INTEGRAL® Series

VERACITY® Series

VERACITY® DIAMOND Series

CADARO BASE/PRO/Enterprise Software

TECHNICAL OPERATIONS MANUAL

CADARO 600 S Tyler St Suite 2009 Amarillo, TX 79101
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INTEGRAL PRODUCT DESCRIPTION

HOW THE INTEGRAL FLOW SENSOR WORKS

The patented INTEGRAL flow sensor from CADARO is designed to measure the real-time flow rate, batch weight, and total accumulated weight of dry flowable materials. Utilizing advanced load cell signal processing technology, the flow sensor is often installed in-line within an existing non-vertical pipe/chute where the material flows. As the product passes through the sensor, it generates an electrical signal that is transmitted to the CADARO PLC control box. The control box employs proprietary software to convert the signal into easily readable data. The INTEGRAL brand is synonymous and replaces the previous NV product series.

For seamless integration, the INTEGRAL flow sensor can be connected to an existing automation system using the CADARO Modbus TCP or Explicit Ethernet IP communications. This is a CADARO CONNECT Enterprise Plan feature. (Contact CADARO Service for directions).

BEST SUITED APPLICATIONS

The INTEGRAL Flow Sensor is particularly well-suited for the following applications:

- Dry flowable materials are characterized by low moisture content and relatively clean composition.
- Processes involving the gravity-fed flow of material in a non-vertical direction at a 45–55 degree angle
- Facilities equipped to perform material calibration tests during initial setup and as required.

LIMITATIONS

While the INTEGRAL Flow Sensor offers exceptional performance in numerous scenarios, it may not be suitable for the following applications:

- Situations involving non-uniform material flow or materials with a long drop, leading to excessive material velocity.
- Environments experiencing abrupt changes in temperature or material moisture, which can affect the accuracy of measurements.
- Installation sites subject to excessive motion, vibration, or exposure to electronic and mechanical shocks.
- Outdoor installations or locations with ambient temperatures below 0°F (-18°C) or above 120°F (49°C).
- Applications requiring NTEP certification for legal trade purposes.
- Installation sites located within 5 feet of strong RF waves or electromagnetic interference sources.

To ensure optimal performance and accurate measurements, please note these limitations when selecting the installation location and relying on the INTEGRAL Flow Sensor.

ENVIRONMENTAL RATINGS (CONTROL BOX, JUNCTION BOX, AND LOADCELL)

Standard Equipment

Standard CADARO equipment is intended for nonhazardous, unclassified locations. It is not approved as an assembled system for Class I or Class II hazardous locations. NEMA and IP ratings describe environmental protection and do not establish hazardous-location approval.

- **Control box:** Houses the PLC, HMI, and associated equipment. Install only in an unclassified location.
- **Sensor junction box:** Houses the load-cell connections and signal conditioner. Standard operation uses 12 or 24 VDC power and RS-485 communications.
- **Load cells:** IP67; operating temperature 0°F to 150°F (−18°C to 65°C). This temperature range applies to the load cells only.

Enclosure protection depends on the supplied configuration and installed penetrations. Refer to the equipment-specific ratings. Keep covers secured, seals intact, and unused openings properly sealed.

Hazardous-Location Configuration

Class II, Division 1 installations require a separately evaluated configuration. Contact CADARO before selection or installation.

The proposed configuration uses an intrinsically safe load-cell circuit and a passive sensor junction box in the classified area. The intrinsically safe interface, nominal 24 VDC power supply, and RS-485 control connection remain in the control box outside the classified area.

Do not install in a classified location until suitability is documented for the applicable dust group, ambient temperature, components, and wiring. Follow the approved installation drawings. Standard operating-temperature limits do not automatically apply to this configuration.

INTEGRAL SERIES FLOW SENSOR ASSEMBLY AND INSTALLATION

BEFORE INSTALLATION

Verify if the material flow rate falls within the rated capacity of the INTEGRAL flow sensor. Calculate the flow rate by measuring the time it takes for a known weight of material (pre- or post-weighed) and convert the measurement to pounds per minute (or as specified for your application). Refer to the chart below to determine the appropriate INTEGRAL flow sensor.

Figure 1: INTEGRAL Sub-Models Specifications

MODEL	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Pipe Size (diameter round/square)*	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight (lbs)
INTEGRAL NR/2K | INTEGRAL NRL/2K	800	2,000	6" OD	Round	32 ⅛" x 13" x 11 ⅝"	67 | –
INTEGRAL NS/5K | INTEGRAL NSL/5K	1,750	5,000	9 ¾" x 9 ¾" ID	Square	30 ⅜" x 16 ¼" x 15"	135 | 200
INTEGRAL NS/20K | INTEGRAL NSL/20K	5,000	20,000	17 ¾" x 17 ¾" ID	Square	36 ½" x 23 ⅝" x 24 ¾"	210 | 275
INTEGRAL NS/50K | INTEGRAL NSL/50K	17,500	50,000	29 ¾" x 29 ¾" ID	Square	36 ½" x 37" x 35 ⅝"	375 | 425

**Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.*

Before installation, ensure that the system is in working condition. This check ensures that the sensor has not been damaged during shipment. To perform this check, follow these steps:

ASSEMBLY OF FLOW SENSOR

Note: Your system will include a shipping bolt and a safety bolt. Remove the shipping bolt. For the INTEGRAL flow sensor, you may be able to access these bolts from the outlet without removing the side piece. If the side panel is removed, the shipping bolt spacer can be seen above the internal sensing box.

Steps to Remove Shipping Spacer

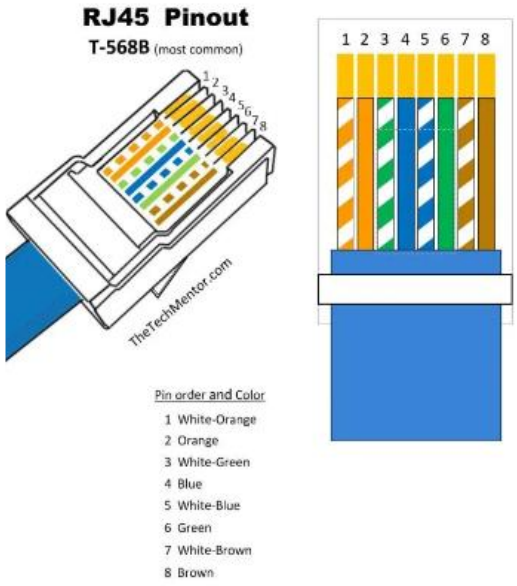
1. Remove the shipping spacer by loosening the shipping bolt running from the external top of the sensor through the sensing box.
2. Note: If the shipping bolt is tightly secured, apply pressure to the bottom of the inner square sensing box to remove it.
3. Take a smaller length bolt with nut [1/4" x 3/4" standard bolt and 1/4" nut not provided – purchase separately] and insert it into the sensor housing in place of the shipping bolt, making sure it does not extend into the inside of the sensing box, but instead remains flush with the interior surface of the sensing box/housing. Tighten the nut to secure both the bolt and the nut in place.

Steps to Lower the Bottom Shipping Bolts

1. Loosen the nuts on the shipping bolts located on the bottom side of the sensor housing.
2. Loosen the bolts until they are flush with the inside bottom surface of the sensor. There are two bolts, one under each load cell, for the inclined sensor.
3. Leave the bolts flush with the inside bottom surface of the sensor and tighten the nuts.

Once the unit has been assembled, place the system on a level/horizontal surface and connect the PLC control box to the sensor using a shielded Ethernet Cat 5/6/7.

1. The sensor comes with a mounted Junction Box on the side of the unit. Normally, it will have inside a Signal Conditioner pre-wired and pre-calibrated to static weight.
2. One side does not have a wired connection, while the other side has one or two wired connections entering the electrical enclosure.
3. The remaining un-wired connection will need to be terminated onsite. This is done by using an RJ45 crimping tool and an RJ45 connector.
    a. The Pinout code for this RJ45 termination is as follows:



4. If the loadcell is reading correctly, there will not be an alarm described as 'Signal Fault' or 'Signal Max'. Apply slight pressure to the interior sensor box and watch for weight to increase, indicating successful communication with the load cell Signal Conditioner board.
5. If the flow factor is zero or if the load cell weight is signal fault or signal max, then refer to section 5.3 Alarm

System Confirmation with Weight

1. Place a small weight, such as a standard 500 or 1,000 gram weight, onto the sensing plate. If a standard weight is not available, a light finger press on the top of the dome or plate will induce a positive increase in the signal.
1. Once placed inside the sensing box, the gross weight should increase steadily, and the net weight should be greater than zero. If this does not occur, please contact CADARO as it is possible that your sensor has been damaged during shipment.
2. **Note:** Resecure the sensing box using the shipping bolts and shipping spacers to protect your system during installation. Ideally, the removal of the shipping spacer and lowering of the shipping bolts within the sensor should be done after installation. However, if it is difficult to access all areas post-installation, these steps can be performed before installation; however, the unsecured unit must be handled with care.

SENSOR INSTALLATION

Best Practices/Guidelines

1. A manual gate or choke immediately upstream or downstream of the automatic gate will ensure consistent and repeatable flow.
2. Certain system configurations may require the inclusion of a gate/choke immediately upstream of the flow sensor.
3. The direction of gate travel should be oriented to direct the incoming material pathway along the bottom portion of the flow sensor. Avoid orientations that direct material towards the top side of the flow sensor.
4. For installations without a gate or choke, avoid placement of the sensor near inflection points that change either the direction or speed of material flow.

Angle of Installation

The INTEGRAL Flow Sensor should be installed at an angle where the dry flowable material being measured flows through a chute and contacts the internal sensing plate. The material should not be free-falling, but instead the material should flow in a uniform, consistent manner, making even contact with the internal bottom and side surfaces of the sensor. Install the sensor at an angle which ensures proper flow, generally between 45 and 55 degrees from horizontal.

Installation Considerations

The sensor will come with an inlet and outlet pipe or bolt holes on the inlet/outlet flange for installation. Do not use the main body between the inlet/housing or outlet/housing to secure the sensor. Ensure that the sensor is leveled perpendicular to the direction of flow. Material should flow over the internal sensing plate in an even and consistent (imagine water or thick oil) manner. Use a level to verify that the sensor is level in the plane perpendicular to the direction of product flow. An angled installation can negatively affect accuracy.

Important: Avoid operating welding equipment in the vicinity of the INTEGRAL flow sensor when it is installed. Prior to any welding activities near or on the equipment where the INTEGRAL flow sensor is installed, remove the INTEGRAL flow sensor. Any damage caused to the INTEGRAL flow sensor by welding equipment will not be covered under the warranty. Refer to Section 10 for further details.

VERACITY PRODUCT DESCRIPTION

HOW THE VERACITY FLOW SENSOR WORKS

The patented VERACITY flow sensor from CADARO is designed to measure the real-time flow rate, batch weight, and total accumulated weight of dry flowable materials. Utilizing advanced load cell signal processing technology, the flow sensor is often installed in-line within an existing vertical pipe/chute where the material flows. As the product passes through the sensor, it generates an electrical signal that is transmitted to the CADARO PLC control box. The control box employs proprietary software to convert the signal into easily readable data. The VERACITY brand is synonymous and replaces the previous FM product series.

For seamless integration, the flow sensor can be connected to an existing automation system using the CADARO Modbus TCP or Explicit Ethernet IP communications. This is a CADARO CONNECT Enterprise Plan feature. (Contact CADARO for more information at info@cadaro.com.)

BEST SUITED APPLICATIONS

The VERACITY Flow Sensor is particularly well-suited for the following applications:

- Dry flowable materials characterized by low moisture content and relatively clean composition.
- Processes involving the gravity-fed flow of material in a vertical direction (90-degree angle from horizontal) with a consistent flow rate.
- Facilities equipped to perform material calibration tests during initial setup and as required.

LIMITATIONS

While the VERACITY Flow Sensor offers exceptional performance in numerous scenarios, it may not be suitable for the following applications:

- Situations involving non-uniform material flow or materials with a long drop, leading to excessive material velocity.
- Environments experiencing abrupt changes in temperature or material moisture, which can affect the accuracy of measurements.
- Installation sites subject to excessive motion, vibration, or exposure to electronic and mechanical shocks.
- Outdoor installations or locations with ambient temperatures below 0°F (-18°C) or above 120°F (49°C).
- Applications requiring NTEP certification for legal trade purposes.
- Installation sites located within 5 feet of strong RF or electromagnetic interference sources.

To ensure optimal performance and accurate measurements, please note these limitations when selecting the installation location and relying on the VERACITY Flow Sensor.

ENVIRONMENTAL RATINGS (CONTROL BOX, JUNCTION BOX, AND LOADCELL)

Standard Equipment

Standard CADARO equipment is intended for nonhazardous, unclassified locations. It is not approved as an assembled system for Class I or Class II hazardous locations. NEMA and IP ratings describe environmental protection and do not establish hazardous-location approval.

- **Control box:** Houses the PLC, HMI, and associated equipment. Install only in an unclassified location.
- **Sensor junction box:** Houses the load-cell connections and signal conditioner. Standard operation uses 12 or 24 VDC power and RS-485 communications.
- **Load cells:** IP67; operating temperature 0°F to 150°F (−18°C to 65°C). This temperature range applies to the load cells only.

Enclosure protection depends on the supplied configuration and installed penetrations. Refer to the equipment-specific ratings. Keep covers secured, seals intact, and unused openings properly sealed.

Hazardous-Location Configuration

Class II, Division 1 installations require a separately evaluated configuration. Contact CADARO before selection or installation.

The proposed configuration uses an intrinsically safe load-cell circuit and a passive sensor junction box in the classified area. The intrinsically safe interface, nominal 24 VDC power supply, and RS-485 control connection remain in the control box outside the classified area.

Do not install in a classified location until suitability is documented for the applicable dust group, ambient temperature, components, and wiring. Follow the approved installation drawings. Standard operating-temperature limits do not automatically apply to this configuration.

VERACITY SERIES FLOW SENSOR ASSEMBLY AND INSTALLATION

BEFORE INSTALLATION

1. Determine the inlet pipe diameter by direct measurement if possible or measure the pipe circumference and divide by 3.14 to calculate the diameter. For other diameters other than the primary sizes, an adapter will be required.
2. Determine if the correct length of vertical spouting can be removed for the VERACITY flow sensor installation. If the sensor length exceeds the amount of vertical spouting available, then either the pipe configuration, type of sensor, or space itself may need to be changed.
3. Determine if the flow rate of the material is within the rated capacity of the VERACITY flow sensor. Calculate the flow rate by timing a known weight of material (either pre-weighed or post-weighed) and converting the numbers to pounds per minute (or the flow rate specified for your application). Refer to the chart below to determine the appropriate VERACITY flow sensor.

Figure 2: VERACITY Sub-Models Specifications

MODEL	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Pipe Size (diameter round/square)*	Configuration	Flow Sensor Dimensions (L x W)	Flow Sensor Weight (lbs)*
VERACITY VR/600	200	600	4" & 6" ID	Round	18 ½" x 11" (4") 22" x 11" (6")	25 (4") 28 (6")
VERACITY VR/2K	800	2,000	6" ID	Round	22 ¼" x 15"	50
VERACITY VR/4K	1,600	4,000	8" & 10" ID	Round	23" x 17" (8") 26" x 17" (10")	60 (8") 65 (10")
VERACITY VR/5K	2,000	5,000	10" ID	Round	26" x 21"	75

**Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.*

ADDITIONAL INSTALLATION SITE CONSIDERATIONS

- **Vertical Orientation:** Ensure that the VERACITY flow sensor is installed in a vertical position to ensure proper functionality and accurate measurements.
- **Handle with Care**: The load cells in the VERACITY flow sensor are sensitive to mechanical shock, vibration, and drops. Avoid dropping the sensor or subjecting it to excessive vibration or mechanical shock. Additionally, do not perform any welding activities on or near the sensor. If welding is necessary nearby, it is recommended to remove the VERACITY flow sensor until the welding process is completed to protect the load cells from potential damage.
- **Uninterrupted Material Flow**: The material being measured must flow freely through the VERACITY flow sensor. To ensure smooth flow, prevent material backup from occurring either from above or below the sensor. If necessary, consider installing a flow regulator or surge bin above the VERACITY flow sensor to maintain proper material flow.
- **Steady Material Flow:** For optimal performance, the VERACITY flow sensor operates best with a steady material flow. Avoid surging or fluctuating flows as they may affect the accuracy of the measurements.

ASSEMBLY OF VERACITY FLOW SENSOR

Before starting the assembly, carefully unpack all the components and compare them to the delivery notice to ensure that all necessary parts are available.

Materials Required for Assembly:

VERACITY VR/600-VR/4K

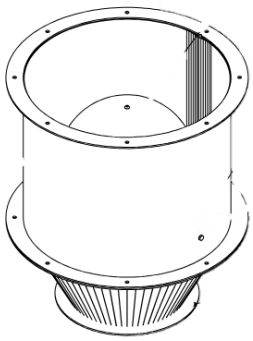
- Wrench set (SAE) for flange clamp bolts
- Phillips screwdriver
- Blue Locktite (Anti-seize compound)

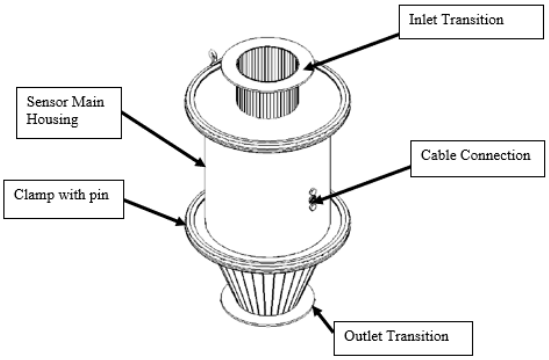
VERACITY VR/5K

- Size 13 socket wrench or ½" socket wrench
- Wrench
- Phillips screwdriver
- Blue Locktite (Anti-seize compound)

Note: Always prioritize safety while handling, assembling, and installing the VERACITY flow sensor.

1. Organizing Components:
   Arrange the components required for the VERACITY flow sensor assembly, including:



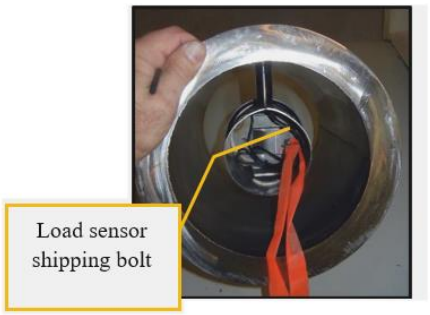


2. Attaching the Flow Sensor Dome:
   Position the dome above the dome base plate to align the screw with the connector on the base plate. Before tightening, apply a small amount of Loctite to the screw. Use a Phillips screwdriver to secure the dome with the bolt. While securing the bolt, hold onto the dome with one hand. Please hand-tighten the bolt and avoid using power tools to prevent damage to the load cell. Be cautious not to apply excessive downward pressure on the cap screw, as it may damage the load cell.

   Important: Whether it is a new installation or cap replacement, always insert the load sensor shipping bolt prior to performing the task.

3. Removing the Load Sensor Shipping Bolt:
   Rotate the sensor main housing to gain access to the load sensor shipping bolt. Once located, carefully remove the shipping bolt. After removing the shipping bolt, return the housing to the upright position.

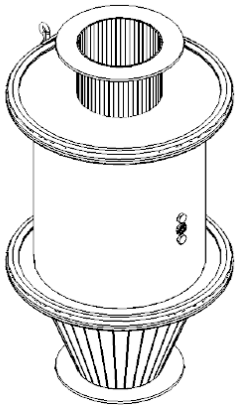
   Important Note: The shipping bolt is intended to provide support during shipping and cap installation. Take extra care when handling the VERACITY flow sensor after removing the shipping bolt.



4. Placing the Outlet Transition:
   Position the outlet transition on a stable work platform or surface.



5. Attaching the Main Housing:
   Place the VERACITY flow sensor main housing on top of the outlet transition. Ensure stability of the components while attaching the flange clamp. Before attaching the lower flange clamp, ensure that it securely encloses the entire transition and housing rings. Close the latch mechanism to secure the retaining clamp, then insert the securing pin as indicated in the provided photo.



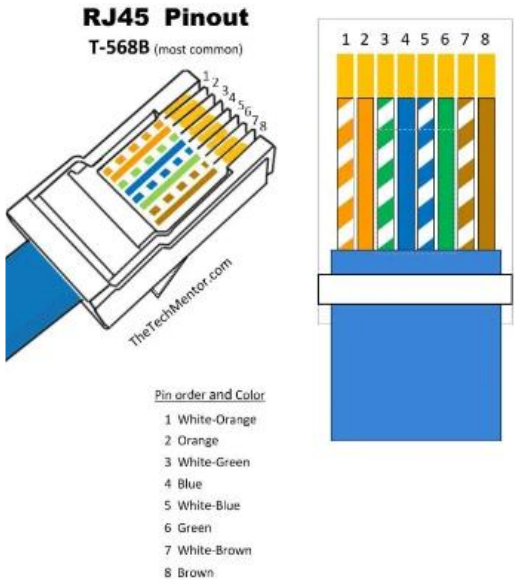
6. Placing the Inlet Transition:
   Position the inlet transition on top of the main flow sensor housing. Ensure stability of the components while attaching the flange clamp.

   Final Installation:
   Complete the installation in a vertical application, attaching the VERACITY flow sensor to the site piping using appropriately sized flanges and flange clamps determined during the pre-site assessment.

   Once the assembly and installation are complete, you can proceed to attach the control box cable to the flow sensor and PLC control box, followed by the calibration process.

Once the unit has been assembled, place the system on a level/horizontal surface and connect the PLC control box to the sensor using a shielded Ethernet Cat 5/6/7.

6. The sensor comes with a mounted Junction Box on the side of the unit. Normally it will have inside a Signal Conditioner pre-wired and pre-calibrated to static weight.
7. One side does not have a wired connection while the other side has one or two wired connections entering the electrical enclosure.
8. The remaining un-wired connection will need to be terminated onsite. This is done by using an RJ45 crimping tool and an RJ45 connector.
    a. The Pinout code for this RJ45 termination is as follows:



9. If the loadcell is reading correctly, there will not be an alarm described as 'Signal Fault' or 'Signal Max'. Apply slight pressure to the interior sensor box and watch for weight to increase, indicating successful communication with the load cell Signal Conditioner board.
10. If the flow factor is zero or if the load cell weight is signal fault or signal max, then refer to section 5.3 Alarm

System Confirmation with Weight

3. Place a small weight, such as a standard 500 or 1,000 gram weight, onto the sensing plate. If a standard weight is not available, a light finger press on the top of the dome or plate will induce a positive increase in the signal.
2. Once placed inside the sensing box, the gross weight should increase steadily, and the net weight should be greater than zero. If this does not occur, please contact CADARO as it is possible that your sensor has been damaged during shipment.

Note: Resecure the sensing box using the shipping bolts and shipping spacers to protect your system during installation. Ideally, the removal of the shipping spacer and lowering of the shipping bolts within the sensor should be done after installation. However, if it is difficult to access all areas post-installation, these steps can be performed before installation; however, the unsecured unit must be handled with care.

INSTALLATION

Best Practices/Guidelines

- A manual gate or choke immediately upstream or downstream of automatic gate will ensure consistent and repeatable flow.
- Certain system configurations may require the inclusion of gate/choke immediately upstream of the flow sensor.
- For installations without a gate or choke, avoid placement of the sensor near inflection points that change either the direction or speed of material flow.

The VERACITY flow sensor is installed by removing a section of vertical spouting and replacing it with the VERACITY flow sensor, as specified in the table below. Metal angle flanges will be used on the existing metal piping to match the flanges on the VERACITY flow sensor, facilitating the installation process.

Note: Stainless steel bolts are commonly used to secure the V-band flanges to both the VERACITY flow sensor and the existing piping. Regular steel bolts and nuts can also be used. If stainless steel bolts and nuts are utilized, it is recommended to apply an anti-seize compound to prevent cold fusion or galling of the bolts.

Important: Avoid operating welding equipment in the vicinity of the VERACITY flow sensor when it is installed. Prior to any welding activities near or on the equipment where the VERACITY flow sensor is installed, remove the VERACITY flow sensor. Any damage caused to the VERACITY flow sensor by welding equipment will not be covered under the warranty. Refer to Section 10 for further details.

VERACITY DIAMOND PRODUCT DESCRIPTION

HOW THE VERACITY DIAMOND FLOW SENSOR WORKS

The patented VERACITY Diamond flow sensor from CADARO is designed to measure the real-time flow rate, batch weight, and total accumulated weight of dry flowable materials. Utilizing advanced load cell signal processing technology, the flow sensor is often installed in-line within an existing vertical pipe/chute where the material flows. As the product passes through the sensor, it generates an electrical signal that is transmitted to the CADARO PLC control box. The control box employs proprietary software to convert the signal into easily readable data.

For seamless integration, the flow sensor can be connected to an existing automation system using the CADARO Modbus TCP or Explicit Ethernet IP communications. This is a CADARO CONNECT Enterprise Plan feature. (Contact CADARO for more information at info@cadaro.com.)

BEST SUITED APPLICATIONS

The VERACITY Diamond Flow Sensor is particularly well-suited for the following applications:

- Low clearance instances. The height of each unit can be found below in the 'VERACITY Diamond Specifications' section.
- Dry flowable materials characterized by low moisture content and relatively clean composition.
- Processes involving the gravity-fed flow of material in a vertical direction (90-degree angle from horizontal) with a consistent flow rate.
- Facilities equipped to perform material calibration tests during initial setup and as required.

LIMITATIONS

While the VERACITY Diamond Flow Sensor offers exceptional performance in numerous scenarios, it may not be suitable for the following applications:

- Situations involving non-uniform material flow or materials with a long drop, leading to excessive material velocity.
- Environments experiencing abrupt changes in temperature or material moisture, which can affect the accuracy of measurements.
- Installation sites subject to excessive motion, vibration, or exposure to electronic and mechanical shocks.
- Outdoor installations or locations with ambient temperatures below 0°F (-18°C) or above 120°F (49°C).
- Applications requiring NTEP certification for legal trade purposes.
- Installation sites located within 5 feet of strong RF or electromagnetic interference sources.

To ensure optimal performance and accurate measurements, please note these limitations when selecting the installation location and relying on the VERACITY Diamond Flow Sensor.

ENVIRONMENTAL RATINGS (CONTROL BOX, JUNCTION BOX, AND LOADCELL)

Standard Equipment

Standard CADARO equipment is intended for nonhazardous, unclassified locations. It is not approved as an assembled system for Class I or Class II hazardous locations. NEMA and IP ratings describe environmental protection and do not establish hazardous-location approval.

- **Control box:** Houses the PLC, HMI, and associated equipment. Install only in an unclassified location.
- **Sensor junction box:** Houses the load-cell connections and signal conditioner. Standard operation uses 12 or 24 VDC power and RS-485 communications.
- **Load cells:** IP67; operating temperature 0°F to 150°F (−18°C to 65°C). This temperature range applies to the load cells only.

Enclosure protection depends on the supplied configuration and installed penetrations. Refer to the equipment-specific ratings. Keep covers secured, seals intact, and unused openings properly sealed.

Hazardous-Location Configuration

Class II, Division 1 installations require a separately evaluated configuration. Contact CADARO before selection or installation.

The proposed configuration uses an intrinsically safe load-cell circuit and a passive sensor junction box in the classified area. The intrinsically safe interface, nominal 24 VDC power supply, and RS-485 control connection remain in the control box outside the classified area.

Do not install in a classified location until suitability is documented for the applicable dust group, ambient temperature, components, and wiring. Follow the approved installation drawings. Standard operating-temperature limits do not automatically apply to this configuration.

VERACITY DIAMOND SERIES FLOW SENSOR ASSEMBLY AND INSTALLATION

BEFORE INSTALLATION

1. For round spouts, determine the inlet pipe diameter by direct measurement if possible or measure the pipe circumference and divide by 3.14 to calculate the diameter. A round pipe/spout will most likely require a round-to-square adapter to mate with the inlet of the sensor.
2. For square/rectangular spouts/pipe, determine the length of all sides and the flange bolt pattern. See the table below for common flange patterns for the different sensor sizes.
3. Determine if the correct length of vertical spouting can be removed for the VERACITY Diamond flow sensor installation. If the sensor length exceeds the amount of vertical spouting available, then either the pipe configuration, type of sensor, or space itself may need to be changed.
4. Determine if the flow rate of the material is within the rated capacity of the VERACITY Diamond flow sensor. Calculate the flow rate by timing a known weight of material (either pre-weighed or post-weighed) and converting the numbers to pounds per minute (or the flow rate specified for your application). Refer to the chart below to determine the appropriate VERACITY flow sensor.

Figure 3: 40° VERACITY Diamond Sub-Models Specifications

40° VERACITY DIAMOND FLOW SERIES SPECIFICATIONS

Model	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Chute Flange	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight VS/VSL (lbs)
VERACITY Diamond VS/1K VERACITY Diamond VSL/1K	400	1,000	4"/ 10"	Square	12 ⅝ X 12 ⅝ X 7	25 lbs | 28 lbs
VERACITY Diamond VS/2.5K VERACITY Diamond VSL/2.5K	1000	2,500	6"/ 14"	Square	17 ⅛ X 17 ⅛ X 9	51 lbs | 57 lbs
VERACITY Diamond VL/4K VERACITY Diamond VSL/4K	1,500	4,000	8"/ 18"	Square	21 ⅛ X 21 ⅛ X 9	62 lbs | 69 lbs
VERACITY Diamond VS/7K VERACITY Diamond VSL/7K	3,000	7,000	10"/ 20"	Square	23 ⅛ X 23 ⅛ X 9	101 lbs | 109 lbs
VERACITY Diamond VS/10K VERACITY Diamond VSL/10K	4,000	10,000	12"/ 20"	Square	23 ⅛ X 23 ⅛ X 9	108 lbs | 116 lbs
VERACITY Diamond VS/14K VERACITY Diamond VSL/14K	5,500	14,000	14"/22"	Square	25 ⅛ X 25 ⅛ X 10	127 lbs | 140 lbs
VERACITY Diamond VS/20K VERACITY Diamond VSL/20K	8,000	20,000	18"/ 28"	Square	32 ⅛ X 32 ⅛ X 11 $^{11}/_{16}$	197 lbs | 219 lbs

*Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.

Figure 4: 53° VERACITY Diamond Sub-Models Specifications

53° VERACITY DIAMOND FLOW SERIES SPECIFICATIONS

Model	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Chute Flange	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight VS/VSL (lbs)
VERACITY Diamond VS/1K VERACITY Diamond VSL/1K	400	1,000	4"/ 10"	Square	12 ⅝ X 12 ⅝ X 7	25 lbs | 28 lbs
VERACITY Diamond VS/2.5K VERACITY Diamond VSL/2.5K	1000	2,500	6"/ 14"	Square	17 ⅛ X 17 ⅛ X 9	51 lbs | 57 lbs
VERACITY Diamond VL/4K VERACITY Diamond VSL/4K	1,500	4,000	8"/ 18"	Square	21 ⅛ X 21 ⅛ X 9	63 lbs | 70 lbs
VERACITY Diamond VS/7K VERACITY Diamond VSL/7K	3,000	7,000	10"/ 20"	Square	23 ⅛ X 23 ⅛ X 12	118 lbs | 128 lbs
VERACITY Diamond VS/10K VERACITY Diamond VSL/10K	4,000	10,000	12"/ 20"	Square	23 ⅛ X 23 ⅛ X 12	125 lbs | 136 lbs
VERACITY Diamond VS/14K VERACITY Diamond VSL/14K	5,500	14,000	14"/22"	Square	25 ⅛ X 25 ⅛ X 13	148 lbs | 164 lbs
VERACITY Diamond VS/20K VERACITY Diamond VSL/20K	8,000	20,000	16"/ 28" 18"/ 28"	Square	32 ⅛ X 32 ⅛ X 15 $^{11}/_{16}$	233 lbs | 258 lbs

*Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.

ADDITIONAL INSTALLATION SITE CONSIDERATIONS

- **Vertical Orientation:** Ensure that the VERACITY flow sensor is installed in a vertical position to ensure proper functionality and accurate measurements.
- **Handle with Care**: The load cells in the VERACITY flow sensor are sensitive to mechanical shock, vibration, and drops. Avoid dropping the sensor or subjecting it to excessive vibration or mechanical shock. Additionally, do not perform any welding activities on or near the sensor. If welding is necessary nearby, it is recommended to remove the VERACITY flow sensor until the welding process is completed to protect the load cells from potential damage.
- **Uninterrupted Material Flow**: The material being measured must flow freely through the VERACITY flow sensor. To ensure smooth flow, prevent material backup from occurring either from above or below the sensor. If necessary, consider installing a flow regulator or surge bin above the VERACITY flow sensor to maintain proper material flow.
- **Steady Material Flow:** For optimal performance, the VERACITY flow sensor operates best with a steady material flow. Avoid surging or fluctuating flows as they may affect the accuracy of the measurements.

ASSEMBLY OF VERACITY DIAMOND FLOW SENSOR

Before starting the assembly, carefully unpack all the components and compare them to the delivery notice to ensure that all necessary parts are available.

Materials Required for Assembly:

- Size 9/16” socket wrench
- Crescent Wrench
- Blue Loctite (Anti-seize compound)

Note: Always prioritize safety while handling, assembling, and installing the VERACITY flow sensor.

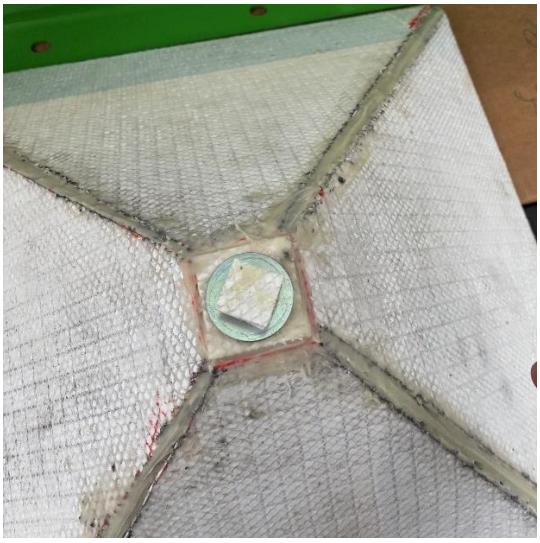
1. Organizing Components:
   Arrange the components required for the VERACITY flow sensor assembly, including the Inlet transition, Sensor body, Outlet transition (if applicable), Dome, and Dome mounting plate.

2. Attaching the Flow Sensor Dome:
   Position the dome above the dome base plate to align the screw with the connector on the base plate. Before tightening, apply a small amount of Blue Loctite to the screw. Use a socket or crescent wrench to secure the dome with the bolt. While securing the bolt, hold onto the dome with one hand. Please hand-tighten the bolt and avoid using power tools to prevent damage to the load cell. Be cautious not to apply excessive downward pressure on the cap screw, as it may damage the load cell.

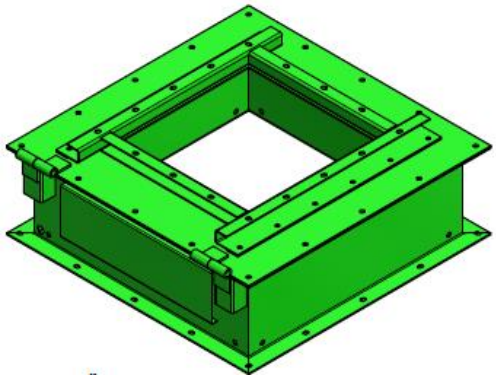
Figure 5: VERACITY Diamond Dome Mounting Plate Example



Figure 6: Mounted Dome w/ Tile Cap



3. Attaching the Main Housing:
   Place the VERACITY flow sensor main housing on top of the outlet transition (if applicable). Ensure stability of the components while attaching the flange bolts.

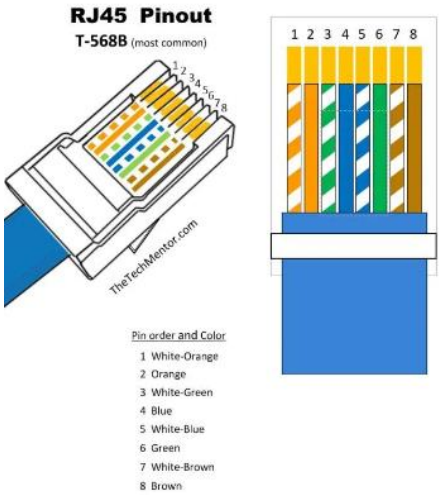


4. Placing the Inlet Transition:
   Position the inlet transition on top of the main flow sensor housing.

   Once the assembly and installation are complete, you can proceed to attach the control box cable to the flow sensor and PLC control box, followed by the calibration process.

Once the unit has been assembled, place the system on a level/horizontal surface and connect the PLC control box to the sensor using a shielded Ethernet Cat 5/6/7.

11. The sensor comes with a mounted Junction Box on the side of the unit. Normally it will have inside a Signal Conditioner pre-wired and pre-calibrated to static weight.
12. One side does not have a wired connection while the other side has one or two wired connections entering the electrical enclosure.
13. The remaining un-wired connection will need to be terminated onsite. This is done by using an RJ45 crimping tool and an RJ45 connector.
    a. The Pinout code for this RJ45 termination is as follows:



14. If the loadcell is reading correctly, there will not be an alarm described as 'Signal Fault' or 'Signal Max'. Apply slight pressure to the interior sensor box and watch for weight to increase, indicating successful communication with the load cell Signal Conditioner board.
15. If the flow factor is zero or if the load cell weight is signal fault or signal max, then refer to section 5.3 Alarm

System Confirmation with Weight

4. Place a small weight, such as a standard 500 or 1,000 gram weight, onto the sensing plate. If a standard weight is not available, a light finger press on the top of the dome or plate will induce a positive increase in the signal.
3. Once placed inside the sensing box, the gross weight should increase steadily, and the net weight should be greater than zero. If this does not occur, please contact CADARO as it is possible that your sensor has been damaged during shipment.

INSTALLATION

Best Practices/Guidelines

- A manual gate or choke immediately upstream or downstream of automatic gate will ensure consistent and repeatable flow.
- Certain system configurations may require the inclusion of gate/choke immediately upstream of the flow sensor.
- For installations without a gate or choke, avoid placement of the sensor near inflection points that change either the direction or speed of material flow.

The VERACITY flow sensor is installed by removing a section of vertical spouting and replacing it with the VERACITY Diamond flow sensor, as specified in the table below. Metal angle flanges will be used on the existing metal piping to match the flanges on the VERACITY Diamond flow sensor, facilitating the installation process.

Note: Stainless steel bolts are commonly used to secure the flanges to both the VERACITY Diamond flow sensor and the existing piping. Regular steel bolts and nuts can also be used. If stainless steel bolts and nuts are utilized, it is recommended to apply an anti-seize compound to prevent cold fusion or galling of the bolts.

Important: Avoid operating welding equipment in the vicinity of the VERACITY flow sensor when it is installed. Prior to any welding activities near or on the equipment where the VERACITY flow sensor is installed, remove the VERACITY flow sensor. Any damage caused to the VERACITY flow sensor by welding equipment will not be covered under the warranty. Refer to Section 10 for further details.

PLC CONTROL BOX INSTALLATION

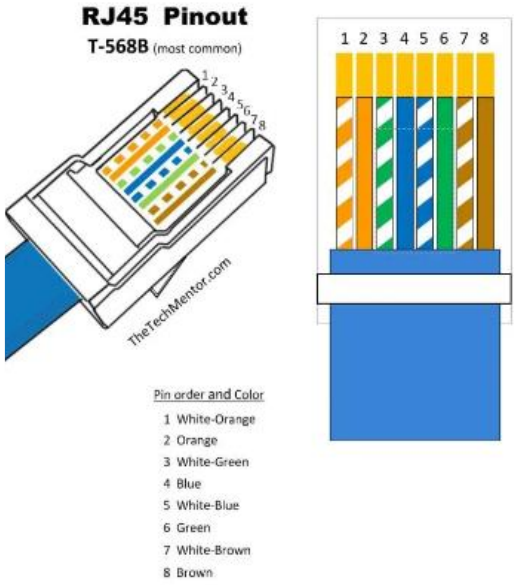
BOX LOCATION

Choose a safe, dry, and convenient location to mount the PLC control box.

We recommend the total cable length between the control box and sensor box be no more than 300 feet. Connect the RJ45 end at the VERACITY flow sensor box to the RJ45 end at the PLC control box.

Depending on the customer, a prefabricated signal cable or a bulk cable without ends may be included. In either case, this cable may be altered to the customer's liking. Qualified personnel should follow the pinout diagram below to ensure the wiring is done correctly. Necessary tools are required.

Figure 7: RJ45 Pinout Diagram

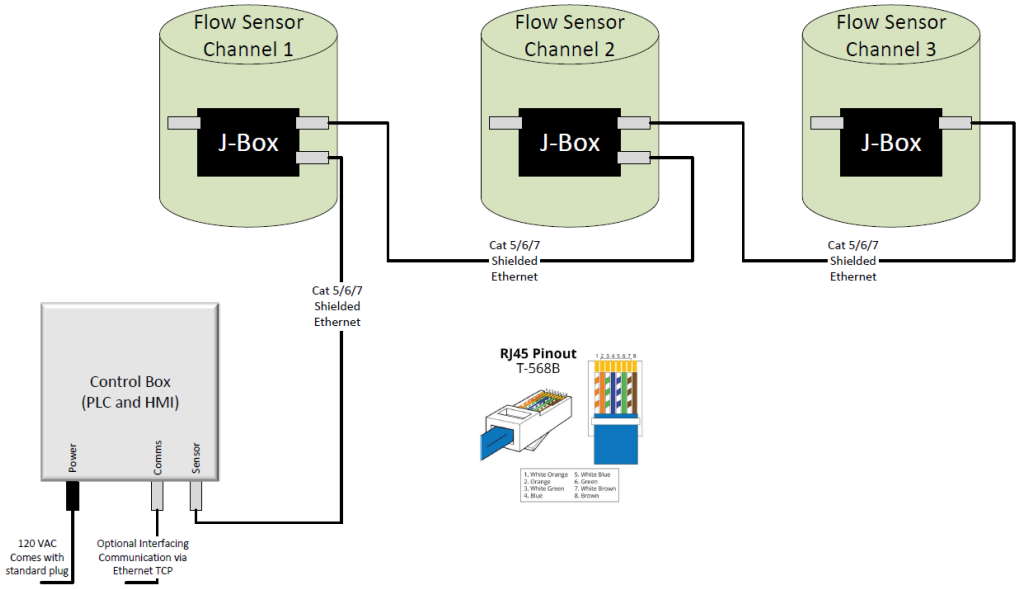


Important: Avoid placing the PLC control box in direct sunlight. Treat the PLC control box with the same care as a computer and avoid placing it where it will be exposed to less ideal conditions. CADARO recommends placing the control box inside a building or, if that is not possible, in its own enclosure to provide shelter and protection from external conditions.

PLC TO SENSOR WIRING

Up to four channels per control box.

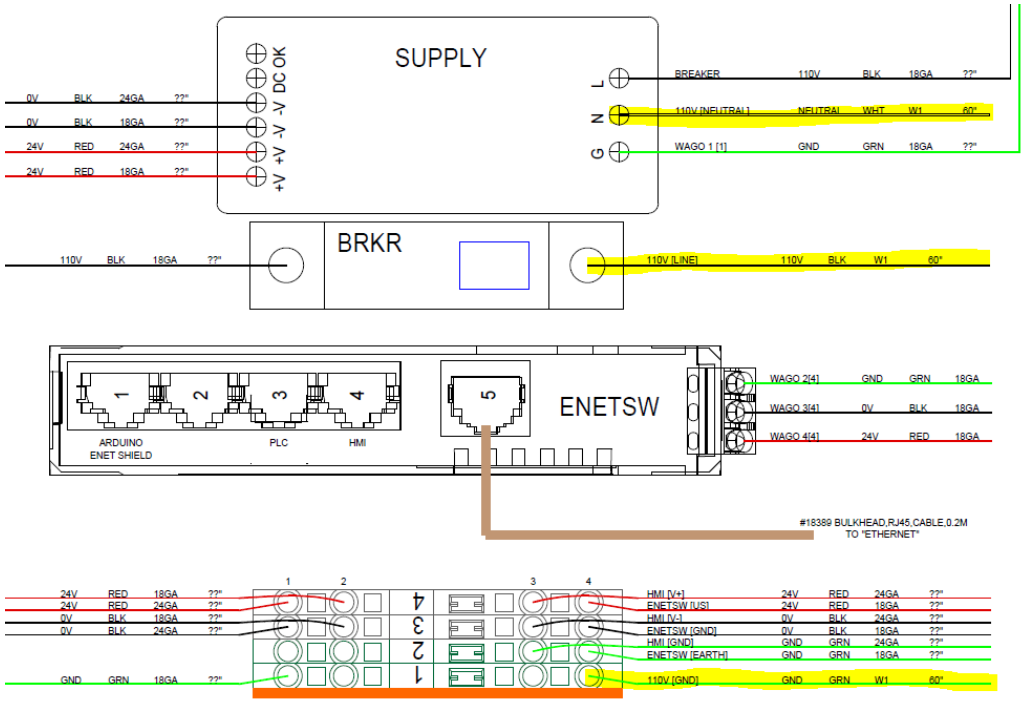
Figure 8: Daisy Chain Wiring Illustration



A single channel would not have two Ethernet comm connectors, just a single input like the 3rd channel seen above.

PLC CONTROL BOX POWER REQUIREMENTS

Figure 9: PLC Power Wiring Diagram



The PLC control box is designed to be plugged into a standard 120V AC outlet. (Reference the chapter and section titled Specifications, Required Power and Suggested UPS.)
Should the customer decide to provide power without using the provided 3-prong outlet, reference the yellow-highlighted wiring code in the above picture.

PLC MODBUS AND MESSAGING DESCRIPTION

For installations with an existing automation system, the flow sensor signal can be managed and delivered via Modbus TCP or Explicit Messaging to an existing automation platform. Our PLC acts as the slave device, storing data inputs and outputs to registers accordingly.

More about Modbus and Messaging is found in the Initialization section below. This is a CADARO CONNECT Enterprise Plan feature.

PLC ETHERNET PIN ASSIGNMENT

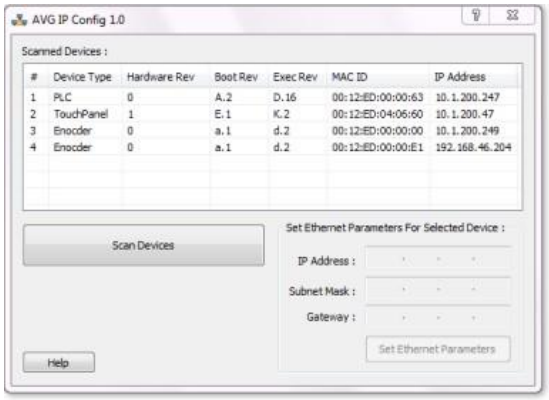
The connector used is a standard RJ45 Ethernet connector. The connector pinout is the same as described above in the figure labeled 'RJ45 Pinout Diagram'.

PLC IP ADDRESS

1. Download the IP configuration program (AVG IPConfig 1.0.2 for Windows) onto your PC.
    a. Provided by CADARO.
2. Connect one Ethernet cable from your PLC control box RJ45 Port to your PC.
3. Open the PLC control box and confirm that there is an Ethernet cable connection between the PLC, and the RJ45 plug on the top of the PLC control box.
4. If there is no Ethernet cable between the RJ45 and the PLC, plug it directly into the Ethernet jack on the PLC.

5. Make sure all devices are powered on.
6. Install and open the ‘AVG IPCofig’ program on your PC and click on "Scan Devices."

Figure 10: AVG IP Config Dialog Box



7. If you only have a connection between the PLC control box and PC, it should detect only one device.
8. If you have multiple networks, choose the device you want to edit from the list.
9. If necessary, change the IP address, Subnet mask, and gateway to your choice. Press “Set Ethernet Parameters” and wait for the system to update.
10. Power cycle (restart) the control system and "Scan Devices" to ensure the IP settings are as desired. It is necessary to restart the PLC control box to engage the new IP Address. Restart the PLC by turning off the power breaker for 30 seconds and turning it back on.

Figure 11: AVG IP Config IP Parameters (Example)

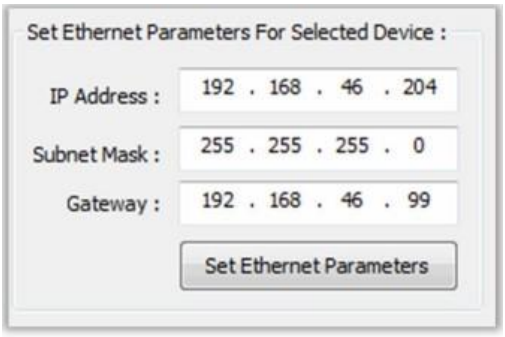


Table 1: Typical IP Parameters

IP Address	192	168	1	X
Subnet Mask	255	255	255	0
Gateway	Empty			

11. Typical private network Ethernet parameters example. Consult IT or CADARO for further support if needed.

It is recommended to store the IP address within the PLC control box for future reference either on a flash drive that is kept **INSIDE** the PLC control box (but not plugged into anything) or written down on a piece of paper or notepad and stored **INSIDE** the PLC control box for easy reference.

START-UP INSTRUCTIONS

STARTUP

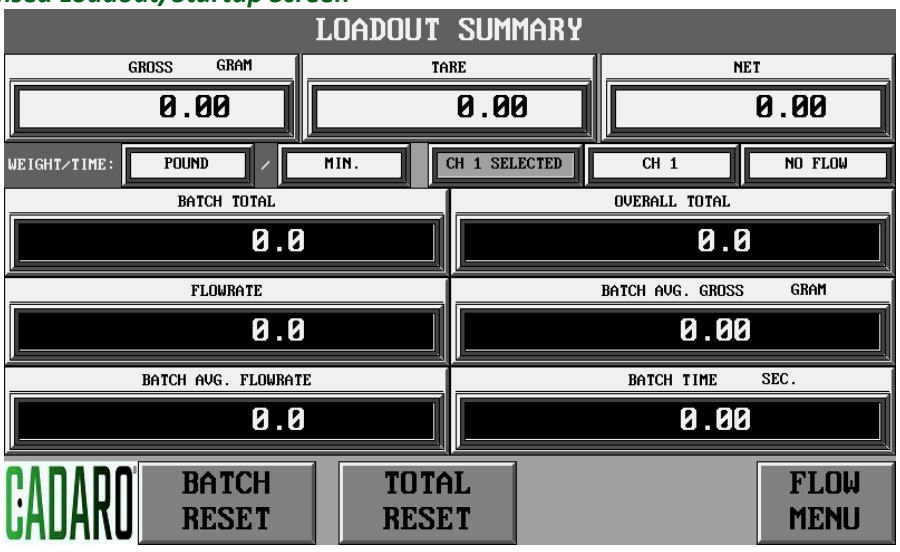
Pre-Licensed Screen

Figure 12: Unlicensed Loadout/Startup Screen



Licensed Screen

Figure 13: Licensed Loadout/Startup Screen



'Loadout Summary' screen can be treated as a default/main screen. After license is entered, this screen gives most of the pertinent information needed to run.
This screen can be later accessed from the 'Flow Sensor Menu' screen.

LICENSING

Pre-Licensed Screen

Figure 14: Unlicensed Screen



From bootup, if a license has not been configured, the above screen will appear.

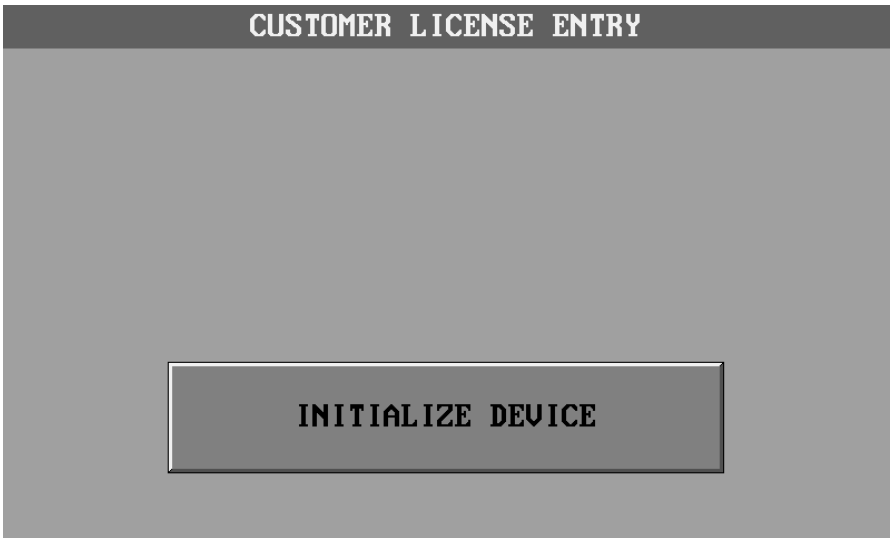
Figure 15: License Accepted Screen.



Enter the prescribed license, if correct, the software will allow for advancement to the below screen.

Post-Licensed Startup Screen

Figure 3: Licensed Bootup or Post-License Entry Screen

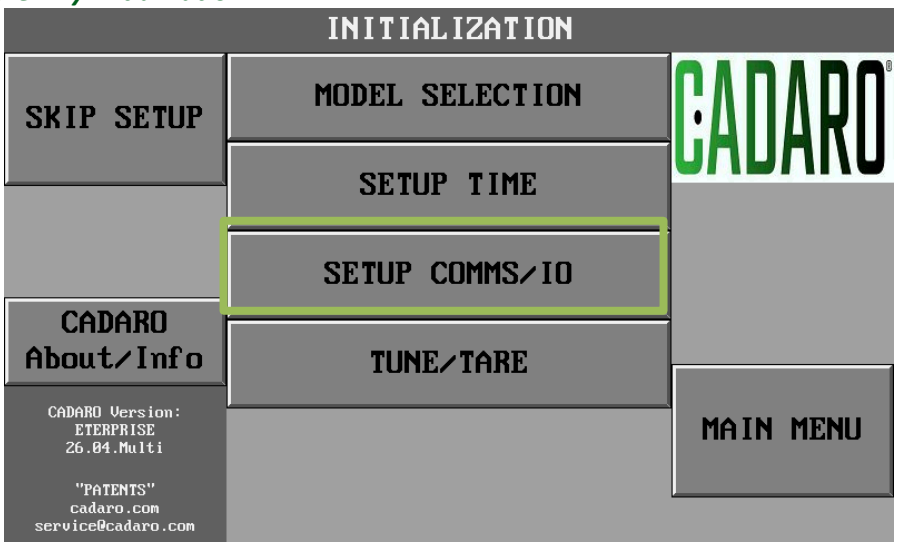


From bootup, if the license has been previously accepted, the above screen will appear. This screen will also appear after the correct license has been entered.

INITIALIZATION

Pre-Initialized

Figure 17: Before Any Initialization

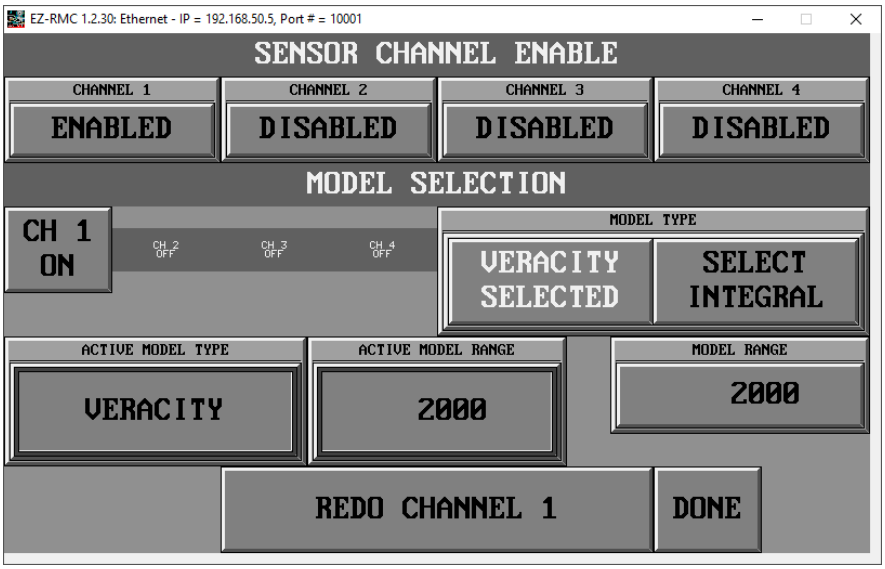


As seen before anything has been initialized to a specific customer or flow sensor box. Please verify the 'Software Version' matches what CADARO has prescribed. If not, contact CADARO.

'Setup Comms/IO' is only accessible by having a CADARO CONNECT Pro or Enterprise Plan. The functionalities within this option are described in further detail below.

Model Selection

Figure 18: Model Selection Screen



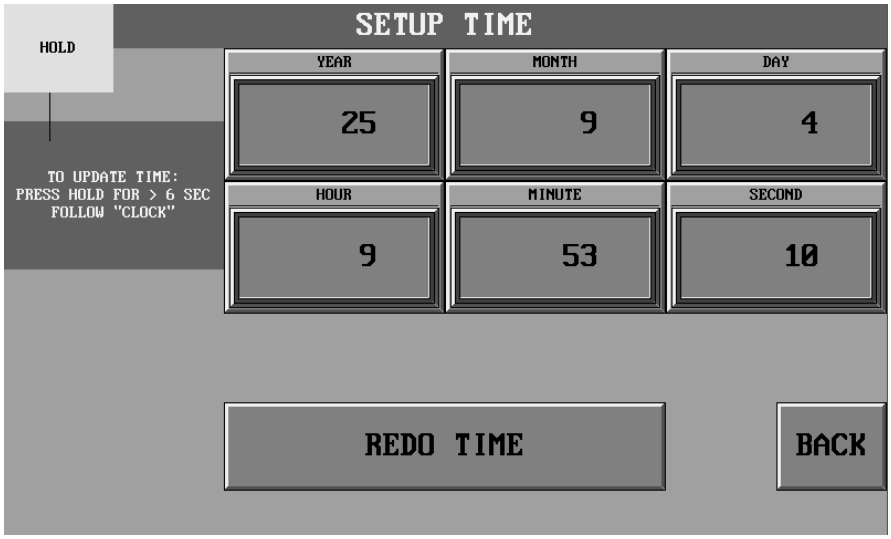
Take care when selecting the model type and range. The model selection step can only be performed once, thereafter, the license will need to be reinitialized.

Up to four channels/sensors can be enabled per control box.

- Assign each channel the proper model and range
- Save channel model and range before switching to next channel

Time

Figure 19: System Time Setup Screen



The system time is important for datalogging time stamps.

To manually update time, gently press and hold the top left 'HOLD' button for over 6 seconds.

Setup Communications and IO

Figure 20: Comms, Modbus, Messaging, and IO Setup Screen



'Setup HMI Comms' and 'Modbus AND Messaging Enable' require a CADARO CONNECT Enterprise Plan. HMI Comms will allow for remote access to the HMI screen and/or the stored data from a desktop.

Enabling Modbus/Messaging turns on the data within the software to allow for remote monitoring and/or control. 'Customer PLC IP Address' needs to be configured if Messaging is the applied communication method.

If Enterprise Plan subscriber: See "CADARO ENTERPRISE Software Technical Operations Manual" for further instruction.

- "HMI Comms Technical Data Sheet"
- "Modbus Technical Data Sheet"

'Initialize IO' is only accessible for CADARO Pro Plan subscribers. See "PRO Software Technical Operations Manual".

Figure 21: Amplifier and Analog Inputs

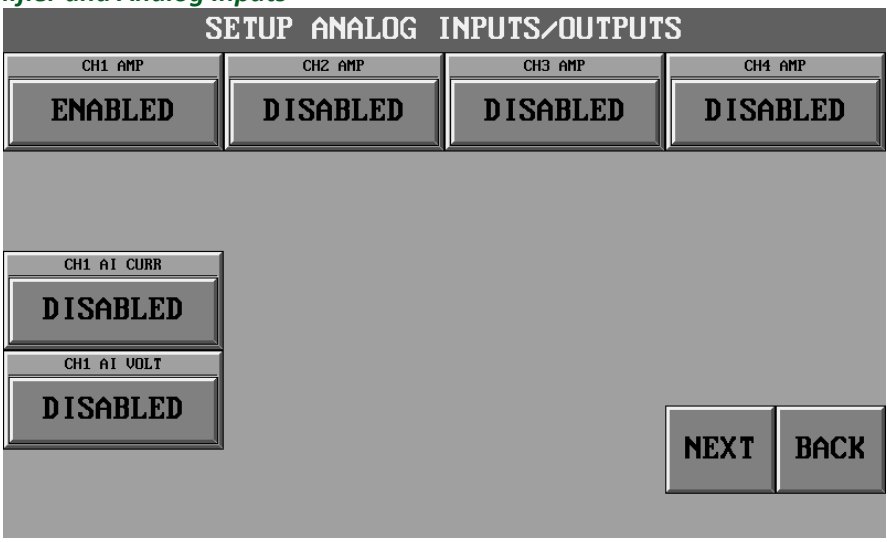


Figure 22: Discrete Input Setup Screen

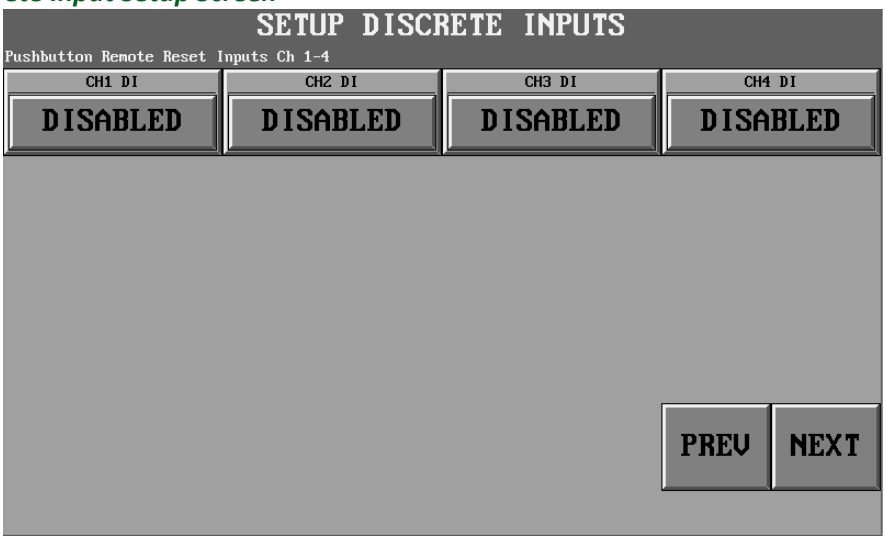
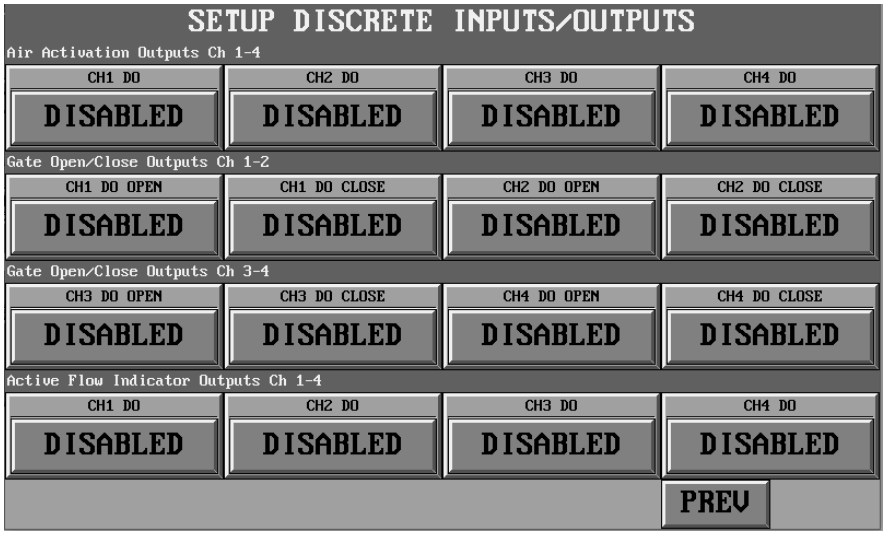
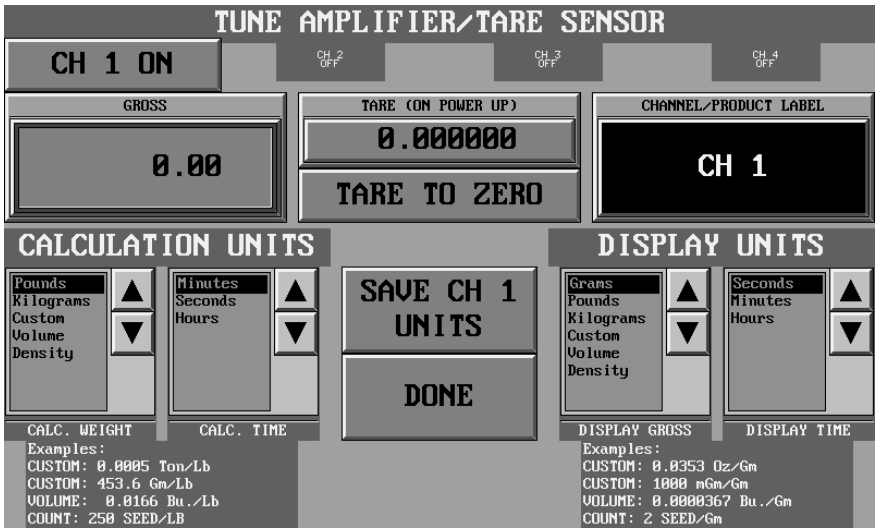


Figure 23: Discrete Output Setup Screen



Tune/Tare Sensor and Set Units

Figure 24: Tune, Tare, and Units Screen



The 'tune amplifier/tare sensor' screen is used to visualize the reading from the amplifier for tuning purposes and tare the net reading if needed.

Taring can be an automatic functionality. If you find the tare does not match the raw (amplifier reading), a manual tare shall be done.

'Channel/Product Label' is used to name the channel. For example, Channel 1 could be named 'Plant Input' and Channel 2 could be 'Plant Output'.

The 'Calculation Units' section allows for setting prescribed or customized units.

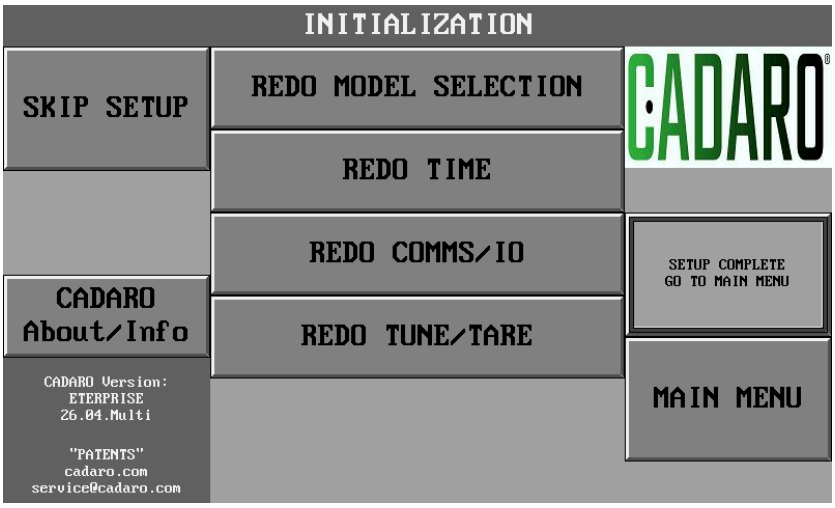
- Custom Example: Short ton = 2000 Lb => 0.0005 Ton/Lb
  - This 0.0005 value is placed in the 'Unit/Lb' entry box
- Volume Example: 1 Bushel = 60 Lb => 0.0166 Bu./Lb
  - This 0.0166 value is placed in the 'Lb/Unit' entry box
- Density Example: 250 seeds/Lb
  - This 200 value is placed in the 'Unit/Lb' entry box

All subsequent screens and value displays will represent the selected unit/time value, after a calibration is performed.

The 'Display Units' section allows for changing how some of the calculation data is displayed on the 'Loadout Summary Screen'.
The raw analog data is the default Grams but can be changed as desired.
The batch run time can be changed to seconds, minutes, or hours.

Post-Initialization

Figure 25: After All Initialization Is Complete



If for any reason the 'Model Selection' needs to be redone, the confirmation screen below will appear.

Figure 26: About Page

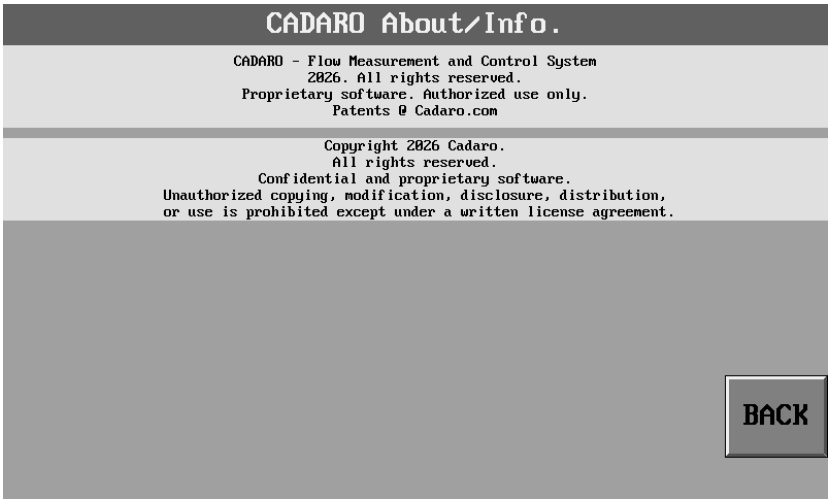


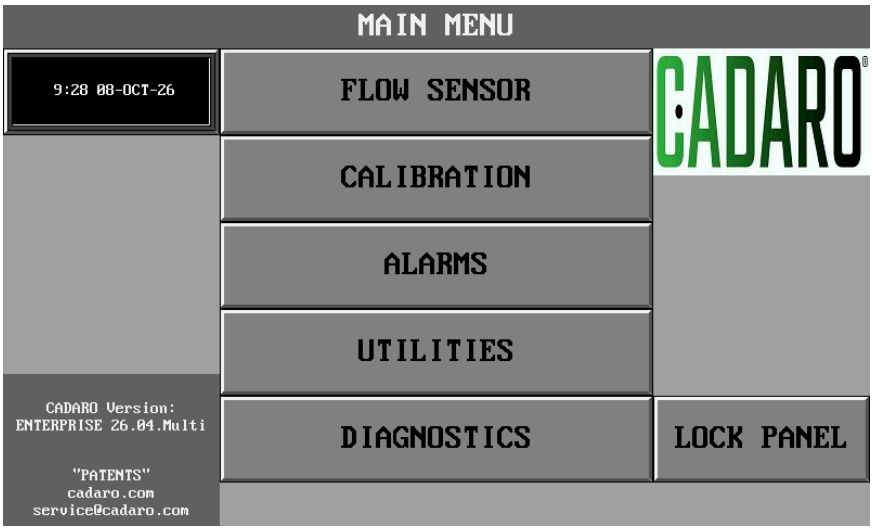
Figure 27: Void License Confirmation



If 'Continue' is clicked, the license will be voided, and a new license will be required to proceed.

MAIN MENU

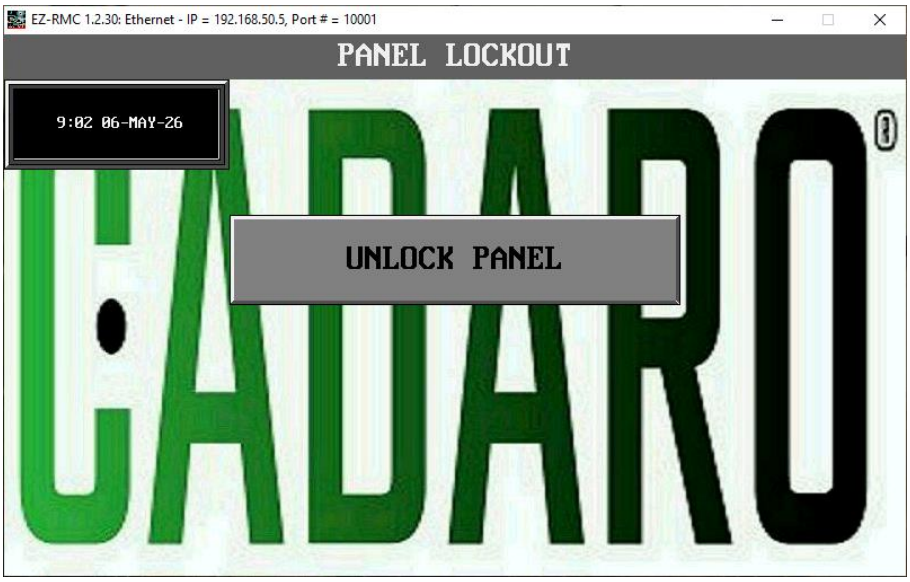
Figure 28: Main Menu Screen. For Post-Initialization Tasks



The screen controls can be locked from this screen.

PANEL LOCKOUT

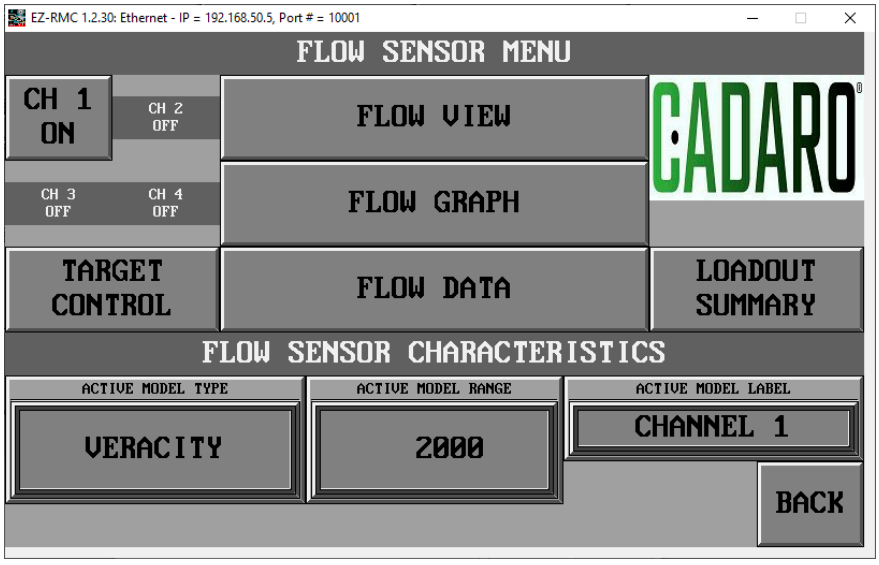
Figure 29: Panel Lockout Screen



Unlocked using the 'Unlock Password'. This password can be changed on the 'Password Settings' screen, accessible from the 'Utilities Menu'. This is covered additionally later. Default is (0000).

FLOW SENSOR

Figure 30: Flow Sensor Menu Screen



Double-Check the 'Active Model Type' and 'Active Model Range' match the installed sensor characteristics for each available

channel.

Flow View

Figure 31: Flow View Screen. No Controls Enabled

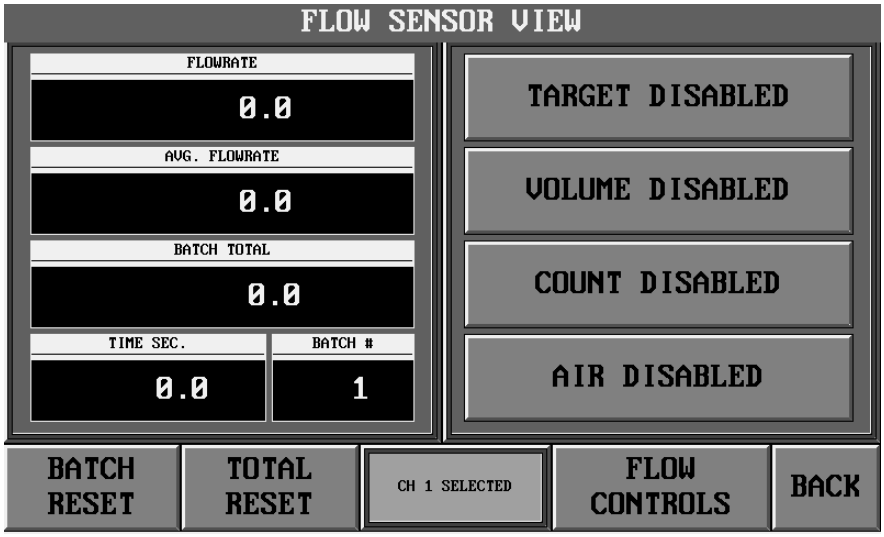
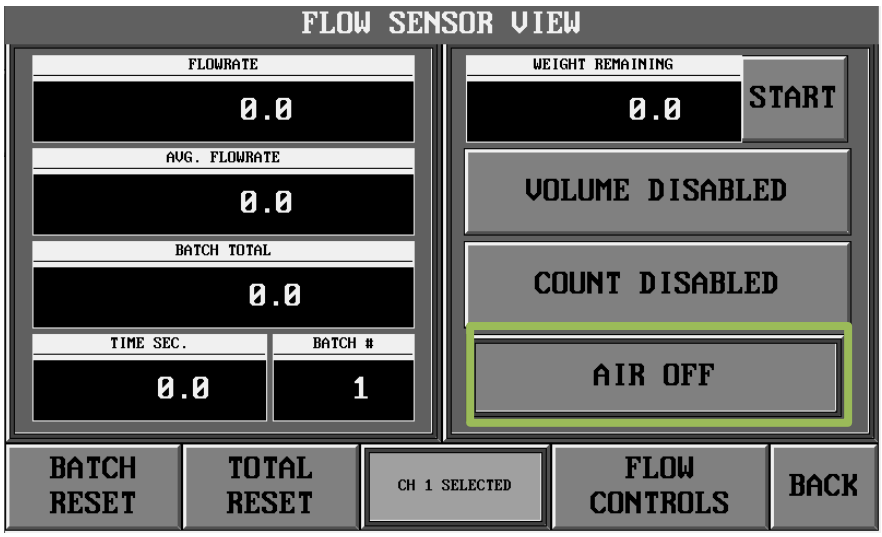


Figure 32: Flow View Screen. All Controls Enabled



Flow Sensor View screen can be the default screen for operator use once the device has been fully initialized and calibrated. Feel free to reach out to CADARO if there are any requests for alterations to this screen.

The target weight capability requires CADARO CONNECT Pro Plan. See “CADARO PRO Software Technical Operations Manual”. More information on ‘Target Presets’ is below.

The air blower capability requires CADARO CONNECT Pro Plan. More information on ‘Air Control’ is below.

Flow Graph

Figure 33: Flow Graph Screen

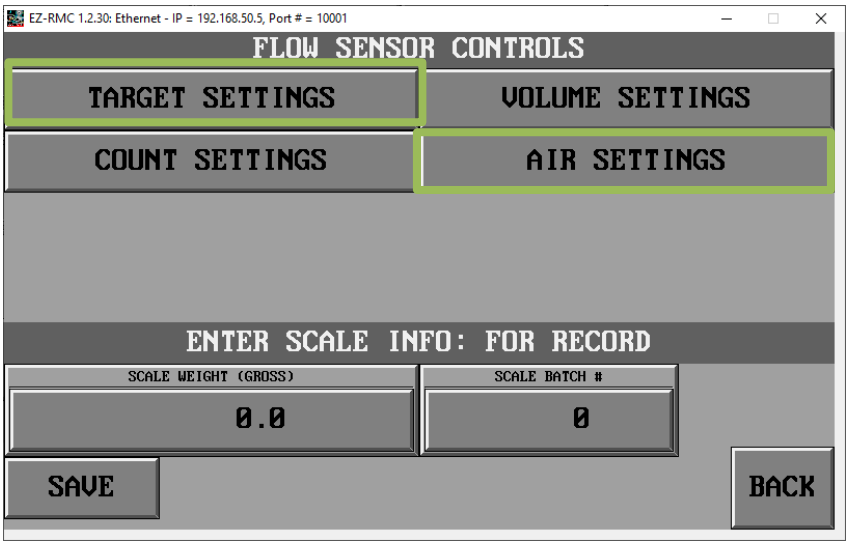


The Flow Graph screen allows for a trendline and historical visual representation of the ‘Current Flow’, ‘Average Batch Flow’, and 'Average Total Flow’. If you request a different value to be trended, contact CADARO.

The y-axis (lbs.) is preset adjustable on the top option bar.

Flow Settings

Figure 34: Flow Settings Screen



‘Target Presets’ and ‘Air Control’ are covered in further detail below.

The ‘Enter Scale Info: For Record’ section allows for manual entry of the scale weight and respective batch for the scale

weight. This data saves to the microSD card upon clicking ‘Save Scale’. This data can later be used as reference.

Flow Settings: Target Presets

Figure 35: Target Presets Screen

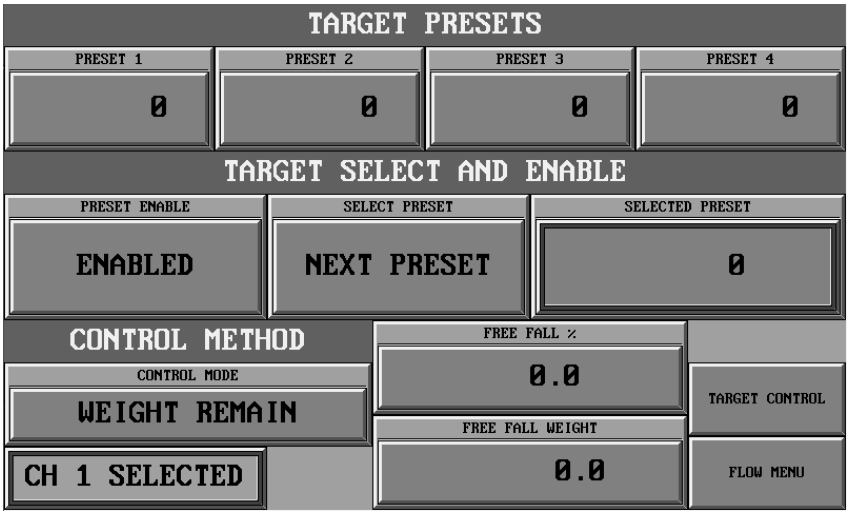
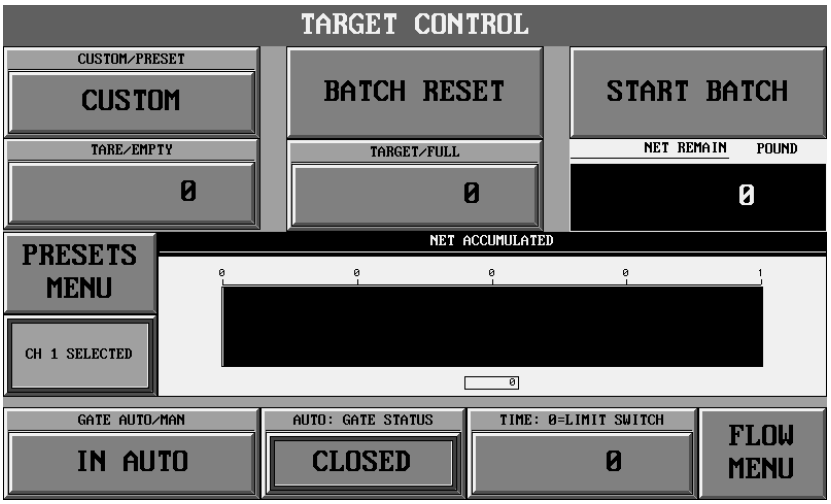


Figure 36: Target Control Screen



The target preset functionality is intended to be used as a controllable output of the PLC when the target is met.
Custom or Preset controls can be controlled from this ‘Target Control’ screen.
If required, a batch can be started/stopped from this screen to open/close a gate.

- The tare/empty weight represents the empty truck weight or starting point of a batch total weight.
- The target/full weight represents the desired amount for the batch.

Example: If the target is 80,000 lbs., PLC will shut the slide gate at 79,000 lbs. to meet the target. This is tunable.
The ‘Time: 0=Limit’ input section will dictate how the gate limit is treated. Setting to 0 will allow limit switches to be in control. Setting above 0, say 2 seconds, will stop opening the gate after two seconds.

The target weight capability requires CADARO CONNECT Pro Plan. If Pro Plan subscriber: See “CADARO PRO Software Technical Operations Manual”, “Target Preset Technical Data Sheet” for further instruction.

Flow Settings: Air Control

Figure 37: Air Control Screen



The auto/manual air blower control is intended to clean the INTEGRAL flow sensor after each batch or other criteria.

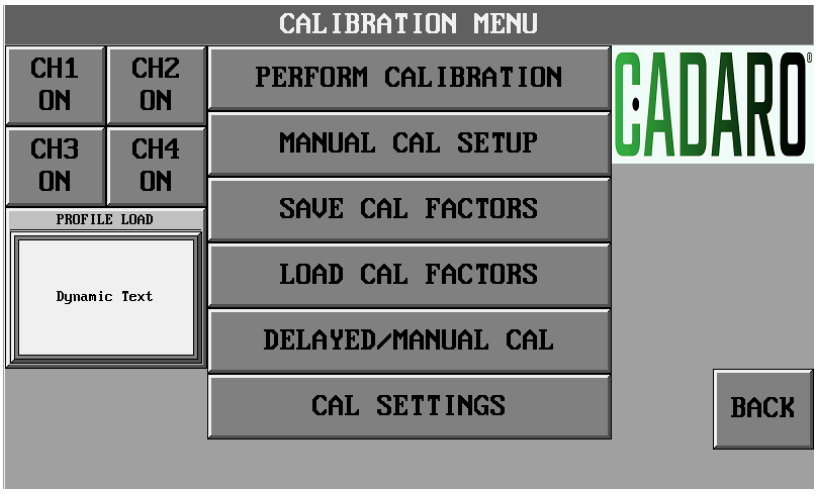
Example: Heavy buildup of dust or residue from material may cause inaccurate readings.

The air blower capability requires CADARO CONNECT Pro Plan. If Pro Plan subscriber: See “CADARO PRO Software Technical Operations Manual”, “Air Control Technical Data Sheet” for further instruction.

CALIBRATION

Calibration Menu

Figure 38: Calibration Menu Screen

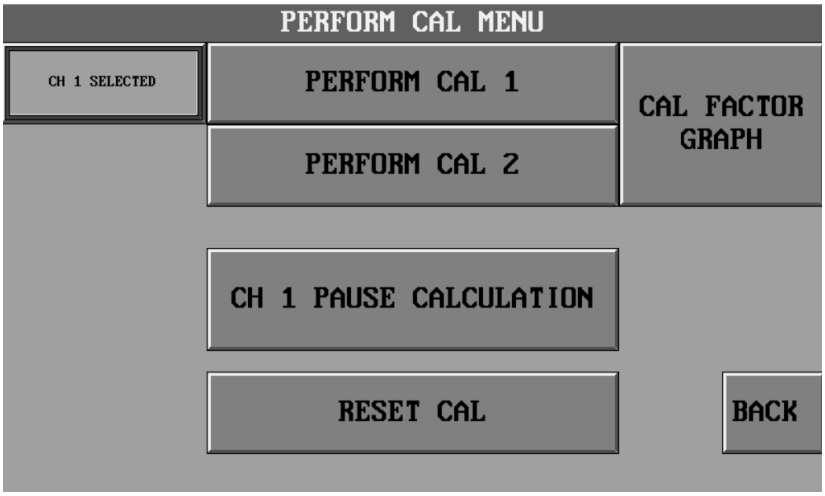


All calibration functions derive from this ‘Calibration Menu’

The ‘Profile Load’ display will indicate which profile was last loaded, if applicable.

Perform Calibration Menu

Figure 39: Perform Calibration Menu Screen



Note: ‘Perform Cal 2’ and ‘Cal Factor Graph’ options only appear after Cal 1 has been performed.

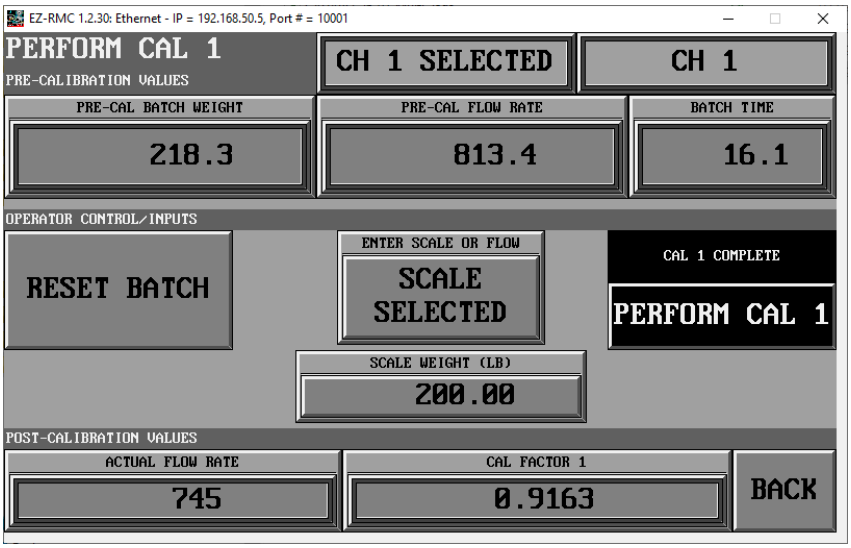
‘Stop Batch’ is used only for calibration scenarios when the process of material is not capable of smooth/quick starts and stops. It can also be used for scenarios when the flow rate of a process takes time to build up to or slow down. Pressing ‘Stop Batch’ will force the software to stop calculating flow, even if material is still flowing.

The physical batch of material used to calibrate a run will need to closely match the calculated batch. Meaning, a manual bypass gate or similar needs to be swung at the same time ‘Stop Batch’ is pressed.

‘Cal Factor Graph’ will display a visual representation of the 2-point logarithmic equation on a graph. This can assist with troubleshooting and understanding the function of 2-point calibration.

Perform Cal 1

Figure 40: Perform Calibration 1 Screen

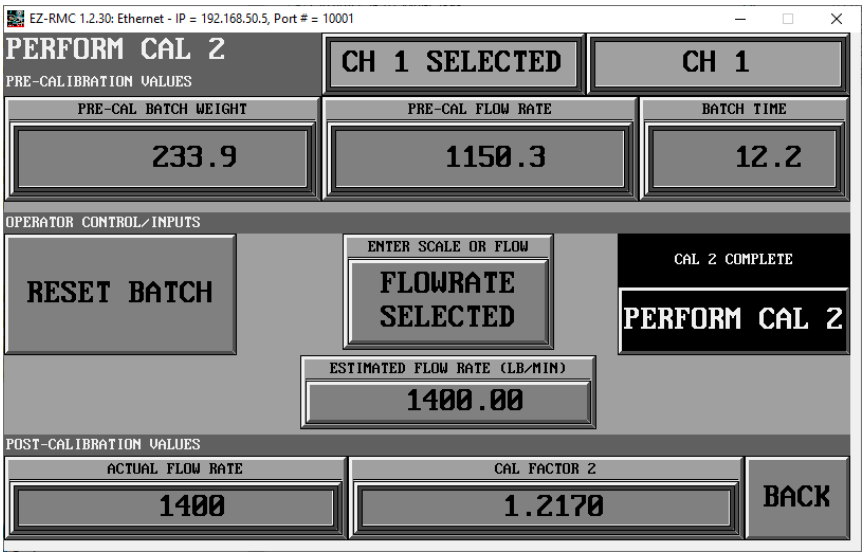


Calibration screen for Cal 1 depicts three rows of information.

- **Row 1** at the top is all pre-calibration values. These values are used as a baseline to calculate 'real' values in row 3.
- **Row 2** is for operator control/input.
  1. Ensure the batch has been reset before running a calibration batch.
  2. Two options for batched calibration feedback:
     - Input scale weight after material has stopped flowing.
     - Input estimated real flow rate (lb/min). Demonstrated in 'Perform Cal 2' screen below.
  3. Press 'Perform Cal 1' after scale weight or estimated flow rate has been submitted.
- **Row 3** is real values calculated from pre-calibration and scale weight/flow rate values.

Perform Cal 2

Figure 41: Perform Calibration 2 Screen



When a second calibration point is performed and calculated by the software, it is called 'Two-Point Cal'.

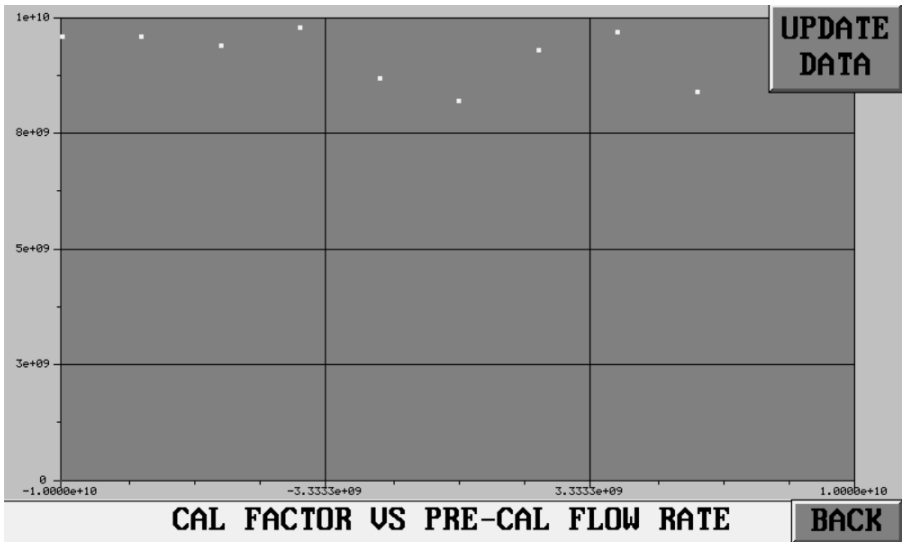
Calibration 2 screen is similar to the Calibration 1 screen.

- 'Two-Point Cal' uses Cal 1 factors and Cal 2 factors to create an equation of calibration information.
- 'Estimated Flow Rate (LB/MIN)' was used in this example to create the Cal Factor 2 Value.

Note: The difference in flow rate between Cal 1 and Cal 2 shall be greater than the 'Cal % Difference' setting. This setting is addressed below in the 'Cal Settings' section.

Cal Factor Graph

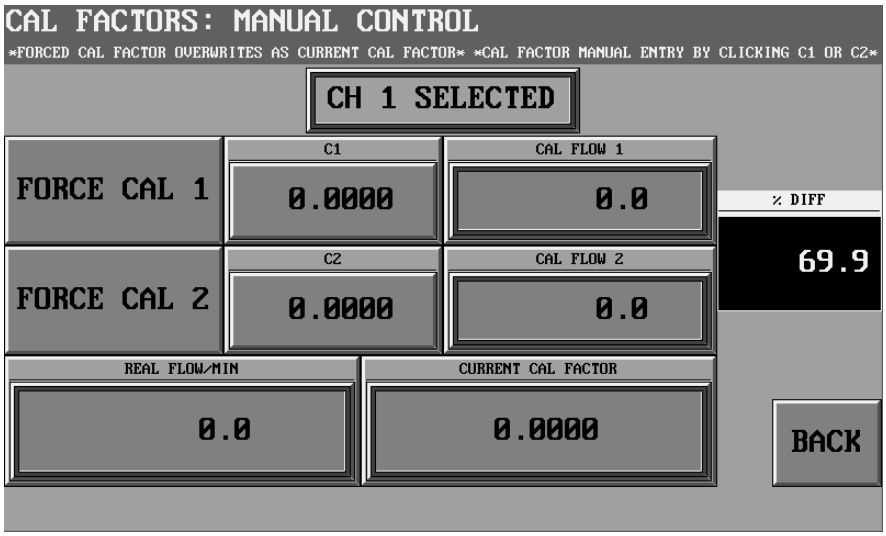
Figure 42: Cal Factor vs Pre-Cal Flow Rate



Clicking 'Update Data' will display the latest graph representation for the selected channel.

Manual Cal Factors

Figure 43: Manual Cal Factor Control Screen

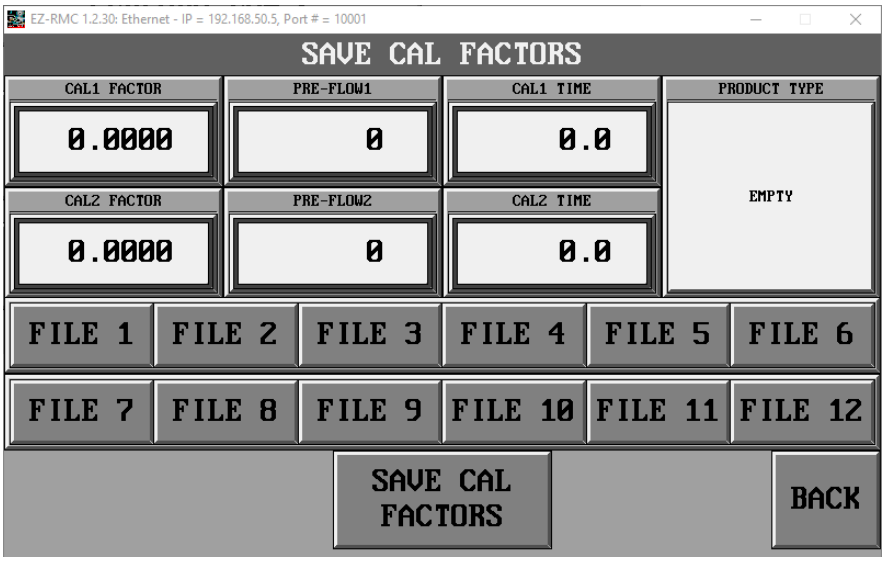


From this screen, calibration values can either be forced or manually changed. This screen also acts as a helpful calibration summary screen.

- Forcing will overwrite all predetermined Cal values. This applies to two-point Cal as well.
- Forcing Cal values for C1 or C2 is done by pressing 'Force Cal 1' or 'Force Cal 2'.
- Only a single force can be active at any given time.
- The C values can be manually changed by clicking C1 or C2 and editing the value.

Save Cal Factors

Figure 44: Save Cal Factors Screen



After a calibration has been performed, the active calibration values will be auto populated onto the 'Save Cal Factors' screen.

- This is where a product or flowrate profile can be saved to the software. Select a 'File Element' to save to before clicking 'Save Cal Factors'. If saving to a previously occupied 'File Element' all previously saved information in that particular 'File Element' will be overwritten.
- The 'Product Type' section allows for shorthand notes about the profile. Limited to 10 characters. Examples may include 'Soybean', 'CornFlow2k', 'Milo2Point', '9Aug2023', etc.
- The software will store up to twelve profiles for future loading to the active calibration when needed. The active profile is always the one loaded into the values on this screen.

For manual saving of calibration information, refer to the below table for guidance.

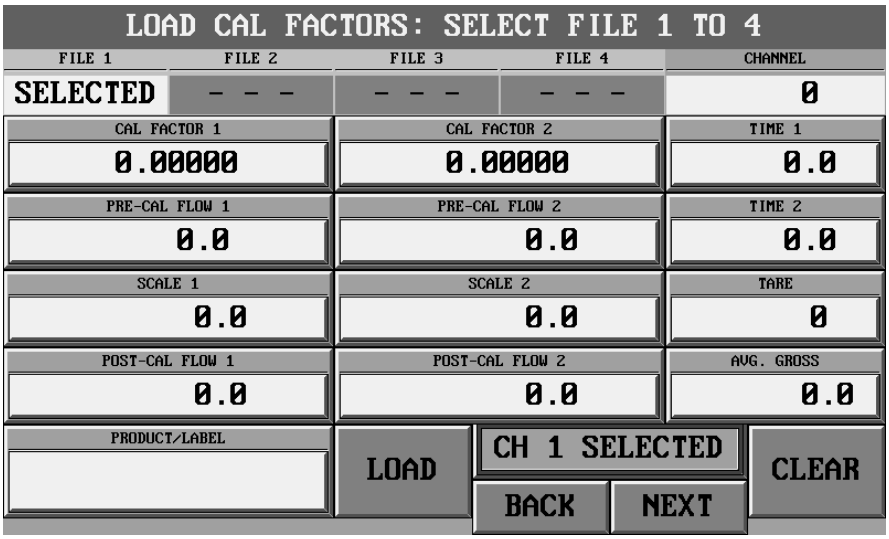
Table 2: Calibration Profile Saving Example

	File 1	File 2	File 3	File 4	File 5	File 6	File 7	File 8	File 9	File 10	File 11	File 12
CAL1												
CAL2												
Pre-Cal Flow1												
Pre-Cal Flow2												
Time1												
Time2												
Scale1												
Scale2												
Estimate Flow1												
Estimate Flow2												
Tare												
Product												

You may also email the calibration information to CADARO directly at info@cadaro.com

Load Cal Factors

Figure 45: Load Cal Factors Screens

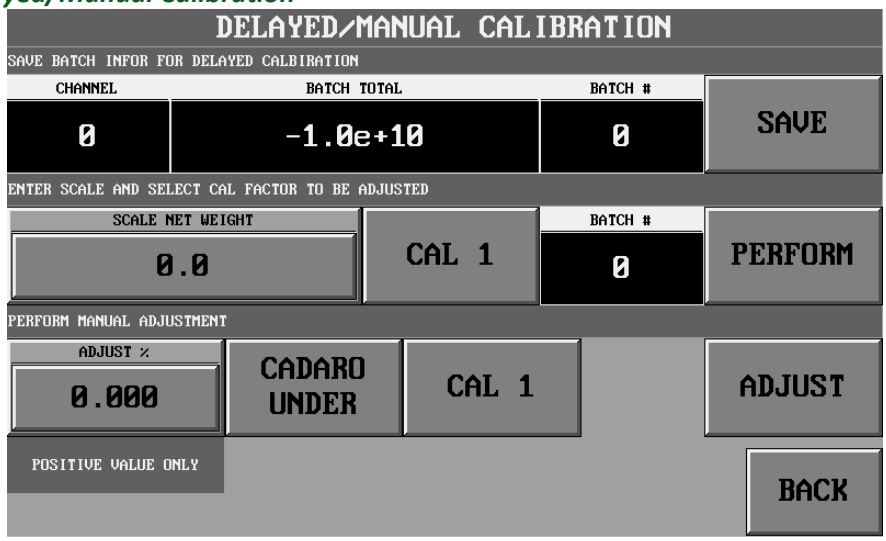


This is the repository of the saved calibration profiles. Four files are depicted on three separate screens to total the twelve files available.

- Select any of the four files by clicking on the top row of buttons.
- Select 'Load' when ready. On the 'Save Cal Factors' screen, the loaded profile is now the active profile.
- 'Clear Profile' will delete the selected profile.
- Be careful to choose the correct profile corresponding to the correct channel.

Delayed/Manual Calibration

Figure 46: Delayed/Manual Calibration



Delayed calibration allows for performing a calibration eligible batch, saving it until scale feedback is received, and finally entering the scale weight at a later time.

- Ensure the correct channel is selected
- Perform a clean batch

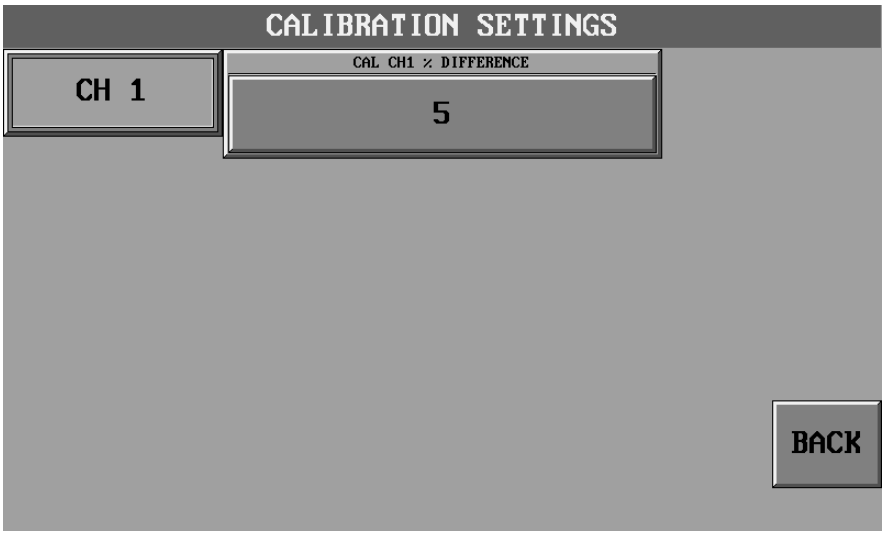
- ‘Save’ the batch for later
- Enter scale weight for the saved batch
- Ensure the proper cal factor is selected
    - Cal 1 is typically normal/high flow
    - Cal 2 is typically low/reference flow for two-point cal
- ‘Perform’ the delayed calibration

Manual calibration adjust allows for minor tweaks to the calibration factor without having to perform a calibration run.

- Ensure the correct channel is selected
- Determine if CADARO’s calculated results for a batch are over or under the scale feedback
- Enter an averaged % over or under, this value must be positive
- Apply this correction to the correct cal factor
- ‘Adjust’ the cal factor

Cal Settings: Password Protected for Supervisor Level Access

Figure 47: Calibration Settings Screen



The ‘Cal % Difference’ is an allowable range between flow rates for Cal 1 and Cal 2.

- For instance, Cal 1 Flowrate of 100 and Cal 2 Flowrate of 79 is acceptable. The % difference is 21%.
- This setting is meant to inform the user of calibration flowrate values being too close, which can cause two-point calibration calculation problems.
- If this condition is violated, it will produce an alarm and nothing more. Specifically, it will continue the calibration calculations as normal, even if they are malfunctioning.

ALARMS

There are seven alarms pre-programmed into the software:

Table 3: Alarm List

Alarm Name	Severity	Solution – Contact CADARO If Needed
Panel/HMI Battery Low	Low	Follow procedure to replace battery with an exact-match battery
PLC Battery Low	Low	Follow procedure to replace battery with an exact-match battery
Signal Fault	High	Signal reading 0. Bad load cell or faulty wiring.
Signal Max Reading	Medium	Signal reading max. Bad load cell or too much flow.
Auto-Tare Fault	Medium	Tare value not updating. Signal issue or not in auto.
Cal Flowrates Too Close	Low	Cal settings need adjustment. Cal 2 flowrate needs to change.
Cal Factor Incomputable	High	Cal 1 and/or Cal 2 flow rate needs adjusting.
Channel 1 Paused	Low	Warning: Calculation paused on channel 1.
Channel 2 Paused	Low	Warning: Calculation paused on channel 2.
Channel 3 Paused	Low	Warning: Calculation paused on channel 3.
Channel 4 Paused	Low	Warning: Calculation paused on channel 4.
Channel 1 Amp Comms Lost	High	Comms to channel 1 signal conditioner lost.
Channel 2 Amp Comms Lost	High	Comms to channel 2 signal conditioner lost.
Channel 3 Amp Comms Lost	High	Comms to channel 3 signal conditioner lost.
Channel 4 Amp Comms Lost	High	Comms to channel 4 signal conditioner lost.

Alarm List

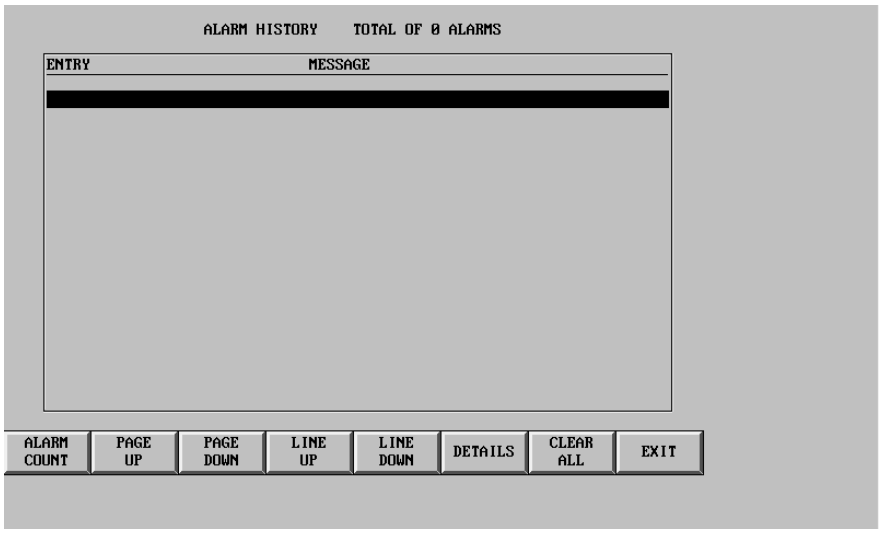
Figure 48: Alarm Summary Screen



All active alarms will be shown here. Refer to the alarm list above for more information.

Alarm History

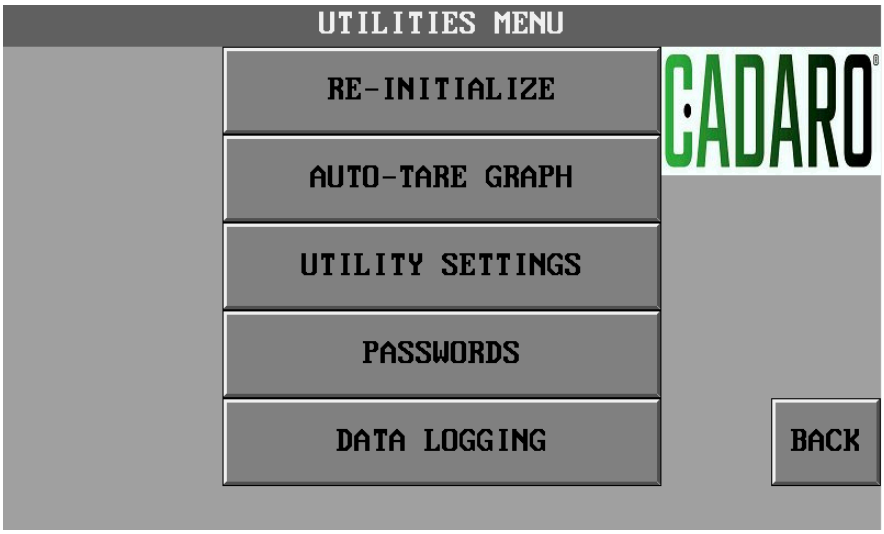
Figure 49: Alarm History Screen



All alarms, whether active or not, will show here. The alarms can be cleared if necessary by clicking 'Clear All'.

Utilities Menu

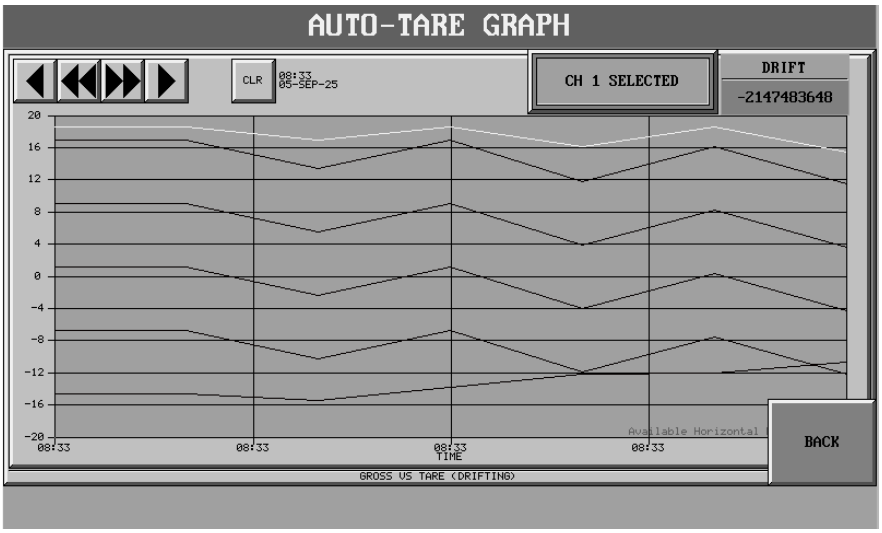
Figure 50: Utilities Menu Screen



- *Re-Initialize* will navigate the user to the 'Initialization' screen.
- *Passwords* is protected by the Supervisor password, which is the default '3456'.

Auto-Tare Graph

Figure 51: Auto-Tare Graph Screen

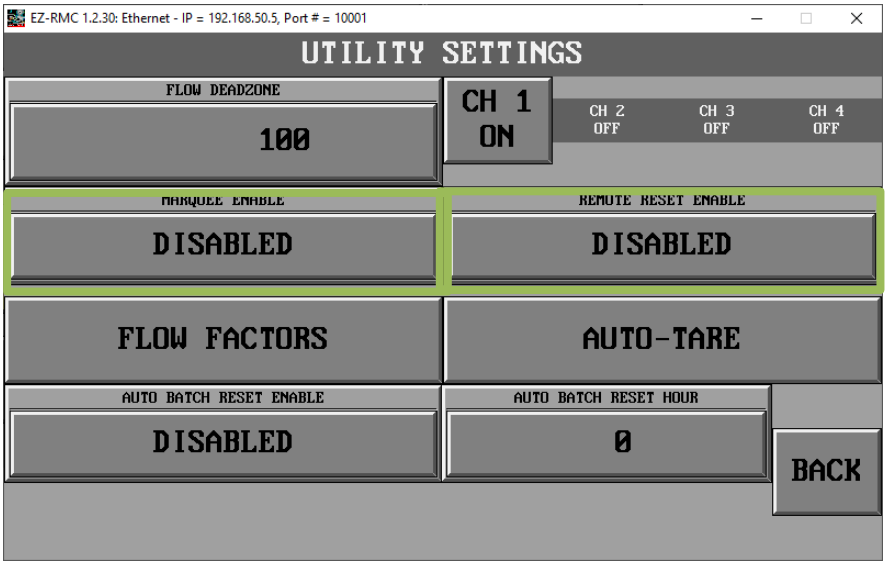


The 'Auto-Tare Graph' screen is used to visualize the 'noise' of the signal.

- This is a direct comparison of the gross (raw) value from the sensor to the tare (zero) value of the software.
- The 'noise' could be from a handful of interactions to the PLC or Loadcell. For example: radio interference, vibration, temperature, etc.
- If auto-tare is enabled, the drift will re-tare when the drift is beyond the tare dead zone for more than five seconds.

Utility Settings

Figure 52: Utilities Setting Screen



Flow Deadzone: The values used to determine active flow. For example: If the tare is 100 and the flow dead zone is 20, then gross will need to be greater than 120 for flow to be considered active.

Possible reasons to change *Flow Deadzone*:

- Considerable noise causing the signal to bounce above the dead zone without actual flow of material. This problem should be fixed in a different way for a long-term solution.
- Material is lightweight or slow flow where the signal is not moving enough to be considered active.

Marquee Enable: An optional installation of a remote LED data display device, or Marquee, can be activated. The *Marquee* capability requires a CADARO CONNECT Enterprise Plan.

- If Enterprise Plan subscriber: See document named "CADARO Marquee Tech Sheet".

Remote Reset Enable: A hardwired push button can be installed to allow for remote resetting of the batch. If other criteria are requested for use by a hardwired push button, please reach out to CADARO Support. The *Remote Reset Enable* capability requires CADARO CONNECT Pro Plan.

- If Pro Plan subscriber: See document named "CADARO Remote Reset (Hardwired) Tech Sheet".

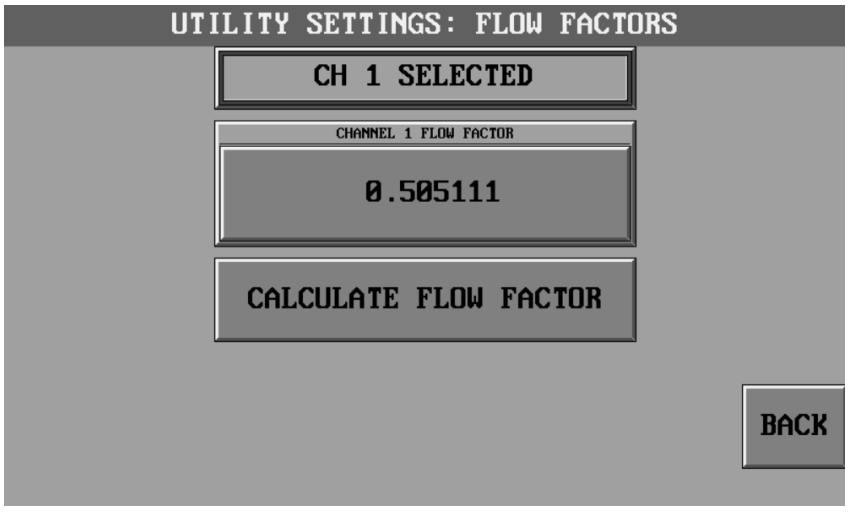
Flow Factors: Separate screen with multiple options described below.

Auto Tare: Separate screen with multiple options described below.

Auto Batch Reset Enable: Enabling this functionality for any or all channels will allow for the batch to be reset automatically on a time basis. For example: If the hour is set to 7 (am) or 19 (pm), the batch will immediately reset when this hour is hit.

Utility Settings: Flow Factors

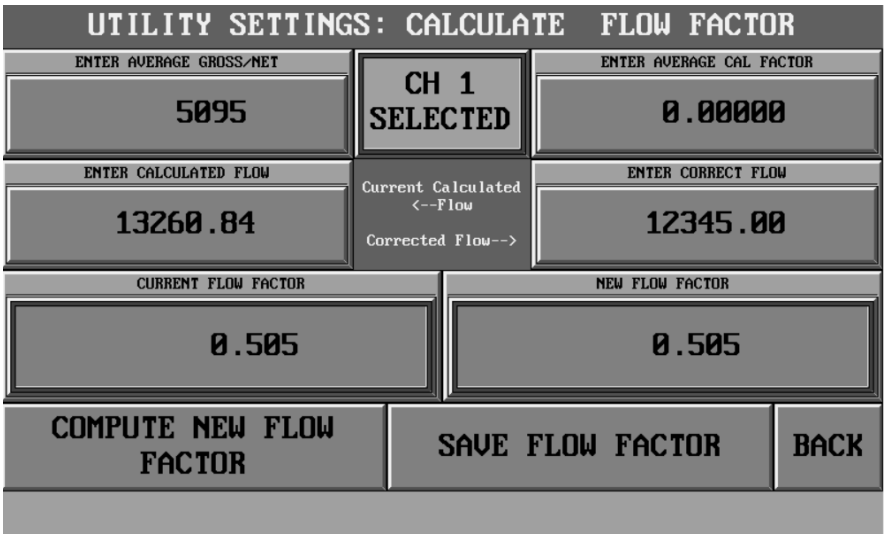
Figure 53: Flow Factors Screen



Flow Factors are an anytime adjustment to calibrated or uncalibrated flow rate. It is a divisor from the raw values delivered from the signal conditioner.
Calculating what this flow factor should be, is done next.

Utility Settings: Calculate Flow Factor

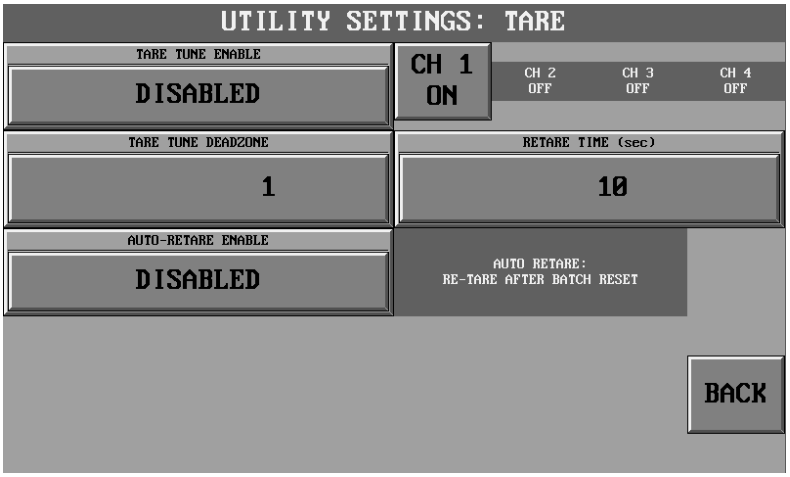
Figure 54: Calculate Flow Factor Screen



The calculate flow factor screen will adjust the channel specific calculated flow rate either before or after calibration.
The following values can be manually adjusted for real-time tweaking of flow rate.
The 'Average Gross/Net' reflects the signal from the signal conditioner and is specifically the average grams reading during the latest material run period.
The 'Average Cal Factor' can be zero if no calibration is applied to the channel. It will be non-zero if there is a calibration applied to the selected channel.
The 'Calculated Flow' is the average flow rate for the latest material run period.
The 'Correct Flow' is the flow rate in which the operator wants.
Select 'Compute New Flow Factor' to calculate the correction factor.
Select 'Save Flow Factor' to apply the new flow factor to the selected channel.

Utility Settings: Tare

Figure 55: Tare Screen



This is 'Tare Tune' functionality, and it is default enabled. When enabled, the tare will adjust itself to follow any deviations

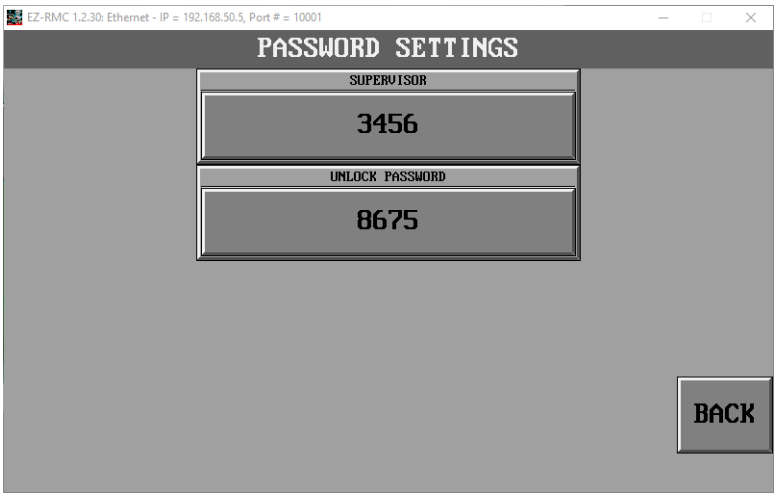
in gross (raw) over time.

The *Tare Tune Deadzone* is the value used to determine if gross has drifted too far from tare, i.e., if gross-minus-tare is greater than 'Tare Tune Deadzone' for greater than five seconds, the tare will 'Auto-Tare'.

The 'Auto-Retare' functionality is default enabled. When enabled, the software will perform a tare each time the batch is reset. This is regardless of drift status.

Passwords

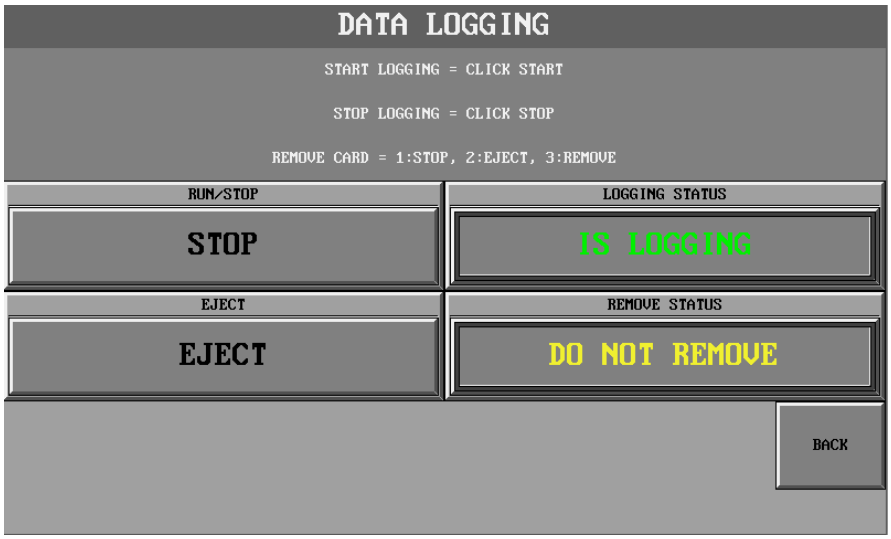
Figure 56: Passwords Screen



The 'Supervisor' password is adjustable by the supervisor only. The default is password '3456'. If changed, do not forget it. This is the only password customers can use to access certain areas of product functionality.
The 'Unlock Password' can only be changed by the 'Supervisor'. Default is '8675'.

Data Logging

Figure 57: Data Logging Screen



There are a handful of pre-programmed scenarios in which data is logged to the on-board microSD card. The PLC manufacturer suggests a 4 GB microSD card, but it has been successful with up to a 32 GB. The card shall be formatted to 'FAT32' with the default allocation size.

This functionality is enabled and running by default.

- If ever there is a blinking notification on the top-left of any screen saying, 'Data Not Logging', please contact CADARO.
- To remove the microSD card or start/stop data logging, follow the on-screen instructions.

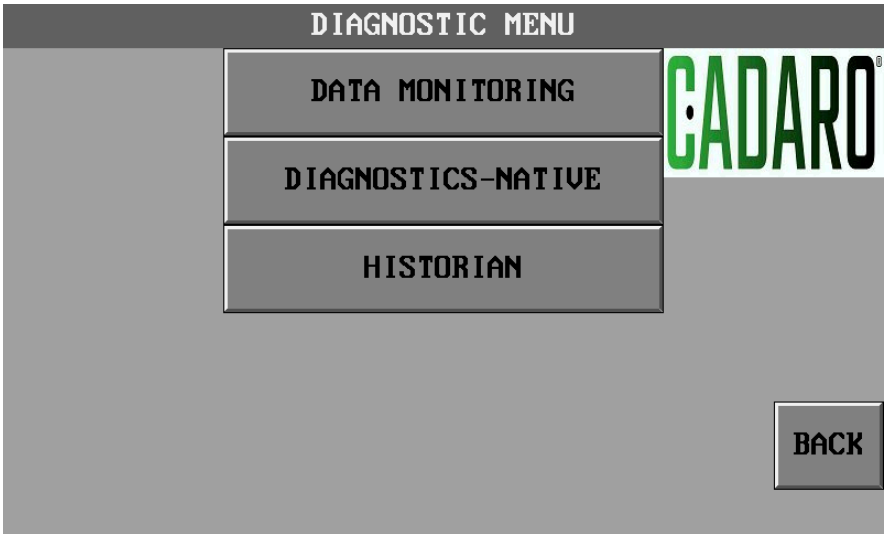
The data logging scenarios and data logged are as follows:

Table 4: Data Logging Criteria

Log Trigger	Data Logged
Batch Reset	Batch Total Batch Number Batch Time Batch Average Flowrate/Min Tare Cal 1 Batch Time Cal 1 Batch Weight Cal 1 Factor Cal 1 Scale Weight Cal 1 Flowrate/Min Cal 1 Pre-Calibration Flowrate/min Cal 2 Batch Time Cal 2 Batch Weight Cal 2 Factor Cal 2 Scale Weight Cal 2 Flowrate/Min Cal 2 Pre-Calibration Flowrate/min
Active Batch	Batch Number Gross Tare Batch Mini-Number Tare Calibration Status Tare Calibration
Scale Save	Scale Weight Scale Batch

DIAGNOSTICS: PASSWORD PROTECTED FOR SUPERVISOR LEVEL ACCESS

Figure 58: Diagnostics Menu Screen



Data Monitoring

Figure 59: Data Monitor Hardwired Signals Screen

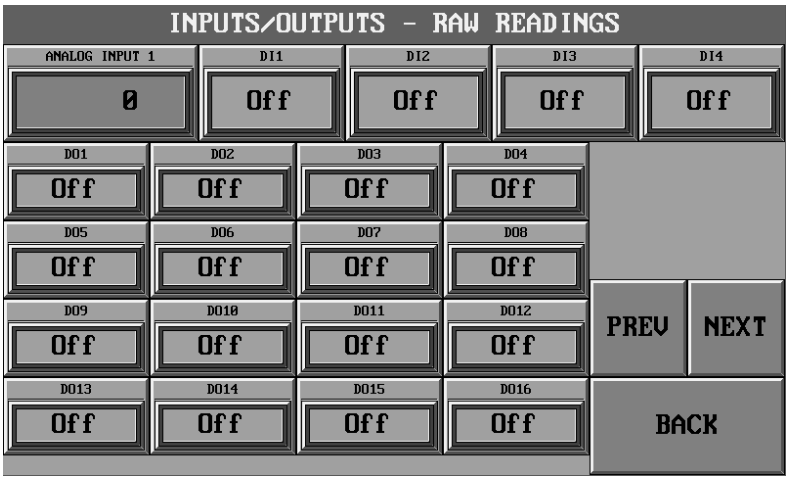


Amplifier Raw Reading is the value from the Signal Conditioner/Amplifier.

- Control = Modbus RTU Control Status
- Error = Modbus RTU Error Status
- 03 = Digital Filtering
- 04 = Decimal Point Position
- 05 = Electricity Zero
- 06 = Acquisition Speed
- 07 = Differential Values
- 08 = Change to Zero

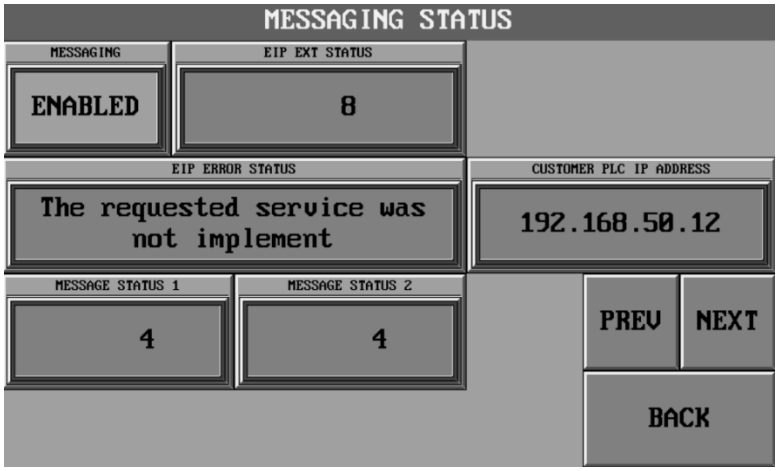
- 09 = Variant Full Degree
- 10 = Variant Delivery Scale
- 11 = Communication Mode
- 12 = Communication Address
- 13 = Communication Rate

Figure 60: Data Monitor Hardwired Signals Screen



'Raw Readings' is the active status of all analog inputs and outputs and all digital inputs and outputs.

Figure 61: Data Monitor Messaging Screen



'Messaging' will help troubleshoot any potential issues with Ethernet Messaging to the Plant PLC.

Figure 62: Data Monitor Modbus Reads 1 Screen

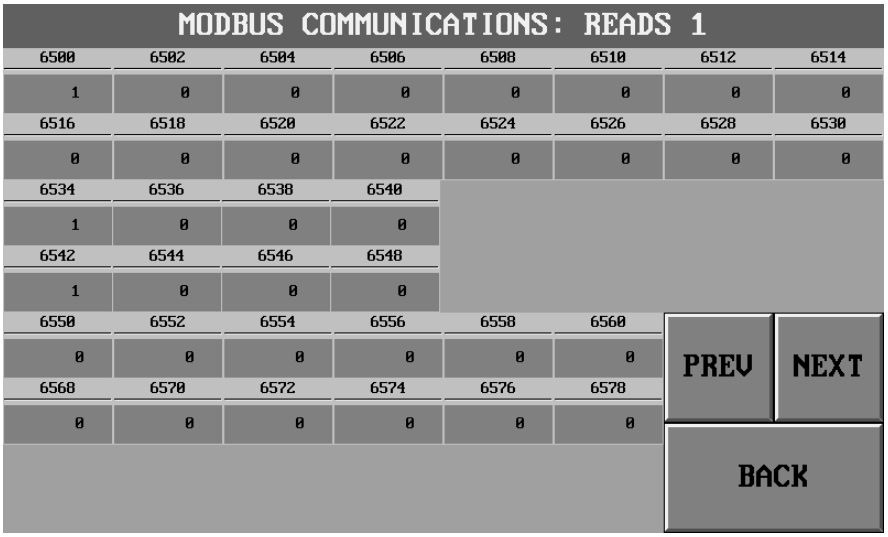


Figure 63: Data Monitor Modbus Reads 2 Screen

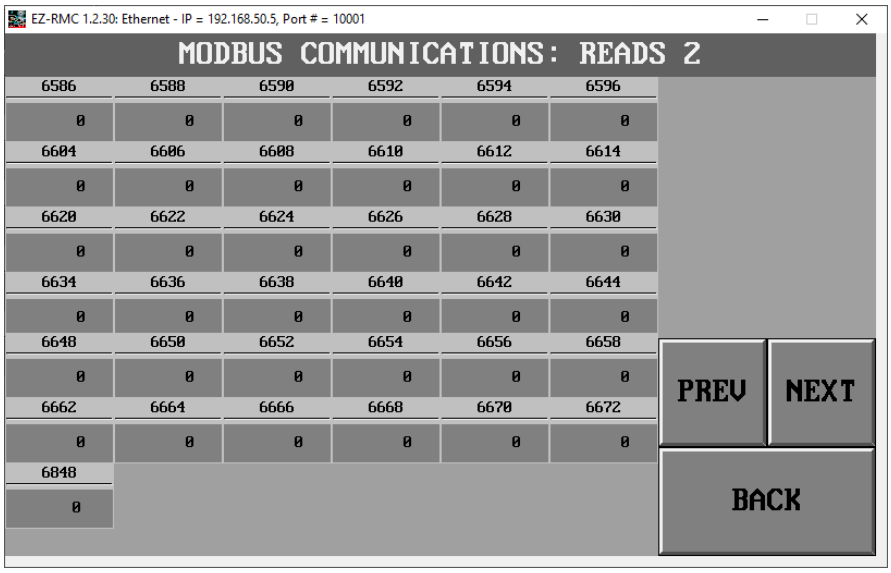


Figure 64: Data Monitor Modbus Reads 3 Screen

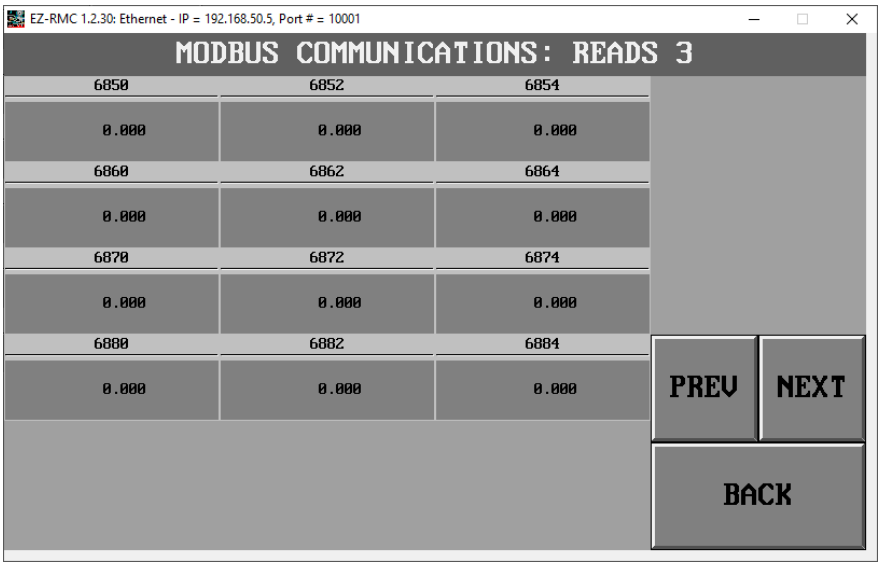


Figure 65: Data Monitor Modbus Reads 4 Screen

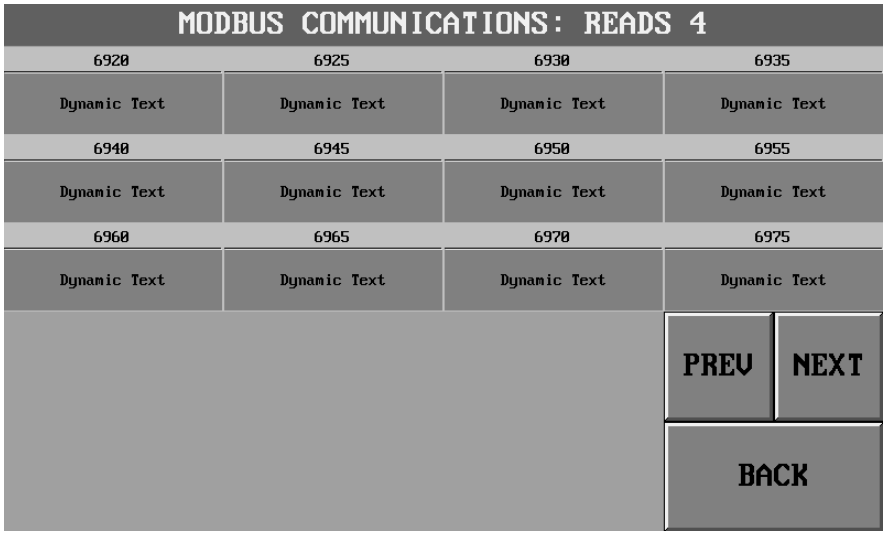


Figure 66: Data Monitor Modbus Writes 1 Screen

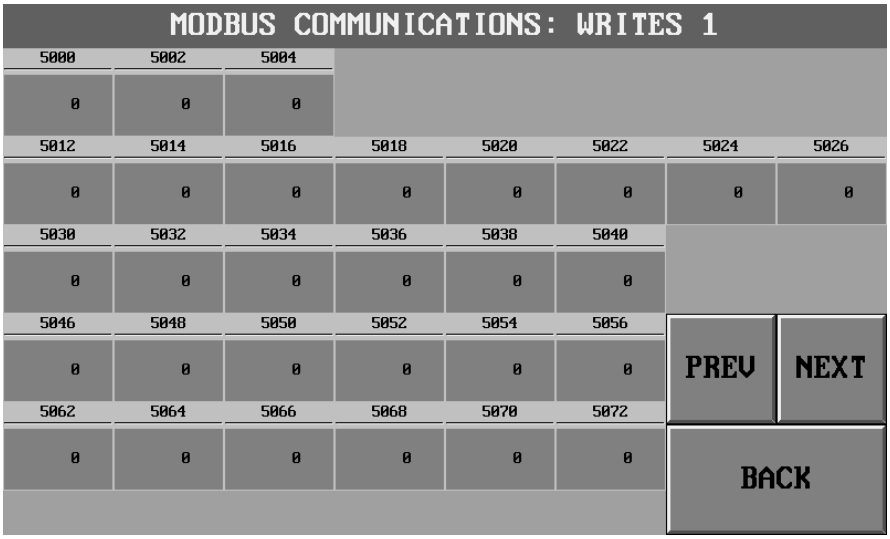


Figure 67: Data Monitor Modbus Writes 2 Screen

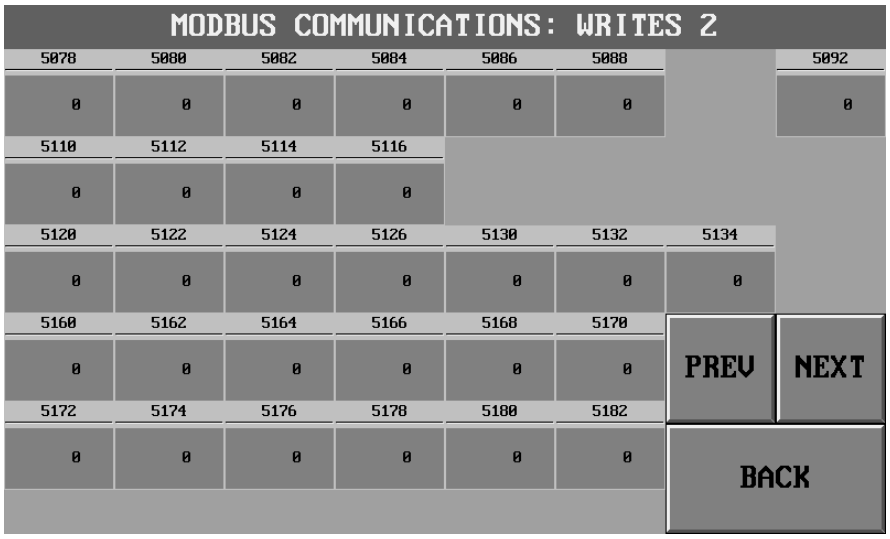


Figure 68: Data Monitor Modbus Writes 3 Screen

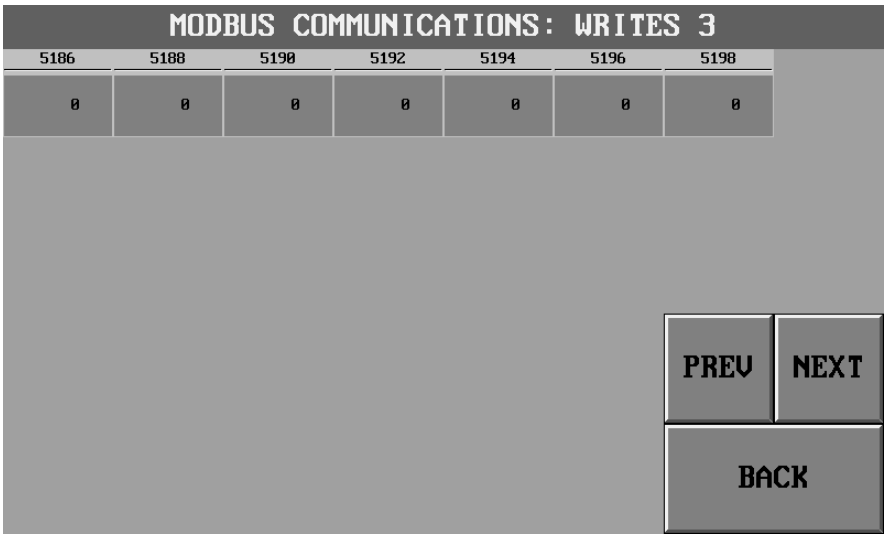


Figure 69: Data Monitor Modbus Writes 4 Screen

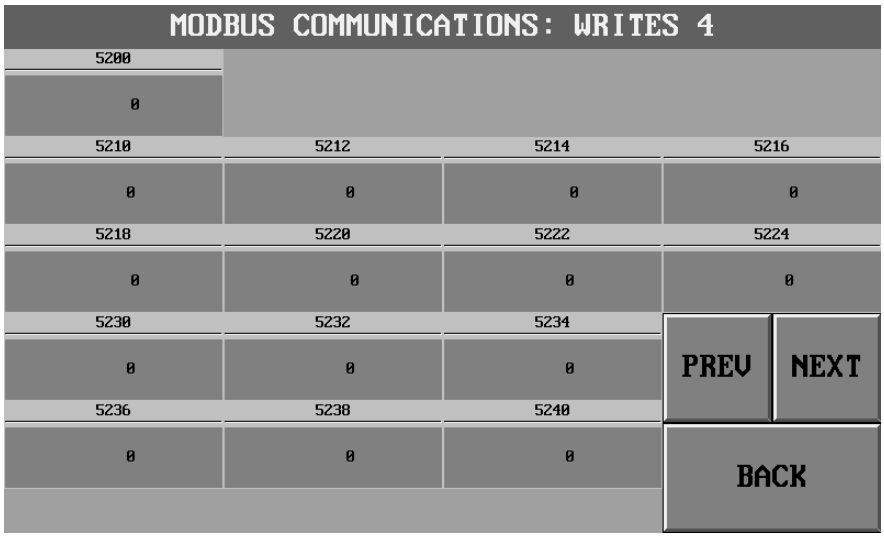


Figure 70: Data Monitor Modbus Writes 5 Screen

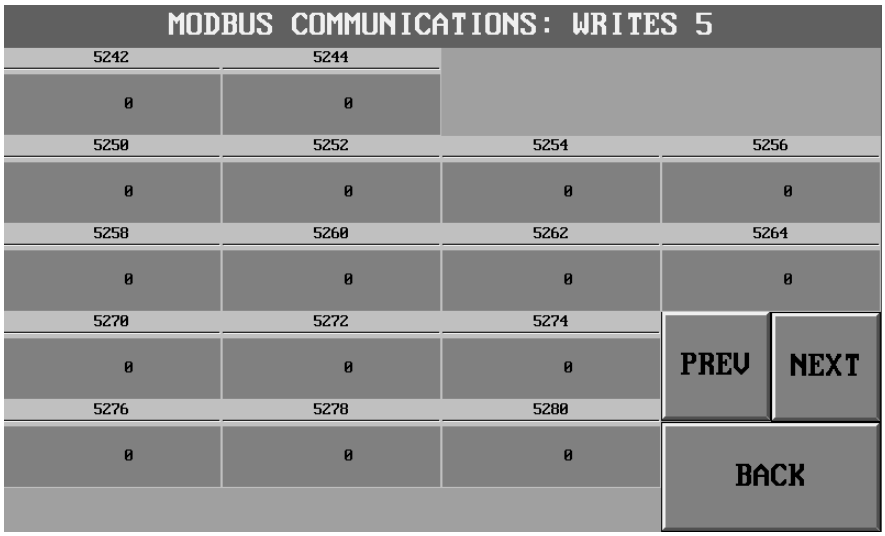
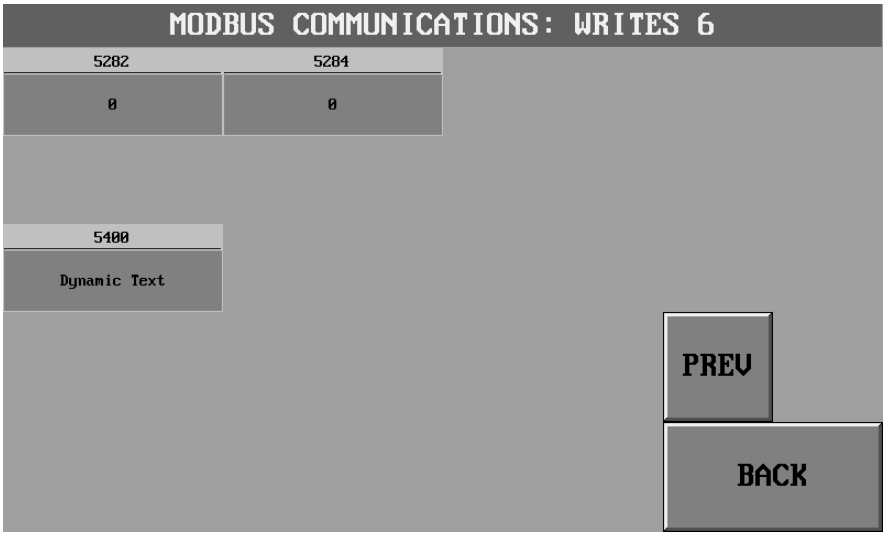


Figure 71: Data Monitor Modbus Writes 6 Screen



TARGET/PRESET TECHNICAL DATA SHEET

OBJECTIVE

PRO/ENTERPRISE:
This section will detail how to use the target control and preset functionality. The target is intended to be the batch weight. This target/preset can be changed by the operator by altering the available four presets and/or cycling through the presets until the active preset is the desired one.

Note: An output may be configured to control a sliding gate or some other mechanism if so desired. Contact CADARO for further information.

SCREEN CONTROL

Figure 72: Accessing Target Presets From Flow Sensor Menu

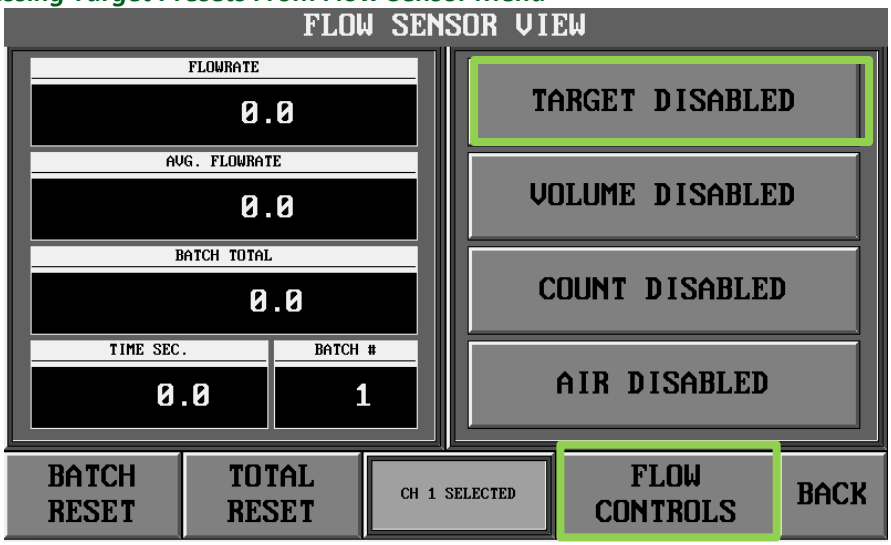


Figure 73: Accessing Target Presets From Flow Sensor Controls

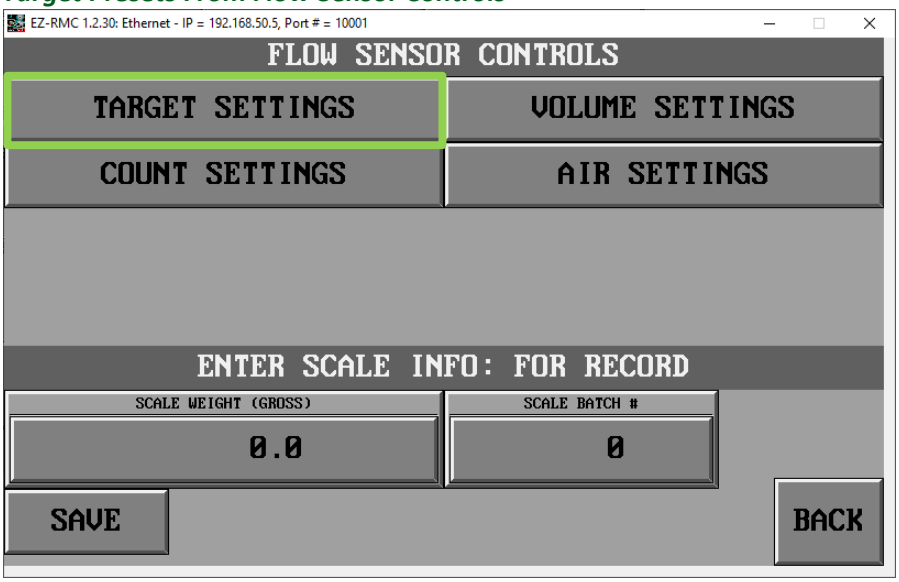


Figure 74: Flow View Screen With Target Enabled

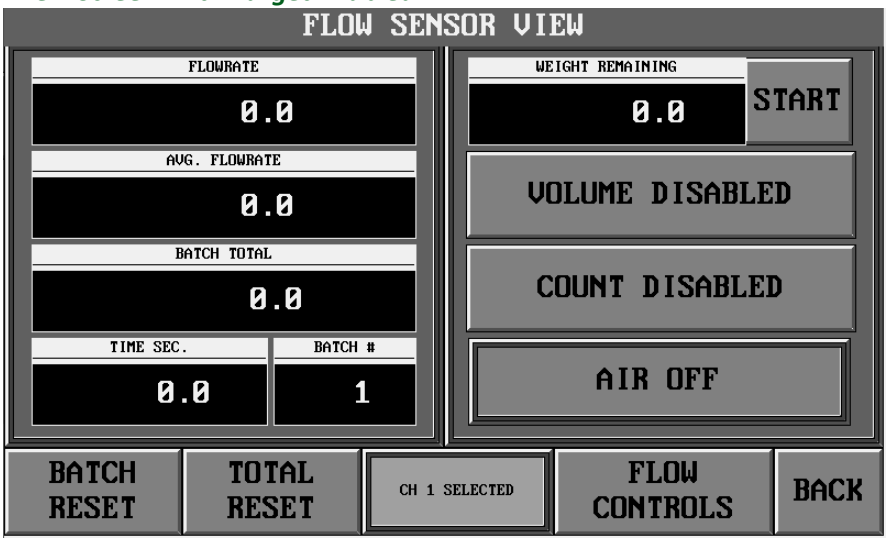


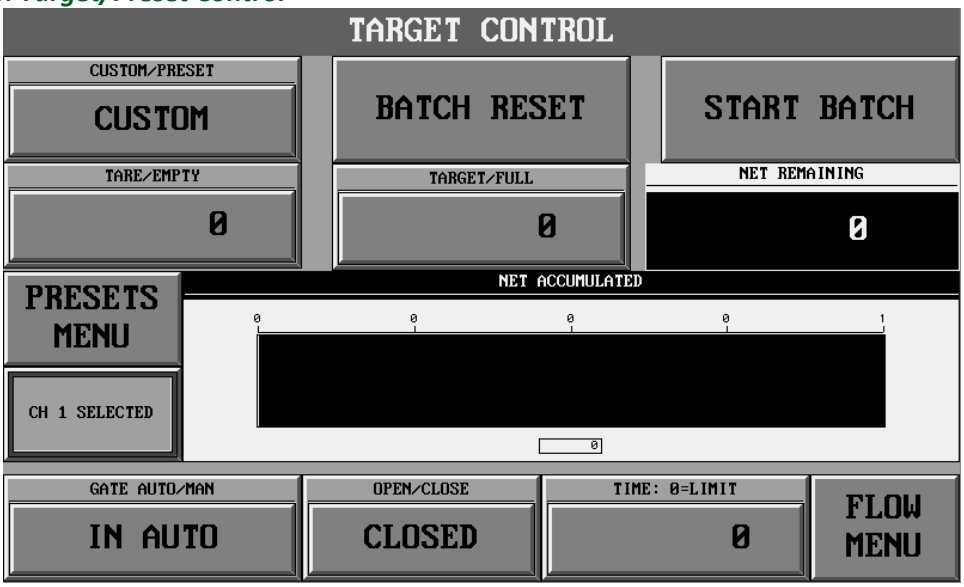
Figure 75: Enter Presets, Cycle Selected Preset, and Set Target Control Method



From the 'Flow Sensor View' screen, the operator can click on the 'Target Disabled' button or 'Flow Controls' to navigate to 'Target Settings' screen.

An additional screen focused on 'Target Control' can be navigated to from the 'Flow Sensor Menu' or 'Target Presets'. This screen allows for additional preset control and custom targets.

Figure 76: Target/Preset Control



Custom or Preset controls can be controlled from this 'Target Control' screen.
If required, a batch can be started/stopped from this screen to open/close a gate.

- The tare/empty weight represents the empty truck weight or starting point of a batch total weight.

- The target/full weight represents the desired amount for the batch.

When ‘Preset/Target Enable’ is enabled, the user can use this target in multiple ways.

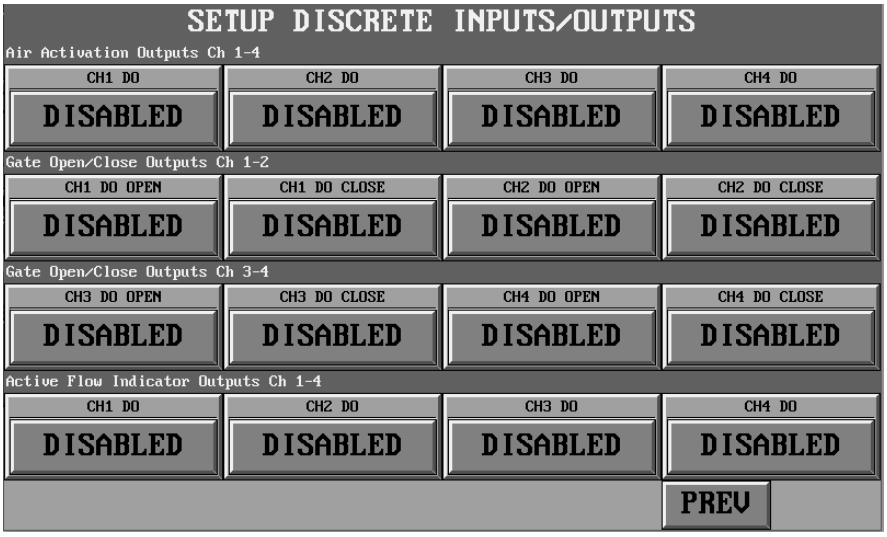
- If a gate is installed on the chute, a %, weight, volume, or count target can be established to shut the gate.
- An alerting system could be set up to notify operators of action needed.
- Notify CADARO if there is a scenario to accommodate.

Figure 77: Enabling The Output



From the main ‘Initialization’ screen, the digital output must be enabled from the ‘Initialize IO’ screen of the ‘Setup Comms’ screen. Each channel has its own default digital output for control scenarios.
When Preset or Target is enabled, the specific channel should auto-enable the output, but it is worth double checking.

Figure 78: IO Enable Control and Status

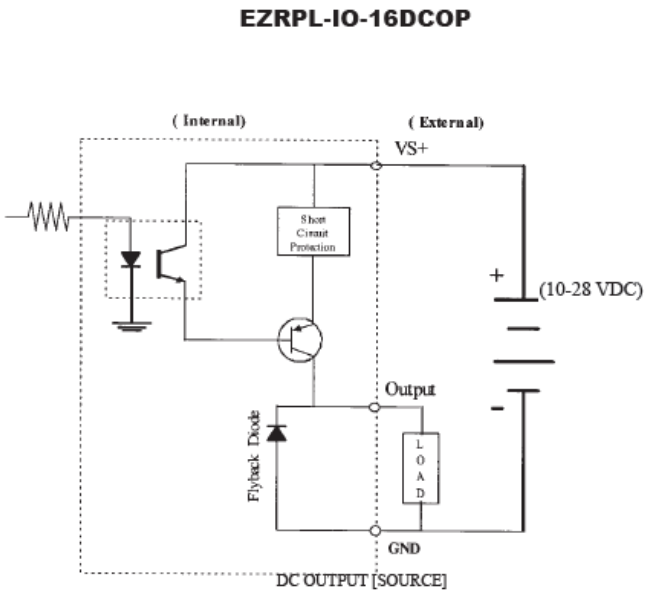


WIRING INSTRUCTIONS

The PLC will have an IO card named ‘16DCOP’ attached to it.

The wiring for a relay or air solenoid shall be as follows:

Figure 79: Output Wiring



Contact CADARO for support.

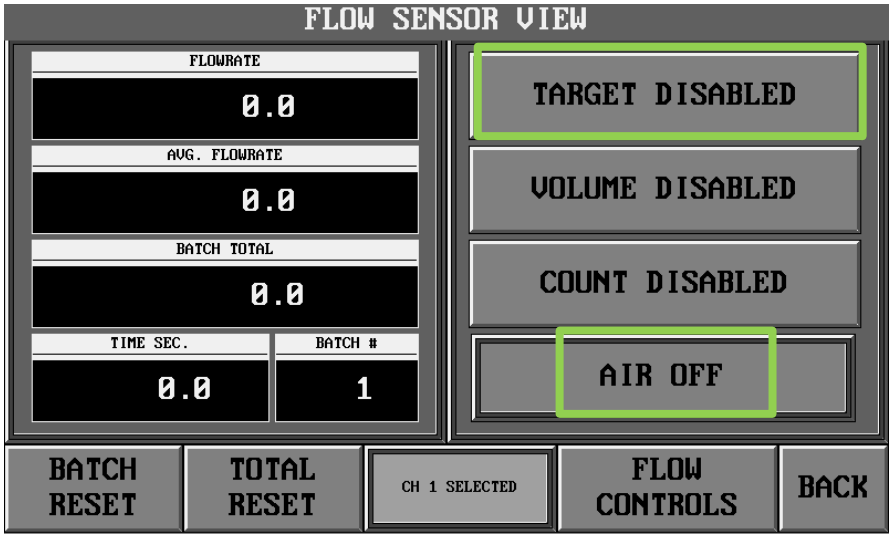
VOLUME CONTROL TECHNICAL DATA SHEET

OBJECTIVE

PRO/ENTERPRISE:
This section will detail how to utilize volume control. Volume control is similar to target control; however, the target is now a volumetric total rather than weight.

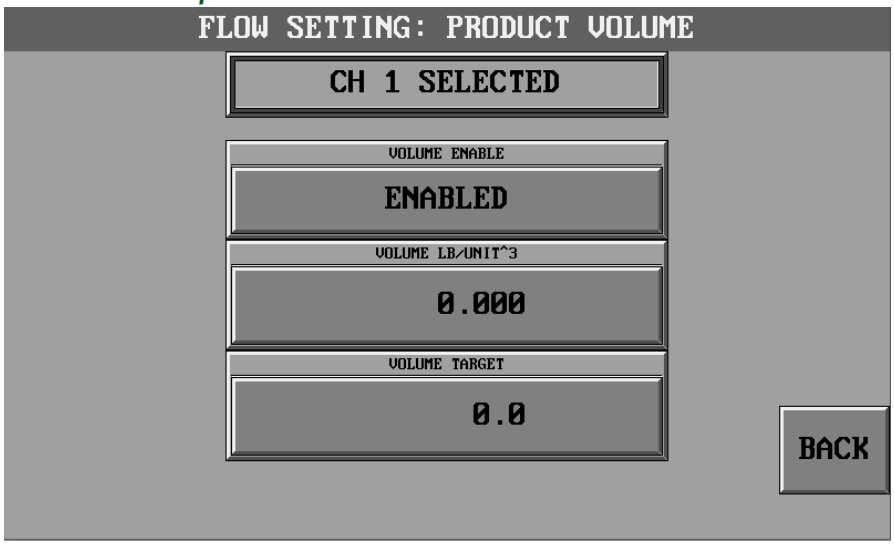
SCREEN CONTROL

Figure 80: Flow Sensor View. Volume Disabled View



From the 'Flow Sensor View' screen, the operator can click on the 'Volume Disabled' button or 'Flow Controls' to navigate to 'Volume Settings' screen.

Figure 81: Volume Control Setup Screen



When volume targeting is enabled, the totalizer will display the quantity of volumetric accumulation. If gate control is physically wired up, the gate will close when the volume target is reached.
For example: 1000 bushels at 60 lb/bu is desired. The gate close command will activate when 1000 bushels is reached, equivalently 60,000 lbs.

Figure 82: Flow Sensor View. Volume Enabled View

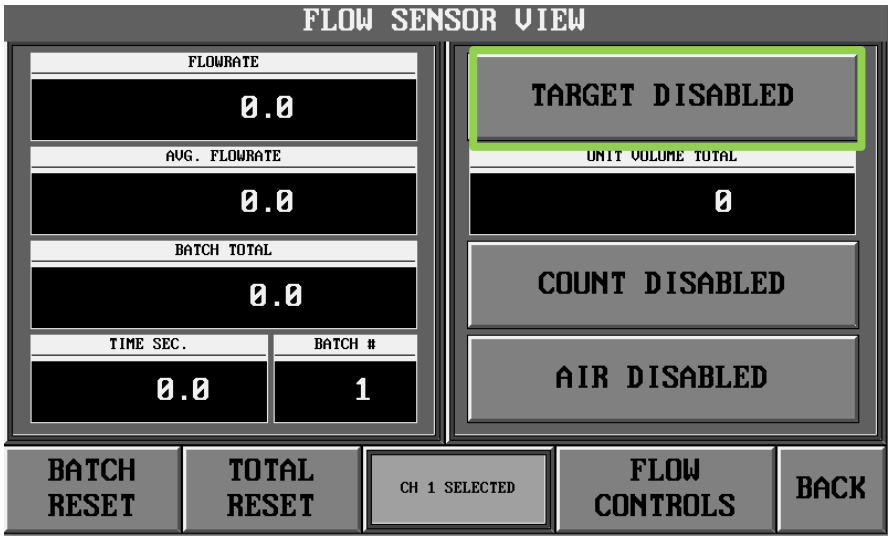
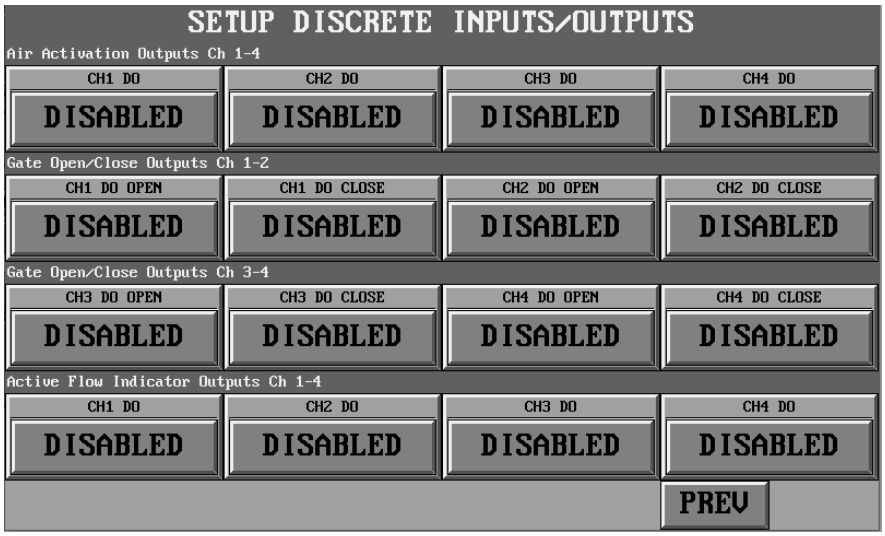


Figure 83: Enabling The Output



From the main ‘Initialization’ screen, the digital output must be enabled from the ‘Initialize IO’ screen of the ‘Setup Comms’ screen. Each channel has its own default digital output for control scenarios.
When Volume Control is enabled, the specific channel should auto-enable the output, but it is worth double-checking.

Figure 84: IO Enable Control and Status

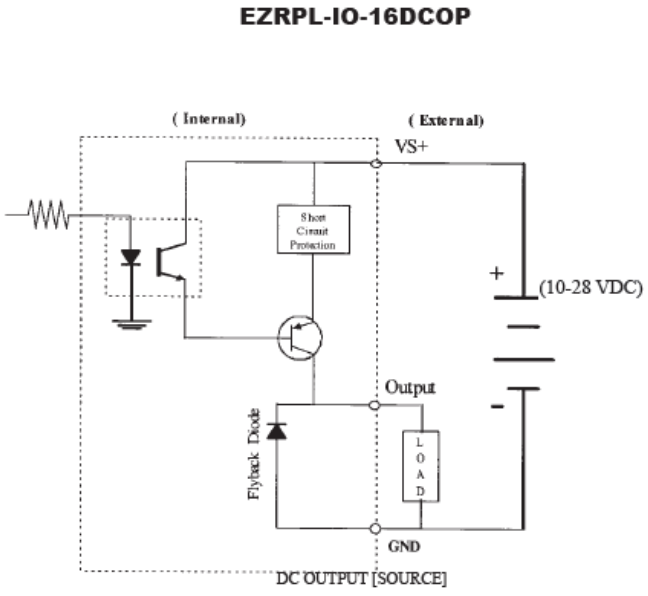


WIRING INSTRUCTIONS

The PLC will have an IO card named '16DCOP' attached to it.

The wiring for a relay or air solenoid shall be as follows:

Figure 85: Output Wiring



Contact CADARO for support.

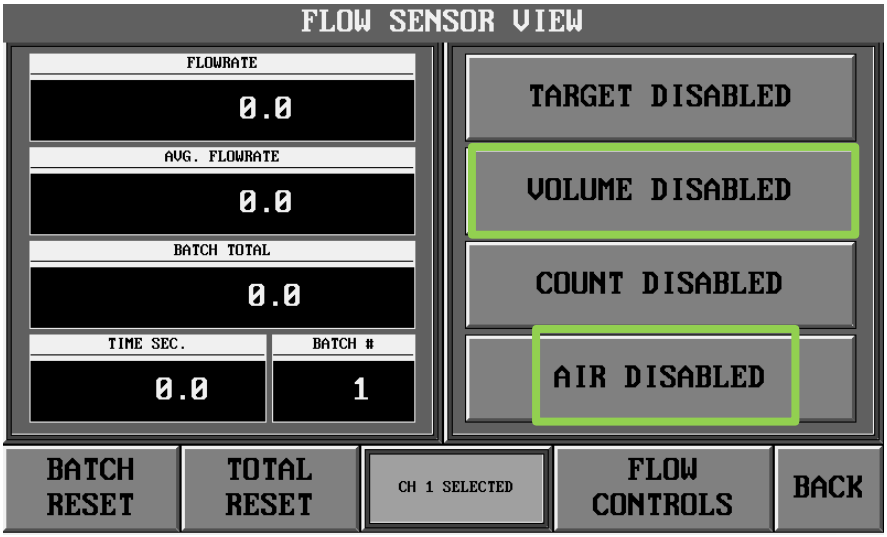
COUNT CONTROL TECHNICAL DATA SHEET

OBJECTIVE

PRO/ENTERPRISE:
This section will detail how to utilize count control. Count control is similar to target control; however, the target is now an accumulated count total rather than weight.

SCREEN CONTROL

Figure 86: Flow Sensor View. Count Disabled View



From the 'Flow Sensor View' screen, the operator can click on the 'Count Disabled' button or 'Flow Controls' to navigate to 'Count Settings' screen.

Figure 87: Count Control Setup Screen



When count targeting is enabled, the totalizer will display the quantity of count accumulation. If gate control is physically wired up, the gate will close when the count target is reached.
For example: 1,000,000 seeds at 200 seeds/lb is desired. The gate close command will activate when 1,000,000 seeds are reached, equivalently 5,000 lbs.

Figure 88: Flow Sensor View. Count Enabled View

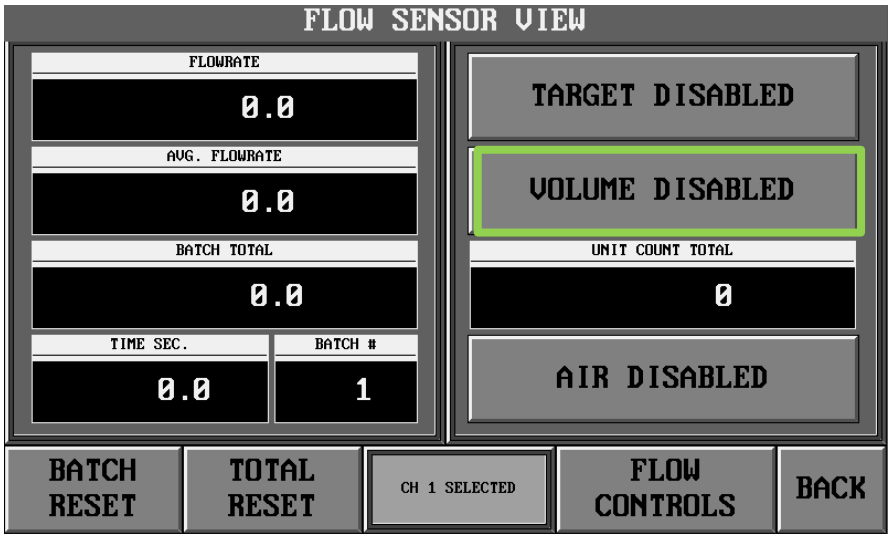
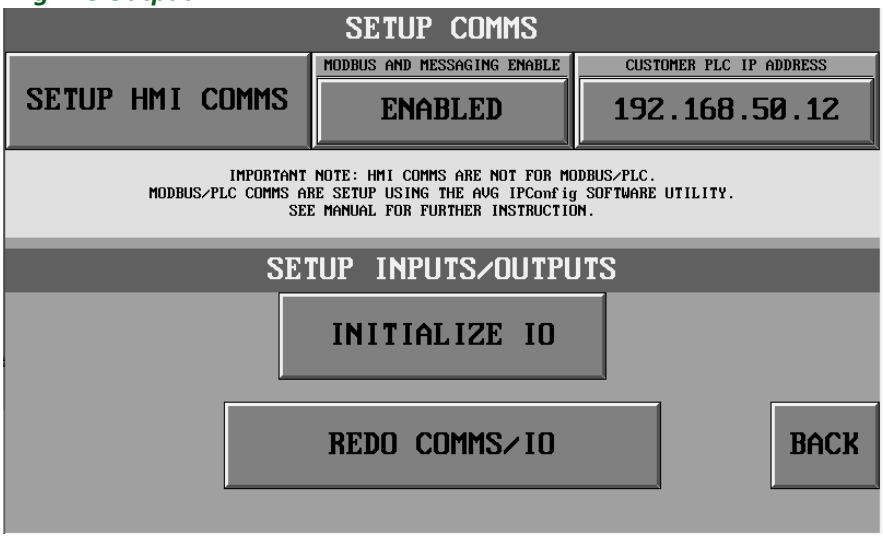
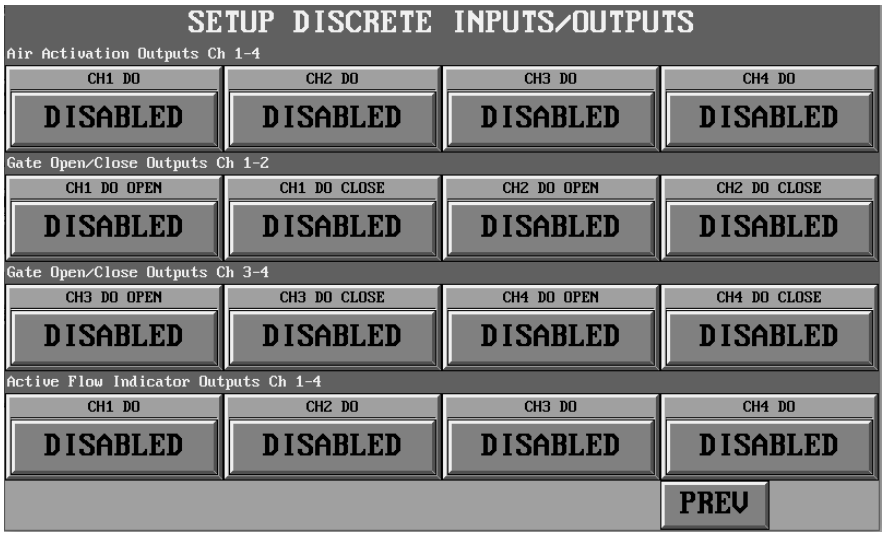


Figure 89: Enabling The Output



From the main 'Initialization' screen, the digital output must be enabled from the 'Initialize IO' screen of the 'Setup Comms' screen. Each channel has its own default digital output for control scenarios.
When Count Control is enabled, the specific channel should auto-enable the output, but it is worth double-checking.

Figure 90: IO Enable Control and Status

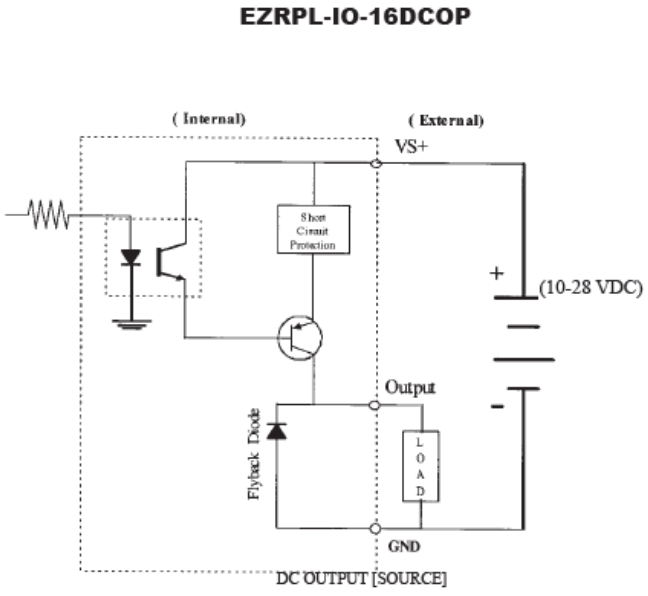


WIRING INSTRUCTIONS

The PLC will have an IO card named '16DCOP' attached to it.

The wiring for a relay or air solenoid shall be as follows:

Figure 91: Output Wiring



Contact CADARO for support.

AIR CONTROL TECHNICAL DATA SHEET

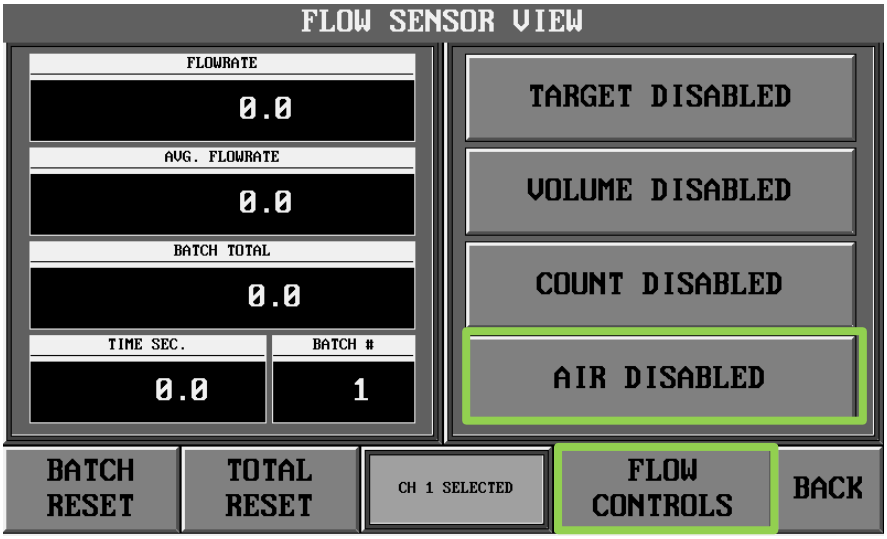
OBJECTIVE

PRO/ENTERPRISE:
This section will detail how to control the digital output for a pneumatic solenoid. The air is intended to blow dust or material buildup under the INTEGRAL sensor's sensing box, around load cells.

Note: This output could be treated as an auxiliary output for custom usage, please consult with CADARO before using this output for non-air control.

SCREEN CONTROL

Figure 92: Flow Sensor View. Air Disabled View



From the 'Flow Sensor View' screen, the operator can click on the 'Air Disabled' button or 'Flow Controls' to navigate to 'Air Settings' screen.

Figure 93: Air Control Setup Screen



If in auto, air will blow after the operator selects reset batch. It will blow for the 'Air On Time (Sec)' duration. When in manual, the air will blow on command when the operator selects 'Man Blow Air' for the same time duration.

Figure 94: Flow Sensor View. Air Enabled View

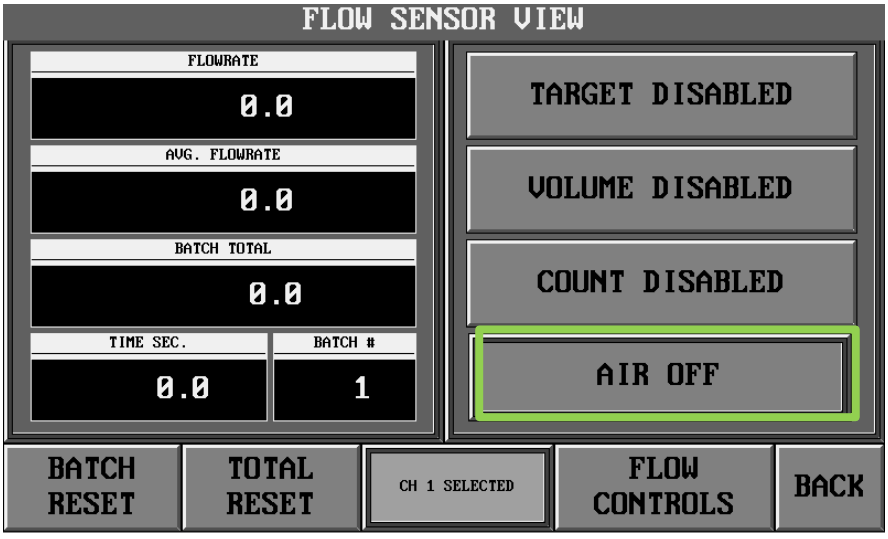
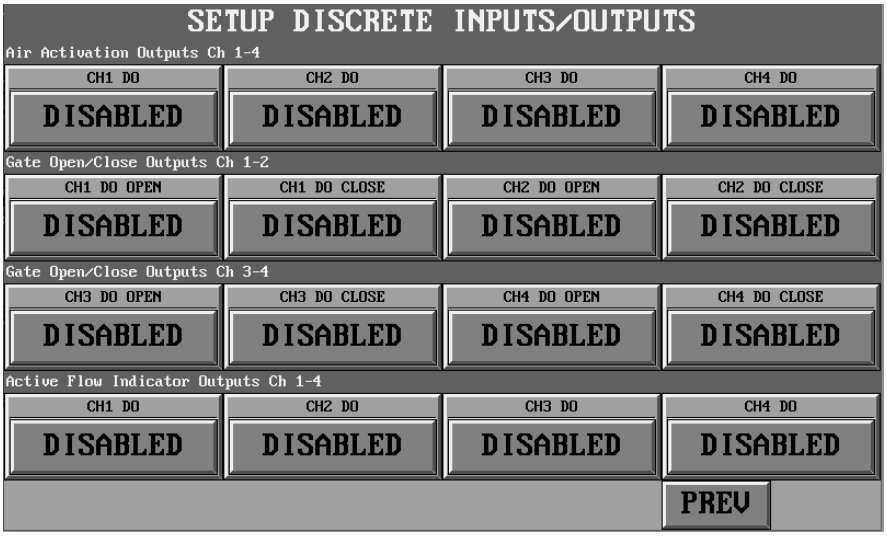


Figure 95: Enabling The Output



From the main 'Initialization' screen, the digital output must be enabled from the 'Initialize IO' screen of the 'Setup Comms' screen. Each channel has its own default digital output for control scenarios.
When Air is enabled, the specific channel should auto-enable the output, but it is worth double-checking.

Figure 96: IO Enable Control and Status

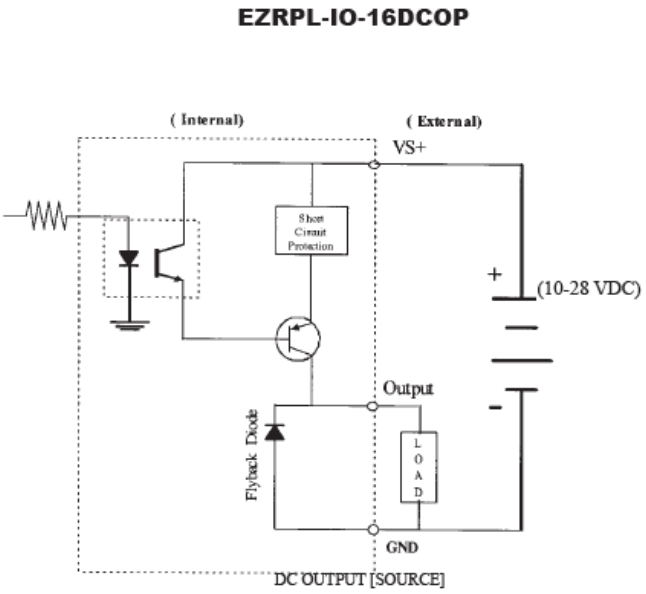


WIRING INSTRUCTIONS

The PLC will have an IO card named ‘16DCOP’ attached to it.

The wiring for a relay or air solenoid shall be as follows:

Figure 97: Output Wiring



Contact CADARO for support.

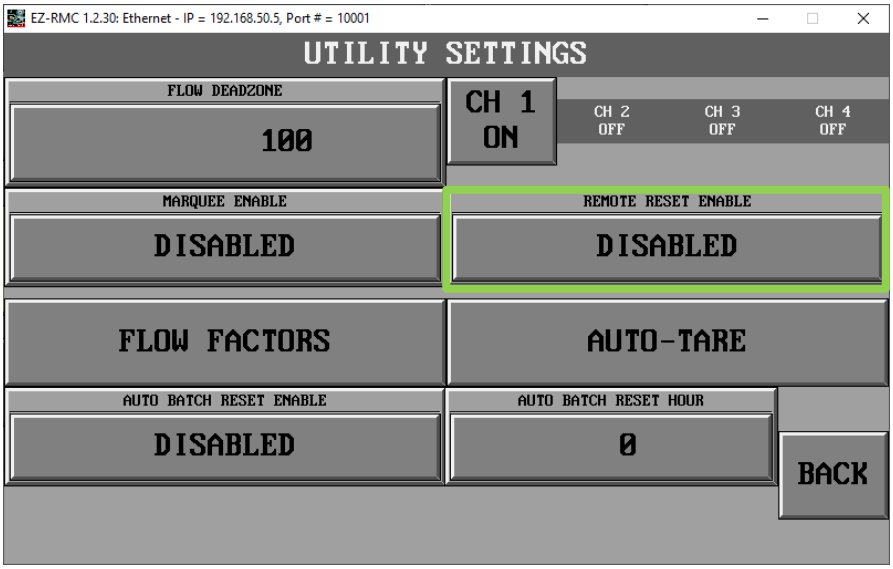
REMOTE RESET (HARDWIRED) TECHNICAL DATA SHEET

OBJECTIVE

PRO/ENTERPRISE:
This section will detail how to control the digital input for a binary pushbutton. The pushbutton is intended to allow for remote access to the PLC for use of resetting the batch.

Note: This input could be treated as an auxiliary input for custom usage, please consult with CADARO before using this input for non-reset control.

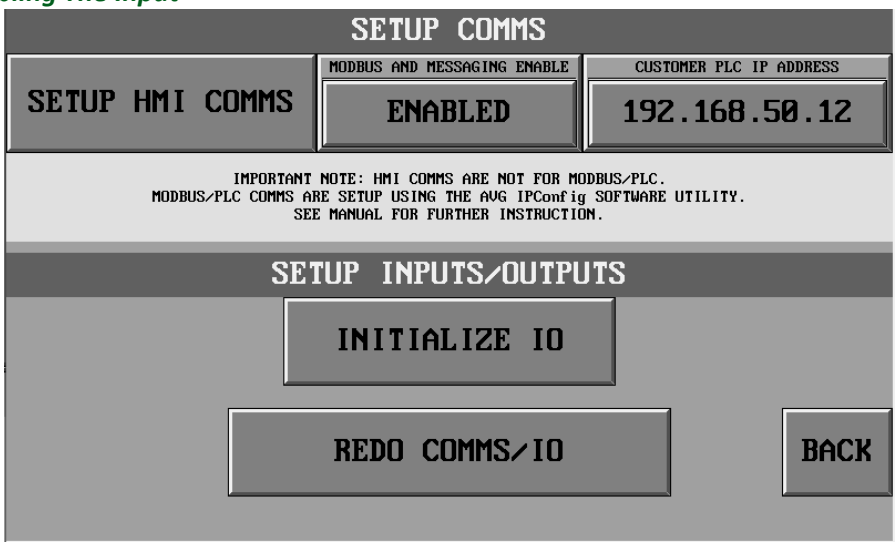
Figure 98: Screen Control



From the 'Main Menu' screen, the operator can click on the 'Utility Settings' button to navigate to 'Remote Reset Enable' button.

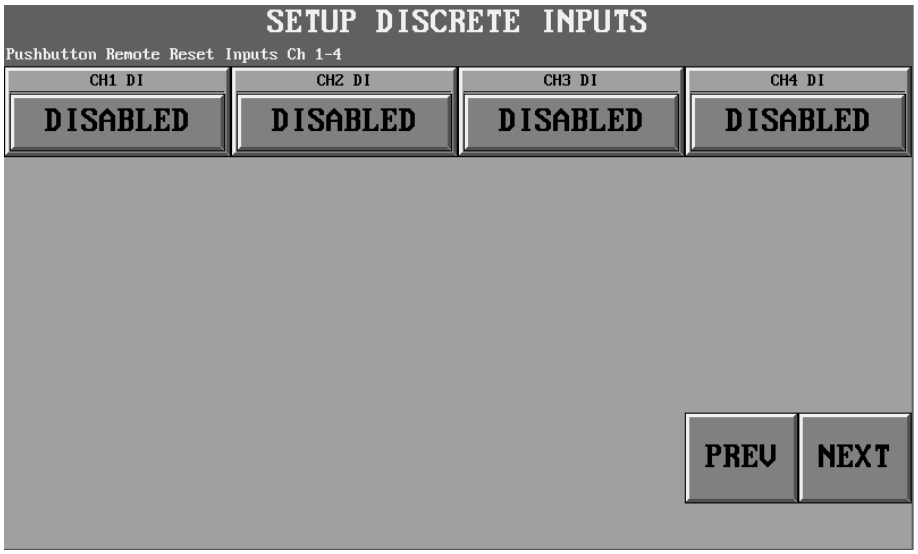
When enabled, the digital input from a remote pushbutton will in turn reset the batch when pressed.

Figure 99: Enabling The Input



From the main 'Initialization' screen, the digital input must be enabled from the 'Initialize IO' screen of the 'Setup Comms' screen. Each channel has its own default digital input for control scenarios.
When Remote Reset is enabled, the specific channel should auto-enable the input, but it is worth double-checking.

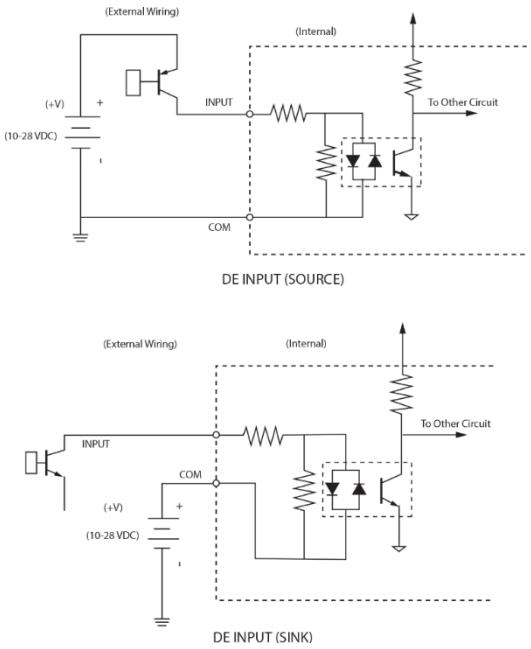
Figure 100: IO Enable Control and Status



WIRING INSTRUCTIONS

The PLC will have an IO card named ‘16DCI’ attached to it.
The wiring for a remote reset pushbutton shall be as follows:

Figure 101: Input Wiring



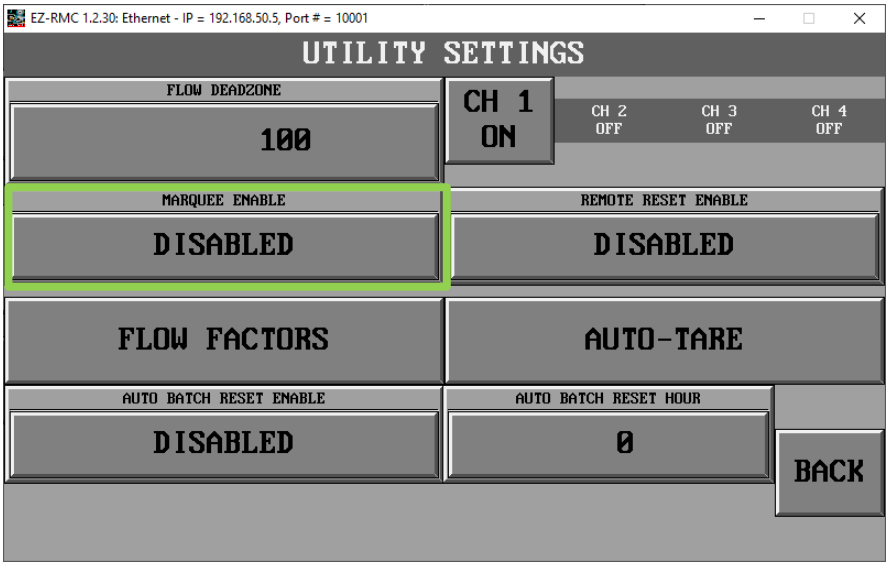
Contact CADARO for support.

MARQUEE TECHNICAL DATA SHEET

OBJECTIVE

ENTERPRISE only:
This section will detail how to enable the Marquee data display device. The Marquee is intended to allow for remote display of active flow rate and batch total weight.

Figure 102: Screen Control



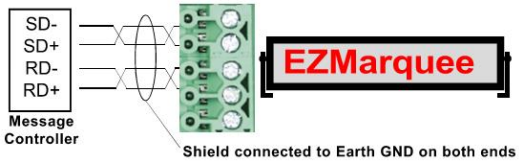
From the 'Main Menu' screen, the operator can click on the 'Utility Settings' button to navigate to 'Marquee Enable' button. When enabled, the data from the PLC will be displayed on the Marquee.

The data default display is 'Active Flow Rate' (lbs./min) and 'Batch Total'(lbs.).

WIRING INSTRUCTIONS

The PLC will have an RS422/485 port attached to it.
The wiring for a RS422 shall be as follows:

Figure 103: Input Wiring



Marquee Terminal Block	PLC Terminal Block
GND	GND
SD-	RD+
SD+	RD-
RD+	SD+
RD-	SD-

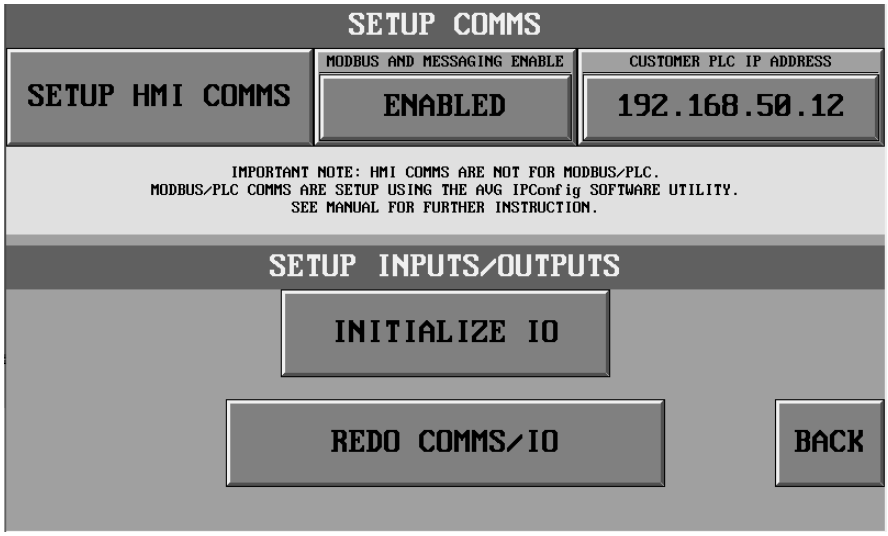
Contact CADARO for support.

HMI COMMS TECHNICAL DATA SHEET

OBJECTIVE

ENTERPRISE only:
This section will detail how to set up HMI comms to get remote access to the screen display and/or the data logging data. The IP setup is typically done over an IT controlled network but could be on a control/private network.

Figure 104: Screen Control



Navigate to the 'Initialization' screen and then to 'Setup Comms/IO'.

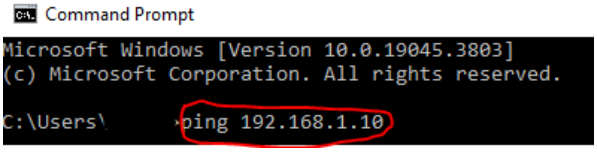
'Setup HMI Comms' will open up a 'Built-in Ethernet Setup' Screen. From here, the comms can be set up as follows.

1. The designated subnet needs to be known at this point.
   - Contact your IT if placing on IT network.
   - CADARO can support the subnet if on a control/private network.
2. Click 'Change IP Address '' and input the device IP address.
3. Subnet should be 255.255.255.0, unless otherwise specified by IT.
4. Gateway can be left blank unless otherwise by IT or CADARO.
5. Leave DNS and NTP as is found.
6. Select 'Save and Exit'.
7. Reboot the system by powering off the breaker, wait 5 seconds, and power back on.

TESTING

From the remote desktop or other computer:

Ping the IP address assigned to the HMI during the setup. This is done by opening the 'Command Prompt' on a windows computer. Type 'ping xxx.xxx.xxx.xxx' where the x's refer to the device IP address.



- If good ping, comms are up and running.
- If no ping, see troubleshooting guide below.

USING REMOTE CAPABILITIES

The programs named 'EZ-RMC' and 'AVG Remote File Manager' may be used to monitor/control and access the data respectively.

1. EZ RMC version 1.2.30 and AVG Remote File Manager version 1.1.12 can be either purchased through the developer or through CADARO. A phone application can also be used for EZ RMC. Contact CADARO if interested in this method.
2. The EZ RMC allows for user specific monitor only or monitor and control capabilities.
3. The AVG Remote File Manager allows for remotely moving the data from the microSD card within the HMI. This data can then be parsed and analyzed on a desktop. The data from the microSD card can also be manually removed at any time without this program.

MODBUS AND MESSAGING TECHNICAL DATA SHEET

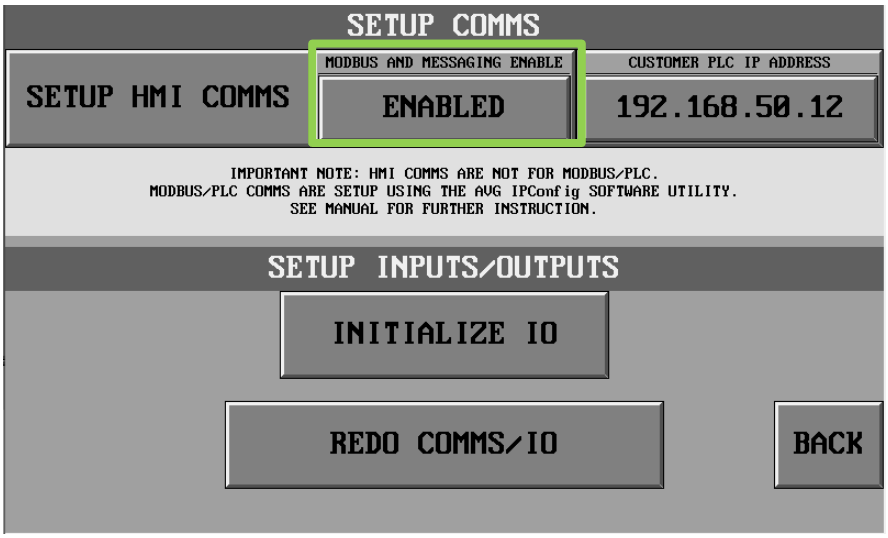
OBJECTIVE

ENTERPRISE only:
This section will detail how to view and control the Modbus or Messaging data between a Master and Slave device. The Master will be whichever system is connected to the CADARO PLC, and the Slave will be the CADARO PLC.

This Modbus or Messaging connection will address predetermined holding registers within the CADARO PLC database. With this functionality, the operator can view data and control functions remotely from the Master device.

Rockwell Automation-Logix Designer Setup and Program available upon request, contact CADARO at info@cadaro.com. Reference “CADARO-ROCKWELL Mod Msg Tech Sheet”

Figure 105: Screen Control



Navigate to the ‘Initialization’ screen and then to ‘Setup Comms/IO’. ‘Modbus Enable’ toggle button is used to allow Modbus or Messaging Master to read from or write to the Slave PLC. Password is ‘3456’.

TESTING

Figure 106: Modbus Testing/Monitoring



With Supervisor credentials, the operator can navigate to 'Main Menu' -> 'Diagnostics' -> 'Data Monitoring'.

Modbus Read and Write register's statuses start on page three of the 'Data Monitoring'.

DATA READS

The data read tables for INTS, DINTS, FLOATS, and ASCII values are detailed below.

If there is any confusion or ambiguity around what a specific data read register represents, please reach out to CADARO for guidance.

DATA WRITES

The data write tables for INTS, DINTS, FLOATS, and ASCII values are detailed below.

Care should be taken when writing to the Slave PLC. The Slave PLC will accept the write at any point during the process and continue with the respective command/request for the write.

The control philosophy for Modbus control is intended to be regarded with the same understanding as would be used for local control at the CADARO HMI.

Note: Consider adding notes or logical restrictions to the Master device, when necessary, to avoid accidental writing to the Slave at inopportune times. Feel free to consult with CADARO if needed.

CADARO MODBUS REGISTER MAP

1. Table 1: Data Register Read Map – INTS

Register	Data Type	Description
6500	INT	CH1 Active Batch Number
6502	INT	CH1 Batch Time – sec
6504	INT	CH2 Active Batch Number
6506	INT	CH2 Batch Time – sec
6508	INT	CH3 Active Batch Number
6510	INT	CH3 Batch Time – sec
6512	INT	CH4 Active Batch Number
6514	INT	CH4 Batch Time – sec
6516	INT	Cal Profile Selected
6518	INT	Alarm – HMI Low Battery @ Value = 1
6520	INT	Alarm – PLC Low Battery @ Value = 1
6522	INT	Alarm – Sensor Fault @ Value = 1
6524	INT	Alarm – Sensor Max @ Value = 1
6526	INT	Alarm – Tare Tune Fault @ Value = 1
6528	INT	Alarm – Cal % Difference @ Value = 1
6530	INT	Alarm – Cal Factor Fault @ Value = 1
6532	INT	
6534	INT	Sensor Channel 1 Selected
6536	INT	Sensor Channel 2 Selected
6538	INT	Sensor Channel 3 Selected
6540	INT	Sensor Channel 4 Selected
6542	INT	Cal Channel 1 Selected
6544	INT	Cal Channel 2 Selected
6546	INT	Cal Channel 3 Selected
6548	INT	Cal Channel 4 Selected

2. Table 2: Data Register Read Map – DINTS

Register	Data Type	Description
6550	DINT	CH1 Active Flowrate – lb/min
6552	DINT	CH1 Batch Average Flowrate – lb/min
6554	DINT	CH1 Batch Weight – lb
6556	DINT	CH1 Total Weight – lb
6558	DINT	CH1 Gross Weight – Raw Analog Signal
6560	DINT	CH1 Tare Weight – Raw Analog Signal
6562	DINT	
6564	DINT	
6566	DINT	
6568	DINT	CH2 Active Flowrate – lb/min
6570	DINT	CH2 Batch Average Flowrate – lb/min
6572	DINT	CH2 Batch Weight – lb
6574	DINT	CH2 Total Weight – lb

Register	Data Type	Description
6576	DINT	CH2 Gross Weight – Raw Analog Signal
6578	DINT	CH2 Tare Weight – Raw Analog Signal
6580	DINT	
6582	DINT	
6584	DINT	
6586	DINT	CH3 Active Flowrate – lb/min
6588	DINT	CH3 Batch Average Flowrate – lb/min
6590	DINT	CH3 Batch Weight – lb
6592	DINT	CH3 Total Weight – lb
6594	DINT	CH3 Gross Weight – Raw Analog Signal
6596	DINT	CH3 Tare Weight – Raw Analog Signal
6598	DINT	
6600	DINT	
6602	DINT	
6604	DINT	CH4 Active Flowrate – lb/min
6606	DINT	CH4 Batch Average Flowrate – lb/min
6608	DINT	CH4 Batch Weight – lb
6610	DINT	CH4 Total Weight – lb
6612	DINT	CH4 Gross Weight – Raw Analog Signal
6614	DINT	CH4 Tare Weight – Raw Analog Signal
6616	DINT	
6618	DINT	
6620	DINT	Target/Preset Weight CH1
6622	DINT	Preset/Target Remaining CH1
6624	DINT	Preset/Target Tare/Empty Weight CH1
6626	DINT	Preset/Target Gross/Full Weight CH1
6628	DINT	Preset/Target Freefall CH1
6630	DINT	Target Hit Status CH1 @ Value 1
6632	DINT	
6634	DINT	Target/Preset Weight CH2
6636	DINT	Preset/Target Remaining CH2
6638	DINT	Preset/Target Tare/Empty Weight CH2
6640	DINT	Preset/Target Gross/Full Weight CH2
6642	DINT	Preset/Target Freefall CH2
6644	DINT	Target Hit Status CH2 @ Value 1
6646	DINT	
6648	DINT	Target/Preset Weight CH3
6650	DINT	Preset/Target Remaining CH3
6652	DINT	Preset/Target Tare/Empty Weight CH3
6654	DINT	Preset/Target Gross/Full Weight CH3
6656	DINT	Preset/Target Freefall CH3
6658	DINT	Target Hit Status CH3 @ Value 1
6660	DINT	

Register	Data Type	Description
6662	DINT	Target/Preset Weight CH4
6664	DINT	Preset/Target Remaining CH4
6666	DINT	Preset/Target Tare/Empty Weight CH4
6668	DINT	Preset/Target Gross/Full Weight CH4
6670	DINT	Preset/Target Freefall CH4
6672	DINT	Target Hit Status CH4 @ Value 1
6848	DINT	Watchdog Incrementor

3. Table 3: Data Register Read Map – FLOATS

Register	Data Type	Description
6850	FLOAT	CH1 Active Cal Factor
6852	FLOAT	CH1 Cal 1 Cal Factor
6854	FLOAT	CH1 Cal 2 Cal Factor
6856	FLOAT	
6858	FLOAT	
6860	FLOAT	CH2 Active Cal Factor
6862	FLOAT	CH2 Cal 1 Cal Factor
6864	FLOAT	CH2 Cal 2 Cal Factor
6866	FLOAT	
6868	FLOAT	
6870	FLOAT	CH3 Active Cal Factor
6872	FLOAT	CH3 Cal 1 Cal Factor
6874	FLOAT	CH3 Cal 2 Cal Factor
6876	FLOAT	
6878	FLOAT	
6880	FLOAT	CH4 Active Cal Factor
6882	FLOAT	CH4 Cal 1 Cal Factor
6884	FLOAT	CH4 Cal 2 Cal Factor

4. Table 4: Data Register Read Map – ASCII

Register	Data Type	Description
6920	ASCII	File 1 Product/Description
6925	ASCII	File 2 Product/Description
6930	ASCII	File 3 Product/Description
6935	ASCII	File 4 Product/Description
6940	ASCII	File 5 Product/Description
6945	ASCII	File 6 Product/Description
6950	ASCII	File 7 Product/Description
6955	ASCII	File 8 Product/Description
6960	ASCII	File 9 Product/Description
6965	ASCII	File 10 Product/Description
6970	ASCII	File 11 Product/Description

Register	Data Type	Description
6975	ASCII	File 12 Product/Description

5. Table 5: Data Register Write Map – INTS

Register	Data Type	Description
5000	INT	Manual Scale Batch Number
5002	INT	Manual Scale Save @ Value = 1
5004	INT	Manual Tare @ Value = 1
5006	INT	
5008	INT	
5010	INT	
5012	INT	Air Auto Toggle CH1: Auto @ Value = 1
5014	INT	Air Manual Cmd CH1: @ Value = 1
5016	INT	Air Auto Toggle CH2: Auto @ Value = 1
5018	INT	Air Manual Cmd CH2: @ Value = 1
5020	INT	Air Auto Toggle CH3: Auto @ Value = 1
5022	INT	Air Manual Cmd CH3: @ Value = 1
5024	INT	Air Auto Toggle CH4: Auto @ Value = 1
5026	INT	Air Manual Cmd CH4: @ Value = 1
5028	INT	
5030	INT	Target Enable CH1: @ Value = 1
5032	INT	Target Preset Cycle Thru CH1: Next @ Value = 1
5034	INT	Target Start CH1: @ Value = 1, 0 = Stopped or Cancel
5036	INT	Target Custom/Preset CH1: Custom @ Value = 1
5038	INT	Gate Auto Toggle CH1: Auto @ Value = 1
5040	INT	Gate Manual Cmd CH1: @ Value = 1
5042	INT	
5044	INT	
5046	INT	Target Enable CH2: @ Value = 1
5048	INT	Target Preset Cycle Thru CH2: Next @ Value = 1
5050	INT	Target Start CH2: @ Value = 1, 0 = Stopped or Cancel
5052	INT	Target Custom/Preset CH2: Custom @ Value = 1
5054	INT	Gate Auto Toggle CH2: Auto @ Value = 1
5056	INT	Gate Manual Cmd CH2: @ Value = 1
5058	INT	
5060	INT	
5062	INT	Target Enable CH3: @ Value = 1
5064	INT	Target Preset Cycle Thru CH3: Next @ Value = 1
5066	INT	Target Start CH3: @ Value = 1, 0 = Stopped or Cancel
5068	INT	Target Custom/Preset CH3: Custom @ Value = 1
5070	INT	Gate Auto Toggle CH3: Auto @ Value = 1
5072	INT	Gate Manual Cmd CH3: @ Value = 1
5074	INT	

Register	Data Type	Description
5076	INT	
5078	INT	Target Enable CH4: @ Value = 1
5080	INT	Target Preset Cycle Thru CH4: Next @ Value = 1
5082	INT	Target Start CH4: @ Value = 1, 0 = Stopped or Cancel
5084	INT	Target Custom/Preset CH4: Custom @ Value = 1
5086	INT	Gate Auto Toggle CH4: Auto @ Value = 1
5088	INT	Gate Manual Cmd CH4: @ Value = 1
5090	INT	
5092	INT	Cal Correction Factor
5094	INT	
5096	INT	
5098	INT	
5100	INT	
5102	INT	
5104	INT	
5106	INT	
5108	INT	
5110	INT	Sensor Channel 1 Select @ Value = 1
5112	INT	Sensor Channel 2 Select @ Value = 1
5114	INT	Sensor Channel 3 Select @ Value = 1
5116	INT	Sensor Channel 4 Select @ Value = 1
5118	INT	
5120	INT	Reset Batch CH1 @ Value = 1
5122	INT	Reset Batch CH2 @ Value = 1
5124	INT	Reset Batch CH3 @ Value = 1
5126	INT	Reset Batch CH4 @ Value = 1
5128	INT	Reset Total CH1 @ Value = 1
5130	INT	Reset Total CH2 @ Value = 1
5132	INT	Reset Total CH3 @ Value = 1
5134	INT	Reset Total CH4 @ Value = 1
5136	INT	
5138	INT	
5140	INT	
5142	INT	
5144	INT	
5146	INT	
5148	INT	
5150	INT	
5152	INT	
5154	INT	
5156	INT	

Register	Data Type	Description
5158	INT	
5160	INT	Cal Load File 1 Select @ Value = 1
5162	INT	Cal Load File 2 Select @ Value = 1
5164	INT	Cal Load File 3 Select @ Value = 1
5166	INT	Cal Load File 4 Select @ Value = 1
5168	INT	Cal Load File 5 Select @ Value = 1
5170	INT	Cal Load File 6 Select @ Value = 1
5172	INT	Cal Load File 7 Select @ Value = 1
5174	INT	Cal Load File 8 Select @ Value = 1
5176	INT	Cal Load File 9 Select @ Value = 1
5178	INT	Cal Load File 10 Select @ Value = 1
5180	INT	Cal Load File 11 Select @ Value = 1
5182	INT	Cal Load File 12 Select @ Value = 1
5184	INT	
5186	INT	Cal Load File @ Value = 1
5188	INT	Cal Save File @ Value = 1
5190	INT	Cal Reset @ Value = 1
5192	INT	Cal Perform 1 @ Value = 1
5194	INT	Cal Perform 2 @ Value = 1
5196	INT	Cal Force 1 @ Value = 1
5198	INT	Cal Force 2 @ Value = 1

6. Table 6: Data Register Write Map – DINTS

Register	Data Type	Description
5150	DINT	Manual Scale Entry
5210	DINT	Target % Freefall Setpoint CH1
5212	DINT	Target WT Freefall Setpoint CH1
5214	DINT	Target Preset 1 CH1
5216	DINT	Target Preset 2 CH1
5218	DINT	Target Preset 3 CH1
5220	DINT	Target Preset 4 CH1
5222	DINT	Target Custom Tare CH1
5224	DINT	Target Custom Target CH1
5230	DINT	Target % Freefall Setpoint CH2
5232	DINT	Target WT Freefall Setpoint CH2
5234	DINT	Target Preset 1 CH2
5236	DINT	Target Preset 2 CH2
5238	DINT	Target Preset 3 CH2
5240	DINT	Target Preset 4 CH2
5242	DINT	Target Custom Tare CH2
5244	DINT	Target Custom Target CH2
5250	DINT	Target % Freefall Setpoint CH3
5252	DINT	Target WT Freefall Setpoint CH3

Register	Data Type	Description
5254	DINT	Target Preset 1 CH3
5256	DINT	Target Preset 2 CH3
5258	DINT	Target Preset 3 CH3
5260	DINT	Target Preset 4 CH3
5262	DINT	Target Custom Tare CH3
5264	DINT	Target Custom Target CH3
5270	DINT	Target % Freefall Setpoint CH4
5272	DINT	Target WT Freefall Setpoint CH4
5274	DINT	Target Preset 1 CH4
5276	DINT	Target Preset 2 CH4
5278	DINT	Target Preset 3 CH4
5280	DINT	Target Preset 4 CH4
5282	DINT	Target Custom Tare CH4
5284	DINT	Target Custom Target CH4

7. **T**able 7: Data Register Write Map – FLOATS

Register	Data Type	Description

8. Table 8: Data Register Write Map – ASCII

Register	Data Type	Description
5400	ASCII	Cal Save Product Type

LOADING SOFTWARE FROM USB FILE

In special circumstances, CADARO may provide the customer with a USB drive. This drive will be preloaded with a file ready for download to the HMI.

Place the USB file into the 'Host' port on the HMI.

Figure 107: USB Port on HMI



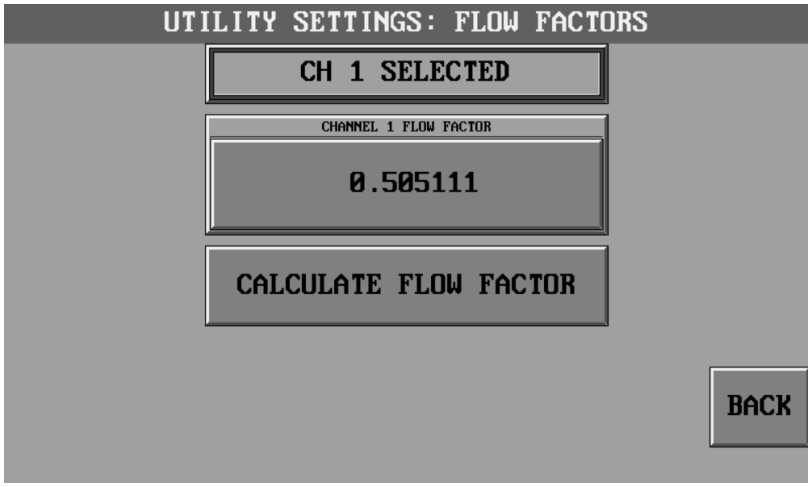
- The HMI screen will automatically load a screen displaying all recognizable files.
- Ideally there will only be one file, select 'Accept' for it to be downloaded.
- Once the software update is completed, the system will automatically restart. If the system does not automatically restart, then power cycle the PLC control box.

Recording System Variables

FLOW FACTOR

Flow factor value can be thought of as an adjustment divisor applied to the flow rate. To find and record this value, navigate from 'Main Menu' -> 'Utilities' -> 'Utility Settings' -> 'Flow Factors'. Each channel enabled may have different flow factors. These are important to record in case data is wiped from the PLC database.

Figure 108: Flow Factor

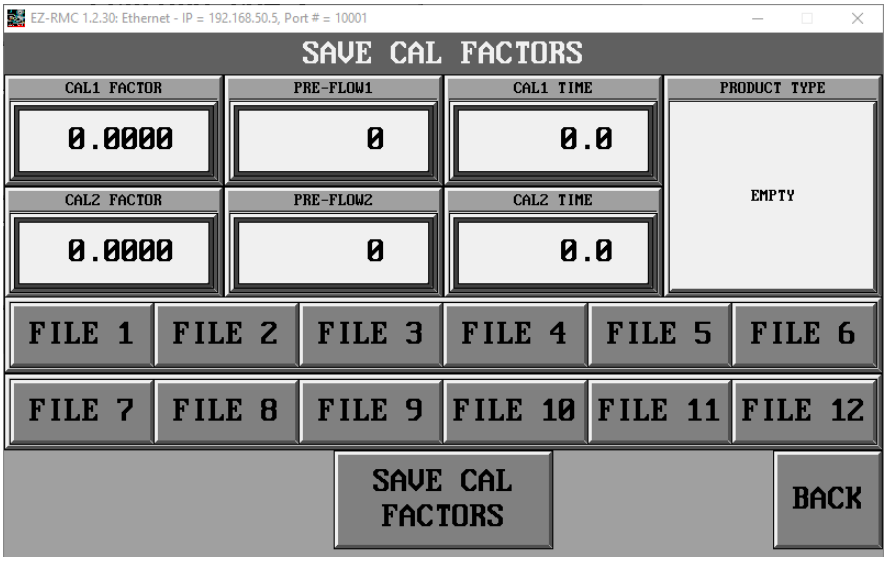


Locate the ‘Tare’ and ‘WT-Factor’ values.
Record: TARE: _____ FLOW FACTOR: _____ Date: _____

CALIBRATION VALUES

Navigate to ‘Save Cal Factors’ screen within the ‘Calibration Menu’ screen.

Figure 109: Save Cal Factor



Cal C1: _____ @ Pre-flow 1 _____ lbs/min @ Time 1 _____ seconds
Cal C2: _____ @ Pre-flow 2 _____ lbs/min @ Time 2 _____ seconds

TROUBLE-SHOOTING TIPS

SLOW OPERATION OR DELAYED SCREEN TRANSITIONS

If the operator notices that the system is experiencing a delay when changing between screens or operating slower than normal, consider power cycling the system.

- Unplug the unit from the 110-volt AC power supply (AVOID opening the enclosure).
- Wait 30 seconds.
- Plug the power cord back into the 110-volt AC power supply and observe if performance improves.

INCORRECT GROSS READING

If the tare reading does not reflect the expected reading, consider checking the connections between the PLC control box and the flow sensor(s).

- If the gross reading shows zero "0" with a static weight (such as a bottle of water), check the connection between the PLC control box and the flow sensor(s).
- If the gross reading does not change when a static weight is placed on the sensor box/plate, and it has been verified that all shipping bolts (one top bolt and 2 bottom bolts) are removed, it is possible that a load cell is not functioning correctly. Contact your CADARO representative for further assistance.

UNRECOGNIZED FLOW RATE BY THE PLC

If the PLC is not recognizing the flow rate, consider the following:

- Ensure that the INTEGRAL flow sensor is properly connected.
- Check for any system restrictions that may be affecting the flow rate.
- If the issue persists, it could indicate a damaged load cell. Contact your CADARO representative for further assistance.

DATA SHARING ISSUES BETWEEN PLC AND SITE AUTOMATION SYSTEM VIA ETHERNET

To resolve issues related to data sharing between the PLC and a site automation system via Ethernet , follow these steps:

- Verify that the Ethernet connection is secure and properly connected.
- Check if the IP parameters at the location have changed and no longer match the CADARO PLC. You can use the IP configuration program from CADARO to investigate and adjust the settings accordingly. Although a newer version of the AVG IPConfig tool may exist, we recommend that ONLY version 1.0.2 (AVG IPConfig 1.0.2.exe) is installed/utilized to view and set IP addresses for external communication.

OPERATOR SCREEN ISSUES

If the screen on the PLC control box is not turning on, consider performing the following checks to ensure power is being provided to the unit:

- Verify that the unit is properly plugged into a 110-volt AC power source.
- If applicable, ensure the interruptible power supply has a visible green light (APC UPS units illustrate a green light under normal conditions). If the power supply is off despite proper connections, it may be faulty.
- If 110-volt AC power is being provided to the PLC control box, and the screen does not power up or respond to touch, there could be an issue with an internal component. Contact your CADARO representative for further assistance.

LOSS OF FACTORY SETTINGS DUE TO POWER LOSS

Values should remain so long as the PLC and HMI backup batteries are in working order.
If a power loss has resulted in the loss of factory settings.

- Replace both HMI and PLC batteries.
- Reference the original or latest calibration sheet. If unavailable, a new initialization and calibration needs to be completed.
- Manually input factory settings into the 'Manual Cal Factors' screen.

NO SIGNAL FROM FLOW SENSOR(S)

If there is no signal from the flow sensor(s), perform the following checks:

- Verify that the cable and connections are in good condition and securely connected on each end of the sensor cable.
- Contact your CADARO representative for further assistance.

NAN (NOT A NUMBER) VALUE

If you encounter a NAN value, which is seen when the code has been lost because of a power disruption (often associated with lightning strikes), please take the following steps:

- Record the C1 and C2 values along with their respective pre-cal flow rates.
- Power cycle the PLC by switching the breaker off for 30 seconds, then back on.
- Allow for bootup.
- Navigate to 'Save Cal Factors' screen within the 'Calibration Menu' screen.
- Check if the recorded values match the on-screen values.
  - If yes, the problem should be resolved.
  - If not, a manual 'Push Cal Factors' will need to be performed using the recorded values.
- Instructions for this can be found in 'Calibration Menu' section.

SERVICE AND REPAIR

CONTACT PHONE NUMBER AND EMAIL ADDRESS

For service or any questions regarding the product, please contact CADARO using the following details:

- Email: service@cadaro.com
- Phone: (806) 338-7478

WARRANTY

Warranty Voidance Notice: Please note that any alterations, repairs, or disassembly performed by unauthorized individuals or persons not authorized by CADARO are strictly prohibited and will result in the voidance of the warranty.

INTEGRAL SPECIFICATIONS

PRODUCT SPECIFICATIONS

Figure 110: INTEGRAL Product Specifications

MODEL	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Pipe Size (diameter round/square)*	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight (lbs)
INTEGRAL NR/2K | INTEGRAL NRL/2K	800	2,000	6" OD	Round	32 ⅛" x 13" x 11 ⅝"	67 | –
INTEGRAL NS/5K | INTEGRAL NSL/5K	1,750	5,000	9 ¾" x 9 ¾" ID	Square	30 ⅜" x 16 ¼" x 15"	135 | 200
INTEGRAL NS/20K | INTEGRAL NSL/20K	5,000	20,000	17 ¾" x 17 ¾" ID	Square	36 ½" x 23 ⅝" x 24 ¾"	210 | 275
INTEGRAL NS/50K | INTEGRAL NSL/50K	17,500	50,000	29 ¾" x 29 ¾" ID	Square	36 ½" x 37" x 35 ⅝"	375 | 425

**Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.*

Flow Sensor Dimensions

Figure 111: INTEGRAL NR/2K

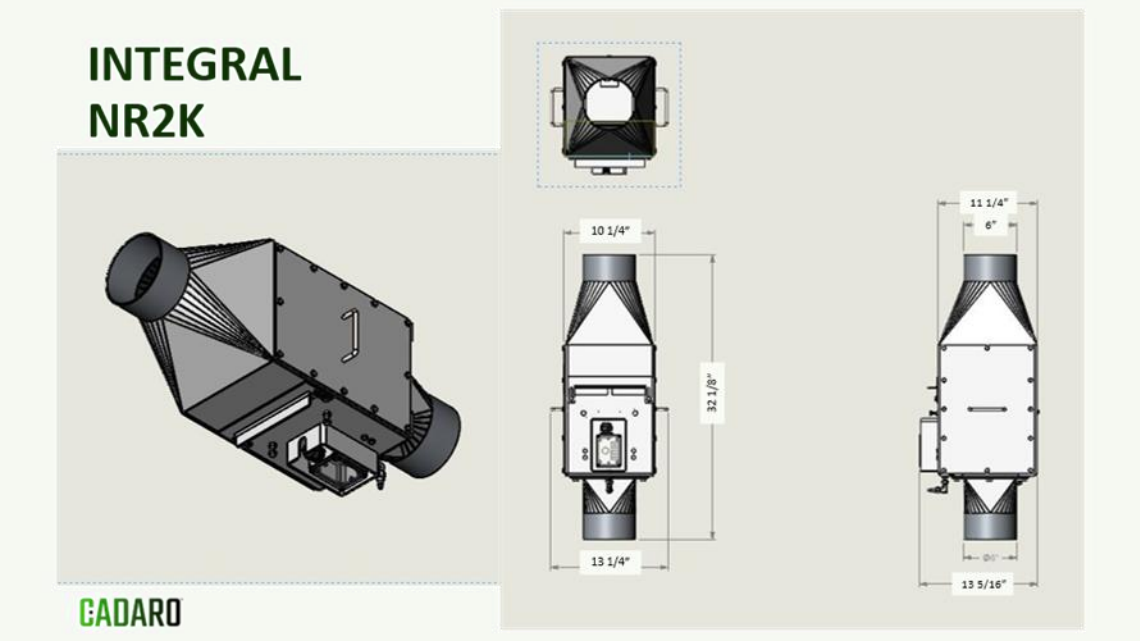


Figure 112: INTEGRAL NS/5K and NSL/5K

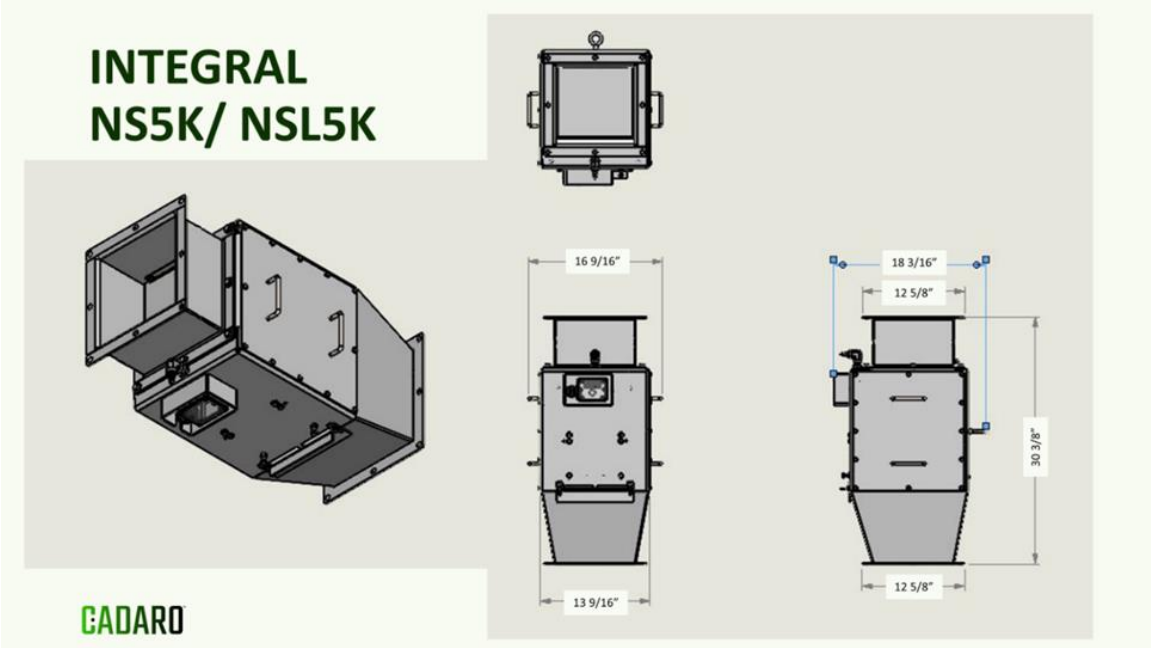


Figure 113: INTEGRAL NS/20K and NSL/20K

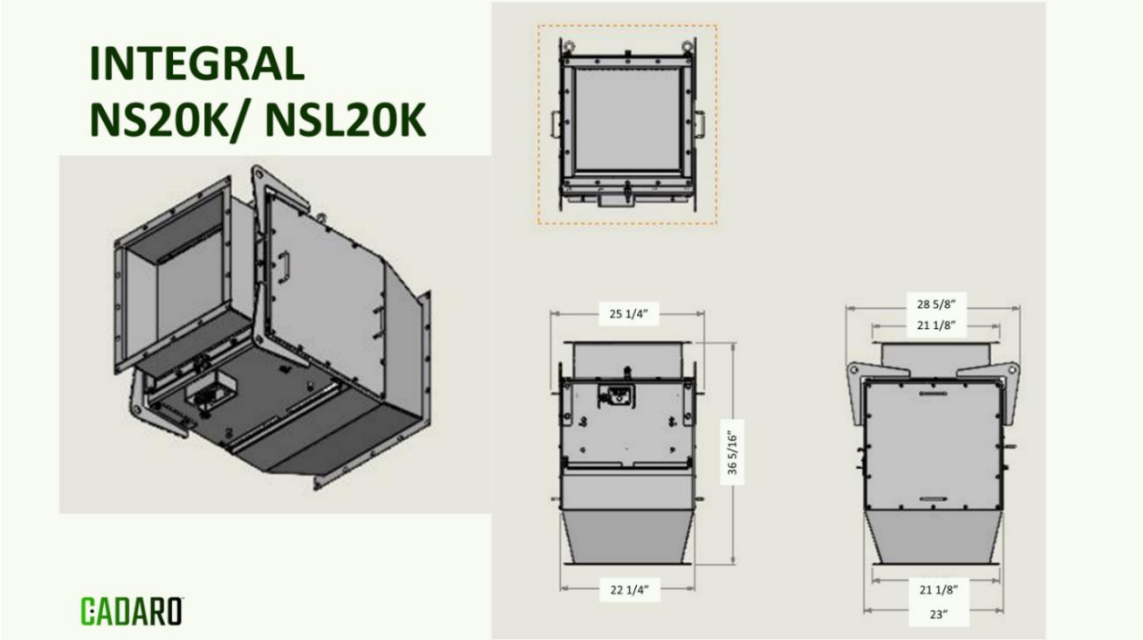
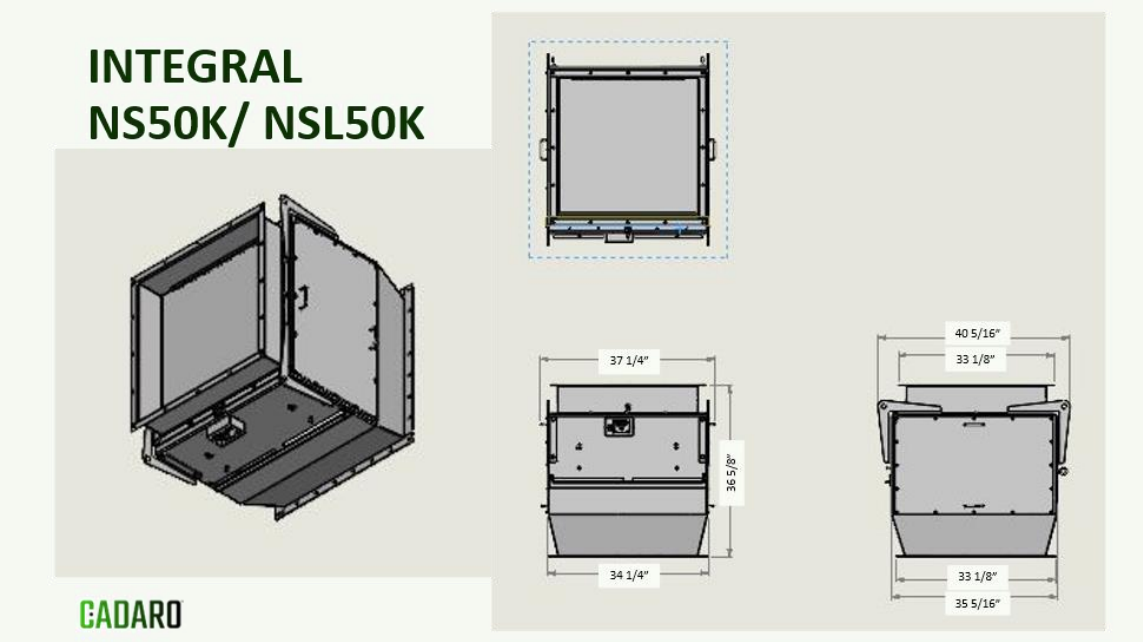


Figure 114: INTEGRAL NS/50K and NSL/50K



INTEGRAL FLANGES

Figure 115: INTEGRAL NS/5K and NSL/5K Flange Detail

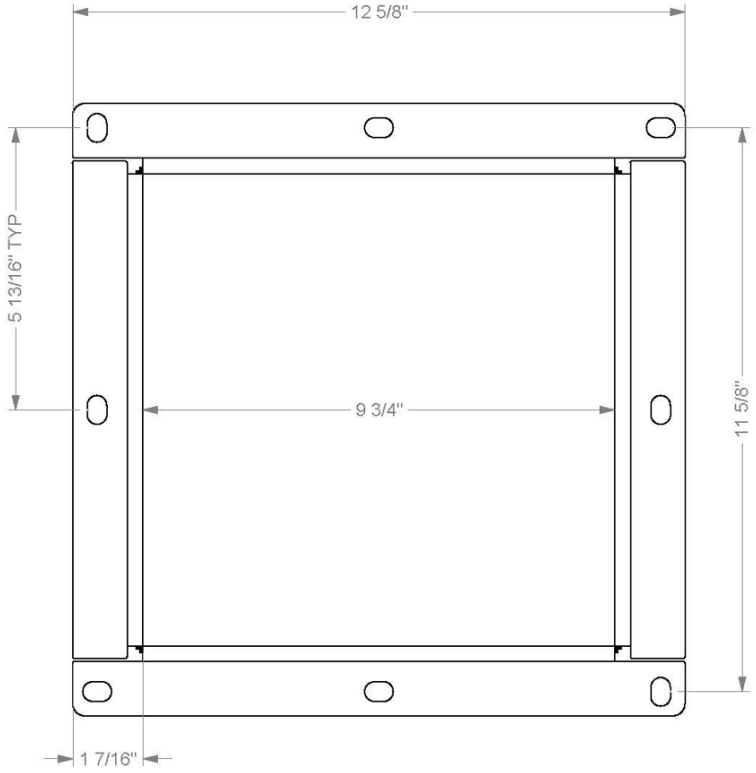


Figure 116: INTEGRAL NS/20K and NSL/20K Flange Detail

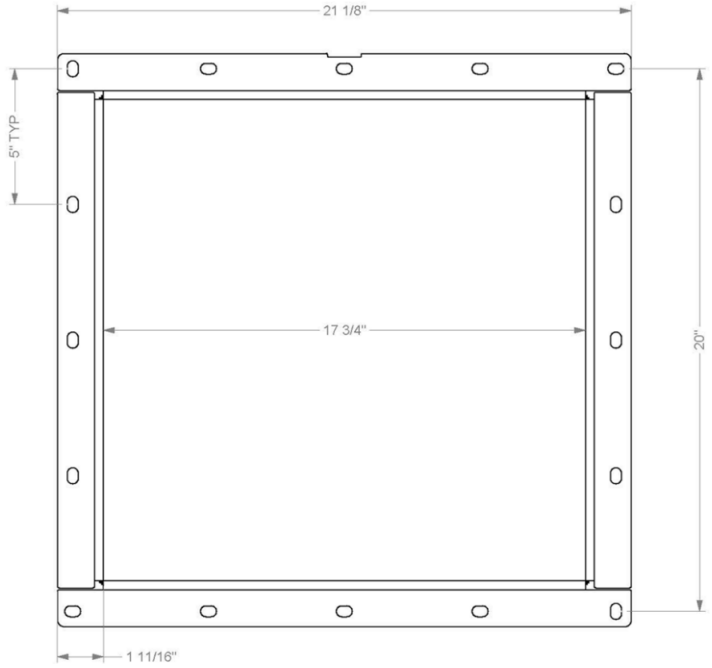
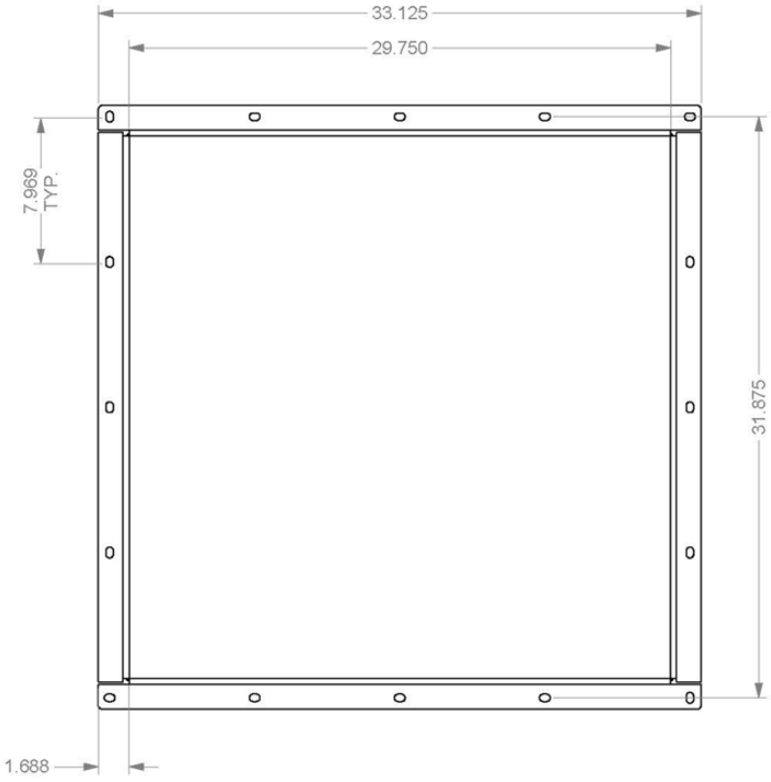


Figure 117: INTEGRAL NS/50K and NSL/50K Flange Detail



VERACITY SPECIFICATIONS

PRODUCT SPECIFICATIONS

Figure 118: Product Specifications

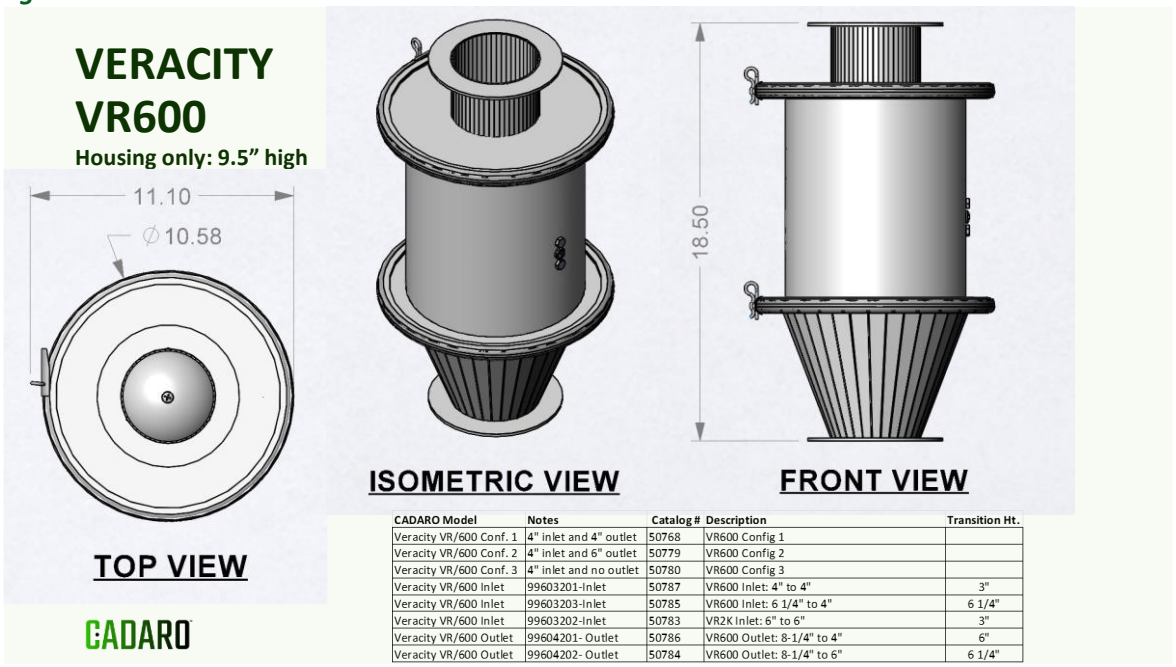
Model	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Pipe Size (diameter round/square)*	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight (lbs)
VERACITY VR/600	200	600	4" & 6" ID	Round	18 ½" x 11" (4") 22" x 11" (6")	25 (4") 28 (6")
VERACITY VR/2K	800	2,000	6" ID	Round	22 ¼" x 15"	50
VERACITY VR/4K	1,600	4,000	8" & 10" ID	Round	23" x 17" (8") 26"x 17" (10")	60 (8") 65 (10")
VERACITY VR/5K	2,000	5,000	10" ID	Round	26" x 21"	75

**Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.*

FLOW SENSOR DIMENSIONS

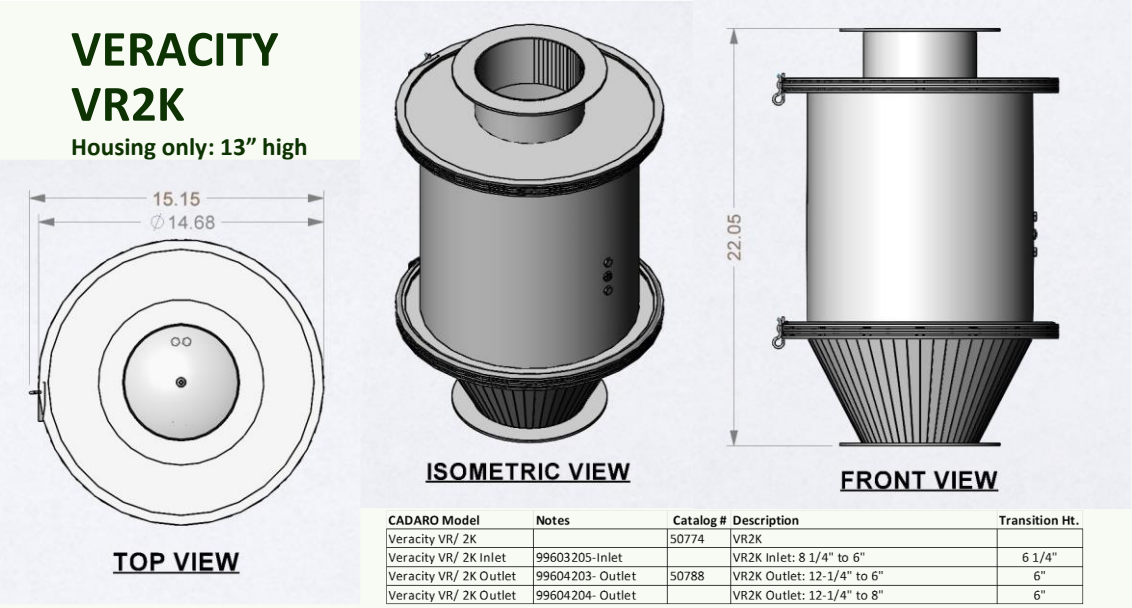
VERACITY Models

Figure 119: VERACITY VR600



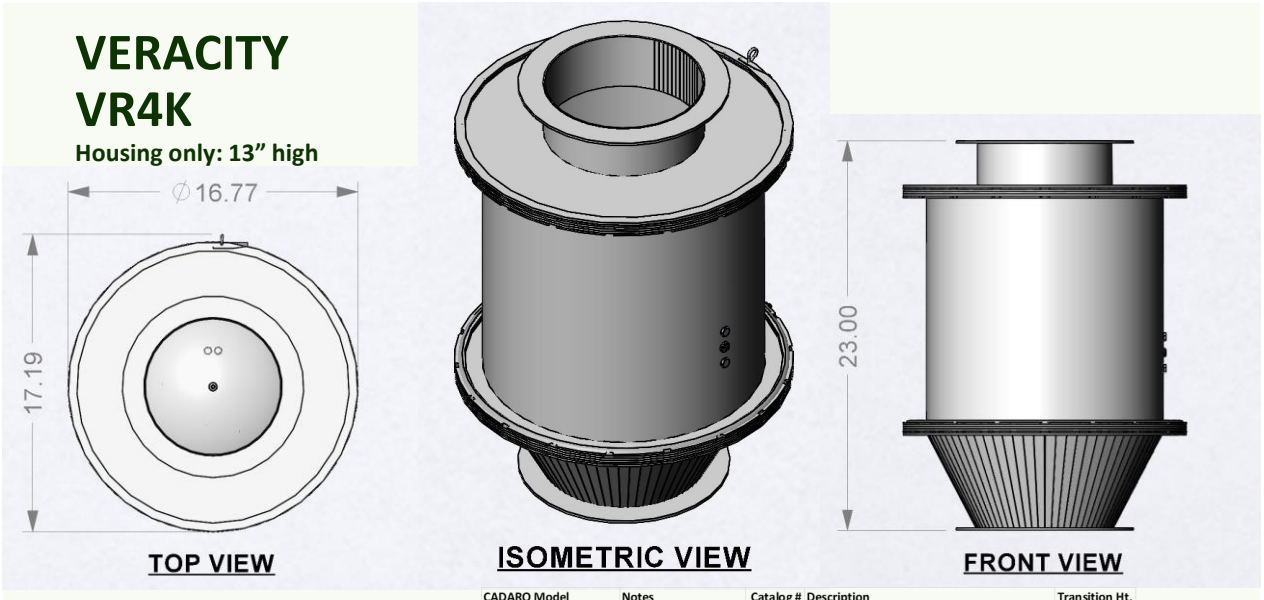
CADARO Model	Notes	Catalog #	Description	Transition Ht.
Veracity VR/600 Conf. 1	4" inlet and 4" outlet	50768	VR600 Config 1	
Veracity VR/600 Conf. 2	4" inlet and 6" outlet	50779	VR600 Config 2	
Veracity VR/600 Conf. 3	4" inlet and no outlet	50780	VR600 Config 3	
Veracity VR/600 Inlet	99603201-Inlet	50787	VR600 Inlet: 4" to 4"	3"
Veracity VR/600 Inlet	99603203-Inlet	50785	VR600 Inlet: 6 1/4" to 4"	6 1/4"
Veracity VR/600 Inlet	99603202-Inlet	50783	VR2K Inlet: 6" to 6"	3"
Veracity VR/600 Outlet	99604201- Outlet	50786	VR600 Outlet: 8-1/4" to 4"	6"
Veracity VR/600 Outlet	99604202- Outlet	50784	VR600 Outlet: 8-1/4" to 6"	6 1/4"

Figure 120: VERACITY VR2K



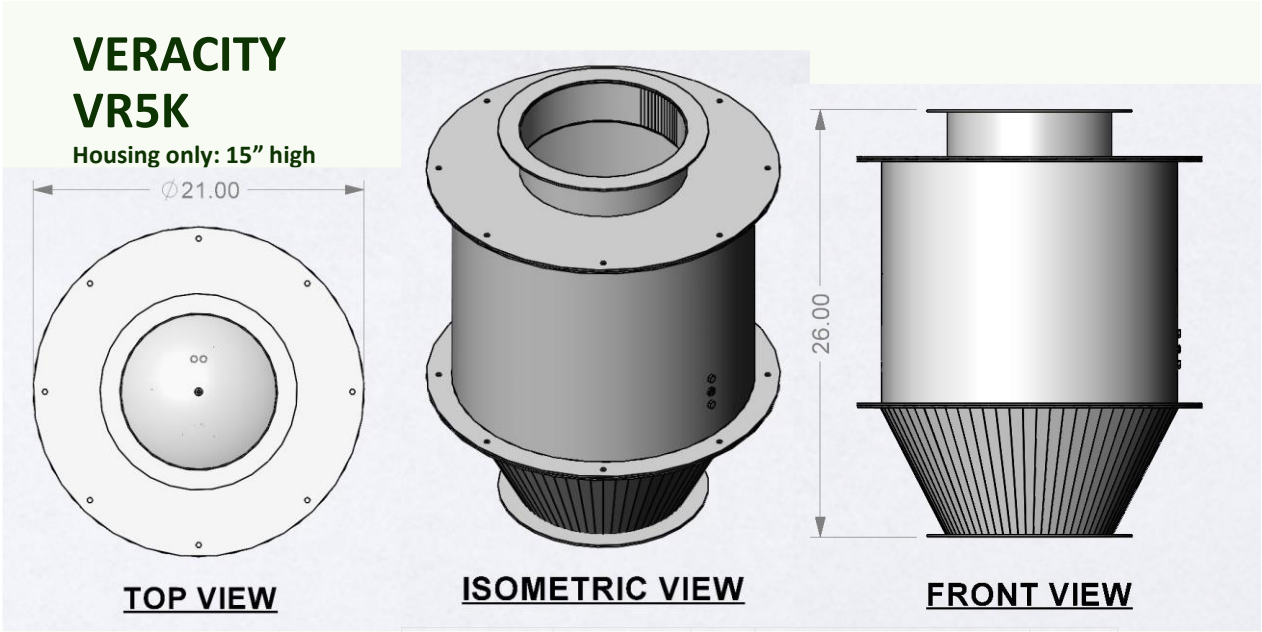
CADARO Model	Notes	Catalog #	Description	Transition Ht.
Veracity VR/ 2K		50774	VR2K	
Veracity VR/ 2K Inlet	99603205-Inlet		VR2K Inlet: 8 1/4" to 6"	6 1/4"
Veracity VR/ 2K Outlet	99604203- Outlet	50788	VR2K Outlet: 12-1/4" to 6"	6"
Veracity VR/ 2K Outlet	99604204- Outlet		VR2K Outlet: 12-1/4" to 8"	6"

Figure 121: VERACITY VR4K



CADARO Model	Notes	Catalog #	Description	Transition Ht.
Veracity VR/ 4K		50770	VR4K	
Veracity VR/ 4K Inlet	99603204-Inlet		VR4K Inlet: 8" to 8"	3"
Veracity VR/ 4K Inlet	99603207-Inlet		VR4K Inlet: 10-1/4" to 8"	6"
Veracity VR/ 4K Inlet	99603210-Inlet		VR4K Inlet: 7" to 7"	3"
Veracity VR/ 4K Outlet	99604205- Outlet		VR4K: 14-1/4" to 8"	6"
Veracity VR/ 4K Outlet	99604206- Outlet		VR4K: 14-1/4" to 10"	6"

Figure 122: VERACITY VR5K

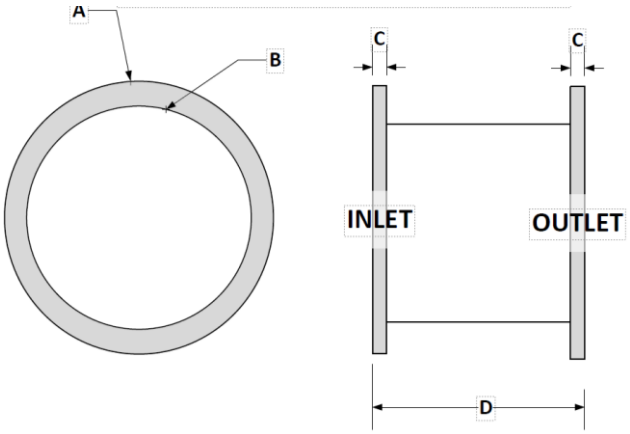


CADARO Model	Notes	Catalog #	Description	Transition Ht.
Veracity VR/ 5K		51481	VR5K	
Veracity VR/ 5K Inlet	99603209-Inlet		VR5K Inlet: 10"to 10"	3"
Veracity VR/ 5K Outlet	99604210- Outlet		VR5K: 18-1/4" to 10"	8"

VERACITY FLANGES

Figure 123: VERACITY Flange Detail

Model	Catalog #	Stock #	Size	Adapter Description	Standard round angle flange size	Nordfab clamp size	A	B	C	D	
VR600- Inlet	50787	99603201	4" to 4"	WELDMENT,TRANS,INLET,4"TO4"	4"	6"	6.00	4.00	0.135	3.00	**A= O.D.**
VR600- Inlet	50785	99603203	6-1/4" to 4"	WELDMENT,TRANS,INLET,6-1/4"TO4"	6"	8"	8.50	6.25	0.135	6.29	**B= I.D.**
VR600- Outlet	50786	99604201	8-1/4" to 4"	WELDMENT,TRANS,OUTLET,8-1/4"TO4"	4"	6"	6.00	4.00	0.135	6.00	**C= Thick**
VR600- Outlet	50784	99604202	8-1/4" to 6"	WELDMENT,TRANS,OUTLET,8-1/4"TO6"	6"	8"	8.50	6.00	0.135	6.27	**D= Depth**
VR2K- Inlet	50783	99603202	6" to 6"	WELDMENT,TRANS,INLET,6"TO6"	6"	8"	8.50	6.00	0.135	3.00	**All Inches**
VR2K- Inlet		99603205	8-1/4" to 6"	WELDMENT,TRANS,8-1/4"TO6"	8"	10"	10.50	8.25	0.135	6.27	
VR2K- Outlet	50788	99604203	12-1/4" to 6"	WELDMENT,TRANS,OUTLET,12-1/4"TO6"	6"	8"	8.50	6.00	0.135	6.00	
VR2K- Outlet		99604204	12-1/4" to 8"	WELDMENT,TRANS,OUTLET,12-1/4"TO8"	8"	10"	10.50	8.00	0.135	6.00	
VR4K- Inlet		99603207	10-1/4" to 8"	WELDMENT,TRANS,INLET,10"TO8"	10"	12"	12.50	10.25	0.135	6.00	
VR4K- Inlet		99603204	8" to 8"	WELDMENT,TRANS,INLET,8"TO8"	8"	10"	10.50	8.00	0.135	3.00	
VR4K- Inlet		99603210	7" to 7"	WELDMENT,TRANS,INLET,7"TO7"	7"	9"	9.50	7.00	0.135	3.00	
VR4K- Outlet		99604205	14-1/4" to 8"	WELDMENT,TRANS,OUTLET,14-1/4"TO8"	8"	10"	10.50	8.00	0.135	6.00	
VR4K- Outlet		99604206	14-1/4" to 10"	WELDMENT,TRANS,OUTLET,14-1/4"TO10"	10"	12"	12.50	10.00	0.135	6.00	
VR5K- Inlet		99603209	10" to 10"	WELDMENT,TRANS,INLET,FM5000	10"	12"	12.50	10.00	0.135	3.00	
VR5K- Outlet		99604210	18-1/4" to 10"	WELDMENT,TRANS,OUTLET,18-1/4"TP10"	10"	12"	12.50	10.00	0.135	8.00	



VERACITY DIAMOND SPECIFICATIONS

PRODUCT SPECIFICATIONS

Figure 124: 40° Dome VERACITY Diamond Product Specifications

VERACITY DIAMOND 40° DOME

Model	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Chute Flange	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight VS/VSL (lbs)
VERACITY Diamond VS/1K VERACITY Diamond VSL/1K	400	1,000	4"/ 10"	Square	12 ⅝ X 12 ⅝ X 7	25 lbs | 28 lbs
VERACITY Diamond VS/2.5K VERACITY Diamond VSL/2.5K	1000	2,500	6"/ 14"	Square	17 ⅛ X 17 ⅛ X 9	51 lbs | 57 lbs
VERACITY Diamond VL/4K VERACITY Diamond VSL/4K	1,500	4,000	8"/ 18"	Square	21 ⅛ X 21 ⅛ X 9	62 lbs | 69 lbs
VERACITY Diamond VS/7K VERACITY Diamond VSL/7K	3,000	7,000	10"/ 20"	Square	23 ⅛ X 23 ⅛ X 9	101 lbs | 109 lbs
VERACITY Diamond VS/10K VERACITY Diamond VSL/10K	4,000	10,000	12"/ 20"	Square	23 ⅛ X 23 ⅛ X 9	108 lbs | 116 lbs
VERACITY Diamond VS/14K VERACITY Diamond VSL/14K	5,500	14,000	14"/22"	Square	25 ⅛ X 25 ⅛ X 10	127 lbs | 140 lbs
VERACITY Diamond VS/20K VERACITY Diamond VSL/20K	8,000	20,000	18"/ 28"	Square	32 ⅛ X 32 ⅛ X 11 $^{11}/_{16}$	197 lbs | 219 lbs

*Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.

Figure 125: 53° Dome VERACITY Diamond Product Specifications

VERACITY DIAMOND 53° DOME

Model	Low Operating Range (lbs/min)*	High Operating Range (lbs/min)*	Inlet/Outlet Chute Flange	Configuration	Flow Sensor Dimensions (L x W x H)	Flow Sensor Weight VS/VSL (lbs)
VERACITY Diamond VS/1K VERACITY Diamond VSL/1K	400	1,000	4"/ 10"	Square	12 ⅝ X 12 ⅝ X 7	25 lbs | 28 lbs
VERACITY Diamond VS/2.5K VERACITY Diamond VSL/2.5K	1000	2,500	6"/ 14"	Square	17 ⅛ X 17 ⅛ X 9	51 lbs | 57 lbs
VERACITY Diamond VL/4K VERACITY Diamond VSL/4K	1,500	4,000	8"/ 18"	Square	21 ⅛ X 21 ⅛ X 9	63 lbs | 70 lbs
VERACITY Diamond VS/7K VERACITY Diamond VSL/7K	3,000	7,000	10"/ 20"	Square	23 ⅛ X 23 ⅛ X 12	118 lbs | 128 lbs
VERACITY Diamond VS/10K VERACITY Diamond VSL/10K	4,000	10,000	12"/ 20"	Square	23 ⅛ X 23 ⅛ X 12	125 lbs | 136 lbs
VERACITY Diamond VS/14K VERACITY Diamond VSL/14K	5,500	14,000	14"/22"	Square	25 ⅛ X 25 ⅛ X 13	148 lbs | 164 lbs
VERACITY Diamond VS/20K VERACITY Diamond VSL/20K	8,000	20,000	16"/ 28" 18"/ 28"	Square	32 ⅛ X 32 ⅛ X 15 $^{11}/_{16}$	233 lbs | 258 lbs

*Operating range can be calibrated to measure lower flow rates but overall range and accuracy requirements need to be considered.

FLOW SENSOR DIMENSIONS

VERACITY Diamond Models

Figure 126: VERACITY Diamond VS1K/VSL1K, 4" Flange

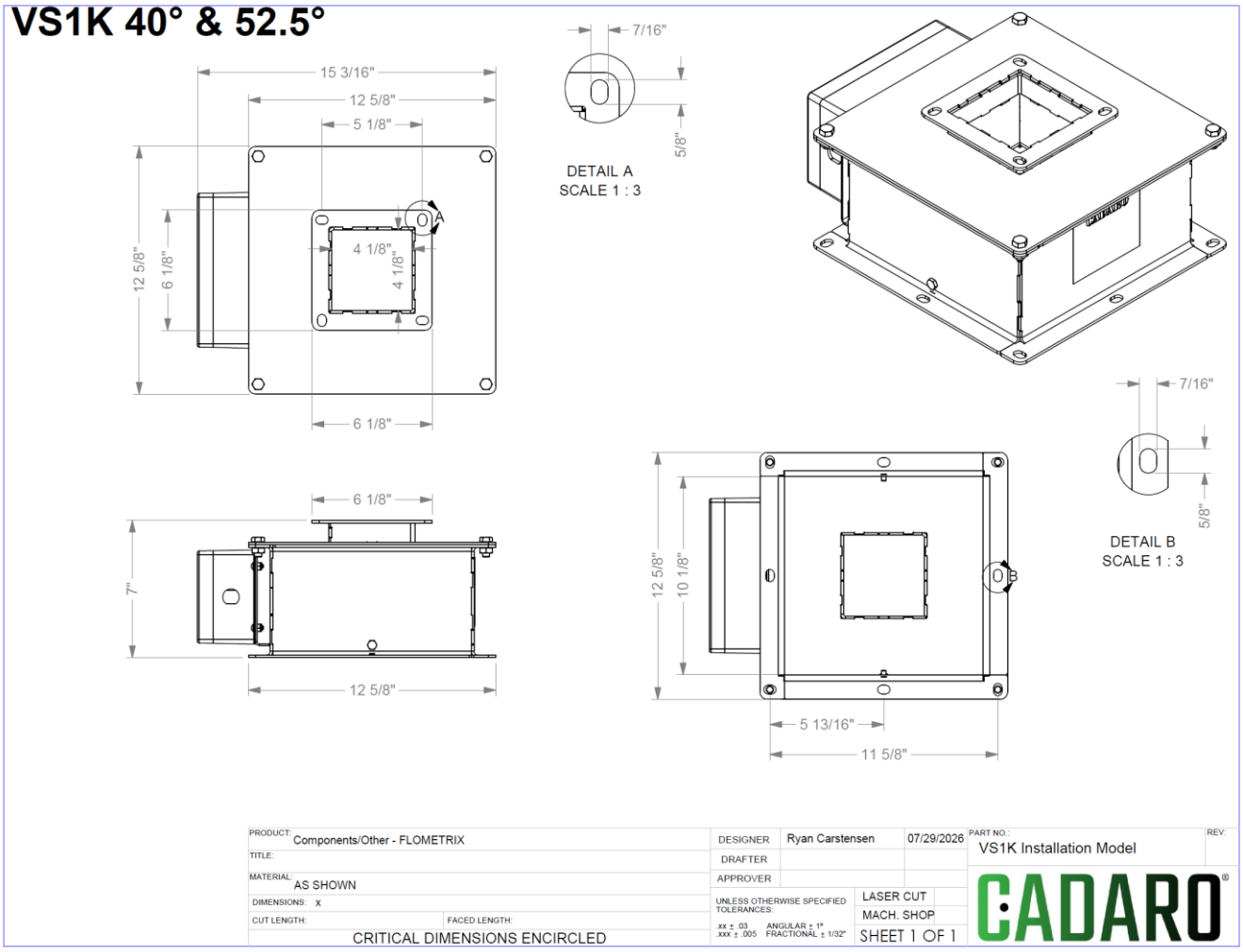


Figure 127: VERACITY Diamond VS2.5K/VSL2.5K, 6" Flange

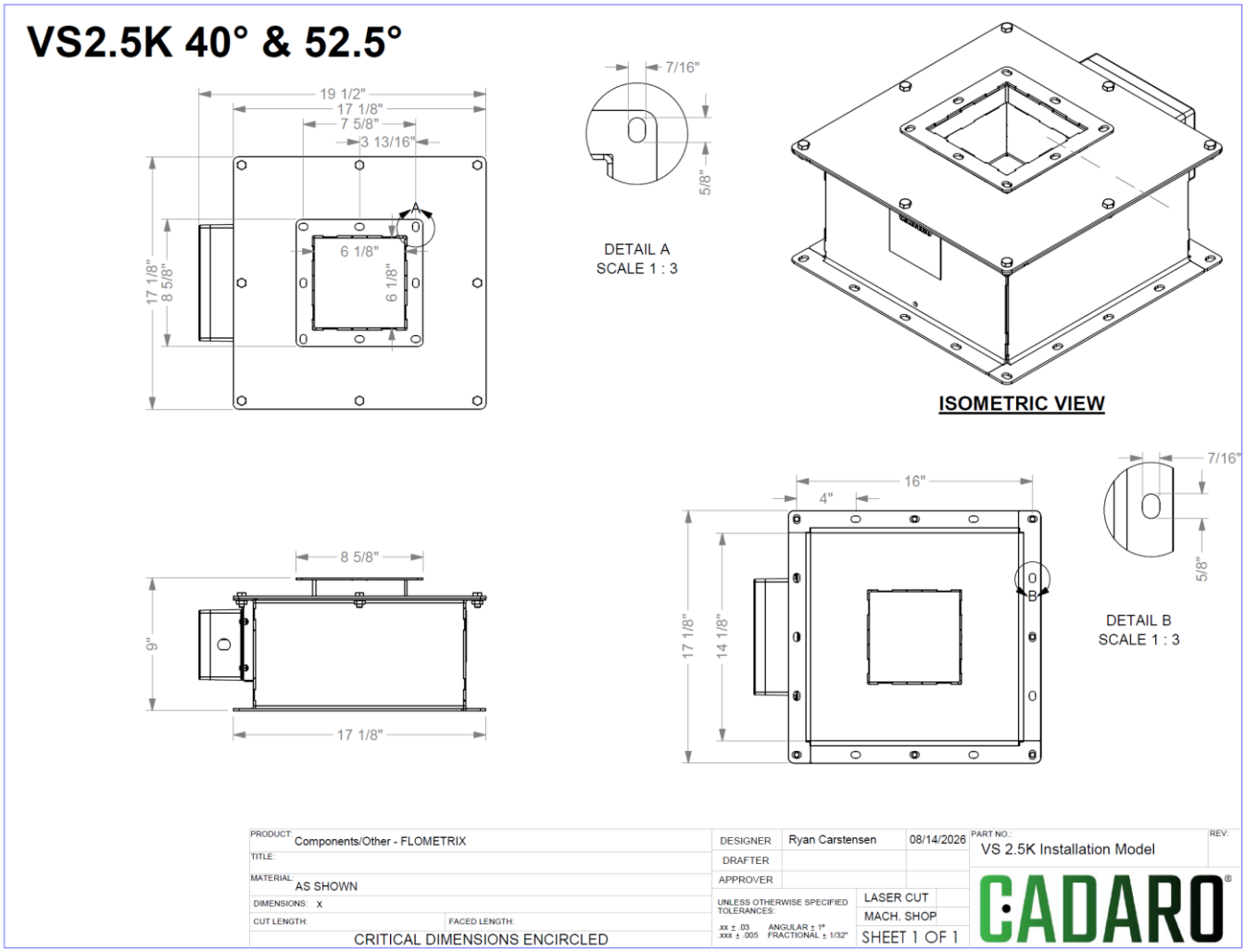


Figure 128: VERACITY Diamond VS4K/VSL4K, 8” Flange

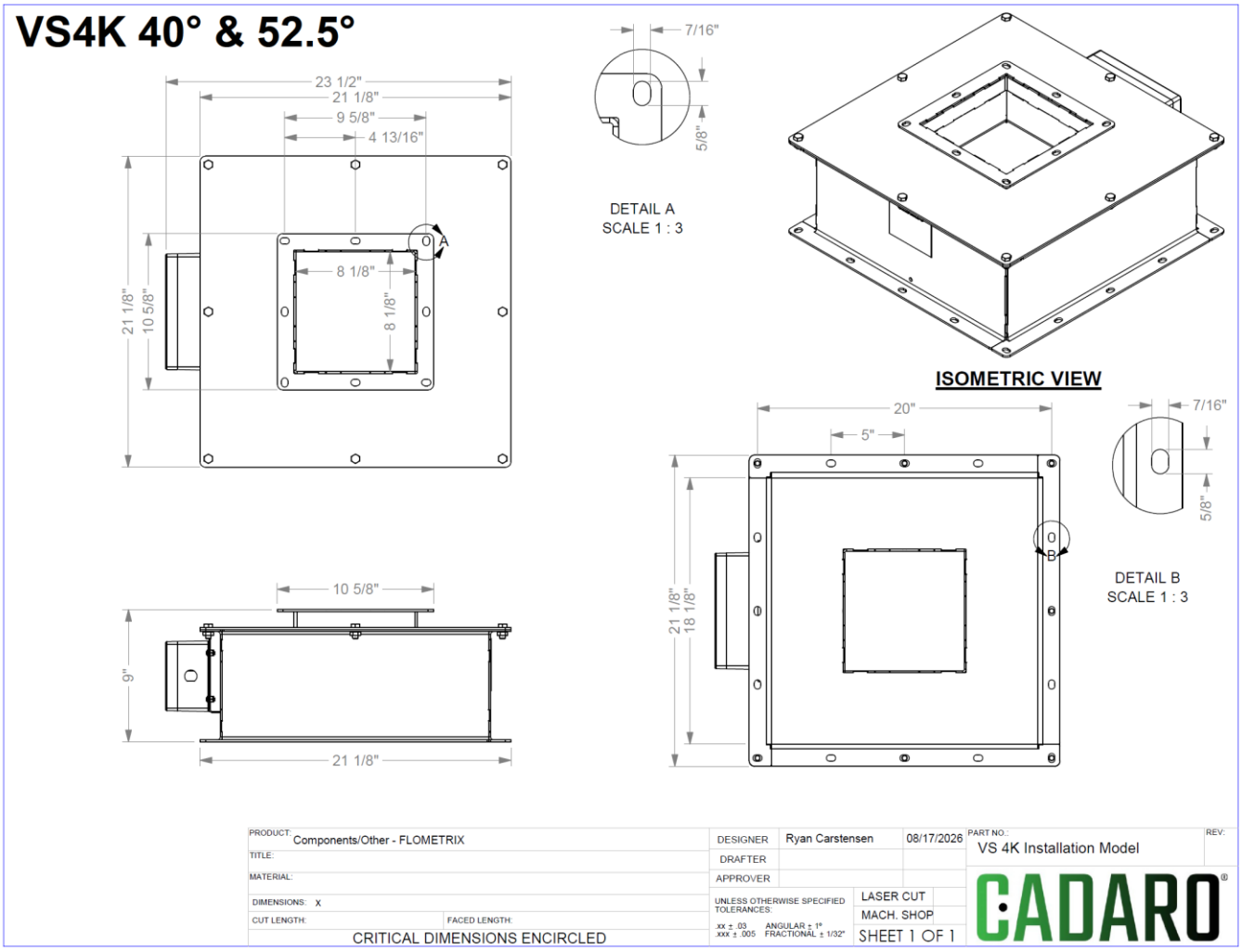


Figure 129: VERACITY Diamond VS7K/VSL7K, 10” Flange

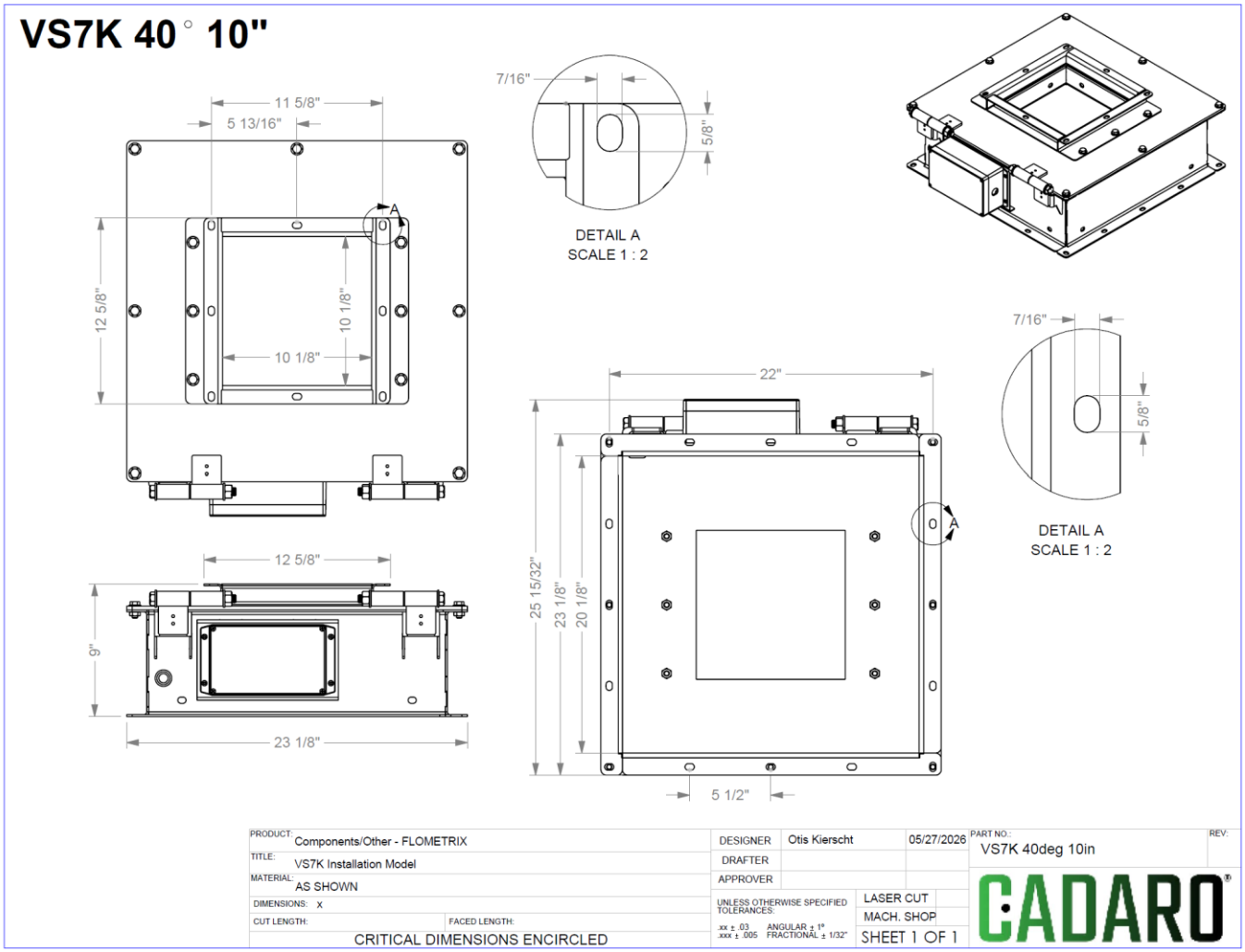


Figure 130: VERACITY Diamond VS10K/VSL10K, 12” Flange, 40° Dome

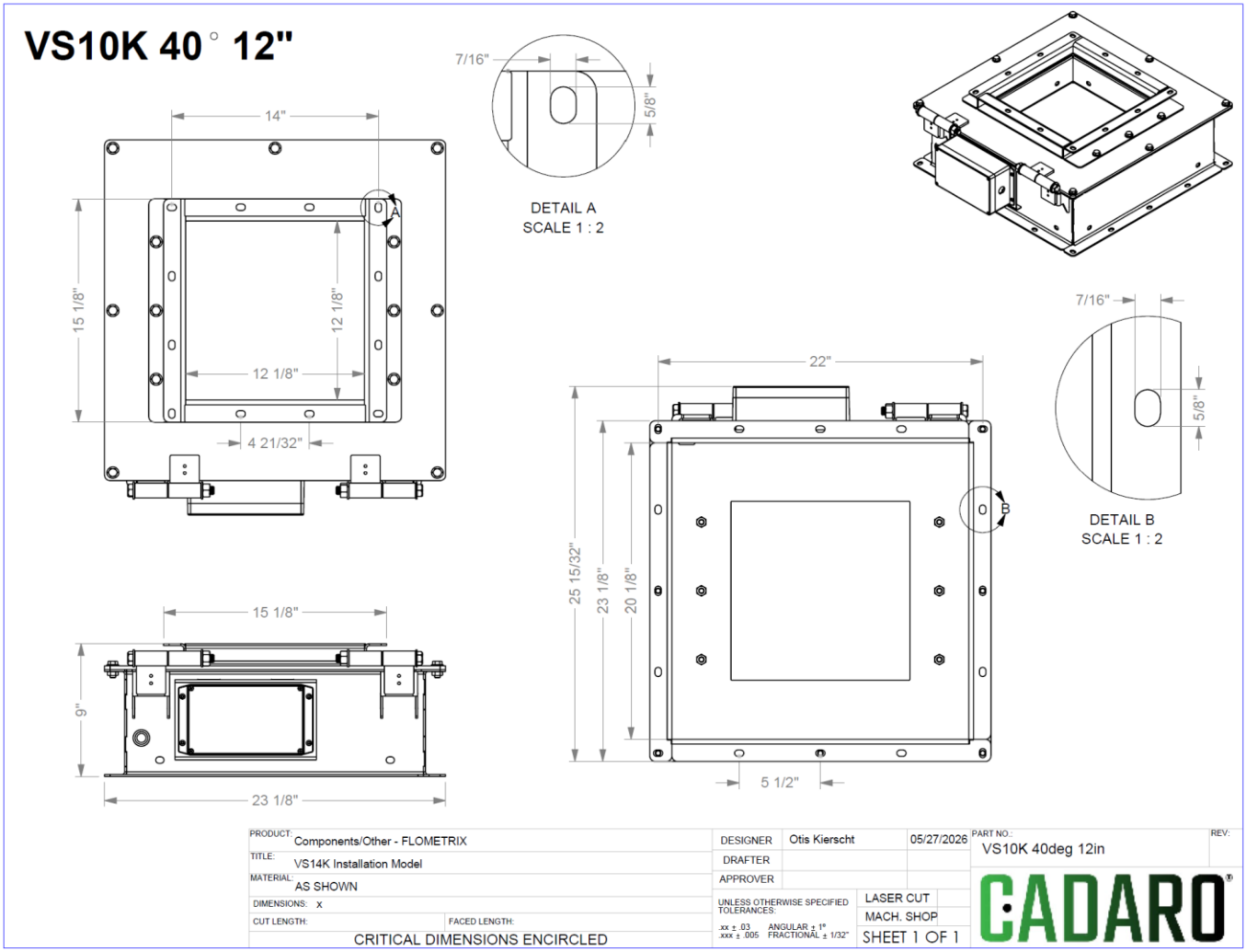


Figure 131: VERACITY Diamond VS10K/VSL10K, 12” Flange, 52.5° Dome

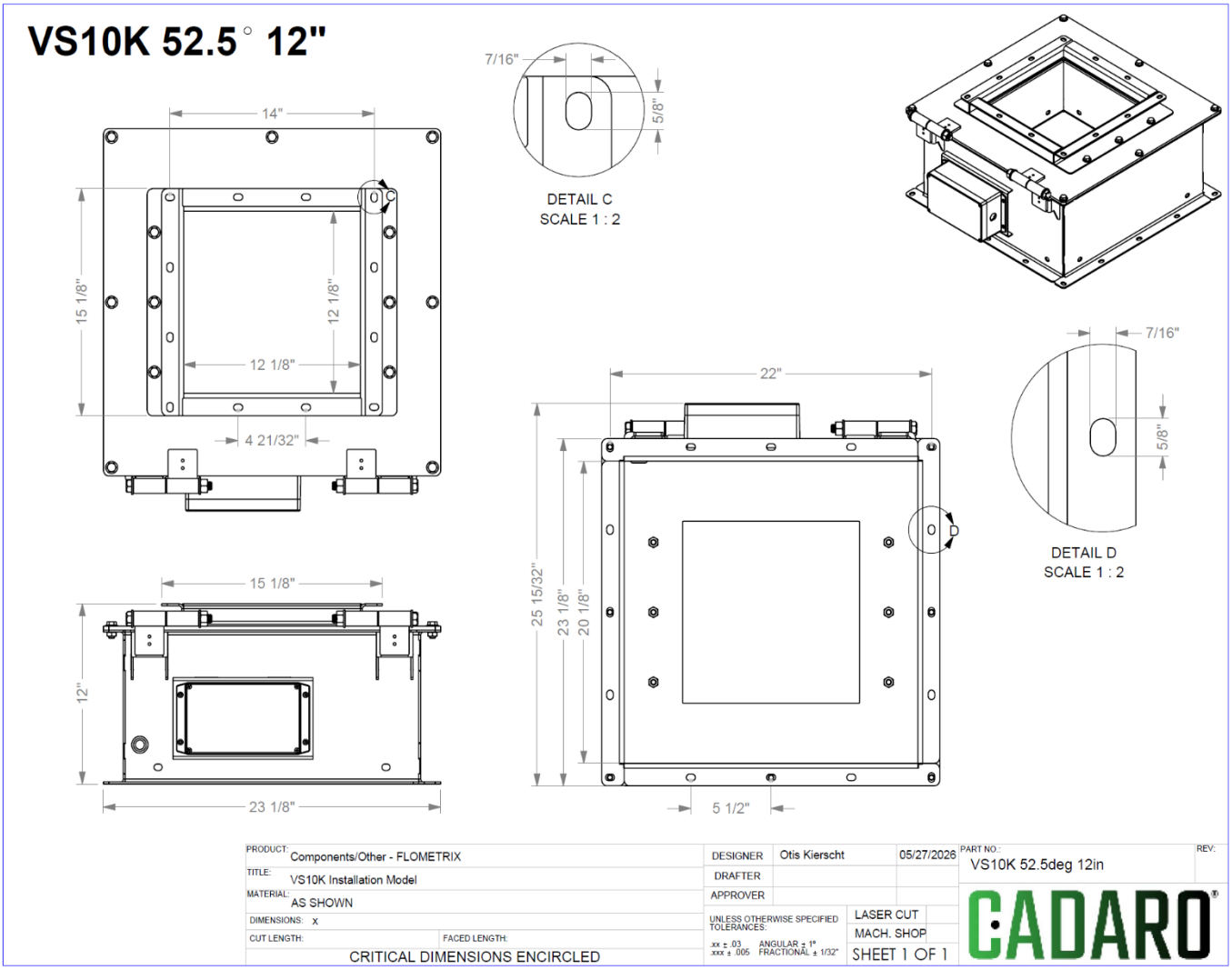


Figure 132: VERACITY Diamond VS14K/ VSL14K, 14” Flange, 40° Dome

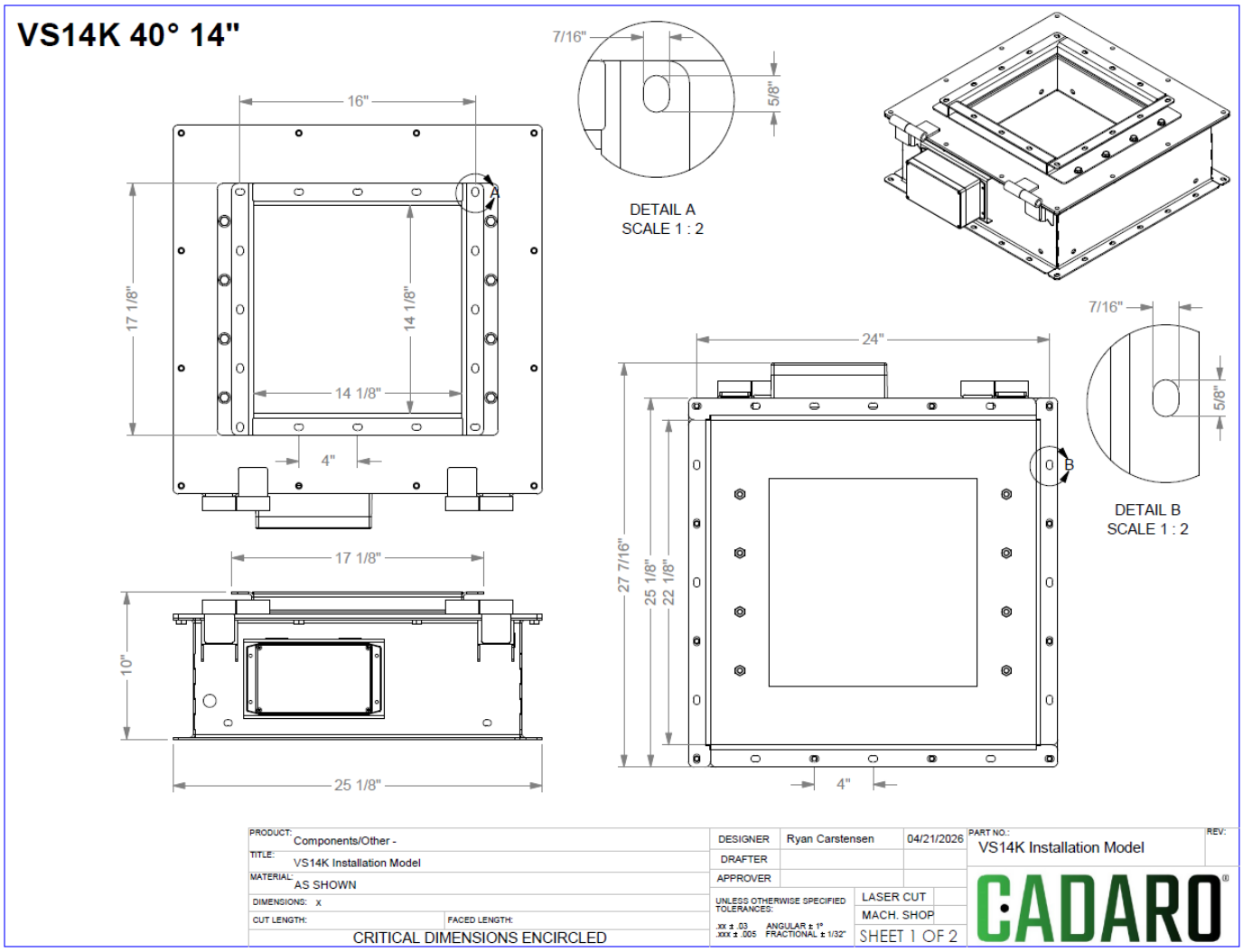


Figure 133: VERACITY Diamond VS14K/ VSL14K, 14” Flange, 52.5° Dome

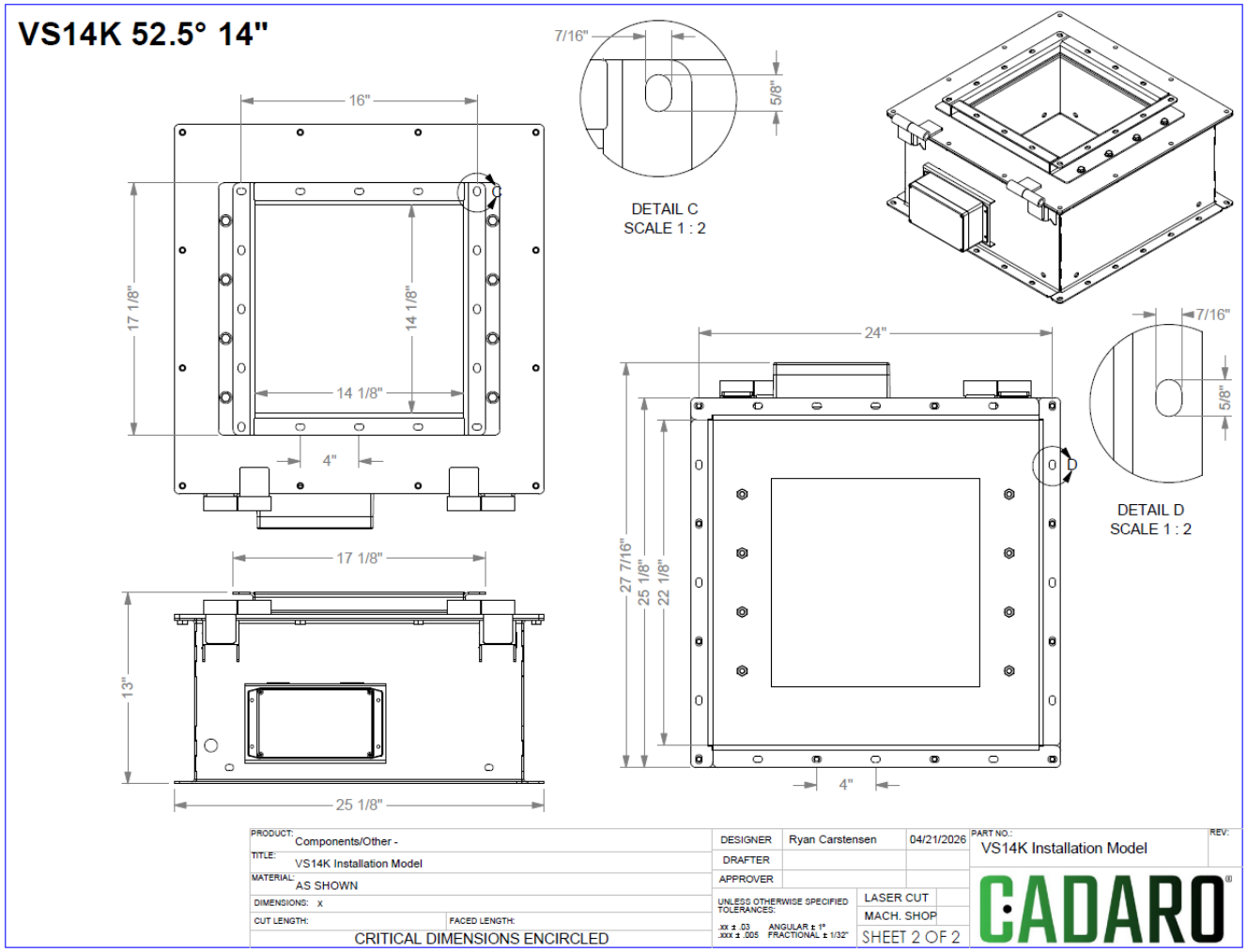


Figure 134: VERACITY Diamond VS20K and VSL20K, 16” Flange, 40° Dome

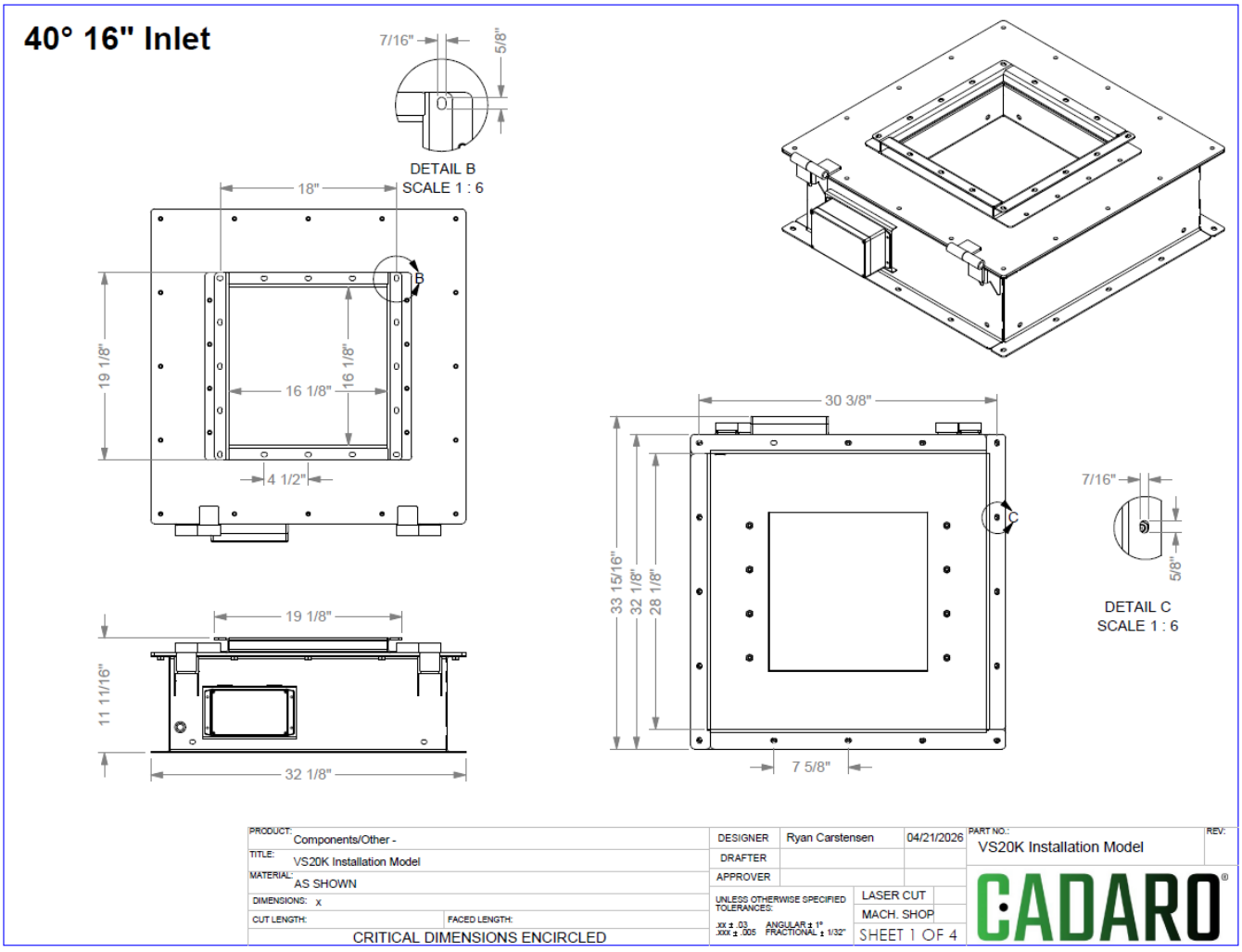


Figure 135: VERACITY Diamond VS20K and VSL20K, 18” Flange, 40° Dome

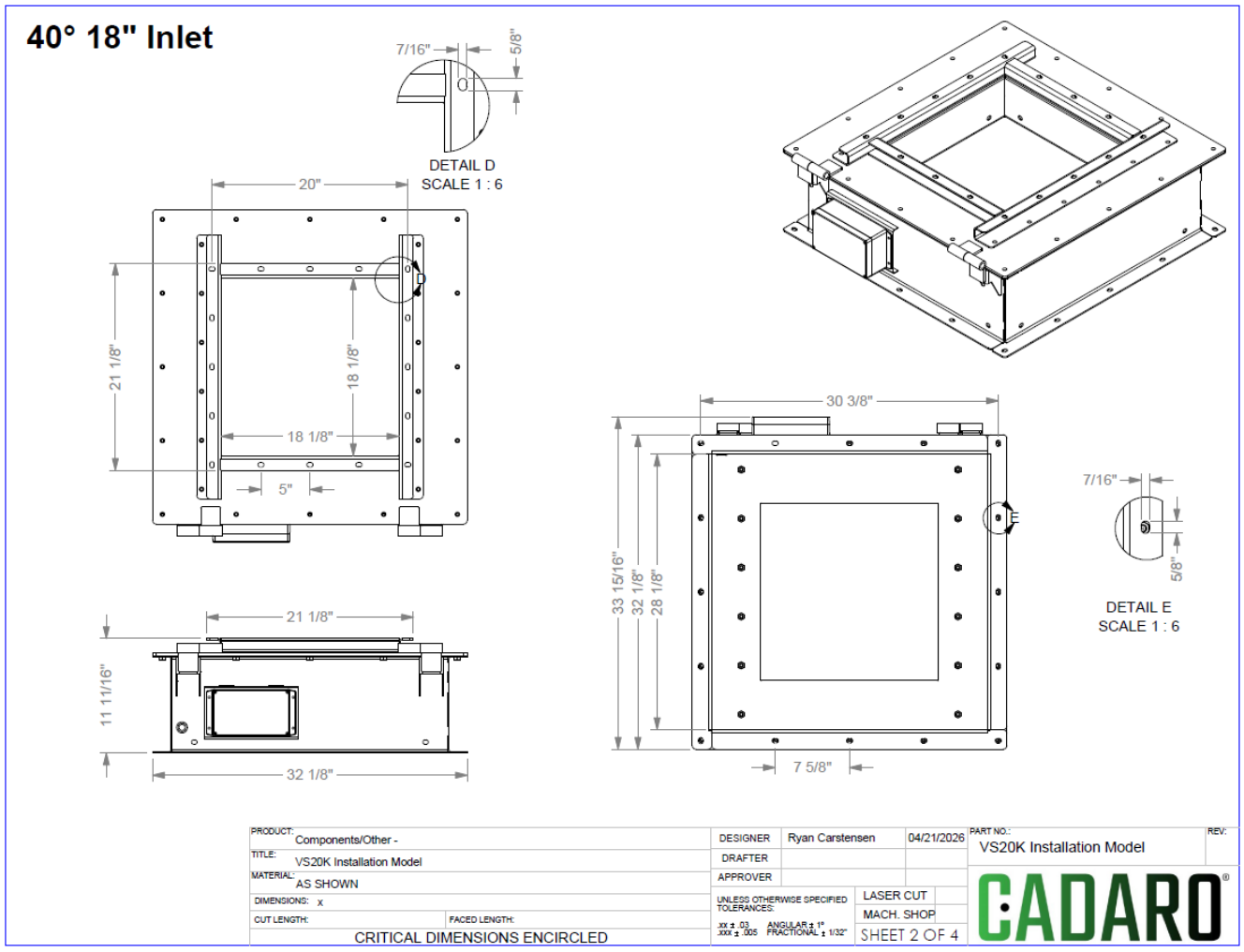


Figure 136: VERACITY Diamond VS20K and VSL20K, 16” Flange, 52.5° Dome

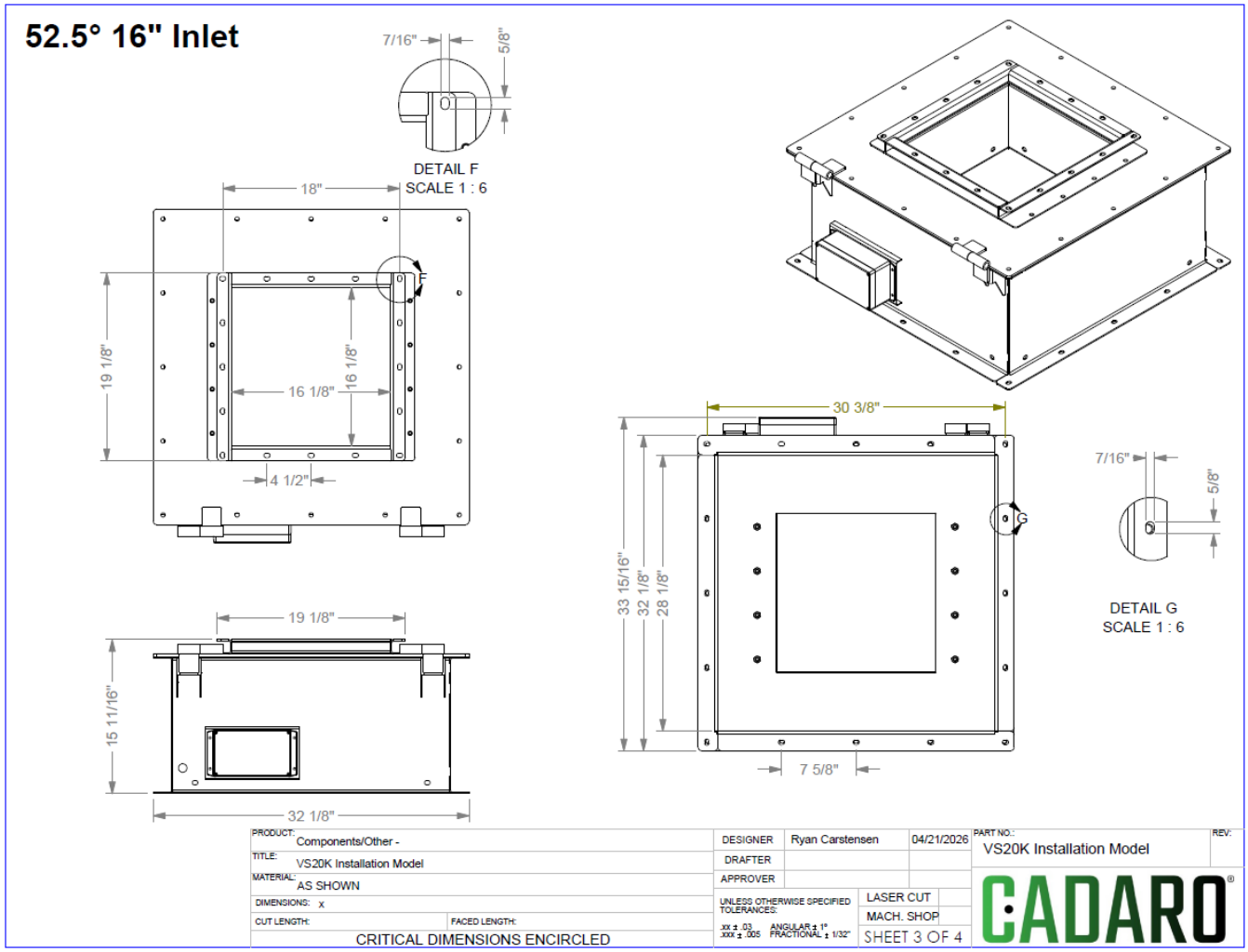
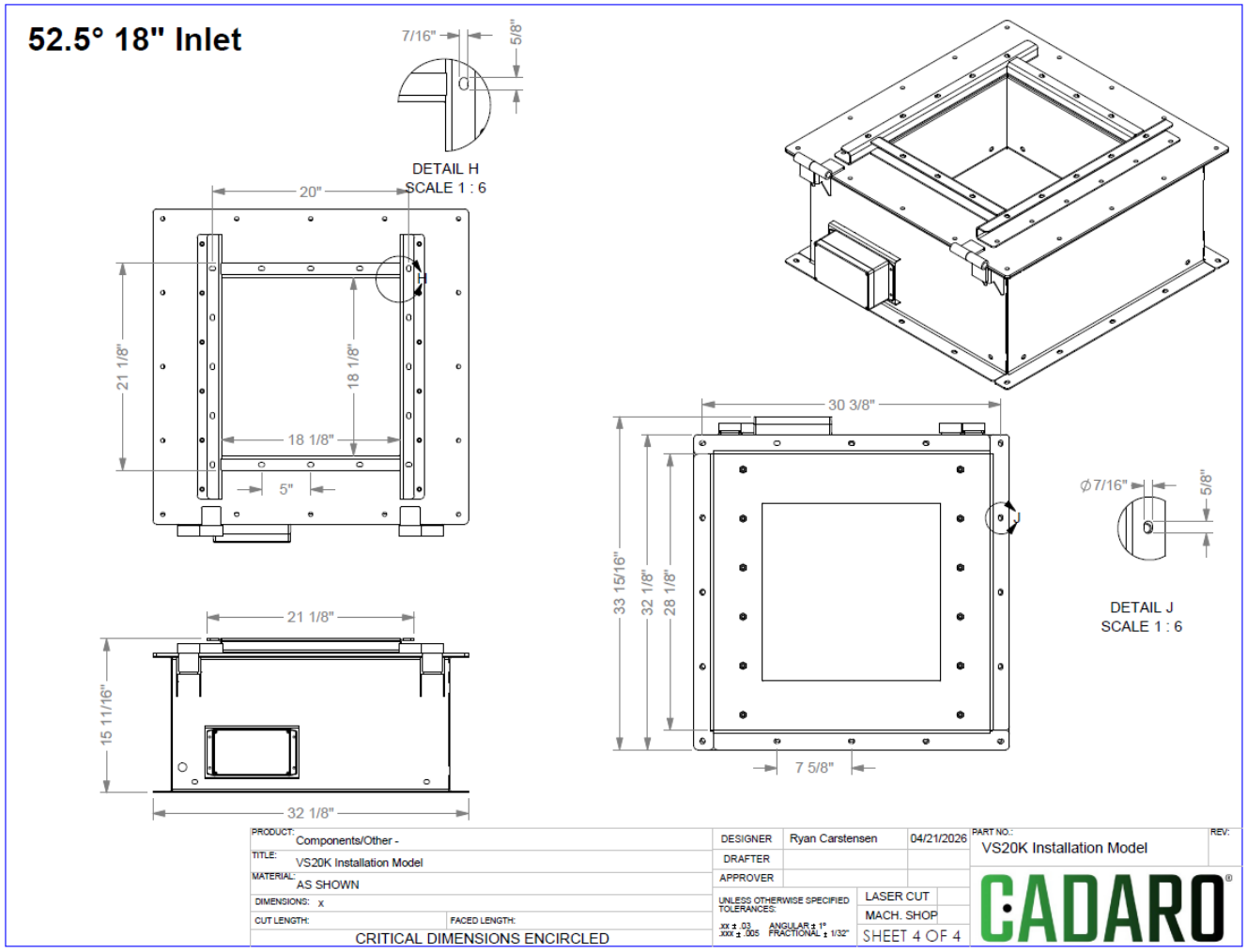


Figure 137: VERACITY Diamond VS20K and VSL20K, 18” Flange, 52.5° Dome



PLC CONTROL BOX INFORMATION

SIGNAL OUTPUT

Ethernet (standard) with Modbus option, and/or 4-channel analog outputs with 0-5 VDC, 0-10 VDC (optional)

PLC CONTROL BOX

12.8 lbs. for single channel

POWER RATING

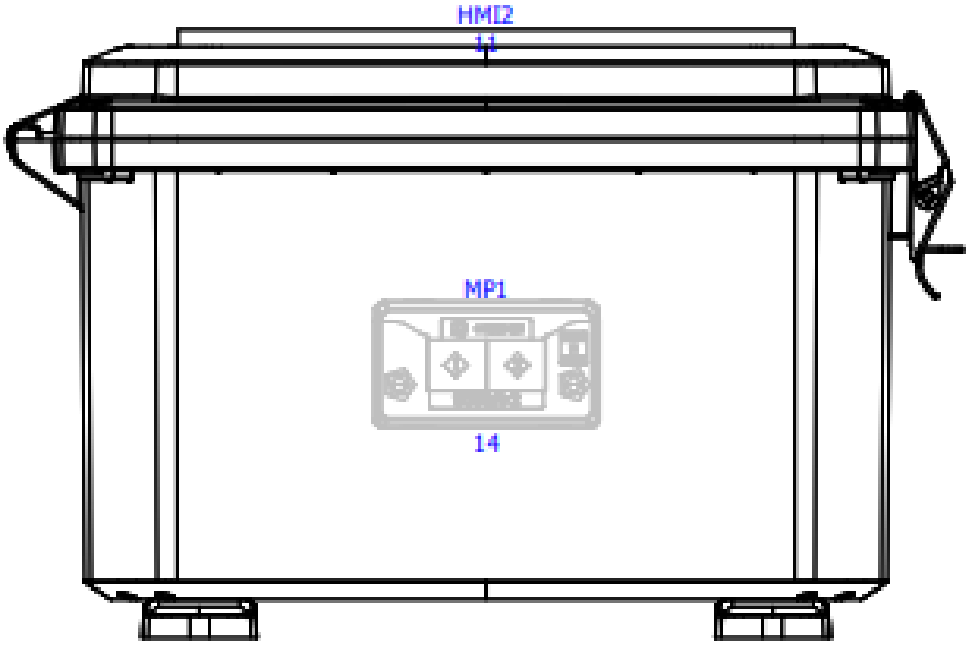
1.3 amps at 110VAC

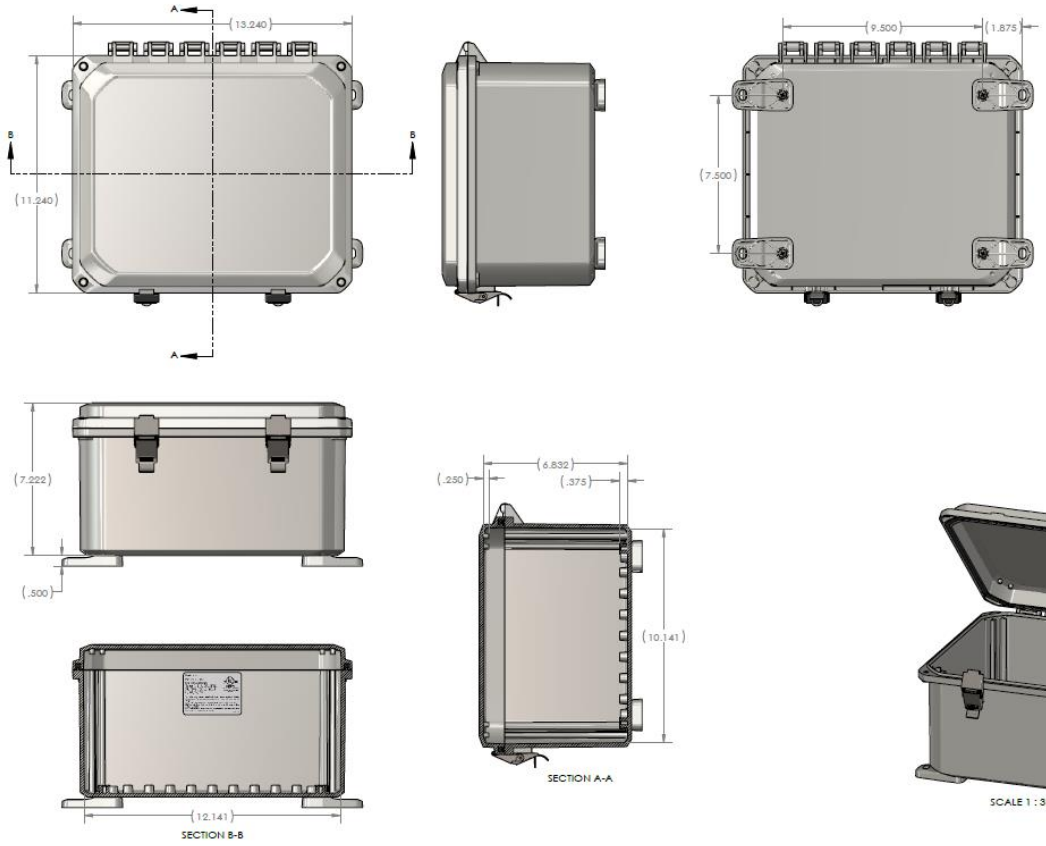
REQUIRED POWER AND SUGGESTED UPS

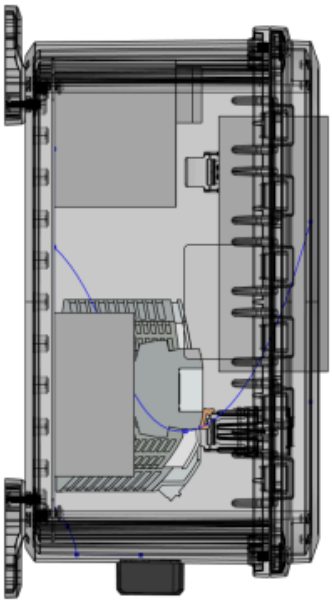
The PLC Control box requires a 110VAC and Uninterruptible Power Supply (UPS) [recommended] along with spike-free, steady voltage. Electrical components may not be covered under OEM warrantee if a quality UPS is not used to power the system. It is further recommended that a professional licensed electrician (or other experienced/qualified individual) evaluate the quality of the original power supply to ensure that spike-free, steady is being supplied to the UPS and to the PLC Control box.

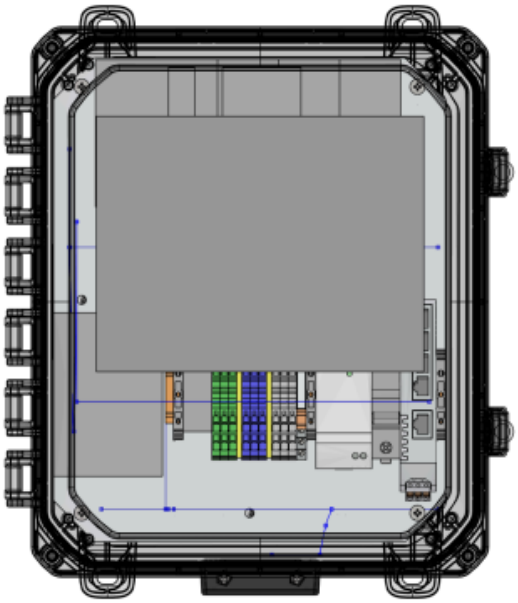
PLC CONTROL BOX DIMENSIONS

Figure 138: PLC control box Enclosure with 7-inch HMI



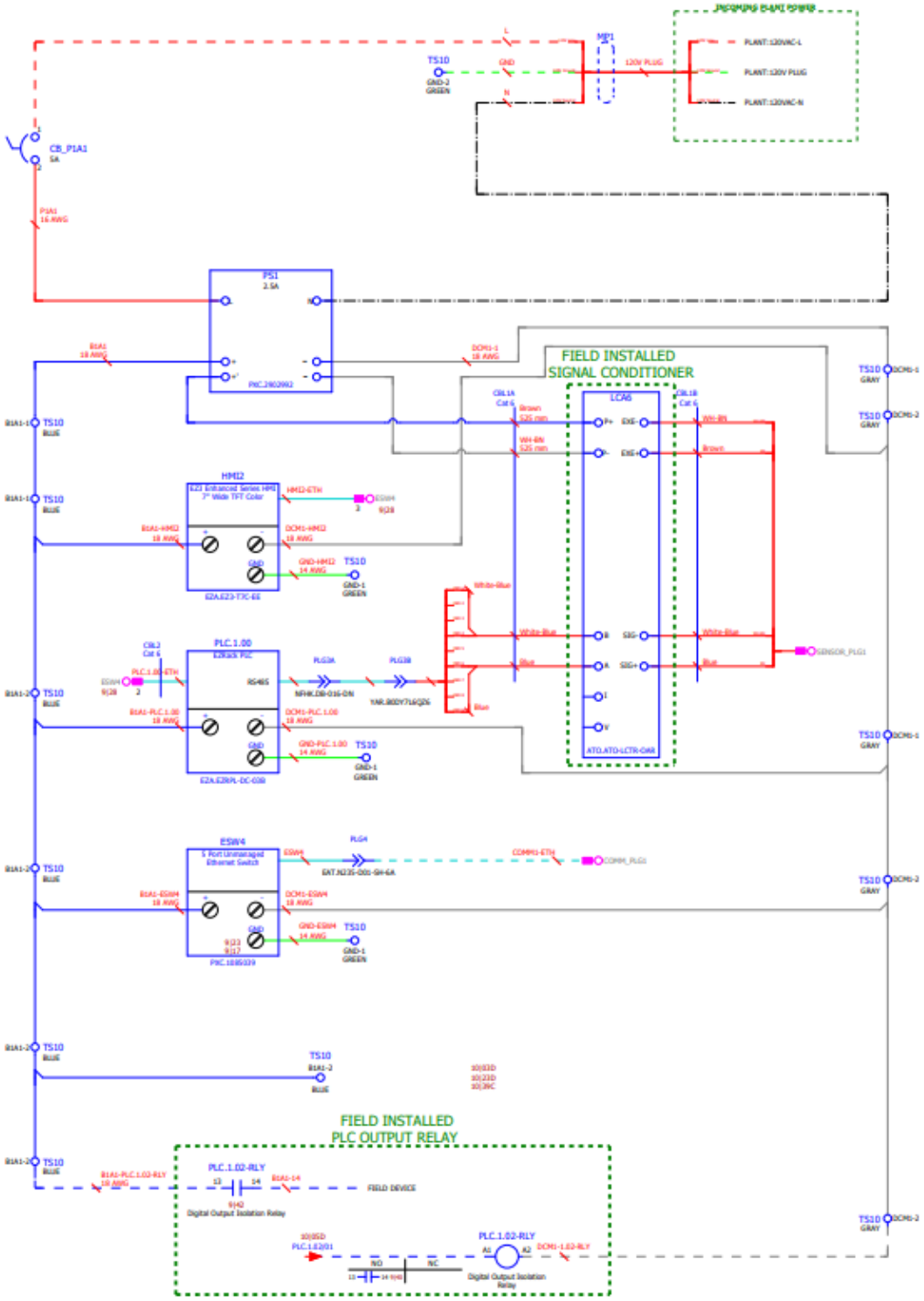

A
(13.240)
B
B
(11.240)
A
(9.500)
(1.875)
(7.500)
(7.222)
(.500)
(.250)
(6.832)
(.375)
(10.141)
SECTION A-A
SCALE 1 : 3.5
(12.141)
SECTION B-B





PLC Wiring Diagram

Figure 139: PLC Wiring Diagram



The PLC control box is designed to be plugged into a standard 120V AC outlet. (Reference the chapter and section titled Specifications, Required Power and Suggested UPS.)
Should the customer decide to provide power without using the provided 3-prong outlet, reference the yellow-highlighted wiring code in the above picture.

BATTERY REPLACEMENT GUIDE: HMI AND PLC BATTERIES

It is recommended that both batteries are replaced every 3 to 5 years, or when a battery alarm appears.

Reloading calibration profile after battery replacement:

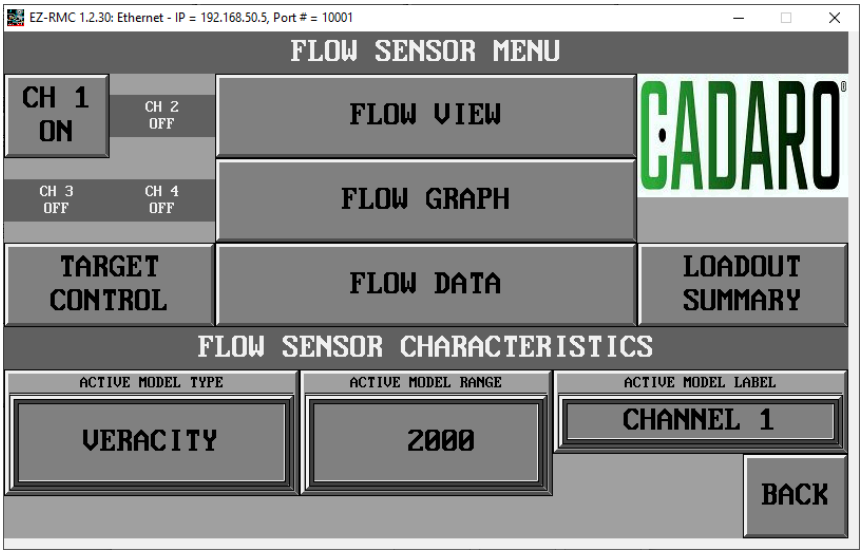
- A partial RAM memory will be wiped when a battery replacement is performed on the HMI.
- ***All RAM memory will be wiped*** when a battery replacement is performed on the PLC.
- If either battery is replaced, or both, there needs to be some preparation beforehand to ensure smooth recovery to full function.

HMI Battery Pre-Replacement Preparation:

1. On the HMI, navigate to 'Flow Sensor Menu'.

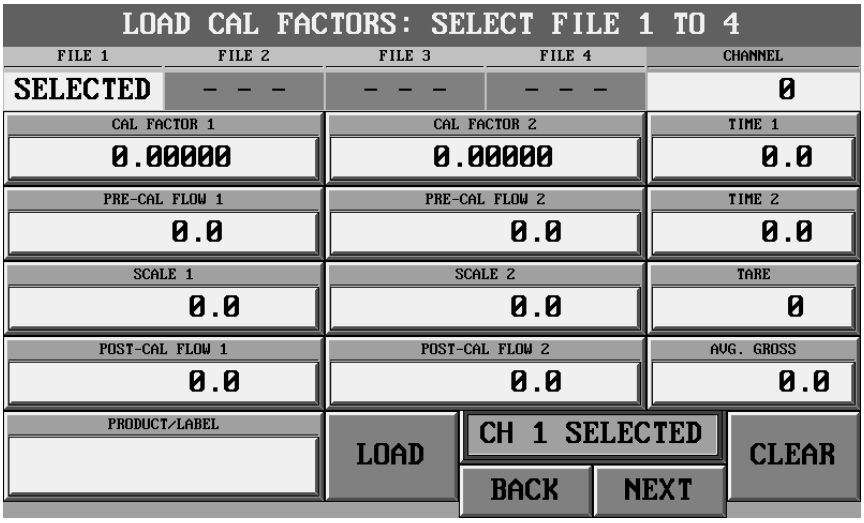
   Take a picture or write down the 'Flow Sensor Characteristics' values of 'Active Model Type' and 'Active Model Range'.

Figure 140: Active Sensor Characteristics



Navigate to the 'Load Cal Factors' screen. Take a picture or note down the values populated in each File.

Figure 141: Cal Factor Profiles



2. After the battery/s have been replaced and the system reinitialized, input the saved calibration profile values to the respective calibration file.
3. To load the profile, select the file at the top of the column. The selected file will be white, while the others are gray.
4. Press 'Load Cal Factors' button at the top.
5. The unit will be back to functioning as before. If not, contact CADARO Support.

HMI Battery Replacement Procedure:

1. Power down the unit by turning the breaker off.
2. Access HMI battery by opening the cover. There is a press-to-open latch opposite the pivot hinge.
3. The battery is near the pivot hinge.



4. Remove the battery and replace it with a new battery. Be sure to follow positive (+) and negative (-) installation instructions on or near where the battery is installed.



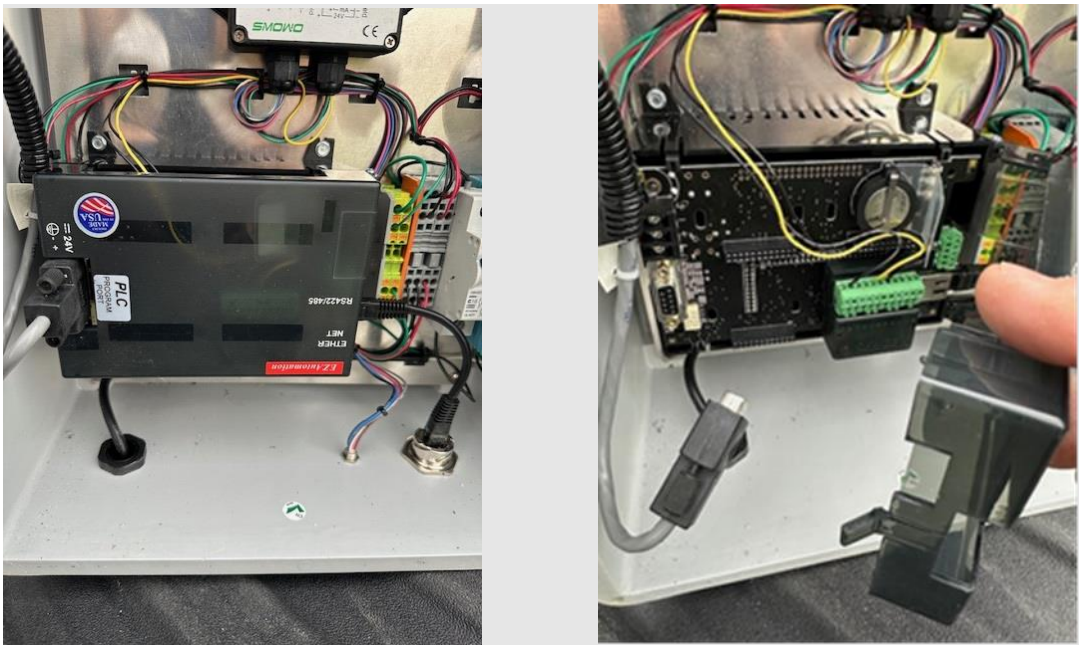
5. Power on the unit by turning the breaker on.
6. **Caution:** Do not touch any equipment or wires while power is applied.
7. Wait a maximum of 30 seconds for the HMI panel to power up. If HMI does not power up, power down the system again by turning the breaker off. Wait 30 seconds. Power up the unit again by turning the breaker on.
8. If still no bootup from the HMI, try 6. a -6.c again.
9. If still no bootup, double-check the battery installation is correct.
10. If still no bootup, contact CADARO Support.

HMI Battery Specifications: LS14250 3.6 Volt 1200 mAh PLC Lithium 1/2AA Battery



Black PLC Battery Replacement Procedure

1. Power down the unit by turning the breaker off.
2. Access the PLC battery by opening the cover. There is a press-to-open latch opposite the pivot hinge.
3. The battery is near the pivot hinge.



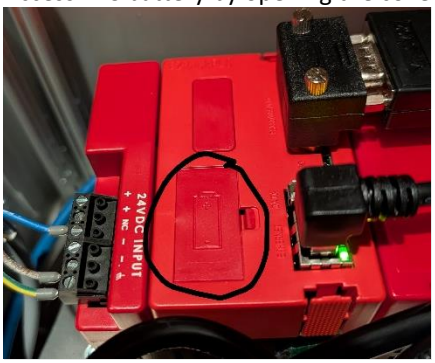
4. Remove the battery and replace it with a new battery. Be sure to follow positive (+) and negative (-) installation instructions on or near where the battery is installed.
   *The PLC battery can be difficult to remove. It is suggested to use a small flathead screwdriver to pry up the pressure clip while using a second small flathead screwdriver to push the battery out.
5. Power on the unit by turning the breaker on.
6. **Caution:** Do not touch any equipment or wires while power is applied.
7. If the screen does not power up, refer to point 6 in the HMI battery replacement section.

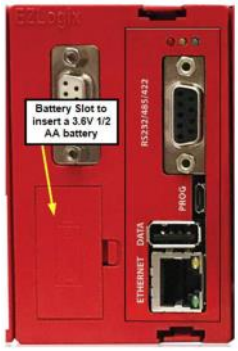
PLC Battery Specifications: CR2032 3-Volt Battery



Red PLC Battery Replacement Procedure

1. Power down the unit by turning the breaker off.
2. Access PLC battery by opening the cover.





3. Remove the battery and replace it with a new battery. Be sure to follow positive (+) and negative (-) installation instructions on or near where the battery is installed.
4. Power on the unit by turning the breaker on.
5. **Caution:** Do not touch any equipment or wires while power is applied.

PLC Battery Specifications: ½ AA, 3.6-volt lithium



CADARO LIMITED WARRANTY

M&S Flowmatics Incorporated, doing business as CADARO, ("CADARO") warrants that all CADARO equipment properly installed by CADARO, or its Distributor or Original Equipment Manufacturer (OEM) will operate according to the written product specifications. CADARO, its Distributor or OEM, at CADARO sole option may determine whether the product fails to meet its specification. Should a Distributor or OEM determine the product fails to meet its specification, it shall submit the claim to CADARO. CADARO must review the determination and accept the claim. All systems and components are warranted against defects in electronic equipment and defects in material/assembly for one (1) year beginning with the delivery date.

CADARO warrants the equipment against faulty workmanship and defective materials. If any equipment fails to conform to these warranties during the warranty period set forth above, CADARO will, at its option, repair or replace the non-conforming portion of the product returned within the warranty period subject to the following conditions:

- Upon discovery by Buyer of a nonconformity and provided such discovery is within the warranty period, Buyer will provide CADARO with prompt written notice within 30 days and provide a detailed explanation of the alleged deficiencies.
- Upon examination of the equipment CADARO will determine whether the equipment fails to meet its specifications consistent with the Operations Manual and such failure was not the result of accident, abuse, welding, misuse, neglect, alteration, improper installation, or improper testing by Buyer or any third party authorized by Buyer. Such determination of any alleged non-conformity shall be made in good faith; however, such determination shall be CADARO' sole and exclusive determination.
- Only CADARO or a party authorized in writing is authorized to make any repairs. The equipment may not have been modified, altered, or changed by any person other than CADARO or a party CADARO authorizes to make the repair, or the warranty shall be void.
- CADARO will have a reasonable time to repair or replace defective equipment. The buyer is responsible for shipping charges to and from CADARO's designated location.

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RECOMMENDED INFORMATION TO BE STORED IN PLC CONTROL BOX

Information

Date	
Serial Number Flow Sensor	
Serial Number PLC Control Box	
Load Cell Tare/Gross	
Flow Factor	
Lined or Unlined Sensing Plate	
Auto Retare	
Dead Zone	
Software Version	
IP Address	
Subnet	
Gateway	
HMI IP Address	

Calibration

	File 1	File 2	File 3	File 4	File 5	File 6	File 7	File 8	File 9	File 10	File 11	File 12
CAL1												
CAL2												
Pre-Cal Flow1												
Pre-Cal Flow2												
Time1												
Time2												
Scale1												
Scale2												
Estimate Flow1												
Estimate Flow2												
Tare												
Product												

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