

ABEM WalkTEM

TRANSIENT ELECTROMAGNETICS

USER'S GUIDE



33 8000 97
v. 1.10

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ABEM WalkTEM User's Guide

1 Introduction

This User's Guide is written as an introduction to using the ABEM WalkTEM Time Domain Ground EM system in the field. It provides a basic introduction to the components that make up the ABEM WalkTEM system and how these are put together and laid out in the field. It also gives a run through of the files used for acquisition, as well as how to actually acquire data. Additionally it also covers how to process the collected data directly in the instrument.

It does not give any details about further processing or inversion of the acquired data, which lies outside the scope of this document.

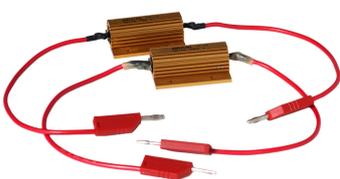
2 ABEM WalkTEM Components

The ABEM WalkTEM system is made up of a number of components. A transmitter coil in applicable length(s), TL-1k6 40x40 m is displayed below, parallel resistors for damping of the transmitter loops, serial resistors for current reduction, transmitter loop lead-in cable, connection cable for external power supply and two types of receiver antennas (RC-5 and RC-200).

There are several available configurations of the ABEM WalkTEM system. This guide will mainly focus on the 40x40 m transmitter loop and dual receiver antenna configuration unless otherwise stated.



Figure 1. The ABEM WalkTEM system

Part description	Article number	
ABEM WalkTEM base unit	33 8100 01	
Transmitter loop lead-in cable, 3m	33 8200 19	
Office power supply	39 0450 16	
External power cable	33 3000 42	
Damping resistors	Various	
Serial resistor	33 8000 88	

TL-1k6 40x40m transmitter loop	33 8000 84	
RC-5 receiver coil	33 8000 80	
RC-200 receiver cord	33 8000 81	
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Figure 2. The components of the ABEM WalkTEM system

2.1 Transmitter loop

The transmitter loop is a single turn, 160 m long, wire with banana plugs at either end. It is laid out in a square shape on the ground; with its side length depending on size of loop (TL-1k6 makes a 40x40 meter square). The start and end of the cable makes one of the loop corners. The loop is then connected to the ABEM WalkTEM banana terminals using the supplied transmitter lead-in cable. The red banana output feeds the transmitter loop in a clockwise direction and is connected in the other end to the black banana connector (Figure 4).

The supplied damping resistor is also connected to the ABEM WalkTEM banana terminals, in parallel with the transmitter loop. The damping resistor has no certain polarity to consider.

The damping resistor value depends on which transmitter loop is used. Correct value for each transmitter loop must be used.

Transmitter loop	Damping resistance
TL-1k6 40x40 meter	200 / 330 ohm (200 ohm works better if the surface is conductive, see section 6.4)
TL-10k 100x100 meter	330 ohm
TL-40k 200x200 meter	470 ohm

Figure 3. Table of damping resistor values

2.2 The ABEM WalkTEM Transmitter

The ABEM WalkTEM transmitter is contained inside the ABEM WalkTEM instrument. The ABEM WalkTEM is powered by two built-in 8Ah 12VDC battery packs and the transmitter by an external power source of 10-34 VDC. The transmitter loop connects to the ABEM WalkTEM transmitter via the transmitter loop lead-in cable (which links the transmitter coil to the black transmitter output banana connector).

The ABEM WalkTEM should always be powered by an external power source when transmitting current into the transmitter loop. Failing to do so may prematurely drain the internal battery.



Figure 4. The transmitter side of ABEM WalkTEM

Care should be taken to ensure all connectors are clean prior to connecting

2.3 RC-200 Receiver antenna (10m x 10m)

The RC-200 receiver antenna is a 40 m long wire (Figure 1) which is laid out in a 10 m x 10 m square. The wire has 2 turns internally. The receiver area is therefore 200 m² and the amplitude gain factor is 7, which gives a total coil amplitude gain factor of 1400. The receiver antenna loop connects to a pre-amp junction box (Figure 5) which is connected to the ABEM WalkTEM instrument by the 33 m lead in cable.

2.4 Receiver antenna connection cable

The receiver connection cable connects the 10 m x 10 m receiver antenna loop to the ABEM WalkTEM instrument. It is permanently connected to the pre-amp junction box and can therefore not be disconnected, (Figure 5).

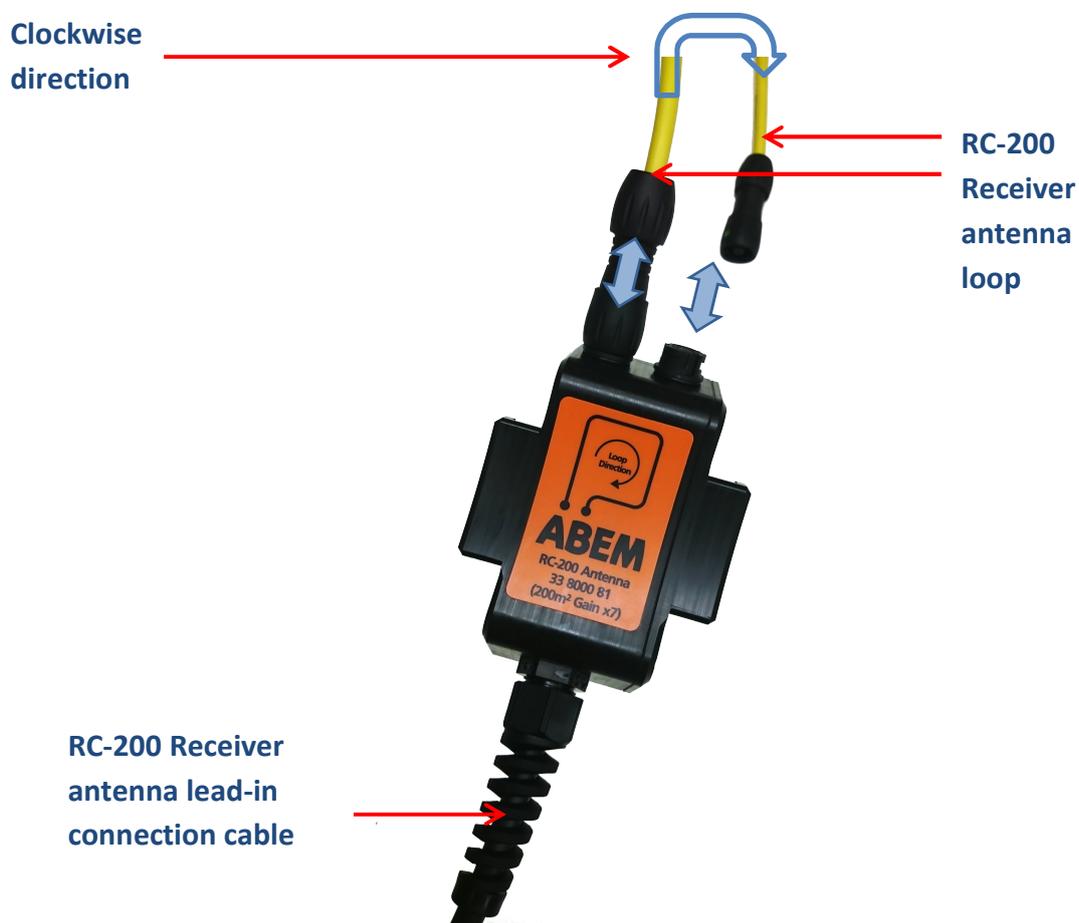


Figure 5. RC-200 receiver antenna. The 10 m x 10 m antenna loop connects to the pre-amp junction box, illustrated by the orange arrow. The lead-in cable connects to one of the input connectors on the ABEM WalkTEM.

2.5 RC-5 Receiver antenna

The orange receiver antenna (Figure 5) is a 0.5 m x 0.5 m square loop with 20 turns internally, giving a total receiver area of 5 m². An amplitude gain factor of 7 gives a total of 35 for the coil amplitude gain factor. The receiver coil connects directly to the receiver with its own lead-in cable as seen in Figure 6.



Figure 6. The RC-5 receiver antenna and lead-in connection cable

2.6 The ABEM WalkTEM Receiver

The WalkTEM receiver, also incorporated in the ABEM WalkTEM instrument, uses an internal 8Ah 12 VDC battery pack identical to the one that is used by the computer and screen. The two receiver antennas are connected to the receiver inputs on the right hand side of the instrument, see Figure 7.

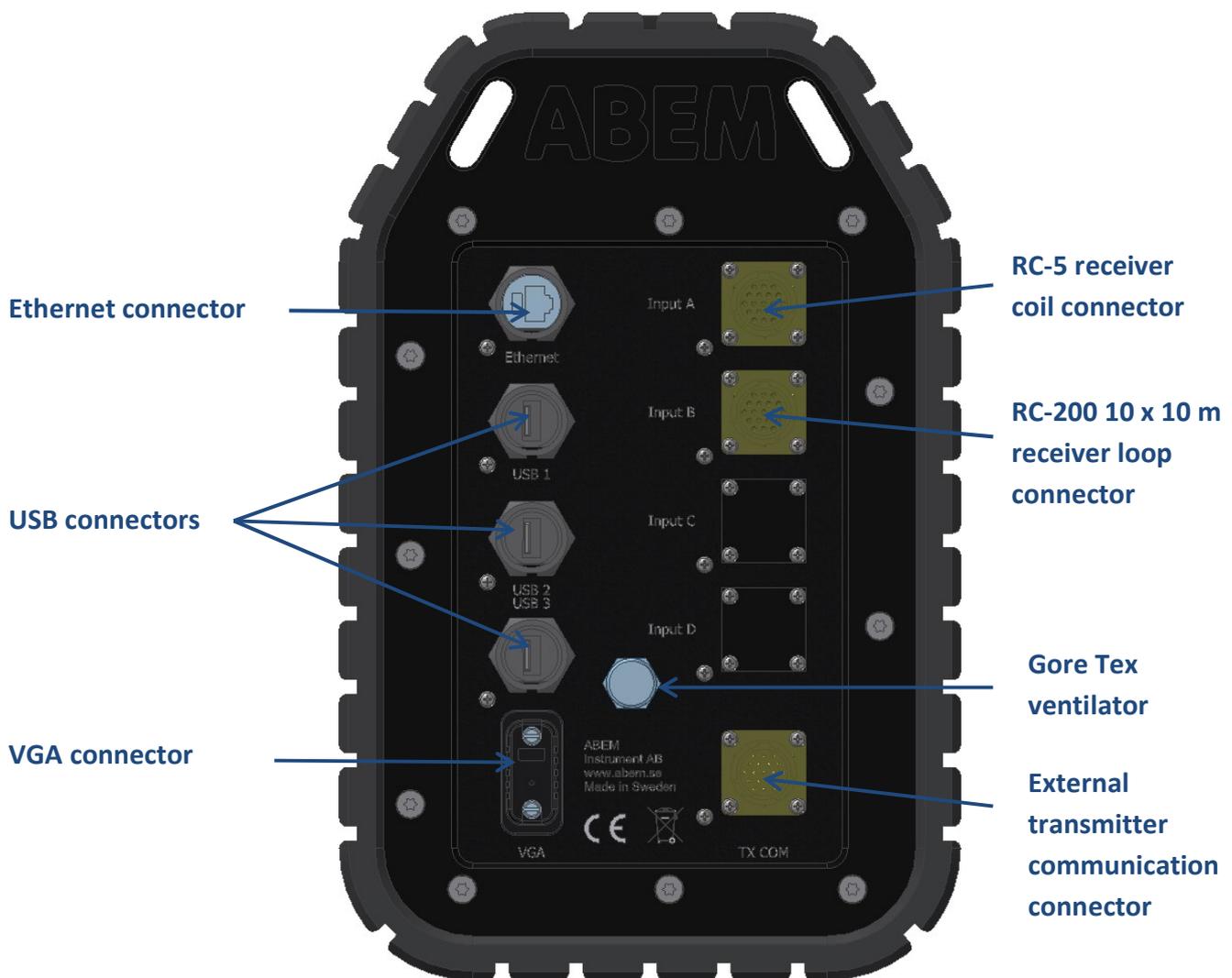


Figure 7. The receiver side of ABEM WalkTEM

2.7 Internal battery packs

The ABEM WalkTEM unit incorporates separate battery packs for the receiver and transmitter. It is also possible to connect an external power source which then will power the transmitter and computer. The receiver always runs on its own internal battery pack.

The ABEM WalkTEM should always be powered by an external power source when transmitting current into the transmitter loop. Failing to do so may prematurely drain the internal battery.

2.8 Battery chargers

The ABEM WalkTEM unit has built-in chargers for both internal batteries, which can be charged totally independent of each other. The battery chargers will run if an external power source is connected and the input voltage is in the range of 12.8 to 19 or > 25 V for the main battery and 12.8 to 19 or > 24 V for the receiver battery. The input voltage required for charging is carefully chosen in order to avoid draining an external power source like a car battery, or two batteries in serial, powering the transmitter. The internal

battery packs can also be charged using the supplied office power supply which connects to a mains (220/110volt) power point.

The ABEM WalkTEM needs to be powered on for the charging of internal batteries to take place.

2.9 Computer

A Windows XP Pro computer is incorporated into the ABEM WalkTEM unit. It runs the measuring application but also supports data interpretation software as well. The computer can be accessed using the USB connectors or by the Ethernet connection. A WLAN antenna is also incorporated in the ABEM WalkTEM unit.

2.10 GPS

The ABEM WalkTEM instrument has a built-in GPS which records the instrument position and stores it together with the collected data. In the ViewTEM PC version software, the measuring location can then be displayed on Google maps from this GPS position.

3 Field Layout / Setup

A typical field configuration for data acquisition using the ABEM WalkTEM is indicated in Figure 8. It comprises a 40 m x 40 m square transmitter loop, and either a small RC-5 receiver coil or the larger RC-200 receiver loop in a center configuration.

It is possible to use both receiver antennas simultaneously, but due to induction in the RC-200 there might be a small influence on the RC-5 when used together in a center configuration.

For illustration purposes both receiver antennas will be used in the following example. For more field layouts, see section with 6.1.

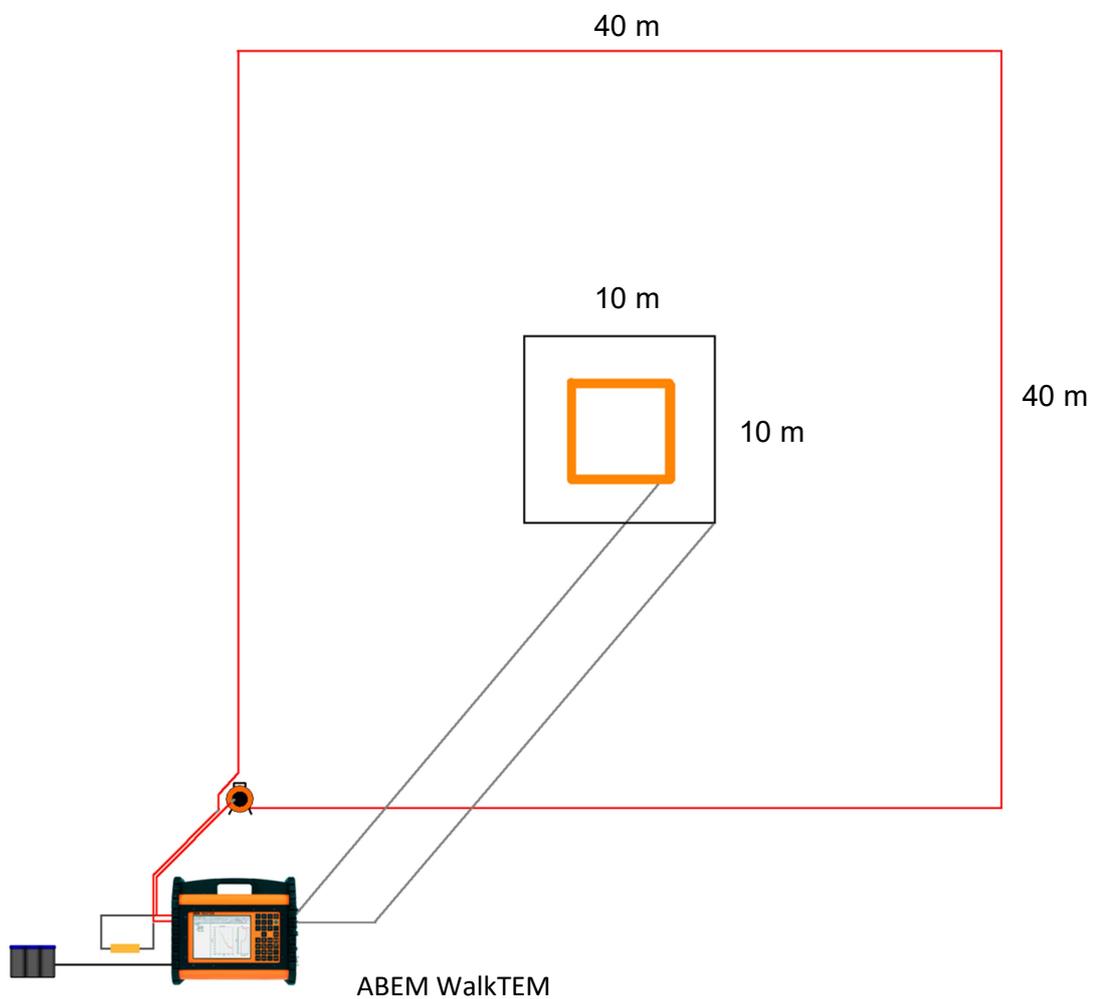


Figure 8. The ABEM WalkTEM field layout.

3.1 Lay out procedure

Field layout can be achieved in approximately 10 minutes or less, depending on the number of field operators. Recommended steps in the layout are as follows:

- 1) Identify the approximate center of the 40 x 40 m transmitter loop and lay out the transmitter cable in a square around the center. Make sure it is as square as possible, so the transmitter area is relatively consistent between soundings. The transmitter loop cable(s) have black indications at each loop corner.

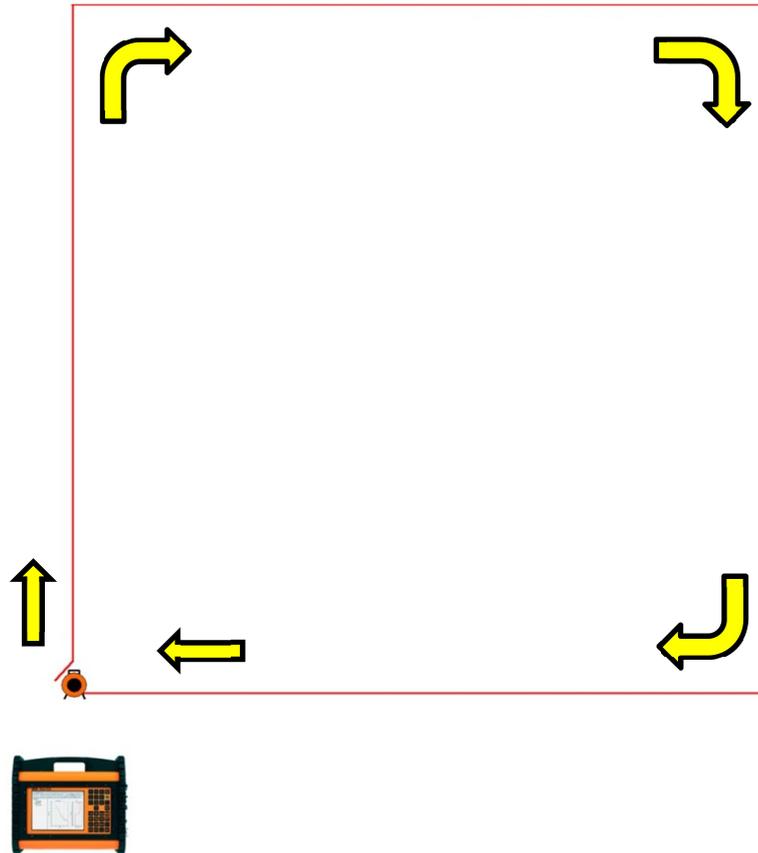


Figure 9. Clockwise routing of the transmitter loop.

- 2) Use the transmitter loop lead-in cable to connect the transmitter loop to the transmitter banana terminals as seen in Figure 10, using the red and black banana plugs. When connecting the transmitter loop make sure that the current is clockwise, i.e. the cable orientated in a clockwise direction with the red (positive) plug connecting the start of the transmitter loop cable and the negative (black plug) connecting the end of the transmitter loop at the connector placed on the reel.



Figure 10. Transmitter loop is connected using the 3 meter lead-in cable. This permits the instrument to be placed 3 meters away from the transmitter loop and the electromagnetic field it generates.

- 3) Place the RC-5 antenna in the middle of the transmitter loop. Make sure that the correct side of the coil is facing upwards; otherwise the acquired data will be negative. The correct side can be tested by collecting data with the coil turned both ways. Usually the black connection box should be facing upwards. When checking the data in the ABEM WalkTEM user interface it needs to be red, as red = positive. The cable connects to the right hand side of the ABEM WalkTEM unit at connector A or B (Figure 11).

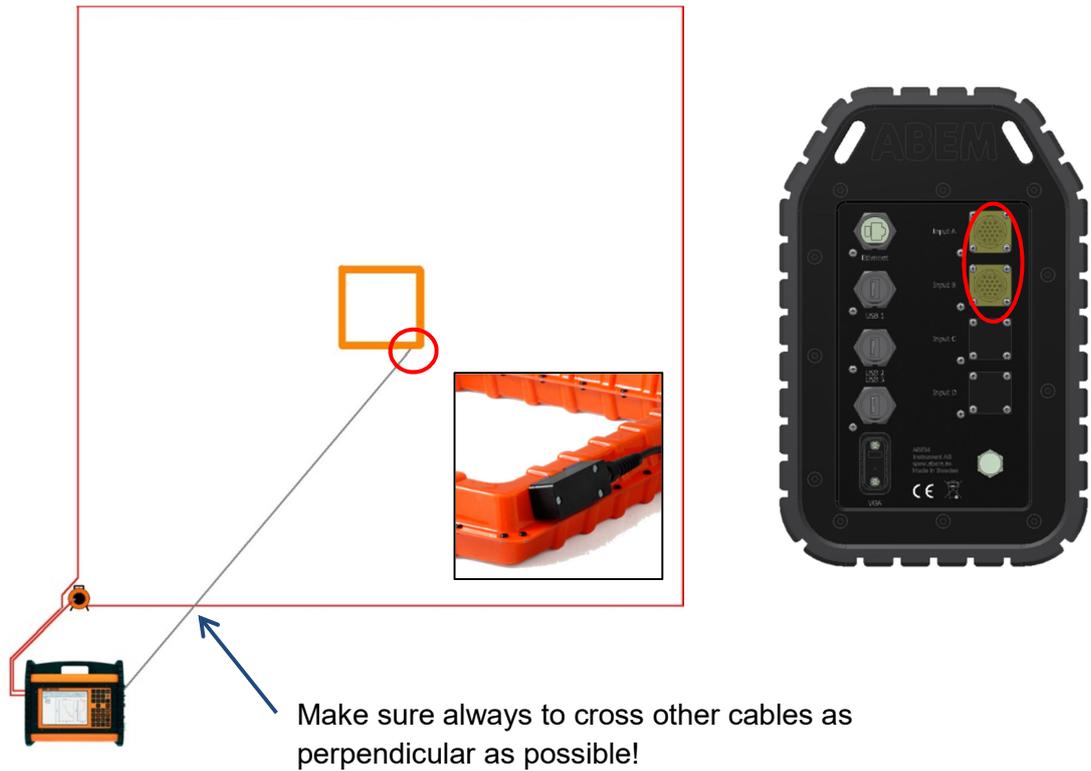


Figure 11. The RC-5 receiver connects to an input on the ABEM WalkTEM.

It is recommended to always connect the RC-5 antenna to Input A. By doing so, it will be easier to remember where it was connected during post-processing

- 4) The RC-200 10 m x 10 m antenna is then laid out around the RC-5 antenna in the manner shown in Figure 11. The RC-200 antenna receiver loop has markings in each corner. Make sure that it is a square and that the RC-5 antenna is placed exactly in the center of the 10 m x 10 m antenna receiver loop. If the RC-5 antenna is not centered, a slight offset between the two receiver loops can be seen in the db/dt curves when collecting the data.

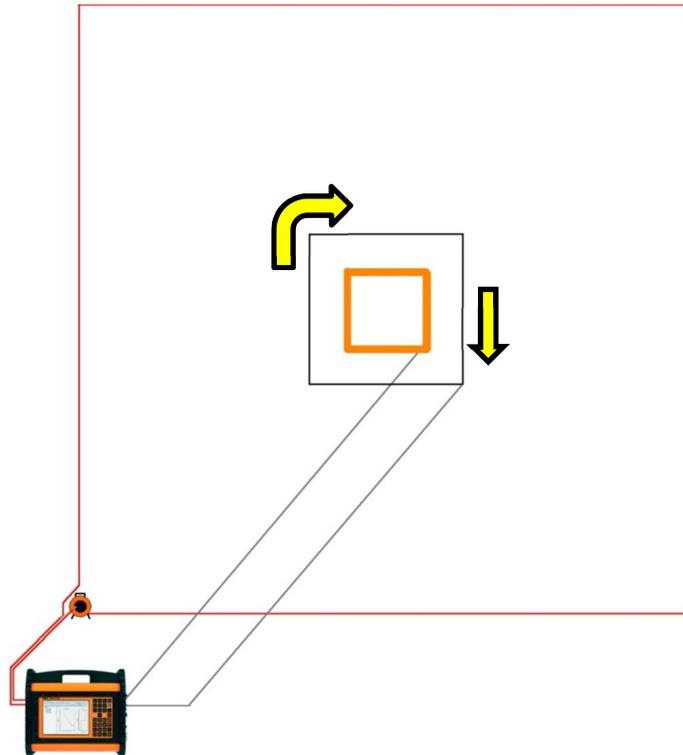


Figure 12. The RC-200 antenna cord is routed in a clockwise direction, centered around the RC-5 antenna.

- 5) Connect the RC-200 10m x 10m receiver loop to the black junction box (Figure 13). Again orientate the cable as indicated on the junction box.



Figure 13. The RC-200 receiver cord is routed in a clockwise direction starting from the disconnectable plug.

- 6) Run the 10 m x 10 m antenna connection cable back to the ABEM WalkTEM unit and plug in to connector A or B (Figure 14).

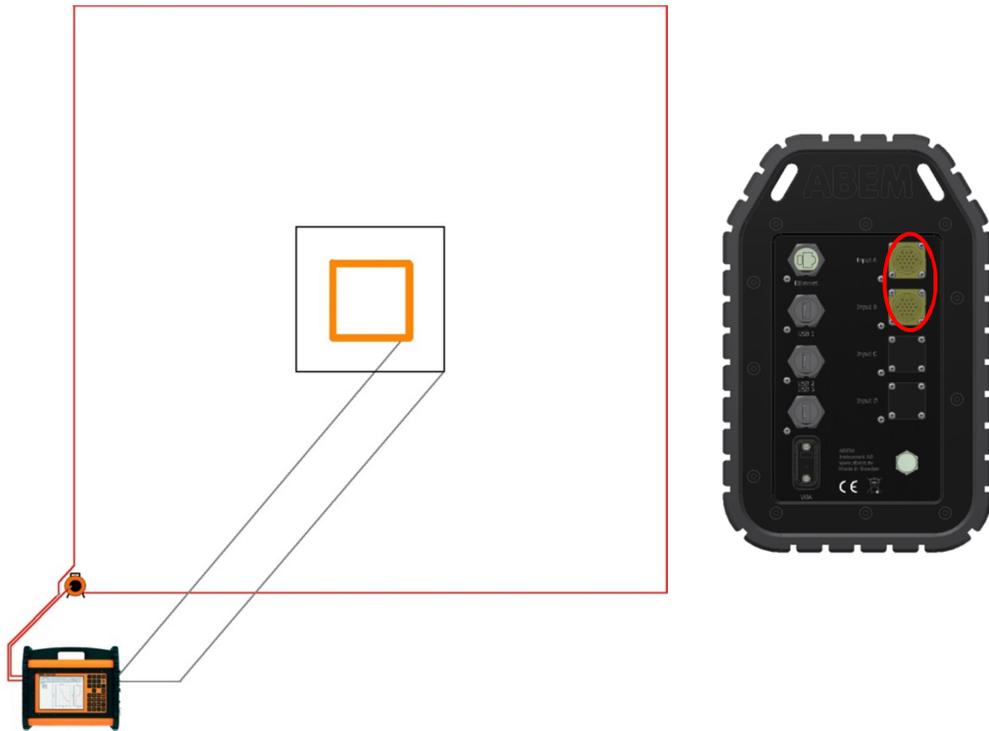


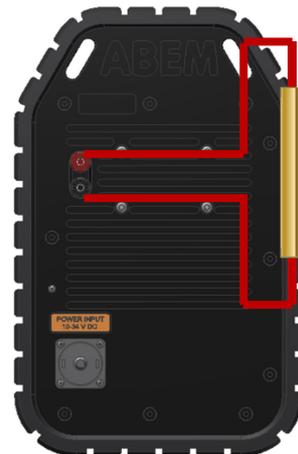
Figure 14. The RC-200 antenna connects to an input on the ABEM WalkTEM

It is recommended to always connect the RC-200 antenna to Input B. By doing so, it will be easier to remember where it was connected during post-processing

- 7) Connect the 200 Ω damping resistor in parallel to the TX loop. The damping resistor has no specific polarity to consider when connecting.

Figure 15. The transmitter loop damping resistor is connected in parallel with the transmitter loop

If the ground top layer is very resistive, it is recommended to use the 330 Ω damping resistor instead (see section 6.4).



It is important that the transmitter loop and damping resistor is connected correctly and that the ABEM WalkTEM transmitter output is not short circuited in any way. Failure to do so may damage the transmitter.

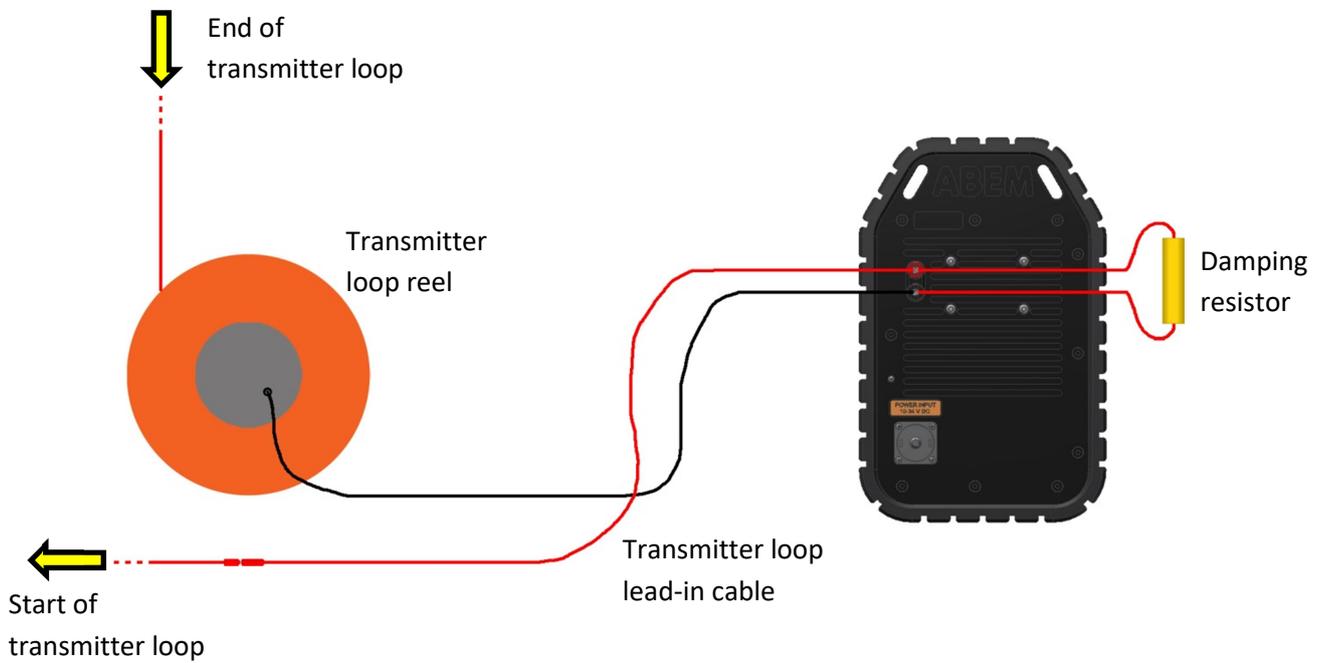
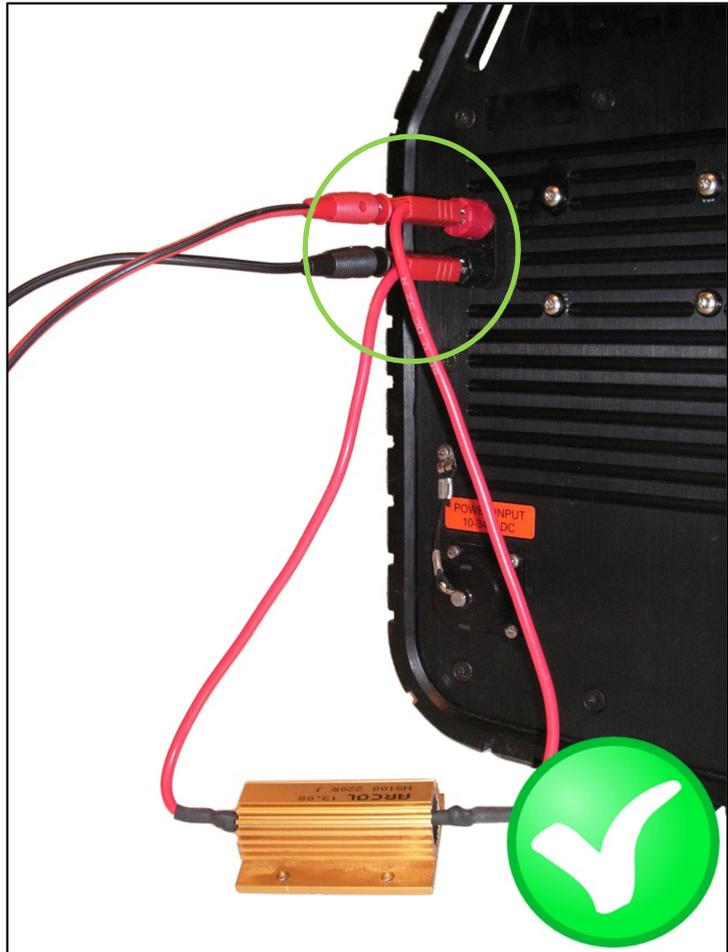


Figure 16. Illustration for connecting the transmitter loop and damping resistor to the ABEM WalkTEM.

When connecting the transmitter loop and damping resistor in parallel on the ABEM WalkTEM banana terminals; always stack the banana connectors as shown on the right.



The example on the right exposes the banana connectors risking short circuit if the two poles touch.

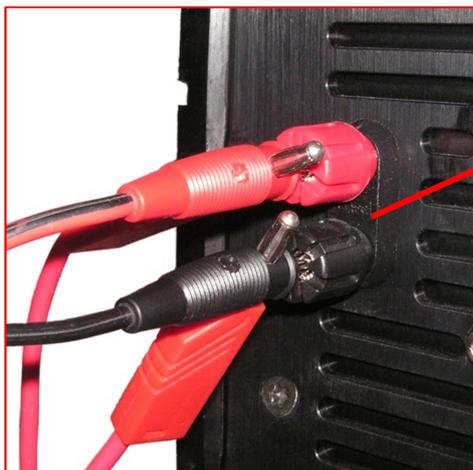
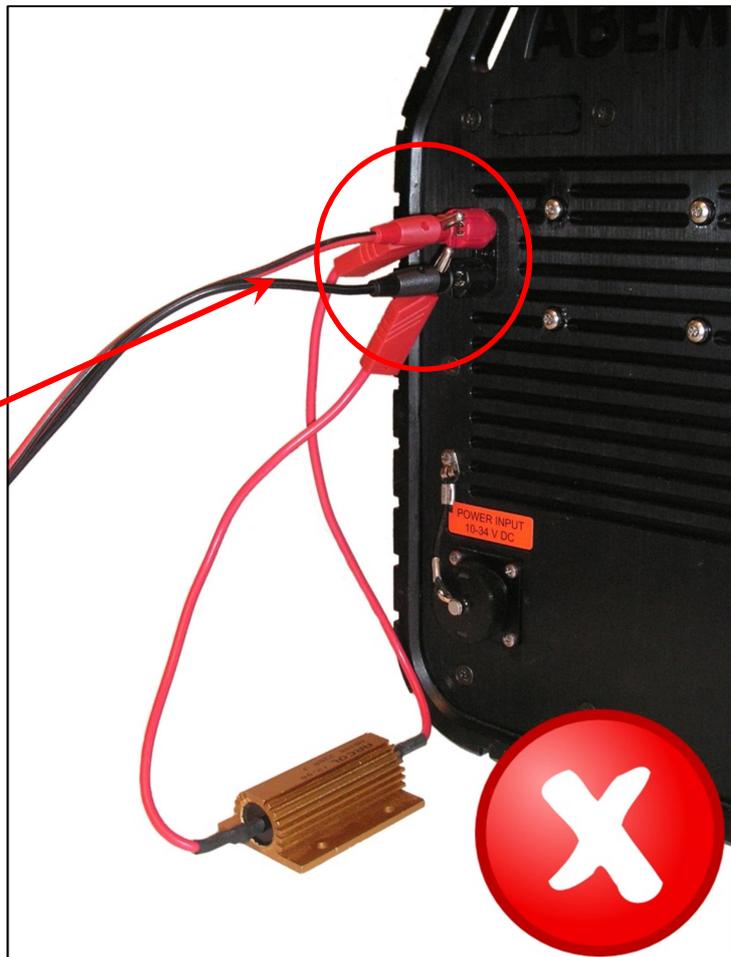


Figure 17. Pictures showing examples of correct and incorrect connecting of a damping resistor.



8) Connect an external power source (car battery) using the included cable.

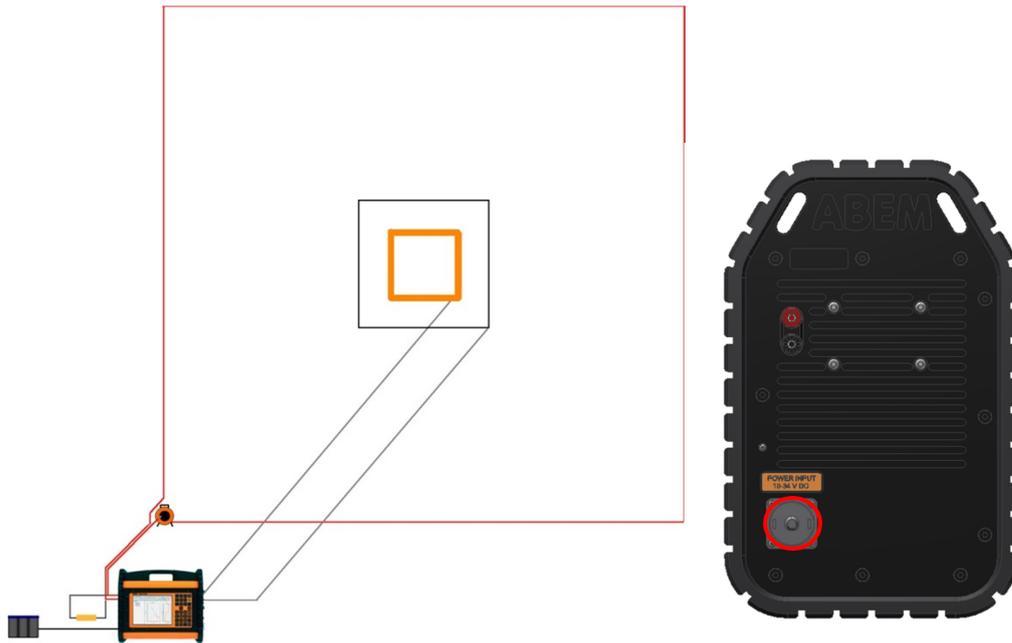


Figure 18. An external car battery must be connected to the Power Input.

Always be careful when connecting the external power supply. Use the supplied external power cable and connect the positive (red) and negative (black) clamps on the power source before connecting the plug to the ABEM WalkTEM power input.

When using a 12 VDC car battery, it should look like this example:

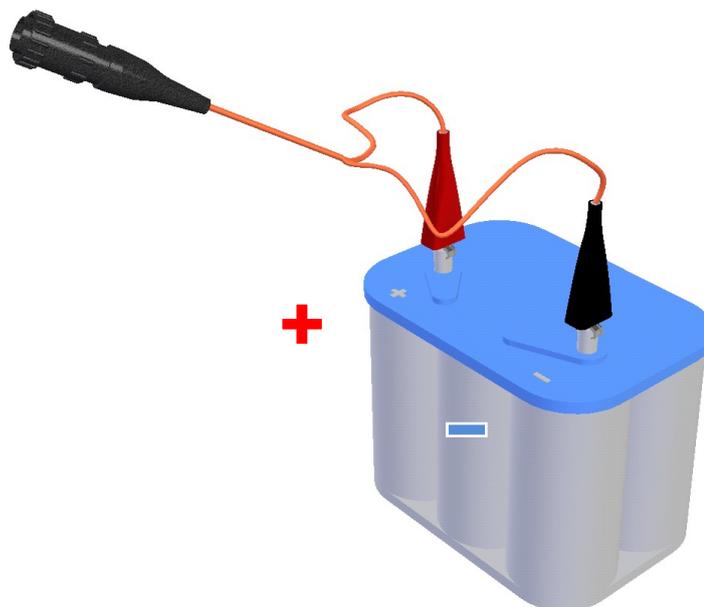


Figure 19. External power cable connection description when using a car battery as external power source

It is also possible to run the ABEM WalkTEM on 24 VDC input voltage. This can be done by connecting two car batteries in serial using the battery serial interlink cable (33 8100 22), ordered separately. Red connectors are used for positive (+) poles and black connectors for negative (-).

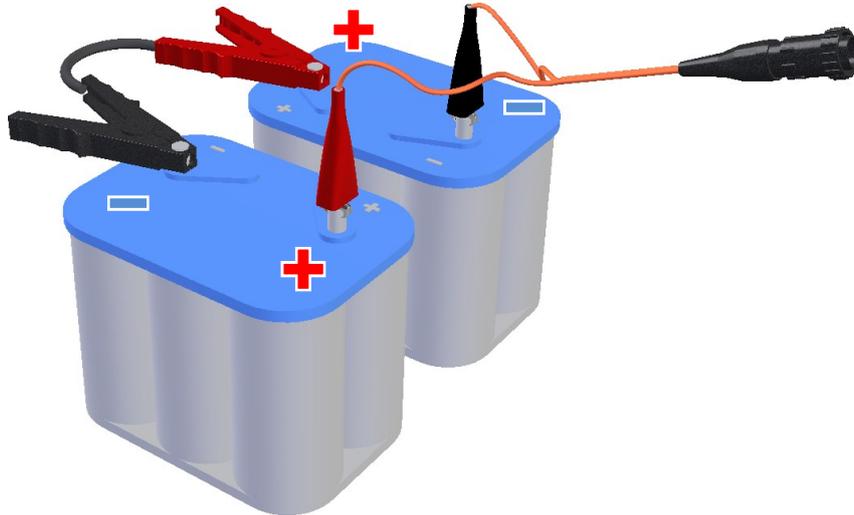


Figure 20. External power cable and battery link cable connection description when using two car batteries in serial

Always connect the batteries in serial before connecting the cable plug to the ABEM WalkTEM.

It is really important to use the utmost care when connecting batteries in serial. A wrong connection could result in both equipment damage as well as personal injury.

Do not perform this connection if you are hesitant on how it should be done. Connections should be carried out by qualified personnel only.

9) The ABEM WalkTEM layout is now complete, and should resemble that shown in Figure 8.

4 ABEM WalkTEM operation

A summary of steps involved in field data acquisition now follow.

- 1) First, turn on the ABEM WalkTEM unit (press button and a green LED will indicate) (Figure 21)
- 2) When the instrument have finished booting Windows, the WalkTEMUI application will start automatically



Figure 21. The location of the power on/off button and power indication lights on the ABEM WalkTEM

4.1 Built-in keypad

The ABEM WalkTEM is operated from the integrated keypad, or using external mouse and/or keyboard connected to the USB ports on the right hand side. This instruction will focus on the integrated keypad.

The keypad is designed with standard Windows control procedures in mind in order to be self-explanatory in most situations.

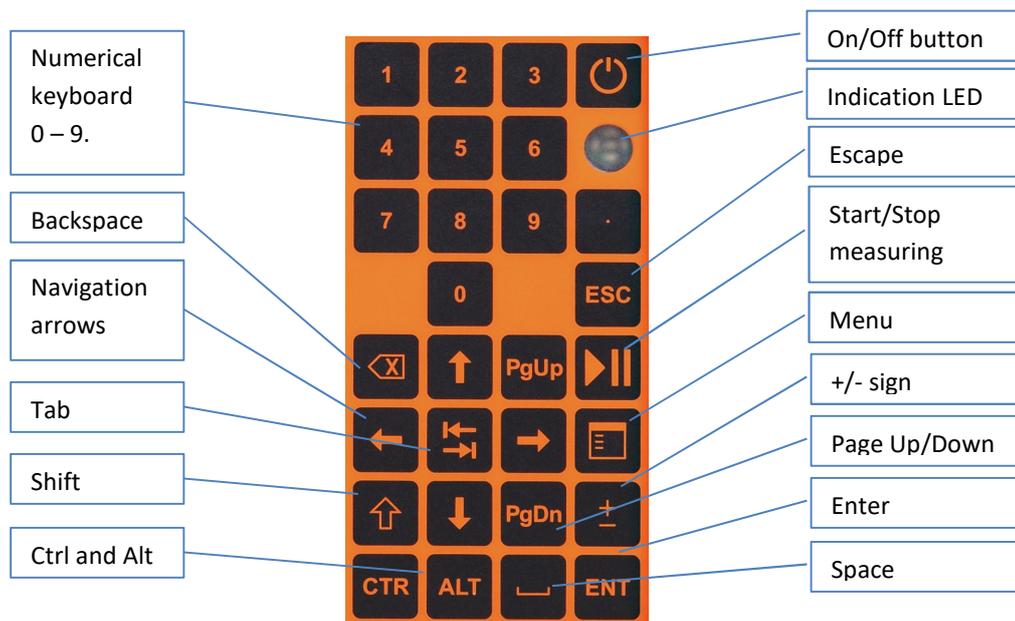


Figure 22. ABEM WalkTEM keypad

Explanation of keypad functions:

Numerical keyboard	 ... 	Permits the number “0 to 9” as well as “.” to be entered. Primarily used in configuration parameter fields
Backspace		Deletes the character on the left of the cursor
Navigation arrows	   	Moves the cursor in desired direction. Primarily used in drop-down menus
Tab		Jumps to the next configuration parameter or command. Jumps backwards in combination with the Shift key
Shift key		Works as a common Shift key on a standard keyboard
Ctrl and Alt	 	Works as Control and Alt keys on a standard keyboard
On/Off button		A short press turns the instrument on. When instrument is switched on and WalkTEMUI is started, another short press will open a dialog with the option to shutdown windows. This turns the instrument off. By holding the button down for 5 seconds, the computer is forced off.
Indication LED		Flashes when instrument is powered on

Esc		Works as a common Escape key on a standard keyboard
Start/Stop measuring		Used as a quick command in order to start or stop a measuring cycle
Menu		Displays a pop-up menu when pressed. Used by itself it corresponds to a mouse right click and brings up a menu. Used in combination with Shift key, the Windows menu appears
+/- sign		For entering a plus or minus sign. Hold Shift key to enter + sign
Page Up/Down		The two buttons <i>PgUp</i> and <i>Pg Dn</i> is used to move between the different pages in the WalkTEM user interface (Configuration, Measuring, Post-Processing and Administration)
Enter		Acts like the Enter key on a standard keyboard. Used to execute commands
Space		Acts like the Space bar on a standard keyboard; input blank space or tick check boxes

Figure 23. Keypad buttons

4.2 ABEM WalkTEM graphical user interface

The ABEM WalkTEM user interface (WalkTEMUI) consists of four (4) pages, marked as tabs in the top row, which enables a sequential work procedure and are named as follows:

Configuration

Measurement

Post-Processing

Administration

Pressing the PgUp (Page Up) or PgDn (Page Down) keys on the keypad browses between these pages on the screen:

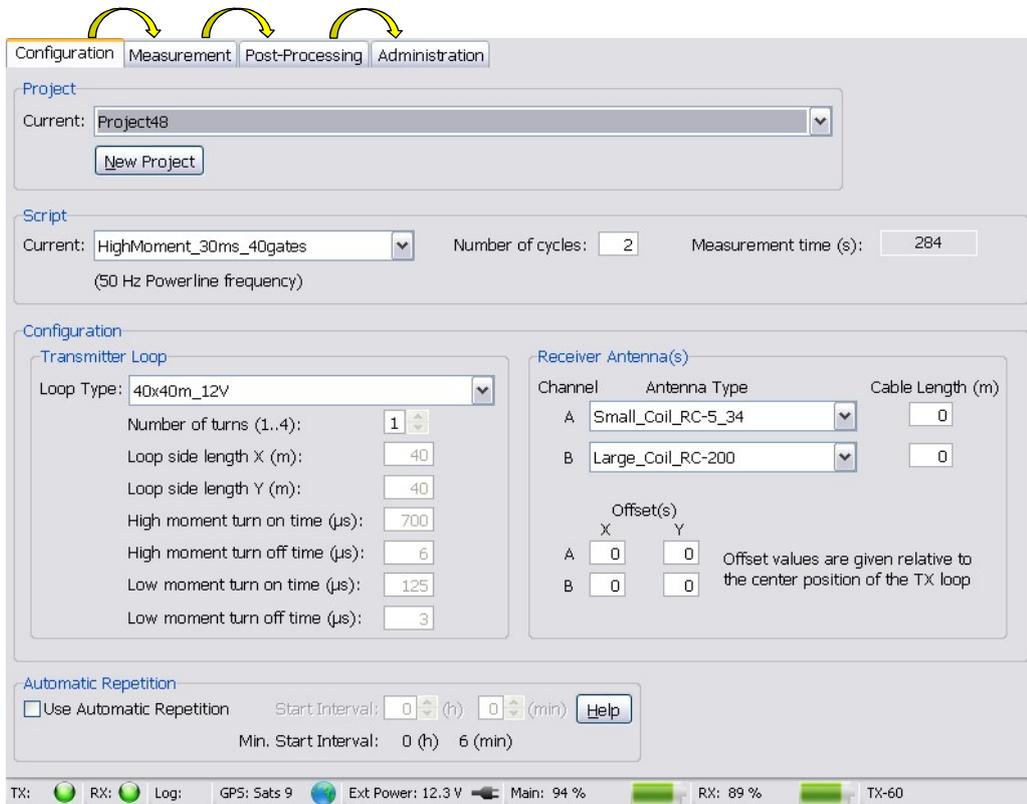


Figure 24. PgUp / PgDn buttons jumps between pages

Pressing the Tab button jumps between fields within the selected page:

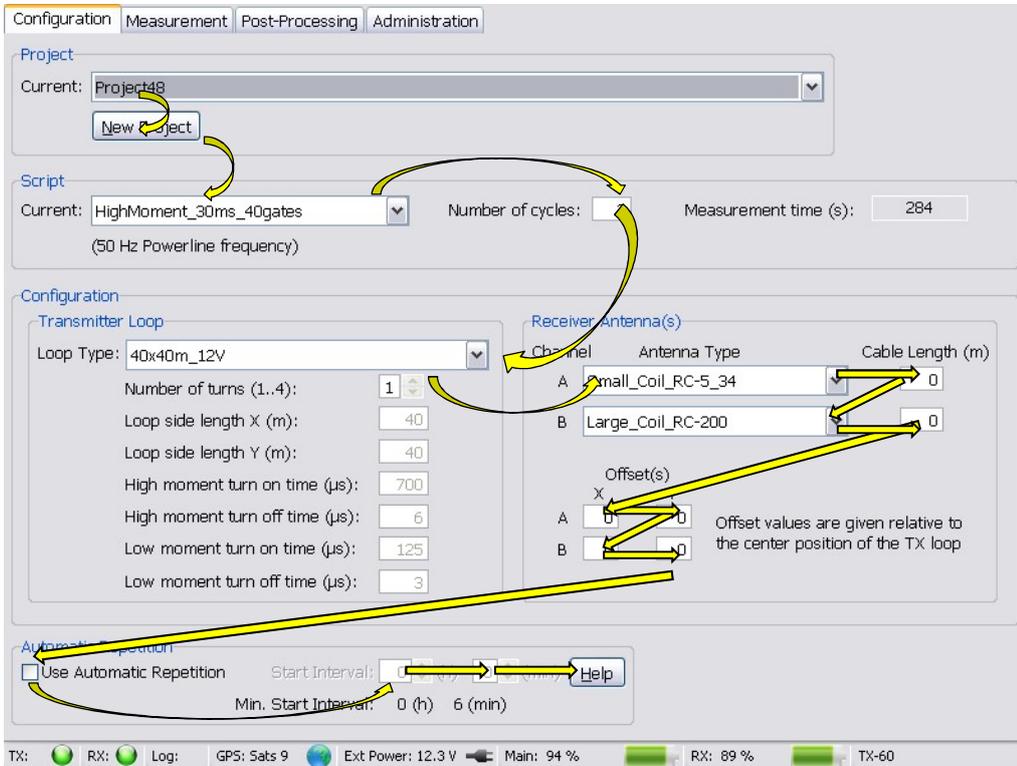


Figure 25. Tab button jumps between fields

The Menu button opens a popup menu with alternatives:

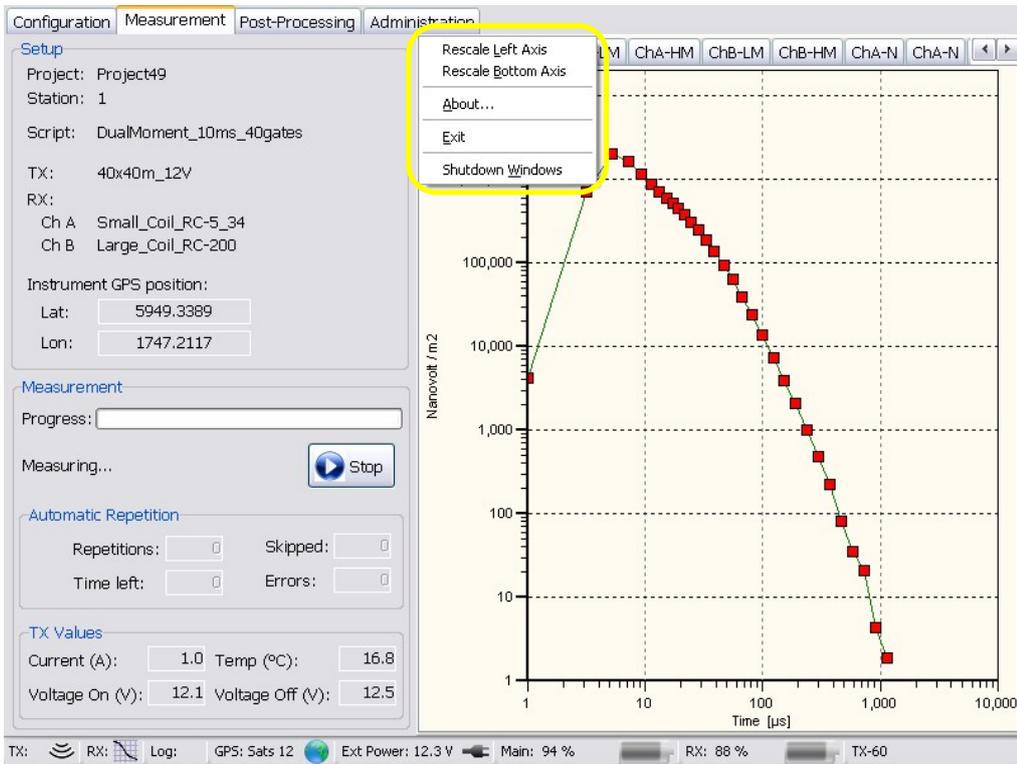


Figure 26. Menu buttons opens popup menu

The lower status bar contains various system information:

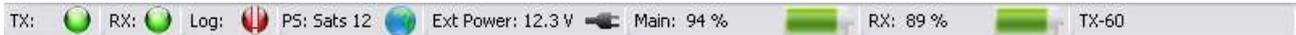


Figure 27. Information bar

Information bar symbols from the left to right means:

- TX and RX** A green check mark means that the transmitter and receiver is online and working properly
When the TX-60 external transmitter is connected to the ABEM WalkTEM and powered on, the “TX” symbol will change to “TX-60”.
- Log** A red exclamation mark icon will appear to the right of the Log text if a serious error has occurred
- GPS** Indicates current GPS satellite status
- Ext Power** Indicates if an external power source is connected and its voltage
- Main Batt.** Battery status icon for the built-in main battery, powering the transmitter and system computer. A flash is shown when battery is being charged.
When an external power source is connected, it will relieve the internal Main battery from powering the system computer.

RX Batt. Battery status for the built-in receiver battery. A flash is shown when battery is being charged

TX-60 Batt. Battery status for the built-in TX-60 external transmitter battery. A flash is shown when battery is being charged.

TX-60 battery status is only available when the TX-60 is powered on and connected to the ABEM WalkTEM.

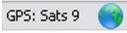
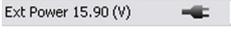
TX and RX		A green dot means that the transmitter and receiver is online and working properly
Log		A red exclamation mark icon will appear to the right of the Log text if an event has occurred in the Event Log in the Administration page
GPS		Indicates current GPS satellite status and number of satellite fixes
External power		Indicates if an external power source is connected and its voltage
Internal batteries		Charge level indicators for internal batteries

Figure 28. Statusbar symbols

Note: The ABEM WalkTEM user interface is closed by pressing the Menu button and choosing *Exit* or *Shutdown Windows* from the shown menu:



Figure 29. Shutdown option in menu pop-up dialog.

4.2.1 Configuration

The Configuration page is where a measurement setup is made prior to doing a measurement.

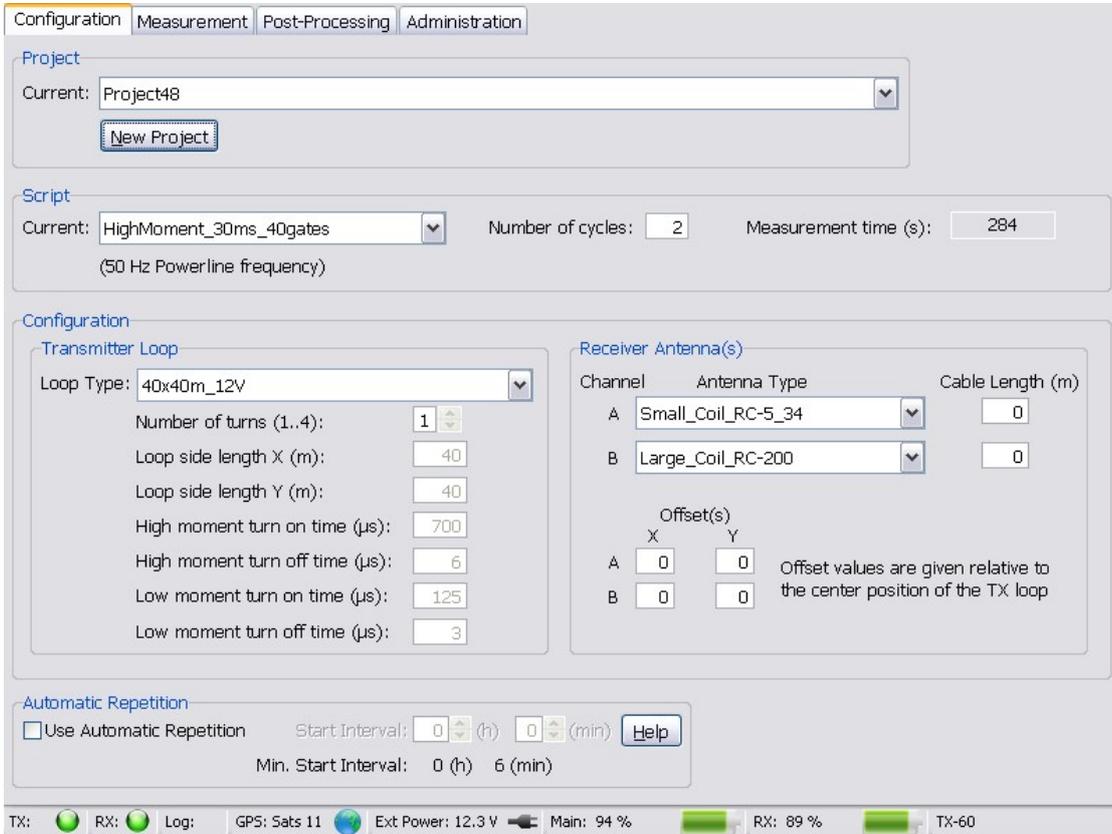


Figure 30. Configuration page

The configuration process is done like this:

1. In the Project panel, a new project can be made or an existing project can be opened. Existing projects are available in the drop-down menu. A new project is made by pressing *New Project*.

- In the Script panel, a script is chosen from the drop-down menu. The script is a pre-defined measurement recipe which contains parameters such as high and low moment readings as well as noise measurements.
- In the Script panel, the number of measuring cycles can be set. An approximate total measuring time will be calculated depending on script and number of measuring cycles and displayed next to the *Number of cycles* field.

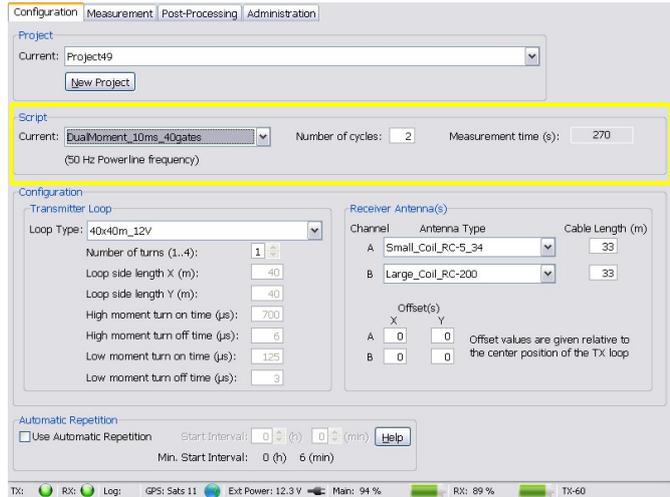


Figure 31. Script panel, where the desired script and number of cycles are set

- In the Configuration panel, transmitter loop type is chosen as well as receiver antenna types for each input channel (A and B). It is done from respective drop-down menu. When choosing a pre-defined transmitter loop, parameters such as Number of turns, Loop size and Turn on- and off times will automatically be loaded and displayed in their respective fields. When choosing a pre-defined receiver coil, their respective lead-in cable lengths will also be automatically loaded in their respective fields. These lengths can be changed by the user if for instance an extension cable is used together with the receiver coil. As a sub-set in the Receiver Antenna(s) panel, it is possible to enter offset position values for the receiver coils in relation to the transmitter loop, see figure 27. This is done if the receiver loop(s) is not centered in the transmitter loop, otherwise these fields can be left with the value 0. All entered values will be stored together with the measuring file.

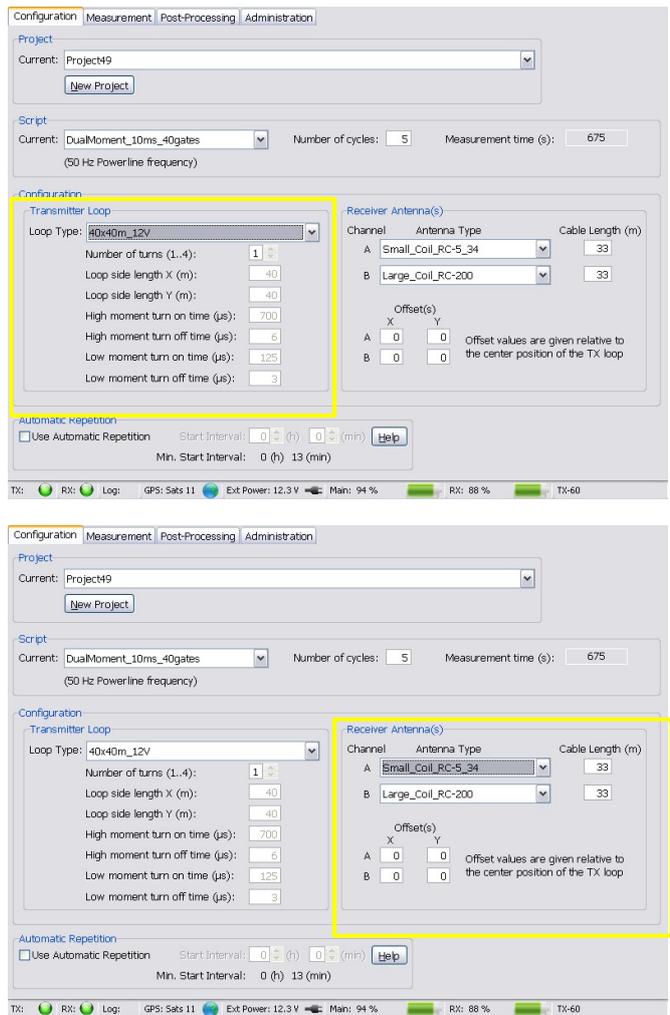


Figure 32. Transmitter Loop and Receiver Antenna(s) configuration panels

- At the bottom of the Configuration page is a panel named Automatic Repetition. This is a feature that permits a configured measurement to be repeated at a chosen time interval.

The function is activated by checking the box on the left in the panel, and then enter the desired time interval between each measurement start. A minimum time interval is calculated based on the measurement setup (script and number of cycles).

The measurement will be repeated until the measurement is manually stopped.

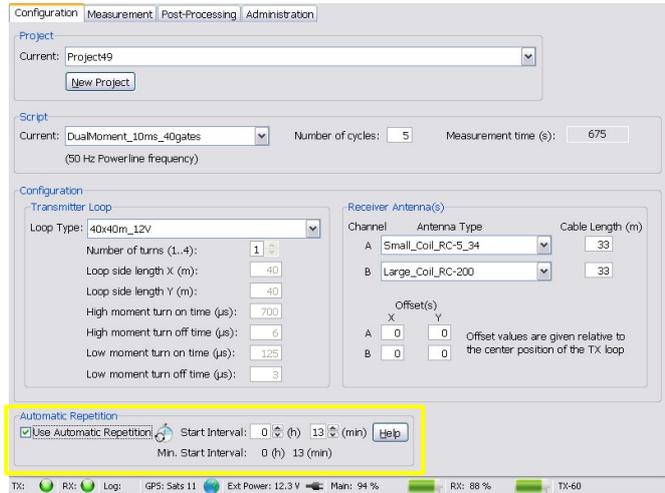


Figure 33. Automatic Repetition setup panel

A Help button is situated on the right in the panel. Clicking the button opens an informative dialog explaining the Automatic Function.

The measuring configuration is now complete. By pressing the PgDn (Page Down) button on the instrument keypad, the next page (Measurement) will be shown.



Figure 34. Automatic Repetition Help dialog

4.2.2 Measurement

The Measurement page is where a measuring is started and stopped. During the measurement, received decays will be plotted in the graph on the right half of the screen.

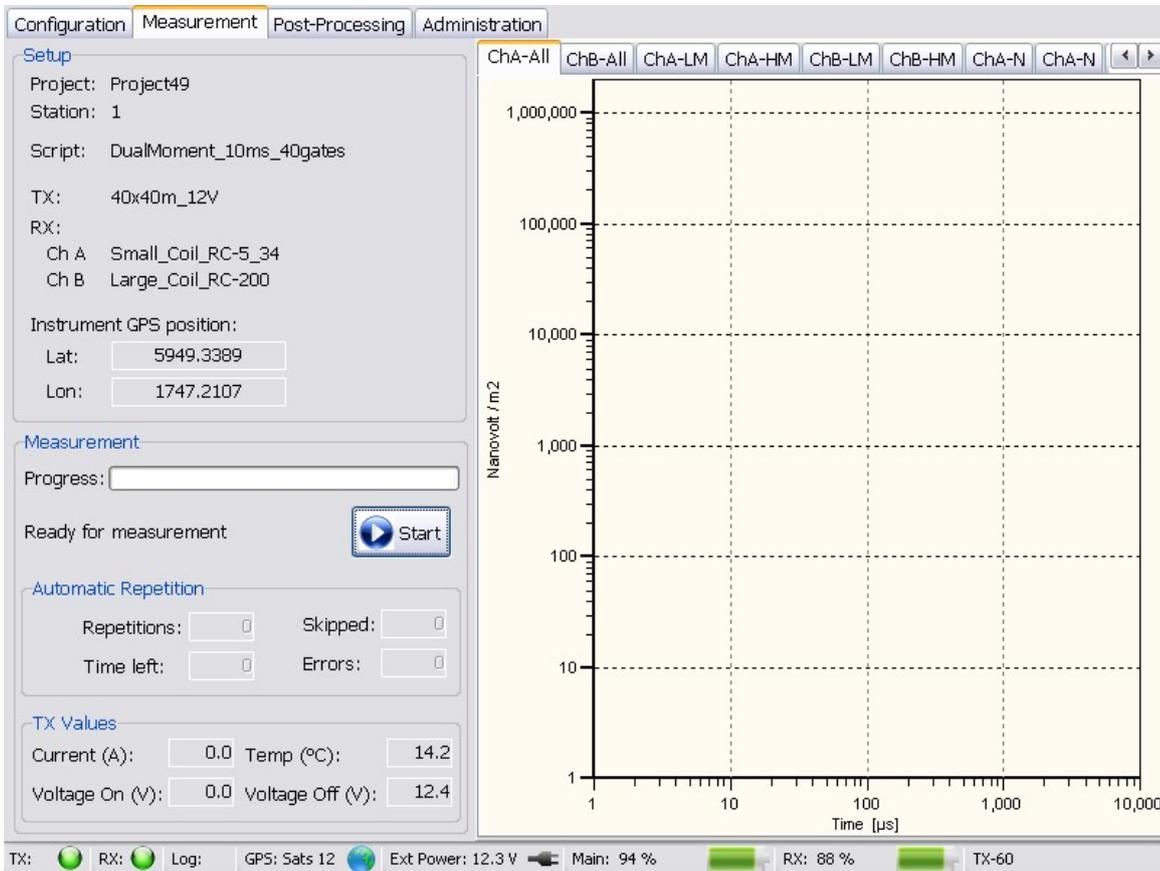


Figure 35. Measurement page

A measurement is carried out like this:

1. In the Setup panel, a summary of the current Project and its configuration is displayed.
2. Each measurement carried out in a Project is labeled as a Station. This is a number that increment every time a measurement is carried out. A project can therefore consist of several Stations numbered as 1, 2, 3.... n.
3. In the Setup panel, the GPS position of the instrument is displayed, see figure 28. This will be saved together with the measured data.

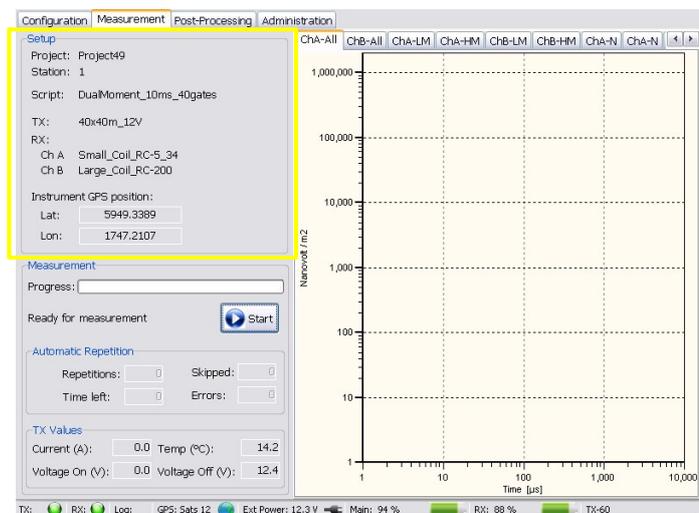


Figure 36. Station and GPS information

4. The measurement is started by pressing *Start*.
5. During measurement, it is possible to tab between the different tabs on top of the graph. The tabs will show the decay for high / low moment as well as noise measurement for each input channel.

By selecting the *ChA-All* or *ChB-All* tab, the graph will automatically alternate between all moments for that input channel.

6. At the lower left side, the transmitted current as well as transmitter voltage can be viewed during the measurement, as well as timing information if Automatic repetition is enabled.

The progress bar fills up during the measurement until it is complete or stopped.

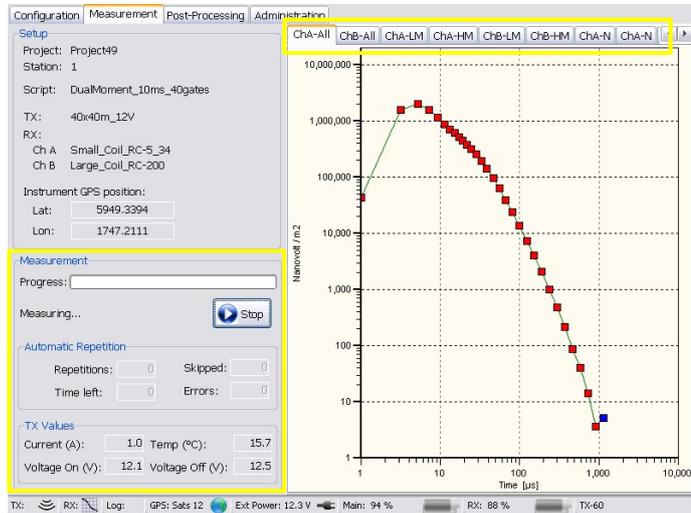


Figure 37. Decay tabs/moments and TX information field

7. By pressing the Menu button, the graph axels can be rescaled.

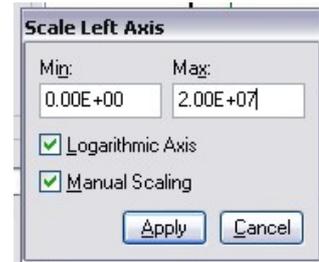


Figure 38. Rescale Axis dialog

4.2.3 Post-Processing

The Post-Processing page is an overview of all projects and stations in the instrument. It is displayed as a file tree on the left side of the screen. By expanding the tree, different stations can be viewed.

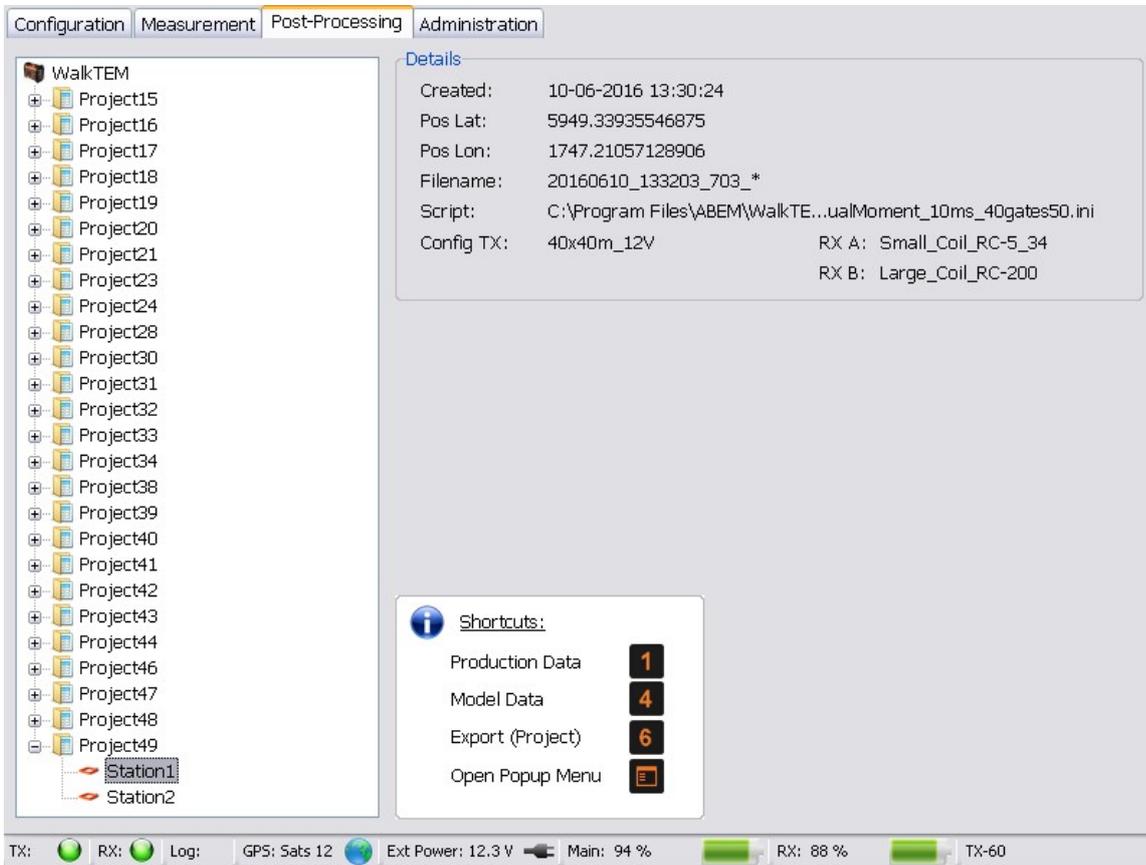


Figure 39. Post-Processing page

By highlighting a specific project or station, information will be displayed on the right side of the screen.

By pressing the Menu button on the keypad when a specific project or station is highlighted, a number of useful options are presented in a popup menu:

Production Data (1) – Marks the specific station with a flag. The letter P will be visible on the station icon. When exported, this station will also be labeled (Prod Data).

Rename (2) – Rename a Project. An external keyboard is needed if renaming requires letters.

Reconvert (3) – Performs an additional data conversion in order to prepare it for further processing. This is normally done automatically after each measurement.

Production Data	1
Rename	2
Reconvert Data	3
Model Data...	4
Export All	5
Export	6
Delete All	Shift+Alt+BkSp
Delete	Alt+BkSp

Figure 40. Post-Processing pop-up menu

Model Data (4) – Launches ViewTEM in instrument mode. This allows a full automatic inversion to be carried out and a layer model to be displayed

Export All (5) – Copies all data in the post-Processing tree to a desired location, e.g. USB memory. This is the normal procedure to extract all data for further handling in the office

Export (6) – Copies the selected Project data to a desired location, e.g. USB memory. This is the normal procedure to extract all data for further handling in the office

Delete All (Shift+Alt+BkSp) – Deletes all Projects / Stations in the Post-Processing tree. The tree root must be highlighted in order to enable the Delete All function.

Delete (Alt+BkSp) – Deletes a selected Project / Station

The additional numbering after each command represents a shortcut command for the desired function, enabling the function to be activated by directly pressing the corresponding command on the instrument keypad. The Post-Processing page also contains a list of the most commonly used shortcuts.



Figure 41. Post-Processing Shortcut list

4.2.4 Administration

The Administration page contains information and settings related to the system itself which is normally not used for data measuring.

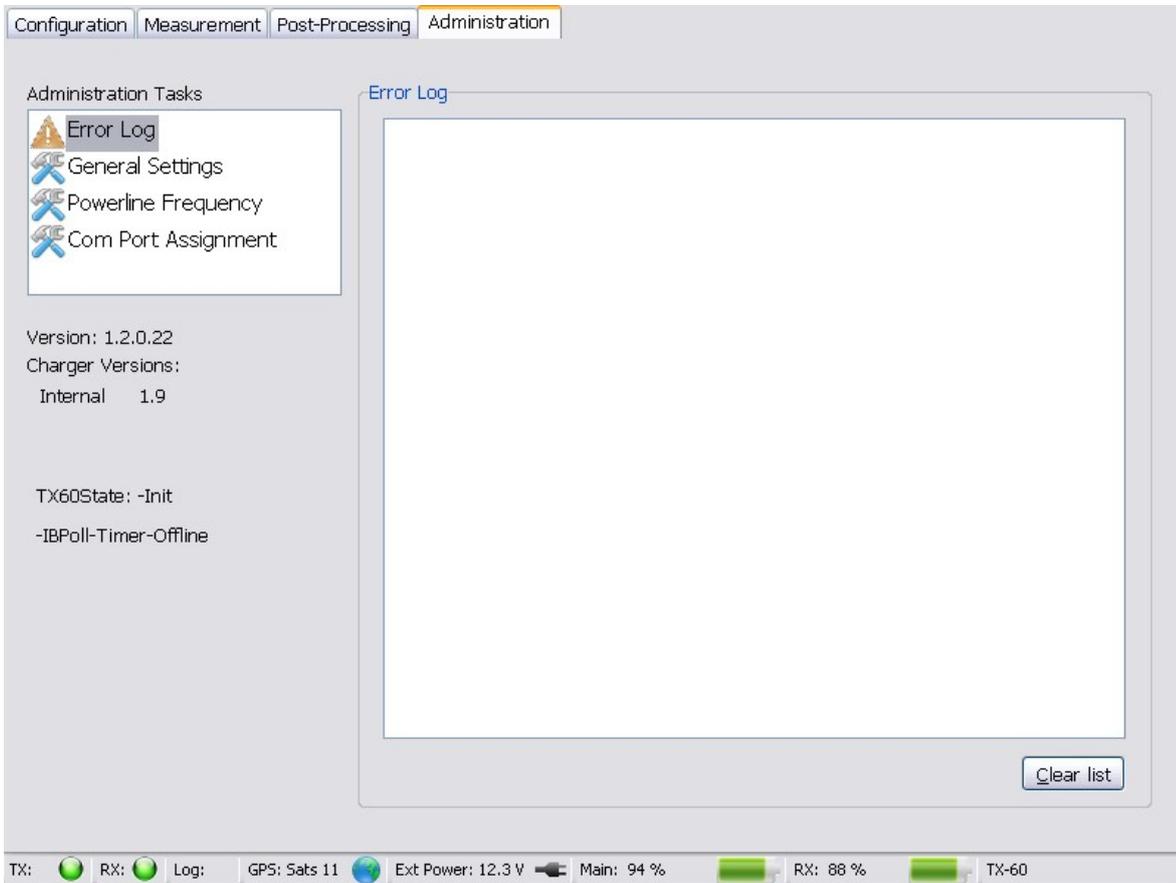


Figure 42. Administration page

Error Log – If some malfunction of the system is detected, the error will be described in the Error Log window

General Settings – Contains settings affecting how the user interface will behave.

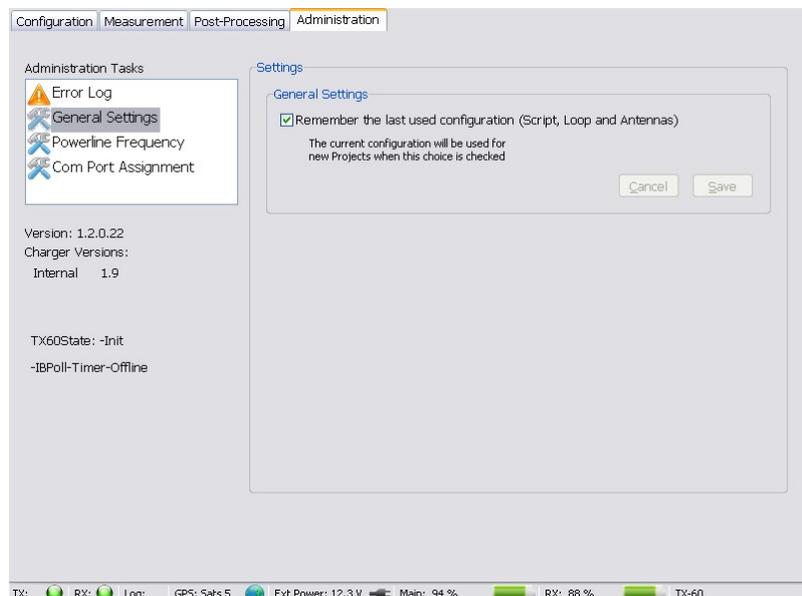


Figure 43. General Settings field

Powerline Frequency – The powerline frequency of the current region can be set here; 50 or 60 Hz. This will automatically filter which scripts are available on the Configuration page.

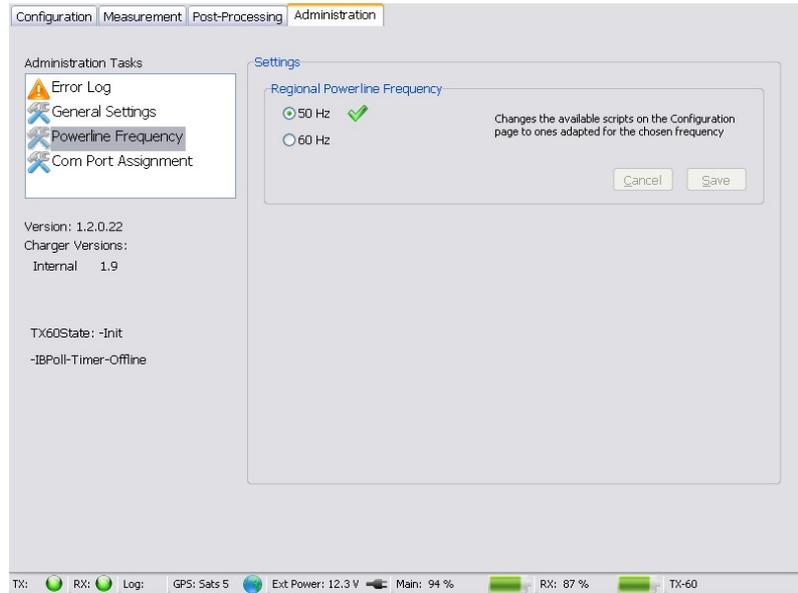


Figure 44. Powerline Frequency settings field

Com Port Assignment – Shows a list of the current com port assignments in the instrument computer, with the possibility to reassign them.

This is a problem solving feature, should there be a need for it. Com ports should otherwise not be reassigned.

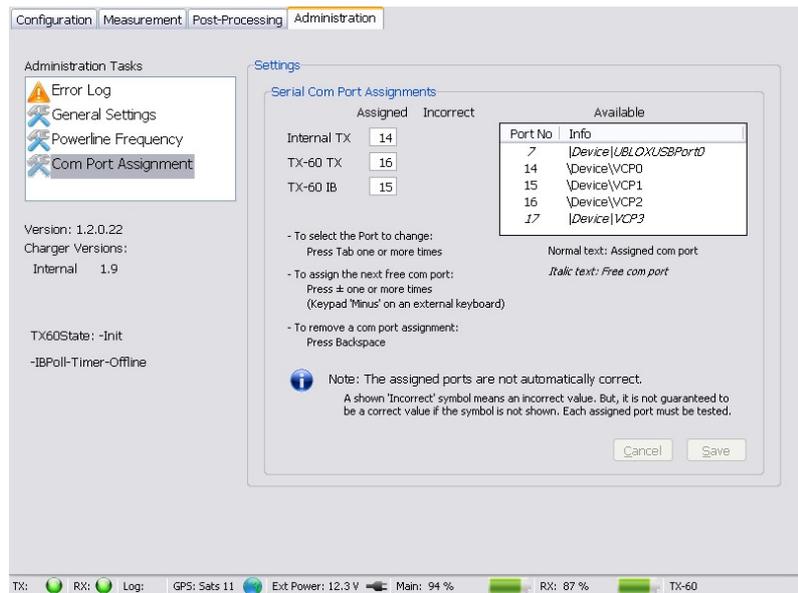


Figure 45. Com Port Assignment field

4.3 Instrument data processing using ViewTEM

The ABEM WalkTEM system comes with a built-in data processing capability as standard. This permits collected data to be immediately processed and presented as a layer model directly on screen, using the ViewTEM software running in instrument mode.

The procedure is as follows:

1. After a completed measurement, ViewTEM can be launched in order to model the data. The procedure is started by highlighting a measuring station in the Project tree in the Post-Processing page, pressing the Menu button and selecting *Model Data*, or by pressing the shortcut command 4 on the keypad. This will launch ViewTEM and start the automatic data filtering of the selected measuring station.

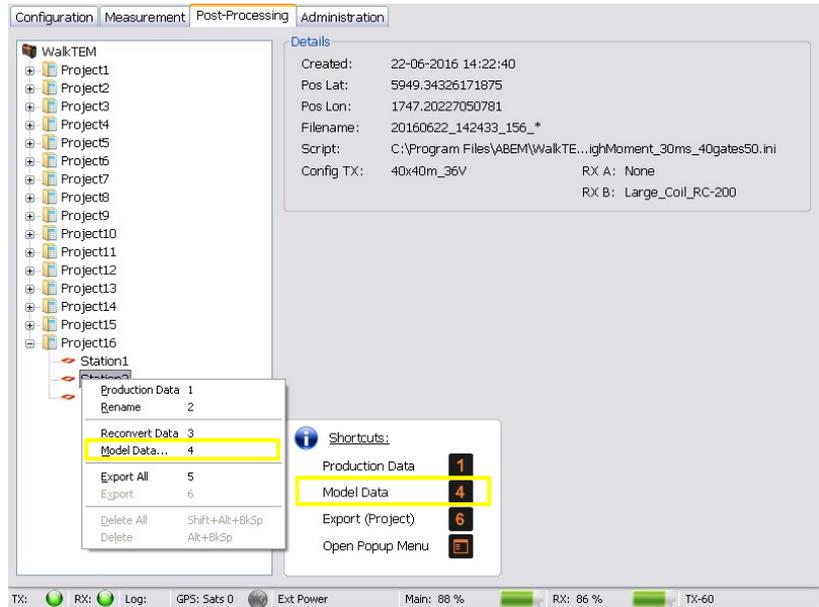


Figure 46. ViewTEM is launched from Post-Processing page

2. The ViewTEM interface consists of two pages; Data View and Simple Inversion. These are presented as tabs at the top of the screen. When launching ViewTEM, it is started in the Simple Inversion page. The loaded view presents the raw data in a graph, but also reports the number of data points in use after filtering (Data Count). The recorded GPS position is also presented.

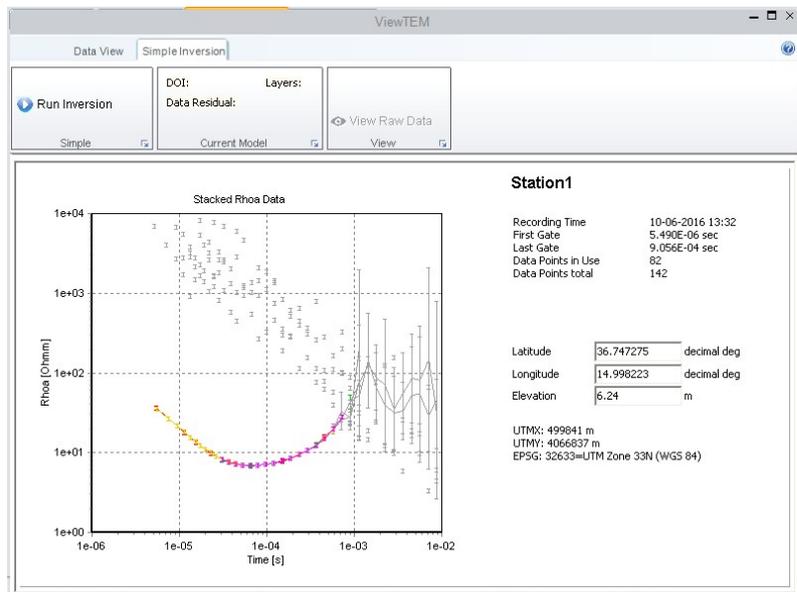


Figure 47. ViewTEM Simple Inversion page

- Highlight the Run inversion command by clicking the arrow down button. When the command is highlighted, simply click the Enter key to start the inversion.

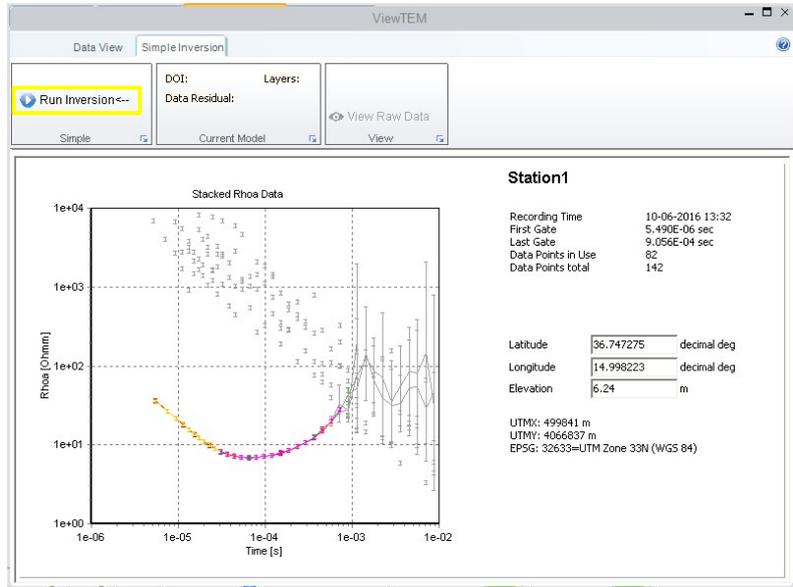


Figure 48. ViewTEM Inversion page

- Data processing is now started, and the progress is presented with a pop-up dialog. An inversion takes approximately one to four minutes to perform in instrument mode.

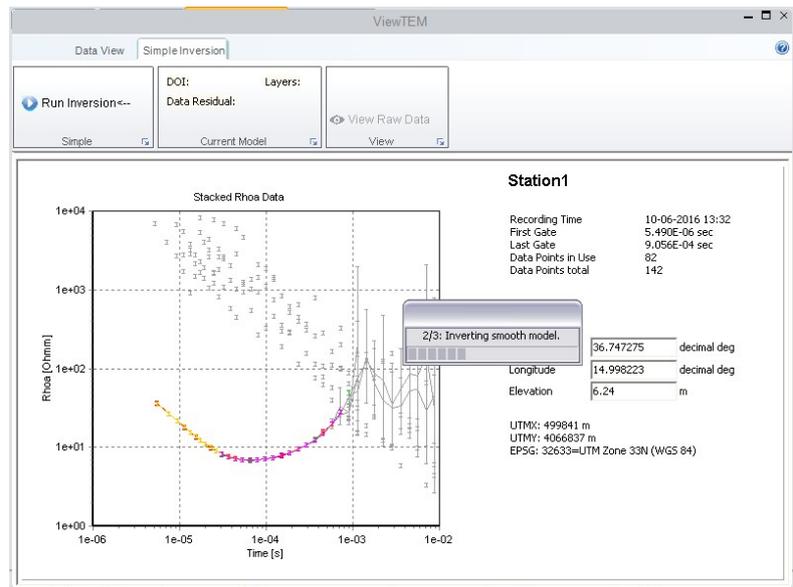


Figure 49. ViewTEM is processing data

- When the inversion is complete, a resistivity smooth layer model will be presented on the right side of the screen and the apparent resistivity over time on the left. This provides immediate feedback on data quality for the conducted measurements. An estimated DOI (Depth Of Investigation) and Data Residual will be presented in the top row.

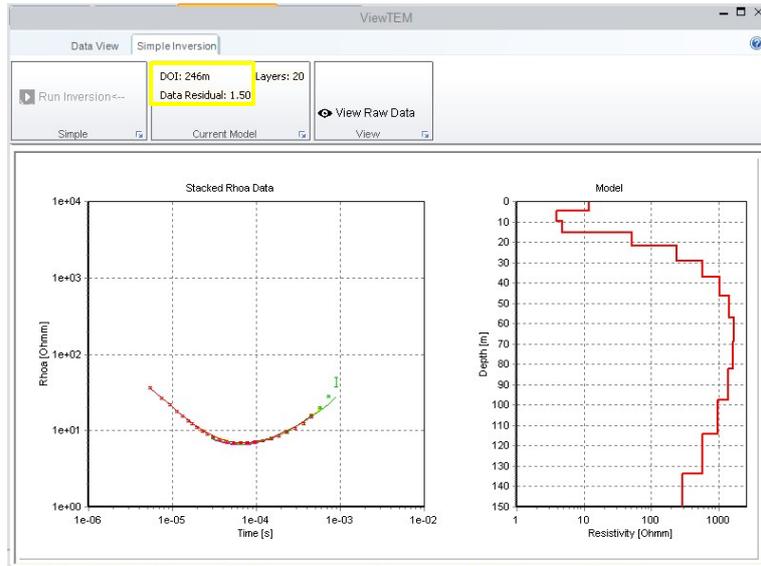


Figure 50. Finished layer model

- By pressing the Esc-button on the keyboard, ViewTEM is closed and the WalkTEM user interface is shown again.

4.4 Using the ABEM WalkTEM with the ABEM TX-60 external transmitter

The ABEM WalkTEM can be used in combination with the ABEM TX-60 external transmitter. The ABEM TX-60 permits higher input voltages than the ABEM WalkTEM and is therefore capable of driving larger transmitter loops with more power.

A detailed description of the ABEM TX-60 and its accessories can be found in the ABEM TX-60 User's Guide (33 8100 97).

Using the ABEM WalkTEM in combination with the ABEM TX-60 is easy. By connecting the ABEM TX-60 to the designated input on the ABEM WalkTEM, using the supplied synchronization cable, the internal communication of the ABEM WalkTEM will automatically switch from its internal transmitter to the ABEM TX-60 instead. The ABEM WalkTEM will still be in control and measuring with the built-in receiver.

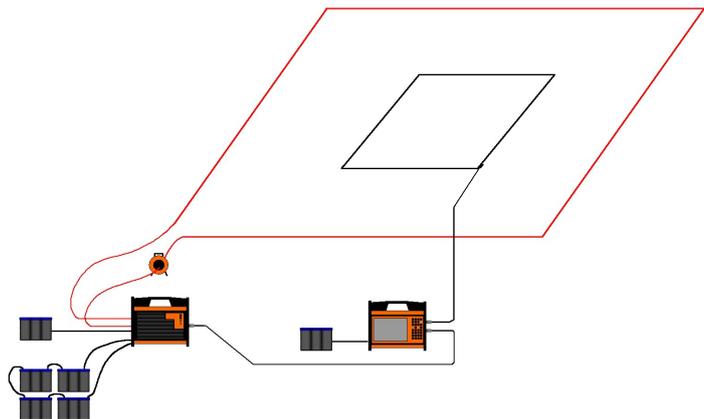


Figure 51. ABEM WalkTEM in combination with ABEM TX-60. The receiver antenna is still connected to the ABEM WalkTEM while the ABEM TX-60 powers the transmitter loop

Since the ABEM TX-60 is intended to be used to reach larger measuring depths, it only operates with High Moment transmissions. Thus, only High Moment measuring scripts should be used.

5 Files

5.1 Scripts

An ABEM WalkTEM measurement is controlled from a pre-defined Script, which contains information of high and low moment as well as noise measurements.

The scripts are placed in the folder C:\Program Files\ABEM\WalkTEMUI\Script and each script consists of two files; .ini and .idx. Both files must have the same name since this is what tells the system that they belong together. The ini-file defines the transmission pulse shape and the idx-file defines the measuring gates.

The end of the script file name always ends with the number 50 or 60. This number corresponds to the power line frequency setting in the script and is not shown in the script name in the drop down menu in the user interface.

5.1.1 Transmitted pulse shape (ini-file)

The current pulse transmitted into the loop is defined of several parameters in the ini-file. These are explained in the next section (5.1.2).

The transmitted pulse is normally defined with a consecutive positive and negative part.

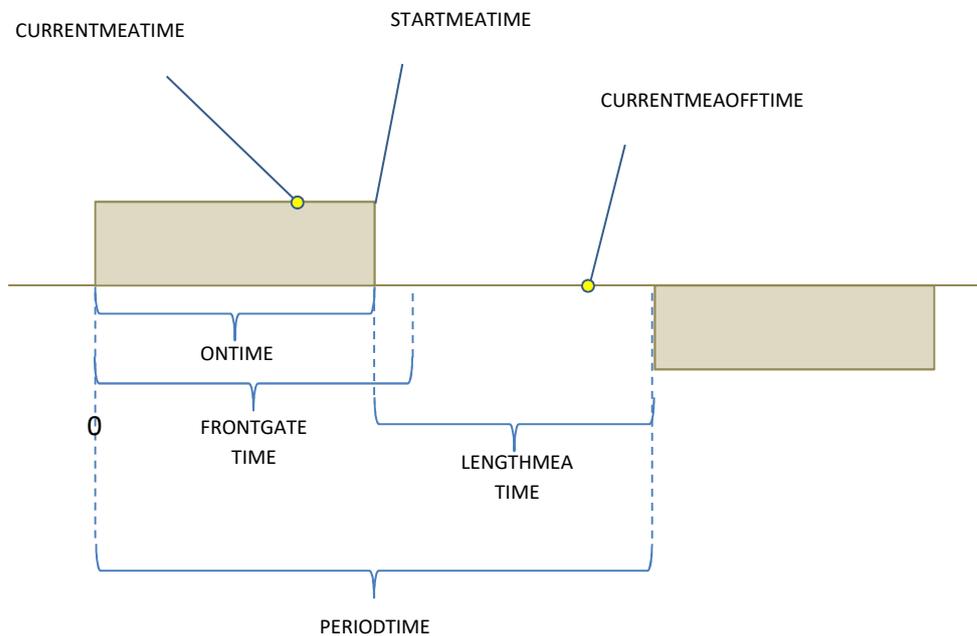


Figure 52. Shape of a typical transmission pulse

5.1.2 Explanation of script ini-file parameters

Parameter in script file (.ini)	Explanation
MOMENTIDS	Defines the different moments in the script. Normally, three moments are defined; Low, High and Noise.
TXCOILID	Defines if the moment is High, Low or Noise moment. High moment = 160 Low moment = 128 Noise moment = 0
TXLOOPAREA	001.0
GAINID	2
BANDFILTID	1
NDATASERIES	Number of stacks (repetitions of the pulse).
NPATTERNREP	Number of repetitions of the transmitted pattern (pulse shape). Since the pulse normally consists of a positive and a negative part, the number of repetitions are equal to the number of stacks (above) divided with the number of pulses in the Signal pattern (below) = NDATASERIES / (+1 -1 equals 2). <i>Example: If the NDATASERIES is 800, the NPATTERNREP is 400 if the SIGNPATTERN is +1 -1.</i>
SIGNPATTERN	Defines the symmetry of the pulse. +1 -1 means positive and negative sequentially.
TXON	1
PERIODTIME	The total length of a cycle. PERIODTIME should be multiples of the power line frequency period time (20 ms for 50 Hz, 16.666 ms for 60 Hz). One positive and one negative cycle equal 2xPERIODTIME. Microseconds from 0 point.
ONTIME	Defines the length of the current pulse. Microseconds from 0 point.
CURRENTMEATIME	Defines when the transmission current is measured. Microseconds from 0 point.
CURRENTMEAOFFTIME	Defines when the transmission current off is measured. Microseconds from 0 point.
STARTMEATIME	Defines when measuring starts. Microseconds from 0 point.
LENGTHMEATIME	The total time (sum) of all measuring gates. Must not be larger than PERIODTIME – ONTIME. Microseconds from start of measuring point.
FRONTGATETIME	Defines how long the received signal is blocked. Microseconds from 0 point.
STOONTIME	Not used
NIndex	Equals the number of gates. Sum of these gates is set in LENGTHMEATIME. Time for each gate is defined in the corresponding .idx file.

Figure 53. Table of script ini-file parameters


```

///Parameters for Ch_0
///Only Parameters for Ch_0 are used for GateSampleFactors!

CountADC_ch0=0.000038143    /// [Volt pr. count]
CoilAmpGain_ch0=35          /// := x7 x 5m2 (x105), :=1 D2S
D2SGain_ch0=1.0
PreAmpGain_1_ch0=1
PreAmpGain_2_ch0=2
PreAmpGain_4_ch0=4
PreAmpGain_8_ch0=8
PostAmpGain_1_ch0=1
PostAmpGain_2_ch0=2
PostAmpGain_4_ch0=4
PostAmpGain_8_ch0=8

///Parameters for Ch_1.

CountADC_ch1=0.000038143    /// [Volt pr. count]
CoilAmpGain_ch1=1400        /// := x7 x 200 m2(x4200), :=1 D2S
D2SGain_ch1=1.0
PreAmpGain_1_ch1=1
PreAmpGain_2_ch1=2
PreAmpGain_4_ch1=4
PreAmpGain_8_ch1=8
PostAmpGain_1_ch1=1
PostAmpGain_2_ch1=2
PostAmpGain_4_ch1=4
PostAmpGain_8_ch1=8

PreAmpGain_SEL_ch0=1.000000
PreAmpGain_SEL_ch1=1.000000
PostAmpGain_SEL_ch0=1.000000
PostAmpGain_SEL_ch1=1.000000

RstOnTime=0.025             /// [us] - Default:= 25ns
DelayRstOnTime=0.1800
TIB_ID=0
PreAmpGain_SEL_ch2=0.000000
PostAmpGain_SEL_ch2=0.000000
PreAmpGain_SEL_ch3=0.000000
PostAmpGain_SEL_ch3=0.000000

```

Figure 55. Parameters in a typical script idx-file. The parameter called IntA, marked above, contains the length of each time gate window in microseconds. The sum of all time gates is the parameter LENGHTMEATIME in the ini-file. The total number of time gates is the parameter NIndex in the ini-file.

			(480), High (125), Low (480)				
HighMoment_25ms_45gates	60 Hz	Measuring script for deep data collecting. Since it doesn't contain any Low moment pulses it's suitable when using the TX-60 external transmitter	Noise (125), High (125)	25 %	2 μs	4765 μs	24538 μs
HighMoment_Noise_10_90ms_51gates	50 and 60 Hz	Measuring script for very deep data collecting, divided into 51 gates	Noise (125), High (125), High (125), High (125), High (125)	10 %	2 μs	17416 μs	89658 μs

Figure 56. List of standard scripts

Note that the scripts supplied with the WalkTEM can be changed without prior notice.

5.2 Data files

The collected data files are sorted in projects and stored in the folder D:\WalkTEM\Data. The projects and stations can be obtained by simply copying to an external media. **It is however recommended always to extract data using the Export command in the Post-Processing page in order to include the database files needed for ViewTEM processing.**

6 Additional field setups and procedures

The ABEM WalkTEM system can be accessorized and setup in many different combinations. Here are some examples of the most common setups and also additional practical tips.

6.1 Field setups

6.1.1 40x40 meter transmitter loop and single antenna

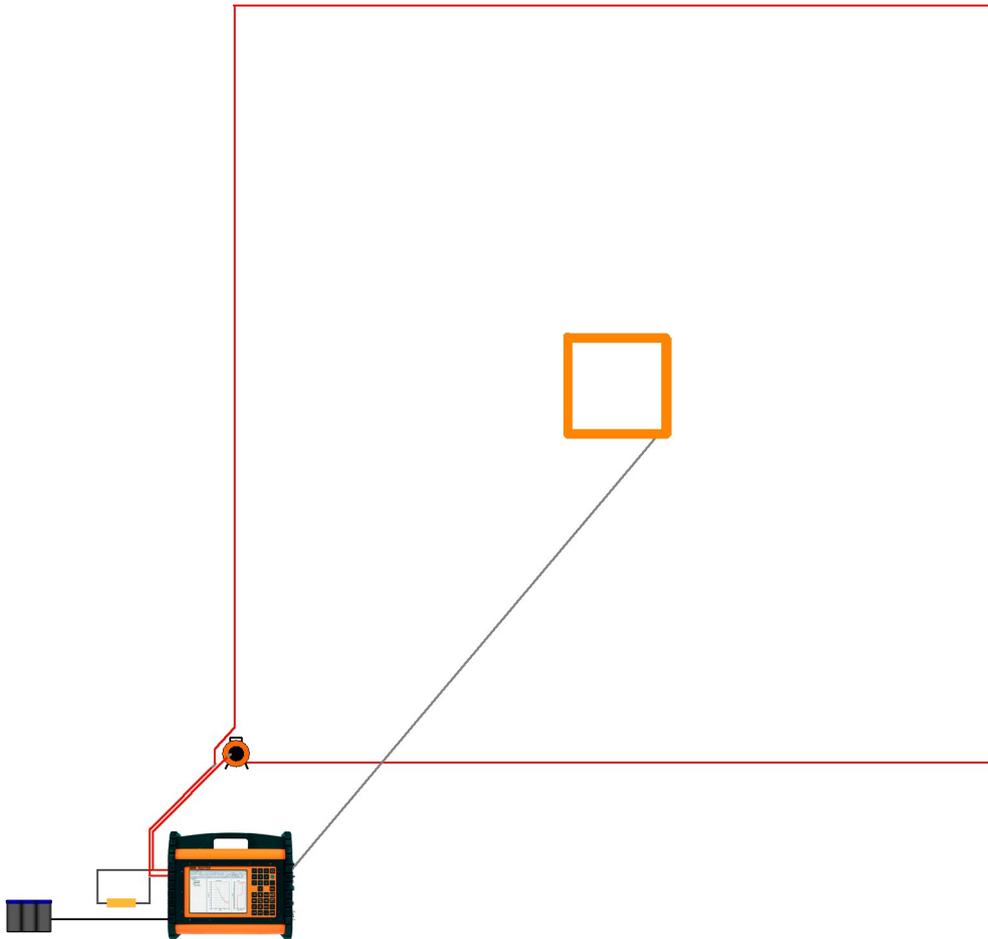


Figure 57. Field setup consisting of a 40x40 meter transmitter loop and a single receiver antennas. A 200 ohm damping resistor is normally used.

Either type of receiver antenna may be used (RC-5 or RC-200) depending on the depth of interest.

If the near surface ground is less conductive, a 330 ohm resistor can be used instead.

6.1.2 40x40 meter transmitter loop and dual antennas

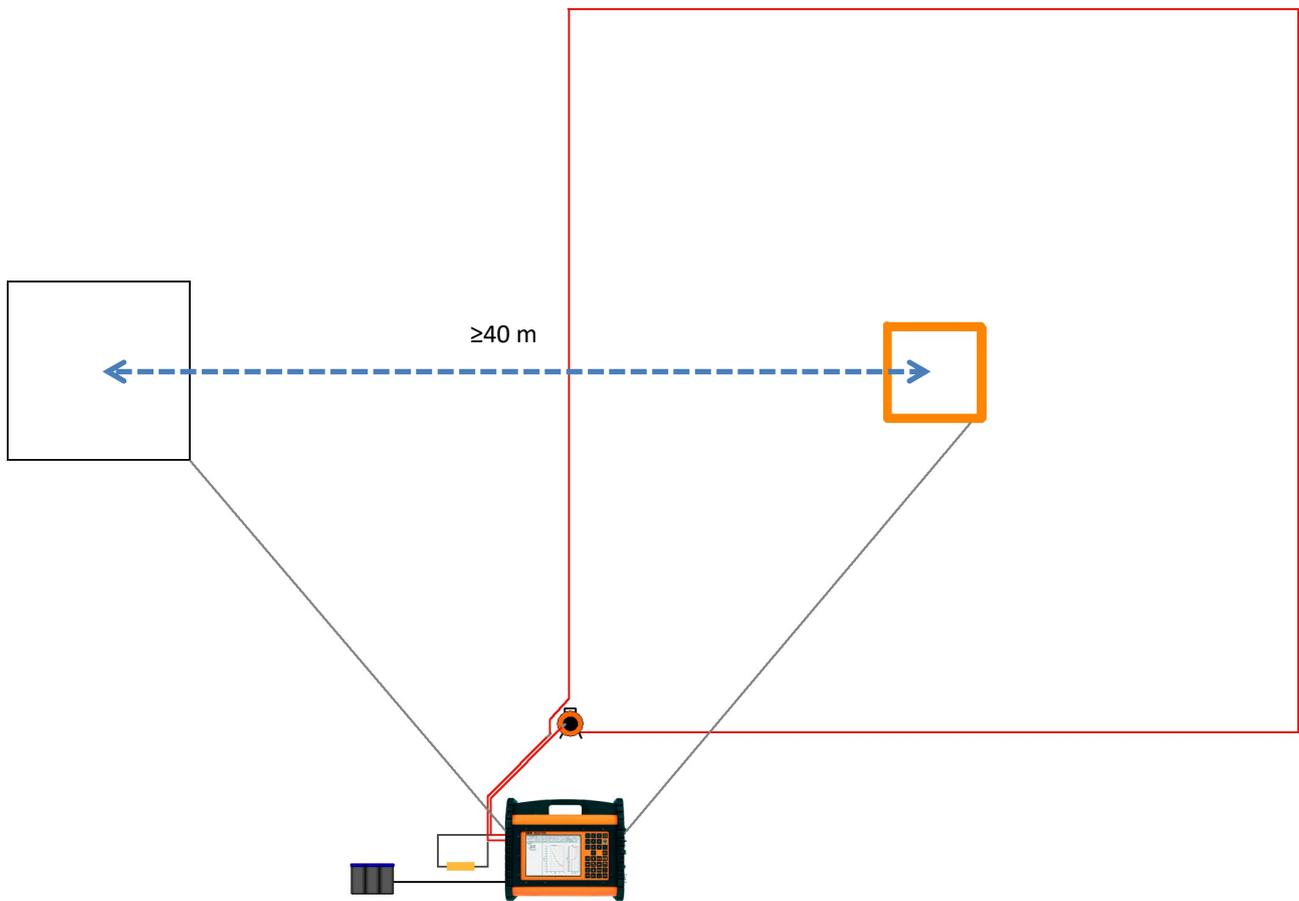


Figure 58. Field setup consisting of a 40x40 meter transmitter loop and dual receiver antennas. The RC-200 receiver antenna is placed offset to the transmitter loop, thus avoiding influencing the RC-5. Shallow data is obtained by the RC-5 and deep data by the RC-200. A 200 ohm damping resistor is normally used.

If the near surface ground is less conductive, a 330 ohm resistor can be used instead.

6.1.3 100x100 meter transmitter loop and single antenna

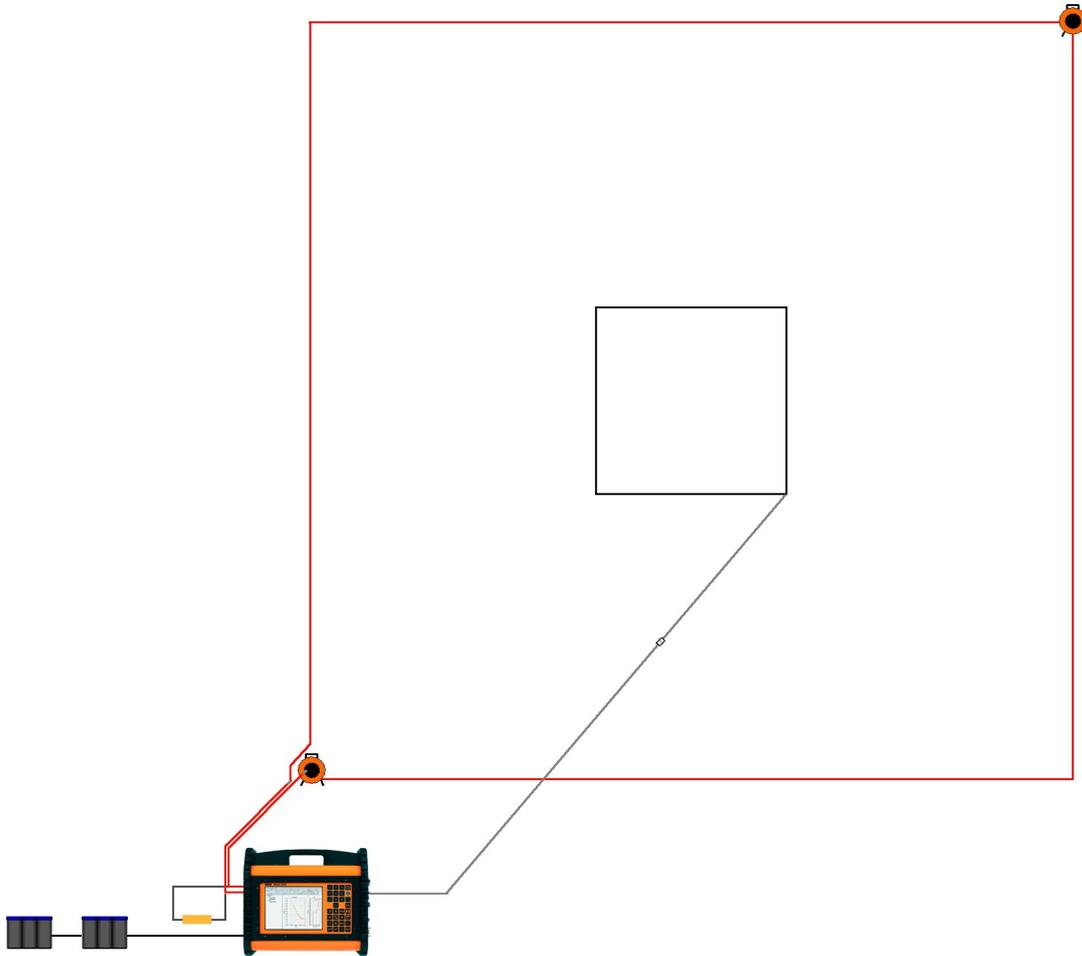


Figure 59. Field setup consisting of a 100x100 meter transmitter loop and a single receiver antenna. The receiver antenna is connected to the ABEM WalkTEM with one 62 m extension cable. The ABEM WalkTEM is powered with two external batteries in serial, supplying 24 VDC, in order to compensate for the higher resistance in the longer cable. A 330 ohm damping resistor is normally used.

In this example an RC-200 receiver antenna is used, but an RC-5 may be used as well depending on the depth of interest.

6.1.4 100x100 meter transmitter loop and dual antennas

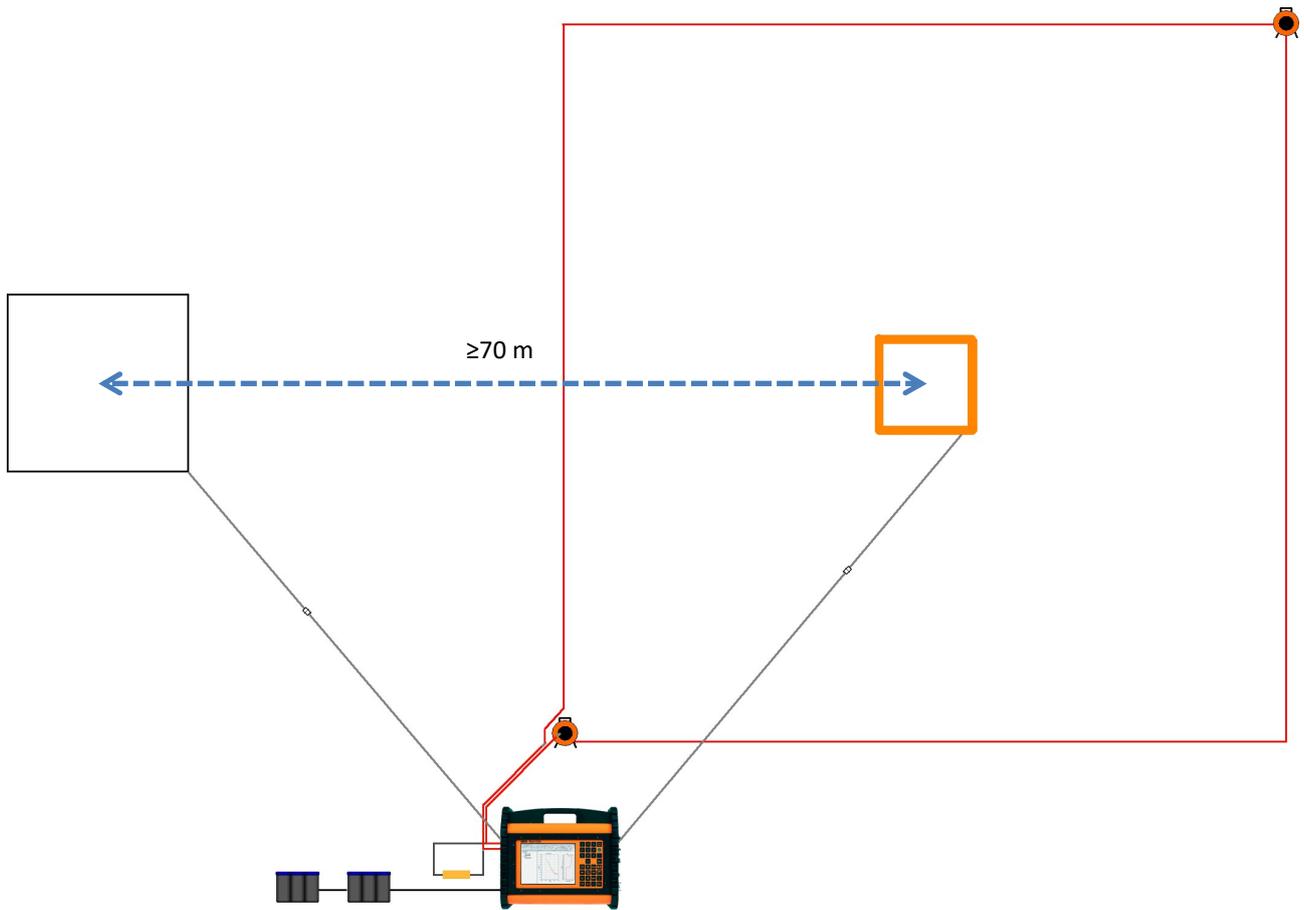


Figure 60. Field setup consisting of a 100x100 meter transmitter loop and dual receiver antennas. The RC-200 receiver antenna is placed offset to the transmitter loop, thus avoiding influencing the RC-5. Shallow data is obtained by the RC-5 and deep data by the RC-200. A 62 m extension cable is needed for each receiver antenna. The ABEM WalkTEM is powered with two external batteries in serial, supplying 24 VDC, in order to compensate for the higher resistance in the longer cable. A 330 ohm damping resistor is normally used.

6.1.5 200x200 meter transmitter loop and single antenna

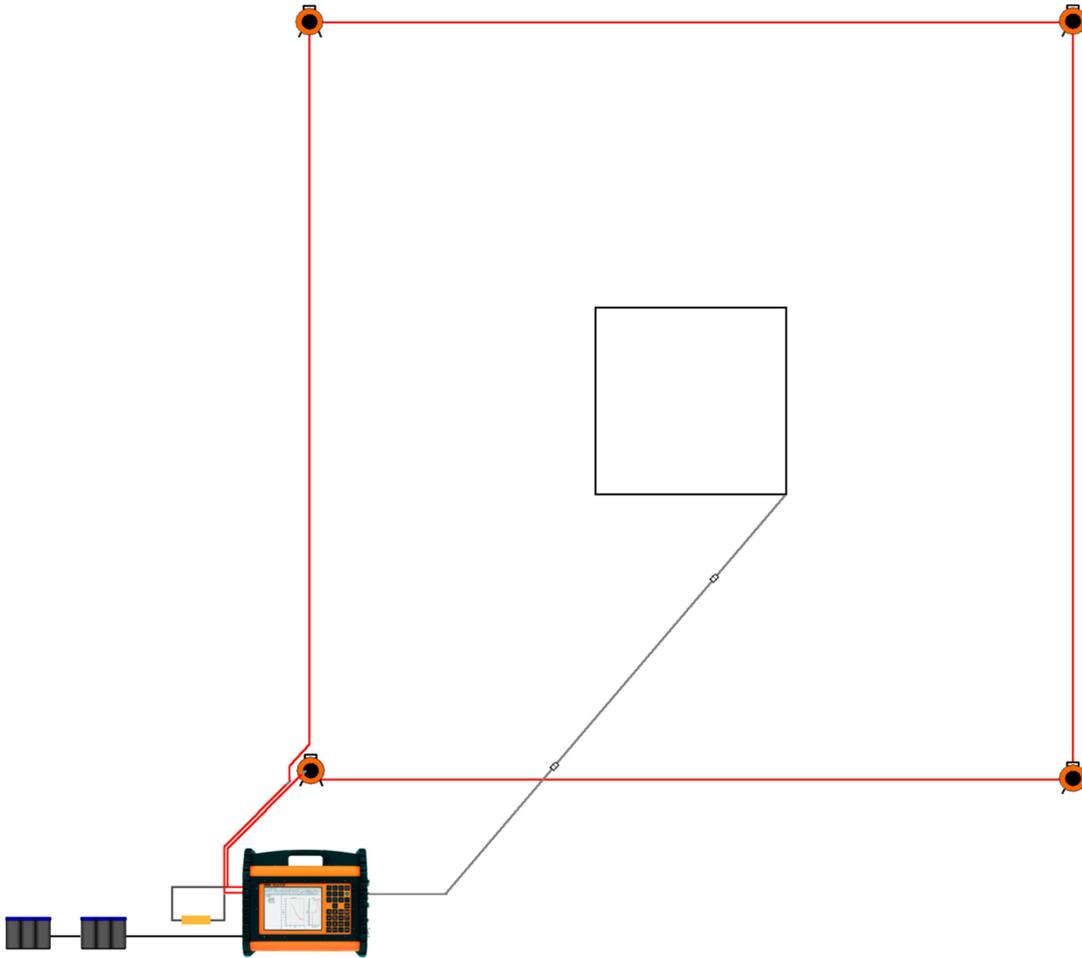


Figure 61. Field setup consisting of a 200x200 meter transmitter loop and one receiver antenna (RC-200). There is no use for the RC-5 receiver antenna since shallow response cannot be obtained when using the 200x200 meter transmitter loop. The RC-200 receiver antenna is connected to the WalkTEM with two 62 m extension cables connected in serial. The ABEM WalkTEM is powered with two external batteries in serial, supplying 24 VDC, in order to compensate for the higher resistance in the longer cable. A 470 ohm damping resistor is normally used.

6.2 Working in low visibility terrain

Laying out the transmitter loop as well as RC-200 receiver loop can be tricky in rough terrain or in areas with reduced visibility. In those conditions an alternative procedure would be to start by placing the small RC-5 receiver antenna on the desired point of the measurement, functioning as the zero point, and then measure and mark each corner of the RC-200 receiver loop as well as the corners of the transmitter loop.

Each corner can be marked with a stick or similar. When all corners are marked, the transmitter loop and RC-200 receiver loop can be rolled out. With a crew of two people, one person can mark the next corner while the other is rolling out the cable.

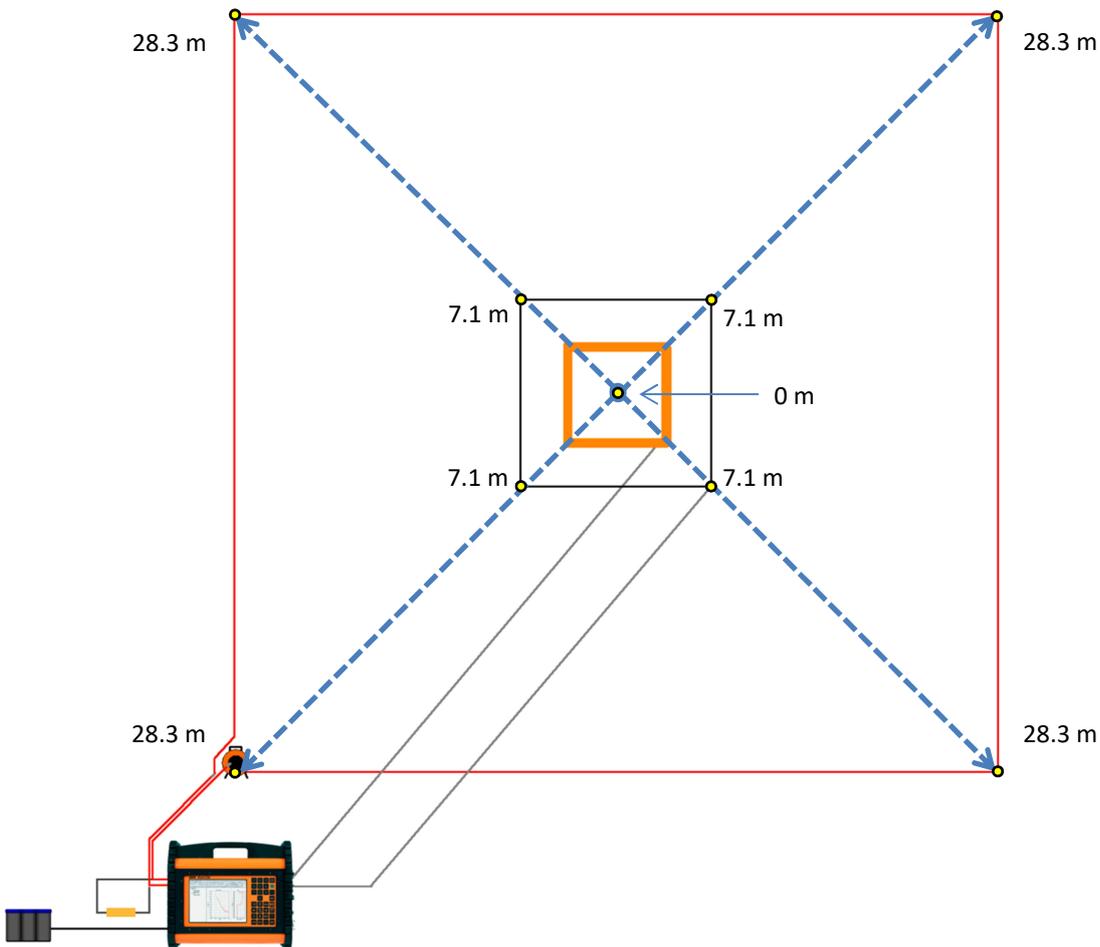


Figure 62. Coordinates for transmitter loop and RC-200 receiver antenna loop corners for a 40 x 40 meter TX loop setup.

6.3 Working in hot conditions

It is always advised to avoid placing the ABEM WalkTEM in direct sunlight and to make sure that the air can circulate freely around the instrument case.

In cases where a suitable field condition cannot be achieved, it is possible to improve instrument cooling by simple actions. By directing an external cooling fan towards the transmitter heat sink, cooling efficiency can be improved. Also, by choosing a measuring script with 25 % duty cycle or less will decrease the heat load to the heat sink.



Figure 63. ABEM WalkTEM convection cooling area on the left side of the instrument.

6.4 Choosing the right damping for the 40 x 40 meter transmission loop

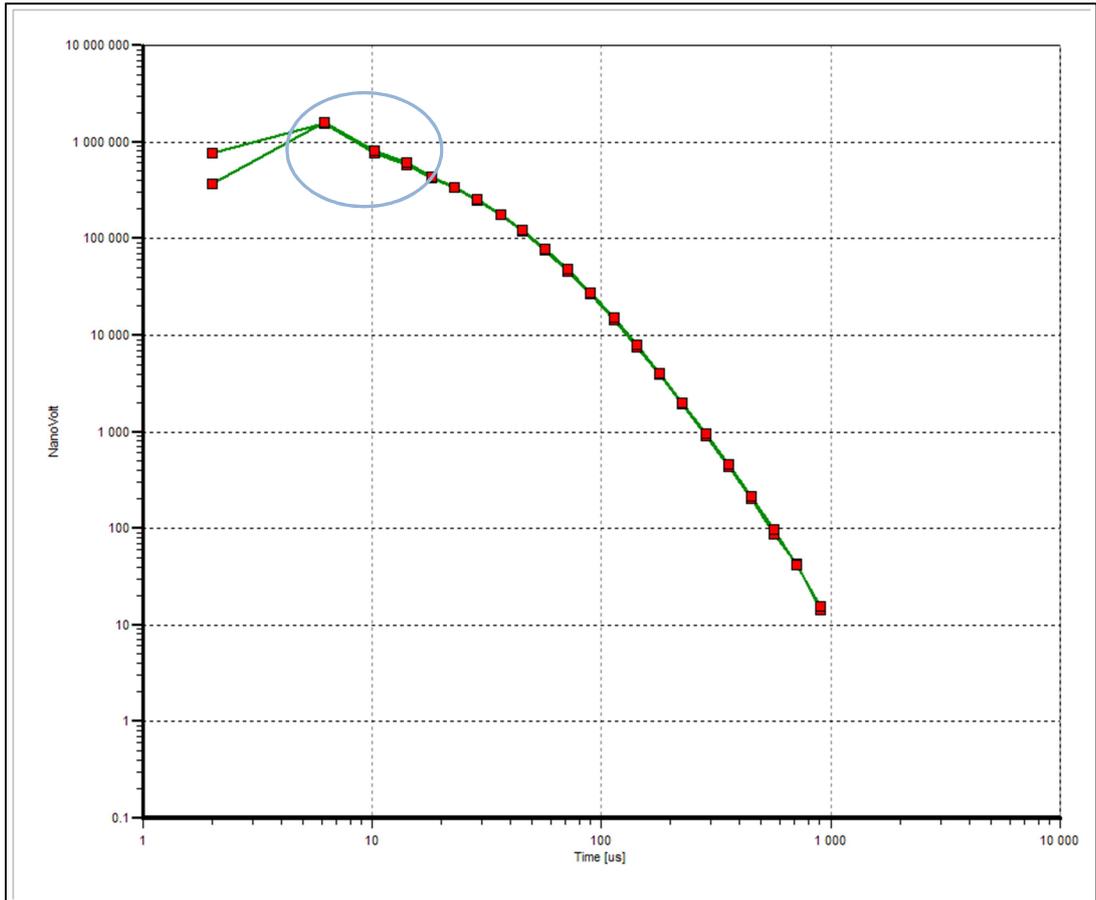
Every transmitter loop comes with a suitable damping resistor, as explained in section 2.1.

The TL-1k6 40 x 40 meter transmitter loop comes with two damping resistor; 200 and 330 ohm. Normally the 200 ohm damping resistor is used, but on some occasions it is recommended to run additional measurements using the 330 ohm resistor if the ground is less conductive near the surface. Vice versa, high conductivity near the surface could cause the signal decay to show minor ringing tendencies, which could be remedied with a higher damping (lower resistor value).

This section will give an example of these conditions and show the difference between the two supplied damping resistors.

First, an example of a measurement using the 330 ohm damping resistor together with the 40 x40 meter transmitter loop:

Figure 50.
Signal decay
when using
330 ohm
damping.



The signal decay shown in the instrument display during measurement has a small dip around 10 us, which necessarily doesn't indicate an anomaly, but is a clue to what is a correct damping in this example.

After a ViewTEM data modelling, shown on the right, it is evident that the ground is very conductive near the surface.

In this situation, it is recommended to perform a second measurement using the 200 ohm damping resistor.

Figure 64. ViewTEM smooth model clearly indicating that the ground is conductive near the surface.

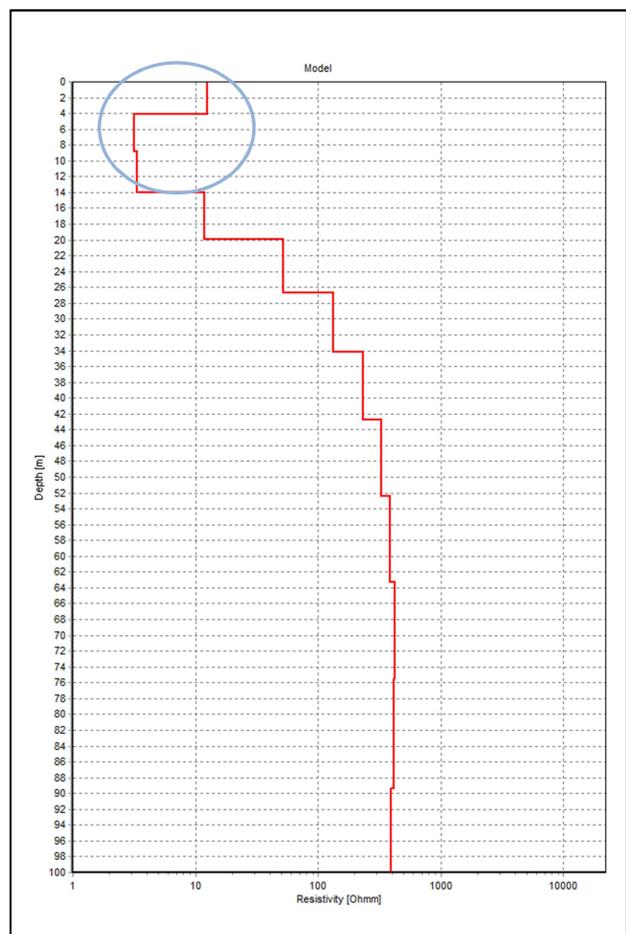
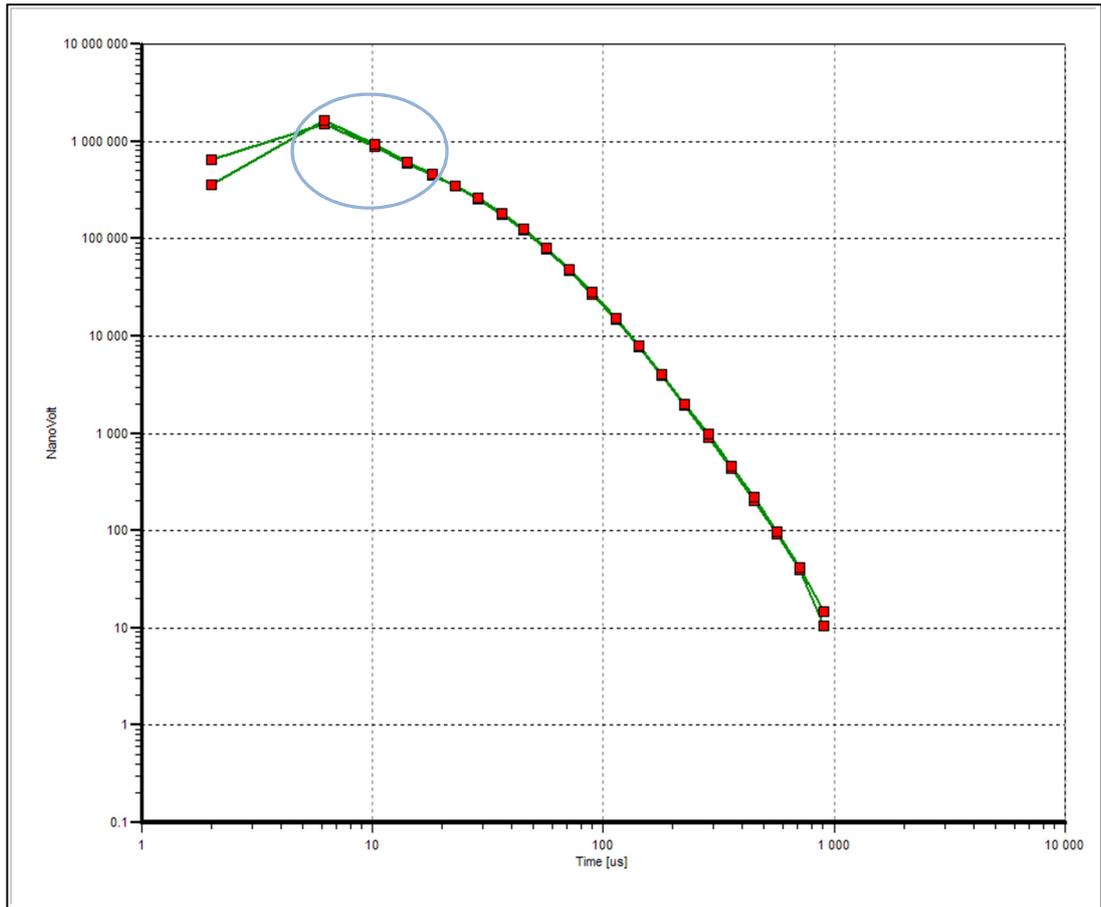


Figure 52.
Signal decay
when using
200 ohm
damping.



When using the 200 ohm damping resistor on the otherwise unchanged setup, the small dip around 10 us in the signal decay is less evident.

The ViewTEM smooth model also indicates a somewhat different result, with a higher resistivity below 16 meters depth, which in this case better fit the expectations of the measuring site.

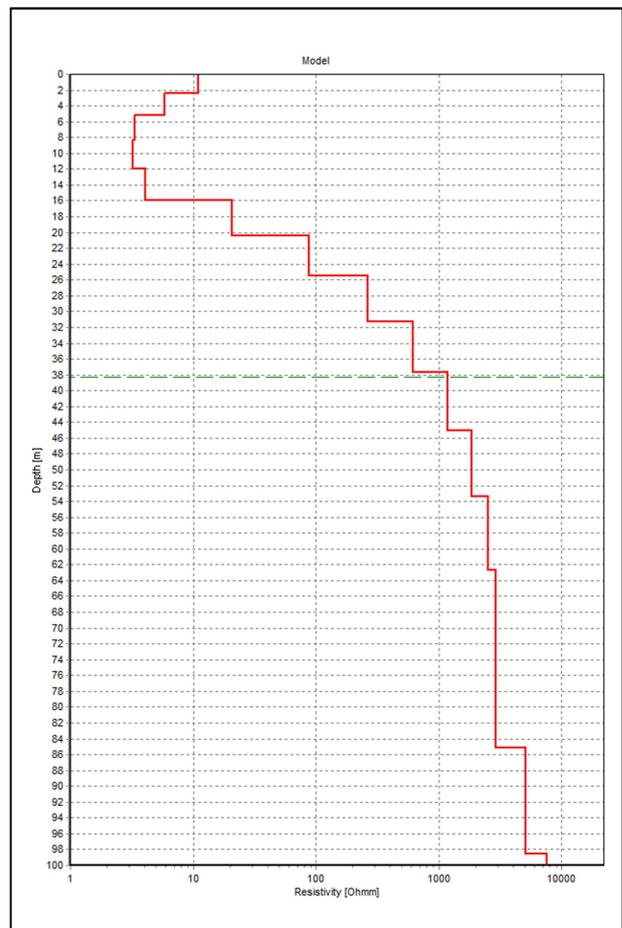


Figure 65. ViewTEM smooth model with damping adjusted for the conductive conditions.

7 Technical specification

General

Casing	Rugged Aluminum case meets IEC IP66
GPS receiver	50 channels SirFstarIII chip
Display	8,4" Active TFT LCD, full color, daylight visible, resolution of 800x600
I / O ports	2 x KPT-19 for receiver coils
Power	2x12 V, Ah internal NiMH power pack 10-34 VDC external power
Battery chargers	Integrated for internal batteries
Dimensions (W x L x H)	390x210x320 mm
Weight	14 kg
Ambient Temperature Range	-20°C to +60°C operating ¹ -30°C to +70°C storage ²

Note 1: Measuring speed may be reduced in high ambient temperatures and internal power dissipation.

Note 2: Non condensing

Integrated Field PC

Processor	Low power Intel Atom, 1,6 GHz
Operating System	Windows XP Pro
Internal RAM	2 GB (DDR SO-DIMM module)
Hard disk capacity	Solid state disk of 100 GB or greater
I / O port	2 x USB 2.0 ports
Network interfaces	1 x IEEE 802.3 TP-10/100/1000 RJ-45 IP 67
WiFi interface	Integrated with built-in antenna

Transmitter

Output current	15 A
On/Off Time	Adjustable from 1 ms to 500 ms in microsecond steps

Receiver

Receiver input	2 Channels
Sampling	1 MHz each channel
Dynamic range	170 dB system 140 dB instantaneously
Repetition rate	From 500 Hz to 0.5 Hz in microsecond steps
Stacking Options	1 to 65,536 in single steps
Windows (Gates)	Up to 200 depending on time series selected in 3 sets (optional, user selectable)
Functions Measured	Transient response, current battery voltage (external and internal), automatic gain/offset calibration, layer model (full data inversion)

Figure 66. ABEM WalkTEM technical specification. All specifications may change without notice as a result of ongoing product developments.

8 Trouble shooting

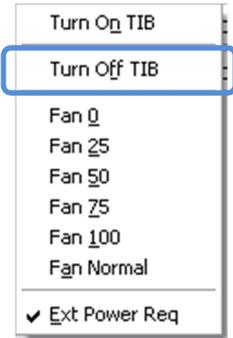
Symptom	Problem description	Remedy
Internal battery has low capacity although office power supply has been connected	The internal battery charger circuitry requires the instrument to be powered on in order to control the charge process	Connect the office power supply and power on the ABEM WalkTEM in order to charge the internal batteries
Internal battery is totally discharged and won't charge	If an internal battery is totally drained, the normal charging process won't start properly	<p>Power off the ABEM WalkTEM by holding the power button for three seconds. This will reboot the charging circuitry and when the ABEM WalkTEM is restarted, a small charging current will be used in order to slowly raise the voltage of the internal batteries.</p> <p>The battery symbol should indicate charging:</p>  <p>If the battery symbol still doesn't indicate charging, repeat the reboot process by holding the power button for three seconds.</p> <p>Once the battery has reached critical voltage, the charging current will increase to normal level.</p> <p>If the RX battery is drained: In order for the RX battery to charge after being fully drained, the RX circuitry also needs to be switched off after the above described reboot procedure is made.</p> <p>This is done from a pop up menu in the user interface, that is made visible by the pressing ALT+Shift+5 on the built-in keyboard.</p> <p>In the menu, click "Turn Off TIB" to switch off the RX circuitry.</p>  <p>The TIB (RX circuitry) will automatically be switched on again after ABEM WalkTEM user interface has been restarted. The TIB can of course also be switched using the pop up menu.</p>

Figure 55. Table of problems and remedies