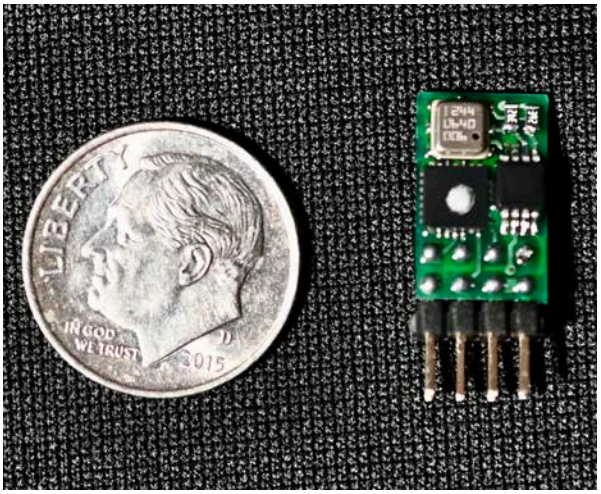
Adrel DeployMax™

Model Rocket Single Deployment Event Altimeter
Designed by Leszek Swed



Important Note!

You will need the following for use with the Adrel DeployMax:
• PC running Windows 10
• USB Type AB cable
• Battery and charger for the deployment charge starter. Current recommendation is a 1S 3.7V Lithium polymer 120-180mah.
•**NOTE:** *The standard Adrel Battery (#811) is NOT recommended for this application.*
•Adrel Battery Charger/Data Port (#812A) for data download only – *not for use as a charger for your deployment charge battery.*
•Adrel DeployMax Software
•https://cdn.shopify.com/s/files/1/1762/3593/files/Adrel_DeployMax_060621_C.pdf?v=1623039234
•Wires and connectors to connect unit to starter and the battery
• The MJG Firewire Initiator is the recommended starter for this unit. This is an ATF non-regulated initiator.
•https://electricmatch.com/pyrotechnics/see/6/5/mjg-firewire-initiator

About the Adrel DeployMax:

The Adrel DeployMax, the smallest, lightest single event altimeter that you can buy. Now, you can use the proven Adrel altimeter algorithms to not only record peak altitudes, but to trigger recovery system deployment as well. This tiny system can easily fit in a 1/2" diameter tube, depending on the starter battery selected.

When I saw the need for a small, single event deployment altimeter, I went back to Leszek Swed, the genius behind the Adrel altimeter, to see if it was possible to design one. Within a few short days, he presented me with a design for consideration. And that's how the Adrel DeployMax came to be.

For years, the Federation Aeronautique Internationale (FAI) has used Adrel altimeters for world championships. These units are examples of incredible engineering, both in hardware and software.

The Adrel DeployMax altimeter™ is National Association of Rocketry (NAR) approved for competition flights and record attempts. It is designed and manufactured by Adrel Electronics in Krakow, Poland.

The DeployMax deployment altitudes are user programmable from 100% (peak) to 50m minimum altitude. The software works looks for a certain number of counts in decreasing altitude before it will fire. That way, it never triggers early. It does not fire not at “true” apogee, but darn close afterwards, ensuring that you capture the flight's highest possible altitude.

Thank you for purchasing this North Coast Rocketry® product. We hope you have an enjoyable time constructing and using this tool. Please read all of these instructions to become familiar with them before starting construction.

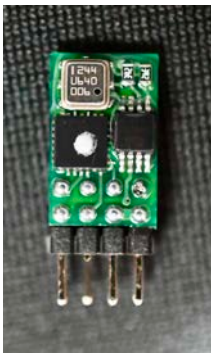
If items are missing or damaged, or if or any reason you are dissatisfied with this product, please let us know at www.NorthCoastRocketry.com. We will gladly replace any item found to be defective. Our goal is for you to be satisfied with your purchase, and to have fun!

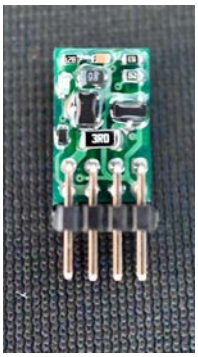
• This product is recommended for adults(18 and older) only.
•North Coast Rocketry certifies that it has exercised reasonable care in the design and manufacture of its products. However, as we cannot control the use of our products once sold, we cannot assume any responsibility or liability for product usage.
• North Coast rocketry shall not be held responsible for personal injury or property damage resulting from the use of our product. The buyer assumes all risks and liabilities arising from the use of our product and uses our product on these conditions.
• North Coast Rocketry makes no warranty regarding our products, except for defects in materials or workmanship for a period of one year after purchase.
•If any of these terms are unacceptable, please return the item to the point of purchase.

Altimeter Overview

The Federation Aeronautique Internationale (FAI) governs all aerosport competition sports worldwide. The FAI recommends that the measurement of altitude in the categories S1 (Altitude) and S5 (Scale Altitude) be measured electronically with the use of altimeters (rather than optical trackers, as was the previous method). The Adrel DeployMax altimeter was developed in accordance with the FAI specifications. The Adrel DeployMax is similar to the original Adrel MaxAlt, except it has an extra row of pins used to trigger a starter.

In addition to measuring the maximum flight altitude to the required precision, the DeployMax altimeter stores altitude measurement results for the entire flight, allowing for a complete review of the flight. The altimeter's small size and weight allow for its inclusion in all types of contest rockets. It is currently the smallest, lightest single event deployment altimeter system on the market.



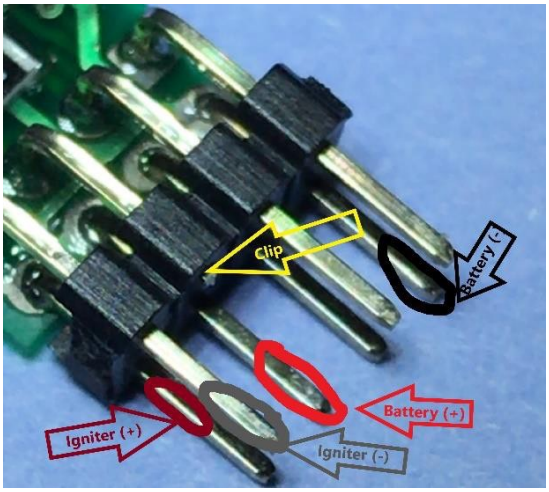


The altimeter height measurement is based on the change of pressure as a function of altitude. The altimeter pressure sensor, calibrated at the factory, measures absolute pressure.

The Adrel data conversion program reads the pressure data from altimeter pressure sensor and converts it to altitude. The conversion is based on an NAR and FAI approved formula, which takes into account the current pressure, pressure changes, temperature, vertical temperature gradient, and change of the density of the atmosphere depending on altitude. Measurements are stored in nonvolatile memory, so they are saved when device is disconnected from power. Altitude measurements can be sampled from 20 measurements per second to 1 measurement every 2 seconds (which can be useful for airplane applications where sampling speed is not as critical).

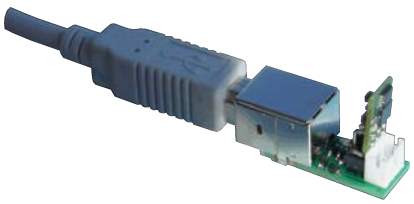
The data chart shows the entire flight of a rocket. The graph can be expanded to better examine the data. For contests, the altimeter is able to store the competitor's competition number. In addition, each altimeter has a recorded permanent unique serial number. For archiving the results of competitions, the measurements can be saved to disk and retrieved any time.

The pin directly below the clipped pin (bottom row, second from left) is the positive pin for the battery connection. The far-right hand pin on the bottom row is the negative pin for the battery connection. The starter pins are the left most pins on the top and bottom row.
The polarity of the igniter pins is for information only.



USB Adapter/Charger

The Adrel DeployMax uses a special adapter that works as both the data port for the altimeter to the computer, and as a charger for the battery. The charger used to connect the altimeter to a computer using a standard USB cable with tip type B. The Adapter has a built-in control system for the single-cell Li-Po battery recharger.



DeployMax starter Setup

Shown below is a typical installation and setup approach for the DeployMax from our NCR beta tester.

The test unit was fit inside a 13mm payload bay. Combined total weight of the unit without a deployment charge was 11.1g. The weights of the various components used are depicted in the images below:

Battery connector

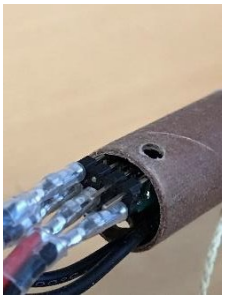
Starter leads

Battery

Starter leads/cap/Kevlar

Dupont connectors
Heat shrink used

Altimeter inside 13mm coupler
Battery placed above in body tube



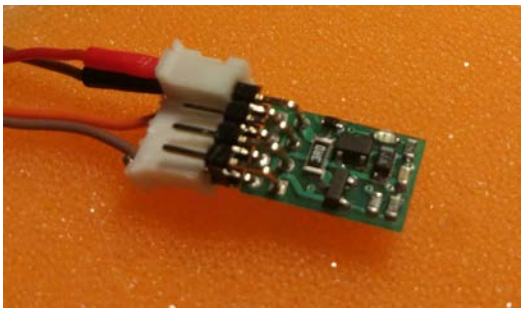
Payload tube

Nose cone

Finished bay

Wires to Starter

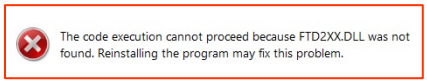
Wires to Battery



Software Installation and Setup

In order to use the Adrel DeployMax on your PC, the drivers must be installed. Go to the NCR website and download the Windows 10 Adrel software. When launching the program, you may see a message that warns you that the program is unrecognized. Ignore the warning and click "Run anyway". It will run and does not appear after the first time you run it.

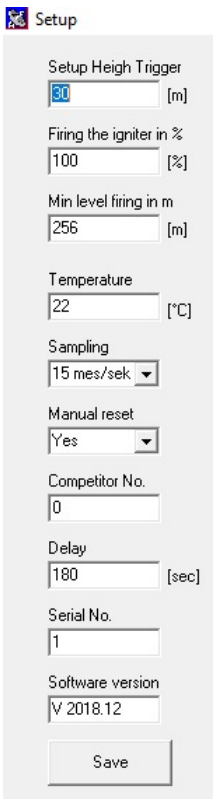
If you get this error message:



first, try running the Adrel install program as the Administrator. If that fails, do a search of the Windows folder looking for the DLL file. You will likely find the file in a folder called "driver file repository" Copy the .dll file, then go to the Adrel executable folder and paste a copy of the .dll file into the folder. Rerun the Adrel program, and it should work.

Altimeter Setup

After you have installed the Adrel drivers (see following) you will need to initialize the altimeter. Connect the altimeter to the computer using a USB cable and run the Altimetr_FTDI Igniter.exe program. Press "Settings", and the "Setup" window appears. Input in the following order:



Setup Height Trigger: The optimum Setup Height Trigger height is about 20- 30 meters. The altimeter records measurements from the last three seconds before detection of measurement start level. If you set the start level too low (0 meters), the measurements could start on the pad, and you will get no altitude data, or incomplete data (if the memory fills up before the flight is complete). If the wind is near the high limit (20 mph), you may want to set the start at 50m to eliminate to possibility of gusts prematurely triggering the altimeter prior to launch.

Firing the Igniter (%): Use 100% for just after apogee initiation. 100% = peak altitude reached. Other settings can be used as a dual deploy if you wish to use motor ejection as a primary deployment event.

Minimum Level Firing (m): Set to 50m or greater. This is the "floor" as to when the unit will fire. It is hard coded to not go go below 50m in any case.

Sample rate (per second): Default is 15 measurements per second. FAI rules state the measurement must be performed at least 10 times per second, but we have found it is best to set the rate at 15 samples per second. This ensures fast measurement with accuracy. Setting a higher frequency of measurements reduces the measurement resolution (to 1 meter).

Manual Reset: (Manual – Yes/No): Set Manual Reset to "No" for contest use. That means the altimeter can not be reset without the use of a computer.

Calibration of Temperature: During the conversion of the pressure to height as the air temperature is taken into account. The altimeter has a built-in temperature sensor. The temperature sensor used in the altimeter is factory calibrated.

Competitor Number: For contests, you may enter a competitor number.

Delay: This is the delay time until the unit arms. The unit should only be powered up once at the pad. In addition, the delay should be set long enough to ensure the rocket can be buttoned up and placed on the pad before the delay expires and the unit is armed. A stopwatch or timer should be used to track the delay time.

When you press "Save", entered settings will be saved to the altimeter. Exit without saving happens if you close the window (click on X). These settings are remembered by the altimeter, even after power is switched off. A single programming session is all that is required.

Reset: Before each flight, you must reset the altimeter. This can be done through the computer program by pressing the button "Reset". After an additional confirmation, the altimeter reset message appears. You can now disconnect the altimeter from the computer and connect the battery. Proper reset is signaled by a single, short-blinking LED. No reset is signaled by 3 blinks of the diode. Altimeter can also be reset manually by shorting the top row of rightmost pins. To make this possible, you must first set the "Manual Reset" to 'Yes'. If it is set to 'No', then reset is only possible through the program.

Preparation for Flight

The order in which the batteries and igniter are connected is very important. You need to perform the following sequence when connecting the Adrel DeployMax:

1) FIRST connect the battery to the unit
2) THEN connect and the igniter.

If you connect the igniter first, the igniter can fire when the battery is connected.

•**NOTE:** *Use of Safety Glasses is suggested when handling the Adrel DeployMax when connecting an igniter and when in flight mode.*

The deployment charge starter is connected to altimeter with separate plug. It is powered from the same battery as altimeter. There is a FET transistor that can handle 5A of current, but it is limited it to 1.2A (with 3.6V battery voltage) and 1.4A (for 4.2V). A 120-180mAH, 3.7v LiPo battery is required. This type of battery is often referred to as a "ultra-micro" or "nano" 1s LiPo. The battery used has a PH 1.25 JST connector on the battery.

•The MJG Firewire Initiator is the recommended starter for this unit. This is an ATF non-regulated initiator. https://electricmatch.com/pyrotechnics/see/6/5/mjg-firewire-initiator

After connecting the reset state is signaled by the LED blinking in single flashes. Before inserting the altimeter into the payload section, you should make sure that the LED is blinking single flashes. If you can see the altimeter after insertion into the payload section, make sure it is blinking single flashes. If it is not blinking single flashes, it will not record a peak altitude on your flight or fire the deployment charge.

Installation of the altimeter into the model is very important. The altimeter payload section can not be airtight. Unlike most US altimeters, though, large holes are not needed. One to two pinholes (0.3-0.4mm/0.012-0.016") are all that are needed for the Adrel BMP to read altitudes. Larger holes may trigger false readings or let the wind trigger the altimeter on the pad.

The altimeter has a three-minute delay window from power up to putting the nose cone on the payload section (or other actions that could change the pressure the altimeter reads) to install the altimeter. You can change in the setup menu under "Delay". For safety reasons, don't power up the altimeter until the last possible moment before placing the model on the pad.

After the three-minute window, the altimeter starts looking to sense liftoff. If you see a single steady flash, you are ready for launch. If you trip the altimeter and it thinks it senses launch, the flash sequence changes to double flashes. If you see double flashes, it's time pull the altimeter out, re-zero it, and connect the battery again.

For best results, the altimeter should be isolated from ejection charges or other effects that create pressure changes. If exposed to the ejection charge, the gasses could corrode the sensitive components of the altimeter.

After the flight, three quick flashes means the altimeter has been triggered and has captured data for download.

The altimeter can be reset without a computer (if you have allowed this in the altimeter setup (see following section) by setting the Manual reset flag to "Yes"). You should wait until the LED blinks 3 times (if altimeter is not reset) and then short for a moment two free contacts of the connector (see below). The LED will blink with single flashes, indicating the altimeter has been reset, and is ready for flight. When you reset the altimeter with the manual method, you do not erase the pervious data on the altimeter. When the altimeter detects launch and begins measurement (indicated by two blinks) the previous data is deleted.

The altimeter is considered "enabled" after the delay period expires and begins sensing for pressure changes indicating launch. Measured changes are not stored in nonvolatile memory, only in the altimeter's instantaneous memory. Once the designated launch altitude (as indicated in the setup menu) is detected, the last 32 and current measurements are saved. The site altitude measured before the launch is regarded as a reference, or zero altitude.

Measurement start is indicated by double blink of the LED. The pressure measurements are saved in memory. After a minimum of 2 seconds after launch detection, the altimeter software looks to see if the model is descending. If it detects a peak altitude of less than 7m, and the model does not descend further, 32 more measurements will be taken, and data collection is completed. Successful capture of the data is indicated by three blinks of LED (when the altimeter has not been reset).

Reading the Altitude

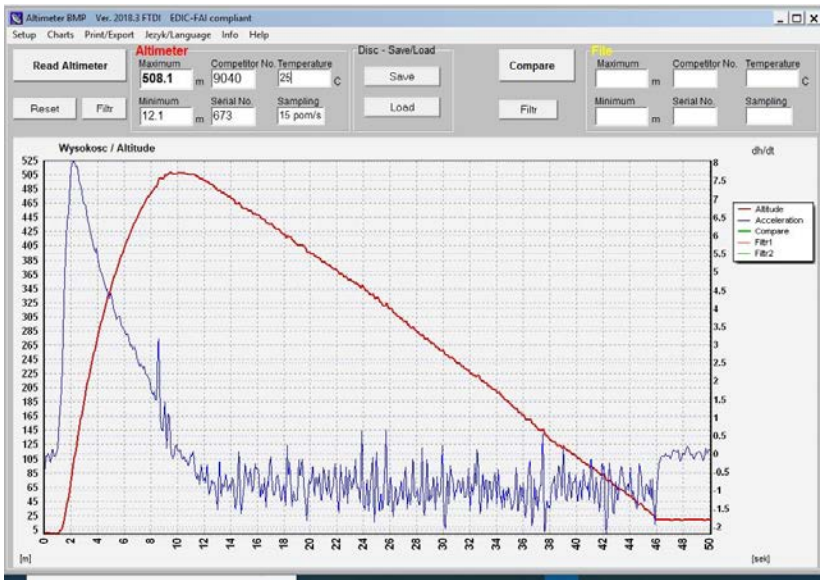
After the flight, check if the altitude has been measured, which is is indicated by a three blinks of LED. IF, after the flight the LED blinks twice, it means that level of the landing has not been detected, but the altitude measurements were made. In either case, disconnect the battery. The measurements were recorded in the memory on the altimeter.

Connect the altimeter to the computer with the data port. When connected to a computer, the altimeter's LED should blink once, then in groups of five flashes. After pressing the "Read altimeter" measurements will be read and displayed on the screen.

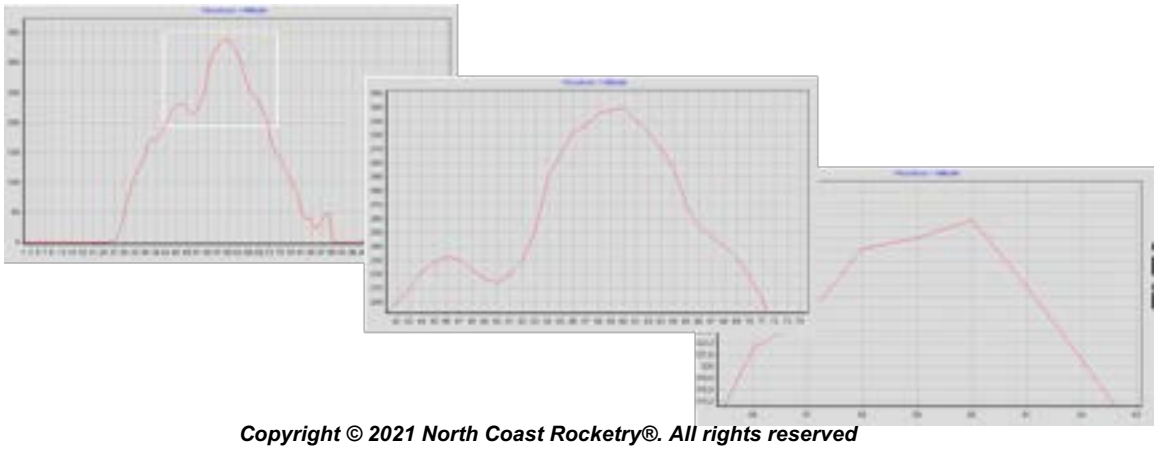
On the right side maximum and minimum altitude will be displayed. In the "contestant" window the number of competitor and the serial number will be displayed.

It is recommended that filter (Filtr") be used before saving data to eliminate noise spikes in the data and to obtain final results.

Read data can be saved on your computer HDD by pressing "Save" in the panel "Disk –Save/Load". Such recorded data can be played back at any time. Altimeter does not need to be connected. The program can read the current temperature measured by the altimeter.

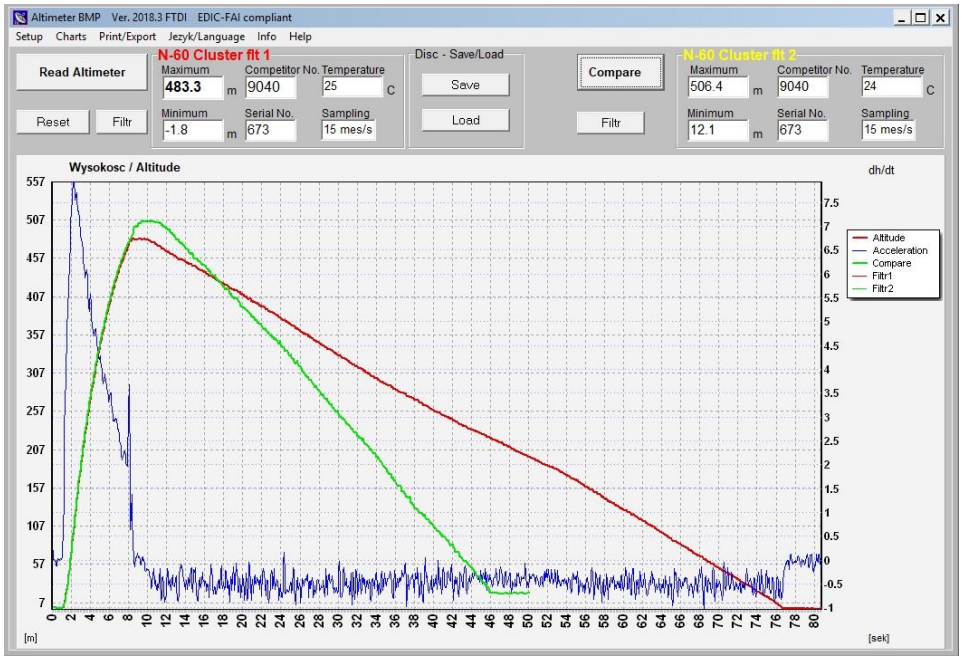


The graph can be zoomed in. Use your mouse to select the area of interest. During zooming, it is important to drag from left to right. Any selection from right to left returns to the view of the entire chart. Below are the charts after zooming in.



Reading the Altitude Measurement (Continued)

Flight graphs can be compared with each other. To do this, read data from altimeter or disk, and then click "Compare". This brings up a file selection window. Please select a file with data to compare and click 'Open'. An additional chart appears on the screen. Speed chart and comparisons can be switched off in the menu tab "Charts".



Temperature Correction:
Altimeter calculated height assumes the temperature that was measured by the altimeter. However, in many cases, the temperature may differ significantly from the actual value (due to holding the altimeter or allowing sunlight to heat it up). The measured temperature may then vary up to several degrees. The difference in calculating the amount of approximately 0.3% per degree C. For example, height of 355.5 meters at 24 C, after correction for 20 C temperature is 350.7 (the difference of 4.8 meters).

Temperature correction is possible in the software. For NAR contest flights, use the standard 15C. For FAI or your own personal use, you can correct to the actual air temperature.. After entering the new value in the "Temperature" field and pressing "Enter", measurements will be re-converted and displayed. It is recommended that the flight cards have a place for recording the ambient temperature.

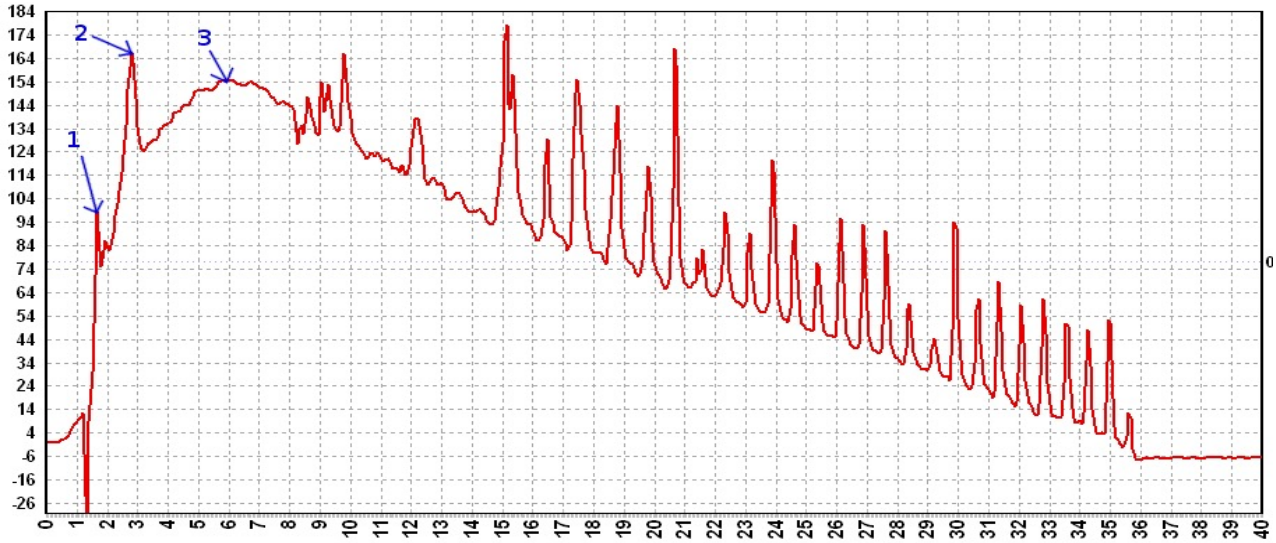
Filtering:
The altimeter may be subject to a number of transient effects (direct airflow, ejection charge overpressure, wind gusts, etc.) which can show up in the final measurements and distort the results. Use the Filter command to remove these erroneous measurements. The measurements are filtered by discarding the transient "peaks". The result is a smooth graph.

Data from the altimeter or the disk can be filtered in using Filter button on the left side of the screen. Generally, it is a good idea to save the raw data to disk, then open that data file and apply the filter to get the final result. Save that file as “Filtered”. Filter parameters can be set settings tab in the Filter.

Special thanks to Larry Kennedy, Chad Ring, Bernard Cawley for beta testing and proof-reading the instructions.

How Does the Filtering Work to Trigger at Apogee?

Software provides filtration of data from pressure sensor. Nevertheless, the use of filtration creates time shift to current measurements. When using altimeter memory to provide real-time filtration, a time delay has to be introduced. It can be seen at chart below. If this would not go under filtration then points 1 and 2 would be detected as apogee and would trigger starter.

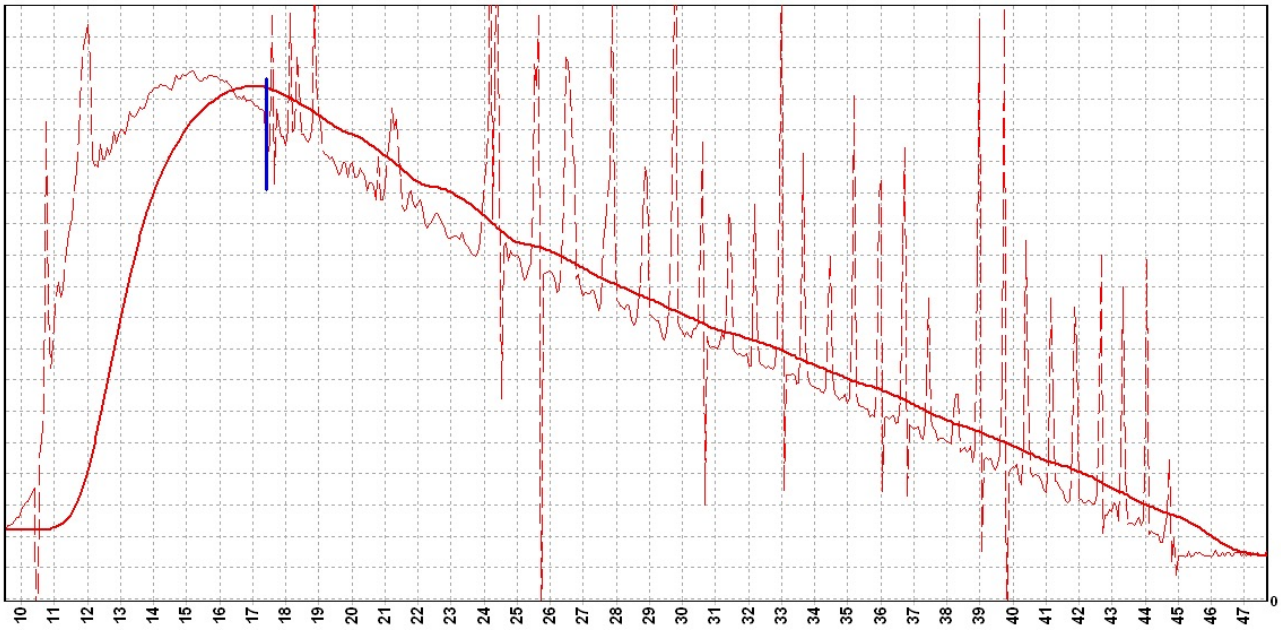


Filtration is a two stage process. First the peaks are smoothed, which is largely the data deviating from main trend. Basing on analysis, it's best to done it based on the next 10 measurements, which creates a 10 samplesdelay.

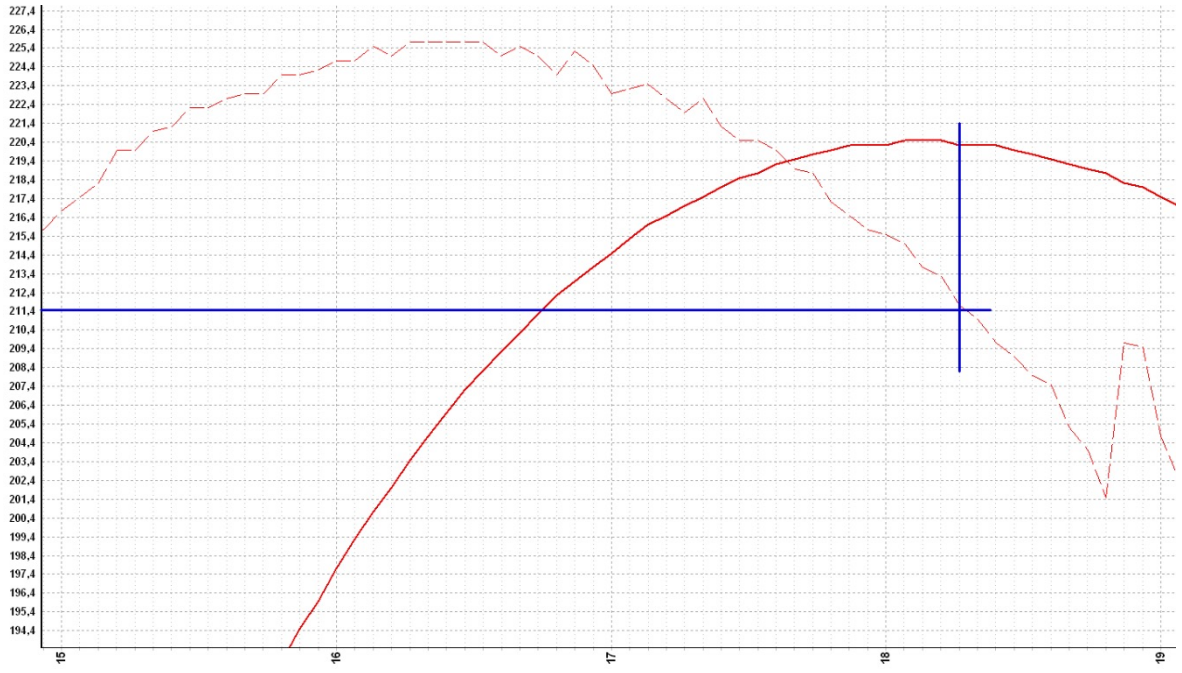
But this is not enough. The chart is still uneven and it's hard to distinguish real apogee. The chart below shows only first stage filtration.

Only after using 2nd stage digital filtration are we able to create unequivocal graph that detects the proper apogee. The triggering point is marked blue. The total delay is 26 samples, which means that event initiation will happen in the descent phase, just after peak altitude.

The data has been validated through analysis of 240 test cases of real-world measurements (the data set is from the 2016 World Championships in Ukraine, including Matt's gold medal winning Scale Altitude flight).



Below you can see delay of measurement – vertical line is point of ignition while horizontal represents true height of rocket. Max height of this flight is 226m, while event initiation will take place at 212m.



Adrel DeployMax Technical Parameters

Method of altitude measurement:	measurement of pressure changes
Measuring Range	-500.... 9000 m
Resolution	0.2 m
Accuracy:	0,5 % (accuracy of measuring the difference of altitude)
Supply Voltage:	3,6V to 6V
Current consumption:	6,5 mA
Sampling:	1 ÷ 2 sec / measurement 10 measurements / sec 15 measurements / sec 20 measurements / sec
Max measurement time:	2-4 h (for 1 ÷ 2 sec / measurement) 13 min (for 10 measurements / sec) 9 min (for 15 measurements / sec) 5 min (for 20 measurements / sec) (total of 8050 measurements)
Measurement triggering:	Set in the range of 0 – 200 m
Measurement end:	Start level + 7m . Then 32 additional measurements are taken