

FIELD SCOUT® SOIL & WATER EC METER

CATALOG #2265FS



Spectrum
Technologies, Inc.

CONTENTS

Introduction	3
EC Probe	4
Probe Calibration	6
Meter Configuration	8
Direct Soil EC Readings	10
SME Measurement	11
Liquid Measurement/Other Features	12
Maintenance/Battery Replacement	13
Specifications	14
Appendices	
1. Classification of Irrigation Water	15
2. Preferred EC Values for Selected Plants	16
3. Interpreting EC Readings From Turf Grass	18
4. Classification of Greenhouse Media	20
5. Diagnostic Messages	21
6. Celsius to Fahrenheit Conversion Chart	22
Warranty	23

This manual will familiarize you with the features and operation of your Field Scout Soil & Water EC Meter.

Please read this manual thoroughly before using your meter. For customer support or to place an order call Spectrum Technologies, Inc. at 800-248-8873 or (815) 436-4440 between 7:30 am and 5:30 PM CST, or FAX at 815-436-4460, or E-Mail at info@specmeters.com.

Website: www.specmeters.com

Spectrum Technologies, Inc. at
12360 S. Industrial Dr. East Plainfield, IL 60585

INTRODUCTION

Congratulations on the purchase of your Field Scout Soil & Water EC Meter. This instrument has been specifically designed for direct measurement of salts in soil media as well as water or nutrient solutions. This manual describes how to use your meter and keep it working accurately for many years. Please read it thoroughly to get effective performance from your meter.

The salinity of the soil solution, irrigation water or fertilizer solution is an important parameter affecting the root zone environment. Any of these factors can have a significant affect on plant growth and physiology. The easiest way to monitor salinity is by measuring the electrical conductivity (EC). EC is strongly correlated to the salinity of the soil solution. EC measurement is also affected by temperature and, to a lesser degree, by soil moisture content.

Use this portable EC meter and probe to measure salinity in greenhouse soil media right on the spot without tedious soil sampling and preparation. Greenhouse production managers can compare readings from plant to plant and fine-tune their fertility program because measurements can be made directly in a plug tray cell without cannibalizing the seedlings. Turf managers can monitor for high salt levels on golf course greens and determine when to flush (leach) salts before turf quality declines.

The meter comes with the Field Scout Soil/Water EC probe. This single, stainless steel probe has a specially designed conical tip. It can measure liquid EC (water or nutrient solutions) or in-situ soil salinity. The probe automatically compensates for temperature.

EC PROBE

Electrical conductivity (EC) is an important parameter in evaluating irrigation water and fertilizer solutions. Crops can be damaged if irrigated with water with a high conductivity. The quality of irrigation water has been classified into 5 separate categories (See Appendix 1, p. 15). EC is also an indicator of the strength of fertilizer solutions. In greenhouse applications and other situations requiring frequent fertilization, EC should be checked regularly to ensure the plants are getting sufficient nutrients while avoiding the effects of salt toxicity. See Appendix 2 (p. 16) for a list of preferred EC values for some common plants. Typically, younger plants will require lower EC than mature plants.

The stainless steel soil EC probe is designed to be inserted directly into soil. The sensing surface is composed of 2 pairs of electrodes on the probe tip. Additionally, the probe is narrow in diameter so it can be used effectively in plug trays.



EC PROBE (CONT.)

Because the EC readings are affected by moisture content, it is important that soil moisture content does not differ significantly between readings. An easy way to achieve this condition is by taking measurements approximately 30 to 60 minutes after an irrigation. This should ensure the soil moisture level has approximately reached field capacity.

The probe should be inserted in the root zone. The measurement region is at the tip of the probe. For turf, the root zone is approximately 2" - 4". For vegetables and small plants, this is about 8" - 12". Wait until the meter reading stabilizes before withdrawing the probe. Taking several measurements will allow a representative average to be computed.

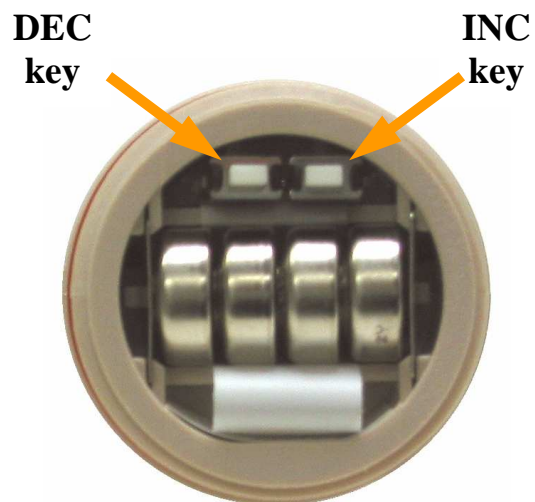
Important: Do not touch the sensor tip with your fingers. The oils on the skin will affect the probe's measurement accuracy.

PROBE CALIBRATION

The meter and probe are factory calibrated. However, to ensure accuracy, the meter should be calibrated at least once a month. The meter is calibrated to an EC of 2764 $\mu\text{S}/\text{cm}$ (2.76 mS/cm) calibration solution. Periodically, the calibration of the meter can be checked by immersing the sensor in this solution. This solution should not be re-used at a later date.

Calibration Procedure

1.) Open battery compartment lid on the top of the meter to access the small white Increment (INC) and Decrement (DEC) calibration keys. When looking at the battery compartment with the calibration keys above the batteries, the DEC key will be to the left.



PROBE CALIBRATION (CONT.)

2.) If necessary, clean the probe with alcohol to remove any residual oils. Rinse the electrode tip in de-ionized (or distilled) water and then rinse it in the calibration standard.

3.) Switch unit on with the ON/OFF key. Place probe tip into a container of calibration standard (2.76 mS/cm). Take care that the 4 exposed electrodes on the tip are not touching the side or bottom of the container holding the buffer solution. Wait for display to stabilize (display value is unchanged and stable for 3 seconds).

4.) Pressing either calibration key will put the meter into CALIBRATION mode. Press the INC or DEC key to adjust the reading. If a key is held down, the adjustment will happen more rapidly.

5.) When the EC of the calibration standard is reached, release the keys for 3 seconds. The temperature reading will briefly flash "CO". The Waterproof EC Tester accepts the calibration value and returns to MEASUREMENT mode.

Important - The meter will NOT calibrate to the common 1414 $\mu\text{S}/\text{cm}$ (1.41 mS/cm) conductivity standard.

METER CONFIGURATION

The digital reader for the Field Scout EC meter must be in Manual, 1-Point calibration mode to allow the meter to be calibrated with the 2.76 mS/cm calibrating solution. The meter should also be set to the HI range mode. This is how the meters are shipped.

Configuring the calibration mode

1. Switch off the display.
2. Press and hold the **INC** key (see meter manual for diagram of calibration keys) then press the **ON/OFF** button to switch on the display. The meter will go into calibration selection mode.
3. The lower display shows "A.CAL" and the upper display blinks the current choice (YES or NO). Press either the **INC** or **DEC** key to select the NO option. This disables the Automatic calibration mode and configures the display for Manual calibration.
4. Press the **HOLD/ENTER** button to confirm the selection. The display shows "CO".
5. After 1 second, the lower display will show "1.Pnt" and the upper display blinks the current choice (YES or NO). Press either the **INC** or **DEC** key to select the YES option. This enables the 1-Point calibration option.
4. Press the **HOLD/ENTER** button to confirm the selection. The display shows "CO" and, after a few seconds, goes to measurement mode.

Range selection

1. Switch off the display.
2. Press and hold the °C/°F key then press the **ON/OFF** button to switch on the display. Release the °C/°F key. The meter will go into Range selection mode and the lower display will show the current choice. The options are "AUTO", "PU", "LO", and "HI". See table below for a description of each range.
3. Press the **HOLD/ENTER** button to select the HI option. In this mode, the units for EC will always be in mS/cm. Some users prefer to set the meter on AUTO range. This gives greater resolution at low EC's.

Abbreviation	EC Range
PU	0 to 200.0 µS/cm
LO	0 to 2000 µS/cm
HI	0 to 20.00 mS/cm
AUTO	Automatic

Definition of the 4 EC range modes that can be set on the meter. The mode will be displayed briefly during the meter power-up sequence.

DIRECT SOIL EC READINGS

Greenhouse Soils

The stainless steel probe of the Field Scout Soil & Water EC Meter can be inserted directly into the soil. By taking measurements at different soil depths, you can determine where the fertilizer is concentrated in the soil. Be aware that the soil moisture content will significantly influence the measured EC value. To ensure accurate measurement, it is recommended that in-situ readings be taken when soil moisture is close to field capacity or saturation. The probe tip (sensor) must be held still in the soil to achieve a stable measurement. Soil EC measurements made with soils at field capacity or saturation will have readings 10-15% more than SME measurements due to a lesser amount of water in the soil.

Soil EC measurements should be made 30-60 minutes after irrigation.

Procedure

- Press On/Off button to power up the meter.
- Insert the probe tip 1 inch below soil surface.
- Wait for reading to stabilize (stable for 3 seconds) [Automatic Temperature Compensation (ATC) will correct for temperature changes].
- Repeat at 1 inch increments in the pot.

Golf Course Greens

A similar procedure can be followed for golf course greens following irrigation or deep-soaking rain event. Probe to the depth of the turf root zone. Measurements exceeding 0.7 mS/cm (approximately equivalent to 2.7 mS/cm in a saturated paste extract) will result in cool season turf grass stress. See **Appendix 3** (p. 18) for more details.

SME MEASUREMENT

Saturated Media Extract (SME) Measurements

Growth media used in most greenhouse operations is high in organic material and processed materials and low in mineral soil. These materials are easier to handle, are well aerated and have good moisture-holding properties, but have limited ability to retain nutrients. Therefore, tests developed for field soils do not always yield meaningful results. Saturated Media Extract (SME) analysis has been shown to eliminate these problems. The samples should not be dried, sieved or pulverized as this will affect the growth medium properties and alter the results. Traditionally, the soil solution from the saturated medium is extracted by a vacuum pump. However, the Field Scout Soil & Water EC Meter allows the saturated sample to be tested directly.

Procedure

- Moisten the media sample with distilled water to reach a consistent “saturated” moisture level. When saturated, the media should glisten and slide from the mixing spatula with little or no free water.
- Wait 15 minutes and add more water if needed. The sample should have the consistency of a paste with slightly more water than if the media was in a pot and fully irrigated.
- Press On/Off button to power up the meter.
- Insert the probe tip into the media and read the results.

LIQUID MEASUREMENT/ OTHER FEATURES

Water (Liquid) Measurements

The Field Scout Soil & Water EC Meter can also measure the EC of liquids. Simply dip the electrode tip into the solution and wait for the reading to stabilize (a stable reading occurs when the readout has not changed for 3 seconds).

Other Features

Hold

Pressing the HOLD key will freeze the display. Press HOLD again to release.

Temperature Units

Press the C/F key to toggle between displaying temperature in Fahrenheit and Celsius.

Auto Ranging

If the meter's range mode is set to AUTO (see **Meter Configuration**, p. 8), the LCD will automatically transition from mS/cm to μ S/cm as the unit of measure when the EC value gets smaller (about 2 mS/cm). They differ by a factor of 1000. For example: 1 mS/cm = 1000 μ S/cm.

MAINTENANCE/ BATTERY REPLACEMENT

Maintenance:

To improve performance and avoid transferring soil-borne diseases, clean the sensor tip by rinsing in alcohol for 5 - 10 minutes.

Replace all batteries if low battery indicator appears, or if readings are faint or unstable.

Store the probe sensor dry.

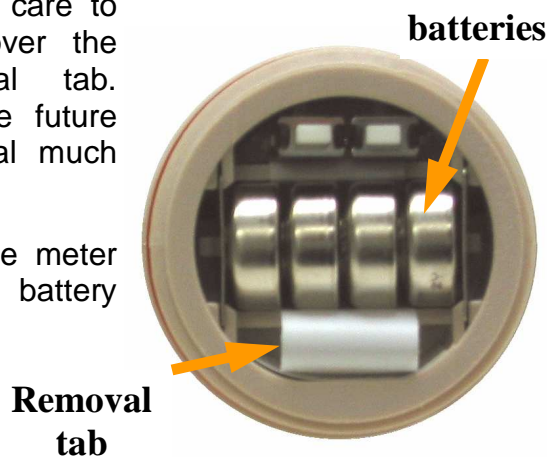
Important: Do not touch the sensor tip with your fingers. The oils on the skin will affect the probe's measurement accuracy.

Changing Batteries:

1.) Open battery compartment lid (located near the LCD screen).

2.) Remove and replace the old batteries. Note polarity shown in battery compartment. When inserting new batteries, take care to place them over the white removal tab. This will make future battery removal much easier.

3.) Recalibrate meter after every battery change.



SPECIFICATIONS

Readout	LCD digital display
EC Range	0.00 - 19.99 mS/cm
Temperature Range	0 - 55 °C (32 - 122 °F)
Accuracy	EC: $\pm 1\%$ Full Scale Temperature: ± 0.5 °C
EC Resolution	0.01 mS/cm
Calibration	1-point with 2.76 mS/cm standard
Temperature Compensation	Automatic from 0 to 50°C
Power	Four LR44 1.5V alkaline batteries
Battery Life	150 hours
Auto Shutoff	After 8.5 minutes

APPENDIX 1

CLASSIFICATION OF IRRIGATION WATER

Excellent	EC < 0.25 mS/cm
Good	0.25 mS/cm < EC < 0.75 mS/cm
Permissible	0.75 mS/cm < EC < 2.0 mS/cm
Doubtful	2.0 mS/cm < EC < 3.0 mS/cm
Unsuitable	EC > 3.0 mS/cm

Categories of irrigation water quality based on electrical conductivity. [Wilcox L.V. (1948) The Quality of Water for Irrigation Use, USDA Technical Bulletin 962]

APPENDIX 2 PREFERRED EC VALUES FOR SELECTED PLANTS

Plant	EC (mS/cm)
Asparagus	1.5 - 2.0
Watermelon	1.5 - 2.5
Carrot	1.5 - 2.0
Cabbage	2.0 - 3.0
Cucumber	2.0 - 3.0
Crysanthemum	1.5 - 2.5
Onion	1.5 - 2.0
Bean	2.0 - 2.5
Strawberry	2.0 - 2.5
Lettuce	1.0 - 1.5
Eggplant	2.5 - 3.0
Melon	1.5 - 2.5
Potato	2.0 - 3.0
Pepper	2.0 - 3.0
Pea	1.0 - 1.5
Tomato	2.5 - 5.0
Celery	2.0 - 2.5
Marrow	2.0 - 2.5

Recommended soil EC for selected vegetable crops.

Note: The values on this table refer to measurement of a saturated media extract (SME). See Appendix 3 for information on converting from direct-insert readings to SME.

	Recommended EC Value (mS/cm)		
	SME ^a	1 to 2 ^b	Pour thru
Poinsettia during weeks 2-12.	2.0 - 3.0	0.85 - 1.25	2.8 - 4.1
Pansies during active growth.	0.25 - 1.5	0.1 - 0.6	0.35 - 2.1
Geraniumus during active growth.	1.6 - 2.4	0.65 - 1.0	2.2 - 3.3

Comparison of substrate tests for various EC sampling methods. (Calvins, Whipker, and Fonteno, North Carolina State University).

^a saturated media extract

^b 1 part soil to 2 parts water

APPENDIX 3

INTERPRETING EC READINGS FROM TURF GRASS

When taking direct-insert EC readings in turf grass with the Field Scout meter, it is often helpful to convert the measurement to the equivalent Saturated Media Extract (SME) value. This conversion will vary for different soils. For sandy soils, the expression:

$$\text{SME} = 2.7\text{FC} + 0.8$$

provides a good approximation. FC refers to the reading taken by the Field Scout meter. This equation is the basis for table 1. Table 2 lists a variety of grass species and the range of EC values (converted to SME) they can tolerate.

FS	SME	FS	SME	FS	SME
0.1	1.1	1.1	3.8	2.1	6.5
0.2	1.3	1.2	4.0	2.2	6.7
0.3	1.6	1.3	4.3	2.3	7.0
0.4	1.9	1.4	4.6	2.4	7.3
0.5	2.2	1.5	4.9	2.5	7.6
0.6	2.4	1.6	5.1	2.6	7.8
0.7	2.7	1.7	5.4	2.7	8.1
0.8	3.0	1.8	5.7	2.8	8.4
0.9	3.2	1.9	5.9	2.9	8.6
1.0	3.5	2.0	6.2	3.0	8.9

Table 1: Conversion from Field Scout direct readings (**FS**) to equivalent Saturated Media Extract (**SME**) values. (*Reference 9:3. PACE Turfgrass Research Institute. San Diego, CA*)

Sensitive < 3 mS/cm	Moderately Sensitive 3 - 6 mS/cm	Moderately Tolerant 6 - 10 mS/cm	Tolerant >10 mS/cm
Annual Bluegrass	Annual Ryegrass	Bent cv. Seaside	Alkaligrass
Colonial Bluegrass	Chewings Fescue	Perennial Ryegrass	Bermudagrass
Kentucky Bluegrass	Creeping Bentgrass	Tall Fescue	Seashore Paspalum
Rough Bluegrass	Hard Fescue	Buffalograss	St. Augustine- grass
Centipedegrass	Bahiagrass	Zoysiagrass	

Table 2. Relative tolerance of turfgrasses to soil salinity measured by the SME Method (“Salinity in Turfgrass”, Harivandi M.A, Butler J.D., Lin W. 1992).

Note: The values on this table refer to measurement of a saturated media extract (SME) . Use table 1 to convert from direct-insert readings to SME.

APPENDIX 4

CLASSIFICATION OF GREENHOUSE MEDIA

Comments	Electrical Conductivity (mS/cm)		
	SME ^a	1 to 2 ^b	1 to 5 ^c
Very low levels. Indicates very low nutrient status.	0 - .74	0 - .25	0 - .12
Suitable range for seedlings and salt sensitive plants.	.75 - 1.99	.25 - .75	.12 - .35
Desirable range for most established plants. Upper range may reduce growth of some sensitive plants.	2.00 - 3.49	.75 - 1.25	.35 - .65
Slightly higher than desirable. Loss of vigor in upper range. OK for high nutrient requiring plants.	3.50 - 5.00	1.25 - 1.75	.65 - .90
Reduced growth and vigor. Wilting and marginal leaf burn.	5.00 - 6.00	1.75 - 2.25	.90 - 1.10
Severe salt injury symptoms with crop.	6.00+	2.25+	1.10+

Soluble salt guidelines for greenhouse media using various media to water ratios (Testing and Nutrition Guideline, MSU Ag Facts Extension Bulletin E-1736, September, 1983).

^a saturated media extract





^b 1 part soil to 2 parts water

^c 1 part soil to 5 parts water

APPENDIX 5

DIAGNOSTIC MESSAGES

Low Battery Indicator

-  - Battery 100% full
-  - Battery 50% full
-  - Battery 25% full
-  - Replace battery soon

OR/UR (steady)

- Measured EC or temperature value exceeds specified maximum or minimum value.
- Sensor electrodes have short circuited
- Sensor is not connected properly

OR/UR/ATC (blinking)

- Short or open circuit at the built-in temperature sensor

Er.0

- Temperature not within specified range.

Er.1

- EC not within specified range.

APPENDIX 7

CELSIUS TO FAHRENHEIT CONVERSION CHART

The Field Scout Soil & Water EC Meter gives temperature readings in Celsius. The conversion from Celsius to Fahrenheit is calculated with the following equation:

$$F = 9/5 * C + 32$$

This information is also contained in the following table:

C	F	C	F	C	F
0	32.0	15	59.0	30	86.0
1	33.8	16	60.8	31	87.8
2	35.6	17	62.6	32	89.6
3	37.4	18	64.4	33	91.4
4	39.2	19	66.2	34	93.2
5	41.0	20	68.0	35	95.0
6	42.8	21	69.8	36	96.8
7	44.6	22	71.6	37	98.6
8	46.4	23	73.4	38	100.4
9	48.2	24	75.2	39	102.2
10	50.0	25	77.0	40	104.0
11	51.8	26	78.8	41	105.8
12	53.6	27	80.6	42	107.6
13	55.4	28	82.4	43	109.4
14	57.2	29	84.2	44	111.2

WARRANTY

This product has been brought to you having passed severe quality control and inspections. Should any trouble occur during the course of normal use, the meter shall be repaired or replaced free of charge in accordance with the stipulations laid down herein. The term of this warranty shall be for one year from date of purchase. This warranty excludes batteries, sensor and accessories.

Warranty Stipulations:

1. The product shall be repaired or replaced free of charge should any trouble occur during the course of normal use if returned within the warranty period (one year from date of purchase). In which event, contact the dealer of purchase. Return the meter with proof of date of purchase.
2. Expenses shall be incurred in the following instances within the warranty period. (Costs such as postage shall be born by the customer)
 - a) When the date of purchase and store name is not written on the warranty.
 - b) When trouble or damage has been incurred due to misuse, abuse, and/or improper handling.
 - c) When the meter has been repaired, modified and dismantled by persons other than the designated agent or service shop.
 - d) In the event of changes in external appearance such as scratches or dirt caused during use or battery fluid leakage.
 - e) In the event of unsuitable movement, dropping or accidents such as fire, earthquakes, floods or a burglary.
 - f) When replacing consumables and accessories.
 - g) When cause of trouble lies not in the meter itself.
 - h) When this warranty is not shown and when necessary particulars have not been written in the warranty.

Our obligation under this warranty is to repair or replace the meter free of charge in accordance with the conditions laid down herein. Accordingly, this warranty doesn't limit your specific legal rights.

For technical service and support, call your distributor or Spectrum Technologies, Inc.

When calling for technical support, have a detailed explanation of the problem that you are experiencing. The more information you can provide, the faster and easier a technical support person will be able to assist you.

If for any reason you are not satisfied, or the meter has failed and you need to return the product for service, you will need to contact Spectrum Technologies, Inc.

Before returning a failed unit, you must obtain a Returned Goods Authorization (RGA) number from Spectrum. You must ship the product(s), properly packaged against further damage, back to Spectrum (at your expense) with the RGA number marked clearly on the outside of the package. Spectrum is not responsible for any package that is returned without a valid RGA number or for the loss of the package by any shipping company.

Spectrum Technologies, Inc.

Spectrum Technologies, Inc.
12360 S. Industrial Dr. East
Plainfield, IL 60544
(800) 248-8873 or (815) 436-4440
Fax (815) 436-4460
E-Mail: info@specmeters.com
Website: www.specmeters.com

Revised 8/15/2007