253 and 257
Soil Matric Potential Sensors
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- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
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- Use only manufacturer recommended parts, materials, and tools.

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- 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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Table of Contents

PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.

1. Introduction ................................................................. 1
2. Precautions ...................................................................... 1
3. Initial Inspection .......................................................... 1
4. QuickStart ...................................................................... 2
   4.1.1 257 Short Cut Programming ......................................................... 2
   4.1.2 253 Short Cut Programming ......................................................... 5
5. Overview .......................................................................... 8
6. Specifications .................................................................... 10
7. Operation .......................................................................... 10
   7.1 Installation/Removal ................................................................. 10
   7.2 Wiring .................................................................................. 11
   7.2.1 257 Wiring ........................................................................... 11
   7.2.2 253 Wiring ........................................................................... 12
   7.3 Programming ........................................................................... 14
   7.3.1 BRHalf Instruction ................................................................. 14
   7.3.2 Calculations ........................................................................... 15
   7.3.2.1 Soil Water Matric Potential in Other Units ...................... 15
   7.4 Interpreting Results ................................................................. 15
8. Troubleshooting ............................................................ 16
9. Reference ........................................................................... 16

Appendices

A. Importing Short Cut Code Into CRBasic Editor... A-1
B. Example Programs ......................................................... B-1

Figures

5-1. 257 Soil Matric Potential Sensor with capacitor circuit and completion resistor installed in cable. Model 253 is the same, except that it does not have completion circuitry in the cable. ........................................... 9
7-1. 257 schematic ........................................................................ 12
7-2. 253 wiring example ................................................................. 13
Table of Contents

Tables

7-1. 257 Wiring ................................................................. 11
7-2. 257-to AM16/32-series Multiplexer Wiring .................... 12
7-3. Data Logger to AM16/32-series Multiplexer Wiring (2 x 32 Mode) 13
7-4. Excitation and Voltage Ranges for CRBasic Data Loggers .... 14
7-5. Conversion of Matric Potential to Other Units .................. 15
B-1. 107/257 Wiring for Example Program ......................... B-1
B-2. Wiring for 253 Example ............................................. B-2

CRBasic Examples

B-1. CR6 Program Measuring a 107 and 257 ....................... B-1
B-2. CR1000X Program Measuring Five 107s and Five 253s ...... B-3
253 and 257 Soil Matric Potential Sensors

1. Introduction

The 253 and 257 soil matric potential sensors are solid-state, electrical-resistance sensing devices with a granular matrix that estimate soil water potential between 0 and –2 bars (typically wetter or irrigated soils).

The 253 needs to be connected to an AM16/32-series multiplexer, and is intended for applications where a larger number of sensors will be monitored. The 257 connects directly to our data loggers.

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

2. Precautions

- READ AND UNDERSTAND the Safety section at the front of this manual.

- The black outer jacket of the cable is Santoprene® rubber. 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.

- Avoid installing in depressions where water will puddle after a rain storm.

- Don’t place the 253 or 257 in high spots or near changes in slope unless wanting to measure the variability created by such differences.

- When removing the sensor prior to harvest of annual crops, do so just after the last irrigation when the soil is moist.

- When removing a sensor, do not pull the sensor out by its wires.

- Careful removal prevents sensor and membrane damage.

3. Initial Inspection

- Upon receipt of a 253 or 257, 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.
4. QuickStart

A video that describes data logger 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 data logger to measure the 253 or 257 and assign data logger wiring terminals. Short Cut is available as a download on www.campbellsci.com. It is included in installations of LoggerNet, PC200W, PC400, or RTDAQ.

The following sections also describe programming with Short Cut.

NOTE

Short Cut requires a soil temperature measurement before the 253 or 257 sensor is added. This is needed because there is a temperature correction factor in the equations that convert sensor resistance. In these Quickstart examples, a 107-L temperature probe is used to measure soil temperature.

4.1.1 257 Short Cut Programming

1. Open Short Cut and click Create New Program.

2. Double-click the data logger model.

3. In the Available Sensors and Devices box, type 107. You can also locate the sensor in the Sensors > Temperature folder. Double-click 107 Temperature Probe. Use the default units of degree Celsius.
4. Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

![Wiring Diagram](image)

5. In the **Available Sensors and Devices** box, type 257. You can also locate the sensor in the **Sensors > Meteorological > Soil Moisture** folder. Double-click **257 Soil Moisture Sensor**. Select the resistance units, soil water potential units, and soil reference temperature.

![Available Sensors](image)
6. Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

7. In **Output Setup**, type the scan rate, meaningful table names, and the **Data Output Storage Interval**. Click **Next**.
8. Select the output options.

9. Click **Finish** and save the program. Send the program to the data logger if the data logger is connected to the computer.

10. If the sensor is connected to the data logger, check the output of the sensor in **LoggerNet**, **PC400**, **RTDAQ**, or **PC200W** to make sure it is making reasonable measurements.

### 4.1.2 253 Short Cut Programming

1. Follow steps 1 through 4 of Section 4.1.1, **257 Short Cut Programming** (p. 2).

2. In the **Available Sensors and Devices** box, type AM16/32. You can also locate the multiplexer in the **Device** folder.
3. In the **Available Sensors and Devices** box, type 253. You can also locate the sensor in the **Meteorological > Soil Moisture** folder. Double click the **253 Soil Moisture Sensor**. Select the number of sensors, resistance units, soil water potential units, and soil reference temperature.

![Image of Available Sensors and Devices]

4. Click on the **Wiring** tab to see how the sensor is to be wired to the AM16/32B. Click **OK** after wiring the sensor.

![Image of 253 Soil Moisture Sensor Wiring Diagram]
5. **In Output Setup**, type a scan rate. When using a multiplexer, Campbell Scientific recommends a scan rate that is at least 30 s. Also type meaningful table names and the **Data Output Storage Interval**. Click Next.

6. Select the output options.
7. Click the **Wiring Diagram** on the left side panel to see how the AM16/32B is to be wired to the data logger.

![Wiring Diagram](image)

8. Click **Finish** and save the program. Send the program to the data logger if the data logger is connected to the computer.

9. If the sensor is connected to the data logger, check the output of the sensor in **LoggerNet**, **PC400**, **RTDAQ**, or **PC200W** to make sure it is making reasonable measurements.

5. **Overview**

The 253 and 257 soil matric potential sensors provide a convenient method of estimating water potential of wetter soils in the range of 0 to –200 kPa. The 253 is the Watermark 200 Soil Matric Potential Block modified for use with Campbell Scientific multiplexers and the 257 is the Watermark 200 Soil Matric Potential Block modified for use with Campbell Scientific data loggers.

The –L option on the Model 257-L and 253-L indicates that the cable length is user specified. This manual refers to the sensors as the 257 and 253. The typical cable length for the 257 is 25 ft.

For 253 applications, most of the cable length used is between the data logger and the multiplexer, which reduces overall cable costs and allows each cable attached to the 253 to be shorter. The cable length of each 253 only needs to cover the distance from the multiplexer to the point of measurement. Typical cable length for the 253 is 25 to 50 ft.

The difference between the 253 and the 257 is that there is a capacitor circuit and completion resistor installed in the 257 cable (FIGURE 5-1) to allow for direct connection to a data logger, while the 253 does not have any added circuitry. For applications requiring many sensors on an analog multiplexer, the 253 is used and one or more completion resistors are connected to the data logger wiring panel. A capacitor circuit is not required for the 253 on a multiplexer because the electrical connection between the sensor and the data logger is interrupted when the multiplexer is deactivated. Any potential
difference between the data logger earth ground and the electrodes in the sensor is thus eliminated.

The 253 and 257 consist of two concentric electrodes embedded in a reference granular matrix material. The granular matrix material is surrounded by a synthetic membrane for protection against deterioration. An internal gypsum tablet buffers against the salinity levels found in irrigated soils.

If cultivation practices allow, the sensor can be left in the soil all year, eliminating the need to remove the sensor during the winter months.

FIGURE 5-1. 257 Soil Matric Potential Sensor with capacitor circuit and completion resistor installed in cable. Model 253 is the same, except that it does not have completion circuitry in the cable.
6. Specifications

Features:

- Survives freeze-thaw cycles
- Rugged, long-lasting sensor
- Buffers salts in soil
- No maintenance required
- 257 contains blocking capacitors in its cable that minimizes galvanic degradation and measurement errors due to ground loops
- For the 253, the multiplexer connection prevents electrolysis from prematurely destroying the probe
- Compatible with Campbell Scientific CRBasic data loggers: CR6, CR800-series, CR1000X, CR1000, CR3000, and CR5000

Range: 0 to –200 kPa
Dimensions: 8.26 cm (3.25 in)
Diameter: 1.91 cm (0.75 in)
Weight: 363 g (0.8 lb)

7. Operation

If you are programming your data logger with Short Cut, skip Section 7.2, Wiring (p. 11), and Section 7.3, Programming (p. 14). Short Cut does this work for you. See Section 4, QuickStart (p. 2), for a Short Cut tutorial.

7.1 Installation/Removal

Placement of the sensor is important. To acquire representative measurements, avoid high spots, slope changes, or depressions where water puddles. Typically, the sensor should be located in the root system of the crop.

1. Soak sensors in water for one hour then allow them to dry, ideally for 1 to 2 days.

2. Repeat Step 1 twice if time permits.

3. Make the sensor access holes to the required depth. Often, a 22 mm (7/8 in) diameter rod can be used to make the hole. However, if the soil is very coarse or gravelly, an oversized hole (25 to 32 mm) may be required to prevent abrasion damage to the sensor membrane. The ideal method of making an oversized access hole is to have a stepped tool that makes an oversized hole for the upper portion and an exact size hole for the lower portion.

4. If the hole is oversized (25 to 32 mm), mix a slurry of soil and water to a creamy consistency and place it into the sensor access hole.
5. Insert the sensors in the sensor access hole. A length of 1/2 inch class 315 PVC pipe fits snugly over the sensor collar and can be used to push in the sensor. The PVC can be left in place with the wires threaded through the pipe and the open end taped shut (duct tape is adequate). This practice also simplifies the removal of the sensors. When using PVC piping, solvent weld the PVC pipe to the sensor collar. Use PVC/ABS cement on the stainless steel sensors with the green top. Use clear PVC cement only on the PVC sensors with the gray top.

6. Force the soil or slurry to envelope the sensors. This will ensure uniform soil contact.

7. Snug fit in the soil is extremely important. Lack of a snug fit is the premier problem with sensor effectiveness.

8. Carefully, back fill the hole, and tamp down to prevent air pockets which could allow water to channel down to the sensor.

9. When removing sensors prior to harvest in annual crops, do so just after the last irrigation when the soil is moist.

8. When removing sensors prior to harvest in annual crops, do so just after the last irrigation when the soil is moist.

9. Do not pull the sensor out by the wires. Careful removal prevents sensor and membrane damage.

9. When sensors are removed for winter storage, clean, dry, and place them in a plastic bag.

7.2 Wiring

7.2.1 257 Wiring

The 257 cable includes a capacitor circuit that stops galvanic action due to the differences in potential between the data logger earth ground and the electrodes in the block. This allows it to connect directly to a data logger (TABLE 7-1 and FIGURE 7-1).

<table>
<thead>
<tr>
<th>Wire Color</th>
<th>Wire Function</th>
<th>Data Logger Connection Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Voltage-excitation input</td>
<td>U configured for voltage excitation¹, EX, VX (voltage excitation)</td>
</tr>
<tr>
<td>Red</td>
<td>Analog-voltage output</td>
<td>U configured for single-ended analog input¹, SE (single-ended, analog-voltage input)</td>
</tr>
<tr>
<td>White</td>
<td>Negative signal</td>
<td>(analog ground)</td>
</tr>
<tr>
<td>Clear</td>
<td>Shield</td>
<td>(analog ground)</td>
</tr>
</tbody>
</table>

¹U terminals are automatically configured by the measurement instruction.
253 and 257 Soil Matric Potential Sensors

7.2.2 253 Wiring

The 253 typically connects to an AM16/32-series multiplexer (TABLE 7-2), but it also is compatible with the long retired AM32 and AM416 multiplexers.

<table>
<thead>
<tr>
<th>Wire Color</th>
<th>Wire Function</th>
<th>Multiplexer Connection Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Voltage-excitation input</td>
<td>H</td>
</tr>
<tr>
<td>Black</td>
<td>Analog-voltage output</td>
<td>L</td>
</tr>
<tr>
<td>Clear</td>
<td>Shield</td>
<td>☼ or ☩ (ground)</td>
</tr>
</tbody>
</table>

The multiplexer connects to the data logger (refer to the multiplexer manual or www.campbellsci.com/am16-32b-ordering for information on the cables available for connecting the multiplexer to the data logger). A 1000 ohm resistor at the data logger wiring panel is used to complete the half bridge circuitry.

TABLE 7-3 and FIGURE 7-2 show the data logger-to-multiplexer connections for the 2 x 32 mode. TABLE B-2, Wiring for 253 Example (a-2), shows wiring for the 4 x 16 mode.
TABLE 7-3. Data Logger to AM16/32-series Multiplexer Wiring (2 x 32 Mode)

<table>
<thead>
<tr>
<th>Data Logger Connection Terminal</th>
<th>Multiplexer Connection Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V</td>
<td>12V</td>
</tr>
<tr>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>C (control terminal)</td>
<td>RES</td>
</tr>
<tr>
<td>C (control terminal)</td>
<td>CLK</td>
</tr>
<tr>
<td>U configured for voltage excitation¹, EX, VX (voltage excitation)</td>
<td>COM ODD H</td>
</tr>
<tr>
<td>U configured for single-ended analog terminal¹, SE (single-ended, analog-voltage terminal)</td>
<td>COM ODD L</td>
</tr>
<tr>
<td>⊝ (analog ground)</td>
<td>COM ⊝ or ⊝ (ground)</td>
</tr>
</tbody>
</table>

¹U terminals are automatically configured by the measurement instruction.

FIGURE 7-2. 253 wiring example
7.3 Programming

*Short Cut* is the best source for up-to-date data logger programming code.

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

**NOTE**

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

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

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

### 7.3.1 BRHalf Instruction

CRBasic data loggers use the BRHalf() instruction with the RevEx argument set to True to excite and measure the 253 and 257. The result of the BRHalf() instruction is the ratio of the measured voltage divided by the excitation voltage. The result needs to be converted to resistance and then converted to soil water potential.

<table>
<thead>
<tr>
<th>Data Logger</th>
<th>mV excitation</th>
<th>Full Scale Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR800 Series</td>
<td>250</td>
<td>± 250 mV</td>
</tr>
<tr>
<td>CR6</td>
<td>200</td>
<td>± 200 mV</td>
</tr>
<tr>
<td>CR1000X</td>
<td>200</td>
<td>± 200 mV</td>
</tr>
<tr>
<td>CR1000</td>
<td>250</td>
<td>± 250 mV</td>
</tr>
<tr>
<td>CR3000</td>
<td>200</td>
<td>± 200 mV</td>
</tr>
<tr>
<td>CR5000</td>
<td>200</td>
<td>± 200 mV</td>
</tr>
</tbody>
</table>
7.3.2 Calculations

The CRBasic program should include the following to calculate resistance, adjust the resistance for soil temperature, and calculate soil water potential:

\[
\text{kohms} = \frac{\text{kohms}}{1 - \text{kohms}} \\
\text{kohms} = \frac{(100 + (1.8 \times \text{T107}_C + 32) - 69.8)}{100} \times \text{kohms} \\
\text{If kohms} \leq 1 \text{ Then} \\
\quad \text{WP}_\text{kPa} = -(20 \times \text{kohms} - 11) \\
\text{Else} \\
\quad \text{WP}_\text{kPa} = -(-0.00279 \times \text{kohms}^3 + 0.19109 \times \text{kohms}^2 + 3.71485 \times \text{kohms} + 6.73956) \\
\text{EndIf}
\]

where,

- \( \text{kohms} \) = the variable storing the BRHalf() result
- \( \text{T107}_C \) = the variable storing the temperature sensor measurement (degree Celsius)
- \( \text{WP}_\text{kPa} \) = water potential

7.3.2.1 Soil Water Matric Potential in Other Units

To report measurement results in other units, multiply the soil water potential by the appropriate conversion constant from TABLE 7-5.

<table>
<thead>
<tr>
<th>Desired Unit</th>
<th>Multiply Result By</th>
</tr>
</thead>
<tbody>
<tr>
<td>kPa</td>
<td>1.0</td>
</tr>
<tr>
<td>MPa</td>
<td>0.001</td>
</tr>
<tr>
<td>Bar</td>
<td>0.01</td>
</tr>
</tbody>
</table>

7.4 Interpreting Results

As a general guide, 253 and 257 measurements indicate soil matric potential as follows:

- 0 to –10 kPa = Saturated soil
- –10 to –20 kPa = Soil is adequately wet (except coarse sands, which are beginning to lose water).
- –20 to –60 kPa = Usual range for irrigation (except heavy clay).
- –60 to –100 kPa = Usual range for irrigation for heavy clay soils.
- –100 to –200 kPa = Soil is becoming dangerously dry for maximum production.
8. Troubleshooting

To test the sensor, submerge it in water. Measurements should be from –3 to +3 kPa. Let the sensor dry for 30 to 48 hours. You should see the reading increase from 0 to 150+ kPa. If the reading does not increase to 150 kPa, replace the sensor. If the reading increases as expected, put the sensor back in the water. The reading should run right back down to zero in 1 to 2 minutes.

If the sensor passes these tests but it is still not functioning properly, consider the following:

1. Sensor may not have a snug fit in the soil. This usually happens when an oversized access hole has been used and the backfilling of the area around the sensor is not complete.

2. Sensor is not in an active portion of the root system, or the irrigation is not reaching the sensor area. This can happen if the sensor is sitting on top of a rock or below a hard pan which may impede water movement. Re-installing the sensor usually solves this problem.

3. When the soil dries out to the point where you are seeing readings higher than 80 kPa, the contact between soil and sensor can be lost because the soil may start to shrink away from the sensor. An irrigation which only results in a partial rewetting of the soil will not fully rewet the sensor, which can result in continued high readings from the 257. Full rewetting of the soil and sensor usually restores soil to sensor contact. This is most often seen in the heavier soils and during peak crop water demand when irrigation may not be fully adequate. The plotting of readings on a chart is most useful in getting a good picture of this sort of behavior.

9. Reference


Parts of this manual were contributed by Irrometer Company, Inc., manufacturer of the Watermark 200.
Appendix A. Importing Short Cut Code Into CRBasic Editor

Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into the CRBasic Editor. By default, these files reside in the C:/campbellsci/SCWin folder.

Import Short Cut program file and wiring information into CRBasic Editor:

1. Create the Short Cut program following the procedure in Section 4, QuickStart (p. 2). After saving the Short Cut program, click the Advanced tab then the CRBasic Editor button. A program file with a generic name will open in CRBasic. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

2. To add the Short Cut wiring information into the new CRBasic program, open the .DEF file located in the C:/campbellsci/SCWin folder, and copy the wiring information, which is at the beginning of the .DEF file.

3. Go into the CRBasic program and paste the wiring information into it.

4. In the CRBasic program, highlight the wiring information, right-click, and select Comment Block. This adds an apostrophe (’) to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The Comment Block feature is demonstrated at about 5:10 in the CRBasic | Features video.

NOTE

Once the file is edited with CRBasic Editor, Short Cut can no longer be used to edit the program it created.
CRBasic Example B-1 measures the resistance (kΩ) of one 257 sensor with the data logger. A 107 temperature probe is measured first for temperature correction of the 257 reading. Voltage range codes for other CRBasic data loggers are shown in TABLE 7-4. Sensor wiring for this example is shown in TABLE B-1.

### TABLE B-1. 107/257 Wiring for Example Program

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Wire</th>
<th>Function</th>
<th>CR6</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>Black</td>
<td>Excitation</td>
<td>U1</td>
</tr>
<tr>
<td>107</td>
<td>Red</td>
<td>Positive Signal</td>
<td>U2</td>
</tr>
<tr>
<td>107</td>
<td>Purple</td>
<td>Negative Signal</td>
<td>⊥</td>
</tr>
<tr>
<td>107</td>
<td>Clear</td>
<td>Shield</td>
<td>⊥</td>
</tr>
<tr>
<td>257</td>
<td>Black</td>
<td>Excitation</td>
<td>U4</td>
</tr>
<tr>
<td>257</td>
<td>Red</td>
<td>Positive Signal</td>
<td>U3</td>
</tr>
<tr>
<td>257</td>
<td>White</td>
<td>Negative Signal</td>
<td>⊥</td>
</tr>
<tr>
<td>257</td>
<td>Clear</td>
<td>Shield</td>
<td>⊥</td>
</tr>
</tbody>
</table>

CRBasic Example B-1. CR6 Program Measuring a 107 and 257

`'CR6 Series`

`'Declare Variables and Units`

Public T107_C
Public kohms
Public WP_kPa

Units T107_C=Deg C
Units kohms=kilohms
Units WP_kPa=kPa

`'Define Data Tables`

DataTable(Table1,True,-1)
DataInterval(0,60,Min,10)
Average(1,T107_C,FP2,False)
Sample(1,WP_kPa,FP2)

EndTable

`'Main Program`

BeginProg

`'Main Scan`

Scan(5,Sec,1,0)

`'107 Temperature Probe measurement 'T107_C'`

Therm107(T107_C,1,U2,U1,0,60,1,0)

`'257 Soil Moisture Sensor measurements 'kohms' and 'WP_kPa'`

BrHalf(kohms,1,mV200,U3,U4,1,200,True,0,15000,1,0)

kohms=kohms/(1-kohms)

kohms=(100+(1.8*T107_C+32)-69.8)/100*kohms

If kohms<=1 Then

WP_kPa=-(20*kohms-11)

Else
CRBasic Example B-2 measures five 107 temperature probes and five 253 sensors on an AM16/32-series multiplexer (4x16 mode) with the CR1000X data logger. In this example, a 107 temperature probe is buried at the same depth as a corresponding 253 sensor. Voltage range codes for other CRBasic data loggers are shown in TABLE 7-4. Sensor wiring is shown in TABLE B-2.

TABLE B-2. Wiring for 253 Example

<table>
<thead>
<tr>
<th>CR1000X</th>
<th>AM16/32B</th>
<th>Sensor</th>
<th>Wire</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V</td>
<td>12V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>RES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>CLK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VX1</td>
<td>COM ODD  H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE1 (1H)</td>
<td>COM ODD  L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td>COM GROUND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE2 (1L)</td>
<td>COM EVEN H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td>COM EVEN L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000 ohm resistor from SE2 to VX2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1H</td>
<td>107</td>
<td>Black</td>
<td></td>
<td>Excitation</td>
</tr>
<tr>
<td>1L</td>
<td></td>
<td>Red</td>
<td></td>
<td>Positive Signal</td>
</tr>
<tr>
<td>‿</td>
<td>Purple</td>
<td></td>
<td></td>
<td>Negative Signal</td>
</tr>
<tr>
<td>‿</td>
<td>Clear</td>
<td></td>
<td></td>
<td>Shield</td>
</tr>
<tr>
<td>2H</td>
<td>253</td>
<td>White</td>
<td></td>
<td>Positive Signal</td>
</tr>
<tr>
<td>2L</td>
<td>Black</td>
<td></td>
<td></td>
<td>Negative Signal</td>
</tr>
<tr>
<td>‿</td>
<td>Clear</td>
<td></td>
<td></td>
<td>Shield</td>
</tr>
</tbody>
</table>

Continue wiring sensors to multiplexer with 107 probes attaching to odd numbered terminals and 253 sensors to even numbered terminals. AM16/32B in 4x16 mode.
## CRBasic Example B-2. CR1000X Program Measuring Five 107s and Five 253s

```crbasic
'CRI1000X
Public T107_C(5), WP_kPa(5), kOhms(5)
Dim i

Units T107_C()=Deg C
Units kOhms()=kOhms
Units WP_kPa()=kPa

DataTable(Hourly, true, -1)
    DataInterval(0, 60, Min, 10)
    Average(5, T107_C, FP2, 0)
    Sample(5, WP_kPa, FP2)
    Sample(5, kOhms, FP2)
EndTable

BeginProg
    Scan(60, Sec, 3, 0)
        PortSet(C1, 1) 'Turn AM16/32 Multiplexer On
        Delay(0, 150, mSec)
        i = 1
    SubScan(0, uSec, 5)
        PulsePort(C2, 10000)
        Therm107(T107_C(i), 1, 1, VX1, 0, 60, 1, 0)
        BrHalf(kOhms(i), 1, mV200, 2, VX2, 1, 200, true, 0, 60, 1, 0)
        kOhms(i) = kOhms(i)/(1-kOhms(i))
        kOhms(i) = (100 + (1.8*T107_C(i) + 32) - 69.8)/100*kOhms(i)
        i = i+1
    NextSubScan
    PortSet(C1, 0) 'Turn AM16/32 Multiplexer Off
    For i = 1 To 5
        If kOhms(i)<=1 Then
            WP_kPa(i) = -(20*kOhms(i)-11)
        Else
            WP_kPa(i) = -(-0.00279*kOhms(i)^3+0.19109*kOhms(i)^2+3.71485*kOhms(i)+6.73956)
        EndIf
    Next i
    CallTable Hourly 'Call Data Table and Store Data
NextScan
EndProg
```
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