TEMcompany

sTEM
Product Description

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TEMcompany
Value groundwater assets

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1. INTRODUCTION

The sTEM system maps subsurface geological layers, making it ideal for locating new groundwater wells, estimating the extent of the aquifer layers and the groundwater recharge conditions. It can also be used to locate fractures and the thickness of a weathered overburden. A third application is mapping surface layers to identify the best sites for artificial infiltration of excess surface water into subsurface aquifers.

The system is designed to be easy to use and requires very little training for the field crew. sTEM is operated from an iOS or Android App, and data is processed on a Windows PC.

A sTEM measurement is achieved by rolling out a 40m x 40m long wire in a square, measuring for a few minutes, roll in the wire, and moving it to the next station. A typical day's production is 15 – 20 stations per day for a field crew of 2 persons. The distance between the stations is typically 250 m, covering more than 1 km^2 per day or about 100 hectares. The depth of investigation is dependent on the overall resistivity of the geological layers, but it can be as much as 300 m.

The system transmits a 5, 10, or 20 Amp current. Small, lightweight batteries deliver the power; only the 20 Amp batteries need to be changed during a full day of operation. The size of the transmitter loop also varies, starting with a very lightweight 20 m x 20 m loop, the standard 40 m x 40 m loop, and the heavier 80 m x 80 m loop. With the last-mentioned large loop investigations, a depth of up to 500 m can be seen.

Data is processed using dedicated software and presented along cross-sections or on maps. Combining the information from the sTEM measurements with topography data, typical resistivities of the aquifer layers, etc., an accurate hydrological image can be created, and well sites can be pinpointed.

The sTEM system is designed to be lightweight and portable. The instrument, transmitter, and receiver spool weigh only around 20 kg. It can easily be transported in a shipping box, making checking it in as luggage on airplanes or putting it on the back of a truck hassle-free. Figure 1 shows a picture of the system.

At TEMcompany, we are committed to providing comprehensive support to our customers. We engage in close dialogue to assist with survey planning, help with data quality control, and even aid in interpreting results. Our team of experts is always available to offer guidance and expertise, ensuring that the sTEM geoscanner provides maximum value.

The price tag for sTEM starts at just over 20,000 EUR for the 5 Amp version. The instrument can easily be upgraded from 5 Amp to 10 Amp with a firmware upgrade. To upgrade to 20 Amp, the instrument must be returned to the workshop for modification. Please ask us about the exact costs for any combination of software, power and transmitter coils.

Figure 1 The sTEM system in operation. The system is operated from an Android or IOS app.

2. STEM INSTRUMENTS

Several factors determine the depth of investigation, including the area of the transmitter loop, the area of the receiver loop, the stacking time, and the transmitter current.

The sTEM transmitter delivers three different maximum currents, as shown in Table 1. The instrument can be upgraded from 5 Amp to 10 Amp with a firmware upgrade.

Property	sTEM5 (sTEM)	sTEM10 (sTEM+)	sTEM20 (sTEM++)
Maximum current	5 Amp	10 Amp	20 Amp
Operation mode: Dual Moment LM /HM	1 Amp/ 5 Amp	1 Amp/ 10 Amp	1 Amp/ 20 Amp
First gate start time (LM/HM)	10 us / 25 us	10 us / 25 us	10 us / 35 us
Last center gate time (LM/HM)	0.93 ms / 12.5 ms	0.93 ms / 12.5 ms	0.93 ms / 12.5 ms
Batteries 14.4 V, Li-Ion	2	2	3
Continues operation time	~4 hr	~2 hr	~2 hr (2 extra batteries)
Number of stations with 5 min measurement time	~40	~20	~20
Weight, incl. batteries	6.1 kg	6.1 kg	6.6 kg

Table 1. The table shows the specs for the three different sTEM instruments. The sTEM20 is delivered with two extra batteries. The maximum current is transmitted in a loop with a maximum impedance of approximately 0.7 ohm. The First gate start time and Last center gate time can change as it is dependent on power line frequency and external VLF noise sources.

3. CENTRAL LOOP TRANSMITTER AND RECEIVER COILS

The sTEM is configured with different coil configurations, allowing the survey to be optimized according to field conditions and the target depth of investigation. The standard unit offers three transmitter coils: 80 m x 80 m, 40 m x 40 m, and 20 m x 20 m. The standard coil is 40 x 40 m, and each coil is designed to transmit maximum current with one of the sTEM systems. The receiver is placed in the center of the transmitter, as shown in Figure 2. The system is shown in Figure 3.

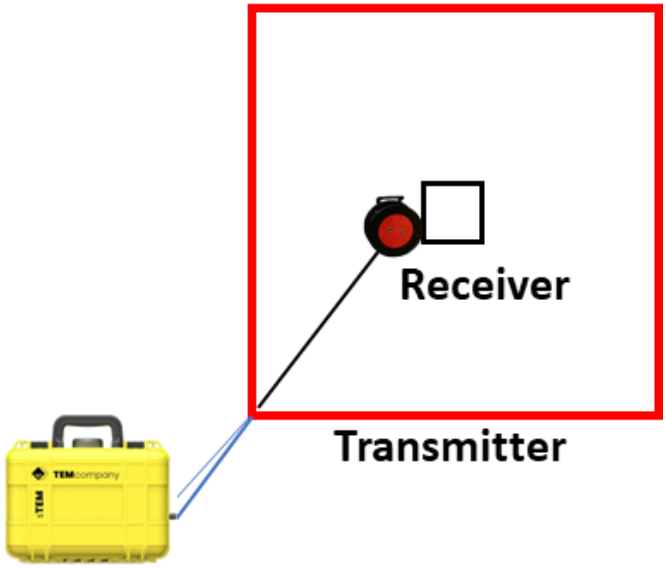

Figure 2 Central loop configuration used for 80 m x 80 m, 40 m x 40 m, and 20 m x 20 m coil configurations. The 4-turn, 3 x 3 m receiver is in the center of the transmitter and is connected to the sTEM instrument with a lead-in cable.

Figure 3 the picture shows the sTEM unit and the transmitter and receiver drums.

Property	20 m x 20 m	40 m x 40 m	80 m x 80 m
Transmitter area	400 m^2	1,600 m^2	6,400 m^2
Transmitter moment	8,000 Amp m^2 (10 Amp)	16,000 Amp m^2 (10 Amp)	128,000 Amp m^2 (20 Amp)
Transmitter total wire length	80 m	160 m	320 m
Transmitter number of drums	1	1	4
Transmitter weight incl. drum	5.2 kg	8.7 kg	7.0 kg / drum
Receiver area	36 m^2	36 m^2	100 m^2
Receiver size (4 turns)	3 m x 3 m	3 m x 3 m	5 m x 5 m
Receiver lead in	15 m	26 m	55 m
Receiver and lead-in number of drums	1	1	2
Weight receiver coil, lead-in and drum	5.3 kg	5.3 kg	8.3 kg
Used with	sTEM5 sTEM10	sTEM10 sTEM20	sTEM10 sTEM20
Depth of investigation	150 - 200 m	250 - 300 m	400 - 500 m

Figure 4 Table 2: The table describes the different transmitter and receiver coil configurations.

Table 2 describes the properties of the transmitter and receiver coils, weight, number of drums, etc. The area of the receiver is the same for all transmitters and is selected so the band pass properties of the coil are sufficient while maintaining the best possible suppression of noise. Other coil sizes can be made upon request.

4. EXTENDED SUPPORT AND INSTRUMENT UPDATES

4.1 Extended support

Access to extended support is possible. With extended support, the team offers almost unlimited support for survey design, data quality assessment, data processing, and other functions.

The extended support is based on a subscription that is renewed annually. Many customers sign up for extended support for the first year and then master the measurements and the system themselves.

4.2 sTEM extended functionality and realtime inversion

The sTEM instrument is designed for future upgrades and can be customized in various ways. It always has a software package that allows basic measurements and data to be exported to a Windows PC for processing.

Extended functionality is offered on a yearly subscription basis. With the subscription, several excellent features are unlocked.

These are:

- Data is inverted in real-time, and resistivity models of the subsurface are displayed every 10 – 20 sec. while measuring. This feature makes it easy to ensure the desired depth of investigation is reached. If the measurement is not deep enough, the time can be increased, so target depth is always obtained. In addition, the data processing is most often done in real-time, and models are ready to be displayed in cross-section or on maps when the day is over.
- The accumulated station stack size is displayed, not only the individual 1 – 3 sec stacks. The accumulated stack shows the data and the data uncertainties after real-time processing.
- The individual transients are gated using non-square gates, also known as tapered gates. Using tapered gates increases the signal-to-noise ratio by up to a factor of 2. In perspective, this is the same as running, for example, the sTEM20 and 40 Amp instead of 20 Amp.
- Several features in the app, Figure 5, are unlocked. These include notes, pictures of the site, and the re-location of the GPS's position from the corner of the transmitter loop to the center.

Figure 5 The picture shows the control app. The display to the left shows the measured decay curves, the display on the right show temperature, current and measurement time.

5. SPIA - PROCESSING SOFTWARE

The data collected by the sTEM instrument is voltage decay curves, which can be processed and inverted to resistivity models. The sTEM instrument outputs a generic data format, which can be imported into the Aarhus SPIA program by AGS/Seequent.

In Aarhus SPIA, the collected data can be viewed, processed, and inverted. Poor-quality data can be turned off, error bars edited, and prior information added to the starting model. The robust and fast AarhusInv inversion code is used for the inversion.

The software allows advanced options and automatic few layer, smooth layer, and sharp layer inversion types.

SPIA is offered on a yearly subscription basis.

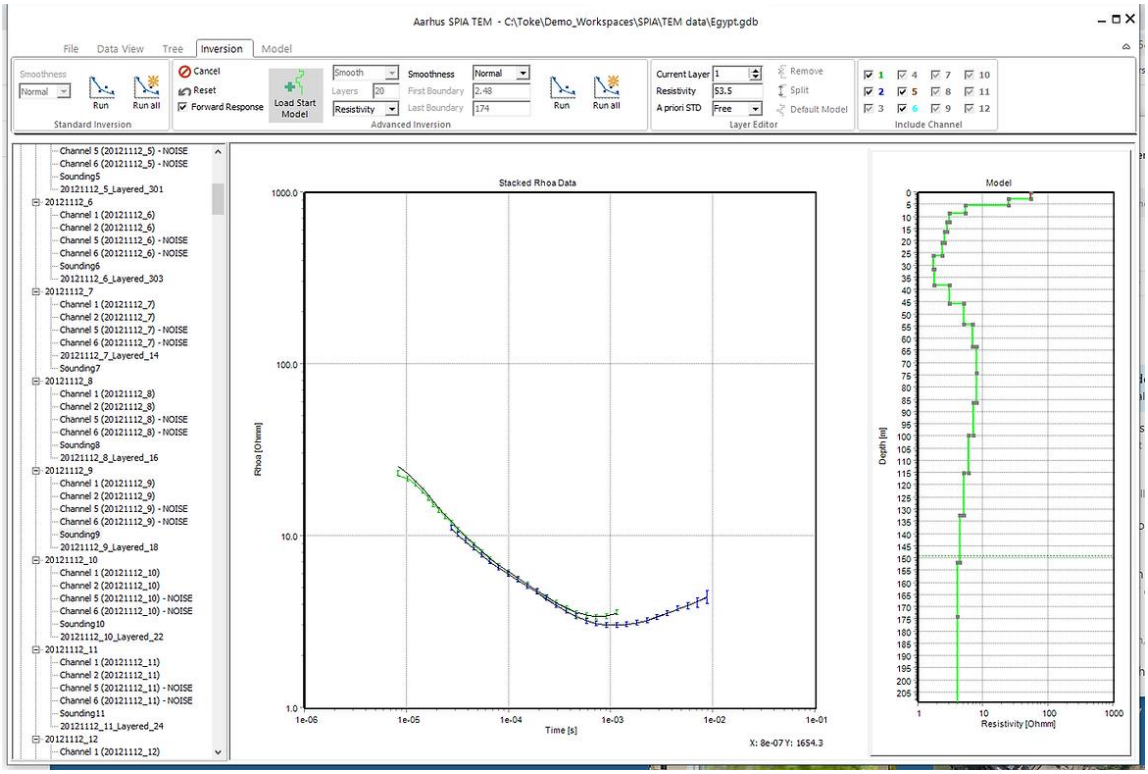

Figure 4. Aarhus SPIA processing screen.