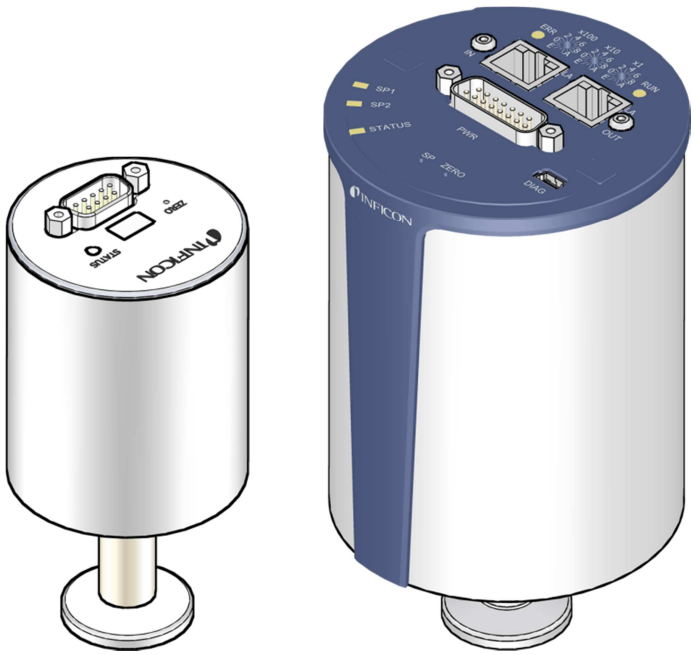
Diagnostic Port

Serial Interface for Capacitance Diaphragm Gauges

CDG025D-X3 4-20 mA Current Loop
Stripe™ CDG045Dhs
Stripe™ CDG100Dhs



General Information

The Diagnostic Port allows the communication of the digital INFICON Capacitance Diaphragm Gauges CDG025D-X3 4-20 mA Current Loop, Stripe CDG045Dhs and Stripe CDG100Dhs with a PC or another appropriate controller.

The Diagnostic Port interface integrated in the gauge allows to digitally transmit measurement values and information on the gauge status as well as to make parameter settings.

The Diagnostic Port is realized as a USB virtual com port with a FTDI FT230XQ chip. Drivers for Windows / MacOS / Linux are available under: http://www.ftdichip.com/Drivers/VCP.htm

Interface Protocol

The Diagnostic Port is used in Master-Slave mode. Without a corresponding request from the Master, the device does not transmit any data.
Instructions to the gauge are transmitted via binary protocol.

Data format

- binary
- 8 data bits
- 1 stop bit
- no parity bit
- no handshake
- baudrate: 57600bps

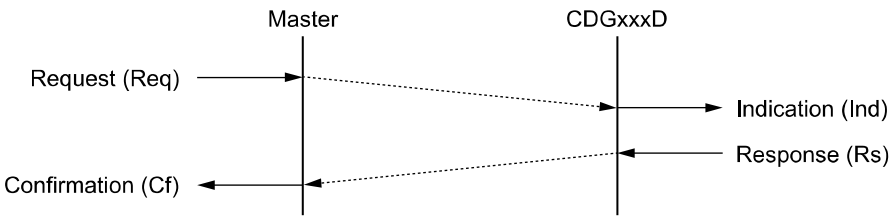
USB plug

Standard USB Mini B plug

Gauge address

It is not necessary to set an address to communicate over the Diagnostic Port interface. For the protocol 0 is always used.

Data Link Layer



The Data Link Layer uses the following terminology:

request (Req)

A request is an instruction (to read/or write) transmitted by the Master.

indication (Ind)

An indication means that the Slave (gauge) recognizes a request from the Master.

response (Rs)

A response is an answer from the Slave to the Master.

confirmation (Cf)

A confirmation is an acknowledgement of the response by the Master.

Protocol Frame

Every protocol layer of the communication protocol is represented in a protocol frame. The maximum length per frame is 64 byte. The data field of the data link layer consists of

- a command (Cmd)
- a parameter identifier (PID)
- a data field (Data).

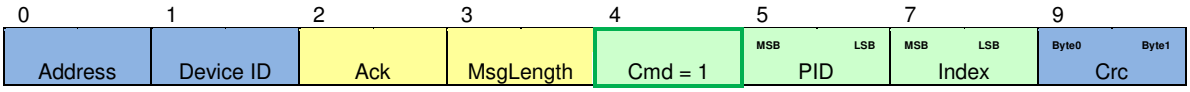
The command determines whether the data transmitted are read or write requests.

Command (Cmd)

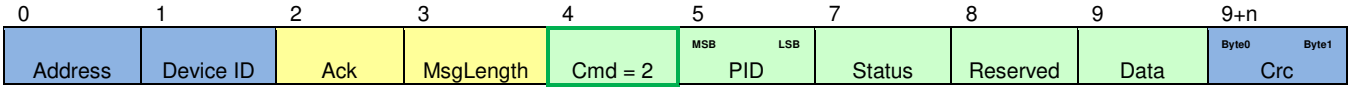
There are ten different command types:

Cmd 1	Value read request from the Master
Cmd 2	Read response from the gauge to a value read request
Cmd 3	Value write request
Cmd 4	Write response from the gauge to a value write request

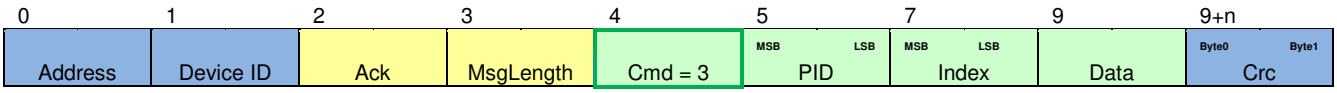
- Cmd 1: Value read request from the Master



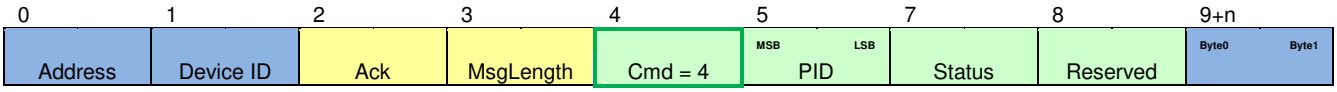
- Cmd 2: Response from the gauge to a value read request



- Cmd 3: Value write request from a Master



- Cmd 4: Response from the gauge to a value write request



Parameter Identifier (PID)

The parameter identifier (PID) addresses a defined parameter of the device.

Data field (Data)

The data field contains the data of a request. In the case of a write request it contains the data transmitted from the Master to the gauge, in the case of a read request it contains the data to be transmitted from the gauge to the Master. Data are transmitted in Big Endian.

Medium Access Layer

The medium access layer contains the following data fields:

- Address for the gauge is always 0
- Device ID (Master: 0, Stripe: 6, CDG025-X3 4-20 mA: 22)
- Header with Ack and Message Length (all APDU data are counted: Cmd, PID, Status, Reserved, Data)
- 16 bit CRC (example → 🗎 7)

Communication Error

If a communication error occurs during transmission the PID is set to 0xFFFF and the meaning of the status byte is as follows:

Status	Description
0	Okay
1	No rights
2	Out of range
3	Wrong PID
4	Wrong length
6	Non volatile memory failure
9	Unknown request
10	Wrong request
11	Wrong index
12	No sense
13	Wrong PID list
14	Busy

Protocol Description

The following parameters can be read via the diagnostic port.

Output pressure

PID	Name	Description	Factory setting	Min.	Max.	Type
222	Pressure	Pressure in vacuum chamber in Real format (in the data unit selected with PID 224)				Real32, ro
201	Gauge status	State of the gauge: 1 Normal measurement 2 Manual set point adjust active 4 Zero adjust active 8 Zero Adjust Warning 16 Pressure overrange warning 32 Pressure underrange warning 64 Heater Warmup 128 Error: gauge isn't adjusted	1			Uint16, ro
224	Data Unit	Data unit of the pressure value 0 mbar 1 Torr 2 Pascal	1	0	2	Uint8, ro

Error

PID	Name	Description	Factory setting	Min.	Max.	Type
213	Cdg Error	0 No error 1 Atm sensor failure 2 Measuring error 4 EEPROM error 8 Heater over temperature 16 Zero adjust out of limit 128 Extended error signalized	0			Uint8, ro
214	Extended cdg error	0 No error 1 Heater temperature failure 2 No communication to measuring board 4 Heater temperature sensor failure 8 Electronic over temperature 16 Firmware operation system (OS) error 32 No communication to the non volatile memory 64 Current loop over temperature	0			Uint16, ro

General information

PID	Name	Description	Factory setting	Min.	Max.	Type
103	Reset	0 Write The sensor carries out a reset. 1 Write The sensor resets all parameters to their factory settings.		0	1	Uint8, wo
104	Run Hours	Operating hours				Uint32, ro
200	Production number	Number used during production of the gauge				String, ro
206	Calibration date	Date of calibration				String, ro
207	Serial Number	Serial number			4294967295	Uint32, ro
208	Product Name	Product name				String, ro
209	Manufacturers Name	Name of manufacturer	INFICON AG			String, ro
210	Manufacturers Model Number	Article number				String, ro
217	Software Date	Creating date of the firmware				String, ro
218	Software Version	Version number of the firmware				String, ro
219	Hardware revision	Hardware revision number				String, ro
226	Gauge type	0 CDG025D 1 CDG045D 2 CDG100D 3 CDG160D 4 CDG200D 10 SCS 11 DSS 99 CUBE	0			Uint8, ro

Sensor details

PID	Name	Description	Factory setting	Min.	Max.	Type
266	Atm Pressure	Pressure of the gauge environment in mbar				Real32, ro
223	Full scale value	Full scale pressure value in the data unit selected with PID 224				Real32, ro

Setpoints

PID	Name	Description	Factory setting	Min.	Max.	Type
274	Setpoint 1 Mode	Setpoint mode 0 Setpoint in low trip mode 1 Setpoint in high trip mode 2 Setpoint in ATM low trip mode 3 Setpoint in ATM high trip mode 7 Status relay mode (4 to 6 are reserved)	0	0	7	Uint8, rw
275	Setpoint 1 Trip Threshold	Setpoint 1 threshold relative to the FSR (PID 223)	0.5	0.0	1.05	Real32, rw
276	Setpoint 1 Hysteresis	Setpoint 1 hysteresis relative to the FSR (PID 223)	0.01	0.01	0.5	Real32, rw
277	Setpoint 1 ATM Factor	Factor for ATM setpoint The atmospheric pressure is multiplied by this factor and used as Setpoint 1. To activate the ATM mode select it with PID 274.	1.0	0.5	1.1	Real32, rw
279	Setpoint 1 Status	Status of Relay 1 (0 = open, 1 = closed)	0			Uint8, ro
281	Setpoint 2 Mode	Setpoint mode 0 Setpoint in low trip mode 1 Setpoint in high trip mode 2 Setpoint in ATM low trip mode 3 Setpoint in ATM high trip mode 7 Status relay mode (4 to 6 are reserved)	0	0	7	Uint8, rw
282	Setpoint 2 Trip Threshold	Setpoint 2 threshold relative to the FSR (PID 223)	0.5	0.0	1.05	Real32, rw
283	Setpoint 2 Hysteresis	Setpoint 2 hysteresis relative to the FSR (PID 223)	0.01	0.01	0.5	Real32, rw
284	Setpoint 2 ATM Factor	Factor for ATM setpoint The atmospheric pressure is multiplied by this factor and used as Setpoint 2. To activate the ATM mode select select it with PID 274.	1.0	0.5	1.1	Real32, rw
286	Setpoint 2 Status	Status of Relay 2 (0 = open, 1 = closed)	0			Uint8, ro

Examples

The following examples show how read and write requests are made.

Read request (reading the pressure)

The required parameter has PID 222.

From Master to Gauge:

0	1	2	3	4	5	7	9	9+n
Address	Device ID	Ack	MsgLength	Cmd	MSB PID LSB	Index	Data	Byte0 Crc Byte1
0x00	0x00	0x00	0x05	0x01	0x00DE	0x0000	-	0xCFCE

From Gauge to Master:

0	1	2	3	4	5	7	8	9	9+n
Address	Device ID	Ack	MsgLength	Cmd	MSB PID LSB	Status	Reserved	Data	Byte0 Crc Byte1
0x00	0x16	0x01	0x09	0x02	0x00DE	0x00	0x00	0x3EEDF4D3	0x8730

Write request (Sp1 acts as status relay)

The required parameter has PID 274. To set the Sp1 into the “Status relay”-mode, 7 must be written.

From Master to Gauge:

0	1	2	3	4	5	7	9	9+n
Address	Device ID	Ack	MsgLength	Cmd	MSB PID LSB	Index	Data	Byte0 Crc Byte1
0x00	0x00	0x00	0x06	0x03	0x0112	0x0000	0x07	0x1B4D

From Gauge to Master:

0	1	2	3	4	5	7	8	9	9+n
Address	Device ID	Ack	MsgLength	Cmd	MSB PID LSB	Status	Reserved	Data	Byte0 Crc Byte1
0x00	0x16	0x01	0x05	0x04	0x0112	0x00	0x00	-	0x0582

Calculating CRC

The data packages are secured with CRC16 in Little Endian with the byte order: byte[0], byte[1].

CRC polynominal 0x1021

CRC initial value 0xFFFF

CRC Example Code

To illustrate how the checksum can be calculated and verified, an example code in C# is given below:

```
using System;

class Program
{
    static void Main()
    {
    // the following test array is a valid protocol frame with crc16 at the end
    byte[] arr = new byte[] { 0x00, 0x00, 0x00, 0x05, 0x01, 0x00, 0xDD, 0x00, 0x00, 0xAB, 0x21};
    UInt16 crc;
    Boolean b;
    // Calculate the crc of the test array arr, of course without crc (therefore length minus 2)
    crc = Crc16.Create(arr, (Byte)(arr.Length - 2));
    // Check, if the test array has a correct crc at the end (it is correct, therefore the returnvalue is
true)
    b = Crc16.Check(arr, (Byte)arr.Length);
    }
}

public class Crc16
{
    // initial value for crc16
    public static UInt16 inital = 0xFFFF;

    // function to create a crc16
    public static UInt16 Create(Byte[] buffer, Byte length)
    {
        UInt16 crc16 = new UInt16();
        UInt16 i = 0;

        // Initial Value for CRC calculation
        crc16 = Crc16.inital;

        while (i < length)
        {
            crc16 = (UInt16)((Crc16.crc16Tab[(crc16 ^ buffer[i++]) & (Byte)0xFF]) ^ (crc16 >> 8));
        }
        return crc16;
    }

    // function to check a buffer with a crc16 at the end
    public static Boolean Check(Byte[] buffer, Byte length)
    {
        UInt16 crc16 = Crc16.inital;
        UInt16 i = 0;
        // calculate crc for the buffer without crc
        while (i < length)
        {
            crc16 = (UInt16)((Crc16.crc16Tab[(crc16 ^ buffer[i++]) & (Byte)0xFF]) ^ (crc16 >> 8));
        }
        if (crc16 == 0)
        {
            return true;
        }
        return false;
    }
    // crc array
    public static UInt16[] crc16Tab =
    {
        0x0000, 0x1189, 0x2312, 0x329B, 0x4624, 0x57AD, 0x6536, 0x74BF,
        0x8C48, 0x9DC1, 0xAF5A, 0xBED3, 0xCA6C, 0xDBE5, 0xE97E, 0xF8F7,
        0x1081, 0x0108, 0x3393, 0x221A, 0x56A5, 0x472C, 0x75B7, 0x643E,
        0x9CC9, 0x8D40, 0xBFDB, 0xAE52, 0xDAED, 0xCB64, 0xF9FF, 0xE876,
        0x2102, 0x308B, 0x0210, 0x1399, 0x6726, 0x76AF, 0x4434, 0x55BD,
        0xAD4A, 0xBCC3, 0x8E58, 0x9FD1, 0xEB6E, 0xFAE7, 0xC87C, 0xD9F5,
        0x3183, 0x200A, 0x1291, 0x0318, 0x77A7, 0x662E, 0x54B5, 0x453C,
        0xBDCB, 0xAC42, 0x9ED9, 0x8F50, 0xFBEF, 0xEA66, 0xD8FD, 0xC974,
        0x4204, 0x538D, 0x6116, 0x709F, 0x0420, 0x15A9, 0x2732, 0x36BB,
        0xCE4C, 0xDFC5, 0xED5E, 0xFCD7, 0x8868, 0x99E1, 0xAB7A, 0xBAF3,
        0x5285, 0x430C, 0x7197, 0x601E, 0x14A1, 0x0528, 0x37B3, 0x263A,
        0xDECD, 0xCF44, 0xFDDF, 0xEC56, 0x98E9, 0x8960, 0xBBFB, 0xAA72,
      0x6306, 0x728F, 0x4014, 0x519D, 0x2522, 0x34AB, 0x0630, 0x17B9,
      0xEF4E, 0xFEC7, 0xCC5C, 0xDDD5, 0xA96A, 0xB8E3, 0x8A78, 0x9BF1,
      0x7387, 0x620E, 0x5095, 0x411C, 0x35A3, 0x242A, 0x16B1, 0x0738,
      0xFFCF, 0xEE46, 0xDCDD, 0xCD54, 0xB9EB, 0xA862, 0x9AF9, 0x8B70,
      0x8408, 0x9581, 0xA71A, 0xB693, 0xC22C, 0xD3A5, 0xE13E, 0xF0B7,
      0x0840, 0x19C9, 0x2B52, 0x3ADB, 0x4E64, 0x5FED, 0x6D76, 0x7CFF,
      0x9489, 0x8500, 0xB79B, 0xA612, 0xD2AD, 0xC324, 0xF1BF, 0xE036,
```

```
        0x18C1, 0x0948, 0x3BD3, 0x2A5A, 0x5EE5, 0x4F6C, 0x7DF7, 0x6C7E,
        0xA50A, 0xB483, 0x8618, 0x9791, 0xE32E, 0xF2A7, 0xC03C, 0xD1B5,
        0x2942, 0x38CB, 0x0A50, 0x1BD9, 0x6F66, 0x7EEF, 0x4C74, 0x5DFD,
        0xB58B, 0xA402, 0x9699, 0x8710, 0xF3AF, 0xE226, 0xD0BD, 0xC134,
        0x39C3, 0x284A, 0x1AD1, 0x0B58, 0x7FE7, 0x6E6E, 0x5CF5, 0x4D7C,
        0xC60C, 0xD785, 0xE51E, 0xF497, 0x8028, 0x91A1, 0xA33A, 0xB2B3,
        0x4A44, 0x5BCD, 0x6956, 0x78DF, 0x0C60, 0x1DE9, 0x2F72, 0x3EFB,
        0xD68D, 0xC704, 0xF59F, 0xE416, 0x90A9, 0x8120, 0xB3BB, 0xA232,
        0x5AC5, 0x4B4C, 0x79D7, 0x685E, 0x1CE1, 0x0D68, 0x3FF3, 0x2E7A,
        0xE70E, 0xF687, 0xC41C, 0xD595, 0xA12A, 0xB0A3, 0x8238, 0x93B1,
        0x6B46, 0x7ACF, 0x4854, 0x59DD, 0x2D62, 0x3CEB, 0x0E70, 0x1FF9,
        0xF78F, 0xE606, 0xD49D, 0xC514, 0xB1AB, 0xA022, 0x92B9, 0x8330,
        0x7BC7, 0x6A4E, 0x58D5, 0x495C, 0x3DE3, 0x2C6A, 0x1EF1, 0x0F78
    };
}
```

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