INSTRUCTION MANUAL

TB4 and TB4MM Rain Gages

Revision: 11/17

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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, 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.

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TB4 and TB4MM Rain Gages

1. Introduction

The TB4 and TB4MM tipping bucket rain gages funnel rain into a mechanism that tips when filled to the calibrated level. The TB4 measures in 0.01 in. increments and the TB4MM measures in 0.2 mm increments. After measurement, the water drains through two orifices in the base, allowing the measured water to be collected in a separate container.

Throughout this manual, both models are referred to as the TB4 unless specified otherwise.

NOTE This manual provides information only for CRBasic dataloggers. It is also compatible with our retired Edlog dataloggers. For Edlog datalogger support, see an older manual at *www.campbellsci.com/old-manuals*.

2. Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- The rain gages are precision instruments. Please handle them with care.
- The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

3. Initial Inspection

- Upon receipt of the tipping bucket rain gage, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation (see Section 3.1, *Ships With (p. 1)*). Contact Campbell Scientific about any discrepancies.
- 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 expected product and cable length are received.

3.1 Ships With

The rain gages ship with:

(1) Allen wrench from original manufacturer

4. QuickStart

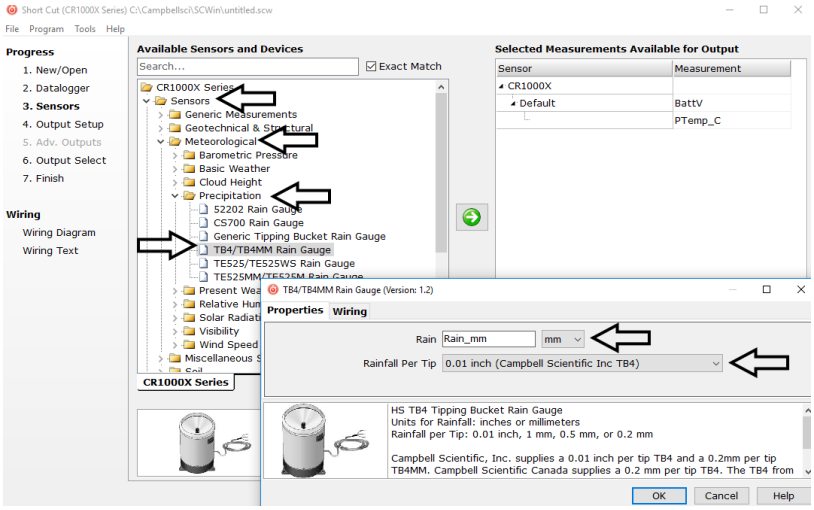
Short Cut is an easy way to program your datalogger to measure the tipping bucket rain gage and assign datalogger wiring terminals. *Short Cut* is available as a download on *www.campbellsci.com*. It is included in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ*.

Use the following procedure to get started.

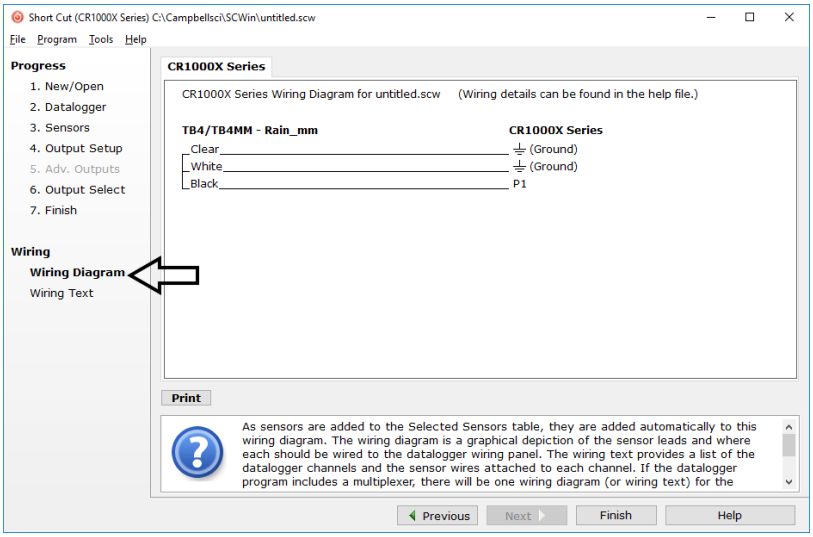
1. Open *Short Cut* and select to create a new program.

2. Double-click the datalogger model.

3. Under the **Available Sensors and Devices** list, select the **Sensors** | **Meteorological** | **Precipitation** folder and double-click **TB4/TB4MM Rain Gauge**. The units default to millimeters, which can be changed by clicking the **Rain** box and selecting one of the other options. The default rainfall per tip value of 0.01 inches should be used if the sensor is a TB4 purchased at Campbell Scientific (U.S. office). Select 0.2 mm if the sensor is a TB4MM purchased at Campbell Scientific (U.S. office) or a TB4 purchase at Campbell Scientific Canada.



4. After selecting the sensor, click **Wiring Diagram** to see how the sensor is to be wired to the datalogger. The wiring diagram can be printed now or after more sensors are added.



5. 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**.

6. If *LoggerNet*, *PC400, RTDAQ*, 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.

7. If the sensor is connected to the datalogger, as shown in the wiring diagram in step 4, check the output of the sensor in the datalogger support software data display to make sure it is making reasonable measurements.

5. Overview

The TB4 and TB4MM tipping bucket rain gages are manufactured by Hydrological Services Pty. Ltd. (Model TB4) and modified for use with Campbell Scientific dataloggers.

These rain gages catch rainfall in the 200 mm (7.87 in) diameter collection funnel. When a full bucket of rainfall is collected, the tipping bucket assembly tips and activates a reed switch. The switch closure is recorded by the datalogger pulse channel. When the bucket tips, the water drains out the screened fittings in the base of the gage.

The rain gages are ideal for locations where intense rainfall events may occur. They include a siphoning mechanism that allows the rain to flow at a steady rate regardless of rainfall intensity. The siphon reduces typical rain bucket errors and produces accurate measurements for up to 50 cm per hour.

The 260-953 Alter-Type Wind Screen can be used with the TB4 and TB4MM to minimize the effects of strong winds. Siting information and the installation procedure for this wind screen is provided in our *260-953 manual*.

6. Specifications

Features:

- More accurate measurement of high-intensity precipitation
- High precision—tips at 0.01-in. increments
- Compatible with the CWS900-series interfaces, allowing it to be used in a wireless sensor network
- Compatible with Campbell Scientific CRBasic Dataloggers: CR200(X) series, CR300 series, CR6 series, CR800 series, CR1000, CR1000X, CR3000, CR5000, and CR9000(X)

Funnel:	200 mm (7.87 in)
Drain Fittings:	Accept 12 mm ID tubing
Measurement Range:	0 to 500 mm/hr (0 to 19.7 in/hr)
Accuracy:	Better than +2% @ 500 mm/hr (19.7 in/hr)
Resolution:	0.254 mm (0.01 in) TB4 0.008 in (0.2 mm) TB4MM
Environmental Conditions	
Temperature:	0 to 70 °C
Humidity:	0 to 100%
Operating Temperature:	–20 to 70 °C
Siphon Capacity:	0.3 mm (0.012 in)
Contact:	Dual reed switch
Capacity:	12 VA (0.5 A maximum)
Base Material:	Thermoplastic
Size	
Weight:	2 kg (4.41 lb)
Height:	330 mm (13 in)
Diameter:	200 mm (7.9 in)

7. Installation

If you are programming your datalogger with *Short Cut*, skip Section 7.1, *Wiring* (p. 5), and Section 7.2, *Datalogger Programming* (p. 5). *Short Cut* does this work for you. See Section 4, *QuickStart* (p. 2), for a *Short Cut* tutorial.

NOTE The 260-953 Alter-Type Wind Screen siting information and installation procedure are provided in our *260-953 manual*.

7.1 Wiring

Connections to Campbell Scientific dataloggers are given in TABLE 7-1.

TABLE 7-1. Wire Color, Wire Function, Datalogger Connection

Wire Color	Wire Function	Datalogger Connection Terminal for Pulse Channel Input	Datalogger Connection Terminal for Control Port Input[1]
Black	Rain signal	**P**, **P_SW**, or **U**[1] (pulse channel)	**C** (control port)
White	Rain signal reference	⏚ (analog ground)	**5 V** (on datalogger)
Clear	Shield	⏚ (analog ground)	⏚ (analog ground)

[1]**U** channels are automatically configured by the measurement instruction.

A long cable has an appreciable capacitance between the lines. A built-up charge could cause arcing when the switch closes, shortening switch life. A 100 Ω resistor is connected in series at the switch to prevent arcing by limiting the current (FIGURE 7-1). This resistor is installed on all rain gages currently sold by Campbell Scientific.

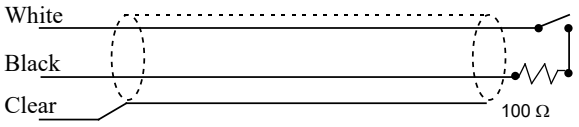


FIGURE 7-1. Rain Gage Schematic

7.2 Datalogger Programming

Short Cut is the best source for up-to-date datalogger programming code. Programming code is needed when:

- Creating a program for a new datalogger installation
- Adding sensors to an existing datalogger program

If your data acquisition requirements are simple, you can probably create and maintain a datalogger program exclusively with *Short Cut*. If your data acquisition needs are more complex, the files that *Short Cut* creates are a great source for programming code to start a new program or add to an existing custom program.

NOTE *Short Cut* cannot edit programs after they are imported and edited in *CRBasic Editor*.

A *Short Cut* tutorial is available in Section 4, *QuickStart* (p. 2). If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in Appendix A, *Importing Short Cut Code Into CRBasic Editor* (p. A-1).

Programming basics for CRBasic dataloggers are in the following sections. Complete program examples for select CRBasic dataloggers can be found in Appendix B, *Example Programs* (p. B-1). Programming basics and programming examples for Edlog dataloggers are provided at *www.campbellsci.com\old-manuals*.

7.2.1 PulseCount Instruction

The TB4 uses a reed switch for measuring precipitation. The **PulseCount()** instruction programs CRBasic dataloggers to measure the reed switch.

```
PulseCount(Dest,Reps,PChan,PConfig,POption,Mult,Offset)
```

- Choose Switch Closure (code 2) for the ***PConfig*** parameter.
- The ***Multiplier*** parameter determines the units in which rainfall is reported. A multiplier of 0.01 converts the output to inches and a multiplier of 0.254 converts the output to millimeters.

7.3 Siting

Mount the rain gage in a relatively level location representative of the surrounding area. Ensure that the orifice is horizontal, at least 1 m above the ground. The ground surface around the rain gage should be natural vegetation or gravel, not paved.

Place the rain gage away from objects that obstruct the wind. The distance should be 2- to 4-times the height of the obstruction.

7.4 Mounting

The TB4 have three equally-spaced pads for mounting the tipping buckets on a flat surface. Each pad includes a hole that fits a 3/8 inch (M8) bolt. The three holes form a 234 mm (9.21 in) diameter bolt circle.

Campbell Scientific offers the CM240 mounting bracket for installing and leveling the TB4. The CM240 may be attached to a CM300-series mounting pole or to a user-supplied 1.5 inch IPS (1.9 inch OD) unthreaded pipe.

The pole or pipe can be placed directly into a concrete foundation (FIGURE 7-2), or attached to a concrete foundation using J-bolts or self-supporting legs (FIGURE 7-3). A concrete pad is recommended, but it should not be installed over large paved or concrete surface.

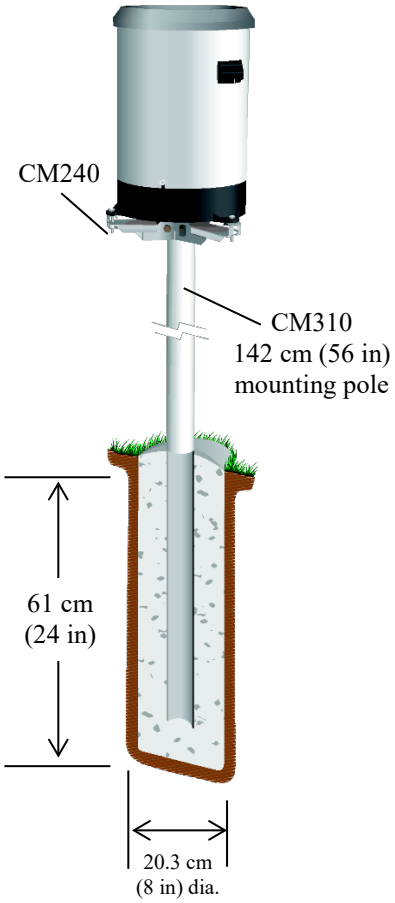


FIGURE 7-2. Rain Gage Installation (pole embedded in concrete)

FIGURE 7-3. Pedestal Base Options

7.5 Leveling

After mounting the rain gage, use the following procedure to level it.

1. Remove the housing assembly from the base by loosening the three housing screws and lifting the housing upward.
2. Adjust the three leveling screws on the CM240 bracket to level the gage (FIGURE 7-4). A bullseye level is mounted on the rain gage base to facilitate leveling (FIGURE 7-5).

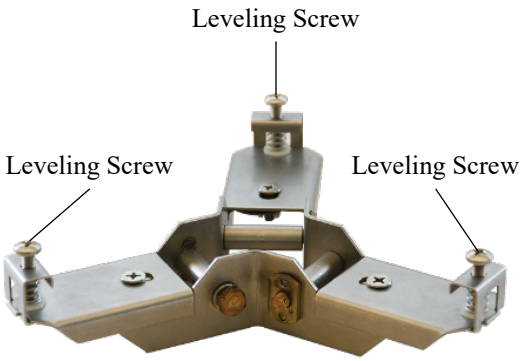


FIGURE 7-4. CM240 Mounting Bracket

3. Remove the rubber shipping band and cardboard packing securing the tipping bucket assembly. Tip the bucket several times to ensure the tipping mechanism is moving freely.
4. Replace the housing assembly and tighten the three screws to secure the housing to the base.

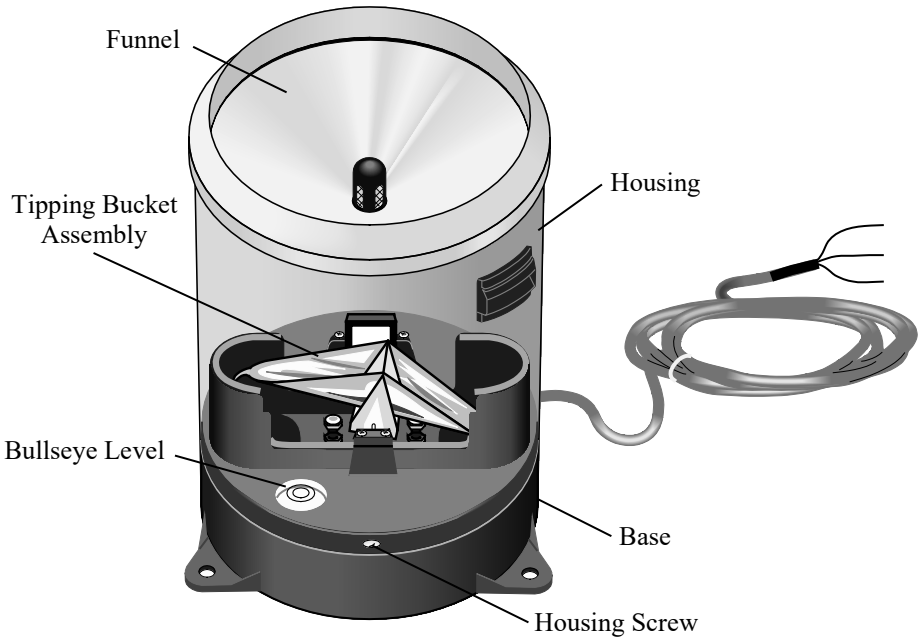


FIGURE 7-5. Main Components of the TB4

8. Troubleshooting and Maintenance

NOTE All factory repairs and recalibrations require a returned material authorization (RMA) and completion of the "Declaration of Hazardous Material and Decontamination" form. Refer to the *Assistance* page at the beginning of this manual for more information.

8.1 Troubleshooting

Symptom: No Precipitation

1. Check that the sensor is wired to the pulse channel specified by the **PulseCount()** instruction.

2. Verify that the ***PConfig***, and ***Multiplier*** and ***Offset*** parameters for the **PulseCount()** instruction are correct for the datalogger type.

3. Disconnect the sensor from the datalogger and use an ohm meter to do a continuity check of the switch. The resistance measured at the terminal block on the inside of the bucket between the black and white leads should vary from infinite (switch open) when the bucket is tipped, to less than an ohm when the bucket is balanced.

8.2 Maintenance

During each site visit, remove any debris, insects, sediment, etc. from the collection funnel, debris screen, siphoning mechanism, or tipping bucket assembly.

Verify the tipping bucket assembly moves freely, and that the datalogger records each bucket tip.

8.2.1 Dismantling for Cleaning

The following items should be checked regularly for cleanliness:

- Filter (FIGURE 8-3)
- Siphon (FIGURE 8-3)
- Tipping bucket assembly (FIGURE 8-1)
- Top surface of adjusting screws
- Housing locking screws; lightly lubricate after cleaning (see FIGURE 8-1)
- All insect screens

To access the above components, dismantle the TB4 using the following procedure:

1. Remove the housing assembly from the base by loosening the three locking screws and lifting the housing upward.

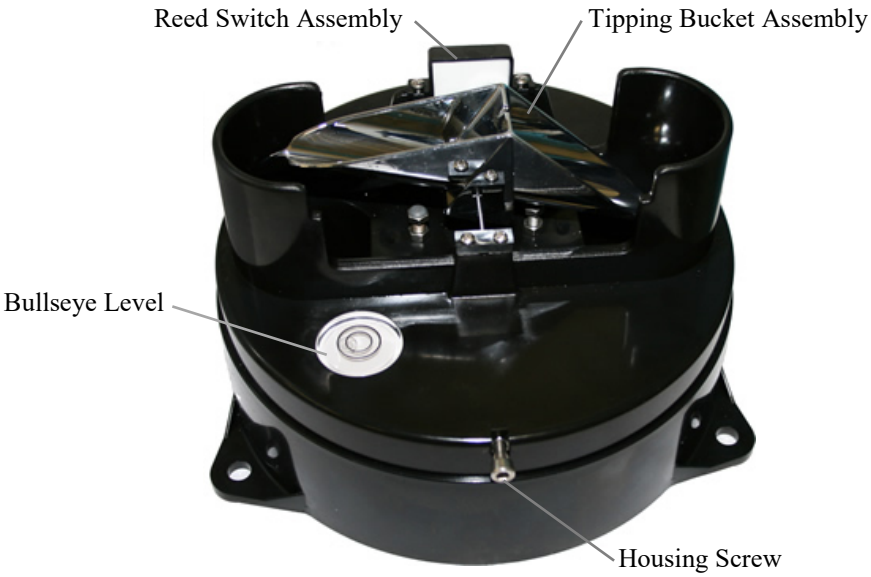


FIGURE 8-1. Components of TB4 Base

2. Separate the filter/siphon assembly from the funnel by pushing the filter while pulling the siphon (see FIGURE 8-2).

CAUTION Do not twist the filter/siphon assembly while pushing and pulling.

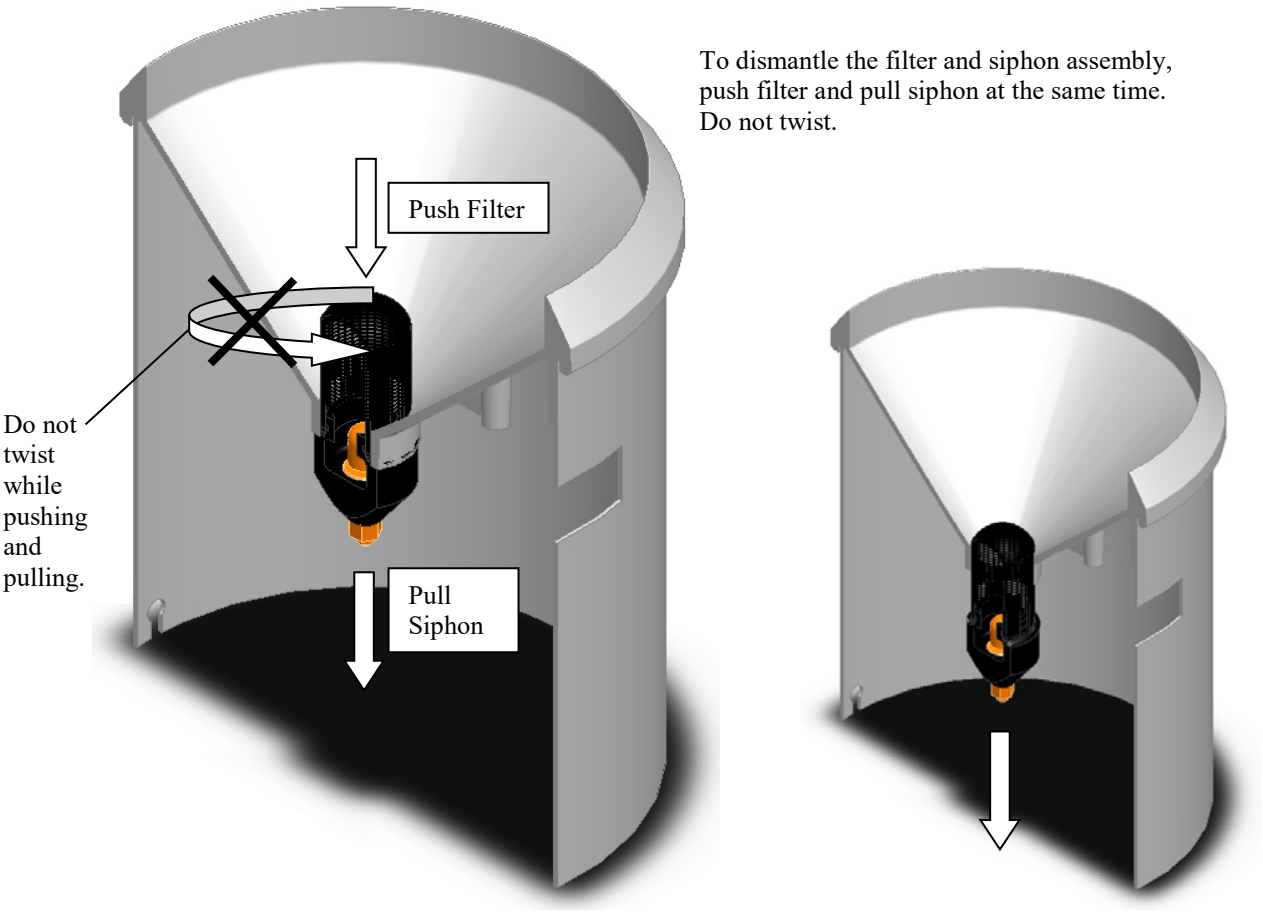


FIGURE 8-2. Dismantling the Filter/Siphon Assembly

3. Disassemble the filter/siphon assembly by doing the following (FIGURE 8-3):

   (a) Unscrew nut
   (b) Lightly press stem down on surface until stem pops out of siphon body
   (c) Remove stem from siphon body
   (d) Unscrew cap
   (e) Clean all items

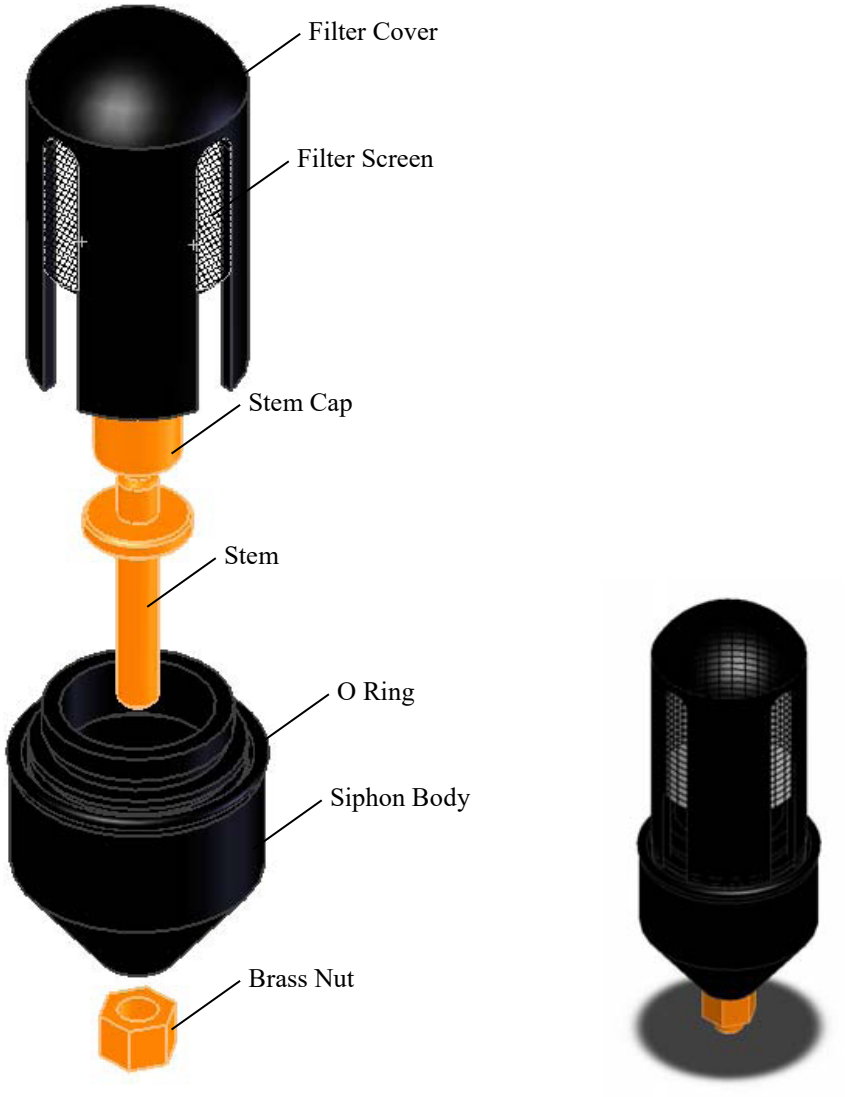


FIGURE 8-3. Filter/Siphon Assembly

8.2.2 Reassembling the TB4

1. Screw cap on stem, finger tighten only (FIGURE 8-3).
2. Push stem into siphon body (FIGURE 8-3).
3. Replace nut and tighten (FIGURE 8-3).

CAUTION Do not over tighten.

4. Push filter/siphon assembly back into place (FIGURE 8-4).

CAUTION Do not twist the filter/siphon assembly while putting it back into place.

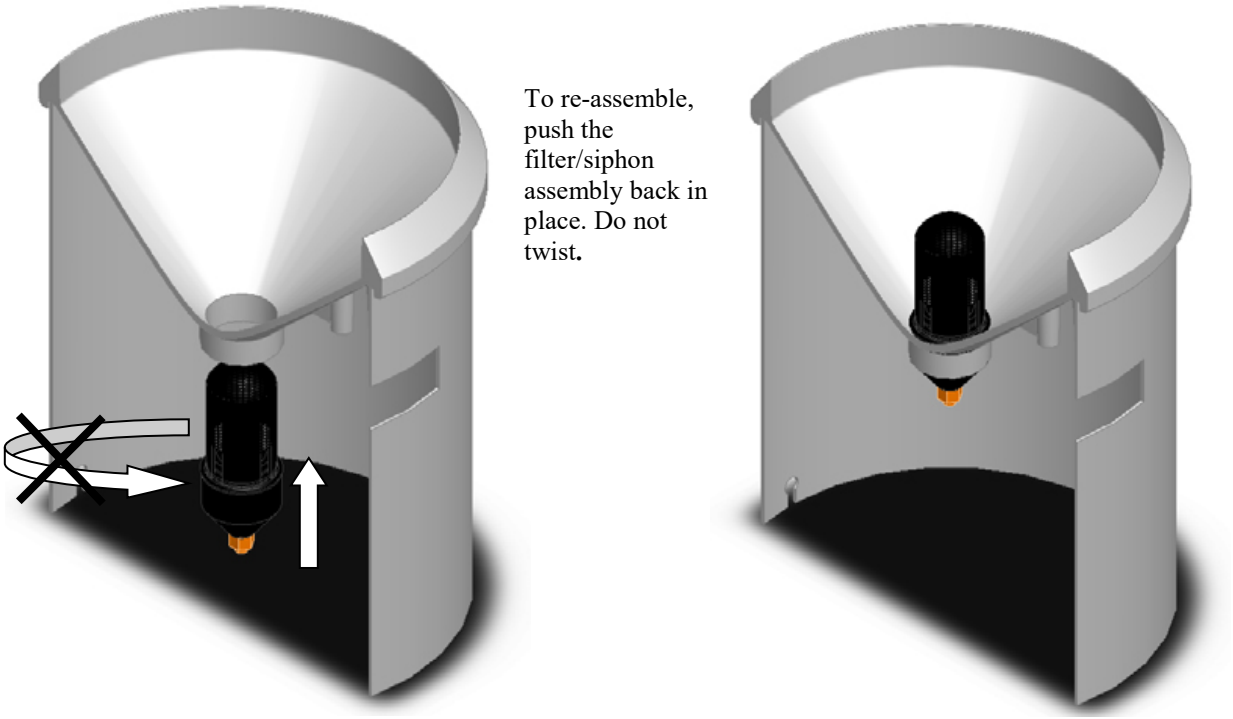


FIGURE 8-4. Reassembling the TB4

5. Place the housing assembly back onto the base and tighten the three screws that secure the housing onto the base.

8.3 Calibration

The sensor is factory calibrated; recalibration is not required unless damage has occurred or the adjustment screws have loosened. Nevertheless, the following calibration check is recommended once every 12 months.

Field calibration check:

1. Remove the housing assembly from the base by removing the three screws and lifting upward on the housing.

2. Check the bubble level to verify the rain gage is level.

3. Pour water through the inner funnel to wet the two bucket surfaces. Using a graduated cylinder, slowly pour 314 cc (19.16 in^3) of water, over a 15-minute period, into the collection funnel. This volume of water is equal to .39 inches of rainfall (10 mm).

4. After the water has passed through the rain gage, the tipping bucket should have tipped 39 times for the TB4 or 50 times for the TB4MM.

5. If the rain gage fails to record the correct number of tips, return the unit to Campbell Scientific for recalibration.

8.3.1 Factory Calibration

If factory calibration is required, contact Campbell Scientific to obtain an RMA (see *Assistance* in the front of the manual).

Appendix A. Importing Short Cut Code Into CRBasic Editor

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

Short Cut creates files, which can be imported into *CRBasic Editor*. Assuming defaults were used when *Short Cut* was installed, these files reside in the C:\campbellsci\SCWin folder:

- .DEF (wiring and memory usage information)
- .CR2 (CR200(X)-series datalogger code)
- .CR300 (CR300-series datalogger code)
- .CR6 (CR6-series datalogger code)
- .CR8 (CR800-series datalogger code)
- .CR1 (CR1000 datalogger code)
- .CR1X (CR1000X datalogger code)
- .CR3 (CR3000 datalogger code)
- .CR5 (CR5000 datalogger code)
- .CR9 (CR9000(X) datalogger code)

Use the following procedure to import *Short Cut* code and wiring diagram into *CRBasic Editor*.

1. Create the *Short Cut* program following the procedure in Section 4, *QuickStart (p. 2)*. 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 the .CR2, .CR300, .CR6, .CR8, .CR1, .CR1X, .CR3, .CR5, or .CR9 extension. Select the file and click **Open**.
4. Immediately save the file in a folder different from C:\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 an apostrophe (') begins each line. This character instructs the datalogger compiler to ignore the line when compiling.

Appendix B. Example Programs

B.1 Pulse Channels Examples

CRBasic Example B-1. CR1000X Pulse Channel Example

```
'CR1000X Program for TB4

'Declare Variables and Units
Public Rain_mm

Units Rain_mm=mm

'Define Data Tables
DataTable(TB4_mm,True,-1)
  DataInterval(0,60,Min,0)
  Totalize(1,Rain_mm,IEEE4,0)
EndTable

'Main Program
BeginProg
  Scan(1,Sec,1,0)
    'TB4 Rain Gage measurement Rain_mm:
    PulseCount(Rain_mm,1,P1,1,0,0.254,0)
    'Call Data Tables and Store Data
    CallTable(TB4_mm)
  NextScan
EndProg
```

CRBasic Example B-2. CR200(X) Series Pulse Channel Example

```
'CR200 Series
'TB4 program

'Declare Variables and Units
Public Rain_mm

Units Rain_mm=mm

'Define Data Tables
DataTable(TB4_mm,True,-1)
  DataInterval(0,60,Min)
  Totalize(1,Rain_mm,0)
EndTable

'Main Program
BeginProg
  Scan(10,Sec)
    'TB4 Rain Gage measurement Rain_mm:
    PulseCount(Rain_mm,P_SW,2,0,0.254,0)
    'Call Data Tables and Store Data
    CallTable(TB4_mm)
  NextScan
EndProg
```

B.2 Control Port Example Programs

The following examples measure a TB4 rain gage using a control port on the datalogger. Wire the sensor as shown in TABLE 7-1, *Wire Color, Wire Function, Datalogger Connection* (p. 5).

CRBasic Example B-3. CR1000X Control Port Example

```
'CR1000X Program for TB4

'Declare Public Variables and Units
Public Rain_mm
Units Rain_mm=mm

DataTable (Rain,True,-1)
  DataInterval (0,60,Min,0)
  Totalize (1,Rain_mm,FP2,0)
EndTable

'Main Program
BeginProg
  Scan (1,Sec,1,0)
    PulseCount (Rain_mm,1,C1,2,0,.254,0)
    CallTable (Rain)
  NextScan
EndProg
```

CRBasic Example B-4. CR200(X) Series Control Port Example

```
'CR200

' A 20 kOhm pull up resistor is required to read a switch closure on C1 or C2
' as a Pulse Counter. The 20 kOhm resistor uses the battery voltage.

'Declare Public Variables and Units
Public Rain_mm
Units Rain_mm=mm

'Define Data Tables
DataTable (Rain,True,-1)
  DataInterval (0,60,min)
  Totalize (1,Rain_mm,0)
EndTable

'Main Program
BeginProg
  Scan (1,Sec)
    'TB4 Rain Gage measurement Rain-mm
    PulseCount (Rain_mm,C2,2,0,.254,0)
    'Call Data Tables and Store Data
    CallTable (Rain)
  NextScan
EndProg
```

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