BICRON RMP
6801 Cochran Road • Solon, Ohio 44139 USA
Telephone: (440) 248-7400
Toll Free: (800) 472-5656
Fax: (440) 349-6581
http://www.bicron.com

eGoldmine "7 Pot Board"

BICRON®
RADIATION MEASUREMENT PRODUCTS

Surveyor 2000™
Portable Survey Meter

User's Manual

Publication No. 1016-0-U-1199-003

* * * Release Date * * *

November 1, 1999

Part No. 1016907
Rev. I

Saint-Gobain Industrial Ceramics, Inc.

SAINT-GOBAIN
INDUSTRIAL CERAMICS

ISO 9001 Quality System Certified

FOREWORD

This manual provides the basic operation and maintenance procedures for the BICRON Surveyor 2000™ Portable Survey Meter.

Section 1.0 Introduction provides a general description of the instrument and its operation, and a detailed listing of its physical and performance specifications.

Section 2.0 Battery Installation describes the procedure for changing the battery and checking its performance.

Section 3.0 High Voltage Test describes how to read the High Voltage.

Section 4.0 Operation provides a detailed description of all the features and settings for the Surveyor 2000, and complete operating instructions.

Section 5.0 Hardware Description provides a brief description of the three electronic circuits that make up the instrument, and a description of the GM Tube.

Section 6.0 Calibration provides directions for calibration of the instrument.

The **Appendices** are: A) QC Acceptance Procedure, which includes calibration procedures, B) a Suggested Spare Parts List, C) a complete Parts List so instruments can be repaired on-site, and D) schematic and pictorial diagrams to facilitate repair procedures.

Writing Conventions

In order to maintain consistency throughout this and all BICRON♦NE manuals, certain writing conventions have been followed for safety warnings. They are divided into three categories and defined as follows:

- DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. ***DANGER NOTICES ALWAYS APPEAR IN BOLD, ITALICIZED UPPER CASE LETTERS.***

- WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. **WARNING NOTICES ALWAYS APPEAR IN UPPERCASE BOLD LETTERS.**

- CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. ***CAUTION notices always appear in bold, italicized letters.***

The definition of these safety warnings is according to ANSI Z535.4. The style of the warnings (bold, italicized, etc.) is BICRON♦NE's.

In addition to the above, we have added the following warning:

- NOTE indicates a situation which has the potential for erroneous data collection, loss of electronic data, or damage to equipment, but which does not directly affect the safety of the operator with respect to this product. The responsibility for any safety consequences as a result of erroneous data lies solely with the operator. *NOTE notices always appear in italics.*

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BICRON RMP WARRANTY STATEMENT COVERING PORTABLE MONITORS

Instruments and options manufactured by Bicron RMP are warranted against defects in materials and workmanship for a period of two years from the date of shipment, unless otherwise agreed upon by Bicron RMP and the customer in writing.

Bicron RMP's obligation with regard to such products shall be limited to repair or replacement FOB Bicron RMP factory or authorized repair station, at Bicron RMP's option.

The calibration (when applicable) for each system is warranted to be within its specified accuracy at the time of shipment. If this initial calibration is determined to be in error, the system will be recalibrated at no charge.

The aforesaid warranty does not cover systems, options or probes which are subject to excessive physical abuse or are used for purposes other than those intended. In no event shall Bicron RMP be liable for consequential or special damages, transportation, installation, adjustment, work done by customer, or other expenses which may arise in connection with such defective product or parts.

EXCLUSION OF LIMITED WARRANTY

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS EXPRESS 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. THE EXCLUSIVE REMEDY OF THE PURCHASER IS LIMITED TO REPAIR, RECALIBRATION, OR REPLACEMENT OF THE SYSTEM AT BICRON RMP's OPTION.

This warranty specifically excludes the following items which are covered by their original manufacturers' warranties: photomultiplier tubes, GM and proportional tubes, crystal and other solid-state detectors and batteries.

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PROCEDURES and CAUTIONS

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

Adequate warnings are included in the 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 Bicron.

It shall be the owner's or user's responsibility to see to it that the procedures and cautionary notes are heeded.

Failure on the part of the user in any way to follow the prescribed procedures shall absolve Bicron and its agents from any resulting liability.

This instrument is intended solely 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.

All instructions and warnings contained in this manual or on the instrument must be read before use and must be strictly followed. Failure to follow these instructions and warnings may result in inaccurate readings and/or user hazard.

Indicated battery and other operations tests must be performed prior to each use to assure that the instrument is functioning properly.

CAUTION

FAILURE TO CONDUCT PERIODIC PERFORMANCE TESTS IN ACCORDANCE WITH ANSI N323-1978, 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 READING OF POTENTIAL DANGER. ANSI N323-1978 BECOMES, BY THIS REFERENCE, A PART OF THIS OPERATING PROCEDURE.

INSPECTION

Instruments should be examined and tested as soon as received. Claims for transportation damages, if any, should be filed at once with the delivery carrier.

1.0 Introduction

1.1 General Description

The Bicron Surveyor 2000 is a portable survey meter designed for use with an appropriate GM probe to detect and measure ionizing radiation.

The instrument features an internal, energy-compensated GM detector (0-2000 mR/h range only), a recessed meter movement, laminated control panel, cpm and mR/h meter scales, single on-off/range selector switch, MHV probe connector and mounted probe holder.

Advanced circuit design provides a detector HV check, anti-saturation, dead time compensation, switch selectable response time (optimized for each range), and built-in audio.

1.2 Specifications

Radiation Detected:
Alpha (depending on probe used); beta; gamma with external probe; gamma and x-ray with internal detector.

Detector:
GM tube, internal; choice of GM probes, external.

Range:
Linear ranges of 0-0.2, 0-2, 0-20, 0-200 mR/h (SWGM or EWGM probe) 0-2000 mR/h (internal detector only); 0-240; 0-2400; 0-24,000; 0-240,000 CPM (external probes).

Accuracy:
Within 10% of reading for ^{137}Cs when calibrated according to NRC Reg. Guide 10.8.

High Voltage:
Electronically stabilized, factory set at 900 V.

HV Test:
Exclusive self test to verify detector HV power supply.

Connector: MHV.

Warmup time: None.

Saturation:
Typically greater than 1000 R/h on all ranges (with exclusive anti-saturation circuit) for internal detector and most GM probes; greater than 5 R/h for pancake GM probes.

Response Time:
Switch-selectable, optimized for each range. 0-90% of final reading as follows:

	Time	
Range	**Fast**	**Slow**
X0.1	6 sec.	25 sec.
X1	2 sec.	6 sec.
X10	1 sec.	3 sec.
X100	<1 sec.	1 sec.
X1000	<1 sec.	1 sec.

Dead time Compensation:
Exclusive circuitry provides a near linear response.

Temperature:
Operational from -40° C to +60° C.

Humidity:
Less than 5% change in reading from 10 - 95% relative humidity.

Control:
Eight position rotary switch: "off", "bat", "HV", "X1000", "X100", "X10", "X1", "X0.1"; rotary response time switch. See Figure 2.

1.0 Introduction (cont'd)
1.2 Specifications (cont'd)

Battery Complement:
Single nine-volt (MN1064 or equal). The additional battery holder may be used for storage of spare or parallel-wired.

Battery Life:
Greater than 100 hours with single battery or greater than 200 hours with parallel batteries option.

Display:
Ruggedized, recessed, high-torque 1 mA meter with 8.51 cm. (3.35 inch) scale marked "0-2 mR/h", "0-2400 CPM", "bat. ok", "HV ok". Meter protected by impact-resistant Lexan® polycarbonate window. See Figure 1.

Geotropism:
Within ± 2% of full scale.

Shock:
100 g per lightweight machine of MIL-STD 202C, method 202B.

Vibration:
5 g in each of three mutually orthogonal axes at one or more frequencies form 10-33 Hz.

Construction:
Splash-proof, shock-proof, two-piece, all-metal case. Scratch-resistant laminated control panel and Bicron Kleen-Krome® trim on case top, durable black polyurethane paint on handle and case bottom, stainless steel probe holder.

Audio:
A built in speaker, controlled by a panel mounted on-off switch, provides an audible "click" for each detector pulse or (if desired) an audible over-range alarm signal.

Size:
10.8 x 20.3 x 17.3 cm (4.25" x 8" x 6.8") including handle and probe clip.

Weight: 1 kg. (2.2 lb), excluding probe.

2.0 Battery Installation

Battery Type: Nine-volt Mallory MN1604 or equivalent.

2.1 Procedure

1. Turn instrument off.
2. Open pull catches at ends of case and separate case bottom from top.
3. Install battery in appropriate clop on bottom circuit board (clip for spare battery is so marked), observing proper polarity.
4. Replace bottom, orienting rubber under battery; close catches.

Parallel-wired Option: Instruments with this option have both battery clips wired into the circuit. Installing a second battery thus provides approximately twice the operational hours of one battery. Only one battery is needed to power the instrument, however.

2.2 Test

To check the condition of the battery turn the Control Switch to the "bat." position (Figure 2). If the battery has sufficient charge, the meter will read within the "bat. ok" range (Figure 1).

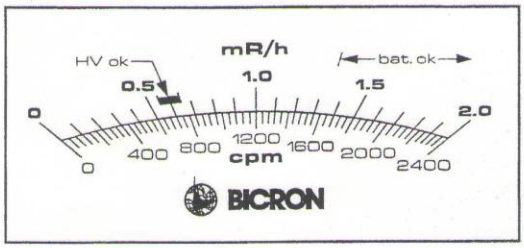


Figure 1
Surveyor 2000 Meter Scale

3.0 High Voltage Test

To check the high voltage setting turn the Control Switch to the "HV" position (Figure 2). If the high voltage is correctly set, the meter will read within the "HV ok" range (Figure 1).

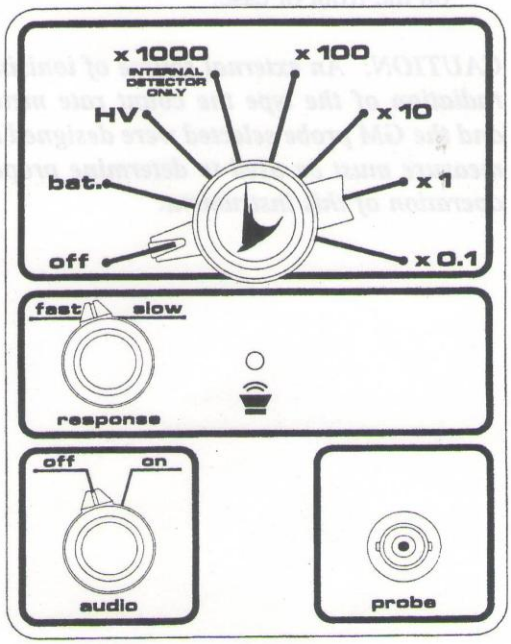


Figure 2
Surveyor 2000 Control Panel

4.0 Operation

4.1 Radiation Measurements

1. When using an external GM probe, select the appropriate response time (Section 4.2 Selectable Response Time) and measurement range (Figure 2). Use only the "X0.1", "X1", "X10", or "X100" ranges. Read only the cpm scale unless using a SWGM (side-wall GM) or EWGM (end window GM) probe which has been calibrated in mR/h with the unit.

2. When using the internal detector, select the appropriate response time and turn the control switch to the X1000 range. Read the mR/h scale only. The detector is mounted near the front of the case, centered vertically and slightly to the right of center horizontally. Position the instrument so that radiation is incident on the front of case.

CAUTION: An external source of ionizing radiation of the type the count rate meter and the GM probe selected were designed to measure must be used to determine proper operation of this instrument.

4.2 Selectable Response Time

In addition to the built in circuitry which optimizes response time for each range, response time can be controlled by the "response" Switch. "slow" or "fast" response time can be selected.

4.3 Audio

An internal speaker produces an audible "click" for each detector pulse. This speaker is controlled by a panel mounted on-off switch labeled "audio".

An audible alarm sounds when the meter is approximately 30% or more above full scale on any range. This over-range alarm can be defeated by turning off an internal on-off switch located on the main circuit board.

The over-range alarm functions only when the panel mounted Audio Control Switch is in the "off" position and the internal switch is "on". When the speaker control is in the "on" position, the over-range alarm is defeated.

5.0 Hardware Description

5.1 Circuit Description

The electronic circuitry in the Bicron surveyor 2000 is contained on three interconnected printed circuit boards. Modern solid-state integrated circuitry is used throughout. The major components are:

1. The high voltage power supply which is a feedback-regulated, electronically stabilized supply for the GM tube potential. Additional circuitry provides an HV test readout on the meter scale.
2. The count-rate meter which is a linear charge pump rate meter that converts the GM tube pulses to an exposure rate reading on the calibrated meter scale. The circuitry includes a unique dead-time compensation technique to provide nearly linear response over the full range, an anti-saturation circuit which forces the meter beyond full scale in high radiation fields, automatic time constant selection, and temperature compensation.
3. The audio circuitry for individual pulse counting and over-range alarm.

5.2 GM Tube (Probes)

The GM rube consists of a thin shell which acts as the cathode, a fine wire anode suspended within the shell, and an inert gas into which a small amount of a halogen gas has been mixed to act as a quenching agent. End window and pancake tubes have a thin mica entrance window.

A potential of approximately 900 volts is maintained between the two electrodes with the anode always positive. This voltage is slightly less than that required to produce a discharge in the gas. When a nuclear particle or ray of sufficient energy enters the GM tube, it ionizes a molecule of the inert gas. The positive ions are attracted to the cathode and the electrons are attracted to the anode because of the high voltage maintained between the electrodes. In their movement toward the electrodes, these charged particles trigger the ionization of additional gas molecules, resulting in an avalanche of ions flowing between the electrodes. The gas discharge thus created is similar to the glow of a neon lamp. The tube conducts as long as the gas is in the ionized state.

The small amount of halogen gas in the gas mixture quenches the flow of ions, suppressing further electron avalanches until another nuclear particle or ray enters the tube. This flowing and quenching results in a rapid pulse or surge of current in the external circuit. The number of pulses per minute is approximately proportional to the radiation exposure rate. The meter, suitably connected to the tube, indicates the exposure rate or counts per minute (depending on probe used) on a calibrated scale.

6.0 Calibration

This section provides a general description of calibration conditions. Detailed calibration procedures are part of the Q.C. Acceptance Procedure in Appendix A.

6.1 Standard (mR/H)

The instrument is normally factory calibrated using ^{137}C's gamma rays for the internal detector and when furnished with a specific model SWGM (side wall GM) or EWGM (end window GM) probe. Recalibration is required (a) after servicing, (b) if the GM probe is replaced, and at regular intervals specified by the appropriate regulatory agencies.

The SWGM (with shield closed) or EWGM probe is placed in a known radiation field with the axis of the probe perpendicular to the beam. The front of the case is placed perpendicular to the beam when calibrating the internal detector.

Individual calibration controls are provided for each range, and are used to adjust the meter reading to correspond to the known exposure rate. The locations of these controls are indicated on the main circuit board.

External probes are calibrated on the "X0.1", "X1", "X10", and "X100" scales only. The internal detector is calibrated on the "X1000" scale only.

NOTE: Do not disturb the settings of any controls except those marked "X0.1", "X1", "X10", and "X100" ("X1000" with internal detector only).

Calibration procedures should follow those specified by the appropriate regulatory agencies.

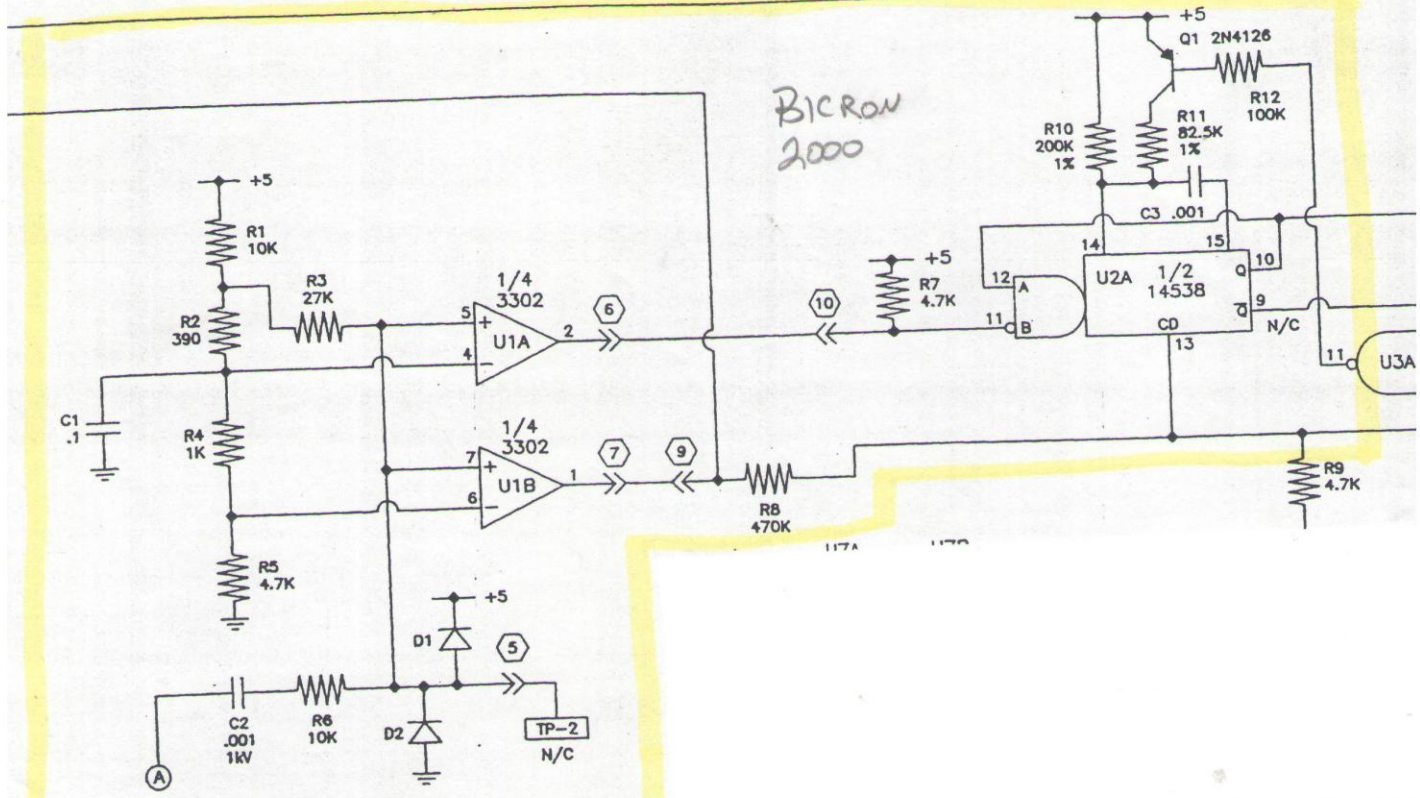
6.2 Optional (CPM) Calibration

Electronic calibration (counts per minute) is the only type that can be done when external probes other than a specific SWGM or EWGM are supplied, or when the instrument is not supplied with a given probe.

When an electronic calibration is performed, the unit is connected to a variable frequency pulse generator. the generator is then set at the frequencies needed to produce 65% and 35% of full scale meter readings (cpm) for each range. Calibration controls are set for 65% of full scale readings, and linearity is checked by going to the 35% readings.

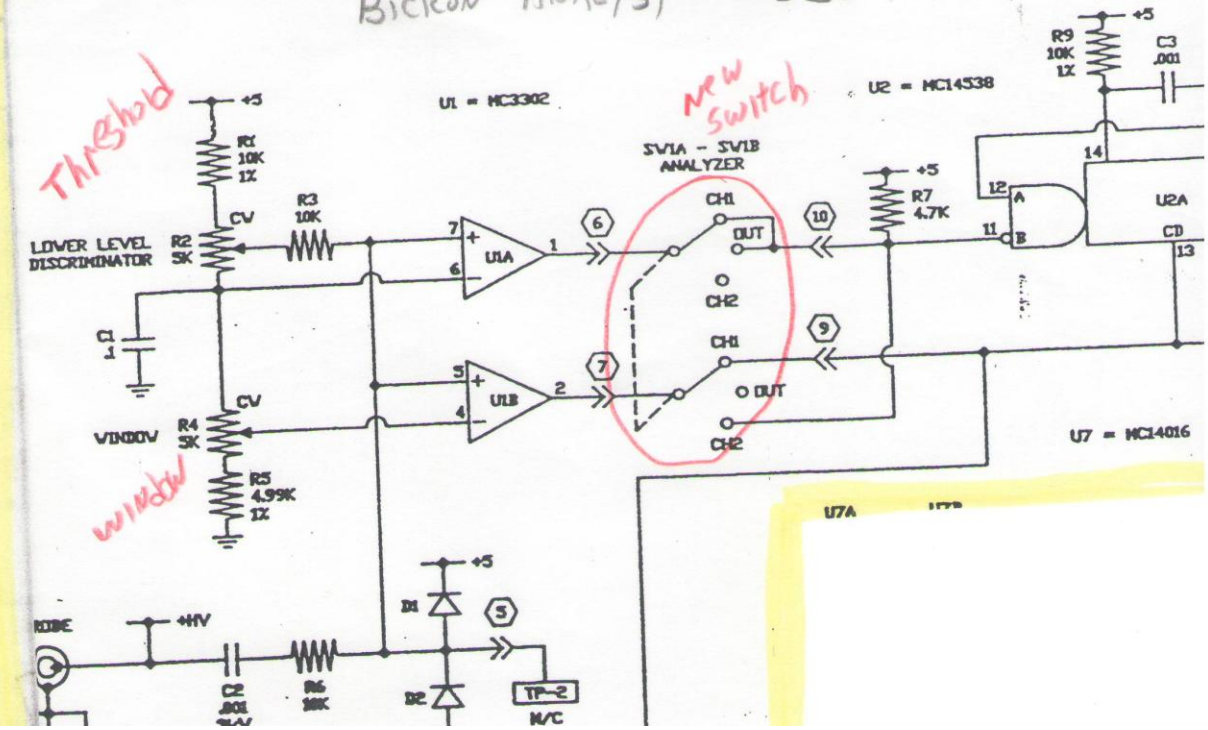
CAD Board

eGoldmine 7POT Board



FRONT END MOD TO eGoldmine 7 POT Board

BICRON ANALYST ADDS WIN/THR-



Appendix A
Bicron QC Acceptance Procedure, No. 1016937

1.0 Preparation

1. Perform a visual inspection of finished product.

2 Remove all 9V batteries and connect a 9.30 V ± 0.05 V power source across the main battery terminals on the battery board.

2.0 Calibration

Perform the following calibrations:

1. Turn the Control Switch to "OFF". Mechanically zero the meter via the rear zero adjustment screw on the meter barrel.

2. Turn the Control Switch to "X1". Check the +5 supply at pin 1 of U6 (ICL 7663). The reading should be 5 VDC ± 10%.

3. Leave the Control Switch set at "X1" and connect a voltmeter between pins 1 (ground) and 15 of the 24 pin connector. Adjust R31 (50Kohm zero pot) so the voltmeter reads 1 mVDC +4/-1.

4. Turn the Control Switch to "HV" and connect a high voltage measuring device with an impedance ≥ 1000 megohms to the high voltage connection on the internal GM tube. Adjust the high voltage supply via R52 (50 Kohm pot) to +900 VDC ±3%.

5. Connect a high voltage measurement device to the external probe connector and rotate the Control Switch through all 8 positions. You should detect HV only at the probe connector in "X100", "X10", "X1" and "X0.1" positions.

6. Connect the HV measuring device across the internal GM tube and rotate the Control Switch through all 8 positions. You should detect HV in "BAT.", "HV", and "X1000" only.

7. Turn the Control Switch to HV and adjust R34 (500 ohm span pot) until the meter reads in the center of the HV OK checkband.

Table T-1

Range	Pulse Generator output (Hz)	Simulated CPM	Acceptable Meter Reading
X100 (65%)	1643	156,000	140,400 - 171,600
X100 (35%)	1066	84,000	75,600 - 92,400
X10 (65%)	246	15,600	14,040 - 17,160
X10 (35%)	136	8,400	7,560 - 9,240
X1 (65%)	26	1,560	1,404 - 1,716
X1 (35%)	14	840	756 - 924
X0.1 (65%)	2.6	156	140 - 171.6
X0.1 (35%)	1.4	84	75.6 - 92.4
NOTE: The values in this table may not correspond to those for other Bicron or competitive models.			

Appendix A
Bicron QC Acceptance Procedure, No. 1016937 (cont'd)

2.0 Calibration (cont'd)

8. Perform a CPM calibration (unless the instrument is to be supplied with a specific SWGM or EWGM probe):

   A. Turn the Control Switch to "X100" and connect a variable frequency pulse generator to test point 2 (pin 5 of the 24 pin connector).

   B. Adjust the frequency to the value required to calibrate the unit at 65% of full scale in the meter (see Table T-1).

   C. Adjust R28 (50 Kohm X100 calibration pot) until the meter reads 65% of full scale.

   D. Readjust the frequency to the value required to calibrate the unit at 35% of full scale (see Table T-1) and note the meter reading.

   E. If the reading is within the acceptable range listed in Table T-1, note the meter readings from steps C and D on a Certificate of Calibration. If not, readjust the frequency to the 65% value and adjust R28 to produce a different reading within the acceptable range.

   G. Repeat steps D and E until the meter readings obtained are within the acceptable ranges for both the 65% and 35% of full scale calibration points.

   H. Repeat steps B, C, D, E and F (if necessary) for the X10 range (using R26, the 500 Kohm X10 calibration pot), the X1 range (using R24, the 5 megohm calibration pot), and the X0.1 range (using R22, the 2 megohm X0.1 calibration pot).

Table T-2

Range	Field Strength (mR/h)	Acceptable Meter Reading (mR/h)
X1000 (65%)	1300	1170. - 1430
X1000 (35%)	700	630. - 770
X100 (65%)	130	117. - 143
X100 (35%)	70	63. - 77
X10 (65%)	13	11.7 - 14.3
X10 (35%)	7	6.3 - 7.7
X1 (65%)	1.3	1.17 - 1.43
X1 (35%)	0.7	0.63 - 0.77
X0.1 (65%)	0.13	0.117 - 0.143
X0.1 (35%)	0.07	0.063 - 0.077

Appendix A
Bicron QC Acceptance Procedure, No. 1016937 (cont'd)

2.0 Calibration (cont'd)

I. If specified to be supplied with an SWGM or EWGM probe, perform an isotopic calibration:

1) Connect the GM probe to the probe connector via a cable.

2) Place the probe in a known ^{137}Cs radiation field in a fixed geometry.

3) Calibrate each range (except X1000) at 65% and 35% of full scale using the values in Table T-2 and the same calibration pots as those listed for a CPM calibration.

4) Note the meter readings from Step 3 on a Certificate of Calibration.

10. The "X1000" range (internal detector) must always be isotopically calibrated.

A. Position the unit so that the internal GM tube is in the proper fixed geometry within a known ^{137}Cs radiation field.

B. Turn the Control Switch to "X1000" and calibrate at 65% and 35% of full scale, using the values in Table T-2 and R30 (the 5 Kohm X1000 calibration pot).

C. Note the meter readings from Step 2 on a Certificate of Calibration.

11. Mark all trimpot bodies in such a way as to show the general position of the adjustment screws after calibration.

Appendix A
Bicron QC Acceptance Procedure, No. 1016937 (cont'd)

3.0 Response Control Test

1. Connect a variable frequency pulse generator to test point 2 (pin 5 of 24 pin connector) and turn the Response Switch to "FAST" and the Control Switch to "X1000".

2. Vary the frequency of the pulse generator and switch between "FAST" and "SLOW", checking the operation.

3. Do the same at "X100", "X10", "X1" and X0.1"

4. Leave the pulse generator connected.

4.0 Audio Switch Test

1. Turn the Audio Switch to "ON" and check to see that the audio functions properly on all five ranges, using the pulse generator. Also, check that the audio remains silent when the Selector Switch is on "BAT." and "HV".

2. Turn the Audio Switch to "OFF" and the Alarm On/off Switch mounted on the main PC board to "ON". Drive the meter well beyond full scale with the pulse generator and observe that a continuous tone is heard. Do this on all five ranges.

3. Disconnect the pulse generator.

Appendix A
Bicron QC Acceptance Procedure, No. 1016937 (cont'd)

5.0 Anti-saturation Circuit Test

1. Turn the Control Switch to "X100" and connect a 1000 megohm resistor across the probe connector (from +900V to ground). The meter should peg beyond full scale.

2. Replace the 1000 megohm resistor with a 2000 megohm resistor. The meter should remain at zero.

3. Remove the 2000 megohm resistor.

6.0 CPM Calibration Test

1. Leave the Control Switch on "X100" and turn the Audio Switch to "ON".

2. Connect a suitable GM probe to the instrument.

3. Place a small check source near the probe and switch to "X100", "X10", "X1", and "X0.1" in turn. You should obtain a meter reading for each range.

Appendix A
Bicron QC Acceptance Procedure, No. 1016937 (cont'd)

7.0 Wrap-up

1. Remove all test equipment from the unit. Turn the Control Switch to "OFF" and install a new +9V alkaline battery (MN-1604 or equivalent) in the appropriate battery clip (either clip if the unit has the parallel-wire battery option).
2. Complete, date, and sign a Certificate of Calibration.

Appendix B
Suggested Spare Parts List

We recommend that you keep some quantity of the following spare parts in inventory. The number of instruments you own and the severity of your operating conditions should guide you in determining specific quantities.

Description	Part No
Main PC Board Assembly	1016017
Switch PC Board Assembly	1016027
Battery PC Board Assembly	9420001
Case Top Assembly	1016147
Handle	9710002
Meter	9400016
Meter Window	9400011
Case Bottom Assembly	1016050
Battery	9750001
Cable, Probe	9801001
Knob, function	9770003
Knob, round w/pointer	9770001

Appendix C
Parts List, No. 1016917

Description	Part No.
Main PC Board Assembly	1016017
Gm Tube Ass'y, Energy-compensated	9730010
Transformer, M8149	9500001
Connector, 24-pin	9780001
Switch PC Board Assembly	1016027
Battery PC Board Assembly	9420001
Case Top Assembly	1016147
Handle	9710002
Meter	9400016
Meter Window	9400011
Meter Support Bracket	9850002
MHV Connector	9782001
Probe Clip	9460004
Case Bottom Assembly	1016050
Miscellaneous	
Battery, 9V alkaline, MN1604	9750001
Cable, Probe, MHV-MHV, 36-inch	9801001
Knob, function	9770003
Knob, round w/pointer	9770001

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Appendix C
Parts List, No. 1016917

Description	Part No.
Main PC Board Assembly	1016017
Gm Tube Ass'y, Energy-compensated	9730010
Transformer, M8149	9500001
Connector, 24-pin	9780001
Switch PC Board Assembly	1016027
Battery PC Board Assembly	9420001
Case Top Assembly	1016147
Handle	9710002
Meter	9400016
Meter Window	9400011
Meter Support Bracket	9850002
MHV Connector	9782001
Probe Clip	9460004
Case Bottom Assembly	1016050
Miscellaneous	
Battery, 9V alkaline, MN1604	9750001
Cable, Probe, MHV-MHV, 36-inch	9801001
Knob, function	9770003
Knob, round w/pointer	9770001

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Appendix D

The drawings listed below follow this page.

Drawing Name	Number	Rev.
Schematic Circuit Diagram, Surveyor 2000	B1016927	C
Main Board PC Assembly, Surveyor 2000	D1016017	K
Switch Board Subassembly, Surveyor 2000	C1016027	F

Specifications Below

SURVEYOR-2000 Specifications:

Radiation Detected: Alpha, beta, gamma and x-ray, depending upon GM probe used.

Detector: Choice of GM probes; side-window, end-window, or pancake. (***sold separately***)

Range: Three linear ranges of
0-0.2 mR/h --- 0-240 cpm
0-2 mR/h --- 0-2,400 cpm
0-20 mR/h ----- 0-24,000 cpm
0-200 mR/h ---- 0-240,000 cpm
0-2000 mR/h (internal detector)

Accuracy: Within 15% of reading for 137Cs between 25% and 100% of full scale.

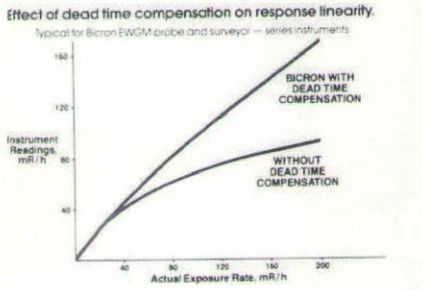
HV Test: Exclusive self-test to verify detector HV power supply.

Saturation: Typically > 1000 R/h on all ranges (with exclusive anti-saturation circuit) for most GM probes; > 5 R/h for pancake.

Response Time: Switch-selectable, optimized for each range, 0-90% of final reading as follows:

Range	Fast	Slow
x0.1	6 sec.	25 sec.
x1	2 sec.	6 sec.
x10	1 sec.	3 sec.
x100	<1 sec.	1 sec.
x1000	<1 sec.	1 sec.

Dead Time Compensation: Exclusive circuitry provides near linear response



Temperature: Operational from -40 to +60C

Humidity: < 5% change in reading from 10% to 95% relative humidity.

Battery Life: A single 9-volt (MN1604 or equal) battery provides > 100 hours of operation or > 200 hours with parallel option.

Control: Six position rotary switch shown; rotary on/off switch for audio.

Display: Ruggedized, recessed, high-torque 1 mA meter with 3.35in (8.51cm) scale.

Geotropism: Within +/- 2% of full scale

Shock: 100g per lightweight machine of MIL-STD 202C, method 202B

Vibration: 5g in each of three mutually orthogonal axes at one or more frequencies from 10-33 Hz

Construction: Splash proof, shock proof, two piece, all metal case. Scratch resistant laminated control panel and Bicron Kleen Krome® trim on top. Durable black polyurethane paint on handle and case bottom. Stainless steel probe clip on handle.

Size: 4.25 x 8 x 6.8in (10.8 x 20.3 x 17.3cm) including handle and probe clip.

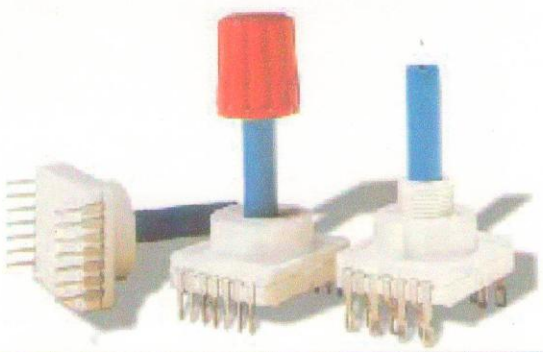
Weight: 2.2 pounds (1kg) excluding probe.

Audio: Built in speaker provides "click" for each pulse, full scale alarm on any range.

Connector: MHV

This product marketed and sold by:
Technical Services Group, Inc.
Atlanta, (Lawrenceville) Georgia USA
Phone: 800-969-XRAY
Local: 770-822-9117 Fax: 770-822-5643

RTA Rotary Switch



- Flat PC board rotary switch 12.8 mm (0.504) height.
- Available in decimal binary or hexa-decimal codes
- Index mechanism with 36, 30 or 22.5° angle for 10, 12 or 16 positions
- RTA can be soldered by hand or by wave. Contacts are protected against flux, but not protected against washing.

Options

- Hand soldering version
- Bush mounting M10 × 0.75
- Adjustable stop
- 6.0 mm (0.236) shaft, with several options
  - 25.0 mm (0.984) length
  - 50.0 mm (1.97) length
  - 25.0 mm and 50 with flat 4.0 mm (0.157) on shaft
  - slot for screw driver

Mechanical data	
Max. number of banks	1
Operating torque	5 Ncm ± 20%
End stop torque	> 60 Ncm
Stop	With/without or adjustable
Mounting	By fixed index 9.5 mm(0.374) of center, for bushing mount only
Contact material	Silver, Gold
Housing material	Thermoplastic

Electrical data	Silver	Gold
Switching mode	BBM	BBM
Max. switching power	5 VA	0.5 VA
Max. switching current	150 mA	20 mA
Max. carrying current	5 A	1 A
Nominal voltage at 50 Hz	60 V	25 V
Contact resistance	< 150 mΩ	< 150 mΩ
Dielectric strength at 50 Hz between contacts and ground terminals	500 V rms	500 V rms
Insulation resistance between contacts or contacts and frame (500 V =)	10^9 Ω	10^9 Ω
Number of operations	10 000	10 000
Bounce	< 5 ms	< 5 ms

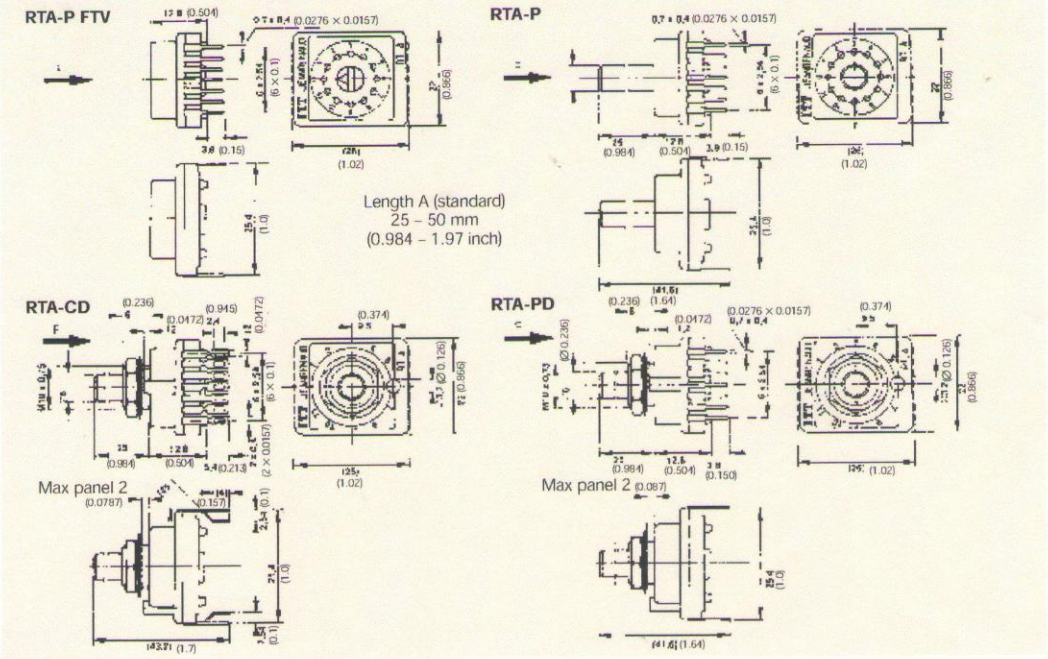
Environmental data		
Climatic category	25/70/21	25/70/21
Storage temperature	– 40°C to + 85°C	– 40°C to + 85°C
Salt spray	NA	NA

Further data		
Solderability	Hand:	350°C/5 s
	Wave:	260°C/5 s
Cleaning		By brushing on copper side of PC board

Combinations per module				
Angle between 2 positions		30°	36°	22.5°
Max. number of positions with	1 pole	12 positions	10 positions	
	2 poles	6 positions	5 positions	
	3 poles	3 positions	3 positions	
	4 poles	2 positions	2 positions	
Binary code		1248 BC	1248 BC	1248 B Gray

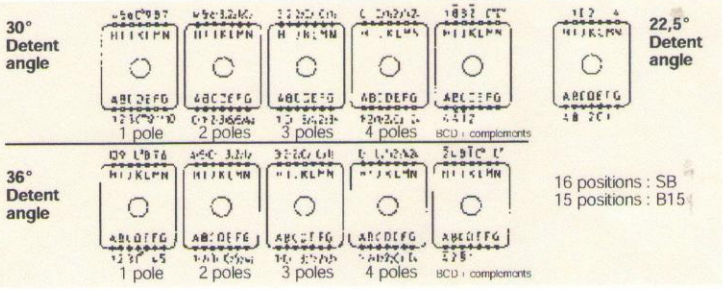
Ordering code: see next page

Dimensional Drawings

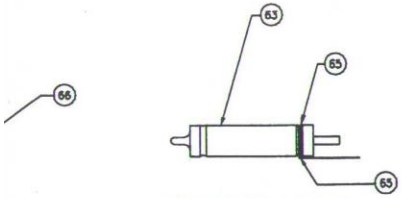


PC board layout

- **View from top**
  input contact C° in RTA 1 pole
- Following codes are stamped on rear of the switch
  CB = Binary code
  1N = 1 pole
  2N = 2 poles
  3N = 3 poles
  4N = 4 poles
  date code

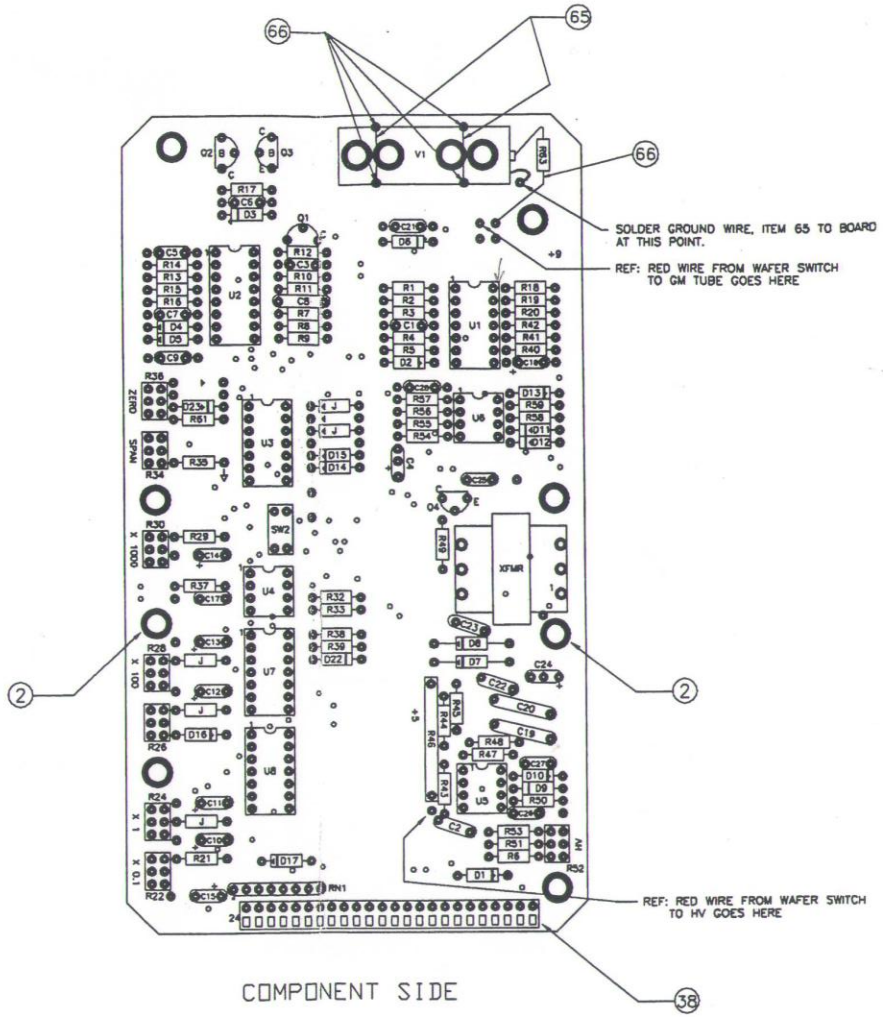


Ordering code		1	2	3	4	5	6	7	8
	Example:	RTA-P	30	112	B12	SD	M	25	S
1	**Designation:** RTA-P with PC pins RTA-C with soldering lugs								
2	**Detent angle** (between 2 positions)**:** 22.5, 30, 36								
3	**Number of poles (first digit) and maximum positions (second and third digit):** or code (direct binary code = B, direct + complement = BC): **30°**: 112, 206, 303, 402, BC: **36°** 110, 205, 303, 402, BC; **22.5°**: B = direct binary code, G = Gray code								
4	**Stop:** B.. = stop with number of position, S = without, R = adjustable								
5	**Bush:** SD = without, AD = with								
6	**Option of shaft:** M = flat shaft								
7	**Shaft length max.:** 25 or 50mm (0.984 or 1.97) F = screw driver slot								
8	**Contact material:** S = silver plated, G = gold plated								



BEND NICKEL WIRE AROUND GM TUBE SECURELY. IF GROUND WIRE IS ALREADY INSTALLED, OMIT ITEM 65. APPLY ITEM 66 TO JUNCTION POINT OF NICKEL WIRE.

ER (9500001), GM TUBE ASSEMBLY.
40651) AND IC'S AFTER BOARD CLEANING.
IK BATTERY PCB MOUNTING PADS AND COAT SOLDER
H CHEMTRONICS CONFORMAL COATING, ITEM #60.

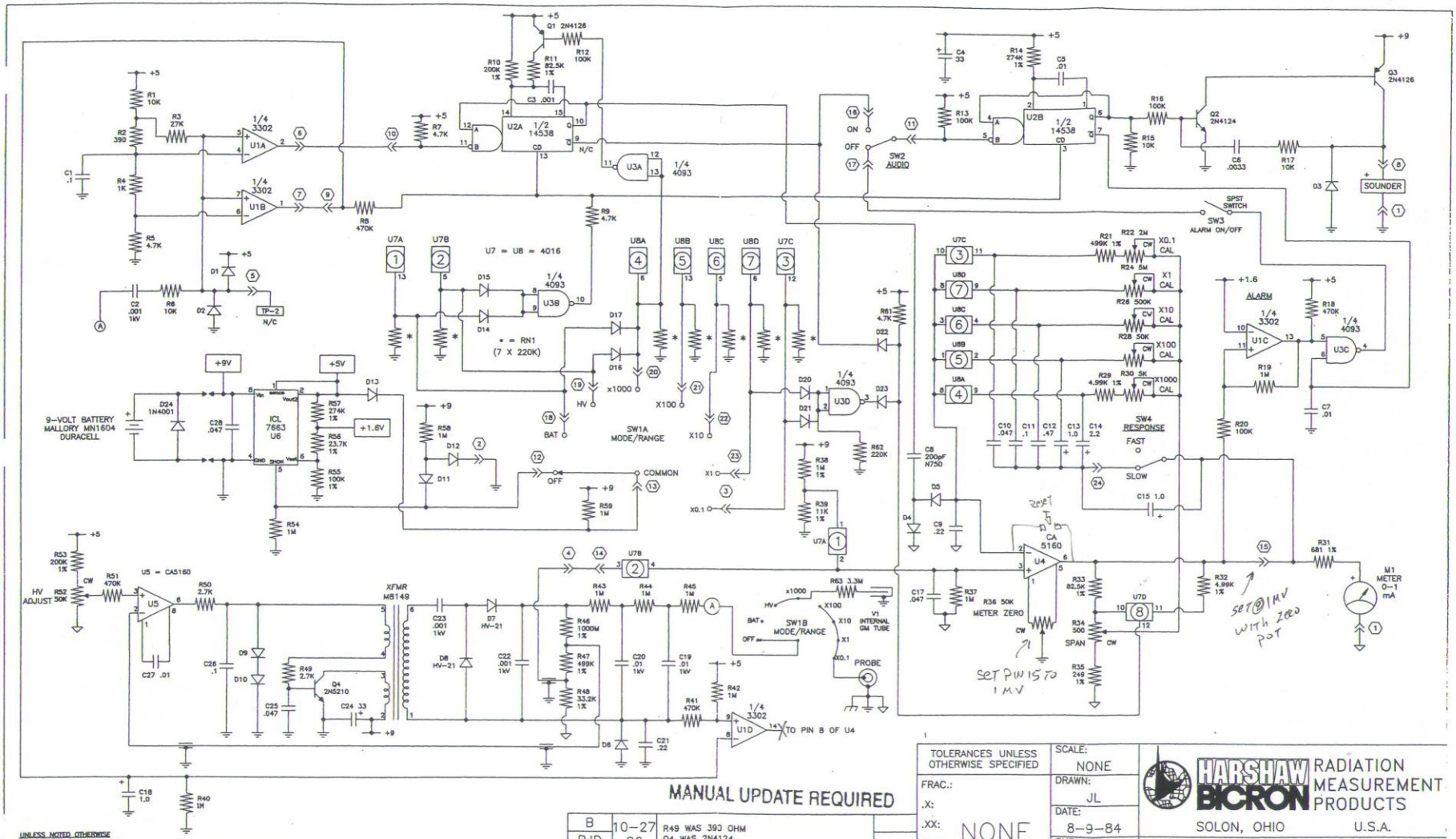


COMPONENT SIDE

COMPONENT	ITEM	PART NO.	QTY	DESCRIPTION
	1	9410004	1	P.C. BOARD, MAIN
	2	9940651	2	Pem Nuts PCB Type*KF2-632
J	3	8800004	5	JUMPERS
R1,R6,R15,R17	4	8110024	4	RES. 10K 1/4W 5%
	5			
R4	6	8113014	1	RES. 1.3K 1/4W 5%
R5,R7,R9,R61	7	8147014	4	RES. 4.7K 1/4W 5%
R19,R37,R40	8	8110044	10	RES. 1MEG. 1/4W 5%
R42-45,R54,R58,R59				
R48	9	8533224	1	RES. 33.2K 1/4W 1%
R56	10	8523724	1	RES. 23.7K 1/4W 1%
R12,R13,R16,R20	11	8110034	4	RES. 100K 1/4W 5%
R14,R57	12	8527434	2	RES. 274K 1/4W 1%
R8,R18,R41,R51	13	8147034	4	RES. 470K 1/4W 5%
R38	14	8510044	1	RES. 1MEG. 1/4W 1%
R22	15	9392051	1	TRIM POT 2MEG.
R55	16	8510034	1	RES. 100K 1/4W 1%
R24	17	9395051	1	TRIM POT 5MEG.
R3	18	8127024	1	RES. 27K 1/4W 5%
R28,R36,R52	19	9395031	3	TRIM POT 50K
R26	20	9395041	1	TRIM POT 500K
R2	21	8120004	1	RES. 200ohm 1/4W 5%
R30	22	9395021	1	TRIM POT 5K
R29,R32	23	8549914	2	RES. 4.99K 1/4W 1%
R11,R33	24	8582524	2	RES. 82.5K 1/4W 1%
R34	25	9395011	1	TRIM POT 500ohm
R35	26	8524904	1	RES. 249ohm 1/4W 1%
R39	27	8511024	1	RES. 11K 1/4W 1%
R46	28	8810071	1	RES. 1000MEG. 1/4W 1%
R21,R47	29	8549934	2	RES. 499K 1/4W 1%
R50,R49	30	8127014	2	RES. 2.7K 1/4W 5%
R10,R53	31	8520034	2	RES. 200K 1/4W 1%
R63	32	8133040	1	RES. 3.3MEG 1/4W 5%
D1-6,D9-17,D22,D23	33	9600004	17	DIODE IN4148
D7,D8	34	9600001	2	DIODE HV-21
S01,S03,S07,S08	35	9784014	4	AUGAT 14 PIN IC SOCKET
S02	36	9784016	1	AUGAT 16 PIN IC SOCKET
S04,S05,S06	37	9784008	3	AUGAT 8 PIN I.C. SOCKET
	38	9780001	1	MOLEX 24 PIN CONNECTOR
RN1	39	8822031	1	RES. NETWORK 220K x 7
U1	40	9640002	1	MC 3302 P IC
U2	41	9650004	1	4538 IC
U3	42	9650001	1	MC 14093 BCP IC
U4 U5	43	9640001	2	CA 5160 E IC
U6	44	9640003	1	ICL 7663 CPA IC
U7 U8	45	9650002	2	CD 4016 BE IC
C1,C11,C26	46	9211041	3	CAPACITOR 0.1uF
C2,C22,C23	47	9201021	3	CAPACITOR 0.001uF 1KV
C3	48	9211021	1	CAPACITOR 0.001uF
C4,C24	49	9233361	2	CAPACITOR 33uF
C8	50	9202011	1	CAPACITOR 200pF N750
C9,C21	51	9212241	2	CAPACITOR .22uF
C12	52	9214741	1	CAPACITOR .47uF
C15,C13,C18	53	9231051	3	CAPACITOR 1.0uF
C14	54	9232251	1	CAPACITOR 2.2uF
C10C17C25C28	55	9214731	4	CAPACITOR 0.047uF
C19,C20	56	9201031	2	CAPACITOR .01uF 1KV
C5 C7 C27	57	9211031	3	CAPACITOR 0.01uF
C6	58	9213321	1	CAPACITOR 0.0033uF
Q1,Q3	59	9610002	1	TRANSISTOR 2N4126
	60	9860401	A/R	CONFORMAL COATING
Q4,Q2	61	9610005	2	TRANSISTOR 2N5210
XFMR	62	9500001	1	TRANSFORMER M8149
	63	9730008	1	GM TUBE
SW2	64	9550001	1	SLIDE SWITCH SPST
	65	9822202	A/R	NICKEL WIRE
	66	9860003	A/R	RTV CLEAR
	67	9100012	1	TIN SHIELD

MANUAL UPDATE REQUIRED

K KDENG	8-9 98	ADDED DRAWING NOTE TO USE CHEMTRONICS CONFORMAL COATING, ITEM #60, AFTER TESTING OF THE PC BOARD.	IN1457	G JAR	9-11 96	COMPLETE VIEW UPDATE	IN1213	D	4-25 96	ITEM 61 WAS QTY 1; ITEM 30 WAS QTY 1; ITEM 12 WAS 8549930; DWG WAS C SIZE	IN1150	TOLERANCES UNLESS OTHERWISE SPECIFIED	SCALE: NONE	BICRON RADIATION MEASUREMENT PRODUCTS	
J WBQ	1-21 98	ADDED GROUND WIRE FROM GM TUBE TO PAD ON P/C BRD & ADDED SOLDER NOTE.	IN1412	F JAR	8-5 96	REMOVED R23 FROM VIEW	IN1204	L WDENG				FRAC.:	DRAWN: J.L.		
H KDENG	10-5 98	ADDED ITEMS 65, 66, & 67. ITEM 63, P/N 9730008 WAS 9730010. ADDED GM TUBE ASSEMBLY DRAWING & DRAWING NOTES.	IN1278	E L WDENG	5-15 96	ROTATED D7 & D8 180 DEG.	IN1136	C		R49 WAS 390 AHM Q4 WAS 2N4124	RJD	.XX: .XXX:	DATE: 8-22-84	MAIN BOARD ASSEMBLY	
				D L WDENG	4-28 96	ITEM 16 WAS 8510030 REMOVED ITEMS 5 & 60	IN1150	B A		FORMERLY SURVEYOR 2000 AHS R2 WAS 390 OHM R4 WAS 1K	RJD RJD	ANGLES: MICRO FIN.: √	CHECKED: DATE:	SURVEYOR 2000	



UNLESS NOTED OTHERWISE
1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MICROFARADS

CONNECTOR PIN BETWEEN MAIN AND SWITCH PCB'S (CN1)

CONNECTION BETWEEN MAIN AND BATTERY PCB'S

REV	DATE	DESCRIPTION	ECN	BY
C	8-7	R49 WAS 1K	IN1205	JR
JAR	96	CONVERTED TO CAD		
B	10-27	R49 WAS 390 OHM		
RJD	86	Q4 WAS 2N4124		
A	9-4	FORMERLY SURV. 2000 AHS		
JSB	85			

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC.:
.X:
.XX: NONE
.XXX:
ANGLES:
MICRO FIN.: √
DE-BURR AND BREAK ALL EDGES

SCALE: NONE
DRAWN: JL
DATE: 8-9-84
CHECKED: JR
DATE: 8/8/96
DO NOT SCALE PRINT

HARSHAW BICRON RADIATION MEASUREMENT PRODUCTS
SOLON, OHIO U.S.A.

Schematic Circuit Diagram
SURVEYOR 2000

DWG. SIZE	BASIC PART NUMBER	REV.
B	1016927	C