

# HTS-1



HIGH-PRECISION TEMPERATURE AND HUMIDITY SENSOR FOR METEOROLOGICAL APPLICATIONS

OPERATING INSTRUCTION | DOCUMENT NO. MS-HTS-1-OI001-36 | © 2025 METEOSENSE





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# 1. Introduction

The HTS-1 is a high-precision, ultra-low-power temperature and humidity sensor designed for professional meteorological and environmental monitoring applications. It offers exceptional energy efficiency, consuming less than 20  $\mu\text{A}$  in sleep mode, making it ideal for battery-powered and remote deployments.

Equipped with multiple industry-standard digital interfaces—including RS-485, RS-232, and SDI-12—the HTS-1 ensures seamless integration into a wide range of data acquisition systems and telemetry networks. Its compact design and robust construction allow for reliable operation in diverse environmental conditions.

## Key Features:

- **Ultra-Low Power Consumption:** Draws less than 20  $\mu\text{A}$  in sleep mode, extending battery life in remote installations.
- **Multiple Communication Interfaces:** Supports RS-485, RS-232, and SDI-12 protocols for versatile connectivity.
- **High Accuracy:** Provides precise temperature and humidity measurements suitable for professional applications.
- **Robust Design:** Engineered to withstand harsh environmental conditions, ensuring long-term reliability.
- **Easy Integration:** Compatible with various data loggers and monitoring systems, facilitating straightforward deployment.

The HTS-1 is an excellent choice for applications requiring accurate temperature and humidity measurements with minimal power consumption, such as weather stations, environmental monitoring, and remote sensing projects.

# 2. Safety Instructions

Before installing or operating the HTS-1 sensor, please read and follow these safety instructions carefully to ensure proper operation and to prevent damage to the device or injury.

## General Safety

- The sensor must be installed and used only by qualified personnel familiar with electronic measurement systems and electrical safety standards.
- Operate the sensor only within the specified voltage, temperature, and environmental limits outlined in the technical specifications.
- Do not open, modify, or disassemble the sensor. There are no user-serviceable parts inside.

## Electrical Safety

- Power the sensor only with a regulated DC power supply within the specified voltage range (typically 5–45 V DC).
- Ensure correct wiring of power and communication lines according to the pinout provided. Incorrect wiring may damage the device.



- Always disconnect power before making or changing wiring connections.

## ESD Protection

- Handle the sensor with proper electrostatic discharge (ESD) precautions.
- Use a grounded workstation and wear an antistatic wrist strap when installing or handling the sensor to avoid damaging sensitive electronic components.

## Environmental Conditions

- Use the sensor only within the specified operating temperature range (–40 °C to +80 °C).
- Do not expose the sensor to corrosive chemicals, flammable materials, or extreme mechanical shock.
- Avoid direct water ingress into the sensor housing or connectors unless properly sealed according to IP protection standards.

## Fire & Heat Hazards

- Do not install the sensor near heat sources or open flames.
- Never short-circuit the power supply or allow conductive materials to bridge electrical terminals.

## Installation & Maintenance

- Mount the sensor securely to avoid mechanical stress or vibration.
- Maintenance or cleaning should only be performed with the device powered off and using dry, lint-free materials.

# 3. Warranty

## Limited Warranty

MeteoSense warrants that the HTS-1 sensor is free from defects in materials and workmanship under normal use for a period of two (2) years from the date of purchase by the original end user.

If a defect arises during the warranty period, MeteoSense will, at its discretion, repair or replace the product at no charge, provided the product has been used in accordance with the guidelines in this manual.

## Warranty Conditions:

- The warranty applies only to the original purchaser and is non-transferable.
- The warranty does not cover damage resulting from misuse, improper installation, accident, modification, or unauthorized repair.
- MeteoSense is not liable for any indirect, incidental, or consequential damages resulting from the use or inability to use this product.
- Claims must be submitted in writing along with proof of purchase (invoice or receipt).



## Warranty Service:

To request warranty service, please contact MeteoSense support at:

 [support@meteosense.de](mailto:support@meteosense.de)

 [www.meteosense.de](http://www.meteosense.de)

Include a description of the issue and the serial number of the device.

## 4. Mounting Location and Installation

To ensure accurate measurements and long-term durability, the HTS-1 should be installed in a suitable, protected environment.

### Recommended Mounting Location

For optimal performance:

- Install the sensor in a Stevenson screen (weather shelter) or a protective enclosure with sufficient ventilation.
- Avoid direct exposure to sunlight, precipitation, and wind gusts, as these can affect pressure readings or degrade sensor components over time.
- Mount the sensor at a representative height for air pressure measurement, away from large heat sources, fans, or artificial pressure variations.

 If mounted outdoors, ensure the enclosure offers adequate protection against condensation, insects, and temperature extremes.

### Mounting Options

The HTS-1 is available in two mounting variants:

#### 1. DIN Rail Version

- Designed for quick installation inside control cabinets or weatherproof housings.
- Simply snap onto a 35 mm DIN rail (EN 60715).
- Ensure the rail is horizontally aligned and securely fixed.

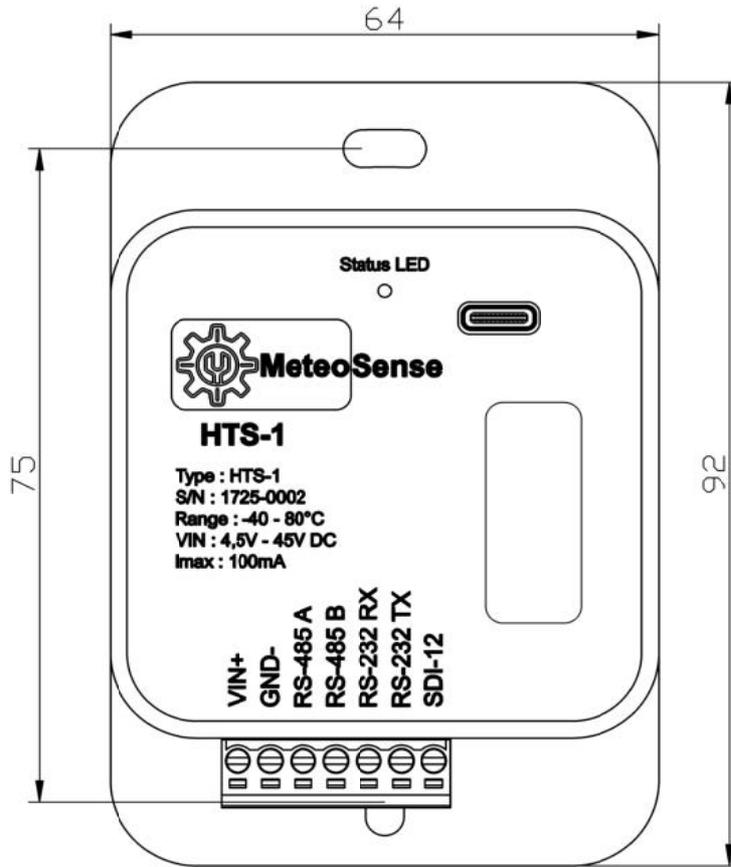
#### 2. Screw-Mount Version

- Equipped with two mounting holes for permanent installation on flat surfaces.
- Use M3 or M4 screws (or suitable equivalents) and ensure the housing is mounted vibration-free.
- Mounting dimensions are provided in the appendix or technical drawing.

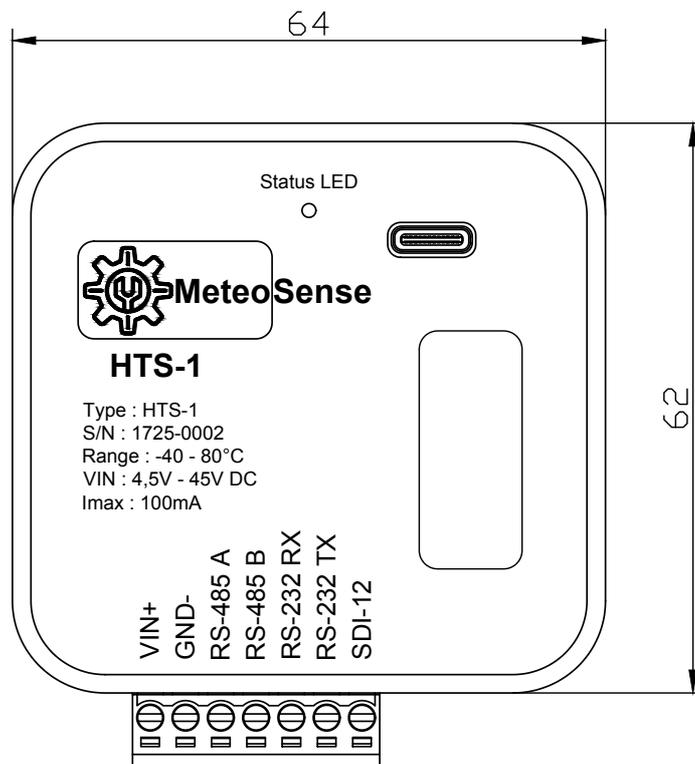


## 5. Technical Specifications

HTS-1 Electrical & General Specifications	
Dc Input Voltage	5 VDC ... 45 VDC (Peak up to 60 VDC)
ESD Protection I/O	15 kV
Reverse Polarity Protection	Yes
Power Consumption	20µA at 12V
Power Consumption always on	3mA at 12V
Number of Sensors	3
Temperature Compensation Range	-40°C ... +80°C
Temperature Range	-40°C ... +80°C
Temperature Units	°C, °F, K
Temperature Accuracy	±0,1°C
Temperature Repeatability (High)	±0.023°C
Temperature Resolution	0.01°C
Temperature Response Time ( $\tau_{63\%}$ )	~4 ... 6 s
Long-term Temperature Drift	<0.03°C/year
Humidity Range	0...100 RH%
Relative Humidity Accuracy	±1.0 (typ.) RH%
Relative Humidity Repeatability (High)	±0.05 RH%
Relative Humidity Resolution	0,01 RH%
Relative Humidity Response Time ( $\tau_{63\%}$ )	~4 – 7 s
Long-term Relative Humidity Drift	<0.2 %RH/year
Interfaces	RS-485, RS-232, SDI-12, USB
Protocols	Modbus RTU/ASCII, SDI-12, USB-CDC
Baud Rate RS-485/RS-232	9.6, 19.2, 38.4, 57.6, 115.2 kbit/s
Baud Rate SDI-12	1.2, 2.4, 4.8 kbit/s
Output Interval Continuous Mode RS-485/RS-232/SDI-12	1 s ... 86400 s
Output Interval USB Streaming	1s ... 3600s
Housing	Anodized Aluminium



DIN rail mount





Before connecting the HTS-1 to a power source or data acquisition system, carefully read the wiring instructions below to avoid damage to the sensor or connected equipment.

## 5.1 Power Supply

- Input voltage range: 5 to 45 V DC (protected up to 60 V)
- Use a regulated DC power supply within this range.
- The sensor is protected against reverse polarity and overvoltage.
- For low-power applications, ensure the supply is capable of supporting both sleep and active current demands (typ.  $<20\mu\text{A}$  sleep,  $\sim 3\text{ mA}$  active).

## 5.2 Electrical Interface

The HTS-1 features a single multi-interface port that supports:

- RS-485 (Modbus RTU or ASCII)
- RS-232 (Modbus RTU or ASCII)
- SDI-12 (Version 1.4)
- USB-C (for configuration, data streaming and service only)

*Communication mode can be configured via USB or command interface (see section 7).*

## 5.3 Pin Assignment

Standard Cable Pinout:

Wire Color	Signal	Description
Red	VIN+	Power supply (+5 to +45 V DC)
Black	GND-	Ground
Blue	RS-485 A	Data+
Yellow	RS-485 B	Data-
Green	RS-232 RX	Sensor transmit (to host RX)
White	RS-232 TX	Sensor receive (from host TX)
Orange	SDI-12 Data	SDI-12 bus line
Shield	Cable Shield*	Connect to earth/ground (optional)



**⚠ Important:** Do not connect the shield wire to system ground (GND). It must be connected only to the metal housing of the sensor. Connecting the shield to GND may cause ground loops, signal interference, or even damage to the sensor electronics under certain conditions. Proper bonding to the housing ensures effective shielding and protects the device from external electrical disturbances.

**⚠ Warning:** Only one communication protocol should be used at a time. Do not connect RS-485 and RS-232 interfaces simultaneously.

## 5.4 Wiring Recommendations

- Keep cable lengths as short as possible for best signal quality.
- For RS-485, use twisted pair shielded cable and terminate the bus properly if needed.
- Avoid routing power and signal lines in parallel with high-voltage cables.
- If installed outdoors, use weatherproof cable glands and seal unused wires.

## 6. Communication Protocols

The HTS-1 supports multiple digital communication protocols to ensure compatibility with a wide range of data acquisition systems:

- Modbus RTU, Modbus ASCII, continues ASCII (RS-485)
- Modbus RTU, Modbus ASCII, continues ASCII (RS-232)
- SDI-12
- USB

Each protocol can be selected via USB setup see section 7 for details.

### 6.1 Modbus protocol

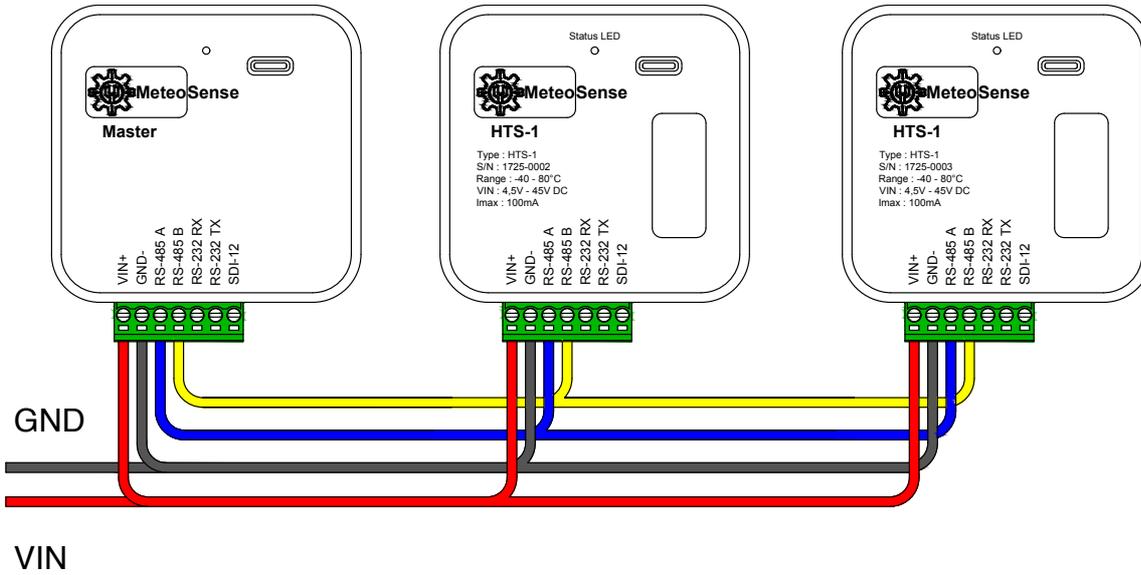
This sensor communicates using the Modbus protocol over an RS-485/RS-232 interface, and operates as a Modbus slave device.

Modbus is a widely adopted, open communication protocol and maintained by the Modbus Organization ([www.modbus.org](http://www.modbus.org)). It is a de facto standard for industrial and environmental sensor integration.

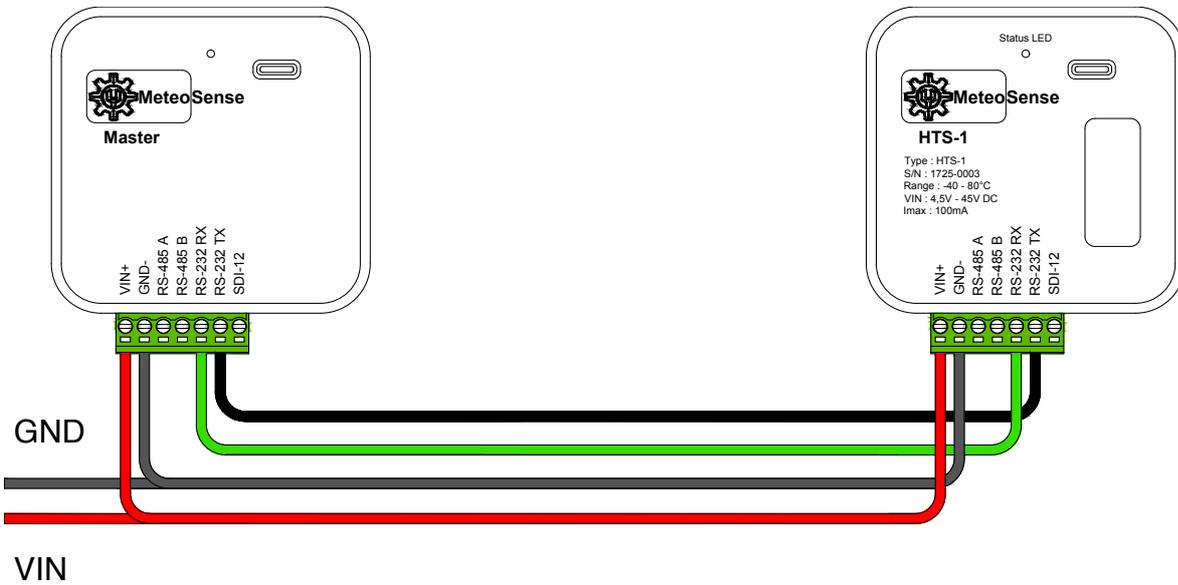


## 6.1.1 Wiring diagram Modbus

### RS-485



### RS-232





## 6.1.2 Modbus RTU

### Protocol Details:

- Protocol version: Modbus Application Protocol Specification V1.1b3
- Communication model: Master-slave
- Transmission mode: RTU (Remote Terminal Unit)
- Physical interface (model-dependent):
  - RS-232 (3-wire: TX, RX, GND)
  - RS-485 (2-wire, half-duplex: A/B differential pair)
- Byte order: Big-Endian (MSB first)
- Data format: Binary
- Error checking: 16-bit CRC (Cyclic Redundancy Check)

### Each Modbus RTU message consists of the following elements:

1. Slave address
2. Function code
3. Data (registers or commands)
4. CRC checksum

The sensor only responds to direct queries from a Modbus master and does not send unsolicited data. This ensures deterministic and reliable communication within multi-device RS-485/RS232 networks.

## 6.1.3 Modbus ASCII

### Protocol Details:

- Protocol version: Modbus Application Protocol Specification V1.1b3
- Communication model: Master-slave
- Transmission mode: ASCII (American Standard Code for Information Interchange)
- Physical interface (model-dependent):
  - RS-232 (3-wire: TX, RX, GND)
  - RS-485 (2-wire, half-duplex: A/B differential pair)
- Message framing:
  - Start character: :
  - Payload: ASCII-encoded hexadecimal characters
  - End characters: Carriage Return + Line Feed (CR LF)
- Error checking: LRC (Longitudinal Redundancy Check)



### Each Modbus ASCII message consists of:

1. A start delimiter (:)
2. The slave address
3. The function code
4. The data, encoded as ASCII hexadecimal
5. An LRC checksum
6. A message terminator (CR LF)

Compared to RTU mode, ASCII mode provides greater readability and ease of debugging, but at the cost of lower data throughput.

The sensor only responds to Modbus master requests and remains silent otherwise.

## 6.1.4 Modbus Commands

- Read Input Register: 0x04 (descriptive data register)
- Write Single Register: 0x06 (device parameter register)

### Modbus Function Codes 0x04 and 0x06

- 0x04 – Read Input Registers:  
This function code is used to read input registers, which are typically read-only and contain real-time data such as sensor readings (e.g., voltage, temperature, or current). These registers are commonly addressed from range 30001 onward in Modbus conventions.
- 0x06 – Write Single Register:  
This function code is used to write a single value to a holding register. Holding registers are read/write and typically store configuration parameters or control values (e.g., setpoints, thresholds). These registers are usually addressed from 40001 onward.

### Logical vs. Protocol-Level Addresses

Modbus documentation and software tools often reference logical register numbers, such as 30201. However, the actual Modbus protocol transmits zero-based addresses relative to the register type.

For example:

- Logical Address: 30201 (Input Register)
- Function Code: 0x04
- Protocol Address (offset):  $30201 - 30001 = 200$  → sent in frame as 0x00C8

The value 200 is the zero-based address used in the Modbus message. It must be interpreted in the context of the selected function code.



## 6.1.5 Input Registers Values (0x04)

Register	Sensor parameter name	Unit	Divisor	Data type	Access
200	Realtime Temperature	°C	100	1xINT16	Read Only
201	Realtime Humidity	Rh%	100	1xUINT16	Read Only
202	Average Temperature 30min	°C	100	1xINT16	Read Only
203	Min. Temperature 30 min	°C	100	1xINT16	Read Only
204	Max. Temperature 30 min	°C	100	1xINT16	Read Only
205	Average Humidity 30min	Rh%	100	1xUINT16	Read Only
206	Min. Humidity 30 min	Rh%	100	1xUINT16	Read Only
207	Max. Humidity 30 min	Rh%	100	1xUINT16	Read Only
208	Average Temperature 1h	°C	100	1xINT16	Read Only
209	Min. Temperature 1h	°C	100	1xINT16	Read Only
210	Max. Temperature 1h	°C	100	1xINT16	Read Only
211	Average Humidity 1h	Rh%	100	1xUINT16	Read Only
212	Min. Humidity 1h	Rh%	100	1xUINT16	Read Only
213	Max. Humidity 1h	Rh%	100	1xUINT16	Read Only
214	Average Temperature 3h	°C	100	1xINT16	Read Only
215	Min. Temperature 3h	°C	100	1xINT16	Read Only
216	Max. Temperature 3h	°C	100	1xINT16	Read Only
217	Average Humidity 3h	Rh%	100	1xUINT16	Read Only
218	Min. Humidity 3h	Rh%	100	1xUINT16	Read Only
219	Max. Humidity 3h	Rh%	100	1xUINT16	Read Only
220	Average Temperature 6h	°C	100	1xINT16	Read Only
221	Min. Temperature 6h	°C	100	1xINT16	Read Only
222	Max. Temperature 6h	°C	100	1xINT16	Read Only
223	Average Humidity 6h	Rh%	100	1xUINT16	Read Only
224	Min. Humidity 6h	Rh%	100	1xUINT16	Read Only
225	Max. Humidity 6h	Rh%	100	1xUINT16	Read Only
226	Average Temperature 12h	°C	100	1xINT16	Read Only
227	Min. Temperature 12h	°C	100	1xINT16	Read Only



Register	Sensor parameter name	Unit	Divisor	Data type	Access
228	Max. Temperature 12h	°C	100	1xINT16	Read Only
229	Average Humidity 12h	Rh%	100	1xUINT16	Read Only
230	Min. Humidity 12h	Rh%	100	1xUINT16	Read Only
231	Max. Humidity 12h	Rh%	100	1xUINT16	Read Only
232	Average Temperature 24h	°C	100	1xINT16	Read Only
233	Min. Temperature 24h	°C	100	1xINT16	Read Only
234	Max. Temperature 24h	°C	100	1xINT16	Read Only
235	Average Humidity 24h	Rh%	100	1xUINT16	Read Only
236	Min. Humidity 24h	Rh%	100	1xUINT16	Read Only
237	Max. Humidity 24h	Rh%	100	1xUINT16	Read Only
238	Dew Point	°C	100	1xINT16	Read Only
239	Enthalpy	kJ/kg	100	1xUINT16	Read Only
240	Wet-Bulb-Temperature	°C	100	1xINT16	Read Only
241	Heat Index	°C	100	1xINT16	Read Only
242	Absolute Humidity	g/m <sup>3</sup>	100	1xUINT16	Read Only

**Note:** The sensor supports selectable Temperature units, including: degrees Celsius, degrees Fahrenheit and Kelvin.

**Note:** All register addresses in this document refer to the zero-based Modbus register addresses used in protocol communication. Some tools may display them as one-based (e.g. address 200 shown as “Register 201”).



## 6.1.6 Modbus RTU Examples (0x04)

Master Request					Slave Response				
Slave Address	Function	Start Address	Quantity Of Regs	CRC	Slave Address	Function	Byte Count	Data Bytes	CRC
01	04	00 C8 (200)	00 01	F0 35	01	04	02	A439 (2212)	AC b6

The master requests the current Temperature from register 200, reading 1 registers. The slave responds in  $1 \times 16$ -bit words (big-endian).

**Note:** Customers can use a Modbus RTU request to read multiple registers at once. For example, the entire range from address 200 to 242 can be accessed in a single Read Input Registers (0x04) request.

## 6.1.7 Holding Registers parameters (0x06)

Register	Sensor parameter name	Values	Standard	Access
0	Modbus slave Address	1-247	1	Write only
50	Baudrate	96 = 9600 192 = 19200 384 = 38400 576 = 57600 1152 = 115200	96	Write only
100	Parity	1 = even 0 = None	0	Write only
110	Power Mode	1 = always on 2 = standby	1	Write only
120	Units	1 = °C 2 = °F 3 = K	1	Write only

**⚠ Important:** When changing the unit of measurement (e.g., from °C to K etc.), the device will automatically clear its internal data memory. This is necessary because changing the unit affects the numeric formatting and string length of the stored values.



## 6.1.8 Modbus RTU Examples (0x06)

Master Request					Slave Response				
Slave Address	Function	Start Address	Value	CRC	Slave Address	Function	Byte Count	Data Bytes	CRC
01	06	00 00 (0)	00 02	08 0b	01	06	00	00 00 02 (2)	08 0b

Change the address from 1 to 2.

**Note:** All configuration changes made via USB, Modbus, or SDI-12 do not require a manual restart.

The sensor automatically performs an internal reboot after applying the new settings.

During this brief restart:

- All previously stored data (e.g., average, min, max values) is retained.
- Measurement and communication resume automatically within a few seconds.

There is no risk of data loss when changing settings such as Modbus address, baud rate, measurement interval, or output unit.

## 6.1.9 Continuous ASCII Mode RS-485/RS-232

Start Char	Address	Value	Term
:	1	+2212+5534 (22,12°C, 55,34Rh)	<CR><LF>

The device supports a continuous ASCII output mode, which can be enabled via the USB interface.

When activated, the sensor automatically transmits an ASCII-formatted string at the configured transmission interval, without requiring a Modbus or command-based request.

This mode is ideal for systems that need real-time data streams (e.g., data loggers, terminal displays, or microcontrollers).

- The mode and transmission interval can be configured via USB.
- Refer to Directory 7 – Interface Settings in the USB configuration menu for detailed options and parameter definitions.

### Power Mode Recommendation

**⚠ Important:** If the selected transmission interval is 10 seconds or less, we recommend enabling the Normal Power Mode to ensure reliable operation and fast response times. For intervals greater than 10 seconds, the device can safely operate in Sleep Mode to reduce power consumption during idle periods. Power mode settings can be configured under USB.



## 6.1.10 RS-485 / RS-232 Sleep Mode

The sensor supports a low-power Sleep Mode to reduce energy consumption during periods of inactivity. This mode is particularly relevant when operating via RS-485 or RS-232.

### Behavior in Sleep Mode

When in Sleep Mode, the sensor's communication interface enters a passive state and does not respond immediately. It must first be woken up by activity on the bus. The following applies:

- The sensor can be woken up by any signal on the bus — it does not require a valid Modbus request.
- Even a brief break condition, a malformed message, or an empty polling attempt is sufficient to trigger wake-up.
- After detecting activity, the sensor becomes fully responsive again after approximately 300 ms.
- The second message (i.e., the actual request) will then be answered normally.

### Communication Timing & Recommendations

- When Sleep Mode is enabled, allow at least 15 seconds of bus inactivity between requests to ensure the sensor has time to enter low-power mode.
- If multiple slaves are connected on the same RS-485 bus, it is sufficient to wake only one device (e.g., the first addressed slave). All other connected sensors will detect the bus activity and wake up in parallel.
- Starting from baud rates  $\geq 57600$ , wake-up timing is more sensitive and depends on bus structure and line length. In such cases, additional delays or retries may be necessary to ensure stable communication



## 6.2.SDI-12

This sensor communicates using the SDI-12 protocol (Serial Data Interface at 1200 Baud), compliant with the SDI-12 Specification Version 1.4. It supports both standard commands and a range of extended functions, enabling flexible integration into environmental monitoring systems.

The sensor responds to all mandatory commands defined by the SDI-12 standard, such as measurement initiation (aM!), concurrent measurements (aC!), and data retrieval (aD0!, aD1!, etc.).

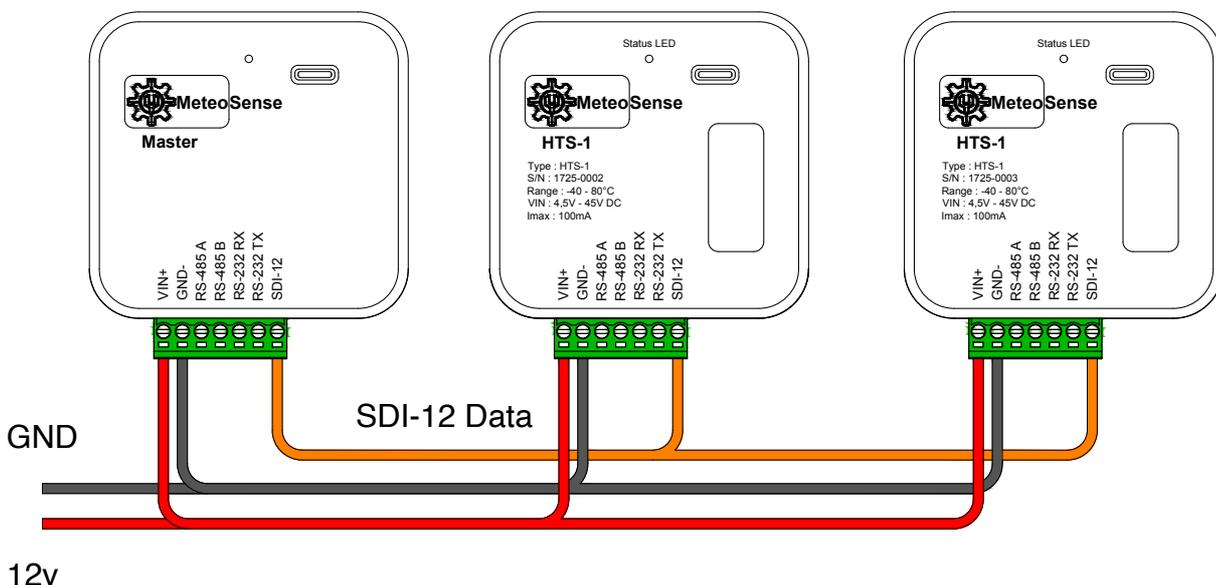
In addition, it implements optional extended commands, including:

- Additional measurement commands (M1!, M2!, ...) to access stored statistical values (e.g., minimum, maximum, average pressure over the past 24 hours)
- CRC-enabled commands (aMC!, aCC!, etc.) that return data with a 16-bit CRC checksum for enhanced communication reliability
- Self-verification (aV!) which provides a simple status response confirming internal function checks
- Sensor discovery (?!), address changes, and other utility functions required for sensor configuration

All command formats and response structures follow the SDI-12 1.4 guidelines. This ensures compatibility with any data logger or data acquisition system that implements the SDI-12 standard.

For detailed information on the protocol, timing, and electrical requirements, please refer to the official SDI-12 documentation available at: [www.sdi-12.org](http://www.sdi-12.org)

### 6.2.1 Wiring diagram SDI-12





## 6.2.2 SDI-12 Commands

This sensor supports standard SDI-12 commands as defined in version 1.4 of the specification.

In addition to basic measurement and identification functions, the sensor provides access to stored statistical pressure data—such as minimum, maximum, and average values over the last 24 hours—via extended measurement commands.

For improved communication reliability, the sensor also supports CRC-enabled command variants, which return measurement data with a 16-bit checksum.

Configuration and utility features such as address assignment and sensor discovery are fully supported.

Name	Command (a = slave Address)	Response
Acknowledge Active	a!	a<CR><LF>
Send Identification	a!	
Change Address	aAb!	b<CR><LF>
Address Query	?!	a<CR><LF>
Start Measurement*	aM!	atttn<CR><LF>
Start Measurement with CRC*	aMC!	atttn<CR><LF>
Send Data	aD0!	a<values><CR><LF> or a<values><CRC><CR><LF>
Start Measurement Register 1-7	aM1!...aM7!	atttn<CR><LF>
Start Measurement Register 1-7 with CRC	aMC1!...aMC7!	atttn<CR><LF>
Start Verification*	aV!	
Start Concurrent Measurement	aC!	atttn<CR><LF>
Start Concurrent Measurement with CRC	aCC!	atttn<CR><LF>
Additional Concurrent Measurement Register 1-7	aC1!...aC7!	atttn<CR><LF>
Additional Concurrent Measurement Register 1-7 with CRC	aCC1!...aCC7!	atttn<CR><LF>
Change Units	aX1!...aX3!	au<CR><LF>

\*This command result in a service request (a<CR><LF>)



## 6.2.2.1 SDI-12 Register

Command (a = slave Address)	Response Value/s
aM!, aMC!, aC!, aCC!	Realtime Temperature, Realtime Humidity
aM1!, aMC1!, aC1!, aCC1!	Avg. Temperature (30min) Min. Temperature (30min) Max. Temperature (30min) Avg. Humidity (30min) Min. Humidity (30min) Max. Humidity (30min)
aM2!, aMC2!, aC2!, aCC2!	Avg. Temperature (1h) Min. Temperature (1h) Max. Temperature (1h) Avg. Humidity (1h) Min. Humidity (1h) Max. Humidity (1h)
aM3!, aMC3!, aC3!, aCC3!	Avg. Temperature (3h) Min. Temperature (3h) Max. Temperature (3h) Avg. Humidity (3h) Min. Humidity (3h) Max. Humidity (3h)
aM4!, aMC4!, aC4!, aCC4!	Avg. Temperature (6h) Min. Temperature (6h) Max. Temperature (6h) Avg. Humidity (6h) Min. Humidity (6h) Max. Humidity (6h)
aM5!, aMC5!, aC5!, aCC5!	Avg. Temperature (12h) Min. Temperature (12h) Max. Temperature (12h) Avg. Humidity (12h) Min. Humidity (12h) Max. Humidity (12h)
aM6!, aMC6!, aC6!, aCC6!	Avg. Temperature (24h) Min. Temperature (24h) Max. Temperature (24h) Avg. Humidity (24h) Min. Humidity (24h) Max. Humidity (24h)
aM7!, aMC7!, aC7!, aCC7!	Dew Point Enthalpy Wet-Bulb-Temperature Heat Index Absolute Humidity



## 6.2.2.2 Acknowledge Active Command (a!)

This command is used to ensure that a sensor is responding to a data recorder or another SDI-12 device. It asks a sensor to acknowledge its presence on the SDI-12 bus.

### Examples of the Acknowledge Active Command (a!):

Command Recorder	Response Sensor a (address 1)	Response Sensor b (address 2)
1!	1<CR><LF>	
2!		2<CR><LF>

## 6.2.2.3 Send Identification Command (a!)

This command is used to query sensors for their SDI-12 compatibility level, model number, and firmware version number.

### Examples of the Send Identification Command (a!)

Command Recorder	Response Sensor a (address 1)	Response Sensor b (address 2)
1!!	114METSENSEHTS1V1125W170000001<CR><LF>	
2!!		214METSENSEHTS1V1125W170000002<CR><LF>

Address	SDI-12 Version	Manufacturer	Model	Software Version	Serial Number
1	1.4	METEOSENSE	HTS1	V11	25W170000001

## 6.2.2.4 Address Query Command (?!)

Address Query Command (?!) in SDI-12 is used to discover sensors on the bus.

### Examples of the Address Query Command (?!)

Command Recorder	Response Sensor a (address 1)	Response Sensor b (address 2)
?!	1<CR><LF>	
?!		2<CR><LF>

## 6.2.2.5 Change Address Command (aAb!)

This command changes the address of a sensor.

### Examples of the Change Address Command (aAb!)



Command Recorder	Response Sensor a (address 1 -> address 2)
1A2!	2<CR><LF>

## 6.2.2.6 Start Measurement Command (aM!)

This command instructs the sensor to begin a measurement. However, the sensor does not return the measurement data immediately. Instead, it responds with the time required to complete the measurement and the number of values it will generate. To retrieve the measurement(s), the Send Data (D0!) command must be issued.

### Examples of the Start Measurement Command (aM!)

Command Recorder	Response Sensor a (address 1)
1M!	10022<CR><LF> <i>„1 value available in 2 seconds“</i>
	1<CR><LF> <i>„Sensor is ready after 1 second“</i>
1D0!	1+22.21+55.34<CR><LF> <i>„Sensor answer: 22,21°C, 55,34RH%“</i>

## 6.2.2.7 Start Concurrent Measurement Command (aC!)

This command instructs the sensor to perform a concurrent measurement. A concurrent measurement means the sensor takes its readings at the same time as other SDI-12 sensors on the bus. However, the sensor does not return any measurement data immediately after this command. Instead, it responds with the time required to complete the measurement and the number of values it will produce. To retrieve the actual measurement data, a Send Data (D0!) command must be issued afterwards.

### Examples of the Start Concurrent Measurement Command (aC!)

Command Recorder	Response Sensor a (address 1)	Response Sensor b (address 2)
1C!	100201<CR><LF> <i>„1 value available in 2 seconds“</i>	
2C!		200201<CR><LF> <i>„1 value available in 2 seconds“</i>
1D0!	1+22.21+55.34<CR><LF> <i>„Sensor answer: 22,21°C, 55,34RH%“</i>	
2D0!		2+22.45+55.54<CR><LF> <i>„Sensor answer: 22,45°C, 55,54RH%“</i>



## 6.2.2.8 Additional Measurement Commands (aM1! . . . aM7!)

Additional M commands provide a way to request different temperature and humidity data stored in the sensor's registers.

For example, the primary M command could return the current temperature and humidity measurement, while aM1, aM2, etc., provide access to specific historical or statistical data. These additional commands may return the minimum, maximum, or average temperature and humidity recorded over the last 24 hours. This allows the data recorder to selectively retrieve different types of temperature and humidity information without triggering a new measurement cycle.

### Examples of the Additional Measurement Commands (aM1! . . . aM7!)

Command Recorder	Response Sensor a (address 1)
1M4!	10026<CR><LF> <i>„3 value available in 2 seconds“</i>
	1<CR><LF> <i>„Sensor is ready after 1 second“</i>
1D0!	1+22.12+15.12+24.14+55.60+45.45+87.45<CR><LF> <i>„Sensor answer: Avg. Temperature (6hour) 22,12°C+ Min. Temperature (6hour) 15,12°C+ Max. Temperature (6hour) 24,14°C+ Avg. Humidity (6hour) 55,60 Rh%+ Min. Humidity (6hour) 45,45 RH%+ Max. Humidity (6hour) 87,45 Rh%“</i>

## 6.2.2.9 Additional Concurrent Measurement Commands (aC1! . . . aC7!)

Additional aC1!..aC7! commands work similarly to the standard aC! command, but provide access to different types of stored temperature and humidity data, such as minimum, maximum, or average values over the last 24 hours.

### Examples of the Start Additional Concurrent Measurement Commands (aC1! . . . aC7!)



Command Recorder	Response Sensor a (address 1)	Response Sensor b (address 2)
1C4!	100206<CR><LF> „3 value available in 2 seconds“	
2C4!		200206<CR><LF> „3 value available in 2 seconds“
1D0!	1+22.12+15.12+24.14+55.60+45.45+87.45<CR><LF>  „Sensor answer: Avg. Temperature (6hour) 22,12°C+ Min. Temperature (6hour) 15,12°C+ Max. Temperature (6hour) 24,14°C+ Avg. Humidity (6hour) 55,60 Rh%+ Min. Humidity (6hour) 45,45 RH%+ Max. Humidity (6hour) 87,45 Rh%“	
2D0!		2+22.12+15.12+24.14+55.60+45.45+87.45<CR><LF>  „Sensor answer: Avg. Temperature (6hour) 22,12°C+ Min. Temperature (6hour) 15,12°C+ Max. Temperature (6hour) 24,14°C+ Avg. Humidity (6hour) 55,60 Rh%+ Min. Humidity (6hour) 45,45 RH%+ Max. Humidity (6hour) 87,45 Rh%“

## 6.2.2.10 Start Verification (aV!)

The aV! (Start Verification) command instructs the sensor to perform an internal self-check and prepare a verification response.

In this implementation, the sensor always responds with a single value of +1 to indicate that the verification was completed successfully.

The result can be retrieved using the standard D0! command.

### Examples of Start Verification (aV!)

Command Recorder	Response Sensor a (address 1)
1V!	10021<CR><LF> „1 value available in 2 seconds“
	1<CR><LF> „Sensor is ready after 1 second“
1D0!	1+1<CR><LF> „Sensor answer: 1“



## 6.2.2.11 Change Units (aX1!...aX3!)

The change units command allows switching the output unit.

The available units are:

- 1 = degrees Celsius,
- 2 = degrees Fahrenheit,
- 3 = Kelvin

### Examples of Change Units (aX1!...aX3!)

Command Recorder	Response Sensor a (address 1)
1X1!	11<CR><LF> „change unit to °C“
1X2!	15<CR><LF> „change unit to °F“

**!** *Important:* When changing the unit of measurement (e.g., from °C to K etc.), the device will automatically clear its internal data memory. This is necessary because changing the unit affects the numeric formatting and string length of the stored values.

## 6.2.2.12 Requesting a Cyclic Redundancy Check (CRC)

To improve error detection, certain SDI-12 commands request measurement data with a 16-bit CRC (Cyclic Redundancy Check) appended.

Using commands like aMC!, aMC1!, ..., aMC6! and aCC!, aCC1!, ..., aCC6!, the sensor returns the measurement data with a CRC value included in the response to the D command.

This provides increased reliability when transferring data.

## 6.2.3 Continuous ASCII Mode SDI-12

Start Char	Address	Value	Term
:	1	+22.21+55.65 (22,21°C, 55,65RH%)	<CR><LF>

The device supports a continuous ASCII output mode, which can be enabled via the USB interface.

When activated, the sensor automatically transmits an ASCII-formatted string at the configured transmission interval, without requiring a Modbus or command-based request.



This mode is ideal for systems that need real-time data streams over a serial USB connection (e.g., data loggers, terminal displays, or microcontrollers).

- The mode and transmission interval can be configured via USB.
- Refer to Directory 7 – Interface Settings in the USB configuration menu for detailed options and parameter definitions.

### Power Mode Recommendation

**⚠ Important:** *If the selected transmission interval is 10 seconds or less, we recommend enabling the Normal Power Mode to ensure reliable operation and fast response times. For intervals greater than 10 seconds, the device can safely operate in Sleep Mode to reduce power consumption during idle periods. Power mode settings can be configured under USB.*

## 6.2.4 SDI-12 Sleep Mode

The sensor supports Sleep Mode during operation over the SDI-12 interface. This helps reduce power consumption between measurement or polling intervals, especially in battery-powered or low-energy environments.

### Behavior in Sleep Mode

- In SDI-12 operation, the sensor automatically enters low-power sleep mode after completing a command or response sequence.
- The sensor does not require an explicit wake-up signal like in RS-485 or RS-232.
- The SDI-12 protocol itself handles wake-up through the standard address + command pattern (e.g., 0M!, 0D0!, etc.).

### Communication Timing Recommendation

**⚠ Important:** *To ensure proper sleep behavior, the SDI-12 bus should remain idle for at least 10 seconds between commands. This allows the sensor to reliably enter and remain in low-power mode until the next request. There are no other restrictions regarding wake-up timing or retries. The sensor will always respond to valid SDI-12 commands, regardless of how long it has been idle.*

## 7. USB Configuration

Your HTS-1 is configurable via USB using a USB CDC (Communications Device Class) interface, which appears as a virtual serial port (COM/tty device) on your computer.



This type of USB connection is widely supported and requires no driver installation on most systems:

- Windows (COMx)
- macOS (/dev/tty.usbmodemXXXX)
- Linux (/dev/ttyACM0, /dev/ttyUSBx)

### Configuration via Serial Terminal

After plugging in the sensor via USB, it can be configured using any standard serial terminal application. These tools allow you to send commands directly to the sensor over its virtual serial interface.

Recommended terminal programs:

- Windows:
  - [PuTTY](#)
  - Tera Term
  - <https://serialmonitor.org/>
- macOS:
  - CoolTerm
  - <https://serialmonitor.org/>
- Linux:
  - minicom, screen, or gterm
  - <https://serialmonitor.org/>

**Note on baud rate:** Although the USB CDC interface simulates a serial port, the baud rate is not used for actual data transmission. However, you still need to set a value (e.g. 9600 or 115200) in your terminal program to establish the connection. The sensor accepts connections regardless of the selected baud rate.

**! Important:** The sensor does not support USB-C to USB-C connections. This is due to the sensor's inability to perform USB-C handshaking or role negotiation, which is required for establishing communication on USB-C-only links.

For proper operation, always use the included USB-A to USB-C cable, which is designed for data transmission and ensures compatibility with the sensor's USB interface.

Using a USB-C to USB-C cable (e.g., between the sensor and a modern USB-C-only PC or tablet) may result in:

- No detection by the host system
- No data communication
- Unreliable or no power delivery

Recommendation:

If your host device only has USB-C ports, use a USB-C to USB-A adapter in combination with the supplied USB-A to USB-C data cable.



*Note: All configuration changes made via USB, Modbus, or SDI-12 do not require a manual restart.*

*The sensor automatically performs an internal reboot after applying the new settings.*

*During this brief restart:*

- *All previously stored data (e.g., average, min, max values) is retained.*
- *Measurement and communication resume automatically within a few seconds.*

*There is no risk of data loss when changing settings such as Modbus address, baud rate, measurement interval, or output unit.*

## 7.1 USB Setup

### **Windows:**

To configure or communicate with the sensor via USB, follow these steps to correctly identify the assigned serial port.

#### 1. Connect the Device

- Plug the sensor into your computer using the included USB-A to USB-C data cable.
- Make sure you are not using a USB-C to USB-C cable, as this is not supported (see USB notice above).

#### 2. Identify the COM Port (Windows)

- Open the Device Manager (devmgmt.msc).
- Expand the section "Ports (COM & LPT)".
- Look for a device named:
  - MeteoSense HTS-1 (COMx)
  - where x is the assigned COM port number.

Example: MeteoSense HTS-1 (COM4)

You can now select this COM port in your Modbus/terminal software or sensor configuration tool.



## macOS CoolTerm:





## 7.2 Menu Navigation

The sensor provides a simple text-based configuration menu via USB, which is accessed using any standard serial terminal program (e.g., Tera Term, PuTTY, CoolTerm).

### Input Method

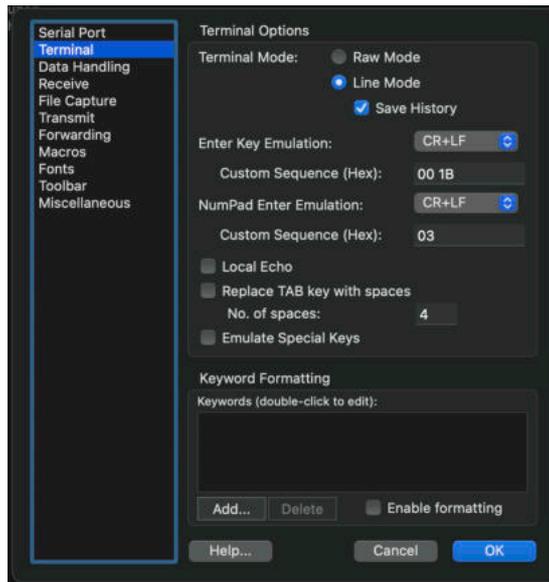
- Menu navigation is controlled exclusively by entering numbers, followed by pressing the Enter key.
- For example, typing 2 and pressing Enter will open submenu item 2.

### Terminal Configuration

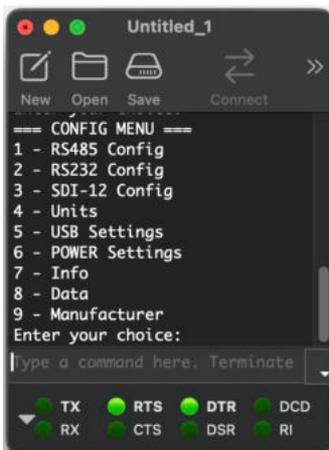
To ensure proper handling of input and line breaks, it is recommended to enable line mode (also called "local line editing" or "line mode") in your terminal program.

This ensures that:

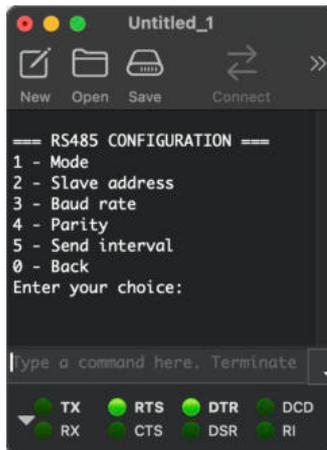
- Numbers are not sent character-by-character
- The sensor only processes input after the full line is submitted with Enter



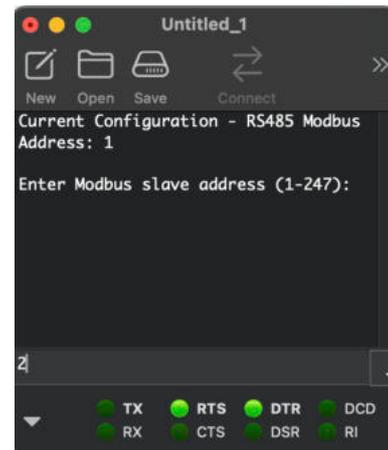
### Example: Changing the Modbus Address via RS-485



1->



2->



2



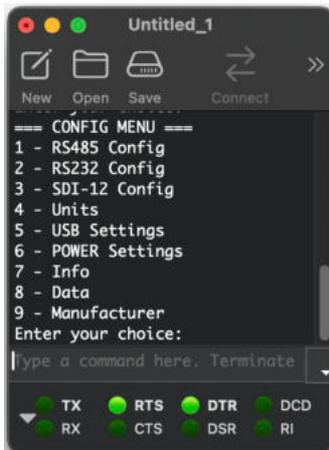
## 7.3 USB Data Streaming

The sensor supports real-time data streaming via USB, allowing continuous transmission of measurement values.

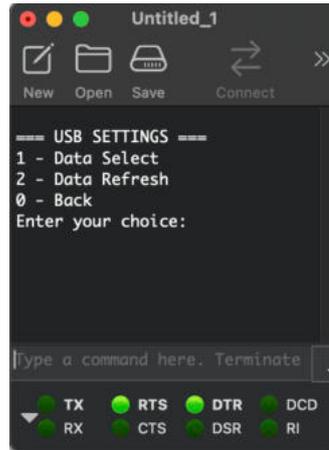
This mode is particularly useful for:

- Live monitoring
- Serial data logging
- Integration with microcontrollers or software tools (e.g. Python, LabVIEW, terminal apps)

### Example: Start USB Streaming



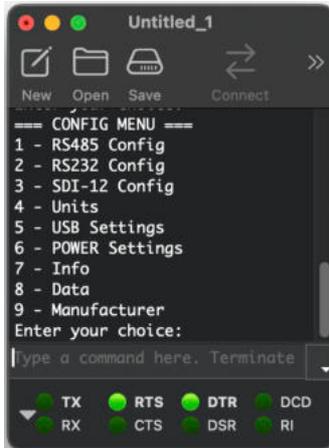
5->



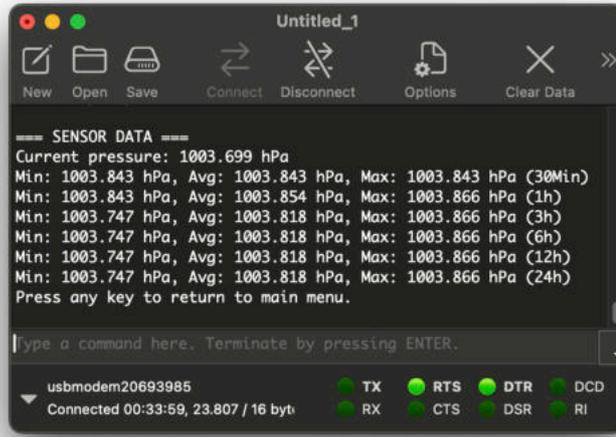
1->



1,2,3,4,5,6,7->



8->



By default, the data is refreshed every 1 second. You can configure the refresh interval to any value between 1 and 3600 seconds, depending

*Note: Example screenshot showing data stream setup (pressure values shown as example)*



## 8. Maintenance & Calibration

The HTS-1 sensor is largely maintenance-free. If needed, the sensor surface can be cleaned using a lint-free, slightly damp cloth. Do not use abrasive materials or harsh cleaning agents.

A check-up and recalibration should be carried out at least every two years by the manufacturer or an authorized service provider. More frequent calibration is typically not necessary, as the sensor features an integrated self-test function.

This self-test continuously monitors sensor performance. If the sensor detects a deviation that requires recalibration, it will indicate this via its LED status indicator. Please refer to the section *LED Codes* for detailed information on when immediate recalibration is necessary.

## 9. Troubleshooting

Symptom	Possible Cause	Recommended Action
Sensor does not respond to request	USB misconfiguration or wrong device settings	Check USB configuration settings
Sensor does not respond via Modbus (holding reg 0x06)	Sensor may be in sleep mode	Check USB configuration and ensure Power Mode = Normal
Sensor shows no activity at all	Startup failure or no LED feedback	Restart device; check if both red and blue LEDs flash at startup. If not: check USB config or contact support

### 9.1 Troubleshooting – LED Error Codes

The HTS-1 sensor is equipped with a red status LED to indicate error conditions at startup or during operation. The following blink patterns can help diagnose potential issues:

LED Pattern Red	Meaning	Device Behavior	Recommended Action
- - - -	Sensor 1 failure	Device still outputs data	Contact support
- - - - -	Sensor 2 failure	Device still outputs data	Contact support
- - - - - -	Sensor 3 failure	Device still outputs data	Contact support
- - -	One sensor significantly out of tolerance	Sensor still active	Recalibration recommended; contact support
- - - - - - -	Two or more sensors out of tolerance, or invalid readings	Data may be inaccurate or corrupted	Contact support



## 10. Accessories / Spare Parts

Nr.	Part Name	Order Number
1	Housing	HTS-1 – T01
2	Backplate	N1803B
3	Backplate DIN Rail	N1803A
4	Filter	HTS1 – T02
5	Circuit Board	HTS-1 – 25w17

## 11. Disposal and Recycling

The HTS-1 contains electronic components. It must not be disposed of with regular household waste.

At the end of its service life, the HTS-1 must be disposed of in accordance with local laws and environmental regulations for electronic equipment and batteries.

- Please take the device to an authorized collection point for electronic waste.
- The built-in battery must be handled and recycled separately in accordance with local battery recycling standards.
- Do not incinerate or expose the battery to fire or high temperatures.

As a manufacturer, we are registered under the German WEEE system (Stiftung EAR) and comply with all obligations regarding product take-back and recycling.

**WEEE-Reg.-Nr. DE 21710845**

By disposing of the HTS-1 correctly, you help protect the environment and support the sustainable reuse of valuable materials.





