Extended features of the new USA1 (Scientific)

With the integration of the new processor (identified as: “scientific version”) several new commands and performance upgrades have been installed in the USA-1 electronic and software. The integration of the new processor is indicated by a “C” character in the type label of the USA-1 systems. All commands of the old processor version are still available without any restrictions. Therefore, this documents reports all new or upgraded features and commands with regard to the scientific version.

- Before changing the parameter P1, P2, P3 and TC or system-calibration (**CA**) it is necessary to change into the service mode with the command **SV**. After one minute the service mode stopped. In the service mode the measuring is not disturb.
- The **BR** (*baud rate*) command additionally accepts 38400, 57600, and 115200 baud for the data transmission.
- The sampling frequency can be set to max. 50 Hz (**SF**=50000). It is no longer distinguished between a slow and a fast device version. Due to the higher baud rates and the accelerated processor speed the instantaneous data of all measuring channels including the external analog inputs can be sent with a maximum of 50 Hz by both device versions, the standard version and the turbulence data extension version. This capability is only restricted by a 3-dimensional head correction procedure, which reduces the output data rate to 40 Hz when it is active. As a result of the faster CPU clock there are much more exactly adjustable sampling frequencies. All values which comply with 600000/n (with n>11) can be generated, the other values are rounded to the nearest matching one.
- A new three-dimensional head correction is available. In addition to the previous values for **HC** the new value HC=4 activates the 3-dimensional-correction (zenith angles: -45 ° … 0 … +45°) for sensor heads with inner bar.

  HC=0 : no correction

  HC=1 : 2-dimensional correction for sensor heads with inner bar

  HC=2 : 2-dimensional correction for sensor heads with outer bars

  HC=3 : 2-dimensional correction for modified sensor heads with outer bars

  HC=4 : 3-dimensional correction for sensor heads with inner bar

- The parameter **SA** (scalar averaging) is now also available for devices with the turbulence extension. If SA is activated, the values vel and dir are replaced by the scalar averaged values vels and dirs. Other values (u, v, w etc.) are not involved.
- Devices with the optionally turbulence extension provide the new parameter **OI** (output instantaneous) which activates the additional output of the instantaneous data between the (not divided) turbulence data sets. Combinations of the bit values 1, 4, 8, and 16 are possible, their meaning corresponds to the definition of the OD command (bits above 16 are permitted).
- You can define an individual delay time for each analog input channel (also Pt100) in a range of 0 to 255 samples. Note that this delay time depends on the sampling frequency. The corresponding parameters are called **D1**, **D2** (Pt100) and **D3** up to **D8**.
- The turbulence extension (not the standard version) now provides an output format with one single data line. It is activated with the **PR** command (protocol) PR=3. The settings PR=1 : NMEA; PR=2 (ASOS) are furthermore not supported by the turbulence extension.

- The averaging time (**AT** command) can now be set to values in the range from 1 to 3600 on both systems: the standard version and the turbulence extension as well. AT=0 is not possible. For only instantaneous data set OI=1 and OD=0.
- The input format of the standard version was changed as follows: The analog input channels are now called **e1** to **e8** (like the USAT-3 and the turbulence extension of the USA1) which replaces the old names a0 to a7. Accordingly the names c0, c1 are turned to **c1**, **c2**.
- The output format of the turbulence extension was changed as follows: Space characters at the end of lines are eliminated. This has no effect on the representation of invalid numbers by space characters also at the end of a line.
- There is a new command which consists of a single question mark (**?**). It generates the output of a list of all variables with their names and settings. The former versions of the turbulence extensions erroneously showed the parameters of the standard processor without their names.
- Up to now the turbulence extension could show only the time zone name UTC in the data header line. Now the time zone is selectable. This requires the new **TZ** parameter which must be set to the time difference to UTC in minutes. The output in the header line is now UTC if TZ=0; UTC+hh (UTC-hh) if TZ is defined in entire hours hh (divisible by 60 without remainder); or UTC+hhmm (UTC-hhmm) if TZ is not divisible by 60 without remainder.
- The analog output 0 … 10 VDC, resp. 0/4 … 20 mA can now be configured more flexible by software commands. With the new parameter **AO** an offset for the analog signal can be defined. This offset is defined as a percentage of the nominal available number range and shifts the zero value of the signal while keeping the full range value of the signal unchanged. So the span is reduced accordingly. A value half of the offset is used as an indication for a system status without valid output signals.

  Example: OA =20 while VR=50; transforms the velocity number range 0 … 50 m/s to a current signal of 20 * 20 mA / 100 = **4 mA as zero** (0 m/s) and **20 mA as full scale** (50 m/s). 25 m/s corresponds to 12 mA.

  In case of line interruption the system will output **0 mA.**

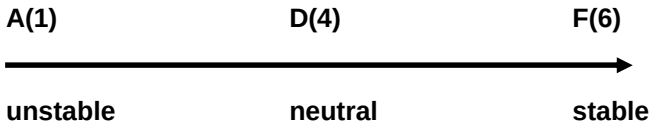
  In case of proper system operation but completely invalidated data (according to the internal plausibility check, see MD parameter for that) the system outputs **2 mA**.

  By setting the parameter **AI** (analog output instantaneous) it is possible to get averaged according the AT-setting or instantaneous analog output values. This parameter is only for the turbulence extension.

  AI=1 instantaneous analog output

  AI=0 averaged analog output
- It is possible to change the calculation of friction velocity u* by changing the **US** parameter. If ustar set to 1(US=1) the calculation considering the 3-D wind vector. By setting US=0 the u* calculation is a simple vector addition.

- In turbulence extension it is possible to get the diffusion classes corresponding with the KTA-1508 guidelines, published 09/88, by setting the parameter **DC**. It shows in the last line of the turbulence data set as **diffc=** after the vel and dir values. **DC=1** shows the diffusion classes in letter from A till F, **DC=2** numeric from 1 till 6.



  - Table of the boundaries

	Boundaries				
V [m/s]	A/B (1/2)	B/C (2/3)	C/D (3/4)	D/E (4/5)	E/F (5/6)
	Net Radiation [W/m²]				
0.0 – 0,9	214	125	60	-2	-9
1.0 – 1.9	214	126	60	-4	-13
2.0 – 2.9	301	162	60	-6	-21
3.0 –3.9	400	232	63	-12	-34
4.0 – 4.9	495	305	67	-28	-55
5.0 – 5.9	-	376	84	-55	-
6.0 – 6.9	-	450	108	-	-
7.0 – 7.9	-	-	150	-	-
8.0 – 8.9	-	-	240	-	-
≥ 10	Class D				

- Cabling
  - Pin assignment RS422 (D-Sub 9 pin) & RS232 (D-Sub 9 pin)

Coninvers 17 pin	color cable 4x2x0,25mm²	D-Sub 9 pin	color cable 2x2x0,14mm²	D-Sub 9 pin	remarks	
Pin 1	white	Pin 4			+ Receive line	RS 422
Pin 2	brown	Pin 3			- Receive Line	
Pin 3	green	Pin 1			+ Transmit Line	
Pin 4	yellow	Pin 2			- Transmit Line	
Pin 5	gray		white	Pin 3	Receive Line	RS 232
Pin 6	pink		brown	Pin 5	Ground Line	
Pin 7	blue		green	Pin 2	Transmit Line	

USA-1
User Manual

sc 03/2006 Version 4.xx/4.xxt

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11/08

Table of Contents

General

The USA-1 system uses ultrasonic pulses along three non-complanar ray paths to measure wind speed and wind direction or alternatively the three orthogonal windcomponents x, y, z. Because the USA-1 has no moving parts it doesn't show any aging of calibration factors or unaccuracies due to stress on bearings as known for conventional measuring system like cup anemometers or wind vanes. Furthermore system operation is possible in icing conditions as all parts of the sensor head can be heated.

All mounting bars, transducers and measuring volumes are advantageously positioned to each other thus providing best measuring accuracies over the whole measuring range.

System performance and measuring accuracies can be easily checked by the operator even at the measuring site. A recalibration can be done by the user just by means of a thermometer and a length scaling.

This manual helps to take full advantage of the USA-1 system and to avoid failure in installation and operation. It contains concise information about data output, system controlling and calibration procedure. Further it includes a description of the optional available system extension for online computed turbulence values.

1. Cabling

Cabling requires a 2-core cable for power supply, a 4-core cable for serial output and system operation, an 8-core cable for the *analog output* (**option**), and an earth line directly connected to the housing. It should be connected to the same earth potential as all devices connected to the USA-1. Outlets for all 3 cables are provided at the bottom of the electronic box. All contacts are accessible on the EMV board inside. To connect these cables you have to open the electronic box. At first you must loosen the four screws at the corners of the case. In order to make the handling of the parts easier, you can unplug the socket joints between the upper and lower part of the case. The EMV board must be screwed off from the lower part of the case. On its back side directly above the cable outlets you find the contacts (See Picture 3 on page 15). Only a screw driver is needed for opening and locking of the electronic box.

Note: Check that cables are tightened again after the electronic box is locked. Careful handling of all electronic parts is essential.

Power Supply Cabling

The USA-1 can be supplied by a voltage of 9 … 36 V_{DC}, if *no* sensor heating is implemented. Systems *with* a 24 V_{DC} sensor head heating must be connected to a 24 V_{DC} power supply. The cables cross section must be at least 1 mm² for a maximum cable length of 100 m. The correct connection to the power board can be seen from picture 3. The colors of the cables are *brown* for the *positive* and *blue* for the *zero* voltage.

Serial Input/Output Cabling (RS 232, optional RS 422)

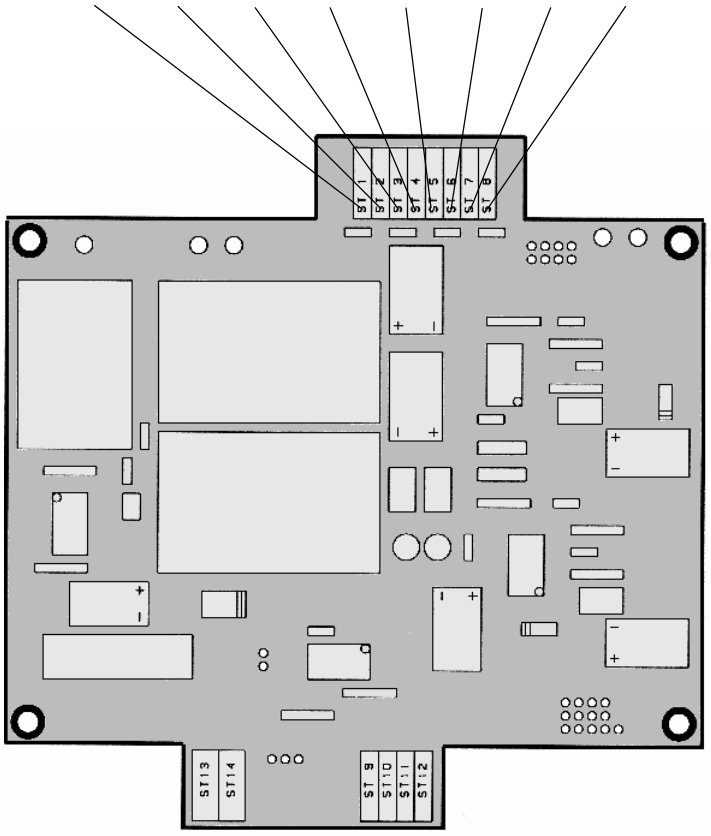
The basic USA-1 has one serial communication line *t0* wired by a 4-core cable to the Contacts ST9-12 as shown in picture 1. This can be either a *RS-232* line or a *RS-422* line (**option**).
In case of the installed **option** for *online calculated turbulence values* line *t0* is reduced to a transmit only line using Contact ST12. Operation and parameter settings must be performed by using the line *t1*, which is assigned to the Contacts ST9-11. Both lines use the same ground Contact ST9.

Analog Output Cabling (Option)

Analog outputs are provided at an 8-pin-socket. The signals can be read as shown in picture 1 (see next page).

Picture 1 : Contacts of Power Supply, Serial and Analog Output (Standard Version)

St 1	St 2	St 3	St 4	St 5	St 6	St 7	St 8
C1	GN1	C2	GN2	C3	GN3	C4	GN4



St 13	St 14
- VDC	+VDC
blue	brown

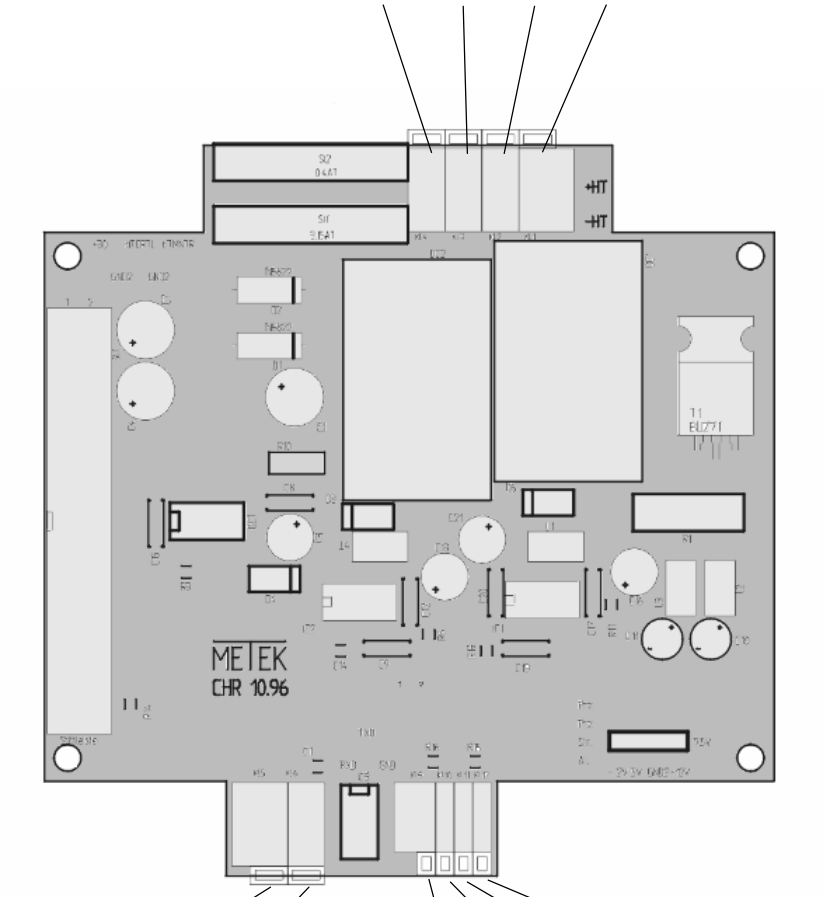
	St 9	St 10	St 11	St 12
RS 232	Gnd	TxD	RxD	TxD (t0)
	brown	green	white	yellow
RS 422	RxD +	RxD -	TxD -	TxD +
	white	brown	yellow	green

- Power Supply

Name	*Contact*	*Color*	*Voltage*	*Remarks*
- VDC	ST13	blue		Zero Voltage
+VDC	ST14	brown		Positive Voltage
			9 V_{DC} ... 36 V_{DC}	USA-1 *without* sensor heating
			24 V_{DC}	USA-1 *with* sensor heating

Picture 2 : Contacts of Power Supply and Serial Output (Version *CHR 10.96*)

St 4	St 3	St 2	St 1
+	H +	Gnd	Gnd
brown	white	blue	



Gnd 2	Gnd 2

	St 9	St 10	St 11	St 12
RS 232	Gnd	TxD	RxD	TxD (t0)
	brown	green	white	yellow
RS 422	RxD +	RxD -	TxD -	TxD +
	white	brown	yellow	green

Pin Assignments

- RS-232 Port (without **option**)

Name	*Contact*	*Remarks*	
GN	ST9	Ground Line	USA-1
TD	ST10	Transmit Line	USA-1
RD	ST11	Receive Line	USA-1

- RS-232 Port (with **option** *for online calculated turbulence parameters*)

Name	*Contact*	*Remarks*	
GN	ST9	Ground Line	USA-1, *t1* and *t0*
TD	ST10	Transmit Line	USA-1, *t1*
RD	ST11	Receive Line	USA-1, *t1*
TD	ST12	Transmit Line	USA-1, *t0*

- RS-422 Port (without **option**)

Name	*Contact*	*Remarks*	
R+	ST9	+ Receive Line	USA-1
R-	ST10	- Receive Line	USA-1
T-	ST11	- Transmit Line	USA-1
T+	ST12	+ Transmit Line	USA-1

- RS-422 Port (with **option** *for online calculated turbulence parameters*)

Name	*Contact*	*Remarks*	
R+	ST9	+ Receive Line	USA-1, *t1*
R-	ST10	- Receive Line	USA-1, *t1*
T-	ST11	- Transmit Line	USA-1, *t1*
T+	ST12	+ Transmit Line	USA-1, *t1*
		port *t0* remains unconnected	

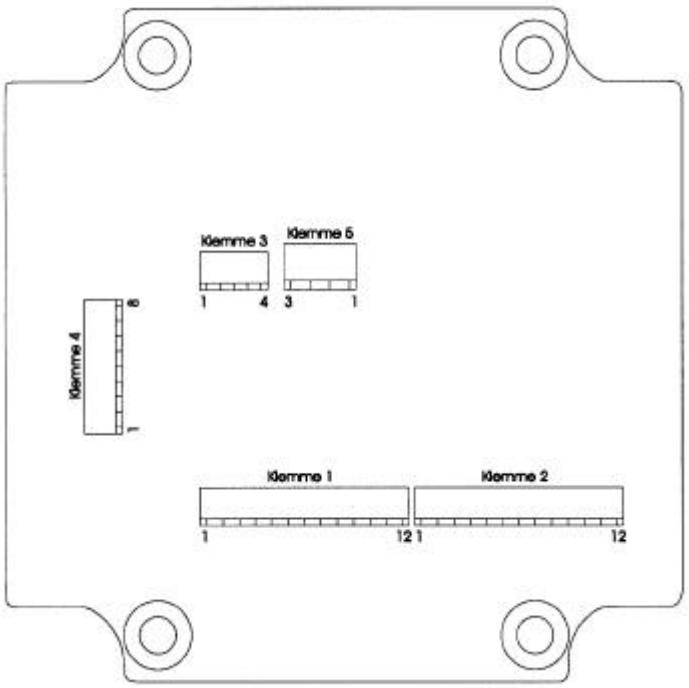
Note: Check the pinning of your RS-422 interface/converter vs. USA-1 pinning !

- Analog Output

Name	*Contact*	*Remarks*
C1	ST1	Channel 1
GN1	ST2	Ground 1
C2	ST3	Channel 2
GN2	ST4	Ground 2
C3	ST5	Channel 3
GN3	ST6	Ground 3
C4	ST7	Channel 4
GN4	ST8	Ground 4

Devices equipped with an EMV board have a different pinning for the external cable connection. This board is mounted in the bottom part of the housing. The cables on the top side of the board are connected to same pins of the power supply board as described above. The not visible bottom side of this board looks like this:

Picture 3 : Connection board / EMV Board



See also chapter 1 *Cabling* on page 11.

Pin Assignments
- Power Supply, Klemme 5

Contact	*Voltage*	*Color*	*Remarks*
Pin 1		blue	Zero Voltage
Pin 2		brown	Positive Voltage
	9 V_{DC} ... 36 V_{DC}		USA-1 *without* sensor heating
	24 V_{DC}		USA-1 *with* sensor heating
Pin 3	24 V_{DC}		Positive Voltage forUSA-1 devices with a *separately* powered sensor heating

- RS-232 Port (without **option**), Klemme 3

Contact	*D-Sub 9 Pin*	***or***	*D-Sub 25 Pin*	*Remarks*	*Color*
Pin 4	Pin 5		Pin 7	Ground Line USA-1	brown
Pin 3	Pin 2		Pin 3	Transmit Line USA-1	green
Pin 2	Pin 3		Pin 2	Receive Line USA-1	white

- RS-232 Port (with **option** *for online calculated turbulence parameters*), Klemme 3

Contact	*Plug #*	*D-Sub 9 Pin*	***or***	*D-Sub 25 Pin*	*Remarks*	*Color*
Pin 4	Plug 1	Pin 5		Pin 7	Ground Line USA-1, *t1*	brown
Pin 3	Plug 1	Pin 2		Pin 3	Transmit Line USA-1, *t1*	green
Pin 2	Plug 1	Pin 3		Pin 2	Receive Line USA-1, *t1*	white
Pin 4	Plug 2	Pin 5		Pin 7	Ground Line USA-1, *t0*	brown
Pin 1	Plug 2	Pin 2		Pin 3	Transmit Line USA-1, *t0*	yellow

- RS-422 Port (without **option**), Klemme 3

Contact	*D-Sub 9 Pin*	***or***	*D-Sub 25 Pin*	*Remarks*	*Color*
Pin 4	Pin 4		Pin 2	+ Receive Line USA-1	white
Pin 3	Pin 3		Pin 14	- Receive Line USA-1	brown
Pin 2	Pin 2		Pin 15	- Transmit Line USA-1	yellow
Pin 1	Pin 1		Pin 3	+ Transmit Line USA-1	green

- RS-422 Port (with **option** *for online calculated turbulence parameters*), Klemme 3

Contact	*D-Sub 9 Pin*	***or***	*D-Sub 25 Pin*	*Remarks*	*Color*
Pin 4	Pin 4		Pin 2	+ Receive Line USA-1, *t1*	white
Pin 3	Pin 3		Pin 14	- Receive Line USA-1, *t1*	brown
Pin 2	Pin 2		Pin 15	- Transmit Line USA-1, *t1*	yellow
Pin 1	Pin 1		Pin 3	+ Transmit Line USA-1, *t1*	green
				port *t0* remains unconnected	

- Analog Output, Klemme 4

Contact	*Remarks*	*Color*
Pin 1	Channel 1	white
Pin 2	Ground 1	brown
Pin 3	Channel 2	green
Pin 4	Ground 2	yellow
Pin 5	Channel 3	gray
Pin 6	Ground 3	pink
Pin 7	Channel 4	blue
Pin 8	Ground 4	red

- Analog In, Klemme 1

Contact	*Remarks*	
Pin 1	count	c2
Pin 2	Ground	c2
Pin 3	count	c1
Pin 4	Ground	c2
Pin 5	Input	e3
Pin 6	Ground	e3
Pin 7	Input	e4
Pin 8	Ground	e4
Pin 9	Input	e5
Pin 10	Ground	e5
Pin 11	Input	e6
Pin 12	Ground	e6

- Analog In, Klemme 2

Contact	*Remarks*	
Pin 1	Input	e7
Pin 2	Ground	e7
Pin 3	Input	e8
Pin 4	Ground	e8
Pin 5	I0+	e1
Pin 6	U0+	e1
Pin 7	I0-	e1
Pin 8	U0-	e1
Pin 9	I0+	e2
Pin 10	U0+	e2
Pin 11	I0+	e2
Pin 12	U0+	e2

2. Communication

The serial port is used for communication. The default parameters (factory settings) are 9600 baud, 8 bit, no parity and one stop bit. Because there is no support for hardware-handshake the USA-1 uses the XON/XOFF-protocol (software-handshake). Each entered input line must be terminated by a CR (Carriage Return) or LF (Linefeed) character, all output lines are terminated by a CR LF sequence. Single input characters are not reflected by the system, but the complete input sequence is reflected after termination for verification. "Blind" editing of input characters is possible by using BS (Backspace).

Note: If system parameters are defined improperly resulting in an output overflow the system will stop operation but remains operable. Because all system parameters are stored by EEPROM, operation is continued after a system restart (power off/on or *RS* command) using the same improperly set system parameters and the system will stop operation again. Therefore, USA-1 offers the possibility to set the parameters to proper values even after the measuring operation has been stopped (example: `OD=0` and `OA=0` will stop any data output as a first aid action). After a system restart the system will now use these actual (and properly set) parameters. Output data stream will start again after a redefinition of output parameters (averaging time, averaging sample number or output data set).

Data Input

The system accepts ASCII-character strings, integer numbers and the special characters equals sign (=) for assigning values to system parameters and question mark (?) for enquiring system parameters. All input characters must be of *capital* characters. Each input line must be terminated by a CR or LF character.
The system offers the possibility to enquire and to adjust various parameters as listed and described in section 3. The command sequences use two-character abbreviations to specify a special parameter followed by an equals sign and the parameter value.

Example: `SF=10000` The sampling frequency is set to 10 Hz.

Parameter settings can be enquired by typing the parameter string followed by a question mark. Typing just a question mark without any parameter specified will show all parameter settings.

Example: `SF?` The sampling frequency of the system is enquired.

Serial Output

Each output line is terminated by a CR LF-sequence. The first character of each line indicates one of the six types of display messages:

`R:` Reply Message
displayed after a restart- or calibration-procedure is finished or if the system sends information about system parameters enquired by the user;

`E:` Error Message
illegal command sequences or invalid measurements are reported;

`C:` Command Message
each command line is reflected to the user for verification;

`M:` Data Message (heater off)
line contains measured data;

`H:` Data Message (heater on)
line contains measured data;

`D:` Data Message (heater defect, should be on)
line contains measured data;

`T:` Time Message
time stamp of measured data following on the next line(s);

The second character of each message is a colon ':'. The colon is followed by the message text itself:

Example 1: `C:SF?` The user asks for the sampling frequency.
`R:SF=10000` The system displays the requested information.

Example 2: `C:XYZ` The user enters an invalid command.
`E:unknown symbol` The system displays an error message.

Each field of a data message is started by a two character sequence indicating the type of the measured data and is followed by an equals sign and a 6-digit integer number covering the range 0 … 65535 for positive values and -32768 … 32767 for signed values respectively. Each data message contains up to four fields separated by spaces. Each data set can consist of max. one time message and up to four data message lines plus an error message in case of system malfunction or erroneus measurements.

Note: The measuring range of a variable is usually smaller than the output number range.

Example: `T:12.08.02_20:50:00`
`M:v_=___121_dh=___356_z_=_____8_t_=__1981`

These lines report a wind velocity of 1.21 m/s, a wind direction of 356 degree, a vertical wind component of 8 cm/s and a temperature of 19.81 degree centigrade measured at the 12th of august 2002 at 8.50 pm. In case of activated sensor head heating the second line would have been displayed as:

`H:v_=___121_dh=___356_z_=_____8_t_=__1981`

Depending on the user's selection various output data sets will be displayed according to table 1.

Table 1: **Serial Output Values**

Variable	*Range*	*Interpretation*		*Units*
x	± 50 m/s	x-component of wind	cm/s	
y	± 50 m/s	y-component of wind	cm/s	
z	± 50 m/s	z-component of wind	cm/s	
t	-30 … +50 °C	temperature		0.01 °C
v / vs	0 … 50 m/s	horizontal velocity	cm/s	
d	0 … 359 °	wind direction		degree
dh	0 … 539 °	wind direction	(hysteresis)	degree
for **option** *analog input/counter* only:				
a0,a1	-30 … +50 °C	PT100-temperatures	0.01 °C	
a2..a7	0 … 10 (0 … 5) V	input voltages	mV	
c0,c1	0 … 65535	clock counts		events

The output values and the optional time stamp for each data set must be selected by setting parameter *OD* (output digital) according to the selection table (see chapter 3.1). Output is generated at the end of each averaging interval as defined by the parameters *AT* and *AV* or on request (refer to commands *RD* and *AA*).

Analog Data Output (Option)

The four analog signals are updated with a rate according to the averaging time *AT* or to the number of averaging samples defined by *AV* or on request (refer to commands *RD* and *AA*). The resolution is 12 bit (4096 steps). The range of the output data can be

adjusted for *x, y, z, v* and *t.*

Variable	*(max.) Range*	*Interpretation*	*Units*
x	± 50 m/s	x-component of wind	cm/s
y	± 50 m/s	y-component of wind	cm/s
z	± 50 m/s	z-component of wind	cm/s
t	-30 … +50 °C	temperature	0.01 °C
v / vs	0 … 50 m/s	horizontal velocity	cm/s
d	0 … 359 °	wind direction	degree
dh	0 … 539 °	wind direction (hysteresis)	degree

The ranges are defined by the parameters *TR, VR* and *ZR* (max. values are shown above) and correspond to a voltage of 0 … 5 or 0 … 10 V, resp. to a current of either 0 … 20 or 4 … 20 mA.
The output variables are selected by setting the parameter *OA* (output analog) according to the selection table (see chapter 3.1).
Time information or data from the *analog input/counter* (**option**) are not allowed for analog output.

Note : When using a current port the output lines must be terminated with a load of maximum 500 Ω. Unused outputs must be terminated too.

Available port types are:

Voltage : 0 … 5 V or
0 … 10 V

Current : 0 … 20 mA or
4 … 20 mA

3. System Operation

The USA-1 system offers a variety of adjustable parameters in order to optimize system performance and to simplify system operation also for untrained persons. One important feature essential for easy operation is the possibility to test the measuring accuracy and to calibrate the system at the measuring site. Therefore disalignments of the sensor head, caused by harmful handling, can be compensated properly by a recalibration done by the user himself.

Parameter Settings

All parameters are stored in EEPROM and remain valid after a power failures or reset procedure. The available parameters are listed below:

SF Sampling Frequency;
integer number within 4 … 25000;
number of samples per 1000 seconds; *SF* can be selected corresponding to the formula *SF* = 200000 / n with n = integer number, 8 ≤ n ≤ 50000;
If intermediate values are defined by the user, the next higher value according to the given formula is used by the USA-1. A list of selectable frequencies is given in Appendix 1. The maximum sampling frequency is limited if special operation modes are used (i.e. output of date/time or data from the **optional** *analog input/counter*). Values below 1000 (=1 Hz) can be only adjusted while *AT* is set to 0. **Note: SF [Hz] x AT must less or equal than 65535 (maximal AV).**

Example: `SF=10000` => sampling frequency is set to 10 Hz;

Note: The *fast versions* of the USA-1 (**option**, version numbers 3.xx) allow settings of *SF* up to 50000 (= 50 Hz).

AV Total Averaging Number;
integer number within 1 … 65535;
this number of samples is used for averaging only if parameter *AT* equals 0; the parameter setting of *AV* is ignored if parameter *AT* is set to ≥1 (see also below); Output is not synchronized to the internal clock.

Example: `AV=18` => averaging time is set to 1.5 s,
if sampling frequency is set to 12 Hz and *AT* is set to 0;

AT Averaging Time;
integer number within 0 … 1800;
averaging intervall defined in seconds; if *AT* is set to 0, averaging will be performed according to the assigned value of *AV* (see above). The sampling frequency *SF* must not be set to any value below 1000 while operating the USA-1 with AT > 0. Output may be synchronized to the internal clock by use of *SY*. **Note: SF [Hz] x AT must less or equal than 65535 (maximal AV).**

Example: `AT=5` => averaging time is set to 5 s;

Example:
```
SF=10000
AV=1
AT=0
```
=> The system will evaluate instantaneous values at a sampling rate of 10 Hz

SY Synchronized Averaging;
integer numbers 0 or 1;
selects whether the averaging intervals defined by *AT* > 0 are synchronized to the internal clock. If *SY* is set to 1 each averaging interval will be shortened or extended, so that the ending time/date in seconds modulo averaging time will be zero. The interval will be extended if it would be shortened to less than half of the averaging time.
Setting or clearing of *SY* will start a new averaging interval.

Example: `SY=0` => start a new un-synchronized averaging interval.

AZ Device Azimuth;
integer number within 0 … 359;
compass bearing of the index mark on the electronic box/sensor head;

Example: `AZ=90` => azimuth is set to 90 degree;

HC Head Correction;
integer numbers 0, 1, or 2;
selection of header correction; to minimize the influence to the mean wind components (and the derived horizontal wind speed) caused by the sensor head geometry it is possible to select one of two analytic function sets for correction. '1' selects the function set for the one center bar model,
'2' selects the function set for the three outer bar model and
'0' disables any online corrections.
The functions are derived from wind tunnel experiments made for the two different sensor head models on a wide range of horizontal wind speeds.

Example: `HC=1` => header correction is activated for the one vertical bar model;

SA Scalar Averaging;
integer numbers 0 or 1;
selects whether the averaging of horizontal wind speed and wind direction is done vectorial (*SA* = 0) or scalar (*SA* = 1). In case of *SA* = 1 the identifier `v` will change to `vs`. Even if `d` or `dh` are not marked separately in this mode `d` and `dh` will be averaged scalar as well. The components `x` and `y` are not affected by this parameter.
The scalar averaging of wind direction is done by separetely averaging and counting values for the left and right half-circle of directions. `d` will be calculated as weighted average of these values (taking into account the correct averaging for slightly varying directions around north).
Note: setting *SA* to 1 takes some CPU time, so reducing *SF* can be necessary.

Example: `SA=0` => select vectorial averaging;
`SA=1` => select scalar averaging;

HT Switching of *Sensor Head Heating* (**Option**);
integer numbers 0, 1, 2;
selection of heating operation;

Example: `HT=0` => heating turned off;
Example: `HT=1` => heating turned on;
Example: `HT=2` => heating is automatically turned on/off, if USA-1 measures temperatures below 4.5 °C / above 5.5 °C;

TC Calibration Temperature;
integer number within -5000 … 5000;
the ambient temperature must be measured by a conventional thermometer if USA-1 is calibrated; it is defined as 0.01 °C within a temperature range of -50 … +50 °C.

Example: `TC=2150` => calibration temperature is set to 21.5 °C;

P1, P2, P3
Path Lengths;
integer number within 1500 … 4500;
define length of the measuring paths as 0.1 mm;

Example: `P1=1785` => Path length 1 defined as 178.5 mm;
Example: `P2=1780` => Path length 2 defined as 178.0 mm;
Example: `P3=1765` => Path length 3 defined as 176.5 mm;

The path lengths must be measured by a simple scaling of 1-mm-grading if USA-1 is calibrated. An estimation of lengths with an accuracy of 0.5 mm will be sufficient.
Normally path lengths will vary within 172 … 180 mm due to mechanical tolerances, but accidental deformation changing path lengths up to 10 mm is tolerable. In this case reliable measurements are possible after calibration of the sensor head (see below), as far as no further damage had happenend to the ultrasonic transducers. If path lengths exceed the range of 170 … 185 mm the system should be checked by METEK.

OD Digital (Serial) Output;
integer number within 0 … 255;
selects serial (digital) output data set; selection according to table 2, Chapter 0;

OA Analog Output;
integer number 0, 1, 2, 3, 32;
selects analog output data set; selection according to table 2, see Chapter 0;

VR Velocity Range;
integer number within 1 … 6000;
range for analog output of the variables *x, y, v, vs*; the used unit is cm/s; the number range is specified by *-VR* … *+VR* for *x* and *y*, and by 0 … *VR* for v;

Example: `VR=3000` => analog data are offered as voltages within
0 … 10 V, resp. currents within 4 … 20 or 0 … 20 mA corresponding to
-30 … +30 m/s for *x* and *y* and
0 … 30 m/s for *v* (see Chapter 0).

ZR Velocity Range (z-component);
integer number within 1 … 6000;
range for analog output of the variable *z*; the used unit is cm/s; the number range is specified by *-ZR* … *+ZR* for *z*;

Example: `ZR=100` => analog data are offered as voltages within
0 … 10 V, resp. currents within 4 or 0 … 20 mA corresp. to -1 … +1 m/s for z

O1, O2,¼ O6
Calibration Parameters;
integer numbers;
these parameters are calculated by the calibration procedure; they are displayed on request; setting of these parameters by the user is not allowed;

LC Last Calibration;
formatted text string;
this parameter shows the date/time of the last successful calibration. It can not be set directly like *TI*. Instead it will be set to the actual value of *TI* when a entered *CA* command signals a successful calibration.

BR Baudrate;
integer number 0, 300, 600, 1200, 2400, 4800, 9600 or 19200;
sets the baudrate of the serial interface line(s). 0 selects the default baudrates of 9600 baud for the standard protocol and 4800 baud for the NMEA protocol.

Example: `BR=19200` => the USA-1 will restart using 19200 baud.

Note: The *fast versions* of the USA-1 (**option**, version numbers 3.xx) allow settings of *BR* up to 38400.

PR Protocol;
integer number 0 or 1[1];
defines whether to use the standard protocol (0) or the alternative NMEA protocol (1), refer to chapter 3.7

Example: `PR=1` => select NMEA protocol

NO NMEA options;
integer number 0 to 31;
Refer to to chapter 3.7

FR Frame;
integer number 0 or 1;
defines whether output data is embedded in a STX/ETX/Checksum frame (1) or not (0). This applies only to the standard protocol. Each frame starts with a STX character followed by the normal output data which had been printed with FR=0. The frame stops with an ETX character and a checksum character. The ASCII value of the lower 7 bits of the checksum character (the MSB will be 0) are computed as the sum modulo 127 of all characters of the current frame (including STX and ETX, excluding the checksum itself). If the calculated checksum is 10 ($0A_{hex}$) which also represents a 'line feed' character then the two characters 'carriage return' 13 ($0D_{hex}$) and 'line feed' and 10 ($0A_{hex}$) are sent by the device.

By using frame please switch the handshake control to none.
The NMEA protocol will be effected as well, but in a different manner: If FR is set to 1 there will be a checksum calculated and applied to every single NMEA sentence. The setting FR=0 will suppress this option, refer to chapter 3.7

TI Time and Date;
formatted text string;
time and date of the internal clock formatted as DD.MM.YY_hh:mm:ss ('D' means numbers of day, 'M' numbers of month, 'Y' numbers of year, 'h' numbers of hour, 'm' numbers of minutes and 's' numbers of seconds). This clock is by default *not* battery buffered. Therefore the system starts with 01.01.70 00:00:00 after a reset procedure and the system clock must be re-definied. A battery buffered high-precision clock is offered as **option**.

Example: `TI=03.04.94 09:04:00`
=> date/time is set to the 3rd of april 1994
9.04 am

TR Temperature Range;
integer number within 1 … 4000;
range for analog output of the variable *t*; the used unit is 0.01 °C; the number range is specified by 10 °C-*TR* … 10 °C+*TR* for *t*;

Example: `TR=2000` => analog data are offered as voltages within
0 … 10 V, resp. currents within 4 or 0 … 20 mA corresp. to -10 … +30 °C for *t*.

TV Test Values for Analog Output;
integer number within 0 … 100;
defines percentage of test values for analog output data;

Example: `TV=20` => the analog output voltage is set to
20 % * 10 V = 2 V, resp.
the output current is set to 20 mA = 4 mA;

[1] other values are custom specific

MD Data Quality Check Control;
integer number within 0 … 65535;
Attention: This parameter is set by factory to value of 30 and should not be changed by the normal user!

Assigning higher values will check the raw data more strictly. Lower values (down to 0) will decrease the limits of the check.

Example: `MD=0` => switch off any quality check

Control Commands

RD Redraw data.
This command redraws the last measured data set on the interfaces. *RD* can be used to request data by an external device without affecting the averaging intervall (contrary to the usage of the command *AA*).

AA Abort averaging intervall.
This command terminates the present averaging interval. The requested measuring variables are calculated and printed. Using a long averaging time (`AT=0`, `AV=65535`) and the command *AA* the system data output and averaging interval can be triggered by an external device.

CA Calibration.
This command is used to calibrate the system. Refer to chapter 3.5 for detailed information.

RS System reset.
This command performs a reset of the USA-1 system. Due to the EEPROM memory the system will start operation again using the same parameter adjustments as used before the reset-command. This command should be used if in case of false parameter adjustment the system operation has been stopped due to software conflicts (happens, if too many values are requested for output with high output rate). In this case the system will still accept commands to correct the false parameter settings, but a reset is required for a successful system restart.

VS Version number.
The system responds to this command by printing its version number.

? Question Mark.
This command will list all the parameters and their actual values as described in the previous chapter.

S1, S2, S3
Save Parameters.
This command will save all parameter settings (including calibration parameters) to one of three independent parameter storages. This settings can be reloaded by one of the commands *L1, L2, L3*. The actual settings are stored automatically as storage #0, which is loaded on power-up.

L1, L2, L3
Load Parameters.
This command will load one of the previously stored parameter sets (see *S1, S2, S3*).

N0 Name Parameters (n, zero).
This command will assign an individual name to the actual parameter set. It can be up to 31 characters long and will be stored together with the other parameters when using the *save parameters* command (see *S1, S2, S3*) and restored again when using the *load parameters* command. The names may be used to characterize the stored parameter sets.

SV Service Mode
Before setting the parameter P1,P2,P3 and TC or starting the calibration procedure it is necessary to change into the service mode. After one minute the service mode is automatically stopped. The service mode does not interrupt the measurements.

Selection of Data Output

By assigning various numbers to the above mentioned parameter *OA* and *OD* different output data sets can be selected (see also chapter 3.1):

Table 2: Output Data Sets

0	No data output;	
1	Output of x, y, z, t;	
2	Output of v, d, z, t;	
3	Output of v, dh, z, t;	
4	Output of a0, a1, a2, a3	serial output only
8	Output of a4, a5, a6, a7	serial output only
16	Output of c0, c1	serial output only
64	Output of time stamp (time only)	serial output only
128	Output of time stamp (date and time)	serial output only

Only analog output (test mode):

32 Output of test values according to setting of parameter *TV*

Only serial (digital) output (test mode):

32 Output of sound pulse propagation time for paths *P1*, *P2* and *P3*;
for each path two hexadecimal coded numbers are displayed which correspond to both travelling directions. In case of malfunction of one or more transducer, the corresponding number(s) are coded as "`ffff`". Covering of the transducers will show the same results.

The codes 1, 2, 3 can be combined with 4, 8, 16, 64 and 128 to get more complex serial output data sets.

Examples:
`OD=81` => selection of x, y, z, t, c0, c1 and time stamp (time only)
by codes 1, 16, 64 (81 = 1 + 16 + 64)
`OD=32` => selection of propagation times (test mode)
by code 32
`OD=130` => selection of v, d, z, t and time stamp (date and time)
by codes 2, 128 (130 = 2 + 128)

The analog signals are offered at the channels 1 … 4 in the order given by table 2. Codes 4, 8, 16, 64 and 128 are ignored for analog output.

Example: If *OA* is set to "2", channel 1 offers wind speed, channel 2 offers wind direction, channel 3 offers vertical windcomponent, and channel 4 offers temperature.

Checking System Accuracy

If the user suspects that any deformation of the sensor head geometry has occured, the first step should be a check of the measuring accuracy.
This test can be done in the field by housing the sensor head in a box or covering the sensor head by a cloth or blanket. Make sure that there are no strong reflections inside the box and that the sound paths are not covered. Both effects can cause a considerable bias of the windcomponents of more than 15 cm/s. Reflections can be recognized by observing the time series of 1-sec-means while changing the sensor head position (for example, rotation of 60 degree). The wind components must not vary more than some cm/s.
Measuring the wind speed or wind components in a non-moving medium would ideally show windspeed zero, but a deviation of up to 10 cm/s can be accepted (The acceptance limit depends strongly on the user requirements, naturally). If the bias of the windcomponents exceed the acceptable range a recalibration must be performed.

Calibration Procedure

If the test of the system accuracy shows unsatisfying results or if most data sets are marked as `INVALID DATA` or as `DATA QUALITY < x%`, the system must be recalibrated. This capability and the easy system check represents a considerable advantage of the USA-1.
The optional *sensor head heating* must be turned off during the calibration (`HT=0`). If the system was heated before, the sensor should cool down approximately to the ambient temperature before the calibration procedure is started.
In order to change parameter P1, P2, P3 and TC or in order to perform a zero calibration (**CA**) the system will request the user to change into a special service mode using the command **SV.**
To start the calibration, the path lengths named as *P1* ,*P2* and *P3* must be entered to the system in 0.1-mm units.
The lengths of the travelling paths can be determined by means of a ruler. A measuring accuracy of 0.5 mm is satisfactory. If the distance between the metal transducer surfaces can't be measured directly, you have to add 1.0 mm for the silicon lenses (0.5 mm for each lense). By using the calliper from the calibration kit you must be add once more 10mm. The different paths can be identified by the punch marks on the top of the sensor or in the following way:

- rotate the system until the black arrow runs from left to right in front of the middle rod;
- path 1 is positioned perpendicular to the orientation of the arrow;
- rotate the system 120 degrees clockwise as seen from the top; path 2 move now to the previous position of path 1; path 3 gets in this position by rotating the systems once more by 120 degrees (clockwise).

Alternatively the test mode for the serial output (`OD=32`) can be used for identifying the travelling paths. Covering of one transducer will show an "`ffff`"-string for the travelling time of the corresponding paths. This procedure requires that the analog output is stopped (`OA=0`) or in test mode (`OA=32`).
For the second step of calibration the USA-1 system must be stored in the housing and the air temperature must be measured by a simple thermometer placed inside. This temperature is used as a calibration temperature and is called *TC*. Its unit is 0.01 °C.
Make sure that there is no reflection of the ultrasonic pulses inside the box. In order to check whether there are any reflections the measurements must be continued inside the box for different positions of the sensor head when rotating it in 60 degree steps. If the variation of windcomponents exceeds more than 5-10 cm/s reflections are present.
Path lengths and calibration temperature must be entered to the system by using the following commands:

Example: `P1=1750`
`P2=1760`
`P3=1755`
`TC=2150`

The above mentioned example defines the paths length of *P1* as 175.0 mm, of *P2* as 176.5 mm, of *P3* as 175.5 mm and the calibration temperature *TC* as 21.5 °C.
When the air motion inside the box has come to rest and after the above mentioned commands are sent to the system, the calibration procedure is continued by entering the command:

`CA`

The calibration is initiated by this command and lasts some seconds. The system performs 100 samples at the actual sampling frequency and displays some "."- characters indicating that calibration is in progress. All system parameters are switched back to the foregoing parameter values automatically after the end of the calibration procedure which is indicated completing the reply message by the word

`done`

In case of any malfunction during calibration, the system aborts the procedure and closes the message line with the word

`failed`

In this case no calibration is performed and the system continues measurements using the old calibration parameters. The reason for a failed calibration can be a hardware malfunction of the system or strong sound reflexions inside the cabinet. Calibration abortion prevents an erroneous calibration. After a successful calibration the system will proceed in the interupted measuring mode (data output, system parameters) without any further action by the user.

Orientation of Sensor Head

The black arrow fixed at the sensor electronic box indicates north direction according to the sensor coordinates (in other words: an air current parallel to the arrow will be a south wind according to the sensor coordinates). The arrow is placed at one side of the electronic box which can be used as a bearing guide to align the sensor parallel to geographic north direction.
In addition the system is able to correct all measured data for any other sensor head orientation. After the installation has been completed the orientation of the black arrow must be measured (we recommend usage of binoculars and/or compass) and its bearing must be defined by entering:

```
AZ=22
```

In this example the black arrow points to 22 degree, but the system will evaluate the wind direction and wind components relative to north direction.

NMEA protocol

A special output protocol type NMEA0183 is offered by the USA-1 system in order to make the usage in marine applications as easy as possible. Because the NMEA-format requires certain interface adjustments usage of the following commands should be done only if the usage of the NMEA format is essential. As mentioned in chapter 0 there are some options available for this protocol. In general the system is switched to NMEA format mode by entering:

```
PR=1
```

The data set is changed according to the NMEA-standards printing out wind velocity and wind direction. This requires that the parameter assigning the type of data set is adjusted to the value "2" automatically. If *BR* equals zero the serial interface is automatically switched to a baud rate of 4800. In NMEA mode the system does not accept any commands except

```
PR=0
```

which will switch the device back to normal operation. So options for the NMEA protocol must be selected before entering `PR=1`. This options refer to the setting of the parameters FR and NO (see chapter 0).
The format of the data output is shown in the following example:

Example: `$WIMWV,176,R,2.8,M,A`

This line is started by an initializing text string, indicating by the characters `MWV` that an information about wind velocity and wind direction is following. The winddirection is displayed with an accuracy of one degree as a three-digit number, followed by the character `R` for relative angles. The wind velocity is displayed in meters (unit indicated by the character `M`) as a three-digit number and with an accuracy of one tenth. The validity of the line is signaled by the trailing character `A`. Invalid lines are marked with the character `V`. The unit of the wind velocity and the can be selected by the parameter NO. This parameter can as well activate/deactivate the output of the `MWV` sentence (refer to table 3 in this chapter).

A second line (indicated by `MTA`) prints the current temperature as a three-digit number with a resolution of 1 °C:

Example: `$WIMTA,024,C`

The output of this sentence can be activated/deactivated according to the setting of parameter NO (refer to table 3 in this chapter). Additional a checksum can be applied to each sentence (`MWV` and `MTA`). This behaviour is selected by parameter FR. If this parameter is set to 1 the checksum is appended to the end of each sentence by use of the delimiter "*" and appears after this character as a two digit hexadecimal value as defined in the NMEA0183 standard. The value is calculated by XOR'ing the 8 binary data bits of each character of the sentence between the leading "$" and the delimiting "*".

Example: `$WIMTA,024,C*33`

Table 3: Possible settings for parameter NO

Parameter Value	Unit of Velocity	Talker Address	MWV output	MTA output
0 to 7			disabled	disabled
8	knots	$II	enabled	disabled
9	mph	$II	enabled	disabled
10	km/h	$II	enabled	disabled
11	m/s	$II	enabled	disabled
12	knots	$WI	enabled	disabled
13	mph	$WI	enabled	disabled
14	km/h	$WI	enabled	disabled
15	m/s	$WI	enabled	disabled
16	knots	$II	disabled	enabled
17	mph	$II	disabled	enabled
18	km/h	$II	disabled	enabled
19	m/s	$II	disabled	enabled
20	knots	$WI	disabled	enabled
21	mph	$WI	disabled	enabled
22	km/h	$WI	disabled	enabled
23	m/s	$WI	disabled	enabled
24	knots	$II	enabled	enabled
25	mph	$II	enabled	enabled
26	km/h	$II	enabled	enabled
27	m/s	$II	enabled	enabled
28	knots	$WI	enabled	enabled
29	mph	$WI	enabled	enabled
30	km/h	$WI	enabled	enabled
31	m/s	$WI	enabled	enabled

4. Online Computed Turbulence Values (Option)

In case of installed **option** for *online computed turbulence values* there is an additional serial port *t1* available for serial input/output used for operating the system and output of the computed data. The ports of the USA-1 (in the following called *t0* and *dac*) are just used to display the instantaneous data which will be available all the time with a specified sampling frequency. Because there is no possibility of controlling the USA-1 via port *t0* there are some standard settings needed for proper operation (parameter names refer to the command set of the USA-1 without the *online computed turbulence values* **option**):

```
PR=0
OD=1
AT=0
AV=1
AZ=0
```

These settings will be adjusted by the **option** after each reset or power-on procedure. Port t1 offers alternative possiblities of parameter settings and operation control effecting the basic USA-1 and the **option**. The following sections will describe how to enter commands, which commands are allowed and what kind of data is computed.

Commands

To enter commands to the new interface *t1* set your terminal to 9600 baud (factory setting, can be altered by the user), 8 data bits, no parity, one stop bit and full duplex. After each reset or power-on procedure the terminal will display messages like this:

```
SNC 700101000000 UTC initializing slave processor .... version 1.21
SNC 700101000000 UTC S O N I C - A n e m o m e t e r   USA-1/T
```

Now the device is ready to accept commands, which can be entered as text strings terminated by CR and/or LF. These commands are not echoed while typing, nevertheless "blind" editing of the command line using the BS (Backspace) character is possible. When the line is terminated the whole line will be displayed with the leading text string "`USA-1/T > `" similar to the "`C:`" displayed by the USA-1 without this **option**.
Any other kind of messages consists of one or more lines where the first line is started by the string "`SNC` *`YYMMDDhhmmss`* `UTC `" where *`YYMMDDhhmmss`* is replaced with the current date and time. Error messages are marked by the string "`SNC` *`YYMMDDhhmmss`* `UTC ?`". The first line of each message is continued by the message text itself. All following lines belong to the same message till reaching another header line "`USA-1/T > `" or "`SNC ...`" announcing the next user input or system message.
Commands are formatted in the same way as for the basic USA-1: There is a set of parameters which can be set by entering their name (2 upper case characters) an equals sign and the desired value; they can be enquired by entering their name followed by a question mark. And there are some control commands (2 upper case characters) which are entered without any characters following except the terminating CR/LF (one of these characters must be entered to close each input line which will be interpreted as a single command).

Valid parameters are:

AT Averaging Time;
integer number within 0, 5 … 3600;
averaging interval defined in seconds. When setting this parameter the actual averaging interval is not affected. Data output will be synchronized to the internal clock. The special value 0 will select instantaneous data for output.
The analog output and the output of the interface *t0* of the USA-1 shows always the instantaneous data.

AZ Device Azimuth;
integer number within 0 … 359;
compass bearing of sensor head indicated by the black arrow of the electronic box. Output on the old interfaces (*t0* and *dac*) keeps uneffected. The instantaneous measured values *x*, *y* and *d* or *dh* refer always to the sensor related orthogonal coordinate system!

BR Baudrate
refer to chapter 3.1

FR Frame
refer to chapter 3.1

HT Switching of the *Sensor Head Heating* (**Option**);
refer to chapter 3.1

O1, O2, ¼ O6
Calibration Parameters;
refer to chapter 3.1

OA Analog Output;
refer to chapter 3.1
(data output to the analog channels occures *SF*/1000 times a second)

OD Digital (Serial) Output;
integer number 1, 5, 9, 13, 17, 21, 25 or 29
Similar to the setting of the parameter *OD* to the basic USA-1 system (refer to table 2 in chapter 3.3).
Changes the set of evaluated data. Other values than listed above are not allowed for this **option** for *online computed turbulence values.*
Selecting one or both sets of analog input values (a0, a1, a2, a3 and/or a4, a5, a6, a7) will calculate their average values, their variances and their covariances with the z wind component.

Note: For compatibility with the USAT-3 the values are renamed to e1 ... e8 (= a0 ... a7) and additional c1, c2 (= c0, c1).

P1, P2, P3
Path Lengths;
refer to chapter 3.1

SF Sampling Frequency;
integer number within 1000 … 10000;
number of samples per 1000 seconds; SF can be selected corresponding to the formular SF = 200000 / n with n = integer number, $20 \leq n \leq 200$;
If intermediate values are defined by the user, the next higher value according to the given formula is used.

Note: The *fast versions* of the USA-1 (**option**, version numbers 3.xx) allow settings of *SF* up to 20000 (= 20 Hz).

TC Calibration Temperature;
refer to chapter 3.1

TI Time and Date;
refer to chapter 3.1

TV refer to chapter 3.1
TR refer to chapter 3.1
VR refer to chapter 3.1
ZR refer to chapter 3.1

Valid commands are:

AA Abort Averaging;
aborts the current averaging intervall, displays the data averaged til now and starts a new averaging intervall according to the setting of parameter *AT*.

CA Calibrate;

performs a calibration of the USA-1. The Parameters *P1, P2, P3* and *TC* should be set to the measured values before entering this command. Refer to chapter 3.5.

RD Redraw;
redraws the last data set.

RS Reset;
resets the whole system (same as power up).

S1, S2, S3
Save Parameters;
saves all parameter settings (including calibration parameters) to one of three independent parameter storages. This settings can be reloaded by use of one of the commands *L1, L2, L3*.

L1, L2, L3
Load Parameters;
loads one of the previously stored parameter sets (see *S1, S2, S3*).

N0 Name Parameters (n, zero);
assigns an individual name to the actual parameter set.

VS Version;
displays the version numbers of the extension and the USA-1.

Messages

Every error message starts with a header line that consists of the string "SNC" followed by a space and 12 characters for the date/time, another space and finally the string "UTC ?" followed by one of the strings below:

`parameter out-of-range`
The entered parameter value is illegal for the specified parameter.

`slave booted`
The USA-1 has booted. This should not happen in normal operation cause this means that just the USA-1 (without extension) started a reset procedure.

`syntax error`
The entered command is syntactical incorrect.

`unknown symbol`
The used parameter or command name is not valid.

Other message are displayed when the user requests the acutal parameter settings (`result: ...`) or calibrates the system (`calibrating ... done/failed`).

Data Format

Every data message starts with a header line that consists of the string "SNC" followed by a space and 12 characters for the date/time, another space and finally the string "UTC". Depending on the users choice the system offers either instantaneous values or averaged values with an adjustable averaging interval.
A set of averaged data adds a summary of the main system parameters and a value for the quality of the measured data to the header line. The values following the strings XCL, YCL, ZCL and TCL are fixed and have no special meaning. They are just displayed for compatibility to the USAT-3 data output.
Other values displayed in the header line are:

AVE the averaging time as defined by *AT*

`SMP` the sampling rate in Hertz as defined by *SF* / 1000

`AZI` the device azimuth as defined by *AZ*

and `SDQ` the sonic data quality which is derived from the quotient of the number of valid instantaneous data sets to the expected number of sets (derived from *AT* and *SF*). The used unit is: percentage of valid data as compared to the expected number.

`HTR` this message informs the user that the sensor head heating was turned on while averaging the data.

The following lines display the (averaged) data using a fixed format: up to 4 values per line each preceeded by its name (5 characters, right-aligned), a space character, an equals sign and an 8 character (right-aligned) floating point number with a fixed number of decimal digits (possibly with trailing zeroes). This number will be replaced by 8 space characters in case of invalid data. The values are separated by a space character. The names of the data and their ordering can be understood from the following example (`OD=1`):

```
SNC 940815090000 UTC AVE     600 SMP      10 AZI       0 SDQ     100 HTR
    x =    1.74     y =   -0.93     z =   -0.14     T =    0.62
 xsig =    0.91  ysig =    0.89  zsig =    0.43  Tsig =    0.47
xycov = -0.3911 xzcov = -0.2010 xTcov = -0.1801
yzcov =  0.0961 yTcov =  0.2170 zTcov =  0.1200
 psig =    1.07  qsig =    0.70  rsig =    0.40
   tp =    0.54    tq =    0.35    tr =    0.20
ustar =    0.39 Tstar =    0.31    Cd =    0.04
  MOs =   -0.03    mf =   -0.19    hf =  144.60
    u =   -0.93     v =    1.74     w =   -0.14
  vel =    1.98   dir =   151.9    DC =       A
```

In case of instantaneous data (*AT* set to 0) the data set is reduced to:

```
SNC 940815090015 UTC
    x =    1.83     y =   -0.79     z =    0.20     T =   20.17
```

Data Names and Meanings

The data names and the used units are shown in the table below:

x	Mean x wind component in the sensor related orthogonal coordinate system (parallel to the black arrow on the electronic box); unit: m/s
y	Mean y wind component in the sensor related orthogonal coordinate system (horizontally perpendicular to *x*); unit: m/s
z	Mean z wind component in the sensor related orthogonal coordinate system (vertical); unit: m/s
T	Mean temperature; unit: °C
xsig	Standard deviation of *x*; unit: m/s
ysig	Standard deviation of *y*; unit: m/s
zsig	Standard deviation of *z*; unit: m/s
Tsig	Standard deviation of *T*; unit: K
xycov	Covariance of *x* and *y*; unit: m^2/s^2
xzcov	Covariance of *x* and *z*; unit: m^2/s^2
xTcov	Covariance of *x* and *T*; unit: mK/s
yzcov	Covariance of *y* and *z*; unit: m^2/s^2
yTcov	Covariance of *y* and *T*; unit: mK/s

zTcov	Covariance of *z* and *T*; unit: mK/s
psig	Standard deviation of the wind component parallel to the mean wind direction; unit: m/s
qsig	Standard deviation of the wind component horizontally perpendicular to the mean wind direction; unit: m/s
rsig	Standard deviation of the wind component vertically perpendicular to the mean wind direction; unit: m/s
tp	Longitudinal turbulence intensity
tq	Transversal turbulence intensity
tr	Vertical turbulence intensity
ustar	Friction velocity u_*; unit: m/s
Tstar	Characteristic temperature T_*; unit: K
Cd	Drag coefficient C_d
MOs	Monin-Obukhov stability parameter; unit: m^{-1}
mf	Vertical momentum flux; unit: kg/ms^2
hf	Vertical heat flux; unit: W/m^2
u	Mean west-east wind component (depends on setting of parameter *AZ*); unit: m/s
v	Mean south-north wind component (depends on setting of parameter *AZ*); unit: m/s
w	Mean vertical wind component; unit: m/s
vel	Mean horizontal wind velocity; unit: m/s
dir	Mean horizontal wind direction (depends on setting of parameter *AZ*); unit: °
DC	Diffusion class

The following data names can be displayed while using the **option** for *analog input/counter* (*OD* > 1):

e1 *e2*	Mean Pt100 temperatures (based on a0, a1 values of the basic system); unit: °C
e3 ... *e8*	Mean values of the analog input channels (based on a2 ... a7 values of the basic system); unit: V
e1sig *e2sig*	Standard deviations of the Pt100 temperatures (based on a0, a1 values of the basic system); unit: K
e3sig ... *e8sig*	Standard deviations of the analog input channels (based on a2 ... a7 values of the basic system); unit: V
e1zco *e2zco*	Covariances of the Pt100 temperatures (based on a0, a1 values of the basic system) with *z*; unit: Km/s
e3zco ... *e8zco*	Covariances of the analog input channels (based on a2 ... a7 values of the basic system) with *z*; unit: Vm/s
c1 *c2*	Counted events (based on c0, c1 values of the basic system); unit: 1

5. Internal Data Logger (Option)

In case of installed option for an *internal data logger* there is an additional first-in/first-out-organized data buffer with a capacity of 16383 data sets on a standard USA-1 resp. 2700 complete turbulence data sets for devices including the turbulence extension.
The logging function is only usefully working with averaged data.
If the logging function is activated, the calculated data are stored in the buffer but not sent to the serial port. When the buffer is completely filled, the oldest data are overwritten. The stored data may be read through the serial port using special commands. The data format remains unchanged. After each read command one complete data set will be sent.

The following commands are available to control the data logging function:

LD Log Data, followed by an integer number 0, 1, 55, or 99

LD=1 Start Logging
The computed turbulence data sets are stored in the logging buffer from now. The old content of the buffer remains unchanged until it possibly will be overwritten when the buffer is full.

LD=0 Stop Logging
The computed turbulence data sets are no longer stored in the logging buffer but sent to the serial port again. The content of the logging buffer remains available.

LD=55 Reset Read Pointer
If old data shall be read again, the read pointer can be positioned to the oldest available data. Now all data sets in the buffer can be read again.

LD=99 Clear Logging Buffer
All stored data are deleted.

LD? Enquire Logging Status
LD=0 or LD=1 will be reflected by the device, corresponding to the actual logging status.

RD Redraw;
The oldest data set will be sent to the serial port but **not** deleted in the logging buffer. If the data set was not received correctly, you can repeat this command any time, if it was received correctly, continue with the *RL-command*.
See also *FR-command* (chapter 3.1) for checksum option.
Note: When using this command to read the logging buffer, the logging status must be set to LD=1 before. Otherwise you receive the actual (newest) data set.

RL Read Log;
First the oldest data set will be removed from the logging buffer. Then the second oldest data set will be sent to the serial port. If the same data set shall be sent again, use the *RD-command*. If only one data set is left in the logging buffer, the message „end of log“ is sent instead.

A typical read procedure looks like this:

Command	*Meaning*	*Effect*
LD=1	Start Logging	No more data are sent to the serial port, all measured data are stored internally from now
some time later :		
RD	Redraw	The oldest stored data set is sent to the serial port
RL	Read Log	The oldest data set which was just sent before will be removed from the memory and the next data set, which has become the oldest now, will be sent.
RL	Read Log	like before
if the last data set was not received correctly :		
RD	Redraw	The last data set will be sent again
RL	Read Log	Continue normal reading
and so on. Finally the stored data are read out completely and no more data are available, but you don't know when it will happen :		
RL	Read Log	The last data set will be removed but no further data can be sent. Instead of this you now receive the message "end of log".
some time later, when new data are available :		
RD	Redraw	The oldest data set will be sent.
RL	Read Log	Remove the just read data set and send the next
and so on.		

Attention :
If you receive an end-of-log message, don't use the RL command in the next step, because it will remove the oldest data set before you have read it. In this case use the RD command first.

The entire read-out procedure is performed by the program 'lcopy', which is delivered on the diskette in this manual.

6. High wind speed option USA-1

Before changing the parameters P1, P2, P3 and TC and before a system-calibration (**CA**) it is necessary to change into the service mode with the command **SV**. After one minute the service mode is stopped. In the service mode the measuring is not disturbed.

The **BR** (*baud rate*) command additionally accepts 38400, 57600, and 115200 baud for the data transmission.

The averaging time (**AT** command) can now be set to values in the range from 1 to 3600 on both systems: the standard version and the turbulence extension as well. AT=0 is possible too, in this case those instantaneous data are sent out, which are defined by the OD resp. OA command.

Furthermore a new processing board has been integrated as an option, which supplies a coherent averaging routine. The command ***AV*** (*number of averaged samples*) is now activated also for settings of **AT** = 4. **AV** defines a coherent averaging routine performed on the time signal of the received A/D converted acoustic signals for all 6 traveling paths. The time interval for the coherent averaging is determined by the product of sample rate and the number of individual samples, which are used for the coherent averaging. The coherent averaging is limited to a maximum time interval of 1 s.

Example: If the *sample rate* **SF** is set to 20 Hz and the *number of averaged samples* **AV** command is set to 10, the coherent values are refreshed every 0.5 s. These coherent values are used according to the *adjusted averaging time* **AT** to determine the averaged values.

The minimum value of AV is 4 and maximum value of SF 40000.

So the maximum output rate is 10Hz by AT=0.

The benefit from this coherent averaging is a significant increase in signal/noise ratio.

7. Specifications

Measuring Range

Wind Velocity	0 …	50 m/s
Wind Components	-50 …	50 m/s
Wind Direction	0 …	359 °
Wind Direction (with Hysteresis)	0 …	540 °
Temperature	-30 …	50 °C
Clock Inputs (**Option**)	0 …	10 Hz
Pt100 Inputs (**Option**)	-30 …	50 °C
Analog Inputs (**Option**)	-10 …	+10 V
or	-5 …	+5 V

Measuring Resolution

Wind Velocity	± 0.01 m/s
Wind Components	± 0.01 m/s
Wind Direction	± 1 °
Temperature	± 0.01 K
Pt100 Inputs (**Option; 12 bit ± 100 °C**)	± 0.025 K
Analog Inputs (**Option; 12 bit ±10 VDC**)	± 2.5 mV

Time Resolution

Sampling Rate[2]	0.004 … 50 Hz
Averaging Interval	1 … 65535 samples

Time Resolution (**Option** for *Online Calculated Turbulence Parameters*)

Sampling Rate[3]	1 … 40 Hz
Averaging Interval	0, 5 … 3600 s

Analog Data Output, 12 Bit Resolution, 0 (4)…20 mA , 500 Ω max. or 0…10 (5) V

Wind Velocity	0 …	60 m/s	(max. range)
Wind Components	-60 …	60 m/s	(max. range)
Wind Direction	0 …	359 °	
Wind Direction (with Hysteresis)	0 …	540 °	
Temperature	-30 …	50 °C	(max. range)

range adjustable for velocities and temperature

Sensor Orientation

Azimuth	0 …	359 °	(adjustable)

[2] fast version: 0.006 — 50 Hz
[3] fast version: 1 — 20 Hz

Power Consumption

Sensor Electronic	approx.	2.5	W
Low Power Mode (no heating, *SF* < 1000)	approx.	1.5	W
Sensor Heating (Option)	approx.	50.0	W

Dimensions

Sound Paths	175	mm
Sensor Head, Inner Bar Type		
Measuring Head (Ø × Height)	320 × 240	mm
Sensor Height With Integrated Electronic Box	690	mm
Sensor Height With Separated Electronic Box	660	mm
Sensor Head, Outer Bar Type		
Measuring Head (Ø × Height)	320 × 330	mm
Sensor Height With Integrated Electronic Box	780	mm
Sensor Height With Separated Electronic Box	750	mm
Separated Electronic Box (Length × Width × Height)	280 × 180 × 330	mm
Integrated Electronic Box	120 × 120 × 90	mm
Mounting Clamp (inner Ø × Length)	40 × 100	mm

Weights

Sensor Head, Inner Bar Type :				
Sensor Head (Integrated Electronic Box)			2.8	kg
Sensor Head (Separated Electronic Box)			7.1	kg
Separated Sensor Head	1.8	kg		
Separated Electronic Box	3.8	kg		
Sensor Head, Outer Bar Type :				
Sensor Head (Integrated Electronic Box)			3.1	kg
Sensor Head (Separated Electronic Box)			7.4	kg
Separated Sensor Head	2.1	kg		
Separated Electronic Box	3.8	kg		

Adjustable Sampling Frequencies (1/1000 Hz):

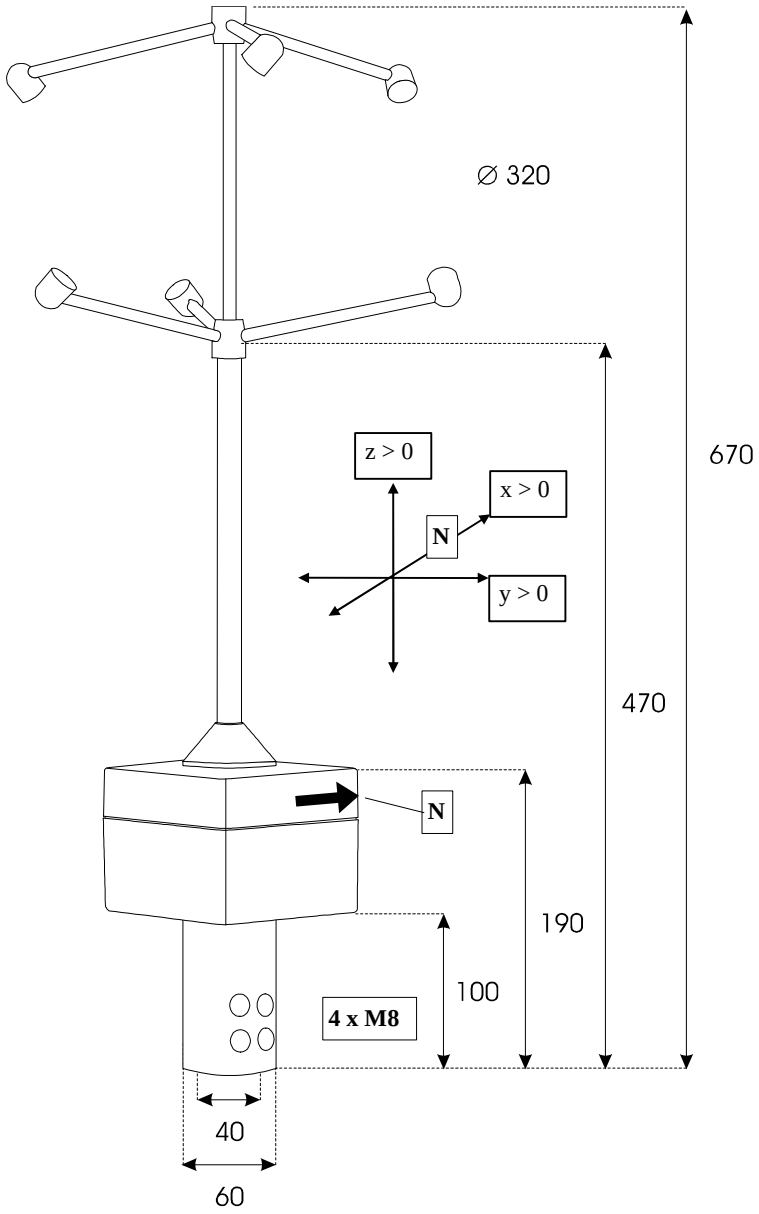
```
    4     5     6     7     8     9    10    11    12    13   ...
  ...   501   502   503   505   506   507   508   510   511   512
  514   515   516   518   519   520   522   523   524   526   527
  529   530   531   533   534   536   537   539   540   542   543
  544   546   547   549   550   552   554   555   557   558   560
  561   563   564   566   568   569   571   573   574   576   578
  579   581   583   584   586   588   589   591   593   595   597
  598   600   602   604   606   607   609   611   613   615   617
  619   621   623   625   626   628   630   632   634   636   638
  641   643   645   647   649   651   653   655   657   660   662
  664   666   668   671   673   675   677   680   682   684   687
  689   692   694   696   699   701   704   706   709   711   714
  716   719   722   724   727   729   732   735   738   740   743
  746   749   751   754   757   760   763   766   769   772   775
  778   781   784   787   790   793   796   800   803   806   809
  813   816   819   823   826   829   833   836   840   843   847
  851   854   858   862   865   869   873   877   881   884   888
  892   896   900   904   909   913   917   921   925   930   934
  938   943   947   952   956   961   966   970   975   980   985
  990   995  1000  1005  1010  1015  1020  1025  1030  1036  1041
 1047  1052  1058  1063  1069  1075  1081  1086  1092  1098  1104
 1111  1117  1123  1129  1136  1142  1149  1156  1162  1169  1176
 1183  1190  1197  1204  1212  1219  1226  1234  1242  1250  1257
 1265  1273  1282  1290  1298  1307  1315  1324  1333  1342  1351
 1360  1369  1379  1388  1398  1408  1418  1428  1438  1449  1459
 1470  1481  1492  1503  1515  1526  1538  1550  1562  1574  1587
 1600  1612  1626  1639  1652  1666  1680  1694  1709  1724  1739
 1754  1769  1785  1801  1818  1834  1851  1869  1886  1904  1923
 1941  1960  1980  2000  2020  2040  2061  2083  2105  2127  2150
 2173  2197  2222  2247  2272  2298  2325  2352  2380  2409  2439
 2469  2500  2531  2564  2597  2631  2666  2702  2739  2777  2816
 2857  2898  2941  2985  3030  3076  3125  3174  3225  3278  3333
 3389  3448  3508  3571  3636  3703  3773  3846  3921  4000  4081
 4166  4255  4347  4444  4545  4651  4761  4878  5000  5128  5263
 5405  5555  5714  5882  6060  6250  6451  6666  6896  7142  7407
 7692  8000  8333  8695  9090  9523 10000 10526 11111 11764 12500
13333 14285 15384 16666 18181 20000 22222 25000
```

Additional Sampling Frequencies for the *Fast Version* (**Option**, Version Numbers 3.xx)

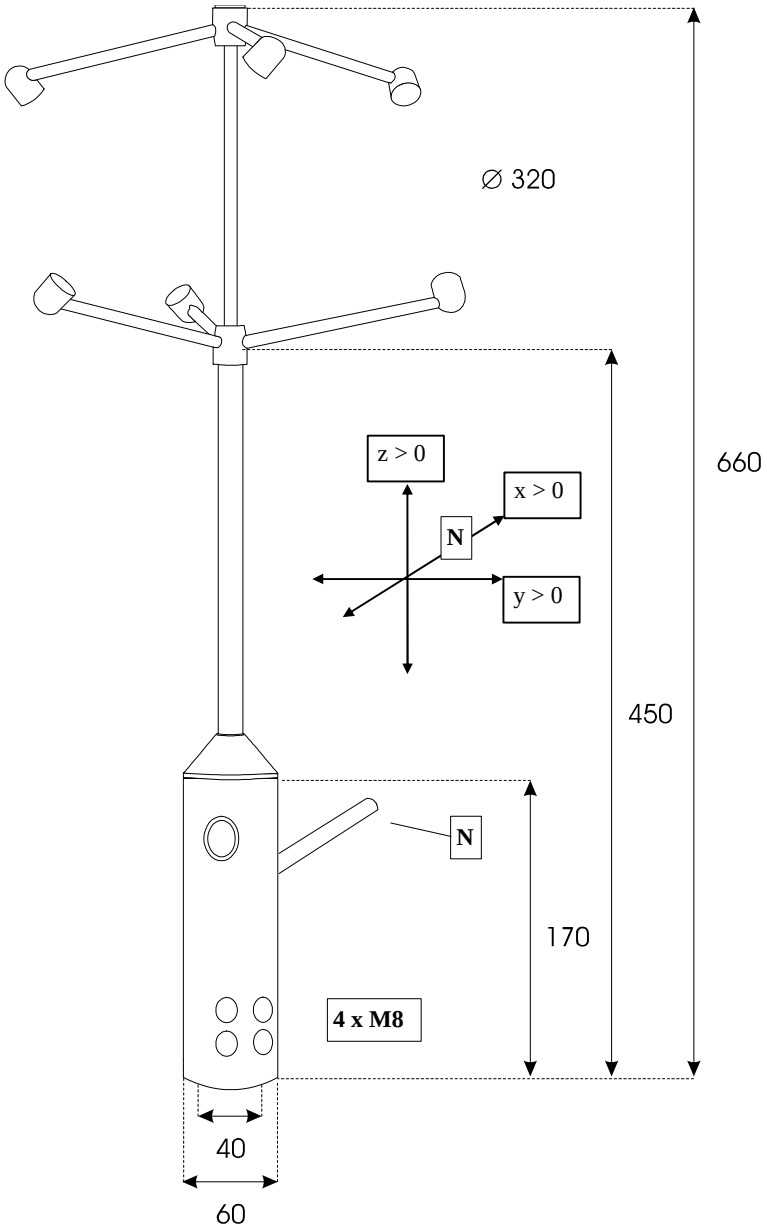
```
  513   517   521   525   528   532   535   538   541   545   548
  551   553   556   559   562   565   567   570   572   575   577
  580   582   583   585   587   590   592   594   596   599   601
  603   605   608   610   612   614   616   618   620   622   624
  627   629   631   633   635   637   639   642   644   646   648
  650   652   654   656   658   661   663   665   667   670   672
  674   676   679   681   683   686   688   690   693   695   698
  700   702   705   707   710   713   715   718   720   723   725
  728   731   733   736   739   742   744   747   750   753   756
  759   761   764   767   770   773   776   779   782   785   788
  792   795   798   801   804   808   811   814   817   821   824
  828   831   835   838   842   845   849   852   856   860   863
  867   871   875   879   883   886   890   894   898   902   907
  911   915   919   923   928   932   936   941   945   950   954
  959   963   968   973   977   982   987   992   997  1002  1007
 1012  1017  1023  1028  1033  1038  1044  1049  1055  1061  1066
 1072  1078  1084  1089  1095  1101  1108  1114  1120  1126  1133
 1139  1146  1152  1159  1166  1173  1179  1186  1194  1201  1208
 1215  1223  1230  1238  1246  1253  1261  1269  1277  1286  1294
 1302  1311  1320  1328  1337  1346  1355  1365  1374  1384  1393
 1403  1413  1423  1433  1444  1454  1465  1476  1486  1498  1509
 1520  1532  1544  1556  1568  1581  1593  1606  1619  1632  1646
```

```
 1659  1673  1687  1702  1716  1731  1746  1762  1777  1793  1809
 1826  1843  1860  1877  1895  1913  1932  1951  1970  1990  2010
 2030  2051  2072  2094  2116  2139  2162  2185  2209  2234  2259
 2285  2312  2339  2366  2395  2424  2453  2484  2515  2547  2580
 2614  2649  2684  2721  2758  2797  2836  2877  2919  2962  3007
 3053  3100  3149  3200  3252  3305  3361  3418  3478  3539  3603
 3669  3738  3809  3883  3960  4040  4123  4210  4301  4395  4494
 4597  4705  4819  4938  5063  5194  5333  5479  5633  5797  5970
 6153  6349  6557  6779  7017  7272  7547  7843  8163  8510  8888
 9302  9756 10256 10810 11428 12121 12903 13793 14814 16000 17391
19047 21052 23529 26666 28571 30769 33333 36363 40000 44444 50000
```

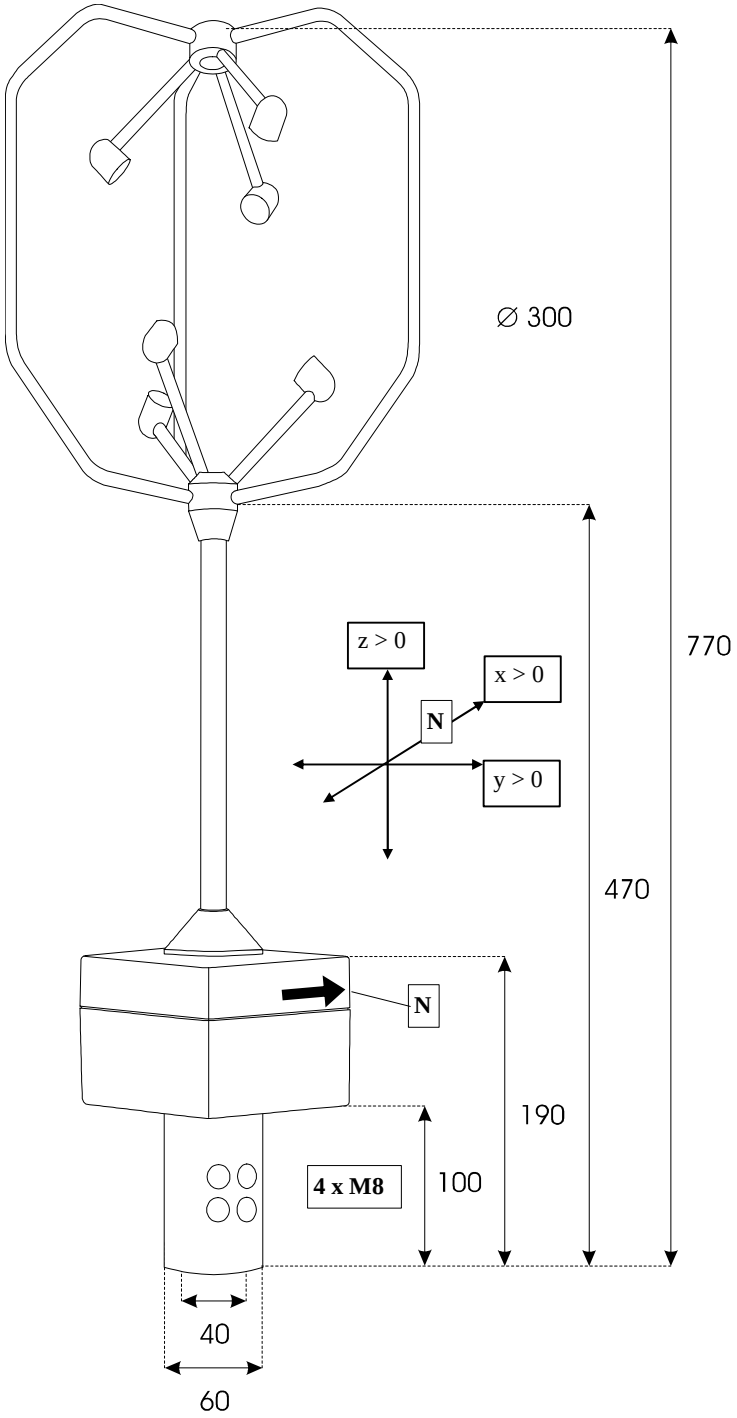
USA-1 Sensor Head
Standard



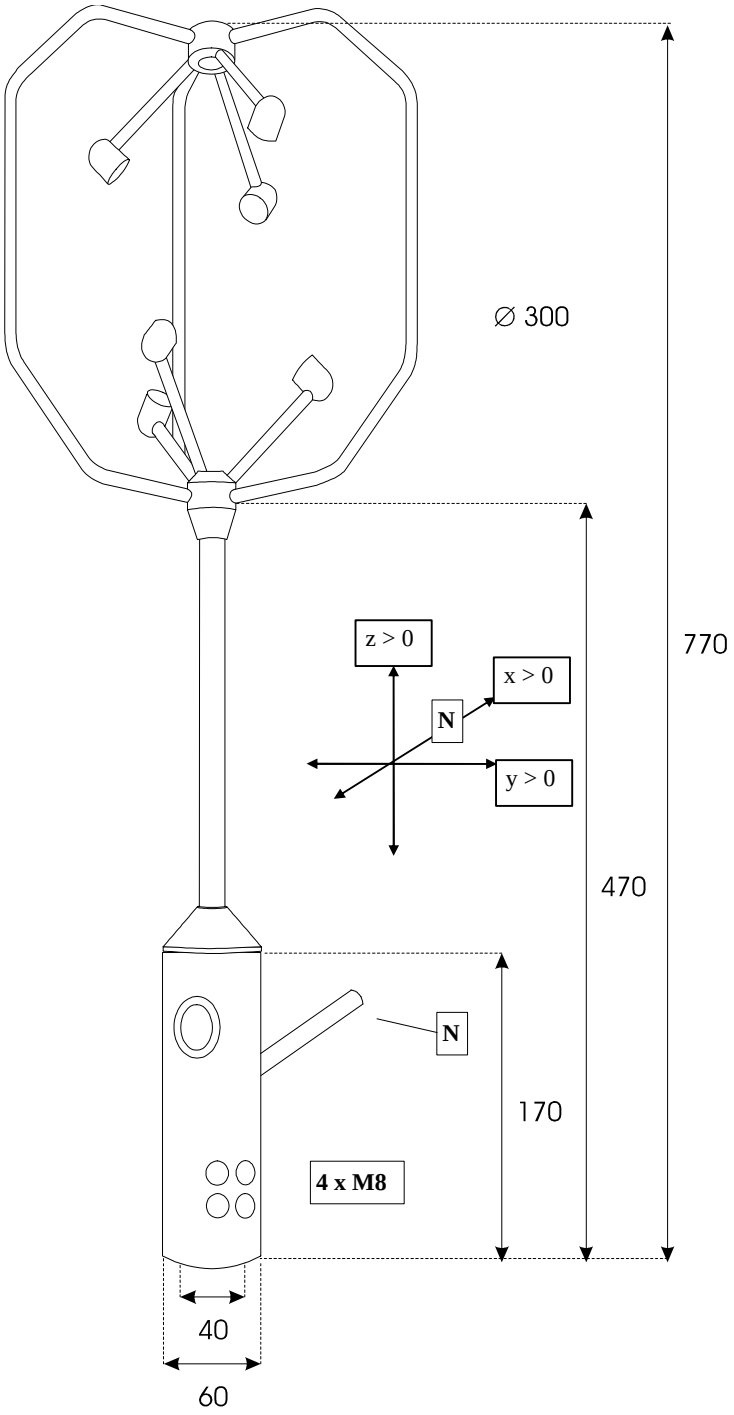
USA-1 Sensor Head
Standard, Separated Version



USA-1 Sensor Head
Outer bars



USA-1 Sensor Head
Outer Bars, Separated Version



Index

—T—

—U—

—V—

—W—

—X—

—Y—

—Z—

USA-1

Serial No.

Adjustments of Operation Parameters

AD = 0		Device Address	M1 =		Modem String
AI=1		Analogue Instantaneous	M2 =		Modem String
AO = 0		Analogue Offset	M3 =		Modem String
AT = 10		Averaging Time	MD = 20		Data Quality Check
AV = 1		Averaging Number	N1, N2, N3		Name Parameters
AZ = 0		Azimuth	NO = 31		NMEA Parameter
BR = 9600		Baud Rate	OA = 0		Output Analogue
D1 = 0		Delay	OD = 1		Output Digital
D2 = 0		Delay	OI = 0		Output Instantaneous
D3 = 0		Delay	PR = 0		Protocol
D4 = 0		Delay	SA = 0		Scalar Averaging
D5 = 0		Delay	SF = 10000		Sampling Frequency
D6 = 0		Delay	SY = 0		Synchronized Averaging
D7 = 0		Delay	TR = 4000		Temperature Range
D8 = 0		Delay	TV = 0		Test Value
DC=		Diffusion class	TZ = 0		Time Zone
FR = 0		Frame	US=1		Mode of ustar-calculation
HC =		Head Correction	VR = 6000		Velocity Range
HT = 0		Heater Control	ZR = 100		Velocity Range (z-comp.)
LD = 0		Log Data			
Analogue Output					
Analogue Input					
Resolution		a2/e3= ±	a3/e4= ±		a4/e5= ±
PT100		a5/e6= ±	a6/e7= ±		a7/e8= ±

Calibration Parameters

Date:							
O1							
O2							
O3							
O4							
O5							
O6							
P1							
P2							
P3							
TC							

Appendix: Data Recording Programs

With this diskette you get software to log the data of several METEK devices on IBM compatible PC.

On the diskette there are six subdirectories:
SRC, DOS, XENIX, WIN32, SUNOS and LINUX.

The subdirectory SRC contains the source codes of the software tools for reference for the operating systems DOS and XENIX. The subdirectories DOS and XENIX contain the executable programs.

The other subdirectories contains the executable programs for the other operating systems. WIN32 denotes the operating systems Windows 95/98 and Windows NT.

Installation on a MS-DOS-System

To install the software on a MS-DOS-system copy the executable programs from the DOS directory to a directory on your hard disk which must be included in the search path. The path is defined by the environment variable PATH usually set within the AUTOEXEC.BAT procedure. Example:

copy A:\DOS*.EXE C:\

Now copy the device driver for the serial interface to the hard disk. Example:

copy A:\DOS*.SYS C:\

To activate this device driver you have to add one or more lines to your CONFIG.SYS file. Example:

DEVICE=C:\V24.SYS C1 B7 X

This line will install the device driver for COM1. To communicate with this interfaces via the device driver the name RS1 must be used instead of COM1. The device driver can handle several serial interfaces. For each interface there has to be added one line (as shown in the example above) to the CONFIG.SYS file. The following options can be entered right behind the name of the driver (V24.SYS):

Cx load driver for the x-th interface

Axxxx interface address = xxxx (4 hexadecimal digits)
(default setting: 03F8 for C1, 02F8 for C2, 03E8 for C3 and 02E8 for C4)

Bx selects the baud rate (if not set by the application program)

x = 0 :	75 Baud	x = 5 :	2400 Baud
x = 1 :	110 Baud	x = 6 :	4800 Baud
x = 2 :	300 Baud	x = 7 :	9600 Baud
x = 3 :	600 Baud	x = 8 :	19200 Baud
x = 4 :	1200 Baud	x = 9 :	38400 Baud

(default: 4800 Baud = B6)

Ixx the driver uses interrupt number xx (2 decimal digits)

Px selects the word length, parity and the number of stop bits
(if not set by the application program)

x = A : 8N2	x = E : 7E1
x = B : 8N1	x = F : 7O1
x = C : 7N2	x = G : 8E1
x = D : 7N1	x = H : 8O1

(default: 8N1 = PB)

X this parameter activates software handshake
(default: deactivated)

The device names (RSx and RSxX) are derived from the parameter Cx. The first name (i.e.RS1) is used to read data from the device. The second name (i.e. RS1X) is used to write data to the device. The DOS programs on this disk expect the first name (RSx) as parameter.

Installation on a Windows (95/98/NT)-System

To install the WIN32 versions of these programs the executable files (*.EXE) have to be copied from the WIN32 directory to a destination directory on the hard disk, which is included in the search path. Example:

copy A:\WIN32*.EXE C:\WINNT

An additional installation of device drivers is not needed.

Extended features of the new USA-1 (Scientific)

Installation on a XENIX-System

To install the XENIX versions of these software tools you have to enter the following commands (we assume there is a directory "/usr/bin" containing all the user defined commands and programs):

```
doscp -r a:/xenix/* /usr/bin
chmod +x /usr/bin/spro /usr/bin/tcopy
```

Make sure that the destination directory (here: /usr/bin) is included in the search path for executable programs.

Installation on a LINUX-System

To install the LINUX versions of these software tools you have to enter the following commands (we assume there is a directory "/usr/bin" containing all the user defined commands and programs):

```
mcopy a:/linux/tcopy /usr/bin
chown uucp.uucp /usr/bin/tcopy
chmod u+s /usr/bin/tcopy
```

Additional the manual pages (i.e. tcopy.1) can be copied by use of 'mcopy' to the directory /usr/man/man1:

```
mcopy a:/linux/tcopy.1 /usr/man/man1
chown bin.bin /usr/man/man1/tcopy.1
chmod 544 /usr/man/man1/tcopy.1
```

Usage of "tcopy"

'tcopy' is a program logging data streams line by line as read from the serial interface. All data transmitted to the serial interface of the PC are written to a file and/or the operating console ("stdout"). In addition "tcopy" can place a date/time mark at the beginning of each received line.

To determine the actual time zone "tcopy" parses the environment variable TZ. This variable should be set to a proper value. Example:

```
set TZ=MEZ
```

Especially for Windows-Systems this setting is essential cause otherwise there could be generated a very detailed description of the time zone name!

To start the program just enter the word "tcopy" and the name of the input device. Optionally the below listed options can be allocated. Each option starts with a slash character ('/') resp. a minus sign ('-') and a (lowercase) character followed by the arguments allowed for the option:

/b baudrate	This option alters the baud rate which is set to 9600 baud by default.
/o outfile	Output data will be written to the file 'outfile'. 'outfile' must be a valid file name. If this option is omitted the output occurs on 'stdout' (the console). Only the DOS and WIN32 version of the program will always generate additional output to the console.
/s	Activates the silent mode, i.e. the program will not print any statistics of the data transfer after the program is terminated.
/t	Activates a leading date/time stamp for each received data line, i.e. each line will start with 12 digits in the format YYMMDDhhmmss. After these digits the name of the time zone is displayed (embedded in one leading and one trailing blank) followed by the contents of the received data line .
/lm	While not using the /o option this parameter will force the program to generate the filenames of data output by itself. These files will be closed and a new file will be created every full minute. The name is generated by the actual date/time and the extension '.dat'. The date/time string building the first part of the filename has the format MMDDhhmm. (DOS and WIN32 versions only)
/lh	Similar to /lm: A new file is created every full hour. (DOS and WIN32 versions only)
/ld	Similar to /lh: A new file is created at 0:00 of each day. (DOS and WIN32 versions only)
/u	unbuffered output (LINUX and XENIX versions only)
/i	interactive mode; all characters entered on the keyboard will be transmitted to the device (DOS and WIN32 only)
/x	deactivation of the XON/XOFF-protocol (WIN32 only)

When entering a erroneous command line a error message and a help message are displayed.

To terminate the program you have to enter a 'interrupt' character (depending on the operating system: control-c, control-break or other). If the -s option is not selected the program will print some statistics on stderr (the operating console).

The command syntax of the tcopy program is:

tcopy [-b baud] [-o outfile] [-s] [-t] [-l m|h|d] [-x] [-u] [-i] line

resp.:

tcopy [/b baud] [/o outfile] [/s] [/t] [/l m|h|d] [/x] [/u] [/i] line

The parameter 'line' should be the name of a device (connected to a port of a USAT-3 or SODAR running the secured standard protocol). For the MS-DOS operating system (V24.SYS device driver required) this could be for example RS1 or RS2. For the XENIX and LINUX operating systems this could be a name of a device (as tty1a or tty2a) or a complete name (including the path) of a device as /dev/tty1a or /dev/tty2a. The WIN32 version of this program expects a interface name of the form COMx (i.e. COM1).

The WIN32 version allows some tokens for the argument to the /o option. This tokens will be replaced with the actual date/time information. The following tokens are recognized:

%a	Abbreviated weekday name
%A	Full weekday name
%b	Abbreviated month name
%B	Full month name
%c	Date and time representation appropriate for locale
%d	Day of month as decimal number (01 – 31)
%H	Hour in 24-hour format (00 – 23)
%I	Hour in 12-hour format (01 – 12)
%j	Day of year as decimal number (001 – 366)
%m	Month as decimal number (01 – 12)
%M	Minute as decimal number (00 – 59)
%p	Current locale’s A.M./P.M. indicator for 12-hour clock
%S	Second as decimal number (00 – 59)
%U	Week of year as decimal number, with Sunday as first day of week (00 – 51)
%w	Weekday as decimal number (0 – 6; Sunday is 0)
%W	Week of year as decimal number, with Monday as first day of week (00 – 51)
%x	Date representation for current locale
%X	Time representation for current locale
%y	Year without century, as decimal number (00 – 99)
%Y	Year with century, as decimal number
%z, %Z	Time-zone name or abbreviation

The percent sign itself must be expressed as %%. Non-existing path names will be generated automatically. The /o option can be comined with the /lm /lh or /ld options.
Additional the WIN32 version supports TCP/IP ports as data source. In this case ‘tcopy’ expects a numerical IP-Adress and a port number as argument for ‘line’. The address part and the port number must be delimited by a colon ‘:’ (example 192.168.1.27:5000).

Usage of "spro"

"spro" processes a secured data transfer protocol as described an detail in the manuals for the USAT-3 and the SODAR manuals. Other devices (i.e. USA-1 or MRR) do not support this type of protocol!

The command syntax is:

spro [-d] [-t timeout] [-b baud] [-o outfile] [-s] line

resp.:

spro [/d] [/t timeout] [/b baud] [/o outfile] [/s] line

The parameter 'line' should be the name of a device (connected to a port of a USAT-3 or SODAR running the secured standard protocol). For the MS-DOS operating system (V24.SYS device driver required) this could be for example RS1 or RS2. For the XENIX and LINUX operating systems this could be a name of a device (as tty1a or tty2a) or a complete name (including the path) of a device as /dev/tty1a or /dev/tty2a. The WIN32 version of this program expects a interface name of the form COMx (i.e. COM1).

Usage of "lcopy"

Extended features of the new USA-1 (Scientific)

'lcopy' is a program communicating with an USA-1 by use of a serial interface (i.e. COM1 or COM2) to read the content of the internal data logger.
Up to now this program is just available in the WIN32 and DOS version. Other devices than the USA-1 are currently not supported.
The correctness of the received data is ensured by use of checksums. Erroneous transmitted data is rejected and will be retransmitted several times. Checksums and control characters are removed from the data stored to a local file, which contains afterwards the data sets in form of plain ASCII text. Cancelled calls of 'lcopy' can be re-invoked without loss of data. Data will be appended to the local file if already existing otherwise the local file is will be created.
To start 'lcopy' just open a MS-DOS command window and enter the word 'lcopy' and the name of the output file and the input device. Alternatively the name of the output file (‘outfile’) can be replaced by use of the option /l. Optionally the below listed options can be allocated. Each option starts with a slash character ('/') for and a (lowercase) character followed by the arguments allowed for the option. ‘outfile’ should be a valid filename. The Windows version accepts for ‘outfile’ as well combinations of tokens, which will be replaced with the actual date/time information. Refer to ‘tcopy’ for a list of recognized tokens.

/b baudrate	This option alters the baud rate which is set to 9600 baud by default.
/d dial	If this option is entered, the program transmits first the string given by 'dial' to the serial interface specified by 'line'. This can be used to setup an Modem connection. In this case lcopy waits for a response of the form CONNECT... before starting the conversation with the USA-1.
/s	Activates the silent mode, i.e. the program will not print any statistics of the data transfer after the program is terminated.
/l	While not entering the 'outfile' parameter this option will force the program to generate the filename of data output by itself. The name is generated by the actual date/time and the extension '.dat'. The date/time string building the first part of the filename has the format MMDDhhmm.
/a address	Optional numerical device address of the connected USA-1 (range: 1 to 99).
Line	The parameter 'line' should be the name of a serial interface (i.e. COM1).

When entering a erroneous command line a error message and a help message are displayed.

To terminate the program you have to enter a 'interrupt' character (control-c, control-break). The program terminates itself when the last data set has been read from the log or when the connection is lost to the device (hang-up of a possible connected Modem or timeout). If the -s option is not selected the program will print some statistics on stderr (the operating console).

The command syntax of the lcopy program is:

```
        lcopy [/b baudrate] [/d dial] [/a address] [/s] /l line
or:     lcopy [/b baudrate] [/d dial] [/a address] [/s] outfile line
```

Example:

```
lcopy /b 9600 /d ATD123 data.dat COM1
```

The data recording is started with 9600 Baud. Before communicating with the USA-1 the string 'ATD123' is transmitted to setup a Modem connection (Hayes compatible Modems will dial the number 123 after receiving this command). The received data is written to the local file data.dat.

Hints on connecting an USA-1 to a Modem

Before connecting an USA-1 to a Modem the Modem has to be configured by use of a terminal program. The commands used for this setup procedure have to be looked up in the documentation of the Modem. It is important to disable both types of handshake (hardware and software). Additional the command echo function and the display of result codes should be disabled. The automatic answering of incoming calls should be activated. Please ensure that incoming calls are answered with the correct baud rate (the same as adjusted for the USA-1!). Further the Modem should be configured to use these parameters after each power-on-reset to avoid malfunction after temporary loss of power. For the physical connection between the Modem and the USA-1 a null-modem cable is required.