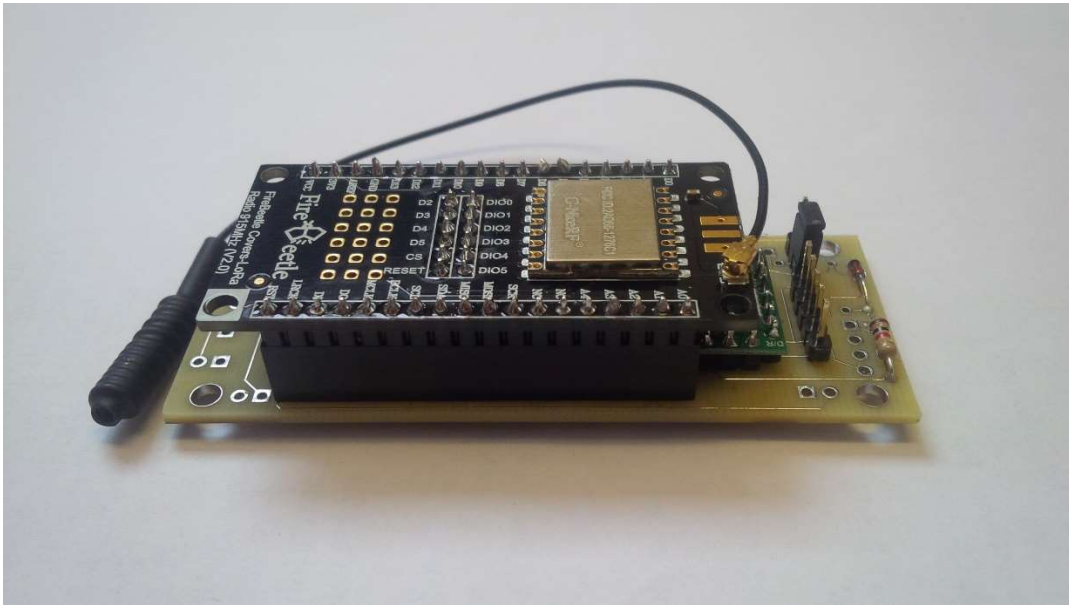


OEM Environmental Monitor
(EMO433, EMO868, EMO915)

User Manual v 1.7



May 2023

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<https://www.asr-web.com>



Innovate!™

Features

- Integrated MCU
- Corrected atmospheric pressure readings
- Derived elevations with customizable datum
- Temperature, humidity and gas readings
- Mesh networking
- Simple serial interface
- Metric or Imperial output units

Application Examples

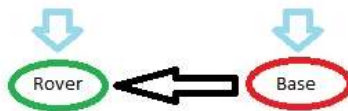
- Indoor elevations
- Building pressurization monitoring
- Multi-node telemetry networks
- Altitude reference for UAVs

Overview

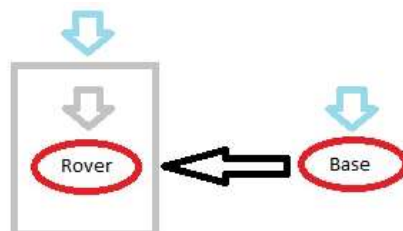
The EMOxxx series differential barometer/altimeter (patent pending) environmental monitor OEM module provides atmospheric pressures and derived elevations at a rover using corrections transmitted from a stationary base. In traditional systems elevations are calculated based on pressure readings for a stand-alone unit and are subject to the errors inherent with environmental changes in pressure. This versatile engine offers three modes of operation detailed below.

Modes

- A) Determining a floating rover elevations based on corrections (black arrow) from a fixed base. In this application the rover outputs a corrected elevation as it is raised or lowered relative to the ambient atmospheric pressure (blue arrows). When used inside an enclosed space such as a building both units must be located within. Multiple rovers can use the same base.



- B) Determining a fixed rover pressure difference based on corrections (black arrow) from a fixed base. In this application the rover outputs a corrected pressure (grey arrow) inside an enclosed space such as a building (grey rectangle) relative to the ambient atmospheric pressure (blue arrows). The base must be located outside the enclosed space. Multiple rovers can use the same base.



- C) Multi-node telemetry. In this application the rover receives remote uncorrected pressure, temperature, humidity and gas readings from multiple bases using a mesh network topology. The pressure data is absolute and not differentially corrected.

Specifications

Differential Pressure Accuracy: +/- 0.039 mbar (+/- 0.35cm) RMS

Absolute Pressure Accuracy: +/- 0.6 mbar

Temperature Accuracy: +/- 0.5 C

Humidity Accuracy: +/- 3% RH

Operating Temperature: -20C to 70C

Current: 20-120mA peak @ 5VDC (EMO433/EMO915), 20-130mA peak @ 5VDC (EMO868)

Dimensions (L x W x H): 82mm x 32mm x 18mm

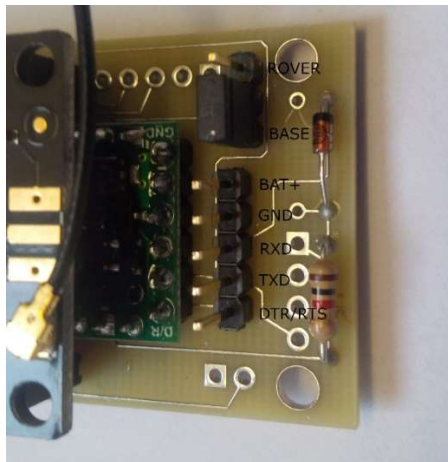
Range: 1Km* (EMO433/EMO915), 5Km* (EMO868)

Voltage: 3.8 – 15 VDC

Weight: 30g

* In mode C above individual bases act as mesh network repeaters when in range of any others potentially increasing totals beyond these specifications.

Pinout

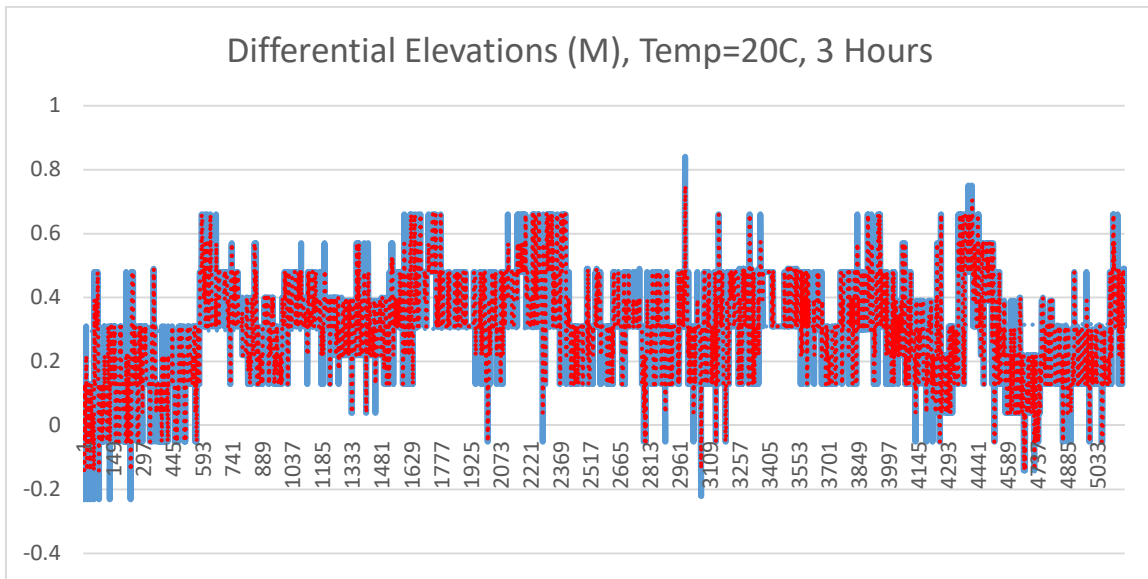
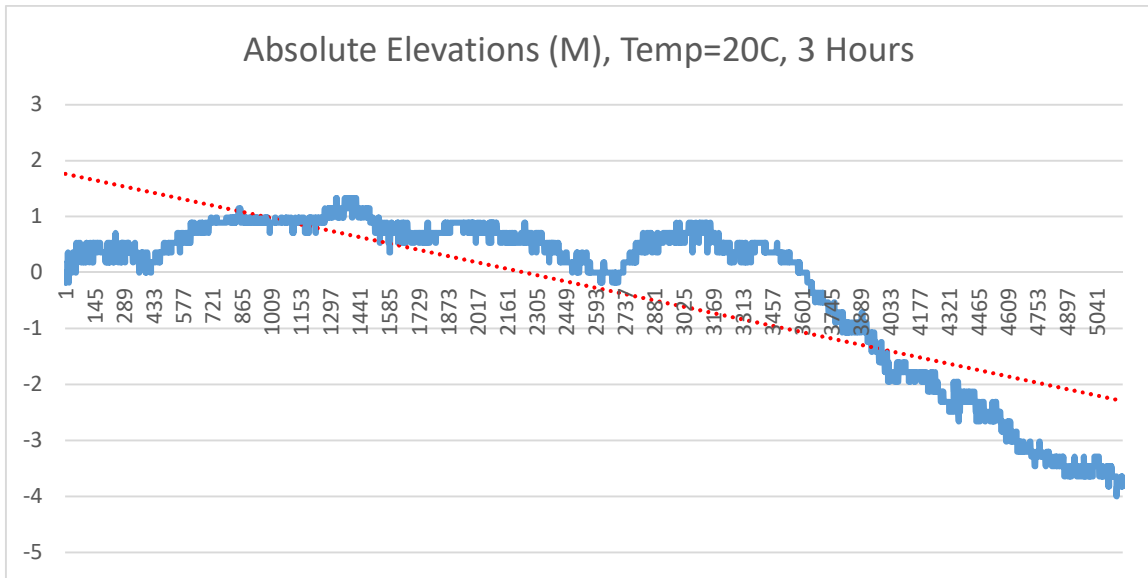


Pin	Description
ROVER	Rover mode jumper selection
BASE	Base mode jumper selection
BAT+	Battery supply (3.8 – 15 VDC)
GND	Ground
RXD	Serial data in
TXD	Serial data out
DTR/RTS	Serial flow control

Serial communication parameters are 9600bps (N,8,1). The DTR/RTS signal pin is only required to update the firmware.

Typical Characteristics

Modules were stationary for testing at a set fixed datum elevation of 0m.



Commands

The general command syntax is *command,{x{,y}}* followed by an exclamation mark (!).

Command	Description
<i>1,x!</i>	Set <i>NetID</i> , both base and rover must match. Valid range is $x=1$ to 999.
<i>2,x!</i>	Set <i>NodeID</i> , every <i>NodeID</i> on <i>NetID</i> must be unique. Valid range is $x=1$ to 999.
<i>3,x!</i>	Set <i>Units</i> . Metric $x=0$ (mb,m, C), Imperial $x=1$ (inHg,ft, F)).
<i>4,x,y!</i>	Average <i>Elevation Datum</i> and <i>Base NodeID</i> (differential mode preset, rover only). Valid <i>Elevation Datum</i> range is $x=-9999.99$ to 9999.99. Valid <i>Base NodeID</i> range is $y=1$ to 999.
<i>5!</i>	Set <i>Elevation Datum</i> and <i>Base NodeID</i> from 4 (differential mode , rover only).
<i>6!</i>	Clear <i>Elevation Datum</i> (absolute mode, rover only).
<i>7!</i>	Resume differential mode if previously set (rover only).
<i>8, x!</i>	Set inverse elevations (differential mode, rover only). Disabled $x=0$ (default), Enabled $x=1$.
<i>9, x!</i>	Ping <i>Base NodeID</i> (rover only). Valid <i>Base NodeID</i> range is $x=1$ to 999.

Output

On initialization the unit will send the string *ASR EMOxxx v.y.y* where:

xxx model number (433,868 or 915 MHz)

y.y firmware revision number

Base output format is as follows:

*NetID,NodeID,B,Units,Local Pressure, Local Elevation, Local Temperature,Local Humidity,Local Gas,Local Vcc/IR,Thermostat[,Local GPS Latitude,Local GPS Longitude]*Checksum*

Rover output (absolute mode default) format is as follows:

*NetID,NodeID,R,Units,Local Pressure, Local Elevation, Local Temperature,Local Humidity,Local Gas,Local Vcc/IR,Thermostat[,Local GPS Latitude,Local GPS Longitude]*Checksum*

Rover output (base telemetry ping response) format is as follows:

*NetID,BaseNodeID,T,Units,Remote Pressure, Remote Elevation, Remote Temperature,Remote Humidity,Remote Gas,Remote Vcc/IR,Thermostat[,Remote GPS Latitude,Remote GPS Longitude]*Checksum*

Rover output (differential mode) format is as follows, output will be ,A, (preset) until set:

*NetID,NodeID,D,BaseNodeID,Units, Differential Pressure,Pressure Residual, Local Elevation Datum, Differential Elevation, Elevation Residual*Checksum*

Checksum is a hex value calculated by applying XOR on each character in the string up to but not including the asterix (*).

Base NodeID must be an available node in the rover telemetry stream output for commands 4! and 5! to output differential results.

Command 8,1! is used to inverse the differential elevations at the rover when the base is moving relative to a stationary rover in mode A. When enabled the *BaseNodeID* in the differential output will be preceded by a negative sign. Sending 8,0! will set the module back to non-inversed output (default). This would be useful in an application such as an altitude reference for a UAV where the base is onboard and transmitting results to a stationary rover on the ground.

Setup

The following is the initial setup procedure:

1. Select BASE jumper position on base.
2. Send 1,*NetID!* to base.
3. Send 2,*NodeID!* to base.
4. Select ROVER jumper position on rover.
5. Send 1,*NetID!* to rover.
6. Send 2,*NodeID!* to rover.
7. Send 3,*Units!* to rover.
8. Send 4,*Elevation Datum,Base NodeID!* to rover.
9. Send 5! to rover (once datum residuals are acceptable in step 8).

NetID, *NodeID* and *Units* settings are persistent and will be retained when power cycled. Only steps 8-9 above are required for a differential solution on subsequent power-ups.

Do not move the modules during the calibration in step 8.

Demo Software

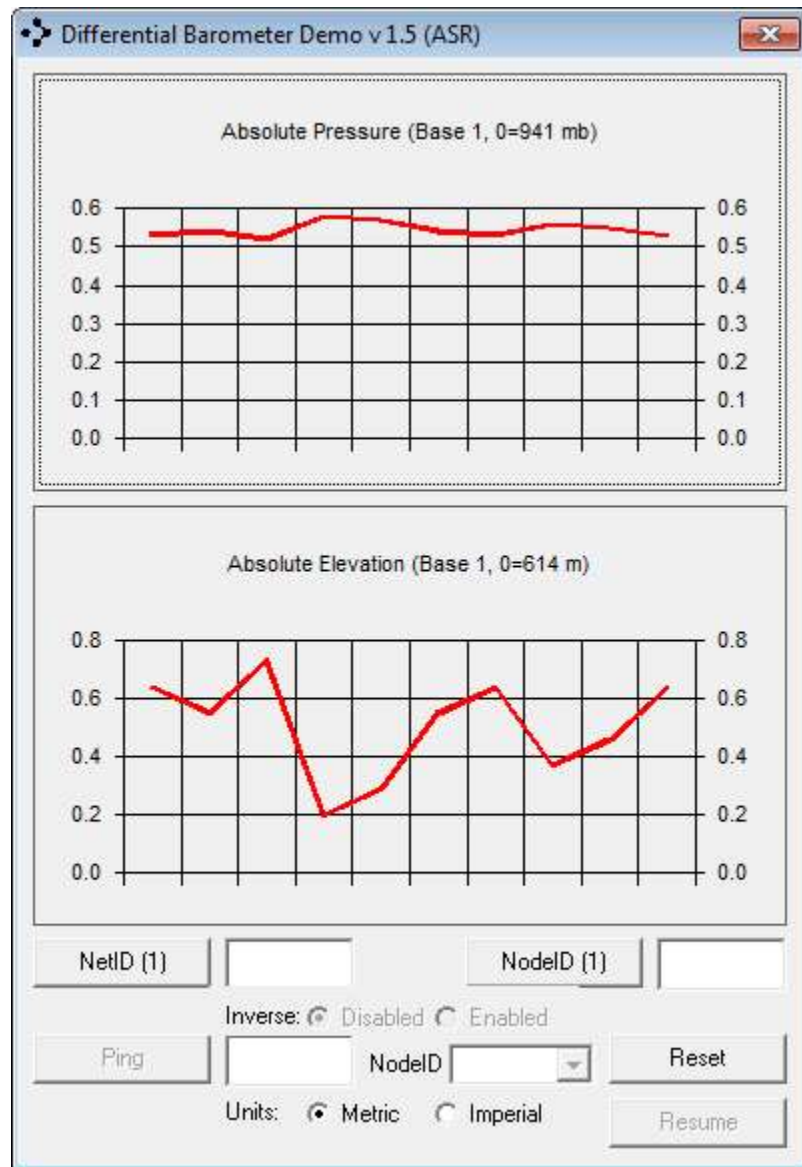
The Differential Barometer Demo software is available for download on our website at <https://www.asr-web.com/support> and allows users to evaluate the capabilities of the system.

Note that a user must be a local administrator on a system in order to install and run this program.

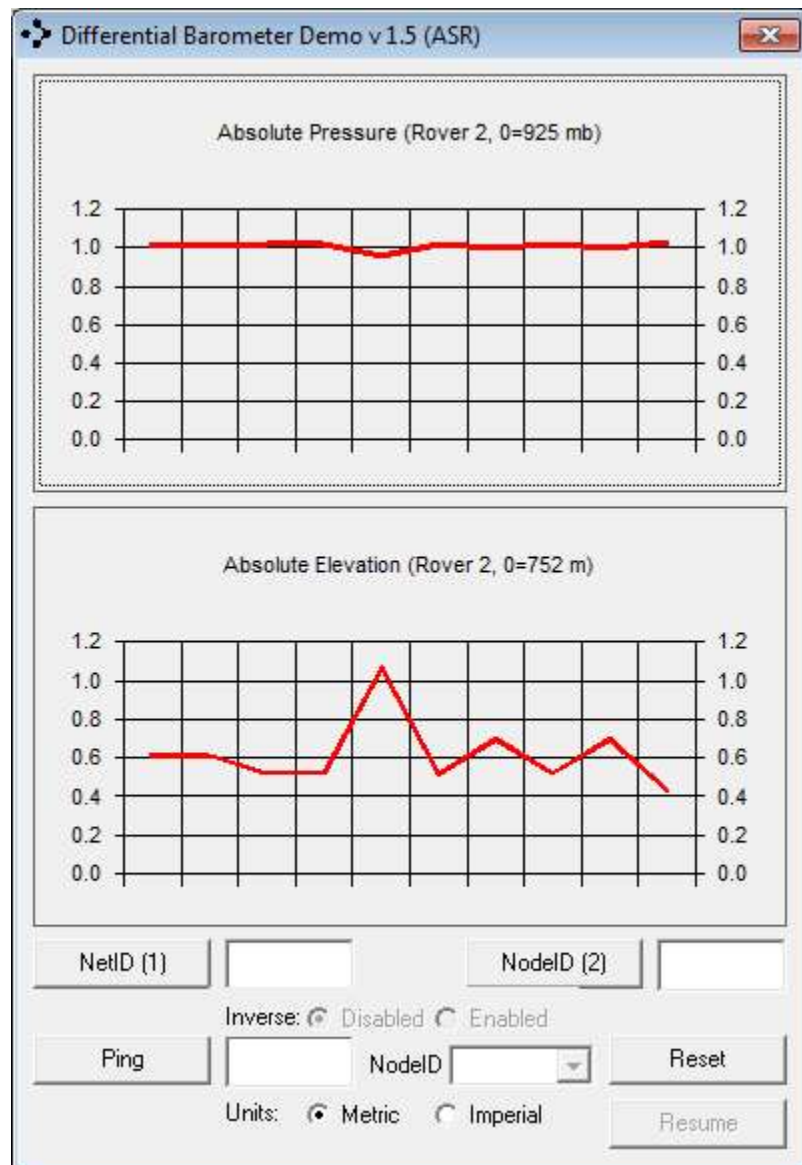
After installation edit the **settings.txt** file in the program installation directory to set the parameters.

Line 1: port number

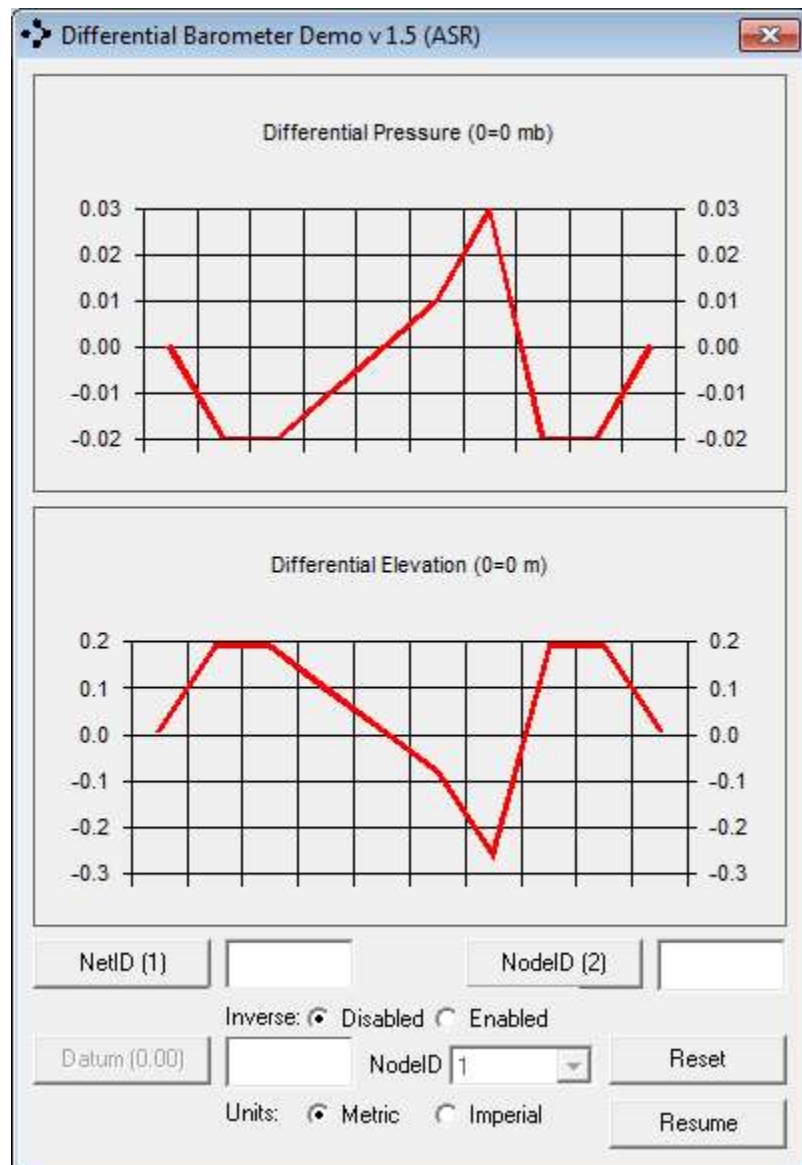
When connected to the base, pressure and elevation graphs are absolute readings. The range corresponding to 0 on the graphs is shown in brackets in each title. The buttons on the bottom top row will be labeled **NetID (x)** where x is the current *NetID* and **NodeID (y)** where y is the current *NodeID*. To set a new *NetID* or *NodeID* enter it into the corresponding text box and click the button. In this mode the **Ping** button is disabled. The current *Units* can be changed on the bottom. The **Reset** button will clear the graphs.



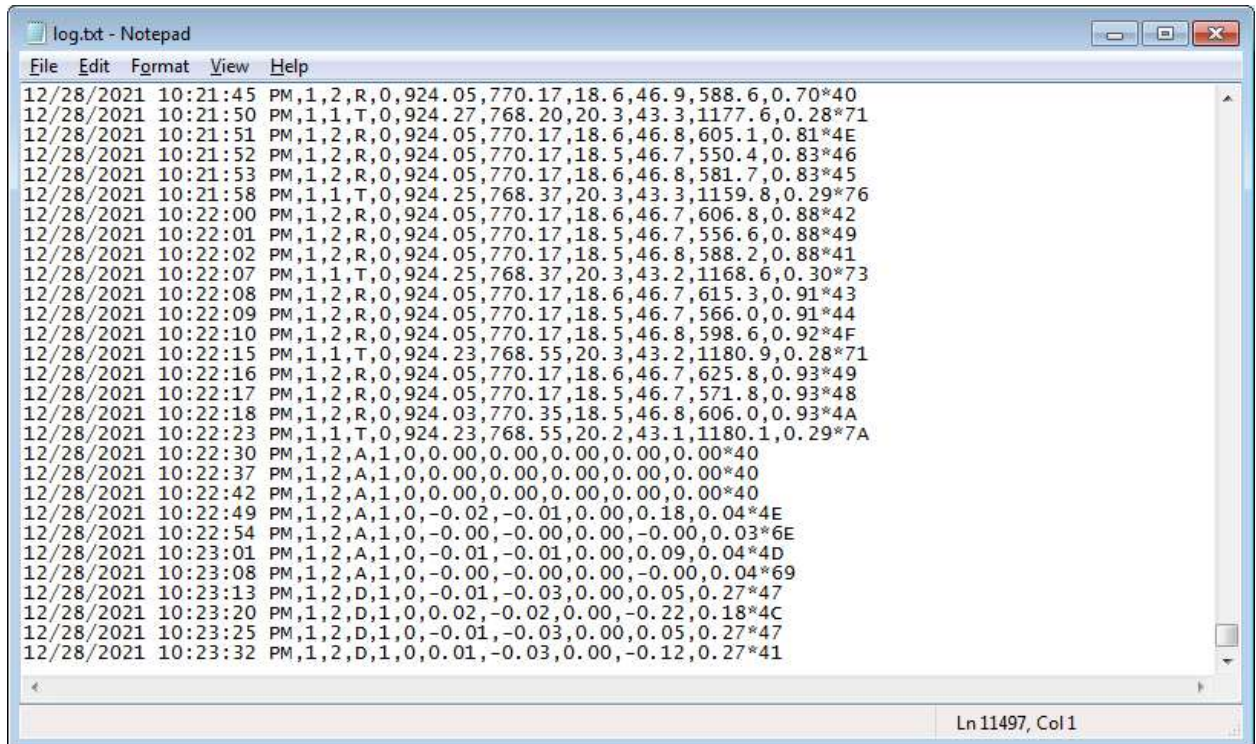
When connected to the rover, pressure and elevation graphs are absolute readings until a datum is set. The range corresponding to 0 on the graphs is shown in brackets in each title. The buttons on the bottom top row will be labeled **NetID (x)** where x is the current *NetID* and **NodeID (y)** where y is the current *NodeID*. To set a new *NetID* or *NodeID* enter it into the corresponding text box and click the button. In this mode the **Ping** button is enabled. Type in a *NodeID* to ping on the same *NetID* and click the **Ping** button. After the **Ping** button is clicked it will change to **Datum** if telemetry is received and the graphs will update accordingly. The current *Units* can be changed on the bottom. The **Reset** button to the right will clear the graphs.



Absolute readings for available base telemetry can be viewed by choosing the *Base NodeID* using the **NodeID** combo box. To set the *Elevation Datum* enter it into the text box and click the **Datum** button. After the **Datum** button is clicked it will change to **Adjust (x)** where x is the current *Elevation Residual* as an average deviation from the preset datum, **do not move the units during the calibration**. To set the *Elevation Datum* click the **Adjust (x)** button and the label will change to **Datum (y)** where y is the current *Elevation Datum* and differential data will be displayed. The **Reset** button to the right will clear the graphs and return to absolute mode. The **Resume** button will continue with the previously defined differential solution.



A **log.txt** file in the application directory stores the output with a date/time stamp.



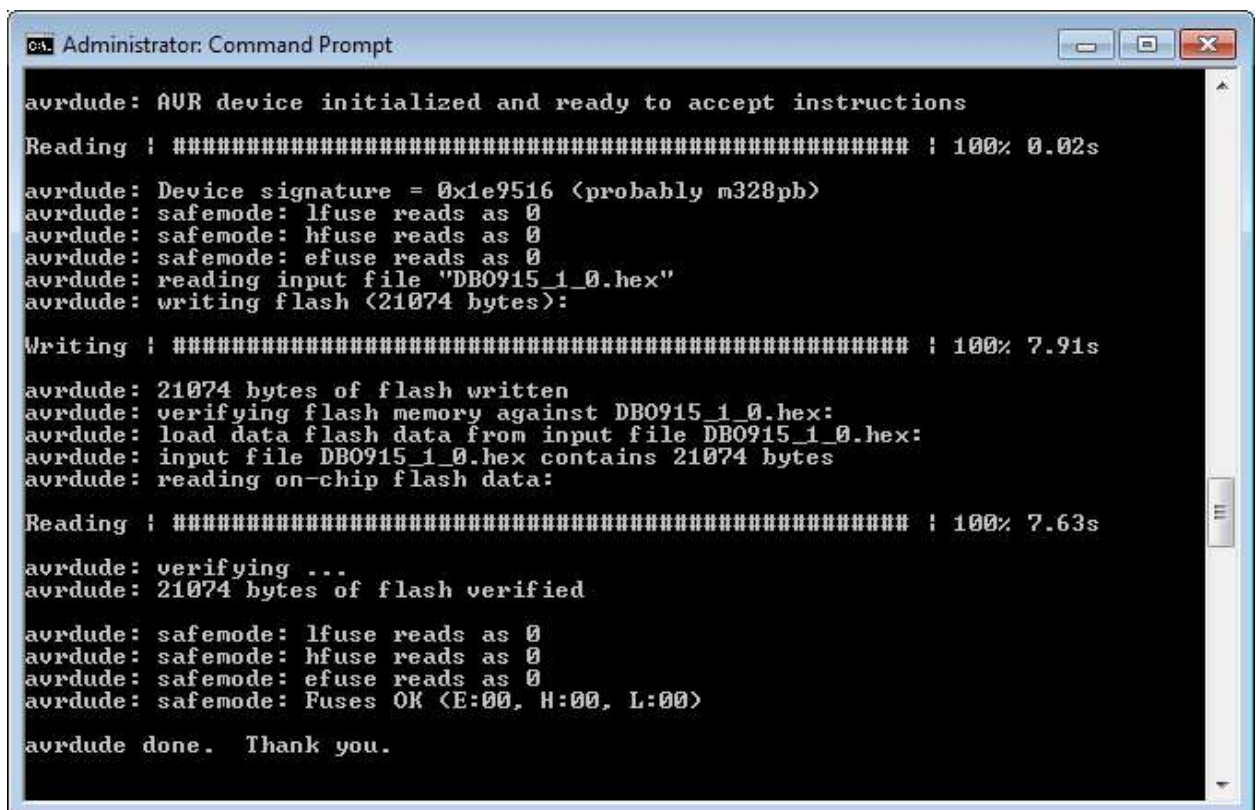
```
log.txt - Notepad
File Edit Format View Help
12/28/2021 10:21:45 PM,1,2,R,0,924.05,770.17,18.6,46.9,588.6,0.70*40
12/28/2021 10:21:50 PM,1,1,T,0,924.27,768.20,20.3,43.3,1177.6,0.28*71
12/28/2021 10:21:51 PM,1,2,R,0,924.05,770.17,18.6,46.8,605.1,0.81*4E
12/28/2021 10:21:52 PM,1,2,R,0,924.05,770.17,18.5,46.7,550.4,0.83*46
12/28/2021 10:21:53 PM,1,2,R,0,924.05,770.17,18.6,46.8,581.7,0.83*45
12/28/2021 10:21:58 PM,1,1,T,0,924.25,768.37,20.3,43.3,1159.8,0.29*76
12/28/2021 10:22:00 PM,1,2,R,0,924.05,770.17,18.6,46.7,606.8,0.88*42
12/28/2021 10:22:01 PM,1,2,R,0,924.05,770.17,18.5,46.7,556.6,0.88*49
12/28/2021 10:22:02 PM,1,2,R,0,924.05,770.17,18.5,46.8,588.2,0.88*41
12/28/2021 10:22:07 PM,1,1,T,0,924.25,768.37,20.3,43.2,1168.6,0.30*73
12/28/2021 10:22:08 PM,1,2,R,0,924.05,770.17,18.6,46.7,615.3,0.91*43
12/28/2021 10:22:09 PM,1,2,R,0,924.05,770.17,18.5,46.7,566.0,0.91*44
12/28/2021 10:22:10 PM,1,2,R,0,924.05,770.17,18.5,46.8,598.6,0.92*4F
12/28/2021 10:22:15 PM,1,1,T,0,924.23,768.55,20.3,43.2,1180.9,0.28*71
12/28/2021 10:22:16 PM,1,2,R,0,924.05,770.17,18.6,46.7,625.8,0.93*49
12/28/2021 10:22:17 PM,1,2,R,0,924.05,770.17,18.5,46.7,571.8,0.93*48
12/28/2021 10:22:18 PM,1,2,R,0,924.03,770.35,18.5,46.8,606.0,0.93*4A
12/28/2021 10:22:23 PM,1,1,T,0,924.23,768.55,20.2,43.1,1180.1,0.29*7A
12/28/2021 10:22:30 PM,1,2,A,1,0,0.00,0.00,0.00,0.00,0.00*40
12/28/2021 10:22:37 PM,1,2,A,1,0,0.00,0.00,0.00,0.00,0.00*40
12/28/2021 10:22:42 PM,1,2,A,1,0,0.00,0.00,0.00,0.00,0.00*40
12/28/2021 10:22:49 PM,1,2,A,1,0,-0.02,-0.01,0.00,0.18,0.04*4E
12/28/2021 10:22:54 PM,1,2,A,1,0,-0.00,-0.00,0.00,-0.00,0.03*6E
12/28/2021 10:23:01 PM,1,2,A,1,0,-0.01,-0.01,0.00,0.09,0.04*4D
12/28/2021 10:23:08 PM,1,2,A,1,0,-0.00,-0.00,0.00,-0.00,0.04*69
12/28/2021 10:23:13 PM,1,2,D,1,0,-0.01,-0.03,0.00,0.05,0.27*47
12/28/2021 10:23:20 PM,1,2,D,1,0,0.02,-0.02,0.00,-0.22,0.18*4C
12/28/2021 10:23:25 PM,1,2,D,1,0,-0.01,-0.03,0.00,0.05,0.27*47
12/28/2021 10:23:32 PM,1,2,D,1,0,0.01,-0.03,0.00,-0.12,0.27*41
Ln 11497, Col 1
```

Firmware Updates

Firmware updates are available for download on our website at <https://www.asr-web.com/support>.

The following is the firmware update procedure:

1. Connect the OEM module to a USB-serial converter, the DSR/DTR line must be used.
2. Connect USB-serial converter to a port on your local machine.
3. Unzip the package.
4. Launch a command window.
5. Change the directory to the location of the package.
6. Invoke update.bat with a single parameter which specifies the serial port number to use.



```
Administrator: Command Prompt

avrdude: AVR device initialized and ready to accept instructions
Reading : ##### : 100% 0.02s
avrdude: Device signature = 0x1e9516 (probably m328pb)
avrdude: safemode: lfuse reads as 0
avrdude: safemode: hfuse reads as 0
avrdude: safemode: efuse reads as 0
avrdude: reading input file "DB0915_1_0.hex"
avrdude: writing flash (21074 bytes):

Writing : ##### : 100% 7.91s
avrdude: 21074 bytes of flash written
avrdude: verifying flash memory against DB0915_1_0.hex:
avrdude: load data flash data from input file DB0915_1_0.hex:
avrdude: input file DB0915_1_0.hex contains 21074 bytes
avrdude: reading on-chip flash data:

Reading : ##### : 100% 7.63s
avrdude: verifying ...
avrdude: 21074 bytes of flash verified

avrdude: safemode: lfuse reads as 0
avrdude: safemode: hfuse reads as 0
avrdude: safemode: efuse reads as 0
avrdude: safemode: Fuses OK (E:00, H:00, L:00)

avrdude done. Thank you.
```