



LDS3000

Protocol Descriptions

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The descriptive contents of the protocols is intended for use the INFICON products

- 560-310 IO1000 Modul
- 560-315 BM1000 PROFIBUS
- 560-316 BM1000 PROFINET
- 560-317 BM1000 DeviceNET
- 560-318 BM1000 EtherNet/IP

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

NOTICE

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 refer to appropriate documentation.

1.2 Field Bus Protocol

With the Bus module BM1000 you can communicate with the LDS3000 via different fieldbus protocols (PROFIBUS-DP, PROFINET, DeviceNet, EtherNet/IP).

2 ASCII Protocol

2.1 Comparison between ASCII- 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

19200 baud, 8 data bits, no parity, 1 stop bit

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 see [chapter 2.6, page 21](#). 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:

	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CAL:CLOSED	report test leak closed (ext. cal. only)	11	W
*CAL:DYN	start external dynamic calibration	4	W
*CAL:EXT	start external calibration (also valid for AQ-mode)	4	W
*CAL:FACTOR_M	start calibration machine factor	4	W
*CAL:FACTOR_S	start calibration machine factor	4	W
*CAL:INT	start internal calibration	4	W
*CAL:PEAK	start peak adjust AQ	4	W
*CAL:PROOFEXT	Start external proof function	4	W
*CAL:PROOFINT	Start internal proof function	4	W
*CAL:STOP	abort calibration	11	W
*CLS	Clear Error	5	W
*CONFIG:AMPTest	When ON amplifier test during calibration (ON, OFF)	370	R/W
*CONFIG:ANODSET	Without argument current mass, 0..2 mass 2 ... 4	433, 434, 435	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:AQ:TIME	Accumulation measurement time in seconds	1765	R/W
*CONFig:AQ:VOLume	Volume of measurement chamber in liter	1763	R/W
*CONFig:AQ:ZEROTime	Accumulation zero time (multiple of measurement time)	1767	R/W
*CONFig:BEEP	(OFF, TRIGGER)	417	R/W
*CONFig:BRIGHtness	Brightness off sniffer LED 0 ... 6	414	R/W
*CONFig:BUSMODULE:ADDReSS	Field bus address nominal value	331	R/W
*CONFig:BUSMODULE:PROFILE	Field bus profile (HMS, INFICON)	333	R/W
*CONFig:BUTSniffer	(left)button of the sniffer probe (OFF, ON)	412	R/W
*CONFig:CALleak:EXTSniff	external test leak of current mass in sniff mode in current sniff unit	392	R/W
*CONFig:CALleak:EXTVac	external test leak of current mass in vacuum mode in current vac unit (also valid for AQ-mode)	390	R/W
*CONFig:CALleak:INT	internal test leak [mbar*l/s]	394	R/W
*CONFig:CALREQ	calibration request (OFF,ON);with read: (OFF, ON_REQUESTED, ON_NOTREQUESTED)	419	R/W
*CONF:CALWarn	Calibration warning W650 (OFF, ON)	429	R/S
*CONFig: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/W
*CONFig:COMP	Compatibility mode (LDS1000, LDS2010,LDS3000, SL3000, AQ). All parameters are set to the default of the selected mode. (AQ: only valid for LDS3000 AQ)	2594	R/W
*CONFig:CORSTDBY	correction of leak rate in stand by (OFF, ON)	524	R/W
*CONFig:DECADEZero	zero funktion "NORM","1-2","2-3", "19/20", "2", "3-4"	410	R/W
*CONFig:DISPL_LIM:HIGH	Number of decades lower than highest limit (0 ... 15 decades)	397	R/W
*CONFig:DISPL_LIM:LOW	Number of decades higher than lowest limit (0 ... 15 decades)	397	R/W
*CONFig:ERRor:AMPAIter	The preamp alternating test can be switched off (OFF, ON)	1120	R/W
*CONFig:FILTER	Leak rate filter "2ZONE","ICAL","FIXED","I_FIL", "I_FIL2"	402	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:HFButton	Right sniffer button to switch flow (OFF,ON)	415	R/W
*CONFig:Highflow	OFF Disable high flow ON Enable high flow	229	R/W
*CONFig:LANGuage	Language (ENGLISH, DEUTch, FRANcais, ITALiano, PORTugues, ESPanol, KATakana, CHInese, RUSSian)	398	R/W
*CONFig:LIGHTAlarm	Sniffer white LED alarm configuration: DISABLED: always same brightness ON: higher brightness if trigger 1 is exceeded BLINK: blink, if trigger 1 is exceeded	413	R/W
*CONFig:LIMITS	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required) for activ mode sniff/Vac.		R/W
*CONFig:LIMITS:LRSniff	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	227	R/W
*CONFig:LIMITS:LRVac	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	226	R/W
*CONFig:LIMITS:SNIFF	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	227	R/W
*CONFig:LIMITS:VAC	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	226	R/W
*CONFig:LRFilter	filter switch-over threshold in current leak rate	403	R/W
*CONFig:MASS	mass (2 (H2), 3, 4 (Helium)(3 not in AQ-mode))	506	R/W
*CONFig:MFAE	actual anode potential reference [V]	167	R/W
*CONFig:MFAE:M2	anode potential reference [V] mass 2	433	R/W
*CONFig:MFAE:M3	anode potential reference [V] mass 3	434	R/W
*CONFig:MFAE:M4	anode potential reference [V] mass 4	435	R/W
*CONFig:MODE	operating mode (VAC, SNIFF, SL3000, AQ) (SL3000 & AQ read only)	401	R/W
*CONFig:PERcent	Gas percentage 1 ... 100 %	416	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:PLCINLINK:1	Configuration of PLC-input. The following settings are possible: NOT_USED, DYN_CAL, EXT_CAL, INT_CAL, SNIFF, START, STOP, ZERO, ZERO_PULS, CLEAR, GAS_BALLAST, SEL_DYN_NORM, START_STOP, KEY1, KEY2, KEY3, CAL, ZERO_UPDATE, INT_LEAK, LEAK_PULS, HIGHFLOW, FACTOR_MACHINE, INT_PROOF, EXT_PROOF, CYCLE, MASS2_4, PEAK_CAL (AQ only)	438	R/W
*CONFig:PLCINLINK:n	n = 2 ... 10 see CONFig:PLCINLINK:1	438	R/W
*CONFig:PLCOUTLINK	Assignment of PLC-outputs *CONFig:PLCOUTLINK:1 for Pin 1 *CONFig:PLCOUTLINK:2 for Pin 2 ... *CONFig:PLCOUTLINK:8 for Pin 8	263	R/W
*CONFig:PLCOUTLINK:1	Configuration of PLC-output. The following settings are possible: OPEN, TRIGGER_1, TRIGGER_2, TRIGGER_3, TRIGGER_4, READY, WARNING, ERROR, CAL_ACTIVE, EMISSION_ON, MEASURE, STANDBY, SNIFF, ERR/WARN, GAS_BALLAST, INT_LEAK, CAL_STAB, CATHODE2, CAL_REQUEST, RUN_UP, ZERO_ACTIVE	263	R/W
*CONFig:PLCOUTLINK:n	n = 2 ... 8 see CONFig:PLCOUTLINK:1	263	R/W
*CONFig:PRESSHigh	Pressure for upper flow limit (mbar)	453	R/W
*CONFig:PRESSLow	Pressure for lower flow limit (mbar)	452	R/W
*CONFig:PRESSXLHigh	Pressure for upper XL-flow limit (mbar)	456	R/W
*CONFig:PRESSXLLow	Pressure for lower XL-flow limit (mbar)	455	R/W
*CONFig:REcorder:LINK1	Function at analog output channel 1 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN, EXP_INV, MANT_HYST, P1_1V_DEC, P2_1V_DEC)	222	R/W
*CONFig:REcorder:LINK2	Function at analog output channel 2 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN, EXP_INV, MANT_HYST, P1_1V_DEC, P2_1V_DEC)	222	R/W
*CONFig:REcorder:SCALE	Analog out scaling "0.5V/DEC", "1V/DEC", "2V/DEC", "2.5V/DEC", "3V/DEC", "5V/DEC", "10V/DEC", "SPECIAL_1"	223	R/W
*CONFig:REcorder:UPPEREXP	Upper Exponent for analog out [mbar*l/s]	224	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:RS232	Protocol (ASCII, LD, LDS1000) "LD", "ASCII", "ANYBUS", "BINARY", "LDS1000", "TUNNEL", read only: "SNIFF"	26	R/W
*CONFig:SEARCh	Search with Trigger2 in HIGH flow (ON, OFF)	380	R/W
*CONFig:SPEEDTMP	rotation speed of TMP in Hz	501	R/W
*CONFig:STANDBYDel	Standby time in minutes 1 ... 60, 0 = OFF	480	R/W
*CONFig:TRIGger1	trigger1 in selected unit	384	R/W
*CONFig:TRIGger1:ATM*cc/s	trigger1 in Atm*cc/s		R/W
*CONFig:TRIGger1:G/a	trigger1 in grams per year		R/W
CONFig:TRIGger1:MBAR/l/s	trigger1 in mbar*/l/s	385	R/W
*CONFig:TRIGger1:OZ/yr	trigger1 in ounce per year		R/W
*CONFig:TRIGger1:PA*m3/s	trigger1 in Pa*m3/s		R/W
*CONFig:TRIGger1:PPM	trigger1 in parts per million		R/W
*CONFig:TRIGger1:SCCM	trigger1 in sccm (only in AQ-mode)		R/W
CONFig:TRIGger1:TORR/l/s	trigger1 in Torr*/l/s		R/W
*CONFig:TRIGger2	trigger2 in selected unit	384	R/W
*CONFig:TRIGger2:ATM*cc/s	trigger2 in Atm*cc/s		R/W
*CONFig:TRIGger2:G/a	trigger2 in grams per year		R/W
CONFig:TRIGger2:MBAR/l/s	trigger2 in mbar*/l/s	385	R/W
*CONFig:TRIGger2:OZ/yr	trigger2 in ounce per year		R/W
*CONFig:TRIGger2:PA*m3/s	trigger2 in Pa*m3/s		R/W
*CONFig:TRIGger2:PPM	trigger2 in parts per million		R/W
*CONFig:TRIGger2:SCCM	trigger2 in sccm (only in AQ-mode)		R/W
CONFig:TRIGger2:TORR/l/s	trigger2 in Torr*/l/s		R/W
*CONFig:TRIGger3	trigger3 in selected unit	384	R/W
*CONFig:TRIGger3:ATM*cc/s	trigger3 in Atm*cc/s		R/W
*CONFig:TRIGger3:G/a	trigger3 in grams per year		R/W
CONFig:TRIGger3:MBAR/l/s	trigger3 in mbar*/l/s	385	R/W
*CONFig:TRIGger3:OZ/yr	trigger3 in ounce per year		R/W
*CONFig:TRIGger3:PA*m3/s	trigger3 in Pa*m3/s		R/W
*CONFig:TRIGger3:PPM	trigger3 in parts per million		R/W
*CONFig:TRIGger3:SCCM	trigger3 in sccm (only in AQ-mode)		R/W
CONFig:TRIGger3:TORR/l/s	trigger3 in Torr*/l/s		R/W
*CONFig:TRIGger4	trigger4 in selected unit	384	R/W
*CONFig:TRIGger4:ATM*cc/s	trigger4 in Atm*cc/s		R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:TRIGger4:G/a	trigger4 in grams per year		R/W
CONFig:TRIGger4:MBAR/l/s	trigger4 in mbar*/l/s	385	R/W
*CONFig:TRIGger4:OZ/yr	trigger4 in ounce per year		R/W
*CONFig:TRIGger4:PA*m3/s	trigger4 in Pa*m3/s		R/W
*CONFig:TRIGger4:PPM	trigger4 in parts per million		R/W
*CONFig:TRIGger4:SCCM	trigger3 in sccm (only in AQ-mode)		R/W
CONFig:TRIGger4:TORR/l/s	trigger4 in Torr*/l/s		R/W
*CONFig:UNIT:LRSniff	leak rate unit sniff mode (ATM*cc/s, MBAR*/l/s, PA*m3/s, TORR*/l/s, PPM, G/A,OZ/YR)	432	R/W
*CONFig:UNIT:LRVac	leak rate unit vac mode (ATM*cc/s, MBAR*/l/s, PA*m3/s, TORR*/l/s, in AQ-mode: sccm)	431	R/W
*CONFig:UNIT:Pressure	pressure unit (ATM, MBAR, PA, TORR)	430	R/W
*CONFig:UNIT:SNDisplay	Display unit sniff (incl. CU1000 display) (ATM*cc/s, MBAR*/l/s, PA*m3/s, TORR*/l/s, PPM, G/A, OZ/YR)	396	R/W
*CONFig:UNIT:VACuum	Display unit vacuum (incl. CU1000 display) (ATM*cc/s, MBAR*/l/s, PA*m3/s, TORR*/l/s), in AQ-mode: sccm	396	R/W
*CONFig:ZEROSTART	zero at start (OFF, ON)	409	R/W
*CONFig:ZEROTIME	zerotime in seconds (0,5 ... 30 s)	411	R/W
*FACTor:CALSniff	calibration factor sniff (actual mass)	521	R/W
*FACTor:CALSLX	calibration factor sniff XL flow (actual mass)	519	R/W
*FACTor:CALVac	calibration factor vacuum (actual mass)	520	R/W
*FACTor:FACMachine	machine factor (actual mass)	522	R/W
*FACTor:FACSniff	sniff factor (actual mass)	523	R/W
*FACTor:RESistor	resistor factor 500G/15G	504	R/W
*HOUR:CATHODE1	Operating hours of cathode 1 [h]	148	R
*HOUR:CATHODE2	Operating hours of cathode 2[h]	149	R
*HOUR:DATE	Date (DD,MM,YYYY)	450	R/W
*HOUR:DEVIce	operating hours of device	142	R
*HOUR:POWer	time since switching on (in minutes)	147	R
*HOUR:TC	operating hours of TMP converter	141	R
*HOUR:TIME	Time (HH,MM)	450	R/W
*HOUR:TURBO	Operating hours of TMP	140	R
*IDN:BMNETType	Bus-Module network type	324	R
*IDN:BMSerial	serial-number Bus module	325	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*IDN:BMVersion	software version Bus module	323	R
*IDN:CRC	check sum	320	R
*IDN:CUVersion	software version control unit	314	R
*IDN:DEvIce	name of instrument (MSB)	301	R
*IDN:DIP1	MSB DipSwitch 1	321	R
*IDN:DIP2	MSB DipSwitch 2	321	R
*IDN:IOVersion	software version I/O module	313	R
*IDN:SERial	serial-number leak detector	406	R
*IDN:SNSerial	Serial number of sniffer probe	404	R
*IDN:SNType	Type of sniffer probe SL3000 3 m, SL3000XL 3 m, SL3000 5 m, SL3000XL 5 m, SL3000 10 m, SL3000XL 10 m, SL3000 15 m, SL3000XL 15 m, Sniffer LDS, ADAPTER, ADAPTER XL, FLOW STANDARD, FLOW STANDARD XL, UNKNOWN	302	R
*IDN:SNVersion	Software version of sniffer probe	311	R
*IDN:TCHARDware	Hardware version of the TMP frequency converter		
*IDN:TCNAME	TMP frequency converter type		
*IDN:TURBO	software version TMP controller	315	R
*IDN:VERsion	software version MSB	310	R
*MEASure:ACCEL:X	Probe acceleration value in X-direction	1581	R
*MEASure:ACCEL:Y	Probe acceleration value in Y-direction	1581	R
*MEASure:ANALOGOUT1	Output voltage analog output channel 1	221	R
*MEASure:ANALOGOUT2	Output voltage analog output channel 2	221	R
*MEASure:ANODCATH	Anode cathode difference [V]	170	R
*MEASure:ANODE	Anode voltage [V]	167	R
*MEASure:CATHODE	Cathode voltage [V]	168	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*MEASure:DIGITALIN	state of the PLC inputs as 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
*MEASure:DIGITALOUT	state of the PLC outputs as binary number; inactive = 0, active = 1 Byte 0, Bit 0: PLC OUT 1 Byte 0, Bit 1: PLC OUT 2 Byte 0, Bit 2: PLC OUT 3 Byte 0, Bit 3: PLC OUT 4 Byte 0, Bit 4: PLC OUT 5 Byte 0, Bit 5: PLC OUT 6 Byte 0, Bit 6: PLC OUT 7 Byte 0, Bit 7: PLC OUT 8	262	R
*MEASure:IEMIS	Emission current [A]	171	R
*MEASure:IFilter	Filtered ion current [A]	1573	R
*MEASure:I Meas	Unfiltered ion current [A]	1568	R
*MEASure:LRAQOFFSET	Offset leak rate in AQ-Mode (only H2), in mbar*l/s	1759	R
*MEASure:LRAQRAW	Leak rate in AQ-Mode, raw with sign and offset in mbar*l/s	1758	R
*MEASure:MIAKP	anode-/cathode potential [V]	170	R
*MEASure:MIAP	anode potential [V]	167	R
*MEASure:MIKP	cathode potential [V]	168	R
*MEASure:MISP	suppressor potential [V]	169	R
*MEASure:P1	p1 pressure in selected unit	130	R
*MEASure:P1:ATM	p1 pressure [atm]		R
*MEASure:P1:MBAR	p1 pressure [mbar]	131	R
*MEASure:P1:PA	p1 pressure [Pa]		R
*MEASure:P1:TORR	p1 pressure [Torr]		R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*MEASure:P2	P2 pressure in selected unit	132	R
*MEASure:P2:ATM	p2 pressure [atm]		R
*MEASure:P2:MBAR	p2 pressure in [mbar]	133	R
*MEASure:P2:PA	p2 pressure [Pa]		R
*MEASure:P2:TORR	p2 pressure [Torr]		R
*MEASure:P3	P3 pressure (only for service)	134	R
*MEASure:P4	P4 pressure (only for service)	135	R
*MEASure:PHEAT	Cathode heating power [W]	207	R
*MEASure:SUPPRESS	suppressor potential [V]	169	R
*MEASure:TEMPeratur:Amplifier	preamplifier temperature [°C]	166	R
*MEASure:TEMPeratur:Electronic	Electronic temperature [°C]	165	R
*MEASure:TEMPeratur:TCBearing	TMP temperature bearing [°C]	145	R
*MEASure:TEMPeratur:TCElectronic	TMP electronic temperature [°C]	144	R
*MEASure:TEMPeratur:TCMotor	TMP motor temperature [°C]	146	R
*MEASure:TEMPeratur:TCPump	TMP temperature bottom [°C]	143	R
*MEASure:TURBO:Current	TMP current [A]	151	R
*MEASure:TURBO:Frequency	TMP frequency [Hz]	138	R
*MEASure:TURBO:Power	TMP power [W]	139	R
*MEASure:TURBO:Voltage	TMP voltage[V]	150	R
*MEASure:U15N	-15 V supply [V]	211	R
*MEASure:U15P	+15 V supply [V]	210	R
*MEASure:U24	24 V supply [V]	200	R
*MEASure:U24IO	24 V supply IO [V]	213	R
*MEASure:U24IO_OUT	24V power out IO [V]	219	R
*MEASure:U24PI	24 V power out pirani [V]	214	R
*MEASure:U24PWR1_2	24 V power out12 [V]	215	R
*MEASure:U24PWR3_4	24 V power out34 [V]	216	R
*MEASure:U24PWR5_6	24 V power out56 [V]	217	R
*MEASure:U24RC	24V_2 power out RC [V]	212	R
*MEASure:U5	+5 V supply [V]	218	R
*MEASure:UHEAT	Cathode heating voltage [V]		R
*MEASure:UVV	preamplifier voltage [V]	202	R
*READ	leak rate in selected unit	128	R
*READ:ATM*cc/s	leak rate [Atm*cc/s]		R
*READ:G/a	leak rate [g/a (only in sniff)]		R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*READ:MBAR*I/s	leak rate [mbar*I/s]	129	R
*READ:PA*m3/s	leak rate [Pa*m3/s]		R
*READ:PPM	leak rate [ppm (only in sniff)]		R
*READ:SCCM	leak rate in sccm (only in AQ-mode)		R
*READ:TORR*I/s	leak rate [Torr*I/s]		R
*RST:AQ	Sets all parameters to factory default for use with AQ-Mode (only valid for LDS3000 AQ)	1161	W
*RST:FACTORY	Sets all parameters to factory default	1161	W
*RST:SL3000	Sets all parameters to factory default for use with SL3000	1161	W
*SERVICE:EMISsion	Emission ON, OFF	9	R/W
*SERVICE:READBuffer	Read service buffer	1300 ... 1310	R
*SERVICE:TMP	Switch TMP on or off (ON, OFF)	10	R/W
*SERVICE:VALVE:INTTL	ON: Opens internal testleak OFF: Closes internal testleak AUTO: Enables internal calibration		R/W
*STArt	Start	1	W
*STArt:AMPTest	Starts Amplifier test	371	W
*STArt:AMPTest	NO_EMISsion Starts Amplifier test with suppressor	2668	W
*STATus	status of LDS3000 "STBY", "ERROR", "CAL", "ACCL", "MEAS", "EMI OFF"		R
*STATus:AMPTest	Possible answers (READY, RUNNING, RANGE ERROR 1...3, RANGE ERROR 2, 3, RANGE ERROR 3, OFFSET ERROR, GAIN ERROR 1, 2, GAIN ERROR 2, 3)	370	R
*STATus:AQ	AQ-mode is: "OPTIONAL" or "POSSIBLE"	1760	R
*STATus:BUSModule	Status Bus-Module "SETUP", "NW_INIT", "WAIT_PROCESS", "IDLE", "PROCESS_ACTIVE", "ERROR", "UNKNOWN", "EXCEPTION"	330	R
*STATus:BUSModule:ADDRess	Field bus address	326	R
*STATus:BUSModule:BAUDrate	Baud rate at field bus	327	R
*STATus:BUSModule:DHCP	DHCP (ENABLED, DISABLED)	340	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*STATus:BUSModule:ERRORCnt	Four error counters, format "a,b,c,d" a: Discarded commands b: Discarded responses c: Serial reception errors d: Fragmentation errors	329	R
*STATus:BUSModule:EXCEPTION	Exception Code of Bus module as hex value	328	R
*STATus:BUSModule:IPADDRESS	IP address of BM1000 (IP based field buses only)	337	R
*STATus:BUSModule:IPGATEWAY	IP address of gateway	339	R
*STATus:BUSModule:IPSUBNETMASK	IP subnet mask (IP based field buses only)	338	R
*STATus:BUSModule:STATIONNAME	BM1000 station name (PROFINET IO only)	336	R
*STATus:CAL	status of calibration (IDLE, INTCAL, EXTCAL, DYNCAL, CLOSE, MACHCAL, PROOFEXT, PROOFINT, FAIL, OPEN, PEAK (AQ only))	260	R
*STATus:CALHist	Calibration history *Factor, Test leak, Anode voltage, Mass, Date, Time, Cathode, State Calibration history entry 1 (newest) Calibration history entry 2 ... Calibration history entry 10	275	R
*STATus:CATHODE	actual state of the cathodes ON1, ON2, AUTO1, AUTO2, (automatic switching) OFF	530	R
*STATus:EMISSION	Emission status: STOP, START, WAIT, RAMP, REGUL, STABLE, DOWN, OFF	264	R
*STATus: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"	290	R
*STATus:ERROR	current number of error / warning („NO ERROR/WARNING“ or 3-digit failure number)	290	R
*STATus:MODE	actual vacuum mode ((VAC, SNIFF, SL3000)	401	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*STATus:PREAMPRESistor	currently used resistance of pre-amplifier (13M, 470M, 15G, 500G, 13M_FIXED, 470M_FIXED, 15G_FIXED, 500G_FIXED)	502	R
*STATus:SNkey	Status of sniffer key. 0 = not pressed 1 = left key pressed, 2 = right key pressed, 3 = both keys pressed	298	R
*STATus:SWITCHONCounter	current number of switching on the MSB	157	R
*STATus: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
*STATus:VALVE	status of valves 0 ... 255 as 8-bit binary number (0 = off; 1 = on) Bit 0 = Test leak Bit 4 = Sniffer valve Bit 1 = Gas ballast	449	R
*STATus:VALVE:TestLeak	ON, OFF	12	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*STATus:WARNINGBits	Status of warnings as 32-bit binary number Bit 0 = warning pressure/flow too high Bit 1 = warning pressure rise Bit 2 = warning anode voltage Bit 3 = warning pirani Bit 4 = warning emission Bit 5 = warning suppressor Bit 6 = warning tmp Bit 7 = warning anybus Bit 8 = warning maintenance Bit 9 = warning IO disconnected Bit 10 = warning 5 V Bit 11 = warning 24 V heater Bit 12 = warning 24 V out12 Bit 13 = warning 24 V out34 Bit 14 = warning 24 V out56 Bit 15 = warning 24 V 8 Bit 16 = warning 24 V 9 Bit 17 = warning 24 V 10 Bit 18 = warning 24 V 11 Bit 19 = warning cathode voltage Bit 20 = warning MSB temperature Bit 21 = warning preamp temperature Bit 22 = warning cal request Bit 23 = warning sniffer disconnected Bit 24 = warning preamp disconnected Bit 25 = warning +15V Bit 26 = warning -15V Bit 27 = warning pressure XL flow Bit 28 = warning real time clock Bit 29 = warning He contaminated	297	R
*STATus:ZERO	Zero (ON, OFF)	6	R
*STOp	stop	2	W
*ZERO	switch zero on	6	W
*ZERO:OFF	switch zero off	6	W
*ZERO:ON	switch zero on	6	W

2.5 Examples

External Calibration

- 1 Open testleak (move sniffer to leak)
- 2 Wait until stable
- 3 Start calibration: *CAL:EXT
- 4 wait until *STATUS:CAL? answers "CLOSE"
- 5 Close testleak (remove sniffer from leak)
- 6 Wait until stable
- 7 send: *CAL:CLOSED
- 8 wait until *STATUS:CAL? answers "IDLE"

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 LD Protocol

3.1 Communication Parameters

Data format

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

3.2 Command format

3.2.1 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 (see page 26)

Command	Meaning	
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 (see page 27)
DATA	Data belonging to master request (Slave reply to write command is sent without data)	$0 \leq n \leq 248$ 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 file "CRC_calculation.c" (C source 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.

Bit 15 ... 13	Meaning	High Nibble (Hex)	Comments
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.

Array parameters in commands table (see chapter 3.4): The number of array elements is set in brackets behind the data type.

3.3 Status Word

Status word bit no.	Meaning
Bit 0	0 = Runup
Bit 1	1 = Measuring VAC
Bit 2	2 = Measuring SNIF
Bit 3	3 = Standby VAC 4 = Standby SNIF 5 = Calibration VAC 6 = Calibration SNIF 7...14 = not used 15 = Not READY
Bit 4	ZERO
Bit 5	Still warning
Bit 6	Sniffer Key
Bit 7	USER CHANGE
Bit 8	PLC Output Change
Bit 9	Trigger 1, 1 = Trigger 1 exceeded
Bit 10	Trigger 2, 1 = Trigger 2 exceeded
Bit 11	not used
Bit 12	not used
Bit 13	Device warning
Bit 14	Device error
Bit 15	Syntax/Command error

3.4 Commands

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
0	0	Control	NOP	R	NO_DATA		"No operation", replies without data	X
1	1	Control	Start	W	NO_DATA		Switch from "standby" to "measure"	
2	2	Control	Stop	W	NO_DATA		Switch from "measure" to "standby"	
4	4	Control	Start calibration	W	UINT8	0, 0, 5	Start calibration: 0 = internal 1 = external 2 = dynamic 3 = machine/sniff factor 4 = proof internal 5 = proof external 7 = peak adjust AQ	
5	5	Control	Clear error	W	NO_DATA		Clear Error or Warning	
6	6	Control	Zero	R/W	UINT8	0, 0, 1	0 = Zero "Off" 1 = Zero "On" respectively update zero value	
9	9	Control	Emission nominal status	R/W	UINT8	0, 1, 1	Emission nominal status 0 = off 1 = on	
10	A	Control	TMP nominal status	R/W	UINT8	0, 1, 1	TMP nominal status 0 = off 1 = on	
11	B	Control	Calibration acknowledge	W	UINT8	0, 0, 1	1 = Continue calibration 0 = cancel calibration	
12	C	Control	Open/close int. testleak	R/W	UINT8	0, 0, 1	0 = close 1 = open incl. Emission monitoring (less sensitive) internal calibration will overwrite the state	
18	12	Control	Mute beep	R/W	UINT8	0, 1, 1	Mute Beep 0 = ON, 1 = OFF	
120	78	Meas	Proof int testleak [mbar/l/s]	R	FLOAT		Result of proof function	
128	80	Meas	Leak rate [sel. unit]	R	FLOAT		Leak rate in selected unit	
129	81	Meas	Leak rate [mbar*l/s]	R	FLOAT		Leak rate in mbar*l/s	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
130	82	Meas	Internal pressure 1 [sel. unit]	R	FLOAT		Pressure p1 in selected unit	
131	83	Meas	Internal pressure 1 [mbar]	R	FLOAT		Pressure p1 in mbar	
132	84	Meas	Internal Pressure 2 [sel. unit]	R	FLOAT		Pressure p2 in selected unit	
133	85	Meas	Internal Pressure 2 [mbar]	R	FLOAT		Pressure p2	
134	86	Meas	Pressure sensor 3	R	FLOAT		Sensor (0 ... 10 V). Config via commands 2630,2634,2638	
135	87	Meas	Pressure sensor 4	R	FLOAT		Sensor (0 ... 20 mA) config via commands 2632,2636,2639	
138	8A	Meas	TMP actual rotation speed [Hz]	R	UINT16		TMP actual rotation speed	
139	8B	Meas	TMP power [W]	R	FLOAT		TMP power in Watt as reportet by TMP controller	
140	8C	Meas	TMP operation hours [h]	R	UINT32		TMP operation hours	
141	8D	Meas	Frequency converter operation hours [h]	R	UINT32		Frequency converter operation hours [h]	
142	8E	Meas	Leak detector operation hours	R	UINT32		Leak detector operation hours	
143	8F	Meas	TMP temperature bottom [deg. C]	R	FLOAT		TMP temperatur bottom [°C]	
144	90	Meas	TMP temperature electronic [deg. C]	R	FLOAT		TMP temperatur electronic [°C]	
145	91	Meas	TMP temperature bearing [deg. C]	R	FLOAT		TMP temperatur bearing [°C]	
146	92	Meas	TMP temperature motor [deg. C]	R	FLOAT		TMP temperatur motor [°C]	
147	93	Meas	Time since power on [min]	R	UINT32		Time since power on [min]	
148	94	Meas	Cathode1 operation hours		UINT32		Cathode1 operation hours	
149	95	Meas	Cathode2 operation hours		UINT32		Cathode2 operation hours	
150	96	Meas	TMP voltage [V]	R	FLOAT		TMP voltage as reported by TMP controller	
151	97	Meas	TMP current [A]	R	FLOAT		TMP current as reported by TMP controller	
157	9D	Meas	Switch on counter	R	UINT16		Counts the switch on cycles 0, 0, 65534	
165	A5	Meas	Electronic temperature [deg. C]	R	FLOAT		MSB temperature [°C]	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
166	A6	Meas	Preamplifier temperature [deg. C]	R	FLOAT		Preamplifier temperature [°C]	
167	A7	Meas	Anode voltage [V]	R	FLOAT		Anode voltage [V]	
168	A8	Meas	Cathode voltage [V]	R	FLOAT		Cathode voltage [V]	
169	A9	Meas	Suppressor voltage [V]	R	FLOAT		Suppressor voltage [V]	
170	AA	Meas	Anode-cathode voltage [V]	R	FLOAT		Anode-cathode voltage [V]	
171	AB	Meas	Emission current [A]	R	FLOAT		Emission current [A]	
172	AC	Meas	Heater input [V]	R	FLOAT		DAC Heater [V]	
200	C8	Meas	24 V supply [V]	R	FLOAT		24 V supply voltage for heater, processor, preamplifier [V]	
202	CA	Meas	Pre amplifier voltage [V]	R	FLOAT		Pre amplifier voltage [V]	
206	CE	Meas	Heater voltage [V]	R	FLOAT		Heater voltage [V]	
207	CF	Meas	Heater power [W]	R	FLOAT		Heater power in W	
209	D1	Meas	24 V power out TMP [V]	R	FLOAT		24 V TMP, voltage [V]	
210	D2	Meas	+15 V supply [V]	R	FLOAT		+15 V voltage [V]	
211	D3	Meas	-15 V supply [V]	R	FLOAT		-15 V voltage [V]	
212	D4	Meas	24 V power out RC [V]	R	FLOAT		24 V RC, CU1000 voltage [V]	
213	D5	Meas	24 V supply IO [V]	R	FLOAT		24 V IO-Modul supply voltage [V]	
214	D6	Meas	24 V power out pirani [V]	R	FLOAT		24 V Pirani, sniffer voltage [V]	
215	D7	Meas	24 V power out12 [V]	R	FLOAT		24 V Power output 1,2 voltage [V]	
216	D8	Meas	24 V power out34 [V]	R	FLOAT		25 V Power output 3,4 voltage [V]	
217	D9	Meas	24 V power out56 [V]	R	FLOAT		26 V Power output 5,6 voltage [V]	
218	DA	Meas	+5 V supply [V]	R	FLOAT		+5 V voltage [V]	
219	DB	Meas	24V power out IO [V]	R	FLOAT		24 V Power out IO-Modul, voltage [V]	
220	DC	Meas	Analog input IO module [V]	R	FLOAT		Analog input voltage IO module in [V]	

Command		Class	Name	R/W	Data type	Min-, Def-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
221	DD	Meas	Analog outputs IO [V]	R/W	FLOAT[2]	0, 0, 10.25	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	Param	Analog output configuration IO module	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 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 settable by command 221 9 = Leak rate exponent invers 10 = Leak rate mantissa hysteresis 11 = P1 1V/decade 12 = P2 1V/decade	
223	DF	Param	Analog output leak rate scale (log. only)	R/W	UINT8	0, 0, 7	Leak rate scaling of analog output in logarithmic mode 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	
224	E0	Param	Analog output upper exponent	R/W	SINT8	-12, -5, 7	Upper limit for the analog out at the I/O module. Value is exponent of the mbar*l/s value. Example: -5 = 1E-5 mbar*l/s	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
226	E2	Param	Leakrate limits vac	R/W	FLOAT[2]	1E-12, 1E-11, 1E4	Upper and lower leak rate limit. Valid for vacuum and AQ-mode. Index 0: lower limit [mbar*l/s] Index 1: upper limit [mbar*l/s] Valid for command 128 "Leak rate [sel. unit]" and analog outputs	X
227	E3	Param	Leakrate limits sniff	R/W	FLOAT[2]	1E-8, 1E-7, 1E4	Index [0]: lower limit [mbar*l/s] Index [1]: upper limit [mbar*l/s] Valid for command 128 "Leak rate [sel. unit]" and analog outputs	X
228	E4	Param	Gasballast mode	R/W	UINT8	0, 0, 2	0 = off, 1 = on, 2 = on (continuous on, not PLC controlled)	
229	E5	Param	Flow control	R/W	UINT8	0, 0, 3	0 = 25 sccm 1 = 300 sccm (low) 2 = 3000 sccm high flow 3 = standby flow	

Command		Class	Name	R/W	Data type	Min-, Def-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
260	104	Status	State calibration	R	UINT8		Status of calibration 0 = READY 1-6 = INT CAL 11-14 = EXT CAL 15 = WAIT_ZERO_EXT 16 = MEAS_ZERO_EXT 21-24 = DYN CAL 25 = WAIT_ZERO_DYN 26 = MEAS_ZERO_DYN 31-36 = CAL Mach factor 37 = WAIT_TL_EXT_MACH 38 = MEAS_TL_EXT_MACH 39 = WAIT_ZERO_EXT_MACH 40 = MEAS_ZERO_EXT_MACH 41-44 = EXT PROOF 45-49 = INT PROOF 51 = FAIL CURRENT 52 = FAIL STATUS 53 = FAIL_TL_TO_SMALL 54 = FAIL_FACTOR 55 = WARN_FACTOR 56 = FAIL_EMIS 57 = PROOF_DEV 59 = PEAKERR 71 = START_AQ CAL 72 = START_PEAK_AQ 73 = PEAK_AQ 74 = MEAS_TL_AQ 75 = WAIT_ZERO_AQ 76 = MEAS_ZERO_AQ	
261	105	Status	PLC input state IO module	R/W	UINT16		Get PLC input state and DIP switch state IO module Bit 0 ... 9 = PLCin 1 ... 10 Bit 10 ... 15 = DIP 1 ... 6 (S1.1, S1.2, S1.3, S1.4, S2.1, S2.2) write for internal use only	

Command		Class	Name	R/W	Data type	Min-, Def-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
262	106	Status	PLC output state IO module	R	UINT8		Get PLC output state IO module Bit 0 ... 7 = PLCOut 1 ... 8	
263	107	Param	PLC output configuration IO module	R/W	SINT8[8]	Default: PLC_OUT1:-2, PLC_OUT2:-3, PLC_OUT3:-4, PLC_OUT4:-5, PLC_OUT5: 6, PLC_OUT6:-8 PLC_OUT7:-10, PLC_OUT8:-1 Min -20 Max 20	Index [0 ... 7] = PLC_OUT1 ... PLC_OUT_8 use negative values for inverted functions 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 17 = ERROR_WARNING 18 = GASBALLAST 19 = STAT_TL 20 = CAL_STABLE 21 = CATHODE2	
264	108	Status	Emission actual status	R	UINT8		Emission status: 0 = STOP 1 = START 2 = WAIT 3 = RAMP 4 = REGULATE 5 = STABLE 6 = DOWN 7 = OFF	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
274	112	Status	Last entry in cal history		UINT8		History list index of the last (newest) entry in the calibration history	
275	113	Status	Cal history		CHAR[*]		<p>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. Answer: ListNo, 'Fac:', Calfac(float), 'Leak:', Testleak(float), 'Anod:', Anodevoltage, 'M', Mass, 'XXXX', year/month/day, hour:min:sec, 'Cat:', Cathode, 'State:', cal state XXXX: VACi = VAC internal VACe = VAC external VACd = VAC dynamic VACM = VAC machine factor SNFi = Sniff internal SNFe = Sniff external SNFd = Sniff dynamic SNFM = Sniff machine factor SNFL = SL3000XL low flow SNFH = SL3000XL high flow Example: 08 Fac: 1.00E+0 Leak: 2.00E-6 Anod: 910 M2 VACe 2014/04/17 09:36:01 Cat: 1 State: 000</p>	X
277	115	Status	Last entry in error history	R	UINT8		Index of the last (newest) entry in the error history list	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
287	11F	Status	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: ListNo, 'ERR' or 'WRN', ErrNo, ErrValue(float), year/month/day, hour:min:sec, 'SwOnCnt:', SwitchOnCnt, 'OnTm:', MinSinceStart Example: 05 WRN220 2.103E+1 2014/17/04 09:37:48 SwOnCnt: 028 OnTm: 035	X
288	120	Status	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: ListNo, 'ERR' or 'WRN', >ErrNO Example: 05 WRN220	X
289	121	Status	Value of actual error	R	FLOAT		Value associated with the actual error or warning	
290	122	Status	Number of actual error	R	UINT16		Error number of the actual error or warning	
291	123	Status	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	Status	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!	X
296	128	Status	List of active errors	R	UINT16[10]		Lists the error/warning numbers since the last "clear error"	

Command		Class	Name	R/W	Data type	Min-, Def-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
297	129	Status	Present warnings	R	UINT32		Each bit represents a warning Bit 0: Warning pressure/flow Bit 1: Warning pressure rise Bit 2: Warning anode voltage Bit 3: Warning pirani Bit 4: Warning emission Bit 5: Warning suppressor Bit 6: Warning TMP Bit 7: Warning Anybus Bit 8: Warning maintenance Bit 9: Warning I/O disconnected Bit 10: Warning 5V Bit 11: Warning U24VHz Bit 12: Warning U24V Pwr12 Bit 13: Warning U24V Pwr 34 Bit 14: Warning U24V Pwr 56 Bit 15: Warning U24V8 Bit 16: Warning U24V9 Bit 17: Warning U24V10 Bit 18: Warning U24V11 Bit 19: Warning cathode voltage Bit 20: Warning temperature MSB Bit 21: Warning temp. preamplifier Bit 22: Warning calibration request Bit 23: Warning sniffer not connected Bit 24: Preamp output too low Bit 25: Warning +15V Bit 26: Warning -15V Bit 27: Warning XL flow	
298	12A	Status	Sniffer button	R	UINT8		Read state SL3000 sniffer button Bit 0 = 1: Left button pressed Bit 1 = 1: Right button pressed	
300	12C	Status	Device identification	R	UINT8[2]		Device identification, always {1,45} for MSB	
301	12D	Status	Device name	R	CHAR[*]		Get device name as ASCII string, always "MSB"	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
302	12E	Status	Sniffer probe type	R	UINT8		READ: 0 = SL3000 3 m 1 = SL3000XL 3 m 2 = Adapter 3 = Adapter XL 4 = Flussnormal 5 = Flussnormal XL 10 = SL3000 5 m 11 = SL3000XL 5 m 20 = SL3000 10 m 21 = SL3000XL 10 m 30 = SL3000 15 m 31 = SL3000XL 15 m 254 = Sniffer LDS 255 = no Sniffer	X
310	136	Status	SW-version MSB	R	UINT8[3]		Software version MSB Index [0]: Main version Index [1]: Sub version Index [2]: Debug version	
311	137	Status	SW-version probe programming master	R	UINT8[3]		SW-Version of sniffer probe (SL3000XL)	
313	139	Status	SW-version I/O module	R/W	UINT8[3]		Software version IO module Index [0]: Main version Index [1]: Sub version Index [2]: Debug version write for internal use only	
314	13A	Status	SW-version control unit	R/W	UINT8[3]		Software version control unit Index [0]: Main version Index [1]: Sub version Index [2]: Debug version write for internal use only	
315	13B	Status	SW version TMP controller	R	CHAR[6]		SW version TMP controller (character string from TMP controller)	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
316	13C	Status	HW-version TMP controller	R	CHAR[6]		HW version TMP controller (character string from TMP controller)	
317	13D	Status	TMP controller name	R	CHAR[6]		TMP controller name (character string from TMP controller)	
318	13E	Status	SW version boot loader	R	UINT8[3]		Software version of boot loader	
319	13F	Status	SW version boot loader I/O module	R/W	UINT8[3]		Software version of boot loader IO module write for internal use only	
320	140	Status	CRC-code MSB	R	UINT32		CRC-code interface board abcdwxyz (hex) abcd: caclulated value wxyz: nominal value	
321	141	Status	DIP switch MSB	R	UINT8		DIP switch setting of the MSB: Bit 7: S171, switch 4 Bit 6: S171, switch 3 Bit 5: S171, switch 2 Bit 4: S171, switch 1 Bit 3: S170, switch 4 Bit 2 ... 0: not used,always 0	
322	142	Status	Field bus status word	R	UINT16		Status word for Bus module refer to Bus module documentation	
323	143	Status	SW version bus module	R	UINT8[3]		SW version bus module	
324	144	Status	Bus module fieldbus type	R	UINT16		Bus module fieldbus type. 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	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
325	145	Status	Serial number plug-in unit bus module	R	UINT8[4]		Serial number plug-in unit bus module	
326	146	Status	Field bus address actual value	R	UINT8		Fiedbus address actual value Refer to AnybusCC specification for enumeration.	
327	147	Status	Field bus baud rate	R	UINT8		Baud rate at field bus Refer to AnybusCC specification for enumeration.	
328	148	Status	Exception code bus module	R	UINT8		Exception code bus module	
329	149	Status	Error counters bus module	R	UINT16[4]		Error counters bus module Index [0] = Discarded commands Index [1] = Discarded Responses Index [2] = Serial Reception errors Index [3] = Fragmentation errors	
330	14A	Status	Bus module state	R	UINT8		State of bus module 0 = SETUP 1 = NW_INIT 2 = WAIT_PROCESS 3 = IDLE 4 = PROCESS_ACTIVE 5 = ERROR 6 = UNKNOWN 7 = EXCEPTION	
331	14B	Param	Field bus address nominal value	R/W	UINT8	0, 126, 255	Fiedbus address nominal value Refer to AnybusCC specification for enumeration.	
333	14D	Param	Field bus profile	R/W	UINT8		Fieldbus profile: 0=HMS_default 1=INFICON	
336	150	Status	Field bus station name	R	CHAR[*]		BM1000 Station name (PROFINET IO only)	
337	151	Status	Field bus IP address	R	UINT8[4]		BM1000 IP address (IP based field busses only)	
338	152	Status	Field bus IP subnet mask	R	UINT8[4]		BM1000 IP address (IP based field busses only)	
339	153	Status	Field bus gateway IP address	R	UINT8[4]		BM1000 gateway IP address (IP based field busses only)	
340	154	Status	Field bus DHCP enabled	R	UINT8		BM1000 DHCP (IP based field busses only)	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
370	172	Param	Amp test	R/W	UINT8		0 = no test with calibration 1 = test with calibration	
371	173	Status	Run Amp test	R/W	UINT8		write: 1 = test now read: 0 = Ready 1 ... 13 test running	
380	17C	Param	Search active	R/W	UINT8	0, 0, 1	0 = Off 1 = ON trigger2 for search in HIGHFLOW SL3000XL only	
385	181	Param	Trigger [mbar*l/s]	R/W	FLOAT[4]	1E-12, 1E-5, 1E3	Trigger in mbar*l/s	
387	183	Status	Trigger status	R	UINT8		Trigger status: 0 = Leck rate < trigger level 1 = Leak rate > trigger level Bit 0 = Trigger1 Bit 1 = Trigger2 Bit 2 = Trigger3 Bit 3 = Trigger4	
390	186	Param	Test leak extern vacuum [mbar*l/s]	R/W	FLOAT[3]	1E-9, 9.9E-1, 9.9E-1	Test leak extern Vacuum [mbar*l/s] (Also valid for AQ mode) Index 0: Mass 2 Index 1: Mass 3 Index 2: Mass 4 Helium	
392	188	Param	Test leak extern sniff [mbar*l/s]	R/W	FLOAT[3]	5.0E-6, 9.9E-1, 9.9E-1	Test leak extern for sniff mode in mbar*l/s Index [0] = Mass2 forming gas 5/95 Index [1] = Mass 3 Index [2] = Mass 4 Helium	X
394	18A	Param	Testleak intern [mbar*l/s]	R/W	FLOAT	1E-9, 9.9E-1, 9.9E-1	Testleak intern in mbar*l/s	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
396	18C	Param	Display unit	R/W	UINT8[2]	0, 0, 3	[0] = VAC 0 - mbar*l/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*l/s 7 - sccm (AQ mode only) [1] = SNIFF 0 - mbar*l/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*l/s 4 - ppm 5 - g/a 6 - oz/yr	X
397	18D	Param	Display limit	R/W	UINT8[2]	0,1,15	Index [0] = lower limit [mbar/l/s] Index [1] = upper limit [mbar/l/s] 0 = normal 1 ... 15 decades higher. In sniff modes the maximum is 11. The space for operation is minimum one decade. When setting is a smaller space, the upper limit will be shifted up.	X
398	18E	Param	Language	R/W	UINT8	Def. english=9	englisch = 9 german = 7 french = 12 italian = 16 spanish = 10 portuguese = 22 russian = 25 chinese = 4 katakana = 17 Numbers according to Microsoft LCID	X
399	18F	Status	Current display limit [selcted unit]	R	FLOAT[2]		Display limit in current unit Index [0] = lower limit Index [1] = upper limit	

Command		Class	Name	R/W	Data type	Min-, Def-., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
401	191	Param	Operation mode	R/W	UINT8	0, 0, 2	0 = VACUUM 1 = SNIFF 2 = SL3000XL (SL3000XL read only)	
402	192	Param	Leak rate filter	R/W	UINT8	0, 1, 4	0 = 2-zone 1 = I-CAL 2 = Fixed 3 = I-Filter 4 = I-Filter slope suppress	
403	193	Param	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 for 2 zone filter. Below this value the averaging time is 10,24s. Above this value the averaging time is 160ms.	
404	194	Status	Serial number sniffer probe	R	CHAR[11]		Serial number of sniffer SL3000XL	X
406	196	Status	Serial number leak detector	R	CHAR[11]		Serial number of the complete leak detector	X
407	197	Status	Serial number MSB	R	CHAR[11]		Serial number of the MSB	X
408	198	Status	Serial number IO module	R/W	CHAR[11]		Serial number of the IO module	X
409	199	Param	Zero with start	R/W	UINT8	0, 0, 1	Zero with Start 0 = OFF 1 = ON	
410	19A	Param	Zero mode	R/W	UINT8	0, 0, 5	suppressed decades: 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	Param	Zero time	R/W	UINT16	5, 50, 300	Update interval for offset value if leakrate signal is negative. Resolution 0,1 s (50 = 5,0 s)	
412	19C	Param	Zero Sniffer key enable	R/W	UINT8	0, 1, 1	0 = zero key disabled 1 = zero key enabled	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
413	19D	Param	Sniffer LED alarm configuration	R/W	UINT8	0, 2, 2	Configures the behavior of the white sniffer pobe LEDs in case of trigger alarm: 0 = disabled (same Brightness as during normal measurement) 1 = on (higher brightness as during normal measurement if possible) 2 = blink	
414	19E	Param	Sniffer white LED brightness	R/W	UINT8	0, 5, 6	Configures the brightness of the white sniffer pobe LEDs in case of normal measurement: 0 = off ... 6 = max Brightness	
415	19F	Param	Flow Sniffer key enable	R/W	UINT8	0, 1, 1	0 = flow key disabled 1 = flow key enabled	
416	1A0	Param	Gas percentage	R/W	FLOAT[3]	1, 100, 100	Forming gas percentage (5 %) Index [0] = H2 Index [1] = Mass3 Index [2] = Helium	X
417	1A1	Param	Sniffer beep	R/W	UINT8	0, 1, 1	0 = Beep disabled 1 = Beep when Trigger1	
419	1A3	Param	Calibration request enable	R/W	UINT8	0, 1, 1	0 = Calibration request disabled 1 = Calibration request enabled	
429	1AD	Param	Warn active	R/W	UINT16	0, 0, 1	Bit 0: 0 = No warning 1 = Warning when calibrating in the first 20 minutes	
430	1AE	Param	Pressure unit	R/W	UINT8	0, 0, 3	Pressure unit 0 = mbar 1 = Pa 2 = atm 3 = Torr	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
431	1AF	Param	Leak rate unit vacuum	R/W	UINT8	0, 0, 3	Leak rate unit vacuum (and for AQ-mode) 0 - mbar ³ /s 1 - Pa ³ m ³ /s 2 - Atm ccs 3 - Torr ³ /s 7 - sccm (AQ-mode only)	
432	1B0	Param	Leak rate unit sniff	R/W	UINT8	0, 0, 6	Leak rate unit sniff 0 = mbarl/s 1 = Pam ³ /s 2 = Atm ccs 3 = Torr ³ /s 4 = ppm 5 = g/a 6 = oz/yr	
433	1B1	Param	Anode setpoint M2 [V]	R/W	UINT16	785, 905, 995	Anode voltage setpoint for mass 2 (hydrogen) [V]	
434	1B2	Param	Anode setpoint M3 [V]	R/W	UINT16	510, 610, 670	Anode voltage setpoint for mass 3 [V]	
435	1B3	Param	Anode setpoint M4 [V]	R/W	UINT16	390, 465, 520	Anode voltage setpoint for mass 4 (helium) [V]	
436	1B4	Param	Emission current setpoint [A]	R/W	FLOAT	1E-4, 2.5E-3, 2.8E-3	Emission current setpoint [A]	

Command		Class	Name	R/W	Data type	Min-, Def-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
438	1B6	Param	PLC input configuration IO module	R/W	UINT8[10]	Default: PLC_IN 1: 11 PLC_IN 2: 4 PLC_IN 3:-12 PLC_IN 4: 7 PLC_IN 5: 2 PLC_IN 6: 3 PLC_IN 7:9 PLC_IN 8:17 PLC_IN 9:0 PLC_IN 10: 0 Min -24 Max 24	Configuration of PLC input port of the IO module Index [0 ... 9] = PLC_IN1 ... PLC_IN10 Use negative values for inverted functions. 0 = NO_FUNCTION 1 = DYN_CAL 2 = CAL_EXTERN 3 = CAL_INTERN 4 = SNIFF_VAC 5 = START 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 17 = ZERO update 18 = open TL 19 = open/close TL with pulse 20 = XL Flow 21 = CAL MACHINE 22 = PROOF INT 23 = PROOF EXT 24 = START/STOP Pulse 25 = MASS 2_4 26 = PEAK CAL (AQ only)	
439	1B7	Param	Key switch state	R	UINT8		Key switch state 0 = inactive, 1 = active, 2 = not used Bit 0&1: KEY_1 Bit 2&3: KEY_2 Bit 4&5: KEY_3 Bit 6&7: not used	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
448	1C0	Param	Valve control location	R/W	UINT16		0 = All valves/outputs controlled by leak detector Set any bit to enable valve/output control by write command 449 See command 449 for a list of possible valves/outputs	
449	1C1	Param	Switch valves	R/W	UINT16		Bit 0 = Test leak valve Bit 1 = gas ballast valve Bit 2 = output 3 Bit 3 = output 4 Bit 4 = sniffer valve Bit 5 = output 6 To enable control by this command, see command 448	
450	1C2	Param	Date+Time [YMDhms]	R/W	UINT8[6]		Date and time use only with array-index 255 (all bytes) Index [0] = year (0 ... 99) Index [1] = month (1 ... 12) Index [2] = day (1 ... 31) Index [3] = hour (0 ... 23) Index [4] = minute (0 ... 59) Index [5] = second (0 ... 59)	X
452	1C4	Param	Min pressure sniff	R/W	FLOAT	1E-3, 4E-1, 18	Minimum pressure p1 in mbar for sniffer mode. If pressure falls below this value, warning 540 (Flow too low) is generated.	
453	1C5	Param	Max pressure sniff	R/W	FLOAT	1E-3, 2, 18	Maximum pressure p1 in mbar for sniff. If pressure rises above this value, warning 542 (Sniffer broken) is generated.	
455	1C7	Param	Min pressure XL sniff	R/W	FLOAT	100, 150, 300	XL flow (P2) too low warn 550	
456	1C8	Param	Max pressure XL sniff	R/W	FLOAT	200, 400, 600	XL flow (P2) too high warn 552	
480	1E0	Param	Auto standby interval [min]	R/W	UINT8	0, 10, 60	Auto standby interval 0 = OFF	
499	1F3	Param	Fan output TMP controller	R/W	UINT8	0, 0, 1	0 = always on 1 = temperature controlled	
501	1F5	Param	TMP rotation speed	R/W	UINT16	1000, 1500, 1500	TMP rotation speed setpoint 1000, 1500 Hz	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
502	1F6	Param	Amplifier range	R/W	UINT8	0, 3, 3	Amplifier range Amplifier control location 508 automatically set (not auto) 0 = 13 MOhm 1 = 470 MOhm 2 = 15 GOhm 3 = 500 GOhm	
504	1F8	Param	500GOhm value	R/W	FLOAT	4.5E1, 5E11, 5.5E11Ohm	500GOhm value	
506	1FA	Param	Mass	R/W	UINT8	2, 4, 4	2 = Mass 2 (H2) 3 = Mass 3 4 = Mass 4 (Helium)	
508	1FC	Param	Amplifier control location	R/W	UINT8	0, 1, 1	Amplifier control location 1 = automatic on (default) 0 = automatic off Write access only possible if "Manual control for service" is active	
519	207	Param	Cal factors sniff high flow	R/W	FLOAT[3]	0.01, 1, 100	Calibration factors for sniff mode high flow Index [0] = mass 2 Index [1] = mass 3 Index [2] = mass 4	
520	208	Param	Calibration factors vacuum	R/W	FLOAT[3]	0.01, 1, 5000	Calibration factors for vacuum mode (and for AQ-mode) Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	
521	209	Param	Calibration factors sniff	R/W	FLOAT[3]	0.01, 1, 100	Calibration factors for sniff mode Index [0] = mass 2 Index [1] = mass 3 Index [2] = mass 4	
522	20A	Param	Machine factors vacuum	R/W	FLOAT[3]	1E-4, 1, 1E5	Machine factors for vacuum mode Index [0] = mass 2 Index [1] = mass 3 Index [2] = mass 4	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
523	20B	Param	Machine factors sniff	R/W	FLOAT[3]	1E-4, 1, 1E4	Machine factors for sniff mode Index [0] = mass 2 Index [1] = mass 3 Index [2] = mass 4	
524	20C	Param	Machine factor in standby on/off	R/W	UINT8	0, 0, 1	machine factor in standby 0 = OFF, 1 = ON	
529	211	Param	Enable warning	R/W	UINT8	0, 1, 1	0 = no warning without sniffer 1 = warning without sniffer	
530	212	Param	Cathode selection	R/W	UINT8	0, 2, 4	0 = CAT1 1 = CAT2 2 = Auto Cat1 3 = Auto Cat2 4 = OFF	
1120	460	Control	Amp alternate test on	R/W	UINT8	0, 1, 1	0 = OFF, 1 = ON (Default is ON)	
1161	489	Control	Parameter reset	W	UINT8		Parameter reset: 0 = Load factory settings 10 = PARA_RESET_LDS1000_MODE 11 = PARA_RESET_LDS2010_MODE 12 = PARA_RESET_SL3000XL_MODE 14 = PARA_RESET_ACCU (only valid for LDS3000AQ)	X
1284	504	Control	Control word	R/W	UINT16		Control word (used for Bus module)	
1285	505	Control	Stop service buffer	R/W	UINT8		0 = save new information 1 = no new information	
1300	514	Meas	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)	X
1301	515	Meas	Service buffer pressure 1	R	FLOAT[150]		see command 1300	X
1302	516	Meas	Service buffer emis current	R	FLOAT[150]		see command 1300	X
1303	517	Meas	Service buffer anode voltage	R	FLOAT[150]		see command 1300	X
1304	518	Meas	Service buffer cathode voltage	R	FLOAT[150]		see command 1300	X
1305	519	Meas	Service buffer heater power	R	FLOAT[150]		see command 1300	X

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
1306	51A	Meas	Service buffer leakrate	R	FLOAT[150]		see command 1300	X
1307	51B	Meas	Service buffer TMP mode	R	UINT8[150]		see command 1300	X
1308	51C	Meas	Service buffer TMP speed	R	FLOAT[150]		see command 1300	X
1309	51D	Meas	Service buffer emission mode	R	UINT8[150]		see command 1300	X
1310	51E	Meas	Service buffer sensor 3	R	FLOAT[150]		see command 1301	X
1567	61F	Meas	Offset current amplifier [A]	R	FLOAT		Zero offset of amplifier	
1568	620	Meas	Unfiltered ion current [A]	R	FLOAT		Unfiltered ion current in A	
1573	625	Meas	Filtered ion current [A]	R	FLOAT		Filtered ion current in A	
1581	62D	Meas	Acceleration	R	UINT8[3]		Index [0] = X-value Index [1] = Y-value Index [2] = 0	
1620	654	Meas	Amplifier test currents [A]	R	FLOAT[5]		Test currents ca. 1.3E-11 A Index [0] = Offset 500G Index [1] = Current 13M Index [2] = Current 470M Index [3] = Current 15G Index [4] = Current 500G	
1621	655	Meas	Int. ADC values	R	UINT16[16]		Values of internal ADC MSB	
1755	6DB	Control	Accumulation key	W	CHAR[12]		Key for unlocking AQ mode 12 digits, always whole array	X
1758	6DE	Meas	Accumulation leak rate (raw) [mbar ³ /s]	R	FLOAT		leak rate raw signal with sign (positive / negative)	
1759	6DF	Meas	Accumulation leak rate offset [mbar ³ /s]	R	FLOAT		leak rate offset (only H2)	
1760	6E0	Status	Accumulation status	R	UINT8		Accumulation status 0 = mode is optional 1 = mode possible	
1761	6E1	Status	Accumulation runup hold time [s]	R	UINT16		Accumulation runup delay in seconds	
1763	6E3	Param	Chamber volume [l]	R/W	FLOAT		Volume of measurement chamber in liter	

Command		Class	Name	R/W	Data type	Min-, Def., Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
1765	6E5	Param	Accumulation measurement time [s]	R/W	UINT16		Accumulation measurement time [s]	
1767	6E7	Param	Accumulation zero time	R/W	UINT8		Accumulation zero time	
1800	708	Status	Active protocol IO	R	UINT8		Active interface protocol for I/O module. Defined by DIP switch at I/O module or command 2593. 0 = LD 1 = ASCII 3 = LDS2010 Binary 4 = LDS1000	
1815	717	Status	Reset source	R	UINT8		Shows the last reason of reset	
2593	A21	Param	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" 0 = LD 1 = ASCII 3 = LDS2010 Binary 4 = LDS1000	
2594	A22	Param	Compatilbly Mode	R/W	UINT8	0, 2, 3	Selected Compatibility Mode 0 = LDS1000 1 = LDS2010 2 = LDS3000 3 = SL3000	
2627	A43	Param	Pressure sensor type	R/W	UINT8[2]		Index [0]: Reserved (Not used) Index [1]: Pressure gauge p2 0 = PSG500 1 = SL3000XL adapter	
2628	A44	Param	Pressure sensor offset	R/W	FLOAT[2]		Index [0]: Offset p1 Index [1]: Offset p2 (only valid if sensor type = SL3000XL adapter)	
2629	A45	Param	Pressure sensor gain	R/W	FLOAT[2]		Index [0]: Gain p1 Index [1]: Gain p2 (only valid if sensor type = SL3000XL adapter)	
2630	A46	Param	P3 min max pressure	R/W	FLOAT[2]	0, 5E-4, 1E4	Range sensor 3 (0 ... 10 V)	

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
2632	A48	Param	P4 min max pressure	R/W	FLOAT[2]	0, 0, 1E4	Range sensor 4 (0 ... 20 mA)	
2634	A4A	Param	P3 min max voltage	R/W	FLOAT[2]	-10, 1.9, 10	Voltage range sensor 3 (0 ... 10 V)	
2636	A4C	Param	P4 min max current	R/W	FLOAT[2]	-20, 4, 20	Current range sensor 4 (0 ... 20 mA)	
2638	A4E	Param	P3 mode	R/W	UINT8	0, 1, 1	Sensor 3 mode 0 = lin, 1 = log	
2639	A4F	Param	P4 mode	R/W	UINT8	0, 0, 1	Sensor 4 mode 0 = lin, 1 = log	
2650	A5A	Param	Set suppressor voltage [V]	R/W	FLOAT		Suppressorvoltage for test	X
2660	A64	Param	Maintenance activ	R/W	UINT8	0, 1, 3	0 = off, 1 = TMP 2 = Membrane pump 3 = TMP + Membrane pump	
2661	A65	Control	Set maintenance	W	UINT8		1 = bearing/lubricant 2 = TMP novated 3 = Membrane pump	
2662	A66	Param	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: "ListNo year/month/day type". Example 3 12/06/01 bearing/lubricant	X
2663	A67	Param	Test sniffer LED	R/W	UINT8		0 = auto, 1 = Good 2 = Bad 3 = Good+Bad 4 = off	X

Command		Class	Name	R/W	Data type	Min-, Def.-, Max- value LDS3000	LDS3000 MSB	No fieldbus support
dez	hex							
2664	A68	Param	Test status LED	R/W	UINT8		0 = auto 1 = red 2 = green 3 = blue 4 = off	X
2665	A69	Param	Maintenance membrane done	R	CHAR[*]		To read send after the array index 255 the UINT8 maintenance list index (0). Without history list index you will get the last (newest) entry Entry format: "ListNo year/month/day type".	X

3.5 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 (if status word Bit 15 is set 1)

Error No.	Meaning
1	CRC-failure
2	Illegal telegram length
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

4 Fieldbus Communication

4.1 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.

Fieldbus systems normally support device-specific configuration files e.g. GSD files for the PROFIBUS field bus system.

You will find the appropriate confi

guration files on the USB memory stick which is supplied with your LDS3000.

Attention:

For the PROFIBUS field bus you can select between two different profiles:

- INFICON (IFCN0E8D.GSD file)
- HMS (HMSB1811.GSD file)

It is strongly recommended to use the INFICON profile, because the setup process in your fieldbus configuration tool (e.g. SIMATIC Manager for PROFIBUS) will be much easier.

Only use HMS profile, if you need it for backward compatibility.

4.2 Setup

- ▶ Select the “Bus modul“ at the control unit (CU1000): “Menu > Settings > Setup > Interfaces > Device sel. > Module at I/O connector”.
- ▶ Select the field bus address at the control unit (CU1000): “Menu > Settings > Setup > Interfaces > Bus Module > Address”.
- ▶ Select the desired profile (HMS or INFICON) at the control unit (CU1000): “Menu > Settings > Setup > Interfaces > Bus Module > Profile”.

Attention:

Address and profile do not come into effect until a restart of the leak detector (power off/power on)!

4.3 Process Data Mapping for Cyclic Data Transfer

4.3.1 Write Process Data (PLC → Leak Detector)

This data word (2 Bytes) is send periodically from the field bus master (e.g. programmable logic controller) to the leak detector.

PROFIBUS and PROFINET IO receive high byte first, DeviceNet and EtherNet/IP receive low byte first.

Byte	Bit	Name	Meaning	Similar to PLC Input	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
1 (high byte)	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	CAL intern	*CAL:INT	4
	5		Transition to 1: 0x10 = Start internal calibration			
	6	CAL extern	Transition to 0: 0x00 = Cancel external or dyn. calibration	CAL extern/CAL dynamic	*CAL:EXT	4
7	Transition to 1: 0x40 = Start external or. dyn. calibration Transition to 2: 0x80 = Acknowledge closed test leak					
2 (low byte)	0	Gas ballast	Transition 0 -> 1: 0x01 = Gasballast on	Gasballast		
	1		Transition 1 -> 0: 0x00 = Gasballast off (if Gasballast mode != GASBALLAST_ON)			
	2	Zero mode	0 = normal			
	3		0x04 = 1 ... 2 dec. 0x08 = 2 ... 3 dec. 0x0C = 19/20 part of the value			
	4		CAL mode			
	5	0x10 = dyn. CAL 0x20 ... 0x30 = not used				
	6	Sniff/Vac	0 = VAC	Sniff	*CONFIG:MODE	401
7	0x40 = SNIF 0x80 = according to PLC-Input 0xC0 = not used					

Data format of write process data is always the same regardless of whether you use HMS profile or INFICON profile.

The current state of this value is visible at the CU1000 control unit via:
"Menu > Info > Interfaces > Page 2, Info Bus module, value 'control word'".

4.3.2 Read Process Data (Leak Detector → PLC)

4.3.2.1 HMS profile

These 12 data bytes are send periodically from the leak detector to the field bus master (e.g. a programmable logic controller):
Attention: PROFIBUS and PROFINET IO send high byte first, DeviceNet and EtherNet/IP send low byte first.

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
1 (high byte)	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	State internal calibration	0 = inactive 0x10 = active 0x20/0x30 = not used	CAL active	*STATUS:CAL?	260
	5					
	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 (low byte)	0	Calibration 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
	1					
	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	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
	6					
7						

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
3		Leak rate (mbar l/s)	Actual leak rate in mbar l/s (IEEE 754 float value)	Recorder output (LR_LIN, LR_LOG ...)	*READ:MBAR*I/S?	129
4						
5						
6						
7		Pressure	Pressure in mbar(IEEE 754 float value)	Recorder output (P1)	*MEAS:P:MBAR?	83
8						
9						
10						
11		Actual error number	Error/warning code (16 bit unsigned integer)		*STATUS:ERROR?	290
12						

4.3.2.2 INFICON profile

These 29 data bytes are send periodically from the leak detector to the field bus master (e.g. a programmable logic controller):
Attention: PROFIBUS and PROFINET IO send high byte first, DeviceNet and EtherNet/IP send low byte first.

Title	Byte	Bit	Name	Meaning	Similar to IO1000 Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
status word	1 (high byte)	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	State internal calibration	0 = inactive 0x10 = active 0x20/0x30 = not used	CAL active	*STATUS:CAL?	260
		5					
		6	State external calibration	0 = inactive 1 = 0x40 = active 2 = 0x80 = waiting for test leak closed 3 = 0xC0 = not used	CAL active	*STATUS:CAL?	260
		7					
	2 (low byte)	0	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
		1					
		2	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
		3					
		4					
		5	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
6							
7							

Title	Byte	Bit	Name	Meaning	Similar to IO1000 Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
leak rate	3 ... 6		Leak rate (mbar ³ /s)	Actual leak rate in mbar l/s (IEEE 754 float value)	Analog output (LR_LIN, LR_LOG...)	*READ:MBAR*I/S?	129
pressure_or_flow	7 ... 10		Pressure	Pressure p1 in mbar (IEEE 754 float value)	Analog output (Pressure p1)	*MEAS:P:MBAR?	83
error_code	11 ... 12		Actual error number	Error/warning code (16 bit unsigned integer)		*STATUS:ERROR?	290
trigger_status	13	0	Status of Trigger 1	0 = Leak rate lower than trigger level 1 = Leak rate higher than trigger level	Trigger 1	*STATUS:TRIGger?	387
		1	Status of Trigger 2		Trigger 2		
		2	Status of Trigger 3		Trigger 3		
		3	Status of Trigger 4		Trigger 4		
		4 ... 7	not used	always 0			
calibration_status	14		calibration_status	For possible values please refer to command 260 in table 3.4, "Commands," page 27.	CAL active	*STATUS:CAL?	260
leak_detector ID	15		leak_detector ID	always 45 for LDS3000 MSB		*IDN:DEvice?	303
device specific float 1	16 ... 19		device specific float 1	Pressure p2 in mbar (IEEE 754 float value)		*MEAS:P2:MBAR?	133
device specific float 2	20 ... 23		device specific float 2	Pressure p3 in user specific unit (IEEE 754 float value)		*MEAS:P3?	134
device specific float 3	24 ... 27		device specific float 3	Pressure p4 in user specific unit (IEEE 754 float value)		*MEAS:P4?	135
device specific word	28 ... 29		device specific word	reserved for further use, always 0			304

4.4 Acyclic Data Transfer

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.

4.4.1 Addressing Rules for Acyclic Access

Mapping from LD command number to field bus:

Fieldbus	Rule	Example for LD_command_number 506 (Mass)
PROFIBUS	$LD_command_number = slot \cdot 255 + index + 1$ $slot = (ADI - 1) / 255$ $index = (ADI - 1) \text{ MOD } 255$	Slot = 1 index = 250
PROFINET IO	Application Process Instance (API) = 0 Slot = 0 Subslot = 1 Index = LD_command_number	API = 0 Slot = 0 Subslot = 1 Index = 506dez = 01FAhex
DeviceNet	Object number A2h (ADI object) Instance_number = LD_command_number Attribute 5 (Value)	Instance_number = 506
EthernetIP	Object number A2h (ADI object) Instance_number = LD_command_number Attribute 5 (Value)	Instance_number = 506

Fieldbus supports all commands from LD protocol, except the commands which are marked accordingly in LD command list (refer to chapter 3.4).

4.4.2 CIP Object "ADI object" (A2h)

The following text only applies to DeviceNet and Ethernet/IP:

Instance Attributes:

#	Name	Access	Type	Description
1	Name	Get	SHORT_STRING	Parameter name (Including length)
2	ABCC Data type	Get	USINT	Data type of instance value
3	No. of elements	Get	USINT	Number of elements of the specified data type
4	Descriptor	Get	USINT	Bit field describing the access rights for this instance <u>Bit: Meaning:</u> 0 Set = Get Access 1 Set = Set Access
5	Value ^a	Get/Set	Determined by attribute #2	Instance value
6	Max value ^a	Get		The maximum permitted parameter value
7	Min value ^a	Get		The minimum permitted parameter value
8	Default value ^a	Get		The default parameter value

a. Converted to/from CIP standard by the module

ABCC Data type:

#	Type	Bits	Description	Range
1	SINT8	8	Signed 8 bit integer	-128... +127
2	SINT16	16	Signed 16 bit integer	-32768... +32767
3	SINT32	32	Signed 32 bit integer	$-2^{31} \dots +(2^{31}-1)$
4	UINT8	8	Unsigned 8 bit integer	0... +255
5	UINT16	16	Unsigned 16 bit integer	0... +65535
6	UINT32	32	Unsigned 32 bit integer	0... $+(2^{32}-1)$
7	CHAR	8	Character (ISO 8859-1)	0... +255
16	SINT64	64	Signed 64 bit integer	$-2^{63} \dots +(2^{63}-1)$
17	UINT64	64	Unsigned 64 bit integer	0... $+(2^{64}-1)$
18	FLOAT	32	Floating point (IEC 60559)	$\pm 1.17549435E-38 \dots$ $\pm 3.40282347E+38$

4.5 Hardware Configuration for Profibus

4.5.1 Hardware configuration with HMS profile

HMS profile is not recommended, use INFICON profile if possible (refer to [chapter 4.1 “Preface”](#)).

Attention:

You must select HMS profile and must use HMSB1811.GSD file for this configuration.

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.

Example hardware configuration (detail from PLC configuration window):

Slot	DP ID	Order Number / Designation	I Address	Q Address	Comment
1	224	Output 1 words		1...2	
2	208	Input 1 word	1...2		
3	209	Input 2 words	3...6		
4	209	Input 2 words	7...10		
5	208	Input 1 word	11...12		

Fig. 1 Example hardware configuration (HMSB1811.GSD)

4.5.2 Hardware configuration with INFICON profile

Attention:

You must select INFICON profile and must use IFCN0E8D.GSD file for this configuration.

Slot	DP ID	Order Number / Designation	I Address	Q Address	Comment
1	224	control word		1...2	
2	208	status word	1...2		
3	209	leak rate	3...6		
4	209	pressure_or_flow	7...10		
5	208	error code	11...12		
6	144	trigger status	13		
7	144	calibration status	14		
8	144	leak detector ID	15		
9	209	device specific float 1	16...19		
10	209	device specific float 2	20...23		
11	209	device specific float 3	24...27		
12	208	device specific word	28...29		

Fig. 2 Example hardware configuration (detail from PLC configuration window)

4.5.3 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 of 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". You will find this document on the USB memory stick which is supplied with your LDS3000.

4.5.4 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".

4.6 Hardware Configuration for PROFINET

4.6.1 Hardware Configuration with INFICON profile

Attention:

You must select INFICON profile and must use the GSDML-V2.3-Inficon-BM1000_PROFINET-20131206.XML file. In addition you must put the INFICON Bitmap File GSDML-0282-03E8-INFICON-BM1000.BMP in the same folder as the xml file.

Slot	Module	Order number	I address	Q address	Diagnostic address:	Comment
0	BM1000	560-316			2041*	
X1	Interface				2040*	
P1	Port 1				2039*	
P2	Port 2				2038*	
1	Ausgang 1 word			1...2		
2	Eingang 1 word		1...2			
3	Eingang 2 word		3..6			
4	Eingang 2 word		7..10			
5	Eingang 1 word		11..12			
6	Eingang 1 byte		13			
7	Eingang 1 byte		14			
8	Eingang 1 byte		15			
9	Eingang 2 word		16..19			
10	Eingang 2 word		20..23			
11	Eingang 2 word		24..27			
12	Eingang 1 word		28..29			
13						
14						

Fig. 3 Sequence of the data words (slots) for PROFINET

4.6.2 Assignment of the PROFINET address

The PROFINET address can only be assigned via the hardware configuration tool of the PLC. To assign the PROFINET IP address via hardware configuration tool of the PLC, please refer to the documentation of the PLC.

5 LDS1000 Protocol

5.1 Interface Parameters

NOTICE

Do not use this protocol for new developments. It has limited functional range and may not be supported in future.

NOTICE

Commands from the LDS1000/LDS2010 manual, which are not listed here, are not supported. If your PLC uses LDS1000 protocol commands, which are not listed here, you may need to adjust your PLC program.

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 LDS1000 protocol are:

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

5.2 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 5.2.1.

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 5.2.2.

Measurement quantities can be queried through the command "G" for "Get", for example: "G1<cr>". The LDS3000 will then respond by outputting the current leak rate. All measurement quantities which may be queried are listed in Chapter 5.2.3.

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 5.2.4.

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 5.2.5.

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 LDS1000 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>" (Note: Some terminal programs may not display character "0" when local echo is on.). Thereafter, the interface is ready to receive. Through this character it is easily possible to check whether or not the data link has been properly installed.

5.2.1 Main functions

Command	Meaning	Reply from leak detector
LR	Leak rate, date, time, output status	
START	Start measurement mode, suppress the background which was measured upon operating START	OK
STOP	Stop the measurement mode, display the current background level	OK
ZERO	ZERO mode on, suppress the background which was measured upon operating ZERO	OK
ZERO OFF	ZERO mode off, display the background which was measured upon operating ZERO	OK
CAL	In STANDBY mode: Start internal calibration In MEASURE mode: Start external calibration	OK
CLEAR	Interrupt calibration/erase error status	OK

Example sequence of commands for external calibration:

	Command	Reply from the LDS3000	Meaning
1	START	OK	The leak detector 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 leak detector is in the measurement mode, the instrument is running in the MEASUREMENT mode.

The internal calibration process runs automatically. After calibration, the LDS3000 will be in the STANDBY mode.

5.2.2 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)	xxxxxxx (always 8 characters) (Byte 0 right) Byte 0 0 = VAC 1 = SNIF Byte 1 always 0 Byte 2 0 = STANDBY 1 = MEASURE Byte 3 0 = CAL inactive 1 = CAL active Byte 4 refers to external calibration, 0 = STANDARD 1 = DYNAMIC Byte 5 -- Byte 6 ACCELERATION BYTE 7 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

	Meaning	Representation
S4	Exceeding of measurement range limits (leak rate)	Useful when leak rates are queried 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 error/warning > 0 = error number (not yet acknowledged). If the error is no longer present, the message may be erased through "CLEAR".
S12	External CAL status	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.
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°)
Service information, may be subject in case of further questions or in case of an error.		
S30	software version	e.g.:1.00
S31	Serial number	xxxxxxxxxxxxxxxx
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 control inputs	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

	Meaning	Representation
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
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.

5.2.3 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

5.2.4 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. For example, "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 = SNIF
U4	Select operating mode This setting is not saved when switching the mains power off.	0 = VAC 1 = SNIF
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
Q/U14	Correction factor for SNIF	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

Command	Meaning	Representation
Q/U24	Unit (unit of measurement for pressure and leak rate in VAC and SNIF) ppm and g/a is not available for VAC	0 = mbar and mbar l/s 1 = Pa and Pa m ³ /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
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	

5.2.5 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
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)

6 Binary Interface Protocol

6.1 Communication Parameters

NOTICE

Do not use the this protocol for new developments. It has limited functional range and may not be supported in future.

NOTICE

Commands from the LDS1000/LDS2010 manual, which are not listed here, are not supported. If your PLC uses LDS1000 protocol commands, which are not listed here, you may need to adjust your PLC program.

Data format

19200 baud, 8 data bits, no parity, 1 stop bit

6.2 Data Format

float	4 Bytes, IEEE754 ($\pm 10^{\pm 38}$), 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)

6.3 Commands

In binary protocol the command to the leak detector always starts with STX (0x05). It is followed by a byte which indicates the length of the telegram (inclusive Start-Byte and checksum). The next byte is the command number. The command byte may be followed by additional information (parameter and/or data). Please refer to table "Commands" for detailed information about command number, parameter and data format.

Every telegram ends with a checksum. The checksum is the sum of all bytes before the checksum byte modulo 256 (decimal). The leak detector replies to every valid command with an acknowledgement. This answer starts with the length byte followed by the command number, additional data (optional) and the checksum.

In case of an error, the leak detector answers with an error byte instead of the command number (refer to chapter "Error Messages").

Timeout to receive data between 2 sign is: 1000 ms.

No.	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		45dec.
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 = VAC 1 = SNIF	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 = inactive 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)
56 57	GetTrigger SetTrigger	Set/read trigger	Byte 0: 1 ... 4 for Trigger 1 ... 4 Byte 1: Unit: 0 = mbar l/s 1 = Pa m³/s 2 = atm cc/s 3 = Torr l/s In sniff mode additional 4 = ppm 5 = g/a	[float]: Trigger value
58 59	GetOpMode SetOpMode	Set/read operation mode		0 = VAC 1 = SNIF
60 61	GetStBy SetStBy	Stand-By read/set		0 = Stand-By 1 = measurement

No.	Name	Description	Parameter	Data
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-SNIF Byte 1: Unit 0 = mbar l/s 1 = Pa m ³ /s 2 = atm cc/s 3 = Torr l/s In sniff mode additionally: 4 = ppm 5 = g/a	5 [float]: value calibrated leak (Int.. cal : 1E-15mbar l/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 m ³ /s 2 = atm cc/s 3 = Torr l/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 = Emission off
74	GetOpHours	Read operating hours		[unit; h];
76	GetSWVersionNr	Read software version		Byte 0: Main-Version; Byte 1: Sub-Version
78 79	GetFacMachine SetFacMachine	Read / set machine factor		[float]
82 83	GetZeroMode SetZeroMode	Choice zero function		0 = 2-3 Decades; 1 = 1-2 Decades; 2 = 19/20 of value; 3 = 2 Decades; 4 = 3-4Decades 5 = complete value
84 85	GetFacSniff SetFacSniff	Read sniff factor		[float]

No.	Name	Description	Parameter	Data
92 93	GetUnit SetUnit	unit read/set		Byte 0: LR-VAC Byte 1: LR-SNIF Byte 2: pressure 0 = mbar / mbar l/s 1 = Pa / Pa m ³ /s 2 = atm / atm cc/s 3 = Torr / Torr l/s only for LR-sniff: 4 = ppm 5 = g/a
99	GetLr	Leak rate	Unit 0 = mbar l/s, 1 = Pa m ³ /s 2 = atm cc/s 3 = Tor l/s In sniff mode additionally: 4 = ppm, 5 = g/a)	[float]

Example 1: Set trigger level 2 to 1.2E-7 mbar l/s

PC → Leak detector

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

Leak detector → PC

3	57	60
0x03	0x39	0x3C
Length	Command	Checksum

Example 2: Get trigger level 2 in mbar l/s

PC → leak detector

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

leak detector → PC:

7	57	52	0	217	89	166
0x07	0x39	0x34	0x00	0xD9	0x59	0xA6
Length	Command	Data	Data	Data	Data	Checksum
		1.2E-7 (4-Byte float)				

6.4 Error messages

232	Command temporary not allowed (for example starting calibration during run-up)
240	Command does not exist
243	Wrong telegram length
244	Parameter not in valid range
252	First character wrong (not 0x05)
253	Transmitted and calculated checksum not equal
254	Timeout (Transmission of a command not completed within 500 msec)
255	Buffer overflow (Overflow of the receive buffer)

7 Trouble Shooting

7.1 Serial communication via RS232 (common)

Error	Possible Reason	Solution
No characters are received via the interface/the leak detector 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 leak detector 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 leak detector and PC/PLC match)
	Wrong protocol selected in the leak detector	Select correct protocol in the leak detector
	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 leak detector 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 leak detector	Select correct protocol in the leak detector

7.2 ASCII Protocol specific

Error	Possible Reason	Solution
IO1000 does not reply/leak detector 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)
leak detector replies with error message to the first command only, following commands are interpreted correctly	Receiving buffer of the leak detector was not empty before sending the first command (e.g. by plugging in the RS232 cable during operation)	In the ASCII protocol the leak detector 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

7.3 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 XXhex XXhex 00hex 00hex XXhex
IO1000 replies 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.

