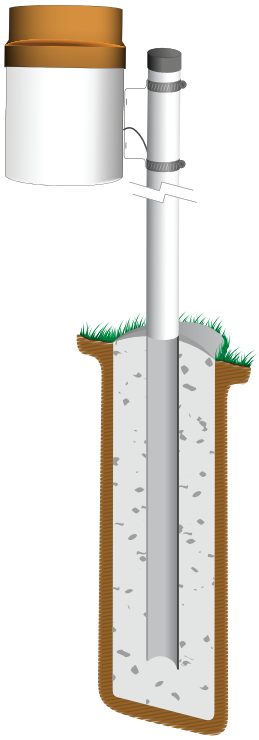
INSTRUCTION MANUAL

TE525 Tipping Bucket Rain Gage

Revision: 10/13



Warranty

The TE525, TE525WS, and TE525MM are warranted for thirty-six (36) months subject to this limited warranty:

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Assistance

Products may not be returned without prior authorization. The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit *www.campbellsci.com* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an application engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our web site at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

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Figures

Tables

TE525 Tipping Bucket Rain Gage

1. Introduction

The TE525 is an adaptation of the standard National Weather Service tipping bucket rain gage. Output is a switch closure for each bucket tip. Three models are available:

- TE525 6 in. orifice 0.01 in. tip
- TE525WS 8 in. orifice 0.01 in. tip
- TE525MM 24.5 cm orifice 0.1 mm tip

Before installing the TE525, please study:

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

2. Cautionary Statements

- The TE525-series tipping bucket rain gages are precision instruments. Please handle them with care.
- Care should be taken when opening the package not to damage or cut the cable jacket.
- Sensor is factory calibrated and should not require field calibration. Refer to Section 9, *Maintenance*, for field calibration check and factory calibration.
- Debris filters, funnel, and bucket reservoirs should be kept clean.
- 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, 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*). 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 TE525 ships with:

(1) Calibration sheet
(2) Hose clamps from original manufacturer
(1) ResourceDVD
(3) Screws from original manufacturer

4. Quickstart

Please review Section 7, *Operation*, for wiring, CRBasic programming, and Edlog programming.

4.1 Siting

The rain gage should be mounted in a relatively level spot which is representative of the surrounding area. The lip of the funnel should be horizontal and at least 30 cm above the ground. It should be high enough to be above the average snow depth. The ground surface around the rain gage should be natural vegetation or gravel. It should not be paved.

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

- The pipe used to mount the bucket must be vertical. Use a torpedo level or something similar to get it as vertical as possible.

- Take the funnel off of the top of the bucket and look inside towards the bottom of the bucket — notice the bubble level. Center the bubble level while mounting the bucket to the pipe. Replace the funnel and seat it completely when the installation is complete.

4.2 Mounting

The CM300-series mounting poles provide a stainless steel 1.5 IPS vertical pole for mounting the TE525 rain gage. Pole length is 58 cm (23 in), 119 cm (47 in), and 142 cm (53 in) for the CM300, CM305, and CM310 models respectively. The CM300-series offers pedestal base options as well, as shown in FIGURE 4-2.

Use the enclosed hose clamps to mount the gage as shown in FIGURE 4-1. The lip of the gage should be at least 5 cm (2 in) above the post or pole. Level the rain gage after mounting it.

NOTE Before final leveling, press either end of the bucket down against its stop to make sure the bucket is NOT hung up in the center.

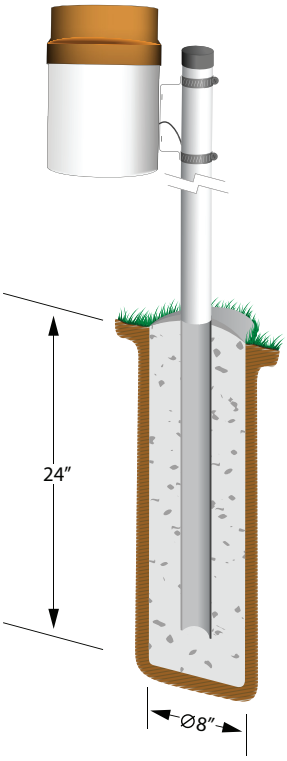


FIGURE 4-1. TE525 Tipping Bucket Rain Gage

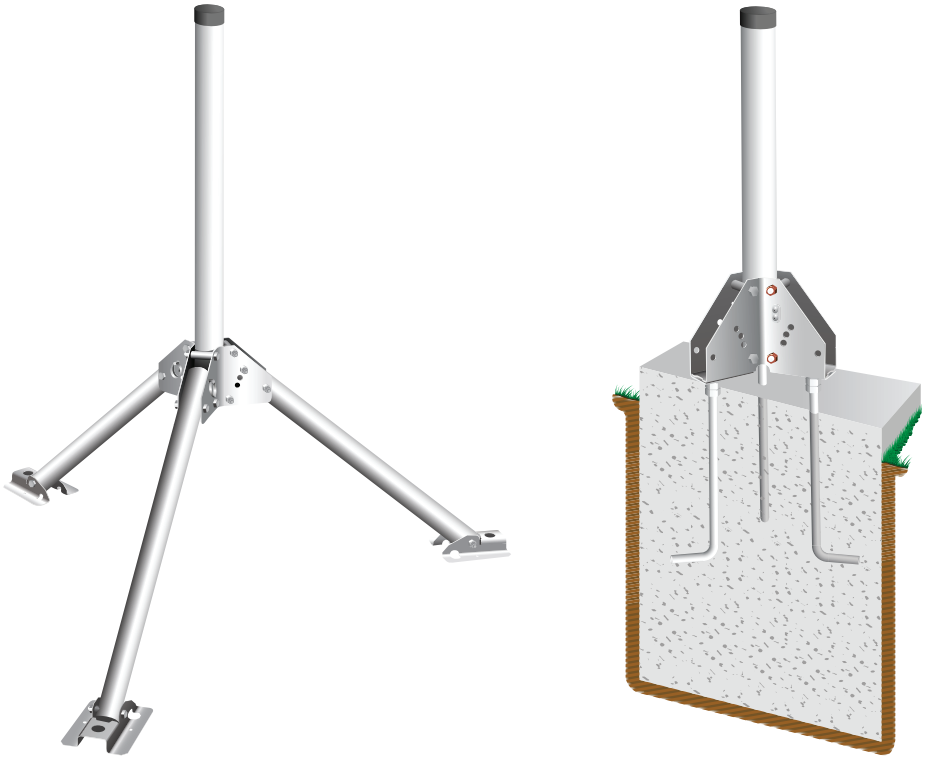


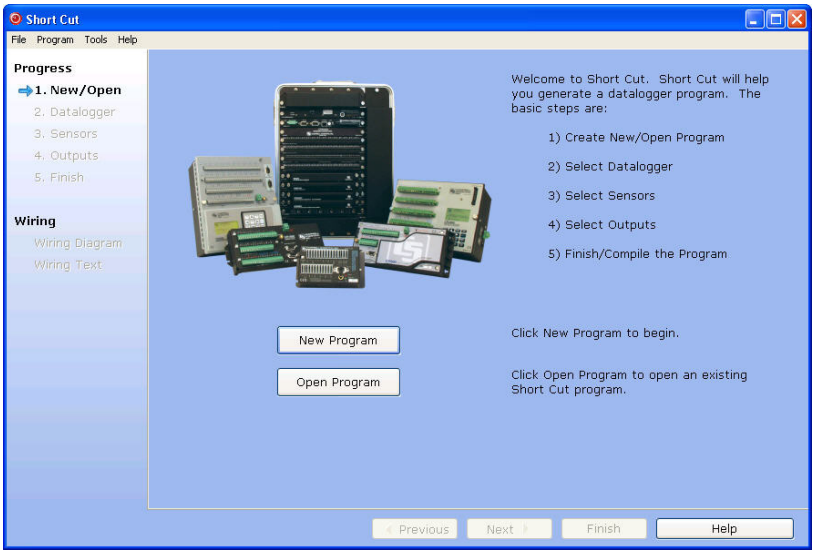
FIGURE 4-2. Pedestal base options

4.3 Use SCWin to Program Datalogger and Generate Wiring Diagram

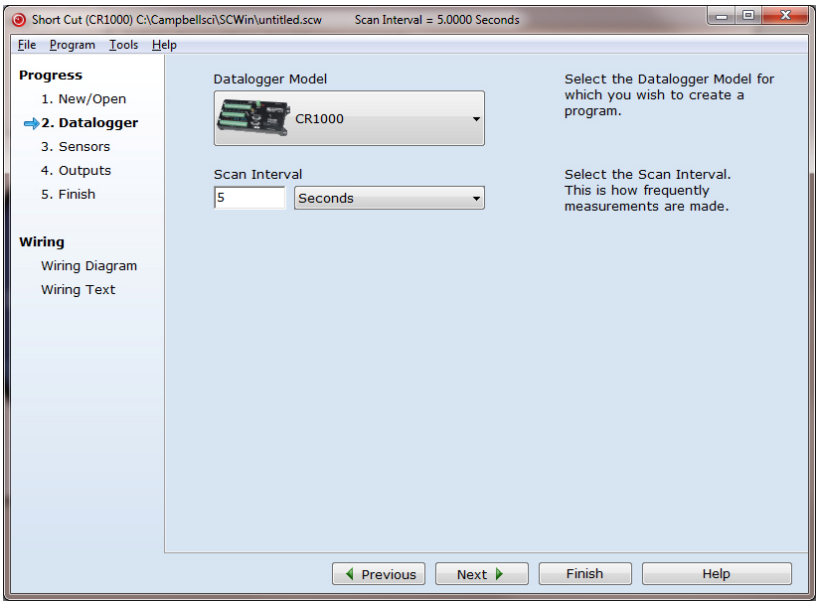
The simplest method for programming the datalogger to measure the tipping bucket rain gages is to use Campbell Scientific's SCWin Program Generator (Short Cut).

NOTE This section shows Short Cut's programming for the TE525/TE525WS. The TE52MM is done similarly.

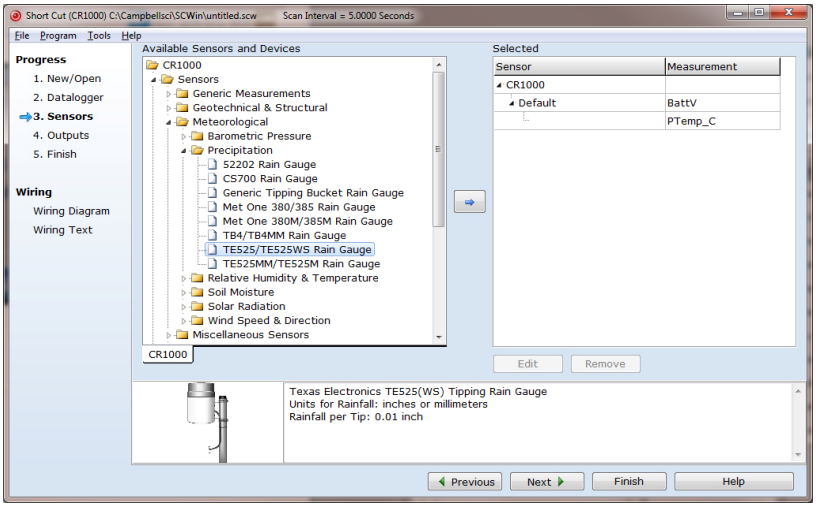
1. Open *Short Cut* and click on **New Program**.



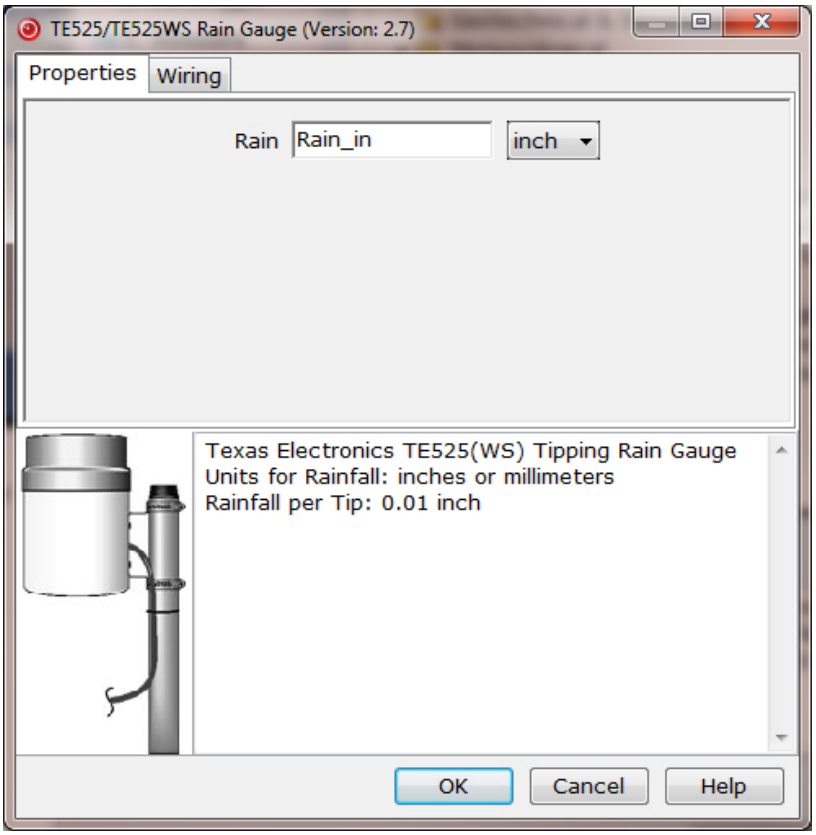
2. Select the **Datalogger** and enter the **Scan Interval**.



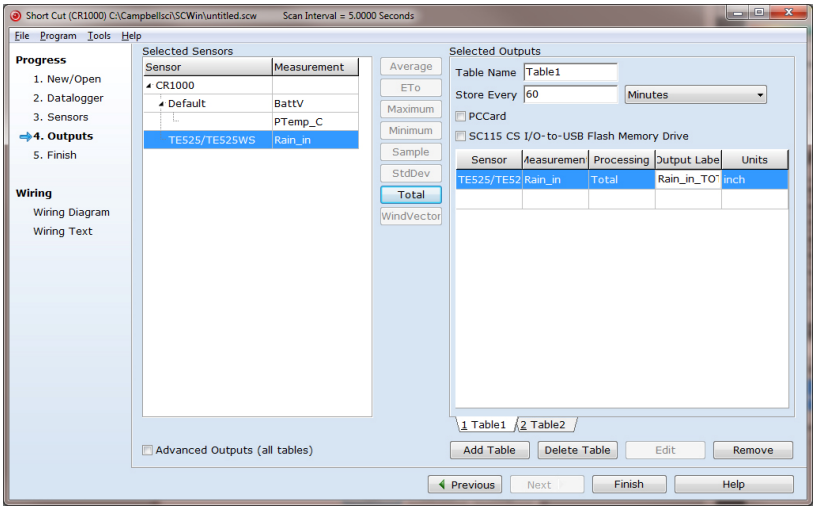
3. Select **TE525/TE525WS Rain Gauge,** and select the **right arrow** (in center of screen) to add it to the list of sensors to be measured, and then select **Next**.



4. Define the name of the **public variable** and the **measurement units**. After entering the information, click on **OK**, and then select **Next**.



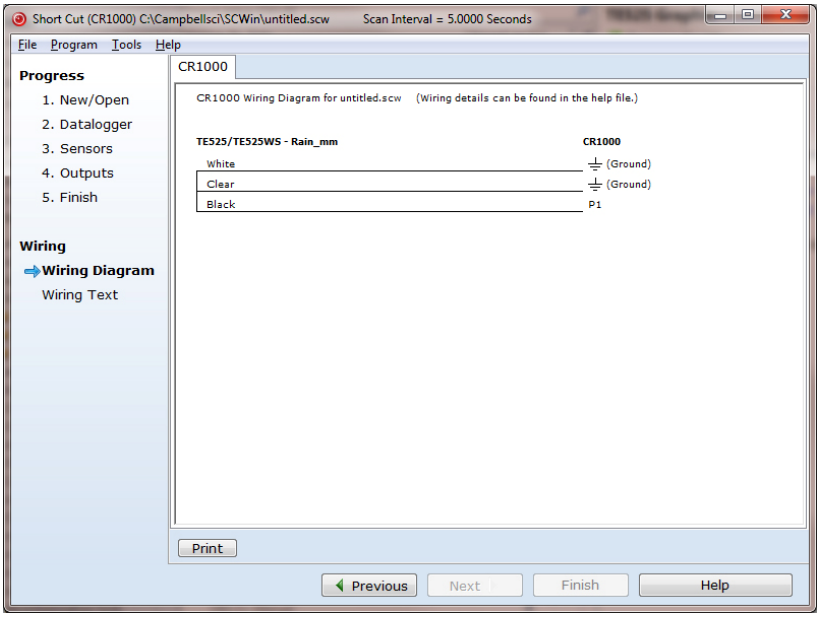
5. Choose the **Output** and then select **Finish**.



6. In the Save As window, enter an appropriate file name and select **Save**.

7. In the Confirm window, click **Yes** to download the program to the datalogger.

8. Click on **Wiring Diagram** and wire according to the wiring diagram generated by Short Cut.



5. Overview

The TE525-series tipping bucket rain gages funnel precipitation into a bucket mechanism that tips when filled to a calibrated level. A magnet attached to the tipping mechanism actuates a switch as the bucket tips. The momentary switch closure is counted by the pulse-counting circuitry of Campbell Scientific dataloggers.

The TE525-series tipping bucket rain gages are manufactured by Texas Electronics and then cabled by Campbell Scientific. The –L after the model number indicates the cable length is specified when ordered. The cable can terminate in:

- Pigtails that connect directly to a Campbell Scientific datalogger (option –PT).
- Connector that attaches to a prewired enclosure (option –PW). Refer to *www.campbellsci.com/prewired-enclosures* for more information.
- Connector that attaches to a CWS900 Wireless Sensor Interface (option –CWS). The CWS900 allows the probe to be used in a wireless sensor network. Refer to *www.campbellsci.com/cws900* for more information.
- Connector that attaches to a CS110 Electric Field Meter or ET-series weather station (cable termination option –C).
- Military-style connector that attaches to a RAWS-P Permanent Remote Automated Weather Station (cable termination option –RQ). This option is not available for the TE525MM.

5.1 Wind Screen

Campbell Scientific offers the 260-953 Wind Screen to help minimize the effect of wind on the rain measurements. This wind screen consists of 32 leaves that hang freely and swing as wind moves past them. Refer to the 260-953 manual for siting information and the installation procedure.

5.2 Snowfall Adapter

Campbell Scientific's CS705 Snowfall Conversion Adapter uses antifreeze to melt snow, allowing the TE525WS to measure the water content of snow. The CS705 cannot be directly used with either the TE525 or TE525MM. However, both the TE525 and TE525MM can be converted to a TE525WS by returning them to Campbell Scientific (see *Assistance* page at the beginning of this document). Refer to the CS705 manual for siting information and the installation procedure.

6. Specifications

Features:

- High precision
- Compatible with all Campbell Scientific dataloggers (including the CR200(X) series)
- TE525WS conforms to the National Weather Service recommendation for an 8-inch funnel orifice.
- TE525WS is directly compatible with the CS705 Snowfall Adapter allowing it to measure the measure the water content of snow.
- Campbell Scientific can modify a TE525 or TE525MM to it to be used with the CS705 Snowfall Adapter. Refer to *Assistance* page at the beginning of this document for the procedure for sending the tipping bucket to Campbell Scientific.

Compatible Dataloggers:

CR200(X)-series
CR800 series
CR1000
CR3000
CR5000
CR9000X
CR510
CR500
CR10(X)
CR23X
CR7
21X

	TE525	TE525WS	TE525MM
Sensor Type	tipping bucket/potted magnetic momentary contact reed switch		
Switch Ratings	30 Vdc at 2 A; 115 Vac at 1 A; closure time: 135 ms; bounce settling time: 0.75 ms		
Bucket Material	white powder coated spun aluminum		
Funnel Collector Material	gold anodized spun aluminum		
Screen Material	gold anodized spun aluminum		
Locking Snap Ring Material	stainless steel		
Operating Temperature	0° to +50°C (32° to 125°F)		
Resolution	1 tip		
Volume per Tip	4.73 ml/tip (0.16 fl. oz/tip)	8.24 ml/tip (0.28 fl. oz/tip)	4.73 ml/tip (0.16 fl. oz/tip)
Rainfall per Tip	0.01 in (0.254 mm)		0.1 mm (0.004 in)
Accuracy	1.0% up to 2 in/hour (50 mm/hr)		
Knife Edge Funnel Collector Diameter	15.4 cm (6.1 in)	20.3 cm (8 in)	24.5 cm (9.7 in)

	TE525	TE525WS	TE525MM
Height	24.1 cm (9.5 in)	26.7 cm (10.5 in)	29.2 cm (11.5 in)
Tipping Bucket Weight	0.9 kg (2 lb)	1 kg (2.2 lb)	1.1 kg (2.4 lb)
Cable	2-conductor shielded cable		
Cable Weight	0.1 kg (0.2 lb) per 10 ft length		

7. Operation

7.1 Wiring

When Short Cut 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 rain gage is typically wired to a datalogger's pulse channel (see TABLE 7-1).

TABLE 7-1. Wiring for Pulse Channel Input

Color	Description	CR800 CR850 CR1000 CR3000 CR5000 CR9000(X)	CR510 CR500 CR10(X)	21X CR7 CR23X	CR200(X) Series
Black	Signal	Pulse Channel	Pulse Channel	Pulse Channel	P_SW
White	Signal Return	⏚	G	⏚	⏚
Clear	Shield	⏚	G	⏚	⏚

Dataloggers listed in TABLE 7-2 have the capability of counting switch closures on some of their control ports. When a control port is used, the return from the rain gage switch must be connected to +5 V on the datalogger.

TABLE 7-2. Wiring for Control Port Input

Color	Description	CR800 CR850 CR1000 CR3000	CR500 CR510	CR10X	CR23X
Black	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.

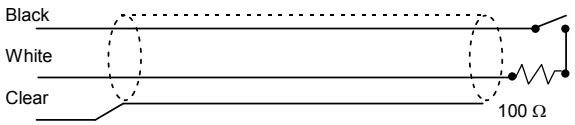


FIGURE 7-1. Rain Gage Schematic

In a long cable, there is 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.

7.2 Datalogger Programming

This section is for users who write their own programs. A datalogger program to measure this sensor can be generated using Short Cut. You do not need to read this section to use Short Cut.

In CRBasic, the rain gage is measured using the **PulseCount()** instruction. Choose switch closure (code 2) for the *PConfig* parameter. Dataloggers that use CRBasic are the CR200(X), CR800, CR850, CR1000, CR3000, CR5000, and CR9000(X).

In Edlog, the **Pulse (P3)** is used to measure the rain gage. Choose switch closure (code 2) for parameter three. Dataloggers that use Edlog are the CR500, CR510, CR10(X), CR23X, CR7, and 21X.

The multiplier used in the **PulseCount()** or **Pulse (P3)** instruction determines the units in which rainfall is reported (see TABLE 7-3).

TABLE 7-3. Multipliers for Rain Measurement

Rain Gage	inches	millimeters
TE525	0.01	0.254
TE525WS	0.01	0.254
TE525MM	0.00394	0.1
TE525 or TE525MM w/8 in funnel	0.0057	0.1459

The volume of water required to cause a tip in the TE525 and the TE525MM is the same. The difference in calibration is strictly due to funnel size. If the CS705 Snowfall Adapter or other eight inch funnel is installed on these gages, use a multiplier from the last row in TABLE 7-3. (The CS705 will not install directly on the TE525MM; the MM funnel must first be replaced with an eight inch funnel.)

7.2.1 Pulse Count Example Programs

The following example programs use a pulse channel to read the output from the rain gage. 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.

7.2.1.1 CR1000 Example Program

```
'CR1000
'TE525/TE525WS & TE525MM sample program
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)
    'For TE525MM Rain Gage, use multiplier of 0.1 in PulseCount instruction
    PulseCount(Rain_mm,1,1,2,0,0.254,0)
    CallTable(Rain)
  NextScan
EndProg
```

7.2.1.2 CR200(X) Series Example Program

```
'CR200(X) Series

'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)
    'TE525/TE525WS Rain Gage measurement Rain_mm:
    PulseCount(Rain_mm,P_SW,2,0,0.254,0)
    'Call Data Tables and Store Data
    CallTable(Rain)
  NextScan
EndProg

'For TE525MM Rain Gage, use multiplier of 0.1 in PulseCount instruction
```

7.2.2 Control Port Example

This example measures a TE525 rain gage in millimeters. A different multiplier would be entered (TABLE 7-3) for other units.

7.2.2.1 CR1000 Example Program

```
'CR1000
'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)
    'For TE525MM Rain Gage use multiplier of 0.1 in PulseCount Instruction.
    PulseCount (Rain_mm,1,18,2,0,.254,0)
    CallTable (Rain)
  NextScan
EndProg
```

8. Troubleshooting

Symptom: No Precipitation

1. Check that the sensor is wired to the Pulse Channel specified by the pulse count instruction.

2. Verify that the Configuration Code (Switch Closure), and Multiplier and Offset parameters for the Pulse Count 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.

9. Maintenance

The funnel and bucket mechanism must be kept clean. Routinely check for and remove any foreign material, dust, insects, etc. The following calibration check is advised every 12 months.

Field Calibration Check:

(1) Secure a metal can that will hold at least one quart of water.

(2) Punch a very small hole in the bottom of the can.

(3) Place the can in the top funnel of the rain gage and pour 16 fluid ounces (1 pint) of water into the can. (A 16 oz. soft drink bottle filled to within 2.5 inches of the top may be used for a rough field calibration. An exact volume will allow for a more precise calibration).

(4) If it takes less than 45 minutes for this water to run out, the hole in the can is too large.

(5) The following number of tips should occur:

TE525, TE525MM	100 ± 3
TE525WS	57 ± 2

(6) Adjusting screws are located on the bottom adjacent to the large center drain hole. Adjust both screws the same number of turns. Rotation clockwise increases the number of tips per 16 oz. of water; counter clockwise rotation decreases the number of tips per 16 oz. of water. One half turn of both screws causes a 2% to 3% change.

(7) Check and re-level the rain gage lid.

Factory Calibration:

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

Appendix A. Edlog Program Examples

A.1 CR10X Pulse Count Example Program

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 **Pulse (P3)** instruction to specify the slot that the pulse card is in.

```
;{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:   0.254              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
```

A.2 CR10X Control Port Example

This example measures a TE525 rain gage in millimeters. A different multiplier would be entered (TABLE 7-3) for other units.

```
;{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:   .254                 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.

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