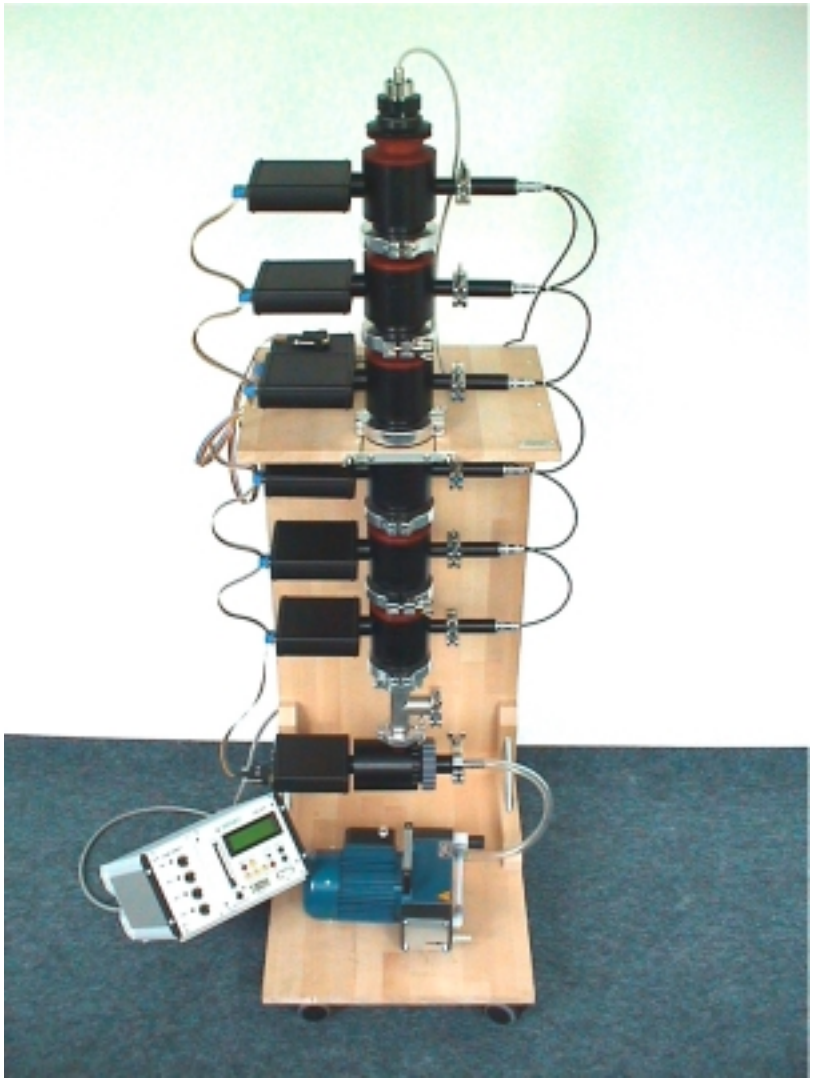
SARAD® GmbH
ENVIRONMENTAL INSTRUMENTS



6 Stage Impactor
SARAD Goettingen ASDA 02

MANUAL

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Technical specification

Cascade impactor Göttingen SARAD ASDA 02

Impactor stages:

Number : 6 (on request up to 8)

Cut-off:

STAGE	$D_{ae50'}$[nm]
6	1939
5	1095
4	626
3	343
2	158
1	72

Material (tubes and orifice): Al, anodised

Foil: 2,5 µm, replaceable

Foil holder: motor driven, slow motion to prevent thick layering of collected aerosols e.g. loss of energy resolution

Screen characteristics:

Cut-off diameter: 3,25 nm

On request: diffusion battery to remove unattached fraction from the sucked air

Filter characteristic:

Back-up filter (absolute) glass fibre, diameter 47 mm

Flow characteristics:

Flow rate: approx. 550 l/h

Pressure difference at stage 1: 0,24 (impactor / atmospheric air)

Transfer pump: oil-less membrane pump, 0,83 m³ / h, vacuum <= 75 mbar

Alphaspectrometer Spectra 5031

(each stage and screen as well as backup filter is equipped with a Spectra 5031 unit)

Channels: 256...4096

Detector: 400 mm² Si surface barrier detector, light protected with 500 nm Al, depletion thickness minimum 100 µm.

Characteristics: ADC dead time 80µs for all channels, max. count rate ~10.000 counts s^{-1}, rise time min. 4 µs, max. 30µs, detector bias 8...36 V.

MEDAS CPU 517

device control and acquisition unit,

Time-step controller operating system for programmable remote control of up to 15 modules via twisted pair wire connection (CAN bus), free adjustable measurement cycles with selectable step operations e.g. access to connected modules

QUAD SWITCH

4 bistable relais outputs (switcher) to actuate external operators i.e. pump and motor drives

Generals:

Power supply: 220 V , 50-60 Hz, 110 V on request

Weight: approx. 55 kg

Height: 130 cm

Holder / stand: Wood, with rolls and board for CPU 517

Introduction

Unpacking

First make sure that every item of the below described packing list is part of the delivery. Take all the materials out of the packing boxes and place them on a clean table for best view.
If anything is missing, please call SARAD GmbH immediately at ++49-351-6580721 or via e-mail saradgmbh@aol.com-

Packing list:

wooden stand, consist of 10 parts (boards and nooks)
6 impactor stages, each with spectrometer unit, motor driven foil holder and orifice plate
1 screen array with detector and separate spectrometer
1 absolute filter stage with spectrometer
1 T-junction to connect a pressure gauge
6 stage clamps
6 motor clamps
3 clamps for T-junction
1 reducer between stage 1 and T-junction
1 clamp for pump connection
1 pressure gauge with pressure sensor and stopper
1 screw-in tool to replace the orifice
fibre-glass filter (10 pieces)
impactor foil
Device control and data transfer module MEDAS (CPU 517 and Quad-Switch)
Cable connection CAN socket to spectrometer unit
Cable connection switch SW 1 to motor
Cable connection switch SW 2 to power socket box
Vacuum pump ILMVAC MP 102E with manual
Manual

General safety instructions

The cascade impactor is a state-of-the-art measurement system, versatile to use for all your needs. Although its use is easy, for your own safety and for a proper operation of the cascade impactor, please read carefully the following instructions:

- Always operate the impactor fixed in his stand in a vertical position!
- Make sure that the impactor is protected against a tip over by its safety chain
- Do not expose the device to rain or any other excess moisture.
- Do not allow liquid to be sucked into the inlet.
- Do not allow corrosive steam or areosols to be sucked into the inlet
- Avoid excess dust content.
- Never operate the impactor without a n installed foil in the stage to protect the detectors.

- Always check carefully weather the motor run or not during sampling.
- Do not unscrew the black bottom of a stage, it will disturb the calibration of the stage. Of coarse it is allowed to unscrew the red top to replace the orifice plate and to change the foil!

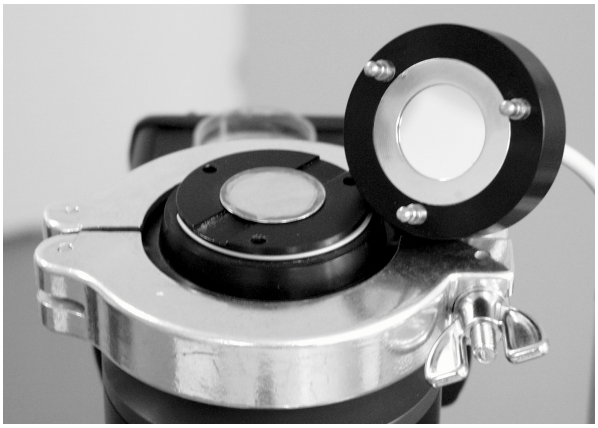
- Read the manuals for the pump and the pressure gauge as well very carefully.

- Pump and MEDAS unit are operated with 220 V (110 V) power supply. Take care for the risk!

Do not open or try to repair in case of a failure neither the vacuum pump nor the MEDAS system!

Maintenance

- To clean the screen array, remove the top detector and replace the screen array holder. Clean the screen with compressed air and wash it in distilled water to clean it.

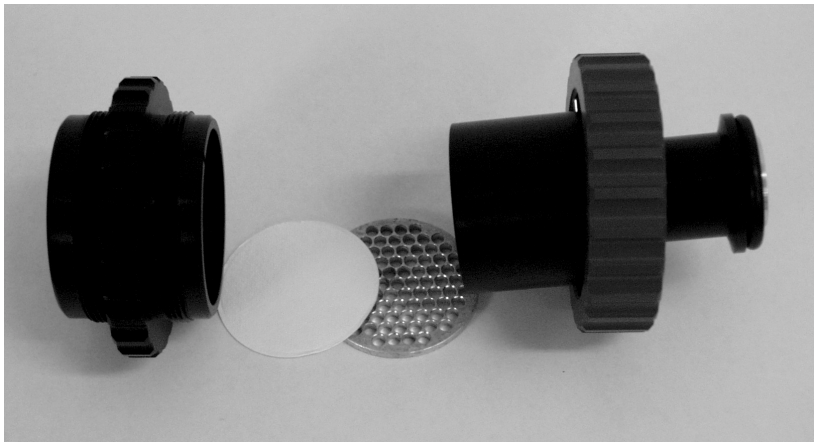


Screen with replaced detector head

- To renew the foil, sever the impactor at the appropriate stages by removing the clamp. Unscrew the red top of the stage and replace the orifice using the grey handy tool. Substitute the old used foil by a new one by replacing the outer ring that fixes the foil on the impactor plate. Do not forget to insert the collimator before pulling the new foil on the holder. The foil has to be fixed without any folds! The best way is to fix the foil with the ring and after that press the whole foil holder on a flat ground i.e. table.

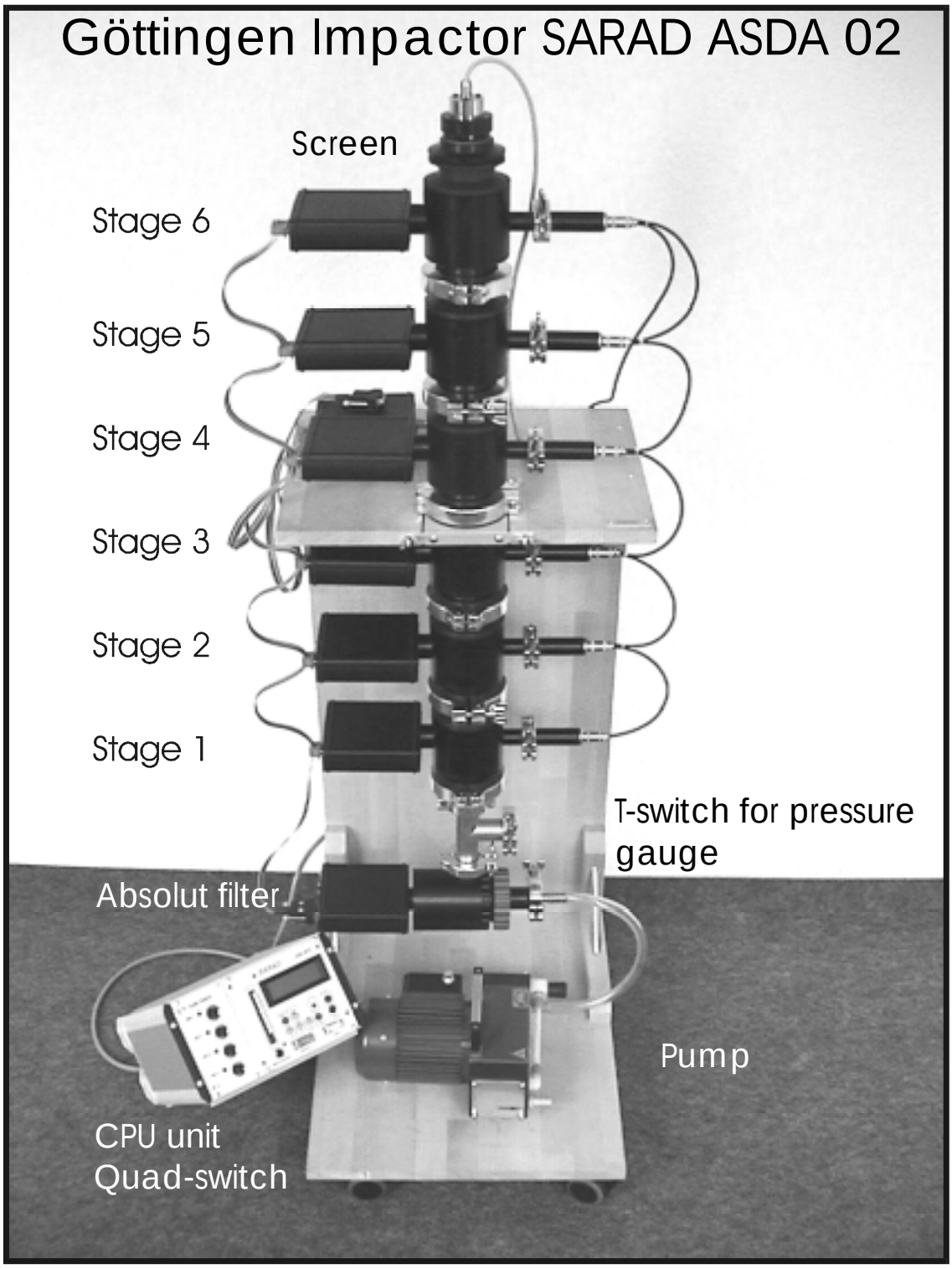
Impactor stage with removed red inlet tube. One the left can see the orifice with screwed on tool, the right picture enables an insight on the foil which covers the detector.

- To renew the filter, unscrew the tube to the pump and loose the front end of the backup filter (opposite to the spectrometer side of this stage) by turning the black part of the end cap. Replace the filter part and unscrew the grey part of the exhaust to replace the perforated plate. Insert a new filter with filter side to the detector! (Diameter 47 mm, glass fibre, i.e. Machery & Nagel 85 / 90). Re-assemble the filter stage.



Backup filter stage (left to right): Filter holder, filter, prop, exhaust to pump

General construction



Implementation of the cascade impactor
GÖTTINGEN IMPACTOR SARAD ASDA 02 – MODIFICATION NRPA Norway

Cable connection
Connect the 8 spectrometer units via the flat cable to the CAN socket at the CPU 517 module. Each spectrometer is characterised by its own CAN-address, the address is also marked on the label on the corresponding plug.

Address	Connected module
CAN 1	Stage 1 spectrometer
CAN 2	Stage 2 spectrometer
CAN 3	Stage 3 spectrometer
CAN 4	Stage 4 spectrometer
CAN 5	Stage 5 spectrometer
CAN 6	Stage 6 spectrometer
CAN 7	Absolute filter spectrometer
CAN 8	Screen
CAN 11	Quad Switch
CAN 12	Logger 4100

The Quad Switch as well as the logger 4100 is already connected to the CAN BUS at address CAN 11 and CAN 12 via an internal connection.

The external operators should be connected to the Quad Switch to enable a comfortable device control by MEDAS e.g. with free adjustable time intervals etc.
Plug the 5-pin socket for the motor drives into i.e. SW 1 and the pump control socket (also 5-pin) into SW 2.

Cable and plug configuration

SERIAL (SUB-D 9pin plug)	TxD	3
	RxD	2
	GND	5

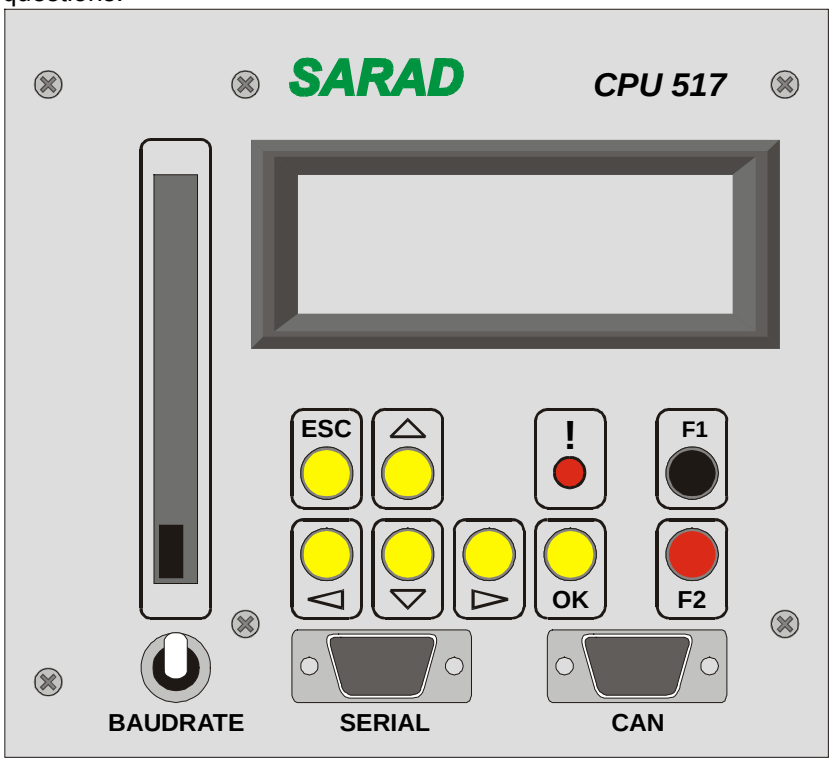
- Serial cable connection to PC: plug to plug-configuration 1:1;
- Connection via modem: socket to plug-configuration: Pin 2 and 3 cross over; at the plug, the pin 4 and 6 as well as 7 and 8 has to be cleared by jumper

CAN (SUB-D 9-pin socket)	CAN-L	9
	CAN-H	5

Now switch on the MEDAS system with the button at the rear panel and start to program your own measurement and device control cycles.

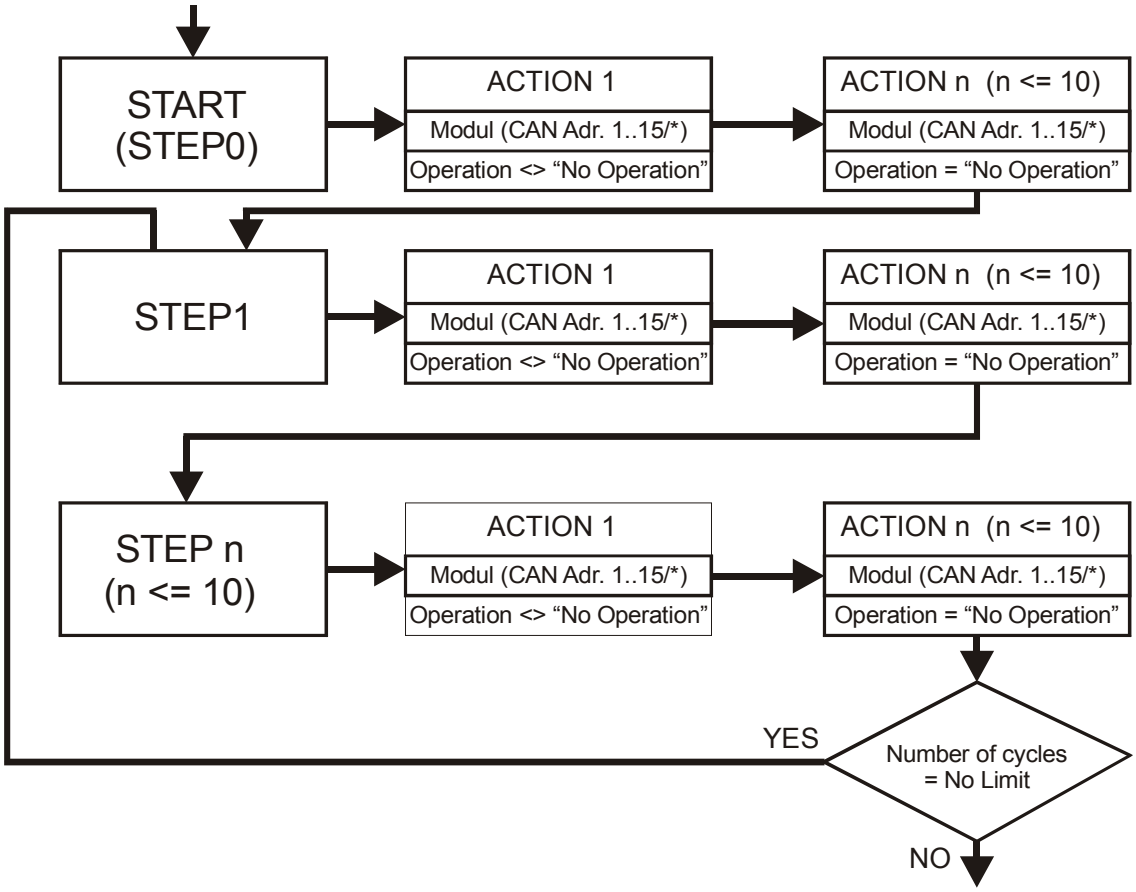
ABOUT THE MEDAS CPU 517

MEDAS (Modular Environmental Data Acquisition system) was developed for the use as autonomous, universal and open measurement system in the field of geophysical, meteorological and radiological questions.



As an essential advantage facing other solutions MEDAS enables an easy adjustment of measurement regimes without any knowledge of programming language but with the performance to connect several operators with different tasks e.g. complex sampling systems with several measuring sensors. In dependence on the need any combination of sensor-data sampling and device control can be realised without additional technical expenditure.
All required functional components are designed in form of independent modules (19"-System), which are connected via a 2 - wire – CAN network. For this reason it is possible to create both, compact instruments as well as spatially distributed systems.
Further modules can be inserted plug & play to a later point in time in the system.
Main part of the programming unit is the CPU 517, the interface to the user with keyboard control or remote control via PC display and serial COM port connection.

The CPU 517 forms the kernel of each MEDAS system. The module realises all access on the network to the connected modules accordingly the programmed tasks alleged by the user, takes over the storage of the measurement data on a RAM-memory card (PCMCIA) and build up interface to the user (keyboard, display and serial interface).
The device control shows similarities to the one of a washing machines: At the end of certain step, operations are executed with the module available in the system. Unlike the used device control of a washing machine, the CPU 517 can be programmed for the certain time interval as well as the kind of operations by the user. In addition, the programmed cycles can be repeated for up to 26 times or without any limit. The following graphic gives an overview over the fundamental terms the MEDAS-system control.



Each measurement cycle consist of up to 10 different steps with different time intervals. Each step consist of up to 10 actions that will be executed at the end of the step.

Hint:
In many cases it is necessary to start a measurement cycle with an action of an operator. Therefore we enable the use of a start-step (step O): For this option, the order will be executed once at the beginning of the first cycle.

After you switched on the device, a menu will appear whereby you scroll through the functions using the buttons <UP> and <DOWN>.

SET CLOCK
Adjust the internal real time clock. Information about the time will be added to every saved data.
The buttons <LEFT> / <RIGHT> enable the selection of hour, minutes and seconds (upper row), day, month and year (lower row). The English format for date is used (mm/tt/yy)

DEFINE CYCLE
As mentioned before, one measurement cycle does consist of up to 10 separate steps. Each step can be described as a period of time whereby in the end of this period one or up to 10 different actions shall be executed by the connected modules. The period of time can be adjusted between 1 and 240 min.
A definite number of cycles build up the whole measurement series, whereby the number of cycles can be restricted to 1 .. 25 or either unlimited till the manual stop by the user. In many cases it is necessary to start a measurement cycle with an action of an operator. Therefore we enable the use of a start-step (step O): For this option, the order will be executed once at the beginning of the first cycle as mentioned above. Those actions at the beginning of a cycle has to be adjusted in the menu <ASSIGN OPERATIONS>.

Select the option <DEFINE CYCLE> and adjust the number of steps you need (<UP>/<DOWN>)
Select the number of repetitions (<LEFT>/<RIGHT>). Confirm with <OK>. Now you are asked to define the length of the time interval for each step. The total length of one cycle therefore depends on the sum of all steps that are executed one after the other. Select your steps with <LEFT>/<RIGHT>

and adjust the time period using the buttons <UP>/<DOWN>. Confirm your selection with <OK> and leave to the main menu.

ASSIGN OPERATIONS

You are able to assign up to 10 different actions / operations to each step in a measurement cycle. Those actions will be executed at the end of the step with fast speed, the speed only depends on the data transfer rate of the scanned CAN bus network. Every action correspond to an executed operation by a connected CAN-module.
At this time, the below listed CAN-modules with the described operations are available. Other modules (SCA 6030 Single channel analyser or Radon-measurement chamber) that are not equipped with a CAN interface are also available either as stand alone or 19" rack unit and has to connected to a CAN module , usually the data logger LOGGER 4100.

Module	Description	Operation
Main module CPU 517	System control software with RAM memory (PCMCIA). User interface with display, keyboard and serial connection	Adjustment of measuremnt cycle, steps and action
Quad Switch	4 galvanically disjoined reverser, independent use for impulse switch (timer) or relais switch	Switch_Port Set_Timer
Logger 4100	8 analogous- and 2 counter inputs Calculation and recording of median values, maximum and minimum. Periodic or stochastic count signal processing	Setup_Logger Start_Logger Stop_Logger Read_Logger
SPECTRA 5031	Multi Channel Analyser with up to 4096 channels for direct connection of alpha / beta / gamma detectors	Setup_SPECTRA Start_SPECTRA Stop_SPECTRA Read_SPECTRA
Single channel analyser (SCA 6030)	2 independent SCA channel to be connected with direct access to data logger 4100	
Radon measurement chamber	Measurement chamber (with / without collecting voltage), Si ion implanted detector (150 / 400 mm²)	

After you selected <ASSIGN OPERATION> , you are able to select the STEP (<UP>/<DOWN>) and define the actions to this step i.e. up to 10 actions in each step (<LEFT>/<RIGHT>). In addition, the STEP 0 (START) allows to execute a command just at the beginning of a measurement cycle. As well as for each step, up to 10 actions can be defined for STEP 0 (START).

The action that has to be executed is characterised by the CAN address of the connected module (1...15) and the selected operation. All possible operations are listed at the right of the CAN address and can be scrolled. The sign "*" , the "joker", instead of a CAN address is an exception: In this case, all connected CAN modules, which are able to execute the command are forced for this action.
After you confirmed your STEP and ACTION NR. with <OK>, you have to select the CAN address of your operator or the "joker" and the corresponding action. Change the address with <UP>/<DOWN> and toggle between the operation using <LEFT>/<RIGHT>. In addition to possible operations one can select "NO OPERATION" (See below).

For each step up to 10 actions can be selected. The order of events correspond to their number. The total number of assigned operations has to start with 1 and be numbered without interruption. Just one "NO OPERATION" in the operation list will lead to a failure for the following actions, they won't be executed. But that means of course that unlike access to connected modules could be prevented by using this "NO OPERATION".

Some of the operation are in the need of certain parameters that are necessary to execute the command. They will be described together with the corresponding module later.

RUN ACQUISITION
After the CYCLE with its STEPS and ACTIONS / OPERATIONS and the number of repetitions is defined, the device is ready to start the data acquisition and device control.
Select RUN ACQUISITION from the main menu and confirm with<OK>.
Before the measurement cycle is started, the CAN network is scanned for connected devices. Any detected device is displayed with its address, type and serial number. In the next step of the initialisation, the system checks weather the connected device and the selected CAN address and the assigned operation is valid e.g. a QUAD SWITCH is never able to act as a spectrometer with data sampling. Unvalued operations will be displayed by a message with information about the faulty command (STEP, ACTION or ADDRESS). Please refer to chapter ASSIGN OPERATION.

HINT: In case of using the joker sign "*", no test will be performed weather a module is connected that is able to execute the command.

If the test ran with success, the data sampling will be started e.g. at first all actions in STEP 0 will be executed and in the following the repetitiously execution of STEP1...STEP n start.

DISPLAYED MESSAGES DURING THE MEASUREMENT CYCLES

The first row in the display gives information about the status of the measurement.
For example:
STATUS 4-7 24/30
4: Fourth run of the repeating cyclic measurement
7: STEP 7 within this cycle
24/30: STEP 7 was adjusted with a time period of 30 min whereby 24 min run down till now. After at least 6 min, all actions written for STEP 7 will be executed.
In the second row, the available space on the PCMCIA memory card is displayed.
The third row gives information about address and operation of the module that is called and executing a command at this time. Because of the speed of action of some operations, sometimes just the last action from the list is displayed.
In the fourth row the CAN status is displayed. A value of 0 correspond to a faultless execution of operations.
Measurement results or the status of an operator can be displayed during the measurement. For selection of the device use <UP>/<DOWN> and scroll through the device information with <LEFT>/<RIGHT>.
Dormancy of the status display after execution of operation is the last executed action and CAN address.

STORAGE OF RESULTS AND MEASUREMENT REPORT

All measurement data will be stored at the PCMCIA memory card that is inserted into the CPU517 main module.

STOP OF A MEASUREMENT CYCLE
To end a measurement cycle, press <ESC>. You will be asked "Exit Acquisition" and have to confirm with <OK>. All connected CAN modules will be stopped and set to dormancy status and the program will return to the main menu.

TRANSMITT DATA
To transfer the data stored at the PCMCIA card, connect a PC or laptop / notebook to the serial interface at the front panel of the CPU 517 module.
After selection of this option you are asked to specify the CAN address of the device whose data should be transferred. Use <UP>/<DOWN> for your selection.
For general it is possible to transfer the data either in ASCII or binary format. An outstanding advantage of the ASCII format is its multipurpose transparency without any additional conversion of data e.g. the possibility to use any PC terminal program and in the following a easy import into a calculation software.
On the other hand, the transfer in ASCII format is more time consuming than the transfer in binary format. If large amounts of data should be transferred via modem, the costs for telephone connection via satellite will rise. In this case, transfer in binary format is the best choice. A special conversion software is delivered to you together with the CPU 517 main module. After conversion, the export file correspond to a ASCII format.

To toggle between ASCII and binary format use <LEFT>/<RIGHT>. Confirm you selection with <OK>.

CLEAR CARD MEMORY
After a previous question, the content of the PCMCIA card will be deleted.

ERRORS

The MEDAS system was developed for autonomous operation at places with limited infrastructure. Usually, solar power is the main supply. This will lead to interruptions in the power supply due to clouds or something else. Does a power supply interruption take place during a data acquisition, the system will automatically restart the capture of data after reestablishment of the power supply.
If the network connection to one of the connected modules is disturbed due to exterior influences, the CPU 517 unit will perform a RESET of the whole system. If the interruption is still in existence, the measurement is quit with an error message.
If the measurement shall be continued in case of the failure of one module, the joker sign "*" has to be used to avoid an error brake down of the cycle.

CONTROL OF THE CPU 517 VIA SERIAL INTERFACE (MODEM / SATELLITE MODEM)

The CPU 517 could either been programmed via keyboard at the front panel of the device or via PC terminal station. To realise this function, the input mask is mirrored to the serial interface. Therefore, a connected PC (cable connection or modem) can be used as a terminal for the necessary adjustment of measurement parameters. The interface is activated as soon as a signal from the PC is receive and deactivated after pushing any button at the CPU 517 unit.
Two different transfer rates are available : 4.800 and 115.200 baud. The fast version has to be used in case of a direct cable connection, the slow one for modem access. To select the transfer rate , use the black toggle switch at the front panel (down = 4800 baud, up = 115.200 baud). If the rate is changed, one has to restart the system e.g. the CPU 517 unit.

HOW TO CONTROL THE DEVICE VIA SERIAL INTERFACE?

Connect the CPU 517 to a PC via cable or modem and adjust the baud-rate, if necessary.
Select and start any PC-terminal software program (i.e. NORTEN TERMINAL) and dajust the transfer options as well (4.800 / 115.200 baud, 8 data bits, 1 stop bit, parity = NONE).

Now you should have permission to access on the CPU 517 unit. The buttons are substituted by the following keys:

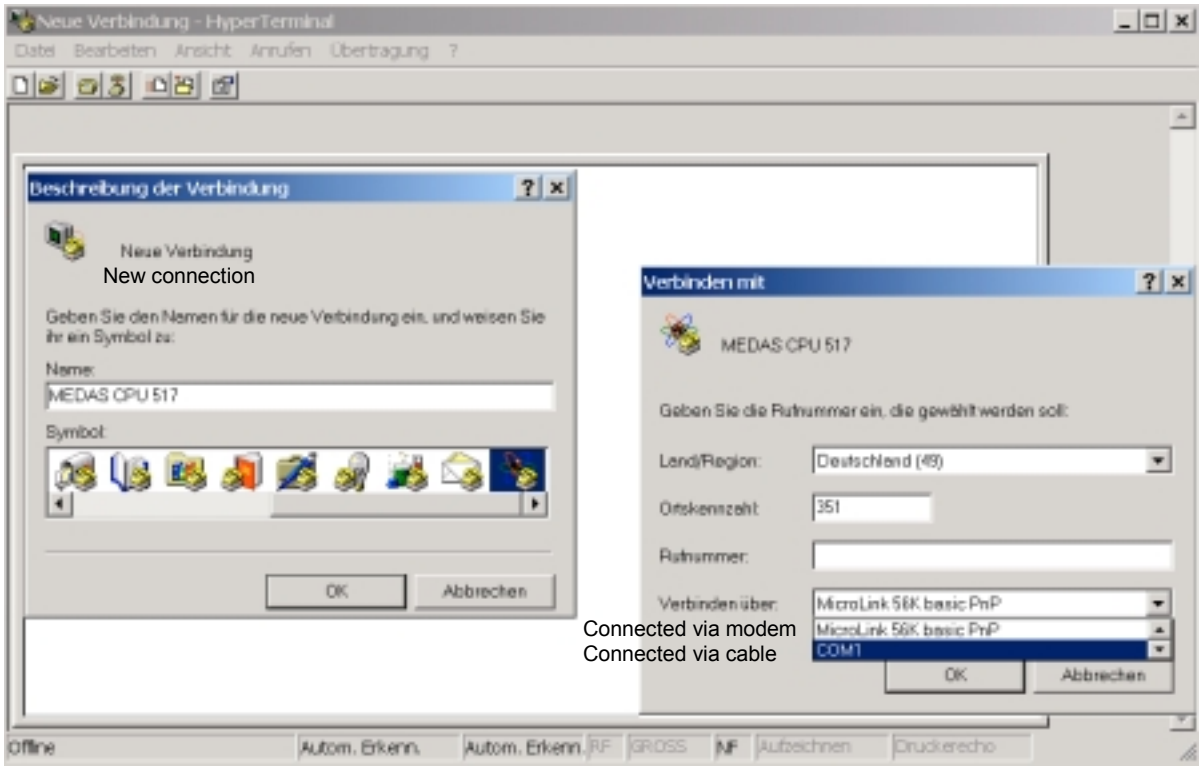
<UP>	„u“
<DOWN>	„d“
<LEFT>	„l“
<RIGHT>	„r“
<OK>	„o“
<ESC>	„e“

HOW TO USE THE WINDOWS TOOL "HYPERTERMINAL" TO TRANSFER DATA AND TO COMTROL THE DEVICE IN REMOTE MODE

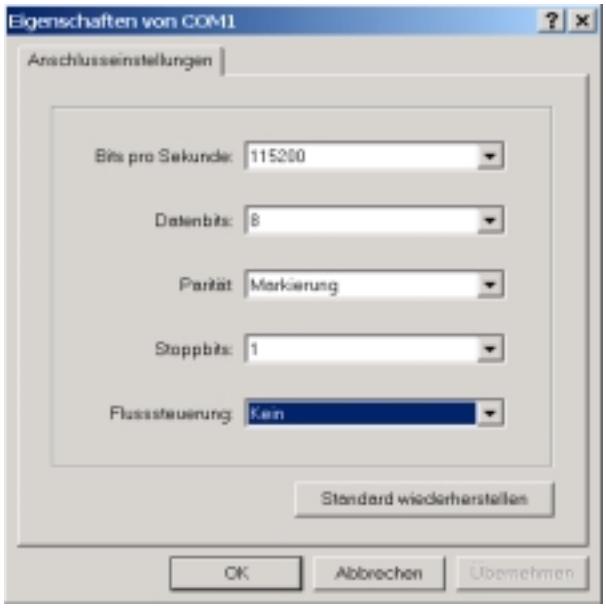
GENERAL INFORMATION
HyperTerminal is a small, easy to use product, designed to satisfy basic terminal communications needs. HyperTerminal was written for Microsoft by Hilgraeve Inc., and contains a subset of the capabilities available in Hilgraeve's full-featured communications software, HyperACCESS.
Designed to realize an easy and fast data transfer between host computers, telenet sites, online server or BBS (bulletin board system), it matches perfectly to the CPU 517 philosophy.
Different possibilities to connect to a basic CPU 517 unit are provided by this terminal program just like modem connection via telephone or direct zero modem cable connection. All of them will enable you to correspond to the control unit of the MEDAS system from everywhere you like. Popular applications are local separated units, just connected via sealed cable connections from site to site or long distance connection in certain countries with the ability to control the CPU 517 , transfer the acquired data and to modify the measurement regime.

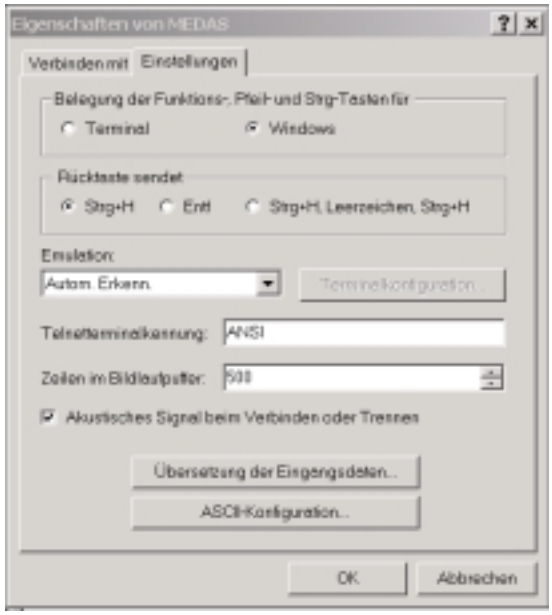
SETTINGS

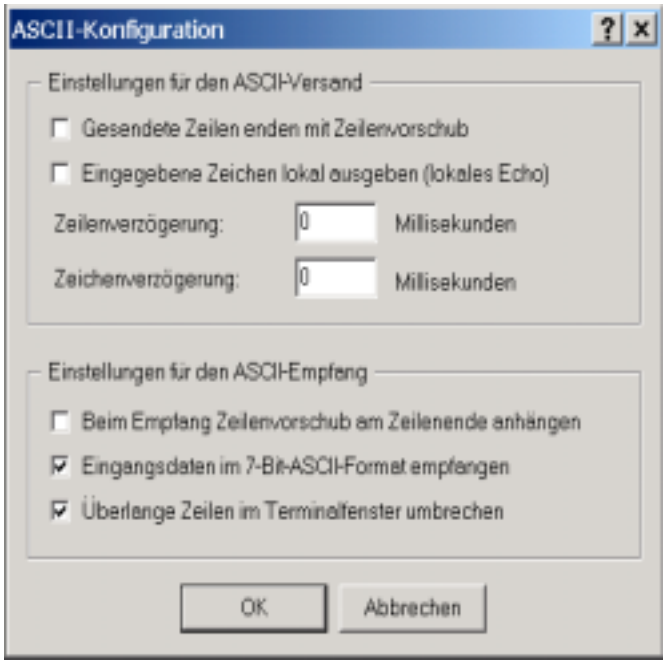
First check whether you installed the terminal program during the WINDOWS installation, otherwise insert the WINDOWS CD and add the missing components. Hilgraeve Hyperterminal will be grouped together with all additional tools and will be available using the WINDOWS start button > Select program > Accessories > Communication > Hyperterminal. The first time, you start your Hyperterminal program no configurated connection is available and you are asked to open a new one:



After you named the new connection, some specific adjustments are necessary:
First adjust your COM port as shown in the left figure. You are allowed to transfer data wit 115.200 or 4.800 bits per seconds, select the correct setting on the front panel of the CPU 517 (black switch up = 115.200, black switch down = 4.800 bits per seconds). Once you confirmed your selection using OK, the port communication will open. Close the port using the command “DISCONNECT” from the main menu row or by clicking the pictogram with the telephone. Switch over to the menu SETTINGS and select the clip chart SETTINGS for a fine tuning of the data transfer and emulation (right figure).







The setting for receiving and sending ASCII data should be set as described on the left handed figure. The correct translation of received data is Shift-JIS.
Hint: No adjustment of the COM port is possible in case that the port is still opened (see the status display row on the lower border of the terminal window.)
After you selected the correct settings, save your personal way of communication to the HyperTerminal directory with the file name extension *.ht.
For every communication to the CPU 517, this settings will be used in the future.
Many helpful advises are implemented into an off-line help for HyperTerminal, refer as well to the manual of your modem in case of using a cable-less connection.

OPEN A CONNECTION

Once you saved a connection, you will be able to open it in direct using a desktop placed icon or using the command OPEN from the menu file in the HyperTerminal program. The connection will start automatically, see the status in the status display.

Assumed that all the settings are correct, you are enabled to communicate with the CPU 517: The user surface on the display of the hardware unit is mirrored to the PC screen. Use the keys “d” down, “u” up, “r” right, “l” left, “o” OK and ESC escape to toggle the same menu than known from the CPU 517 unit. Each command will be executed without any dead time in direct.
HINT: Just four menus will displayed together, use up and down to select those that are not displayed!

TRANSFER DATA

The most wanted operation will be the transfer of a series of measurement data from the PCMCIA card to the PC or laptop. For this purpose and to handle the data afterwards and export them into a calculation software, the ASCII data will be converted into a .txt-file. HyperTerminal will provide the needed tool, it is named “record a text”: During the data transfer, the data will be translated simultaneous into the txt format. Therefore activate this function using the command “record text” before you transfer the data.
Select the menu option <TRANSMITT DATA> and confirm your selection using the key o. Toggle the device list to select the needed CAN address. Use the keys l <left> or r <right> to adjust the appropriate data format (binary or ASCII). Confirm the CAN address with OK , data will be transferred automatically.

The HyperTerminal Windows does not give enough space the display the data, the figure below will show an example of an ASCII data set.

```
1:   Assign Operations
2:   Run Acquisition
3: > Transmitt Data
4:   Clear Card Memory
1: Choose Device/Format
2: CAN:12  ASCII
Logger 4100 at CAN12    AIN1 [mV]      AIN2 [mV]      AIN3 [mV]      AIN4 [mV
]      AIN5 [mV]      AIN6 [mV]      AIN7 [mV]      AIN8 [mV]      CT1 [cts
2002/05/08 18:59:23                                          2
2002/05/08 20:59:23                                          3
2002/05/08 22:59:23                                          3
```

As the record function <RECORD TEXT> from the HyperTerminal menu was activated before, the transmitted data will be saved as .txt-files. Stop the recording of the .txt-file to close the file.
TXT-files may be imported into any calculation program i.e. WINDOWS EXCEL (see figure below)

1: Choose Device/Format										
2: CAN:12 ASCII										
Logger 4100 at CAN12	AIN1 [mV]	AIN2 [mV]	AIN3 [mV]	AIN4 [mV]	AIN5 [mV]	AIN6 [mV]	AIN7 [mV]	AIN8 [mV]	CT1 [cts]	CT2 [cts]
08.05.2002 18:59									272	
08.05.2002 20:59									373	
08.05.2002 22:59									339	
09.05.2002 00:59									393	
09.05.2002 02:59									325	
09.05.2002 04:59									300	
09.05.2002 06:59									336	
09.05.2002 08:59									343	

Data will be displayed according to your logger input (AIN 1-8, two TTL counter inputs) and according to your selection of average, maximum, minima or total values.

Using SARAD SCA 6030, Logger 4100 and Radon module MOD01-03 /400 mm² for Radon measurements

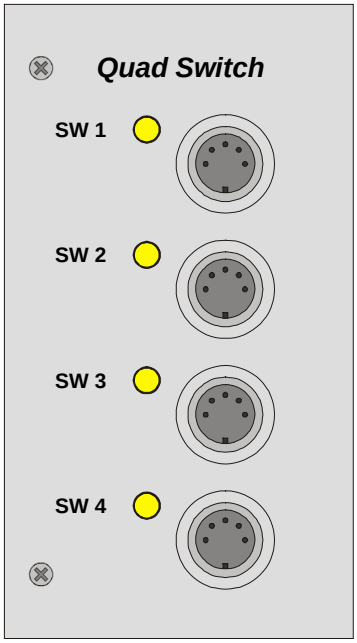
SARAD calibration drums provide a closed system for calibration procedures of equipment.
All necessary electronic connections are prepared to record temperature, humidity and decay impulses at the same time in a customised measurement regime.
Temperature and humidity will be measured by a humitter sensor that will be connected to a LOGGER 4100 in direct via a subD plug at AIN 1-4 input socket.
To record the radon decay impulses, two TTL counter inputs are prepared: CT1 will enable a fast channel recording using counts of Po-218 and Radon exclusive, CT2 will add Po-214 impulses to increase the counting statistics .
At this time, results will be displayed in a txt-file according to the sensor characteristics (mV for temperature, humidity, pH, Eh and several other sensors), counts for the Radon signal. A calibration protocol will be delivered together with each detector module showing the detector spectrum with lower and upper limits for each TTL channel and the efficiency of detection (counts per minute per kBq per m³. A new SARAD software is in preparation to provide a comfortable user surface and to enable an individuell sensor adjustment e.g. to explain results in their valid SI-unit. Our internet presentation will report about the progress periodically.

To calculate the radon concentration at any time, use the below mentioned formula
(Example)
C_{Rn} [kBq/m³] = ($cts_{CH1 / CH2}$ / Δt [min]) / E

C_{Rn}	Radon concentration
$Cts_{CH1 / CH2'}$	recorded counts in channel 1 or channel 2 (fast or slow mode)
Δt	integration time in minutes
E	efficiency of detection (counts per minute per kBq per m³)

E (fast) = 0,51 counts*min^{-1}/ kBq*m^{-3}
E (slow) = 0,75 counts*min^{-1}/ kBq*m^{-3}

MEDAS MODULES WITH DIRECT ACCESS VIA CAN NETWORK



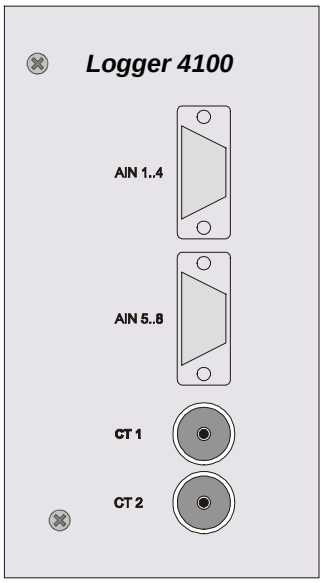
QUAD SWITCH module

The QUAD SWITCH module provides 4 galvanically disjoined reverser, independent to use for impulse switch (timer) or relais switch.
By this unit i.e. the control of pumps, ventilation fan or mechanical motors will be enabled according the requirements as programmed in the cycles of the CPU 517.

OPERATION	PARAMETER/VALUES
Switch Port Enables the adjustment of each of the four switches to the needed position (on (set)/ off (reset)/ unchanged (hold last status))	Selection of switch (1...4) „S“ (SET): “ON” Set the switch (opening contact open, closing contact closed) „R“ (RESET): “OFF” Reset the switch (Closing contact open, opening contact closed) „U“ (UNCHANGED): Last status is hold
Set Timer Sets the switch for a definite time into the set (on) status	1. display page Selection of the switch (1...4) „X“: (MARK) This switch will be taken into consideration „-“: (UNMARK): Switch will be unconsidered 2. display page adjustment of definite time to switch „0..120“ Sekunden

LOGGER 4100

The LOGGER 4100 is a good choice to record analogous and digital sensor signals. Per unit, 8 analogous and 2 digital counter inputs a placed to once disposal.
In input voltage range of the analogous channels amounts 4 V. The internal 12-bit ADC enables a resolution of the input signal to 1 mV.

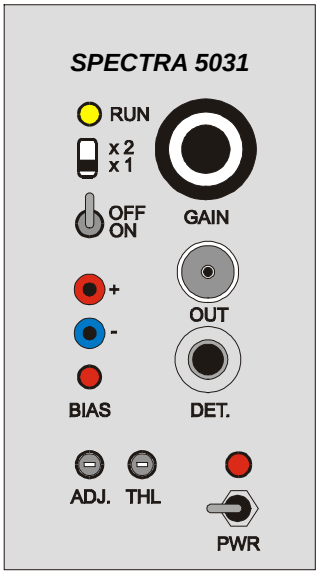


Several input configurations are available: unipolar / bipolar or single ended / differential.

The digital 16-bit counter channel is operated with a TTL input level, the minimum pulse time of the impulse is 2 µs. A counter overflow (more than 65535 impulses) has to be avoid by an appropriate sampling rate (for a periodic signal, this will lead to a frequency limit of 65,5 kHz because the minimum sampling resolution is one second).
The sampling rate can be adjusted between 1...60 s^{-1}. All input channels will be scanned in a cycle.
Mean values for all recorded signals will be calculated during the whole measurement cycle. The average value is characterised by the time interval between two recording operations at one channel. Because of possibility to select single channels, different time intervals for each channel can be assigned. In opposite to this, the sampling interval for all activated channels is the same.
Beside the calculation of average values, the minimum and maximum values during the measurement interval can be recorded. After a channel is scanned and recorded, the average, minimum and maximum values will be reset. To adapt the counter input to signals with low frequency, the average value can be replaced by the value of the total count sum of the measurement interval.

Operation	**Parameter / values**
Setup Logger Adjustment of the range of the input voltage and reference potential of the analogous input channels Single ended: measurement against signal's ground Differential: measurement against different analogous input Unipolar: input voltage between 0..+4V Bipolar: input voltage between –2..+2V	**Selection of the input modus** „SU“ (Single ended / Unipolar) „SB“ (Single ended / Bipolar) „DU“ (Differential / Unipolar) „DB“ (Differential / Bipolar)
Start Logger Sets the channel that has to be started and defined the internal sampling frequency of the module	„X“ (MARK): Channel will be started „-“ (UNMARK): Channel won't be started
Read Logger Assignment of the channel that will be recorded and which data should be stored	1. display page Analogous inputs „X“ (MARK): Read channel „-“ (UNMARK): do not read channel Digital inputs „A“ (AVERAGE): Read mean value and store the average „T“ (TOTAL COUNTS): read total count sum of the interval and store the value „E“ (EXTENDED): Read mean, minimum and maximum of the interval and store the values 2. display page The second page gives you the possibility to read the analogous inputs in pairs (1/2...7/8) in extended or standard mode. „E“ (EXTENDED): Read mean, minimum and maximum of the interval and store the values „S“ (STANDARD): Read mean value of the interval and store the average
Stop Logger Quit the recording and sampling of the input	No parameter

SPECTRA 5031



The SPECTRA 5031 offers a powerful, flexible and complete solution to alpha spectroscopic applications. It was specially developed for applications requiring simultaneous analysis of multiple samples with minimum equipment cost. Each unit integrates the necessary signal amplification ,detector bias control, multi channel memory and CAN-bus interface.
For the most, a spectroscopic resolution of 256 channels is suitable e.g. measurement of aerosol size distributions and Radon progeny.
SPECTRA 5031 provides a spectroscopic resolution of 256, 512, 1024, 2048 or 4096 channel.
Each spectrometer can be equipped with a 400 mm² ion implanted silicon detector, light protected with 500 nm Al. The depletion thickness is for minimum 100 µm for standard, other types or sizes on request.
Preamplifier and pulse shaping unit are fixed together with the detector in a compact housing (MOD 01/03).
Device control of the spectrometer is performed by the CPU 517 unit (via direct access by the CPU 517 or in terminal mode via PC).

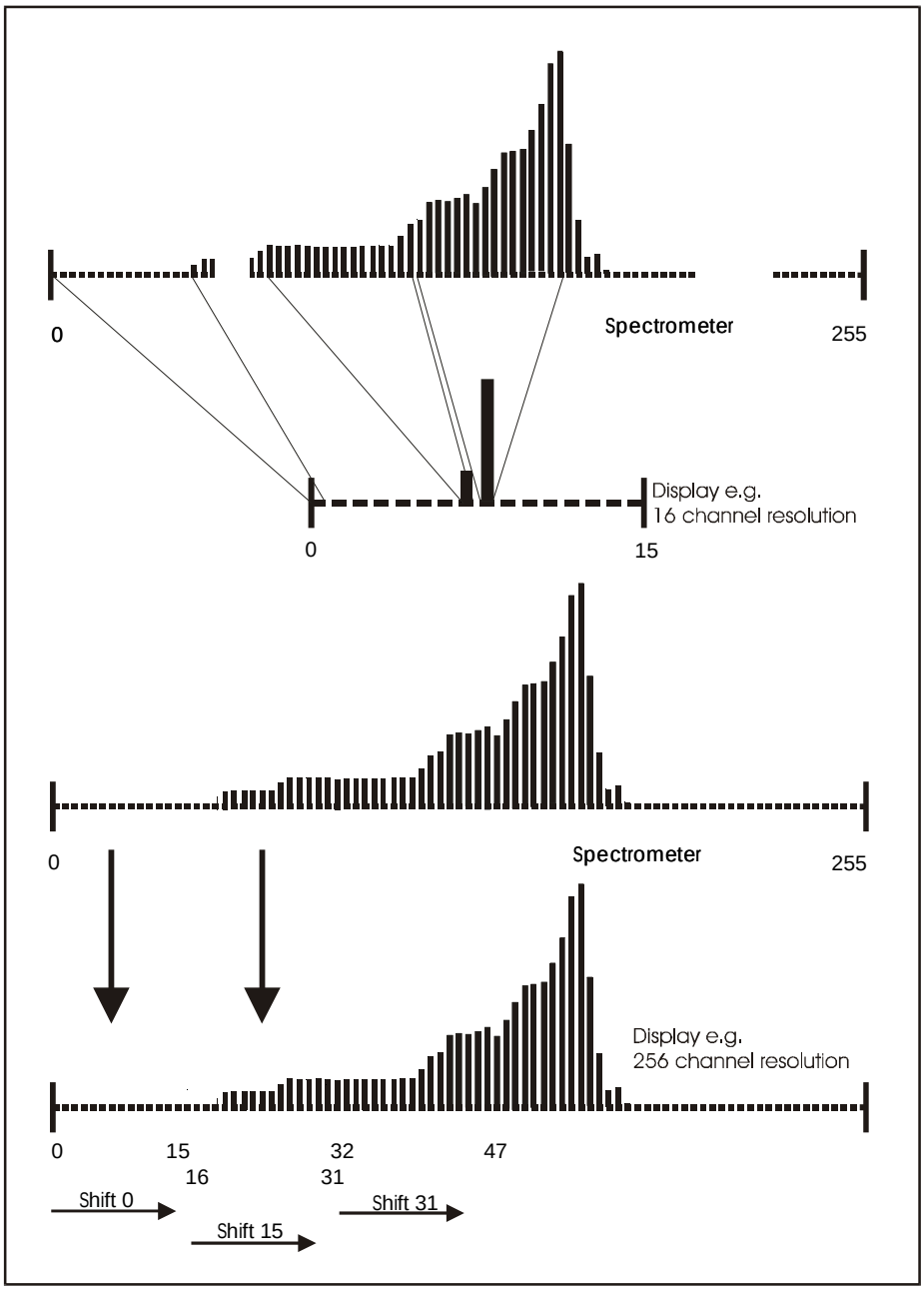
LED on / flashing	Spectrometer is in stand by mode
LED off	Data acquisition on the run

A small screw in a hollow enables the adjustment of the amplifier gain. This option should only be used by skilled and advanced users!

Operation	**Parameter**
SETUP SPECTRA	In case that a spectrometer card with a resolution of up to 4096 channels is installed, one can adjust the resolution step by step between 256....4096 channels. Zoom (1,2,4,8,16): correspond to 256, 512, 1024, 2048 and 4096 channels. Shift adjustment
START SPECTRA	No parameter
STOP SPECTRA	No parameter
READ SPECTRA	Adjustment of suitable zoom factor (1,2,4,8,16) and corresponding shift (spectrum offset to view the region of interest) Adjusted parameters define the display resolution only.

ABOUT THE SPECTROMETER´S RESOLUTION AND THE POSSIBILITY TO VIEW THE RESULTS IN A 16 CHANNEL DISPLAY OF A CPU 517

For principals, a 16 channel display is able to view the whole content of spectrum with a resolution of 256 channels. Two possibilities are provided by the CPU 517 unit.
For a first appraisal, it might be useful to compress the content of 256 channels to 16 channels at the display. That means that 16 neighbouring are added in one channel, for a result one gets a spectrometric resolution of a 16 channel spectrum. One the other hand, the shift function enables the view of a large spectrum step by step.
For the best performance, it would be useful to check the peak area first using a source or a test measurement and after that adjust the spectrometer to a satisfying resolution and fix the area with the shift function.



Spectrometric resolution and adjustment by suitable zoom factor and shift

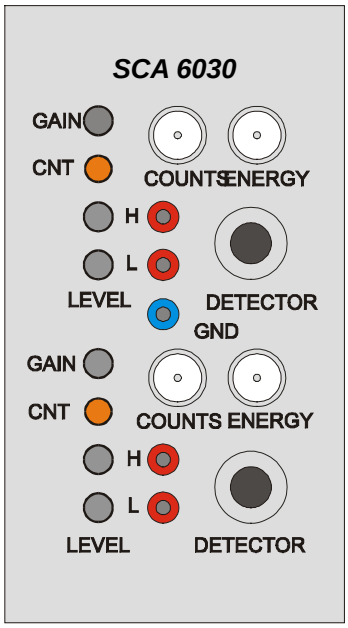
For each resolution or zoom factor (in exception of zoom1 e.g. 16 channels to view), the shift function enables 16 steps to view the whole spectrum.
In example: The spectrum of 256 channels is zoomed by zoom 4. That means, the resolution is reduced to 64 channels, every four neighbouring channels are summed up. To show the 64 channels in a display with 16 columns, you need 4 separate parts. But sometimes the peak maximum is at the border between two parts. Therefore one can cover the whole range with a suitable shift adjustment.

MEDAS MODULES WITHOUT DIRECT ACCESS VIA CAN NETWORK

SCA 6030

Generel safty instructions

- Please pay attention to the technical data for power supply and TTL-impulse output voltage described in the following.
- Changes in the adjustment of parameters of the calibration potentiometer shall be carried out only if a suitable radioactive source and a multi channel analyser or oscilloscope is available.
- Do not open the device

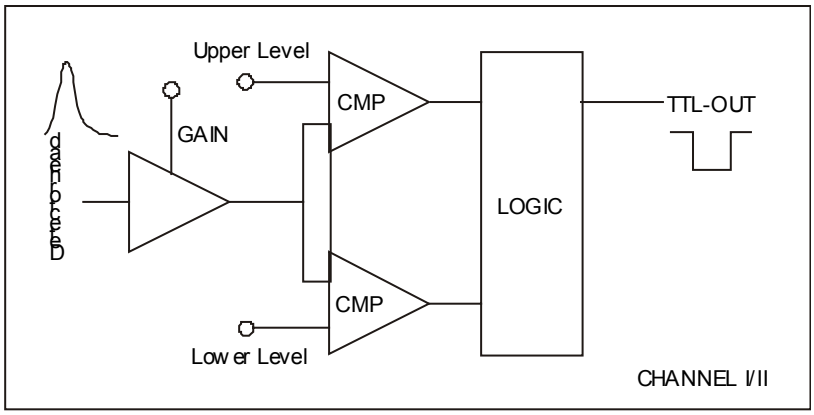


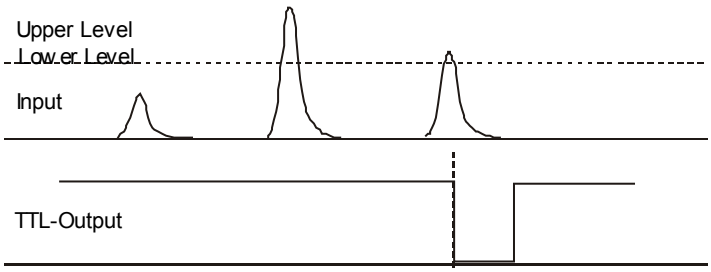
The SCA 6030 supports when used together with the calibration drum, the 400 mm² Si-detecter that is fixed in the diffusion bell and placed within the calibration drum.
The connection will be performed by a 4 pole plug placed into the socket named “InP” (in the figure”detector”) on the front panel of your SCA 6030. Note: During the use of the calibration drum, one will usually connect the diffusion bell and its detector to the SCA, but it is as well possible to replace the detector and bell from the drum and connect it directly to the SCA e.g. other Si-detectors (please ask SARAD for possible replacements)
The Si-detector provides an analogous output signal with an alpha energy equivalent impulse e.g. height of impulse ~ energy. The corresponding calibration is mentioned below.
Detector bias and power supply are delivered by circuits on the board of the SCA 6030.

As you see, the SCA 6030 is made of two part that are equal: This will provide the channel one (fast mode) and channel two (slow mode). Only one of this channels will be connected to the LOGGER 4100 (input CT1)

Signal processing

The SCA 6030 turns the output signal of the detector head into a TTL impulse as shown in the sketch below:





Each SCA 6030 is equipped with two independent SCA channels. For the measurement of Radon e.g. the measurement of the Radon-progeny plated out on the detector surface (Po-218 and Po-214), the channels are adjusted to enable the determination of fast changes in the Radon concentration as well as long term measurements:
Channel 1 is adjusted to register the decay events of Rn-222 and Po-218 (5.4 MeV and 6.0 MeV), channel 2 is adjusted to add in addition the impulses counted as an effect of the decay of Po-214 (7.7 MeV). Therefore, channel 1 is suitable to measure with a short response time one changes of the Radon concentration (**fast mode**), channel 2 will be used if one does not assume rapid changes and suppose a radioactive equilibrium between Radon and its daughter products (**slow mode**). In addition, the channel 2 is more sensitive with a higher efficiency due to the enlarged number of counted impulses e.g. Po-214 in addition.
The corresponding voltage adjustments are written in the calibration protocol.

Each counted impulse in each channel will be signalled by an flash of a red LED.

Comperator threshold (energy adjustment)

The threshold of the comperator CMP to turn an analogous impulse into a TTL impulse can be adjusted by small screws in a hollow. This option should only be used by skilled and advanced users! Each level e.g. upper or lower has to be adjusted separately!
In channel 1, upper and lower level of the threshold frame the energy range between 4000 and 6200 keV e.g. sensitive to impulses of Rn-222 up to Po-218. In channel 2, upper and lower level of the threshold frame the energy range between 4000 and 8000 keV e.g. sensitive to impulses of Rn-222 up to Po-214.
The corresponding voltage can be measured at poles on the right side beneath the small screws.

Hint: You need a calibration source with known energy emission and a MCA or oscilloscope to do any adjustment!

Output signal

The SCA 6030 provides you the possibility to transfer either the counted impulses as TTL impulses or the direct measurement signal, two labelled BNC sockets for each SCA channel are mounted on the front panel of the 6030.

Gain

During the factory calibration, the gain is adjusted to fit the energy range to the energy of the emitted alpha particels of Rn-222, Po-218 and Po-214.

Technical data

Operating voltage:	6...12V=
Consumed power:	ca. 25mA
Impulse output:	TTL-level (negative logic)
Impulse :	40 µs
Output resistance:	100 Ω

HOW TO RUN AN IMPACTOR MEASUREMENT

1. Connect all external operators (motor drives and pump) to the QUAD SWITCH of your MEDAS module. It is assumed that all modules and operators shall be started at the same time in the beginning of a measurement cycle. Therefore, the pump has to be connected to second relais that controls the power supply via 110 V. The input of this external relais switch has to be connected to the power supply at place, the output to the pump with a 110 V plug delivered together with the pump.
2. Replace the plastic stopper at the T-junction and connect the junction to the pressure gauge as shown in the picture below:

Correct connection of pressure gauge to the T-junction

3. Run the pump without a started measurement and adjust the flow though the impactor cascades to 550 l / h, if flow meter is available. From major importance is a relation between the outer air pressure and the measured pressure behind stage 1 of **0.24**.
4. Program your measurement cycle with CPU 517 as following (for a measurement with a duration of two hours with continues pump and automatically stop after two hours! Feel free to create your own and customised measurement cycle!)

Define step

Define one step. At the end of this step, all actions will be carried out
Set the time of the step to 2 hours.
Set the repetition of cycles to 0 (1)

Assign operation

Use STEP (0) and assign a start action 1 for CAN 11 SW1=S SW2=S SW3=R SW4=R switch 1 and switch 2 will be set to start the motor drives and the pump. Assign a action 2 for CAN * = START SPECTROMETER (starts **all** connected spectrometer)

Change to Step 1 and assign following operations
Action1 CAN * STOP SPECTROMETER
Action2 CAN * READ SPECTROMETER
Action3 CAN 11 SW1=R SW2=R SW3=R SW4=R

5. Use the ESC button to leave to the main menu and select <RUN AQUISITION> to start the measurement
6. Use <TRANSMITT DATA> to transfer the data from the PCMCIA card to your PC for further calculation of the spectra data.

IMPORTANT HINTS:

Any detector delivered by SARAD that is part of this impactor ASDA02 was calibrated for its energy resolution in the same way than the other ones.
Before you are able to interpretate your impactor data, you have to calibrate the device to the real measurement conditions e.g. foil cover etc. To calibrate the device suck progeny-rich air through the cascades and record a spectrum. Control the spectrum at the display of the CPU 517 e.g. set the STEP time to short 5 min and the repetition to NO LIMIT to get a time distribution.

The aerosols plated out at the foil are size distributed in the following way

STAGE	$D_{ae50'}$[nm]
6	1939
5	1095
4	626
3	343
2	158
1	72

The screen delivered by SARAD has a 50% plate out-diameter of 3,25 nm.
See also certification calibrate by GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN ISOTOPENLABORATORIUM

All 50 % values are determined for a flow rate of **550 l/h** and a relation between the outer air pressure and the measured pressure behind stage 1 of **0.24**.

For more information about cascade impactor measurements and radon progeny, please refer to

PORSTENDÖRFER, J.: Radon: Measurements related to dose (1996). Environmental International; Vol.22, Suppl. 1, pp. S563-S583. Elsevier Science Ltd. Pergamon.