Series OV-110
Omni-Valve

Instruction Manual

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OV-110 Rev. 5/6/2024

Hydro Instruments
Series OV-110 Omni-Valve

Table of Contents

# I. FUNCTIONS, CAPABILITIES, AND CONSTRUCTION

1. SAFETY PRECAUTIONS

GENERAL: Be sure to follow all applicable and prudent safety precautions when working with chemicals and electrical equipment.

ELECTRICAL: The circuit board and incoming A/C power line do include electrical shock risk. Take care to avoid electrical shocks and do not touch any part of the circuit board or A/C power line unless you are certain that A/C power has been disconnected from the system.

CHECK FOR DAMAGE: Before removing the product from the shipping packaging, carefully check the equipment for damage. If any product is found damaged, do not put it into operation or install it. Contact Hydro Instruments to discuss repair or replacement of the damaged equipment.

2. **Function of the OV-110:** The OV-110 Omni-Valve is designed to automatically control

FIGURE 1 – SYSTEM EXAMPLE: WALL PANEL OMNI-VALVE AND RESIDUAL ANALYZER
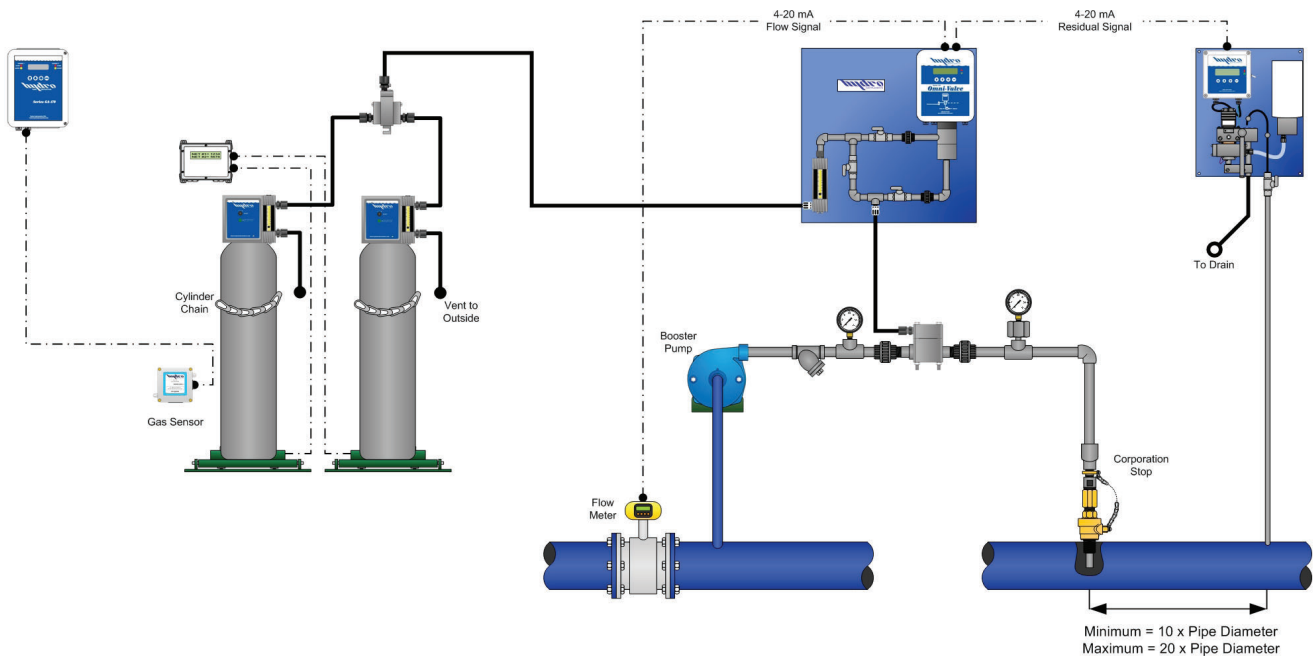
chemical feed rate based on one or more electrical input signals. Figure 1 shows an example installation drawing.

3. **Physical Installation:** The Omni-Valve must be mounted in the chemical feed line downstream from a chemical flow meter and upstream from the feed point (i.e. ejector, vacuum pump or check valve diffuser). Consider Figure 1 above.

NOTE: If the automatic valve is being used for liquid chemical feed such as sodium hypochlorite, having the chemical physically higher than the valve will create a hydrostatic pressure which could cause failure of the valves internal seals.

FIGURE 2 – OV-110 CONTROLLER ELECTRONICS

Modbus
Connections

OV-110
Printed Circuit Board

Power Supply Board

Home Switch Assembly
with Threaded Adapter

Micro SD
Card Slot

Motor Switch

Stepper Motor

Motor Wires

Toggle
Switch

AC Power
Terminal Block

OV-110
Mechanical
Subassembly

Date: 2019-02-01-v1

**OV-110 CONTROLLER
ELECTRONICS**

Dwg. No. OV-110-CONTROLLER
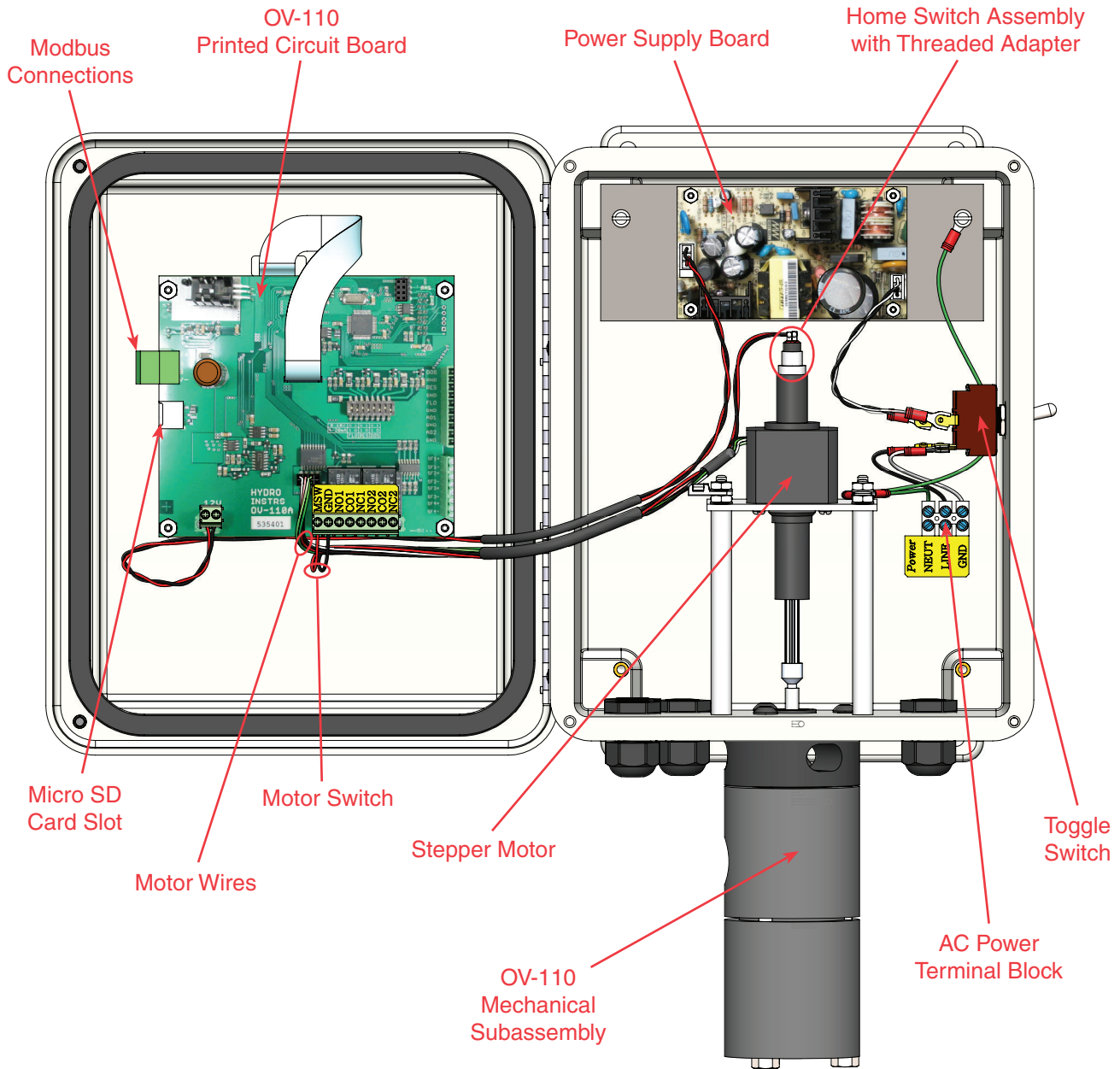
4. **Chemical Types and Ranges:** For gaseous chemical feed applications, the OV-110 Omni-Valve is most commonly used for chlorine, sulfur dioxide, ammonia, and carbon dioxide. For liquid chemical feed applications, the OV-110 Omni-Valve is most commonly used for sodium hypochlorite, hydrochloric acid, sodium bisulfite, sodium bisulfate, sodium chlorite, and aqueous ammonia solutions. Consult Hydro Instruments for usage in other chemical applications and for available feed rate ranges.

5. **Physical Design:** *(See Figure 2)*
   The Omni-Valve is the combination of a microprocessor controller and control valve in one compact unit. Both the microprocessor and the valve motor assembly are housed together in one NEMA 4X rated enclosure. The valve body is mounted onto the bottom face of the enclosure. The valve body is constructed of solid machined PVC parts. There are several different valve body sizes available. Valve shafts, valve stems, valve seats, and O-ring materials are selected for maximum corrosion resistance to the chemical being used. Two PTFE shaft seals separate the chemical from the interior of the enclosure. There is also a vent port to the outside in between the two shaft seals for additional protection against chemical entry to the enclosure. A variety of valve seats and valve stems are available to provide many different chemical feed rate ranges.

6. **Electrical Power, Inputs & Outputs:** *(See Figures 2 & 3)* The Omni-Valve has the following electrical connections.
   a. Standard power is 110–255VAC, 50/60 Hz universal power supply.
       Optional 12VDC power is available for special order.
   b. Three analog input channels. Each channel has dip switches to select between 4-20mA and 0-10V. Each channel has a 150 Ohm input impedance.
       FLO – Used for water flow meter or proportional control input signals.
       RES – Used for residual, ORP, or other set point input signals.
       DOS – Various user selected uses available. See Sections II and VII.2.
   c. Four 24 VDC relay input channels (SF1 – SF4). Used for Step Feed Control. NOTE: The acceptable range is 12 to 24 VDC. See Section II.6. If not using step feed control, then SF3 can be used for external selection of duty/standby. Also, (if enabled in Section VII.4 then) SF4 can be used for remote control of Auto/Manual mode. See Figure 3 and Section VII.4.
   d. Two 4-20mA analog output channels. Both represent chemical feed rate (based on valve position). Each channel has a 250 Ohm output impedance.
   e. There are two relays. Both NC and NO connections are available. Rating is 10 Ampere (resistive) and 250 VAC 250 VDC.
       See Figure 3 and Section VI screens 6b and 6c. Each relay can be individually selected to indicate either normal alarms, Auto/Manual, or Duty/Standby.
   f. Modbus RS-485 communication. The Omni-Valve is equipped for remote display and communication using the modbus RS-485 standard. To do this, you must define the node, baud rate and parity of the system. For more information on how to setup modbus refer to the Modbus Communication Setup document.

7. **Alarm Conditions & Acknowledgement:** Alarm conditions are displayed on the alarm screen in operation mode. See Section V.

   Acknowledgement – Press the "minus" ⊖ key to acknowledge the alarm.

   NOTE: Any of the below contacts will activate this alarm relay. The alarm is non latching.

8. **Dip Switches:** These switches are used to select whether the analog input channels are to be used for 4-20 mA or 0-10 Volts. They are always set for 4-20 mA at the factory. *(See Figure 3.)*

   a. Switch 1 and 2 set the FLO (PV1) input channel for a 4-20 mA input when switch 1 is on (up) and switch 2 is off (down). The FLO input channel is set for 0-10 Volts when switch 1 is off (down) and switch 2 is on (up).

   b. Switch 3 and 4 set the RES (PV2) input channel for a 4-20 mA input when switch 3 is on (up) and switch 4 is off (down). The RES input channel is set for 0-10 Volts when switch 3 is off (down) and switch 4 is on (up).

   c. Switch 5 and 6 set the DOS (PV3) input channel for a 4-20 mA input when switch 5 is on (up) and switch 6 is off (down). The DOS input channel is set for 0-10 Volts when switch 5 is off (down) and switch 6 is on (up).

Control Mode	Alarm Condition	Description	Action
Flow Pacing	Flow Signal Loss	PV1 Signal below 4 mA	Valve Close or Hold Position**
Flow Pacing	Low Flow	PV1 Signal below set point*	None
Residual/ORP	Res/ORP Signal Loss	PV2 Signal below 4 mA	Valve Close or Hold Position**
Residual/ORP	Low Residual	PV2 Signal below set point***	None
Residual/ORP	High Residual	PV2 Signal above set point***	None
Compound Loop or Feed Forward	Flow Signal Loss	PV1 Signal below 4 mA	Switch to Residual/ORP Condn 1
Compound Loop or Feed Forward	Low Flow	PV1 Signal below set point*	None
Compound Loop or Feed Forward	Res/ORP Signal Loss	PV2 Signal below 4 mA	Switch to Flow Pacing Control
Compound Loop or Feed Forward	Low Set Point	PV2 Signal below set point***	None
Compound Loop or Feed Forward	High Set Point	PV2 Signal above set point***	None

FIGURE 3 – PINOUT DIAGRAM FOR OV-110 CIRCUIT BOARD
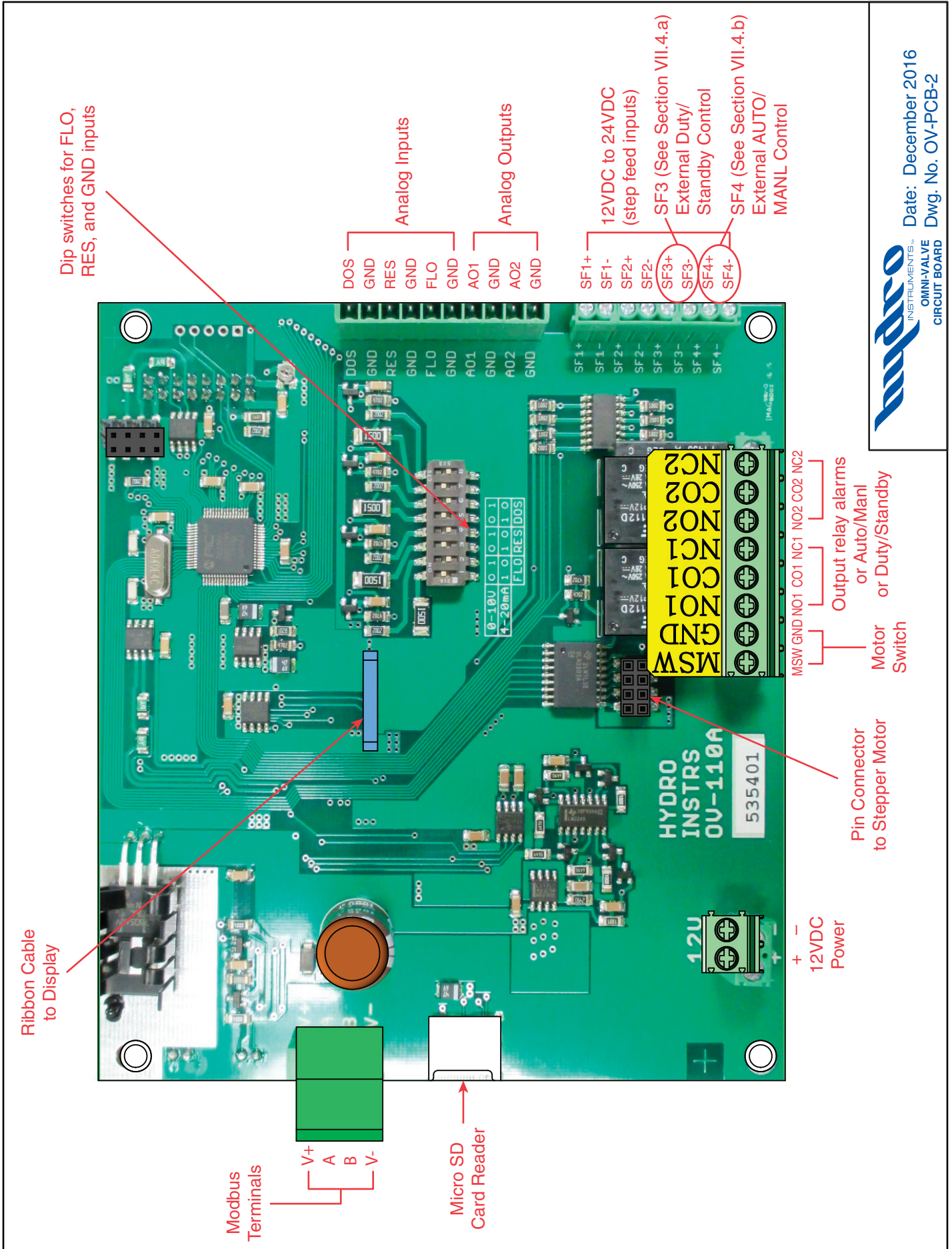
II. CONTROL METHODS

The OV-110 Omni-Valve offers the following control methods. The control method is selected in the Configuration Mode (See Section VI).

1. **Flow Pacing (Proportional):** Figure 4 below shows an example installation.

    a. *Application:* This control method is suitable when water quality is consistent, but water flow rate is variable.

    b. *Control Signals:* In this case, a 4-20mA (or 0-10V) signal from the water flow meter (measuring water flow just upstream from the injection point) is input to the FLO/GND input channel of the OV-110.
    NOTE: If desired, a proportional 4-20mA control signal from any PLC can be used in the same fashion.

    c. *Control Concept:* Chemical feed rate is adjusted in direct proportion to the input signal with no delay.

    d. *Initial Settings:* In the Configuration Mode (Section VI), the flow settings will need to be adjusted to match the water flow meter being used.

    e. *User Interaction:* During operation, the user only needs to adjust the dosage setting to adjust the ratio of chemical feed rate to water flow rate. Optionally the dosage can be remotely adjusted by means of the DOS/GND input channel. See Section VII.2.

FIGURE 4 – FLOW PACING
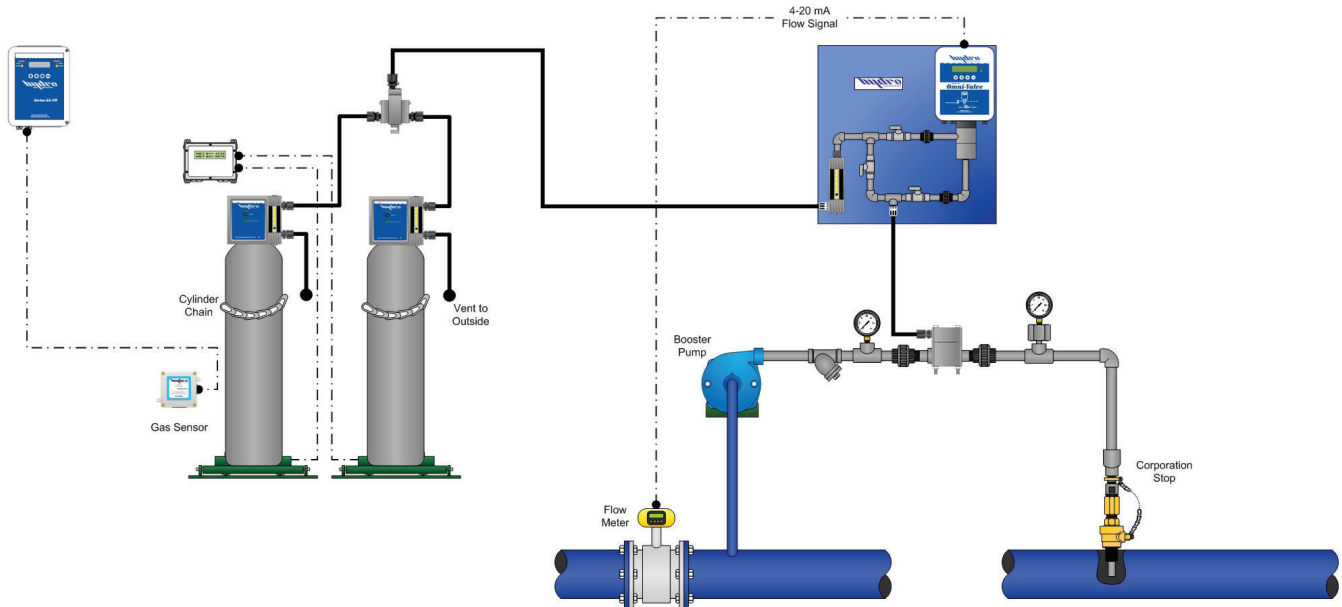
2. **Residual/ORP (Set Point):** Figure 5 below shows an example installation.

   a. *Application:* This control method is suitable when water quality is variable, but water flow rate is constant or relatively steady.

   b. *Control Signals:* In this case, a 4-20mA (or 0-10V) signal from the residual analyzer (measuring residual just downstream from the injection point) is input to the RES/GND input channel of the OV-110.

   c. *Control Concept:* Chemical feed rate is periodically adjusted in order to keep the resultant chlorine residual (or ORP or similar chemical concentration) on the user determined set point.

      i. Sample point selection is very important. Sample point must be at least 10 x pipe diameter downstream (to ensure complete mixing prior to sampling) and the lag time ("lag time" = the time it takes the chemical to travel from the Omni-Valve to the residual analyzer) should be minimized to optimize control (ideally limit this time to less than 5 minutes).

      ii. The Omni-Valve will only adjust chemical feed rate once every lag time. Each time the lag time expires, the Omni-Valve will compare the residual reading with the residual set point and if the residual reading is not on set point, then the chemical feed rate will be adjusted to bring the residual back toward the set point.

   d. *Initial Settings:* In the Configuration Mode (Section VI):

      i. The residual settings will need to be adjusted to match the residual analyzer that is being used.

      ii. The lag time will need to be measured on site and then entered.

      iii. Dead Band: The Dead Band allows for an adjustable range around the set point that is considered acceptable for residual. As long as the residual reading is within this range (+ or -) from the set point, then the residual is considered to be on set point.

      iv. Integral: The Integral "I" controls the magnitude of each chemical feed rate adjustment. The typical range is 10% < I < 30%. If the integral setting is too low, then the Omni-Valve will be too slow in making adjustments and if the integral setting is too high, then it will continually overshoot the set point (residual oscillating between too high and too low).

   e. *User Interaction:* During operation, the user only needs to adjust the residual set point. Optionally the set point can be remotely adjusted by means of the DOS/GND input channel. See Section VII.2.

FIGURE 5 – RESIDUAL (SET POINT)

9

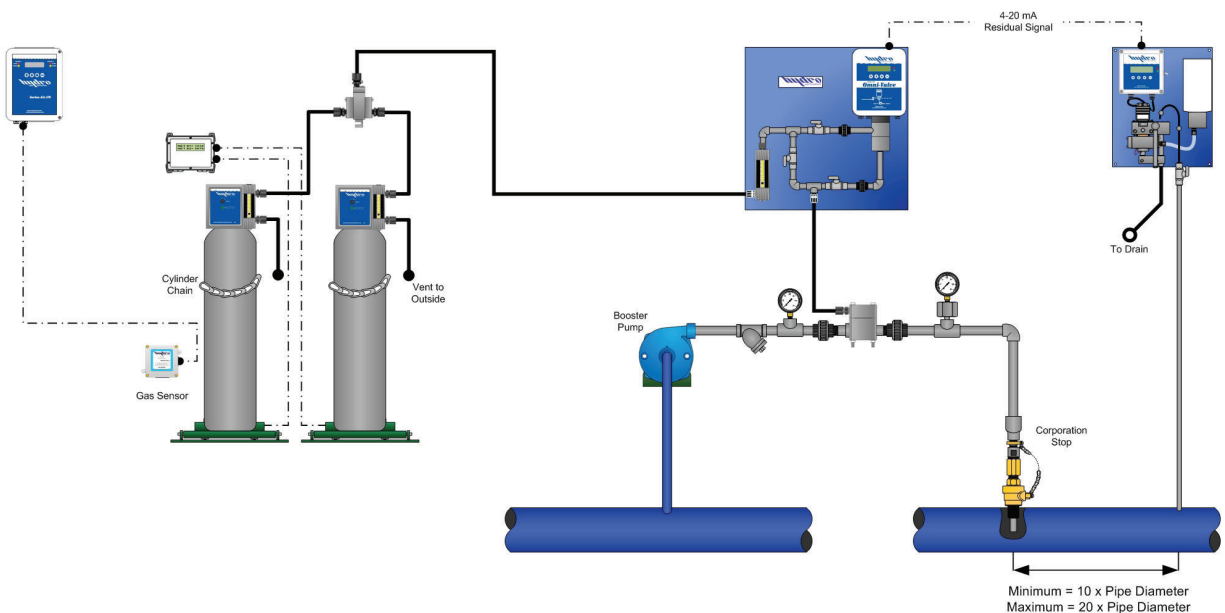3. **Compound Loop (PID):** Figure 6 below shows an example installation.

   a. *Application:* This control method is suitable when both water quality and water flow rate are variable.

   b. *Control Signals:* In this case, two input signals are required:
      i. A 4-20mA (or 0-10V) signal from the water flow meter (measuring water flow just upstream from the injection point) is input to the FLO/GND input channel of the OV-110.
      ii. A 4-20mA (or 0-10V) signal from the residual analyzer (measuring residual just downstream from the injection point) is input to the RES/GND input channel of the OV-110.

   c. *Control Concept:* Both Flow Pacing (Section II.1) and Residual (Section II.2) are being carried out simultaneously. Review both above Flow Pacing and the Residual Control sections.

   d. *Initial Settings:* In the Configuration Mode (Section VI):
      i. All of the settings from both Flow Pacing (Section II.1) and Residual (Section II.2).
      ii. Flow Stop: If the water flow completely stops, then the Omni-Valve will continue to adjust based on residual. This can be avoided by setting a lower limit on the flow signal below which the automatic control will automatically turn off. See section VII.3.
      iii. Variable lag time: Since the lag time is often approximately inversely proportional to the water flow rate (meaning as the water flows faster, the lag time will decrease), Compound Loop Control method allows for a variable lag time. If variable lag time is to be used, then it needs to be enabled, the lag time, the water flow rate at that entered lag time, and a maximum allowable value for lag time must all be entered in the Configuration Mode.

   e. *User Interaction:* During operation, the user will adjust both the dosage (Section II.1) and the residual set point (Section II.2). Optionally the dosage or the set point can be remotely adjusted by means of the DOS/GND input channel. See section VII.2.

FIGURE 6 – COMPOUND LOOP (PID)
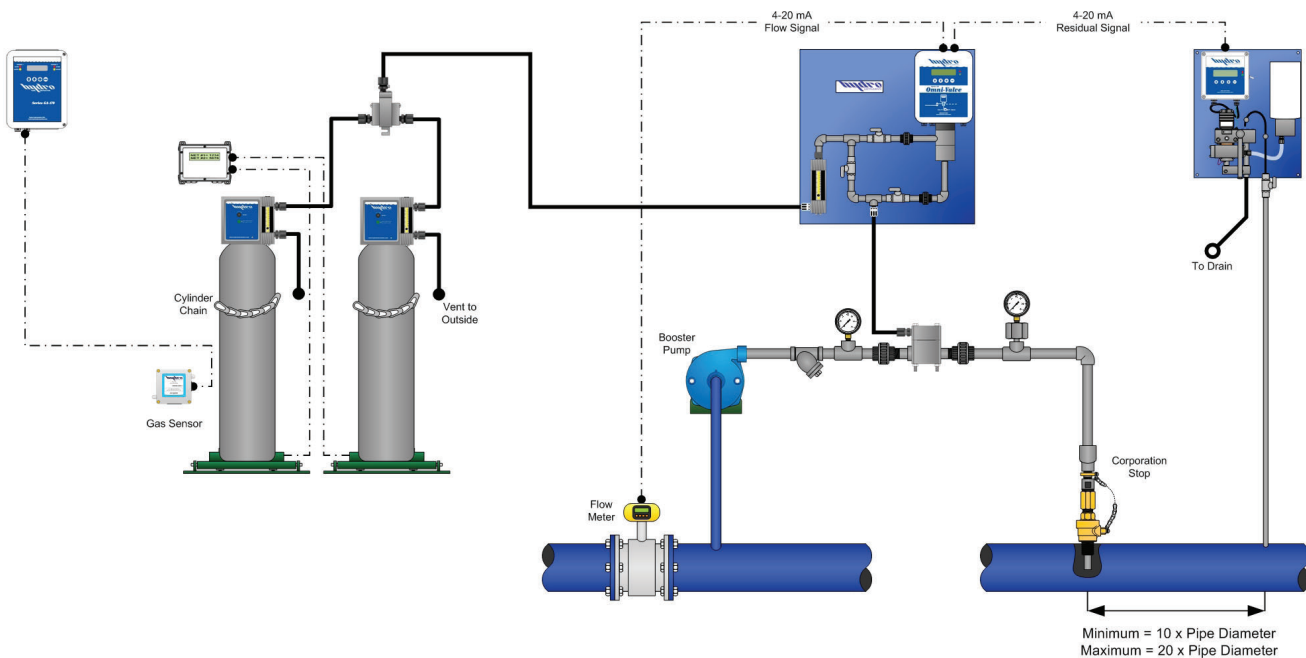
4. **Dual Input Feed Forward:** Figure 7 below shows an example installation.

   a. *Application:* Chemical feed rate is controlled in proportion to the mass flow rate of a second chemical that is already in the water stream. This is most commonly used in de-chlorination and chloramination applications. In these applications, chemical is being injected in order to react with another chemical that is already present in the water stream.

   b. *Control Signals:* In this case, two input signals are required:
      i.   A 4-20mA (or 0-10V) signal from the water flow meter (measuring water flow just upstream from the injection point) is input to the FLO/GND input channel of the OV-110.
      ii. A 4-20mA (or 0-10V) signal from the residual analyzer (measuring residual of the target chemical just upstream from the injection point) is input to the RES/GND input channel of the OV-110.

   c. *Control Concept:* This method requires a water flow signal and a residual signal for the other chemical that is already present in the water stream. The Omni-Valve uses these two signals to calculate the mass flow rate of the other chemical in the water stream. The Omni-Valve will then control chemical feed rate in proportion to this mass flow rate.

   d. *Initial Settings:* In the Configuration Mode (Section VI):
      i.   All of the settings from both Flow Pacing (Section II.1).
      ii. Residual (Section II.2) signal reading parameters only (no Dead Band, Lag Time, or Integral).

   e. *User Interaction:* During operation, the user only needs to adjust the dosage setting to adjust the ratio of chemical feed rate to the other chemical mass flow rate. Optionally the dosage can be remotely adjusted by means of the DOS/GND input channel. See Section VII.2.

FIGURE 7 – DUAL INPUT FEED FORWARD
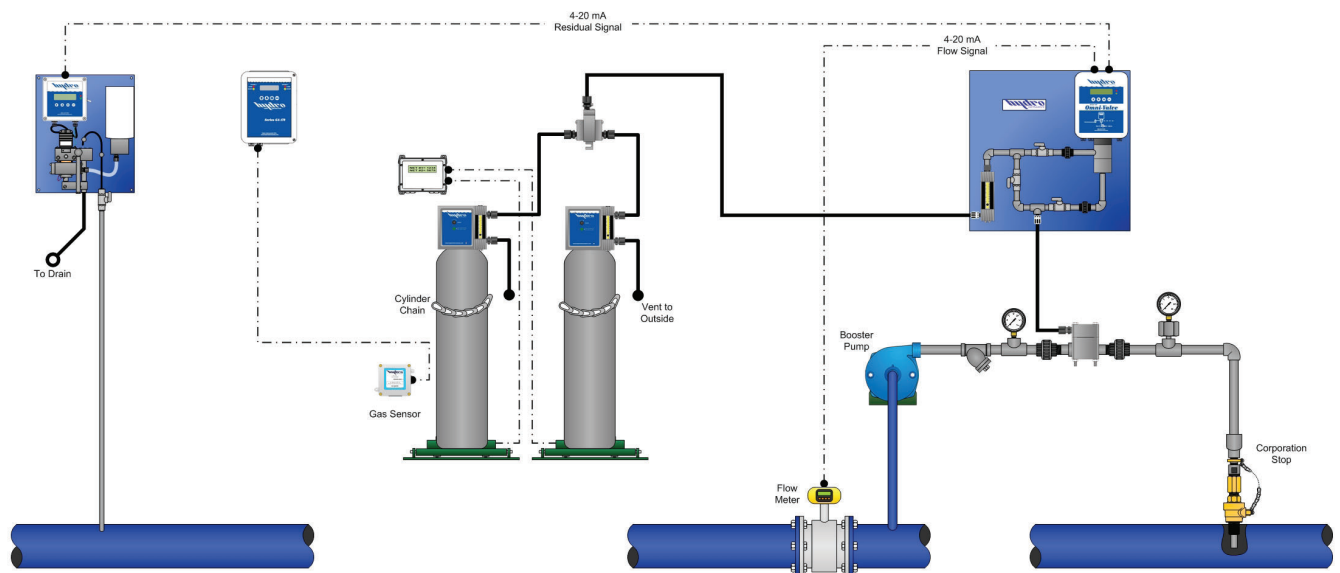
5. **Step Feed:** Figure 8 below shows an example installation.

   a. *Application:* This control method is useful for systems injecting chemical into a line downstream of one to four supply pumps when each of the pumps has a fixed flow rate (up to four wells or other pumps feeding one line).

   b. *Control Signals:* In this case, there will be up to four 24VDC dry contact input signals. These signals are used to indicate whether each pump is on or off. The signals are to be connected to the SF1+/SF1-, SF2+/SF2-, SF3+/SF3-, and SF4+/SF4- input channels. NOTE: The acceptable range is 12 to 24 VDC.

   c. *Control Concept:* Up to four relay contact signals are input to the Omni-Valve. Each relay can be allotted a fixed chemical feed rate. The Omni-Valve chemical feed rate is then set to the sum of the feed rates allotted to the relays that are active.

   d. *Initial Settings:* In the Configuration Mode (Section VI), the chemical feed rate for each input channel must be entered.

   e. *User Interaction:* During operation, no user interaction is required.

FIGURE 8 – STEP FEED
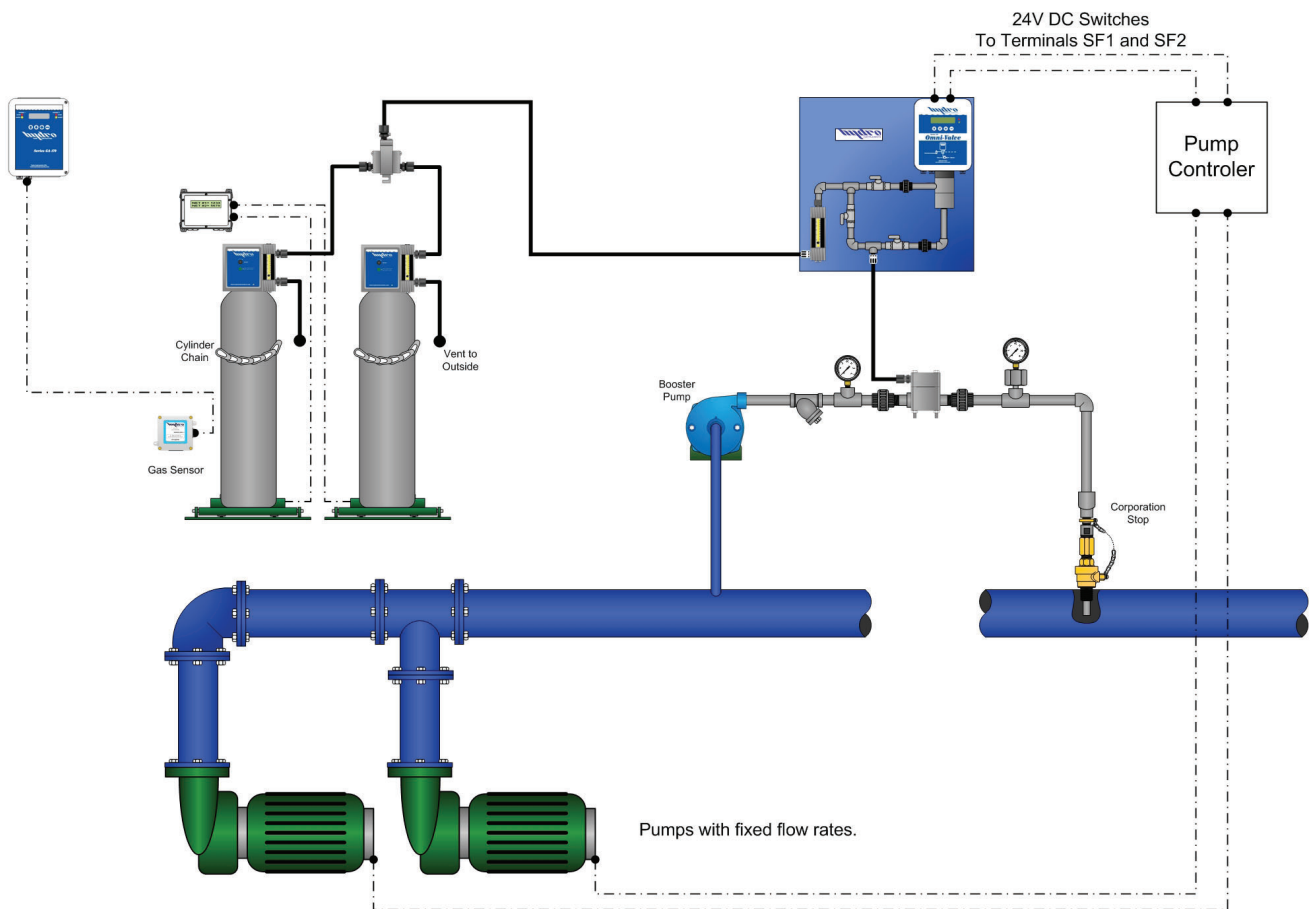
6. **Dual Set Point:** Figure 9 shows an example installation.

   a. *Application:* This control method is designed for applications injecting chemical upstream of a contact chamber. In such cases, a residual analyzer nearby the injection point can be used to control chemical injection. This allows for automatic control of residual at the injection point. However, control of the residual at the outlet of the contact chamber is the ultimate goal. If water quality remains constant then there will be a fixed drop in residual between the injection point and the contact chamber outlet. However, water quality variations will cause this residual drop to be variable. This control method is used to overcome this problem and allow for fully automated chemical feed rate control in such situations.

   b. *Control Signals:* In this case, two input signals are required:
      NOTE: Refer to Section VII.2.d. for information on how to activate the DOS/GND input.
      i.   A 4-20mA (or 0-10V) signal from the residual analyzer (measuring residual just downstream from the injection point) is input to the RES/GND input channel of the OV-110.
      ii. A 4-20mA (or 0-10V) signal from the residual analyzer (measuring residual at the contact chamber outlet) is input to the DOS/GND input channel of the OV-110.

   c. *Control Concept:* The OV-110 can be operated in either Residual Control or Compound Loop Control using the Dual Set Point control method. In either case, the chemical feed rate control will be carried out using the residual signal coming into RES/GND (as described in Sections II.2 and II.3).
      i.   As in the above Section II.2 and II.3, there will be a lag time for the injection point analyzer (RES/GND channel). We will call this lag time "LT1". As described in Sections II.2 and II.3, this lag time should be limited to 5 minutes or less.
      ii. There will also be a lag time for the residual analyzer (DOS/GND channel) that is located at the outlet of the contact chamber. This lag time (call it LT2) should be set as the delay from feed rate changes to registering on the DOS/GND analyzer plus 3 to 4 times LT1. For example, if LT1 = 100 seconds and the delay for the DOS/GND analyzer is 1800 seconds, then set LT2 = 1,800 + 3 x 100 = 2,100 seconds. LT2 has a range up to 9999 seconds (over 2 hours & 46 minutes).
      iii. In this Dual Set Point control method, there is a user adjustable set point for each of the analyzers. We will call them SP2 (RES/GND channel) and SP3 (DOS/GND channel).
      iv. The Dual Set Point control method concept is that each time the LT2 lag time expires, the Omni-Valve will compare the residual reading (on DOS/GND channel) with its SP3 set point. If this residual reading is not on set point, then the Omni-Valve will then automatically adjust the SP2 accordingly.

   d. *Initial Settings:* In the Configuration Mode:
      i.   The residual settings will need to be adjusted to match each of the residual analyzers.
      ii. Both of the lag times (LT1 and LT2) will need to be measured on site and entered.
      iii. "PV3 Integral" is used to adjust the magnitude of each SP2 adjustment. (1% < PV2 Integral < 100%). The default value is 50%. See section VI, screen 8c.
      iv. Some of the settings made for the "Res" input will be used for "Res2". Those include: units, decimal position, filter time, and dead band.

   e. *User Interaction:* If in Residual Control Mode, then the user will be able to adjust both of the residual set points (SP2 and SP3). If in Compound Loop Control Mode, then the user will also adjust the dosage.

FIGURE 9 – DUAL SET POINT

To Drain

Contact Chamber
> 30 minutes

To Drain

Minimum = 10 x Pipe Diameter
Maximum = 20 x Pipe Diameter

Corporation
Stop

4-20 mA
Residual Signal Two

4-20 mA
Residual Signal One

4-20 mA
Flow Signal

Booster
Pump

Flow
Meter

Vent to
Outside

Cylinder
Chain

Gas Sensor
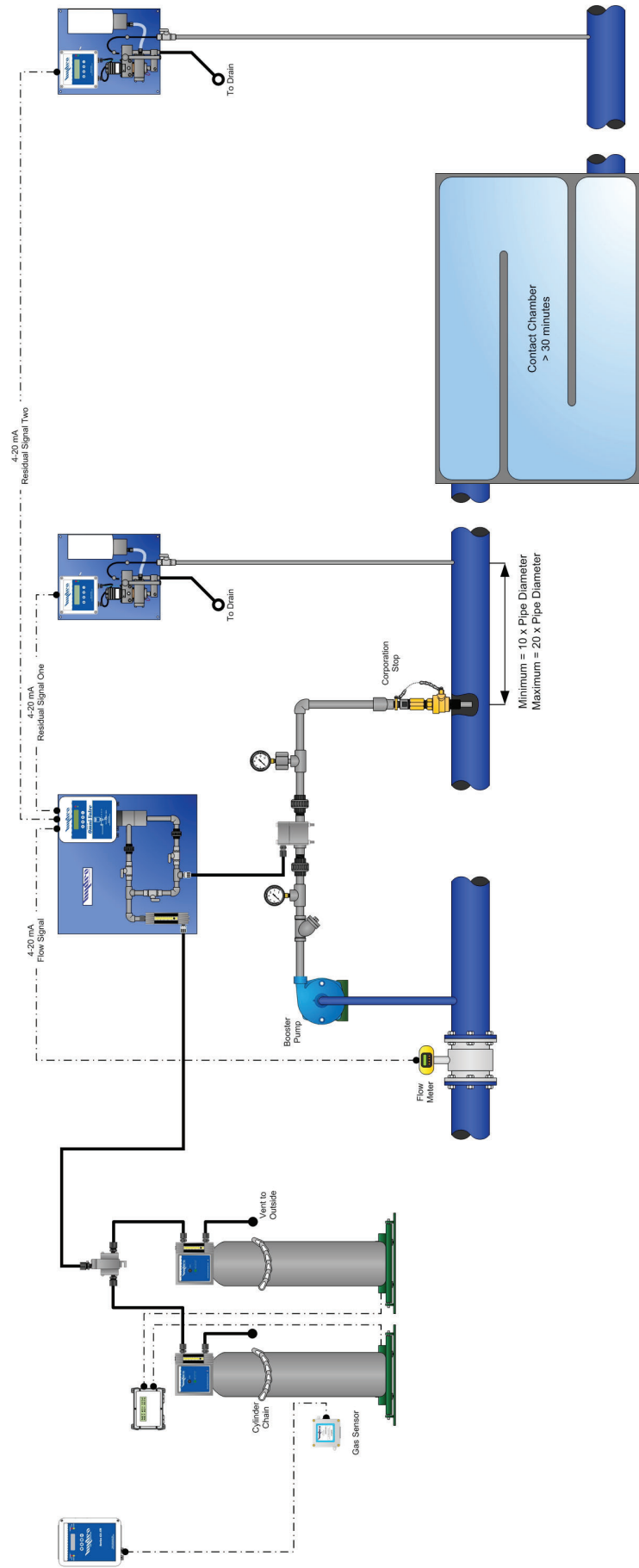
III. USER INTERFACE

The Omni-Valve operation and adjustments are carried out through the following interface features.

1. Keypad Operation – The keypad is used in all three modes of the OV-110. Generally the keys are used as outlined here below. However, detailed instructions will follow.

    a. ⬆ & ⬇ keys – These keys are used to cycle through the various display screens. These keys will be referred to as "up arrow" and "down arrow".

    b. ⊕ & ⊖ keys – These keys are generally used to adjust settings and values within the screen being displayed. These keys will be referred to as "plus" and "minus". Additionally, the plus key is used as Enter for blinking options on the Configuration modes SETUP screen or to Enter yes/no selections while in the Advanced Calibration mode.

2. On the main operating screen you can manually switch between automatic (AUTO) and manual (MANL) modes of the Omni-Valve by pressing the ⊕ key. The valve can be changed from AUTO to MANL remotely as well, see section VII.4 for details.

IV. MOTION CONTROL, VALVE, AND 10 POINT LINEARIZATION

The Omni-Valve uses a linear stepper motor for valve stem motion control. The motor shaft is directly coupled to the valve shaft. The motor covers its range of motion in 2000 steps. The motor position over the range can also be described in terms of motor steps (where a position of 0 steps is the fully closed position and a position of 2000 steps is the fully open position). In a given system, each motor position will correspond to a chemical feed rate. For example motor positions from 0 to 215 might correspond to zero chemical feed and motor position 1925 might correspond to the maximum chemical feed rate. There is a calibration procedure that must be carried out with an external chemical flow meter in order to calibrate each Omni-Valve in each installation (calibrate the motor position vs. chemical feed rate). Consider Figures 10 through 12 and review Section VII screens 6a – 7.

FIGURE 10 – OPEN AND CLOSED VALVE POSITIONS
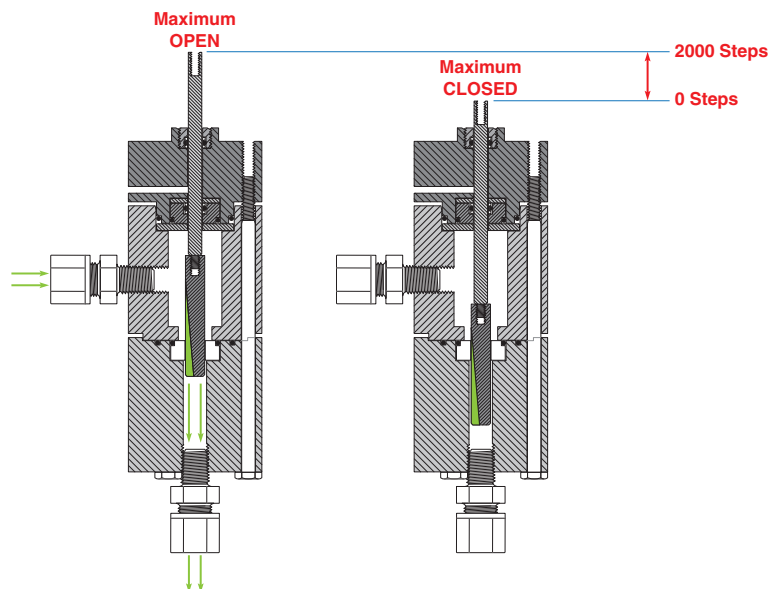
FIGURE 11 – EXAMPLE FEED RATE AND MOTOR POSITION CHART

Maximum OPEN
2000 Steps

0 Steps
Maximum CLOSED

Maximum OPEN
2000 Steps

0 Steps
Maximum CLOSED

Feed Rate %	Feed Rate kg/hr	Motor Position Steps
0%	0	160
5%	0.5	305
10%	1	395
15%	1.5	450
25%	2.5	600
35%	3.5	750
50%	5	1010
70%	7	1300
85%	8.5	1570
100%	10	1820
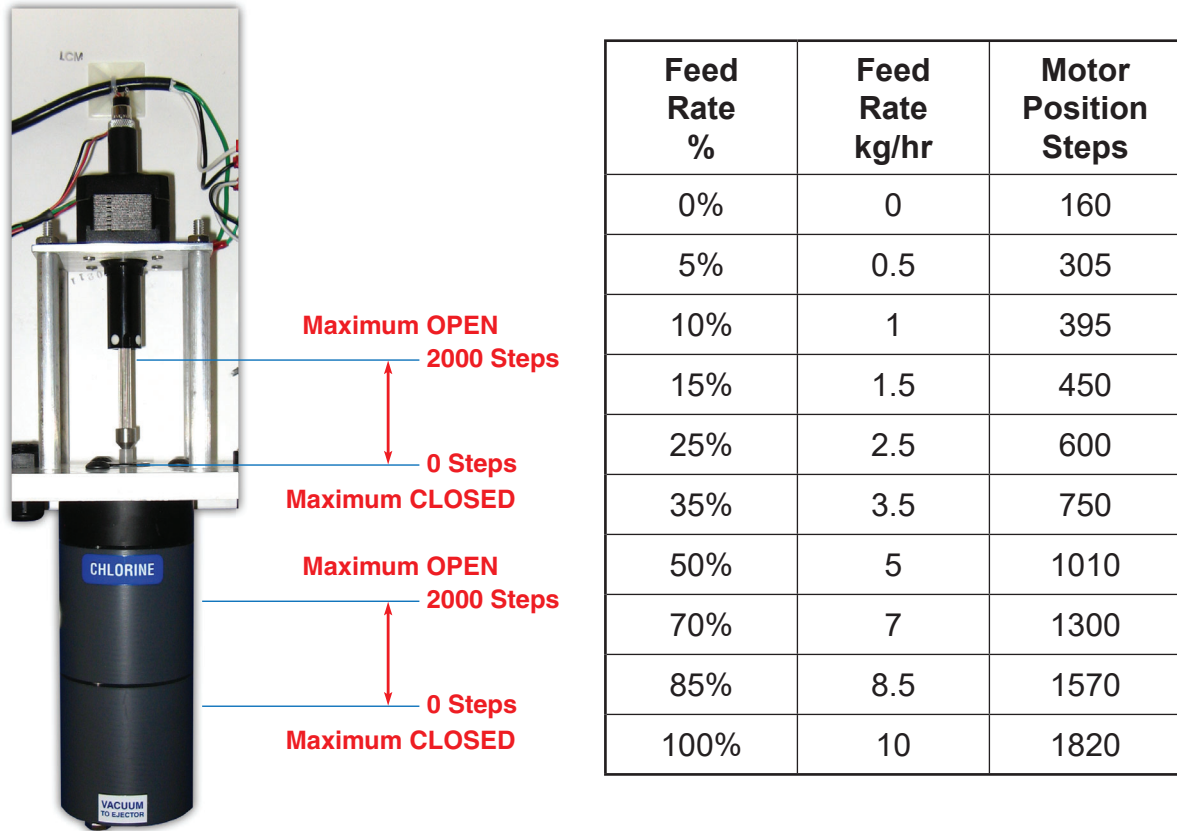
FIGURE 12 – TEN POINT CALIBRATION CHART

10 Point Calibration
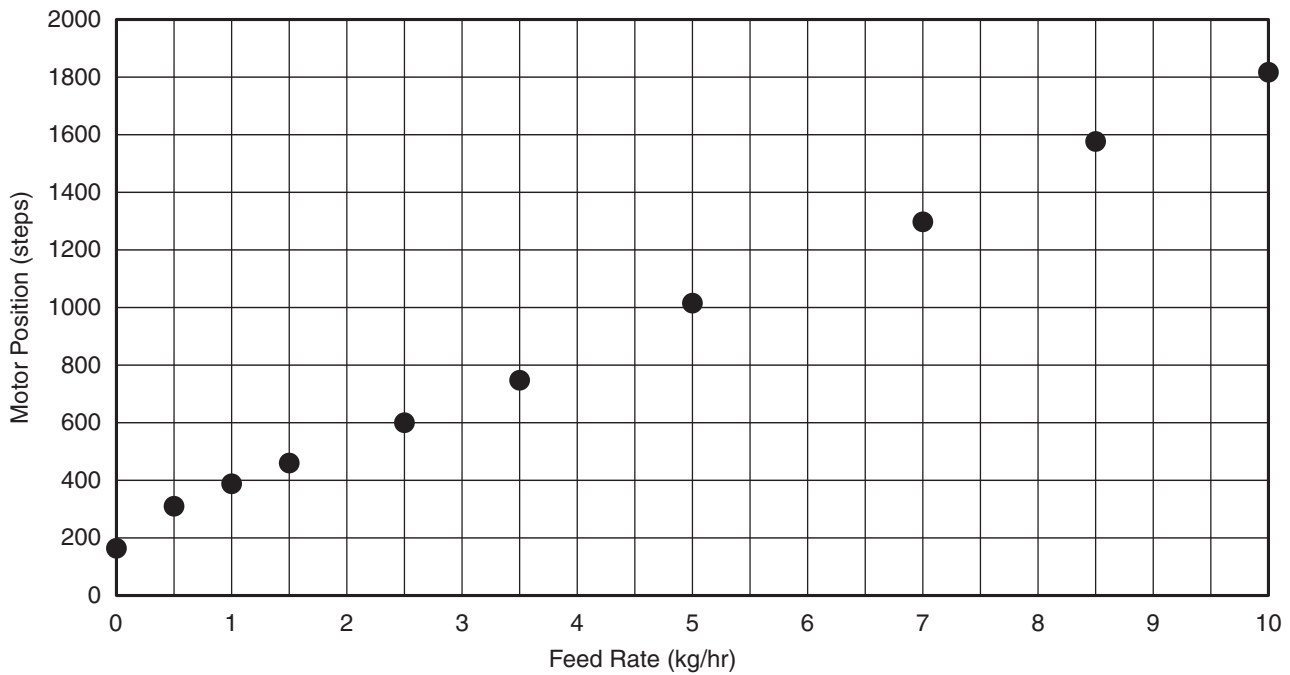
V. OPERATION MODE

The operation mode is a set of screens that display the main operating parameters based on the control type selected in the configuration mode. The dosage, residual/ORP set point, and chemical feed rate can be adjusted from these screens.

FIGURE 13 – OPERATION MODE SCREENS
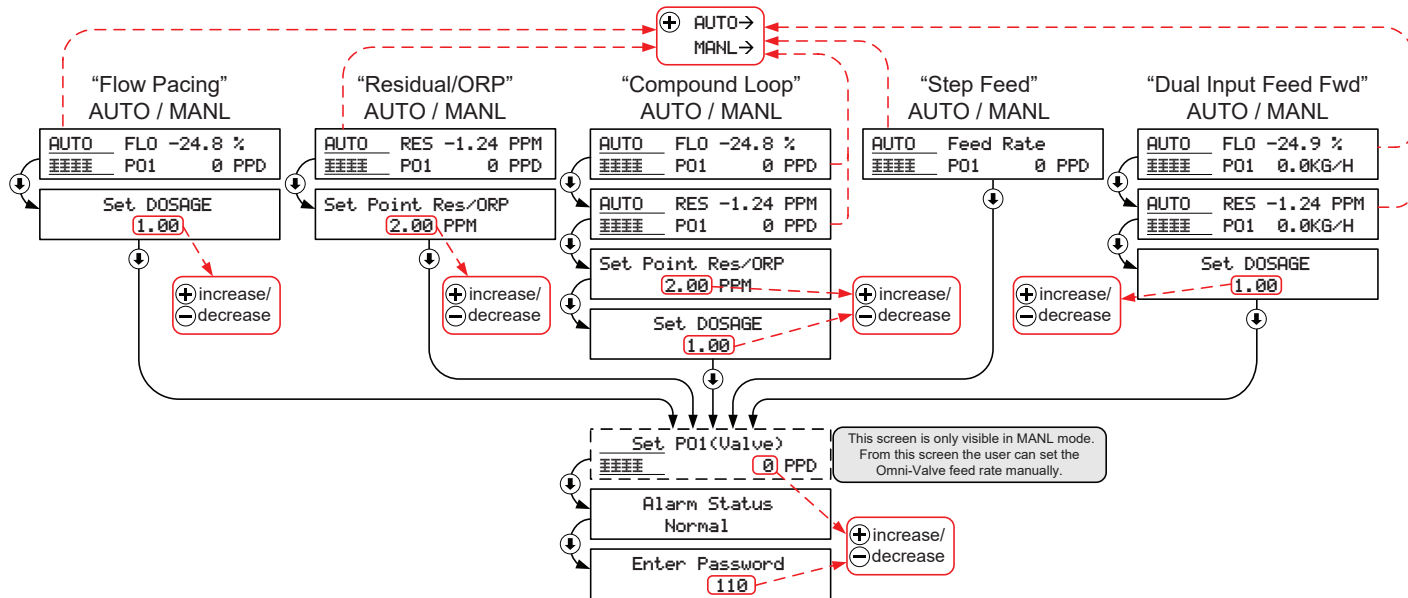
NOTES:

1. On the first screen on each mode, use the ⊕ key to switch between AUTO and MANL.
2. "Set PO1 (valve)" screens only appear if set to MANL mode. From this screen the user can set the Omni-Valve feed rate manually using the ⊕ and ⊖ keys.
3. Use the ⊕ and ⊖ keys to adjust Dosage, Set Points, Valve Position (PO1) etc…

Dosage: This value is a multiplication factor for the calculated chemical feed rate. It can be set to fine tune the feed rate when in Flow Pacing, Compound Loop, Feed Forward or Dual Set Point control.

Flow Pacing Example:
Valve Output = [(Actual Flow/Flow Full Scale) * Valve Full Scale] * Dosage

Setpoint: The set point is the residual/ORP/pH value that the Omni-Valve will try to maintain.

VI. CONFIGURATION MODE

FIGURE 14 – CONFIGURATION SCREENS

Control Type
Flow Pacing

SETUP: FLO RES STEP OUT ALM ADCAL

Flow Pacing→
Residual/ORP→
Compound Loop→
Step Feed→
Dual Input Feed Fwd→

ADCAL

Begin Adv Cal Mode? No Yes

Refer to Section VII and Figure VII for detailed "Advanced Calibration Mode" instructions.

ALM

Alarm Delay Time 10 secs

Output Relay 1 Usage Normal Alarms

Normal Alarms→
Auto(Off)/Man1(On)→
Duty(Off)/Stdby(On)→
PO1 Gas Flow Alarm→

Output Relay 2 Usage Normal Alarms

OUT

Output Units PPD

PPD→GR/H→KG/H→GPH→
GPM→GPD→LPM→LPH→%→

Output Decimal Posn 00000

00000→0000.0→
00.00→0.000→
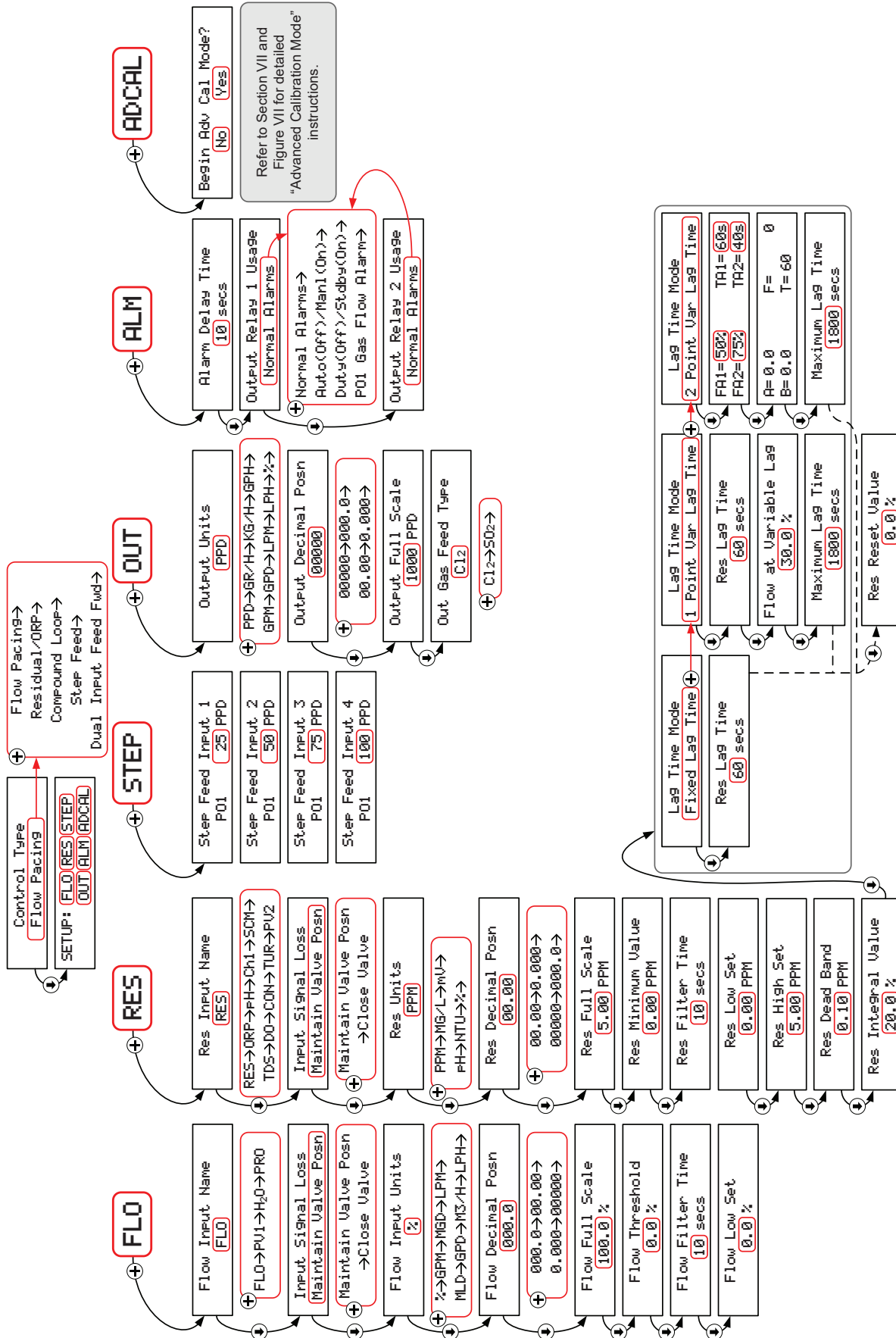
Output Full Scale 1000 PPD

Out Gas Feed Type Cl2

Cl2→SO2→

STEP

Step Feed Input 1 PO1 25 PPD

Step Feed Input 2 PO1 50 PPD

Step Feed Input 3 PO1 75 PPD

Step Feed Input 4 PO1 100 PPD

RES

Res Input Name RES

RES→ORP→pH→Ch1→SCM→
TDS→DO→CON→TUR→PV2

Input Signal Loss Maintain Valve Posn

Maintain Valve Posn →Close Valve

Res Units PPM

PPM→MG/L→mV→
pH→NTU→%→

Res Decimal Posn 00.00

00.00→0.000→
00000→0000.0→

Res Full Scale 5.00 PPM

Res Minimum Value 0.00 PPM

Res Filter Time 10 secs

Res Low Set 0.00 PPM

Res High Set 5.00 PPM

Res Dead Band 0.10 PPM

Res Integral Value 20.0 %

FLO

Flow Input Name FLO

FLO→PV1→H$_2$O→PRO

Input Signal Loss Maintain Valve Posn

Maintain Valve Posn →Close Valve

Flow Input Units %

%→GPM→MGD→LPM→
MLD→GPD→M3/H→LPH→

Flow Decimal Posn 000.0

000.0→00.00→
0.000→000000→

Flow Full Scale 100.0 %

Flow Threshold 0.0 %

Flow Filter Time 10 secs

Flow Low Set 0.0 %

Lag Time Section

Lag Time Mode 2 Point Var Lag Time

FA1=50% TA1=60s
FA2=75% TA2=40s

A=0.0 F= 0
B=0.0 T=60

Maximum Lag Time 1800 secs

Lag Time Mode 1 Point Var Lag Time

Res Lag Time 60 secs

Flow at Variable Lag 30.0 %

Maximum Lag Time 1800 secs

Res Reset Value 0.0 %

Lag Time Mode Fixed Lag Time

Res Lag Time 60 secs

The configuration mode of the Omni-Valve allows the user to adjust key parameters to the control type selected. As a general reference all settings on the analyzer should match the setting on the incoming signals. The following is a brief description of what each setting does. Note that based on the type of control method selected all the screens may not appear.

Enter Password: To enter the configuration mode, a password must be entered. Hydro Instruments' has set this password equal to "110".

Control Type: This screen allows the user to select the control type desired. Refer to section II for the optimal control type desired.

FLO – Flow

These screens are used for setting up the water flow signal and control parameters.

Flow Input Name (1a): This screen allows the user to enter a name for the flow signal. Options include: PV1, H_2O, PRO, FLO.

Input Signal Loss (1b): This screen will dictate to the Omni-Valve what to do when the FLO (PV1) signal has been lost. The Omni-Valve can either maintain its current feed or close the valve to stop feed until the signal is restored. If using Compound Loop control and the RES (PV2) signal is still present than the valve will switch to Residual Set Point control.

Flow Input Units (1c): This screen allows the user to set the flow units on the omni-valve. Options included: %, GPM, MGD, LPM, MLD, GPD, M^3/H, LPH.

Flow Decimal Posn (1d): This screen sets the decimal position of flow signal on the omni-valve.

Flow Full Scale (1e): This screen sets the full scale of flow rate the omni valve will display. I.E. the flow rate when the signal input is at 20 mA (or 10 V). It is very important to match this with the full scale of the flow meter.

Flow Threshold (1f): This value determines the flow percentage below which the flow signal will be ignored. This also re-scales the incoming flow signal. For example, with a 4-20 mA signal and a flow threshold of 50%, the omni-valve will remain closed at any signal below 12 mA and will begin feeding above 12 mA linearly up to 20 mA. For normal operation this value should be set at 0% so that it will feed throughout the whole 4-20 mA range.

Flow Filter Time (1g): This value will set the time over which the omni-valve will average incoming flow signal.

Flow Low Set (1h): This is used for alarm indication for when the flow rate has gone below the set value.

RES – Residual

These screens are used for setting up the residual signal and control parameters.

Res Input Name (2a): This screen allows the user to enter a name for the residual signal. Options include: RES, ORP, pH, Ch1, PV2, SCM, TDS, DO, CON, TUR.

Input Signal Loss (2b): This screen will dictate to the Omni-Valve what to do when the RES (PV2) input signal has been lost. The Omni-Valve can either maintain its current feed or close the valve to stop feed until the signal is restored. If using Compound Loop control and the FLO (PV1) signal is still present than the valve will switch to Flow Pacing control.

Res Units (2c): This screen allows the user to enter the units for the incoming residual signal. Options include: PPM, mg/L, mV, pH, NTU, %.

Res Decimal Posn (2d): This screen sets the decimal position of residual on the Omni-Valve.

Res Full Scale (2e): This screen sets the full scale residual/ORP displayed on the Omni-Valve. This corresponds the 20 mA (or 10 V) output from the downstream controller.

Res Minimum Value (2f): This screen sets the low end value of the residual/ORP signal. This would correspond to the 4 mA (or 0V) incoming signal from the downstream controller. This value is more often adjusted in ORP control type applications.

Res Filter Time (2g): This value will set the time over which the omni-valve will average incoming residual/ORP signal.

Res Low Set (2h): This is used for alarm indication for when the residual/ORP fall below the set value. Setting this value to 0 turns the alarm off.

Res High Set (2i): This is used for alarm indication for when the residual/ORP is above the set value.

Res Dead Band (2j): The dead band allows for an adjustable range around the set point that is considered an acceptable residual level. As long as the residual/ORP value is within +/- this value from the set point, the omni-valve will consider this level "ok" and not make any adjustments.

Res Integral Value (2k): This value is used in the PID control calculations to make calculated adjustments back to the set point. An integral value too high will cause large swings above and below the set point and an integral value to low will take too long to reach the set point. A typical value will be between 10-30 %. Hydro Instruments' factory sets this value at 20%.

Lag Time Mode (2l): Choose the lag time method on this screen. A fixed lag time sets a constant lag time to always be used. One point and two point variable lag times are used in Compound Loop for added control over the process. Variable lag times are used to adjust the residual lag time based on changes in process flow. A faster process flow rate will reach the downstream instrument faster and vice versa.

Res Lag Time (2m): The lag time is the time between when the Omni-Valve makes an adjustment and when it reads the incoming residual signal based on the adjustment. Lag times should be measured (and then entered) between when the Omni-Valve makes and adjustment and when that adjustment reaches the downstream instrument. This is a very important value for the most accurate and reliable control.

Flow at Variable Lag (3a): This is the process flow value below which the Omni-Valve will start to increase the lag time to the maximum lag on screen 3b.

Maximum Lag Time (3b): When variable lag time is selected on screen 2l, this value represents the longest time the Omni-Valve will wait to take a reading from the PV2 instrument once a feed adjustment has been made.

Two Point Variable Lag Time Settings (3d): For more advanced processes that have multiple varying lag times. Each lag time and its corresponding flow variable can be input on this screen.

Two Point Variable Lag Time Live Values (3e): As each lag time is calculated for the two point variable lag times their live data is displayed on this screen.

Res Reset Value (3c): This value is used in compound loop control for when the flow signal falls below the set value the incoming residual/ORP signal will be ignored.

RES2 – Residual Outlet

These screens are used for setting up the second residual signal and control parameters. These are for use with Dual Set-Point Control only.

System Outlet Range (8a): This screen is used to set the minimum and maximum value of a second residual/ORP analyzer. This is for dual set point control and the inputs for this analyzer should be wired into the DOS/GND line.

System Outlet Point (8b): Also referred to as "Lag Time 2", this value sets the time between when the Omni-Valve makes an adjustment and when it measures the incoming signal from the PV3 instrument based on that adjustment.

PV3 Integral Value (8c): This value is used in the PID control calculations to make calculated adjustments back to the set point. A larger integral value will make larger feed rate changes. Setting the value too high will cause rapid swings above and below the set point and setting it too low will take too long to reach the set point. Hydro Instruments recommends this value be set at 50%.

System Outlet (8d): This screen is used to set a fixed or variable lag time for the PV3 instrument.
A variable lag time can be used to adjust the PV3 lag time based on changes in the process flow.
A faster process flow rate will reach the downstream instrument faster and vice versa.

Maximum Lag Time (8e): When variable lag time is selected on screen 8d, this value represents the longest time the Omni-Valve will wait to take a reading from the PV3 instrument once a feed adjustment has been made.

Flow at Variable Lag (8f): This is the process flow value below which the Omni-Valve will start to increase the lag time to the maximum lag input on screen 8e.

OUT – Output

These screens are used for setting up the valves chemical feed output.

Output Units (4a): This screen allows the user to select the units or the chemical feed rate (PO1). Options include: %, PPD, g/hr, kg/hr, GPH, GPM, GPD, LPM, LPH.

Output Decimal Posn (4b): This screen sets the decimal position of chemical feed rate on the Omni-Valve.

Output Full Scale (4c): This screen sets the full scale of the chemical feed rate the omni valve will display.

Output Gas Type (5a): This screen allows the user to select between CL2 and SO2. This is important for control types where residual control is important as the CL2 acts proportionally to the residual signal (i.e. when the value is below set point it adds more chemical) and SO2 acts inversely proportional to the residual signal (I.E. when the residual signal is above the set point it adds more chemical). Thus SO2 is most commonly selected when de-chlorinating or pH control.

STEP – Step Feed

These screens are used for setting the incremental feed rates when using step feed control.

Step Feed Input 1 (7a): This value sets the percentage of full scale the omni-valve will feed when the SF1 terminal is activated.

Step Feed Input 2 (7b): This value sets the percentage of full scale the omni-valve will feed when the SF2 terminal is activated.

Step Feed Input 3 (7c): This value sets the percentage of full scale the omni-valve will feed when the SF3 terminal is activated.

Step Feed Input 4 (7d): This value sets the percentage of full scale the omni-valve will feed when the SF4 terminal is activated.
Note that if multiple pumps will be activated at once, the sum should not exceed 100%.

ALM – Alarm

These screens are used for setting up additional alarm features.

Alarm Delay Time (6a): Set the time for which a condition must be in alarm state for the alarm to activate.

Output Relay # Usage (6b, 6c): The user can independently select each of the relays to indicate one of three parameters: normal alarms, auto/manual, or duty/standby.

VII. ADVANCED CALIBRATION MODE

FIGURE 15 – ADVANCED CALIBRATION SCREENS
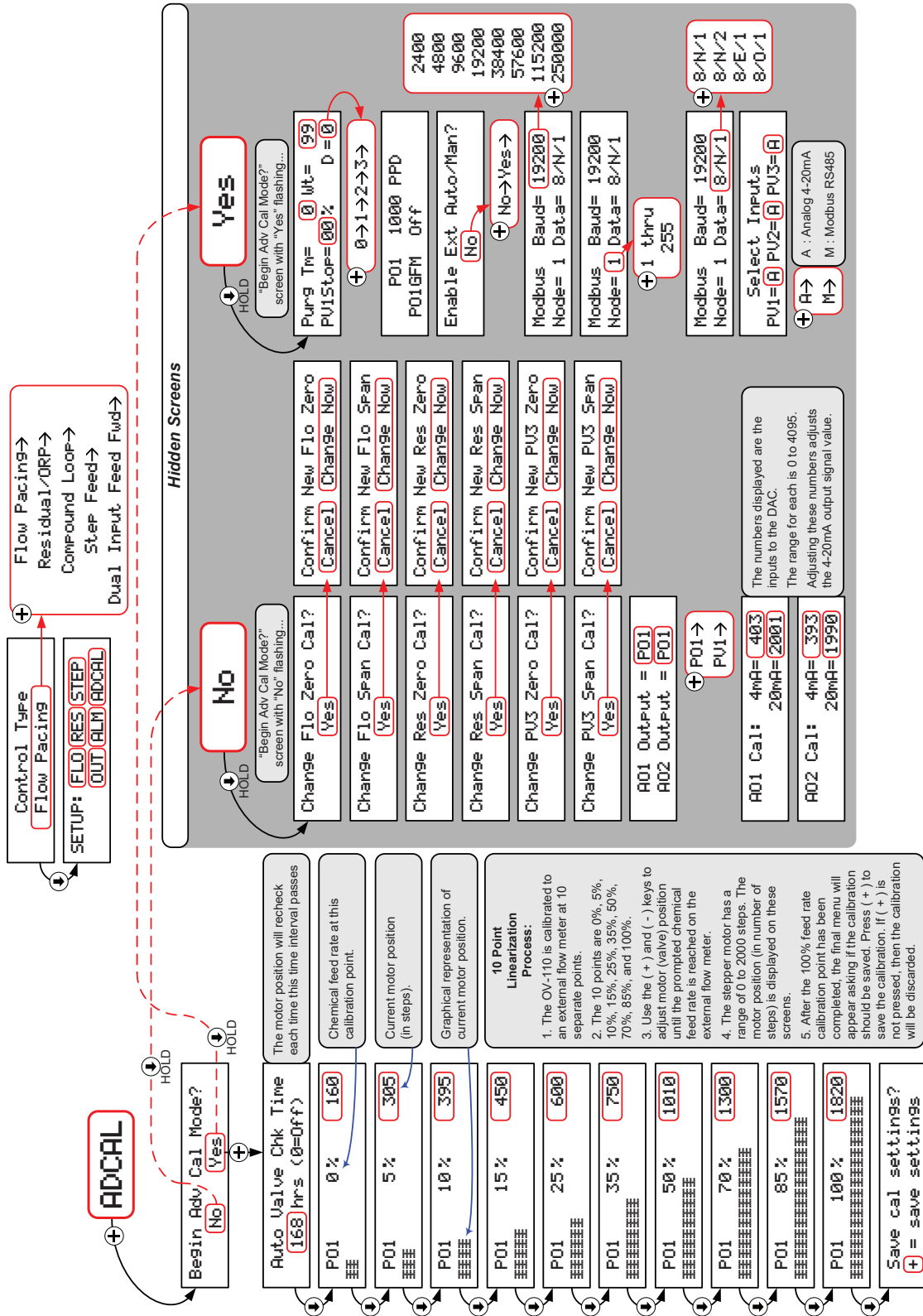
1. **Purge Feature (For Liquid Feed Systems):** In applications using the Omni-Valve to feed liquid chemicals (especially at low flow rates), the valve orifice can become blocked with particles in the liquid chemical. In order to overcome this issue, the Omni-Valve can be programmed to fully open for a set time on a periodic basis. The two parameters on line one of screen 5b are related to the Purge Feature.

   a. The period between openings is the "Purg Tm" (the time is in minutes). A setting of 60 means that the valve will open once every 60 minutes. A setting of 0 means that the purge feature is not enabled.

   b. The "Wt" is the duration of time resting at fully open (the time is in seconds). A setting of 15 means that when the valve opens, it will remain fully open for 15 seconds.

2. **Dosage Method Selection:** The parameter "D" on the bottom right of hidden screen 5b is used to determine the use of the 3rd 4-20mA input channel (DOS/GND). The options are as follows:

   NOTE: If D is not set = 0, then an appropriate 4-20mA input signal must be connected to DOS/ GND.

   a. *D = 0:* The 3rd 4-20mA input channel is not being used.

   b. *D = 1:* This is valid for Flow Pacing, Compound Loop, and Dual Input Feed Forward Control Methods. With D = 1 the user will not be able to adjust the dosage in operation mode using the keypad.
      i. If the OV-110 is in AUTO mode, then the 3rd 4-20mA input channel will set the dosage (refer to Section II.1). In this case, an input value of 4 mA will set dosage = 0 and a 20 mA input signal will set dosage = 10.0.
      ii. If the OV-110 is in MANL mode and the Purge Feature is not enabled, then the 3rd 4-20mA input channel will directly control the chemical feed rate (1:1 ratio between input and feed rate).

   c. *D = 2:* This is valid for Residual & Compound Loop Control Methods. With D =2 the user will not be able to adjust the residual set point in operation mode using the keypad. The 3rd 4-20mA input channel will set the residual set point (see Section II.2). In this case, an input value of 4 mA will set residual set point = "Res Min" and a 20 mA input signal will set residual set point = "Res Span".

   d. *D = 3:* This is only valid for Dual Set Point Control Method. See Section II.5. The 3rd 4-20mA input channel will be used for the residual analyzer at the outlet of the contact chamber. The residual decimal points and units for display must be the same as the residual analyzer on RES/GND.

3. **Flow Stop:** This feature is specifically intended for use with the compound loop control method to prevent valve adjustments based on the residual signal when water flow has stopped. This feature allows the user to enter a flow value below which the valve will drive closed and remain closed (until flow returns above the entered value). This setting is the "PV1Stop" parameter on the bottom left of hidden screen 5b. The default value is zero (PV1Stop = 0 means this feature is not enabled), but the PV1Stop setting can be adjusted using the ⊕ and ⊖ keys as desired.

4. **External Duty/Standby and Auto/Manual Control Options:** The following features allow the 24VDC SF3 and SF4 channels to be used for external control of these settings.

   NOTE: Any DC voltage between 12 and 24 volts is acceptable for these input channels. See Figure 3.

   NOTE: These features are only available if the OV-110 is not set to step feed control mode.

   a. *Duty / Standby (SF3):* This feature does not require any user adjustments. If the OV-110 is

not in step feed control mode, then a 24 VDC input signal to channel SF3 will put the OV-110 into standby condition (in standby the OV-110 will drive closed and remain closed). If there is no voltage signal into SF3, then the OV-110 will operate normally.

b. *Auto / Manual (SF4):* This feature requires the user to first enable external control of AUTO/ MANL mode on advanced calibration screen 5c. If external control has been enabled, then a 24 VDC input signal into channel SF4 will set the OV-110 into AUTO (automatic) mode and if there is no voltage signal into SF4, then the OV-110 will be in MANL (manual) mode. When external control has been enabled, the user will not be able to select AUTO/MANL using the keypad.

5. **Modbus Communication:**
   a. Screen 5d allows the user to adjust the Modbus communication settings. See the separate Modbus communication instruction for details.
   b. Screen 5e allows the user to select the three inputs (PV1, PV2, PV3 also known as FLO, RES, DOS). If "A" is selected then that input will be read from the analog input channel. If "M" is selected then that input will be read over Modbus. Each of the three input channels can be individually selected as either "A" or "M".

VIII. TROUBLESHOOTING AND MAINTENANCE

1. **Factory Default**: If there is an electronics problem that cannot be solved by any of the below efforts, then you might consider performing a factory default. However, when this is done all calibration data is lost and must be reset. Therefore it is best to try other steps first because you will have to go through both the Advance Calibration Mode and the Configuration Mode to enter all control and calibration settings.. In order to perform a factory default follow these steps:

   1. Turn off the power to the OV-110.
   2. Hold both the "up arrow" ⬆ key and the "down arrow" ⬇ key on the front panel.
   3. While holding both keys, turn on the power to the OV-110.

   SAFETY NOTE: Be sure to follow all safety precautions before attempting to service the OV-110 Omni-Valve. Be sure to disconnect power from the OV-110 Omni-Valve before servicing electronics.

2. **Servicing the Valve Body:** (See Figures 14 and 16) If the valve becomes difficult to move or for the purpose of preventative maintenance (recommended every 12 to 24 months) the valve body should be serviced according to the following procedure:

   a. **Removal of the valve body from the monitor enclosure:**
      i. Remove the three bolts at the bottom end of the valve body.
      ii. Remove the Lower Body and Middle Body parts of the valve body assembly.
      iii. Unscrew the Valve Stem and intermediate Valve Stem from the motor shaft. Avoid using pliers or any tool that will scar the surface of these parts.
      iv. Unscrew and remove the three bolts inside the enclosure that hold the Upper Body to the enclosure.

   b. **Top Shaft Seal**: Also remove the OV2-33 Seal Cap from the top of the Upper Body using a spanner wrench. There is a 3RS-108 O-Ring and Teflon seal under this part. When reinstalling the OV2-33 Seal Cap do not over tighten. Use 7-10 inch-pounds torque.

   c. **Maintenance**: All parts should be inspected for damage, cleaned, and lubricated* before reassembly. Generally, O-Rings should be replaced if in use for more than 12 months. The Valve Seat may require replacement if there are any cuts or burrs noticed. Hydro recommends replacement of AV2-62 during valve servicing.

   * Use appropriate lubrication for your chemical application. Contact your local representative of Hydro Instruments if there is any uncertainty.

d. **Reinstallation: IMPORTANT** – It is critically important that the threads on the Valve Stem and Intermediate Valve Stem be securely tightened during installation. Follow this procedure:

    i.   Install all O-rings, Teflon Seals, Seal Cap and Stem Seal parts into the Upper body first. Then slip the Intermediate Valve Stem through the assembly.

    ii.   Secure the Upper Body to the enclosure being sure to use a new gasket between the two parts.

    iii.   Thread the Intermediate Valve Stem hand tight onto the motor shaft threaded adapter. Avoid using pliers or any tool that will scar the surface of the stem.

    iv.   Thread the Valve Stem hand tight onto the Intermediate Valve Stem. Avoid using pliers or any tool that will scar the surface of the stem.

    v.   Install the Middle Body and Lower Body being sure not to move them in a way that would possibly unthread the Intermediate Valve Stem or the Valve Stem threads.

NOTE: The bolts used to secure the valve body (3 bottom + 3 top) should be tightened to 20-25 inch-pounds torque.
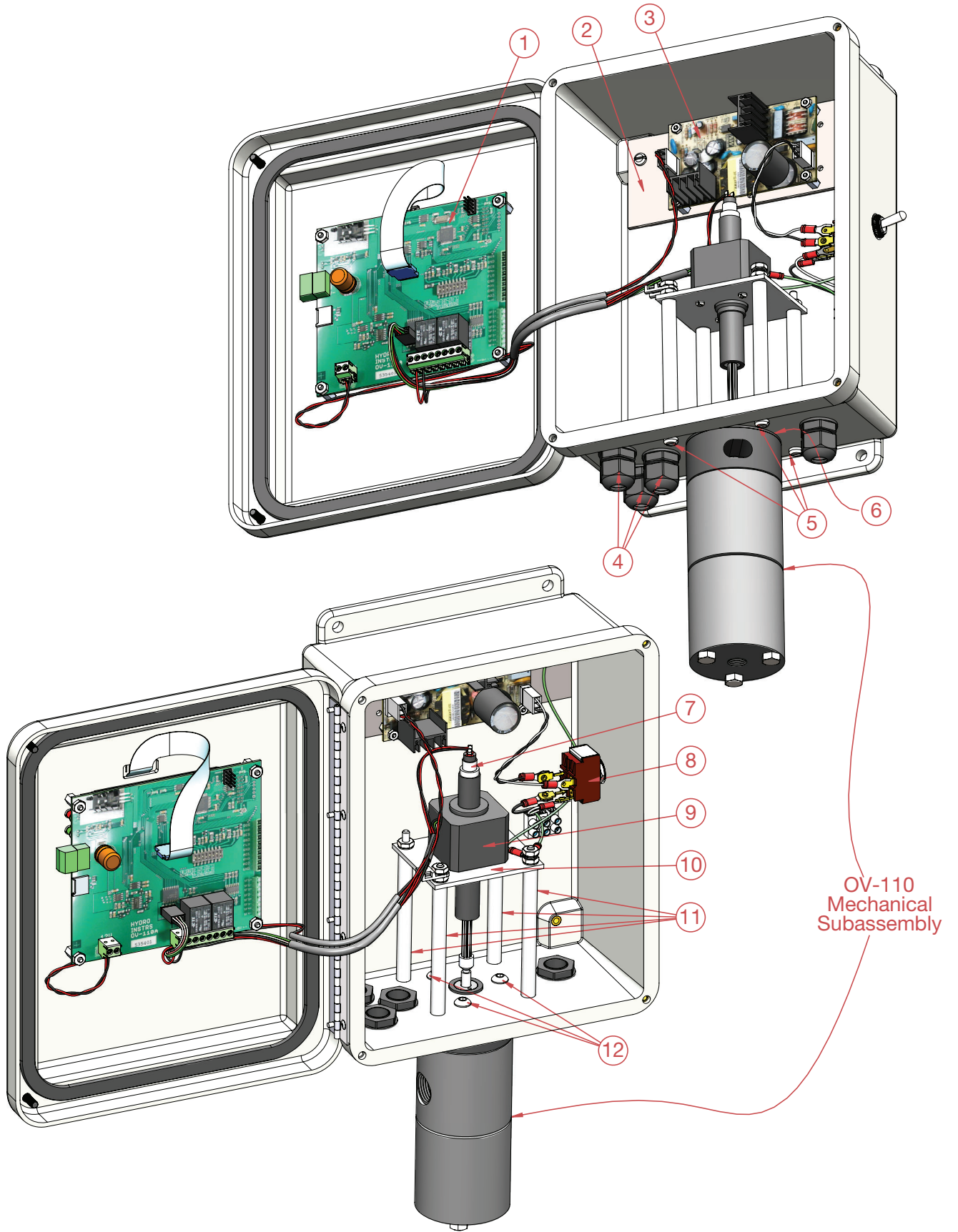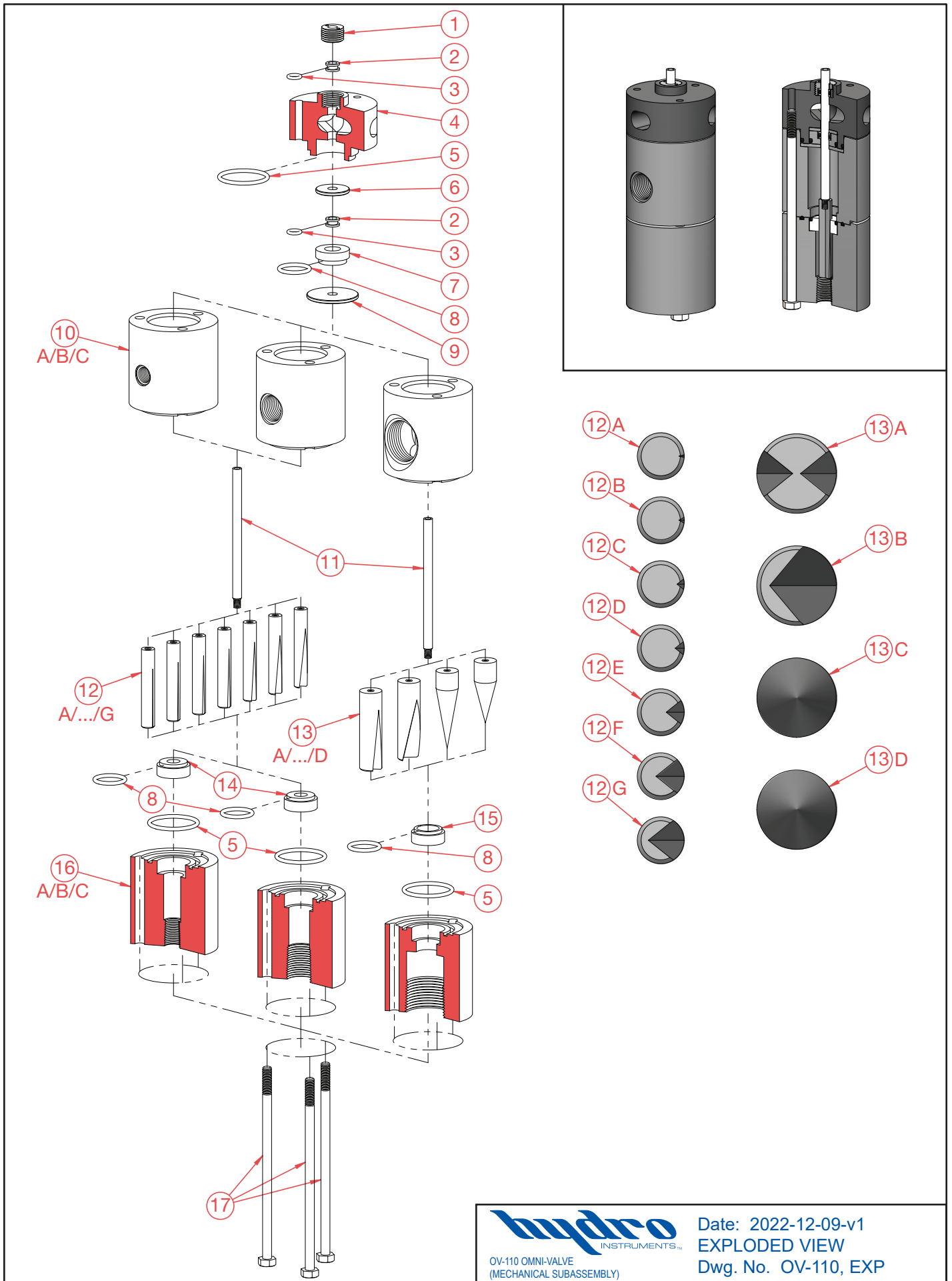
OV-110
Mechanical
Subassembly

Item No.	Description	Quantity	Part No.
1	OV-110 Printed Circuit Board	1	Consult Factory
2	Power Supply Mounting Plate	1	MP-PS-2
3	Power Supply Board 12VDC, 2.1A	1	PSB-12VDC-OV
4	Liquid Tight Fitting	4	BLT-199
	- Required O-Ring for Liquid Tight Fitting	4	OH-BUN-112
5	10-24 x ⅝" Pan Head Machine Screw	4	BTH-STA-244
6	Upper Body Gasket	1	AV-GASKET
7	Home Switch Assembly with Threaded Adapter	1	OV-HOMESWITCH
8	Toggle Switch	1	PTS-01
9	OV-110 Stepper Motor and Home Switch	1	OV-MOTOR
10	OV-110 Mounting Plate	1	MP-1
11	OV-110 Stand Off	4	AV-SO-2
12	Upper Body Bolt (¼-20 x ½" Button Head Socket Cap Screw)	3	BTH-STA-537

Item callouts:
1, 2, 3, 4, 5, 6, 2, 3, 7, 8, 9
10 A/B/C
11
12 A/.../G
13 A/.../D
14
8
8
5
15
8
5
16 A/B/C
17

12 A
12 B
12 C
12 D
12 E
12 F
12 G

13 A
13 B
13 C
13 D

OV-110 OMNI-VALVE
(MECHANICAL SUBASSEMBLY)

Date: 2022-12-09-v1
EXPLODED VIEW
Dwg. No. OV-110, EXP

30

Item No.	Description	Quantity	Part No.
1	ᴾᴹ Seal Cap	1	OV2-33
2	ᴾᴹ Teflon Seal	2	OVS-108
3	ᴾᴹ O-Ring	2	OH-VIT-108
4	Upper Body	1	AVB-10-2
5	ᴾᴹ O-Ring	2	OH-VIT-124
6	Small Disc	1	AV-4
7	ᴾᴹ Stem Seal	1	OV-5
8	ᴾᴹ O-Ring	2	OH-VIT-116
9	Large Disc	1	AV-3
10A	Middle Body (250 PPD)	1	AV2-112-250
10B	Middle Body (500 PPD)	1	AV2-112-500
10C	Middle Body (2,000 PPD)	1	AV2-112-000
11	Valve Shaft	1	AV2-12
12A	Valve Stem (4 PPD)	1	AV2-72-004
12B	Valve Stem (10 PPD)	1	AV2-72-010
12C	Valve Stem (25 PPD)	1	AV2-72-025
12D	Valve Stem (50 PPD)	1	AV2-72-050
12E	Valve Stem (100 PPD)	1	AV2-72-100
12F	Valve Stem (250 PPD)	1	AV2-72-250
12G	Valve Stem (500 PPD)	1	AV2-72-500
13A	Valve Stem (1,000 PPD)	1	AV2-72-1000
13B	Valve Stem (2,000 PPD)	1	AV2-72-2000
13C	Valve Stem (8+)	1	AV2-72-000-8P
13D	Valve Stem (8++)	1	AV2-72-000-8PP
14	ᴾᴹ Valve Stem Seat (500 PPD)	1	AV2-62
15	ᴾᴹ Valve Stem Seat (2,000 PPD)	1	AV2-6-000
16A	Lower Body (250 PPD)	1	AV2-92-250
16B	Lower Body (500 PPD)	1	AV2-92-500
16C	Lower Body (2,000 PPD)	1	AV2-92-000
17	Bolts	3	¼"-20 x 5½"
18A	ᴾᴹ NPT Fitting (100 PPD) *Not Shown*	2	BKF-64
18B	ᴾᴹ NPT Fitting (250 PPD) *Not Shown*	2	BKF-84
18C	ᴾᴹ NPT Fitting (500 PPD) *Not Shown*	2	BKF-108
ᴾᴹ	Part & Maintenance Kit (100 PPD)		KT1-100-OV
ᴾᴹ	Part & Maintenance Kit (250 PPD)		KT1-250-OV
ᴾᴹ	Part & Maintenance Kit (500 PPD)		KT1-500-OV
ᴾᴹ	Part & Maintenance Kit (2,000 PPD)		KT1-040-OV

hydro INSTRUMENTS™

OV-110 OMNI-VALVE
(MECHANICAL SUBASSEMBLY)

Date: 2022-12-09-v1
BILL OF MATERIALS
Dwg. No. OV-110, BOM