TRITIUM MONITOR

TRIATHALON-H3

with optional Totalizer

OPERATION AND MAINTENANCE MANUAL

Revision 0

DATE: 20-Aug-2014

Generic Version

OVERHOFF TECHNOLOGY CORPORATION
1160 US ROUTE 50, MILFORD, OHIO, USA

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1.0. GENERAL DESCRIPTION

This tritium monitor consists of dual 2-liter ionization chambers with an integral electrometer coupled to the electronic circuits for display and control inside one fiberglass reinforced plastic molded enclosure suitable for wall mounting.

One ionization chamber, referred to as the measurement or upstream chamber, measures in a positive manner. The second ionization chamber, referred to as the compensation or downstream chamber, is identically constructed but subtracts from the measurement of the upstream chamber. This is how dual chambers serve to cancel the effects of external gamma fields and provide differential measurements.

Ionization chambers respond not only to the airborne radioisotope, which circulates through the ionization chamber, but also respond to the presence of external high-energy radiation capable of ionizing the air inside. Therefore, ionization chambers will respond to X-rays and gamma radiation as well. Additional gamma radiation suppression can be accomplished by using lead shielding. The electrometer serves to transform this current into a form and magnitude suitable for display, alarm, and external uses, as the ionization current itself is very weak.

The monitor contains all signal processing, alarm and external interface circuits, read out, and all required power supplies. The signal processing circuits serve to reject unwanted signals and to translate the electrometer signal voltage into a form and magnitude suitable for display, alarm and external uses as well.

The alarm circuits provide a visual signal and relay outputs for remote connection to denote that a preset level of measurement has been exceeded or certain malfunctions.

2.0. PHYSICAL DESCRIPTION

The Model Triathalon-H3 is a single range, ionization chamber monitor for the measurement of tritium in a NEMA 4X enclosure suitable for permanent installation and for continuous duty.

The enclosure has a hinged door with a polycarbonate window. Behind the hinged door is a front panel that is hinged so that it can be opened for servicing the various components inside. The sample inlet and exhaust fittings are located on the left side of the enclosure. Fittings for Tritium and Total Tritium measurement are located on the right side of the enclosure. Wiring conduit connections are provided on the bottom of the enclosure and consist of AC power conduit and control wiring conduit.

The following are located on the front panel:

- Fuse holder, main power switch, ‘ON’ and ‘OFF’ indicators.
- An LCD color touch screen serves the majority of control and display functions. These include the tritium measurement, alarm set points and indication.
- A 0-10 LPM adjustable flowmeter to indicate and control the sample flow.

The following are attached to the enclosure subpanel inside the enclosure:

- Dual 2 liter ionization chamber;
- Sample pump, differential pressure switch used for sensing a low flow condition, and all DIN rail mounted electrical connections.

The following are located on the outer left side of the enclosure:

- Stainless steel tubing connections for sample inlet and exhaust
- HEPA filter for downstream sample stream.

The following are located on the outer right side of the enclosure:

- Hose connections for a desiccant column used for noble gas compensation mode
- HEPA filter for downstream sample stream.

3.0. FEATURES

While the basic purpose of the Overhoff Model Tiathalon-H3 tritium monitor is to measure the presence and level of tritium (HTO and HTO+HT), this particular instrument, described herein, has these special features.

1. Tritium Monitoring measurement range over four plus decades, using dual ionization chambers with a nominal volumes of 2 liters each.

2. One ionization chamber (measurement or upstream) serves to collect the current produced as tritium decays radioactively. The second ionization chamber (downstream or compensation) is identically constructed, but subtracts from the measurement of the upstream chamber. Overhoff tritium monitors are equipped with special circuitry to identify and reject ionization currents that are produced by decaying radon, or other airborne alpha emitting radioisotopes.

3. There is an internal pump system for sample transport through the ionization chamber.

4. The Model Tiathalon-H3 consisting of the tritium monitor and the pump system as described above provides all data and performs all local control functions.

4.0. PERFORMANCE SPECIFICATIONS

The following specifications will apply when this is used for the measurement of tritium:

4.1. MEASUREMENT

Range	1 – 19999 $\mu Ci/m^3$
Display	LCD color touch screen
Accuracy	± 5 % of reading, ± L.S.D., whichever is greater
Stability and Drift	±1$\mu Ci/m^3$ long term (thirty days), ambient temperature conditions
Noise	±1$\mu Ci/m^3$, 1 sigma, with alpha suppression in use
Response Rate	two linear electronic time constants approximately 20 seconds for signals up to about 80 $\mu Ci/m^3$ approximately 3 seconds for signals above 80 $\mu Ci/m^3$
Gamma Compensation	A second ionization chamber of equal volume, mounted on the same axis, serves to cancel effects of external gamma fields
Offset Compensation:	Manual compensation control provided to offset the effects of gamma radiation and/or tritium build-up
Over Range Indication	The LCD screen will flash when the measurement has exceeded 19999 $\mu Ci/m^3$
Warm Up Time:	less than five minutes

4.2. ALARM SYSTEMS

Tritium Level	There are two Tritium Level Alarms, the indicator on the LCD is normally green and the message displayed is “Tritium Level OK”.
Alert Level	Tritium Alert Level Alarm preset from 1 – 1000 $\mu Ci/m^3$. Upon a Tritium Level Alarm the indicator on the LCD will turn yellow and display “ALERT LEVEL ALARM”.
High Level	Tritium Level Alarm preset from 10 – 10000 $\mu Ci/m^3$. Upon a Tritium Level Alarm the indicator on the LCD will turn red and display “HIGH TRITIUM LEVEL”.
Mode	Default mode for level alarms is non-latching, Enter SET-UP to select either latching or non-latching modes.
Malfunction	Two conditions initiate a MALFUNCTION ALARM 1. Power Supply Fault; Upon any failure of the low voltage power supplies, the LCD will turn red and display “POWER SUPPLY FAULT LV. Upon any failure of the high voltage bias supplies, the LCD will turn red and display “POWER SUPPLY FAULT HV. 2. Sample flow; upon a low flow condition, the LCD will turn red and display “LOW FLOW”.
Relay closure	Relays for all alarms operate in the failsafe mode

4.3. IONIZATION CHAMBER

VOLUME	measuring: 1,600 cm^3 total wetted: 2,000 cm^3
ELECTRODES	Solid wall on both sides
GASKETS	silicone rubber
PRESSURE	0.1 to 2 atmospheres
PORTS	3/16’’ I.D. Vinyl Tubing
MATERIALS OF CONSTRUCTION	all wetted surfaces, stainless steel

4.4. EXTERNAL SAMPLE CONNECTIONS — 3/8’’ O.D. Stainless Steel Swagelok Fittings

4.5. FLOWMETER — 0-10 LPM adjustable rotameter

4.6. DUST AND ELECTROSTATIC FILTER — high efficiency 99.99% at 0.1 microns cartridge type Solberg Manufacturing Product No. HE04

4.7. PUMP — long life continuous duty linear motor driven diaphragm type, Medo Model VCO201E1

4.8. ENVIRONMENTAL TEMPERATURE — storage: -30° C to +50° C; operating: 5° C to +50° C

HUMIDITY	0 to 95 % R.H.

4.9. REMOTE INTERFACE — refer to Figure 3, Customer Connections

SCREW TERMINALS CONNECTIONS	high and low analog outputs alarm relay outputs

4.10. POWER — 115 VAC, 50/60 Hz, 5A, single phase

4.11. PHYSICAL

ENCLOSURE	Molded fiberglass with polycarbonate window on a hinged door. Color: light gray, NEMA 4X, IP66
DIMENSIONS	16.2’’ Wide x 20.3’’ High x 9.19’’ deep [41.2cm Wide x 51.5cm High x 23.4cm deep]
WEIGHT	43 lbs [19.6 kg]

5.0. PRINCIPLE OF IONIZATION CHAMBER MEASUREMENTS

A tritium monitor is an instrument using flow through ionization chambers designed to determine the presence and level of radioactive gas (tritium) in air or other gas streams. These monitors may be used to detect radioactive gases in many applications like:

room air
stacks, hoods, or other effluent passages
process piping
glove boxes, and similar

These monitors are generally calibrated in terms of (micro) Curies per cubic meter though other units can be used as requested (Bequerel, pCi/cm^3, etc.).

The principle of measurement is based on collecting the current that is generated by the radioactive decay (of tritium) inside an ionization chamber. The ionization current is proportional to the total activity of the radionuclide (tritium) being detected.

A tritium monitor consists of the following parts:

1. An ionization chamber to collect the ionization current.
2. A sampling system to circulate the sample (air) through the ionization chamber.
3. An electrometer to amplify the very weak ionization current.
4. All other associated electronics to process and display the signal.

Ionization chambers respond not only to the airborne radioisotope, which circulates through the ionization chamber, but also respond to the presence of external high energy radiation capable of ionizing the air inside. Therefore, ionization chambers will respond to X-rays and gamma radiation as well.

To overcome this effect, Overhoff Technology Corporation (Overhoff) tritium monitors are sometimes supplied with compensating ionization chambers. Here a second ionization chamber is used to cancel the effects of external radiation. Overhoff tritium monitors are equipped with special circuitry to identify and reject ionization currents that are produced by decaying radon, or other airborne alpha emitting radioisotopes.

5.1. CONTAMINATION, PLATE OUT OF HTO

When measuring significant levels of tritium for any but very short periods of time, the walls of the ionization chambers will become coated with a thin layer of tritium oxide. This leads to a background signal, where value may vary with time and is larger than the minimum desired signal level.

5.2. DUST FILTERS

Dust filters must always be included in the sample flow stream upstream of the ionization chamber. Accretion of dust, in even the slightest amount, results in erratic and noisy instrument behavior. If accumulation of dust and dirt in the ionization chamber is allowed to continue, the chamber will ultimately have to be disassembled and cleaned out. An arcing due to dirt build up can also destroy the sensitive electrometer circuit.

5.3. RESPONSE OF IONIZATION CHAMBERS TO RADIATION

The current generated in an ionization chamber is the result of collecting electrons generated from ionization of gas caused by occurrence of a nuclear event in the gas inside.

The number of ions (magnitude of the current) is influenced by numerous factors like energy, physical nature and particle range. As a good rule of thumb for beta particles in air, one secondary electron (and one positive ion) is formed for every 34 electron volts of energy lost by the primary beta particle as it travels its path.

The Curie is defined as 3.71×10^{10} nuclear decay events per second. The mean energy of tritium decay is 5.69 kev. Therefore it is calculated that 1 Curie of tritium produces an ion current very close to

$$1 \times 10^{-6} \text{ amperes.}$$

A concentration of 1 μCi/m^3 of tritium in a chamber of a volume of 1 liter will thus produce a current of

$$1 \times 10^{-15} \text{ amperes.}$$

It must be remembered that the ionization chamber responds to the quantity of tritium present inside. This is to say that effects due to temperature and pressure may, depending upon the circumstances of measurement, need to be accounted for. Even if a sample of gas is known to contain tritium at a certain concentration, i.e., parts per million or other, it must be remembered that the activity, i.e., amount per unit volume, is nevertheless dependent upon temperature and pressure. The ionization chamber only responds to the quantity of radioactivity inside.

Ionization chambers also exhibit several other peculiarities. The wall effect can be a problem if the track length of the decaying particle is appreciable when compared to the dimensions of the chamber.

For ionization chambers with small linear dimension, and if the track of ionized particles is comparatively long (the mean free path), an appreciable part of the energy of the primary particle is simply dissipated in the wall of the ionization chamber. This effect increases as the chamber dimensions shrink, and decreases as the chamber dimensions increase.

In air, atmospheric pressure, the maximum mean free path of a tritium beta particle is of the order of five millimeters, and for chambers with linear dimensions of ten centimeters or greater this “wall” effect becomes negligible.

At high concentrations, another effect takes place.
When the ion population density is high, some of these positive and negative ions will recombine and are lost to the measurement electrode.

This is known as saturation or as stagnation since the effect is more pronounced in corners of the ionization chamber where the potential field gradient is low. Increasing the ionization chamber voltage can reduce the effect.

For measurements of tritium at very high concentrations, such as are required when working with pure T_2, special chamber geometry is employed. Long slender ionization chambers, with relatively large internal ion collecting electrodes and short spacing between the chamber elements will enhance field gradients. With even moderate polarization potentials of 100 V or so, such chamber geometry shows linear response even to pure tritium streams.

5.4. DISCRIMINATION AGAINST ALPHA PULSES

Since the energy of an alpha decay is at least 10,000 times more active than that of a tritium beta event, suppression of alpha pulses needed in order to distinguish the presence of tritium at low levels. Stable and accurate measurements of tritium for values below 50 $\mu Ci/m^3$ can only be obtained with means to suppress response to alpha decay.

Alpha decay events, as detected in an ionization chamber, are not instantaneous. The special circuitry, which recognizes the alpha pulses, requires some amount of time to suppress the event. During pulse suppression, the instrument analog circuitry is placed in a “holding” mode; response is frozen during the interval associated with the alpha event. The holding intervals occur at random, but effectively add to the apparent time constant of the electronics. The instrument response becomes slower with increasing radon or gamma noise background. For large background the instrument will even freeze completely, the alpha pulse light will be permanently illuminated.

5.5. TECHNICAL SPECIFICATIONS

The proposed instrument will be designed and constructed for your particular application. It will be built and tested to these specifications.

Circuit diagrams and interconnections between parts of the monitor, as well as those leading to user selected remote devices or interfaces, will be provided with the maintenance manual.

Consult the factory for further information, or for application engineering at

1160 US Route 50, P.O. Box 182
Milford, OH 45150-9705, USA
Telephone (513) 248-2400
Facsimile (513) 248-2402
Email: support@overhoff.com

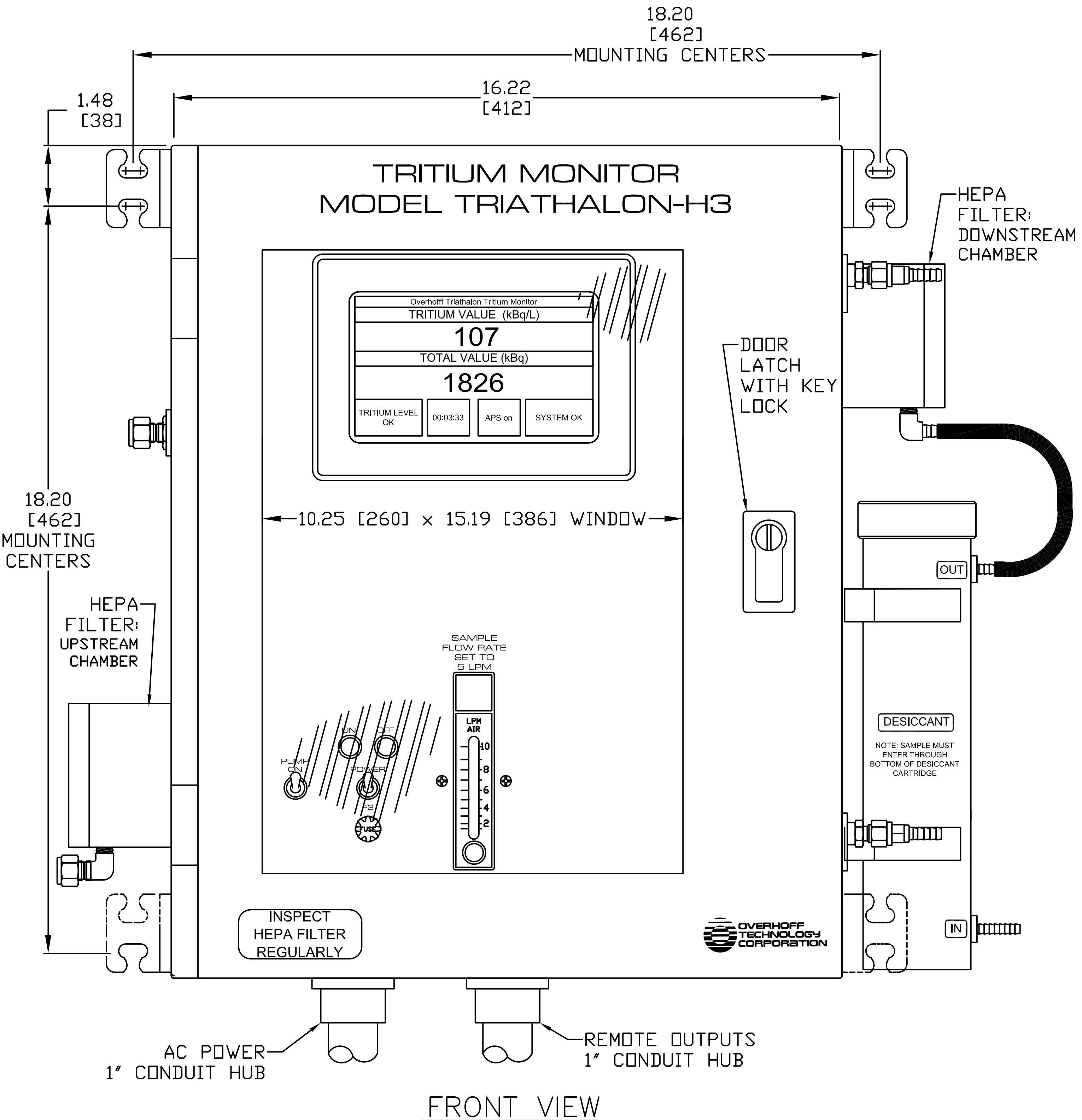


FIGURE 1
MODEL TRIATHALON
TRITIUM MONITOR

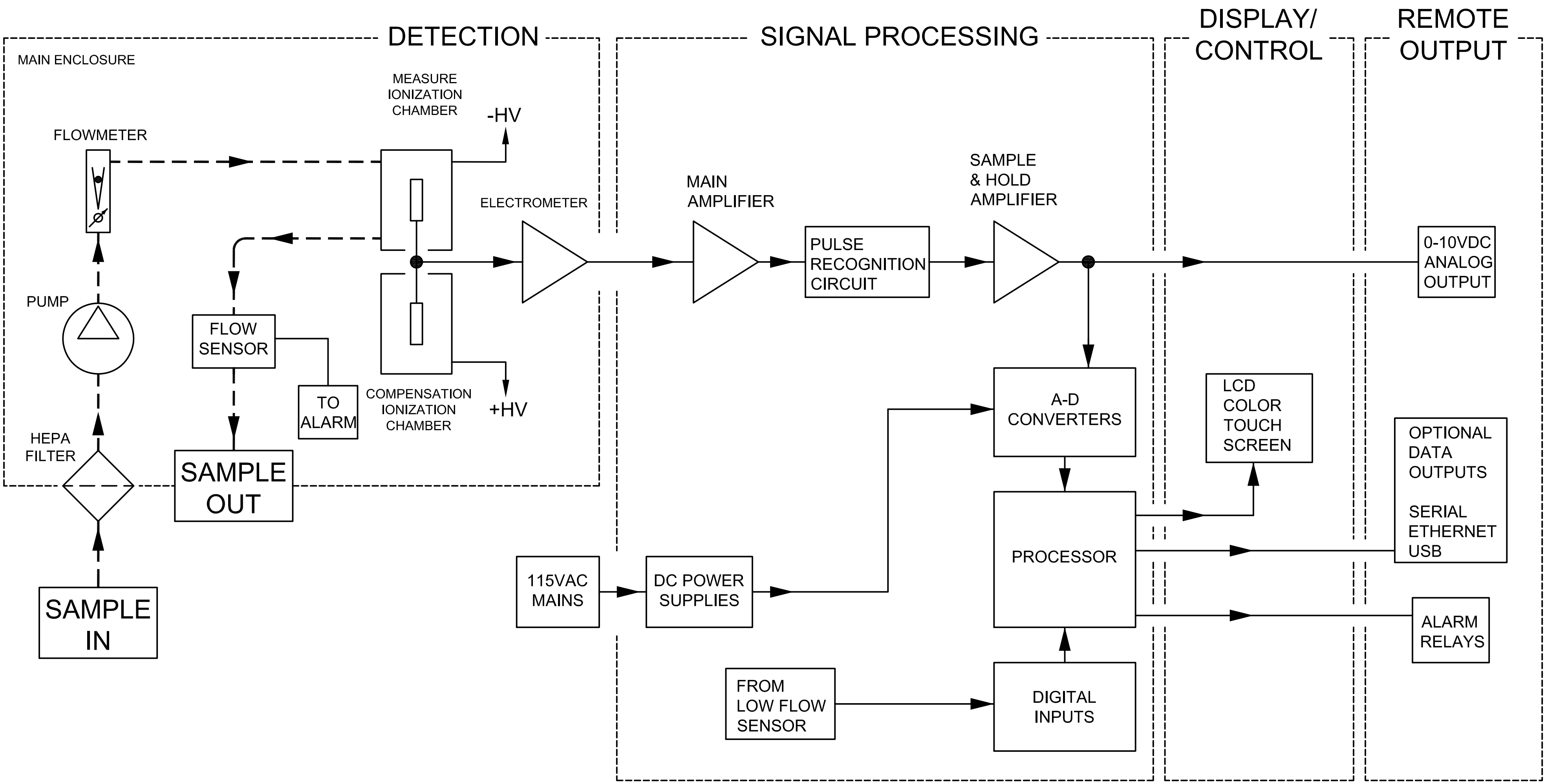


FIGURE 2
BLOCK DIAGRAM
OVERHOFF MODEL TRIATHALON-H3
TRITIUM MONITOR

Model TRIATHALON-H3 Customer Connections

Terminal No.	Description
TB1-0	Chassis Ground
TB1-1	From 115VAC Source (Neutral)
TB1-2	From 115VAC Source (Line)

TB1-8	Low Analog Output (Analog Common)
TB1-9	High Analog Output (0-10V)
TB1-10	Reset Total, switch closure for 2 seconds minimum with TB1-11
TB1-11	Reset Total, switch closure for 2 seconds minimum with TB1-10

TB601-1	High Level Alarm No. 1, N.C.
TB601-2	High Level Alarm No. 1, N.O.
TB601-3	High Level Alarm No. 1, COM.
TB601-4	High Level Alarm No. 2, N.C.
TB601-5	High Level Alarm No. 2, N.O.
TB601-6	High Level Alarm No. 2, COM.
TB601-7	Alert Level Alarm No. 1, N.C.
TB601-8	Alert Level Alarm No. 1, N.O.
TB601-9	Alert Level Alarm No. 1, COM.
TB601-10	Alert Level Alarm No. 2, N.C.
TB601-11	Alert Level Alarm No. 2, N.O.
TB601-12	Alert Level Alarm No. 2, COM.
TB601-13	Malfunction Alarm No. 1, N.C.
TB601-14	Malfunction Alarm No. 1, N.O.
TB601-15	Malfunction Alarm No. 1, COM.
TB601-16	Malfunction Alarm No. 2, N.C.
TB601-17	Malfunction Alarm No. 2, N.O.
TB601-18	Malfunction Alarm No. 1, COM.

FIGURE 3
CUSTOMER CONNECTIONS

SECTION II. INSTALLATION

1.0. GENERAL

The following instructions include all information necessary for the correct installation of the equipment and for the verification of proper operation.

The following information is covered by these instructions:

1. Equipment Checklist
2. Installation Details
3. Storage, Handling and Unpacking
4. Assembly

Equipment Supplied

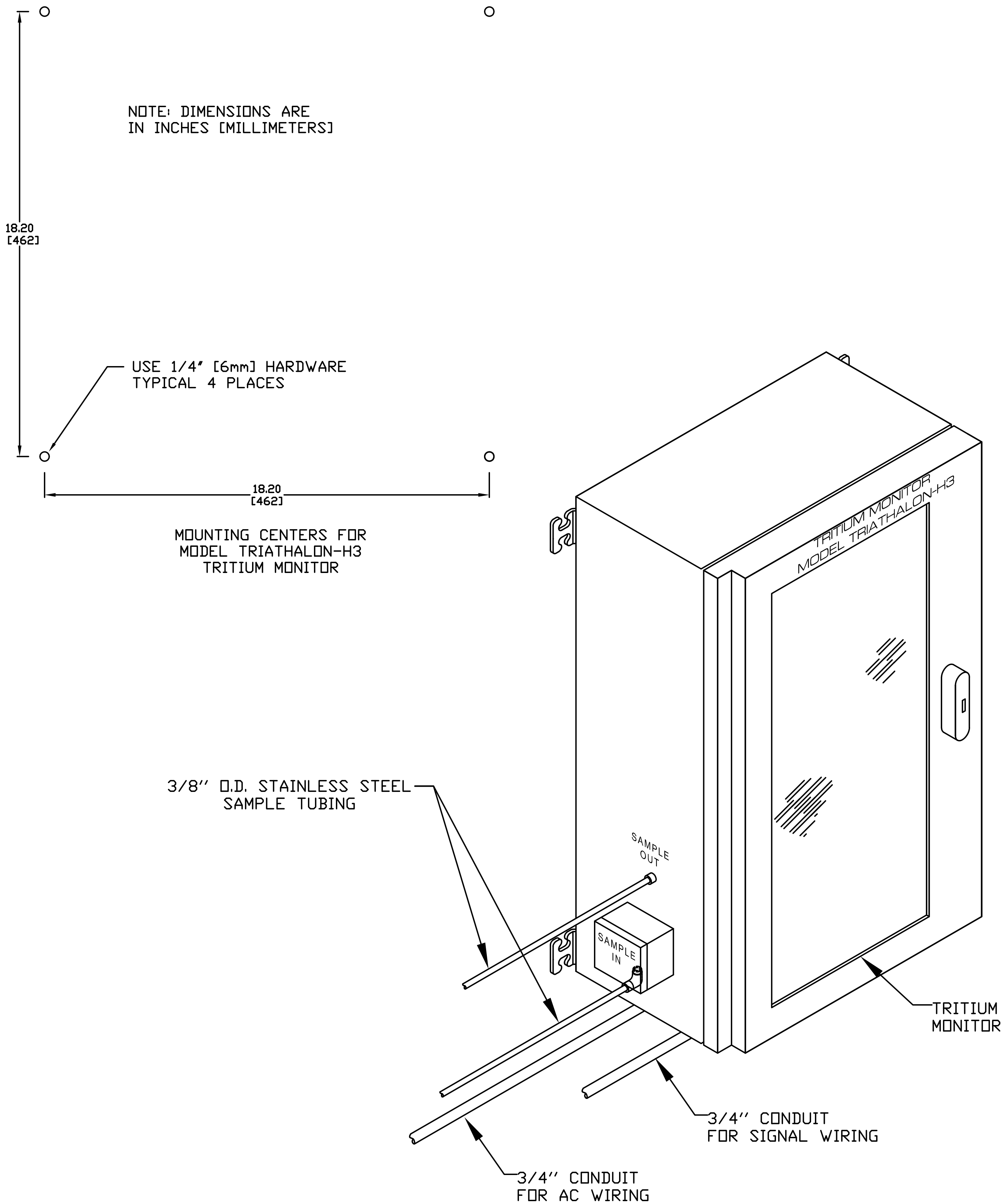
The following equipment has been supplied by the manufacturer:

1 each, Tritium Monitor, Overhoff Technology Model Triathalon-H3

Monitor is enclosed in a fiberglass case ready for wall mounting

Dimensions: 16.2’’ Wide x 20.3’’ High x 9.19’’ deep
[41.2cm Wide x 51.5cm High x 23.4cm Deep]
Excluding door handle and mounting hardware

Weight: 43 lbs [19.6 kg]



TYPICAL INSTALLATION
MODEL TRIATHALON-H3
TRITIUM MONITOR

2.0. EQUIPMENT CHECK LIST

The equipment is packaged in cardboard containers marked in accordance with Packaging and Delivery Procedures.

The contents of the container(s) is as follows:

Carton 1 of 1, 1 each, Tritium Monitor Overhoff Technology Model Triathalon-H3

3.0. STORAGE, HANDLING, UNPACKING

This equipment has been packaged to protect it against damage while stored for extended periods of time in ordinary storage (dry warehouse) facilities.

STORAGE

The individual pieces are protected with plastic wrap and packed in boxboard containers containing one pouch of drying agent to prevent corrosion from high humidity.

The plastic wrapping should not be broken open until the equipment is ready for installation.

The equipment should be protected from damage, should not be dropped, and should be protected from extreme temperatures. Storage conditions of -30° C to +50° and 0 – 95% RH are recommended.

HANDLING

The equipment consists of moderately fragile electronic equipment and should be handled with care. It should not be dropped, subjected to mechanical stress or extreme temperatures.

Evidence of surface damage, creases or tears to the box board containers should be reported at once. If the damage is more than superficial, the container should be opened and the plastic wrap inspected for tears. If torn, inspect the contents for damage. If there is no damage to the equipment, repair the tear in the plastic wrap with heavy-duty adhesive tape. Damaged equipment should be reported at once.

UNPACKING

The equipment should not be unpacked until ready for installation.

When ready for installation, the equipment should be unpacked at the site. No special tools are required for unpacking. Use a sharp knife to cut the adhesive tape seals on the box board containers. Evidence of corrosion of physical damage should be reported at once.

The equipment should be lifted carefully out of the carton and the plastic cover carefully unwrapped.

The carton(s) and plastic cover(s) may be retained for future use in the event that the equipment is to be returned to storage. Retain the installation instructions for used by the appropriate personnel.

4.0. ASSEMBLY

Assembly work consists of:

1. Attaching the enclosure to the wall using the appropriate anchors and tools as required.

2. Attaching conduit and wiring.

3. Attaching stainless steel tubing between the monitor and the existing pumping unit, as well as tubing to and from the sampling point for the pumping unit.

ENCLOSURE AND PUMPING UNIT

Pictorial installation instructions are enclosed with each unit. These units are to be permanently attached to the wall using lead anchors or similar means. The monitor and associated pumping unit may be located close to each other, but spaced sufficiently to permit ease of access for piping and conduit installation.

SAMPLE CONNECTIONS

Sample inlet and outlet connections are attached to the fiberglass enclosure 3/8'' O.D. Stainless Steel tubing compression type.

CONDUIT AND WIRING

The power requirement is 115VAC, 60Hz, 5A, single phase. Conduit fittings are located on the bottom of the enclosure to be used for AC power supply to the tritium monitor as well as control wiring connection. Install the conduit as required. Install the AC wiring between the monitor and existing pumping unit. Use wiring of the appropriate type and current rating. Install wiring for signal and relay connections as required.

Return all keys used to lock the door to the appropriate personnel.

5.0 MAINTENANCE

The Triathalon series instruments have been designed for many years of trouble free service.

Periodic or routine maintenance is comprised mainly of regular inspection of the dust filter, ensuring that it is replaced if it appears to be dirty.

5.1. OPERATOR MAINTENANCE

The following operational checks may be performed at monthly intervals or sooner.

Inspect dust filter for excessive dust build up. Check the flowmeter indication to verify a maximum flow rate above 10 liters per minute. Return the flowrate to the recommended value of 4-6 LPM or as otherwise established for your particular installation.

Use a gamma check source to check operation of the instrument.

Manipulate the alarm set point potentiometer to verify correct functioning of the alarm.

If the instrument is suspected of DRIFT, the zero reading may be verified. This should be done by an instrument engineer or technician.

5.2. SUPERVISORY MAINTENANCE

The following tasks are the responsibility of the supervisory engineering staff.

1. Calibration verification is to be performed at yearly intervals, or as otherwise specified.

2. Response checks (in case of need for cursory verification of the operational status of the ionization chambers and of the whole system), of the system may be tested by using a low strength gamma radiation check source. This must be done under the strict supervision of a health physicist. The gamma source is brought into proximity of each ionization chamber and the response is observed.

5.3. FACTORY MAINTENANCE

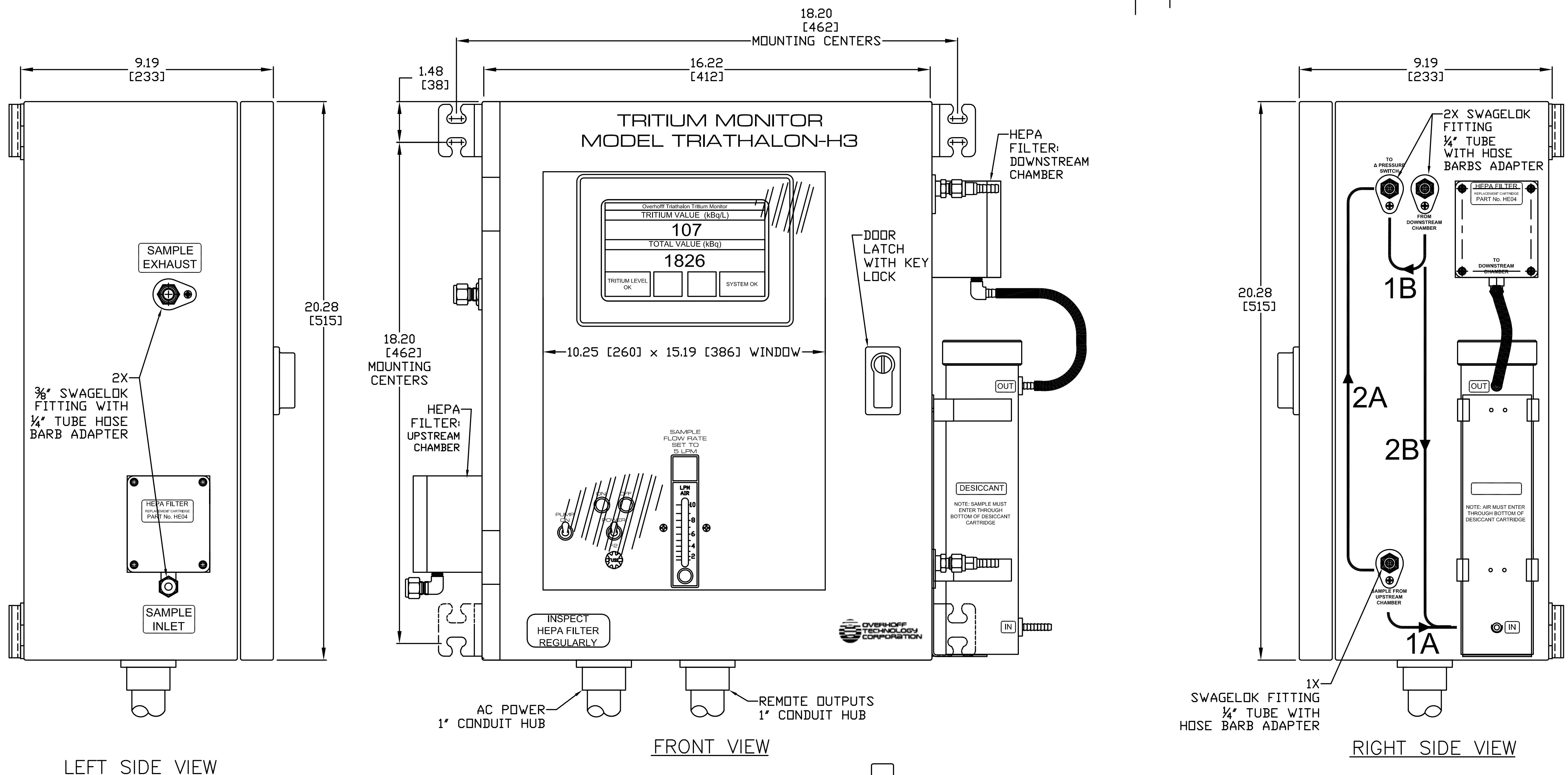
A determination that the system appears to have suffered a functional failure should require that the factory be notified (telephone (513) 248-2400, facsimile (513) 248-2402). Engineering assistance via telephone or facsimile, will be supplied by the manufacturer OVERHOFF TECHNOLOGY CORPORATION.

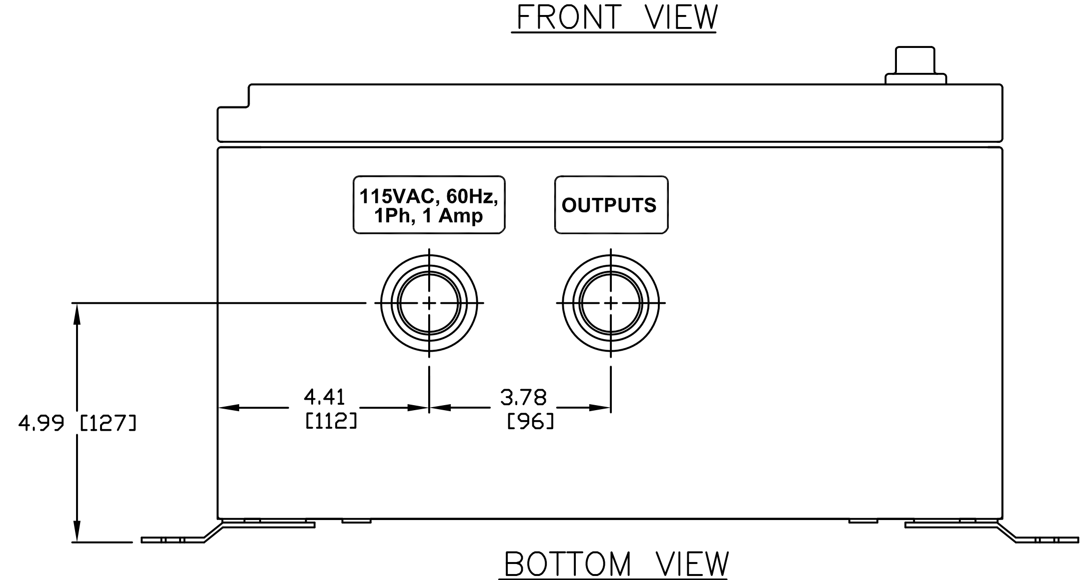
Should it appear to be necessary to return the instrument to our factory, authorization for the return must be obtained from Overhoff Technology Corporation prior to shipping. In-freight charges will be borne by the customer.

SECTION III. DRAWINGS AND SCHEMATICS

DRAWING NUMBER	DESCRIPTION
1021345 Sheet 1 of 2	Enclosure General Layout, Model Triathalon-H3
1021345 Sheet 2 of 2	Enclosure General Layout, Model Triathalon-H3
1021345-PD	Pneumatic Flow Diagram, Model Triathalon-H3

REVISIONS			
REV	DESCRIPTION	DATE	APPVD



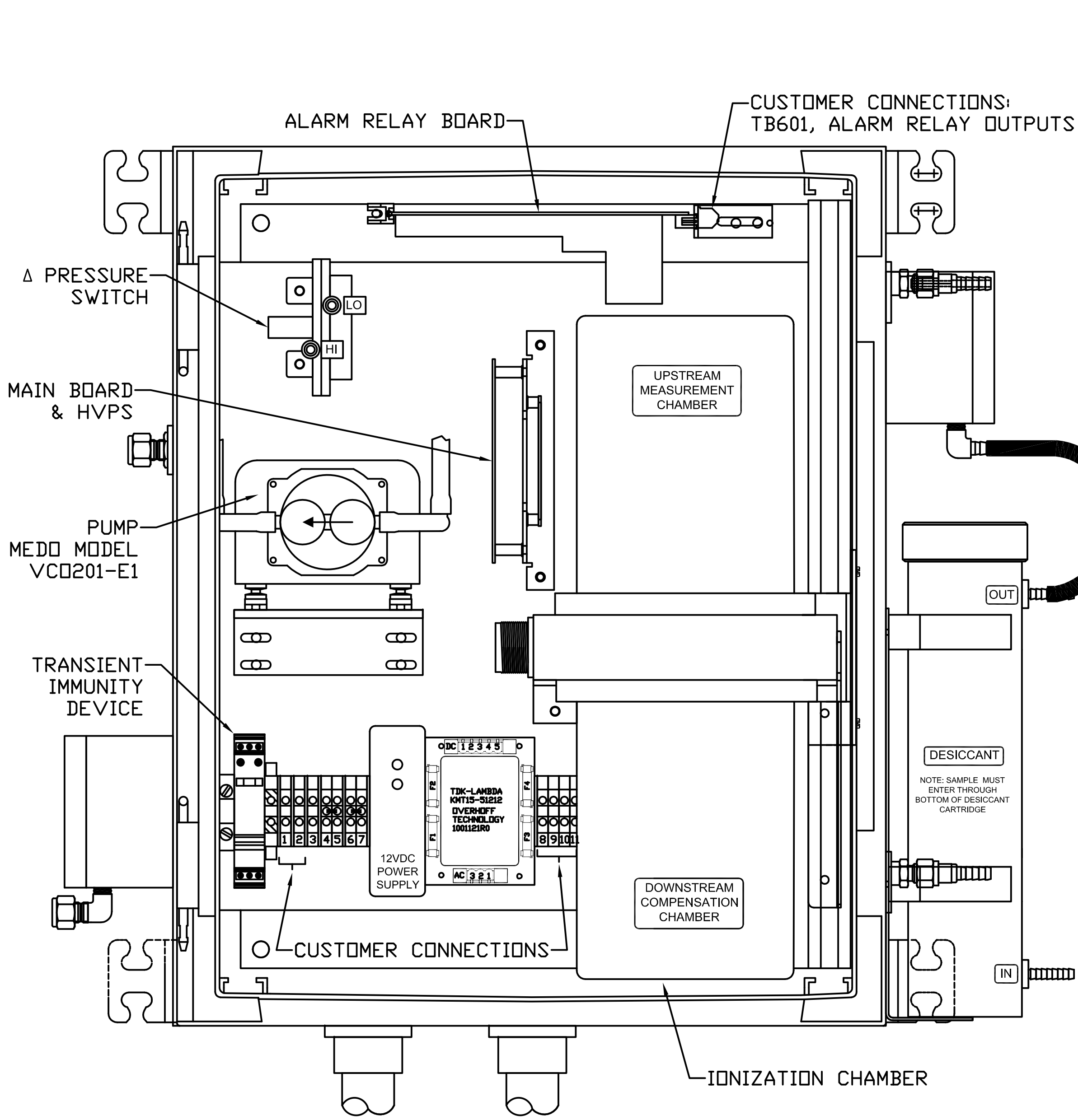


NOTES:

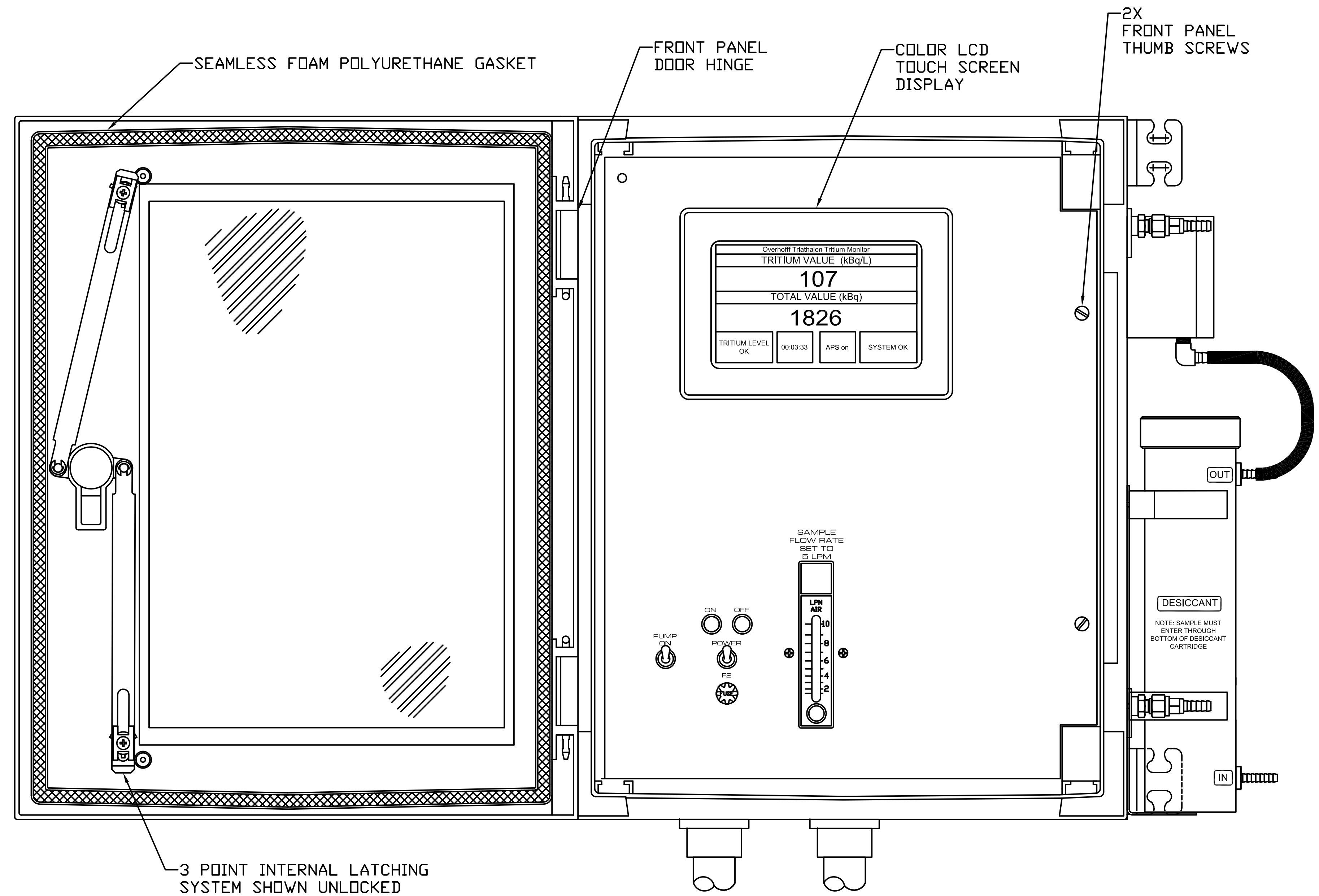
1. DIMENSIONS = INCHES [MILLIMETERS]
2. TRITIUM MONITOR UNIT WEIGHT; 42 LBS [19.6 kg]
3. ENCLOSURE SPECIFICATIONS:
   - A. MANUFACTURER: VYNCKIER, CATALOG No. ANB2016-HKLA-AFPH2016-A
   - B. ENCLOSURE MATERIAL MADE OF LIGHT GREY (RAL 7035) HOT MOLDED FIBERGLASS REINFORCED POLYESTER.
   - C. U.L. LISTED PER STD. 508.
   - D. CSA CERTIFIED PER STD. C22.2 NO. 94.
   - E. NEMA RATED TYPE 3, 3R, 3S, 4, 4X, 12 AND 13.
   - F. IEC 529 RATED IP 66-11.
   - G. RESISTANT TO TEMPERATURES UP TO 150 DEG C.
   - H. SELF EXTINGUISHING AND HALOGEN FREE.
4. WALL MOUNTING BRACKET SPECIFICATIONS:
   - A. MANUFACTURER: VYNCKIER, CATALOG No. AN-MFSS, PACK OF 4, ORDER QUANTITY IS 1 EACH.
   - B. MATERIAL: STAINLESS STEEL
   - C. WALL MOUNTING HARDWARE NOT SUPPLIED, USE 0.25 [6] DIA. HARDWARE TO MOUNT DIRECTLY TO WALL OR UNISTRUT CHANNEL
5. FOR PNEUMATIC FLOW DIAGRAM, REF DWG NO. WD-TRIATHALON
6. FOR WIRING DIAGRAM, REF DWG NO. WD-321-OPG-2759.

MODEL TRIATHALON-H3 TRITIUM MONITOR WORK ORDER: CUSTOMER:	OVERHOFF TECHNOLOGY CORPORATION — MILFORD, OHIO 45150 U.S.A. TRITIUM MONITOR MODEL TRIATHALON-H3, ENCLOSURE GENERAL LAYOUT
DRAWN: J. CREECH — DATE: 5-20-2014	SIZE: B — FILE NAME: 1021345-xxxx.dwg — DWG NO.: 1021345 — REV: 0
APPROVED: D. WILLIAMSON — DATE: 5-20-2014	SCALE: 0.25 — SHEET 1 OF 2

REVISIONS			
REV	DESCRIPTION	DATE	APPVD



FRONT VIEW –
DOOR REMOVED TO SHOW SUBPANEL LAYOUT



FRONT VIEW – COVER OPEN 180 DEG.

MODEL TRIATHALON-H3
TRITIUM MONITOR

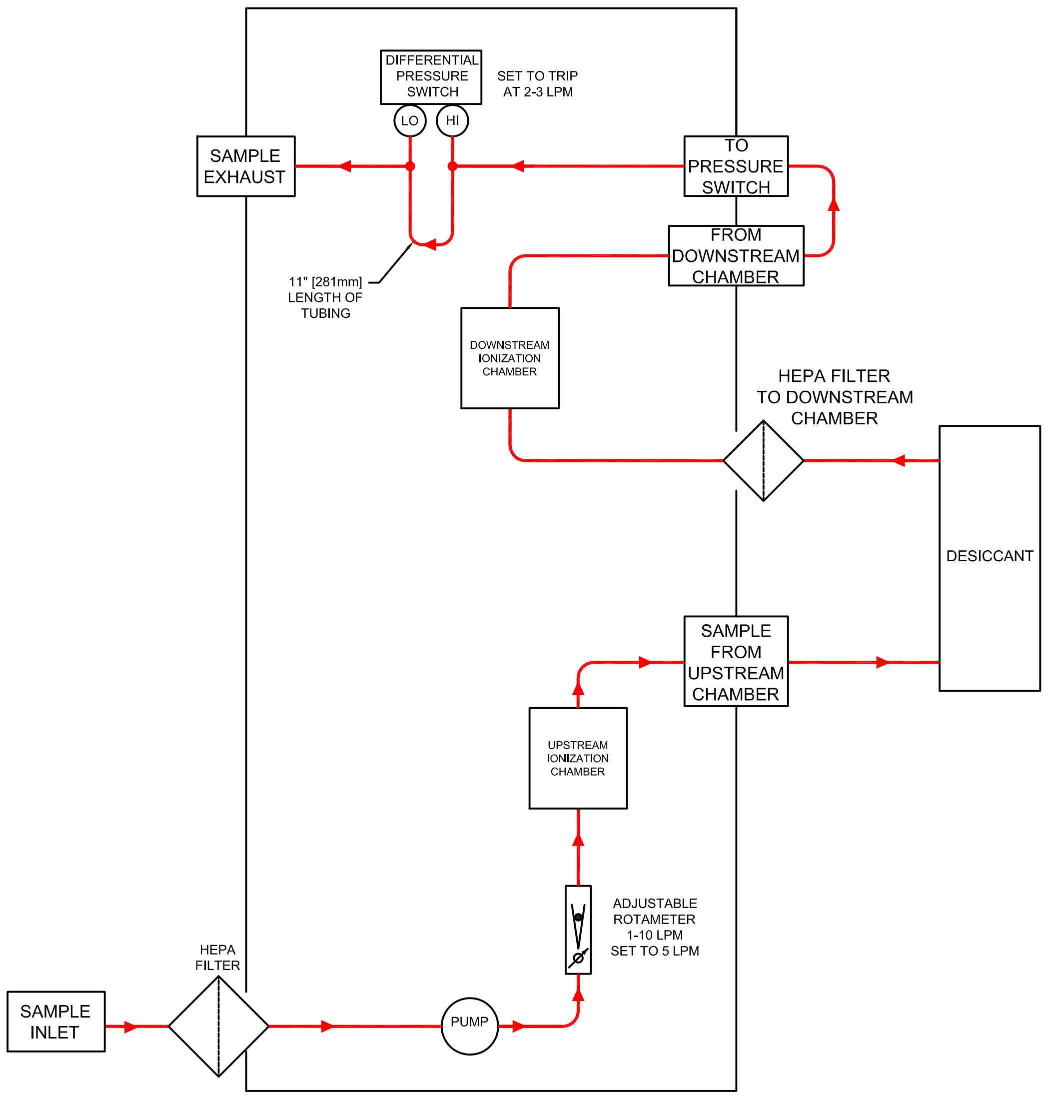
WORK ORDER:
CUSTOMER:

OVERHOFF TECHNOLOGY CORPORATION
MILFORD, OHIO 45150 U.S.A.

TRITIUM MONITOR MODEL TRIATHALON-H3, ENCLOSURE GENERAL LAYOUT

DRAWN	DATE	SIZE	FILE NAME	DWG NO.	REV
J. CREECH	5-20-2014	B	1021345-xxxx.dwg	1021345	0
APPROVED	DATE	SCALE	0.25	SHEET	2 OF 2
D. WILLIAMSON	5-20-2014				

REV	REVISIONS DESCRIPTION	DATE	APPROVED

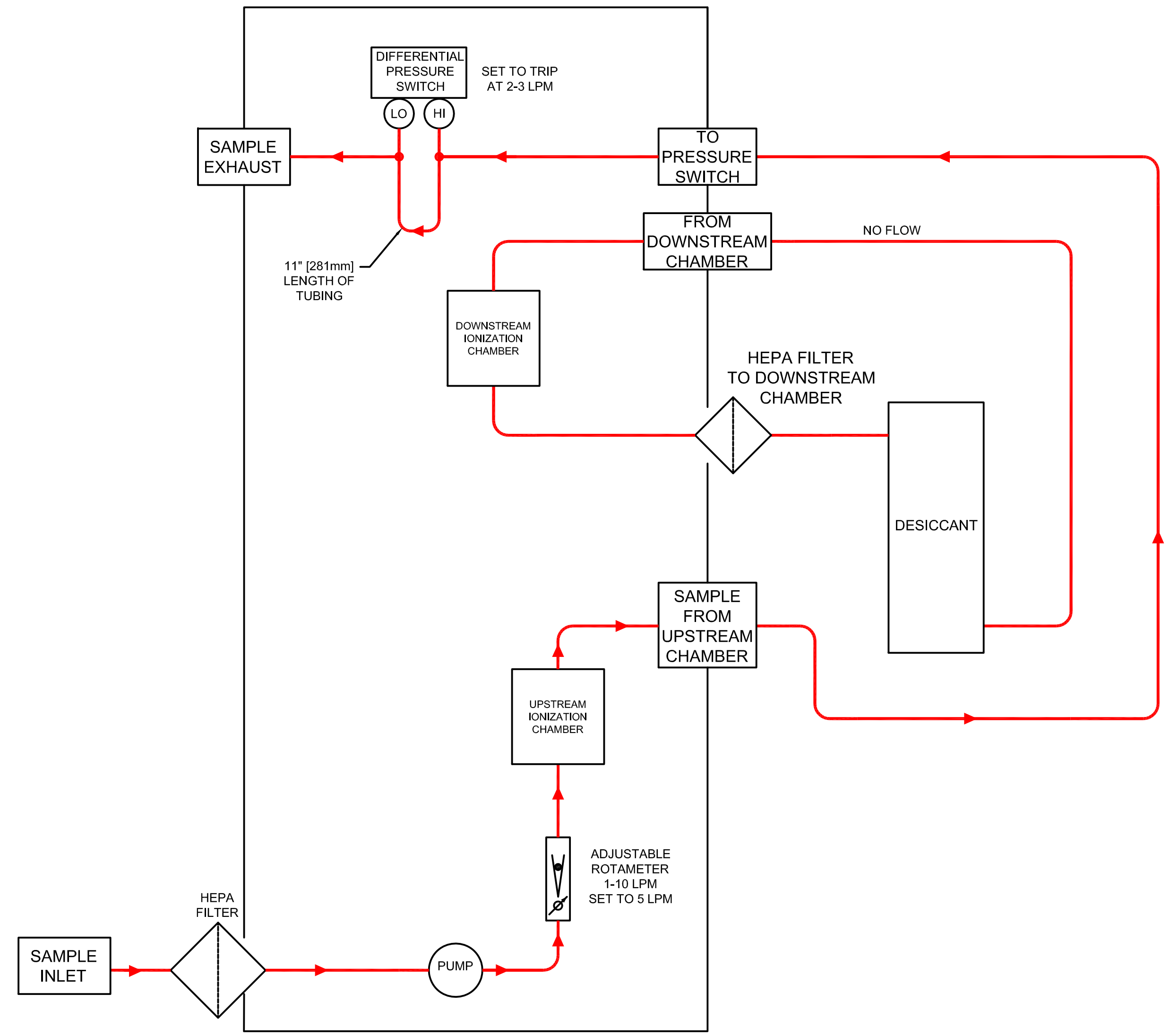


NORMAL MODE OF OPERATION

PNEUMATIC FLOW DIAGRAM

MODEL TRIATHALON-H3

for TRITIUM (HTO) ONLY MEASUREMENT



ALTERNATE MODE OF OPERATION

PNEUMATIC FLOW DIAGRAM

MODEL TRIATHALON-H3

for TOTAL TRITIUM (HTO+HT) MEASUREMENT

AND GAS CALIBRATION

MODEL TRIATHALON-H3
TRITIUM MONITOR

WORK ORDER:
CUSTOMER:

OVERHOFF TECHNOLOGY CORPORATION

MILFORD, OHIO 45150 U.S.A.

MODEL TRIATHALON-H3
PNEUMATIC DIAGRAM

DRAWN	DATE	SIZE	FILE NAME	DWG NO.	REV
P. BUERKLE	8-1-12	B	1021345.dwg	1021345-PD	
APPROVED D. WILLIAMSON	DATE 8-1-12	SCALE NONE		SHEET 1 OF 1	

OPERATION INSTRCTIONS

Triathalon Tritium Monitor

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1. STARTUP

The front panel toggle switch on the right turns the system on. The left toggle switch turns on the pump.

The display will show the following sequence as the instrument initializes:

An Overhoff Technology splash screen is displayed for 10 seconds

A black screen with a blinking cursor in the upper left corner is displayed for 30 seconds

A white screen divided into two buttons is displayed for 2 seconds

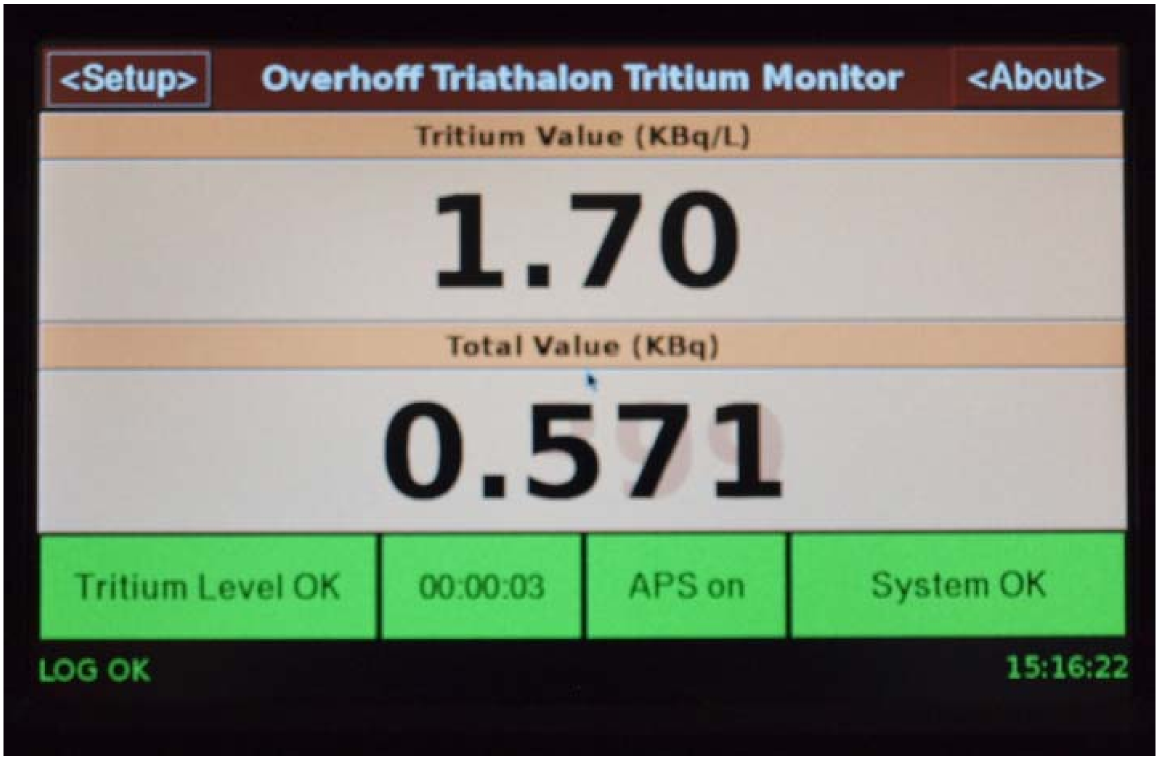
A white screen with a pointer in the center is displayed for 10 seconds

The main screen will appear, and data will be shown several seconds later

2. SHUTDOWN

The Triathalon can be switched off from the front panel on-off switch without hurting the computer, but when datalogging, you should go to the menu Setup->Shutdown/Upgrade/Defaults and press the “Shutdown Software” button before switching the power off.

3. THE MAIN SCREEN



<About> button: displays the model, software revision number, and contact information

<Setup> button: allows setup parameters of the instrument to be changed

"Tritium Level OK" button: this button will turn yellow or red if the tritium limits are exceeded. This button should also be pressed to acknowledge an alarm.

The second button in the bottom row displays the time over which the total activity has been summed. If "manual reset mode" is selected, pressing this button clears the total, and resets the time to zero. If "automatic reset mode" is selected, the total will be reset at midnight automatically.

"APS ON" button: press this button to turn alpha pulse suppression on or off.

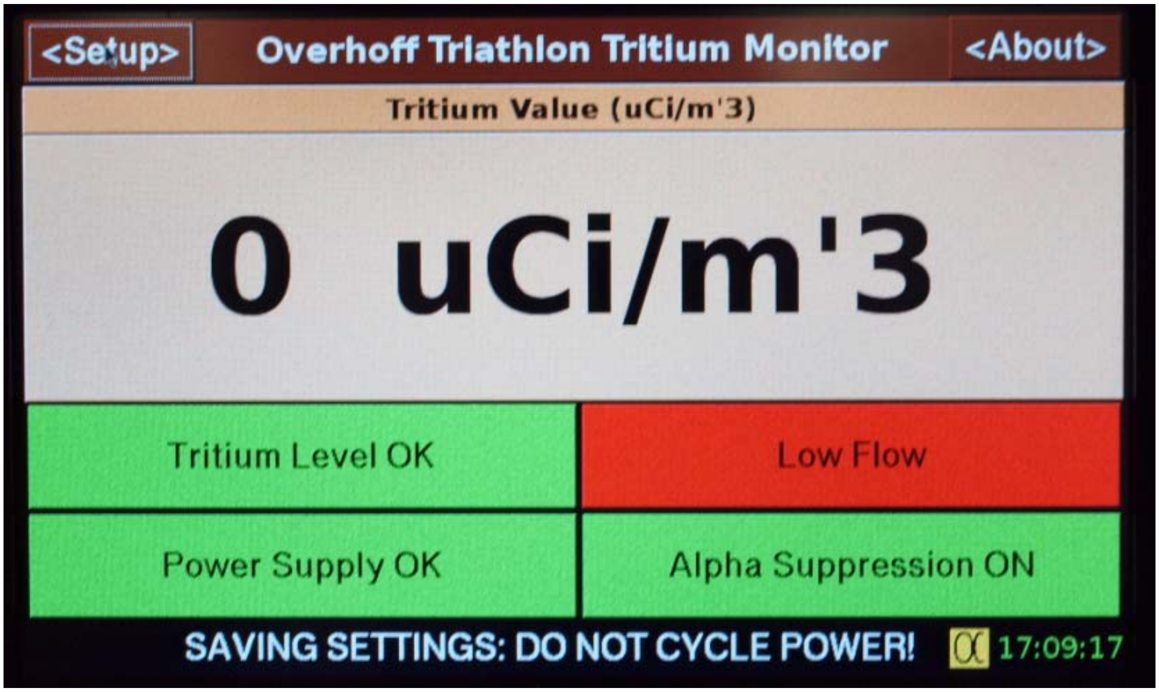
"System OK" button: this button will turn red if a malfunction condition is detected: this could be due a low flow condition, an internal communications problem, or a power supply problem. Pressing this button has no effect.

The field in the lower right corner displays time in hour:minute:second format. It will update every one second. This is a way to know that the monitor is still functioning even when the tritium value is not changing.

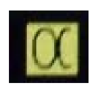
Additional field in the bottom left corner – this field will display a count of the number of datalog points taken. This will reset to zero every midnight.

Note: when the "Alpha Suppression" button is pressed (and also after any setup parameters are changed in the "Setup" screen) the message "SAVING SETTINGS – DO NOT CYCLE POWER" will be displayed on the bottom line of the display. It is very important that the power not be switched off while this message is being shown! The message is shown below.

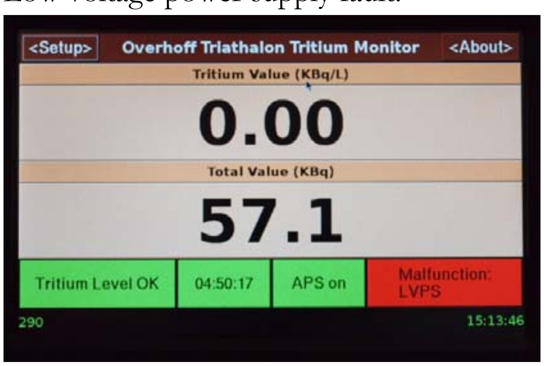
NOTE: Do not turn off the Triathalon when it is saving its settings!
The "Saving Settings" message will disappear when the save is complete.



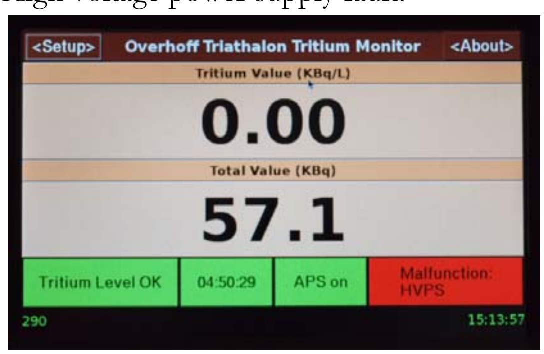
Main Screen Indicatiors:

Alpha pulse icon: if Alpha Suppression is turned on, this icon  will appear whenever an alpha pulse is detected and suppressed.

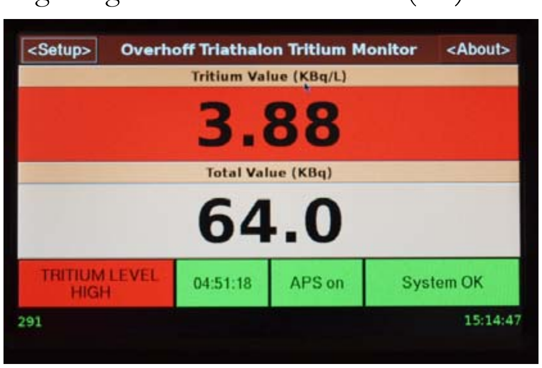
Low voltage power supply fault:



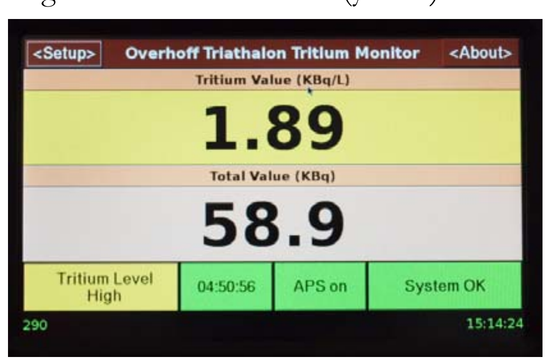
High voltage power supply fault:



High High alarm level exceeded (red):



High alarm level exceeded (yellow):



Low flow alarm:

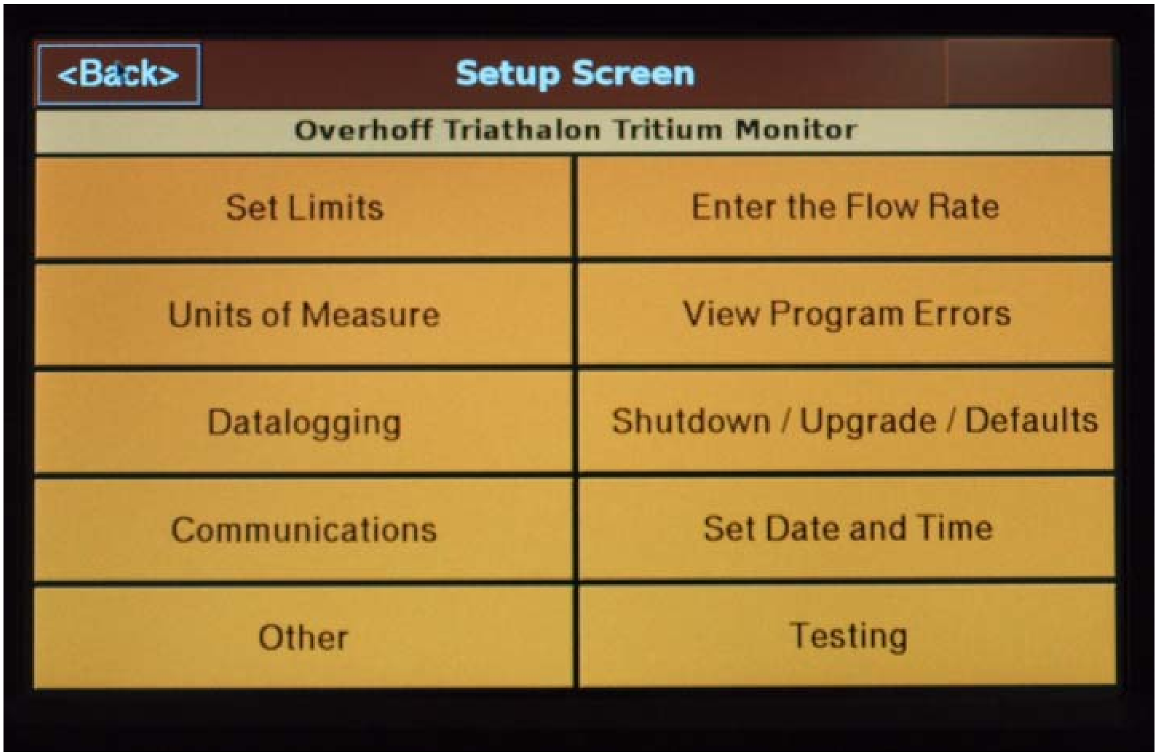
Internal communications alarm:

4. THE ABOUT SCREEN

Pressing the "About" button on the front panel will display this screen with contact information, and the version of software running in the Triathalon.

5. THE SETUP SCREEN

The setup screen is shown when the <Setup> button on the main screen is pressed.



There are 10 buttons that you can press on the setup screen. Each is explained below.

1. Set Limits – allows you to define the limit mode and values for the "high high tiritum" and "high tritium" limits.
2. Units of Measure – here you can set the units for concentration, total activity, and volume.
3. Datalogging: the monitor can log its data to an internal USB flash drive. Here you can set the parameters to make this happen.
4. Communications - the monitor can send its data to a remote computer. Here you can set the parameters to make this happen.
5. Other - here you can specify an offset for the monitor, so that it reads zero when there is no tritium present. (On totalizing instruments only - you can also set the total activity to log the value and reset to zero every midnight.)
6. Flow Rate - you can enter the value displayed on the flow meter into this screen, to be used in the calculation of total activity. (This is necessary in totalizing instruments only.)
7. View Program Errors – program error conditions are trapped so they don't crash the computer. Any program errors that occur are logged, and you can view them in these screens.
8. Software – allows you to shutdown and update the computer's software. Although the power can be switched off without hurting the computer, you should shut down the software first, to make sure that datalogged datapoints are not lost, and the total activity is written to the daily file (totalizing instruments only.)
9. Date and Time – sets the computer's internal clock.
10. Testing – allows you to boot into full Debian Linux for troubleshooting purposes, display the raw data coming from the tritium monitor board, or simulate a software failure.

In any screen, clicking "OK" will save the new setup value, and clicking "Cancel" will not save the new setup values.

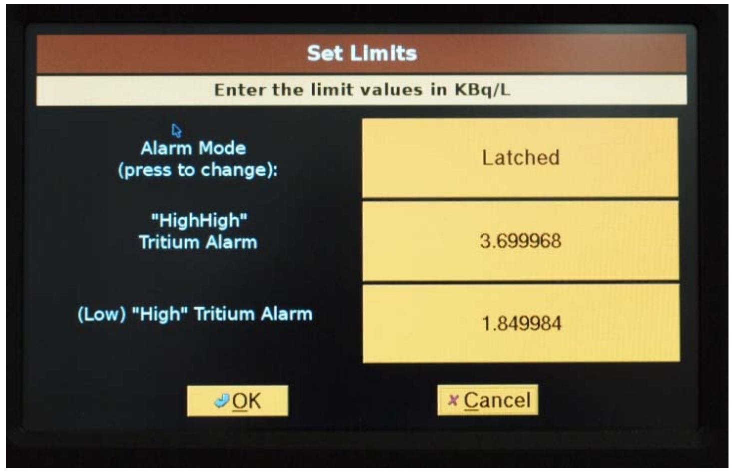
1. Set Limits:

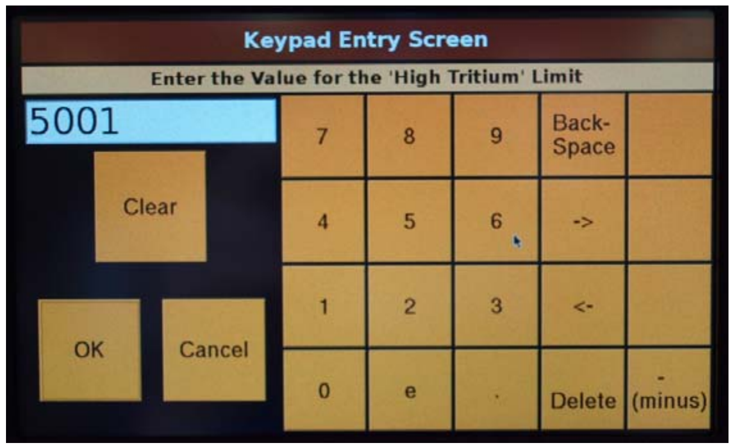
There are two limits: a "High High" limit, and a "High" limit. Each limit has a separate relay which will close when the tritium limit value is exceeded. Both limits share the same button on the main screen.

Press the top right button once or twice to change the alarm mode. The alarm modes are "Unlatched", "Latched" and "Acknowledge". Alarm modes are explained below. The alarm mode cannot be set independently for "High High" and "High".

Pressing the other two buttons in the Set Limits Form will display the "Keyboard Entry Screen". There you can set the limit values.

Note: if you change the units of display, you must make sure that the limit values are set correctly to match the new units.





Alarm Modes

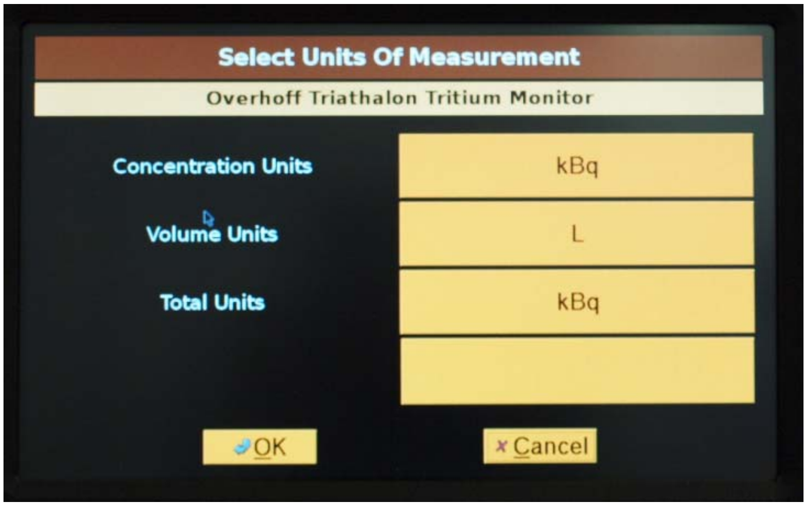
An "alarm" has three components: the screen indicators, the relay output, and the audio alarm (note: not all models have autio alarms). An alarm is "Active" (this means "on" or "true") when the value of radiation is above a "limit value".

LATCHED In the latched mode, the alarm remains active as long as the value of radiation remains above the limit value and until the alarm's screen button is pushed. That is: if the value of radiation goes below the limit value before the screen button is pushed, the alarm's components will remain active until the screen button is pushed. The alarm's screen button doesn't seem to do anything if the alarm condition remains true, but the button will allow the alarm's components to be cleared when the value of radiation goes below the limit value.

UNLATCHED In the unlatched mode, value of radiation goes above the limit value, all three alarm components turn on and stay on as long as the value of radiation stays above the limit value. All alarm components will turn off when the value of radiation becomes less than the limit value. The alarm's screen button button has no effect in this mode.

ACKNOWLEDGE Same as LATCHED, but pressing the alarm's screen button turns off the audio alarm, even when the alarm condition remains true. For instruments without an audio alarm, this mode is identical to the "Latched" mode.

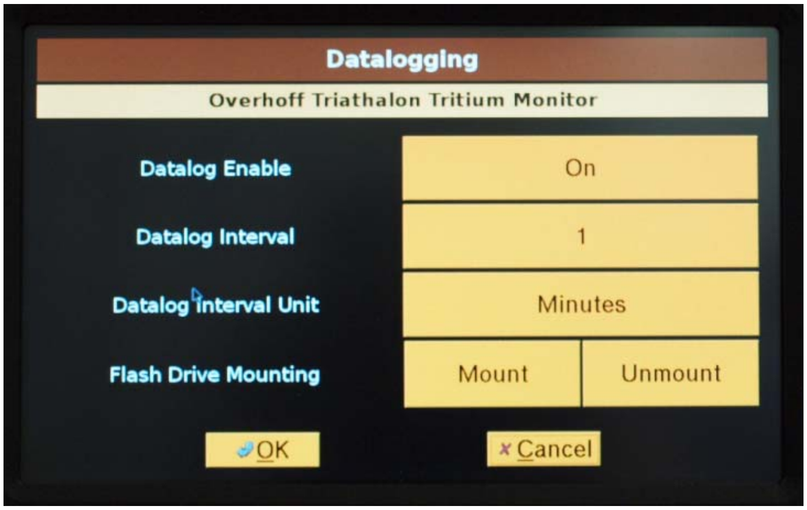
2. Units of Measure:



Press the buttons in the right column to cycle through all the choices.

Concentration Units and Volume Units should be set to one of the following: pCi/cc (or pCi/ml), nCi/L, uCi/m'3, mCi/m'3, Ci/m'3, MBq/m'3, kBq/L, Bq/cc (or Bq/ml), or MPCA and m'3.

3. Datalogging:



You can store datapoints to a USB flash drive inserted in the USB slot on the computer board (the bottom slot, closest to the board). Press the buttons in the right column of the form, to:

(1) Turn datalogging on or off.

(2, 3) Choose an interval for datalogging in seconds or minutes. The monitor measures a new value every one or two seconds. When a longer period of time is chosen for datalogging, datapoints are averaged over this time period.

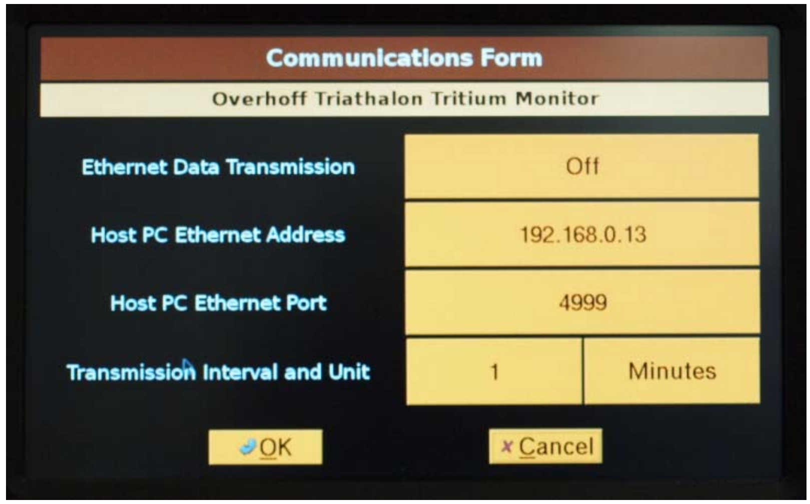
Mount / Unmount the flash drive: this is very important. If you remove the flash drive before unmounting it, data may be lost.

<u>Filenames and locations of data files:</u> the software organizes data files on the USB flash drive in a folder naming system based on the current date.

- The top level folder will have subfolders named for a year. "2009", "2010", etc.
- Each year will have subfolders named with the abbreviation of a month: "Jan", "Feb", etc.
- Each month will have daily data files named year_mm_dd.txt. Example: 2009_11_06.txt.

For instruments with a totalizer, there is also a file "DailyTotals.txt" in each month's subfolder, which contains the sum of the day's detected total activity. If there is more than one line in a day, it means that the software was stopped (the current total activity is written to this file when the software is stopped).

4. Communications:



You can transmit datapoints to a program running on a remote computer Press the buttons in the right column to:

(1) Turn transmitting on or off.
(2,3) Specify the IP address and listening port of the remote computer.

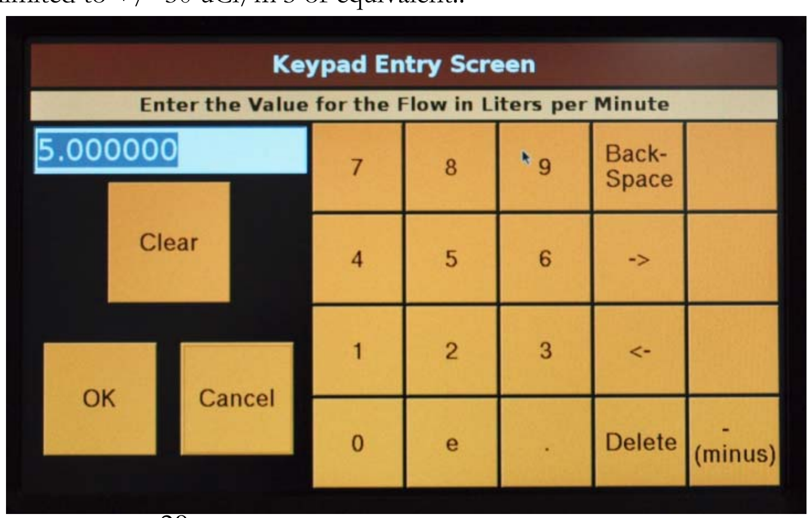
(4,5) Choose an interval for data transmission in seconds or minutes. The monitor computes a new value every one or two seconds. When a longer period of time is chosen for transmitting, all datapoints are averaged over this time period.

The format of the data in a datapacket is the same as is written to the USB flash drive, and this is detailed in section 5.

5. Other:

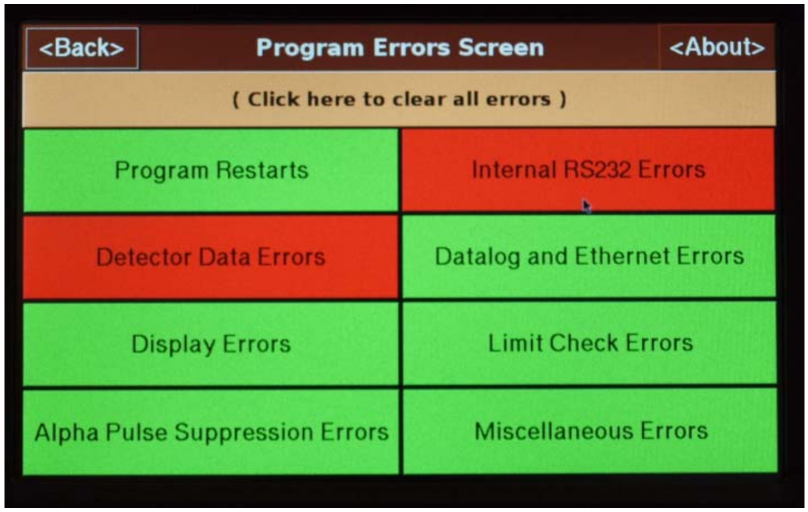
"Total Activity Reset Mode" On instruments that measure total activity over a time interval, this controls the end of the interval. With Manual Mode, the instrument will continue to totalize until a front panel button is pressed, or a remote reset signal is received. In Automatic Mode, the total will automatically be set to zero at midnight every day.
"Enter an Offset" An offset can be entered that will "zero"the instrument's reading, so that the instrument reads zero when no tritium is present. This value must be entered in the units of concentration display. The value is limited to +/- 30 uCi/m'3 or equivalent..

6. Flow Rate

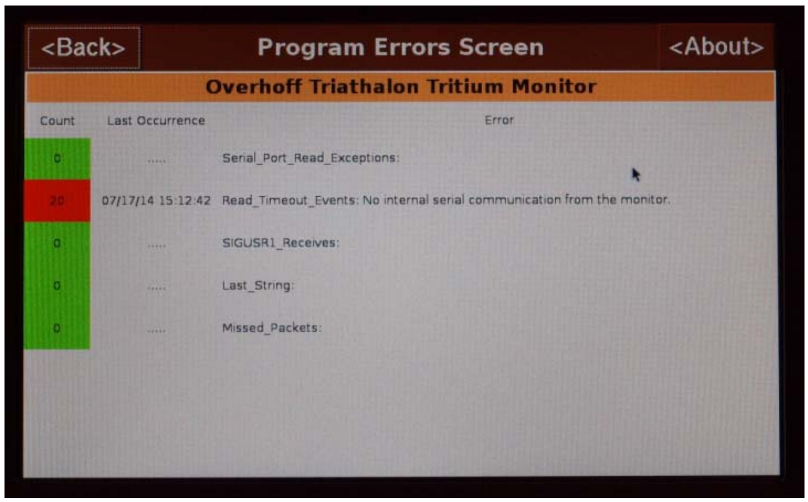


This screen allows you to enter the flow rate in Liters per minute. (It is only necessary to set the flow rate in instruments that perform totalization.)

7. View Program Errors



Program error conditions are trapped so they don't crash the computer. Any program errors that occur are logged, and you can view them by pressing one any the buttons in this screen.



The number of errors, the time of last occurrence, and information about each error is displayed.

8. Software

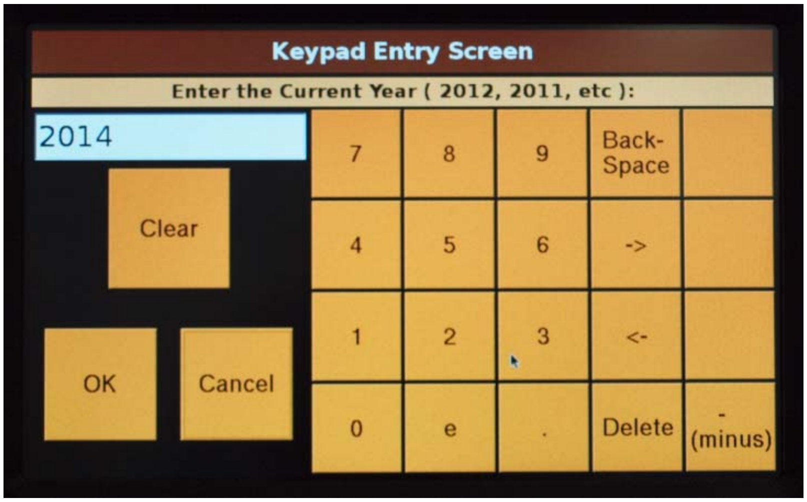
Restore Factory Defaults: pressing this button will reset all setup parameters to the original factory settings.

The Update Software button will attempt to load new software into the computer from an update file on the USB flash drive. The procedure is described in section 6.

Shutdown Software button: It is good to always do this before turning off the power. This makes sure that datalogged datapoints are not lost, and the total activity is written to the daily file (totalizing instruments only.)

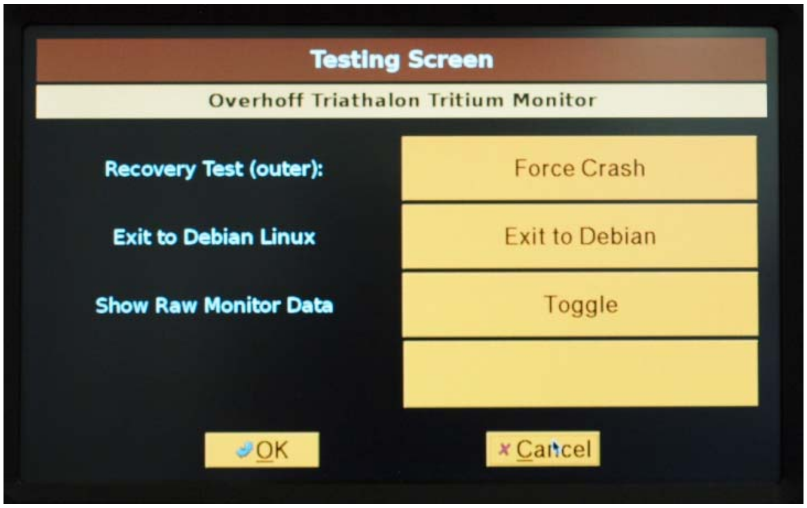
Copy button: this writes the setup files, "otcmeas.cnf" and "otcconfig.cnf", to the USB flash drive. This is only necessary in order to send these files to Overhoff to help diagnose problems.

9. Date and Time



This screen will allow you to set the computer's internal clock to the correct time. Click "OK" after each step. Enter the:
year,
month (1 -12),
day (1-31),
hour (0-23),
minute (0 -59),
and second (0-59).

10. Testing



Force crash: the computer will automatically restart the program if it ever crashes – pressing this button will force the program to crash.

Exit to Debian Linux: this button allows the computer to boot fully into Linux for troubleshooting purposes, and for setting a different IP address.

Show Raw Monitor Data: also for troubleshooting purposes, the raw data that the monitor board passes to the computer can be displayed at the bottom of the front panel screen.

Note: during the final stages of bootup, a screen is displayed with two buttons. Pressing the top button boots into the program's run-time environment. Pressing the bottom button boots into the full Linux environment. In both environments, xterm windows can be displayed, into which you can enter Linux commands for troubleshooting purposes.

6. MORE ON DATALOGGING

The USB flash drive behavior with this instrument's computer is not as nice as you may be used to, on a Windows PC. For best results, follow these guidelines:

1) Always insert the USB flash drive into the bottom USB slot (closest to the computer board).
2) Always have a USB flash drive inserted at bootup, even when datalogging is turned off.
3) To read the USB flash drive on an external computer, press Setup->Datalogging-> Unmount before removing the flash drive, remove it, and insert the spare flash drive in its place.
4) Press Setup->Datalogging->Mount after reinserting the flash drive. NOTE: it may say "Mount Error" – try again until it mounts. It usually mounts within 10 seconds of being inserted.
5) Overhoff has included two flash drives that are known to work. Not every brand of flash drive will work with this computer.

Datalogging is enabled by default, and it is set up to store one datapoint per minute. At this data rate, one USB flash may hold 10 years of data.

Data Format:

```
11/03/2012;12:03:02;1;154.887700;MBq/m'3;0.000000;Ci;0.000000;Ci;110000□□
11/03/2012;12:03:00;1;154.887700;MBq/m'3;0.000000;Ci;0.000000;Ci;110000□□
11/03/2012;12:02:59;1;154.887700;MBq/m'3;0.000000;Ci;0.000000;Ci;110000□□
11/03/2012;12:02:57;1;154.887700;MBq/m'3;0.000000;Ci;0.000000;Ci;110000□□
11/03/2012;12:02:55;1;154.887700;MBq/m'3;0.000000;Ci;0.000000;Ci;110000□□
```

1) Date
2) Time
3) Number of datapoints (1)
4) Tritium Concentration
5) Tritium Concentration Unit
6) Total Activity in the interval (totalizing instruments only)
7) Total Activity unit (totalizing instruments only)
8) Total Activity since last reset (totalizing instruments only)
9) Total Activity since last reset unit (totalizing instruments only)
10) Limit check bits: note: these are the state of the overlimit, not the state of the relay
    - HighHigh overlimit
    - High overlimit
    - Malfunction Alarm
    - HV failure
    - LV failure
    - Unused

(The two end characters shown are \r\n)

7. SOFTWARE UPGRADE PROCEDURE: Overhoff may provide new software releases to add new features or to fix bugs. The new release software will be sent to customers as an email attachment named .tgz. Do not unzip this file.

This file should be placed UNZIPPED on one of the Overhoff USB flash drives in a folder named "install". After this has been done, there are two ways to proceed.

A. Manual Update

1) Shutdown the Overhoff instrument, remove the USB flash drive (if present) and place the USB flash drive with the new software in the bottom slot, closest to the board.
2) Connect a computer keyboard to the top USB slot.
3) Power on the Overhoff instrument.
4) Wait approximately 30 seconds, then be ready to press anywhere in the top half of the screen when the screen turns white and some text appears. Press anywhere in top half of the screen the screen immediately when the text is shown.
5) A window should be displayed.
6) Type this command into the window: /home/opg/mupg
   (mpug stands for manual upgrade)
7) A list of files should appear on the screen.
8) Wait until the Linux prompt appears again. When it does appear, the upgrade has been completed.
9) (Optional) Replace the original USB flash drive (if there was one present)
10) Type this command into the window: reboot
11) Remove the keyboard from the USB slot.

B. Automated Update – this is currently broken – use the Manual Update method.

1) Pressing the "About" button, and write down the current version of software.
2) Go to Setup -> Datalogging screen.
3) Unmount the USB flash drive currently inserted. (press "Unmount" button).
4) Remove and insert the USB flash drive with the new upgrade file.
5) Wait 10 seconds, then mount the USB flash drive (press "Mount" button).
6) Press "cancel", then press the "Shutdown/Upgrade/Defaults" button.
7) Press the "Update Software Button".
8) Wait several seconds; then you should hear a soft noise as the new software is written to the internal flash drive for 6 or 7 seconds.
9) The screen will clear and the computer will reboot.
10) Verify that the new software was installed by pressing the "About" button.

8. NETWORK ADDRESSING

When communications are enabled, the Overhoff instrument will automatically send a data packet to a remote PC's IP address and listening port at a time interval configured by the user.

The Overhoff's internal computer's IP Address is factory-set to 192.168.0.58. This can be changed by editing the file /etc/network/interfaces with the text editor "nano":

1) Connect a keyboard to the open USB slot on the computer
2) Stop acquisition by pressing the button Setup->Testing->Exit to Debian
3) Wait for bootup, then press the "Debian" button, then press the "xterm" menu selection
4) Enter the following command nano /etc/network/interfaces
5) Change the following fields to the IP Addresses you want:

    address 192.168.0.50
    network 192.168.0.0
    netmask 255.255.255.0
    broadcast 192.168.0.255

6) Save the file with <ctrl>o
7) Exit nano with <ctrl x>
8) Reboot the computer by entering the following command : reboot
9) Remove the keyboard

9. 4-20 mA CONNECTION (this is optional and is not present on all Triathalons):

The 4-20 mA board is conveniently mounted on the rear of the front panel. The two short bare wires show where the two leads are to be connected.

NOTE THE POLARITY!

the leads are labelled OUTPUT+ and OUTPUT-.