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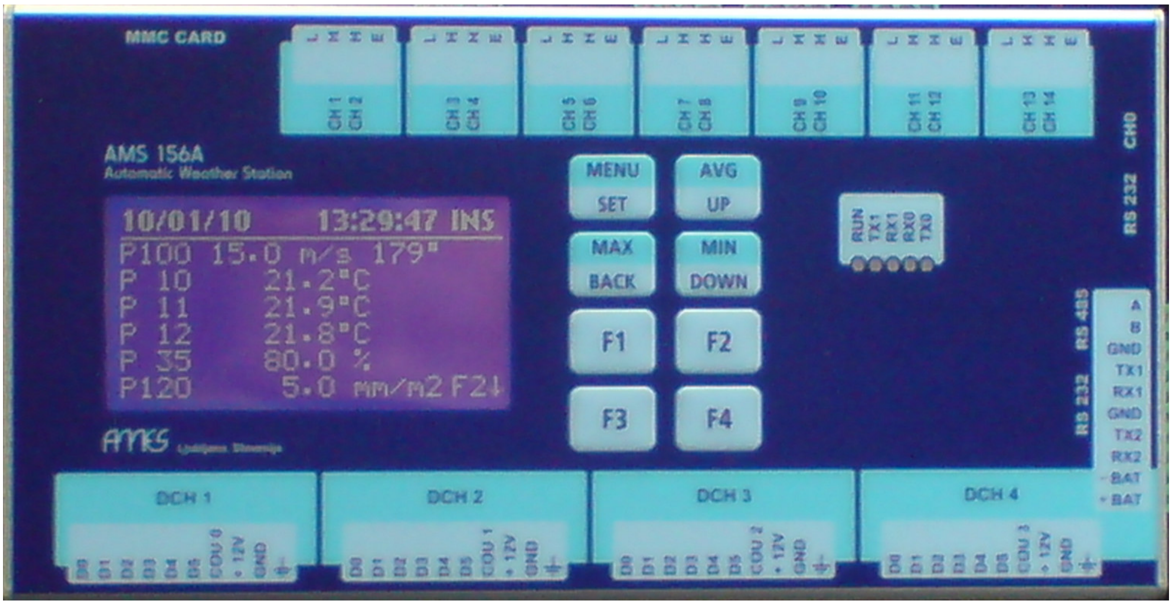
METEOROLOGICAL STATION
AMS 156A



Manual

Ljubljana, January 2011

CONTENTS

DESCRIPTION OF THE STATION

AMS 156A is small, low power meteorological station. Aluminum casing, that can be easily mounted on the mounting rail, contains:

- Station electronics (processor, display, keyboard, sensor and communication interfaces)
- Cable terminals, over voltage protectors, communication connectors
- ETHERNET network module (optional), that supports the following protocols: CMP, ARP, IP, TCP, UDP, DHCP, HTTP, SNMP, SMTP.
- Station temperature sensor (temp. CPU)
- Air pressure sensor (option)
- MMC/SD memory card connector (64MB to 1GB)

<u>In standard configuration, AMS 156A has:</u>

- 4 16-bit counters
- 18 digital inputs (0 – 24V)
- 8 analog inputs over 12-bit ADC (100KHz).

  Input voltage for analog inputs can be set either by software (PGA setting, gain 1, 2, 4, 8, 16, 0.5) or by setting fixed gain of input amplifiers. Available are input attenuators for input voltages higher than 5 V.

  When measuring instant inputs, voltage on 100 Ohm resistor is measured.

  It is possible to select by software 4 12-bit differential inputs instead of 8 single-end.

- 8 analog inputs, 16 or 24 bit (5 -100 Hz).

  Input voltage can be set by software (PGA gain setting)

+- 20mV bipolar mode	0 mV – 20 mV unipolar mode
+- 40mV bipolar mode	0 mV – 40 mV unipolar mode
+- 80mV bipolar mode	0 mV – 80 mV unipolar mode
+-160mV bipolar mode	0 mV – 160 mV unipolar mode
+-320mV bipolar mode	0 mV – 320 mV unipolar mode
+-640mV bipolar mode	0 mV – 640 mV unipolar mode
+- 1.28 V bipolar mode	0 mV – 1.28 V unipolar mode
+- 2.56 V bipolar mode	0 mV – 2.56 V unipolar mode

  It is possible to select by software 4 differential inputs instead of 8 single-end. Differential inputs are convenient for connections of PT100 temperature sensors.

- 4 current generators

  First two generators can be programmed to supply output currents from 0.2 to 20mA.

  Second two generators can be used individually for currents 2 x 200 µA or joined for current 1 x 400 µA (PT100).

- 2 voltage generators

  they can be programmed to output 0.2 to 10V

- Voltage generator 3V (max. 100mA)

- **Communication channel 0** (RS232, RS 485 or optics) is used for communication with the local computer. Serial transmission is 300 to 115200 Bd, 8 data bits, 1 stop bit, no parity.

- **Communication channel 1** (RS232, RS 485) is used for communication with the sensors. Serial transmission is 300 to 115200 Bd, 8 data bits, 1 stop bit, no parity.

- **Communication channel 2** (SD I-12, RS 232) is used for communication with the wind sensors. Serial transmission is:

  For RS232: 300 to 115200 Bd, 8 data bits, 1 stop bit, no parity.
  For SDI -12: 1200 Bd, 7 data bits, 1 stop bit, even parity.

Communication lines are connected as follows:

Channel 0 (I / O)

Main communication channel (RS232C, CH0) is used to connect AMS 156A to computer, modem or GSM modem. It can be upgraded to optic serial link.

Standard 9-pole male connector is used:

CH0

PIN	1	2	3	4	5	6	7	8	9
SIGNAL	DCD	RXD	TXD	DTR	GND	DSR	RTS	CTS	RI

Channel 1 (I / O)

CH1 communication channel is used as a link with intelligent sensors, which have RS232, RS422 or RS485 serial connections.

CH1 is connected through 10-pin connector, located on AMS 156A motherboard. With an optional circuit, optical serial link can be established on CH1.

CH1 — RC232C / Rs485

PIN	1	2	3	4	5	6	7	8	9	10
SIGNAL	+BAT	-BAT	RX2	TX2	GND	**RX1**	**TX1**	**GND**	**RS485 B**	**RS485 A**

Channel 2 (I / O)

CH2 communication channel is used as a link with intelligent sensors.
It can be used for RS232 or SDI-12 communication.

CH2 — **RS232C**

PIN	1	2	3	4	5	6	7	8	9	10
SIGNAL	+BAT	-BAT	**RX2**	**TX2**	**GND**	RX1	TX1	GND	RS485 B	RS485 A

CH2 — **SDI-12**

PIN	1	2	3	4	5	6	7	8	9	10
SIGNAL	D0	D1	D2	D3	D4	D5	COU3 **SDL**	**+12V**	**GND**	D0

OPERATION OF THE STATION

AMS 156A presents measured parameters on built-in, backlit alphanumeric LC display. Data can be presented in alphanumeric, instrument-like, or graphic way. Shown are:

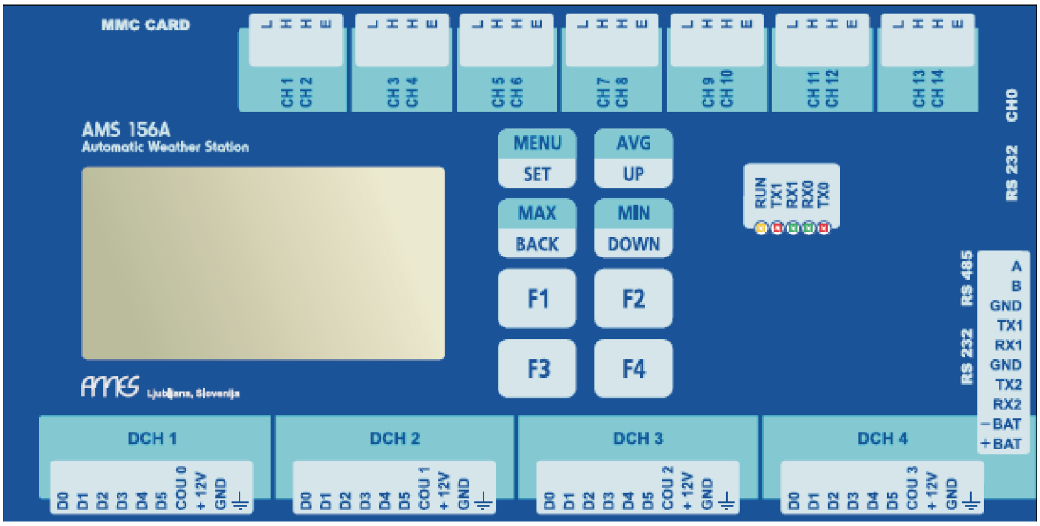
- Instant values
- Average values
- Minimum values
- Maximum values

Station is controlled by a menu system. All set parameters are permanently stored in EPROM memory and are not lost when station is shut down.

At the end of each data processing interval, mean values and extremes are stored with time stamps to the EEPROM data storage. These data can be reviewed later on the display or transmitted serially to the external computer. AMS 156A can store data for aprox. 300 data processing intervals. This means, that data for 7 days are stored, provided that data processing interval is set to 30 minutes. Data are stored on FIFO principle (first in – first out – oldest data are replaced by the newest).

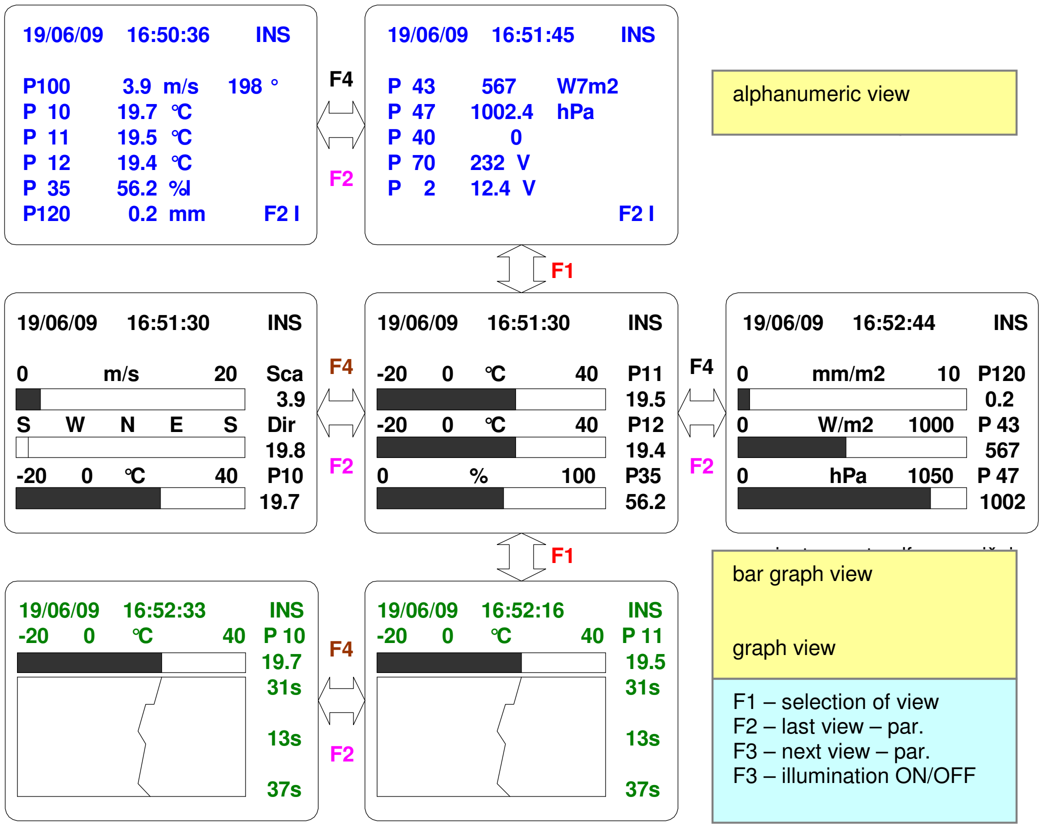
After AMS 156A is turned on, LCD is initialized and microprocessor tested, followed by the test of memory content. If memory error is detected, message *EEPROM ERROR* is shown on LCD and default values are restored. In this case, all constants and settings, different from the default ones, should be reentered. Under normal conditions, this situation should never appear.

Operation of RVM 96C is controlled by keyboard; some of the keys have double functions: upper ones are used in the measuring mode ("RUN MODE"), lower are used when operating in the menu mode. Keyboard layout is shown on the following picture:



MENU / **SET** ... enter menu mode / confirm function
AVG / **UP** ... show average values / UP in menu
MAX/**BACK** ... show maximums / BACK in menu
MIN / **DOWN** ... show minimums / DOWN in menu
F1 ... display type (alphanumeric, instrument-like or graphics)
F2 ... previous display or previous parameter
F3 ... display illumination ON / OFF
F4 ... next display or next parameter

After initialization, AMS 156A starts to measure in normal 'Run mode' and display instant data, according to the selected display type (F1). There are three possible types of displaying data. Screens of all of them are shown on the following picture:



P100	Wind (speed [m/s°] direction [°])
P 10	Air temperature 2m [°C]
P 11	Air temperature 0.5m [°C]
P 12	Air temperature 5 cm [°C]
P 35	Relative humidity [%]
P 120	Precipitation [mm/m2]
P 43	Solar radiation [W/m2]
P 47	Atmospheric pressure [hPa]
P 40	Leaf wetness [min]
P 70	Supply voltage, mains [V]
P 2	Supply voltage, DC [V]

Instant values are refreshed each second. This is the basic mode of displaying data.

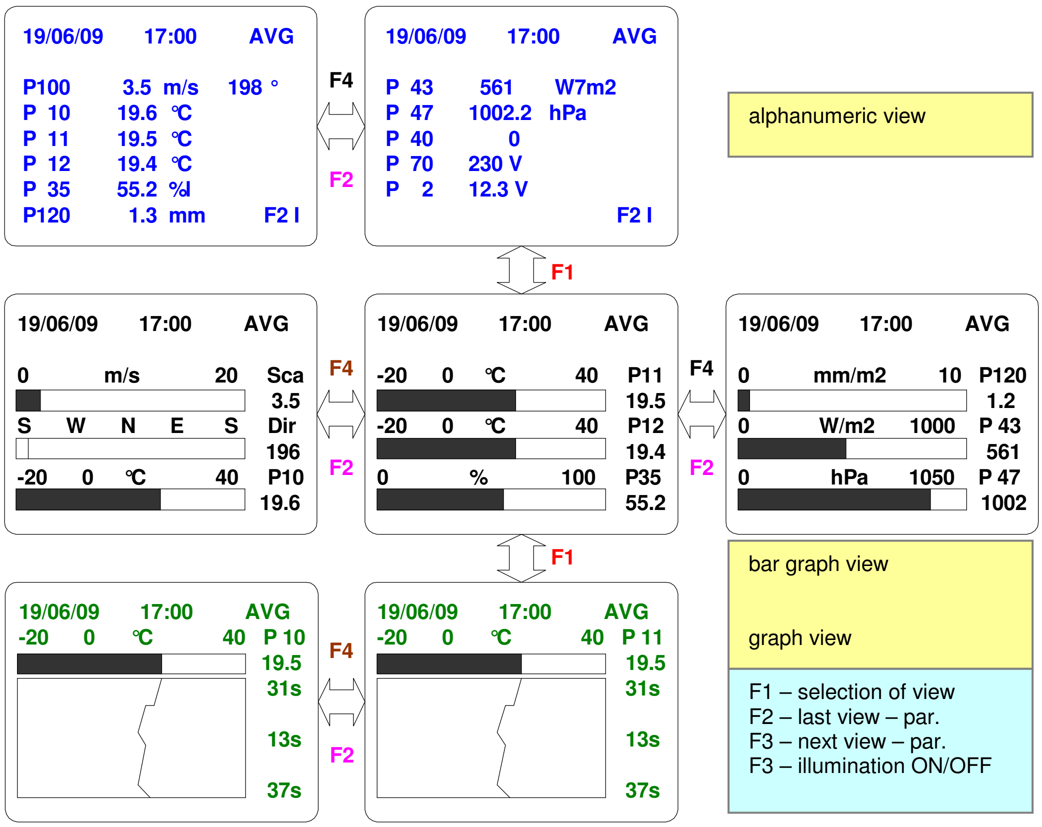
In the "RUN MODE", we can switch from displaying instant data to the average, minimum or maximum values, by pressing keys **AVG**, **MIN** or **MAX** respectively. All these keys, when pressed second time, return instrument to display instant values.

Formats of displays in AVG, MIN or MAX mode are nearly identical to formats of instant data; type of the displayed data is marked only by an abbreviation in the upper right corner of the display:

INS: ... instant values
AVG: ... average values
MIN: ... minimums
MAX: ... maximums

Average data of the last interval

Press key **AVG** (Average). LCD shows (depending on the selected display type):

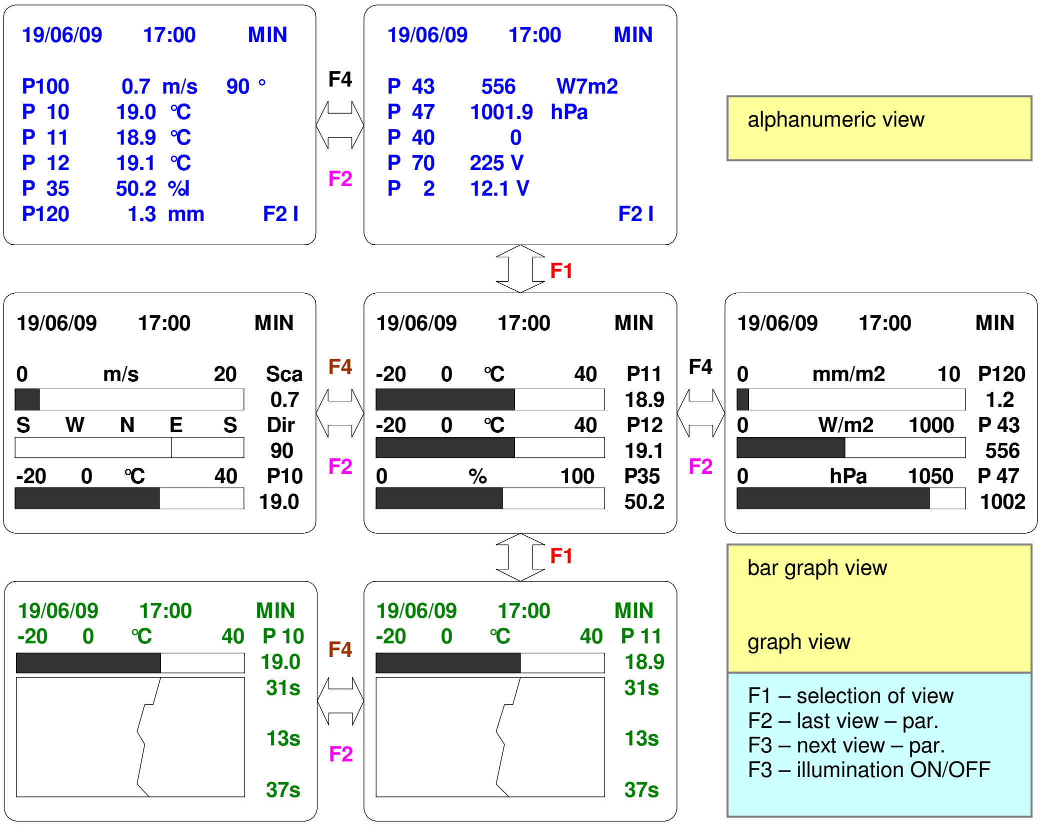


Shown are average values from the last averaging interval. Until end of the first averaging interval, all values are zero. Data are refreshed at the end of each averaging interval (e.g., if averaging interval is set to 30 min, each half an hour).

To return to display instant values, press **AVG** again. By pressing keys **MIN** or **MAX**, it is possible to display minimums or maximums directly.

Minimums of the last interval

Press key **MIN** (Minimums). LCD shows (depending on the selected display type):

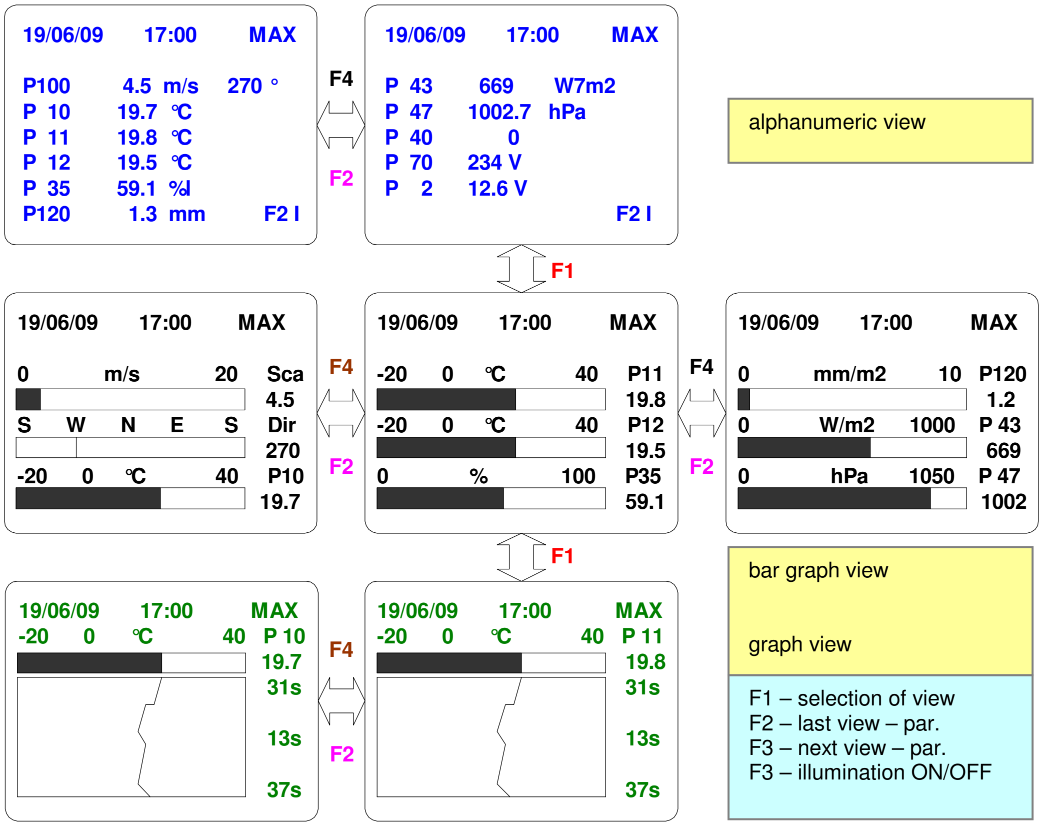


Shown are minimum values from the last averaging interval. Until end of the first averaging interval, all values are zero. Data are refreshed at the end of each averaging interval (e.g., if averaging interval is set to 30 min, each half an hour).

To return to display instant values, press **MIN** again. By pressing keys **AVG** or **MAX**, it is possible to display average values or maximums directly.

Maximums of the last interval

Press key **MAX** (Maximums). LCD shows (depending on the selected display type):



Shown are maximum values from the last averaging interval. Until end of the first averaging interval, all values are zero. Data are refreshed at the end of each averaging interval (e.g., if averaging interval is set to 30 min, each half an hour).

To return to display instant values, press **MAX** again. By pressing keys **AVG** or **MIN**, it is possible to display average values or minimums directly.

Storing data to EEPROM memory

Regardless of the type of the displayed instant data, data are stored in the EEPROM memory at the end of each averaging interval. Historic data from this memory can be reviewed later on the AMS 156A, or sent to the external computer. Data are not stored, if station is not in the measuring mode (during setting of the internal parameters or reviewing stored data). To prevent unnecessary loss of data, instrument automatically returns to the measuring mode, when operator does not press any key for more than 30 seconds.

Data sampling

Internal interrupt signals trigger data sampling in equal time intervals. For each parameter, data sampling interval can be set in 1-second increments from 1 to 60 seconds. By default, all data sampling intervals are set to 1 second.

Averaging interval

Averaging interval is adjustable to the following values:

1min., 2 min., 5 min., 10 min., 20 min., 30 min., 1 h

By default, averaging interval is set to 30 minutes.

At the end of each averaging interval, all statistical values are computed.

DATA PROCESSING

Data calculations are divided ito two types: instant calculations and calculations at an the end of averaging intervals.

Instant calculations are all mathematical and logical calculations made immediately after the data are sampled. These are done in regular intervals, determined by the time of individual parameter data sampling. Time counting starts when the station is turned on, and after that, from the beginning of each averaging interval. With this calculations, the instant values are determined.

Averaging calculations are done at end of averaging interval. Beacuse the interval is the same for all parameters, this calculation is done for all parametrs simultaneously. The averaging time is counted from each full hour (a full hour always means an end of an averaging interval). With this calculations, average values, standard deviations, extremes and their times, sums, statuses, etc. are set and logical checks on data are performed. All these values are null until the station completes at least one full averaging interval.

1 WIND SPEED AND DIRECTION CALCULATIONS

1.1 Determining the instant value

Wind speed and direction are both parameters with a digital interface. They are measured each second. Both quantities determine the wind vector. The wind speed is calculated by reading the 16bit value from the sensor and nominate the value using the following equation:

$$v_{i0} = \mathrm{a} x_i$$

The sensor constant a= 0.05 m/s is achieved if we account for that the sensor gives 20 impulses at 1m/s (as is the case with AMES digital sensors). Wind speed is normally given in meters per second.

Instant wind direction f_i is calculated by transforming the read code from the measuring registers from gray code into binary code and multiplying with the direction sensor constant:

$$\mathrm{f_i} = \mathrm{a} x_i$$

The constant a for a 5-bit sensor equals 11,25 degrees, and 6,625 degrees for a 6-bit sensor. The constant is always given in degrees.

1.2. Calculating statistical values

At the end of a measuring interval with wind the following statistical values are calculated: vector speed and vector direction, maximum speed and its direction, time of maximum, minimum speed and its direction, time of minimum, scalar wind speed, direction stability, standard deviation of the x speed components, standard deviation of the y speed components, terminal speed and direction. Vector speed is calculated if instant wind speeds are summed up:

$$\left|\vec{v}\right| = \sqrt{v_x^2 + v_y^2}$$

$\left|\vec{v}\right|$ is the average vector speed

v_x is the average x-component of wind speed

$$v_x = \frac{\sum_{1}^{N} v_i \sin(\mathrm{f_i})}{\mathrm{N}}$$

v_y is the average y-component of wind speed

$$v_y = \frac{\sum_{1}^{N} v_i \cos(\mathrm{f_i})}{\mathrm{N}}$$

v_i is the instant wind speed, f_i is the instant wind direction and N is the number of measured values within the averaging interval.

Average vector direction is calculated using:

$$f_0 = arctg\left(\frac{v_x}{v_y}\right)$$

$f = f_o$ for $v_x \geq 0$ and $v_y \geq 0$
$f = \pi - f_o$ for $v_x < 0$ and $v_y > 0$
$f = \pi + f_o$ for $v_x \leq 0$ and $v_y \leq 0$
$f = -f_o$ for $v_x > 0$ and $v_y < 0$

The scalar speed is the arithmetic average of all speeds V_i within the averaging interval.

$$v_s = \frac{\sum_1^N v_i}{N}$$

Direction stability is the ratio between the vector speed and the scalar speed.

$$s = \frac{|\vec{v}_v|}{v_s}$$

The terminal direction is the average scalar velocity in the last 10 minutes of the interval.

$$v_t = \frac{\sum_1^N v_i}{N}$$

Terminal direction is the direction that dominated during the last 10 minutes of the averaging interval. It is calculated by summing how many times the wind corresponded with any of the abvailable directions (forming wind direction hystogram). The most frequent direction is the terminal wind direction.

Standard wind direction deviation is calculated using:

$$\sigma = \sqrt{\frac{\sum_1^N (v - v_i)}{N - 1}}$$

Standard wind speed x-component deviation is calculated using:

$$\sigma_x = \sqrt{\frac{\sum_1^N (v_x - v_i \sin(\mathrm{f_i}))}{N-1}}$$

Standard wind speed y-component deviation is calculated using:

$$\sigma_y = \sqrt{\frac{\sum_1^N (v_y - v_i \sin(\mathrm{f_i}))}{N-1}}$$

Maximum wind speed is the largest speed measured during the averaging interval.

$$v_{\max} = \min(v_i)\Big|_1^N$$

The maximum winds speed direction is the direction in which the wind was blowing at the time it reached it's maximum speed. The maximum wind speed time is the time (hour, minute second) at which the wind was blowing at its maximum speed.
Minimum speed is the lowest speed recorded during the averaging interval.

$$v_{\min} = \max(v_i)\Big|_1^N$$

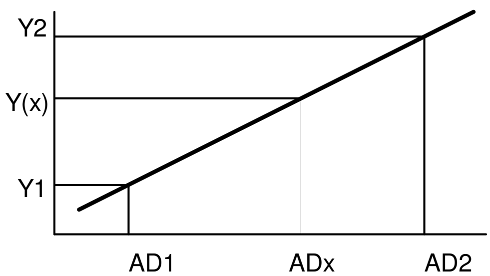
Minimum speed direction is the direction that the wind was blowing when it was moving at it's slowest recorded speed. Minimum speeds time is the time (hour, minute second) when the lowest speed was recorded

2 TEMPERATURE CALCULATIONS

2.1 Determining instant values

Temperature is a parameter whose sensor has an analogue output. The interval of measurments is normaly 1 second. Temperature is measured by first taking the output signal from the sensor through an analogue-digital converter (ADC) and then doing the calculation.

Calculating the A/D value is done using a line, intersecting two points in a graph, where x is the value of the 12(16)bit AD converter and y is the required physical quantity:



Therefore: $temp = (temp2 - temp1)\dfrac{ad - ad1}{ad2 - ad1} + temp1$

where ad1 and ad2 give calibrating points of the AD converter in binary format and termp1-temp2 are their respective temperature values..

For each quantity an instant measurement value is defined. This is composed from multiple individual samples from the AD converter, taken in a short time of sampling interval (e.g. 1 second). The maximum sampling rate is 20 kHz. The instant measurement X, that the station is displaying, is therefore defined as the average of the many ADC values taken in a preset sampling interval (this is done to filter out the possible noise on the input signal)

$$X = \sum_{i=1}^{i=N} A(i)$$

Where N is the number of samples from the ADC in a single sampling time interval, and A is a value from an individual readout.

The temperature is given in degrees Celsius.

2.2 Calculating statistical values

With temperature, the following statistical values are calculated: average temperature, maximum temperature, minimum temperature, time of minimum and maximum temperatures, terminal temperature and standard deviation.

The average temperature is an arithmetic average of all values within an averaging interval:

$$T = \frac{\sum_{1}^{N} T_i}{N}$$

N being the number of values and Ti the Instant value.

Maximum temperature is the highest measured temperature measured during the averaging interval.

$$T_{max} = \max(T_i)\Big|_1^N$$

Time of maximum and minimum are the times (hour, minute second) of the measured maximum and minimum temperatures respectably.

Minimum temperature is the lowest measured temperature measured during the averaging interval.

$$T_{min} = \min(T_i)\Big|_1^N$$

Termin value average is the average value calculated during the last minute of the averaging interval.

$$T_t = \frac{\sum_1^M T_i}{N}$$

M is the number of values taken during the last minute of the averaging interval.

Standard deviation is calculated using:

$$\sigma = \sqrt{\frac{\sum_1^N (T - T_i)^2}{N - 1}}$$

Calculating daily statistical values

With temperature, the following statistical daily values are calculated: average daily temperature and minimum and maximum daily temperature and their respective time (hour, minute second).

The average daily temperature is calculated as an arithmetic average of all averages calculated during the day (T_l).

$$T_d = \frac{\sum_1^L T_l}{L}$$

L is the number of intervals during the day.

Maximum daily temperature is the highest temperature measured during the day.

$$T_{d\max} = \max(T_i)\Big|_1^L$$

Time of maximum is the tima at which the highest temperature was recorded.

Minimum daily temperature is the lowest temperature measured during the day.

$$T_{d\min} = \min(T_i)\Big|_1^L$$

Time of minimum is the time at which the lowest temperature was recorded.

3 RELATIVE HUMIDITY CALCULATIONS

3.1 Determining instant values

Relative humidity is a parameter, whose sensor has an analogue output. The sampling time for the sensor is normaly 10 seconds. Relative humidity is taken by routing the analogue signal to a analogue – digital converter (ADC) and then calculating the transformation.

The value read from the ADC is nominated using:

$$rh = (rh2 - rh1)\frac{ad - ad1}{ad2 - ad1} + rh1$$

where ad1 and ad2 are the calibrating points of the ADC in binary form and rh1 - rh2 being there respective humidity values.

Relative humidity is given as a percentage of RH.

3.2 Calculating statistical values

With relative humidity the following values are calculated: average relative humidity, maximum relative humidity and its time, minimum average humidity and it's time, terminal relative humidity and standard deviation.

Average relative humidity is the arithmetic average of all values within an averaging interval:

$$H_t = \frac{\sum_1^N H_i}{N}$$

N being the number of values measured during the interval and H_i being instant value.

Maximum value is the largest humidity value measured during the interval.

$$H_{max} = \max(H_i)\Big|_1^N$$

Time of maximum is the moment (hour, minute second) when the maximum was measured.

Minimum value is the smallest humidity value measured during the interval.

$$H_{min} = \min\left(H_i\right)\Big|_1^N$$

Time of maximum is the moment (hour, minute second) when the maximum was measured.

Terminal value is the arithmetic average value during the last minute of the interval.

$$H_t = \frac{\sum_1^M H_i}{M}$$

M being the number of measured values and Hi being the instant value.

Standard deviation is calculated using:

$$\sigma = \sqrt{\frac{\sum_1^N \left(H - H_i\right)^2}{N-1}}$$

4 SOLAR RADIATION CALCULATIONS

4.1 Determining instant values

Solar radiation is a parameter, whose sensor has an analogue output. Sampling time is usualy 1 second. Radiation is calculated by first routing the output through a analogue digital converter (ADC) and then doing the transformation.

The value from the ADC is expressed:

$$sun = (sun2 - sun1)\frac{ad - ad1}{ad2 - ad1} + sun1$$

where ad1 and ad2 represent the calibrating points of the ADC in binary form, and sun1 – sun2 being their respective radiation points.

Solar radiation is given in W/m2.

4.2 Calculating statistical values

Whit Solar radiation, the following values are calculated at the end of a half hour interval: average value, max value and time of maximum, minimum value and its time and standard deviation.

Average solar activity is an arithmetic average of radiation over the half hour period.

$$S = \frac{\sum_{1}^{N} S_i}{N}$$

N being the number of intervals during the interval, and Si the instant value.

The maximum value is the highest measured solar radiation during the half hour.

$$S_{max} = \max(S_i)\Big|_1^N$$

Time of maximum is the time (hour, minute second), when said maximum was measured.

The minimum value is the lowest measured solar radiation during the half hour.

$$H_{min} = \min(S_i)\Big|_1^N$$

Time of minimum is the time (hour, minute second), when said minimum was measured.

Standard deviation is calculated using:

$$\sigma = \sqrt{\frac{\sum_{1}^{N}(S - S_i)^2}{N-1}}$$

5 . AIR PRESSURE CALCULATIONS

5.1 Determining instant values

Air pressure is a parameter, whose sensor has an analogue output. Teh sampling time for the sensor is normaly 10 seconds. Air pressure is measured by routing the analogue signal to an analogue – digital converter (ADC) and then calculating the transformation.

The value from the ADC is calculated using:

$$press = (press2 - press1)\frac{ad - ad1}{ad2 - ad1} + press1$$

Pressure is expressed in mB (hPa).

5.2 Calculating statistical values

With air pressure, the following values are calculated at the end of a half hour interval: average value, max value and time of maximum, minimum value and its time and standard deviation.
Average air pressure is an arithmetic average of radiation over the half hour period.

$$ZT = \frac{\sum_{1}^{N} ZT_i}{N}$$

N being the number of measured values within the interval, and ZTi being the instant value.

The maximum is the highest value measured during the interval.

$$ZT_{max} = \max(ZT_i)\Big|_1^N$$

The time of maximum is the exact time the maximum was recorded.

The minimum is the lowest value measured during the interval.
.

$$ZT_{min} = \min(ZT_i)\Big|_1^N$$

The time of minimum is the exact time the minimum was recorded.

Standard deviation is calculated using:

$$\sigma = \sqrt{\frac{\sum_{1}^{N} (ZT - ZT_i)^2}{N - 1}}$$

6. PRECIPITATION CALCULATIONS

Precipitation is a parameter with a digital interface. Data is read every second from the counter, integrated over five minutes and reseting it after every five minutes. The precipitation value is calculated by multiplying the result with the sensor constant.

$$D_i = D_{in} a$$

With D_i being the 5minute sum of precipitation over the 5 minute period in D_{in} the readout from the counter and a the conversion constant (a = 0.1mm/impulse).

The half hour value is the sum of all 5-minute values in a 1/2 h interval:

$$D_{pu} = \sum_{1}^{N} D_i$$

D_{pu} is the half hour sum, D_i are 5-minute sums, N the number of values measured during the half hour.

The daily precipitation is the sum of all half hour values during the day:

$$D_d = \sum_{1}^{L} D_{pu}$$

D_d is the daily value.
L is the number of measured 1/2 h intervals.
The 12-h sum is the sum of both the 7-19 interval and the 19-7interval. It is calculated from the sums of half hour intervals:

$$D_{pd} = \sum_{1}^{M} D_{pu}$$

D_{pd} is the 12h sum of precipitations and M the number of intervals in 12 hours.

SENSOR NONLINEARITY CORRECTION

Sensor used in the station are not perfectly linear in their entire operating range (PT100 temperature sensors for example). Nonlinearity is corrected by first calibrating them in a controled environment. Their operating curve is than approximated by a 3rd degree polynomial. The approximation is done with the smallest square method. The expression is:

$$Q = \sum_{1}^{N} \left(Y_i - p(x)\right)^2$$

where p(x) is the approximating polynomial for the calibrating curve.

$$p(x) = k_0 + k_1 x_i + k_2 x_i^2 + k_3 x_i^3$$

Yi is the actual polynomal value of the parameter and xi the measured value. N is the number of measurements. Coefficients k0, k1, k2 in k3 are defined by solving a system of linear equations.

Q / k0 = 0
Q / k1 = 0
Q / k2 = 0
Q / k3 = 0

The k0, k1, k2 in k3 coefficients are entered into the measuring system and measurement is corrected using the polynomial p(x). The nonlinearity correction is done after nominating binary values for each measurement. The default coefficient values are:

k0 = 0
k1 = 1
k2 = 0
k3 = 0

The nonlinearity correction can be done for air temperature, relative humidity, precipitation, air pressure, solar radiation and wind speed.

AUTOMATIC DATA VERIFICATION

Part of the data verification control is the formation of appropriate control statuses for those parameters that are behaving out of normal bounds. The computer does the control automaticaly, using the following criteria:

a.) at the end of the averaging interval a check is made, whether the average, minimal and maximal values do not exceed the physicaly acceptable borders. These borders are as follows:

PARAMETER	LOW BORDER	HIGH BORDER
temperature	-45 C	45 C
Relative humidity	5 %	100 %
Wind speed	0 m/s	30 m/s
Wind direction	0 st.	360 st.
Solar radiation	-10 W/m^2	1900 w/m2
Air pressure	805 hPa	1095 hPa
precipitation	0 mm	300 mm

b.) a check is made whether:

max > avg > min .

If found false then the measurement is wrong.

c.) controlling, whether (max - avg) < C and (avg - min) < C.

C is as follows:

PARAMETER	C
Air temperature	10 C
Relative humidity	20 %
Wind speed	3 • avg m/s
Air pressure	20 hPa
Solar radiation	1000 W/m2

If the relations are false than the measurement is wrong.

c.) checking, whether the minimum and the maximum differentiate by at least D (so the response is not constant):

PARAMETER	D
Air temperature	0.1 C
Relative humidity	0.2 %
Wind speed	0.05 m/s
Wind direction	5 degrees
Air pressure	0.1 hPa
Solar radiation	1 W/m2

MENU SYSTEM OF AMS 156A

Operator can input constants and set operating parameters of AMS 156A by using the menu tree of the instrument. Keys on the keyboard have the following meanings:

SET ... confirm the selection / input
UP ... Go to the upper menu or increase numeric value
DOWN ... Go to the lower menu or decrease the numeric value
BACK ... return from the function / break the operation

By pressing **SET**/**MENU**, we enter the basic, “root” menu.

Use UP and DOWN keys to select the desired submenu or action, use SET to confirm the selection, use BACK to return to the previous selection. UP in DOWN keys can be used also to set the numeric values. They have auto-repeat feature; by keeping them pressed for more than 3 seconds auto repeat accelerates for the first, and by keeping them pressed for more than 7 seconds, for the second time. Each value that is being set is displayed in inverse mode.

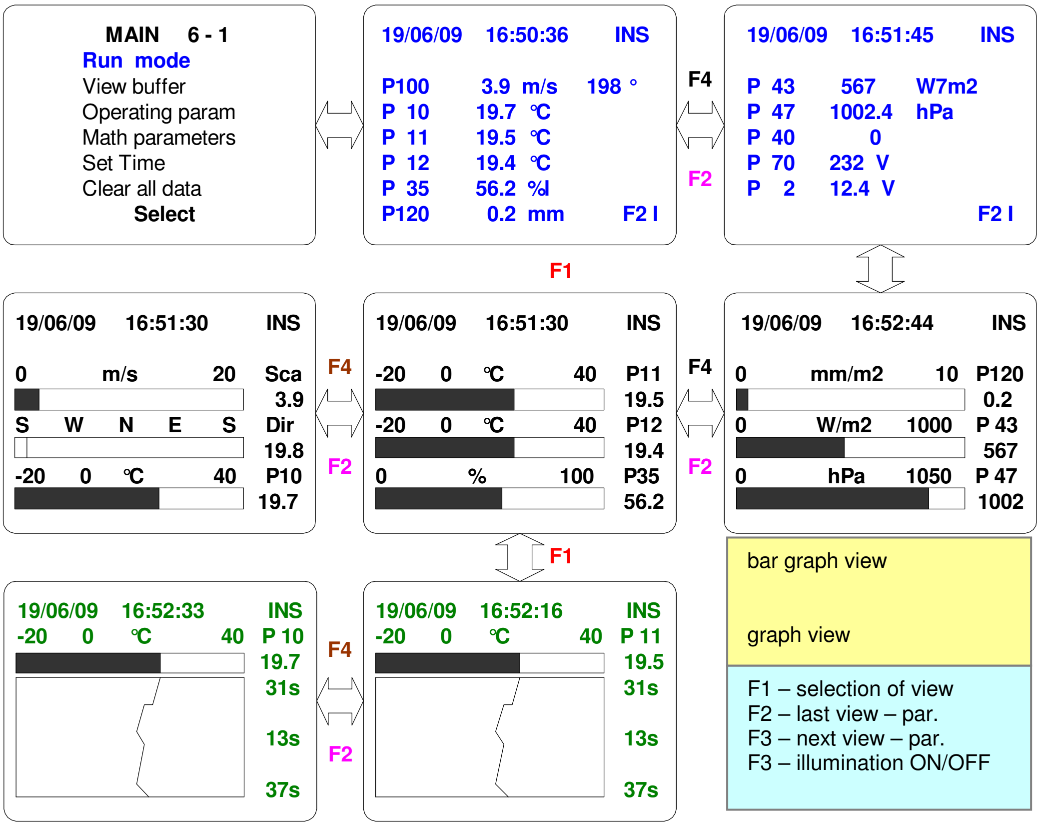
For security reasons, “MATH PARAMETERS“ menu requires to enter the password number (set to **23**).

Overview of the menu-structure

Menu 6-1. (Alphanumeric)	RUN MODE	... display data on alphanumeric screen
(Instrument-alpha)	NEXT PARAM	... display data on instr.-alphan. screen
(Graphic-Alfa)	SHOW PARAM	... display data on graphic-alphan. screen
Menu 6-2: VIEW BUFFER		... view historic data from memory
Menu 6-3: OPERATING PARAMETERS		... set parameters for operation
Menu 6-4: MATH PARAMETERS		... set parameters for data processing
Menu 6-5: SET TIME DATE		... set time and date
Menu 6-6: CLEAR ALL DATA		... clear EEPROM memory

Description of the menus

Menu 6-1: Run mode
Display current measured and computed data



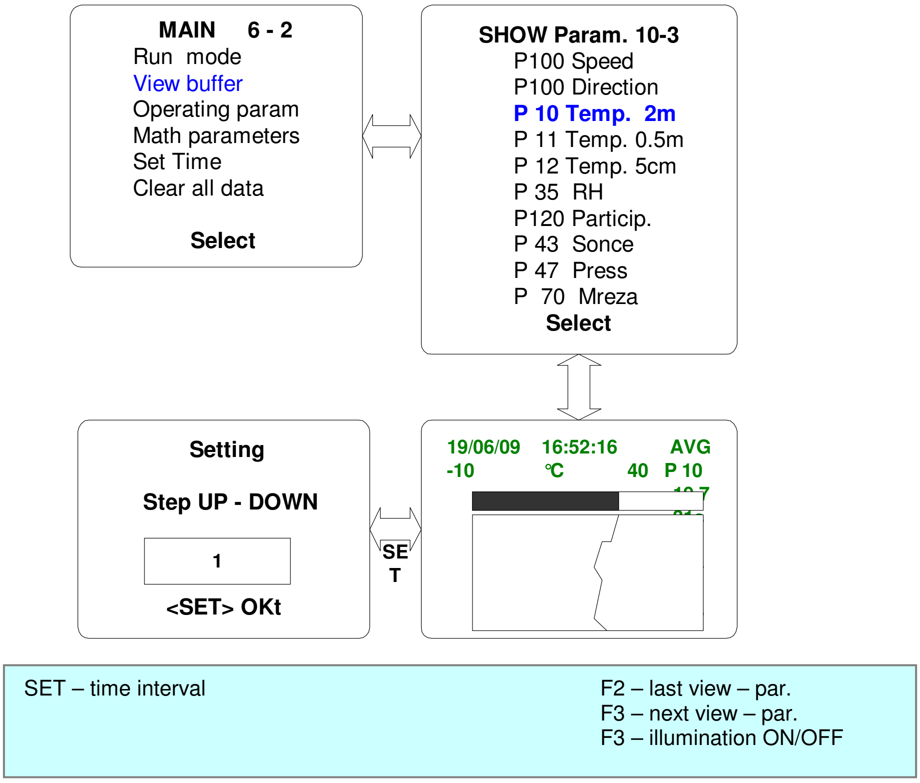
F1 toggles between different display modes. Each time **F1** is pressed, next display mode is started. Function works in a circular way.

F2 and **F4** are used for quick transition between parameters or screens.
F2 is used for previous parameter or screen.
F4 is used for next parameter or screen.

Each time any key is pressed, LCD is automatically illuminated for 10 second.

F3 is used to switch display illumination ON (permanently) or OFF.

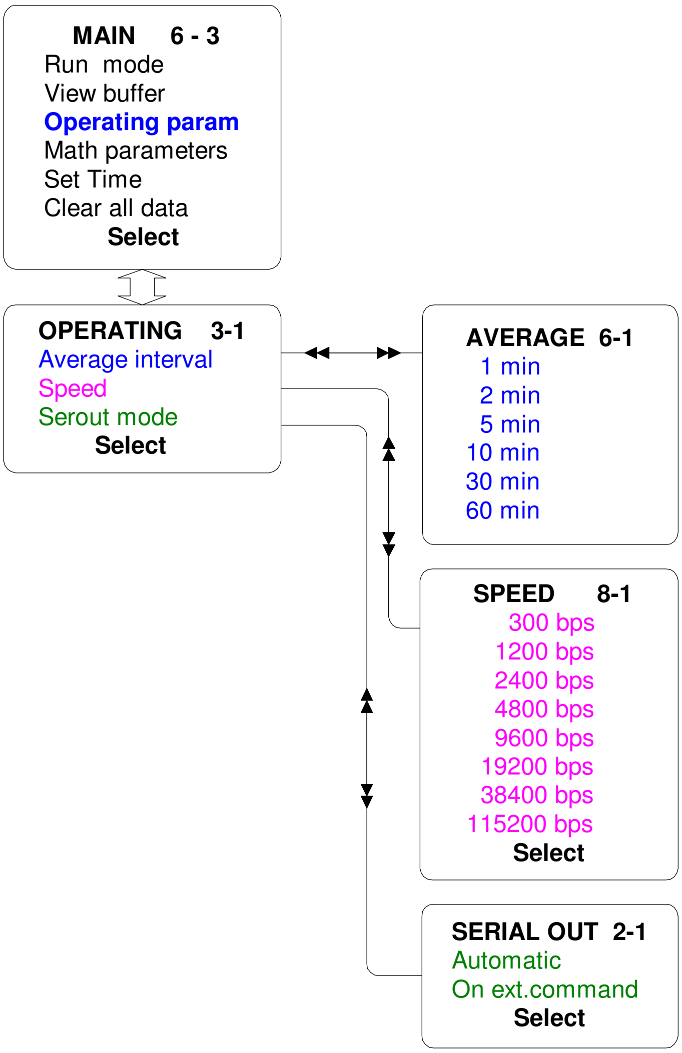
Menu 6-2: Wiew buffer
View historic data.



Statistical data are transferred to the internal database at the end of each data processing interval (date, time, average values, minimums, maximums, wind scalar and vector data). Maximum 300 data intervals could be stored in the database on the FIFO principle.

Select parameter and press SET. Last 36 intervals are shown with marker at the last computed interval. By pressing UP / DOWN marker (and data presentation) slide through the time. To change the step of the marker, pres SET, change step by UP / DOWN (in number of data-processing intervals, 1 to 36), confirm by SET. By pressing BACK we can choose different parameter or by pressing BACK again, exit from the View buffer menu.

Menu 6-3: Operating parameters
Set operating parameters of AMS 156A



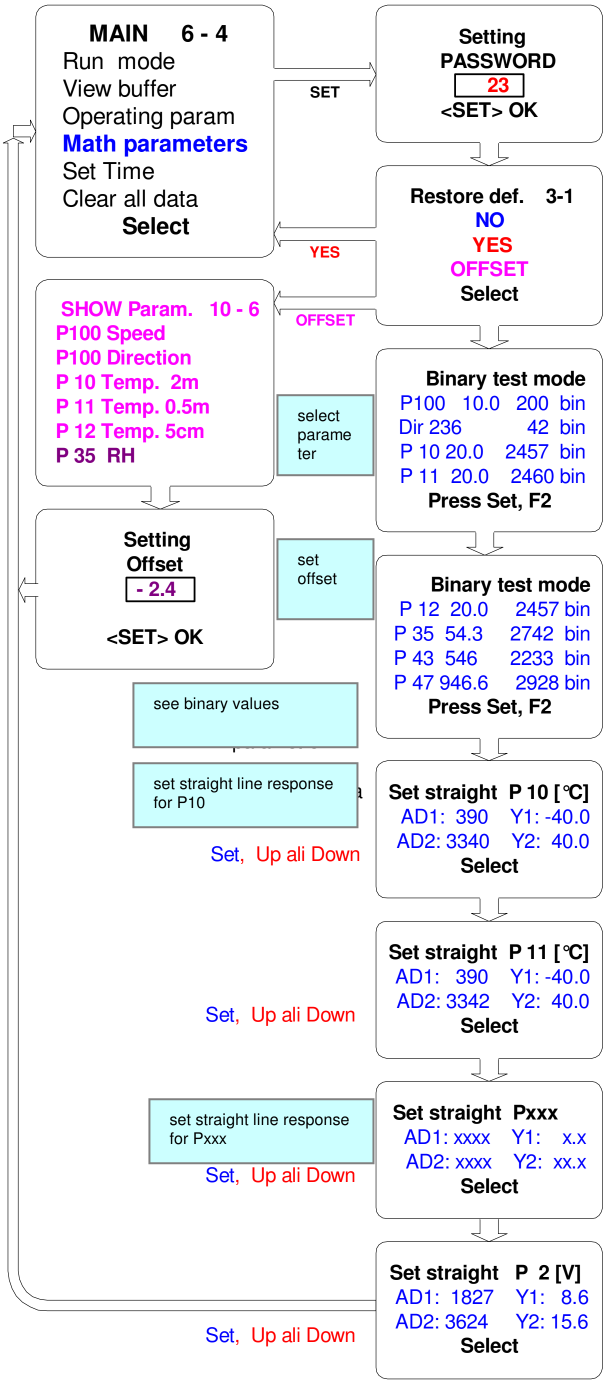
Select the data processing (averaging) interval

Set the serial transmission speed. Default value is **19200 bps**.

Automatic – send average data automatically at the end of each data processing interval

On ext. Command – pole average data

Menu 6-4: Math parameters
Set parameters, used to calculate measured values.



To enter, input **PASSWORD.** To set password, press or hold **UP** (or **DOWN**)**,** until numer **23** is displayed on LCD**,** than press **SET**.

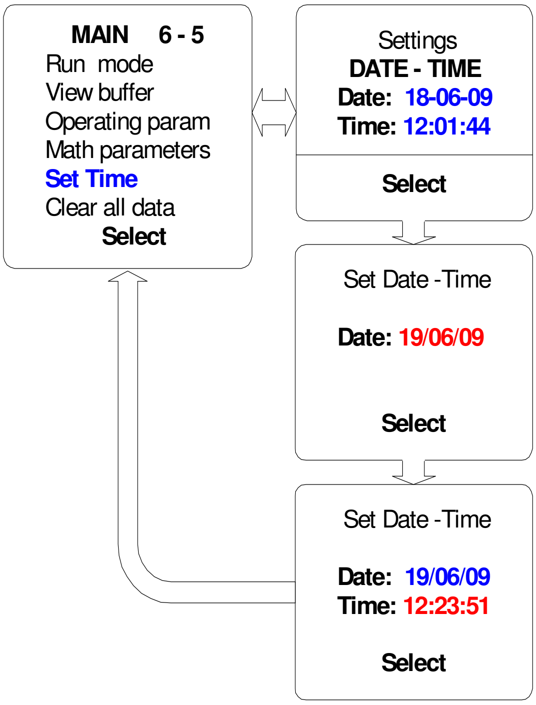
Choose YES, NO or OFFSET and press **SET**. For **YES,** default constants are copied to EEPROM. If we choose NO, we proceed to defining of new constants. If **OFFSET** is selected, parameter, for which the offset change is required, must be selected first. After this, we must define new offset. Both selections are confirmed by pressing **SET**.

Physical value, followed with the corresponding binary value is shown for each parameter (max. 4 parameters per screen). These values are used to define responses of interfaces as straight lines through two points. **F2** is used to swithch between screens. **SET** invokes menu for setting constants.

Two points should be entered as binary (e.g. AD1=669bin and AD2=3340bin) and physical values (e.g. Y1= -10.0°C in Y2=40.0°C) To enter values, use **UP**, **DOWN** and **SET** to confirm.

When last parameter is reached, **SET** returns us to the main menu. **BACK** stores new data to the EEPROM.

Menu 9-5: Set Time
Set date and time



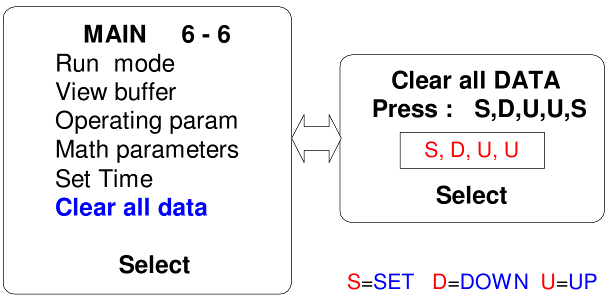
Actual DATE / TIME is shown. **BACK** exits from menu without altering the current data. To adjust TIME / DATA, press **SET**

Set DATE (by pressing **UP** or **DOWN**). For each correct value, press **SET**.

Set TIME in the same way.

Display shows the adjusted DATE / TIME. When real time corresponds to the set value, press **SET** (thus starting a clock)

Menu 6-6: Clear all Data
Erase all data from the memory



Function erases all data that are stored in the internal EEPROM memory. For the security reasons, it is activated only with the following sequence of keys: SET, DOWN, UP, UP, SET. After this, EEPROM is completely erased (all stored data are lost!) and message “Buffer cleared ! “ appears on the screen.

AMS 156A has a circular database; when memory is full, the oldest data are automatically replaced with the newest. Clearing of the internal memory to make space for the data is thus not necessary.

Database can store 300 intervals. Depending on the selected data processing interval, this means the storage for :
1h averaging interval => 12 days
30 min => 6 days
10min => 2 days, 1min => 5 hours

AMS 156A Commands

Proper communication parameters must be set on the connected computer, as follows:

COM	**X**	COM port to which RS 232 cable is connected
Baud rate	**XXXX**	Transmition speed, to which RVM 96C is set (by default 19200), could be XXX=1200, 2400, 4800, 9600, 19200, 38400 and 115200 bps
Data:		**8**
Parity:		**none**
Stop:		**1**
Flow control:		**none**

HELP

ECHO	Set echo =>ON =>OFF
NAME n	Set station name, n = 0 to 255
TIME	Return time-date
STIME H:M:S D/M/Y	Set time-date
SERMODE	ON, OFF Interval, INS Instant print
DEFAULT	Restore DEFAULT values
AVG t	Set averaging interval, t = 1, 2, 5, 10, 30, 60 [min]
SPEED b	Set COM0 speed, b = 300, 1200, 2400, 4800, 9600, 19200, 38400, 115200
SPCOM1 b	Set COM1 speed, b = 1200,2400,4800,9600,19200
VALI n	Set required percentage of valid samples, n = 0 - 100 [%]
ST_LEV h.h	Set station height a.s.l., h.h = station height above sea [m]
RGAU n.n	Set rain gauge increment n.n
LATITUDE n.nnnn	Set station Latitude (N)
SPp x0 y0 x1 y1	Set straight line response, p=par. x0 y0 x1 y1
OFSP p n	Set offset, p=par. n=offset (30,60, …)
BPp	Continuously return binary values for parameter, p=par.
ADC	Continuously return binary values for all ADC channels
CFG	Return station configuration
TRANSP	=>ON =>OFF Transparent Com0,Com1
TSDI	=>ON =>OFF Transparent Com0,SDI-12 (opcija)
TA	Read instant data
PINS	Read instant data
PA	Read average data
PAVG	Read average data
NUPuummssDDMMYYYY	Set time-date
GET PuummDDX.KKK	KKK=name Seek record
PAGE n	n = record. Read last n record
PALL	Read ALL
Pp n	p = par. [10,11,12,35,47,100,101,120] n=num record
PAR p n	Parmeter on_off: p=par. [10,11...] n=1 ON (option)
ERASE	Erase all data !!!
RESET	Reset AMP

Each command should be terminated with **<CR >** (= <ENTER>)

ECHO (ON or OFF)

ECHO ON *<CRr>*	makes all typed commands visible on the terminal screen
ECHO OFF *<CRr>*	makes commands invisible on the terminal screen (default)

NAME (0…255)

NAME n <cr>	Set station number **n**.

Example: *NAME 19 <CR>*

Response: **Name:19** *<CR><LF>*

TIME

Returns current time and date

Example: TIME <CR>

Response: **12:37:50 18/08/09***<CR><LF>*

STIME <H:M:S D/M/Y>

Set time and date.

Example: STIME 12:37:46 18/8/9 <CR>

Response: **T= 12:37:46 D= 18/08/09***<CR><LF>*

SERMODE (ON, OFF or INS)

SERMODE ON	<cr>	Enable transfer of average values to the serial port
SERMODE INS	<cr>	Enable permanent transfer of average values to the serial port
SERMODE OFF	<cr>	Disable transfer of average values to the serial port

DEFAULT

Store default values to EEPROM

Example:DEFAULT <CR>

Response: **EEPROM ERROR !**<CR><LF>
Resore default ! !<CR><LF>

AVG t

Set averaging interval

[**1**]= 1 min, [**2**]= 2 min, , [**5**]=5 min, [**10**]=10 min, [**30**]=30 min, [**60**]=60 min

Example: AVG 30 <CR>
Response: **Average 30 min***<CR><LF>*

Averaging interval was set to 30 minutes.

SPEED b

Set transmission speed of main communication channel (COM 0)
b = 300, 1200, 2400, 4800, 9600, 19200, 38400, 115200 (default 19200 bps)

Example: SPEED 19200 <CR>

Response: **Serspeed Com0 19200 bps***<CR><LF>*

SPCOM1 b

Set transmission speed for second communication channel (COM 1)
b = 1200, 2400, 4800, 9600, 19200 (default 9600 bps)

Example: SPEED 9600 <CR>

Response: **Serspeed Com1 9600 bps***<CR><LF>*

VALI n

Set percentage of valid samples in averaging interval, that is required to produce valid statistical computations

n = 0 - 100 [%]

Example: VALI 70 <CR>

Response: **Validity=70% Count-mea=1260***<CR><LF>*

At least 70% of all data samples in the averaging interval should be present and valid, to declare the interval as a valid one (without error).

ST_LEV h.h

Set station height above sea level [m]

Example: ST_LEV 506.8 <CR>

Response: **Station level = 506.8 m***<CR><LF>*

RGAU n.n

Set increment of raingauge

Example: RGAU 0.1 <CR>

Raingauge measures in 0.1mm increments

LATITUDE n.nnnn

Set geographic latitude of the station

Example: LATITUDE 46.09155 <CR>

Response: **Latitude= 46.09155 N** *<CR><LF>*

SPp x0 y0 x1 y1

Set straight line response of interface for the parameter **p** (in example below, P30)

Example: SP30 669 -10.0 3340 40.0 <CR>

Response: **Par. x0 y0 x1 y1***<CR><LF>*
P 10 390 -20.0 3340 40.0*<CR><LF>*
**** SAVE EEPROM ! *****<CR><LF>*

OFSP p n

Set offset for the parameter **p** (in example below, P30)

Example: OFSP 30 -1.2 <CR>

Response:

P 30 Offset: -1.2
**** SAVE EEPROM ! ****

BPp

Continuously display binary values of parameter **p** (in example below, P10). **ESC** terminates displaying data.

Example: BP30 <CR>

Response:

```
P 10     CH=06     2149 bin       17.7 st.C       < ESC >
P 10     CH=06     2152 bin       17.7 st.C       < ESC >
P 10     CH=06     2154 bin       17.7 st.C       < ESC >
P 10     CH=06     2156 bin       17.8 st.C       < ESC > ...............
```

< ESC > returns to the measuring mode

ADC

Continuously display all analog channels. **ESC** terminates displaying data.

Example: ADC <CR>

Response:

```
CH08:    0 CH07:    0 CH06: 2165 CH05:    1 CH04:    0 CH03:    0 CH02:    0 CH01:    0 CH09: 1451
CH08:    0 CH07:    0 CH06: 2164 CH05:    1 CH04:    0 CH03:    0 CH02:    0 CH01:    0 CH09: 1452
CH08:    0 CH07:    0 CH06: 2164 CH05:    1 CH04:    0 CH03:    0 CH02:    0 CH01:    0 CH09: 1451
CH08:    0 CH07:    0 CH06: 2164 CH05:    1 CH04:    0 CH03:    0 CH02:    0 CH01:    0 CH09: 1452
```

< ESC > returns to the measuring mode

CFG

Display station configuration

Example: CFG <CR>

Response:

```
St. Name OLIMJE: M19 program v1.0  2009 SN0032


ON      P 10, YSI44203
ON      P 11, YSI44203
ON      P 12, YSI44203
ON      P 35, HMP45D
ON      P 43, CM6B
ON      P 47, Setra 270
ON      P 40, DVL142/G
ON      P100, TRwS 500
ON      P120, LINE VOLTAGE
ON      P 70, Ames

Int. print OFF
Average 30 min
Serspeed Com0 19200 bps
Serspeed Com1 1200 bps
Log OFF
Validity=70%    Count-mea=1260
Station level = 299.0 m
Baro. difference =   0.0 m
Wind level =  10.0 m
Latitude=  46.05250 N
UTC=0 ura

WIND1   AMES, VAISALA
WIND2   NO

Rain1 gauge= 0.1 mm/m2

Par.      x0      y0      x1      y1

Tmp. postaja
P101       0       0.0   2830      12.0
Hitrost
P100       0       0.0   1000      50.0

P 10     390     -40.0   3146      40.0
P 11     390     -40.0   3145      40.0
P 12     390     -40.0   3145      40.0
P 35       2       0.0   1689     100.0
P 43       8       0.0   2333    1000.0
P 47       0     800.0   3814    1100.0
P 70    2290     200.0   2740     235.0
P  2       0       0.0   2830      12.0
```

TRANSP (ON or OFF)

Command starts (ON) or teminates (OFF) direct (transparent) connection between main communication channel COM0 and second communication channel COM1 (usually used to connect sensors). COM1 can be used either as Rs232c, Rs422 or Rs485 port. Thus we can remotely reach and directly control sensors that are connected to COM1. In case that COM1 is used in Rs422 or Rs485 mode, each line is sent from COM0 to COM1 only when <CR> is received. Full, concurent transparency is achieved only in case, when both COM0 and COM1 operate in RS232c mode.

When in transparent mode, station automatically returns to the measuring mode, when no character is received on COM0 for more than 120 seconds.

Example: TRANSP ON <CR> or TRANSP OFF<CR>

Response:

Transparent mode ON or Transparent mode OFF

TSDI (ON or OFF)

Command starts (ON) or teminates (OFF) direct (transparent) connection between main communication channel COM0 and SDI-12 data bus (COM2, speed 1200 bps, 1 start bit, 7 data bits, even parity, 1 stop bit).

Data bus is used to communicate with sensors, using SDI-12 protocol. Uporaba tega ukaza nam dovoljuje direktno povezavo na senzor vezan na vodilo COM2. Thus we can remotely reach and directly control sensors that are connected to COM2. Each line is sent from COM0 to COM2 only when <CR> is received.

When in transparent mode, station automatically returns to the measuring mode, when no character is received on COM0 for more than 120 seconds.

Example: TSDI ON <CR> or TSDI OFF<CR>
Response:

SDI-12 Transparent mode ON or SDI-12 Transparent mode OFF

TA or PINS

Return instant data

Example: TA <CR> or PINS <CR>

Response:

```
0148
P0      17:15   09/01/2009      22.2    0.0     M19     22.6    0.0
P100    2.3     216      00
P10     19.1      00
P11     19.2      00
P12     19.3      00
P35     56.2      00
P120    0.0       00
P43     524       00
P47     963.1     00
P40     0         00
P70     231       00
1775
```

INSTANT DATA

Parameter code	Data
<02>	STX followed by the message length “%04d”<CR><LF>
P0	time of transmission
	date of transmission
	average CPU temperature
	average supply voltage
	location (station name)
	CPU temperature
	supply voltage
P100	wind speed
	wind direction
	Status
P10	air temperature 2 m
	Status
P11	air temperature 0.5 m
	Status
P12	air temperature 20 cm
	Status
P35	Relative humidity
	Status
P43	Solar radiation
	Status
P47	Atmospheric pressure
	Status
P120	5 min precipitation sum
	Status
P40	Leaf wetness
	Status
P70	Line voltage
	Status
	ETX followed by checksum “%04X”<CR><LF>
<03>	(16bit SUM, mask ffff, ETX included in checksum)

PA or PAVG

Return average data from the last averaging interval

Example: PA <CR> ali PAVG <CR>

Response:

```
<02> 0397
P0     09:29 10/04/2009  14:32 06/04/2009  25.0  13.4  M19   09:00 10/04/2009
       09:12 21/02/2009
P100   0.2   111   1.3   52    08:52 0.1   90    08:59  0.6   0.6   71   0.2
       0.1   0.1   00
P10    13.3  14.2  08:36  12.7  08:31  14.8   0.1   00
P11    13.4  13.6  08:45  12.9  08:39  14.8   0.1   00
P12    13.3  13.4  08:48  12.8  08:33  14.8   0.2   00
P35    75.8  83.1  08:36  64.7  08:59  65.8   0.2   00
P43    544   582   08:58  465   08:33  577    0.4   00
P47    953.5 953.7 08:33  953.4 08:48  953.5  0.0   00
P120   0.00  0.00  0.00   0.00  0.00  0.00  0.00  0.00  00
P40      0     00
P70    235   240   08:37  232   08:56   240   0.0   00
□4075
<03>
```

Parameter code	Data
<02>	STX followed by the message length "%04d"<CR><LF>
P0	time of transmission
	date of transmission
	time of last RTC setting
	date of last RTC setting
	CPU temperature
	supply voltage
	location (station name)
	averaging time
	averaging date
	time of last reset
	date of last reset
P100	Avg.: average vector speed/direction
	Max.: maximum speed/direction / time of maximum
	Min.: minimum speed/direction / time of minimum
	Scalar speed: average scalar speed
	Termin. v.: average vector speed/direction in last 10 min. of averaging interval
	St. dev. speed: standard deviation of wind speed
	St. dev. X: standard deviation of x component
	St. dev. Y: standard deviation of y component
	Validity (00 – O.K.)
P 10 P 11 P 12 P 35 P 43 P 47 P 70	Avg.: average value
	Max.: maximum value / time of maximum
	Min.: minimum value / time of minimum
	Termin. v.: average value in last minute of averaging interval
	St. dev.:standard deviation
	Validity (00 – O.K.)
P40	Leaf wetness (0: sensor is wet less than ½ of averaging interval, 1: sensor is wet at least ½ of averaging interval)
	Validity (00 – O.K.)
P120	½ hour precipitation sum
	1. 5 minute precipitation sum
	2. 5 minute precipitation sum
	3. 5 minute precipitation sum
	4. 5 minute precipitation sum
	5. 5 minute precipitation sum
	6. 5 minute precipitation sum
	12-h precipitation sum, 7-19, 19-7
	Validity (00 – O.K.)
<03>	ETX followed by checksum "%04X"<CR><LF> (16bit SUM, mask ffff, ETX included in checksum)

GETPuummDDMMX.KKK

Return average data from the requested interval

uu	-	hour
mm	-	minute
DD	-	day
X	-	X
KKK	-	M19 (station name)

Example: GETP0900X.M19 <CR>

Response:

```
<02> 0397
P0     09:29 10/04/2009  14:32 06/04/2009  25.0  13.4  M19   09:00 10/04/2009
       09:12 21/02/2009
P100   0.2   111   1.3   52    08:52 0.1   90    08:59  0.6   0.6   71   0.2
       0.1   0.1   00
P10    13.3  14.2  08:36  12.7  08:31  14.8   0.1   00
P11    13.4  13.6  08:45  12.9  08:39  14.8   0.1   00
P12    13.3  13.4  08:48  12.8  08:33  14.8   0.2   00
P35    75.8  83.1  08:36  64.7  08:59  65.8   0.2   00
P43    544   582   08:58  465   08:33  577    0.4   00
P47    953.5 953.7 08:33  953.4 08:48  953.5  0.0   00
P120   0.00  0.00  0.00   0.00  0.00  0.00  0.00  0.00  00
P40     0     00
P70    235   240   08:37  232   08:56   240   0.0   00
□4075
<03>
```

NUPuummssDDMMLLLL

Set station clock

NUPuummssDDMMLLLL<ETX>%4X

Where:			
	NUP	-	header
	uu	-	hour
	mm	-	minute
	ss	-	second
	DD	-	day
	MM	-	month
	LLLL	-	year
	<ETX>	-	end character (03 HEX)
	%04X	-	checksum (format specification)

Format specification %04X (16-bit SUM, mask ffff, ETX included in checksum)

After control of checksum, AMS 156A returns: DOBIL (positive) or NAPAKA (negative).

PALL

Return all data from the internal database. Transmission starts with the oldest record.

Example: *PALL <CR>*

Response:

```
<02> 0397
P0     09:29 10/04/2009  14:32 06/04/2009  25.0   13.4  M19    09:00 10/04/2009
       09:12 21/02/2009
P100   0.2    111    1.3    52     08:52 0.1    90     08:59  0.6    0.6    71    0.2
       0.1    0.1    00
P10    13.3   14.2   08:36  12.7   08:31  14.8   0.1    00
P11    13.4   13.6   08:45  12.9   08:39  14.8   0.1    00
P12    13.3   13.4   08:48  12.8   08:33  14.8   0.2    00
P35    75.8   83.1   08:36  64.7   08:59  65.8   0.2    00
P43    544    582    08:58  465    08:33  577    0.4    00
P47    953.5  953.7  08:33  953.4  08:48  953.5  0.0    00
P120   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   00
P40     0      00
P70    235    240    08:37  232    08:56   240   0.0    00
□4075
<03><02> 0397
P0     09:29 10/04/2009  14:32 06/04/2009  24.7   13.1  M19    08:30 10/04/2009
       09:12 21/02/2009
P100   0.4    231    1.7    88     08:12  0.2    91     08:17  0.4    0.2    71    0.2
       0.1    0.1    00
P10    12.9   13.4   08:12  12.5   08:02  12.8   0.1    00
P11    12.7   13.1   08:05  12.4   08:23  12.7   0.1    00
P12    12.4   12.7   08:27  12.3   08:19  12.3   0.2    00
P35    72.1   74.2   08:16  70.3   08:05  71.9   0.1    00
P43    658    683    08:19  433    08:17  643    0.1    00
P47    953.1  953.7  08:23  953.4  08:21  953.5  0.0    00
P120   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   00
P40     0      00
P70    231    239    08:22  229    08:27   231   0.0    00
□4075
<03><02> 0397
P0     09:29 10/04/2009  14:32 06/04/2009  25.0   13.4  M19    08:00 10/04/2009
.
.
.
.
.
□4075
<03>
```

until end of database is reached or <**ESC**> is received.

Transfer can be paused by pressing <**SPACE**> and continued by pressing the same key. Transfer is terminated with pressing <**ESC**>.

PAGE n

Return last n records from the internal database. Transmission starts with the oldest record. If n is bigger than memory capacity (aprox. 300), complete database is transmitted.

Example: PAGE 10 <CR>

Response: last 10 records are returned in a format, described with the PALL command.

Pxx <nnn>

Return data of last **<nnn>** intervals for parameter **xx.**

Example: *P10 4 <CR>* (xx = 10; nnn = 4)

Response:

Hour	Date	Parameter	avg	max	time-max	min	time-min	term	st.dev	status
07:30	17/07/2009	P 10	18.1	18.2	07:31	18.1	07:31	18.1	0.0	00
07:00	17/07/2009	P 10	18.2	18.2	07:30	18.2	07:30	18.2	0.0	00
06:30	17/07/2009	P 10	18.3	18.4	07:29	18.2	07:29	18.3	0.0	00
06:00	17/07/2009	P 10	18.3	18.3	07:28	18.1	07:28	18.2	0.0	00

PAR p n

Include or exclude parameter **p** from data transmissions of **PAVG** or **PA** commands.

p=parameter n = 1 ON, n = 0 OFF

Example: *PAR10 0 <CR>* (Parameter P10 is not listed)

Response:

P 10 OFF

ERASE

Erase complete database

Example: ERASE <CR>

Response: Log erased !

RESET

Reset station. Command is used to reset station and enable booting new versions of software.

Example: RESET <CR>

Response: Boot...(@@@)!

TECHNICAL DATA

Dimensions:	200mm * 100mm * 60mm (L x W x H)
Mass:	0.7 kg
Protection:	Al closed case
Mounting:	mounting rail
Operating temperature:	-30 to +70 °C
Power consumption:	30 mA w/o illumination, 60-80mA with illumination; cca 180mA with integrated ETHERNET (100 M)
Connectors:	5 x 10 pin, 7 x 4pin, 1 x DB9 male RS232, 1 x FCC 8pol (Ethernet), 1 x SD/MMC
Elektronics:	CMOS
Display:	LCD, graphic 128x64, illuminated
Keyboard:	Sealed, flat
Power supply:	external, 11 to 15 V DC
Analog inputs:	8 channels 12 bit (or 4 differential) 8 channels 16 or 24 bit (or 4 differential)
Digital inputs:	18 (0 to 24V)
Digital counters:	4 (16 bit 0 - 24V)
Current generators:	2 x 0.2 - 20mA 2 x 200uA
Voltage generators:	2 x 0.2 -10V 1 x 3V
Analog outputs (option):	2 channels, 4 - 20 mA
Digital outputs:	4 (TTL)
Connection of sensors:	paralelno up to 2 km or: 2-wire RS 485, up to 5 km RS 232A, RS 485, SDI-12
Connection to the computer:	RS 232, 300 - 115200 Bd RS 485, 300 - 115200 Bd Optics, 300 - 115200 Bd Ethernet, 10 – 100 M

ADDENDUM