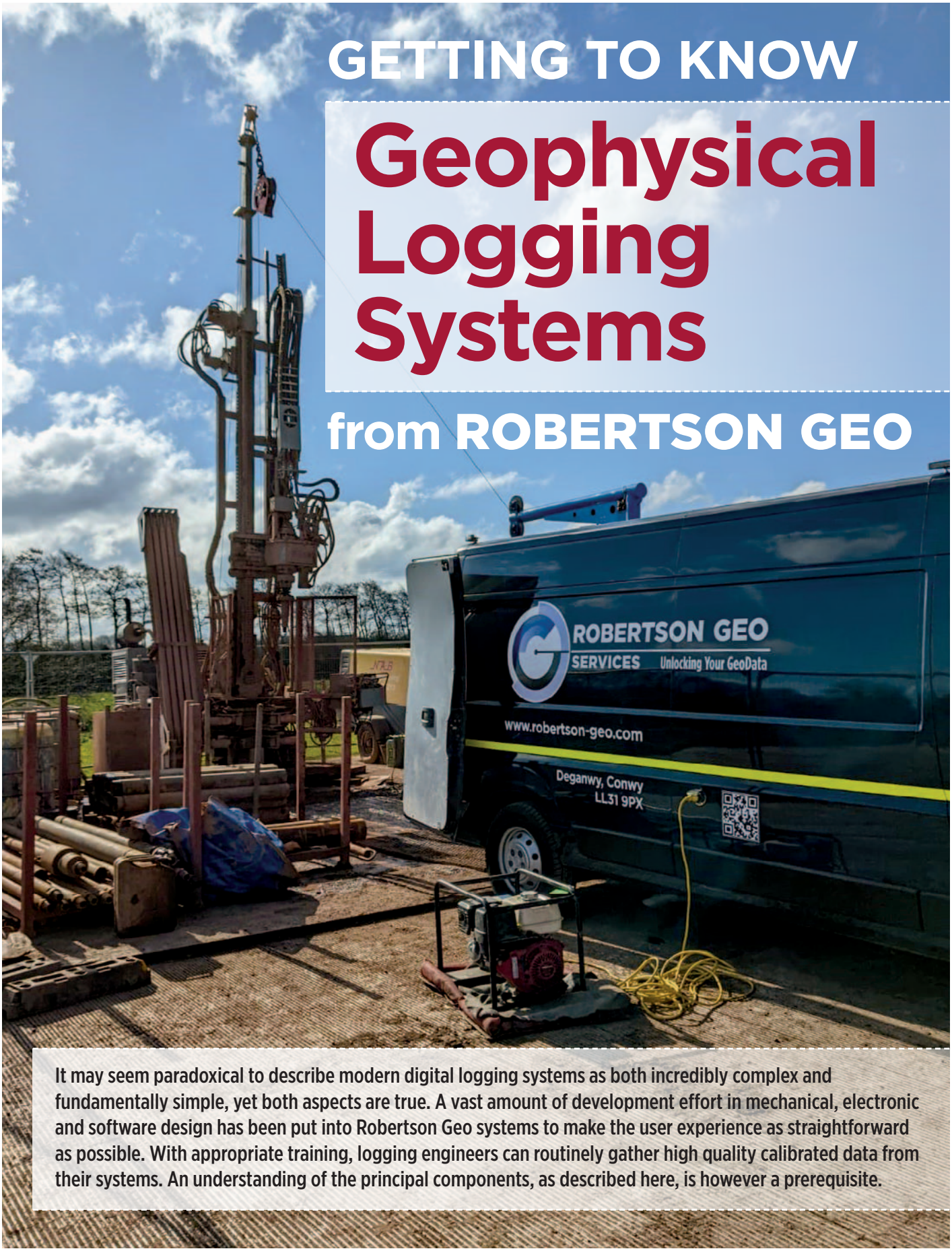
ROBERTSON GEO
Unlocking Your GeoData

GETTING TO KNOW
Geophysical Logging Systems
from ROBERTSON GEO



It may seem paradoxical to describe modern digital logging systems as both incredibly complex and fundamentally simple, yet both aspects are true. A vast amount of development effort in mechanical, electronic and software design has been put into Robertson Geo systems to make the user experience as straightforward as possible. With appropriate training, logging engineers can routinely gather high quality calibrated data from their systems. An understanding of the principal components, as described here, is however a prerequisite.

Above: Logging engineers need to be resourceful – here using a tree to support the winch during portable operations.

Getting to know Geophysical Logging Systems from Robertson Geo

The Main Components

A Robertson Geo geophysical logging system is made up of several items of electrical and mechanical equipment which work together to make specialized measurements within a borehole at known depths. Despite there being a considerable range of measurements, there are several key principles which hold true throughout.

The logging system operates under computer control via a USB connection. The computer is fed with data measurements from a borehole probe and data from surface instruments associated with a logging winch. This allows the system to make a graph or table of measurements against borehole depth or time, as required. The computer allows control of many functions of the system both automatically and under operator control.

In general, a logging system will consist of an electrical power source, a computer and software, a geophysical logger (Micrologger2), a logging winch, a tripod (or sheave wheel), borehole probes, connecting cables, probe accessories and maintenance items. Robertson Geo logging systems are relatively compact but will require a vehicle to transport the equipment to site, in most cases this will be a customised dedicated logging vehicle.

Electrical Power Source

The most common option for providing electrical power to Robertson Geo logging systems is a properly voltage-regulated AC mains generator.

This should have sufficient spare capacity to run all the equipment on the job, especially relevant for heavy probes or deep boreholes where the winch is pulling hard. If a reliable single-phase domestic mains power supply (220V or 110V) is available on-site this may be used instead.

A true-sinewave type DC to AC mains inverter, together with batteries, may also be used in place of the generator. A 12V power supply unit will be required for 12V winches and the Micrologger2 when using AC mains only.

For logging systems based on small winches (Mini Winch or 500m Winch) the entire system may be run using 12V power only. This will require one or more car or leisure type batteries connected in parallel to directly power the winch and surface system. Battery based options are useful for sites where liquid fuel generators are not allowed or where concerns about pollution may exist.

Computer and Software

Laptop style computers are favoured by logging engineers as they are self-contained and can run on their own internal batteries, often for several hours. They are extremely resilient to

power dropouts, switching seamlessly from AC power to battery power without re-booting. Laptops provide versatility as they can be used both for portable operations and in vehicle-based setups. It is good practice to dedicate a computer to logging operations to prevent unforeseen clashes with other software and to avoid connecting to the internet before or during logging. Operating system updates need to be approached with caution as they can cause problems. Following an operating system update, the whole system should be thoroughly tested before commencing field operations.

Robertson Geo provides a minimum recommended specification for logging computers as shown in the table below.

Recommended Logging Computer Minimum Specification	
Operating System:	Windows 11 (64-bit)
Processor:	Intel Core i7 or AMD Ryzen 7 (or equivalent)
Memory (RAM):	16 GB minimum
Storage:	512 GB PCIe M.2 SSD min
Graphics:	Dedicated GPU

Older computers with lower specifications may be sufficient for many probe/software combinations but will need to be fully tested first. The latest laptops may have only a single USB port and if additional devices such as a mouse need also to be connected, a USB hub can be used. In this case the system again needs to be fully tested to ensure that there are no clashes between devices and the system operates correctly. It also recommended that operators using laptops for logging ensure that they have sufficient access rights assigned to them to allow for full control in field situations where contact with centralised IT departments may be limited. Installing logging software is usually a trouble-free operation but using auto-install for USB drivers is best avoided. The instructions in the relevant software manual should be followed very carefully with respect to driver installation.

Through the logging software it is possible to configure and control power and communications with the borehole probes, monitor real-time depth and data from the probes and optionally configure winch cable tension. Configuration of most aspects of the system are made within the software and, once familiar with this, it is worth making a written record of all settings for future reference together with copies of all specialist files in case one needs to start again.

There are many facets to geophysical logging with Robertson Geo software packages and specific training is recommended for all but the most expert users. Post-processing of data, using GeoCAD® is also a vital part of the logging service and this may be undertaken in the field but is more commonly done elsewhere. Log processing is another expert field where training will benefit.

Micrologger2

The Micrologger2 is the principal surface acquisition device used by almost all Robertson Geo systems. Since its introduction in 2001 this small robust unit has been at the heart of most systems, now field-proven for ease of use and reliability. The unit provides power and communications through the logging winch to the borehole probes under software control from the logging computer via a USB connection. The power required is 12V, either from a battery or more commonly from an AC source through a supplied transformer.

The logger has an on/off switch which also indicates power is present and will flash when the borehole probe power is activated. There are various connectors on the unit for power, USB and data through a special 4m long data lead connected to the logging winch. A green 'Link' light on the Micrologger2 will flash frequently during software startup and thereafter periodically after connection has been established. When the unit is powered, it is also usual to hear sound from the internal cooling fan.

The Micrologger2 also registers depth changes which come from the depth encoder mounted on a wheel, either direct on the logging winch or, on a tripod positioned over the borehole. Tension is also monitored from a strain gauge, where fitted. These signals are passed through the special data lead from the winch, along with power and data to and from the borehole probe.

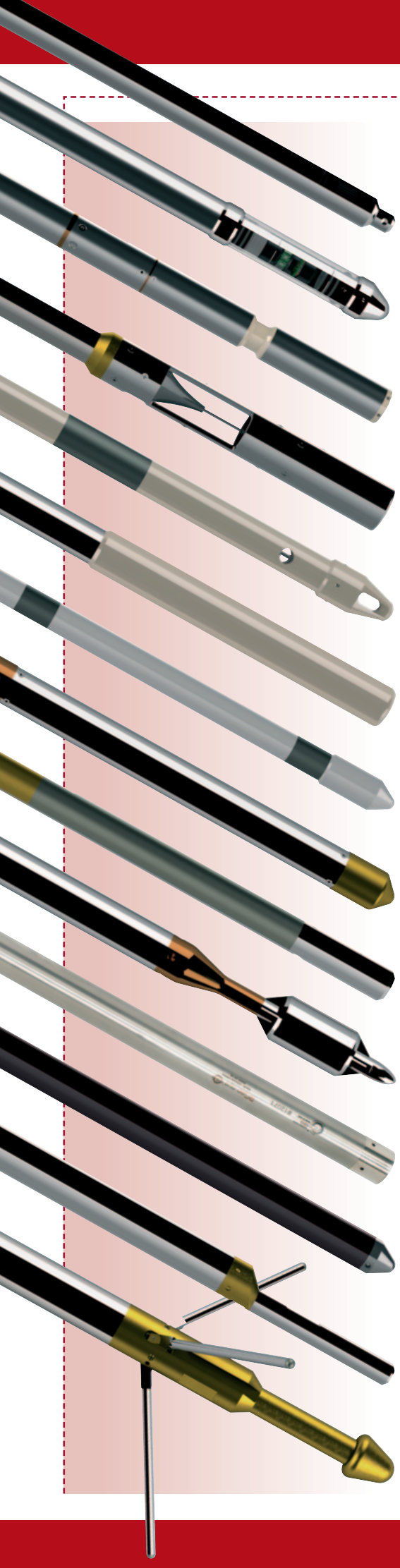
Logging Winch

All Robertson Geo winches feature an electrically driven rotating drum of special 'armoured' wire cable, which contains electrical wires embedded within to pass power and data to a borehole probe. This cable and associated connection are designed to operate at considerable depth and fluid pressure. A robust connector known as a cablehead is fitted on the free end of the logging cable to provide connection to the borehole probe.

This connector also provides mechanical support between the probe and logging cable. The ability to renew the cablehead by stripping down and re-joining to a newly exposed piece of logging cable is an essential skill to learn for geophysical logging. This should be undertaken periodically as a regular maintenance task, with frequency dependent upon winch usage and operating conditions. Damage to the cablehead can also occur at any time in the field requiring the operator to replace the cablehead, often under less-than-ideal conditions.

The winch will feature a movement control panel to regulate speed of cable travel and direction, along with an emergency stop and an overcurrent circuit breaker. There will also be connection points for power supply, Micrologger2 data cable and a depth connection for a remote depth encoder on a tripod. Most winches will also feature a connection point and switch for an earth stake to be used for electrical logging.

The logging cable will travel over a calibrated wheel which will turn in unison with cable movements to register depth. A further smaller wheel is present on 2000m winches to exert pressure onto a load cell to register cable tension. To pass the rotating cable connections through to the stationary frame of the winch a device known as a slip ring is used. This has a set of sealed rotating contacts at the axle of the cable drum to provide power and data connectivity for the borehole probe.



Tripod/Sheave Wheel

For vertical boreholes, a wheel mounted on a tripod or alternatively one or two sheave wheels are used to allow passage of the cable into the borehole as the cable usually pays out horizontally from the winch. The Robertson Geo tripod consists of a free-spinning wheel fixed to a strong metal plate, into which can be attached three sectional support legs to suspend the wheel over the borehole.

The depth encoder may be mounted on this tripod so that movements of the wheel can be sensed by the Micrologger2 via the depth cable. In some cases where heavy or long probes are used it will be preferable to use a sheave wheel setup requiring a top connection from either a drilling rig or a crane.

Borehole Probes

Robertson Geo logging probes are designed to operate reliably under the extreme conditions of fluid pressure and temperature found at depth. In addition, they must be transported to and from site safely and be handled carefully to avoid shocks which can damage some of the delicate components.

The variety of probes measure many physical properties of formations and may feature orifices, windows, or moving parts. Some probes are heavy whereby handling may require the use of a team or lifting equipment. Probes receive power from the Micrologger2 through the winch logging cable to operate. All communications to and from the probe are digital, allowing the probes to receive commands and transmit the measurement data back to the surface in real time.

Many probes will require the use of some accessories such as special carrying cases, connector covers, centralisers (to keep probes in the middle of the borehole), de-centralisers (to press the probe into contact with the borehole wall), calibrators or testers, and sometimes a weighted sinker bar to overcome buoyancy issues in thicker fluids. A few probes use radioactive sources to stimulate the formation for measurement and special considerations for handling these safely are required. Most probes will require some form of calibration beyond that provided at the factory and jigs are available to do this in the field or at base.

Conclusion

When the basic principles of geophysical logging are understood, Robertson Geo logging systems can be regarded as relatively straightforward to operate and maintain. Operators need to have a safety-first attitude as they are often handling the equipment in challenging environments, with the winch needing constant vigilance when operating. A good understanding of the relevant software used to collect and process the data is also required.

Robertson Geo offers a variety of training packages which can be customised to meet client needs. These can be conducted at the Robertson Geo base in Conwy or remotely at a client site.

In addition, training videos are available to customers here at our **dedicated Youtube channel**.