WINSENSE

ISFET pH Sensor Kit

(part no. P010101)

2.4 Establish a linear line equation

The typical relationship between pH and output voltage of an *ISFET*.

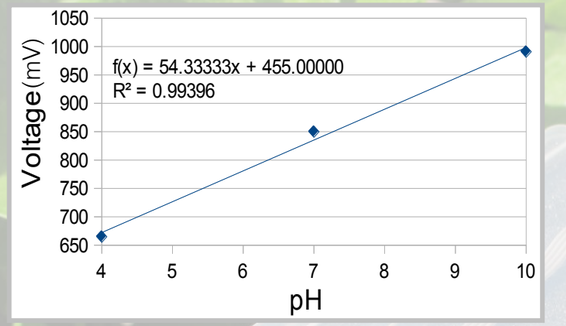


Figure 5 Example of a relationship between pH level and the output voltage of the *ISFET*.

Figure 5 shows the data and the fitting linear trend line. The slope (sensitivity) from the fitting curve with linear trend line is 54.33333mV/pH and the intercept at pH=0 is 455.00000mV.

R^2, in the inset, calculated from a linear trend line is 0.99396. R^2 = 1.00000 means the data can be fitted perfectly with a straight line. The less the R^2, the less linear the data. In practice, the *ISFET* is not perfectly linear, therefore it is advisable to calculate the linear slopes and intercepts of 2 lines; one is from pH 4 to pH 7 and the other line is from pH 7 to pH 10. After measuring the liquid of interest, use the slope and intercept of the relevant range (line) to calculate the pH value from the measured output voltage.

3. Storage

3.1 Switch off the circuit box when finished. If the red LED is lit when turn on the circuit, replace the battery.

3.2 The *RE* membrane is porous hence the KCl can diffuse through it. Therefore after cleaning the *RE* with clean water, store the *RE* in KCl solution or clean water to reduce diffusion and leak rate of KCL solution.

3.3 Clean *ISFET* with clean water and dry with clean cloth or paper.

WINSENSE

4. Cautions

4.1 Since no *ISFET* has exactly the same sensitivity or offset, it is necessary to measure the *ISFET* in the buffer solutions and establish a linear line equation (please refer to the measurement procedure) before use.

4.2 If the linear line cannot be established, contact Winsense Co., LTD.

4.3 *ISFET* responses to the light therefore to eliminate the effect of light, either measure in the dark room or cover the container with foil.

4.4 For constant monitoring, at least clean the *ISFET* and *RE* with clean water regularly and calibrate in pH 7 buffer solution to ensure good measurement.

5. Troubleshooting

5.1 When the output voltage is noticeably higher than usual, check if there is air bubble near the *RE* membrane. If so, shake the *RE* until the air bubble is moved away from the membrane. Then try the measurement again.

5.2 During measurement, ensure the KCl level of *RE* is higher than the measured liquid level in order to maintain the KCl concentration level of *RE* in a long run.

6. Warranty and promotion

For product warranty, other products, and promotion, visit http://winsense.co.th

7. Contact

WINSENSE Co., LTD
Technical information: +6688499-4548 or tech@winsense.co.th
Sales and marketing: +6681144-3644 or sales@winsense.co.th
Feedback: feedback@winsense.co.th
Visit WINSENSE at
http://winsense.co.th

User's manual *Winsense ISFET pH Sensor Kit*

Winsense *ISFET* pH Sensor Kit (IPK) includes

1. Ion Sensitive Field Effect Transistor (*ISFET*, part no. S010101) pH Sensor is a semiconductor device which has the following properties:
   - *ISFET* is non-glass.
   - pH measurement range is from 1 to 14.
   - The sensitivity of the *ISFET* is > 45 mV/pH.
   - The material in the kit can withstand the temperature in the range 0-100 Celsius.
   - The output voltage of circuit is 0 - 2 V.
2. One Ag/AgCl reference electrode (*RE*, part no. S010102)
3. A conditioning and read-out circuit box (circuit box, part no. S010103) with a 9 V battery.
4. A set of pH 4, 7, and 10 buffer solutions for Calibration (buffer solutions, part no. S010104)
5. A plastic case with supporting sponge.
6. This user's manual pamphlet.

1. The description of the parts in the IPK

1.1 *ISFET* is a Metal Oxide Semiconductor Field Effect Transistor (MOSFET) without a gate and leave the gate dielectric layer intact. The Silicon nitride (Si_3N_4) gate dielectric layer is used as a Hydrogen ion (H^+) sensing layer. The sensing action is done by the changing of its threshold voltage (turn on voltage) by the presence of H^+ in a measured solution. *ISFET* and *RE* comprise 3 terminals:

1.1.1 Gate terminal (G) is the RE terminal. The gate terminal does not react with the solution being measured. It determines the change in the threshold voltage which changes with the pH level of the solution. (Before use, remove the heat shrinkable tube on one end of the RE, then the white ceramic will be seen.)

1.1.2. Drain terminal (D) is an electrical terminal of the ISFET which is biased at a certain voltage and current.

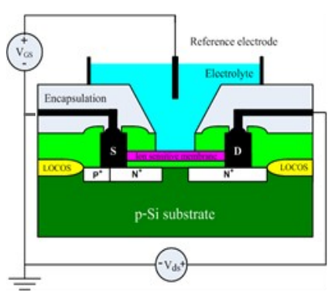
1.1.3. Source terminal (S) is an electrically grounded terminal of the ISFET.

Figure 1 shows the schematic of *ISFET*, *RE*, and the measurement set up.

1.2 The detail of the circuit box is shown in Figure 2.

1.2.1 Three input signal terminals D, S, and G are connected to ISFET drain, source terminals and the RE, respectively.

1.2.2 The output signal across the 2 terminals: V+ and GND can be read out from a voltmeter or connected to A/D converter circuit.



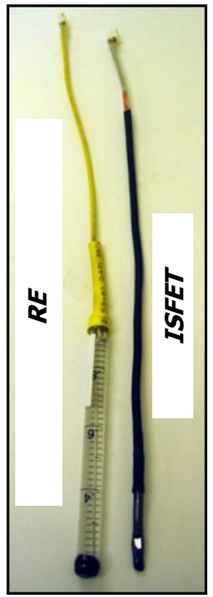
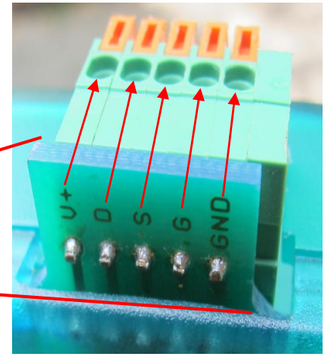
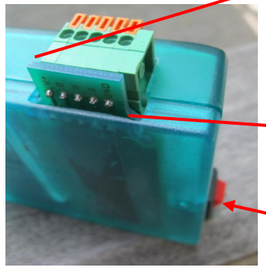


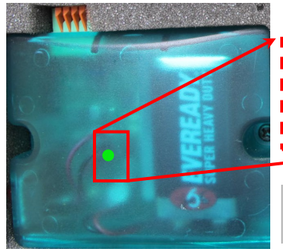
Figure 1 Drawing of the two-terminal *ISFET* (D and S) and the associated external *RE* acting as a gate terminal (G). The *RE* is made of Ag/AgCl contained in KCl solution with a ceramic salt bridge.

The terminals are labeled on the PCB underneath the terminal block; Drain (D), Source (S) and *RE* (G) and the output V+ and GND.





The on/off switch is on the side.



Green LED indicates, ready.

RED LED indicates, change battery.

Top view of the circuit box and the position of the LED light.

Figure 2 The circuit box, the input/output terminals and LED light position

1.3 Buffer solutions
pH 4, 7 and 10 buffers are provided in 3 bottles. These buffers are for calibration purpose. The buffers can be ordered from Winsense Co., LTD.

Figure 3 pH 4, 7 and 10 buffer solutions are included in the kit.

2. Measurement Procedure

2.1 Connect *ISFET* (D and S) and *RE* (G) to the associated terminals on the circuit box and connect 2 wires from V+ and GND terminals (see top right inset of Figure 2) to positive and ground terminals of a voltmeter.

2.2 Turn on the switch located on the side of circuit box as shown in the top left inset of Figure 2. When the circuit is on, the green LED will be lit.

2.3 Then measure the output voltage in 10, 7, 4 buffer solutions in order, *i.e.*

2.3.1 Clean the ISFET and RE then bring into pH 10 buffer, record the output voltage when the reading is stable.

2.3.2 Clean the ISFET and RE then bring into pH 7 buffer, record the output voltage when the reading is stable.

2.3.3 Clean the ISFET and RE then bring into pH 4 buffer, record the output voltage when the reading is stable.

Clean with water & dry with paper

When the reading is stable, record the voltage values, pH 10=991 mV, pH 7=850 mV, and pH 4=665 mV, for examples.

pH=10

pH=7

pH=4

Figure 4 Measurement procedure: the *ISFET* and the *RE* tips should be submerged into the solution.