

Understanding and Testing the CR1000 Box

What is the CR1000?

The CR1000 box is the data logger for the system. **Fig. 1** shows a front view of the CR1000.



Fig. 1: Front view of the CR1000 box (top). Green circles represent various lights, while grey circles represent the circuit breakers.

Walk through of the CR1000 box

The front of the CR1000 is quite simple, there is a circuit breaker/ power switch and a series of status lights (**Fig. 1**) The back of the box has all of the connections, which are outlined in **Fig. 2**.

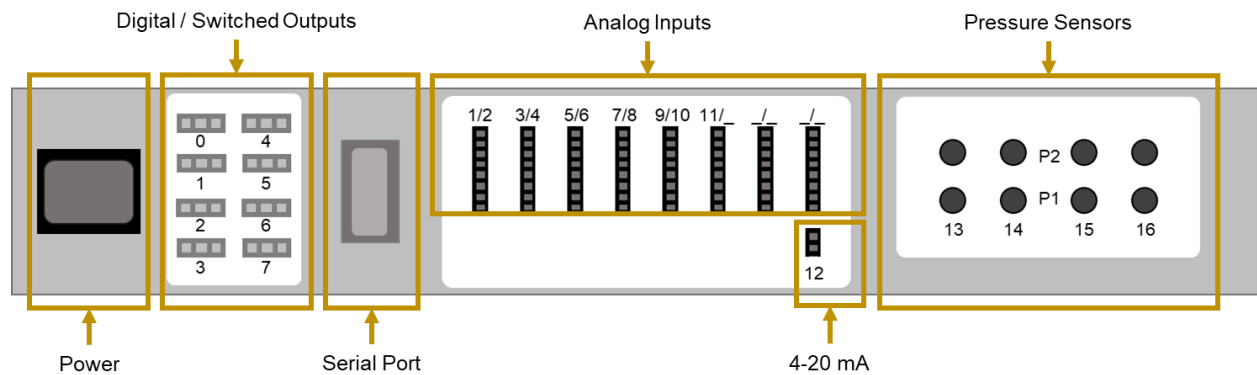


Figure 2: Walkthrough of the back of the CR1000. Numbering of the connections is how it appears on the box.

Digital/ Switched Outputs

The digital or ‘switched’ outputs are used to trigger a relay (or switch). There are eight digital outputs available on the back of the CR1000 box, and these are numbered 0-7.

All of the digital outputs on the CR1000 are 3-pin connectors (**Fig. 3**).



Figure 3: Key for the 3-pin digital/ switched output connectors.

For a typical system, digital outputs #0 and #1 are the two used for the solenoids that control the bypass flow and for the electronic ball valve which controls the system size cut (determines the path of the analyzer flow). The configuration file determines which connection goes to which port. To check this look in the CR1000 section of the configuration file for these lines:

```
/aerosol/Components/CR1000/DigitalOutputs/DisableBypassValve, 0  
/aerosol/Components/CR1000/DigitalOutputs/PM1Impactor, 1
```

The zero and one indicates that the solenoid cable should be on connection 0 while the impactor switch should be on connection 1.

Analog Inputs

There are 8 analog input connections on the back of the CR1000 box, numbered 1-11 with two numbers for each connector (**Fig. 2**). These connections are all 8-pin connections. For a typical CR1000 the labels on these connectors correspond to the channels in the CR1000 menu.

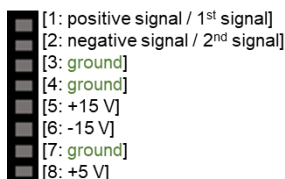


Figure. 4 Key for the 8-pin connectors.

4-20 mA Connector

There is one 4-20 mA analog input connector (**Fig. 2**). This is used for the pressure transducer connected to the pitot tube in the pump box. The current from the transducer is dropped across a resistor and the CR1000 gets a voltage representation of the current. Usually, this connector corresponds to channel 12 in the CR1000 menu.

Pressure Sensors

There are 8 pressure sensors, 4 pairs of high and low. Typically, these are all wired and assigned to channels #13, 14, 15, and 16. In practice only two of these sensors are typically used, one for the nephelometer impactors and one for the CN box.

Connector Use and Example Channel to Port Assignment

Here we show the port/ channel assignment at the Barrow AK, USA (BRW) site as of 2023. Figure 5 shows the port use labeled and the channel numbers for the port. Then, text from the configuration file setting the channels is shown. Note that the order of the channel assignment below is not how it appears in the original configuration file, but it has been reordered to walk through the ports as they are described in this document.

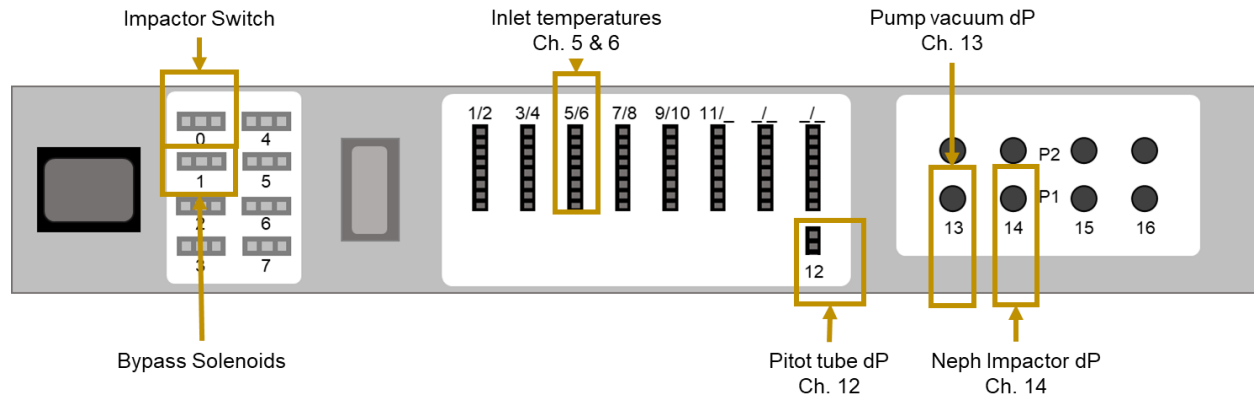


Figure 5: Port and channel usage at the BRW site as of 2023.

Lines for assignment of the digital/ switched output ports:

```
/aerosol/Components/CR1000/DigitalOutputs/DisableBypassValve,0
/aerosol/Components/CR1000/DigitalOutputs/PM1Impactor,1
```

Lines for assignment of the analog input ports:

```
/aerosol/Components/uMAC/Variables/T_V51/Channel,5
/aerosol/Components/uMAC/Variables/T_V51/Metadata/*rDescription,"Splitter
temperature"
```

```
/aerosol/Components/uMAC/Variables/T_V11/Channel,6
/aerosol/Components/uMAC/Variables/T_V11/Metadata/*rDescription,"Impactor box
inlet temperature"
```

Lines for assignment of the 4-20mA and pressure sensor ports:

```
/aerosol/Components/CR1000/Variables/Pd_P01/Channel,12
/aerosol/Components/CR1000/Variables/Pd_P01/Metadata/*rDescription,"Stack
pitot tube"
```

```
/aerosol/Components/CR1000/Variables/Pd_P12/Channel,13
/aerosol/Components/CR1000/Variables/Pd_P12/Metadata/*rDescription,"Pump
vacuum"
```

```
/aerosol/Components/CR1000/Variables/Pd_P11/Channel,14
/aerosol/Components/CR1000/Variables/Pd_P11/Metadata/*rDescription,"Impactor
pressure drop"
```

How to test a CR1000 box

Have an impactor box set up and ready. Make sure the CR1000 has power and the breaker on the front is pushed in, is connected to the serial hub and has the necessary connections to the impactor box – this all concerns the first three connections outlined in **Fig. 2**.

Testing the 8-pin Connectors

Navigate to the CR1000 instrument screen on the cpd laptop and move to the second display by pressing “M”, and then “D” Next Display (**Fig. 6**). This will allow you to see all of the channel outputs.

Using an RH to 8-pin adaptor connect the RH probe to each of the 8-pin ports one at a time. Check the readout on the CR1000 instrument screen for the connections associated with each 8-pin port. At this point it is helpful to know the calibration on your CR1000 for temperature, and to know that the RH should be ~100x the channel readout. To check the calibration look in the configuration file for:

```
/aerosol/Components/CR1000/variables/T_V11/Calibration/#0,-40.0  
/aerosol/Components/CR1000/variables/T_V11/Calibration/#1,100.0
```

The #0 is the intercept and the #1 is the slope. Check to make sure the channels are getting reasonable RH and temperature inputs. Its also helpful to test with more than one RH probe as some of the probes could be broken or one very reliable/new probe.

NOTE: this is the only configuration where the CR1000 gets an RH reading, and it should be in the first of the two channels associated with the port. So if you were on the first 8-pin port RH would be in channel 8 and temperature would be in channel 9.

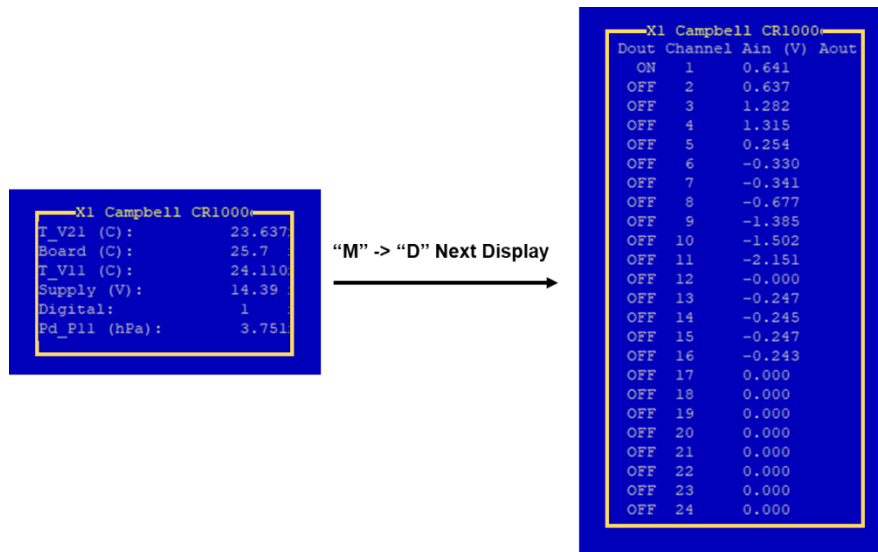


Fig. 6: What the CR1000 instrument screen will look like and what the next display will look like with all the channel data.

Testing the Pressure Transducer and Pressure sensors

Navigate back to the main instrument screen (**Fig. 6, left**). Connect a pressure transducer to the 2-pin port on the CR1000 (**Fig. 2**). Blow into the transducer and if the pressure variable on the instrument main screen goes up the connection works.

For the pressure sensors attach a handheld pump across two of the sensors. Do one or two pumps and see if the pressure on the instrument main screen goes up, if it does the sensors work.

Testing Impactor Box Controls

For this test it can be helpful to have a PID box also connected so that the MCF will open and you will have flow that you can measure.

For the solenoids go to the system status menu and put the impactor box into bypass mode. If you hear the solenoids click this control works. Even better if you have flow measure at the “Return Flow From Neph” on the impactor box before and after changing the mode, if flow stops in bypass mode the solenoid control works.

For the impactor switch, go to the impactor schedule on the main cpd menu. Activate the next action and you should hear the switch move in the box. If this does not happen, you could have a problem with the switch or with the configuration file – check both before testing again.