



## Ion Sensitive Field Effect Transistor (ISFET)

### Winsense ISFET pH Sensor (WIPS)

#### Special Features:

- Si<sub>3</sub>N<sub>4</sub> (Silicon Nitride) Insulating gate
- Operates as a MOSFET at a constant voltage V<sub>ds</sub> current I<sub>ds</sub>
- Quality control by predetermined electrical measurement cycle after packaging
- Single supply, low power, small size

#### Product Description:

Sensing principle:

The sensitive element is a Field Effect Transistor; whose metal gate is replaced by a Reference Electrode and the solution of interest.

The ISFET devices are realized with microelectronic technology compatible with CMOS processes.

- Si<sub>3</sub>N<sub>4</sub> insulating gate ISFET devices measure the pH value in a wide range from basic to acidic solutions

#### Applications:

- Smart farming
- Water Quality monitoring
- Environment control
- Security, industrial process control

#### Interface electronics:

- Analog read out circuit with output 1-2 V.

#### Characteristics

Input/Outputs:

- Bias condition: V<sub>ds</sub>=0.3 V  
I<sub>ds</sub>=25-35 uA
- Output: Analog voltage 1-2 V

#### Base structure

- Sensor base materials: Silicon, Silicon nitride, Silicodioxide
- Technology: 6" planar CMOS process

#### Selective membrane

- pH-sensitive material: Si<sub>3</sub>N<sub>4</sub>

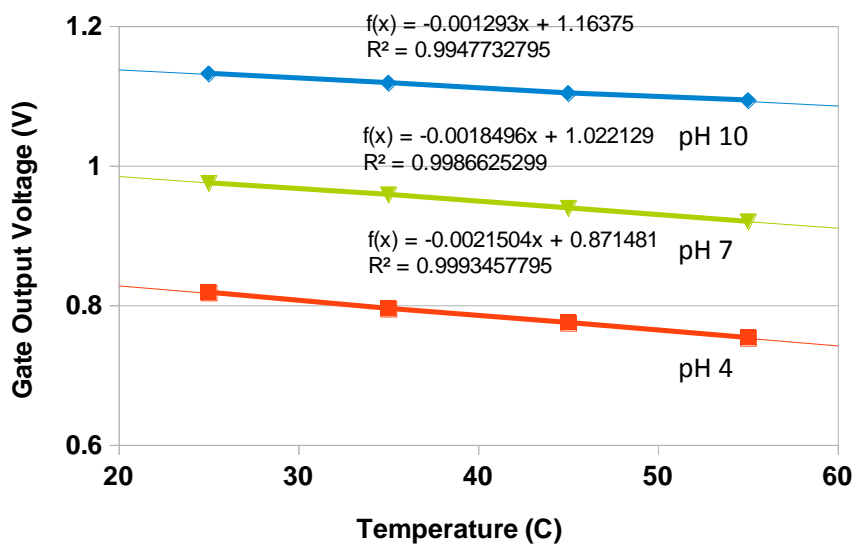
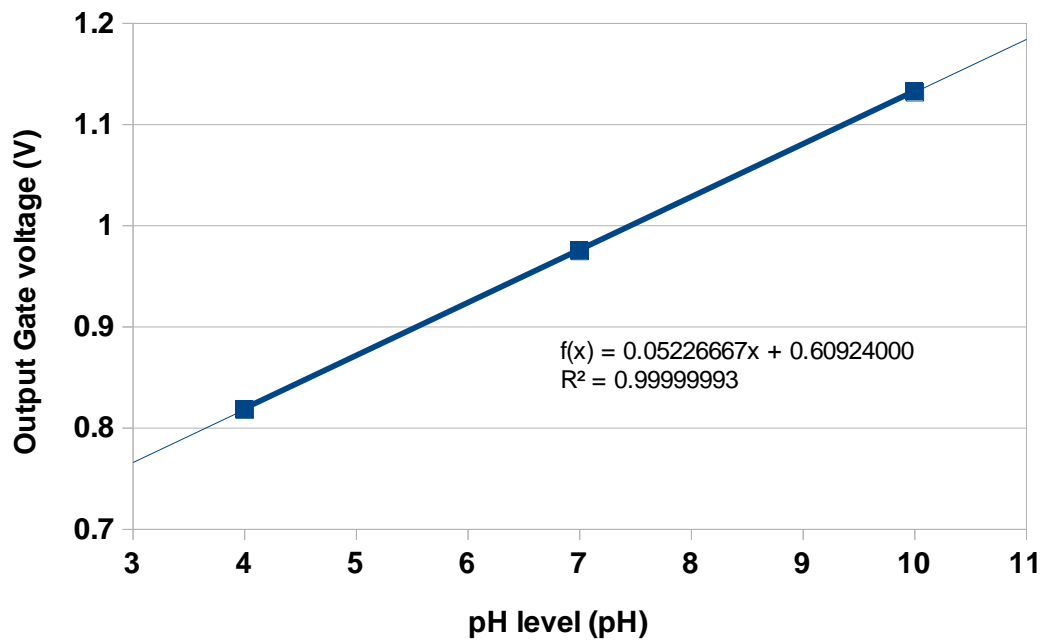
#### Sensor dimensions:

	Width	Length	Thickness	Unit
Sensor chip dimension	1400	3550	650	Um
PCB dimension	2	20	1.6	mm

## pH Sensor Characteristics

DC Specifications:

	Min	Typical	Max
Biased Vds		0.3 V	
Biased Ids		30 uA	
Sensitivity ( $\Delta V/\Delta pH$ )	45 mV/pH	50 mV/pH	58 mV/pH
Temperature coefficient	1.29 mV/°C (pH 10)	1.84 mV/°C (pH 7)	2.15 mV/°C (pH 4)



### pH Sensor Specifications

**Sensitivity:** 50 mV/pH

**Range:** pH 2 - pH 12

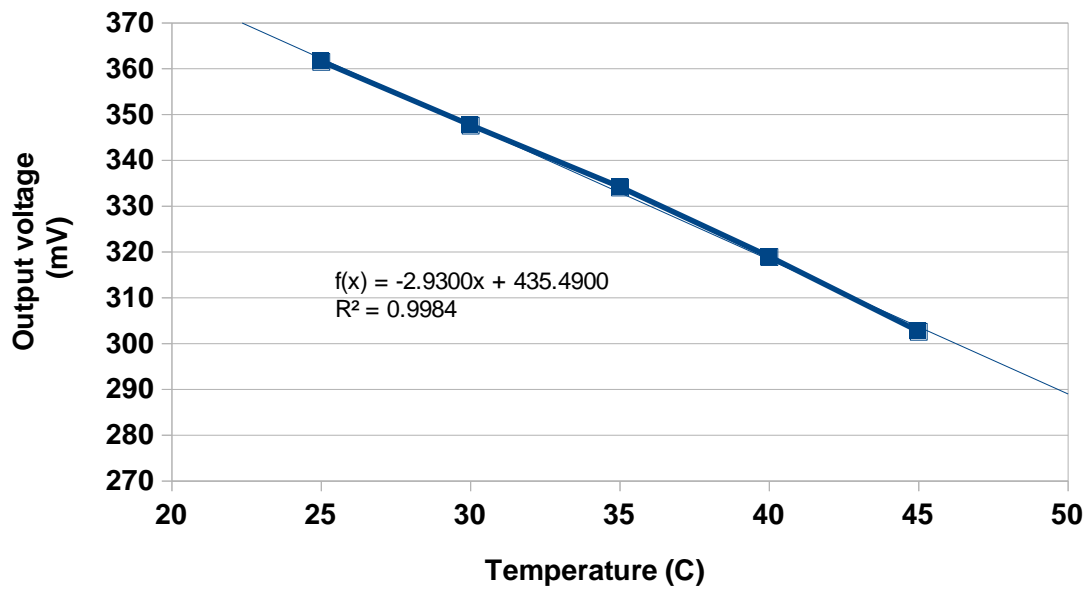
**Accuracy:** 0.01 pH

**Operating temperature:** 0°C - 100°C

**Response time:** 10 s

### Temperature Sensor Characteristics

Temperature Sensor Diode:



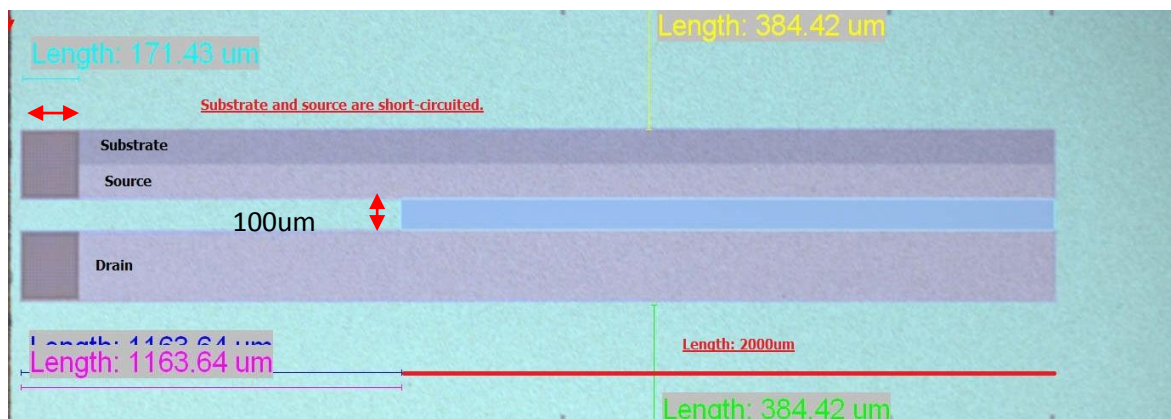
### Temperature Sensor Specifications

**Sensitivity:** -2.93 mV/degC

**Range:** 0 - 100°C

**Response time:** 1s

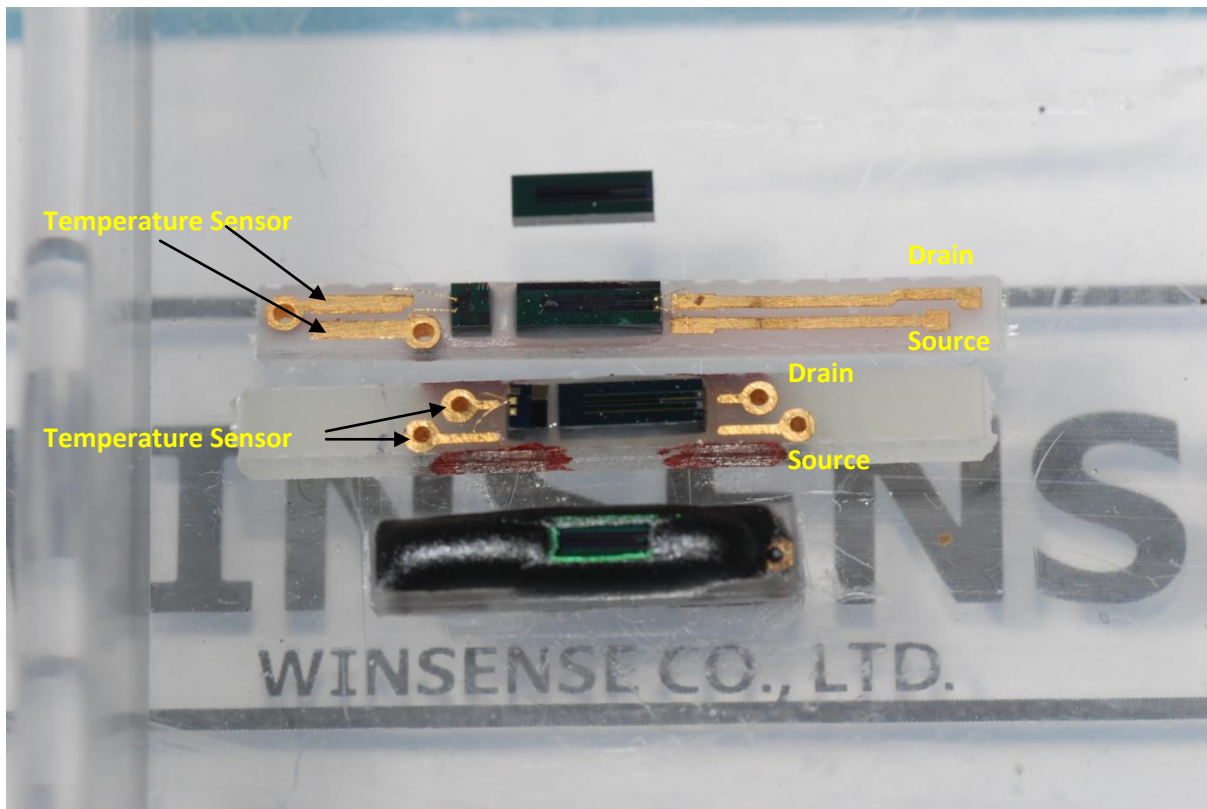
### Sensor terminals and connections:



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## Chip connections and connections of packaged sensor:



From top to bottom:

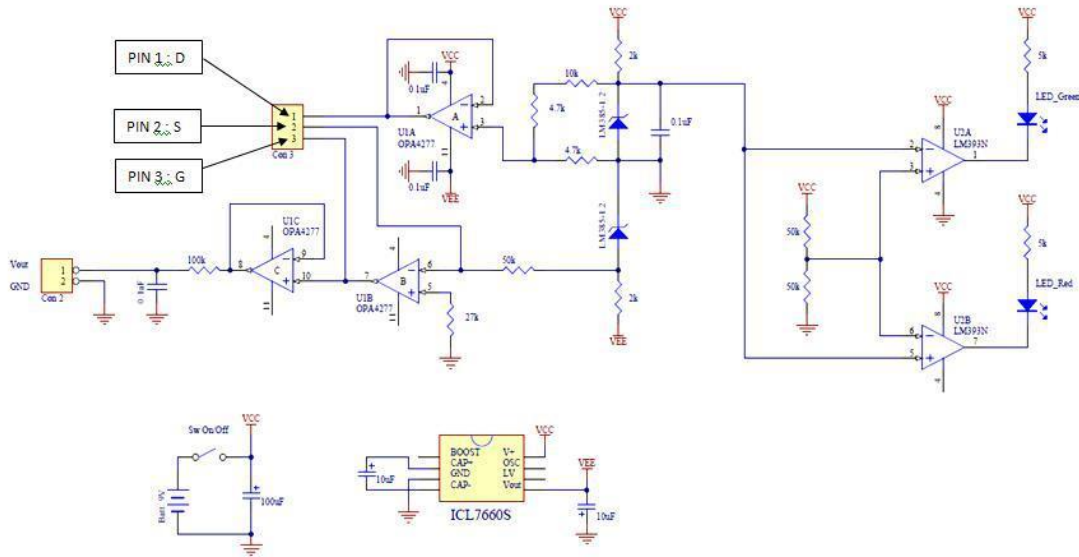
1. ISFET chip
2. Temperature (left) and ISFET (right) chips wire bonded on a PCB
3. Temperature (left) and ISFET (right) chips wire bonded on another PCB with shorter wiring
4. ISFET wire bonded to PCB after encapsulation

## Reference-electrode

For stable measurements an Ag/AgCl Reference electrode is required. Submerged together with the packaged ISFET chip, it acts as metal gate electrode and provides a stable reference potential.

# WIPS Control Electronic

## Measurement circuit:



## Operating mode:

**Principle:** The circuit configuration is used to keep a constant drain current ( $I_{ds}$ ) and voltage ( $V_f$ ) for the ISFET operation providing an output voltage ( $V_g$ ) linearly depending on pH level of the solution under test.

## Recommended Handling and Operating Conditions:

- The ISFET is sensitive to light, it is then preferably operated out of direct light as calibration is normally performed in dark.

## Important precautions:

- Avoid any electrostatic discharge at the ISFET connections when handling in dry air
- Store the Ref Electrode in KCl solution when not in use.