

## [1]Scope

This document explains Soil sensor which can measure EC (Electrical conductivity), Moisture (Volumetric water content; VWC) and Temperature simultaneously in soil and water.

### 1-1 Specific applications

- Long term monitoring of temperature, moisture, fertilizer in the soil for agriculture.
- Agriculture irrigation system control
- Long term river and pond water condition monitoring
- Aquaculture pond water condition control
- Soil and water environment research

### 1-2 Unsuitable Application

Applications listed in "Limitation of Applications." in this document.

## [2] Part number

<b>2-1</b>	Part Description	Soil sensor
<b>2-2</b>	MURATA Part No.	SLT5009
	Customer Part No.	Please fill in your part number.

## [3]Feature

- Simple user interface : three sensors in one package.
- High accuracy moisture sensor : eliminate the effect of saline(ions).
- High performance EC sensor : high accuracy with multi electrodes. it is possible to measure EC of pore water.
- 3D environment measurement : Gathering 3D information with multi placement.
- Rugged and water proof structure : IP68 equivalent. Sensors in strong package.
- Corresponding for wireless system : Low voltage and Low power consumption.
- Variety of interface : UART, RS232, RS485, RS485(MODBUS), SDI-12

## [4]Sensing target

### ①EC sensor

Electrical conductivity depends on contained anion/ cation amount.  
(NO<sub>3</sub>,NH<sub>4</sub>,H<sub>2</sub>PO<sub>4</sub>,K,Ca,Mg,NaCl etc..)

### ②Moisture sensor

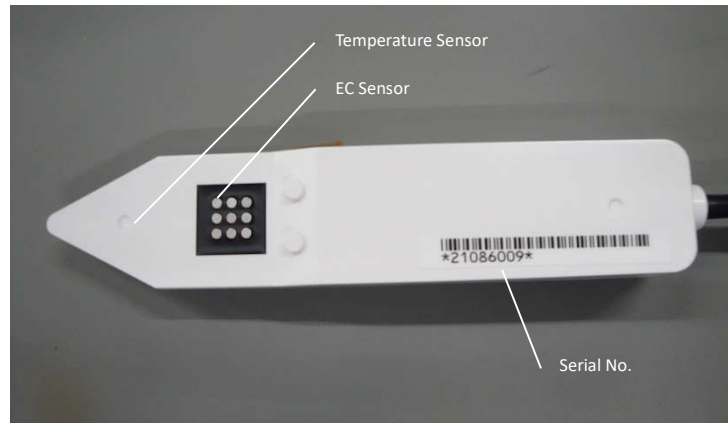
Measure the electric permittivity, translate to VWC.

### ③Temperature sensor

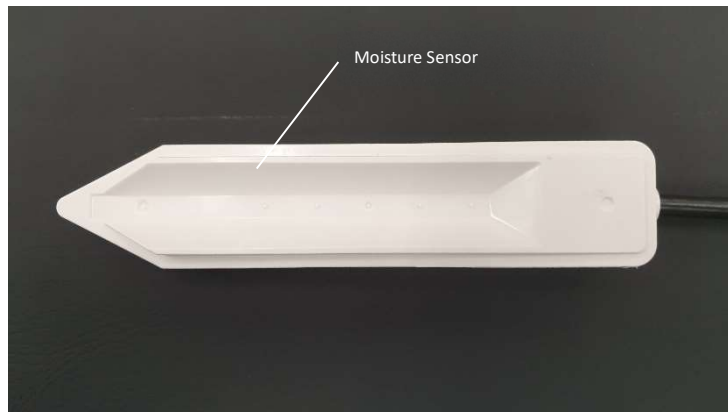
Temperature in the soil and water environment.

**[5]Sensor Figure**

Sensor size: 132.5 x 27 x 16.2 mm  $\pm 0.2$ mm



**Top side view**



**Back side view**

**[6]Specification**

EC		Comments
Range[dS/m]	0—5	
Resolution[dS/m]	0.001	
Accuracy[%]	±3	FS
Temperature		
Range[°C]	-20 – 60	
Resolution[°C]	0.0625	
Accuracy[°C]	±1.0 ±1digit	r.d.g
Moisture		
Range[%]	0—60	
Resolution[%]	0.1	
Accuracy[%]	±3	FS

Items	minimum	typical	maximum	Remark
Operation Power Supply[V]	3.0	-	6.0	
Active Current[mA]	25	30	50	@Read/Write cycle
Operation Temperature[°C]	-20	-	60	
Measurement Cycle [ms]	Free			
Enclosure Class	IP68			equivalent
Interface	RS485			
Protocol	MODBUS			
Cable length[m]	3			Standard

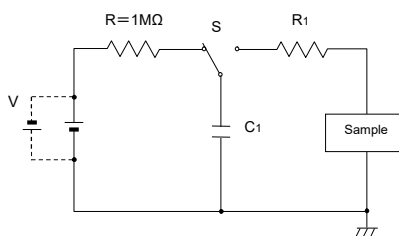
※Remark: In case of freezing condition, moisture sensor value and EC sensor value may vary drastically since the relative dielectric constant changes drastically.

**[7]Weathering performance、Mechanical performance**

	item	Method of test	Method of judgement
7-1	High Temperature bias test	Temperature $70\pm 2^{\circ}\text{C}$ with 3.0V powersupply during 250 hours	Satisfy table1
7-2	Low Temperature bias test	Temperatue $-20\pm 2^{\circ}\text{C}$ with 3.0V powersupply During 250 hours	Satisfy table1
7-3	High Moisture bias test	Temperature $60\pm 2^{\circ}\text{C}$ , Humidity 90~95% with 3.0V powersupply during 250 hours	Satisfy table1
7-4	Temperature cycling test	Temperature $-20\pm 2^{\circ}\text{C}$ during 30minites Temperature $60\pm 2^{\circ}\text{C}$ during 30minites 400 cycles	Satisfy table1
7-5	Salt spray test	Temperature $35\pm 2^{\circ}\text{C}$ salt concentration $5\pm 1\%$ during 96 hours	Satisfy table1
7-6	Vibration test	10~55Hz/10G max stroke1.5mm 1octave/min 24times/1direction・3direction sweeptime 5min sweepmethod log	Satisfy table1
7-7	Electrostatic Breakdown test	Fig.1 $\pm 2\text{kV}$ $C1=100\text{pF}$ , $R1=1.5\text{k}\Omega$	Satisfy table1
7-8	Water proof test	① Firstly, 8- 4 Temperature cycling test, next, underwater with underwater pressure of 1.0m equivalent during 30minites ② Firstly, 8-3 High moisture bias test, next, underwater with underwater pressure of 1.0m equivalent during 30minites	
7-9	Dust proof test	Field test in the soil grain size under 20um over one year (ref : normal IP6 test, grain size is 75um)	

Table1. Method of judgement for weathering and mechanical performance

item	Method of judgement
EC、VWC	Change amount within $\pm 3\%$ for initial value

**Fig.1**

## [8]Sensor operation

### ①EC sensor

EC sensor can measure electrical conductivity of surrounding environments. The basic method is the resistance measurement between two electrodes using alternating voltage. The electrodes need to be protected from corrosion. Therefore, it is important to use the low voltage and the high corrosive-resistant materials.

Normally EC sensor measures the bulk EC(total resistance of soil material, pore water and air). Bulk EC is influenced by water and ions in the soil. Now to know the Pore EC(resistance only in pore water) is important as an indicator of the concentration of fertilizer in the soil. Pore EC is not influenced by volume of water, it is a measurement value which reacts for only volume of ions in the soil.

- Bulk EC is a value suitable for measurement of ions in the water.

- Pore EC is a value suitable for measurement of ions in the soil.

Murata sensor extracts pore EC value by murata original algorithm.

All sensors have the high accuracy by calibration compensated the temperature dependence also before shipment.

Furthermore, EC sensor outputs the raw A-D converter values also, the customer can examine the essential quality for the environments.

### ② Moisture sensor

Moisture sensor can measure VWC(volumetric water content) of surrounding environments. The basic method is the electric permittivity measurement between two electrodes using alternating voltage with 200MHz. The electric permittivity bears a proportionate to VWC. The electric permittivity at air(no water) becomes close to 1. On the other hand, the electric permittivity at water(100%) becomes close to 80.

High frequency of 200MHz can eliminate the error effect by the content of ions.

All sensors have the high accuracy for the temperature compensation.

Furthermore, moisture sensor outputs the raw A-D converter values also, the customer can examine the essential quality for the environments.

### ③Temperature sensor

Temperature sensor utilizes application of diode K factor. It realizes to measure with a high speed and a high accuracy.

**[9]How to use**

This soil sensor conforms **RS485 interface and Modbus protocol**, and can connect with maximum 31 units.

It needs to set a unique number if you want to communicate with multiple sensors. The initial value is 1, at first please write a unique number to SENSOR NUMBER register one by one.

And this soil sensor does not have a terminal register. Please connect 120Ω terminal register if you need.

**[10]Communication specification****Applicable Model**

SLT5009

**Interface**

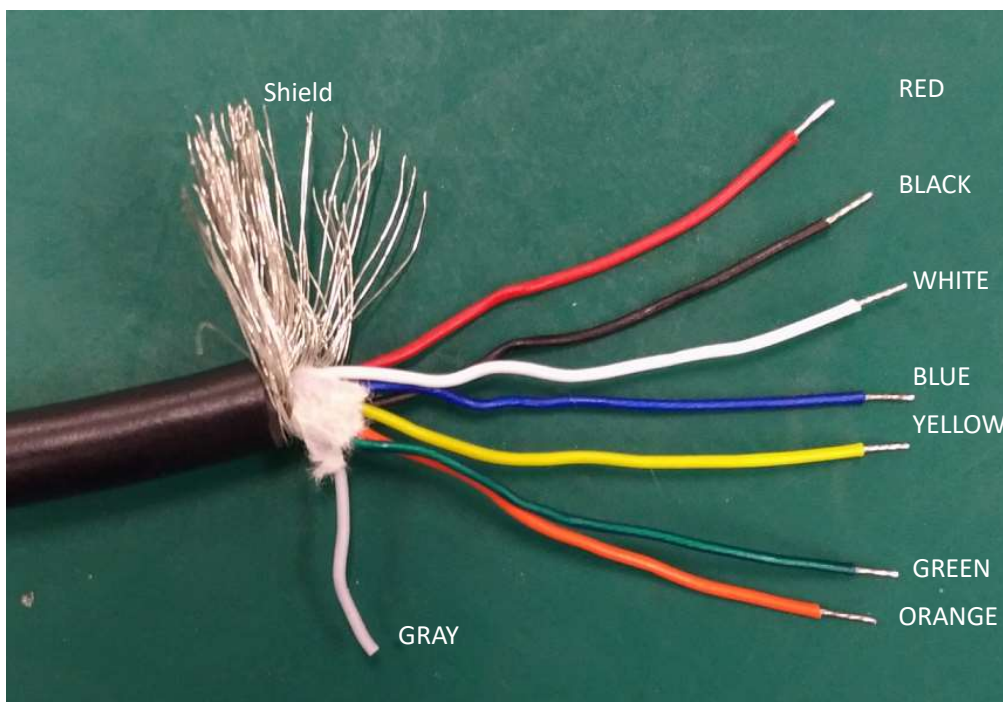
<b>Connection Type</b>	<b>RS485(half duplex)</b>
<b>Signal</b>	Data+, Data-, GND
<b>Baud rate</b>	9600
<b>Data</b>	8 bit
<b>Parity</b>	None
<b>Stop</b>	1 bit
<b>Flow Control</b>	None
<b>Data Format</b>	<b>Binary</b>
<b>Note:</b>	If you want to connect your PC and a soil sensor with a USB port, you may use a USB-Serial Converter cable( UTS-485TB-V2 etc.)

**Cable**

No.	Color	Input/output						Remark
		Name	Symbol	IO		Min	Max	
1	RED	Supply Voltage	VDD	-		3.0	6.0	
2	BLACK	Ground	VSS	-		0.0	0.0	
3	WHITE	Enable the device	EN	IN	VIH	0.8 x VDD	VDD	H: Active
					VIL	VSS	0.2 x VDD	L: Standby
4	BLUE	Inverting Data	Data-	INOUT	VCM	-7	12	※1
5	YELLOW	Noninverting Data	Data+	INOUT	VTH	-0.2	-0.05	
					VOD	1.5	VINT	
6	GREEN	No connected	NC	-		-	-	※2
7	ORANGE	No connected	NC	-		-	-	※2
8	GRAY	-	-	-		-	-	※3
-	-	Internal Voltage	VINT	-		3.3		

**Remarks:**

- ※1 : VCM is common-mode input voltage range. VTH is receiver differential threshold voltage. VOD is differential driver output.
- ※2 : **GREEN and ORANGE cables must be floating.** Because they are pulled up to VINT(Internal voltage) internally.
- ※3 : **GRAY cable and Shield line** are connected to GND(VSS) is recommended for the stability of communication.

**Cable Type**



## Communication Format

Name	Size	Description
Slave Number	1 byte	1 – 31 : Slave number of sensor 0 : broadcast (act for all slaves)
Function Code	1 byte	Specify "read" or "write"
Data	Up to 26 bytes	Read data or write data
Error Check	2 bytes	Error Check field based on CRC-16.

## Function Code

Function Code	Action
0x03	Read n words
0x10	Write n words

※1 word=16bits=2bytes

## Operation Method

- ① Start to measure: write "0x00" and "0x01" to SNSR\_CTRL register(0x000a,0x000b).  
↓
- ② Monitor the state of sensor : read the state("0x00" or "0x01") in SNSR\_STATE register(0x000c,0x000d).  
0x00 : Still under measuring or not start to measure.  
0x01 : finish to measure.  
↓
- ③ Read the measurement data : read the data in each registers  
(After finishing the measurement (SNSR\_STATE register value="0x01"))

**Write Function(0x10)**

Following shows an example of start of measurement

<b>Message</b>			<b>Response</b>		
<b>Host device -&gt; Soil Sensor(SlaveNum=0x01)</b>			<b>Soil Sensor(SlaveNum=0x01) -&gt; Host device</b>		
No.	Format	Example data	No.	Format	Example data
1	Slave Number	0x01	1	Slave Number	0x01
2	Function code	0x10	2	Function code	0x10
3	Start Address(Upper)	0x00	3	Start Address(Upper)	0x00
4	Start Address(Lower)	0x0a	4	Start Address(Lower)	0x0a
5	Number of registers(Upper)	0x00 ※in word(*2bytes)	5	Number of registers(Upper)	0x00 ※in word(*2bytes)
6	Number of registers(Lower)	0x01 ※in word(*2bytes)	6	Number of registers(Lower)	0x01 ※in word(*2bytes)
7	Data Length	0x02 ※in bytes(Number of registers*2)	7	CRC-16(Lower)	0x21
8	Register value(Upper)	0x00 ※Data for writing to address 0x000a	8	CRC-16(Upper)	0xcb
9	Register value(Lower)	0x01 ※Data for writing to address 0x000b			
10	CRC-16(Lower)	0x67			
11	CRC-16(Upper)	0x3a			

**Broad Cast Query**

As the sensor receives a broad cast query from host device, the sensor always acts by the command. However the action is limited in the case of continuous write (0x10).

**Read Function(0x03)**

Following shows an example of confirmation of measurement finish or not.

**Message****Host device -> Soil Sensor(SlaveNum=0x01)**

No.	Format	Example data
1	Slave Number	0x01
2	Function code	0x03
3	Start Address(Upper)	0x00
4	Start Address(Lower)	0x0c
5	Number of registers (Upper)	0x00 ※in word(*2bytes)
6	Number of registers (Lower)	0x01 ※in word(*2bytes)
7	CRC-16(Lower)	0x44
8	CRC-16(Upper)	0x09

**Response****Soil Sensor(SlaveNum=0x01) -> Host device**

No.	Format	Example data
1	Slave Number	0x01
2	Function code	0x03
3	Data Length	0x02 ※in bytes(Number of registers*2)
4	Register value(Upper)	0x00 ※Register value in Address 0x000c
5	Register value(Lower)	0x01 ※Register value in Address 0x000d
6	CRC-16(Lower)	0x79
7	CRC-16(Upper)	0x84

**Error Message**

If a host device sends an inappropriate message, it will receive an error message.

Format	Size
Slave Number	1 byte
Function Code   0x80	1 byte
Error Code	1 byte
CRC-16(Lower)	1 byte
CRC-16(Upper)	1 byte

Error Code	Description
0x01	Illegal Function Code
0x02	Illegal Start Address
0x03	Illegal Protocol / format
0x05	CRC-16 error
0x06	Sensor is under measurement
0x10	Failed to write to register
0x20	I2C communication error

**Register Map**

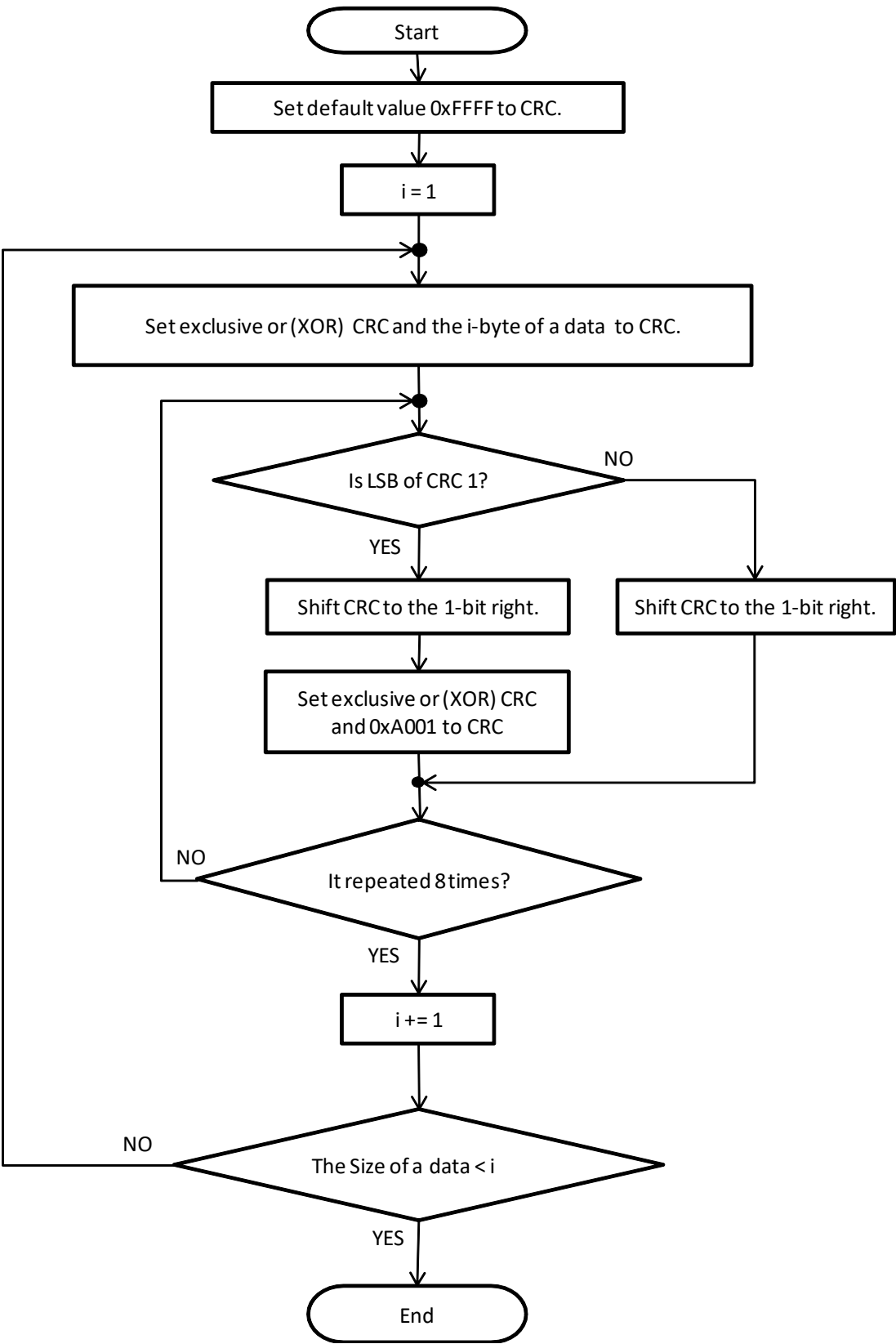
Address	R/W(※)	Register name	Reset value	7	6	5	4	3	2	1	0
0x0000	R	MAJOR_VERSION_U	0x00	—							
0x0001	R	MAJOR_VERSION_L	—	MAJORV[7:0]							
0x0002	R	MINOR_VERSION_U	0x00	—							
0x0003	R	MINOR_VERSION_L	—	MINORV[7:0]							
0x0004	R	REVISION_U	0x00	—							
0x0005	R	REVISION_L	—	REVISION[7:0]							
0x0006	R	SERIAL_NO_UU	—	SERIALN[31:24]							
0x0007	R	SERIAL_NO_UL	—	SERIALN[23:16]							
0x0008	R	SERIAL_NO_LU	—	SERIALN[15:8]							
0x0009	R	SERIAL_NO_LL	—	SERIALN[7:0]							
0x000A	RW	SNSR_CTRL_U	0x00	—							
0x000B	RW	SNSR_CTRL_L	0x00	—							
0x000C	R	SNSR_STATE_U	0x00	—							
0x000D	R	SNSR_STATE_L	0x00	—							
0x000E	R	DDS_U	0x00	—							
0x000F	R	DDS_L	0x00	—							
0x0010	R	ADC_EC_U	0x00	—							
0x0011	R	ADC_EC_L	0x00	—							
0x0012	R	ADC_PERMITTIVITY_U	0x00	—							
0x0013	R	ADC_PERMITTIVITY_L	0x00	—							
0x0014	R	ADC_BATTERY_U	0x00	—							
0x0015	R	ADC_BATTERY_L	0x00	—							
0x0016	R	TEMP_U	0x00	—							
0x0017	R	TEMP_L	0x00	—							
0x0018	R	EC_BULK_U	0x00	—							
0x0019	R	EC_BULK_L	0x00	—							
0x001A	R	Reserved	0x00	Reserved							
0x001B	R	Reserved	0x00	Reserved							
0x001C	R	VWC_U	0x00	—							
0x001D	R	VWC_L	0x00	—							
0x001E	R	Reserved	0x00	Reserved							
0x001F	R	Reserved	0x00	Reserved							
0x0020	R	Reserved	0x00	Reserved							
0x0021	R	Reserved	0x00	Reserved							
0x0022	R	EC_PORE_U	0x00	—							

0x0023	R	EC_PORE_L	0x00	ECPORE[7:0]	
0x0024	R	Reserved	0x00	Reserved	
0x0025	R	Reserved	0x00	Reserved	
0x0026	RW	SENSOR_NUMBER_U	0x00	—	
0x0027	RW	SENSOR_NUMBER_L	—	—	ADDRESS[4:0]

### Parameter description

Name	Description	Range																																
xx Version Revision	Firmware version. Firmware version consists of major version, minor version and revision.	-																																
Serial_No	Unique ID.	-																																
SNSR_CTRL	Start bit for measuring.	-																																
SNSR_STATE	State of sensor. 0x00: under measuring or not start to measure. 0x01: finish to measure.	-																																
DDS	Output of 12-bit Analog-to-Digital converter : reference clock for EC sensor.	0 ~ 4095																																
ADC_EC	Output of 12-bit Analog-to-Digital converter : EC sensor output.	0 ~ 4095																																
ADC_PERMITTIVITY	Output of 12-bit Analog-to-Digital converter : moisture sensor output.	0 ~ 4095																																
ADC_BATTERY	Output of 12-bit Analog-to-Digital converter : half of power-supply voltage.	0 ~ 4095																																
TEMP	<p>Temperature value: It becomes the output value of [°C] unit by multiplying 0.0625. Data is represented in 2's complement.</p> <p>Temperature table</p> <table> <tr> <th colspan="2">TEMP[11:0]</th><th rowspan="2">Temperature [°C]</th></tr> <tr> <th>Binary</th><th>Hex</th></tr> <tr> <td>0100_0110_0000</td><td>460</td><td>70</td></tr> <tr> <td>0100_0101_1111</td><td>45F</td><td>69.9375</td></tr> <tr> <td>:</td><td>:</td><td>:</td></tr> <tr> <td>0000_0000_0001</td><td>001</td><td>0.0625</td></tr> <tr> <td>0000_0000_0000</td><td>000</td><td>0</td></tr> <tr> <td>1111_1111_1111</td><td>FFF</td><td>-0.0625</td></tr> <tr> <td>:</td><td>:</td><td>:</td></tr> <tr> <td>1110_1100_0001</td><td>EC1</td><td>-19.9475</td></tr> <tr> <td>1110_1100_0000</td><td>EC0</td><td>-20</td></tr> </table>	TEMP[11:0]		Temperature [°C]	Binary	Hex	0100_0110_0000	460	70	0100_0101_1111	45F	69.9375	:	:	:	0000_0000_0001	001	0.0625	0000_0000_0000	000	0	1111_1111_1111	FFF	-0.0625	:	:	:	1110_1100_0001	EC1	-19.9475	1110_1100_0000	EC0	-20	-2048 ~ 2047 (-128 ~ 127.9375°C)
TEMP[11:0]		Temperature [°C]																																
Binary	Hex																																	
0100_0110_0000	460	70																																
0100_0101_1111	45F	69.9375																																
:	:	:																																
0000_0000_0001	001	0.0625																																
0000_0000_0000	000	0																																
1111_1111_1111	FFF	-0.0625																																
:	:	:																																
1110_1100_0001	EC1	-19.9475																																
1110_1100_0000	EC0	-20																																
EC_BULK	<p>Bulk EC value: <b>It is a value suitable for measurement of ions in the water.</b> It becomes the output value of [dS/m] unit by multiplying 0.001.</p>	0 ~ 65535 (0 ~ 65.535 dS/m)																																
VWC	<p>VWC(Volumetric Water Content) value: It becomes the output value of [%] unit by multiplying 0.1.</p>	0 ~ 1000 (0 ~ 100.0 %)																																
EC_PORE	<p>Pore EC value: <b>It is a value suitable for measurement of ions in the soil.</b> It becomes the output value of [dS/m] unit by multiplying 0.001.</p>	0 ~ 65535 (0 ~ 65.535 dS/m)																																
SENSOR NUMBER	Sensor number. The initial value is 1. Set a unique number if you want to communicate with multiple sensors.	0 ~ 31																																

CRC-16





**CRC-16 (Program)**

```
USHORT CRC16(int size, BYTE* data)
{
    USHORT cr = 0xFFFF;

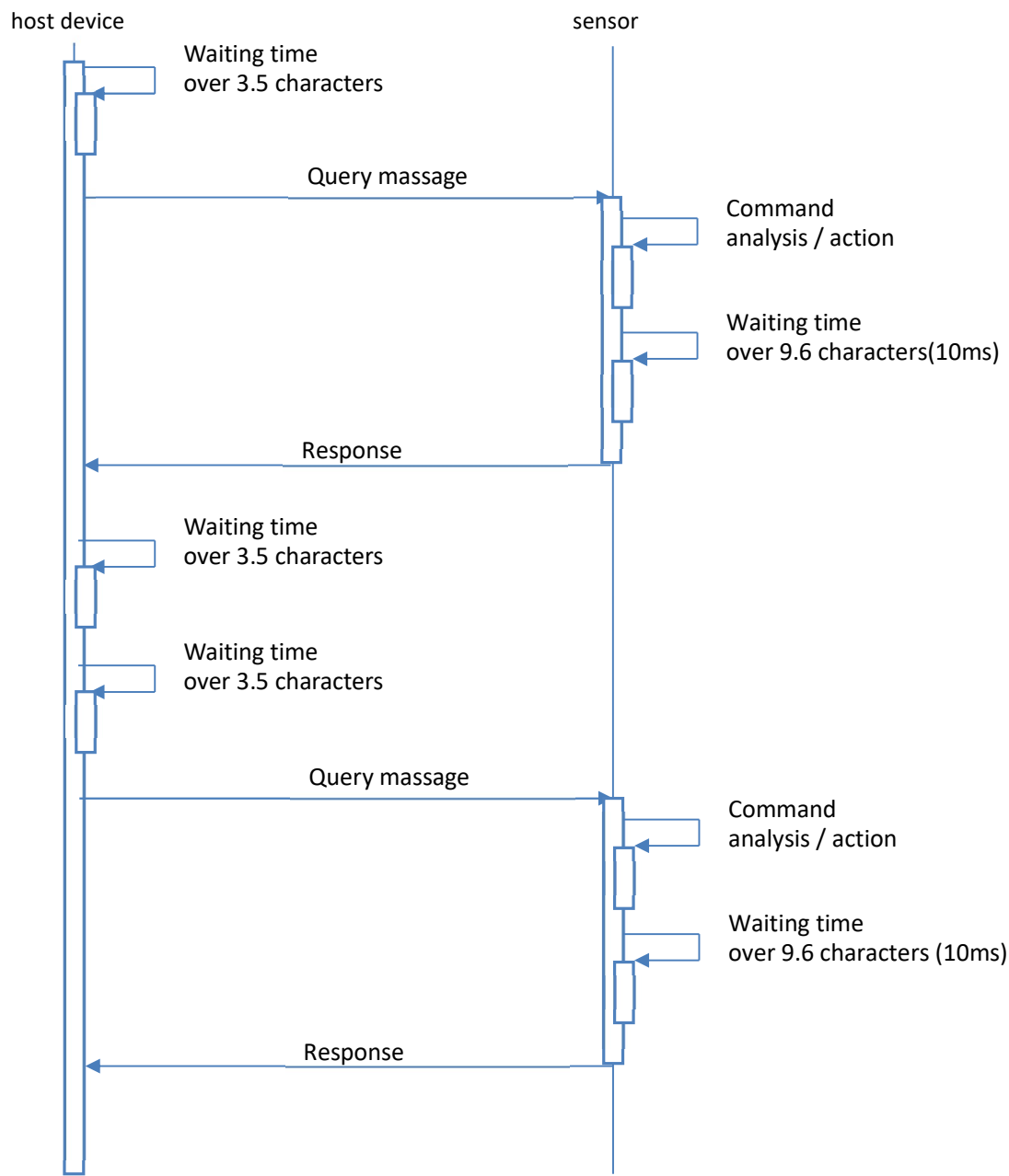
    for(int i = 0; i < size; i++)
    {
        cr = cr ^ data[i];

        for(int j = 0; j < 8; j++)
        {
            if((cr & 0x0001) == 0x0001)
            {
                cr >>= 1;
                cr ^= 0xA001;
            }
            else
            {
                cr >>= 1;
            }
        }
    }

    return cr;
}
```

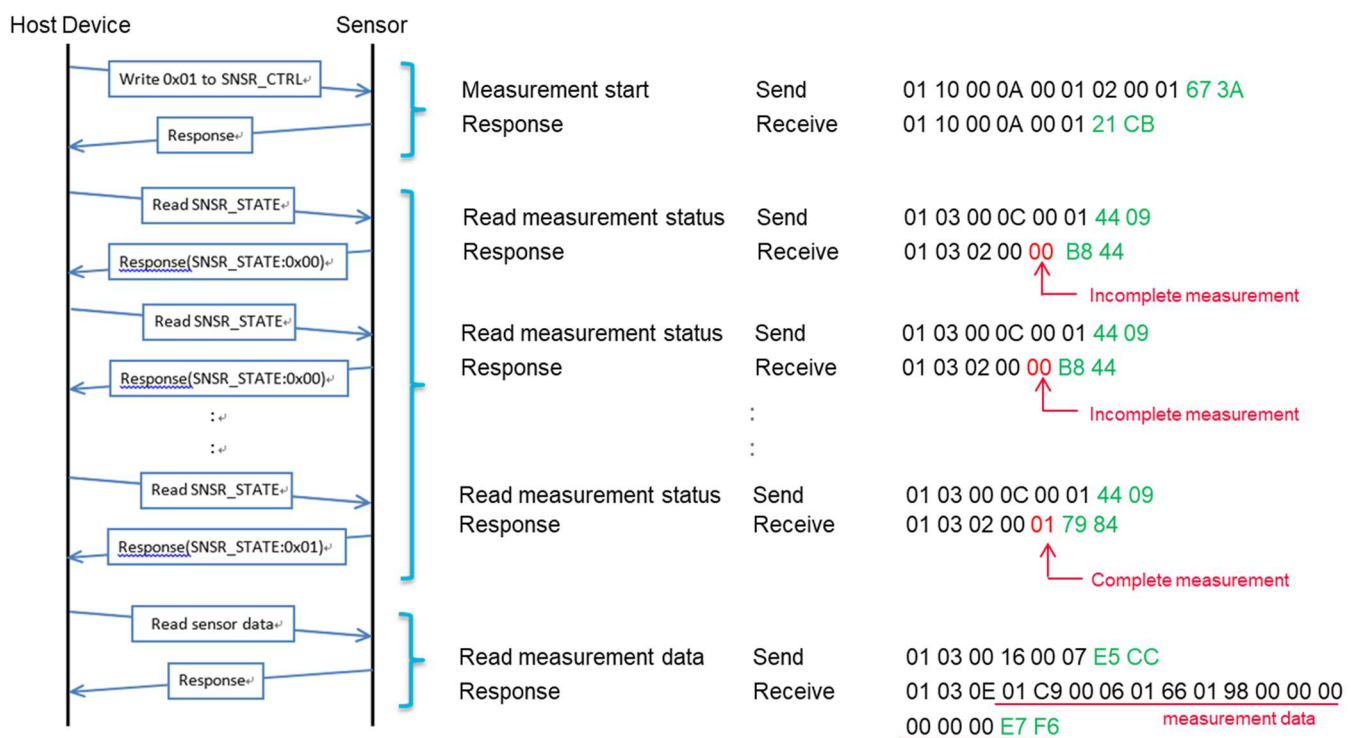
Time Chart

Sequence



## Sample code, Timing chart

- ① Start to measure: write "0x00" and "0x01" to SNSR\_CTRL register(0x000a, 0x000b).
- ② Monitor the state of sensor : read the state("0x00" or "0x01")  
in SNSR\_STATE register(0x000c, 0x000d).  
0x00 : Still under measuring or not start to measure.  
0x01 : finish to measure.
- ③ Read the measurement data : read the data in each registers.  
(After finishing the measurement (SNSR\_STATE register value="0x01"))



※ Green character is CRC-16 code. Please calculate according to the CRC-16 program described in the specification and use it for transmission and error check at reception.

### • Command to read measurement data of ①～⑦

Read measurement data	Send	01 03 00 16 00 07 E5 CC
Response	Receive	01 03 0E 01 C9 00 06 01 66 01 98 00 00 00 00 00 00 E7 F6
		① ② ③ ④ ⑤ ⑥ ⑦

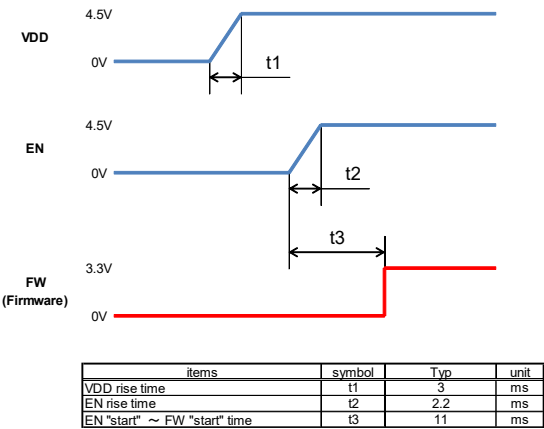
### • How to read the measurement data

- |   |           |                         |                       |
|---|-----------|-------------------------|-----------------------|
| ① | TEMP      | : 01 C9 ⇒ 0x01C9 ⇒ 457d | x0.0625 ⇒ 28.5625[°C] |
| ② | EC_BULK   | : 00 06 ⇒ 0x0006 ⇒ 6d   | x0.001 ⇒ 0.006[dS/m]  |
| ③ | DummyData | : 01 66                 |                       |
| ④ | VWC       | : 01 98 ⇒ 0x0198 ⇒ 408d | x0.1 ⇒ 40.8[%]        |
| ⑤ | DummyData | : 00 00                 |                       |
| ⑥ | DummyData | : 00 00                 |                       |
| ⑦ | EC_PORE   | : 00 00 ⇒ 0x0000 ⇒ 0d   | x0.001 ⇒ 0.000[dS/m]  |

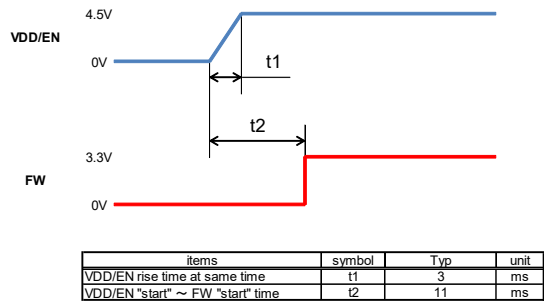
Power ON timing

\* Cable length 3m

Timing case 1: VDD "High" -> EN "High"

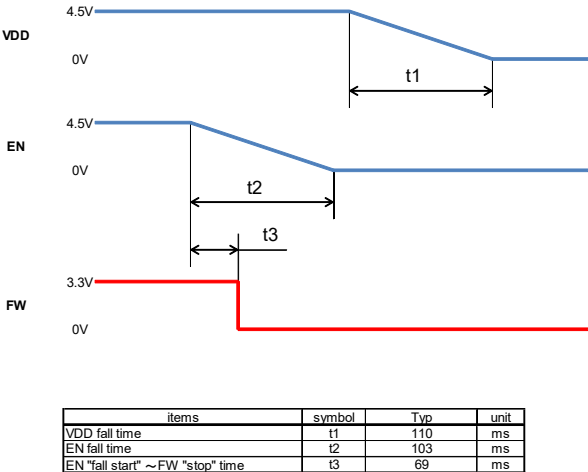


Timing case 2: VDD and EN "High" at same time

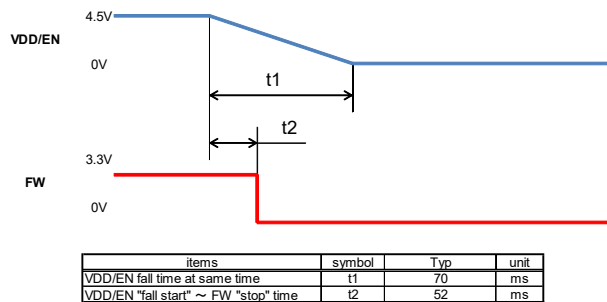


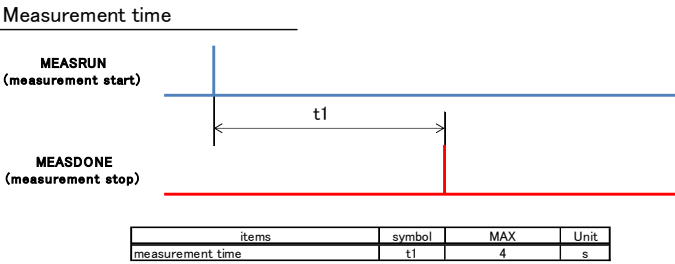
Power off timing

Timing case 1: EN "Low" -> VDD "Low"



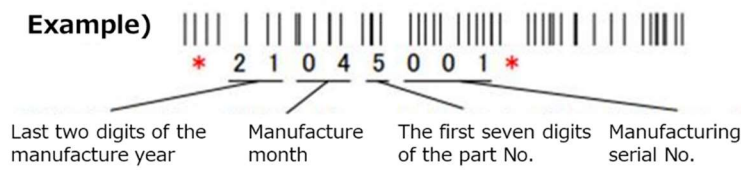
Timing case 2: VDD and EN "Low" at same time





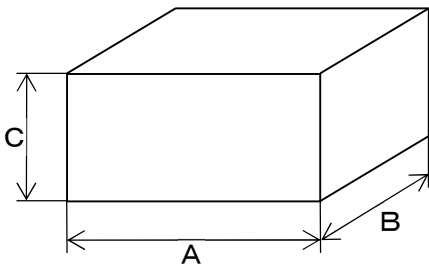
[11] Product label

The serial number is printed on the surface of the product body.



[12] Packing

After packing the products one by one with package cushioning, put them in a bag. Furthermore, it is packed in one of three types of boxes according to the quantity as follows.



Box type	Size(Typical mm)			Maximum quantity
	A	B	C	
40 号	336	263	227	15 pcs.
10 号	267	170	120	5 pcs.

[13] Warranty

13-1. Warranty period

The warranty period is one year after delivery.

13-2. Warranty details

The sensor will be exchanged free of charge in case of a malfunction occurred under the normal use that has followed the specifications and cautions of this document.

※The warranty is only covered by the contents in the specification that meet our measurement standard.

13-3. Disclaimer

Murata shall be under no liability in respect of any fault and damage as follows.

- (1) Misuse, improper handling, improper repair, and improper alteration.  
(Including failure to use normally in accordance with handling method and caution described in this document.)
- (2) Improper handling such as dropping or impact on transportation or moving.
- (3) Fire, earthquake, lightning surge, or other natural disaster.
- (4) Gas damage (hydrogen sulfide gas, etc.).
- (5) Non-specified power connection and erroneous connection.
- (6) Cause from any other devices which is connected to the system.
- (7) Excessive stress, dent, scratch
- (8) Chemicals, organic solvents
- (9) Biological factors

[14] ⚠Caution

14-1. Limitation of Applications

The products listed in the document (hereinafter the product(s) is called as the “Product(s)”) are designed and manufactured for applications specified in the document. (hereinafter called as the “Specific Application”).

We shall not warrant anything in connection with the Products including fitness, performance, adequateness, safety, or quality, in the case of applications listed in from (1) to (11) written at the end of this precautions, which may generally require high performance, function, quality, management of production or safety. Therefore, the Product shall be applied in compliance with the specific application.

WE DISCLAIM ANY LOSS AND DAMAGES ARISING FROM OR IN CONNECTION WITH THE PRODUCTS INCLUDING BUT NOT LIMITED TO THE CASE SUCH LOSS AND DAMAGES CAUSED BY THE UNEXPECTED ACCIDENT, IN EVENT THAT (i) THE PRODUCT IS APPLIED FOR THE PURPOSE WHICH IS NOT SPECIFIED AS THE SPECIFIC APPLICATION FOR THE PRODUCT, AND/OR (ii) THE PRODUCT IS APPLIED FOR ANY FOLLOWING APPLICATION PURPOSES FROM (1) TO (11) (EXCEPT THAT SUCH APPLICATION PURPOSE IS UNAMBIGUOUSLY SPECIFIED AS SPECIFIC APPLICATION FOR THE PRODUCT IN OUR CATALOG SPECIFICATION FORMS, DATASHEETS, OR OTHER DOCUMENTS OFFICIALLY ISSUED BY US\*).

- (1) Aircraft equipment
- (2) Aerospace equipment
- (3) Undersea equipment
- (4) Power plant control equipment
- (5) Medical equipment
- (6) Transportation equipment
- (7) Traffic control equipment
- (8) Disaster prevention/security equipment
- (9) Industrial data-processing equipment
- (10) Combustion/explosion control equipment
- (11) Equipment with complexity and/or required reliability equivalent to the applications listed in the above.

For exploring information of the Products which will be compatible with the particular purpose other than those specified in the document, please contact our sales offices, distribution agents, or trading companies with which you make a deal, or via our web contact form.

Contact form: <https://www.murata.com/contactform>

\*We may design and manufacture particular Products for applications listed in (1) to (11). Provided that, in such case we shall unambiguously specify such Specific Application in the document without any exception. Therefore, any other documents and/or performances, whether exist or non-exist, shall not be deemed as the evidence to imply that we accept the applications listed in (1) to (11).

14-2. Addition of fail-safe function

To avoid of unprecedented failure caused by this product, please include appropriate fail-safe protection function to the overall system.

## [15] Caution of storage

15-1. Temperature -20~+60℃.

Please store it in the room without the sudden temperature change.

15-2. A deterioration in the quality of product is caused when kept of chemical atmospheres such as acid, alkali, salt, organic gas, sulfur. Please store it avoiding the chemical atmosphere.

15-3. Please store it avoiding direct sunlight, heat, vibration.

15-4. A failure is caused by the dropping of product.

Please handle and store it with the state not to drop easily.

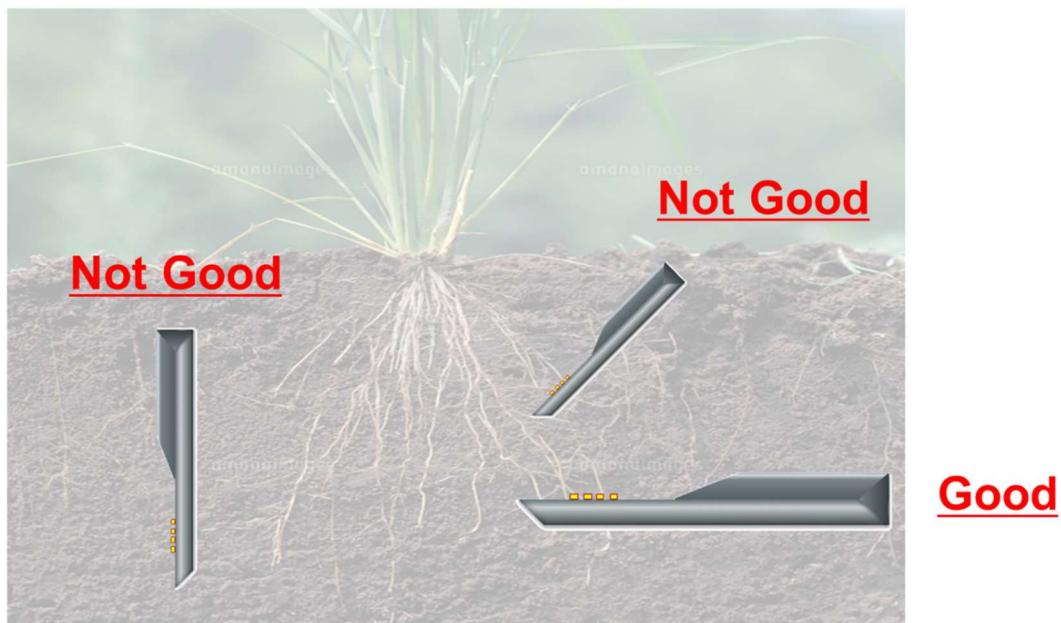
## [16] Request

1. When using the product, please be sure to evaluate it in the condition of being mounted on your product.
2. Please do not use this product deviating from the description in this delivery specification.

## (Appendix)

Handling method

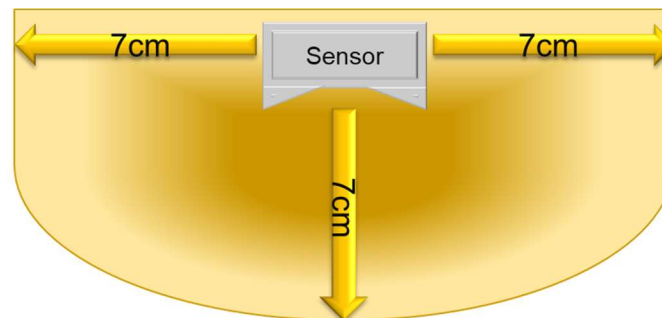
Recommended way of setting up





## Sensing/detecting area

The effective sensing area is 7cm from the bottom, left and right of the sensor for VWC and EC\_pore measurement.



## Recommended way of setting up ①

- ✓ Set EC sensor side (the side you can see 9 electrodes) upward.
- ✓ Put the sensor in the target ground depth (from the ground level to EC sensor surface)



① Dig a hole in the ground



② put fine soil through a sieve



③ Put sensor with sticking to soil, then move right/left for more close sticking

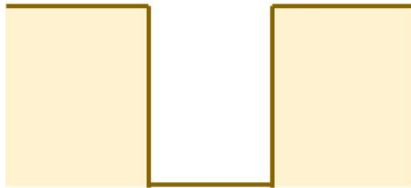


④ By fixing sensor, put more fine soil

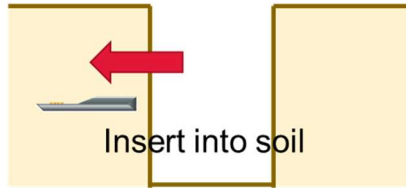


⑤ After soil covering the whole sensor, add more soil with surroundings

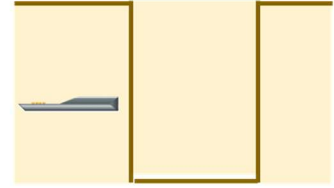
## Recommended way of setting up ②



① Dig a hole in the ground



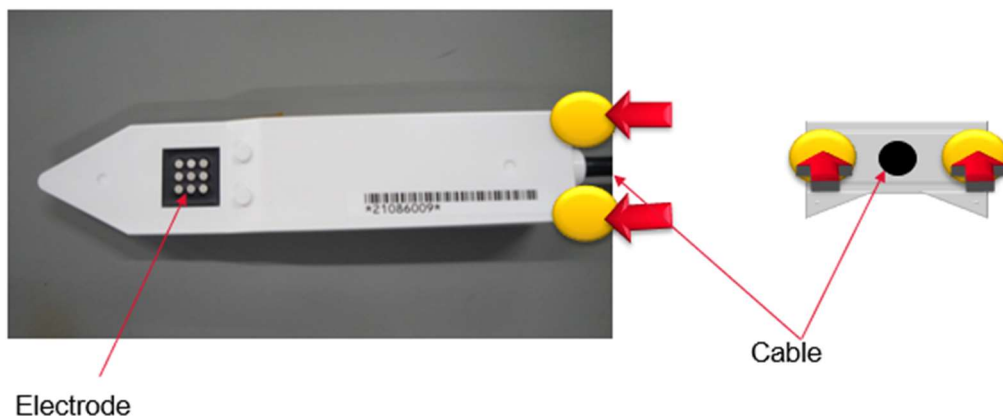
② Insert into soil from hole section  
Please insert the whole sensor in the soil



③ Bury the hole

## Handling of setting and removal

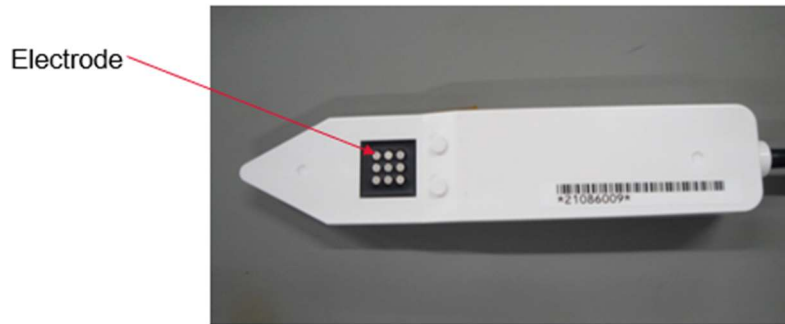
When you set it up in the soil, please push it from the two yellow mark positions. Please do not apply force to the electrical cable, and please do not touch the electrode directly. When you remove it from the soil, please do not pull the electrical cable.



## Storage method after removal

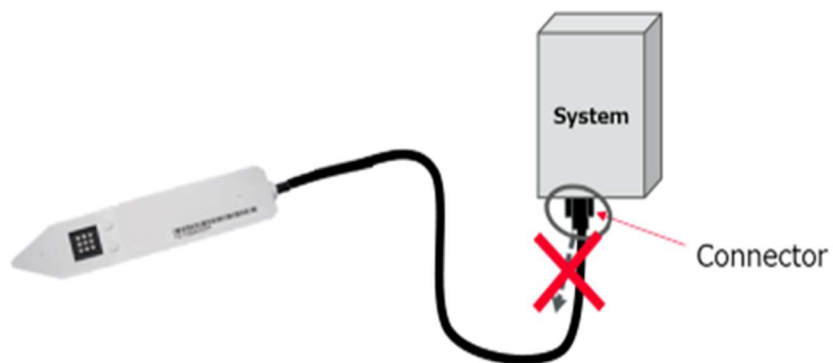
Please store it after washing with water.  
If needed, please use a neutral detergent for tableware.

Please wash it with soft cloth, do not use any hard metal on electrodes.  
After that, please dry the sensor completely before storage, and store it avoiding direct sunlight.



### Precaution for use

Please do not pull out the connector with the sensor power on.



Revision history

Product number		Item		Page	
SLT5009		Revision history		1	
date	revision	Change items	Contents	Person in charge	approve
2022.03.07	1.0.0		Create a new entry	Kubo	Dan
2022.09.22	1.0.1	P8 [10]Communication specification/ Cable / EN	The following is added to Remark H: Active L: Standby	Oba	Dan
2022.12.27	1.0.2	[1]Scope 1-1 Specific applications  [1]Scope 1-2 Unsuitable Application  [2] Part number  [14] Caution  [16] Request	To revise company-wide regulations. * There is no change in technical content.  To unify the notation with our other products.	Oba	Dan
		Murata Manufacturing Co., Ltd.			