OPERATION/MAINTENANCE MANUAL

PORTABLE TRITIUM MONITOR

MODEL 200SS

OVERHOFF TECHNOLOGY CORPORATION
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1.0. INTRODUCTION

Model 200SS portable tritium monitor is a small, high sensitivity, hand held, battery operated survey meter.

The instrument will measure tritium in its elemental form.

1.1. PHYSICAL DESCRIPTION

The Model 200SS uses two identical ionization chambers in a side by side arrangement. Both ionization chambers, with a total volume of 200 cc, are used for tritium measurement. The Model 200SS is **not** gamma compensated.

The sample stream is drawn through the ionization chambers by means of a small rotary vane pump which is plumbed at the outlet of the second ionization chamber. Entry of dust particulates is prevented by attaching a good quality particulate filter ahead of the instrument sampling inlet.

A large easy to read liquid crystal digital panel meter with a range from 1 to 19,999 $\mu Ci/m^3$ is used for measurement display. Other units of measurement, such as MBq/m^3, $\mu Sv/hr$, or others may be specified by the user at time of an requesting a unit. The instrument exhibits a basic sensitivity of the order of 3 $\mu Ci/m^3$, which it is able to attain due to the fact that it is immune to response to both radon and cosmic ray noise.

Power is supplied by a pair of "D" size batteries. While it is recommended that Alkaline cells be used, the instrument will also operate with NiMH or even Carbon Zinc batteries, although operating duration will be shorter. Onset of battery depletion is signaled by illumination of an LED located next to the meter face. An external power supply can be used by attaching to a receptacle on the front panel.

A nine position alarm level stepped attenuator, adjustable over partial scale (.01 - 5 %) is located on the front panel. A steady tone is emitted by an acoustic signaler if the measurement exceeds the set point. A steady tone is heard if the sample air flow has been interrupted. The alarms are non-latching.

The instrument case is constructed of light weight aluminum. A handle is attached for hand held survey use.

The version covered by this manual differs from the standard Model 200SS arrangement. It includes the following optional feature(s):

- Power jack receptacle on the front panel, AC power converter is included

Gas flow connections are made externally to the instrument by appropriate attachment of flexible plastic hose. See Figure 2 .

2.0. TECHNICAL SPECIFICATIONS

MEASUREMENT DISPLAY	4 1/2 digit LCD 1–19,999 $\mu Ci/m^3$
GAMMA COMPENSATION	No
RESPONSE RATE	12 seconds to reach 90 % of final reading,
NOISE LEVEL	$\pm$3 $\mu Ci/m^3$, 1 S.D. (5 second electronic time constant)
ZERO STABILITY	after 1 minutes (or less) warm up, the zero drift to less than 3 $\mu Ci/m^3$
ALARM (ACOUSTIC)	1. nine position stepped attenuator set point for signal of 2 – 1,000 $\mu Ci/m^3$, steady tone 2. low flow produces a steady tone
ALARM (VISUAL)	signal level: red LED low flow: yellow LED, low battery: red LED
DUST FILTER	in line disposable cartridge Pall No. 12082
SAMPLING SYSTEM	2 hose barb ports are located on the front panel
IONIZATION CHAMBER VOLUME	effective volume: 200 cm^3 each, 400cm^3 total port to port volume: 440 cm^3
PUMP	Internal rotary vane pump for 5 to 10 volume changes per minute
POWER	two “D” size batteries alkaline, carbon-zinc or NiMH,
ENVIRONMENTAL	-0° C to +40° C, 0 - 98 % RH
CASE	light weight aluminum
SIZE AND WEIGHT	7.6" L, 5.2" W, 4.4" H excluding handle, 5 lbs (2.3 kg)
ACCESSORIES	• 2 “D” size batteries • sniffer hose • dust filter • optional power converter, 100-240 VAC, 50/60 Hz, 25A to 3.3 Vdc @1.2A, 5.5 mm O.D. x 2.1 mm I.D. plug, center pin is positive

3.0. CIRCUIT DESCRIPTION

CAUTION: This instrument has not been designed for indiscriminate opening or disassembly of the internal parts. The bias voltage for the ionization chamber cans are may be present even when the instrument is switched OFF. It contains highly sensitive semiconductors which are damaged by even the slightest electrostatic discharge

3.1. IONIZATION CHAMBERS

In its simplest form, an ionization chamber is an enclosed volume with two electrodes. Voltage is applied between the electrodes, generating an electric field which will segregate and collect electric charges which are created by nuclear events occurring inside the chambers. Nuclear events may consist of ionization of air molecules by external or internal alpha, beta or gamma radiation.

Model 200SS monitors are designed to measure tritium. Activity of tritium decay is such that a concentration of 1 $\mu Ci/m^3$ in a volume of one liter will generate an ionization current of about 0.95×10^{-15} amperes. This is a very weak current.

Alpha pulses from naturally occurring radon, are much more energetic, they can produce short current bursts of up to 10^{-13} amperes during decay, and therefore appear as large noise "spikes" which can seriously impair tritium measurement.

Gamma radiation also has a strong effect. In practice, a gamma radiation field of 1 mR/hr will create the same amount of ionization as 90 $\mu Ci/m^3$ of tritium.

A tritium monitor, in order to measure to low concentrations, must be able to respond only to tritium and be immune to alpha or gamma radiation. Use the OFFSET COMPENSATION potentiometer to balance out any ionization current contribution from external gamma radiation.

In the 200SS instruments, two ionization chambers are arrayed in a side by side, both chambers are used for tritium detection.

The ionization chamber polarizing voltage is supplied by an electronic low-noise regulated high voltage (-80VDC) supply. Although the surfaces of the ionization chambers are painted, but this is a very thin layer of insulation and, to avoid damage to the electrometer, must NOT be touched by hand.

3.2. ELECTROMETER

Also known as a transimpedance amplifier, it serves the purpose of converting the extremely feeble ionization current into a voltage suitable for further signal processing and measurement display.

The heart of the electrometer consists of a specially selected ultra high impedance semiconductor device which has been chosen both for ultra low internal current leakage as well as long term d.c. stability. The semiconductors used in Model 200SS instruments are suitable for measurement of currents as low as10^{-16} amperes.

In Model 200SS, the electrometer is directly attached to the ionization chamber assembly, which is protected by a rectangular metal cover.

3.3. SIGNAL PROCESSING AMPLIFIER

A single printed circuit board attached directly to the front face of the instrument contains all power supply and signal processing electronics.

Proprietary circuitry is used for the recognition and elimination of transient signals due to radon or high energy cosmic ray pulses. Model 200SS instruments, with digital display, use a dedicated internal circuit to disable the pulse rejection circuit when the measured signal reaches approximately 30 – 80 $\mu Ci/m^3$.

A front panel control has been provided for adjustment of the set point (level) at which the acoustic alarm is desired to sound. The acoustic signaler has the second function of alerting the user that sample gas flow is impeded.

4.0. CONFIGURATION

4.1. EXTERNAL FEATURES

The front panel features include:

1. the digital panel meter, 1–19,999 $\mu Ci/m^3$
2. function control knob
3. alarm level control knob, 2–1,000 $\mu Ci/m^3$ x10
4. low battery LED
5. signal level alarm LED
6. low flow alarm LED
7. acoustic signaler
8. calibration potentiometer (under phillips screwhead)
9. offset potentiometer knob
10. sample IN/OUT hose barbs
11. battery compartments
12. snap holder for dust filter
13. optional jack for external power supply, 3Vdc (never exceed 3.5V)

Side features include:

14. snap holder for dust filter
15. target for gamma source check

4.2. HOSE CONNECTIONS

The instrument will respond to any radioactive gas passing through the instrument as well as tritium.

The external plumbing (hose attachments) is as follows.

A sniffer hose is attached to a small in line dust filter which is attached directly to the IN hose barbs.

Sample is drawn through the measurement ionization chamber by downstream pump.

The compensation ionization chamber is closed off .

NOTE 1: NEVER OPERATE THE INSTRUMENT WITHOUT A DUST FILTER IN THE SAMPLE STREAM

NOTE 2: THE INSTRUMENT MUST BE IN THERMAL EQUILIBRIUM WITH ITS SURROUNDINGS.

5.0. OPERATION

Ensure that a dust filter is connected in line ahead of this instrument flow inlet in use.

The following steps are necessary and sufficient to operate the instrument:

1. Set measurement alarm level to desired value.

2. Rotate mode switch to the **MEASURE** position.

   Allow two to three minutes for the instrument to stabilize.

   The instrument is now ready for use. In this mode the ionization chambers are active, but the pump is not. The instrument is in a so called "standby mode" ready to sample the instant the mode switch is advanced to the next position.

3. Rotate the mode switch to the **SAMPLE** position.

NOTE: If the **LOW FLOW** LED is illuminated, the sampling hoses are obstructed, or, for whatever reason, sample flow through the chambers has ceased.

It is IMPERATIVE that the sample stream be free from dust, dirt or moisture. Not only will the instrument show erratic behavior, but it may cease to function entirely. If moisture is ingested, then continued pumping to evaporate and expel the moisture can be attempted. If this fails, the instrument must be returned to the factory for service.

Condensation can occur if an instrument is brought from a cold environment into warmer surroundings. Furthermore, temperature changes to the instrument, both lower to higher as well as higher to lower will create transient currents in the electrometer which can appear as large phantom measurement signals.

The instrument must be allowed to thermally equilibrate to its surroundings prior to use.

If there is an OFFSET due to thermal disequalibrium, use the following procedure:

OFFSET COMPENSATION:

1. Switch the instrument into the measure mode
2. After approximately three minutes. The instrument should indicate 0000 on the digital panel meter. An offset of approx. 4-6 $\mu Ci/m^3$ is typical for situations due to temperature changes. This offset should disappear as thermal equilibrium is attained.
3. Adjust the OFFSET compensation potentiometer knob as required. The location is shown in Figure 1.

NOTE: The rotation direction for the adjustment is clockwise for change in a positive direction.

General Operation Notes:

NOT SUITABLE FOR USE IN WET LOCATIONS

NOT SUITABLE FOR USE IN EXPLOSION HAZARD ENVIRONMENTS

The monitor can be located on any flat surface, such as a table top, or, it can be mounted to a wall bracket or shelf, or on a small moveable cart. In all cases, the instrument must be protected against vibration, shock, moisture and dirt.

6.0. CALIBRATION

6.1. METHOD

Tritium monitors employing ionization chambers, such as Model 200Ss may be calibrated with either of two methods. The first method consists of injecting a known activity of tritium gas; the second method uses external gamma radiation of a known field strength.

To ensure trace ability to National Standards, the first method must be employed. This method is time consuming and quite difficult to perform with precision. The first method is, however, useful as a “type” test, and can serve as a basic accurate calibration from which the gamma response (the second method) can be cross correlated.

The second method uses an external gamma field.

6.2. GAS CALIBRATION

Since the instrument is essentially linear, a relatively high concentration can be used for most accurate results. Values between 300 – 2,000 $\mu Ci/m^3$ are suggested, but other values from 100 – 5,000 $\mu Ci/m^3$ may be used.

Instructions for the use of gas calibrators are generally provided by the manufacturer of the gas calibrator, and these should be followed.

Some general hints can be given.

It is important that the calibration sample be well circulated through the entire calibration system loop. The calibration loop should include the measurement chambers only.

Adequate time should be allowed for the system pressure and temperature to come to equilibrium, and that no excess pressure is built up.

The inclusion of a previously calibrated "master" or "reference" tritium monitor in the sampling loop is highly recommended.

The calibration can actually be repeated for several levels of tritium activity. This is not done to verify the linearity of the tritium monitor (which is highly linear) but to ensure that the calibration process itself is free from subtle errors.

If calibration is performed, and the instrument response is somewhat different from the expected value, then small adjustments can be made by turning the calibration potentiometer with a small screw driver. The calibration potentiometer is accessed by removing the phillips head screw.

6.3. GAMMA CALIBRATION

If the unit has previously been calibrated with tritium gas, then it is sufficient to use a gamma radiation source to produce a response when placed at a specified location relative to the instrument under test. If the gamma source is long lived, no chronological correction is needed. To verify calibration at a future date, the original gamma source must be used. Records must be kept to identify relative location of the source and the expected result. Be sure that temperature and pressure variations are taken into account.

If calibration by either of these methods is performed, and the instrument response is somewhat different from the expected value, then small adjustments can be made by turning the calibration potentiometer with a small screw driver. The calibration potentiometer is accessed by prying off the small plastic cover.

Large changes in calibration are evidence of malfunction. The factory should be consulted

at Tel: (513) 248-2400, Fax (513) 248-2402, or support@overhoff.com

6.4. GAMMA CHECK

If a tritium monitor has previously been calibrated by any other method, gas or gamma, a low intensity gamma radiation source check can be used as a quick verification of monitor performance. On both sides of the instrument case towards the front are defined locations for "**GAMMA CHECK**". When using the identical gamma check source, at the defined spot, it should always produce the same instrument response, provided, of course, temperature and pressure variations are taken into account. This source check may be performed at a frequency of your choice, it could be daily, weekly or monthly. We recommend a small laboratory gamma check source of the type which is commonly intended for G-M counters or other survey instruments. For example; a 10 micro Curie, Cesium-137 check source should be sufficient for a monitor reading of 100-200 $\mu Ci/m^3$.

IMPORTANT: Do not adjust the calibration when performing a gamma check.

7.0. MAINTENANCE

Overhoff 200 series portable instruments have been designed for many years of trouble free service. Very little maintenance is required, but some periodic attention may be necessary, especially if the instrument is to be used in adverse environments.

When not in use, the monitor should be stored in a cool dry environment.

The batteries should be replaced within half an hour when the low battery light illuminates. Access to the batteries is made by twisting off the caps located on the front panel. Any battery of the proper shape and voltage can be used.

OPERATOR MAINTENANCE

The following operational checks may be performed at daily, weekly or monthly intervals to suit. Pump life is in excess of 1000 hours of actual use, its life is preserved by ensuring that the instrument is operated only with dust filters in line. Inspect dust filter for excessive dust build up. Check the flow rate. The pump should have sufficient flow such that the Low Flow Alarm is not indicated when 10ft of the sniffer hose is connected to the inlet.

GAMMA CHECK, If a tritium monitor has previously been calibrated by any other method, gas or gamma, a low intensity gamma radiation source check can be used as a quick verification of monitor performance. On both sides of the instrument case are the defined locations for "**GAMMA CHECK**". When using the identical gamma check source, at the defined spot, it should always produce the same instrument response, provided, of course, temperature and pressure variations are taken into account. This source check may be performed at a frequency of your choice, it could be daily, weekly or monthly. We recommend a low intensity gamma check source of the type which is commonly intended for G-M counters or other survey instruments. For example; a 10 micro Curie, Cesium-137 check source should be sufficient for a monitor reading of 100-200 $\mu Ci/m^3$.

IMPORTANT: Do not adjust the calibration when performing a gamma check.

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.

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.

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.

8.0. SERVICE

This instrument contains components that are easily destroyed if the case is opened and handled without proper precaution.

Overnight service is provided by the factory. Special training can be given to qualified technical personnel who are entrusted with instrument service and repair responsibility.

Warranty is void if maintenance or repair (other than that which is listed in this manual) is performed by an unauthorized repair facility.

9.0. REPLACEABLE PARTS

The following parts and components are disposable items and may be obtained from Overhoff Technology Corporation or from any original supplier:

Batteries, primary power	"D" size, alkaline, EN95
Dust filter	Pall No. 12082
Dust Filter Clip	Clic No. 51
Ionization Chamber	P/N 1020686
Pump	P/N 50085
Hose Barb, sample in	Brass, P/N 22BH-4-2
Hose Barb, sample out	Brass, P/N 230-4-2
Panel Meter	P/N DMO-742
AC power converter	P/N KTPS05-03315U-V1-P1 Input: 100-240 VAC, 47-63Hz, 0.19A Output: 3.3 Vdc @ 1.5 A Output Plug: 5.5 mm O.D. x 2.1 mm I.D. Plug Center pin is positive

10.0. WARRANTY

All instruments built by Overhoff Technology Corporation are warranted to perform as claimed.

Defective components or workmanship of the instrument will be corrected free of charge for parts or labor within a period of one year from delivery. Nonperformance of the instrument as a result of negligence on behalf of the customer is not covered by this warranty.

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.

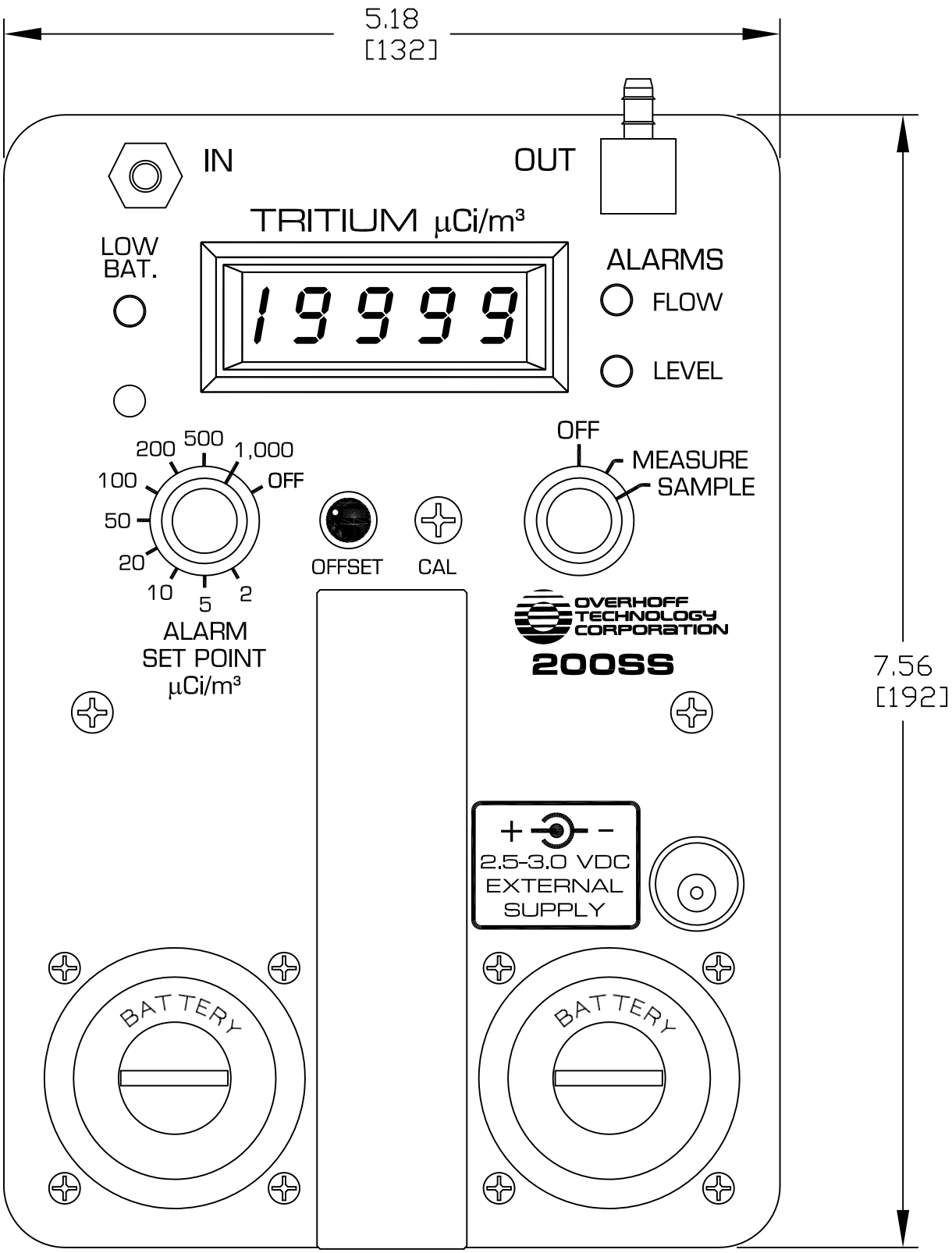


FIGURE 1
FRONT PANEL CONTROLS
MODEL 200SS

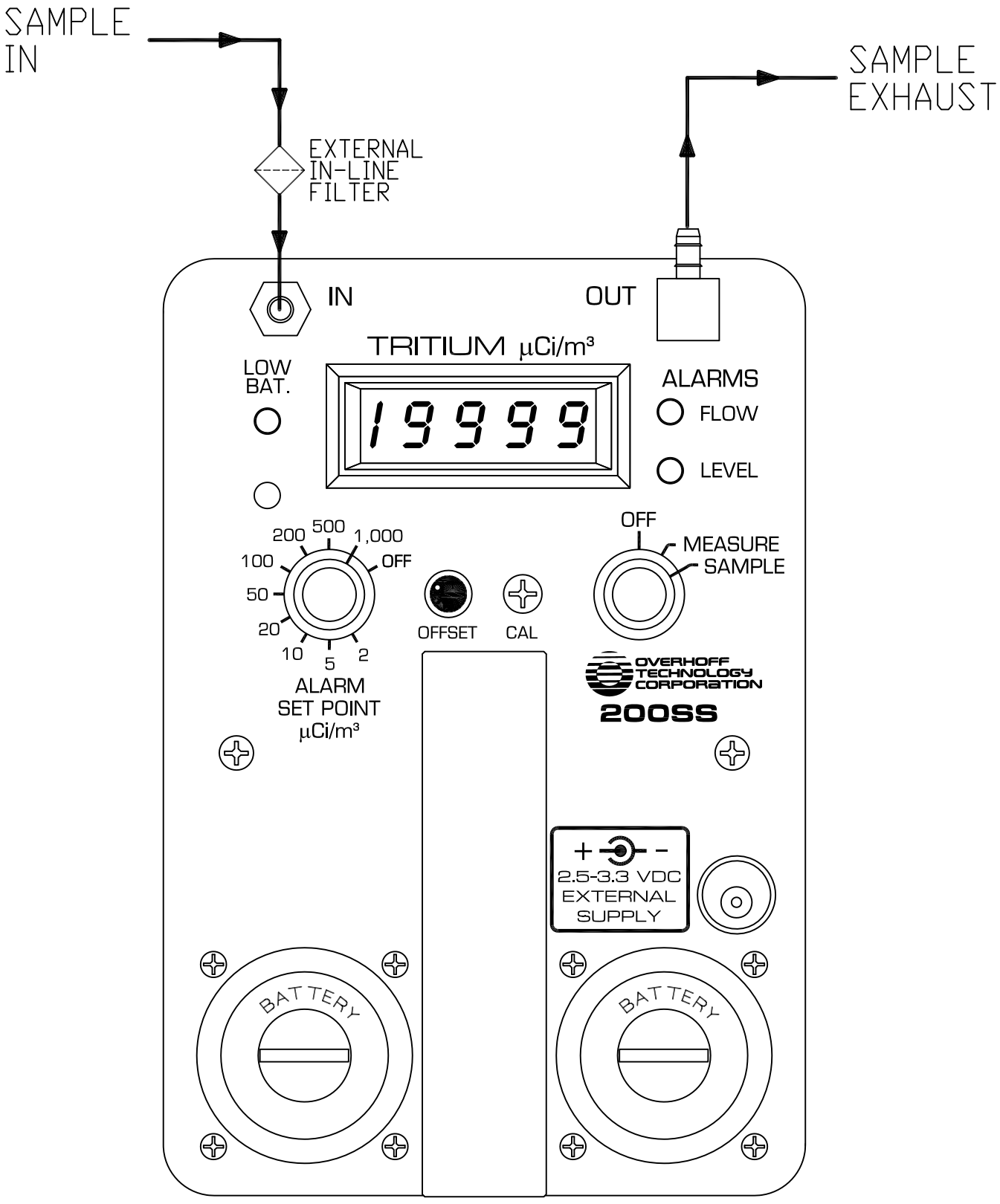
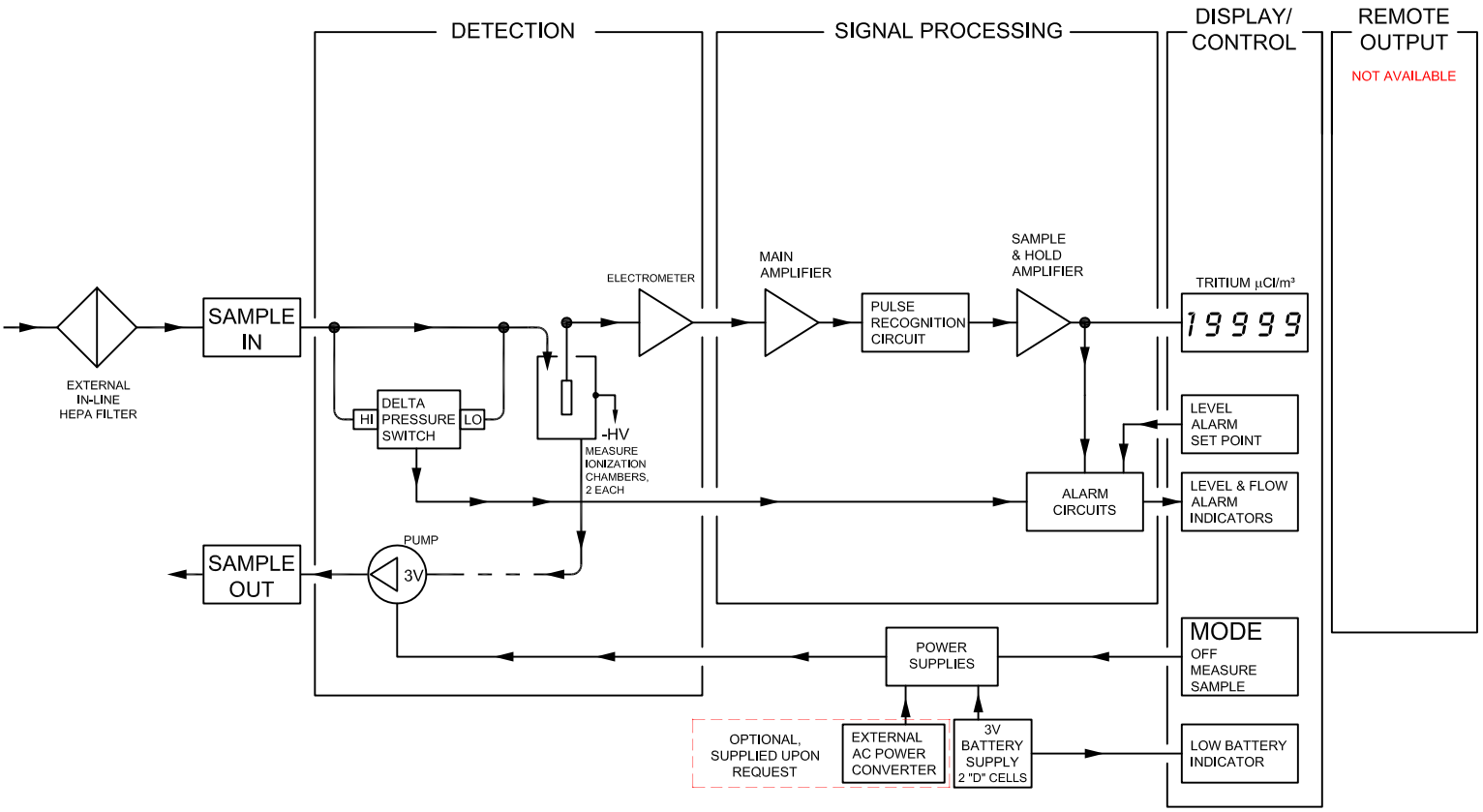


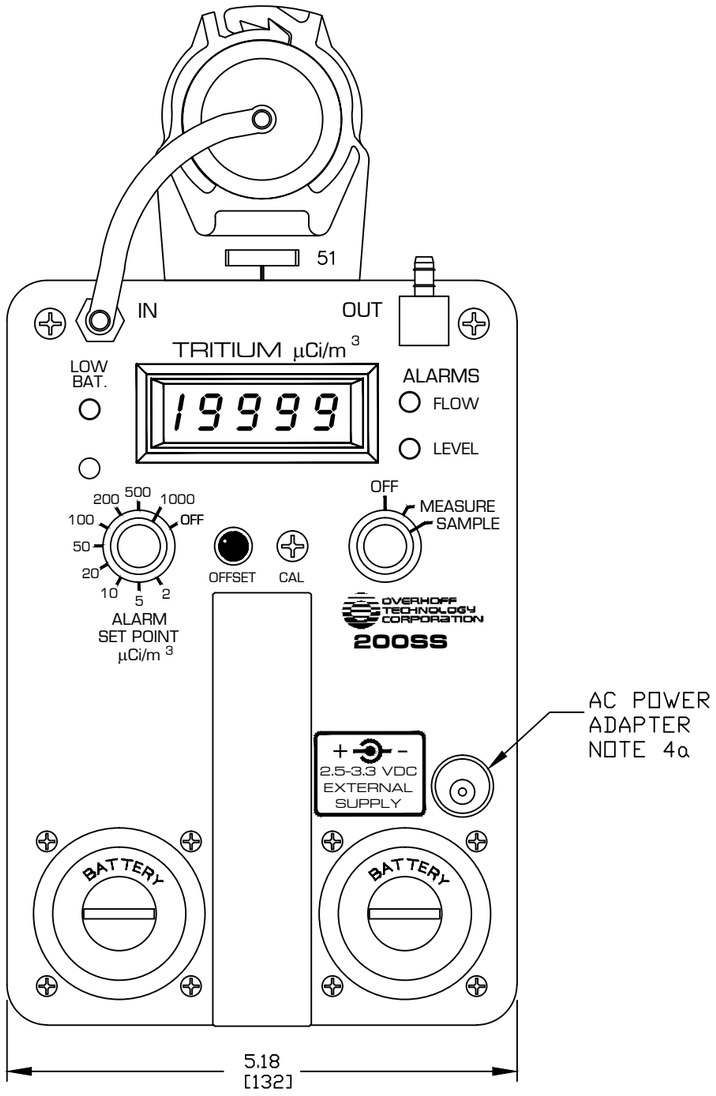
FIGURE 2
HOSE BARB CONNECTIONS
MODEL 200SS



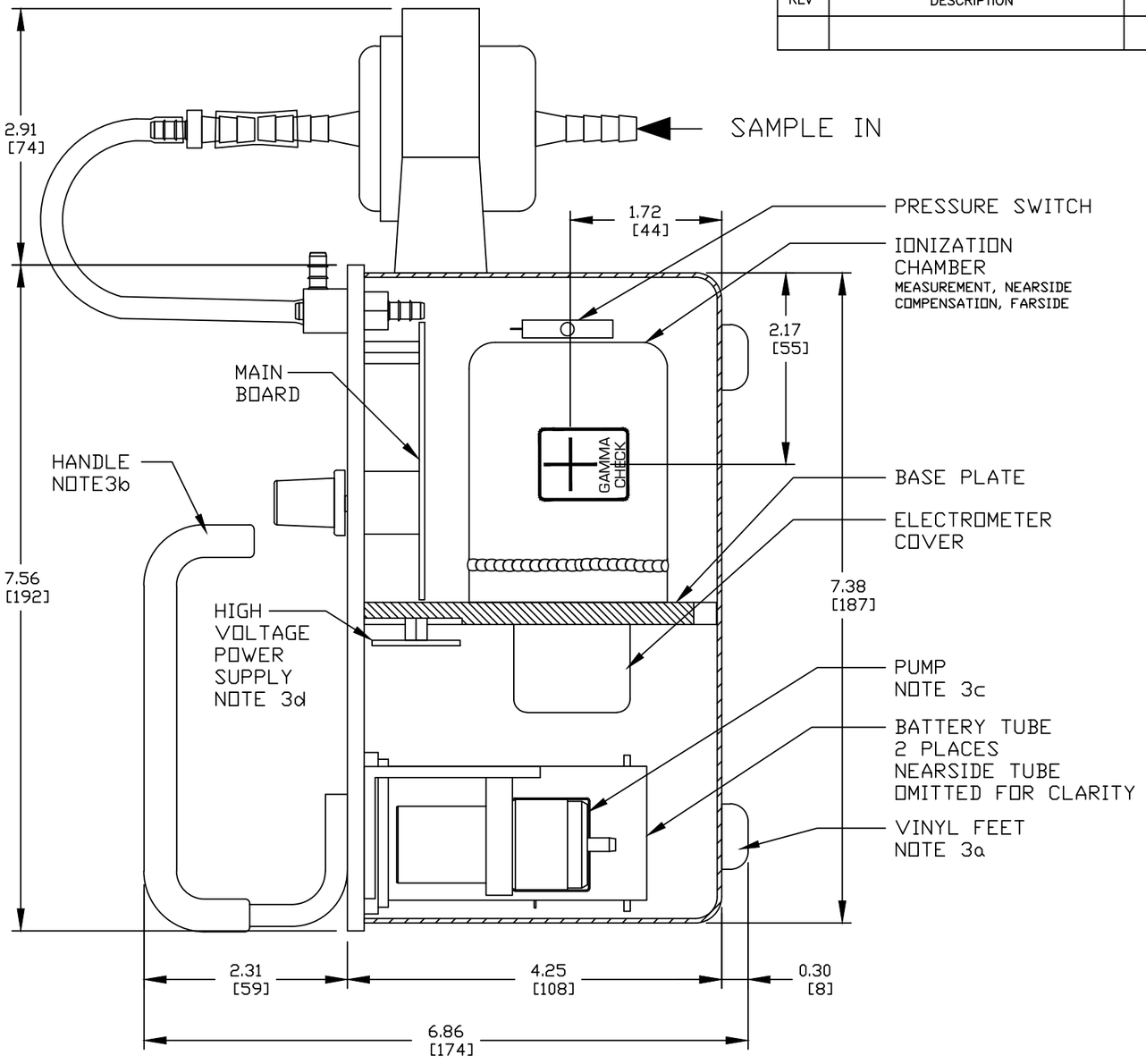
FUNCTIONAL BLOCK DIAGRAM
MODEL 200SS

OVERHOFF TECHNOLOGY CORPORATION

REV	DESCRIPTION	DATE	APPROVED



AC POWER ADAPTER NOTE 4a



NOTES:
1. DIMENSIONS: INCHES[MM], FOR REFERENCE ONLY
2. MODEL 200SS, #1021420:
   - A) DESCRIPTION: DUAL ION CHAMBER (NON-GAMMA-COMPENSATED) 200 cm³ EACH, 400 cm³ TOTAL NOMINAL VOLUME
   - B) MEASUREMENT RANGE: 1 TO 19,999 µCi/m³
   - C) DISPLAY: 4½ DIGIT LCD
3. INCLUDES THESE STANDARD FEATURES:
   - A) BLACK VINYL FEET WITH ADHESIVE - BACKING.
   - B) HANDLE WITH BLACK VINYL COVERING. (DIPPED)
   - C) AIR PUMP WILL BE AIR-TIGHT
   - D) HIGH VOLTAGE POWER SUPPLY
4. INCLUDES OPTIONAL FEATURES:
   - A) FRONT PANEL RECEPTACLE FOR EXTERNAL AC POWER ADAPTER

MODEL: 200SS
PORTABLE TRITIUM MONITOR

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

GENERAL ARRANGEMENT, MODEL 200SS PORTABLE TRITIUM MONITOR WITH DUAL IONIZATION CHAMBERS, NON-GAMMA COMPENSATED & OPTIONAL AC POWER ADAPTER

DRAWN	DATE	SIZE	FILE NAME	DWG NO.	REV
J. CREECH	02-09-15	B	1021420-W03934-1.DWG	1021420	0
APPROVED D. WILLIAMSON	DATE 02-09-15	SCALE 0.65		SHEET 1 OF 1	