Guideline Geo

ABEM LS Extender

User Guide



Our Thanks...

Thank you for choosing Guideline Geo and ABEM! The very core of our philosophy is to provide our users with excellent products, support, and services. Our team is committed to providing you with the most efficient and easy-to-use solutions to meet your efficiency and productivity needs.

Whether this is part of your first ABEM system or an addition to the ABEM collection, we believe that a small investment of your time to familiarize yourself with the product by reading this manual will be rewarded with a significant increase in productivity and satisfaction.

Please let us know about your use and experience of our products and the contents and usefulness of this manual. We are excited to be part of your journey!

Under copyright laws, this manual may not be copied, in whole or in part, without the written consent of Guideline Geo. The ABEM logo is a trademark of Guideline Geo, registered in Sweden and other countries. Other company and product names mentioned herein are trademarks of their respective companies.

The product described in this document is subject to continuous developments and improvements. All particulars of the product and its use contained in this document are given by Guideline Geo in good faith. However, all warranties implied or expressed, including but not limited to implied warranties or merchantability, or fitness for purpose, are excluded. This document is intended only to assist the reader in the use of the product and every effort has been made to ensure that the information in this manual is accurate. Guideline Geo shall not be liable for any loss or damage arising from the use of any information in this document, or any error or omission in such information, or any incorrect use of the product.

Mention of third-party products is for informational purposes only and constitutes neither an endorsement nor a recommendation. Guideline Geo assumes no responsibility with regards to the performance or use of these third-party products.

Guideline Geo AB

www.guidelinegeo.com

Table of Contents

Preface 5

Safety Information 6
- General Safety, Electrical and Electrode Safety 6
- Battery Safety, Use in Wet or Harsh Environments 7
- Damaged or Abnormal Equipment, Maintenance and Service 8

Regulatory & Compliance Information 9
- Intended Use, Compatibility and Limitations of Use, Electromagnetic Compatibility 9
- Product Identification, EU Compliance 10
- Manufacturer, Unauthorized Modifications 11

About LS Extender 12
- Limitations of use 12

Unpack. Inspect. Register 13
- Repacking and Shipping 13
- Registering ABEM LS Extender 13

Assembly & Start-up 14
- Unboxing and initial set-up 14
- Cable connections 15
  - 8 × 16 Layout, 4 × 32 Layout, 6 × 21 Layout, 6 × 32 Layout 16
- Optional Guideline Geo shoulder strap 16

Indicator Lights 17

LS Extender in the Terrameter UI 18
- External Devices menu 18
- Power menu, Progress menu 19

LS Extender Spreads & Protocols 21
- Terrameter spread file format 21
- Terrameter Protocol file format 22

Troubleshooting & Maintenance 23
- Troubleshooting: power issues 23
- Troubleshooting: connection issues 24
- Maintenance: before survey, Maintenance: post-survey 25

Storage 26
- Before Storage, Storage Environment, Battery Storage 26

Disposal & Recycling 28
- Electrical and Electronic Equipment, Battery Disposal, Packaging 28
- Further Information 29

Appendix 1 – Frequently Asked Questions 30

Appendix 2 – Technical Specifications 31

Appendix 3 – Spreads & Protocols 32
- Extracts from a 4x32 spread file 32
- Extracts from a 128-electrode protocol file 36

Preface

About this Manual

This manual is written for the end user, explaining how to set up and configure the product and providing detailed instructions on its use. It should be read in conjunction with the ABEM Terrameter User Manuals.

v1.1 3rd November 2026

Additional Resources

Training:	www.guidelinegeo.com/training-gpr-resistivity-seismics-tem/
Downloads:	www.guidelinegeo.com/support-service-advice-training/resource-center/
Applications:	www.guidelinegeo.com/application-areas/

Feedback

Feedback regarding the contents of this manual or the product may be sent using any of the contact details found at www.guidelinegeo.com

Safety Information

Read and understand this manual and the ABEM Terrameter LS 2 user manual before installing, operating, maintaining, or transporting the LS Extender.
The LS Extender is intended for professional use in geophysical surveys and monitoring applications. Operators should be familiar with electrical resistivity and induced polarization measurement methods and the associated electrical hazards.

General Safety

- Use the LS Extender only for its intended purpose and in accordance with the instructions in this manual.
- Use only compatible equipment, cables, batteries, power supplies, and accessories specified or approved by Guideline Geo.
- Inspect the LS Extender, cables, connectors, and accessories before use. Do not operate equipment that is damaged or shows signs of abnormal operation.
- Do not modify the LS Extender or its electrical connections.
- Do not open the enclosure. Service and internal repairs shall only be performed by Guideline Geo or authorized service personnel.
- Keep connectors clean and dry and always inspect before mating. Do not mate connectors containing water, dirt, or other foreign material.

Electrical and Electrode Safety

WARNING – ELECTRICAL HAZARD

During a measurement, electrical potentials are applied to electrodes connected to the measurement system. Electrodes, electrode cables, connectors, and other conductive parts of the measurement circuit may therefore present an electrical hazard.



- Never touch electrodes, exposed conductors, cable connectors, or other conductive parts of the measurement circuit while a measurement is in progress.
- Before connecting, disconnecting, moving, or servicing electrodes or measurement cables, stop the measurement and ensure that the system is no longer transmitting.
- Treat the complete electrode spread as potentially live whenever a measurement is in progress.
- Prevent unauthorized persons and animals from accessing electrodes and cables during measurements.
- Do not use damaged electrode cables, connectors, or electrodes.
- Exercise particular caution when surveying near electrical installations, buried or overhead power cables, pipelines, fences, or other conductive structures. Follow applicable local safety regulations and site procedures.

The LS Extender includes status indicators to provide information about the state of the measurement system:

CAUTION indicator

When illuminated, a Terrameter is connected and switched on. A measurement may be initiated from the Terrameter. Exercise caution when working with the electrode spread or connected cables.



WARNING indicator

When illuminated, a measurement is in progress and electrodes connected to the measurement system may be electrically energized. Do not touch or disconnect electrodes, measurement cables, or connectors.



Battery Safety

The LS Extender uses a rechargeable lithium-ion battery.

- Use only batteries specified or approved by Guideline Geo for use with the LS Extender.
- Switch off the LS Extender before installing or removing the battery. The battery is not hot-swappable.
- Use the battery bay adapter when required for the installed battery type.
- Do not use a damaged, swollen, leaking, deformed, or abnormally hot battery.
- Do not short-circuit, crush, puncture, disassemble, or expose batteries to fire or excessive heat.
- Keep battery contacts clean and dry.
- Charge batteries only using charging equipment specified or approved for the battery.
- If a battery becomes unusually hot, emits an unusual smell, changes shape, leaks, or shows other signs of damage, discontinue use and move it away from combustible materials, if this can be done safely.
- Follow applicable regulations when transporting, storing, or disposing of lithium-ion batteries.

Use in Wet or Harsh Environments

The LS Extender is designed for outdoor field use and has an IP66-rated enclosure when correctly assembled and used as specified.

- Ensure that the battery compartment is correctly closed and that seals are clean, undamaged, and correctly positioned before use.
- Inspect connectors and seals before operation in wet or dusty environments.
- Do not mate wet or contaminated connectors. Allow connectors to dry and clean them before connection and upon completion of the survey.
- Do not operate the LS Extender if the enclosure, battery compartment, connectors, or seals are damaged in a way that could compromise environmental protection.
- The LS Extender must not be submerged in water.

Damaged or Abnormal Equipment

Immediately stop using the LS Extender if:

- the enclosure, connectors, battery compartment, or cables are significantly damaged
- water or other foreign material is suspected to have entered the enclosure
- the battery shows signs of damage or overheating
- the equipment emits smoke, unusual smells, or excessive heat
- or the equipment behaves unexpectedly in a way that could affect safe operation.

In any such event, switch off and disconnect the equipment where it is safe to do so and contact Guideline Geo or an authorized service representative.

Maintenance and Service

Routine inspection, cleaning, and battery replacement may be performed as described in this manual.

The LS Extender contains no other user-serviceable parts. Do not open, modify, or attempt internal repairs to the unit. Unauthorized modifications or repairs may compromise electrical safety, environmental protection, electromagnetic compatibility, product compliance, or any remaining warranty period.

For service or repair, contact Guideline Geo or an authorized service representative.

Regulatory & Compliance Information

Intended Use

The ABEM LS Extender is an external switching unit intended to increase the number of electrodes available to ABEM Terrameter LS 2 systems for electrical resistivity and induced polarization measurements.

The LS Extender is intended for professional use in geophysical surveys and monitoring applications by personnel familiar with the operation of electrical resistivity and induced polarization measurement equipment.

The LS Extender shall be used in accordance with this manual and the ABEM Terrameter LS 2 user manual.

Compatibility and Limitations of Use

The LS Extender is designed for use with ABEM Terrameter LS 2, cables, accessories, batteries, and power sources as specified by Guideline Geo.

The following limitations apply:

- The LS Extender and ES10-64C external switch units shall not be used together within the same measurement layout.
- The LS Extender requires an ABEM Terrameter LS 2 running a supported software version.
- The equipment shall only be operated within the environmental and electrical limits specified in this manual.
- Damaged equipment, cables, connectors, batteries, or accessories shall not be used.
- The LS Extender shall not be modified or used in configurations not specified or approved by Guideline Geo.
- Only compatible accessories and interconnection cables specified or approved for the LS Extender shall be used.

Failure to follow these requirements may affect measurement performance, safety, environmental protection, regulatory compliance, or any remaining warranty period.

Electromagnetic Compatibility

The LS Extender has been designed to comply with applicable electromagnetic compatibility requirements when installed and operated as specified by Guideline Geo.

To maintain electromagnetic compatibility:

- use the LS Extender only with compatible equipment, cables, and accessories specified or approved by Guideline Geo
- ensure that all connectors are correctly installed and secured
- do not modify the equipment, cables, connectors, or internal electronics
- follow the installation, connection, and operating instructions provided in this manual.

Operation of the equipment in configurations other than those specified by Guideline Geo may affect electromagnetic compatibility.

Environmental Protection

The LS Extender enclosure is rated IP66 under the conditions specified by Guideline Geo.

Before operation, ensure that:

- seals are clean, correctly positioned, and undamaged
- the battery compartment is correctly closed
- connectors are clean and free from moisture and foreign material
- connectors are correctly seated and any locking rings fully engaged
- and that the enclosure and connectors are not damaged.

The IP rating does not mean that the LS Extender is suitable for immersion in water.

Refer to the Technical Specifications section for the specified operating temperature range and other environmental limitations.

Product Identification

Each LS Extender is identified by a product label containing information required for identification and traceability.

The serial number should be quoted when contacting Guideline Geo regarding service, support, or product-related questions.

Do not remove, cover, or damage regulatory, safety, or identification markings on the product.

EU Compliance

The ABEM LS Extender has been designed and assessed for conformity with applicable European Union legislation.

The applicable legislation and harmonized standards are specified in the EU Declaration of Conformity for the product.

The current EU Declaration of Conformity is available from Guideline Geo.

Manufacturer

Guideline Geo AB
Skolgatan 11
SE-939 31 Malå
Sweden
www.guidelinegeo.com

Unauthorized Modifications

Changes or modifications to the LS Extender that have not been expressly approved by Guideline Geo may affect safety, performance, environmental protection, electromagnetic compatibility, and regulatory compliance.

Unauthorized modification may also invalidate approvals or certifications applicable to the equipment.

Unauthorized modification will invalidate any outstanding warranty period.

About LS Extender

The ABEM LS Extender is a modern external switch unit designed, primarily, to increase the number of available electrodes on the ABEM Terrameter LS 2. Provided that the Terrameter is running the latest version of the user interface software (v2.13.0 or above), the LS Extender is plug-and-play, with the only other preparation being to upload and select appropriate spread and protocol files to leverage the additional switching capabilities. The LS Extender uses the same spread and interlink cables as the ES10-64C.

This User Manual should be used in conjunction with the ABEM Terrameter User Manuals.



Limitations of use

The LS Extender is a modern alternative to the existing ES10-64C external switch unit, but they are not compatible with each other. As a result, an LS Extender cannot be used in the same layout as an ES10-64C.

The maximum distance between a Terrameter and the first LS Extender is 750 m; this allows for stable command signals between the devices. Each LS Extender acts as a repeater for command signals, so the maximum distance between additional Extenders is also 750 m. There is practically no limit to the number of Extenders that can be attached to a single Terrameter. Real-world limiting factors, such as cost or attempted depth of investigation, would be the primary constraint upon the scale of a system.

Unpack. Inspect. Register

Great care should be taken when unpacking the equipment. Be sure to verify the contents in the packing list and inspect the equipment and accessories for any loose parts or other damage.

Note: The packing list, included with the shipment, should be read carefully, and any discrepancy should be reported to our sales department via www.guidelinegeo.com

Note: All packing material should be kept if any damage occurs during shipping.

File any claim for shipping damage with the carrier immediately after discovering the damage and before the equipment is used. Any claims for missing equipment or parts should be filed with Guideline Geo within fourteen (14) business days from receiving the equipment.

Repacking and Shipping

The Guideline Geo packaging is specifically designed for shipping the LS Extender. This packing kit should be used whenever shipping is necessary. If original packing materials are unavailable, pack the instrument in a large enough box to allow at least 80 mm of shock-absorbing material to be placed all around the instrument. This includes the top, bottom, and all sides.

Warning: Never use shredded fibres, paper or wood wool, as these materials tend to pack down and permit the instrument to move inside its packing box.

Please read our shipping instructions before returning instruments to Guideline Geo. These instructions can be found on our website at www.guidelinegeo.com.

Registering ABEM LS Extender

By registering your equipment, you ensure you will receive valuable information, such as manual updates, software upgrades and other product information, which helps optimize the equipment's utilization and realize the maximum return on your investment. To register your equipment, visit our Product Registration page, which can be found in the Help Centre at www.guidelinegeo.com

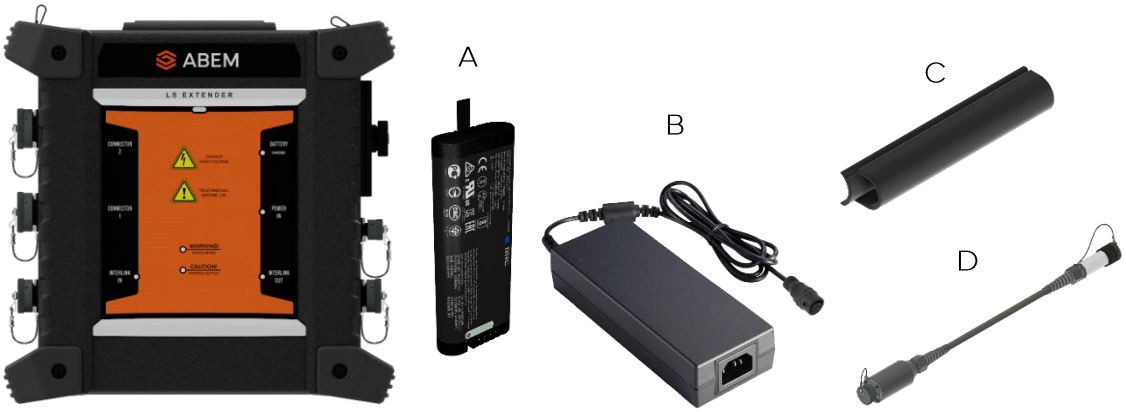


Note: The serial number is found on the label at the rear of the LS Extender.

Assembly & Start-up

Unboxing and initial set-up

The LS Extender is delivered with an internal battery (**A**, 30-49500026), office power supply (**B**, 21-006199), battery bay adapter (**C**, 11-004345A), and an LS Extender interlink adapter (**D**, 36-001548).



Twist the black, ridged knob on the right side of the unit to release the battery bay cover. Insert the battery bay adapter and battery (if using the standard 10.8 V battery), then push the lid firmly closed until it clicks shut.

Note: The battery bay adapter is not needed when using the higher capacity 14.4V battery (30-003049).



Higher capacity 14.4 V battery (30-003049) in LS Extender

Regular 10.8 V battery (30-49500026) and battery bay adapter



To charge the battery, plug the office power supply into the power port below the battery bay. The “charging” indicator LED will come on whilst charging and go-off when the battery is fully charged.

Cable connections

When setting up a measurement in the field, the Interlink Adapter should be connected to the "Interconnect" port of the Terrameter. The interlink cable(s) are then used to connect between the Interlink Adapter and the LS Extender "Interlink In" port on the left side of the device.



Terrameter *Interconnect* > Interlink Adapter > Interlink Cable(s) > LS Extender *Interlink In*

If more than one Interlink Cable is required, Interlink Cable Joints (21-33001275_2, circled above) are back-to-back connectors which will join one cable to the next.

If more than one LS Extender is required, the subsequent Extenders are connected with more Interlink Cables running between the "Interlink out" and "interlink in" ports on each unit; no additional adapters are required.

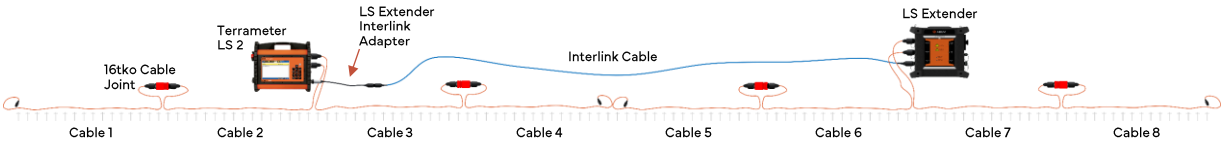


It is best-practice to connect all the Extenders within the layout and then switch them on in sequence, starting with the unit nearest the Terrameter.

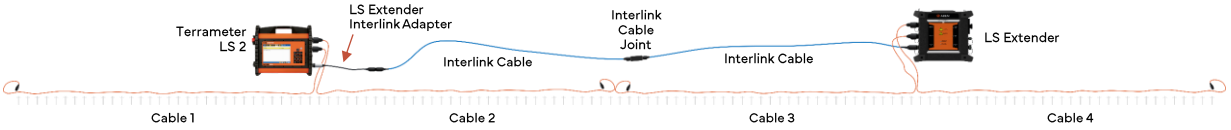
The imaging cables (or Terrameter Breakout Boxes) are then connected to Connector 1 and Connector 2 on the Terrameter and Extender(s).

The following schematic diagrams show examples of cable spreads utilizing one or more LS Extenders.

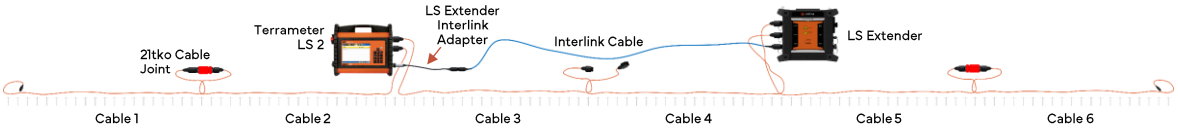
8 × 16 Layout (single interlink cable example)



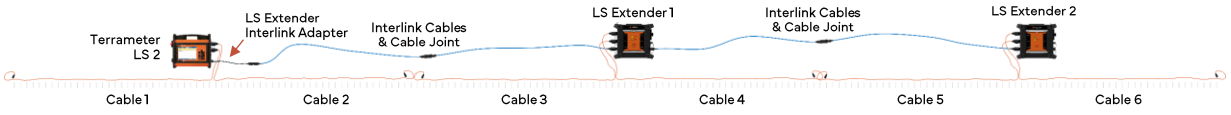
4 × 32 Layout (example with multiple interlink cables)



6 × 21 Layout (with single interlink cable)



6 × 32 Layout (with multiple interlink cables)



Optional Guideline Geo shoulder strap

A useful accessory for the LS Extender is the carrying strap. The buckles on the end of strap will simply clip into the strap loops behind the rubber bumpers on the top side of the unit. The strap ends can also be configured to fit through the slots in the end panels of the ABEM Terrameter instruments to make transporting the resistivity meter easier.

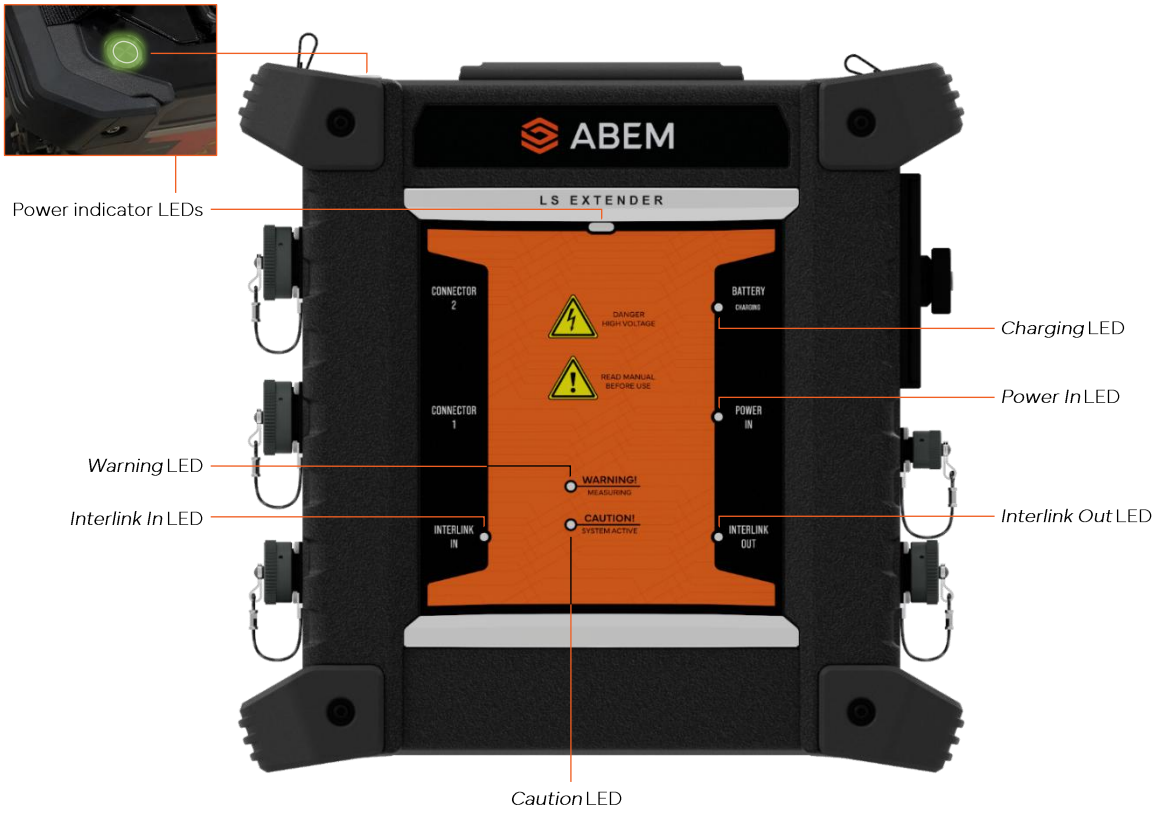






Indicator Lights

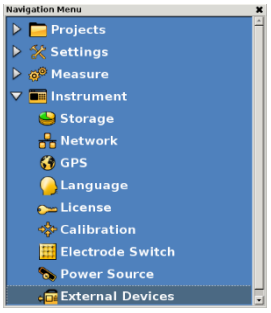
There are a series of indicator lights on the LS Extender to confirm various function states, communication both up- and down-stream between the Extender and the instrument, or between individual Extender units. The indications are as follows:



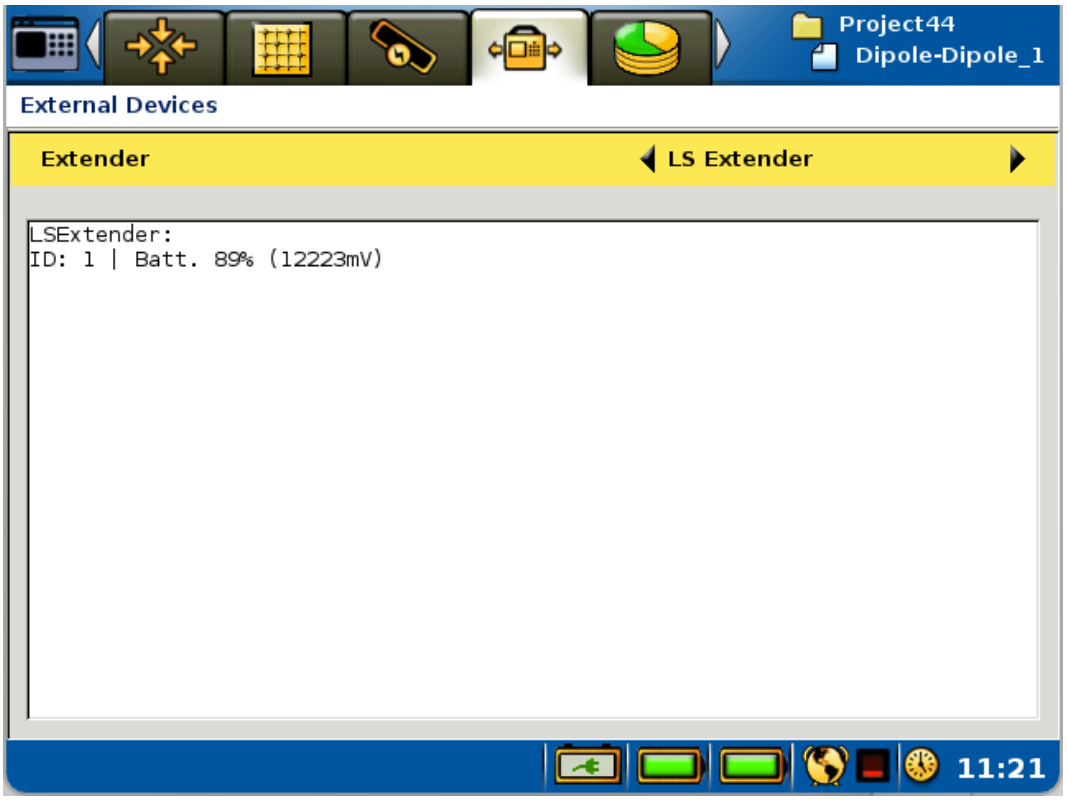
Power indicators	When lit, the Extender has power and is switched on.
Interlink In	When lit, a compatible device upstream of the Extender is switched on and communication established.
Interlink Out	When lit, a compatible device downstream of the Extender is switched on and communication established.
Caution	When lit, a Terrameter is connected and has been switched on; a measurement could start at any time.
Warning	When lit, a measurement is underway and therefore some electrodes will be live.
Charging	When lit, the office power supply is connected and the internal battery is charging. The light will go out when the battery reaches capacity.
Power In	When lit, an external source of power is connected (either an office power supply or an external 12 V battery).

LS Extender in the Terrameter UI

The only menu change required, which is outside of the usual process of setting up a measurement (i.e. creating a project, and then a task by choosing a spread and protocol, defining settings, creating a station and starting measurement) is to select the external switching device from the *External Devices* menu. This is located within the *Instrument* section of the main menu.



External Devices menu

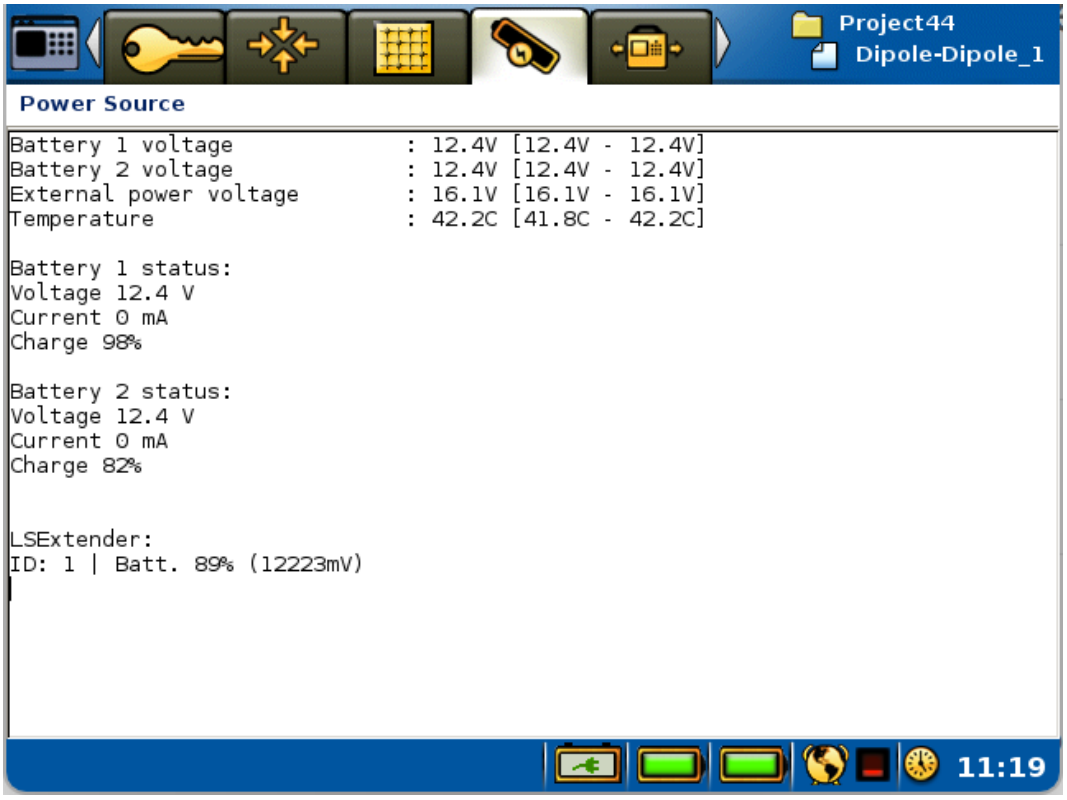


This menu is used to define which external unit is going to be connected (LS Extender, ES10-64C, or Terrameter Log). It has no impact on measurements when no external device is attached; the spread file will determine whether the instrument looks for the selected device when initiating a measurement.

Once a selection is made, the choice will be remembered, so it should not be necessary to make another selection, unless using a different external device.

If the LS Extender is selected, additional information will be displayed about any Extender(s) attached to the Terameter, if they are powered-on. This information includes the ID number and battery status. ID numbers for Extenders are assigned sequentially along the line as they are connected to the Terrameter.

Power menu



If one, or more, LS Extenders are attached to the Terrameter (and are switched on) their battery status will also appear in the power menu.

Progress menu



When a powered-on LS Extender is attached to the Terrameter, and a compatible spread and protocol has been chosen in the Task menu, additional Extender information will be shown on the Progress screen, in the log.

At the start of measurement, it will indicate that connection has been made by displaying the Extender ID and battery status of all Extenders in the spread.

During measurement, error messages will be provided for lost communication and/or low voltage from the internal battery.

LS Extender Spreads & Protocols

The LS Extender is compatible with existing spreads and protocols. Electrodes connected to a Terrameter via an LS Extender are referenced in the same way as they are when using the existing ES10-64C external switch unit.

Note: Due to the LS Extender working with spreads originally written for use with the ES10-64C, some spread/protocol names may still make reference to "ES".

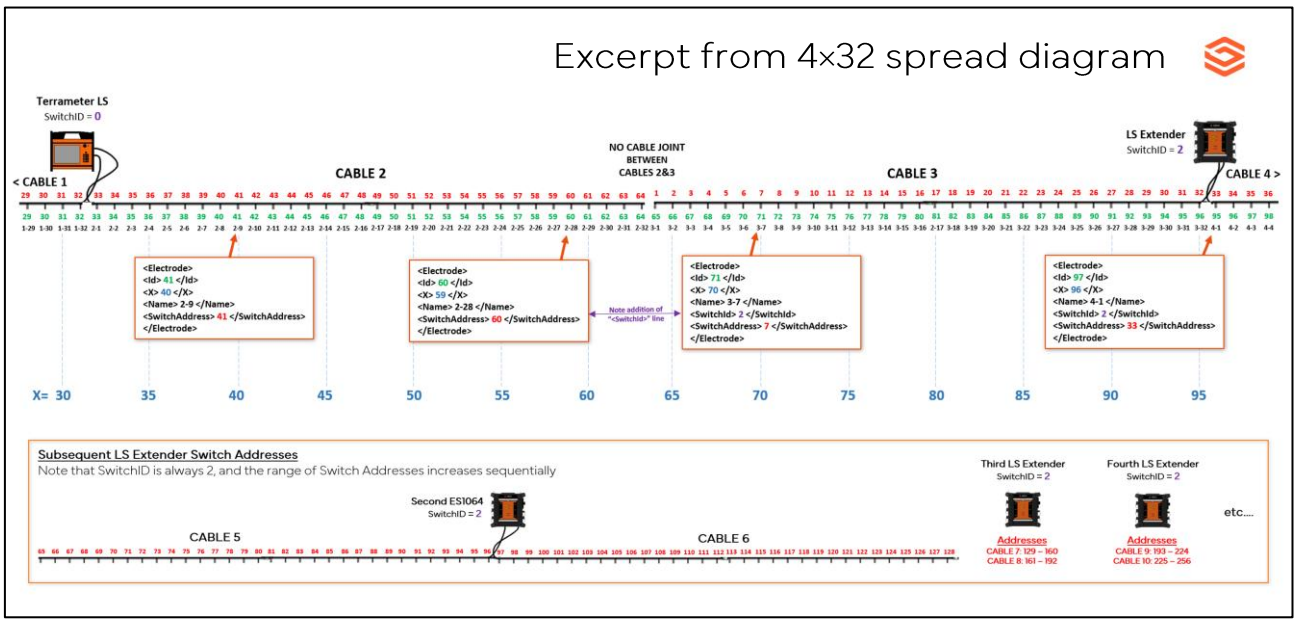
Terrameter spread file format

The spread files used by the Terrameter LS 2 instruct the instrument which cable set is attached to it and how the cable take-outs are connected to the internal relay switch matrix (Terrameter LS 2) or external switch unit (LS Extender). This limited summary of spread files should be read in conjunction with the Spreads & Protocols section of the Terrameter LS 2 user manual.

The spread file starts with some basic header information relating to naming and roll-along settings. Beneath the header and roll-along information is where the position and switch connection for the take-outs on each cable are defined. These are in a sequential list and each take-out is defined by the following parameters:

- **<Id>** This gives an ID number to each take-out. These will be used in the protocol files to define electrodes for current injection / measurement.
- **<X>** This is the distance along the entire cable spread, using the first take-out as the reference point, i.e. "0". This value has no distance units, it is the number of electrode spacings from zero; this will be multiplied by the "X" electrode spacing (entered when creating a new task) to provide 'real-world' distances in the final data file.
- **<Name>** This variable defines what will be shown on the instrument display when it refers to specific take-outs, for example on the *Electrodes* screen.
- **<SwitchID>** The *SwitchID* tells the instrument where to 'find' the Switch Address (below); if this line is not present, it will default to "0" which is the internal relay switch board. If one or more LS Extender units have been used, take-outs on cables connected to these will need the Switch ID set to "2".
- **<SwitchAddress>** This defines which switch on either the instrument or LS Extender a take-out is connected to. There are a total of 64 switch addresses split between the two input connectors. The relationship between switch address (i.e. pin number on the connector) and takeouts on the cable spread will vary from cable-set to cable set. The simplest example is a regular 32-takeout cable set, where switch addresses 1-32 (Connector 1) connect directly to take-outs 1-32 on Cable 1. Switch addresses 33-64 (Connector 2) connect directly to take-outs 1-32 on Cable 2. Switch addresses on the first LS Extender start from "1" (one) again (but now with a Switch ID of "2" in the electrode description) and the address numbers will then increase continuously along the spread, regardless of how many extra LS Extender units are added to the system.

The following diagram shows part of a 4x32 spread file with spread file attribute for selected electrodes.



An extract from a 4×32 spread file can be found in the Appendix of this manual.

Terrameter Protocol file format

The protocol files describe the type of electrode array(s) in use, the measuring sequence, and can be designed to do measurements using arbitrary arrays. A protocol file always refers to at least one spread description file, which simplifies the protocol files immensely, since each electrode only needs to be referred to by the number assigned to it within the <Id> flag of the spread description file. Protocol flags are as follows:

- <SpreadFile> specifies the associated spread description file(s). If there is more than one compatible spread file, this statement is repeated.
- <Sequence> marks start and end of the measuring sequence (i.e. the list of electrode pairs for current and voltage).
- <Measure> defines a measurement, or set of measurements, using one current electrode pair.
- <Tx> specifies electrodes to be used for current during a measurement.
- <Rx> specifies all potential electrodes used for measurement during a current injection defined by the <Tx> flag. There can be an unlimited number of potential electrode pairs for a single current electrode pair; the instrument will repeat current injections until the required measurements have all been taken.

This limited summary of protocol files should be read in conjunction with the Spreads & Protocols section of the Terrameter LS 2 user manual.

An extract from an actual protocol file can be found in the Appendix of this manual.

Troubleshooting & Maintenance

The LS Extender is built with ruggedness as a core design principle but, as with all electronic equipment, handling the LS Extender with care and avoiding harsh handling and heavy blows to the case is advisable.

If the LS Extender will be shipped regularly or transported over large distances, it is advisable to invest in the optional LS Extender instrument case. This is a specific flight-case with bespoke foam interior, designed to carry the Extender and accessories.

Always pick up the LS Extender by the handle or the corner bumpers; never pick it up by one of the cables connected to it.

Below, troubleshooting for connectivity issues and some useful suggestions for maintenance procedures are provided.

Always check our website, www.guidelinegeo.com, for the latest news and updates, and, if necessary, contact Guideline Geo support (support@guidelinegeo.com) or your closest Guideline Geo sales representative for additional help.

Troubleshooting: power issues

If the LS Extender is not turning on:

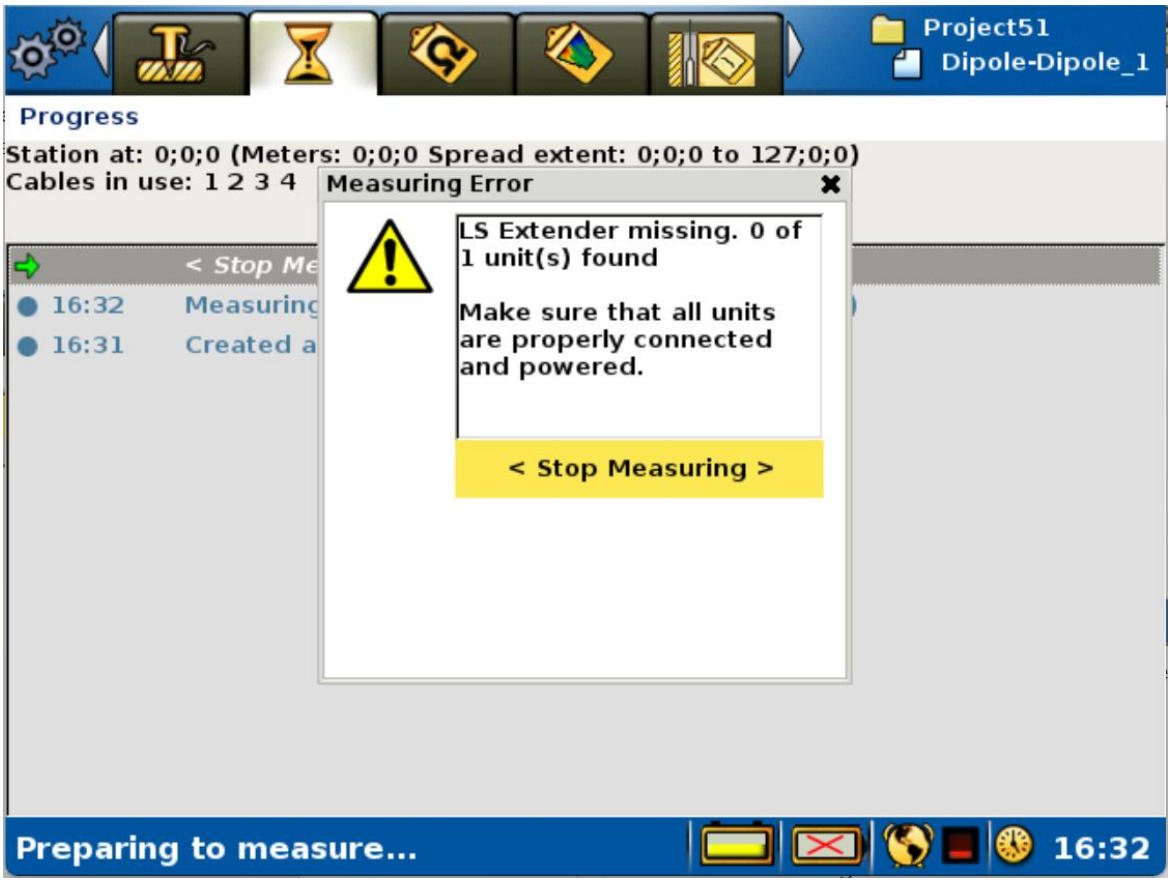
- Double-check that the power button has latched in the on position and not sprung back out.

- If using internal power:
    i. Remove the battery and check the state of charge using the on-battery fuel gauge.
    ii. Check the connector bank on the battery for damage or foreign objects.
    iii. If you have a spare battery, try inserting this and powering on (the LS Extender can use the same Li-ion batteries as found in post-2025 Terrameter instruments).

- If using external power:
    i. Check the power cable for damage.
    ii. Check the connectors for damage and/or foreign objects.
    iii. Check the status of the power source, whether it is a power adapter or external battery.

- If the unit will still not power on, take a note of any lights that are showing on the device, and the result of the above checks, and report the issue to support@guidelinegeo.com

Troubleshooting: connection issues



If the LS Extender is not showing in any of the relevant menus of the Terrameter instrument, or you receive the warning shown in the above screenshot when trying to measure, take the following actions:

- Check for power on the LS Extender, using the troubleshooting guide above if no lights are showing on it.
- Check the Interlink Cable Adapter for damage.
- Check the connectors on the Interlink Cable Adapter, as well as the *Interconnect* port on the Terrameter for signs of damage to the casing or pins and/or foreign objects.
- Check the Interlink In / Out connectors for damage or foreign objects and dirt.
- Try restarting both the LS Extender and the Terrameter.
- If the unit will still not operate, take a note of any lights that are showing on the device, and the result of the above checks, and report the issue to support@guidelinegeo.com

Maintenance: before survey

Make sure that the battery is charged or that the external power source / cable is in good condition.



If using an external power source, ensure connectors are clean and dry before engaging. If using the internal battery, make sure that the battery compartment is firmly closed.

If using the standard (smaller) internal battery, it is essential that the battery bay adapter (right) is used to provide additional support to the battery within the housing. The adapter goes in at the bottom of the battery bay.



Maintenance: post-survey

Check the O-ring around the battery bay. It should be changed if broken.



Check all connectors for dirt and moisture. If the LS Extender is being stored in a cool dry environment, leave dust caps off to ensure connectors are completely dry, particularly if very wet conditions were encountered during survey.

If the battery is to be stored for extended periods it is advisable to charge it (40-60%) and then charge occasionally during the storage period. This will increase the operational lifespan of the batteries. It is not recommended to leave the battery in the device for long periods of time if not being used, leave them uncharged for longer than 1 month, or store them without charging for more than a year.



If the battery is stored in the device remember to use the Battery Bay Adapter if using the smaller standard battery.

The exterior can be wiped down with a damp cloth to remove excessive dirt. Do not use harsh chemical or abrasive cleaners.

Storage

Proper storage helps protect the LS Extender and maintain the service life of the equipment and battery.

Before Storage

Before storing the LS Extender:

- Switch off the unit and disconnect all cables and external power sources.
- Inspect the enclosure, connectors, seals, and battery compartment for damage.
- Remove dirt and moisture from the exterior using a soft, damp cloth. Do not use abrasive or aggressive chemical cleaners.
- Ensure that connectors are clean and completely dry before fitting the protective caps.
- If the equipment has been used in wet conditions, allow it to dry thoroughly in a clean, dry, and well-ventilated environment before storage.
- Ensure that the battery compartment and its seal are clean and dry.

Do not pack or store the LS Extender while it is wet.

Storage Environment

Store the LS Extender in a clean, dry environment, protected from direct sunlight, precipitation, excessive humidity, corrosive substances, and extreme temperatures.

For long-term storage, use the original packaging or the optional LS Extender transport case where practical.

Do not place heavy objects on the LS Extender or store it in a way that may damage the enclosure, connectors, or controls.

Refer to the Technical Specifications for applicable environmental limits.

Battery Storage

For extended storage periods, remove the Li-ion battery from the LS Extender.

For optimum battery service life:

- Store the battery at approximately 40–60% state of charge.
- Store the battery in a cool, dry location away from direct sunlight and heat sources.
- Do not store a fully discharged battery.

- Check the battery periodically during long-term storage and recharge it when necessary to prevent deep discharge.
- Do not store or use batteries that are damaged, swollen, leaking, deformed, or show other signs of deterioration.
- Protect the battery terminals from short circuits during storage and transport.
- Before returning the LS Extender to service after an extended storage period, inspect the equipment and battery for damage and ensure that the battery has sufficient charge.

Disposal & Recycling

The LS Extender and its batteries contain materials and components that should be recovered and recycled where possible. Proper disposal helps conserve resources and prevents potentially harmful substances from entering the environment.

Electrical and Electronic Equipment

Do not dispose of the LS Extender as unsorted municipal waste. The crossed-out wheeled bin symbol on the product indicates that the equipment is subject to separate collection and shall not be disposed of together with unsorted municipal waste.

At the end of its service life, the LS Extender shall be collected separately and handled in accordance with applicable local regulations for waste electrical and electronic equipment (WEEE).

Where applicable, return the equipment through an authorized collection or recycling system. Contact Guideline Geo or your local Guideline Geo representative for information regarding appropriate return, collection, and recycling options.

Battery Disposal

The LS Extender uses a removable rechargeable lithium-ion battery. Remove the battery from the LS Extender before the equipment is sent for recycling.

Do not dispose of batteries as unsorted municipal waste. Used batteries shall be collected separately and returned through an appropriate battery collection or recycling system.

When handling batteries for disposal or recycling:

- Do not dispose of batteries in fire.
- Do not crush, puncture, open, or otherwise damage the battery.
- Protect the battery terminals against short circuits during storage and transport.
- Handle damaged, swollen, leaking, or overheated batteries with particular care and in accordance with applicable local requirements.
- Follow applicable regulations for the transport of lithium-ion batteries.

Packaging

Packaging materials should be reused or recycled where appropriate and disposed of in accordance with local waste collection requirements.

Where possible, retain the original packaging for future transport or shipment of the LS Extender.

Further Information

Waste collection and recycling requirements may vary between countries and regions. Follow applicable local regulations and use authorized collection or recycling systems.

For additional information regarding disposal, recycling, or return of Guideline Geo equipment, contact Guideline Geo or your local Guideline Geo representative.

Appendix 1 – Frequently Asked Questions

Does the LS Extender replace the ES10-64C?

Not completely. For layouts requiring more than 750m between the Terrameter and the external switch, the ES10-64C is still necessary. Adding or replacing an external switch unit to a first-generation LS or Terrameter VES will require an ES10-64C.

Can the LS Extender be used together with ES10-64C external switch units?

No. They are not compatible systems: the Extender is an alternative switching unit, not a direct replacement.

If the LS Extender is part of a monitoring system, can it be driven by an AC/DC converter?

Yes. The office power supply is suitable if the equipment is in a weather-proof housing, otherwise a generic external power cable can be provided to wire into a custom power network.

What is the maximum number of LS Extenders I can use?

More than is practical: theoretical capacity is 255 units in series from a single Terrameter LS 2.

What is the longest distance between the units?

The system has been tested to 750 m between Terrameter and Extender, and/or between each subsequent Extender.

How long will the battery last?

The standard (small) battery provides in excess of a day's survey. The larger battery has approximately 30% greater capacity and is particularly useful in cold environments where Li-ion batteries are less effective.

Is the battery 'hot-swappable'?

No. To swap the battery, pause any ongoing measurement, switch the LS Extender off, replace the battery, then restart the Extender. It will automatically re-sync with the Terrameter and you can resume measuring.

Will I know if the LS Extender battery is running low?

Yes. The battery status is shown in the Extender tab of the Terrameter UI, and also the power tab. It is also written into the activity log on the Progress tab of the measurement screens when data collection starts. There are then additional pop-up warnings if the battery voltage in an Extender drops too low.

Can the Li-ion batteries from a Terrameter be used in LS Extender?

Yes.

Can I use the smaller smart battery (as used in the latest Terrameters) without the "Battery bay adapter"?

We advise against this. If the battery bay adapter is lost, a replacement should be ordered as soon as possible. Without the adapter, the majority of support is being provided by the battery connector and battery terminals, especially if the unit is stood upright. This could cause damage which would require a return-to-factory repair.

Can the LS Extender take full advantage of the number of channels on the Terrameter?

The same limitation applies as on the ES10-64C – a maximum of 7 channels can be used when working wholly with electrodes on the Extender - this is due to the configuration of the Terrameter and Interlink cabling.

Are existing interlink cables compatible?

Yes. Only the adapter is different (the LS Extender plugs into the "Interconnect" port, not the "Aux" port).

Are existing electrode spread cables compatible?

Yes. The electrode spread cable connectors are the same on Terrameters, ES10-64C units and the LS Extender.

Are existing spreads and protocols compatible with the LS Extender system?

Yes. The same spreads that worked with the ES10-64C work with the LS Extender.

Is a shipping case available for the LS Extender?

Yes. It is not supplied 'as standard' due to many LS Extenders being bought for long-term monitoring.

Appendix 2 – Technical Specifications

Switching matrix	10 × 64, providing 64 active electrodes
Comms & diagnostics	Interlink upstream OK Interlink downstream OK System active indicator Ongoing measurement warning Battery / power status
Control signals	Extenders act as repeaters for control signals
Max. separation between devices	750 m
Maximum number of Extenders	255
Maximum channel usage	7 channels concurrently
Connectivity	2× KPT 32-pin for imaging cables 1× KPT 19-pin 'Interlink In' 1× KPT 19-pin 'Interlink Out'
Power	10.8 V, 6.8 Ah internal Li-ion battery 14.4 V, 6.8 Ah internal Li-ion battery (optional) Onboard charging Office power supply
Casing	Rugged shock-resistant case with rubber bumpers IEC IP66 Integral folding handle
Ambient temp. range	-20 °C to +70 °C
W × H × D	34 × 33 × 13 cm
Weight	7.1 kg without battery / 7.5 kg with battery
Accessories	Shoulder strap Spare batteries Shipping case Battery charging cradle Interlink cables

Appendix 3 – Spreads & Protocols

Extracts from a 4x32 spread file

```
<?xml version="1.0" encoding="UTF-8" ?>

  <Spread>
    <Name>4X32_LS_ES</Name>
    <Description>LS to ES on right, 32tko cables, no overlap</Description>

    <CreateStation>
        <Name>4 cables no move</Name>
        <X>0</X>
    </CreateStation>

    <CreateStation>
        <Name>1 cable forward</Name>
        <X>32</X>
    </CreateStation>

    <CreateStation>
        <Name>1 cable backwards</Name>
        <X>-32</X>
    </CreateStation>


    <Cable>
        <Name>1</Name>

        <Electrode>
            <Id>1</Id>
            <X>0</X>
            <Name>1-1</Name>
            <SwitchAddress>1</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>2</Id>
            <X>1</X>
            <Name>1-2</Name>
            <SwitchAddress>2</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>3</Id>
            <X>2</X>
            <Name>1-3</Name>
            <SwitchAddress>3</SwitchAddress>
        </Electrode>

                *SPREAD FILE CONTINUES*

        <Electrode>
            <Id>28</Id>
            <X>27</X>
            <Name>1-28</Name>
            <SwitchAddress>28</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>29</Id>
            <X>28</X>
            <Name>1-29</Name>
            <SwitchAddress>29</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>30</Id>
            <X>29</X>
            <Name>1-30</Name>
            <SwitchAddress>30</SwitchAddress>
        </Electrode>

        <Electrode>
```

- XML header information
- Start of Spread information & Spread name (shown in instrument menus)
- Description shown in LS Toolbox "Spread & Protocol" dialogue
- Options for starting, rolling-along and finishing profiles
- Start of first Cable description & Cable name
- Start of first Electrode description
- End of first Electrode description
- Start of Next Electrode description
- End of Electrode description

```
        <Id>31</Id>
        <X>30</X>
        <Name>1-31</Name>
        <SwitchAddress>31</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>32</Id>
        <X>31</X>
        <Name>1-32</Name>
        <SwitchAddress>32</SwitchAddress>
    </Electrode>
</Cable>
```

- End of first Cable description

```
<Cable>
    <Name>2</Name>

    <Electrode>
        <Id>33</Id>
        <X>32</X>
        <Name>2-1</Name>
        <SwitchAddress>33</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>34</Id>
        <X>33</X>
        <Name>2-2</Name>
        <SwitchAddress>34</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>35</Id>
        <X>34</X>
        <Name>2-3</Name>
        <SwitchAddress>35</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>36</Id>
        <X>35</X>
        <Name>2-4</Name>
        <SwitchAddress>36</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>37</Id>
        <X>36</X>
        <Name>2-5</Name>
        <SwitchAddress>37</SwitchAddress>
    </Electrode>
```

- Start of next Cable description & Cable name

SPREAD FILE CONTINUES

```
    <Electrode>
        <Id>62</Id>
        <X>61</X>
        <Name>2-30</Name>
        <SwitchAddress>62</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>63</Id>
        <X>62</X>
        <Name>2-31</Name>
        <SwitchAddress>63</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>64</Id>
        <X>63</X>
        <Name>2-32</Name>
        <SwitchAddress>64</SwitchAddress>
    </Electrode>
</Cable>
```

- End of second Cable description

```
<Cable>
    <Name>3</Name>

    <Electrode>
        <Id>65</Id>
        <X>64</X>
        <Name>3-32</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>32</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>66</Id>
        <X>65</X>
        <Name>3-31</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>31</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>67</Id>
        <X>66</X>
        <Name>3-30</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>30</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>68</Id>
        <X>67</X>
        <Name>3-29</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>29</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>69</Id>
        <X>68</X>
        <Name>3-28</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>28</SwitchAddress>
    </Electrode>
```

- Start of third Cable description & Cable name; this is the first Cable on the LS extender

- Electrode descriptions now include "SwitchID 2" indicating that they are on one of the external switch units

SPREAD FILE CONTINUES

```
    <Electrode>
        <Id>93</Id>
        <X>92</X>
        <Name>3-4</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>4</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>94</Id>
        <X>93</X>
        <Name>3-3</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>3</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>95</Id>
        <X>94</X>
        <Name>3-2</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>2</SwitchAddress>
    </Electrode>

    <Electrode>
        <Id>96</Id>
        <X>95</X>
        <Name>3-1</Name>
        <SwitchId>2</SwitchId>
        <SwitchAddress>1</SwitchAddress>
    </Electrode>
</Cable>
```

- End of third Cable description

```
    <Cable>                                                    • Start of fourth Cable description & Cable name
        <Name>4</Name>

        <Electrode>
            <Id>97</Id>
            <X>96</X>
            <Name>4-1</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>33</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>98</Id>
            <X>97</X>
            <Name>4-2</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>34</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>99</Id>
            <X>98</X>
            <Name>4-3</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>35</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>100</Id>
            <X>99</X>
            <Name>4-4</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>36</SwitchAddress>
        </Electrode>
```

SPREAD FILE CONTINUES

```
        <Electrode>
            <Id>125</Id>
            <X>124</X>
            <Name>4-29</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>61</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>126</Id>
            <X>125</X>
            <Name>4-30</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>62</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>127</Id>
            <X>126</X>
            <Name>4-31</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>63</SwitchAddress>
        </Electrode>

        <Electrode>
            <Id>128</Id>
            <X>127</X>
            <Name>4-32</Name>
            <SwitchId>2</SwitchId>
            <SwitchAddress>64</SwitchAddress>
        </Electrode>

    </Cable>                                                   • End of fourth Cable description

</Spread>                                                      • End of Spread description
```

Extracts from a 128-electrode protocol file

```
<?xml version="1.0" encoding="utf-8"?>
```
- XML header information

```
<Protocol>
    <Name>Dipole-Dipole</Name>
```
- Start of Protocol information & Protocol name (shown in instrument menus)

```
    <Description>DipoleDipole for 128 electrode spread</Description>
```
- Description shown in LS Toolbox "Spread & Protocol" dialogue

```
    <SpreadFile>8x16_LS_ES.xml</SpreadFile>
    <SpreadFile>8x16_ES_LS.xml</SpreadFile>
    <SpreadFile>4x32_LS_ES.xml</SpreadFile>
    <SpreadFile>4x32_ES_LS.xml</SpreadFile>
```
- Compatible Spread files

```
    <Arraycode>3</Arraycode>
```
- Industry-recognized array codes for identifying the protocol (based on Res2DInv)

```
    <Sequence>
```
- Start of measurement sequence

```
        <Measure>
            <Tx>34 40</Tx>
            <Rx>46 52</Rx>
            <Rx>22 16</Rx>
            <Rx>52 58</Rx>
            <Rx>58 64</Rx>
            <Rx>10 16</Rx>
            <Rx>70 64</Rx>
            <Rx>4 10</Rx>
            <Rx>70 76</Rx>
            <Rx>82 88</Rx>
        </Measure>
```
- First Tx pair, using electrode "Id" values from Spread file
- First set of Rx pairs

```
        <Measure>
            <Tx>3 4</Tx>
            <Rx>1 2</Rx>
            <Rx>6 7</Rx>
            <Rx>7 8</Rx>
            <Rx>8 9</Rx>
            <Rx>9 10</Rx>
            <Rx>10 11</Rx>
        </Measure>
```
- Second Tx pair and associated Rx pairs

```
        <Measure>
            <Tx>9 10</Tx>
            <Rx>7 8</Rx>
            <Rx>12 13</Rx>
            <Rx>13 14</Rx>
            <Rx>5 6</Rx>
            <Rx>14 15</Rx>
            <Rx>17 18</Rx>
            <Rx>18 19</Rx>
        </Measure>
```

PROTOCOL SEQUENCE CONTINUES

```
        <Measure>
            <Tx>74 83</Tx>
            <Rx>119 128</Rx>
            <Rx>92 101</Rx>
            <Rx>65 56</Rx>
            <Rx>101 110</Rx>
            <Rx>47 56</Rx>
            <Rx>110 119</Rx>
            <Rx>38 47</Rx>
            <Rx>29 38</Rx>
            <Rx>20 29</Rx>
        </Measure>

        <Measure>
            <Tx>108 110</Tx>
            <Rx>126 128</Rx>
            <Rx>104 106</Rx>
            <Rx>114 116</Rx>
            <Rx>102 104</Rx>
            <Rx>116 118</Rx>
            <Rx>118 120</Rx>
            <Rx>98 100</Rx>
            <Rx>94 96</Rx>
        </Measure>
```
- Last Tx pair and associated Rx pairs

```
    </Sequence>
</Protocol>
```
- Closing-out of Protocol file



Guideline Geo

your guide to the subsurface