

TUTORIAL 5405

Choosing the Logger iButton That's Right for You

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Abstract: For many first-time users, finding the right logger that meets their needs can be a challenging task. In simple language, this tutorial explains logger iButtons and their applications and accessories. It also discusses logger iButtons' primary and special features, as these can be critical factors in making the right choice.

Introduction

Logger iButton® devices have gained a lot of popularity with researchers. With multiple logger iButton products currently available, Maxim frequently receives customer requests for help in selecting the best logger for their application. This application note introduces all logger iButtons with both their primary and special features. A selection chart then guides the reader to the product that is best for the intended use.

What Is a Logger iButton?

An iButton looks like an oversized coin cell battery (**Figure 1**). Instead of the positive and negative pole of a battery, it has a data contact (the lid) and a ground-reference contact (the body). These two contacts are all that is needed for digital communication using the 1-Wire® protocol. Inside the stainless steel battery casing are the electronics. A logger iButton contains a logger chip with an integrated temperature sensor, a watch crystal to ensure accurate timing, a protection device to prevent damage from electrostatic discharge (ESD), and a long-life lithium coin cell to provide power for operation. In addition, a logger for humidity also contains a humidity sensor and related control circuitry.



Figure 1. From front to back: logger iButtons, a Blue Dot™ receptor, a USB adapter.

Why Use a Logger iButton?

Since logger iButton devices are very small (16.3mm diameter and 5.9mm tall), they easily fit into places that are too tight for conventional loggers, which are the size of a stack of credit cards. They are typically used for environmental science, and to verify proper temperature when shipping food, produce, or pharmaceutical products such as vaccines.

Logger iButton Accessories

A logger iButton right out-of-the-box is dormant, "all systems shut down." To get it working, it first must be connected to a computer, typically a Windows® PC. One needs a cable with an iButton receptor ("blue dot") on one end and an RJ-11 plug (like a landline phone cable) on the other end. The RJ-11 plug connects to a 1-Wire adapter with a USB or COM port interface. The adapter itself is plugged into the matching port of the PC. A list of accessories can be [found here](#). The software to communicate with iButton loggers is called OneWireViewer. It can be [downloaded for free](#) and works with either adapter.

Primary Features of Logger iButtons

Logger iButton data sheets describe all the technical details for software developers to develop their own software application. Consequently, these data sheets are very long and may be difficult to navigate, especially just to find the features that are important to select the right device for a particular use. For convenience, **Table 1** lists all logger iButtons and their primary features. There are essentially two logger iButton models: the [DS1921](#) and the [DS1922/DS1923](#). There are variants for each model.

Part	Data-Log Memory (Bytes)	User Memory (Bytes)	Security	Temperature Range (°C)	Temperature Resolution (°C)	Temperature Error
DS1921G	2048	512	N/A	-40 to +85	0.5	±1°C from 30°C to +70°C
DS1921H	2048	512	N/A	+15 to +46	0.125	±1°C
DS1921Z	2048	512	N/A	-5 to +26	0.125	±1°C
DS1922L	8192	512	Password: read-only; full access	-40 to +85	0.5 (SR)* 0.0625 (HR)**	±0.5°C from 10°C to +65°C***
DS1922T	8192	512	Password: read-only; full access	0 to +125	0.5 (SR)* 0.0625 (HR)**	±0.5°C from +20°C to +75°C***
DS1922E	8192	576	Password: read-only; full access	+15 to +140	0.5 (SR)* 0.0625 (HR)**	±1.5°C from +110°C to +140°C
DS1923	8192	512	Password: read-only; full access	-20 to +85	0.5 (SR)* 0.0625 (HR)**	±0.5°C from 10°C to +65°C***

*SR = standard resolution, 8 bits.

**HR = high resolution, 11 bits.

***In high-resolution mode and with software correction (post processing).

The main distinguishing feature is the size of the **data-log memory**, the location where the measured data is stored. The more memory, the longer the monitoring can last. Then there is the **user memory**, a logging-independent storage area for data, e.g., relating to the shipment. The OneWireViewer can format the user memory and create a user-readable/writable text file. Some people may be concerned about data **security** to prevent tampering with evidence or unauthorized access.

The size of the data-log memory and the presence/absence of security features are likely the deciding factors when selecting an iButton logger. Now let's look into the variations. The basic **temperature range** is from -40°C to +85°C. The standard **temperature resolution** is 0.5°C. This combination is available for both the DS1921G and DS1922L. The DS1922/DS1923 offer a finer resolution of 0.0625 (= 1/16) °C, which, if used in this mode, fills the data-log memory twice as fast and can drain the battery up to 8 times faster than standard resolution. On the upside, you get a smaller **temperature error**, which may be important in some situations. The smaller error requires some post processing of the recorded temperature values, which is automatically done by the OneWireViewer.

For the DS1921 model, there are two variants besides the standard model DS1921G. The DS1921H is customized for a resolution of 0.125 (= 1/8) °C, and a 31°C wide temperature range that is centered at +31°C. This range includes human body temperature (the origin of the "H" in the part number) and covers comfortable to very high room temperatures. The DS1921Z is essentially the same, but the range is centered at +10°C. This range includes the freezing temperature of water (= zero °C, the origin of the "Z" in the part number) and covers very cold to comfortable room temperatures. Note that the finer resolution does not lower the temperature error.

For the DS1922 model, there are also two variants besides the standard DS1922L. The DS1922T has a temperature range that is shifted by 40°C toward higher temperatures. The achievable accuracy remains the same as with the DS1922L. The temperature range of the DS1922E goes 15°C higher than the DS1922T, but this causes a significant reduction in lifetime and accuracy. The DS1923 is essentially the same as the DS1922L, but with a humidity sensor added. Logging temperature and humidity at equal resolution fills the data-log memory twice as fast as logging temperature only.

Special Features of Logger iButtons

There are additional or secondary features that may have an impact on the final choice. **Table 2** lists the same logger iButtons, but this time showing the special features.

The measurements are taken at a user-specified interval, called the **sampling rate**. Typical values are 6 minutes to 240 minutes. This range is covered by both models. The DS1922/DS1923 can go far beyond this toward shorter and longer rates. If, for example, during an entire day less than 6 measurements are to be taken, the DS1922/DS1923 is the only choice. Sampling rates faster than 6 minutes usually do not produce useful data since the logger needs some time to adapt itself to an external temperature change. Another useful feature is the **start delay**, as it may be necessary to set up several loggers days, weeks, or even months before the actual measurements are to be taken. If the intended use requires a start delay longer than 7 weeks, the DS1922/DS1923 is the only choice.

Although the data-log memory of the DS1921 may be "a bit short," this model has a powerful defense, the **histogram** and **alarm logging** features. Histogram is a logging mode where the frequency of a particular temperature value is recorded and the time relationship is lost. If a user-defined safe temperature range is exited, this event is logged as an alarm together with a time stamp for each alarm event and the duration of the alarm. To obtain the same function from a DS1922/DS1923, one first needs to read the data-log memory and then process the data on the computer. The DS1921 does the entire math on its own. The OneWireViewer does not include this form of post processing; however, it allows downloading the histogram and alarm log of a DS1921.

The DS1923 is the only logger iButton with a **humidity** function. A hole in the data contact allows access for air to reach the humidity sensor inside. It is important to ensure that humidity does not condense and then reach the interior of the logger in the form of water. If it happens, the recorded humidity values are incorrect. This can cause permanent damage to the logger and end its life prematurely. As with temperature, there is a **range**, **resolution**, and **error** for humidity measurements. With an error of $\pm 5\%RH$, there is no advantage in using the high-resolution mode for humidity.

Table 2. Logger iButtons and their special features

Part	Sampling Rate	Start Delay	Histogram	Alarm Logging	%RH Range	%RH Resolution	%RH Error
DS1921G	1 to 255 minutes	Up to 45.5 days	63 bins, 2°C wide	12 events high, 12 events low	N/A	N/A	N/A
DS1921H	1 to 255 minutes	Up to 45.5 days	64 bins, 0.5°C wide	12 events high, 12 events low	N/A	N/A	N/A
DS1921Z	1 to 255 minutes	Up to 45.5 days	64 bins, 0.5°C wide	12 events high, 12 events low	N/A	N/A	N/A
DS1922L	1s to 273 hours	Up to 31 years or start upon alarm	N/A	N/A	N/A	N/A	N/A
DS1922T	1s to 273 hours	Up to 31 years or start upon alarm	N/A	N/A	N/A	N/A	N/A
DS1922E	1s to 273 hours	Up to 31 years or start upon alarm	N/A	N/A	N/A	N/A	N/A
DS1923	1s to 273 hours	Up to 31 years or start upon alarm	N/A	N/A	0% to 100%	0.64 (SR) 0.04 (HR)	$\pm 5\%RH$ (typ)*

*With software correction (post processing).

Matching Features and Needs

Now as the primary and special features of all logger iButtons have been explained, it is time to choose. The selection chart in **Figure 2** guides you from start to finish.

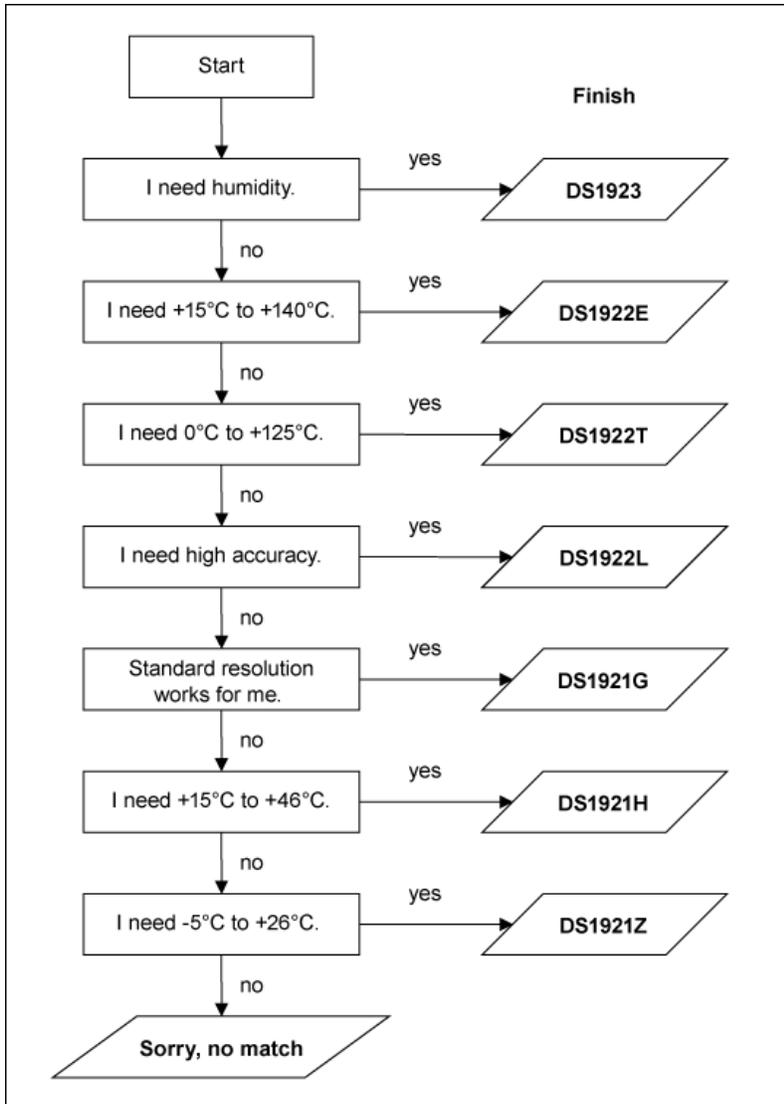


Figure 2. Logger iButton selection chart.

For the most common temperature range of -40°C to +85°C, if accuracy is most important, the DS1922L is the logger of choice. The DS1921G could be the winner if accuracy can be sacrificed in favor of roughly half the cost. If humidity sensing is required, the only choice is the DS1923. All other logger iButtons are niche products for specialized applications. After the right logger is found, refer to **Table 3** and verify that all of the critical features are supported.

Table 3. Logger iButtons Summary							
Part	Long Battery Life	Histogram	Alarm Logging	High Resolution	Large Memory	Humidity Logging	Recommended Use
DS1921G*	✓	✓	✓	—	—	—	General-purpose, low-cost temperature logger. Best for long-time monitoring using histogram function.
DS1921H**	✓	✓	✓	✓	—	—	Room temperature or body temperature logger. Best for long-time monitoring using the histogram function.
DS1921Z**	✓	✓	✓	✓	—	—	Refrigerator temperature logger. Best for long-time monitoring using the histogram function.
DS1922L***	—	—	—	✓	✓	—	DS1921G upgrade with more data-log memory and better accuracy or resolution.
DS1922T***	—	—	—	✓	✓	—	Specialty logger for the +80°C to +125°C range.
DS1922E***	—	—	—	✓	✓	—	Specialty logger for the +110°C to +140°C range.
DS1923***	—	—	—	✓	✓	✓	Environmental monitoring (must be noncondensing).

*When checking the ordering information for the DS1921G, you will see two part number ordering suffixes, -F5# and -F5N#. Both parts are technically identical. For the -F5N# version you can download a NIST traceability certificate.

**The part number ordering suffix is -F5#; a NIST traceability certificate is not available.

***The part number ordering suffix is -F5#, which includes the option to download a NIST traceability certificate.

Summary

For many first-time users, finding the right logger that meets their needs can be a challenging task. In simple language, this application note explains logger iButtons, and their applications and accessories. Next the focus turns to logger iButtons' primary and special features, as they can be a critical factor in making the right choice. A selection chart then guides the reader to identifying a particular device. This document concludes with a summary table and usage recommendations.

Further Reading

Application note 5335, "[Determining the Mission Parameters for Temperature Logger iButton Devices](#)"

Tutorial 4373, "[OneWireViewer and iButton Quick Start Guide](#)"

User guide 3358, "[OneWireViewer User's Guide](#)"

Application note 5057, "[OneWireViewer Tips and Tricks](#)"

Application note 4629, "[iButton Data-Logger Calibration and NIST Certificate FAQs](#)"

Application note 3761, "[DS1922/DS1923 Battery Gas Gauge](#)" (does not apply to the DS1922E)

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Windows is a registered trademark and registered service mark of Microsoft Corporation.

Related Parts

DS1921G	Thermochron iButton
DS1921H	High Resolution Thermochron iButton Range H: +15°C to +46°C; Z: -5°C to +26°C
DS1921Z	High Resolution Thermochron iButton Range H: +15°C to +46°C; Z: -5°C to +26°C
DS1922E	High-Temperature Logger iButton® with 8KB Data-Log Memory
DS1922L	Temperature Logger iButton with 8KB Datalog Memory
DS1922T	Temperature Logger iButton with 8KB Datalog Memory
DS1923	Hygrochron Temperature/Humidity Logger iButton with 8KB Data-Log Memory

More Information

For Technical Support: <http://www.maximintegrated.com/support>

For Samples: <http://www.maximintegrated.com/samples>

Other Questions and Comments: <http://www.maximintegrated.com/contact>

Application Note 5405: <http://www.maximintegrated.com/an5405>

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