



M I C R O S E N S

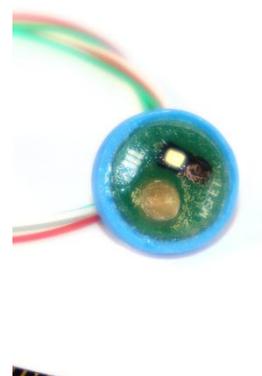
Product Data Sheet

# MSFET-3350 pH sensor with integrated reference electrode

## Ta<sub>2</sub>O<sub>5</sub> gate Ion Sensitive Field Effect transistor (ISFET)



- The ISFET devices are realized with microelectronic technology compatible with CMOS processes.
- Ta<sub>2</sub>O<sub>5</sub> insulating gate ISFET devices measure the pH value in a wide range from basic to acidic solutions
- Module dimension:  
**MSFET3351 :**  
50 mm x 5 mm x 3 mm  
**MSFET3352 :**  
Ø12mm x 6mm



### Special Features:

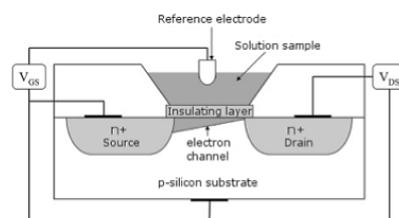
- Ta<sub>2</sub>O<sub>5</sub> Insulating gate
- Single supply, low power, small size
- Integrated Ag/AgCl reference electrode

### Applications:

- Pre-calibrated module for portable systems
- Water Quality monitoring
- Environment control
- Security, industrial process control

### Sensing principle:

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



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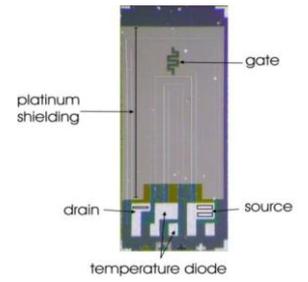
## MSFET 3330-2 Integrated Sensor

**Base structure**

- Sensor base materials: Silicon, Polysilicon
- Technology: 4" planar CMOS process

**Selective membrane**

- pH-sensitive material: Ta<sub>2</sub>O<sub>5</sub>



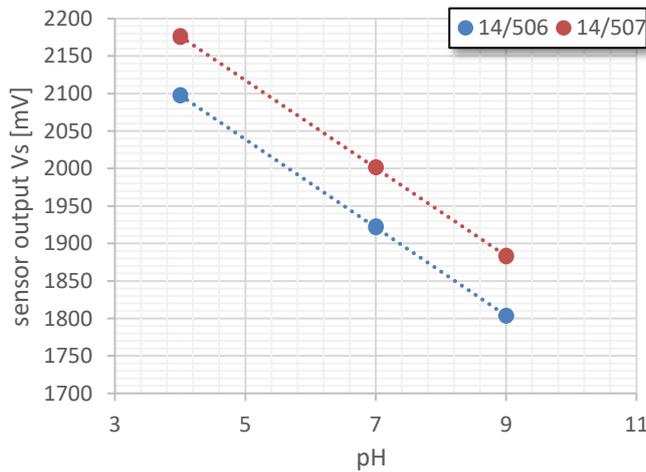
**Sensor dimensions:**

	Width	Length	Height	Unit
<b>Chip dimensions</b>	1.2	3	0.3	mm
<b>Packaged sensor (3351)</b>	5	50	2-3	mm
<b>Packaged sensor (3352)</b>	12	12	6	mm

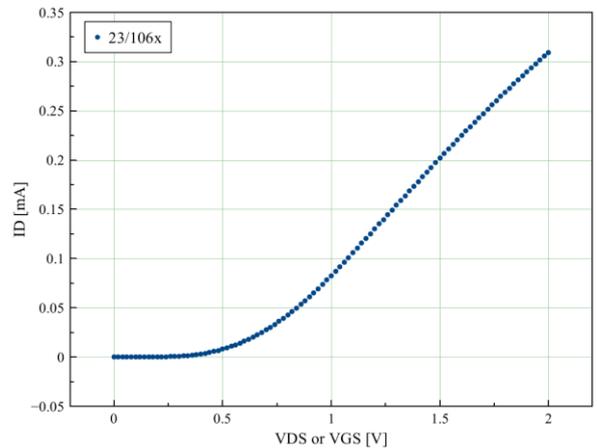
## pH Sensor Characteristics

**DC Specifications:**

	min	typical	max	Unit
<b>V<sub>ds</sub></b>		0.5		V
<b>I<sub>ds</sub></b>		0.1		mA
<b>Sensitivity (ΔVs/pH)</b>	-50	-55.0	-59.2	mV/pH



**Ta<sub>2</sub>O<sub>5</sub> gate ISFET pH sensitivity**  
 Ag/AgCl reference electrode: mini DriRef (WPI),  
 V<sub>ds</sub> = 0.5V, I<sub>ds</sub> = 100μA, Slope = -58.8 mV/pH



Id-V<sub>gs</sub> characteristic of the MSFET3351-2 at pH7. V<sub>ds</sub> = 0.5V.

## pH Sensor Specifications

<b>Sensitivity:</b>	55 mV/pH unit
<b>Range:</b>	pH 1 ... pH 12
<b>Accuracy:</b>	0.05 pH
<b>Operating temperature:</b>	0°C ... 80°C

### Note:

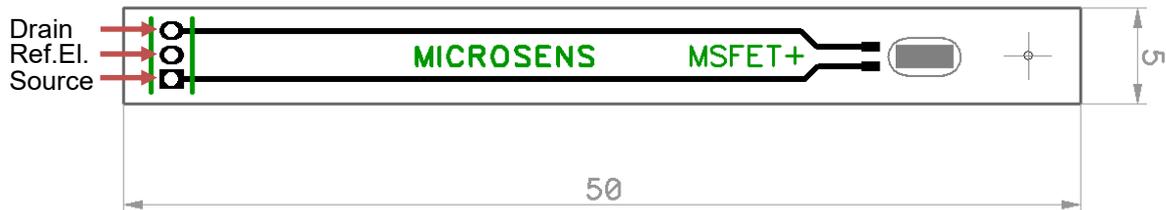
The measured value for pH 7 may vary when the reference electrode is changed. Therefore it might be necessary to recalibrate the ISFET output before measurements.

The **temperature dependence** of the ISFET sensor manifests in a change in the offset voltage. For temperatures below 50°C the offset voltage changes on average **-0.4 mV/°C**.

The offset voltage of a MSFET3330-2 changes slowly with time during a measurement. The **average drift** of a standard MSFET3330-2 is **-0.2 mV/day**. The overall drift of the output voltage also depends on the stability of the reference electrode integrated into the MSFET3350 module.

## Sensor connections

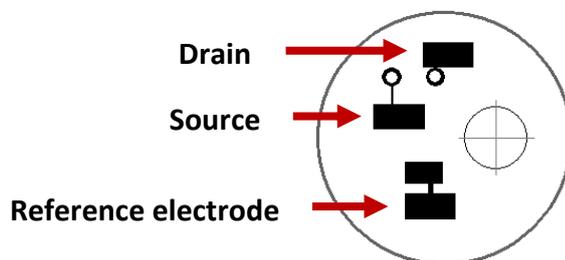
### MSFET3351:



Schematics of the ISFET on its PCB. "Source", "Drain" and "Ref.El." connect to the respective ISFET connector of the interface electronics.

The standard connector is not watertight. Upon special request the connection can be made waterproof.

### MSFET3352:



Schematics of the ISFET on its PCB. "Source", "Drain" and "Ref.El." connect to the respective ISFET connector of the interface electronics.

The MSFET3352 is packaged into a PETG 3D printed housing to protect the sensor head's backside from humidity.

## Handling Recommendations

### Recommended Operating Conditions:

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

### Cleaning recommendations:

- Rinse with DI water
- Let dry in air (dust free environment)
  - Alternatively: blow dry
- Avoid:
  - Rinsing with solvent (acetone, ethanol, isopropanol)
  - Rinsing with detergents
  - Drying with blotting tissues

### Important precautions:

- Avoid any electrostatic discharge at the ISFET connections when handling in air. As a precaution the sensor module should be powered down, when the sensor is removed from the solution.
- Switch off the sensor electronics before disconnecting the sensor.
- Store the sensor under dry conditions. Avoid excessive illumination.
- Avoid contact with high concentrations of solvents (acetone, ethanol, isopropanol) or detergents.

## Measurement circuit recommendation

The measurement circuits need to provide a constant voltage  $V_{ds}$  and a constant drain current ( $I_{ds}$ ) to the ISFET. The output voltage ( $V_s - V_g$ ) is then linearly depending on pH or targeted ions.

MICROSENS offers different interface solutions for the MSFET3350, ranging from stand-alone USB powered digital interfaces to small analog benchtop modules. We will be happy to help you select the best suited interface for your application.