Interface Description
for the Dose Area Product Measuring Systems

VacuDAP
valid from software version: 1.21

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1 General information

1.1 Introduction

This description is valid for the dose area product measuring systems VacuDAP. This document explains the communication with the measuring system via the serial interface.

In detail the following actions are possible:

- Remote control (RESET, TEST)

- Transfer of measuring data

- Changing of measuring mode

- Changing of parameters

> ⚠ A detailed description of the measuring system as well as the meaning of the parameters can be found in the **Operation Manual**!

1.2 Basics

The communication interface of VacuDAP devices is a RS485 without galvanic isolation. It is possible to use devices of VacuDAP family in a RS485 network.

Using the Interface-cable RS232 (including a interface converter with galvanic isolation; Order-No. 952 00 61) a VacuDAP device can be connected to the serial interface RS232 of a PC or a Printer.

The RS485 interface of VacuDAP operates in **half duplex** mode. Developing application software for VacuDAP family please note the timing conditions of communication.

1.3 Hardware connection

RS485: Shielded data cable with 4-pin male cable connector (TRIAD 01; compatible with BINDER 712) and the following pin assignment:

Pin	Signal	Notes	View at connector pins
1	$+U_S$	Supply voltage	
2	GND	Reference potential, ground	
3	RS485-B	RxD/TxD-N	
4	RS485-A	RxD/TxD-P	

Table 1: Pin assignment for interface RS485

RS232: Shielded data cable with 9-pin female connector (Sub-D) and the following pin assignment:

Pin	Signal	Notes
2	TXD	Transmit data
3	RXD	Receive data
5	SGND	Signal ground

Table 2: Pin assignment for Interface-cable RS232

In case of RS232 supply voltage is connected by a DC-power connector (Outer-Ø: 5,5 mm; pin-Ø: 2,5 mm) where the center pin has positive potential.

1.4 COM settings

For communication with a host computer (e. g. PC) the serial interface (COM) of the computer, which is connected with the measuring system, must be configured as shown in *Table 3*.

Baud rate	9 600
Data bits	8
Stop bits	1
Parity	none
Protocol	none

Table 3: Interface settings (COM)

1.5 Communication modes

Communication between the VacuDAP device and host computer can be done in two modes – command mode and continuous mode.

Command mode:

The host computer operates as **Master** while the VacuDAP device is the **Slave**. I.e. the host computer sends commands which are answered by the DAP measuring system.

Continuous mode:

The VacuDAP device sends continuous data. The host computer can send commands in the interval between the data strings.

The VacuDAP device starts in command mode. Switching to the alternative mode is always possible with the command **Xk<CRLF>** (see *2.3 Parameter summary and 4. Communication timing*).

1.6 Power up timing

After applying the supply voltage the VacuDAP device initializes the serial interface and sends the string

test<CRLF>.

After about 13 seconds the device transmits the result of the test function –

test ok<CRLF> or **err xxxx<CRLF>**.

About 15 seconds after applying the supply voltage the VacuDAP device sends the string

<readyCRLF>.

Initialization is complete and the device is ready for communication.

2 Communication

2.1 Data format

Computer and VacuDAP device communicate using **ASCII-Code** according to this description. Commands, measuring data and status messages have a **variable length** and are always terminated by CRLF.

2.2 Command structure

A command is structured as follows:

$$\textbf{adcc[p]<CRLF>}$$

Address —————
Command code —————
Parameter —————
Terminator —————
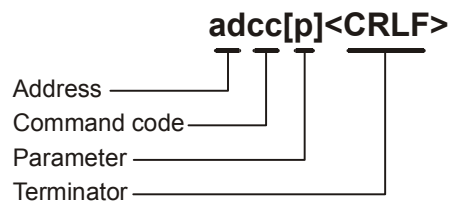
address	capital letters A, B or C, ...
	Please note: The capital **X** is the broadcast address. Using this address the command is valid for all devices in a network.
command code	small letters (see at command description)
parameter	In addition for the commands s (send) and c (change) the parameter **p** has to be specified (see *2.4 Parameter summary*).

All parts of a command have to be typed without spaces or brackets.

2.3 Command summary

Command	Designation	Notes	Reply
d	data	Send measuring data	at once
r	reset	Start RESET-Function	after approx. 2 s
t	test	Start TEST-Function	after approx. 8 s
k	communication	Change communication mode	at once
s*p*	send	Send parameter	at once
c*pw*	change	Change parameter	at once
w	write	Save changes	after approx. 1 s
x	backup	Set all parameters to default values	after approx. 1 s
q	quit	Quit warning and error messages	at once
z	status	Send system status	at once

Table 4: Commands

Here p specifies the parameter (see *2.4 Parameter summary*) and w the new value of the parameter (allowed values see *Table 5*).

2.4 Parameter summary

Parameter	Designation	Notes	Setting range
a	address	Address (Measuring channel)	A, B
f	measuring mode	Measuring mode	0: Radiography; 1: Fluoroscopy
r	position	Position of measuring chamber	0: above table; 1: below table
k	cf-above	Calibration factor, above table	0.5 ...1.75
d	cf-under	Calibration factor, below table	0.25 ... 1.50
p	Printer	Printer type	0 ... 99
o	test value highres	TEST value for high resolution mode	50 ... 9999
m	test value highrate	TEST value for high DAP-rate mode	50 ... 9999
l	Resolution	Resolution of DAP measurement	0: high DAP-rate; 1: high resolution
&	measuring unit	Measuring unit	0: Gy*cm²; 1: Gy*m²
;	SIO delay	Delay of answering to command Xd	0: 100 ms; 1: 5 ms

Table 5: Parameters

> ⚠ Changing of parameters has decisive influence on the indicated value of the measuring system. Therefore only authorized persons may change the parameters after careful reading of the Operation Manual.

The right of access on parameter change can be controlled by using a pin code for authorization (see *5.Right of access*).

2.5 Status and error messages

Message	Meaning	Notes
o.k.<CRLF>	Command done	
sn-error<CRLF>	Syntax error	Wrong or incomplete command
zc-error<CRLF>	Zero-Check error	Reset during irradiation (see also Operation Manual page 21)
errxxx<CRLF>	Error for TEST-Function	TEST value out of tolerance range (see *Operation Manual*)

Table 6: Status and error messages

A warning or error status has to be acknowledged (command **q**) before new commands can be sent.

3   Command descriptions

In this chapter typical commands will be described in detail. By means of these examples you can draw conclusions about the functionality of the other commands.

3.1 Request status

Syntax	Meaning	Example	Reply
ad**z**\<CRLF>	channel ad send system status	Az\<CRLF>	o.k.\<CRLF> or 1...255\<CRLF>

The reply of the command **z** is the status of the measuring system, which is characterized by one byte (decimal number between 0 and 255). The different bits have the following meaning:

Bit	Meaning(Bit = 1)	decimal
0 (LSB)	not used	1
1	TEST-Warning	2
2	DAP rate overflow	4
3	Zero-Check-Error	8
4	TEST-Error	16
5	HV-Error	32
6	not used	64
7 (MSB)	not used	128

Table 7: Correlation of status bits to error and warning messages

A combination of warning and error messages is possible as status of the measuring system. A value > 0 has to be analyzed as shown in *table 7*.

The value 0 means „System o.k."

Hints for trouble shouting can be found in the *operation manual*.

3.2 Quitting warning or error status

Syntax	Meaning	Example	Reply
ad**q**\<CRLF>	Channel ad quit warning or error status	Aq\<CRLF>	o.k.\<CRLF>

3.3 Start RESET-Function

Syntax	Meaning	Example	Reply
ad**r**\<CRLF>	channel ad do RESET-Function	Ar\<CRLF>	o.k.\<CRLF> (or error message, see *Table 5*)

3.4 Request measuring data

Syntax	Meaning	Example	Reply
ad**d**<CRLF>	channel ad send measuring data	Ad<CRLF>	4.3626e-01<TAB>9.008e-01<TAB> 9.000e-01<CRLF> <u>Meaning:</u> DAP = 436.26 mGy*cm² DAPrate = 900.8 mGy*cm²/s; Irradiation time = 0.900 s

The output are three floating-point numbers separated by tab stops and terminated with CRLF. These numbers are the dose area product (DAP) in Gy*cm², the dose area product rate (DAPrate) in Gy*cm²/s and the irradiation time in seconds.

If needed the measuring unit can be changed into Gy*m² for DAP (Gy*m²/s for DAP-rate). In these case the parameter **&** has to be 1 (see table 5).

3.5 Read parameters

Syntax	Meaning	Example	Reply
ad**s**p<CRLF>	channel ad send value of parameter *p*	Ask<CRLF>	k:1.00<CRLF>

3.6 Write (change) parameters

Syntax	Meaning	Example	Reply
ad**c**pw<CRLF>	channel ad change parameter p to value w	Ack1.10<CRLF>	o.k.<CRLF>

3.7 Save changes

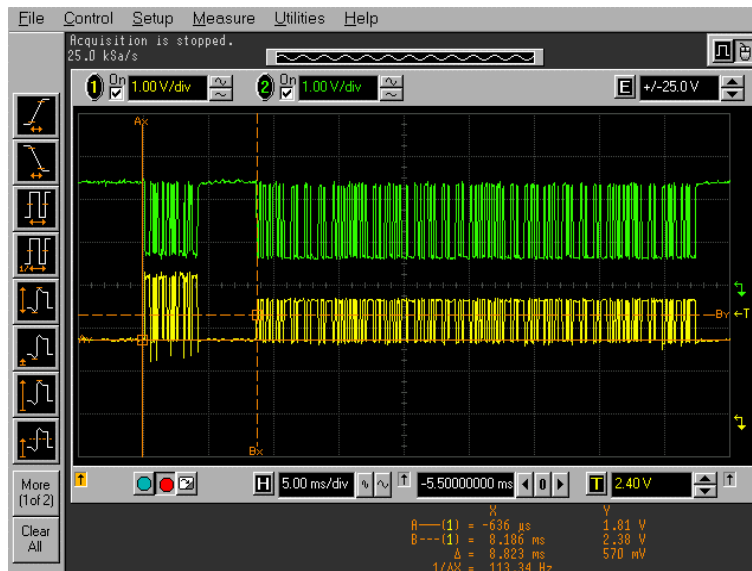| Syntax	Meaning	Example	Reply
ad**w**<CRLF>	channel ad save all parameters	Aw<CRLF>	o.k.<CRLF>

It is necessary to **save** (**w**) all changes, to transfer them to the permanent memory (EEPROM). Changes, which were not saved, will be lost after power-off.

4 Communication timing
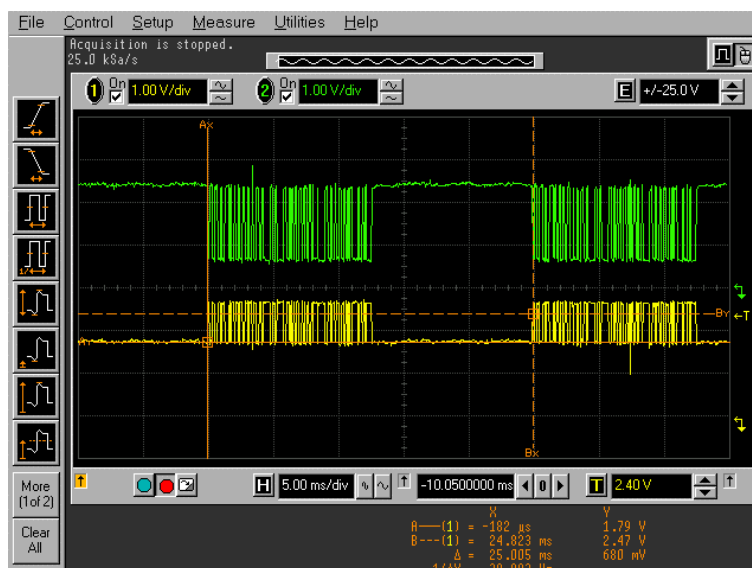
4.1 Command mode

The following pictures are showing the signals of communication line RS485A and RS485B.

Picture1: Communication command mode

The first packet beginning with marker A is the command Xd<CRLF> from host computer to VacuDAP device. About 4ms after command termination follows beginning with marker B the data packet answer from the VacuDAP device. For compatibility to older software versions the answer can be delayed 100ms. This option can be chosen by a special parameter.

4.2 Continuous mode

Picture2: Communication command mode

The VacuDAP device sends **every 25ms** (from marker A to marker B) a data packet with fixed length of 12ms. After this it is possible to send a command from host computer to VacuDAP device. Typical commands like RESET, TEST or CHANGE COMMUNICATION have a length of 5ms. The command routine of VacuDAP device will delay then continuous sending of data.