Protocol Descriptions

LDS800/LDS3000/LDS3000 AQ/XL3000flex

I/O-Modul, Bus-Modul

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1 Interface Protocol

NOTICE

A write command may cause write access to the internal EEPROM of the device. This also applies to commands that write the same value that is already stored in the EEPROM.

Since the EEPROM has a limited write cycle endurance, unnecessary write commands should be avoided.

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

1.1 Serial Interface Protocols

With the IO1000 module you can communicate with the LDS800 or LDS3000 or XL3000flex 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). A list of all error messages, can be found in chapter "Error Messages [▶ 31]". The transmission can be cancelled and the receive-buffer will be cleared with ESC (ASCII code 27dec/1Bhex), ^C (ASCII code 3dec/03hex) or ^X (ASCII code 24dec/18hex).

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

Parameter can be Boolean or numerical:

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

Error due to incorrect format

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.

► Always use a point as the decimal marker.

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	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		R/W
*CONFig:AQ:TIME	Accumulation measurement time in seconds. LDS3000AQ only.	1765	R/W
*CONFig:AQ:VOLume	Volume of measurement chamber in liter. LDS3000AQ only.	1763	R/W
*CONFig:AQ:ZEROTime	Accumulation zero time as multiple of measurement time. LDS3000AQ only.	1767	R/W
*CONFig:BEEP	SL3000 sniffer beep (OFF, TRIGGER, SEARCH). LDS3000(AQ)/XL3000flex only.	417	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:BRIGHTness	Brightness off sniffer LED 0 … 6. LDS3000(AQ)/XL3000flex only. **The notation LDS3000(AQ) always means: Applies to LDS3000 and LDS3000 AQ**	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). LDS3000(AQ)/XL3000flex only.	412	R/W
*CONFig:CALleak:EXTSniff	External test leak of current mass in sniff mode in current sniff unit. LDS3000(AQ)/XL3000flex only.	392	R/W
*CONFig:CALleak:EXTVac	external test leak of current mass in vacuum mode in current vac unit	390	R/W
*CONFig:CALleak:INT	internal test leak [mbar*l/s]	394	R/W
*CONFig:CALLOCKWarmup	No Cal first 20 min	2667	R/W
*CONFig:CALREQ	calibration request (OFF,ON);with read: (OFF, ON_REQUESTED, ON_NOTREQUESTED)	419	R/W
*CONF:CALWarn	Warning 650 during Cal in first 20 minutes: (ON, OFF)	429	R/W
*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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:COMP	Compatibility mode (LDS1000, LDS2010, LDS3000, SL3000, AQ). AQ mode is only possible if it is unlocked. LDS800 only supports "LDS3000" mode. When switching mode all parameters are set to the default of the new selected mode.	2594	R/W
*CONFig:CORSTDBY	correction of leak rate in stand by (OFF, ON)	524	R/W
*CONFig:DECADEZero	zero function "NORM","1-2","2-3", "19/20", "2", "3-4","EcoBoost"	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:EQUIMOLMass	Mol mass in g/mol of equivalence gas for current used mass.	470	R/W
*CONFig:EQUIMOLMass:M2	Mol mass in g/mol of equivalence gas for mass 2.	470	R/W
*CONFig:EQUIMOLMass:M3	Mol mass in g/mol of equivalence gas for mass 3.	470	R/W
*CONFig:EQUIMOLMass:M4	Mol mass in g/mol of equivalence gas for mass 4.	470	R/W
*CONFig:ERRor:AMPAlter	Amplifier alternating error (ON, OFF)	1120	R/W
*CONFig:FILTer	Leak rate filter "2ZONE","ICAL","FIXED","I_FIL", "I_FIL2"	402	R/W
*CONFig:HFButton	Right SL3000 sniffer button to switch flow (OFF,ON). LDS3000(AQ)/XL3000flex only.	415	R/W
*CONFig:HIghflow	SL3000 high flow mode OFF: Disable high flow ON: Enable high flow LDS3000(AQ)/XL3000flex only.	229	R/W
*CONFig:LANGuage	Language (ENGlish, DEUtch, FRAncais, ITAliano, PORtugues, ESPanol, KATakana, CHInese, RUSsian)	398	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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 LDS3000(AQ)/XL3000flex only.	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) LDS3000(AQ)/XL3000flex only.	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) LDS3000(AQ)/XL3000flex only.	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 LDS3000(AQ)/XL3000flex only.	403	R/W
*CONFig:MAINTenance	"Confirm the maintenance carried out BEARING, TMP, MEMBRANE	2661	W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:MASS	mass (2 (H2), 3, 4 (Helium)	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" and "AQ" operating modes are read only. LDS800 supports "VAC" operating mode only.	401	R/W
*CONFig:PERcent	Gas percentage 1…100 % LDS3000(AQ)/XL3000flex only.	416	R/W
*CONFig:PHOTOINTMode	CalMate mode: "PROOF_CAL, CAL, PROOF" LDS3000(AQ)/ XL3000flex only.	479	R/W
*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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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, CAL_REQUEST, RUN_UP, ZERO_ACTIVE, EMISSION_ON, MEASURE, STANDBY, SNIFF, ERR/WARN, GAS_BALLAST, INT_LEAK, CAL_STAB, CATHODE2, ZERO_STABLE (only with EcoBoost).	263	R/W
*CONFig:PLCOUTLINK:n	n = 2 … 8 see CONFig:PLCOUTLINK:1	263	R/W
*CONFig:PRESSACCUHigh	Max pressure accumulation mode [mbar]	533	R/W
*CONFig:PRESSACCULow	Min pressure accumulation mode [mbar]	532	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) LDS3000(AQ)/XL3000flex only.	455	R/W
*CONFig:PRESSXLLow	Pressure for lower XL-flow limit (mbar) LDS3000(AQ)/XL3000flex only.	456	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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 (in mbar*l/s) for analog out	224	R/W
*CONFig:RS232	Protocol (LD, ASCII,ANYBUS,BINARY, LDS1000, TUNNEL, read only: SNIFF)	26	R/W
*CONFig:SEARch	Search with Trigger2 in HIGH flow (ON, OFF) LDS3000(AQ)/XL3000flex only.	380	R/W
*CONFig:SNIFFERWARN	OFF = no warning if sniffer not connected ON = warning (warning No. 130) if sniffer not connected LDS3000(AQ)/XL3000flex only.	529	R/W
*CONFig:SPEEDTMP	rotation speed of TMP in Hz	501	R/W
*CONFig:STANDBYDel	Auto standby time in minutes 1…60, 0=OFF. LDS3000(AQ)/XL3000flex only.	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:TRIGger1:SCCM	trigger1 in sccm		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		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		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		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) LDS3000(AQ)/XL3000flex only.	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)	396	R/W
*CONFig:UNIT:VACuum	Display unit vacuum (incl. CU1000 display)	396	R/W
*CONFig:WARNTOError	Warnings shown as errors	361	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 for currently used mass. LDS3000(AQ)/XL3000flex only.	521	R/W
*FACtor:CALSXL	calibration factor sniff XL flow for currently used mas. LDS3000(AQ)/XL3000flex only.	519	R/W
*FACtor:CALVac	Calibration factor vacuum for currently used mass.	520	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*FACtor:EQUISNIFF	Equivalence gas factor for sniff operation mode for current used mass. LDS3000(AQ)/XL3000flex only.	469	R/W
*FACtor:EQUISNIFF:M2	Equivalence gas factor for sniff operation mode for mass 2. LDS3000(AQ)/XL3000flex only.	469	R/W
*FACtor:EQUISNIFF:M3	Equivalence gas factor for sniff operation mode for mass 3. LDS3000(AQ)/XL3000flex only.	469	R/W
*FACtor:EQUISNIFF:M4	Equivalence gas factor for sniff operation mode for mass 4. LDS3000(AQ)/XL3000flex only.	469	R/W
*FACtor:FACMachine	Machine factor for currently used mass.	522	R/W
*FACtor:FACSniff	Sniff factor for currently used mass. LDS3000(AQ)/XL3000flex only.	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
*IDN:BMVersion	software version Bus module	323	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*IDN:BOOTversion	Software version bootloader main board	318	R
*IDN:CRC	check sum	320	R
*IDN:CUOSBUILDDATE	Control unit OS build date	357	R
*IDN:CUOSVERSION	Control unit OS software version	308	R
*IDN:CUSERIAL	Serial number control unit	350	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:IOBOOTversion	software version boot loader I/O module	319	R
*IDN:IOSERIAL	Serial number I/O module	408	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 LDS3000(AQ)/XL3000flex only.	311	R
*IDN:TCHARDware	Hardware version of the TMP frequency converter		
*IDN:TCNAME	Turbo converter type		

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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:ANALOGIN	Analog input voltage of I/O-module [V]		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
*MEASure:DIGITALIN	state of the PLC inputs as 16-bit binary number; inactive=0, active=1 Byte 0, Bit 0: PLC In 1 Byte 0, Bit 1: PLC In 2 Byte 0, Bit 2: PLC In 3 Byte 0, Bit 3: PLC In 4 Byte 0, Bit 4: PLC In 5 Byte 0, Bit 5: PLC In 6 Byte 0, Bit 6: PLC In 7 Byte 0, Bit 7: PLC In 8 Byte 1, Bit 0: PLC In 9 Byte 1, Bit 1: PLC In 10 Byte 1, Bit 2: DIP_1 Byte 1, Bit 3: DIP_2:	261	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
	Byte 1, Bit 4: DIP_3: Byte 1, Bit 5: DIP_4 Byte 1, Bit 6: DIP_5		
*MEASure:DIGITALOUT	state of the PLC outputs as 16-bit binary number; inactive=0, active=1	262 362	R
*MEASure:IEMIS	Emission current [A]	171	R
*MEASure:IFilter	Filtered ion current [A]	1573	R
*MEASure:IMeas	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:LRMAX	Maximum leak rate since last query via interface in selected unit	188	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:OFFset	Offset current [A]	1567	R
*MEASure:P1	p1 pressure in selected unit	130	R
*MEASure:P1:ATM	p1 pressure in atm		R
*MEASure:P1:MBAR	p1 pressure in mbar	131	R
*MEASure:P1:PA	p1 pressure in Pa		R
*MEASure:P1:TORR	p1 pressure in Torr		R
*MEASure:P2	P2 pressure in selected unit	132	R
*MEASure:P2:ATM	p2 pressure atm		R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*MEASure:P2:MBAR	p2 pressure in mbar	133	R
*MEASure:P2:PA	p2 pressure in Pa		R
*MEASure:P2:TORR	p2 pressure in Torr		R
*MEASure:P3	P3 pressure. For service only. LDS3000(AQ)/XL3000flex only.	134	R
*MEASure:P4	P4 pressure. For service only. LDS3000(AQ)/XL3000flex only.	135	R
*MEASure:PHEAT	Cathode heating power [W]	207	R
*MEASure:PREAMPOFFset	Preamplifier offset [A]		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] LDS3000(AQ)/XL3000flex only.	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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 in Atm*cc/s		R
*READ:G/a	leak rate in grams per year (only in sniff)		R
*READ:MBAR*l/s	leak rate in mbar*l/s	129	R
*READ:PA*m3/s	leak rate in Pa*m3/s		R
*READ:PPM	leak rate in parts per million (only in sniff)		R
*READ:SCCM	leak rate in sccm (only in AQ-mode)		R
*READ:TORR*l/s	leak rate in Torr*l/s		R
*RST:AQ	Sets all parameters to factory default for use with AQ-Mode (Accu-Mode)	1161	W
*RST:CALHistory	Clears calibration history	1161	W
*RST:ERRORHistory	Clears error history	1161	W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*RST:FACTORY	Sets all parameters to factory default	1161	W
*RST:SL3000	Sets all parameters to factory default for use with SL3000		W
*SERVICE:EMISsion	Emission ON, OFF	9	R/W
*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 leak detector (ERROR, RUNUP, EMISSION, CAL_ACTIVE, STANDBY)	Status word	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" LDS3000AQ only.	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 (only AQ))	260	R
*STATus:CALDETAIL	Detailed status of calibration as number	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*STATus:CHANGEDReason	Comma separated list of all set reason changed bits. (MASS, OP_MODE, SETPOINT_1, SETPOINT_2, LR_UNIT, DISP_LIM, LANGUAGE, FLOW_XL, GAS_PERCENT, EQUI_FAC_SNIFF,EQUI_MOL_MASS) "NO_VALUE_CHANGED" if no bit is set.		
*STATus:EMISsion	Emission status: STOP, START, WAIT, RAMP, REGUL, STABLE, DOWN, OFF	264	R
*STATus:ERRHist	Actual error history entr 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"	287	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
*STATus:PREAMPRESistor	currently used resistance of pre-amplifier (13M, 470M, 15G, 500G, 13M_FIXED, 470M_FIXED, 15G_FIXED,500G_FIXED)	502	R
*STATus:RESETSource	Source for last device reset: POWER_ON, LOW_POWER, WINDOW_WATCHDOG, INDEPENDENT_WATCHDOG, SOFTWARE and/or NRST_PIN	1815	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*STATus:SNkey	Status of sniffer key. 0 = not pressed 1 = left key pressed, 2 = right key pressed, 3 = both keys pressed	298	R
*STATus:STABLE	Status of EcoBoost "STABLE", "UNSTABLE" use *ZERO:ON with EcoBoost only if "STABLE"	493	R
*STATus:SWITCHONCnt	Switch on counter	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	387	R
*STATus:VALUEChanged	Value changed flag	1565	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	status of Test leak valve (ON, OFF)	12	R/W
*STATus:WARNINGBits	Warning-Bits which indicate pending warnings. See table "Present warnings"	297	R
*STATus:ZERO	Zero (ON, OFF)	6	R
*STOp	stop	2	W
*ZERO	switch zero on	6	W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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

Command	Meaning	
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 "Status Word [▶ 36]"
Cmd H/L	Command	Bit 15 ... 13: Command-specifier Read/Write etc. see "Commands [▶ 38]" Bit 12: free Bit 11 ... 0: Command see "Commands [▶ 38]"
DATA	Data belonging to master request (Slave reply to write command is sent without data)	0 ≤ n ≤ 248 If I/O module (7-byte additional header) is used, then limit maximum data length to 241.
CRC	Checksum	Calculate CRC for all bytes (except CRC byte) Polynomial: 0x98, Name: DOWCRC, Maxim/Dallas, $X^8+X^5+X^4+1$ Info: CRC calculation see 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 "Telegram structure [▶ 32]"
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 can be found in Chapter "Commands [▸ 11]": 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 Meaning of the "nonvolatile" column

See the table in the following chapter.

N/A	not applicable
no	Parameter value is not stored in non-volatile memory
yes	Parameter value is stored non-volatile in the EEPROM of the basic unit
yes (xxx)	Parameter value is stored non-volatile in unit "xxx" (for exampleTMP = TMP controller, RTC = realtime clock etc.)

3.5 Commands

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
0	0	NOP	R	N/A	NO_DATA	"No operation", replies without data	X
1	1	Start	W	N/A	NO_DATA	Switch from "standby" to "measure"	
2	2	Stop	W	N/A	NO_DATA	Switch from "measure" to "standby"	
4	4	Start calibration	W	N/A	UINT8	Start calibration: 0 = internal 1 = external 2 = dynamic 3 = machine/sniff factor 4 = proof internal 5 = proof external 7 = peak adjust AQ	
5	5	Clear error	W	N/A	NO_DATA	Clear Error or Warning	
6	6	Zero	R/W	no	UINT8	0 = Zero "Off" 1 = Zero "On" respectively update zero value	
9	9	Emission nominal status	R/W	no	UINT8	Emission nominal status 0 = off 1 = on	
10	A	TMP nominal status	R/W	no	UINT8	TMP nominal status 0 = off 1 = on	
11	B	Calibration acknowledge	W	N/A	UINT8	1 = Continue calibration 0 = cancel calibration	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
12	C	Open/close int. testleak	R/W	no	UINT8	0 = close 1 = open incl. Emission monitoring (less sensitive) internal calibration will overwrite the state	
18	12	Mute beep	R/W	no	UINT8	Mute SL3000 Beep 0=Beep on 1=Beep muted	
120	78	Proof int testleak [mbarl/s]	R	no	FLOAT	Result of proof function	
128	80	Leak rate [sel. unit]	R	no	FLOAT	Leak rate in selected unit	
129	81	Leak rate [mbar*l/s]	R	no	FLOAT	Leak rate in mbar*l/s	
130	82	Internal pressure 1 [sel. unit]	R	no	FLOAT	Pressure p1 in selected unit	
131	83	Internal pressure 1 [mbar]	R	no	FLOAT	Pressure p1 in mbar	
132	84	Internal Pressure 2 [sel. unit]	R	no	FLOAT	Pressure p2 in selected unit	
133	85	Internal Pressure 2 [mbar]	R	no	FLOAT	Pressure p2	
134	86	Pressure sensor 3	R	no	FLOAT	p3 sensor (0...10 V). Config via commands 2630,2634,2638 LDS3000(AQ)/XL3000flex only	
135	87	Pressure sensor 4	R	no	FLOAT	p4 sensor (0...20 mA) Config via commands 2632,2636,2639 LDS3000(AQ)/XL3000flex only	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
138	8A	TMP actual rotation speed [Hz]	R	no	UINT16	TMP actual rotation speed	
139	8B	TMP power [W]	R	no	FLOAT	TMP power in Watt as reportet by TMP controller	
140	8C	TMP operation hours [h]	R	yes (TMP)	UINT32	TMP operation hours	
141	8D	Frequency converter operation hours [h]	R	yes (TMP)	UINT32	Frequency converter operation hours [h]	
142	8E	Leak detector operation hours	R	yes	UINT32	Leak detector operation hours	
143	8F	TMP temperature bottom [deg. C]	R	no	FLOAT	TMP temperature bottom [deg. C] (Pfeiffer TMP only)	
144	90	TMP temperature electronic [deg. C]	R	no	FLOAT	TMP temperatur electronic [°C]	
145	91	TMP temperature bearing [deg. C]	R	no	FLOAT	TMP temperatur bearing [°C]	
146	92	TMP temperature motor [deg. C]	R	no	FLOAT	TMP temperatur motor [°C]	
147	93	Time since power on [min]	R	no	UINT32	Time since power on [min]	
148	94	Cathode1 operation hours		yes	UINT32	Cathode1 operation hours	
149	95	Cathode2 operation hours		yes	UINT32	Cathode2 operation hours	
150	96	TMP voltage [V]	R	no	FLOAT	TMP voltage as reported by TMP controller	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
151	97	TMP current [A]	R	no	FLOAT	TMP current as reported by TMP controller	
157	9D	Switch on counter	R	yes	UINT16	Counts the switch on cycles	
165	A5	Electronic temperature [deg. C]	R	no	FLOAT	MSB temperature [°C]	
166	A6	Preamplifier temperature [deg. C]	R	no	FLOAT	Preamplifier temperature [°C]	
167	A7	Anode voltage [V]	R	no	FLOAT	Anode voltage [V]	
168	A8	Cathode voltage [V]	R	no	FLOAT	Cathode voltage [V]	
169	A9	Suppressor voltage [V]	R	no	FLOAT	Suppressor voltage [V]	
170	AA	Anode-cathode voltage [V]	R	no	FLOAT	Anode-cathode voltage [V]	
171	AB	Emission current [A]	R	no	FLOAT	Emission current [A]	
172	AC	Heater input [V]	R	no	FLOAT	DAC Heater [V]	
200	C8	24 V supply [V]	R	no	FLOAT	24 V supply voltage for heater, processor, preamplifier in V	
202	CA	Pre amplifier voltage [V]	R	no	FLOAT	Pre amplifier voltage [V]	
205	CD	Analog inputs IO module [V]	R/W	N/A	FLOAT[3]	Analog input voltage IO1500 in [V] write for internal use only	
206	CE	Heater voltage [V]	R	no	FLOAT	Heater voltage in V	
207	CF	Heater power [W]	R	no	FLOAT	Heater power in W	
209	D1	24 V power out TMP [V]	R	no	FLOAT	24 V TMP, MSB Pin C30 voltage	
210	D2	+15 V supply [V]	R	no	FLOAT	+15 V voltage	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
211	D3	-15 V supply [V]	R	no	FLOAT	-15 V voltage	
212	D4	24 V power out RC [V]	R	no	FLOAT	24 V output voltage for remote control port, MSB Pin A30	
213	D5	24 V supply IO [V]	R/W	no	FLOAT	24 V IO-Modul supply voltage [V] write for internal use only	
214	D6	24 V power out pirani [V]	R	no	FLOAT	24 V output voltage for pirani, MSB Pin C31	
215	D7	24 V power out12 [V]	R	no	FLOAT	24 V output voltage 1,2 for RC. MSB Pin C27	
216	D8	24 V power out34 [V]	R	no	FLOAT	24 V output voltage 3,4 MSB Pin C21	
217	D9	24 V power out56 [V]	R	no	FLOAT	24 V output voltage 5,6 MSB Pin B31	
218	DA	+5 V supply [V]	R	no	FLOAT	+5 V supply voltage	
219	DB	24V power out IO [V]	R	no	FLOAT	24 V output voltage for IO-Modul, MSB Pin B30	
220	DC	Analog input IO module [V]	R/W	no	FLOAT	Analog input voltage IO module in [V] write for internal use only	
221	DD	Analog outputs IO [V]	R/W	no	FLOAT[2]	Analog output voltage for IO module in [V] It is possible to write an arbitrary voltage value, if the "Analog output configuration" (command 222) of the accordant channel is set to 8	
222	DE	Analog output configuration IO module	R/W	yes	UINT8[2]	Function of analog output Index 0: Channel 1 Index 1: Channel 2 Functions see table "Analog output configuration"	
223	DF	Analog output leak rate scale (log. only)	R/W	yes	UINT8	Leak rate scaling of analog output in logarithmic mode Functions see table "Analog output leak rate scale (log. only)"	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
224	E0	Analog output upper exponent	R/W	yes	SINT8	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	
226	E2	Leakrate limits vac	R/W	yes	FLOAT[2]	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	Leakrate limits sniff	R/W	yes	FLOAT[2]	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 LDS3000(AQ)/XL3000flex only	X
228	E4	Gasballast mode	R/W	yes	UINT8	0 = off, 1 = on, 2 = on (continuous on, not PLC controlled)	
229	E5	Flow control	R/W	yes	UINT8	0 = 25 sccm 1 = 300 sccm (low) 2 = 3000 sccm high flow 3 = standby flow LDS3000(AQ)/XL3000flex only	
260	104	State calibration	R	no	UINT8	Status of calibration See table "State calibration"	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
261	105	PLC input state IO module	R/W	no	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	
262	106	PLC output state IO module	R	no	UINT8	Get PLC output state IO module Bit 0 … 7 = PLCOut 1 … 8	
263	107	PLC output configuration IO module	R/W	yes	SINT8[8]	Index 0...7 = PLC_OUT1 ... PLC_OUT_8 See table "PLC output conf."	
264	108	Emission actual status	R	no	UINT8	Emission status: 0 = STOP 1 = START 2 = WAIT 3 = RAMP 4 = REGULATE 5 = STABLE 6 = DOWN 7 = OFF	
274	112	Last entry in cal history		yes	UINT8	History list index of the last (newest) entry in the calibration history	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
275	113	Cal history		yes	CHAR[*]	Text of calibration in the history list. To read send after the array index 255 the UINT8 history list index (0...9). Without history list index, you will get the last (newest) entry. Entry format: see enumerations table	X
277	115	Last entry in error history	R	yes	UINT8	Index of the last (newest) entry in the error history list	
287	11F	Error history	R	yes	CHAR[*]	Text of an error/warning in the history list. To read send after the array index 255 the UINT8 history list index (0...15). Without history list index, you will get the last (newest) entry. Entry format: see enumerations table	X
288	120	TMP error history	R	yes (TMP)	CHAR[*]	Text of an error/warning in the TMP history list. To read send after the array index 255 the UINT8 history list index (1...10). Entry format: see enumerations table	X
289	121	Value of actual error	R	no	FLOAT	Value associated with the actual error or warning	
290	122	Number of actual error	R	no	UINT16	Error number of the actual error or warning	
291	123	List of signal values of active errors	R	N/A	FLOAT[10]	Lists the signal values of the errors/warnings since the last "clear error"	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
294	126	Text of error number	R	N/A	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	List of active errors	R	no	UINT16[10]	Lists the error/warning numbers since the last "clear error"	
297	129	Present warnings	R	no	UINT32	Each bit represents a warning. See table "Present warnings"	
298	12A	Sniffer button	R	no	UINT8	Read state SL3000 / SL200 sniffer button Bit 0 = 1: SL3000 left Button or SL300 button pressed Bit 1 = 1: SL3000 right button pressed LDS3000(AQ)/XL3000flex only	
300	12C	Device identification	R	N/A	UINT8[2]	Device identification: {1,45} for LDS3000/LDS3000AQ/XL3000flex {1,42} for LDS800 {4,45} for OEM version	
301	12D	Device name	R	N/A	CHAR[*]	Get device name as ASCII string, always "MSB"	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
302	12E	Sniffer probe type	R	N/A	UINT8	LDS3000(AQ)/XL3000flex only 'READ: 0 = SL3000 3m 1 = SL3000XL 3m 2 = Adapter 3 = Adapter XL 4 = Flow standard 5 = Flow standard XL 10 = SL3000 5 m 11 = SL3000XL 5m 20 = SL3000 10m 21 = SL3000XL 10 m 30 = SL3000 15m 31 = SL3000XL 15m 254 = Sniffer LDS 255 = no Sniffer / unknown WRITE: Set or clear XL-Bit (for Service)	
308	134	Control unit OS software version	R/W	N/A	CHAR[30]	Software version control unit operating system. Write for internal use only.	
310	136	SW-version MSB	R	N/A	UINT8[3]	Software version MSB Index 0: Main version Index 1: Sub version Index 2: Debug version	
311	137	SW-version probe programming master	R	N/A	UINT8[3]	SL3000 SW-Version LDS3000(AQ)/XL3000flex only	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
313	139	SW-version I/O module	R/W	N/A	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	SW-version control unit	R/W	N/A	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	SW version TMP controller	R	N/A	CHAR[6]	SW version TMP controller (character string from TMP controller)	
316	13C	HW-version TMP controller	R	N/A	CHAR[6]	HW version TMP controller (character string from TMP controller)	
317	13D	TMP controller name	R	N/A	CHAR[6]	TMP controller name (character string from TMP controller)	
318	13E	SW version boot loader	R	N/A	UINT8[3]	Software version of boot loader	
319	13F	SW version boot loader I/O module	R/W	N/A	UINT8[3]	Software version of boot loader IO module write for internal use only	
320	140	CRC-code MSB	R	N/A	UINT32	CRC-code interface board abcdwxyz (hex) abcd: caclulated value wxyz: nominal value	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
321	141	DIP switch MSB	R	no	UINT8	DIP switch setting of the MSB: Bit7: S171, switch 4 Bit6: S171, switch 3 Bit5: S171, switch 2 Bit4: S171, switch 1 Bit3: S170, switch 4 Bit2...0: not used,always 0 Bit 4/5/6/7 Device type 0000xxxx - LDS3000 1001xxxx - LDS800	
322	142	Field bus status word	R	no	UINT16	Status word for Bus module refer to Bus module documentation	
323	143	SW version bus module	R	N/A	UINT8[3]	SW version bus module	
324	144	Bus module fieldbus type	R	no	UINT16	Bus module fieldbus type. Refer to AnybusCC specification for enumeration.	
325	145	Serial number plug-in unit bus module	R	N/A	UINT8[4]	Serial number plug-in unit bus module	
326	146	Field bus address actual value	R	no	UINT8	Fiedbus address actual value Refer to AnybusCC specification for enumeration.	
327	147	Field bus baud rate	R	no	UINT8	Baud rate at field bus Refer to AnybusCC specification for enumeration.	
328	148	Exception code bus module	R	no	UINT8	Exception code bus module	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
329	149	Error counters bus module	R	no	UINT16[4]	Error counters bus module Index: 0: Discarded commands 1: Discarded Responses 2: Serial Reception errors 3: Fragmentation errors	
330	14A	Bus module state	R	no	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	Field bus address nominal value	R/W	yes	UINT8	Fiedbus address nominal value Refer to AnybusCC specification for enumeration.	
333	14D	Field bus profile	R/W	yes	UINT8	Fieldbus profile: 0=HMS_default 1=INFICON	
336	150	Field bus station name	R	yes (BM)	CHAR[*]	BM1000 Station name (PROFINET IO only)	
337	151	Field bus IP address	R	yes (BM)	UINT8[4]	BM1000 IP address (IP based field busses only)	
338	152	Field bus IP subnet mask	R	yes (BM)	UINT8[4]	BM1000 IP subnet mask (IP based field busses only)	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
339	153	Field bus gateway IP address	R	yes (BM)	UINT8[4]	BM1000 gateway IP address (IP based field busses only)	
340	154	Field bus DHCP enabled	R	yes (BM)	UINT8	BM1000 DHCP (IP based field busses only) 0=disabled; 1=enabled	
350	15E	Serial number control unit	R	N/A	CHAR[11]	Serial number control unit Write for internal use only.	
355	163	Serial number TMP	R	N/A	CHAR[11]	Serial number of TMP (Leybold TMP only) See command 405 for serial number of TMP converter.	
356	164	Serial number TMP communication electronic	R	N/A	CHAR[11]	Serial number of TMP communication electronic (front end, Leybold TMP only). See command 405 for serial number of TMP converter.	
357	165	Control unit OS build date [YMD]	R/W	N/A	UINT8[3]	Build date of operating system of control unit. Index 0: Year (1..99) Index 1: Month Index 2: Day Write for internal use only.	read only
361	169	Warnings shown as errors	R/W	yes	UINT16[8]	List of warning numbers (value between 0 and 999) which will be displayed as error. Value 0 means "no entry"	
362	16A	PLC output state IO module	R	no	UINT16	Get PLC output state IO module Bit0..15 = PLCOut 1...16	
363	16B	PLC output configuration IO module	R/W	yes	SINT8[16]	Index 0…15 = PLC_OUT1 ... PLC_OUT_16 See table "PLC output conf."	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
370	172	Amp test during calibration	R/W	yes	UINT8	Amplifier test during internal calibration 0 = Off 1 = ON	
371	173	Run Amp test	R/W	no	UINT8	Write: Write value 1 to run Amplifier test Read: Amplifier test state	
380	17C	Search active	R/W	yes	UINT8	trigger2 for search in HIGHFLOW SL3000XL only 0 = OFF 1 = ON LDS3000(AQ)/XL3000flex only	
385	181	Trigger [mbar*l/s]	R/W	yes	FLOAT[4]	Trigger in mbar*l/s Index 0: Trigger 1 Index 1: Trigger 2 Index 2: Trigger 3 Index 3: Trigger 4	
387	183	Trigger status	R	no	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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
390	186	Test leak extern vacuum [mbar*l/s]	R/W	yes	FLOAT[3]	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	Test leak extern sniff [mbar*l/s]	R/W	yes	FLOAT[3]	Test leak extern for sniff mode in mbar*l/sIndex 0 :Mass2 forming gas 5/95 Index 1: Mass 3 Index 2: Mass 4 Helium LDS3000(AQ)/XL3000flex only	
394	18A	Testleak intern [mbar*l/s]	R/W	yes	FLOAT	Testleak intern in mbar*l/s	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
396	18C	Display unit	R/W	yes	UINT8[2]	[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	Display limit	R/W	yes	UINT8[2]	[0] = increase lower limit 0=normal; 1..7 decades higher [1] = decrease upper limit 0=normal; 1..7 decades lower	X

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
398	18E	Language	R/W	yes	UINT8	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	Current display limit [selcted unit]	R	N/A	FLOAT[2]	actual Display limit in current unit [0] = lower limit [1] = upper limit	
401	191	Operation mode	R/W	yes	UINT8	0 = VACUUM 1 = SNIFF 2 = SL3000 (only readable) 3 = accumulation mode (only readable) 4 = accumulation mode (only readable)	
402	192	Leak rate filter	R/W	yes	UINT8	0 = 2-zone 1 = I•CAL 2 = Fixed 3 = I-Filter 4 = I-Filter slope suppress	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
403	193	Leak rate threshold for averaging time [mbar*l/s]	R/W	yes	FLOAT	Leak rate threshold for averaging time in mbar*l/s. Below this value the averaging time is 10.24s. Above this value the averaging time is 160ms. LDS3000(AQ)/XL3000flex only	
404	194	Serial number sniffer probe	R	N/A	CHAR[11]	Serial number of SL3000 LDS3000/XL3000flex only	X
405	195	Serial number TMP controller	R	N/A	CHAR[11]	Serial number TMP controller (Leybold TMP only)	X
406	196	Serial number leak detector	R	yes	CHAR[11]	Serial number of the complete leak detector	X
407	197	Serial number MSB	R	N/A	CHAR[11]	Serial number of the MSB	X
408	198	Serial number IO module	R/W	N/A	CHAR[11]	Serial number of the IO module	X
409	199	Zero with start	R/W	yes	UINT8	Zero with Start 0 = OFF 1 = ON	
410	19A	Zero mode	R/W	yes	UINT8	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 6 = EcoBoost	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
411	19B	Zero time	R/W	yes	UINT16	Update interval for offset value if leak rate signal is negative. Resolution 0,1 s (50 = 5,0 s) Only valid for leak rate filter "2-zone" and "Fixed" (refer to command 402)	
412	19C	Zero Sniffer key enable	R/W	yes	UINT8	0 = zero key disabled 1 = zero key enabled LDS3000(AQ)/XL3000flex only	
413	19D	Sniffer LED alarm configuration	R/W	yes	UINT8	Configures the behavior of the white sniffer pobe LEDs in case of trigger alarm. LDS3000(AQ)/XL3000flex only. 0=disabled (same Brightness as during normal measurement) 1=on (higher brightness as during normal measurement if possible) 2=blink	
414	19E	Sniffer white LED brightness	R/W	yes	UINT8	Configures the brightness of the white sniffer pobe LEDs in case of normal measurement: 0=off ... 6=max Brightness LDS3000(AQ)/XL3000flex only	
415	19F	Flow Sniffer key enable	R/W	yes	UINT8	0 = flow key disabled 1 = flow key enabled LDS3000(AQ)/XL3000flex only	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
416	1A0	Gas percentage	R/W	yes	FLOAT[3]	Forming gas percentage (5 %) Index 0: Mass 2 (H2) Index 1: Mass 3 Index 2: Mass 4 (Helium) LDS3000(AQ)/XL3000flex only	
417	1A1	Sniffer beep	R/W	yes	UINT8	0= Beep disabled 1=Beep when Trigger1 LDS3000(AQ)/XL3000flex only	
419	1A3	Calibration request enable	R/W	yes	UINT8	0 = Calibration request disabled 1 = Calibration request enabled	
429	1AD	Warn active	R/W	yes	UINT16	Bit0: 0 = No warning 1 = Warning when start Cal in first 20 minutes of operation	
430	1AE	Pressure unit	R/W	yes	UINT8	Pressure unit mbar = 0 Pa = 1 atm = 2 Torr = 3	
431	1AF	Leak rate unit vacuum	R/W	yes	UINT8	Leak rate unit vacuum (and for AQ-mode) 0 - mbar*l/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*l/s 7 - sccm (only AQ-mode) 8 - sft3/yr	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
432	1B0	Leak rate unit sniff	R/W	yes	UINT8	Leak rate unit sniff LDS3000(AQ)/XL3000flex only. 0 - mbar*l/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*l/s 4 – ppm 5 - g/a 6 - oz/yr 7- sccm 8 - sft3/yr	
433	1B1	Anode setpoint M2 [V]	R/W	yes	UINT16	Anode voltage setpoint for mass 2 (hydrogen) in V	
434	1B2	Anode setpoint M3 [V]	R/W	yes	UINT16	Anode voltage setpoint for mass 3 in V	
435	1B3	Anode setpoint M4 [V]	R/W	yes	UINT16	Anode voltage setpoint for mass 4 (helium) in V	
436	1B4	Emission current setpoint [A]	R/W	yes	FLOAT	Emission current setpoint [A]	
438	1B6	PLC input configuration IO module	R/W	yes	UINT8[10]	Configuration of PLC input port of the IO module Index 0...9 = PLC_IN1...PLC_IN10 See table "PLC input conf."	
439	1B7	Key switch state	R	N/A	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 dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
448	1C0	Valve control location	R/W	no	UINT16	Bit=0: Controled by leak detector Bit=1: Controled by write command 449	
449	1C1	Switch valves	R/W	no	UINT16	see table "Valves" For setting valve by write comman see also command 448	
450	1C2	Date+Time [YMDhms]	R/W	yes (RTC)	UINT8[6]	Date and time use only with array-index 255 (all bytes) year (1..99), month, day, hour (0..23), min, sec	X
452	1C4	Min pressure sniff	R/W	yes	FLOAT	Minimum pressure p1 in mbar for sniffer mode. If pressure falls below this value, warning 540 (Flow too low) is generated.	
453	1C5	Max pressure sniff	R/W	yes	FLOAT	Maximum pressure p1 in mbar for sniff. If pressure rises above this value, warning 542 (Sniffer broken) is generated.	
455	1C7	Min pressure XL sniff	R/W	yes	FLOAT	XL flow (p2) too low warning 550. LDS3000(AQ)/XL3000flex only	
456	1C8	Max pressure XL sniff	R/W	yes	FLOAT	XL flow (p2) too high warning 552. LDS3000(AQ)/XL3000flex only	
469	1D5	Equivalence gas factor sniff	R/W	yes	FLOAT[3]	Equivalence gas factor for sniff operation mode. LDS3000(AQ)/XL3000flex only. Index 0: Mass 2 (H2) Index 1: Mass 3 Index 2: Mass 4 (Helium)	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
470	1D6	Molar mass of equivalence gas [g/mol]	R/W	yes	FLOAT[3]	Molar mass of equivalence gas in g/mol. LDS3000(AQ)/XL3000flex only. Index 0: Mass 2 (H2) Index 1: Mass 3 Index 2: Mass 4 (Helium)	
479	1DF	CalMate mode	R/W	yes	UINT8	Mode for calibration or proof with CalMate. LDS3000(AQ)/XL3000flex only. 0 = Inserting sniffer tip into the CalMate triggers Proof. Switch to calibration by pressing the right sniffer button. 1 = Inserting sniffer tip into the CalMate triggers calibration. Proof not possible 2 = Inserting sniffer tip into the CalMate triggers Proof. Calibration not possible	
480	1E0	Auto standby interval [min]	R/W	yes	UINT8	Auto standby interval 0 = OFF LDS3000(AQ)/XL3000flex only	
482	1E2	Date+Time [s]	R/W	yes (RTC)	UINT32	Date and time of the battery-buffered real-time clock Data format is seconds since date 1.1.2000 time 00:00:00 see also LD command 450	
493	1ED	Status of EcoBoost	R	N/A	UNIT8	Status of EcoBoost 0 = unstable 1 = stable 2 = idle (EcoBoost not active) Use Zero On with EcoBoost only if stable	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
499	1F3	Fan output TMP controller	R/W	yes	UINT8	0 = always on 1 = temperature controlled	
501	1F5	TMP rotation speed	R/W	yes	UINT16	TMP rotation speed 1000, 1500Hz	
502	1F6	Amplifier range	R/W	no	UINT8	Amplifier range Amplifier control location 508 automatically set (not auto) 0 = 13 MOhm 1 = 470 MOhm 2 = 15 GOhm 3 = 500 GOhm	
504	1F8	500GOhm value	R/W	yes	FLOAT	500GOhm value	
506	1FA	Mass	R/W	yes	UINT8	2 = Mass 2 (H2) 3 = Mass 3 4 = Mass 4 (Helium)	
508	1FC	Amplifier control location	R/W	no	UINT8	Amplifier control location 1 = automtic on (default) 0 = automatic off Write access only possible if "Manual control for service" is active	
519	207	Cal factors sniff high flow	R/W	yes	FLOAT[3]	Calibration factors for sniff mode high flow. LDS3000(AQ)/XL3000flex only. Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
520	208	Calibration factors vacuum	R/W	yes	FLOAT[3]	Calibration factors for vacuum mode (and for AQ-mode) Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	
521	209	Calibration factors sniff	R/W	yes	FLOAT[3]	Calibration factors for sniff mode. LDS3000(AQ)/XL3000flex only. Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	
522	20A	Machine factors vacuum	R/W	yes	FLOAT[3]	Machine factors for vacuum mode Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	
523	20B	Machine factors sniff	R/W	yes	FLOAT[3]	Machine factors for sniff mode LDS3000(AQ)/XL3000flex only. Index 0: mass 2 Index 1: mass 3 Index 2: mass 4	
524	20C	Machine factor in standby on/off	R/W	yes	UINT8	machine factor in standby 0 = OFF, 1 = ON	
529	211	Enable warning	R/W	yes	UINT8	LDS3000(AQ)/XL3000flex only. 0 = no warning without sniffer 1 = warning (warning No. 130) without sniffer	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
530	212	Cathode selection	R/W	yes	UINT8	0 = CAT1 1 = CAT2 2 = Auto Cat1 3 = Auto Cat2 4 = OFF	
532	214	Min pressure accumulation mode [mbar]	R/W	yes	FLOAT	Minimum pressure p1 in mbar for accumulation mode. If pressure falls below this value, error 557 (Pressure too low, throttle blocked) is generated.	
533	215	Max pressure accumulation mode [mbar]	R/W	yes	FLOAT	Maximum pressure p1 in mbar for accumulation mode. If pressure rises above this value for 5 seconds, warning 520 (Pressure too high) is generated.	
574	23E	Popup message number	R	no	UINT8	Number of pop message. "0" means no message	X
575	23F	Text of popup message number	R	N/A	CHAR[*]	Text of popup message To read send after the index the UINT8 popup message number Without error number you will get the text of the actual popup message Use only with index=255!	X
576	240	Clear popup message	W	N/A	NO_DATA	Clear popup message. Sets number of popup message to "0"	X
585	249	Tau for I*Filter [s]	R/W	yes	UINT16	Tau in seconds for zero compensation. Only valid for leak rate filter I*Filter.	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
605	25D	Speaker settings	R/W	yes	UINT8[4]	Speaker settings for IO1500 byte [0] = frequency high byte byte [1] = frequency low byte byte [2] = speaker volume byte [3] = 1 = slow frequ change	
1120	460	Amp alternate test on	R/W	yes	UINT8	Enables resp. Disables amplifier alternating monitoring (Error message 358) 0 = disabled, 1 =enabled Enabled by default	
1161	489	Parameter reset	W	N/A	UINT8	Parameter reset: 0: Load factory settings 3: Clear error history 4: Clear calibration history 10: PARA_RESET_ LDS1000_MODE 11: PARA_RESET_ LDS2010_MODE 12: PARA_RESET_SL3000XL_MODE 14: PARA_RESET_ACCU (only valid for LDS3000AQ)	X
1284	504	Control word	R/W	no	UINT16	Control word (used for Bus module)	
1285	505	Stop service buffer	R/W	no	UINT8	0 = save new information 1 = no new information	
1299	513	EcoBoost time constant mass 2 [s]	R	yes	FLOAT	EcoBoost vacuum time constant (only valid for mass 2)	
1300	514	Service buffer ion current	R	N/A	FLOAT[150]	To read send after the array index 255 the UINT8 block number, each block 10 values (block 14 is newest)	X

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
1301	515	Service buffer pressure 1	R	N/A	FLOAT[150]	see command 1300	X
1302	516	Service buffer emis current	R	N/A	FLOAT[150]	see command 1300	X
1303	517	Service buffer anode voltage	R	N/A	FLOAT[150]	see command 1300	X
1304	518	Service buffer cathode voltage	R	N/A	FLOAT[150]	see command 1300	X
1305	519	Service buffer heater power	R	N/A	FLOAT[150]	see command 1300	X
1306	51A	Service buffer leakrate	R	N/A	FLOAT[150]	see command 1300	X
1307	51B	Service buffer TMP mode	R	N/A	UINT8[150]	see command 1300	X
1308	51C	Service buffer TMP speed	R	N/A	FLOAT[150]	see command 1300	X
1309	51D	Service buffer emission mode	R	N/A	UINT8[150]	see command 1300	X
1310	51E	Service buffer sensor 3	R	N/A	FLOAT[150]	see command 1301	X
1362	552	Maintenance TMP [d]	R	yes	UINT32	Maintenance TMP [d] Number of days until next maintenance is due.	
1366	556	Maintenance interval TMP [d]	R	N/A	UINT16	Maintenance interval of TMP in days. This is a constant. The value does not indicate the time until the next maintenance is due!	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
1400	578	Group measure	R	no	UINT8[6]	Measurement data see table / enumerations	X
1564	61C	Value changed reason	R	no	UINT32	Cause of setting the value changed flag (see status word bit 11). Bit 0: Mass (506), Bit 1: Operation mode (401), Bit 2: Setpoint 1 (385), Bit 3: Setpoint 2 (385), Bit 4: Leak rate unit display (396), Bit 5...11: not used Bit 12: Display-Limit (399), Bit 13...14: not used Bit 15: Language (398) Bit 16: Flow_XL (229) Bit 17: Gas percent (416) Bit 18: Equivalent gas factor (469) Bit 19: Mol mass of equivalent gas (470) Bit 20: Search active (380) Bit 21: EcoBoost stable (493) Bit 22 ... 31: not used A write command to the corresponding command in brackets causes the corresponding bit to be set here. A later read command on the commando clears the bit again. Another way to clear all bits is to write a 0 on command 1565.	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
1565	61D	Value changed flag	R/W	no	UINT8	Value changed flag Read: Same value as Statusword Bit 11 Bit will be set if one or more value changed reason flags (see commando 1564) are set. Write: Write 0 to clear the value changed flag. This will also clear all value changed reason flags (see commando 1564).	
1567	61F	Offset current amplifier [A]	R	N/A	FLOAT	Currently subtracted offset current [A]	
1568	620	Unfiltered ion current [A]	R	N/A	FLOAT	Unfiltered ion current in A	
1573	625	Filtered ion current [A]	R	N/A	FLOAT	Filtered ion current in A	
1581	62D	Acceleration	R	N/A	UINT8[3]	Index 0: X axis value Index 1: Y axis value Index 3: always 0	
1620	654	Amplifier test currents [A]	R	no	FLOAT[5]	Test currents ca. 1.3E -11 A	
1755	6DB	Accumulation key	W	N/A	CHAR[12]	Key for unlocking AQ mode 12 digits, always whole array LDS3000 only.	X
1758	6DE	Accumulation leak rate (raw) [mbar*l/s]	R	N/A	FLOAT	eak rate raw signal with sign (postive / negative) LDS3000AQ only	
1759	6DF	Accumulation leak rate offset [mbar*l/s]	R	N/A	FLOAT	leak rate offset (only H2) LDS3000AQ only.	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
1760	6E0	Accumulation status	R	N/A	UINT8	Accumulation status LDS3000AQ only. 0 = mode is optional 1 = mode possible	
1761	6E1	Accumulation runup hold time [s]	R	N/A	UINT16	Accumulation runup delay in seconds LDS3000AQ only.	X
1763	6E3	Chamber volume [l]	R/W	yes	FLOAT	Volume of measurement chamber in liter LDS3000AQ only.	
1765	6E5	Accumulation measurement time [s]	R/W	yes	UINT16	Accumulation measurement time in seconds. LDS3000AQ only.	
1767	6E7	Accumulation zero time	R/W	yes	UINT8	Accumulation zero time (multiple of measurement time) LDS3000AQ only.	
1800	708	Active protocol IO	R	no	UINT8	Active interface protocol for I/O module. Defined by DIP switch at I/O module or command 2593. Values: See enumerations table	
1815	717	Reset source	R	no	UINT8	Shows the last reason of reset	
2593	A21	Interface protocol IO	R/W	yes	UINT8	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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
2594	A22	Compatibilty Mode	R/W	yes	UINT8	Selected Compatibility Mode 0 = LDS1000 1 = LDS2010 2 = LDS3000 3 = SL3000 5 = Accumulation (optional) 6 = Accumulation 2 (optional)	
2627	A43	Pressure sensor type	R/W	yes	UINT8[2]	Index 0: Reserved (Not used) Index 1: Pressure gauge p2 0 = PSG500 1 = SL3000XL adapter	
2628	A44	Pressure sensor offset	R/W	no	FLOAT[2]	Index 0: Not used Index 1: Offset p2 (only valid if sensor type = SL3000XL adapter)	
2629	A45	Pressure sensor gain	R/W	no	FLOAT[2]	Index 0: Not used Index 1: Gain p2 (only valid if sensor type = SL3000XL adapter)	
2630	A46	P3 min max pressure	R/W	yes	FLOAT[2]	Range sensor p3 (0..10 V) LDS3000(AQ)/XL3000flex only	
2632	A48	P4 min max pressure	R/W	yes	FLOAT[2]	Range sensor 4 (0..20 mA) LDS3000(AQ)/XL3000flex only	
2634	A4A	P3 min max voltage	R/W	yes	FLOAT[2]	Voltage range sensor 3 (0..10 V) LDS3000(AQ)/XL3000flex only	
2636	A4C	P4 min max current	R/W	yes	FLOAT[2]	Current range sensor 4 (0..20 mA) LDS3000(AQ)/XL3000flex only	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
2638	A4E	P3 mode	R/W	yes	UINT8	Sensor 3 mode 0=lin, 1=log LDS3000(AQ)/XL3000flex only	
2639	A4F	P4 mode	R/W	yes	UINT8	Sensor 4 mode 0=lin, 1=log LDS3000(AQ)/XL3000flex only	
2650	A5A	Set suppressor voltage [V]	R/W	no	FLOAT	Suppressorvoltage for test	X
2660	A64	Maintenance activ	R/W	yes	UINT8	0 = off, 1 = TMP 2 = Membrane pump 3 = TMP + Membrane pump	
2661	A65	Set maintenance	W	N/A	UINT8	Confirm the maintenance carried out 1 = bearing/lubricant 2 = TMP novated 3 = Membrane pump	
2662	A66	Maintenance done	R	N/A	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

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
2663	A67	Test sniffer LED	R/W	no	UINT8	Test good / bad LED SL200 0 = auto 1 = good 2 = bad 3 = good and bad 4 = off	X
2665	A69	Maintenance membrane done	R	N/A	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: see enumerations table	X
2667	A6B	No Cal first 20 min	R/W	yes	UINT8	No calibration in first 20 min.	

3.6 Enumerations

Analog output configuration (command 222)

Value	Function
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

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

Value	Function
0	0.5 V/decade
1	1 V/decade
2	2 V/decade
3	2.5 V/decade
4	3 V/decade

Value	Function
5	5 V/decade
6	10 V/decade
7	special 1

State calibration (command 260)

Value	Meaning
0	CAL_STATE_READY
1	CAL_STATE_START_INT
2	CAL_STATE_WAIT_TL_INT
3	CAL_STATE_PEAK_INT
4	CAL_STATE_MEAS_TL_INT
5	CAL_STATE_WAIT_ZERO_INT
6	CAL_STATE_MEAS_ZERO_INT
11	CAL_STATE_START_EXT
13	CAL_STATE_PEAK_EXT
14	CAL_STATE_MEAS_TL_EXT
15	CAL_STATE_WAIT_ZERO_EXT
16	CAL_STATE_MEAS_ZERO_EXT
21	CAL_STATE_START_DYN
24	CAL_STATE_MEAS_TL_DYN
25	CAL_STATE_WAIT_ZERO_DYN
26	CAL_STATE_MEAS_ZERO_DYN
28	CAL_STATE_START_AIR
29	CAL_STATE_PEAK_AIR

Value	Meaning
30	CAL_STATE_MEAS_AIR
31	CAL_STATE_START_MACH
32	CAL_STATE_WAIT_TL_INT_MACH
33	CAL_STATE_PEAK_INT_MACH
34	CAL_STATE_MEAS_TL_INT_MACH
35	CAL_STATE_WAIT_ZERO_INT_MACH
36	CAL_STATE_MEAS_ZERO_INT_MACH
37	CAL_STATE_WAIT_TL_EXT_MACH
38	CAL_STATE_MEAS_TL_EXT_MACH
39	CAL_STATE_WAIT_ZERO_EXT_MACH
40	CAL_STATE_MEAS_ZERO_EXT_MACH
41	CAL_STATE_START_PROOF_EXT
42	CAL_STATE_MEAS_PROOF_EXT
43	CAL_STATE_WAIT_ZERO_PROOF_EXT
44	CAL_STATE_MEAS_ZERO_PROOF_EXT
45	CAL_STATE_START_PROOF
46	CAL_STATE_WAIT_TL_PROOF
47	CAL_STATE_MEAS_TL_PROOF
48	CAL_STATE_WAIT_ZERO_PROOF
49	CAL_STATE_MEAS_ZERO_PROOF
53	CAL_STATE_FAIL_TL_TO_SMALL
54	CAL_STATE_FAIL_FACTOR
55	CAL_STATE_WARN_FACTOR

Value	Meaning
56	CAL_STATE_FAIL_EMIS
57	CAL_STATE_PROOF_DEV
59	CAL_STATE_PEAKERR
60	CAL_STATE_PROOF_EXT_PI_OK
61	CAL_STATE_EXT_PI_OK
71	CAL_STATE_START_AQ
72	CAL_STATE_START_PEAK_AQ
73	CAL_STATE_PEAK_AQ
74	CAL_STATE_MEAS_TL_AQ
75	CAL_STATE_WAIT_ZERO_AQ
76	CAL_STATE_WAIT_VVTEST_AQ
77	CAL_STATE_WAIT_AQ_CYCLE
78	CAL_STATE_WAIT_PEAK_AQ_CYCLE
79	CAL_STATE_ZERO_AQ_CYCLE
80	CAL_STATE_EXT_PI_START
81	CAL_STATE_EXT_PI_WAIT_INIT_TL
82	CAL_STATE_EXT_PI_WAIT_TL
83	CAL_STATE_EXT_PI_PEAKFIND
84	CAL_STATE_EXT_PI_MEAS_TL
85	CAL_STATE_EXT_PI_REMOVE_SNIFFER
86	CAL_STATE_EXT_PI_WAIT_INIT_BG
87	CAL_STATE_EXT_PI_WAIT_BG
88	CAL_STATE_EXT_PI_MEAS_BG

Value	Meaning
95	CAL_STATE_PROOF_EXT_PI_START
96	CAL_STATE_PROOF_EXT_PI_WAIT_INIT_TL
97	CAL_STATE_PROOF_EXT_PI_WAIT_TL
98	CAL_STATE_PROOF_EXT_PI_MEAS
99	CAL_STATE_PROOF_EXT_PI_REMOVE_SNIFFER
100	CAL_STATE_PROOF_EXT_PI_WAIT_INIT_BG
101	CAL_STATE_PROOF_EXT_PI_WAIT_BG
102	CAL_STATE_PROOF_EXT_PI_MEAS_BG

PLC output configuration IO module (command 263)

use negative values for inverted functions

Value	Function
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

Value	Function
14	MEASURE
15	STANDBY
16	SNIFF
17	ERROR_WARNING
18	GASBALLAST
19	STAT_TL
20	CAL_STABLE
21	Cathode2
22	Status zero stable

Cal history (command 275)

Answer:	ListNo, Calfac(float), Testleak(float), Anodevoltage, Mass, VACx or SNFx or AQ x, year/month/day, hour:min:sec, Cathode, cal state
Example:	"08 Fac: $0.00E^{+0}$ Leak: $0.00E^{+0}$ Anod: 000 M2 VAC 2000/00/00 00:00:00 Cat: 1 State: 000'

Error history (command 287)

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

TMP error history (command 288)

Answer:	ListNo + 'ERR' or 'WRN' + ErrNo
Example:	"05 WRN220'

Present warnings (command 297)

Value	Meaning
0x00000001	Warning pressure/flow
0x00000002	Warning pressure rise
0x00000004	Warning anode voltage
0x00000008	Warning pirani
0x00000010	Warning emission
0x00000020	Warning suppressor
0x00000040	Warning TMP
0x00000080	Warning Anybus
0x00000100	Warning maintenance
0x00000200	Warning I/O disconnected
0x00000400	Warning 5V
0x00000800	Warning U24VHz
0x00001000	Warning U24V TL valve
0x00002000	Warning U24V Pwr 34
0x00004000	Warning U24V Sniff valve
0x00008000	Warning U24V RC
0x00010000	Warning U24V IO
0x00020000	Warning U24V TMP
0x00040000	Warning U24V Pirani
0x00080000	Warning cathode voltage
0x00100000	Warning temperature MSB
0x00200000	Warning temperature preamplifier

Value	Meaning
0x00400000	Warning calibration request
0x00800000	Warning sniff not connected
0x01000000	Preamp output too low
0x02000000	Warning 15Vp
0x04000000	Warning 15Vn
0x08000000	Warning Press XL-Flow
0x10000000	Warning RTC
0x20000000	Warning Contamination

PLC input configuration IO module (command 438)

use negative values for inverted functions

Value	Function
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

Value	Function
14	KEY_2
15	KEY_3
16	CAL
17	ZERO_UP
18	TL
19	TL_PULS
20	XL_FLOW
21	MACHINE_FAC
22	PROOF_INT
23	PROOF_EXT
24	START_PULS
25	MASS2_4
26	PEAK_CAL

Valves (command 448 & 449)

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

Active protocol IO (command 1800)

0	LD protocol
1	ASCII protocol

2	ANYBUS protocol
3	Binary protocol (LDS2010 only)
4	LDS1000 protocol
5	Tunnel (service only)
6	reserved
7	reserved, not used
8	reserved, not used
9	reserved, not used

Maintenance history (command 2665)

Answer:	"ListNo Operation_hours Membrane pump"
Example:	"3 0016000 Membrane pump"

3.7 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 or XL3000flex, you need an INFICON Bus-Module BM1000 connected to the I/O port of the LDS3000 or XL3000flex.

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

You will find the appropriate configuration files on the USB memory stick which is supplied with your bus module.

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

1   Select the "Bus modul" at the control unit (CU1000): "Menu > Settings > Setup > Interfaces > Device sel. > Module at I/O connector".

2   Select the field bus address at the control unit (CU1000): "Menu > Settings > Setup > Interfaces > Bus Module > Address".

3   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 Transition to 1: 0x10 = Start internal calibration	CAL intern	*CAL:INT	4
	5					
	6	CAL extern	Transition to 0: 0x00 = Cancel external or dyn. calibration Transition to 1: 0x40 = Start external or. dyn. calibration Transition to 2: 0x80 = Acknowledge closed test leak	CAL extern/CAL dynamic	*CAL:EXT	4
	7					

Byte	Bit	Name	Meaning	Similar to PLC Input	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
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			
			0x04 = 1 ... 2 dec.			
			0x08 = 2 ... 3 dec.			
			0x0C = 19/20 part of the value			
	4	CAL mode	0 = external CAL	Select dyn/norm		
	5		0x10 = dyn. CAL			
			0x20 = not used			
			0x30 = Peak find (AQ mode only)			
	6	Sniff/Vac	0 = VAC	Sniff	*CONFIG:MODE	401
			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	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					

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
2 (low byte)	0 1	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
	2 3 4	Emission	0 = 0x00 = Emission off 1 = 0x04 = Cathode 1 fixed 2 = 0x08 = Cathode 2 fixed 3 = 0x0C = Cathode 1 auto 4 = 0x10 = Cathode 2 auto	Emission on	*STATUS:CATHODE?	530
	5 6 7	State	0 = 0x00 = Standby 1 = 0x20 = Error 2 = 0x40 = Calibration 3 = 0x60 = Runup 4 = 0x80 = Measure 5 = 0xA0 = Emission Off 6 ... 7 = 0xC0 … 0xE0 = not used	Run up, CAL active, Error, Ready	*STATUS?	Status word
3 4 5 6		Leak rate (mbar l/s)	Actual leak rate in mbar l/s (IEEE 754 float value)	Recorder output (LR_LIN, LR_LOG ...)	*READ:MBAR*l/S?	129

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
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					

Title	Byte	Bit	Name	Meaning	Similar to IO1000 Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
status word (continued)	2 (low byte)	0 1	Calibarion request	0 = CAL request function disabled 1 = 0x01 = CAL request function enabled but no CAL requested 2 = 0x02 = CAL request function enabled and CAL requested 3 = 0x03 = not used	CAL request	*CONFIG:CALREQ?	419
		2 3 4	Emission	0 = 0x00 = Emission off 1 = 0x04 = Cathode 1 fixed 2 = 0x08 = Cathode 2 fixed 3 = 0x0C = Cathode 1 auto 4 = 0x10 = Cathode 2 auto	Emission on	*STATUS:CATHODE ?	530
		5 6 7	State	0 = 0x00 = Standby 1 = 0x20 = Error 2 = 0x40 = Calibration 3 = 0x60 = Runup 4 = 0x80 = Measure 5 = 0xA0 = Emission Off 6 ... 7 = 0xC0 … 0xE0 = not used	Run up, CAL active, Error, Ready,	*STATUS?	Status word
leak rate	3 … 6		Leak rate (mbar*l/s)	Actual leak rate in mbar l/s (IEEE 754 float value)	Analog output (LR_LIN, LR_LOG...)	*READ:MBAR*l/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

Title	Byte	Bit	Name	Meaning	Similar to IO1000 Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
trigger_status	13	0	Status of Trigger 1	0 = Leak rate lower than trigger level	Trigger 1	*STATUS:TRIGger?	387
		1	Status of Trigger 2	1 = Leak rate higher than trigger level	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 see table 3.4, "Commands [▷ 38]".	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 · 255 + index + 1 slot = (ADI - 1) / 255 index = (ADI - 1) 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, see "Commands [▷ 11]".

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 Bit:Meaning: 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	$-2^{31}...\ +(2^{31}-1)$
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	$-2^{63}...\ +(2^{63}-1)$

#	Type	Bits	Description	Range
17	UINT64	64	Unsigned 64 bit integer	$0... +(2^{64}-1)$
18	FLOAT	32	Floating point (IEC 60559)	$\pm 1.17549435E-38...$ $\pm 3.40282347E+38$

4.5 Hardware Configuration for Profibus

4.5.1 Hardware configuration with HMS profile

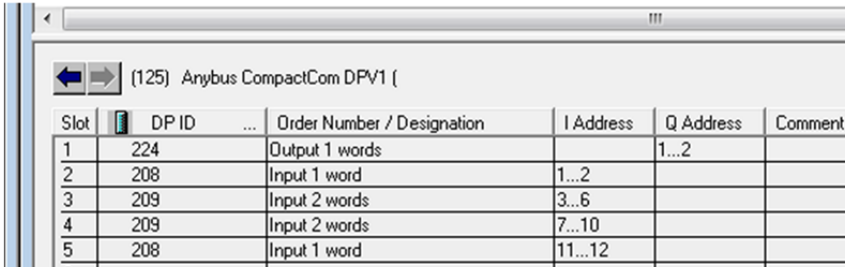HMS profile is not recommended, use INFICON profile if possible. See chapter "Preface [▶ 84]".

Attention:

You must select HMS profile und 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.

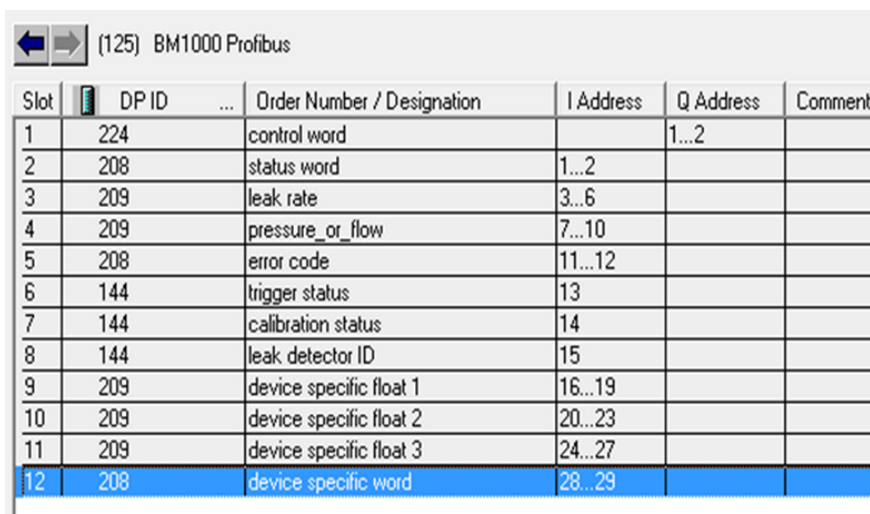Example hardware configuration (detail from PLC configuration window):

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		

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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							

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 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.**

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 "Main functions [▶ 100]".

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 "Status Requests [▶ 100]".

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 "Request for Measurement Data [▶ 104]".

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-4<cr>" changes the level for the first trigger to 1E-4. The commands used to set and query parameters are listed in chapter "Entry of Instrument Settings [▶ 105]".

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 "Running of service functions [▶ 108]".

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)	xxxxxxxx	(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 refers to external calibration,
		Byte 4	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	
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	

		Meaning	Representation
S6	Key switch status		0 = Key switch defective 1 = No key 2 = Key 1 3 = Key 2 4 = Key 3
S10	Current error		0 = no errorr/warning > 0 = 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		xxxxxxxxxxxxxxx
S32	Operating hours counter		xxxxxx

	Meaning	Representation
S35	Valve position	xy (always 2 characters) "1" valve open "0" valve closed Byte x Valve for calibrated leak Byte y Sniffer valve
S39	Status of the remote contol inputs	xxxxxxx (always 7 signs) (Byte 0 first) Byte 0: Input 7 Byte 1: Input 6 Byte 2: Input 5 Byte 3: Input 4 Byte 4: Input 3 Byte 5: Input 2 Byte 6: Input 1 Byte 7: always 0
S41	Preamplifier	Amplification of the preamplifier can be changed through F26 … F30. xy x: Status: 0 = auto, 1 = manuell y: Amplification: 0 = 13M; 1 = 470M; 2 = 15G; 3 = 0,5T
S42	Turbo pump	xxxxx (Byte 0 first) Byte 0: speed too low Byte 1: speed too high Byte 2: always 0 Byte 3: FAIL converter ("1"-Error) Byte 4: running up/acceleration
S43	Emission control	xxxxx (Byte 0 first) Byte 0: Status number Byte 1: Nominal status

	Meaning	Representation
		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
G1	Leak rate (LR) Number is output in the selected unit.	e.g.: 1.00E -10
G3	Forevacuum pressure (PV) Number is output in the selected unit.	e.g.: 1.3E -3

Command	Meaning	Representation
G4	Output Leak Rate Date Time Status Status: ACCL, STBY, MEAS, CALI, CALX, ERRO	e.g.: LR=1.00E -10 26.Oct03, 15:25:29 MEAS
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 1.0×10^{-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

Command	Meaning	Representation
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.: 1.0E 4
Q/U13	Machine factor for VAC	e.g.: 1.0E 0
Q/U14	Correction factor for SNIF	e.g.: 1.0E 0
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

Command	Meaning	Representation
Q/U21	Date	e.g.: 24.Nov04 Abbreviations for the months: Jan, May, Sep, Feb, Jun, Oct, Mar, Jul, Nov, Apr, Aug, Dec
Q/U22	Time	e.g.: 14:40:07
Q/U24	Unit (unit of measurement for pressure and leak rate in VAC and SNIF) ppm and g/a is not available for VAC	0 = mbar and mbar l/s 1 = Pa and Pa m3/s 2 = atm and atm cc/s 3 = mbar and g/a 4 = mbar and ppm 5 = Torr and Tor l/s
Q/U27	Leak rate of the internal calibrated leak (always in mbar l/s	e.g.: 1.0E -7 9.9E -1 for not available
Q/U28	leak rate of the external calibrated leak	e.g.: 1.0E -5 9.9E -1 for not available
Q/U31	Number of suppressed decades	0 = 1 to 2 decades 1 = 2 to 3 decades 2 = 3 to 4 decades 3 = 2 decades 4 = complete value 5 = 19/20 of value
Q/U32	Zero suppression when START	0 = off 1 = on
U45	Compatibility Mode	2 = LDS2010-Mode 3 = LDS3000-Mode
Q/U56	Factor 500G - 15G	

Command	Meaning	Representation
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 ($\pm 10^{\pm38}$), 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 see chapter "Error Messages [▶ 31]".

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

No.	Name	Description	Parameter	Data
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 = inactiv 1 = active 2 = wait for calibrated leak close (only at external calibrations)
55	SetCal	Start/Stop calibration	0 = int.Cal 1 = ext.Cal	0 = stop; 1 = start 2 = finish (TL close; only at external calibrations)
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

No.	Name	Description	Parameter	Data
60 61	GetStBy SetStBy	Stand-By read/set		0 = Stand-By 1 = measurement
62	GetErrorCode	Read actual error number		Actual error number (1 Byte), 0 = no error
63	SetClearError	Quit error/cancel calibration		
66 67	GetTL SetTL	Value of the calibrated leak read/set	Byte 0: 0 = int.TL 1 = ext.TL-VAC 2 = ext.TL-SNIF Byte 1: Unit 0 = mbar l/s 1 = Pa m³/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 -15 mbar 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 m³/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		

No.	Name	Description	Parameter	Data
72	GetState	State of the device		0 = Standby 1 = error 2 = Cal 3 = run up 4 = ready 5 = Emisssion off
74	GetOpHours	Read operating hours		[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 valuet; 3 = 2 Decades; 4 = 3-4Decades 5 = complete value
84 85	GetFacSniff SetFacSniff	Read sniff factor		[float]
92 93	GetUnit SetUnit	unit read/set		Byte 0: LR-VAC Byte 1: LR-SNIF Byte 2: pressure 0 = mbar / mbar l/s 1 = Pa / Pa m³/s 2 = atm / atm cc/s 3 = Torr / Torr l/s

No.	Name	Description	Parameter	Data
				only for LR-sniff: 4 = ppm 5 = g/a
99	GetLr	Leak rate	Unit 0 = mbar l/s, 1 = Pa m³/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.

Error	Possible Reason	Solution
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 replys with CRC error (error code 1)	Wrong CRC calculation	Check you CRC code calculation. See example C source file "CRC_calculation.c" provided by INFICON. Check your code with unit test function in this source code file.