ELECTRON MACHINE CORPORATION

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E-SCAN *EVO*

ELECTRONICALLY-SCANNING EVOLUTION

IN-LINE REFRACTOMETER

OPERATING AND SERVICE MANUAL

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E-Scan *EVO*

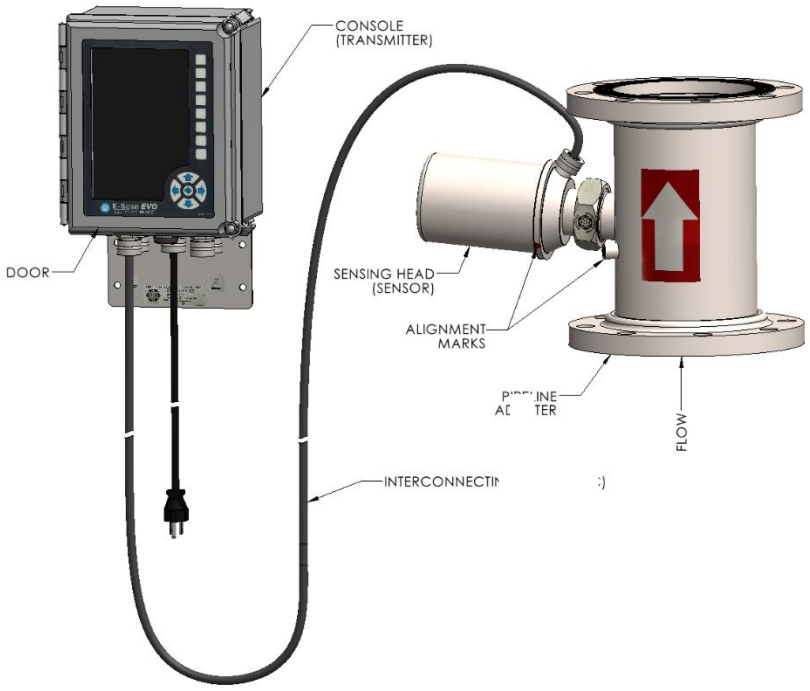
Introduction

The E-Scan ***EVO*** is a flexible, intelligent, electronically scanning critical angle refractometer platform incorporating future-ready modular architecture while maintaining full backward compatibility with the previous platform of MPR E-Scan refractometers provided by Electron Machine since 1995. This next "Evolution" for in-line refractive index measurement of process fluids directly correlates with dissolved solids, percent, °Brix, and other meaningful process parameters. The E-Scan ***EVO*** may be used as an error indicator or an integral part of a complete process control system.

The E-Scan ***EVO*** represents a major technological leap forward: preserving what has worked in the past with modular upgrade capability, intuitive user interface, enhanced diagnostics, intelligent cleaning, and many other features to provide value over time. The E-Scan ***EVO*** is factory calibrated for specific applications to quickly provide precise and reliable performance while packaged into a rugged system to withstand the harshest industrial environments.

Please contact us with any questions or concerns, we pride ourselves on delivering world-class customer support. As the originators of the first in-line refractometer, patented in 1957, Electron Machine has decades of knowledge to provide the solution you need, and we stand behind our products.

NOTE: The adapter should be oriented to place the sensing head in a horizontal plane to ensure that deposit buildup and air pocket/foam creation will be minimal.



The E-Scan ***EVO*** consists of:

Console

Door

Interconnecting Cable

Sensing Head

Pipeline Adapter

(or other means to interface with the liquid process)

Important Manual Information

The Chapter title is at the top of each page for quick reference through the manual. Important points, reminders, and warning messages are printed in bordered boxes such as:

NOTE: Box indicates important messages.

CAUTION

Electron Machine Corp. recommends that sensing heads be removed only when there is no process liquid (or potential energy) in a pipeline when possible.

When removing the sensing head from an operating pipeline or process, *do not assume that the line is empty, not under pressure, or that the isolation or bypass means is working properly*. If an EMC Isolation Valve is used, ensure that the most current Procedure for Safely Removing Sensing Head or Maintenance Plug has been followed by a trained Technician utilizing the "Safeguard Tool." The Procedure can be downloaded at www.electronmachine.com and training can be arranged by contacting service@electronmachine.com.

IF ANY PRESSURE IS PRESENT WHEN THE NUT IS LOOSENED, STOP! DO NOT REMOVE THE SENSING HEAD. RETIGHTEN THE MOUNTING NUT. NO RESISTANCE OR SIGN OF PRESSURE SHOULD BE PRESENT BEFORE PROCEEDING. If purge cleaning is installed, cleaning media (steam, water, etc.) must also be turned off and properly secured before attempting to remove the sensing head.

Perform Pre-Job Safety Analysis (PJSA) and follow Standard Operating Procedures (SOPs) or Work Practices to mitigate potential risks or hazards identified with a line break operation at your facility and for your application.

Use proper and facility approved Personal Protective Equipment (PPE) as determined by PJSA and SOPs.

Stand to the side when removing the sensing head.

Clean all process liquid residue from the spud-piece on the adapter prior to re-insertion of sensing head. Check to ensure the old O-ring has been removed. The O-ring seal should be replaced before re-installation.

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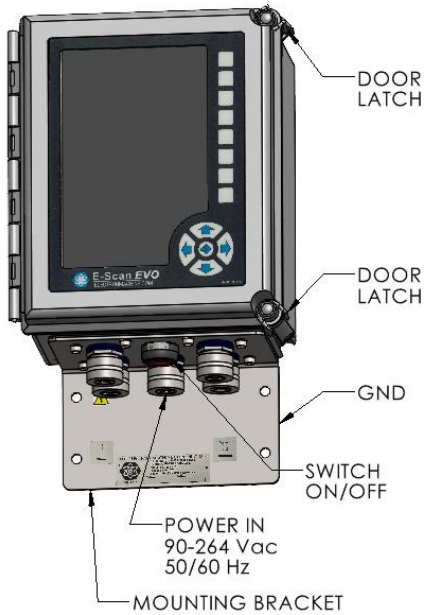
2 E-Scan ***EVO*** Installation

2.1 Site Selection

The E-Scan ***EVO*** console must be mounted in a non-hazardous "safe" environment where ambient conditions allow personnel to remain for extended periods. The enclosures are NEMA 4X rated and should be kept closed. Do not mount or install the Console or the Sensing Head in a location that interferes with or impairs the use of disconnect equipment, instrument access panels or EMO (Emergency Off) controls of other equipment.

The E-Scan ***EVO*** can be used in outdoor conditions with no additional protection. An optional VORTEX Cooler is offered by EMC for cabinets housing E-Scan ***EVO*** Consoles.

The E-Scan ***EVO*** Console must be secured to prevent unauthorized and unqualified personnel from accessing the interior. Door latches are provided; however, the responsibility of securing these latches with a padlock or other safety lock are the responsibility of the end user.



A mounting bracket is provided to secure the E-Scan ***EVO*** console. This must be a solid surface with sufficient strength and/or re-enforcement. In the event the mounting of the console should be on gypsum board/sheetrock/drywall, Electron Machine Corporation recommends utilizing an appropriate backing panel, secured to the underlying structure, and then securing the console to the backing panel. An optional mounting bracket set is also available for additional support to the top of the console as well as to secure the console to a 2" (51mm) vertical pipe.

Protective earthing must be made between the E-Scan ***EVO*** console's mounting bracket and earth ground. This can be achieved by securing a ground strap from the mounting bracket to an earth ground lug or post nearby.

2.2 Power Requirements

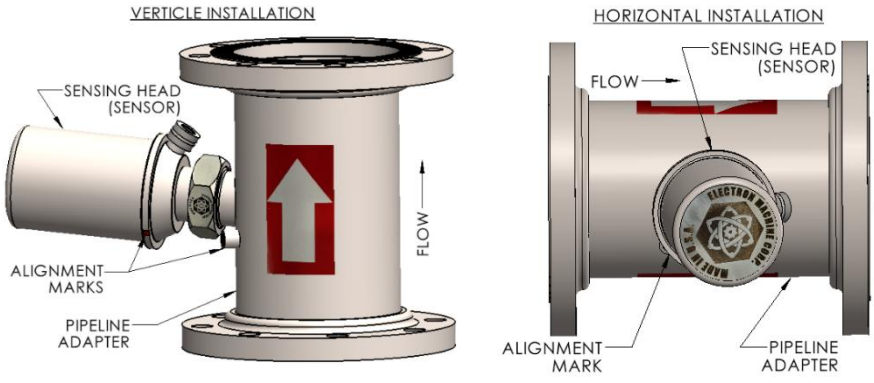
The A.C. power should be supplied from a line which is not subjected to power interruptions or heavy inductive loads. The power supply used by the E-Scan ***EVO*** is self-switching and can accept the following power inputs. A.C. power can be 90-264 VAC at 50 or 60 Hertz, 2.0A. The label on the console concerning AC power simplifies power to 100-240 VAC at 50 or 60 Hz, 2.0A which is most standard.

2.3 Installation of Sensing Head

NOTE: Prior to shipment of an E-Scan ***EVO*** system, each sensing head is matched to the specific console and factory calibrated. DO NOT ATTEMPT TO CALIBRATE!

The E-Scan ***EVO*** Sensing Head must be mounted in a non-hazardous "safe" environment, unless specifically rated otherwise. The Sensing Head is attached to the process line by a pipeline/tank adapter, with a minimum of three times the diameter of the line in which the sensing heads are to be installed, from any elbow, bend, injection point or valve. The adapter can be stainless steel or other material as specified by the customer and must not be placed in an area where vibration is severe or excessive. If the adapter is flow-directional, a label will indicate direction of flow.

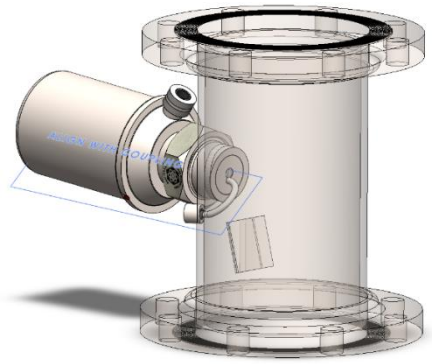
If the Sensing Head is to be mounted on a vertical pipe, the fluid flow should be upward. Downward flow could result in air pockets or foam inside of the pipe.



If the Sensing Head is mounted on a horizontal pipe, the Sensing Head should be parallel with the ground on the side of the pipe (not on the top or bottom of the pipe). Air pockets and foam can occur on the top of the pipe and sediment may be collected at the bottom.

NOTE: The adapter should be oriented to place the sensing head in a horizontal plane to assure that deposit buildup and air pocket/foam creation will be minimal.

NOTE: Alignment marks are provided to ensure the optical surfaces and cleaning nozzle are aligned and the temperature sensor will not be in a direct line with the steam blast.



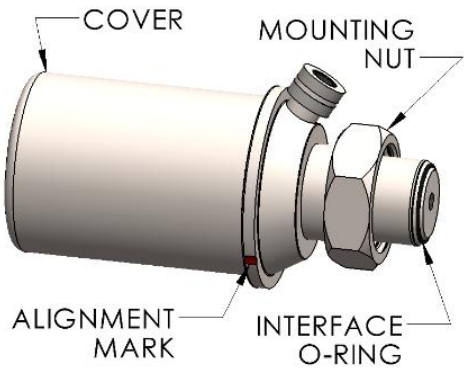
If the adapter has provisions for prism cleaning or steam purging, the Sensing Head will need to be rotated or "aligned" for proper cleaning. A "notch" (with red paint) alignment mark is on the main body of the Sensing Head. This notch is aligned with the prism cleaning coupling on the adapter (typically ¼" NPT). The cable entry of the Sensing Head will also be on the downstream side of the flow.

The Sensing Head prism is slightly offset requiring this alignment to ensure the cleaning nozzle is properly aimed with the prism optical surface. This alignment ensures that the Sensing Head temperature sensor is up-stream of the cleaning process to minimize recovery time after a prism cleaning or steam purge event. While this alignment does not need to be exact, care should be taken to ensure it is within approximately 10 degrees.

The probe end of the sensing head has a groove for an interface O-ring. Various O-ring materials are available for compatibility with specific applications.

The O-ring must be in place prior to installing the head into the adapter to prevent the process fluid from leaking.

The head is attached to the adapter by a 2-inch sanitary nut. For metal adapters, the nut should be tightened to no more than 50 ft-lbs. (68 N-m) of torque. The nut compresses the O-ring to provide the seal, so excessive torque is not needed.

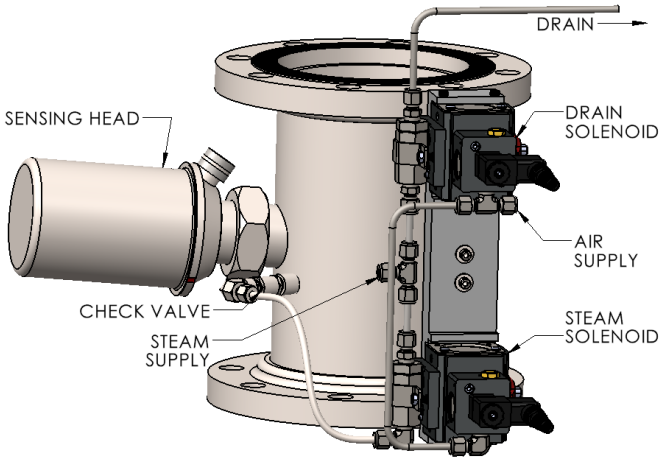


NOTE: The Sensing Head mounting nut should be tightened with a wrench, supplied with the E-Scan EVO, to a maximum of 50 ft-lbs (68 N-m) or torque.

The sensing head houses optical components, which are susceptible to the effects of moisture. The cover should only be removed temporarily, by turning counterclockwise, for service by a qualified technician. A small amount of desiccant is within the Sensing Head to absorb any moisture remaining.

2.4 Purge Cleaning Attachment

If an application tends to develop coatings on the optical surface of the Sensing Head, provisions will be provided or can be added for Purge Cleaning. Typically, the cleaning media is either steam or pressurized water, although unique systems are available for specific applications. On adapters with this provision, the cleaning port is normally utilized with a ¼ NPT connection.



The Smart Purge Pak, shown installed on a Spool Adapter, is the most common solution. Automatically controlled by the E-Scan ***EVO***, solenoid valves drain and then purge the prism cleaning media for an effective, long-term solution with minimal maintenance. A check valve is installed directly onto the cleaning port to prevent process products in the pipeline from clogging the purge tube.

If a similar configuration is designed using customer supplied components, care must be taken to ensure that the purge cleaning media is the proper temperature and pressure for effective removal, the valves are located the proper distance from the cleaning port, and tubing is a correct size for the application. Typical values are +/-50°F (28°C) from the process and at least 50psi (3.44 bar) above process pressure. See Section 4, E-Scan ***EVO*** Operation, or contact Electron Machine Corporation for more information.

Trial and error must, of necessity, be employed in determining the minimum steam time necessary for proper steam cleaning of the prism due to variables from application to application.

NOTE: To avoid excessive prism deterioration, keep the intervals between the purge times at maximum, which may vary from minutes to 120 minutes, and the prism clean time at a minimum of approximately 5 seconds. IMPORTANT: A major cause of refractometer trouble is the prism clean process.

2.5 Cooling System Requirements

When supplied with a vortex cooler, a clean and dry air supply of the proper pressure (approximately 90 PSI at 8 cubic ft/min.) is required. If equipped with the cooling fan option, the console must be mounted in a controlled environment.

2.6 Start-Up

Note: Important! Prior to shipment the sensing head is matched to the console and factory calibrated. DO NOT ATTEMPT TO RE-CALIBRATE.

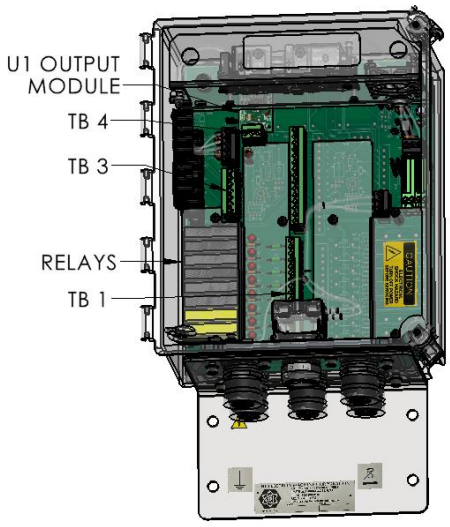
Turn power ON. Allow sufficient time for the sensing head to stabilize at the process temperature. It is recommended that no adjustments be made for at least 15 minutes after starting up.

Compare the reading against a sample taken from the process line close to where the unit is installed and at the process operating temperature. If the sample does not equal the displayed reading, adjust the Measurement Shift per the Operation section.

3 Outputs

3.1 Analog Outputs

The E-Scan ***EVO*** also offers current and voltage outputs for the measurement and temperature. The measurement is a standard output, and temperature is an option that can be added at any time.



Current output for these readings is a 4-20mA signal that is referenced to ground (non-isolated) so that any device that is connected to these outputs must have a floating (or isolated) input. The output for the measurement reading is found on TB 3 terminals 1 and 2. Terminal 1 is the positive output and terminal 2 is the negative. The optional output for the temperature is located on TB 3 terminals 3 and 4, 3 being the positive output and 4 is negative in this case.

The modules on the top of the Interface Board represent the output modules. The one on the left U1 is the output module for the measurement. U2 is the output module for the temperature. The other modules (U3 and U4) are for optional features and are explained in the optional addendums to this manual.

If a 0-10Vdc output is desired, then TB 4 terminal 1 is the measurement output and terminal 2 is the temperature output. Terminal 3 is the common for both outputs.

3.2 Relays

The E-Scan ***EVO*** can support up to 8 configurable relays. The typical setup includes two relays for purge and condensate drain. Additional relays should be requested during the order process. These relays are controlled by the integrated logic of the E-Scan ***EVO*** to serve such functions as prism clean, alarms, lightbars, horns, valves, etc.

The Interface Board (located in the console, and containing the relays), provides 120/240Vac power source via TB1 and TB5, terminals 14 and 15. Power ratings for these terminals are fused at 1.0A each.

3.3 Digital Outputs

Digital outputs for the E-Scan ***EVO*** are currently limited to RS-232. This output is available on the ***EVO*** ESP32 PC Card on COM1. For more information and for future digital communication types currently under development, please contact Electron Machine Corporation for more information.

4 E-Scan ***EVO*** Operation

Note: This equipment is designed for continuous operation and to be left powered ON for extended periods of time when in contact with processed fluids.

4.1 Operation Panel

The Operator's Panel or Front Panel consists of a display and a 13-button touch pad, which form the interface between the operator and the instrument. The display consists of a 10.1" 1280 x 800-pixel TFT LCD screen, which provides the operator with various messages. The 13-button touch pad allows the operator to navigate the menu structure, make entries, and execute commands.

The three basic types of messages displayed are:



Variable:

These information lines contain either set points that may be altered by the operator, or measurement variables that are updated by the processors.

Alternate Action:

Works much like a two-position switch and is used to select various menu options. The operator can alternate between two states, such as ON and OFF.

Error Display:

Flashes continuously to attract operator's attention to an error condition.

4.1.1 Button Touch Pad Function Chart



Scrolls cursor horizontally to the left and used to initiate editing of calibration voltages in the calibration table, and temperature values in the compensation table.



Scrolls cursor horizontally to the right and used to initiate editing of all system parameters excluding those accessed by the LEFT ARROW.

During Purge Cycle, this button can be used to advance to the next cycle mode before the time setting has elapsed.



Scrolls cursor vertically in the "Up" direction.



Scrolls cursor vertically in the "Down" direction and stores a sample for measurement shift.



Used to select or "ENTER" cursor items and to save edited data.



Used to select items displayed immediately to the left on the screen.

4.2 Operational Mode

4.2.1 What Operational Mode Does

In normal mode the system displays the following information:



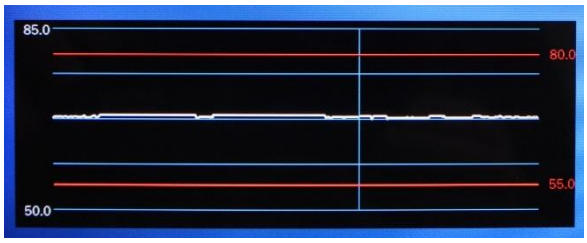
- System status indicators:
- Software version number and unit serial number
- Name of the current product being measured
- Purge information
- Current time and date
- System status Indicators
- Process product measurement
- Alarm points for measurement
- On-line temperature in °F or °C
- Measurement graph
- Error status for conditions
- Measurement trending
- Measurement and Lamp Voltage
- Graphics menu for access to system features

Note: In operational mode set points cannot be changed or adjustments made.

Graph

The graph span limits are derived from the Measurement Range Min. and Max. limits set in Output and are drawn on the display at the top and bottom of the graph area as dotted lines.

The graph time defaults to 30 minutes. If purge cycle time is set, the graph is set to three times this setting. If Measurement Alarms are stored, they display in red.



The measurement signal itself is drawn in the graph area and can be recognized as a single continuous stream of information that is 2 pixels thick.

4.2.2 System Indicators

These indicators appear in the top right box of the main screen

C	Isolation valve is closed. The E-Scan ***EVO*** will not initiate prism cleaning.
T	Below minimum purge temp setting. No purge cleaning is allowed.
H	Measurement Hold. Current readings and analog outputs are maintained until complete. Indicates a cleaning cycle is in progress by a purge message, as well as a current measurement voltage display while in normal mode.
P	Purge failed. This means the previous purge cycle did not properly clean the prism.
W	Purge water temperature is not within parameters.
O	Measurement over range. Currently reading above calibration points on the calibration table.
U	Measurement under range. Current reading below calibration points on the calibration table.
S	Measurement sample reading has been recorded as the reference for measurement shift adjustment

4.2.3 Menu Options Summary

Operational mode is entered by default, upon power up. To gain access to other system features press the MENU button on the Front Panel Touch Pad.

Note: The screen names and set points below are just an example, they will vary from application to application.

When ANY button is selected except the DOWN arrow, menu options are displayed on the normal mode screen.



Measurement Shift - option allows the operator direct access to the measurement shift adjustment which is used to correct for any shifts in the measurement voltage. After calibration and before compensation, a measurement shift adjustment may be needed to "zero in" the measurement reading due to measurement voltage shifts that could occur when going from room temperature to the process base temperature used for the temperature compensation run. Measurement shift adjustment may also be needed after installation to make instrument readings agree with normal testing methods.

Products - option allows the operator to select a product from a list of previously calibrated products. When a new product is chosen, all operating parameters are automatically loaded so that the E-Scan ***EVO*** can immediately be ready to measure the "new" product selected. (Using Tech access - See Menu Options Detail for more information.)

This menu option also allows the operator to enter actual product names which are attached to associated product numbers. In addition, this option enables the operator to create new products by storing product information into unused product numbers.

Cal Table- (Read only in normal operation, requires entering tech access to adjust.) option allows the operator to enter calibration set points. This consists of calibration limits, and measurement shift adjustment. Since complete calibration is performed in advance by Electron Machine Corporation, it would be a rare condition for the operator to access calibration measurement.

Purge Cycle - (Some functions require entering tech access to adjust.)
Allow the operator to configure the E-Scan ***EVO*** Purge Cycle time, Condensate Drain time, Purge duration, Hold Delay time, set minimum purge temperature and other purge functions if enabled.

Settings – (Password protected) Allows the operator to adjust input, output and alarm functions of the unit.

Purge – (Only visible if demand purge/hold enabled) option allows the operator to initiate a purge from normal mode in addition to the automatic purge cycle timing setup in calibration limits. The purge function cleans the sensing head prism and since configured for intelligent cleaning will automatically start another purge cycle if the previous purge was unsuccessful. Purge can be aborted using the right arrow button.

Diagnostics - (Some functions require entering tech access to adjust.) option provides the operator with data that can be used to test and troubleshoot system problems. The operator can display logs, all voltages from the sensing head, test relays on the interface board, output min., mid., and max., analog data to test and calibrate analog output, and enter system time and date in cases of battery failure.

Preference – (Password protected) Allows authorized users access to additional settings such as Decimal Format, Temperature display values, Measurement units, graph span and time and date settings.

Tech Access – (Password protected) Allows authorized users access to additional settings such as Input, Output, Alarms, Diagnostics and Preference sub menus. – See Menu Options Detail for more information.

Log Out – Exit's any password protected areas, returning ***EVO*** to normal mode. E-Scan ***EVO*** automatically logs a user out after 20 Minutes of inactivity.

4.2.4 Menu Options Detail

*****WARNING*****

Entering the password for Tech Access will allow changes to settings that can alter functional use of the E-Scan ***EVO***. This access should be limited to those personnel that are qualified and have been authorized to make changes, fully understand the effect of these changes, and how changes will impact the functional operation of the E-Scan ***EVO***. Access will remain available for 20 minutes since the last keypad button has been pressed, or the user can also select Log Out from the main screen.

Password: 101010

4.2.4.1 Measurement Shift (formally known as Analog Shift)



The measurement shift adjustment is used to move the calibration curve in a positive or negative direction. This parameter allows the stored calibration curve to be fine-tuned for actual process conditions and to correlate with off-line field-testing methods.

This is the voltage used to obtain calculated value from the calibration table that will reflect an accurate displayed reading in Solids. (Range is 0-10 volts.)

The maximum manual adjustment allowed in either the positive or negative direction is 1.5 volts. If additional compensation is required, please contact Electron Machine for the proper steps to do so.

Auto Adjustment

To perform automatic Measurement Shift adjustment, the current measurement reading should be recorded in the E-Scan ***EVO*** when the sample is taken from the process. This can be accomplished in measurement shift of operation using the Record Sample button on the front panel. Sampled Reading will display the process measurement value at the time of when the record sample was pushed.

The final part of automatic adjustment consists of entering the lab reading of the sample taken. Input the lab reading by pressing the Edit button. Using the arrow keys, type in the lab reading and press the "Enter" key. After the lab reading is entered, press the calculate shift button. The software will automatically determine the amount of adjustment needed to "zero" the instrument. The newly calculated value is displayed as a digital number in the range of -1.5 to +1.5 volts. Press the Save & Exit to leave the Measurement Shift menu.

Note: If the process measurement changes after the sampled reading is recorded then the final adjusted reading will not reflect the lab reading. However, since the adjustment is calculated from the recorded sampled reading, the final reading will be accurate and will not require further manual adjustment. Thus, lab reading should only be thought of as the desired reading if the process is stable. In all other cases, lab reading simply provides a means of calculating an error adjustment from a previously recorded reference point.

Manual Adjustment

The operator should proceed with caution when adjusting measurement shift manually since this will change the output of the instrument. To reduce the likelihood of manual adjustment error, it is suggested that the default least significant digit be altered first so the operator can observe the effects on the measurement reading.

4.2.4.2 Products



The product selection menu contains eight menu options:

Load - This option allows the operator to choose a specific product, provided this product has been previously calibrated and configured for on demand use.

New- This option allows the operator to create a new product. Tech access required for operation.

Rename. - This option allows the operator to change the name of a product by selecting a product number that will be the destination for the current product calibration and configuration information. Tech access required for operation.

Save As – This option allows the operator to copy the highlighted existing product. Tech access required for operation.

Delete – This option allows the operator to delete the selected product number. Tech access required for operation.

Next Page – This option allows the operator to select from multiple pages of stored products 1-40 different products.

Prev Page – Allows navigation through multiple pages.

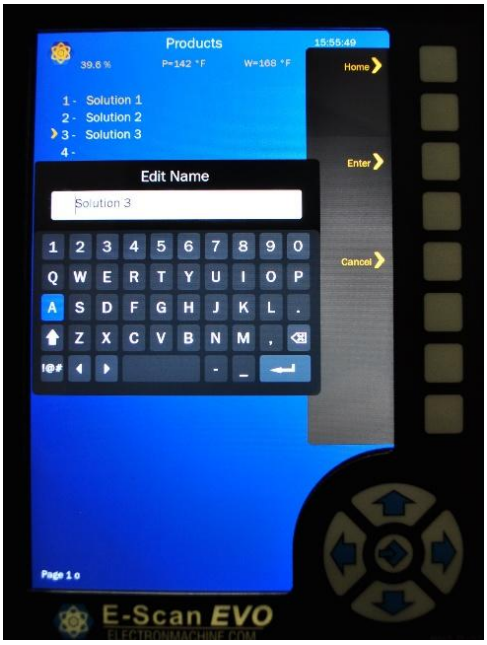
Exit – Allow operator to leave the product selection page.

Load Product Selection

Using the Arrow buttons the operator can highlight the desired product. Then press the load option on the menu to activate the desired product.

The operator can only "LOAD" products that are available which are identified by a product name.

Rename Product Selection



Allow the user to rename any selected stored product. Using arrow keys an operator can select the desired stored product to rename by highlighting the desired product number and pushing the rename menu button.

This is the product name mode alphabet menu. Using the Front Panel arrow buttons, the operator can key in the new name for the selected product. It displays the current product name and the alphabetic characters available for assigning a product name in the center.

Home – Exit menu and return to home screen without saving changes.

ENTER – Saves changes.

Cancel – Returns user to products menu without saving edits.

Save As Products Selection

This function saves the loaded product to the highlighted number selection. The newly saved product will be labeled **New Product. The operator will then need to use the rename function to store the desired product description.

Note: Up to 40 products are available. The operator can use the "Next Page" and "Prev Page" buttons to view a set of 10 products per page.

4.2.4.3 Cal Table Menu Selection



The calibration menu contains eight menu options:
Note: Any updating of calibration will reset measurement shift to zero. Read only, must utilize Tech Access for edit functions.

Save & Exit - This option saves any edited information and returns unit to normal operations screen.

Add Sample - This option allows an operator to add a measurement sample to the highlighted sample number, once entered the unit will capture the current measurement voltage.

Edit Sample - This option allows entry to the display value of the measurement sample of a highlighted sample number.

Edit Voltage - This option allows entry to the calibration voltages of a highlighted sample number.

Delete Sample – Removes the highlighted sample number.

Sort Table – This option will sort the calibration table based on the voltage.

Next/Prev Page - Allows editing of the 1-30 sample values. There are 2 pages of available samples to be stored.

Exit – Returns user to normal operation screen without saving.

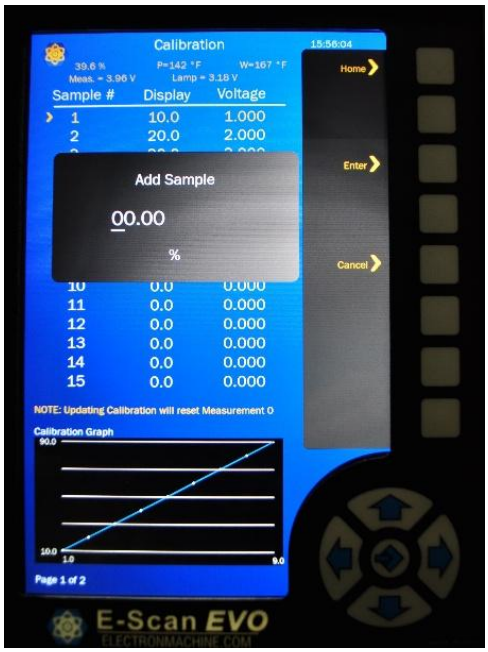
The Calibration Graph displays at the bottom of the Calibration Table. This allows you to view the calibration of the unit. The Measurement Voltage and Display Units plot presents two factors:



1) The anticipated voltage necessary to display a specific units amount on the Console Display.

2) Identifies any errant data points relating to the calibration of the Sensing Head.

The data line should be relatively linear, with some materials displaying a slight bow to the data line. Most materials generate a line of a uniform slope. Any data points that disrupt a smooth plot are to be examined closely, as the reading supplied by the Measurement Voltage will display an incorrect value on the Console Display.



Selecting the **"Add Sample, Edit Sample or Edit Voltage."** option from the calibration menu results in adjustment of the calibration measurement table.

The calibration measurement table is created when you place actual solution samples to be measured on the sensing head and then save the desired measurement reading for that sample along with the current measurement voltage. This table is graphically equivalent to approximating a measurement curve with a series of straight lines. Calibration data is only entered here during factory setup or exchanging the sensor in the field. ONLY ENTER DATA IN THESE FIELDS AT THE GUIDANCE OF QUALIFIED PERSONNEL. Utilize Engineering Order Sheet (EOS) that matches the Serial number of the sensing head being installed. (if you do not have the EOS contact Electron Machine Corp to obtain.)

Note: Calibration cup and oils are required for full calibration, contact EMC for part # and additional directives on process.

Add Sample

This option allows an operator to add a measurement sample to the highlighted sample number, once entered the unit will capture the current measurement voltage.

Use the DOWN ARROW button on the Front Panel to select the corresponding sample # to be edited, press Add Sample to edit the displayed value, then press Enter to acquire the current measurement voltage.

Edit Display



This option allows entry to the display value of the measurement sample of a highlighted sample number without capturing the current measurement voltage.

Use the DOWN ARROW button on the Front Panel to select the corresponding sample # to be edited and press Edit SAMPLE to edit the appropriate measurement value then press Enter to store the value.

Edit Voltage



This option allows entry to the calibration voltages of a highlighted sample number.

Use the DOWN ARROW button on the Front Panel to select the corresponding sample # to be edited and press Edit Voltage to edit the appropriate voltage value then press Enter to store the value.

4.2.4.4 Purge Cycle

Note: Save & Exit must be pressed to store any changes.

Purge Cycle Time: (0-120 min) This is the time interval in minutes between automatic purging. During purging, all system readings and analog outputs are frozen. A "0" setting disables automatic purging.

Condensate Drain Time: (0-120 Sec) When the purge cycle is activated, this is the time in seconds that elapses before a prism clean occurs. During this time the condensate drain relay is activated and condensation is allowed to drain before steam cleaning.



Purge Time: (0-20 Sec) This is the time in seconds during which cleaning of the prism occurs and the prism clean relay is activated.

Hold Delay Time: (1-300 Sec) This is the time in seconds that elapse after a prism clean occurs. This time allows a delay to occur before resuming normal process measurement. Readings are held constant during the period.

Min. Purge Temperature: The Purge Cycle will not begin unless the measurement temperature is above this value. This is typically configured to ensure the liquid process is actively flowing to ensure that steam or other cleaning media is not introduced into an inactive pipeline.

Smart Clean: option activates an intelligent prism clean process. This will cause the system to automatically initiate another cleaning cycle if the previous cleaning was unsuccessful. After three unsuccessful attempts, purging will be aborted, and a "P" system indicator will appear in the normal mode display.

Demand Purge Button: option activates a main menu option to allow activation of a prism clean process.

Allow Continuous Purge: option activates an option to allow continuous activation of a prism clean process, dependent on input relay configuration and usage.

Note: These following menu options are greyed out unless activated by factory personnel and require optional hardware.

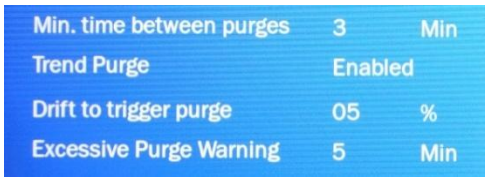
Trend Purge: This option triggers the purge function based upon % drift from the nominal or mean measurement value.

Deviation Purge: This option triggers the purge function based upon deviation from the baseline value.

High-Temp Drain: This option controls the condensate drain time based on the temperature of the delta in cleaning water temperature and process temperature.

Note: These following calibration limits require enabling Trend based purge

Trend Purge Screen



Min. time between purges: This option sets the minimum time a purge can be activated regardless of % Drift.

Drift to trigger purge: This option triggers the purge function based upon % drift from the normal displayed reading immediately following the last hold period of a purge cycle.

Excessive Purge Warning: This warning is activated when the TREND CYCLE PURGE function is triggered three consecutive times and that time interval falls within the predefined limits of MINIMUM TIME BETWEEN PURGES (Low), and PURGE CYCLE TIME (High), but below the EXCESSIVE PURGE WARNING (Alarm Limit). To disable the alarm set EXCESSIVE PURGE WARNING to 0 (zero).

(Example): Minimum Time Between Purges: 3 minutes; Purge Cycle Time: 10 minutes; Excessive Purge Warning: 5 minutes

(Ex 1)

1st. purge at 4-minute cycle
2nd purge at 4:30 minutes*
3rd purge at 3:30 minutes
WARNING ACTIVATED

(Ex 2)

1st. purge at 4-minute cycle
2nd purge at 4:30 minutes
3rd purge at 7:30 minutes
NO WARNING ACTIVATED

Functional Setup: (This should be done during normal operating conditions)

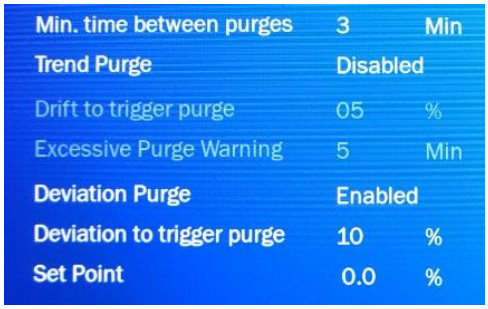
Set Minimum Time Between Purges: 3 minutes
Set Purge Cycle Time: 90 minutes
Set Excessive Purge Warning: 0 minutes.

Allow system to run for a period of 1-2hrs. After the runtime, use the purge log to determine how often the purge cycle is taking place. (10min, 20min, 30min, etc.) This will become your purge cycle time, set PURGE CYCLE TIME to this value. Set EXCESSIVE PURGE WARNING to 30% less than the purge cycle time, but this can be tailored to your requirement. You can leave the Minimum Time Between Purges at 3 minutes, or you can bring it up 5 minutes.

The system will now dynamically purge when needed.

Note: The following calibration limits require enabling Deviation-triggered purge.

Deviation Purge Screen



Min. time between purges: This option sets the minimum time a purge can be activated regardless of % Deviation.

Deviation to trigger purge: This option triggers the purge function based upon deviation from the baseline value.

Set Point: This option establishes the baseline from which the deviation trigger activates the purge function.

Note: These following min/max calibration limits require optional hardware and enabling High Temp Cond. Drain.

High-Temp Drain Screen



Min Water/Head Delta: This is the minimum difference between process temperature and purge water temperature required to switch from drain cycle to purge cycle. This will trigger a visual alarm when purge water temp does not reach target at end of condensate drain time. Relays can also be configured to activate by the factory.

Max Safe Water Temp.: This will trigger a visual alarm when purge water temp goes above. Relays can also be configured to activate by the factory.

Min. Drain Time: When the purge cycle is activated, this is the time in seconds that elapse before meeting Min Water/Head Temp. Diff. During this time the condensate drain relay is activated and condensation is allowed to drain before prism wash.

4.2.4.5 Settings



The Settings screen contains three menu options: Using the Front Panel buttons, the operator can highlight and then select the specified setting options.

Input – This allows the operator to change specific input parameters that pertain to the instrument.

Output - This allows the operator to change specific output parameters that pertain to the instrument.

Alarms - This allows the operator to choose the type of alarms for both measurement and temperature readings such as High/Low, Low/Low, or High/High and set their set points.

Input



Filter Weight: (0-99, Standard 10) This is a value that controls system response time to process measurement changes. The larger the value the slower the response time. The filter weight divided by 10 will give approximate response time in seconds to achieve 63% output of a step input change.

Measurement Scale Base: This is a base value for the measurement scale. If set to zero, the measurement will be scaled from the calibration table or else from the given base.

Measurement Scale: This is a scale for the process measurement that allows fine tuning so that the reading can be adjusted to match lab samples. The default is 100%. The formula for scaling is as follows: NEW MEAS = (((Current Meas. - Base) * Scale) + Base)

Output

Note: The temperature output requires additional hardware.

WARNING: Entering this page will change instrument output! Editing any values on this page will change instrument output.



There are two standard outputs that produce a 0 - 10 volt and 4-20 mA signal and are used for process measurement and temperature.

Measurement Range Min.: This is the minimum measurement reading that will produce a 4 ma or 0-volt output.

Measurement Range Max.: This is the maximum measurement reading that will produce a 20 ma or 10-volt output.

Temperature Range Min.: This is the minimum temp reading that will produce a 4 ma or 0-volt output.

Temperature Range Max: This is the maximum temp reading that will produce a 20 ma or 10-volt output.



Force Output: Allows E-Scan ***EVO*** to output the highlighted low/high volts to match different DCS loads for manual adjustments (only displays when "VOLTS" are highlighted).

Measurement 4-20 Low: Adjusts the minimum measurement output that will produce a 4 ma or 0-volt output to work with different loads.

Measurement 4-20 High: Adjusts the maximum measurement output that will produce a 20 ma or 10-volt output to work with different loads.

Temperature 4-20 Low: Adjusts the minimum temperature output that will produce a 4 ma or 0-volt output to work with different loads.

Temperature 4-20 High: Adjusts the maximum temperature output that will produce a 20 ma or 10-volt output to work with different loads.

The 4-20mA and 0-10v outputs are dynamic (self-powered). Do not attempt to power with a 24v input.

Configuration Alarms Selection



The next available configuration menu option is "Alarms". When selected, it activates the following display: Using the arrows and Edit button an operator can set the desired alarms and their respective data points.

1. **Meas. Arl**. - The process measurement alarms can be configured as High/Low, Low/Low, High/High, Deviation/Setpoint, and No Meas. Alarms.

High/Low Alarm - An error occurs if the process measurement falls below a low limit or exceeds a high limit.

Low/Low Alarm - An error occurs if the process measurement falls below a low limit. An additional error occurs below a low-low limit.

High/High Alarm - An error occurs if the process measurement exceeds a high limit. An additional error occurs beyond a high-high limit.



Dev/Sept Meas. Alarm - An error occurs when the process measurement exceeds above or below a setpoint by a fixed amount. The deviation is applied to both sides of the setpoint equally. The setpoint can be remotely changed using the Remote Display Panel option. This also is the setpoint used in the PID Controller option and can be remotely changed using the Remote Display Panel.

2. Temp. Alr. - The process temperature alarms can be configured as High/Low, Low/Low, High/High, No Temp. Alarms and Head Temp Alarm.

High/Low Alarm - An error occurs if the process temperature falls below a low limit or exceeds a high limit.

Low/Low Alarm - An error occurs if the process temperature falls below a low limit. An additional error occurs below a low-low limit.

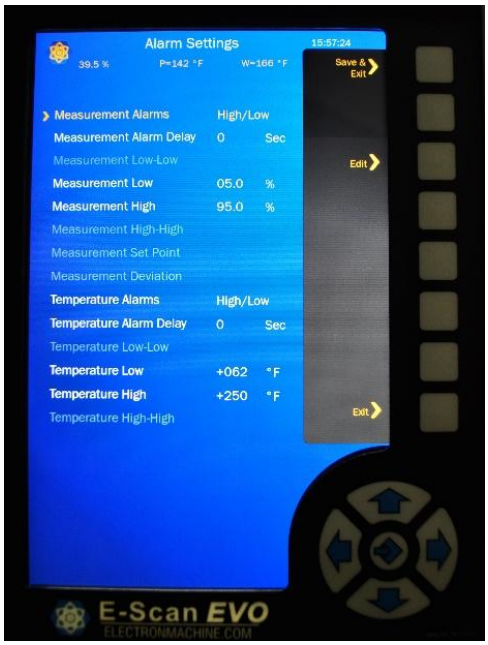


High/High Alarm - An error occurs if the process temperature exceeds a high limit. An additional error occurs beyond a high-high limit.

Head Temp Alarm – An error occurs if internal head temp exceeds a high limit. Requires optional hardware.

Alarm Set Points

Set point descriptions can change depending on Alarm type selection.



Measurement Alarm Delay: (0-60) This is the alarm delay time in seconds for the process measurement that must expire while a limit is exceeded before an error is activated.

Measurement Alarm Low: If the measurement falls below this limit, a system alarm is activated. An error message will appear in the status window in normal mode, and the low measurement alarm relay will be turned on.

Measurement Alarm High: If the measurement exceeds this limit, a system alarm is activated. An error message will appear in the status window in normal mode, and the high measurement alarm relay will be turned on.

Temperature Alarm Delay: (0-60) This is the alarm delay time in seconds for the process temperature that must expire while a limit is exceeded before an error is activated.

Temperature Alarm Low: If the temperature falls below this limit, a system alarm is activated. An error message will appear in the status window in normal mode, and the low temperature alarm relay will be turned on.

Temperature Alarm High: If the temperature exceeds this limit, a system alarm is activated. An error message will appear in the status window in normal mode, and the high temperature alarm relay will be turned on.

4.2.4.6 Purge

NOTE: This option is only available if Demand Purge Button is enabled under Purge Cycle Settings.

Selecting the "Purge" option will invoke a purge cycle. When purging, the 'H' system indicator (measurement hold) is displayed in the system box, the purge mode is displayed in the purge box, and the voltage is displayed by the measurement volt dial. The timing information for purging is set in the calibration limits menu.



During the purge process, all readings and analog output are "on hold" or frozen.

Each purge operation mode can be aborted before the selected time expiration by selecting the right arrow button from the Front Panel at which time the system will resume normal operation. Following the termination of the purge cycle, the 'H' indicator and the information at the bottom is removed. Successive purge cycles will be started if the previous purge was unsuccessful and/or terminated if smart clean is enabled. This will continue for three entire purge cycles; at which time a 'P' system indicator is displayed if all purges were unsuccessful.

The purging consists of three internal cycle times:

Condensate Drain Time: This time allows any condensation to drain before steam cleaning if steam is being used as the cleaning agent, or can be used to allow water to heat up, etc. If not needed, this time can be set to zero.

Prism Clean Time: This is the actual time during which cleaning of the prism occurs.

Hold Delay Time: This time allows a delay to occur before resuming normal operation.

NOTE: Purging can be automatically initiated by setting up a purge cycle time in the calibration limits.

4.2.4.7 Diagnostic

WARNING: Changing values on this page while process is in operation is not advised!

There are eight total relays available on request, two of which are used as inputs (unless system configured for High Temp Cond. Drain). The other six relays are activated when either measurement alarms are occurring or when purging.

Using the Front Panel buttons, all relays except the input relays can be tested by toggling the output conditions and visually checked by examining the relay LEDS on the interface board. Also, by supplying an external voltage, the operator can test the custom input relays.



The Diagnostics menu contains the following options:

Home – Returns user to normal operation mode with menu open.

+/- – This allows the operator to toggle system relays for testing or troubleshooting purposes. The toggled relays can be visually checked by examining the relay LEDS on the interface board. This option also allows the operator to test custom inputs.

Event Log - This option allows the operator to view a log containing a history of system errors and warnings. Each log entry contains an error/warning message along with a time and date stamp.

Purge Log - This option allows the operator to view a log containing a purge history. There are up to 6 pages. This log will enable the operator to see important information about purge history.

High Temp Purge Log – This option allows the operator to view a log containing a purge history. There are up to 6 pages. This log will enable the operator to see important information about purge history.

Smart Purge Log – This option allows the operator to view a log containing smart purge history. There are up to 6 pages. This log will enable the operator to see important information about purge history.

Exit – Returns user to normal operation mode with menu open.

The "Voltages" are displayed in the lower portion of the display:

Measurement Voltage: The voltage produced when measuring a sample. The first voltage displayed is the raw sensing head voltage. The voltage in brackets is the compensated voltage. Range is (0-10 volts).

Temperature Voltage: A voltage that produces the process temperature readout as follows: (Voltage - .5v) * 50 = Deg. C.

Lamp Voltage: A nominal voltage needed to maintain a signal of proper amplitude.

Water Voltage: This is the water temperature voltage, communicated by a secondary RTD; used in the High Temp. Cond Drain process.

Event Log Menu Selection



Allows the operator to view a log containing a history of system errors and warnings. Each log entry contains an error/warning message along with a time and date stamp.

Home: This option allows the operator to return E-Scan ***EVO*** to normal operation

Clear Logs: This option allows the operator to clear all the logs.

Prev Page: This option allows the operator to go back a page.

Next Page: This option allows the operator to advance a page.

Exit: This option allows the operator to return to previous menu.

Purge Log Menu Selection



Allow the operator to view a log containing a purge history. There are up to 6 pages. This log will enable the operator to see important information about purge history. Each log entry contains the trigger mechanism and completion message along with a time and date stamp.

Home: This option allows the operator to return E-Scan ***EVO*** to normal operation

Clear Logs: This option allows the operator to clear all the logs.

Prev Page: This option allows the operator to go back a page.

Next Page: This option allows the operator to go forward a page.

Exit: This option allows the operator to return to previous menu.

Note: These following menu options require optional hardware and factory enabling of these features.

High Temp Purge Log Menu Selection



This option allows the operator to view a log containing a history of each purge. Includes head temp, purge water temp, drain time, and voltage drop.

Home: This option allows the operator to return E-Scan ***EVO*** to normal operation.

Clear Logs: This option allows the operator to clear all the logs.

Prev Page: This option allows the operator to go back a page.

Next Page: This option allows the operator to advance forward a page.

Exit: This option allows the operator to return to previous menu.

Smart Purge Log Menu Selection



This log will enable the operator to see important information about the purge history.
Each log entry contains a time and date stamp. The results of the purge, how long the purge lasted, and the voltage drop during the purge.

Home: This option allows the operator to return E-Scan ***EVO*** to normal operation.

Clear Logs: This option allows the operator to clear all the logs.

Prev Page: This option allows the operator to go back a page.

Next Page: This option allows the operator to advance a page.

Exit: This option allows the operator to return to previous menu.

4.2.4.8 Preferences Menu

The Preferences menu allows editing of the following:



Refract Decimal Format: This option allows the measurement readout to be displayed in various resolutions by selecting a decimal place format.

°C or °F: This feature allows selection of Fahrenheit or Celsius.

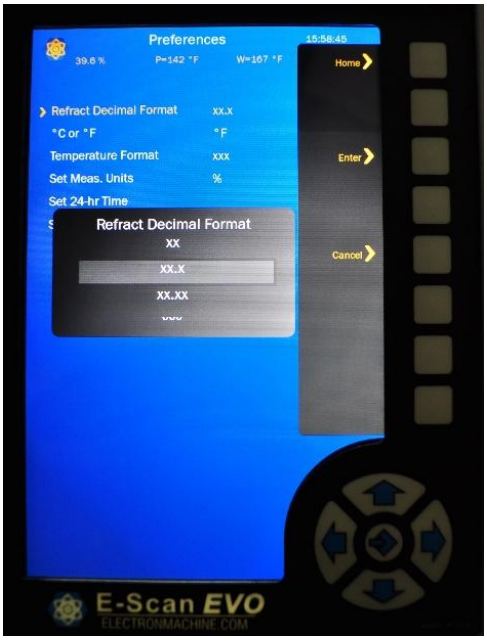
Temperature Format: This option allows the temperature readout to be displayed in various resolutions by selecting a decimal place format.

Set Meas. Units: This option allows the operator to assign a meaningful title to the measurement readout such as Brix, Solids, R.I., Scale, etc.

Set 24-hr Time: This is the time displayed in military format in normal mode.

Set Date: This is the date displayed in normal mode.

Refract Decimal Format

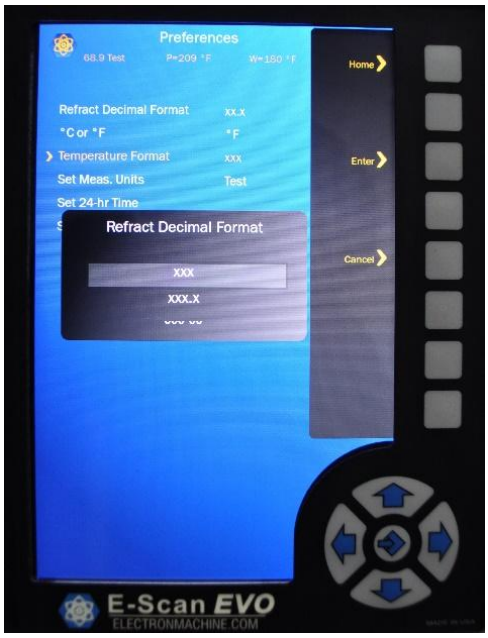


By highlighting the Refract Decimal Format and selecting Edit:

The decimal place option allows the operator to configure various measurement readout formats. When selected, all measurement readings as well as calibration limits will reflect the chosen format. The format chosen will depend on the resolution desired by the operator.

NOTE: The decimal format affects displayed readings only. Maximum resolution is still maintained internally for accurate output.

°C to °F



Highlighting the "°C or °F" and pressing the (±) Key will change the display of the temperature between Celsius and Fahrenheit.

Temperature Format - By highlighting the Temperature Format and selecting Edit:

The decimal place option allows the operator to configure various temperature readout formats. When selected, all temperature readings as well as calibration limits will reflect the chosen format. The format chosen will depend on the resolution desired by the operator.

NOTE: The decimal format affects displayed readings only. Maximum resolution is still maintained internally for accurate output.

Set Meas. Units



Highlighting the "Set Meas. Units" and selecting Edit will display the following.

This is the measurement title alphabet menu. It displays the alphabetic characters available for designating a title, and the measurement title itself at the bottom which is updated as characters are selected.

Using the Front Panel ARROW and ENTER buttons a measurement title can be selected and then saved. When the "-Save-" option is selected, all characters from the edit cursor position in the measurement title onward are erased, thus saving only the measurement title characters that precede the edit cursor position.

Set 24-hr Time Units



Highlighting the "Set 24-hr Time" and selecting Edit will allow the clock to be adjusted.

This is the 24-hour time clock displayed on the normal operations page and used in all logs.

Using the Front Panel ARROW and ENTER buttons the clock can be set and then saved to the current local time.

When the "-Save & Exit-" option is selected, all edits of the page have been saved.

Set Date



Highlighting the "Set Date" and selecting Edit will the date to be adjusted.

This is the date displayed on the normal operations page and used in all logs.

Using the Front Panel ARROW and ENTER buttons the clock can be set and then saved to the current local time.

When the "-Save & Exit-" option is selected, all edits of the page have been saved.

4.3 Problem Analysis / Troubleshooting

4.3.1 Problem Analysis

The following analysis procedures are meant to aid in isolating failures down to the board level. Board or device replacement with a fast turnaround is available from EMC.

Before any troubleshooting, always check that all cards are properly plugged in, ribbon cables are properly socketed and that correct power is supplied.

Typical display ranges for voltages in test mode are:

LED voltage	2.5 - 4.0V (Varies slightly with temperature and cable length.) (Normal Range 2.8~3.8 Volts)
Measure voltage	Varies with process 0-10V range with 2-8 Vdc nominal.
Temperature voltage	0 to 5 Vdc = -25 to 225°C

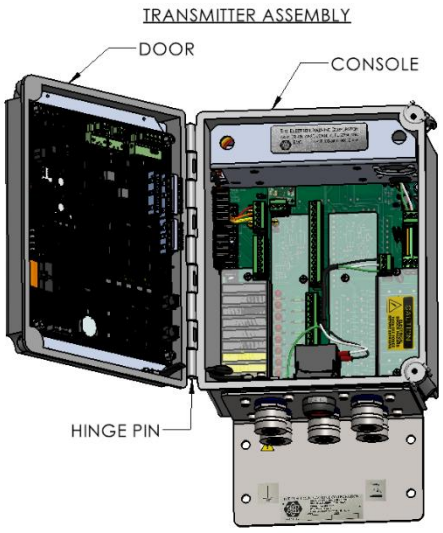
Trouble Shooting Chart

SYMPTOM	POSSIBLE CAUSE
Clock running – No Measurement	***EVO*** I/O board failure
Clock not running – have measurement	Display controller failure
Buttons do not respond properly.	Connector from overlay to I/O board not or improperly mated with J5. Front panel overlay defective. Defective I/O board (keyboard section).

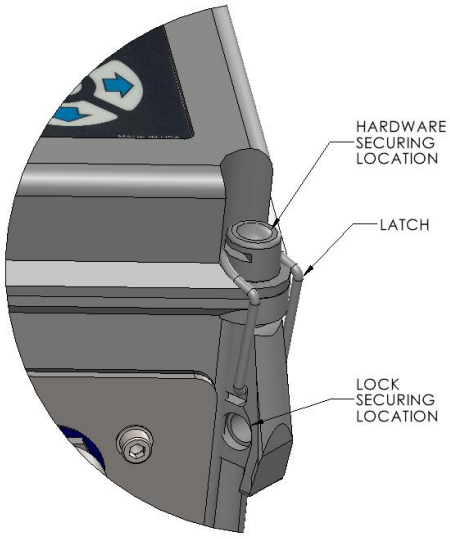
SYMPTOM	POSSIBLE CAUSE
"NO TEMP. VOLTAGE" flashing on display	If voltage between TB1-3 and TB1-10 on the IB is less than 0.2 volt and the process temperature is above 25° C, check 2.5-volt regulator VR-1 in the head. Sensing head failed. I/O card failed.
"NO MEAS. VOLTAGE" flashing on display	If positive voltage does not exist between TB1-12 and TB1-3 on the IB, check for process flow across prism. Sensing head failed. I/O card failed.
Measurement incorrect.	Check display for O, U, or T indicators. Check for large digital offset value. Re-zero using measurement shift (in software). Re-zero head using zero pot in sensing head.
"NO LAMP VOLTAGE" flashing on display	Sensing head failed. Check for AGC voltage on LED. Preamp card failed. I/O card failed.

4.4 Technical Information

4.4.1 Transmitter Description



The foundation of the E-Scan ***EVO*** is the Door, which is attached to the Console with a simple hinge pin and connected with ribbon cables. Together, the Console and Door comprise the Transmitter assembly. As separate modular components, they are matched together when new, but can be upgraded, repaired, and/or replaced separately at any time by qualified technicians. The E-Scan ***EVO*** Door is also backwards-compatible with the previous generation of MPR E-Scan refractometers. As additional advancements become available in the future, various sub-assemblies will also be upgraded with the intent of also being backwards-compatible with the E-Scan ***EVO*** Transmitter assembly (Console and Door).

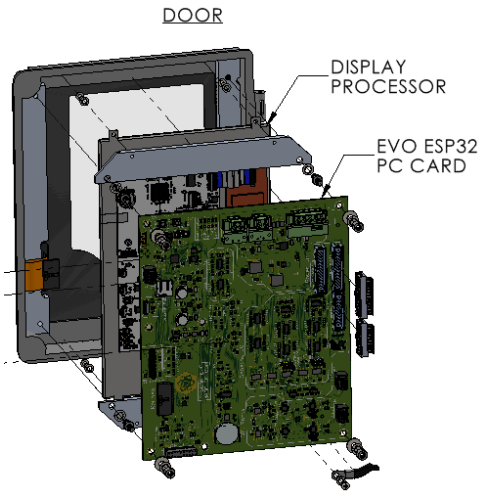


The Transmitter is constructed of molded fiberglass polyester to give protection in harsh environments when the latches are securely fastened, and the integrity of the gasket has not been compromised. Additional enclosure options are also available for specific applications with even more demanding protection requirements.

The security of the latches must be assured to prevent inadvertent and/or unauthorized openings according to appropriate site requirements. The latches may also be replaced and/or supplemented with locks and fastening hardware for this purpose.

NOTE: The Door must remain securely closed and latched to the Console at any time when in operation and any potential source of energy is available. Service only by a trained and qualified Technician once potential energy has been appropriately removed and in compliance with appropriate requirements.

4.4.2 Door Description



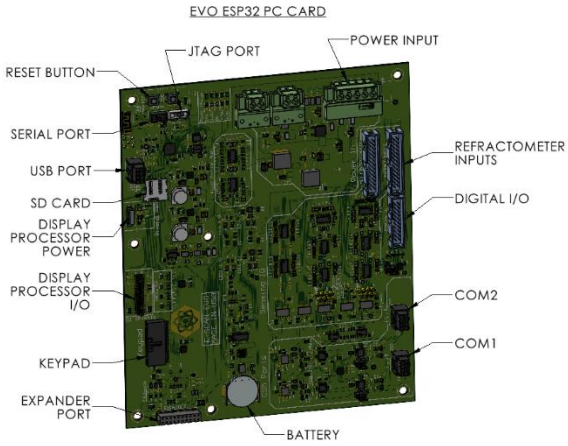
The Door of the E-Scan ***EVO*** contains all the digital processing components and is comprised of two major components; the Display Processor and the ***EVO*** ESP32 PC Card; each with their own microcontroller operating independently but continually communicating with each other. This combination was specifically engineered for ultimate reliability and robust performance even in the event of component failure.

Display Processor

The Display Processor, provided by a 3rd party manufacturer, operates using internally developed software to form the user-interface with the E-Scan ***EVO***. A high-resolution screen is combined with a powerful microcontroller into one device that is powered from and communicates directly with the ***EVO*** ESP32 PC Card. Featuring a 10.1" sunlight-readable industrial screen, with 1280x800 pixels, this device provides a window into the operation of the E-Scan ***EVO*** and allows changes to be made to the operating parameters running on the ***EVO*** ESP32 PC Card. Nonvolatile memory is installed on the Display Processor for logging information and to back up the operating parameters stored on the ***EVO*** ESP32 Card. In the event of a Display Processor failure, the ***EVO*** ESP32 PC Card will continue to function.

***EVO* ESP32 PC Card**

The ***EVO*** ESP32 PC Card is a custom designed, state of the art combination of electronic components utilizing proprietary software and featuring a 32-bit high-performance dual-core microcontroller unit with integrated system on chip technology. In addition to the primary processing functions, this card also incorporates the analog-to-digital and digital-to-analog conversions. The ***EVO*** ESP32 PC Card communicates directly with, and powers, the Display Processor in addition to other networked devices that will be introduced as they become available in the future. This unique architecture allows the core functions of the E-Scan ***EVO*** to continue to operate even if the Display Processor has failed and allows the ***EVO*** ESP32 PC Card to be replaced quickly with operating parameters automatically loaded from the Display Processor.



Power for the ***EVO*** ESP32 PC Card is provided directly from the Power Supply in the form of +5, +15, -15Vdc to the Power Input. In typical installations, Red is +5V, Orange is +15V, Yellow is -15V, and Black is GND. Connection to the Customer Interface Board is accomplished through ribbon cables to Refractometer Inputs and Digital I/O. The Keypad, Display Processor I/O and Power complete the remaining connections on the Door for standard E-Scan ***EVO*** Refractometer systems.

A CR2032 coin-type battery provides real-time clock power with a recommended replacement interval of every two years?

Numerous other input and output connections are available for optional and future upgrades. Please contact Electron Machine for more information on these developing features.

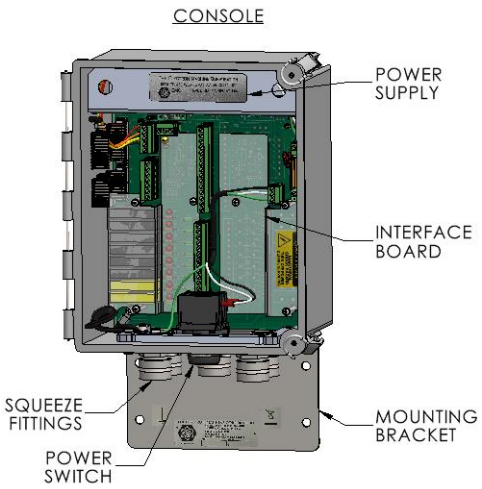
4.4.3 Console Description

The Console portion of the Transmitter assembly primarily contains the peripheral analog devices and wiring connections of the E-Scan ***EVO***. The Console itself is a modular component designed to be backwards-compatible with the previous generation MPR E-Scan Door and Sensing Head.

Mounting Bracket, Squeeze Fittings, Power Switch

A robust S/S mounting bracket provides a secure mounting base to attach the E-Scan ***EVO*** to a variety of surfaces and must be electrically grounded as described in Section 1.1. Additionally, the bracket also aids in dissipating internal heat generated from the electronic components housed within the sealed transmitter.

Five (5) total S/S squeeze fittings are also incorporated into the mounting bracket for cable penetration into the Console, leaving typical E-Scan ***EVO*** systems three (3) extra at time of manufacture. Appropriate sealing "blanks" are provided for unused squeeze fittings to maintain protection class, which can quickly be removed as needed.



A latching On/Off power switch is centrally located in the middle of the bottom of the Console. The switch removes power to components inside the Console, however electrical energy is still present on the switch itself, so power must be removed externally from the Console by a qualified technician for the internal portion of the Console can be considered de-energized.

Interface Board

The Interface Board is located on the back wall of the console. This large but simple board is primarily a pass-through for input/output electrical signals and supplies. All connections are made to connectors that plug into this board and thus can be un-plugged when needed. Connections for the Sensing Head are made on TB1 along with fused AC power (for use with output relays). TB2 is for input/output relay connections, TB3 is for 4-20mA signal output connections, and TB4 is for 0-10Vdc signal output connections.

AC power connects to the board on TB9, passes through 2A fuses, and is passed on to the Power Supply from TB10.

Various input/output solid-state relays can be configured and plugged into the left side of the Board (K1-K8) with status indicator LED lights and axial-leaded fuses for each. At the top of the Board, 4-20mA modules can be accommodated: measurement is standard on the left side for most applications (U1), while temperature is optional and immediately to the right (U2).

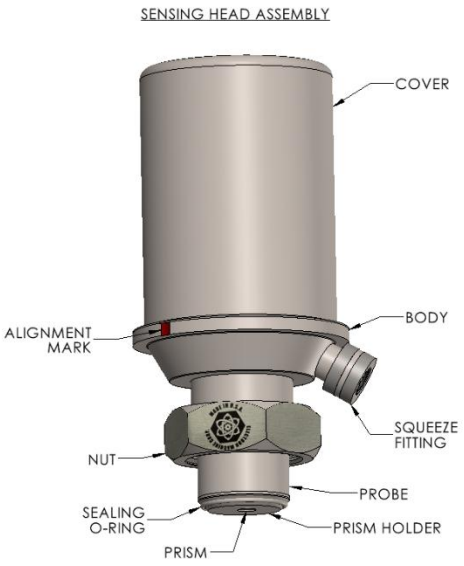
Two ribbon cables transmit electrical signals to and from the Door. The 20-pin cable (J5) is for digital signals to control the relays, while the 26-pin cable (J6) is for analog signals from the Sensing Head and to the analog outputs on the Interface Board.

Power supply

The power supply is at the top of the console and features an integrated circulation fan. AC power is converted to +5Vdc, +15Vdc, and -15Vdc and connected to the Door as well as the Interface Board.

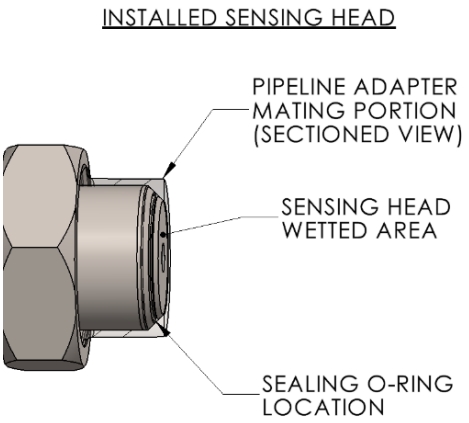
4.4.4 Sensing Head (Sensor) Description

The Sensing Head (or Sensor) of the E-Scan ***EVO*** is mounted in the Pipeline Adapter (or other application specific adapter) and is in direct contact with the liquid process to perform the Refractive Index (R.I.) measurement. The Sensing Head is matched to the Transmitter and ICC Cable when new but can be replaced as needed with other Sensing Heads by qualified technicians. The Sensing Head is also backwards compatible with the previous generation of MPR E-Scan refractometer.



The design of the Sensing Head (and associated Pipeline Adapter) provides a "Probe" for the actual measurement. This Probe is typically available in two lengths (Standard or Extended) to appropriately break the boundary layer of liquid moving through the pipeline, while also minimizing the wetted area and components exposed to the potentially harsh liquid process. This design allows for the Prism, the Prism Holder, and the Sealing O-Ring to be the only wetted components.

Once installed, the Sensing Head nut compresses the O-ring onto the mating portion of the adapter, thus sealing the connection and allowing remaining external components of the Sensing Head from contacting the liquid process.

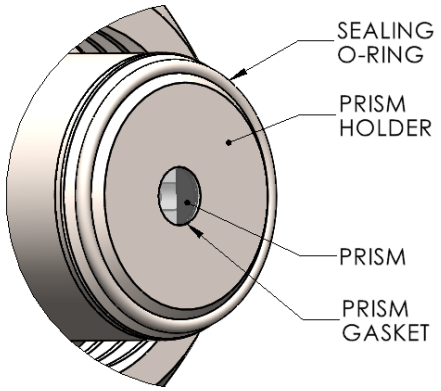


Please see the Installation Section of this manual for more information regarding installing the Sensing Head.

Wetted Components

The Prism, Prism Holder (and Gasket), and Sealing O-ring are the only components of the Sensing Head that are in contact with the liquid process, thus forming the Wetted Components.

SENSING HEAD WETTED COMPONENTS



Prism

The Prism is custom manufactured from Sapphire material with specific reflective angles according to the application to be measured. Sapphire is used for its transparent optical properties and its resistance to chemicals, scratching, and high pressure. A small circular portion of the Prism is in contact with the process liquid and forms the extremely rugged interface by which the Refractive Index of the process occurs and is thus measured by the E-Scan ***EVO***.

Prism Holder (and Gasket)

The Prism Holder is the only metallic portion of the Sensing Head that is continually in contact with the process liquid. Normally manufactured from duplex stainless steel, the Prism Holder is available in a variety of materials and alloys to be specifically suited for the application. The Prism is precisely mounted, or "clamped," to the Prism Holder utilizing a gasket to ensure an appropriate seal while under pressure while also minimizing any geometry changes of the internal optical components due to changes in process temperature and pressure. The Gasket is also available in a variety of materials suitable for specific applications.

Sealing O-ring

The Sealing O-ring is installed in the groove of the Prism Holder to form the seal within the Pipeline Adapter. This O-ring should be replaced anytime the Sensing Head is removed from the Pipeline Adapter to ensure a proper seal. Various materials are available according to the application.

External Components

The external components of the Sensing Head, which are not in normal contact with the liquid process, are all manufactured from stainless steel to provide long-lasting protection in harsh industrial environments, for the optical and electronic components housed within. These components consist of the Body, Squeeze Fitting, Cover, Probe, and Nut.

The Body is the primary chassis from which all other components of the Sensing Head are mounted from. The alignment mark, outlined with red paint, indicates how the Sensing Head is to be oriented when installed in the Pipeline Adapter, please see the Installation Section for more information.

The Squeeze Fitting provides a tight liquid seal for the Interconnecting Cable to enter this Sensing Head and can also be used for orientation in the Pipeline Adapter, towards the downstream flow. The Squeeze Fitting should be secured one-half to one full turn beyond hand tight to ensure a long-term seal. Additionally, while this penetration is liquid tight, care should be taken to avoid continuous exposure to nearby sources of liquids and other potential contamination.

The Cover screws onto the Body utilizing an O-ring seal and should always be in place during normal operation, since external light will affect the measurement of the E-Scan ***EVO***. Additionally, care should be taken to minimize the impacts of moisture and other environmental contamination on the electronic and optical components inside. The Cover can be removed by turning counterclockwise, temporarily for maintenance by a qualified technician. In applications where thin stainless steel is not desirable, the Cover can be made from other materials that are suitable for the environment.

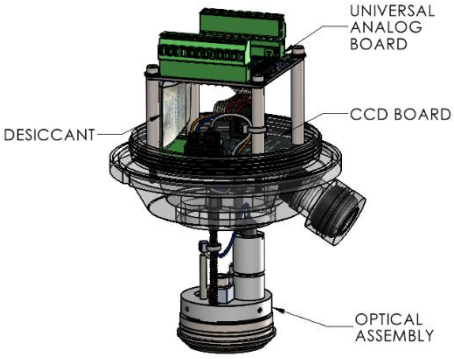
NOTE: The Cover must remain secured to the Sensing Head during normal operation. Remove for service only by a trained and qualified Technician when appropriate.

The Probe of the Sensing Head contains the optical components of the refractive index measurement and provides a surface by which the Nut is contained for securing the Sensing Head to the Pipeline Adapter. The Probe is available in Standard and Extended lengths and must be paired with the appropriately corresponding Pipeline Adapter.

The Nut is of a coarse "Acme" thread design and is not the sealing surface for the Sensing Head. The Nut is used to compress the Sealing O-ring into the mating portion of the Pipeline Adapter, where the seal to the liquid process occurs. As such, there is no need to overly tighten the Nut to provide a secure seal. No more than 50 ft-lbs. (68 N-m) of torque should be applied. Please see the Installation Section of this manual for more information regarding installing the Sensing Head.

Internal Components

SENSING HEAD INTERNAL COMPONENTS



The Internal Components of the E-Scan ***EVO*** are typically only accessed for installation, troubleshooting, and maintenance. The electronic and optical components are specifically designed to operate for extended intervals in harsh industrial environments, so long as the Cover and the Squeeze Fitting are adequately secured. These components consist of the Optical Assembly, CCD Board, Universal Analog Board, and Desiccant.

Optical Assembly

The Optical Assembly contains the Wetted Components secured along with the LED Assembly, Thermistor Assembly, associated mounting fixtures and hardware. All optical components used to generate the refractive index light signal are contained in this single assembly providing a rigid and robust yet simple and flexible design.

As the portion of the Sensing Head that is exposed to the full effects of the liquid process, the Optical Assembly is subjected to the most extreme pressure, temperature, vibration, and abrasion. Efforts to reduce these issues can dramatically increase the useful service life of the Optical Assembly. When needed, the Optical Assembly can be replaced by trained and qualified technicians.

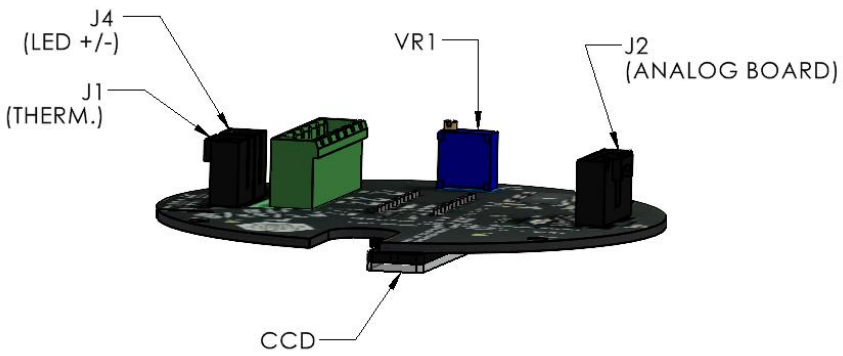
The LED (light-emitting diode) generates the light signal for the measurement utilizing an encapsulated device that is precisely focused through a set of lenses onto a mirrored surface of the sapphire Prism. An additional lens focuses the signal generated onto the CCD Board for detection. See Measurement Method for more information.

The Thermistor is positioned very close to the external surface of the Prism Holder. The provided signal is primarily used to compensate for the interaction of temperature on the refractive index measurement. The temperature signal can also be transmitted separately for monitoring purposes of the liquid process.

CCD Board

The CCD Board contains the charge-coupled device (CCD) that converts the refractive index light signal into a digital image. The digital signal is amplified and then transmitted to the Universal Analog Conditioning Board for further processing. An adjustment potentiometer, VR1, is accessible to qualified technicians. Connections for the LED and the Thermistor are also made on this Board.

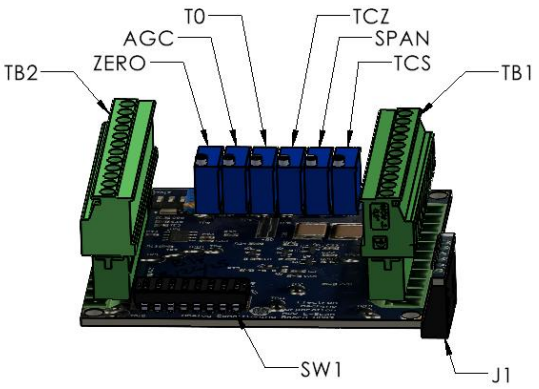
CCD BOARD



Universal Analog Board

The Universal Analog Board provides power to and receives the digital signal from the CCD Board (J1), applies a temperature compensation bias, and then converts this signal to an analog voltage. This method of converting digital-to-analog signals allows simple components to be used, eliminating the need for sensitive processing electronics to be located in the Sensing Head.

UNIVERSAL ANALOG BOARD



Six potentiometers (pot) are used to configure the refractive index signal to the 0-10Vdc output. The "Zero" pot is the "course zero" for adjusting the Sensing Head Voltage output. The remaining pots are used for the initial calibration of the Sensing Head and are sealed once properly adjusted. Switches, identified as SW1, are also only adjusted during initial calibration and should not be adjusted in the field.

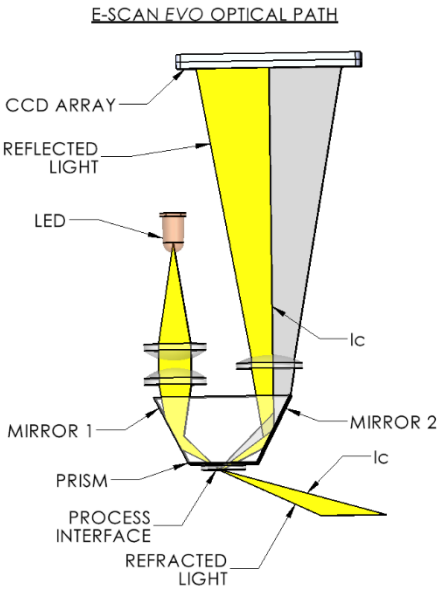
Connections for the Interconnecting Cable (ICC) are made to the board on TB1 utilizing a removeable connector.

Desiccant

A bag of Desiccant is secured on standoffs in the Sensing Head. The quantity provided is more than adequate for applications where the process temperature is above ambient temperature. For applications where the process temperature is below ambient temperature, the Desiccant will need to be replaced yearly or any time the Cover is removed for more than 15 minutes.

Measurement Method

As an optical measuring device, the E-Scan ***EVO*** utilizes an Optical Assembly within the probe of the Sensing Head to determine the critical angle of refraction. Incident light is focused with lenses to cover a range of angles that include the critical angle of refraction (Ic) for the process liquid to be measured. Any change to the speed of light of the liquid process results in the critical angle of refraction changing, resulting in the corresponding reflected light illuminating a given number of pixels on the CCD array. The temperature of the liquid process is also measured, and these signals are transmitted as 0-10Vdc back to the Transmitter for processing.



The foundation of this simple measurement, first patented by Electron Machine in 1957, results in a simple and robust measurement with no moving parts and rugged, long-lasting components. So long as the orientation and integrity of the optical components remains, no drift can occur.

Two fundamental principles of this optical process measurement must be recognized for practical applications, however:

Refractive Index of a liquid process will only change due to components that are dissolved in solution (dissolved solids). If components are not dissolved in the solution (suspended solids), the refractive index will not change. The E-Scan ***EVO***, a refractometer, can very accurately measure dissolved solids but cannot, by measurement principle, measure total solids (dissolved solids + suspended solids).

The Refractive Index measurement occurs at the process interface. For the E-Scan ***EVO***, this interface is the Prism surface in contact with the liquid process. As a result, the interface needs to be free from contaminants or deposits (coatings, films, etc.), and in contact with a representative sample of the liquid process. Please consult Electron Machine Corp. to discuss specific applications and the suggested methods to ensure a reliable measurement.

Interconnecting Cable Description

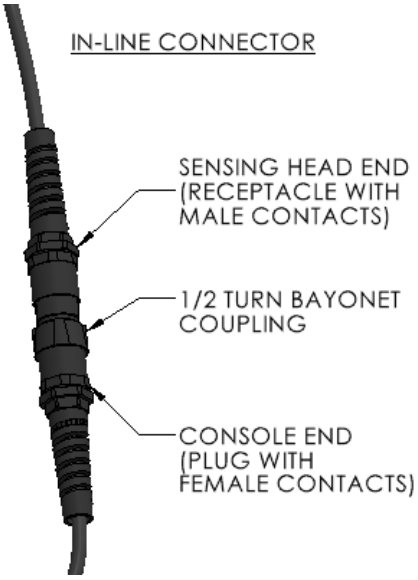
The Interconnecting Cable (ICC) provides power to the Sensing Head (Sensor) while also transmitting signals back to the Console. This proprietary cable is tray-rated and shielded with a total of ten (10) conductors. Electron Machine Corporation recommends using only this cable with no substitutions. Since milli-volt level signals are being transmitted, the use of junction boxes or additional terminals is also not recommended.

NOTE: Turn OFF the E-Scan EVO before connecting or disconnecting any part of the Interconnecting Cable or using the In-Line Connector. Damage to the Sensing Head can result.

The E-Scan ***EVO*** is provided standard with a 20' (6m) ICC. Custom ICC cable lengths can also be supplied as needed.

For many applications, the E-Scan ***EVO*** will also include an In-Line Connector to facilitate easy replacements of Sensing Heads. The composite material connector is waterproof, corrosion-proof, and UV-resistant for reliability in harsh industrial environments.

Once power is turned off, the In-Line Connector can be separated by turning the "Bayonet Coupling" one-half turn counterclockwise. The reverse procedure is used to re-connect, taking care to ensure that the power is not on at any time unless the connector is securely connected.



Refractometer Specifications

Accuracy	+/-0.0002 R.I. min (typ. 0.1% by weight) to 0.000075 R.I. max
Span	0.0015 R.I. minimum (1° Brix)
	0.214 R.I. maximum (100° Brix)
Repeatability	Corresponds to accuracy.
Sensitivity	Corresponds to accuracy.
Stability	No recorded drift / 24-hour period.

Response time:

Console	250m.s. to 15 min.
Head	<500m.s. for .0015 R.I. change with 90% recovery on 0.015R.I. span.
Process temperature	-40° F to 300° F (-40° C to 150°C)
Ambient temperature	-20° F to 125°F (-40° C to 52°C)
Calibration	See Engineering Order Sheet (EOS)

Sensing head wetted materials of construction: 2205 Duplex SS, sapphire, PEEK, Teflon (other alloys and elastomers available)

Outputs	4-20mA non-isolated 0 – 10Vdc non- isolated

Available Options

- Custom Cable Lengths – 10’ – 1000’
- Varying Sensor Materials
  - SS2205
  - Alloy 20
  - Hastelloy C
  - PVC
  - Teflon
  - Teflon Coated
  - Others on request
- Custom Calibrations
- Custom Languages
- Product Sampling and Evaluation
- Secondary Enclosures
- Supplemental Cooling
- Startup Services
- On Site Training

4.4.5 Service

EMC Warranty

The Electron Machine Corporation warrants that the equipment manufactured by Electron Machine Corporation is free of defects in material and workmanship. Should such fault arise within two years of date of shipment from our factory, the Electron Machine Corporation will repair or replace the defective part upon its prepaid return to Umatilla, Florida USA. This warranty does not apply to equipment which has been tampered with or abused.

Return of Defective Parts

Please include model number and serial number in all correspondence.

No return authorization is necessary. Pack defective parts carefully to avoid damage in transit. The shipper will be liable if, in the opinion of the carrier, insufficient packing was used. Attach a letter stating the nature of the difficulty encountered, the reason for failure (if known), the date of delivery of original equipment, the approximate time in operation, and ship to:

Service Department
The Electron-Machine Corporation
15824 County Road 450 West
Umatilla, FL 32784-2349

All return shipments must be prepaid.

Service in the Field

Services of factory trained field engineers are available at standard rates upon request.

Please contact Electron Machine Corporation at, by phone at (352) 669-3101 or by e-mail at service@electronmachine.com

For after-hours emergency technical service please call 352-669-3101 and follow the prompts. This process will forward your call to the current on-call Service Technician's cellular phone.

4.4.6 Spare Parts

How to Order Parts

Orders for parts should be addressed to sales@electronmachine.com, or can be ordered by phone at (352) 669-3101 or by mail at:

Technical Sales Department
The Electron-Machine Corporation
15824 County Road 450 West
Umatilla, FL 32784-2349

Note: Purchase orders should include the model number and the serial number of the equipment that the part is to be used with, in addition to the part number or drawing number and the chassis number.

If the part number or the drawing number is not known, give a detailed description including a sketch, if possible. All orders will receive prompt attention.

Phone: (352)-669-3101 E-Mail: sales@electronmachine.com

Recommended Spare Parts

EMC Number	Description
200100	E-Scan ***EVO*** Door Assembly
511002	Standard / Custom Range Sensing Head E-Scan
511026	Extended Sensing Head 0-65% BL (1.333 - 1.501 BRIX)
511028	Extended Sensing Head 55-85% BL (1.453 - 1.537 BRIX)
187496	Power Supply PS-40
596407	O-ring 17-030 Teflon (pkg of 10)
46601	Fuse Pico 5-amp LittelFuse (pkg of 5)
45801	Fuse 1-amp Slo Blo LittelFuse (pkg of 5)

4.4.7 Maintenance

4.4.7.1 Sensing Head Identification

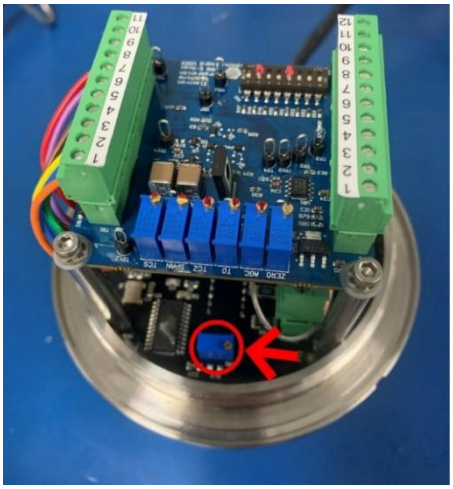
In 2021 Electron Machine began the manufacturing of a updated sending head to modernize the components and redesign the card layout to make the more tolerate of harsh environments. It is important to be able to identify these different styles of sensing heads as pot location and adjustment required can vary between styles.

The "Old Style" sensing head can be identified by the rectangular analog card that sits vertically in the sensing head.

The "New Style" sensing head ban be identified by the square analog card that sits horizontally (flat) in the sensing head.



"Old Style"



"New Style"

4.4.7.2 Lamp Adjustment Procedure

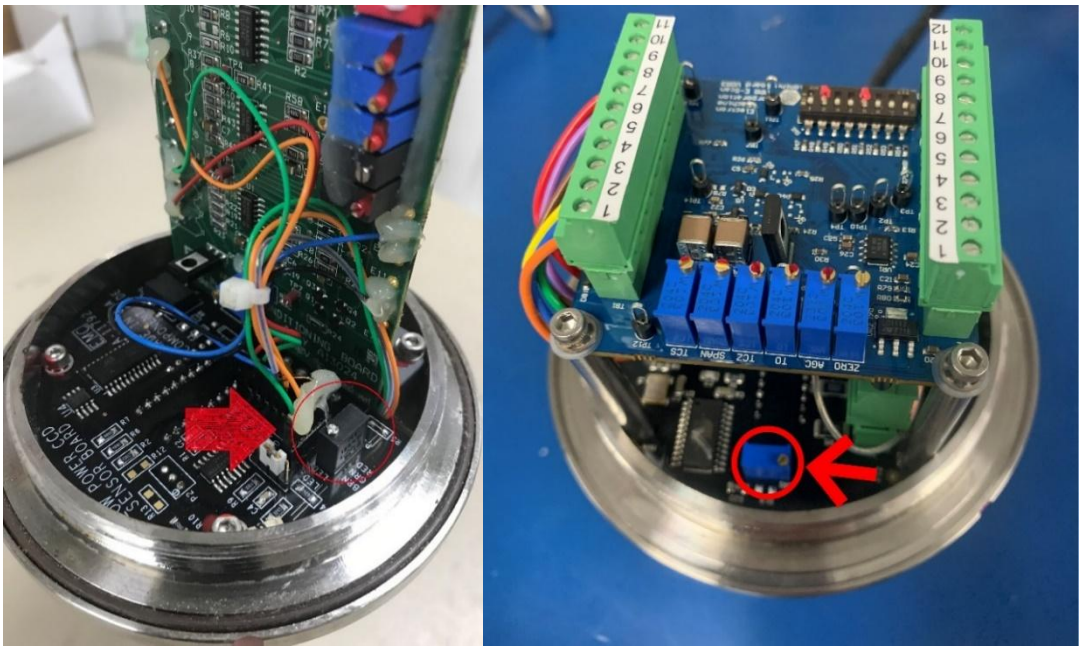
The lamp voltage operates between 2.8vdc at room temperature and up to 4vdc at operating temperature. If lamp voltage is below 3.5vdc when measured no adjustment is necessary, however, at 4vdc will give Check Lamp Alarm. If the alarm is activated the Lamp Voltage needs to be adjusted.

"These adjustments are meant to be made at operating temperatures."

1. Ensure the steam cleaning is operational and properly cleaning the sensing head. (Dirty Optics can cause High Lamp Voltage). Also ensure there is product in the line.

2. Remove the sensing head COVER and adjust P1 (see image below) on the CCD Board for 3.2vdc as seen in Diagnostics Voltages or with a voltmeter across TB1 (3gnd & 9 lamp) on original Analog Board or TB1 (2gnd & 6 lamp) on Universal Analog Board.

Note: The optics are sensitive to exterior light, it may be necessary to shield the sensing head from any light when adjusting.



4.4.7.3 Sensing Head Replacement

(Refer to www.electronmachine.com for an online video demonstration)

Remove Sensing head from pipeline adapter. (See Head Removal Procedure)



****** Before Removing******

- Ensure the console is powered off.
- Ensure no pressure is felt on installed sensing head.
- Ensure pipeline level is drained.
- Install maintenance plug any time sensing head is removed from pipeline adapter.
- Always use PPE when removing sensing head.
- Use Head Removal Safety Tool – If Available

If head is equipped with quick disconnect clipper connector, simply twist connector loose and skip to **Check for EOS Sheet** below.



If there is no quick disconnect, remove sensing head cover by unscrewing.

Take note of wiring color/label wire location/ refer to I/C Drawing

Loosen/Remove wires from terminal strip.

Loosen squeeze fitting cap.

Remove cable from sensing head.

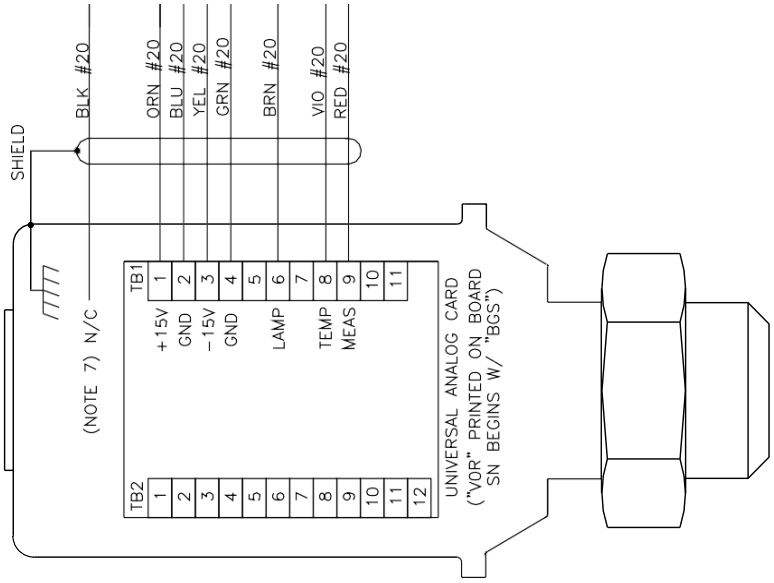
Re-install sensing head cover before returning head for repair.



Check for EOS Sheet attached to replacement sensing head to ensure proper range for installation application.

If head is equipped with quick disconnect, simply reconnect and skip to **Install sensing head** below or remove head cover from replacement head.

Hold on to the calibration info sheet (EOS) that is attached to replacement head. (You will need to enter this information into the console in later steps)



Insert Cable and connect wires to proper position on terminal strip.

** Refer to drawing B-13313 E-Scan Systems Interconnect Diagram **

Tighten wires in terminal strip.

Install sensing head cover.

Tighten squeeze fitting.

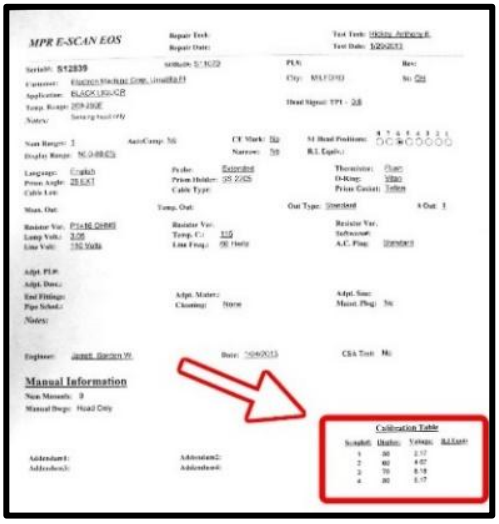
Remove shipping tape from O-Ring on end of sensing head. Ensure O-Ring is properly seated.

Install sensing head into pipeline and turn on power
Note proper orientation, tighten to proper torque with supplied wrench

Enter Calibration
See Console Measurement Calibration Procedure Sheet

4.4.7.4 Console Measurement Calibration Procedure

(Refer to www.electronmachine.com for an online video demonstration)



Refer to E-Scan ***EVO*** EOS sheet calibration table for input values.

Power on Console

(Allow time for console to boot up)



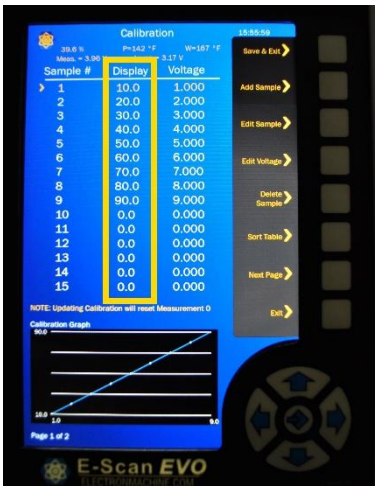
Push any side key to access menu.

Enter Tech Access using password.

Select Enter

Select Cal Table





Use arrow keys to highlight appropriate Sample #

Check that console's "Display" values match calibration table on EOS sheet. If they do, then skid down to "Volts" adjustment. If they do not, then proceed to "Display" adjustment below.

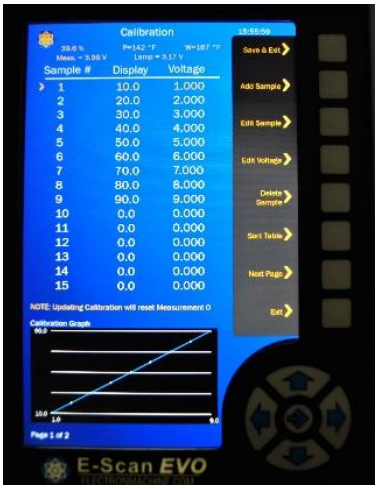
To edit console "Display" values: Use arrow keys to highlight the Sample # to edit. Select Edit Sample and Key in EOS sample values. Push ENTER



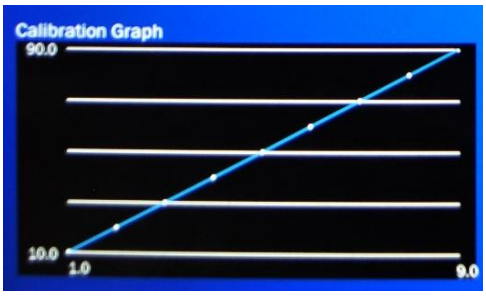
Edit console "Voltage" to match EOS sheet provided with replacement sensing head. Start with Sample 1



To edit console "Voltage" values: Use arrow keys to highlight the Voltage # to edit. Select Edit Voltage and Key in EOS sample values. Push ENTER



Observe Calibration Graph to ensure a linear slope is displayed.



After all values entered press Save & Exit.

Console will return to normal operation.

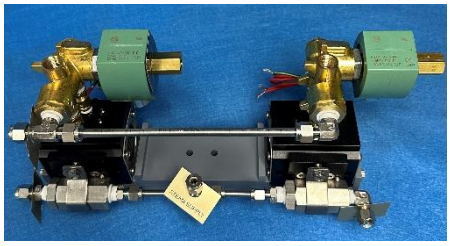


4.4.7.5 Safely Removing Sensing Head

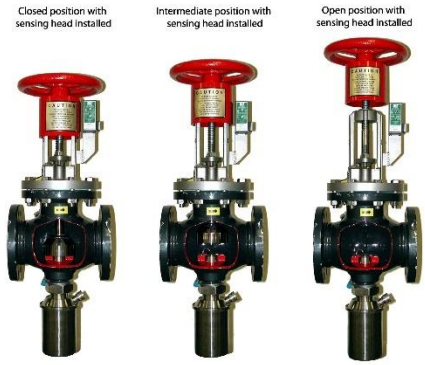
Always wear appropriate Personal Protective Equipment (P.P.E.) as required by your company's safety procedures.

Please refer to www.electronmachine.com for an online demonstration.

Disable steam purging on the sensing head being removed.



Close isolation valve by turning red hand-wheel clockwise to a hard full stop. "Rock" hand-wheel shut several times to ensure clean closure.



Electron Machine Corporation
Isolation Valve cut-away

Verify the bottom of hand-wheel is in the "closed" position as indicated on the bonnet casting.

Do not over-tighten or use leverage increasing tools (cheater bars, etc.).

If hand-wheel does not fully close, STOP!! DO NOT REMOVE THE SENSING HEAD OR MAINTENANCE PLUG.



If isolating a sensing head used with System: Confirm offline status of refractometer on system display.

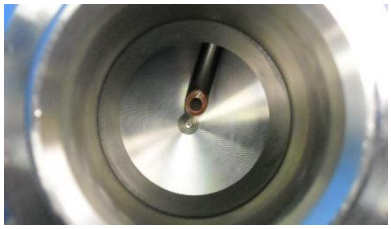
Suggested to Install Isolation Valve Adapter Safeguard Tool

Loosen sensing head or maintenance plug mounting nut one (1) complete turn.

Relieve trapped pressure on the sensing head or maintenance plug before proceeding. Push and pull the sensing head in and out between the mounting nut and the adapter. You should be able to move the sensing head about ¼" (6mm). Continue the movement until liquor drains from the adapter and no pressure is felt on the sensing head. (The liquor is under pressure until it is drained.)

STOP!!
IF THERE IS A RESISTANCE AGAINST THE SENSING HEAD RETIGHTEN THE MOUNTING NUT.
DO NOT REMOVE THE SENSING HEAD OR MAINTENANCE PLUG.

When there is no sign of pressure felt, standing to one side, completely remove the mounting nut.



After removing the sensing head, flush all liquor from the adapter for easy installation next time.

Inspect steam purge tube for damage. If you have a spare sensing head skip to step 15.



Before installing maintenance plug check the O-ring for damage and to ensure it is in place.



Install maintenance plug with O-ring and tighten to 50 foot-pounds of torque (68 Newton-Meter) using supplied wrench.

Leave isolation valve in closed position and tag appropriately as required by your company's safety procedures.

Install Spare Sensing head with O-ring. Note proper alignment of sensing head. (Alignment mark with steam purge fitting and interconnecting cable squeeze fitting downstream).

Tighten to 50 foot-pounds of torque (68 Newton-Meter) using supplied wrench.

Open Isolation valve slowly while checking for any possible indications for leaks.


4" Isolation Valve in open position with E-Scan sensing head installed

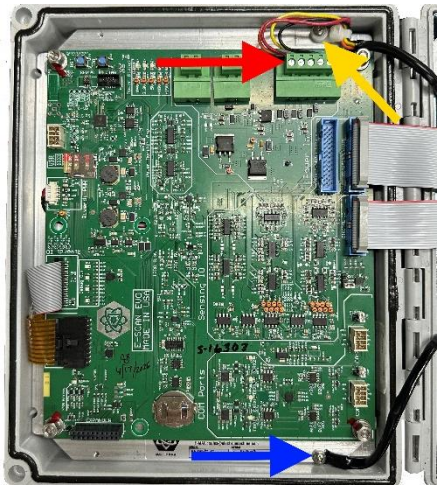
Hand-wheel should be turned counterclockwise to the fully opened position by hand for normal operation.

Enable Steam Purging on the installed sensing head.

4.4.7.6 Door Replacement Procedure

(Refer to www.electronmachine.com for an online video demonstration)

If possible, write down console Cal Table, Purge Cycle, and any addition Settings



Power Down and open E-Scan ***EVO*** console

Remove lower grounding strap (Blue Arrow)

Loosen power supply wires (Red Arrow)
Note wire color and location

Remove power wire retaining screw (Yellow Arrow) and power wires from door

Remove ribbon cables from console.





Remove hinge pin rod.

Remove door and package for repair.

Install new door using existing hinge pin rod

Secure lower grounding strap (Blue Arrow)

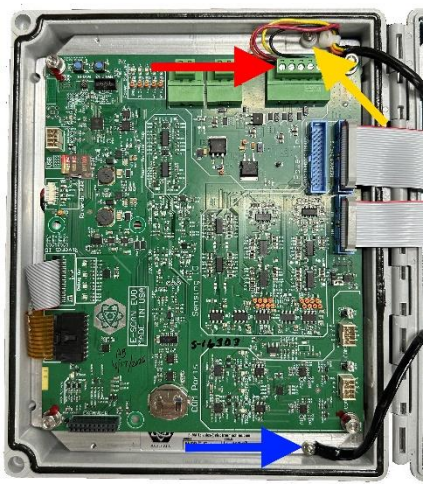
Secure power wire retaining screw (Yellow Arrow)

Connect and secure power wires (Red Arrow)

Connect ribbon cables.

Securely latch door shut and power on console.

Refer to Console Measurement Calibration sheet.



CAUTION

When removing the sensing head from an operating line, do not assume that the line is empty or that the isolation or bypass means is working properly. If an EMC isolation valve is used, be sure its travel is not limited by any external attachments or other interference, and the valve is closed tightly. No pressure should be felt on the head as the mounting nut is being removed.

ANY PRESSURE FELT WHEN THE NUT IS LOOSENED MUST BE INVESTIGATED BEFORE PROCEEDING. Steam should be turned off before attempting to remove head.

Use facility approved PPE and protective clothing. Stand to the side when removing the sensing head.

Clean all product residue from spud-piece on adapter prior to re-insertion of sensing head.

Check to ensure the old O-ring has been removed. The O-ring seal should be replaced before re-installation.

CAUTION

Close off isolation valve or remove the sensing head and replace it with maintenance plug prior to steam cleaning process lines to prevent prism breakage.

Notes:

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4.4.7.7 Drawings List

Drawing #	Rev	Description
A-13372		Outline E-Scan ***EVO*** System
B-13313		E-Scan ***EVO*** Systems Interconnect Diagram
B-11365	H	Assembly MPR E-Scan / ***EVO*** Interface Board
B-11366	C	Schematic E-Scan / ***EVO*** Interface Board
B-13315		Interconnecting Cable Console to Head, E-Scan ***EVO*** "New Style"
B-13314		Interconnecting Cable Console to Head, E-Scan ***EVO*** "Old Style"

*****NOTE*****

The E-Scan *EVO* is shipped with a "new style" sensing head and utilizes 16ga 10 conductor wiring. The unit is fully compatible with the "old style" sensing heads when wired properly.

If your wiring needs are not listed above, please refer to the Addendum that came with your older MPR E-Scan console or contact Electron Machine for the correct drawing.