

ME2000A Fine Fuel Moisture Meter

User Manual



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1 Description of the Meter

The ME2000A fine fuel moisture meter was designed to be used in the field by officers involved in prescribed burns and wildfires. The purpose of the meter is to quickly and accurately determine the percentage moisture content of forest duff, surface litter (leaf, twig and bark material found on forest floors), plus grasses and elevated live and dead shrub fuels. This material is the fine fuel and is one of the most important factors in determining fire intensity, the forward rate of spread and forward spotting (how likely spot fires will develop ahead of the fire front).

The conventional laboratory method of determining the moisture content of material such as this is to dry it in an oven at 105°C for about 24 hours or until no further moisture can be driven off. This method is slow and energy consuming and is not feasible in the field. Diurnal variation and site-to-site variation in fine fuel moisture contents need to be taken several times during the course of a fire and in several locations. The ME2000A, about the size of a lunch-box, can be carried to any point in a forest and operated there. Fine fuel moisture measurements can be taken within a few minutes of reaching a site.

The principle of the meter's operation is electrical resistance, a method which has been used successfully for many years in forest fire operations and more particularly in the agricultural grain industry. Meters such as the Marconi Moisture Meter and the Protimeter are two such grain meters which have been in use for many years. Because these meters were developed for the measurement of moisture in grains, the range of moisture measured is insufficient for fire behaviour prediction. The ME2000A can measure resistances up to 10 teraohms (10×10^{12} ohms) which corresponds to fuel moisture contents as low as 2% oven dry weight (the usable range of the meter is 3 – 200% O.D.W.)

Because resistance is an indirect measure of moisture content, some of the assumptions of converting resistance to moisture content need to be known. Firstly, the conductivity of the moisture in the fine fuel is enhanced with the presence of mineral nutrients. Because the level of nutrients varies between, for example, eucalypts, acacias, pines, spruce etc., and due to the condition of the fuel, i.e. live vs dead vs dead & rotting after long exposure to the elements, then an appropriate calibration function must be used. These calibrations are stored in the meter and are selected by the user. Secondly, the resistance of a material is proportional to the length of the electrical path through it, so the electrodes in the sample cell of the meter are set to a fixed distance and separated by a very thin insulating layer. Therefore the top of the cell must be kept clean otherwise the electrical path may be reduced with the presence of dirt or wet material and result in an unduly low resistance reading. See Page 9 for cleaning information

The ME2000A meter is run by a microcontroller, enabling all the measurements to be taken automatically and incorporated into a function which calculates the moisture content of the sample. The meter is also able to store up to 600 moisture content readings each of which includes the location identifiers, time, date and moisture content reading. This information can be downloaded to a personal computer (PC) as and when required. The on-board processor can also be reprogrammed easily by the user to enter a different set of fuel types. An easy to use program, ME2000 Manager, allows this to be done from any PC using a serial communication interface operating under a Microsoft Windows operating system, such as Windows 8 or 10.

A 6 volt DC, sealed, lead-acid battery powers the meter. It will operate continuously for about 12 hours before recharging is necessary. To conserve energy the meter will automatically turn itself off after 20 minutes if no key has been pressed. Pressing the on/off switch will reactivate the unit. The battery can be recharged at any time, but it will fully charge if left plugged in overnight. Recharging every month may be all that is needed for most users, since most moisture readings will only take a couple of minutes to complete. See page 12 for details.

The fuel samples need to be cut and/or ground up (using the fine fuel scissors and grinder) before measurement to homogenise the sample and create a good contact with the electrodes. Significant variation in moisture content may be found in different parts of a single leaf as well as between the leaves

therefore grinding reduces this variation.

Because the moisture content of fuels varies widely even within a small area of a forest, two or three samples from a site should be measured and averaged. The ease and rapidity of measurement with this meter makes this a simple task.

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1.1 Component List:

This list indicates the complete ME2000A moisture meter kit which is supplied when a moisture meter is ordered. When ordering any parts separately from Wiltronics Research Pty Ltd, please use the indicated part number.

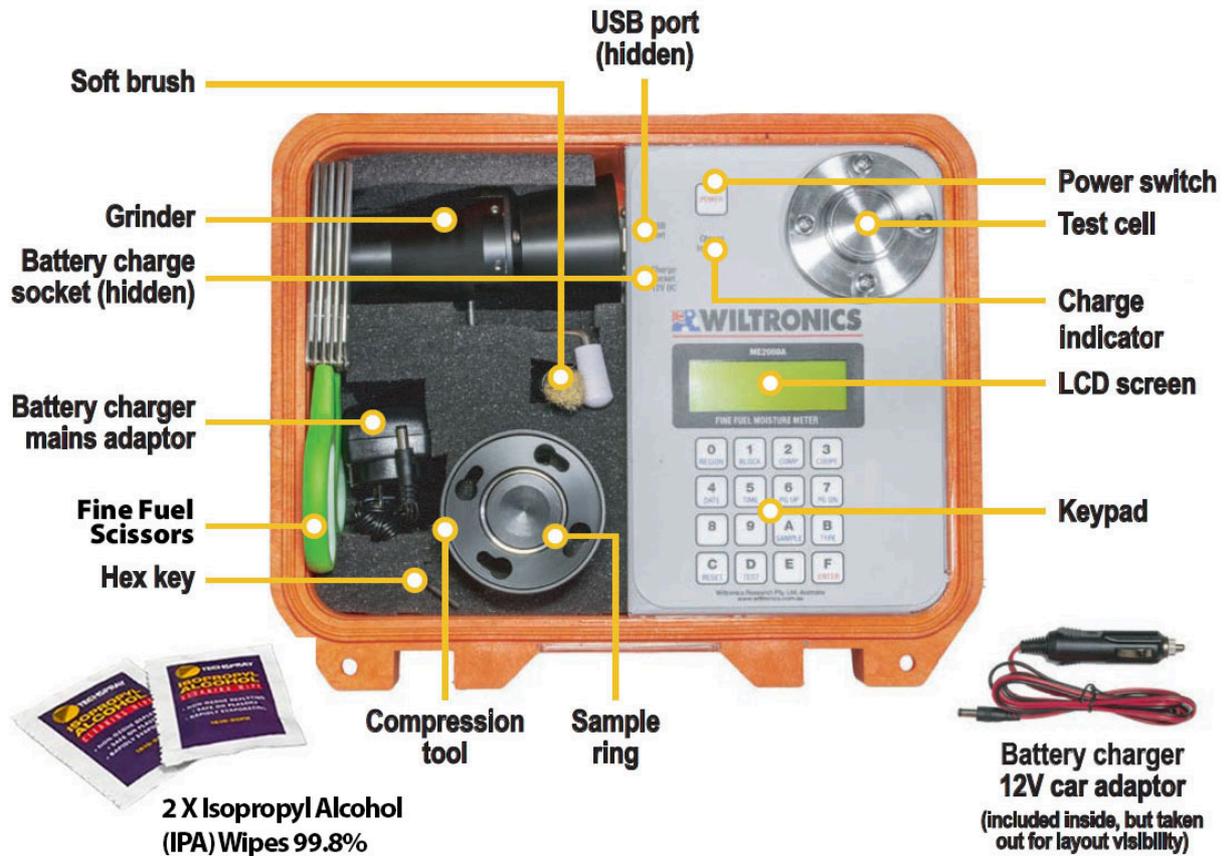
Part Number or Document Code	Description
ME2000A	Assembled meter.
ME2000A flash drive	Media containing ME2000 Manager software, FTDI USB Serial Port driver, meter manuals and calibration data current at time of release.
105-0220	No12 S/1600R White Bristle Brush.
ME2018	Hand compression tool.
ME2010	Hand grinder (see note 1.1a).
ME2013	Multi-blade fine fuel scissors.
HAM2.5-0001	M2.5 Hex key (to separate grinder for cleaning when necessary).
ME2005	Sample ring (stainless steel cylinder).
105-8899	One 1.8m USB A-type connector to B-type connector cable.
105DC10V1	User Manual hard copy.
ME2015	12VDC car cigarette lighter adapter lead for battery charging.
ME2016	12VDC, 1Amp mains (Australian) plug pack for battery charging.
ME2011/PART	Sample 2pcs 99.8% Isopropyl Alcohol Wipes

Notes:

1.1a The grinder has replaceable parts which may be ordered from Wiltronics Research Pty Ltd when required such as when damaged or worn out. Alternatively the grinder can be returned to Wiltronics Research Pty Ltd for repair or restoration,

Accessories and Consumeables Available	
ME2012	Replacement Cutter & Grill for Hand Grinder
ME2011	Isopropyl Alcohol (IPA) Wipes - 99.8% 1610 - 50pk

1.2 Meter Layout (inside)



1.3 Keypad Layout

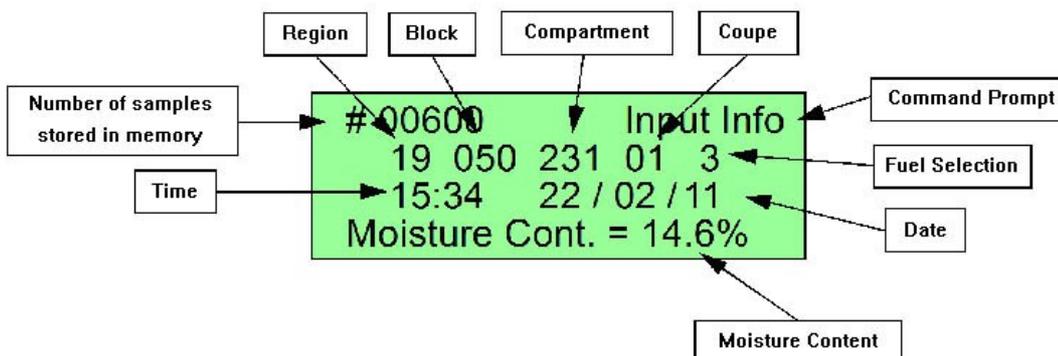
0 REGION	1 BLOCK	2 COMP	3 COUPE
4 DATE	5 TIME	6 PG UP	7 PG DN
8	9	A SAMPLE	B TYPE
C RESET	D TEST	E	F ENTER

Most Keys serve two functions. The first function is for selecting the operation to be performed, e.g. **Sample** commands the meter to make a sample reading, **Region** commands the meter to accept the next two digits as the code for the region, etc. The second function is as an alphanumeric keypad entry, i.e. for entering 0 to 9 and A to E. The key labelled 'ENTER', although also marked as 'F' does not enable the entering of 'F' as data and functions purely as the ENTER key at all times.

List of functions:

- Region** commands the meter to accept the next two digits as the code for the region location.
- Block** commands the meter to accept the next three digits as the code for the block location.
- Comp** commands the meter to accept the next three digits as the code for the compartment location.
- Coupe** commands the meter to accept the next two digits as the code for the coupe location.
- Date** commands the meter to accept a new date setting entered from the keypad.
- Time** commands the meter to accept a new time setting entered from the keypad.
- PgUp** scrolls back through the stored moisture measurements one record at a time.
- PgDn** scrolls forward through the stored moisture records one at a time.
- Sample** commands the meter to measure the moisture content of the current sample.
- Type** select from a list of fuel types so that parameters used match the sample being measured.
- Reset** clears all stored measurements and resets the counter to one.
- Test** same as **Sample**, but the data is stored with an E prefix to signify it is a test not a fuel sample.
- Enter** signifies to the meter that a command is complete and ready for execution.

1.4 Display Layout



IMPORTANT NOTE:

Fuel selection indicates which fuel in the numbered list (from 1 to 8) stored in the ME2000A memory was selected for the test. This number is not related to fuel types in the fuel list found on the CD/DVD ROM or flash drive or in ME2000 Manager software. ***It is important that the user make a note of which fuel specifically was used since if the fuel parameters in the ME2000A are changed or modified then the fuel selection number (as indicated in the diagram above) may no longer refer to the fuel parameters that were used in the test.***

2 Checking the Operation of the Meter

- 2.1 Open the case.
- 2.2 Turn on the power.
*Banner will display momentarily indicating the meter type and version number.
Sample information screen (see 1.4) will then display and stay resident on screen.*
- 2.3 Enter location information if the results are to be stored and the location is important to you:
Press **REGION** key followed by two digit code and finish with **ENTER**
Press **BLOCK** key followed by three digit code and finish with **ENTER**
Press **COMPartment** key followed by three digit code and finish with **ENTER**
Press **COUPE** key followed by two digit code and finish with **ENTER**

(Note 1: All or part of this location information may be omitted. Each component of the location information may be changed independently. The location data will remain constant until changed or the meter is turned off.)

(Note 2: If an error is made in entering a number, keep pressing until the correct code is displayed, only the last two (or three) digits entered will be displayed and stored.)

- 2.4 To enter the fuel **TYPE** function and select any calibration from the listed fuels:
Press the **TYPE** key
Eight possible calibrations will be displayed on the screen
NOTE: A standard set of fuel calibration values are supplied ready to use on the meter but these may be changed. Typically each fuel type calibration already loaded is representative of a fuel type group, named A, B, C, etc. See appendix 3 for further details on existing types and groups. The lists are not exhaustive and more fuel types are available in the fuels list in the ME2000 Manager software. If the required fuel type is not available on the meter, see section 5 of this manual for details on using ME2000 Manager to change the fuel types on the meter.

Press a number between 1 and 8 to select the fuel type to be used in the test.

- 2.5 Make sure the sample cell is clean by wiping with a clean dry cloth or clean with acetone when necessary.
- 2.6 Press **TEST** key and wait for the moisture reading to be displayed. This should take about 40 seconds to complete.
- 2.7 Press **ENTER** if you want to store this reading or any other key if not.
- 2.8 The moisture content of this standard sample should be <5%, if below 3% the warning ***RANGE*** should be displayed, if the reading is above 5%, clean the sample cell and test again. Cleaning with a solvent such as acetone may be necessary if sticky substances adhere to the sample cell. If the calibrated moisture content cannot be achieved then the meter will need to be returned to a service centre for closer checking.

(Note: A moisture content of 1.0% means that a fuel type has not been selected at step 4)

3 Measuring the Moisture Content of a Sample

- 3.1 Open the case.
- 3.2 Turn on power.
*Banner will display momentarily indicating the meter type and version number.
Sample information screen (see 1.4) will then display and stay resident on screen.*
- 3.3 Enter location information if the results are to be stored and the location information may be important to you later, otherwise skip to step 3.4:
Press **REGION** key followed by two digit code and finish with **ENTER**
Press **BLOCK** key followed by three digit code and finish with **ENTER**
Press **COMPartment** key followed by three digit code and finish with **ENTER**
Press **COUPE** key followed by two digit code and finish with **ENTER**
- (Note 1: All or part of this location information may be omitted. Each component of the location information will remain constant until it is changed or the meter is turned off.)*
- (Note 2: If an error is made in entering a number, keep pressing until the correct code is displayed, only the last two (or three) digits entered will be displayed and stored.)*
- 3.4 Enter the fuel **TYPE** calibration to be used for the calculation of moisture content from the electrical resistance measured.
Press **TYPE** key. Eight possible fuel types will be displayed on the display.
Press a single digit (1-8) corresponding to the appropriate fuel type to be measured
- 3.5 Place the sample ring on the sample cell.
- 3.6 Mount the grinder on the sample cell.
- 3.7 For leaves of non-conifer trees (and grasses in general), grind about five leaves, one at a time, using a "two rotations forward and two rotations backward" action. For conifer types, take a small handful of leaves (needles, for example), cut them up into short lengths using the herb scissors, placing the cuttings directly into the grinder, then proceed to grind them with the "two rotations forward and two rotations backward" action.
- 3.8 Remove the grinder and evenly spread the ground material in the sample ring over the test with your finger. The ground material should fill about half the available volume in the ring on top of the test cell. If not then grind more leaf material into the sample ring as described previously in section 3.7.
- 3.9 Mount the compression tool on the sample cell and wind down the compressor until the ratchet slips.
- 3.10 Press **SAMPLE** key and wait for the sample's moisture content to be displayed.
Sampling will take between 3 seconds (moist samples) and 40 seconds (very dry samples) before the moisture content is displayed. (Typically about 10 to 15 seconds.)
**A moisture content of 1.0% indicates a fuel type was not selected at step 4.*
A warning message (* **RANGE *) will be displayed if the fuel sample is near the upper or lower limit of the measurement range.*
A warning message (*ERROR***) will be displayed if the fuel sample is outside measurable limit.*

- 3.11 Press **ENTER** if you want to store this reading or any other key if not.
- 3.12 Unscrew and remove the compression tool, remove the sample ring and clean away the compressed sample material with the supplied brush. Wipe the sample cell with a clean, dry cloth if necessary. If the sample has any sticky residue that remains on the test cell, clean it off using a cloth or paper tissue dampened with a little acetone or isopropyl alcohol. Medical swabs can be obtained that provide a small quantity of cotton or other cloth-like material soaked in medical alcohol, typically isopropyl alcohol. Using medical swabs circumvents the need to carry highly flammable liquid solvent into the field.
- 3.13 Repeat procedure from step 3.6 for a second and third sample and average the results.

4 **Cleaning The Test Cell**

Note: Removing Contaminating Residues

To maintain the accuracy of your moisture readings, the most important thing in the field, is to keep the surface of the test cell top face, residue free.

When or how often to clean the test cell is very subjective:

Recommended

Dry Brown or Fragmenting Fuel

- At the end of the day

Dry Brown Fuel with samples containing some Dry Green Fuel

- 2-3 times a day

Dry Green fuel or samples containing some Live Fuel

- After each session

Live Fuel

- After each individual sample is tested

Factory testing has determined that the only test cell cleaning products that are effective and don't leave a contaminating residue are:

99.98% Isopropyl Alcohol or 100% Pure Acetone

The most convenient product is 99.98% Isopropyl alcohol wipes

Due to its flammability, liquid is 99.98% Isopropyl Alcohol or Pure 100% Acetone is not recommended, particularly in the field.

All other products leave a contaminating residue. Particularly nail polish remover (liquid or wipes), 70% Isopropyl Alcohol (liquid or wipes) ect.

Wiltronics can supply 99.8% Isopropyl Alcohol wipes in packs of 50 as a consumable item (*Wiltronics Part No. ME2011*)

5 **Reviewing Stored Data**

The number of stored moisture measurements are displayed at the top left corner of the screen (see 1.4). This data can be viewed from the meter by scrolling through the stack one at a time.

- 5.1 Open the case.
- 5.2 Turn on power.
*Banner will display momentarily indicating the meter type and version number.
Sample information screen (see 1.4) will then display and stay resident on screen.*
- 5.3 Press **PgUp** or **PgDn** to activate the review mode. Press **PgUp** to view the previously stored moisture data to the one currently displayed on the screen or Press **PgDn** to view the next stored moisture data to the one displayed on the screen. Press **ENTER** (or any other key) to return to standby mode.

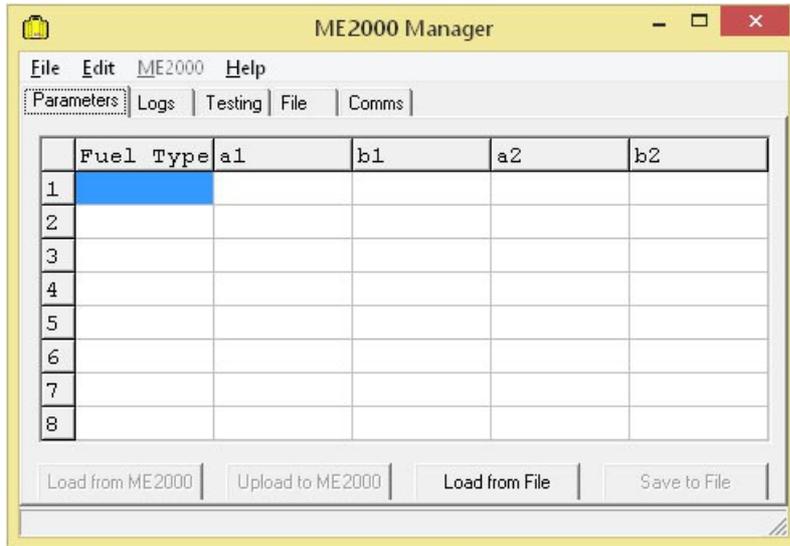
New data will always be added to the end of the current list of data.

6 Using ME2000 Manager Software to Up/Download Parameters and Data.

ME2000 Manager is a MS Windows application designed to simplify the process of entering new fuel types into the ME2000A meter, downloading current fuel type information for modification or saving to file, editing from a list of existing fuel types, etc.

ME2000 Manager is available on the CD/DVD ROM or flash drive that was provided with the meter and can be installed simply by copying the folder labelled, “ME2000 Manager”, to the PC. It can also be executed directly from the CD/DVD ROM or flash drive.

Once installed, run ME2000 Manager and the following window will be displayed...



Note that the tabbed page displayed may differ if the software has been previously run, since settings are saved to the registry, when exiting the software, for use next time it is run.

Next, connect the ME2000A meter to the PC via a serial or USB port. See Appendix 4 for details on establishing a serial communications connection between the ME2000A meter and a PC if uncertain of the procedure. Ensure that the meter is switched on before proceeding further.

6.1 To download data and fuel parameters to ME2000 Manager:

6.1.1 With the mouse, left-click the “Parameters” tab to display the parameters tabbed page.

6.1.2 Click the “Load from ME2000” button or select “ME2000 → Parameter/Data Download” from the menu. Within a few seconds the table should be filled with fuel type names and parameters. These can be edited in the grid if new parameters are desired as outlined in section 5.2 and then uploaded back to the meter as detailed in section 5.3.

6.1.3 To save parameters, click the “Save to File” button or select “File → Save As”, then follow the normal procedure for saving the parameters file using the “Save As” dialogue box. In this way, different sets of parameters can be saved to different file names for convenience when loading previously specified sets of parameters.

6.1.4 Click the “Logs” tab to select the logs tabbed page. Any previously downloaded logged data from the ME2000A meter (from step 5.1.2) will appear in the logs tabbed page. To save any logged data, select “File → Save Logs” from the menu and use the dialogue box. An

automatically generated file name will be displayed and this may be altered if so desired. Then select the “Save” button to save the logs file.

6.2 To modify fuel parameters for use in the ME2000A:

- 6.2.1 With the mouse, left-click the “Parameters” tab to display the parameters tabbed page if not already selected.
- 6.2.2 With the left mouse button, click the grid cell to modify and type in the new data. This can be done with both the fuel type name cells and the numeric parameter cells.
- 6.2.3 If so desired, there is a large list of existing fuel parameters that can be selected from. Select the fuel parameter row in the grid to be changed using a left-click, then right-click and select “Import from Fuels List” or select “Edit → Import from Fuels List” from the menu. A large list of fuel parameters will appear.
- 6.2.4 To quickly locate a fuel in the list, enter a partial name in the search box at the top of the list and press enter. NOTE that since not all descriptions in the list follow a careful naming convention, it is often more effective to enter something like “euc” for eucalyptus types, since they are sometimes labeled as eucy and sometimes as eucalypt, etc. The search algorithm is very simple and does a simple case-insensitive text search. Clearing the search box and pressing enter will cause all fuels to reappear.
- 6.2.5 From the list of available fuel parameters in the “Fuel Parameters List” dialogue box, double left-click the desired fuel to import or left-click once and select “Select” from the menu. The new fuel parameters will now replace the previously selected ones in the parameters tabbed page. Note that the fuel type name may not be meaningful since it is truncated so it is advisable to modify it before uploading the new parameters to the ME2000A.

6.3 To upload fuel parameters to the ME2000A meter:

NOTE: All cells in the parameters tabbed page grid must be filled with valid data prior to upload or the software will not upload the parameters to the ME2000A meter.

- 6.3.1 With the mouse, left-click the “Parameters” tab to display the parameters tabbed page if not already selected. Any updates and modifications should be done in the grid. If merely changing just some of the existing meter parameters first download the existing meter parameters as outlined in section 5.1 and then modify as required, outlined in section 5.2.
- 6.3.2 Once the desired fuel parameters have been entered into the parameters tabbed page grid, click the “Upload to ME2000” button or select “ME2000 → Parameter Upload” from the menu.
- 6.3.3 If the upload was successful then a small information dialogue should appear indicating “Upload Complete”. Click “OK”. If the “Upload Complete” information dialogue box does not appear within a few seconds, then there may be a problem with communications. Check that the meter power is still on and ensure communications is working, then try again. See Appendix 4 for further details.

6.4 Modifying the Fuel Parameters List:

The “Fuel Parameters List” dialogue box contains a list of previously determined parameters for a variety of specific fuel types. This list can be edited. Fuel parameters in the “Parameters” tabbed page can be imported into the list and fuel types in the list can be modified or deleted.

- 6.4.1 To place the fuel parameters list in edit mode, select “Edit → Edit Fuels List”.
- 6.4.2 To change a fuel parameter or fuel description, select the cell to modify and edit the cell contents directly.
- 6.4.3 To add a new fuel type, select the row which the new fuel will be placed above, then either right-click the row and select “Insert New Fuel” or select “Edit → Insert New Fuel” from the menu. An empty row will be inserted and appropriate data can then be entered.
- 6.4.4 To delete an existing fuel, select the row to be deleted and either right-click and select “Delete Selected Fuel” or select “Edit → Delete Selected Fuel”. A confirmation dialogue box will appear. Click “Yes” to continue or “No” to cancel the delete.
- 6.4.5 When done, simply close the “ Fuel Parameters List” window by selecting “Cancel” from the menu or clicking the system window close icon in the top right corner. Any changes will now be saved.
- 6.4.6 To export a fuel from the “Parameters” tabbed page fuel list to the “Fuel Parameters List”, select the “Parameters” tabbed page if not already selected, left-click the fuel to export to the fuel parameters list, right-click and select “Export to Fuels List” or select “Edit → Export to Fuels List”. The fuel will be appended to the end of the list.

7 Clearing the Stored Data from the Moisture Meter.

With the moisture meter turned on, Press **RESET** followed by **ENTER** to clear all stored data.

8 Setting the Time and Date

To set the time and date on the meter, Press **TIME** and enter the new time (**hhmm**) followed by **ENTER** or Press **DATE** and enter new date (**dd mm yy**) followed by **ENTER**.

9 Charging the Battery

The ME2000A meter is fitted with a sealed lead-acid battery. There is no maintenance required. The battery should have a life of between two and five years.

When the battery voltage is low, the Charge Indicator on the meter will flash red. This indicates less than 15 minutes use available. Finish using unit, store data if necessary then turn off. Only use again after recharging unit.

When fully charged, the battery should operate the meter continuously for about 12 hours. This represents potentially hundreds of moisture readings.

Unlike a nickel cadmium battery, this battery can be charged whenever convenient, and in fact is best kept fully charged. When in regular use, it would be advisable to charge the battery at least once a week. A 10 hour charge cycle (overnight) is sufficient to fully charge the battery from dead flat. Charging for longer than this is not necessary, but will not damage the battery. The charger could be left on continuously as the unit goes into trickle mode after initial boost charge, but this is not necessary. When the meter is not being used for extended periods, it is advisable to charge the battery about once every two months to keep it in good condition.

Charge Indicator - The light emitting diode (LED) will light when battery is being charged. Red LED on indicates full charge current, Green LED on indicates battery charged, trickle charge current. Flashing red LED indicates LOW battery volts. Unit may for a short time show green and red if between full and trickle charge.

Recommendations:

Regular use of meter: Charge battery overnight once per week.

In storage: Charge battery overnight once every two months.

NOTE: Long term storage of the ME2000A without battery recharge can lead to a short battery life or even permanent battery operation impairment.

CAUTION:

FULLY CHARGE BATTERY BEFORE STORAGE OF THE METER.

Acknowledgments

The technology used in this meter has been developed by the Fire Research & Development group of the Centre for Forest Tree Technology (Department of Sustainability & Environment) in conjunction with the School of Engineering, Federation University. The major collaborators on this project were Kevin Tolhurst (CFTT, DCNR), Graeme Hood (Federation University), Andrew Wilson (DCNR) and Matt Fenwick.



APPENDIX A. SPECIFICATIONS

Physical Dimensions

Length:	330 mm
Width:	290 mm
Height:	150 mm
Weight:	5.0 Kg

Construction

Case:	Pelican Protector Case 1400.
Sample cell:	Stainless steel 316 with polyester film insulator.
Sample ring:	Stainless steel 316.
Grinder:	P/N ME2010.
Stainless steel cutter and grill	Part No. ME2012.
Compression tool	Part No. ME2020.
Display:	4 lines x 20 characters, backlit LCD.
Keypad:	Membrane, surface mount, positive touch, 4 x 4 keys.
Power consumption:	280 mA in standby mode, 330 mA in measurement mode.
Battery:	6 V, 4.0 AH, sealed lead-acid type.
Battery Chargers:	12VDC, 1A, double insulated, overload protected, mains plug pack with 2.5mm DC plug.
	12V car cigarette lighter adaptor with a 1.5m lead and 2.5mm DC plug.
Charge Indicator:	Bi-colour (red/green) light emitting diode.

Performance

Temperature operating range:	0 to 50°C.
Resistance measurement:	5×10^2 to $5 \times 10^{13} \Omega$.
	<i>* RANGE * warning given when resistance is below 8×10^2 or above 6×10^{12}.</i>
Nominal moisture content range:	3% to 200% ODW.
Reproducibility:	0.1% of moisture content.
Accuracy:	1% moisture content or 10% of the indicated moisture content, whichever is the greater.
Resolution:	0.1% moisture content.

Communications

Serial interface:	Virtual COM port via USB using an A-type to B-type USB cable.
Baud Rate:	19200
Data Bits:	8
Stop Bits:	1
Parity:	none
Flow Control:	none

APPENDIX B. A GUIDE TO FUEL MOISTURE CONTENT AND FIRE BEHAVIOUR.

Eucalypt

(Adapted from: McArthur, A.G. (1962,1967), For. & Timb. Bureau, Leaflets 80, 107)

Surface Fine Fuel Moisture Content (% ODW)	Indicative Fire Behaviour (Eucalypt Fuels)
< 4	<i>Fuel extremely dry.</i> Severe spotting, crown fire, uncontrollable.
4 - 6	<i>Litter very dry.</i> Fire behaviour could be severe, spotting likely, possible crown fire.
6 - 9	<i>Litter dry.</i> Conditions may not be suitable for fuel reduction burning, fuel very easy to ignite, spotting initiated by large firebrands only, but high intensity fire may develop.
9 - 13	<i>Litter is reasonably dry.</i> Eucalypt litter easy to ignite. Burning readily sustained. Fuel reduction may be carried out in light fuels under very mild weather conditions. Limited spotting from large firebrands.
13 - 16	<i>Litter just moist.</i> Eucalypt fuel moderately easy to ignite. Burning is sustained. A suitable range for fuel reduction when other conditions, particularly wind, are suitable. Spotting unlikely.
16 - 22	<i>Litter is damp.</i> Eucalypt fuel is difficult to ignite. Burning difficult to sustain. Low intensity fuel reduction burn could be patchy. No spotting.
22 - 28	<i>Litter is wet.</i> Fuel very difficult to ignite. Burning very difficult to sustain.

Radiata Pine

(Source: Woodman, M. & Rawson, R. (1982), Fire Research Report No. 14)

Fine Fuel Moisture Content (% ODW)	Indicative Fire Behaviour (Radiata Pine Fuels)
< 7	Very intense wildfire possible
7 - 10	<i>Elevated</i> dead needles carry fire of high intensity, which is difficult to control. <i>Surface</i> needles carry fire of moderate to high intensity.
10 - 15	<i>Elevated</i> dead needles carry fire of moderate intensity (e.g. ROS > 1 m/min). <i>Surface</i> needles easily ignited and carry fire of moderate intensity.
15 - 20	<i>Elevated</i> dead needles easily ignited and carry fire of low intensity (e.g. ROS up to 1 m/min). <i>Surface</i> needles ignite and carry slow moving fire (e.g. ROS < 0.5 m/min).
20 - 25	<i>Elevated</i> dead needles will ignite and just carry a fire (e.g. ROS < 0.2 m/min). <i>Surface</i> needles will just ignite and only carry fire with the assistance of wind.
25 - 30	<i>Elevated</i> dead needles will just ignite and will carry fire only with the assistance of wind. <i>Surface</i> needles will not ignite.

Note 1. *Elevated* dead needles refer to dead pine needles lodged on branches, vegetation or debris on the forest floor so that they are well aerated and above the ground.

Note 2. *Surface* needles refer to the top part of the duff layer of dead pine needles. They are more compacted than elevated dead needles, but better aerated than the underlying part of the duff layer.

APPENDIX C. CALIBRATION

As mentioned in the description this meter uses resistance to calculate the moisture content. Due to the different levels of mineral nutrients present in different fuel types it is necessary to calibrate the meter to a given fuel type and fuel condition in order to achieve accurate moisture measurements.

Most samples tested to date fall into a group of 13 calibration coefficients designated A to M. Some newer available coefficients associated with conifers have been added to the available list of coefficients. A list of coefficients can be viewed using the ME2000 Manager software, see section 5 of this manual for further details. The following tables indicate calibration coefficients, fuel types, leaf condition and coefficient groups regarding some of the generalised coefficients (A to M) and how they apply to some common fuel types.

The following table lists fuel group types and useful moisture reading limits associated with each type.

Minimum and Maximum possible moisture content readings in each fuel type group.		
FUEL TYPE GROUP	MINIMUM MOISTURE CONTENT (%)	MAXIMUM MOISTURE CONTENT (%)
A	18.5	127.8
B	15.3	133.8
C	12.8	141.7
D	10.8	151.9
E	8.6	168.3
F	6.5	196.1
G	4.8	200.0
H	3.7	200.0
I	2.8	200.0
J	2.2	200.0
K	1.6	200.0
L	1.3	200.0
M	2.5	200.0

When testing the meter, with no fuel sample, a reading less than or equal to the minimum moisture content %, for the fuel type group selected should be expected.

Appendix C (cont.)

The following table indicates categorisation of fuels according to condition.

Fuel (leaf) condition classification guide.	
Condition	Description
FRESH	Picked live from the plant, also referred to as live fuel.
GREEN	Cut from the tree and allowed to dry for up to one month with little or no rain. Typically fresh logging slash.
BROWN	Shiny nut brown, less than three months since removal from the plant and not yet having experienced heavy rains. Examples are recently fallen leaves or leaves in elevated slash.
GREY	Pale brown or fawn as a result of nutrient leaching but the leaves are still intact. Commonly appearing as surface litter for non-conifer or upper duff layer for conifer.
FRAGMENTED	Advanced state of decay. Rotting, fragmenting matter for non-conifer. Typically dark coloured, fragmenting matter in the lower duff layer for conifer.

The table below indicates fuel coefficients for the ME2000A meter for a range of fuel group types. These provide effective averages for fuels classified under each indicated fuel group type, from A to M. Some fuels have not been classified under any of these groups. The list provided in ME2000 Manager software indicates the fuel group for each fuel unless the fuel is not associated with a group in which case no group is indicated.

ME2000A Meter Fuel Group Type Calibration Coefficients.				
Fuel Group Type	a ₁	b ₁	a ₂	b ₂
A	21.037	-0.4154	3.5636	0.6811
B	21.273	-0.5165	3.6165	0.6798
C	21.673	-0.6254	3.6856	0.677
D	22.306	-0.7526	3.7741	0.672
E	23.522	-0.9449	3.9122	0.6613
F	26.034	-1.2699	4.1343	0.6387
G	29.965	-1.712	4.3957	0.6063
H	34.972	-2.23	4.6441	0.572
I	41.665	-2.885	4.8891	0.5363
J	49.153	-3.5879	5.091	0.5063
K	62.005	-4.7439	5.3334	0.4701
L	88.777	-7.0001	5.6284	0.4264
M	146.16	-11.301	5.9137	0.385

Appendix C (cont.)

According to species and leaf condition, generalised meter coefficients can be selected as indicated in the following table.

NOTE: Italicised data indicates estimated coefficients, not actually tested.

Species	Leaf Condition				
	Fresh	Green	Brown	Grey	Fragments
Acacia	A	<i>D</i>	F	<i>J</i>	<i>M</i>
Angophora	<i>C</i>	<i>E</i>	H	<i>K</i>	<i>M</i>
Banksia	E	<i>I</i>	L	<i>L</i>	<i>M</i>
Bracken	<i>A</i>	<i>C</i>	G	M	<i>M</i>
Bush Peas	D	<i>E</i>	<i>H</i>	<i>M</i>	<i>M</i>
Cassinia	A	<i>C</i>	<i>G</i>	<i>K</i>	<i>M</i>
Casuarina	D	<i>E</i>	<i>F</i>	G	<i>M</i>
Eucalypt (ash)	<i>B</i>	<i>D</i>	F	K	M
Eucalypt (blackbutt)	<i>B</i>	<i>D</i>	I	J	M
Eucalypt (bloodwood)	<i>B</i>	<i>D</i>	G	K	M
Eucalypt (box, coastal)	<i>B</i>	<i>D</i>	G	K	M
Eucalypt (box, inland)	<i>B</i>	<i>D</i>	G	I	M
Eucalypt (foothills)	B	C	<i>G</i>	<i>I</i>	M
Eucalypt (gum)	<i>C</i>	<i>E</i>	F	H	M
Eucalypt (ironbark)	<i>C</i>	<i>E</i>	F	I	M
Eucalypt (jarrah)	<i>C</i>	<i>E</i>	<i>G</i>	K	M
Eucalypt (mahogany)	<i>C</i>	<i>E</i>	<i>G</i>	H	M
Eucalypt (mallee)	C	<i>E</i>	<i>G</i>	J	M
Eucalypt (peppermint)	<i>B</i>	<i>E</i>	H	I	M
Eucalypt (silvertop)	<i>B</i>	<i>E</i>	<i>H</i>	J	M
Eucalypt (stringybark)	B	C	H	I	M
Grass (Kangaroo)	E	<i>G</i>	<i>J</i>	<i>L</i>	<i>M</i>
Grass (Wallaby)	D	<i>G</i>	<i>J</i>	<i>L</i>	<i>M</i>
Grevillea	A	<i>D</i>	<i>H</i>	<i>K</i>	<i>M</i>
Heath	C	<i>F</i>	<i>H</i>	<i>K</i>	<i>M</i>
Melaleuca	E	<i>G</i>	<i>I</i>	J	<i>M</i>
Pine (Pinaster)	<i>C</i>	<i>G</i>	J	<i>K</i>	<i>M</i>
Pine (Radiata)	<i>B</i>	<i>E</i>	<i>H</i>	L	<i>M</i>
Xanthorrhoea	A	<i>D</i>	<i>H</i>	L	<i>M</i>

PLEASE NOTE:

The above table is not exhaustive and an extensive table of fuel types and their specific parameters is available in the ME2000 Manager software. See section 5 of this manual for details on the use of ME2000 Manager for modifying fuel parameters and uploading and downloading parameters to the meter as well as accessing the parameters list.

APPENDIX D. ESTABLISHING A SERIAL CONNECTION WITH A PC

In order to download parameters and data from the ME2000A meter it is necessary to first connect the ME2000A to a PC via its USB serial port. This is done using the USB cable (with A-type and B-type connectors) which is supplied with the ME2000A.

Section D.1 details establishing the physical interface.

Section D.2 details using ME2000 Manager software to establish communications.

Note that “click” refers to a mouse left-click unless otherwise specified.

D.1 Connecting the USB Serial Communications Hardware.

D.1.1 Establishing the USB Serial Port Hardware Connection.

The ME2000A meter has a USB type-B connector and is supplied with a suitable cable to connect to a PC's USB port.. An FTDI USB Serial Port interface is used in the ME2000A.

Power up the ME2000A and connect it to the PC using the USB (A-type to B-type connectors) cable provided. Assuming that the serial cable was correctly installed, then proceed to section D.1.2.

For MS Windows 7, 8 and 10, the operating system should “discover” the connected USB device and proceed to load an appropriate driver. Normally, MS Windows will have the driver either readily available in the driver cache (typically already on the PC's hard disk) and there should be no problems, or will obtain the driver from the Internet if connected. The operating system should load the driver immediately. If there is an issue, then the necessary driver is supplied on the memory media (CD/DVD ROM or flash drive) that came with the ME2000A meter. Insert the CD/DVD ROM into the CD/DVD ROM drive or plug the flash drive into a USB port and follow the operating system dialogue box prompts to enable the operating system to find the driver on the memory media. NOTE that it may require either one or two drivers to be loaded, depending on existing drivers available in the operating system.

Assuming that the driver was correctly installed, then proceed to section D.1.2.

If the driver failed to load then see section D.1.3.

D.1.2 Determining which Serial COM Port to use.

Now that a COM port is available, it is necessary to determine which COM port designator (COM number) it has been allocated (ie. whether COM1 or COM2, etc).

On the PC, select either “Start → Control Panel” or right-click Start (Windows icon in the lower left of the desktop screen) and select “Device Manager”. In the case of using the Control Panel, in the window that appears, a number of items are displayed. Locate the “System” item and left-double-click it to bring up a tabbed page window. This may require that you have logged in as a system administrator. Click the “Hardware” tab. Click the “Device Manager” button. (In MS Windows 8, run the Control Panel app, select System and Security, then select System in the main list, then in the left pane select Device Manager).

Once in the Device Manager window, there should appear a list of hardware device types. One of these items is “Ports (COM & LPT)”. Double click it to expand it (or click [+] or the arrow next to it

once).

All COM port type interface devices should appear. These will include any ports pertaining to actual physical serial (RS232) COM ports as well as any virtual COM ports including the COM port assigned to the USB Serial Interface of the ME2000A, assuming that the driver was correctly installed and the meter is currently connected to the PC.

The name, “USB Serial Port (COMx)”, will be visible where COMx can be one of COM1, COM2, COM3, etc. If there is more than one real or virtual COM ports marked as “USB Serial Port” then the quickest way to determine which one to select is to disconnect and reconnect the ME2000A USB interface and observe which COM port vanishes and then reappears. In Figure D.1, COM8 is the appropriate COM port.

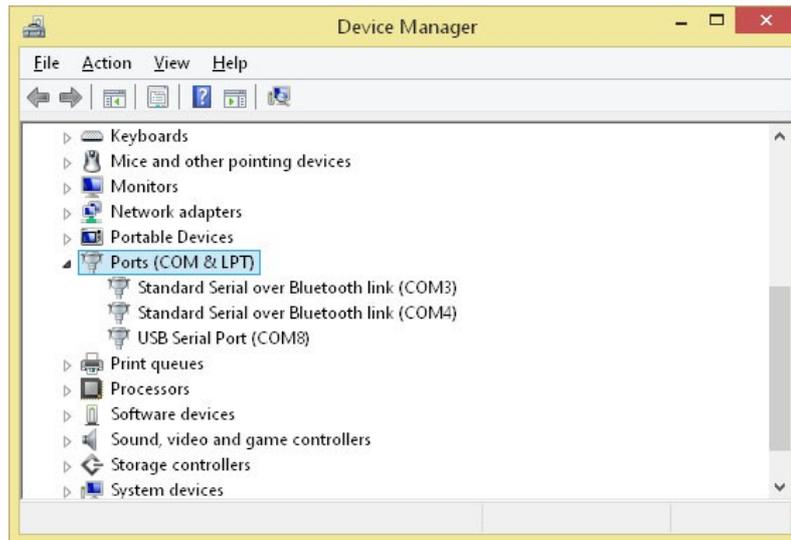


Figure D.1: Windows Device Manager.

Assuming that the USB Serial Port driver was correctly installed and the COM port designator has been determined, then if using ME2000 Manager software on the PC, proceed to section D.2.

If the USB Serial Port's COM port does not appear in the hardware list while it is connected to the PC then it is likely that the driver has failed to load or the hardware may be faulty. See section D.1.3.

D.1.3 Failure to load the USB Serial Port Driver.

If the USB-to-serial adapter driver was not successfully loaded, then consult the MS Windows help section on how to install new hardware. This can be quickly accessed by setting focus on a Windows window (such as a Windows Explorer window or the desktop or start screen) and pressing key F1. You should ensure that Internet access is enabled when doing so since a great deal of MS Windows help is available over the Internet with current MS Windows operating systems.

Enter “Add new hardware” into the “Search” entry box and press the “enter” key or click the icon next to the search entry box, then click on any of the most appropriate links displayed in the search results and follow the instructions.

If this fails then there may be a problem with the USB interface (on the PC or in the ME2000A) or the driver disk that was supplied. In such an event please contact Wiltronics Research Pty Ltd, Australia.

D.2 Connecting the ME2000A to a PC using ME2000 Manager.

ME2000 Manager was specifically designed to facilitate easier use of the ME2000A moisture meter in conjunction with a PC running an MS Windows operating system.

If ME2000 Manager has not already been installed, then install it on the PC using the supplied CD/DVD ROM or flash drive. The software does not require any special installation process and the directory on the supplied memory media containing the program can simply be copied directly to the PC's storage media directly or even executed from the supplied memory media. Ensure the you have the necessary operating system permission to execute or load new software. If not, see your system administrator.

Once loaded, run ME2000 Manager. The following window should appear:

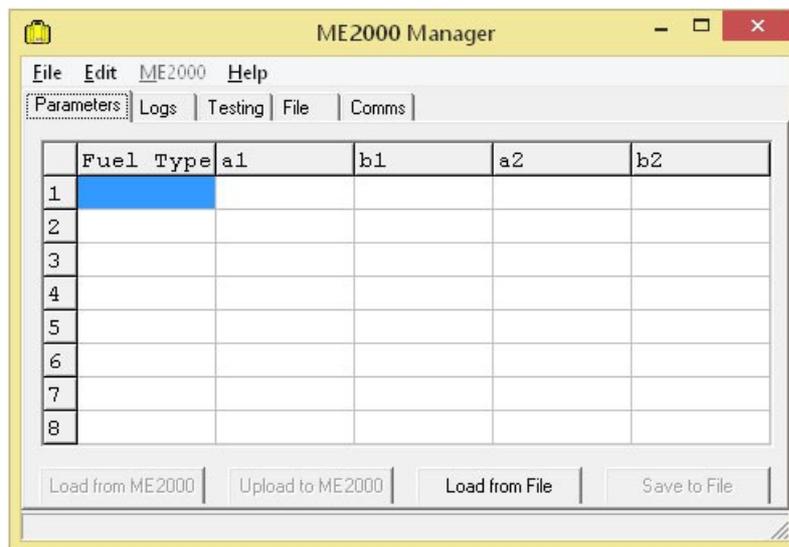


Figure D.2: ME2000 Manager.

If the software was previously loaded then the tabbed page that is displayed may differ from that shown in Figure D.2.

NOTE: ME2000 Manager is 32-bit software. If you have difficulty running the software it may be necessary to modify its compatibility properties. As of the time this document was created, it runs without problems on MS Windows 7, 8 and 10.

To test that communications are working between the PC and the ME2000A meter, select the “Comms” tabbed page. Go to “Edit → Comms Settings”. A small dialogue box should appear. In the “Port” drop-down list, select the COM designator that was previously determined. For example, if COM4 is the designator, select COM4. Only available COM ports will appear in the drop-down list. When done, click “OK”.

Press the key marked “E” on the ME2000A keypad and the following should appear in the “Comms” tabbed page:

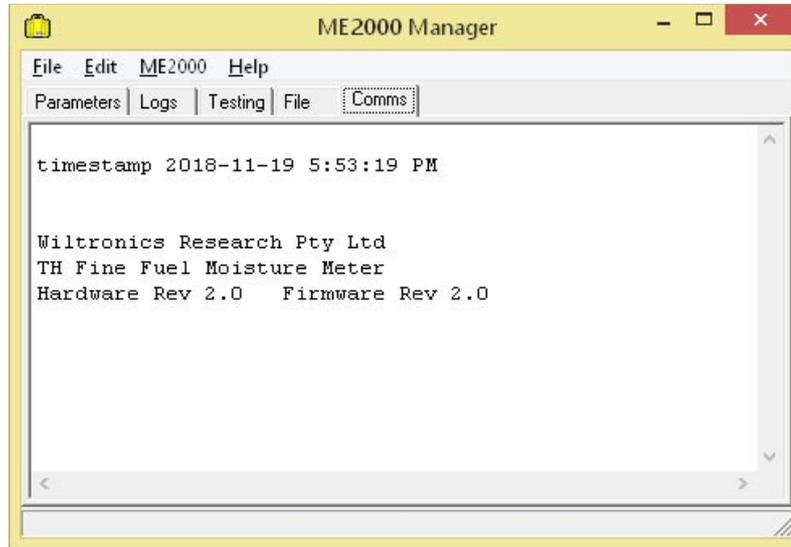


Figure D.3: Comms tabbed page of ME2000 Manager when checking the communications link.

The time stamp displayed will differ but the lines following show that the meter and the PC are now “talking”. Once the settings have been correctly made, ME2000 Manager will remember the correct settings between sessions and the COM port does not have to be selected again.

If the COM designator is changed for some reason or communication later fails after starting ME2000 Manager at a later time, then check the setting as described in section D.1.2 and correct it in ME2000 Manager, setting it as described above, ensuring first that communications has been disabled. Select “File → Close Comms Port” from the menu if the port has already been opened. When a new COM designator has been selected, select “File → Open Comms Port” to re-enable the communications link.

NOTE: Do not open the communications port in ME2000 Manager when the ME2000A is switched off. If this was done, click “File → Close Comms Port”, then switch on power to the ME2000A, ensure the USB cable is connected to both the meter and the PC and then select “File → Open Comms Port”.