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AQUAMETRO
OIL & MARINE

Installation and Operation Manual

Viscosity Control System

Viscosity Controller VC312/VC322/VC622/VC722

Fuel Viscosity System

Content

1 Introduction

Thank you for your decision to work with Aquametro Oil & Marine Viscosity Control System (VCS).
This manual describes the installation, commissioning and use of Viscosity Control System. For additional information, please contact your local sales agent info@aquametro-oil-marine.com / www.aquametro-oil-marine.com.

1.1 Liability disclaimer

The manufacturer cannot monitor the compliance to this manual as well as the conditions and methods during the installation, operation, usage and maintenance of the system regulator.
Improper installation can cause damages and endanger people. Therefore, we assume no responsibility and liability for losses, damages or costs that result due to incorrect installation, improper operation, usage and maintenance or in any manner associated therewith. Similarly, we assume no responsibility for patent right or other right infringements of third parties caused by usage of this system regulator. The manufacturer reserves the right, without prior notification, to make modifications concerning the product, technical data or installation and operating manual.

1.2 Safety precautions

Viscosity Control System must only be used for its intended purpose and comply with local and international safety regulations. All documentation is to be followed exactly. None of the information stated here or elsewhere releases planners, installers and operators from their own careful and comprehensive assessment of the respective plant configuration in terms of functional capability and operational safety.

- Local applicable working regulations must be complied with, during all work on the plant and/or ship.
- All safety-, installation- and operation instruction as described in this manual must be followed.
- Sensors, actuators and control valves are sensitive instruments and should be treated carefully.
- When removing or reinstalling sensors or components from the Viscosity Control System, safety instructions in the respective operating manual must be followed.
- Check the Viscosity Control System periodically for tightness of the connections and for proper functioning.
- The unit must be installed to 110 VAC or 230 VAC according to wiring diagram.
- Electrical wiring and installations are subject to statutory regulations, which must be taken into account when planning the system.
- Viscosity Control System is not for installation in zones subject to explosion hazards.
- If work is to be done on the installation, before each intervention release the pressure in the installation

This manual provides instruction for installation, start-up and operation of Aquametro Oil & Marine Viscosity Control System.

It is essential that this manual be thoroughly reviewed, with full comprehension of the matters explained herein, before attempting installation and start-up.

The materials and workmanship incorporated into the Aquametro Oil & Marine Viscosity Control System are designed to provide trouble-free service throughout the equipment lifetime. However, like any rotating equipment, satisfactory performance depends on correct initial sizing, proper installation and periodic inspection, monitoring of operating conditions (pressure, temperature, vibration, flow and electric power) and prescribed maintenance. This manual has been prepared to assist the operator in understanding the workings of the Viscosity Control System and provide direction for proper installation, start-up, operation and maintenance.

IMPORTANT SAFETY INFORMATION

WORK SAFE SYMBOL

This symbol will appear in this manual at all remarks for operational safety, where risks for health and life of personnel exist. Observe these points and proceed with caution in these cases.
Cautions should be identified to other users

ATTENTION NOTICE

This symbol will appear in this manual where special attention must be paid in order to maintain a correct operating procedure and to avoid damage to the Viscosity Control System components and/or other plant equipment.

1.3 Receiving and storage requirements

Inspect Viscosity Control System components and separate delivered parts as soon as they are received.
Make notes and photos of damage (also package damages) or missing items.
File any claims with the transportation company immediately and notify vendor of the damages.

Normal packaging is designed to protect Viscosity Control System components and separate parts during shipping and storage. Upon receipt at customers' warehouse, store Viscosity Control System components and separate parts indoors, in a sheltered and dry location.

2 Application

The Aquametro Oil & Marine Viscosity Controller, with the scope of functionality from relays, several digital and analog out- and inputs and other additional devices, is built to tackle the most demanding process and marine applications for viscosity control systems.
The Viscosity Controller is a microprocessor-based industry controller series in panel mounting format 96 x 96 mm.
Design and operating elements are especially devised for easy and convenient handling and operation. The controller is available as two or one channel controller with programmable proportional differential and integral action. All relay contacts are potential free.

A Controller may be part of a complete Aquametro Oil & Marine Viscosity Control System. For instructions covering the other components of this system, refer to the separate MBA as supplied with these components.

2.1 Description of Viscosity Controller

Scope of supply

Controller	VC312	Three-point-step switchable depending on the state of a binary input 2 information signal outputs (no galvanic isolation) 1 additional contact

	Continuous control or Three-point-step control switchable depending on the state of a binary input
VC622	2 information signal outputs 2 additional contacts Double continuous control optional

3 Controller installation / implementation

3.1 General

Figure 4-1: Controller type - Display

1-Display for relay function
2-Descriptive text for displayed value
3-Digital value displays
4-Unit of display
5-Key for setpoint and parameter mode
6-Setpoint adjustment

Measuring inputs / ranges:

<table>
<tr><td>ai1:</td><td>Pt100 or standard signal, range 0 to 400°C resp. adjustable, preadjustment 4 to 20 mA / 0 to 50 cSt</td></tr>
<tr><td>ai2:</td><td>Pt100 or standard signal, range 0...400°C resp. adjustable, preadjustment 4 to 20 mA / 0 to 200 °C</td></tr>
<tr><td>ai3:</td><td>VC622/722 only
Remote resistance transmitter or standard signal preadjustment 4 to 20mA / 0 to 100 %</td></tr>
<tr><td>Binary input:</td><td>VC322/622/722
2 binary inputs, external voltage 0/24 VDC or potential free contact
0 V resp. contact open: status = 0;
24 V resp. contact closed: status = 1
b1: 0 = control channel 1 active; 1 = control channel 2 active
b2: 0 = continuous output(s) = 0%; 1 = auto. control</td></tr>
<tr><td rowspan="3">Relay output:</td><td>VC312
3 relays with potential-free changeover contacts incl. spark extinction, switch. power 250V 2A, preadjusted.:
K1 - Control function three point step (+)
K2 - Control function three point step (-)
K3 & K4 – Common relay switched by limit comparator assigned to actual value 1&2</td></tr>
<tr><td>VC322
4 relays with potential-free changeover contacts incl. spark extinction, switch. power 250V 2A, preadj.:
K1 - Control function three point step (+)
K2 - Control function three point step (-)
K3 - Relay switched by limit comparator assigned to actual value 1
K4 - Relay switched by limit comparator assigned to actual value 2</td></tr>
<tr><td>VC622/722
K1 – Relay switched by limit comparator assigned to actual value 1
K2 - Relay switched by limit comparator assigned to actual value 2
K3 -
K4 -</td></tr>
<tr><td>Analogue outputs</td><td>4 signal- / continuous outputs 0/4..20 mA, galvanically isolated, preadjustment:
<table>
<tr><th></th><th>VC312</th><th>VC322</th><th>VC622</th><th>VC722</th></tr>
<tr><td>S1:</td><td>Actual value 1</td><td>Actual value 1</td><td>Continuous Y1</td><td>Continuous Y1</td></tr>
<tr><td>S2:</td><td>Actual value 2</td><td>Actual value 2</td><td>Actual value 1</td><td>Continuous Y2</td></tr>
<tr><td>S3:</td><td>Nil</td><td></td><td>Actual value 2</td><td>Actual value 1</td></tr>
<tr><td>S4:</td><td>Nil</td><td></td><td></td><td>Actual value 2</td></tr>
</table></td></tr>
</table>

3.1.1 Planning

Topics covered in this chapter:

- Installation checklist
- Best practices
- Power requirements
- Other installation considerations
- Recommended installations for the controller
- Perform a pre-installation controller check

3.1.1.1 Installation checklist

- Verify the contents of the product shipment to confirm that you have all parts and information necessary for the installation.
- Make sure that all electrical safety requirements are met for the environment in which the controller will be installed.
- Make sure that the local ambient temperatures and pressure are within the limits of the controller.
- Make sure that you will have adequate access to the controller for verification and maintenance.
- Verify that you have all equipment necessary for your installation. Depending on your application, you may be required to install additional parts for optimal performance of the controller.

3.1.1.2 Best practices

The following information can help you get the most from your Controller.

- Handle the Controller with care. Follow local practices for lifting or moving the meter.
- Always store and transport the Controller in its original packaging.
- Do not expose the Controller to excessive vibration (greater than 0.5 g continuously). Vibration levels in excess of 0.5 g can affect the meter accuracy.

3.1.1.3 Power requirements

Following are the DC power requirements to operate the controller:

- Power supply: 100 to 250 VAC, approx. 14 VA
- alternative 24 V AC / DC

Power cable recommendations for explosion-proof/flameproof controller

3.1.1.4 Other installation considerations

Numerous external factors can affect the meter's successful operation. To ensure that your system works correctly, consider the factors covered in this section when designing your installation.

Select a location away from electrical and magnetic fields.

3.1.2 Installation

Before installation inspect the controller for any visible signs of damage caused during transport. Check power supply acc. to name plate.
Push the housing from the front into the DIN- panel cut-out and secure from behind with the fastening devices supplied.

The controller is designed for panel mounting, a panel thickness of 2.5 mm is required.

To panel-mount the controller

1. Cut a hole of the correct size (96.8 x 96.8 mm)
2. Insert the controller
3. Mount and fix the clamps

Do not overtighten the screws and allow sufficient space for cable installation and service.

3.1.3 Electrical wiring

Plug bar on the back face of the controller; connect up the controller at the rear following the wiring diagram; wire cross section max. 1.5 mm^2

- To avoid cross interference all low voltage measuring lines and pilot wires must be encased
- in a **shielded cable** (the shielding must be earthed one-sided)
- The control leads must be **fused** externally to protect the output relays.
- Phase wire and neutral wire must not be transposed.

Refer to chapter "8.3 Electrical connection diagrams" to connect all cables in accordance to the electrical connection plan.

4 Controller operation

Default values

Default values for your meter are configured at the factory. The specific values are determined by the options that were specified on the purchase order. These are provided on the configuration sheet that was shipped with your meter.

4.1 Putting into operation

Switch on power supply. Digital display and control lamps (if available) will light up according to the setpoint after some seconds. If nothing happens check the fine-wire fuse (if available) on the back panel of the controller and the electrical wiring. Adjust set value and check other adjustments.

Operating status

The upper display shows the actual value (channel / measuring input 1), the lower display remains empty or (depending on the version and settings) shows

- the attendant unit of measure (°C, °F, %...)
- an additional actual value, the setpoint value or the controller output value Y
- or the additional actual value only when the ▲ key is pressed.

Alternative type:

Switch over the upper display to the several actual values by pressing the ▲ key, the lower display shows the number of the attendant measuring input.

Setpoint value setting

Press P key shortly (do not hold down)
The upper display shows the abbreviation of the activated setpoint adjustment mode, the lower display shows the adjusted value.
The indicated value can now be changed by the ▼ (lower) and ▲ (higher) -keys.
Each variation of the set value is immediately active, without any more operating steps.
The arrow keys have a built-in accelerator mode: longer pressing causes faster alterations.

Return to operating level

Press P key shortly (or automatically after 30 seconds without any key-action)

optional: Press P key shortly again: *SP =set values of further control loops (*=no.) /
SP* =further set values of the control loop / SPE =external setpoint (display mode only);
flashing display signifies that the function is not active at the moment

4.2 Display and operation level

Setpoint value setting

Briefly press the P button (do not hold)

A flashing frame with the description SP shows the activated setpoint level. The upper text display shows the parameter name "SP=" and the adjusted value, the lower text display optionally shows a description text.

The displayed value can now be changed using the ▼ and ▲ buttons.
A setpoint change is effective immediately, without any further operational steps.

'Arrow' button acceleration effect: longer pressing causes faster changing.

Return to operating mode
briefly press the P button (or automatic after > 30 sec)

Manual operation: (optional)

MAN.	Press and hold the ▲ button, then additionally press the ▼ button, then release both. (For multi-channel controllers, first select the channel number CH.. using the up/down buttons and continue with the P button, after which:) The display shows "MAN or Hand", plus the setting variable, if it exists. The control function is switched off. Manual control is now possible using the ▼ and ▲ keys **Return** to operating mode: **only** with P button, no automatic switching back from manual operation! Optional: Start self-optimisation (see chapter Optimisation): press the P button >5 sec whilst in manual control function; the lower display jumps to "-Ad-". Abort: press the P button again >5 sec

4.3 Display operating status (VC622/722 only)

Graphical representation: Briefly press the ▲ button (do not hold). Actual- and setpoint values of the controller are displayed as a continuous diagram. The actual recording cycle is signalised by an ongoing red dot.
Vertical yellow lines with grey background for date and time represent recording interruptions.

Optional: To switch on the cursor press P button briefly:

The cursor is moved along the time axis with the (earlier) ▲ / (later) ▲ buttons, the values of the cursor position are shown in accordance to the date and time.

Briefly press the P button to switch off the cursor

4.4 Parameter settings level

Access from the operating level

Depending on the controller type, the operating level has to be unlocked with a switch on the back panel of the device.

After polling (see instructions for level PARA 1 / 2), a flashing frame with the description PAR1 / PAR2 shows the activated parameter level.
The upper text display shows the first parameter name and the adjusted value, the lower text display optionally shows a description text.

Continue to the next parameter and/or confirm entry:
briefly press the P button each time.

To change the setting displayed: Press the ▼ ▲ buttons**:**

	Settings in detail: (existence depends on version and type):		
PARA 1	Polling: press and hold the P button >5 sec, release it after the display reacts.	Factory setting	Notes
COD2	Code number 2 (password) for parameter levels (1 to 9999)	1	
CH..	(only) for multi-channel controllers: Selection of desired channel (no.)		
P	Proportional range Xp (%) (for more details, see "Optimisation")	35.0	
I	Integral action time Tn (min) (for more details, see "Optimisation")	6.0	
D	Rate time Tv (min) (for more details, see "Optimisation")	0.2	
SH	Response sensitivity ("dead zone") Xsh (%)	0.1	
SA	Setpoint distance (absolute) for following switching contact no	5.0 / 3.0	
SP	Independent setpoint for switching contact no.	0.0	
SD	Hysteresis (switching difference on/off) for switching contact no	3.0	
	return to operating mode: briefly press the P button (or automatic after > 30 sec)		

PARA 2	Polling: press and hold the P button, additionally press the ▼ button, hold both buttons for >5 sec, release them after the display reacts:	**Factory setting**	**Notes**
COD2	Code number 2 (password) for parameter levels (1 to 9999)	1	
Unit	Switches the unit of display (°C / °F)	°C	
***BLO/*BHI**	(only) for voltage / current input: start / end of display range	#	
***ELO/*EHI**	(only) for external setpoint: start / end of setpoint range	#	
***SLO/*SHI**	(only) for information signal output: start / end of range	#	
NST	Number of decimal places of the display (0 / 1 / 2, depending on range)	0	
***Lo / *HI**	Setpoint setting range, lower / upper limit	#	
CRST	Contrast setting for display (0 to 20)	32	

BRGH	Brightness display (30 to 100)	50	
DSP1	Variable shown in first display line (10 mm) (OFF / SP / Y / IST..)		
DSP2	Variable shown in second display line (10 mm) (OFF / SP / Y / IST..)		
DSP3	Variable shown in third display line (10 mm if DSP4=OFF, otherwise 3 mm) (OFF / SP / Y / IST..)		
DSP4	Variable shown in fourth display line (3 mm) (OFF / SP / Y / IST..)		
EIN1..4	(SP = setpoint, Y=setting variable, Ist * = Actual value channel / measuring input*) Unit of measurement for corresponding display line (°C / °F / % / bar / mbar / mPas / cSt / Kgm^3 / mm / KPa / L / m^3/h) Note: no conversion! C		
Text1/2/3/4	Description text for corresponding display line1..4: choose from a predefined list (ACT.VAL.,SETPOINT, SUPPLY,RETURN) resp. 1 additionally editable text; *changeable by PKS-software,	1=ACT.VAL1 2= ACT.VAL2 3= SETPOINT	
	Return to operating mode: briefly press the P button (or automatic after > 30 sec)		
	***** = ID number in case of several measuring inputs or control loops	.# = corresp. range	

4.5 Configuration level

Access from the operating level

Depending on the controller type, the operating level has to be unlocked with a switch on the back panel of the device.

Polling: press and hold the P button, additionally press the ▲ button, hold both buttons for >5 sec, release them after the display reacts:
A flashing frame with the description CONF shows the activated parameter level. The upper text display shows the first parameter name and the adjusted value, the lower text display optionally shows a description text.

continue to the next parameter and/or confirm entry:
briefly press each time the P button

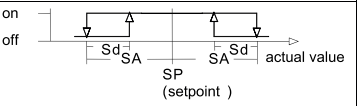
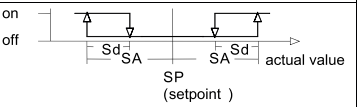
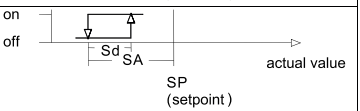
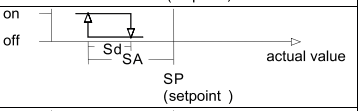
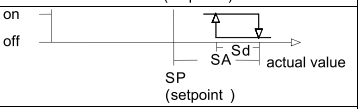
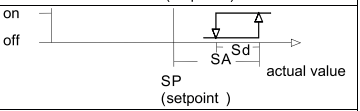
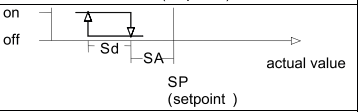
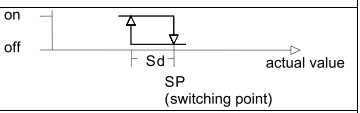
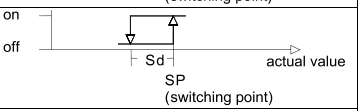
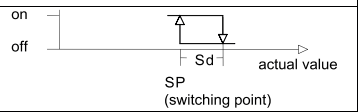
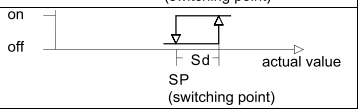
To change the setting displayed:
Number values: Press the ▼ ▲ buttons, text values: press the ▲ button

	Settings in detail: (existence depends on version and type):	Factory setting	Notes
CODE	Code number for configuration level (1 to 9999), Alternatively: Hold the P button for more than 10 sec after code entry	1	
COD1	Possibility of setting the code number for the configuration level (option).	1	
COD2	Possibility of setting the code number for the parameter levels (option).	1	

LNG	Language selection of the menu text (Deutsch, English, User def, Off)	English	
CONF	Selection of the configured controller function (if existent)		
	return to operating mode: Briefly press the P button or: **continue** to the following settings: press the P-button and hold it > 5 sec: Note: when continuing after changing a function, the display first flashes for a few seconds, only then does the desired switching over or back take place		

SPEF	Configuration external/second setpoint "BIN" (activation by binary input) / "MENU" (activation from the setpoint level) / "SP2" / "AUS"=OFF	MENU	
AIN*	Input type for input no.*: "RTD / 0 to 20 / 4 to 20(mA) / 0 to10 / 2 to 10 (V) / AUS=OFF" (note different terminals for I/U!)**	4 to 20 mA	
IST*	Correction value for changing the controller display (+/-)		
SP 2/E	Type of effect of second / external setpoint: "Add/ Sub/ AbS" (adding / subtracting / absolute value)	AbS	
***YM**	Setting time of the controlled drive "6 to 600" (sec)	60 sec	
***CY' '**	Switching frequency in two-point controllers: "2 to 120" (sec.)	20 sec	
***OUT**	Setting output signal "0 to 20 / 4 to 20" (mA) /0 to 10 / 2 to 10 (V)"	4 to 20 mA	
***OUT**	Setting output characteristic: direct / inverse "di / in" (with 2 outputs: "in in / in di / di in / di di")	in in in 0	
***td**	For 2 outputs: dead zone between outputs 1 and 2 "0...10%" 0.0		
***AP**	Output signal working point (-100 to +100)	50	
FG A/E	Automatic adjustment of remote transmitter input (see extra sheet 99ar)		
Sou*	Assignment of inform. output signal(s)* (act. value/setp., setting var..)	Ist1	
Sou*	Type of information output signal(s)* "0 to 20/4 .to 20(mA)/ 0 to 10/2 to 10(V)" (* Sout= Signal 1; Sou2 = Signal 2)		
***Y_S**	Behaviour of the setting output in the event of measurement line error: Relay position: "rel1 / rel2 / OFF" Continuous output: "0...100" (%)	rel2(70.) rel1(20.)	
bin.Eing	Sub-menu for binary input configurations Polling: press the P button and hold it > 5 sec		
BIN*	Direction of control action binary input* direct / inverse (di/in)	di	
BIN*	Assignment of collective relay: Stat=none, SREL= collective relay	Stat	
BIN*	Switch-on delay (0...300 sec)	0	
REL*	Function mode of additional contact (relay no.)	LCA / LCE	
REL*	Measuring input / control loop assigned to additional contact	IST 1	
REL*	Add. contact – relay pos. in event of meas. line error "SiE/SiA"(on/off)	Si A	
DSPL	Display representation: NORM (grey / black), INV (black / white)	NORM	
Adr	if equipped with interface: bus address (number)	5	
BAUD	if equipped with interface: baudrate (9600/ 19200/ 38400)	38400	
	return to operating mode: briefly press the P button again ***** = ID number in case of several inputs / outputs or control loops. ******= Rtd input of ain2 is additionally usable if equipped with ext. setpoint and activation using SP-F		

Selectable switching functions (depending on version):

For setting please refer to configuration level under REL*		
Switching functions for trailing contacts:		
LC A	Break contact on either side of setpoint (Limit comparator). Relay drops out as deviation increases (Aus = off)	
LC E	Make contact on either side of setpoint (Limit comparator). Relay picks up as deviation increases (Ein = on)	
Su A	Break contact below setpoint. Relay drops out as actual value decreases (Aus = off)	
Su E	Make contact below setpoint. Relay picks up as actual value decreases (Ein = on)	
So A	Break contact above setpoint. Relay drops out as actual value increases (Aus = off)	
So E	Make contact above setpoint. Relay picks up as actual value increases (Ein = on)	
St A	Heating stage below setpoint. Relay drops out as actual value increases (Aus = off)	
Switching functions for independent contacts:		
	Hysteresis below:	
US A	Relay drops out with increasing actual value (Aus = off)	
US E	Relay picks up with increasing actual value (Ein = on)	
	Hysteresis above:	
USCA	Relay picks up as actual value decreases	
USCE	Relay drops out with decreasing actual value	

4.6 Manual optimization

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

P = proportional band Xp (%):

lower value = longer impulses, more sensitive reaction
higher value = shorter impulses, less sensitive reaction
Examples: - Oscillating temperature without distinct initial overshot: Xp too low;
- The setpoint is reached very slowly after initial exceeding: Xp too high.

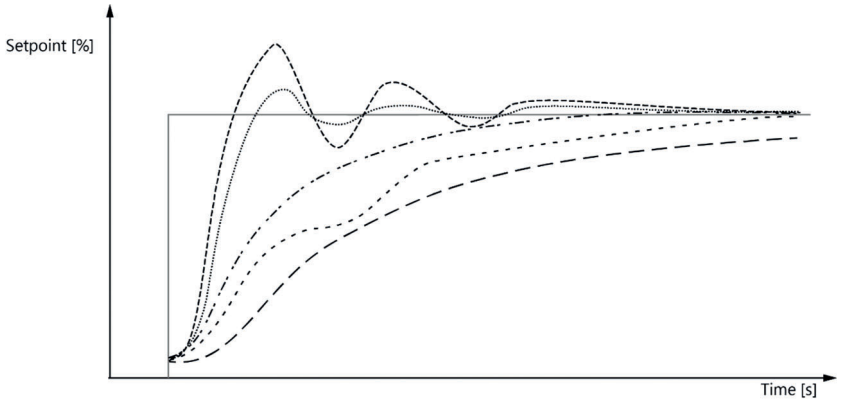
I = integral action time Tn (min):

lower value = shorter impulse gaps, faster balancing
higher value = longer impulse gaps, slower balancing
Examples: - the set value is reached very slowly without overshooting: Tn too high;
- high initial overshot followed by fading oscillation: Tn too low.

D = rate time Tv (min):

increases the controller reaction in case of fast actual value or setpoint alterations (adjust only if necessary). Higher values cause higher increase

Empirical dimensioning of Xp / Tn / Tv



Based on the actual value curves, the control loop can be re-optimized:

- – — — — — — —: Actual value is only slowly approaching the set point.
  Setting rule: Increase proportional component. If this leads to an improvement, then reduce the integration time. This repeat to one satisfactory regulator result is achieved.
- - - - - - - - - - - -: Actual value slowly approaches the set point with slight oscillations.
  Setting rule: Increase proportional component. If this leads to an improvement, then reduce the
- —- -—- -—- -—- -—- : Actual value approaches the set point without significant overshoot.
  Optimal controller behavior for processes that do not allow overshoot.
- ····· **: Actual value is approaching the set point with a slight muted overshoot.**
  Optimal controller behavior for fast control and compensation of Interference components. ()
  Setting rule: The first overshoot should not be 10% of the setpoint step exceed.
- ·–––––––––––––––– : Actual value approaches the setpoint quickly, but oscillates far over. The Vibrations are damped and thus just barely stable
  Setting rule: reduce proportional component. If this is an improvement leads, then increase the integration time. This repeat to one satisfactory regulator result is achieved.

5 Maintenance and repair

5.1 Calibration

All our Viscomaster Systems are calibrated in the factory.

An accuracy check and recalibration is offered at Aquametro Oil & Marine, this is usually dependent on customer, operator or regulation requirements. This interval depends largely on the operating conditions, process liquid and the application the system is installed in.

5.2 Service maintenance

CAUTION

The surfaces of the device/system and the medium may be hot.

Risk of burns!

- Carry out work only on cooled devices/systems.
- Work may only be performed by authorized specialists in accordance with the applicable regulations.
- Use appropriate protective equipment.

WARNING

The device/system may be under pressure.

Risk of severe injury!

- Carry out work only on non-pressurized devices/systems.
- When working on the device/system watch out for leaking medium.
- Work may only be performed by authorized specialists in accordance with the applicable regulations.
- Use appropriate protective equipment, particularly safety goggles

WARNING

The device/system may be under high voltage.

Risk of severe injury!

- Carry out work only on non-powered devices/systems.
- When working on the device/system watch out for faulty isolation or open cable cores and ends.
- Work may only be performed by authorized specialists in accordance with the applicable regulations.
- Use appropriate protective equipment

ATTENTION !

Use of unsuitable cleaning agents and procedures.

Risk of malfunction or damage!

Follow the cleaning instructions on the next page.

Before working on the hydraulics:

- put the system or section out of operation
- close the stop valves
- release the pressure
- put a suitable tray underneath the connection to be worked on
- be prepared for spillage, have absorbent at hand

Cleaning of Viscosity Controller:

- do not use any aggressive solvents
- rinse hydraulic part of flow meter thoroughly

Aquametro Oil & Marine recommends to use the following cleaning solvents:

- Gasoline used for cleaning purposes
- Cleaner's naphtha
- Petroleum ether

Bevor working on the electronic

- For repair remittance remove plug board with connected leads on the rear side, loosen fastening devices and remove controller from the panel.
- In case of remittance, please give precise details of the fault to reduce time and cost of repair.

To restart the system:

- slowly open the stop valves, avoiding pressure surges ("water hammer")
- vent the pipe well check tightness

Maintenance

ATTENTION !

Use of unsuitable cleaning agents and procedures.
Risk of malfunction or damage!
Follow the cleaning instructions on the next page.

Check connections periodically for tightness and if necessary retighten.
Check insulation periodically for completeness and functionality and reattach if necessary.

Steam valve spindle has to be kept clean and lubricated, if necessary, lubricate the spindle with Molykote including grease.
Following the initial temperature and pressure load, retighten the screws of all flange connections (also cover and connection piece flanges), the valve cone should be located in the center

All electronic controllers in the product range of the manufacturer are virtually maintenance-free.
Provided that the controller is correctly installed and put into operation and is protected against mechanical damage and inadmissible operating conditions, it should give years of trouble-free service. In case of faults repair work by the customer should be restricted to the externally accessible leads and connections and components the customer is expressly permitted to deal with himself (bridge circuits, fuses).
All further work, especially on internal components will terminate warranty, makes subsequent inspection and fault repair more difficult and can cause considerable damage to the circuitry.

5.3 Spare parts

ATTENTION !

Use of wrong Spare Parts
Risk of malfunction or damage!
Use only original spare parts, supplied by Aquametro Oil & Marine

Spare part list and Maintenance instruction may be requested from Aquametro Oil & Marine.

6 Troubleshooting

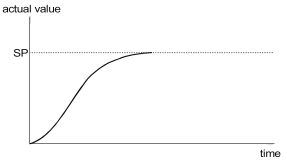
6.1 Controller problems and recommended actions

Problem	Possible causes	Recommended actions
Err 1...6	Fault on measuring input nr. ...	check measuring lines for short circuit or breakage check measuring input by connecting a RTD
Err 55	Fault on loading the parameter;	press any key, the controller starts in emergency operation mode, configuration of the parameters has to be checked
Err 50	Hardware error in program section	no further operation possible, remit controller for repair
Err 52	Hardware error in data section no further operation possible, remit controller for repair	no further operation possible, remit controller for repair
Err 58 Err 59 Err 60 Err 61	Binary inputs out of function (status = 0), Digital outputs out of function (switched off), Relay outputs out of function (switched off), Analogue outputs out of function (0 %),	remit controller for repair
Err 62 Err 63	Data connection to the modular fault detector 826.. interrupted, Data connection to the hardware expansion modules interrupted,	check cables
	Error messages during self-adaptation:	
Err 202	Ambient conditions are not suitable for self-adaptation;	adjust parameter manually
Err 205	routine exceeded the setpoint	raise setpoint or lower actual value and start adaptation again
Err 206	Fault on measuring input during adaptation;	check the wiring and start adaptation again

6.2 Process troubleshooting

Problem	Possible causes	Recommended actions
Viscosity reading oscillating	» Normal process noise » Two-phase flow » Deposition or coating, especially asphaltenes, on the tines » Contaminants in the process fluid » Vibration in the pipeline	» Check your process conditions. » Check for two-phase flow, stratification, or settling. Install a pump. Check for environmental conditions that produce stratification (e.g., a heat source). » Increase back pressure to minimize bubble formation. » Clean the tines. » Minimize vibration in the pipeline.
	Energy level in heating system to low	Check whether other consumers cyclically draw energy
	Steam Valve oscillating	Wrong adjustments of control loop Adapt control loop (Increase P – check if necessary increase I / small steps for the changes)
Viscosity signal too low / Temperature not reached	Air entrapped in fuel oil system	Vent the system at the bypass valve
	Heat Valve not fully opened	Adapt Control Loop parameter
	Heat Valve close to max. Position	Steam system power at max
Viscosity Signal remains at maximum Value	Fuel too cold during start up	Check fuel line trace heating ans or fuel heater
	Fuel too cold during normal operation due to insufficient heating	Increase output signal of controller to hear exchanger. Consult AOM if this does not solve the problem
No Viscosity /Temperature Signal	Air entrapped in fuel oil system	Vent the system
	No Electrical supply to viscosity sensor	» Check main Supply » Check fuses of control unit/power supply unit » Check integrity of electrical connection
	Current loop connection broken	Check electrical wiring of 4-20mA output signal
	Viscosity sensor malfunction	Contact AOM

To balance any appearing deviation as quickly a non-oscillation operation conditions of the PID Loop is required.

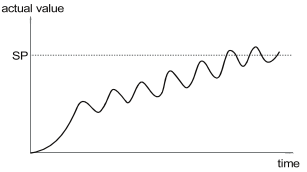


P = proportional band Xp (%):

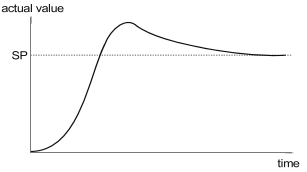
Lower value = longer impulses (three-point step control), more sensitive reaction,
Higher value = shorter impulses (three-point step control), less sensitive reaction.

Examples:

- Oscillating temperature/viscosity without distinct initial overshoot:
  P (Xp) too low



- Setpoint is reached very slowly after initial overshooting:
  P (Xp) to high

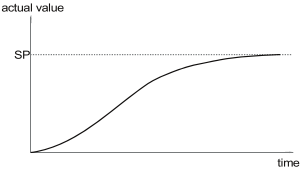


I = Integral action time Tn (min):

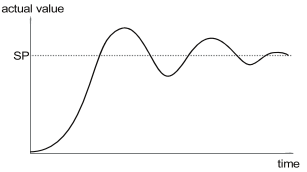
Lower value = shorter impulse gaps (three-point step control), faster balancing
Higher value = longer impulse gaps (three-point step control), slower balancing

Examples:

- the set value is reached very slowly without overshooting:
  I (Tn) too high



- high initial overshot followed by fading oscillation:
  I (Tn) to low



D = rate time Tv (min):

Increases the controller reaction in case of fast actual or setpoint alterations (adjust only if necessary).
Higher values cause higher increase.

7 Decommissioning, dismantling and disposal

CAUTION

The surfaces of the device/system and the medium may be hot.

Risk of burns!

- Carry out work only on cooled devices/systems.
- Work may only be performed by authorized specialists in accordance with the applicable regulations.
- Use appropriate protective equipment.

WARNING

The device/system may be under pressure.

Risk of severe injury!

- Carry out work only on non-pressurized devices/systems.
- When working on the device/system watch out for leaking medium.
- Work may only be performed by authorized specialists in accordance with the applicable regulations.
- Use appropriate protective equipment, particularly safety goggles

7.1 Decommissioning

Disconnect all sources of energy.
Remove the devices from the system.
Pay particular attention to the disposal instructions in section 7.4.

7.2 Dismantling

Not required.

7.3 Return of materials

Never send a device/system back if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
Costs incurred for waste disposal and injury (burns, etc.) due to inadequate declaration and/or cleaning will be charged to the delivering company or the operator.

For a device that is sent back to Aquametro Oil & Marine for repair or calibration the following point are an absolute must:

- Always quote type and serial number when contacting an Aquametro Oil & Marine office or an Aquametro representative.
- Always enclose a duly completed "Declaration of decontamination" form (FO0451e).
- Only in special cases (e.g. for the reconstruction of causes of errors) and only with the prior consent of the Aquametro Oil & Marine, equipment must be returned in the impurified state. In this case also the contact person at Aquametro Oil & Marine, which has granted the approval to return a crude device must be stated.

7.4 Disposal

At the end of its life cycle, this product should be disposed of according to local regulations regarding waste recycling or disposal.
Batteries and rechargeable batteries shall be recycled separately.

The separate collection and recycling of used products will help to conserve natural resources, and ensures that they are disposed of in a way that does not cause damage to the environment and nature.

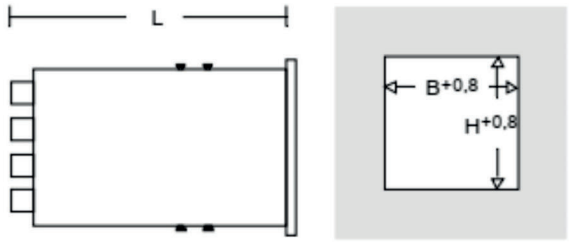
8 Technical data

8.1 Hardware characteristics

Body		
	Display	Two lines dot matrix
	Keypad	3 Tactile membrane keys
	Size	96x96x150
	Weight	0,5kg approx.
	Panel Cut-out	B+0,8 / H+0,8
	Protection Class	IP54 (IP20 Terminals)
Environmental		
	Operating temperature Range	0-60°C
	Operating humidity range	<75%RH (non-condensating) Climate Category KWF to EN60529
	Storage temperature range	-20 – 70°C
	Vibration	Conforms to EN60068-2-6
Electrical		
	Supply range	100 – 240 V AC 50-60Hz Alternative 24 V AC/DC
	Power consumption	14W max
	Relays Contact	Potential free, switching power 250V 2A

8.2 Dimensional drawings

Figure 4-2: Installation Dimensions

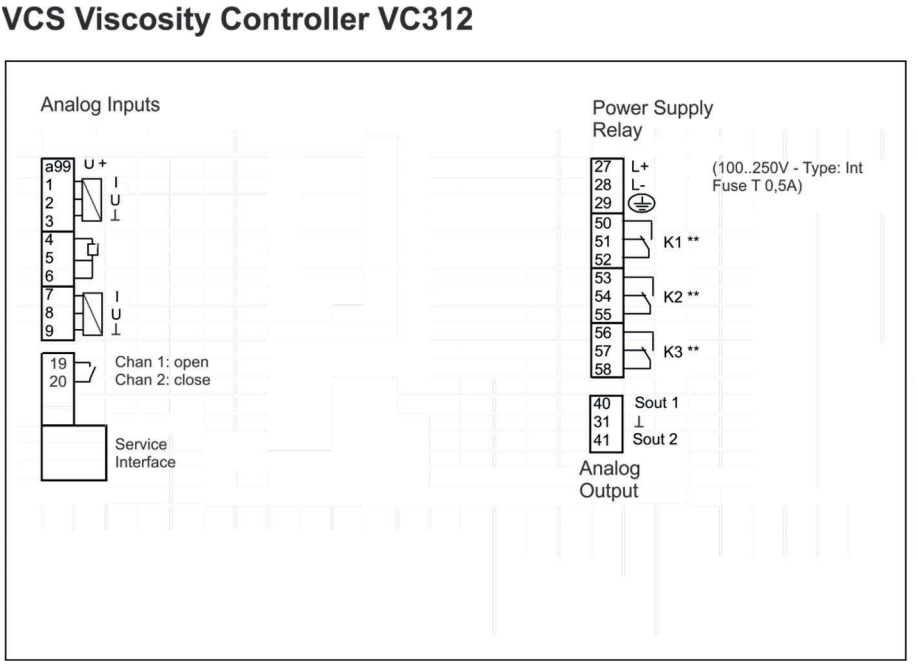


Form 96x96: L=150mm, B=92mm, H=92mm

8.3 Electrical connection diagrams

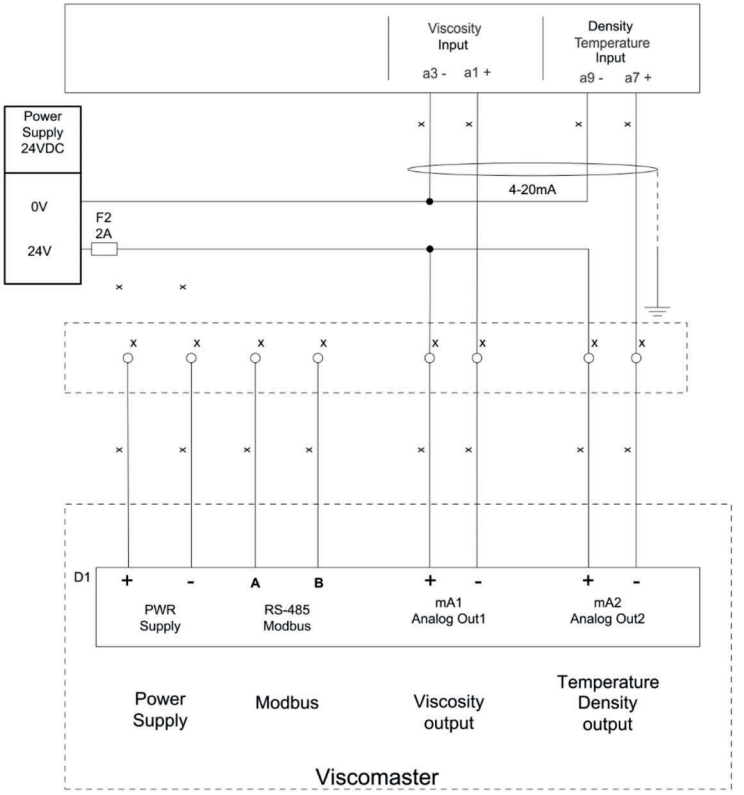
8.3.1 VC312 controller connection

Detailed connection diagram is made in project drawings.



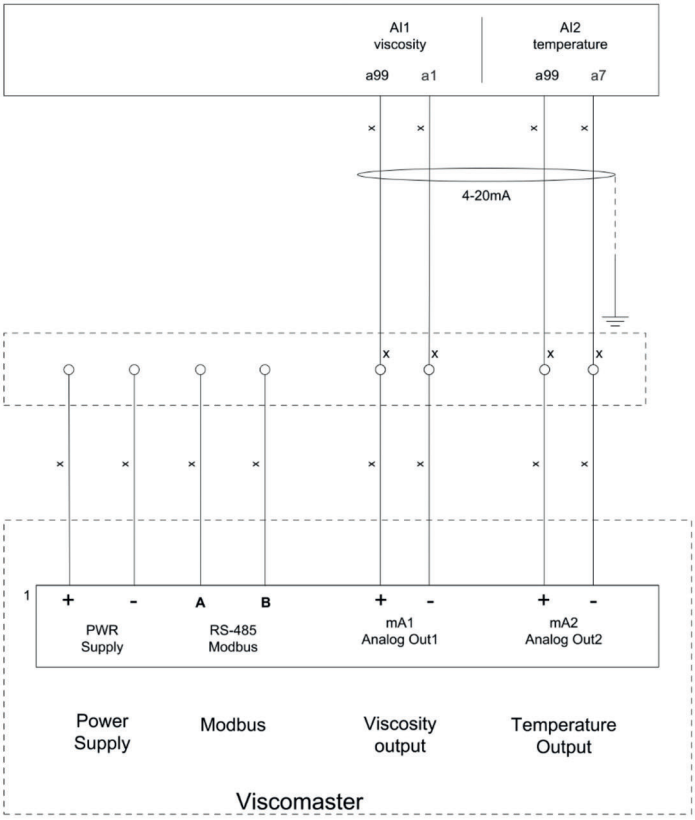
VCS Viscosity Controller VC312

Wiring - Viscomaster Sensor / Controller (Passive)



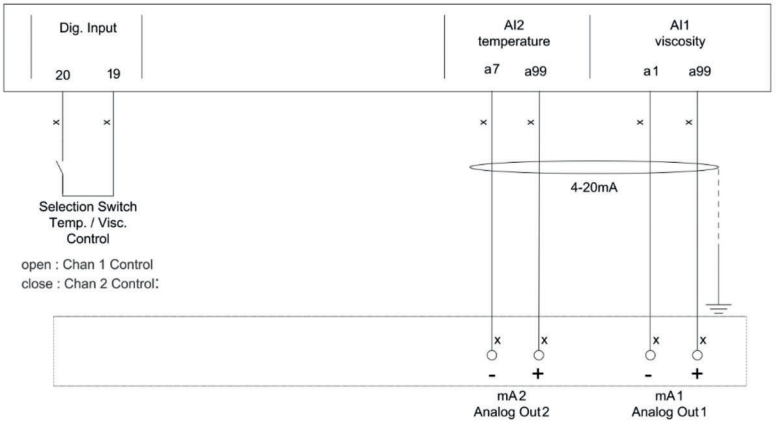
VCS Viscosity Controller VC312

Wiring - Viscomaster Sensor / Controller (Active)



VCS Viscosity Controller VC312

Wiring - Binary Input (Switch Control) / Analog Input (active)

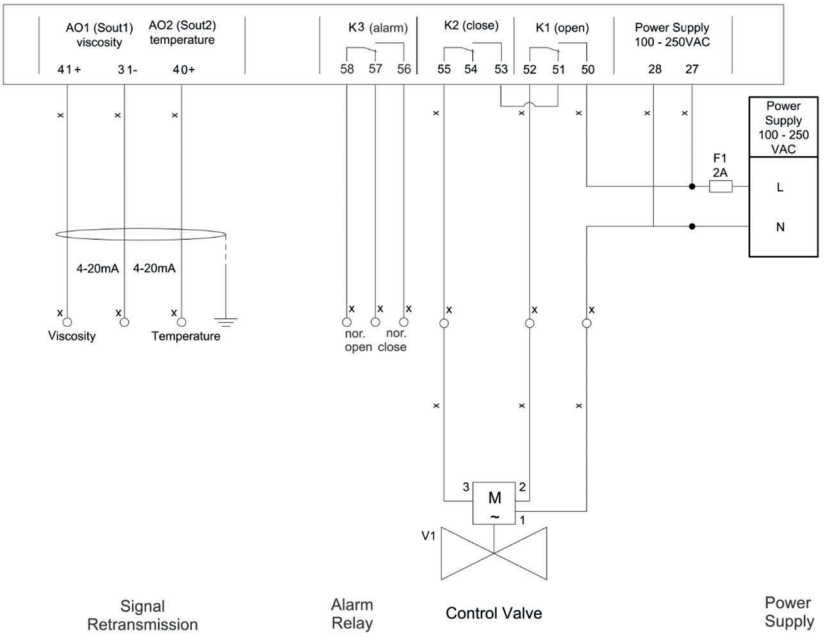


Binary Input

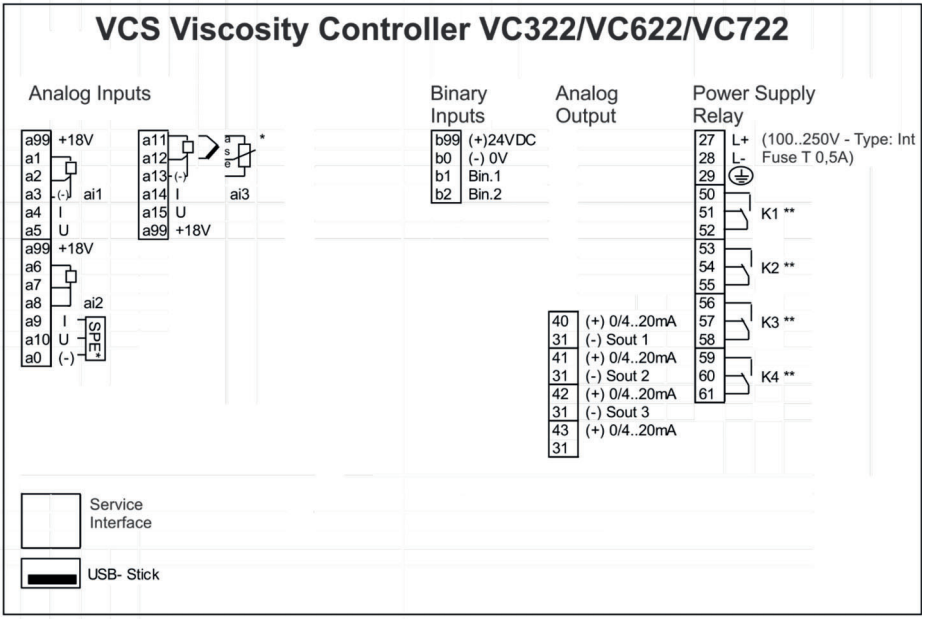
Analog Input

VCS Viscosity Controller VC312

Wiring - Signal Retransmission Alarm Relay / Step Control Valve / Power Supply

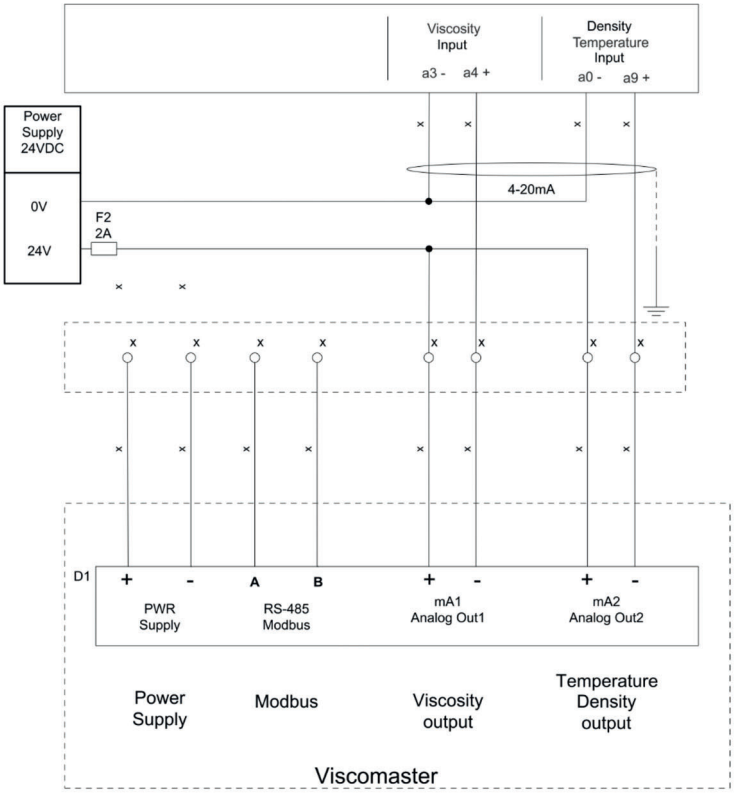


8.3.2 VC622 (322/622/722) controller connection



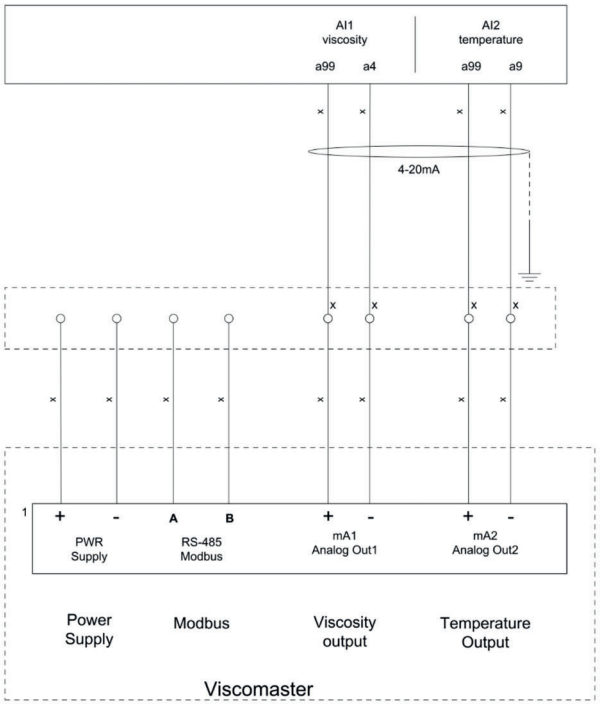
VCS Viscosity Controller VC322/622/722

Wiring - Viscomaster Sensor / Controller (Passive)



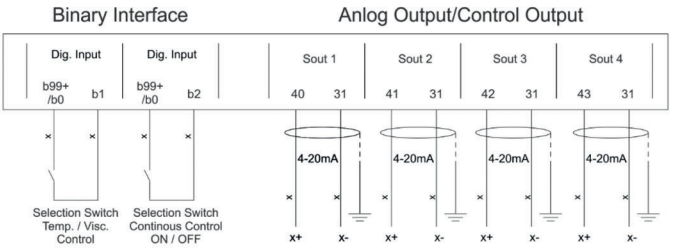
VCS Viscosity Controller VC322/622/722

Wiring - Viscomaster Sensor / Controller (Active)



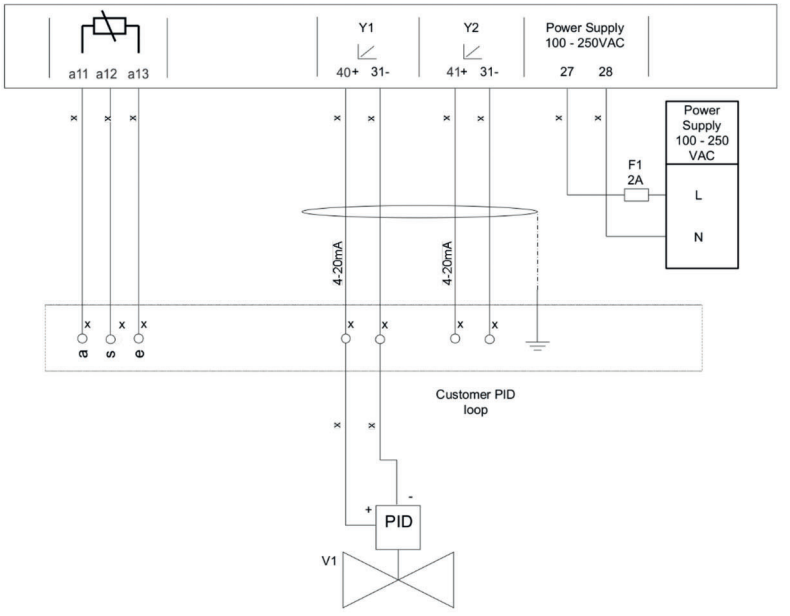
VCS Viscosity Controller VC622/722

Wiring - Binary Input / Analog Output / Valve Control



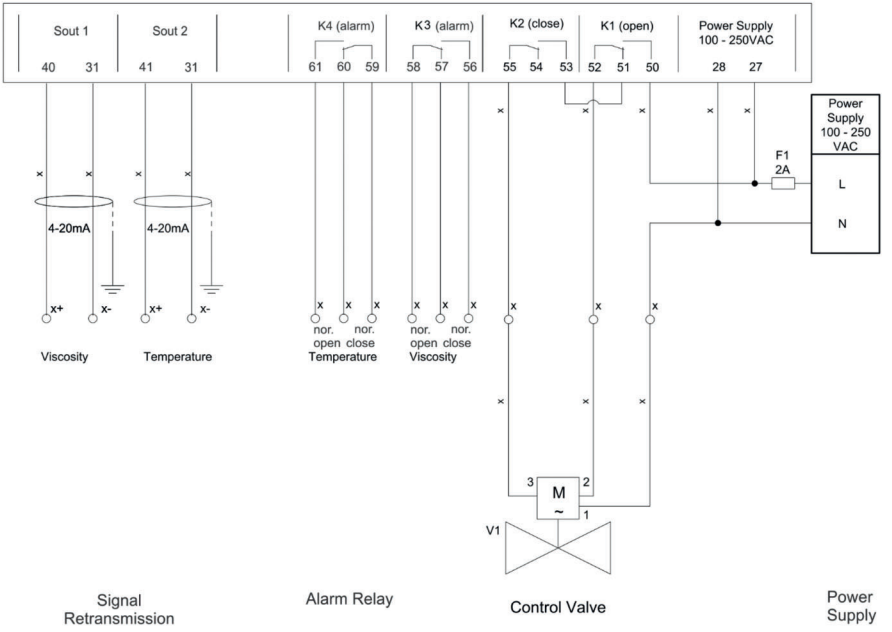
VCS Viscosity Controller VC622/722

Wiring - Power Supply / Continous Control Output / Valve Feedback



VCS Viscosity Controller VC322

Wiring - Signal Retransmission Alarm Relay / Step Control Valve / Power Supply



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