
Sigma 4 Active Recording

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Date	Version Number	Document Changes	Author
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11/14/2017	1.01	Updated Deployment Information for VScope	Mark Day

Table of Contents

1	Introduction	5
2	Overview	6
2.1.....	<i>Sigma 4 Overview</i>	6
2.2.....	<i>Sigma 4 Array Overview</i>	7
2.3.....	<i>Typical Operation</i>	7
3	Initial Setup	8
3.1.....	<i>Connecting the Array</i>	8
3.2.....	<i>WiFi Setup</i>	12
4	Testing the Units.....	13
4.1.....	<i>Observer Overview</i>	13
4.1.1	Creating a New Prospect.....	13
4.1.2	Network Settings	15
4.1.3	Recording Parameters	15
4.1.4	Limits.....	16
4.2.....	<i>Pulling Unit Status</i>	17
4.3.....	<i>Active and Passive Recording</i>	17
4.4.....	<i>Set Operating Mode</i>	18
5	VScope 3	19
5.1.....	<i>Creating the Project</i>	19
5.2.....	<i>Deploy Settings</i>	20
5.3.....	<i>DAQ Settings</i>	21
5.4.....	<i>Recording</i>	21
5.5.....	<i>Plot Settings</i>	22

1 Introduction

This document is meant to act as a quick start guide for Active Seismic Recording using a Sigma 4, or an array of Sigma 4s.

There are 4 main steps for Active Recording with a Sigma 4 array that will be covered in this document.

1. Setting up the Array
2. Connecting to the Array
3. Testing the Array
4. Recording Active Shot Records

For active recording, you will need a WiFi mesh for the units to communicate with one another. There are also 2 programs you will need. Make sure these are installed on your computer.

- Observer – For Testing the Array
- VScope – For Recording Active Shots



Figure 1

2 Overview

This section provides an overview of a Sigma 4, a Sigma 4 Array using a WiFi mesh, and a brief explanation of typical Active Recording operation.

2.1 Sigma 4 Overview

The Sigma 4 has several connection ports: Sensors, AUX, Charge, GPS, Power, and Data. Each of these has several options for accomplishing different tasks.

- The Sensor port is used to either connect to external geophone sensors, or you can connect a Sensor Shorting Plug to use the Sigma 4s internal geophones.
- The AUX port can be used to connect a hammer switch to trigger the unit, or to connect a USB flash drive for external storage.
- The Charge port is connected to an internal battery which can be charged by using a Sigma 4 charger, or you can connect a Battery Shorting Plug to power the Sigma 4 with the internal battery.
- The GPS port is used to connect to an external GPS module. The Sigma 4 can also come with an internal GPS option, in which case this port is not used.
- The Power port is used to power up the Sigma 4 if you are not using the internal battery.
- The Data port is used to connect to a computer by using a 10-pin ethernet cable. It can also be used to power a WiFi network station.

WARNING: Do not connect the Sigma 4 to a computer using a cable with POE (Power Over Ethernet). It could damage the network port on your computer. These cables are labelled RED.

These ports are all covered more in-depth in the Initial Setup section below.

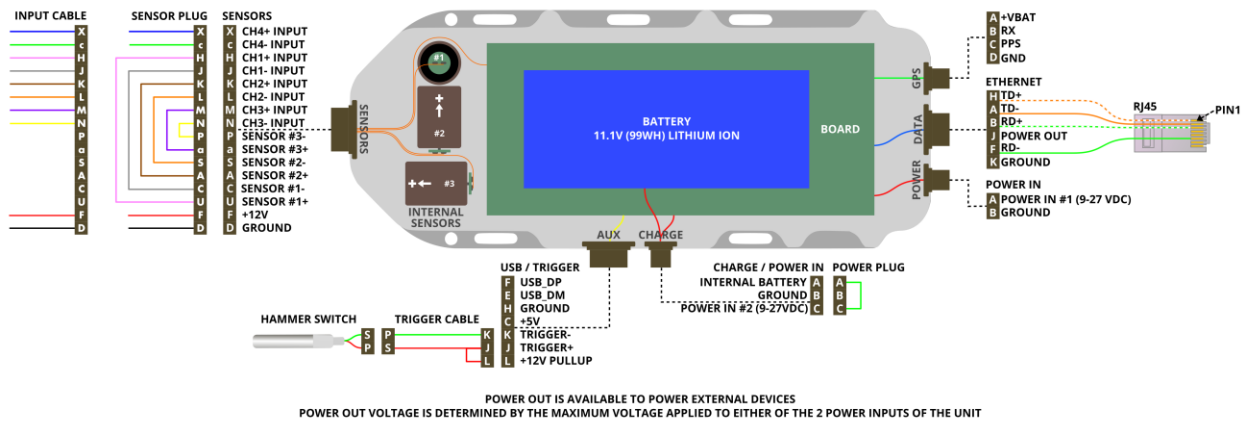
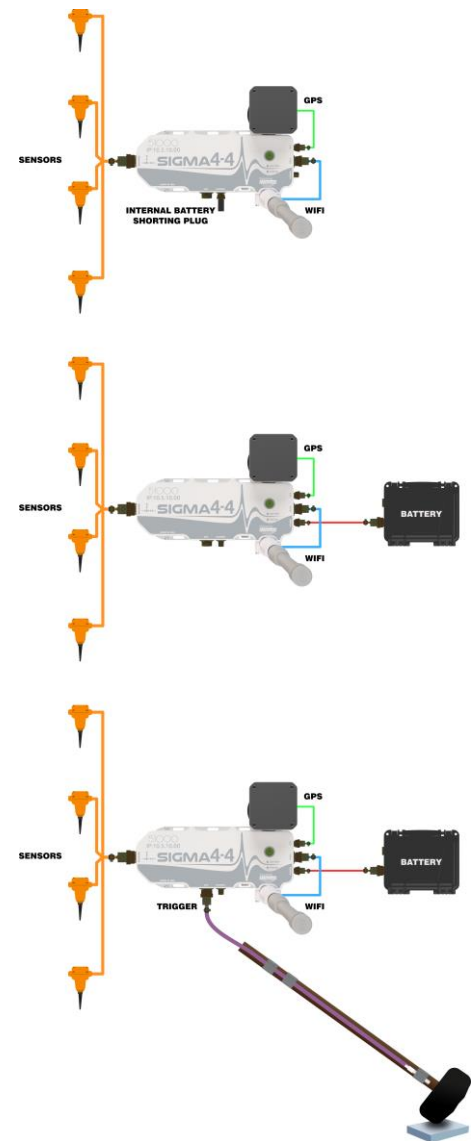


Figure 2

2.2 Sigma 4 Array Overview

A Sigma 4 Array for Active Recording should contain several Sigma 4 units, each with GPS (internal or external), sensors, power, and a WiFi station. One Sigma will have a connected Trigger Switch for triggering the units. This is typically attached to a hammer.

Each Sigma can be powered using an external battery, or by connecting the internal battery shorting plug to use the internal battery.



2.3 Typical Operation

Typical operation for Active Recording with a Sigma 4 array is as follows.

1. Physically set up the Sigma 4 array
2. Connect to the array over WiFi
3. Use Observer to test the units before recording
4. Deploy each Sigma 4 in VScope
5. Begin Active Recording



3 Initial Setup

This section shows the initial hardware setup for each Sigma 4. This includes all the connected cables, and how to set up your network and connect to the WiFi mesh.

3.1 Connecting the Array

For each Sigma 4 in the array:

1. Using a 10-pin POE cable connect the WiFi station to the Data port and mount to Sigma 4. You can also connect the WiFi station using a longer POE cable and mount it to a pole for more height. (Figure 4)



Figure 3



Figure 4

2. Connect the GPS station to the Sigma 4. If your Sigma 4 has the internal GPS option, then you can skip this step.



Figure 5

3. Connect sensors to the Sensor port. You can also connect the Sensor Shorting Plug to use the internal geophone sensors.



Figure 6

4. Connect Sigma 2-Pin Power to power on the unit. You can also connect the Battery Shorting Plug to use the internal battery (Figure 8), or connect a charging cable to the Charge port to both charge and power the unit. You can also flip the switch on the charger so that it only charges the Sigma 4 without powering it on.



Figure 7



Figure 8

5. If you are using this unit as a trigger, connect the Hammer Switch to the Aux port.



Figure 9

3.2 WiFi Setup

When deploying the Sigma 4 array, each WiFi station must have line of sight to at least one other WiFi station.

Once all the Sigma 4s have been connected and deployed to the correct locations, you can connect to the array with a computer.

When connecting to the Sigma WiFi mesh, you can either use your computer's internal WiFi, or connect to an additional WiFi station using a POE adapter and 2 ethernet cables (Figure 10).



Begin by connecting to the WiFi network called "Sigma", the default password is "1234567890".

Each WiFi Station can communicate with the next to send data over longer distances, or around obstructions such as trees or hills (Figure 11).

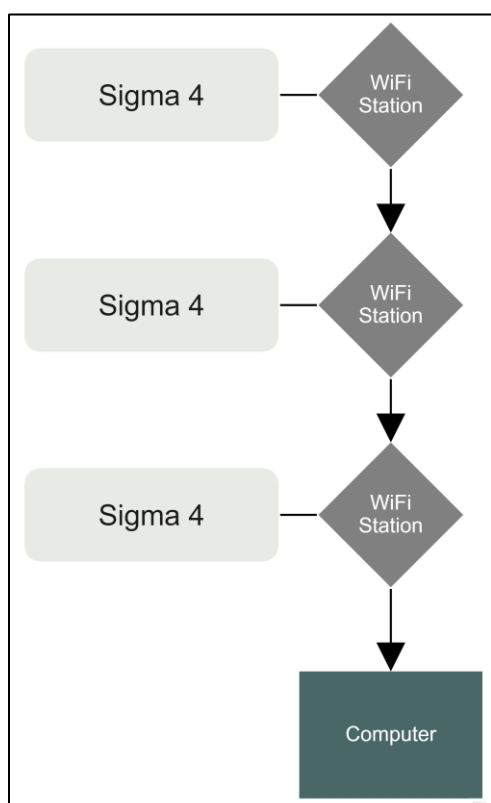


Figure 11

If you are having trouble connecting to the network, ensure that you have good line of sight to at least 1 WiFi station. Also, try temporarily pausing your firewall/virus protection.

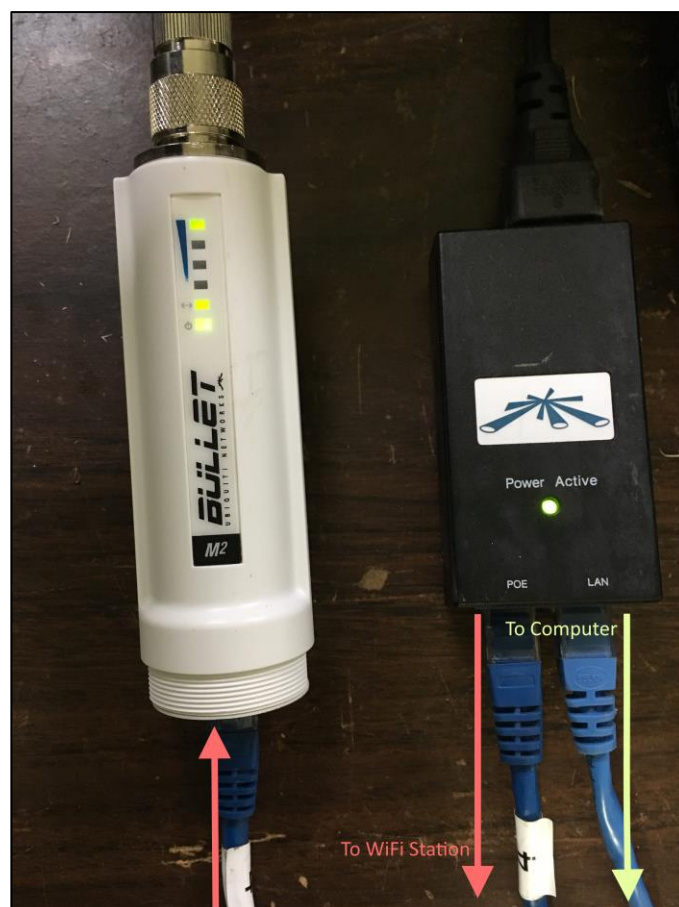


Figure 10

4 Testing the Units

This section explains how to get information from each Sigma 4 to ensure that everything is setup and working correctly. The process for getting status from the Sigma 4 array is as follows.

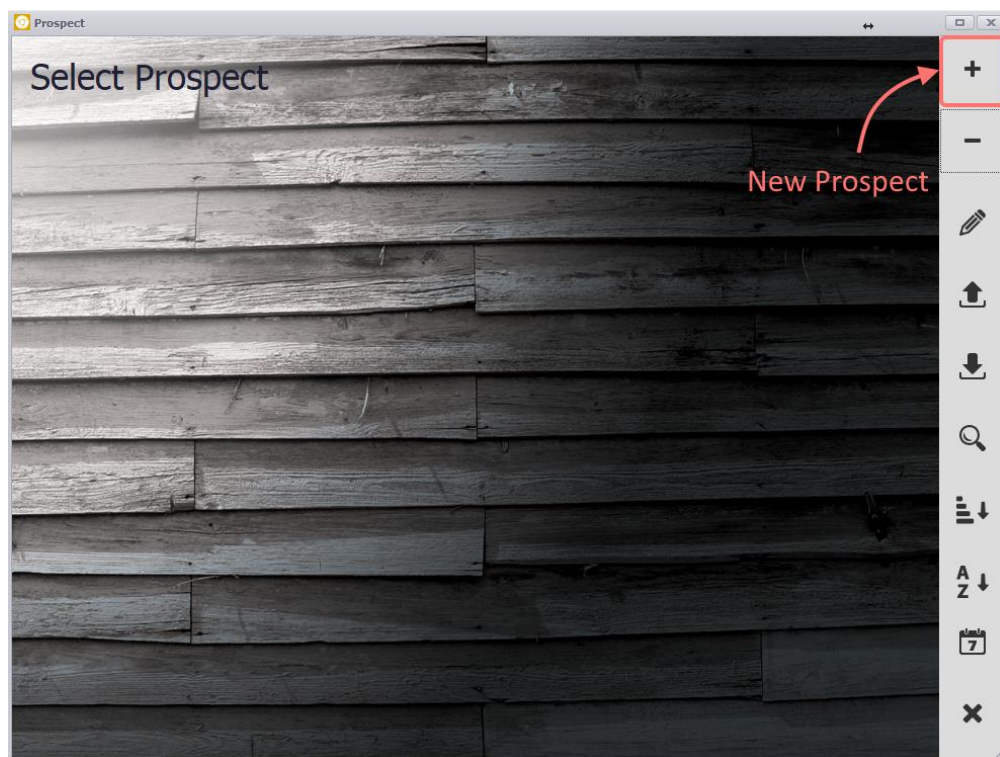
1. Open or Create a new Prospect
2. Discover the Sigma 4 array
3. Pull Status

4.1 Observer Overview

Observer is a powerful program which can be used to communicate with the Sigma 4 units, configure recording parameters, set sensor limits, and get status from each Sigma 4. Each of these will be briefly covered here, but for Active Recording getting status is the only important part.

4.1.1 Creating a New Prospect

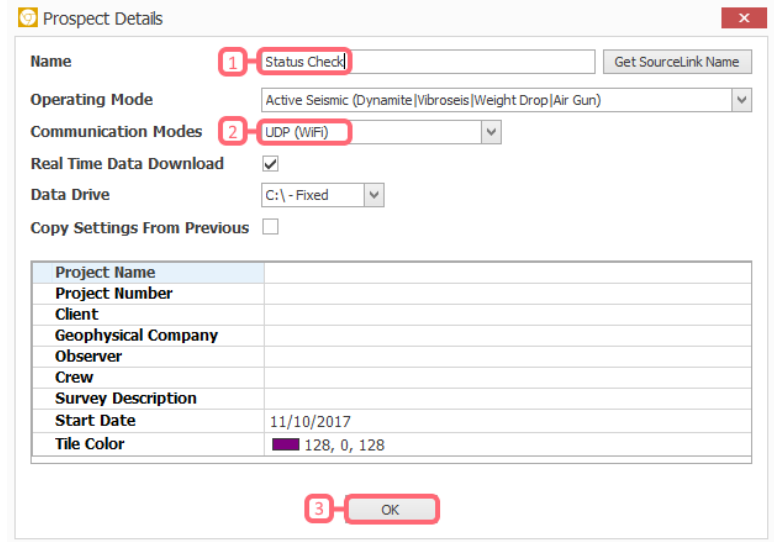
Click on the New Prospect button to create a new Prospect.



This will open the Prospect Details dialog.

1. Give your Prospect a meaningful name.
2. Set the Communication Mode to UDP.
3. Click OK

At this point, the Operating Mode doesn't matter since we are just using Observer to pull status from the Sigma 4s.



Prospect Details

Name: 1 - Status Check Get SourceLink Name

Operating Mode:

Communication Modes: 2

Real Time Data Download: ☒

Data Drive:

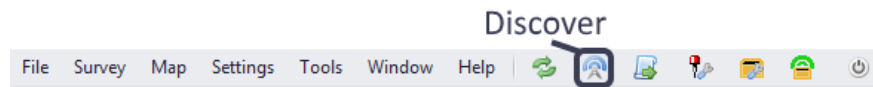
Copy Settings From Previous: ☐

Project Name	
Project Number	
Client	
Geophysical Company	
Observer	
Crew	
Survey Description	
Start Date	11/10/2017
Tile Color	128, 0, 128

3 OK

When Observer opens a Prospect for the first time, it will show the Recording Parameters. These are covered later in VScope, just click OK for now.

Click the “Discover” Icon located at the top of Observer.



The Units list should then populate with the discovered Sigma units.

Units

General

Age

Eval

Box

GPS

RecSts

RecPrm

TrPrm

Chnnl

Snsr



Inst











































Net

Prblms

Sigma Only

Problems Only



Type	Status	Box Id	Anchor	Bat	GPS	Rec	Snsr	Instr
		2000	(11 - 18)					
		2018	(11 - 13)					
		2038	(11 - 1)					
		2045	(11 - 18)					
		2049	(11 - 18)					
		2050	(11 - 1)					

4.1.2 Network Settings

Network Settings can be found under Settings => Network on the top menu bar. If you are having trouble connecting to the units over WiFi, check here to make sure UDP is enable and that the Inter Packet Delay is set to 500.

Network Settings

☐ Send Deployment Info To Units

☐ Enable MRN

☒ Enable UDP (Ethernet/WiFi)

IP Settings

Inter Packet Delay: 500 Cable: 50
WiFi: 200
Mesh: 500

☐ Enable Ping

☐ Auto Pull Status on Discovery

☒ Always Include All Boxes In Discover

☐ HyMesh Setup on StartUp [Setup HyMesh Now](#)

MRN Settings

Connection Type: USB

Connection Port: 3

Operating Mode: Recorder

☐ Auto Deploy Repeaters On Discovery

☐ Enable MRN Debug Messages

☐ Smart Global Operations

☐ DANGER! Tx at least every: 3 seconds

Discover Wait: 3000 ms

Discover Initial Inter Packet Timeout: 3000 ms

Discover Max Inter Packet Timeout: 10000 ms

First Response Timeout: 2000 ms

Additional Response Timeout: 500 ms

Skipped Response Timeout: 3000 ms

Max Retries: 3

Min LQ: 40

Verify Addressable Node: ☒

Wait For Idle Network Before Transmit: ☐

[Cancel](#) [OK](#)

4.1.3 Recording Parameters

Recording Parameters can be found under Settings => Recording Parameters on the top menu bar. For Active Recording, it is best to set these up in VScope, but you can set them here as well for testing if you desire.

Recording Parameters

Recording Parameters

Sample Rate: 2 ms

Input Gain: High Gain

Low Cut Filter: 0.015 Hz

Filter Type: Linear

Sensor Type: Passive

☒ Enabled Advanced Options

Advanced

Internal File Size: 60 seconds

[Cancel](#) [OK](#)

System Type

Trigger Type: Continuous Recording

Standalone Mode: ☒

☐ Enable Advanced Options

Advanced Trigger

Trigger Source: Auto

Channel: 1

Level: 1 V

PreTrigger Delay: 0 sec

Auto Start: Without Start Command

Timer Start At: 00:00:00 (UTC)

Repeat Every: 00:01:00 (h:m:s)

4.1.4 Limits

The Limits menu can be found under Settings => Limits on the top menu bar. Observer will flag an error on any Sigma 4 that is outside the bounds of the limits you set. It is important to note that the limits set here are different from the internal limits set in the Sigma 4. To keep operation simple, you can leave these limits in their default state.

The screenshot shows the 'LimitsForm' dialog box with the following sections and settings:

- Auto Deployment Distance:** Maximum distance from receiver to Sigma for auto deployment: 50 meters.
- Map Text Zoom:** Minimum screen width for the text to be visible on map: 1,000 meters.
- Geometry Error Condition:** Maximum distance from Sigma to Anchor receiver: 50 meters.
- Proximity Error Condition:** Minimum distance between Sigma boxes: 0 meters.
- GPS:** Minimum Satellites: 6.
- Ping:** Maximum Ping Roundtrip: 6.
- Spread Noise:** Spread Noise (uV) Min: 1, Max: 5000. ☐ Spread Noise Gradient Colors.
- Sensor:**

	Min	Max
Resistance (Ohm)	0	10000
Frequency (Hz)	0	15
Damping Bt (%)	20	80
Sensitivity (%)	1	100
Leakage (MOhm)		5
Sensor Noise (uV)	0	1000
- Battery:**
 - ☐ Enable Observer Only Battery Limits
 - Battery Warning (V): 11.5
 - Battery Error (V): 9
- Versions:**

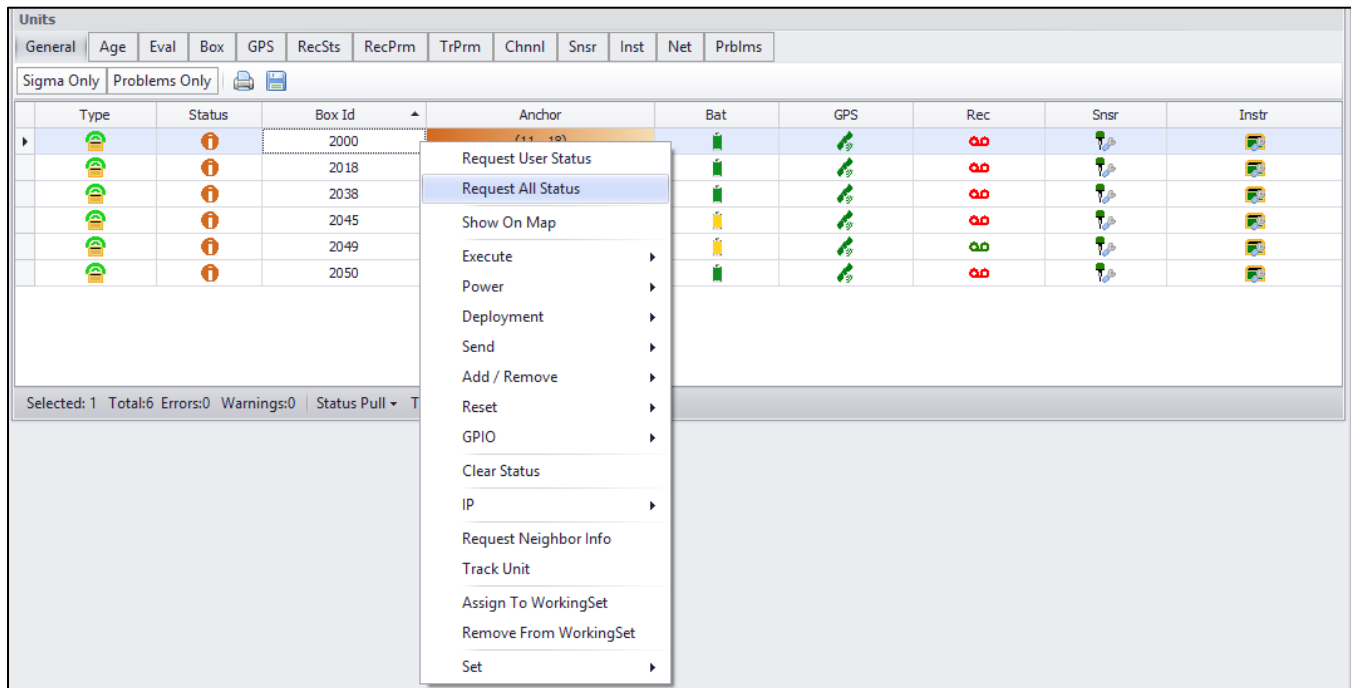
MRN Version	==	125
Sigma Version	>=	16.22
DAQ Version	>=	5.92

Buttons at the bottom: Cancel, Advanced, OK.

4.2 Pulling Unit Status

To pull status from the Sigma units:

1. Select 1 or multiple units in the list.
2. Right-click and select Request All Status.
3. Wait a few seconds for each box for status to be received.



Once Status has been pulled, you can navigate through the various tabs to get detailed information about each unit.

4.3 Active and Passive Recording

Each Sigma 4 has two operating modes, active and passive. When in active mode, the Sigma will only start recording when it has been triggered, usually by using a hammer switch. In passive mode, the Sigma will record continuously.

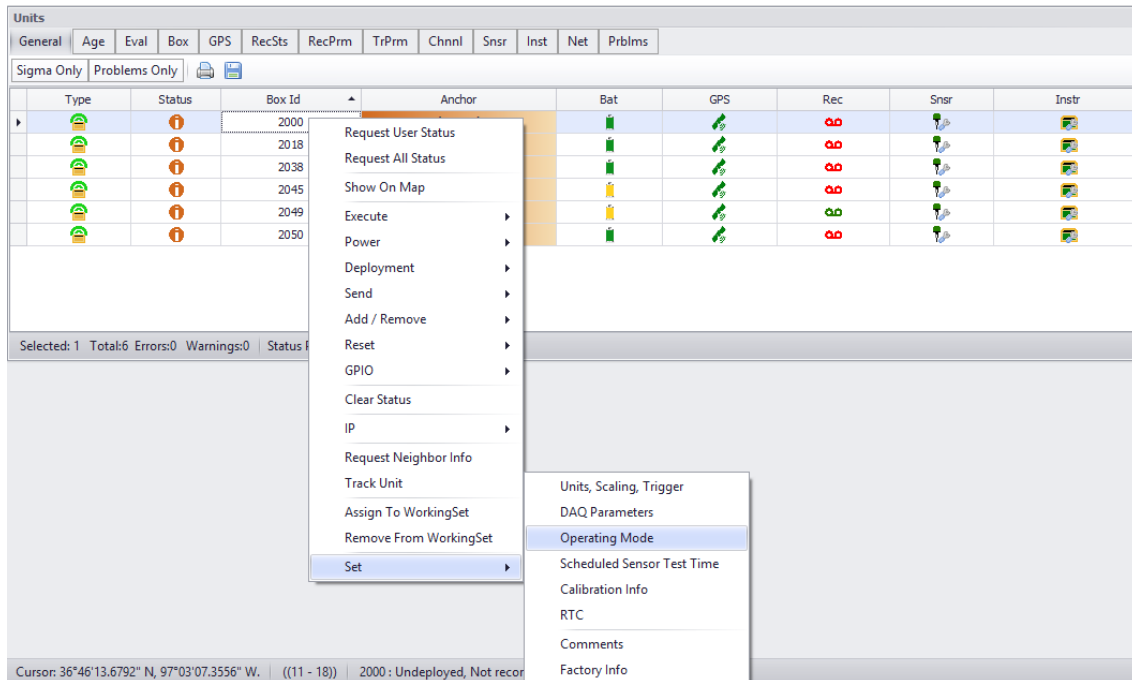
You can easily tell which operating mode each Sigma is in by looking at its Box Id in Observer. If the Id is 4 digits long, it is in active recording mode. If the Id is 5 digits long, it is in passive recording mode.

- Box Id 2000 | Active Recording
- Box Id 52000 | Passive Recording

Observer can be used to change the operating mode on each unit.

4.4 Set Operating Mode

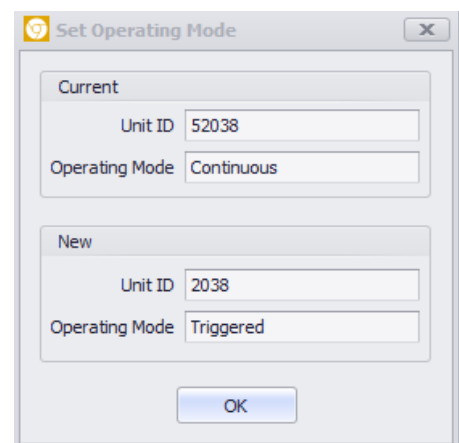
After discovering the Sigma 4s and pulling status, you should ensure that they are in active recording mode. If the units are in passive recording mode (Box Id is 5-digits), you can set each unit to active recording mode by right-clicking the unit and going to Set => Operating Mode.



You can do this by selecting one unit or multiple units at once. If you do this with multiple units, the Set Operating Mode dialog will not appear, and they will automatically switch operating modes.

Right-click the unit you would like to change and select Set => Operating Mode.

➡ **Note:** Observer must be in communication with the unit to change its operating mode. If the Box Id does not change after setting this, click Discover again and ensure that Observer can communicate with the unit.

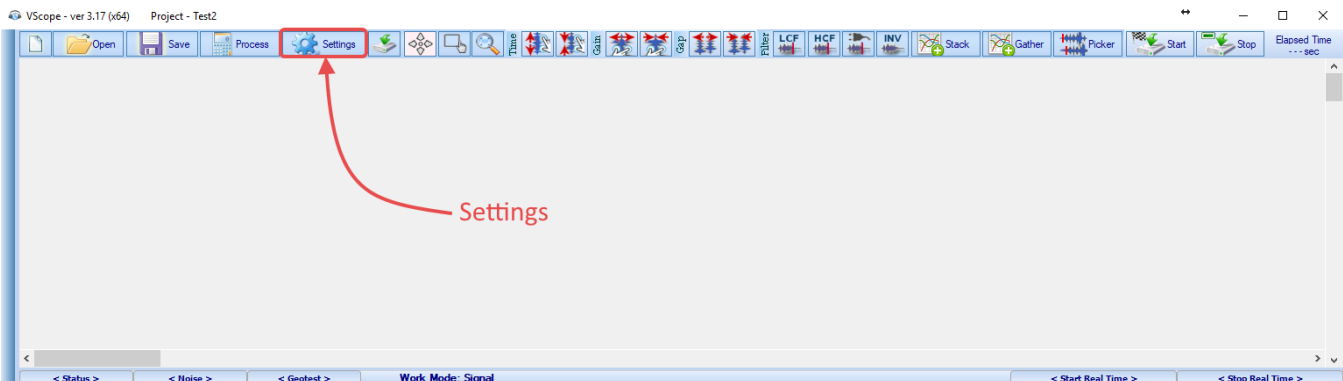


5 VScope 3

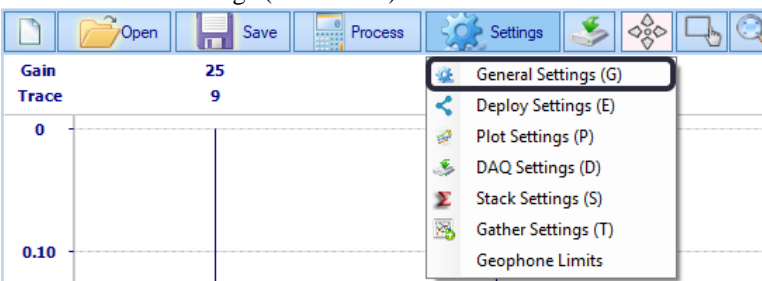
The following section explains how to record active seismic data using VScope 3. Before continuing, ensure that all the units are in communication with the computer through Observer, and that they are in Active (Triggered) Operating mode.

5.1 Creating the Project

Once VScope is open, you will need to create a project to save data to. Click on the Settings button at the top of the window.

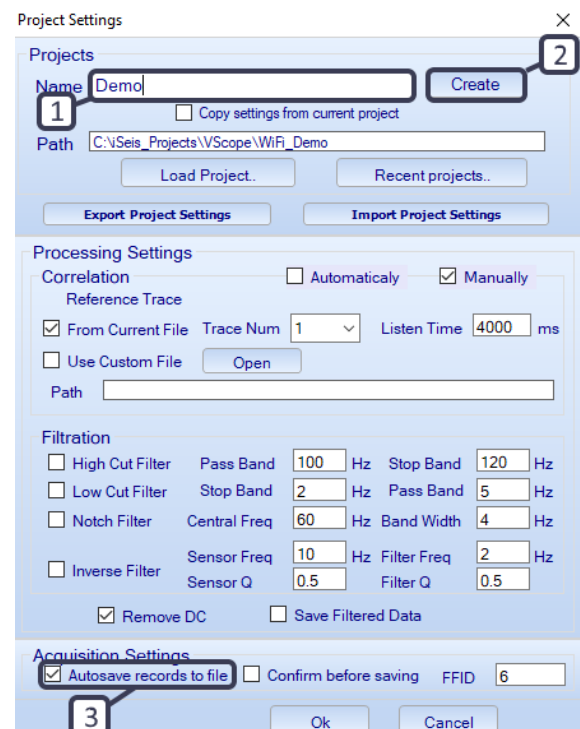


Select General Settings (Shortcut G).



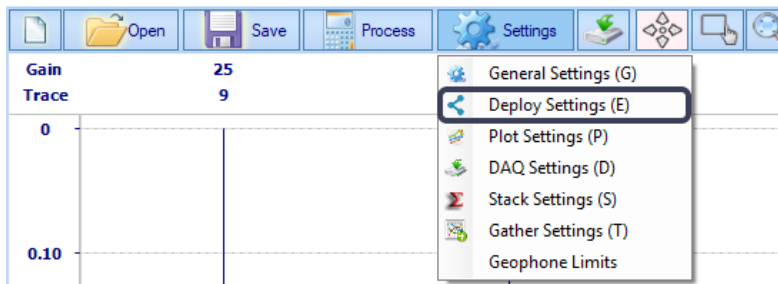
This will open the Project Settings window.

1. Name your project as desired.
2. Click Create. This will automatically fill the Path where all the data will be stored.
3. Select Autosave records to file for every record to automatically be saved.
4. Processing Settings and Filtration can be set as desired and adjusted later.
5. Click OK to finish.

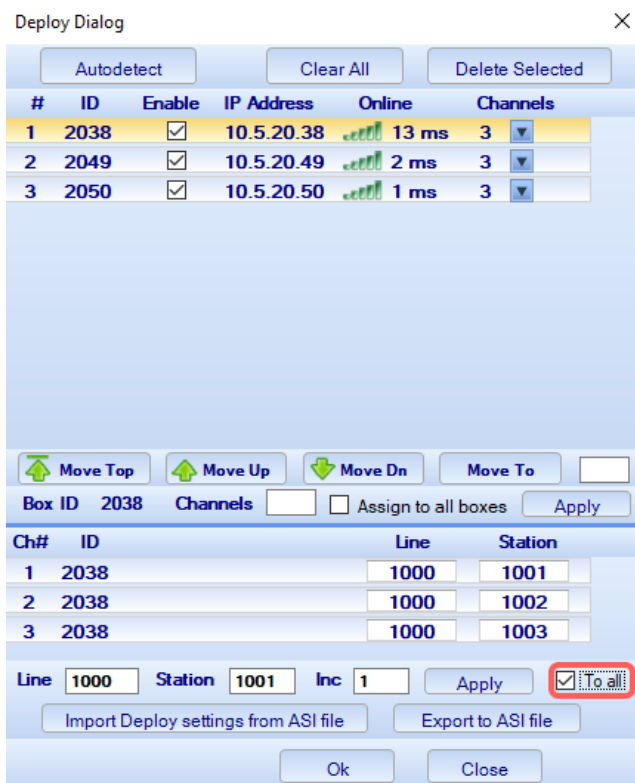


5.2 Deploy Settings

Next, select Settings => Deploy Settings (Shortcut E).



Once the Deploy Dialog opens, click Autodetect to populate the list with the connected Sigma units.



You can move the order of the units by clicking Move Up or Move Down. You should order them in the same order that they are laid out physically.

After ordering the units in the list, select the first unit and enter a Line and Station number, and set the Increment to 1. It is suggested to start Line and Station numbers in the 1000s to make it easier to parse (See Example).

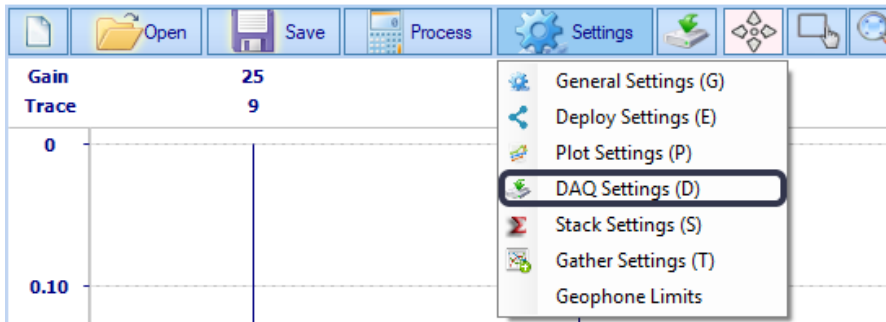
Check "To all" to increment through all of the units in the list.

Click Apply, and check to make sure each box was assigned a Line and Station correctly.

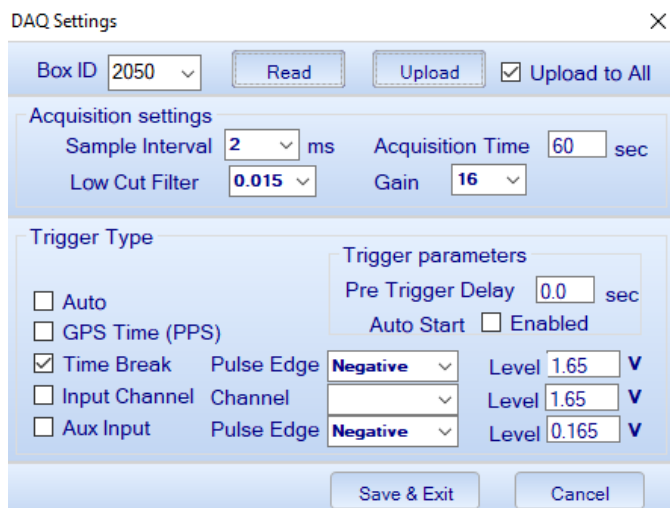
Once finished, click OK.

5.3 DAQ Settings

To ensure that all the Sigma units have the correct configuration, click Settings => DAQ Settings (Shortcut D).



The DAQ Settings window allows you to set the Acquisition Settings, Trigger Type, and Trigger Parameters of all the units, or just the selected one.



You can select Read to see what the current settings of the selected unit are.

For Active Recording with a hammer switch, set the Acquisitions Settings as desired.

Set the Trigger Type to Time Break.

Enable Auto Start if you want VScope to automatically prepare for the next shot. Otherwise, you must click Start before each shot.

Select Upload to All, then click on Upload to send the configuration to all the connected units.

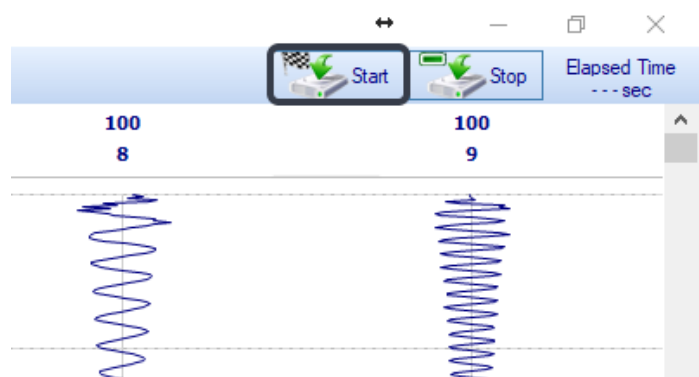
Click Save & Exit to finish.

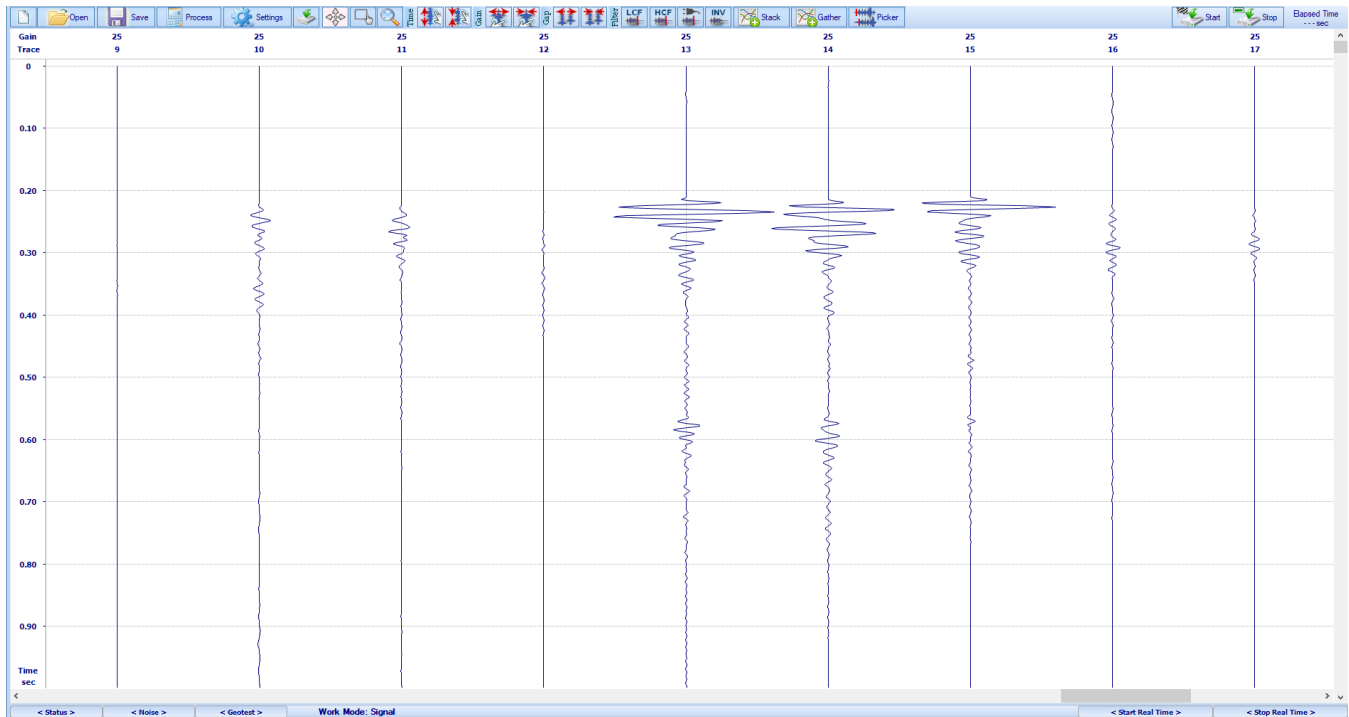
5.4 Recording

At this point, everything is ready to begin recording. Simple click Start and begin using the hammer switch. If you enabled Auto Start, then you will only need to click Start for the first shot. Otherwise, you will need to click Start before each shot.

When one unit is triggered, it will send the GPS timing information to all the other units via WiFi, and they will all begin recording simultaneously.

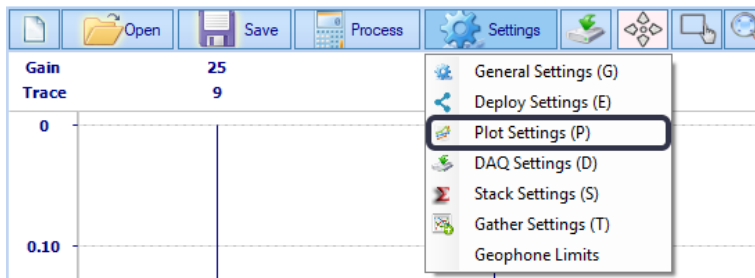
If Autosave is selected in the Project Settings, VScope will automatically save all shot records to the project folder. C:/iSeis_Data/VScope/ProjectName





5.5 Plot Settings

If you need to adjust the graph to get a better view of the data, go to Settings => Plot Settings (Shortcut P).



Here, you can adjust the plot parameters to change the view plot.

