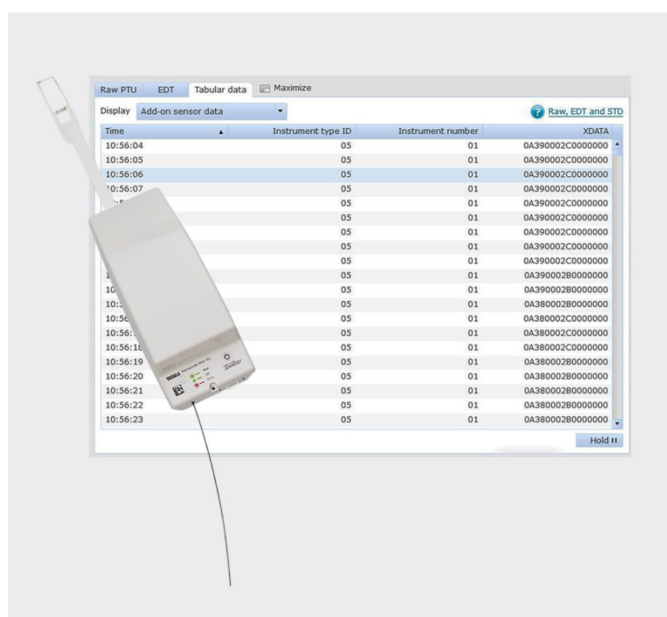


USER'S GUIDE

Vaisala Radiosonde RS41 Additional Sensor Interface



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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the product.

About This Manual

This manual explains how to obtain additional sensor data with radiosonde RS41, and how to transfer the data to a readable format with DigiCORA Sounding System MW41.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Vaisala radiosonde RS41 Additional Sensor Interface, introduces the Vaisala Radiosonde RS41 additional sensor interface.
- Chapter 3, Additional Sensor Data, explains additional sensor-related data in Sounding System MW41.
- Chapter 4, Performing Additional Sensor Soundings, explains how an additional sensor sounding is performed with Sounding System MW41.

Version Information

Table 1 **Manual Revisions**

Manual Code	Description
M211604EN-C	This version. May 2015. Editorial correction in Chapter 2.
M211604EN-B	Previous version. August 2014. Edited information in Figure 1.
M211604EN-A	First version. June 2014.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M211486EN	Ozone Sounding with Vaisala Radiosonde RS41 User's Guide
M211667EN	Vaisala Radiosonde RS41-SG and RS41-SGP User's Guide
-	Vaisala DigiCORA Sounding System MW41 On-line Help, available in the sounding system software user interface

Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING

Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION

Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE

Note highlights important information on using the product.

Recycling



Recycle all applicable material.



Dispose of batteries and the unit according to statutory regulations. Do not dispose of with regular household refuse.

Trademarks

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CHAPTER 2

VAISALA RADIOSONDE RS41 ADDITIONAL SENSOR INTERFACE

This chapter introduces the Vaisala Radiosonde RS41 additional sensor interface.

Introduction to Additional Measurements

In addition to temperature and humidity profiles, other in-situ measurements of the atmosphere provide valuable information for researchers and the climatological community. With the help of a radiosonde, a sensor can be flown in the atmosphere to gather the additional information required.

Vaisala radiosonde RS41 has an asynchronous serial interface (XDATA interface) that reads data from an additional sensor so that it can be transferred to a suitable digital format. The radiosonde sends the additional digital information, together with the radiosonde measurement data (height, ambient temperature and humidity), to the ground equipment. The ground equipment then transfers the data to a readable .xml format. For an overview, see Figure 1 on page 8.

The features available in radiosonde RS41 allow you to build suitable interfacing for a third party sensor to be used with the radiosonde and Vaisala DigiCORA Sounding System MW41.

With the help of this manual, you can build suitable interfacing for the following type of sensors:

- Ozone sensor (preferably with Vaisala Ozone Interface Board OIF411)
- 3rd party data acquisition systems and small sensors
- Cryogenic Frost point Hygrometer CFH for water vapor
- Lyman-alpha fluorescence hygrometer FLASH-B for water vapor
- COBALD instrument for aerosols
- Other 3rd party sensors

NOTE

Check the data format's compatibility with XDATA from the manufacturer of the additional sensor.

RS41 additional sensor interface connects with Sounding System MW41 and a computer for service and fault finding.

Additional sensors are not polled, they send the data automatically.

Figure 1 below presents the basic principle of the functioning of the Vaisala Radiosonde RS41 additional interface. The XDATA provided by the additional sensors (number 4 in Figure 1 below) can be sent either directly or via OIF411 (number 2). If the additional sensors are connected in a series (number 4), OIF411 must always be the first one in the series of sensors.

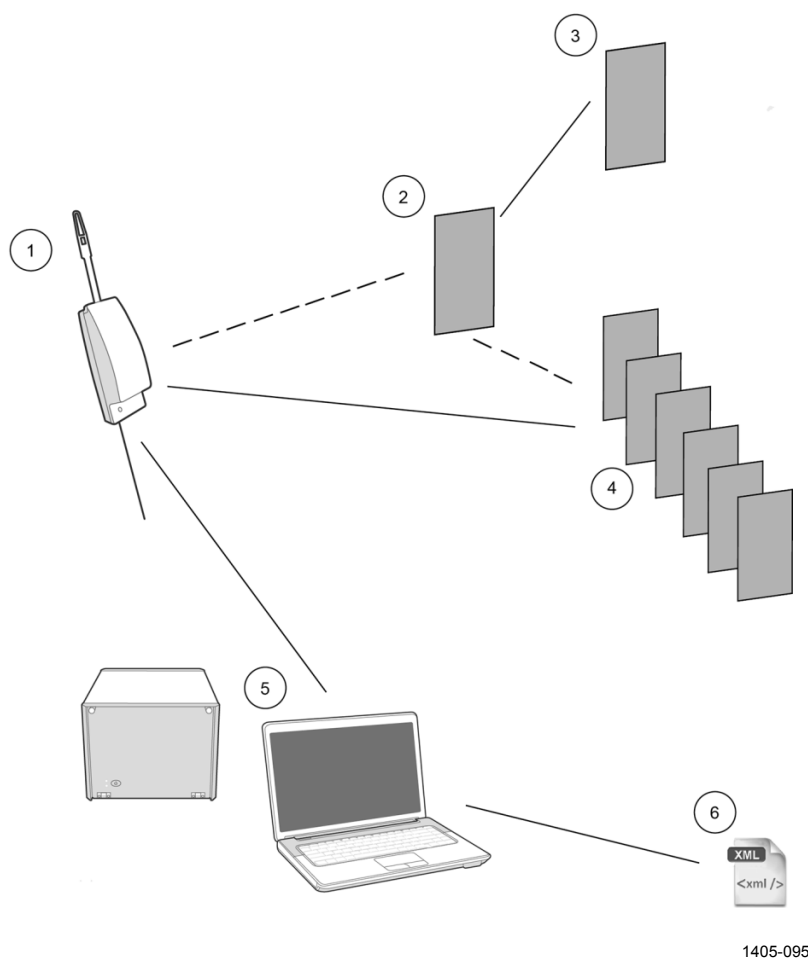


Figure 1 Vaisala Radiosonde RS41 Additional Interface Overview

The following numbers refer to Figure 1 on page 8:

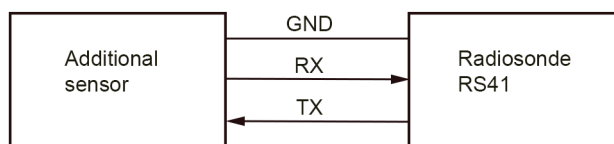
- 1 = Radiosonde RS41
- 2 = Ozone Interface Board OIF411 (optional, sold as RSA411)
- 3 = Ozone sensor
- 4 = Additional sensors
- 5 = Sounding System MW41
- 6 = XML file

Software Interface

XDATA Protocol

As explained above, the XDATA interface connects a sensor to the radiosonde, allowing the sensor to send data through the radiosonde transmitter and to combine them with routine pressure, temperature, humidity and wind data. The interface is based on a simple digital transmission between the sensor and the radiosonde.

The XDATA interface consists of two wires of asynchronous serial data. The other is for transmitting and the other for receiving data. The third wire is GND (ground).



1403-190

Figure 2 XDATA Interface

The XDATA interface enables the following functions:

1. Connecting an additional sensor.
2. Power supply from the radiosonde to an additional sensor.

Daisy Chaining

Up to eight additional sensors can be connected in series, that is, daisy-chained. Note that if Ozone Interface Board OIF411 is part of the chain, it must be placed as the first additional sensor in the series.



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Figure 3 Additional Sensors in a Daisy Chain

Daisy chaining requires that the sensors have two serial connectors, where one is listening to the data coming from the sensor upstream, and one is transmitting data towards the radiosonde (or the next sensor downstream). The sensors send their own data, or pass on data from other sensors upstream. This requires that the sensors are able to buffer data from upstream sensors while transmitting their own data.

Hardware Interface

In additional sensor soundings, the radiosonde works as a transparent channel from the additional sensor to the ground station, through which the data is transmitted as such.

Interface in Additional Sensor

A typical connector in an additional sensor is a four-pin MTA-100, for example, part number 640456-4 manufactured by Tyco Electronics. See Figure 4 on page 11 for an example of the connector, and explanations for the pins.

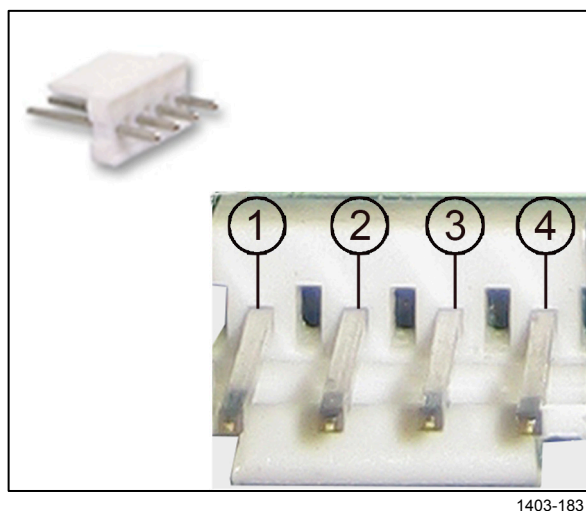


Figure 4 **MTA-100 Connector and a Close-up of the Pins**

The following numbers refer to Figure 4:

- 1 = Pin 1: Common (GND)
- 2 = Pin 2: Instrument Serial OUT
- 3 = Pin 3: Instrument Serial IN
- 4 = Pin 4: Common (GND, not used by RS41)

Interface in RS41

The additional sensor interface is located at the back end of RS41. The pins are explained in Figure 5 on page 12.

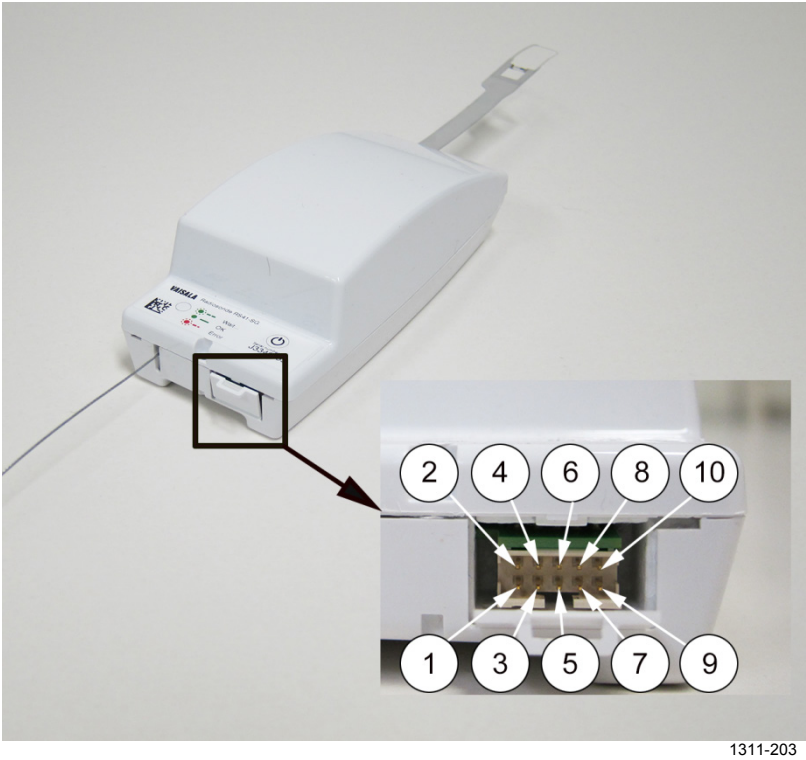


Figure 5 **Position and Pins of the Additional Sensor Connector in RS41**

Table 3 **Electrical Interface of Radiosonde and Additional Sensor**

Radiosonde				Additional Sensor	
Pin	Name	I/O	Function	Pin	Name
1	GND	-	Ground	1	Common
2	RXD	I	Serial data from the additional sensor. Low level voltage 0.0...1.0 V High level voltage 1.5...5.5 V	2	Instrument Serial Out
3	TXD	O	Serial data to the additional sensor. Low level voltage 0.0 V High level voltage 3.0 V	3	Instrument Serial In
4	Reserved	-	Do not connect		Do not connect
5	3V7	O	+3.7 V \pm 3 % supply voltage to the additional sensor, max 50 mA		Supply voltage input (optional)
6-10	Reserved	-	Do not connect		Do not connect

The serial data line is not an RS-232 line, but a three-volt TTL UART line. The RXD pin is five-volt tolerant and it can be directly connected to a microcontroller. According to the voltage convention, the additional sensor drives the RXD pin high between data bytes.

NOTE

The TXD signal is not currently supported by RS41 software since the radiosonde is only used to transmit data from additional sensors to the ground station. However, it is good practice to connect it to the additional sensor so that its receiver input does not float. See also Figure 6 below.

A supply voltage of 3.7 V for additional sensors is available in pin number five. The voltage is present as long as the radiosonde is switched on. The maximum allowed output current is 50 mA.

Default settings for additional sensor data transmission are 9600 bps, no parity, eight data bits, one stop bit, and no handshaking.

Interface Cable

An additional sensor interface cable can be constructed as follows. The numbers in Figure 7 refer to Table 4 on page 14.

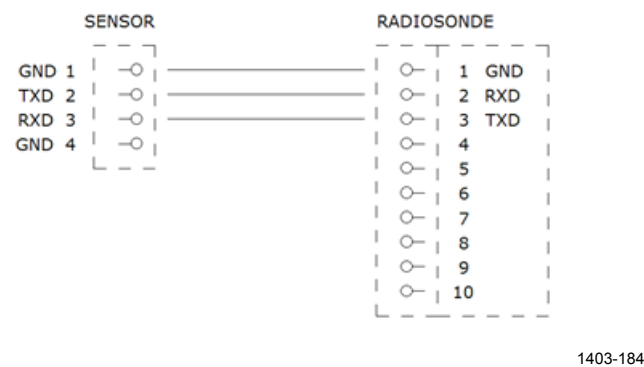


Figure 6 Additional Sensor Interface Cable Wiring

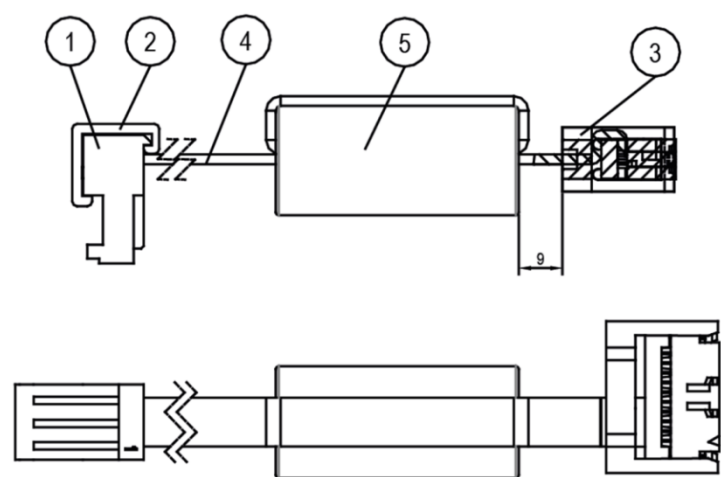


Figure 7 Additional Sensor Interface Cable Drawing

Table 4 Interface Cable Part List

Ref	Code	Manufacturer	Note
1	3-643816-4	TE Connectivity	4-socket MTA-100 connector for additional sensor
2	640550-4	TE Connectivity	Dust cover for MTA-100 connector
3	89361-710SLF	FCI	IDC connector with strain relief for RS41
4	HF625/10	3M	Flat cable 3xAWG28, pitch 1 mm. Remove the 7 extra wires.
5	74270032	Würth Elektronik	Ferrite tube for filtering RF interference

Pin 1 is marked with a triangle on the RS41 connector body (number 3 in Figure 7).

NOTE

The radiosonde enclosure has been designed in such a way that the additional sensor connector can only be attached in the correct direction.

The flat cable needs to be wound one turn through the ferrite tube to prevent external RF interferences from affecting the accuracy of the radiosonde measurements. The performance has been tested with a flat cable of up to two meters in length.

NOTE

The ferrite tube can be omitted if the flat cable is shorter than 10 cm.

The standard additional sensor cable has three pins. If a cable with five pins is used (as presented in Figure 8 on page 15), the fifth pin provides supply voltage for the radiosonde.



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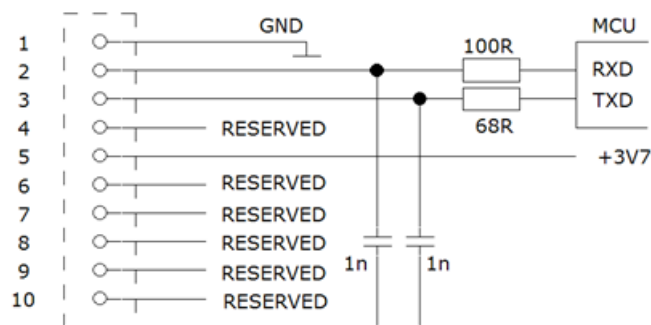
Figure 8 Close-Up of a Five-Pin RS41 Connector with Power Supply



1311-211

Figure 9 Additional Sensor Interface Cable Connected to RS41

The detailed circuit diagram of the additional sensor interface of RS41 is illustrated in the Figure 10 on page 16.



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Figure 10 RS41 Additional Sensor Interface Circuit Diagram

A design example of an additional sensor interface is illustrated in Figure 11 below. In the example, the additional sensor is powered by the radiosonde. The radiosonde TXD is not connected since it has no use in this case.

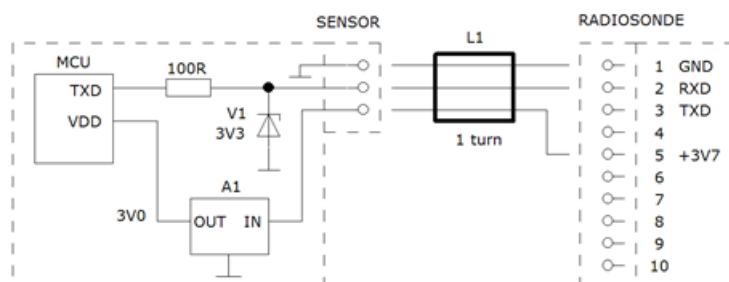


Figure 11 Example of an Additional Sensor Interface Design

Table 5 Design Example Part List

Ref	Note
L1	Ferrite tube for filtering RF interference. Refer to section Interface Cable on page 13.
V1	ESD protection diode of 3.3 V
A1	Low dropout regulator (optional)

If the maximum current required by the additional sensor is 50 mA, the supply voltage can be provided by the radiosonde. Otherwise the sensor needs to be powered by an external battery.

CHAPTER 3

ADDITIONAL SENSOR DATA

This chapter explains additional sensor-related data in Sounding System MW41. For further information on preparing and monitoring a sounding with MW41, see the on-line help, available in the sounding system software user interface.

Data from Additional Sensor to Radiosonde

Communication from additional sensor to radiosonde consists of ASCII strings. Each additional sensor sends its own string which starts with "xdata=" and ends with CR (Carriage Return), or LF (Line Feed). The transfer rate is about 200 bytes/second.

The first two characters after "xdata=" are the instrument type identifier, for example, "01" for instrument type 1. Instrument types 1 - 7 are ozone radiosondes, 8 - 15 are hygrometers, and 18 is a Cobald backscatter radiosonde.

The next two characters define the instrument number. Each additional sensor sends its own instrument number as "01" and increments the instrument number field of other passed-through additional sensor data by one. This means that the instrument number of the additional sensor nearest to the radiosonde is 1, for the next one it is 2, and so on.

The actual additional sensor data comes after the instrument type and the instrument number fields.

An example of communication with two additional sensors connected to a radiosonde is shown below. Note that all data is in hexadecimal format.

The additional sensor closest to the radiosonde sends the string

```
xdata=2701880826017B  
where
```

- 27 = instrument type
- 01 = instrument number
- 880826017B = sensor-specific data

The second additional sensor sends the string

```
xdata=3101DF7A6B88153F07B7
```

where

- 31 = Instrument type
- 01 = Instrument number
- DF7A6B88153F07B7 = sensor-specific data

The first sensor increments the instrument number of the second one, so the radiosonde receives the second additional sensor data as

```
xdata=3102DF7A6B88153F07B7.
```

Processing Sounding Data

Additional sensor data can be processed either after the sounding or during the sounding, using the script interface. Vaisala recommends processing the data after the sounding.

Processing Data After Sounding

After the sounding, the special sensor data is stored as ASCII strings in an archived .mwX data file. To access the sensor data, you must first unzip the .mwX file. The data is contained in XML format in a file called *AdditionalSensorData.xml*. See Table 6 below for information on the additional sensor-related data.

Table 6 AdditionalSensorData

Column Name	Type	Description
SOUNDINGIDPK	String	Unique sounding ID
RADIORXTIMEPK	Double	Radio time [s]
INSTRUMENTTYPEPK	String	Instrument type identifier
INSTRUMENTNUMBERPK	String	Instrument number
MEASUREMENTOFFSET	Double	Measurement time offset of the additional sensor data [s]
DATASRVTIME	String	Data server timestamp [yyyy-MM-dd HH:mm:ss.fff]
GPSTIMEOFFSET	Byte	Offset to the frame's GPS time [1/20 s]
XDATA	String	XData from the additional sensor

Processing Data During the Sounding

If you want to process the data during the sounding, you need to write a script for it. If you also want to edit the data during the sounding, you must activate the script. Import the scripts to the same Script Group in MW41 and select the main script. Make sure that Script group is set active.

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CHAPTER 4

PERFORMING ADDITIONAL SENSOR SOUNDINGS WITH RS41 AND MW41

This chapter explains how an additional sensor sounding is performed with Sounding System MW41. For more details on creating and monitoring additional sensor data in MW41, see the MW41 on-line help, available in the sounding software user interface.

NOTE

Special sensor sounding is an optional feature for MW41 and is only available for licensed users.

Preparation Steps

Follow the steps below to begin a sounding with an additional sensor.

1. Start the MW41 software and login.
2. Place the radiosonde on the ground check device when prompted to do so.
3. Scroll down in the Radiosonde selection window and select the correct special sensor from the drop-down list. This must be done during the radiosonde ground check.
To perform a special sensor sounding with your own sensor, select **Generic sensor** in the drop-down list. By default, the selection is None.
4. Enter the information required in the window that follows.
5. After the ground check phase is finished, connect the special sensor to the radiosonde.

CAUTION

Do not connect the special sensor connector to RS41 while the radiosonde is being prepared by the ground check device. Connecting the sensor during the ground check will interrupt the preparations and MW41 will return to the Radiosonde selection window.

- 6. Click **Apply** to accept and continue with the sounding preparations. The system will be ready for release after the special sensor has been connected and data is received in MW41.

In the Monitoring window, you can check the Tabular data tab prior to launch to make sure that everything is in order.

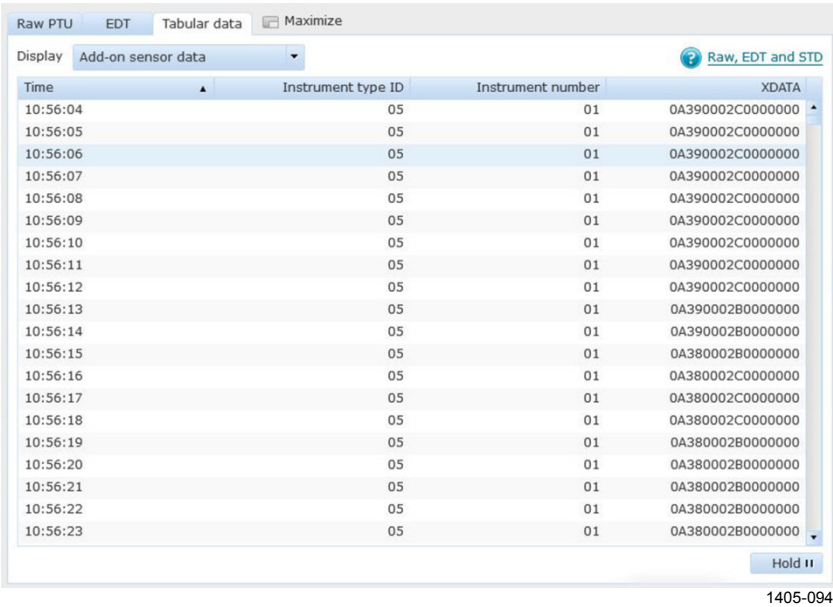
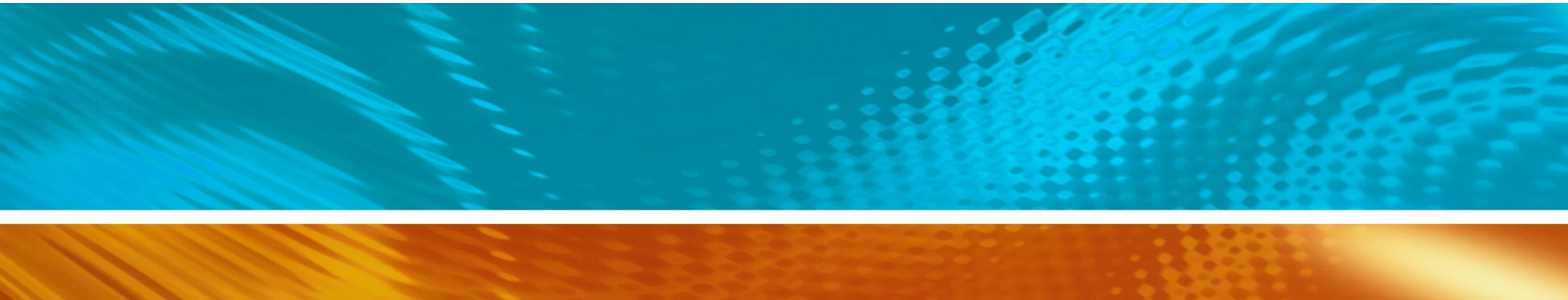


Figure 12 Monitoring Additional Sensor Data in MW41



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