

Logmore Data Logger

User Manual

Logmore Data Logger 1



Product summary

A Logmore data logger monitors conditions and provides supply chain visibility together with Logmore Cloud services. Logmore combines the world's first QR 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 Logmore logger:

- Internal temperature sensor
- Sensor measurement data stored and encrypted locally
- Dynamic QR code for data upload
- Optimized power consumption with no active radios
- Data collected with any smartphone or other QR code reader directly to a secure cloud

Example applications:

- Cold chain monitoring
- Fresh chain monitoring for perishables
- Parcel and product level temperature 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 1 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:

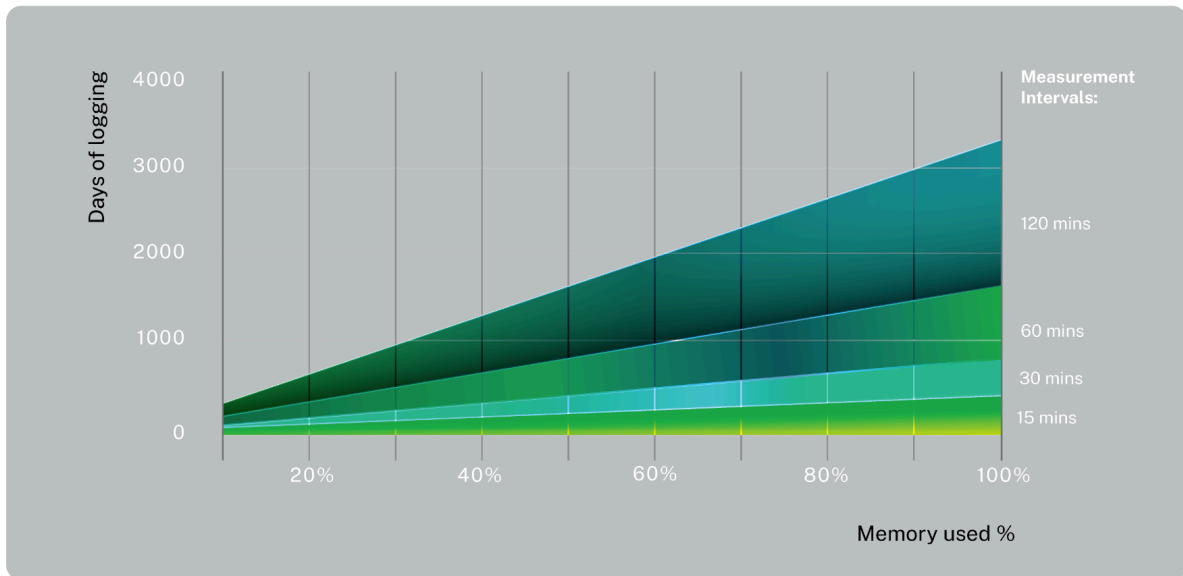
1. The Logmore data logger measures set variables and stores the measurements into the internal memory.
2. The Logmore data logger reads a set of measurements stored in the internal memory.
3. The Logmore data logger compresses the measurements with Logmore's compression algorithm.
4. The Logmore data 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 of Logmore Data Logger 1 to fill based on logger settings.

Logging interval	Estimated time until memory full
1 minute	667 h = 28 days
15 minutes (default)	10000 h = 416 days
60 minutes	40000 h = 1667 days



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 measurement 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 frequency and measured values both affect compression efficiency. 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 50 000 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.

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 "0123456789ABCDEFGHIJKLMNPOQRSTUVWXYZ+-.\$.:". 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

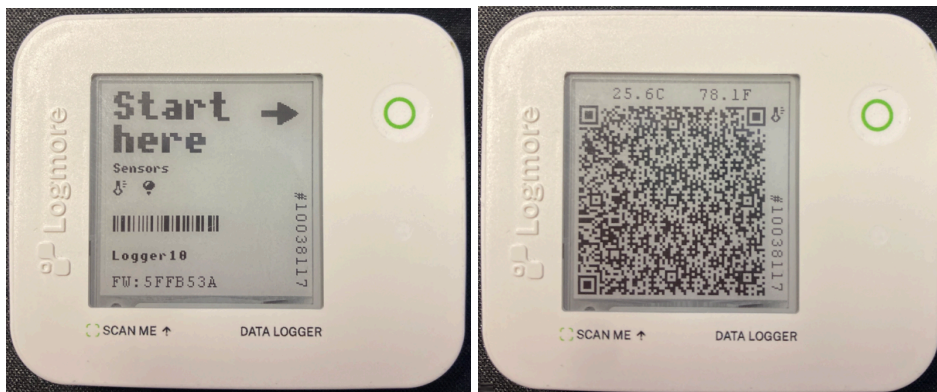
Logmore data logger 1 can operate in 3 different modes.

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*. This is only needed once. After this, the logger will log all sensors until the battery goes empty.

Important notice!

Start logger from “welcome mode” to “normal mode” in warm temperature (above zero celsius degree). This is because the display does not refresh below zero degree due technical reasons and the user can not confirm that the logger has started normal operation. When the “welcome” window changes to normal operation, there is full screen QR-code and current temperature shown on top of the screen. Always ensure that Logger is in “normal mode” (Full screen QR code is on) before usage.



Left picture: Push button to start Right picture: Device in normal mode and logging

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.

Notice! Display automatic update is limited to temperature +2...+50 °C. As a manual button press, the display will update on temperature 0...+50 °C. Users need to notice that when updating the display in a near 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 +2 °C.

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.

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

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 *History mode* and shows the first history QR code
- **Wait:** QR code updates automatically, with a cadence set in config

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

The default configuration is factory set.

Setting	Value
Base time unit, all models	15 minutes
Temperature logging interval	1 (1 x 15 minutes)
Temperature sensor resolution	See sensor specification
Display update interval	1 (1 x 15 minutes)
Display full draw	Every 200th draw

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 Data Logger 1

Logmore Data Logger 1 model is intended and optimized for single-use purposes, and therefore contains

a smaller battery than other Logmore Data Logger models, with a typical lifetime of 4 months and shelf life of 1 year. In case a longer lifetime is needed, we recommend to use other Logmore Data Logger models that are designed for multi-use over a long time period.

The battery life of a logger varies depending on the storage and usage environment, as well as the device configuration and actual measurements the logger records.

Optimal storage temperature for battery operated devices is between +10°C and +25°C. Storing in warm temperatures above 30 C decreases the battery life. Activating the logger in cold temperatures decreases the battery life drastically. Therefore, the logger should ideally be turned on at room temperature before being taken to a cold environment. Even if storing the data logger in a colder environment, we recommend always bringing the data logger to room temperature before activating it.

While the device is activated, 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.

Low battery

When the battery level is very low (voltage limit of 2.585 V) QR Logger will stop updating the display, but sensor logging and data measurement still continues. Latest QR code 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 protective label off. The Logger can then be attached using this revealed sticker. If the sticker is not needed to attach the logger, leave the protective label on it.

Real-time clock

Each Logger has an internal real-time clock (RTC), so that every measurement is accurately timestamped and the time domain cannot be faked by a reading device. The accuracy 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.

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 Red LED will flash every 5 seconds.	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 $+60^{\circ}\text{C}$) for too long a time.	The lifetime of the device is over, and the device cannot be used for measuring conditions. After Battery Dead (Blinking LED), 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
The text "Battery Low" on the screen.	<p>The battery of the data logger is approaching the end of the lifetime, and to save battery the screen is not updated anymore automatically. Logger is still logging when this indication is on.</p> <p>This message usually appears in a cold environment but returns to normal state when warmer. In this case the logger continues to refresh the display automatically. Sensor logging is on all the time.</p>	<p>The lifetime of the device is ending soon, and the device should be replaced with a new one.</p> <p>After Battery Low, the screen can still be manually updated to read the latest measurements from the QR code.</p> <p>Usually this happens in a cold environment and the first thing to do is to warm up the logger at room temperature and read data to the cloud by scanning the data logger.</p>
901 error in cloud scan	No connection to sensor	<p>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.</p> <p>If there are several errors, the device is faulty. Please refer to the warranty of the device.</p>
902 error in cloud scan	Connection to sensor exists, but there is an error on data checksum	
903 error in cloud scan	Error on the external temperature sensor	

Use case errors:

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



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