Instruction Manual

RS232 Interface of UNIDOS E

[D545.131.1/0]

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Safety Instructions

- This document is a supplement to the instruction manual UNIDOS E.
  You are only allowed to use it in connection with that manual.
- Follow the Safety Instructions given in that manual.
- Especially keep in mind, that peripheral devices connected to the RS232 interface of the UNIDOS E must meet the requirements of IEC 950.

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1 General

It is required, that the user has read the instruction manual of the UNIDOS E and knows how to operate it.
To get used to the UNIDOS E serial communiction, we recommend to use a terminal program like the Mircosoft-Windows HyperTerminal or the PTW terminal program PTWterm.

1.1 Interface overview

Physical
The UNIDOS E has an RS232 interface that supports the transmission rates 4800, 9600 and 19200 baud. The data format is 8 bit, no parity. If the COM port of your personal computer has a 9 pin D connector (standard IBM layout), use a PTW cable K47 or K67-30.
If it has a 25 pin connector, use a gender changer additionally. See page 9 for a complete physical description of the interface.

Protocol
Information is exchanged by means of ASCII strings, called *telegrams*. All telegrams are concluded by the characters <CR> (carriage return, hexadecimal 0D) and <LF> (line feed, hexadecimal 0A). This end mark is omitted in all telegram descriptions.
For all communiction, a strict ping pong principle must be observed: after sending a telegram to the UNIDOS E, the PC program must wait for the answer from UNIDOS E, before it may send a new telegram.

Notation
In this text, the character • is used to depict a space character contained in a telegram.

2 Telegram description

2.1 Telegram categories

The telegrams can be divided in several groups:

- Utility telegrams — To set up the measurement range and mode, device settings as the interval time, used unit, voltage setting and so on
- Calibration telegrams — To read/write all calibration data as it is displayed in the CHAMBER menu of the device
- Data telegrams — To read out the measured data
- Measurement telegrams — To control the measurement state of the device as STA, INT, NUL and so on
- Correction telegrams — To correct measured radiological data
- Information telegrams — As device status and PTW identification

For a complete list of all telegrams see section 2.3 on page 6.

2.2 Telegram structure

Telegrams are composed of one or more basic characters, defining the command, and parameters.
Example: In the telegram I0044 is I the ‘interval time’ command and 0044 the parameter for the setting.
Telegrams containing parameters alter a setting. If the parameter is omitted in the telegram, the actual setting is returned. For clarification parameters are printed in *italic* in the following sections.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044

2.3 Telegram list

The telegrams are listed in alphabetical order. ee is the number of the chamber entry. Valid values are 01 to 35.

Telegram	Response	Description	page
CReeB*bbbbb*	CReeBbbbbb	Read or write the block check value of entry ee	17
CReeF*f*	CReeF±m.mmmmE +ee	Read or write the calibration factor N of entry ee. Parameter *f*: 0.0 or ¤*f*¤ = 1.0E+2 … 1.0E+12	17
CReeN*name*	CReeNname	Read or write the label of entry ee. Parameter *name*: max 19 characters, spaces allowed	17
CReeQ*q*	CReeQq	Read or write the measuring quantity of entry ee. Parameter *q*: W = Dw ; A = Ka ; C = Ka*I (CT-chamber) ; S = Js ; L = Js*I	17
CReeS*s*	CReeSssssss	Read or write the detector serial number of entry ee. s = 0 … 999999	17
CReeT*t*	CReeTt	Read or write the dose rate reference time of ee. Parameter *t*: S = /sec ; M = /min ; H = /h	17
CReeU*x*	CReeUx	Update (x = 1) or read (no x) the result of the check sum protection of entry ee	17
CReeV*v*	CReeV±vvv	Read or write the voltage setting of entry ee. Parameter v: 0 ; 50 ; 100 … 400 in steps of 50 volts	17
D		Read measured value of actual measurement mode	14
D0		Read measured value of measurement mode 0	14
D1		Read measured value of measurement mode 1	14
D2		Read measured values of both measurement modes	14
DM	DM·m.mmE±ee	Read maximum value of measurement mode 1 for the actual range setting	14
DMr	DMr·m.mmE±ee	Read maximum value of measurement mode 1 for range r	14
DR	DR0.mmmE±ee	Read measurement resolution of actual measurement mode and range	15
DR*m*	DRm0.mmmE±ee	Read measurement resolution of measurement mode m and actual range setting	15
DR*mr*	DRmr0.mmmE±ee	Read measurement resolution of measurement mode m and range r	15
DU		Read unit of actual measurement mode	15
DU*m*		Read unit of measurement mode m	15
HLD	HLD	Equivalent to HLD key	13
I*i*	Iiiii	Read or write interval time. Parameter *i*: 1 … 9999	-
INT	INT	Equivalent to INT key	13
Kx	Kx	Lock (x = 0) or unlock (x = 1) the UNIDOS E keyboard	-
KD	KDm.mmm	Read the resulting air density correction factor kD	18
KK*f*	KKm.mmm	Read or write the setting of the additional correction factor k. Parameter *f*: 0.500 … 2.000	18
KP*f*	KPmmmm.m	Read or write the atmospheric pressure p. Parameter *f*: 500.0 … 1300.0	18
KS*x*	KSx	Read or write the correction setting. Parameter *x*: 1 = correction applied ; 0 = correction not appllied	18
KT*f*	KTf	Read or write the ambient temperature t. Parameter *f*: 10.0 … 40.0	18

Telegram	Response	Description	page
KTR	KTRx	Read the setting of the reference temperature. Parameter x: 0 = 20℃ ; 1 = 22℃	-
L*x*	Lx	Read or write the language setting. Parameter *x*: E = English ; D = German	-
M*x*	Mx	Read or write the actual measurement mode. Parameter *m*: 0 = dose or charge ; 1 = dose rate or current	13
NEW	NEW	Rebuilds the measurement setup. All calibration factors are checked and the measurement is set to the initial state	17
NUL	NUL	Equivalent to NUL key	19
NULCx	NULCx	Configuration of zeroing behaviour	19
NULE	NULEddddd	Read error code of last zeroing	19
NULT	NULTdd	Read remaining time in seconds until end of zeroing	19
PTW	UNIDOS·E·x.xxv	Read PTW-Information. x.xx is the firmware version	11
PW	PWx	Read password setting. Parameter *x*: 0 = no password protection ; 1 = protection active	-
PWxp	PWx	Set password setting. p is the password string as described in the UNIDOS E instruction manual	-
RES	RES	Equivalent to RES key	13
R*r*	Rr	Read or write range setting. Parameter *r*: L = Low ; M = Med ; H = High	-
S	Ssss	Read the status of the actual measurement mode. Possible values of parameter sss: RUN RES STA INT HLD NUL NER MEN ERR	-
S*m*	Smsss	Read status of measurement mode m	-
SC	SCx	Read calibration status of the actual device setting. Parameter *x*: 1 = calibrated ; 0 = uncalibrated	11
SD	SDddddd	Read device status	11
SE	SEddddd	Read error status	12
SER	SERssssss	Read device serial number	-
SET*ee*	SETee	Read or write setting of active chamber entry	12
STA	STA	Equivalent to STA key	13
STAm;ttt.h	STAm;ttt.h	Opens the so called streaming mode and starts an charge or dose measurement. The type of transferred data is chosen by parameter m.	16
U*u*	Uu	Read or write unit setting. Parameter *u*: E = electrical units ; R = radiological units	12
V*v*	V±vvv	Read or write actual voltage setting. Valid values for parameter *v*: 0 ; 50 ; 100 ; 150 ; 200 ; 250 ; 300 ; 350 ; 400	13

2.4 Important hints

- If UNIDOS E is in a menu, it can not be controlled via the RS232 interface. All telegrams with the exception of the information telegrams PTW, S, SC, SD, SE and SER will be responded with E03. If it is in a menu, the response to the S telegram is SMEN.
- Timeouts: the typical timeout setting is 2 seconds. After changing the high voltage setting, a wait time of 5 seconds has to be observed, before sending another telegram. In the default setup, the response to the NUL telegram will be send after 51 seconds at the end of the zeroing.
- To avoid confusion due to user operation at the UNIDOS E keyboard, it is recommended to lock the UNIDOS E keyboard by the K0 telegram during remote control of UNIDOS E.
- If UNIDOS E is switched on with no mains connected, the RS232 interface is disabled to save battery energy. In this case, the interface has to be activated in the SETUP\RS232 menu by hand.
- If the RS232 interface is enabled and battery supplied, the remote station should drive the UNIDOS E signals RxD and CTS to their quiescent state, e.g., RxD to ⇔ -3V and CTS to ⇩ 3V. This is not a must, but helps to save battery energy.

2.5 A sample session

Perrform steps 1 to 3 in the given sequence to set up UNIDOS E and read out measured data.

Step 1: physical setup
Connect the UNIDOS E „Serial“ connector to the RS232 connector of your computer. Switch UNIDOS E on and set it manually to the desired unit, range and measurement mode. If it is battery supplied, enable the RS232 interface. Check the baud rate setting. The measurement screen must be displayed.

Step 2: open communication
Start the communication program on your computer. Make shure that it is set up correctly. Send the telegram PTW. The response must be UNIDOS·E·x.xxv, where x.xx is the firmware version and v is replaced by i or a space character. Repeat this for maximum 3 times. If there is still no correct response, check the computer programs setup and the used communication port.

Step 3: start measurement and read data
If step 2 succeeded, send the telegrams M0 and STA. By repeatedly sending D, D1 or D2 telegrams you can watch the change of the measured data.

3 Overview tables

3.1 Technical data of the interface

The serial interface of UNIDOS E conforms to RS/EIA/TIA-232E. It is electrically isolated from the device.
Features:
Baudrate 4800 / 9600 / 19200
Data format 8 bit, no parity, 1 stop bit
Connector 9 pin sub-D socket
The interface is of DTE type (data terminal equipement), e.g., UNIDOS E sends on TxD and drives RTS.

Pin assignment of the UNIDOS E „Serial“ connector and how to connect it to a 9 or 25 pin connector with ‘standard IBM layout’:

UNIDOS E 9 pin				IBM 25 pin	IBM 9 pin		
Pin	Signal	type		Pin	Pin	Signal	type
1	no connection		↔	1	1	shield	
2	TxD	out	→	3	2	RxD	in
3	RxD	in	←	2	3	TxD	out
4	1)		←	5	4	DTR	out
5	SGND		↔	4	5	SGND	
6	1)		→	6	6	DSR	in
7	CTS	in	←	20	7	RTS	out
8	RTS	out	→	7	8	CTS	in
9	no connection						

1) Pins 4 and 6 are internally connected

For connections to a standard 9 pin connector, use PTW cable L178012 (2m, ‘K47’), L178026 (5m) or T22373/K67-30 (30m).
For connections to a standard 25 pin connector use a gender changer additionally.

For information only:
If the serial interface is switched on, but at the quiescent state, the voltage measured at TxD is ⇔ -5V and that at RTS is ⇩ 5V, with reference to SGND.

Handshake:
If the handshake is set in the RS232 menu to ‘None’, UNIDOS E sents data regardingless of the level of its CTS (clear to send) input signal. RTS (request to send) is set to ‘TRUE’ (⇩ 5V) as long as the RS232 interface is switched on.
If the handshake is set to ‘CTS/RTS’, UNIDOS E only sents data, as long as its CTS input signal is at a ‘TRUE’ condition (⇩ 3V). Unsent data is held in the output buffer until CTS returns to ‘TRUE’ or the output buffer overflows. RTS is set to ‘TRUE’ until a telegram delimiter <CR><LF> is received. With this, RTS goes to ‘FALSE’ (⇔ -5V) until the received telegram is recognized by UNIDOS E.

3.2 Error codes

Error telegram	Description
E01	Unkown command or illegal parameter
E02	Command not allowed in this context (STA in mode 1, etc.)
E03	Command not allowed at the moment (UNIDOS E is in a menu or in an error state)
E04	Command can not be executed, since this would increase the high voltage setting
E05	Error during zeroing: range Low can not be zeroed
E06	Zeroing not possible
E07	Output buffer overflow
E09	Error at writing to EEPROM
E10	Parameter out of limits

4 Telegram details

This chapter gives information details, not mentioned in the telegram list.

4.1 Information telegrams

PTW
In the response to the PTW telegram, UNIDOS·E·x.xxv, is x.xx the firmware version and v represents the device version: if Roentgen is an allowed unit too, v is replaced by the character i (international version), if not, v is replaced by a space character.

SC
The calibration status depends on the actual unit and chamber entry setting. For electrical units, the status is 'calibrated' if the device is correctly calibrated at PTW. For radiological units, the calibration status is the logical AND of electrical calibration and the calibration status of the active chamber entry. A chamber entry is calibrated, if its calibration factor is not equal to zero.

SD
Read device status. In the response to the telegram, SDddddd, ddddd is a five digit number with leading zeroes. When ddddd is converted to binary representation, its set bits signal the following operating condition:
bit .0 : LCD of UNIDOS E is not operational (command timeout)
bit .1 : LCD of UNIDOS E is not operational (auto mode timeout)
bit .2 : battery operation
bit .3 : Low battery
bit .4 : dont care
bit .5 : reference temperature is 22°C
bit .6 : unit Roentgen is excluded
bit .7 : range Low is not properly zeroed
bit .8 … bit .15 : dont care
bit .0 is the least significant bit
If bit .0 or bit .1 is set, the display is not operational. UNIDOS E still continues to operate and to measure, but all display operations are omitted, the display is no longer updated. The measured values, available by the D telegrams, are still correct.

SE
Read error status. In the response to the telegram, SEddddd, ddddd is a five digit number with leading zeroes. When ddddd is converted to binary representation, its set bits signal the following error condition:
bit .0 : error at calculation of measurement parameters (ddddd = 00001)
bit .1 : data acquisition error (ddddd = 00002)
bit .4 : non critical EEPROM data has to be corrected (ddddd = 00016)
bit .6 : calibration data error (ddddd = 00064)
bit .0 is the least significant bit. All others bits are dont care.
If ddddd is not equal to zero, the error should be cleared by manual operation at the device. Operate as advised on the display of UNIDOS E.
Remark:
If such an error occurs, the answer to the S telegram will be SERR, signaling the error state, too. UNIDOS E is not capable to measure in this state and almost all modifying telegrams are locked out and answered by E03. The underlying error condition has to be cleared first. These error conditions are very unlikely to occur, but they may occur as a result of the internal self tests.

4.2 Utility telegrams

SET
Read or write setting of active (= loaded) chamber entry. Some features have to be obeyed:
- if the chamber voltage of the entry to be loaded is higher than the one present, the telegram is answered by E04 and the entry is not loaded. In this case the telegram SETeeA has to be send to load the new entry anyhow.
- if the voltage setting has to be changed, UNIDOS E needs a 5 seconds wait time before processing the next telegram
- if set to electrical units, all SETee telegrams, that alter the entry setting, are answered by E02

U
Read or write unit setting. Some features have to be obeyed:
- when changing from electrical to radiological units, the voltage of the loaded entry will be reestablished. If this is higher than the one present, the telegram is answered by E04 and the unit will not be changed. In this case the telegram URA has to be send to set up radiological units anyhow and to increase the high voltage
- if the voltage setting has to be changed, UNIDOS E needs a 5 seconds wait time before processing the next telegram

V
Read or write voltage setting. Some features have to be obeyed:

- if the voltage setting is changed, UNIDOS E needs a 5 seconds wait time before processing the next telegram
- in the response to the V telegram, V±vvv, vvv is a 3 digit number with leading spaces. The V response also transmits the high voltage polarity setting. If the high voltage is negative, a minus sign is sent, if it is positive, a space character instead of the + sign.

4.3 Measurement telegrams

- The telegrams RES, STA and INT are only allowed, if UNIDOS E is in mode 0, the so called 'dose mode'. In mode 1, the 'dose rate mode', they are answered by E02.
- In mode 0 and if in the RES state, the HLD telegram is answered by E02.
- The NUL telegram is accepted at all measuring states of both measurement modes.

4.4 Data telegrams

Parameter	Explanation
m	Measurement mode. 0 = dose or charge ('dose mode') ; 1 = dose rate or current ('dose rate mode')
ttttt.h	Elapsed measurement time. ttttt is a five digit decimal number with leading spaces, h can have the values 0 or 5 If the maximum measurement time of 64800 seconds is exceeded, OL····· will be send
L	One digit number, whose set bits, when converted to binary representation, signal the following conditions: .0 : Low battery ; .1 : Range Low not properly zeroed .1 is only set, if the range is set to Low and the 'NoNUL' condition is fulfilled
sss	Measurement status as described with the S telegram at section 2.3
FL	Two digit number, whose set bits, when converted to binary representation, signal the following error condition: .0 : overload ; .1 : mathematics error ; .2 : amplifier error ; .3 : HV error ; .4 : data acquisition error (note 1)
±m.mmm	Mantissa of the measured value. The field consists of six characters. Smaller numbers are right justified, with leading spaces. For positive numbers a space character is sent instead of the + sign. If the limits of representation (±999.9E+20) are exceeded, +OL··· or -OL··· is transmitted, depending on the sign
E±ee	Exponent of the measured value. Two digit number with leading zeroes. The sign is always transmitted, either as + or -. If the limits of representation are exceeded, ···· is transmitted.

Parameter	Explanation
a	Resolution of the measured value. One digit. Valid values: 2 : resolution below 1% (conforming to ** on the measurement display) 1 : resolution below 0.5% (conforming to *) 0 : resolution is 0.5% or better
bbbbb	Block check value of the response telegram. Five digit number, representing a 16bit unsigned integer with leading zeroes. The block check value of a telegram is calculated starting from the first character of the response up to and including the character preceeding bbbbb and must be equal to the value of bbbbb (note 2)

Notes
1) The bits .1, .2 and .4 can only occur in case of a hardware failure of the device.
   The bits .0 and .3 signal error conditions, that can occur at normal operating conditions.
2) The check sum algorithm uses the standard CCiTT-16 generating polynomial
   $x^{16} + x^{12} + x^5 + 1$

Response to the D telegram
Dm;ttttt.ts;L;sss;FL;±m.mmmE±ee;a;bbbbb
Measurement mode, time, flags, status, measured value and resolution are that of the actual measurement mode.

Response to the D0 or D1 telegram
The same as for the D telegram. All transferred information is that of the measurement mode specified.

Response to the D2 telegram
D2;ttttt.ts;L;sss;FL;±m.mmmE±ee;a;sss;FL;±m.mmmE±ee;a;bbbbb
The measurement time is that of the dose rate measurement. The status, error flags, measured value and resolution are transferred for both measurement modes, starting with mode 0 (dose mode).
Note that even if the dose measurement is in the RES or HLD mode, the measurement time will increase. On the other hand, the measurement time will not increase, if the dose rate measurement is in the HLD state.

Response to the DM telegram
DM•m.mmE±ee
The transferred value is the lower of both absolute maximum values (there are two: one for positive and one for negative measured values) of mode 1 in the actual range setting as it is displayed in the status line of UNIDOS E.

Response to the DMr telegram
DMr•m.mmE±ee
The transferred value is the lower of both absolute maximum values (there are two: one for positive and one for negative measured values) of mode 1 of the specified range as it is displayed in the resolution box of UNIDOS E (press keys ESC+↓ simultaneously)

Response to the DR telegram
DR0.mmmE±ee
The transferred value is the resolution of the actual measurement mode in the actual range setting. The fraction of the mantissa may have 3, 2 or 1 digits, depending on the resolution. The exponent is given in multiples of 3.

Response to the DRm telegram
DRm0.mmmE±ee
The transferred value is the resolution of the specified measurement mode in the actual range setting.

Response to the DRmr telegram
DRmr0.mmmE±ee
The transferred value is the resolution of the specified measurement mode in the specified range setting.

Response to the DU telegram
DUx
The transferred value is the unit of the actual measurement mode. For the possible values of x see below.

Response to the DUm telegram
DUx
The transferred value is the unit of the specified measurement mode.

Possible values of x depending on the unit, measurement mode and measuring quantity:

Electrical units	mode 0	mode 1		
	C	A		
Radiological units				
q		t = S	t = M	t = H
W (Dw)	Gy	Gy/s	Gy/min	Gy/h
A (Ka)	Gy	Gy/s	Gy/min	Gy/h
C (Ka*l)	Gy*cm	Gy*cm/s	Gy*cm/min	Gy*cm/h
S (Js)	R	R/s	R/min	R/h
L (Js*l)	R*cm	R*cm/s	R*cm/min	R*cm/h

4.4.1 Streaming mode

Streaming mode is a special operating mode of the UNIDOS E. In this mode, UNIDOS E sends data telegrams at a repetition interval specified by the activating telegram. Streaming mode is the only operating mode, where UNIDOS E sends information without a preceeding telegram. If it is activated, the following actions are performed:

- A dose measurement is started. Mode 0 is set to the STA state and mode 1 to the RUN state
- the keyboard of UNIDOS E is locked
- UNIDOS E now sends data telegrams of the specified measurement mode and in the specified time slices until the streaming mode is closed
- streaming mode is closed by any telegram. Prefer K1 to release the keyboard too.

Activating telegram

STAm;ttt.h

m specifies the desired measurement data. Valid values are 0, 1, or 2.
h is the fractional part of the time gap and may have the values 0 or 5.
ttt is the integral part of the time gap. Valid values are 000 … 999. The parameter must be right justified with leading spaces or zeroes. The minimum time gap is 000.5 seconds.
The activating telegram is responded with a telegram same to the activating one. After that, data telegrams as described below will be sent.
If the time gap is different from the UNIDOS E data update time of 0.5 seconds, e.g. 2.5 seconds, the dose values sent will be those measured after 2.5, 5.0, 7.5 seconds and so on. The dose rate values are also those measured at 2.5, 5.0, 7.5 seconds and so on. These are not the mean values of these intervals, they are the measured values of the intervals between 2.0 … 2.5, 2.5 … 5.0, 5.0 … 7.5 seconds.

Streaming mode data format for m = 0 or m = 1

Xm;ttttt.ts;L;sss;FL;±m.mmmE±ee;a;bbbbb

This is the response to a Dm telegram, where X replaces D. The character X is used in no other telegrams and may be used as a delimiter.

Streaming mode data format for m = 2

X2;ttttt.ts;L;sss;FL;±m.mmmE±ee;a;sss;FL;±m.mmmE±ee;a;bbbbb

This is the response to a D2 telegram, where X replaces D.

The output buffer of UNIDOS E might overflow, if the handshake signal CTS is inactive and UNIDOS E can not send the streaming mode data. In this case, UNIDOS E will discard the streaming mode data packet and puts the error message E07 into the output buffer instead.

4.5 Calibration telegrams

Warning:
The modification of calibration factors may have enormous influence on the measured value. The user is fully responsible for any changes of the calibration factors.
It is highly recommended to check that the factors written to UNIDOS E are those stored in UNIDOS E, i.e. to compare command and response.
Furthermore the user must be careful not to overwrite other calibration data inadvertendly.

4.5.1 General

- All calibration data is permanently stored in an EEPROM.
- Radiological calibration data is stored in units of chamber entries.
- Every chamber entry has its own block check value to guarantee the calibration data integrity.
- If the password protection is enabled, the following data components of entries 01 … 30 can not be altered: calibration factor, entry label, detector serial number, measuring quantity, block check value. In this case, the response to the respective telegram is E02. Disable the password protection first, if any of the mentioned components of this entries has to be changed.

Important note:
- If any component of a chamber entry is altered, the check sum of the entry must be updated (telegram CReeU1) before the measurement is rebuilt. Otherwise the rebuild will lead to an EEPROM error (response to SE telegram = SE00064) and UNIDOS E is no longer operational.
- It is sufficient to update the checksum once after changing all components of an entry.
- The altered calibration data is only taken into account after a rebuild of the measurement. This can be done by the NEW telegram. The rebuild is also performed at a change of actual entry, voltage, range or unit, or a reset of UNIDOS E by pressing the keys ESC+RES simultaneously, but NEW is the most convenient way.
- If the rebuild of the measurement also changes the high voltage setting, a 5 second wait time has to be observed before UNIDOS E proceeds new telegrams.

If the voltage of the actual entry is changed by the V telegram, it is not necessary to update the entries check sum, since this is already done by UNIDOS E.

4.5.2 Entry components

- calibration factor (telegram CReeF)
- entry label (telegram CReeN)
- detector serial number (CReeS)
- measuring quantity (telegram CReeQ)
- reference time of the dose rate measurement (telegram CReeT)
- voltage setting of the entry (telegram CReeV)
- block check value of the entry, which completes the entries checksum to 00000 (telegram CReeB)

The reference time and voltage setting can be changed even if the entry is password protected, but remember to update the check sum by CReeU1.

4.5.3 Calibration factors data format

User input

- calibration factors can be entered in floating point (347.5) or scientific (3.475E2) notation
- the exponent character may be written E or e, the positive sign of the exponent is optional

Data format send by UNIDOS E

- calibration factors are always expressed in scientific notation as ±m.mmmmE+ee
- positive numbers have a space character instead of the + sign
- the exponent character is E, the sign of the exponent is always given
- the exponent number is a two digit number with leading zeroes

4.6 Correction telegrams

All correction telegrams can be sent even if UNIDOS E is set up for electrical units, but the setting of any correction parameter has no effect on the measurement.
If radiological units are set up, a running measurement is aborted and the measurement is rebuilt, if the correction status is changed by KSx or if one of the following parameters is changed, while correction is on (KS1): ambient temperature t, air pressure p or additional correction factor k.

4.7 Zeroing

The NUL telegram starts zeroing. During zeroing, the response to the S telegram is SNUL. A zeroing, invoked by the NUL telegram, can not be aborted either by keybord or by a different telegram. Although the response to NUL is sent at the end of zeroing in standard configuration, it is possible to send telegrams 'in between', e.g. a NULT telegram to check the remaining time.

4.7.1 Zeroing results

In standard configuration, the response to the NUL telegram is sent at the end of zeroing. Possible responses are:

- NUL - zeroing was successful. In this case, the response is sent approximately 51 seconds after the invoking command
- E06 - zeroing is not possible. In this case, the response may appear earlier than 51 seconds after the NUL command
- E05 - zeroing is only possible, if range Low is not zeroed. This response will also appear 51 seconds after the NUL command

In case of the E05 response, UNIDOS E displays an error box, asking to abort all zeroing results or to only take into account the results of the ranges Med and High and leave Low unzeroed. This error box can also be operated by the serial inferface:
if the box appears, the measurement status is set to NER (NUL error), the response to the S telegram is SNER

- if telegram STA is sent while UNIDOS E is in the NER state, the zeroing result of range Low is aborted and range Low is marked as 'unzeroed'. This corresponds to a 'NoNUL' indication on the display and bit .7 set in the response to the SD telegram. The response to the NULE telegram will be NULE00000 and the measurement is rebuilt.
  The zeroing results applied to Low are those of the last successful zeroing of that range.
- if telegram RES is sent while UNIDOS E is in the NER state, all zeroing results are aborted. The ddddd part of the NULE response will be different from zero, signalling a failed zeroing. The measurement is rebuilt. The zeroing results applied to all ranges are those of the last successful zeroing.

The ddddd part of the NULE response is set to 00000 at a reset of UNIDOS E (ESC+RES) or at the start of zeroing.

4.7.2 Configuration of zeroing behaviour

It may be more convenient for a computer program controlling the UNIDOS E, if the response to the NUL command is sent at the beginning of the zeroing and to check the progress of the operation by polling some status information. Furthermore it may be desired not to show the dialog box in case of response E05 and to set range Low to 'unzeroed' immediately.

The NULCx telegram offers two possibilities to configure the zeroing behaviour. x is a one digit number, whose bits set up UNIDOS E in the following manner:

bit .0 is the 'immediate response' bit. If it is set, the response NUL is immediately sent at the start of zeroing. The progress of zeroing can be checked by the NULT telegram and by watching the response to the S telegram. If it changes from SNUL to SNER, the E05 error box has to be closed by STA or RES. If it changes to SRUN or SRES, the NULE response has to be checked. If ddddd is 00000, zeroing was successful and all ranges are properly zeroed. If it is different from 00000, all results have been aborted.

bit .1 is the 'immediate disable' bit. If it is set and the E05 error condition occurs, range Low will be marked as 'unzeroed' immediately and the E05 error box will not appear. If the ddddd part of the NULE response is equal to 00000, zeroing was successful and bit .7 of the response to SD has to be checked, if Low is 'unzeroed' or not. If ddddd is different from 00000, all results are aborted.

The default value of NULC is 0. It is reestablished at a reset of UNIDOS E (ESC+RES).

Overview: zeroing behaviour as a function of NULC and error conditions:

zeroing	**NULC0**	**NULC1**	**NULC2**	**NULC3**
successful	response = NUL at the end resulting state = 1)	immediate response = NUL resulting state = 1)	response = NUL at the end resulting state = 1)	immediate response = NUL resulting state = 1)
Low not zeroable	response = E05 at the end, E05 box appears resulting state = 2)	immediate response = NUL, E05 box appears resulting state = 2)	response = NUL at the end, Low is 'unzeroed' without E05 box resulting state = 4)	immediate response = NUL Low is 'unzeroed' without E05 box resulting state = 4)
zeroing failed	response = E06 at the end results are aborted resulting state = 3)	immediate response = NUL, results are aborted resulting state = 3)	response = E06 at the end results are aborted resulting state = 3)	immediate response = NUL results are aborted resulting state = 3)

Resulting state:

1) Zeroing succeeded, all results are used, Status = RUN/RES, NULE = 00000, measurement is rebuilt, SD .7 = 0
2) The E05 box opens. Status = NER, NULE is different from 00000, waiting for STA or RES
3) Zeroing failed. Status = RUN/RES, NULE different from 00000. All results are aborted, measurement is rebuilt. If SD .7 was set before, it is set again.
4) Low is 'unzeroed' without dialog box. The result of Low is aborted. Status = RUN/RES, NULE = 00000, measurement is rebuilt, SD .7 set

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