APPLICATION NOTE

Sensor

Eddy Covariance Hardware Troubleshooting

Preparing for a Site Visit

06/2026

RELIABLE MONITORING SINCE 1974

Campbell SCIENTIFIC®

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1. Introduction

This troubleshooting guide helps diagnose problems with a CSAT3A, CSAT3B, or IRGASON sonic anemometer that is reporting NAN values or has active diagnostic flags. The guide is intended to help you prepare for your next site visit. Campbell Scientific recommends contacting your technical support representative **before** planning an on-site visit.

> **NOTE:**
> The CSAT3C is the direct successor of the CSAT3B. For most users, the CSAT3C is a drop-in replacement for the CSAT3B. In this guide, directions for the CSAT3B also apply to the CSAT3C.

1.1 CSAT site visit check list

Before your on-site visit:

Contact Campbell Scientific technical support.

For customers in the US:

- **Call:** (435) 227-9100
- **Email:** support@campbellsci.com

For customers outside of the US:

- Contact your Campbell Scientific regional office.

Please collect the following information before calling, if available:

- How long the unit has been deployed in the field
- When the system stopped operating normally
- When the last site visit and maintenance occurred
- Time since the molecular sieve was last replaced
- Time since the last zero and span
- Current battery voltage
- Active diagnostic flags
- IP address, port, and PakBus address (if connecting remotely)

What to bring:

- Laptop with Windows 7, 8, 10, or 11 and an available USB port
- 2 x USB to Mini-USB cables
- 2 x USB-C (if using the CSAT3C)
- 1 x USB-B (if connecting directly to the EC100 port instead of the port on the bottom of the enclosure
- *ECMon* software (installed)
- *Device Configuration Utility* (installed separately or included with *LoggerNet* or *PC400*)
- Multimeter
- Spare 12 V battery
- Sonic wick replacement kit*
- Spare anemometer cables*
- Spare Campbell Scientific data logger*
- Spare sonic anemometer or IRGASON*

> NOTE:
> Items with an * are recommended for remote sites or any deployment where extended data loss is not acceptable.

1.2 Perform visual inspection

Physical obstructions and weather or animal damage are the most common causes of data loss in field-deployed anemometers. Inspect the unit before troubleshooting anything else.

Obstructions

Check for anything blocking the sonic path: spider webs, bird nests, dirt, or debris. Clear any obstructions, then check whether diagnostic flags are still active. See: Interpreting ECMon error/diagnostic flags (p. 8).

Transducer condition

Inspect each transducer for the following:

- Corrosion on the metal cylinder
- Fraying wicks or wicks covering the transducer face

- Erosion or chipping on the transducer face (newer faces are circular and white; older faces are black)

Photograph any damage for your records.

Transducer alignment

The anemometer has three transducer pairs, each with one transducer on the upper claw and one on the lower. Use a ruler or straightedge to verify each pair is aligned. Misalignment indicates the sonic claws have been bent.

Gas head windows

Visually inspect the gas head windows. Look for corrosion, water intrusion, and fogged lenses.

EC155

Verify that the following connections are secure:

- Cable from the EC100 to the EC155
- Electronics cable and zero air tubing from the scrub module (if installed) to the CPEC enclosure
- Span gas tubing from the tank to the CPEC enclosure
- Zero/span gas delivery tube from the CPEC enclosure to the EC155

Also inspect all wires and cables inside the EC100 and CPEC enclosures.

1.3 Perform routine maintenance

Sonic anemometer wicks

Replace wicks that are missing, frayed, or blocking the transducer path. Use the sonic wick replacement kit. In windy environments, apply one small drop of superglue near the base of each transducer to secure the wick.

CSAT3B desiccant

The desiccant is located under the electronics box, secured by a large brass plug removable with a large screwdriver. When removing the plug, also inspect the interior of the electronics box for condensation or standing water. Replace the desiccant if depleted. See: www.campbellsci.com/order/30749.

IRGASON molecular sieve

The molecular sieves are located in the arms of the IRGASON and can be accessed using a screwdriver. There are two molecular sieves, one in each arm, and they should be replaced every six months. See: www.campbellsci.com/32897.

EC100 desiccant

Verify the EC100 box is properly sealed and contains fresh desiccant. Use the internal humidity indicator to determine whether replacement is needed. See: www.campbellsci.com/order/42815.

Power

Use a multimeter to verify the sonic anemometer is receiving 12 V or more. Also verify the rest of the system enclosure is properly sealed and dry.

2. Diagnosing errors

If your CSAT3A, CSAT3B, or IRGASON sonic anemometer is giving erroneous measurements (values of 0, NAN, or values that don't make sense), perform these diagnostic steps to determine the details of the fault. Some issues can be resolved through maintenance in the field; others may require requesting an RMA (Return Merchandise Authorization) from Campbell Scientific technical support.

Start here: Use the following to navigate to the section that applies to your situation:

- If the system is reporting bad values (0, NAN, or values that do not make sense), go to How to check ECMon for errors (p. 4).
- If ***ECMon*** is showing a warning flag, go to Interpreting ECMon error/diagnostic flags (p. 8).
- If technical support has requested diagnostic files, go to Creating diagnostic reports (p. 15).
- If the unit needs maintenance, go to How to zero and span your IRGASON (p. 33) and Cleaning (p. 33)
- If you need to request a return for repair, go to How to request an RMA (p. 34).

3. How to check *ECMon* for errors

Diagnostic flags can be verified for the IRGASON in ***ECMon*** (Eddy Covariance Monitor), available at www.campbellsci.com/downloads.

On site, launch ***ECMon*** and connect the EC100 electronics to the PC using the included EC100 USB cable. The USB port is on the base of the EC100 enclosure box. Once connected, select the appropriate communications port on the ***ECMon*** main page and click **Connect**.

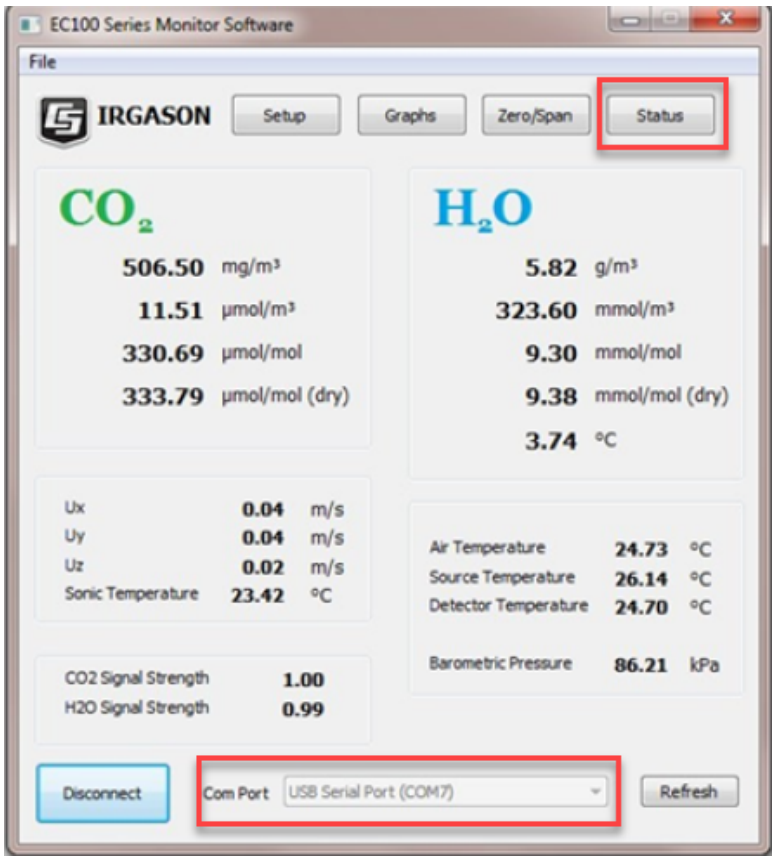


*Figure 3-1. **ECMon** main page*

Next, click the **Status** button.

The following screen captures show the **Status** window in normal operation, as well as common warning flags and their most frequent causes.

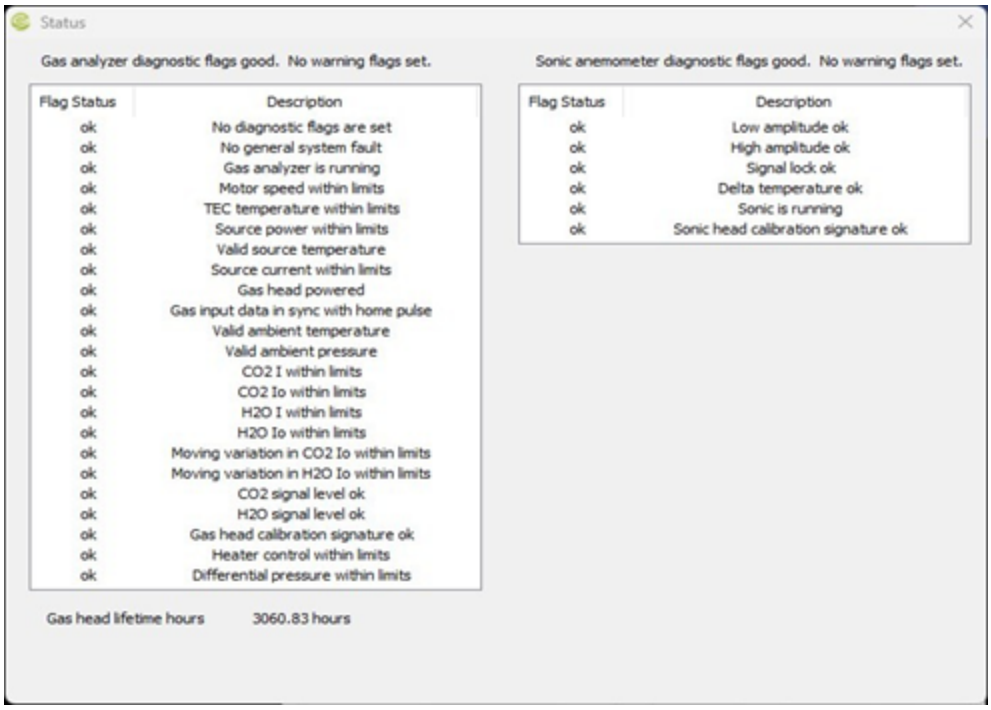


*Figure 3-2. **ECMon Status** window with no warning messages*

The *ECMon* Status window will display *Data are suspect* and *Invalid ambient temperature* when there is a problem with the auxiliary temperature sensor. Verify the sensor is connected and functioning.

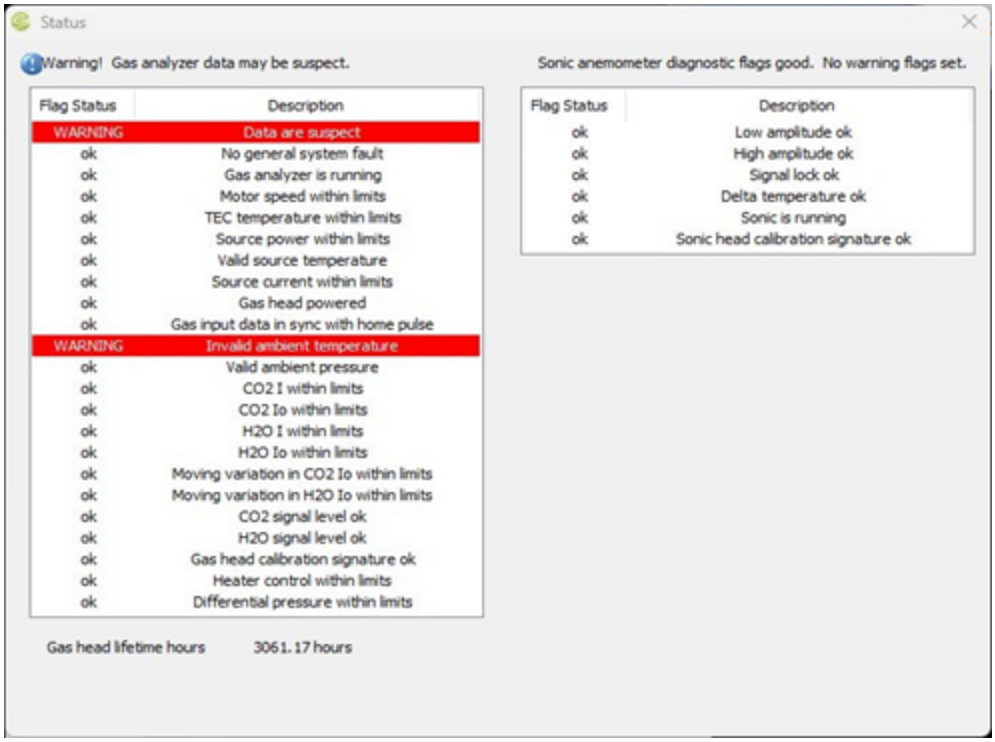


*Figure 3-3. **ECMon Status** window with Invalid ambient temperature warning*

The *ECMon* Status window will display multiple warnings when the sonic and gas analyzer paths are blocked, including:

- *Data are suspect*
- *CO2 I exceeds limits*
- *CO2 Io exceeds limits*
- *H2O I exceeds limits*
- *H2O Io exceeds limits*
- *CO2 signal level too low*
- *H2O signal level too low*, and
- *WARNING Acquiring ultrasonic signals*

Liquid water on the sonic transducers or gas analyzer windows is the most common cause, particularly during or just after rain or heavy dew. Vermin obstruction or unit failure are also possible. For specific flag descriptions, see: Interpreting ECMon error/diagnostic flags (p. 8).

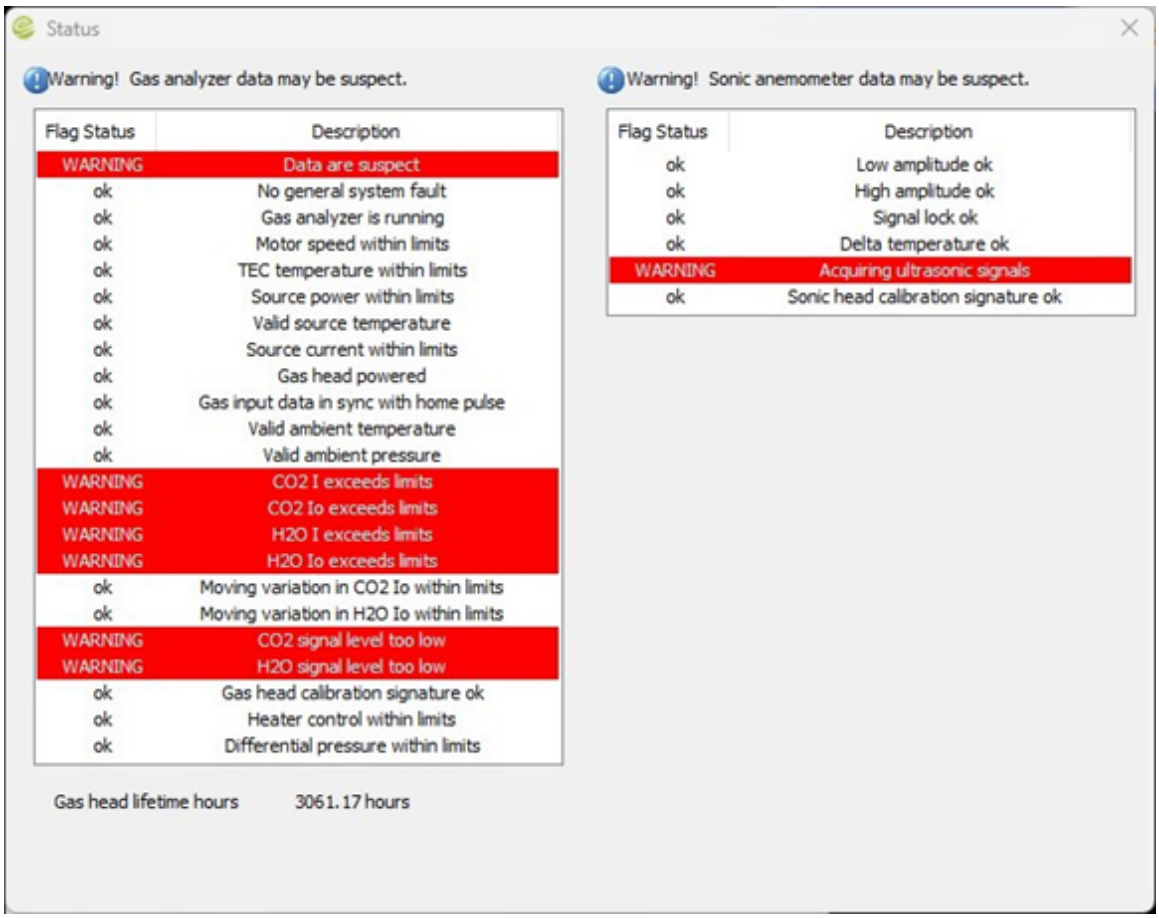


Figure 3-4. Multiple warnings when the sonic and gas analyzer paths are blocked

4. Interpreting *ECMon* error/diagnostic flags

This section explains what each diagnostic flag means. Many flag descriptions instruct you to run the **Sonic**, **Gains**, and **Gas Head** diagnostic reports. Those reports are generated using the procedures in Creating diagnostic reports (p. 15). If you have not yet generated those reports, go to that section first before interpreting the results here.

4.1 Sonic anemometer diagnostic flags explained

Campbell Scientific sonic anemometers have built-in diagnostic flags that serve three purposes:

- indicating operational problems
- disabling data output to prevent reporting erroneous data
- providing information to help diagnose instrument issues

The flag descriptions below are general guidance and are not a substitute for contacting Campbell Scientific technical support. Always pass any active diagnostic flags to your technical support representative.

Flag 1: Bad Data

Indicates another diagnostic flag is active. It disables data output. It does not identify the root cause. If this is the only flag you see, look more carefully; another flag is almost certainly active alongside it.

Flag 2: Low Amplitude (sonic_amp_l_f)

The amplitude of the voltage signal being received is below an established threshold. This flag is often triggered intermittently along with the high amplitude flag when something, such as rain, is moving in and out of the path of the anemometer. This may also be a sign of transducers failing with age. If you see this flag, run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 3: High Amplitude (sonic_amp_h_f)

The amplitude of the voltage signal being received is above an established threshold. This flag is often triggered intermittently along with the low amplitude flag when something, such as rain, is moving in and out of the path of the anemometer. If you see this flag, run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 4: Signal Lock (sonic_sig_lck_f)

The sonic anemometer is unable to obtain a good time of flight measurement from the incoming sonic signal. This flag is often triggered when something is blocking the path of the analyzer. It is also one of the most common indicators that a sonic transducer needs to be replaced. Contact Campbell Scientific technical support if this persists with no visible obstructions. If you see this flag, run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 5: Delta Temperature (sonic_del_T_f)

The sonic temperatures reported by the three pairs of sonic transducers differ from each other by more than an established threshold. This flag is nearly always triggered when one or more pairs of sonic transducers is beginning to fail. Contact Campbell Scientific technical support to verify the unit needs to be repaired. If you see this flag, run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 6: Acquiring Signals (sonic_aq_sig_f)

This flag is most often triggered when the path of the sonic anemometer is completely blocked by an obstruction. Check for obstructions. If no obstruction is detected, a sonic transducer is likely failing. Contact Campbell Scientific technical support to have it replaced. Be sure to include the **Sonic**, **Gains**, and **Gas Head** diagnostic reports when you contact a Campbell Scientific IRGASON expert.

Flag 7: Calibration Error (sonic_cal_err_f)

Occurs if the unique calibration file that ensures measurement accuracy over a range of temperatures, has been corrupted or lost. This most often occurs if the system enters a low power state with voltages <10.5 V. Having a stable uninterrupted power supply should prevent this issue. Verify power and contact your Campbell Scientific technical support representative with the serial number and model of your sonic anemometer. They will provide further instructions to send the calibration file to this unit.

> NOTE:
> EC100 OS v8.02 has some important updates to help prevent calibration file losses. If a calibration file loss occurs, please report the EC100 OS version to your Campbell Scientific technical support representative.

4.2 Gas analyzer diagnostic flags explained

Campbell Scientific infrared gas analyzers all have built-in diagnostic flags that serve three purposes: indicating operational problems, disabling data output to prevent erroneous reporting, and helping diagnose instrument issues.

This section covers how to locate and interpret diagnostic flags for system diagnosis. These interpretations are general guidance and are not a substitute for contacting technical support. Always report active diagnostic flags to your technical support representative.

Flag 1: Bad Data (irga_bad_data_f)

Generic flag that disables data output from the analyzer. It is normally triggered when any other diagnostic flag is active. It does not provide troubleshooting information, but indicates the gas

analyzer is reporting NAN values for CO2 and H2O mass densities. If this flag is active, it is a secondary symptom rather than the root cause. Most other diagnostic flags will also trigger this flag.

Flag 2: General Fault (irga_gen_fault_f)

Indicates a general hardware fault. Although this flag confirms that a problem exists within the system, it does not identify the specific cause. Run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 3: Startup (irga_startup_f)

This flag is normal during analyzer start up. The analyzer requires a few minutes to stabilize, and the flag clears automatically once start up is complete. While this flag is active, gas analyzer outputs are disabled. If the flag does not clear after start up, run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 4: Motor Speed (irga_motor_spd_f)

Indicates the motor speed differs significantly from the set point of 60 Hz. If this flag is active and the system is receiving adequate power, the unit should come in for repair. The issue is likely with the motor. Run the Sonic diagnostics (p. 27), Gains diagnostics (p. 28), and Gas head diagnostics (p. 30) reports for more information.

Flag 5: TEC Temperature (irga_tec_tmpr_f)

Triggered when the thermoelectric cooler on the gas analyzer detector differs significantly from the set point of –40 °C. If this flag is active and the system is receiving adequate power, the unit should come in for repair on an RMA. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 6: Source Power (irga_src_pwr_f)

Indicates the power being supplied to the source lamp is outside the established limits. If this flag is active and the system is receiving adequate power, the unit should come in for repair. Most often this is a symptom of a source lamp that needs to be replaced. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 7: Source temperature (irga_src_tmpr_f)

Indicates the temperature of the thermistor in the upper arm near the source lamp is outside of the set limits. This most commonly means the source lamp is overheating, which may indicate a short and possible need for replacement. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 8: Source current (irga_src_curr_f)

The current supplied to the source lamp is outside of established limits. Usually, it is high due to filaments shorting in the lamp from age or impact to the analyzer. Similar to the source power diagnostic, this indicates that the lamp likely needs to be replaced and should come in for repair. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 9: Gas Head Power Down (irga_off_f)

Indicates the gas head has been powered off. It is typically triggered when the voltage supplied to the EC100 drops below 10.5 V. In some cases, the gas head does not automatically power back on when the supply voltage returns to 12 V. If this occurs, connect to the EC100 using ***Device Configuration Utility***. Scroll to the bottom of the settings list and locate the **Gas Head Power Down** setting. If the setting value is 1 (enabled), change it to 0 (disabled) to restore normal operation.

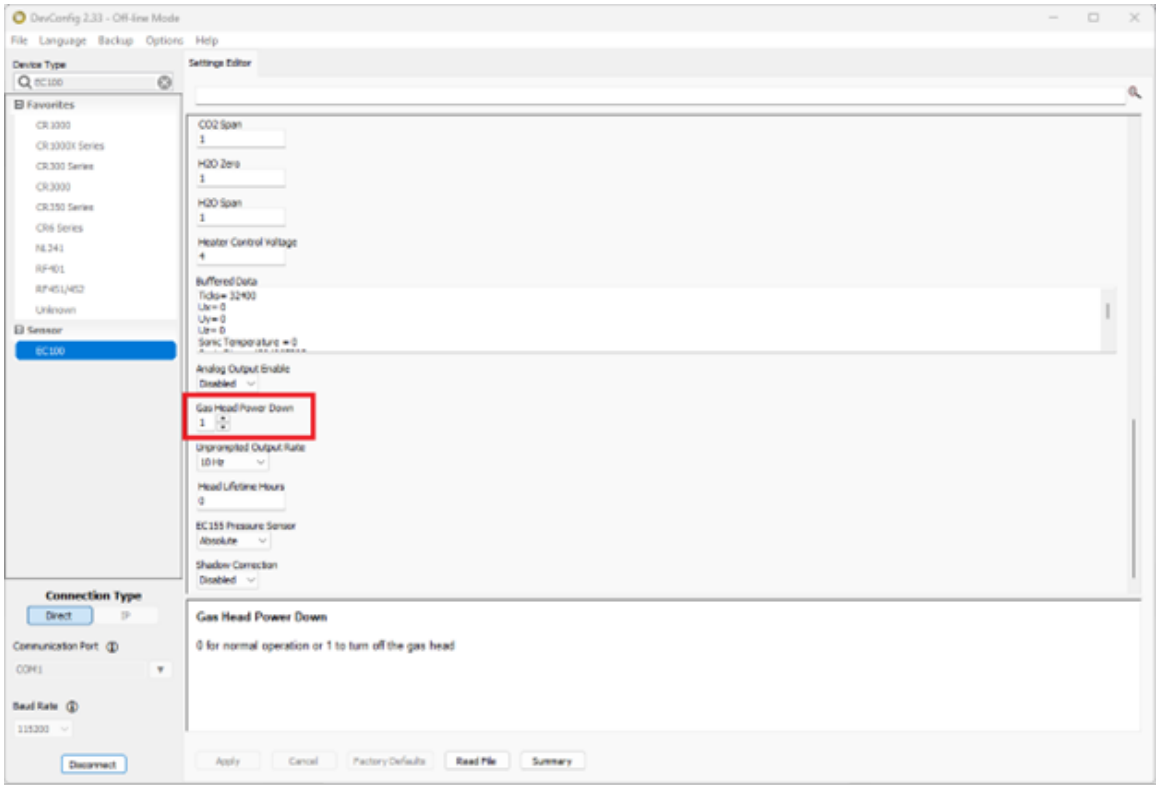


Figure 4-1. Gas head power-down setting

Flag 10: Synchronization error (irga_sync_f)

Indicates a problem with the synchronization of the chopper wheel and the measurement system. Synchronization is controlled by an encoder on the motor that drives the chopper wheel.

This flag is rarely encountered. If it becomes active, it typically indicates a hardware issue that cannot be resolved in the field, and the unit should be returned to Campbell Scientific for evaluation and repair. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 11: Ambient temperature (irga_amb_tmpr_f)

A common flag that indicates either there is not a Temp109 probe connected to the EC100 box or that the probe needs to be replaced. Either connect a working probe or disable the temperature probe setting in *ECMon*.

Flag 12: Ambient pressure (irga_amb_press_f)

This is a common flag that indicates either the barometer on the EC100 board is not functioning properly or the incorrect barometer configuration has been selected.

Verify the **barometer setting** in *ECMon* is set to **Basic**. If a CS106 barometer is connected, the setting should be **Enhanced** (this configuration is less common). If the correct setting is selected and the flag remains active, the EC100 may require repair.

If the **ambient pressure value** reads 50.000, this is an error code indicating the EC100 is configured for **Enhanced** mode but no CS106 barometer is connected. This condition can also trigger a calibration file error. Correcting the barometer configuration may clear both the ambient pressure flag and the calibration file error.

> NOTE:
> Flags 13 through 20 are among the most commonly observed diagnostic flags when an issue occurs with a gas analyzer. While these flags provide useful information about the state of the measurements, they can be triggered by a wide variety of causes and are often not sufficient on their own to identify the root problem.
>
> If any of these flags are active, provide the terminal diagnostic reports to Campbell Scientific technical support for troubleshooting assistance.
>
> As a first step, perform routine maintenance on the system:
>
> - Clean the analyzer windows.
> - Replace the desiccant.
> - Perform a new zero and span calibration of the analyzer.
>
> See this video on performing a Zero and Span: www.campbellsci.com/videos/zero-and-span.

Flag 13: CO2 Signal (irga_CO2_l_f)

Indicates that the CO2 filter signal is outside the set limits. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the

Sonic, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 14: CO2 Reference (irga_CO2_Io_f)

Indicates the signal when the CO2 reference filter is being measured is outside of limits. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 15: H2O Signal (irga_H2O_I_f)

This flag indicates that the signal when the H2O filter is being measured is outside of limits. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 16: H2O Reference (irga_H2O_Io_f)

This flag indicates that the signal when the H2O reference filter is being measured is outside of limits. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 17: CO2 Reference variation (irga_CO2_Io_var_f)

This flag indicates the variation in the CO2 reference signal over time is large. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 18: H2O Reference variation (irga_H2O_Io_var_f)

This flag indicates the variation in the H2O reference signal over time is large. To address this error, you may need to perform a zero and span. Alternatively, it could need a factory calibration. Start by sending the **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 19: CO2 Signal Strength (irga_CO2_sig_strgth_f)

This flag indicates the signal strength of the CO2 reference signal is low. Signal strengths should typically be above 0.7 (70%). Most commonly cleaning the windows will resolve this issue. If cleaning doesn't resolve the issue, send your **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 20: H2O Signal Strength (irga_H2O_sig_strgth_f)

This flag indicates the signal strength of the CO2 reference signal is low. Signal strengths should typically be above 0.7 (70%). Most commonly cleaning the windows will resolve this issue. If cleaning doesn't resolve the issue, send your **Sonic**, **Gains**, and **Gas Head** diagnostic reports to a Campbell Scientific IRGASON expert. See: Creating diagnostic reports (p. 15).

Flag 21: Calibration error (irga_cal_err_f)

This flag is common after power loss or power surges at a station. It indicates that the calibration file has been corrupted or lost. Make sure to update the EC100 OS to v8.02 or newer to help prevent this issue. Contact technical support with the serial number of the analyzer and a screenshot of the error. They will provide the most recent calibration file for the analyzer and instructions for uploading it to the EC100.

Flag 22: Heater control (irga_htr_ctrl_off_f)

This indicates that the window heaters for the gas analyzer are off. Check the setting in ***ECMon*** to turn it on if they should be turned on.

Flag 23: Differential Pressure (irga_diff_press_f)

Applies to EC155 systems only. Indicates insufficient flow between the sample cell and pump. Possible causes include sample cell pressure sensor failure, pump pressure sensor failure, pump failure, system blockage, system leaks, and clogged filters. Contact Campbell Scientific technical support for troubleshooting assistance. You can find diagnostics for the pump and the valve in the **zerospan_check_notes** table.

5. Creating diagnostic reports

5.1 CSAT terminal diagnostics

This section covers terminal diagnostics for the CSAT3B, CSAT3C, and IRGASON. Use these procedures when the analyzer is reporting NAN values or has active diagnostic flags and Campbell Scientific technical support has requested additional diagnostic information. Terminal commands provide detail about the performance of each transducer pair and are intended for troubleshooting purposes only. Do not use terminal mode for any other purpose.

Before proceeding, review the CSAT site visit check list (p. 1) and confirm you have contacted Campbell Scientific technical support.

5.1.1 What you will need

1. Computer with Windows 7, 8, 10, or 11 and an available USB port
2. USB to Mini-USB cable (one should have been included with your EC100 or CSAT3B)
3. USB-C cable (if servicing a CSAT3C)
4. USB-B cable (if servicing an EC100)
5. ***Device Configuration Utility*** (installed separately OR included with ***LoggerNet*** or ***PC400*** software) available at: www.campbellsci.com/devconfig
6. Multimeter
7. A micro USB, micro USB to USB-C,or USB to RS-232 cable (depending on which data logger the system is interfacing with)

5.1.2 Enter the CSAT terminal mode

When connected to an EC100 or CSAT3B as an **Unknown** device, you can access the device's terminal mode.

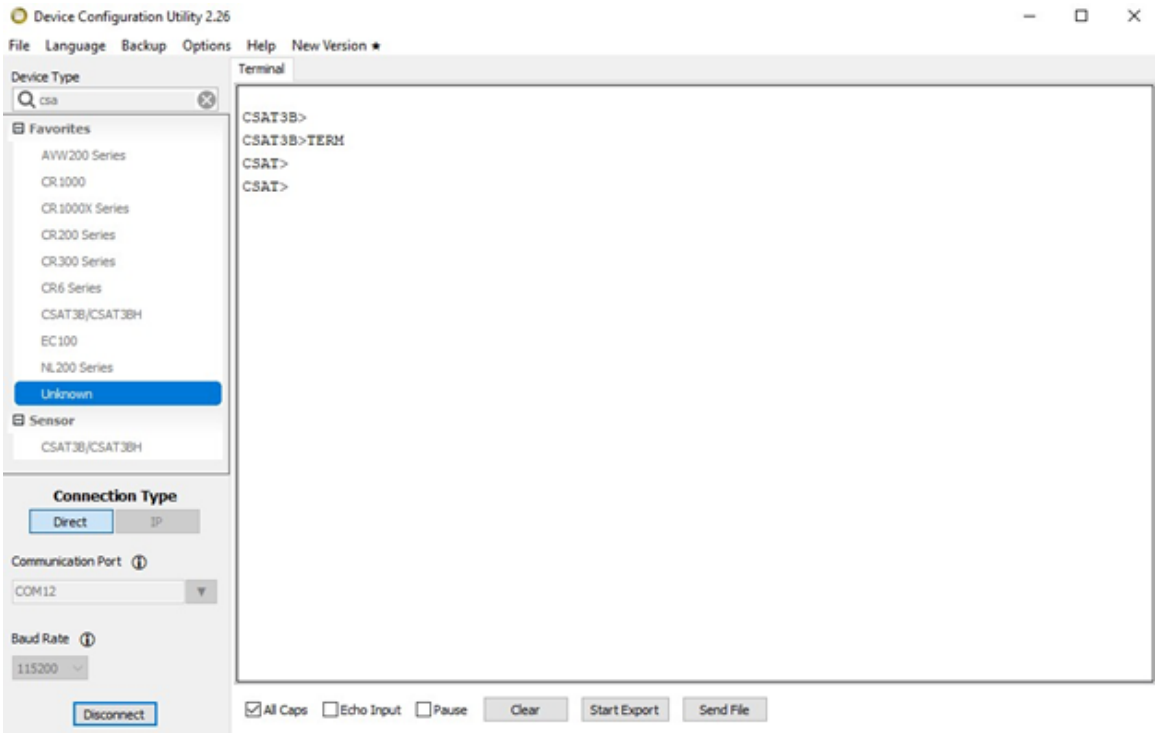
> **CAUTION:**
> Many settings can be changed from this terminal. Changing these settings from their current values may cause the anemometer to stop functioning properly.

Before sending any commands, verify they are entered exactly as shown and use only the commands listed below.

You do not need to interpret the terminal output, but be sure to save and send the results to your Campbell Scientific technical support representative. To do this:

1. Use a multimeter to verify the unit is powered with 12 VDC (up to 24 VDC for CSAT3B).
2. The EC100 has two USB connection options: a micro USB connector on the bottom of the enclosure and a USB-B connector on the USB port; use either to connect. To connect to the CSAT3B, use a micro USB cable. To connect to the CSAT3C, use a USB-C cable.
3. Open ***Device Configuration Utility*** on your computer.
4. Select the type as **Unknown Device**.
5. Select the appropriate **Communication Port** for the anemometer.
6. Click the **Connect** button.
7. Press **Enter** until a **CSAT3B>** prompt is returned.

8. Type **TERM** and press **Enter** (TERM must be typed relatively quickly, caps lock is not necessary). The return prompt should now be **CSAT>**.



> **NOTE:**
> If your CSAT3B is set to unprompted USB output, you will first need to disable this setting.

If at any point during the procedure the terminal becomes unresponsive and you can no longer obtain a CSAT> prompt, exit the terminal and restart from this point in the instructions. If the issue persists, power cycle the analyzer by removing power for at least 30 seconds and then reapplying it. Once the analyzer has restarted, try the procedure again.

5.1.3 How to create and save text files from the terminal

The terminal commands are useful for troubleshooting **only** if you save the resulting output. While you can capture screen shots, saving the output as text files (.txt) is recommended because it preserves all data and produces much smaller files.

> **TIP:**
> The instructions below indicate when to start and stop logging to these text files. Follow the steps carefully to ensure all required output is captured.

To create a file:

1. Click the **Start Export** button at the bottom of the terminal window.
2. Enter a descriptive file name.
3. Choose a save location that you can easily find later. The default location is C:\CampbellSci\DevConfig.
4. Click **Save** to begin recording the terminal output to the file

To close a file:

1. Click the **End Export** button at the bottom of the terminal window.
2. Navigate to the selected directory and verify the file was saved as expected.

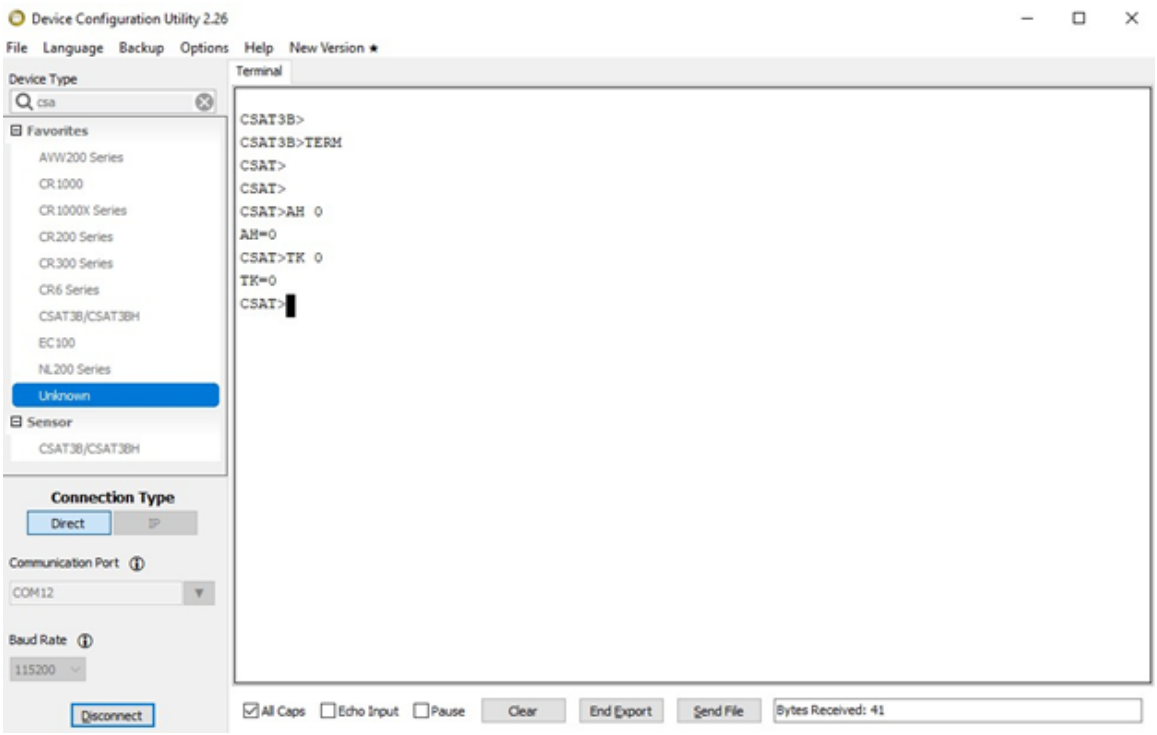
5.1.4 Turn off acquiring and tracking

This step is necessary when the anemometer has active diagnostic flags that cause the unit to report only NAN values for the three wind directions and sonic temperature.

> **CAUTION:**
> Turning off acquiring and tracking causes the system to ignore diagnostic flags and report incorrect wind values. These settings **must** be re-enabled after you have finished creating diagnostic output files.

To do this:

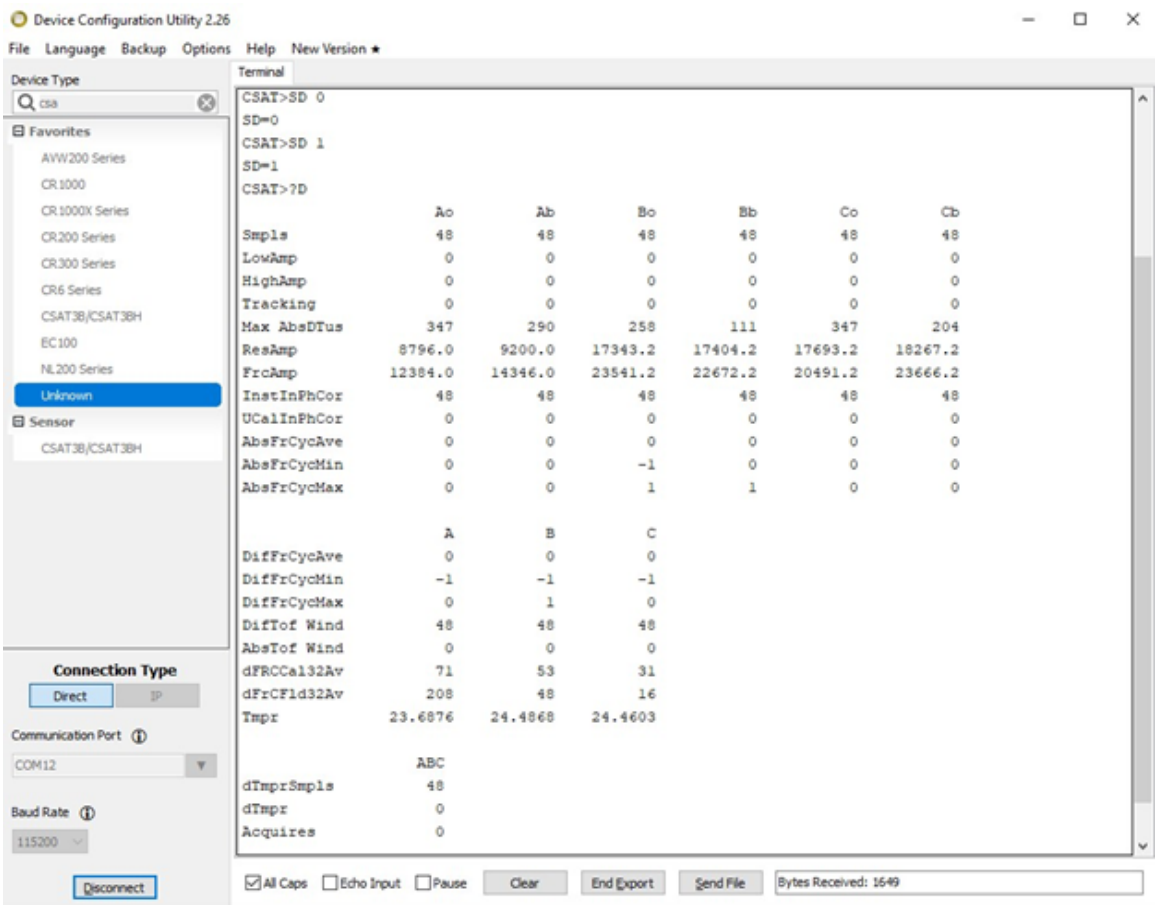
1. Press **Enter** until you get a **CSAT>** prompt.
2. Type **AH 0** and press **Enter**.
3. Type **TK 0** and press **Enter**.



5.1.5 Output summary diagnostics

This is the fastest way to display the average readings of each of the three pairs of transducers over time. It also provides the smallest and most readable file. If using the terminal, always output this information to send to technical support. To do this:

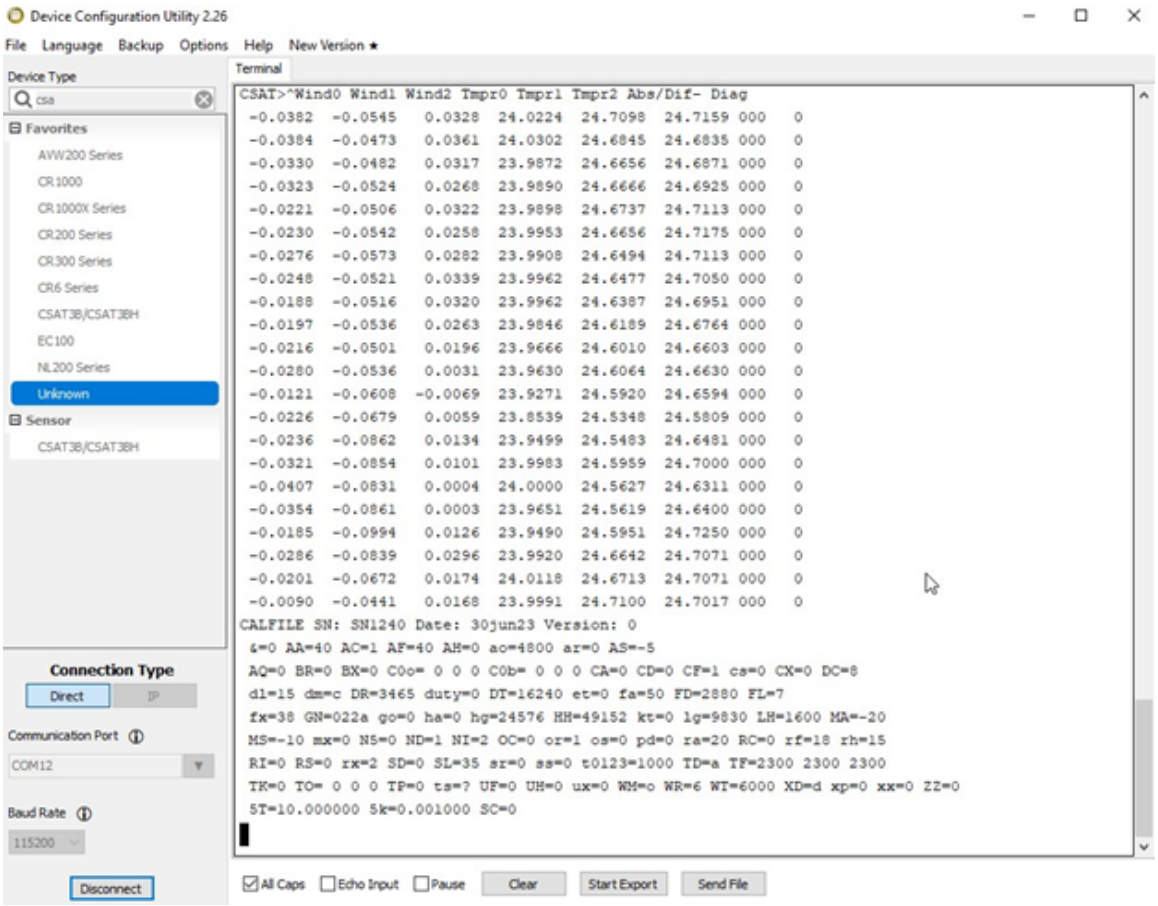
1. Press **Enter** until you get a **CSAT>** prompt.
2. Type **SD 0** and press **Enter**.
3. Open an output text file and choose a directory to save it to.
4. Type **SD 1** and press **Enter**.
5. WAIT! Let the analyzer collect data for 10 to 15 minutes.
6. Type **?D** and press **Enter**.
7. Close and save the output text file.



5.1.6 Output sonic temperatures

This output provides a time series record of the readings from the three sonic transducer pairs and their corresponding sonic temperatures. Reviewing these measurements over time can help identify whether one or more transducer pairs are operating improperly. To aid troubleshooting, always export this output and send it to technical support. To do this:

1. Press **Enter** until you get a **CSAT>** prompt.
2. Specify an output text file and choose a directory to save it to.
3. Type **^** (keyboard shortcut is Shift + 6) and press **Enter**.
4. WAIT! Let the analyzer collect data for 10 to 15 minutes.
5. Type **^** and press **Enter** to exit this mode.
6. Close and save the output text file.

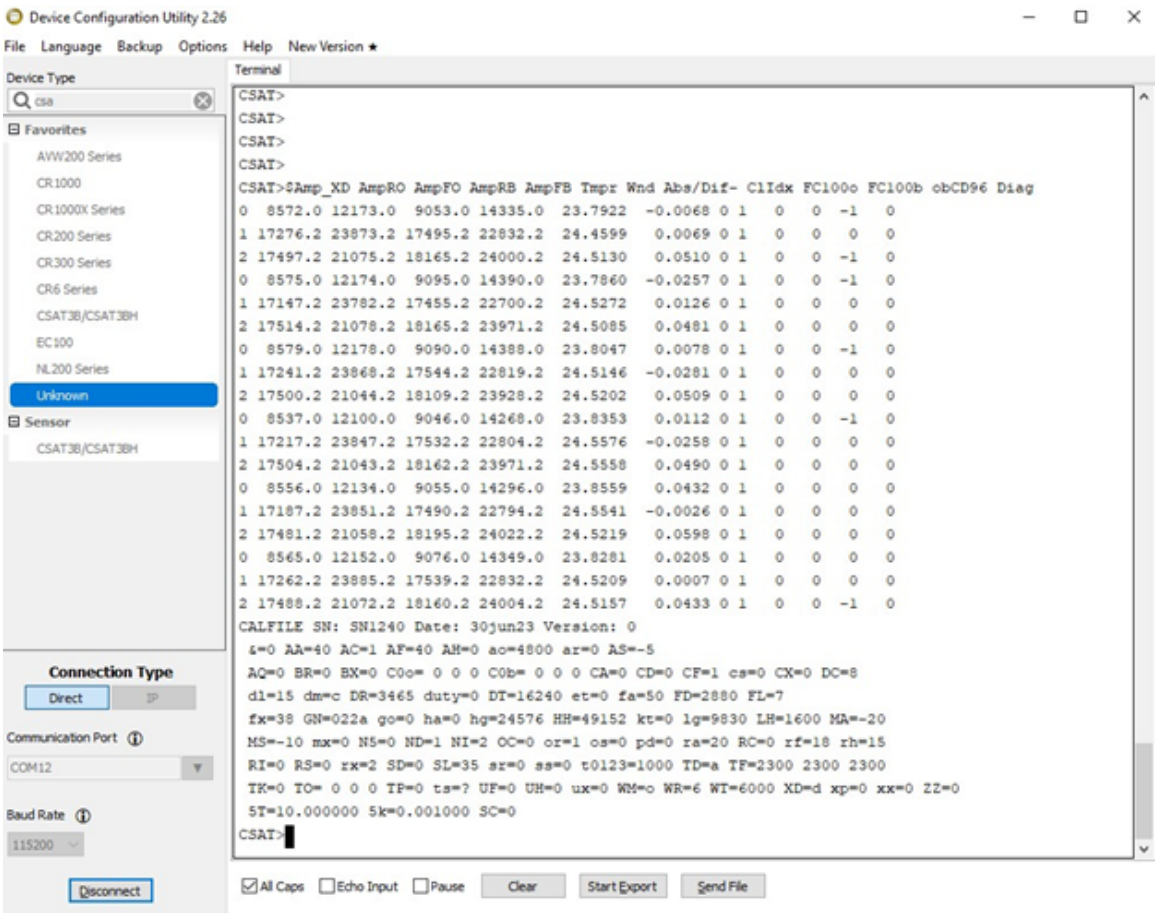


5.1.7 Output gain and ADC counts

This output provides the gain values and ADC counts for the three sonic transducer pairs over time. From a technical standpoint, it is the closest representation of the anemometer's raw measurement data available through the terminal.

These data can be especially useful for diagnosing transducer, signal quality, or electronics issues. As with the other diagnostic outputs, export and save this information so it can be reviewed by technical support.

1. Press **Enter** until you get a **CSAT>** prompt.
2. Specify an output text file and choose a directory to save it to.
3. Type **$** (keyboard shortcut is Shift + 4) and press **Enter**.
4. WAIT! Let the analyzer collect data for 10 to 15 minutes.
5. Type **$** and press **Enter** to exit this mode.
6. Close and save the output text file.



5.1.8 Save and send the output files

The files should now be saved as .txt files and can be opened using Notepad or any other text editor. Make note of the directory where the files were saved so you can locate them later. When internet access is available, email the files to your Campbell Scientific technical support representative for review.

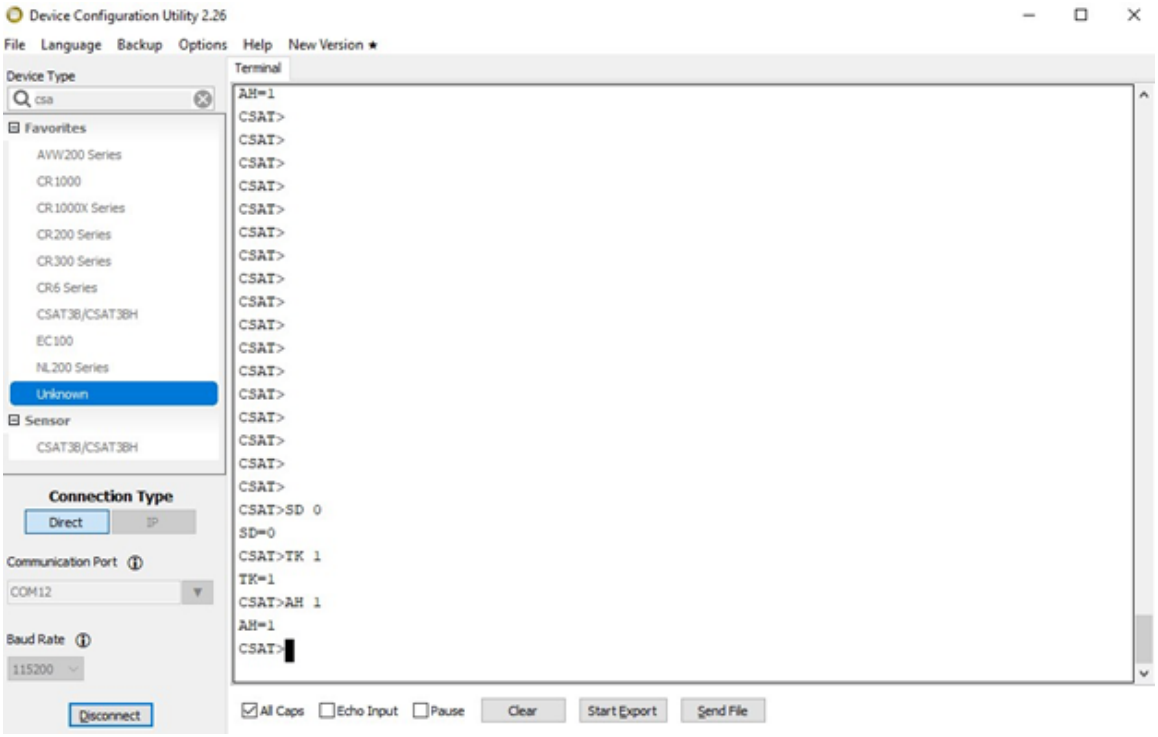
5.1.9 Reset the terminal commands

> **CAUTION:**
> Make sure to reset all commands to their default values when you are finished. If this step is not completed, the anemometer may report invalid data.

To do this:

1. Press **Enter** a few times until you get a **CSAT>** prompt again.
2. Type **SD 0** and press **Enter**.

3. Type **TK 1** and press **Enter**.
4. Type **AH 1** and press **Enter**.



You can now exit the terminal mode and return the anemometer to normal operation.

> **TIP:**
> If you are using a CSAT3x in unprompted USB mode, you will also need to reconnect to the unit in ***Device Configuration Utility***, select CSAT3x, and change the operating mode back to its normal setting.

5.2 Creating the gas analyzer diagnostic report

This troubleshooting guide is intended to help diagnose problems with any IRGASON, EC150, or EC155 infrared gas analyzer that is reporting NAN values or has active diagnostic flags. It is designed to assist you in using the analyzer's terminal mode to gather additional information as requested by Campbell Scientific technical support.

These commands provide additional detail on the performance of internal analyzer components and are intended for troubleshooting purposes only.

CAUTION:
Do not use terminal mode for any other commands. Doing so may cause the anemometer to report invalid data.

Be sure to contact your Campbell Scientific technical support representative before an on site visit. You should also review the CSAT site visit check list (p. 1) before using this document.

5.2.1 What you will need

1. Computer with Windows 7, 8, 10, or 11 and an available USB port
2. USB to Mini-USB cable (one should have been included with your EC100 or CSAT3B)
3. USB-C cable (if servicing a CSAT3C)
4. USB-B cable (if servicing an EC100)
5. ***Device Configuration Utility*** (installed separately OR included with ***LoggerNet*** or ***PC400*** software) available at: www.campbellsci.com/devconfig
6. Multimeter

5.2.2 Enter the EC100 terminal mode

When connected to an EC100, CSAT3B, or CSAT3C as an **Unknown** device, you can access the device's terminal mode.

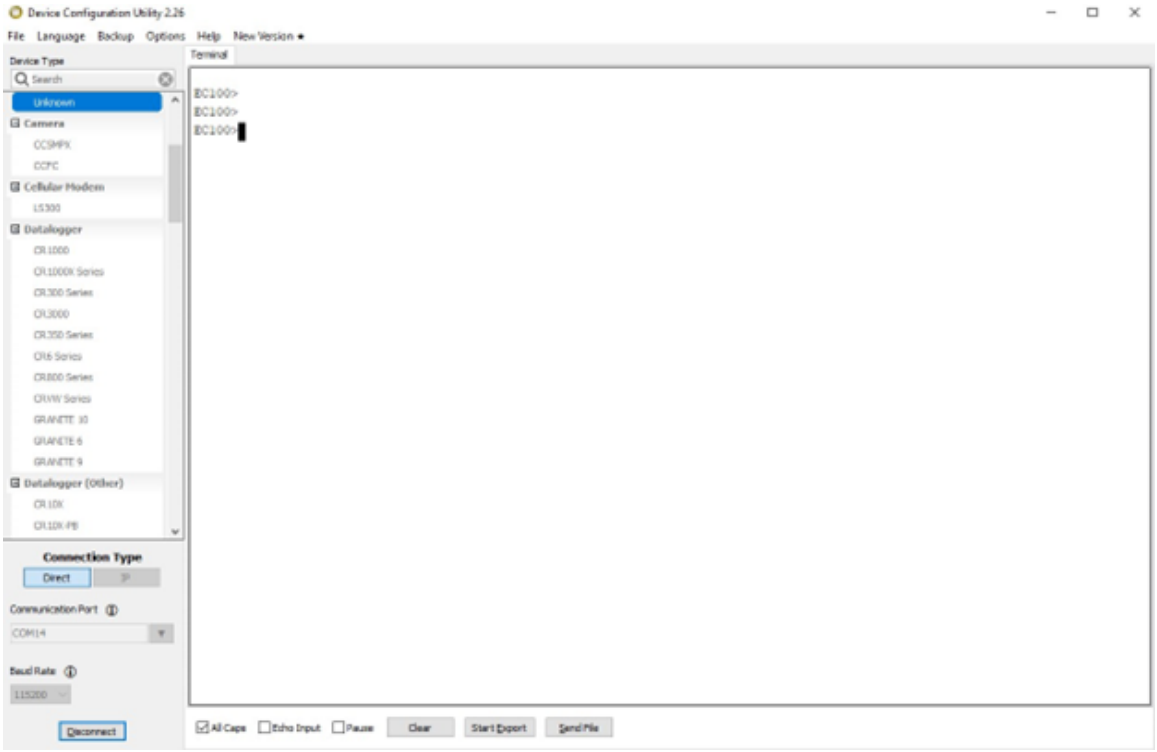
CAUTION:
Many settings can be changed from the terminal, and changing these settings may cause the anemometer to stop functioning properly.

Before sending any commands, verify they are entered exactly as shown. Use only the commands listed in this section.

Save the terminal output and send it to Campbell Scientific technical support. Interpretation of the results is not required. To do this:

1. Verify the unit is powered with 12 VDC (up to 24 VDC for CSAT3B) using a multimeter.
2. Connect a mini-USB cable to the bottom of the EC100 box.
3. Open ***Device Configuration Utility*** on your computer.
4. Select the type as **Unknown**.
5. Select the appropriate **Communication Port** for the EC100.

6. Click the **Connect** button.
7. Press **Enter** until an **EC100>** prompt is returned.



If the terminal becomes unresponsive and the EC100> prompt is not available, exit the terminal and restart from this point in the instructions. If the issue persists, power cycle the analyzer by removing power for at least 30 seconds, then reapply power and try again.

5.2.3 How to create and save text files from the terminal

The terminal commands are useful for troubleshooting **only** if you save the resulting output. While you can capture screen shots, saving the output as text files (.txt) is recommended because it preserves all data and produces much smaller files.

> **TIP:**
> The instructions below indicate when to start and stop logging to these text files. Follow the steps carefully to ensure all required output is captured.

To create a file:

1. Click the **Start Export** button at the bottom of the terminal window.
2. Enter a descriptive file name.

3. Choose a save location that you can easily find later. The default location is C:\CampbellSci\DevConfig.
4. Click **Save** to begin recording the terminal output to the file

To close a file:

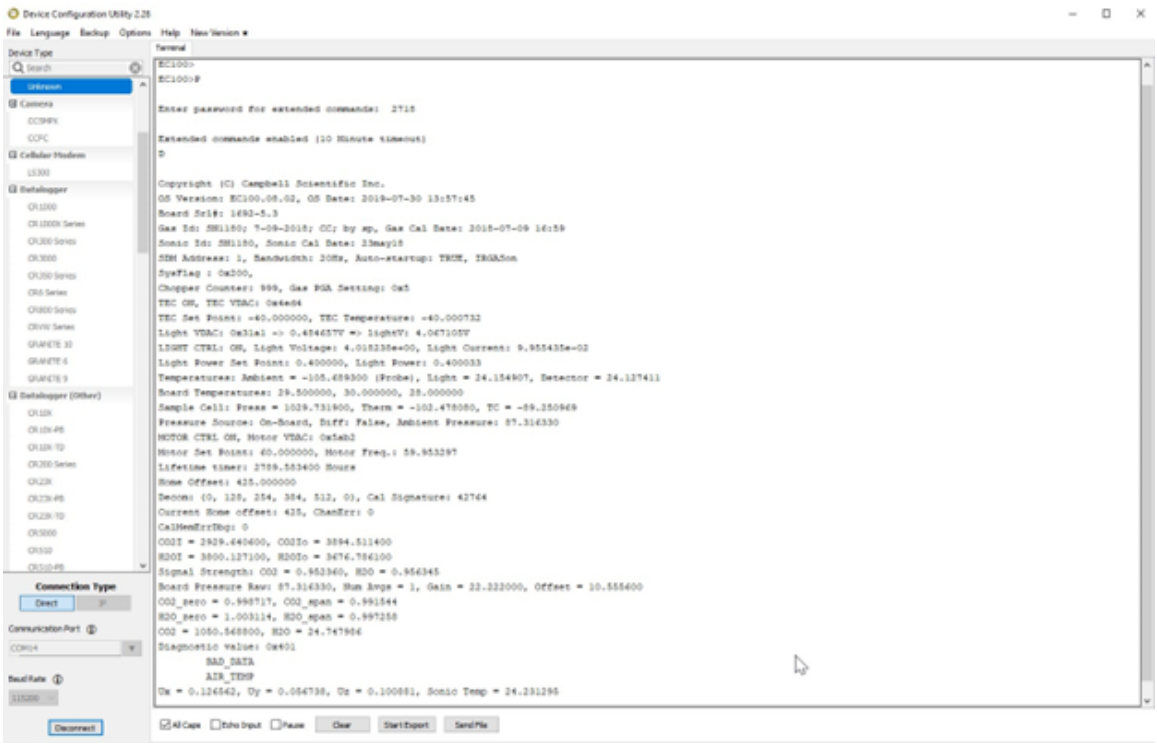
1. Click the **End Export** button at the bottom of the terminal window.
2. Navigate to the selected directory and verify the file was saved as expected.

5.2.4 Output summary diagnostics

> CAUTION:
> Before beginning, confirm the gas analyzer diagnostic LED on the EC100 is **not** orange. The LED is orange during warm-up. After powering on, allow a few minutes for the LED to turn green or red before proceeding.

This procedure displays diagnostics for the lamp, motor, and detector, and provides the fastest way to identify problems with these components. If using the terminal, capture this output before contacting technical support.

1. Press **Enter** until the **EC100>** prompt appears.
2. Type **P** and press **Enter**.
3. Type **2718** and press **Enter**.
4. Specify an output text file and choose a directory to save it to.
5. Type **D** and press **Enter**.
6. Close and save the output text file.



5.2.5 Save and send the output files

The files are saved as .txt files and can be opened in any text editor. Note the save directory, then email the files to your Campbell Scientific technical support representative when internet access is available.

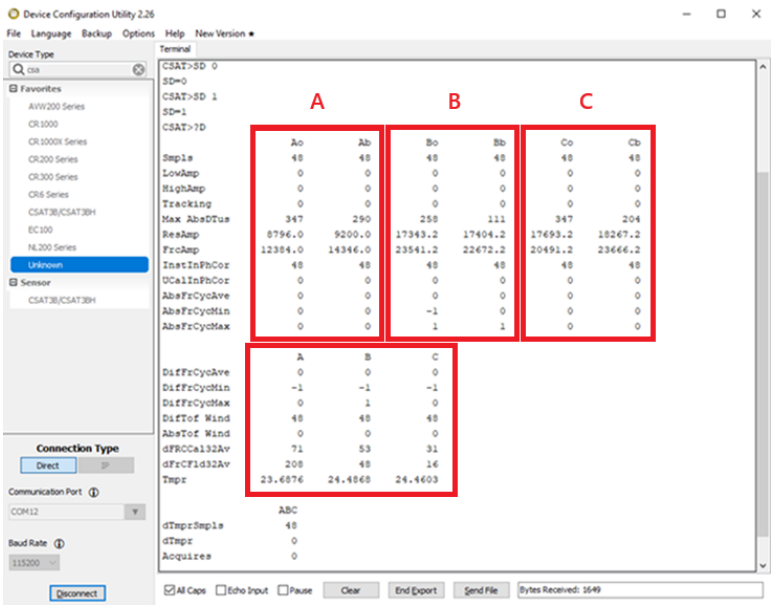
You can now exit the terminal mode and return to normal operation.

6. Interpreting the CSAT terminal diagnostic reports

When viewing the reports, the results are split into three sections. The first section is Sonic diagnostics.

6.1 Sonic diagnostics

The sonic section contains data for the three transducer pairs (A, B, C) that measure 3D wind direction and temperature.



Smpls: number of samples collected.

LowAmp, **HighAmp**, **Tracking**: diagnostic flag counts. All should be 0. LowAmp is the number of times the signal dropped below the minimum amplitude threshold. HighAmp is the number of times it exceeded the maximum amplitude threshold. Tracking is the number of times the signal transit time fell outside expected bounds

DifFrCyc (Differential Frequency Cycle): the deviation of the received signal from the center of the expected waveform. Values closer to 0 indicate healthier transducers. The average should be significantly closer to 0 than the min and max. Min and max values should be below 20. Values of 20 or above indicate transducer failure; the unit must be sent to Campbell Scientific for maintenance on an RMA. See directions in How to request an RMA (p. 34).

Tmpr (Temperature): the three temperature values should be similar to each other; the reported sonic temperature is the average of the three. If one value differs significantly from the other two, that transducer may be failing. Request an RMA (see How to request an RMA [p. 34]).

6.2 Gains diagnostics

The gains section shows the gain applied to each of the three transducer pairs. The top row is the column names.

The four columns of interest are highlighted below:

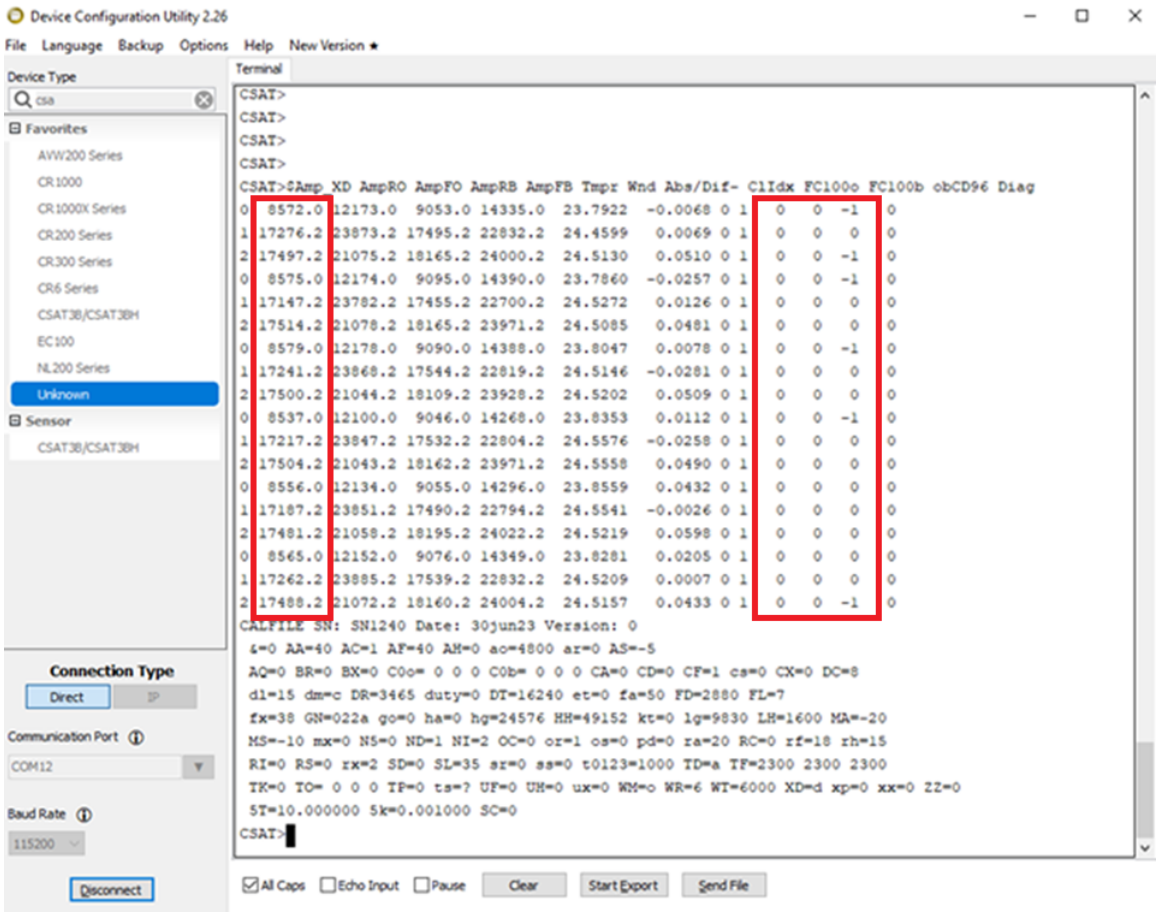


Figure 6-1. Columns of interest for the gains section

The unlabeled far-left column contains row identifiers 0, 1, and 2, which correspond to transducer pairs A, B, and C.

The first data column is **$Amp**. The decimal suffix of each value indicates the current gain level. As transducers age, the gain increases gradually to compensate. Interpret the suffix as follows:

0 to .2: Good. No action required.

.3 to .4: Serviceable. The transducer is aging but still functional. Flag for inspection at the next scheduled site visit. If the suffix reaches .5 before that visit, contact Campbell Scientific technical support.

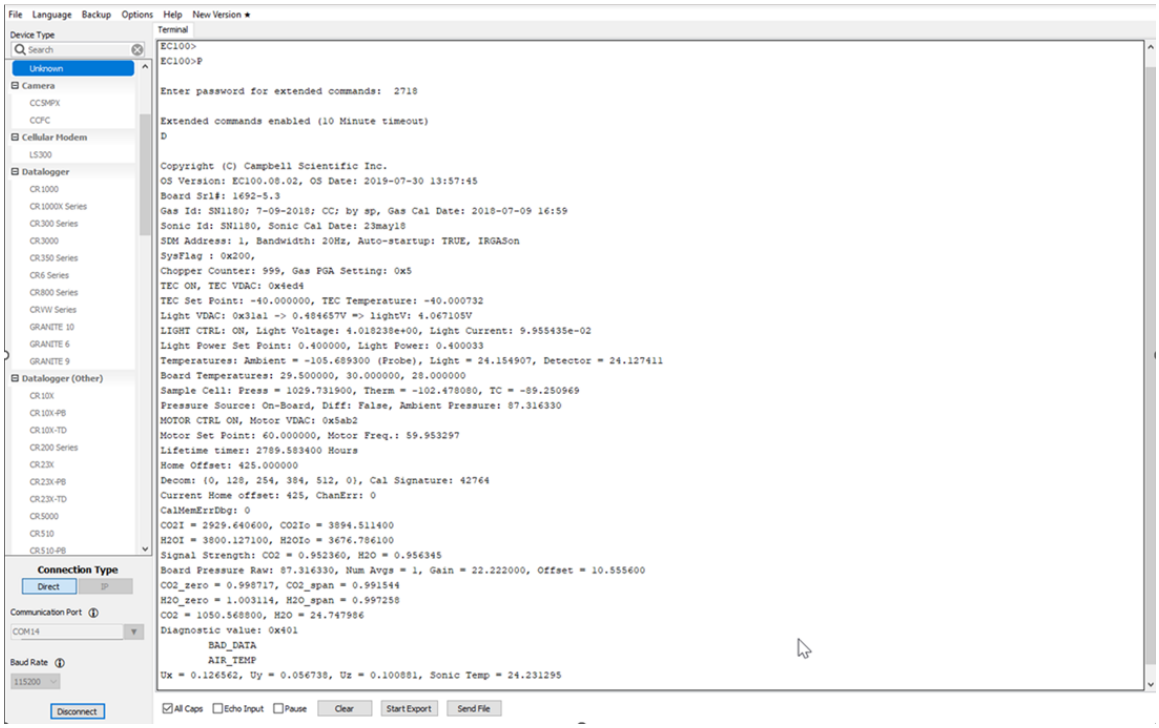
.5 to .6: Failed. The transducer is producing excessive noise and must be replaced. Contact Campbell Scientific technical support and request an RMA (see How to request an RMA [p. 34]).

The **C1Idx**, **FC100o**, and **FC100b** columns represent the **DifFrCyc** (Differential Frequency Cycle) values measured over a longer window. All values should be below 20.

6.3 Gas head diagnostics

The gas head diagnostics section provides information about the OS version, internal temperatures, and light source condition.

Row identifiers 0, 1, and 2 correspond to transducer pairs A, B, and C.



OS Version: Should be EC100 .08.02 or newer.

> **NOTE:**
> OS versions earlier than v8.02 are at risk of calibration file loss.

NOTE:
The serial numbers (SN) of the **Gas Id** and the **Sonic Id** do not need to match; each is tied to its respective calibration file. If either value reads 0, the device is not communicating. Verify the power supply voltage and all wiring connections to the unit.

```
Copyright (C) Campbell Scientific Inc.
OS Version: EC100.08.02, OS Date: 2019-07-30 13:57:45
Board Srl#: 1692-5.3
Gas Id: SN1180; 7-09-2018; CC; by sp, Gas Cal Date: 2018-07-09 16:59
Sonic Id: SN1180, Sonic Cal Date: 23may18
SDM Address: 1, Bandwidth: 20Hz, Auto-startup: TRUE, IRGASon
SysFlag : 0x200,
Chopper Counter: 999, Gas PGA Setting: 0x5
```

Light source values:

- **lightV:** should be within 10% of 4 V
- **Light Current:** should be close to 0.1; a value of 0.15 or higher is too high
- **Light Power:** should be close to 0.4

If **lightV** is dropping while Light Current is rising, the source lamp has failed and needs to be replaced.

```
Copyright (C) Campbell Scientific Inc.
OS Version: EC100.08.02, OS Date: 2019-07-30 13:57:45
Board Srl#: 1692-5.3
Gas Id: SN1180; 7-09-2018; CC; by sp, Gas Cal Date: 2018-07-09 16:59
Sonic Id: SN1180, Sonic Cal Date: 23may18
SDM Address: 1, Bandwidth: 20Hz, Auto-startup: TRUE, IRGASon
SysFlag : 0x200,
Chopper Counter: 999, Gas PGA Setting: 0x5
TEC ON, TEC VDAC: 0x4ed4
TEC Set Point: -40.000000, TEC Temperature: -40.000732
Light VDAC: 0x31a1 -> 0.484657V => lightV: 4.067105V
LIGHT CTRL: ON, Light Voltage: 4.018238e+00, Light Current: 9.955435e-02
Light Power Set Point: 0.400000, Light Power: 0.400033
Temperatures: Ambient = -105.689300 (Probe), Light = 24.154907, Detector = 24.127411
Board Temperatures: 29.500000, 30.000000, 28.000000
Sample Cell: Press = 1029.731900, Therm = -102.478080, TC = -89.250969
Pressure Source: On-Board, Diff: False, Ambient Pressure: 87.316330
MOTOR CTRL ON, Motor VDAC: 0x5ab2
Motor Set Point: 60.000000, Motor Freq.: 59.953297
Lifetime timer: 2789.583400 Hours
Home Offset: 425.000000
Decom: (0, 128, 254, 384, 512, 0), Cal Signature: 42764
Current Home offset: 425, ChanErr: 0
CalMemErrDbg: 0
CO2I = 2929.640600, CO2Io = 3894.511400
H2OI = 3800.127100, H2OIo = 3676.786100
Signal Strength: CO2 = 0.952360, H2O = 0.956345
Board Pressure Raw: 87.316330, Num Avgs = 1, Gain = 22.222000, Offset = 10.555600
CO2_zero = 0.998717, CO2_span = 0.991544
H2O_zero = 1.003114, H2O_span = 0.997258
CO2 = 1050.568800, H2O = 24.747986
Diagnostic value: 0x401
        BAD_DATA
        AIR_TEMP
Ux = 0.126562, Uy = 0.056738, Uz = 0.100881, Sonic Temp = 24.231295
```

I and Io values:

The **I** values are the measured channel signals; the **Io** values are the reference channel signals.

```
Copyright (C) Campbell Scientific Inc.
OS Version: EC100.08.02, OS Date: 2019-07-30 13:57:45
Board Srl#: 1692-5.3
Gas Id: SN1180; 7-09-2018; CC; by sp, Gas Cal Date: 2018-07-09 16:59
Sonic Id: SN1180, Sonic Cal Date: 23may18
SDM Address: 1, Bandwidth: 20Hz, Auto-startup: TRUE, IRGASon
SysFlag : 0x200,
Chopper Counter: 999, Gas PGA Setting: 0x5
TEC ON, TEC VDAC: 0x4ed4
TEC Set Point: -40.000000, TEC Temperature: -40.000732
Light VDAC: 0x31a1 -> 0.484657V => lightV: 4.067105V
LIGHT CTRL: ON, Light Voltage: 4.018238e+00, Light Current: 9.955435e-02
Light Power Set Point: 0.400000, Light Power: 0.400033
Temperatures: Ambient = -105.689300 (Probe), Light = 24.154907, Detector = 24.127411
Board Temperatures: 29.500000, 30.000000, 28.000000
Sample Cell: Press = 1029.731900, Therm = -102.478080, TC = -89.250969
Pressure Source: On-Board, Diff: False, Ambient Pressure: 87.316330
MOTOR CTRL ON, Motor VDAC: 0x5ab2
Motor Set Point: 60.000000, Motor Freq.: 59.953297
Lifetime timer: 2789.583400 Hours
Home Offset: 425.000000
Decom: (0, 128, 254, 384, 512, 0), Cal Signature: 42764
Current Home offset: 425, ChanErr: 0
CalMemErrDbg: 0
CO2I = 2929.640600, CO2Io = 3894.511400
H2OI = 3800.127100, H2OIo = 3676.786100
Signal Strength: CO2 = 0.952360, H2O = 0.956345
Board Pressure RAW: 87.316330, Num Avgs = 1, Gain = 22.222000, Offset = 10.555600
CO2_zero = 0.998717, CO2_span = 0.991544
H2O_zero = 1.003114, H2O_span = 0.997258
CO2 = 1050.568800, H2O = 24.747986
Diagnostic value: 0x401
        BAD_DATA
        AIR_TEMP
Ux = 0.126562, Uy = 0.056738, Uz = 0.100881, Sonic Temp = 24.231295
```

> **NOTE:**
> The CO2 reference value (CO2Io) should always be higher than the measured value (CO2I).

Acceptable ranges:

- **CO2I**: 2000–4000
- **CO2Io**: 3000–4000
- **H2OI**: 2000–4000
- **H2OIo**: 3000–4000

Signal Strength: close to 1.0

Zero and span values: should be close to 1.0. If they are not, the sensor needs to be re-zeroed and spanned before returning to service (see: How to zero and span your IRGASON [p. 33]).

7. How to zero and span your IRGASON

> CAUTION:
> If you have just replaced the molecular sieve, wait 24 hours before zeroing or spanning.

Before you begin

- Zero and span calibration can be performed in the field, though site accessibility may make this difficult. Campbell Scientific recommends zeroing with a zero air generator and spanning in a lab environment..
- If you do not have calibrated span gas available, Campbell Scientific can perform the zero-and-span.

For complete instructions, refer to the IRGASON manual (*Zero and Span* section): Irgason.pdf.

Or watch the training video: www.campbellsci.com/videos/zero-and-span

8. Cleaning

Before beginning cleaning or inspection, review the safety precautions in the IRGASON manual (*Precautions* section): s.campbellsci.com/documents/us/manuals/irgason.pdf.

Remove debris

Check for and remove spiderwebs and bird nests.

Clean the analyzer windows

Clean the windows if the CO2 or H2O signal strength drops below 0.7 (70% of the original value). Monitor signal strength in the output data or in ***ECMon***. To clean, apply isopropyl alcohol (2-propanol/isopropanol) with a cotton swab or a non-scratching tissue or cloth. After cleaning, verify signal strength returns to a value close to 1.0.

Inspect desiccant and scrubber bottles

Every six months, check the molecular sieves and desiccant bottles following the instructions in the IRGASON manual (*Replacing Desiccant and Scrubber Bottles* section): s.campbellsci.com/documents/us/manuals/irgason.pdf.

9. How to request an RMA

Step 1: Determine whether the window requires an RMA

Gas windows manufactured before 2017 may need their detector and source covers replaced. This applies to **IRGASON units with serial numbers 1439** or earlier, and **EC150 units with serial numbers 1486** or earlier. To identify whether your unit already has the updated cover, look for a black silicone ring around the window. Units with this ring do not require an RMA for the window. In this photograph, the white arrow indicates where the black ring appears on updated units.

Step 2: Check internal components regardless of window condition

Inspect the window for fogginess or moisture beneath the lens. Even if the window appears intact, inspect the chemical desiccant bottles and the inside of the arm for contamination or corrosion. Window condition alone does not confirm the unit is functioning correctly.

Step 3: Initiate the RMA

Generate the Sonic, Gains, and Gas Head diagnostic report (see Creating diagnostic reports [p. 15]). If applicable, photograph the sonic transducers and gas windows, and capture a screenshot of any diagnostic flags shown in ***ECMon***. Then contact a Campbell Scientific CSAT specialist at (435) 227-9100, Monday through Friday, 8:00 a.m. to 5:00 p.m. Mountain Time.

Step 4: Manage the deployed unit while the RMA is in progress

- **No valid data (all NAN or flagged outputs)**: Power the unit down and remove it from the flux data record. Log the date the unit was taken offline in the station log.
- **Partially degraded data (some valid outputs)**: You may leave the unit deployed, but flag the affected data in your records and notify your data manager. Do not use unflagged data from this period without reviewing it against the active diagnostic flags.

Contact technical support if you need guidance specific to your site or data continuity requirements.

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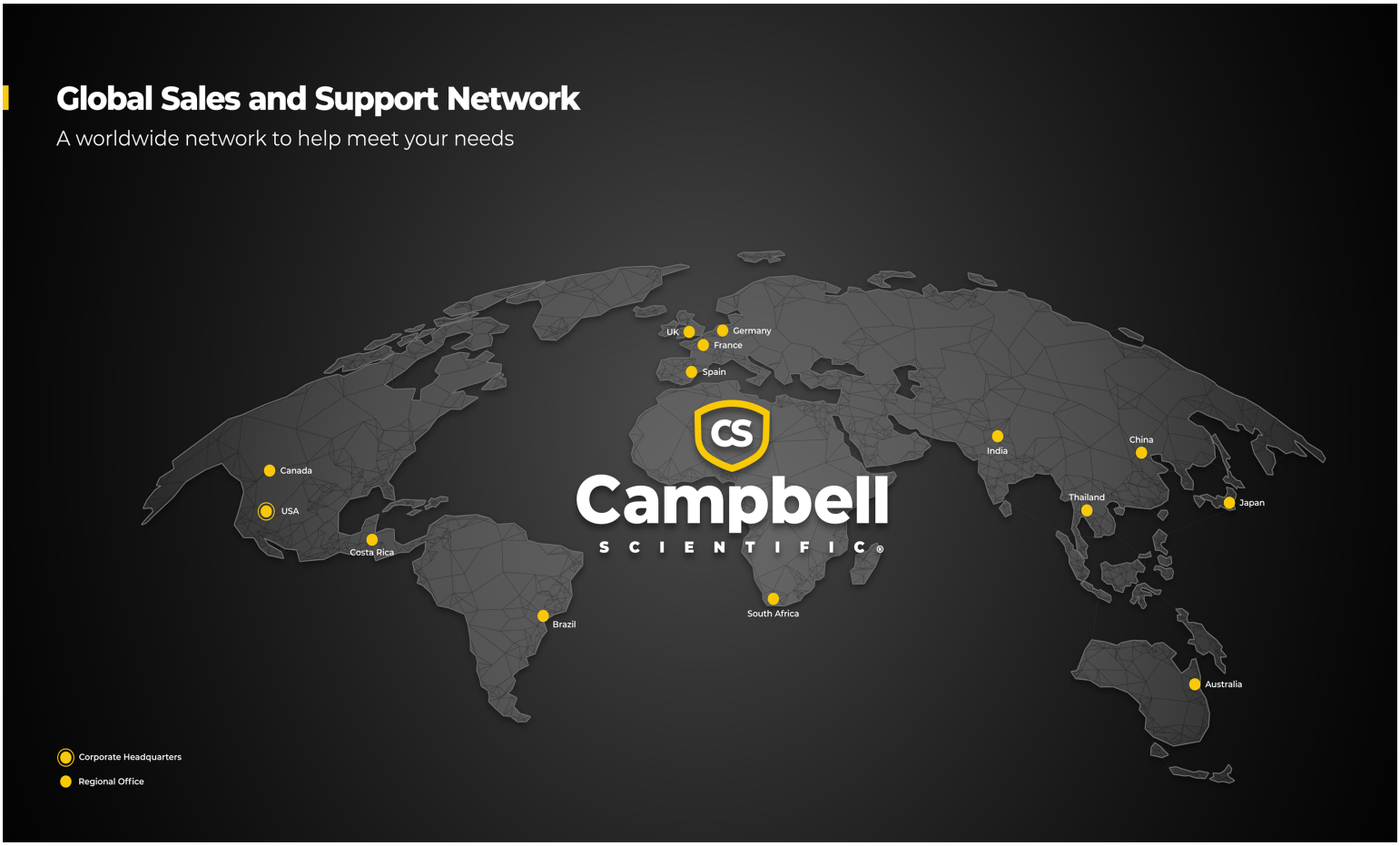

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