USER MANUAL

CS526 ISFET ph Probe

Issued: 18.8.15

CSL 947

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This equipment is guaranteed against defects in materials and workmanship. This guarantee applies for six months from date of delivery. We will repair or replace products which prove to be defective during the guarantee period provided they are returned to us prepaid. The guarantee will not apply to:

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- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

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PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area: 1 in^2 (square inch) = 645 mm^2

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Pressure: 1 psi (lb/in^2) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. *Please note, however, that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality.

Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a "#" symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

Recycling information

At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.

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Precautions

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC**. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.eu or by telephoning +44(0) 1509 828 888 (UK). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, or 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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CS526 ISFET pH Probe

1. Introduction

The CS526 ISFET pH Probe measures pH from 2 to 12 in aqueous or semi-solid solutions. It outputs TTL serial data that is read by compatible dataloggers (see Section 6, *Specifications*).

Before using the CS526, please study

- Section 2, *Cautionary Statements*
- Section 3, *Initial Inspection*
- Section 4, *Quickstart*

More detailed instructions for operation, troubleshooting, and maintenance are available in the remaining sections.

2. Cautionary Statements

- READ AND UNDERSTAND the *Precautions* section at the front of this manual.

- Campbell Scientific warranty does not cover a clogged reference diaphragm or improperly cleaned or maintained ISFET chip (see Section 9, *Maintenance*).

- Maximum input voltage is 5 Vdc. Incorrect wiring may cause performance loss and irreversible damage.

- To prevent scratching the sensor chip when cleaning, first soak the sensor in soapy water and then gently scrub with a toothbrush (see Section 9, *Maintenance*). Most scratches occur when hard particles are rubbed on the chip surface. Scratches cause irreversible damage to the probe.

- Do not use hydrofluoric acid, acetone, MEK, or similar agents to clean the probe.

- Cable can be damaged by abrasion, rodents, sharp objects, twisting, crimping or crushing, and pulling. Take care during installation and use to avoid cable damage.

- The CS526 is rugged, but it should be handled as a precision scientific instrument.

- The CS526 has no user-serviceable parts. Any attempt to disassemble the device will void the six-month warranty.

- Care should be taken when opening the shipping package to not damage or cut the cable jacket. If damage to the cable is suspected, consult with a Campbell Scientific application engineer.

3. Initial Inspection

Upon receipt of the CS526, inspect the packaging and contents for damage. File damage claims with the shipping company.

The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the correct product and cable length are received.

4. Quickstart

For complete installation, programming, and calibration information, see Sections 7.1 through 7.3.

4.1 Preparation for Use and Installation

1. Soak the CS526 in 7-pH buffer solution for 15 minutes.

2. Follow the calibration procedure outlined in Appendix C, *Calibration*.

3. Place the CS526 in the liquid being measured. The CS526 ISFET pH probe can be installed without regard to orientation.

NOTE When installing in a well, the #7421 Split Mesh Cable grip is recommended to centre and suspend the cable, reducing cable stretch.

4.2 Use SCWin to Program Datalogger and Generate Wiring Diagram

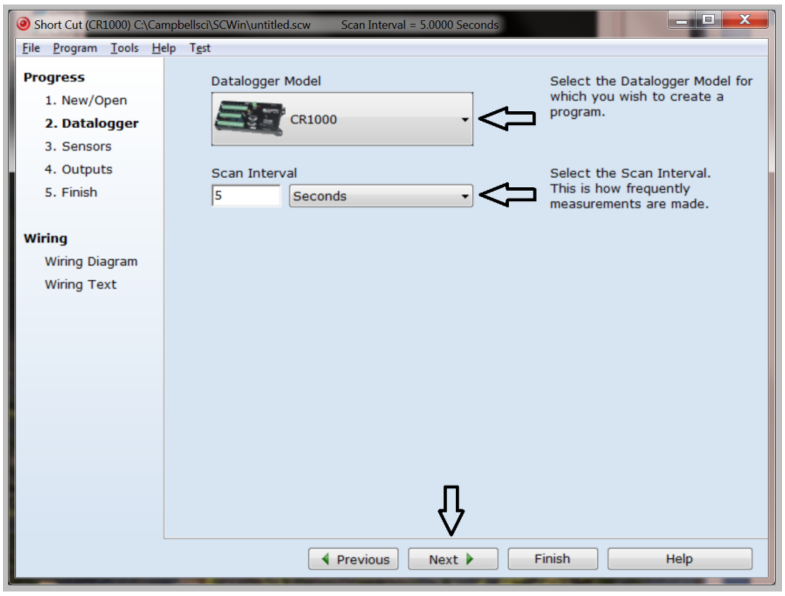
Short Cut is an easy way to program your datalogger to measure the CS526 and assign datalogger wiring terminals. The following procedure shows using *Short Cut* to program the CS526.

1. Install *Short Cut* by clicking on the install file icon. Get the install file from either *www.campbellsci.com*, the ResourceDVD, or find it in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ* software.

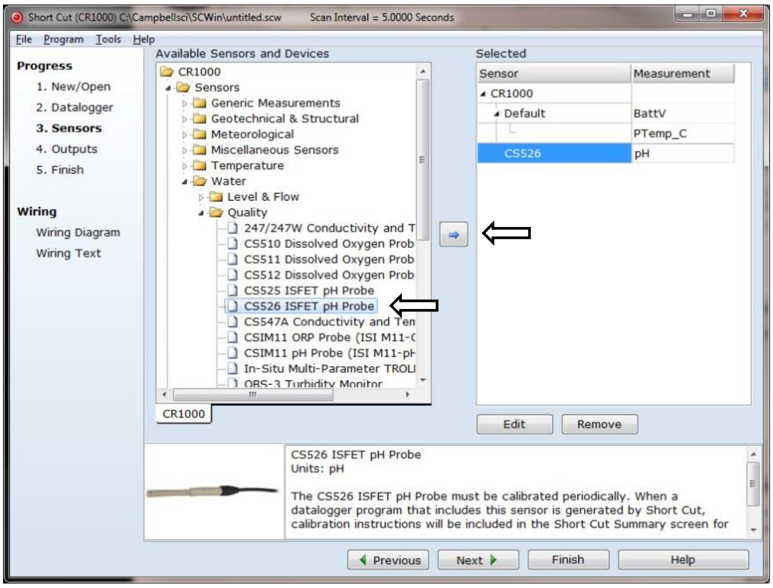
2. The *Short Cut* installation should place a Short Cut icon on the desktop of your computer. To open *Short Cut*, click on this icon.

3. When *Short Cut* opens, select **New Program**.

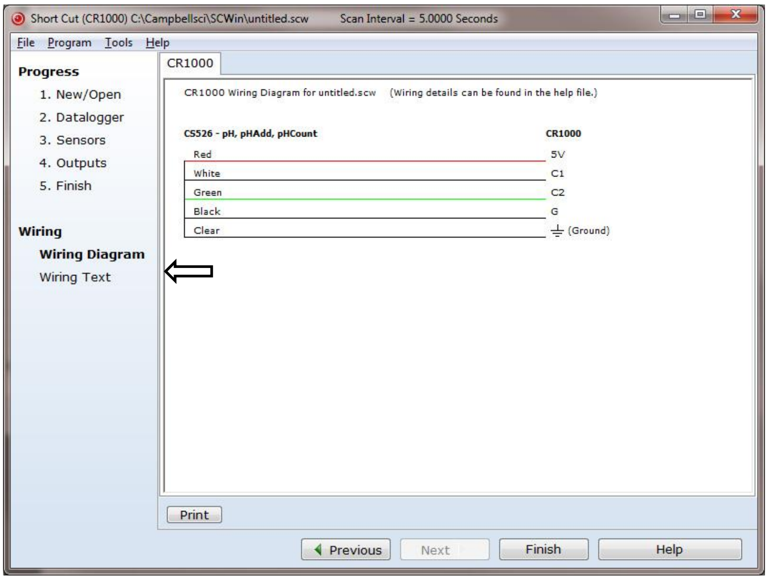
4. Select **Datalogger Model** and **Scan Interval** (default of 5 seconds is OK for most applications). Click **Next**.



5. Under the **Available Sensors and Devices** list, select the **Sensors | Water | Quality** folder. Select **CS526 ISFET pH Probe**. Click  to move the selection to the **Selected** device window.



6. After selecting the sensor, click at the left of the screen on **Wiring Diagram** to see how the sensor is to be wired to the datalogger. The wiring diagram can be printed out now or after more sensors are added.



7. Select any other sensors you have, then finish the remaining Short Cut steps to complete the program. The remaining steps are outlined in *Short Cut Help*, which is accessed by clicking on **Help | Contents | Programming Steps**.

8. If *LoggerNet*, *PC400*, or *PC200W* is running on your PC, and the PC to datalogger connection is active, you can click **Finish** in *Short Cut* and you will be prompted to send the program just created to the datalogger.

9. If the sensor is connected to the datalogger, as shown in the wiring diagram in step 6, check the output of the sensor in the datalogger support software data display to make sure it is making reasonable measurements.

5. Overview

The CS526 uses SENTRON's high-tech, Ion Sensitive Field Effect Transistor (ISFET) semi-conductor as its pH-sensitive element, and includes a silver/silver chloride – potassium chloride reference system.

The CS526's design allows it to be suitable for a variety of liquid pH-monitoring applications. Its electronics are safely embedded in a durable PEEK body. Elimination of the glass-bulb removes the possibility of broken glass, making the CS526 more rugged and safer to use.

NOTE The CS526 is shipped dry and therefore must be soaked in pH solution before use.

6. Specifications

Features:

- Safety — the ISFET with durable PEEK material can be used safely in applications where broken glass is a hazard to the user.
- Intelligent electronics — the CS526 combines the latest developments in ISFET pH sensing technology with state-of-the-art signal processing. This allows for accurate, fast and reliable results.
- Quality — designed and manufactured under stringent quality control conditions in an ISO 9001 environment. Each sensor is individually tested to the most demanding testing protocols, and the electronics comply fully with CE directives and with EMC standard IEC61326:2005.
- Compatible with Campbell Scientific CRBasic dataloggers: CR800 series, CR1000, and CR3000.

Measurement

Range:	2 to 12 pH
Accuracy:	±0.2 pH with 2-point calibration
24 hr drift:	<0.15 pH (after 15-min soak in pH 7 at 25°C)

Operating

Temperature:	10° to 40°C
Water Pressure:	0 to 700 kPa (0 to 101.5 psi)

Power Requirement

Source:	5 Vdc
Load:	15 mA maximum

Output:	TTL logic, 2400 bps 8 data bits, no parity, 1 stop bit
Maximum Cable Length:	100 m (328 ft)
Cable Type:	Three-twisted pair, 24-AWG cable with Santoprene® jacket

Sensor Material: PEEK

Weight
w/10-ft cable: 318 g (11.2 oz)

Dimensions
Length: 102 mm (4 in)
Diameter: 16 mm (0.63 in)

Certifications: ISO 9001
CE compliant
EMC standard IEC61326:2005

7. Operation

If you are programming your datalogger with *Short Cut*, skip Section 7.1, *Wiring*, and Section 7.2, *Datalogger Programming*. *Short Cut* does this work for you. See Section 4, *Quickstart*, for a *Short Cut* tutorial.

7.1 Wiring

Table 7-1. Wiring

Wire Colour	Wire Label/Function	Datalogger Connections
Red (see following caution)	Power 5V	5V
Black	Ground	G
White	Rx	Control Port (odd numbered)
Green	Tx	Control Port (even numbered)
Clear	Shield	G

CAUTION This probe must be connected to the datalogger's 5 V terminal (**not** 12 V). Connecting to a higher voltage will damage the probe beyond repair.

7.2 Datalogger Programming

7.2.1 Get Data Command

The datalogger needs to send a "get data" serial command to the CS526 to get the pH data. This command is sent to the CS526 via the **SerialOut()** CRBasic instruction (see Section 0, *SerialOut() Instruction*). Table 7-2 shows the "get data" command and its response.

Table 7-2. “Get Data” Command and Response	
Command	**Response**
1Mn!<CR> Where: n = a single dummy character (typically use 1)	**1<value><CR><LF>** Where: <value> = the probe’s reading for pH (in digital counts).

7.2.2 CRBasic Instruction Sequence

A sequence of CRBasic instructions is used to measure the sensor. Table 7-3 shows the instruction sequence. Information about the instructions is provided in Section 7.2.3, *Instruction Descriptions*, and an example program is provided in Appendix B, *Example Program*.

Table 7-3. Instruction Sequence	
Instruction	**Function**
SerialOpen()	Set up a datalogger port for serial communication (see Section 7.2.3.1, *SerialOpen() Instruction*)
Scan()	Establish a scan rate
SerialOut()	Send “get data” command to the CS526. See Section 7.2.1, *Get Data Command*, and 0, *SerialOut() Instruction*, for more information.
SerialIn()	Set up the COM port to receive the incoming serial data (see Section 7.2.3.3, *SerialIn() Instruction*). Please note that in the beginning of the CRBasic program, the variable used in the **SerialIn()** instruction needs to be declared as an ASCII string format.
SplitStr()	Split out digital count value for pH from the input string.

NOTE Probe output is “Counts”. A corrected multiplier and offset are required to provide an output in pH units (see Appendix C, *Calibration*).

7.2.3 Instruction Descriptions

7.2.3.1 SerialOpen() Instruction

The **SerialOpen()** instruction has the following syntax:

SerialOpen(*ComPort*,*BaudRate*,*Format*,*TXDelay*,*BufferSize***)**

ComPort **—** the datalogger COM port in which the probe is connected.
BaudRate **—** choose 2400
Format **—** choose 16, which is TTL Logic; No parity, one stop bit, 8 data bits; No error checking
TXDelay **—** enter 0
BufferSize **—** enter at least twice the number of maximum expected characters + 1, which is 41.

7.2.3.2 SerialOut() Instruction

The **SerialOut()** instruction has the following syntax:

SerialOut(*ComPort*,*OutString*,*WaitString*,*NumberTries*,*TimeOut***)**

ComPort **—** the datalogger COM port in which the probe is connected.
OutString **—** use "1M1!"+CHR(13) for the OutString when the default probe address of 1 is used.
WaitString **—** enter the null (“”) WaitString to tell the datalogger to wait for the echo of each character in the OutString
NumberTries **—** enter 0
TimeOut **—** specifies the time, in 0.01 seconds, that the datalogger should wait for the WaitString or echo of each character in the OutString (0 is used in the example program).

7.2.3.3 SerialIn() Instruction

The **SerialIn()** instruction has the following syntax:

SerialIn(*Dest*,*ComPort*,*TimeOut*,*TerminationChar*,*MaxNumChars***)**

Dest **—** specifies the variable in which the incoming data will be stored. Please note that in the beginning of the CRBasic program, this variable needs to be declared as ASCII string format (see example program in Appendix B, *Example Program*)
ComPort **—** the datalogger COM port in which the probe is connected.
TimeOut **— 20** should be adequate, which gives a 200 ms maximum delay time. The TimeOut parameter is used to specify the amount of time, in 0.01 seconds, that the datalogger should wait before proceeding to the next instruction.
TerminationChar **—** enter **0**
MaxNumChars **— 20** should be adequate (specify the maximum number of characters to expect per input)

7.2.3.4 SplitStr() Instruction

The **SplitStr()** instruction has the following syntax:

SplitStr(*SplitResult*,*SearchString*,*FilterString*,*NumSplit*,*SplitOption***)**

SplitResult **—** an array in which the split string will be stored.
SearchString **—** the string on which this instruction will operate. This will be the variable entered for the Dest parameter for the **SerialIn()** instruction (see above).
FilterString **—** enter **"String"** (this value will be ignored because of the SplitOption that will be used).
NumSplit **—** enter **2**
SplitOption **—** enter **0**. This splits out numeric values.

7.2.4 Programming for Calibration

To output in pH units instead of digital counts, enter the offset and multiplier into the datalogger program. Simple program instructions can be used to make the required periodic calibration easier. See Appendix C, *Calibration*, for an example program.

7.3 Calibration

Calibration should be carried out according to the detailed procedure outlined in Appendix C, *Calibration*. The calibration should use two or more pH standards, listed in Table 7-4, which are available from Campbell Scientific.

Table 7-4. Calibration Standards

pH	**Part Number**
4	#25587
7	#25586
10	#25588

Frequency of calibration depends on the level of accuracy required and the coating / fouling nature of the measured samples.

8. Troubleshooting

NOTE Contact Campbell Scientific if the CS526 is not operating properly and requires return to Campbell Scientific Ltd.

The most common causes for erroneous pH data include:

- poor sensor connections to the datalogger
- damaged cables
- scratched chip
- contaminated or clogged diaphragm

Problem:
Output signal is at its maximum value.

Possible reasons:
- Probe is not in fluid.
- Chip is polluted.
- Diaphragm is polluted.
- Chip is scratched.

Suggestions:
- Put probe in fluid.
- Clean probe (Section 9.1, *Cleaning*).
- Probe cannot be fixed if chip is scratched.

Problem:
Probe response is very slow.

Possible reason:
- Diaphragm is chipped or polluted.

Suggestion:
- Clean probe (Section 9.1, *Cleaning*).

Problem:
Probe signal is drifting.

Possible reasons:
- Diaphragm can be dried out.
- Chip is scratched.

Suggestions:
- Soak probe for 10 minutes in saturated KCl solution (pn #16349).
- Probe cannot be fixed if chip is scratched.

9. Maintenance

CAUTION The CS526 needs to be periodically cleaned and calibrated to ensure accurate readings and proper operation.

The CS526 has no user-serviceable parts.

9.1 Cleaning

Proper maintenance of a probe is important. If the probe is not properly and regularly cleaned, the probe can malfunction due to a contaminated diaphragm or ISFET chip. Contamination on/or blockage of the sensor and reference electrode diaphragm surface is the most likely cause for probe failure.

Probe wear is another cause for probe failure. Probe wear is often, but not necessarily, preceded by a period of declining calibration slope values. Probe wear is dependent on how the probe is used and stored (see Section 9.2, *Storage*). Worn probes need to be replaced.

9.1.1 When to Clean

Often the probe should be cleaned daily, but the appropriate cleaning frequency is dependent on the type of sample being measured.

Clean the probe if any of the following occur:

- Low slope
- Drift

- Instability of the reading
- Slow calibration
- Probe will not calibrate
- pH value doesn't change as expected when changing samples

Additionally, when sampling coloured liquids, the probe should be cleaned when the reference diaphragm is no longer white.

9.1.2 Cleaning Procedure

Read Section 9.1.2.1, *Cleaning Tips*, before following this procedure.

1. Place probe in warm tap water (~60°) with a mild detergent and soak for 5 minutes, stir periodically.

2. Scrub the surface of the chip and the diaphragm (Figure 9-1) with a soft toothbrush and water with a mild detergent (see Caution).

CAUTION Never brush the probe tip, especially the ISFET chip, before rinsing and flushing thoroughly with water. Before rinsing debris and particles may be on the sensor surface and brushing them into the sensor may damage it. When in doubt, soak the probe for a while in warm water with a mild detergent.

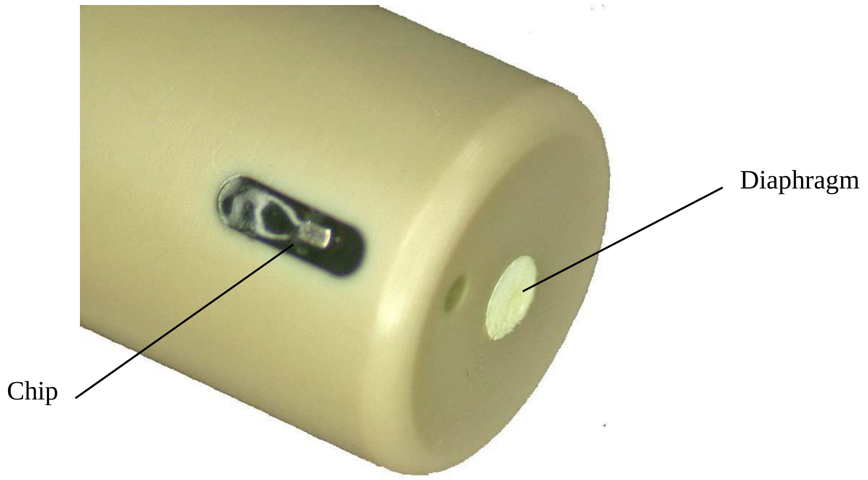


Figure 9-1. Tip of the CS526 probe

3. Rinse thoroughly with deionized water.

4. Revitalize the probe (Section 9.1.3, *Revitalizing*)

5. Calibrate the probe (Appendix C, *Calibration*).

9.1.2.1 Cleaning Tips

- To avoid scratches on the sensor surface, rinse the probe thoroughly using water before cleaning the probe with the soft brush supplied with the meter and tap water with a mild detergent added. Most scratches on the sensor are caused when there are hard particles in the sample and the sample is rubbed into the sensor when cleaning with the toothbrush.

- Proteins, fats, and oils may be removed by scrubbing in a solution of Terg-A-Zyme (Alconox company), a pepsin solution, or a similar product. Afterwards, rinse thoroughly with deionized or distilled water.

- Do not use hydrofluoric acid, acetone, MEK, or similar agents to clean the probe.

9.1.3 Revitalizing

Revitalization is performed to regenerate the diaphragm in the pH probe. For best results, clean the probe first as described in Section 9.1.2, *Cleaning Procedure*, before revitalizing.

1. Make sure the probe is warm (around 60°C).

2. Place the probe directly (without flushing it with deionized water or cooling it down) in a saturated KCl-solution (pn #16349) at room temperature and keep it in the solution for 20 minutes.

This cold KCl-dip will regenerate the reference system and the diaphragm.

9.2 Storage

9.2.1 Short-Term Storage (2 days or less)

1. Clean the probe first with water and possibly a mild detergent.

2. Place it in a clean container with fresh pH7 buffer solution (pn 25586) to prevent contamination of the probe directly after cleaning.

9.2.2 Long-Term Storage (more than 2 days)

1. Clean the probe first with water and possibly a mild detergent.

2. Place one drop of demi-water in the probe’s protective cap.

3. Place the protective cap on the probe tip.

CAUTION Always revitalize and recalibrate the probe before using it again after long term storage (see Section 9.1.3, *Revitalizing*, and Appendix C, *Calibration*).

Appendix A. Importing Short Cut Code

This tutorial shows:

- How to import a *Short Cut* program into a program editor for additional refinement.
- How to import a wiring diagram from *Short Cut* into the comments of a custom program.

A.1 Importing Short Cut Code into a Program Editor

Short Cut creates files that can be imported into *CRBasic Editor* program editor. These files normally reside in the C:\campbellsci\SCWin folder and have the following extensions:

- .DEF (wiring and memory usage information)
- .CR1 (CR1000 datalogger code)
- .CR8 (CR800 datalogger code)
- .CR3 (CR3000 datalogger code)

Use the following procedure to import *Short Cut* code into *CRBasic Editor*

1. Create the *Short Cut* program following the procedure in Section 4, *Quickstart*. Finish the program and exit *Short Cut*. Make note of the file name used when saving the *Short Cut* program.

2. Open *CRBasic Editor*.

3. Click **File | Open**. Assuming the default paths were used when *Short Cut* was installed, navigate to C:\CampbellSci\SCWin folder. The file of interest has a ".CR1", ".CR8", or ".CR3" extension, CR1000, CR800, or CR3000 dataloggers, respectively. Select the file and click **Open**.

4. Immediately save the file in a folder different from \Campbellsci\SCWin, or save the file with a different file name.

NOTE Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the datalogger program. Change the name of the program file or move it, or *Short Cut* may overwrite it next time it is used.

5. The program can now be edited, saved, and sent to the datalogger.

6. Import wiring information to the program by opening the associated .DEF file. Copy and paste the section beginning with heading "-Wiring for CRXXX–" into the CRBasic program, usually at the head of the file. After pasting, edit the information such that a **'** character (single quotation mark) begins each line. This character instructs the datalogger compiler to ignore the line when compiling the datalogger code.

Appendix B. Example Program

The following is a CR1000 program that measures the CS526. This program assumes the CS526 is connected to COM1 (C1 / TX and C2 / RX) on the CR1000.

```
'CR1000 Series Datalogger

'Declare variable for digital pH measurement
Public pHCount

'Declare variables for serial input from sensor
Dim rawstring As String * 20, pHDigit(2)

'Main Program
BeginProg

  'Set up datalogger port for serial communication
  SerialOpen ( Com1,2400,16,0,41)

  'Establish  program scan rate of 60 seconds
  Scan (60,Sec,0,0)

    'Send get data command to CS526
    SerialOut (Com1,"1M1!"&CHR(13),"",0,0)

    'Set up COM1 to receive incoming serial data.
    'Set timeout to maximum 200 mS
    SerialIn (rawstring,Com1,50,0,20)

    'Split out digital count value for pH from string input
    SplitStr (pHDigit(),rawstring,"String",2,0)

    pHCount = pHDigit(2)

  NextScan
EndProg
```

Appendix C. Calibration

This calibration process uses pH-7 and pH-4 buffer solutions.

NOTE Protect the sensing chip from UV radiation during calibration. If calibrating in sun or fluorescent light, shield the sensing chip from UV radiation by using dark containers for the buffer solutions.

Load the example CRBasic program into the datalogger (Appendix C.1, *Example Calibration Program*). Wire the CS526 to the datalogger according to the following diagram.

Wire Colour	**Datalogger Connection**
Red (Caution! 5 Vdc Max!)	5V
Black	G
White	Control Port (Tx)
Green	Control Port (Rx)
Clear	G

Use the Numeric Display found in the datalogger software *PC200W*, *PC400*, *LoggerNet*, *PConnect*, or *PConnectCE* to monitor the measurement in real time.

1. Place the CS526 into a pH-7 buffer solution (pn #25586).
2. Monitor the [pHmV] reading in the Numeric Display and allow it to stabilize.
3. Change the value in [pH7record] to -1.
4. Remove the CS526 from the pH-7 buffer solution and rinse with deionized water.
5. Blot the CS526 dry with a soft cloth or paper towel.
6. Place the CS526 in a pH-4 buffer solution (pn #25587).
7. Allow the [pHmV] reading to stabilize.
8. Change the value in [pH4record] to –1.
9. Change the value in [pHcal] to –1.
10. The CS526 is now ready to be placed in the solution to be measured.

C.1 Example Calibration Program

Following is a simple example program to facilitate the two-point calibration. Although this is a CR1000 program, the other dataloggers are programmed similarly.

```
'CR1000 Series Datalogger
'Define Variables
Public pH, pHCount
Public PTemp, batt_volt
Public pH4record, pH4Count
Public pH7record, pH7Count
Public pHcal, pHmult1
Public pHoffset1

Dim rawstring As String * 20, pHDigit(2)

'Define Data Tables
DataTable (TenMin,1,-1)
  DataInterval (0,10,Min,10)
  Average (1,pH,FP2,False)
EndTable

'Main Program
BeginProg
  SerialOpen (Com1,2400,16,0,41)

  Scan (10,Sec,0,0)
    PanelTemp (PTemp,250)
    Battery (batt_volt)
    SerialOut (Com1,"1M1!"&CHR(13),"",0,0)
    SerialIn (rawstring,Com1,50,0,20)
    SplitStr (pHDigit(),rawstring,"String",2,0)
    pHCount = pHDigit(2)

    'Calibration
    If PH4record = -1 Then
      pH4Count = pHCount
      pH4record = 0
    EndIf

    If pH7record = -1 Then
      pH7Count = pHCount
      pH7record = 0
    EndIf

    If pHcal = -1 Then
      pHmult1 = 3/(pH7Count - pH4Count)
      pHoffset1 = 7 - pHmult1 * pH7Count
      pHcal = 0
    EndIf

    pH = pHmult1 * pHCount + pHoffset1

    CallTable TenMin
  NextScan
EndProg
```

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