User Manual

MULTIDOS
RS232 Interface

D177.131.2/0   2003-07   Di/Se

For your notes

Contents

1 For your Safety

- This document is a supplement to the PTW-MULTIDOS User Manual and is valid only in conjunction with that manual.

- The safety statements given in both user manuals are applicable and must be observed.

- In addition to these safety statements, please note that devices connected to the interface described in this manual must fulfill the requirements of the IEC standard 60950 or IEC 61010-1 (EN 61010-1).

2 General

To get used to the MULTIDOS serial communication, we recommend to use a terminal program like the Microsoft-Windows HyperTerminal.

3 Interface Configuration

MULTIDOS RS232 interface:

Baud rates:	4800, 9600, 19200, 38400 (recommended)
Code:	8 data bits
Stop bit:	1 stop bit
Parity:	none

If the COM port of your personal computer has a 9 pin D connector (standard IBM layout), use a PTW cable L178012 (2m), L178026 (5m) or T22373/K67-30.
If it has a 25 pin connector, use a gender changer additionally.

Pin assignment:

Pin	MULTIDOS signal
2	TxD (out)
3	RxD (in)
4	-
5	SGND
6	-
7	CTS (in)
8	RTS (out)

Pins 4 and 6 are internally connected. By this, an external DTR signal may be returned as DSR to the external device.

Either RTS/CTS hardware handshake or no handshake may be used.

4 Principles of Computer Communication

Between MULTIDOS and the connected PC, data is exchanged by means of sequences of ASCII characters which are concluded by the characters CR (carriage return, hexadecimal 0D) and LF (line feed, hexadecimal 0A). This sequences are called telegrams. The CRLF end mark is omitted in all telegram descriptions. For all communication, a strict ping pong principle must be observed: after sending a telegram to the MULTIDOS, the PC program must wait for the answer from MULTIDOS, before it may send a new telegram.

NOTE

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

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5 General Telegrams

These telegrams are valid for all MULTIDOS applications.

5.1 Device Identification

Telegram	Description	Response
PTW	Read device information. x.xx is the firmware version, u describes the radiological unit	MULTIDOS•x.xxu
SER	Read MULTIDOS serial number	SERxxxxxx

5.2 Keyboard

Telegram	Description	Response
Kx	Disable or reenable the MULTIDOS keyboard. Parameter x: 0 = disabled, 1 = enabled	Kx

5.3 Basic Device Settings

Telegram	Description	Response
Lx	Set/Read language setting. Parameter x: E = Englisch, D = German	Lx
Idddd	Set/Read interval time. Parameter dddd: 0006 up to 9999	Idddd
Aa	Set/Read the MULTIDOS application. Parameter a: A = Afterloading, C = Constancy Check, D = Dual Dosemeter, M = Multi Channel, L = Linear Array. Wait 5 seconds after sending Aa	Aa
Aquit	Restart the current application. Wait 5 seconds after sending Aquit	Aquit
BRbbbbb	Set/Read baud rate. Parameter bbbbb: 04800, 09600, 19200, 38400	BRbbbbb

5.4 Controlling a Measurement

Telegram	Description	Response
STA	Equivalent to <STA> key	STA
INT	Equivalent to <INT> key	INT
RES	Equivalent to <RES> key	RES
HLD	Equivalent to <HLD> key	HLD
NUL	Equivalent to <NUL> key. Response NUL or E06 is send after 28 seconds	NUL
Mx	Set/Read measuring mode. Parameter x: 0 = Dose, 1 = Doserate	Mx
S	Read measurement status. Valid values of parameter sss: RES, STA, HLD, INT, RUN, NUL, ERR	Ssss

5.5 Error Codes

Error code	Description
E01	Unknown command or illegal parameter
E02	Command in wrong context (STA for doserate measurement, etc.)
E03	Command not allowed at the moment (MULTIDOS is in a menu)
E06	Error during zeroing
E07	Answer could not be sent (transmission buffer full)
E09	Error during write to EEPROM
E10	Parameter out of limits

5.6 Status telegrams

Telegram	Description	Response
SC	Calibration status of the actual unit of measurement, involving all components contributing to data acquisition, as there might be a reference or monitor chamber. Parameter x: 0 = any of the components involved is uncalibrated, 1 = all used components are calibrated. x = 0 conforms to a „uncalibrated" message on the display	SC*x*

Note:
An electrical measurement will have the calibration status 1, even if the radiological calibration factors stored in MULTIDOS are marked „uncalibrated" (= set to default), as long as the electrical calibration is marked to be „calibrated".

Telegram	Description	Response
SD	Device status. iiiii is a five digit decimal number, whose bits, when converted to binary representation, signal the following condition when the bit is set: .0 $\Rightarrow$ MULTIDOS display is not accessible (command timeout) .1 $\Rightarrow$ MULTIDOS display is not accessible (automode timeout) .2 $\Rightarrow$ electrical calibration possible .3 $\Rightarrow$ Set1 of application dual channel is write protected .4 $\Rightarrow$ radiological unit is Roentgen .5 $\Rightarrow$ reference temperature for air density correction is 22°C .6 $\Rightarrow$ HV error .7 $\Rightarrow$ ME 48 is connected to MULTIDOS .0 is the least significant bit	SD*iiiii*

Note:
If bit .0 or .1 is set, the display is not operational. The firmware still continues to execute and to measure, but all display operations are omitted, the display will no longer be refreshed. The measured values, available by the D telegrams, are still correct.

Telegram	Description	Response
SE	Reads the error number. *ddddd* is a five digit decimal number, whose bits, when converted to binary representation, signal the following error condition, if the bit is set: .0 $\Rightarrow$ error at calculation of measurement multipliers .2 $\Rightarrow$ error during data acquisition .4 $\Rightarrow$ EEPROM corrected (non critical) .6 $\Rightarrow$ EEPROM error (critical) .0 is the least significant bit	SE*ddddd*

Note:
There will never be more than one bit set at once, since MULTIDOS checks all error sequentially. Because of that, each error condition corresponds to a discrete value of *ddddd*.

ddddd is always equal to 00000, as long as the response to the S telegram is not SERR. SE is designed to give a more detailed information of the error type.

6 Brief Description

Perform steps 1 to 5 in the given sequence to set up the MULTIDOS and read out measured data.

Step 1: physical setup
Connect the RS232 cable to the desired COM port of your personal computer. Switch the MULTIDOS on and set it manually to the desired application. Set up the following items: unit, absolute or relative readings, measuring mode, interval time, baudrate. Note that MULTIDOS will reawake in this configuration, when it is switched on again.

Step 2: open communication		
Start the communication program on your PC. The program must be set up correctly!		
Telegram	Response	Description
PTW	MULTIDOS	Correct response signals proper communication setup and that MULTIDOS is ready for communication. See note 1
Aa	Aa	Set/Read the MULTIDOS application. Parameter a: A = Afterloading, C = Constancy Check, D = Dual Dosemeter, M = Multi Channel, L = Linear Array. Sending A reads the current application, sending A with parameter changes the application.
SER	SERxxxxxx	Correct response signals the MULTIDOS is ready to measure

Notes:
1. The answer must return within 3 seconds. The first seven characters of the response telegram must be MULTIDOS (the response itself contains more characters). Repeat this telegram three times maximum, if you do not receive the expected response or no response at all.
2. For all telegrams: if the expected response is not received, MULTIDOS is set up in a wrong way.

Step 3: zero adjustment		
Telegram	Description	Response
NUL	The response is sent at the end of the procedure after approx. 35 seconds max. If zeroing fails, E06 is responded instead of NUL. Obey the warm up time and the guidelines for zeroing.	NUL

Step 4: set up and start measurement		
Telegram	Description	Response
I$xxxx$	Set the interval time between 6 und 9999 seconds (replace Parameter $xxxx$ by 0006 to 9999). Only necessary to alter a previous setting.	I$xxxx$
Mx	Set/Read MULTIDOS measuring mode. Parameter x: 0 = Dose/Charge, 1 = Doserate/Current Sending M reads the current mode, sending M with parameter changes the mode.	Mx
STA	Same effect as the <STA> key	STA
INT	Same effect as the <INT> key	INT

Note: During a running measurement a new measurement may be immediately started by STA or INT.

Step 5: read measured values		
Telegram	Description	Response
D	Reads the measured values	see application chapters in this manual

During serial communication, it is recommended to disable the MULTIDOS keyboard by the K0 telegram.
All MULTIDOS setup (used unit and measuring mode, reference used or not, etc.) can also be done by telegrams.
If MULTIDOS is running in menu mode, all telegrams with the exception of PTW will be responded by E03.

7 Application Dual Channel Dosemeter

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*.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044.

7.1 Basic Settings

Telegram	Description	Response
PW*x*P	Set/Read the password protection. Parameter *x*: 0 = clear protection, 1 = Set protection. P is the password string as described in the MULTIDOS User Manual	PWx
Q*x*	Set/Read the type of data readings on the display. Parameter *x*: 0 = absolute values, 1 = relative values (channel 2 divided by channel 1)	Qx
R*xy*	Set/Read range settings. Parameter *x*: setting of channel 1. Parameter *y*: setting of channel 2. Valid values of *x* and *y*: L = Low, H = High, - = keep current setting. Valid values of the response *o* and *t*: L or H. *o* is the setting of channel 1, *t* the setting of channel 2	Rot
R*xy*	Set/Read range settings. Parameter *x*: setting of channel 1. Parameter *y*: setting of channel 2. Valid values of *x* and *y*: L = Low, H = High, - = keep current setting. Valid values of the response *o* and *t*: L or H. *o* is the setting of channel 1, *t* the setting of channel 2	Rot
SET*s*	Set/Read the calibration set to be applied. Parameter *s*: 1 up to 5	SETs
SP	Read the protection setting of the calibration data. Parameter p is a one digit number, whose bits show the protection status: bit .0 is set = password protection is set, bit .1 is set = hardware protection is active	SPp
U*x*	Set/Read unit of measurement. Parameter *x*: A = Ampere, S = Gy/s, M = Gy/min, H = Gy/h	Ux

7.2 Data telegrams

7.2.1 Read measured values

The response to a data telegram consists of various fields, separated by semicolons. The fields contain parameters and text.

The response to the D telegram is:

Dm;$ttttt.n$s;sss;FL;O;L;M;±$m.mmm$E±ee;a;±$m.mmm$E±ee;a;·####.#;$bbbbb$

The measured values and resolution indicators are that of the actual measuring mode and are transmitted channel 1 first, followed by channel 2. The ratio is always transmitted, even if absolute values are displayed (see below).

7.2.2 Description of parameters

m	Actual measuring mode. Valid values: 0 $\Rightarrow$ Dose or Charge, 1 $\Rightarrow$ Doserate or Current
$ttttt.n$	Elapsed measurement time. Consists of seven characters. Small numbers are right justified, with leading spaces. Parameter n can have the values of 0 or 5. If the maximum measurement time of 64800 seconds is exceeded, OL••••• will be transmitted.
sss	Measurement status. Valid values: RES, STA, HLD, INT, RUN, NUL, ERR.
FL	Global flags. A two digit number, whose <u>set</u> bits, when converted to binary representation, signal the following error: .0 $\Rightarrow$ any of both channels is overloaded at the moment .1 $\Rightarrow$ math error in any channel .2 $\Rightarrow$ MULTIDOS data acquisition error .3 $\Rightarrow$ MULTIDOS HVerror at the moment .4 $\Rightarrow$ overload in any of both channels since the start of a dose measurement .5 $\Rightarrow$ MULTIDOS HV error since the start of a dose measurement .0 is the least significant bit
O	Overload flags of the doserate / current measurement. One digit, whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ overload in channel 1 .1 $\Rightarrow$ overload in channel 2
L	Latched overload flags of the dose / charge measurement. One digit, whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ overload in channel 1 since the start of a dose measurement .1 $\Rightarrow$ overload in channel 2 since the start of a dose measurement
M	Math error flags of the actual measurement mode. One digit, whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ math error in channel 1 .1 $\Rightarrow$ math error in channel 2
±$m.mmm$	Mantissa of the measured value. This field consists of six characters. Smaller numbers are right justified, with leading spaces. Positive numbers use a space character instead of the minus sign. If the limits of representation (±999.9E+20) are exceeded, +0L••• or -0L••• will be transmitted, depending on the sign.
E±ee	Exponent of the measured value. Two digit number, with leading zeroes if necessary. The sign is always transmitted, either as + or -. If the limits of representation are exceeded, •••• will be transmitted.
a	Resolution of the measured value. One digit. Valid values: 2 $\Rightarrow$ resolution below 1% (conforming to ** on the measuring screen) 1 $\Rightarrow$ resolution below 0.5% (conforming to *) 0 $\Rightarrow$ resolution is 0.5% or better

•####.#	Ratio of measured value of channel 2 divided by the measured value of channel 1, given in percent. The decimal point position is fixed. Smaller numbers are right justified, with leading spaces. Positive numbers use a space character instead of the minus sign. If the maximum representable ratio of ±9999.9 is exceeded, •####.# will be transmitted. If one of the measured values exceeds it limits of representation, •----.- will be transmitted.
bbbbb	Block check sequence of the response. This is a five digit number, representing a 16 bit un-signed integer, with leading zeroes if necessary. The block check sequence is calculated starting from the first character of the response up to the character preceding bbbbb and must be equal to the value of bbbbb.

7.2.3 Read maximum value

The response to the DMc telegram is
DMc•m.mmE±ee
where c is the channel number (valid values are 1 or 2). The transmitted value is the maximum value of the doserate / current measurement for the active unit (radiological or electrical) and actual measuring range of that channel. The value is formatted in scientific notation.

7.2.4 Read Resolution

The response to the DRc telegram is
DRc•0.mmmE±ee
where c is the channel number (valid values are 1 or 2). The transmitted value is the resolution of the actual measuring mode for the active unit (radiological or electrical) and actual measuring range of that channel. The number of digits following the decimal point may vary from 1 to 3.

7.2.5 Measuring unit

Telegram	Response
DU	DUu

Reads the absolute unit of measurement of the active measuring mode. Possible values of u:
when MULTIDOS is set to radiological units: Gy Gy/s Gy/min Gy/h
when MULTIDOS is set to electrical units: C   A

7.3 Correction Telegrams

Telegram	Description	Response
KSx	Set/Read the correction setting. Parameter x: 0 = correction off, 1 = on	KSx
KPp	Set/Read the value of the atmospheric pressure p. p = 0500.0 … 1300.0	KPnnnn.n
KTt	Set/Read the value of the ambient temperature t. t = 10.0 … 40.0	KTnn.n
KTR	Read the setting of the reference temperature. Parameter x: 0 = 20°C, 1 = 22°C	KTRx
KD	Read the calculated air density correction factor kD	KDn.nnn
KKck	Set/Read the overall correction factor k of channel c. k = 0.500 … 2.000	KKcn.nnn

7.4 Calibration Factors

Telegram	Description	Response
CRsFcf	Set/Read the calibration factor f of channel c of set s	CRsFccf
CRsNname	Set/Read the name of set s. name is a string of 19 characters max.	CRsNname
CRsTcid	Set/Read the ID of channel c of set s. id is a string of 15 characters max.	CRsTccid
CRsQq	Set/Read the measuring quantity of set s. Parameter q: W = Dw, A = Ka, S = Js	CRsQq
CRsUx	Update (x = 1)/Read (no x) the result of the check sum protection of set s	CRsUx
CRsBbbbbb	Set/Read the block check value bbbbb of set s	CRsBbbbbb

8 Application Multi Channel Dosemeter

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*.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044.

8.1 Basic Settings

Telegram	Description	Response
U*x*	Set/Read unit of measurement. Parameter *x*: A = Ampere, S = Gy/s, M = Gy/min, H = Gy/h	Ux
R*x*	Set/Read measuring range. Parameter *x*: L = range Low, H = range High	Rx
SET*s*	Set/Read the calibration set to be applied. Parameter *s*: 1 up to 5	SETs

8.2 Data telegrams

8.2.1 Read measured values

The response to the D*mima* telegram is:
D*mima*;*m*;*ttttt.n*s;*sss*;*FL*;*lm*;*um*;*am*;*OOOO*;*LLLL*;*MMMM*;*Kbbbbb*

The various fields contain the following information:

mi	number of first channel to be read (01 … 12)
ma	number of last channel to be read (01 … 12)
m	actual measuring mode (0 = Dose, 1 = Doserate)
ttttt.n	elapsed measuring time
sss	actual measurement status. String of 3 characters
FL	global measurement flags as Overload in any channel, HVerror, etc. Two digit number
lm	number of maximum channel of group 1-6 (marked on display by '<'). Two digit number
um	number of maximum channel of group 7-12 (marked on display by '<'). Two digit number
am	number of absolute maximum channel (marked on display by '<<'). Two digit number
OOOO	overload flags of the doserate measurement of all 12 channels. Four digit number
LLLL	overload flags of the dose measurement of all 12 channels. Four digit number
MMMM	MathError flags of the actual measuring mode. Four digit number
K	measured values of all requested channels. See below
bbbbb	block check value of the data telegram. Five digit number

The field *K* consists of (ma-mi+1) values of the following format: ±m.mmmE±ee;

8.2.2 Read Resolution

The response to the DRc telegram is
DRcc0.mmmE±ee
where cc is the channel number (valid values are 01 to 12). The transmitted value is the resolution of the actual measuring mode. The number of digits following the decimal point may vary from 1 to 3.

8.2.3 Measuring unit

Telegram	Response
DU	DU*u*

Reads the absolute unit of measurement of the active measuring mode. Possible values of *u*:
when MULTIDOS is set to radiological units: Gy Gy/s Gy/min Gy/h
when MULTIDOS is set to electrical units: C   A

8.3 Correction Telegrams

Telegram	Description	Response
KS*x*	Set/Read the correction setting. Parameter *x*: 0 = correction off, 1 = on	KSx
KP*p*	Set/Read the value of the atmospheric pressure *p*. *p* = 0500.0 … 1300.0	KPnnnn.n
KT*t*	Set/Read the value of the ambient temperature *t*. *t* = 10.0 … 40.0	KTnn.n
KTR	Read the setting of the reference temperature. Parameter *x*: 0 = 20°C, 1 = 22°C	KTRx
KD	Read the air density correction factor *kD*	KDn.nnn
KK*k*	Set/Read the overall correction factor *k*. *k* = 0.500 … 2.000	KKn.nnn

8.4 Calibration Factors

Telegram	Description	Response
CR*s*F*ccf*	Set/Read the calibration factor *f* of channel *cc* of set *s*	CRsFccf
CR*s*I*x*	Set/Read the 'Is calibrated' flag of set *s*. Parameter *x*: 0 = uncalibrated, 1 = calibrated	CRsIx
CR*s*N*name*	Set/Read the name of set *s*. Parameter *name*: string of 19 characters max. (spacers allowed)	CRsNname
CR*s*T*ccid*	Set/Read the ID *id* of channel *cc* of set *s*. Parameter *id*: string of 15 characters max. (spacers allowed)	CRsTccid
CR*s*D*dd.mm.yyyy*	Set/Read the calibration date of set *s*	CRsDdd.mm.yyyy
CR*s*U*x*	Update (*x* = 1)/Read (no *x*) the result of the check sum protection of set *s*	CRsUx
CR*s*B*bbbbb*	Set/Read the block check value *bbbbb* of set *s*	CRsBbbbbb

9 Application Constancy Check

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*.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044.

- If the unit is changed, the measurement is continued and the measuring values are re-calculated to the new measuring unit.

- All telegrams that begin with X are only valid in XMODE. The XMODE is activated with XM1. If it is not activated, you get E01 back as the telegram response.

It is only possible to select a set if the set is calibrated or if it is possible to calibrate the MULTIDOS or if the MULTIDOS is in XMODE or if there is no calibrated set at all.

9.1 Basic Settings

Telegram	Description	Response
U*x*	Set/Read unit of measurement. Parameter *x*: 1 = Ampere, 2 = Gy/s, 3 = Gy/min, 4 = Gy/h	Ux
R*x*	Set/Read range settings. 1: Range Low, 2: Range High	Rx
SET*s*	Set/Read the calibration set to be applied. Parameter *s*: 1 up to 5	SETs
V	Checking whether Gray or Röntgen, 0 : Gray 1 : Röntgen	Vx
XM*x*	x = 0: Switching of the extension mode x = 1: Switching on the extension mode	XMx
XD*x*	Read/Set the display mode 0: normal, 1: omit the renewing of the display	XDx

9.2 Data telegrams

The response to a data telegram consists of various fields, separated by semicolons. The fields contain parameters and text.

9.2.1 Description of parameters

cc	Channel number, consisting of two characters. Valid values: 01 to 12or the channels 1 to 12
m	Actual measuring mode. Valid values: $0 \Rightarrow$ Dose or Charge, $1 \Rightarrow$ Doserate or Current
u	unit of measurement. Parameter *x*: 1 = Ampere, 2 = Gy/s, 3 = Gy/min, 4 = Gy/h
ttttt.n	Elapsed measurement time. Consists of 7 characters. Small numbers are right justified, with leading spaces. *n* can take the values 0 or 5. If the maximum measurement time of 64800s is exceeded, OL••• will be transmitted.
sss	Measurement status. Valid values: RES, STA, HLD, INT, RUN, NUL, ERR.
FL	Global flags. A two digit number, whose bits, when set to one, signal the following: .0 $\Rightarrow$ any of all channels is overloaded .1 $\Rightarrow$ math error in any channel .2 $\Rightarrow$ MULTIDOS data acquisition error .3 $\Rightarrow$ MULTIDOS HVerror .4 $\Rightarrow$ MULTIDOS electrically uncalibrated .5 $\Rightarrow$ MULTIDOS electrically uncalibrated
±m.mmm mmm	Mantissa of the measured value. This field consists of 9 characters. Smaller numbers are right justified, with leading spaces. Positive numbers use a space character instead of the minus sign. If the limits of representation (±999.9E+20) are exceeded, +0L••• or -0L••• will be transmitted, depending on the sign.
E±ee	Exponent of the measured value. Two digit number, with leading zeroes if necessary. The sign is always transmitted, either as + or -.
ma	highest channel number for data transmission with DA telegram Valid values: 01 to 12.
bbbbb	Block check sequence of the response. This is a five digit number, representing a 16 bit unsigned integer, with leading zeroes if necessary. The block check sequence is calculated starting from the first character of the response up to the character preceding *bbbbb* and must be equal to the value of *bbbbb*.

9.2.2 Data telegrams

Telegram	Response
DA;*ma*	DA;*ma;ttttt.n*s;*m;u*;K*bbbbb*

Reads the measured values of channels *1* to *ma*
K contains the measurement data and consists of *ma* parts:
*FL;±m.mmmmmm*E±*ee*;
K contains no channel numbers, the data is transmitted in the order from channel 1 to channel *ma*.

Telegram	Response
D;*cc*	D;*cc;ttttt.n*s;*m;u;FL;±m.mmmmmm*E±*ee*;bbbbb

Reads the measured value of a single channel.

9.3 Correction Telegrams

Telegram	Description	Response
C;*x*	Set/Read Air Density Correction 0: Off 1: On	C;x
CP;*xxxx.x*	Set/Read nominal air pressure (500.0 <= p <= 1300.0), default: 1013.2hPa	CP;xxxx.x
CT;*xx.x*	Set/Read the temperature (10.0 <= T <= 40.0), default: 20/22°C	CT;xx.x
CD	Checking the correction factor temperture/air density without kQE	CD;x.xxxx
CK;*x.xxxx*	Set/Read Beam Quality Factor. (0.0000 < kQE <= 2.0000), default: 1.0000	CK;x.xxxx

9.4 Calibration Factors

Telegram	Description	Response
XR;*s;cc;f*	Set/Read the radiological calibration factor for channel *cc* in set *s*	XR;s;cc;±m.m mmmE+ee
XRF;*s*	Set/Read the flag for set *s* for radiologically calibrated/uncalibrated 0: not calibrated, 1: calibrated	XRF;s;x
XRN;*s;name*	Set/Read the name for set *s* with radiological calibration factors	XRN;s;name
XRD;s;*dd.mm .yyyy*	Set/Read the radiological calibration date for set *s*	XRD;s;dd.mm .yyyy
XRC;*s*	Renew the check sum radiological calibration factor for set *s*	XRC;s

9.5 Errors

Telegram	Description	Response
ERR	Checking the error status flag of MULTIDOS Bit0: MENU_ERROR Bit1: ELCAL_ERROR Bit2-7: not used Bit8: RADCAL_ERROR Set 1 Bit9: RADCAL_ERROR Set 2 Bit10: RADCAL_ERROR Set 3 Bit11: RADCAL_ERROR Set 4 Bit12: RADCAL_ERROR Set 5 Bit13-15: not used	ERR;xxxxx

10 Application Linear Array LA 48

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*.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044.

10.1 Basic Settings

Telegram	Description	Response
U*x*	Set/Read unit of measurement. Parameter *x*: A = Ampere, S = Gy/s, M = Gy/min, H = Gy/h	U*x*
R*x*	Set/Read setting of reference channel. Parameter *x*: 0 = without reference, 1 = refer to reference chamber, 2 = refer to monitor signal	R*x*

10.2 Data telegrams

The response to a data telegram consists of various fields, separated by semicolons. The fields contain parameters and text.
The format of the response to the Dcc and DA telegrams differs, depending if measuring against a reference signal is set up or not.

10.2.1 Description of parameters

cc	Channel number, consisting of two characters. Valid values: 01 to 47 for the LA 48 channels 1 to 47 R• for the reference channel, M•for the monitor signal V1 addresses the channel which measures the 900 volts, V4 that to measure the 400 volts
m	Measuring mode. Valid values: $0 \Rightarrow$ Dose or Charge, $1 \Rightarrow$ Doserate or Current
ttttt	Elapsed measurement time. Consists of five characters. Small numbers are right justified, with leading spaces. If the maximum measurement time of 64800s is exceeded, OL••• will be transmitted.
sss	Measurement status. Valid values: RES, STA, HLD, INT, RUN, NUL, ERR.
f	Flags for a single channel. One digit, whose bits, when converted to binary representation, signal the following errors when the bit is set: .0 $\Rightarrow$ overload in that channel .1 $\Rightarrow$ math error in that channel .0 is the least significant bit.
FL	Global flags. A two digit number, whose bits, when set to one, signal the following: .0 $\Rightarrow$ any of all channels is overloaded (including reference or monitor, if used) .1 $\Rightarrow$ math error in any channel (including reference or monitor, if used) .2 $\Rightarrow$ MULTIDOS data acquisition error .3 $\Rightarrow$ MULTIDOS HVerror .4 $\Rightarrow$ 900 volts error in ME 48 .5 $\Rightarrow$ 400 volts error for reference chamber
a	Resolution of the reference (chamber or monitor, whichever is used). One digit. Valid values: 2 $\Rightarrow$ resolution below 1% (conforming to ** on the measuring screen) 1 $\Rightarrow$ resolution below 0.5% (conforming to *) 0 $\Rightarrow$ resolution is 0.5% or better

±*m.mmm*	Mantissa of the measured value. This field consists of six characters. Smaller numbers are right justified, with leading spaces. Positive numbers use a space character instead of the minus sign. Notes: For channels 1 to 47 <u>and</u> if measurement against reference is used, this field may have the „values" >=1000 and <•5E-4 If the limits of representation (±999.9E+20) are exceeded, +0L••• or -0L••• will be transmitted, depending on the sign.
E±ee	Exponent of the measured value. Two digit number, with leading zeroes if necessary. The sign is always transmitted, either as + or -. For channels 1 to 47 and if measurement against reference is used, the exponent field will be omitted. If the limits of representation are exceeded, •••• will be transmitted.
r	Setting of the reference selection. Valid values: 0 = no reference, 1 = referred to reference chamber, 2 = referred to monitor signal.
mi	Number of that LA 48 channel having the smallest absolute value. Valid values: 01 to 47
ma	Number of that LA 48 channel having the largest absolute value. Valid values: 01 to 47

bbbbb	Block check sequence of the response. This is a five digit number, representing a 16 bit unsigned integer, with leading zeroes if necessary. The block check sequence is calculated starting from the first character of the response up to the character preceding *bbbbb* and must be equal to the value of *bbbbb*.

10.2.2 Single channel data

Telegram	*cc*	Response	Notes
D*cc*	01 .. 47	Without reference: D*cc*;*m*;*ttttt*s;*sss*;±*m.mmm*E±*ee*;*f*,*FL*;*bbbbb*	
	01 .. 47	With reference: D*cc*;*m*;*ttttt*s;*sss*;±*m.mmm*;*f*,*FL*;*bbbbb*	1
	R• or M•	D*cc*;*m*;*ttttt*s;*sss*;±*m.mmm*E±*ee*;*f*,*FL*;*a*;*bbbbb*	2, 3
	V1 or V4	D*cc*;*m*;*ttttt*s;*sss*;±*m.mmm*E±*ee*;*f*,*FL*;*bbbbb*	4, 5

Reads the measured value of a single channel.

Notes:
1. For LA 48 channels, when using a reference, the exponent field is omitted (rational number, as displayed on the measuring screen)
2. DR• or DM• is only allowed if the corresponding reference is activated. Otherwise the response will be E02.
3. The response contains the resolution of the channel additionally
4. This values always have an exponent field, independent from the reference setting
5. In both measuring modes the value of the measured high voltage is responded

Examples:
1. The measuring mode may be doserate, the measuring status may be HLD, no reference used, the measured value of channel 14 at the HLD-time may have been 27.7mGy/s, MULTIDOS may show a HVError, the HLD state has been entered after 31 seconds.
   The response to the D14 telegram will be D14;1;•••31s;HLD;••27.7E-03;0;08;43712
   (the block check sequence is fictitious)
2. The measuring mode may be dose, the reference chamber may be used as reference, whose measured value of -1.4µGy may have a resolution worse than 1%. An interval measurement may be started but the HLD state has not yet been reached, the actual measurement time may be 21 seconds. The 900 volts of the ME 48 may be out of limits.
   The response to the DR• telegram will be DR•;0;•••21s;INT;••-1.4E-06;0;16;2;00413
   (the block check sequence is fictitious)

10.2.3 Data of all channels

Telegram	Response
DA	DA*m*;*ttttts*;*sss*;*r*,*mi*,*ma*;*FL*;[*R*]*Kbbbbb*

Reads the measured values of all channels simultaneously. Notes:
1. *R* is an optional field, which is only transmitted when a reference is used. The [] are not transmitted, they only depict the optional character of the field. It contains the measurement data of the activated reference and consists of the following fields: ±*m.mmm*E±*ee*;*f*,*a*;
2. *K* contains the measurement data of the 47 channels and consists of 47 parts looking like this:
   ±*m.mmm*[E±*ee*];*f*;
   If a reference is used, the exponent field is not transmitted.
   K contains no channel numbers, the data is transmitted in the order from channel 1 to channel 47.

Length of the response (including DA, without CR LF):
with reference: (26 + 15 + 47 * 9   + 5) characters = 469 characters
without reference: (26 +   0 + 47 * 13 + 5) characters = 642 characters

10.2.4 Measurement resolution

Telegram	Response
DR*cc*	DR*cc*0.*mmm*E±ee

Reads the absolute resolution of channel *cc*. Notes:
1. This is the resolution of the active (displayed) measuring mode (mode 0 or 1)
2. Depending on the actual resolution, *mmm* consists of 3, 2 or 1 digit
3. The resolution is always given as an absolute value, even if measurement against reference is selected.
4. Channel numbers R• and M• are only valid, if measurement against reference is selected. Otherwise the response will be E02.

Example:
For the unit of measurement Gy/min the resolution of channel 17 in mode 1 (= dose rate) may be 50μGy/min, displayed as 0.05 mGy/min.
Therefore, in mode 1 the response to DR17 will be DR170.05E-03

10.2.5 Measurement unit

Telegram	Response
DU	DU*u*

Reads the absolute unit of measurement of the active measuring mode. Possible values of *u*:
when MULTIDOS is set to radiological units: Gy Gy/s Gy/min Gy/h
when MULTIDOS is set to electrical units: C   A

If the radiological unit is Roentgen, replace Gy by R in the upper lines.

11 Application Afterloading

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*.
Example: I0044 sets the interval time, I reads the actual interval time and is answered by I0044.

11.1 Basic Settings

Telegram	Description	Response
U*x*	Set/Read unit of measurement. Parameter *x*: A = Ampere, S = Gy/s, M = Gy/min, H = Gy/h	U*x*
R*x*	Set/Read measuring range. Parameter *x*: L = range Low, H = range High	R*x*
SET*s*	Set/Read the calibration set to be applied. Parameter *s*: 1 up to 5	SET*s*
SETA*aa*	Set/Read the status of the channels of the applied set. *aa* is a 2 digit decimal number, whose <u>set</u> bits, when converted to binary representation, signal the following status: .0 $\Rightarrow$ channel 1 of the rectum probe is active .1 $\Rightarrow$ channel 2 of the rectum probe is active .2 $\Rightarrow$ channel 3 of the rectum probe is active .3 $\Rightarrow$ channel 4 of the rectum probe is active .4 $\Rightarrow$ channel 5 of the rectum probe is active .5 $\Rightarrow$ channel of the bladder probe is active .0 is the least significant bit *aa* can take values from 00 to 63.	SETA*aa*

11.2 Control Telegrams

Telegram	Description	Response
NEW	Reinitialize measurement	NEW
NULE	Read the channels (only active channels are considered) with erroneous results during last zeroing. ee is a 2 digit decimal number, whose <u>set</u> bits, when converted to binary representation, signal the following status: .0 $\Rightarrow$ channel 1 of the rectum probe was out of offset limits ... .4 $\Rightarrow$ channel 5 of the rectum probe was out of offset limits .5 $\Rightarrow$ channel of the bladder probe was out of offset limits .0 is the least significant bit ee can take values from 00 to 63.	NUL*ee*
NULL*r*	Read the offset current limits for measuring range *r* Limits (Ampere) in the data format ±*m.mmmE±ee;* Data output: rectum probe channels 1 to 5, bladder channel Example for measuring range Low: NULLL•41.70E-12;•42.25E-12;•41.40E-12;•42.10E-12;•41.80E-12;•42.05E-12;	NULL*r*Limits
NULO*r*	Read the offset current measured during last zeroing in measuring range *r* Results (Ampere) in the data format ±*m.mmmE±ee* Data output: rectum probe channels 1 to 5, bladder channel Results for deactivated channels are 0.0 Example for measuring range Low with deactivated channel 1: NULOL••0.00E-12;••0.60E-12;••0.50E-12;•-0.10E-12;••0.70E-12;••0.55E-12;	NULLO*r*-Results

11.3 Data telegrams

11.3.1 Read measured values

The response to a data telegram consists of various fields, separated by semicolons. The fields contain parameters and text.
The response to the D telegram is:
D*m*;*ttttt.n*s*;sss*;*FL*;*OO*;*LL*;*MM*;*R*;*K*bbbbb*.

11.3.2 Description of parameters

m	Actual measuring mode. Valid values: $0 \Rightarrow$ Dose or Charge, $1 \Rightarrow$ Doserate or Current
ttttt.n	Elapsed measurement time. Consists of seven characters. Small numbers are right justified, with leading spaces. Parameter n can have the values of 0 or 5. If the maximum measurement time of 64800 seconds is exceeded, OL••••• will be transmitted.
sss	Measurement status. Valid values: RES, STA, HLD, INT, RUN, NUL, ERR.
FL	Global flags. A two digit number, whose <u>set</u> bits, when converted to binary representation, signal the following error: .0 $\Rightarrow$ any channel is overloaded at the moment .1 $\Rightarrow$ math error in any channel .2 $\Rightarrow$ MULTIDOS data acquisition error .4 $\Rightarrow$ overload in any channel since the start of a dose or charge measurement .0 is the least significant bit
OO	Overload flags of the current status of the doserate or current measurement. 2 digit decimal number whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ channel 1 .5 $\Rightarrow$ channel 6 .0 is the least significant bit *OO* can take values from 00 to 63.
LL	Latched overload flags of the dose or charge measurement. 2 digit, whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ channel 1 .5 $\Rightarrow$ channel 6 .0 is the least significant bit *LL* can take values from 00 to 63.
MM	Math error flags of the actual measurement mode. 2 digit, whose set bits, when converted to binary representation, signal the following errors: .0 $\Rightarrow$ channel 1 .5 $\Rightarrow$ channel 6 .0 is the least significant bit *MM* can take values from 00 to 63.
R	Number of the rectum channel with the highest measured value. *R* can take values from 1 to 5
$\pm m.mmm$	Mantissa of the measured value. This field consists of six characters. Smaller numbers are right justified, with leading spaces. Positive numbers use a space character instead of the minus sign. If the limits of representation ($\pm999.9E+20$) are exceeded, +0L••• or -0L••• will be transmitted, depending on the sign.
$E\pm ee$	Exponent of the measured value. Two digit number, with leading zeroes if necessary. The sign is always transmitted, either as + or -. If the limits of representation are exceeded, •••• will be transmitted.
bbbbb	Block check sequence of the response. This is a five digit number, representing a 16 bit unsigned integer, with leading zeroes if necessary. The block check sequence is calculated starting from the first character of the response up to the character preceding *bbbbb* and must be equal to the value of *bbbbb*.

11.3.3 Read maximum value

The response to the DMc telegram is
DMc•m.mmE±ee
where c is the channel number. The transmitted value is the maximum measurable value of the doserate or current measurement. The value is formatted in scientific notation.

11.3.4 Read Resolution

The response to the DRc telegram is
DRc•0.mmmE±ee
where c is the channel number. The transmitted value is the resolution of the actual measuring mode for the channel. The number of digits following the decimal point may vary from 1 to 3.

11.3.5 Measuring unit

Telegram	Response
DU	DU*u*

Reads the absolute unit of measurement of the active measuring mode. Possible values of *u*:
when MULTIDOS is set to radiological units: Gy Gy/s Gy/min Gy/h
when MULTIDOS is set to electrical units: C   A

11.4 Calibration Factors

Telegram	Description	Response
CR*s*A*aa*	Set/Read the status of the channels of set *s*. *aa* is a 2 digit decimal number, whose <u>set</u> bits, when converted to binary representation, signal the following status: .0 $\Rightarrow$ channel 1 of the rectum probe is active .1 $\Rightarrow$ channel 2 of the rectum probe is active .2 $\Rightarrow$ channel 3 of the rectum probe is active .3 $\Rightarrow$ channel 4 of the rectum probe is active .4 $\Rightarrow$ channel 5 of the rectum probe is active .5 $\Rightarrow$ channel of the bladder probe is active .0 is the least significant bit *aa* can take values from 00 to 63. from 00 to 63.	CR*s*A*aa*
CR*s*F*cf*	Set/Read the calibration factor *f* of channel *c* of set *s*	CR*s*F*ccf*
CR*s*N*name*	Set/Read the name of set *s*	CR*s*N*name*
CR*s*T*dtyp*	Set/Read the ID of detector *d* of set *s*. *typ*: string with max.15 characters (ASCII; 20H to 7FH) Space characters are allowed. Ä, Ö, Ü, ä, ö, ü, ß, µ are supported. *d*: R (rectum probe), B (bladder probe)	CR*s*T*cctyp*
CR*s*D*dd.mm.yyyy*	Set/Read the calibration date of set *s*	CR*s*D*dd.mm.yyyy*
CR*s*U*x*	Update (*x* = 1)/Read (no *x*) the result of the check sum protection of set *s*	CR*s*U*x*
CR*s*B*bbbbb*	Set/Read the block check value *bbbbb* of set *s*	CR*s*B*bbbbb*