

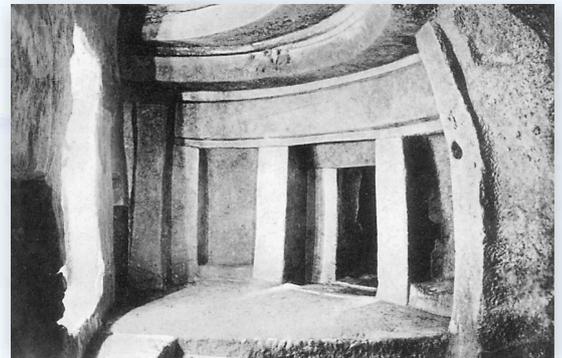
## GENII SYSTEMS FOR CONSERVATION AND SCIENTIFIC RESEARCH

The protection of important archaeological and heritage sites will involve the analysis of complex environmental factors in order to understand the potential causes of degradation. Eltek GenII telemetry datalogging systems have been used in key heritage sites to undertake research into potentially damaging environmental conditions and ensure preventative action can be taken to protect these sites for the long term future. It is often not until a detailed scientific study has been performed, gathering a variety of environmental factors over a significant period of time that damaging influences (sometimes even those which were thought to be corrective) can be correctly understood.

### Case study 1 - The Ħal-Saflieni Hypogeum, Malta

The Ħal-Saflieni Hypogeum is Malta's most important archaeological site but has suffered increasingly from environmental damage since its discovery in 1902. An extensive conservation project carried out between 1991 and 2000 reduced ongoing damage from the increasing numbers of visitors but the site is still undergoing worrying levels of degradation. Observed damage includes:

- Salt efflorescence (the site is set in limestone infiltrated with water)
- Flaking stonework
- Calcite deposits
- Pooled water and flooding



#### Environmental study using Eltek equipment

In 2011, Eltek equipment was used to perform a year long study into the possible causes of this degradation. The following parameters were recorded using an Eltek GenII telemetry system:

- Relative humidity and ambient temperature (both internal and external to the site)
- Surface temperature
- Air velocity
- Photosynthetic active radiation
- Pool depth
- Surface wetness
- CO<sub>2</sub>
- Other gases
- Volatile organic compounds
- Visitor numbers

A total of 59 transmitters were used to gather data throughout the site, with particular attention paid to the buffering effects of the visitor centre built above the hypogeum and the effect of visitors passing through the site.

#### Measuring relative humidity in a 100% environment

Due to the very demanding levels of humidity within the hypogeum, special RH sensors that could withstand levels of RH up to 100% had to be used. Eltek were able to provide warmed Vaisala HM-155 RH sensors that give accurate and highly reliable data even under these harsh conditions.

#### Calculating additional parameters

The Eltek Darca Heritage software features advanced analysis tools that allow the user to create 'calculated' parameters which are derived from physically measured parameters. This allowed the system to provide dewpoint temperature (DPT), absolute humidity (AH) and condensation data for analysis.



## Case study 2 - Canterbury Cathedral

The versatile and modular range of sensors in the Eltek system allows for a wide range of sensors to be added as and when required. The following example of monitoring the conditions at Canterbury Cathedral illustrates the phased expansion capacity of the system as the data is interrogated in increasing depth.

### Canterbury Cathedral - a background

Canterbury Cathedral is the Mother Church of the worldwide Anglican Communion. This is a complex and prestigious site which has been in use since the 7th century. A wide range of specialised heritage and conservation professionals now assist in managing the site. Understanding the micro-climates within and around the building as well as understanding changes in the building itself are crucial to the maintenance of the fabric and care of visitors and worshippers in this very active Cathedral.

### The Black Prince's Tester

An Eltek datalogging system was installed to help understand the deterioration mechanisms of this important and complex painted timber structure. Located on the South side of the Cathedral and close to windows, it was exposed to high light levels at various times of the year. The Eltek system allowed an understanding of the conditions and the efficacy of preventive measures. The following sensors were deployed to provide the required information:

- Visible and UV light sensors
- Crack meter
- Surface, ambient and radiant temperature
- Humidity

### Libraries and Archives

The Cathedral holds a large collection of historic archives and library materials. Using Eltek repeaters to extend the radio range of the transmitters meant that the data logging system could be easily expanded to cover a larger area than just the main body of the Cathedral. Outlying buildings and heavily built strong rooms were thus also provided with radio coverage.

### Wall Paintings

Temperature, relative humidity and surface temperature are recorded at a number of sites in the body of the Cathedral, the crypt and the roof spaces. A weather station records external conditions including temperatures, wind speed & direction and rainfall. Interpretation of this data provides information on the thermal and hygral buffering of the building envelope, an indication of the risk of salt activity and the effect of visitor flow. The Darca Heritage software is used to calculate parameters such as absolute humidity (AH) and dewpoint temperature (DPT) from these physical parameters and to plot and interrogate the data.

### Stained Glass

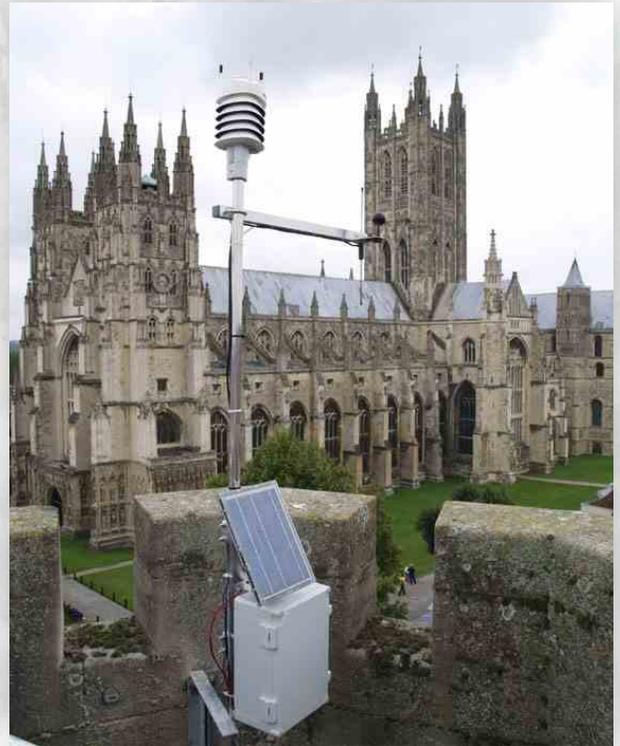
After initial installation, the Eltek system was soon expanded to include more transmitters. The stained glass conservators wanted to be able to understand the conditions around important mediaeval glass and to be able to measure the effectiveness of interventive treatments. Sensors were developed to measure surface wetness and airflow in addition to the surface and ambient temperatures and RH already in use.

### Structural Monitoring

To help plan preventive and maintenance work and assist an expert team of stonemasons, the Eltek monitoring system was extended to provide structural information at points in and around the Cathedral. Structural monitoring now in place includes monitoring the movement in cracks or joints, using inclinometers to accurately measure the effect of wind loading and bells ringing in the main Bell Harry tower and piezo sensors in bore holes to measure the movement of the water table around the building.

### Analysing the data from a single software application

The data logging system has been running since 2007 and now extends to approximately 70 transmitters and 200 channels of data. The Darca Heritage software allows for all of this complex collection of data to be downloaded and scrutinised in one software application. The site is divided into Zones relevant to each user group so that the most relevant information is immediately available to the user.



### Site-based data acquisition, analysis and reporting software for Eltek Gen II telemetry systems

Darca Heritage 2 has been designed in conjunction with conservators specifically for environmental monitoring on a large scale site, with sensors referred to according to their physical location and data accessed by multiple users:

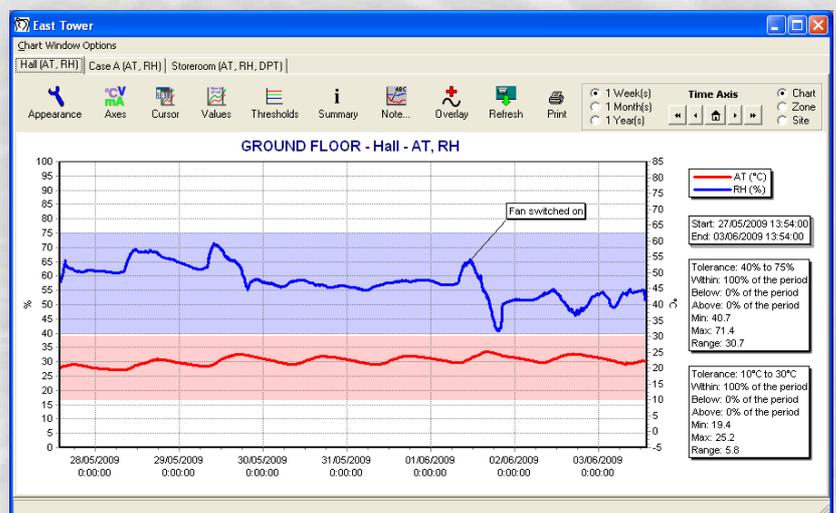
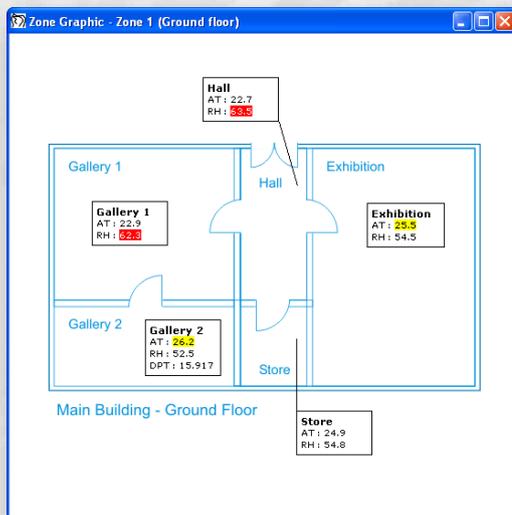


The Site is initially divided into 'Buildings'. From there, each building is divided into physical 'Zones', each of which is divided into 'Groups' of measured data points.

- Transmitters capture sensor data and send it to a receiver/logger.
- Gen II receiver/loggers receive data.

It provides powerful but simple-to-use tools for configuring and metering sensors, changing data logger settings, updating site data automatically and analysing up-to-the-minute data either graphically or statistically. All site layout information and downloaded data is stored centrally in a database for ease of maintenance.

Additionally, calculated parameters may be added and analysed alongside measured parameters, and sensors may be metered graphically on user-entered floor plans.



- Safe limits feature warns if any channel inputs are outside of safe limits. Channels outside safe limits appear colour-coded when using the analysis tools and users may be alerted by email or text message when alarm conditions occur
- Channels from any Zone or Group may be overlaid temporarily or permanently onto the graph
- Top time axis may be added to overlay data from different time periods
- Graph can be scrolled and zoomed, and user-defined 'Time Selector' control flicks between different time periods
- Appearance of titles, axes, plot colours and graph colours is highly customisable
- Cursor tool to view numerical value of a point on the graph
- Automatic periodic report generation with custom user templates
- Many different statistics can be displayed about the current graphed data including time spent in alarm
- Deployment of single site on multiple PCs on LAN and WAN as well as on a remote PC
- Datalogger access via GSM modem – no network required

# GENII RX250AL RECEIVER / LOGGER

The RX250AL Receiver logger is the heart of a GenII logging system. It is not necessary to have a PC permanently connected and the built in battery means data logging is not interrupted if there is a temporary AC mains failure. Multiple Loggers can be used for wide area coverage. Alarms (including SMS alarms) come as standard. (To use SMS alarms, a GSM modem is required).

## RX250AL

- Data Logger with integral receiver
- Alarm and GSM text output
- 24 hour built-in standby battery
- 247K readings expandable to 2M readings
- Dual RS232 serial ports
- Up to 250 channels
- Up to 125 transmitters
- Communication options: USB, GSM and Ethernet

## Transmitters

- Available with or without LCD display
- Transmitters with up to 8 inputs
- Sensors can be integral, external or a combination of both
- Inputs available for Voltage, Current, Temperature, Pulse, Digital or Light
- Powered by standard alkaline batteries
- Up to 5 year battery life (30 minute logging interval)



# GENII RP250GD REPEATER

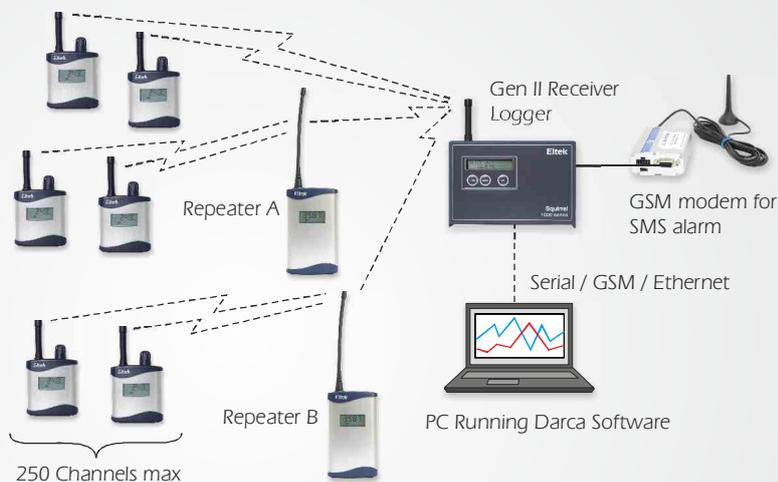
The RP250GD receives and rebroadcasts signals from GenII transmitters, significantly extending the distance over which a system can operate. Multiple repeaters can be used in a system.

## Features

- Contains high performance receiver and transmitter compliant to EN 300-220
- LCD indicates on-air transmitter identity, status and signal strength
- Extends range of transmitters many fold
- Multiple repeaters can be used, enabling difficult sites to be covered easily
- Mains powered with built-in rechargeable batteries to provide up to 48 hours standby in the event of a mains failure.
- Antenna socket permits use of external antenna to improve performance in difficult conditions
- Software is used to configure the repeater and download transmitter activity data.



# SYSTEM CONFIGURATION



Typical System Configuration

## Radio Telemetry Logging System Features

- Wireless connection of sensors
- 12 bit resolution for high accuracy
- 250 channel system capability
- Easy system design and installation
- Range easily extended by Repeaters
- Tamperproof wall mounting brackets
- Transmitter battery alarm
- Display and keypad for "on line" metering
- Darca setup, graphing and data export software
- Extensive communications options