Product Manual

Sensor

ARG314

Rain Gauge

Published: 12/1/2022
Copyright © 2022
Campbell Scientific
CSL I.D - 1387

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Guarantee

This equipment is guaranteed against defects in materials and workmanship. We will repair or replace products which prove to be defective during the guarantee period as detailed on your invoice, provided they are returned to us prepaid. The guarantee will not apply to:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. Quotations for repairs can be given on request. It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment, in support of this policy a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

Note that goods sent air freight are subject to Customs clearance fees which Campbell Scientific will charge to customers. In many cases, these charges are greater than the cost of the repair.

Campbell Scientific Ltd,
80 Hathern Road,
Shepshed, Loughborough, LE12 9GX, UK
Tel: +44 (0) 1509 601141
Fax: +44 (0) 1509 270924
Email: support@campbellsci.co.uk
www.campbellsci.co.uk

About this manual

Some useful conversion factors:

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

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

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

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

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.

Campbell Scientific Ltd, Campbell Park, 80 Hathern Road, Shepshed, Loughborough, LE12 9GX, UK
Tel: +44 (0) 1509 601141 Fax: +44 (0) 1509 270924
Email: support@campbellsci.co.uk
www.campbellsci.co.uk

Safety

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.

Table of Contents

List of Figures

Tables

ARG314 Rain Gauge

1. Introduction

The ARG314 rain gauge is manufactured by Environmental Measurements Ltd. It is the recommended solution for many hydrological or meteorological applications such as weather stations and flood warning systems. The ARG314 is a versatile gauge suitable for climates with all types and low to moderate intensities of rainfall. The injection moulded UV-stabilised material from which the gauge is made means that the ARG314 is an extremely robust and versatile instrument, ideal for applications where data precision and accuracy are critically important.

The internal tipping bucket mechanism has been designed to ensure maximum performance repeatability.

Traditional cylinder-shaped rain gauges are inaccurate because of wind blowing over the orifice. The physical presence of the gauge causes air to accelerate, carrying rainfall away from the collecting vessel. The effect of this can be up to a 20% reduction in rainfall catch. The unique aerodynamic shape of the EML range of scientific standard rain gauges reduces this effect, ensuring a high level of confidence in the accuracy of our measurements.

2. Precautions

- READ AND UNDERSTAND the Safety section at the front of this manual.
- The ARG314 is a precision instrument that must be handled with care.
- Remove the piece of foam from under the tipping mechanism before use. This foam may be saved and used whenever the sensor is transported.

3. Initial inspection

- Check the packaging and contents of the shipment. If damage occurred during transport, immediately file a claim with the carrier. Contact Campbell Scientific to facilitate repair or replacement. Check model information against the shipping documents to ensure the expected products and the correct lengths of cable are received. Model numbers are found on each product.
- Included in the box: ARG314 Gauge, three levelling feet plus fixings, see Figure 1.

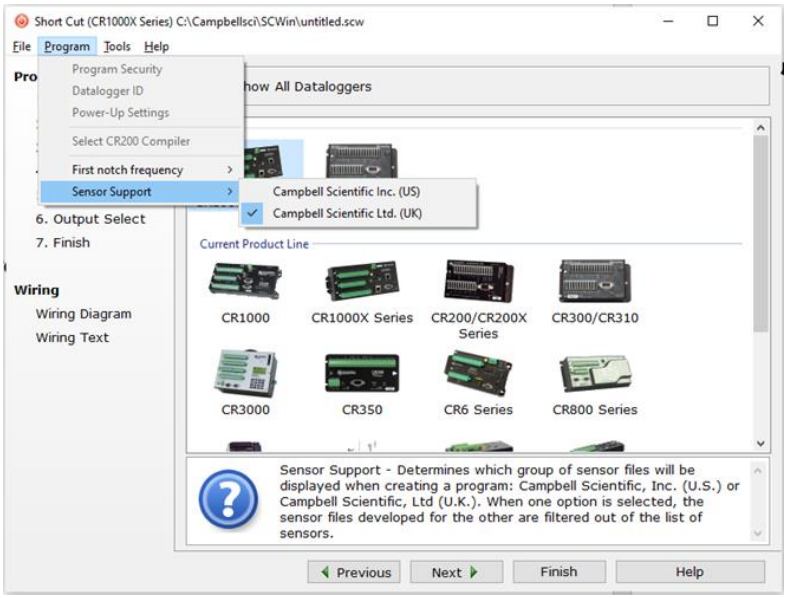
- Sensors purchased from Campbell Scientific are normally pre-fitted with cable.
- Report any shortages immediately to Campbell Scientific.

Figure 1: The levelling feet as packed

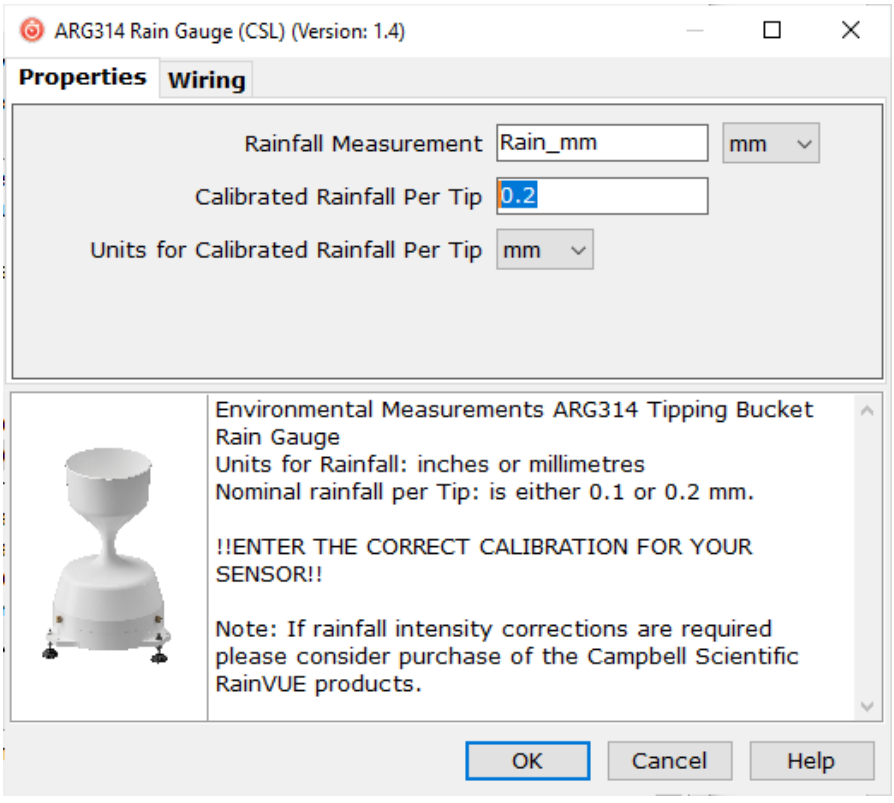
4. QuickStart

A video that describes datalogger programming using *Short Cut* is available at: *www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3*. *Short Cut* is an easy way to program your datalogger to measure the ARG314 and assign datalogger wiring terminals. *Short Cut* is available as a download on *www.campbellsci.com*. It is included in installations of *LoggerNet*, *PC400*, or *RTDAQ*. The following procedure also describes programming with *Short Cut*. Support for the ARG314 is added in a version of *Short Cut* released in early 2022. If your version of *Short Cut* does not include the ARG314 please select the Generic Rain gauge option and note the wiring details below.

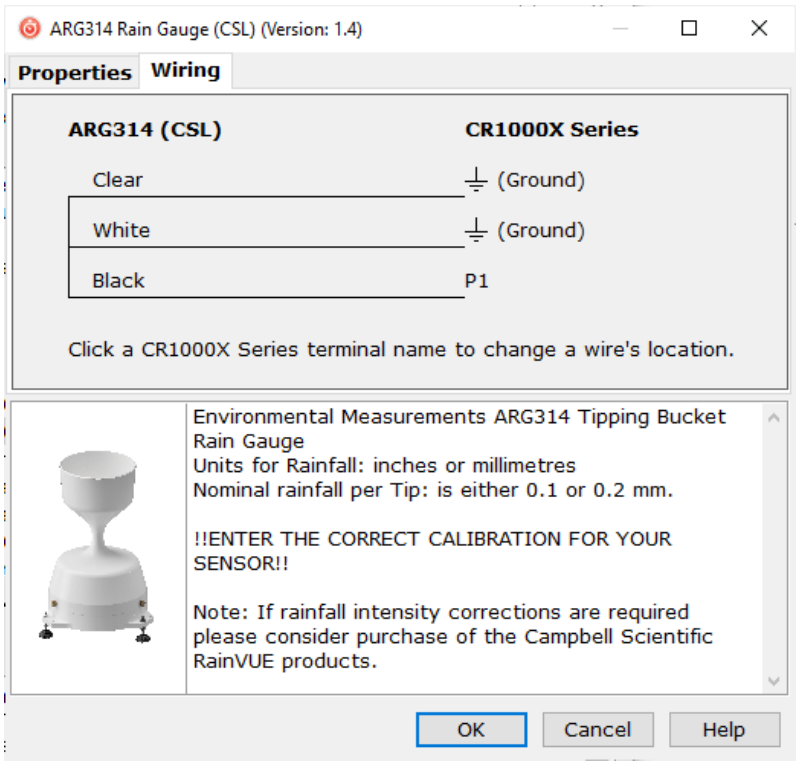
1. Open *Short Cut* and select to create a new program.
2. You first need to select the Campbell Scientific Ltd sensor support set as the ARG314 only appears in that set. Select the Program, Sensor Support and Campbell Scientific Ltd (UK) set.



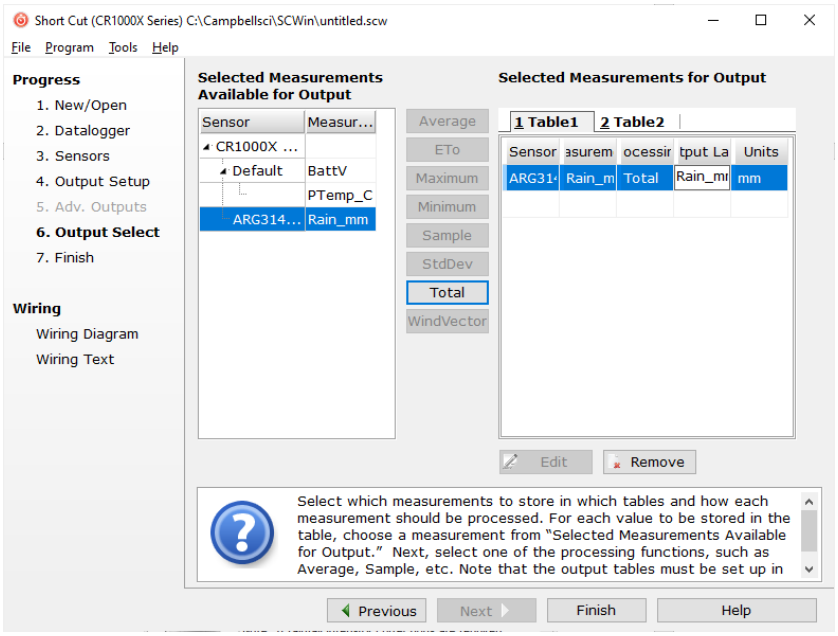
3. Now double-click the datalogger model.
4. In the Available Sensors and Devices box, type ARG314 or locate the sensor in the Sensors | Meteorological | Precipitation folder. Double-click ARG314 Raingauge (CSL).
5. In the properties screen select the units of measurement of the output required and enter the sensor calibration factor. The factory calibration is quoted on a sticker inside the sensor and on the supplied calibration certificate. It will normally be close to either 0.1 or 0.2 mm per tip, depending on the model ordered.



6. Then click the Wiring tab to see how the sensor is to be wired to the datalogger.



7. Next follow the normal steps when adding a sensor and create an output table. The rain measurement can then be selected to add as a total of rainfall recorded over the table output interval.



8. Finish the program generation and load it into the datalogger. The function of the gauge can be checked by pouring a small amount of water into the funnel. For programs with a fast scan interval check the total of rain fallen over the output interval

of the table storing rain data, rather than the current rain measurement as it can be difficult to see the individual tips.

For full installation instructions please read the installation section below.

5. Overview

The ARG314 funnels rainfall through a stainless-steel screen filter that traps debris, preventing it from impeding the flow of precipitation. Rainfall flows through a nozzle into one of two bucket halves.

The internal tipping mechanism assembly rotates around a pivot point. The tipping mechanism tips when the first bucket fills to a fixed calibrated level, then the tipping mechanism moves the second bucket under the funnel.

A magnet attached to the tipping mechanism actuates a reed switch as the bucket tips. Closure of the reed relay can be detected by the logger on a pulse channel.

The outgoing water drains through outlets.

The aerodynamic design of the ARG314 reduces the amount of rain that wind carries away from the collecting vessel.

6. Specifications

Sensor type: Tipping bucket with magnetic reed switch

WMO Compliant: Yes

Rainfall per tip: 0.1 mm or 0.2 mm (nominal)

Accuracy Rainfall: ±1% up to 120 mm/hr

Operating temperature: 1 to 70 °C (34 to 158 °F)

Funnel diameter: 20.0 cm (7.87 in)

Height: 43.5 to 46.5 cm (17.1 to 18.3 in) with feet adjustment

Weight: 2.5 kg

Material: White, ASA LI-911 plastic

7. Installation

If you are programming your data logger with *Short Cut*, skip the Wiring, and Data logger programming sections of this manual. *Short Cut* does this work for you. See the QuickStart section, for a *Short Cut* tutorial.

7.1 Wiring

Internally, the ARG314 is fitted with a 2-way terminal for connection (the green terminal). This provides connection across the relay contacts. Campbell Scientific provide a cable which is wired to these terminals with the following cable colours and function.

TABLE 1. Wire Colour, Wire Function, Datalogger Connection

Wire Colour	Wire Function	Datalogger Connection Using Pulse Terminals	Datalogger Connection Using Control Terminals[1]
Black	Rain Signal	P, P_SW, or U[2] (pulse channel)	C (control port)
White	Rain Signal Reference	⏚ (Analogue ground)	5 V (on datalogger)
Clear	Shield	⏚ (Analogue ground)	⏚ (Analogue ground)

[1] The CR200(X)-series and CR300-series dataloggers are not compatible with the control terminal method.

[2] U terminals are automatically configured by the measurement instruction.

If replacing the cable, as this is a contact closure (switch) device it does not matter which way around that you connect the wires to the terminals.

> NOTE:
>
> The ARG314 has a 100 ohm resistor fitted internally, in series with the reed relay to reduce the chance of damage to the relay contacts with long cable runs. This should be borne in mind if fault finding a problem installation with an ohmmeter.

7.2 Datalogger programming

Short Cut is the best source for up to date datalogger programming code. 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. A Short Cut tutorial is available in the QuickStart section above.

Programs cannot be edited in Short Cut after they are imported in CRBasic Editor.

Programming basics for CRBasic dataloggers are provided in the following sections. Programming basics and programming examples for Edlog dataloggers are provided at www.campbellsci.com/old-manuals.

The PulseCount() instruction programs CRBasic dataloggers to measure the ARG314 rain gauge.

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

- Choose Switch Closure for the PConfig parameter. For the CR6 and CR1000X, choose Switch Closure with pull up.
- The Multiplier parameter is entered to match the exact calibration of the sensor, as given on the calibration certificate. This relates to the rainfall equivalent per tip and contact closure by the sensor. It should be a number close to 0.1 or 0.2 mm. This multiplier can be scaled accordingly if the result is needed in units other than mm of rain.

The value stored in the destination variable is then normally totalized using the Totalize instruction in a Data table. The Data table must be called after the pulse count instruction to ensure proper totalling of the rainfall.

7.3 Siting

A rain gauge site is often a compromise between exposure requirements and operational constraints. The ideal site is level ground with a uniform scattering of objects in the surrounding area thus reducing overall wind speeds. However, these objects should not be too large to cause eddying or high gusts to occur near to the gauge, or so close to prevent rain from entering the gauge. The gauge should ideally be no closer than at least twice the height of the obstruction. Extensive details on rain gauge siting best-practice can be found in Chapter 6 of the WMO Guide to Meteorological Instruments and Methods of Observation. Although the ARG314 rain gauge is designed to operate in higher wind speeds, care must still be taken to avoid over-exposing the gauge where possible. Large expanses of open flat land should be avoided. If the application is very specific, such as monitoring a building site, then the siting of the rain gauge is largely prescribed by use.

NOTES:

No two rain gauge designs are ever likely to produce identical results, and even two identical rain gauges can give slightly different catches even when sited close to each other.

If the gauge is to be operated in the area of livestock, then a fence will almost always be required to prevent damage from and to the animals.

7.4 Unpacking the rain gauge and fitting the feet

Make sure to remove the piece of foam from under the bucket mechanism. This foam may be saved and used whenever the rain gauge is transported. The ARG314 is supplied fully assembled except for the three levelling feet, which need to be fitted to the gauge. There should be a locking nut above and below the gauge base, and the feet should be positioned below, as in Figure 1.

7.5 Mounting and levelling the rain gauge

The ARG314 can be mounted directly onto any flat surface, and securely fastened as required. There is a small circular spirit level provided on the outside of the base of the rain gauge, which should be used to level the rain gauge. Levelling is critical to ensuring the accuracy of rainfall measurements, failure to do this properly will result in a systematic error. Always check the level on every site visit. The gauge is levelled by slackening the locking nuts on the adjustable feet, adjust feet for level and tighten locking nuts (Figure 1).

As the gauge is relatively lightweight it should be fastened to the ground, particularly for windy sites. On soft ground pegs can be used, using the holes provided next to the feet adjusters. For permanent ground level, installation screws or bolts can be used through the same holes to fix the sensor to the ground. A single concrete paving slab, drilled with suitable holes, can be used as a base for semi-permanent installations.

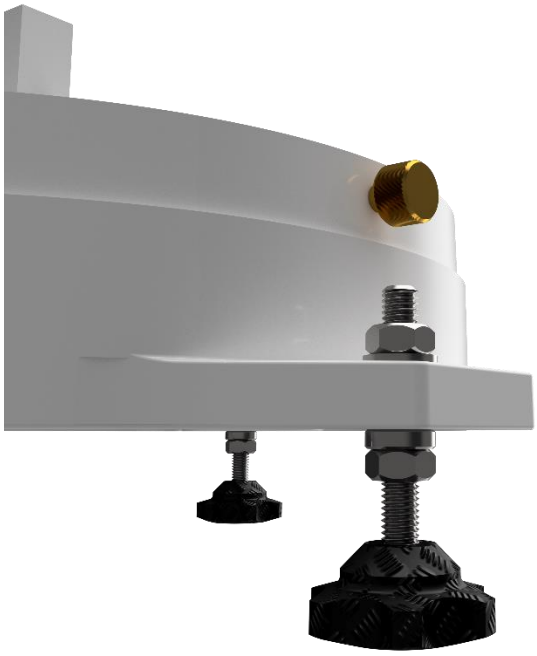


Figure 1 – ARG314 Levelling Feet

7.5 Alternative mounting options

It is not always possible to mount a rain gauge on the ground surface. Examples of applications which make use of rain gauges mounted above the ground include urban monitoring, areas prone to ground-flooding and areas prone to snowfall. It should be noted that regardless of which option is used to mount the gauge, it must be firmly fixed and not susceptible to vibration. Vibration may lead to 'false-tipping' of the bucket mechanism and thus contribute to erroneous or inaccurate measurements.

The CM241 mounting plate is available to mount the sensor on the top of a pole (please refer to the RainVUE10 installation guide for further details).

8. Operation of the ARG314

Rainfall is measured by the well-proven tipping bucket method. Precipitation is collected by the funnel and flows through a stainless-steel gauze filter, trapping and removing any leaves, dirt, etc. See Figure 3. Water then drips from the nozzle into one of the two halves of the tipping bucket.

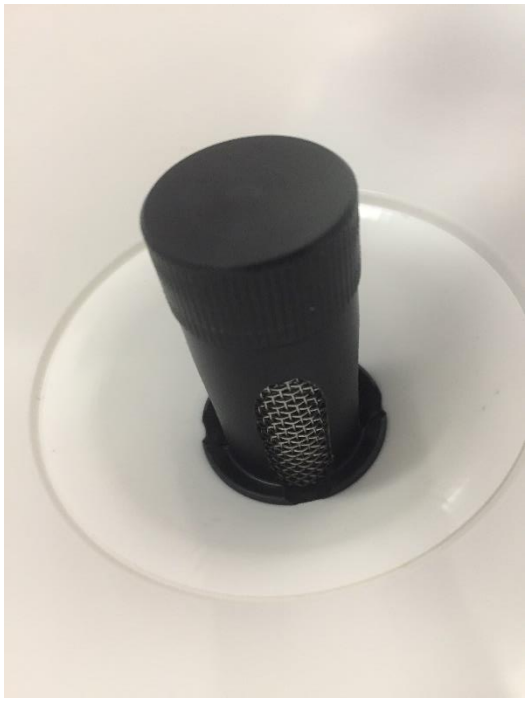


Figure 3 - Filter and filter cap (left) / Nozzle delivering water into tipping bucket (right)

The internal tipping bucket assembly rotates around precision rolling pivot bearings. The balance arm tips when the first bucket is full, emptying this rainwater and positioning the second bucket under the funnel. The tipping process repeats indefinitely as long as the rain continues to fall, with each tip corresponding to a calibrated fixed quantity of rainfall. At each tip of the bucket the moving arm forces the magnet past the reed switch causing contact to be made for a few milliseconds. As each bucket side is used in turn, the outgoing water is drained away via outlets and discarded. Figure 4 shows the internal mechanism of the ARG314.

Figure 4 - Internal image of the ARG314 tipping bucket mechanism

The exact calibration of each tip is pre-set by adjustable stops located under the tipping buckets. Do not alter these stops unless as part of a calibration exercise. A levelling bubble is provided as an aid to levelling of the rain gauge. Connections to the reed switches are made via the green connector terminal.

9. Maintenance and Calibration

9.1 Basic Maintenance

To ensure reliable and accurate measurements it is recommended that the following checks are carried out at each visit to the rain gauge (if the gauge is still connected to a data logger and the logger is operating, care must be taken to avoid tipping the bucket when carrying out these checks).

1. Inspect the funnel and filter for any damage or blockage.
2. Depending upon geographical location, at certain times of the year leaves may accumulate in the funnel. The leaves can easily be removed from the funnel and the filter cleaned by removing the end cap from the filter tube, remove the stainless-steel filter gauze carefully, clean and re-fit the filter and cap. If leaves are a persistent issue an extra coarse filter plate is available to order from Campbell Scientific.
3. Fine dirt and dust can also block the filter preventing or reducing the flow rate to the buckets beneath. If rainfall is detected with a delay it is likely the filter is partly blocked. Standing water in the funnel is also a symptom of this. Remove and clean the filter as described above.
4. Check that the gauge is still level. Small movements may occur over time.
5. Remove the funnel and clean any dirt from the tipping bucket, being careful not to tip the bucket should the rain gauge still be logging.
6. During any occasion when the rain gauge is disconnected from the logger, it is good practice to check the balance arm of the tipping bucket for stiffness. The easiest way to do this in the field is to try and balance the bucket in its centre position. It should be very difficult to get the bucket to sit in this position as it should tip to one side or the other if moving freely. If the bucket shows signs of sticking examine the bucket closely for any dirt or wear on the pivot pin and bucket tubes.

9.2 Calibration

The sensitivity of the rain gauge is accurately calibrated during the manufacturing to either a nominal 0.1 or 0.2 mm/tip using a purpose-built calibration rig supplying an adjustable constant head of water allowing accurate calibration of the rain gauge. Each rain gauge is supplied with its own calibration figure to three decimal places. All gauges are calibrated to a tolerance of 2% of the nominal tip value.

A re-calibration and overhaul service is also offered to customers; we recommend re-calibration every 12 to 24 months depending on applications. Contact Campbell Scientific for further details and costs.

For information on how we calibrate the rain gauges see British Standards document BS 7843-1:2012 and the CIMO Guide to Meteorological Instruments and Methods of Observation (Chapter 6). These documents describe the processes of bucket balancing, static calibration at a fixed intensity, and dynamic calibration using variable intensities.

There is also a Rain Gauge Field Test Kit which can be deployed in the field to test the accuracy of the calibration at different rainfall intensities. This is available to special order.

10. Troubleshooting

Check the following for these symptoms:

10.1 No Precipitation

1. Check that the sensor is wired to the pulse channel specified by the PulseCount() instruction.
2. Verify that the Configuration Code (switch closure) and Multiplier parameters for the PulseCount() instruction are correct.
3. Check the funnel filter is not blocked.
4. Disconnect the sensor from the datalogger and use an ohmmeter 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 wires should vary from infinite (switch open) when the bucket is tipped, down to close to 100 Ohms (switch closed) when the bucket is balanced/tipping. If the resistance is not infinite when the bucket is not balanced but a few tens of Kilo-ohms, it is likely there is water ingress into the connectors of the system – this can prevent tip detection.

10.2 Delayed recording of precipitation

Check the filter is not partly blocked by fine dust or dirt and clean if it is.

10.3 Under reading of precipitation

1. Check the sensor is level.
2. Check the correction calibration factor has been entered.
3. Checked the sensor is not too sheltered or exposed to very high windspeeds.

10.4 Over-reading of precipitation

1. Check the sensor is level.
2. Check there are no overhanging structures that could cause drips to fall into the sensor.
3. Check the sensor is rigidly mounted and not subject to vibration.

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Global Sales & Support Network

A worldwide network of companies to help meet your needs

Australia
Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil
Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada
Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China
Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com

Costa Rica
Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France
Location: Vincennes, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany
Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

South Africa
Location: Stellenbosch, South Africa
Phone: 27.21.8809960
Email: sales@campbellsci.co.za
Website: www.campbellsci.co.za

Southeast Asia
Location: Bangkok, Thailand
Phone: 66.2.719.3399
Email: thitipongc@campbellsci.asia
Website: www.campbellsci.asia

Spain
Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

UK
Location: Shepshed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA
Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com

Other Locations: Sales and support are provided in many other locations through an extensive network of international reps. For the full list, please visit ***www.campbellsci.com/contact#dir***.