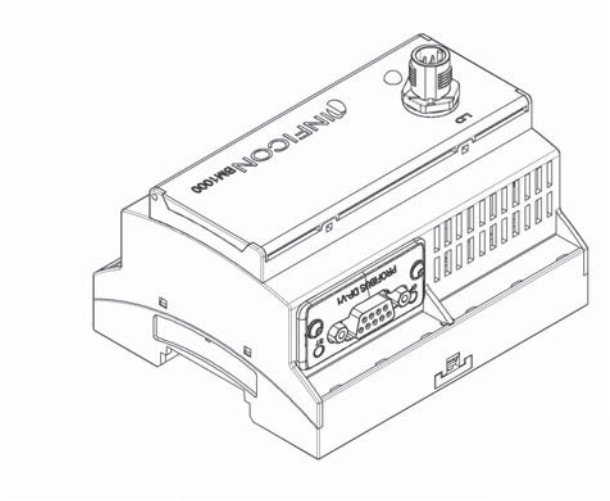
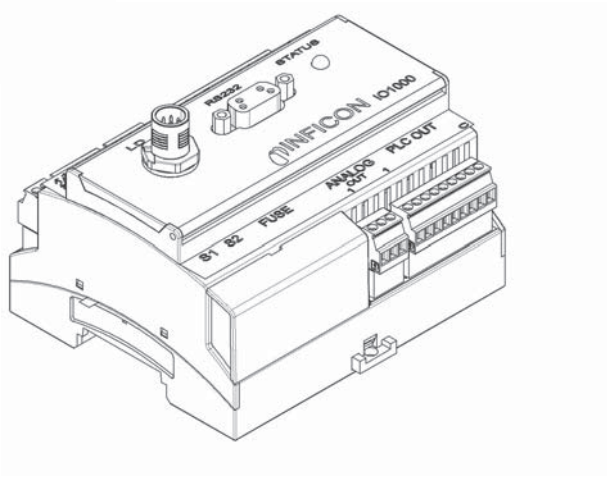
PROTOCOL DESCRIPTIONS





LDS3000

Interface Protocols

Catalog no.	560-310, 560-315
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INFICON

This document applies to the software version stated on the cover page. If you need a different version, please contact our sales staff.

Content

1 Interface Protocols

1.1 Serial Interface Protocols

With the IO1000 module you can communicate with the LDS3000 via the following serial interface protocols:

- ASCII Protocol (enabled by default)
- LD Protocol

If you want to replace a LDS1000 or LDS2010 with a LDS3000 you can also use

- Binary Interface Protocol
- LDS1000 Compatibility Protocol

HINWEIS

Do not use the last two protocols for new developments. They have limited functional range and may not be supported in future.

The serial interface protocol can be selected via DIP switch at the IO module IO1000 or via control unit CU1000. Please refere to appropriate documentation.

1.2 Field Bus Protocols

With the Bus module BM1000 you can communicate with the LDS3000 via the following field bus protocols:

- PROFIBUS-DP Protocol
- Other fieldbus protocols (PROFINET, DeviceNet, EtherNet/IP, MODBUS RTU, MODBUS TCP, CANopen, EtherCAT, CC-Link, ControlNet) may be available on request. Please contact your local INFICON representative.

2 ASCII Protocol

2.1 Comparison between ASCCI- and LD protocol

ASCII- and LD protocol have nearly the same functional range, but each of them have some advantages and disadvantages :

ASCII protocol:

Advantages:

- human readable
- easy to use with simple terminal program

Disadvantages:

- No checksum, therefor lower data security
- PC/ PLC software must convert numerical values from ASCII string to binary
- Lower efficiency (for example: 8 data bytes for one float value)

LD protocol:

Advantages:

- Leak detector status always transmitted in each slave telegram
- High data security due to CRC checksum
- Binary transmission of numerical values – no conversion needed in PC/ PLC software
- High efficiency (for example: 4 Byte data bytes for one float value)

Disadvantages:

- Not human readable
- Not useable with simple terminal program

2.2 Communication Parameters

Data format	
Baudrate	19.200, 8 data bits, 1 stop bit, no parity

2.3 Command Format

In ASCII protocol any command starts with « * » (ASCII code 42dec/2Ahex) and is finished with the end sign CR (ASCII code 13dex/0Dhex). There is no differentiation between upper and lower case. A blank is required between the command and the parameter, no other blanks are allowed.

There is a short and an extended form of the command. Either the short or the extended command must be used, no other abbreviations are allowed (The short form is here written in capitals but the SW don't difference upper and lower cases). Command Words have to be separated by a colon. A command can be composed of up to three words. Parameters have to be separated by a comma.

Each command is answered with the requested data, „ok“ or „EXX“ (in case of an error). For a list of all error messages 2.6. The transmission can be cancelled and the receive-buffer will be cleared with ESC (ASCII code 27dec/1Bhex), ^C (ASCII code 3dec/03hex) or ^X (ASCII code 24dec/18hex).

Some commands can be used as queries, some can be used to set menu parameter and some can be used for both. A query is marked by a „?“ (ASCII code 63dec/3Fhex) after the command; for setting data the command has to be followed by the new value to be set.

Parameter can be Boolean or numerical:

<b>	Boolean	0 / 1 or OFF / ON
<No>	Numeric representation format: integer, real (15.6) or exponential (4.5^{-7})	
	Format: [space] [sign] [ddd] [.] [e[sign]ddd] (d:digit)	

Notice Always use a point as the decimal marker. If a comma is used during numerical data entry, the conversion of the number is cancelled at this point and only the integer part of the number will be used.

Timing recommendations for the PC/PLC - Program:

Sample rate > 100 ms

Timeout between request to and answer from LDS3000: 1500 ms

After sending a command the answer must be waited for before sending a new command. Otherwise the receive buffer may be overwritten.

2.4 Commands

				Relates to LD cmd. no.	Read / Set
*CLS			Clear Error	5	S
*IDN			Identification		
	:CRC		check sum	320	R
	:DEVice		name of instrument	301	R
	:VERsion		software version MSB	310	R
	:SERial		serial-number leak detector		R
	:TURBO		software version TMP controller	315	R
	:DIP1		MSB DipSwitch 1 (binär)	321	R
	:DIP2		MSB DipSwitch 2 (binär)	321	R
	:CUversion		software version control unit	314	R
	:IOversion		software version I/O modul	313	R
	:TCHARDware		hardware version TMP controller	316	R
	:TCNAME		TMP controller name	317	R
	:BMVersion		software version Bus modul		R
	:BMSerial		serial-number Bus modul		R
	:BMNETType		Bus module network type		R
*STATus			status of LDS2010 (ACCL, STBY, MEAS, CAL, ERROR, EMIOFF)	Status word	R

				Relates to LD cmd. no.	Read / Set
	:CAL		status of calibration (IDLE, INTCAL, EXTCAL, DYNCAL, CLOSE, FAIL)	260	R
	:CALHist		Last error history entry Factor, Test leak, Anode voltage, Mass, Date, Time, Cathode, State	275	R
		1	Calibration history entry 1 (newest)		
		2	Calibration history entry 2		
		…			
		10	error history entry 10 (oldest)		
	:ERRor		current number of error / warning („NO ERROR/ WARNING“, 3-digit failure number)	290	R
	:ERRHist		Actual error history entry In LDS2010 compatibility mode: dd.mm.yy hh.mm Exx Exx is error number from LDS2010 error number group All other compatibility modes: ListNo 'ERR' or 'WRN' ErrNo ErrValue(float), year/month/day hour:min:sec 'SwOnCnt:' SwitchOnCnt 'OnTm:' MinSinceStart “WRNxxx vvv yy/mm/dd hh:mm:ss SwOnCnt: zzz OnTm: ttt“ or “ERRxxx vvv yy/mm/dd hh:mm:ss SwOnCnt: zzz OnTm: ttt“ xxx: Error or warning number from LDS3000 error number group vvv: Measured value	290	R
		1	error history entry 1 (newest)	290	R
		2	error history entry 2	290	R
		.....			
		16	error history entry 16 (oldest)	290	R
	:MODE		actual vacuum mode (VAC, SNIFF)	401	R
	:ZERO		Zero (ON, OFF)	6	R
	:VALVE		status of valves 0...255 as 8-bit binary number (0:off; 1:on) Bit0: Test leak Bit4: Sniffer valve Bit1: Gas ballast	449	R
	:TRIGger		status of trigger S1,S2,S3,S4 with S1…S4 is “ON” or “OFF” depending of the states of trigger1 to trigger4	385	R

				Relates to LD cmd. no.	Read / Set
	:PREAMPRESistor		currently used resistance of pre-amplifier (13M, 470M, 15G, 500G, 13M_FIXED, 470M_FIXED, 15G_FIXED, 500G_FIXED)	502	R
	:CAThode		actual state of the cathode OFF, ON1 (fix cathode 1), ON2 (fix cathode 2), AUTO1 / AUTO2 (automatic switching; cathode 1 respectively 2 actual active)	530	R
	:BUSModule		Status Bus-Modul “SETUP”,"NW_INIT”, "WAIT_PROCESS","IDLE", "PROCESS_ACTIVE","ERROR", "UNKNOWN", "EXCEPTION"	330	R
		:EXCEPtion	Exception Code of Bus module as hex value		R
		:ERRORCnt	Four error counters, format “a,b,c,d” a: Discarded commands b: Discarded responses c: Serial reception errors d: Fragmentation errors		R
		:ADDRess	Field bus address		R
		:BAUDrate	Baud rate at field bus		R
*READ			leak rate in current unit	128	R
	:ATM*cc/s		leak rate in Atm*cc/s	---	R
	:G/a		leak rate in g/a (only in sniff)	---	R
	:MBAR*l/s		leak rate in mbar*l/s	129	R
	:PA*m3/s		leak rate in Pa*m3/s	---	R
	:PPM		leak rate in ppm (only in sniff)	---	R
	:TORR*l/s		leak rate in Torr*l/s	---	R
*STArt			start	1	S
*STOp			stop	2	S
*CAL	:STOP		abort calibration	11	S
	:INT		start internal calibration	4	S
	:DYN		start external dynamic calibration	4	S
	:EXT		start external calibration	4	S
	:CLOSED		report test leak closed (ext. cal. only)	11	S
*ZERO			switch zero on	6	S
	:ON		switch zero on	6	S
	:OFF		switch zero off	6	S
*MEAS					
	:P or :P1		P1 pressure in current unit	130	R
		:ATM	P1 pressure in atm	---	R
		:MBAR	P1 pressure in mbar	83	R
		:PA	P1 pressure in Pa	---	R
		:TORR	P1 pressure in Torr	---	R
	:P2		P2 pressure in current unit	132	R
		:ATM	P2 pressure in atm	---	R
		:MBAR	P2 pressure in mbar	133	R
		:PA	P2 pressure in Pa	---	R

				Relates to LD cmd. no.	Read / Set
		:TORR	P2 pressure in Torr	---	R
	:P3		P3 pressure (only for service)	134	R
	:P4		P4 pressure (only for service)	135	R
	:UVV		preamplifier voltage [V]	202	R
	:MIAP		anode potential [V]	167	R
	:MIKP		cathode potential [V]	168	R
	:MISP		suppressor potential [V]	169	R
	:MIAKP		anode-/cathode potential [V]	170	R
	:U15N		-15 V supply [V]	211	R
	:U15P		+15 V supply [V]	210	R
	:U24		24 V supply [V]	200	R
	:U24IO		24 V supply IO [V]	213	R
	:U24IO_OUT		24V power out IO [V]	219	R
	:U24PI		24 V power out pirani [V]	214	R
	:U24PWR1_2		24 V power out12 [V]	215	R
	:U24PWR5_6		24 V power out56 [V]	217	R
	:U24RC		24V_2 power out RC [V]	212	R
	:U5		+5 V supply [V]	218	R
	:TEMPeratur				
		:Amplifier	preamplifier temperature [°C]	166	R
		:Electronic	electronic temperature [°C]	165	R
		:TCElectronic	TMP electronic temperature [°C]	144	
		:TCPump	TMP temperature bottom [°C]	143	R
		:TCBearing	TMP temperature bearing [°C]	145	R
		:TCMotor	TMP electronic temperature [°C]	146	R
	:TURBO				
		:Frequency	TMP frequency [Hz]	138	R
		:Voltage	TMP voltage [Hz]	150	R
		:Current	TMP current [A]	151	R
		:Power	TMP power [W]	139	R
	:ANALOGOUT 1		Output voltage analog output channel 1	221	R
	:ANALOGOUT 2		Output voltage analog output channel 2	221	R

				Relates to LD cmd. no.	Read / Set
	:DIGITALIN		state of the PLC inputs as 16-bit binary number; inactive=0, active=1 Byte 0, Bit 0: PLC In 1 Byte 0, Bit 1: PLC In 2 Byte 0, Bit 2: PLC In 3 Byte 0, Bit 3: PLC In 4 Byte 0, Bit 4: PLC In 5 Byte 0, Bit 5: PLC In 6 Byte 0, Bit 6: PLC In 7 Byte 0, Bit 7: PLC In 8 Byte 1, Bit 0: PLC In 9 Byte 1, Bit 1: PLC In 10 Byte 1, Bit 2: DIP_1 Byte 1, Bit 3: DIP_2: Byte 1, Bit 4: DIP_3: Byte 1, Bit 5: DIP_4 Byte 1, Bit 6: DIP_5	261	R
	:IMess		Unfiltered ion current [A]	1568	R
*CONFig					
	:CALleak		leak rate of test leak		
		:INT	internal test leak in mbarl/s	394	R/S
		:EXTVac	external test leak in vacuum mode in current vac unit	390	R/S
		:EXTSniff	external test leak in sniff mode in current sniff unit	392	R/S
	:CALREQ		calibration request (OFF,ON); with read: (OFF, ON_REQUESTED, ON_NOTREQUESTED)	419	R/S
	:CAThode		target state of the cathode OFF (not saved after power loss) ON1 (fix cathode 1) ON2 (fix cathode 2) AUTO (automatic switching cathode) with read: AUTO1 / AUTO2: Auto with cathode 1 respectively 2 actual active	530	R/S
	:RS232		Protocol (ASCII, LD, LDS1000)	26	R/S
	:MASS		mass (2,3,4)	506	R/S
	:MFAE		actual anode potential reference [V]	167	R
		:M2	anode potential reference for mass 2 [V]	433	R/S
		:M3	anode potential reference for mass 3 [V]	434	R/S
		:M4	anode potential reference for mass 4 [V]	435	R/S
	:MODE		operating mode (VAC, SNIFF)	401	R/S
	:RECorder				
		:LINK1	Function at analog output channel 1 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN)	222	R/S
		:LINK2	Function at analog output channel 1 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN)	222	R/S

				Relates to LD cmd. no.	Read / Set
		:SCALE	Analog out scaling	223	R/S
		:UPPEREXP	Upper Exponent (in mbar*l/s) for analog out	224	R/S
	:TRIGger1		trigger1 in current unit	384	R/S
		:ATM*cc/s	trigger1 in Atm*cc/s	---	R/S
		:G/a	trigger1 in g/a	---	R/S
		:MBAR*l/s	trigger1 in mbar*l/s	385	R/S
		:PA*m3/s	trigger1 in Pa*m3/s	---	R/S
		:PPM	trigger1 in ppm	---	R/S
		:TORR*l/s	trigger1 in Torr*l/s	---	R/S
	:TRIGger2		trigger2 in current unit	384	R/S
		:ATM*cc/s	trigger2 in Atm*cc/s	---	R/S
		:G/a	trigger2 in g/a	---	R/S
		:MBAR*l/s	trigger2 in mbar*l/s	385	R/S
		:PA*m3/s	trigger2 in Pa*m3/s	---	R/S
		:PPM	trigger2 in ppm	---	R/S
		:TORR*l/s	trigger2 in Torr*l/s	---	R/S
	:TRIGger3		trigger3 in current unit	384	R/S
		:ATM*cc/s	trigger3in Atm*cc/s	---	R/S
		:G/a	trigger3in g/a	---	R/S
		:MBAR*l/s	trigger3in mbar*l/s	385	R/S
		:PA*m3/s	trigger3in Pa*m3/s	---	R/S
		:PPM	trigger3in ppm	---	R/S
		:TORR*l/s	trigger3in Torr*l/s	---	R/S
	:TRIGger4		trigger4 in current unit	384	R/S
		:ATM*cc/s	trigger4 in Atm*cc/s	---	R/S
		:G/a	trigger4 in g/a	---	R/S
		:MBAR*l/s	trigger4 in mbar*l/s	385	R/S
		:PA*m3/s	trigger4 in Pa*m3/s	---	R/S
		:PPM	trigger4 in ppm	---	R/S
		:TORR*l/s	trigger4 in Torr*l/s	---	R/S
	:UNIT				
		:LRVac	leak rate unit vac mode (ATM*cc/c, MBAR*l/s, PA*m3/s, TORR*l/s)	431	R/S
		:LRSniff	leak rate unit sniff mode (ATM*cc/c, MBAR*l/s, PA*m3/s, TORR*l/s, ppm, g/a)	432	R/S
		:Pressure	pressure unit (ATM, MBAR, PA, TORR)	430	R/S
	:ZEROTime		zerotime in seconds (0,5…30s)	411	R/S
	:CORSTBY				R/S
	:ZEROSTART		zero at start (OFF, ON)	409	R/S
	:SPEEDTMP		rotation speed of TMP in Hz	501	R/S
	:BUTSniffer		button of the sniffer probe (OFF, ON)	412	R/S
	:LRFilter		filter switch-over threshold in current leak rate	403	R/S

				Relates to LD cmd. no.	Read / Set
	:PLCOUTLINK	:1 or :1_2 :2 or :3_4 :3 or :5_6 :4 or :7_8 :5 or :9_10 :6 or :11_12 :7 or :13_14 :8 or :15_16	assignment of PLC-outputs "OPEN", “INV_OPEN”, "TRIGGER_1","INV_TRIGGER_1", "TRIGGER_2","INV_TRIGGER_2", "TRIGGER_3","INV_TRIGGER_3", "TRIGGER_4","INV_TRIGGER_4", "READY","INV_READY", "WARNING","INV_WARNING", "ERROR","INV_ERROR”, “CAL_ACTIVE",“INV_CAL_ACTIVE", "CAL_REQUEST","INV_CAL_REQUEST”, "RUN_UP", “INV_RUN_UP”, "ZERO_ACTIVE", "INV_ZERO_ACTIVE", “EMISSION_ON", “INV_EMISSION_ON” "MEASURE", “INV_MEASURE”, "STANDBY", “INV_STANDBY”, "SNIFF", “INV_SNIFF”	263	R/S
	:PLCINLINK	:1 :2 :3 :4 :5 :6 :7 :8 :9 :10	assignment of PLC-inputs („NOT_USED“, „DYN_CAL“, „INV_ DYN_CAL “, „EXT_CAL“, „INV_ EXT_CAL “, „INT_CAL“, „INV_ INT_CAL “, „SNIFF“, „INV_ SNIFF“, „START“, „INV_ START “, „STOP“, „INV_ STOP “, „ZERO“, „INV_ZERO“, „ZERO_PULS”, „INV_ ZERO_PULS” “CLEAR”, “INV_CLEAR”, “GAS_BALLAST”, “INV_ GAS_BALLAST ”,"SEL_DYN_NORM","INV_SEL_DYN_NORM", "START_STOP", "INV_START_STOP", „KEY1”, „INV_ KEY1”, „KEY2”, „INV_ KEY2”, „KEY3”, „INV_KEY3”,)	438	R/S
	:DECADEZero		zero function „NORM“,(„1-2“, “2-3“, „19/20“, „2“, „3-4“)	410	R/S
*HOUR					
	:DATE		date TT,MM,JJJJ	450	R/S
	:DEVice		operating hours of device	142	R
	:POWer		time since switching on (in minutes)	147	R
	:TIME		time hh,mm	450	R/S
	:TURBO		operating hours of TMP	140	R
	:TC		operating hours of converter	141	R
*FACtor					
	:FACSniff		sniff factor	523	R/S
	:FACMachine		machine factor	522	R/S
	:RESistor		resistor factor 500 G / 15 G	504	R/S

				Relates to LD cmd. no.	Read / Set
	:CALSniff		calibration factor sniff	521	R/S
	:CALVac		calibration factor vacuum	520	R/S
*SERVICE					
	:READBuffer		Read service buffer	1300 .. 1310	R
*STARTFLASH			Flash-Update starten	2619	S
*RST	:FACTORY		Sets all parameters to factory default	1161	S
	:CALHistory		Clears calibration history	1161	S
	:ERRORHistory		Clears error history	1161	S

2.5 Examples

Command	answer	
*stat? (CR)	MEAS (CR)	mode
*status? (CR)	MEAS (CR)	mode
*read? (CR)	2.876E-7 (CR)	leak rate according to programmed unit
*read:pa*m3/s? (CR)	2.876E-6 (CR)	leak rate in a different unit
*start (CR)	OK (CR)	start measurement
*conf:trig1? (CR)	1.0E-9 (CR)	retrieve trigger 1
*conf:trig1 2.0E-9 (CR)	OK (CR)	set trigger 1

2.6 Error Messages

Message	Meaning
OK	command completed
E01	wrong command start (no „*“)
E02	illegal blank
E03	command word 1 illegal
E04	command word 2 illegal
E05	command word 3 illegal
E06	control by RS232 not enabled
E07	argument faulty
E08	no data available
E09	error buffer overflow
E10	command invalid
E11	query not allowed
E12	only query allowed
E13	not yet implemented

3 LDS1000 Protocol

3.1 Interface Parameters

So that the connected instruments (PC) may communicate with the LDS3000, it is required to set-up the interface parameters on the connected instruments.

The settings for the LDS3000 are:

9600 baud, 8 data bits, no parity, 1 stop bit, No handshake and CR as the end sign.

3.2 Interface Commands

The list is ordered to their functions.

The interface commands are composed of the following parts:

Structure

COMMAND <cr>

COMMAND PARAMETER <cr> COMMAND PARAMETER,

PARAMETER <cr>

<cr>: Carriage return (13d)

Example

STOP <cr> G10 <cr>

U24.0 <cr>

There exist several types of command. The main functions of the leak detector are in plain text which points to the function. For example, the command "START <cr>" starts the measurement mode. In response to this command, the PC receives "OK <cr>". A list of the main functions is provided in Chapter 1.4.1.1.

Besides this, conditions may be queried through commands which begin with a "S" for "Status" and which have a parameter attached. A list of all status query commands is given in Chapter 1.4.1.2.

Measurement quantities can be queried through the command "G" for "Get", for example: "G1<cr>". The LDS 3000 will then respond by outputting the current leak rate. All measurement quantities which may be queried are listed in Chapter 1.4.1.3.

If the entry of settings is required in the way normally performed through the menus shown on the Control Unit, the command "U" for "Update" may be used to change the corresponding parameter. The parameter itself may be output via the serial interface through the command "Q" for "Query". For example, "U 0, 1.0E-04<cr>" changes the

level for the first trigger to 1E-4. The commands used to set and query parameters are listed in Chapter 1.4.1.4.

Through "Q 0<cr>" the trigger level can be read.

Less frequently used functions which normally will only be run for servicing can be invoked through the command "F" for "Function". For example: "F10<cr>" switches the emission off. A list of these functions is given in Chapter 1.4.1.5.

During servicing the command "V" for "Valves" may be used to switch the valves. For example: "V 1,0 <cr>" opens the internal calibrated leak.

Through the reset character <ESC> (27d or 1Bh) without <cr> the interface of the LDS 1000 may be reset back to a defined state. A received string which might be processed at that moment is erased and its processing is terminated. Receiving of the <ESC> character is acknowledged by "OK<cr>" (In the case of the "TERMINAL" program from Microsoft the character "O" is not displayed when the local echo is on). Thereafter, the interface is ready to receive. Through this character its is easily possible to check whether or not the data link has been properly installed.

3.2.1 Main functions

Command	Meaning	Reply from the LDS1000	Equivalent to key or PLC input
LR	Leak rate, date, time, output status		
START	Start measurement mode, suppress the background which was measured upon operating START	OK	MEAS active
STOP	Stop the measurement mode, display the current background level	OK	MEAS inactive
ZERO	ZERO mode on, suppress the background which was measured upon operating ZERO	OK	ZERO active
ZERO OFF	ZERO mode off, display the background which was measured upon operating ZERO	OK	ZERO inactive
CAL [X1)]	Internal/external calibration	OK	CAL
CLEAR	Interrupt calibration/erase error status	OK	CLEAR active

[X1*)]Calibration: In the STANDBY mode, the internal calibration is started.

In the MEASURE mode, the external calibration is started. The status of the external calibration may be queried through S12. Sequence of commands for external calibration:

	Command	Reply from the LDS1000	Meaning
1	START	OK	The LDS1000 enters the measurement mode, the calibrated leak must be opened, wait until the signal has stabilised.
2	CAL	OK	External calibration is being started.
3	S12	1	External calibration is running.
4	S12	2	Calibrated leak must be closed, wait until the signal is stable.
5	CAL	OK	Calibration is continued.
6	S12	0	Calibration complete, the LDS1000 is in the measurement mode, the instrument is running in the MEASUREMENT mode.

The internal calibration process is run automatically. There after, the LDS3000 will be in the STANDBY mode.

3.2.2 Status Requests

Besides the main functions, there exist a variety of request commands for outputting the status which reflect the current state of the LDS3000.

For example: "S 2<cr>". The LDS3000 replies by: "00000110<cr>", for example. This means that the LDS3000 is in the "Measure" mode.

Status Information:

	Meaning	**Representation**	
S2	Instrument status (number)	xxxx xxxx Byte 0 Byte 1 Byte 2 Byte 3 Byte 4 Byte 5 Byte 6 BYTE 7	(always 8 characters) (Byte 0 right) 0 = VAC 1 = SNIFF always 0 0 = STANDBY 1 = MEASURE 0 = CAL inactive 1 = CAL active refers to external calibration 0 = STANDARD 1 = DYNAMIC -- ACCELERATION FAIL
S3	Relay status	xxxx xxxx (always 8 characters) (Byte 0 first) Byte 0: < TRIG 1 Byte 1: < TRIG 2 Byte 2: < TRIG 3 Byte 3: < TRIG 4 Byte 4: Ready Byte 5: always 0 Byte 6: CAL-REQUEST Byte 7: no ERROR	
S4	Exceeding of measurement range limits (leak rate)	Useful when leak rates are uueried through the command G1. 0 - within the measurement range 1 - Underrange. The actual leak rate is below the output value. This may occur in particular after activating the Zero function or when restricting the measurement range through "MANUAL". 2 - Overrange	
S6	Key switch status	0 - Key switch defective 1 - No key 2 - Key 1 3 - Key 2 4 - Key 3	
S10	Current error	0 - no errorr / warning > 0 otherwise error number (not yet acknowledged). See TH ??? Chapter ????. If the error is no longer present, the message may be erased through "CLEAR".	
S12	External CAL status	Is used to monitor the calibration process with an external calibrated leak. See also TH ??? Chapter ???. 0 - inactive 1 - active; calibration is running at the moment. 2 - "Close" The external calibrated test leak must be closed and acknowledged through CAL after the signal has stabilised.	

	Meaning	Representation
S14	ZERO status	"Zero" 0 - no correction 1 - a constant leak rate is suppressed
S18	CAL request status	See command Q/U 19 0 - no request 1 - request is present (temperature difference of 5°)
Serviceinformationen, die bei Rückfragen oder im Fehlerfall zur Lösung eines Problems beitragen können		
S30	software version	e.g.:1.00
S31	Serial number	xxxxxxxxxxxxxx
S32	Operating hours counter	xxxxxx
S35	Valve position	xy (always 2 characters) "1" valve open "0" valve closed Byte x Valve for calibrated leak Byte y Sniffer valve
S39	Status of the remote contol inputs	See TH ??? Chapter ???. xxxxxxx (always 7 signs) (Byte 0 first) Byte 0: Input 7 Byte 1: Input 6 Byte 2: Input 5 Byte 3: Input 4 Byte 4: Input 3 Byte 5: Input 2 Byte 6: Input 1 Byte 7: always 0
S41	Preamplifier	Amplification of the preamplifier can be changed through F26 … F30. xy x: Status: 0 - auto, 1 - manuell y: Amplification: 0 - 13M; 1 - 470M; 2- 15G; 3 - 0,5T
S42	Turbo pump	xxxxx (Byte 0 first) Byte 0: speed too low Byte 1: speed too high Byte 2: always 0 Byte 3: FAIL converter ("1"-Error) Byte 4: running up/ acceleration

	Meaning	Representation
S43	Emission control	xxxxx (Byte 0 first) Byte 0: Status number Byte 1: Nominal status 0- off, 1 - Standby, 2 -on Byte 2: Actual status 0 - off, 1 - Standby, 2 -on Byte 3: Cathode 1 - Cathode 1, 2 - Cathode 2
S51	Calibration factor M4 Vacuum	e.g.: 7.492E-13
S52	Calibration M4 Sniff	e.g.: 7.492E-13
S70	Output the number of the current interface error	"ok", if no error is present.
S72	Output the number of the current error message (except interface errors)	e.g.: ER53 12.Oct. 11:50
S73	Output the number of the wrong parameter	"ok", if no error is present.

3.2.3 Request for Measurement Data

Measurement data can be queried through the command G for "GET".

Command	Meaning	Representation
G6	Forevacuum pressure (PV) in volts (1000 mbar: 10.0V).	e.g.: 02.629
G7	Preamplifier signal (EVS) in volts.	e.g.: 01.456
G8	Electronics temperature (ELTA) in °C	e.g.: 23.5
G9	Amplifier temperature (EVSTA) in °C	e.g.: 29,2
G10	Anode potential (MIAP) in volts.	e.g.: 457
G11	Cathode potential (MIKP) in volts.	e.g.: 378
G12	Suppressor potential (MISP) in volts.	e.g.: 330
G13	Anode-Cathode potential (MIAKP) in volts.	e.g.: 79
G19	Speed of the turbopump (TMP) in Hz.	e.g.: 1048
Measurement data for servicing:		
G6	Forevacuum pressure (PV) in volts (1000 mbar: 10.0V).	e.g.: 02.629
G7	Preamplifier signal (EVS) in volts.	e.g.: 01.456

Command	Meaning	Representation
G8	Electronics temperature (ELTA) in °C	e.g.: 23.5
G9	Amplifier temperature (EVSTA) in °C	e.g.: 29,2
G10	Anode potential (MIAP) in volts.	e.g.: 457
G11	Cathode potential (MIKP) in volts.	e.g.: 378
G12	Suppressor potential (MISP) in volts.	e.g.: 330
G13	Anode-Cathode potential (MIAKP) in volts.	e.g.: 79
G19	Speed of the turbopump (TMP) in Hz.	e.g.: 1048

3.2.4 Entry of Instrument Settings

The settings of parameters in the control modus "RS232" may be changed via the command "U" for update when the jumper XJ1 has been set to RS232. The parameters may be output via the serial interface through the command "Q" for query. Forexample, "U0, 1.0E-4<cr>" changes the level for the first trigger to 1.0x 10-4.

Through "Q0<cr>" the trigger level can be read.

The settings are each explained in the Technical Handbook jina50e1-a.

In order to use the commands U51 to U66 the password needs to be entered.

Command	Meaning	Representation
Q/U0	Trigger 1 in current unit	e.g.: 1.0E-5
Q/U1	Trigger 2 in current unit	e.g.: 1.0E-5
Q/U2	Trigger 3 in current unit	e.g.: 1.0E-5
Q/U3	Trigger 4 in current unit	e.g.: 1.0E-5
Q4	Output the operating mode	x, y (always 2 signs) X: 0 – SPS, 1 - RS232 Y: 0 – VAC. 1 - SNIFF
U4	Select operating mode This setting is not saved when switching the mains power off.	**0** - VAC 1 - SNIFF
Q/U7	Sensitivity Threshold. Leak rate in current unit at which the sensitivity (averaging time) is switched over.	e.g.: 1.0E-10
Q/U8	Zero time in seconds (period of time for which the leak rate signal must remain below the saved background level until the saved background level itself is corrected).	e.g.: 5
Q10	Always 0	
Q11	Limit-Low in current unit	e.g.: 1.0E-8
Q12	Limit-HIGH in current unit	e.g.: 1.0E4
Q/U13	Machine factor for VAC	e.g.: 1.0E0

Command	Meaning	Representation
Q/U14	Correction factor for SNIFF	e.g.: 1.0E0
Q/U16	Operating mode for ext. CAL The setting is not saved when switching off the mains power.	**0** - with autotune 1- dyn. CAL without autotune
Q/U19	Request for CAL (Enable CAL message for a temperature difference of 5° C).	**0** - off 1 - on
Q/U20	Mass of the gas which is detected in the mass spectrometer	2 , 3, 4 e.g.: 4
Q/U21	Date	e.g.: 24.Nov04 Abbreviations for the months: Jan May Sep Feb Jun Oct Mar Jul Nov Apr Aug Dec
Q/U22	Time	e.g.: 14:40:07
Q/U24	Unit (unit of measurement for pressure and leak rate in VAC and SNIFF) ppm and g/a is not available for VAC	0 - mbar and mbar l/s 1 - Pa and Pa m3/s 2 - atm and atm cc/s 3 - mbar and g/a 4 - mbar and ppm 5 - Torr and Tor l/s
Q/U27	Leak rate of the internal calibrated leak (always in mbar l/s	e.g.: 1.0E-7 9.9E-1 for not available
Q/U28	leak rate of the external calibrated leak	e.g.: 1.0E-5 9.9E-1 for not available
Q/U31	Number of suppressed decades	0 - 1 to 2 decades 1 - 2 to 3 decades 2 - 3 to 4 decades 3 - 2 decades 4 – complete value 5 - 19/20 of value
Q/U32	Zero suppression when START	0 - off 1 - on
U45	Compatibility Mode	2 – LDS2010-Mode 3 – LDS3000-Mode
Q/U56	Factor 500G - 15G	
Q/U57	MSV anode potential for masse 2 in volts	e.g.: 890

Command	Meaning	Representation
Q/U58	MSV anode potential for masse 3 in volts	e.g.: 590
Q/U59	MSV anode potential for masse 4 in volts	e.g.: 455
Q/U66	Always 0	

3.2.5 Running of service functions

These function calls are not required for normal measurement operations. They are thus all protected by the password (see command U5) with the exception of function F3. The control mode must be set to RS232.

Command	Meaning	Representation
F3	Parameter RESET, resetting of all parameters (except internal test leak and LCD-contrast) to factory defaults. Erase error memory.	
F17	Switch on cathode 1	
F18	Switch on cathode 2 (MEK2 = on)	
	Hardware RESET (same as when switching OFF and the ON again)	

4 Binary Interface Protocol

4.1 Communication Parameters

Data format	
Baudrate	19.200, 8 data bits, no parity, 1 stop bit
float	4 Bytes, IEEE754 (± $10^{\pm 38}$), 3 Byte Mantissa, 1 Byte Exponent/Sign
unsigned long int [ulint]:	4 Bytes, integer without algebraic sign MSB … LSB (0 … 4294967295)
unsigned short int [usint]:	2 Bytes, integer without algebraic sign MSB, LSB (0 … 65535)
signed short int	2 Bytes, integer without algebraic sign MSB, LSB (-32768 … 32767)
unsigned char [uchar]:	1 Byte, integer without algebraic sign (0 … 255)
unsigned char [uchar]:	1 Byte, character ASCII Code (0 … 255)

4.2 Commands

On every command you have to acknowlede with a cmd number. In case of error instead of a cmd number a error byte (≥ 230) is transfered.

Nr	Name	Description	Parameter	Data
2	GetPv	Fore vacuum pressure	Byte 0: unit (0-mbar, 1-Pa, 2-atm, 3-Torr)	Pv [float]
5	GetDeviceID	Device type		LDS2000Plus: 31dec.
8 9	GetGasballast SetGasballast	Gas ballast valve		Byte 0: 0-off, 1-on, 2- main fail safe -on
36 37	GetCalFac SetCalFac	Calibration factor	Byte 0: 0-Vacuum; 1-Sniff	Factor [float]
40 41	GetMass SetMass	Measure mass		[uchar, 2/3/4 for mass 2/3/4]
50 51	GetZero SetZero	Zero (suppress background)		0-off 1-on
54	GetCal	Read calibration state	0-int.Cal; 1-ext.Cal	0-inactiv; 1-active; 2-wait for calibrated leak close (only at external calibrations)
55	SetCal	Start / Stop calibration	0-int.Cal; 1-ext.Cal	0-stop; 1-start; 2-finish (TL close; only at external calibrations)

Nr	Name	Description	Parameter	Data
56 57	GetTrigger SetTrigger	Set / read trigger	Byte 0: 1...4 for Trigger 1...4 Byte 1: Einheit: 0-mbar*l/s, 1-Pa*m³/s, 2-atmcc/s, 3-Torrl/s; In sniff mode additional 4-ppm and 5-g/a	[float]: Trigger value
58 59	GetOpMode SetOpMode	Set / read operation mode		0-Vacuum; 1-Sniff
60 61	GetStBy SetStBy	Stand-By read / set		0-Stand-By; 1-measurement
62	GetErrorCode	Read actual error number		Actual error number (1 Byte) 0= no error
63	SetClearError	Quit error / cancel calibration		
66 67	GetTL SetTL	Value of the calibrated leak read / set	Byte 0: 0-int.TL; 1-ext.TL-vac; 2-ext.TL-sniff Byte 1: unit: 0-mbar*l/s, 1-Pa*m³/s, .2-atmcc/s, 3-Torrl/s; In sniff mode additionally: 4-ppm, 5-g/a	5 [float]: value calibrated leak (Int.. cal : 1E-15mbarl/s for no internal calibrated leak in use)
68 69	GetFilterSetPoint SetFilterSetPoint	Leak rate for switching the averting time	Unit: 0-mbar*l/s, 1-Pa*m³/s, .2-atmcc/s, 3-Torrl/s; In sniff mode additionally: 4-ppm, 5-g/a	[float]: LR-limit value
70	GetSerialNumber	Read serialnumber		
72	GetState	State of the device		0-Standby; 1-error; 2-Cal; 3-run up; 4-ready; 5-Emisssion off
74	GetOpHours	Read operating hours		[uint; h];
76	GetSWVersionNr	Read software version		Byte 0: Main-Version; Byte 1: Sub-Version
78 79	GetFacMachine SetFacMachine	Read / set machine factor		[float]

Nr	Name	Description	Parameter	Data
82 83	GetZeroMode SetZeroMode	Choice zero function		0=2-3 Decades; 1=1-2 Decades; 2=19/20 of valuet; 3=2 Decades; 4=3-4Decades 5=complete value
84 85	GetFacSniff SetFacSniff	Read sniff factor		[float]
92 93	GetUnit SetUnit	unit read / set		Byte 0: LR-vac; Byte 1: LR-sniff; Byte 2: pressure 0-mbar / mbarl/s; 1-Pa / Pam³/s; 2-atm / atmcc/s; 3-Torr / Torrl/s only for LR-sniff: 4-ppm; 5-g/a
99	GetLr	Leak rate	Unit (0-mbar*l/s, 1-Pa*m³/s, .2-atmcc/s, 3-Torrl/s; In sniff mode additionally 4-ppm, 5-g/a)	[float]

Example:

SET Trigger 2 to 1.2E-7mbarl/s

HOST → LDS2010:

5	10	57	2	0	52	0	217	89	176
0x05	0x0A	0x39	0x02	0x00	0x34	0x00	0xD9	0x59	0xB0
Start	Len	Cmd	Para0	Para1	Data	Data	Data	Data	Checksum
Trigger	Trig. 2	mbarl/s	1.2E-7 (4-Byte float)						

LDS2010 → HOST

3	57	60
0x03	0x39	0x3C
Len	Cmd	Checksum

GET Trigger 2 in mbarl/s

HOST → LDS2010:

5	6	56	2	0	69
0x05	0x06	0x38	0x02	0x00	0x45
Start	Len	Cmd	Para0	Para1	Checksum
Trigger	Trig. 2	mbarl/s			

LDS2010 → HOST

7	57	52	0	217	89	166
0x07	0x39	0x34	0x00	0xD9	0x59	0xA6
Len	Cmd	Data	Data	Data	Data	Checksum

1.2E-7 (4-Byte float)

4.3 Error messages

232 → RS232Invalid → Temporary not allowed (example CAL during run up)

240 → RS232Cmd → Command existiert nicht

243 → RS232Len → Numbrer or length of parameters faulty

244 → RS232Para → Parameter out of acceptable range

252 → RS232Start → First character wrong (unlike 0x05)

253 → RS232Checksum → Transmited and calculated Checksumme unlike

254 → RS232Timeout → Timeout (Transmission of a command not completed after 500 msec)

255 → RS232Buffer → Bufferoverflow (Overflow of the Receive-Buffers)

5 LD Protocol

5.1 Communication Parameters

Data format

Baudrate 19.200, 8 data bits, 1 stop bit, no parity

5.2 Command format

5.2.1 Telegram structure

Master sends

ENQ	LEN	ADR	CmdH	CmdL	DATA (n bytes)	CRC
0	1	2	3	4	5	5 + n

Slave answers

STX	LEN	StwH	StwL	CmdH	CmdL	DATA (n bytes)	CRC
0	1	2	3	4	5	6	6 + n

Command	Meaning	
ENQ	0x05	Start of master request
STX	0x02	Start of slave response
LEN	Number of telegram bytes	without ENQ(STX)/LEN, however with CRC max. 253, so the total slave telegram length is max. 255
ADR	Slave address	Slave address = 1: non-addressed bus. Address byte is ignored.
Stw H/L	Status word	Info from slave to master (5.3)
Cmd H/L	Command	Bit 15 ... 13: Command-specifier Read/Write etc. (see table “Cmd H/L: Command: Command-specifier”) Bit 12: free Bit 11 ... 0: Command (5.3)
DATA	Data belonging to master request (Slave reply to write command is sent without data)	0 <= n <= 248 If I/O module (7-byte additional header) is used, then limit maximum data length to 241.
CRC	Checksum	Calculate CRC for all bytes (except CRC byte) Polynomial: 0x98, Name: DOWCRC, Maxim/Dallas, X^8+X^5+X^4+1 Info: CRC calculation see document "CRC_calculation.c" (C souce code)

Cmd H/L: Command: Command-specifier

Bit 15 ... 13	Meaning	High Nibble (Hex)	Comments
000	Read value	0	
001	Write value	2	
010	Read lower limit value	4	Min values also defined for read commands.
011	Read upper limit value	6	Max values also defined for read commands.
100	Read default value	8	Def values also defined for read commands.
101	Read command name in plain text	A	Please refer to chapter “Command name in plain text” below.
110	Read command info	C	Please refer to table “Command info” below
111	not used	E	

Command name in plain text

- 7-Bit ASCII, only printable characters (0x20 and 0x7E)
- Always in English
- Units in square brackets

Command info

1. Byte	Data type (see table “Data types”)
2. Byte	Number of array elements: 0 = no data, no array 1 = data, no array 2 ... 255 = array
3. Byte	Bit 0: 1 = Reading allowed, 0 = Reading not allowed Bit 1: 1 = Writing allowed, 0 = Writing not allowed Bit 2 ... 7: always 0 (not used)

Data types

Value	Meaning	Acronym	Comments
1	Signed 8 bit integer	SINT8	
2	Signed 16 bit integer	SINT16	
3	Signed 32 bit integer	SINT32	
4	Unsigned 8 bit integer	UINT8	
5	Unsigned 16 bit integer	UINT16	
6	Unsigned 32 bit integer	UINT32	
7	Character	CHAR	ISO 8859-1; printable characters
16	Signed 64 bit integer	SINT64	
17	Unsigned 64 bit integer	UINT64	
18	Floating point/real number	FLOAT	IEEE 754
20	no data	NO_DATA	For commands without data, such as Start

All data types are used in Big Endian format (Motorola format), i.e. the byte with the highest-order bits is transferred first.

Arrays

- Read single elements: Array index in first DATA-byte
- Write single elements: Array index in first DATA byte and values in following DATA bytes
- Read all elements: Pseudo array index 255 in first DATA byte
- Write all elements: Pseudo array index 255 in first DATA byte and values in following DATA bytes
- Response from slave (in case data are sent): Array index or pseudo array index in first DATA byte and values in following DATA bytes

All elements of an array have the same Min/Def/Max value.

5.3 Commands

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
Status word	Bit 0	Status word in slave telegram				Device state Bit 0
Status word	Bit 1	Status word in slave telegram				Device state Bit 1
Status word	Bit 2	Status word in slave telegram				Device state Bit 2
Status word	Bit 3	Status word in slave telegram				Device state Bit 3
Status word	Bit 4	Status word in slave telegram				ZERO
Status word	Bit 5	Status word in slave telegram				Still warning
Status word	Bit 6	Status word in slave telegram				Sniffer Key
Status word	Bit 7	Status word in slave telegram				USER CHANGE
Status word	Bit 8	Status word in slave telegram				PLC Output Change
Status word	Bit 9	Status word in slave telegram				Trigger 1 1 = Trigger 1 exceeded
Status word	Bit 10	Status word in slave telegram				Trigger 2 1 = Trigger 2 exceeded
Status word	Bit 11	Status word in slave telegram				not used
Status word	Bit 12	Status word in slave telegram				not used
Status word	Bit 13	Status word in slave telegram				Device warning
Status word	Bit 14	Status word in slave telegram				Device error
Status word	Bit 15	Status word in slave telegram				Syntax / Command error
0	0	NOP	R	NO_DATA		"No operation", replies without data
1	1	Start	W	NO_DATA		Switch from "standby" to "measure"
2	2	Stop	W	NO_DATA		Switch from "measure" to "standby"
4	4	Start calibration	W	UINT8		Start calibration: 0 = internal 1 = external 2 = dynamic 3 = machine/sniff factor
5	5	Clear error	W	NO_DATA		Clear Error or Warning
6	6	Zero	R/W	UINT8		0 = Zero "Off" 1 = Zero "On" respectively update zero value
9	9	Emission nominal status	R/W	UINT8		Emission nominal status 0 = off 1 = on

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
10	A	TMP nominal status	R/W	UINT8		TMP nominal status 0 = off 1 = on
11	B	Calibration acknowledge	W	UINT8		1 = Continue calibration 0 = cancel calibration
12	C	Open/close int. testleak	R/W	UINT8		0 = close 1 = open incl. Emission monitoring (less sensitive) internal calibration will overwrite the state
128	80	Leak rate [sel. unit]	R	FLOAT		Leak rate in selected unit
129	81	Leak rate [mbar*l/s]	R	FLOAT		Leak rate in mbar*l/s
130	82	Internal pressure 1 [sel. unit]	R	FLOAT		Pressure p1 in selected unit
131	83	Internal pressure 1 [mbar]	R	FLOAT		Pressure p1 in mbar
132	84	Internal Pressure 2 [sel. unit]	R	FLOAT		Pressure p2 in selected unit
133	85	Internal Pressure 2 [mbar]	R	FLOAT		Pressure p2
134	86	Pressure sensor 3	R	FLOAT		Sensor (0...10 V). Config via commands 2630,2634,2638
135	87	Pressure sensor 4	R	FLOAT		Sensor (0...20 mA) config via commands 2632,2636,2639
138	8A	TMP actual rotation speed [Hz]	R	UINT16		TMP actual rotation speed
139	8B	TMP power [W]	R	FLOAT		TMP power in Watt as reportet by TMP controller
140	8C	TMP operation hours [h]	R	UINT32		TMP operation hours
141	8D	Frequency converter operation hours [h]	R	UINT32		Frequency converter operation hours [h]
142	8E	Leak detector operation hours	R	UINT32		Leak detector operation hours
143	8F	TMP temperature bottom [deg. C]	R	FLOAT		TMP temperatur bottom [deg. C]
144	90	TMP temperature electronic [deg. C]	R	FLOAT		TMP temperatur electronic [deg. C]

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
145	91	TMP temperature bearing [deg. C]	R	FLOAT		TMP temperatur bearing [deg. C]
146	92	TMP temperature motor [deg. C]	R	FLOAT		TMP temperatur motor [deg. C]
147	93	Time since power on [min]	R	UINT32		Time since power on [min]
148	94	Cathode1 operation hours		UINT32		Cathode1 operation hours
149	95	Cathode2 operation hours		UINT32		Cathode2 operation hours
150	96	TMP voltage [V]	R	FLOAT		TMP voltage as reported by TMP controller
151	97	TMP current [A]	R	FLOAT		TMP current as reported by TMP controller
157	9D	Switch on counter	R	UINT16		Counts the switch on cycles 0, 0, 65534
165	A5	Electronic temperature [deg. C]	R	FLOAT		MSB temperature in °C
166	A6	Preamplifier temperature [deg. C]	R	FLOAT		VV temperature in °C
167	A7	Anode voltage [V]	R	FLOAT		Anode voltage in V
168	A8	Cathode voltage [V]	R	FLOAT		Cathode voltage in V
169	A9	Suppressor voltage [V]	R	FLOAT		Suppressor voltage in V
170	AA	Anode-cathode voltage [V]	R	FLOAT		Anode/cathode voltage in V
171	AB	Emission current [A]	R	FLOAT		Emission current (A)
172	AC	Heater input [V]	R	FLOAT		DAC heater (V)
200	C8	24 V supply [V]	R	FLOAT		24 V supply voltage for heater, processor, preamplifier in V
202	CA	Pre amplifier voltage [V]	R	FLOAT		Pre amplifier voltage [V]
206	CE	Heater voltage [V]	R	FLOAT		Heater voltage in V
207	CF	Heater power [W]	R	FLOAT		Heater power in W
209	D1	24 V power out TMP [V]	R	FLOAT		24 V TMP, MSB Pin C30 voltage in V
210	D2	+15 V supply [V]	R	FLOAT		+15 V voltage in V
211	D3	-15 V supply [V]	R	FLOAT		-15 V voltage in V

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
212	D4	24 V power out RC [V]	R	FLOAT		24 V RC, remote control, MSB Pin A30, voltage in V
213	D5	24 V supply IO [V]	R/W	FLOAT		24 V IO module supply voltage [V]
214	D6	24 V power out pirani [V]	R	FLOAT		24 V Pirani, sniffer MSB Pin C31 Voltage in V
215	D7	24 V power out12 [V]	R	FLOAT		24 V power outputs 1.2 MSB Pin C27 Voltage in V
216	D8	24 V power out34 [V]	R	FLOAT		24 V power outputs 3.4 MSB Pin C21 Voltage in V
217	D9	24 V power out56 [V]	R	FLOAT		24 V power outputs 5.6 MSB Pin B31 Voltage in V
218	DA	+5 V supply [V]	R	FLOAT		+5 V voltage in V
219	DB	24V power out IO [V]	R	FLOAT		24 V IO modul, MSB Pin B30 Voltage in V
220	DC	Analog input IO [V]	R/W	FLOAT		Analog input voltage IO module in [V]
221	DD	Analog outputs IO [V]	R/W	FLOAT[2]		Analog output voltage for IO module in [V] It is possible to write an arbitrary voltage value, if the "Analog output configuration" (command 222) of the accordant channel is set to 8
222	DE	Analog output configuration IO modul	R/W	UINT8[2]	ANALOG-OUT 1: 0, 3, 12 ANALOG-OUT 2: 0, 4, 12	Function of analog output Index 0: Channel 1 Index 1: Channel 2 Functions see table "Analog output configuration"
223	DF	Analog output leak rate scale (log. only)	R/W	UINT8	0, 0, 7	Leak rate scaling of analog output in logarithmic mode Functions see table "Analog output configuration"
224	E0	Analog output upper exponent	R/W	SINT8	1E-12, 1E-5, 1E7	Upper limit for the analog out at the I/O modul. Value is exponent of the mbar*l/s value. Example: -5 = 1E-5 mbar*l/s
228	E4	Gasballast mode	R/W	UINT8	0, 0, 2	0=off, 1=on, 2=on (continuous on, not PLC controlled)
260	104	State calibration	R	UINT8		Status of calibration See table "State calibration"
261	105	PLC input state IO modul	R/W	UINT16		Get PLC input state and DIP switch state IO modul Bit 0..9 = PLCin 1..10 Bit 10..15 = DIP 1..6 (S1.1,S1.2,S1.3,S1.4,S2.1,S2.2)

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
262	106	PLC output state IO modul	R	UINT8		Get PLC output state IO modul Bit0..7 = PLCOut 1..8
263	107	PLC output configuration IO modul	R/W	SINT8[8]	PLC_OUT1: -16, -2, 16 PLC_OUT2: -16, -3, 16 PLC_OUT3: -16, -4, 16 PLC_OUT4: -16, -5, 16 PLC_OUT5: -16, -6, 16 PLC_OUT6: -16, -8, 16 PLC_OUT7: -16, 0, 16 PLC_OUT8: -16, 0, 16	Index 0...7 = PLC_OUT1 ... PLC_OUT_8 See table "PLC output conf."
264	108	Emission actual status	R	UINT8		Emission status: STOP= 0 START= 1 WAIT= 2, RAMP= 3, REGULATE= 4 STABLE= 5 DOWN= 6 OFF= 7
274	112	Last entry in cal history		UINT8		History list index of the last (newest) entry in the calibration history
275	113	Cal history		CHAR[*]		Text of calibration in the history list. To read send after the array index 255 the UINT8 history list index (0...9). Without history list index you will get the last (newest) entry. Entry format: see enumerations table
277	115	Last entry in error history		UINT8		Index of the last (newest) entry in the error history list
287	11F	Error history	R	CHAR[*]		Text of an error/warning in the history list. To read send after the array index 255 the UINT8 history list index (0...15). Without history list index you will get the last (newest) entry. Entry format: see enumerations table
288	120	TMP error history	R	CHAR[*]		Text of an error/warning in the TMP history list. To read send after the array index 255 the UINT8 history list index (1...10). Entry format: see enumerations table

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
289	121	Value of actual error	R	FLOAT		Value associated with the actual error or warning
290	122	Number of actual error	R	UINT16		Error number of the actual error or warning
291	123	List of signal values of active errors	R	FLOAT[10]		Lists the signal values of the errors/ warnings since the last "clear error"
294	126	Text of error number	R	CHAR[*]		text of an error/warning number To read send after the index the UINT16 error number Without error number you will get the actual error/warning Use only with index=255!
296	128	List of active errors	R	UINT16[10]		Lists the error/warning numbers since the last "clear error"
297	129	Present warnings	R	UINT32		Each bit represents a warning see enumerations table
300	12C	Device identification	R	UINT8[2]		Device identification, always {1,45} for MSB
301	12D	Device name	R	CHAR[*]		Get device name as ASCII string, 'always "MSB"
310	136	SW-version MSB	R	UINT8[3]		Software version MSB Index 0: Main version Index 1: Sub version Index 2: Debug version
313	139	SW-version I/O modul	R/W	UINT8[3]		Software version IO modul Index 0: Main version Index 1: Sub version Index 2: Debug version
314	13A	SW-version control unit	R/W	UINT8[3]		Software version control unit Index 0: Main version Index 1: Sub version Index 2: Debug version
315	13B	SW version TMP controller	R	CHAR[6]		Character string from turbo controller
316	13C	HW-version TMP controller	R	CHAR[6]		Character string from turbo controller
317	13D	TMP controller name	R	CHAR[6]		Character string from turbo controller
318	13E	SW version boot loader	R	UINT8[3]		Software version of boot loader
319	13F	SW version boot loader I/O modul	R/W	UINT8[3]		Software version of boot loader IO modul
320	140	CRC-code MSB	R	UINT32		CRC-code interface board abcdwxyz (hex) abcd: caclulated value wxyz: nominal value

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
321	141	DIP switch MSB	R	UINT8		DIP switch setting of the MSB: Bit7: S171, switch 4 Bit6: S171, switch 3 Bit5: S171, switch 2 Bit4: S171, switch 1 Bit3: S170, switch 4 Bit2...0: not used,always 0
322	142	Field bus status word	R	UINT16		Status word for Bus modul refer to Bus module documentation
323	143	SW version bus modul	R	UINT8[3]		SW version bus modul
324	144	Bus module fieldbus type	R	UINT16		Bus module fieldbus type. Refer to AnybusCC specification for enumeration.
325	145	Serial number plug-in unit bus modul	R	UINT8[4]		Serial number plug-in unit bus modul
326	146	Field bus address	R	UINT8		Fiedbus address Refer to AnybusCC specification for enumeration.
327	147	Field bus baud rate	R	UINT8		Baud rate at field bus Refer to AnybusCC specification for enumeration.
328	148	Exception code bus modul	R	UINT8		Exception code bus module
329	149	Error counters bus module	R	UINT16[4]		Error counters bus module Index: 0: Discarded commands 1: Discarded Responses 2: Serial Reception errors 3: Fragmentation errors
330	14A	Bus module state	R	UINT8		State of bus module see Enumarations
331	14B	Field bus address nominal value	R/W	UNIT8		Fieldbus address nominal value. Refer to AnybusCC specification for enumeration.
385	181	Trigger [mbar*l/s]	R/W	FLOAT[4]	1E-12, 1E-5, 1E3	Trigger in mbar*l/s
390	186	Test leak extern vacuum [mbar*l/s]	R/W	FLOAT	1E-9, 9.9E-2, 9.9E-2	Test leak extern for vacuum mode in mbar*l/s
392	188	Test leak extern sniff [mbar*l/s]	R/W	FLOAT	1E-7, 9.9E-2, 9.9E-2	Test leak extern for sniff mode in mbar*l/s
394	18A	Testleak intern [mbar*l/s]	R/W	FLOAT	1E-7, 9.9E-2, 9.9E-2	Testleak intern in mbar*l/s
401	191	Operation mode	R/W	UINT8	0, 0, 1	0 = VACUUM 1 = SNIFF

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
402	192	Leak rate filter	R/W	UINT8	0, 1 ,2	0 = 2-zone 1 = I•CAL 2 = Fixed
403	193	Leak rate threshold for averaging time [mbar*l/s]	R/W	FLOAT	1E-11, 1E-10, 9.9E3	Leak rate threshold for averaging time in mbar*l/s. Below this value the averaging time is 10,24s. Above this value the averaging time is 160ms.
406	196	Serial number leak detector	R	CHAR[11]		Serial number of the complete leak detector
407	197	Serial number MSB	R	CHAR[11]		Serial number of the MSB
408	198	Serial number IO modul	R	CHAR[11]		Serial number of the IO modul
409	199	Zero with start	R/W	UINT8	0, 0 ,1	Zero with Start 0 = OFF, 1 = ON
410	19A	Zero mode	R/W	UINT8	0, 0, 5	unterdrückte Dekaden: **0 = suppress all** 1 = 1 -2 decades background suppression 2 = 2 -3 decades background suppression 3 = 2 decades background suppression 4 = 3-4 decades background suppression 5 = 19/20 of the raw signal background suppression
411	19B	Zero time	R/W	UINT16	0 , 5 , 30	Update interval for offset value if leakrate signal is negative. Resolution 0,1 s (50 = 5,0 s)
412	19C	Zero Sniffer Key Enable	R/W	UINT8	0, 1, 1	0 = zero key disabled 1 = zero key enabled
419	1A3	Calibration request enable	R/W	UINT8	0, 0, 1	0 = Calibration request disabled 1 = Calibration request enabled
430	1AE	Pressure unit	R/W	UINT8	0, 0, 3	Pressure unit mbar = 0 Pa = 1 atm = 2 Torr = 3
431	1AF	Leak rate unit vacuum	R/W	UINT8	0, 0, 2	Leak rate unit vacuum 0 - mbarl/s 1 - Pam^3/s 2 - Atm ccs 3 - Torrl/s 4 - ppm 5 - g/a

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
432	1B0	Leak rate unit sniff	R/W	UINT8	0, 0, 5	Leak rate unit sniff 0 - mbarl/s 1 - Pam3/s 2 - Atm ccs 3 - Torrl/s 4 - ppm 5 - g/a
433	1B1	Anode setpoint M2 [V]	R/W	UINT16	785, 905, 995	Anode voltage setpoint for mass 2 (hydrogen) in V
434	1B2	Anode setpoint M3 [V]	R/W	UINT16	510, 610, 670	Anode voltage setpoint for mass 3 in V
435	1B3	Anode setpoint M4 [V]	R/W	UINT16	390, 465, 520	Anode voltage setpoint for mass 4 (helium) in V
436	1B4	Emission current setpoint [V]	R/W	FLOAT	1E-4, 2.5E-3, 2.8E-3	Emission current setpoint [V]
438	1B6	PLC input configuration IO module	R/W	UINT8[10]	PLC_IN 1: -16, 11, 16 PLC_IN 2: -16, 4, 16 PLC_IN 3: -16, -12, 16 PLC_IN 4: -16, 7, 16 PLC_IN 5: -16, 2, 16 PLC_IN 6: -16, 3, 16 PLC_IN 7: -16, 9,16 PLC_IN 8: -16, 0, 16 PLC_IN 9: -16, 0, 16 PLC_IN 10: -16, 0, 16	Configuration of PLC input port of the IO module Index 0...9 = PLC_IN1...PLC_IN10 See table "PLC input conf."
439	1B7	Key switch state	R	UINT8		Key switch state 0=inactive, 1=active, 2= not used Bit0&1: KEY_1 Bit2&3: KEY_2 Bit4&5: KEY_3 Bit6&7: not used
448	1C0	Valve control location	R/W	UINT16		Bit=0: Controled by leak detector Bit=1: Controled by write command 449
449	1C1	Switch valves	R/W	UINT16		see table "Valves" For setting valve by write comman see also command 448

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
450	1C2	Date+Time [YMDhms]	R/W	UINT8[6]		Date and time use only with array-index 255 (all bytes) year (1..99), month, day, hour (0..23), min, sec
452	1C4	Min pressure sniff	R/W	FLOAT	1E-3, 4E-1, 18	Minimum pressure p1 im mbar for sniff mode. If pressure falls below this value, warning 540 (Flow too low) is generated.
453	1C5	Max pressure	R/W	FLOAT	1E-3, 18, 18	Maximum pressure p1 in mbar for sniff and vacuum. If pressure rises above this value, warning 520 (Pressure too high) is generated.
499	1F3	Fan output TMP controller	R/W	UINT8	0, 0, 1	0 = always on 1 = temperature controlled only valid after restart of leak detector
501	1F5	TMP rotation speed	R/W	UINT16	1000, 1500, 1500	TMP rotation speed 1000, 1500Hz
502	1F6	Amplifier range	R/W	UINT8	0, 3, 3	Amplifier range Amplifier control location 504 automatically set (not auto) 0 = 13 MOhm 1 = 470 MOhm 2 = 15 GOhm 3 = 500 GOhm
504	1F8	500GOhm value	R/W	FLOAT	4.5E1, 5E11, 5.5E11Ohm	500GOhm value
506	1FA	Mass	R/W	UINT8	2, 4, 4	2 = Mass 2 (H2) 3 = Mass 3 4 = Mass 4 (Helium)
508	1FC	Amplifier control location	R/W	UINT8	0 = controlled by write command 502 1 = controlled auto	Amplifier control location
520	208	Calibration factors vacuum	R/W	FLOAT[3]	1E-2, 1, 5000	Calibration factors for vacuum mode Index 0: mass 2 Index 1: mass 3 Index 2: mass 4
521	209	Calibration factors sniff	R/W	FLOAT[3]	1E-2, 1, 100	Calibration factors for sniff mode Index 0: mass 2 Index 1: mass 3 Index 2: mass 4
522	20A	Machine factors vacuum	R/W	FLOAT[3]	1E-4, 1, 1E4	Machine factors for vacuum mode Index 0: mass 2 Index 1: mass 3 Index 2: mass 4

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
523	20B	Machine factors sniff	R/W	FLOAT[3]	1E-4, 1, 1E5	Machine factors for sniff mode Index 0: mass 2 Index 1: mass 3 Index 2: mass 4
524	20C	Machine factor in standby on/ off	R/W	UINT8	0, 0, 1	machine factor in standby 0 = OFF, 1 = ON
530	212	Cathode selection	R/W	UINT8	0, 3, 4	0 = CAT1 1 = CAT2 2= Auto Cat1 **3= Auto Cat2** 4 = OFF
1161	489	Parameter reset	W	UINT8		Parameter reset: 0: Load factory settings 3: Clear error history 4: Clear calibration history 10: PARA_RESET_ LDS1000_MODE 11: PARA_RESET_ LDS2010_MODE
1282	502	IO module telegram receive counters	R	UINT16[5]		Counter for telegrams received via commands 1280 and 1281 Index: 0=LD protocol 1=ASCII protocol 3=Binary protocol 4=LDS1000 protocol
1283	503	IO module telegram transmit counters	R	UINT16[5]		Counter for telegrams transmitted Index: 0=LD protocol 1=ASCII protocol 3=Binary protocol 4=LDS1000 protocol
1284	504	Control word	R/W	UINT16		Control word (used for Bus module)
1285	505	Stop service buffer	R/W	UINT8		0=save new information 1=no new information
1300	514	Service buffer ion current	R	FLOAT[150]		To read send after the array index 255 the UINT8 block number, each block 10 values (block 14 is newest)
1301	515	Service buffer pressure 1	R	FLOAT[150]		see command 1300
1302	516	Service buffer emis current	R	FLOAT[150]		see command 1300
1303	517	Service buffer anode voltage	R	FLOAT[150]		see command 1300
1304	518	Service buffer cathode voltage	R	FLOAT[150]		see command 1300
1305	519	Service buffer heater power	R	FLOAT[150]		see command 1300
1306	51A	Service buffer leakrate	R	FLOAT[150]		see command 1300

Command dez	Command hex	Name	R/W	Data type	Min-, Def.-, Max-value	Meaning
1307	51B	Service buffer TMP mode	R	FLOAT[150]		see command 1300
1308	51C	Service buffer TMP speed	R	FLOAT[150]		see command 1300
1309	51D	Service buffer emission mode	R	FLOAT[150]		see command 1300
1310	51E	Service buffer sensor 3	R	FLOAT[150]		see command 1301
1568	620	Unfiltered ion current [A]	R	FLOAT		Unfiltered ion current in A
1569	621	Amplifier 1 internal	R	FLOAT		
1573	625	Filtered ion current [A]	R	FLOAT		Filtered ion current in A
1800	708	Active protocol IO	R	UINT8		Active interface protocol for I/O module. Defined by DIP switch at I/O module or command 2593. Values: See enumerations table
1815	717	Reset source	R	UINT8		Shows the last reason of reset
2593	A21	Interface protocol IO	R/W	UINT8	0, 1, 4	Selected interface protocol for I/O module. Only valid if DIP switch at I/O module is set to "000"=
2594	A22	Compatibilty Mode	R/W	UINT8	0, 2, 2	Selected Compatibility Mode
2619	A3B	Start flash update	W	UINT16		Writing 0x5555 to start flash update via control unit interface
2630	A46	P3 min max pressure		FLOAT[2]	0, 5E-4, 1E4	Range sensor 3 (0..10 V)
2632	A48	P4 min max pressure		FLOAT[2]	0, 0, 1E4	Range sensor 4 (0..20 mA)
2634	A4A	P3 min max voltage		FLOAT[2]	-10, 1.9, 10	Voltage range sensor 3 (0..10 V)
2636	A4C	P4 min max current		FLOAT[2]	-20, 4, 20	Current range sensor 4 (0..20 mA)
2638	A4E	P3 mode		UINT8	0, 1, 1	Sensor 3 mode 0=lin, 1=log
2639	A4F	P4 mode		UINT8	0, 0, 1	Sensor 4 mode 0=lin, 1=log
2650	A5A	Set suppressor voltage [V]		FLOAT		Suppressorvoltage for test
2660	A64	Maintenance activ	R/W	UINT8	0, 0, 1	0 = off, 1 = on
2661	A65	Set maintenance	W	UINT8		1= bearing/lubricant
2662	A66	Maintenance done	R	CHAR[*]		To read send after the array index 255 the UINT8 maintenance list index (0...9). Without history list index you will get the last (newest) entry Entry format: see enumerations table

5.4 Enumerations

Analog output configuration (command 222)

Value	Meaning
0	off
1	p1
2	p2
3	Leak rate mantissa
4	Leak rate exponent
5	Leak rate linear
6	Leak rate logarithmic
7	Leak rate logarithmic H.
8	Voltage setable by command 221
9	Leak rate exponent invers
10	Leak rate mantissa hysteresis
11	p1 1V/decade
12	p2 1V/decade

Analog output leak rate scale (log. only) (command 223)

Value	Meaning
0	0,5 V / decade
1	1 V / decade
2	2 V / decade
3	2,5 V / decade
4	3 V / decade
5	5 V / decade
6	10 V / decade
7	special_1

State calibration (command 260)

Value	Meaning
0	READY
1	START_INT
2	WAIT_TL_INT
3	PEAK_INT
4	MEAS_TL_INT
5	WAIT_ZERO_INT
6	MEAS_ZERO_INT
11	START_EXT
13	PEAK_EXT
14	MEAS_TL_EXT
15	WAIT_ZERO_EXT
16	MEAS_ZERO_EXT
21	START_DYN
25	WAIT_ZERO_DYN
26	ZERO_DYN
51	CURRENT
52	FAIL_STATUS
53	FAIL_TL_TO_SMALL

Value	Meaning
54	FAIL_FACTOR
55	WARN_FACTOR
56	FAIL_EMIS
59	PEAKERR

PLC output configuration IO module (command 263)

Value	Meaning
-16	SNIFF_N
-15	STANDBY_N
-14	MEASURE_N
-13	EMISSION_ON_N
-12	ZERO_ACTIVE_N
-11	RUN_UP_N
-10	CAL_REQUEST_N
-9	CAL_ACTIVE_N
-8	ERROR_N
-7	WARNING_N
-6	READY_N
-5	TRIG4_N
-4	TRIG3_N
-3	TRIG2_N
-2	TRIG1_N
-1	OPEN_N
0	OPEN
1	OPEN
2	TRIG1
3	TRIG2
4	TRIG3
5	TRIG4
6	READY
7	WARNING
8	ERROR
9	CAL_ACTIVE
10	CAL_REQUEST
11	RUN_UP
12	ZERO_ACTIVE
13	EMISSION_ON
14	MEASURE
15	STANDBY
16	SNIFF

Cal history (command 275)

Answer	ListNo, 'Fac:', Calfac(float), 'Leak:', Testleak(float), 'Anod:', Anodevoltage, 'M', Mass, 'VAC' or 'SNIF', year/month/day, hour:min:sec, 'Cat:', Cathode, 'State:', cal state
Example	08 Fac: 0.00E+0 Leak: 0.00E+0 Anod: 000 M2 VAC 2000/00/00 00:00:00 Cat: 1 State: 000

Error history (command 287)

Answer	ListNo, 'ERR' or 'WRN', ErrNo, ErrValue(float), year/month/day, hour:min:sec, 'SwOnCnt:', SwitchOnCnt, 'OnTm:', MinSinceStart
Example	05 WRN220 2.103E+1 2012/03/26 09:27:48 SwOnCnt: 028 OnTm: 015

TMP error history (command 288)

Answer	ListNo, 'ERR' or 'WRN', ErrNo
Example	05 WRN220

Present warnings (command 297)

Value	Meaning
0x00000001	Warning pressure/flow
0x00000002	Warning pressure rise
0x00000004	Warning anode voltage
0x00000008	Warning pirani
0x00000010	Warning emission
0x00000020	Warning suppressor
0x00000040	Warning TMP
0x00000080	Warning Anybus
0x00000100	Warning maintenance
0x00000200	Warning I/O disconnected
0x00000400	Warning 5V
0x00000800	Warning U24VHz
0x00001000	Warning U24V Pwr12
0x00002000	Warning U24V Pwr 34
0x00004000	Warning U24V Pwr 56
0x00008000	Warning U24V8
0x00010000	Warning U24V9
0x00020000	Warning U24V10
0x00040000	Warning U24V11
0x00080000	Warning cathode voltage
0x00100000	Warning temperature MSB
0x00200000	Warning temperature preamplifier
0x00400000	Warning calibration request
0x00800000	Warning sniffer not connected
0x01000000	Preamp output too low

Bus module fieldbus type (command 324)

Value	Meaning
0x0005	Profibus
0x0020	CANOpen
0x0065	ControlNet
0x0084	Profinet IO
0x0096	Profinet IO 2-port
0x0085	Ethernet IP
0x0087	EtherCAT
0x0080	Modbus TCP
0x0090	CCLInk
0x0045	ModbusRTU
0x0025	DeviceNet

Bus module state (command 330)

Value	Meaning
0	SETUP
1	NW_INIT
2	WAIT_PROCESS
3	IDLE
4	PROCESS_ACTIVE
5	ERROR
6	UNKNOWN
7	EXCEPTION

PLC input configuration IO module (command 438)

Value	Meaning
-16	CAL
-15	KEY_3_N
-14	KEY_2_N
-13	KEY_1_N
-12	START_STOP_N
-11	SELECT_DYN_NORMAL_N
-10	GASBALLAST_N
-9	CLEAR_N
-8	ZERO_PULS_N
-7	ZERO_N
-6	STOP_N
-5	START_N
-4	SNIFF_VAC_N
-3	CAL_INTERN_N
-2	CAL_EXTERN_N
-1	DYN_CAL_N
0	NO_FUNCTION
1	DYN_CAL
2	CAL_EXTERN
3	CAL_INTERN
4	SNIFF_VAC
5	START

Value	Meaning
6	STOP
7	ZERO
8	ZERO_PULS
9	CLEAR
10	GASBALLAST
11	SELECT_DYN_NORMAL
12	START_STOP
13	KEY_1
14	KEY_2
15	KEY_3
16	CAL

Valves (command 448 & 449)

Bit	Meaning
0	Test leak valve
1	gas ballast valve
2	output 3
3	output 4
4	sniffer valve
5	output 6

Maintenance history (command 2662)

Answer	ListNo, year/month/day, type
Example	3 12/06/01 bearing/lubricant

5.5 Error messages

Telegram error handling

- Slave discards all characters until it receives a STX as telegram start identifier.
- Slave does not generate an error message, if address is not correct.
- Slave reports CRC errors with error message 1 (CRC failure)
- Slave reports length errors with error message 2 (Illegal telegram length) or 11 (Data length is not correct for the command)

To prevent the response from colliding with the next request, the slaves do not respond in case of a timeout.

Error numbers (for Stw: Bit 15 to 1)

1	CRC-failure
2	Illegal telegram lenght
10	command doesn't exist
11	Data length is not correct for the command
12	Read not allowed
13	Write not allowed
14	Array-Index out of range or missing
20	Control actually not allowed with this interface
21	Password not OK
22	Command actually not allowed (e.g. calibration during Run-Up)
30	Data not in range
31	No data available

In case of error: STX, LEN, Stw, Cmd and one Data-Byte (with error number) sent

6 Fieldbus Communication

6.1 Preface

In order to use Fieldbus Communication with LDS3000, you need an INFICON Bus-Module BM1000 connected to the I/O port of the LDS3000.

When setting up the PROFIBUS communication you need to use the GSD file provided by INFICON.

The following file contains the communication characteristics for the PROFIBUS: HMSB1811.GSD

You can download the file at
http://www.anybus.de/

6.2 Setup

► Select the „Bus modul“ at the control unit (CU1000): MENU > SETTINGS > SETUP > INTERFACES > ACCESSORY > DEVICE SEL. > BUS > OK.

► Select the field bus at the control unit (CU1000): MENU > SETTINGS > SETUP > INTERFACES > BUS MODULE > ADDRESS.

Information Attention: This value do not come into effekt until a restart of the leak detector (power off / power on)!

6.3 Process Data Mapping for Cyclic Data Transfer

6.3.1 Write Process Data (PLC-> Leak Detector)

This data is sent periodically from the programmable logic controller to the leak detector:

Byte	Bit	Name	Meaning	Similar to PLC Input	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
1	0	(not used)				
	1	Zero	Transition 0 -> 1: 0x02 = Zero on Transition 1 -> 0: 0x00 = Zero off	ZERO	*ZERO	6
	2	Clear	Transition 0 -> 1: 0x04=Clears errors and warnings	Clear	*CLS	5
	3	Start/Stop	Transition 0 -> 1: 0x08= Start Transition 1 -> 0: 0x00= Stop	Start / Stop	*START / *STOP	1, 2
	4	CAL intern	Transition to 0: 0x00 = Cancel internal calibration Transition to 1: 0x10 = Start internal calibration	CAL intern	*CAL:INT	4
	5					
	6	CAL extern	Transition to 0: 0x00 = Cancel external or dyn. calibration Transition to 1: 0x40 = Start external or. Dyn. calibration Transition to 2: 0x80 = Acknowledge closed test leak	CAL extern / CAL dynamic	*CAL:EXT	4
	7					

2	0 1	Gas ballast	Transition 0 -> 1: 0x01 = Gasballast on Transition 1 -> 0: 0x00 = Gasballast off (if Gasballast mode != GASBALLAST_ON)	Gasballast		
	2 3	Zero mode	0 = normal 0x04 = 1 ... 2 dec. 0x08 = 2 ... 3 dec. 0x0C = 19/20 part of the value			
	4 5	CAL mode	0 = external CAL 0x10 = dyn. CAL 0x20…0x30 = not used	Select dyn/ norm		
	6 7	Sniff/Vac	0 = Vacuum 0x40 = Sniff 0x80 = according to PLC-Input 0xC0 = not used	Sniff	*CONFIG:MODE	401

Information The PROFIBUS-DP protocol is subject to change. If you are using this protocol, please ask INFICON for an update.

6.3.2 Read Process Data (Leak Detector → PLC)

This data is sent periodically from the leak detector to the programmable logic controller:

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
1	0	(not used)	always 1			
	1	Zero active	0 = off 0x02 = on	ZERO active	*STATUS:ZERO?	
	2	Error	0 = no error 0x04 = error	Error		Status word
	3	Warning	0 = no warning 0x08 = warning	Warning		Status word
	4 5	State internal calibration	0 = inactive 0x10 = active 0x20/0x30 = not used	CAL active	*STATUS:CAL?	260
	6 7	State external calibration	0 = inactive 1 = 0x40 = active 2 = 0x80 = waiting for test leak closed 3 = 0xC0 = not used	CAL active	*STATUS:CAL?	260

2	0 1	Calibarion request	0 = CAL request function disabled 1 = 0x01 = CAL request function enabled but no CAL requested 2 = 0x02 = CAL request function enabled and CAL requested 3 = 0x03 = not used	CAL request	*CONFIG:CALREQ?	419
	2 3 4	Emission	0 = 0x00 = Emission off 1 = 0x04 = Cathode 1 fixed 2 = 0x08 = Cathode 2 fixed 3 = 0x0C = Cathode 1 auto 4 = 0x10 = Cathode 2 auto	Emission on	*STATUS:CATHODE?	530
	5 6 7	State	0 = 0x00 = Standby 1 = 0x20 = Error 2 = 0x40 = Calibration 3 = 0x60 = Runup 4 = 0x80 = Measure 5 = 0xA0 = Emission Off 6 ... 7 = 0xC0…0xE0 = not used	Run up, CAL active, Error, Ready	*STATUS?	Status word
3 4 5 6		Leak rate (mbar·l/s)	Actual leak rate in mbar·l/s (IEEE 754 float value)	Recorder output (LR_LIN, LR_LOG ...)	*READ:MBAR*l/S?	129
7 8 9 10		Pressure	Pressure in mbar(IEEE 754 float value)	Recorder output (P1)	*MEAS:P:MBAR?	83
11 12		Actual error number	Error / warning code (16 bit unsigned integer)		*STATUS:ERROR?	290

6.4 Acyclic Data Transfer

Information If you want to use acyclic data transfer with PROFIBUS, you must use a PROFIBUS master which supports DPV1 data transfers. A PROFIBUS master which supports DPV0 only, can only use cyclic data transfer

6.4.1 Addressing Rules for Acyclic Access

Application data instance (ADI) is equal to LD command number.

Fieldbus	Rule	Example
PROFIBUS	ADI = slot · 255 + index + 1 slot = (ADI - 1) / 255 index = (ADI - 1) MOD 255	LD command 506 (Mass): Slot = 1 index = 250
CANopen	index = 2000h + ADI	
ModbusRTU	holding register [1 ... 16] = 210h + (ADI - 1) · 16 + ADI_array_index	
ModbusTCP	holding register [1 ... 16] = 210h + (ADI - 1) · 16 + ADI_array_index	
DeviceNet	Instance_number = ADI	
EthernetIP	Instance_number = ADI	
CCLink	no acyclic access available	

Fieldbus supports all commands from LD protocol, except the commands in the following list:

26	Interface protocol (read only)
27	Used interface
275	Cal history
287	Error history
288	TMP error history
294	Text of error number
406	Serial number leak detector
407	Serial number MSB
450	Date + Time [YMDhms]
1161	Parameter reset
1300	Service buffer ion current
1301	Service buffer pressure 1
1302	Service buffer emis current
1303	Service buffer anode voltage
1304	Service buffer cathode voltage
1305	Service buffer heater power
1306	Service buffer leakrate
1307	Service buffer TMP mode
1308	Service buffer TMP speed
1309	Service buffer emission mode
1310	Service buffer sensor 3
2619	Start flash update
2594	Compatibility mode
2661	Set maintenance
2662	Maintenance done

6.5 Hardware Configuration for Profibus

Sequence of the data words (slots) must be:

- Output at first, inputs at second.
- One or two words are accessible at once.
- Output and inputs must have the same memory start address.

6.5.1 Assignment of the PROFIBUS Address

The PROFIBUS address can be assigned via CU1000 or via the hardware configuration tool of the PLC.

To assign the PROFIBUS address via CU1000 select

► "Main Menu -> Settings -> Set up -> Interfaces -> Bus module -> Address".

To assign the PROFIBUS address via hardware configuration tool of the PLC

► refer to the documentation af your PLC.

If you use a Siemens Step 7 you can also

► refer to the document: „How to configure an Anybus PROFIBUS slave module with Siemens Step 7“

downloadable at http://www.anybus.com/support/support.asp?PID=321&Product-Type=Anybus-CompactCom

6.5.2 Diagnosis with the CU1000 Info Menu

The current state of the BM1000 is visible in the info menu of the control unit CU1000: MENU > INFO > INTERFACES > PAGE 2 > INFO BUS MODULE.

6.5.3 Serial communication via RS232 (common)

Error	Possible Reason	Solution
No characters are received via the interface / the Modul1000 does not answer	Wrong cable	Please use a 1:1 cable, (NO null-modem cable, also called cross-over cable!)
	Problems with flow control	Deactivate flow control in PC/PLC or use cable according to the wiring diagram in Section 2
	Wrong COM-Port used at PC	Select correct COM-Port
No characters are received via the interface / the Modul1000 does not answer	Wrong interface parameters (Baud rate, Data bits, Parity, Stop bits)	Check if interface parameters (Baud rate, number of data bits, parity bit and number of stop bits in the LDS3000 and PC / PLC match)
	Wrong protocol selected in the Modul1000	Select correct protocol in the LDS3000
	PC uses an USB-RS232 converter	In general the IO1000 will also work with an USBRS232- converter. However, these often cause multiple difficult to track problems (driver, flow control.) Please test your PC program on a “real” RS232 interface first preferably. Especially with USB-RS232-converters it is often helpful to use a cable according to the wiring diagram in chapter 4 of the IO1000 documentation.
	Serial interface of PC is (still) occupied with a different program	Check if other programs uses the serial interface. It is also possible that an already closed program has not released the interface again yet. In this case a restart of the PC will help.
The Modul1000 replies with „unreadable“ characters	Wrong interface parameters (Baud rate, Data bits, Parity, Stop bits)	Check if interface parameters (Baud rate, number of data bits, parity bit and number of stop bits in the IO1000 and PC / PLC match)
	Wrong protocol selected in the LDS3000	Select correct protocol in the LDS3000

6.5.4 ASCII Protocol specific

Error	Possible Reason	Solution
IO1000 does not reply / Modul1000 replies after several command with „E10“	„Carriage Return“ at the end of the command is missing	Finish all commands with „Carriage Return“ (ASCII 0dhex / 13dez)
Modul1000 replies with error message to the first command only, following commands are interpreted correctly	Receiving buffer of the LDS3000 was not empty before sending the first command (e.g. by plugging in the RS232 cable during operation)	In the ASCII protocol the LDS3000 has not time out function which will empty the receiving buffer automatically. Therefore, the buffer should be emptied before the first command by sending of ESC, ^C or ^X

6.5.5 LD Protocol specific

Error	Possible Reason	Solution
IO1000 does not reply	Wrong Address	Always use Address 1 in LD protocol.
	Other protocol errors	Try to use NOP command (05hex 04hex 01hex 00hex 00hex 77hex) first, to check if connection works in general. The answer should be 02hex 05hex ??hex ??hex 00hex 00hex ??hex
IO1000 replys with CRC error (error code 1)	Wrong CRC calculation	Check you CRC code calculation. See example C source file "CRC_calculation.c" provided by INFICON. Check your code with unit test function in this source code file.

INFICON GmbH, Bonner Strasse 498, D-50968 Cologne, Germany

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