REMS KIT

TEER Measurement

INSTRUCTION MANUAL

Serial No._____

121411

World Precision Instruments

CONTENTS

ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

Fig. 1—(left) The REMS KIT probe is designed for use with the EVOM² TEER measurement meter and LabTrax 8/16 data acquisition system.

Fig. 2—(right) The EVOM2 is an epithelial volt ohm measurement system.

INTRODUCTION

The **REMS KIT** is designed to perform routine TEER (Trans-Epithelial Electrical Resistance) measurements in tissue culture research. Based on the original design principles of WPI's popular hand-held TEER measurements system (EVOM^2), the REMS KIT has been developed specifically for integration with automated High Throughput-Screening (HTS) applications where TEER measurements are made robotically on cell cultures grown on 24-well and 96-well microplates.

The use of this product requires Microsoft® Visual Studio® and software development in C#.net or VB.net. This document assumes that users have a working knowledge of Visual Studio. For help with that program, please refer to your Microsoft documentation.

Parts List

After unpacking, verify that there is no visible damage to the sensor. Verify that all items are included:

(1) **54230 REMS KIT electrode**. It is designed to take TEER measurements using the Corning Costar 24-well microplates, and the Millipore Multiscreen™ Caco-2 96-well microplate. The electrode plugs into the EVOM2. The rectangular block attached to the REMS Kit electrode is designed to be mounted on a robot.

(1) **54214 Dummy electrode**. The Dummy electrode is used in place of the actual electrode for testing the positioning of the robotic arm and electrode.

(1) **LabTrax 8/16** Data Acquisition System. The EVOM2 output connects to this system.

(1) **EVOM2** Meter

(1) **REMS KIT** software CD containing a sample project and two library (.DLL) files

(1) **EVOM2** Adapter that allows the REMS KIT to plug into the **EVOM2.**

(1) Instruction Manual

Unpacking

Upon receipt of this system, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 7 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 7 of this manual.

INSTRUMENT DESCRIPTION

Instrument Description

The system includes a **REMS KIT** electrode (and a dummy electrode), the **EVOM²** and a data acquisition system.

Setup

1. Plug the **REMS KIT** electrode into the **EVOM²** adapter and connect the adapter to the Input port on the **EVOM²**.

Fig. 3—This adapter allows you to plug the REMS KIT electrode into the EVOM².

2. Attach the **EVOM²** Output port to Channel 0 Input on the **LabTrax 8/16**.
3. Connect the **LabTrax 8/16** to a USB port on a computer.

OPERATING INSTRUCTIONS

After the cell membranes have grown to form a monolayer, the microplate is filled with an electrolyte solution. The **REMS KIT** electrode probe is then placed in the first cell of the microplate. A command to take a resistance measurement is then sent from the user's program to the **REMS KIT** electrode. The **EVOM²** takes a resistance reading which is recorded by the **LabTrax 8/16**.

The precise location of the **REMS** electrode over each well provides reproducible resistance measurements of tissue grown on porous filter microplates. The use of AC current to measure resistance provides several advantages over DC current measurement including:

- Absence of offset voltages on measurements.
- Zero net current is passed through the membrane, therefore it is not adversely affected by a current charge.
- Electrochemical deposition of electrode metal is avoided.

REMS KIT is a combination of hardware and a .NET library for acquiring data samples from a WPI electrode. Using the .NET library, you can develop your own custom applications in C#.NET or VB.NET.

NOTE: The use of this product requires Microsoft® Visual Studio®. This document assumes that you have a working knowledge of Visual Studio. For help with that program, please refer to your Microsoft documentation.

To acquire data:

1. Open Microsoft Visual Studio and add the WPI.DAQ.dll and WPI.RemsKit.dll libraries to your project
2. Use the API to set up the **REMS KIT** sampler, acquire data or stop recording.

The REMS KIT API

Setting up the REMS KIT Sampler

The **REMS KIT** API consists of a single class that represents the sampling hardware. The system recognizes the data acquisition USB connection as a serial connection. The COM port endpoint must be set during instantiation of the RemsKitSampler. The standard setup is:

```
string comport = "COM5";
RemsKitSampler sampler = new RemsKitSampler(comPort);
sampler.Connect()
```

If there is a failure to connect through the provided COM port, an exception is thrown.

Acquiring Data

The resistance value measured through the probe is returned as a double from the GetResistanceValue() API call.

```
double resistance = sampler.GetResistanceValue();
```

Shutting Down

You can stop recording and close the serial connection by calling Disconnect().

```
sampler.Disconnect();
```

The REMS Kit Electrode

The REMS electrode is designed to handle TEER measurements of cells grown in Corning Costar HTS Transwell-24 (**REMS KIT**). Each manufacturer's microplates will have different coordinates. Adjustments to the robotic software may need to be made when a different plate is used.

Since the electrode is made from soft metal that can be easily damaged when colliding with a hard object, the **REMS KIT** contains a dummy electrode for checking the positioning of the robotic arm. It has the same dimensions as the real electrode with no electrical connection. The two probes on the dummy are made of solid stainless steel and are robust. First mount the dummy electrode on the robot to check the positioning of the robotic arm. The real electrode should not be mounted until the dummy probes can move freely without touching anything but the fluid.

Testing the Electrode

The electrode can be tested by measuring the resistance of a blank HTS plate filled with either culture media or 150mM KCl. The resistance reading of the blank insert is normally in the range of 100–300Ω, depending on the conductivity of solution, the brand of the insert, the type of the tray (96 or 24 well tray) and temperature. This value should be higher than the resistance reading of the electrode without the HTS plate (normally below 100Ω). If the reading is within this range and is stable and reproducible, the electrode is ready to use.

MAINTENANCE

Cleaning

After using the electrode, it should be rinsed with distilled water and dried with a soft cloth or tissue. With use, the electrode surface could become coated with foreign materials. This build-up, or contamination, will degrade the performance of the system. If the meter readings become less stable, the electrode can be cleaned as follows:

1. Soak the electrode in 1 N HCl for five minutes.
2. Next soak the electrode in a 5% solution of sodium hypochlorite (NaClO), which is undiluted household bleach, for five minutes.

CAUTION: Do not let the HCl or bleach come in contact with the stainless steel component of the electrode holder.

3. Rinse the electrode thoroughly with distilled water after cleaning to remove any remaining corrosive fluid.

Sterilization

The electrode is non-sterile as supplied. The electrode can be sterilized using alcohol (one of the most common methods), ethylene oxide, UV or a bactericide (Cidex Plus [WPI #7364]).

A Typical Sterilization Protocol Using Alcohol:

CAUTION: Do not leave the electrode in alcohol for more than 30 minutes. Continuously soaking the electrode in alcohol will weaken the protective coating on the electrode and shorten its lifetime.

In a laminar flow hood:

1. Immerse the electrode in 70% ethanol for 15 minutes. Allow it to air dry for 15 seconds.

2. Rinse the electrode in a sterile electrolyte solution similar to the experimental cell culture medium or in 0.1 M KCl or 0.15 M NaCl solution.

3. The electrode is now ready to use.

NOTE: When the electrode is exposed to strong visible or UV light, a dark colored oxide film slowly forms on the electrode surface. This film normally will not affect the performance of the electrode. To avoid the formation of the film, shield the electrode from strong light.

Storage of the Electrode

The electrode should be rinsed with distilled water and stored dry and in the dark.

ACCESSORIES

Table 1: Accessories

Part Number	Description
54230	REMS Kit Electrode
54214	REMS Kit Dummy Electrode

SPECIFICATIONS

This unit conforms to the following specifications:

Membrane Resistance Range 0–10,000Ω

AC square wave current ..... ±10µA @ 12.5Hz

Typical measurement time ..... 1 second per measurement.

WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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