D1X – Interface Protocol for Users

1. Interface configuration

9600 baud, 8 data bits, no parity, 1 stop bit

2. Operating mode

The D-1X may be alternatively configurated to allow for 3 different **modes of operation**

1.) *polling mode*: the pressure transmitter transmits only after a request
2.) *cyclical output of pressure value:* the pressure transmitter independently transmits the current pressure in time intervals set by the user, which amount to a multiple of 10 ms
3.) *cyclical output of pressure and temperature value*: the pressure transmitter independently transmits the current pressure 10 times each in time intervals set by the user, which amount to a multiple of 10 ms, and then transmits the current temperature once

Changing from one operating mode into another is possible any time during active operation by means of a software instruction. This change, however, will be lost when the power supply is cut off. A permanent change of the operating mode can only be enabled by means of the EASY-COM-software.

Set operating mode

1.) Change operating mode to polling mode:

HOST transmits

S (=0x53)	O (=0x4F)	0xFF	CS	CR

DMU replies

s (=0x73)	o (=0x6F)	0xFF	CS	CR

2.) Change operating mode to cyclical output of pressure

HOST transmits

S (=0x53)	O (=0x4F)	0xFE	CS	CR

DMU does not reply

3.) Change operating mode to cyclical output of pressure and temperature:

HOST transmits

S (=0x53)	O (=0x4F)	0xFD	CS	CR

DMU does not reply

3.1 Polling mode

3.1.1 Read out DMU's lower limit of range (MBA)

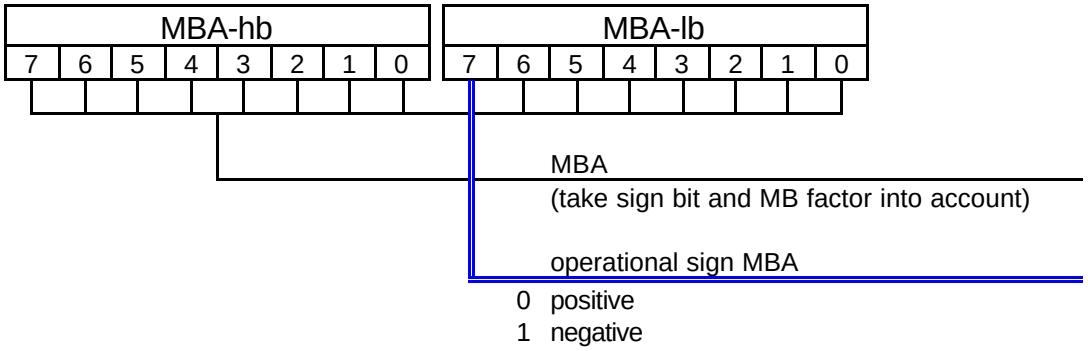
HOST transmits

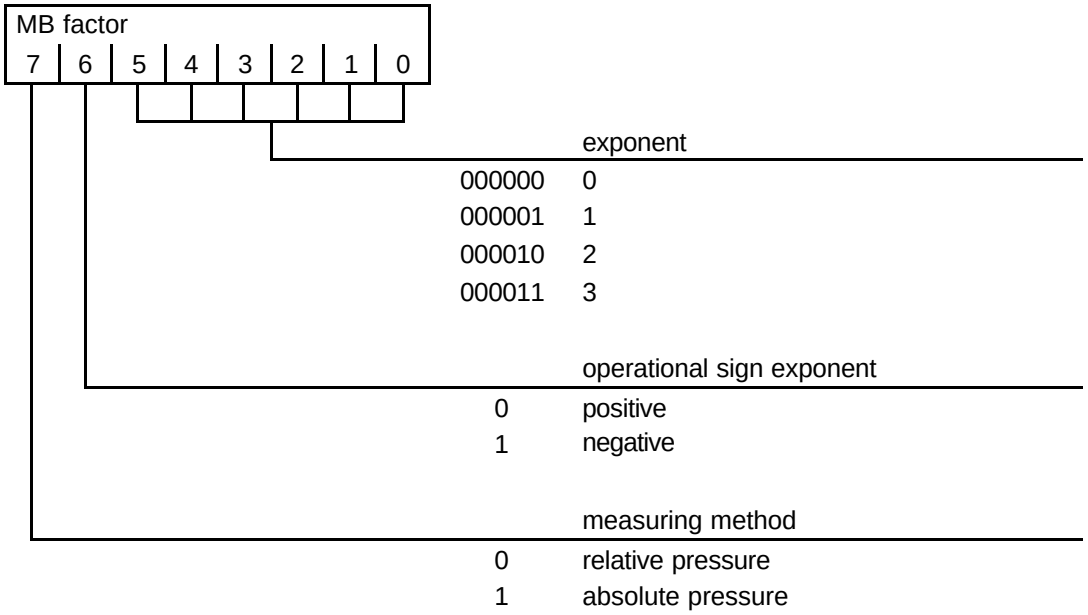
M (=0x4D)	A (=0x41)	0x00	CS	CR

DMU replies

0x03	MBA-hb	MBA-lb	MB-factor	CS	CR

Meaning of the bytes received:





3.1.2 Read out DMU's upper limit of range (MBE)

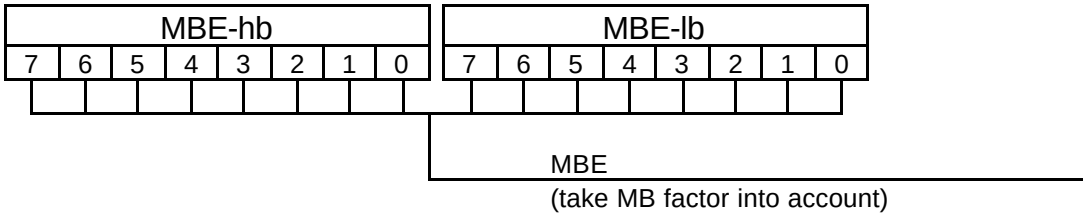
HOST transmits

M (=0x4D)	E (=0x45)	0x00	CS	CR

DMU replies

0x04	MBE-hb	MBE-lb	MB-factor	CS	CR

Meaning and evaluation of the bytes received



Meaning and evaluation of the MB-factor - see 3.1.1 MBA

Example:

a.) MBA= -1 bar rel. and MBE= 3 bar rel.
→ MBA-hb=0x00, MBA-lb=0x8A,
→ MBE-hb=0x00, MBE-lb=0x1E, MB factor=0x41

b.) MBA= 0 bar rel. and MBE= 0.25 bar rel.
→ MBA-hb=0x00, MBA-lb=0x00,
→ MBE-hb=0x00, MBE-lb=0x19, MB-Faktor=0x42

3.1.3 Read out pressure value as physical unit

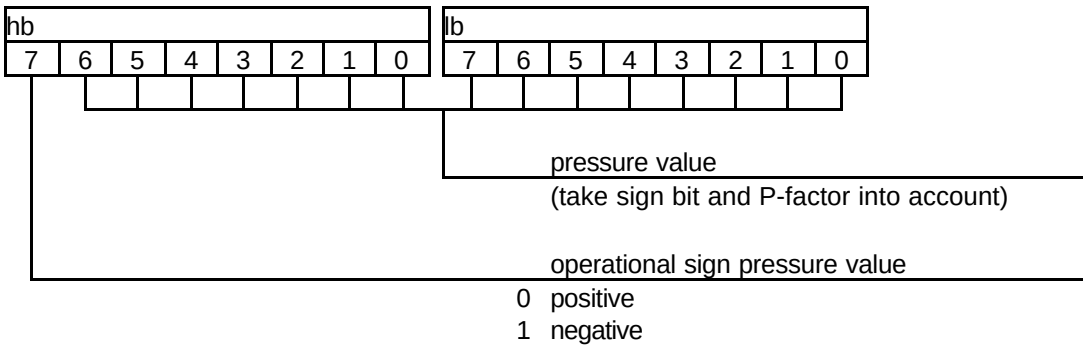
HOST transmits

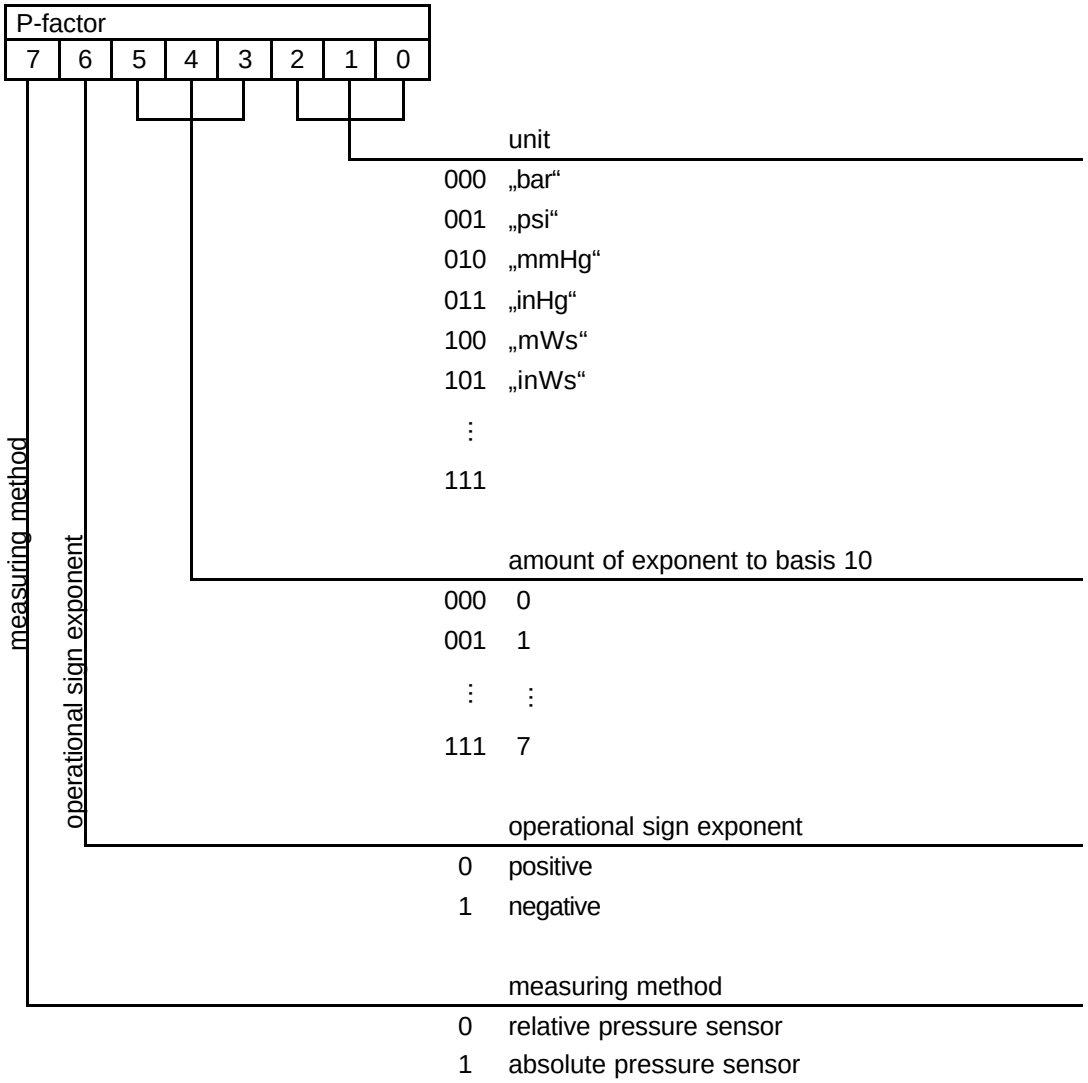
P (=0x50)	Z (=0x5A)	0x00	CS	CR

DMU replies

P (=0x50)	hb	lb	P-factor	CS	CR

Meaning of the bytes received:





The real pressure value is calculated from this with:

$$\text{pressure value} = (hb * 256 + lb) \bullet \text{P - factor[bit 6..3]}$$

(in the physical unit of the DMU, e.g. bar)

in which the MSB of hb contains the operational sign:
MSB=1: negative pressure value
MSB=0: positive pressure value

Example:

a.) MBA= -1 bar rel. and MBE= 3 bar rel., pressure value = -1 bar rel.
→ hb=0xA7, lb=0x10, P-factor=0x60

b.) MBA= 0 bar rel. and MBE= 0.25 bar rel. , pressure value = 0.125 bar rel.
→ hb=0x30, lb=0xD4, P-factor=0x68

3.1.4 Read out pressure value in digits

In this data format, the pressure signal will be coded in the optimum resolution of 50,000 digits. In the MBA, the pressure transmitter supplies 10,000 digits, in the MBE 60,000 digits.

HOST transmits

P (=0x50)	K (=0x4B)	0x00	CS	CR

DMU replies

k (=0x6B)	hb	lb	status byte	CS	CR

The real pressure value is calculated from this with:

$$\text{pressure value} = \frac{((\text{hb} * 256 + \text{lb}) - 10000) \bullet [(\text{MBE} - \text{MBA})]}{50000} + \text{MBA}$$

in which: MBA = DMU's nominal lower limit of range (e.g. in bar)
MBE = DMU's nominal upper limit of range (e.g. in bar)

The status byte will be transmitted only after the DMU's software version 1.0[1]. For previous versions, the P-factor will be transmitted instead.
status byte = 0: internal instrument diagnosis without fault
status byte = 1: internal instrument diagnosis found the supply voltage to be too low.The correct measuring function within the specified accuracy limits cannot be guaranteed anymore. This may happen when a notebook with very low interface levels is used for operation.

3.1.5 Read out temperature value

HOST transmits

T (=0x54)	W (=0x57)	0x00	CS	CR

DMU replies

T (=0x54)	hb	lb	0x00	CS	CR

The real temperature value is calculated from this with:

$$\text{temperature value} = \frac{(\text{hb} * 256 + \text{lb})}{2}$$ (in Celsius degrees)

in which the LSB of hb contains the operational sign:
LSB=1: negative temperature value
LSB=0: positive temperature value

[1] The number of the software version may be read out using the EASY-COM software.

3.1.6 Read out instrument number

The 4-digit alphanumeric identification embossed onto the hexagon of the instrument pressure connection is filed in the memory of the pressure transmitter as identification feature and may be read out with the following instruction.

HOST transmits

K (=0x4B)	N (=0x4E)	0x00	CS	CR

DMU replies

K (=0x4B)	sign1	sign2	sign3	sign4	CS	CR

Contrary to the consecutive series number printed onto the type plate of the instrument, this must not necessarily be a number that was assigned only once.

3.1.7. Response time in polling mode

The time the DMU takes until it transmits a reply to a request received may be set using the following instruction. For applications critical in terms of time, the time may be reduced to under 1 ms (time=0x00). This time, however, may possibly be too short in case the DMU is used, for example, on a PC with an MS-WINDOWS operating system. In this case, it can be prolonged up to 15ms (time=0xFF).

HOST transmits

A (=0x41)	Z (=0x5A)	time	CS	CR

DMU replies

a (=0x61)	z (=0x7A)	time	CS	CR

The setting performed like that is volatile. A permanent change of the setting can only be enabled by using the EASY-COM software.

3.2 Cyclical output of pressure value

The DMU independently transmits the current pressure value in a time interval (multiple of 10 ms) set by the user.

DMU transmits cyclically as pressure value

k (=0x6B)	hb	lb	status byte[2]	CS	CR

Calculation of the real pressure value - see 3.1.4

[2] Only after software version 1.0 of the DMU; prior to that the P-factor was transmitted instead

3.3 Cyclical output of pressure and temperature value

The DMU independently transmits in a time interval set by the user, which amounts to a multiple of 10 ms. The current pressure is transmitted 10 times each; the current temperature is then transmitted once.

DMU transmits cyclically as pressure value

k (=0x6B)	hb	lb	status byte[3]	CS	CR

Calculation of the real pressure value – see 3.1.4

DMU transmits cyclically as temperature value

T (=0x54)	hb	lb	0x00	CS	CR

Calculation of the real pressure value - see 3.1.5

4. Output interval for cyclical operating mode

A value between 1 and 65535 (=0xFFFF) may be programmed as time interval between the output of the data via the RS 232. This value multiplied with 10ms comes to the resulting cycle length.

Program output interval for cyclical operating mode

HOST transmits

I (=0x49)	time interval-highbyte	time interval-lowbyte	CS	CR

DMU replies

i (=0x69)	time interval-highbyte	time interval-lowbyte	CS	CR

The setting performed like that is volatile. A permanent change of the setting can only be enabled by using the EASY-COM software.

Example.: Time interval-highbyte= 0x03, time interval-lowbyte=0xE8
→ resulting cycle length= 10 sec

5. Reactivation of factory settings

Only possible by using the EASY-COM software

[3] Only after software version 1.0 of the DMU; prior to that the P-factor was transmitted instead

6. Generating the checksum

For generating the checksum all preceding bytes of the instruction have to be added. For the result's lowbyte the two's complement has to be calculated to finally get the checksum.

6.1 source code example for generating the checksum

The following Delphi-source code example illustrates how to calculate the checksum.

```
//////////////////////////////////////////////
// generates the checksum for the function's
// input string
//
// ->szWert: input string the checksum has to be
//              calculated for
//
// Return:
//   Checksum
function TD10Model.createChecksum (szWert: String): Char;
var
        i,
        tmp   : integer;
begin
        tmp := 0;

        for i := 1 to length (szWert) do
                tmp := tmp + ord(szWert[i]);

        tmp := LoByte(tmp);
        tmp := (tmp xor $FF);
        inc(tmp);

        createChecksum := CHR(tmp);
end;
//////////////////////////////////////////////
```

6.2 Example for generating the checksum for the instruction „Read out DMU's lower limit of range (MBA)"

As shown in 3.1.1 for reading the MBA the host transmits

M (=0x4D)	A (=0x41)	0x00	CS	CR

For this instruction the checksum CS is calculated by:

- adding preceding bytes: 0x4D + 0x41 + 0x00 = 0x008E
- take the lowbyte: 0x8E
- take the complement: 0x72

So 0x72 is the checksum for this instruction.

7. Abbreviations

CS: check sum, calculated from the complement of the lowbyte of the sum of the preceding bytes
CR: carriage return (0x0D) as end-of-instruction mark
DMU: pressure transmitter
hb: highbyte
lb: lowbyte
MSB: most significant bit
LSB: least significant bit
MBA: lower limit of range
MBE: upper limit of range
MB: measuring range
0x: hexadecimal