Guide For Field Operations

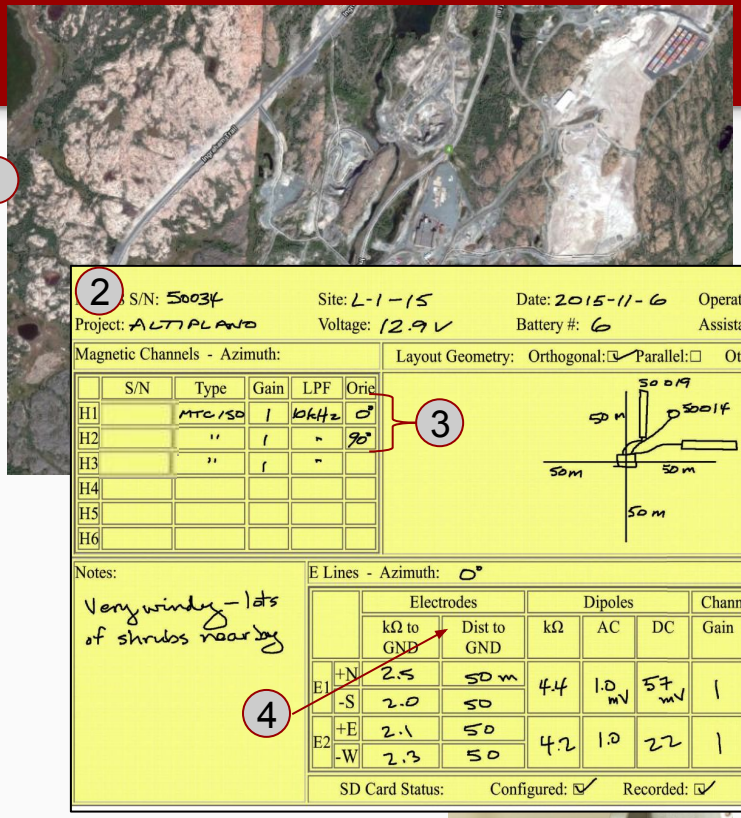
- Planning
  - Choosing the site
  - Creating the configuration file
- Layout on site
  - Equipment and Tools
  - Set up the layout
  - Connecting GPS / Battery
  - Calibrating the equipment
- On Site
  - Setting up a survey site
  - Electric Channels
  - Magnetic Channels
- Testing
  - Checklist
  - Test Recording
- Best practices

Choose the site

1. Choose the **Site(s)**
2. Configuration Layout
   E-lines orientation
   - True North
   - Magnetic North
   - Azimuth
3. Identify the magnetic declination
4. Define how your equipment will be allocated
5. Create the file configuration (config.json) SD Card

Avoid:
- Hikers
- Industrial or transport activity
- Power lines or electric fences
- Protect the equipment from wild animals, livestock, and even from vegetation (under windy conditions, can induce micro-vibrations that will add noise to the recording)

*Obtain permission to conduct the work on the site

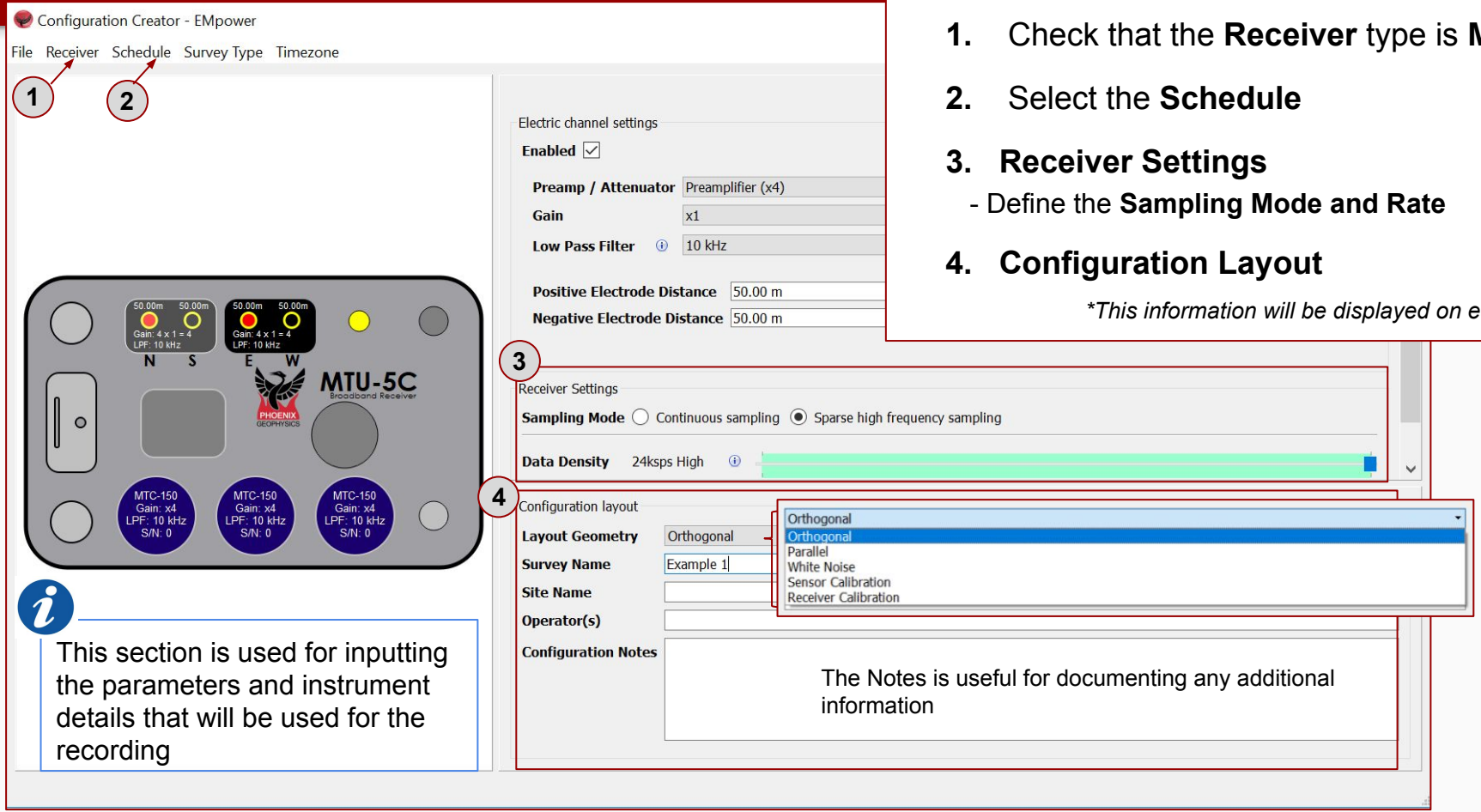


Create the configuration file

Complete the information:

1. Check that the **Receiver** type is **MTU-5C**
2. Select the **Schedule**
3. **Receiver Settings**
   - Define the **Sampling Mode and Rate**
4. **Configuration Layout**

**This information will be displayed on each channel*



This section is used for inputting the parameters and instrument details that will be used for the recording

Equipment and Tools

Equipment

1. Configuration Layout
2. Laptop + EMpower
3. SD Card for each operation
   - Calibration Sensor
   - Calibration Receiver
   - Configuration File
     (Orthogonal, Parallel or White Noise)
4. Receiver
5. Magnetic Sensors
6. Electrodes
7. E-line cable
   - Red for north
   - Black for south
   - Yellow for east
   - Blue for wes

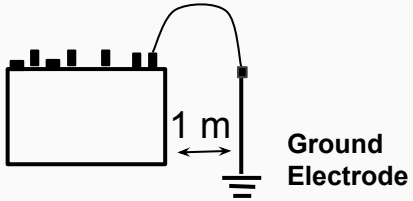
Tools

1. Shovel
2. Container of salt water (50 g/L)
3. Handheld compass
4. Tape measure

Set up the layout

1. Ensure that you are at the right location as defined on the map
   - Use a handheld GPS compass
2. The site centre
   - Choose a dry spot
3. Stay clear of noise sources
4. For the ground electrode, choose the center spot less than 1 m from the receiver

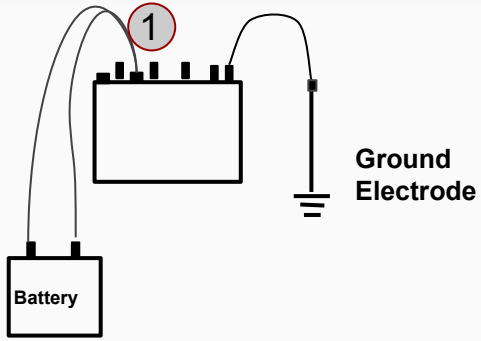
**keep the receiver at least 1 m away from the E-Lines, to avoid electromagnetic interference*

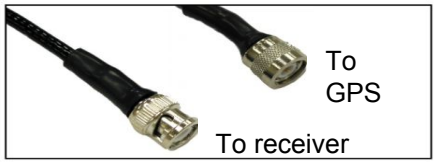


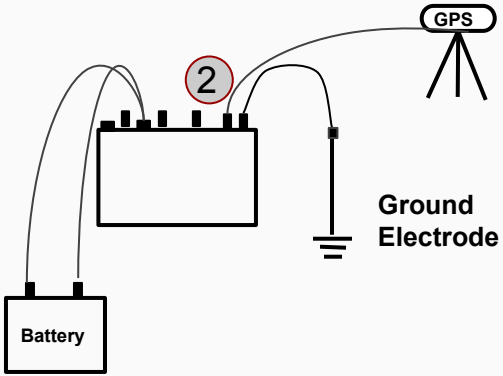
Connecting GPS / Battery

1. **Battery**
   - Connect the battery,
     - Red (+) positive
     - Black (-) negative
   - Fit the slotted connector (to the receiver's connector)

2. **GPS**
   - Connect the cables on the GPS antenna and Receiver
   - Open the antenna tripod, if necessary tape the antenna tripod to a stake, post or large tripod



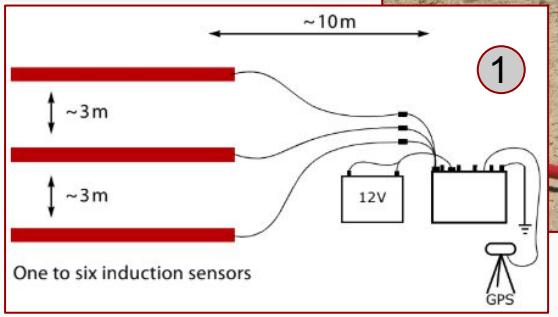




Calibrating Equipment

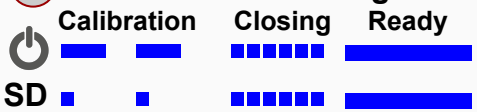
1. Connect the sensors (Sensors should only be calibrated outdoors and away from noise)
2. Insert the SD Card on the receiver
   - Config file for Receiver
   - Config file for Sensor
3. Turn on the Receiver
4. Start the Calibration Recording
5. Use the Manage module fto view and quality control the calibration

*The calibration process should take place at the beginning of every survey (The sensors do not have to be buried to be calibrated)



3 Turn on the receiver

4 Calibration Recording



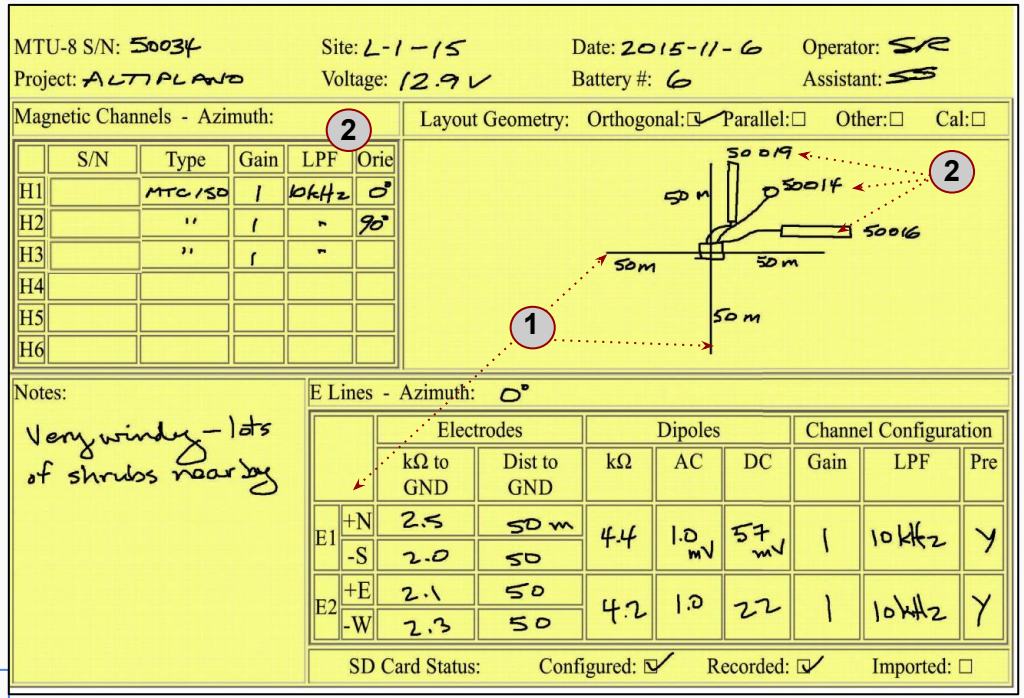
Indicators

- *Slow, equal pulses*
- *Solid color / Off*
- *Rapid, equal pulses*
- *Short unequal pulses*

Setting up a survey site

1. Following the Configuration Layout, use a compass to orient the electrodes place to the north, south, east, and west to layout the E-lines
   - Use coloured adhesive tape to mark the length of half the desired dipole on precut E-line cables **colour-coded:**
     - Red for north - Black for south
     - Yellow for east - Blue for west
2. Using the position of the electrodes orient the Sensors place following the Configuration Layout
   - Try to order by serial number where the minor number is for Hx

**The longer the dipole, the better signal-to-noise ratio but the greater the AC the voltage included by the local power grid*



MTU-8 S/N: 50034 Site: L-1-15 Date: 2015-11-6 Operator: SR
Project: ALTIPLANO Voltage: 12.9 V Battery #: 6 Assistant: SS

Magnetic Channels - Azimuth:

	S/N	Type	Gain	LPF	Orie
H1		MTC150	1	10kHz	0°
H2		"	1	"	90°
H3		"	1	"	
H4					
H5					
H6					

Layout Geometry: Orthogonal:☑ Parallel:☐ Other:☐ Cal:☐

Notes:
Very windy - lots of shrubs nearby

E Lines - Azimuth: 0°

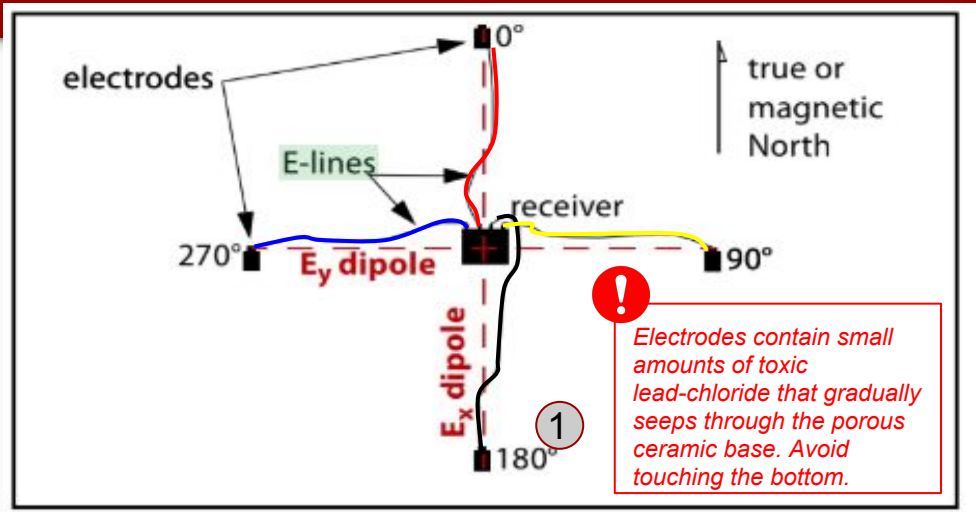
		Electrodes		Dipoles			Channel Configuration		
		kΩ to GND	Dist to GND	kΩ	AC	DC	Gain	LPF	Pre
E1	+N	2.5	50 m	4.4	1.0 mV	57 mV	1	10kHz	Y
	-S	2.0	50						
E2	+E	2.1	50	4.2	1.0	22	1	10kHz	Y
	-W	2.3	50						

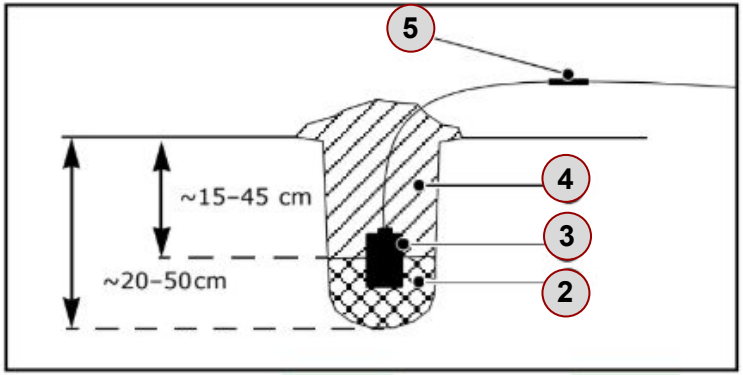
SD Card Status: Configured: ☑ Recorded: ☑ Imported: ☐

For any adjust on the E-lines or Sensors installation (See troubleshooting section)

Electric Channel

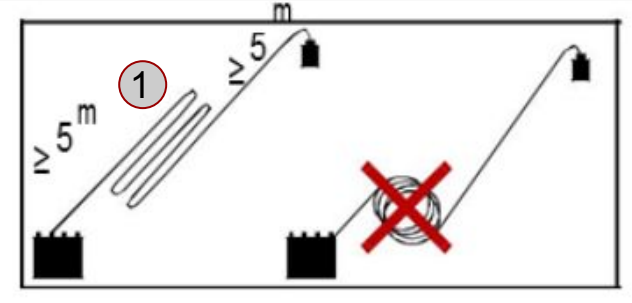
1. Register the electrode number and /or cable number on the Layout Sheet
2. Dig a small hole about 20-50 cm deep removing any sizeable rocks
   - Loosen the dirt at the bottom of the hole
     Pour in at least 1 liter of salt water and mix it with the dirt to form a uniform mud
3. Place the electrode upright in the hole
   Rotating it back and forth to position it solidly in the mud, Leave the electrode cable extended outside the hole (5)
4. Cover the electrode completely with the loose dirt
5. Connect E-lines to electrodes



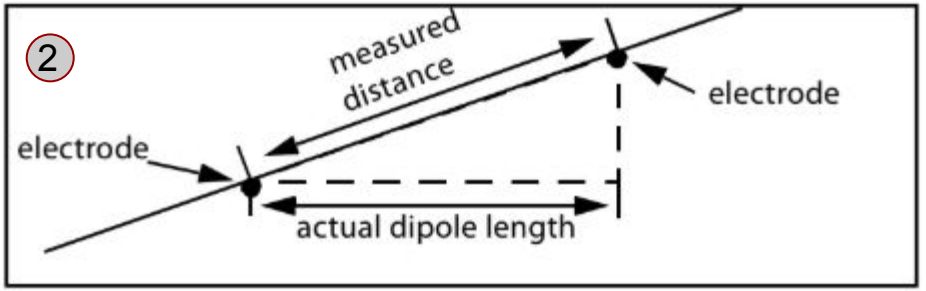


Best practices

1. **Excess cable:**
   - Always lay excess cable in elongated S-shapes, no closer than 5m from the ends



2. **Slope:**
   - E-lines laid out down a steep slope can also create a problem: the measured distance between the electrodes no longer equals the actual horizontal length of the dipole. Instead, the measured distance is a vector resulting from both horizontal and vertical displacement
     **If you encounter inclines of 20°, you must compensate using trigonometry*
   - One way is to calculate how much to lengthen the E-lines when laying out the site so that the horizontal component of the vector is the desired dipole length
   - Alternatively, you can make no compensation in the field, and instead calculate the actual horizontal dipole length before processing the data



To minimize wind-induced noise, ensure that the sensors cables lie flat on the ground
Place weights on them every meter or so if necessary

Magnetic Sensors

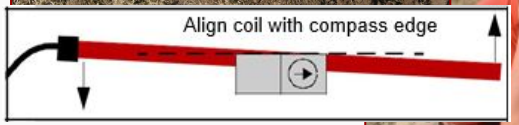
Alignment of the sensors

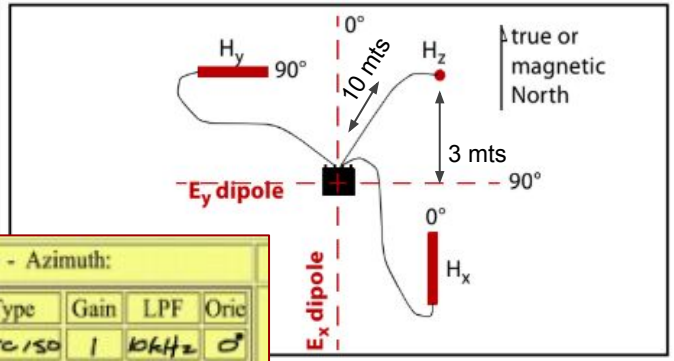
1. **Horizontal (Hx, Hy)**
   - The free end of **Hx** points North (connector points south)
   - The free end of **Hy** points East (connector points west)
   - 40 cm deep x 15 cm from each end
   - 10-15 cm from each side

2. **Vertical (Hz)**
   - Dig a narrow hole deep enough to completely bury the sensor

**The Sensors should be 10 meters away from the receiver and 3 meters between each sensor*

3. Register on the layout the serial numbers of the coils (Sensors) before burying them





3

Magnetic Channels - Azimuth:

	S/N	Type	Gain	LPF	Orie
H1		MTC/150	1	10kHz	0°
H2		"	1	"	90°
H3		"	1	"	
H4					
H5					
H6					

Working with six sensors:
Ensure to put H1 to H3 sensors well separated in one quadrant, and H4 to H6 sensors well separated in the opposite quadrant.

Checklist

- Battery
- GPS antenna
- Inserting the SD card
- GPS synchronization
- Measure and orient electrode and sensor
- Keep cables flat on the ground, (not draped over plants or obstacles). Bury or weight the cables if necessary to reduce wind noise
- Ensure clear sight-lines between the GPS antenna and the sky
- Test Recording (see next page)

Keep accurate records on a layout sheet.

Test Recording

1. Insert the **SD Card**
2. Turn on the **receiver**
3. Recording data test (no longer than 10 minutes)
4. Stop the recording
5. Turn off the receiver
6. Open Empower
7. Click the Evaluate button
8. Select View data
   - Select the SD card *(The recording process creates two folders, log and recdata)*
   - Open recdata folder and select the recording file and click Choose
   - Review the information recording

**Verify that there was not a warning icon on the left of the channels or next to the Recording ID*