# PCS.2000
# User Manual

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# 1 Introduction

The PCS.2000, a mobile Doppler-SODAR ('**SO**nic **D**etection **A**nd **R**anging') system, is a ground based remote sensing system for the measurement of vertical profiles of the horizontal wind vector and turbulence in the lower parts of the atmosphere. Special characteristics of PCS.2000 are:

- µ-Processor-controlled data sampling and data evaluation
- high volume ranging ( > 96 dB) due to low noise amplifiers
- high transmit power ( > 800 W[1] electrical power), providing high data availability even in case of unfavorable site conditions
- spectral analysis by software algorithm (DFT) providing an accurate determination of measured data and height range; no need of filter adjustment
- 3 network ports, selectable output of different data sets for each port
- parameter storage for several sets of operation parameters
- optimization of transmit pulse length and spectral resolution according to selected height resolution
- transmit frequency adjustable for optimized operation performance at sites with noisy frequency bands
- automatic matching (selectable) of transmit power according to signal quality in a selectable height range, providing low annoyance of environment by system operation
- reliable plausibility check of all measured values reported in data sets
- easy to use system operation
- unattended system operation by automatic restart capability after power failure

## 1.1 Organization of this manual

The basic measuring principles of the Doppler SODAR PCS.2000 are explained in chapter 1.2. The installation of the PCS.2000 at the measuring site and the starting procedure of the PCS.2000 are described in chapter 2 and chapter 3. *Before* using the system these chapters should be carefully read and completely understood. The various error messages and their interpretation are discussed in chapter 4. Data output formats for all measuring values are summarized in chapter 5. The technical data of PCS.2000 are listed in chapter 6.

## 1.2 Measuring Principle SODAR

The measuring principle of the mobile Doppler SODAR PCS.2000 is similar to echo sounder or RADAR technique. The SODAR transmits short and high powered acoustic

[1] 300 W for antennas with 24 speakers

pulses of a certain frequency into the atmosphere. A small fraction of the acoustic energy is scattered back from density fluctuations of the atmosphere. Because these micro turbulent density fluctuations are moved by the mean wind flow, the frequency of the backscattered signal is shifted according to the wind component parallel to the propagation of the acoustic waves (Doppler effect). This signals can be received and the frequency shift can be determined by a sensitive receiver. By means of the propagation time of the acoustic wave and the estimated acoustic velocity the distance (or the height range) of the measuring volume can be evaluated. Because the wind vector may be described by three wind components, three independent measurements of different orientations are required. Therefore, the PCS.2000 system consists of one physical acoustic antenna which can be seen as a set of 5 logical antennas. This logical antennas are used for transmission as well as for receiving mode. In order to reduce an interference with environmental noise and to suppress the influence of echoes from fixed targets, the acoustic antenna is lined with an absorbing material. Narrow acoustic beams are achieved by usage of a phased array of 64 resp. 24 high power loudspeakers. The speakers are switched to 4 different phases (0°, 90°, 180° and 270°) to pan the beam to one of the 5 directions, one of them is directed vertically upward.

The transmit frequency, signal power, pulse length and pulse repetition rate of the acoustic pulses of PCS.2000 are either manually adjustable or automatically controlled thus providing optimized parameter matching to the given conditions at the measuring site, to the actual backscattering conditions, to the desired height resolution resp. height range.

As a special characteristic of PCS.2000 a gaussian shaped time signal rather than a rectangular pulse is used for the acoustic pulses and the receiving windows. Therefore, the spectral characteristics of the signal and of the spectral analysis is easily to compute.

The backscattered signal of the acoustic wave is processed by a low noise pre-amplifier and a band-pass filter in order to limit its spectral bandwidth.

Separately for each height step the digitized signals (16-bit-analog/digital converter) are multiplied by a gaussian shaped filter function to avoid side lopes of the spectral signal. The signals are spectral analyzed by a Fourier-Transformation. The resulting instantaneous power spectra (of each acoustic pulse) are averaged for each measuring height and for each logical antenna over the whole averaging interval (incoherent sampling). In order to estimate the spectral characteristics of the background noise, two independent measurements of the background noise are performed before the transmission of the acoustic pulses and analyzed in the same way as the received signal. The derived noise spectra are averaged according to the averaging of the received signal. At the end of the averaging interval the mean noise spectra are subtracted from the mean signal spectra. Due to the averaging process the statistical significance of the averaged noise spectra is highly improved as against the instantaneous noise spectra. This results in a reliable determination and elimination of the environmental noise. Furthermore, the comparison of the averaged spectra of received signal and noise yields a reliable plausibility check of the data quality.

After the elimination of the noise contributions from the residual averaged signal spectra, their moments are calculated by fitting a gaussian-shaped function. The zero-moment corresponds to the signal intensity, the first moment to the radial wind velocity parallel to the acoustic ray path and the second moment to the turbulent variations of the radial velocity. Using a gaussian shaped transmit pulse function as well as a gaussian shaped receiving window enables the software to take account of the effect of spectral broadening due to the limited time function of transmission and receiving.

The incoherent sampling and averaging process improves the signal/noise ratio of the received signal. Therefore, the SODAR system PCS.2000 also can be used even under bad backscattering conditions, e.g. at locations characterized by high background noise.

## 1.3 Measuring Principle RASS

To get the temperature profile in a height range comparable to the SODAR (several hundred meters) the RASS ('**R**adio **A**coustic **S**ounding **S**ystem') measuring principle uses the reflections of electromagnetic waves at refractivity fluctuations. These required refractivity fluctuations occur in the natural atmosphere. They are generated by its turbulent inhomogenities but have very different intensities. For this reason the RASS uses artificial refractivity fluctuations generated by acoustic pulses from the vertical antenna A3 of the SODAR system. This insures a reasonable intensity at a known distribution of wave numbers. RADAR frequency and acoustic frequency must meet the Bragg condition to guarantee a constructive interference. This means that the wavelength of the acoustic waves is half of the wavelength of the electromagnetic waves.
Because the acoustic frequency may vary strongly with the time and the height, which is caused by influence of temperature, the RASS does not use only one single acoustic frequency but a signal covering a specific bandwidth. The mean frequency of the transmitted acoustic signal is adjusted to the measured ground temperature. For an electromagnetic frequency of 1274 MHz ($\lambda_e$ = 0.23 m) this corresponds to a acoustic wavelength of $\lambda_a$ = 0.115 m resulting in a typical mean frequency of 2900 Hz (depending on temperature).
Similar to the measuring principle of the SODAR the reflected RADAR waves will show a frequency shift in comparison with the transmitted waves, which is a measure of the sound velocity. The air temperatures in the different heights can be derived from the sound velocities which must be corrected for the vertical wind measured by the SODAR. The analyzing of the received signal is done by the same algorithms as described above for the SODAR.
The electromagnetic transmitter is running in CW[2]-mode. The used bandwidth is very small therefore and only limited by the frequency stability of the oscillator. Due to the CW-mode the RASS uses separate vertical aligned electromagnetic antennas for transmitting and receiving.

[2] CW = continous wave

# 2 Installation

The PCS.2000 speaker array (phased array) is controlled by a standard PC, by use of a special interface unit and the antenna electronic unit. Further components are the power supply unit and a temperature sensor for readjustment of the acoustic velocity caused by temperature variations.
The PC interface is available as an external device or as a device that can be mounted to a 5¼" disk bay.
The software is delivered on a floppy disk or a CD-ROM. A standard PC with an Intel compatible microprocessor is required for installation. The PC should use one of the operating systems MS Windows NT or MS Windows 2000. You will need a free parallel printer interface (LPT1:), a sound card (contact METEK for questions of compatibility) and a free 5¼" disk bay for the internal PC interface.

## 2.1 Indoor Components

The internal version of the PC interface has to be mounted in a free 5¼" disk bay. The front site should be accessible cause here are the connection plugs for the cables to the antenna electronic and the temperature sensor. Power is supplied from the rear by use of a standard 4-pin PC power connector for disk drives. The external PC interface uses an integrated AC adaptor.
On the rear of the interface you will find a 25 pin DSub plug for connection to the parallel printer interface (LPT1:). Further there are two 3.5 mm stereo jacks, which have to be connected with the line-in/line-out connectors of the sound card.
The LEDs on the front panel of the PC interface will indicate the sequence of operation for the individual acoustical beam directions.

## 2.2 Cabel Connections and Outdoor Components

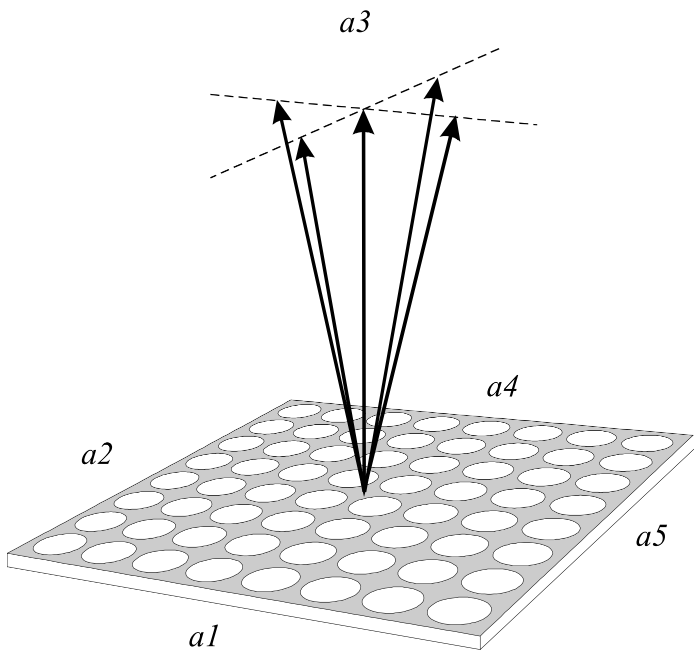
Four of the five logical antennas (*a1, a2, a4* and *a5*) are adjusted by an angle of inclination from about 10 up to 30 degrees (depending on the transmit frequency). The fifth antenna (*a3*) is orientated vertically. When choosing the measuring site and the antenna orientations special aspects should been taken into account.

1. The basic condition of Doppler SODAR technique is a homogeneous wind flow for all three measuring volumes of the three acoustic antennas. Due to their different orientation the measuring volumes are not identical. Therefore, the wind flow at the measuring site should not be affected by orographic structures, especially high buildings.
2. Noisy conditions at the measuring side should be reduced as much as possible. Advantageous orientation of the antenna apart from any sources of noise will contribute to noise reduction.
3. In order to avoid influence of fixed echoes any kind of structures like buildings, trees, and towers should be avoided along the ray path of the acoustic antennas.

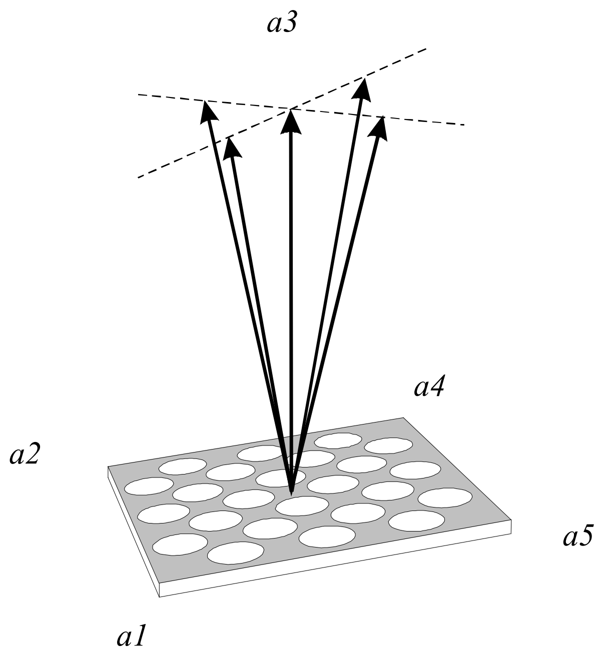
At least the antennas *a1* and *a2* should be setup for undisturbed measurement, because their radial wind components will be used to calculate the horizontal wind velocity. The radial components of the antennas *a4* and *a5* are not used for any further calculations. The zenith angel can be modified by adjustment of the transmit frequency. The azimuth orientation has to be optimized by some test measurements.
The acoustic antenna is designed as an array of 64 resp. 24 high power loudspeakers mounted at the bottom of the acoustic shield. The loudspeakers are supplied and controlled by two cables that must be connected to the antenna electronic according to the identification labels on the sockets and the cables. The antenna electronic is connected to the PC interface and the power supply by two cables of about 25 m length (standard). The latter electronic units must be supplied by 230 $V_{AC}$, 16 A. The PC is specified only for indoor installation with an ambient temperature of 5 – 45 °C. If the components are installed in a rack on the antenna trailer (useful only for mobile version) the temperature should be automatically controlled by a rack/cabinet heating. Usage of an uninterruptable power supply unit is recommended if the supply voltages show deviations or spikes of more than 10% of the nominal voltage. The PT100-temperature sensor must be installed outdoors and should be protected as best as possible against sunlight to avoid temperature deviation.
Afterwards the remaining connections have to be set up. This concerns the connection of PC peripherals (keyboard, mouse, etc.) and the connection of the temperature sensor to the PC interface. Possibly there are other devices to be connected for the different options.

## 2.3 RASS-Installation

The parabolic antennas (receiver and transmitter) must be aligned strictly vertical (check this with a spirit level!). The distance between the parabolic antennas should be typically 5 to 6 meters, where the acoustic phased array must be placed in the middle between the transmitting and receiving RASS antenna.
The electronic RASS-components (signal source, power amplifier and receiver) are typically mounted in a separate outdoor housing.
The power amplifier and the receiver are connected to the parabolic antennas by use of two HF-cables. It is very important to seal the HF-cables at the antenna feeds cause the connectors are not waterproof. The power amplifier gets his input from the signal source by use of a short BNC cable. The receiver has two output connectors, which are labeled with „RASS-NF-Signal“ and „Crosstalk“. These outputs have to be connected to a adapter box which concentrates the two signals to one cable which is connected to the „RASS“ socket on the PC interface. Finally all electronic components of the RASS must be supplied by 230 $V_{AC}$, 16 A.
The crosstalk level between transmitter and receiver antenna is very important for the correct operation of the RASS. The actual level is displayed at the front side of the receiver unit. Additional all data sets generated by the processing/control unit will show the actual value in their header line.
The optimal level is 20 to 40 units on the display which corresponds to –2 to –4 Volt (Refer to the value shown in the header of the data sets. The level can be adjusted by slightly rotating moving of the antennas.




Assignment of beam directions (64 speakers)




Assignment of beam directions (24 speakers)

## 2.4 Installation of Software

As a last step the software has to be installed. The special software for the PCS.2000 is a component of the SODAR control software. The installation procedure is described in detail in its own user manual. As a difference to the standard SODAR control software there is an additional file on the disk: SDR2000.EXE. This file will be copied to the destination folder while installing the remaining software components. The SODAR control software (as described in the separate manual) can be used as well for setup of other conventional METEK SODAR systems.

Now the system is ready for operation (refer to chapter 3).

**Important Note for MS Windows XP:**

The PCS.2000 software uses by default the TCP/IP port 5000 for system setup. MS Windows XP uses this port for „Universal Plug & Play“ (UPnP service).
There are two ways to circumvent this conflict: You may disable the UPnP functionality by disabling (start type: deactivated) the SSDP service (start ? run ? services.msc).
or you may configure the PCS.2000 software to use a different port (ask METEK how to patch this values in the registry (HKLM\SYSTEM\CurrentControlSet\Services\SdrSrvc\...).

# 3 Operation

Use a telnet client to connect to the command line interface (*n0*) of the PCS.2000-system (port 5000[3]) or use simply the SODAR control software with its MS Windows conform graphical user interface. This chapter explains the operation by use of a telnet client. The description of the SODAR control software is published as a separate manual.

## 3.1 Command Language

The PCS.2000 is operated by typing simple commands on the operation console. These commands consist of several input symbols (keywords, numbers, special characters) separated by *spaces*. The commands are terminated by *carriage return*, *newline*, or *semicolon* characters. All keywords may be entered in upper or lower case, and you may abbreviate them by omitting their last characters as long as they differ from all other keywords.
The commands to the PCS.2000 are organized in three classes: control commands, output-related commands, and parameter assignments. These classes are explained in detail in the following chapters.
If you mistype a command the system responds with an error message (refer to chapter 4) and the current input line will be erased.
To correct typing mistakes use the *delete* or the *backspace* keys to 'rub out' or erase the last characters on the line; hitting *control-w* (i.e. holding down the *control* key while typing *w* or *W*) will erase the last word on the line, and hitting *control-u* will erase the entire line. You can erase characters only back to the beginning of the command line. At any time you may redisplay the actual command line on the screen by typing *control-r*; normally, this will be useful when the output of a system message has destroyed your typing.
Another character with a special meaning is the *number-sign* '#' that starts an arbitrary commentary. All characters up to the end of the line are skipped. Such comments may be helpful if you want to feed special command sequences from files. In order to get question marks and other special characters (not *XON/XOFF*!) into user messages or comments the '\' *backslash* (don't confuse with '/') will prevent the next character from interpretation. To get the backslash itself into the text, it must be doubled.
The following table summarizes all characters with a special meaning:

| | |
|---|---|
| *?* | (*question mark*) — output help text |
| *SP* | (*space*) — separator between symbols |
| *HT* | (*horizontal tab / control-i*) — as *SP* |
| *CR*[4] | (*carriage return / enter*) — command terminator, end-of-line |
| *LF* | (*linefeed*) — as *CR* |
| *VT* | (*vertical tab / control-k*) — as *CR* |
| *FF* | (*formfeed / control-l*) — as *CR* |

[3] this port number may interfere with Microsoft Windows XP (refer to chapter 2.4)
[4] will be ignored for network connections

| | |
|---|---|
| *EOT* | (*control-d / end-of-file*) — as *CR* |
| *;* | (*semicolon*) — command terminator (without end-of-line) |
| *DEL* | (*delete / rubout*) — erase last character of line |
| *BS* | (*backspace / control-h*) — as *DEL* |
| *ETB* | (*control-w*) — erase last word of line |
| *NAK* | (*control-u*) — erase entire line |
| *DC2* | (*control-r*) — redisplay input line |
| *XOFF* | (*control-s*) — stop output (*software-handshake*) |
| *XON* | (*control-q*) — resume output (*software-handshake*) |
| \ | (*backslash*) — include following character literally |
| # | (*number-sign*) — remainder of line is commentary |

## 3.2 Starting Up

After power on the PCS.2000 will start the net work server functions for the net work ports listed in chapter 3.5. Operation is resumed according to the last used operation mode. The system will issue some initialization messages and prompts the user for command input, when the user sets up a connection to the operating console *n0*. Manual operation control will only be required after the first installation or when parameters should be changed.
After the first power up procedure or changing of the orientation of the antennas the new configuration should be announced to the control/processing unit, e.g.:

*service*
*zenith = 20*
*azimuth = 0*

Afterwards the remaining parameters can be set (refer to chapter 3.8) and sets of measured values can be selected for output (refer to chapter 3.5).
This basic setting can be saved to the parameter storage. You assign to it a free selectable name with which you can recall this setting to be used again later on (refer to chapter 3.9). Recalling the parameter set will disable the service mode and restrict the operation control.

## 3.3 Operation Modes

The PCS.2000-system is operated in two modes. The *normal operation mode* allows only limited operation control and altering. As far as an operation parameter is to be changed the system must be operated in *service mode*. The purpose of these two types of operation modes is to avoid any unintentionally parameter settings and to provide for uninterrupted measurements and data output via the data ports *n1* and *n2*. Only if the system operation of

the PCS.2000 must be adjusted to other requirements or site conditions the parameter should be altered.
Therefore, it is not possible to use most of the control commands (refer to chapter 3.4) and all parameter settings (refer to chapter 3.8) in normal mode. The same restriction applies to the output commands and output termination commands (refer to chapter 3.5 and 3.6) effecting the data ports *n1* and *n2*. Operations to the parameter storage are locked as well (refer to chapter 3.9). The normal operation mode is left by the command:

*service*

This keyword is of great importance for the reliable operation of the system and must not be abbreviated. This command causes switching to the service mode. The active operation mode is displayed when the *status* command is entered to the system.
For leaving the service mode enter the *reset* command (refer to chapter 3.4), which presets all operation parameters with the values defined by the last *recall* command. Another possibility of leaving the service mode is to reinstall one of the parameter sets stored in the parameter storage using the *recall* command (refer to chapter 3.9).

## 3.4 Control Commands

The control commands influence the basic state of the system. They consist of only one keyword confirmed by the return key. All control commands are listed in the following table (only *service* and *synchronize* are allowed in normal operation mode):

| | |
|---|---|
| *stop* | The actual averaging interval is stopped, i.e. the measurement is paused. |
| *start* | The effect of a possibly previously entered *stop* command is canceled. In any case, the actual averaging interval is terminated and a new one is started. |
| *continue* | The effect of a previously entered *stop* command is canceled. The measurement is continued. If the averaging interval was not paused, this command has no effect. |
| *synchronize* | The current averaging interval will be shortened or extended, so that the ending time/date in seconds *modulo* averaging time will be zero. If the shortened interval is less than half of the averaging interval, the interval will be extended.<br>This command has no effect if the averaging time has been set to 0 for exclusive output of *instantaneous* data. |
| *service* | The system is switched to service mode and the PCS.2000 becomes fully operable. This keyword must not be abbreviated due to the great importance in view of system operation. |
| *reset* | All parameters and variable settings are restored according to the parameter set activated by the last call of the *recall* command (refer to chapter 3.9). The system is switched to normal operation mode. |

## 3.5 Output Commands

The output commands consist of an optional list of ports, an optional list of components (radial and/or vectorial) and a list of kinds of data or system information. The list of ports contains the names of all ports that shall output the data. The names must be separated by space characters and/or a comma. The port list is terminated by a colon ':'. Unless the service mode is entered, the specification of any other ports than *n0* is prohibited. The PCS.2000 supports the following ports:

| | |
|---|---|
| *n0* | Operating console (*TCP/IP*, port 5000[5]) |
| *n1* | Data port (*TCP/IP*, port 5001) |
| *n2* | Data port (*TCP/IP*, port 5002) |

The sequence of output commands is continued by the optional list of names of antennas/radial components concerning all radial measured values and *variables* (measured parallel to the axis of the antennas):

| | |
|---|---|
| *a1* | Antenna 1 |
| *a2* | Antenna 2 |
| *a3* | (Vertical-)Antenna 3 |
| *a4* | Antenna 4 |
| *a5* | Antenna 5 |
| *ar* | (RASS-)Antenna R (*RASS* **option** only) |

Alternatively the vector components can be specified by (refers only to *vectorial component* values):

| | |
|---|---|
| *u* | West-East Windcomponent |
| *v* | South-North Windcomponent |
| *w* | Vertical Windcomponent |

This list is terminated by an colon ':' as well. If the list is omitted all vector components are used for output selection.
The list of information to be output may contain kinds of data from the table below. Those data are calculated and output to the selected ports after each averaging interval.:

| | |
|---|---|
| *height* | Measuring height; unit: m |
| *spectra* | Mean power spectra for each antenna; unit: dB |
| *power* | Mean (peak) power for the power spectra of each antenna; unit: dB |

[5] this port number may interfere with Microsoft Windows XP (refer to chapter 2.4)

| | |
|---|---|
| *reflectivity* | Mean reflectivities for each antenna; unit: dB |
| *radial component* | Mean radial wind components/sound velocity of each antenna; unit: m/s |
| *sigma* | Standard deviations of the radial components; unit: m/s |
| *vectorial component* | Mean wind components in a cartesian earth related coordinate system using West-East, South-North and vertical component for *u*, *v* and *w;* unit: m/s |
| *velocity* | Mean wind velocities in a polar coordinate system; unit: m/s |
| *direction* | Mean wind directions in a earth related polar coordinate system; unit: ° |
| *phisigma* | Standard deviations of the vertical wind inclinations: unit: ° |
| *diffusion* | Stability classes, derived according to various diffusion tables defined by the variable *dcscheme* (refer to chapter 3.8) |
| *temperature* | Temperatures, evaluated from the acoustic velocities, which are possibly adjusted to the vertical wind components (if valid), available only for installed *RASS* **option**; unit: °C |
| *availability* | Availabilities of instantaneous spectra used for averaging for each height step (spectra not rejected due to overload or high ambient noise); unit: % |
| *signal noise ratio* | Weighted ratios between the maximum values of the noise reduced spectra and the maximum difference within the measured noise spectra (variance of noise) or:<br>Weighted ratios between signal powers and the estimated noise powers for *instantaneous* data.<br>unit: dB<br>Zero is defined as the default limit for recognition of erroneous measurements of the corresponding radial components. |
| *plausibility* | Error codes for each antenna (and derived values) according to the various plausibility checks of the instantaneous and mean spectra. If the error codes are not selected for output, all those measured values that have not passed the plausibility checks successfully are marked as invalid.<br>The interpretation of the error codes is described in chapter 5. |

The measurement types *height*, *power*, *reflectivity*, *radial component*, *spectra*, *signal noise ratio* and *plausibility* can be additionally output as *instantaneous* data after each measuring cycle for all active antennas. To do this, the keyword *instantaneous* must precede the name of the according measurement type.

Beyond these types of data, some system information can be inquired by adding their names to the list of output data. You should notice these information are sent to the operating console *n0* only. As distinct from the data output these information are sent immediately and only once per command.

| | |
|---|---|
| *variables* | Output of a list of all system parameters. |
| *status* | Output of actual system status and operation mode ('*stop*', '*service*'), of the remaining *averagetime* for the running averaging interval and a table of ports and the names of the allocated types of data. |
| *ports* | Output of a list for each port including the assigned available height *ranges*, and selected *time zone*. |
| *catalog* | Output of a directory containing all allocated parameter sets of the parameter storage. |

Please notice that all output commands will effect the system status in a cumulative way. Additionally selected ports or types of data will be added to the existing output tasks. Existing tasks will not be affected.

The following examples should help you to understand the syntax and semantic of the output commands:

*n0 n1 : radial component velocity variables plausibility*

— this command line allocates (additionally to eventually existing output tasks) the ports *n0* and *n1* for the output of the radial wind components and the error codes (plausibility) for all antennas, for the output of the wind velocity and once for the output of the system parameters (*n0* only).

*n2 : a3 u : sigma vectorial*

— this command line allocates (additionally to eventually existing output tasks) the port *n2* for the output of the standard deviation of the radial wind component of antenna *a3* and for the output of the west-east windcomponent.

## 3.6 Terminating Data Output

Similar to the output commands the commands for terminating data output start with an optional port list (refer to chapter 3.5) terminated by a colon ':'. This list is followed by an optional list of vector components/antennas (refer to chapter 3.5) and finally the keyword end. If a port list (component list) is given, the command only concerns output tasks for this ports (components), if it is omitted, all ports resp. vector components/antennas will be affected.
You may extend the command by typing a colon ':' and a list of types of data. In this case only the output for the indicated data is terminated (default setting is to terminate all data !).
The effect of a previously entered *stop* command (refer to chapter 3.4) will be canceled by any end command.

Examples:

*end*

— All output allocations are terminated.

*n1 n2 : a1 a2 a3 u : end*

— The output allocations involving the antenna *a1*, *a2* or *a3* or the west-east vector component *u* are terminated for the ports *n1* and *n2*.

*end : velocity direction*

— The output of wind *velocity* and wind *direction* are terminated for all ports.

## 3.7 Protocol Assignment

Protocol assignments consist of a mandatory list of ports (refer to chapter 3.5) terminated by a colon ':' and followed by a keyword shown in the table below, an equal sign '=' and a valid value (possible values are listed in the table). Following the terminating colon ':' of the port list you are allowed to place several such assignments in one command each separated by a comma and/or space characters.

| | |
|---|---|
| *timezone* | This keyword activates the time zone convention for the specified ports. Allowed values for this keyword are:<br>*UTC* Universal Time Convention<br>*GMT* Greenwich Mean Time, equal to *UTC*<br>*MEZ* Central European Time<br>*MESZ* Central European Summer Time<br>Additional an offset may be given to adjust the output even to non european time zones. This offset can be a signed dimensioned number (unit: s) or a signed dimensionless number in the format ±hh or ±hhmm entered directly after the name of the referenced time zone. Positive offsets are used for time zones east of the reference. Negative offsets are used for time zones west of the reference. |
| *set* | Selection of a set of height steps for data output for the specified ports. This set is specified by a list of single measuring heights (Unit: m) and complete ranges of measuring heights (two heights, separated by a colon ':') separated by space. |

Note : To ports on which the *sncprtcl* is activated can assigned neither measuring heights (*set*) nor time zones (*timezone*).

Example:

*n0 n1 : set = 40 : 100 160*

— The data output on port *n0* and *n1* is restricted to the measuring heights from 40 to 100 m, and 160 m

## 3.8 Parameter Assignments

The command line for any parameter setting is started by an optional list of antennas (*a1*, *a2*, *a3*, *a4*, *a5*, and *ar* (*ar* for *RASS* **option** only)), according to the list of vector components in chapter 3.5) separated by a comma and/or space characters, terminated by a colon ':' and followed by any of the below listed parameter names and its assignment to a value. In general, this assignment consists of an equals sign '=' and the new value assigned to the parameter. There may be several assignments separated by spaces and/or a comma on the same line.

*azimuth* The parameter specifies the antenna orientation (compass bearing) of the antenna *a1*. The correct specification is of great importance for any application. The angles of the antennas *a2*, *a4*, and *a5* result automatically dependent on their arrangement to *Azimuth* + 90°, *Azimuth* + 180°, and *Azimuth* + 270°. The horizontal orientation of these antennas can not be set explicitly. Unit: °

*step* Depth of a height interval; allowed are values above 5 m and below the smallest value of an ensemble consisting of

100 m,
the difference between maximum and minimum measuring height and
the doubled minimum measuring height.

Unit: m

*zenith* Vertical antenna alignment (angle relative to vertical direction) of antennas *a1*, *a2*, *a4* and *a5*. The matching *transmit frequency* for the actual environmental temperature is calculated automatically. Allowed values range between 1° and 89°. Typical values are 20 to 30°. Unit: °

*averagetime* Averaging time; typical values are 60 to 600 s. For most standard applications a value of 600 s is required. Alternatively the value 0 can be assigned to this parameter to perform an exclusive output of *instantaneous* data. Unit: s

*minheight* Lowest measuring height (lower limit for the measurement); allowed values range between half of the height step value and the value of the highest measuring height diminished by 50% of the height step value. Unit: m

*maxheight* Maximum measuring height (upper limit for the measurement); allowed values are between the value of the lowest measuring height plus one height step and the lowest height of the ambient noise measurement (see below). Unit: m *noise* Lowest height limit for the measurement of the ambient noise; the time delay after the transmission of the preceding acoustic pulse can be converted to a theoretical height scale using the acoustic velocity. This height scale is used for the measurement of the ambient noise. In principle, this value must be higher than the maximum measuring height, but in order to avoid reliably any interference between the backscattered signal and the ambient noise measurement a height should be chosen from which no more useful signals are expected (typically above 300 m). Unit: m

*date* Adjusting date and time can be done in two ways:

1. Input of a dimensionless number representing date and time using the syntax [[YY]YYMMDD]hhmm ('Y' means numbers of year, 'M' means numbers of months, 'D' means numbers of day, 'h' means numbers of hours and 'm' means numbers of minutes. All number enclosed in brackets '[' ']' may be omitted, if they are not to be altered. This string of numbers can be followed by a time zone (refer to chapter 3.7); if no time zone is specified, the time zone specified for *t0* will be used.
2. Input as a dimensioned number (unit: s), that represents the time period from actual date back to the date of 01 January 1970, 00:00 UTC. This way offers the possibility to use the integrated pocket calculator function of the PCS.2000 to adjust the internal clock (refer to example).

*transmitfrequ* Transmit frequency of the acoustic SODAR signal; allowed are values between 1000 and 4000 Hz. The *zenith* angle resulting from the frequency and the actual environmental temperature will be set automatically. Unit: Hz

*volume* Signal power of the acoustic signal of the three acoustic antennas; if the optional list of antennas is omitted, the adjustment will be active for all antennas! Allowed values range from 1 to 4095 and may be followed by the keyword *auto*. If the numeric value is omitted, the volume keeps unchanged. If the keyword *auto* is used, due to receiving conditions an automatic adjustment will be performed by the system after the end of each averaging interval. Usage of the auto mode is recommended.

*range* Measuring range of each acoustic antenna; if the optional list of antennas is omitted, the adjustment will be active for all acoustic antennas. The values are adjusted by any of the three keywords *lower* (in case of a strong negative radial wind component, i.e. the wind blows parallel to the antenna orientation), *center* (normal conditions with moderate wind components) or *upper* (strong positive radial wind component, i.e. the wind blows antiparallel to the antenna orientation). All keywords can be extended by the keyword *auto* thus providing an automatic adjustment of the measuring range due to the ambient wind conditions. Usage of auto mode is recommended for all non vertical antennas.

Note : The *auto*matic control of the parameters *gain*, *volume*, and *range* is only available for *averagetime* $\neq 0$. Because the statistical quality of *instantaneous* data is too bad to extract parameters for an automatic control.

*dcscheme* Type of reference table for derivation of the stability classes. Allowed values are one of the following keywords:

*t7188* Reference Table 7.1, KTA 1508, Version 9/88

| Class Boundary | A/B | B/C | C/D | D/E | E/F |
|---|---|---|---|---|---|
| $\sigma_\phi$ [°] | 14.5 | 10.5 | 7.0 | 3.3 | 1.8 |

*t7387* Reference Table 7.3, KTA 1508, Version 4/87

| Class Boundary | A/B | B/C | C/D | D/E | E/F |
|---|---|---|---|---|---|
| $u$ [m/s] | $\sigma_w$ [m/s] | | | | |
| 0.0-3.9 | 0.65 | 0.50 | 0.35 | 0.20 | 0.15 |
| 4.0-5.9 | 0.85 | 0.65 | 0.45 | 0.25 | 0.20 |
| 6.0-7.9 | 1.10 | 0.80 | 0.60 | 0.25 | 0.20 |
| ≥ 8.0 | — | 1.00 | 0.75 | 0.25 | 0.15 |

*t7388* Reference Table 7.3, KTA 1508, Version 9/88

| Class Boundary | A/B | B/C | C/D | D/E | E/F |
|---|---|---|---|---|---|
| $u$ [m/s] | $\sigma_w$ [m/s] | | | | |
| 0.0-0.9 | 0.590 | 0.437 | 0.270 | 0.160 | 0.090 |
| 1.0-1.9 | 0.884 | 0.616 | 0.426 | 0.257 | 0.097 |
| 2.0-2.9 | 1.060 | 0.774 | 0.577 | 0.397 | 0.234 |
| 3.0-3.9 | 1.230 | 0.940 | 0.677 | 0.457 | 0.297 |
| 4.0-4.9 | 1.430 | 1.130 | 0.857 | 0.533 | 0.357 |
| 5.0-5.9 | 1.550 | 1.227 | 0.977 | 0.613 | 0.403 |
| 6.0-6.9 | 1.800 | 1.480 | 1.165 | 0.720 | 0.564 |
| 7.0-7.9 | — | 1.590 | 1.370 | 0.900 | 0.645 |
| 8.0-8.9 | — | — | 1.550 | 0.936 | 0.630 |
| ≥ 9.0 | — | — | 1.830 | 0.860 | 0.630 |

*t7488* Reference Table 7.4, KTA 1508, Version 9/88

| Class Boundary | A/B | B/C | C/D | D/E | E/F |
|---|---|---|---|---|---|
| $u$ [m/s] | $\sigma_w$ [m/s] | | | | |
| 0.0-0.9 | 0.651 | 0.498 | 0.311 | 0.211 | 0.155 |
| 1.0-1.9 | 0.605 | 0.443 | 0.310 | 0.192 | 0.145 |
| 2.0-2.9 | 0.579 | 0.447 | 0.335 | 0.200 | 0.147 |
| 3.0-3.9 | 0.653 | 0.500 | 0.353 | 0.218 | 0.157 |
| 4.0-4.9 | 0.804 | 0.543 | 0.402 | 0.247 | 0.173 |
| 5.0-5.9 | 0.870 | 0.645 | 0.450 | 0.251 | 0.175 |
| 6.0-6.9 | 0.957 | 0.699 | 0.508 | 0.257 | 0.173 |
| 7.0-7.9 | 1.350 | 0.820 | 0.572 | 0.260 | 0.190 |
| 8.0-8.9 | — | 0.947 | 0.612 | 0.248 | 0.161 |
| $\geq$ 9.0 | — | — | 0.756 | 0.127 | — |

*prompt* Text which prompts the user to enter commands; it helps to differ between several systems, if they are all used by one console unit. Allowed is any text string embedded either in single (') or doubled (") quotation marks.

*label* Text which is enclosed in the starting line of the measured data set; it helps to identify measuring data of several systems if they are stored on the same devices. Allowed is any text string embedded either in single (') or doubled (") quotation marks.

*RASS* **option** only:

*Distance* Distance between transmitting and receiving RASS-antenna (parabolic mirror); unit: m

Except for the above mentioned parameters you can assign a value to the keyword *synchronize* (refer to chapter 3.4). Possible values are:

*on* A synchronization is forced after each start of a new measuring interval. After a restart of the PCS.2000 or after the *recall* of a parameter set, which was saved with this setting an automatical synchronization is performed.

*center* Similar to *synchronize = on*, but the center of each averaging interval is referenced for synchronization. All subsequent averaging intervals will be shortened or extended, so that the ending time/date in seconds *modulo* averaging time will be half of the averaging time.

*off* The synchronization is disabled.

Examples of assignment commands:

*ave = 600*

— The averaging time is set to 600 seconds.

*a1 : range = upper auto*

— The measuring range of antenna *a1* is set to upper range (strong positive radial wind component) and automatic adjustment due to the measured radial wind component.

## 3.9 Usage of the Parameter Storage

The parameter storage is used to store several sets of parameters. This utility simplifies the correct adjustment of the various parameter if they have to be altered frequently due to different applications or measuring sites. Each parameter set can be adjusted in service mode by the commands described before and stored identified by an unique name. In service mode a stored parameter can be recalled any time by this name. The PCS.2000 will be switched to the same state that was valid when saving the parameter set, but now working in normal operation mode. The directory of the parameter set names can be requested any time by entering the command *catalog* (refer to chapter 3.5).
Several commands are available for usage of the parameter sets. They all consist of one of the keywords listed below and an arbitrary unique name representing a certain set of parameter values. This name should start with a letter followed by letters and/or digits and should be different from all other command keywords. Other names must be entered in single (') or doubled (") quotes. In this case blanks and special characters are allowed, too. It should be noted that the system differs between small and capital letters. The following keywords are possible:

| | |
|---|---|
| *save* | The present parameter set is stored. The text string following this keyword is used as the name of this special set of parameters. If this name already exits, the present parameter set replaces the old one. The operating mode is not changed. |
| *recall* | This command is only allowed in service mode. The requested parameter set assigned to the specified name is activated. |
| *delete* | The specified parameter set is deleted in the directory of parameter sets and the allocated memory is released for further usage. The actual operating mode is not changed. |

Examples:

*save xyz*

— The present parameter set is stored and will be identified from now by the name *xyz*.

*recall xyz*

— The parameter set identified by the name *xyz* is activated, the *program* list is erased and the system is switched to normal operation mode.

*delete xyz*

— The parameter set with the name *xyz* is deleted from the directory. The parameter set can not be used anymore. It only can be restored by using the keywords mentioned in the last chapters for parameter setting.

## 3.10 Notes to the Network Usage

The PCS.2000 can communicate with other machines and terminals which support the *TCP/IP-Protocol*.
The communication is carried out by the logical network ports *n0*, *n1* and *n2*, which are assigned to the *TCP/IP ports* 5000[6], 5001, and 5002. *n0* is the operating console. The connecting and disconnecting can be performed by opening and closing the *telnet* program. On a machine running with the UNIX operating system such a call could look like this:

*telnet 192.168.1.10 5000* *# connect to n0 or*
*telnet 192.168.1.10 5001* *# connect to n1*

where *192.168.1.10* is the *TCP/IP address* of the PC controlling the antenna electronic. For a detailed description of such programs refer to the documentation of the respective operating system or the used network terminal.

**Important:** Besides consider that *each* user in a network can access (and control) the device! A simultaneous access of the same port by several users is not possible.

[6] this port number may interfere with Microsoft Windows XP (refer to chapter 2.4)

# 4 Error and System Messages

All error messages reporting system malfunctions, erroneous input commands, and most of the system messages which give informal comments about the system operation are printed out on the console interface *n0*.
Assuming *label* is set to '*SDR*' all messages are opened by a leading text string of the following form:

```
SDR 980608142938 MEZ ...
```

Error messages differ from informal system messages by their leading question mark '?'. The informal system messages are discussed in the following text. After user connects to port *n0* a system message is printed out on the console:

```
M E T E K  S O D A R - S y s t e m PCS.2000
```

The system message

```
resetting parameter to ...
```

reports the name of a stored parameter set if the parameters were restored by their previous values using the *reset* command (refer to chapter 3.4).

The errors are divided into several classes: syntactic and semantic mistakes by the user, transient errors of other origin and errors caused by severe hardware or software faults. Typical error messages of the first type are:

```
syntax error
```

— reports erroneous command input; further information about the allowed input at the point of mistake may be inquired by typing a question mark '?' (refer to chapter 3.1).

```
please, enter service mode to do this
```

— command is allowed only if the system is operated in service mode.

```
illegal value: ... <= ... <= ...
```

— these error messages report unmatched assignments of system parameters.

```
not allowed for the antennas given
```

— the user tried to change the *azimuth* orientation of an antenna with a specific angle resp. to change the *zenith* angle of the vertical antenna (*a3*) to a value unequal zero. If the system includes the corresponding option, it also results in an error message when you try to assign a non zero value to the *zenith* angle or a *range* to a RASS antenna.

```
starting value (...) > ending value (...)
value between two rangegates: ...
```

— error while trying to assign a height *set*.

`no parent entry for reset`

— the *recall* command must be used at least once, before calling *reset* the first time.

`... not found`

— a parameter set with the entered name is unknown.

`no slot free for ...`

— the memory for the various parameter sets is completely occupied and no memory space is available for further entries

`name too long: ...`

— names for parameter sets are limited to a length of 60 characters

`quotes (...) missing`

— the closing quotation mark of a character string is missing

`line too long`

— the lengths of command lines are limited to approx. 500 characters

`illegal timezone`

— an illegal *timezone* has been entered (not within the range from `UTC-1200` to `UTC+1200`).

The following error messages depict transient faults:

```
antenna ... defective
PT 100 defective
```

— the reported units are either defect and have to be replaced or they are not connected to the system.

Serious problems are reported by the following messages, which are not expected to occur in normal operation mode. They indicate severe faults in the hardware or software:

```
operating system error: ...
internal parameter error: ...
network error: ... errno ...
illegal symbol: #...
unknown error in function ...
domain error in function ...
singularity in function ...
overflow in function ...
underflow in function ...
total loss of significance in function ...
partial loss of significance in function ...
```

# 5 Data Output Formats

Each output is started by a preceding header line. This header line is started by a text string consisting of a *label* indicating the used measuring device (e.g. 'SDR') followed by a blank character, a 12-character date/time string (format YYMMDDhhmmss), another blank character and an abbreviation for the used *timezone*. The time specifies the time instant when the data are generated (calculated) and corresponds for measurement value output to the end of the averaging interval.
An ordinary data set (averaged data) starts with a summary of the most important system parameters in the following format: 1 blank character, a 3-character abbreviation of the parameter name and the parameter value represented by a 6-digit floating point number. Some parameters have three values according to the three antennas (for *RASS* **option**: partly two or four). All parameters are listed below in the given order:

| | |
|---|---|
| AVE | *averagetime* |
| MIN | *minheight* |
| MAX | *maxheight* |
| NOI | *noise* |
| STP | *step* |
| VOL | *volume* (5 or 6 values) |
| XMT | *transmitfrequ* (2$^{nd}$ value for *RASS* **option**) |
| MIX | Mixing Frequencies (determined by *range* or ground temperature) (5 or 6 values) |
| SMP | Sampling Frequency (= half of *RASS* sampling frequency) |
| AZI | *azimuth* (5 values) |
| ZEN | *zenith* |
| TMP | Ground Temperature |
| DST | *distance* of the transmitting and the receiving *RASS* antenna (*RASS*-**option** only) |

If the system is operated in service mode the string 'SRV' is appended to the header line. In normal operation mode the line is finished or it is terminated with a string of the form 'EL*x*'. This string will only be generated if an error occurred within the last averaging interval. $x$ denotes the error level. Errors with $x \geq 5$ are severe.
For the output of *instantaneous* data this header line is restricted to the *label* and the date/time/*timezone* parameters.
The lines containing the measured data are printed out after the header line in a fixed text structure. Instantaneous and averaged data use the same format. Each line is started by a 3-character abbreviation of the measured data type. The data themselves are listed as 6-digit number, each number represents the measured value in a certain measuring height. The types of the measured data are listed below (the lower case letters *a* indicates the number of a radial component/antenna: 1 ... 5, R (R for *RASS* **option** only); *c* indicates a vectorial component: U ... W and *n* counts the spectral lines: 0 ... 9, A ... V):

| | |
|---|---|
| H | *height*; Unit: m |
| F*na* | *spectra*; Unit: dB |
| P *a* | *power*; Unit: dB |
| R *a* | *reflectivity*; Unit: dB |
| VR*a* | *radial component*; Unit: m/s |
| VV*c* | *vectorial component*; Unit: m/s |
| V | wind-*velocity*; Unit: m/s |
| D | wind-*direction*; Unit: ° |
| S *a* | *sigma* of radial components; Unit: m/s |
| SD | *phisigma* (Standard deviation of wind inclination); Unit: ° |
| DC | *diffusion* classes; (see below) |
| TMP | *temperature* (*RASS* **option** only); Unit: °C |
| DA*a* | *availability*; Unit: % |
| SN*a* | *signal noise ratio*; Unit: dB |
| ER*a* | *plausibility* codes; (see below) |

All values within a data set are coded (right-aligned) into 6 characters each; the first character can only be a space or minus sign. The numbers consist of a minus sign, if necessary, one or more digits followed by a decimal point ('.') and some other digits (trailing zeros are discarded, a decimal point appears only if it is followed by a digit). Alternatively, if the number is too big or too small for the first form, the leading digit is followed by an 'e', a sign ('+' or '-') and 2 digits for the exponent. Invalid values and such exceeding $\pm 10^{99}$ are replaced by 6 spaces, otherwise the values are rounded to the nearest representable one.
The *diffusion* classes are printed as upper case letters (A ... F) preceded by 5 leading spaces.
The plausibility codes represent the results of the plausibility test which are performed on the instantaneous power spectra as well as on the averaged power spectra. They are displayed within 6 characters as right-aligned octal numbers (number to the base of 8) each with a leading zero. The results of the various tests affect single bits in the displayed code which are accumulated by the logic or operator:

| bit | octal code | meaning |
|---|---|---|
| 0 | 00001 | Saturation of the receiver for one or several samples. The affected instantaneous spectra are rejected and not used in the averaging process. The measurements are not influenced by the saturation events. |
| 1 | 00002 | High level of white noise for one or several samples. The affected instantaneous spectra are rejected and not used in the averaging process. The measurements are not influenced by the white noise events. |
| 2 | 00004 | Local maximum in the spectra too strong as compared to the main/absolute maximum. Local maxima can be generated by fixed echoes, high ambient noise of certain frequencies. The computed radial components and all derived values are invalid. |
| 4 | 00020 | Signal/Noise ratio too low. The computed radial components and all derived values are invalid. |
| 5 | 00040 | Low statistical significance of the measured backscattered acoustic signal. Most of the instantaneous signal spectra have been rejected. The computed radial components and all derived values are invalid. |
| 6 | 00100 | Low statistical significance of the measured ambient noise. Most of the instantaneous noise spectra have been rejected. |
| 8 | 00400 | The maximum of the averaged signal spectrum is too slim as compared to the theoretical value. The computed radial components and all derived values are invalid. |
| 9 | 01000 | The maximum of the averaged signal spectrum is too wide. The computed radial components and all derived values are invalid. |
| 10 | 02000 | The maximum of the averaged signal spectrum is smaller than the maximum of the averaged noise spectrum. The computed radial components and all derived values are invalid. |
| 11 | 04000 | The standard deviation as computed by the width of the averaged signal spectrum shows an imaginary value. If the atmospheric turbulence is very low (below 15 cm/s) this error message can occur frequently. The sigma-value must be set to zero. |

If the error code "0" is given, all tests have been passed successfully and the computed radial wind component is valid. According to the given table the radial components are qualified as valid or invalid. This qualification extends also to the measurement values *power, reflectivity, radial component* and vertical *vectorial component* wind component. The derived values wind *velocity*, wind *direction* and the other vectorial wind components are valid, if at least the radial components of antenna *a1* and *a2* are valid (if the vertical wind component is invalid, it is assumed to be zero which holds for most conditions for averaging interval ≥ 600s). The values for *sigma* is valid if the corresponding radial component is valid. The

derived values *phisigma* and the *diffusion* classes are valid only, if all three radial wind components are valid. The calculated *temperature*s (*RASS* **option** only) are valid if the *ar* component is valid (the vertical wind component, which is used for correction, is assumed to be zero if *a3* is invalid). If the *plausibility* codes are not requested for output the invalid data are replaced by blanks.
Only those lines containing measured values selected for data output are printed out. In the height ranges used for the measurements of the ambient noise (512.5 m and 537.5 m in the example below) only the data types *height, spectra*, and *plausibility* are available. The following example shows a typical data set (without *RASS* **option**):

```
SDR 900801104706 MEZ AVE   600 MIN  37.5 MAX 182.5 NOI   500 STP    25 VOL  4095
  4095  4095 XMT  2131 MIX  2131  2131  2131 SMP 222.1 AZI   357   267     0 ZEN
    20 TMP 26.46
H      50    75   100   125   150   175 512.5 537.5
R 3 113.7 106.7 103.4 98.35 96.08 95.08
VVW  0.41 0.374 0.589 0.434 0.052 0.161
V   0.521 1.277 3.138  2.54  1.42 3.275
D   303.4 346.2 344.6 356.9 27.63 36.42
S 3 0.898 0.569 0.472 0.823 0.866 0.795
SD  21.29 16.57 8.009 14.13 18.49 11.72
DC      A     B     C     A     A     A
ER1     0     0     0     0     0     0     0     0
ER2     0     0     0     0     0     0     0     0
ER3     0     0     0     0     0     0     0     0
```

According to the output of the measured data the output of requested informal messages is started by the mentioned text string of the header line. With the system parameters, the text string is followed by a space, the keyword *variables* and a colon ':'. The next lines hold the parameters, each denoted by its name, its value(s) and, if applicable, its physical dimension. Example with parameter information for all acoustic antennas *a1*, *a2*, and *a3*:

```
SDR 900731134049 MEZ variables:
averagetime: 600 s  transmitfrequ: 1674.1 Hz
minheight: 37.5 m  maxheight: 362.5 m  step: 25 m  noise: 500 m  fixedech
o: 150 m
dcscheme: t7387  testvalue: 0

antenna 1:
azimuth: 357 dgr  zenith: 20 dgr  range: center auto  volume: 4095 auto
gain:   512  512  512  512  512  512  512  512  512  512  512  512  512
  512  512  512  512  512  512  512  512  512  512  512  512  512 auto

antenna 2:
azimuth: 267 dgr  zenith: 20 dgr  range: center auto  volume: 4095 auto
gain:   512  512  512  512  512  512  512  512  512  512  512  512  512
  512  512  512  512  512  512  512  512  512  512  512  512  512 auto

antenna 3:
azimuth: 0 dgr  zenith: 0 dgr  range: center   volume: 4095 auto
gain:   512  512  512  512  512  512  512  512  512  512  512  512  512
  512  512  512  512  512  512  512  512  512  512  512  512  512 auto
```

The (dummy) gain values are printed just for reasons of compatibility to other METEK SODAR systems.
The header line for the state information consists of the leading text string mentioned above, a space, the text 'system status' and a colon ':'. The next line reports the actual system operation mode by displaying '- stop -', '- service -' and/or '- synchronized -' resp. '- synchronized (center) -' or nothing (empty line). The following lines show the remaining averaging time and the ground temperature. After that a table is displayed showing up the set of selected measuring values for each ports. Example (without *RASS* **option**):

```
SDR 900731134053 MEZ system status:
- stop -- service -
```

```
remaining averagetime: 594 s  temperature:   7.5 C

defaults: t0    a1 a2 a3    u v w

 t0   t1   t2  dac
 x    x    x        height
                    spectra
                    power
 3    3    3        reflectivity
                    radial component
 W    W    W        vectorial component
 x    x    x    x   velocity
 x    x    x    x   direction
 3    3    3        sigma
 x    x    x        phisigma
 x    x    x    x   diffusion
                    availability
                    signal noise ratio
123  123  123       plausibility
```

The message for the state of the *ports* with their assignment timezones, and height sets is displayed as shown in the next example:

```
SDR 900731134056 MEZ port status

      port  protocol  timezone  baud  bits parity  set

        n0  stdprtcl       MEZ                     20 : 330
        n1  stdprtcl       MEZ                     20 : 330
        n2  stdprtcl       UTC                     20 : 330
```

The *catalog* listing of the parameter storage consists essentially of a table containing for each stored parameter set its logical slot number, the slot number of the parent parameter sets, date and time of last modification and finally the parameter set name. The parameter set with the slot number 0 has no name and is always existing. This is the currently used parameter set, whose contents can be displayed by the *variables* command. The table is followed by a line showing the actual memory usage. Example:

```
SDR 900731133829 MEZ catalog

  slot  parent     date/time  name

     0       1  900716124536
     1       0  900716124536  startup
     2       1  900716125025  brokdorf
     3       1  900716125623  grohnde
     5       1  900719094014  wuergassen

         5 entries, 53 free
```

# 6 Specifications

**Measuring Ranges**

| | |
|---|---|
| wind velocity | 0 — 35 m/s |
| wind direction | 0 — 360 ° |
| standard deviation radial wind comp. | 0 — 3 m/s |

**Measuring Accuracy**

| | |
|---|---|
| wind velocity (0 — 5 m/s) | ± 0.5 m/s |
| wind velocity (5 — 35 m/s) | ± 10 % |
| wind direction(0.8 — 35 m/s) | ± 5 ° |
| radial wind components | ± 0.1 m/s |
| standard deviation radial wind comp. | ± 0.15 m/s |

**Measuring Heights**

| | |
|---|---|
| lowest measuring height (adjustable depending on height resolution) | 10 m |
| height resolution (adjustable) | 5 — 50 m |
| data availability (depending on site conditions and system parameter) | 80 % up to 200 m |

**Transmit Frequency**

| | |
|---|---|
| acoustic: adjustable | 1.5 — 3 kHz |
| electromagnetic (optional/RASS) | 1290 MHz |

**Power Consumption**

| | |
|---|---|
| PC with interface | 230 V, 250 W |
| power supply unit | 230 V, 130 W[7] |
| RASS electronic unit (optional) | 230 V, 350 W |
| Low power version PCS-2000/24 LP | 230 V, 90W |

**Data Transfer**

| | |
|---|---|
| network connector | 10/100 Mbit/s, Ethernet |

[7] 50W for antennas with 24 speakers

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