Instruction Manual

Ion Chamber Survey Meter

Models 450B and 450B-DE-SI

Part No. 450B-3-1
Rev. 1

Published 9/98
By VICTOREEN, LLC
Printed in U.S.A.

VICTOREEN
Manufacturer's Declaration of Conformity

Product Name: Ion Chamber Survey Meter

Product Model #: 450B

Test Report # 950667, 960710, & 0317A

Family Member(s): 450CHP, 450B-DE-SI

The above referenced Product is in Conformity with the provisions of the applicable directives and amendments.

This product has been designed and manufactured in accordance with the following harmonized standards:

EMC 89/336/EEC

EMISSIONS	***IMMUNITY***
EN 55022:87, group 1,class B conducted emissions	***EN50082-1 :92, Generic Immunity*** ***IEC 801-2:91:ESC, 4kv direct, 8 kv air*** ***IEC 801-3:84:rf Immunity severity level 2***

LVD 73/23/EEC

EN 61010-1:95

The Technical Construction File required by this Directive is maintained at the corporate headquarters of Victoreen, LLC, 6000 Cochran Road, Cleveland, Ohio.

Report Date: 31 August 1998

Representative: Edward W. Siurek, III

Title: Director of Regulatory Affairs and Quality Assurance

VICTOREEN

Manufacturer's Declaration of Conformity

Product Name: Infrared Communicator

Product Model #: 450-1A

Test Report # 960710 & 0418

Family Member(s): 450-1A-230V

The above referenced Product is in Conformity with the provisions of the applicable directives and amendments.

This product has been designed and manufactured in accordance with the following harmonized standards:

EMC 89/336/EEC

EMISSIONS

EN 55022:87, group 1,class B conducted emissions

IMMUNITY

EN50082-1 :92, Generic Immunity
IEC 801-2:91:ESD, 4 kv direct, 8 kv air
IEC 801-3:84:rf immunity severity level 2
*IEC 801-4:88 Electrical Fast Transiant**
**(see users manual)*

LVD 73/23/EEC

EN 61010-1:95

The Technical Construction File required by this Directive is maintained at the corporate headquarters of Victoreen, Inc., 6000 Cochran Road, Cleveland, Ohio.

Report Date: 3 April 1998

Representative: Edward W. Siurek III

Title: Director of Regulatory Affairs and Quality Assurance

PROCEDURES, WARNINGS, AND CAUTIONS

The equipment described in this manual is intended to be used for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

Although the equipment described in this manual is designed and manufactured in compliance with all applicable safety standards, certain hazards are inherent in the use of electronic and radiometric equipment.

WARNINGS and **CAUTIONS** are presented throughout this document to alert the user to potentially hazardous situations. A **WARNING** is a precautionary message preceding an operation which has the potential to cause personal injury or death. A **CAUTION** is a precautionary message preceding an operation which has the potential to cause permanent damage to the equipment and/or loss of data. Failure to comply with **WARNINGS** and **CAUTIONS** is at the user's own risk and is sufficient cause to terminate the warranty agreement between Victoreen and the customer.

Adequate warnings are included in this manual and on the product itself to cover hazards that may be encountered in normal use and servicing of this equipment. No other procedures are warranted by VICTOREEN. It shall be the owner's or user's responsibility to see to it that the procedures described here are meticulously followed, and especially that **WARNINGS** and **CAUTIONS** are heeded. Failure on the part of the owner or user in any way to follow the prescribed procedures shall absolve VICTOREEN and its agents from any resulting liability.

Indicated battery and other operational tests must be performed prior to each use to assure that the instrument is functioning properly. If applicable, failure to conduct periodic performance tests in accordance with ANSI N323-1978 (R1983) **Radiation Protection Instrumentation Test and Calibration**, paragraphs 4.6 and 5.4, and to keep records thereof in accordance with paragraph 4.5 of the same standard, could result in erroneous readings of potential danger. ANSI N323-1978 becomes, by this reference, a part of this operating procedure.

NOTE

When the Model 450B or 450B-DE-SI is used in conjunction with the Model 450-1A communicator, it is possible that a transient induced lock-up could occur. It is also possible that communication between the communicator and the computer can be interrupted. Normal operation can be resumed by resetting the unit. This is accomplished by turning the unit off and then back on again.

READ YOUR INSTRUCTION MANUAL

WARRANTY

This instrument with its accessories, excluding those accessories listed below , is warranted by VICTOREEN, LLC against defects in materials and workmanship for a period of one year from the date of original shipment. During the warranty period VICTOREEN will repair or, at its option, replace at no charge an instrument containing such defect, provided that it is returned, transportation prepaid, to an authorized VICTOREEN service facility. Instruments repaired under warranty will be returned transportation prepaid.

In addition, the nuclear radiation calibration (when applicable) for each instrument is warranted to be within its specified accuracy at the time of shipment. If an error in this initial calibration is discovered, the instrument will be recalibrated at no charge, provided it is returned as described above. This does not apply to any calibration deviation that may result from normal use.

There are no warranties, expressed or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond that stated here. This expressed warranty excludes coverage of, and does not provide relief for, incidental or consequential damages of any kind or nature, including, but not limited to loss of use, loss of sales or inconvenience. This exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the instrument at VICTOREEN's option.

This warranty does not apply if the product, as determined by VICTOREEN, has been damaged by accident or misuse, or as a result of service or modification by other than an authorized VICTOREEN service facility. This warranty is void if the unit is subjected to temperatures above 72° C unless otherwise indicated.

This warranty specifically excludes the following items which are covered by their original manufacturers' warranties: photomultiplier tubes, Geiger and proportional tubes, crystal and other solid state detectors, batteries, and major ancillary items of instrument systems, such as, but not limited to recorders and pumps.

INSPECTION AND MATERIAL RETURN INSTRUCTIONS

Instruments should be examined and tested as soon as received by the purchaser. Claims for damage, if any, should be filed at once with the carrier. Any material returned for repair must be accompanied by a valid customer purchaser order, identifying the work to be done. A Material Return Form is provided at the back of this manual. Send the completed form with items returned for repair to enable our Sales Personnel to process the order as quickly as possible.

Material valued at $200.00 or more and/or weighing more than twenty pounds should be shipped the best way prepaid and fully insured.

VICTOREEN suggests that any instrument weighing over twenty pounds be wrapped in heavy craft paper and packed in a double corrugated carton or wooden box. Protect the instrument on all sides with at least three inches of excelsior or similar padding. Mark the case plainly with suitable caution warnings to insure careful handling.

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NOTE

This manual covers Model 450B and 450B-DE-SI. Any references to 450B also apply to the 450B-DE-SI except as noted.

1.1 Product Description

The Model 450B Ion Chamber Survey Meters (Figure 1-1) are hand-held, battery operated units designed to measure alpha above 4 MeV, beta above 100 keV, and gamma & X-ray radiation above 7 keV, using the latest CMOS and LCD technology. The 450B case is constructed of high strength ABS plastic. A gasket and desiccant pack seal moisture out of the unit and provides a cushion for the internal components. The readout consists of a 2 1/2 digit liquid crystal display and a 100 segment analog bargraph. The bargraph contains a zero segment and twenty groups of five segments each. A permanent scale is located on the display screen. The major divisions of the scale indicate the units corresponding to the range that the meter is measuring. Units of measurement are displayed next to the 2 1/2 digit display. LOW BAT and FREEZE will appear on the display when the instrument is operating in these modes. External controls consist of an ON/OFF button and a MODE button. The unit is auto-ranging and auto-zeroing. The auto-on circuit for the backlight is enabled when twilight conditions occur. The 450B has an audio alarm which can be set by the user. Two nine-volt batteries, located in the back of the instrument, provide over 200 hours of continuous operation. A 440 mg/cm^2 bakelite shield is provided as a beta shield. The shield also serves as an equilibrium thickness for photon measurements & protects the mylar window.

1.2 Operational Features

1.2.1 Overrange Rate

If the instantaneous radiation rate measured by the Model 450B exceeds 50 R/h (0.5 Sv/h), the 'R' in R/h or the 'Sv' in Sv/h displayed will blink to notify the user that the radiation field exceeds the measuring capability of the instrument. Also, a potential error in the integrated radiation value may exist due to this condition. The blinking will stop when the integrated value is cleared.

1.2.2 Low Battery Indicator

There are about 6 hours of operation remaining when the LOW BATTERY indicator first becomes visible. When the LOW BATTERY indicator blinks, there is less than one hour of operation remaining. These times are for 2 batteries installed and from the first occurrences of these indications. If the instrument is turned off during a low battery condition, the batteries will recover somewhat, but time of operation remaining will be less.

1.2.3 Audio Alarm

The audio alarm setpoints are set using the communicator connected to a computer along with the associated software. The audio alarm setpoint is set in increments of 1% full scale. That is from 1% to 100% of full scale. The "A" command in the menu allows access to the scale and percent setpoint. The alarm will sound when readings reach or exceed the setpoint.

1.2.4 Integrate Mode

The Integrate Mode allows the Model 450B to display the integrated exposure. Exposures are accumulated up to 999 R (9.99 Sv).

1.2.5 Freeze Mode

The Freeze Mode will move a "bar" on the bargraph display to show the user the peak value, and will lock on the maximum range. The unit will continue to read and display current readings.

1.2.6 Auto-on Backlight

The Model 450B is equipped with a backlight which automatically turns on when ambient light drops below a predetermined level. The backlight will turn off when the ambient light exceeds the predetermined level, which is factory set.

1.3 Log Features

The 450B automatically logs temperature inside the ionization chamber, the scale of the rate data, and the rate data. Using the Model 450-1A communicator connected to a computer and the associated software, a menu will be displayed on the computer. Refer to "Remote Operation Using the Model 450-1A Communicator" for additional information. The X command uploads the data using the communicator in the following format:

Temperature	Scale	Data	
022	0	0.01	<CR LF>,

Which is interpreted as 22° Centigrade and 0.01 mR/h. The data are signed. If the instantaneous sum of input radiation + input leakage + input noise is negative, the data will be recorded with a negative sign. In this case, the sum of the leakage and noise would be greater in magnitude and opposite direction of the current produced by input radiation because current due to radiation is always positive.

Scale Number	Range of Data	Units	Range of Data	Units
0	0 - 5	mR/h	0 - 50	µSv/h
1	0 - 50	mR/h	0 - 500	µSv/h
2	0 - 500	mR/h	0 - 5	mSv/h
3	0 - 5	R/h	0 - 50	mSv/h
4	0 - 50	R/h	0 - 500	mSv/h

A reading of(-015 0 3.06) is -15° C and 3.06 mR/h in Roentgen units.

A reading of (-015 0 30.6) is -15° C and 30.6 µ Sv/h in Siever units.

The log data time interval can be set from 1 to 255 seconds, and can be saved in the EEPROM using the E command. Use the S command to read and modify the log time interval or simply to read what is the current value.

There is room for 2700 log data sets (temperature, scale, and data comprise a data set) available in the RAM memory. When the memory is full, data storage stops until the memory is cleared. The log data memory is cleared:

1. At instrument turn-on.
2. When the Y command in communications is used.
3. When specified by the S command.

When the 450B is turned off, the log data are lost. The log data may be input to a spread sheet using the import structured command and then plotted.

1.4 Specifications

Radiation Detected	Alpha above 4 MeV, Beta above 100 keV & Gamma above 7 keV.	
Operating Ranges	**450B**:	0 to 5 mR/h, 0 to 50 mR/h, 0 to 500 mR/h , 0 to 5 R/h, 0 to 50 R/h
	450B-DE-SI:	0 to 50 µSv/h, 0 to 500 µSv/h, 0 to 5 mSv/h, 0 to 50 mSv/h, 0 to 500 mSv/h
Accuracy	± 10% of reading between 10% and 100% of full scale indication on any range, exclusive of energy response (Calibration source is ^{137}Cs).	
Detector	349 cc volume air ionization chamber; phenolic chamber wall 246 mg/cm^2. Chamber window is composed of 1.7 mg/cm^2 mylar, 0.025mm thick. A coating of graphite has been applied to the walls to make them conductive. The collection potential is -63 Volts. The Chamber is vented through the desiccant.	
	450B-DE-SI: In order to achieve energy response consistent with measurements of H*(10) as required by ICR4-47, aluminum has been added to the back wall, 38% of the side wall area, and to the beta slide.	
Warm-Up Time	Less than one minute for initial operation.	
Response Time	Time measured from 10% to 90% of final value for a step increase/decrease in radiation rate such that a range change does not occur:	
	450B: 0 to 5 mR/h, range: 8 seconds. 0 to 50 mR/h, range: 2.5 seconds. 0 to 500 mR/h range: 2 seconds. 0 to 5 R/h, range: 2 seconds. 0 to 50 R/h , range: 2 seconds.	
	450B-DE-SI: 0 to 50 µSv/h, range: 8 seconds. 0 to 500 µSv/h, range: 2.5 seconds. 0 to 5 mSv/h, range: 2 seconds. 0 to 50 mSv/h, range: 2 seconds. 0 to 500 mSv/h range: 2 seconds.	

NOTE:

Instantaneous exposure rate is limited to 50 R/h (0.5 Sv/h), including but not limited to a pulsed field.

Precision	Within 10% of reading.
Readout	Liquid Crystal Display: Contains an analog bar graph with a permanent scale on the display and a 2 1/2 digit display. Analog Display: The bargraph consists of 100 segments, 2 1/2 inches long; the scale has five major divisions; the appropriate value for the operating range of the instrument will appear below the scale.Digital Display: The digital display is 2 1/2 digits followed by a significant zero digit depending on the operating range of the instrument. The leading 1/2 digit is blank, or a "1", or a "0" for clarity. Units of measure appear to the right of the digital display. Appropriate multipliers also appear on the display units: As indicated under Range, programmable in R/h or Sv/h.
External Controls	ON/OFF button, MODE button.
Automatic Features	Ranging and zeroing are fully automatic.
Environment	Operating Temperature Range: -40 ° to +70 ° C (ANSI N42.17C sect. 8.1.2)
	Relative Humidity Range: 0 to 100%, @ +60 ° C non-condensing Geotropism: Less than 1%

Dimensions (L x W x H)	8 in. x 4 in. x 6 in. (20 cm x 10 cm x 15 cm)
Weight	Approximately 2 lb., 7 oz. (1.11 kg)
Batteries	Two nine Volt transistor batteries provide over 200 hours continuous operation. Three Lithium cells provide chamber bias voltage of 63V (10 year life expectancy).
Audio Alarm	Set through communication programs. Setting at 1% increments, 1% to 100% full scale.
Temperature Sensor	A temperature sensor in the 450B-DE-SI is used to adjust for offset drift due to temperature. Readings are not corrected for changes in air density due to pressure and temperature.

Accessories

Remote Communicator	Part No: 450-1A; allows remote operation and calibration of the Model Communicator 450B Survey Meter, readout of stored log data.

Specifications

Power	115 VAC 50/60 Hz, 2.5 watts. Optional 230 VAC unit available: Part # 450-1A-230V
Fuses	115 VAC use 0.125A, 250V 3AG Slo Blo 230 VAC use 0.062A, 250V 3AG Slo Blo
Check Source	Part No.: 450 UCS; allows user to check for proper instrument operation. Gives a nominal reading of 1.0 mR/h (100 µ Sv/h)

1.5 Energy Response

Figure 1-2 shows the 450B-DE-SI photon energy response.

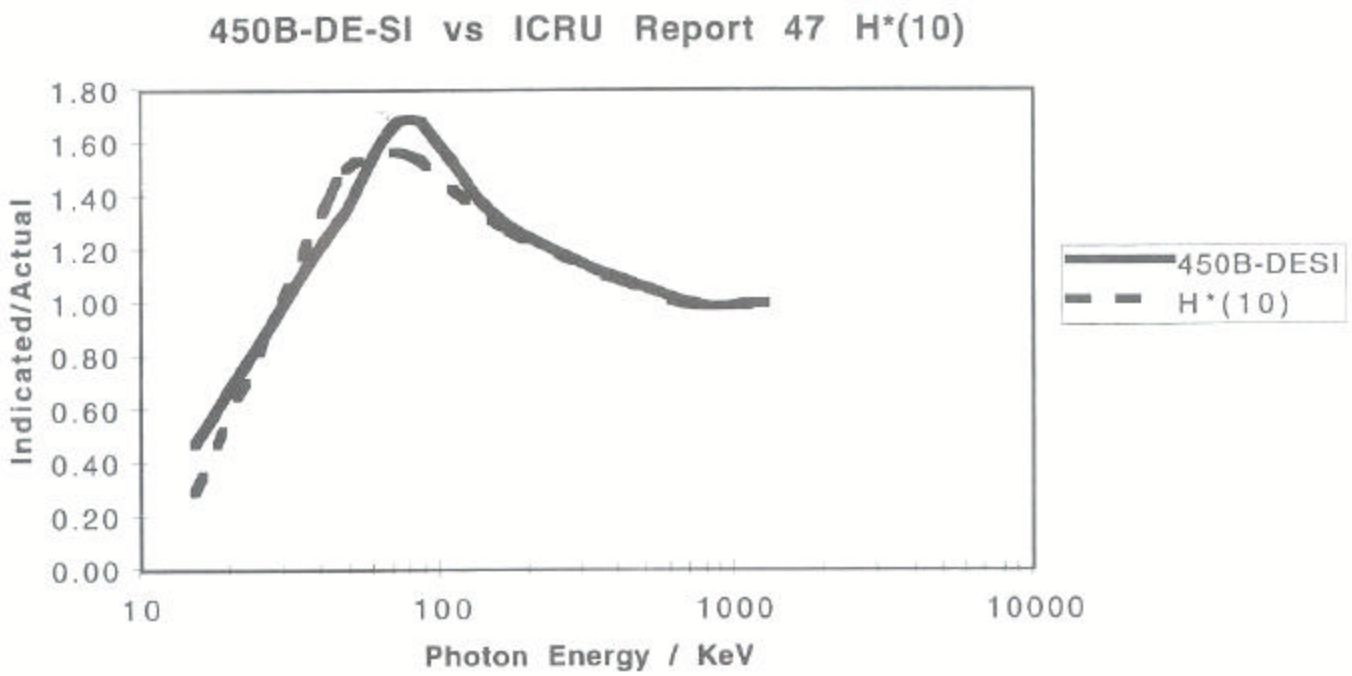

Figure 1-2. Model 450B-DE-SI Energy Response

Section 2 - Receiving / Storage

2.1 Receiving Inspection

Upon receipt of the package:

1. Inspect the carton(s) and contents for damage. If damage is evident, file a claim with the carrier and notify the VICTOREEN Customer Service Department:

Victoreen, LLC
6000 Cochran Road
Cleveland, Ohio 44139

Phone: (440) 248-9300
Fax: (440) 248-9301
www.victoreen.com

2. Remove the contents from the packing material.
3. Verify that all items listed on the packing list have been received and are in good condition.

NOTE

If any of the listed items are missing or damaged, notify the VICTOREEN Customer Service Department.

2.2 Storage

If the unit is to be stored prior to use, pack it in the original container, if possible, and store in an environment free of corrosive materials, fluctuations in temperature and humidity, vibration or shock. The instrument should be stored with the two 9 Volt batteries removed. Refer to 11.2 & 11.5 for additional battery information. Prior to use, check the condition of the desiccant. A blue color indicates that the desiccant is good, while a pink color indicates the need to replace/regenerate.

2.3

Do not immerse the 450B or 450B-DE-SI. The unit is not water proof. Liquid could damage the circuits. The unit should be kept clean and free from dirt and contamination. The unit may be cleaned by wiping with a damp cloth using any commercially available cleaning or decontaminating agent.

3.1 External Controls

There are two external controls on the survey meter: an ON/OFF button and a MODE button.

3.1.1 ON/OFF Button

Press the ON/OFF button to turn the unit on. All the elements in the display turn on and the microprocessor runs through an initialization procedure. Part of the procedure includes reading the calibration coefficients stored in EEPROM. If an EEPROM read error occurs, an error code (E1) will be displayed at power-on and unity calibration coefficients will be used.

The bargraph and digital display will show a reading which decreases as the instrument stabilizes. The initial reading usually starts in the 50R/h (50 mSv/h) range and decreases through the lower ranges to a reading of less than 0.5 mR/h (5 µSv/h) within 40 seconds. When the elements in the display turn off, with the exception of those necessary for normal operation, the user can begin the measurement process.

3.1.2 Mode Button

The Model 450B can be configured (using Communicator Model 450-1A) so that:

1. The MODE button alternately toggles display of exposure rate values or display of integrated exposure.
2. The MODE button toggles the freeze mode ON/OFF.
3. The MODE button is disabled.

To configure the MODE button to the opposite function (1 or 2 above) without a communicator, use the following procedure:

1. Turn the unit off.
2. Press the MODE button.
3. Turn the unit on while continuing to press the MODE button.
4. Release the MODE button when the display is in the "all elements on" condition.
5. [illegible] the MODE button to toggle the instrument between the rate mode and the newly [illegible]d freeze or integrate mode.

3.1.3

The int[illegible]tional 30 seconds after the instrument is turned on and all of the time after that. However the integrated exposure can only be displayed when the MODE button has been configured as a toggle to display exposure rate/integrated exposure. If the MODE button is pressed within the 30 second initialization period of the unit, the display will read "0".

When integration starts, "0.0 µR (0.00 µ Sv)" will be displayed. Toggle MODE to read exposure rate as required.

To reset the integration display, toggle the display from the rate mode to the integrate mode. Keep the MODE button pressed for about 5 seconds. The display will clear, and then read "0.0 µR (0.00 µ Sv)". Exposures are accumulated up to 999 R (9.99 Sv).

3.1.4 Freeze Mode

When configured to select the freeze mode, the MODE button acts as a toggle switch. Press the button until FREEZE appears on the display. Operation in the freeze mode gives the user a constant reference of the highest exposure rate obtained from the time the freeze function is initialized. The highest reading will appear as a single bar on the bargraph. The current reading will continue to be displayed on the digital display and the bargraph. If a measurement is obtained which exceeds the freeze bar reading, the freeze bar will move to the higher measurement point. The operating range of the 450B remains locked on the highest range attained during the freeze mode so that the scale and the multiplier remain the same.

For example, assume the scale units appear as 10, 20, 30, 40, 50 and the freeze bar is at 47 mR/h on the bargraph. If the 450B then measures a radiation field of 120 mR/h, the scale units will change to 100, 200, 300, 400, 500 and the freeze bar will appear on the graph at 120 mR/h. If the survey meter measurement goes below 100 mR/h, the units on the scale will not change until the survey meter is taken out of the freeze mode. However, the digital display will continue to show the current reading. The survey meter will operate in the freeze mode until the user toggles the MODE button to return to the normal operating mode.

Note: If a measurement is obtained which causes a range change higher than the alarm setpoint range, the alarm will sound and continue to sound until the freeze mode is disabled.

3.2 Self -Test

When the 450B survey meter is first turned on, it runs through a functional self test procedure. During this self-test, the firmware version of the unit is displayed, along with the **HI** or **LO** chamber bias.

WARNING

If chamber bias is LO, the instrument can't measure high radiation rates accurately. Service to the instrument is required.

If the unit passes the self-test, it will go into the normal operating mode. If the unit fails the self-test it will remain locked with the firmware revision displayed. Consult a Victoreen Customer Service Representative for corrective action.

3.3 Remote Operation Using the Model 450-1A Communicator

3.3.1 Installation

The Model 450B periodically tests for input at its infrared (IR) receiving device. When an infrared signal is detected, the Model 450B sends test signals using its infrared sending device and, if a Model 450-1A Communicator is present and operational, the survey meter will enter into the communications mode. The 450B display will clear and the letters "CO" will be displayed as an indication that the unit is in the communications mode.

Communicator Model 450A-1 is compatible with a CRT or printing terminal having a standard RS-232 connector and a 1200 baud rate. A computer with a modem or terminal emulator may be used in place of the terminal. The terminal or computer should be set up for 1200 baud, 7 data bits, no parity bit, and 1 stop bit. To install the Model 450-1A communicator:

1. Attach the communicator link assembly to the top of the survey meter.
2. Place the spring clips, on the communicator, into the small slots in the lower edge of the front of the instrument.
3. Run the telephone cable toward the handle of the unit and connect it to the communicator's main box.

NOTE

If the telephone cord is not connected properly, the communicator will not work.

4. When "CO" appears on the 450B display, press the computer or terminal space bar twice.

If the Model 450 displays the "CO" message but there is no response at the terminal after pressing the space bar twice, perform the following tests:

1. Be sure that the Communicator and terminal are properly connected via the RS-232 cable.
2. The communicator can be configured as "data terminal equipment" or as "data communication equipment". In the terminal configuration it receives data on pin 2 and sends data on pin 3 of the 25 pin connector. In the data communication equipment configuration, it sends data on pin 2 and receives data on pin 3. The communicator is factory configured as data terminal equipment. The configuration can be changed as follows:
   a. Remove the top cover from the main box of the communicator.
   b. Locate the jumpers on the printed circuit board at the end near the connectors.
   c. Change the jumper from the solid path (terminal configuration) to the dotted path (data communication equipment configuration) as indicated on the board. (Model 450A-1)
3. Test the terminal or computer being used as follows:
   a. Use a small screwdriver or paper clip to temporarily connect pins 2 and 3 of the connector that plugs into the communicator. This causes the device to send to itself.
   b. Type characters on the keyboard and watch for a response on the screen. If there is no response, consult the user's manual for the device.
4. If using a modem program, be sure that it is properly loaded and running. Also be sure that the modem program is compatible with the 450-1A. The 450-1A does not support protocol such as x-on and x-off; therefore, the modem program must have a terminal mode.

If there is a problem getting the communications message (CO) to be displayed on the 450B:

1. Be sure that the Model 450-1A Communicator is plugged into the AC line and that power is on.

2. Be sure that the telephone cord is connected and on the right hand side of the instrument handle. It may be necessary to move the link assembly from side to side in small increments until it is properly aligned.

If there is still a problem, consult the Victoreen customer service department for further instructions.

3.3.2 Remote Operation

When communication between the Model 450B and the remote terminal have been established, the following menu will be displayed on the terminal screen:

CALIBRATE FACTOR FUNCTIONS

F	Read saved
M	Modify
R	Review modified
T	Test
E	Exit & save new
Q	Quit, keep old

MODIFY OPERATION

U	Units
H	Freeze/integrate
S	Set data log parameters
A	Set blink alarm

CMD?

The program is ready to receive any of the single letter commands at the CMD? prompt. The calibration and operation functions are discussed in the following sections.

3.4 Calibration Functions

The calibration functions are as follows:

F This command reads and displays the calibration coefficients and other data from the internal EEPROM. If the unit was factory calibrated, the calibration date and the technician's initials will also be displayed.

M This command allows the user to modify the current calibration coefficients. Maximum and minimum limits are 75% and 125%. Changing a rate calibration factor from 100 to 110 will increase the instrument reading 10% in a constant field. However, changing the integrate calibration factor from 100 to 110 will decrease the integrated amount displayed in a constant field for the same length of time since the integrate calibration is a reciprocal relation in the instrument.

R This command allows the user to review the current calibration coefficients.

T This command allows the user to test the operation of the survey meter using changed calibration coefficients before they are stored in EEPROM. One second rate values are sent to the terminal. To exit from the test mode, press the space bar several times until the menu is displayed. Press CNTRL - L to return to the main menu.

E This command allows the user to store the calibration coefficients and operational parameters in EEPROM. Up to 14 characters can be entered in the "Notes" portion of the display. Press Esc to abort this function.

X This command sends logged data in RAM to the terminal or computer. The format is temperature, scale number, data, return/linefeed. The X command may be used any number of times without destruction of the stored data. The data output process may be stopped by pressing the space bar as many times as necessary to stop the output stream.

Q This command quits but does not save any of the changed calibration coefficients or operational parameters in the EEPROM.

3.5 Operation Functions

The operation functions are as follows:

U This command allows the user to change the units of measure from Roentgen to Sievert units and vice versa.

NOTE:

When changing the units of measure, the unit will need to be recalibrated.

H This command allows the user to change the function of "MODE" from freeze to integrate & vice versa.

S This command sets data log parameters. When selected, screen will display:

Log data memory cleared:

0 at turn-on only

1 also at integrate reset

2 Log interval entry (100 sec)

A This command allows the user to set the blink and audio alarm limit. The alarm is factory set to blink the display if the exposure rate exceeds 50 R/h (0.5 Sv).

Y This command does not appear in the terminal screen menu. When the Y command is evoked, the data log RAM will be cleared, and the data pointer will be reset to the beginning of memory. The response on the screen is "clearing ram" followed by the menu.

3.6 Optional Check Source Use (450 UCS)

WARNING

The check source contains radioactive materials, used for the verification of survey meter operation. Use care in the handling and storage.

To check the Model 450B, perform the following:

1. Turn instrument on and allow one minute to warm up.
2. Press side springs to open the beta shield.
3. Place the check source flat against the end window.
4. Check for a nominal reading of 1.0 mR/h (100 uSv/h).

Section 4 - Theory of Operation

4.1 General

WARNING

This unit contains Lithium cells with a potential voltage of 63V on the battery assembly. Use care in handling this assembly during removal and installation. Damage to the instrument or bodily harm may result.

NOTE

The user is cautioned about indiscriminately opening and disassembling the instrument. The high impedance circuits of the ion chamber are easily contaminated with grease and dirt which produce electrical leakage. Complete Assembly/ Disassembly instructions are available in the Maintenance Section of this manual.

The Model 450B is an air ionization chamber instrument calibrated in exposure rate units of roentgens/ hour (or Sieverts/hour) for gamma and X-ray in the energy range of 20 keV to 2 MeV through the sliding Bakelite shield. It can also be used for X-ray in the energy range of 7 keV to 30 keV with the sliding shield open. The Model 450B responds to, but is not calibrated for, beta radiation, with the slide open. Beta energies which can be measured are above 100 keV. The two thin mylar windows have a combined density thickness of 1.7 mg/cm^2. The 450B also responds to alpha radiation above 4 MeV.

The liquid crystal display shows the radiation rate in digital and analog form with the range multiplier values also showing on the scale. It is a lightweight electronic device which requires the computational capabilities of a microprocessor to make it operate. It functions in a multiplex mode called quadruplex. This mode uses four backplanes to accommodate the 128 elements of the display.

The microprocessor performs data collection, averaging, multiplication by stored calibration factors, range changing, and battery check functions, in addition to driving the LCD. Between computational periods, it "sleeps" in a low power mode to conserve battery power. The microprocessor reads stored information from an electrically erasable memory, EEPROM, which is used by the program for calibration and display units. The EEPROM will retain stored data when the instrument is OFF or when the batteries are removed. Data can be entered into the EEPROM using the Model 450-1A Communicator available from Victoreen. Operation using the Model 450-1A Communicator is discussed in Section 9 - Operation.

63 V collection voltage for the ion chamber is obtained from Lithium cells which have a 10 year life. All internal power for the instrument is supplied by the 9 V batteries, accessible from the rear of the instrument.

The digital and bargraph displays read directly. The bargraph display update periods are listed in Table 10-1. The digital display updates at one second intervals nearest the current bar display update. The bargraph and digits display do not always show the same reading because the bargraph is faster than the digital update. It is more convenient to watch the bargraph when the reading is changing quickly and to read the value of a slowly changing or static reading by looking at the digital display.

Values can be displayed in SI units (Sv/h). This can be requested when the survey meter is ordered from the factory or it can be changed by the operator using the Model 450-1A Communicator.

The bargraph display is a digital presentation, programmed to appear as a linear analog meter display. It is also referred to as the analog display throughout this manual.

Table 10-1. Bargraph Display Update Periods

Range	Update Period
50 R/h (500 mSv/h)	0.05 second
5 R/h (50 mSv/h)	0.1 second
500 mR/h (5 mSv/h)	0.1 second
50 mR/h (500 µSv/h)	0.15 second
5 mR/h (50 µSv/h)	0.25 second

There are 20 bars between each major division. The numerical values of the five major divisions change appropriately for the range in which the instrument is operating. For instance, the first major division would have the numeric value of 1, 10 or 100. The minor divisions are worth 0.05, 0.5 or 5. The incremental nature of both the digital reading and the analog bargraph provide greater accuracy for reading in different portions of the scale. For example, on the 0-5 mR/h (0-50μ Sv/h) range, with a digital reading of 2.0 and above, the analog bargraph can be read more accurately than the digital display. Below a digital reading of 2.0, the digital display is more accurate because it consists of three significant digits. The stated precision of the digital display is accurate only above a reading of 0.20 on the 0-5 mR (0-50 Sv) scale.

NOTE

The same analysis applies to all the other ranges because the number of significant digits or active bar elements are independent of the position of the decimal point or the units multiplier.

There is a small hysteresis built into the range changing circuit so that the instrument does not keep changing scales if the reading is at the threshold of range change. It is important in calibration of the instrument that the calibration coefficients track from range to range because an oscillatory condition can occur if the calibration on a given range is low and the coefficient for the next more sensitive range is high.

In addition to FREEZE, the other message that can appear on the display is LOW BAT. When the LOW BAT message appears, the batteries should be changed within one hour.

The display will indicate HI for good chamber voltage bias condition.

4.2 Firmware

The program in the 450 ROM is proprietary to VICTOREEN. The firmware version appears in the digital part of the LCD display (prior to the "all elements on" display) when the instrument is turned on. The firmware program consists of three main parts: operation, communication, and monitoring.

The operation portion of the firmware performs all of the control functions needed to read and control the electrometer and range change amplifier, calculate radiation rate, and display the calculated values on the LCD Display. In addition, the measured data are smoothed and displayed in an exponential manner with time that simulates the rise and fall time of an ordinary meter display. Range changing is performed automatically. If a large increase in signal is detected, the range changing skips to higher ranges bypassing exponential rise with time to get to the new reading quickly. The instrument continually integrates the detected radiation signal and saves the accumulated amount which may be read by the operator at any time. The operator may also reset the integration process.

Section 5 - Maintenance

5.1 Preventive Maintenance

Very little maintenance is required for the survey meter, but some periodic attention may be necessary, especially if the instrument is used in harsh industrial conditions.

NOTE

Install fresh batteries prior to performing any calibration on this instrument.

5.2 Battery Replacement

The LOW BAT message will appear on the display approximately 6 hours prior to the instrument becoming inoperable. To ensure that the instrument operates to specification, it is recommended that the batteries be changed within one hour after the LO BAT message appears. The instrument will function on one battery for approximately 100 hours, allowing replacement of one battery at a time if the instrument must remain operational during battery change-over. Regular or alkaline transistor batteries can be used for replacement purposes.

Batteries are accessible from the rear of the instrument.

NOTE

Be sure to observe proper polarity when replacing the batteries.

5.3 Ion Chamber Window Replacement

1. Remove the 9 volt batteries to be sure that the instrument will remain off during the disassembly process.
2. Remove the six (6) screws from the case top.
3. Carefully remove the case bottom from the thick gasket that seals the top and bottom.
4. Remove screws holding phenolic chamber cover to the base.
5. Determine the conductive side of the replacement mylar sheet using an ohm meter.
6. Carefully, so as not to crinkle it, place the new mylar on the top of the chamber, conductive side up. (inside the chamber) Electrically connect conductive side of mylar to conductive side of chamber.
7. Use adhesive to secure the mylar to the phenolic chamber.
8. Any wrinkles in the mylar may be removed with a hot air gun. Do not apply too much heat, the mylar may break. Small ripples in the surface will not affect the operation of the instrument. Attach phenolic chamber to the base.
9. Secure the case top to the case bottom, with the gasket in between, using the six screws removed in Step 2.
10. Replace the 9 Volt transistor batteries, being sure to observe proper polarity.

5.4 Outer Mylar Window Replacement

1. Remove the 9 volt batteries to be sure that the instrument will remain off during the disassembly process.
2. Remove the six (6) screws from the case top.
3. Carefully remove the case bottom from the thick gasket that seals the top and bottom.
4. Remove the damaged mylar. Replace with the conductive side facing in. Dag conductive side of mylar to inside of case.
5. Position the replacement window assembly on the case bottom (screen).
6. Secure the case top to the case bottom, with the gasket in between, using the six screws removed in Step 2.
7. Replace the 9 Volt transistor batteries, being sure to observe proper polarity.

5.5 HV Battery Board and Desiccant Replacement

WARNING

This unit contains Lithium cells with a potential voltage of 63V on the battery assembly. Use care in handling this assembly during removal and installation. Damage to the instrument or bodily harm may result.

This assembly contains the desiccant and Lithium cells for chamber bias. To regenerate desiccant, remove desiccant vial from battery assembly and bake silica gel at 50° C for 24 hours. Reinstall Desiccant.

1. Remove the 9 volt batteries to be sure that the instrument will remain off during the disassembly process.
2. Remove the six (6) screws from the case top.
3. Carefully remove the case bottom from the thick gasket that seals the top and bottom.
4. Remove the four (4) screws and lockwashers from the battery assembly.
5. To replace the three 21V Lithium cells, remove old Lithium cells by de-soldering, and solder into place the new Lithium cells. Battery Boards and cells are listed in Appendix A "Replacement Parts".
6. Secure the battery board to the survey meter assembly with the four screws and lockwashers removed in step 4.
7. Secure the case top to the case bottom, with the gasket in between, using the six screws removed in Step 2.
8. Replace the 9 Volt transistor batteries, being sure to observe proper polarity.

Section 6 - Troubleshooting

6.1 Troubleshooting Precautions

CAUTION

Many components on the printed circuit board are static sensitive. ESD precautions should be observed when handling the printed circuit board assembly.

CAUTION

If the device indicates a relatively high radiation rate, there is a possibility that the unit has been contaminated, CAUTION should be observed when replacing or working on this unit. High rates can quickly cause the operator's cumulative exposure to increase with the potential for injury.

NOTE

Install fresh batteries prior to performing any calibration on this instrument.

6.2 Troubleshooting

Self Test Failure:

If the unit fails self test, it will remain locked on the firmware revision number. Consult Victoreen.

High Background Readings:

Remove desiccant and bake per section 5.5. After replacement, bake unit at 50° C for 8 hours.

Erratic Readings:

Check for broken ion chamber window or loose collector. Check for loose chamber bias connector. Refer to section 5.3 if required.

Appendix A - Customer Replaceable Parts

Victoreen Part Number	Description
455-1-53	Case Bottom Assembly
450-1-63	Decal, 450B
450-1-65	Decal, 450B-DE-SI
181036	Handle
455-1-15	Battery PC Board Assembly
181061	Lithium Battery Assembly; 7-CR 1220 Lithium Cells
181017	Desiccant Vial Assembly
181019	450B Tube, mylar window assembly
182020	450B-DE-SI Tube, mylar window assembly
MSM-1918	Mylar film (Must specify Qty.)
450UCS	Check Source