USER MANUAL

52202/52203
Tipping Bucket Raingauge

Issued: 16.4.18

CSL 382

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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.

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WHEN MEASUREMENTS MATTER

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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.

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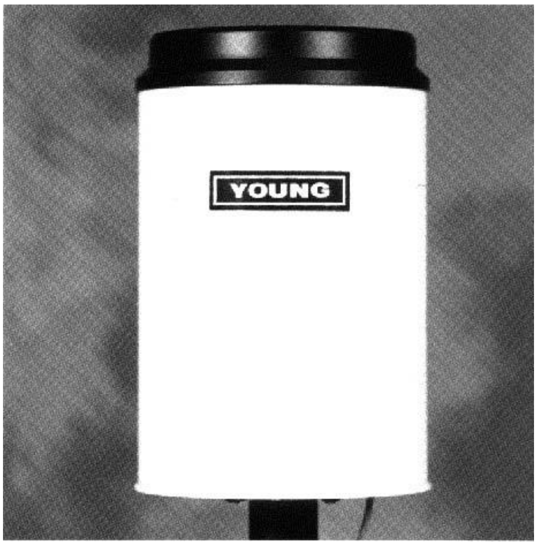
52202/52203 Tipping Bucket Raingauges

The 522 range consists of two well-designed tipping bucket raingauges, manufactured by R M Young, which meet the specifications of the WMO and combine durable construction with very reasonable cost. The gauge construction makes extensive use of thermoplastic components to give maximum performance with good resistance to corrosion. The 52202 incorporates a heater for year-round use in all climates, while the 52203 is an unheated version of the same gauge. The gauges can be mounted on a flat level surface or mounted on a 34 mm diameter pole.



1. Introduction

The 52202, manufactured by R. M. Young, is an electrically heated tipping bucket rain gauge that measures rain, snow, and other frozen precipitation. Its catchment area of 200 cm^2 and measurement resolution of 0.1 mm meet the recommendations of the WMO. This heated rain gauge is compatible with all Campbell Scientific dataloggers, and it is used in environmental monitoring applications.

Extensive use is made of thermoplastic components in the manufacture of the gauges which helps to ensure maximum performance and value with minimal maintenance. The gauges have built-in bullseye levelling devices for easy and precise adjustment.

The design uses a proven tipping-bucket mechanism for simple and effective rainfall measurement. The bucket geometry and material are specially selected for maximum water release, thereby reducing contamination and errors. Measured precipitation is discharged through a collection tube (which can then be collected if required) for verification of total rainfall. The heated version should be used in climates where snow and ice are expected.

NOTE This manual provides information only for CRBasic dataloggers. It is also compatible with most of our retired Edlog dataloggers. For Edlog datalogger support, see an older manual at *www.campbellsci.com/old-manuals* or contact a Campbell Scientific application engineer for assistance.

2. Cautionary Statements

- READ AND UNDERSTAND the Safety section at the front of this manual.
- WARNING: Disconnect heater power before attempting to service or repair this equipment. Failure to do so may result in personal injury or death due to electrocution.
- Debris filters, funnel, and bucket reservoirs should be kept clean.
- The 52202/52203 is a precision instrument that must be handled 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.

2.1 Initial Inspection

- Upon receipt of the 52202/52203, 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.

3. Specifications

Gauge Catchment Area:	200 cm^2
Resolution:	0.1 mm per tip
Accuracy:	2% up to 25 mm/hour 3% up to 50 mm/hour
Output:	Magnetic reed switch
Contact Rating;	24V AC/DC, 500 mA max.
Operating Temperature:	-20°C to +50°C (for 52202 heated version)
Heater (52202):	Rated 18W @ 24V AC
Power Req. (52202):	18-24V AC, 0.75A min.

4. Installation and Siting

4.1 Choice of Site

Site the gauge carefully, avoiding obvious sources of error such as nearby trees or buildings. A useful ‘rule of thumb’ is that the distance between the gauge and any obstruction should be at least as great as twice the height of the obstruction above the ground. For standard meteorological sites in the UK, the Meteorological Office specify the height at which the rim of a raingauge should be above a short grass surface, and the 52202/52203 should be exposed similarly if measurements are required for comparison with those from agrometeorological or synoptic sites.

In some countries it is common practice for the gauge to be mounted above the ground – for example with the lip at a height of 1 metre. A suitable 34 mm diameter pole can be used to achieve this requirement.

NOTE No two raingauge designs are ever likely to produce identical results, and identical raingauges can give slightly different catches even when sited within a metre of each other.

While the 52202/52203 raingauges have been designed for pole mounting, research has shown that a raingauge obstructs the flow of air and that the flow accelerates and turbulence increases over the top of the funnel. This can cause less rain to be collected in the funnel than otherwise would have fallen on the ground. In most cases, this phenomenon is ignored but it may be corrected for arithmetically, or overcome physically either using special wind deflection screens around the gauge or by placing the gauge in a pit so that the rim of the funnel is level with the ground. The pit is covered by a grating to simulate the aerodynamic roughness of the ground surface while preventing any splash into the funnel. There are obvious advantages with this method, but it is not always practical (for example in sites subject to significant snowfall). Further details on the exposure of raingauges are given in HMSO (1956, 1982) and by Rodda (1967). Another useful text on exposure and associated errors is Painter (1976).

The gauge should also be sited to avoid possible contamination by falling leaves, dirt or other debris.

4.2 Installation

4.2.1 Unpacking

Unpack the raingauge carefully. The model 52202/52203 is fully calibrated by the manufacturer before despatch. The moveable bucket is fitted with a retainer to prevent damage during shipping, and this retainer must be removed during installation, as indicated below.

4.2.2 Mounting

The 52202 and 52203 raingauges are specifically designed for mounting on a pole or tube of 34 mm outside diameter — see Figure 1, below. If required, the pole mounting assembly can be removed and the gauge can be mounted directly to a flat surface using appropriate securing bolts. The base mounting flange is provided with three holes on a 160 mm pitch circle diameter for bolting purposes. The raingauge is a light-weight instrument and it must therefore be bolted down securely.

If you need to mount the gauge on concrete, we recommend the use of Rawlbolts. Alternatively, a concrete paving slab may be more convenient as a base, in which case through-bolts or screws are suitable. Whichever is chosen, we recommend the use of large washers to spread the load more evenly around the mounting holes in the plastic base. You will also need to make provision to safely route the cable from its exit beneath the raingauge to the datalogger/enclosure.

The raingauge should be mounted on your prepared site as follows:

1. Loosen the three screws that retain the housing to the base assembly, and carefully lift the housing free of the base.

2. Remove the shipping retainer from the bucket and verify that the bucket tips freely.

3a. If you are mounting the gauge on a pole, loosen the retaining clip and slide the base assembly onto the pole. When in the required position tighten the clip to secure the gauge.

3b. If you are mounting the gauge to a flat surface, remove the pole mounting assembly to reveal the flat mounting base. Mount the gauge to the required surface using three appropriate sized bolts.

4. When the gauge is securely mounted adjust the levelling screws until the 'bulls-eye' levelling device is centred.

5. Replace the housing and retighten the screws.

NOTE If you are installing the 52202 heated version of the gauge, attach an appropriate power supply (rated 0.75A min. at 18-24V) to terminals C & D before the housing is fitted.

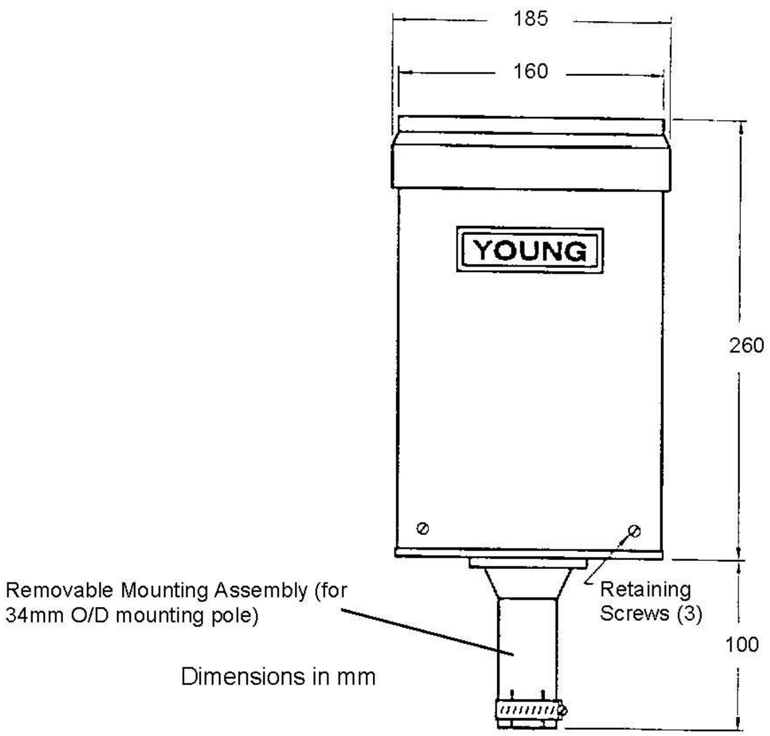


Figure 1 Dimensions of 52202/52203 Tipping Bucket Raingauge

4.2.3 Levelling

If the raingauge is tilted by more than a few degrees, the bucket mechanism may be thrown out of balance, significantly affecting its calibration. Furthermore, during wind-driven rain the response of a gauge with a tilted funnel collector will vary with wind direction. Check that the raingauge is level frequently — see the following sections on maintenance and calibration.

5. Wiring

The raingauge is supplied with a 6m 4-wire cable, which may be extended if required using screened cable. For most applications the raingauge may be connected directly to a pulse counting input on the datalogger as shown in Figure 2.

NOTE The red and black wires are only used for the 52202 heated gauge.

For a very long cable, a significant capacitance can exist between the conductors, which discharges across the reed switch as it closes. As well as shortening the life of the switch, a voltage transient may be induced in any other wires which run close to the raingauge cable each time the gauge tips. If you intend to use a long cable (greater than 30 metres) you should fit a 100Ω series resistor in the cable as close to the gauge as possible as shown in Figure 2, below, in order to protect the reed switch from arcing and to prevent transients. It is best to fit this resistor inside the raingauge to protect it from any possible contamination from rain or snow.

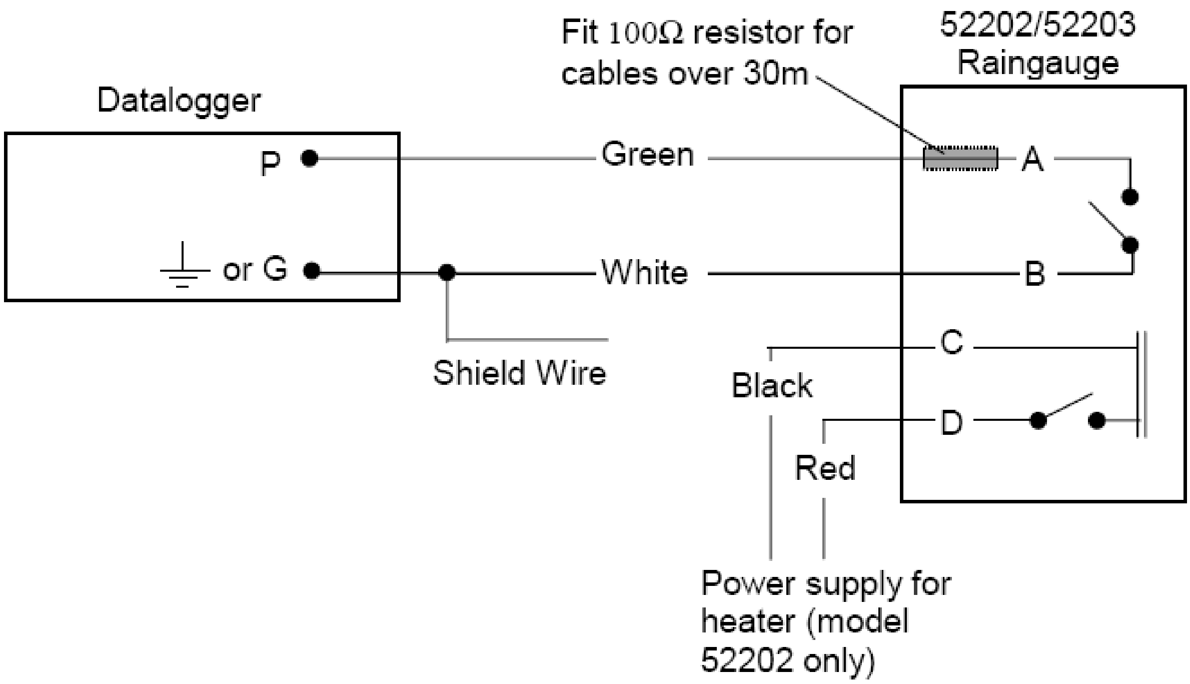


Figure 2 Wiring Diagram for 52202/52203

5.1 Wiring to a Pulse Channel

NOTE When Short Cut software is used to generate the datalogger program, the sensor should be wired to the channels shown on the wiring diagram created by Short Cut.

The 52202 is typically wired to a datalogger's pulse channel (see Table 4-1).

Table 4-1. Wiring for Pulse Channel Input

Colour	Description	CR800 CR1000 CR3000 CR5000	CR500 CR510 CR10X	21X CR7 CR23X	CR200(X) Series
Green	Signal	Pulse Channel	Pulse Channel	Pulse Channel	P_SW
White	Signal Return	⏚	G	⏚	⏚
Clear	Shield	⏚	G	⏚	⏚

5.2 Wiring to a Control Port

Dataloggers listed in Table 4-2 have the capability of counting switch closures on some of their control ports. When a control port is used, the return from the rain gauge switch must be connected to +5 volts on the datalogger.

Table 4-2. Wiring for Control Port Input

Colour	Description	CR800 CR1000 CR3000	CR500 CR510	CR10X	CR23X
Green	Signal	Control Port	C2/P3	Control Port	Control Port
White	Signal Return	5 V	5 V	5 V	5 V
Clear	Shield	⏚	⏚	G	⏚

The CR10 does not support the use of control port inputs with the Pulse Count instruction.

5.3 Model 52202 Raingauge with Heater

Model 52202 has a built-in heater to enable the raingauge to be used all year round in cold climates. The heater can be powered from any 18-24V AC supply. Connect the red wire to the positive and the black wire to the negative terminal. The heater consumes up to 0.75 amps.

NOTE The heater is not guaranteed to melt heavy ice concentrations or snow which has filled the bucket area.

6. Datalogger Programming

NOTE This section is for users who write their own programs. A datalogger program to measure this sensor can be generated using Campbell Scientific's Short Cut Program Builder software. You do not need to read this section to use Short Cut.

Precipitation is measured using a Pulse Count with a switch closure configuration code. The multiplier used in the Pulse Count instruction determines the units in which rainfall is reported (see Table 5-1).

Table 5-1. Multipliers

Rain Gauge	0.01 in.	1 in.	0.1 mm	1 mm
52202	0.394	0.00394	1.0	0.1

6.1 Pulse Channel Example Programs

The following example programs use a pulse channel to read the output from the precipitation gauge. The CR1000 example will also work with the CR800, CR850, CR3000, and CR5000. CR9000(X) programming is similar to the CR1000 except it has an additional parameter in the PulseCount instruction to specify the pulse module's slot.

The CR10X program will also work with the CR500, CR510, CR10, 21X or CR23X. CR7 programming is similar to the CR10X but has an additional parameter in the PulseCount instruction to specify the slot that the Pulse Card is in.

6.1.1 CR1000 Example Program

```
'CR1000

'RM_Young Tipping    Blk > P1
'                    Wht > ground
'Cabling for heater goes to 24VAC power supply

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

BeginProg
    Scan(1,Sec,1,0)
        PulseCount(Rain_mm,1,1,2,0,0.1,0)
        CallTable(Rain)
    NextScan
EndProg
```

6.1.2 CR200(X) Series Example Program

```
'CR200(X) Series

'RM_Young Tipping    Blk > P_SW
'                    Wht > ground
'Cabling for heater goes to 24VAC power supply

'Declare 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)

        '52202 Rain Gauge measurement Rain_mm:
        PulseCount(Rain_mm,P_SW,2,0,0.1,0)

        'Call Data Tables and Store Data
        CallTable(Rain)
    NextScan
EndProg
```

6.1.3 CR10X Example Program

```
;{CR10X}
*Table 1 Program
   01:  1.0000          Execution Interval (seconds)

1: Pulse (P3)
   1:    1              Reps
   2:    1              Pulse Channel 1
   3:    2              Switch Closure, All Counts
   4:    3              Loc [ Rain_mm ]
   5:    0.1            Multiplier
   6:    0              Offset

2: If time is (P92)
   1:    0              Minutes (Seconds --) into a
   2:    60             Interval (same units as above)
   3:    10             Set Output Flag High (Flag 0)

3: Set Active Storage Area (P80)
   1:    1              Final Storage Area 1
   2:    101            Array ID

4: Real Time (P77)
   1:    1220           Year,Day,Hour/Minute (midnight = 2400)

5: Totalize (P72)
   1:    1              Reps
   2:    3              Loc [ Rain_mm ]

*Table 2 Program
   01:  0               Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

6.2 Control Port Example

The following example programs use a control port to read the output from the precipitation gauge. The CR1000 example will also work with the CR800, CR850, and CR3000. The CR10X program will also work with the CR500, CR510, or CR23X.

6.2.1 CR1000 Example Program

```
'CR1000

'RM_Young Tipping   Blk > C4
'                   Wht > 5v
'Cabling for heater goes to 24VAC power supply

'Declare Variables and Units
Public BattV
Public Rain_mm

Units BattV = Volts
Units Rain_mm = mm

DataTable(OneMin,True,-1)
    DataInterval(0,1,Min,10)
    Totalize (1,Rain_mm,FP2,False)
EndTable

'Define Data Tables
DataTable(OneDay,True,-1)
DataInterval(0,1440,Min,10)
    Minimum(1,BattV,FP2,False,False)
    Totalize (1,Rain_mm,FP2,False)              'RM Young tipping bucket
EndTable

'Main Program
BeginProg
    Scan(5,Sec,1,0)
        'Default Datalogger Battery Voltage measurement BattV
        PanelTemp (PTemp,_50Hz)
        Battery(BattV)

        'RM Young Heated Rain Gauge measurement Rain_mm
        PulseCount(Rain_mm,1,14,2,0,0.1,0)

        'Call Data Tables and Store Data
        CallTable(OneMin)
        CallTable(OneDay)
    NextScan
EndProg
```

6.2.2 CR10X Example Program

```
;{CR10X}
;
*Table 1 Program
   01:  1              Execution Interval (seconds)

1: Pulse (P3)
   1:    1             Reps
   2:    8             Control Port 8 (switch closure only)    ;Black wire connect to C8
   3:    2             Switch Closure, All Counts
   4:    1             Loc [ Rain_mm ]
   5.    0.1           Multiplier
   6:    0             Offset

2: If time is (P92)
   1:    0             Minutes (Seconds --) into a
   2:    60            Interval (same units as above)
   3:    10            Set Output Flag High (Flag 0)

3: Set Active Storage Area (P80)
   1:    1             Final Storage Area 1
   2:    101           Array ID

4: Real Time (P77)
   1:    1220          Year,Day,Hour/Minute (midnight = 2400)

5: Totalize (P72)
   1:    1             Reps
   2:    1             Loc [ Rain_mm ]

*Table 2 Program
   02:  0.0000         Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

Output Instruction 72, Totalize, is used in the output section of the program to output the total rainfall over the output interval. This section should be executed every scan and not placed in a subroutine or conditional statement.

7. Maintenance

To ensure reliable and accurate measurements, we recommend that the following checks be carried out every month if possible:

1. Inspect the funnel for any damage or blockage and check the integrity of the connecting cable. At certain times of the year, leaves may accumulate in the bottom of the funnel, clogging the filter and preventing the flow to the buckets beneath, or reducing the flow rate to a slow drip. The obstruction is best cleared by inverting the funnel (after removal from the base) and pouring water back through from the spout beneath the collecting surface.

2. Check that the gauge is still level. It is surprisingly easy for an apparently immovable gauge to become tilted as a result of small ground movements, vandalism or just inquisitive fingers.

3. Check the movement of the tipping bucket and the functioning of the gauge. This can be done by slowly pouring a measured quantity of water (say 100 ml) through the gauge and counting the tips — see calibration section below. It is worthwhile carrying this out at regular weekly intervals (for example, every Monday at 0900) while leaving the gauge connected to the datalogger. Providing a significant volume of water is used, these weekly checks can easily be identified in the logged measurements. This simple procedure confirms that the gauge is functioning, detects any marked change in the calibration and (if carried out punctually) introduces an independent time check into the records.

8. Calibration

To check or recalibrate the raingauge, the following steps are suggested:

1. With the raingauge properly levelled, slowly drip a measured volume of water into the collection funnel at a rate of approximately 3.3 ml per minute. This is equivalent to a rainfall of 10 mm/hour, as recommended in BS7843 Section 2.1 for calibration of tipping bucket raingauges.
2. Carefully count how many times the bucket tips — it should tip five times for each 10 ml of water. For example, if you use 100 ml of water the bucket should tip approximately 50 times. You can count the number of tips manually or with a datalogger connected to the raingauge.
3. If the count shows an error of more than 2%, adjust the calibrating screws to correct the error — raise the screws if the count is low, lower the screws if the count is high. *Always adjust both screws equally.*

This type of dynamic calibration gives repeatable results in a test environment, but it is not a true representation of the gauge's sensitivity to natural precipitation. When used in the UK useful results can be obtained by comparing the output from the 52202/52203 with the catches from a standard 'Snowdon pattern' gauge (HMSO, 1956) sited nearby. If this comparison is carried out with care, a calibration factor for natural rainfall can be calculated from the slope of a graphical plot of (number of tips) against (catch from Snowdon gauge in mm).

9. Advantages and Limitations of a Tipping Bucket Raingauge

Gauges which operate on the tipping bucket principle provide a digital output, which simplifies connection to a datalogger. The pulses returned during rainfall may be counted over any time interval desired allowing accurate determination of the rainfall rate (this variable, sometimes called 'intensity', is frequently used in soil erosion studies and is relevant to some aspects of crop pathology).

A tipping bucket gauge responds to discrete quanta of rainfall, and the accuracy and reproducibility of this quantum are determined not only by factors such as friction in the bearings, etc. but also by the rate of fill of the buckets. When the rainfall rate is high, a bucket may *start* to tip when the necessary volume of water has been collected, but while the bucket is moving away from the funnel outlet, an extra volume will have been collected and lost through spillage. The resulting degradation in accuracy is of the order of 4% at rainfall rates of 25 mm/hr and 8% at 133 mm/hr for most gauges (Parkin et al, 1982). This is important when results from gauges of different designs are compared. These errors worsen when gauge sensitivity is increased. It follows that gauge design is always a compromise between the need for good resolution and good overall accuracy in rainfall totals.

References

HMSO (1956) *Handbook of Meteorological Instruments*, Part 1, Met.0. 577.

HMSO (1982) *Observers Handbook*, Met.0. 933.

Painter, R.D. (1976) in *Methods of Plant Ecology* pp 369-410. Ed. by S.B.Chapman, Blackwell Scientific Press, Oxford

Parkin, D.A., King, W.D. and Shaw, D.E. (1982) *An automatic raingauge network for a cloud seeding experiment* J.Appl.Meteorol. p 228.

Rodda, J.C., (1967) *The rainfall measurement problem* Proc. IAHS Gen. Ass.

Bern, IAHS Pub. No. 78, 215-231

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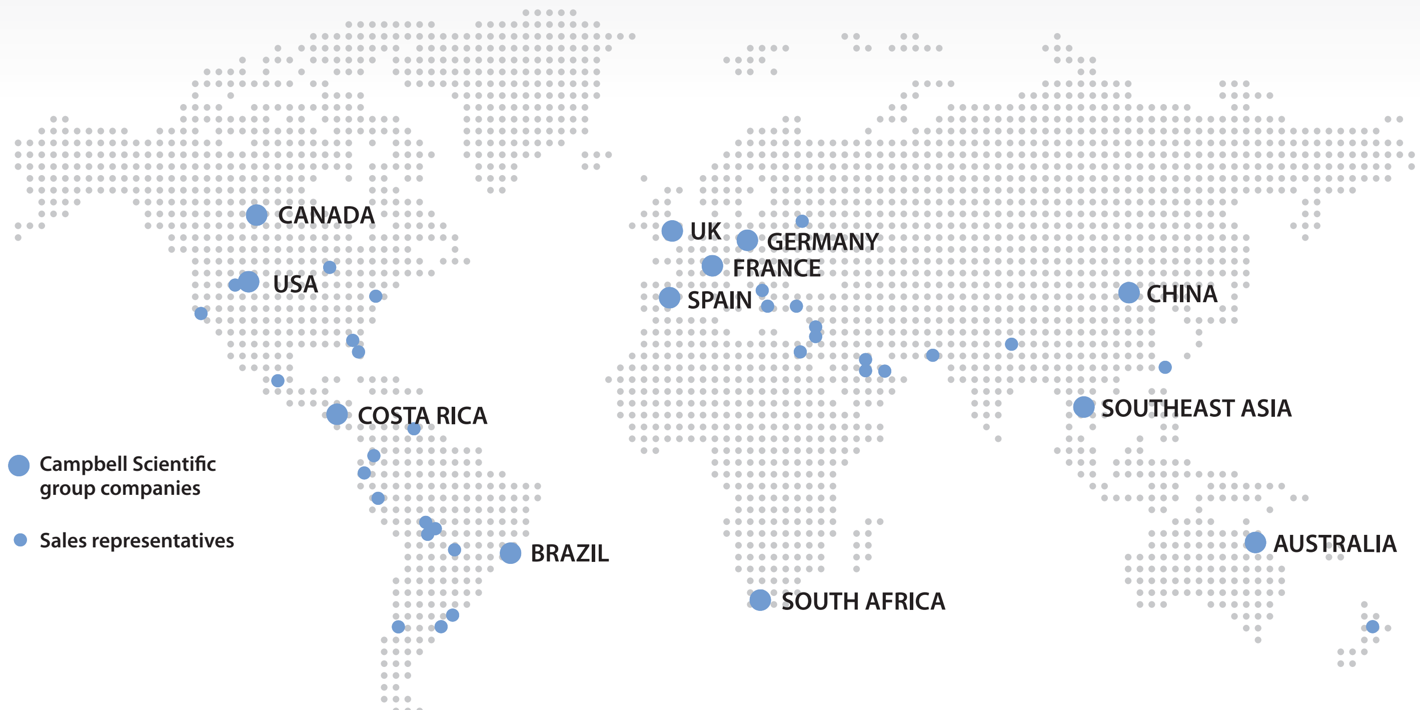

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Other Locations: Sales and support are provided in many other locations through an extensive network of international reps. For the full list, please visit ***www.campbellsci.com/contact#dir***.