HDU-Sensors

HDM18/19-Modules

High precision active sensors and modules for biomedical, laboratory and environmental applications

Conductivity – Temperature - Pressure - Flow - pH

ASCII Protocol Documentation

Preface

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Revisions

Version	Date	Author	Change
1.0	25.09.14	CST	Initial version.
1.1	04.03.15	CST	Revised system error codes.
1.2	12.03.15	CST	Updated remarks for commands ADJPWW and SYSBDW.
1.3	01.09.16	CST	Update of General Specification. Distinction between System Functions and User Functions. Added Measuring value states.
1.4	17.07.17	HMU	Corrected: General Specification
1.5	14.11.19	WPF	HDM18/19 added, minor corrections, USB Driver installation

Table of Contents

Introduction

Scope of this document

This document specifies the ASCII protocol of the IBP HDU-Sensors and HDM-Modules.

Related Documentation

HDU- and HDM-Modules User Manual

SAFETY INSTRUCTIONS
Read the HDU- and HDM18/19 User-Manual
and this documentation carefully and
entirely before using the HDU-Sensors.

Abbreviations and Definitions

Abbreviation	Definition
ASCII	American Standard Code for Information Interchange
CRC	Cyclic Redundancy Check this value is calculated from a string of data values and is used by the recipient of the data string to check the string integrity.
LSB	Least significant byte/bit
MSB	Most significant byte/bit
Word	A measure of data size associated with a particular Modbus register number. A word is equivalent to 2 bytes or 16 bits.

USB Driver Installation

Windows 10 Operating System

The USB Driver will install automatically when the sensor's USB communications cable is plugged into the computer. After the installation is complete, access the coputer's Device Manager, Ports (COM and LPT) to determine the COM Port number to use when communicating with the sensor.
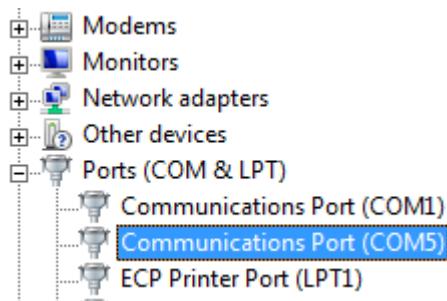
Windows 7, NT, XP, Vista Operating Systems

For these operating systems it will be necessary to manually install the USB driver. Obtain a copy from your IBP / Mesa Labs support personnel. If provided in compressed (zip) format, uncompress it.

Plug the sensor's USB communications cable into plugged into the computer and access the device manager, "Other Devices".   Locate and right click on the USB-UART Emulator device. Select Update Driver Software and browse to the location the driver was stored.
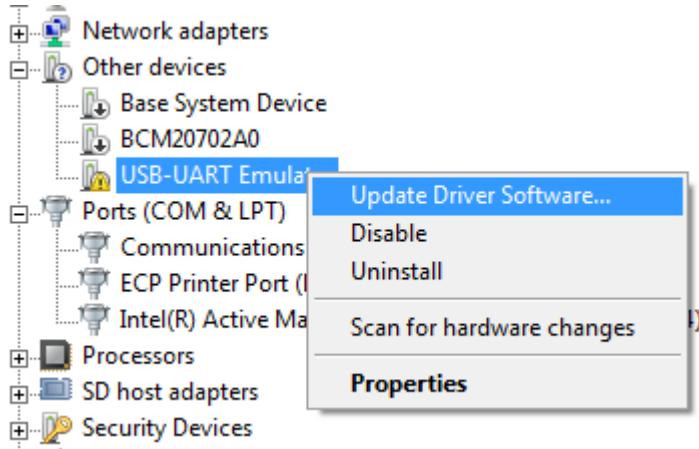
A new COM port should then appear in Ports. On some computers it may be necessary to also update the Port (COM and LPT) device if it appears with the warning icon. Use the same driver to update.

Technical Data

General Specification

Parameter	Specification
Bus Type	RS-485 (ANSI/TIA/EIA-485), Two-wire and USB with a virtual serial COM port via with a special interface cable
Mode	Slave mode only
Baud Rate	115.2 kBit/s (default) or 9600 (configurable)
Flow control	No flow control at all = NO RTS/CTS, no XON/XOFF
Byte Characteristics	8-bit, Non parity, 1 stop bit
Slave Response to Master	2 ms for a typical command answer with baud rate of 115.2 kBit/s. 90-160ms for commands storing into FLASH memory
Protocol Supported	Proprietary IBP ASCII-Format
Max. Data Signaling Error Accepted	2% in reception, 1% in transmission
Line Polarization	All devices are handling line polarization.

IBP ASCII protocol

Key for Access Rights

The following access rights are defined for each command and are stated in the R/W column of the IBP ASCII register map table:

Key	User Access Rights
R	Read-only access
W	Write only access (zero when read)
UW	Write with user password – Password is: US!AD

Line Termination

All following commands must be followed by a Carriage Return (0x0D or <CR>).

IBP ASCII Protocol

Answers returned by the device are also terminated by a <CR>.

System error codes

HDU-modules evaluate various error states. The first error occurring is stored and can be read out with the command 'SYSERR':

Error code	Description
0000	OK, no error
0010	CRC program error
0011	CRC data error
0012	Watchdog reset
0013	Invalid request, command unknown
0014	Timeout
0015	Command interpreter terminated
0016	Unbalanced quotes
0017	Reset condition on I/O channel
0018	Empty command line
0019	Wrong count of arguments
0020	Invalid argument no. 1
0021	Invalid argument no. 2
0022	Invalid argument no. 3
0023	Invalid argument no. 4
0024	Invalid argument no. 5
0025	Invalid argument no. 6
0026	Invalid argument no. 7
0027	Invalid argument no. 8
0028	Invalid argument no. 9
0029	Invalid argument no. 10
0030	Maximum count of parameters exceeded
0031	Syntax Error – only HDM18/19
0032	Communication Timeout – only HDM18/19
0033	Communication CRC Error – only HDM18/19
0034	Communication Buffer Error – only HDM18/19
0035	Error Stack Overflow – only HDM18/19
0036	Device too hot – only HDM18/19
0037	Device too cold – only HDM18/19
0038	Charge Power not loadable – only HDM18/19
0090	Overcurrent
0099	Common error

IBP ASCII Protocol

Adjustment error codes

HDU-modules evaluate various adjustment error states. The first error occurring is stored and can be read out with the command 'ADJSTR':

Error code	Description
00	OK, no error
01	No channel selected/configured
02	Maximum number of set-points reached
03	HW/ADC fault
04	Invalid set-point value
05	Invalid digital value
06	Invalid offset value
07	Invalid gain value

Measuring value states

HDU-modules evaluate various states for analog measuring values. They can be read out with the commands 'VALASTR' or 'VALSTR':

State	Description
0	Not initialized
1	Ready and OK
2	Analog limit overflow
3	Analog limit underflow
4	Internal error
5	Invalid
6	Hardware overflow (E.g. ADC)
7	Hardware underflow (E.g. ADC)

IBP ASCII Protocol

Common Functions

1.1.1 System Functions

Command	R/W	Function	Format	Return	Remark
SYSASR	R	Returns supported ASCII Protocol Specification number.	SYSASR	[x.y] or 99: Error	[x.y] = ASCII Protocol Specification number x = major release number y = minor release number
SYSERR	R	Returns and resets system error code.	SYSERR	[n] or 99: Error	[n] = 4 digit error code number See System error codes
SYSFRW	UW	Factory Reset: Restores all user adjustment tables and configurations from factory default values.	SYSFRW	01: OK 99: Error	
SYSLCR	R	Returns a 10 digit date of last calibration.	SYSLCR	String or 99: Error	Eg. 2014/09/25
SYSSNR	R	Returns the 16 digit serial number.	SYSSNR	String or 99: Error	E.g.: 1234457887654321
SYSSVR	R	Returns the software version number.	SYSSVR	[x.y.n] or 99: Error [x.y.z] = software version number	x = major release number y = minor release number z = patch level number
SYSTMO	W	Sets transparent mode on. Enables Data transmission between USB and UART. No further commands will be accepted. Will be disabled again, if device is powered down.	SYSTMO	01: OK	Only in SmartHDM device cable

IBP ASCII Protocol

1.1.2 User Functions

Command	R/W	Function	Format	Return	Remark
USRBDW	W	Writes a new baud rate.	USRBDW [baud] Baud = 115200 (Standard) or Baud = 9600	01: OK 99: Error	Resets factory and user passwords in case of successful operation.
USRCDR	R	Returns the string of the user configurable channel description.	USRCDR [n] n = Channel number	String or 99: Error	Channel number corresponds to the position in the string from command 'VALAR'
USRCDW	W	Writes a string into the user-configurable channel description.	USRCDW [n] [String] [n] = Channel number [String] = Channel description Use quotation marks around [String], if [String] contains space characters. Those additional quotation marks are not part of the description	01: OK 99: Error	Channel number corresponds to the position in the string from command 'VALAR' Maximum string length is 40 characters.
USRDDR	R	Returns the string of a user configurable device description.	USRDDR	String or 99: Error	
USRDDW	W	Writes a string into the user-configurable device description.	USRDDW [String] [String] = Device description Use quotation marks around [String], if [String] contains space characters. Those additional quotation marks are not part of the description	01: OK 99: Error	Maximum string length is 40 characters.
USRDLR	R	Returns channel damping length (in seconds).	USRDLR [n] [n] = Channel number	String or 99: Error	Channel number corresponds to the position in the string from command 'VALAR'
USRDLW	W	Writes channel damping length (in seconds).	USRDLW [n] [x.y] [n] = Channel number [x.y] = floating-point damping length [s]	01: OK 99: Error	Channel number corresponds to the position in the string from command 'VALAR'
USRDTR	R	Returns channel damping threshold (in channel measuring units).	USRDTR [n] [n] = Channel number	String or 99: Error	Channel number corresponds to the position in the string from command 'VALAR'
USRDTW	W	Writes channel damping threshold	USRDTW [n] [x.y]	01: OK	Channel number corresponds to

		(in channel measuring units).	[n] = Channel number [x.y] = floating-point threshold value	99: Error	the position in the string from command 'VALAR'
USRMUAR	R	Reads current measuring units of all channels.	USRMUAR	String or 99: Error E.g.: mmHg;mmHg;s	
USRMUOR	R	Reads all measuring unit options for a channel.	USRMUOR [n] [n] = Channel number	String or 99: Error	E.g.: mmHg;mbar;kPa;psi Channel number corresponds to the position in the string from command 'VALAR'
USRMUR	R	Reads measuring unit of a channel.	USRMUR [n] [n] = Channel number	String or 99: Error	E.g.: mmHg
USRMUW	W	Writes a measuring unit of a channel.	USRMUW [n] [unit] [n] = Channel number [unit] = String	01: OK 99: Error	Read possible options with command USRMUOR

IBP ASCII Protocol

1.1.3 Data Transmission

Command	R/W	Function	Format	Return	Remark
VAL	R	Reads all analog values.	VAL	String or 99: Error	E.g.: 0.1234567/123.123 Used for HDV compatibility. Command 'VALAR' recommended.
VALAR	R	Reads all analog values.	VALAR	String or 99: Error	E.g.: 0.1234567/123.123
VALASTR	R	Reads all analog value states.	VALASTR	String or 99: Error	E.g.: 1/1 See Measuring value states
VALR	R	Reads an analog value.	VALR [n] [n] = Channel number	String or 99: Error	E.g.: 0.1234567
VALSTR	R	Reads an analog value state.	VALSTR [n] [n] = Channel number	String or 99: Error	E.g.: 1 See Measuring value states

IBP ASCII Protocol

1.1.4 IBP HDM97 Functions

Command	R/W	Function	Format	Return	Remark
hdm	R	Reads all analog values.	hdm	String	Maximum polling rate 200 ms.
hdmares	R	Resets all values.	hdmares	No return value.	Flow sensor specific.
HDMCHN	R	Reads channel numbers.	HDMCHN	String	
HDMCMO	W	Enables continuous mode.	HDMCMO	No return value.	
HDMCMF	W	Disables continuous mode.	HDMCMF	No return value.	
HDMEIH	R	Reads current measuring units of all channels.	HDMEIH	String	E.g.: mmHg;mmHg;s
HDMSNR	R	Returns the 16 digits serial number.	HDMSNR	String	
HDMVERS	R	Returns the software version number.	HDMVERS	String	

Module Specific Functions

1.1.5 HDU-CDTP (Conductivity / Temperature) Functions

Command	R/W	Function	Format	Return	Remark
SCTARR	R	Reads auto-range mode.	SCTARR	[n] or 99: Error [n] = 0: auto-range disabled [n] = 1: auto-range enabled	
SCTARW	W	En-/Disables auto-range mode.	SCDARW [n] [n] = 0: Disables auto-range mode [n] = 1: Enables auto-range mode	01: OK 99: Error	
SCTCCR	R	Reads cell constant. Without argument, it reads the cell constant valid at 0.014 S/cm. The command accepts one argument as conductivity reference value[S/cm] to read the cell constant for.	SCTCCR or SCTCCR [x.y] [x.y] = Conductivity reference value	String or 99: Error E.g.: 0.5500	Unit 1/cm
SCTCRR	R	Reads the current conductivity channel range number.	SCTCRR	[n] or 99: Error [n] = 1: 0 – 0,4 mS/cm [n] = 2: 0,4 – 4 mS/cm [n] = 3: 4 – 40 mS/cm [n] = 4: 40 - 400 mS/cm	
SCTCRW	W	Requests a new conductivity channel range number.	SCTCRW [n] [n] = 1: 0 – 0,4 mS/cm [n] = 2: 0,4 – 4 mS/cm [n] = 3: 4 – 40 mS/cm [n] = 4: 40 - 400 mS/cm	01: OK 99: Error	Overwritten, if auto-range enabled

SCTTCMR	R	Reads temperature compensation mode.	SCTTCMR	String or 99: Error [String] = lin [String] = dyn [String] = nLF [String] = off	lin: linear mode dyn: dynamic mode nLF: DIN EN27888 mode off: compensation disabled
SCTTCMW	W	Writes temperature compensation mode.	SCTTCMW [String] [String] = lin [String] = dyn [String] = nLF [String] = off	01: OK 99: Error	
SCTTCR	R	Reads a temperature coefficient and its reference temperature.	SCTTCR [n] [n] = 1: 1st temperature coefficient [n] = 2: 2nd temperature coefficient	String or 99: Error E.g.: 2.0700/37.00	Unit : %/K and °C
SCTTCW	W	Writes a new temperature coefficient and the optional reference temperature. The command accepts two or three arguments: Two arguments are used for temperature coefficients valid at 37.0°C and 25.0°C. Three arguments are used to additional write the reference temperature for each temperature coefficient.	SCTTCW [n] [x.y] or SCTTCW [n] [x.y] [z.y] [n] = 1: 1st temperature coefficient (37°C) [n] = 2: 2nd temperature coefficient (25°C) [x.y] = floating point temperature coefficient optional: [z.y] = floating-point reference temperature	01: OK 99: Error	Linear mode: Command accepts only 1st temperature coefficient. 2nd temperature coefficient refused. Dynamic mode: Command accepts 1st and 2nd temperature coefficient. DIN EN27888 and off mode: Command accepts no temperature coefficients.

IBP ASCII Protocol

1.1.6   HDU-FL (Flow) Functions

Command	R/W	Function	Format	Return	Remark
SFLACW	W	Reset of accumulated value.	SFLACW	01: OK 99: Error	

IBP ASCII Protocol

1.1.7 HDU-PR (Pressure) Functions

Command	R/W	Function	Format	Return	Remark
SPRTAR	R	Read current tare value of pressure channel.	SPRTAR	String or 99: Error	
SPRTAW	W	Tare pressure channel.	SPRTAW	01: OK 99: Error	
SPRDRR	R	Read current start value of pressure drop measurement.	SPRDRR	String or 99: Error	
SPRDRW	W	Start of pressure drop measurement.	SPRDRW [xx] xx = Time in seconds Eg: SPRDRW 10 Start drop measurement with 10 seconds	01: OK 99: Error	

1.1.8   HDU-pHTP (pH / Temperature) Functions

Command	R/W	Function	Format	Return	Remark
SPHASYR	R	Reads pH electrode asymmetry	SPHASYR	String or 99: Error	Unit: V
SPHGRDR	R	Reads pH electrode graduation	SPHGRDR	String or 99: Error	Unit: %
SPHSLPR	R	Reads pH electrode slope	SPHSLPR	String or 99: Error	Unit: V
SPHTPMR	R	Reads temperature measurement mode.	SPHTPMR	String or 99: Error [String] = intern [String] = extern	intern: The temperature will be measured via the measuring cell. extern: provide solution temperature with command 'SPHTPW'.
SPHTPMW	W	Writes temperature measurement mode.	SPHTPMW [String] [String] = measure [String] = static	01: OK 99: Error	
SPHTPR	R	Reads the solution temperature for temperature compensation.	SPHTPR	String or 99: Error	
SPHTPW	W	Writes an external solution temperature for temperature compensation.	SPHTPW [x.y] [x.y] = floating point temperature value	01: OK 99: Error	