

**instruction  
and service manual**

# countmaster

*Geiger Counter-Assayer*



A SUBSIDIARY OF HOFFMAN ELECTRONICS CORPORATION

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## **Introduction**

*Your Hoffman Countmaster is a sensitive, precision made Geiger Counter-Assayer for use in Civil Defense, contamination investigation, as well as prospecting and field assaying. The electronic design of this instrument utilizes the very latest advanced miniature electronic techniques, including printed circuits. All the engineering skills developed through more than ten years experience in designing and producing accurate, sensitive military electronic equipment has gone into the design of your Countmaster. In addition, your Hoffman Countmaster is designed to withstand the most rugged field use.*

*Before attempting to use your Hoffman Countmaster, study the entire Operating Instructions to become thoroughly familiar with the instrument and its features.*

**Controls**

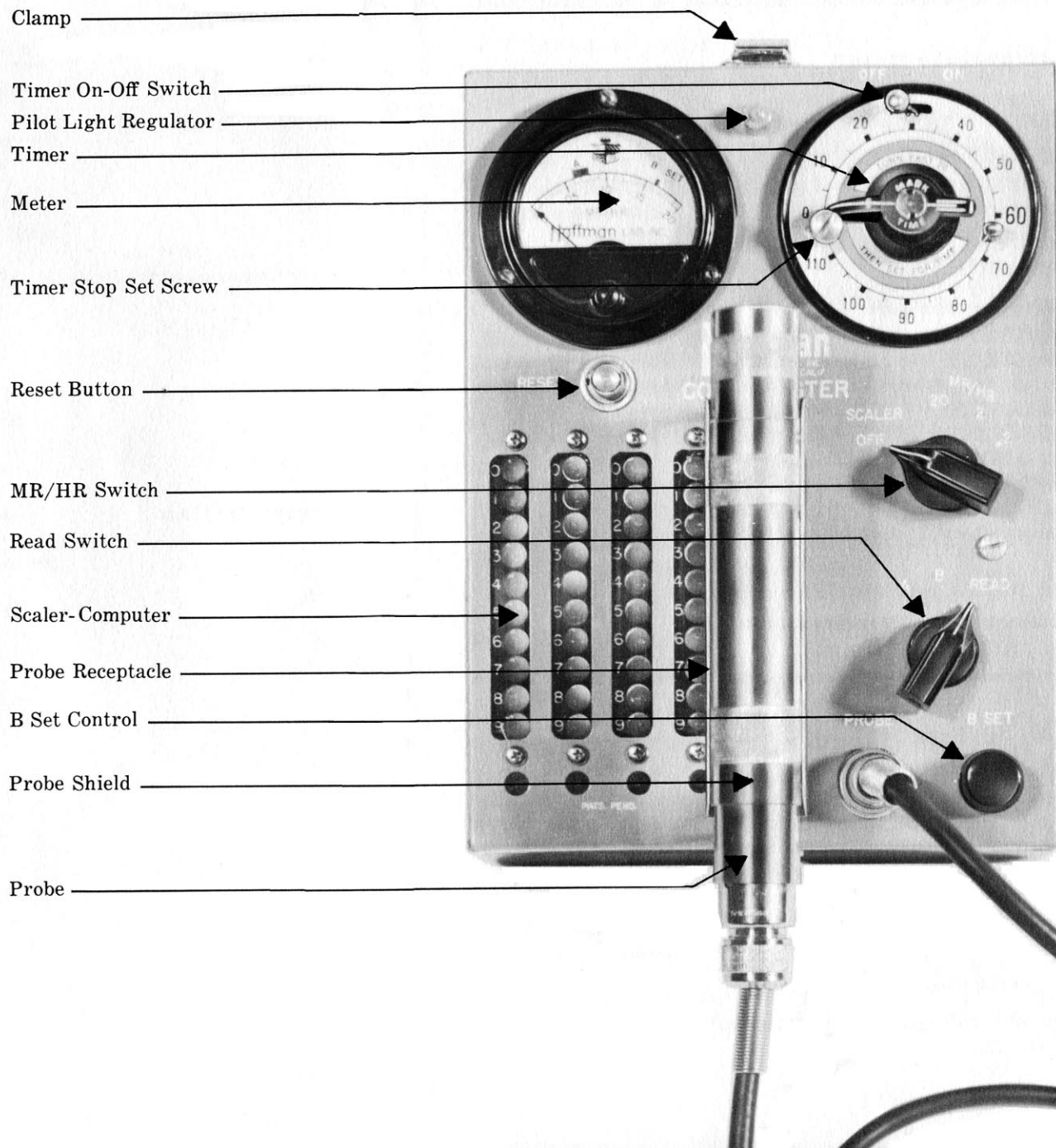


Figure 1.

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## How to operate meter

*See Figure 1 for location of controls.*

1. Turn READ switch to B position.
2. Turn Milliroentgen-per-hour (MR/HR) switch to 20. Pilot Light Regulator will glow. If light does not glow, see Maintenance Section.
3. Turn B SET knob until meter pointer is on black line in green area under B SET.
4. Turn READ switch to READ position.
5. If Meter does not read above the first two black lines left of .05, advance MR/HR switch to 2 position. If Meter reading is still below the first two lines, advance switch to .2 position. The .2 position is preferable for most operations.  
In position 20, Meter calibration points .05, .10, .15, and .20 are read as 5, 10, 15, and 20 MR/HR.  
In position 2, calibration points of Meter are read as .5, 1.5, and 2 MR/HR.  
In position .2, calibration points of Meter are read as marked on Meter.
6. Turn MR/HR switch to OFF position when instrument is not in use.

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## How to operate scaler

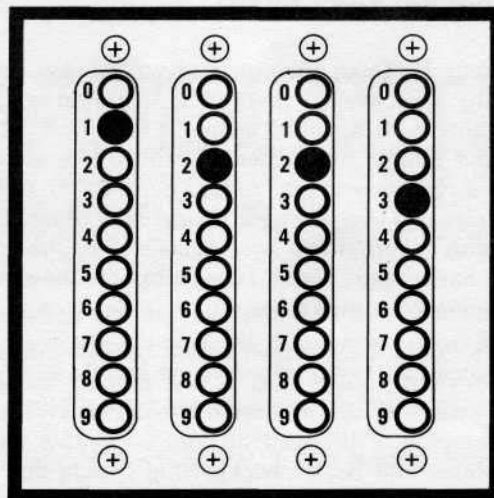
The neon bulbs of the Scaler require ultra-violet light such as sunshine to light properly. When using your Hoffman Countmaster in a mine tunnel, or darkened room, illuminate the face of the instrument with a flashlight or an ultra-violet lamp. Gamma rays cause the Geiger-Mueller (G-M) tube to discharge. Scaler indicates the total number of times the G-M tube discharges.

1. Turn READ switch to B position.
2. Be sure toggle switch above Timer knob is in OFF position.
3. Turn MR/HR switch to SCALER position. Pilot Light Regulator will glow.

4. Turn B SET knob until Meter pointer is on black line in green area under B SET.
  5. Press RESET button.
  6. Turn TIMER knob clockwise to desired time. Loosen Timer Stop Set Screw with a coin, or other tool. Turn Timer Stop until it rests against the pointer. Tighten Set Screw.
  7. Place Timer ON-OFF switch to ON position and IMMEDIATELY return to OFF position. TIMER will operate for the set time, then automatically shut-off the counter. Neon bulbs of Scaler will show total count until RESET button is pressed to erase total.
- NOTE: *If Timer has not been operated for several hours, it is recommended that the first count always be disregarded as the spring in the Timer may have taken a set which could reduce the accuracy. It is suggested that the Timer be operated two or three times before using Scaler.*
- NOTE: *If you wish to operate Scaler longer than two minutes, set Timer ON-OFF switch to ON position. It is not necessary to adjust Timer knob. Scaler will operate until switch is returned to OFF position.*
8. Read lights on Scaler from left to right as thousands, hundreds, tens, and units. (See Figure 2.)
  9. For additional counts, repeat Steps 5 through 8 inclusive. Do not reset Timer Stop as described in Step 6.

Figure 2.

*Solid circles indicate bulbs are lit. Read this count as 1,223 counts per minute.*



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## Battery condition check

### A BATTERIES

Turn READ switch to A position and MR/HR switch to any position past OFF. Meter should indicate in green area under A.

### B BATTERIES

Turn READ switch to B position and MR/HR switch to any position past OFF. Turn B SET knob until meter pointer is on black line in green area under B SET. If meter pointer cannot be brought up to this point, replace B batteries. For changing batteries, see Maintenance Section.

It is recommended that this check always be made before starting to prospect to make sure your batteries are fresh. Regardless of battery condition, it is good practice to carry a spare set of batteries in your car for field replacement. Batteries are easily replaced.

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## Background count

Your Hoffman Countmaster will always record a small reading in any area, even if there is no Uranium ore present. This reading is called a background count. It is caused principally by cosmic rays and minute quantities of radioactive material which are present nearly everywhere. Actual deposits of Uranium are indicated by increases over the area background count. Background count varies with geographical location as well as the time of day. When taking a background count, be sure to note the exact location of the meter pointer for reference.

To take a background count, set the Timer and operate Scaler as previously described. A one minute background count is recommended as the minimum time. The average count will usually be somewhere between 30 and 60 counts per minute. Record both Meter and Scaler background counts and you are ready to start prospecting that particular area.

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## Prospecting

Unlike other metallic ore, ore containing Uranium and Thorium are radioactive. This means the material emits invisible rays called Beta and Gamma rays. These rays are best pin-pointed with a Geiger-Mueller counter.

Your Hoffman Countmaster measures these rays in two ways. One is by milliroentgens-per-hour. The other method is by measuring the number of pulses made by the G-M tube during a set time.

The Meter measures radioactive intensity. The Scaler-Computer counts the number of pulses made by the G-M tube. The Timer provides the constant time base necessary for accuracy when using the Scaler.

The best method for carrying out a search for Uranium varies according to topography and geology of the area. In general move slowly over the ground. For best results hold the probe parallel to the surface with the shield open. When the shield is open, both beta and gamma rays are detected. When the shield is closed only gamma rays are detected.

*CAUTION: To open probe, hold shield and push probe FORWARD. Do not pull probe back. Do not attempt to remove probe from handle by pulling up on the cord. Lift up by the end of the probe only.*

For general prospecting with the Meter, it is not necessary to remove the probe from the handle. Merely extend the probe full length. An increase in the Meter reading will indicate a deposit. While either the Meter or Scaler may be used, it is better to use the Meter for prospecting, since the reading obtained in making the background count may be used as reference point from which increases in radioactivity will be readily apparent.

The increase in Meter reading will depend upon the depth at which the deposit occurs and the material covering it. A very thorough investigation of the ground should be made whenever the Meter reading increases significantly over the background count. When an increased Meter reading occurs, take a count with the Scaler to determine the exact amount of the increase. A one minute count should be taken if a one minute background count was used.



If using the Scaler for prospecting, turn the MR/HR switch to the SCALER position, and the Timer ON-OFF switch to the ON position. A very sharp increase in the count rate on the Scaler will be observed as a deposit is approached.

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## Grid survey

A grid survey or contour map is very useful for pin pointing deposits as well as to determine whether the radioactivity in an area is due to a vein deposit, or to a relatively low-grade deposit that is scattered over a wide area. Your Hoffman Countmaster is particularly well suited to making accurate grid surveys.

There are two methods used for making a grid survey. In the first, a series of twenty-foot squares are plotted on a map covering the area under survey. Make one minute counts with the Scaler at the center of each square, and record the count in the proper square. This method is best suited for plotting the locating of Carnotite or other ores which are characteristically widely dispersed.

For locating Pitchblend veins where uranium oxide ( $U_3O_8$ ) is fairly well concentrated, the second method may be used. This is called a topograph map, or technically, an isorad map. For an isorad map simply rule off the area to be surveyed like a checkerboard, or grid. Take one or two minute counts with the Scaler at the corners of each square, and record the counts in the proper location on your map. For these readings hold the probe at a constant height.

After the readings are taken and recorded, divide all readings into three ranges; high, intermediate, and low. Connect all readings of the same range together by drawing a pencil line through the numbers. (See Figure 3.)

By this method it is usually possible to distinguish any significant pattern that might be present. If there are any well defined areas in which the readings are uniformly high, or in which only one figure is outstandingly high, then such areas should be investigated further by taking assay readings on particular samples from that area. A detailed description of Grid Surveys is found in "Prospecting for Uranium," published by Superintendent of Documents, U. S. Government Printing Office, Washington, D.C.

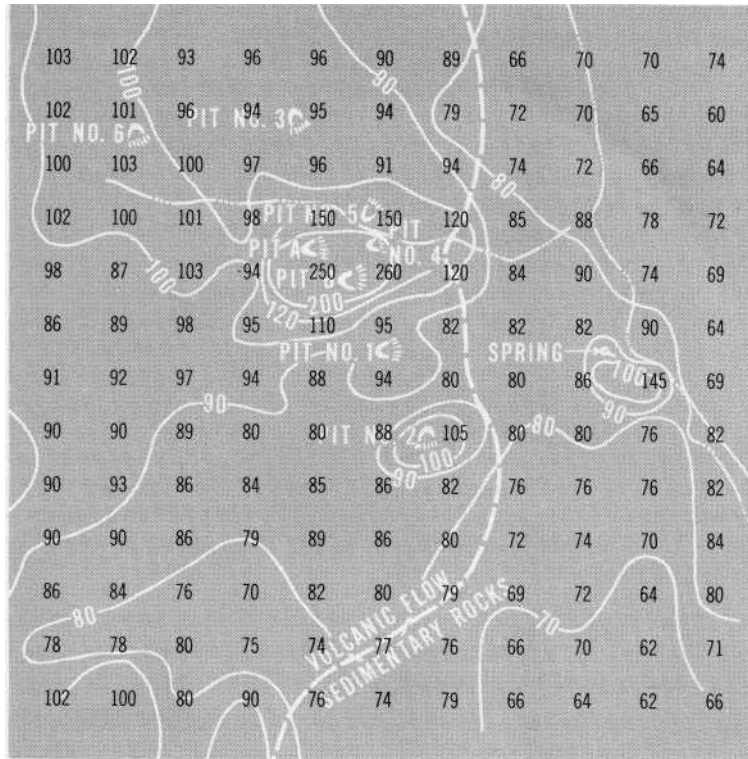


Figure 3. Typical isorad map

### Plotting a calibration curve

Before attempting a radiometric assay, it is necessary for you to plot a calibration curve for your Hoffman Countmaster. It is impossible for the factory to plot this curve, as accuracy depends on the manner in which you choose to perform your field assays. The type of container used, whether the ore is fine ground, the size of pea gravel, or a hand specimen; all are important factors in calibrating your instrument for dependable accuracy.

Enclosed in the package with your Hoffman Countmaster are two calibrating charts; one is scaled from 0 to 1%,  $U_3O_8$  equivalent, the other 0 to 4%. The 4% chart is merely an expanded version to allow for use with high grade ore.

Ore used for calibrating may be in any one of three forms; solid piece of hand specimen size, ore broken with a hammer to pea gravel size, or pulverized to face powder consistency. A radiometric assay of the same piece of ore in each of the three forms will give a different reading in counts per minute, but have the same percentage of  $U_3O_8$ . The hand specimen will give the highest count, and have the greatest error due to mass effect. The face powder consistency will give the lowest count and have the highest degree of accuracy. It is necessary to use three or four pieces of ore with different uranium content, for the greatest calibrating accuracy.

One ore sample should be in the region of .25 to .30%  $U_3O_8$ , (approximately 500 counts per minute); one .80 to .90%, (2000 counts per minute); one about 2.00%, (2800 counts per minute). If a fourth sample is used it should be about 3.4%, (4200 counts per minute). If this suggestion is used, plot your calibration curve on the 0 to 4% chart. If lower grades are used, plot your curve on the 0 to 1% chart.

Ore samples may be purchased from most mining supply houses, or gem stores, or, you may use your own ore. To determine that the samples have different uranium content, use the Meter.

Your Countmaster may be calibrated by any one of the three methods, or all three methods just as you prefer. This can all be done with the same pieces of ore. Label the lower grade sample #1, next higher #2, and so on. When recording the counts be sure to identify by count and sample number. If you are calibrating your instrument for all three methods, be sure to identify your recorded count as Sample #1, hand specimen; Sample #1, pea gravel; and so on.

For all counts, be sure all extra ore is removed from the area so it will not affect the background count. Take a background count and record it.

NOTE: *When taking calibration counts, be sure the shield is open for both beta and gamma ray detection.*

HAND SPECIMEN—For this method use the following procedure: Take a two minute Scaler count on three or four sides of the ore, recording the count for each side. Be sure you hold the probe tight against the ore for each count. Counts per minute will probably vary

with each side. Total the counts for all sides, and take an average. Subtract the background count. This will give you your net count.

**PEA GRAVEL**—For this method use the following procedure: Using a hammer, break the ore sample into approximately pea gravel size. Mix broken ore thoroughly and place in a clean container. A one pound coffee can is recommended for this method. The can should be filled approximately three-quarters full with broken ore. Scribe a line around the inside of the can, marking the level of the ore. This is important as when other ore is to be assayed, the exact amount of ore must be placed in the same can to stabilize the mass effect.

Now dent two sides of the can slightly to form a depression, so the probe will fit snugly over the top of the can. This will stabilize the probe location and the distance the probe will be from the ore.

*NOTE : Once your coffee can has been prepared, save it as an important part of your equipment. It is very important that the same container be used in exactly the same manner for each assay count. After the above preparation is completed, lay the probe in the depressions in the can and take a two minute count. Record the count and subtract your background count. This will give you your net count.*

**POWDER**—For this method use the following procedure: Grind the ore specimen to the consistency of face powder. Mix thoroughly and place only part of the powder in a small, clean, large mouth glass bottle such as a pill bottle, or a paper cup. Scribe a line around the container to mark the level of the powder. Powder should be tamped down as much as possible before the line is scribed.

Hold the probe against the open mouth of the container making sure one of the open windows is pointing downward toward the powder. Take a two minute count and subtract the background count. Once your Countmaster is calibrated, the same glass bottle or paper cup must be saved and used in exactly the same manner for the stabilized conditions that will give you important accuracy.

It is always advisable to take several counts regardless of which method is used. Always total the counts, take an average, and subtract the background count from the average count for the net count.

It is now necessary to take all of the hand specimen, crushed rock, or powdered ore to a laboratory for a radiometric assay. The analysis received from the laboratory will be expressed in uranium

oxide,  $U_3O_8$  equivalent. This means that the radioactivity of your samples is equivalent to the radioactivity of laboratory samples which contains the amount of uranium indicated by the analysis.

Your samples will be returned from the laboratory identified by your sample numbers. Each number will show the laboratory.  $U_3O_8$  equivalent. This may be written in several ways;  $U_3O_8e$  or  $U_3O_8equiv$  (both mean equivalent); or  $U_3O_8 rad$  for radioactivity.

You are now ready to plot a calibration curve on your chart. Take Sample #1, the ore with the lowest count. Scaler counts are recorded across the bottom of the chart, left to right.  $U_3O_8$  equivalent percentages are on the left side of the chart, reading bottom to top.

Locate on the chart the number that corresponds to the number of counts this sample indicated. Lightly draw a straight line up directly opposite the  $U_3O_8$  percentage given in the laboratory analysis. (See Figure 4.) Lightly draw another line from the  $U_3O_8$  percentage to cross the line previously drawn. Where the two lines cross, mark an X.

Repeat above procedure for all other samples of the same form, hand specimen, etc. When all the samples are located on your chart, draw a line connecting all the location points. (See Figure 5.) Be sure the line is curved to join the location points, or if points should be too much out of line, draw your curve to pass between the X points.

As previously suggested, you may, if you wish, calibrate your Countmaster for all three methods; hand specimen, pea gravel, and powder. If this is done, mark each plotted curve with a different color, then indicate in one corner of the chart what each color means such as Red, hand specimen; blue, pea gravel, and so on.

Once your Hoffman Countmaster is calibrated, it is never necessary to repeat the procedure, unless you change the Geiger tube. If you do change the Geiger tube, however, be sure to re-calibrate the instrument.

Once your Countmaster is calibrated you can make accurate, dependable running checks on the quality of ore, and marginal ore possibilities can be examined without waiting for laboratory radiometric assays. The counts from the Scaler can immediately be transferred to  $U_3O_8$  equivalent by referring to your calibration chart.

If finer accuracy is required, the Hoffman Countmaster Sample Chamber is available. This complete field kit comes laboratory

Figure 4.

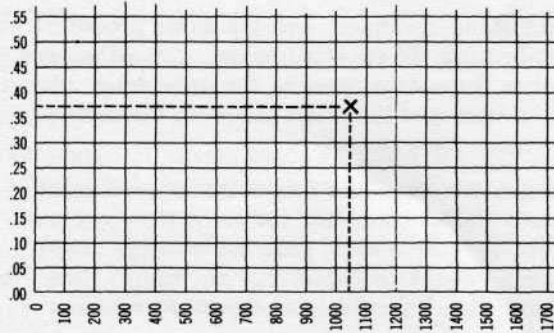
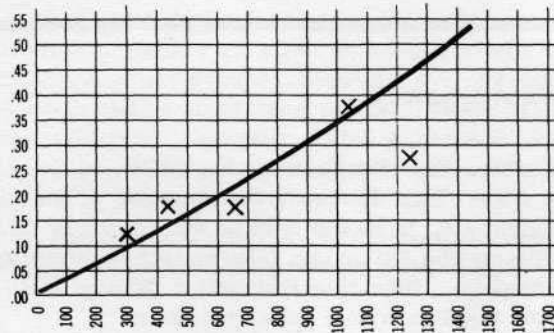


Figure 5.

A Calibration Chart can be used only for the counter for which it was prepared.



calibrated for you. The kit consists of a small lead shielded sample chamber, a standard radioactive sample, two sample pans, and a field assaying chart. The chart will have the curve plotted for your particular instrument. With the Sample Chamber, the Countmaster will make radioactive assays in the field that are surpassed in accuracy only by the most complex laboratory equipment.

## Radiometric assaying

Once your Hoffman Countmaster is calibrated, radiometric assays are very simple. Only one important fact must be remembered. When assaying ore, you MUST use the same method for preparing the ore sample that you used to calibrate your instrument. If you used the Hand Specimen to calibrate, use approximately the same

size Hand specimen, and the same procedure you followed when calibrating. If calibrating ore was either pea gravel or powder form, it must be put into the same form, placed in the same type container, and the probe placed in the same position, and the same distance from the ore.

If you are careful to follow this procedure, it is only necessary to run a Scaler count for the same time you used when calibrating. Take several counts, take an average count, subtract the background count to obtain the net count. Refer to your calibration chart (See Figure 5.) to convert your counts per minute into  $U_3O_8$  equivalent.

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## Maintenance

*Caution:* Your Countmaster has 900 volts. Be sure MR/HR switch is OFF. Your Hoffman Countmaster is an intricate electronic instrument. It should only be worked on by an experienced technician. The following information is supplied for the repair technician. Take this Instruction Manual with you. It will help your repairman do a better job faster.

### CHANGING BATTERIES

A complete list of batteries that are usable with the Countmaster is printed on the inside bottom of the case. If batteries do not meet the Battery Condition Check, replace batteries.

To replace B batteries, unlock latches at the ends of the case, and lift cover by the probe support. Simply unhook spring holding batteries in place, and carefully pull clip boards away from the wires. Do not use tools, or the clips may be damaged. To connect new batteries, merely press the clip board in place.

A Batteries may be removed by unhooking springs. Batteries will lift out. The 15 volt B Battery mounted immediately under A Battery brackets is removed by pulling back spring bracket, and battery will fall out.

*Caution:* Plus ( + ) and minus ( - ) polarity is marked on board just above 15 volt B Battery. Be sure to line up polarity markings on battery with markings on board when replacing.

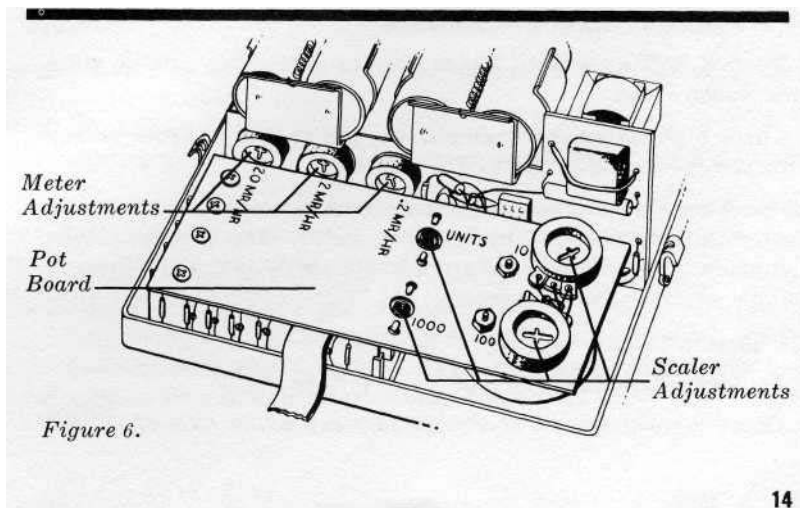
## METER CALIBRATION

**RADIATION METHOD** To gain access to the three Meter calibration adjustments, lift instrument out of case, turn over, and unhook spring holding B batteries in place.

A gamma ray source of known value in MR/HR may be used to calibrate the Meter. It is desirable to use three different radioactive sources; one source for each range, for the most accurate calibration. Place the source against the side of the probe with the shield closed. Adjust the calibration control until the Meter reads the same intensity plus background intensity and scattering. (See Figure 6.)

## PULSE GENERATOR METHOD

1. Use a pulse generator with 1.5 volt negative pulses, width of 5 microseconds, and frequency of 1,200 pulses per second between pin #1 of probe socket and ground. (See Figure 7.) Adjust control marked 20 MR/HR under front panel so Meter reads 20 MR/HR, or full scale deflection. Caution: Pulse generator should be decoupled from Countmaster by a .0047 mfd, 1500 volt capacitor as there is 900 volts at pin # 1 of probe socket.
2. Set pulse generator frequency to 120 pulses per second and adjust 2 MR/HR control until Meter reads 2 MR/HR, or full scale deflection.
3. Set pulse generator frequency to 12 pulses per second and adjust .2 MR/HR control until Meter reads .2 MR/HR, or full scale deflection.





### SCALER CALIBRATION

*Note:* Meter must be calibrated first. Scaler lamps require ultra-violet light for reliable operation, sun, fluorescent or strong incandescent illumination. Be sure probe is disconnected.

1. Turn READ switch to B position and leave in this position while calibrating Scaler.
2. Set TIMER switch in OFF position.
3. Turn MR/HR switch to SCALER position.
4. Adjust B SET knob until meter pointer is ONE DIVISION ABOVE black line in green area under B Set.
5. Adjust control marked "UNITS" on back of panel until all "Unit" lamps are lit. (See Figure 6.) Then back off adjustment until lights just stop counting.
6. Repeat Step 4.
7. Adjust controls marked "10", "100", and "1000" in the same manner.

*Note:* Be sure to repeat Step 4 after each row of lights is adjusted.

8. Turn B SET knob until meter pointer is on black line in green area under B Set. Scaler is now in calibration.

### HIGH VOLTAGE CHECK

1. Disconnect probe at probe receptacle.
2. Turn READ switch to B position.
3. Turn MR/HR switch to 20 position.  
The Pilot Light Regulator should light.
4. Turn B SET knob until Meter Pointer is on black line in green area under B Set.
5. Check high voltage between pin #1, and ground at probe socket. This voltage should be 900 to 975 volts d.c.

*Note:* The 900 volts can only be accurately measured with an electrostatic voltmeter. Any ordinary meter, even a vacuum tube voltmeter type, will load the circuit sufficiently to cause a drop in voltage of 100 volts or more.

### LOW VOLTAGE CHECK

1. Perform Steps 1, 2, and 3 of High Voltage Check.
2. Check low voltage under chassis between center arm of B SET

control and ground. This voltage should be between 126 to 138 volts.

3. Turn B SET knob full clockwise. The MR/HR Meter should read between 18 and 20 MR/HR for fresh B batteries.

4. Turn READ switch to A position and MR/HR switch to any ON position. Meter should indicate in green area under A if batteries are fresh.

#### REPLACING SCALER BULBS

To replace Scaler bulbs, uncover base of bulbs by removing four screws and two nuts holding pot board in place, and carefully tip board back. (See Figure 6.)

*Note:* All bulbs are color coded on the base. Check the following chart for bulb voltages. Any bank of ten bulbs must have all bulbs with the same voltage within 5 volts.

*Important:* Replace bulbs with General Electric Type NE 96-Glow Lamp.

#### VOLTAGE CHART FOR SCALER BULBS

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| <i>Color Code</i>  | <i>Lowest Starting Voltage</i>                 |
|--------------------|--|
| <i>Brown .....</i> | <i>Starts glowing between 115 to 120 volts</i> |
| <i>Red.....</i>    | <i>Starts glowing between 120 to 125 volts</i> |
| <i>Orange.....</i> | <i>Starts glowing between 125 to 130 volts</i> |
| <i>Yellow.....</i> | <i>Starts glowing between 130 to 135 volts</i> |
| <i>Green.....</i>  | <i>Starts glowing between 135 to 140 volts</i> |

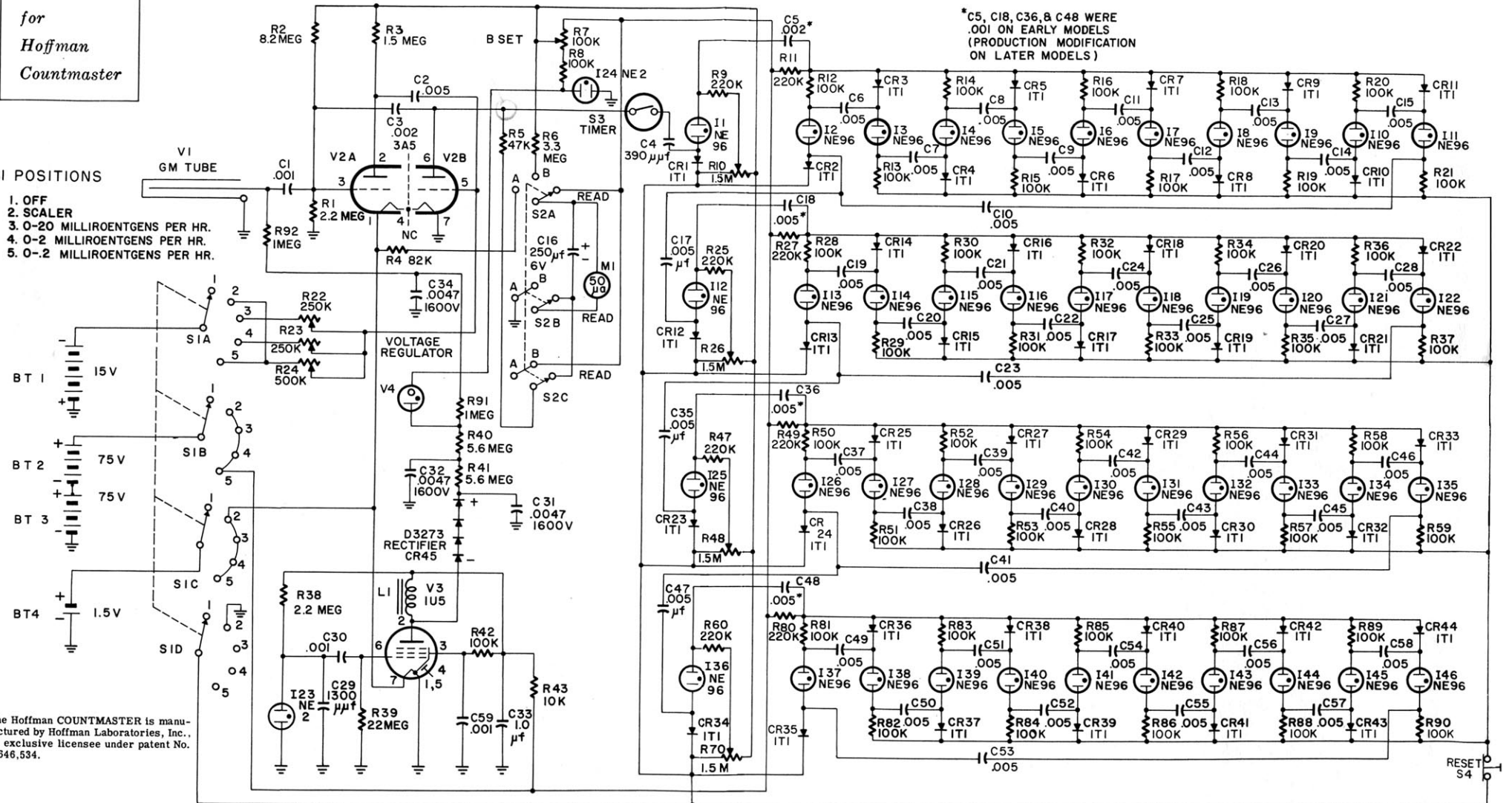
*Caution:* A row of four bulbs at the base of the Scaler are Trigger Bulbs. These must be replaced with bulbs with voltages corresponding to the Brown or Red bulbs. The color coding on the base of the bulbs was done at the factory. When replacing bulbs, do not look for bulbs with similar color coding. Instead, check for lowest firing voltage.

Figure 7.

Pull out →

Circuit schematic for Hoffman Countmaster

- SI POSITIONS
1. OFF
  2. SCALER
  3. 0-20 MILLIROENTGENS PER HR.
  4. 0-2 MILLIROENTGENS PER HR.
  5. 0-2 MILLIROENTGENS PER HR.



The Hoffman COUNTMASTER is manufactured by Hoffman Laboratories, Inc., as exclusive licensee under patent No. 2,646,534.

RESET S4