

MAN150

# Model DPM Digital Potential Meter

## Reference Manual Part # 4110



**MCM**  
**MCMILLER Co.**

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## Table of Contents

<b>Topic</b>	<b>Page</b>
<b>Description</b>	<b>3</b>
<b>Preparing Meter &amp; Reference Electrode for Use</b>	<b>4</b>
<b>Maintaining &amp; Checking Your Reference Electrode</b>	<b>6</b>
<b>Structure-To-Soil or Water Potentials</b>	<b>7</b>
<b>Structure-to-Structure Potentials</b>	<b>8</b>
<b>Applications for DPM</b>	<b>9</b>
<b>Maintenance of Meter</b>	<b>10</b>
<b>Installing New Battery</b>	<b>11</b>
<b>Trouble-shooting</b>	<b>12</b>
<b>Precautions</b>	<b>13</b>
<b>Specifications</b>	<b>14</b>

## **Description**

The MCM Digital Potential Meter is a very simple to operate meter designed for one-handed operation under almost any climatic conditions in which it is feasible to perform indoor or outdoor corrosion or cathodic protection tests. It is equally useful in difficult environments such as on a pipeline right-of-way underneath high voltage power lines or in marine environments. If accidentally dropped overboard, your Digital Potential Meter will float, even with a completely filled reference electrode attached.

The DPM meter comes complete with reference electrode, test lead, manual, and a padded carrying case. The DPM is an indicating type meter and does not store readings of any kind.

Since potential measurements are by far the most common measurement made by the corrosion engineers, you will find the DPM to be extremely useful for a large number of applications as outlined below. It is both accurate and highly sensitive.

### **BOTTOM VIEW OF METER CASE**



A – 2V RANGE PUSH BUTTON SWITCH

B – 20V PUSH BUTTON RANGE SWITCH  
(Must be pressed along with 2v Range  
Switch button to get 20v)

C – RED (Positive) INPUT BANANA JACK

D – BLACK (Negative) INPUT  
1/4-20 Female Thread

## **Preparing Meter & Reference Electrode for Use**

Your new meter will have a 9v battery already installed. Press and hold the 2v range button. The display window should immediately show “.000” or “.001” or should become either of these values within several seconds. If there is no number displayed or if a battery symbol is displayed, the battery is weak, dead or has become disconnected. See “*Installing New Battery*” on page 12.

As received from the factory, a new copper sulphate reference electrode will be dry but some blue copper sulphate crystals should be visible in the transparent window of the electrode tube. To prepare the electrode for use, unscrew the top end of the electrode and fill to bottom of threads with distilled or demineralized water. If electrode is to be used or stored below 32 F (0 C), substitute MCM’s “Electrode Anti-Freeze Solution” for the water.

With top end of electrode securely tightened, shake the electrode a few times to help the copper sulphate crystals to dissolve. Wait several minutes and check inside of tube to make sure that there are some undissolved crystals visible in the tube. This is to insure that the solution is saturated. If there are no crystals remaining after shaking the tube, open up the tube and add more copper sulphate crystals. Don’t worry, you can’t get too many crystals in the tube, but you must have some crystals remaining undissolved at all times.

Unscrew the knurled thumb nut from end of the electrode and screw electrode into the threaded recess in the bottom of the body of the meter. Place the banana plug of the red test lead (supplied with meter) into the red banana jack in the bottom of the body of the meter.

Remove and save the orange plastic protective cap from the bottom end of the electrode tube. This will expose the porous ceramic plug of the reference electrode so that it can be placed in contact with soil or water. By this time the porous plug should feel slightly moist.

Meter and electrode are now ready for use.

## Model RE-5 Reference Electrode



A – Knurled brass thumb nut

B – Electrode tube filled with distilled water  
or MCM's Antifreeze Solution.

C – Copper sulphate crystals - must always show  
some visible in the tube.

D – Porous ceramic tube

E – Orange plastic protective cap  
(remove when taking readings)

## Maintaining & Checking Your Reference Electrode

After a period of use, it is possible for your reference electrode to become contaminated as a result of osmosis through the porous plug. This is especially true if many readings are taken in areas where salt may be present.

For this reason, it is wise to check your reference electrode periodically against another reference electrode which has been used **only** as an office reference and has never been used out in the field. This is most easily accomplished by putting the two electrodes in a non-metallic container with a little tap water and measure the voltage between them. Hopefully this value will be less than 10MV. If the voltage is greater than 10MV, rinse out the field electrode and replace with new copper sulphate crystals and distilled water (or MCM's electrode anti-freeze solution). Do NOT use a knife blade, file or emery cloth to clean the copper rod. Use a 3M green abrasive pad. This will do the job without contamination to the copper rod.

**NOTE: *If all or nearly all of your measurements will be made in sea water or brackish water, you should consider using a silver-silver chloride reference electrode in place of the copper sulphate reference electrode which is normally supplied with the Model DPM. Call M.C. Miller Co. for details or check our web site [www.mcmiller.com](http://www.mcmiller.com).***

Before taking a potential reading, always make sure that there is at least enough solution remaining in the electrode tube to touch the copper rod and that there are some undissolved copper sulphate crystals in the bottom of the tube.

The orange protective cap supplied with your electrode serves to prevent evaporation of the electrode solution and provide some mechanical protection to the porous plug.

Replacement electrode parts, copper sulphate crystals, as well as other electrode accessories are available through the M.C. Miller Co. Inc.

## Measuring Structure-to-Soil or Structure-to-Water Potentials

Assuming that you have prepared both meter and reference electrode as detailed previously, measuring a potential is very easy.

Remove the orange protective cap from the reference electrode. Place the lower end of the reference electrode (the porous ceramic plug) in solid contact with soil or water at desired location. For best results, there should be no vegetation between electrode and the soil.

Connect the clip end of the test lead onto the metallic structure being tested. Make sure that the contact point with structure is clean and shiny.

Press and hold the 2V range pushbutton.

Read and record the voltage value obtained, unless the meter indicates "1.". This indicates an over range condition. Switch meter to 20V range by pressing and holding both pushbuttons. If the meter again indicates an over range, the input voltage exceeds 20V and cannot be measured by this meter.

***IMPORTANT: The polarity of a reading is a vital part of the reading and should always be recorded along with the numerical value on your data sheet.***

NOTE: Most potential readings will normally be negative and therefore display will show a (-) minus sign. If there is no minus sign displayed then the reading is positive, but no positive sign will be displayed.

See "Applications" section below.

### STRUCTURE-TO-SOIL POTENTIAL USING DPM METER



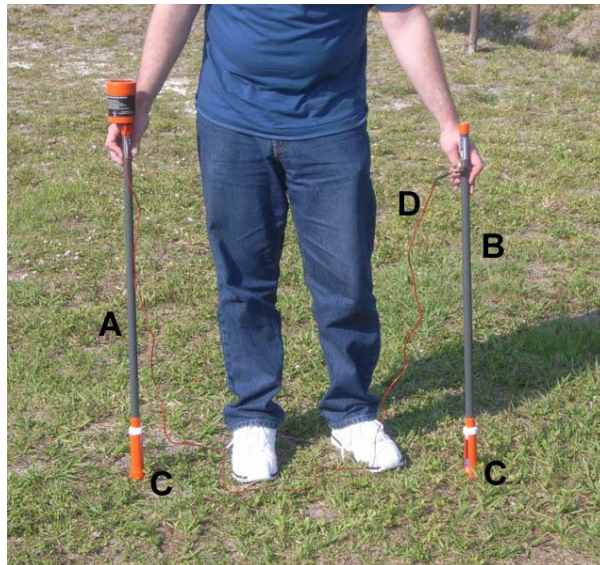
- A – DPM with protective cover
- B – Wire connection to structure
- C – Porous plug in contact with ground  
(Vegetation removed)

## **Structure-to-Structure Potentials**

This type of measurement will require the use of two leads. One test lead will have to terminate in a banana plug in order to fit into the positive (red) banana jack on the bottom of the body of the meter. In order to make use of the threaded negative input terminal of the meter, you will need to insert the threaded adapter (which is supplied with the meter). Now you can connect test clip or banana plug of a test lead onto this adapter.

See “Applications” below.

### **USING TWO REFERENCE ELECTRODES**



A – Intermediate Electrode Extension  
CAT # 16203

B – Electrode Extension  
CAT # 16101

C – Reference Electrode RE-5 or RE-5C  
CAT # 15108 or 15210

D – Interconnection Wire – Meter to  
Other Reference Electrode



## Application for DPM

There are a number of logical applications for the DPM in the field of corrosion and cathodic protection measurements as follows:

- Testing insulation on buried metallic piping, such as transmission lines, service lines, etc.
- Testing buried or underground duct installations of metallic sheathed power or communications cable
- Testing buried metallic tanks such as at filling stations
- Testing marine structures such as pilings, docks, and wharfs
- Testing metallic hulled vessels such as ships, yachts, barges, tankers, floating docks
- Making coating fault surveys on buried metallic piping
- Testing elevated water storage tanks
- Testing bare concentric copper neutral wires of URD cable installations
- Testing underground manhole installations on piping or cable systems
- Checking conditions of steel rebar in reinforced concrete
- Checking for current flow in soil or water
- Checking performance of impressed current ground beds
- Performing cathodic protection interference tests
- Testing metal tower footings of electric transition line towers
- Testing batteries

## **Maintenance of Meter**

### **Your meter requires minimal maintenance:**

The battery should be replaced whenever the battery symbol shows in the display window. If the battery symbol is suddenly displayed during a normal day of test activities, you may finish out the day of testing before having to replace the battery. On the other hand, if the symbol is displayed the first time the meter is used after a period of disuse, then the battery should be replaced at once.

The meter should be kept reasonably clean by wiping with a cloth and then allowed to dry before placing back in the carrying case.

The meter and the electrode assembly are reasonably watertight and will float if accidentally dropped into the water. However, the meter should be immediately removed from the water, wiped with a towel and allowed to dry thoroughly before placing it back into the case. If period of immersion is more than a few seconds, the three 4-40 screws at the top of the meter body should be temporarily removed and any accumulated moisture be allowed to evaporate before placing meter back in use.

It is a good idea to store the meter and electrode in the padded case when not in use.

If the meter is accidentally dropped, it is a good idea to check it by connecting to a brand new "D" cell battery. If meter reads between 1.5V and 1.6V, it probably did not become damaged. Digital meters usually read correctly or not at all, unlike analog meters which can experience mechanical problems after being dropped.

**See "Installing New Battery"**

## **Installing New Battery**

The current drain in your meter is quite small and only occurs when one or both of the range buttons are being pressed. This means that you should anticipate a long battery life.

Almost any 9V battery can be used in your meter. The alkaline type, such as Energizer or Duracell type, will last longer since their shelf life (up to 4 years) is longer than the cheaper, standard type carbon-zinc battery.

### **Replacement Procedure**

To gain access to the battery, slide off the orange plastic protective cover from the upper end of the meter body. Then remove and save the three 4-40 screws from the meter bezel. (Please Note the position of the meter to the position of the push button switch on the tube. Reinsert in the same manner.)

Gently withdraw the meter assembly from its case until the battery is accessible.

Remove the spring battery retaining clip from the battery and original battery. Plug in the replacement 9V battery and reinstall the spring battery retaining clip.

Slide meter assembly back into its case and insert the three 4-40 screws, making sure that the meter is correctly aligned as specified above.

### **TOP OF METER WITH ORANGE PROTECTIVE COVER REMOVED**



**A – 3 SCREWS (Remove to get to Battery)**

## Accessing the 9V Battery



**A - 9V Battery with retaining clip**

## Trouble-shooting

In order for your DPM system to function properly, the meter, the reference electrode and the test leads must all be in satisfactory condition. The following are some simple tests that you can make to isolate any apparent source of trouble.

- If there is no display in the window when 2V or both 2V and 20V range buttons are pressed, open up the meter (see section on battery replacement) and check to see that the battery is in place. If properly connected, it is held in place by the spring retaining clip. Also check to make sure that if nothing appears to be wrong, replace battery. If this does not cure the problem, check for loose or broken wires or connectors. If you cannot locate and fix the problem, send the meter back to the factory for repairs (obtain RMA from M. C. Miller).
- If the display shows all zeros or nearly so when you would expect a substantial reading, connect any new 1.5V battery cell between the two input terminals, using two test leads and the threaded adapter. Pressing the 2V range button should yield a reading between 1.5V and 1.6V if meter is working satisfactorily. If the battery and the test leads are known to be OK, then check inside meter for a loose or disconnected wire. If none of these tests disclose the problem, send the meter back for repair (obtain RMA number from M. C. Miller Co.)

- If the meter and battery appear to be working properly but readings are zero or almost zero, check reference electrode to make sure that fluid inside the electrode is contacting the copper rod and that the orange plastic cap has been removed from the bottom of the electrode tube so that the moist porous plug can contact the soil (or water) properly. Also check to see that there are some excess undissolved copper sulphate crystals in the electrode tube.
- If the meter, battery and electrode appear to be normal but the reading is not obtained or is intermittent, check test lead using an ohmmeter or substitute another test lead.
- Zero or lower than anticipated readings are sometimes caused by frozen soil, dry sand, rock or paving being in contact with reference electrode. Try using a cup of tap water on point of contact of porous plug to lower contact resistance. Freezing of electrode fluid will produce the same problem and destroy the electrode. Use of MCM's Electrode Anti-Freeze Solution will permit the electrode to be used or stored down to about -10F without damage. Avoid taking readings through paving material whenever possible.
- Intermittent jumpy readings can be result of using the meter too close to a transmitting antenna of a mobile radio system. The only practical solution is to either move further away from the antenna or to not key the transmitter when attempting to take readings.

## **Precautions**

**COPPER SULPHATE**, which is the main ingredient inside your reference electrode, is listed by the U.S. Government as a poisonous substance. It must NOT be ingested and body parts should be washed with water if contact is made with either copper sulfate or the electrode solution. Keep copper sulfate and reference electrode away from children.

**HIGH VOLTAGE** associated with electric fences can cause damage to your meter. **Do NOT** allow test leads to touch an electric fence because the insulation on the test leads will not withstand the high voltage pulses (up to 15,000V).

## Specifications

- 3-1/2V digital liquid crystal display
- Ranges: 0-2V and 0-20V DC
- Accuracy – ½% over most of temperature range, 1% at limits of operating temperature range.
- Weatherproofed meter case (can be floated in water momentarily).
- 20 mega-ohm input resistance on both ranges
- AC filter eliminates error caused by 60Hz AC up to 50V on 2V range, up to 100V on 20V range.
- Temperature range of operation, -4F to +185F
- Operates on one 9V battery
- Weight including carrying case –approximately 3 lbs
- Size: meter with electrode attached, 2-1/2” diameter by 10” long
- Size: carrying case, 12-1/4” by 7-1/4” by 4-3/4”.