



Protocol Description

ELT Vmax

Battery Leak Detector

Catalog No.
600-301

From software version
V1.41



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1 Interface Protocols

Note:

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.

1.1 Serial Interface Protocols

With the IO1000 module you can communicate with ELT Vmax via the following serial interface protocol:

- LD Protocol

The serial interface protocol can be selected via DIP switch at the IO module IO1000 or via operating unit of ELT Vmax. Please refer to appropriate documentation.

1.2 Field Bus Protocol

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

2 LD Protocol

2.1 Communication Parameters

Data format

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

2.2 Command format

2.2.1 Telegramm 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

Command	Meaning	
STX	0x02	Start of slave response
LEN	Number of telegram bytes	without ENQ(STX)/LEN, however with CRC max. 253, so the total slave telegram length is max. 255
ADR	Slave address	Slave address = 1: non-addressed bus. Address byte is ignored.
Stw H/L	Status word	Info from slave to master (see page 9)
Cmd H/L	Command	Bit 15 ... 13: Command-specifier Read/Write etc. (see table "Cmd H/L: Command: Command-specifier") Bit 12: free Bit 11 ... 0: Command (see page 10)
DATA	Data belonging to master request (Slave reply to write command is sent without data)	$0 \leq n \leq 248$ If I/O module (7-byte additional header) is used, then limit maximum data length to 241.
CRC	Checksum	Calculate CRC for all bytes (except CRC byte) Polynomial: 0x98, Name: DOWCRC, Maxim/Dallas, $X^8+X^5+X^4+1$ Info: CRC calculation see file "CRC_calculation.c" (C source code)

Cmd H/L: Command: Command-specifier

Bit 15 ... 13	Meaning	High Nibble (Hex)	Comments
000	Read value	0	
001	Write value	2	

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

Command name in plain text

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

Command info

1. Byte	Data type (see table "Data types")
2. Byte	Number of array elements: 0 = no data, no array 1 = data, no array 2 ... 255 = array
3. Byte	Bit 0: 1 = Reading allowed, 0 = Reading not allowed Bit 1: 1 = Writing allowed, 0 = Writing not allowed Bit 2 and 3: These bits indicate whether additional data is required for a read command: Bit 2=0 & Bit3=0: no additional data required Bit 2=1 & Bit3=0: 1 Byte additional data required

Bit 2=0 & Bit3=1: 2 Byte additional data required
 Bit 2=1 & Bit3=1: 4 Byte additional data required
 Bit 4 ... 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 (LD command 4)

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

- Read single elements: Array index in first DATA-byte
- Write single elements: Array index in first DATA byte and values in following DATA bytes
- Read all elements: Pseudo array index 255 in first DATA byte

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

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

Array parameters in commands table (see chapter 2.4): The number of array elements is set in brackets behind the data type.

2.3 Status Word

Status word bit no.	Meaning
Bit 0	0 = RUNUP 1 = STANDBY 2 = EVACUATION 3 = MEASURE 4 = CALIBRATION 5 = ERROR 6 = EMPTY CHAMBER
Bit 1	
Bit 2	
Bit 3	
Bit 4	not used
Bit 5	Still pending device warning
Bit 6	not used
Bit 7	not used
Bit 8	PLC Output Change
Bit 9	Setpoint 1, 1 = Setpoint 1 exceeded

Status word bit no.	Meaning
Bit 10	Setpoint 2, 1 = Setpoint 2 exceeded
Bit 11	Value changed via interface command. Refer to command 1565.
Bit 12	not used
Bit 13	Unconfirmed device warning
Bit 14	Device error
Bit 15	Syntax/Command error

2.4 Commands

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
0	0	NOP	R	NO_DATA	"No operation", replies without data	X
1	1	Start	W	NO_DATA	Start	
2	2	Stop	W	NO_DATA	Stop	
4	4	Start calibration	W	UINT8	<p>Start calibration:</p> <p>2 = Zero (empty chamber) with mol mass of the measurement</p> <p>3 = inline</p> <p>4 = measure empty chamber with mol mass of calibration (only inline; only required if meas mass is different from calibration mass)</p> <p>Command sets calibration state; start with command 11 (calibration acknowledge) afterwards</p>	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
5	5	Clear error	W	NO_DATA	Clear Error or Warning	
11	B	Calibration acknowledge	W	UINT8	Calibration acknowledge 0 = cancel 1 = continue	
15	F	Purge	R/W	UINT8	Purge Write: 0 = Cancel 4 = Simple purge on Read: 1 = Idle 4 = Simple purge	
128	80	Leak rate [interface unit]	R	FLOAT	Leak rate [interface unit]	
129	81	Leak rate [mbar*l/s]	R	FLOAT	Leak rate [mbar*l/s]	
130	82	Internal pressure 1 [interface unit]	R	FLOAT	Pressure p1 in interface unit	
131	83	Internal pressure 1 [mbar]	R	FLOAT	Pressure p1 in mbar	
132	84	Internal pressure 2 [interface unit]	R	FLOAT	Pressure p2 in interface unit	
133	85	Internal pressure 2 [mbar]	R	FLOAT	Pressure p2 [mbar]	
142	8E	Leak detector operation hours	R	UINT32	Leak detector operation hours	
147	93	Time since power on [min]	R	UINT32	Time since power on [min]	
157	9D	Switch on counter	R	UINT16	Counts the switch on cycles	
165	A5	Electronic temperature [deg. C]	R	FLOAT	Internal temperature in °C	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
200	C8	24 V supply [V]	R	FLOAT	24 V supply voltage(internal) in V	
210	D2	+15 V supply [V]	R	FLOAT	+15 V supply voltage	
213	D5	24 V supply IO [V]	R/W	FLOAT	24 V IO-Modul supply voltage [V] write for internal use only	
216	D8	24 V supply PC-board [V]	R	FLOAT	24 V PC board voltage (digital used)	
218	DA	+5 V supply [V]	R	FLOAT	+5 V supply voltage	
219	DB	24V power out IO [V]	R	FLOAT	24 V output voltage for IO-Modul, pressure sensors, chamber lights	
220	DC	Analog input IO module [V]	R	FLOAT	Analog input voltage IO module in [V] write for internal use only	
221	DD	Analog outputs IO [V]	R/W	FLOAT[2]	Analog output voltage for IO module in [V] It is possible to write an arbitrary voltage value, if the "Analog output configuration" (command 222) of the accordant channel is set to 8	
222	DE	Analog output configuration IO module	R/W	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	UINT8	Leak rate scaling of analog output in logarithmic mode	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Functions see table "Analog output configuration"	
224	E0	Analog output upper exponent	R/W	SINT8	Upper limit for the analog out at the I/O module. Value is exponent of the value in selected unit. Example: -5 = 1E-5	
242	F2	5V internal supply [V]	R	FLOAT	Internal 5V reference	
259	103	Text of calibration state	R	CHAR[*]	Text of an calibration state / result To read send after the index the UINT8 state number Without state number you will get the actual calibration state Use only with index=255!	X
260	104	State calibration	R	UINT8	Status of calibration See table "State calibration"	
261	105	PLC input state IO module	R/W	UINT16	Get PLC input state and DIP switch state IO module Bit 0..9 = PLCin 1..10 Bit 10..15 = DIP 1..6 (S1.1,S1.2,S1.3,S1.4,S2.1,S2.2) write for internal use only	
262	106	PLC output state IO module	R	UINT8	Get PLC output state IO module Bit0..7 = PLCOut 1..8	
263	107	PLC output configuration IO module	R/W	SINT8[8]	Index 0...7 = PLC_OUT1 ... PLC_OUT_8 See table "PLC output conf."	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
275	113	Calibration log	R	CHAR[*]	<p>Text of a calibration in calibration log.</p> <p>To read send after the array index 255 the UINT8 history list index (0...19).</p> <p>Without index or index 0 you will get the last (newest) entry.</p> <p>Index 19 is the eldest on.</p> <p>Answer format:</p> <p>ListNo, Calfac(float), Testleak(float), Mass, VAC or SNIF, year/month/day, hour:min:sec,</p> <p>Example:</p> <p>"Fac: 1.08E+0 Leak: 1.54E-7 Mass: 467 2015/08/21 10:13:46"</p>	X
280	118	Used entries in calibration log	R	UINT8	Used entries in calibration log	X
281	119	Used entries in error log	R	UINT8	Used entries in error log	X
287	11F	Error log	R	CHAR[*]	<p>Text of an error/warning in error log.</p> <p>To read send after the array index 255 the UINT8 history list index (0...19).</p> <p>Without index or index 0 you will get the last (newest) entry.</p> <p>Index 19 is the eldest one.</p> <p>Answer:</p>	X

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Calfac(float), Testleak(float), Mass, year/month/day, hour:min:sec, Example: "Fac: 1.08E+0 Leak: 1.54E-7 Mass: 59 2015/08/21 10:13:46"	
289	121	Value of actual error	R	FLOAT	Value associated with the actual error or warning	
290	122	Number of actual error or warning	R	UINT16	Error number of the actual error or warning	
291	123	List of signal values of active errors	R	FLOAT[10]	Lists the signal values of the errors/warnings since the last "clear error"	
294	126	Text of error number	R	CHAR[*]	text of an error/warning number To read send after the index the UINT16 error number Without error number you will get the actual error/warning Use only with index=255!	X
295	127	Text of warning bits	R	CHAR[*]	Explanation text for a specific warning bit: To read, send after the index the UINT8 bit position Use only with index=255!	X
296	128	List of active errors or warnings	R	UINT16[10]	Lists the error/warning numbers since the last "clear error"	
297	129	Present warnings	R	UINT32	Each bit represents a warning see enumerations table	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
298	12A	Sniffer button	R	UINT8	Read state SL3000 sniffer button Bit 0 = 1: Left Button pressed Bit 1 = 1: Right button pressed	
300	12C	Device identification	R	UINT8[2]	Device identification Index 0: 1 - INFICON Index 1: 71 -ELT Vmax	
301	12D	Device name	R	CHAR[*]	Get device name as ASCII string, always "ELT Vmax "	
309	135	SW-version web server	R/W	UINT8[3]	Software version of web server based operating unit Index 0: Main version Index 1: Sub version Index 2: Debug version write for internal use only	Read only
310	136	SW-version MSB	R	UINT8[3]	Software version basic unit Index 0: Main version Index 1: Sub version Index 2: Debug version	
313	139	SW-version I/O module	R/W	UINT8[3]	Software version IO module Index 0: Main version Index 1: Sub version Index 2: Debug version	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					write for internal use only	
318	13E	SW version boot loader	R	UINT8[3]	Software version of boot loader	
319	13F	SW version boot loader I/O module	R/W	UINT8[3]	Software version of boot loader IO module write for internal use only	
320	140	CRC-code basic unit	R	UINT32	CRC-code basic unit abcdwxyz (hex) abcd: calculated value wxyz: nominal value	
321	141	DIP switch basic unit	R	UINT8	DIP switch setting of basic unit Bit 0..3: S1.1 .. S1.4 Bit 4..7: S2.1 .. S2.4	
322	142	Field bus status word	R	UINT16	Status word for Bus module refer to Bus module documentation	
323	143	SW version bus module	R	UINT8[3]	SW version bus module	
324	144	Bus module fieldbus type	R	UINT16	Bus module fieldbus type. Refer to AnybusCC specification for enumeration.	
325	145	Serial number plug-in unit bus module	R	UINT8[4]	Serial number plug-in unit bus module	
326	146	Field bus address actual value	R	UINT8	Fiedbus address actual value Refer to AnybusCC specification for enumeration.	
327	147	Field bus baud rate	R	UINT8	Baud rate at field bus Refer to AnybusCC specification for enumeration.	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
328	148	Exception code bus module	R	UINT8	Exception code bus module	
329	149	Error counters bus module	R	UINT16[4]	Error counters bus module Index: 0: Discarded commands 1: Discarded Responses 2: Serial Reception errors 3: Fragmentation errors	
330	14A	Bus module state	R	UINT8	State of bus module 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	UINT8	Fieldbus address nominal value Refer to AnybusCC specification for enumeration.	
336	150	Field bus station name	R	CHAR[*]	BM1000 Station name (PROFINET IO only)	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
337	151	Field bus IP address	R	UINT8[4]	BM1000 IP address (IP based field busses only)	
338	152	Field bus IP subnet mask	R	UINT8[4]	BM1000 IP address (IP based field busses only)	
339	153	Field bus gateway IP address	R	UINT8[4]	BM1000 gateway IP address (IP based field busses only)	
340	154	Field bus DHCP enabled	R	UINT8	BM1000 DHCP (IP based field busses only) 0=disabled; 1=enabled	
351	15F	Ethernet IP address	R	UINT8[4]	IP address of Ethernet port. Write for internal use only. IP address cannot be set via this command.	
352	160	Ethernet IP sub net mask	R	UINT8[4]	IP sub net mask of Ethernet port. Write for internal use only. IP sub net mask cannot be set via this command.	
353	161	Ethernet MAC address	R	UINT8[6]	MAC address of Ethernet port. Write for internal use only. MAC address is not settable via this command.	
354	162	Mass storage serial number	R	CHAR[30]	Serial number of solid state drive. Write for internal use only.	
384	180	Setpoint [interface unit]	R/W	FLOAT[4]	Setpoint in interface unit Index 0: Setpoint 1	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					(used for Alarm) Index 1: Setpoint 2 Index 2: Setpoint 3 Index 3: Setpoint 4	
385	181	Setpoint [mbar*l/s]	R/W	FLOAT[4]	Setpoint in mbar*l/s Index 0: Setpoint 1 (used for Alarm) Index 1: Setpoint 2 Index 2: Setpoint 3 Index 3: Setpoint 4	
387	183	Setpoint status	R	UINT8	Setpoint status: 0=Leak rate < setpoint 1=Leak rate > setpoint Bit 0: Setpoint 1 Bit 1: Setpoint 2 Bit 2: Setpoint 3 Bit 3: Setpoint 4	
388	184	Calibration leak external [mbar*l/s]	R/W	FLOAT	Calibration leak external [mbar*l/s]	
406	196	Serial number leak detector	R	CHAR[11]	Serial number of the complete leak detector	X
407	197	Serial number basic unit	R	CHAR[11]	Serial number basic unit (internal IO1500)	X

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
408	198	Serial number IO module	R/W	CHAR[11]	Serial number of the optional IO module	X
419	1A3	Calibration request enable	R/W	UINT8	0 = Calibration request disabled 1 = Calibration request enabled	
430	1AE	Pressure interface unit	R/W	UINT8	Pressure unit interface mbar = 0 Pa = 1 atm = 2 Torr = 3	
431	1AF	Leak rate interface unit vacuum	R/W	UINT8	Leak rate unit interface 0 - mbar*/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*/s	
438	1B6	PLC input configuration IO module	R/W	SINT8[10]	Configuration of PLC input port of the IO module Index 0...9 = PLC_IN1...PLC_IN10 See table "PLC input conf."	
449	1C1	Valve state	R	UINT16	State of the valves Bit=0: closed Bit=1: open Bit 0...5: V1...V6	X
450	1C2	Date+Time [YMDhms]	R/W	UINT8[6]	Date and time use only with array-index 255 (all bytes)	X

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					year (1..99), month, day, hour (0..23), min, sec	
454	1C6	Lower leak rate limit	R/W	UINT8	Lower leak rate limit (decades) 0 = 1E-7 mbar*l/s 1 = 1.0E-6 mbar*l/s 2 = 1.0E-5 mbar*l/s 3 = 1.0E-4 mbar*l/s	
517	205	Offset chamber calibration mass [A]	R/W	FLOAT	Offset empty chamber [A] with mol mass of calibration	X
518	206	Offset chamber [A]	R/W	FLOAT	Offset empty chamber [A] with mol mass of the measurement	X
520	208	Calibration factor	R/W	FLOAT	Calibration factor	
555	22B	Max. evacuation time until measure [s]	R/W	UINT16	Maximum evacuation time until measure mode should be reached. This means that the chamber reaches the measurement pressure (Vacuum). If this time is exceeded, the leak detector shows error message no. 580.	
574	23E	Popup message number	R	UINT8	Number of pop message. "0" means no message	X
575	23F	Text of popup message number	R	CHAR[*]	text of popup message To read send after the index the UINT8 popup message number	X

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Without error number you will get the text of the actual popup message Use only with index=255!	
576	240	Clear popup message	W	NO_DATA	Clear popup message. Sets number of popup message to "0"	X
800	320	Pressure display unit	R/W	UINT8	Display unit for pressures mbar = 0 Pa = 1 atm = 2 Torr = 3	
801	321	Leak rate display unit	R		Display unit for leak rate 0 - mbar*I/s 1 - Pa*m3/s 2 - Atm ccs 3 - Torr*I/s	
810	32A	Internal pressure 1 [display unit]	R	FLOAT	Pressure p1 in display unit	
811	32B	Internal pressure 2 [display unit]	R	FLOAT	Pressure p2 in display unit	
812	32C	Internal pressure 3 [display unit]	R	FLOAT	Pressure p3 in display unit	
830	33E	Calibration leak [mbar*I/s]	R/W	FLOAT	Calibration leak [mbar*I/s]	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
831	33F	Calibration leak [interface unit]	R/W	FLOAT	Calibration leak [interface unit]	
832	340	Calibration leak [display unit]	R/W	FLOAT	Calibration leak [display unit]	
840	348	Setpoint [display unit]	R/W	FLOAT[4]	Setpoints in display unit Index 0: Setpoint 1 (used for Alarm) Index 1: Setpoint 2 Index 2: Setpoint 3 Index 3: Setpoint 4	
860	35C	Leak rate [display unit]	R	FLOAT	Leak rate [display unit] (limited to lower display limit, refer to command number 454)	
865	361	Group measure [display unit]	R	UNIT8[23]	Measurement data in display unit see table / enumerations	X
880	370	Leak rate limit [mbar*/l/s]	R	FLOAT[3]	Leak rate limit in mbar*/l/s [0] = low [1] = low user [2] = high	
882	372	Leak rate limit [interface unit]	R	FLOAT[3]	Leak rate limit in interface unit [0] = low [1] = low user	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					[2] = high	
884	374	Leak rate limit [display unit]	R	FLOAT[3]	Leak rate limit in display unit [0] = low [1] = low user [2] = high	
1161	489	Parameter reset	W	UINT8	Parameter reset: 0: Load factory settings 3: Clear error history 4: Clear calibration history 6: Restart bus module 8: HMI Soft reset 9: HMI Power reset 10: TMP replaced 12: Clear test history 13: Load HMI factory settings	X
1284	504	Control word	R/W	UINT16	Control word (used for Bus module)	
1285	505	Stop service buffer	R/W	UINT8	Stop service buffer 0=recording active 1=recording stopped	
1350	546	Valve cycle counter	R	UINT32[12]	Valve cycle counter see table / enumerations	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
1365	555	Maintenance exhaust filter [h]	R	UINT32	Maintenance exhaust filter [h] 0 ... 20000h (default: 10000 h)	
1367	557	Maintenance air filter [h]	R	UINT32	Maintenance air filter [h] 0 ... 4000h (default: 2500 h)	
1399	577	Group measure [interface unit]	R	UINT8[23]	Measurement data in interface unit see table / enumerations	X
1400	578	Group measure	R	UINT8[23]	Measurement data see table / enumerations	X
1450	5AA	Select chamber	R/W	UINT16	Select Chamber: 0 = chamber not yet written (only for read) 1 = Inficon rigid chamber 2 = Inficon chamber 1 Command sets multiple parameters. When these are changed later on a read only gives the latest written chamber-number or zero.	X
1451	5AB	Select electrolyte	R/W	UINT16	Select electrolyte: 0 = electrolyte not yet written (only for read) 1 = DMC (Masse 59) 2 = R134A (Masse 69)	X

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Command sets multiple parameters. When these are changed later on a read only gives the latest written electrolyte-number or zero.	
1452	5AC	Normfactor	R/W	FLOAT	Normfactor	
1453	5AD	Molar mass to measure [g/mol]	R/W	UINT16	Mol mass 2 ... 199 used during measuring	
1454	5AE	Not used, Pre-LD-, LD-Measure-, Not used time [s]	R/W	UINT16[4]	Measure time span [0]: Not used [1]: Pre-accumulation time [2]: Leak measure time [3]: Not used	
1455	5AF	Automatic start	R/W	UINT8	Automatic start dependant of the proximity switch of the chamber flap 0 = disable 1 = enable	
1456	5B0	Vacuum chamber limit [mbar]	R/W	FLOAT	Pump down pressure of the chamber	
1459	5B3	Serial number Gas Detection Unit	R	CHAR[11]	Serial number Gas Detection Unit	
1460	5B4	Software version Gas Detection Unit	R	UINT8[3]	Software version Gas Detection Unit	
1461	5B5	Actice filament Gas Detection Unit	R	UINT8	Actice filament Gas Detection Unit 0=None, 1=A, 2=B	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
1466	5BA	Total pressure gas detection unit [mbar]	R	FLOAT	Total pressure gas detection unit [mbar]	
1470	5BE	Molar mass to calibrate [g/mol]	R/W	UINT16	Mol mass 2 ...199 used during calibration	X
1479	5C7	External pump connected	R/W	UINT8	2: external pump connected and externally controlled process 3: as 2, with Baseline-Correction	
1480	5C8	Pressure Offset external pump [mbar]	R/W	FLOAT	Pressure offset for external pump (-2.0 to 10.0 mbar; +1,0 default)	
1481	5C9	Max allowed leak test in row	R/W	UINT16	Max allowed positive leak test in a row 0: deactivate 1-9: count of allowed positive leaks before CalRequest	
1482	5CA	Clean purge limit [mbar*/l/s]		FLOAT	Purge limit that indicates that the system is clean again (0: deactivated)	
1483	5CB	Clean purge limit [Interface unit]		FLOAT	Purge limit that indicates that the system is clean again (0: deactivated)	
1484	5CC	Clean purge limit [Display unit]		FLOAT	Purge limit that indicates that the system is clean again (0: deactivated)	
1489	5D1	State of external pump / vent valves	R	UINT8	Recommended state of external valves for pump & vent Bit 0: 0: external Pump off 1: on Bit 1: 0: external vent valve closed	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					1: opened	
1499	5DB	Gross leak trigger	R/W	FLOAT	Trigger for gross leak	X
1500	5DC	Gross leak factor	R/W	FLOAT	faktorTriggerGrobeck	X
1503	5DF	Chamber pressure limit [mbar]	R/W	FLOAT	Chamber pressure limit Threshold for Warning 520 (only Inline-Process)	
1564	61C	Value changed reason	R	UINT32	Cause of setting the value changed flag (see status word bit 11). Bit 0: Mass (506), Bit 1: LD-Mesure Time (1454), Bit 2: Setpoint 1 (385), Bit 3: Setpoint 2 (385), Bit 4: Leak rate unit (432, 802, 431, 801), Bit5: Pressure unit (430, 800), Bit 6: Lower Limit Decade (454), Bit 7: Not used, Bit 8: Date+Time (450), Bit 9: Automatic-Contol Off Bit 10: not used Bit 11: not used Bit 12: Not used, Bit 13: Popup message (574)	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Bit 14: Parameter Reset (1161 with value 13) Bit 16 ... 31: not used	
1565	61D	Value changed flag	R/W	UNIT8	Value changed flag Read: Same value as Statusword Bit 11 Write: Write 0 to clear value changed flag Bit will be set if one or more Values of this list has been changed (for example via interface command): Mass (506), LD-Mesaure Time (1454), Setpoint 1, Setpoint 2, Leak rate unit, Pressure unit, Lower Limit Decade (454), Date+Time (450), Automatic-Contol Off Display-User-Limit, New Popup-Message, Parameter Reset (1161 with value 13)	
1567	61F	Offset current [A]	R	FLOAT[2]	Offset Current: 0: new	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					1: old	
1575	627	Ion current (raw) [A]	R	FLOAT	Ion current in A. Raw value of the gas detection unit	
1795	703	Progress bar [%]	R	UINT8	Progress bar in percent during run up phases	
1800	708	Active protocol IO	R	UINT8	Active interface protocol for I/O module. Defined by DIP switch at I/O module or command 2593. Values: 0 = LD protocol	
1815	717	Reset source	R	UINT8	Shows the last reason of reset (internal)	
2480	9B0	Internal pressure 3 [sel. unit]	R	FLOAT	Pressure p3 [selected unit]	
2481	9B1	Internal pressure 3 [mbar]	R	FLOAT	Pressure p3 [mbar]	
2585	A19	HMI button	R	UINT8[2]	Read state HMI buttons [0]: START [1]: STOP 0 = inactive 1 = active	
2591	A1F	Local control	R/W	UINT8	Local control (hardware button) 0 = START, STOP and Calibration is locked 1 = START, STOP and calibration is allowed 2 = START, STOP and calibration is allowed, if a user is logged in	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
2593	A21	Interface protocol IO	R/W	UINT8	Selected interface protocol for I/O module. Only valid if DIP switch at I/O module is set to "000" 0 = LD 1= Don't use	
2642	A52	Used entries in maintenance log	R	UINT8	Used entries in maintenance log	X
2643	A53	Maintenance log	R	CHAR[*]	Text of a maintenance in maintenance log. To read send after the array index 255 the UINT8 maintenance list index (0...19). Without index, you will get the last (newest) entry. Example: "00 2016/06/10 OpTm: 229 Bpump Lubricant ExhaustF AirF SnifferF RefLeak TMP"	X
2660	A64	Maintenance warning active	R/W	UINT8	Maintenance warning active (0: disabled, 1: enabled) Bit 0 = Backing pump Bit 1 = not used Bit 2 = Exhaust filter Bit 3 = Air filter Bit 4 = Sniffer tip filter Bit 5 = Expiry date reference leak Bit 6 = not used	

Command dec	Command hex	Name	Read / Write	Data type	ELT Vmax	No fieldbus support
					Bit 7 = not used	

2.5 Enumerations

Group measure, interface unit (command 1399)

Meaning	Data type	Offset	Command dec
ImessRaw [A]	FLOAT	0	1575
p1 [interface unit]	FLOAT	4	130
p2 [interface unit]	FLOAT	8	132
p3 [interface unit]	FLOAT	12	2480
Individual bits: Bit 0 ... 2: Not used Bit 3: Underrange Bit 4: Overrange Bit 5...15: Not used	UNIT16	16	
For internal use only	UNIT8	18	internal
For internal use only	UNIT8	19	internal
For internal use only	FLOAT	20	internal

Group measure, mbar / mbar*l/s (command 1400)

Meaning	Data type	Offset	Command dec
ImessRaw [A]	FLOAT	0	1575
p1 [mbar]	FLOAT	4	131
p2 [mbar]	FLOAT	8	133
p3 [mbar]	FLOAT	12	2481
Individual bits: Bit 0 ... 2: Not used Bit 3: Underrange Bit 4: Overage Bit 5...15: Not used	UNIT16	16	
For internal use only	UNIT8	18	internal
For internal use only	UNIT8	19	internal
For internal use only	FLOAT	20	internal

Group measure, display unit (command 865)

Meaning	Data type	Offset	Command dec
ImessRaw	FLOAT	0	1575
p1 [display unit]	FLOAT	4	810
p2 [display unit]	FLOAT	8	811
p3 [display unit]	FLOAT	12	812

Individual bits Bit 0 ... 2: Not used Bit 3: Underrange Bit 4: Overrange Bit 5...15: Not used	UNIT16	16	
For internal use only	UNIT8	18	internal
For internal use only	UNIT8	19	internal
For internal use only	FLOW	20	internal

Analog output configuration (command 222)

Value	Meaning
0	off
1	off (don't use)
2	off (don't use)
3	LR mantissa
4	LR exponent
5	LR linear
6	LR log.
7	off (don't use)
8	Voltage settable by command 221

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

Value	Meaning
-------	---------

0	0,5 V / decade
1	1 V / decade
2	2 V / decade
3	2,5 V / decade
4	3 V / decade
5	5 V / decade
6	10 V / decade

Active protocol IO (command 1800)

Last telegram received from IO module (command 1286)

Last telegram transmitted to IO module (command 1287)

Value	Meaning
0	LD protocol
1	Don't use
2	ANYBUS protocol
3	
4	
5	Tunnel (service only)

State calibration (command 260, 259)

Value	Meaning
-------	---------

0	CAL inactive: No CAL since power on
5	CAL active: Wait for empty measure
6	CAL active: Empty measure active
7	CAL active: Wait for testleak measure
8	CAL active: Testleak measure active
10	CAL runs successfully
15	CAL aborted by user
20	CAL error: Factor too low
21	CAL error: Factor too high
22	CAL error: Offset too low
23	CAL error: Offset too high
24	CAL error: Delta between empty and testleak measure too small

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	RUN_UP

7	READY
8	MEASURE
9	WARNING
10	ERROR
11	ERROR_WARNING
12	CAL_ACTIVE
13	CAL_REQUEST
14	PURGE_OR_ZERO_ACTIVE
15	PPROXIMITY_SWITCH
16	V11_EXT_PUMP
17	V12_EXT_VENT

PLC output configuration IO module Default values

PLC_OUT_1	CAL_REQUEST - Inverted
PLC_OUT_2	ERROR_WARNING - Inverted
PLC_OUT_3	TRIG1 - Inverted
PLC_OUT_4	TRIG2 - Inverted
PLC_OUT_5	MEASURE
PLC_OUT_6	PURGE_OR_ZERO_ACTIVE
PLC_OUT_7	READY
PLC_OUT_8	CAL_ACTIVE

PLC input configuration IO module (command 438)

Use negative values for inverted functions.

Value	Function
0	NO_FUNCTION
1	START
2	STOP
3	CAL
4	ZERO
5	PURGE
6	CLEAR

PLC_IN_1	Start
PLC_IN_2	Stop
PLC_IN_3	Cal
PLC_IN_4	Zero
PLC_IN_5	Purge
PLC_IN_6	Clear
PLC_IN_7	no function
PLC_IN_8	no function
PLC_IN_9	no function
PLC_IN_10	no function

Table 1: PLC input configuration IO module Default values

Present warnings (command 297)

Value Index / Bit	Meaning
0x00000002	Warning Ecotec
0x00000080	Warning Anybus
0x00000100	Warning maintenance
0x00000200	Warning I/O disconnected
0x00000400	Warning 5V
0x00000800	Warning U24VHz
0x00001000	Warning supplay voltages
0x00100000	Warning temperature IO1500
0x00400000	Warning calibration request
0x00800000	Warning operating unit not connected
0x02000000	Warning +15V out of range
0x04000000	Warning -15V out of range
0x08000000	Warning backing pump
0x10000000	Warning real time clock

2.6 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)
1. 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

3 Fieldbus Communication

3.1 Preface

In order to use fieldbus communication with ELT Vmax, you need an INFICON Bus-Module BM1000 connected to the LD port of the leak detector.

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 BM1000.

3.2 Setup

Select the “Bus modul“ at the operating unit: “> Setup > Accessories > Device Selection”.

Enter the field bus address at the operating unit: “> Setup > Accessories > Bus Module”.



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

3.3 Process Data Mapping for Cyclic Data Transfer

3.3.1 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 LD cmd.
1 (high byte)	0	Inline	Transition to 0: No Inline, Transition to 1: Ext pump		
	1	State	Transition to 2: Inline w/o baseline, Transition to 3: Inline with baseline		
	2	Clear	Transition 0 -> 1: 0x04=Clears errors and warnings	Clear	5
	3	Start/Stop	Transition 0 -> 1: 0x08= Start Transition 1 -> 0: 0x00= Stop	Start/Stop	1, 2
	4	Purge	Transition to 0: Cancel purge, Transition to 1: Start modus purge		
	5		Transition to 2: Start purge		
	6	CAL extern	Transition to 0: 0x00 = Cancel external calibration	CAL extern/CAL dynamic	4
7	Transition to 1: 0x40 = Start external calibration Transition to 2: 0x80 = Acknowledge empty chamber Transition to 3: 0xC0 = Acknowledge test leak in chamber				
2 (low byte)	0	Cal extern	Transition to 0: Cancel cal, Transition to 1: Empty measure cal		
	1		Inline		
	2	not used			
	3				
	4	not used			

	5				
	6	not used			
	7				

“The current state of this value is visible at the operating unit via:

“ > Accessories > Bus module”.

3.3.2 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 LD cmd.
status word	1 (high byte)	0	not used			
		1	not used			
		2	Error	0 = no error 0x04 = error	Error	Status word
		3	Warning	0 = no warning 0x08 = warning	Warning	Status word
		4	State inline	0 = no inline		
		5		1 = external pump 2 = Inline without baseline 3 = Inline with baseline		

		6	State external calibration	0 = inactive 1 = Wait empty measure 2 = Wait test leak measure 3 = Empty or test leak measure active	CAL active	260	
		7					
	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	419	
		1					
		2					not used
		3					
		4					
		5	State	0 = 0x00 = Standby 1 = 0x20 = Error 2 = 0x40 = Calibration 3 = 0x60 = Runup 4 = 0x80 = Measure 5 = not used 6 ... 7 = 0xC0 ... 0xE0 = not used	Run up, CAL active, Error, Ready,	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...)	129	

pressure_or_flow	7 ... 10		Pressure	Pressure p1 in Interface Unit (IEEE 754 float value)	Analog output (Pressure p1)	130
error_code	11 ... 12		Actual error number	Error/warning code (16 bit unsigned integer)		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	387
		1	Status of Trigger 2		Trigger 2	
		2	Status of Trigger 3		Trigger 3	
		3	Status of Trigger 4		Trigger 4	
		4 ... 7	not used	always 0		
calibration_status	14		calibration_status	For possible values please refer to command 260 in table 2.4, "Commands," page 10.	CAL active	260
leak_detector ID	15		leak_detector ID	always 70 for ELT Vmax		
device specific float 1	16 ... 19		device specific float 1	Pressure p2 in Interface Unit (IEEE 754 float value)		132
device specific float 2	20 ... 23		device specific float 2	Pressure p3 in Interface Unit (IEEE 754 float value)		2480
device specific float 3	24 ... 27		device specific float 3	reserved for further use, always 0		135
device specific word	28 ... 29		device specific word	reserved for further use, always 0		304

3.4 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.

3.4.1 Addressing Rules for Acyclic Access

Mapping from LD command number to field bus:

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

3.4.2 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	Valuea	Get/Set	Determined by attribute #2	Instance value
6	Max valuea	Get		The maximum permitted parameter value
7	Min valuea	Get		The minimum permitted parameter value
8	Default valuea	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	-231... +(231-1)
4	UINT8	8	Unsigned 8 bit integer	0... +255
5	UINT16	16	Unsigned 16 bit integer	0... +65535

#	Type	Bits	Description	Range
6	UINT32	32	Unsigned 32 bit integer	0... +(232-1)
7	CHAR	8	Character (ISO 8859-1)	0... +255
16	SINT64	64	Signed 64 bit integer	-263... +(263-1)
17	UINT64	64	Unsigned 64 bit integer	0... +(264-1)
18	FLOAT	32	Floating point (IEC 60559)	±1.17549435E-38... ±3.40282347E+38

3.5 Hardware Configuration for Profibus



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

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

Fig. 1: Example hardware configuration (detail from PLC configuration window)

3.5.1 Assignment of the PROFIBUS Address

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

To assign the PROFIBUS address via operating unit 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 BM1000.

3.5.2 Diagnosis with the operating unit

The current state of the BM1000 is visible in the info menu of the operating unit: “ > Accessories > Bus module”.

3.6 Hardware Configuration for PROFINET

3.6.1 Hardware Configuration



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

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

Fig. 2: Sequence of the data words (slots) for PROFINET

3.6.2 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.

4 Trouble Shooting

4.1 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 the following.
	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 USB-RS232 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

RS232 Connecting Cable

A standard RS232 cable can be used (straight-through connecting cable, RxD and TxD not crossed). The RS232 hardware handshake must be switched off (in RS232 control program written by the user). If switching off of the hardware handshake is not possible, an RS232 connecting cable wired as follows may also be used:

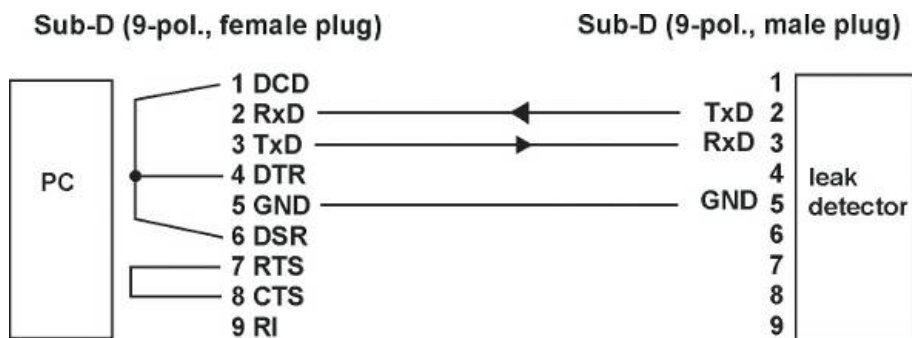


Fig. 3: RS232 cable

4.2 LD Protocol specific

Error	Possible Reason	Solution
IO1000 does not reply	Wrong Address	Always use Address 1 in LD protocol.

Error	Possible Reason	Solution
	Other protocol errors	Try to use NOP command (05hex 04hex 01hex 00hex 00hex 77hex) first, to check if connection works in general. The answer should be 02hex 05hex XXhex XXhex 00hex 00hex XXhex
IO1000 replies with CRC error (error code 1)	Wrong CRC calculation	Check you CRC code calculation. See example C source file "CRC_calculation.c" provided by INFICON. Check your code with unit test function in this source code file.

