

Minikin

Datalogger with embedded sensors - smart sensors

User's Manual



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1 General description

Minikin is a precious baby datalogger with embedded sensors (*smart sensors*) for long-term monitoring of ambient factors (temperature, humidity, global radiation), although some types can be connected to external sensors, too. The specification of *Minikin* overcomes most of common products.

The sensor body is watertight (all models except of THi up to 0.2 bar) made from stainless steel and high-quality plastic. The humidity sensor is covered with hydrophobic sintered stainless steel filter.

All *Minikin* smart sensors have infrared access to computer. For communication, a special USB/IrDA cable is necessary.

Datalogger for temperature measurement can be buried into the soil or immersed in water or non-aggressive liquid (up to 2 meters unless otherwise specified) for a long time. When measuring air temperature, the datalogger has to be protected against irradiation with a radiation shield or placed in shady location.

The datalogger memory stores up to 60,000 measured values what means up to 5 years of unattended measurement of one variable is hourly interval. The time intervals of measurement and storing to memory are generally different so that one value can represent the average of more readings.

The memory is non-volatile type therefore the measured data are safely stored even in case of full battery discharge or battery damage. There are two memory operating modes: (i) the oldest data are overwritten with the actual ones or (ii) the logger stops operation when the memory is full.

Minikins are powered with the long-life Lithium-ion battery. The battery supplies the two-channel datalogger running each minute for ca one year. The battery can be easy replaced by user.

Data from the datalogger memory can be downloaded to a PC running under operating system Windows[®]XP or higher.

Dataloggers are supported with fancy graphical software for data viewing, pre-processing and export to common file formats (text, Excel). The software contains also advanced statistic module intended for processing of long-time data series, user define calculation and other options available for all EMS products.



2 Specifications

<i>Datalogger</i>	
Voltage range	±20 mV to ±1,250 mV in eight ranges
Resolution	16 bits
Voltage accuracy	0.03 % of full scale
Operating ranges	
- temperature	-30 to 60 deg.C
- relative humidity (TH)	0 to 100%
- measuring intervals	10 sec to 4 hrs
- interval of averaging (storing)	10 sec to 4 hrs
- clock accuracy (-10 až 40 deg.C)	better than ±1 minute per month
- memory size	128 kByte
- memory capacity	up to 60,000 measured values
Battery	Lithium-ion 3.6V; 900mAh
Battery lifetime	
- measuring interval 1 minute	1 year
- measuring interval 1 hour	ca 6 years
<i>Built-in sensors accuracy</i>	
- temperature	± 0.2 deg.C
- relative humidity (TH)	± 2%
- radiation	± 5%
<i>Protection rating</i>	IP69
Size (diameter x length)	30 x 84 mm (20 x 104 mm slim version)
Weight	80 to 100 g



3 Operation

3.1 Sensor installation

Datalogger can be used in any environment non-aggressive against stainless steel, polyethylene and synthetic rubber. The operating temperature should not exceed the range -30 to 60 deg.C and the overpressure 0.2 bar (two meters of water column).

Minikin has no power switch. It is ready to run immediately after inserting of the battery. The system configuration needs connected PC running the Mini32 software.

When it is not in use (operation off), the battery lasts for about five years. The battery status as well as the available memory in terms of remaining time is indicated by each communication. Since even the switched off system consumes a little but not negligible amount of energy, it is a good idea to remove the battery from the system when the use in following years is not supposed. Note that for next operation the system will ask for initialization. See section [After power drop-out](#).

Example: The battery of a datalogger switched off by the software lasts for 5.1 years. Measuring with two channels each hour shorts the battery life to 4.7 years, measuring in ten-minute interval withdraws the battery after 3.4 years.

3.2 Start operation

The communication with a PC needs a special cable delivered by sensor manufacturer. The cable head with red transparent lid contains also a strong magnet necessary for system activation. In order to that the cable head has to be put close to the datalogger bottom until the datalogger responses with red light behind the bottom.

Then, just keep the distance between the datalogger and the cable head up to 50 cm. Since the communication is relatively power demanded process, put the sensor from the cable range as soon as the session finished (during file processing etc.).

Note that for restoring the communication in case of very short logger-cable distance it is necessary to put the cable head back of the logger and put it close again.



The USB/IrDA communication needs a driver that has to be installed on the computer. The driver is available on the manufacturer web site.



Mini32 software package supports the datalogger handling and data processing. Besides of basic operation as configuration and data download it offers a lot of interesting features for advanced data viewing and processing. The Mini32 is also intended for preparing a data base of measurement with more EMS data logging systems. Note that the software contains on-line help with brief information relevant to opened window.

3.2.1 Basic setting

Run Mini32 software and push "Configuration" button. Set both interval of measurement and two-character device code.

Double click on a channel line opens a channel setting window. Set channel on and add a description. Fill in the sensor parameters in needed (V2i). Repeat this by all used channels.

Left mouse click on ON/OFF button starts/stops data logging.

Press "Send" button in order to send the configuration to the datalogger.

3.2.2 Advanced setting

Push "More" button in "Configuration" window in order to approach advanced setting screen. This option enables:

- Datalogger reset (initialization). Initialize resets all system variables to default values, changes datalogger time and password, erases the data from memory and sets the memory operation mode – see [General description](#). System calls for initializing automatically always when the supply voltage has dropped below 2.9 Volts, i.e. after battery replacement or its total discharge. In such a case is the user asked for initializing after each communication attempt. Warning – save data always before initializing – they will be lost by afterwards!
- Memory erase (RAM clear) should be done when the memory is full and the data overwriting is disabled and also when the data continuity is senseless or misleading – when the sensor is moved to different location for instance. Make sure the data were successfully saved before memory erasing!
- Hardcopy of memory (HCM). The whole memory content will be saved to file. Use it in case of problem with data conversion after downloading which could be caused by damaged data structure due to external factors. Send the file to producer for free encoding.
- Password. A four-character word can be introduced. Password disables unauthorized changes of configuration.
- Set time. The datalogger time will be corrected according to computer time. This option is intended for small deviations only. Otherwise the time setting has to be performed by system initialization.



3.2.2.1 After power drop-out

It is necessary to initialize the datalogger always when the battery voltage drops below 2.9 Volt. This comes usually after the battery replacement or after its removing. See [Advanced setting](#).

Note: The battery status is continuously calculated (since the last zero voltage occurrence which normally indicates the battery replacement) according to the time of operation (measurement, communication with PC, data download). Naturally, the full capacity of the new battery is supposed. Therefore, the battery duration will be overestimated in case of using a used one or very old battery. See also [Battery replacement](#).

3.2.2.2 Memory capacity

Maximum number of days of the measurement stored in memory can be easily estimated according to formula

$$N = 60000 / (n * k)$$

where

n = number of averaged values within a day

k = number of channels in use

Example: Air temperature and humidity values stored in memory each hour allows data logging for more than three years.

3.3 Data downloading

There are more ways of data downloading procedure according to the actual Mini32 development (downloading of certain number of days, fast download, sequential download of many neighboring loggers, entering site sensitive prefix etc.).

Data download and saving process is activated after pushing "Download" button. Data from memory are saved in the file prefix_XY_2005_04_28.hex where "prefix" is an arbitrary entered word, XY is the device code (see [Base setting](#)) and 2005_04_28 is computer date (YMD). These HEX file contains the stored data and complete configuration information including the actual battery voltage and datalogger time in a compressed format suitable for fast transfer to computer. Since this format is not usable for next data processing, the file is subsequently converted to another format - DCV (XY_2005_04_28.dcv). This file contains the same information as the HEX one; it is typically four times larger but suitable for fast drawing and data processing. In case of accidental wrong data processing (erasing) in DCV file it is easy to create the DCV file again after opening the original HEX file. Therefore, it is a good idea to save the original HEX files for archive purposes.



4 Data processing

Mini32 software allows a wide range of data operation, mainly:

- connection files of the same configuration coming from different time periods
 - mixing files of different systems
 - calculation mean values of different time intervals (hours, days)
 - drawing selected variables in time with the possibility of easy erasing of irrelevant values
 - export of data to text or Excel format
 - export of graphs to JPG format
 - drawing of vertical profiles
 - drawing frequency distribution graphs
 - printing of graphs
 - basic statistical analysis
 - regression data analysis
 - user defined calculation
 - non-linear multi-regression analysis
- etc. according to the actual program version.

5 Maintenance

Datalogger *Minikin* does not need any special maintenance, just to keep sensor active surfaces (humidity sensor, radiation sensor window) clean and out of aggressive environment.

5.1 Battery replacement

The battery replacement is easy after screwing-off the datalogger head with the electronics from the stainless housing. A 2.5 or 3 mm small-bladed screwdriver is necessary for screwing the battery terminals.

Please **short circuit the battery terminals with a metal tool (screwdriver, knife, door key...) after removing the old battery** to make sure that the battery energy counter is reset.

After the battery replacement, the system needs to be initialized – see [After power drop-out](#).



6 Warranty

The producer warrants right function of the measuring system for three years after it is accepted by a customer. All the faults will be removed free of charge during this time, at the measuring device itself as well as at sensors. The producer is not responsible for the faults originated by careless manipulation, incorrect operations, wrong applications or theft. The warranty covers the battery failure for three months only.

The freight to manufacturer is paid by customer; the sending back is paid by manufacturer.

7 Sensor sensitive information

7.1 Humidity sensor chemical resistivity (THi, RTHi)

Humidity sensors based on the polymer dielectric properties are principally sensitive to certain chemicals. For this reason please avoid exposure in environment containing

- Ammonia hydroxide – destroys the sensor
- Acetone – destroys the sensor
- Ethanol – destroys the sensor
- Methanol – irreversibly decreases the sensor sensitivity
- Benzene – irreversibly decreases the sensor sensitivity
- Formaldehyde, Toluene, Xylene - irreversibly decreases the sensor sensitivity for a few percent

7.2 Temperature sensors (all types)

The temperature sensors are placed inside the datalogger body. The sensors are Pt1000 type, "A" grade. The time constant of the sensor exposed in air is ca 15 minutes and 2 minutes when immersed into water.

7.3 Global radiation sensor (RTi, RTHi)

The radiation sensor is based on a semiconductor diode. It is calibrated to daylight and it can't be used for any kind of measurement where the sun spectra deformation is expected like reflected radiation, radiation transmitted by leaves etc.

The sensor specification is as follows:

- Calibration error under the daylight condition max. 5%
- Linearity up to 1%
- Cosine error <10% up to 85 deg. angle of incidence

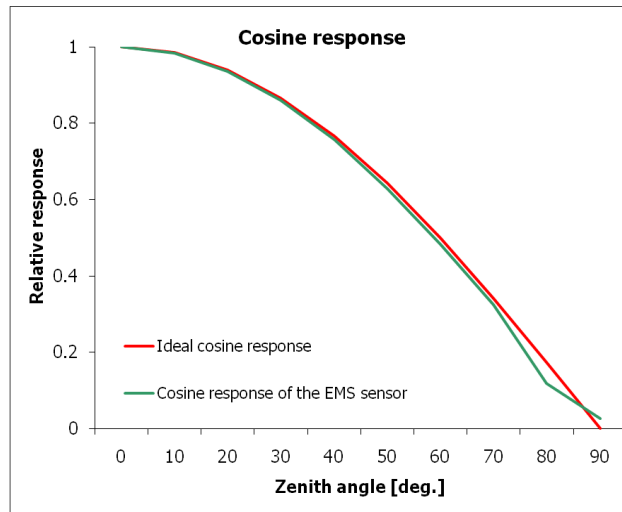
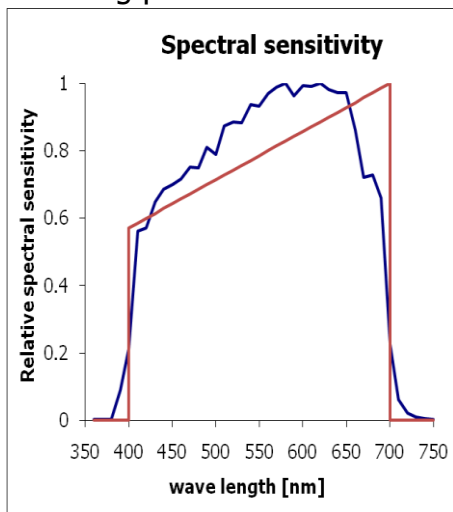
Note the necessary sensor leveling!



7.4 Quantum sensor (QTi, QTHi)

The sensor is calibrated as energy quantum in the spectral range between 400 and 700 nm – photosynthetic active radiation [$\mu\text{mol.m}^{-2}.\text{sec}^{-1}$].

The spectral characteristic of the sensor and the cosine response are shown on following pictures:



Note the necessary sensor leveling!

7.5 Triple sensors (RTHi, QTHi)

Those sensors are intended for the reliable measurement of all main meteorological variables related to plant physiology. Since the reliability of temperature and humidity measurement seriously depends on the sensor protection against irradiation, these sensors are only available as built in the radiation shield.

