100 years Since 1925 SIAP+MICROS Environmental Monitoring Solutions

T011H-TBAR-UHIVS / T011I-TBAR-USDI12

High accuracy atmospheric pressure sensor

User and maintenance manual

Firmware version 1.0.0

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1. Introduction

This manual contains important information for the use and maintenance of the T011H-TBAR-UHIVS and T011I-TBAR-USDI12 atmospheric pressure sensors. Always consult the manual before performing any operation on the instrument.

1.1 Purpose and target audience of the manual

The manual provides:

- Safety information on the T011H-TBAR-UHIVS and T011I-TBAR-USDI12 products
- Information on device hardware and connections
- Information on installation, use, maintenance, and disposal of the device

The manual is primarily intended for technical personnel such as:

- Monitoring network designers
- Monitoring network operators
- Installers
- Technical operators
- Maintenance personnel

Keep this manual in a safe place and always have a copy available for operators.

1.2 Contact and support information

For technical and commercial information and support, please refer to the manufacturer's contact details.

SIAP+MICROS S.p.A.

Via del Lavoro 1,

31020 – San Fior (TV) - Italy

https://www.siapmicros.com/

https://www.siapmicros.com/contatti/

For detailed technical documentation, please refer to the product page.

https://www.siapmicros.com/sistemi-di-misura/pressione-atmosferica/

1.3 Conventions and symbols used

The following symbols may be used in the text, with their meanings explained below.

 General warning/danger symbol. It indicates a potential risk that may cause damage to persons or property. Pay particular attention when you see this symbol.

 Disposal. The product must NOT be disposed of as municipal waste but rather in accordance with the European Directive on Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.

⎓ Direct voltage and direct current symbol.

Important text Pay particular attention when you see text framed in red.

Risky operation White text on a red background indicates a potentially hazardous operation for the equipment, such as:

- Loss of measurement configuration
- Loss of functionality
- Degradation of measurement performance
- Damage to equipment

For operator safety, it is necessary to follow the procedures described in this manual and read all the notes carefully.

Hereinafter, the terms "TBAR – U," "TBAR," "sensor," "device," "barometer," "instrument," and "product" will be used interchangeably to refer to the T011H-TBAR-UHIVS and T011I-TBAR-USDI12 products.

2. Precautions and safety measures

2.1 Intended use

The instrument is a high accuracy barometer designed to measure atmospheric pressure in the range 500 – 1100 mBar.

2.2 Warnings

The manufacturer declines any responsibility in the event of faults due to failure to follow the instructions, tampering, use not covered by this manual, improper use of the device, or use by untrained operators. Only authorized and trained personnel should have access to the work area for normal use and maintenance operations.

General safety rules

- Only handle the instrument with completely dry hands.
- The instrument must not be operated in the presence of flammable gases, fumes, or in any environment where there is a risk of explosion.
- Do not remove, replace, or modify any electrical or mechanical parts.
- Maintenance operations, replacement of components, and work inside the device must only be carried out by SIAP+MICROS technical personnel or personnel trained by SIAP+MICROS.
- Pay attention to any warning labels against potentially dangerous procedures.

2.3 Moving

To avoid damage to the equipment, take care during transport. Avoid impacts. Transport the TBAR – U in suitable protective packaging.

2.4 Removing the packaging

Before removing the packaging and installing the instrument, make sure you have taken the following precautions:

- Wear suitable gloves to protect yourself against abrasion, etc.
- If any damage caused during transport by the supplier is found, return the instrument to the supplier.
- Once removed from the packaging, place the instrument and its components on a flat surface.
- Pay attention to the connectors on the side of the instrument container during this operation.

Before installing the instrument, check that:

- The mains voltage in the installation area complies with the operating conditions of the instrument.

2.5 Powering up

To turn on the instrument, simply insert the connection cable as described in chapter three.

Do not exceed the maximum supply voltage of 30V. ⎓

Pay particular attention when connecting the 7-pin connection cable: first ensure that all other signals on the connector are correctly connected on the data logger side/acquisition instrumentation side or suitably isolated.

2.6 During operation

During operation, avoid tampering with electrical connections: completely disconnect the power supply before performing any operation.

2.7 Storage

If you do not plan to use the equipment for an extended period (at least one year):

- Disconnect all cables from the device, place it in a transparent plastic bag together with a bag of desiccant salts, and seal the bag with adhesive tape. Label the bag with the contents and weight of the equipment, adding the words

HANDLE WITH CARE

- Store the instrument in an environment with a temperature between 0 and 60 degrees Celsius and humidity not exceeding 80%.
- Ensure that the instrument is stored in a stable position and that it cannot be damaged or moved due to carelessness or distraction.
- Do not stack other instruments or weights on top of it. Do not stack the instrument on top of other instruments and, in any case, ensure that the support underneath is solid and stable.

2.8 Maintenance

The sensor does not require any maintenance.

However, it is advisable to periodically check the proper functioning of the instrument, for example annually, by comparing it with reference instruments.

2.8.1 Cleaning the instrument

Before cleaning the instrument, disconnect all connection cables. Use soft, dry cloth for cleaning. Never use damp cloths, solvents, water, or other liquids. Compressed air can be used to remove any dust residues.

2.8.2 Power line protection

The product is equipped with protection devices against overvoltage, overcurrent, and electrostatic discharge. The power supplies are also equipped with reverse polarity protection circuitry. Always pay particular attention to the connections and always refer to the technical specifications of the instrument available at https://www.siapmicros.com/sistemi-di-misura/pressione-atmosferica/ for applicability limits. See chapter three for more details.

2.9 Disposal

In accordance with European Union Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), this product must be disposed of at a designated collection point for the recycling of electrical and electronic equipment.

For further information on your nearest recycling center, please contact your local authority.

3. Hardware and connections

3.1 Barometric sensor overview

The TBAR – U is an atmospheric pressure sensor in the range of 500 – 1100 mBar. For details on the measurement cycle and available electrical quantities, refer to chapter five on device operation. The components of the TBAR – U are shown in the following figure.

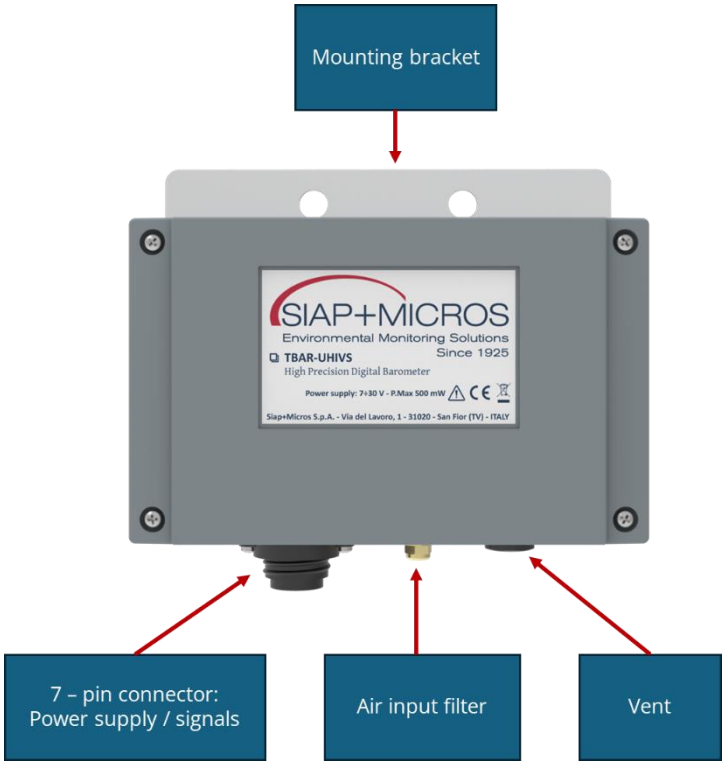


Figure1: Atmospheric pressure sensor

- **7-pin interface connector**

  This connector provides power and all electrical signals for interfacing.

- **Vent**

  Ensures pressure compensation and preserves the container seal.

- **Inlet filter**

  Filter that prevents foreign materials, such as dirt and insects, from entering the pressure measurement chamber.

- **Mounting bracket**

  Allow installation on different types of connections and consists of two holes with a diameter of 10 mm and a center distance of 52 mm. The following figure 2 shows the overall dimensions of the sensor in [mm].

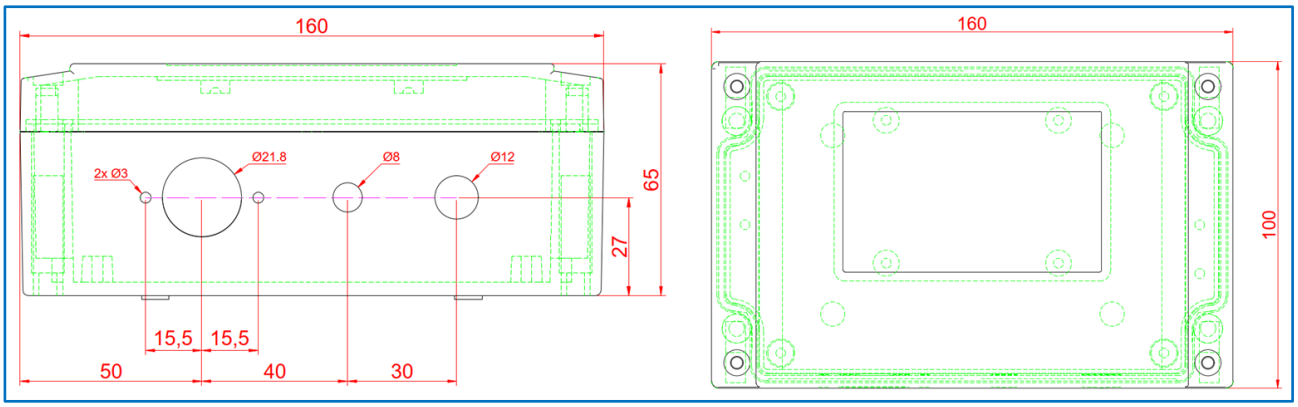


Figure2: TBAR – U dimensions in [mm]

3.2 Electrical connections

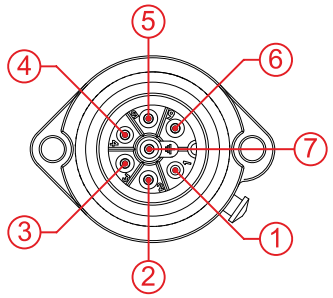
The electrical connections are shown on a 7 – pin Amphenol C016 30C006 100 12 connector.

3.2.1 T011H-TBAR-UHIVS

The T011H-TBAR-UHIVS barometer provides measurements in:

- MODBUS protocol on RS – 485
- Analog voltage output 0 – 2V
- Analog current output 4 – 20mA

The electrical connections are shown in the following figure.



Pin	Signal
1	A – RS485
2	B – RS485
3	+(0 – 2V)
4	+(4 – 20mA)
5	–(0 – 2V) –(4 – 20mA)
6	+Power supply
7	GND

Figure3: Electrical connections T011H-TBAR-UHIVS

The color of the rows in the "Signal" column of the table reflects the color of the wires in the standard connection cable that can be supplied by SIAP+MICROS.

With reference to the connector shown in Figure 3:

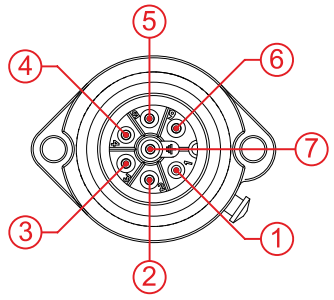
1. Pin 1: **A – RS485**, positive of RS – 485, referring to the GND ground of pin 7.
2. Pin 2: **B – RS485**, negative of RS – 485, referring to the GND ground of pin 7.
3. Pin 3: **+(0 – 2V)**, positive of the 0 – 2V voltage output, referring to pin 5.
4. Pin 4: **+(4 – 20mA)**, positive of the 4 – 20mA current output, referenced to pin 5.
5. Pin 5: **–(0 – 2V) / –(4 – 20mA)**, negative of the voltage and current outputs.
6. Pin 6: **+Power supply**, positive power supply (continuous voltage range 7V to 30V⎓).
7. Pin 7: **GND**, negative power supply and voltage reference for electrical levels at pins 1 and 2.

3.2.2 T011I-TBAR-USDI12

The T011I-TBAR-USDI12 barometer provides measurements in:

- MODBUS protocol on RS – 485
- SDI – 12 protocol
- 4 – 20mA analog current output

The electrical connections are shown in the following figure.



Pin	Signal
1	A – RS485
2	B – RS485
3	SDI – 12
4	+(4 – 20mA)
5	–(4 – 20mA)
6	+Power supply
7	GND

Figure4: Electrical connections T011I-TBAR-USDI12

The color of the rows in the "Signal" column of the table reflects the color of the wires in the standard connection cable that can be supplied by SIAP+MICROS.

With reference to the connector shown in Figure 4:

1. Pin 1: **A – RS485**, positive of RS – 485, referenced to the GND ground of pin 7.
2. Pin 2: **B – RS485**, negative of RS – 485, referenced to the GND ground of pin 7.
3. Pin 3: **SDI – 12**, data line for the SDI – 12 protocol, referenced to the GND ground of pin 7.
4. Pin 4: **+(4 – 20mA)**, positive of the 4 – 20mA current output, referenced to pin 5.

5. Pin 5: **–(4–20mA)**, negative of the 4 – 20mA current output.
6. Pin 6: **+Power**, positive power supply (continuous voltage range 7V to 30V⎓).
7. Pin 7: **GND**, negative power supply and voltage reference for electrical levels at pins 1 and 2.

3.3 Electrical characteristics

This section describes the electrical characteristics of the signals at the seven-pin connector of the two types of barometers, with reference to electrical limits, filtering, protection against polarity reversal, overvoltage, overcurrent, and electrostatic discharge. The description is divided into the following sections:

- Power supply
- RS – 485 bus
- SDI – 12 bus
- Analog output 4 – 20mA
- Analog output 0 – 2V

3.3.1 Power supply (T011H-TBAR-UHIVS / T011I-TBAR-USDI12)

The power supply is connected to pins 6 (positive) and 7 (negative) of the seven-pin connector.

- Operating voltage range 7V to 30V ⎓ .
- For power consumption, refer to the technical specifications.

The power supply is equipped with a three – stage protection circuit, gas discharge tube, varistor, and TVS, for protection against over currents, over voltages, and electrostatic discharges. Protection characteristics:

- Nominal DC trigger voltage: 75V.
- DC impulse triggering voltage: < 400V @ 100 V/µs, < 700V @ 1 kV/µs.
- Overcurrent protection: 3kA (8/20 µs and 10 protection operations), 3.5kA maximum (1 operation 8/20 µs).
- Electrostatic discharge protection: up to 18 kV; IEC 61000-4-2 level 4, IEC 61000-4-5 (surge) IPP = 3A (8/20 µs).
- Protection fuse: resettable PTC technology, holding current 0.5 A and trigger current 1 A. Trigger time: 150 ms at an overcurrent of 8 A.

The power supply is also equipped with a polarity reversal protection circuit.

3.3.2 RS – 485 (T011H-TBAR-UHIVS / T011I-TBAR-USDI12)

The RS – 485 is present at pins 1 (positive) and 2 (negative) of the seven-pin connector.

- The positive line, pin 1, has a pull – up to the sensor's internal 3.3V. This pull – up is located between the RS – 485 transceiver and all line protections before the connector.
- The negative line, pin 2, has a pull – down to the internal ground of the sensor. This pull – down is located between the RS – 485 transceiver and all line protections before the connector.
- There is a line low – pass filter with a 3dB cutoff frequency of approximately 7MHz.

Each line is equipped with a three – stage protection circuit, gas discharge tube, varistor, and TVS, for protection against over currents, over voltages, and electrostatic discharges. Protection characteristics:

- Nominal DC trigger voltage: 75V.
- DC impulse triggering voltage: < 400V @ 100 V/µs, < 700V @ 1 kV/µs.
- Overcurrent protection: 3kA (8/20 µs and 10 protection operations), 3.5kA maximum (1 operation 8/20 µs).
- Electrostatic discharge protection: ESD: IEC 61000-4-2, ±30kV for contact discharge, ±30kV for air discharge. EFT: IEC 61000-4-4, 50A (5/50ns). Lightning strike: IEC 61000- 4-5, 19 A (8/20 µs).
- Protective fuse: resettable PTC technology, holding current 0.12 A and triggering current 0.3 A. Triggering time: 100ms at an overcurrent of 1 A.

3.3.3 SDI – 12 (T011I-TBAR-USDI12)

The SDI – 12 data line is present at pin 3 of the seven-pin connector of the T011I-TBAR-USDI12.

The impedance on the line follows the specifications recommended by the SDI – 12 standards:

- 220kΩ pull – down resistance.
- Capacitor between line and ground: 2.2nF.
- Series resistors on the line, before and after the filter, 560Ω.

The line therefore has a low – pass filter with a 3dB cutoff frequency of approximately 130kHz.

The line is equipped with a three – stage protection circuit, gas discharge tube, varistor, and TVS, for protection against over currents, over voltages, and electrostatic discharges. Protection characteristics:

- Nominal DC trigger voltage: 75V.
- DC impulse triggering voltage: < 400V @ 100 V/µs, < 700V @ 1 kV/µs.
- Overcurrent protection: 3kA (8/20 µs and 10 protection operations), 3.5kA maximum (1 operation 8/20 µs).

- Electrostatic discharge protection: IEC 61000-4-2, ±30kV for contact discharge, ±30kV for air discharge.
- Protection fuse: resettable PTC technology, holding current 0.12 A and tripping current 0.3 A. Tripping time: 100 ms at an overcurrent of 1 A.

3.3.4 4 – 20 mA analog output (T011H-TBAR-UHIVS / T011I-TBAR-USDI12)

The 4 – 20 mA analog output is present at pins 4 (positive) and 5 (negative) of the seven-pin connector.

The voltage present on the line is equal to the sensor supply voltage, while the current is proportional to the measured signal, as explained in chapter five.

The maximum load depends on the sensor supply voltage:

- 250 Ω @ Valim > 11V ⎓
- 200 Ω @ 10V < Valim ≤ 11V ⎓
- 150 Ω @ Valim ≤ 10V ⎓

The output is equipped with a three – stage protection circuit, gas discharge tube, varistor, and TVS, for protection against over currents, over voltages, and electrostatic discharges. Protection characteristics:

- Nominal DC trigger voltage: 75V.
- DC impulse triggering voltage: < 400V @ 100 V/µs, < 700V @ 1 kV/µs.
- Overcurrent protection: 3kA (8/20 µs and 10 protection operations), 3.5kA maximum (1 operation 8/20 µs).
- Electrostatic discharge protection: up to 18 kV; IEC 61000-4-2 level 4, IEC 61000-4-5 (surge) IPP = 3A (8/20 µs).
- Protection fuse: resettable PTC technology, holding current 0.12 A and trigger current 0.3 A. Trigger time: 100 ms at an overcurrent of 1 A.

3.3.5 0 – 2V analog output (T011H-TBAR-UHIVS)

The 0 – 2V analog output is present at pins 3 (positive) and 5 (negative) of the seven-pole connector of the T011H-TBAR-UHIVS.

The voltage present on the line is proportional to the measured signal as explained in chapter five.

The output is equipped with a three – stage protection circuit, gas discharge tube, varistor, and TVS, for protection against over currents, over voltages, and electrostatic discharges. Protection characteristics:

- Nominal DC trigger voltage: 75V.
- DC impulse triggering voltage: < 400V @ 100 V/µs, < 700V @ 1 kV/µs.

- Overcurrent protection: 3kA (8/20 µs and 10 protection operations), 3.5kA maximum (1 operation 8/20 µs).
- Electrostatic discharge protection: up to 18 kV; IEC 61000-4-2 level 4, IEC 61000-4-5 (surge) IPP = 3A (8/20 µs).

Protection fuse: resettable PTC technology, holding current 0.12 A and trigger current 0.3 A. Trigger time: 100 ms at an overcurrent of 1 A.

3.4 Identification label

The identification label is located on the top of the sensor, as shown in the figure below for the two barometer versions T011H-TBAR-UHIVS and T011I-TBAR-USDI12.

Figure5: T011H-TBAR-UHIVS label

Figure6: T011I-TBAR-USDI12 label

4. Installation and commissioning

The barometer must be installed in accordance with the recommendations of WMO-No. 8, Guide to Instruments and Methods of Observation, Volume I, Chapter 3 (Measurement of atmospheric pressure): the barometric sensor must be installed in an environment free from drafts, with rigid and vibration – free mounting, protected from impact and improper handling, and positioned so as to avoid artificial wind effects. Installation must avoid errors due to wind, radiation, vibrations, and pressure shocks. Temperature effects are compensated internally by the measurement method. In indoor installations or inside other containers, a static head connected to the outside must be used, located in an open area not affected by the proximity of buildings. Pressure input, installation height, mounting, and periodic calibration must be kept under control according to WMO-No. 8 recommendations.

For installation, the sensor is equipped with a mounting bracket with two holes 52 mm apart and 10 mm in diameter. The following figure shows the mechanical dimensions of the mounting bracket.

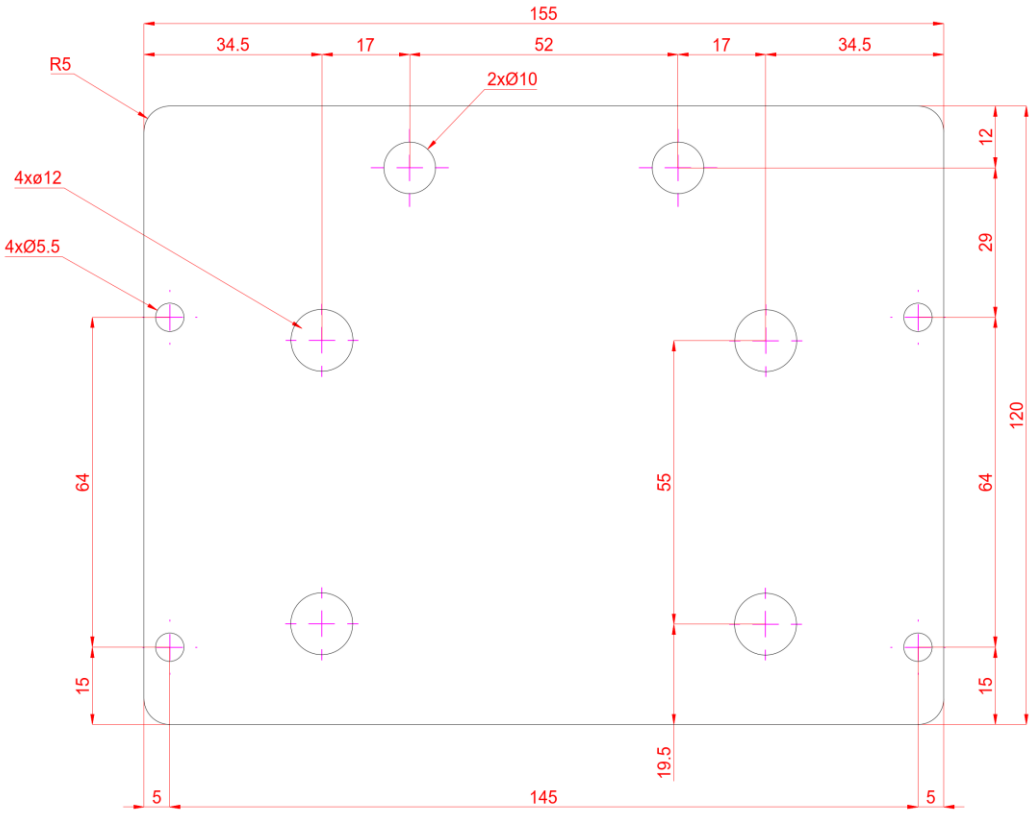


Figure7: Mounting bracket dimensions

To start up the sensor, connect the connection cable to the seven-pin connector. The sensor is not equipped with on/off buttons, LED indicators, or other interfaces.

5. Operation

5.1 Operating principle

The sensor uses a sensing element based on TERPS (Trench Etched Resonant Pressure Sensor) technology, i.e., a silicon resonant pressure sensor. This technology is used to achieve high accuracy and stability over time.

The operating principle is resonance: the applied pressure acts on a mechanical silicon structure that includes a resonant element. The deformation induced by the pressure changes the mechanical stress state of the resonator and, consequently, varies its resonance frequency. The pressure measurement is then derived from this frequency variation. A temperature sensor and an extensive calibration procedure compensate for the effects of temperature on the sensor's operating range.

Unlike traditional piezoresistive sensors, which measure a change in electrical resistance, TERPS technology uses an optimized resonant structure to provide superior accuracy and stability compared to more common pressure measurement technologies.

The pressure measurement is updated at the output every second but has an integration time of twenty seconds to ensure the measurement accuracy reported in the technical specifications.

The measurement is returned at the output as:

- Digital value in standard MODBUS protocol (T011H-TBAR-UHIVS / T011I-TBAR-USDI12)
- Digital value in SDI – 12 protocol (T011I-TBAR-USDI12)
- Analog current output in 4 – 20mA (T011H-TBAR-UHIVS / T011I-TBAR-USDI12)
- Analog voltage output 0 – 2V (T011H-TBAR-UHIVS)

5.2 Acquisition and measurements

The pressure measurement is acquired every second and, at the same time, is made available in the MODBUS and SDI – 12 communication protocols. The analog output value is also updated during this phase. In addition to pressure measurement, the sensor acquires a series of diagnostic measurements. Details on the various measurements available are provided below.

- **Pressure [mBar]**

  This is the main measurement of the sensor, expressed in mBar.

- **Internal temperature [°C]**

  Measurement of the internal temperature of the sensor, expressed in °C.

- **Internal humidity [%]**

  Measurement of the relative humidity inside the sensor, expressed in %.

- **Power supply voltage [V]**

  The sensor supply voltage is expressed in volts and measured at each cycle.

5.3 Communication protocols

The sensor makes its measurements available in:

- MODBUS, in the T011H-TBAR-UHIVS version.
- MODBUS and SDI – 12, in the T011I-TBAR-USDI12 version.

5.3.1 MODBUS protocol

The sensor, in both versions T011H-TBAR-UHIVS and T011I-TBAR-USDI12, supports the standard MODBUS protocol carried on RS – 485. Please refer to the MODBUS standard specifications available on the website https://www.modbus.org/modbus-specifications.

The physical characteristics of the communication port are:

- Speed: 9600 bps
- Data bits: 8
- Stop bits: 1
- Parity check: none

The default MODBUS call address of the TBAR – U is **5**.

The MODBUS functions supported for reading measurements are:

- Function *0x03 Read Holding Registers*
- Function *0x04 Read Input Registers*

Both functions share the same data table: the content of the reading of a Holding Register will be identical to the reading of the same Input Register. Both functions are read-only.

Measurements are represented in the IEEE 754 **float** representation standard. Each data is therefore 32 bits wide and will be obtained by reading two consecutive 16bit registers. The byte order, according to the MODBUS standard, is classified as **swapped float**. This means that if a float is represented by the 4byte sequence ABCD, with A being the most significant byte and D the least significant byte, its swapped float representation will be in the order **CDAB**. Since MODBUS registers are 16bit, this means that the least significant byte pair **CD** will be found in the lower index register and the most significant byte pair **AB** in the next register.

Below is the register table with the measurement value map.

Register	# registers – data type	Measurement type	Measurement meaning	Unit of measurement	Recommended decimals
1	2 – Swapped Float	Main measurement	**Pressure**	[mBar]	2
3	2 – Swapped Float	Diagnostics	**Internal temperature**	[°C]	1
5	2 – Swapped Float	Repeated measurement	**Pressure**	[mBar]	2
7	2 – Swapped Float	Repeated measurement	**Internal temperature**	[°C]	1
9	2 – Swapped Float	Diagnostics	**Internal humidity**	[%]	1
11	2 – Swapped Float	Internal use	**DO NOT USE**	---	---
13	2 – Swapped Float	Diagnostic	**Power supply voltage**	[V]	2
15	2 – Swapped Float	Internal use	**DO NOT USE**	---	---
17	2 – Swapped Float	Internal use	**DO NOT USE**	---	---
19	2 – Swapped Float	Internal use	**DO NOT USE**	---	---

For compatibility reasons with other SIAP+MICROS barometric sensors, the measurements in registers 1 and 3 are repeated in registers 5 and 7 respectively.

5.3.2 SDI – 12 protocol

The SDI – 12 protocol is only present on the T011I-TBAR-USDI12 version of the sensor and supports the SDI – 12 standard, specification 1.4. For more information on the protocol, refer to the SDI – 12 standard specifications available at https://www.sdi-12.org/specification.

The SDI – 12 call address of the TBAR – U is **'5'**, the ASCII version of the MODBUS address 5. In general, addresses are converted to ASCII using the numbers '0' to '9', the uppercase letters of the alphabet, 'A' to 'Z', followed by the lowercase letters, 'a' to 'z', for a total of 62 possible addresses.

In the following, the convention will be used to indicate with:

- <CR> the carriage return character expressed in hexadecimal as 0x0D
- <LF> the new line character expressed in hexadecimal as 0x0A

Responses to commands end with the sequence <CR><LF>.

In the following, the commands are illustrated with the generic address indicated by **<a>**. In practice, this must be replaced with the address of sensor '5'.

5.3.2.1 Sensor test <a>!

The command <**a>!** can be used to check the presence of the sensor on the BUS. The sensor responds to the command with

<a><CR><LF>

5.3.2.2 Send identifier <a>I!

The command <**a>I!** can be used to request a sensor identifier. The sensor responds to the command with

<a>14*SMSpa*TBARUH*100 <CR><LF>

The interpretation of the response to the command is as follows:

- **<a>**: the sensor address.
- **14**: the SDI – 12 specification version 1.4.
- **SMSpa**: identifies the manufacturer SIAP+MICROS S.p.A.
- **TBARUH** is the generic name of the product.
- **100** is the firmware version 1.0.0.

5.3.2.3 Address change <a>A<b>!

The standard provides for the command <a>A<b>! to change the sensor address from <a> to <b>. The response to the command provides the new address.

<b><CR><LF>

It is important to note that the address change also affects the MODBUS protocol. For example, if you change the address from '5' to 'A', the MODBUS address changes from 5 ('5') to 10 ('A').

5.3.2.4 Current address request ?!

If you do not know the sensor address, you can use the ?! command, to which the sensor responds with its address.

<a><CR><LF>

The command can only be used if there is a single sensor on the SDI – 12 bus.

5.3.2.5 Commands and procedures for reading measurements

The SDI – 12 protocol provides various types of commands for requesting measurements, for which reference should be made directly to the standard specification. Here we will describe the commands supported by the T011I-TBAR-USDI12 pressure sensor.

Query commands generally involve two distinct phases:

1. Preliminary command to request measurement execution (commands <a>M!, <a>M1!, ... <a>M9!, <a>C!, <a>C1!, ... <a>C9!, <a>MC!, <a>MC1!, ... <a>MC9!, <a>CC!, <a>CC1!, ... <a>CC9!).
2. Measured data request command (commands <a>D0! ... <a>D9!)

The pressure sensor provides two distinct methods for obtaining measurement values:

1. Start measurement command and measurement retrieval command
2. Measurement retrieval command without start measurement command

START MEASUREMENT COMMAND AND MEASUREMENT RETRIEVAL

This mode involves sending a single measurement start command followed by the measurement retrieval command, as illustrated below.

- Measurement start command **<a>M!** or alternatively **<a>C!** to which the sensor always responds with:

  <a>0004<CR><LF>

  indicating that four total measurements are immediately available.

- Measurement retrieval command **<a>D0!** to which the sensor always responds with:

  <a><pressure><temperature><humidity><power supply><CR><LF>

To include a CRC check, send the measurement start commands **<a>MC!** or **<a>CC!**.

Here is an example sequence:

➔ <a>M!

🡐 <a>0004<CR><LF>

➔ <a>D0!

🡐 <a><pressure><temperature><humidity><power supply><CR><LF>

<a>M! was used, but the same applies to <a>C!, <a>MC! , and <a>CC!.

MEASUREMENT RETRIEVAL COMMANDS WITHOUT MEASUREMENT START COMMAND

Measurements can also be requested with single commands in a single step.

- Measurement retrieval with the **<a>R0!** command, to which the sensor responds with:

  <a><pressure><temperature><humidity><power supply><CR><LF>

To include a CRC check, send the command <a>RC0!.

Here is an example sequence:

➔ <a>R0!

🡐 <a><pressure><temperature><humidity><power supply><CR><LF>

As required by the SDI – 12 standard, measurements are separated by their sign. No other separator characters are used.

5.4 4 – 20mA Analog output

The analog current output is present on both sensor versions and reports only the pressure measurement in analog form with the following correspondence:

4mA ➔ 500mBar

20mA ➔ 1100mBar

The analog output is 14 bits on 25mA full scale, which translates into an output resolution of approximately 0.06mBar on the pressure measurement data.

If, for any reason, the measured pressure value is lower than the physical minimum of 500 mBar, the output will assume a value of 4mA.

If, for any reason, the measured pressure value exceeds the physical maximum of 1100 mBar, the output will assume a value of 20mA.

In the event of a measurement error, the current output will assume a value of 22mA to signal the anomaly.

5.5 0 – 2V Analog output

The analog voltage output is only present on the T011H-TBAR-UHIVS version of the sensor and reports only the pressure measurement in analog form with the following correspondence:

0V ➔ 500mBar

2V ➔ 1100mBar

The analog output is 14 bits on 2.5V full scale, which translates into an output resolution of approximately 0.05mBar on the pressure measurement data.

If, for any reason, the measured pressure value is lower than the physical minimum of 500mBar, the output will assume a value of 0V.

If, for any reason, the measured pressure value exceeds the physical maximum of 1100mBar, the output would assume a value of 2V.

In the event of a measurement error, the voltage output will assume a value of 2.2V to signal the anomaly.

6. Revision history

The following table lists the changes made to this document.

Version	Date	Updates
1	*03/16/2026*	*First version of the document.*

All information contained in this document is current at the time of printing. SIAP+MICROS S.p.A. reserves the right to change it without prior notice.

7. Reference directives

The reference directives for the sensor are:

- 2014/30/EU The Electromagnetic Compatibility Directive (EMC)
- 2014/53/EU The Radio Equipment Directive (RED)
- 2014/35/EU The Low Voltage Directive (LVD)
- 2011/65/EU The Restriction of Hazardous Substances Directive (RoHS)