AARHUS GEOINSTRUMENTS

Field setup and use of tTEM 2x4 and 3x3 systems

Version 2.04

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1 ELECTRONICS SETUP

First step in getting a system ready for field use, assuming the frame is assembled, is setting up the electronics.

1.1 Electronic parts

The items required for a tTEM system are as follows – (see figure 1):

Transmitter unit (Tx unit)

A double suitcase, where one suitcase is containing the transmitter and the other the cooling system.

Receiver unit (Rx)

A suitcase containing the receiver unit (Rx) sometimes referred to as a TiB (Tem In a Box). This Rx is powered up by a smaller lithium battery. Galv/com cable is connecting Rx and Tx unit.

Tablet

The tablet is placed in front of the ATV. On the tablet a remote desktop connection is created to the computer in the Tx unit.

Power supply

Suitcase containing a 100 Ah battery powering up the Tx unit. A power cable should be connected between the battery and the Tx unit.

Not included/ must be acquired:

- Coolant for the cooling system (use coolant suited for use with aluminum – never use alcohol as it will crack the pump reservoir)
- Platform
- ATV

Figure 1: The placement of instruments on the back of the ATV. Note that Rx cable as well as Tx coil are secured to the ATV. All instruments should be securely fastened to the ATV.

1.2 Filling the coolant reservoir in Tx unit

When receiving a tTEM system the coolant reservoir in the Tx unit will be empty. It must be filled with coolant suited for aluminum/aluminium before powering up. Coolants suited for aluminum are found in every auto parts store. If using a coolant concentrate, be sure to follow manufacturers recommendations for dilution ratio. The coolant concentrate should be diluted using distilled water. If in doubt about concentration, a higher dilution is generally better.

To insert coolant, first unscrew the top fill cover of the reservoir. This is easily done using a coin or an allen key (depending on pump type)– see Figure 2

Figure 2: Press the bypass button to run the pump and empty the reservoir.

Figure 3: Unscrew the top fill cover of the reservoir using a coin or an allen/unbrako/hex key (depending on pump type).

Next, fill coolant in the reservoir. A lab-type plastic squeeze bottle is recommended. It may take a couple of fillings for the reservoir to be filled. Fill the reservoir and run the pump by pushing the bypass button seen in Figure 2. This will circulate the pump and likely empty the reservoir, allowing you to fill water again in an iterative approach. It takes around 2-3 fillings before the system and reservoir are full – approximately half a liter is required.

1.3 Empty the coolant reservoir in Tx unit

Emptying the coolant is often required when shipping the Tx unit by air freight. To do this, unscrew the top lid and a similar bottom lid, then it is possible to empty the reservoir into a bucket. Turn the suitcase back and forward to get the last coolant out.

1.4 Instruments and cables

The instruments are now ready to be placed on the ATV and powered on. The completed setup on the ATV can be seen on Figure 1. It is important that suitcases are standing upright with correct distance between them. Take care that the water hose is not too close to the hot exhaust pipe.

Rx (TiB)

The Rx can now be opened and powered on. Connect the battery, either NiMh or RRC Lithium. The Galv/com cable between the Tx unit and the TiB can also be connected in both ends. The appropriate connectors are marked on both Tx unit and TiB. The Rx cable can also be connected to the TiB, where the *CH0, tTEM* marking is. Once completed, it should look like Figure 4.

Figure 2: A Rx (TiB) fully set up with Galv/Com cable, Rx cable and RRC Lithium battery connected.

Tx unit

The Tx unit now has the Galv/com cable attached. Attach the Tx coil in the connector marked "TX Coil" on the Tx unit. Last step is powering on the Tx unit. This is done by connecting the Tx unit to the battery with the provided power cable. The connector on the Tx unit is marked "Power Input". Once everything is done, it should resemble Figure 5 and Figure 6.

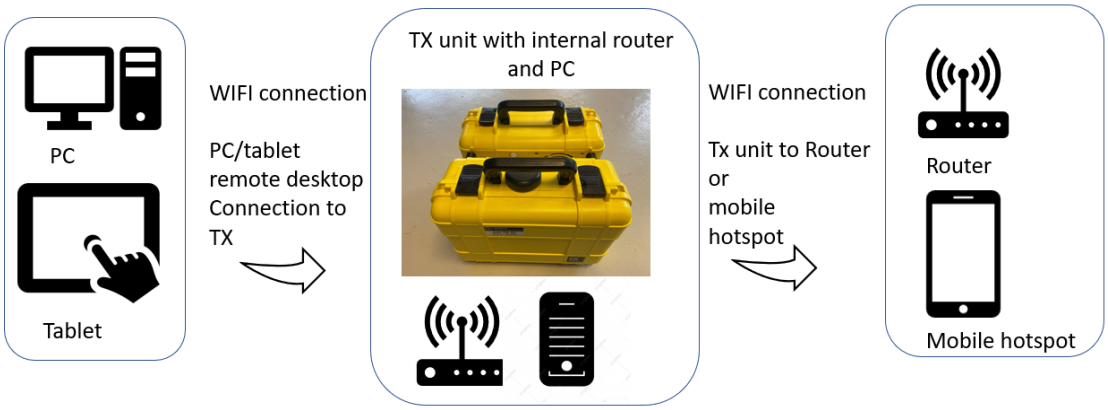
Figure 4: The back of the Tx unit with Tx coil and Galv/com cables connected.

Figure 3: The front of the Tx unit. Note the power cable is connected.

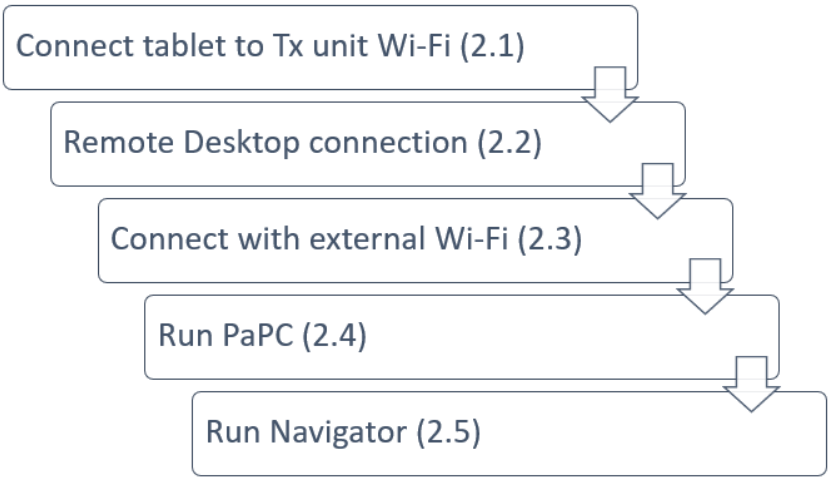
2 WIRELESS CONNECTION

After all instruments are on the ATV and powered on, we are ready to start the software.

Pictogram of the set up:



The start up process is shown in flow chart below. Each process is described in more details – see chapter reference.



When a survey is finished and measurements are completed, the different programs must be shut down following these 3 steps in this order:

1. Press ***Pause measuring*** in *AarhusNavigator (see* Figure 13*)* and shut down the program.
2. In *PaPC2*, press the ***End*** button seen in the bottom of Figure 12. Then press ***File*** and ***Exit***.
3. Press the desktop shortcut marked "WARNING - shutdown"

2.1 Connect tablet to Tx unit Wi-Fi

Using the tablet provided, connect to the Wi-Fi broadcasted from the Tx unit. Be sure to connect to the 5G network, to ensure faster connection, as in Figure 7.

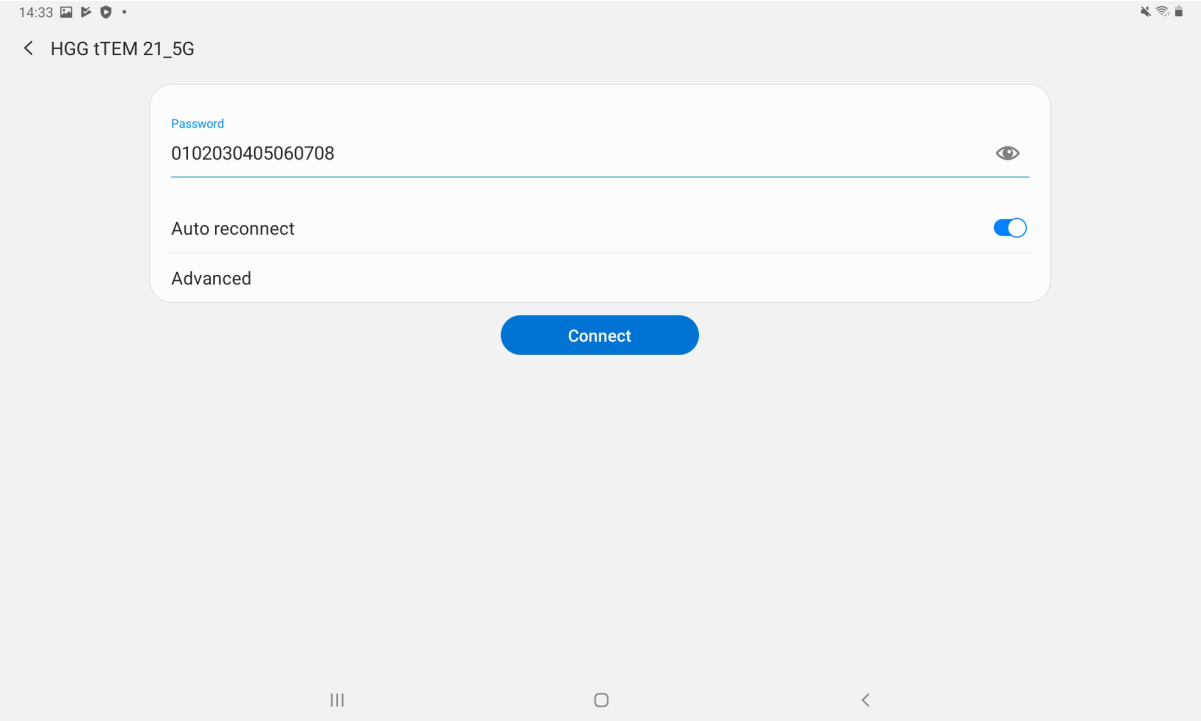


Figure 5: Connecting to the Wi-Fi broadcasted by the Tx unit.

SSID: *tTEM XX_5G*

Password: 0102030405060708

2.2 Remote desktop connection

After successfully connecting to the Wi-Fi, use the tablet to establish a remote desktop connection. This is done by opening the app called *RD Client*. There should be a PC connection available called *192.168.1.5*, as seen in Figure 8:

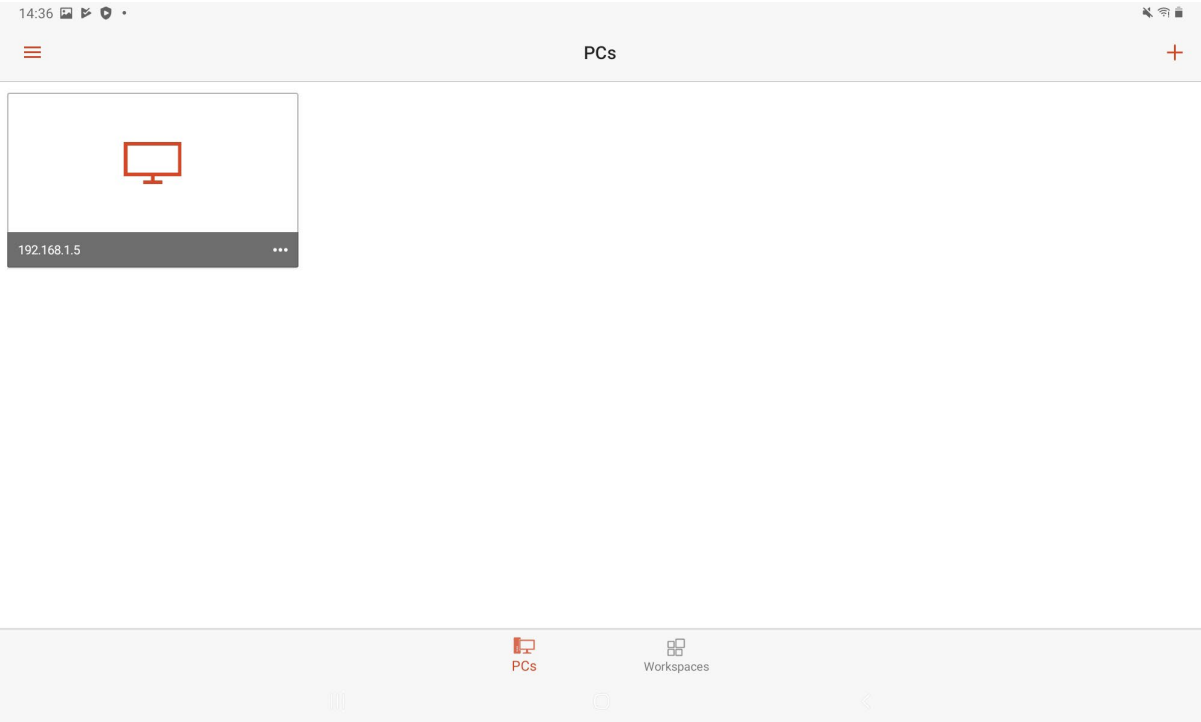


Figure 6: The PC connection "192.168.1.5" used for establishing a remote desktop connection to the Tx unit.

If the connection shown in Figure 7 is not present, read below. If it is present, please skip ahead to page 8.

To add the connection, press the **+** sign in the top right corner of the screen and press ***Add PC***, as seen in Figure 9 below.

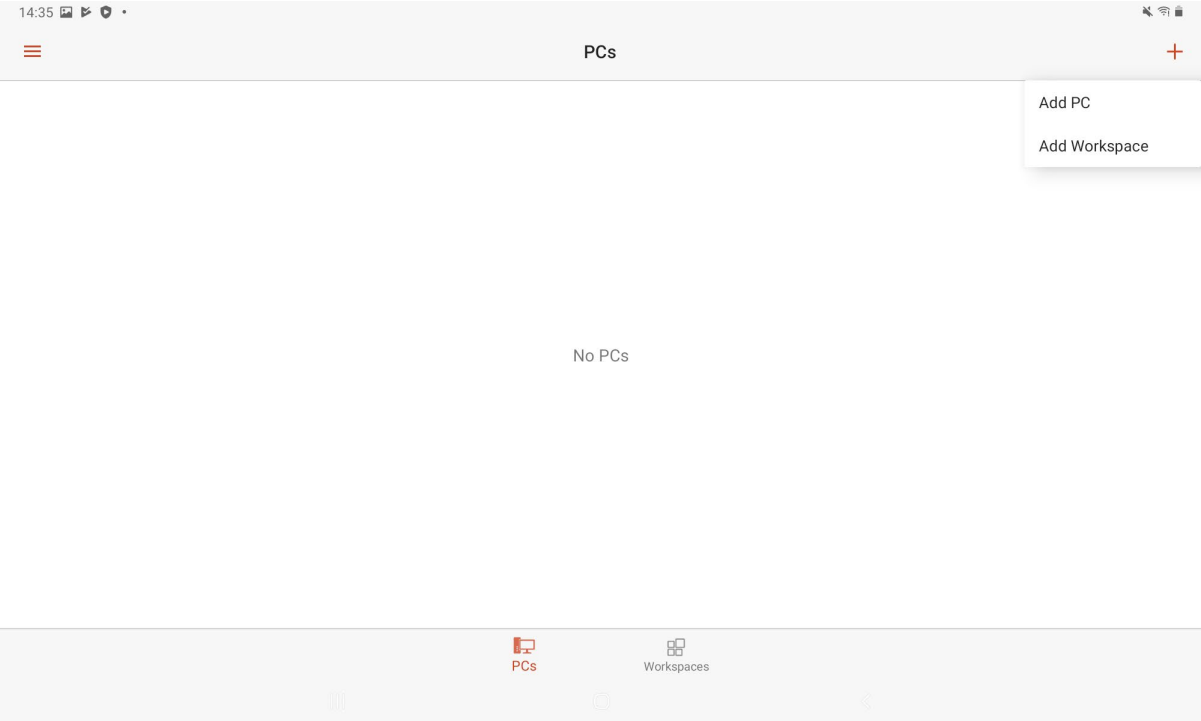


Figure 7: To add the the connection, press + in the top right corner and click on Add PC.

A pop-up will appear, prompting a PC name. Type in 192.168.1.5, and click ***Save***, as seen below in Figure 10:

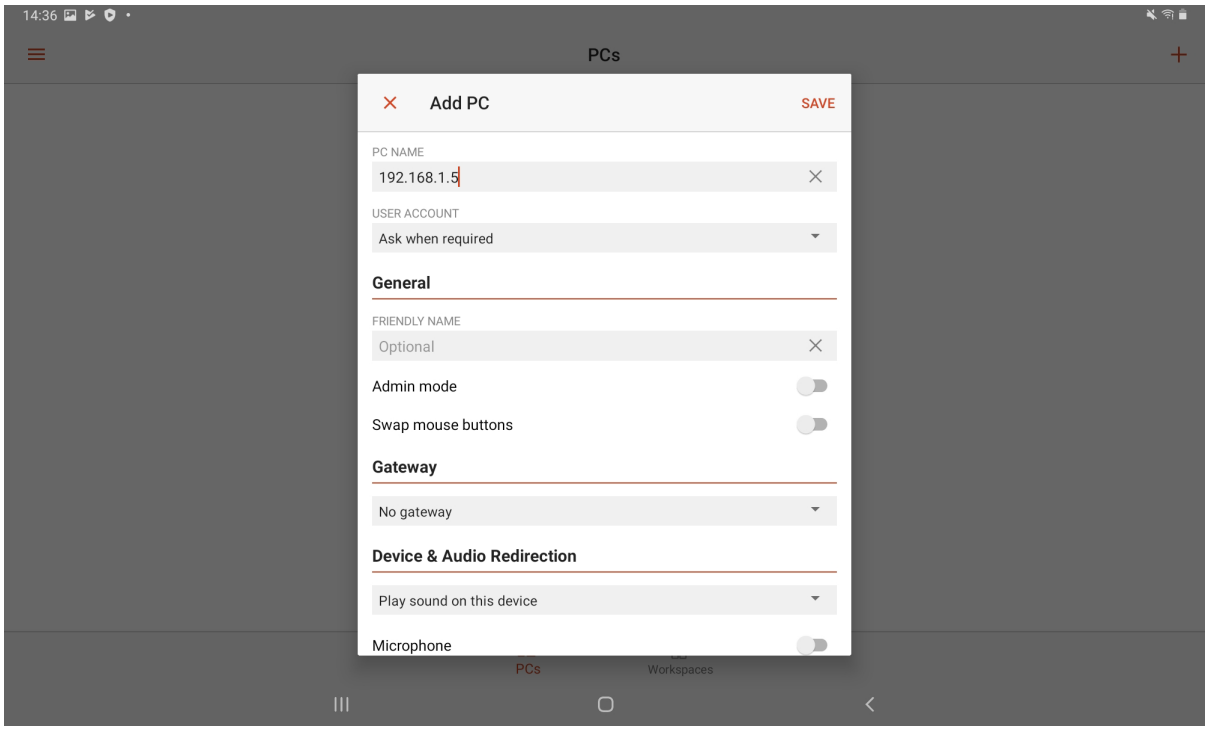


Figure 8: Type 192.168.1.5 in PC name and click save.

To establish a connection to the Tx unit, press the icon shown in Figure 7. You will now be prompted to type in credentials, see Figure 11. Username and password are both admin

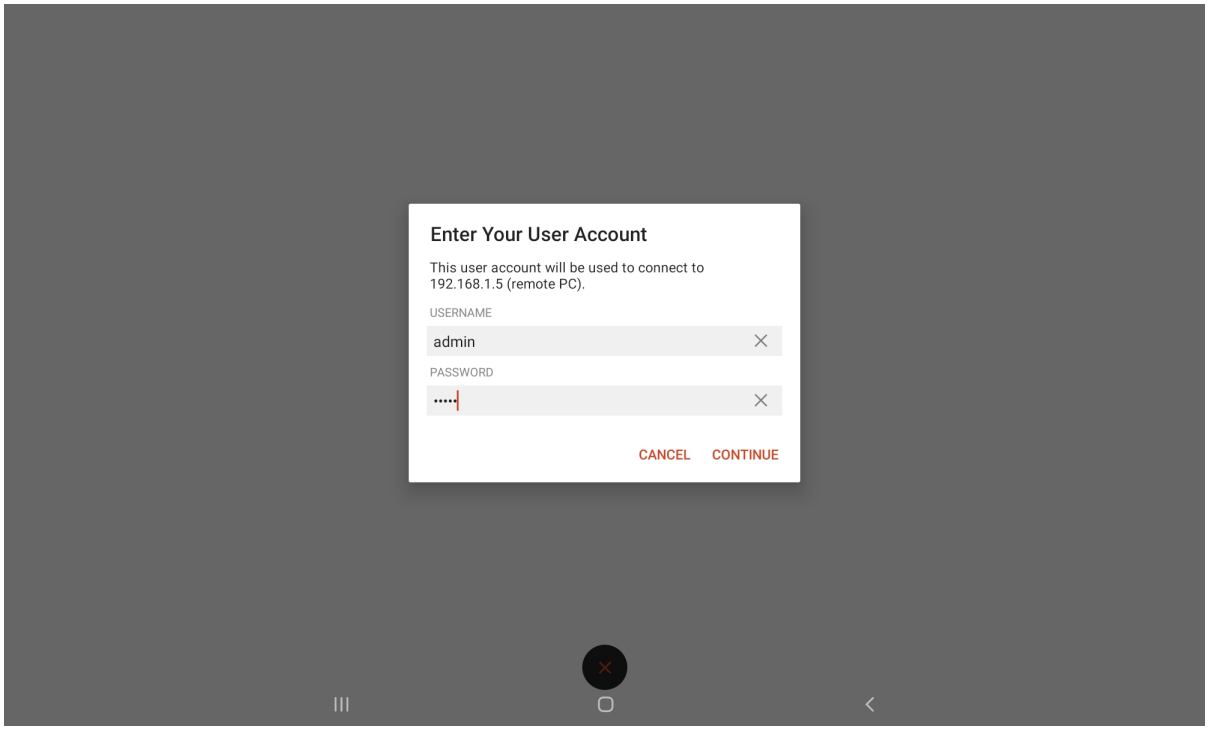


Figure 9: Username: admin password: admin

You are now successfully connected to the Tx unit via remote desktop and you should be able to see the desktop of the Tx unit as seen in Figure 12:

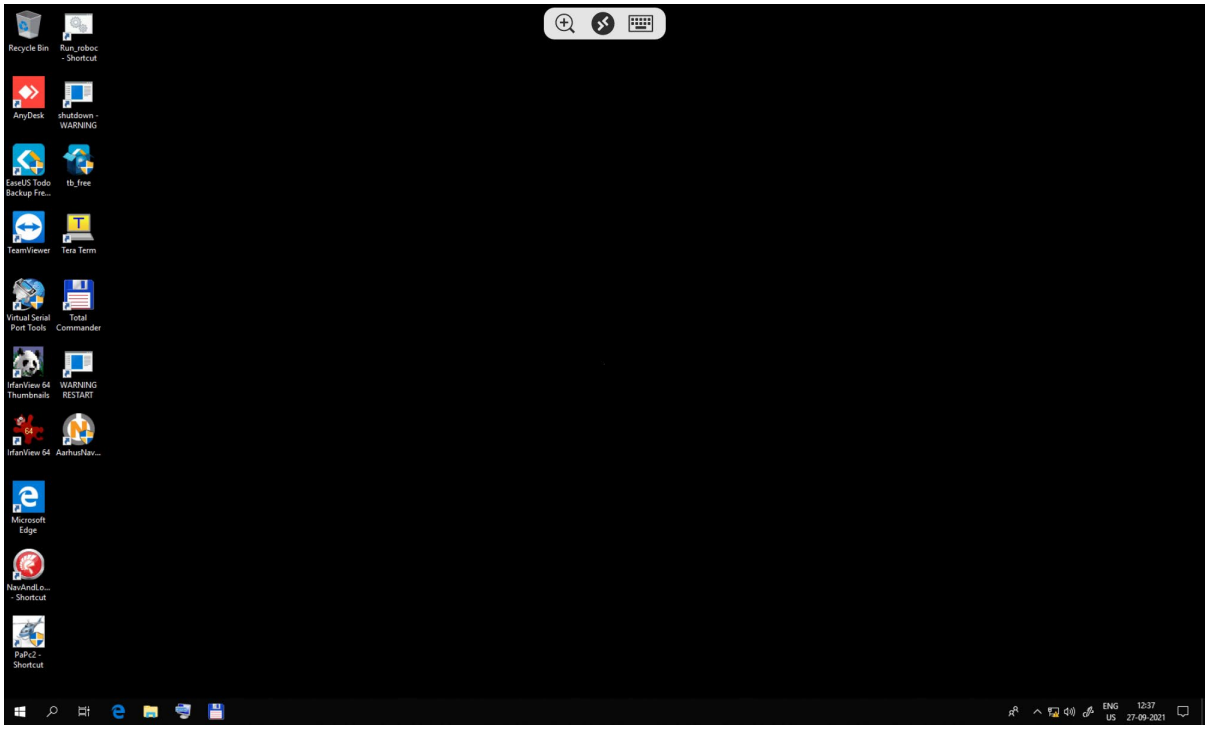


Figure 10: Once connected to the Tx unit, your screen on the tablet should show the desktop of the Tx unit.

2.3 External Wi-Fi / MOBILE hotspot

Sometimes it is advantageous to connect the Tx unit to external Wi-Fi network or a hotspot (typically from a phone). This makes it possible to upload data to a shared folder (e.g. Dropbox, Rushfiles, etc.) but also opens the possibility for remote support when needed. To do this, press the computer icon in the taskbar in the bottom right corner of your desktop screen. Then select and log on to the Wi-Fi network of choice, as seen in Figure 13.

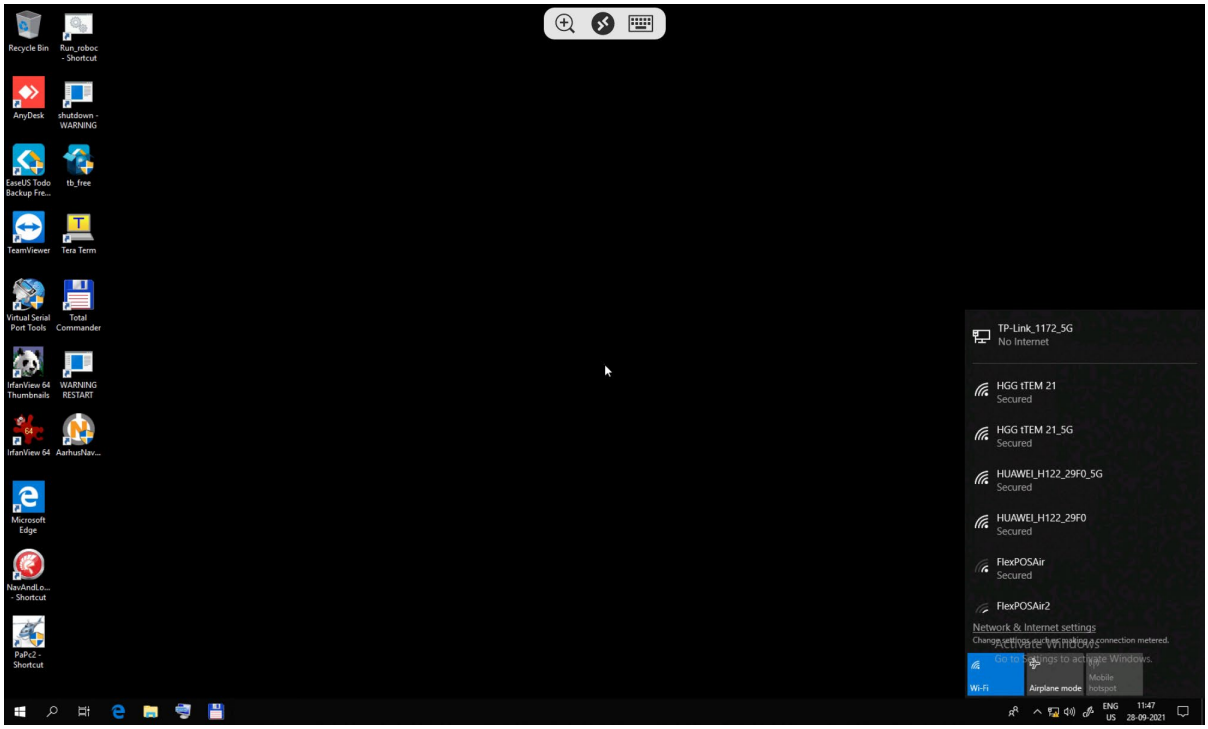


Figure 11: Connecting the Tx unit to an external Wi-Fi network or hotspot.

3 PAPC2

PaPC2 is the program responsible for the measurements made by the Tx unit. To open it, double click the *PaPC2* shortcut found on the desktop and wait for it to open. The program will go through an initializing sequence. Once completed, it should look like Figure 14. Note that the status icons in the left top part of the program are green and read *Tx OK* and *TiB OK*.

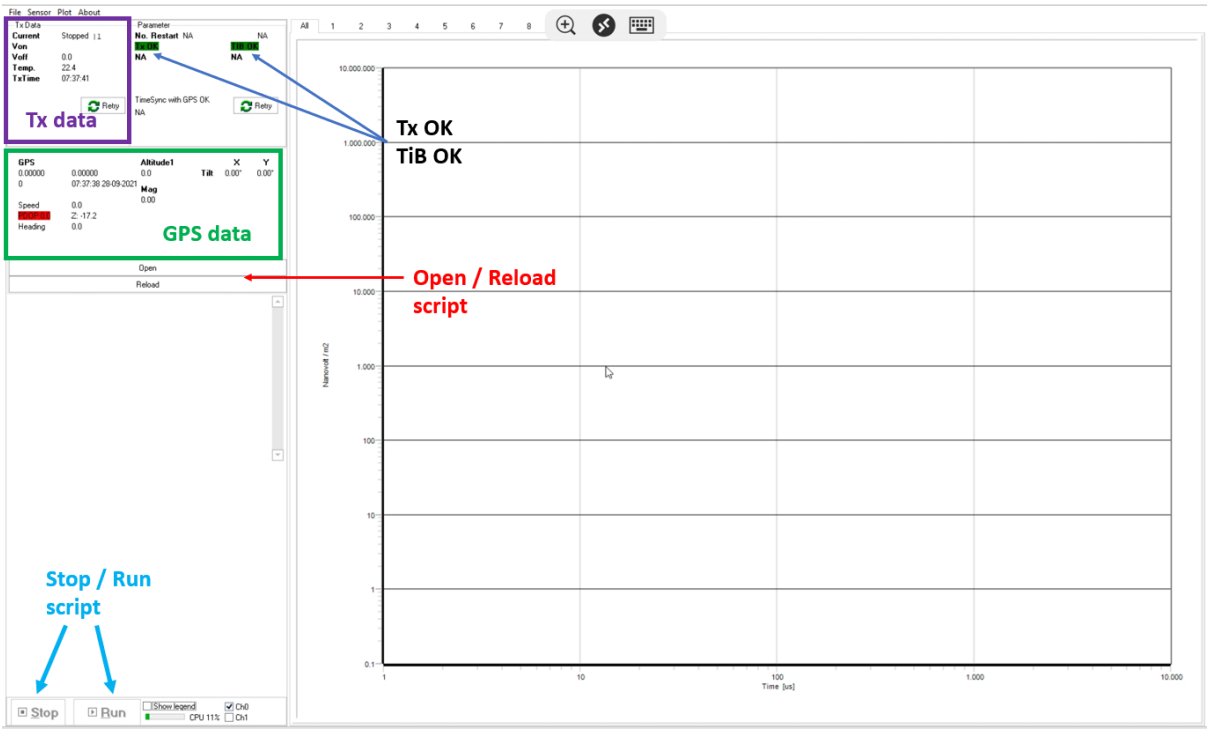


Figure 12: PaPC2 user interface. The right side of the screen shows LM and HM data curves. Left side of the screen features Tx and TiB status, Tx data, GPS data as well as the ability to Open, Reload, Run and Stop scripts.

Besides looking at Tx and Tib status (Tx OK and TiB OK in Figure 12), and confirming they are green, the GPS data section should also be examined before commencing. Verify, that GPS data such as position, time and date are present.

To start measuring, it is necessary to load a script. This is done by pressing either ***Open*** or ***Reload***, marked with a red arrow in Figure 12. Pressing ***Open*** allows you to browse and choose a script (see chapter 2.5).

Pressing ***Reload*** automatically loads the script last used. To run the script and start measuring, press ***Run*** in the bottom left corner of the screen, as seen marked with a light blue color. When running, the right side of the program will show the data curve. To exit fullscreen, and open *AarhusNavigator*, press ***File / Exit Fullscreen***. If you try to minimize the *PaPC2* program, it will disappear into the taskbar in the bottom right corner of your desktop screen.

3.1 Scripts

The script defines number of gates, timing, LM/HM, stacking, repetition frequency and more.

In some countries the utility frequency of the power grid is 60 Hz and, in these countries, a script cancelling out the 60 Hz powerline noise must be used and will be provided by Aarhus GeoInstruments.
Always ensure you are using the correct script. Modifying a script is at your own risk and consult us before making any changes.

4 AARHUS NAVIGATOR

Once *PaPC2* is running, *AarhusNavigator* is opened by clicking on the *AarhusNavigator* shortcut on your desktop. For an in-depth description of the use of *AarhusNavigator*, please refer to the *AarhusNavigator* manual. This manual assumes that a campaign has been started, and that the reader is working on an existing campaign.

First, press ***Start Measuring*** and select the ***Data*** tab in the upper right corner. This ensures that the same data curve is displayed on the right side of the *AarhusNavigator* as well as in *PaPC2*. Please Note that ***Start and Stop Measuring*** **in** AarhusNavigator does not start and stop the *PaPc2* program. When *AarhusNavigator* is running, it will look like Figure 15.

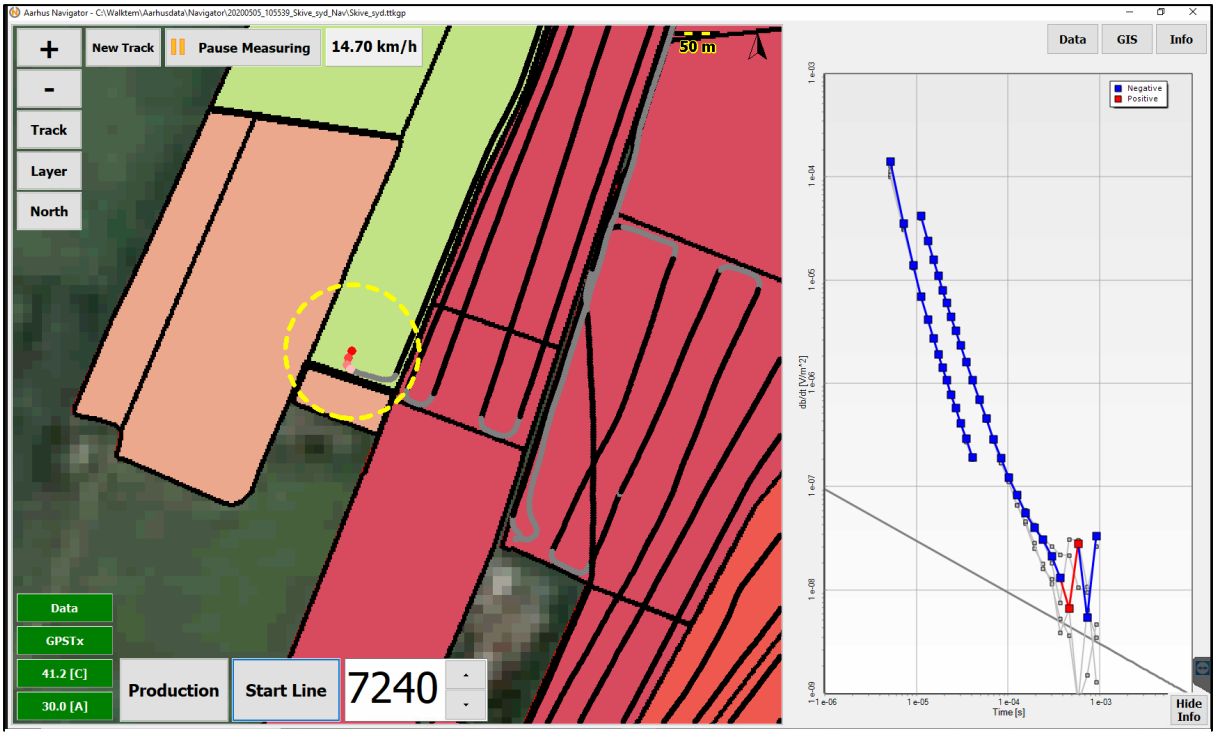


Figure 13: A typical Aarhus Navigator setup when system is running in production. In the data plot, the grey line indicates a typical noise floor of the tTEM data.

Figure 13 shows a typical layout of Aarhus navigator when the tTEM system is running in production. On the right panel, LM and HM curves can be seen. On the left side, the GIS interface is seen with a background map and track lines. The red dot shows the current position of the system. There is a moving yellow circle around the red dot drawn with a chosen diameter set in the setup (.ini) file. This circle is to help the driver to maintain the desired line spacing. On the GIS interface in the bottom left there are four-status alarms. If all the alarms are shown in green, the system is running within normal parameters, otherwise the alarm color will change. See section 2.3 for alarm colors.

Once ready to begin measuring, click ***Start Line*** or ***Start Test***. To end a line or test, press ***End Line*** or ***End Test***. Both starting and ending can also be done by pressing in the middle of the GIS screen. Lines should be ended before beginning to turn and started after the system is approximately straight behind.

5 SURVEY

5.1 Before going to the field

Following should be checked before starting a survey:

- Create a check list with all the items you want to bring to the field (always a good advice). Use it to make sure you bring everything and have everything when you return
- Batteries charged (RRX battery, 100 Ah battery and tablet). It is recommended to either have a power bank connected to the tablet or charging the tablet directly from ATV.
- Geotiff and shapefiles with relevant information of the survey area – Ideally transfer files and create navigator workspace before going to the field to ensure files are correct.
- If possible, bring a spare RX-cable. Should you damage the cable, the fieldwork can continue.

After the survey is conducted following files are needed for the import into Aarhus Workbench:

GEX-file (a file containing the waveform of the transmitter being used and calibration factors, supplied by AGI and maintained by instrument owner)

TFI-file (during import, the data is convolved with a filter that removes 50/60 Hz noise and DC offset and reduces the vibration noise. The filter also includes a low-pass filter. A filter for both LM and HM is stated in the filter file

GPR file (contains information about processing filters etc.)

A more elaborate explanation can be found here:

https://hgg.au.dk/fileadmin/HGGfiles/Reports/Guide_tTEM.pdf

5.2 Field use – things to be aware of

Before starting up the ATV and driving, there are some pointers and things to be aware of listed below

- ***If something breaks, it is going to be a cable***. This is of course an exaggeration, but true in many cases. When driving, and especially turning, keep an eye on the cables between the ATV and Tx platform (this means the Tx coil leadin as well as the Rx cable). The cables will

be more under tension when turning, and it is very important (especially in the beginning) to learn just how tight you can make the turns.

- ***Watch your speed and watch your equipment***. The tTEM system is, including ATV, almost 20 meters long. Whenever you are driving in tight quarters, around corners etc., look back and keep an eye on the system. Even though it is tempting to open the throttle on the ATV, please do not. The faster you are driving, the more difficult it will be to stop or correct your course. Remember to look at the RC20 platform as well, which, if you are not careful, tends to get tangled in trees, bushes etc. This happens due to inattentiveness and because the system is almost 20 meters long, the turns must be larger than many think.

- ***Setup of instruments and cables must be checked*** if they are coiled/any loops. Make sure the distances is correct – if there is excess of cable there is risk of creating loops and distance might be wrong.

During a field campaign, it is important to continually keep an eye on the condition of the equipment. Below is a checklist with things to check up on, on a regular basis.

- Each day before driving, a quick tightening of all M20 bolts should be performed.
- Keeping the equipment clean and tidy without mud and dirt helps the reliability.
- Check all cables and ropes for fraying and excessive wear. This includes the connectors.

6 TROUBLE SHOOTING

Following issues can appear:

Problem	Check	Solution
Tib – no contact	Check in PaPC if TiB is online or offline	Is Tib-battery charged? Take out Tib battery – wait a few seconds and put it back in
Not able to open/re-load script	check if TiB is online	Check if galv/com cable and TiB battery are connected and check if more than one instance of papc is running.
Only measuring noise in PaPC and is not seeing any data		Connect RC20, check if Rx cable is connected, check if Tx coil is connected and outputting current in PaPC program.
To be expanded..		

6.1 Reporting incidents

Under normal driving conditions, the tTEM system will last for several thousand kilometers without replacing any parts. Should an accident occur – e.g., hitting something while driving, ripping a cable or rope etc., and spare parts are needed, proper documentation is necessary. In your request for spare parts or support, please include several pictures, as well as a detailed account of the incident. This will speed up the support process.

Request for spare parts or support should be sent to the following email:

support@aarhusgeoinstruments.dk.

6.2 Data transfer

Transfer data from the Tx unit

After completing measurements, the data needs to be exported from the TX. If you have the Tx unit connected to an external Wi-Fi or hotspot, it is possible to transfer the data to an online shared folder (e.g. Dropbox, Rushfiles etc.). If a laptop is connected to the TX WiFi, the data can be copied through the remote desktop connection.

Data from various loggers are stored in the following folders:

c:\tTEM\Aarhusdata\Navigator
Aarhus Navigator projects are located here. You may copy the entire project folder, but only the *.lin fil is needed for WorkBench import.

c:\tTEM\Aarhusdata\tTEMLog

Data files written by tTEMLog Program. Data is separated into days and Runs. Contains timestamped *.skb (binary data files) and *.sps (ASCII files with transmitter and GPS information).

c:\tTEM\Aarhusdata\PaPcData

Legacy format data written by PaPc. Not needed for WorkBench import

Local copy (remote desktop style)

Use any PC with a Windows operating system. Connect the Tx unit using remote desktop connection, as described in 2.2. Copy data folders and paste into your local pc. Folders will be copied over remote terminal. For faster transfer of data make sure to connect your PC to 5 GHz Wi-Fi network if available. Use of Mac or Linux to download data is possible, but not supported.

To import tTEM data into workbench, you will need to copy the raw data folder from tTEMLog and the production mask file (.lin) located in the Aarhus Navigator project folder. Data should be exported every day after end of fieldwork. One day of fieldwork will have the size of around 1-2 GB.

6.3 Shutting down the Tx unit

When data is transferred, the Tx unit can be shut down. This is done by clicking the *Shutdown – WARNING* shortcut on the desktop. After this, the power cable between the Tx unit and the battery can be removed.

7 DATA QUALITY CHECK

It's recommended to check the data collected preferable same day or day after.

Import data to Aarhus Workbench and check gates (LM and HM), current and temperature to secure system operating correctly. Below a setup in Aarhus Workbench can be seen, time interval can be increased to e.g half an hour reducing the number of intervals to check.