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HygroFlex HF4 Humidity Temperature Transmitters: User Guide Document title	Instruction Manual Document Type Page 1 of 34

HygroFlex HF4 Humidity Temperature Transmitters

User Guide



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Applicability:

This manual applies to all instruments of the HF4 series with firmware version 1.x, where 1.x can be 1.0, 1.1, etc. Changes to the last digit of the version number reflect minor firmware changes that do not affect the manner in which the instrument should be operated.

1 Overview

The HF4 transmitter measures temperature, relative humidity and the dew or frost point. The HF4 series is designed for fixed installation in HVAC and light industrial applications where a high measurement accuracy is required at conditions within the range of 0 to 100 %RH and -50 to 100°C (-58 to 212°F). The electronics operating range is limited to -40...60 °C (-10...60°C with the optional LC display).

The HF4 features well proven sensors and a robust housing. Digital signal processing ensures consistent product performance and also facilitates the task of field maintenance with features such as potentiometer free – digital calibration.

Based on the ROTRONIC AirChip 3000 digital technology the HF4 series offers the following functions:

- User configurable settings
- Calculation of the dew or frost point
- Humidity temperature calibration and adjustment
- Simulator mode
- Automatic humidity sensor test and drift compensation
- Fail safe mode
- Data recording

The ability for the user to easily update the AirChip 3000 firmware means that instruments of the HF4 series can be kept up-to-date regarding any future functionality improvement.

HF4 transmitters with analog output signals: two types of electronic circuit are available: HF42: 2-wire, loop powered (4...20 mA current signal) and HF43: 3-wire (voltage or current signal). Both circuit types provide linear analog outputs signals for transmission over a length of cable to a remote display, recorder, controller or data processing unit and can be used to measure humidity only, temperature only or both parameters.

HF4 transmitters with digital output: the HF45 is available with the following digital interface options: RS-485, USB + RS-485 or Ethernet (TCP/IP) + RS-485. Use of a digital interface allows the simultaneous reading of relative humidity, temperature and calculated parameter. The communication protocol used by the RS-485 interface offers several options that can be configured by the user. This includes a Modbus compatible protocol.

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2 Models

2.1 Ordering codes

Transmitters with analog output signals: HF42 (2-wire, loop powered) and HF43 (3-wire)							
1	2	3	4	5	6	7	Circuit type, supply voltage and output signal type
HF420-							2-wire (loop powered), 10 to 28 VDC, 4...20 mA
HF431-							3-wire, 15 to 40 VDC or 12 to 28 VAC, 0...20 mA
HF432-							3-wire, 15 to 40 VDC or 12 to 28 VAC, 4...20 mA
HF433-							3-wire, 5 to 40 VDC or 5 to 28 VAC, 0...1 V
HF434-							3-wire, 10 to 40 VDC or 8 to 28 VAC, 0...5 V
HF435-							3-wire, 15 to 40 VDC or 12 to 28 VAC, 0...10 V
Installation type / Mechanical configuration							
	D						Duct mount (through wall)
	W						Wall mount
Parameters (analog outputs)							
		B				X X	Humidity (0...100 %RH) and Temperature - see range below
		H	X X			X X	Humidity only (0...100 %RH)
		T				X X	Temperature only - see range below
		1	X X				Humidity and Dew / Frost point - see range below
		A					Temperature and Dew / Frost point - see range below
Standard temperature output ranges							
			1 X				0...50 °C
			2 X				10...40 °C
			3 X				-40...60 °C
			4 X				-30...70 °C
			5 X				-40...85 °C
			6 X				0...100 °F
			7 X				0...200 °F
			9 X				-50...200 °F
			S T				Custom range – specify when ordering
Optional keypad and display (horizontal mount only)							
					D		Keypad and display (HF42: no backlight – HF43: w. backlight)
					X		No keypad and display

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1	2	3	4	5	6	7	
							Cable fittings
					1		1x M16 cable grip (horizontal, type D w. display and type W)
					2		1x M16 cable grip (vertical, type D w/o display)
					3		1x ½" conduit adapter (horizontal, type D w. display and type W)
					4		1x ½" conduit adapter (vertical, type D w/o display)
							Standard dew / frost point output ranges
						B	X -50...50
						C	X -50...100
						D	X -50...200
						S	C Custom range – specify when ordering

Notes:

- Output 1: relative humidity or dew point
- Output 2: temperature
- The enclosure of all models with the optional display and keypad is designed to be installed in the horizontal position
- The M16 cable grip is located at the bottom of the enclosure
- The ½" conduit adapter is located on top of the enclosure
- The dew / frost point range uses the same unit (°C or °F) as the temperature output. The factory default setting is frost point below freezing.
- Custom range: be sure to clearly specify the desired range at the time of the order. When a special range has been ordered, the letters ST and SC are used in columns 4 and 7 in the above table. These generic codes will be replaced with a specific code only for quantity and repeat orders

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Transmitters with digital output: HF45						
1	2	3	4	5	6	Circuit type and supply voltage
HF456-						3-wire, 5 to 40 VDC or 12 to 28 VAC
Installation type / Mechanical configuration						
	D					Duct mount (through wall)
	W					Wall mount
Parameters						
		X				Humidity (RH) and Temperature (T)
		1				RH + T + Dew / Frost point
Optional keypad and display						
			D			Keypad and display with backlight
			X			No keypad and display
Cable fittings and digital interface						
				5		1x M16 cable grip, RS-485 interface
				6		1x 1/2" conduit adapter, RS-485 interface
				7		1x M16 cable grip, USB + RS-485
				8		1x 1/2" conduit adapter, USB + RS-485
				9		1x M16 cable grip, Ethernet + RS-485
				A		1x 1/2" conduit adapter, Ethernet + RS-485
				B		1x M16 cable grip, Ethernet wireless + RS-485
				C		1x 1/2" conduit adapter, Ethernet wireless + RS-485
				D		1x M16 cable grip, MODBUS ASCII interface
				E		1x 1/2" conduit adapter, MODBUS ASCII interface
Unit system						
					M	Metric
					E	English

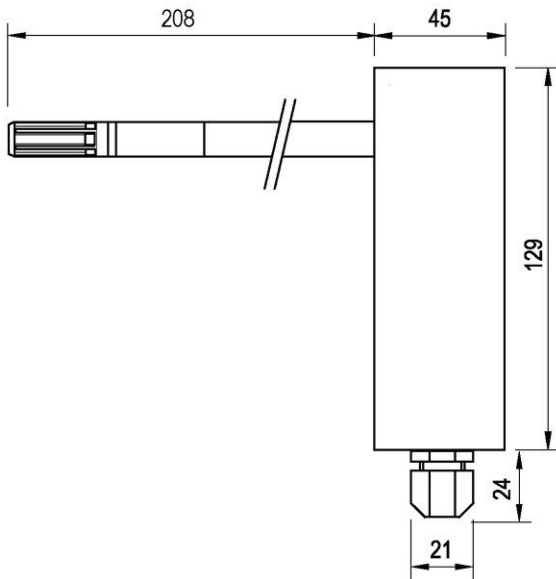
Notes:

- The enclosure of all models with digital interface is designed to be installed in the horizontal position
- The M16 cable grip is located at the bottom of the enclosure
- The 1/2" conduit adapter is located on top of the enclosure
- The factory default setting for the dew point calculation is the frost point below freezing
- The same terminal block is used for either the Modbus interface or the RS-485 interface. A MODBUS network and a RS-485 network are physically identical and differ only in the communication protocol being used. The default communication protocol used with the RS-485 interface is RO-ASCII. When ordered with the MODBUS interface, the transmitter is configured by the factory to use the MODBUS ASCII communication protocol

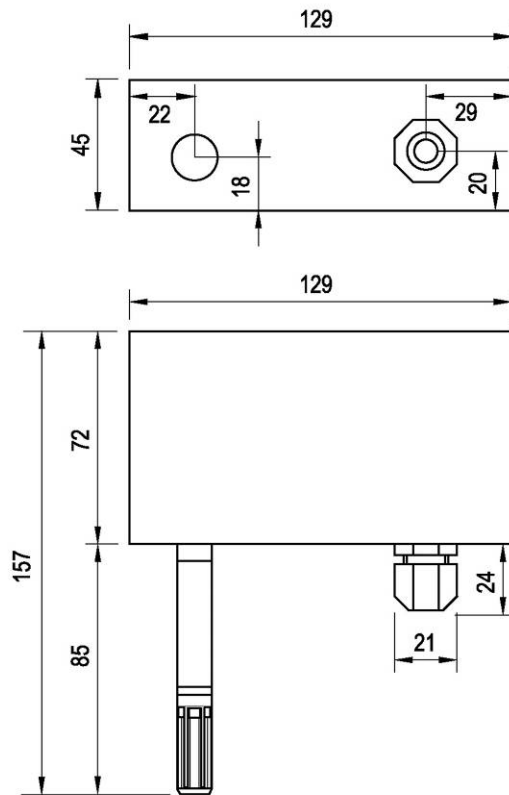
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2.2 Mechanical configurations and dimensions

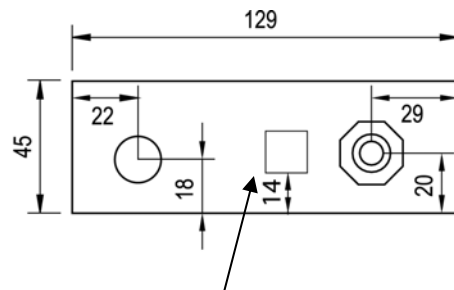
Type D: duct mount (vertical)



Type W: wall mount (horizontal)



Dimensions in mm



Models with USB or Ethernet interface

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2.3 Display and keypad option



The LC display option for the HF43 and HF45 has a backlight. The LC display option for the HF42 does not have a backlight.

The upper line corresponds to relative humidity or dew / frost point and the bottom line corresponds to temperature.

The display can be configured to show a trend indicator on each line:

- ▲: increasing value
- ▼: decreasing value

In the event of an alarm the display shows the symbol [!] to the right of the value.

For instructions see the following HW4 manual: **E-M-HW4v2-F2-003**.

3 General description

3.1 Power supply

Depending on the circuit type, the HF4 requires the following power supply:

- a) **HF42** (2-wire, loop powered): 10...28 VDC - depending on the load connected to the output(s). The minimum supply voltage can be determined as follows:

$$V_{\min} = 10 \text{ V} + (0.02 \times \text{Load}^*) \quad * \text{Load resistance in ohms.}$$

For the maximum load of 500 Ω, the minimum supply voltage is 10 + (0.02 x 500) = 20 VDC. With both output circuits closed, the maximum current consumption is 40 mA.

- b) **HF43** (3-wire with analog outputs): 15 to 40 VDC (see note below) or 12 to 28 VAC. With both output circuits closed, the maximum current consumption is 50 mA.

Note: depending on the type of output signal, the HF43 will operate with the following minimum voltage

0...1 V outputs:	5 VDC or 5 VAC
0...5 V outputs:	10 VDC or 8 VAC
0...10 V outputs:	15 VDC or 12 VAC
0...20 mA or 4 ...20 mA outputs:	6 VDC or 5 VAC with 0 Ω load 15 VDC or 12 VAC with 500 Ω load

- c) **HF45** (3-wire) with digital outputs: 5 to 40 VDC or 12 to 28 VAC. Maximum current consumption:

Model with USB interface:	50 mA
Model with Ethernet (TCP/IP) interface:	300 mA

3.2 Measured parameters

The HF4 measures relative humidity with a ROTRONIC Hygromer® IN1 capacitive sensor and temperature with a Pt100 RTD.

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3.3 Calculated parameters

Using the ROTRONIC HW4 software, the HF4 can be configured by the user to calculate either the dew point or the frost point.

3.4 Analog output signals (HF42 and HF43)

HF42 and HF43

With the ROTRONIC HW4 software any of the two analog output signals can be made to correspond to one of the following:

- Relative humidity
- Temperature
- Dew or frost point

Any output can also be disabled.

The scale of each analog output can be set within the numerical limits of -999.99 and 9999.99.

The D/A converters used to generate the analog output signals feature a 16-bit resolution.

The D/A converters used to generate the analog output signals feature a 16-bit resolution and exhibit a small positive offset at the bottom of the signal range as indicated below:.

Signal type	Maximum offset at range bottom
0...1 V	3 mV
0...5 V	50 mV
0...10 V	90 mV
0...20 mA	4 µA
4...20 mA	No offset

HF43

The ROTRONIC HW4 software allows changing the type of output signal to one of the following: 0...20 mA, 4...20 mA, 0...1V, 0...5V or 0...10V. Both output signals are automatically configured with the same signal type. No calibration or adjustment is required after changing the type of output signal.

In the case of voltage output signals, load requirements apply to the external device or circuit connected to the HF43 transmitter. These requirements are defined in the "Operation" chapter

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3.5 Digital interface (HF45)

a) RS-485 serial interface

The HF45 has always a RS-485 serial interface. When the number of available network ports is limited, this interface can be used to connect together up to 64 devices in a multi-dropped arrangement. In principle, an unlimited number of such networks can be monitored with the HW4 software, but each RS-485 multi-drop network is limited to 64 devices. The HF45 can be used either as a slave or a master, without special configuration. The master is automatically the device that is directly connected to a network (PC or LAN) by means of a USB port or TCP/IP port.

RS-485 Compatibility: The communication protocol used by the HF45 and other AirChip 3000 products is not compatible with the protocol used by the previous generation of ROTRONIC instruments. Do not connect legacy products and AirChip 3000 products to the same RS-485 multi-drop network.

b) USB or Ethernet interface

The HF45 is also available with the following interface combinations: USB + RS-485 or Ethernet +RS-485. In that case the protection grade of the HF4 enclosure is no longer IP65 / NEMA 4 rated.

c) Communication protocol options

The measurement data can be read without having to use the ROTRONIC HW4 software. Starting with firmware version 1.3, the HF4 offers the following communication protocol options (ASCII) which can be selected by connecting the HF4 to a PC running the ROTRONIC HW4 software (version 2.1.1 or higher):

- **RO-ASCII:** this is the standard (default) communication protocol used by all AirChip 3000 devices and by the HW4 software. In principle, this protocol supports all of the AirChip 3000 functions but some of the functions require a certain amount of computations to be carried out by an external device such as a PC.
- **Custom:** this communication protocol can be used to provide compatibility of the HF4 with an existing communication system. The Custom communication protocol is limited to reading measurement data from the HF4. Functions such as device configuration, humidity and temperature adjustment, etc. are not supported. The Custom protocol is applicable to all AirChip 3000 devices with a digital interface and allows RS-485 networking
- **Modbus:** the Modbus protocol available with the HF4 is limited to reading measurement data from the HF4. Functions such as device configuration, humidity and temperature adjustment, etc. are not supported by the Modbus protocol.

When using either the RO-ASCII or the Custom protocol, the HF4 can be set to send data automatically after each refresh cycle without requiring a data request. When this mode is enabled, the receiving device must be listening at all times in order to get the measurement data.

For details, see document **E-M-AC3000-CP**

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3.6 Service connector

The service connector (UART interface with a mini-USB type connector) allows connecting the HF4 either to a PC running the ROTRONIC HW4 software or to a probe input of another instrument that is compatible with the HygroClip 2 (HC2) probes. In both cases a service cable is required. See "Maintenance" for the location of the service connector and for the type of service cable to be used.

- Connecting the HF4 to a PC is used to configure the HF4, gain access to the HF4 functions such as humidity and temperature adjustment, read data from the HF4 on the PC and update the AirChip 3000 firmware.
- Connecting the HF4 to the probe input of another instrument is useful only when the other instrument has its own display and keypad, and has an internal menu equivalent to the menu of the HP23 hand-held calibrator. The connection allows showing the data measured by the HF4 on the other instrument display and also allows using the other instrument internal menu to do for example a humidity and temperature adjustment of the HF4.
- **HF45 (digital outputs):** the digital interface (USB, Ethernet and RS-485) offers the same functionality as the service connector but does not allow connecting the HF4 to a HP23 hand-held calibrator.

3.7 Sensor protection (dust filter)

The HF4 is supplied with a Polyethylene filter to protect the sensors against dust particles and high air velocity.

4 User configurable settings and functions

The HF4 ships configured as specified on the customer order. Models with analog outputs can be installed and used just as any conventional humidity and temperature transmitter and most users will never need to use the HF4 configurable settings and functions. Models with a digital interface generally require some configuration by the user.

Making use of the HF4 configurable settings and functions is entirely up to the user and the appropriate settings depend on the user application. We have provided below a short description of the HF4 functions and also indicated the factory default settings.

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4.1 Function overview

MEASUREMENT ACCURACY AND RELIABILITY	
AirChip 3000 Functions	Description
▶ Humidity / temperature adjustment	<ul style="list-style-type: none"> ○ 1-point or multi-point humidity calibration or adjustment ○ 1-point or 2-point temperature calibration or adjustment ○ Generate a time stamp for calibrations and adjustments ○ Retain and view last adjustment date and adjustment values ○ Generate calibration and adjustment protocols
▶ Automatic humidity sensor test and optional drift compensation	<p>Tests the humidity sensor for drift caused by contaminants and can be used to automatically apply a correction. The test is automatically carried out at regular intervals of time. Can be configured, enabled, or disabled</p> <p>The humidity sensor status can be verified either with the HW4 software or with the instrument display (if available) and is shown as Good, SQ-tuned (corrected for drift) or Bad (defective)</p>
▶ Data recording	<p>The data recording function differs from a true data logging function in the sense that the AirChip 3000 does not time stamp the data. This data recording function can be used to investigate events such as a sensor malfunction as well as to retrieve data that would otherwise be lost</p> <ul style="list-style-type: none"> ○ Start or stop data recording - up to 2000 value pairs (%RH and temperature). Starting a recording session erases all previously recorded data ○ The recording mode and log interval can be specified ○ When the device is powered off, the recording session is paused but not ended. As long as the recording session has not been ended, the device automatically resumes recording data when powered up again ○ The recorded data can be downloaded to a PC with the HW4 software, time stamped and viewed

MEASUREMENT LOOP VALIDATION	
AirChip 3000 Functions	Description
▶ Simulator mode	Used to make the HF4 generate fixed values for the humidity, temperature and calculated parameter. Can be configured, enabled or disabled

DEVICE SAFEGUARDS	
AirChip 3000 Functions	Description
▶ Device write protection	Used to protect the HF4 with a password to prevent unauthorized digital access by a digital user. Can be configured, enabled or disabled
▶ Internal menu access from keypad	Used to prevent accidental changes to the HF4 settings and temperature-humidity adjustment by disabling the MENU key on the optional keypad. Can be enabled or disabled

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PROCESS PROTECTION / PROTECTION OF OTHER DEVICES	
AirChip 3000 Functions	Description
▶ Limit humidity output to 100 %RH	Used to prevent the humidity signal from exceeding 100 %RH when condensation forms on the sensor. Can be enabled or disabled
▶ Out-of-limit value alarm	Used to specify the normal range for humidity, temperature and the calculated parameter depending on the user application. Can be configured, enabled or disabled Out-of-limit values trigger a digital alarm which can be also be seen on the optional display
▶ Bad sensor alarm	Built-in function. Cannot be disabled A bad humidity or temperature sensor triggers a digital alarm which can be also be seen on the optional display
▶ Fail safe mode	Used to specify a "safe" fixed value for humidity and for temperature in the event of a sensor failure. Can be configured, enabled or disabled

4.2 Factory default settings

Notes:

- Configuration of the HF4 by the user and access to its functions requires a PC with the ROTRONIC HW4 software (version 2.1.1 or higher) installed. Service cable AC3006 or AC3009 is used to connect the HF4 service connector to a USB port of the PC. The HF45 can also be connected to the PC using either its USB or Ethernet interface
- Settings and functions that can also be either partially or fully accessed from the optional keypad are marked with the letter **K** (see also Operation > Internal Menu).

Configurable Settings		Applicability	Factory default
Unit system (Metric or English)	K	HF42, HF43, HF45	As per ordering code
Analog signal type (4...20 mA or other)		HF43	As per ordering code
Psychrometric calculation		HF42, HF43, HF45	As per ordering code
Output 1 parameter, scale and unit		HF42, HF43	As per ordering code (%RH or DP)
Output 2 parameter, scale and unit		HF42, HF43	Temperature, unit as per ordering code
Display resolution (optional)		HF42, HF43, HF45	1 decimal
Display backlight (optional)	K	HF43, HF45	Always on
Displayed parameters	K	HF42, HF43, HF45	As per ordering code
Trend indicator (display)		HF42, HF43, HF45	Enabled
Communication protocol		HF43 with DI, HF45	RO-ASCII
RS-485 address		HF43, HF45	0
TCP/IP settings		HF45	See document IN-E-TCPIP-Conf
Device name		HF43, HF45	Instrument model

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Functions		Applicability	Factory default
Humidity / temperature adjustment	K	HF42, HF43, HF45	
Device write protection		HF42, HF43, HF45	Disabled
Menu access from keypad		HF42, HF43, HF45	Enabled
Limit humidity output to 100 %RH		HF42, HF43, HF45	Enabled
Out-of-limit value digital / display alarm		HF42, HF43, HF45	Disabled
Data recording	K	HF42, HF43, HF45	Enabled (loop mode – 10 min. interval)
Automatic humidity sensor test		HF42, HF43, HF45	Disabled
Humidity sensor drift compensation		HF42, HF43, HF45	Disabled
Fail safe mode		HF42, HF43, HF45	Disabled
Simulator mode		HF42, HF43, HF45	Disabled

- For a detailed description of all AirChip 3000 / HF4 main functions see document **E-T-AC3000-DF-V1**
- Instructions regarding the configuration of the HF4 and access to its functions are provided in the following manuals:
 - E-M-HW4v2-F2-003**
 - E-M-HW4v2-Main** (§ 6.5)
 - E-M-HW4v2-DR-001**
 - E-M-HW4v2-A2-001**
 - E-M-AC3000-CP**
- Instructions for configuring the TCP/IP settings of the HF45, are provided in document **E-M-TCPIP-Conf**
- The factory default setting for dew / frost point calculation is frost point below freezing

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5 Mechanical installation

5.1 General guidelines

Relative humidity is extremely dependent on temperature. Proper measurement of relative humidity requires that the probe and its sensors be at exactly the temperature of the environment to be measured. Because of this, the location where you choose to install the probe can have a significant effect on the performance of the instrument. The following guidelines should guarantee good instrument performance:

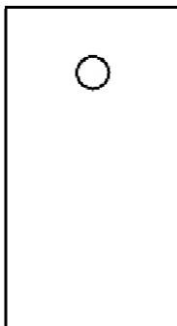
- a) **Select a representative location:** install the probe where humidity, temperature and pressure conditions are representative of the environment to be measured.
- b) **Provide good air movement at the probe:** air velocity of at least 200 ft/ minute (1 meter/second) facilitates adaptation of the probe to changing temperature.
- c) **Avoid the following:** (1) Close proximity of the probe to a heating element, a cooling coil, a cold or hot wall, direct exposure to sun rays, etc. (2) Close proximity of the probe to a steam injector, humidifier, direct exposure to precipitation, etc. (3) Unstable pressure conditions resulting from excessive air turbulence.
- d) **Immerse as much of the probe as possible in the environment to be measured.**
- e) **Prevent the accumulation of condensation water at the level of the sensor leads.** Install the probe so that the probe tip is looking downward. If this is not possible, install the probe horizontally.

5.2 HF4 enclosure

The HF4 enclosure consists of a base and a cover held together with 4 screws. To open the enclosure, use a metric 2.5 mm hex key. Prior to re-assembling the enclosure, verify that the red seal is sitting properly in its groove on the base.

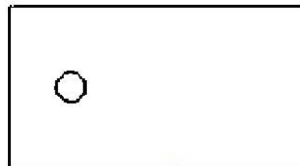
5.3 Installation of the HF4 type D (through wall mount)

Mounting position of the enclosure



Vertical:

HF42 and HF43 type D
without keypad and display



Horizontal:

HF42 and HF43 type D with
keypad and display

HF45 type D

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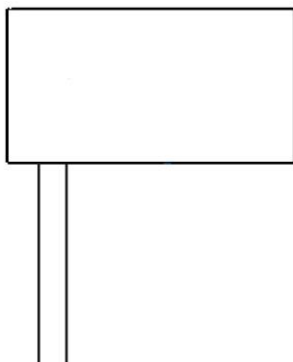
Mounting hardware



Part **AC5005** is a flange with compression fitting that is designed to hold the probe of the HF4 type D when mounted through a wall (see Accessories). The HF4 does not require any additional support. The AC5005 allows easy installation and removal of the HF4.

5.4 Installation of the HF4 type W (surface mount)

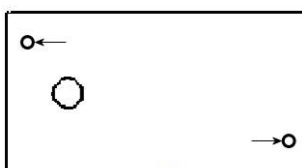
Mounting position of the enclosure



Horizontal:

HF42, HF43 and HF45 type W

Mounting hardware



Method 1: The HF4 is supplied with 2 screws, 2 drywall anchors and two rubber washers. The base of the enclosure has 2 screw-wells (see drawing) that are normally closed at the bottom. Use the template provided with the HF4 to drill mounting holes in the wall and insert the drywall anchors. Place a rubber washer on each screw. Insert a screw in each well and push to open the bottom of the well.



Method 2: When a DIN-rail (35 mm / 1 3/8 ") is available use part **AC5002** (not included). This is a DIN-rail mounting kit consisting of 2 clamps that attach to the back of the enclosure with the screws provided.

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6 Electrical installation

6.1 General wiring guidelines

Power supply wiring

Heavy machinery and instrumentation should not share the same power supply wiring. If this cannot be avoided, noise filters and surge protectors should be used. Most UPS devices have those features already integrated.

General guidelines for signal cables

The following guidelines are derived from European Standard EN 50170 for the transmission of signals by copper wires. When planning an installation, the rules provided by EN 50170 should be followed under consideration of local circumstances to determine the position of machines and equipment.

All ROTRONIC products are tested for Electromagnetic Compatibility according to EMC Directive 2004/106/EG and following European standards:

- EN 61000-6-1: 2001, EN 61000-6-2: 2005
- EN 61000-6-3: 2005, EN 61000-6-4: 2001 + A11

Whenever the level of electromagnetic interference is expected to be high, both the instruments and signal cables should be placed as far away as possible from the source of interference.

In general, signal cables should be installed in bundles or channels / conduits, separate from other cables as indicated in the table below:

<ul style="list-style-type: none"> • Bus signals such as RS485 • Data signals for PCs, printers etc. • shielded analog inputs • unshielded direct current (<= 60V) • shielded process signals (<= 25 V) • unshielded alternate current (<= 25V) • coaxial cables for CRT monitors 	in common bundles or channels / conduits
<ul style="list-style-type: none"> • direct current from 60 V to 400 V (unshielded) • alternate current from 25V to 400 V (unshielded) 	in separated bundles or channels / conduits, without minimum distance
<ul style="list-style-type: none"> • direct and alternate current > 400 V (unshielded) • Telephone lines • lines leading into EX-rated areas 	in separated bundles or channels / conduits, without minimum distance

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Lightning protection

Cabling in areas with a risk of lightning requires a lightning protection. For cabling underground in between buildings, we recommend the use of special fiber optic cables. If this is not possible, use copper cables that are suitable for underground installation.

6.2 Guidelines for RS-485 wiring (HF45)

See document **E-DV04-RS485.01**: RS485 Network Installation and Start-up Guidelines

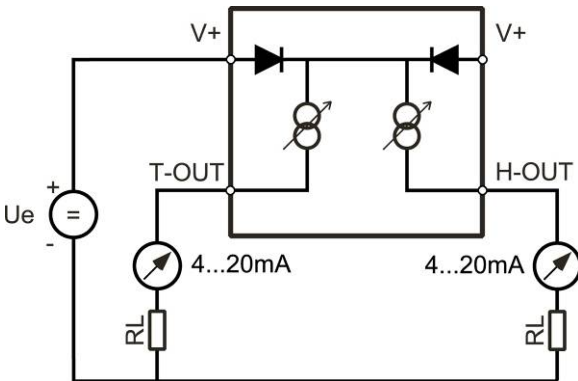
6.3 Cable grip and cable specifications

The HF4 is supplied either with one M16 sealing cable grip or with a ½" conduit adapter. The M16 cable grip provides effective sealing only with cables having the proper outside diameter. Preferably, use a cable with an outside diameter of 6 to 7 mm (0.236 to 0.275 inch) with 18 AWG wires.

6.4 Wiring

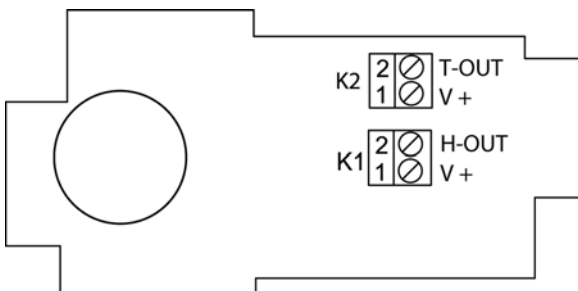
6.4.1 HF42: 2-wire, loop powered transmitter

Electrical diagram



The maximum permissible cable length connecting the HF42 to other devices is determined by the total resistance resulting from the addition of the cable resistance and that of the devices connected in series with the unit. This resistance should not exceed 500 ohms.

Terminal block diagram



Terminals	Description
K2-2: T-OUT	Temperature output (+) OUT-2
K2-1: V+	Power supply: 10...28 VDC (+)
K1-2: H-OUT	Relative humidity or dew point (+) OUT-1
K1-1: V+	Power supply: 10...28 VDC (+)

Note: connect the + of the power supply to only one of the V+ terminals. The two terminals marked V+ are internally connected.

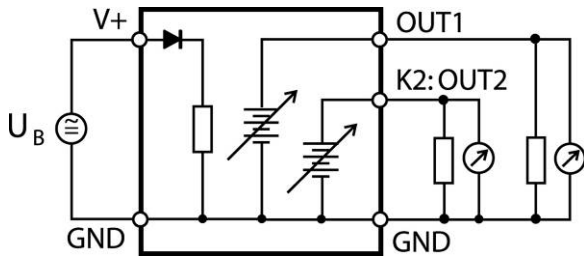
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Measuring humidity or temperature only

Unless configured to measure either humidity only or temperature only, proper operation of the HF42 requires both current loops to be closed. The HF42 can be directly ordered from the factory to measure either humidity or temperature only. When necessary, any unused output of the HF42 can be disabled with the ROTRONIC HW4 software. When the HF42 is configured with one of the two outputs disabled, close only the loop that is being used.

6.4.2 HF43: 3-wire transmitter

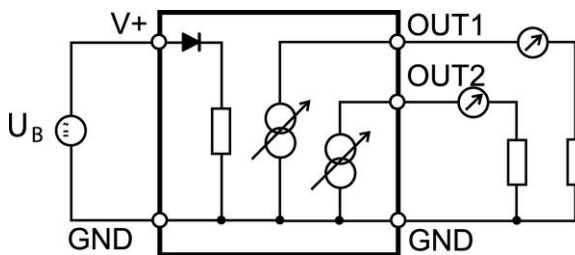
Electrical diagram for voltage outputs



The maximum permissible cable length can be determined under consideration of the voltage drop caused by the current flowing to the devices connected to the unit. The voltage drop in the cable depends both on cable resistance and on the equivalent resistance of the devices connected in parallel to the unit. The total resistance connected to each unit output should be at least 1000 ohms. Cable resistance should not be more than 1/1000 of the load resistance.

Minimum load requirements apply to the external device or circuit connected to the HF4 transmitter. These requirements are defined in the "Operation" chapter

Electrical diagram for current outputs

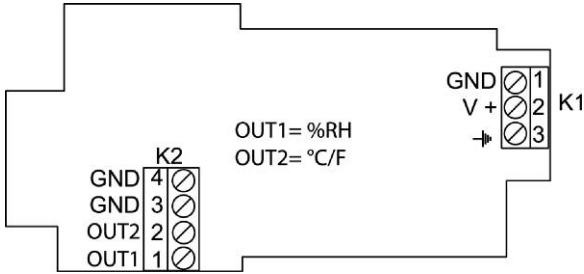


The maximum permissible cable length, connecting the unit to other devices, is determined by the total resistance resulting from the addition of the cable resistance and that of the devices connected in series with the unit. This resistance should not exceed 500 ohms.

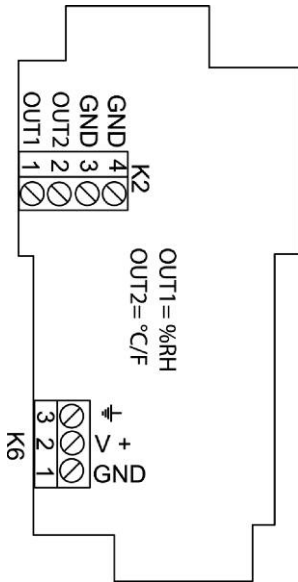
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Terminal block diagram

Type D and W (horizontal mount)



Type D (vertical mount)



Terminals	Description
K1-1: GND	Power supply (-) or neutral (tied with other GND)
K1-2: V+	Power supply: 15...40 VDC (+) or 12...28 VAC (Phase)
K1-3: -▶	Protective ground (see note below)
K2-4: GND	Ground (tied with other GND)
K2-3: GND	Ground (tied with other GND)
K2-2: OUT2	Temperature output (+)
K2-1: OUT1	Relative humidity or dew point (+)
K6-1: GND	Power supply (-) or neutral (tied with other GND)
K6-1: V+	Power supply: 15...40 VDC (+) or 12...28 VAC (Phase)
K6-3: -▶	Protective ground (see note below)

Note: Terminals K1-3 or K6-3 (protective or earth ground) are not tied with GND. If so desired, K1-3 or K6-3 can be tied with GND by closing a solder pad on the PCB

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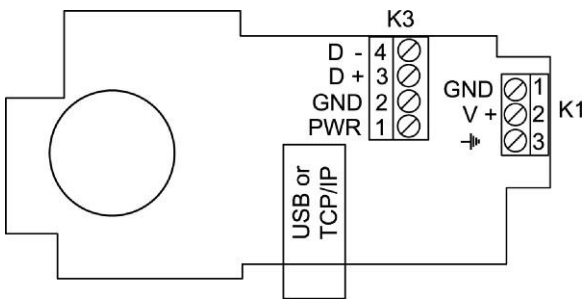
Measuring humidity or temperature only

Operation of the HF43 does not require both current loops to be closed. When using the HF43 to measure either humidity only or temperature only, close only the loop that is being used.

Using the ROTRONIC HW4 software, any unused output of the HF43 can be disabled.

6.4.3 HF45: digital output

Connectors and terminal block diagram



Terminals	Description
K1-1: GND	Power supply (-) or neutral (tied with other GND)
K1-2: V+	Power supply: 5...40 VDC (+) or 12...28 VAC (Phase)
K1-3: -▶	Protective ground (see note below)
K3-4: D-	RS-485 Bi-directional TX- / RX -
K3-3: D+	RS-485 Bi-directional TX+ / RX +
K3-2: GND	Ground / Power supply (-)
K3-1: PWR	DC (+) 15...40 VDC (+) (optional, see note below)

Notes:

Terminal K1-3: this terminal (protective or earth ground) is not tied with GND. If so desired, K1-3 can be tied with GND by closing a solder pad on the PCB

Terminal block K3 (RS-485): pins K3-1 and K3-2 can be used to power all instruments on a RS-485 multi-drop from a single external 15 VDC power supply with adequate mA rating. In this case, do not use terminals K3-1 and pin K1-2 (normally used to power the HF45).

WARNING: Connecting a device to an active Ethernet network can disrupt communications on the network. Before connecting the HF4, make sure that it is properly configured for your network

6.4.4 Grounding (all models)

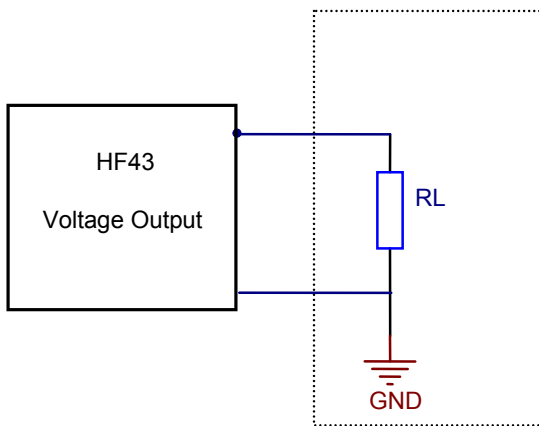
We generally recommend grounding the (-) side of the power supply, especially if the electronics will be subjected to a low humidity environment (35 %RH or less).

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7 Operation

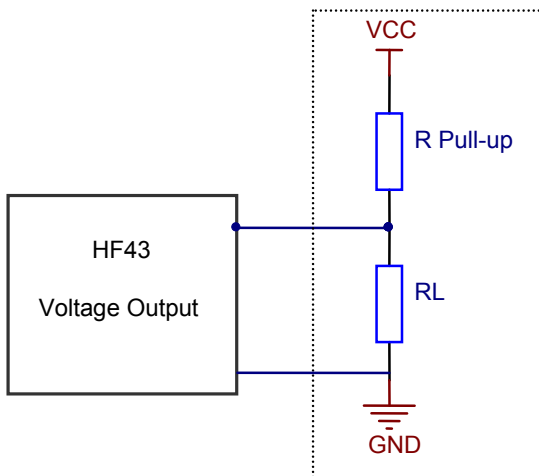
7.1 Minimum load requirements for the HF43 with voltage outputs

The following requirements apply to any external device or circuit connected to the HF43 transmitter with voltage outputs:



HF43 output signal	Input resistance RL
0...1V	$\geq 1\text{k}\Omega$
0...5V	$\geq 5\text{k}\Omega$
0...10V	$\geq 10\text{k}\Omega$

In the situation where the external device uses an internal pull-up resistor the value of this resistor should meet the requirements shown below. It is also necessary to add a pull-down resistor RL connected to ground in order to be able to read 100% of the range of the HF43 voltage output.



HF43 signal	VCC	R pull-up	RL
0...1V	3.3V	$\geq 250\text{ k}\Omega$	1 k Ω

HF43 signal	VCC	R pull-up	RL
0...1V	5.0V	$\geq 400\text{ k}\Omega$	1 k Ω
0...5V	5.0V	$\geq 400\text{ k}\Omega$	5 k Ω

HF43 signal	VCC	R pull-up	RL
0...1V	10.0V	$\geq 1\text{ M}\Omega$	1 k Ω
0...5V	10.0V	$\geq 1\text{ M}\Omega$	5 k Ω
0...10V	10.0V	$\geq 1\text{ M}\Omega$	10 k Ω

7.2 HF42 and HF43 transmitters (analog outputs)

If so desired, use the HW4 software to configure the HF4. Complete the mechanical and electrical installation and simply power up the HF4.

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7.3 HF45 (digital output)

Configuration and full access to all HF45 functions requires a PC with the ROTRONIC HW4 software installed.

Starting with firmware version 1.3, the HF45 offers several communication protocol options that allow users to read the measurement data without the HW4 software. When using the standard RO-ASCII protocol, access to some of the HF45 functions is also possible without HW4. For details, see document **E-M-AC3000-CP**.

IMPORTANT: Depending on the type of digital interface, either the PC or the HF45 must be configured by the user as indicated below.

a) USB network connection

Prior to connecting the HF45 to a USB port you must install the ROTRONIC USB driver on the HW4 PC. For instructions see the HW4 manual **E-M-HW4v2-Main** (§ 6.3)

b) Ethernet (TCP/IP) network connection (wired or wireless)

Prior to connecting the HF45 to an active Ethernet network you must configure the HF45 TCP/IP settings. For instructions see the HW4 manual **E-M-HW4v2-Main** (§ 6.4) and technical note **E-M-TCPIP-Conf**

WARNING: Connecting a device to an active Ethernet network can disrupt communications on the network. Before connecting the HF4, make sure that it is properly configured for your network

c) RS-485 serial interface (multi-drop)

Instructions for using the HF45 with a RS-485 network are provided in the following manuals: **E-M-HW4v2-Main** (§ 6.5), **E-M-HW4v2-F2-003** and **E-DV04-RS485.01**.

Notes:

- Instruments connected to the same RS-485 network must use the same baud rate and each instrument must be given a unique RS-485 address
- **RS-485 Compatibility:** The communications protocol used by the HF45 and other AirChip 3000 products is not compatible with the protocol used by the previous generation of ROTRONIC products. Do not connect legacy products and AirChip 3000 products to the same RS-485 multi-drop network.

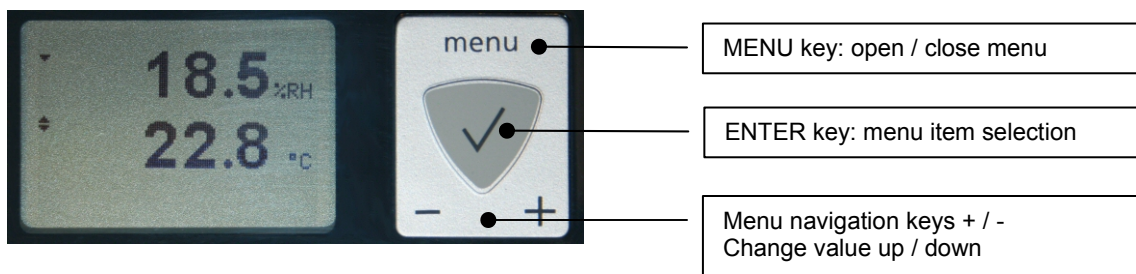
The specifications of the RS-485 interface are as follows:

Baud rate : 19200
Parity : none
Data bits : 8
Stop bits : 1

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7.4 Internal menu (optional keypad and display)

Note: Unauthorized access to the menu can be prevented by disabling the “display menu” setting (use the HW4 software > Device Manager > Display)



Main Menu	Menu Items	Selections / Information	Notes
Settings			
	Record	On / Off	Data recording (max. 2000 values)
	Unit	°C / °F	Temperature / dew or frost point
	Back Light	Key Press / On / Off	Display backlight mode
Device Information			
	Version	Firmware version	
	Serial Nbr	Serial number	
	Address	RS-485 address	
	Type	Device type	
	Name	Device name	User defined
	SensorTest	Humidity sensor status	Off / Good / SQ-Tuned / Bad
Humidity Adjust			
	RefValue	Humidity reference value	± 0.1 %RH steps
	<Adjust>		1-point adjustment only (offset)
Temperature Adjust			
	RefValue	Temperature reference value	± 0.1 °C steps
	<Adjust>		1-point adjustment only (offset)

- **Record:** both the recording mode (start / stop and the log interval cannot be changed from the menu and are as configured with the ROTRONIC HW4 software
- **SensorTest:** Off means that the humidity sensor has not been tested due to the configuration settings of the test. For a description of the automatic humidity sensor test and drift compensation (SQ-tuning) see documents **E-T-AC3000-DF-V1** and **E-M-HW4v2-F2-003**

7.5 Displayed parameters (optional keypad and display)

When the menu is not active, press the ENTER key to change which parameters are shown on the display:

- Relative humidity and temperature
- Dew / frost point and temperature (when the calculated parameter is enabled)

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8 Maintenance

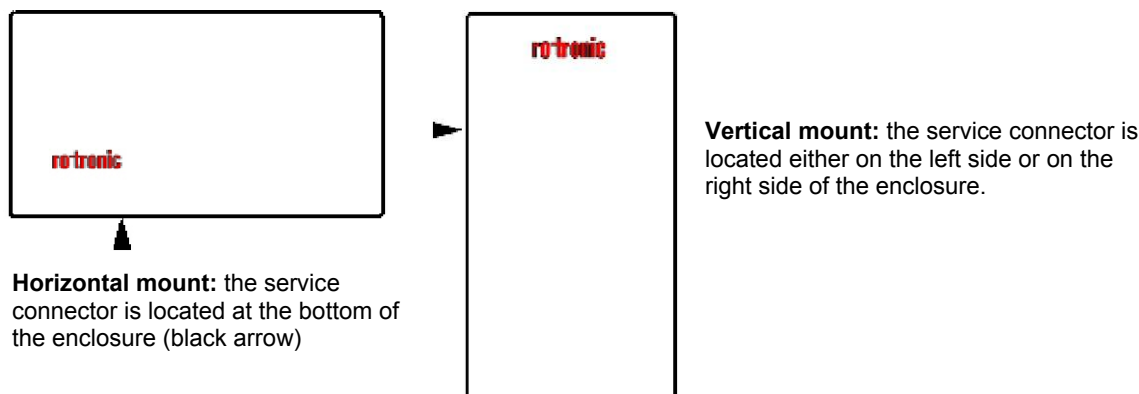
8.1 Service cable

- Cable AC3006 is used to connect the HF4 to a USB port of a PC running the ROTRONIC HW4 software.
- As an alternative, cable AC2001 is used to connect the HF4 to a probe input of the HP23 hand-held calibrator. For service purposes, the HP23 offers essentially the same functionality as the HW4 software.

8.2 Location of the service connector (mini USB type)

WARNING: the service connector is a UART interface with a mini-USB connector type. Do not connect the service connector directly to the USB port of a PC or hub.

The service connector can be accessed without opening the enclosure after removing the small red sealing cover.



8.3 Periodic calibration check

Both the Pt 100 RTD temperature sensor and associated electronics are very stable and should not require any calibration after the initial factory adjustment.

Long term stability of the ROTRONIC Hygromer humidity sensor is typically better than 1 %RH per year. For maximum accuracy, calibration of the HF4 should be verified every 6 to 12 months. Applications where the HF4 is exposed to significant pollution may require more frequent verifications.

a) Procedure for adjusting the HF4 from the optional keypad

The optional keypad of the HF4 allows a 1-point adjustment of temperature or humidity against a reference. A 1-point adjustment has the effect of adding the same offset to all measured values. A multi-point adjustment is not possible from the keypad and requires using either a PC with the HW4 software installed or another instrument such as the HP23 hand-held calibrator.

- When the parameter to be adjusted is stable, press the MENU key to show the internal menu on the display
- Use the (-) key to select either H-Adjust or T-Adjust and press the ENTER key
- Make sure that the text line beginning with RefValue is highlighted and press the ENTER key
- Use the (+) or (-) key to change the reference value as desired
- Use the (-) key to highlight the Adjust text line and press the ENTER key
- The HF4 confirms the adjustment with the message "Adjust OK"
- Press the MENU key twice to exit the menu and return the HF4 to normal operation

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Notes:

- The calibration point is automatically deleted from the probe memory after an adjustment
- Because the HF4 has no real time clock, the date of the adjustment is not written to the HF4. If retaining the adjustment date is important, use the HW4 software to adjust the HF4.

b) Procedure for adjusting the HF4 with the ROTRONIC HW4 software:

- Use cable AC3006 to connect the service connector of the HF4 to a USB port of a PC with the HW4 software installed. Note that the ROTRONIC USB driver must be installed on the PC as explained in the HW4 manual **E-M-HW4v2-Main**. In the case of the HF45, a connection with the PC can be established via the USB (ROTRONIC USB driver) or Ethernet interface.
- Start HW4 on the PC and search for the HF4 (HW4 Main Menu Bar > Devices and Groups > Search for USB Masters).
- After finding the HF4 with HW4, expand the device tree to see the HF4 functions. Select Probe Adjustment.
- For further instructions see HW4 manual **E-M-HW4v2-A2-001**

8.4 Cleaning or replacing the dust filter

Depending on the application, the dust filter may require cleaning from time to time. Cleaning should be done without removing the filter from the probe. Clean the filter with a fine brush. If this is not sufficient, the filter should be replaced. To do this, unscrew the filter from the probe. Before putting on a new dust filter, check the alignment of both sensors with the probe. The wires that connect the sensors to the probe are very thin and bend easily. If this happens, correct the alignment by holding the sensor very gently with a pair of small flat nosed pliers.

8.5 Validation of the output signals transmission

If so desired, transmission of the HF4 output signals can be validated by using the simulator function. The HW4 software is required to enable and configure this function. When this function is enabled the HF4 generates fixed digital and analog signals as specified by the user. For instructions see document **E-M-HW4v2-F2-003**

9 Firmware updates

Firmware updates will be available on the ROTRONIC website for downloading. Firmware files are given a name that shows both to which device the file applies and the version number of the firmware. All firmware files have the extension HEX. Procedure for updating the firmware:

- Use cable AC3006 to connect the service connector of the HF4 to a USB port of a PC with the ROTRONIC HW4 software installed. Note that the ROTRONIC USB driver must be installed on the PC as explained in the HW4 manual **E-M-HW4v2-Main**. In the case of the HF45, a connection with the PC can be established via the USB (ROTRONIC USB driver) or Ethernet interface.
- Copy the firmware update file from the ROTRONIC website to the PC.
- Start HW4 software on the PC and search for the HF4 (HW4 Main Menu Bar > Devices and Groups > Search for USB Masters).
- After finding the HF4, expand the device tree to see the HF4 functions. Select Device Manager. In the Device Manager menu bar select Tools > Firmware Update. For instructions see document **E-M-HW4v2-F2-003**

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10 Technical data

10.1 Specifications

General	HF42	HF43	HF45
Device type	Humidity temperature transmitter with analog output signals		Humidity temperature transmitter with digital output
Circuit type	2-wire, loop powered	3-wire	
Mechanical configuration types	D and W		

Power supply and connections	HF42	HF43	HF45
Supply voltage (VDD)	10...28VDC V min = 10 V + (0.02 x Load*) *Load resistance in ohms.	15...40 VDC or 12...28 VAC	5...40 VDC or 12...28 VAC
Nominal current consumption	2 x 20 mA	< 50 mA	Model with USB interface: 50 mA Model with Ethernet interface: 300 mA
Electrical connections	Terminal block and M16 cable grip or ½" conduit adapter		Connector (USB or Ethernet), terminal block (power supply and RS-485) and M16 cable grip or ½" conduit adapter
Polarity protection	Protective diode on V+		

Humidity measurement	HF42	HF43	HF45
Sensor	ROTRONIC Hygromer [®] IN1		
Measuring range	0...100 %RH		
Measurement accuracy at 23 °C	±1.0 %RH		
Repeatability	0.3 %RH		
Long term stability	< 1 %RH / year		
Sensor time constant	Typical 10 sec, 63% of a 35 to 80 %RH step change (1m/sec air flow at sensor)		

Temperature measurement	HF42	HF43	HF45
Sensor	Pt100 RTD, IEC 751 1/3 class B		
Measuring range limits	-50...100 °C / -58...212 °F		
Measurement accuracy at 23 °C	±0.2 °C		
Repeatability	0.05°C		
Long term stability	< 0.1°C / year		
Sensor time constant	Typical 4 sec, 63% of a step change (1m/sec air flow at sensor)		

Calculated parameters	HF42	HF43	HF45
Psychrometric calculations	Dew or frost point (user configurable option)		

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Start-up time and data refresh rate	HF42	HF43	HF45
Start-up time	3.4s (typical)	1.9s (typical)	1.9s (typical)
Data refresh rate	3.4s (typical)	1.7s (typical)	1.7s (typical)

Configurable analog outputs	HF42	HF43
Output 1	Can be made to correspond to any parameter	
Factory default parameter	Relative humidity or dew / frost point	
Factory default scale	As per ordering code	
Output 2	Can be made to correspond to any parameter	
Factory default parameter	Temperature	
Factory default scale	As per ordering code	
Output 1 and Output 2		
Signal type	4...20 mA	0...20 mA 4...20 mA 0...1 V 0...5 V 0...10 V (user configurable)
User configurable scaling limits	-999.99 ... +9999.99 engineering units	
Maximum offset at bottom of signal range	no offset	0...1V signal range : 3 mV 0...5 V signal range : 50mV 0...10 V signal range : 90mV 0...20 mA signal range : 4uA 4...20 mA signal range : no offset
Short circuit tolerant	Yes	
Maximum external load	500 Ω	500 Ω (current output)
Minimum external load	0 Ω	1 kΩ (0...1 V output) 5 kΩ (0...5 V output) 10 kΩ (0...10 V output) 0 Ω (current output)

Digital interface	HF45
Interface type	RS-485, USB and RS-485 or Ethernet (TCP/IP) wired or wireless and RS-485

Service connector	HF42	HF43	HF45
Interface type	UART		
Maximum service cable length	5 m (16.4 ft)		

General specifications	HF42	HF43	HF45
Optional display	LC, 1 or 2 decimals resolution, no backlight, trend and alarm indication	LC, 1 or 2 decimals resolution, backlight, trend and alarm indication	
Probe material	Polycarbonate		
Probe dust filter material	Polyethylene		
Housing material	ABS		
Housing protection grade	IP 65 (except HF45 – USB or Ethernet)		
Physical dimensions	See Models		
Weight	250 g (8.8 oz)		250 g (8.8 oz)

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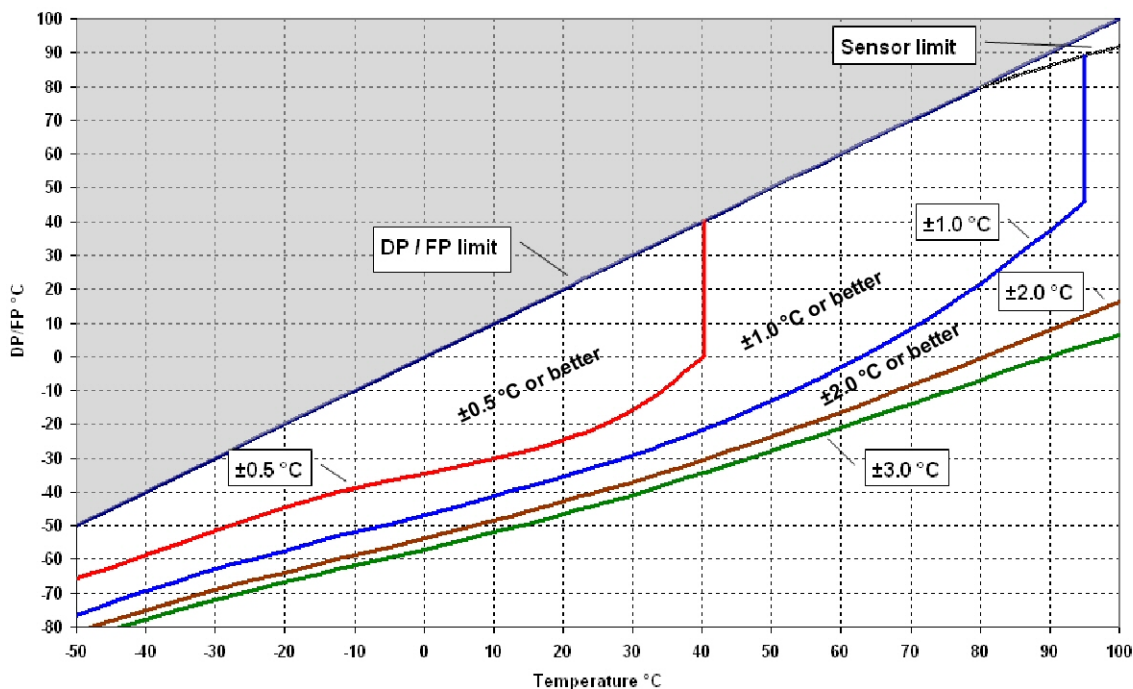
Conformity with standards	HF42	HF43	HF45
CE / EMC immunity	EMC Directive 2004/108/EG: EN 61000-6-1: 2001, EN 61000-6-2: 2005 EN 61000-6-3: 2005, EN 61000-6-4: 2001 + A11		
Solder type	Lead free (RoHS directive)		
Fire protection class	Corresponds to UL94-HB		
FDA / GAMP directives	compatible		

Environmental limits	HF42	HF43	HF45
Storage and transit	-50...+70 °C / -20...+70 °C (models with display), 0...100 %RH, non condensing		
Operating limits at electronics	-40 ... +60 °C / -10...60 °C (models with display), 0...100 %RH, non condensing		
Temperature limits at probe	-50...+100 °C (valid for type D)		
Maximum humidity at sensor	100 %RH up to 80 °C (176 °F) 75 %RH at 100 °C (212 °F)		
Maximum air velocity at probe	20 m/s (3,935 ft /min)		
Critical environments	Humidity sensor: as per DV04-14.0803.02 - Critical chemicals		

10.2 Dew point accuracy

The HF4 can be configured to calculate either the dew point or frost point based on the measurement of relative humidity and temperature. The accuracy of this conversion varies, depending on the humidity and temperature conditions as shown in the graph below:

DP/FP Accuracy



Example: at a temperature of 20 °C, a frost point value of -25 °C is measured with an accuracy of ± 0.5 °C or better.

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11 Accessories

11.1 Configuration and communication software

The ROTRONIC HW4 software (version 2.1.0 or higher) allows configuring the HF4. HW4 is compatible with Windows XP, Vista and NT4 with SP6a or higher. For more details see separate instruction manual provided with the software.

Order Code	Description
HW4-E	HW4 software, Standard Edition (single user)
HW4-P	HW4 Professional Edition, ERES regulations compliant (FDA / GAMP), multi user

11.2 Service cables


Order Code	Description	
AC3006	Mini-USB service connector (UART) to a PC USB port. Cable electronics convert UART interface to USB interface. Approximate length: 1.7 m HF4 must be powered	
AC2001	Mini-USB service connector (UART) to 7-pin probe connector of the HP23 hand-held calibrator or other instrument with display and keypad. Approximate length: 1.7 m HF4 must be powered	

IMPORTANT:

- Prior to using cable AC3006 the ROTRONIC USB driver must be installed on the PC (available from the HW4 CD or from www.rotronic-humidity.com). For installation instructions see document **E-M-HW4v2-Main** (§ 6.3).




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11.3 USB / RS-485 converter cable

Order Code	Description
AC3010	<p>USB / RS-485 converter. Allows connecting the RS-485 port of a HF45 transmitter with digital option to the USB port of a PC. Within the RS-485 network, the HF45 behaves as a slave.</p> 

IMPORTANT: Prior to using cable AC3010, the ROTRONIC USB driver must be installed on the PC (available from the HW4 CD or from www.rotronic-humidity.com). For installation instructions see document **E-M-HW4v2-Main** (§ 6.3).

11.4 Mounting hardware

Order Code	Description
AC5002	<p>DIN-rail mounting kit (consists of 2 clamps that attach to the back of the enclosure with the screws provided).</p> <p>DIN-rail (35 mm / 1 3/8") not included</p> 
AC5005	<p>Mounting flange with compression fitting for (15 mm / 0.6" diameter probe).</p> <p>Use for tough wall installation of the HF4 type D</p> <p>Maximum temperature 100 °C (212°F)</p> 
AC5001	<p>Sleeve for adapting a 15 mm / 0.6" diameter probe to a 25 mm / 1.0 " diameter through-wall mounting hole (HF42 and HF43 type D, vertical mounting position)</p> <p>Facilitates the replacement of older products with a 25 mm probe diameter</p> 


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11.5 Calibration accessories

Order Code	Description
EA00-SCS	0.5 %RH humidity std, SCS cert., pack of 5
EA05-SCS	5 %RH humidity std, SCS cert., pack of 5
EA10-SCS	10 %RH humidity std, SCS cert., pack of 5
EA20-SCS	20 %RH humidity std, SCS cert., pack of 5
EA35-SCS	35 %RH humidity std, SCS cert., pack of 5
EA50-SCS	50 %RH humidity std, SCS cert., pack of 5
EA65-SCS	65 %RH humidity std, SCS cert., pack of 5
EA80-SCS	80 %RH humidity std, SCS cert., pack of 5
EA95-SCS	95 %RH humidity std, SCS cert., pack of 5
ER-15	Calibration device for 15mm diameter probes

For instructions regarding the ROTRONIC humidity standards and calibration devices see document **E-M-CalBasics**.

11.6 Spare filters

Order Code	Slotted cap	Filter Insert	Notes
NSP-PCB-PE	 Polycarbonate, black	Polyethylene	Standard filter insert
NSP-PCB-WM		Wire mesh	For applications requiring faster response time
NSP-PCB-TF		Teflon	High humidity, low air flow

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12 Supporting documents

Document File Name	Contents
E-T-AC3000-DF-V1	AirChip 3000 Description and Main Functions
E-M-HW4v2-DIR	List of the HW4 manuals
E-M-HW4v2-Main	HW4 software version 2: General instructions and functions common to all devices
E-M-HW4v2-F2-003	HW4 software version 2: HF4 transmitters Device configuration and AirChip 3000 functions
E-M-HW4v2-A2-001	HW4 software version 2: Probe Adjustment function AirChip 3000 devices
E-M-HW4v2-DR-001	HW4 software version 2: Data Recording Function AirChip 3000 Devices
E-M-AC3000-CP	AirChip 3000 Communication Protocol Options
E-DV04-RS485.01	RS485 Network Installation and Start-up Guidelines
E-M-TCPIP-Conf	Configuration procedures for ROTRONIC devices with Ethernet (TCP/IP) interface
E-M-CalBasics	Temperature and humidity calibration basics
E-T-HumiDefs	Humidity Definitions Instructions for using the ROTRONIC humidity standards

Note: All document file names have an extension corresponding to the document release number (example of a first release: E-M-HW4v2-Main_10). This extension is not shown in the above table.

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13 Document releases

Doc. Release	Date	Notes
_10	Jul. 10, 2008	Original release
_11	Oct. 2, 2008	Added service cables AC3008 and AC3009 Added cable AC3010
_12	Oct. 31, 2008	Modified the order code tables Added minimum load requirements for the HF43 Added communication protocol options Added additional information regarding operation of the HF45
_13	Dec. 3, 2008	Changed the factory default settings
_14	Feb. 4, 2009	Deleted service cables AC3008 and AC3009 Reference to HW4 manuals: changed the file name of all documents such as E-M-HW4v2.1-Main to E-M-HW4v2-Main