Logmore Data Loggers

User Manual

Logmore Data Logger 10
Logmore Data Logger 20
Logmore Data Logger 30
Logmore Data Logger 40
Logmore Data Logger 50
Logmore Data Logger 60

Logmore Data Logger 10+ (3-point calibrated)
Logmore Data Logger 20+ (3-point calibrated)
Logmore Data Logger 30+ (3-point calibrated)
Logmore Data Logger 40+ (3-point calibrated)
Logmore Data Logger 50+ (3-point calibrated)
Logmore Data Logger 60+ (3-point calibrated)

Product summary

A Logmore data logger monitors conditions and provides supply chain visibility together with Logmore Cloud services. Logmore combines the world's first data logger with a scalable software service infrastructure. Upload the data stored in a data logger's QR code by scanning the QR code with any smartphone or QR scanner. The usability of Logmore's dynamic QR code and effortless data upload substantially reduce the workload and waste footprint in logistics condition monitoring.

Main features of the data logger:

- Multiple sensors available: temperature, external temperature probe, humidity, shocks, light
- Sensor measurement data stored and encrypted locally
- Dynamic QR code for data upload
- Optimized power consumption to enable long lifetime
- Applicable for one-way shipments as well as multi-shipment use
- Data collected with any smartphone or other QR code reader directly to a secure cloud

Example applications:

- Cold chain monitoring
- Temperature control of pharmaceutical dry-ice shipments
- Fresh chain monitoring for perishables
- Shock monitoring for electronic and industrial equipment
- Parcel and product level condition monitoring
- Supply chain visibility via secure cloud platform
- Data analytics and risk assessments
- User alerting for a resilient supply chain

This user manual gives basic information related to Logmore data logger functionality and how to use it. More detailed technical data can be found on the respective Logmore data logger data sheet, and other information related to Logmore products is available for you at [Logmore Knowledge Center](#).

Logmore data loggers have CE, FCC and UKCA conformity markings. These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Measurement data

The normal sensor measurement logging and cloud synchronization operation proceeds in the following sequence:

1. The Logmore data logger measures set variables and stores the measurements into the internal memory.
2. The Logmore data logger reads a set of measurements stored in the internal memory.
3. The Logmore data logger compresses the measurements with Logmore's compression algorithm.
4. The Logmore data logger encrypts the data with a unique device-specific encryption key.
5. The Logmore data logger generates a new web URL with this data embedded in an encrypted format.
6. The Logmore data logger generates a new QR code for this URL and displays it on the screen.
7. The QR reading device (smartphone, laser scanner) scans the Logmore data logger and opens the respective URL.
8. The Logmore web service receives the link, decrypts the data, saves it into the database and responds to the end-user with a view to present a summary of the data on a mobile device screen.

## Data storage and internal memory

Logmore data logger has an internal memory, where over 40 000 individual measurement data points can be stored. Every time a new sensor measurement is performed, the results are saved to a storage block. Once the internal memory capacity is full, new measurements overwrite the oldest measurements stored in the internal memory. See attached table for estimates of how long it takes for the internal memory to fill based on logger settings.

	Sensor configuration			
	1: Temperature only		2. Temperature+humidity	
Logging interval	Estimated time until memory full (in hours)	Estimated time until memory full (in days)	Estimated time until memory full (in hours)	Estimated time until memory full (in days)
1 minute	667 h	28 d	333 h	14 d
15 minutes (default)	10000 h	416 d	5000 h	**213 d**
60 minutes	40000 h	1667 d	20000 h	833 d

How long it takes until internal memory is full with one sensor in use:
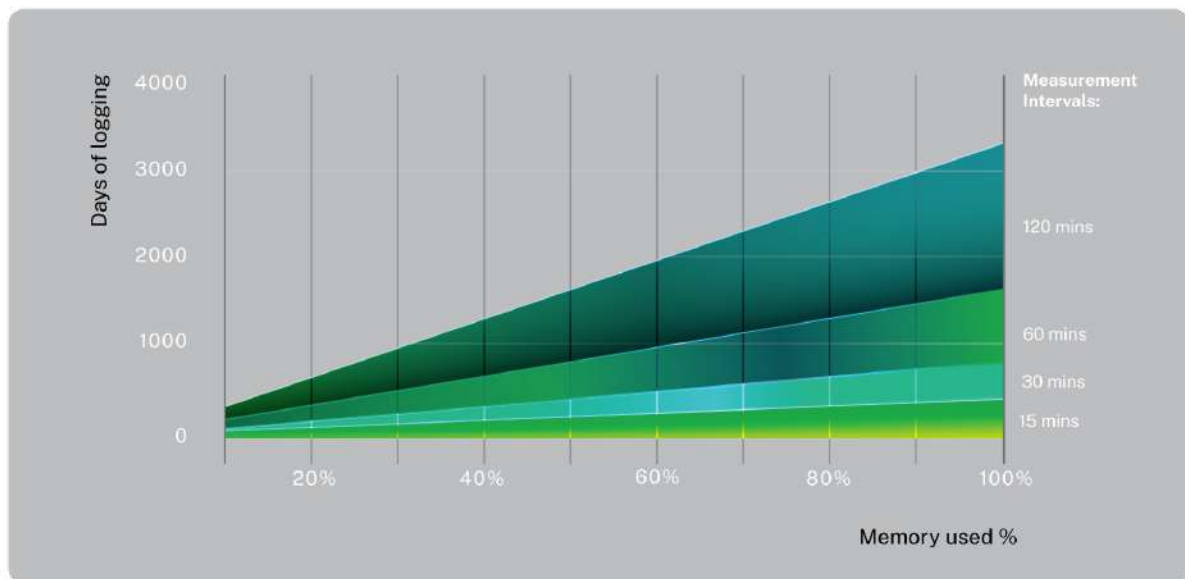
How long it takes until internal memory is full with two sensors in use:
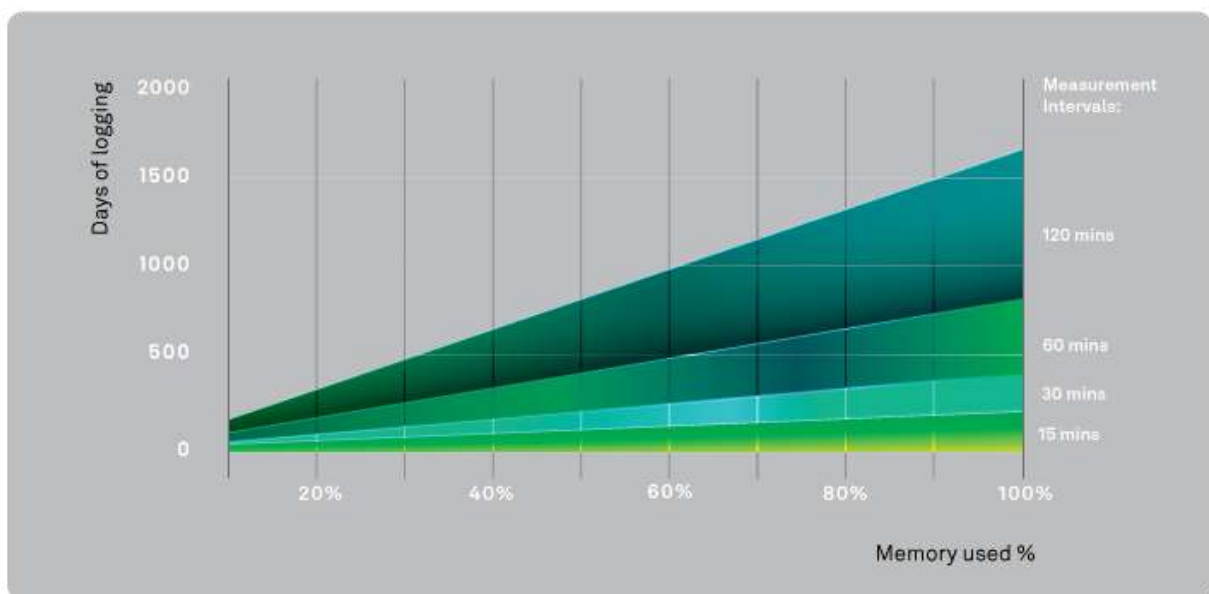
QR Code

We have selected an optimal QR code version to allow easy reading with any smartphone, but still dense enough to contain a lot of measuruent data: version 13, ECC low.

Compression

When generating the URL and the QR code based on the measurement data, Logmore data logger's software fits as many measurements into one QR code as possible. The data is compressed by Logmore's custom compression algorithm. Due to compression, the exact number of measurements stored in a single QR code varies by application. Measurement resolution, enabled sensors, amount of shocks, and measured values all affect compression efficiency. Shocks are not compressed but stored and encoded as is. One QR code link can contain 63 XYZ shocks. If all measurements stored in the internal memory can not fit in one QR code, the history can be browsed on "history pages" by entering a history mode with the multi-use button of the logger device.

The following examples give an idea of the available data in a single QR code. In all examples, if all measurements in the internal memory do not fit into a single QR code, the rest of the data can be displayed on a second, a third, and subsequent "history pages".

Example 1: Logmore data logger measures temperature only in constant conditions. Logmore data logger is set to a very stable environment where the temperature does not change at all.

Sensor measurement and a single QR code can fit approximately:
- Full internal memory can fit 40 000 individual sensor measurements, which is equivalent to about 16 months of data with a 15 minute measuring interval.
- In this case a single QR code could contain thousands of the latest measurements. Continuous equivalent measurements are easier to compress than variable environments. A real variable environment typically means a few thousand measurements on a single QRcode (look at example 2).

Example 2: **Logmore data logger measures temperature only in a typical indoor environment.** The data logger is set to a normal office environment where the temperature changes slowly between 20°C and 24°C. Measurement resolution is the default 0.2°C.

A single QR code can fit approximately:
- ~2500 temperature measurements, which is equivalent to ~26 days with a 15 minute measuring interval.

Example 3: Logmore data logger measures temperature and humidity. The logger is set to a normal office environment where the temperature changes slowly between 20°C and 24°C and humidity between 25%RH and 40%RH. Measurement resolution is the default 0.2°C and 3%RH.

A single QR code can fit approximately:

- ~1500 temperature measurements
- ~1500 humidity measurements

  → Together a total of ~3000 measurements, which is equivalent to ~15 days with a 15 minute measuring interval and 2 active sensors.

Example 4: **Logmore data logger measures temperature and shocks.** QR Logger is set to a normal office environment where the temperature changes slowly between 20 °C and 24 °C. QR Logger measures 10 XYZ shocks that are stored.

A single QR code can fit approximately:

- 10 shock measurements
- ~2000 temperature measurements

  → Together a total of ~2010 measurements, which is equivalent to ~21 days of temperature measurement data, with a 15 minute measuring interval and 2 active sensors.

Example 5: **Logmore data logger measures temperature, humidity, and ambient light.** data logger is placed in a refrigerator where the temperature and thus humidity changes constantly. Ambient light stays mostly at the "totally dark" value.

Single QR code can fit approximately:

- ~400 humidity measurements
- ~400 temperature measurements
- ~400 ambient light measurements

  → Together a total of ~1200 measurements, which is equivalent to ~4 days, with a 15 minute measuring interval and 3 active sensors.

Data selection into the data link

Due to the way the logger firmware handles data compression, steady conditions take up less space in the logger memory than conditions with a lot of variance. The less variance there is in terms of any specific measured factor, the more data fits into each QR code.

If multiple sensors are being logged, the following sensor emphasis algorithm is used for the selection of data per QR code and related data link:

1. An even part of the capacity is dedicated for each sensor (eg. 50% temperature, 50% humidity)
2. Each sensor history data is compressed and placed into a dedicated part of the data link.
3. If all the sensor measurement data in the internal memory fits into the dedicated part, there is some space left over for another sensor.
   a. Data of a sensor with the latest non-compressed measurements is compressed into the available space. The maximum used space per free space-filling operation is the same as the original dedicated space (eg. 50%). If this operation still leaves free space in the data link, this process is repeated until the data link is fully utilized or internal memory does not have any more data to compress.

Note: Due to the nature of compression, one sensor might have more measurement history data visible in one QR code compared to another. In the picture below, the humidity sensor has 2x more data because the humidity does not change and thus will compress more efficiently.
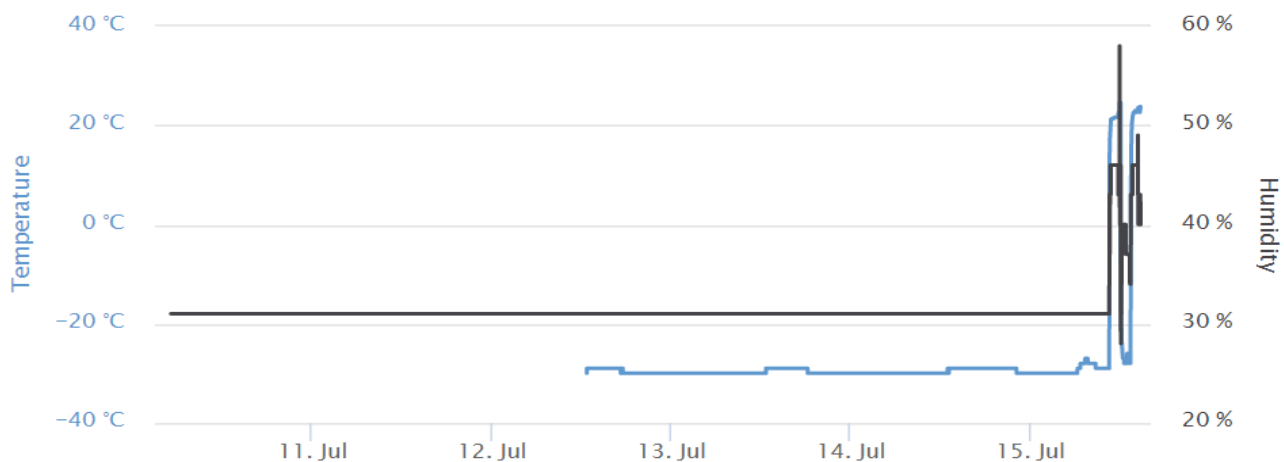
URL Protocol

Data url syntax:

HTTPS://<host>/<protocol version><logger serial><encrypted and compressed payload>

Host: Default host is RT.AG.

Protocol version: Used by Logmore web services. Length: 1 character.

Logger serial: Logger serial number can be decoded without a decryption key. Serial is base41 encoded with charset "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ+-.$:". For decoding example code see Logmore Knowledge Base article.

Encrypted and compressed payload: Measurement data is compressed and then encrypted. Data can't be viewed and/or changed without Logmore Cloud service to ensure data validity and security.

Validation: To validate the QR Logger URLs check the example code in the Logmore Knowledge Base.

Data logger device modes

Logmore data logger can operate in 4 different modes.

1. Welcome mode

This is the default mode when the data logger is brand new. The logger is not turned on and is not logging. Press the button to start the logger and enter *Normal mode.*

2. Normal mode

The logger is logging at set intervals and the QR code is displayed on the screen (refreshed typically every 15 min as default).

Press the button to refresh the screen immediately. Double-press takes the logger to *History mode* and draws the first history screen. Make a long press to go to *Configuration mode*.

Notice! Display automatic update is limited to temperature 0...+50 ℃. As a manual button press, the display will update on temperature -5...+50 ℃. Users need to notice that when updating the display in a minus degree environment, the display takes more power from the battery and this is not recommended when the battery lifetime is near to the end. In this case, the best way to update the screen is to wait until the logger temperature is above 0℃.

3. History mode

History QR is shown on the screen and a sequential history screen number is shown at the top (eg. History #05). Press the device button to go to the next history screen. Make a long press to return to *Normal mode*. The device automatically returns from *History mode* to *Normal mode* in 30 seconds.

4. Configuration mode

There is a possibility for the end-user to make their own device configurations by using a mobile phone display. The *Configuration mode* of the device is used for adjusting the existing configuration with light.

Set the data logger device that you aim to configure to *Configuration mode* by making a long button press in *Normal mode.* Read more about light configuration later in this document or in https://help.logmore.com. The logger automatically returns from *Configuration mode* to *Normal mode* in 30 seconds.

Multi-use button

Logmore data logger has one button. The duration of a button press determines what function is activated.

Button press types

Short press	0.1 seconds to 1.99 seconds
Long press	2.0 seconds to 10.0 seconds
Press of over 10 seconds or under 0.1 seconds is not registered.	

Button press actions

In Welcome mode screen

- **Short press** to start the Logger and go to normal mode
- **Long press** to start the Logger and go to normal mode
- Wait: no

In Normal mode screen

- **Short press** to refresh the display. Next short press enters *History mode* and shows the first history QR code
- **Long press** to enter into *Configuration mode*
- **Wait:** QR code updates automatically, with a cadence set in config

In Configuration mode screen

- **Long press** to return to Normal mode
- **Short press** to return to Normal mode
- **Wait**: After 30 seconds, if no config received, go to Config fail

In config result screen (ok/fail)

- **Long press** to return to Normal mode
- **Short press** to return to Normal mode
- **Wait:** After 30 sec return to Normal mode

In History mode screen

- **Long press** to return to Normal mode
- **Short press** to show next History page
- **Wait:** After 3 min return to Normal mode

At end of history screen sequence (No more history available)

- **Long press** to return to Normal mode
- **Short press** to return to Normal mode
- **Wait:** After 30 sec return to Normal mode

Device configuration

Logmore data loggers can be configured with Logmore's custom light config solution. You can find the configuration section in Logmore Cloud by accessing the logger you want to configure. It communicates with the QR Logger through the screen of the phone or a computer. Web service flashes the screen black and white. QR Logger receives this light pattern and decodes it into new configuration values (such as logging interval). To enter QR Logger's *Configuration mode,* long press the multi-use button.

Available configs

Please note: many of the configurations have limited availability in our public web service offering. Contact us to know more.

Setting	Description	Available values	Notes
Base time unit	Used for timing logging and screen update actions	10 seconds ... 7.5 days	
Temperature logging interval	Enable/disable logging of an internal temperature sensor. Multiple the base time unit.	0 ... 65535	Value of 0 disables logging.
Temperature sensor resolution	Configure the temperature sensor resolution per measurement range. See sensor specification.	Custom protocol	
Temperature probe logging interval	Enable/disable logging of a temperature probe. Multiple the base time unit.	0 ... 65535	
Temperature probe resolution	Configure the temperature sensor resolution per measurement range. See sensor specification.	Custom protocol	
Humidity logging interval	Enable/disable logging of internal humidity sensor. Multiple the base time unit.	0 ... 65535	Value of 0 disables logging.
Humidity sensor resolution	Configure the humidity sensor resolution per measurement range. See sensor specification.	Custom protocol	
Ambient light logging interval	Enable/disable logging of internal ambient light sensor. Multiple the base time unit.	0 ... 65535	Value of 0 disables logging.
Ambient light sensor resolution	Configure the ambient light sensor resolution per measurement range. See sensor specification.	Custom protocol	

Display update interval	Sets how often the display (top text and QR code) is updated. Multiple the base time unit.	0 ... 65535	
Display full draw	How often the display is fully re-drawn to increase contrast (every nth partial update).	0 ... 65535	
Shock logging mode	Set the shock logging mode.	0: Disabled 2: Single value (Sum) 3: X/Y/Z values 6: X/Y/Z values and tilt after shock	
Shock threshold	Set the shock measurement threshold	1 ... 16 g, 0.125 g steps	1 g -> triggers all the time as it matches the gravity on earth.
Shock measuring time	Active shock monitoring time after threshold is exceeded.	0 ... 25.5 seconds	
After shock tilt measuring time	When using shock logging mode 6 this config can be used to set the tilt measuring time.	0 ... 25.5 seconds	
Top text	See [Display areas](#)	Custom protocol	
Config serial	Used to sync configurations between QR Logger and web service.	0 ... 255	
Time	RTC time sync	Unix timestamp	

Default configuration

The default configuration is factory set.

All sensors (Check logger model to ensure availability of respective sensors)

Setting	Value
Base time unit, all models	15 minutes
Temperature logging interval	1 (1 x 15 minutes)
Temperature sensor resolution	See sensor specification
External Temperature probe logging interval	1 (1 x 10 minutes)
External Temperature sensor resolution	See sensor specification
Humidity logging interval	1 (1 x 15 minutes)
Humidity sensor resolution	See sensor specification
Ambient light logging interval	8 (8 x 15 minutes = 2 hours)
Ambient light sensor resolution	See sensor specification
Shock logging mode	3 (X/Y/Z values)
Shock threshold	8 g
Shock measuring time	5 seconds
Display update interval	1 (1 x 15 minutes)
Display full draw	Every 200th draw
Top text	Temperature in °C and F

Battery

Each data logger uses an internal "Lithium Coin" cell battery as its energy source. Once the battery life is over, the logger won't be functioning. The battery cannot be changed nor charged. We recommend you recycle Logmore loggers.

Battery lifetime of a data logger

The battery life of a logger varies depending on the usage environment, as well as the device configuration and actual measurements the logger records. In essence, a larger number of active sensors and more frequent measurement cadence drain more battery. In addition, the battery consumption depends on the ambient temperature, and is highest on temperatures below -20°C or above +50°C.

The graph below describes a calculated battery consumption curve, on different temperatures for various data logger models. For each model, all the available sensors are being actively used. As an example:

- On 20°C, the battery of data logger 20 measuring temperature and humidity will last up to 7 years
- On 0°C, the battery of data logger 60 measuring internal & ext temperature, humidity and shocks will last up to 4 years

Display update between 0 .. 49°C.
15 min logging interval: Logger 10, Logger 20 and Logger 30.
10 min logging interval: Logger 40, Logger 50 and Logger 60.
Two acceleration measurements per day.
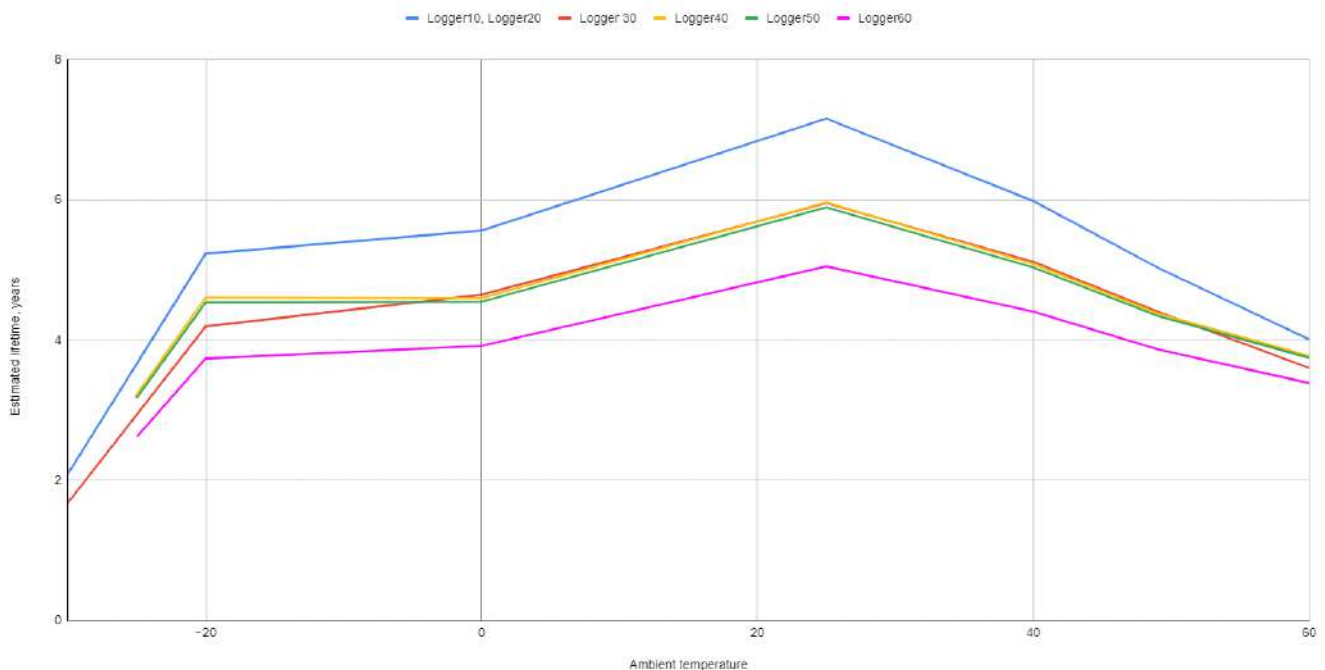
Low battery

When the battery runs out (voltage limit of 2.0 V) QR Logger will stop logging and updating the screen. Latest screen stays visible as the e-paper screen doesn't require any power when not being refreshed. Some energy is preserved in the battery so in warm conditions (~ 20 °C) reading the full history is possible (using the multi-use button and history mode) as long as there is enough energy left in the battery.

Sticker

Behind the data logger device is a sticker. An adhesive sticker can be revealed by pulling the instruction label off. The Logger can then be attached using this revealed sticker. If the sticker is not needed to attach the logger, leave the instruction label on it.

Real-time clock

Each Logger has an internal real-time clock (RTC), so that every measurement is accurately pinpointed to a certain time and the time domain cannot be faked by a reading device. The accuracy of the real-time clock is 20 ppm, and the time is synchronized to accuracy of ±5 seconds at the time of manufacturing. The real-time clock is temperature compensated and monitored by the device hardware.

Security

Data encryption

Each logger has a unique encryption key in its internal memory. All measurement data encoded into the QR code link is AES128-encrypted with this key. All the data communications between the data logger, the reading device (code scanner or smartphone) and the Logmore web service transfer the data in this encrypted format. Data within the QR code can not be decoded or forged without knowing the encryption key. The counterpart of the encryption key is stored in the Logmore web service database.

This makes it possible for anyone to read the QR code and open the link (and thus upload the measurements to the web service), but only people with authorized access can see the actual data. data logger's serial number can be decoded without the encryption key, as it is not encrypted in the URL. For more information see URL Protocol. Network communications are in every possible usage scenario secured with the HTTPS protocol.

Serial Number

Each data logger device has a unique serial number that cannot be changed. Serial number is also visible on the display.

Logger error indications

Logger will indicate when an error is noticed.

Critical errors:

Description	Problem	Solution
The text "Battery Dead" on the screen and the LED will flash every 5 seconds. The LED will stop flashing when the battery is totally empty.	The battery of the data logger device is not functioning anymore. It is too empty, or has been too cold (under -30°C) or too warm (above +60°C) for too long a time.	The lifetime of the device is over, and the device cannot be used for measuring conditions. After Battery Dead, the last measurement data can still be read from the QR-code but the device does not run and log sensor measurements anymore.

An error indicated, but the device is still operational:

Description / error code	Problem	Solution
901	No connection to sensor	The device is still working but has missed a sensor reading. Unless there aren't multiple recurring errors, there is no need to take action. If there are several errors, the device is faulty. Please refer to the warranty of the device.
902	Connection to sensor exists, but there is an error on data checksum	
903	Error on the external temperature sensor	
Clock drifting	A real time clock will be monitored by device hardware. If clock drifting occurs, there is an indication that the device clock is not up to date anymore. In case the drifting is more than 30 minutes per year, an indication is given by the	In the rare case of the device clock drifting more than 30 minutes, the data logger is faulty and should not be used anymore. Please refer to the warranty of the device.

	Cloud service, while reading the QR code on the device.	

Use case errors:

Description / error code	Problem	Solution
-30°C	A negative temperature error, indicating the device has been colder than -30 °C	If no critical "Battery Dead" error occurs on the device itself, a user can continue to use the data logger device.
+60°C (or higher positive number)	A positive temperature error, indicating too high measured temperature up to +79 °C	

Logmore Oy

www.logmore.com

Korkeavuorenkatu 35

FI-00130 Helsinki, Finland

info@logmore.com