USER GUIDE

for the **SMARTem24** and **DigiAtlantis** Systems

DATE: 5 December 2012

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1 Introduction

This User Guide provides details on operation of the SMARTem24 System and the borehole DigiAtlantis System. It is written with the presumption that the operator or user has existing knowledge of electrical geophysical surveying. This Guide is intended to be used as a standalone document, and also as the software's online HELP.

The SMARTem24 and DigiAtlantis Systems have a commonality that allows users familiar with one system to easily understand and use the other. Each system relies on the SMARTem24 software to acquire, display and process collected data and therefore functionality within the software is similar for both systems. The software can also be installed on a PC for the purposes of QC and data processing.

This Guide steps through setting up each of the hardware components and software settings for acquiring electrical geophysics survey data. Included are sections on:

- Description of the supplied system's hardware components (**sections 6 & 20**)
- Synchronising transmitter Controller and Receiver (**sections 7 & 8**)
- Setting up the transmitter (section 9)
- Setting up the Receiver and connecting sensors (section 10)
- Setting up the survey on the Receiver using the SMARTem24 software (**sections 12** (Quick Start) , **13** (Hot keys) , and **22** (full description of software))
- Recharging batteries (**section 17**)
- Delivering data (**section 14**

2 Shipping & Handling

Despite the rugged nature of EMIT's equipment all components should be handled with care during transport and use. All equipment is packed in a heavy duty aluminium or plastic case for care and ease of transport. Dimensions and weights for shipping are included in **section 20.**

Equipment should be inspected prior to use. Damaged items should not be used – please notify EMIT and return items to EMIT for repair.

The equipment should be stored in a cool and dry location.

The following items have Li-Ion batteries, and to meet international shipping requirements these items are shipped with a caution label for handlers.

- SMARTem24 Receiver
- SMARTem24 Transmitter Controller
- DigiAtlantis Receiver
- DigiAtlantis Probe

Additionally, the DigiAtlantis Probe will be accompanied by copy of the UN Transport Testing Report - certifying that the batteries are approved for shipping via air freight.

A packing list detailing each item packed in the case is included in the case. We recommend this list be checked upon receipt to ensure all components have been received. If the equipment has been provided on a hire basis EMIT requests that the list be checked off and returned with the equipment at the end of the hire period. A list of standard system hardware components is also included in **section 6**

When connecting equipment do not apply undue force. Ensure all connectors are clean and free from dirt. Take care with the SMARTem24 touch-screen and avoid impacts. Please use only the supplied magnetic stylus for optimum results.

EMIT recommends this documentation remain with the equipment.

3 Servicing & Support

Any equipment sold by EMIT includes a 12 month warranty unless otherwise specified.

SMARTem24 Software is provided with the equipment and all updates are available for download from EMIT's website. Should the software be required for a PC please contact EMIT.

The SMARTem24 and DigiAtlantis Receivers are provided for the purpose of recording electrical geophysical data , and performing subsequent processing and display. The Receivers should not be treated as a general use laptop for receiving email or surfing the internet, or other miscellaneous activities. Computers that communicate with the Receiver directly (via network cable) or indirectly (via usb stick) should have an up-to-date anti-virus software.

All personnel using the equipment should have had appropriate training.

If the equipment has been provided on a hire basis, in accordance with the rental agreement the customer shall:

- not alter the equipment without the approval of EMIT.
- not endanger the safety or condition of the equipment.

4 Training

EMIT can provide training for all equipment and software at a location to suit. Please contact EMIT for further information.

5 EMIT Contact Details

Please contact EMIT should you have any queries regarding information contained in this User Guide. We would appreciate being notified if you find any errors or omissions so that they can be rectified for other users.

ElectroMagnetic Imaging Technology Pty Ltd ("EMIT") can be contacted via the following:

physical address:	6 / 9 The Avenue MIDLAND WA 6056 AUSTRALIA
phone:	+61 8 9250 8100
email:	support@electromag.com.au
website:	www.electromag.com.au

6 System Specifications

The SMARTem24 System and the borehole DigiAtlantis System are presently provided as two separate systems. The systems have different hardware components yet maintain familiarity through commonality in operation.

Full listing and description of the individual parts is included in section **20**

6.1 SMARTem24 System

The SMARTem24 system is a compact, portable, 16-channel, PC based package which is the next generation of a system that has already set the benchmark in electrical geophysical surveys. It has been designed to be efficient in the field and to deliver the highest quality TEM, IP, CSAMT and MT data. The GPS Synchronisation, small footprint, long-life batteries and bright colour touch-screen make this instrument a pleasure to operate.

The system consists of a SMARTem24 Receiver and a SMARTem24 Transmitter Controller. The specifications of each component are described in the following subsections.

6.1.1 SMARTem24 Receiver

The SMARTem24 Receiver is a multichannel 24-bit digital receiver for electrical geophysical surveys. It consist of the base unit with an integrated Toughbook®. At no time should attempts be made to separate these components.

Specifications	
Number of input channels	Up to 16
Max input signal level, per channel	+/- 10 V on gain 1 +/- 1 V on gain 10 +/- 0.1 V on gain 100
Input impedance	10 Mohm
Bandwidth	Up to 60 kHz
Sample rate	12.0 - 120 ksps per ADC
Synchronisation	GPS, direct trigger, crystal, asynchronous
Base frequency	Programmable: 50/60 Hz, compatible ranges 0.00 1Hz to 10 kHz
Internal Battery	Dual 14.4 V Li-Ion (hot swappable), external 12-28 V
Battery life	>10 hrs (constant operation)
Operating System	Windows XP or 7 Tablet
Display	10.4" XGA 1000 nit daylight-readable colour LCD
User interface	Touch-screen, digitiser and active stylus screen, QWERTY keypad (backlit optional), touchpad
Data storage	160 GB (or optional SSD), USB, SD and CF cards
Transmitter control	As per SMARTem24 Transmitter Controller
Network	Wireless, Ethernet
Dimensions	310 mm x 290 mm x 120 mm
Weight	8 kg

6.1.2 SMARTem24 Transmitter Controller

The SMARTem24 Transmitter Controller is compatible with transmitters made by Geonics, Zonge, Phoenix and others.

Specifications

Synchronisation	GPS, crystal, direct trigger
Duty cycle	25%, 50%, 100%
Base frequency	Programmable: 50/60 Hz, compatible ranges 0.001 Hz to 10 kHz
Transmitter current recording rate (optional)	12.5 - 120 ksps
Internal Battery	Li-Ion (or external 12 V power supply)
Battery life	>12 hrs (constant operation)
Dimensions	310 mm x 260 mm x 135 mm
Weight	5 kg

6.2 DigiAtlantis System

DigiAtlantis is a digital 3-component borehole magnetometer system for TEM, MMR and magnetics. It represents a new generation of borehole EM system with 24-bit, rapid, simultaneous sampling of the magnetometer's three components to improve data quality and significantly increase efficiency.

The colour display is fully customisable for viewing raw and processed data as profiles or decays, along with real-time data viewing. Signal processing options results in improved QA and QC.

The system consists of a DigiAtlantis Probe, a DigiAtlantis Receiver and two DigiAtlantis Controllers – one to control the Probe and one (optional) to control the transmitter.

The specifications of each component are described overleaf.

6.2.1 DigiAtlantis Receiver

The DigiAtlantis Receiver is a rugged and lightweight Toughbook®.

Specifications	
Dimensions	271 mm x 216 mm x 49 mm
Weight	2.3 kg
Display	10.4" XGA 1000 nit daylight-readable colour LCD
User interface	Touch-screen, digitiser and active stylus screen, QWERTY keypad (backlit optional), touchpad
Data storage	160 GB (or optional SSD), USB, SD and CF cards
Operating System	Windows XP
Connectivity	Single Ethernet connection to DigiAtlantis Controller
Internal Battery	Li-Ion (or external 12 VDC or 240 VAC power)
Battery life	>10 hrs (constant operation)

6.2.2 DigiAtlantis Probe

The DigiAtlantis Probe is a 3-component magnetometer borehole tool for TEM, MMR and magnetics surveys. It includes accelerometers to measure orientation.

DigiAtlantis Probes can be differentiated from the analogue Atlantis Probes by the serial numbers stamped into their metal casing – a DigiAtlantis Probe will be numbered 100 or greater.

Specifications	
Dimensions	2280mm x 33mm (Ø)
Weight	7kg
Sensor	3 orthogonal fluxgate magnetometers
Depth rating	2000m
Max signal level	+/-70uT
Sensor noise level	max. 6pT/√Hz @ 1Hz on all components
Noise level	approx. 3pT on late time window at 1Hz transmitting frequency
A/D	24-bit delta-sigma
Available gain settings	1, 10 or 100
Sample rate	12.5 – 25 kHz per ADC, simultaneously
Bandwidth	0-4 kHz
Internal Battery	Li-Ion
Battery life	>10 hrs (extended with power-feeding)

6.2.3 DigiAtlantis Controller

Two DigiAtlantis Controllers are provided with the DigiAtlantis System - one provides communications with the DigiAtlantis Probe and the other functions as a Transmitter Controller. The DigiAtlantis Controller is compatible with transmitters made by Geonics, Zonge, Phoenix and others.

Specifications	
Dimensions	310 mm x 260 mm x 135 mm
Weight	5 kg
Synchronisation	GPS, direct trigger, crystal
Waveform shape	Bipolar rectangular
Duty cycle	25%, 50%, 100%
Base frequency	Programmable: 50/60 Hz, compatible ranges 0.001 Hz to 10 kHz
Internal Battery	12 V NiMh (or external 12 VDC power)
Battery life	>10 hrs (constant operation)

7 Common Hardware Operations

This section describes common operations for the hardware components of each system, particularly power cycling. LEDs and menu buttons.

7.1 SMARTem24 System

7.1.1 Warnings

Please observe these operational warnings.

- Transmitter Controllers provide the transmitter timing control signal to the transmitter. These do not power on/off the transmitter. Always turn off the transmitter before any work is done on circuits attached to the transmitter. Please refer to the operations manual for the transmitter being used for safe operation of the transmitter.
- The system electronics need to be kept cool (<50degC). Try to keep the components shaded from direct sunlight but exposed to cooling breezes.

7.1.2 SMARTem24 Receiver

7.1.2.1 Power on / off

The SMARTem24 Receiver is an integrated device comprised of a Toughbook® unit and the base unit, with a power management system that balances power consumption between the two components. The two components are powered on and off individually. Please follow the sequence below for **optimum** performance of the power management system.

Power on

1. On the base unit, press the power button, wait until it beeps and the Power LED is illuminated.
2. On the Toughbook® unit, slide the power control to the right and hold until it starts.

Power off

1. On the Toughbook® unit,
    a) Close and Exit the SMARTem24 software
    b) Shut down the Windows operating system from the 'Windows Start bar' and wait for the unit to power off.
2. On the base unit, press the power button until the device shuts down.
    a) Note that there is an option in the SMARTem24 StatusApp to automate this on Software exit.

7.1.2.2 LEDs

Power LED (base unit)

- Green: base unit is powered on
- Red: external power detected
- Green with red double quick flash (once per second): System not authorised for data acquisition.

Transmitter control signal and Battery LEDs (red and green)

This LED pair indicates status for two states:

1. the timing control signal status (red)
2. and the battery status (green) when the device is powered off and a charger is connected.

Timing control signal:

- Red alternate flashing: indicates output activity of the timing control signal - frequency and polarity.

Battery charger / external power is connected (and Power LED is red):

- One LED per internal battery: + is battery A; - is battery B
- Blank: no battery detected (if required, check battery connections).
- Green solid: battery is charging.
- Green flashing: battery is fully charged.

Lock LED (red and green)

This single LED indicates both the status of the 1PPS timing reference (red) and the synchronisation lock (green):

- Red slow flash (once per second): no external signal found.
- Red quick flash (once per second): external signal is good, or in Direct Control (Stand Alone) mode.
    - GPS mode: requires minimum 3 GPS satellites and timing error less than 100 nanosecs.
- Red double quick flash (once per second): GPS leap second update has been received. Restart the device to apply.
- Solid green with red quick flash (once per second): valid timing solution is locked.
- Solid green with red double quick flash (once per second): Valid timing solution is locked and GPS leap second update has been received. Restart the device to apply new leap second value..

7.1.2.3 Converting screen to Tablet Mode

To convert to Tablet mode:

1. open the display screen so it stands perpendicular to the keyboard.
2. slide and hold the display release latch and rotate the display 180^0 clockwise until it clicks.
3. close the display (now face up), align the corner screws and lock using the front latch.

Reverse these steps to revert back.

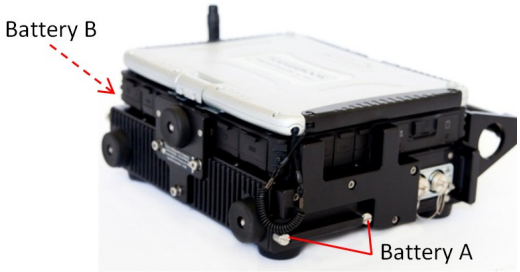
7.1.2.4 Swapping / Changing Batteries

The SMARTem24 base unit includes provision for two Li Ion batteries (see **section** 20.1.1). These can be 'hot-swapped' for fully charged batteries at any time without requiring the device to be powered off.

Battery status can also be interrogated using the SMARTem24 StatusApp, as described in **section** 11.

Battery capacity is also displayed as a digital bar graph on the end of each battery underneath the paper pull-tab once the SMARTem24 Receiver's battery cover has been removed.

1. Unscrew the two slotted screws securing the battery cover, as indicated below for Battery A, and remove the battery cover. The screws are spring loaded so take care as the cover may spring off.



2. Remove the battery by grasping and pulling the tab attached to it.
3. Insert the replacement battery with notched edge first aligning the slot with its notch. Gently push the battery in until it is recessed by about 5mm.
4. Reattach the battery cover using the slotted screws, taking care to enclose the battery's paper tab. The edge of the battery cover should align with the bottom, or top, edge (battery A or B respectively) of the base unit..

Ensure that battery, battery cover and screws are free from dirt when replacing.

7.1.3 SMARTem24 Transmitter Controller

7.1.3.1 Power on / off

Power on

Press and hold down the power button until the red power LED is illuminated and the system beep occurs (approx. 2 seconds).

Power off

Press and hold down the power button until the device powers off.

- The Controller will automatically power-off after 1-hour of no activity

Reset

May be required if the device stops responding to user input .

Hold down the power button for 10 seconds. On release the system should power off, and may restart.

7.1.3.2 LEDs

Power LED (red)

Indicates status of internal batteries.

- Solid: device is powered on and battery level is normal.
- Flashing: battery capacity is less than 1% remaining.

Transmit +/- LEDs (red)

- Alternate flashing: indicates output activity of the timing control signal - frequency and polarity.
- Blank: no activity (no transmission of timing control signal)

1PPS LED (red)

Indicates the status of the 1PPS timing reference, either from GPS satellites or external device, (depending on which synchronisation mode is selected):

- Slow flash (once per second): no external signal found.
- Quick flash (once per second): external signal is good.

- GPS mode: requires minimum 3 GPS satellites and timing error less than 100 nanosecs.

- Double quick flash (once per second): GPS leap second update has been received. Restart the device to apply.

Lock LED (red)

Indicates synchronisation lock:

- Solid: valid timing solution is locked.
- Blank: not locked.

ABCD LEDs

Only used during battery charging.

7.1.3.3 Menu Buttons

To manually configure the Controller's parameters, use the menu screen and buttons:

- **Select** key to enter,
- **Arrow** keys to scroll through menu items
- **Menu** key to go up one menu level

7.1.3.4 Activating transmitter timing control signal

Activation of the Transmitter Controller's transmitter timing control signal is a separate operation once the device has been powered on. This only sends the timing control signal to the transmitter – please refer to the transmitter's operation manual for safely powering the transmitter loop.

Start Transmission

Press the play/pause button to activate transmission of the transmitter control signal.

- The 'Transmit +/-' LEDs will illuminate and indicate output activity of the transmitter timing control signal - frequency and polarity.

Stop Transmission

Press the play/pause button to deactivate transmission of the transmitter control signal.

- The 'Transmit +/-' LEDs will be blank.

7.2 DigiAtlantis System

7.2.1 Warnings

Please observe these operational warnings.

- When running the Controller on 12V auxiliary power-feed, a supplemental power feed signal transmitted down the winch cable can be potentially up to 90V. Please see the Auxiliary 12V Power-Feed section 7.2.3.3 for more information.
- Do not connect a DigiAtlantis Probe to an analogue Atlantis Controller or charger. The systems are not compatible and component failure may occur.
- Transmitter Controllers provide the transmitter timing control signal to the transmitter. These do not power on/off the transmitter. Always turn off the transmitter before any work is done on circuits attached to the transmitter. Please refer to the operations manual for the transmitter being used for safe operation of the transmitter.
- The system electronics need to be kept cool (<50degC). Try to keep the components shaded from direct sunlight but exposed to cooling breezes.

7.2.2 DigiAtlantis Receiver

7.2.2.1 Power on / off

Power on

Slide the power control on the Receiver to the right and hold until the device starts.

Power off

1. Close and Exit the SMARTem24 Software
2. Shut down the Windows operating system from the 'Windows Start bar' and wait for the device to power off.

7.2.3 DigiAtlantis Controller

7.2.3.1 Power on / off and Reset

Power on

Press and hold down the power button until the red power light is illuminated and the system beeps.

- If a DigiAtlantis Probe is connected, the Controller will also automatically attempt to power it on and synchronise to it.

Power off

Press and hold down the power button for 1 second.

- If a DigiAtlantis Probe is connected the Controller will attempt to shut down the Probe before powering off, and this may take a few seconds
- The Controller will automatically power off after 1-hour of no activity

Reset

May be required if the device stops responding to user input a system.

Hold down the power button for 10 seconds. On release the device should power off. Older versions may restart.

7.2.3.2 LEDs

Please refer to SMARTem24 Transmitter Controller in section 7.1.3.2 as the LEDs have similar functionality.

Additional LEDs for when the Probe is connected - CH1, CH2, CH3 & CH4 LEDs - are described below.

CH1 LED

Indicates DSL status.

blank:	only at startup before DSL is configured
orange:	DSL attempting to establish link at requested rate
green:	DSL connected at requested rate
orange flash:	DSL connection attempting to establish link at fallback rate
green flash:	DSL connected at fallback rate
red:	DSL Off
red flash:	DSL Fault – refer to Trouble Shooting in section 23.

CH2 and CH3 LEDs:

If the Probe disconnects these LEDs will stay in their last state to give an indication of why the probe might have shut down.

CH2 LED

Indicates probe battery status.

off:	no health info from probe yet
green:	ok
orange:	warning getting low
red:	flat

CH3 LED

Indicates probe temperature status.

off:	no health info from probe yet
green:	ok
orange:	warning getting hot / cold
red:	temperature out of operating range

CH4 LED

Indication for probe power-feeding.

Off:	Not power-feeding
Orange:	Adjusting power-feed to recommended levels
Green:	Power-feeding at recommended levels and tracking
Red:	Fault

7.2.3.3 Auxiliary 12V Power-Feed

It is anticipated that the Controller battery life is ~12hrs. This will be reduced in hot weather and with battery age.

Battery voltage in the DigiAtlantis Controller, and a DigiAtlantis Probe, may be extended by attaching an external 12V battery to the Controller at the 'Charge' connector. When a Probe is connected the Controller will also supplement power, via the winch cable, to the Probe's battery.

This is a supplementary system only - battery voltage will continue to decrease, although more slowly, as the power-feed system is not able to provide 100% of the system power requirements

The external battery can be connected at any time during the survey without having to turn off the Controller. If auxiliary power is likely to be needed it should be connected at the start of the survey. Note that this does not recharge the batteries and if power-feed is disconnected the system may shut down due to low voltage.

Caution: When running the DigiAtlantis Probe Controller on 12V Auxiliary Power-Feed up to 90V can be potentially transmitted down the winch cable.

7.2.3.4 Menu Buttons

To manually configure the Controller's parameters, use the menu screen and buttons:

- **Select** key to enter,
- **Arrow** keys to scroll through menu items
- **Menu** key to go up one menu level

7.2.3.5 Transmitting Timing Signal

Activation of the Transmitter Controller's transmitter timing control signal is a separate operation once the device has been powered on. This only sends the timing control signal to the transmitter – please refer to the transmitter's operation manual for safely powering the transmitter loop.

Start Transmission

Press the play/pause button to activate transmission of the transmitter control signal.

- The 'Transmit +/-' LEDs will illuminate and indicate output activity of the transmitter timing control signal - frequency and polarity.

Stop Transmission

Press the play/pause button to deactivate transmission of the transmitter control signal.

- The 'Transmit +/-' LEDs will be blank.

7.2.4 DigiAtlantis Probe

7.2.4.1 Power on / off

The DigiAtlantis Probe is powered on/off at the DigiAtlantis Controller once the Controller is powered on (see previous section 7.2.3).

It is anticipated that the Probe battery life is 6-8hrs. These times will be reduced in hot weather.

Probe power on

Press the play/pause button on the DigiAtlantis Controller to power on the Probe.

- Synchronisation between the Probe and the Controller may take up to 1 minute.
- Should the Probe be disconnected and reconnected at any time the connection must be re-established by again pressing the play/pause button.
- The Controller will attempt to power-on and synchronise to the Probe whenever the Controller is turned on.

Probe power off

Press the play/pause button on the DigiAtlantis Controller to power off the Probe.

- To prevent unnecessary drain on the Probe's internal battery it should be powered off before being disconnected.
- The Probe will automatically power off after 10 minutes of no activity.

8 Synchronisation / Timing Procedure

Synchronisation is a term used to describe the matching of timing solutions between the transmitter and receiver so that recorded data is consistently timed with the transmitter waveform. The timing solutions are synchronised in the controller devices for the SMARTem24 or DigiAtlantis Systems.

Each device contains a precision Oven Controlled Crystal Oscillator (OCXO) which can be synchronised to provide an accurate timing solution. There are two methods of synchronising the devices, the choice of which depends on where and how the survey is being conducted.

1. ***GPS synchronisation*** (refer to **subsection** 8.1)
    - Typically used for surface surveys as good GPS coverage is anticipated.
    - This is the default timing mode for both the SMARTem24 System and the borehole DigiAtlantis System.
    - This method is quick and easy to setup and the devices do not need to be brought together or configured at the same time. Additional systems can easily be brought online.
2. ***Crystal Synchronisation*** (refer to **subsection** 8.2)
    - Typically used for underground surveys or when one controlling device does not have access to GPS.
    - Requires the controlling devices to be brought together for syncing. If one of the devices is restarted then resynchronisation will be necessary.

There are no limitations to making changes to the systems after synchronisation is complete. This allows the user to change the setup, for example the transmitter frequency, without having to resynchronise.

Readings are time stamped with the receiver 's timing solution:

- for GPS timing this will be UTC time;
- for crystal timing this will be time since the controller was powered on. This can be reset to a pseudo-UTC time if GPS lock is obtained prior to crystal synchronisation.

The synchronisation methods are outlined in the following subsections.

Direct Drive (Control) or Stand Alone Mode

An additional option for managing the timing is to have the receiver directly controlling (driving) the transmitter timing. Whilst this is not a synchronisation option, but rather a transmitter control option, the receiver may be synchronised to GPS or simply used stand alone. This **Stand Alone** (direct drive / control) mode requires the Receiver to be in close vicinity to the transmitter and directly connected by a control cable, which may or may not be appropriate due to transmitter type, logistics or Health & Safety concerns.

- To use this mode with GPS timing, refer to point 1 above.
- To use this mode as **Stand alone** go directly to the setting up the transmitter in sections 9.3 (for SMARTem24) or 9.4 (for DigiAtlantis).

8.1 GPS Synchronisation

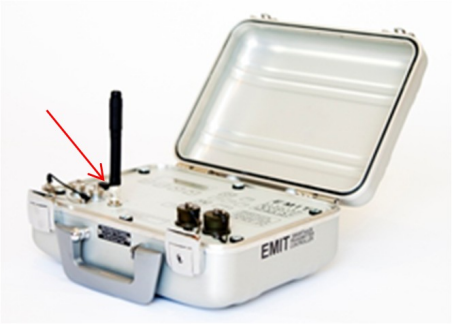
GPS Mode is the default timing mode for both the SMARTem24 System and the borehole DigiAtlantis System. Each device contains a GPS-disciplined timing reference which provides an accurate timing solution using GPS time as an absolute reference.

GPS synchronisation can be established, or re-established, at any time, assuming devices have GPS reception.

The steps for GPS synchronisation are outlined in the following subsections for each system's components.

8.1.1 SMARTem24 Transmitter Controller

1. Connect the GPS antenna (100-101 (with in-line connector)) to the SMARTem24 Transmitter Controller at the GPS antennae connector as indicated below.



2. Turn on the Transmitter Controller (refer to section 7).
3. Wait for a timing solution to be established – this may take up to 3 minutes, or more. The status of the LEDs, outlined in section 7, will display the progress of the synchronisation.
4. The device is synchronised when:
    - Good GPS lock has occurred: 1PPS LED flashes quickly, once per second.
    - Device is synchronised: Lock LED illuminates solid green.
5. Once synchronised, refer to section 9.1 to connect to the transmitter, or to section 8.1.2 to synchronise the Receiver.

8.1.2 SMARTem24 Receiver

1. Connect the GPS antenna (100-091 (with right angled connector)) to the SMARTem24 Receiver at the GPS antenna connector as indicated below.

2. Turn on the Receiver's base unit (refer to section 7.1.2.1).
3. Wait for a timing solution to be established – this may take up to 3 minutes, or more. The status of the LEDs, outlined in section 7, will display the progress of the synchronisation. This may also be be monitored using the SMARTem24 StatusApp software as outlined in **section** 11.2.
4. The device is synchronised when:
    - Good GPS lock has occurred: Lock LED illuminates solid green with a quick red flash.
5. Go to the previous **subsection** 8.1.1 to synchronise the SMARTem24 Transmitter Controller, or to **section** 10.1 to setup the SMARTem24 Receiver for surveying.

8.1.3 DigiAtlantis Controller

1. Connect the GPS antenna (with in-line connector, 100-102) to the DigiAtlantis Controller at the 'GPS' connector as indicated below.

2. Turn on the Controller (refer to section 7.2).
3. Wait for a timing solution to be established – this may take up to 3 minutes, or more. The status of the LEDs, outlined in section 7, will display the progress of the synchronisation.
4. The device is synchronised when:
    - Good GPS lock has occurred: 1PPS LED flashes quickly, once per second.
    - Device is synchronised: Lock LED illuminates solid green.
5. In addition, the Probe is synchronised with the Controller when:
    - Lock LED is illuminated.
    - Sync LED is illuminated red, and CH1, CH2, CH3 LEDs are green.
6. When the system is synchronised, refer to **section** 9 to connect to the transmitter or section 10 to setup the Receiver..

8.2 Crystal Synchronisation

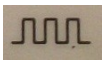
Crystal synchronisation adjusts the crystal oscillator timing reference of the slave (usually the receiver) to match that of the master (typically the Transmitter Controller). Multiple slaves can be synced to the Master. Crystal synchronisation may be used for any survey, however the devices will need to be brought together at the commencement of the survey to carry this out.

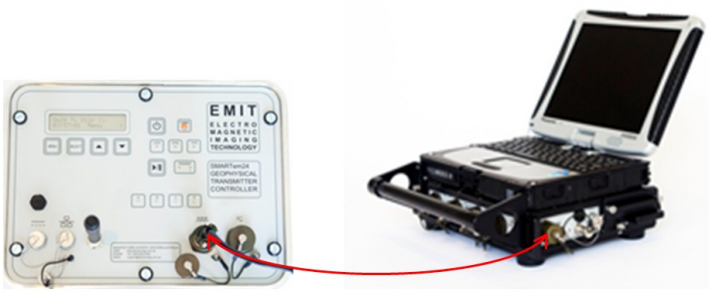
Whilst all equipment provided by EMIT has been designed to be rugged and hard wearing, for longevity of the equipment it is recommended that all components be treated as fragile.

- Crystals need to be sufficiently warm and stable prior to synchronisation. Allow 30 minutes for this, and even longer in cold weather. If the crystals are not sufficiently warm, the drift levels on them may make synchronising too difficult, or may lead the clocks to drift significantly after the synchronising operation.
- For best performance shock, movement and re-orientation should be kept to a minimum once the devices are synchronised.
- If the devices are restarted they will need to be brought together and resynchronised prior to surveying.
- Drift rates should be checked at the end of the day, and possibly during the day. Resynchronisation may be required.

The steps for crystal synchronisation for each System are outlined in the following subsections.

8.2.1 SMARTem24 System

1. Power on the SMARTem24 Receiver and the SMARTem24 Transmitter Controller prior to synchronisation to allow crystals to warm up. Allow 30 minutes for this.
2. Use the SMARTem24 sync cable (100-039) to connect the Transmitter Controller to the Receiver at the  timing connector on both devices, as indicated below.



SMARTem24 Transmitter Controller *SMARTem24 Receiver*

3. On the Transmitter Controller: (refer to **section** 7.1.3 for using menu buttons)
    a. Put the Controller into Stand Alone timing mode:
        i. Setup > Sync Setup > Set Sync Mode > Stand Alone
        ii. the PPS LED should start to flash red once per second and Lock LED illuminates red.
4. On the SMARTem24 Receiver:
    a. Open the SMARTem24 StatusApp (by double-clicking the icon on the bottom right side of the screen, section 11), and follow the Crystal Sync Mode instructions in **section 11.3.2.**
5. When synchronised, disconnect the sync cable from each device.

8.2.1.1 Synchronisation Status & Measuring Drift

Status of the synchronisation can be viewed at any time on the SMARTem24 Receiver via the SMARTem24 StatusApp (see **section 11.3.2**) when the two devices are connected.

1. Connect the two devices with the sync cable, as outlined in previous subsection
2. Open the SMARTem24 StatusApp > Sync Ctl Tab.
3. Note the Sync State, Drift Rate and Error values:

a) Acceptable drift rate would be in the order of 2usec/Hr. Large values within 5 minutes of a sync indicate a poor sync and the synchronisation process should be repeated.

b) Record the Error and Drift Rate value at the end of the day and provide these values to the data processor. These may be required to process any synchronisation issues.

8.2.2 DigiAtlantis System

Two identical controllers are provided with the DigiAtlantis system – one will be used to for the Probe and one for the transmitter.

1. Power on both Controllers prior to synchronisation to allow crystals to warm up. Allow 30 minutes for this.
2. Use the DigiAtlantis sync cable (100-039) to connect the Controllers at the 'SMARTem' connector on both devices, as indicated below.

DigiAtlantis Controller front panel (Transmitter Controller)

DigiAtlantis Controller front panel (Probe Controller)

3. Allocate one device to be the Transmitter Controller and the other to be the Probe Controller.
4. On the Transmitter Controller, use menu buttons (**section** 7.2.3) to:
   a) Put the Controller into Transmit mode
      - Setup > Set Mode > Tx Controller Only
   b) Put the Controller into Stand Alone timing mode:
      - Setup > Sync Setup > Set Sync Mode > Stand Alone
   c) The PPS LED should start flashing once per second and Lock LED turns on.
5. On the Probe Controller:
   a) Put the Controller into Acquisition mode:
      - Setup > Set Mode > Acquire Only
   b) Put the Controller into Sync timing mode:
      - Setup > Sync Setup > Set Sync Mode > Sync Mode
6. At this point both devices are starting to synchronise. The Probe Controller's LED will display sync status, and are synchronised when:
   - PPS LED flashing 1Hz : receiving valid timing information .
   - Lock LED : illuminates
   - If not synchronising, check the connections and confirm the Controllers are configured correctly as described in steps 4. and 5. above.
7. When synchronised, unplug the sync cable from each device. Do not power-off either controller or you will need to resynchronise.

8.2.2.1 Synchronisation Status & Measuring Drift

Status of the synchronisation can be viewed on the Probe Controller's Sync Status screen at any time when the devices are (re)connected.

1. Use the DigiAtlantis sync cable (100-039) to connect the DigiAtlantis Controllers at the 'SMARTem' connector on both devices, as outlined in previous subsection.
2. On the Probe Controller, use menu buttons (**section** 7.2.3) to display the Sync Status screen:

   Status > Sync Setup > Sync Status

   e: Synchronised error in microseconds; accumulated drift between the systems;

   c : Tuning control voltage;

   phase: phase difference in degrees between clocks.
3. Disconnect the sync cable when finished.

9 Transmitter Setup

The SMARTem24 system is compatible with various transmitters, including Zonge, Phoenix, Gap Geophysics Australia and Geonics types. Each of these systems has a unique timing solution, and other transmitters that replicate those solutions may also be utilised, assuming the connectors are standardised.

The steps to connect to the transmitter are outlined in the following subsections for each system.

Refer to the transmitter manual for powering the loop.

9.1 SMARTem24 Transmitter Controller

Refer to **section** 7.1.3 for common button operations of the SMARTem24 Transmitter Controller.

1. Ensure that the SMARTem24 Transmitter Controller has been synchronised.
2. Ensure that the transmitter is turned off.
3. Select the appropriate transmitter control cable for the transmitter being used, eg Zonge.
4. Use this transmitter control cable to connect the transmitter to the Controller at the  timing connector as indicated below.

5. On the Controller, use menu buttons (**section** 7.2.3) to:
    a. Set the TX Frequency
        - Setup > Tx Setup > Set Tx Freq.
    b. Set the TX duty cycle
        - Setup > Tx Setup > Set Tx Duty Cycle
    c. Set the the local powerline frequency
        - Setup > Tx Setup > Set Pwr Line Freq.
    d. Set the timing table to be compatible with (non-SMARTem24) receiver (if being used)
        - Setup > Tx Setup > Timing Table
    e. Set the TX type
        - Setup > Tx Setup > Tx Type
6. Activation of the Controller's timing signal can now be done – play/pause button.
7. Go to **section** 10.1 to setup the SMARTem24 Receiver for surveying.
8. When the survey has completed, shut down the transmitter, shut down the Controller and disconnect the cables.

9.2 DigiAtlantis Transmitter Controller

Refer to **section** 7.2.3 for common button operations of the DigiAtlantis Transmitter Controller

1. Ensure that the DigiAtlantis Transmitter Controller has been synchronised.

2. Ensure that the transmitter is turned off.
3. Select the appropriate transmitter control cable for the transmitter being used, eg Zonge.
4. Use this transmitter control cable to connect the transmitter to the Controller at the 'SMARTem' connector, as indicated below.

Figure 1: DigiAtlantis Controller front panel

Transmitter (a ZT30 is shown)

5. On the Controller, use menu buttons (**section** 7.2.3) to:
   a) Put the Controller into Transmit mode
      - Setup > Set Mode > Tx Controller Only
   b) Set the TX Frequency
      - Setup > Tx Setup > Set Tx Freq.
   c) Set the TX duty cycle
      - Setup > Tx Setup > Set Tx Duty Cycle
   d) Set the the local powerline frequency
      - Setup > Tx Setup > Set Pwr Line Freq.
   e) Set the timing table to be compatible with (non-SMARTem24) receiver (if being used)
      - Setup > Tx Setup > Timing Table
   f) Set the TX type
      - Setup > Tx Setup > Tx Type
6. Activation of the Controller's timing signal can now be done – play/pause button.
7. Go to **section** 10.1 to setup the SMARTem24 Receiver for surveying.
8. When the survey has completed, shut down the transmitter, shut down the Controller and disconnect the cables.

9.3 SMARTem24 Direct Control (Stand Alone)

In this mode the SMARTem24 Receiver provides the transmitter timing control signal directly to the transmitter. Power into the loop is still controlled by the transmitter - please refer to the transmitter manual for powering the loop.

1. Ensure that the transmitter is turned off.
2. Select the appropriate transmitter control cable for the transmitter being used, eg Zonge.
3. Use this cable to connect the transmitter to the SMARTem24 Receiver at the transmitter control  connector as indicated below.

4. Once the system is setup and ready to survey, activation of the timing control signal will occur at the start of each scope or acquisition reading, and deactivate at the end of the reading.
    - If the operator would prefer that the transmitter was activated continuously, rather than at each reading, then this may be managed via the SMARTem24 software using Start / Stop buttons at Main Menu > Setup > Transmitter > Local Transmitter Continuous.
5. Go to **section** 10.1 to setup the SMARTem24 Receiver for surveying.
6. When the survey has completed, shut down the transmitter, shut down the Receiver and disconnect the cables.

9.4 DigiAtlantis Direct Control (Stand Alone)

In this mode the DigiAtlantis Receiver provides the transmitter timing control signal directly to the transmitter. Power into the loop is still controlled by the transmitter - please refer to the transmitter manual for this.

1. Ensure that the transmitter is turned off.
2. Select the appropriate transmitter control cable for the transmitter being used, eg Zonge.
3. Use this cable to connect the transmitter to the DigiAtlantis Probe Controller at the 'SMARTem' connector as indicated below.

4. Once the system is setup and ready to survey, activation of the timing control signal is managed by the SMARTem24 software using the Start / Stop buttons at Main Menu > Setup > Transmitter > Local Transmitter Continuous.
5. Go to **section** **10.2** to setup the DigiAtlantis Receiver for surveying.
6. When the survey has completed, shut down the transmitter, shut down the Receiver and disconnect the cables.

10 Receiver Setup

Once synchronisation has been established proceed to connect all the other components of the receiver system.

10.1 SMARTem24 Receiver

Start the SMARTem24 Receiver, as described in **section** 7

10.1.1 Connecting Sensors

1. Sensors can be connected via appropriate cables to the front analogue input connectors . Contact EMIT if appropriate cables are required.
2. Refer to section 8 to synchronise the Receiver, and to section 11 to setup the SMARTem24 software.

10.2 DigiAtlantis Receiver

The DigiAtlantis Receiver is a Toughbook® and connects to the DigiAtlantis Controller & Probe via a network cable.

10.2.1 Connecting the Probe

A winch with an appropriate length of 4-core cable is required to use the DigiAtlantis Probe. To ensure optimum performance of the Probe the cable and winch should be wired in the correct manner. Refer to wiring diagram provided in **section** 21.

Prior to connecting the equipment ensure the mechanical integrity of the winch cable head by checking components such as the pin alignment and O-rings, and cleaning or replacing as necessary.

1. Use the network cable (100-043) to connect the DigiAtlantis Receiver to the DigiAtlantis Controller at the 'Network' connectors.

DigiAtlantis Receiver

DigiAtlantis Controller

2. Use the controller-winch cable (100-048) to connect the winch to the Controller at the 'Probe' connector.
    - If carrying out surface testing, or utilising the Probe for a surface survey, the shorter bypass cable may instead be connected directly between the Probe and Controller.
3. Connect the DigiAtlantis Probe to the winch.
4. Power on the DigiAtlantis Controller and the Probe.
    - The Probe requires a continuous connection to the Controller to maintain an accurate time reference. Disconnecting the probe will require the systems to synchronise which can take up to 1 minute.

The Probe may be safely plugged / unplugged into the Controller at any time.

12V Auxiliary Power may be connected at any time to prolong the Controller and Probe batteries. Refer to **section 7.2.3.3** on how to do this.

11 SMARTem24 StatusApp

The SMARTem24 StatusApp is additional software that allows the user to view the status of the connected device in regard to operating temperatures, battery capacity, GPS status and is also used to manage synchronisation options.

The software is supplied on the SMARTem24 and DigiAtlantis Receivers and can be accessed via:

1. the StatusApp icon on the Windows System Tray (lower banner, right side)
2. the Windows Menu:
   Windows Start Menu > Programs > EMIT > SMARTem24 Utilities.

The software will be automatically minimised at start-up, and can be retrieved by double clicking on the system tray icon.

To close the StatusApp, (e.g. prior to updating the Sm24Utils package) right click on the StatusApp icon and select Exit.

If, and when, the StatusApp needs upgrading refer to SMARTem24 Utilities in section 18.3.

11.1 Summary Tab

This displays the:

- Device type, serial number and IP address of the connected hardware.
- Battery charge level and estimated runtime (SMARTem24 receiver's only).
- Battery voltages (DigiAtlantis and DigiProbe).
- Various temperature measurements internal to the device.
- DSL connectivity information (DigiAtlantis only).

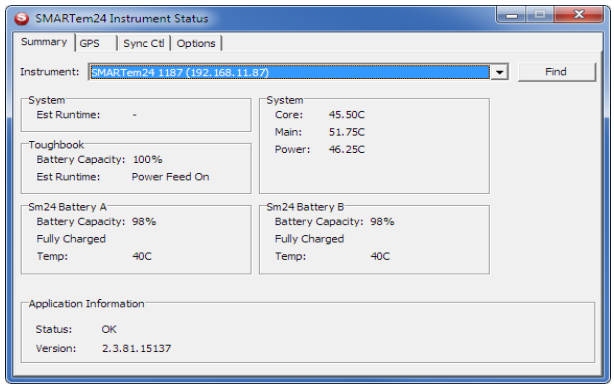


Figure 2: Summary Tab - SMARTem24 connected

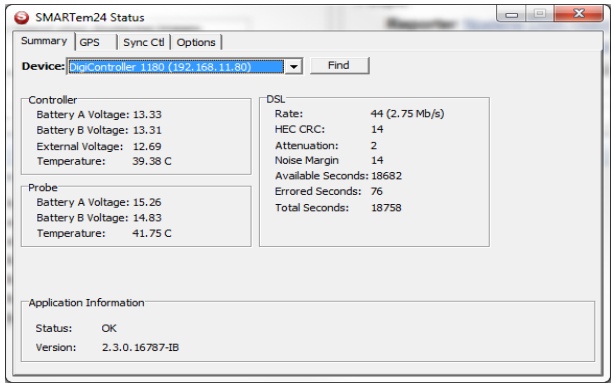


Figure 3: Summary Tab - DigiAtlantis connected

11.2 GPS Tab

This displays information about the GPS.

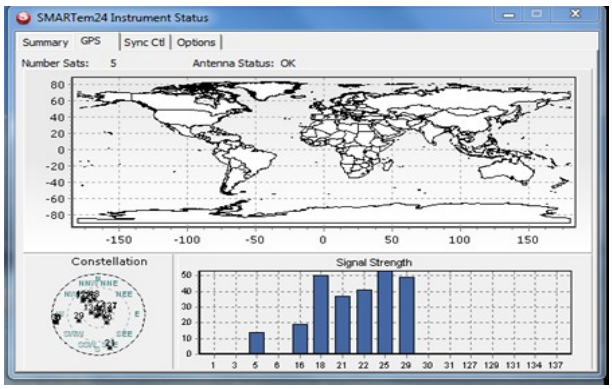


Figure 4: GPS Tab

Number Sats: displays the number of satellites that are currently being tracked.

Antenna status: displays physical status of the antenna, and will indicate either:

- Antenna OK.
- Antenna short circuit detected.
- Antenna open circuit detected.

World Map graphic: displays as a red 'cross' symbol the current GPS location of the receiver, on a world map schematic .

Constellation: displays the current GPS constellation. This can aid in positioning of the GPS antenna in areas with limited visibility of the sky.

Signal Strength graph: displays the signal strength per GPS satellite ID number of the current constellation. Values greater than 10 would indicate good signal strength

11.3 Synchronisation Control Tab

This implement or change synchronisation modes and tabulates and displays graphically the status and quality of the synchronisation, including drift rates. The actual information displayed depends on which mode is currently set. The sync process is automatic, but may also be controlled manually and adjusted from here if required.

Mode: (default= GPS Mode) the mode of synchronisation to be used. Select from the drop down list.

- GPS Mode (default): see subsection 11.3.1.
- Sync Mode (crystal) : See subsection 11.3.2.
- Stand Alone (direct drive): See subsection 11.3.3.

Master: (default= off) option used by EMIT to continuously output the 10MHz and PPS (pulse per second) signals. Normally, these signals are automatically output when required, eg when the synchronisation cable is connected.

11.3.1 GPS Mode

Selection of this mode uses GPS UTC time as the timing reference. This is the default synchronisation mode for SMARTem24 and DigiAtlantis Systems.

Once the GPS antenna is connected and current time and position is calculated from the GPS satellites the system will automatically start the synchronisation process. This process is automatic and no user input is required.

At startup, 4 GPS satellites are required to calculate the current time and position; thereafter only three are required to maintain accuracy. If at any time the GPS signal is lost the system will automatically use the internal crystals to maintain synchronisation.

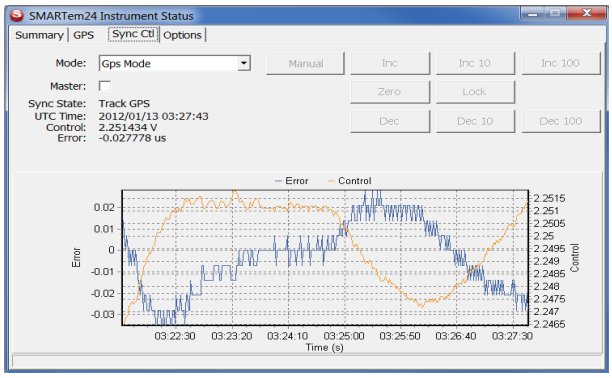


Figure 5: Sync Control Tab – GPS Mode

Sync State: displays the current synchronisation state of the device, being:

- Warmup
- Waiting for Sync: waiting for GPS sync signal.
- Reset Time: aligning clocks PPS to GPS.
- Tuning Crystal: adjusting frequency of crystal to match GPS.
- Tracking GPS: continually updating frequency to track GPS. Device is now GPS synchronised.

UTC Time: displays the GPS current UTC time.

Control: displays the current OCXO control (tuning) voltage (V).

Error: displays the error (us) between internal system time and GPS UTC time.

Graph display: displays the Error and Control values in real time.

11.3.2 Crystal Sync Mode

Selection of this mode provides crystal synchronisation of the system's slave controller with with the remote master controller device. Typically the master device is the Transmitter Controller which will be in "**Stand Alone**" mode.

Once this mode is enabled the systems will automatically attempt to synchronise. However Manual synchronisation via adjustment of the control value may also be undertaken.

Refer to the following subsections for steps required for auto or manual crystal synchronisation.

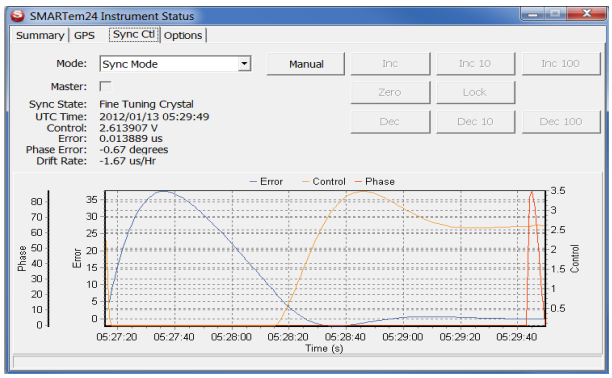


Figure 6: Figure 1. Sync Ctl Tab – Sync Mode

Sync State: displays the current synchronisation state of the device, being:

- Warmup.
- Waiting for Sync: waiting for External sync signal.
- Reset Time: aligning clocks PPS to External Sync.
- Tuning Crystal: course adjustment of crystal to match External Ref.
- Fine Tuning Crystal: fine adjustment of crystal to match External Ref (using phase).
- Correcting Time: re-aligning clocks PPS to External Sync.
- Locked: devices are crystal synchronised.

UTC Time: displays the GPS current UTC time.

Control: displays the current OCXO control (tuning) voltage (V).

Error: displays the error (us) between internal system time and remote time.

Phase Error: Phase Error (degrees) between the internal 10MHz clock and the remote 10MHz reference clock. This is effectively a zoomed in version of error.

Drift Rate: Estimated drift rate (us/Hr) based on the amount of change in the phase error.

Graph display: displays the Error, Control and Phase values in real time.

Manual button (Sync Mode only) : (default= off) click to enable control buttons for manual synchronisation. Should only be used when Sync State is 'Fine Tuning' or better. Once activated the increment buttons will be enabled.

- Auto Sync is described below in **subsection** 11.3.2.1**.**
- Manual Sync procedure is described below in **subsection** 11.3.2.2**.**

11.3.2.1 Auto Crystal Sync

The procedure to perform an auto crystal synchronisation is as follows:

1. Refer to section 8.2 to setup the transmitter as the Master Clock source.
2. Connect the Sync cable (100-039) between the slave and master device.
3. Ensure the displayed Device on the Summary Tab is correct.
4. On the Sync Ctl Tab select '**Sync Mode**' in the **Mode** drop down list.
5. The two system will then communicate and configure themselves as required.
6. The system will then automatically start the synchronisation process:
    1. the Receiver's LOCK LED will change from a slow red pulse to a quick red flash.
    2. The **Sync State** will display the progress of sync status.
    3. When Sync State becomes 'Locked' the systems are successfully synchronised.
        1. SMARTem24 Receiver LOCK LED will illuminate green with a quick red flash.
        2. Controller display will not differ.
7. When synchronised, disconnect the sync cable from each device.
8. To view the drift / error at any time reconnect the two devices with the sync cable, and refer to section 8.2.1.1.

11.3.2.2 Manual Crystal Sync

If automatic synchronisation is unsatisfactory it is possible to manually synchronise the devices by adjusting the Crystal control voltage.

The procedure to perform this manual synchronisation is as follows:

1. Setup the system as per the auto sync process.
   The '**Manual**' button will be enabled when the system is ready for manual control.
2. Press the '**Manual**'.
   The adjustment controls will enable themselves once the system is ready.
3. Use the adjustment controls to adjust the Crystal control voltage until the phase error is stable with a drift rate of less the 2us/hour.
   The magnitude of the phase error is not important.
    - Use the **Inc** / **Inc 10** / **Inc 100** button to increase the control voltage by coarse (100) or fine (1) steps.
    - Use the **Dec** / **Dec 10** / **Dec 100** button to decrease the control voltage by coarse (100) or fine (1) steps.
    - Use the **Zero** button to reset the control voltage to the mid point (0V).
4. Once an acceptable drift rate has been achieved press the '**Lock**' button. This resets the time reference to the reference pulse per second (PPS) which realigns the pulses.
5. **Lock LED** will then illuminate once the offset error has been corrected.
6. When synchronised, disconnect the sync cable from each device.
7. To view the drift / error at any time reconnect the two devices with the sync cable, and refer to section 8.2.1.1.

11.3.3 Direct Drive (Stand Alone) Mode

Selection of this mode places the system into a 'locked timing state' without any synchronisation. Crystal is running freely. No adjustment required, although the Manual buttons can be enabled.

This mode would not usually be utilised, but may be used when:

1. the SMARTem24 Receiver is directly connected to the transmitter via a control cable.
2. The transmitter and DigiAtlantis Probe are connected to the one DigiAtlantis Controller.
3. Using the device as a master time source.
    - **NB**: It is recommended that the Transmitter Controller be the master time source.
4. Testing the device in the office environment.

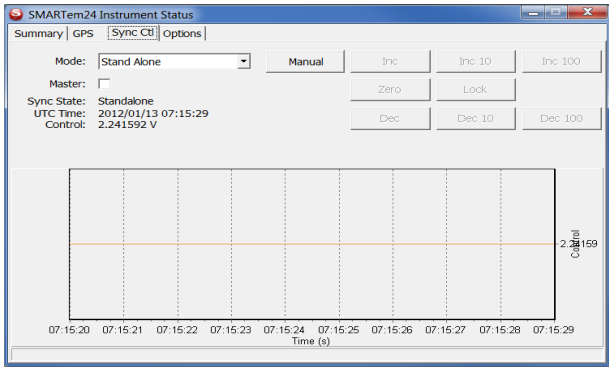


Figure 7: Sync control Tab – Stand Alone Mode

Sync State: displays the current synchronisation state of the device, being Standalone only.

UTC Time: displays the GPS current UTC time.

Control: displays the current OCXO control (tuning) voltage (V).

11.4 Options Tab (Battery management)

The user can configure various setting for warning notifications and device battery management options.

Warning notifications will popup from the Windows system tray based on these settings.

The options for each system are described separately in the following subsections.

11.4.1 SMARTem24 Options

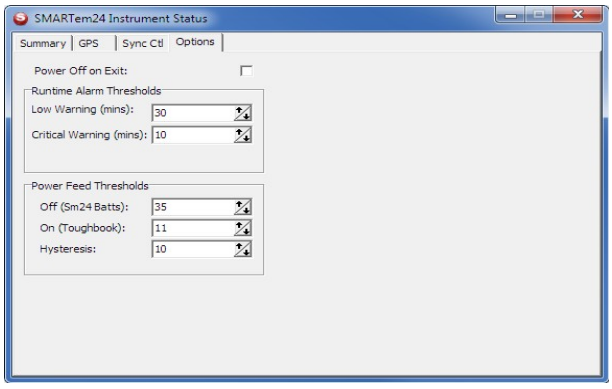


Figure 8: Options Tab - SMARTem24 Connected

Power Off on Exit: (default= no) select to automatically shutdown the Receiver base unit when the StatusApp Exits.

Run Time Alarm Thresholds

Sets the time remaining threshold for when to display warning notifications that the Receiver's battery voltage is low or critical.

Low Warning: (default= 30 mins) enter the time remaining (minutes) at which to flag a low battery warning. This message will be repeated every 5 minutes.

Critical Warning: (default= 10 mins) enter the time remaining (minutes) at which to flag a critical battery warning. This message will be repeated every 2 minutes.

Power-Feed Thresholds

When the Receiver system is fully charged during use the base unit power-feeds to the Toughbook®. Use these settings to disable power-feeding based on battery capacity thresholds.

Off: (default= 35%) enter the Toughbook® battery capacity (percentage) above which power-feed from the Receiver's base unit will be disabled.

On: (default= 11%) enter the Toughbook® battery capacity (percentage) below which power-feed from the Receiver's base unit will be enabled.

Hysteresis: (default= 10%) if the base unit's battery capacity *also* drops below the '**Off**' threshold then power-feeding to the Toughbook® will be limited. A cycle of power-feeding can be maintained only between limits defined by the Toughbook®'s '**On**' value and ('**On**' + '**Hysteresis**') value. Enter this *additional* hysteresis capacity (percentage) for disabling power-feed.

11.4.2 DigiAtlantis Options

Options for when to display battery level warning notifications as pop up windows from the lower system tray,right hand side.

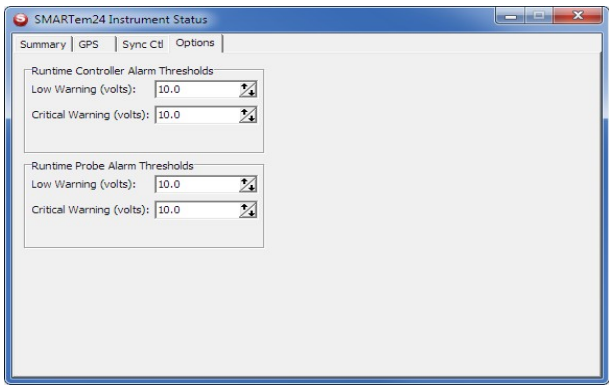


Figure 9: Options Tab - DigiAtlantis Connected

Runtime Controller /Probe Alarm Thresholds

Sets the voltage thresholds for when to display warning notifications (as pop-up windows) that the Controller or Probe battery voltages are low or critical.

Low Warning: (defaults= 10 Volts) enter the voltage (Volts) at which to flag a low battery warning. This message will be repeated every 5 minutes.

Critical Warning: (defaults= 10 Volts) enter the voltage (Volts) at which to flag a critical battery warning. This message will be repeated every 2 minutes.

12 Quick Start Guide - Survey Setup - SMARTem24 Software

For more detailed information on the SMARTem24 Software see **section** 22.

The SMARTem24 Software is required to operate both the SMARTem24 and the DigiAtlantis systems.

Welcome Screen

When the program is started the welcome screen is displayed. There are three settings that must be defined from this screen –

- the user profile, which defines the custom graphical settings and the operator name,
- the project file, which defines the names and locations of all the files associated with a survey,
- and the settings file, which defines the survey specifications.

The 'About' button also provides software version, HELP and license information.

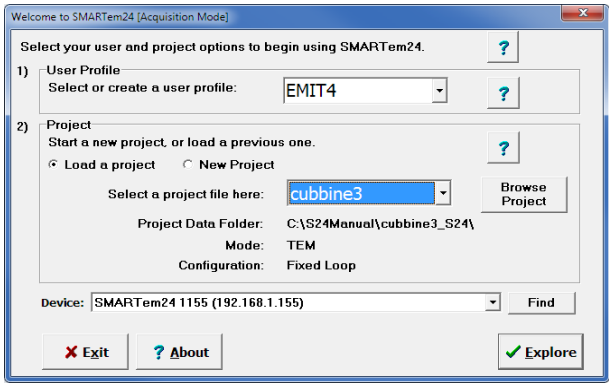


Figure 10: Welcome Screen

The User Profile defines the layout of the data display in the Main Screen and is also saved in the data files as the operator name. Old profiles can be reloaded from the list or create a new one by typing in a new name, in which case default layouts will be used for data display.

When starting a new survey a new Project needs to be created- this is typically the survey line name.

Next, define the survey mode & configuration by either loading settings from a previous survey, or selecting them. The connected device should limit the available options here. Note that these two settings affect the layout and options available in the software and cannot be changed once the Project has been created.

If continuing a survey then load the project file from the list.

Select the connected Device . The device that is powered on and connected to the SMARTem24 Receiver will be displayed in the list or may be found using the 'Find' button.

When this screen is complete, click the 'Explore' button to enter the software where the Main Screen will be displayed.

Main Screen

This Main Screen displays the data as Graphical Panels according to the User Profile and the current View type (drop down list at the top left). Additional menus down the left and along the top and bottom provide the controls for displaying information. General survey information is displayed along the top in blue text.

For a new user the View type will default to Data with a Decay Panel and a Profile Panel displayed. For a new project these will be blank.

Setup

For a new project, click the '**Setup' button** to configure the survey parameters. Step through each of these Menus and enter the required values. Click 'OK' button to save these settings and go back to the Main Screen. Hit the F1 key at any time to get HELP on that screen.

Once Setup specifications are correct data can be acquired.

Scope mode

Incoming data utilising the current settings may again be confirmed in scope mode by clicking the '**Scope' button**. In Scope mode no data is saved to file. If the Confirm Parameters window is displayed check values and confirm validity before proceeding.

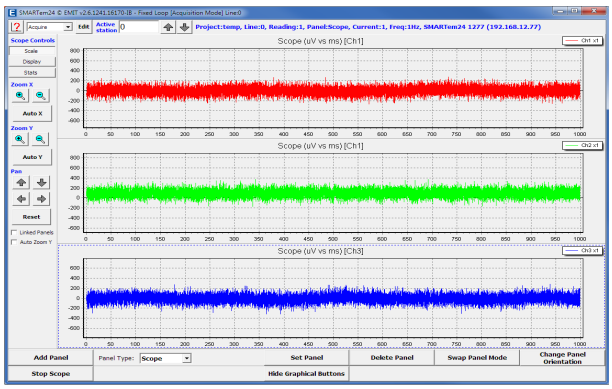


Figure 11: Scope Screen

Use the Scope Options menu on the left to customise the panel. Click on one of the tabs to view options for zooming Display, setting Scale or calculating Statistics.

Acquire mode

When the incoming data is satisfactory and the system is ready to survey, click the '**Acquire' button** to start the acquisition process, collect data and save to file.

During acquisition buttons are available so that readings may be stopped during the acquire cycle and data acquired to that time will be saved to file or, if necessary, may instead be cancelled.

Acquisition progress is shown as a progress bar along the top. The display panels will update with incoming data if real time processing is turned on. When the acquisition cycle has completed the Main Screen will change from Acquire View to the Data View.

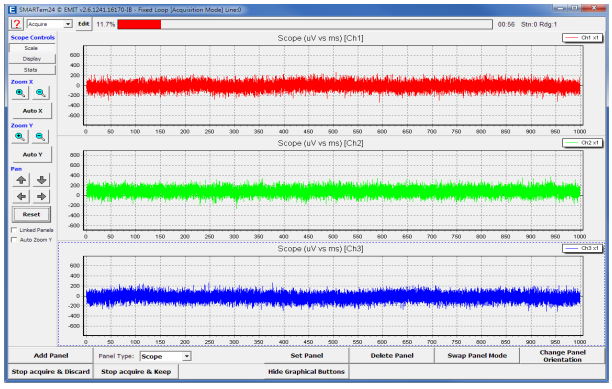


Figure 12: Acquire Screen

The acquired data for the active line/station will be displayed in the graphical panels. The quantity, type and layout of these panels can be changed using the Graphics Buttons along the bottom. The information displayed in each panel can be modified using the Options menu on the left.

The panel presently selected will have a dashed-blue border. Select the panel by clicking on it. The Options menu will update according to the type of panel selected.

Display Panels can be added by selecting the Panel type first and then click 'Add' button on the Graphical Buttons Menu. Change the type by clicking the 'Set' button. This menu can be displayed or hidden by clicking the 'Show/Hide Graphical Buttons' button.

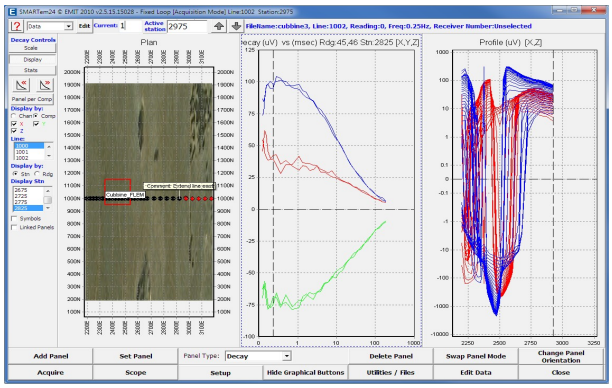


Figure 13: Main Screen

Use the Control Menus on the left to customise each panel. The Control Menu displayed will be for the currently selected panel.

The display can be changed by changing the View type (top left list box) and then customising the panels for that View. Switching between Views allows a quick way of displaying data in different panels rather than constantly adding and removing panels.

Another reading may be acquired at the active station by simply clicking the 'Acquire' button. This will automatically increment the reading number.

Data processing and other useful functions are performed via the Utilities/Files or Edit Data options.

Once the data has been interrogated and the quality is satisfactory, move to the next station. Increment the active station by typing in the station value, or use the up/down arrow buttons or the ']' '[' shortcut/hotkeys. A list of shortcut/hot keys is available overleaf as section 13

The screen can be locked down so that it is always displayed. The touch-screen keyboard can then also be utilised and the display rotated to suit. Refer to section 7.1 on how to do this without damaging the device. Remember to protect the screen from damage when walking through dense bush.

End of survey / day

At the end of the survey day, click 'Close' on the Main Screen and click 'Exit' to close the software. Then shut down the Receiver - first the Microsoft Windows software from the Start bar, and then the base unit.

Refer to **section** 14 for transferring data files to another computer.

Refer to **section 17** for recharging batteries.

13 SMARTem24 Software Shortcut Keys / Hotkeys

There are several programmed key combinations ('hotkeys' or 'shortcut keys') that enable quick access to commonly used tasks. These are listed below.

Key	Function
F1	Help.
F2	Change panel to Scope, or add Scope Panel if no panel present.
D or F3	Change panel to Decay or add Decay Panel if no panel present.
P or F4	Change panel to Profile or add Profile Panel if no panel present.
F5	Change panel to Stacked or add Stacked Panel if no panel present.
F6	Change panel to Raw or add Raw Panel if no panel present.
F9	Zoom In X Axis.
F10	Zoom Out X Axis.
F11	Zoom In Y Axis.
F12	Zoom Out Y Axis.
A	Acquire.
I	Measure the receiver electrode Impedance (IP only).
S	Scope.
Esc	Stop Acquire/Scope, or Exit some functions.
[	Decrement Active station.
]	Increment Active station.

14 Transferring Data Files

The SMARTem24 project includes several files for the setup, the acquired data plus some optional files. These files are saved in the project folder , and are described in the following section.

*.project

*.sini

*.dat (TEM surveys)

*.mmr (MMR surveys)

*.ip (IP surveys)

*.atl (DigiAtlantis surveys only)

*.sur (optional, may be generated for DigiAtlantis)

*.tx (optional)

raw folder

stacked folder

If data files are to be transferred to another computer then:

- only the data files (**.dat* / **.mmr* / **.ip* files are required.

If data files are to be viewed with SMARTem24 software then:

- **.project*,
- **.sini* files, and
- **.atl* files are also required.

If further processing is to be undertaken that recreates the data files, e.g. applying different turn-off ramp time or adding primary field column, then:

- stacked folder will also be required.

If further interrogation is to be undertaken, eg time series or spectra of raw data, then:

- raw folder will also be required.

If viewing stacked or raw files then the entire folder contents *may not* be required – interrogation of only a few files may suffice – and will speed up file transfer. Reprocessing will likely require files for all readings.

Acquired readings are saved to the data files with reading number, station, component and time references. The names of stacked or raw files are cross referenced based on some of these parameters.

15 File Formats

Files supported by SMARTem24 software, either those generated by the software or those that can be imported, are detailed below.

15.1 General

15.1.1 Date_Time stamps

All data file are time stamped with the time of the switch on sample. For files containing data this will be either:

- UTC where available, or
- Running time since the (master) time controlling device was powered on.

UTC time

All UTC time stamps are in the following format:

<yyyymmdd_hhmmss.uuuuuu>

- **yyyy**: year
- **mm**: month
- **dd**: **d**ay
- **hh**: hour
- **mm**: minute
- **ss**: second
- **uuuuuu**: fractional second

15.2 Project (*.project) file

This ASCII file contains information on version number, last opened data file and scales for Images.

Project files can be loaded by double clicking on the file or loaded through the Welcome Screen using the list of previously saved/loaded projects or by using the **Browse** button.

File name

The name of the **.project* file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' will be converted to underscores '_'. Consideration should be given to shorter lengths as this name is included in the naming of stacked and raw files.

File location

The file is located in the current project folder.

File format

This file should not be edited.

15.3 Settings (*.sini) file

An ASCII file containing the SMARTEM24 software setup settings for the project as they were defined when the project was last closed. Many of these settings are also saved in the data file so that the acquisition history is properly recorded.

Each project has a settings file within the project folder. Once loaded the settings (survey parameters) are available for editing via the Main Menu > Setup button.

The settings file may be exported to become part of the default list on the Welcome Screen, so that similar setting may be used to start other surveys.

- Export the settings **.sini* file via Main Menu > Setup > Files > Export Settings File button. See section 22.5.6.

NB: This file should NOT be edited.

File name

Settings **.sini* files must be the same name as the project **.project* file.

File location

File is stored in the current project folder.

File format

This file should not be edited.

15.4 User Profile (*.ini) file

An ASCII file that contains display settings, specifically View settings, for the specified user (is the user profile name). This allows operators, or users, to customise the display of data to suite their preferences. Therefore the one project may be opened by different users each with their own customised view settings.

User Profiles are created, and selected, during software startup on the Welcome Screen.

The name of the User Profile is the name of the **.ini* file. The name is also saved in the data file as the 'Operator'. Additional operators will become part of the default list and available for selection at startup.

The currently loaded User Profile is updated with the current display settings whenever the software is closed.

User Profile **.ini* files can be shared to other users and renamed so that data may be viewed in a similar manner.

If the operator name is changed on the Survey (Setup) Screen then a new User Profile **.ini* file of that name is created with the current display settings. This can be accessed via:

- Main Menu > Setup > Survey > General > edit the Operator name. See section 22.5.2.

NB: This file should NOT be edited.

File location

User Profile **.ini* files are stored in the User subfolder that can be located via :

- Start Menu > EMIT > SMARTem24 [version] > Application Common Location

File name

Name of a User Profile **.ini* file is usually the operator name.

The name of the User Profile may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' will be converted to underscores '_'.

File format

This file should not be edited.

15.5 Raw (*.raw) file

A binary file containing time series sampled raw data from the device for the entire reading cycle.

For acquisitions with a DigiAtlantis one raw file will be created per reading as the data is multiplexed. For all other surveys, raw files will be created on a per channel basis.

These files can be displayed in the SMARTem24 software in a Raw Panel.

File location

**.raw* files are saved in the 'raw' sub folder for the current project.

File names

Naming of each *.raw file has the following format:

ProjectName_Date_Time_Component_ChannelNumber_ReadingNumber.raw

ProjectName: the name of the *.project.

Date_Time: data & time of the acquisition, see previous subsection 15.1.1 Date_Time stamps for decoding this value.

Component: channel component as defined on the Hardware (Setup) Screen.

ChannelNumber: ADC channel number.

ReadingNumber: incrementing reading number.

File format

The raw file is structured as follows:

1. An arbitrary number of text / XML data blocks that indicate status and progress of the device when starting an acquire. Each block is terminated by an empty line terminated by a CR/LF pair. ie byte pattern CRLF/CRLF
2. A XML **DataInfo structure** followed by an empty line terminated by a CR/LF pair.
3. The raw data, the format and organisation of this data stream is describe below.

DataInfo Structure

```
<DataInfo>
  <SysInfo>
    <Name>018-06-A</Name>
    <DateTime>20110628_022317.0000000</DateTime>
    <LeadTime>2</LeadTime>
    <ReadingNumber>1</ReadingNumber>
    <Timing>
      <PwrLineMode>0</PwrLineMode>
      <TransType>eTransZonge</TransType>
      <TransCtlrType>eTransCtlrEmit24</TransCtlrType>
      <SampleRate>24000</SampleRate>
      <Freq>1</Freq>
      <Duty>50</Duty>
      <Sweeps>1</Sweeps>
      <SweepRatio>1</SweepRatio>
      <TxEpoch>0</TxEpoch>
    </Timing>
  </SysInfo>
  <ChannelInfo_array>
    <ChannelInfo>
      <SlotNumber>0</SlotNumber>
      <ChanNumber>3</ChanNumber>
      <GroupDelay>0</GroupDelay>
      <DataFormat>e24BitFormat</DataFormat>
      <Gain>100</Gain>
      <MinVoltage>-0.2</MinVoltage>
      <MaxVoltage>0.2</MaxVoltage>
      <NullingVoltage>0</NullingVoltage>
      <CalInfo>
        <m_slope>-40103779.3013</m_slope>
        <scale>-2.49353057847e-08</scale>
```

```
        <y_offset>-3403.93925788</y_offset>
        <r2_correlation>0.999999986272</r2_correlation>
        <volt_offset>8.4878266268e-05</volt_offset>
        <y_zero_offset>-3858.82633333</y_zero_offset>
        <y_zero_volt_offset>9.62210145918e-05</y_zero_volt_offset>
      </CalInfo>
    </ChannelInfo>
  </ChannelInfo_array>
</DataInfo>
```

CalInfo Structure Fields

m_slope: slope of the fitted line between volts and raw data using linear regression.

scale: inverse of m_slope.

y_offset: y-axis intercept using the line regression (in bits).

r2_correlation: square of the correlation coefficient.

volt_offset: **y_offset** converted to volts.

y_zero_offset: measured offset with zero input voltage.

y_zero_volt_offset: **y_zero_offset** converted to volts.

Converting Raw Data to Volts

The raw data is little endian and each sample is either 3 byte (24bit) or 4 byte (32bit) signed data as specified by the DataInfo/ChannelInfo_array/ChannelInfo/DataFormat field.

To convert the raw data (24 / 32 bit format) to volts:

1. multiply by: DataInfo/ChannelInfo_Array/ChannelInfo/CalInfo/scale
2. adding: DataInfo/ChannelInfo_Array/ChannelInfo/CalInfo/y_zero_volt_offset + DataInfo/ChannelInfo_Array/ChannelInfo/NullingVoltage

15.6 Stacked (*.stk) file

A binaryfile containing data that represents a half period of stacked data. The first data sample (**sample zero**) is the initiation point of transmitter switch-off. The sample count in a stacked file is the number of samples in a transmitter half period.

Files can be viewed in the SMARTem24 software in a Stacked Panel.

File name

Naming of each *.stk file is similar to Raw files, and has the following format:

ProjectName_Date_Time_Component_ChannelNumber_ReadingNumber.raw

ProjectName: the name of the *.project.

Date_Time: data & time of the acquisition, see previous subsection 15.1.1 Date_Time stamps for decoding this value.

Component: channel component as defined on the Hardware (Setup) Screen.

ChannelNumber: ADC channel number.

ReadingNumber: incrementing reading number.

File location

**.stk* files are saved in the 'stacked' sub folder for the current project.

File format

The file is structured as follows:

- Header block consisting of a number of ASCII lines terminated by an empty line terminated by CRLF pair.
  - Line 1: version & file creation date
  - Line 2: timing information related to the data stream.
  - Line 3: header (space separated)
  - Line 4: data (space separated) corresponding to header described on line 4.
  - Line 5: empty
- A binary data stream
  - Each sample is 8 byte double precision floating point number (IEEE Standard 754) in volts.
  - The total number of samples is equal to the SAMP_RATE * 0.5 / FREQ.

Example file – Header block only

```
Application Version: 2.6.0.16088-IB - created Tue Jan 10 16:45:56 2012
SAMPLESHIFT:0  TURNON:0  DUTY:50  POWFREQ:ePwrLine50Hz
RDNG C FREQ CURR SAMP_RATE GAIN UNITCONVERSION SENSORCLASS UNITS NSTACKS
34   V   1   1   24000   1   7000000   Magnetometer   pT/A   128
```

15.7 TEM (*.dat) data file

An ASCII file automatically created by the SMARTem24 software that contains processed, windowed TEM survey data plus the settings relevant to that processing.

Files can be viewed in the SMARTem24 software in a Decay or Profile Panel.

File names

Name of a *dat file is usually the survey line or the drill hole .

The name of the data **.dat* file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' will be converted to underscores '_'.

It is suggested that any reprocessed files have additional annotation following some agreed convention that reflects the processing undertaken.

File format

Data files store processed data with one record per reading per channel.

Data rows are stored by increasing station, reading, component.

Example File

To be advised.

15.8 MMR (*.mmr) data file

An ASCII file automatically created by the SMARTem24 software that contain contain processed, windowed survey MMR data plus the settings relevant to that processing.

Files can be viewed in the SMARTem24 software in a Decay or Profile Panel.

File names

Name of a **.mmr* data file is usually the survey line or the drill hole .

The name of the data file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' will be converted to underscores '_'.

It is suggested that any reprocessed files have additional annotation following some agreed convention that reflects the processing undertaken.

File format

Data files store processed data with one record per reading per channel.

Data rows are stored by increasing station, reading, component.

Example File

To be advised.

15.9 IP (*.ip) data file

An ASCII file automatically created by the SMARTem24 software that contain contain processed, windowed survey IP data plus the settings relevant to that processing.

Files can be viewed in the SMARTem24 software in a Decay or PsuedoSection Panel.

File names

Name of a **.ip* data file is usually the survey line, or possibly the survey area for multi-line files.

The name of the data file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' will be converted to underscores '_'.

It is suggested that any reprocessed files have additional annotation following some agreed convention that reflects the processing undertaken.

File format

Data files store processed data with one record per reading per channel.

Data rows are stored by increasing station, reading, component.

Example File

To be advised.

15.10 Atlantis (*.atl) file

An ASCII file containing DigiAtlantis specific information (e.g. magnetometer and accelerometer measurements). Data is saved to file on each acquisition

File is sorted by increasing reading number, one row per component.

Header information is similar to the data files.

The **.atl* file is referenced in the header of the **.dat* or **.mmr* file.

File name

The file is automatically created by the SMARTem24 software and uses the same name as the data file. However, the name may be edited and then reassigned to the data file in the software.

Name of an Atlantis **.atl* file is usually the survey line or the drill hole .

The name may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' may be converted to underscores '_'.

File location

The file is located in the current project folder.

File format

Atlantis files store probe data & information with one record per reading per channel.

Data rows are stored by increasing reading, component.

Example file

To be advised.

15.11 Borehole Survey (*.sur) file

An ASCII file containing orientation information of a borehole (borehole depth, azimuth and dip) and is used to calculate the east, north and RL position of each station in the borehole. Values may be supplied from other surveys, or may be calculated and saved to file by SMARTem24 software as a processing option for DigiAtlantis data.

This is an optional file, but needs to be loaded whenever an additional process requires actual station locations.

The **.sur* file is referenced in the header of the **.dat* or **.mmr* file.

File name

Name of *sur file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' may be converted to underscores '_'.

File location

Files created by SMARTem24 software are located in the current project folder. User created files will have a copy saved in this folder.

File format

- Contains three columns of data separated by a space – borehole depth, azimuth and dip.
- Dip values may range from 90 to -90 and is defined as being positive downward, and negative for upward facing holes.
- Azimuth may range from 0 to 360 and is relative to survey grid north.
- Comments may be included and are preceded by forward slash '/' character. Any characters after the comment character (and including it) will be ignored.

The file has the following format :

Segment_1_Start_Depth Segment_1_Azimuth Segment_1_Dip

Segment_2_Start_Depth Segment_2_Azimuth Segment_2_Dip

.

.

Segment_n_Start_Depth Segment_n_Azimuth Segment_n_Dip

Example file

```
/ Depth Azi Dip - optional comment
0 210.0 58.0 / Another optional comment
52 209.2 58.6
100 209.7 57.5
151 210.7 56.0
200 209.7 56.0
250 208.2 54.0
290 209.2 51.4
```

15.12 Transmitter Loop (*.tx) file

An ASCII file listing east, north, RL co-ordinates of the transmitter loop vertices. Values may be entered directly into the file, or may be entered into the SMARTem24 software which are then automatically saved to file.

This is an optional file but needs to be loaded whenever an additional process requires loop details.

Transmitter Loops can be managed using the Loop Editor (see section 22.5.4.1).

The **.tx* file is referenced in the header of the **.dat* or **.mmr* file.

File name

Name of **.tx* file may be any combination of alpha or numeric characters. Symbols should not be used. Spaces ' ' may be converted to underscores '_'.

File location

Files created by SMARTem24 software are located in the current project folder. User created files will have a copy saved in this folder.

File format

- Contains three columns of space-separated data : east north RL . If only two columns are present then the RL of each vertex will be set to 0.0.
- Each row of the file contains a single transmitter vertex. The rows of vertices should be defined in either a clockwise or anti-clockwise sense (vertices out of order will produce strange shaped loops).

The file has the following format :

Vertex_1_East Vertex_1_North Vertex_1_Elevation

Vertex_2_East Vertex_2_North Vertex_2_Elevation

.

.

Vertex_n_East Vertex_n_North Vertex_n_Elevation

- Comment lines may be included in the file by using the / character.
- A warning will be issued when reading the file if there are 2 or less valid vertices.

Example file

```
/ x y z - optional comment line
97100 82250 185
97100 82550 185
97400 82550 185
97400 82250 185
```

15.13 Customised window schemes *(SMARTem24User.times)* file

An ASCII file with customised window schemes that may be used during acquisition or for reprocessing. These can can be utilised by selecting its 'unique name' from the Window Scheme list via:

- Acquisition: Main Menu > Setup > Timing > Window Scheme
- Reprocessing: Main Menu > Utilities/Files > Reprocess > Windowed Data Options > Adjust Windowing Scheme.

File names

Name of file must always be *SMARTem24User.times* .

File location

The file is included as part of the SMARTem24 software installation and can be located for editing via :

Start Menu > EMIT > SMARTem24 [version] > Application Common Location

File Format

This ASCII file contains definitions with the following fields. Instructions for editing the file are contained within the file.

- Multiple window schemes may occur in this file, each being a 'repeated' block of the example file shown below.
- **TF** is used as a filter for which Survey Mode the scheme will be available for, such that:
  - Times: for TEM surveys
  - IPTimes: for TIP surveys

Warning: Do NOT edit the *SMARTem24.times* file - it will be overwritten when a new version of the application is installed.

Example File

```
NEW TIMES              / Key word to indicate the start of a new set of values.
TF:Times               / Filter for when this list will be selectable: Times or IPTimes
NAME:MyTimes           / Unique name that will be displayed in the software.
BFREQ:1.0              / Base frequency in Hz.  Use -1 if frequency dependence is unimportant.
FORMAT:SE              / Window time arrangement: SE (= StartTime EndTime) or MW (= MidTime Width)
UNITS:ms               / Window time units: us, ms or s
TIMESSTART             / List of window times, as per FORMAT
   0.087499    0.112498
   0.108627    0.139664
   0.134858    0.173389
   0.167423    0.215258
TIMESEND               / End of window times

NEW TIMES              / Key word to indicate the start of a new set of values.
TF:Times               / Filter for when this list will be selectable: Times or IPTimes
NAME:MyLowFreq         / Unique name that will be displayed in the software.
BFREQ:0.1              / Base frequency in Hz.  Use -1 if frequency dependence is unimportant.
FORMAT:SE              / Window time arrangement: SE (= StartTime EndTime) or MW (= MidTime Width)
UNITS:ms               / Window time units: us, ms or s
TIMESSTART             / List of window times, as per FORMAT
0.5   1.0
1.0   5.0
5.0   10.0
10.0  50.0
50.0   100.0
100.0   500.0
500.0   1000.0
1000.0   2400.0
TIMESEND               / End of window times
```

15.14 Customised sensors (*CustomSensorDefinition.xml*) file

An XML file that allows user to add calibration data for there own sensor. These custom sensors will then be presented as an option in the Sensor drop down list via :

- Main Menu > Setup > Hardware > Sensor

File name

Name of file must always be *CustomSensorDefinition.xml* .

File Location

This file is included during software installation, but will not overwrite existing files. The file can be located for editing via :

Start Menu > EMIT > SMARTem24 [version] > Edit Sensor Definition

Format

This XML file contains **Sensor** definitions with the following fields. Instructions for editing the file are contained within the file.

Description: the unique name that will be displayed in the Sensor drop down list.

Type: the type of sensor. Valid options are Coil, Electrode, Generic or Magnetometer

Conversion ('base unit'/V) : (default= 1) coefficient used to convert Volts at the channel ADC to the sensor's base unit. Further normalisations applicable to the sensor type, eg pT/A, are accomplished via UNITS selection in the Main Menu > Setup > Hardware Screen.

- Coil / Electrode / Generic : base unit= V, so Conversion= 1
- Magnetometer: base unit= pT, therefore, for example:
  - If magnetometerA produces 5 uV at the channel input per pT at the sensor, then the Conversion for this sensor would be 1pT/(5*10^-6)V= 200000 (pT per V).
  - If magnetometerB produces 10 uV at the channel input per pT at the sensor, then its Conversion value would be 1pT/10uV = 100000 (pT/V).

SensorDelay (us): (optional, default= 0) Group delay of the sensor. Exclusion of this field will allow the value on the Main Menu > Setup > Timing Screen (default=0) to be used.

ReceiverArea (m^2): (default= 1) Effective area of the sensor. Required for coil sensors, optional for other sensors.

Example Format

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Copyright EMIT-->
<!-- Future versions of this file will most likely contain a version tag.-->
<SensorDefinition xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:noNamespaceSchemaLocation="SensorSchema.xsd">
<SensorDefinition_array>
  <Sensor>
    <Description>MyCoil_1000</Description>
    <Type>Coil</Type>
    <Conversion>100.0</Conversion>
    <ReceiverArea>1000.0</ReceiverArea>
  </Sensor>
  <Sensor>
    <Description>MyMag2Hz</Description>
    <Type>Magnetometer</Type>
    <Conversion>23689.470</Conversion>
    <SensorDelay>60.0</SensorDelay>
  </Sensor>
</SensorDefinition_array>
</SensorDefinition>
```

16 Data Processing

Processing, or reprocessing, of data files can be undertaken in the field to correct for errors, or may be undertaken at a later stage for QC and interpretation purposes. Some of the common processing options are listed below.

Field processing

- Edit transmitter loop co-ordinates
    - Utilities/Files Menu > DigiAtlantis Processing button
    - Setup Menu > Transmitter menu
- Reassign reading number to a station on a per reading basis
    - Edit Data menu
- Adjust effective current value on a reading or time-frame basis
    - Edit Data menu
- Adjust transmitter turn-off value on a reading or time-frame basis (note that changing the current will also effect the turn-off time)
    - Edit Data menu
- Add comments
    - Edit Data menu
- Rotate DigiAtlantis data based on new probe calibration information
    - Utilities/Files Menu > DigiAtlantis Processing button

Data QC

- (Re)create stacked or data files
    - Utilities/Files menu > Reprocess button
- Export a subset of the data file to a TEM/MMR file compatible with Maxwell software
    - Utilities/Files menu > Export TEM button
- Shift stacked files due to drift or synchronisation errors
    - Edit Data menu (data file will then need to be recreated from these adjust stacked files via reprocessing)
- Apply simple maths (+ - * /) to account for incorrect sensor type
    - Edit Data menu
    - (* or / only) Utilities/Files Menu > Reprocessing button
- Create a borehole survey path file
    - Utilities/Files menu > DigiAtlantis Processing button
- Calculate the Theoretical Primary Field at each station location
    - Utilities/Files menu > DigiAtlantis Processing button
- Reverse polarity of all data
    - Utilities/Files menu > DigiAtlantis Processing button

17 Battery Charging

Procedures for recharging each system are included the following subsections which also include estimated recharge times. LEDs will indicate battery status during charge.

Battery charging should be undertaken in a safe, secure location free of inclement weather. Recharge equipment differs between the SMARTem24 and DigiAtlantis systems and should not be interchanged. Inspect all cabling and connectors prior to use and do not use if damaged.

17.1 SMARTem24 System

The components of the SMARTem24 System are charged separately, as outlined in the following subsections.

17.1.1 SMARTem24 Receiver

1. Ensure all components are powered off.
2. Connect the AC charger cable (100-103) to the SMARTem24 Receiver's base at the "Charge" connector.

Note: Align the red dots on both connectors and gently push straight in until seated – no rotation is required.

3. Connect the other end of the AC charger cable to 240V power outlet and turn on 240V power.

   +/- LED will provide feedback on the charge status for each of the two internal batteries.
4. When fully charged, turnoff the 240V power and disconnect the cable from the SMARTem24 Receiver. Do not attempt to rotate the connector when disconnecting.

17.1.1.1 Estimated recharge times

Estimated recharge times for flat batteries are:

- Receiver's base to 100% ~4 hrs
- Receiver's Toughbook® to 100% ~ 3.5 hrs

17.1.2 SMARTem24 Transmitter Controller

1. Ensure all components are powered off.
2. Connect the AC charger cable (100-103) to the SMARTem24 Transmitter "Charge" connector.
3. Connect the other end of the AC charger cable to 240V power outlet and turn on 240V power.
   - LED labelled 'A' LED will provide feedback on the charge status.
4. When fully charged, turnoff the 240V power and disconnect the cable from the SMARTem24 Receiver. Do not attempt to rotate the connector when disconnecting.

17.1.2.1 Estimated recharge times

Estimated recharge times for flat batteries are:

- SMARTem24 Transmitter Controller to 100% ~2 hrs

17.1.2.2 LED Indicators

ABCD LEDs:

Only the 'A' LED is used and displays the charge status.

Serial no's lower than 1220:

- Green with red flash: charging
- Green: fully charged
- Red: error

Serial no's 1220 onward:

- Green flash: charging
- Green: fully charged
- Red: error

17.2 DigiAtlantis System

All components of the DigiAtlantis System are usually charged at the same time, however individual components may be charged if required.

The DigiAtlantis Probe must be connected via a DigiAtlantis Controller, which must always be connected to the leftmost connector so that the batteries in both devices are charged.

To recharge the DigiAtlantis system follow this procedure:

1. Ensure all components are powered off.
2. For DigiAtlantis Probe & Controller
    a) Use the DigiAtlantis Probe charge/test cable (100-038) to connect the DigiAtlantis Probe to a DigiAtlantis Controller.
    b) Use a DigiAtlantis Controller charge cable (100-037) to connect this DigiAtlantis Controller to the DigiAtlantis Charger. This must be plugged into the charger's left-most connector so that the two sets of batteries are charged.
3. For DigiAtlantis Controller only (no probe)
    a) Use a DigiAtlantis Controller charge cable (100-037) to connect the DigiAtlantis Controller to the DigiAtlantis Charger at the right-most connector. This connector will only charge one set of Controller batteries.
4. Plug the DigiAtlantis Charger into a 240V power connector and turn on.

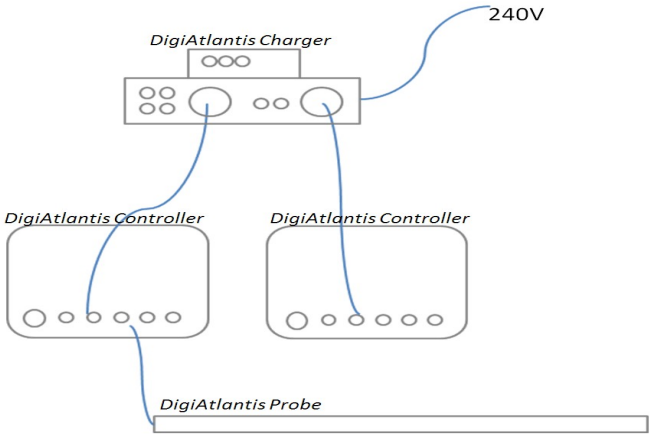


Figure 14: Schematic of DigiAtlantis recharging setup

5. Check the LEDs to ensure that no errors have occurred and leave the system to charge. Description of LED indicators is contained overleaf in subsection 17.2.2.
6. When all battery LEDs are solid green the system is fully charged, and can be disconnected in reverse order to the above.

17.2.1 Estimated recharge times

Estimated recharge times for flat batteries are:

- DigiAtlantis Probe to 100% ~ 6 hrs
- DigiAtlantis Controller to 100% ~ 4 hrs

If the charger is reset during charging it will automatically restart the charge cycle

Note: Once the batteries are fully charged the DigiAtlantis Charger will revert to trickle charge.

17.2.2 LED Indicators

The LEDs on the front panel of the DigiAtlantis Charger display the charge status.

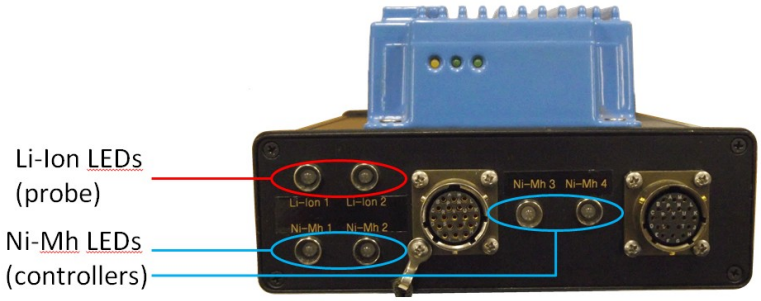


Figure 15: DigiAtlantis 240V Charger (front panel)

The pair of Li-Ion LEDs indicate the status of batteries in the DigiAtlantis Probe which needs to be connected to the controller on the left-most charge connector.

The two pairs of Ni-Mh LEDs indicate the status of batteries in the two DigiAtlantis Controllers.

LEDs in the following states define routine behaviour:

- Traffic light (red-orange-green) : System is being reset, wait. Occurs at power on or connection of new battery or Controller.
- Very brief orange blink : System waiting to detect batteries. Connect Controller (& Probe).
- Solid orange : Constant current phase (bulk of normal charge cycle).
- Orange with green blink : Constant voltage phase (near end of normal charge cycle - batteries close to fully charged.)
- Solid green : Charge Complete.

LEDs in the following states define errors:

- Slow orange blinking : Trickle charge whilst battery voltage is very low. Once voltage is sufficient it should revert to regular charging.
- Rapid red - orange blinking : Output paused while input volts too low. Hardware fault - Contact EMIT.
- Solid red : Fault. System requires a power reset to resume. Restart power to the charger.
- Three Red Flashes : Charge suspended. Battery voltage to low.
- Two Red Flashes : Charge suspended. Battery voltage to high.
- Slow Red Blinking : Charge suspended. Battery voltage to hot.
- Fast Red Blinking : Thermistor error. Needs power cycle to reset.
- Orange Blinking : Timeout

18 Updating SMARTem24 Software

There are two SMARTem24 applications that can be updated. These are:

- SMARTem24 Software, for the Receiver or a PC.
- SMARTem24 Utilities, extra files for the Receiver only (see subsection 18.3).

Installing SMARTem24 applications on the Receiver or a PC is similar to installing other Windows software, and the procedures are outlined in the following subsections.

SMARTem24 update files, and the accompanying Release Notes of software changes, may be downloaded from the EMIT website by registered SMARTem24 users. Users will need to be logged on to access these files.

Registered users may subscribe to the *Update Notification Service* to be advised when a new software release occurs. Once logged into the website, refer to My Account > Notifications to amend subscription status.

18.1 Updating SMARTem24 Receiver

SMARTem24 Software and SMARTem24 Utilities are released as separate installation files. There is no requirement to update these together, or in any particular order.

The process for updating either of these software is identical and is as follows

1. Download the installer files from the EMIT website and copy to a USB memory stick:
   - *SMARTem24 full-version installer.exe*
   - *SMARTem24 Utilities installer.exe*
1. Power on the SMARTem24 Receiver (see **section** 7.1.2.).
2. Log on to an administrator account - the "SMARTem24 Admin" account is provided for this purpose - contact EMIT for the password.
   - For Receivers running Windows XP - the Installer Manager is no longer necessary.
   - Owners of Receivers may add their own administrator accounts.
3. Ensure that the applications are not running.
   - For SMARTem24 Utilities, also close the StatusApp (which automatically starts at Startup) via the icon on the system tray in the lower right of the screen.
4. Insert the memory stick in the Receiver and double click on the relevant '...*installer.exe*' file to run the installer. Install one application at a time.

Once completed SMARTem24 software will have a new icon available on the desktop with installed version number. Utilities will use the same links.

18.2 Installing or Updating a PC

To install or update the SMARTem24 software on a PC the user will need to:

1. Download the new 'SMARTem24 full-version installer' from the EMIT website.
2. Ensure that the SMARTem24 Software is not running.
3. Double click on the 'SMARTem24 full-version installer'. This will launch the installation.

Once completed, a new shortcut icon is available on the desktop with installed version number.

18.3 SMARTem24 Utilities

The SMARTem24 Utilities is an application installed on SMARTem24 and DigiAtlantis Receivers to provide additional hardware support.

This application includes the following utility applications which are discussed elsewhere in this document:

- SMARTem24 StatusApp, used to display the status of the connected device and GPS, to manage synchronisation options and set warning levels (see section 11)
- SMARTem24 Firmware Updater, used for updating the system's firmware (see section 19.2)

The SMARTem24 Utilities may be updated when required. The process for this is outlined at the start of this section 18.

19 Updating Firmware

Firmware updates may need to be undertaken from time to time and may be undertaken by the user.

Device Firmware for SMARTem24 and DigiAtlantis systems are updated using Firmware Image **.up2* file and the SMARTem24 Firmware Update software.

The **Firmware Image **.up2* file** is a single unified file that contains update information for all EMIT devices and hardware revisions. Updates are available from the EMIT website. The Firmware Update software is included as part of the SMARTem24 Utilities installation.

Steps to update the firmware are outlined below, with description of the SMARTem24 Firmware Updater included as subsection 19.2.

To support these firmware updates the SMARTem24 Software will usually also need to be updated - a warning message will be displayed in the software if incompatible . Please contact EMIT to confirm if updated software is required and if so follow the steps outlined in **section** 18.

Steps to update the firmware are as follows:

NB: When upgrading a SMARTem24 Transmitter Controller the SMARTem24 Receiver cannot be used - the Controller must be connected to a separate PC and the IP address configured (requires administrator privileges). See subsection 19.1. for configuration instruction. When updating DigiAtlantis systems the supplied Toughbook can be used.

1. Prior to updating ensure that devices are fully charged . If the device powers off whilst updating then the firmware may become corrupt which may require its return to EMIT for recovery.
2. Download the new Firmware Package File (is the Image **.up2* file) from the EMIT website and copy to a USB memory stick.
3. Attach the device to be updated to the PC and power them on.
    - SMARTem24 Transmitter Controller must be connected to the configured PC (refer to subsection 19.1).
    - All other devices should be connected the relevant system's Receiver.
4. Close all other applications on the PC whilst the update is being performed.
5. Insert the memory stick in the PC and double click on the Firmware Image **.up2* file. This will launch the SMARTem24 Firmware Updater.
6. The application will automatically connect to the attached device.
    - If more than one device is attached, eg DigiAtlantis Controller & Probe, select the desired device from the drop down box. **NB**: Probes should be updated prior to the Controller.

7. Press the Update button to begin the update. The application will display progress and status during the process in the Progress Window.. If there are any problems with the update it will be displayed here.
8. When successfully finished the device will power down and may automatically restart itself.
9. Firmware update is then complete.

19.1 SMARTem24 Transmitter Controller

The update process for this device cannot be implemented from the SMARTem24 Receiver and therefore requires a separate PC with an Ethernet connector. The user will require administrator access on the PC in order to install EMIT's applications and to configure IP addresses.

The steps to configure the IP address of the SMARTem24 Transmitter Controller are as follows:

1. Install the **SMARTem24 Utilities onto the PC, selecting only the Firmware Updater module.**
2. Configure the PC with a static IP address with the following parameters (you may wish to note the previous values):
    - IP Address: 192.168.0.10
    - Subnet Mask: 255.255.224.0

    Methods for doing this will vary depending on what version of Windows is installed. As a guide:
    - Open 'My Computer'
    - Right click on the 'Network' link and select 'Properties'.
    - Select 'Local Area Connection', and then select 'Properties'.
    - Select 'TCP' option, and then select 'Properties'.
    - Click 'Use the following IP Address'
    - Type in the IP Address and Subnet Mask numbers listed above
    - Click 'OK'.

    Should the above procedure not work, look up the process specific to the Operating System on the PC being used.
3. Use the supplied Ethernet cable (100-100) to connect the SMARTem24 Transmitter Controller to the PC.
4. Power on the Controller.
5. Start the Firmware Updater Utility.
6. The application will populate the Device combo box with an IP address if all previous steps have been completed correctly.
7. Perform the update as per the process described at the start of this section 19.
8. Once the update is complete restore the PC's original IP configuration.

19.2 SMARTem24 Firmware Updater

This application is used to update firmware on the selected device. The following subsections briefly describe the available functions of the application. Refer to the start of this section 19 for procedures for updating.

19.2.1 Update Tab

Use this page to configure, apply and display status of the update.

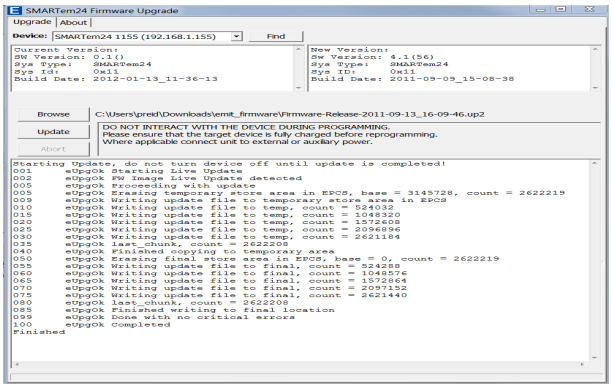


Figure 16: SMARTem24 Firmware Updater – Update Tab

Device: select from the list the currently connected device being updated. Use the Find button to locate other devices not listed.

Current Version: displays firmware information of the currently selected device

- **Software Version**: version number of the firmware
- **Device Type**: displays the type of system component. Confirm that this is correct.
- **Hardware (Sys) ID**: EMIT hardware ID
- **Build Date**: date of the firmware version.

New Version: displays the new update information from the selected Firmware Image **.up2* file for the currently selected device.

Browse button: click to load the **.up2* file containing update information. Currently loaded file name will be displayed.

Update Now button: click to apply the update.

Progress Window: window displays progress and status messages as the update progresses.

- If the update is successful without any critical errors then the last rows should state 'Completed' and 'Finished'.

19.2.2 About Tab

The displays the Software Version information of the SMARTem24 Firmware Updater and for the currently loaded Unified Firmware Image **.up2* file, as selected on the Update Tab.

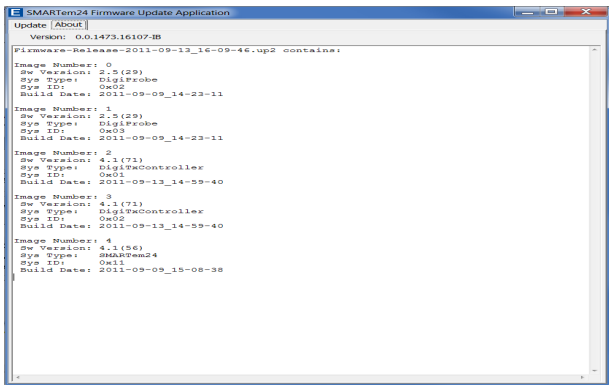


Figure 17: SMARTem24 Firmware Updater – About Tab

20 Hardware Parts Descriptions

20.1 SMARTem24 System

The standard system is comprised of the following parts:

Part#	*Description*	*Qty*
100-001	SMARTem24 Receiver	1
100-103	AC Charger and cable	2
CH5050	Desktop battery charger	1
NL2054HD22	Smart Li-Ion battery	4
100-091	GPS antenna (right angle connector)	2
100-097-5M	Breakout cable (banana plug, 5m)	2
100-098	AUX DC power cable (6 amp)	2
CFCHARGE	CF-19 charger	1
100-056	SMARTem24 Transmitter Controller	1
100-102	GPS antenna (patch, 4.5m)	1
100-101	GPS antenna (vertical stick)	1
100-039	SMARTem24 sync cable	1
100-040	Transmitter control cable (Zonge)	1
100-099	Transmitter control cable (Geonics)	1
100-100	Ethernet cable	1

Each cable is labelled with the EMIT part number for ease of identification.

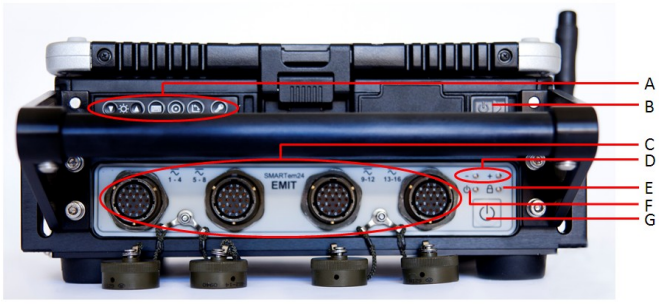
Shipping

Plastic case; 48 x 40 x 21cm; 13.0 kg

Plastic case; 63 x 49 x 35; 24.0 kg

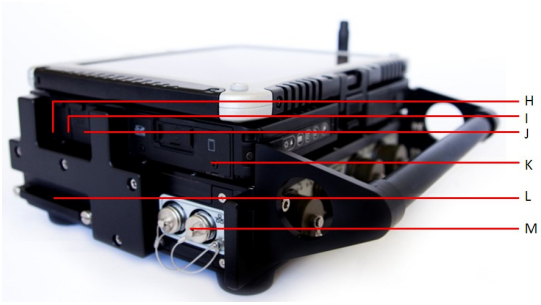
20.1.1 SMARTem24 Receiver

The SMARTem24 Receiver consists of a Toughbook® integrated into EMIT's proprietary base unit. For assistance with the Toughbook® component please refer to either the Toughbook® Operation Guide provided with the Receiver or to the Reference Manual available on the Receiver via the Windows Start button.



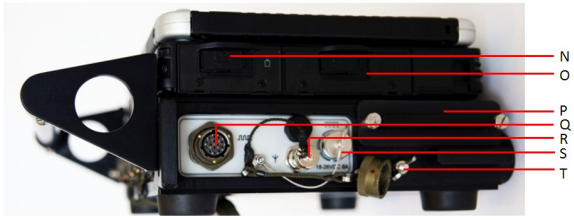
SMARTem24 Receiver – FRONT

A. Toughbook® tablet buttons – use when in Tablet mode.
   - LCD brightness
   - Panel mode
   - Enter
   - Rotation
   - Security
B. Toughbook® power switch
C. Analogue input connectors (up to 16 channels over 4 inputs)
D. Battery and transmitter control LED
E. 'Lock' LED
F. Power LED (base unit)
G. Power button (base unit)



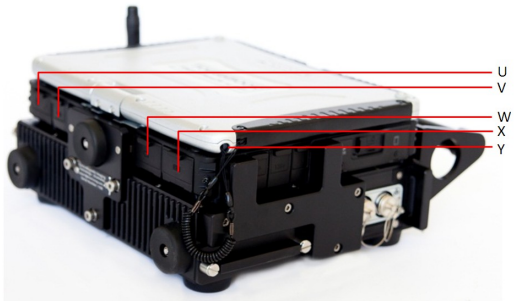
SMARTem24 Receiver – LEFT side

H. Toughbook® USB Port
I. Toughbook® IEEE 1394 interface connector
J. Toughbook® modem port
K. Toughbook® additional card slots
L. Battery A slot
M. LAN connectors



SMARTem24 Receiver – RIGHT side

N. Toughbook® battery
O. Toughbook® hard disk drive
P. Battery B slot
Q. Synchronisation & transmitter control connector
R. GPS antenna connector
S. Charger or external 24V DC connector
T. Earth wingnut connector



SMARTem24 Receiver – REAR

U. Toughbook® headphone and microphone connectors
V. Toughbook® USB port
W. Toughbook® external display port
X. Toughbook® serial port
Y. Toughbook® stylus/digitiser pen holder

SMARTem24 Receiver – TOP

Z. Toughbook® touch-screen

AA. Toughbook® screen release latch

AB. Toughbook® LED indicators

- Wireless ready
- Wireless WAN status
- Caps lock
- Number lock
- Scroll lock
- Hard disk drive status

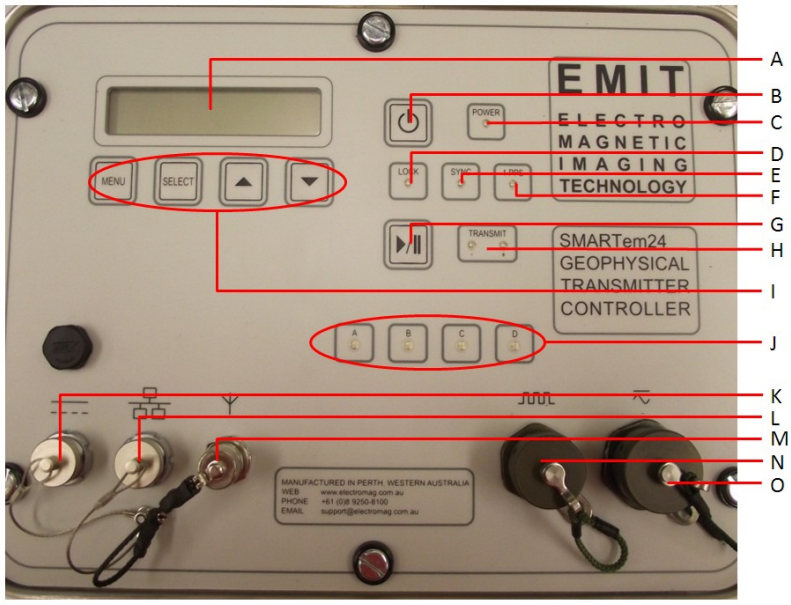
AC. Toughbook® screen alignment screws

AD. Toughbook® power LED indicators

- Battery status
- Power status

AE. Toughbook® screen locking latch

20.1.2 SMARTem24 Transmitter Controller



SMARTem24 Transmitter Controller

A. LCD display
B. Power button
C. Power LED
D. Lock LED
E. Sync LED
F. 1PPS LED
G. Play/Pause button
H. Transmit + / - LEDs
I. Menu Select and Scroll buttons
J. LEDs: A=charger; B,C,D not used
K. Charger or external 24V DC connector
L. Network connector
M. GPS antenna connector
N. Synchronisation & transmitter control connector
O. Analogue connector (optional)

20.2 DigiAtlantis System

The standard system is comprised of the following parts:

Part#	*Description*	*Qty*
100-030	DigiAtlantis Probe	1
CF19	DigiAtlantis Receiver (Toughbook®)	1
100-042	Toughbook® AC adapter and cable	1
100-041	Toughbook® DC adapter and cable	1
100-044	Toughbook® 12V DC line connector	1
100-050	DigiAtlantis Controller	2
100-102	GPS antenna (patch, 4.5m)	2
100-115	DigiAtlantis Charger	1
100-043	DigiAtlantis Controller network cable	1
100-036	DigiAtlantis Controller battery cable	2
100-037	DigiAtlantis Controller charge cable	2
100-038	DigiAtlantis Probe charge/test cable	1
100-039	Sync cable	1
100-040	Transmitter control cable (Zonge)	1

For first time users, the following will also be provided:

100-048	DigiAtlantis Controller / winch cable	1
100-123	Wiring diagram (DigiAtlantis Winch Wiring) (see **section 21**).	1

Each cable is labelled with the EMIT part number for ease of identification.

Shipping

Aluminium case; 240 x14 x 14cm; 10.0kg

Plastic case; 48 x 40 x 21cm; 10.0kg

Plastic case: 48 x 40 x 21cm; 10.0kg

20.2.1 DigiAtlantis Receiver

The DigiAtlantis Receiver is a rugged and lightweight Toughbook®. For assistance with the operation of this component please refer to either the Toughbook® Operation Guide provided with the DigiAtlantis Receiver or to the Reference Manual available via the Windows Start button on the Toughbook® itself.

DigiAtlantis Receiver – TOP

A. Toughbook® touch-screen
B. Toughbook® display release latch
C. Toughbook® LED Indicators
   - Wireless ready
   - Wireless WAN status
   - Caps lock
   - Number lock
   - Scroll lock
   - Hard disk drive status
D. Toughbook® display alignment screws
E. Toughbook® Power LED indicators
   - Battery status
   - Power status

All parts are the same as those listed as Toughbook® in **section 20.1.1.**

20.2.2 DigiAtlantis Controller

DigiAtlantis Controller

A. LCD display
B. Power button
C. Power LED
D. Lock LED
E. Probe Sync LED
F. 1PPS LED
G. Play/Pause button
H. Transmit + / - LEDs
I. Menu Select and Scroll buttons
J. CH1, CH2, CH3 and CH4 LEDs
K. LAN connector
L. GPS Antenna connector
M. Charger or external 12V DC connector
N. Probe connector
O. Synchronisation & transmitter control connector
P. Analogue connector

20.2.3 DigiAtlantis Probe

DigiAtlantis Probe

A. Cable connector
B. Stainless steel casing
C. Fibreglass casing. Sensor is located 10-15cm from this end of the probe.

21 Wiring Diagrams / Schematics

The following wiring diagrams have been included for use in either preparing or repairing cables.

Please contact EMIT should further assistance be required.

100-036: DigiAtlantis Controller to Battery (12V Auxiliary Power Feed) cable

100-037: (DigiAtlantis Controller to Charger) cable

100-038: DigiAtlantis Probe to Charger cable

100-039: Sync cable

100-040: Transmitter Control cable – Zonge

100-048: DigiAtlantis Controller to Winch cable

100-098: SMARTem24 Auxiliary Power cable

100-099: Transmitter Control cable – Geonics

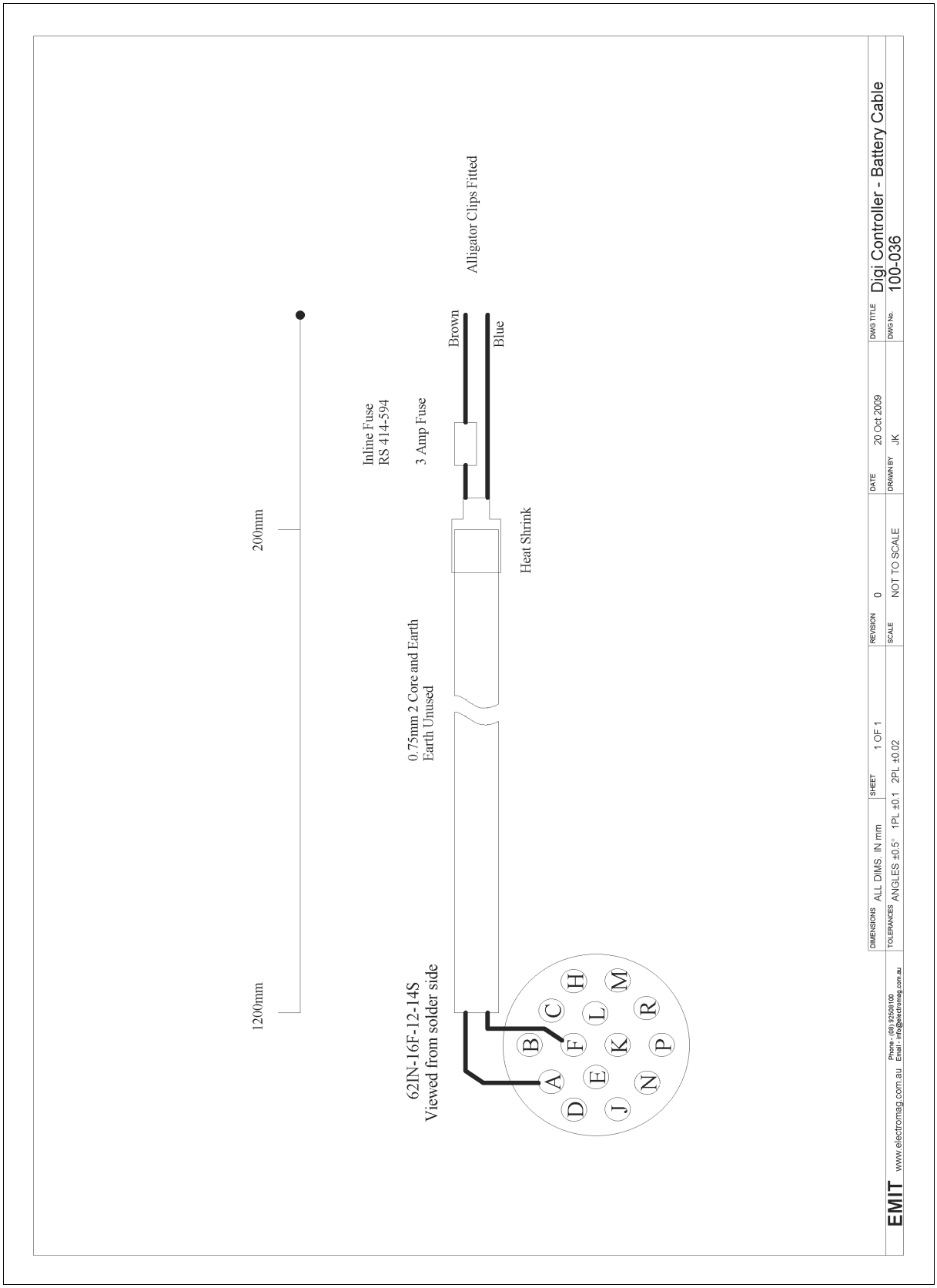
100-104: Transmitter Control cable – Phoenix

100-123: DigiAtlantis 4-core Winch cable

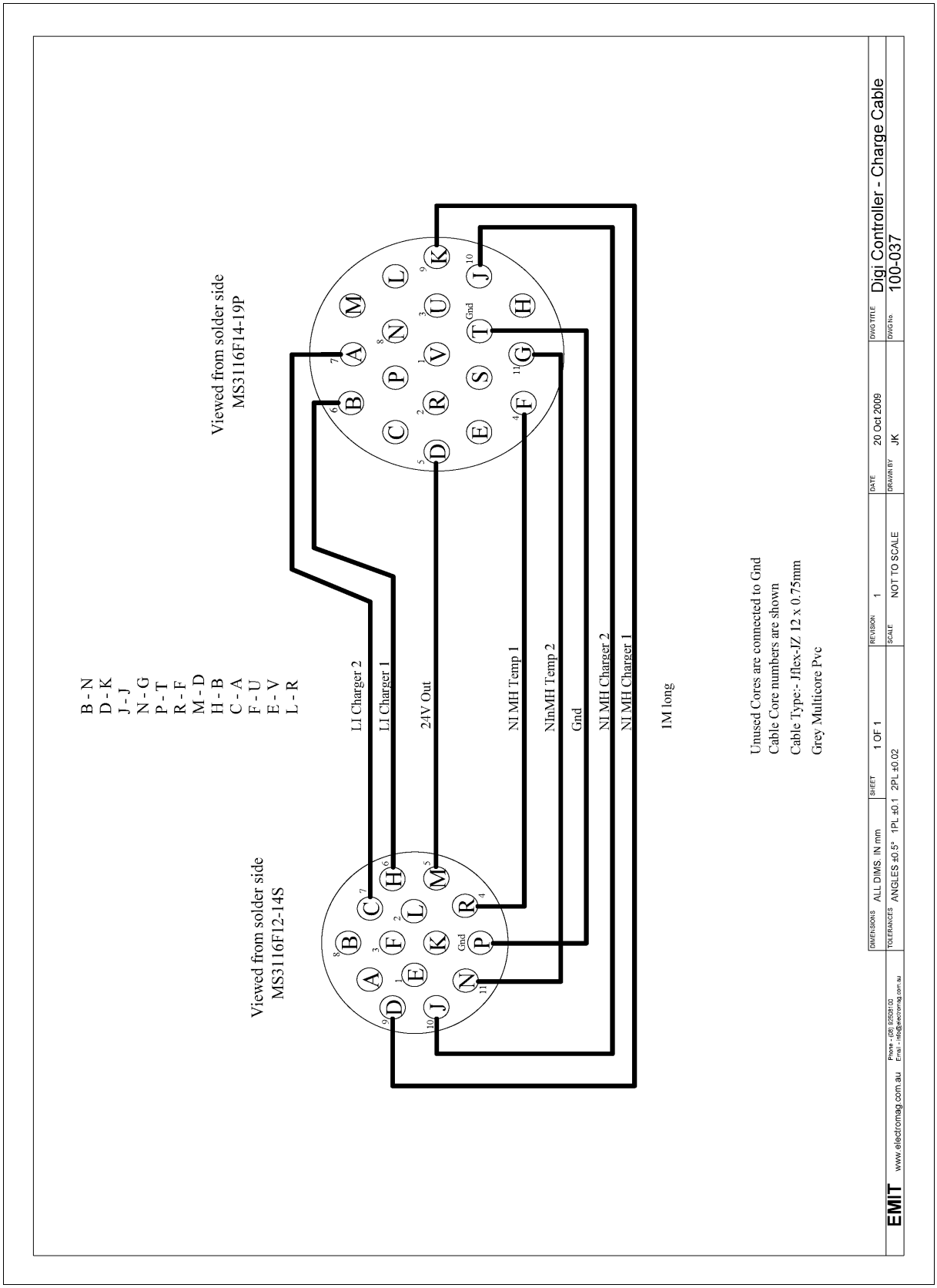
100-144: DigiAtlantis 2-core Winch cable

Analogue Input Connector wiring

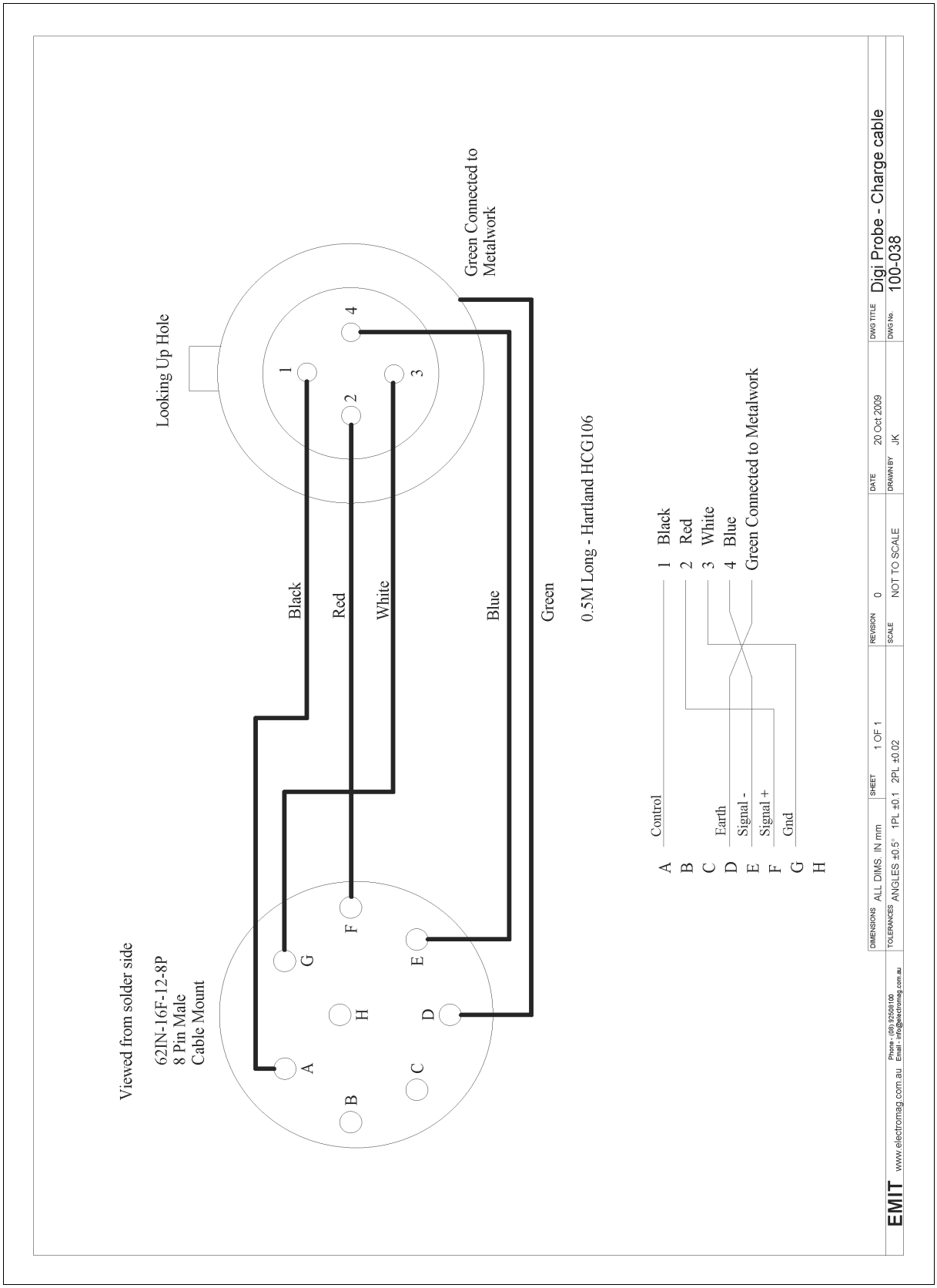
100-036: DigiAtlantis Controller to Battery (12V Auxiliary Power Feed) cable



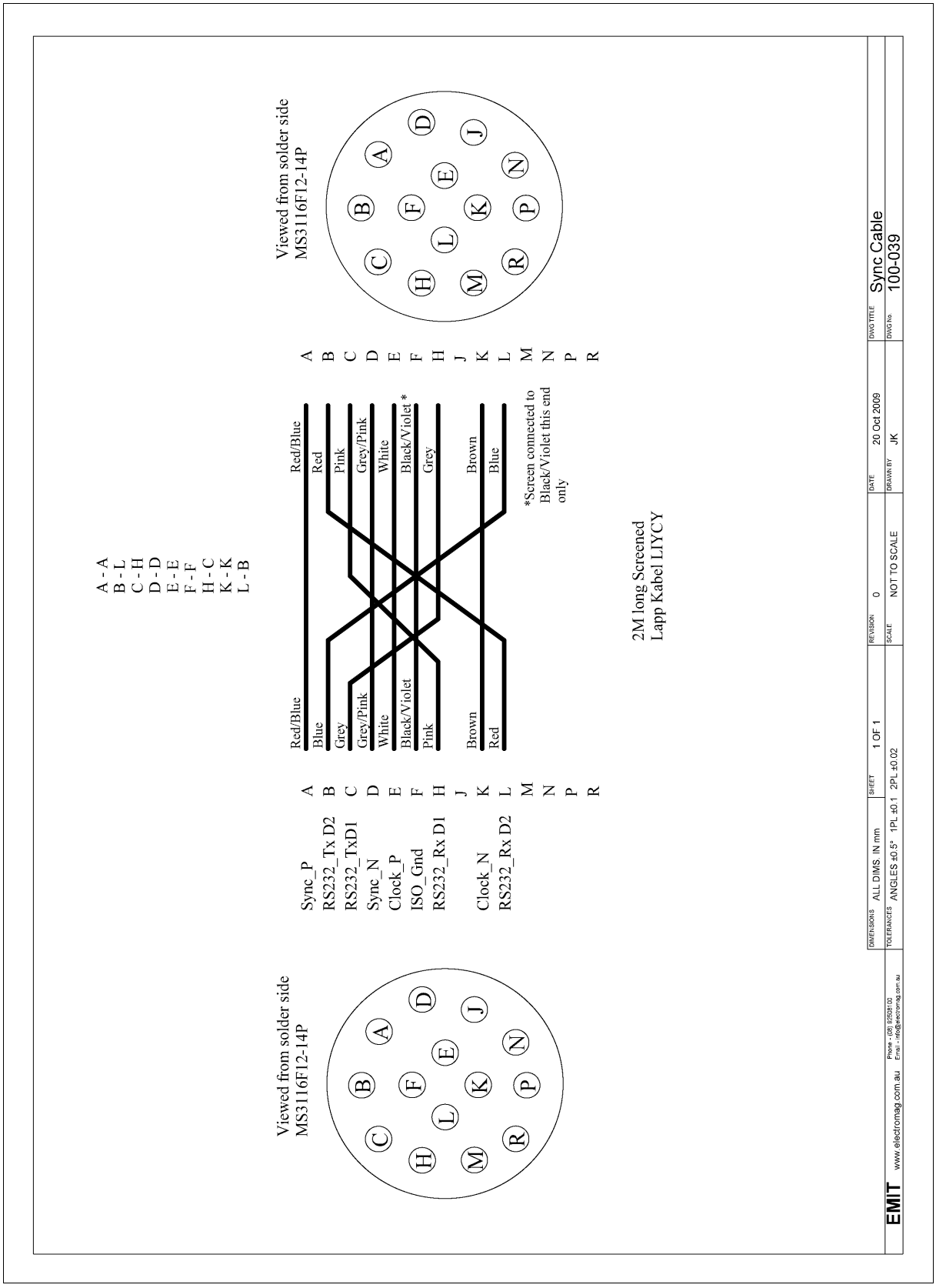
100-037: (DigiAtlantis Controller to Charger) cable



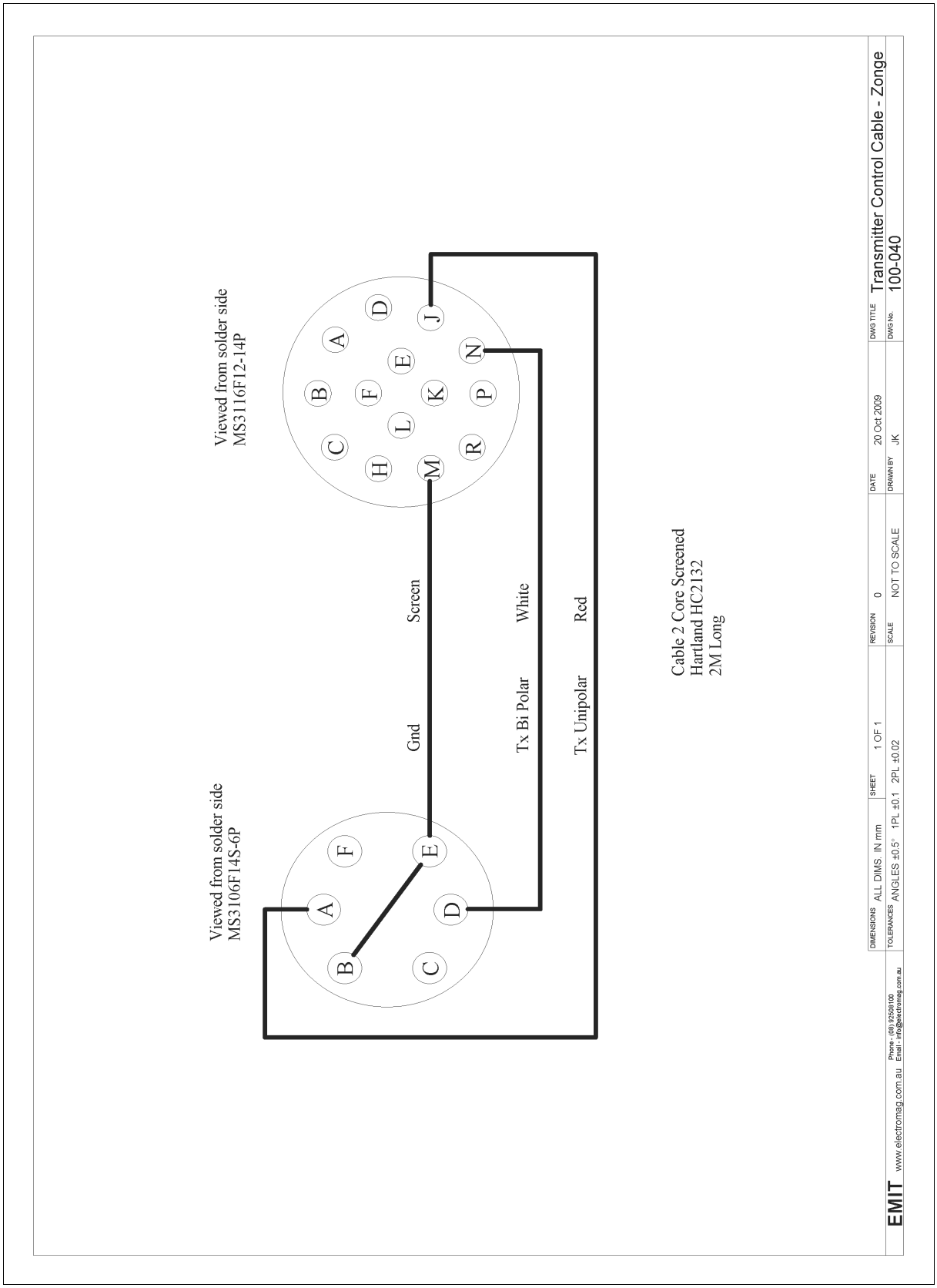
100-038: DigiAtlantis Probe to Charger cable



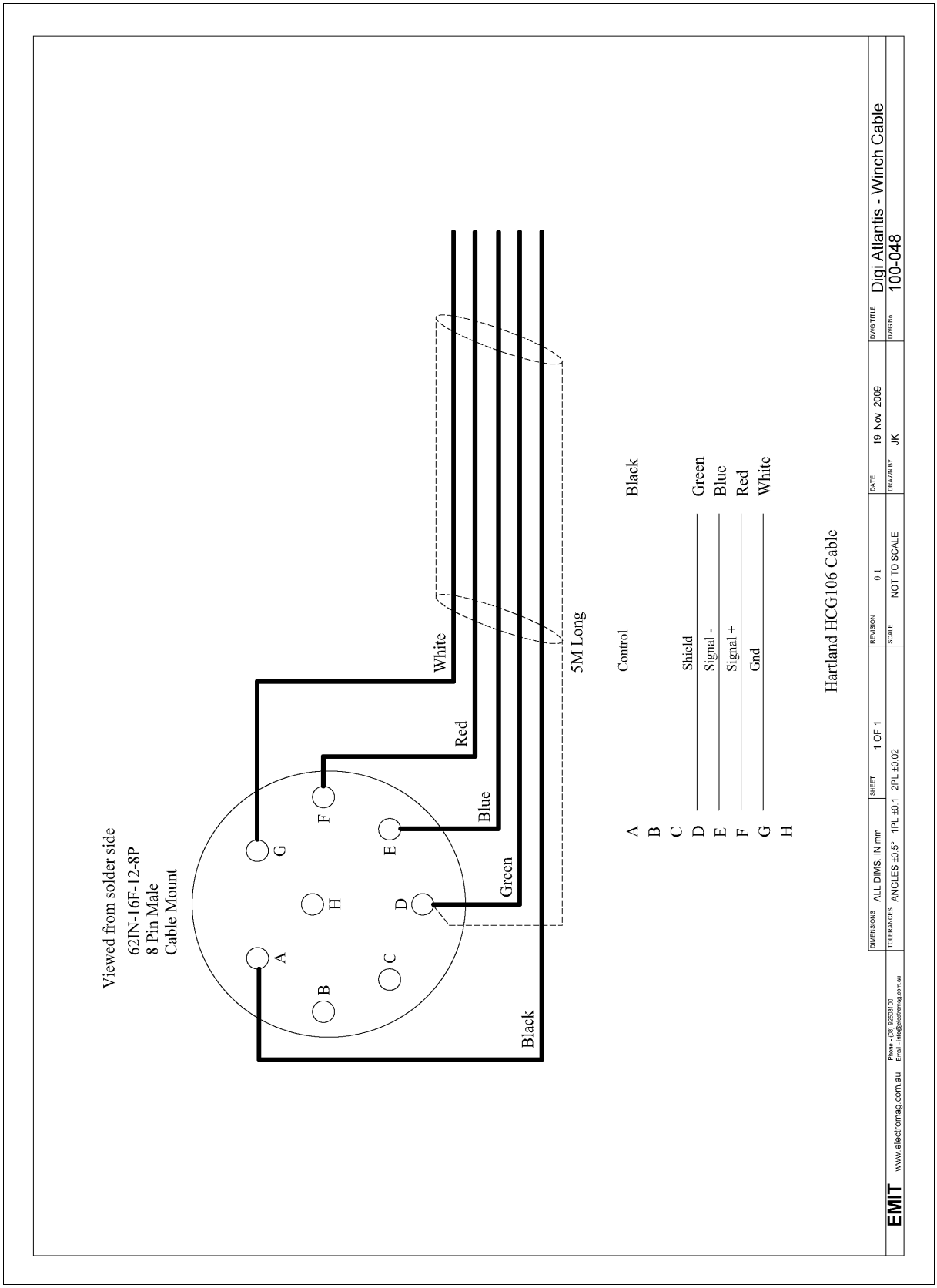
100-039: Sync cable



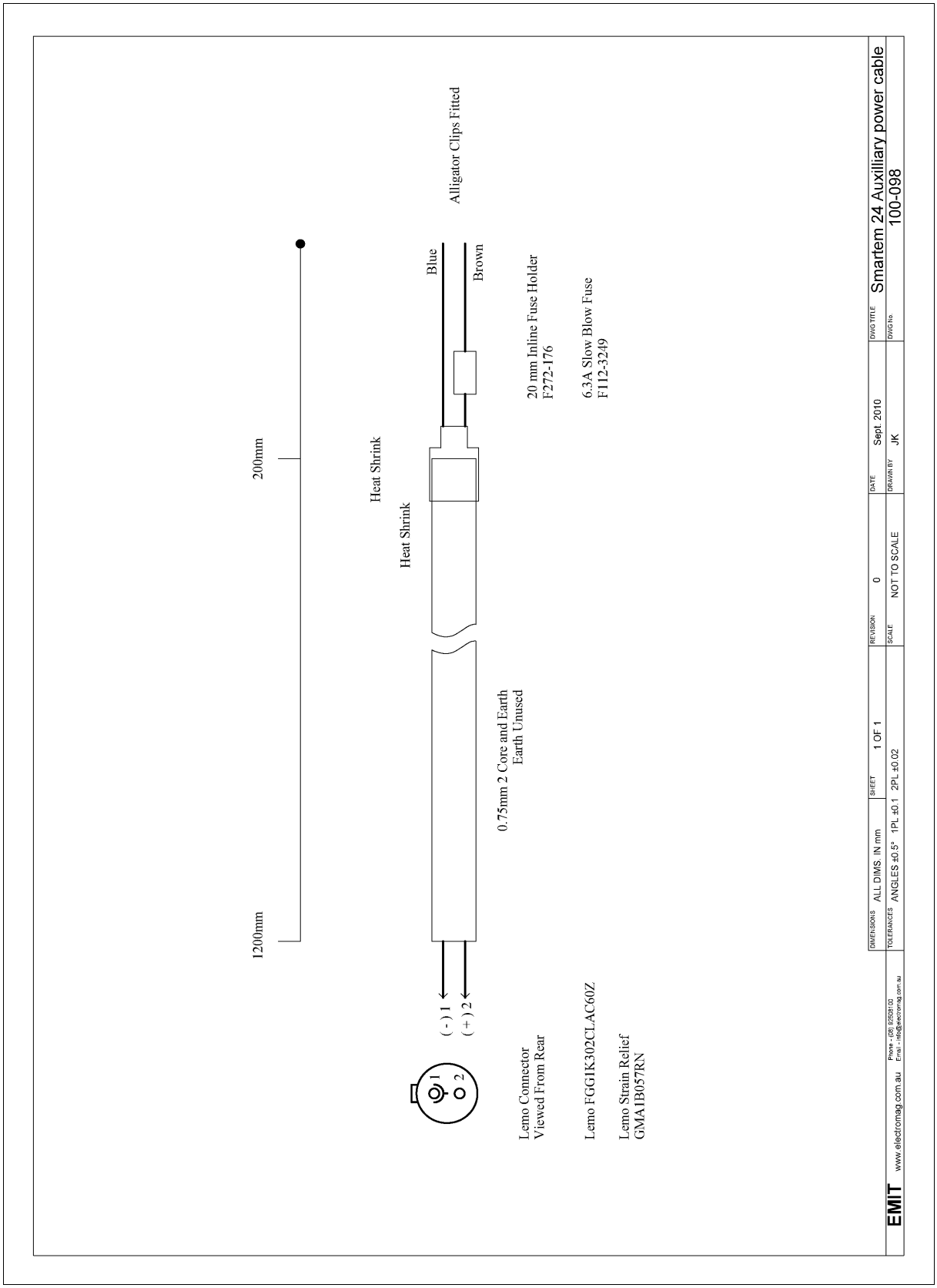
100-040: Transmitter Control cable – Zonge



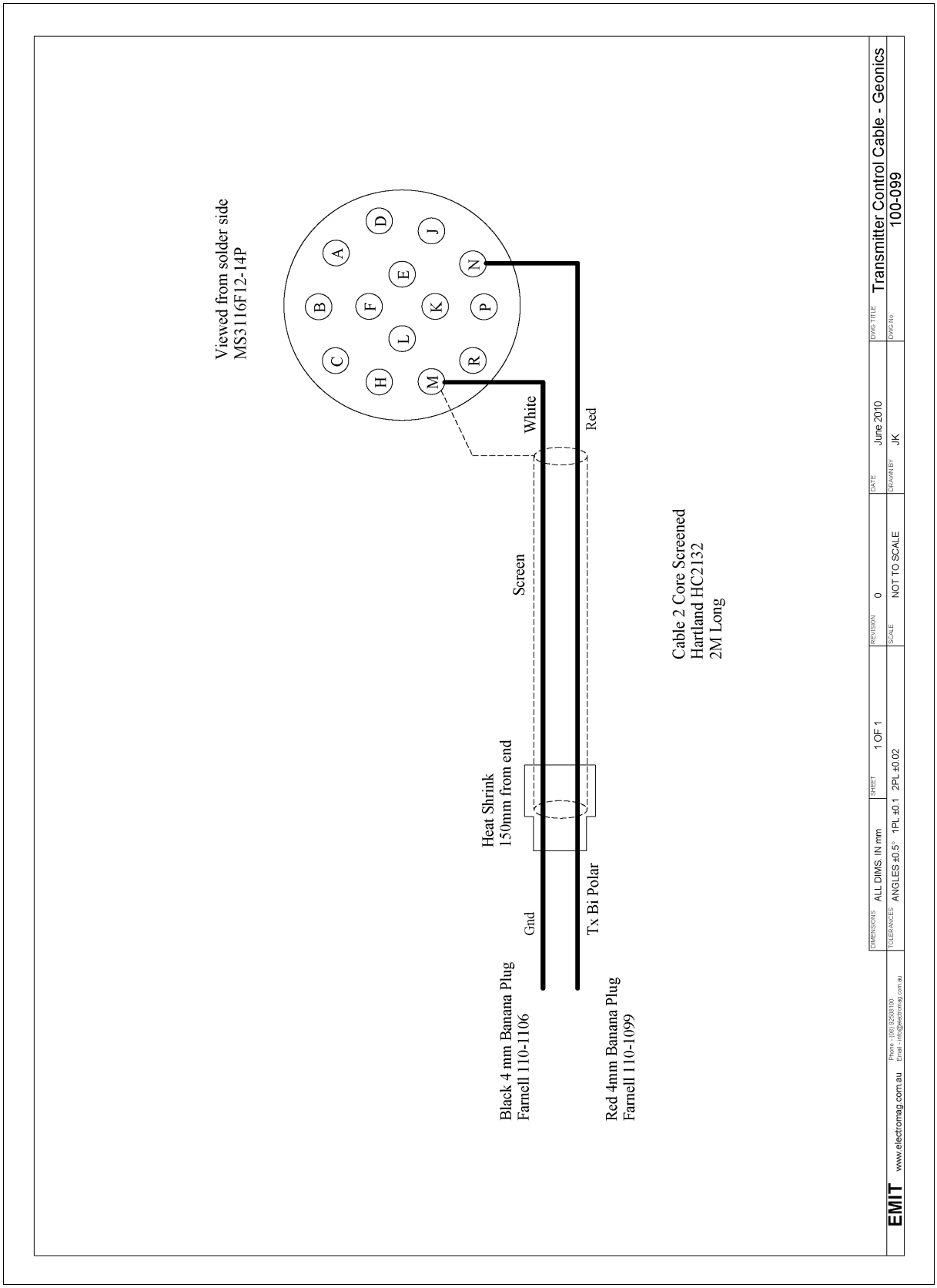
100-048: DigiAtlantis Controller to Winch cable



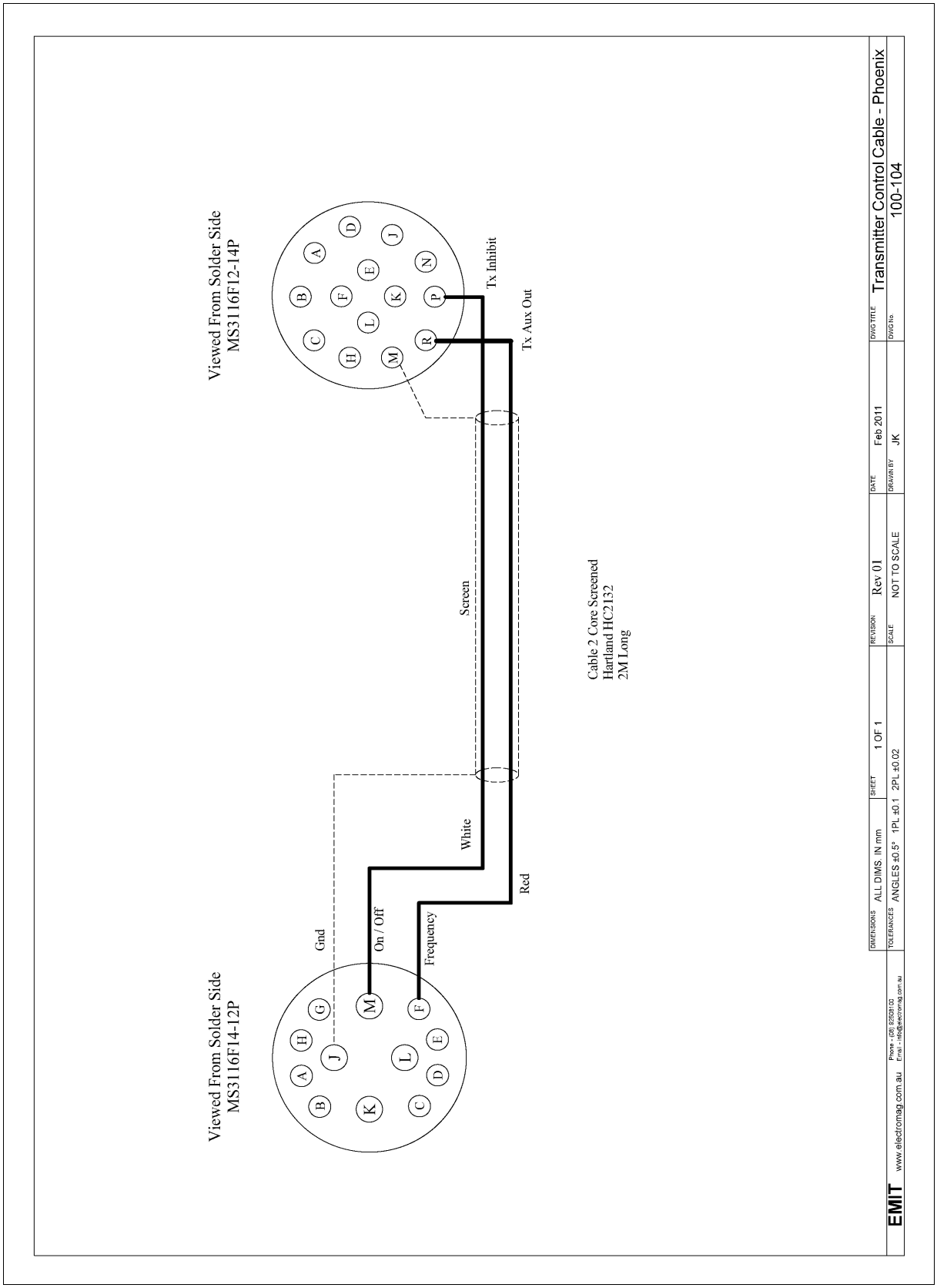
100-098: SMARTem24 Auxiliary Power cable



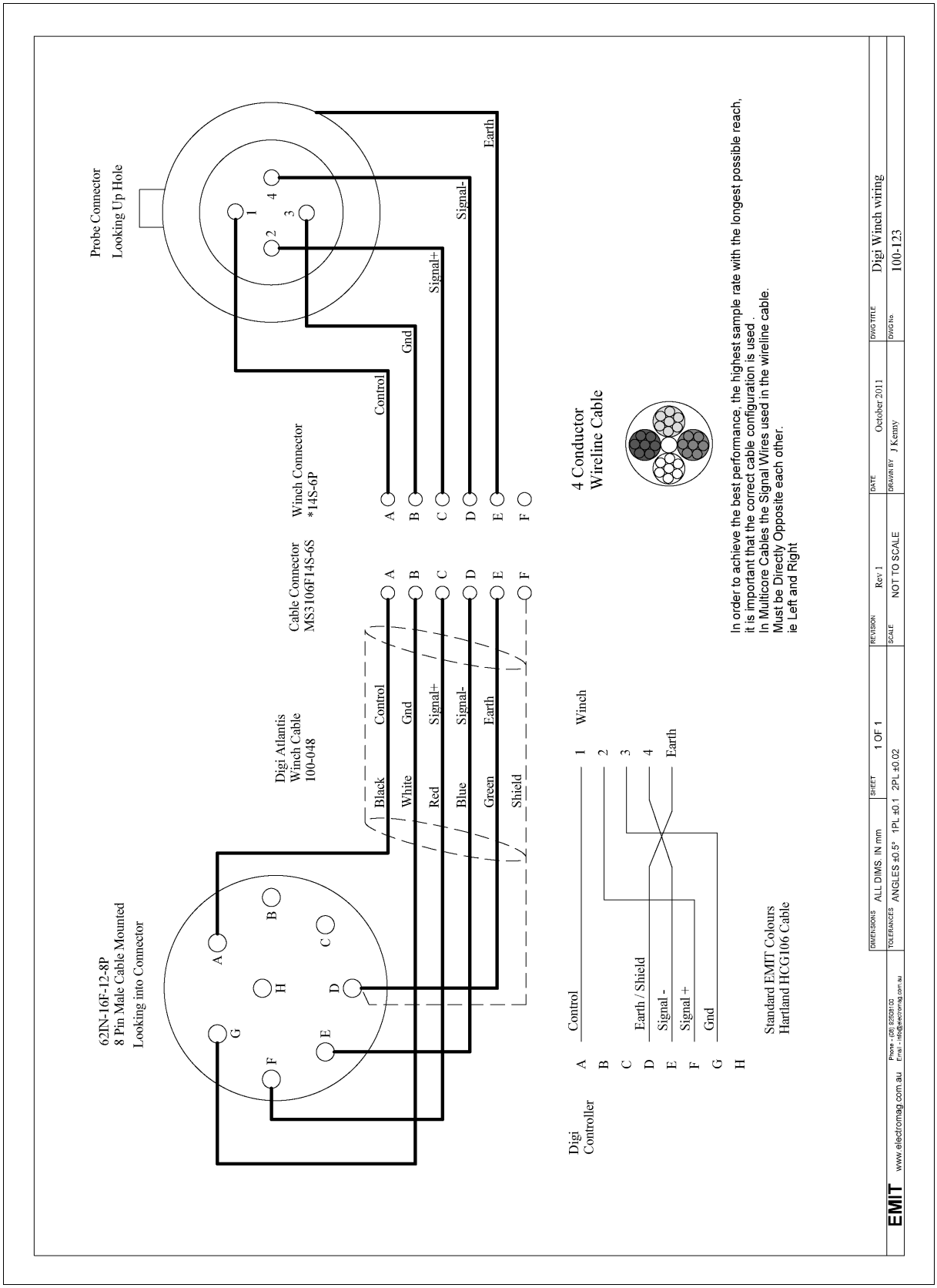
100-099: Transmitter Control cable – Geonics



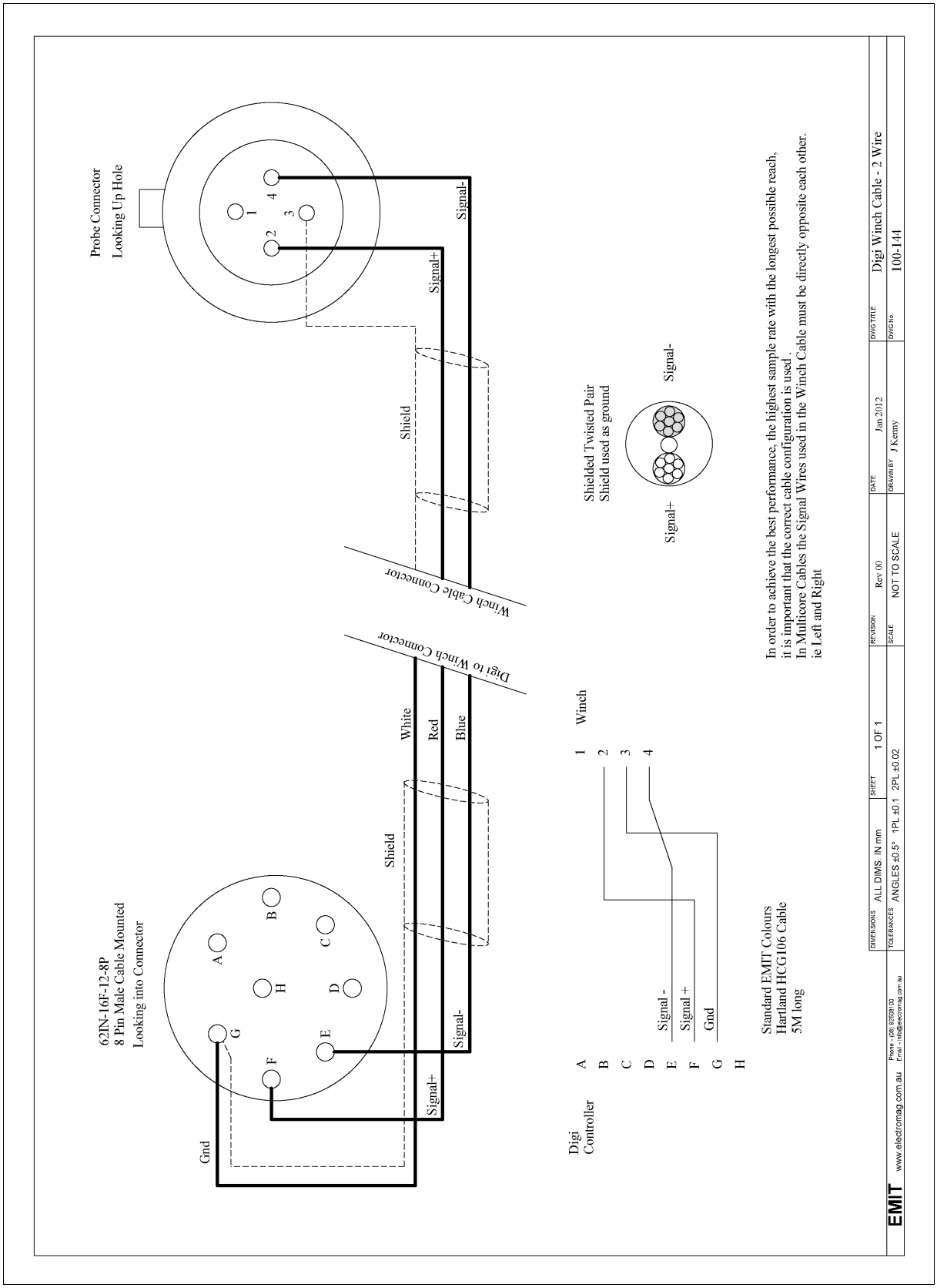
100-104: Transmitter Control cable – Phoenix



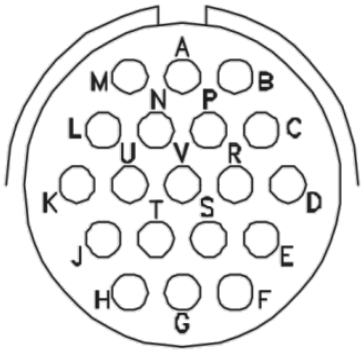
100-123: DigiAtlantis 4-core Winch cable



100-144: DigiAtlantis 2-core Winch cable



Analogue Input Connector wiring

		Function	
Amphenol 62IN-16F-14-19P 	**Pin**	**SMARTem24 Receiver**	**Controller (SMARTem24 & DigiAtlantis)**
	A	+13V out (100 mA max)	+15V out (100 mA max)
	B	Ch2 -ve	NC
	C	Ch2 +ve	NC
	D	Ch1 -ve	
	E	Ch1 +ve	
	F	SCL -ve	
	G	-13V out (100 mA max)	-15V out (100 mA max)
	H	SDA +ve	
	J	Ch4 -ve	NC
	K	Ch4 +ve	NC
	L	Ch3 -ve	NC
	M	Ch3 +ve	NC
	N	Ch3 Gnd	NC
	P	Ch2 Gnd	NC
	R	Ch1 Gnd	
	S	SCL +ve	
	T	SDA -ve	
	U	Ch4 Gnd	NC
	V	Power Gnd	

22 SMARTem24 Software

This section provides full details of operation of the SMARTem24 Software. This should be read in conjunction with the Quick Start Guide - Survey Setup - SMARTem24 Software in section 12.

Installation & Updates

Instructions for Updating SMARTem24 Software on the Receiver is included in section 18.

The software may also be installed on any PC for the purposes of QC and data processing. Please contact EMIT to arrange access should it be required.

Licensing

A software or dongle licence is required to run the SMARTem24 Software.

EMIT recommends the user check the status of their licence prior to commencing field work via the Licence Authorisation Form (see subsection 22.1.1.2). Software licenses have an expiry date, and the system will advise the user when approximately 5 days remain so a new license can be acquired. First time installations will require a license at first run.

Help function

The SMARTem24 Software has a Help Function which links to this document. Where available click on  help button, or press F1, for help on that topic.

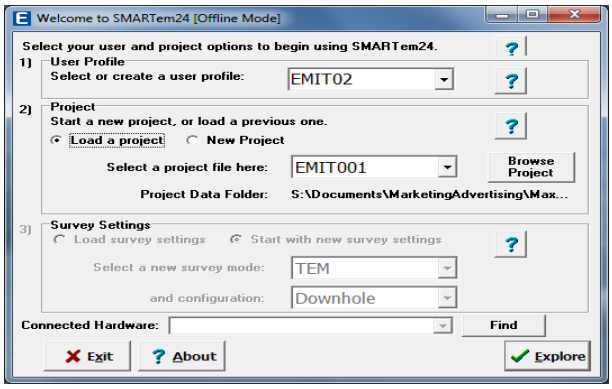
Starting SMARTem24 software

Start the software from either the desktop shortcut  icon or the Start menu.

When the program is started the Welcome Screen is displayed. This screen allows the user to prepare for a survey or access existing data for processing. This screen is also the last screen the user will see when exiting the SMARTem24 Software.

22.1 Welcome Screen

When the SMARTem24 software is started the Welcome Screen is displayed. This screen allows the user to prepare for a survey or access existing data for processing. This screen is also the last screen the user will see when exiting the software.



This section assumes that the hardware device to be used for the survey is already connected as detailed in earlier sections. If the SMARTem24 Software is being used with no hardware connected, eg in an office situation, some variation may occur.

User Profile

This loads predefined settings to view the data (which may then be changed) and is also saved as the operator name in the data file.

Settings are saved in a User Profile **ini*.file with the file name as the name entered here. When using the SMARTem24 Software any modifications to the data display settings are automatically saved to this file.

Select or create a User Profile: select an existing User Profile from the list or create a new one by editing the name. A User Profile must be specified for the software to run.

Project

Chose to load an existing project or start a new one.

Load a project: select the project to load from the list, or use the browse button to locate it. If you are continuing a survey from the previous day, use this option.

- the location of the loaded **.project* file will be displayed, along with its Survey Mode and Configuration.

New Project: enter the name of the new project to be created. This will typically be:

- borehole name for DigiAtlantis surveys
- line name for single line surveys
- area name for multi-line surveys
    - the location of the new **.project* file will be displayed.

Survey Settings

Choose to reuse settings from a previous survey or start with new Settings.

NB: Loaded Projects will start with their previously saved settings and so this option is disabled.

These settings defines the mode and configuration of the survey to be undertaken and are saved in the settings **.sini* file. These two settings cannot be changed once the project has been created, and they will constrain some software options (eg DigiAtlantis specific processing) but not others (eg base frequency, stacks, etc).

Load settings: select this option if your (new) project will use similar settings to a previous survey. Select the settings **.sini* file from the list.

- mode and configuration used in the selected settings file will be displayed.

Start with new settings: select this option to use the settings selected below:

- **Survey mode**: select mode of survey from the drop down list.
    - TEM or MMR must be selected for DigiAtlantis surveys
- **Configuration**: select the configuration from the list.
    - Downhole must be selected for DigiAtlantis surveys .

Device

This is the device that will be used for the survey.

Text box: The device presently connected and powered on should be displayed,along with its IP address. If a different device is shown, reselect from the list provided or click the Find button to locate it.

- It is essential the equipment is connected and powered on prior to clicking the Find button.

Other buttons

Explore button: click to enter the application to define survey specifications and acquire, process or display data.

Exit button: click to exit the program.

About button: click to open the About Windowfor information on the software version number and license status. See subsection 22.1.1.1.

22.1.1.1 About Window

This displays the software version, and provides a link for Help or Security Licensing Info.

This window can be accessed via the Welcome Screen > About button.

Security Info & Options button: click to access the Licence Authorisation Form for licence status and requesting renewal of the licence. See subsection 22.1.1.2.

22.1.1.2 Licence Authorisation Form

The SMARTem24 Software requires a security licence to run. This form displays the authorised security type, time remaining and details for requesting a renewal of the license.

This form can be accessed from the Welcome Screen > 'About' button > 'Security Info & Options' button.

Security: Is either 'Dongle' (if plugged in) or 'Software Key'.

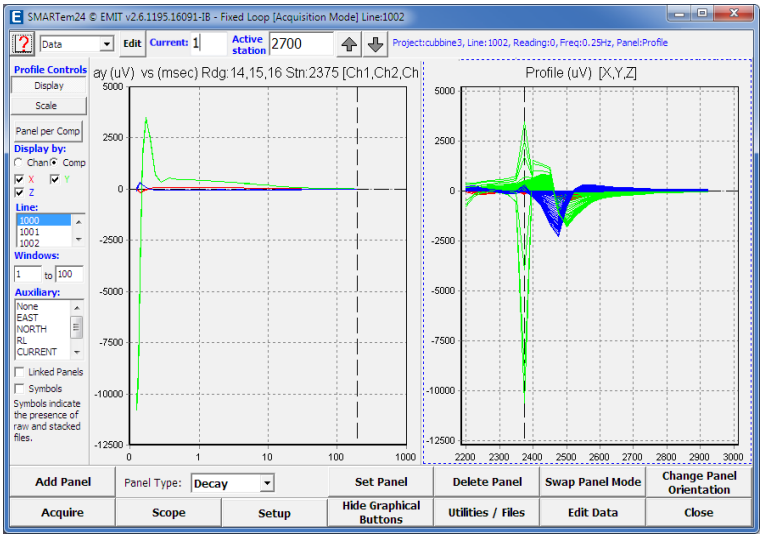
Remaining: Displays the remaining days left of the license.

To request a new licence follow the instructions detailed on this form.

22.2 Main Screen

This is the main data display area and is displayed after clicking 'Explore' button on the Welcome Screen.

This window displays the data as Graphical Panels (charts). General survey information is displayed along the top in blue text. Additional menus down the left and along the top and bottom provide the controls to customise the display of this data and information.



Information Bar (top): displays general information about the survey; provides controls for changing the active station, and controls for selecting and editing Views. See subsection 22.2.3

Graphical Panels (centre): refers to each of the charts that display the acquired data for the active line/station. The quantity, type and layout of these panels can be changed using the **Graphics Buttons** along the bottom. The information displayed in each panel can be modified using the **Control Menu** on the left. The panel presently selected will have a dashed-blue border. Select the panel by clicking on it. See subsection 22.2.6

Graphics buttons (bottom): Use these buttons to configure the type of panels displayed and the screen layout of those panels. See subsection 22.2.2

Main Menu (bottom): Use these buttons to collect and process data. Refer the next section for each of these. See subsection 22.2.5.

Options Menu (left side): options for configuring the displaying the data in each Graphical Panel. There are multiple Tabs each for specific aspects of the panel. There is an Options menu for each panel type - only one Options menu is displayed at any time, and it updates upon selection of a Panel – the selected Panel having a dotted blue border. See subsection 22.2.4.

22.2.1 Overview – Graphical Panels & Views

The display of data in SMARTem24 software is based around the concept of Views and Graphical Panels.

Graphical Panels are the individual charts that display the various data. Only one type of data can be displayed in each panel, but multiple panels of the same, or different, type may be displayed. For example, two components of data may be displayed in a single Decay Panel, along with a Profile Panel for Z component and another Profile Panel for X component. Each of these may be scaled and zoomed independently using the options on the **Control Menus**. The number of panels, their orientation and their display order can be modified using the **Graphical Buttons.**

To assist displaying data in multiple ways a default set of **Views** is supplied with each view containing Display Panels pertinent to the View type. For example the Data View has a Decay Panel and a Profile Panel. The Acquire View has multiple Scope panels – one for each input channel. These Views can be swapped using the drop down list at the top left in the Information Bar. Swapping between Views therefore provides a convenient method of redisplaying data, rather than constantly adding and deleting or changing Panel types.

For new users a default set of Views are loaded. These can then be customised within the software and are automatically saved to the current **User Profile** when the software is closed. Settings will only be saved to the currently loaded User Profile.

Viewing of data within SMARTem24 software therefore depends on the Views contained within the selected User Profile on the Welcome Screen rather than being saved with the Project.

Further explanation is contained in the following subsections.

22.2.1.1 Views

A view is a collection of Graphical Panels, and their associated settings (such as panel layout), that form the basis of the Main Screen display. The selected view is displayed on the Information Bar. A useful collection of views will allow the user to see their data in many different ways by simply swapping to a different view, as needed.

A standard collection of views is provided with the install and five Views are used as the default settings for new users (ie a new user profile). These Views are:

- **Raw view**: contains a single Raw panel to display raw data already collected (and saved).
- **Acquire view**: contains a single Scope panel and provides an oscilloscope, or live, display of the data being received from the device. This screen is displayed during the acquisition cycle.
- **Stacked view**: contains a single Stacked panel in which processed stacked data already collected (and saved) from a device is displayed, for all input channels.
- **(MMR) Data view**: contains a (Argand) Decay panel and a Profile panel. This screen is displayed once the acquisition cycle has completed.
- **Profile view**: contains a single Profile panel in which a profile of the survey data is displayed.

Customising Views

The list of Views can be edited via the Graphical Options Form. Views can be saved to file, which allows easy access to standard views for different projects.

The configuration of the panels in the current view can be changed using the Graphics Buttons near the bottom of the Main screen. These buttons (add, swap, delete etc) allow the overall view layout to be customised.

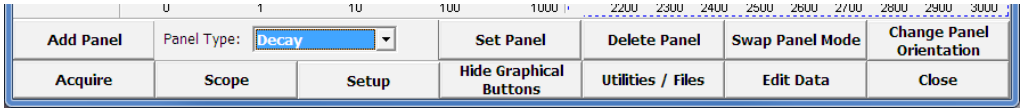
The data displayed in each panel can be further edited by utilising Control Menu options down the left side.

View Behaviour

When acquiring data the Main Screen will automatically switch to the 'Acquire' view and upon completion of the reading will automatically switch back to the 'Data' view. Change Views by selecting from the drop down list.

22.2.2 Graphics Buttons

These buttons near the bottom of the Main Screen control the type of graphical panels displayed, and configures the screen layout of those panels. These button operations will apply to adding new panels or to the currently selected panel – which can be recognised by having a blue dashed border.



This Graphics Button menu can be displayed or hidden – this is controlled by clicking the 'Show/Hide Graphical Buttons' button in the Main Menu along the bottom of the Main Screen. Each of the buttons is described below.

Buttons

Panel Type list: select from the list the panel type to be added or set. The panel types listed are limited by the survey type, and will include a selection of these types. This selection will used by the Add or Set Panel buttons.

- Scope: oscilloscope view of input channel data
- Raw: display raw data for single channels, by whole or sections of file
- Stacked:display stacked data for all or single channels
- Decay (TEM projects only): display decays as log and/or linear scale for all or single channels
- Argand (MMR projects only): display MMR data as frequency plots
- Profile (TEM projects only): display profiles of TEM data for all or single channels
- MMR Profile (MMR projects only): display profiles of MMR data for all or single channels
- Plan: display all survey information as plan, load a background image, plan stations.

The Control Menu will change to reflect the options available for the selected panel. See section 22.2.4.

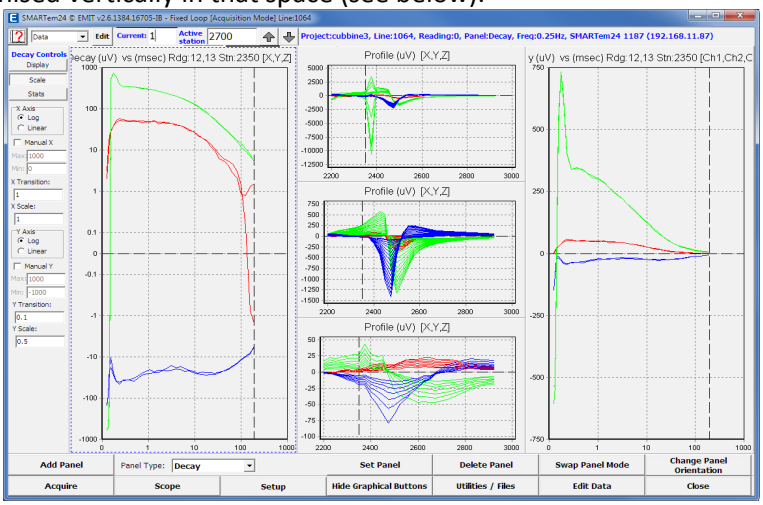
Add Panel button: click to add a panel of the selected type.

Set Panel button: click to change the selected panel (has the blue dashed border) to the selected type.

Delete Panel button: click to delete the selected panel (has the blue dashed border).

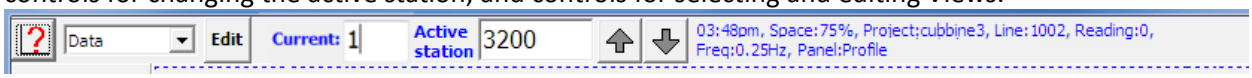
Swap Panel Mode button: select a panel to be swapped, then click this button to initiate the swap process and then click the destination panel. The two selected panels should have swapped places on the screen.

Change Panel Orientation button: click to change between vertical (portrait) mode, horizontal (landscape) mode and group mode. In group mode, panels of the same type that are in sequential order take up the space of one panel, and organised vertically in that space (see below).



22.2.3 Information Bar

This area along the top of the Main screen displays general information about the survey, provides controls for changing the active station, and controls for selecting and editing Views.



This Information Bar is always displayed on the Main screen.

Controls

Preferences button: click to toggle on/off the display of Control Menus (section 22.2.4).

View drop down list: select the View type from the list to swap between predefined display settings. For a new user this will initially list the default views which include, Acquire, Raw , Stacked and Data. If Views are added, deleted or renamed then the list will update.

Edit button: click to open the Graphical Options Form (see subsection 22.2.3.1) which allows the user to set default Views; rename, import and save Views; and also customise the information displayed in the **General Status Information bar**(see below).

Current: displays the transmitter current. Values can be edited.

Active station: displays the current Station that the next acquired reading will be saved to. Values can edited or incremented using the adjacent arrow buttons (see below) or the *[* and *]* short cut keys. This location is displayed as a medium sized red dot on the Plan Panel.

Up / Down arrows: click a button to increment / decrement the displayed **active station** (see above) by the increment value defined by the Main Menu > Setup > Survey Stations > Increment Distance value. See Survey (Setup) Screen in section 22.5.2

General status information bar: displays commonly referenced information regarding the survey. The information displayed can be customised via the **Edit button** (see above) > Graphical Options Form, as detailed below in subsection **22.2.3.1**

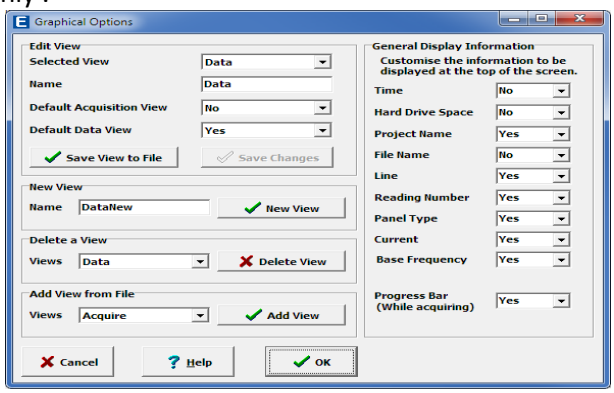
22.2.3.1 Graphical Options Form

This form allows the user to customise Views and the information displayed in the Information Bar of the Main Screen.

On the left side the user can edit, add and remove Views. These will update the options available in the View drop down list.

On the right side the user can choose which general information is to be displayed along the top of the Main Screen.

This information is saved to the current User Profile only .



This form is accessed via the 'Edit' button on the Information Bar along the top of the Main Screen.

Edit View

Use these options to rename Views, save Views to file and set the default Views to be used during and after the acquisition cycle.

Selected View: select from the list the View to be edited/selected. This will only list Views in the current User Profile – if required, change the list using the buttons further down the screen.

Name: edit the name of the View.

Default Acquisition View: chose whether the **selected view** is the View to be displayed during the acquisition cycle. Selecting 'yes' will reset any other Views to 'no'.

Default Data View: chose whether the **selected view** is the View to be displayed on completion of the acquisition cycle. Selecting 'yes' will reset any other Views to 'no'.

Save View to File button: click to save a View file with this **Name**.

- This file can be distributed to other users so that the same display configuration may be utilised.

Save Changes button: click to apply and save these changes.

New View

Name: edit the name of the new View

New View button: click to create a new View file with this name. This will be added to the View lists.

Delete a View

Name: select from the list the View to be removed/deleted.

Delete View button: click to delete the selected View for the User Profile. This will no longer be available in the View lists.

Add View from File

Name: select from the list the name of the View file to be added to this User Profile.

Add View button: click to import the selected View file. This will be added to the View lists.

General Display Information

Select which general information to display in the Information Bar.

Time:

Hard Drive Space: displays percentage (%) of disk space on the receiver is available for saving data.

Project Name: displays the name of the current project, as defined/selected on the Welcome Screen during startup.

File Name: displays the name of the current data file, as defined/selected via Utilities/Files Form or Setup > Files (and Folders) Screen.

Line: displays the active line that the next acquisition will be saved to, as selected via Setup > (Setup) Summary Screen. Note that this may be different to the data currently being displayed.

Reading Number: displays the last reading number. The next acquisition will increment this value.

Panel Type: displays the type of Graphical Panel currently selected – this will have the blue border.

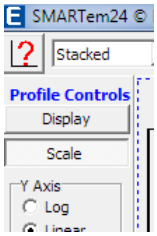
Current: displays the value of the effective transmitter current, as defined in the Main Menu > Setup > (Setup) Summary Screen or Transmitter (Setup) Screen

Base Frequency: displays the current base frequency setting, as defined on Main Menu > Setup > Timing (Setup) Screen.

Progress Bar: during acquisition this will display the progress over time of the acquisition cycle, presented as a blue bar and a percentage (%) value.

22.2.4 Control Menu

Control Menus are displayed down the left side of the Main screen and provides user control for the data displayed in each Display Panel. Display of the Control Menus can be turned on/off using the preferences (question mark) button on the Information Bar.



There is a Options menu for each panel type and has the same name, eg Profile Options for the Profile Panel. Only one Control menu is displayed at any time, and it updates upon selection of a Panel – the selected Panel having a dotted blue border. Select a new Panel by clicking on it with the cursor/mouse.

The options appear as buttons, check boxes, list items or cells for entering values.

For ease of use the options are further organised into Tab displays which have similar general functionality between the panel types. The available Tabs are:

Display Tab: constrains the information being displayed (eg components or channels, station, spectra, auxiliary, loops) and drawing style (eg symbols)

Scale Tab: constrains the axis limits (eg log or linear, min & max value, zooming), cycle to next station.

Stats Tab: calculates & display statistics for the displayed data.

Setup Tab: design survey stations & lines, add or remove stations

Image Tab: load and locate images to display as a background (Plan Panel only)

Full detail for each Control Menu option, as they appear for each Graphical Panel and organised by Tab type is detailed in section 22.2.6.

22.2.5 Main Menu

Provides access to the main screens, forms and dialogues used for setting survey parameters, viewing data during acquisition, and processing data.

Acquire button: click to initiate the acquire process that will collect and save data to file. See section 22.2.

Scope button: click to initiate the Scope mode and display input channel data in real time. Data will NOT be saved to file.

- For a new survey it is recommended that channel input data be displayed in Scope mode and confirmed for integrity prior to acquiring data via the Acquire button. See section 22.4

Setup button: click to edit all parameter settings for the survey. See section 22.5.

Show/Hide Graphical Buttons button: click to display graphical buttons as a row immediately above these buttons. Click button again to hide this extra row of buttons.

Utilities / Files button: click to edit, create or rename data files, and to gain access to DigiAtlantis specific and general reprocessing options. See section 22.6.

Edit Data button: click to edit data or stacked files to add comments, change transmitter current, turn off times or adjust stacked files for synchronisation issues. See section 22.7

Close button: click to return to the Welcome Screen.

22.2.6 Graphical Panels & Options

Graphical Panels are charts of various types that display the acquired data. These include:

- Scope: oscilloscope view of input channel data
- Raw: display raw data for single channels, by whole or sections of file
- Stacked:display stacked data for all or single channels
- Decay (TEM projects only): display decays as log and/or linear scale for all or single channels
- Argand (MMR projects only): display MMR data as frequency plots
- Profile (TEM projects only): display profiles of TEM data for all or single channels
- MMR Profile (MMR projects only): display profiles of MMR data for all or single channels
- Plan: display all survey information as plan, load a background image, plan stations.

The quantity, type and layout of these panels can be configured using buttons on the Graphics Buttonsmenu (see **section 22.2.2**).

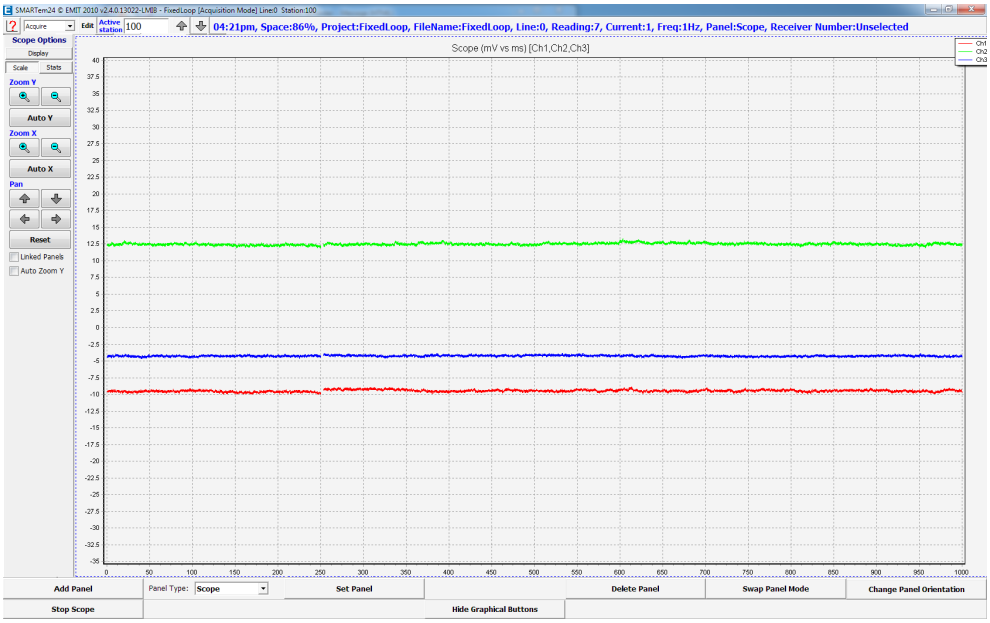
The data being viewed can be adjusted using the Control Menu (see **section** 22.2.4).

The options for each Control Menu Tab, organised by Graphical Panel type, are included in the following subsections.

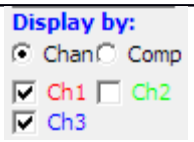
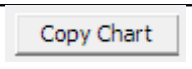
22.2.6.1 Scope Panel

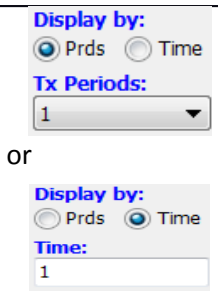
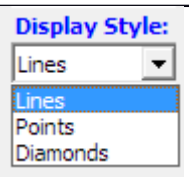
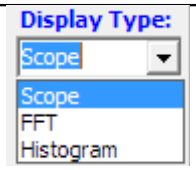
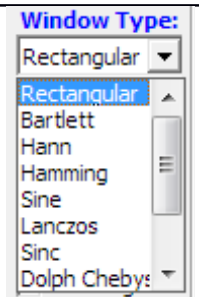
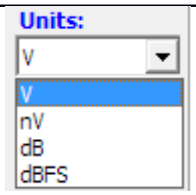
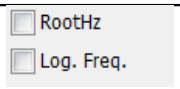
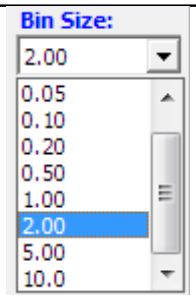
This panel displays in real time the voltage levels for selected channels. All channels can be displayed on a single panel, or many panels can be used to display the channels separately. **Scope** panel will only update and display data during an acquisition or in scope (data not saved to file) mode. Options are similar to the Raw Panel.

The heading *Scope (mV vs ms) [Ch1,Ch2,Ch3]* provides the user with details of the data being viewed.

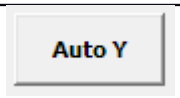
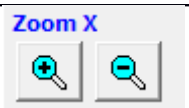
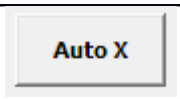
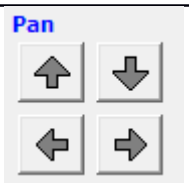
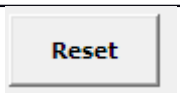
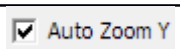


22.2.6.1.1 Scope Options – Display Tab

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Copy Chart**: Click this button for a screen capture of the selected Scope panel.
	**Plot stacked**: Select to display **stacked** voltages of the sensors. This option is only enabled when the user has selected *Real Time Processing* in the Setup Screen (see **section** 22.5).

	**Display by**: Choose whether to display Scope panel by (transmitter) TX Period or Time. Then define the length of display by either selecting from the list below how many TX periods to display, or enter a time period value in msecs.
	**Display Style**: Select from the drop-down list the display style of data points for Raw or Scope Panels. Lines: connect data points by a line (no symbols) Points: draw symbol for each data point (no lines) Diamonds: draw larger symbol for each data point (no lines)
	**Display Type**: Select from the drop-down list to display as Scope or spectra options: • Scope: time series display • FFT and then also select Window (FFT) Type, Units and vertical axis. • Histogram and then also select Bin Size.
	**Window (FFT) Type**: Select from the drop-down list the type of FFT to apply. This is an additional control when 'Display Type' as FFT is selected on Scope panel.
	**Units**: an additional control when 'Display Type' as FFT is selected on Scope panel.
	**An** additional control when 'Display Type' as FFT is selected on Scope panel. **Root Hz**: display axis as root Hz, rather than Hz **Log Freq**.: display axis as log scaler, rather than linear
	**Bin Size**: an additional control when 'Display Type' as Histogram is selected on Scope panel. Select the bin size for the histogram.

22.2.6.1.2 Scope Options – Scale Tab

	Zoom Y: click a button to manually zoom Y axis in or out. Zoom value depends on Log (1 decade per click) or Linear (50% / 200%) scales.
	**Auto Zoom Y**: click to automatically scale Y axis from first waveform. If the signal drifts off, the user will need to click the button again each time.
	**Zoom X**: Click on a button to manually zoom X-axis in or out. Zoom amount depends on scales : Log (1 decade per click) or Linear (50% / 200% per click).
	**Auto X**: click to Set the X axis extents to include all data - as defined by the selection from the Display Tab > **Display By** control (eg 2 periods, or 3 seconds).
	**Pan**: Click on a button to pan around the panel. Shifts the panel in that direction. Pan amount depends on scales: Log (1 decade per click) or Linear (25% per click))
	**Reset**: click to auto scale the axes limits.
	**Linked Panels**: if checked, all panels of this type (Scope) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Scope panels in the view, such as panning and zooming.
	**Auto Zoom Y**: select to automatically scale Y axis from first waveform at the start of each reading. If the signal drifts off, the user will need to click the **Auto-Y** button.

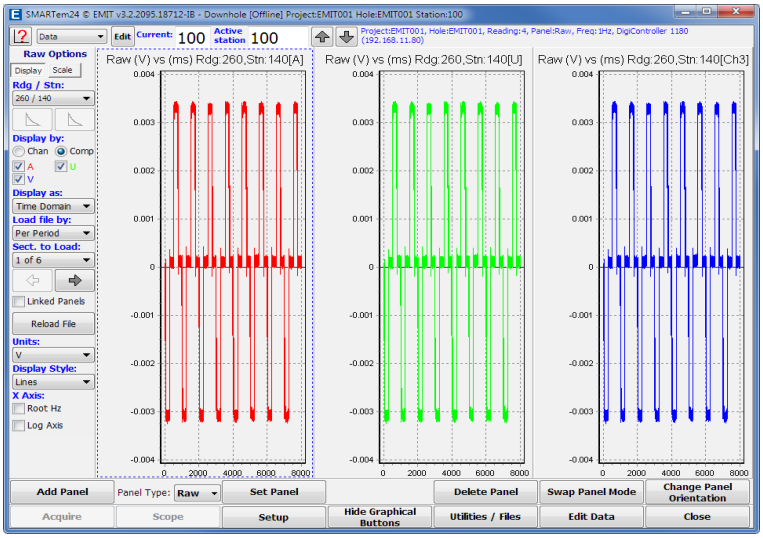
22.2.6.1.3 Scope Options – Stats Tab

Average(V):	**Average (V)**: displays the average voltage (V) for the data currently displayed.
Peak(dB@Hz):	**Peak (dB@Hz)**: displays the magnitude (decibels) and frequency (Hz) of the highest frequency component.
THD(dB):	**THD(dB)**: Total Harmonic Distortion (decibels) of the Peak signal.
THD+N(dB):	**THD+N(dB)**: Total Harmonic Distortion plus noise (dB) of the Peak signal.

22.2.6.2 Raw Panel

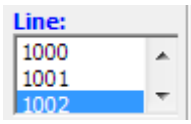
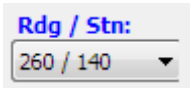
This panel displays raw files. Due to their large size, options are provided to display a file in sections.

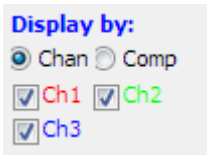
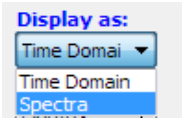
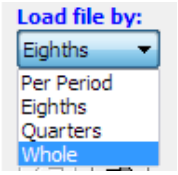
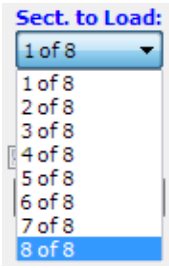
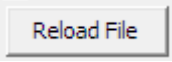
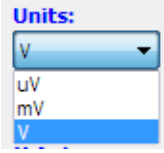
The heading *Raw (V) vs (msec) Rdg: 297 Stn:10* provides details of the data being viewed.

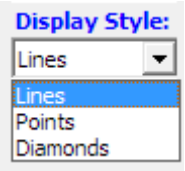
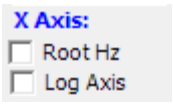


Note: For DigiAtlantis (only) Raw and Stacked files, the cross-components are saved in their raw orientations [X,Y] and have not been rotated to be aligned with borehole azimuth. Rotation to borehole azimuth is performed when Stacked data is windowed and saved to data file as [U,V] components. Also note that the polarity of Z and Y in Raw and Stacked files are reversed to that of final [A,U,V] data due to orientation of sensors in the probe housing.

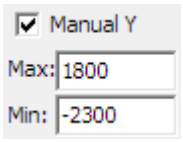
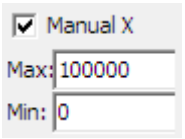
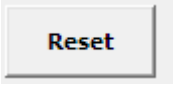
22.2.6.2.1 Raw Options – Display tab

	**Line**: Select which line to display. Only displays for multi-line files. Note that the displayed line may be different to the active line displayed on the Information Bar.
	**Rdg/Stn**: Select from the drop-down list the Reading/Station to be displayed. Only one item can be selected.
	**Left / right arrow**: Click a button to display previous or next Station/Reading Button hover hint depends on 'Display by:' option.

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Display as**: Select from the drop down list the style of display of raw data. • Time Series (amplitude vs seconds) • Spectra (dB vs Hz)
	**Load file by**: Select from the drop-down list which portion of the raw file to display. 'Whole' file will be slower to refresh than 'per period'. The portion chosen will also set the upper and lower limits for Manual X selection on the Scale Tab.
	**Sect. to Load**: Select from the drop-down list which adjacent section of the raw file to display. List items will depend on the 'Load file by:' option. The section chosen will also set the upper and lower limits for Manual X selection on the Scale Tab.
	**Left / right arrow**: Click a button to display Previous or Next section of the raw file. Will automatically decrement/increment the 'Sect. to Load' item.
	**Linked Panels**: if checked, all panels of this type (Raw) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Raw panels in the view, such as panning and zooming.
	**Reload file**: Click button to Reload the raw file.
	**Units**: Select from the drop-down list the units to display the time series data as.

	**Display Style**: Select from the drop-down list the display style of data points for Raw or Scope Panels. • Lines: connect data points by a line (no symbols) • Points: draw symbol for each data point (no lines) • Diamonds: draw larger symbol for each data point (no lines)
	**X Axis**: Additional scaling of x-axis when data is displayed as Spectra. **Root Hz**: select to display X-axis as root Hz, rather than Hz. **Log Axis**: select to display X-axis as log scale, rather than linear

22.2.6.2.2 Raw Options – Scale Tab

	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values. Limits on the values depend on the choice of 'Load file by' and 'Sect. to load' on the Display Tab.
	**Zoom Y**: Click on a button to manually zoom Y axis in or out. Zoom value depends on Log (1 decade per click) or Linear (50% / 200%) scales.
	Zoom X: Click on a button to manually zoom X- axis in or out. Zoom amount depends on scales : Log (1 decade per click) or Linear (50% / 200% per click).
	**Pan**: Click on a button to pan around the panel. Shifts the panel in that direction. Pan amount depends on scales: Log (1 decade per click) or Linear (25% per click))
	Reset: click to auto scale the axes limits.

22.2.6.3 Stacked Panel

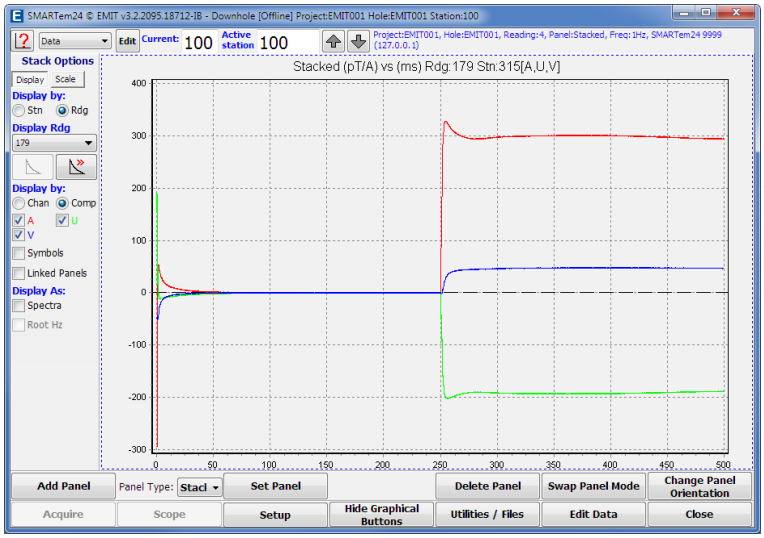
This panel displays **Stacked** files either by station or reading number and then on a per component or channel basis, depending on Options settings.

The heading *Stacked (pT/A) vs (msec) Rdg: 183,184 Stn:305 [Z,X,Y]* provides details of the data being viewed.

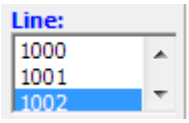
The time axis represents the entire stacked file – being from the start of turn-off (time zero) to the start of turn-off for the next half waveform.

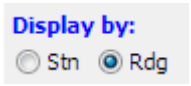
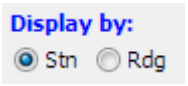
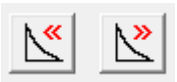
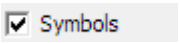
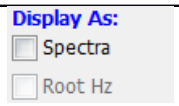
Note that for DigiAtlantis Raw and Stacked files for cross-components are in their raw orientations [X,Y] and have not been rotated to be aligned with borehole azimuth. Rotation to borehole azimuth is performed when Stacked data is windowed and saved to file as [U,V] components. Also note that the polarity of Z and Y in Raw and Stacked files are reversed to that of final [A,U,V] data due to orientation of sensors in the probe housing.

When only one curve is displayed a statistical analysis will be performed to show the mean, standard deviation and standard error of the mean.

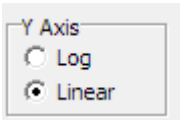
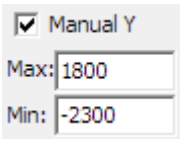
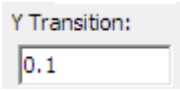


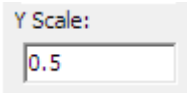
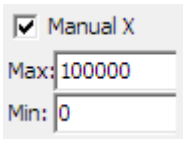
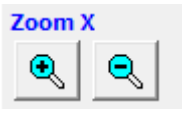
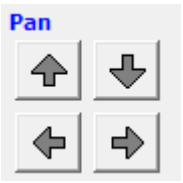
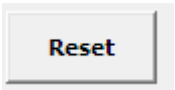
22.2.6.3.1 Stacked Options – Display Tab

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Line**: Select which line to displayed. Only displays for multi-line files.

 or 	**Display by**: Select whether to display data by station or reading.
 or 	**Display Stn / Rdg**: Select which Station(s) or Reading(s) to be displayed. Multiple selections are possible by holding down the CTRL key during selection.
	**Left / right arrows**: Click a button to display previous or next Station/Reading Button text depends on 'Display by:' option
	**Symbols**: Select to display a symbol at each data point.
	**Linked Panels**: if checked, all panels of this type (Stacked) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Stacked panels in the view, such as panning and zooming.
	**Display as**: Select whether to display stacked file as frequency spectra. Additional control to display x-axis as either Hz or Root-Hz.

22.2.6.3.2 Stacked Options – Scale Tab

	**Y Axis**: Choose to display Y axis as Log or Linear scales.
	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Y Transition**: Enter a value. Data below this amplitude will display as Linear (rather than Log). This is an additional control when displaying Y axis as Log scale.

	**Y Scale**: Enter a value for height of the Transition zone relative to height of Log decades. Values less than 1 will be narrower, larger than 1 will be wider. This is an additional control when displaying Y axis as Log scale.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values.
	**Zoom X**: Click on a button to manually zoom X- axis in or out. Zoom amount depends on scales : Log (1 decade per click) or Linear (50% / 200% per click).
	Zoom Y: Click on a button to manually zoom Y axis in or out. Zoom value depends on Log (1 decade per click) or Linear (50% / 200%) scales.
	**Pan**: Click on a button to pan around the panel. Shifts the panel in that direction. Pan amount depends on scales: Log (1 decade per click) or Linear (25% per click))
	**Reset**: click to auto scale the axes limits.

22.2.6.4 Decay Panel

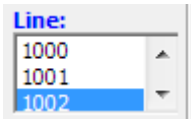
This panel displays time domain **Decays** by station or reading number and then by channel or component. During an acquisition this panel will be updated when the reading is complete.

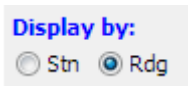
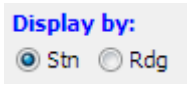
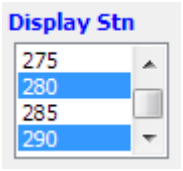
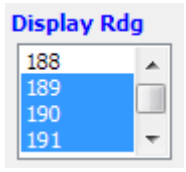
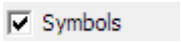
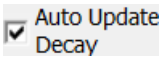
This panel can also be used for deleting decays using the right mouse button options. Within the Graphical Panel, select a reading by hovering with the mouse. The line will become bold and blue text will advise the reading number as per the example below. When the required decay is selected, right click and select from the options provided.

When you click on the decay panel, the currently selected window time (denoted by the vertical bar) will be applied to any profile panels in the view – that window time line will get highlighted. When the decay panel station changes, the vertical bar on the profile panel will also update. In a similar manner, when the profile panel is clicked on, the decay panel will update its selected station and window time.

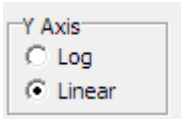
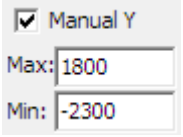
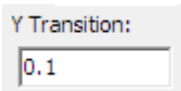
The heading Decay (pT/A) vs (msec) Rdg: 189, 190, 191 Stn:290 [A,U,V] provides details of the data being viewed.

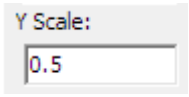
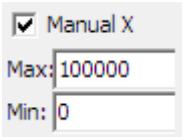
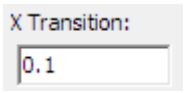
22.2.6.4.1 Decay Options – Display Tab

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Line**: Select which line to displayed. Only displays for multi-line files.

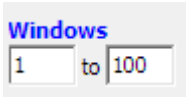
 or 	**Display by**: Select whether to display data by station or reading.
 or 	**Display Stn / Rdg**: Select which Station(s) or Reading(s) to be displayed. Multiple selections are possible by holding down the CTRL key during selection.
	**Left / right arrow**: Click a button to display previous or next Station/Reading Button text depends on 'Display by:' option.
	**Symbols**: Select to display a symbol at each data point.
	**Linked Panels**: if checked, all panels of this type (Decay) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Decay panels in the view, such as panning and zooming.
	**Auto Update Decay**: if checked, then clicking on a particular station in a Profile panel will automatically change this panel to display data for that station. If not checked then it will continue to display the station chosen in the Display Stn / Rdg control.

22.2.6.4.2 Decay Options – Scale Tab

	**Y Axis**: Choose to display Y axis as Log or Linear scale.
	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Y Transition**: Enter a value. Data below this amplitude will display as Linear (rather than Log). This is an additional control when displaying Y axis as Log scale.

	**Y Scale**: Enter a value for height of the Transition zone relative to height of Log decades. Values less than 1 will be narrower, larger than 1 will be wider. This is an additional control when displaying Y axis as Log scale.
	**X Axis**: Choose to display X axis as Log or Linear scales.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values.
	**X Transition**: Enter a value. Data below this amplitude will display as Linear (rather than Log). This is an additional control when displaying X axis as Log scale.
	**X Scale**: Enter a value for height of the Transition zone relative to height of Log decades. Values less than 1 will be narrower, larger than 1 will be wider. This is an additional control when displaying X axis as Log scale.

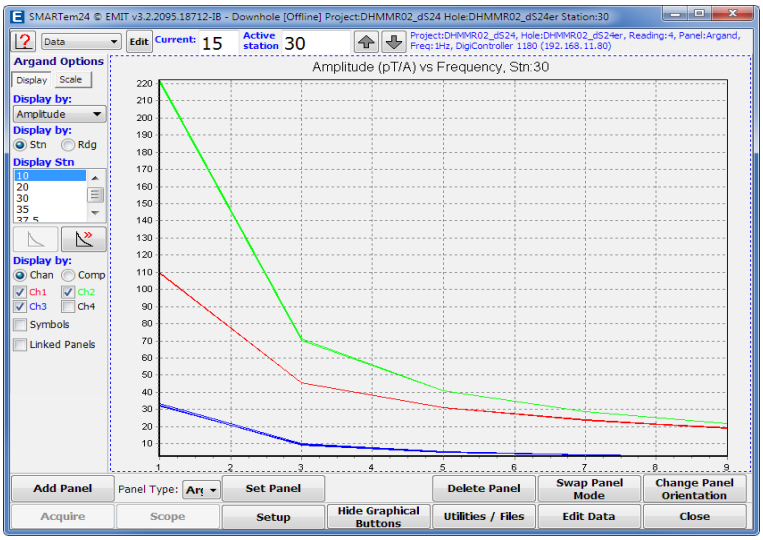
22.2.6.4.3 Decay Options – Stats Tab

	**Windows**: Enter the first and last time windows to be used for statistical calculations.

22.2.6.5 Argand Panel

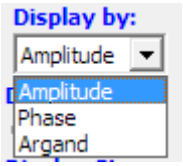
This panel displays frequency domain data by station or reading number and then by channel or component. **Argand** panels are only available for use within frequency domain projects. Different display styles are available – argand (in-phase verses quadrature), amplitude (amplitude verses frequency) and phase (phase verses frequency). This panel will be updated with the latest acquisition data when the acquisition is complete.

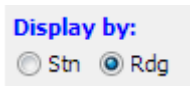
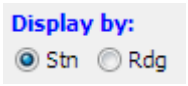
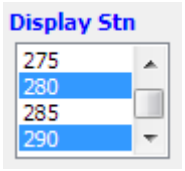
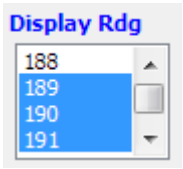
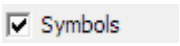
The heading *Inphase (pT/A) vs Quadrature (pT/A) Stn:60* provides details of the data being viewed.



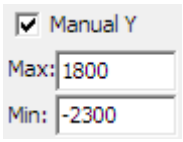
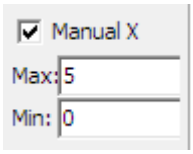
This panel can also be used for deleting readings using the right mouse button options. Within the Graphical Panel, select a reading by hovering with the mouse. The line will become bold and blue text will advise the reading number. When the required reading is selected, right click and select from the options provided.

22.2.6.5.1 Argand Options – Display Tab

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Display by**: select between Amplitude, Phase or Argand.

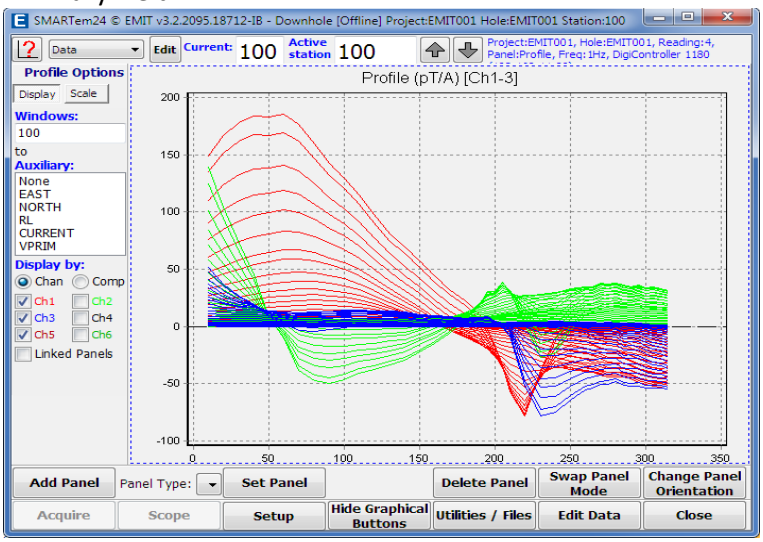
 or 	**Display by**: Select whether to display data by station or reading.
 or 	**Display Stn / Rdg**: Select which Station(s) or Reading(s) to be displayed. Multiple selections are possible by holding down the CTRL key during selection.
	**Left / right arrows**: Click a button to display previous or next Station/Reading Button text depends on 'Display by:' option.
	**Linked Panels**: if checked, all panels of this type (Argand) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Argand panels in the view, such as panning and zooming.
	**Symbols**: Select to display a symbol at each data point.

22.2.6.5.2 Argand Options – Scale Tab

	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values.

22.2.6.6 Profile Panel

This panel displays the **Profile** of the active line (user selected in a multi-line project) on a channel or component basis, depending on the Control selection. Auxiliary data may also be displayed, such as the Theoretical Primary Field.



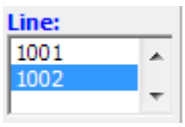
The heading *Profile (pT/A) [A,U,V]* provides details of the data being viewed.

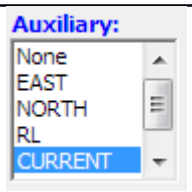
If multiple readings have been acquired per station, the profile displays the average response at each station. If symbols are turned on, then each data point will be marked by a symbol - the type of symbol depends on which raw and/or stacked data files are available.

Clicking on a Profile's station will update the Decay panel to display that station, as well as the vertical bar on the decay panel, denoting the currently selected window time. In a similar manner, clicking on the decay panel, or changing its station, will change the vertical bar and the selected line on the profile panel.

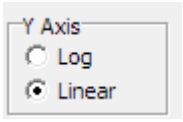
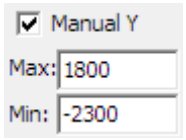
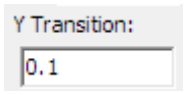
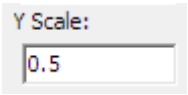
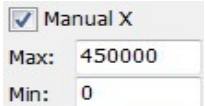
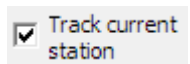
Hover the mouse over a data line to also provide further information, such as the name of the line or the time channel.

22.2.6.6.1 Profile Options – Display Tab

 or 	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
	**Line**: Select which line to displayed. Only displays for multi-line files.

	**Windows**: Enter the first and last time windows to be displayed. Allows the panel to focus on early time values, or late time values, if desired.
	**Auxiliary**: Select from the drop-down list additional parameters to include in the profile panel. Reprocessing may provide additional list items. Multiple selections are possible by holding down the CTRL key during selection.
	**Linked Panels**: if checked, all panels of this type (Profile) will have the same scale (but not necessarily the same maximum or minimum). Some options will then affect all Profile panels in the view, such as panning and zooming.

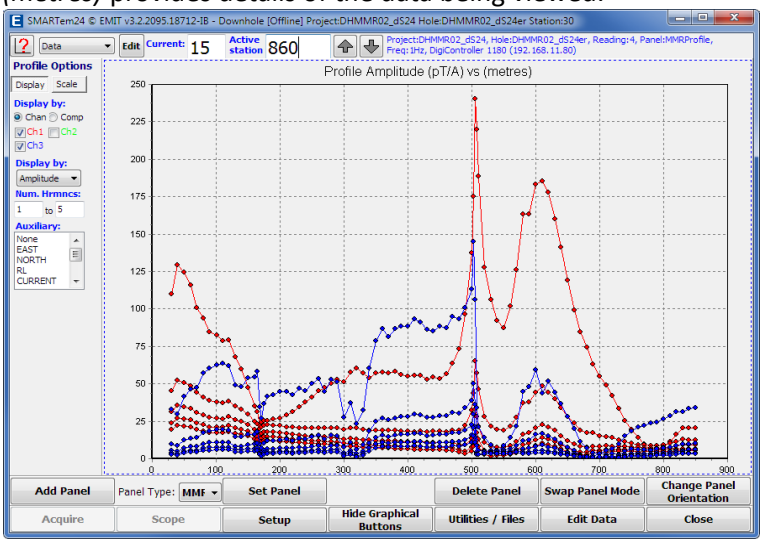
22.2.6.6.2 Profile Options – Scale Tab

	**Y Axis**: Choose to display Y axis as Log or Linear scales.
	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Y Transition**: Enter a value. Data below this amplitude will display as Linear (rather than Log). This is an additional control when displaying Y axis as Log scale.
	**Y Scale**: Enter a value for height of the Transition zone relative to height of Log decades. Values less than 1 will be narrower, larger than 1 will be wider. This is an additional control when displaying Y axis as Log scale.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values.
	**Track current station**: Select to automatically pan the display by the station increment. Only available when 'Manual X' is selected.

22.2.6.7 MMR Profile Panel

This displays **MMR** profile data along the survey line by channel or component. MMR profile panels are only available for use within MMR projects.

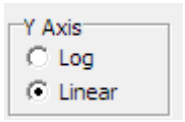
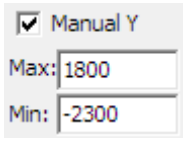
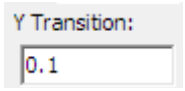
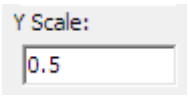
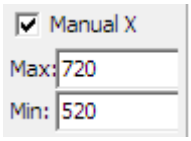
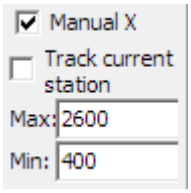
The heading *Amplitude (pT/A) vs (metres)* provides details of the data being viewed.



22.2.6.7.1 (MMR) Profile Options - Display tab

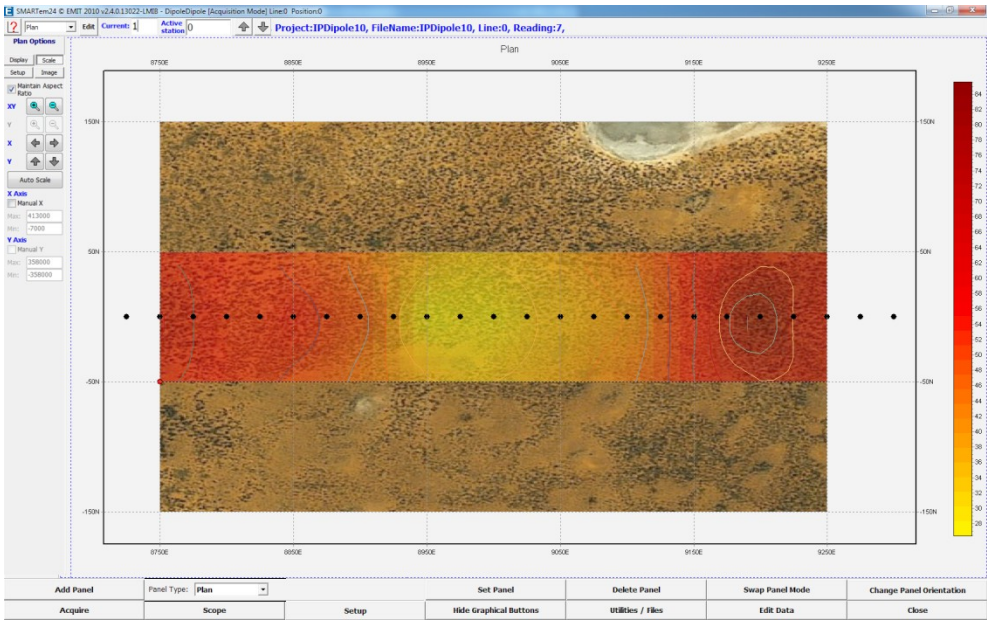
Display by: Chan Comp Ch1 Ch2 Ch3 or **Display by:** Chan Comp A U V	**Display by**: Choose whether data is to be selected/displayed by Channel or Component. Then select from the list below which Channels or Components are to be displayed. The displayed list will expand to encompass all available Channels or Components. Colours of selections denote the display colour in the Panel.
Display by: Amplitude (Amplitude, Phase, InPhase, Quad)	**Display By**: Select from the list the type of data to display, including: • Amplitude vs Station • Phase vs Station • In-phase vs Station • Quadrature vs Station
Num. Hrmncs: 1 to 5	**Number of Harmonics**: Enter the first and last harmonic to be displayed.
Auxiliary: None, EAST, NORTH, RL, CURRENT	**Auxiliary**: Select from the drop-down list additional parameters to include in the profile panel. Reprocessing may provide additional list items. Multiple selections are possible by holding down the CTRL key during selection.
Symbols	**Symbols**: Select to display a symbol at data points if a raw or stacked file is available. If many readings are involved, the display may take some time to redraw.

22.2.6.7.2 (MMR) Profile Options – Scale Tab

	**Y Axis**: Choose to display Y axis as Log or Linear scales.
	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values.
	**Y Transition**: Enter a value. Data below this amplitude will display as Linear (rather than Log). This is an additional control when displaying Y axis as Log scale.
	**Y Scale**: Enter a value for height of the Transition zone relative to height of Log decades. Values less than 1 will be narrower, larger than 1 will be wider. This is an additional control when displaying Y axis as Log scale.
	**Manual X**: Select to enable manual zoom for X axis with the following maximum and minimum values. Enter maximum and minimum values.
	**Track current station**: Select to automatically pan the display by the station increment. Only available when 'Manual X' is selected.

22.2.6.8 Plan Panel

This panel displays a top down or **Plan** (bird eye) view of a survey. An image can be loaded as a backdrop for superimposing stations, transmitter loops and comments. The user can also display multiple readings or multiple stations concurrently.



Pre-survey planning

Load an aerial image as a geographic background for the survey. Add lines of stations, and mark locations with comments - such as heritage warnings.

During-survey - feedback

The field crew can use the GPS, updating the display in real time, on the plan panel to navigate to planned stations. Notes regarding quality issues or mineral finds can be added as comments to stations.

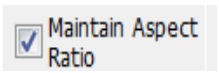
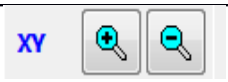
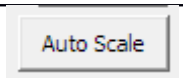
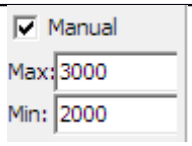
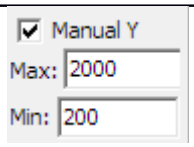
Post-survey overview

Back at the office, the plan panel is a starting point to seeing how a survey went and mapping data results to geographic features. IP data can be displayed over the top of station locations.

22.2.6.8.1 Plan Options – Display Tab

☑ Tx Loops	**Tx Loops**: Select to display the transmitter loops
☑ Rx Done	**Rx Done**: Select to display, as black dots, the stations that have been surveyed.
☑ Rx Not Done	**Rx Not Done**: Select to display, as red diamonds, the stations that are yet to be surveyed.
☑ Image	**Image**: Select to display the loaded (background) image
☑ Current Position	**Current Position**: Select to display, as a red dot, the current (GPS) position.

22.2.6.8.2 Plan Options – Scale Tab

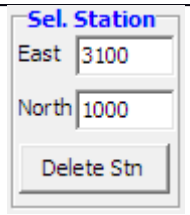
	Unclick to adjust the zoom of X and Y axes independently. Separate Zoom X and Zoom Y buttons will become active, as will the **Manual Y** option (see below)
	**Zoom (X and Y)**: click a button to zoom in or out.
	**Zoom X or Zoom Y**: Click on a button to zoom in or out for X or Y axis, independently. These are additional buttons that are only available when Exaggeration (see below) is turned on.
	**Pan**: Click on a button to shift the panel in that direction, 25% per click.
	**Auto Scale**: Click to rescale the panel in order to display all information.
	**Manual X**: Select to enable manual zoom of X axis using the following values. With no exaggeration, Y axis will adjust automatically to maintain 1:1 ratio. Manual scaling is automatically turned on if the zoom or pan buttons are utilised, and is turned off if the auto-scale button is clicked
	**Manual Y**: Select to enable manual zoom for Y axis with the following maximum and minimum values. This is an additional option that is only enabled when Exaggeration (see below) is turned on. Manual scaling is automatically turned on if the zoom or pan buttons are utilised, and is turned off if the auto-scale button is clicked.

22.2.6.8.3 Plan Options – Image Tab

Load Image	**Load image**: Click button to load an image file to display in the background of the Plan Panel. Image location is defined below.
Clear Image	**Clear Image**: Click button to remove the image from display in the Plan Panel.
X Axis Max 2800 Min 2000	**X Axis**: Enter values that will locate the east and west bounds of the image. Image will be automatically relocated and resized to fit these values.
Y Axis Max 1500 Min 950	**Y Axis**: Enter values that will locate the north and south bounds of the image. Image will be automatically relocated and resized to fit these values.

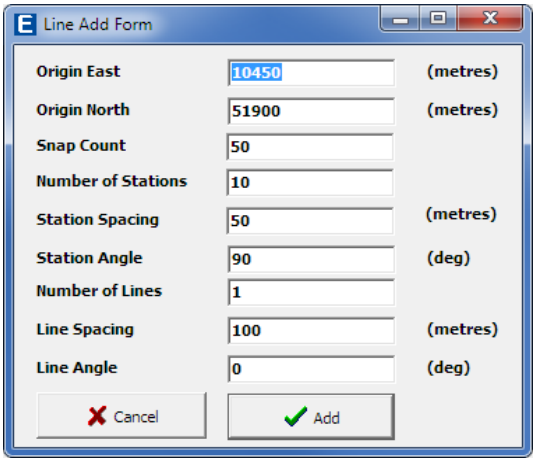
22.2.6.8.4 Plan Options – Setup Tab

Add Line	**Add Line**: Click button to open the Add Line Form to define the planned stations along a new line - this is useful for adding stations *en-masse*. (See section 22.2.6.8.4.1.) New stations, not yet surveyed, will be shown by red dots. Single stations may be added using the **Add Station** button (see button below).
Load Area File	**Load Area File**: Presently disabled.
Clear Stations	**Clear Stations**: Click button to remove all planned stations.
Add Loop	**Add Loop**: click button to open the Loop Editor Form to manually edit loop co-ordinates or load from a file. (See section 22.5.4.1)
☑ Station Drag	**Station Drag**: Select to enable manual dragging, using the mouse, of planned station locations.
Add Station East 3090 North 1000 Add Stn	**Add Station**: Click the button to add a station at the entered location. New stations, not yet surveyed, will be shown by red dot. Station location will be automatically rounded to the Snap Distance value (see below) when the Add Stn button is clicked.
Snap Dist 50	**Snap Distance**: The snap value used for adding stations. Co-ordinates added will be automatically adjusted This is the same value used for the Display Tab > Inc.

	**Delete Station**: Click the button to delete the selected station (shown by yellow dot). Stations may be selected by selecting with mouse button, or entering its east and north location.

22.2.6.8.4.1. Add Line Form

This form is used to add lines of stations for planning purposes.



Access this form via Main Menu > Plan Panel > Setup Tab > Add Line button.

Added lines can be removed using the **Clear Stations** button.

Origin East: (default= current minimum) enter the easting (m) of the first station to be added.

Origin North: (default= current minimum) enter the northing (m) of the first station to be added.

Snap count: (default= snap distance) enter the distance value (m) that station co-ordinates will be snapped to.

Number of stations: (default= 10, last used) enter the number of stations to be added, per line.

Station spacing: (default= 50) enter the along line distance (m) between stations to be added.

Station angle: (default= 90, last used) enter the direction (degrees) that the along-line stations will added.

Number of lines: (default= 1, last used) enter the number of lines of stations to be added.

Line spacing: (default= 100, last used) enter the across line (m) distance between lines to be added. Negative values may be used.

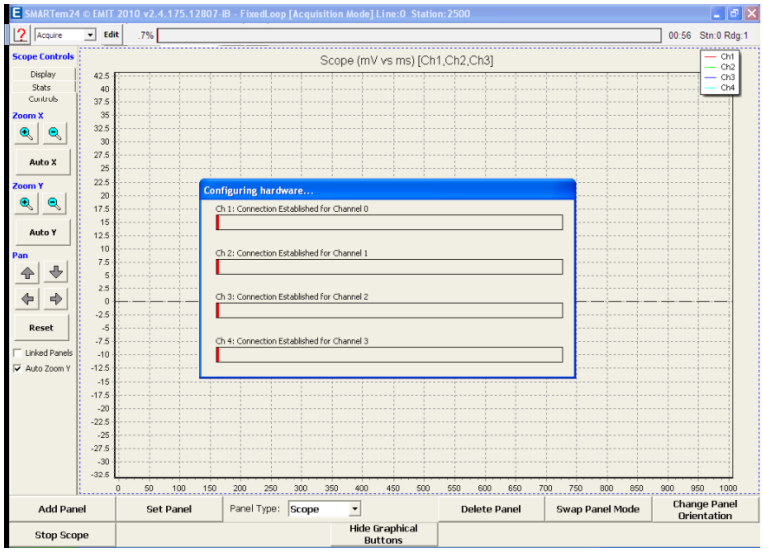
Line angle: (default= 0, last used) enter the across-line direction (degrees) that lines will be added.

22.3 Acquire Screen

This screen is displayed once the acquisition process has been initiated by clicking the Acquire button on the Main menu. The View will change from Data View to Acquire View, with raw signal displayed in Scope panels.

NB: For a new survey it is recommended that the user click the Scope button prior to clicking the Acquire button (see **section** 22.4).

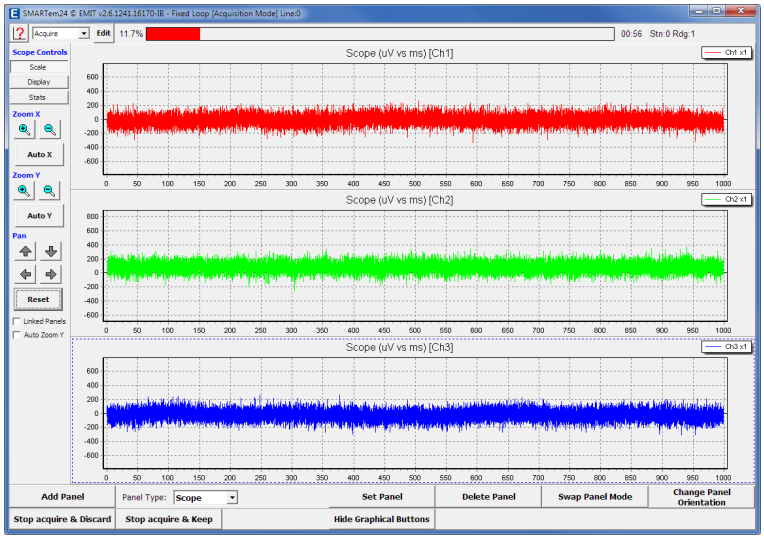
For DigiAtlantis projects, survey settings will be sent to the Probe - this will take a few seconds.



If *nulling* is on, the program will initiate a nulling cycle with which will also take a few seconds. Status will be displayed via progress bars.

If the *Confirm Parameters* option has been enabled then the Confirm Parameters Window will be displayed. This provides information on voltages, temperatures, probe orientation, signal strength and status. The user needs to acknowledge this screen before proceeding - clicking *OK* will continue the reading.

The progress bar at the top of the screen indicates the percentage complete and time remaining for that reading.



During acquisition buttons are available so that readings may be stopped during the acquire cycle and data acquired to that time will be saved to file or, if necessary, may instead be cancelled.

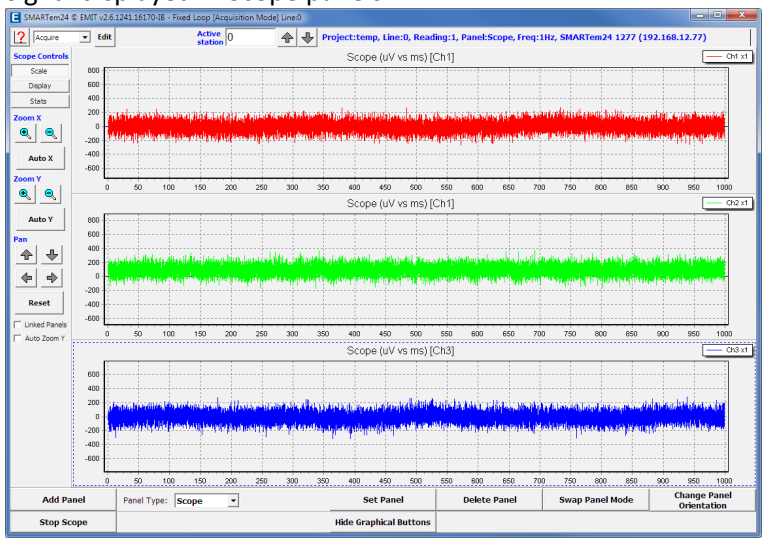
Extra panels can be added or deleted during the acquisition using Graphics Buttons(see section22.2.2), giving the user the opportunity to examine the data. If the data is of poor quality, the user can click the *Stop and Discard Data* button to terminate that reading.

Once the bar reaches 100%, the acquisition is complete. The data will be processed at this stage, and will take a few seconds. Progress is again indicated by a progress bar.

Upon completion, the View will switch back to the Data View.

22.4 Scope Screen

Displays channel data in real time once the Scope process has been initiated. The View will change to Acquire View, with raw signal displayed in Scope panels.



Access this screen via the Main Menu > Scope button.

For a new survey it is recommend that the user do this prior to selecting the Acquire Button. This will allow Raw Data to be viewed without it being recorded.

For DigiAtlantis projects, survey settings will be sent to the Probe - this will take a few seconds.

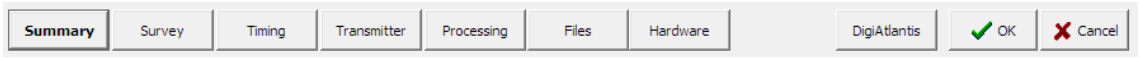
If *nulling* is on, the program will initiate a nulling cycle with which will also take a few seconds. Status will be displayed via progress bars.

The user should visually confirm that the data is as expected on the Scope Screen. This allows the user to identify any issues prior to collecting data.

Once satisfied with the data integrity, click *Stop Scope* button.

22.5 Setup Screen

The Setup screen is where the survey settings (eg timing, channels, prospect) are entered. Menu buttons along the bottom provide dialogues for entering settings particular to that aspect of the survey.



This screen is accessed via Main Menu > Setup button.

Summary button: click to edit commonly changed settings, eg station, line. See section 22.5.1.

Survey button: click to edit general client information, station increments, borehole collar co-ordinates and set automatic repeats. See section 22.5.2.

Timing button: click to edit transmitter waveform and windowing settings. See section 22.5.3

Transmitter button: click to edit transmitter type and current , TX loop and to manually start timing signal (only when transmitter directly connected by a control cable). See section 22.5.4.

Processing button: click to enable smart processing and filtering options, edit measured primary field settings and enable real time processing. See section 22.5.5.

Files button: click to export settings file, rename data file and enable saving of stacked and raw files. See section 22.5.6.

Hardware button: click to edit settings for each input channel, including component, sensor type, nulling, gain, data units and slingram offset. See section 22.5.7.

Location button: (not available in DigiAtlantis projects) See section 22.5.8.

DigiAtlantis button: (DigiAtlantis projects only) click to edit DSL rate, local magnetic field values and get device orientation, battery & temperature information. See section 22.5.9.

The screens can be navigated and edited entirely from the keyboard using arrow, tab and enter keys. For changes to be applied, click OK. Discard changes with the Cancel button.

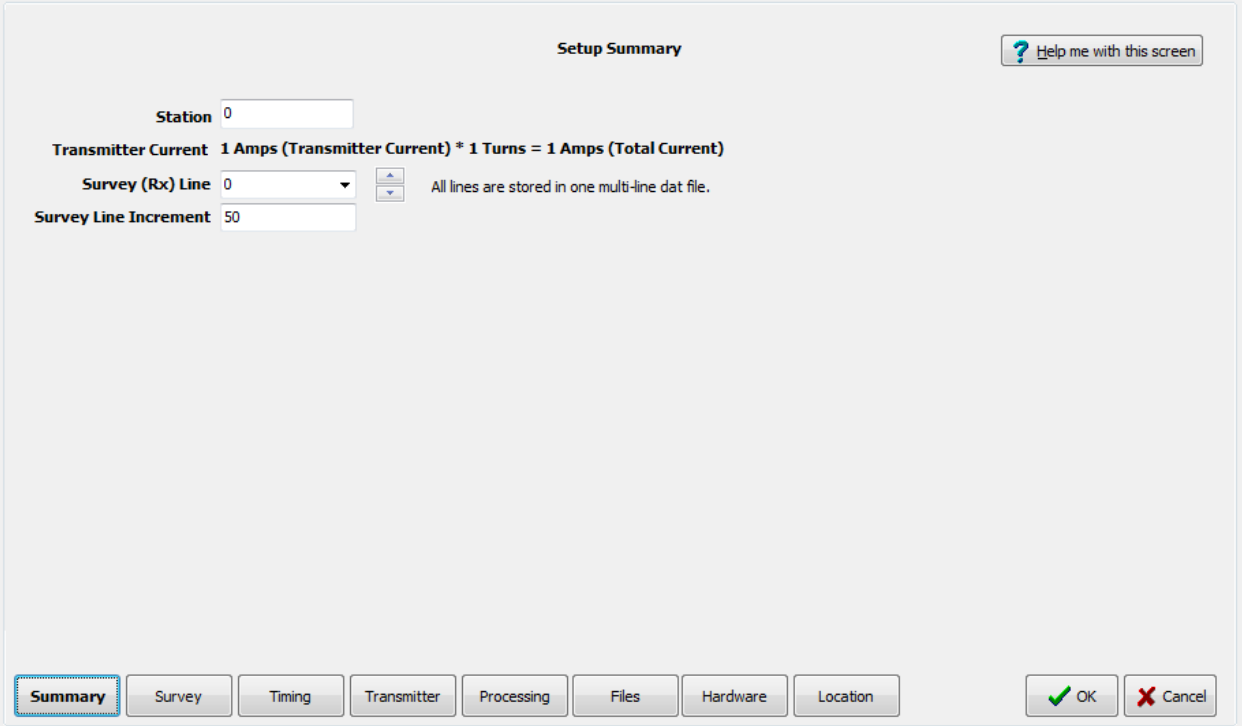
NB: No edits are saved unless the OK button is used to close the screen.

NB: Setting options displayed will depend on the survey configuration and survey mode entered on the Welcome Screen. If the settings are invalid for the survey being undertaken, close and return to the Welcome Screen to create a new project.

Screen Images contained on the following pages are for example only and do not display all possible selections as these would depend on the connected device and the survey settings selected. However, all selection options will be described here.

22.5.1 (Setup) Summary Screen

Provides a summary of the frequently edited survey settings and are positioned here for convenience. Values may be edited here, or in the relevant menu.



Access this screen via the Main Menu > Setup > Summary button.

Station: (default= 0) this number (m) represents a position along the line. The next acquisition will be saved to this location. For drillhole surveys this value typically represents the distance down the borehole.

Transmitter Current: value of the current (Amps) being transmitted through the transmitter loop. Effective current value (current * turns) is displayed and reflects the settings made on the Transmitter (Setup) Screen. This value may change as often as every reading and will affect current normalised values. This value needs to be verified prior to (each) data acquisition.

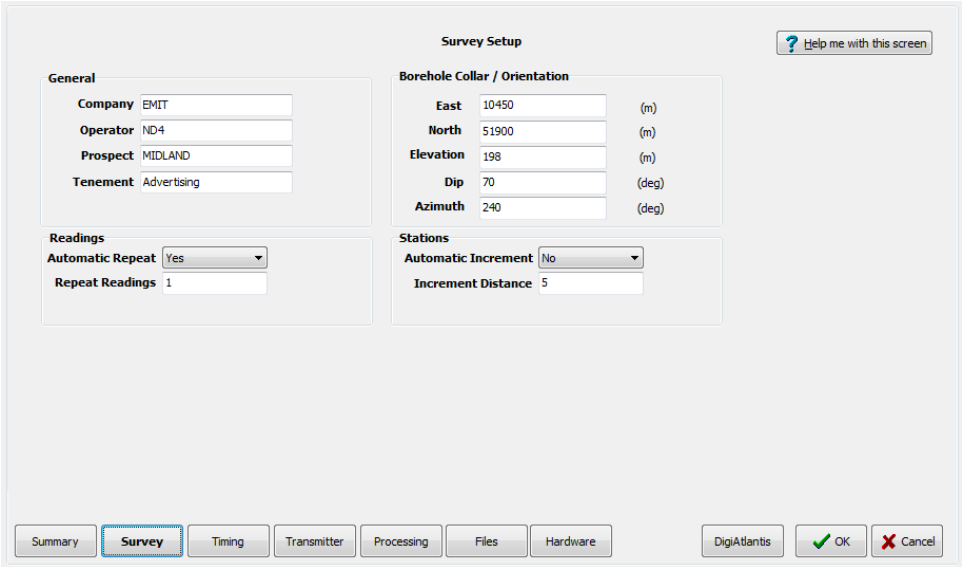
Survey (Rx) Line: (default= 0,project name) is the current line name. This is also used as the data file name. This line becomes the active line as displayed in the Information Bar on the Main Screen .

- For DigiAtlantis projects this will create a new data file.
- For other surveys this line will be appended in the current data file - creating a multi-line file. For multi-line files, it is possible to display data from a non-current line via the **Line:** selection on the Control Menu > Display tab.

Survey Line Increment: (default= 50) enter the across line distance (m) between survey lines. This value is used by the Survey Line increment function on the (Setup) Summary Screen for multi-line files.

22.5.2 Survey (Setup) Screen

Enter survey meta data, borehole collar details for DigiAtlantis projects only, set autorepeats and auto station increments.



Access this screen via the Main Menu > Setup > Survey button.

General

This configures general survey information. Most of this information is written as headers to the data file. Type data in the editable text boxes.

Company: (optional, default= unknown) name of the company / client / contractor.

Operator: (default= user) name of the User Profile being used.

Prospect: (optional, default= unknown) name of the project / survey area.

Tenement: (optional, default= unknown) name of the area or property being surveyed.

Line Direction: (default= east/west) sets how line and station values are interpreted. Select from the drop down list.

- **East/West**: stations increase to the east.
- **North/South**: stations increase to the north.

Readings

Readings are data acquisitions at a particular location (station). Reading numbers are automatically incremented (by 1) for each acquire. Some surveys require multiple (repeat) readings at each station - rather than having to manually instigate repeat readings this setting allows the system to automatically initiate sequential, repeat readings at the active station.

Automatic Repeat: (default= no) the control to enable or disable automatic repeats. Select from the drop down list.

Repeat Readings: (default= 1) the number of extra readings on each acquire.

- If set to 1 when Automatic Repeat is enabled, two readings will be taken every time an acquisition is initiated.

Borehole Collar / Orientation

Specifies the co-ordinates and orientation of the borehole and are used to calculate station E,N,RL co-ordinates. These values are saved in the header of the data file.

East: (default= 0) enter the east (m) value of the borehole collar.

North: (default= 0) enter the north (m) value of the borehole collar.

Elevation: (default= 0) enter elevation (m) value of the borehole collar.

Dip: (optional, default= 0) enter the average angle of descent (dip angle) (degrees) of the borehole.

- Enter a value between -90 and 90. Enter a negative value for up-holes.

Azimuth: (optional, default= 0) enter the average azimuth angle (degrees) of the borehole in local grid.

- Enter a value between 0 and 360.

Note: Detailed dip and azimuth values along the borehole may be utilised via the DigiAtlantis Processing dialogue, see section 22.6.1).

Stations

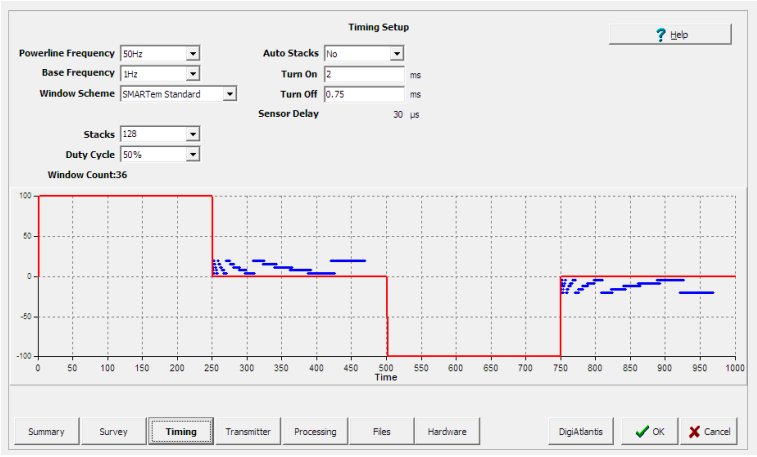
Automatic Increment: (default= no) the control to enable or disable automatic increments of the station whenever a reading is completed.

Increment Distance: (default= 50,5) the distance (m) along a survey line between each reading. This value is used by the station automatic increment function, and also manual station increment on the Main Screen using arrow keys or hot keys '[' or ']'

22.5.3 Timing (Setup) Screen

The timing screen configures the transmitter and timing configuration, and has a graphical representation of the transmitter wave and the windowing intervals, as specified by the user settings.

Make selections from the drop down lists.



Access this screen via the Main Menu > Setup > Timing button.

Powerline Frequency: (default= 50) is the frequency (Hz) of the local power lines. This selection will adjust the available base frequencies in order to minimise powerline effects. Select from the drop down list.

Base Frequency: (default= 1Hz) is the transmitter frequency (Hz) being directed into the transmitter loop. Options are constrained by Powerline frequency setting. Select from the drop down list.

Window Scheme: (default= SMARTem Standard) is the timing scheme for the Windows at which the final data will be calculated. Standard window schemes are provided. Select from the drop down list.

- Users may also create and load their own window schemes using Customised window schemes (SMARTem24User.times) file. See section 15.13.

Stacks: (default= 128) is the number of stacks to be included for the averaging process in the final data. The number will determine the length of the reading (two stacks per transmitter period). This value should be long enough to achieve high signal-noise but short enough to achieve the required productivity. Some users prefer to take a single reading per station of high stacks, but for QC purposes it may be preferable to take several readings of smaller stacks. Select from the drop down list.

Duty Cycle: (default= 50%) defines the relative amount (%) of on time versus off time in the transmitter half period. Graphic will update depending on selection. Select from the drop down list.

- 25%: transmitter is on for 25% of the half period, and off for 75%.
- 50%: transmitter is on for 50% of the half period.
- 100%: transmitter is on 100% of the time, with no off time.
- means that the transmitter will be transmitting for half the time during a single wavelength.

Window Count: displays the total number of timing windows within the fundamental frequency, based on base frequency, duty cycle and window scheme selection.

Auto Stacks: (default= no) control to enable automatic stacking. If set to *Yes,* when the base frequency is changed the Stack count will also change to keep the length of the reading approximately the same. Select from the drop down list.

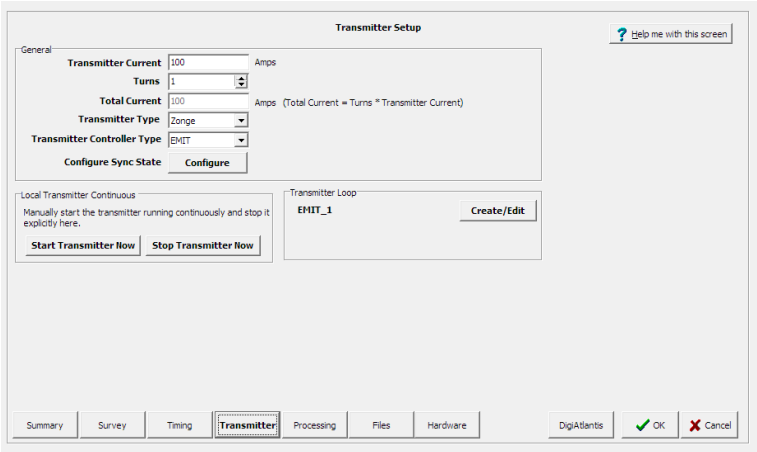
Turn On: (optional, default= 0) is the time (ms) taken for the transmitter current to turn on at the start of each transmitter period.

Turn Off: (default= 0) is the time (ms) taken for the transmitter current to turn off. This used for positioning the windows along the waveform in relation the start of the switch off.

Default Sensor Delay: (default= 0,30) is the time (us) taken for the sensor output to respond to applied signal. This is used in acquisition to allow for different response-time characteristics of sensors. DigiAtlantis values cannot be edited.

22.5.4 Transmitter (Setup) Screen

Configuration settings for the transmitter and transmitter loop. If directly connected the transmitter can be controlled directly from here.



Access this screen via the Main Menu > Setup > Transmitter button.

General

Transmitter Current: (default= 100,1) value of the current (Amps) being transmitted through the transmitter loop. This value may change as often as every reading and will affect current normalised values. This value needs to be verified prior to (each) data acquisition.

Turns: (default= 1) is the whole number of turns of the transmitter loop.

Total Current: (default= 100,1) is the total effective current (Amps), calculated as current * turns. This value is saved to the data file as the 'Current' value.

Transmitter Type: (default= Zonge) select the type of the transmitter being used. If the transmitter controller is connected to the receiver and is being configured through this mode then this selection is important.

- This selection is not utilised for any processing but is saved in the header of the data file for record keeping.

Transmitter Controller Type: (default= EMIT) select the type of the transmitter controller being used. Incompatible selections may cause final processed data to be incorrect due to different timing solutions.

Configure Sync State: is used to configure a connected transmitter controller with the above settings.

- **Configure**: click this button to initiate the configuration.

Local Transmitter Continuous

When the transmitter is directly connected to the Receiver then activation of the transmitter timing control signal can be manually controlled via the SMARTem24 software. (This emulates the play/pause button on the Transmitter Controller.)

Start Transmitter Now button: click to activate transmission of the timing control signal.

Stop Transmitter Now button: click to deactivate transmission of the timing signal.

Transmitter Loop

Transmitter loops can be configured here,f or fixed loop or moving loop projects. For fixed loop projects, the name of the loop is displayed.

Create/Edit button: click to open the Loop Editor Form to configure fixed loop settings.

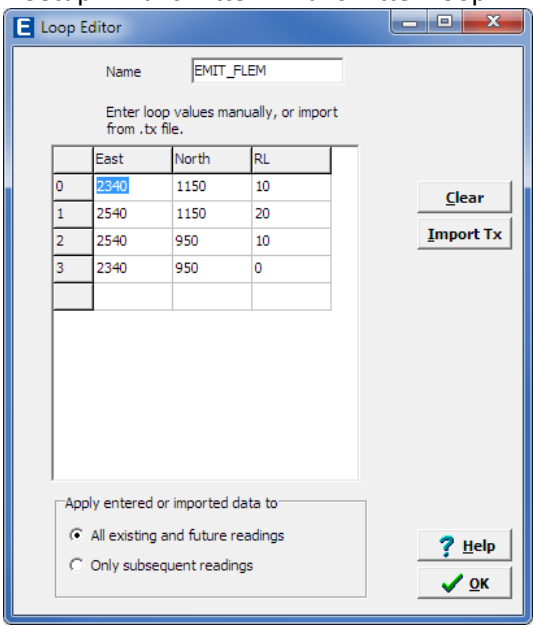
Side: (default= 50) the along line length (m) of the moving loop .

Across: (default= 50) the across line length (m) of the moving loop.

22.5.4.1 Loop Editor Form

Open this form to configure the transmitter loop for fixed loop surveys. Information may be entered manually or imported from a **.tx* file.

Moving loops are configured elsewhere, via the Main Menu > Setup > Transmitter > Transmitter Loop.



Access this form via the Main Menu > Setup > Transmitter > Transmitter Loop Create/Edit button.

Name: (default= default_loop) type the name of the transmitter loop. When this form is closed the vertices will be saved to a transmitter loop **.tx* file of this name.

- The name of the transmitter file is also saved into the header of the data file.
- These co-ordinates are generally not used for acquisition process, but are used by some processing options.

A listing of the co-ordinates of the vertices of the loop is displayed. These should be entered in either a clockwise or anticlockwise sense.

East, North, RL columns: the co-ordinate of each vertex of the transmitter loop. These should be in the same co-ordinate system as the survey station co-ordinates, and collar co-ordinates for DigiAtlantis projects. Enter co-ordinates as one row per vertex.

Clear button: click to set all loop co-ordinate values to zero.

Import Tx button: click to load co-ordinates from an existing **.tx* file. Refer to section 15.12 for Transmitter Loop (*.tx) file format.

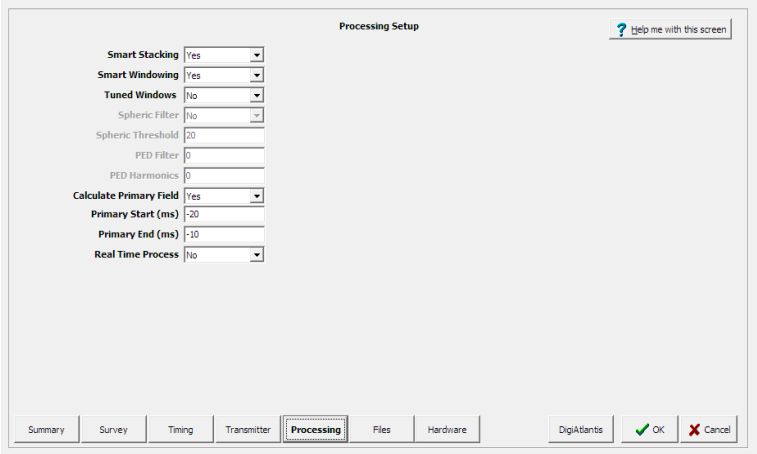
Apply data to: select how to apply the loop to readings in the data file.

- **All existing and future readings**: resets the loop column for the entire file to the current loop name.
- **Subsequent readings**: sets this loop for future readings only.

OK button: click to save changes and return to the Setup Screen.

22.5.5 Processing (Setup) Screen

Parameters used for processing raw data to final windowed data during acquisition are defined here.



Access this screen via the Main Menu > Setup > Processing button.

Smart Stacking: (default= yes) is option to use tapered stacking where a portion of the initial and final stacks will have less effect on the data.

Smart Windowing: (default= yes) is option to use tapered windowing where a portion of the initial and final stacked samples within a window will have less effect.

Tuned Windows: (default= no) is an option to adjust & optimise window sizes to minimise the effects of the selected noise source. Only windows of sufficient width are modified and the modifications are subtle enough so there is no significant change to the start or end time of the window. Select the noise source from the list.

Spheric Filter: (default= no, presently disabled) is an option to enable filtering of spherics (short spikes in the data, typically from from electricity storms) during reprocessing. Values that exceed a certain range (threshold) from the running average will be discarded. This process is somewhat time consuming so may be performed during reprocessing instead.

- **Threshold**: (default= 20) enter threshold value (mV). Data exceeding the average by this value will be discarded. The value should be large enough to not exclude normal data noise levels.

PED Filter: (default= 0, presently disabled) is frequency of PED to be filtered out.

PED Harmonics: (default= 0, presently disabled) number of harmonics to include in PED filtering.

Calculate Primary Field: (default= yes) option to calculate the **measured primary field** during acquisition.

- The value is averaged over a time range defined below, relative to the start of transmitter switch off. Enter :
  - negative values for B field data (to capture on-time data),
  - and positive values for dB/dt data (to capture ramp data) and MMR data.

Primary Start (ms): (default= -3) enter start of the time range.

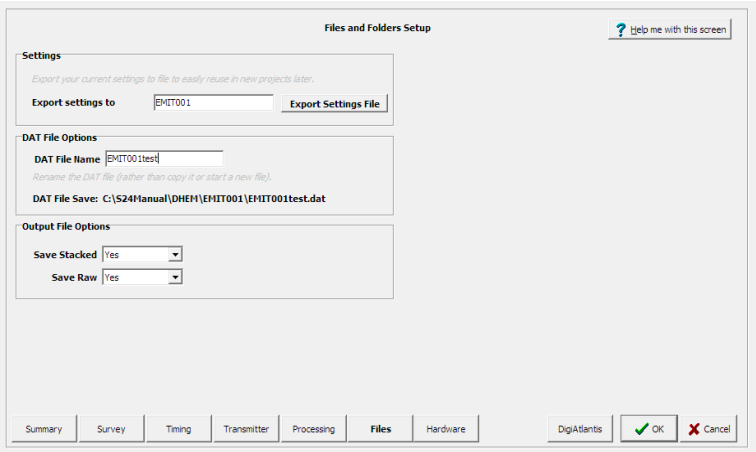
Primary End (ms): (default= -2) enter end of the time range.

Real Time Process: (default= no) option to control when these processes are undertaken.

- **Yes**: processing occurs during a reading's acquisition cycle with incrementally processed data being displayed.
- **No**: all processing occurs at the completion of the reading, which takes a few seconds.

22.5.6 Files (and Folders) Screen

Options to export files.



Access this screen via the Main Menu > Setup > Files button.

Settings

Option to export survey settings to a **.sini* file for later use in a new project.

Export settings to: (default= project name) edit name of settings **.sini* file to be created

- **Export Settings File**: click to apply file export

Data File Options

Option to rename the currently loaded data file rather than copying it or starting a new file. This will also change the line name.

Data file Name: (default= project name) enter a new name for the loaded data file

File will be renamed when the software is closed.

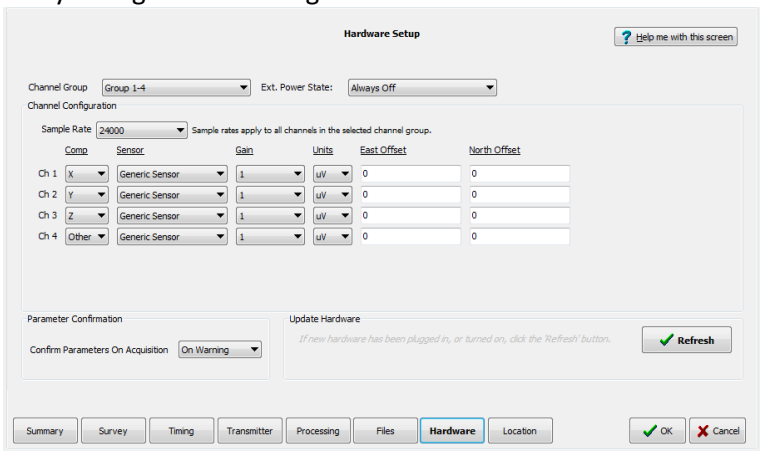
Output File Options

Save Stacked: (default= yes) option to automatically save stacked files per acquisition cycle. If raw files are saved then stacked files can always be recreated through reprocessing.

Save Raw: (default= yes) option to save raw files per acquisition cycle. It is recommended that these files be saved to allow for reprocessing, recreating of stacked files or for interrogation if required.

22.5.7 Hardware (Setup) Screen

Use this screen to configure settings for the the connected hardware device on a per input channel basis. User can set sensor types, gain values, sensor offsets and final data units. Options on display will be limited by the connected device and survey configuration settings selected on the Welcome Screen.



Access this screen via the Main Menu > Setup > Hardware button.

Channel Group: (default= Groups1-4, DigiProbe 1-3) select the input channel group to be configured. The SMARTem24 has up to 16 input channels that are organised as 4 groups of up to 4 channels each.

Ext Power State: Allows configuration of the power feed output from each 19-pin socket. This option is not available in DigiAtlantis or IP projects. Possible options are:

- **Always Off**: (default) No power is ever applied to the selected Channel Group's 19 pin connector.
- **Always On**: Power is continuously applied out of the selected Channel Group's 19 pin connector. This should be used when connecting SMART Surface Fluxgates or other sensors that receive their power from the SMARTem24 receiver.
- **Auto Off During Rdg**: Power feed to the selected Channel Group's 19 pin connector is turned off during a reading and back on once the reading has been completed. This should be used where the sensor (coil for example) is self powered but has an EMIT Tilt / Orientation sensor attached. This helps improve the SNR as the EMIT Tilt sensors generate a small amount of EMI that can be seen on very low noise coils.

Channel Configuration

Sample Rate: (default= 24000) frequency (samples per second) at which the input response is sampled for analogue to digital conversion. There is one ADC per input channel but all use the same sample rate. Select from the drop down list. Note that this is different to the base frequency.

Channels can be configured individually with the following parameters:

Comp: (default= off) option to define the sensor component. Select from the drop down list.

- If set to 'off' then no data will be displayed or saved for that input channel.

Sensor: select from the drop down list.

- Additional sensors may be added to this list using Customised sensors (CustomSensorDefinition.xml) file, as described in section 15.14.

Nulling: (default= yes) option to null the earth's magnetic field prior to passing through the ADC to improve resolution. Select from the drop down list. This will add a few seconds to the acquisition cycle.

Gain: (default= 1) option to apply a multiplier to incoming voltage signal prior to the ADC to improve resolution. The high resolution of the SMARTem24's 24-bit ADCs generally mean a value of 1 is adequate for most surveys. Careful selection ensures data is not clipped by voltage limits of the ADC (+/-12V). Select from the drop down list.

Units: (default= uV,pT/A) option to select the units for the data file. Options list will be limited by sensor selection. Select from the drop down list.

(Rx-Sensor) East Offset: (default= 0) is the distance (m east) that the sensor is offset from the receiver GPS (limited by the sensor cable length). Enter a negative value if the sensor is west of the receiver.

(Rx-Sensor) North Offset: (default= 0) is the distance (m north) that the sensor is offset from the receiver GPS (limited by the sensor cable length). Enter a negative value if the sensor is south of the receiver.

Slingram:(default= no) option to enable slingram configuration. Once enabled the fixed offset between the sensor and transmitter can be defined - this would generally be constant for a survey. The station value becomes the mid-point between the transmitter and receiver.

- **(Tx-Rx) Offset**: (default= 0) enter the distance (m) between the receiver and the centre of the transmit loop. A value of 0 is equivalent to an inloop survey, ie setting slingram= no. Enter a negative value if the transmitter is west/south of the receiver.
- **Direction**: option to define the direction that the transmitter and receiver are offset from each. An along line displacement will result in the offset being applied to the station term, and an across line displacement will change the line value. It is therefore possible to perform a multi-line and multi-station acquisition.
    - **AlongLine**: (default) indicates that the Tx is in front or behind the sensor when traversing along the survey line
    - **AcrossLine**: indicates that the Tx is to the left or right of the sensor when traversing along the survey line.

Parameter Confirmation

Option to control the display of system warning messages and to save a system log file (primary used for error resolution)

Confirm Parameters on Acquisition: (default= on warning) option for when to display the Confirm Parameters Window. Select from the drop down list.

- **Never**: do not ever display.
- **Always**: display on every acquire.
- **On Warning**: display only when a warning is activated.
- Refer to section 22.5.7.1 for the information being displayed.

Update Hardware

Option to update the screen settings based on the connected hardware. This should be initiated when new hardware has been connected.

Refresh button: click to update the screen.

22.5.7.1 Confirm Parameters Window

This is a pop up window that displays information on the connected device for the each acquisition.

At the start of each acquisition the Receiver obtains status and configuration information from the device . Values important to integrity of the system and survey data are displayed in this 'Confirm Parameters' window. The information displayed differs for the system being used, and each are described in the following subsections.

If some of the values are approaching invalid levels the screen will display them in red to indicate a problem. If a value has reached critical level then acquisition may be prevented. Any values in a warning state will be shown in red and the 'Status' field will give a description of the problem - otherwise there will be a green tick.

The 'OK' button will be disabled when a value is in a critical state and the device in question will soon be turning itself off.

The information provided by the device is saved in the data file, for each reading, for error diagnostic purposes.

The user may chose to display or hide this window until a warning is detected, depending on the display setting (Never / Always / On Warning) as selected on the Hardware (Setup) Screen, accessed via Main Menu > Setup > Hardware > Confirm Parameters on Acquisition.

SMARTem24 Receiver

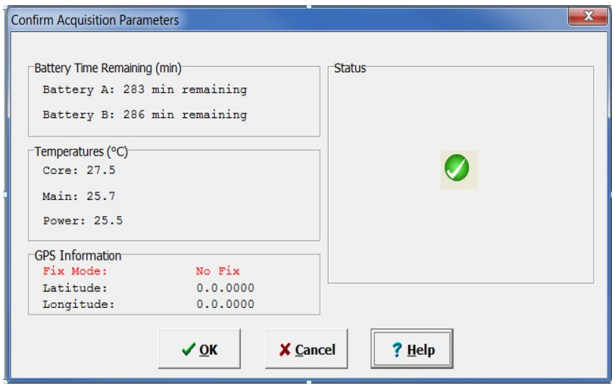


Figure 18: Confirm Parameters window - SMARTem24 System

Battery Time Remaining: an estimate of receiver run time remaining. If this figure exceeds a lower threshold, users may prefer to abort a reading in order to attend to the low power situation - failure to do so may result in an interrupted reading.

Temperatures: Various temperatures are reported to the user each with their own monitored thresholds. In the even that temperatures become out of specification, the values will be highlighted in red.

Status: The SMARTem24 Receiver is capable of reporting a wide range of status and problem shooting information. In the event of an issue with acquisition, diagnostic information can be provided here.

DigiAtlantis Receiver

The Confirm Parameters window is displayed at the start of an acquisition, after the probe has performed any required nulling.

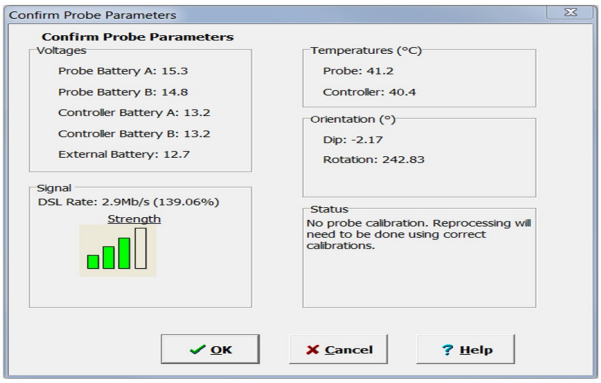


Figure 19: Confirm Parameters window - DigiAtlantis System

Voltages: the battery levels for the Probe and Controller.

- If the voltages are getting too high or low they will be flagged in red.

Signal: displays the data transfer (DSL) rate from the Controller to the Probe.

- DSL Rate: displays the current rate in Mb/s, and also as a percentage (%) of the *minimum recommended DSL rate* at the current sampling rate.
- If this value is below 100% then there is a risk that the acquisition will fail. section 22.5.9 tabulates minimum recommended DSL values based on sampling rates.
- Strength graphic: graphical representation of the DSL Rate percentage.

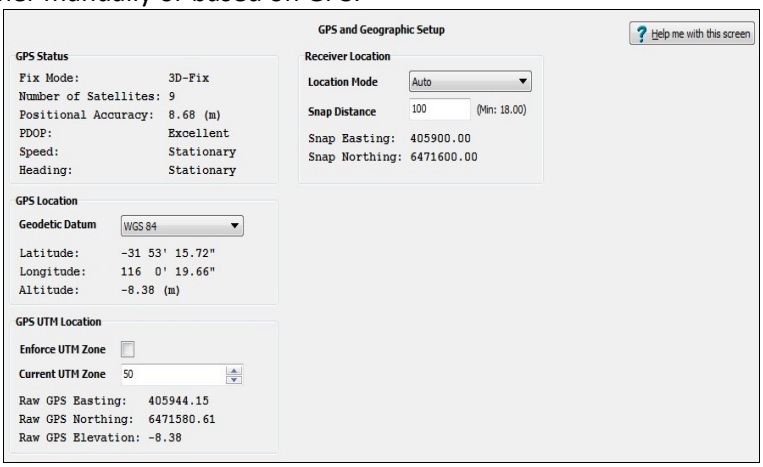
Temperatures: lists the Probe and the Controller's internal temperatures. If these temperature are getting too high or low they will be flagged in red.

Orientation: displays the orientation of the probe - Dip, Azimuth and Rotation.

- If the Azimuth is unavailable then local magnetic field information has not been entered. This may be calculated through post processing (Update Rotation button on DigiAtlantis Processing Dialogue) or configured now via Main Menu > Setup > DigiAtlantis > Local Magnetic Field Values.

22.5.8 Location (GPS & Geographic Setup) Screen

Options to define the station location either manually or based on GPS.



Access this screen via the Main Menu > Setup > Location button.

GPS Status

Displays the current GPS status

GPS Location

Geodetic Datum: (default= WGS84) defines the reference ellipsoid for GPS processing. Select from the list.

Latitude/Longitude/Altitude: calculated from the GPS information using the chosen Geodetic Datum.

GPS UTM Location

Enforce UTM Zone: (default=off)

UTM Zone: (Defaults to the zone calculated from the GPS) select UTM zone (1-60) to be used, or 0 to use UPS (Universal Polar Stereographic).

Raw GPS Easting/Northing/Elevation: calculated from the GPS Location, using the chosen UTM Zone or the UPS if the zone was set to 0.

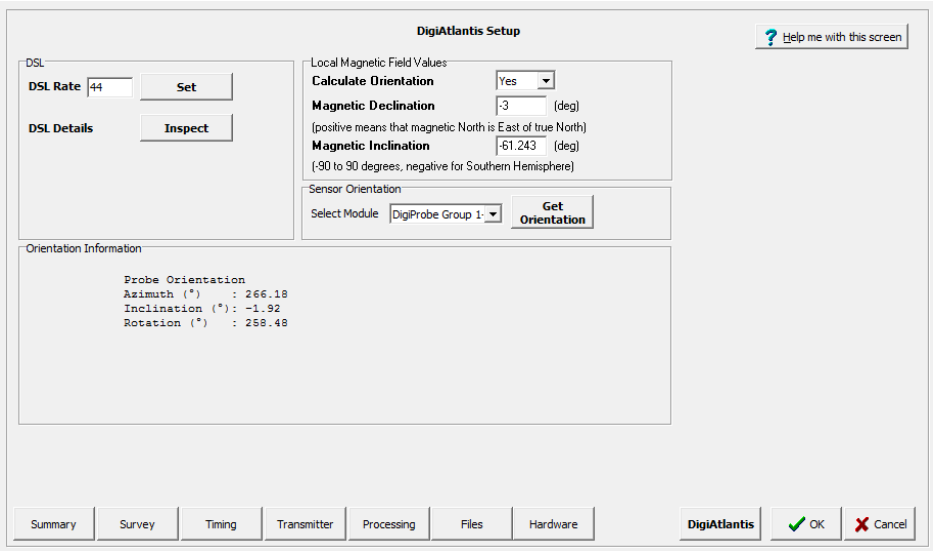
Receiver Location

Configures the settings for defining location of the receiver, and hence the station position. Only available for surface TEM projects.

Location Mode: (default= manual) option to define the receiver position, choose from the list.

- **Manual**: user to manually increment station locations.
- **Auto**: software will calculate station co-ordinates (E,N,RL) based on GPS information and the following settings:
    - **Snap Distance**: (default=50) resolution of co-ordinates. Note that this should be at least twice as large as the GPS positional accuracy shown in the GPS Status information.
    - **Snap Easting/Northing:** calculated from the GPS UTM Location, using the current Snap Distance.

22.5.9 DigiAtlantis (Setup) Screen



Access this screen via the Main Menu > Setup > DigiAtlantis button.

DSL

Display and select data transfer (DSL) rate from the Controller to the Probe.

DSL Rate: (default= 44) enter the rate to be used.

- Recommended minimum values for a given sample rate (as selected on Hardware (Setup) Screen) are listed below.

Sample Rate (sps)	Minimum DSL Rate
24k	36
19.2k	30
18k	28
16k	25
14.4k	22
12k	19

- If using a long winch and having having trouble establishing a good DSL connection, refer to section Optimising DSL connection rate for long (+2km) winches in subsection 22.5.9.1.
- **Set button**: click to apply this setting.

DSL Details Inspect button: click to open the DSL Details form, which displays the current DSL status.

Local Magnetic Field Values

Define the magnetic field orientation at the survey site to enable azimuth of the probe to be calculated. Magnetic field values can be obtained from http://www.ga.gov.au/oracle/geomag/agrfform.jsp.

These values may also be configured on the Survey File Options Form via the Main Menu > Utilities /Files > DigiAtlantis Processing > SUR File Create button (section 22.6.1.1).

Calculate Orientation: (default= no) option to calculate the azimuth of the probe based on the following magnetic field values. If set to yes then azimuth will be displayed on the Confirm Parameters Window.

Magnetic Declination: (default= 0) enter the declination (degrees) of the earth's magnetic field at survey location relative to grid north.

- Values range from -180 to 180. Enter a positive value if magnetic north is east of grid north.

Magnetic Inclination: (default= 0) enter the inclination (degrees) of the earth's magnetic field at survey location.

- Values range from -90 to 90. Enter a negative value for southern hemisphere.

Sensor Orientation

Options to calculate sensor azimuth using the above magnetic field values.

Select Module: select the connected device from the list.

Get Orientation button: click to calculate and display current orientation information, including azimuth.

22.5.9.1 Optimising DSL connection rate for long (+2km) winches

Long winches can make it difficult to establish a reliable DSL connection between the probe and the controller.

To check whether your winch may cause a communication problem, connect the system as normal and confirm the state of the LEDs on the Probe's Controller :

- CH1 LED: solid green = link is ok.
- for other states, refer to the Common Hardware Operations section on LEDs, section 7.2.3.2.

Even if the DSL link is established there may be too many errors for an acquisition to succeed. In which case both the DSL rate and the sample rate (configured on the Hardware (Setup) Screen, section 22.5.7, via Main Menu > Setup > Hardware) may need to be adjusted.

Also refer to Trouble Shooting in section 23 to confirm hardware integrity.

Check DSL Details

To check the current DSL status, open the **DigiAtlantis DSL Details** form via Main Menu > Setup->DigiAtlantis > DSL > DSL Details > Inspect button.

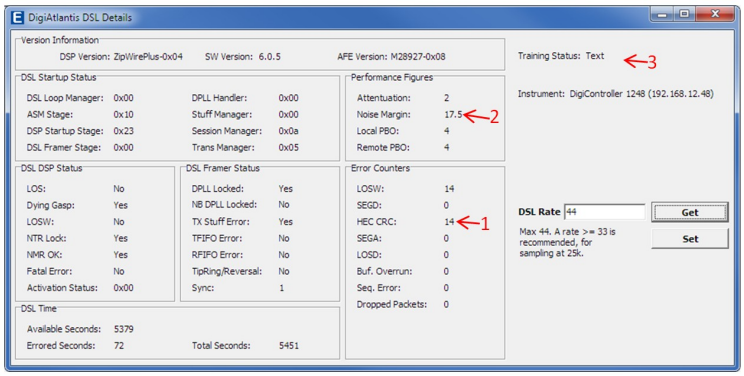


Figure 20: DSL Details form (1= errors, 2= noise, 3= link status)

To check the errors, observe the *HEC CRC* field (see #1 in Figure 20). If this number is incrementing it indicates an error prone connection (note it may be non-zero but shouldn't be increasing) and the DSL link should be adjusted.

Note: When the probe is moving in the borehole to another station there may be a burst of CRC errors, so we do not rely on this value to determine if we should drop the DSL link under normal operating conditions.

Procedure to optimise DSL rate

The following procedure is a guide for setting the DSL rate, in the case where long or poor condition winches are producing communication failures.

1. Connect the system to the winch.
2. Turn the system on.
    - The first time a connection over the winch is attempted it may take about 3 minutes before the probe and controller establish a connection, at its fallback rate which is not fast enough to collect data.
3. Wait for the connection, indicated by the CH1 LED.
    - A flashing green CH1 LED indicates a reduced connection speed. You must have a connection to continue. See **Trouble Shooting** below if you cannot initially connect over the winch.
4. Check the DSL details on the **DSL Details form** , as outlined above.
5. Click the 'Get' button to display the current DSL rate.
6. To adjust the DSL rate, type in the new value and click 'Set'. The rate should be set as high as the winch allows. Refer to table in section 22.5.9 - DigiAtlantis (Setup) Screen for minimum DSL values based on sampling rate. Start from the bottom of the list and work up until a link becomes reliable, then drop back one setting..

   The *noise margin* in the performance figures is recommended to be 9 or above (see #2 in Figure 20). Lowering the DSL rate will increase the noise margin.
7. The controller's CH1 LED will turn red as the controller and probe reset the DSL connection to the new speed. Wait for it to turn green - this may take several minutes. If it does not succeed after two minutes, the system will automatically attempt to re-establish the connection at a fallback rate of 12. Do NOT resubmit the rate during this time as it may result in the Probe and Controller being out of step with each other.

   The *states* the system goes through when establishing a connection can be monitored on the **DSL Details form's** top right corner, under 'Training Status' (see #3 in Figure 20):

   ASM_Pending

   ASM_Waiting_TSilence

   ASM_GHS_Activating_State

   ASM_BP_Activating_State

   ASM_FR_Activating_State

   ASM_Active_state

   If the system is failing to progress with establishing the connection, it will flick backwards and forwards between the first three or four states on the list repeatedly, rather than progressing down to the final state. (See TroubleShooting below)
8. After the connection has been established, hit the 'Get' button again to confirm that the system has connected at the desired rate.
9. Check the 'HEC CRC' field - the value should not be incrementing over time. If it is, then the DSL connection should be changed to a lower rate. Refer to **point 6.**
10. When performing an acquire, there will be information on the DSL rate on the survey parameter confirmation form. This will indicate if the DSL rate is lower than what the sampling rate requires to succeed.

Trouble Shooting

Also refer to Trouble Shooting in section 23 to confirm hardware integrity.

If the winch is particularly long and resulting in communication errors or dropped connections, it may be best to follow the instructions above via a direct connection using the probe charge cable, ie without the winch, to establish the initial connection.

In this case, set the desired DSL rate, wait for the confirmation window to pop up stating that the desired DSL rate has been successfully sent, and a red light should appear for CH1. Then quickly connect the controller and probe back to the winch. This must be accomplished within one minute to guarantee enough time for the connection to be established.

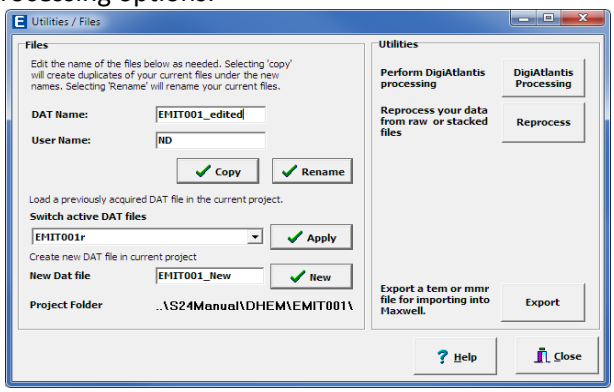
If after four minutes the connection still hasn't been established, hitting the play/pause button will reset the connection. The system will then attempt to connect at the standard DSL rate of 44, and successively drop the rate from there. Refer to controller's CH1 LED for status.

If all else fails please connect the probe to the controller using the Probe Charge cable and cycle the power on the controller.

Note: During the survey, if the connection is lost for any longer than 2 minutes the probe / controller might try to re-establish the connection at the fallback rate, at which point the speed may need to be reset again. This is indicated by the SMARTem24 software failing to collect enough data and the CH1 LED status (flashing green).

22.6 Utilities/Files Form

Left side of the screen allows the user to copy or rename data files, switch between existing data files and create new data files. The right side is for extra processing options.



This form is accessed via Main Menu > Utilities / file button.

Files

Datafile Name: (default= project) displays the name of presently loaded data file. Edit this name to enable the Copy and Rename buttons.

User Name: (default= user) displays the name of the presently loaded **User Profile.** Edit this name to enable the Copy and Rename buttons.

- **Copy button**: click to copy the loaded files to the displayed file names.
- **Rename button**: click to rename the loaded files to the displayed file names.

Switch active DAT files: closes the current file and loads an existing data file from the project folder. Select the file from the drop down list. Only one data file can be loaded into the software at a time.

- **Switch button**: apply the selected file switch. Button will be inactive if no other data files exist in the project folder.

New data file: (default= project_New) edit the name of new data file. Might be used for creating the next survey line for surface surveys that use similar project settings. Not recommended for downhole surveys.

- **New button**: click to create a new empty data file with this file name.

Project Folder: displays the name of the current project folder, as defined at start-up, where the data is saved.

Utilities

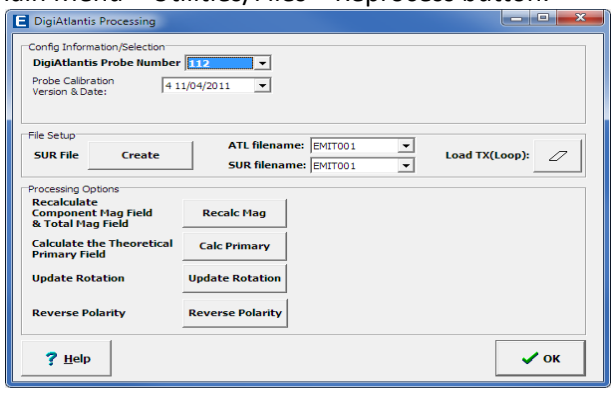
DigiAtlantis Processing button: (only displayed for DigiAtlantis projects). Click to open the DigiAtlantis Processing Dialogue for extra processing options. Refer to section 22.6.1.

Reprocess button: click open the Reprocessing Form to create stacked or data files from raw or stacked files with any updated settings. Refer to section 22.6.2.

Export button: click to open the Export Form to export data file to a TEM/MMR format file. File will have reduced number of columns and can be separated based on component, units or line. File is suitable for import into Maxwell. Refer to section 22.6.3.

22.6.1 DigiAtlantis Processing Dialogue

This screen provides processing options specific to DigiAtlantis projects. To recreate a data file from stacked or raw files use the reprocessing screen, via Main Menu > Utilities/Files > Reprocess button.



This screen is accessed via Main Menu > Utilities/Files > DigiAtlantis Processing button.

Configuration Information/Selection

Options to alter the DigiAtlantis Probe number and to select calibration settings. If the Probe being used does not appear on the list some processing options will be disabled. Contact EMIT

DigiAtlantis Probe Number: select the Probe number. This is automatically detected during acquisition but also may be set here.

Calibration Version & Date: calibrations are undertaken by EMIT and provide sensor data used for calculating probe orientation. This is used during acquisition and for any post-processing. Select from the list the most recent calibration.

File Setup

Settings to create or change loop, survey and DigiAtlantis files associated with the data file. These file selections will be used in reprocessing options.

SUR File:

- **Create button**: click to open the Survey File Options Form. See section 22.6.1.1.

ATL filename: (default= project) associates a DigiAtlantis **.atl* file with the loaded data file. This file is automatically defined during acquisition but may be changed to a different file if required.

- Select a file from the drop down list. Only files in the project folder will be available.

SUR filename: (default= project) associates a survey **.sur* file with the loaded data file. This may be a new file created by either SMARTem24 or from another survey.

- Select a file from the drop down list. Only files in the project folder will be available.

Load TX(Loop): use this option to load and/or edit loop information.

- **Loop button**: click button to open the Loop Editor Form. See section 22.5.4.1.

Processing Options

Recalculate Component & Total Magnetic Field: this option copies the component magnetic field values from the Atlantis **.atl* file and then calculates the total magnetic field value.

- **Recalc Mag button**: click to update the data file

Calculate Theoretical Primary Field: this option calculates the theoretical primary field, based on station location (E, N, RL) and loop information. Accuracy of result depends on accuracy of survey information (collar values or load a **.sur* file) and loop geometry (**.tx* file) & current.

- **Calc Primary button**: click to update the data file

Update Rotation: use this option to adjust the orientation of the cross-hole components and rotate the data.

- **Update Rotation button**: click button to open the Update Rotation Form. See section 22.6.1.2.

Reverse Polarity: this option reverses polarity of all data by (multiplying by -1). Is applied to all components/channels. Is generally used when measured primary field (VPRI) is reversed to theoretical primary field.

- **Reverse Polarity button**: click to update the data file and the Display Panels.

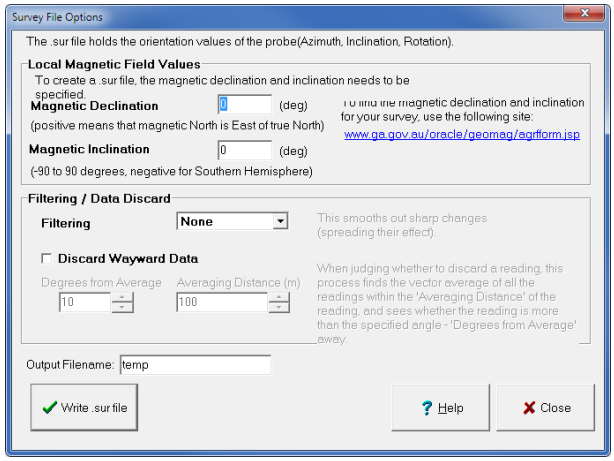
OK button: will apply these settings to the data file.

22.6.1.1 Survey File Options Form

For DigiAtlantis projects only. Use this form to create a survey **.sur* file that contains borehole orientation at each station . Calculations are based on the earth's magnetic field values at the survey location.

A survey file is used to calculate E,N, RL of each station, which are required for some processing options.

Once the file is created it should be inspected for integrity. There are some filtering options on this screen to assist this. If satisfied the file can be loaded back into the project via the previous screen -the DigiAtlantis Processing Dialogue.



Access this form via Main Menu > Utilities / Files > DigiAtlantis Processing > SUR File Create button.

Local Magnetic Field Values

Define the magnetic field orientation at the survey site. Magnetic field values can be obtained from http://www.ga.gov.au/oracle/geomag/agrfform.jsp.

These values may also be configured via the Main Menu > DigiAtlantis button.

Calculate Orientation: (default= yes) option to calculate the azimuth of the probe based on the following values. If set to yes then azimuth will be displayed on the Confirm Parameters Window.

Magnetic Declination: (default= 0) enter the declination (degrees) of the earth's magnetic field at survey location relative to grid north.

- Values range from -180 to 180. Enter a positive value if magnetic north is east of grid north.

Magnetic Inclination: (default= 0) enter the inclination (degrees) of the earth's magnetic field at survey location.

- Values range from -90 to 90. Enter a negative value for southern hemisphere.

Filtering / Data Discard

Use these options to filter or discard wayward orientations. Wayward orientations will produce wayward data.

Filtering: (default= none) option to apply a moving box-car averaging of orientations during calculations. Select the filter width (number of adjacent stations to be averaged) from the list.

Discard Wayward Data: (default= no) option to delete orientations that exceed (moving) average values by user defined threshold during calculations.

Degrees from Average: (default= 10) enter the maximum difference (threshold) (degrees) from the average angle that is acceptable. Larger values will be discarded.

Averaging Distance: (default= 100) enter the width (borehole length) (m) that defines how many adjacent stations are included in the moving average calculations.

Output filename: (default= project) edit the name of the survey **.sur* file to create

Write .sur file button: click to calculate orientations and save to survey file based on these settings.

22.6.1.2 Update Rotation Form

DigiAtlantis projects only. This from is used to update cross-hole component data by updating the rotations. Stacked files are not required for this processing.

This option is commonly used to process near-vertical holes to a fixed azimuth when the azimuth cannot be determined from poor accelerometer values .

Select Rotation Method

Choose which method to use for the rotation calculations. Options are:

Accelerometers: (default) this uses the accelerometers to identify the probes original orientation, as determined by default on acquire. Use this option if probe calibrations have changed. This may be inaccurate if the probe orientation was near vertical.

Magnetic Field: this compares measured magnetic field values from the probe to earth's local magnetic field values to determine the rotation. This may be inaccurate if there is a magnetic anomaly in the area but for steep holes may provide a better fit than the accelerometers. Calculations use the displayed local magnetic field values.

Local Magnetic Field Values

Define the magnetic field orientation at the survey site. Magnetic field values can be obtained from http://www.ga.gov.au/oracle/geomag/agrfform.jsp.

These values may also be configured via the Main Menu > DigiAtlantis button.

Magnetic Declination: (default= 0) enter the declination (degrees) of the earth's magnetic field at survey location relative to grid north.

- Values range from -180 to 180. Enter a positive value if magnetic north is east of grid north.

Magnetic Inclination: (default= 0) enter the inclination (degrees) of the earth's magnetic field at survey location.

- Values range from -90 to 90. Enter a negative value for southern hemisphere.

Field Strength: (optional, default= 0) enter the field strength (nT) of the the earth's magnetic field at survey location.

Specify an Azimuth

This option forces the rotation of the data to a fixed azimuth. Can be used if neither of the Rotation Methods are finding the correct orientations accurately, and a manual specification of the azimuth is required. Always use this for near-vertical holes.

Note: entering a value in one cell automatically updates the other cell so that the components are always orthogonal, with U being 90deg clockwise from V component.

Specify Azimuth: (default= no) select to enable user specified azimuth option.

New Azimuth U component:(default= 90) enter an angle (degrees) for the U component's new azimuth.

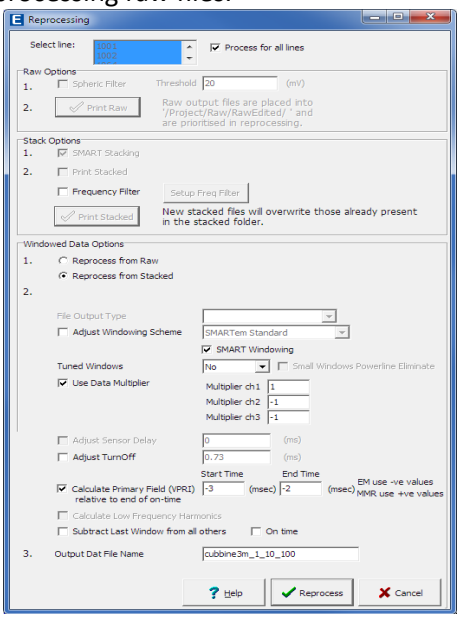
- Enter a value between 0 and 360 in the local grid.
- The U component value should represent the azimuth of the borehole, which may be determined by generating a borehole survey *.sur file. For near vertical holes you may wish to use the general drilling azimuth in the survey area.

New Azimuth V component: (default= 0) enter an angle (degrees) for the V component's new azimuth.

Rotate button: click to apply these settings.

22.6.2 Reprocessing Form

This form is for (re)creating data files, creating stacked files and reprocessing raw files.



This form can be accessed via Main Menu > Utilities / Files > Reprocess button.

Select Line: only available for multiline projects, and displays all the lines available. Select the lines to be reprocessed. Multiple lines may be selected using Ctrl or Shift keys in combination with mouse or arrow keys.

- This option may be used to produce a single line processed data file from a multiline project.
- To export a single line without any changes, the Export Form may also be used via Main Menu > Utilities / Files > Export button. See section 22.6.3.

Process for all lines: select this option to include all lines in the project in the reprocessing. This will disable individual selections.

Raw Options (presently disabled)

Option to apply filtering to raw files. New files are created in new subfolder '...project\raw\rawEdited\' so that the original files are retained.

Spheric Filter: (default= off) select this option to enable filtering of spherics (short spikes in the data, typically from from electricity storms) during reprocessing. Values that exceed a certain range (threshold) from the running average will be discarded.

- **Threshold**: (default= 20) enter threshold value (mV). Data exceeding the average by this value will be discarded. The value should be large enough to not exclude normal data noise levels.

Print Raw button: click to apply these settings and create the new raw files.

Stack Options

Options to create and apply filter to stacked files.

SMART stacking: (default= yes) select this option to use tapered stacking, whereby a portion of the initial and final stacks will have less effect on the data, during reprocessing.

Print Stacked: (default= no) select this option to save new stacked files with these settings when reprocessing. Old files will be overwritten.

Frequency Filter: (default= no) select this option to enable notch filtering during reprocessing. Settings are configured via the adjacent button.

Setup Frequency Filter button: click this button to open the Frequency Filter Form to configure settings for applying notch frequency filtering to stacked files. See section 22.6.2.1

Print Stacked button: click to apply these settings and create new stacked files. Old files will be overwritten without any warnings.

Windowed Data Options

Options for creating (new) data files, from either raw for stacked files, with some extra processing options, including on-time window schemes. Some incorrect survey settings values that were used during the survey can be 'corrected' here.

Reprocess from Raw or Stacked: (default= stacked) chose whether to reprocess data using raw files or stacked files. Use of stacked files is faster as many processing steps have already been undertaken.

File Output Type: presently disabled, so always outputs data files of the same data type.

Window Scheme: (default= SMARTem Standard) is the timing scheme for the windows at which the final data will be calculated. Standard window schemes are provided. Select from the drop down list.

- Users may also create and load their own window schemes using Customised window schemes (SMARTem24User.times) file. See section 15.13.

Smart Windowing: (default= yes) select to use tapered windowing during reprocessing where a portion of the initial and final stacked samples within a window will have less effect.

Tuned Windows: (default= no) an option to adjust & optimise window sizes to minimise the effects of the selected noise source. Only windows of sufficient width are modified and the modifications are subtle enough so there is no significant change to the start or end time of the window. Select the noise source from the list.

- **No**: no adjustment
- **Powerlines**: select of filter 50 / 60Hz and harmonics.
    - **Small Window Powerline Eliminate** (SWiPE): (default= no) option to further reduce the effects of powerlines on narrow windows.
- **PED**: Personal Emergency Device, an in-mine communication system centred on 374Hz. Select to filter PED and harmonics.

Use Data Multiplier: (default= no) select to enter multiplier values for each channel.

Adjust Sensor Delay: (default= no) select to use this new sensor delay (ms).

Adjust TurnOff: (default= no) select to use this new transmitter turn off time (ms).

Calculate Primary Field (VPRI): (default= yes) option to calculate the measured primary field during acquisition. The value is averaged over the defined time range, relative to the start of transmitter switch off.

- Enter negative values for B field data (to capture on-time data), and positive values for dB/dt data (to capture ramp data) and MMR data.
- **Start Time (ms)**: (default= -20) enter start of the time range.
- **Primary End (ms)**: (default= -10) enter end of the time range.

Calculate Low Frequency Harmonics: (default= no, presently disabled)

Subtract Last Window from all others: (default= no) select to subtract the last window from all the other windows.

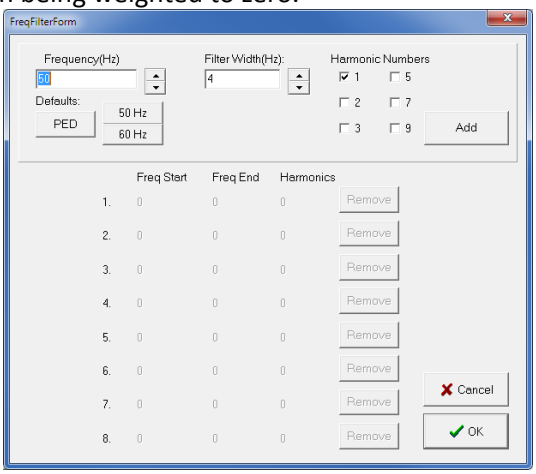
On time: (default= no) select to apply the selected window scheme during on-time rather than off-time.

Output data file name: (default= data_New) edit the name of the file to be created with these settings. Files can be overwritten.

Reprocess button: click to create the data file based on these processing settings. If the file exists a warning will be displayed.

22.6.2.1 Frequency Filter Form

Use this form to configure the filter settings when reprocessing stacked files. The filter being applied is a notch filter. Filtered frequencies are interpolated rather than being weighted to zero.



Access this form via Main Menu > Utilities / Files > Reprocess > Stack Options > (enable Frequency Filter) > Setup Freq Filter button.

Set Frequency

Use this upper section to define the characteristic of each filter frequency. Multiple frequencies may be added by entering new values and clicking the Add button.

Frequency (Hz): (default=50) enter the frequency to be added to the filtering process. The buttons below may also be used to quickly define the value:

- **PED button**: (default= 374) click to use this value.
- **50Hz button**: (default= 50) click to use this value.
- **60Hz button**: (default= 60) click to use this value.

Filter Width (Hz): (default= 4) Enter the width of the filter.

Harmonics numbers: (default= 1)select which odd harmonics of the selected frequency are to be included in the filtering.

Add button: click to add these selections to the filter list. Click this button after editing the values to add multiple frequencies.

Freq Start, Freq End, Harmonics

This lists the frequency settings to be applied, and is appended to each time the **Add button** is clicked. List items include calculated and selected parameters of the filtering based on the user entered values.

FreqStart: starting frequency of filter range, calculated as (**Frequency** – ½ **Width**).

Freq End: starting frequency of filter range, calculated as (**Frequency** + ½ **Width**).

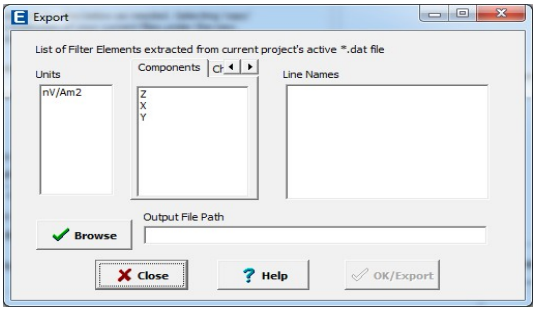
Harmonics: the odd harmonic to be included. Multiple harmonics will be listed as separate rows.

Remove button: click a button to remove that row of settings from the processing.

OK button: click to save these processing settings and return to the previous screen.

22.6.3 Export Form

This form allows the user to export data to a TEM/MMR format, which has a reduced number of columns and can be separated on a per component, units or line basis. Files are suitable for import into Maxwell.



This form is accessed via the Main Menu > Utilities/Files > Export button.

The user may select none, one, or many items from each lists to specify export filter criteria. Any data common to all selections will be exported. The more items selected the smaller the exported file No selections will result in all data being exported.

Units: lists all the data units that appear in the data file.

Components: lists all the components that appear in the data file.

Channels: lists all the channels that appear in the data file.

Line Names: lists all the Line Names that appear in the data file. Multi-line files which therefore display multiple line names.

Browse: click to define the name of the new file and its location. This must be set.

Output File Path: displays the defined file name and path. This entry may be edited.

- File extension is assigned automatically based on data type, ie **.tem* for TEM data, **.mmr* for MMR data. Other extensions will be rejected.

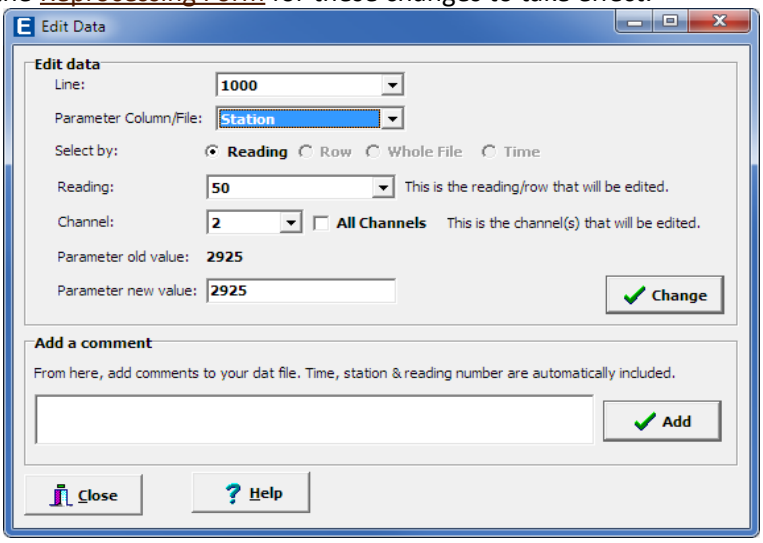
OK/Export button: click to create the new file based on these selections. If the file exists a warning will be displayed.

Cancel button: click to cancel the export process and return to previous screen.

22.7 Edit Data Form

Open this form to add comments and to edit or update some column values in data files, and to adjust stacked files to account for timing / synchronisation issues.

Various options become active depending on their relevance to selections made. In some instances the data file will need to be reprocessed via the Reprocessing Form for these changes to take effect.



This form is accessed via Main Menu > Edit Data button.

Add a comment

The comment will be written to the data file as rows below the header information, along with the time, station and reading when the comment was added.

Text box: Type comment to be added in the text box, e.g. powerlines, buildings, reason for any edits.

Add button: click button to accept the comment.

Edit data

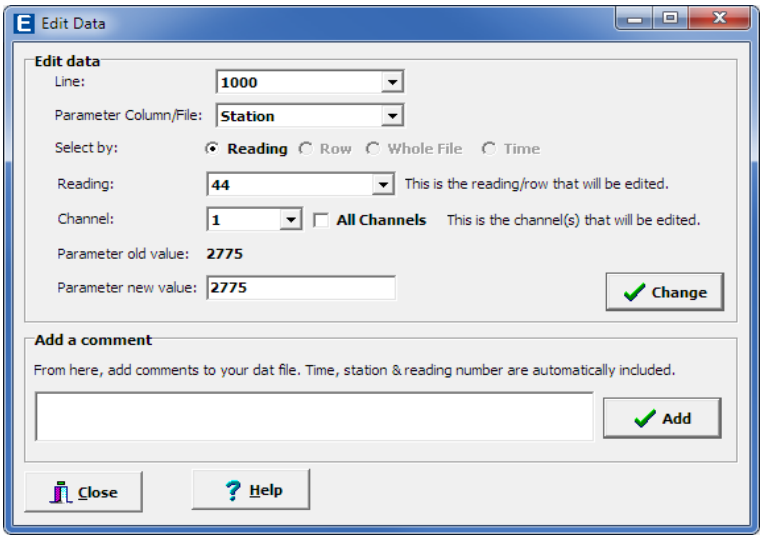
Line: Survey line to be processed. Choose from the drop down list

Parameter Column/File: Parameter to be edited. Choose from the drop down list.

- **Station**: edit station value.
- **Effective Current (A)**: edit transmitter effect current value.
  - **Update Stacked Files**: additional option to also edit the associated stacked file.
- **Turnoff (ms)**: edit transmitter turn off (column) value.
- **Stacked File**: edit stacked file to shift the data to account for synchronisation issues.
- **Data**: edit data (CH1, CH2...) values by applying a basic maths operation (+, -, * or /).

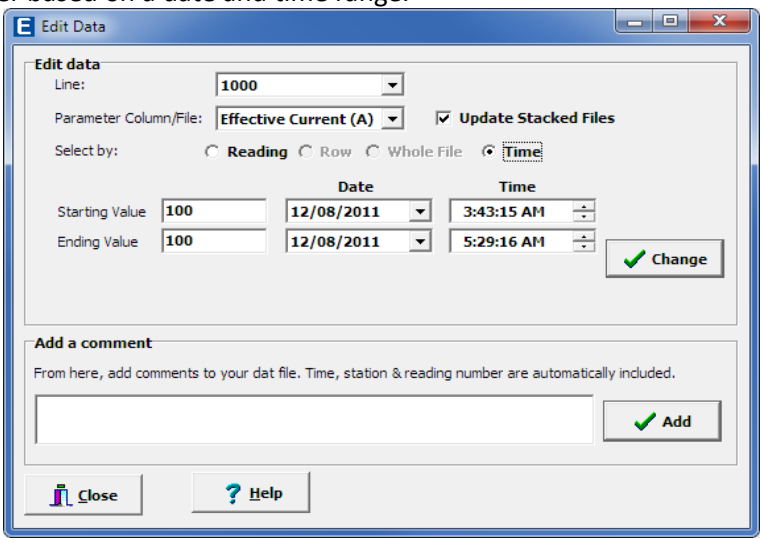
Select by: Selection constraint on the parameter being edited. Select from the relevant radio buttons.

- **Reading**: Select to edit the parameter on a per reading basis.



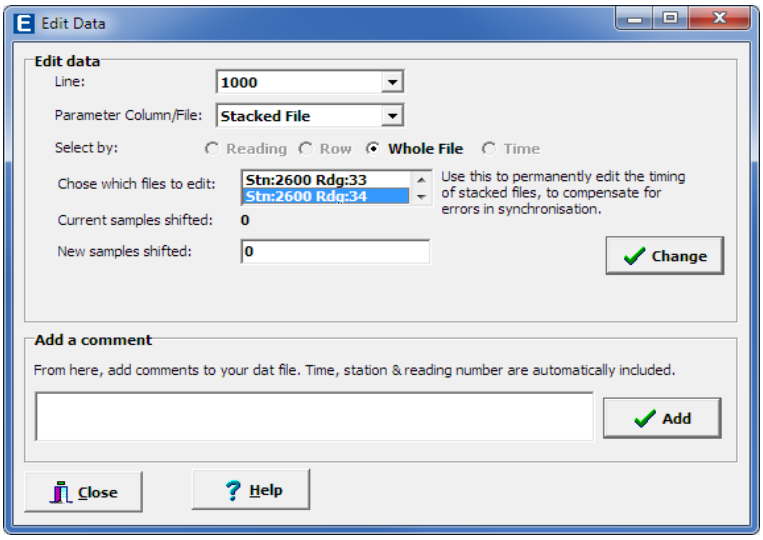
- **Reading**: Chose the reading number from the drop down list.
- **Channel**: Chose which channel(s) to be selected, either all channels/row or a single channel/row.
- **Parameter old value**: displays the Parameter's current value of the current selection.
- **Parameter new value**: type in the Parameter's new value .

- **Time**: Select to edit the parameter based on a date and time range.



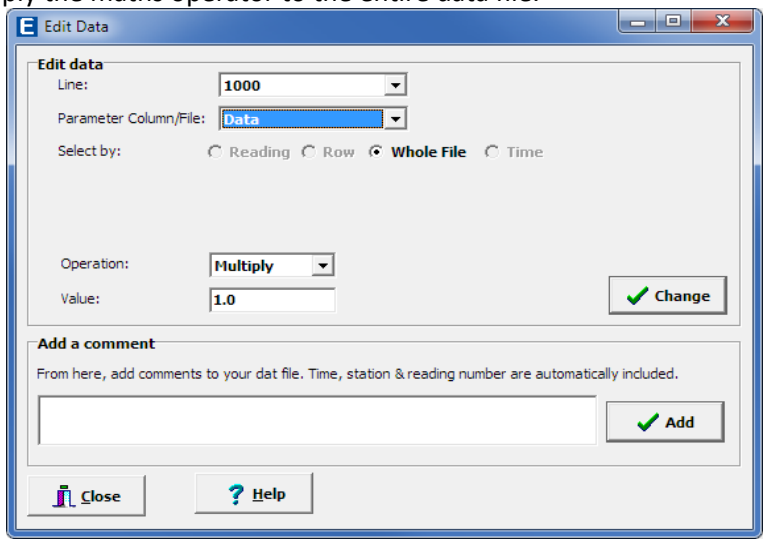
- **Starting Date, Time**: (default= first reading) Choose start date & time for the time range.
- **Ending Date, Time**: (default= last reading) Choose end date & time for the time range.
- **Starting Value**: (default= first readings value) Type in the Parameter's value for the start of the time range.
- **Ending Value**: (default= last reading's value) Type in the Parameter's value for the end of the time range.

- **Whole File**: Select to edit the parameter for the whole file.
  - For **Stacked files** this will adjust the time offset of the data from zero time. Note that this value is always relative to original zero time and is not cumulative. Data file will need to be recreated from stacked files for these changes to take effect.



- **Chose which files to edit**: select the relevant file reference from the list.
- **Current samples shifted**: displays the offset value of the current selection.
- **New samples shifted**: (default= 0) Type in the new offset value.
    - For synchronisation issues, the number of samples to be shifted can be calculated as (sampling rate * time (secs) to be offset).
    - Hint: It may be useful to have the stacked panel visible, and zoomed in, so that the effect of the applied shift can be seen.

- For **Data** files this will apply the maths operator to the entire data file.



- **Operation**: (default= multiply) Select the maths operator to be applied from the drop down list.
- **Value**: (default= 1) Type in the value to be applied by the operation.

Change button: click to apply the edits.

Close button: click to close the form and not make any changes. Returns to the main screen.

23 Trouble Shooting

This section contains some basic trouble shooting information.

More information can be found online at http://www.electromag.com.au/faq.php

System Unresponsive

Perform a hard reset.

- Refer to Power on / off in section 7 Common Hardware Operations.

Excessive GPS lock time

- Restart the device, ie Controller or Receiver.

No GPS detected

- Ensure that the GPS antenna has an unobstructed view of the sky.
- Restart the device. The device will recalibrate the antenna noise floor on startup.

Transmitter / Receiver out of sync by 1 second

- Ensure that the leap seconds setting is correct on both the transmitter and receiver.
  - Refer to LEDs in section 7 Common Hardware Operations.

23.1 DigiAtlantis System

Intermittent loss of DSL

- DSL rate is incompatible for long (+2km) winches.
  - Refer to section 22.5.9.1for Optimising DSL connection rate for long (+2km) winches .
- Check Gearhart-Owen socket connection. Replace 4 pin socket assembly with new assembly if worn.
- Check winch for intermittent shorts to shield or adjacent wires.
- Check winch wiring.
  - Refer to Wiring Diagrams / Schematics in section 21 for details on optimum configuration.

24 Glossary

Accelerometer	Is a sensor that measures the force of gravity. In the DigiAtlantis System they are useful in determining the dip and rotation of the probe.
Acquire View	The View displayed by the SMARTem24 Software during data acquisition. It normally contains at least one Scope Panel (Oscilloscope**)** to provide a live view of the data being received.
Acquisition	*or acquire; also see Reading* Term used to reference the gathering (display & saving) of geophysical data with the SMARTem24 Software**.**
Active Station	Software station location where the next acquisition will be assigned to.
Argand Panel	This panel displays frequency data as argand, amplitude or phase plots. Argand panels are only available within MMR projects.
ATL File	**.atl file* An ASCII file containing DigiAtlantis specific information (e.g. magnetometer and accelerometer measurements). Data is saved to file on each acquisition.
Atlantis	Is an analogue, 3-component borehole EM system manufactured by EMIT. This analogue technology has been superseded by the DigiAtlantis.
Atlantis Probe	A hardware component of the analogue Atlantis system. This fluxgate magnetometer borehole probe transmits analogue data to a SMARTemV on the surface. Atlantis gathers three components of data, one channel at a time.
Axis	*See Component*
Calibration	Sensor specific data obtained by EMIT that is used to accurately calculate orientation of the DigiAtlantis probe. Serviced probes will likely have a new calibration.
Channel	The input channel that the connected hardware's component is assigned to.
Collar	Refers to the the top of a borehole (usually the opening at the surface). The collar co-ordinates (East, North, Elevation) can be entered into the software.
Component	*or direction* Is an axis of measurement, usually denoted as X, Y, or Z. Borehole survey data that has been processed to be aligned with hole azimuth is referred to as A, U or V components. Most sensors measure responses in either one component or three orthogonal components.
Controller	*See Transmitter Controller or Probe Controller*

CSAMT	Controlled Source Audio Magnetotellurics
DAT File	**.dat file* An ASCII file containing processed TEM survey data.
Data Folder	The computer location where all data is stored during acquisition & processing. The default is C:\Data\<project folder>.
Data View	The View that the software returns to when an acquisition is complete.
Decay	Representation of a response as a function of time after transmitter switching. Usually simplified from stacked data using Windowing Schemes.
Decay Panel	A panel to display decays , selected by station or reading number and channel or component. This panel is updated when the acquisition is complete, and may be used to remove bad decays.
DigiAtlantis	A digital, 24 bit, three component, fluxgate magnetometer borehole system made by EMIT. The DigiAtlantis samples all **components** at the same time, digitises at the sensor, and transmits the signal to the Receiver. The DigiAtlantis is the next generation of the **Atlantis Probe**.
DigiAtlantis Controller	A component of the DigiAtlantis system. There are usually two Controllers provided with the system; one to be used as a Probe Controller and one to be used as a Transmitter Controller.
DigiAtlantis Probe	A hardware component of the DigiAtlantis system. The Probe measures responses from three component simultaneously and transmits the digital data to the DigiAtlantis Receiver on the surface.
DigiAtlantis Receiver	A hardware component of the DigiAtlantis system. The DigiAtlantis Receiver is a Toughbook® computer.
Downhole	In a borehole.
EMIT	ElectroMagnetic Imaging Technology Pty Ltd - an instrumentation and software developer for electrical geophysics. Products include the SMARTem24 and DigiAtlantis systems and Maxwell Software. For assistance please contact EMIT.
Fluxgate	A type of sensor for measuring magnetic field strength.
Firmware	A term used to denote the fixed, usually rather small, software and/or data structures that internally control the Hardware.
Graphical Buttons	A menu that provides controls for configuring the Graphical Panels.
Graphical Options form	A form that allows users to alter the View list and General Information displayed on the Main Screen.

Graphical Panels	Each of the charts that displays data. Configuration of the panels is managed via the Graphical Buttons.
Hardware Definition File	*or HwDef.xml file* An xml file. Contains configuration information of the previously connected device , and is used for the Hardware setup.
Half period	*Or half-cycle* Half a transmitter period.
INI File	*Or* *.ini file *see User Profile***.**
IP	Induced Polarisation.
IP Spread	Layout of an IP survey.
Licence Authorisation form	A form (see section 22.1.1.2) within the Software to view, request or renew the security license. EMIT recommends users check the licence status prior to going out into the field.
Line	A survey line consisting of survey stations.
Local Magnetic Field Values	Local magnetic field values are available from www.ga.gov.au/oracle/geomag/agrfform.jsp. These are used to calculate the azimuth of the DigiAtlantis Probe (see **section** 22.5 **DigiAtlantis**). It is recommended that these values are entered prior to starting the survey so azimuth values are continuously updated.
Magnetometer	A sensor for measuring magnetic field strength. Also see *Fluxgate*, *SQUID*.
Magnetotellurics	*or MT* The natural electrical and magnetic fields of the Earth's subsurface. MT surveys measure the natural variations of these fields at the surface.
Maxwell Software	Programme developed by EMIT to display, edit and model electrical geophysics data.
Measured Primary Field	or *VPRIM* A measurement of the primary field signal, saved to the data files as a column of data. May be saved during acquisition or calculated from stacked files via reprocessing.
MMR	Magnetometric Resistivity, a type of survey.
MMR Profile Panel	A panel to display MMR data (amplitude, phase, in-phase or quadrature) as profiles by Channel or Component.
Moving Loop	A style of **EM** survey with a moving transmitter loop.
ms	millisecond.

MT	*See **Magnetotellurics**.*
Nulling	The process of removing the DC magnetic field response from the **magnetometer** sensors so that the AC part of the field can be amplified.
Oscilloscope	An instrument used to display and analyse the waveform of electronic signals. In effect, the device draws a graph of the signal voltage as a function of time.
Plan Panel	A panel to display the survey area as a plan view . An image can be loaded as a backdrop for superimposing stations, tx loops, comments and other information.
Probe	See ***DigiAtlantis Probe***
Probe Controller	Controller device providing timing and communication to and from the probe.
Profile	A plot of responses as a function of Station (distance) along a survey line.
Profile Panel	A panel to display the data as a profile on a per channel or component basis.
Program Version Number	**SMARTem24 Software** is version controlled has the following version number format, eg 2.1.13.10858. Access these details via Welcome Screen > About button.
Project	Represents all the settings and data gathered (or to be gathered) in a single area. This may constitute many lines of data, and thus multi-line data files. To copy a project to another PC, copy the entire project folder.
Project File	**.project file* An ASCII file referencing the last opened data file plus some image scales. Used in conjunction with settings and data files to define a project. Project files can be loaded by double clicking on the file or through the **Welcome Screen.**
Raw File	**.raw file* A binary files containing raw data - see section 15 and can be viewed in raw panels. Represents the unprocessed voltages recorded by a receiver for the entire acquisition cycle for the reading.
Reading	The data collection acquisition cycle. Multiple readings can be performed at a **Station**, each having a different reading number, which is automatically incremented.
Receiver	*or Rx* Refers to either the SMARTem24 or DigiAtlantis Receiver, depending on its context.

RL	Relative Level or **Elevation**.
Rotation	(DigiAtlantis only) This represents the angle that the probe has been rotated around the probe's main axis, for a reading, and is normally calculated using the probe's accelerometers. Cross-component data is automatically unrotated (using rotation and calibration information) at the end of the acquisition cycle so that final processed data aligns with borehole direction (although this final data is typically referred to as being 'rotated'). Data may be rotated via DigiAtlantis Reprocessing using alternative methods and to a specified azimuth.
Scope Panel	A panel to display channel voltages in real time, similar to an Oscilloscope. Panels can display all channels or separate channels.
Sensor Definition File	*or SensorDefinition.xml*; *or *.xml* This file is used to define sensor types for SMARTem24 software. It includes basic sensors. Additional sensors may be included in the *CustomSensorDefintion.xml* file (see **section** 15.14).
Sensor Delay	Group delay of the sensor. Is used when windowing data, as defined in the Sensor_Definition_File.
Settings file	*See SINI File*.
SINI file	*Or *.sini file or settings file.* An ASCII file containing the software settings of a survey (e.g. location, transmitter, file options). Each project has a settings file within the project folder. A settings file can be exported to become part of the default list on the **Welcome Screen**. The content of a Settings File can be edited in the **Setup Menu** (see **section** 22.5).
Site Code	A text string requested by EMIT as part of the SMARTem24 Software Licence and can be found on the Licence Authorisation form (see **section** 22.1.1.2).
Site Key	A text string provided to users as part of the SMARTem24 **Software Licence** and can be found on the **Licence Authorisation** form (see **section** 22.1.1.2).
SMARTem	The family of geophysical receiver systems manufactured by EMIT. It includes the SMARTemV which has been superseded by the SMARTem24.
SMARTem24	A 24-bit, 16 channel, receiver system, manufactured by EMIT, capable of a variety of electromagnetic geophysics surveys.
SMARTem24 Transmitter Controller	*Also see* ***Transmitter Controller*** A component of the SMARTem24 system. One Controller is normally provided with the SMARTem24 system.

SMARTem24 Receiver	*Also see Receiver* A hardware component of the SMARTem24 system. The Receiver is an integrated instrument comprised of a Toughbook® and the SMARTem24 Receiver's base.
SMARTem24 Receiver Base	The base section of the SMARTem24 Receiver.
SMARTem24 Software	Programme provided by EMIT for collection of data on SMARTem24 Receivers and DigiAtlantis Receivers. Also used to process SMARTem24 data.
SMARTemV	A 16-bit, 8 channel receiver system manufactured by EMIT. *Also see* SMARTem.
Software	*See* SMARTem24 Software.
Software Licence	Software based authorisation to run the SMARTem24 software. See Licence_Authorisation.
SQUID	Type of **Magnetometer**.
Stacked File	**.stk* file A file containing stacked data - see section 15 - and can be viewed in Stacked Panels. Stacking is the process of averaging raw data over many transmitter periods (2 stacks per period) to improve signal to noise ratio. The number stacks and will influence the length of a Reading.
Station	The location at which measurements are made. In the case of a **borehole** survey, the station number is normally the distance the survey tool has travelled down the borehole, ie winch depth.
SUR File	*or *.sur* file An ASCII file containing orientation information (station, azimuth and inclination) of the borehole. Is used to calculate station Easting, Northing and RL.
Survey Configuration	Specifies which survey arrangement is being employed (e.g. **Downhole** or **Moving Loop)**. Selected on the Welcome Screen. This selection combines with **Survey Mode** to control the SMARTem24's configurable parameters, available displays, nature of the acquisition and processing options.
Survey Mode	Specifies which survey technique is being undertaken (e.g. TEM, MMR or TIP). Select on the . This selection combines with **Survey Configuration** to control the SMARTem24's configurable parameters, available displays, nature of the acquisition and processing options.

Synchronisation	*or timing* The SMARTem24 and the DigiAtlantis systems can synchronise via GPS and crystal. For set up of these timing modes refer to **section** 8
TDEM	*See TEM*
TEM	*or TDEM* Transient (or Time Domain) ElectroMagnetics
Theoretical Primary Field	*or TPRIM* The theoretically calculated primary magnetic field strength. Calculations use the location of the Transmitter Loop, the transmitter current and the locations of the stations.
Timing	*See* Synchronisation
TPRIM	Abbreviation for Theoretical Primary Field.
Transmitter Controller	Controller device providing the timing signal for the transmitter.
TX File	*or *.tx file or Transmitter Loop File* An ASCII file listing co-ordinates of the transmitter loop vertices - the wire on the ground connected to the transmitter that provides the primary field.
User Profile	*or User File; or *.ini file* Stores the graphical selections made by the user; enabling different users to retain their own graphical settings. Files are saved automatically upon exiting the software. A User Profile must be selected to use SMARTem24. When a new User Profile is started default settings are loaded.
View	A particular configuration of display panels and their settings that are saved with the **User Profile**. A default set of Views are included for first time users which may be customised, and are selected via the **Information Bar**. A useful collection of views will allow the user to easily swap to a different way of viewing the data. The list of Views may be modified via the **Graphical Options form**.
View File	*or *.view file* Stores the graphical settings defining a **View**. In normal usage this information is stored entirely with the User Profile, but additional Views can be saved to file and loaded manually by the user.
VPRIM	See **Measured Primary Field**.
Welcome Screen	First dialogue that appears when starting the **SMARTem24_Software**. Start surveys, load data or query software license from here.

Windowing Scheme	Specifies the start and end times of a series of windows used for **Windowing - the process of averaging stacked data** at specified time frames to reduce the number of samples, eg for a **Decay.**. Standard schemes are included with SMARTem24, but users may create their own if required.

End of SMARTem24 User Guide document.

Please contact EMIT should you have any queries regarding this Guide. We would appreciate being notified if you find any errors or omissions.

Much appreciated,

EMIT Team.