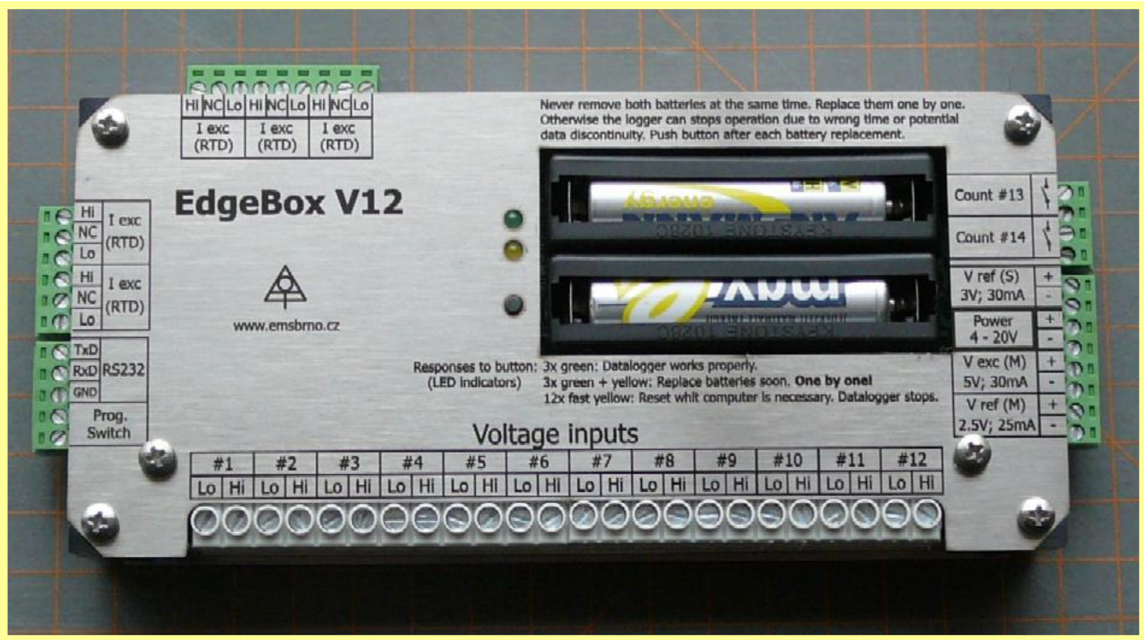
Datalogger EdgeBox V12/12c

User's Manual

September 2011



Jiří Kučera - Environmental Measuring Systems
Turistická 5
621 00 BRNO
Czech republic
Fax +420 513 034 071
www.emsbrno.cz

Content:

1 DATALOGGER GENERAL DESCRIPTION

Datalogger EdgeBox V12 is a battery supplied equipment for automatic data recording in both field and laboratory applications. The logger is made for easy installation in any enclosure with DIN-rail holders. It is powered by two alkaline AA 1.5 V batteries although an external power supply can be used, too.

The voltage input terminal part is designed with respect to direct connection of thermocouples. The temperature of terminals is measured with A-class Pt 1000 sensor and the temperature difference along the terminal block is minimized by an internal massive aluminum block and an external terminal cover.

On the contrary, model V12c with connector-type terminals is intended for standard applications where faster sensor connection to datalogger is preferred.

1.1 MAIN FEATURES

- compact size
- low current consumption
- twelve voltage inputs
- built-in current source for direct temperature measurement with ten RTD temperature sensors in four-wire connection
- measurement of selected sensor in periods of averaging only
- reference voltage activated in measuring periods or only in periods of averaging
- two pulse counters
- programmable external switch
- high storage capacity 220 000 values
- advanced Windows® software for datalogger setting, data retrieval and processing
- ready for remote access via GSM modem

1.2 SPECIFICATIONS

Channel types	Twelve differential voltages, two 16-bit counters, input terminal temperature, one service channel
Voltage inputs	± 20 mV up to ± 2.5 V in eight ranges
Voltage limit	maximum +5 Volts from GND on any input terminal
Accuracy	0.03 % of full scale
Resolution	16 bits
Counting input types	contact closure (R threshold ca 100 kohms)
Max. frequency of pulses	300 Hz
Measuring interval	3 sec to 4 hrs
Averaging interval	3 sec to 4 hrs
Warm-up time	1/ up to 5 sec before each measurement cycle 2/ up to 5 sec in each period of averaging (if larger than that set by measuring intervals)
Exciting voltage	5 Volts, ± 2 mV (active by measurement)
max. load	30 mA
voltage drop	Approx. 6 mV/mA of loading current
Reference voltage	1/ 2.5 Volts ± 10 mV, limited to ca 25 mA (active by measurement) 2/ 3.0 Volts ± 10 mV, limited to ca 25 mA (active by periods of averaging only)
RTD excitation current (five sections)	ca 150 µA, measured and stored to data file
Maximum voltage per one section*	300 mV
Overvoltage protection	diode suppressors connected to each input terminal
Power supplying:	
A/ internal 3 Volts	- two AA-type alkaline battery
B/ external 4 to 16 Volts completed with:	- **one** AA-type **backup** alkaline battery - **two** continuously **recharged** NiMH batteries
Power consumption idle/measuring:	
Internal batteries (2 x 1.5 V AA)	200 µA idle, 25 mA when measuring (plus exited load)
External batteries (4 to 20 Volts)	ca 250 µA idle (just one (backup) internal alkaline battery is inserted), 25 mA when measuring
Back up battery (1.5 V alkaline)	350 uA idle (no external power supply connected)
Memory capacity	220,000 records
Output programmable switch	bi-stable relay 125 V A.C.; 0.5 A (resistive load, shifted on the end of the measuring process,)
Size	175 x 75 x 22 mm
Weight	0.45 kg with alkaline batteries
Operating range	-20 to 60 deg.C

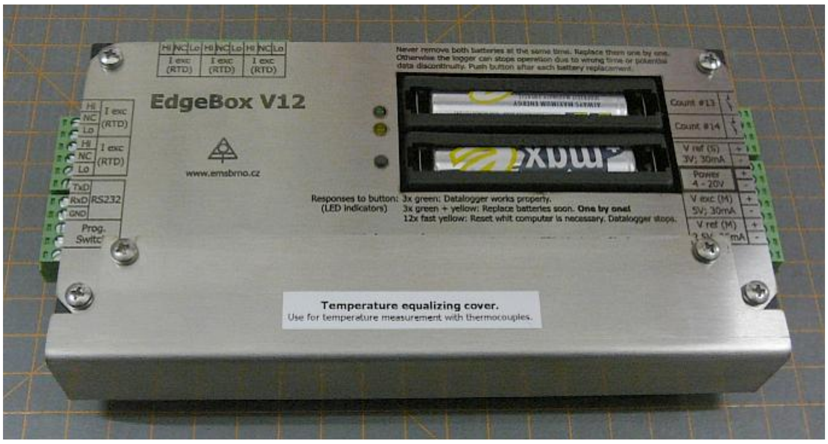
** voltage drop on a resistor(s) connected to one excitation section. With another words, the maximum value of connected resistor(s) should not exceed 1400 ohms.*

1.3 ASSEMBLY

The datalogger case is composed of stainless steel plates kept together with four black anodized aluminum edge cubes.

Voltage terminals are located on the front side. Since the accurate measurement with thermocouples requires accurate measurement of the terminal temperature, the terminal row touches an aluminum block inside the logger. The aluminum block equalizes the temperature along terminals and its temperature is measured with a precise thermosensor.

An additional stainless cover should be screwed up over terminals with already connected thermocouple wires for better temperature stability under very fast external temperature changes (V12).

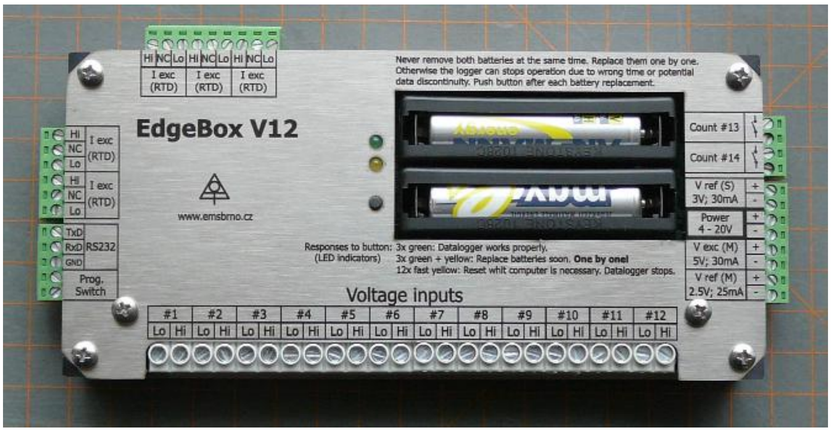


The maximum error when the datalogger temperature change reaches 1 deg.C per minute is ca 0.5 deg.C of measured values.

In the upper panel, there is an opening for battery holders. Here are also two LED diodes and a check button for brief system test described on the front panel:

- Three blinks by green LED - system is O.K.
- Three blinks by both green and yellow LEDs – replace battery soon
- Twelve fast yellow blinks – real time has been lost due to flat batteries, systems stops. Reset with computer is necessary. Data in memory are untouched.

The other terminals for connecting of two pulse sensors, excitation voltages and serial line wires are designed as multipolar connectors and placed on lateral sides. The terminal location is shown on following picture:



The temperature measurement with RTD thermosensors supposes four-wire connection. Two wires lead the excitation current (ca 150 μA) to the sensor and next two wires connect the sensor voltage to measuring terminals. Excitation wires should be connected to "Hi", "Lo" terminals labeled as Iexc (RTD). The terminals marked as "NC" are intended for easy serial connection of two Pt100 excitation wires connected to one section. This way, up to ten Pt100 sensors can be connected to five excitation terminals.

The 2.5 mm Jack plug for connection to PC is placed on the front side to the left of channel #1.

1.4 POWER MANAGEMENT

The datalogger is designed to be basically powered from internal (2 x AA) batteries or from an external power supply.

1.4.1 SUPPLYING FROM INTERNAL BATTERIES (2 X AA ALKALINE)

Two alkaline batteries run the logger measuring 12 channels each minute for ca three months. If batteries get empty (battery voltage is lower than 2 Volts), the logger stops the measurement in order to save energy for internal clock and for future communication with PC. Principally, even one battery which is not completely flat keeps the system ready (but not measuring). Therefore, the battery replacement **one-by-one** shouldn't make any problem since the remaining battery supplies the system with enough energy and serves as a backup one. However, in case of total battery withdrawing, the datalogger real time is lost and its refreshment from a connected PC is necessary. Nevertheless, the data in the memory and the datalogger configuration remains untouched and the measurement continues.

The battery and system status are indicated by two LEDs on the upper panel. The green led indicates the normal operation that means it burns during the regular measurement as well as by communication with PC or other external system (modem).

The system status can be briefly tested after pushing the small button bellow LEDs:

- 3 x green — batteries O.K.
- 3 x green + yellow — batteries should be replaced
- 12 x yellow (fast) — system clock is stopped due to low battery voltage

When the fast yellow flashings appear, the system has to be refreshed with connected PC running Mini32 software.

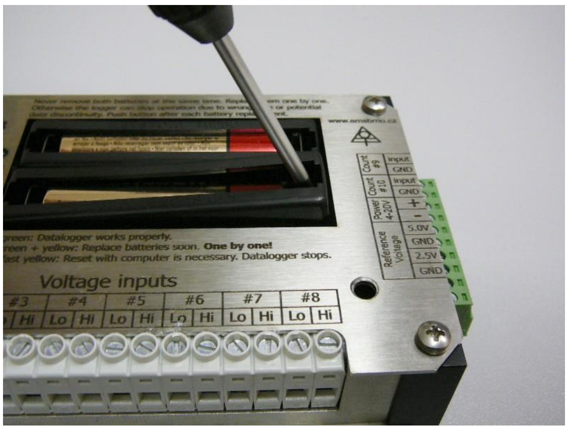
1.4.2 EXTERNAL POWER SUPPLYING

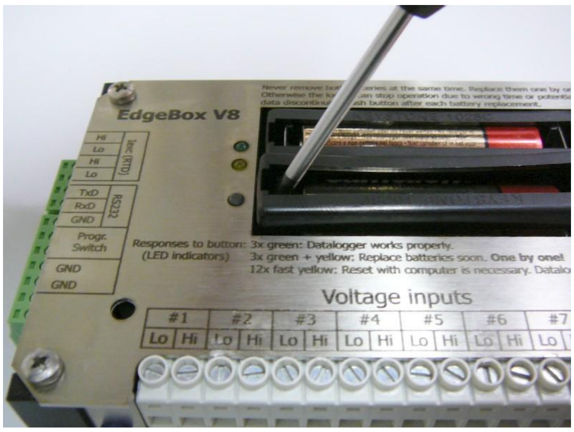
The datalogger can be supplied also from an external power source with the voltage in the range between 4 and 20 Volts. There are two possible arrangements here:

- **two NiMH** batteries are inserted into the datalogger battery holders. The external power supply continuously recharges the NiMH batteries they power the unit for a long time (months) in case of external power voltage failure. However, the recharging circuit could temporarily warm the printed board and consequently produce the temperature gradient along input terminals. *Therefore, this arrangement is not recommended for the temperature measurement with directly connected thermocouples.*
- **one** (only one!) **alkaline** battery put into any holder of the externally powered datalogger makes the system backup. The logger will not measure while the external voltage is missing but the system communicates with PC and it is ready for immediate work after the power voltage is restored. This solution suits to measurement with thermocouples since the PC board in not affected by any additional heat coming from battery recharging circuits.

1.4.3 BATTERY REPLACEMENT

A small screwdriver is a good tool for removing the battery holder. Lift it up carefully one by one on both ends:





Important note #1: *Replace batteries one-by-one when the datalogger is powered by internal batteries only. This technique will keep the system under the voltage and does not lose the real time (and possibly data pointer – see chapter 1.4.1). Always check the system status by pushing the check button!*

Note #2: Never use cheap zinc-carbon batteries – their capacity is much lower and they tend to leakage.

Note #3: Watch battery polarity!

2 DATALOGGER OPERATION

2.1 MEMORY

The datalogger principally measures in regular intervals electrical signals connected to input channels and stores the measured values in the memory.

The datalogger operates in two modes according what to do if its memory is full

- the logger continues operating and replaces oldest data in memory with actual values
- the logger stops operation when the memory is full

The operating mode is set by the process of datalogger reset (Initialization).

2.2 DATA AVERAGING

The measured values are saved directly or (more often) as an average within certain time interval. For instance, the logger measures each minute and each hour calculates the average and saves this average in the memory.

NOTE: A non-averaging function can be set by any channel (indicated by "n/a" in the "ON/off" column). Such channels are measured only once in intervals of averaging and directly stored in the memory. This is recommended for the measurement of slowly changing variables (like soil properties) in systems which have to measure much faster because of other fast changing variables (solar radiation etc.).

2.3 CHANNEL TYPES

EdgeBox V12 dataloggers have two main channel types – voltage and counters. Two additional channels are necessary in some particular cases – terminal temperature for the measurement of "cold junction" of thermocouples and the excitation current required by RTD sensors.

2.3.1 VOLTAGE

The range of voltage channel has to be set manually during the datalogger configuration. For those gauges they are included in library, the proper sensor range is mentioned beside the gauge name (refer to Mini32 software manual). The range of user-defined sensors should be set according to the knowledge of their output characteristic. If the input signal exceeds the range, the voltage value is replaced with missing value symbol (refer to Mini32 software manual for details). Please note that the maximum voltage range from zero up to +5 Volts regarding to GND (or negative pole of external power supply) on each terminal is allowed otherwise an interference between channels will occur!

2.3.2 COUNTERS

Note: Both pulse inputs suppose mechanical switch (reed contact) or a floating electronic output with an open collector transistor.

16-bit means in practice that the counter capacity within the measuring interval is 65536 pulses. This capacity should be considered when setting the measuring interval. If the number of pulses exceeds the counting capacity, the counter starts to count again from zero so all the pulse number equal to counter capacity is forgotten.

The maximum frequency range of all counters is limited because of noise suppressing by input circuit to ca 500 pulses per second (Hz).

The output of counters as well as of the voltage channels is saved as a 2-byte number. Because of precision within the whole range of pulse frequency and averaging/measuring interval ratio, there are two virtual ranges, **F**ast and **S**low.

The Fast one stores the pulse number in memory as an average from the measuring intervals the same way as by voltage channels (the pulses from each measuring interval are summarized and that divided by the averaging/measuring interval ratio). However, because the pulse average is stored as integer it causes a significant rounding error by small amount of pulses. On the other hand, the Fast range allows using the whole counter capacity (65 536 pulses) in each measuring period.

The error of the measurement low frequency pulses with Fast range depends on the interval ratio and the pulse number. See following example showing the worst cases:

Averaging/measuring interval ratio = 10					
*Number of pulses coming within the **averaging** interval*	*2*	*5*	*15*	*35*	*95*
*Output value in data file [pulses per **measuring** period]*	*0*	*1*	*2*	*4*	*10*
*Right value [pulses per **measuring** period]*	*0.2*	*0.5*	*1.5*	*3.5*	*9.5*
Error in %	*100*	*50*	*33*	*14*	*5*

*The maximal rounding error decreases with the pulse frequency and rises up with the interval ratio. So please set the **S**low range for low frequency pulse signals (tipping bucket rain gauge i.e.).*

*The **S**low range is completely exact because pulses are stored not as the average but as the total per averaging interval and the calculation of mean value is made in computer with high accuracy. However, the maximum pulse number in the averaging period cannot exceed the counter capacity (65 366 pulses). As the consequence, the maximal number of pulses allowed to come within the measuring period is reduced by interval ratio:*

Slow range						
Averaging / measuring interval ratio	*1*	*2*	*5*	*10*	*20*	*50*
Max. pulse number allowed in measuring interval	*65536*	*32768*	*13107*	*6553*	*2376*	*1310*

Summarized: ***Slow*** **range should be preferred until the expected number of pulses coming within the measuring interval does not exceed the value calculated as 65536/interval ratio. Otherwise, the *Fast* range has to be set.**

Example: Measuring interval = 10 sec, storing interval = 10 minutes > interval ratio 600/10 = 60. Consequently, 65536/60 = 1090 imp in 10 sec. time interval are allowed. That means, if the maximum estimated pulse frequency does not exceed 1090/10 = 109 Hz, slow range of the counter can be set.

Note: The power consumption of the datalogger significantly rises up with the frequency of counted pulses higher that ca 10 Hz. The maximum power consumption when both counters are processing pulse frequency above 500 Hz is the same as eight voltage channels are measured each 15 seconds.

*In praxis – use **slow** range for tipping bucket rain gauges and **fast** range for pulse output anemometers.*

2.3.3 INTERNAL (TERMINAL) TEMPERATURE

This variable is necessary for the temperature measurement with the thermocouples. The terminals are used as the reference junction and therefore the knowledge of their temperature is required. The measurement of internal temperature is switched on automatically when the thermocouple based gauge is chosen (channel #13).

2.3.4 RTD SENSOR EXCITATION CURRENT

Channel #14 measures (also switched automatically by system if required) the excitation current passing through RTD sensors (Pt100, Pt1000, Ni100). These values are used for calculation during the data conversion to engineering values.

2.4 EXCITATION VOLTAGE

Some sensors need energy for their power supplying during or a reference voltage the measuring process. For this purpose, the datalogger is equipped with three voltage excitation sources; 5 V; 2.5 V and 3 V which are active during the measurement.

5 V source is intended mostly for sensor powering. The voltage is accurate just in case of zero load. Otherwise the voltage decreases a bit with load current for ca 6 mV per 1 mA of output current. (0.12 %/mA). The maximum load current is limited approximately by 30 mA.

2.5 V is a reference voltage which does not depend on the load current at all. However, the maximum current is limited by 25 mA.

3 V reference voltage is activated **by the average intervals only**. Is serves for supplying power demanding sensors measured in averaging (larger) intervals. Maximum current is limited to ca 25 mA.

2.5 GAUGE TYPES

A set of common gauges is predefined in attached software Mini32 relevant to EdgeBox V12 model.

2.6 TIMING OF THE MEASUREMENT

There are two different time periods that should be mentioned - measuring period and the period of averaging (storing into the memory).

Another time period called "warm-up" time (1 to 5 seconds) can be set if some sensors need settling time higher than one hundred milliseconds for stabilizing (reset). Since there are two excitation outputs independently activated in time of the measurement and in time of averaging, also two independent "warm-up" times has to be set. Clearly, the "warm-up" time in averaging period cannot be shorter than the measuring one.

Note that all these time intervals periods influence the memory capacity and the battery lifetime.

2.7 STORAGE CAPACITY

The memory is organized in cycle so the oldest data are continuously overwritten with the newest ones. The total memory capacity is slightly above 220,000 values independently on the channel type.

2.8 BATTERY LIFETIME

The battery duration time in days depends on the number of voltage or pulse channels active, on the interval of measurement and on the warm-up time (see the file (EMS_bat_mem.xls). The counters demand to power supply is proportional to the pulse frequency and it could lead to substantial reduction of battery life (See 2.3.2).

2.9 REAL TIME CLOCK

The datalogger time is set by the initializing process. Before the start of the initialization, the computer time is offered for possible editing.

The datalogger time can be also corrected directly without necessary initialization since. This option is supported by all EMS dataloggers manufactured in summer 2011 and later.

2.10 PROGRAMMABLE SWITCH

The programmable output switch is aimed for the control of external systems. The typical use is switching the modem for the remote data transfer in certain time period in selected days in order to save the batteries, switching the external power supply during the measurement process etc. The switch can be basically programmed in diurnal or hourly cycle. Up to ten switching on periods per unit (day, hour) can be set and activate in each unit or selected ones. Refer to Mini32 software manual for more information.

2.11 DATALOGGER COMMUNICATION

The EdgeBox dataloggers do not have any display or keyboard; the datalogger setting, data downloading and viewing suppose the use of PC computer. Computer can be connected to the datalogger directly via a special cable with 9-pin D-sub and 2.5 mm stereo Jack connectors.

3 SOFTWARE

The program Mini.exe (32-bit version working under all Windows® operating system) or Mini32.exe (Windows® 95, 98, NT, XP, Vista, 7) supports all necessary operations for datalogger setting, data handling and file processing via RS232 serial line connection (special PC cable is required). The software components are placed in the directory c:\Program Files\EMSoft\Mini32\ if not specified otherwise during the installation process. On-line help facility will guide you through particular software topics.

Note: Since currently produced notebooks are already not equipped with serial (COM) port, an additional USB/RS232 convertor has to be used. . It is strongly recommended to use a FTDI compatible convertor and use the driver available on EMS web site.

The installation of Mini32 software includes also firmware files containing internal datalogger code (firmware) of all supported hardware systems.

Since the software includes a lot of sophisticated options like statistics, advanced graphics, user defined calculation etc., some options might be accessible in future after the registration only.

Refer to Mini32 user's manual for software details and other related information.

4 WARRANTY

The product is warranted by exporter against defects in material and workmanship for a period of **two years** from the date of shipment from the company.

The product found to be defective during the warranty period will be repaired or replaced and returned freight prepaid.

The producer is not responsible for the faults originated by careless manipulation, incorrect operations, wrong applications or the destruction of seals.