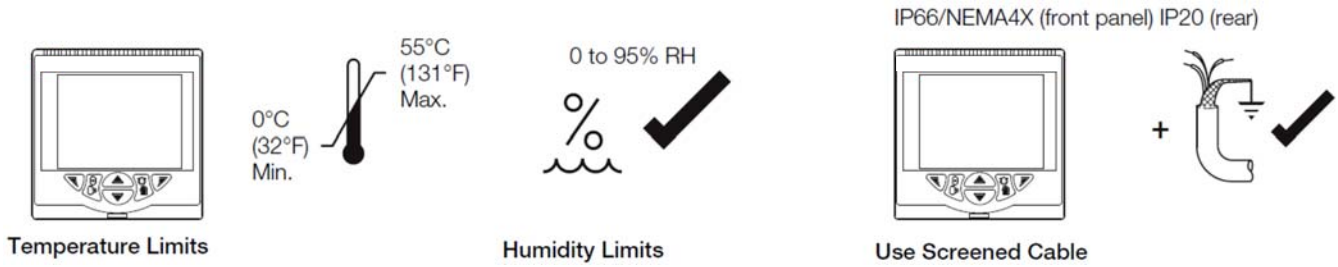


Figure 4 Environmental Requirements

6.2 DIMENSIONS

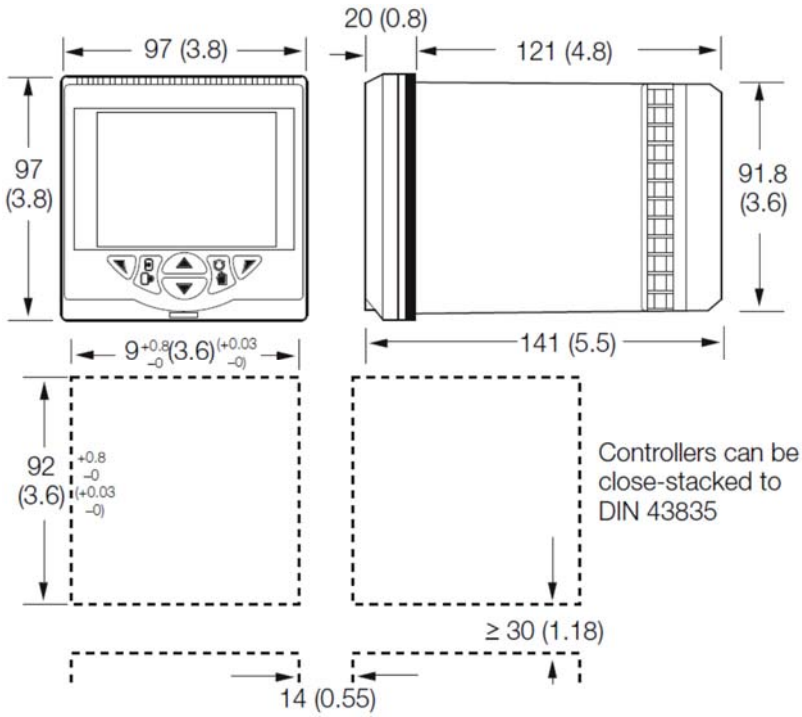


Figure 5 Controller dimensions in mm (in.)

6.3 MOUNTING

The controller is designed for panel mounting. For NEMA4X protection, a panel thickness of 2.5 mm is required.
To panel-mount the controller:

1. Cut a hole of the correct size for the controller in the panel (92 x 92 mm).
2. Insert the controller into the panel cut-out, referring to
3. Figure 6:
4. Position the upper panel clamp A at the top front of the case against the panel.
5. Locate the panel clamp anchor B in slot C.
6. Tighten the panel clamp anchor screw D until panel clamp A is secured against the panel.

☞ DO NOT OVERTIGHTEN THE SCREW.

7. Repeat steps 3 to 5 to fit the lower panel clamp E and panel clamp anchor F.

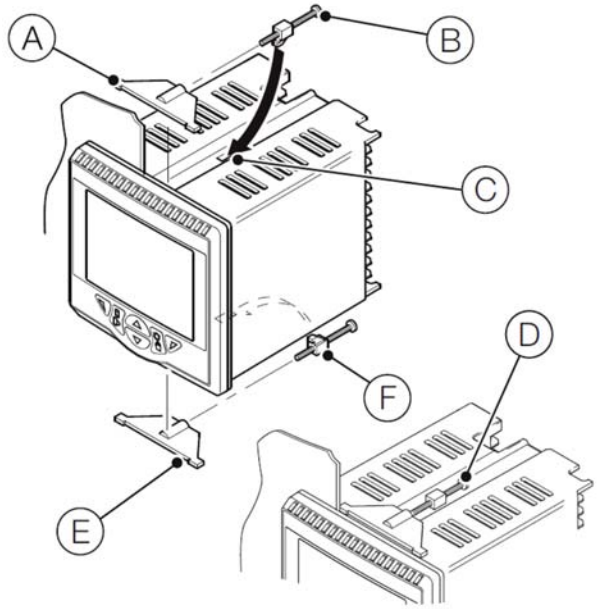


Figure 6 Mounting details

☞ ALLOW SUFFICIENT SPACE FOR INSTALLATION OF CABLES AND FOR SERVICING.

6.4 ELECTRICAL INSTALLATION

WARNING

- The controller is not fitted with a power switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation.
- The switch must be mounted in close proximity to the controller within easy reach of the operator and must be marked clearly as the disconnection device for the controller.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- Use cable appropriate for the load currents. The terminals accept cables from 18 to 14 AWG (0.8 to 2.5mm2).
- Always route signal leads and power cables separately, preferably in earthed (grounded) metal conduit.
- It is required that screened cable is used for signal inputs and relay connections.
- The instrument conforms to Mains Power Input Overvoltage Category 2, Pollution Degree 2 (EN601010–1). (This equipment is protected through double insulation – Class II.)
- Analog/digital inputs and outputs, transmitter power supply and DC power supply are SELV (Safety Extra Low Voltage) circuits.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts, for example terminals.
- Terminals for external circuits are for use with equipment with no accessible live parts only.
- If the controller is used in a manner not specified by VAF, the protection provided by the equipment may be impaired.
- All equipment connected to the controller's terminals must comply with local safety standards (IEC 60950, EN601010–1).

TERMINAL SCREWS MUST BE TIGHTENED TO A TORQUE OF 0.1 Nm (0.9 lbf/in).

NOTE:
The VAF electronic controller may be part of a complete VAF viscosity control system. The controller is available in two types to match the specific requirements for different viscosity control systems. For the different systems, different external connection diagrams are available, according to the drawing list below.
Before connecting the controller to other system components thoroughly check the compatibility of all system parameters and signals. Connecting non compatible system components will lead to faulty operation and possible destruction of these components.

Electrical drawing	Channels	Controller type	Controller output	Retransmission	
				Viscosity	Temperature
0850-2161	1	Viscosity	4-20 mA	yes	-
0850-2162	1	Viscosity	relay	yes	yes
0850-2163	2	Viscosity/temperature	4-20 mA	yes	-
0850-2164	2	Viscosity/temperature	relay	yes	yes

The electrical drawings can be found in section 17.

6.4.1 VAF electronic viscosity controller

1. Connect the 4-20 mA signals for viscosity and temperature from the ViscoSense® interfacebox to the input terminals at the back of the controller, in accordance with the electrical connection diagrams in section 17.
2. Connect the cable for main power supply to the terminals at the back of the controller, in accordance with the electrical connection diagrams in section 17.
3. Make sure that all connectors are properly seated before starting operation.

6.4.2 Control valve

1. Connect the 4-20 mA or relays output terminals at the back of the controller to the valve, in accordance with the electrical connection diagrams in section 17 and the directions in the instruction manual supplied with the valve.
2. Connect the cable for main power supply as instructed in the instruction manual supplied with the control valve.

THE CONTROL LEADS MUST BE FUSED EXTERNALLY TO PROTECT THE OUTPUT CIRCUITS.

7 OPERATING INSTRUCTIONS

7.1 GENERAL OVERVIEW

7.1.1 Display overview

The VAF controller display and icons are shown below.

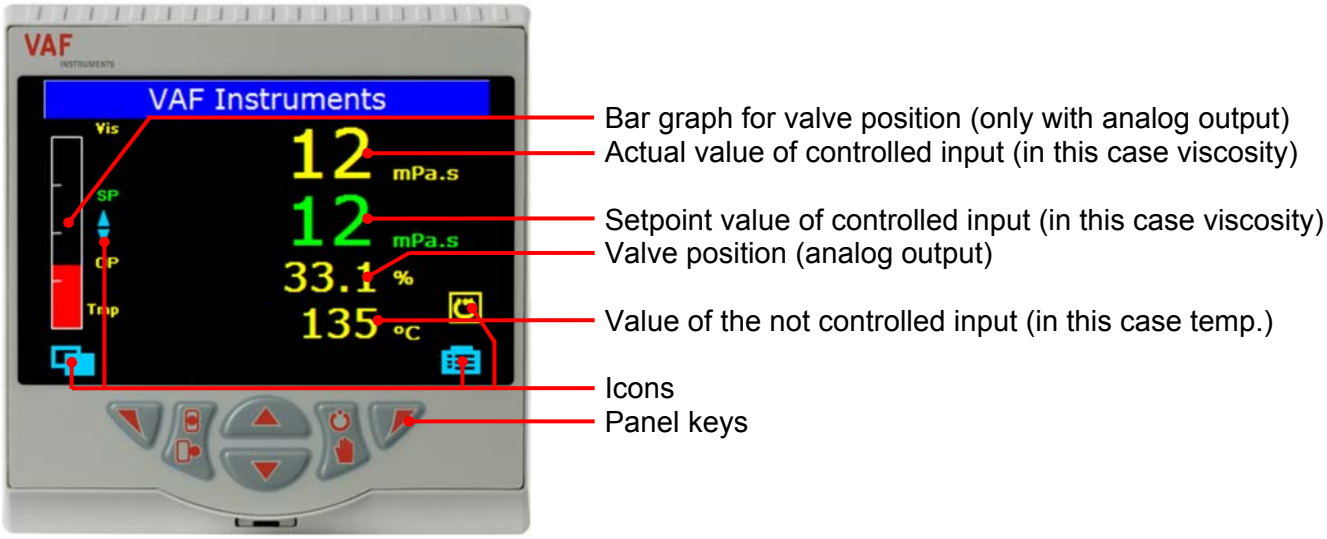


Figure 7 Controller display

NOTE:
Depending on the configuration of the controller, the actual display may be different from the display shown above.

7.1.2 Icons

Operator Level Menu

Access Level

Adjust–Indicates which value is adjusted by the / keys

Manual Mode

Process Alarm

Auto Mode

7.1.3 Front panel keys

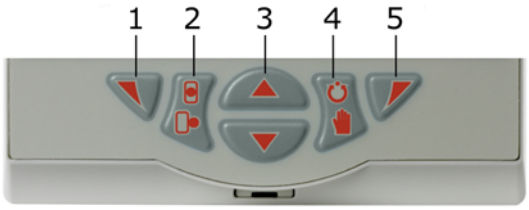


Figure 8 Front panel keys

1.  Navigation key (left)
2.  Not used
3.  Up/Down keys - navigate up/down menus and increase/decrease displayed values.
4.  Auto/Manual control mode selection key.
5.  Navigation key (right)

7.1.4 Basic Operations

After the power is switched on, the controller will perform a self test, initialise and afterwards show the following display.

Figure 9 Start-up screen

Depending in which control mode the controller was in, before the power was turned off, the display will look as shown below.

Figure 10 Dual channel controller in viscosity type mode, with relay output

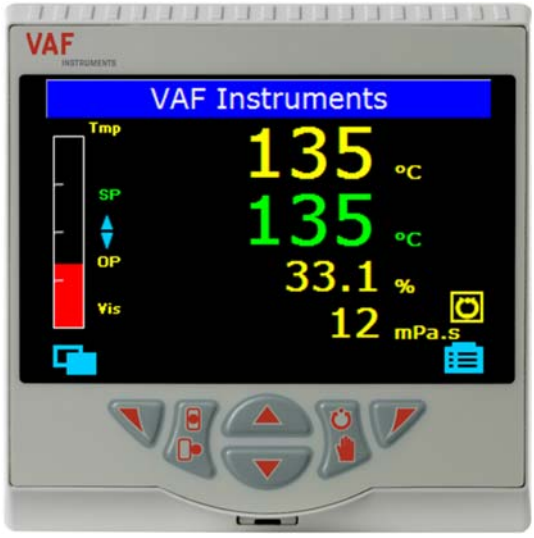


Figure 11 Dual channel controller in temperature type mode, with analog output

The controller will automatically start up in AUTO control mode in the Operator Page 1.

- AUTO mode is the normal closed loop viscosity or temperature control mode which means that the output is adjusted automatically by the controller in response to the measurements from the input sensor.
- The Operator Page 1 is the standard layout of the display from where the different menus can be accessed and the different functions can be controlled.

NOTE:
Changing the controller type from viscosity to temperature (or vice versa) is only available if the controller is equipped with 2 channel input.

7.2 MENU LAYOUT AND SETUP

Before the controller can be used, it has to be properly configured. Most parameters are already set at the VAF factory, but some parameters still have to be set to the appropriate values in accordance to the specific system.

The controller has a menu layout as shown below.

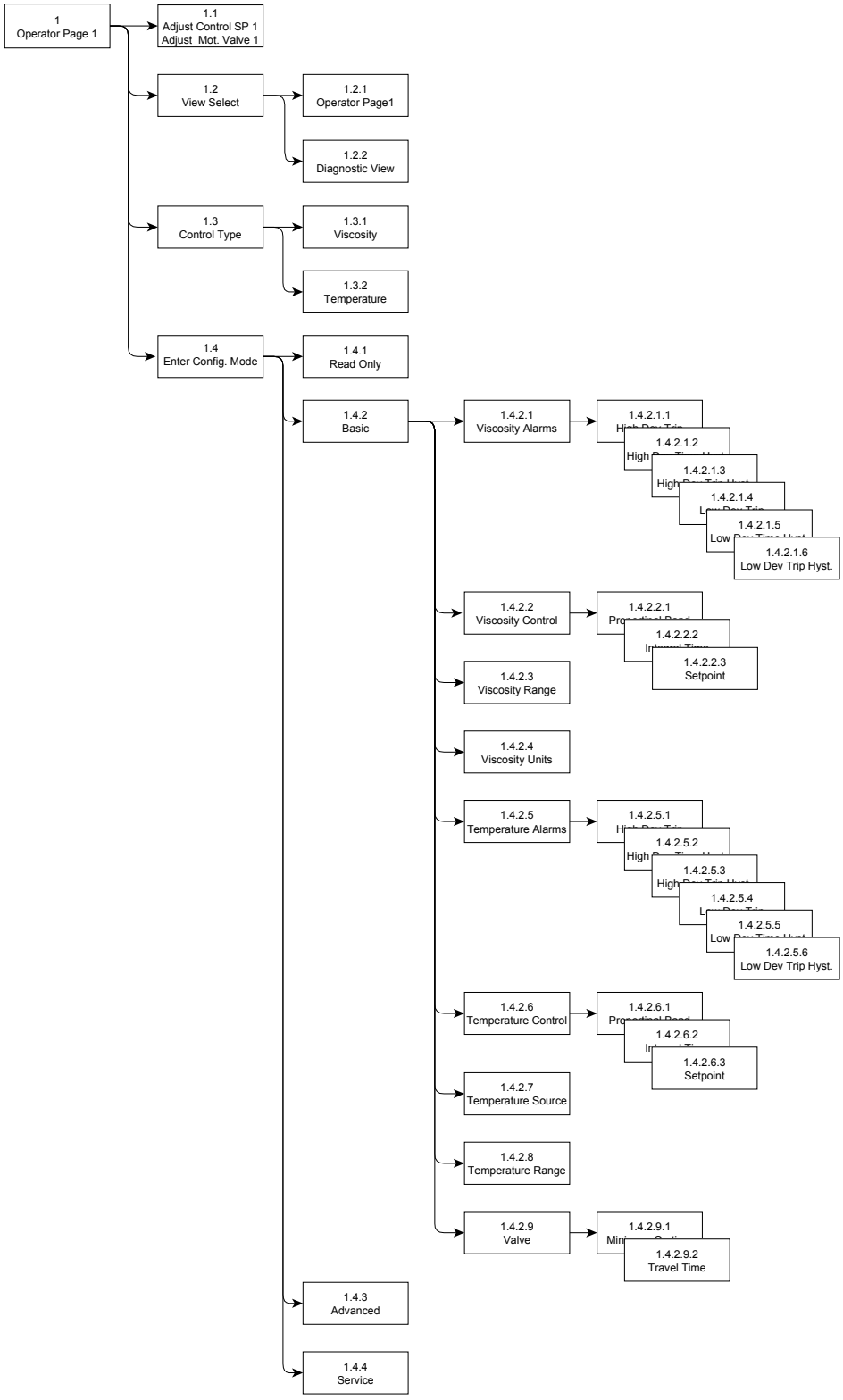


Figure 12 Menu layout

7.2.1 Basic Setup Menu (menu 1.4.2)

When the controller has started up, the Operator Level Menus can be accessed by pressing the left navigation key.

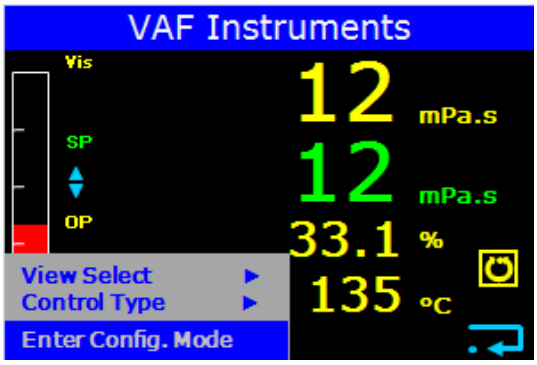


Figure 13 Enter Configuration Mode

- Press the down key to navigate through the menu to the Enter Config. Menu and press the right navigation key to enter.
- Next, press the down key to scroll down to Basic and press the right navigation key to enter.

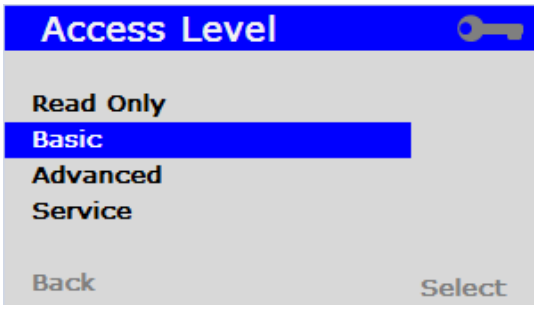


Figure 14 Access Level Menu

In the Read Only Menu all the device settings can be viewed.
Both Advanced and Service Menus are not accessible for the user.

Before the Basic Menu can be entered, a password must be entered. The password is “2”.

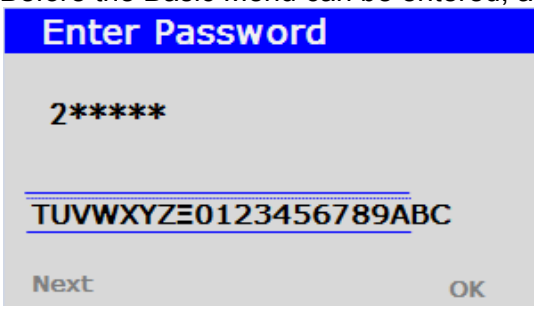


Figure 15 Enter Password

- Press the / up/down keys to enter “2”.
- Press the left navigation key for “Next”.
- Finally press the right navigation key to confirm.

From the Basic Setup Menu all parameters, available for the user, can be set.

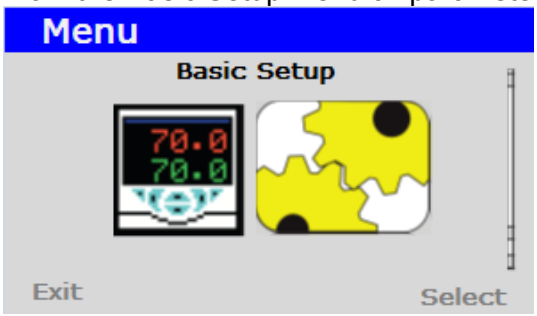


Figure 16 Basic Setup Menu

In the following sections all menus and parameters will be explained.

BASED ON THE SPECIFIC CONFIGURATION OF THE CONTROLLER NOT ALL PARAMETERS MAY BE AVAILIBLE.

7.2.1.1 Viscosity Alarms Menu (menu 1.4.2.1)

In the viscosity alarms menu parameters can be set regarding the viscosity alarms.

Menu	Description	Range	Default	Remark
1.4.2.1.1	High Deviation Trip	-9999 - 99999 mPa.s	2 mPa.s	The value is the amount added to the current setpoint in order to trigger the alarm. If the current viscosity exceeds this total value the alarm is triggered. Example: Setpoint = 12 High Deviation Trip value = 2 Alarm is triggered if actual value > 14 (12+2).
1.4.2.1.2	High Deviation Time Hysteresis	0 - 9999 s	10 s	The value is the time delay, before the alarm is triggered. Example: High Dev Time Hyst. = 10 s. Alarm viscosity value = 14 (12+2) Actual viscosity value = 16 Alarm is triggered after 10 seconds.
1.4.2.1.3	High Deviation Trip Hysteresis	0 - 99999 mPa.s	0 mPa.s	The value is the amount subtracted from the sum of the setpoint and High Deviation Trip in order to turn off the alarm. If the actual viscosity is less than this value the alarm will turn off. Example: Setpoint = 12 High Deviation Trip value = 2 High Deviation Trip Hysteresis = 1 Alarm is turn off if actual value < 13 (12+2-1).
1.4.2.1.4	Low Deviation Trip	-9999 - 99999 mPa.s	-2 mPa.s	The value is the amount added to the current setpoint in order to trigger the alarm. If the current viscosity level is less than this total value the alarm is triggered. Example: Setpoint = 12 High Deviation Trip value = -2 Alarm is triggered if actual value < 10 (12+ -2).
1.4.2.1.5	Low Deviation Time Hysteresis	0 - 9999 s	10 s	The value is the time delay, before the alarm is triggered. Example: Low Dev Time Hyst. = 10 s. Alarm viscosity value = 10 (12+ -2) Actual viscosity value = 8 Alarm is triggered after 10 seconds.
1.4.2.1.6	Low Deviation Trip Hysteresis	0 - 99999 mPa.s	0 mPa.s	The value is the amount added to the sum of the setpoint and Low Deviation Trip in order to turn off the alarm. If the actual viscosity exceeds this value the alarm will turn off. Example: Setpoint = 12 Low Deviation Trip value = -2 High Deviation Trip Hysteresis = 1 Alarm is turn off if actual value > 11 (12+ -2+1).

7.2.1.2 Viscosity Control Menu (menu 1.4.2.2)

In the viscosity control menu parameters can be set regarding the way controller the viscosity is controlled.

Menu	Description	Range	Default	Remark
1.4.2.2.1	Proportional Band	1.0 – 999.9%	34 %	Lower value = longer impulses, more sensitive reaction Higher value = shorter impulses, less sensitive reaction
1.4.2.2.2	Integral Time	0 – 10000 s	240 s	Lower value = shorter impulse gaps, faster balancing Higher value = longer impulse gaps, slower balancing
1.4.2.2.3	Setpoint	0 - 50 mPa.s	12 mPa.s	The value is the setpoint the controller has when first turned on.

7.2.1.3 Viscosity Range Menu (menu 1.4.2.3)

In the viscosity range menu the analog viscosity input and output range can be set.
The input range and retransmission output range are always the same.

Menu	Description	Range	Default	Remark
1.4.2.3	Viscosity Range	0 – 10 0 – 20 0 – 25 0 – 50	0 – 50	The value is depending on the output range of the ViscoSense® interfacebox. The range is stated on the inside of the interfacebox. When in doubt, check the ViscoSense® specifications. Example: Low analog input 4 mA ~ 0 mPa.s High analog input 20 mA ~ 50 mPa.s.

7.2.1.4 Viscosity Units Menu (menu 1.4.2.4)

In the viscosity units menu the units for viscosity displayed on the screen can be set.

Menu	Description	Range	Default	Remark
1.4.2.4	Viscosity Units	mPa.s cSt	mPa.s	Unit in which the viscosity is displayed on the screen.

7.2.1.5 Temperature Alarms Menu (menu 1.4.2.5)

In the temperature alarms menu parameters can be set regarding the temperature alarms.

Menu	Description	Range	Default	Remark
1.4.2.5.1	High Deviation Trip	-9999 - 99999 °C	10 °C	The value is the amount added to the current setpoint in order to trigger the alarm. If the current temperature exceeds this total value the alarm is triggered. Example: Setpoint = 135 High Deviation Trip value = 10 Alarm is triggered if actual value > 145 (135+10).
1.4.2.5.2	High Deviation Time Hysteresis	0 - 9999 s	10 s	The value is the time delay, before the alarm is triggered. Example: High Dev Time Hyst. = 10 s. Alarm temperature value = 145 (135+10) Actual temperature value = 147 Alarm is triggered after 10 seconds.
1.4.2.5.3	High Deviation Trip Hysteresis	0 - 99999 °C	0 °C	The value is the amount subtracted from the sum of the setpoint and High Deviation Trip in order to turn off the alarm. If the actual temperature is less than this value the alarm will turn off. Example: Setpoint = 135 High Deviation Trip value = 10 High Deviation Trip Hysteresis = 5 Alarm is turn off if actual value < 140 (135+10-5).
1.4.2.5.4	Low Deviation Trip	-9999 - 99999 °C	-10 °C	The value is the amount added to the current setpoint in order to trigger the alarm. If the current temperature level is less than this total value the alarm is triggered. Example: Setpoint = 135 High Deviation Trip value = -10 Alarm is triggered if actual value < 125 (135+ -10).
1.4.2.5.5	Low Deviation Time Hysteresis	0 - 9999 s	10 s	The value is the time delay, before the alarm is triggered. Example: Low Dev Time Hyst. = 10 s. Alarm temperature value = 125 (135+ -10) Actual temperature value = 123 Alarm is triggered after 10 seconds.
1.4.2.5.6	Low Deviation Trip Hysteresis	0 - 99999 °C	0 °C	The value is the amount added to the sum of the setpoint and Low Deviation Trip in order to turn off the alarm. If the actual temperature exceeds this value the alarm will turn off. Example: Setpoint = 135 Low Deviation Trip value = -10 High Deviation Trip Hysteresis = 5 Alarm is turn off if actual value > 130 (135+ -10+5).

7.2.1.6 Temperature Control Menu (menu 1.4.2.6)

In the temperature control menu parameters can be set regarding the way controller the viscosity is controlled.

Menu	Description	Range	Default	Remark
1.4.2.6.1	Proportional Band	1.0 – 999.9%	34 %	Lower value = longer impulses, more sensitive reaction Higher value = shorter impulses, less sensitive reaction
1.4.2.6.2	Integral Time	0 – 10000 s	240 s	Lower value = shorter impulse gaps, faster balancing Higher value = longer impulse gaps, slower balancing
1.4.2.6.3	Setpoint	0 – 200 °C	135 °C	The value is the setpoint the controller has when first turned on.

7.2.1.7 Temperature Source Menu (menu 1.4.2.7)

In the temperature source menu the type of temperature input can be set.

Menu	Description	Range	Default	Remark
1.4.2.7	Temperature Source	mA PT100	mA	The value is depending whether the controller is connected to the ViscoSense® interfacebox. If connected to the interfacebox the temperature source is always mA. Only when an external PT100 is used the temperature source is PT100.

7.2.1.8 Temperature Range Menu (menu 1.4.2.8)

In the temperature range menu the analog temperature input and output range can be set.
The input range and retransmission output range are always the same.

Menu	Description	Range	Default	Remark
1.4.2.7	Temperature Range	0 – 100°C 0 – 200 °C	0 – 200 °C	The value is depending on the output range of the ViscoSense® interfacebox. The range is stated on the inside of the interfacebox. When in doubt, check the ViscoSense® specifications. Example: Low analog input 4 mA ~ 0 °C High analog input 20 mA ~ 200 °C.

7.2.1.9 Valve Menu (menu 1.4.2.9)

Menu	Description	Range	Default	Remark
1.4.2.9.1	Minimum On Time	0 – 60 s	2 s	The value is the minimum time a relay is energized. This is to prevent the relay from chattering.
1.4.2.9.2	Travel Time	0 – 5000 s	60 s	The value is the time it takes the valve to travel from a completely closed position to a completely open position.

7.3 CHANGING THE CONTROLLER TYPE FROM VISCOSITY TO TEMPERATURE (OR VICE VERSA)

NOTE:
Changing the controller type from viscosity to temperature (or vice versa) is only available if the controller is equipped with 2 channel control action.

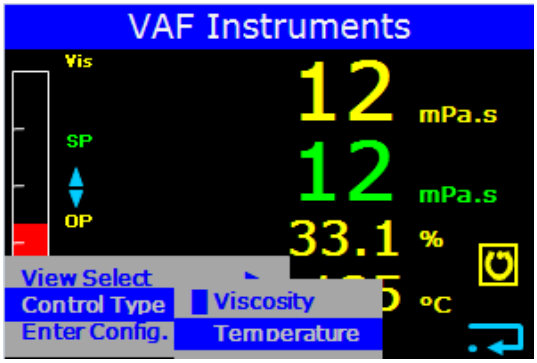


Figure 17 Viscosity to Temperature change over

- Press the down key to navigate through the menu to Control Type and press the right navigation key to enter.
- Press the down key to scroll down to Temperature and press the right navigation key to enter.

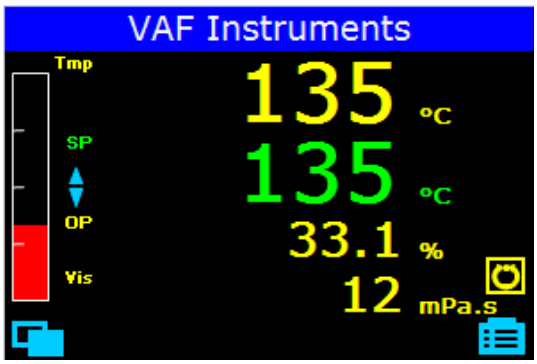


Figure 18 Temperature control

To change back to viscosity control type, repeat the steps above but, select Viscosity instead of Temperature.

7.4 ADJUSTING THE SETPOINT IN AUTOMATIC CONTROL MODE

When the controller is in automatic control mode, pressing the / up/down keys will change the setpoint. Depending on the control type (viscosity or temperature) the viscosity or temperature setpoint is adjusted.

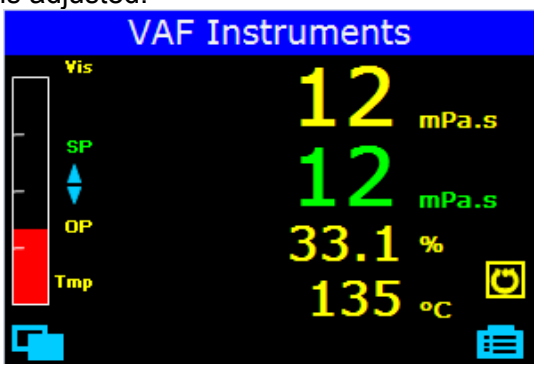


Figure 19 Controller in automatic control mode

7.5 CHANGING FROM AUTOMATIC TO MANUAL CONTROL MODE (OR VICE VERSA)

When the controller starts-up, the control mode is normally automatic.
If an input alarm occurs because an input signal is not present at start-up, the controller will start-up in manual mode.

In automatic control the valve position is controlled by a normal closed loop control mode which means that the output is adjusted automatically by the controller in response to the measurements from the input sensor (viscosity or temperature, depending on the control type).

- To change the control mode from automatic to manual (or vice versa), press the Auto/Manual control mode selection key.

The current status of the controller is indicated by the icon in the right lower corner.

-  Auto Mode
-  Manual Mode

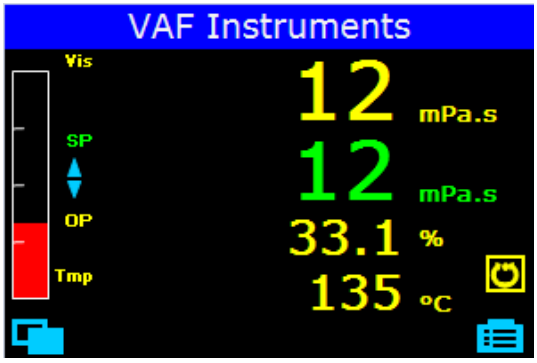


Figure 20 Controller in automatic control mode

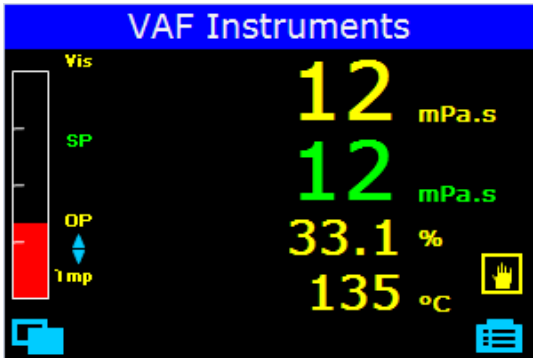


Figure 21 Controller in manual control mode

In manual control the valve position is not controlled or adjusted automatically, but remains in the position set by the operator.

7.6 ADJUSTING THE VALVE POSITION OR SETPOINT IN MANUAL CONTROL MODE

When the controller is in manual control mode, pressing the / up/down keys will normally change the position of the valve.

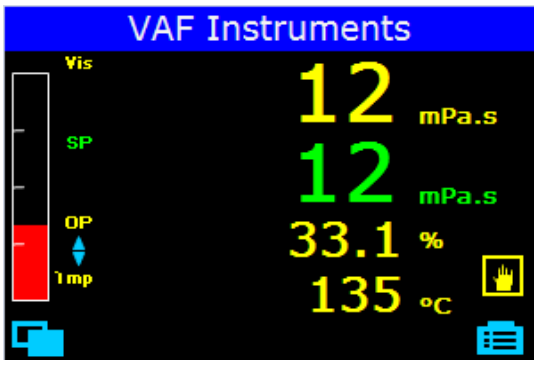


Figure 22 Controller in manual control mode, ready to adjust the valve position.

It might be desirable to adjust the setpoint in manual mode (e.g. to have the setpoint within the upper and lower thresholds of the alarms).

- To adjust the setpoint in manual mode press the left navigation key.
- Press the down key (if required) to navigate through the menu to Adjust Control SP1 and
- press the right navigation key to enter.

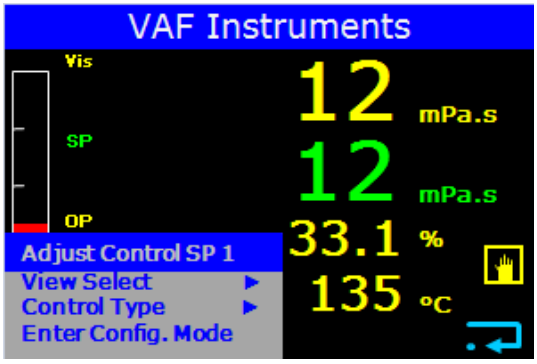


Figure 23 Controller in manual control mode, ready to adjust the setpoint.

The controller is now in manual control mode. Pressing the / up/down keys will now change the setpoint.

- To change back for adjusting the valve position in manual mode, press the left navigation key.
- Press the down key (if required) to navigate through the menu to Adjust Control OP1 and
- press the right navigation key to enter.

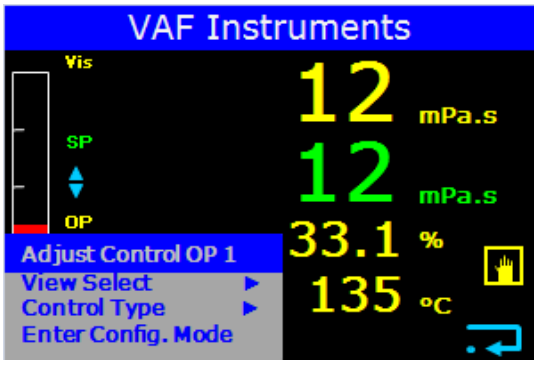


Figure 24 Controller in manual control mode, ready to adjust the valve position.

7.7 ALARM INDICATORS

7.7.1 Process alarm

If a process alarm occurs, it is indicated as follows:

The red alarm icon in the top left corner of the display flashes

Description of diagnostics shows up in the diagnostics status bar

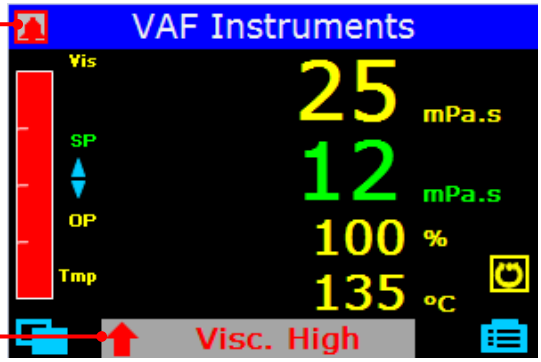


Figure 25 Viscosity alarm

Process alarms are triggered when viscosity or temperature are outside the thresholds set in the Viscosity Alarms Menu (menu 1.4.2.1), section 7.2.1.1 and Temperature Alarms Menu (menu 1.4.2.5), section 7.2.1.5.

Standard the controller is configured so that only an alarm is triggered for the input, the controller type is set to.
If the controller type is set to viscosity, an alarm is only triggered when the viscosity is outside the viscosity alarm thresholds. When the temperature is outside the temperature alarm thresholds no alarm is triggered.
If the controller type is set to temperature, an alarm is only triggered when the temperature is outside the temperature alarm thresholds. When the viscosity is outside the viscosity alarm thresholds no alarm is triggered.

When an alarm should be triggered on both viscosity and temperature, the controller can be configured by VAF as a dual alarm controller.

7.7.2 Sensor failure

Beside a process alarm, an alarm is also triggered when there is a sensor break.

If a sensor failure occurs, it is indicated as follows:

The red alarm icon  in the top left corner of the display flashes

Description of the alarm tag shows up in the diagnostics status bar

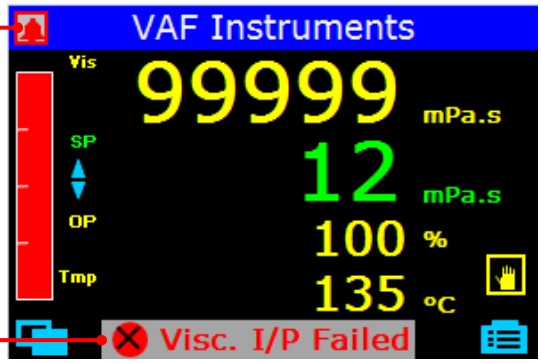


Figure 26 Sensor failure

When a sensor failure occurs the controller switches to manual mode automatically. If the sensor failure is resolved the controller will stay in manual mode.

7.7.3 Alarm acknowledgement

To acknowledge an alarm

- Press the left navigation key.
- Press the down key (if required) to navigate through the menu to Alarm Acknowledge.
- Press the right navigation key to enter.

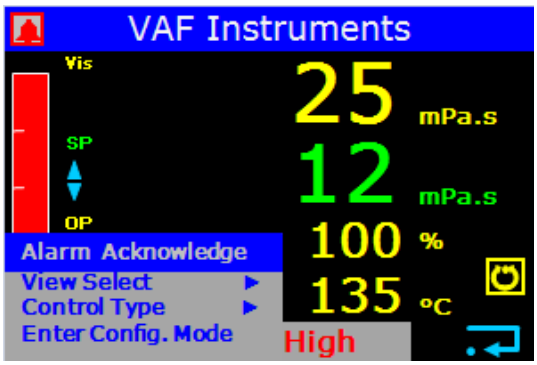


Figure 27 Alarm Acknowledge

If the alarm condition is still present when the alarm is acknowledged, the alarm icon in the top left corner will stop flashing and will be continuously lit. This state will continue for as long as the alarm condition remains. When the alarm condition disappears the indication will also disappear.

If a relay has been connected to the alarm output, it will de-energise when the alarm condition occurs. Depending on how the wiring is connected to the relay, the contact will open or close. The alarm will remain in this condition until the alarm is acknowledged and the alarm conditions are no longer present.
If the alarm conditions disappears before the alarm is acknowledged, the alarm indication will also disappear.

7.7.4 Diagnostic view

To navigate to Diagnostic View

- Press the left navigation key.
- Press the down key (if required) to navigate through the menu to View Select.
- Press the right navigation key to enter.

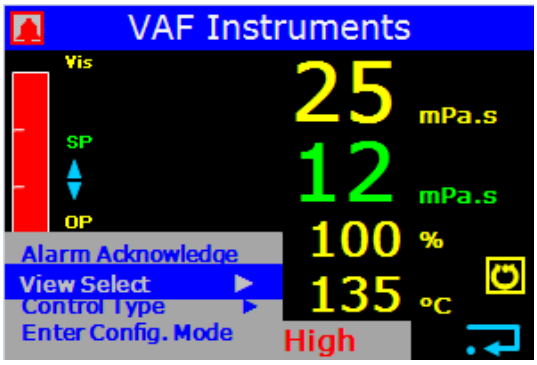


Figure 28 View Select

To navigate to the Diagnostic View

- Press the down key to navigate to Diagnostic View.
- Press the right navigation key to enter.

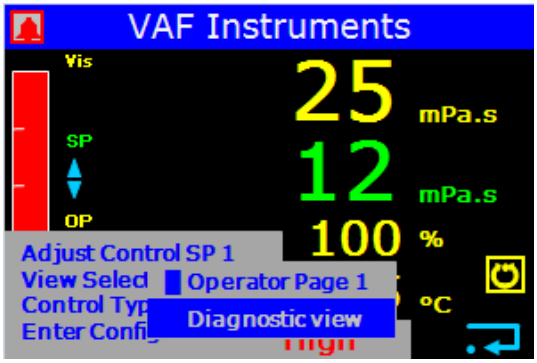


Figure 29 Entering Diagnostic view

In the diagnostic view the current alarms are shown.

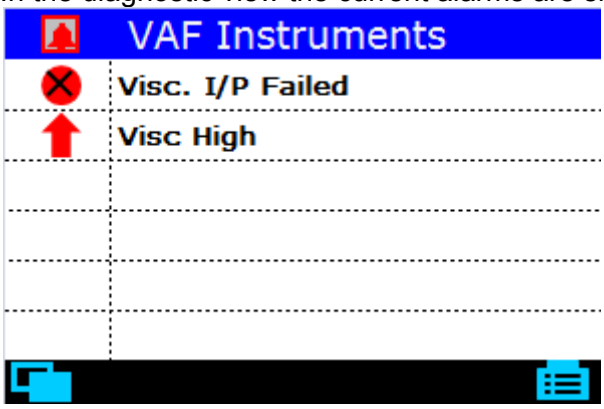


Figure 30 Diagnostic View

If an alarm is acknowledged, but not yet resolved a checkmark is shown in the line where the acknowledged alarm is shown.

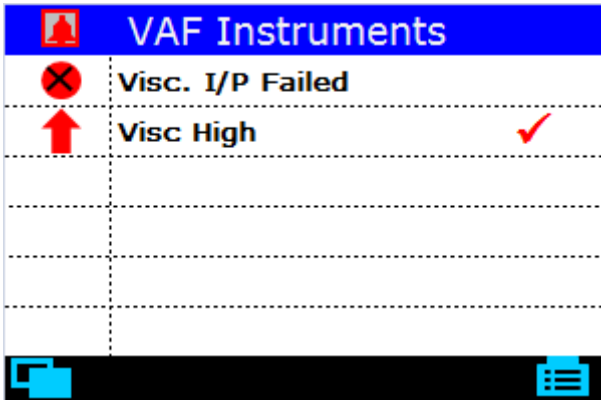


Figure 31 Diagnostic View with acknowledged alarm

8 MAINTENANCE

Under normal conditions the VAF electronic viscosity controller requires no maintenance.
Conditions what are considered “Normal” are;

- A clean operating environment
- The controller is installed in accordance with the installation instructions given.
- Operation of the controller and the related control system in accordance with this manual and other related publications
- Uninterrupted power supply at normal specified values.

WHEN CLEANING OF THE CONTROLLER HOUSING IS REQUIRED USE A SOFT CLOTH. DO NOT USE SOLVENTS OR AGGRESSIVE FLUID ON PLASTIC COMPONENTS OR PARTS.
PREVENT ANY MOISTURE PENETRATING THE CONTROLLER.

9 REPAIR OR REPLACEMENT

SAFETY PRECAUTIONS:
MAKE SURE THAT ALL SAFETY REQUIREMENTS AS DESCRIBED IN SECTION 4 ARE MET BEFORE ANY WORK IS COMMENCED.

9.1 CUSTOMER REPAIR RESTRICTION

In case of malfunction, repair work by the user should be restricted to the externally accessible leads, connections and components to which the user is expressly permitted to deal with himself. (e.g. bridge circuits, fuses etc.).
All further work, especially on internal components will terminate warranty and can cause considerable damage to the circuitry.

9.2 REPLACEMENT

To replace the controller, the following steps should be taken:

- Write down all parameter settings as described in sections 7.2.1.1 trough 7.2.1.9.
- Switch off the 100/240 VAC electrical supply.
- Make sure that all connections to the controller are labelled correctly so that re-installation can be done without any errors.
- Disconnect all the connections in a reverse order as described in section 6.
- Reinstall a replacement controller as described in section 6.
- Set all the previous written down parameter settings as described in sections 7.2.1.1 trough 7.2.1.9.

10 TAKE OUT OF SERVICE

SAFETY PRECAUTIONS:
MAKE SURE THAT ALL SAFETY REQUIREMENTS AS DESCRIBED IN SECTION 4 ARE MET BEFORE ANY WORK IS COMMENCED.

The controller can be taken out of service by switching off the 100/240 VAC electrical supply and disconnecting all wires.

11 REMOVAL AND STORAGE OF EQUIPMENT

SAFETY PRECAUTIONS:
MAKE SURE THAT ALL SAFETY REQUIREMENTS AS DESCRIBED IN SECTION 4 ARE MET BEFORE ANY WORK IS COMMENCED.

To remove and store the controller, the following steps have to be taken:

- Switch off the 100/240 VAC electrical supply.
- Make sure that all connections to the controller are labelled correctly so that re-installation can be done without any errors.
- Disconnect all the connections in a reverse order as described in section 6.
- Store the controller in a cool and dry location, is such way that the controller cannot be damaged.

12 MALFUNCTION AND SEND FOR REPAIR

In case of a malfunction, follow the guidelines as described in section 15.
If the controller cannot get functioning properly again following the guidelines as described in section 15, contact VAF Instruments for instructions.
In the event the controller has to be sent back for repair, always send the whole controller including the outer housing directly to:

VAF Instruments B.V.
Attn. Service Department
Vierlinghstraat 24
3316 EL Dordrecht
The Netherlands

When the controller is returned to VAF, please make sure that the controller is sufficiently packed.
To ensure that your case is handled without any delay please make sure the package is labelled with the following information:

- Customer name
- Vessel name or Hull number
- Packing List
- Brief problem description and reason for return.
- Return shipping address.

13 ENVIRONMENT

The controller itself has no negative influence on the environment during normal operation.

14 DISPOSAL

The controller consists of metal, plastics and electronic parts. It should be disposed of responsibly in accordance with local environmental regulations.

15 TROUBLE SHOOTING AND FAULT FINDING

15.1 DIAGNOSTIC INFORMATION

The electronic controller has a provision for diagnostic indication.
Failures alarms and errors are displayed in the diagnostic view.

15.2 TROUBLE SHOOTING

15.2.1 General trouble shooting

Problem possible cause	Corrective action
Display remains blank No electrical supply to controller	Check mains supply of controller.

15.2.2 Viscosity trouble shooting

Problem possible cause	Corrective action
Process Alarm: Visc. Low Viscosity signal too low (May be indicated by wrong temperature of the fuel oil)	
Air entrapped in fuel oil system.	Vent the system at the bypass valve.
Fuel mixed with MDO	Check valves of fuel supply.
Fuel temperature too high during normal system operation, due to overabundant heating.	Decrease output signal of the controller to the heat exchanger. Check if control valve functions properly. Consult the factory if this does not solve the problem.
Process Alarm: Visc. High Viscosity signal remains at maximum value (May be indicated by wrong temperature of the fuel oil)	
Fuel too cold during start-up.	Check fuel line heat tracing and/or fuel heater.
Fuel temperature too low during normal system operation, due to insufficient heating.	Increase output signal of the controller to the heat exchanger. Check main steam or thermal oil supply. Check if control valve functions properly. Consult the factory if this does not solve the problem.

Problem possible cause	Corrective action
Sensor Failure: Visc. I/P Failed No viscosity signal	
No electrical supply to the viscosity sensor	Check mains supply of the ViscoSense® interface box. Check the fuses of the control unit and/or power supply unit. Check the integrity of all electrical connections.
Current loop connection broken.	Check electrical wiring of the ViscoSense® interface 4-20 mA output signal.
Viscosity sensor malfunctioning	Contact VAF Instruments or nearest service representative for repair.

15.2.3 Temperature trouble shooting

Problem possible cause	Corrective action
Process Alarm: Temp. Low Temperature signal too low	
Fuel temperature too low during normal system operation, due to insufficient heating.	Increase output signal of the controller to the heat exchanger. Check main steam or thermal oil supply. Check if control valve functions properly. Consult the factory if this does not solve the problem.
Process Alarm: Temp. High Temperature signal too high	
Fuel temperature too high during normal system operation, due to overabundant heating.	Decrease output signal of the controller to the heat exchanger. Check if control valve functions properly. Consult the factory if this does not solve the problem.
Sensor Failure: Temp. I/P Failed No temperature signal	
No electrical supply to temperature sensor	Check mains supply of the ViscoSense® interface box. Check the fuses of the control unit and/or power supply unit. Check the integrity of all electrical connections.
Current loop connection broken.	Check electrical wiring of the ViscoSense® interface 4-20 mA output signal.
Viscosity sensor malfunctioning	Contact VAF Instruments or nearest service representative for repair.

15.2.4 Process trouble shooting

Problem possible cause	Corrective action
Oscillating temperature without distinct initial overshot	Proportional band P_b (%) setting it too low. Adjust the P_b setting (menu 7.2.1.2, 7.2.1.6) A higher P_b setting results in shorter impulses and a less sensitive reaction.
The set point is reached very slowly after initial exceeding	Proportional band P_b (%) setting it too high. Adjust the P_b setting (menu 7.2.1.2, 7.2.1.6) A lower P_b setting results in longer impulses and a more sensitive reaction.
High initial overshot followed by fading oscillation	Integral action time T_i (s) setting it too low. Adjust the T_i setting (menu 7.2.1.2, 7.2.1.6) A higher T_i setting results in longer impulse gaps and slower balancing.
The set value is reached very slowly without overshooting	Integral action time T_i (s) setting it too high. Adjust the T_i setting (menu 7.2.1.2, 7.2.1.6) A lower T_i setting results in shorter impulse gaps and faster balancing.

An optimum adaptation of the control parameters (P,I) is necessary in order to balance an appearing deviation as quickly, non-oscillating and exactly as possible, according to the give operation conditions. Generally these adjustments require a lot of professional knowledge that cannot be replacement by this brief information. The information above is for help purpose only:

16 CERTIFICATES OF CONFORMITY AND CERTIFICATES OF APPROVAL

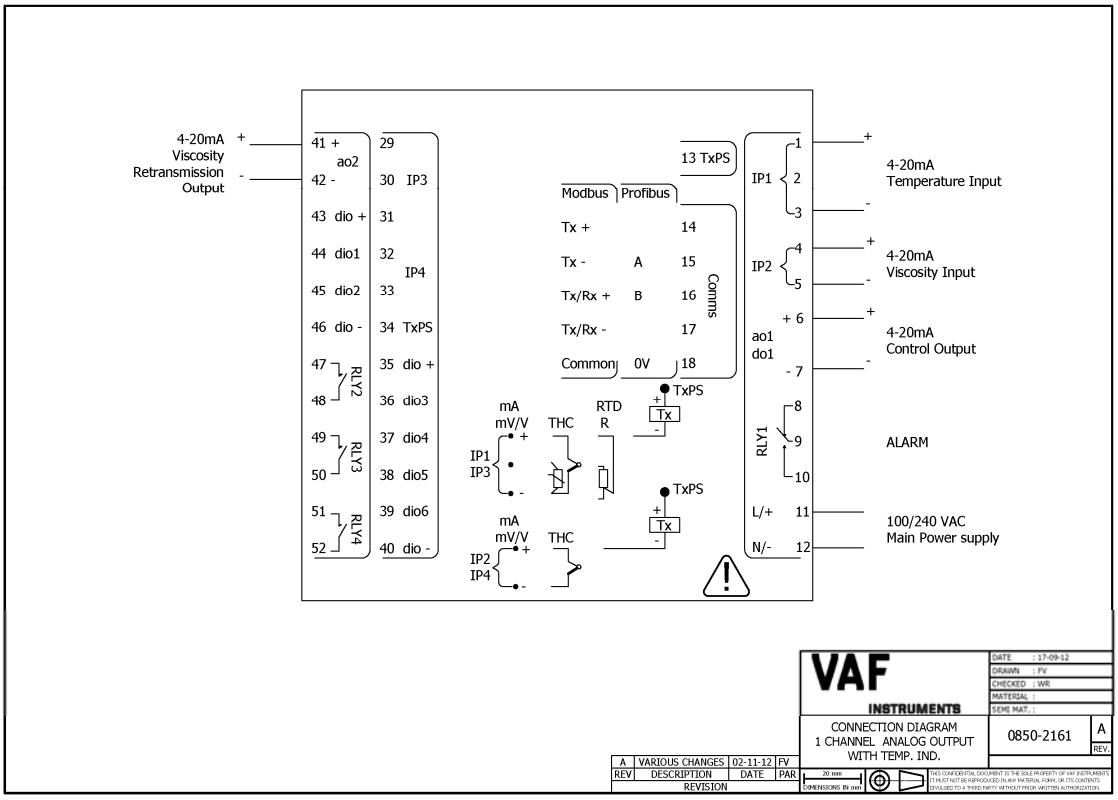
At this time no certificates of conformity or certificates of approval are available.

17 DRAWINGS

Description:	Drawing number:
Connection diagram 1 channel analog output	0850-2161
Connection diagram 1 channel relay output	0850-2162
Connection diagram 2 channel analog output	0850-2163
Connection diagram 2 channel relay output	0850-2164
Connection diagram 2 channel analog output + I/I splitter VS2	0850-2174
Connection diagram 2 channel analog output (3x) + I/I splitter VS3	0850-2218
Connection diagram 2 channel analog output (4x) + I/I splitter VS3/VS3D	0850-2219

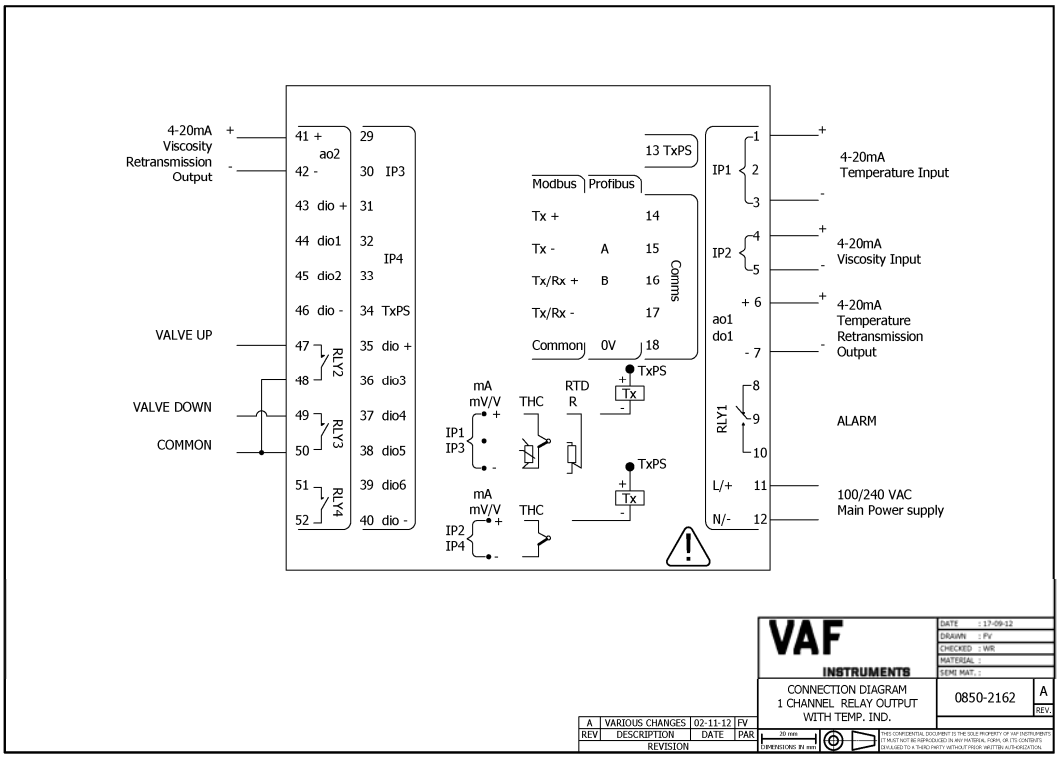
Connection diagrams to be used with Viscotherm and supply for dp/I transmitter:

Description:	Drawing number:
Connection diagram 2 channel relay output	0850-2176
Connection diagram 1 channel relay output	0850-2177
Connection diagram 1 channel analog output	0850-2178

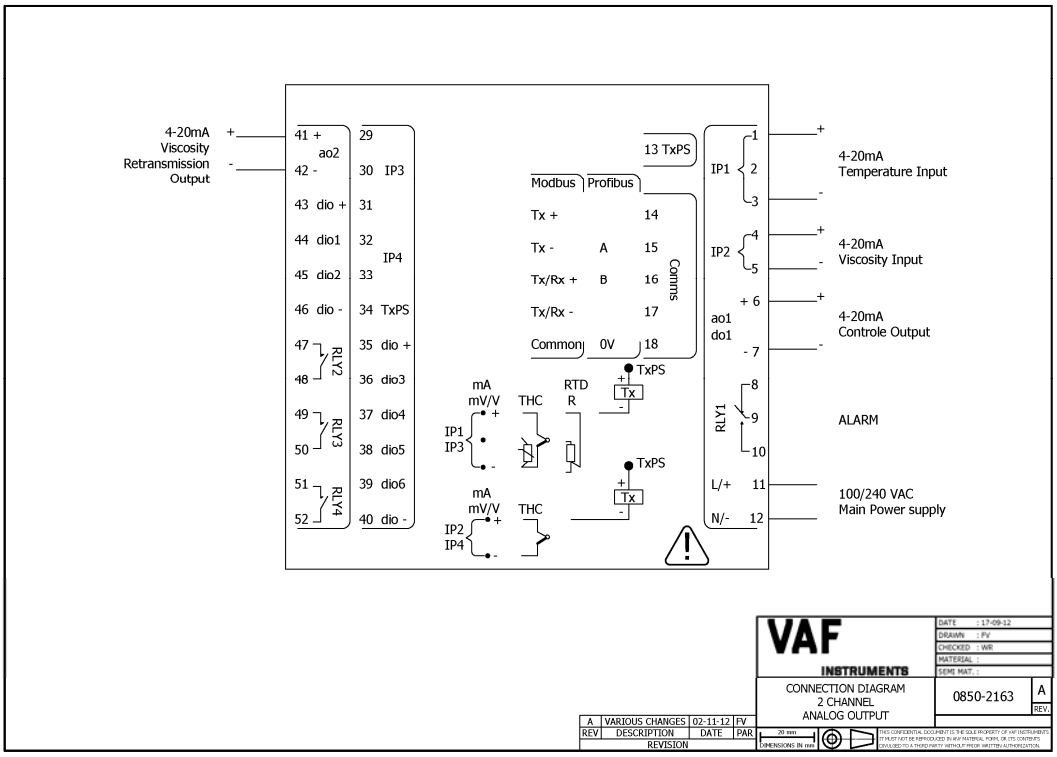


Drawing 1, 0850-2161 Connection diagram 1 channel analog output

For isolated retransmission of analogue temperature signal, we refer to connection drawing 0850-2174 & 0850-2218 (Drawing 5.1 & 5.2).

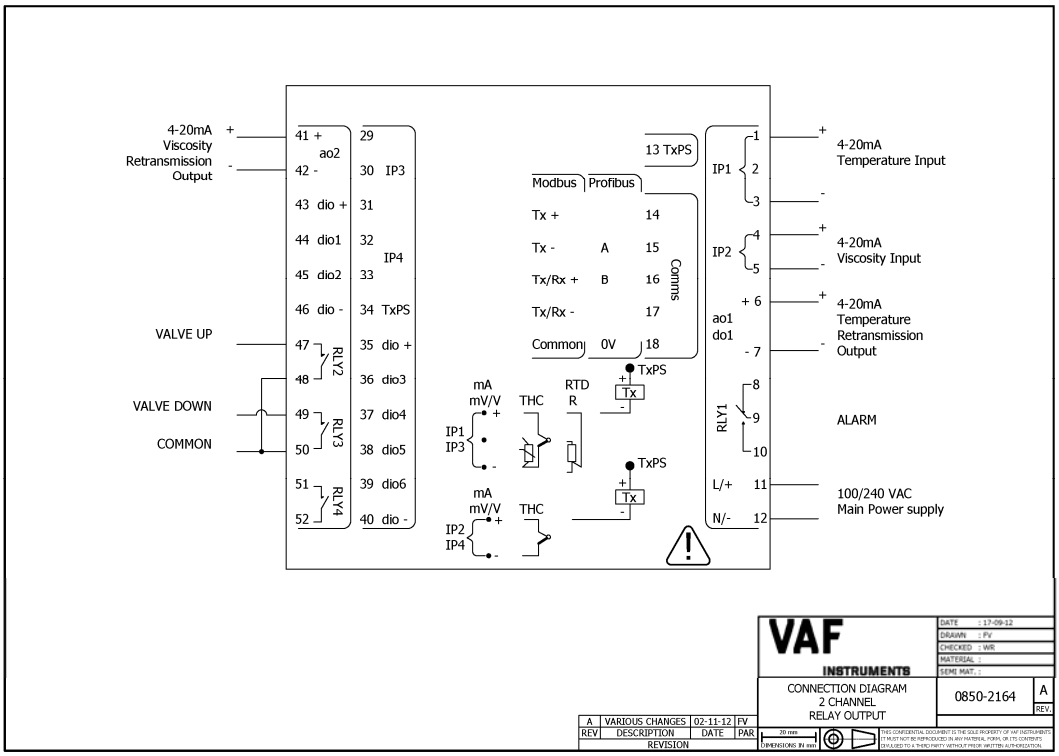


Drawing 2, 0850-2162 Connection diagram 1 channel relay output

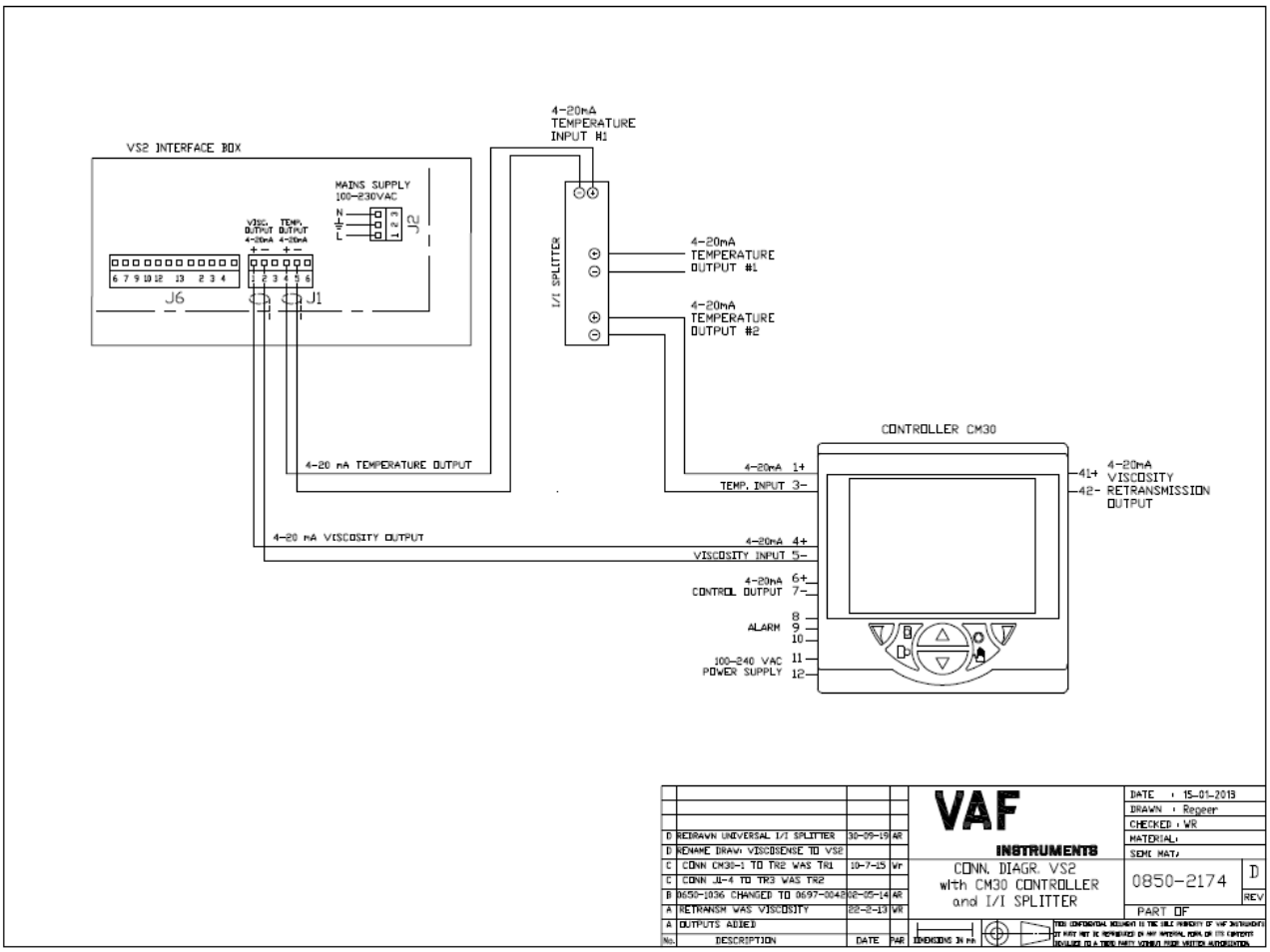


Drawing 3, 0850-2163 Connection diagram 2 channel analog output

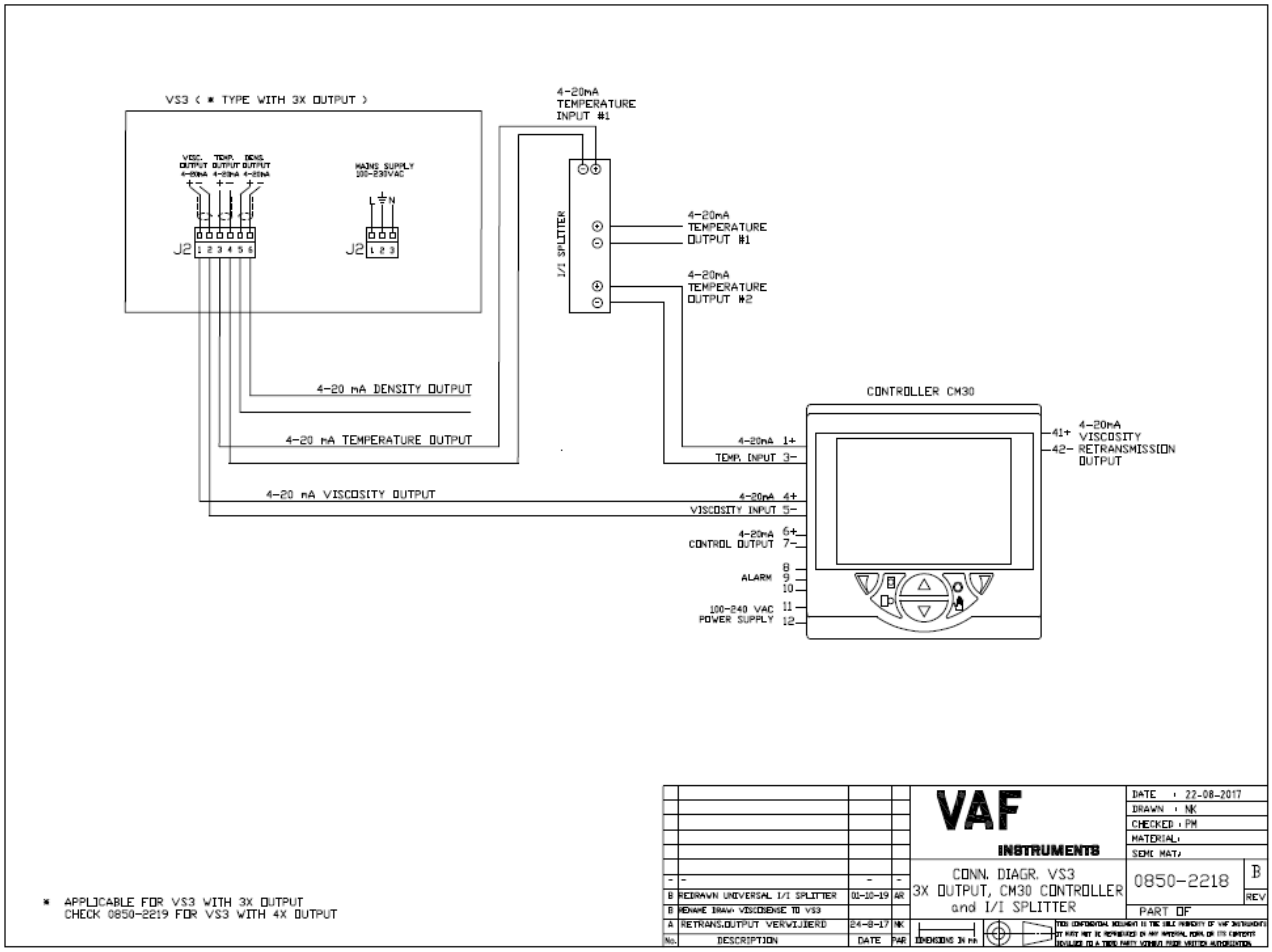
For isolated retransmission of analogue temperature signal, we refer to connection drawing 0850-2174 & 0850-2218 (Drawing 5.1 & 5.2).



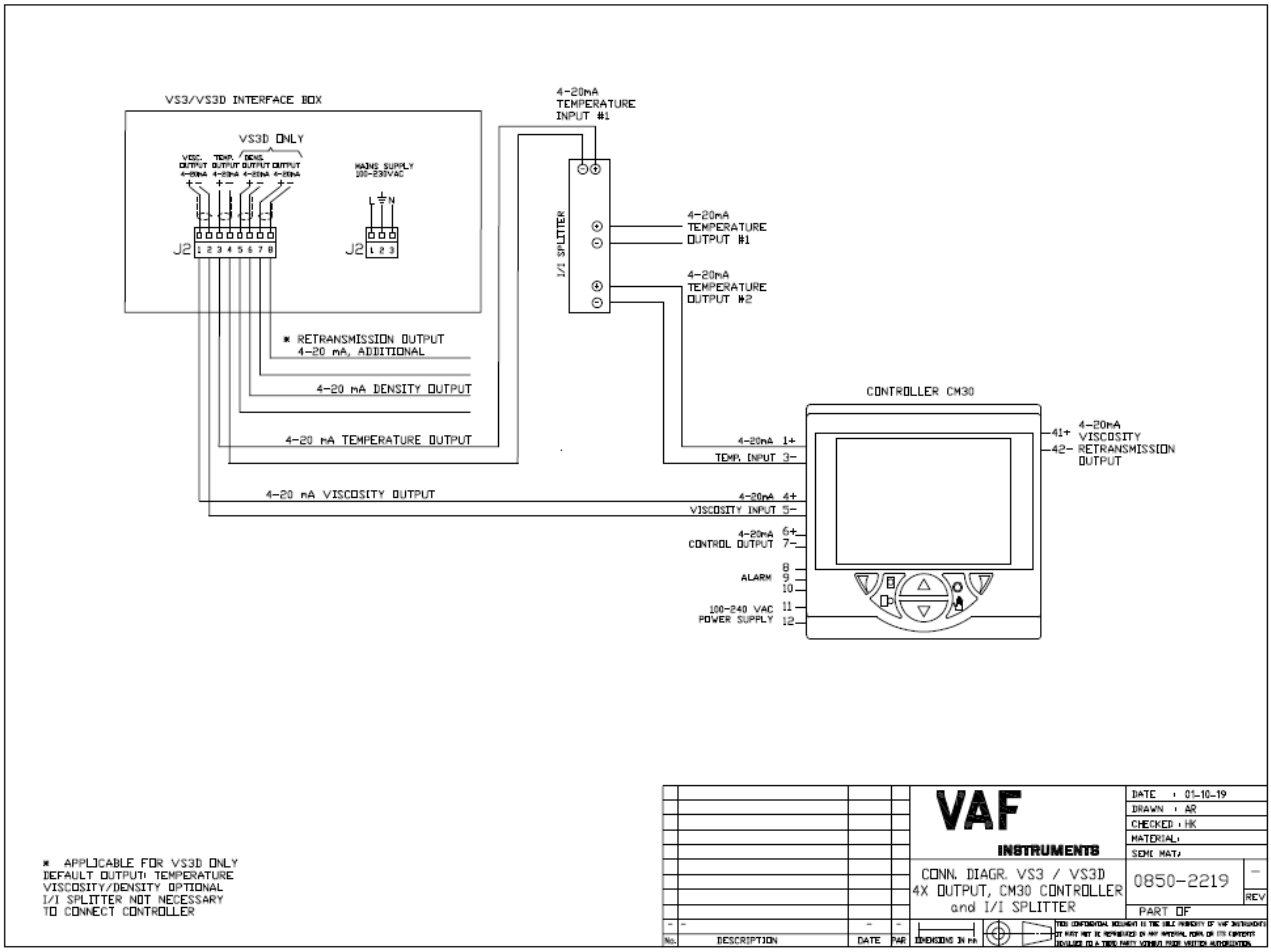
Drawing 4, 0850-2164 Connection diagram 2 channel relay output



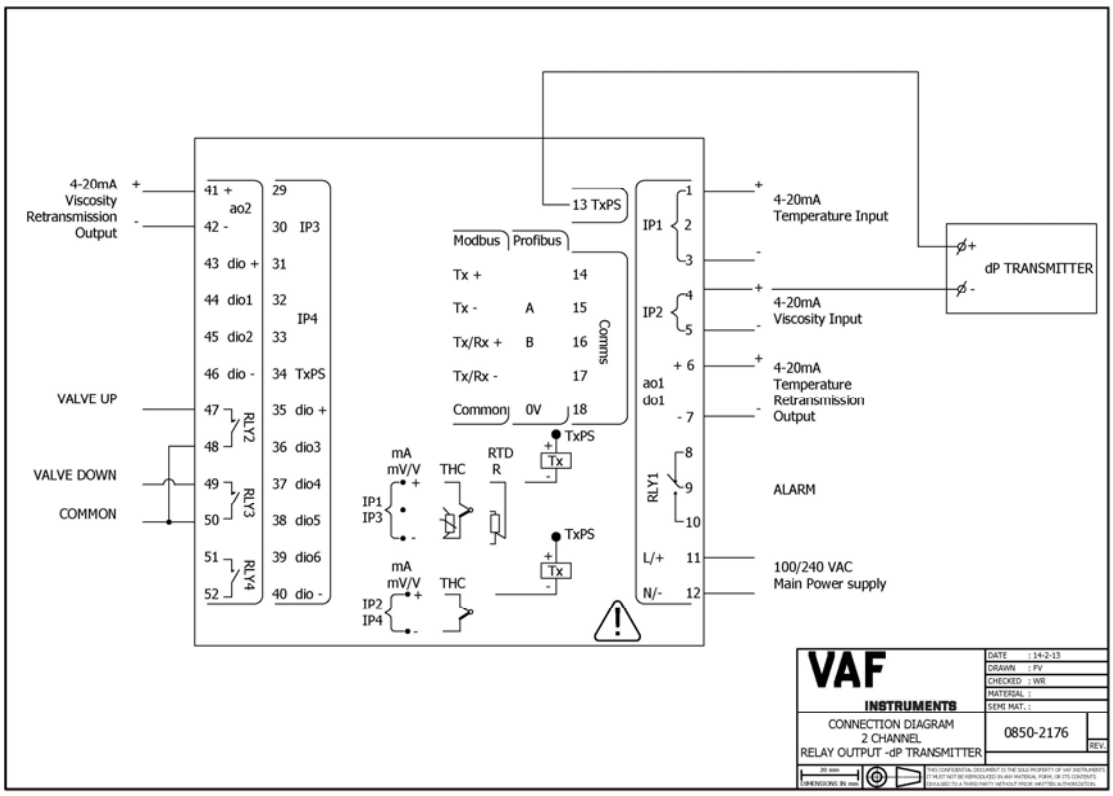
Drawing 5.1, 0850-2174 Connection diagram 2 channel analog output + I/I splitter VS2



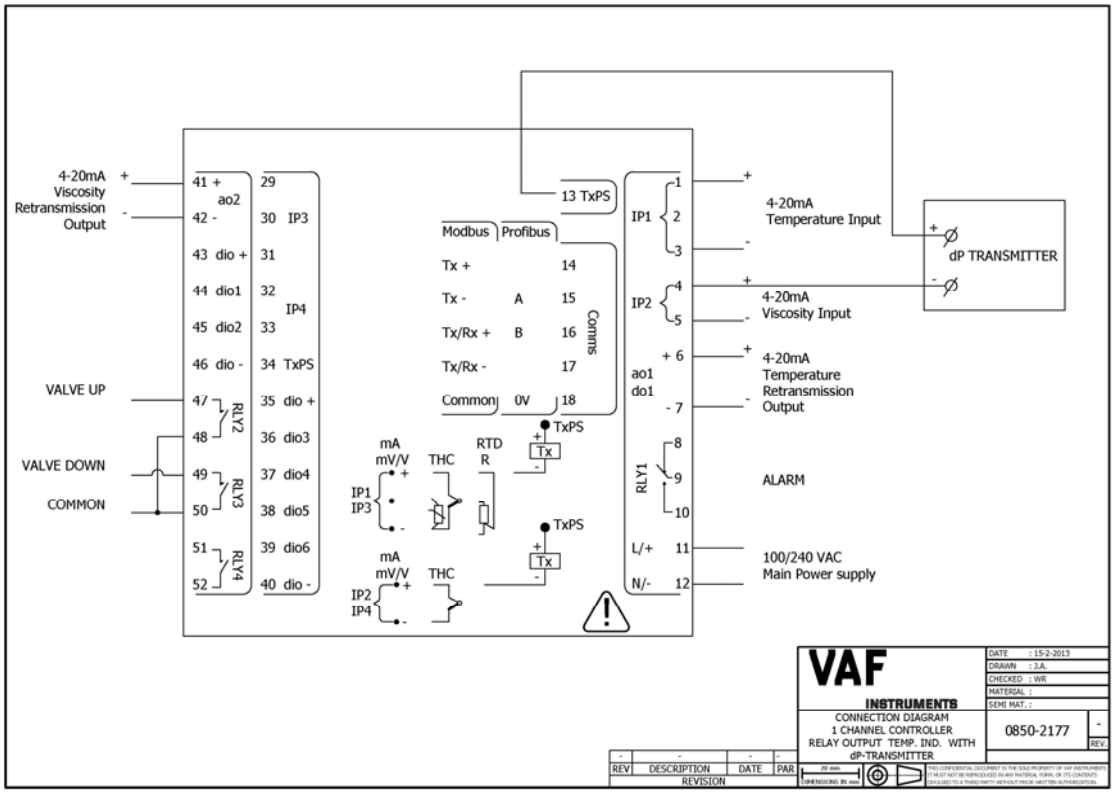
Drawing 5.2, 0850-2218 Connection diagram 2 channel analog output (3x) + I/I splitter VS3



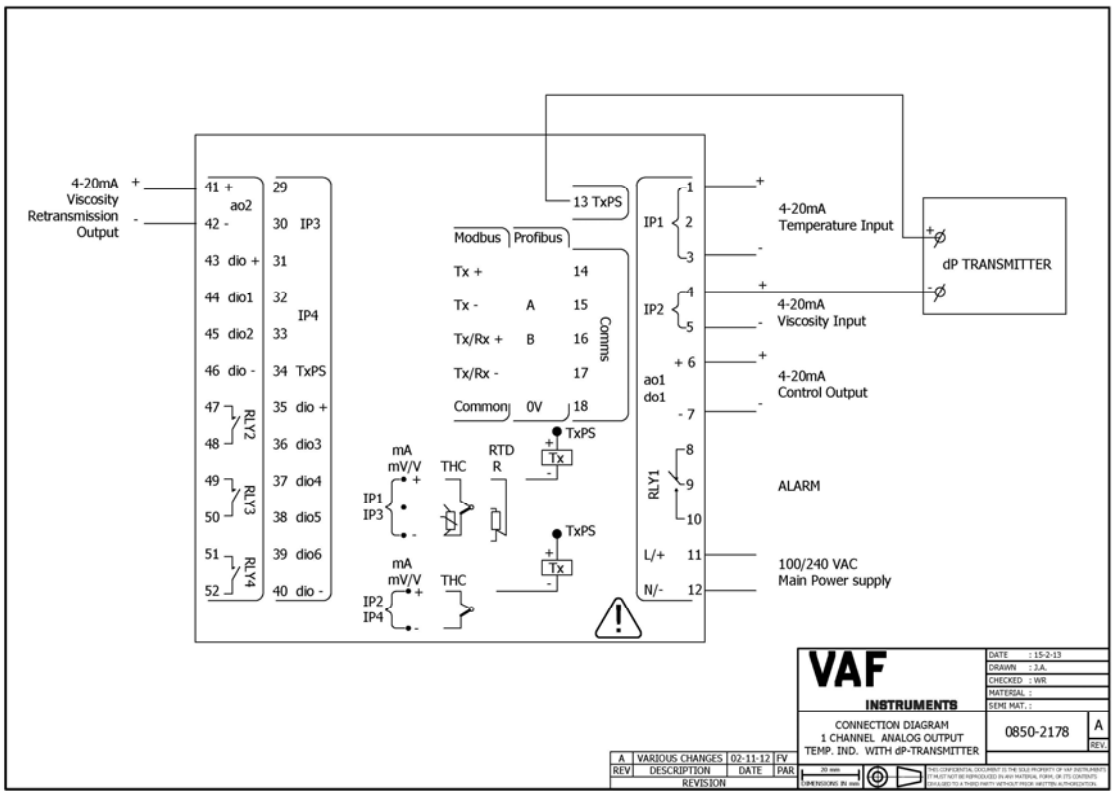
Drawing 5.3, 0850-2219 Connection diagram 2 channel analog output (4x) + I/I splitter VS3/VS3D



Drawing 6, 0850-2176 Connection diagram 2 channel relay output



Drawing 7, 0850-2177 Connection diagram 1 channel relay output



Drawing 8, 0850-2178 Connection diagram 1 channel analog output

18 ABBREVIATIONS

NO	Normally Open
NC	Normally Closed

19 SPARE PARTS

No spare parts are required or available for the controller.

20 WARRANTY CONDITIONS

1. Without prejudice to the restrictions stated hereinafter, the contractor guarantees both the soundness of the product delivered by him and the quality of the material used and/or delivered for it, insofar as this concerns faults in the product delivered which do not become apparent during inspection or transfer test, which the principal shall demonstrate to have arisen within 12 months from delivery in accordance with sub article 1A exclusively or predominantly as a direct consequence of unsoundness of the construction used by the contractor or as a consequence of faulty finishing or the use of poor materials.

   1A. The product shall be deemed to have been delivered when it is ready for inspection (if inspection at the premises of the contractor has been agreed) and otherwise when it is ready for shipment.

2. Articles 1 and 1A shall equally apply to faults which do not become apparent during inspection or transfer test which are caused exclusively or predominantly by unsound assembly/installation by the contractor. If assembly/installation is carried out by the contractor, the guarantee period intended in article 1 shall last 12 months from the day on which assembly/installation is completed by the contractor, with the understanding that in this case the guarantee period shall end not later than 18 months after delivery in accordance with the terms of sub article 1A.

3. Defects covered by the guarantee intended under articles 1, 1A and 2 shall be remedied by the contractor by repair or replacement of the faulty component either on or off the premises of the contractor, or by shipment of a replacement component, this remaining at the discretion of the contractor. Sub article 3A shall equally apply if repair or replacement takes place at the site where the product has been assembled/installed. All costs accruing above the single obligation described in the first sentence, such as are not restricted to shipment costs, travelling and accommodation costs or disassembly or assembly costs insofar as they are not covered by the agreement, shall be paid by the principal.

   3A. If repair or replacement takes place at the site where the product has been assembled/installed, the principal shall ensure, at his own expense and risk, that:
   a. the employees of the contractor shall be able to commence their work as soon as they have arrived at the erection site and continue to do so during normal working hours, and moreover, if the contractor deems it necessary, outside the normal working hours, with the proviso that the contractor informs the principal of this in good time;
   b. suitable accommodation and/or all facilities required in accordance with government regulations, the agreement and common usage, shall be available for the employees of the contractor;
   c. the access roads to the erection site shall be suitable for the transport required;
   d. the allocated site shall be suitable for storage and assembly; the necessary lockable storage sites for materials, tools and other goods shall be available;
   e. the necessary and usual auxiliary workmen, auxiliary machines, auxiliary tools, materials and working materials (including process liquids, oils and greases, cleaning and other minor materials, gas, water, electricity, steam, compressed air, heating, lighting, etc.) and the measurement and testing equipment usual for in the business operations of the principal, shall be available at the correct place and at the disposal of the contractor at the correct time and without charge;
   f. all necessary safety and precautionary measures shall have been taken and adhered to, and all measures shall have been taken and adhered to necessary to observe the applicable government regulations in the context of assembly/installation;
   g. the products shipped shall be available at the correct site at the commencement of and during assembly.

4. Defects not covered by the guarantee are those which occur partially or wholly as a result of:
   a. non-observance of the operation and maintenance instructions or other than foreseeable normal usage;
   b. normal wear and tear;
   c. assembly/installation by third parties, including the principal;
   d. the application of any government regulation regarding the nature or quality of the material used;
   e. materials or goods used in consultation with the principal;
   f. materials or goods provided by the principal to the contractor for processing;
   g. materials, goods, working methods and constructions insofar as are applied at the express instruction of the principal, and materials or goods supplied by or on behalf of the principal;
   h. components obtained from third parties by the contractor insofar as that party has given no guarantee to the contractor.

5. If the principal fails to fulfil any obligation properly or on time ensuing from the agreement concluded between the principal and the contractor or any agreement connected to it, the contractor shall not be bound by any of these agreements to any guarantee regardless of how it is referred to. If, without previous written approval from the contractor, the principal commences disassembly, repair or other work on the product or allows it to be commenced, then every agreement with regard to guarantee shall be void.

6. Claims regarding defects must be submitted in writing as quickly as possible and not later than 14 days after the discovery of such. All claims against the contractor regarding faults shall be void if this term is exceeded. Claims pertaining to the guarantee must be submitted within one year of the valid complaint on penalty of invalidity.

7. If the contractor replaces components/products under the terms of his guarantee obligations, the replaced components/products shall become the property of the contractor.

8. Unless otherwise agreed, a guarantee on repair or overhaul work carried out by the contractor or other services shall only be given on the correctness of the manner in which the commissioned work is carried out, this for a period of 6 months. This guarantee only covers the single obligation of the contractor to carry out the work concerned once again in the event of unsound work. In this case, sub article 3A shall apply equally.

9. No guarantee shall be given regarded the inspection conducted, advice given and similar matters.

10. Alleged failure to comply with his guarantee commitments on the part of the contractor shall not absolve the principal from his obligations ensuing from any agreement concluded with the contractor.

11. No guarantee shall be given on products which form a part of, or on work and services on, goods older than 8 years.

Revision 1212(2):
Chapter 3.1.8, section 7.2.1, section 7.3, and section 7.7.1: minor typos corrected.
Chapter 7.1.4: removed software version from picture.

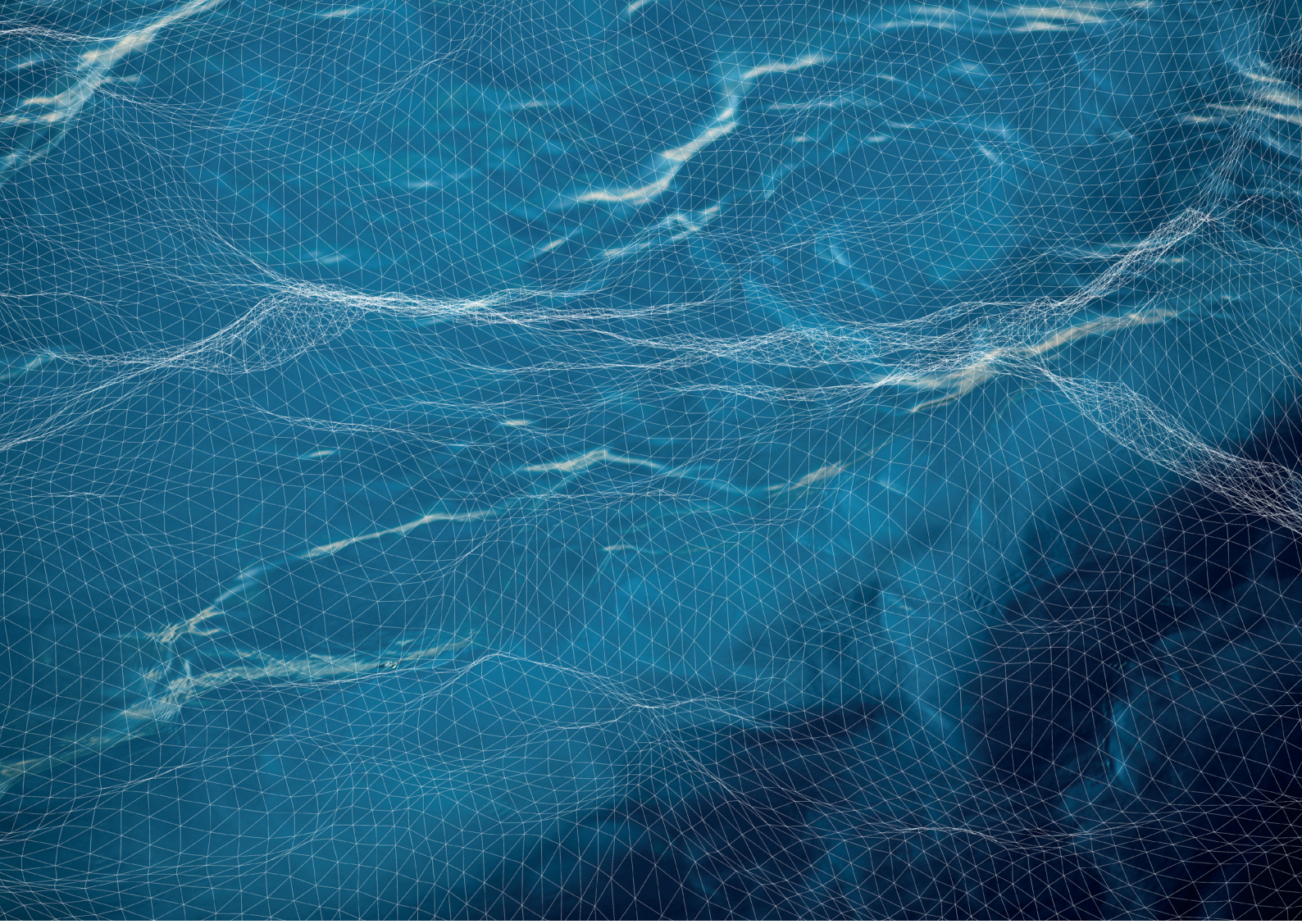
Revision 0317:
Chapter 17: Connection drawing of I/I galvanically isolation of temperature signal added.

Revision 0215:
Chapter 17: Connection diagrams Viscotherm® added

Revision 0715:
Chapter 17: Drawing 0850-2174 adjusted

Revision 0216:
Chapter 3.1.8: Outputs: Load corrected (750 Ω)

Revision 1019:
Chapter 1.1 & 2.3.1: References added to TIB's ViscoSense®3, ViscoSense®3 Ex d, ViscoSense®3D, ViscoSense®3D Ex d.
Chapter 17: Connection diagram (0850-2218) and connection diagram (0850-2219) added.



VAF

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