Protocol Descriptions

LDS Arnova

Mass spectrometer module

Catalog No.
560-500

From software version
V1.11

jira56en1-01-(2604)

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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 LDS Arnova via the following serial interface protocols:

- ASCII Protocol (enabled by default)
- LD Protocol

The serial interface protocol can be selected via DIP switch at the I/O 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 LDS Arnova 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 [▷ 23]". 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 LDS Arnova: 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:EXT	start external calibration	4	W
*CAL:INT	start internal calibration	4	W
*CAL:PROOFEXT	Start external proof function	-	W
*CAL:PROOFINT	Start internal proof function	-	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 is Mass#1…Mass#3	-	R/W
*CONFig:BUSMODULe:ADDRess	Field bus address nominal value	331	R/W
*CONFig:CALleak:EXTSniff	External test leak of current mass in sniff mode in current sniff unit.	392	R/W
*CONFig:CALleak:EXTVac	external test leak of current mass in vacuum mode in current vac unit	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:CORSTDBY	correction of leak rate in stand by (OFF, ON)	-	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 #1.	470	R/W
*CONFig:EQUIMOLMass:M3	Mol mass in g/mol of equivalence gas for mass 2#.	470	R/W
*CONFig:EQUIMOLMass:M4	Mol mass in g/mol of equivalence gas for mass #3.	470	R/W
*CONFig:ERRor:AMPAlter	Amplifier alternating error (ON, OFF)	1120	R/W
*CONFig:FILTer	Leak rate filter	402	R/W
*CONFig:LANGuage	Language (ENGlish, DEUtch, FRAncais, ITAliano, PORtugues, ESPanol, KATakana, CHInese, RUSsian)	398	R/W
*CONFig:LIMITS	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required) for activ mode sniff/Vac.	-	R/W
*CONFig:LIMITS:LRSniff	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	227	R/W
*CONFig:LIMITS:LRVac	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	226	R/W
*CONFig:LIMITS:SNIFF	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	227	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*CONFig:LIMITS:VAC	Limits for interfaces: low,high limit low and high (with comma separated) in current leak rate unit. (at least factor 10 between both required)	226	R/W
*CONFig:LRFilter	filter switch-over threshold in current leak rate	403	R/W
*CONFig:MAINTenance	Confirm the maintenance carried out BEARING, TMP, MEMBRANE	2661	W
*CONFig:MASS	mass (0 for Mass #1, 1 for Mass #2, 2 for Mass #3)	506	R/W
*CONFig:MFAE	actual anode potential reference [V]	167	R/W
*CONFig:MFAE:0	anode potential reference [V] mass #1	433	R/W
*CONFig:MFAE:1	anode potential reference [V] mass #2	434	R/W
*CONFig:MFAE:2	anode potential reference [V] mass #3	435	R/W
*CONFig:MODE	Operating mode (only VAC)	401	R/W
*CONFig:PERcent	Gas percentage 1…100 %	416	R/W
*CONFig:PHOTOINTMode	CalMate mode: "PROOF_CAL, CAL, PROOF"	479	R/W
*CONFig:PLCINLINK:1	Configuration of PLC-input. The following settings are possible: NOT_USED, EXT_CAL, INT_CAL, SNIFF, START, STOP, ZERO, ZERO_PULS, CLEAR, GAS_BALLAST, START_STOP, KEY1, KEY2, KEY3, CAL, ZERO_UPDATE, INT_LEAK, LEAK_PULS, HIGHFLOW, FACTOR_MACHINE, INT_PROOF, EXT_PROOF, CYCLE, MASS_AIR_AR	438	R/W
*CONFig:PLCINLINK:n	n = 2 … 10 see CONFig:PLCINLINK:1	438	R/W
*CONFig:PLCOUTLINK	Assignment of PLC-outputs *CONFig:PLCOUTLINK:1 for Pin 1 *CONFig:PLCOUTLINK:2 for Pin 2 … *CONFig:PLCOUTLINK:8 for Pin 8	263	R/W
*CONFig:PLCOUTLINK:1	Configuration of PLC-output. The following settings are possible: OPEN, TRIGGER_1, TRIGGER_2, TRIGGER_3, TRIGGER_4, READY, WARNING, ERROR, CAL_ACTIVE, CAL_REQUEST,	263	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
	RUN_UP, ZERO_ACTIVE, EMISSION_ON, MEASURE, STANDBY, SNIFF, ERR/WARN, GAS_BALLAST, INT_LEAK, CAL_STAB, CATHODE2, ZERO_STABLE		
*CONFig:PLCOUTLINK:n	n = 2 ... 8 see CONFig:PLCOUTLINK:1	263	R/W
*CONFig:PRESSHigh	Pressure for upper flow limit (mbar)	453	R/W
*CONFig:PRESSLow	Pressure for lower flow limit (mbar)	452	R/W
*CONFig:RECorder:LINK1	Function at analog output channel 1 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN, EXP_INV, MANT_HYST, P1_1V_DEC, P2_1V_DEC)	222	R/W
*CONFig:RECorder:LINK2	Function at analog output channel 2 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG, LR_LOG_H, EXTERN, EXP_INV, MANT_HYST, P1_1V_DEC, P2_1V_DEC)	222	R/W
*CONFig:RECorder:SCALE	Analog out scaling "0.5V/DEC", "1V/DEC", "2V/DEC", "2.5V/DEC", "3V/DEC", "5V/DEC", "10V/DEC", "SPECIAL_1"	223	R/W
*CONFig:RECorder:UPPEREXP	Upper Exponent (in mbar*l/s) for analog out	224	R/W
*CONFig:RS232	Protocol (LD, ASCII, ANYBUS, TUNNEL, read only: SNIFF)	26	R/W
*CONFig:SNIFFERWARN	OFF = no warning if sniffer not connected ON = warning (warning No. 130) if sniffer not connected	529	R/W
*CONFig:SPEEDTMP	rotation speed of TMP in Hz	501	R/W
*CONFig:TRIGger1	trigger1 in selected unit	384	R/W
*CONFig:TRIGger1:ATM*cc/s	trigger1 in Atm*cc/s	-	R/W
*CONFig:TRIGger1:G/a	trigger1 in grams per year	-	R/W
*CONFig:TRIGger1:MBAR*l/s	trigger1 in mbar*l/s	385	R/W
*CONFig:TRIGger1:OZ/yr	trigger1 in ounce per year	-	R/W
*CONFig:TRIGger1:PA*m3/s	trigger1 in Pa*m3/s	-	R/W
*CONFig:TRIGger1:PPM	trigger1 in parts per million	-	R/W
*CONFig:TRIGger1:SCCM	trigger1 in sccm	-	R/W

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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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)	432	R/W
*CONFig:UNIT:LRVac	leak rate unit vac mode (ATM*cc/s, MBAR*l/s, PA*m3/s, TORR*l/s, sccm)	431	R/W
*CONFig:UNIT:Pressure	pressure unit (ATM, MBAR, PA, TORR)	430	R/W
*CONFig:UNIT:SNDisplay	Display unit sniff	396	R/W
*CONFig:UNIT:VACuum	Display unit vacuum	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.	521	R/W
*FACtor:CALVac	Calibration factor vacuum for currently used mass.	520	R/W
*FACtor:EQUISNIFF:M2	Equivalence gas factor for sniff operation mode for mass #1	469	R/W
*FACtor:EQUISNIFF:M3	Equivalence gas factor for sniff operation mode for mass #2	469	R/W
*FACtor:EQUISNIFF:M4	Equivalence gas factor for sniff operation mode for mass #3	469	R/W
*FACtor:FACMachine	Machine factor for currently used mass.	522	R/W
*FACtor:FACSniff	Sniff factor for currently used mass.	523	R/W
*FACtor:RESistor	resistor factor 500G/15G	504	R/W
*HOUR:CATHODE1	Operating hours of cathode 1 [h]	148	R
*HOUR:CATHODE2	Operating hours of cathode 2[h]	149	R
*HOUR:DATE	Date (DD,MM,YYYY)	450	R/W
*HOUR:DEVice	operating hours of device	142	R
*HOUR:POWer	time since switching on (in minutes)	147	R
*HOUR:TC	operating hours of TMP converter	141	R
*HOUR:TIME	Time (HH,MM)	450	R/W

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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
*IDN:BOOTversion	Software version bootloader main	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:TCHARDware	Hardware version of the TMP frequency converter	-	R
*IDN:TCNAME	Turbo converter type	-	R
*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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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: Byte 1, Bit 4: DIP_3: Byte 1, Bit 5: DIP_4 Byte 1, Bit 6: DIP_5	261	R
*MEASure:DIGITALOUT	state of the PLC outputs as 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: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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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
*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.	134	R
*MEASure:P4	P4 pressure. For service 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].	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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*MEASure:U15P	+15 V supply [V]	210	R
*MEASure:U24	24 V supply [V]	200	R
*MEASure:U24IO	24 V supply IO [V]	213	R
*MEASure:U24IO_OUT	24V power out IO [V]	219	R
*MEASure:U24PI	24 V power out pirani [V]	214	R
*MEASure:U24PWR1_2	24 V power out12 [V]	215	R
*MEASure:U24PWR3_4	24 V power out34 [V]	216	R
*MEASure:U24PWR5_6	24 V power out56 [V]	217	R
*MEASure:U24RC	24V_2 power out RC [V]	212	R
*MEASure:U5	+5 V supply [V]	218	R
*MEASure:UHEAT	Cathode heating voltage [V]	-	R
*MEASure:UVV	preamplifier voltage [V]	202	R
*READ	leak rate in selected unit	128	R
*READ:ATM*cc/s	leak rate 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	-	R
*READ:TORR*l/s	leak rate in Torr*l/s	-	R
*RST:CALHistory	Clears calibration history	1161	W
*RST:ERRORHistory	Clears error history	1161	W
*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

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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: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
*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, CLOSE, FAIL, OPEN)	260	R

Command	Meaning	Relates to LD cmd. no.	Read / Write
*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
*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.	-	R
*STATus:EMISsion	Emission status: STOP, START, WAIT, RAMP, REGUL, STABLE, DOWN, OFF	264	R
*STATus:ERRHist	Actual error history entry 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 I*Zero 3.0 "STABLE", "UNSTABLE" use *ZERO:ON with I*Zero 3.0 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	297	R
*STATus:ZERO	Zero (ON, OFF)	6	R
*STOp	stop	2	W
*ZERO	switch zero on	6	W
*ZERO:OFF	switch zero off	6	W
*ZERO:ON	switch zero on	6	W

2.5 Examples

External Calibration

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

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

2.6 Error Messages

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

3 LD Protocol

3.1 Communication Parameters

Data format

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

3.2 Command format

3.2.1 Telegram structure

Master sends

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

Slave answers

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

Command	Meaning	
ENQ	0x05	Start of master request
STX	0x02	Start of slave response
LEN	Number of telegram bytes	without ENQ(STX)/LEN, however with CRC max. 253, so the total slave telegram length is max. 255
ADR	Slave address	Slave address = 1: non-addressed bus. Address byte is ignored.
Stw H/L	Status word	Info from slave to master see "Status Word [▶ 27]"

Command	Meaning	
Cmd H/L	Command	Bit 15 … 13: Command-specifier Read/Write etc. see "Commands [▶ 29]" Bit 12: free Bit 11 … 0: Command see "Commands [▶ 29]"
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.
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 [▶ 24]"
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 [▶ 9]": 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 1 = Measuring VAC 2 = Measuring SNIF 3 = Standby VAC 4 = Standby SNIF 5 = Calibration VAC 6 = Calibration SNIF 7…14 = not used 15 = Not READY
Bit 1	
Bit 2	
Bit 3	
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

Status word bit no.	Meaning
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 No operation	R	N/A	NO_DATA	"No operation", replies without data	X
1	1	Start	W	N/A	NO_DATA	Switch from "standby" to "measure"	X
2	2	Stop	W	N/A	NO_DATA	Switch from "measure" to "standby"	X
4	4	Start calibration	W	N/A	UINT8	Start calibration: 0 = internal 1 = external 4 = proof internal 5 = proof external	
5	5	Clear error	W	N/A	NO_DATA	Clear Error or Warning	X
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	Read only
10	A	TMP nominal status	R/W	no	UINT8	TMP nominal status 0 = off 1 = on	Read only
11	B	Calibration acknowledge	W	N/A	UINT8	1 = Continue calibration 0 = cancel calibration	X
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	
120	78	Proof int testleak [mbar*l/s]	R	no	FLOAT	Result of proof function	
128	80	Leak rate [sel. unit]	R	no	FLOAT	Leak rate in selected unit	Read only
129	81	Leak rate [mbar*l/s]	R	no	FLOAT	Leak rate in mbar*l/s	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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	Read only
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	Read only
134	86	Pressure sensor 3	R	no	FLOAT	p3 sensor (0…10 V). Config via commands 2630,2634,2638	
135	87	Pressure sensor 4	R	no	FLOAT	p4 sensor (0…20 mA) Config via commands 2632,2636,2639	
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	Read only
140	8C	TMP operation hours [h]	R	yes (TMP)	UINT32	TMP operation hours	Read only
141	8D	Frequency converter operation hours [h]	R	yes (TMP)	UINT32	Frequency converter operation hours [h]	Read only
142	8E	Leak detector operation hours	R	yes	UINT32	Leak detector operation hours	Read only
143	8F	TMP temperature bottom [deg. C]	R	no	FLOAT	TMP temperature bottom [deg. C] (Pfeiffer TMP only)	Read only
144	90	TMP temperature electronic [deg. C]	R	no	FLOAT	Shimadzu-TMP: TMP controller temperature Pfeiffer-TMP: TMP electronic temperature	Read only
145	91	TMP temperature bearing [deg. C]	R	no	FLOAT	Shimadzu: TMP bearing temperature Pfeiffer TC80: TMP rotor temperature	Read only
146	92	TMP temperature motor [deg. C]	R	no	FLOAT	Shimadzu: TMP bearing temperature Pfeiffer TC80: TMP power stage temperature	Read only

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
147	93	Time since power on [min]	R	no	UINT32	Time since power on [min]	Read only
148	94	Cathode1 operation hours	R	yes	UINT32	Cathode1 operation hours	
149	95	Cathode2 operation hours	R	yes	UINT32	Cathode2 operation hours	
150	96	TMP voltage [V]	R	no	FLOAT	TMP voltage as reported by TMP controller	Read only
151	97	TMP current [A]	R	no	FLOAT	TMP current as reported by TMP controller	Read only
157	9D	Switch on counter	R	yes	UINT16	Counts the switch on cycles	Read only
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	Read 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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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	
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	Read 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	X
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	X
228	E4	Gasballast mode	R/W	yes	UINT8	0 = off, 1 = on, 2 = on (continuous on, not PLC controlled)	
260	104	Calibration status	R	no	UINT8	Status of calibration See table "State calibration"	
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	Read only
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."	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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	R	yes	UINT8	History list index of the last (newest) entry in the calibration history	
275	113	Cal history	R	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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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"	Read only
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"	Read only
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	
300	12C	Device identification	R	N/A	UINT8[2]	Device identification, alway {1,41}	
301	12D	Device name	R	N/A	CHAR[*]	Get device name as ASCII string, always "LDS Arnova"	Read only
308	134	Control unit OS software version	R/W	N/A	CHAR[30]	Software version control unit operating system. Write for internal use only.	Read 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	
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	Read only

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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)	Read only
316	13C	HW-version TMP controller	R	N/A	CHAR[6]	HW version TMP controller (character string from TMP controller)	Read only
317	13D	TMP controller name	R	N/A	CHAR[6]	TMP controller name (character string from TMP controller)	Read only
318	13E	SW version boot loader	R	N/A	UINT8[3]	Software version of boot loader	Read only
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	Read only
320	140	CRC-code MSB	R	N/A	UINT32	CRC-code interface board abcdwxyz (hex) abcd: caclulated value wxyz: nominal value	
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 - LDS Arnova	
322	142	Field bus status word	R	no	UINT16	Status word for Bus module refer to Bus module documentation	Read only

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
323	143	SW version bus module	R	N/A	UINT8[3]	SW version bus module	Read only
324	144	Bus module field bus type	R	no	UINT16	Bus module fieldbus type. Refer to AnybusCC specification for enumeration.	Read only
325	145	Serial number plug-in unit bus module	R	N/A	UINT8[4]	Serial number plug-in unit bus module	Read only
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.	Read only
328	148	Exception code bus module	R	no	UINT8	Exception code bus module	Read only
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	Read only
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	Read only
331	14B	Field bus address nominal value	R/W	yes	UINT8	Fiedbus address nominal value Refer to AnybusCC specification for enumeration.	
336	150	Field bus station name	R	yes (BM)	CHAR[*]	BM1000 Station name (PROFINET IO only)	Read only

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
337	151	Field bus IP address	R	yes (BM)	UINT8[4]	BM1000 IP address (IP based field busses only)	Read only
338	152	Field bus IP subnet mask	R	yes (BM)	UINT8[4]	BM1000 IP subnet mask (IP based field busses only)	Read only
339	153	Field bus gateway IP address	R	yes (BM)	UINT8[4]	BM1000 gateway IP address (IP based field busses only)	Read only
340	154	Field bus DHCP enabled	R	yes (BM)	UINT8	BM1000 DHCP (IP based field busses only) 0=disabled; 1=enabled	Read only
350	15E	Serial number control unit	R	N/A	CHAR[11]	Serial number control unit Write for internal use only.	Read 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	
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	
390	186	Test leak extern vacuum [mbar*l/s]	R/W	yes	FLOAT[3]	Test leak extern Vacuum [mbar*l/s] Index 0: Mass #1 Index 1: Mass #2 Index 2: Mass #3	
392	188	Test leak extern sniff [mbar*l/s]	R/W	yes	FLOAT[3]	Test leak extern for sniff mode in mbar*l/s Index 0: Mass #1 Index 1: Mass #2 Index 2: Mass #3	
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
398	18E	Language	R/W	yes	UINT8	english = 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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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	
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.	
405	195	Serial number TMP controller	R	N/A	CHAR[11]	Serial number TMP controller (Leybold TMP only)	Read only
406	196	Serial number leak detector	R	yes	CHAR[11]	Serial number of the complete leak detector	Read only
407	197	Serial number MSB	R	N/A	CHAR[11]	Serial number of the MSB	Read only
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	
416	1A0	Gas percentage	R/W	yes	FLOAT[3]	Forming gas percentage, always 100%	
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 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 Mass #1[V]	R/W	yes	FLOAT	Anode voltage setpoint for mass #1 in V	
434	1B2	Anode setpoint Mass #2 [V]	R/W	yes	FLOAT	Anode voltage setpoint for mass #2 in V	
435	1B3	Anode setpoint Mass #3 [V]	R/W	yes	FLOAT	Anode voltage setpoint for mass #3 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	SINT8[10]	Configuration of PLC input port of the IO module Index 0...9 = PLC_IN1...PLC_IN10	
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	
448	1C0	Valve control location	R/W	no	UINT16	Bit=0: Controled by leak detector Bit=1: Controled by write command 449	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
449	1C1	Switch valves	R/W	no	UINT16	see table "Valves" For setting valve by write command see also command 448	
450	1C2	Date+Time [YMDhms]	R/W	yes (RTC)	UINT8[6]	Date and time of the battery-buffered real-time clock use only with array-index 255 (all bytes) year (1..99), month, day, hour (0..23), min, sec	X
452	1C4	Min pressure sniff [mbar]	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 [mbar]	R/W	yes	FLOAT	Maximum pressure p1 in mbar for sniff. If pressure rises above this value, warning 542 (Sniffer broken) is generated.	
469	1D5	Equivalence gas factor sniff	R/W	yes	FLOAT[3]	Equivalence gas factor for sniff operation mode. Always 1	
470	1D6	Molar mass of equivalence gas [g/mol]	R/W	yes	FLOAT[3]	Molar mass of equivalence gas in g/mol Index 0: Mass #1 Index 1: Mass #2 Index 2: Mass #3	
479	1DF	CalMate mode	R/W	yes	UINT8	Mode for calibration or proof with CalMate. 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	
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	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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 I*Zero 3.0 only if stable	
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	500 GOhm value	R/W	yes	FLOAT	500 GOhm value	
506	1FA	Mass	R/W	yes	UINT8	0 = Mass #1 1 = Mas #2 2 = Mas #3	
507	1FB	Anode voltage stepoints [V]	R/W	yes	FLOAT[3]	Anode voltage setpoints in Volt Index 0: Anode voltage for Mass #1 Index 1: Anode voltage for Mass #2 Index 2: Anode voltage for Mass #3	
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	

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 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. 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. 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	0 = no warning without sniffer 1 = warning (warning No. 130) without sniffer	
530	212	Cathode selection	R/W	yes	UINT8	0 = CAT1 1 = CAT2 2 = Auto Cat1 3 = Auto Cat2 4 = OFF	
574	23E	Popup message number	R	no	UINT8	Number of pop message. "0" means no message	X

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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.	
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	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 vac. time constant [s]	R	yes	FLOAT	EcoBoost vacuum time constant	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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
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 leak rate	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
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: not used 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.	Read only

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).	Read only
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	
1620	654	Amplifier test currents [A]	R	no	FLOAT[5]	Test currents ca. 1.3E-11 A	
1771	6EB	Leak rate without zero [mbar*l/s]	R	N/A	FLOAT	leak rate without zero (only with EcoBoost)	
1772	6EC	Prediction of leak rate [mbar*l/s]	R	N/A	FLOAT	Prediction of leak rate (only with EcoBoost)	
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	Read only
1815	717	Reset source	R	no	UINT8	Shows the last reason of reset	Read only
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	Read only

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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)	
2632	A48	P4 min max pressure	R/W	yes	FLOAT[2]	Range sensor 4 (0..20 mA)	
2634	A4A	P3 min max voltage [V]	R/W	yes	FLOAT[2]	Voltage range sensor 3 (0..10 V)	
2636	A4C	P4 min max current [mA]	R/W	yes	FLOAT[2]	Current range sensor 4 (0..20 mA)	
2638	A4E	P3 mode	R/W	yes	UINT8	Sensor 3 mode 0=lin, 1=log	
2639	A4F	P4 mode	R/W	yes	UINT8	Sensor 4 mode 0=lin, 1=log	
2650	A5A	Set suppressor voltage [V]	R/W	no	FLOAT	Suppressor voltage for test	X
2657	A61	Anode peak width voltages [V]	R	yes	FLOAT[3]	Information about peak width of last peak finding Index 0: Voltage to the left of the peak with half the ion current of the peak Index 1: Voltage of peak Index 2: Voltage to the right of the peak with half the ion current of the peak All values are anode voltages in volts	

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
2658	A62	Anode peak ion currents [A]	R	yes	FLOAT[2]	Information about ion currents at peak from last peak finding Index 0: Ion current when leak is open Index 1: Ion current when leak is closed All values are ion currents in amperes	
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
2663	A67	Test good bad 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

Command dec	Command hex	Name	Read / Write	non volatile	Data type	Meaning	No fieldbus support
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
5	5 V/decade
6	10 V/decade
7	special 1

State calibration (command 260)

Value	State name	Meaning
0	CAL_STATE_READY	Leak detector is ready for operation
1	CAL_STATE_START_INT	Internal calibration is running
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	External calibration is running
13	CAL_STATE_PEAK_EXT	
14	CAL_STATE_MEAS_TL_EXT	
15	CAL_STATE_WAIT_ZERO_EXT	External calibration is running: Leak detector waits, close external test leak
16	CAL_STATE_MEAS_ZERO_EXT	External calibration is running (measure background)
41	CAL_STATE_START_PROOF_EXT	External proof function is running
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	Internal proof function is running
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	Error: Calibrated leak value to small
54	CAL_STATE_FAIL_FACTOR	Error: Calibration factor out of range
55	CAL_STATE_WARN_FACTOR	Warning message: Calibration factor is substantially higher or lower than the old factor
56	CAL_STATE_FAIL_EMIS	Error message: Emission fail

Value	State name	Meaning
57	CAL_STATE_PROOF_DEV	Warning message: Proof failed, please recalibrate
59	CAL_STATE_PEAKERR	Error during peak finding

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
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

Value	Meaning
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
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
2	CAL_EXTERN
3	CAL_INTERN
5	START
6	STOP
7	ZERO

Value	Function
8	ZERO_PULS
9	CLEAR
10	GASBALLAST
12	START_STOP
13	KEY_1
14	KEY_2
15	KEY_3
16	CAL
17	ZERO_UP
18	TL
19	TL_PULS
22	PROOF_INT
23	PROOF_EXT
24	START_PULS
25	MASS2_4

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

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 LDS Arnova, you need an INFICON Bus-Module BM1000 connected to the I/O port of the LDS Arnova.

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 INFICON website (www.inficon.com).

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".

Attention:

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

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)

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 1 ≙ 0x02 : on	ZERO active	*STATUS:ZERO?	
		2	Error	0 : no error 1 ≙ 0x04 : error	Error		Status word
		3	Warning	0 : no warning 1 ≙ 0x08 : warning	Warning		Status word
		4 5	State internal calibration	0 : inactive 1 ≙ 0x10 : active 2…3 ≙ 0x20/0x30 : not used	CAL active	*STATUS:CAL?	260
		6 7	State external calibration	0 : inactive 1 ≙ 0x40 : active 2 ≙ 0x80 : waiting for test leak closed 3 ≙ 0xC0 : not used	CAL active	*STATUS:CAL?	260

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	Calibration request	0 : CAL request function disabled 1 ≙ 0x01 : CAL request function enabled but no CAL requested 2 ≙ 0x02 : CAL request function enabled and CAL requested 3 ≙ 0x03 : not used	CAL request	*CONFIG:CALREQ?	419
		1					
		2	Emission	0 ≙ 0x00 : Emission off 1 ≙ 0x04 : Cathode 1 fixed 2 ≙ 0x08 : Cathode 2 fixed 3 ≙ 0x0C : Cathode 1 auto 4 ≙ 0x10 : Cathode 2 auto	Emission on	*STATUS:CATHODE?	530
		3					
		4					
		5	State	0 ≙ 0x00 : Standby 1 ≙ 0x20 : Error 2 ≙ 0x40 : Calibration 3 ≙ 0x60 : Runup 4 ≙ 0x80 : Measure 5 ≙ 0xA0 : Emission Off 6 … 7 ≙ 0xC0 … 0xE0 : not used	Run up, CAL active, Error, Ready,	*STATUS?	Status word
		6					
		7					
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
trigger_status	13	0	Status of Trigger 1	0 = Leak rate lower than trigger level 1 = Leak rate higher than trigger level	Trigger 1	*STATUS:TRIGger?	387
		1	Status of Trigger 2		Trigger 2		
		2	Status of Trigger 3		Trigger 3		
		3	Status of Trigger 4		Trigger 4		
		4…7	not used	always 0			

Title	Byte	Bit	Name	Meaning	Similar to IO1000 Output	Similar to RS232 ASCII cmd.	Similar to RS232 LD cmd.
calibration_status	14		calibration_status	For possible values please refer to command 260 see table 3.4, "Commands [▶ 29]".	CAL active	*STATUS:CAL?	260
leak_detector ID	15		leak_detector ID	always 45 for LDS Arnova 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

Fieldbus	Rule	Example for LD_command_number 506 (Mass)
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 [▶ 9]".

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}… $+(2^{63}-1)$
17	UINT64	64	Unsigned 64 bit integer	0… $+(2^{64}-1)$
18	FLOAT	32	Floating point (IEC 60559)	±1.17549435E-38… ±3.40282347E+38

4.5 Hardware Configuration for Profibus

4.5.1 Assignment of the PROFIBUS Address

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

To assign the PROFIBUS address via CU1000 select

- ▶ Main Menu > Settings > Set up > Interfaces > Bus module > Address

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

- ▶ refer to the documentation of your PLC.

4.5.2 Diagnosis with the CU1000 Info Menu

The current state of the BM1000 is visible in the info menu of the control unit CU1000:

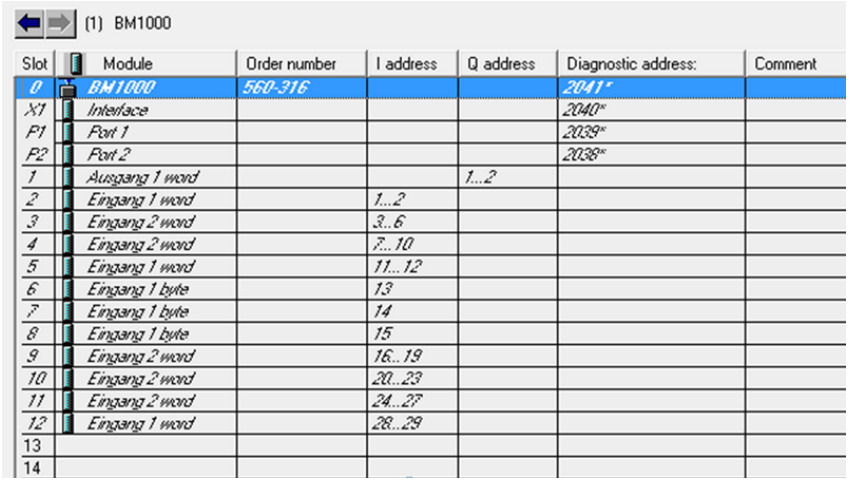
- ▶ Menu > Info > Interfaces, Page 2 - Info Bus module

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.


(1) BM1000

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 Trouble Shooting

5.1 Serial communication via RS232 (common)

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

5.2 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

5.3 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. Use example source code at https://github.com/INFICON/LD_ProtocolExample as reference. Check your code with unit test function in this source code file.

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