



HDU-Sensors

High precision active sensors
for biomedical, laboratory and environmental applications

Temperature

Conductivity

Pressure

Flow

pH



ASCII Protocol Documentation

Version 1.2

Preface

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Publisher: IBP Medical GmbH
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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.
	01.04.15	CST	Extended HDU-pHTP commands (SPHASYR).

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1 Introduction

1.1 Scope of this document

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

1.2 Related Documentation

HDU-User Manual



SAFETY INSTRUCTIONS

Read the HDU-User-Manual and this documentation carefully and entirely before using the HDU-Sensors.

1.3 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.

2 Technical Data

2.1 General Specification

Parameter	Value
Bus Type	RS-485 (ANSI/TIA/EIA-485), Two-wire
Mode	Slave mode only
Baud Rate	115000
Byte Characteristics	8-bit, Even parity, 1 stop bit
Protocol Supported	Proprietary IBP ASCII-Format
Max. Data Signaling Error Accepted	2% in reception, 1% in transmission
Line Polarization	All devices are handling the line polarization.

3 IBP ASCII protocol

3.1 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)
FW	Write with factory password
UW	Write with user password – Password is: US!AD

3.2 HDU device IDs

The device ID's can be used for example to configure display devices automatically. Each device provides a set of parameters describing the device. The device parameters are listed in the following list describe the existing measurement or actuator channels. Several parameters are separated by commas. The following rules apply:

Stelle	Beispiel	Bedeutung
1	P	Primary measurement channel
1	S	Secondary measurement channel
1	H	HiRes Primary measurement channel
1	A	AVA-Modul
2,3,4	010	Parameter ID: °C
2,3,4	900	Parameter ID: Pumpe

Device	Device ID	Parameter ID
Sensor Temperature	100	P010
Sensor Conductivity/Temperature	200	P022,S025,P010
Sensor Pressure	300	P030,P040,S310
Sensor Pressure HiRes	301	H030,H040,S310
AutoCal MP	390	P040,S040,A501
Sensor Flow	600	P060,S066
Sensor pH	700	P070,S010

3.3 Parameter IDs

Parameter	Unit	Parameter ID
Temperature	°C	010
	°F	011
Conductivity	µS/cm	020
	mS/cm	021
	S/cm	022
Temperature Coefficient	%/K	025
Pressure	mmHg	030
	mBar	031
	kPa	032
	psi	033
Pressure Drop	mmHg	040
	mBar	041
	kPa	042
	psi	043
Flow	ul/min	060
	ml/min	061
	l/min	062
Flow (accumulated)	ul	065
	ml	066
	l	067
pH	pH	070

3.4 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
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
0090	Over current
0099	Common error

3.5 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

3.6 Common Functions

3.6.1 Basic Functions

Command	R/W	Function	Format	Return	Remark
SYSAPR	R	Returns supported ASCII Protocol Specification number.	SYSAPR	[x.y] or 99: Error [x.y] = ASCII Protocol Specification number	x = major release number y = minor release number
SYSBDW	W	Writes a new baudrate.	SYSBDW [baud] Baud = 115200 (Standard) or Baud = 9600	01: OK 99: Error	Resets factory and user passwords in case of successful operation.
SYSCDR	R	Returns the string of the user configurable channel description.	SYSCDR [n] n = Channel number	String or 99: Error	Channel number corresponds to the position in the string from command 'VALAR'
SYSCDW	W	Writes a string into user configurable channel description.	SYSCDW [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.
SYSDDR	R	Returns the string of a user configurable device description.	SYSDDR	String or 99: Error	
SYSDDW	W	Writes a string into user configurable device description.	SYSDDW [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.
SYSDLR	R	Returns channel damping length (in seconds)	SYSDLR [n] [n] = Channel number	String or 99: Error	Channel number corresponds to the position in the string from command 'VALAR'

SYSDLW	W	Writes channel damping length (in seconds)	SYSDLW [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'
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	
SYSIDR	R	Returns HDU Device ID	SYSIDR	[n] or 99: Error [n] = HDU Device ID E.g.: 200 for HDU-CDTP Sensor	See HDU device IDs
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

3.6.2 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	
VALIDR	R	Reads all device specific parameter IDs.	VALIDR	String or 99: Error	See Parameter IDs
VALR	R	Reads an analog value.	VALR [nn] [nn] = Channel number	String or 99: Error E.g.: 0.1234567	
hdm	R	Reads all analog values.	hdm	String	Used for IBPView compatibility. Minimum polling rate 200ms.
HDMCMO	W	Enables continuous mode.	HDMCMO	No return value.	Used for IBPView compatibility.
HDMCMF	W	Disables continuous mode.	HDMCMF	No return value.	Used for IBPView compatibility.

3.6.3 Adjustment Functions

Command	R/W	Function	Format	Return	Remark
ADJPWW	W	En-/disables adjustment write protection.	ADJPWW [String] [String] = User password	01: OK 99: Error	Reset with: - power on - command SYSBDW
ADJCFGW	UW	Configures and starts a new adjustment sequence. Sets up an empty volatile adjustment table.	ADJCFGW [n] [n] = Channel number	01: OK 99: Error	Channel number corresponds to the position in the string from command 'VALAR'.
ADJMAXR	UR	Reads maximum number of possible set-points within adjustment table.	ADJMAXR	[n] or 99: Error [n] = number of possible set points	
ADJCVW	UW	Inserts current analog set-point value into volatile adjustment table.	ADJCVW [x.y] [x.y] = floating point analog setpoint value	01: OK 99: Error	
ADJEDW	UW	Edits a specific analog set-point value from volatile adjustment table .	ADJEDW [n] [x.y] [n] = Index within adjustment table [x.y] = New analog setpoint value	01: OK 99: Error	Index is valid from 1 to maximum number of possible set-points.
ADJENW	UW	Finishes adjustment sequence. Stores volatile adjustment table into user memory. Clears volatile adjustment table.	ADJENW	01: OK 99: Error	Restart new adjustment sequence with command 'ADJCFGW'.
ADJSTR	R	Reads adjustment status.	ADJSTR	[n] or 99: Error [n] = 2 digit error code number	See Adjustment error codes
ADJVRR	UR	Reads current volatile adjustment table.	ADJVRR	String or 99: Error	Formatted lines with index.
ADJRMW	UW	Removes a setpoint from volatile adjustment table.	ADJRMW [n] [n] = Index within adjustment table	01: OK 99: Error	Index is valid from 1 to maximum number of possible set-points.
ADJLDW	UW	Loads adjustment table for current selected channel from user memory into volatile adjustment table.	ADJLDW	01: OK 99: Error	

3.7 Module Specific Functions

3.7.1 HDU-CDTP 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.	SCTCCR	String or 99: Error E.g.: 0.5500	Unit 1/cm
SCTCRR	R	Reads 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: 1 st temperature coefficient [n] = 2: 2 nd temperature coefficient	String or 99: Error E.g.: 2.0700/37.00	Unit : %/K and °C
SCTTCW	W	Writes a new temperature coefficient and optional reference temperature. The command accepts two or three arguments: Two argument are used for a 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: 1 st temperature coefficient (37°C) [n] = 2: 2 nd 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 1 st temperature coefficient. 2 nd temperature coefficient refused. Dynamic mode: Command accepts 1 st and 2 nd temperature coefficient. DIN EN27888 and off mode: Command accepts no temperature coefficients.

3.7.2 HDU-FL Functions

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

3.7.3 HDU-PR 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	

3.7.4 HDU-pHTP 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] = measure [String] = static	measure: temperature will be measured via the measuring cell. static: 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 the solution temperature for temperature compensation.	SPHTPW [x.y] [x.y] = floating point temperature value	01: OK 99: Error	

3.7.5 HDU-TP Functions

Command	R/W	Function	Format	Return	Remark