LAB Documentation

Communication Protocol

Operating instructions

for SIMDOS RC Plus

Before operating the pump and the accessories, please read the operating instructions on the web site (www.knf.com/downloads) and pay attention to the safety precautions!

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2 General

The SIMDOS RC Plus pumps can be controlled by using the standard RS232 serial interface (COM1, COM2, …). The RS232 serial interface allows one pump to be controlled by a PC based software tool. Any of the commands listed in this document can be carried out as single commands for pump control or verification purpose. This may be of help for customers, who want to develop their own pump control tool.

If your PC does not provide an RS232 serial interface, then use an USB to RS 232 Adaptor!

The communication protocol is only available for the following products:

Name	KNF Typ
SIMDOS 10 XX RC Plus	FEM1.10 XX.18 RCP
SIMDOS 02 XX RC Plus	FEM1.02 XX.18 RCP

3 Initial start-up

> ## ⚠ WARNING
>
> **Danger of automatic start-up**
> The pump starts up by itself and without warning.
> - ➢ Do not transmit a start command until the system has been tested and is ready for operation
> - ➢ Mark remote-controlled pumps
> - ➢ Before start-up, check that hoses and equipment are leak-tight and working properly
> - ➢ Do not operate the pump with hazardous media

1. switch on the pump
2. Remove protective caps from RC connector plug.
3. Connect the serial cable (D-Sub cable) to the pump.
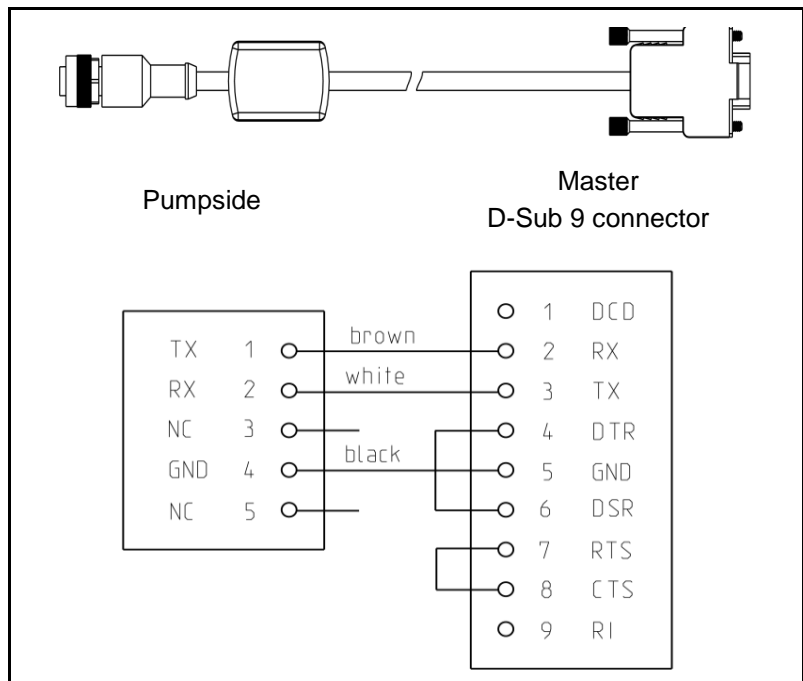4. Connect serial cable for remote control (D-Sub cable) to a suitable signal source.

Fig. 1:   KNF Flodos serial cable pin assignment

5. If your PC is not equipped with an RS 232 Interface, an additional adaptor is needed.
6. Make sure that the cables are connected
7. Check connection with:

Transmit

Name	STX	Address	Cmd str	ETX	LRC
Example	2	00	?SI	3	36

Receive:

Name	STX	Cmd str	ETX	LRC
Example	2	3	1	2

8. If the address has to be changed, make sure, that the message is send with the right address.

4   Universal commands

The address number 99 has a special function. Commands, which don't require an answer, can be sent to address 99. The command will be carried out by all pumps. This enables synchronized functions such as the start of all pumps at once.

5   Interface parameters

The pump is permanently set to the following values:

Name	Value
Baud Rate	9600 Baud
Data Bits	8
Parity	No
Stop Bit	1

Handshake: There's no monitoring. The user is responsible that the pump is not overloaded.

Timing: The typical reaction time of the pump is 2 ms. If the answer takes longer than 100 ms, there is either a problem with the communication or the pump is still busy with a time consuming function e.g. new pump initializations.

6 Data format

Each transmission packet consists of the following bytes:

Transmit

Name	STX	Address		Cmd str			ETX	LRC
Size	1 Byte	2 Bytes		3 – 10 Bytes			1 Byte	1 Byte
Example	2	0	0	?	S	I	3	36

STX (02h)	Start of Text
Address	Pump address '00' – '99' ASCII, can be set on the pump
command string (cmd str)	Order of ASCII symbol according to command description
ETX (03h)	End of Text
LRC	Checksum

Each receiver packet consists of the following bytes:

Receive :

Name	STX	Cmd str		ETX	LRC
Size	1 Byte	1 – 9 Bytes		1 Byte	1 Byte
Example	2	0	0	3	36

STX (02h)	Start of Text
Answer	All data are in ASCII format
ETX (03h)	End of Text
LRC	Checksum

The checksum is the last byte in a command string. All bytes (except the checksum (LRC)) are linked by an XOR operation. The receiver of a message compares the received checksum with the calculated checksum from the received data; if the values are identical, the transmission is considered to be error-free.

Instead of a calculated LRC the ASCII Code of the letter 'U' (decimal 85) can be transmitted. In this case, the pump does not compute the checksum of the received data and takes the checksum as valid.

Pseudo code for LRC computation:

LRC = 0
CharacterIndex = 0
Repeat
   LRC = LRC xor CommandString[CharacterIndex]
   CharakterIndex = CharakterIndex + 1
Until CharakterIndex = LENGTH(CommandString) - 1
….
Compare LRC with the received LRC-byte (first byte after ETX)
….
 	
Where LENGTH() is a function that returns the number of bytes that CommandString contains.
Assuming that the first character in the CommandString array is accessed by index value 0.

7 Protocol answer

First, the pump checks the formal correctness of any received command. The Format as described in this document and LRC have to be correct. The address in the received packet has to be equal to the pump's address. After the acceptance of the command, it will be executed.

If the command has been executed, the processing of the command is either positively or negatively acknowledged.

Positive acknowledge ACK (deciaml 6) means a successful processing of the command.

Negative acknowledge NACK (decimal 21) means either a formal error while receiving the command or a failure to process the command. No details are available.

If the command to the pump demands a reply (i.e. status information or the value of a parameter), a leading ACK indicates the successful processing of the command. Afterwards the actual content of the answer is transmitted. In case of an invalid command a single NACK is returned.

Example: An answer for a formally correct command that demanded a reply, like: **?SI** (Pump Address)

: Transmit

Name	STX	Address		Cmd str			ETX	LRC
Example	2	0	0	?	S	I	3	36

Receive

Meaning	Ack	STX	Data		ETX	LRC
Example	#6	2	0	0	3	1

The Pump address is 00.

#6	ACK
STX (02h)	Start of text
Data block	ASCII code according to the command list
ETX (03h)	End of text
LRC	Checksum

Overview of protocol response of the pump

Situation of received packet	Response	Remarks
Correct LRC, Address match, formally correct content and command successfully executed	ACK	Formally correct means a valid command mnemonic and the right number of digits for the parameter
Formally incorrect content	NACK	Invalid mnemonic or parameter field contains an incorrect number of digits
Parameter out of range	NACK	Any set parameter is range checked
Command not executed	NACK	An internal state prevents the command from execution
Wrong LRC	No answer	'U' is generally accepted as a valid LRC for any received packet
Wrong address	No answer	
Address = 99	No answer	

<div style="border:1px solid;">

NOTICE

It is not allowed that two pumps can send their answers simultaneously

</div>

The protocol answer can be deactivated (see command SPn).

In this case no ACK or NACK sign is returned. The reply for commands that asked for information is always returned.

8 Operation modes and their limitations

MS==0: Run Mode

DT: unused

DV: unused

RV is forced to be within the interval [RV_{min}, RV_{max}] by the firmware.

MS==1: Metering by set volume and time

DT: is forced to be within the interval [DT_{min}, DT_{max}] by the firmware.

$$DT_{min} = \frac{DV}{RVmax}$$

$$DT_{max} = \frac{DV}{RVmin}$$

DV: set by the user (check limits [DV_{min}, DV_{max}])

RV is forced to be within the interval [RV_{min}, RV_{max}] by the firmware.

MS==2: Metering by set flow rate and time

DT: set by the user

DV: calculated by firmware

$$DV = \frac{DT}{RV}$$

RV is forced to be within the interval [RV_{min}, RV_{max}] by the firmware.

Legend	
DT:	Dispense time [s]
RV:	Flow rate [µl/min]
DV:	Metering volume [µl]

SIMDOS 02

RV_{min}	0.03ml/min
RV_{max}	20ml/min
DV_{min}	0.03ml
DV_{max}	1000l

SIMDOS 10

RV_{min}	0.1ml/min
RV_{max}	100ml/min
DV_{min}	0.1ml
DV_{max}	1000l

9   Commands

9.1   Function list

9.1.1 Mode select: Run-mode / Dispense-mode

Summary: Selects the active operating mode of the pump.

Set command

Command string:	**MSn**	
Parameter name:	**MS**	
Parameter value:	**n**	(1 digit, right adjusted)
Example:	**MS1** ⇒	Dispense Mode, ml and Time is active

n	Function
0	Run Mode is active (Factory preset)(Auto-start preset)
1	Dispense Mode ml and time is active
2	Dispense Mode ml/min and time is active

Read command

Command string:	**?MS**	
Answer:	**n**	(1 digit, right adjusted)
Example	Transmit	**?MS**
	Receive	**1**

n	Meaning
0	Run Mode is active
1	Dispense Mode ml and time is active
2	Dispense Mode ml/min and time is active

Display on Pump User Interface:

n	Display
0	Volume: unit = ml/min Time: - - min - - sec
1	Volume: unit = ml Time: 99 min 99 sec
2	Volume: unit = ml/min Time: 99 min 99 sec

Power OFF behavior:	State of **MS** is saved
Auto-start Power OFF behavior:	State of **MS** is saved
Remarks:	Take notice of the limits! See chapter 8.

9.1.2   Start, Stop, Prime/Drain

Summary: To initiate primary pump function. Start pumping, stop pumping, start Prime/Drain cycle.

Set command

Parameter name: **KY**

Parameter value: **n**   (1 digit, right adjusted)

Command string: **KYn**

Example: **KY2** $\Rightarrow$ Priming the pump

n	Function
0	Stop (Factory preset)
1	Start (Auto-start preset)
2	Prime/Drain (1 stroke)
3	Pause

Read Command:

Command string: No parameter read function

Display on Pump User Interface:

n	Display
0	Volume counter stops and the STOP indicator is active
1	Volume counter either resets to 0 or keeps its value and starts counting corresponding to the previous state of pump (either 0 (STOP) or 3 (PAUSE))
2	Volume counter resets to 0 and finally displays the dispensed volume of the prime stroke
3	Volume counter xxx stops, is blinking and the PAUSE indicator is active

Power OFF behavior: State of **KY** reset to factory preset (Always Stop when power ON).

Auto-start Power OFF behavior: State of **KY** reset to factory preset (Always Stop when power ON).

Remarks: See **AS** (Section 9.1.20) for more information on autostart

9.1.3   Run mode flow rate µl/min.

Summary: Sets the set value for the flow rate in Run mode. The unit is µl/min.

Set command

Command String   **RVnnnnnnnn**

Command name: **RV**

Parameter value: **nnnnnnnn**   (8 digits, right adjusted)

Example: **RV00020000** $\Rightarrow$ 20'000 µl/min

SIMDOS10

nnnnnnnn	Function
0...99'999'999	Set value for the flow rate [µl/min] in Run mode
00'100'000	FEM 1.10 Maximum accepted value (NACK if higher)
00'001'000	FEM 1.10 Minimum accepted value (NACK if lower)
00'010'000	Factory preset

SIMDOS02

nnnnnnnn	Function
0...99'999'999	Set value for the flow rate [µl/min] in Run mode
00'020'000	FEM 1.02 .18 Maximum accepted value (NACK if higher)
00'000'030	FEM 1.02 .18 Minimum accepted value (NACK if lower)
00'10'000	Factory preset

Read Command

Command String   **?RV**

Answer: **nnnnnnnn**   (8 digits, right adjusted)

Example: Transmit   ?RV

Receive   **00020000**

nnnnnnnn	Meaning
0…99999999	Current set value for flow rate in µl/min

Display on Pump User Interface:

SIMDOS10

nnnnnnnn	Display
1.0 … 100.0	Volume nnn.n ml/min (when in Run mode **MS** = 0)

SIMDOS02

nnnnnnnn	Display
0.03 … 20.00	Volume nn.nn ml/min (when in Run mode **MS** = 0)

Power OFF behavior:	Value of **RV** is saved
Auto-start Power OFF behavior:	Value of **RV** is saved
Remarks:	Take notice of the limits! See chapter 8.

9.1.4   Dispense mode dispense volume μl

Summary: Sets the set value for the dispense volume in Dispense-mode. The unit is μl.

Set command

Command string   **DVnnnnnnnn**

Command name: **DV**

Parameter value: **nnnnnnnn**   (8 digits, right adjusted)

Example: **DV00020000** $\Rightarrow$ 20'000 μl

SIMDOS10

nnnnnnnn	Function
0...99'999'999	Set value for the dispense volume in Dispense mode [μl]
00'999'999	Maximum accepted value (NACK if higher)
00'001'000	Minimum accepted value (NACK if lower)
00'010'000	Factory preset, Auto-start preset

SIMDOS02

nnnnnnnn	Function
0...99'999'999	Set value for the dispense volume in Dispense mode
00'999'999	Maximum accepted value (NACK if higher)
00'000'030	Minimum accepted value (NACK if lower)
00'10'000	Factory preset, Auto-start preset

Read command

Command string: **?DV**

Answer: **nnnnnnnn**   (8 digits, right adjusted)

Example   Transmit   ?DV

Receive   **00020000** $\Rightarrow$ 20'000 μl

nnnnnnnn	Meaning
min…99999999	Current set value for dispense volume in μl

Display on Pump User Interface:

nnnnnnnn	Massage
min … 999.9	Volume nnn.n ml (when in Dispense mode MS = 1)

Power OFF behavior: Value of **DV** is saved

Auto-start Power OFF behavior: Value of **DV** is saved

Remarks: Take notice of the limits! See chapter 8.

9.1.5   Dispense mode time for dispensing a volume

Summary:

Sets the set value for the time to dispense a volume in Dispense mode.

Set command

Command string: **DThhmmssss**

Parameter name: **DT**

Parameter value: **hhmmssss**   (8 digits, [hh:mm:ss.ss] "h": hour, "m": minute, "s":seconds, ".ss": 1/100 seconds)

Example: **DT00010000** ⇒ 1 min

hhmmssss	Function
99'99'99'99	Set value for the time to dispense a volume in Dispense mode
99'59'59'99	Maximum accepted value (NACK if higher)
00'00'01'00	Minimum accepted value (NACK if lower)
00'00'10'00	Factory preset, Auto-start preset (10 seconds)

Read command

Command string: **?DT**

Answer: **hhmmssss**   (8 digits, right adjusted)

Example: Transmit   **?DT**

Receive   **00010000** ⇒ 1 min

hhmmssss	Meaning
0…99999999	"h": hour, "m": minute, "s":seconds, ".ss": 1/100 seconds

Display on Pump User Interface:

nn:nn	Display	
mm:ss	00:01 - 59:59	Time: mm [min.] ss [sec.] (when in Dispense mode **MS** = 1 or 2)
hh:mm	01:00 - 99:59	Time: hh [h.] mm [min.] (when in Dispense mode **MS** = 1 or 2)
off	--:--	Time: - - min - - sec (when in Run mode **MS** = 0)

User Interface behavior:

- If time is dialed from "0" to a time value, then: **MS** = 1 or 2, **DV** = **RV**
- If time is dialed to "0", then: **MS** = 0, **RV** = **DV**, display time "off"

Power OFF behavior: Value of **DT** is saved

Auto-start Power OFF behavior: Value of **DT** is saved

Remarks: Take notice of the limits! See chapter 8.

NOTICE
The pump will only accept this dispense time, as long as it is between the pump internal min. and max. time for dispensing a selected basic dispense volume, otherwise the pump will set the internal min. or max. time. A simple read back helps to check the actual dispense time. Time resolution is 1.00s.

9.1.6 Dispense mode: number of volumes

Summary: The number of cycles, that the given volume shall be dispensed, is defined

Set command

Command string: **DNnnnnn**

Command name: **DN**

Parameter value: **nnnnn** (5 digits, right adjusted)

Example **DN00050** $\Rightarrow$ 50 cycles

nnnnn	Function
0	Function off
1	Cyclic dispensing is deactivated
2...999	nnnnn represents the number of dispensed volumes
1000	Infinite number of repetitions

Read command

Command string: **?DN**

Answer: **nnnnn** (5 digits, right adjusted)

Example: Transmit **?DN**

Receive **00050** $\Rightarrow$ 50 cycles

nnnnn	Meaning
0	Function off
1	Cyclic dispensing is deactivated
2...999	Currently configured number of dispense volumes
1000	Dispense volume is infinitely repeated

Display on Pump User Interface:

nnnnn	Display
0	Function off
1	Cyclic dispensing is deactivated (no indication)
2...999	Counter of dispensed volumes / Number of volumes
1000	The text string "INF"

Power OFF behavior: Value of **DN** is saved

Auto-start Power OFF behavior: Value of **DN** is saved

Remarks: 1/100 s are rounded to seconds as this is the minimum resolution of time.

9.1.7 Dispense mode: Break time between volumes

Summary: Break time between two programmed dispense cycles

Set command

Command string: **DBnnnnn**

Parameter name: **DB**

Parameter value: **nnnnn** (5 digits, right adjusted)

Example: **DB00010** $\Rightarrow$ 10 seconds break time

nnnnn	Function
1...5999	Break time in seconds

Read Command

Command string: **?DB**

Answer: **nnnnn** (5 digits, right adjusted)

Example: Transmit **?DB**

Receive 00010 $\Rightarrow$ 10 seconds break time

nnnnn	Meaning
1...5999	Break time in seconds

Display on Pump User Interface:

nnnnn	Display
1...5999	Break time in seconds, is counting backwards when active

Power OFF behavior: Value of DB is saved

Auto-start Power OFF behavior: Value of DB is saved

Remarks: --

9.1.8   Actual run or dispense time counter.

Summary: Time counter of the Dispense mode (and Run mode). Counter resets to 0 and starts at dispense start or run start

Set command

Command string: **No command string**
Parameter name: --
Parameter value: --
Example: --

Read command

Command string: **?TT**

Answer: **hhmmssss**   5 digits, right adjusted
[hh:mm:ss.ss] "h": hour, "m": minute, "s":seconds, ".ss": 1/100 seconds

Example: Transmit   **?TT**

Receive   **00010000** ⇒ 1 minute

hhmmssss	Meaning
0…99999999	"h": hour, "m": minute, "s":seconds, ".ss": 1/100 seconds
00000000	Dispense is not started / Run is not started

Display on Pump User Interface:
No Display

Power OFF behavior: Value of **TT** is not saved
Auto-start Power OFF behavior: Value of **TT** is not saved
Remarks: --

9.1.9   Actual run or dispense volume counter µl

Summary: Volume counter of the Dispense mode (and Run mode). Counter resets to 0 and starts at dispense start or run start

Set command

Command string: **No command string**
Parameter name: --
Parameter value: --
Example: --

Read command

Command string: **?TV**
Answer: ***nnnnnnnnn***   (9 digits, right adjusted)
Example: Transmit   **?TV**

Receive   **000010000** $\Rightarrow$ 10 ml

nnnnnnnnn	Meaning
0…999'999'999	Dispensed volume in µl

Display on Pump User Interface:

n	Display
0…999999.9	Dispensed volume since last pump start in ml
> 999999	If Upper limit of TV is reached the counter stops

Power OFF behavior: Value of **TV** is not saved
Auto-start Power OFF behavior: Value of **TV** is not saved
Remarks: Since the pump only dispenses during pressure strokes, the dispense counter needs calibration. The counter is based on the calibrated pump stroke volume which is summed up by incremental steps.

Take note of the upper limit. If the dispensed volume is larger than the upper limit of **TV**, the volume counter displays the difference to 1000 l and the display shows "> 1000 l"

9.1.10 Analog control signal type selection

Summary: Selects the analog signal type

Set command

Command string: **RAn**

Parameter name: **RA**

Parameter value: **n**   (1 digit, right adjusted)

Example: **RA2** ⇒   Analog signal 4…20mA

n	Function
0	Analog signal 0…10V (Factory default)
1	Analog signal 0…20mA
2	Analog signal 4…20mA
3	Analog signal 0..5V
9	Analog signal OFF

Read command

Command string: **?RA**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?RA**

Receive   **2** ⇒   Analog signal 4…20mA

n	Meaning
0	Analog signal **0…10V** (Factory default)
1	Analog signal **0…20mA**
2	Analog signal **4…20mA**
3	Analog signal **0..5V**
9	Analog signal **OFF**

Display on Pump User Interface:

Display indicates only if analog input is active or not.

User Interface behavior: When analog signal is changed from "off" to another value, then: **RA** changes accordingly.

Power OFF behavior: Value of **RA** is saved

Auto-start Power OFF behavior: Value of **RA** is saved

Remarks: --

NOTICE
If pump is not in "run mode" any value except "analogue off" is not accepted. (NACK will be returned)

9.1.11 Flow rate range selection for analog input

Summary: Sets one of the three flow rate ranges

Set command

Command string: **RBn**

Parameter name: **RB**

Parameter value: **n**   (1 digits, right adjusted)

Example: **RB2** ⇒   flow rate range is set to 0.15 – 15%.

n	flow rate range
0	1 – 100% of full scale (Factory default)
1	0.3 – 30% of full scale
2	0.15 – 15% of full scale

Read command

Command string: **? RB**

Answer: **n**   (1 digits, right adjusted)

Example: Transmit   **?RB**

Receive   **RB2** ⇒   flow rate range is set to 0.15 – 15%.

n	flow rate range
0	1 – 100% of full scale (Factory default)
1	0.3 – 30% of full scale
2	0.15 – 15% of full scale

Display on Pump User Interface:

No special indications on the main display. It's indicated in the range setting menu (System=>Range)

- The displayed fow rate (main display) will change according to the selected flow rate range.

User Interface behavior: When the flow rate ranges is changed to another value, then: **RB** changes accordingly.

Power OFF behavior: Value of **RB** is saved

Auto-start Power OFF behavior: Value of **RB** is saved

Remarks: The analog input must be activated:

- 0 – 5 V
- 0 – 10 V
- 0 – 20 mA
- 4-20 mA

otherwise the pump ignores any correct applied analog signal and the pump is only controlled by the user interface.

9.1.12   Digital input 1 function

Summary: Selects the function of the digital input 1.

Set command

Command string: **L1nn**

Parameter name: **L1**

Parameter value: **nn**   (2 digits, right adjusted)

Example: **L101** ⇒   Digital input 1, is configured for a level controlled Start/stop signal

nn	Function	
00	Signal:	Off (Factory default)
01	level controlled:	Start/stop
06	edge controlled:	Start/stop

Read command

Command string: **?L1**

Answer: **nn**   (2 digits, right adjusted)

Example: Transmit   **?L1**

Receive   **L101** ⇒   Digital input 1, is configured for level controlled Start/stop signals

nn	Meaning	
00	Signal:	Off (Factory default)
01	level controlled:	Start/stop
06	edge controlled:	Start/stop

Display on Pump User Interface:

Display indicates only if digital input is active or not (high and low).

User Interface behavior: IF **L1** is set to 01 or 06, the selected option is not accessible for **L2**.

Power OFF behavior: Value of **L1** is saved

Auto-start Power OFF behavior: Value of **L1** is saved

Remarks: **L1** and **L2** cannot be set to 01 or 06 at the same time. Protocol answer is NACK in case of conflicting settings.

9.1.13 Digital input 2 function

Summary: Selects the function of the digital input 2.
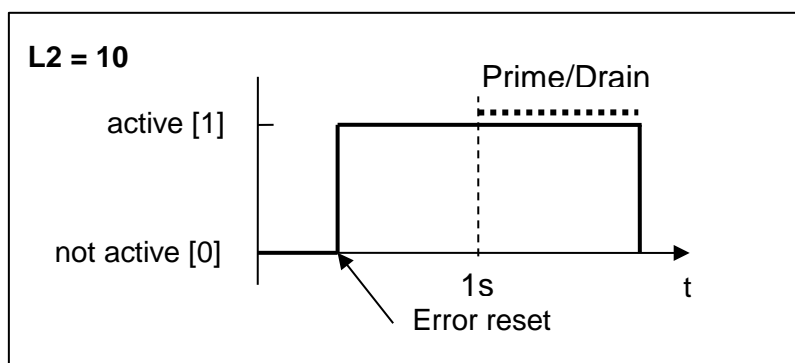
Set command

Command string: **L2nn**

Parameter name: **L2**

Parameter value: **nn** (2 digits, right adjusted)

Example: **L201** ⇒ Digital input 2, is configured for level controlled Start/stop signals

nn	Function
00	Signal 2: Off (Factory default)
01	level controlled: Start/stop signal
06	edge controlled: Start/stop signal
08	Pump Error reset & Pump Stop on signal edge.
09	Prime/Drain on signal level and error reset on signal edge
10	Error reset on signal edge and Prime/Drain after 1 second on signal level

Logic level

L2 = 08

active [1]

not active [0]

Error reset

t

L2 = 09

Prime/Drain

active [1]

not active [0]

Error reset

t

L2 = 10

Prime/Drain

active [1]

not active [0]

1s

Error reset

t
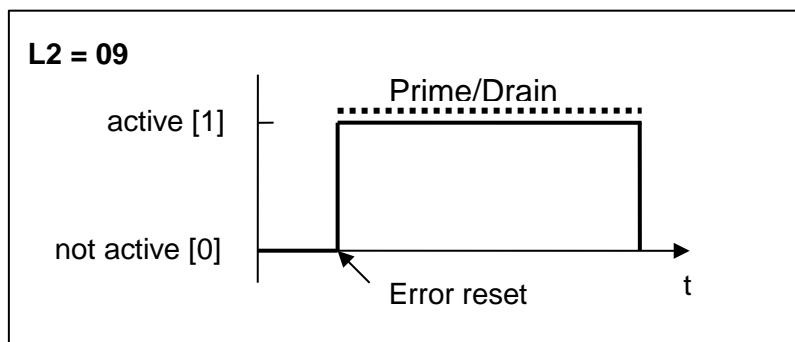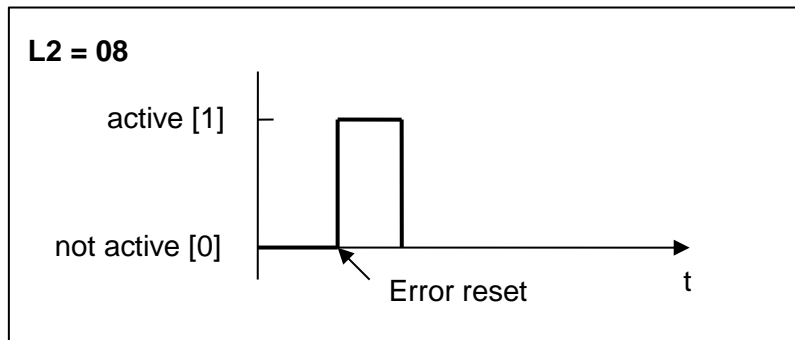
Read command

Command string: **?L2**

Answer: **nn**   (2 digits, right adjusted)

Example: Transmit   **?L2**

Receive   **L201** ⇒   Digital input 2, configured for level controlled
                        start/stop signals

nn	Meaning
00	Signal 2: Off (Factory default)
01	level controlled: Start/stop
06	edge controlled: Start/stop
08	Pump Error reset & Pump Stop on signal edge.
09	Prime/Drain on signal level and error reset on signal edge
10	Error reset on signal edge and Prime/Drain after 1 second on signal level

Display on Pump User Interface:

Display indicates only if digital input is active or not (high and low).

User Interface behavior: IF **L2** is set to 01 or 06, the selected option is not accessible for **L1**.

Power OFF behavior: Configuration of **L2** is saved

Auto-start Power OFF behavior: Configuration of **L2** is saved

Remarks: **L1** and **L2** cannot be set to 01 or 06 at the same time. Protocol answer is NACK in case of conflicting settings.

9.1.14 Open collector output function

Summary: Defines the function of the open collector output (low active)

Set command

Command string: **RSn**

Parameter name: **RS**

Parameter value: **n**   (1 digit, right adjusted)

Example: **RS1** ⇒   Output on active level, when motor is running

n	Function
0	active signal level when Alarm on Error (Factory default)
1	active signal level when Motor is running
2	active signal level when Volume finish
3	active signal pulse: every 1/10 revolution (10 pulses per revolution)
4	active signal pulse: 1 pulse per 20µl SIMDOS 02 1 pulse per 100µl SIMDOS 10

Read command

Command string: **?RS**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?RS**

Receive   **RS1** ⇒   Output on active level, when motor is running

n	Meaning
0	active signal level when Alarm on Error (Factory default)
1	active signal level when Motor is running
2	active signal level when Volume finish
3	active signal pulse: every 1/10 revolution (10 pulses per revolution)
4	active signal pulse: 1 pulse per 20µl SIMDOS 02 1 pulse per 100µl SIMDOS 10

Display on Pump User Interface:

Display does not indicate any output signals.

User Interface behavior: IF **L1** is set to 01 or 06, the selected option is not accessible for **L2**.

Power OFF behavior: Value of **RS** is saved

Auto-start Power OFF behavior: Value of **RS** is saved

Remarks: --

9.1.15 Language select

Summary: Selects the language of the user interface

Set command

Command string: **LSn**

Parameter name: **LS**

Parameter value: **n**   (1 digit, right adjusted)

Example: **LS1** $\Rightarrow$ German

n	Function
0	English
1	German
2	French
3	Spanish
4	Italian
5	Chinese
6	Japanese

Read command

Command string: **?LS**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?LS**

Receive   **LS1** $\Rightarrow$ German

n	Meaning
0…6	User interface language according to parameter value

Display on Pump User Interface:

n	Display
0…6	User interface language according to parameter value

Power OFF behavior: Value of **LS** is saved

Auto-start Power OFF behavior: Value of **LS** is saved

Remarks: --

9.1.16 Customer level measured calibration volume

Summary: Customer level calibration based on Run mode flow rate or Dispense mode volume

Set command

Command string: **CFnnnnnnnn**

Parameter name: **CF**

Parameter value: **nnnnnnnn** (8 digits, right adjusted)

Example: **CF 00000100** $\Rightarrow$ 100 µl or 100 µl/min, it depends on the mode of operation

n	Function
0...99999999	Customer measured flow rate [µl/min] or dispense volume in [µl]

Read command

Command string: **No parameter read function**

Answer: -

Example: -

Display on Pump User Interface:

n	Display
0…9999	Measured value nnnn in ml (when in Dispense mode **MS**=1)
0…9999	Measured value nnnn in ml/min (when in Run mode **MS**=0)

Power OFF behavior: Value of **CF** is not saved

Auto-start Power OFF behavior: Value of **CF** is not saved

Remarks: The parameter **CF** is a user input value only.

Setting **CF** initiates the computation of the calibration parameter **CH**. See definition of **CH**.

NOTICE
CH is computed based on CF (see section 9.1.17).
If the value of CF violates - after computation - the range of CH, CF is not accepted and a NACK sign is returned.

9.1.17 Customer level calibration factor %

Summary: Customer level calibration factor for pump stroke volume

Set command

Command string: **CHnnnnn**

Parameter name: **CH**

Parameter value: **nnnnn**   (5 digit, right adjusted)

Example: **CH08000**   ⇒ Minimum accepted value 80%, the pump is cali-
                                 brated to the lowest range

nnn.nn	Function
0...999.99	Percentage of the factory calibrated pump stroke volume
080.00	Minimum accepted value 80% (NACK if lower)
120.00	Maximum accepted value 120% (NACK if higher)
100.00	100% (Factory default)

Read command

Command string: **?CH**

Answer: **nnnnnn**   (5 digits, right adjusted)

Example: Transmit   **?CH**

                  Receive   **CH08000** ⇒ Pump is calibrated to 80%

nnn.nn	Message
0 …999.99	Pump stroke volume correction in % by user calibration

Display on Pump User Interface:

nnn.nn	Message
0...999	Calibration "**nnn**" %

Power OFF behavior: Value of **CH** is saved

Auto-start Power OFF behavior: Value of **CH** is saved

Remarks: Setting the parameter **CF** initiates the computation of the calibra-
                  tion parameter **CH.**

pseudo code
$CH_{new} = CH_{old} * RV_{set} / CF$ or $CH_{new} = CH_{old} * DV_{set} / CF$

CH_{new} Relative customer level calibration   (new)

CH_{old} Relative customer level calibration (original)

RV_{set}/ DV_{set} Set flow rate or set dispense volume

CF Measured flow rate or volume (it depends on the mode of operation)

NOTICE
If the Limit for **CH** is exceeded a NACK sign is returned and the calibration is not accepted

9.1.18 Characteristic pump profile selection

Summary: Selects the active pump profile

Set command

Command string: **CCn**

Parameter name: **CC**

Parameter value: **n**   (1 digit, right adjusted)

Example: **CC1** $\Rightarrow$ Profile for volatile fluids is active

n	Function
0	Standard profile is active
1	Profile for volatile fluids is active
2	Profile for viscous fluids is active
3	Profile for high viscous fluids is active
4	Reserved

Read command

Command string: **?CC**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?CC**

Receive   **CC1** $\Rightarrow$ Profile for volatile fluids is active

n	Meaning
0	Standard profile is active
1	Profile for volatile fluids is active
2	Profile for viscous fluids is active
3	Profile for high viscous fluids is active
4	Reserved

Display on Pump User Interface:

n	Display
0	Agent "**Standard**"
1	Agent "**Degassing**"
2	Agent "**Visc100cSt**"
3	Agent "**Visc500cSt**"
4	Reserved

Power OFF behavior: Value of **CC** is saved

Auto-start Power OFF behavior: Value of **CC** is saved

Remarks: --

9.1.19 LCD display contrast

Summary: Sets the contrast level of the LCD display.

Set command

Command string: **LCnnn**

Parameter name: **LC**

Parameter value: **nnn**   (3 digits, right adjusted)

Example: **LC060**   ⇒ LCD Contrast 60%

n	Function
000 ... 100	LCD display contrast setting
100	Maximum accepted value (NACK if higher)
000	Minimum accepted value (NACK if lower)
040	(Factory default)

Read command

Command string: **?LC**

Answer: **nnn**   (3 digits, right adjusted)

Example: Transmit   **?LC**

Receive   **LC040** ⇒ LCD Contrast 40% (default setting)

nnn	Meaning
000…100	LCD display contrast setting

Display on Pump User Interface:

nnn	Display
000…100	Contrast "nnn"

Power OFF behavior: Value of **LC** is saved

Auto-start Power OFF behavior: Value of **LC** is saved

Remarks: Take notice of the limits!

9.1.20 Auto-start after power on

Summary: Settings of automatic start after power off/switch off.

With active Auto-start the pump will start automatically if one of the following actions takes place:

- The power plug is attached to the pump
- The pump is switched on

<table>
<tr><td align="center">**NOTICE**</td></tr>
<tr><td>If any input control signal is configured the pump will stay in pause state until a start trigger is given.</td></tr>
</table>

Set command

Command string: **SAn**

Parameter name: **SA**

Parameter value: **n**   (1 digit, right adjusted)

Example: **SA1**   ⇒ activate Auto-start

n	Function
0	Auto-start inactive (Factory default)
1	Auto-start active

Read command

Command string: **?SA**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?SA**

Receive   **SA1** ⇒ Auto-start is active

n	Meaning
0	Auto-start is inactive
1	Auto-start is active

Display on Pump User Interface:

n	Display
0	No display
1	"AS" is displayed above unit indicator

Power OFF behavior: Value of **SA** is saved

Auto-start Power OFF behavior: Value of **SA** is saved

Remarks: --

9.1.21 Pump model and firmware version

Summary: To recognize pump model and firmware version.

Set command

Command string: **No command string**

Parameter name: **--**

Parameter value: **--**

Example: **--**

Read command

Command string: **?SV**

Answer: **nnnnnnnnnn**   (10 char, right adjusted)

Example: Transmit   **?SV**

Receive   **SV001021307** $\Rightarrow$ FEM1.02 mit Firmware 1.307

pppppvvvvv	Meaning
00110xxxxx	FEM1.10
00102xxxxx	FEM1.02
xxxxx01300	5 digits Firmware version

Display on Pump User Interface:

pppppvvvvv	Meaning
	On boot screen display FEM"ppppp" Vers. "vvvvv"

Power OFF behavior: --

Auto-start Power OFF behavior: --

Remarks: --

9.1.22 Communication check function

Summary: Communication check function. Returns pump address if communication works correctly.

Set command

Command string: **No command string**

Parameter name: **--**

Parameter value: **--**

Example: **--**

Read command

Command string: **?SI**

Answer: **nn**   (2 digits, right adjusted)

Example: Transmit   **?SI**

Receive   **00** ⇒ Factory default

nn	Meaning
00	Corresponds to the pump address (Factory default)
01 … 98	Corresponds to the pump address

Display on Pump User Interface:
No Display

Power OFF behavior: Value of **SI** is not saved

Auto-start Power OFF behavior: Value of **SI** is not saved

Remarks: To solve communication problems read Chapter 0, 6, 7 and 10

9.1.23 Protocol answer setting

Summary:

First, the pump checks the formal correctness of any received command. The Format as described in this document and LRC have to be correct. The address in the received packet has to be equal to the pump's address. After the acceptance of the command, it will be executed.

If the command has been executed, the processing of the command is either positively or negatively acknowledged.

Positive acknowledge ACK (deciaml 6) means a successful processing of the command.

Negative acknowledge NACK (decimal 21) means either a formal error while receiving the command or a failure to process the command. No details are available.

The command disables the acknowledgment of the received command. (no ACK/NACK sign)

Set command

Command string:	**SPn**	
Parameter name:	**SP**	
Parameter value:	**n**	(1 digit, right adjusted)
Example:	**SP1**	$\Rightarrow$ Protocol answer is active

n	Function
0	Protocol answer inactive
1	Protocol answer active (Factory default)

Read command

Command string:	**?SP**	
Answer:	**n**	(1 digit, right adjusted)
Example:	Transmit	**?SP**
	Receive	**SP1** $\Rightarrow$ Protocol answer is active

n	Meaning
0	Protocol answer inactive
1	Protocol answer active ACK and NACK are sent

Display on Pump User Interface:
No Display

Power OFF behavior:	Value of **SA** is saved
Auto-start Power OFF behavior:	Value of **SA** is saved
Remarks:	--

9.1.24 Initialize the pump (new start)

Summary: Reset the pump similar to power OFF/power ON. (After a severe error like motor error or overpressure)

Set command

Parameter name: **IN**

Parameter value: **no parameter value**

Example: **IN** $\Rightarrow$ Pump will be restarted (as power OFF/power ON)

Read command

Command string: **No command string**

Answer: --

Example: --

Display on Pump User Interface:

No Display

	Display
	Pump displays boot screen

Power OFF behavior: --

Auto-start Power OFF behavior: --

Remarks: --

9.1.25 Pump reset to factory settings

Summary: This function brings the pump back to the factory settings.

- All the modified custom settings except pump address will be set back to the factory settings.
- Any custom calibration values will be set back to the factory calibration values.

Set command

Command string:	**IP**
Parameter name:	**IP**
Parameter value:	**no parameter value**
Example:	**IP** $\Rightarrow$ Pump will be set to factory settings

Read command

Command string:	**No command string**
Answer:	--
Example:	--

Display on Pump User Interface:

No Display

	Display
	-No changes
	-The pump parameters are set to default value.

Power OFF behavior:	--
Auto-start Power OFF behavior:	--
Remarks:	--

9.1.26   Pump status request

Summary: Reads back the pump status:

Set command

Command string: **No command string**

Parameter name: --

Parameter value: --

Example: --

Read command

Command string: **?SSn**

n	Function
1	Operations - status
2	System - status
3	Run mode - status
4	Dispense mode - status
5	Reserved
6	Fault diagnosis

Answer: **nnn**   (3 digits, right adjusted)

1. Example: Transmit   **?SS2**

              Receive   **002** $\Rightarrow$ I/O 1 input high

2. Example: Transmit   **?SS2**

              Receive   **004** $\Rightarrow$ I/O 2 input high

3. Example: Transmit   **?SS2**

              Receive   **006** $\Rightarrow$ I/O 1 input high and I/O 1 input high

Byte 1	value	Operation - status
Bit 0	[1]	[0] Motor don't turn, [1] Motor turns
1	[2]	[0] No pump fault, [2] Pump fault
2	[4]	[0] Display ON, [4] Display OFF
3	[8]	
4	[16]	
5	[32]	
6	[64]	
7	[128]	

Byte 2	value	System - status
Bit 0	[1]	[0] motor not adjusted, [1] motor adjusted
1	[2]	[0] I/O 1 input low, [2] I/O 1 input high
2	[4]	[0] I/O 2 input low, [4] I/O 2 input high
3	[8]	[0] motor not on UT, [8] motor on UT
4	[16]	
5	[32]	
6	[64]	
7	[128]	

Byte 3	value	Run mode - status
Bit 0	[1]	[0] RUN-mode stopped [1] RUN-mode started
1	[2]	
2	[4]	
3	[8]	
4	[16]	
5	[32]	
6	[64]	
7	[128]	

Byte 4	value	Dispense mode - status
Bit 0	[1]	[0] Dispense-mode stopped [1] Dispense-mode started
1	[2]	
2	[4]	
3	[8]	[0] user stop active [8] user stop NOT active
4	[16]	
5	[32]	
6	[64]	
7	[128]	

Byte 6	value	Fault diagnosis
Bit 0	[1]	[1] Overpressure,
1	[2]	[2] Reserved
2	[4]	[4] Reserved
3	[8]	[8] Analog signal under 4 mA
4	[16]	[16] Power supply failure
5	[32]	[32] Motor error
6	[64]	[64] Temperature exceeded
7	[128]	[128] No encoder sensor signal

Remarks: See section 10.2

9.1.27 Pump address nn

Summary: Sets the pump address for serial interface commands.

Set command

Command string: **ADnn**

Parameter name: **AD**

Parameter value: **nn**   (2 digits, right adjusted)

Example: **AD10** $\Rightarrow$ Set the network address of the pump to 10

nn	Function
00 ... 98	Pump address

Read command

Command string: **?AD**

Answer: **nn**   (2 digits, right adjusted)

Example: Transmit   **?AD**

Receive   **10** $\Rightarrow$ The network address of the pump to 10

nn	Meaning
00 ... 98	Current Pump address

Display on Pump User Interface:
No display

Power OFF behavior: Value of **AD** is saved

Auto-start Power OFF behavior: Value of **AD** is saved

Remarks: The external control program has to use the correct (modified) address to send commands to the pump.

Address 99 is reserved for commands that shall be executed synchronously by every pump in the network.

9.1.28 Maintenance position

Summary: Move to maintenance position. When this function is activated, the eccentric of the pump moves to a position where maintenance is easily possible.

Set command

Command string: **MPn**

Parameter name: **MP**

Parameter value: **n**   (1 digit, right adjusted)

Example: **MP1** ⇒   Move to the maintenance position

n	Function
0	No movement to maintenance position (Factory default)
1	Movement to maintenance position is triggered

Read command

Command string: **?MP**

Answer: **n**   (1 digit, right adjusted)

Example: Transmit   **?MP**

Receive   **1** ⇒ Maintenance position reached and active

n	Function
0	Out of maintenance position
1	Maintenance position reached and active

Display on Pump User Interface:

n	Function
0	No display
1	Full screen displays "Maintenance"

Power OFF behavior: Value of **MP** is not saved

Auto-start Power OFF behavior: Value of **MP** is not saved

Remarks: While a maintenance state:

- A stop command switches the motor torqueless.
- A start command starts the pump normally
- A prime command moves the diaphragm in the montage position (lower dead centre).

10 Troubleshooting

10.1 Communication problems

1. Check if pump is powered

2. Check connectivity

   • Make sure that the cables are connected
   • Choose the COM port at the PC which is connected to the USB to R232 Adaptor

3. Check COM port interface settings (see Section 5)

4. Check pump address, the default address is 00 (see also section 9.1.22)

5. If there is no answer,

   • Make sure that's only one pump active in the network

Transmit

Name	STX	Address		Cmd str			ETX	LRC
Example	2	9	9	A	D	!	00	3	37

=>Every active pump in the network will be readdressed with 00.

   • Check:

Transmit

Name	STX	Address		Cmd str		ETX	LRC
Example	2	9	9	?	S	I	3	36

Receive

Meaning	Ack	STX	Data		ETX	LRC
Example	#6	2	0	0	3	1

=>The Pump address is 00.

6. If the address has to be changed, make sure, that the message is send to the right address.

10.2 Displaying of error messages

Display	Description	Fault remedy
Error 1 Motor	Control deviation too high, motor is overloaded ➢ Pump blocked	➢ Switch pump on / off
Error 2 Temperature	Motor overheating	➢ Allow pump to cool ➢ Reduce ambient temperature
Error 3 Supply	Supply voltage is less than 21.6 V	➢ Supply with 24 V and sufficient power
Error 4 Encoder	Position measuring malfunction	➢ Switch pump on / off
Error 5 4 – 20 mA	Analog set point setting less than 2 mA	➢ Check control signal ➢ Check cable
Error 6 Flash	Error in memory	➢ Switch pump on / off
Error 7 Overpressure	System pressure exceeds 7 bar	➢ Check pump for closed valves and blocked filters

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