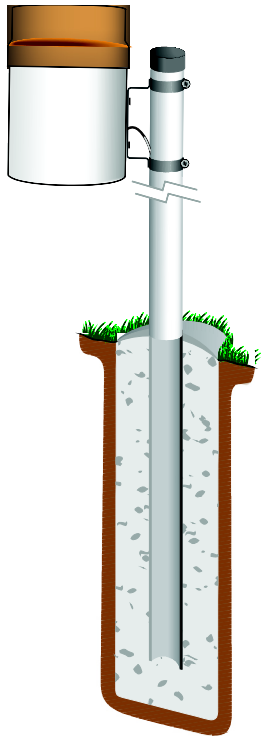
INSTRUCTION MANUAL

TE525 Tipping Bucket Rain Gage

Revision: 11/14



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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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TE525 Tipping Bucket Rain Gage

1. Introduction

The TE525 Tipping Bucket Rain Gage is an adaptation of the standard National Weather Service tipping bucket rain gage. It outputs 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

2. Cautionary Statements

- READ AND UNDERSTAND the *Precautions* section at the front of this manual.
- TE525-series tipping bucket rain gages are precision instruments that must be handled with care.
- Sensor is factory-calibrated and should not require field calibration. Refer to Section 9.2, *Maintenance*, for field calibration check and factory calibration.
- Debris filters, funnel, and bucket reservoirs should be kept clean.
- Santoprene® rubber, which composes the black outer jacket of the TE525 cable, will support combustion in air. It is used because of its resistance to temperature extremes, moisture, and UV degradation. It is rated as slow burning when tested according to U.L. 94 H.B. and passes FMVSS302. However, local fire codes may preclude its use inside buildings.

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 (see Section 3.1, *Ships With*). Model numbers are found on each product. On cables and cabled items, the model number is usually found at the connection end of the cable. Report any shortages immediately to Campbell Scientific.

3.1 Ships With

The TE525 ships with:

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

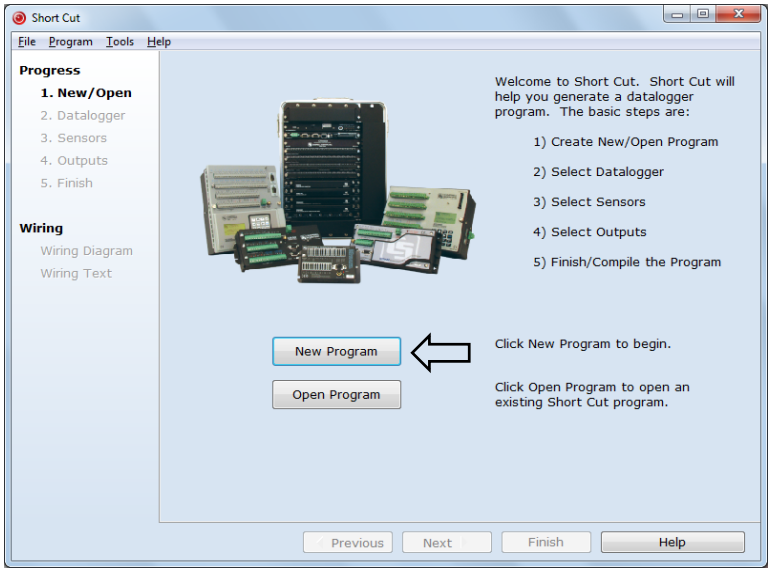
4. Quickstart

Short Cut is an easy way to program your datalogger to measure the 107 probe and assign datalogger wiring terminals. Use the following procedure to get started.

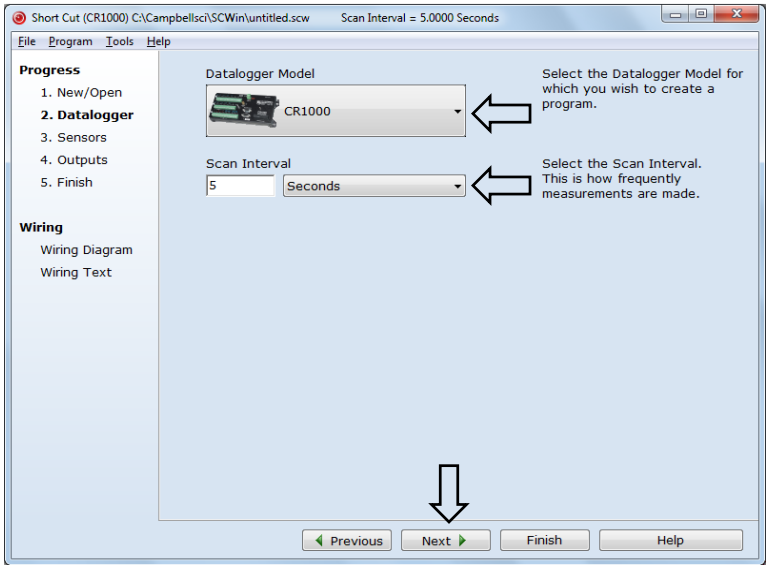
1. Install *Short Cut* by clicking on the install file icon. Get the install file from either *www.campbellsci.com*, the ResourceDVD, or find it in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ* software.

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

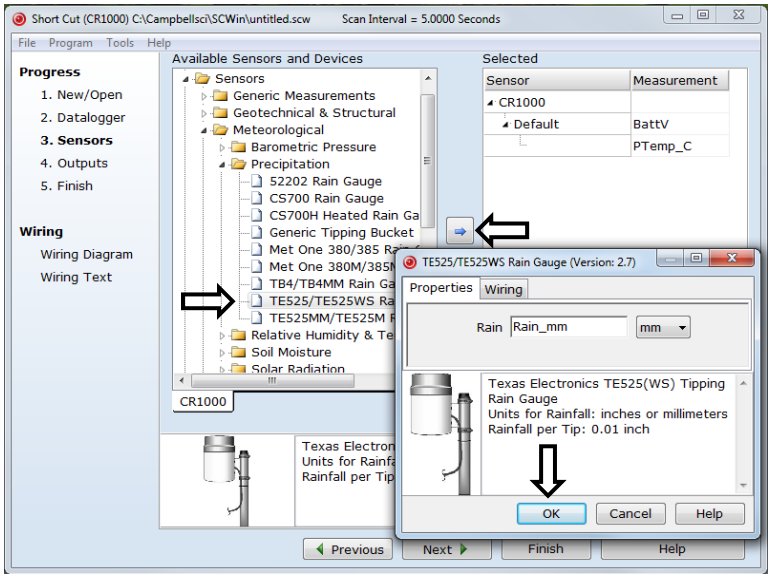
3. When *Short Cut* opens, select **New Program**.



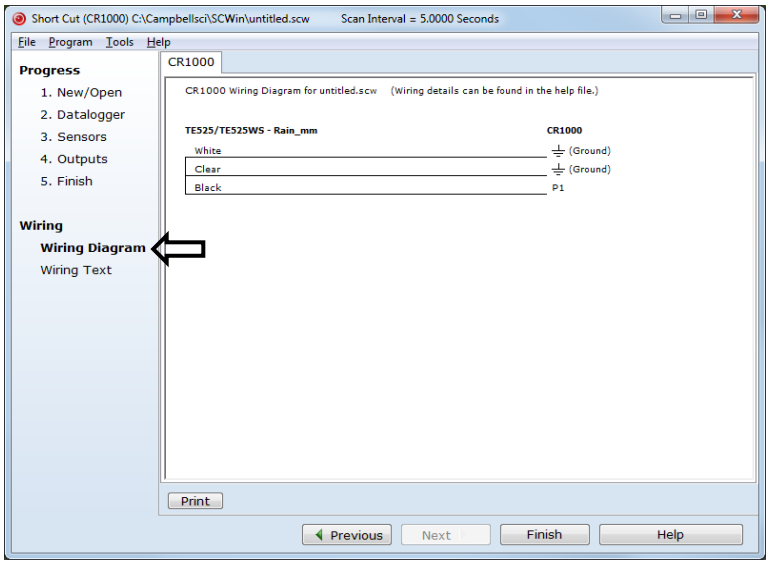
4. Select **Datalogger Model** and **Scan Interval** (default of **5** seconds is OK for most applications). Click **Next**.



5. Under the **Available Sensors and Devices** list, select the **Sensors | Meteorological | Precipitation** folder. Select **TE525/TE525WS Rain Gauge** or **TE525MM/TE525M Rain Gauge**, depending on which model you have. Click  to move the selection to the **Selected** device window. Data defaults to millimeters. This can be changed by clicking the **mm** box and selecting **inch**.



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



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

8. If *LoggerNet*, *PC400*, *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.

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

5. Overview

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 cabled by Campbell Scientific.

5.1 Wind Screen

Campbell Scientific offers the 260-953 Wind Screen to help minimize the effect of wind on rain measurements. This wind screen consists of 32 freely hanging leaves that 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 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
- 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.

Sensor Type:	Tipping bucket/potted magnetic momentary-contact reed switch
Operating Temperature Range:	0 to 50 °C
Storage Temperature Range:	–40 to 70 °C
Switch Ratings:	30 Vdc at 2 A 115 Vac at 1 A
Closure Time:	135 ms
Bounce Settling Time:	0.75 ms
Materials:	
Bucket:	white powder-coated spun aluminum
Funnel Collector:	gold anodized spun aluminum
Screen:	gold anodized spun aluminum
Locking Snap Ring:	stainless steel
Cable:	2-conductor shielded cable
Cable Weight:	0.1 kg (0.2 lb) per 10 ft

TABLE 6-1. Specification Comparisons			
	TE525	**TE525WS**	**TE525MM**
Volume per Tip[1]	4.73 ml (0.16 fl. oz)	8.24 ml (0.28 fl. oz)	4.73 ml (0.16 fl. oz)
Rainfall per Tip	0.01 in (0.254 mm)	0.01 in (0.254 mm)	0.1 mm (0.004 in)
Resolution	1 tip	1 tip	1 tip
Accuracy	±1 % up to 1 in/hr +0, –3 % from 1 to 2 in/hr +0, –5 % from 2 to 3 in/hr	±1 % up to 1 in/hr +0, –2.5 % from 1 to 2 in/hr +0, –3.5 % from 2 to 3 in/hr	±1 % up to 10 mm/hr +0, –3 % from 10 to 20 mm/hr +0, –5 % from 20 to 30 mm/hr
Funnel Collector Diameter[2]	15.4 cm (6.060 in)	20.3 cm (8 in)	24.5 cm (9.7 in)
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)

[1]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.

[2]If the CS705 Snowfall Adapter or other eight-inch funnel is installed on these gages, refer to TABLE 7-2 for the multiplier. See Appendix C, *Changing Funnels with a Different Size*, before replacing funnels on any TE525 tipping bucket rain gage with a different size funnel.

7. Installation

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

7.1 Wiring to Datalogger

TABLE 7-1. Wire Color, Function, and Datalogger Connection			
Wire Color	**Wire Function**	**Datalogger Connection Terminal for Pulse Channel Input**	**Datalogger Connection Terminal for Control Port Input**[1]
Black	Pulse Output	**P**, **P_SW**, or **U** (pulse channel)	**C** (control port)
White	Ground	**AG** or ⏚ (analog ground)	**5 V** (on datalogger)
Clear	Shield	**AG** or ⏚ (analog ground)	**AG** or ⏚ (analog ground)

[1]Dataloggers capable of measuring pulse counts on their control ports include CR800-series, CR1000, and CR3000.

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*. 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.1, Importing Short Cut Code into a Program Editor*. Programming basics for CRBasic dataloggers are provided in the following sections. Complete program examples for select dataloggers can be found in Appendix B, *Example Programs*.

The **PulseCount()** instruction programs CRBasic dataloggers (CR200(X), CR6, CR800, CR850, CR1000, CR3000, CR5000, CR9000(X)) to measure the TE525 rain gage.

```
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 (TABLE 7-2).

TABLE 7-2. 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

7.3 Siting

Mount the rain gage in a relatively level spot representative of the surrounding area. Ensure that the lip of the funnel is horizontal, at least 30 cm above the ground, and higher than the average snow depth. 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.

- The mounting pipe must be vertical. Use a torpedo level to stand it as vertical as possible.

- Take the funnel off of the top of the bucket and look inside toward 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.

7.4 Mounting

The TE525 includes hose clamps to mount the gage to a 1- to 2-inch pipe. As an alternative for added stability and for better leveling capabilities, the CM270 leveling base could be used instead (FIGURE 7-3). This leveling base is included with the CM705 Snowfall Adapter but can also be purchased separately.

CM300-series mounting poles provide a stainless steel 1.5 IPS vertical pole for mounting the TE525 rain gage. See FIGURE 7-1 for multiple base options.

Model	**Pole Length**
CM300	58 cm (23 in)
CM305	119 cm (47 in)
CM310	142 cm (53 in)

FIGURE 7-1. Mounting pole base options

Mount the gage with its lip at least 5 cm (2 in) above the post or pole (FIGURE 7-2). 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.

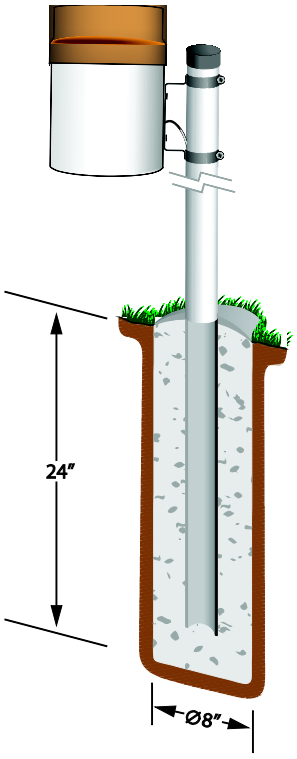


FIGURE 7-2. TE525 Tipping Bucket Rain Gage

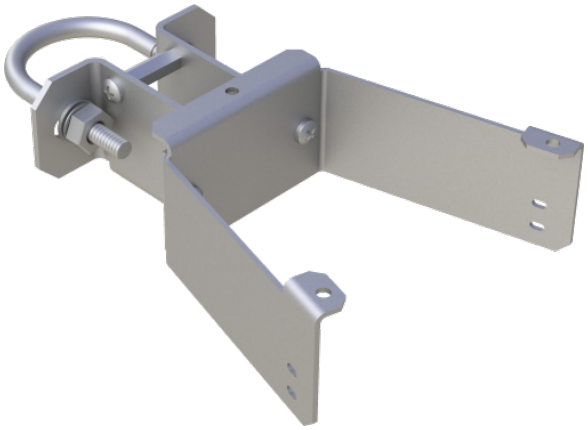


FIGURE 7-3. CM270 Rain Gage Mount attaches to the base of a TE525-series rain gage to give added stability.

8. Operation

8.1 Sensor Schematic

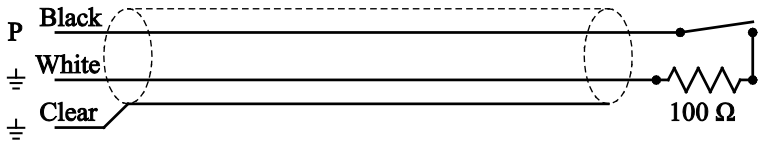


FIGURE 8-1. TE525-series Rain Gage Schematic

8.2 Measurement

Campbell Scientific dataloggers measure TE525 rain gages by counting switch closures and converting the total to rainfall. The **PulseCount()** instruction employs dedicated pulse count accumulators, which continuously monitor the input signal, even when the datalogger is between program scans. To create a pulse, an internal 100 kΩ pull-up resistor pulls the pulse input to 5 Vdc when the switch is open, and a switch closure to ground pulls the input to 0 Vdc.

8.3 Long Cable Lengths

Long cables have appreciable capacitance between 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 current (FIGURE 8-1). Campbell Scientific installs this resistor on all current rain gages.

9. 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.

9.1 Troubleshooting

Symptom: No Precipitation

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

2. Verify that the ***Configuration Code*** (switch closure) and ***Multiplier*** 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 (switch closed) when the bucket is balanced.

9.2 Maintenance

The funnel and bucket mechanism must be kept clean. Routinely check for and remove any foreign material, dust, insects, etc.

9.3 Calibration

A field 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).

10. Attributions and References

Santoprene® is a registered trademark of Exxon Mobile Corporation.

Appendix A. Importing Short Cut Code

This tutorial shows:

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

A.1 Importing Short Cut Code into a Program Editor

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

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

The following procedures show how to import these files for editing.

A.1.1 CRBasic Datalogger

Use the following procedure to import *Short Cut* code into *CRBasic Editor* (CR6, CR1000, CR800, CR3000, CR200(X), CR5000, CR9000(X) dataloggers).

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

2. Open *CRBasic Editor*.

3. Click **File** | **Open**. Assuming the default paths were used when *Short Cut* was installed, navigate to C:\CampbellSci\SCWin folder. The file of interest has a ".CR6", ".CR1", ".CR8", ".CR3", ".CR2", ".CR5" or ".CR9" extension, for CR6, CR1000, CR800, CR3000, CR200(X), CR5000, or CR9000(X) dataloggers, respectively. Select the file and click **Open**.

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

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

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

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

Appendix B. Example 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 for having an additional parameter in the **PulseCount()** instruction to specify the pulse module's slot.

B.1 CR1000 Pulse Channel Example Program

```
'Program records precipitation from one TE525 or TE525WS Rain Gage once a
'second and stores the total every 60 minutes

'Wiring Diagram
'==============
'TE525 or TE525WS

'  Wire
'  Color      Function           CR1000
'  -----      --------           ------
'  Black      Pulse Output        P1
'  White      Ground              AG*
'  Clear      Shield              AG*

'*AG = Analog Ground (represented by ground symbol on CR1000 wiring panel

'Declare the variables and units for the rain measurement
Public Rain_mm
Units Rain_mm=mm

DataTable(Table1,True,-1)
  DataInterval(0,60,Min,0)
  Totalize(1,Rain_mm,FP2,0)
EndTable

BeginProg
  Scan(1,Sec,1,0)
    PulseCount(Rain_mm,1,1,2,0,0.254,0)
    'For TE525MM Rain Gage, use multiplier of 0.1 in PulseCount instruction
    'Call Data Table
    CallTable(Rain)
  NextScan
EndProg
```

B.2 CR200(X) Series Example Program

```
'Program records precipitation from one TE525 or TE525WS Rain Gage once a
'second and stores the total every 60 minutes

'Wiring Diagram
'===============
'TE525 or TE525WS

'  Wire
'  Color       Function           CR1000
'  -----       --------           ------
'  Black       Pulse Output        P1
'  White       Ground              AG*
'  Clear       Shield              AG*

'*AG = Analog Ground (represented by ground symbol on CR200(X) wiring panel

'Declare the variables and units for the rain measurement
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)
    'For TE525MM Rain Gage, use multiplier of 0.1 in PulseCount instruction
    'Call Data Tables and Store Data
    CallTable(Rain)
  NextScan
EndProg
```

B.3 CR1000 Control Port Example Program

```
'Program records precipitation from one TE525 or TE525WS Rain Gage once a
'second and stores the total every 60 minutes

'Wiring Diagram
'==============
'TE525 or TE525WS
'
'  Wire
'  Color      Function           CR1000
'  -----      --------           ------
'  Black      Pulse Output        C8
'  White      Ground              AG*
'  Clear      Shield              AG*

'*AG = Analog Ground (represented by ground symbol on CR200(X) wiring panel

'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,1,18,2,0,.254,0)
'For TE525MM Rain Gage use multiplier of 0.1 in PulseCount Instruction.

CallTable (Rain)
  NextScan
EndProg
```

Appendix C. Changing Funnels with a Different Size

C.1 TE525 and TE525MM

The TE525 and TE525MM rain gages use the same tipping mechanism that is calibrated to tip with the same amount of water. Changing the funnel does not necessitate changing the tipping mechanism, but it does require changing the multiplier in the datalogger program to match the funnel size. See TABLE 7-2, *Multipliers for Rain Measurement*, for the correct multiplier.

C.2 TE525WS

The TE525WS rain gage uses a different tipping mechanism that is calibrated differently than the TE525 or TE525MM. The tipping mechanism must be replaced to work with a TE525 or TE525MM funnel. Send the rain bucket into the Campbell Scientific repair department for modifications. Contact Campbell Scientific to obtain an RMA (see *Assistance* at front of manual).

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