www.hwdbg.com

Technical Datasheet

HWD TH02-XXXX

Temperature and Humidity sensor

Key features:

- Temperature ranges:
  -45°C to +130°C / -40°C to +60°C / -40°C to +100°C
- Humidity range: 0-100% RH
- Outputs:
  - Analogue: 0-2V, 0-1V, 0-5mA, 0-20mA or 4-20mA
  - Digital: Fieldbus or Modbus
- Power Supply: 7-30V
- Humidity accuracy: ±1.5% RH
- Temperature accuracy: ± 0.1°C
- Compact size
- Cyclic Redundancy Check (CRC)

Description

The HWD TH02-XXXX is a sensor device capable of operating with a very high precision over the -45 to +130°C range. It is ideal for meteorological and industrial applications where accuracy and low power consumption are a necessity. Furthermore, it is compatible with various types of data loggers and existing systems due to its numerous digital and analogue outputs. The reliability of the measured data at a low error rate is ensured by the integrated CRC. The temperature and humidity sensor is wrapped in a compact cylindrical design of 122.20 x 15 x 15 mm.

Applications

- Industrial controlling, measuring and monitoring systems
- Hydrological and meteorological equipment

Pinout

PIN	DESIGNATOR	COLOUR
1	+Vcc	Orange
2	GND	White/Orange
3	Temperature (Analogue)	Green
4	GND	White/Green
5	Humidity (Analogue)	Blue
6	GND	White/Blue
7	RS485 + (A)	Brown
8	RS485 – (B)	White/Brown
9	Shield	Black

Table 1 *Sensor Pinout*

Absolute maximum ratings

PARAMETER	SYMBOL	RATING			UNITS
		Min	Typical	Max	
Supply voltage	V_{cc}	7	-	30	V
Analogue output voltage	V_{out}	0	-	2	V
Interface line	V_{line}	0	-	5	V
Operating temperature	T_{op}	-45	-	+125	°C
Storage temperature	$T_{storage}$	-45	-	+130	°C
Average supply current	I_{supply}	5	5.5	6	mA
Accuracy Temperature	T_{acc}	± 0.1	± 0.1	± 0.3	°C
Resolution Temperature	T_{res}	-	0.008	-	°C

Temperature Repeatability	T_{rTemp}	-	0.04	-	°C
Response Time Temperature	t_{rTemp}	-	> 2	-	s
Long Term Drift Temperature	T_{dTemp}	-	-	<0.03	°C/yr
Humidity measuring range	H	0	-	100	% RH
Accuracy Humidity	H_{acc}	± 1.5	± 1.5	± 2	% RH
Resolution Humidity	H_{res}	-	0.01	-	% RH
Humidity Repeatability	H_{rHum}	-	0.08	-	% RH
Response Time Humidity	t_{rHum}	-	8	-	s
Long Term Drift Humidity	H_{dHum}	-	< 0.25	-	% RH /yr

***Table 2** Absolute Maximum Ratings*

Product Modifications

MODIFICATION	ANALOGUE OUTPUT	RANGE (Analogue)	DIGITAL OUTPUT	RANGE (Digital)
HWD TH02-AU2	0-2V	Temperature: -40 to +60°C Humidity: 0 to 100%	-	-
HWD TH02-AUF2	0-2V	Temperature: -40 to +60°C Humidity: 0 to 100%	RS485 Fieldbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%
HWD TH02-AUM2	0-2V	Temperature: -40 to +60°C Humidity: 0 to 100%	RS485 Modbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%
HWD TH02-AI	4-20mA	Temperature: -40 to +100°C Humidity: 0 to 100%	-	-

HWD TH02-AIF	4-20mA	Temperature: -40 to +100°C Humidity: 0 to 100%	RS485 Fieldbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%
HWD TH02-AIM	4-20mA	Temperature: -40 to +100°C Humidity: 0 to 100%	RS485 Modbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%
HWD TH02-AU1	0-1V	Temperature: -40 to +60°C Humidity: 0 to 100%	-	-
HWD TH02-AUF1	0-1V	Temperature: -40 to +60°C Humidity: 0 to 100%	RS485 Fieldbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%
HWD TH02-AUM1	0-1V	Temperature: -40 to +60°C Humidity: 0 to 100%	RS485 Modbus protocol	Temperature: -45 to +130°C Humidity: 0 to 100%

Table 3 *Device Modifications*

Fieldbus byte sequence

Configuration:

- *Baud rate:* 19200 bits/s
- *Parity:* Odd
- *Stop bits:* 1

Request:

0x00	0x00	AddrLow	AddrHigh	CRC1

Temperature request: **00 00 1A 08 DE (Hex)**

Humidity request: **00 00 1B 08 DD (Hex)**

Response:

DataLow	DataHigh	CRC2

Note:

- *Temperature data* - UINT16 number which represents the temperature and it can be converted to degrees Celsius using the following formula:

$$Current\ temperature\ (°C) = -45 + 175 \times \frac{T}{2^{15} - 1}$$

- *Humidity data* - UINT16 number which represents the relative humidity and it can be converted to percentages using the following formula:

$$Current\ relative\ humidity\ (\%) = 100 \times \frac{H}{2^{15} - 1}$$

CRC:

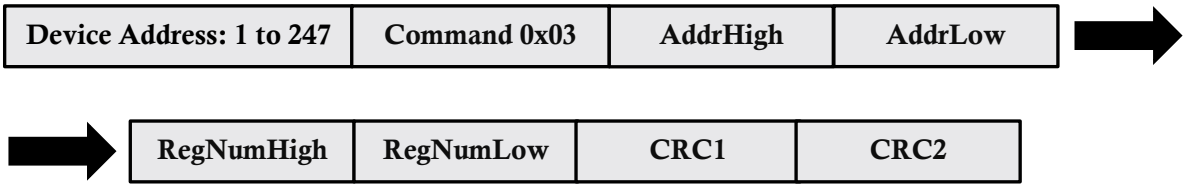
CRC1 = ((AddrHigh + AddrLow) ⊕ 0xFF) + 1

CRC2 = ((DataHigh + DataLow) ⊕ 0xFF) + 1

Modbus byte sequence

Read input register

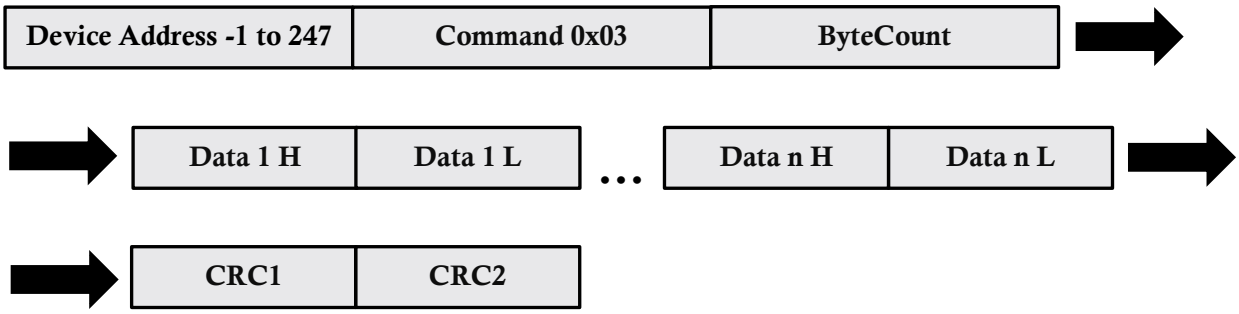
Request:



Notes:

- **AddrHigh** and **AddrLow** - The Data Address of the first register requested.
- **RegNumHigh** and **RegNumLow** - The total number of registers requested.
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error detection.

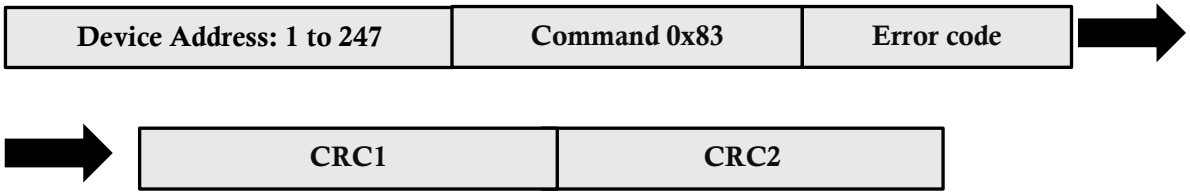
Normal Response:



Notes:

- **ByteCount** - The number of data bytes to follow.
- **Data n H/L** - The values of the requested input register(s) (High/Low).
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error detection.

Error Response:

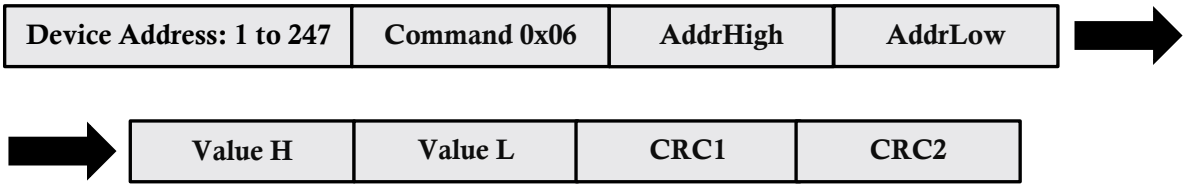


Notes:

- **Error code** - 1 to 4, depending on the type of error.
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error checking.

Write input register

Request:

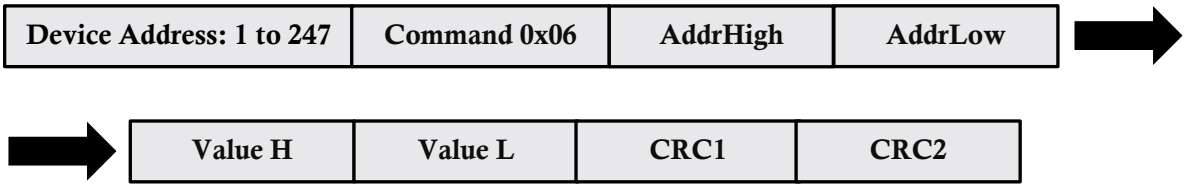


Notes:

- **AddrHigh** and **AddrLow** - The Data Address of the requested register.

- **Value H/L** - The value that has to be written in the requested register.
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error detection.

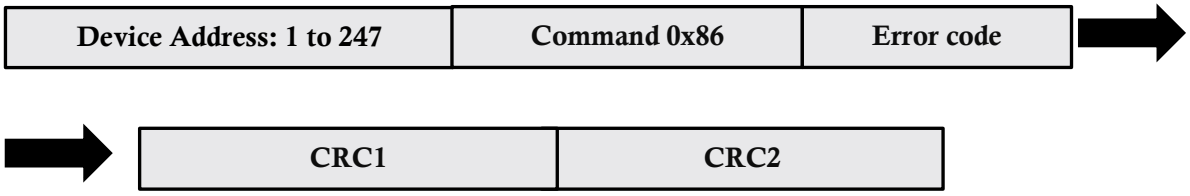
Normal Response:



Notes:

- **AddrHigh** and **AddrLow** - The Data Address of the requested register.
- **Value H/L** - The value that has to be written in the requested register.
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error detection.

Error Response:



Notes:

- **Error code** - 1 to 4, depending on the type of error.
- **CRC1** and **CRC2** - The CRC (cyclic redundancy check) for error checking.

Note:

- **More about Modbus byte sequence can be found here:** https://ipc2u.com/articles/knowledge-base/modbus-rtu-made-simple-with-detailed-descriptions-and-examples/

Modbus data registers

HOLDING REGISTER	VALUE	ABBREVIATION	TYPE	R/W
0	Temperature	T	UINT16	R
1	Humidity	H	UINT16	R
2	Average temperature – averaged over the predefined time period	Tavg	UINT16	R
3	Average humidity – averaged over the predefined time period	Havg	UINT16	R
4	Minimum temperature– measured over the predefined time period	Tmin	UINT16	R
5	Minimum humidity– measured over the predefined time period	Hmin	UINT16	R
6	Maximum temperature– measured over the predefined time period	Tmax	UINT16	R
7	Maximum humidity– measured over the predefined time period	Hmax	UINT16	R
8	Status register	-	UINT16	R
9	Device Serial Number	-	UINT16	R

Table 4 *Modbus data registers*

Data registers' values explained:

- *Temperature data (T, T_{avg}, T_{min}, T_{max})* - UINT16 number which represents the temperature and it can be converted to degrees Celsius using the following formula:

$$Temperature\ (°C) = -45 + 175 \times \frac{T}{2^{15} - 1}$$

- *Humidity data (H, H_{avg}, H_{min}, H_{max})* - UINT16 number which represents the relative humidity and it can be converted to percentages using the following formula:

$$Relative\ humidity\ (\%) = 100 \times \frac{H}{2^{15} - 1}$$

Status register representation:

	STATUS REGISTER																
15																	**0**
	Device ID (Modbus)								Average Time Configuration		Sensor Heating		Parity Configuration		Baud Rate Configuration		Sensor Status

Table 5 *Status register representation*

- *Bit 0* - Sensor Status

VALUE	STATUS
0	Sensor working properly
1	Sensor not responding

Table 6 *Sensor Status*

- *Bit 1 : Bit 2* - Baud Rate Configuration

VALUE	BAUD RATE
0	9600
1	19200

Table 7 *Baud Rate Configuration*

- *Bit 3 : Bit 4* - Parity Configuration

VALUE	PARITY
0	No parity
1	Even parity
2	Odd parity

Table 8 *Parity Configuration*

- *Bit 5* - Sensor Heating

VALUE	HEATER
0	OFF
1	ON

Table 9 *Sensor Heating*

- *Bit 6 : Bit 7* - Average Time Configuration

VALUE	AVERAGE TIME [min]
0	1
1	2
2	5
3	10

Table 10 *Average Time Configuration*

- *Bit 8 : 15* - Device ID (Modbus)

Modbus configuration registers

HOLDING REGISTER	VALUE	TYPE	R/W
1000	Baud rate configuration	UINT16	W
1001	Parity configuration	UINT16	W
1002	Device ID (Modbus)	UINT16	W
1003	Heater configuration	UINT16	W
1004	Average time configuration	UINT16	W
1005	Sensor reset	UINT16	W

Table 11 *Modbus configuration registers*

Notes:

- Configuration registers' values are the same as the corresponding status register values indicated above. All other values will result in Modbus exception.
- In order to reset the sensor, 1 (DEC) should be written to the corresponding holding register 1005 (DEC). Any other values will result in Modbus exception.

Setup

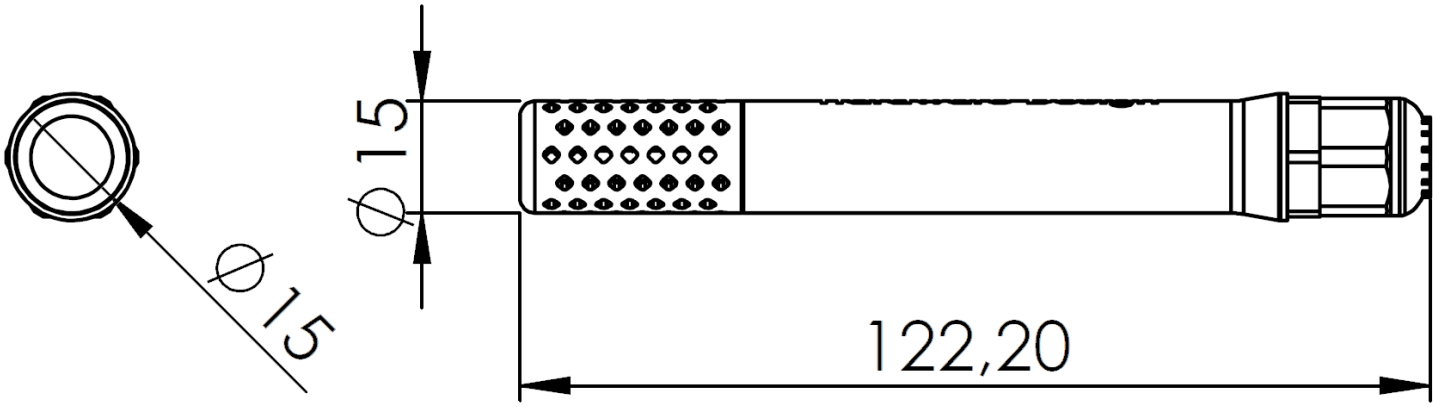
When powered on the device enters '*Configuration Mode*', a period of 30 seconds, during which the configuration registers can be altered so that they can match the system requirements. The default settings in '*Configuration Mode*' are:

- **Protocol:** Modbus
- **Baud rate:** 9600 bits/s
- **Parity:** NONE
- **Transmission:** 8 bits
- **Device ID:** 17 (0x11)
- **Average time configuration:** 1 min
- **Sensor Heating:** OFF

Note:

- All changes made during '*Configuration Mode*' are saved in a non-volatile memory. The saved configuration of the device can be read via the status register at all times. An attempt to alter the configuration registers after the '*Configuration Mode*' will result in exception.

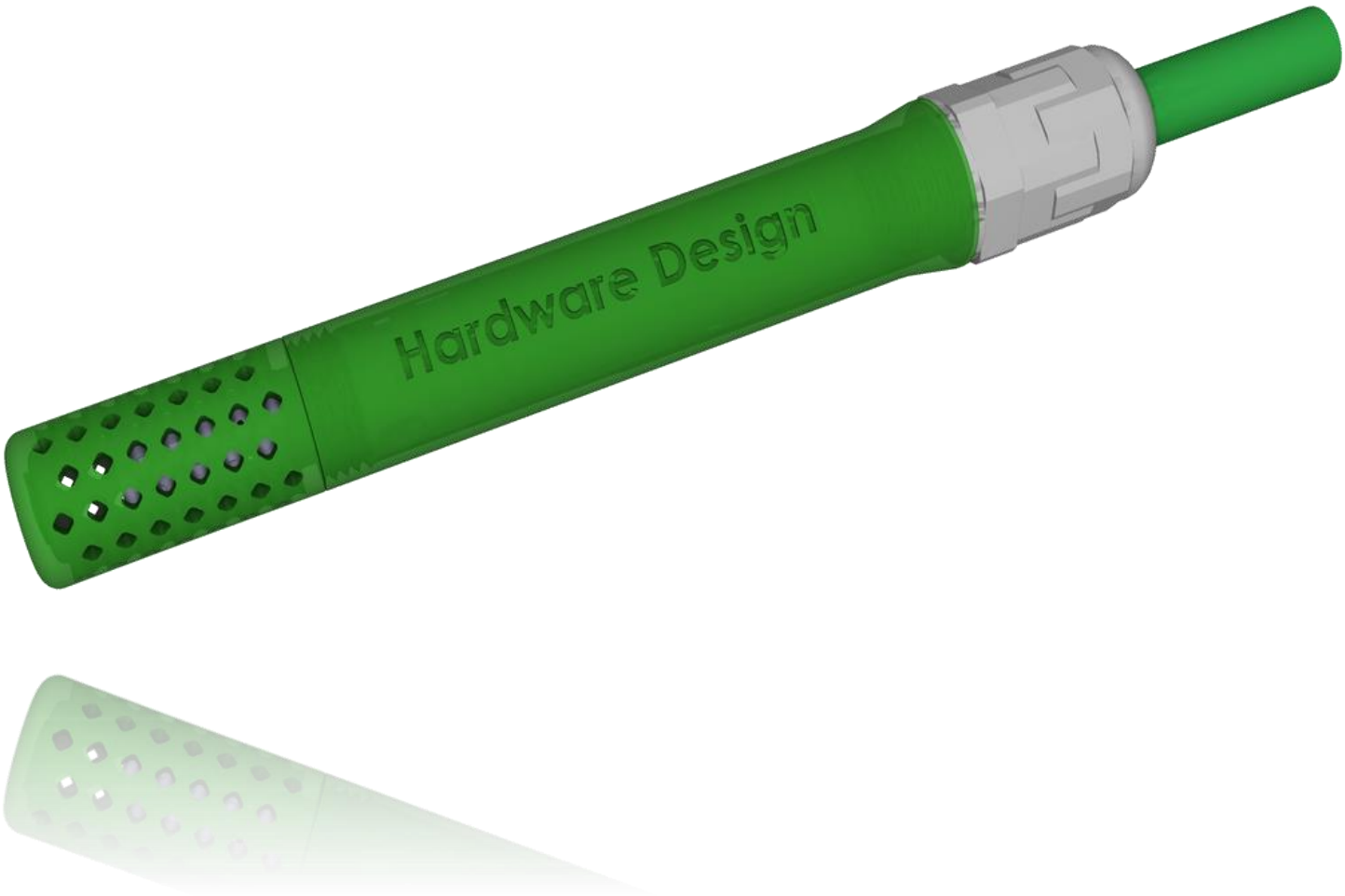
Technical drawing



Note: All units are in mm.

Revision History

DATE	REVISION	PAGE	MODIFICATIONS
July 2020	1.0	-	-
Jan 2021	2.0	-	Modbus registers



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