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Using Campbell AVW2xx Vibrating Wire Interfaces

MultiLogger Application Note #21

Overview

The AVW2xx series of interfaces from Campbell Scientific provide high-quality vibrating wire measurements by using a spectrum analysis technique to output the gage readings. This provides for high-quality measurement of the vibrating wire gages particularly in electrically noisy environments as well as higher resolution in electrically quiet environments.

There are several versions of the AVW2xx available:

- AVW200 – For wired configurations, or for wireless using non-Campbell wireless solutions.
- AVW206 – Includes integrated 900MHz spread spectrum radio for wireless applications.
- AVW211 – Includes integrated 922MHz spread spectrum radio for wireless applications.
- AVW216 – Includes integrated 2.4GHz spread spectrum radio for wireless applications.

This MultiLogger Application Note will detail the configuration issues involved for using the wired (connected directly to the Campbell CR800 or CR1000) as well as wireless versions (units that include an integrated spread spectrum radio).

Note: The Gage Types | Makes | Models supported in MultiLogger all use a range of 400-4000Hz for the vibrating wire frequency range. This should be adequate for most installations. Contact Canary Systems for direction to narrow or widen the frequency range.

The following wired configurations will be detailed:

- AVW200 with direct connect gages.
- AVW200 with multiplexers controlled by the MCU.
- AVW200 with multiplexers controlled by the AVW200.

The following wireless configurations will be detailed:

- AVW2xx with direct connect gages.
- AVW2xx with multiplexers controlled by the AVW2xx.

See the AVW200 Operators Manual for more information on other deployments.

Note: MultiLogger currently only supports the AVWxx when using the CR800 and CR1000 MCU's.

Configuring the AVW2xx with CSI Device Configuration Software

Note: For proper function the CR800 FW must be v8 or higher, for the CR1000 v17 or higher.

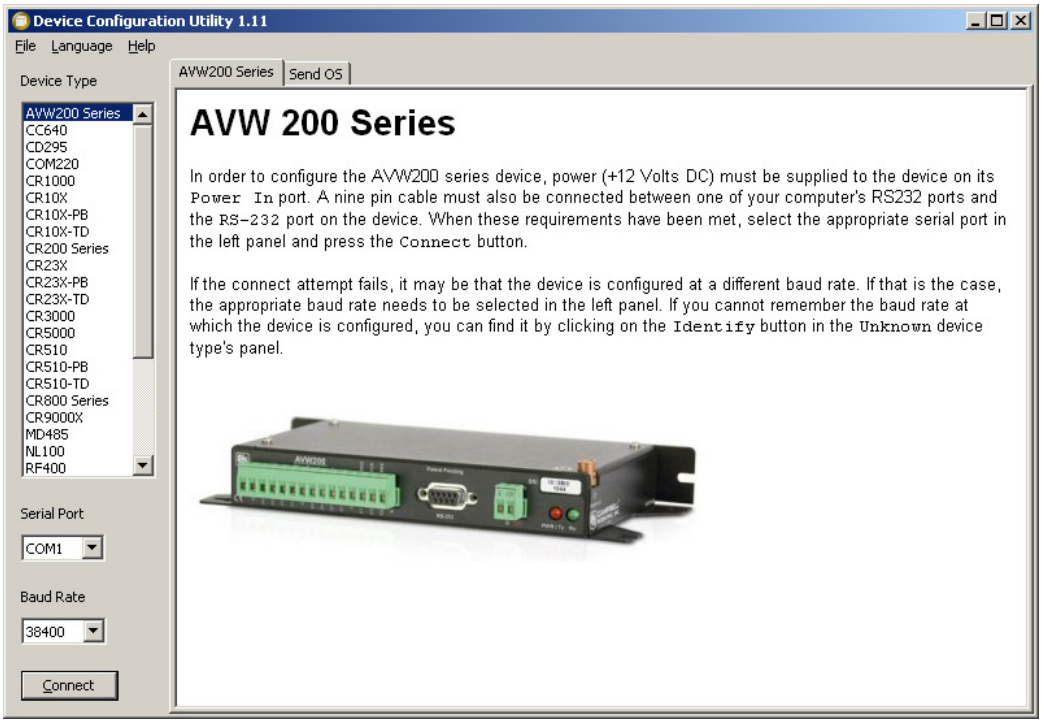
The first step is getting familiar with the Device Configuration software and the settings of the AVW2xx. It is very straight-forward to configure the unit for the wired or wireless deployments. The Device Configuration software is included with LoggerNet or may be downloaded from the Campbell Scientific website at http://www.campbellsci.com/downloads

Follow these steps:

1. Connect a 12V power supply to the AVW2xx, either using an AC Adaptor or the CR800 /CR1000 12V & G connections on the wiring panel.

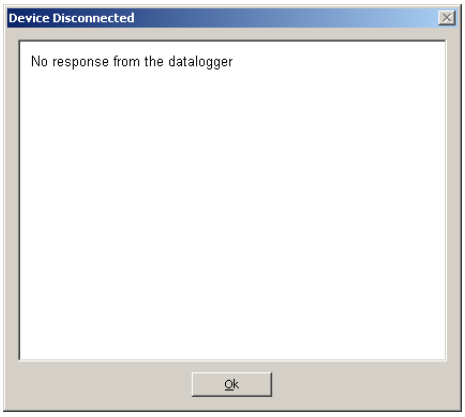
2. Connect a standard RS-232 cable between the AVW2xx RS-232 port and the computers COM port.

3. Launch the Device Configuration software. The AVW2xx is the first device in the Device Type list so it will display by default when launching the software.

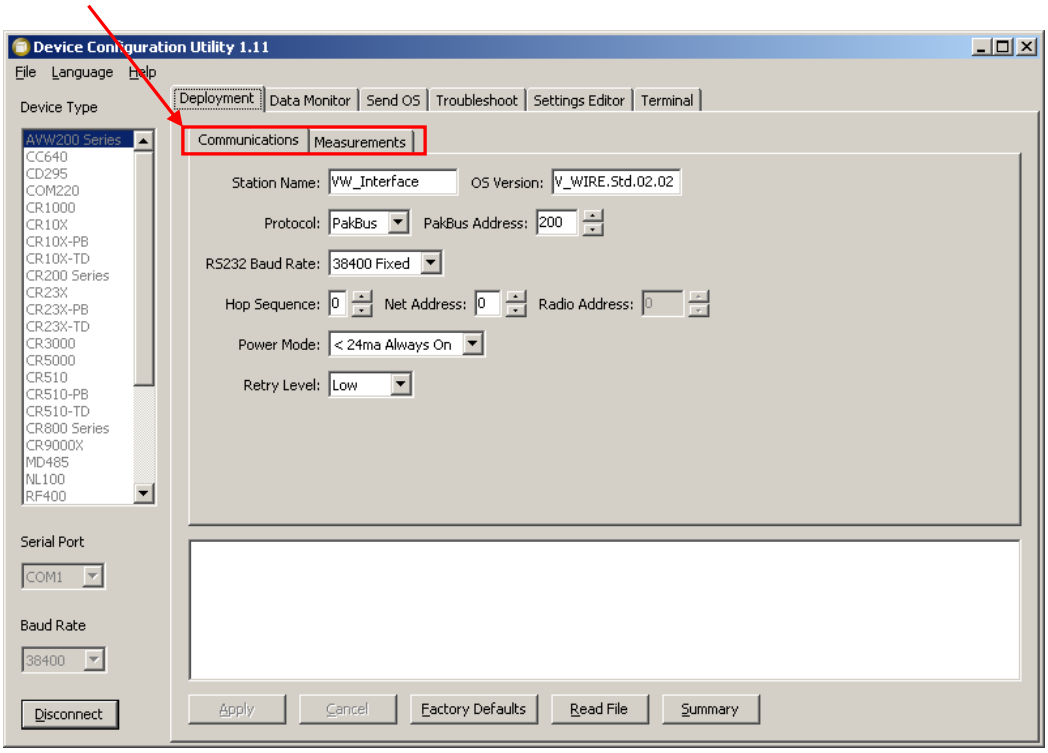


4. Press the Connect button to connect to the AVW2xx.

   If you receive the error shown at right then check connections and try again.



Once connected you will see a main tab control, then a secondary tab control on the main Deployment tab. The secondary tabs, Communications and Measurements are used for configuring the AVW2xx.



See the AVW200 Operators Manual for information on the other tabs of the main tab control.

Note: For the AVW200 (non-wireless) the radio settings will be disabled.

The following are the main settings for configuring wired or wireless deployments:

Wired Deployments

- **PakBus Address**
- **SDI-12 Address (found on Measurements tab – set to 0)**
- **Multiplexer Type (if using multiplexers – found on Measurements tab)**

Wireless Deployments

- **PakBus Address**
- **Multiplexer Type (if using multiplexers – found on Measurements tab)**
- **Hop Sequence**
- **Radio Address**
- **Power Mode**

Note: For wireless deployments make sure the Hop Sequence, Net Address and Power Mode match the RF4xx being used for communication with the AVW2xx.

If settings are changed press the **Apply** button to update the AVW2xx, otherwise press **Disconnect**. A summary report will display, this can be saved as an XML file for updating other units or printed for record keeping.

See the following section on configuring the RF4xx radio for wireless deployments.

Configuring the RF4xx with CSI Device Configuration Software

For wireless applications the RF4xx spread spectrum radio must be configured for use with the AVW2xx. Use Campbells Device Configuration software to configure the radio. The Device Configuration software is included with LoggerNet or may be downloaded from the Campbell Scientific website at http://www.campbellsci.com/downloads

Follow these steps:

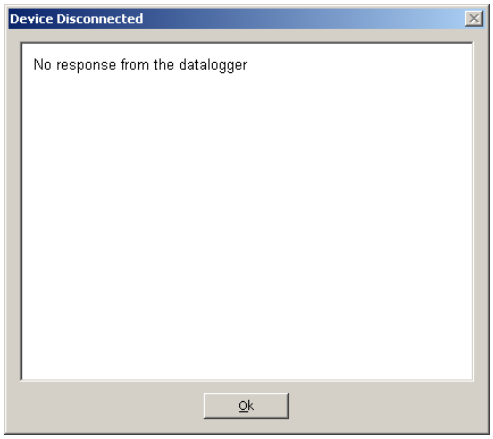
1. Connect a 12V power supply to the RF4xx, either using an AC Adaptor or the coax power cable which allows you to wire to the CR800 /CR1000 12V & G connections on the wiring panel. Alternately you may connect the CS I/O connectors on the RF4xx and CR800/CR1000 using the supplied SC12 cable.

2. Connect a standard RS-232 cable between the RF4xx RS-232 port and the computers COM port.

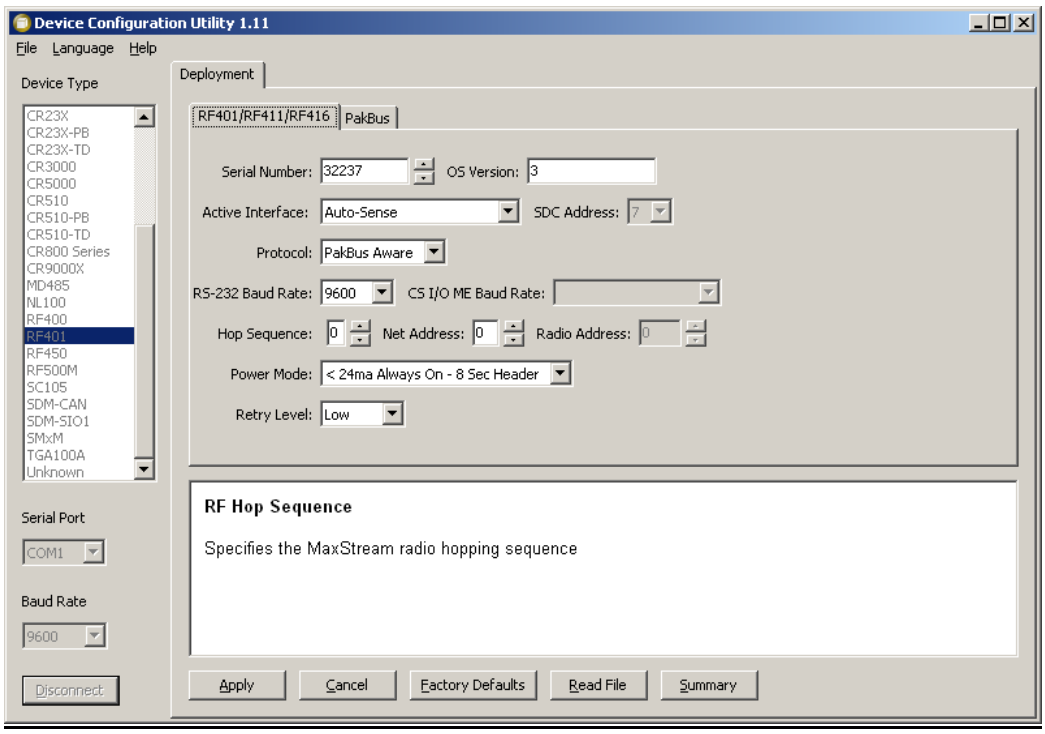
3. Launch the Device Configuration software. Scroll down the Device Type list to find the The AVW2xx is the first device in the Device Type list so it will display by default when launching the software.

4. Press the **Connect** button in Device Configuration then press the green Configuration Mode button on the RF4xx, located between the RS-232 connection and antenna connection.

   If you receive the error shown at right then check connections and try again. The red power LED should be illuminated on the RF4xx.



5. Once connected you will be shown the **Deployment** tab for the RF4xx.



The following are the main settings for configuring the RF4xx:

- **Protocol (set to PakBus Aware)**
- **Hop Sequence**
- **Radio Address**
- **Power Mode**

Note: Make sure the Hop Sequence, Net Address and Power Mode match the AVW2xx being used with RF4xx.

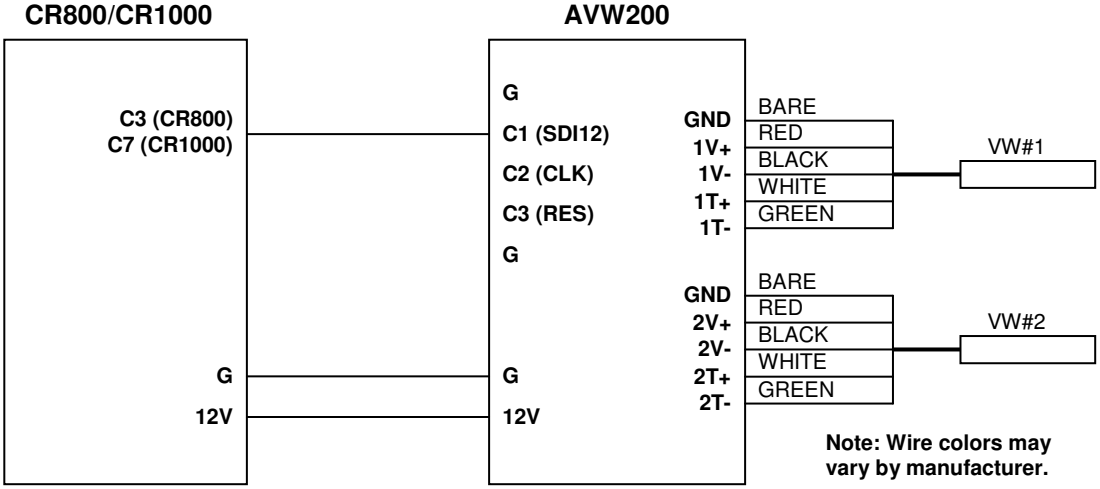
See the RF4xx Operators Manual for information on other settings but for most deployments no other settings need to be modified from the factory defaults.

Note: Contact Canary Systems for direction with more complicated configurations including use of static PakBus route maps.

If settings are changed press the **Apply** button to update the RF4xx, otherwise press **Disconnect**. A summary report will display, this can be saved as an XML file for updating other units or printed for record keeping.

Wired Configuration – AVW200 with Direct Connect Gages

The following configuration depicts an AVW200 connected directly to the CR800 or CR1000, with gages connected directly (no multiplexers) to the AVW200. Up to 2 gages may be directly connected to the AVW200. The connection scheme utilizes SDI-12, this allows a single control port connection to the MCU. Other configurations are possible including use of the RS-232 port. See the AVW200 Operators Manual for more information on these configurations.



To configure MultiLogger use the following Direct Connect **Gage Type** | **Make** | **Model** selections:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	Generic	AVW200 CH1 12V Digits	Channel 1 with 12V excitation	Digits
		AVW200 CH1 12V Hz	Channel 1 with 12V excitation	Hz
		AVW200 CH1 5V Digits	Channel 1 with 5V excitation	Digits
		AVW200 CH1 5V Hz	Channel 1 with 5V excitation	Hz
		AVW200 CH2 12V Digits	Channel 2 with 12V excitation	Digits
		AVW200 CH2 12V Hz	Channel 2 with 12V excitation	Hz
		AVW200 CH2 5V Digits	Channel 2 with 5V excitation	Digits
		AVW200 CH2 5V Hz	Channel 2 with 5V excitation	Hz

Notes:

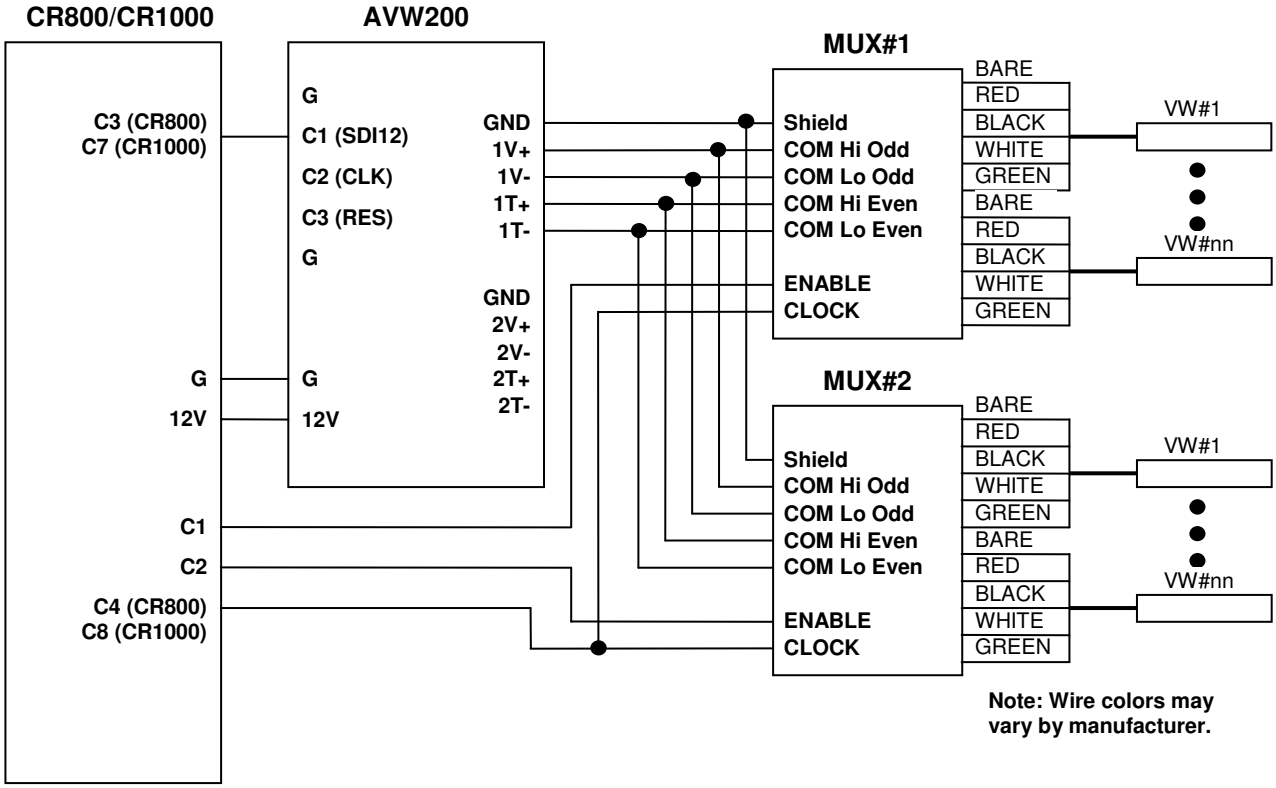
- All of these Models use a frequency range of 400-4000Hz which should be adequate for most installations. Contact Canary Systems for direction to narrow or widen the frequency range.
- All of these Models use SDI-12 address 0. Contact Canary Systems for direction when using a different SDI-12 address.

To read the **Upper Channel** (Temperature Device):

Device	Description	Output Units
AVW200_YSI44005-℃	YSI type 44005 on Channel 1 or 2	℃
AVW200_YSI44005-℉	YSI type 44005 on Channel 1 or 2	℉

Wired Configuration – AVW200 with Multiplexers Controlled by MCU (2-6 multiplexers)

The following configuration depicts an AVW200 connected directly to the CR800 or CR1000, with gages connected to multiplexers controlled by the CR800 or CR1000. Note: A maximum of 2 multiplexers can be connected to the CR800 using this configuration. See the following section for connecting up to 4 multiplexers to the CR800 and up to 10 multiplexers to the CR1000.



Use the following configuration for the multiplexers:

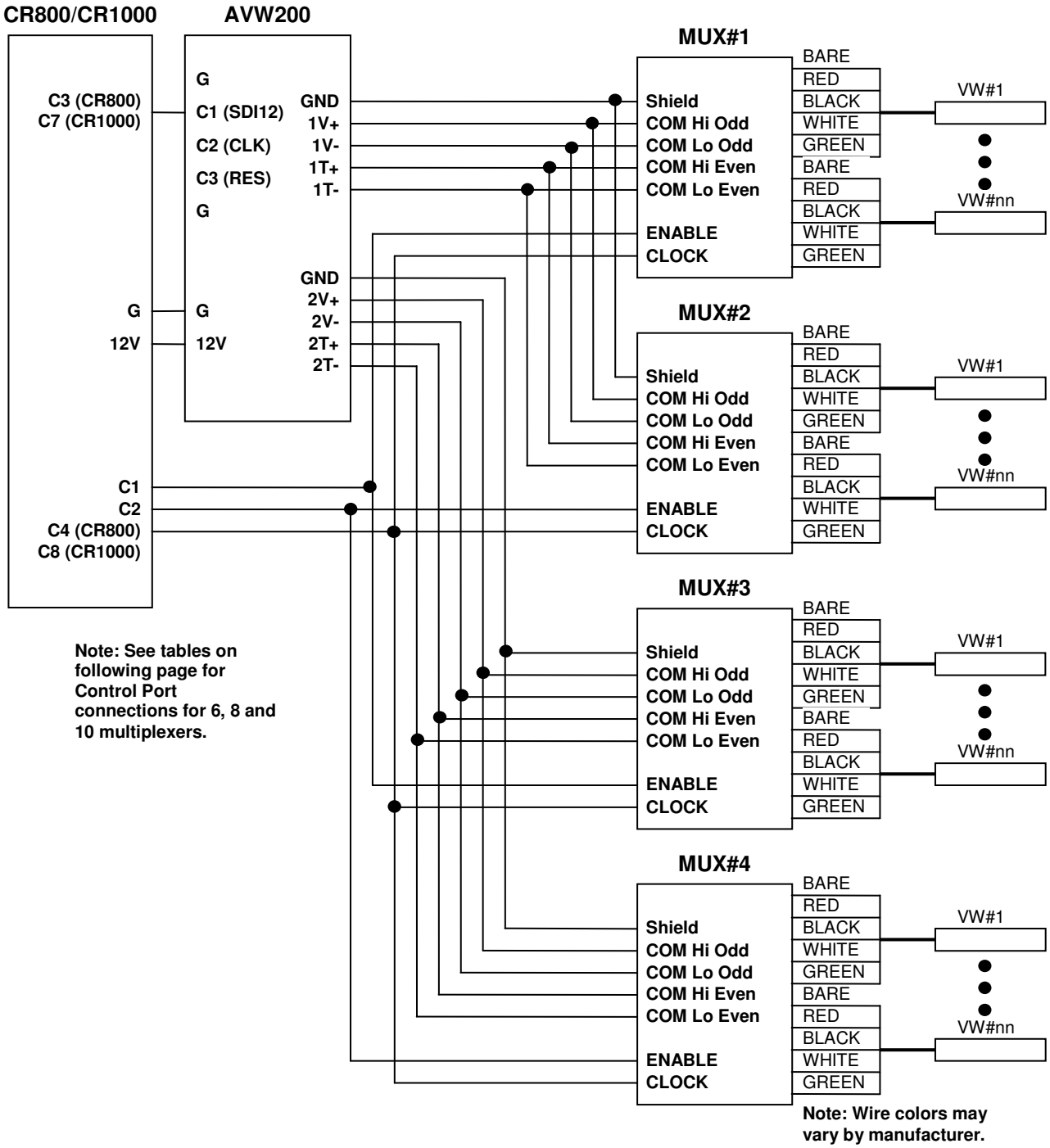
Mux	Mux Model	Gage Type	Channels	Wires	Enable	Clock
1	As Req'd	Vibrating Wire	16/32	4/2	C1	C4 (CR800) C8 (CR1000)
2	As Req'd	Vibrating Wire	16/32	4/2	C2	C4 (CR800) C8 (CR1000)
3	As Req'd	Vibrating Wire	16/32	4/2	C3 (CR1000)	C8 (CR1000)
4	As Req'd	Vibrating Wire	16/32	4/2	C4 (CR1000)	C8 (CR1000)
5	As Req'd	Vibrating Wire	16/32	4/2	C5 (CR1000)	C8 (CR1000)
6	As Req'd	Vibrating Wire	16/32	4/2	C6 (CR1000)	C8 (CR1000)

Use the same gage types for Channel Configuration as shown in Direct Connect Section.

Note: Only use the Channel 1 Gage Types.

Wired Configuration – AVW200 with Multiplexers Controlled by MCU (4-10 multiplexers)

The following configuration depicts an AVW200 connected directly to the CR800 or CR1000, with gages connected to multiplexers controlled by the CR800 or CR1000. Up to 4 multiplexers can be controlled when using the CR800, up to 10 (up to 12 can be controlled but MultiLogger is limited to 10) when using the CR1000.



See the tables on the following page for the 4, 6, 8 and 10 multiplexer connection/configuration tables.

Use the following configuration for 4 multiplexer configuration:

Mux	Mux Model	Gage Type	Channels	Wires	Enable	Clock	AVW2xx CH
1	As Req'd	Vibrating Wire	16/32	4/2	C1	C4 (CR800) C8 (CR1000)	1
2	As Req'd	Vibrating Wire	16/32	4/2	C2	C4 (CR800) C8 (CR1000)	1
3	As Req'd	Vibrating Wire	16/32	4/2	C1	C4 (CR800) C8 (CR1000)	2
4	As Req'd	Vibrating Wire	16/32	4/2	C2	C4 (CR800) C8 (CR1000)	2

Use the following configuration for 6 multiplexer configuration (CR1000 only):

Mux	Mux Model	Gage Type	Channels	Wires	Enable	Clock	AVW2xx CH
1	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	1
2	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	1
3	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	1
4	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	2
5	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	2
6	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	2

Use the following configuration for 8 multiplexer configuration (CR1000 only):

Mux	Mux Model	Gage Type	Channels	Wires	Enable	Clock	AVW2xx CH
1	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	1
2	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	1
3	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	1
4	As Req'd	Vibrating Wire	16/32	4/2	C4	C8	1
5	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	2
6	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	2
7	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	2
8	As Req'd	Vibrating Wire	16/32	4/2	C4	C8	2

Use the following configuration for 10 multiplexer configuration (CR1000 only):

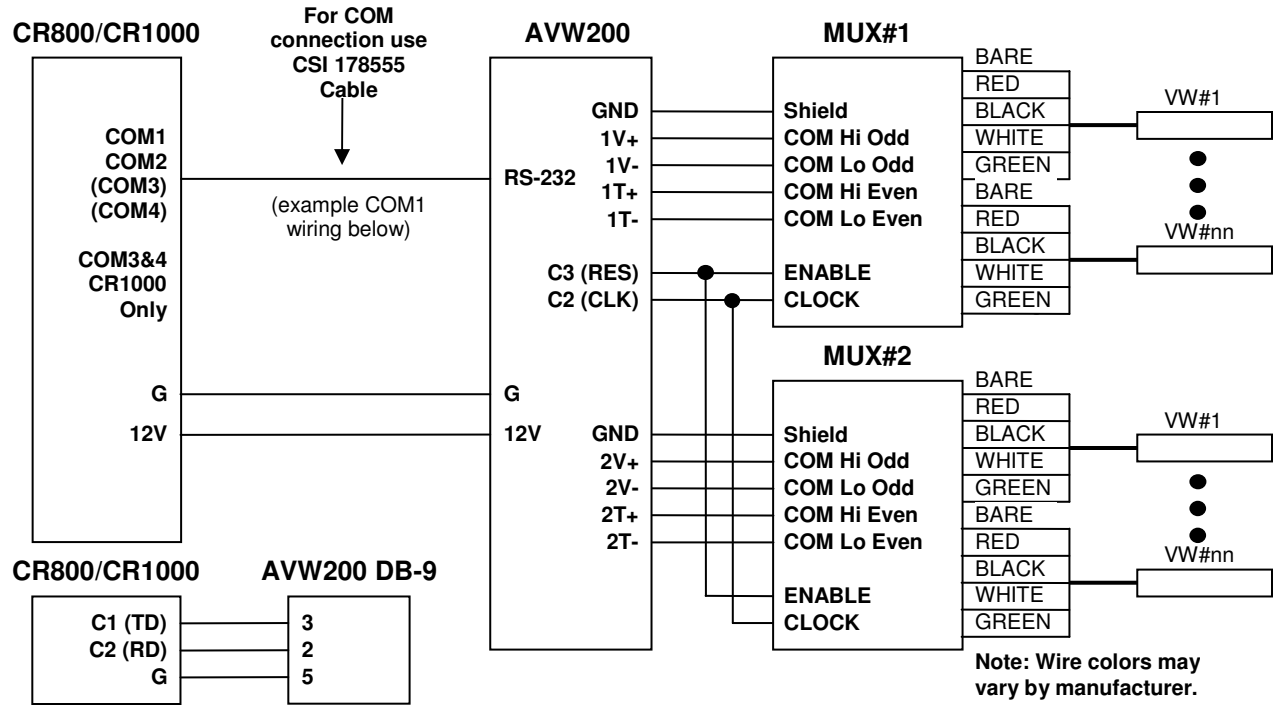
Mux	Mux Model	Gage Type	Channels	Wires	Enable	Clock	AVW2xx CH
1	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	1
2	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	1
3	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	1
4	As Req'd	Vibrating Wire	16/32	4/2	C4	C8	1
5	As Req'd	Vibrating Wire	16/32	4/2	C5	C8	1
6	As Req'd	Vibrating Wire	16/32	4/2	C1	C8	2
7	As Req'd	Vibrating Wire	16/32	4/2	C2	C8	2
8	As Req'd	Vibrating Wire	16/32	4/2	C3	C8	2
9	As Req'd	Vibrating Wire	16/32	4/2	C4	C8	2
10	As Req'd	Vibrating Wire	16/32	4/2	C5	C8	2

Note: Use the same gage types for Channel Configuration as shown in Direct Connect Section. Be sure to use appropriate Channel type to match multiplexer to AVW2xx wiring.

Wired Configuration – AVW200 with Multiplexers (up to 2)

The following configuration depicts an AVW200 connected directly to the CR800 or CR1000, with gages connected to multiplexers controlled by the AVW200.

Note: You will need to configure the AVW2xx for which type of multiplexer is connected. See the introductory section for information on using Campbells Device Configuration software to do this.



Each multiplexer would be configured separately in MultiLogger. When configuring the multiplexers use the Multiplexer Model **AVW2xx**. Configure the Channels to match the multiplexer configuration. Up to 16 vibrating wire gages with temperature can be read, or 32 channels without temperature.

Use the following **Gage Type** | **Make** | **Model** selections for the Multiplexer 1 Channel Configuration:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	AVW2xx	COM1 PB200 CH1 Digits	PakBus ID 200 CH1 connected to Com1	Digits
		COM2 PB200 CH1 Digits	PakBus ID 200 CH1 connected to Com2	Digits
		COM3 PB200 CH1 Digits	PakBus ID 200 CH1 connected to Com3	Digits
		COM4 PB200 CH1 Digits	PakBus ID 200 CH1 connected to Com4	Digits

Use the following **Gage Type** | **Make** | **Model** selections for the Multiplexer 2 Channel Configuration:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	AVW2xx	COM1 PB200 CH2 Digits	PakBus ID 200 CH2 connected to Com1	Digits
		COM2 PB200 CH2 Digits	PakBus ID 200 CH2 connected to Com2	Digits
		COM3 PB200 CH2 Digits	PakBus ID 200 CH2 connected to Com3	Digits
		COM4 PB200 CH2 Digits	PakBus ID 200 CH2 connected to Com4	Digits

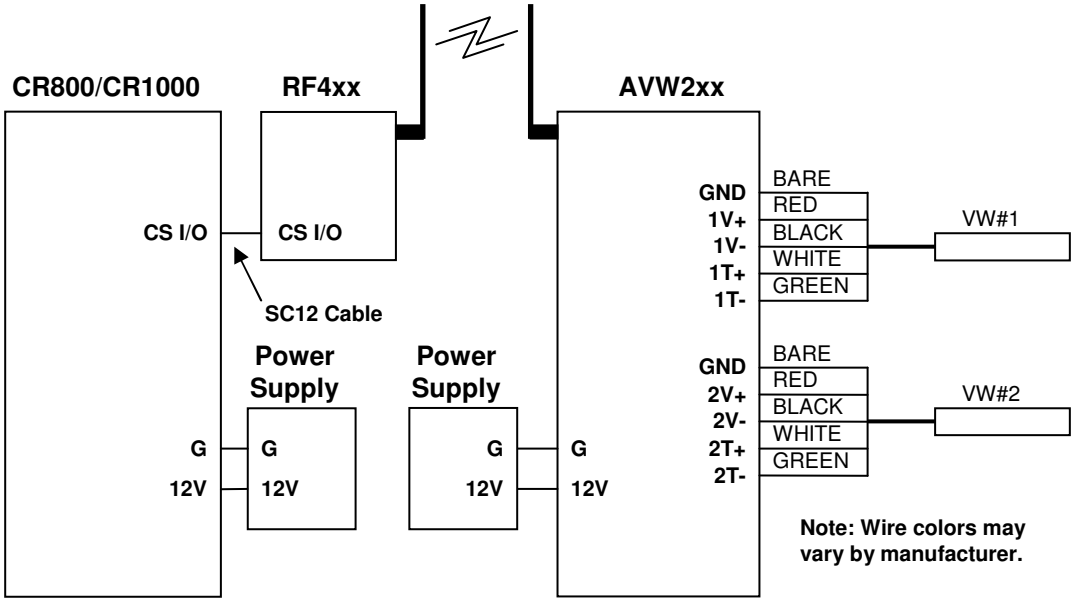
Note: These gage types all use 12 volt excitation which should be appropriate for most gages. Contact Canary Systems if you experience unexplained measurement instability.

To read the **Upper Channel** (Temperature Device):

Device	Description	Output Units
AVW200_YSI44005-℃	YSI type 44005 on Channel 1 or 2	℃
AVW200_YSI44005-℉	YSI type 44005 on Channel 1 or 2	℉

Wireless Configurations – AVW200 with Instruments Directly Connected

The following configuration depicts an AVW200 connected wirelessly to the CR800 or CR1000 with gages connected directly (no multiplexers) to the AVW200. Up to 2 gages may be directly connected to the AVW200. The radio is a matching RF4xx, connected to the MCU on the CS I/O connection using the SC12 cable. See the introductory sections on configuring the AVW2xx and RF4xx for wireless operation. **Contact Canary Systems for assistance with using other communications interfaces for the RF4xx – the RS-232 port and COM1-COM4 (COM1-COM2 on CR800) can be supported.**



To configure MultiLogger use the following Direct Connect **Gage Type** | **Make** | **Model** selections:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	AVW2xx	SDC7 PB2nn CH1 Digits	PakBus 2nn CH1 connected to SDC7 (CS I/O)	Digits
		SDC7 PB2nn CH2 Digits	PakBus 2nn CH2 connected to SDC7 (CS I/O)	Digits

Where;
PB2nn: Select the actual address for the device in use.

Note that PakBus addresses 200-215 are currently supported. Contact Canary Systems if your application requires deployment of more than 16 AVW2xx's.

Note: These gage types all use 12 volt excitation which should be appropriate for most gages. Contact Canary Systems if you experience unexplained measurement instability.

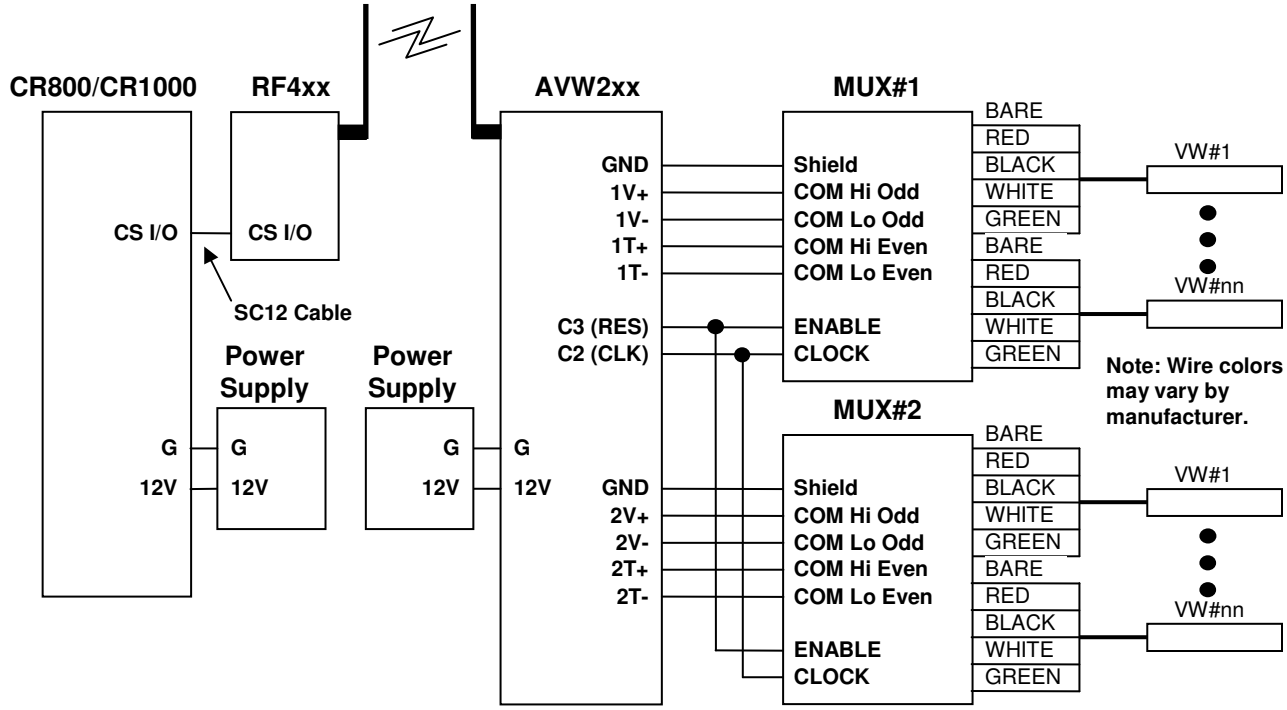
To read the **Upper Channel** (Temperature Device):

Device	Description	Output Units
AVW200_YSI44005-°C	YSI type 44005 on Channel 1 or 2	°C
AVW200_YSI44005-°F	YSI type 44005 on Channel 1 or 2	°F

Wireless Configurations – AVW200 with Multiplexers (up to 2)

The following configuration depicts an AVW200 connected wirelessly to the CR800 or CR1000 with gages connected to multiplexers connected to the AVW200. Up to 2 multiplexers may be directly connected to the AVW200. The multiplexers may be configured for 16 channel mode to include reading the temperature, or 32 channels without temperature.

Note: You will need to configure the AVW2xx for which type of multiplexer is connected. See the introductory section for information on using Campbells Device Configuration software to do this.



Each multiplexer would be configured separately in MultiLogger. When configuring the multiplexers use the Multiplexer Model **AVW2xx**. Configure the **Channels** to match the multiplexer configuration. Up to 16 vibrating wire gages with temperature can be read, or 32 channels without temperature.

Use the following **Gage Type** | **Make** | **Model** selections for the Multiplexer 1 Channel Configuration:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	AVW2xx SDC7	PB200 CH1 12V Digits	PakBus 200 CH1 with 12V excitation	Digits
		PB200 CH1 12V Hz	PakBus 200 CH1 with 12V excitation	Hz
		PB200 CH1 5V Digits	PakBus 200 CH1 with 5V excitation	Digits
		PB200 CH1 5V Hz	PakBus 200 CH1 with 5V excitation	Hz

Use the following **Gage Type** | **Make** | **Model** selections for the Multiplexer 2 Channel Configuration:

Gage Type	Make	Model	Description	Output Units
Vibrating Wire	AVW2xx SDC7	PB200 CH2 12V Digits	PakBus 200 CH2 with 12V excitation	Digits
		PB200 CH2 12V Hz	PakBus 200 CH2 with 12V excitation	Hz
		PB200 CH2 5V Digits	PakBus 200 CH2 with 5V excitation	Digits
		PB200 CH2 5V Hz	PakBus 200 CH2 with 5V excitation	Hz

Note: PakBus addresses 200-215 are currently supported however MultiLogger is limited to 10 multiplexers. Select the appropriate PakBus address to match the device in use.

See the previous section for configuring the temperature measurement.

Troubleshooting

The Campbell AVW200 Operators Manual has additional information on trouble-shooting, particularly for the wireless deployments.

It also contains information on using the Device Configuration software to view the vibrating wire signal responses to trouble-shoot poorly performing gages or noisy environments.

This section will provide guidelines to aid in trouble-shooting the commonly encountered issues.

MultiLogger provides several metrics to aid in troubleshooting, as follows:

- When instruments are disconnected or otherwise fail to read the Text Monitor will show OVERRANGE, or a stored value of **-99999**. The minimum amplitude used to verify a gage measurement is 0.1mV This may need to be adjusted for some instrument types.

- When the AVW2xx is disconnected or otherwise unable to communicate with the MCU the Text Monitor will display a value of **-99998**.

- UserLoc(1) holds the output amplitude of the vibrating wire signal. This can be added to the Text Monitor (you'll need to turn off **Auto Configure Locations** in the **Configure** | **Preferences** form of Logger to view this location).

- Additional metrics such as Signal-to-Noise Ratio (SNR) can be shown in the UserLocs by editing the instruction file for the selected **Gage Type** | **Make** | **Model** (press the gear button and remove the comment characters from the lines of programming).

Follow these steps to resolve the commonly encountered issues:

1. Check all power connections. When using the RF4xx make sure the red PWR led is lit.

2. Check all wiring connections. Use the diagrams provided in this Application Note.

3. Use the Device Configuration software to check settings in the AVW2xx per instructions outlined previously. If using SDI-12 with directly connected AVW2xx's check the SDI-12 address setting. This should be set to 0. If using other interfaces double-check the PakBus ID.

4. If using a wireless deployment use the Device Configuration software to check that the radio and AVW2xx wireless settings match. **The Hop Sequence and Net Address MUST MATCH.** Also the Power Mode should match, other combinations to reduce power consumption should be tested thoroughly prior and during deployment.

5. If using a wireless deployment then check all antenna cabling and connections. Check signal strength using the RF4xx diagnostics.

6. If using multiplexers with the AVW2xx make sure the correct multiplexer **Model** is selected. If using the MCU to control multiplexers then select the model of the multiplexer attached. If using the AVW2xx to control to the multiplexers then make sure the multiplexer **Model** is set to AVW2xx.

7. Check that the **Gage Type** | **Make** | **Model** selected for each channel matches the wiring and AVW2xx configuration.