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Operating instructions

Digital ALMEMO® D6 sensor

Atmospheric pressure sensor FDAD12SA
Temperature / humidity / atmospheric pressure sensor FHAD46x
Temperature / humidity / atmospheric pressure sensor FHAD36R
NTC psychrometer and atmospheric pressure sensor FNAD46
Infra-red sensor FIAD43
NTC temperature sensor ZAD040FS / FS2
Hot-wire thermoanemometer and atmospheric pressure sensor FVAD35
Thermoanemometer FVAD05-TOKx
Rotating vanes FVAD15
Rotating vanes FVAD15H
Heat flow sensor FQAD00
CO_2 and atmospheric pressure sensor FYAD00CO2
Precision pressure sensors FDAD33/35
Color temperature sensor FLAD23CCT
V-lambda-radiation sensor FLAD03VL1

V3.8
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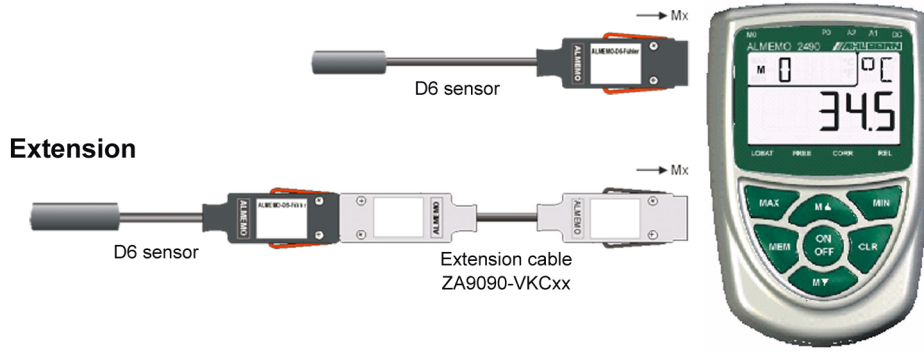
1. ALMEMO® D6 digital sensors

ALMEMO® D6 digital sensors incorporate not only an I2C interface integrated in the plug but also a second serial interface. Each such sensor can thus be connected to any ALMEMO® device with the 'DIGI' setting; (from V5 up an update may be required). It will thus be possible to configure and use new functions and quantities not actually supported by your ALMEMO® devices; this is achieved by means of the ALMEMO® Control software and a sensor menu stored in the sensor itself. For measured values all functions for correction, spot adjustment, and multi-point adjustment are available as in previous versions. (see 2.2) A new function is the possibility of programming an internal measured value smoothing factor over multiple channels, (see 3.3).

2. Operation as sensor on any ALMEMO® instrument

The ALMEMO® D6 sensor, using measuring range ´DIGI´, supplies digital measured values from up to 4 measuring channels to the ALMEMO® device, where these are then processed as usual. Any channel can be switched off, deactivated, and reactivated via the ALMEMO® device itself; and concealed channels (marked with ~) can be managed in exactly the same way. Certain function channels can also be programmed and used. The sensor is powered via the measuring instrument. To operate certain sensors in sleep mode it will be necessary to program a sleep extension.



The operating radius of these sensors when connected to a measuring instrument can be extended by means of universal extension cables ZA9090-VKCxx; measured values and connector programming can then be transmitted interference-free in serial form via an RS485 driver.

When configuring the sensor menu, given the absence of drivers for the second interface, the extension must be no more than 10 meters in length. When using the extension cable sleep mode operation is not possible.

2.1 Atmospheric pressure measurement and compensation

Some measurable variables (those in the measuring range list marked 'with PC') are affected by atmospheric pressure; failure to take account of this may lead to substantial errors. To ensure the highest possible level of accuracy these D6 sensors are fitted as standard with an atmospheric pressure sensor; this is always used automatically for atmospheric pressure compensation (PC) - even if the channel concerned is not activated. Atmospheric pressure is programmed by default as a climate variable; it can thus be configured as a reference function and the measured value can be used to also compensate other sensors.

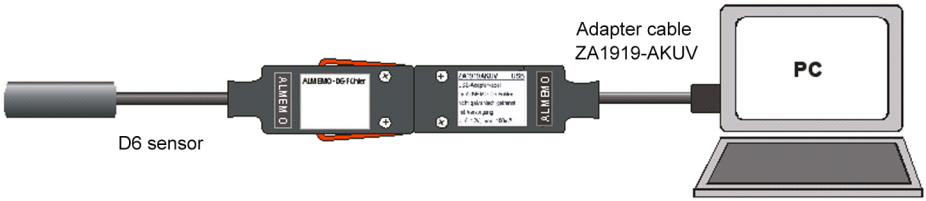
2.2 Correction of measured values

For the primary measuring channels it s possible in the D6 sensor to store values not only for spot adjustment but also for multi-point adjustment; (the device must have option KL). On completion of calibration the measuring accuracy will thus be determined no longer by the measuring instrument but exclusively by the sensor itself.

2.3 Sensor menu

Each D6 sensor has a stored individual sensor menu; this can be downloaded via the serial interface; it is used to configure measuring quantities and ranges, an averaging period for measured value smoothing, or other specific sensor functions. As operating device either a PC or a new ALMEMO® V7 measuring instrument can be used.

3. Configuration on PC via USB adapter cable



The ALMEMO® D6 sensor can be connected directly to a PC using USB adapter cable ZA1919-AKUV at a baud rate of 115.2 kilobaud. A microcontroller incorporated in the adapter cable automatically sets the power supply, baud rate, and device address that the sensor requires.

Connecting a D6 sensor directly to the PC is performed primarily for the purpose of sensor configuration.

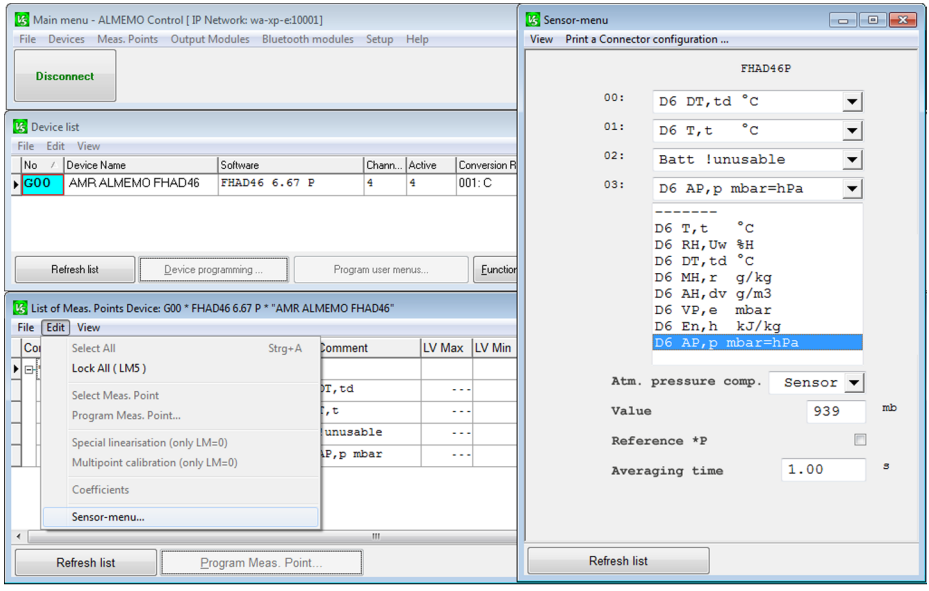
Each such sensor can be configured in various ways, depending on its operating mode, i.e. connected to an ALMEMO® measuring instrument or directly to a PC via the USB adapter cable. (See the following table):

Funktions	connected to	
	the ALMEMO® device	directly on the PC
Measuring channel deactivate	yes*	yes (see 3.3)
Meas. channel activate (without range change)	yes*	yes (see 3.3)
D6-range change	no	yes (see 3.3)
V6-function channels use or change	yes*	no
Atm. pressure as a reference for ALMEMO® device set	yes*	yes (see 3.3.1)
Atmospheric pressure program on firm value	no	yes (see 3.3.1)
damping program	no	yes (see 3.3.2)
Correction val., zero, slope, base factor program	yes*	yes*
Multi-point calibration	yes**	with factory calibration (KA9001DW)

* See the device's operating instructions and / or the ALMEMO® Manual
** with device option KL

3.1 Using the sensor menu

To access and use the sensor menu the ALMEMO® Control software should be used (from V. 5.14.0.330 up). 'Sensor menu' is located in the measuring points list under 'Edit'. Here the four measuring points can be programmed with the special D6 measuring ranges for the D6 sensor and other settings. At the interface the available measuring ranges appear with new easy-to-understand abbreviations, while on the measuring instrument itself only the 'DIGI' range can be used. Not only the range is programmed but also automatically the units (2 characters) and a comments text; the channel is then locked at level 5. Ranges can be deleted by selecting '- - - -' in the list.
Function channels * are determined in the measuring instrument - either as parameters or the result of calculations. They can therefore only be programmed and used by the device itself. The following function channels are available :
Batt, Mess, Alrm, Diff, Max, Min, M(t), n(t), M(n), Flow, Time
However, if connected directly to the PC, these are not available. The advisory note '! unusable' will be displayed in the comments text.
Further parameters, depending on sensor type, can be set (e.g. temperature / atmospheric pressure compensation).
Once configuration has been completed the D6 sensor can be connected to any ALMEMO® measuring instrument.



3.2 Atmospheric pressure compensation

If the sensor incorporates an atmospheric pressure sensor atmospheric pressure compensation is set by default to ´Sensor´; i.e. in the sensor menu the current measured value is displayed under ´Value´. However, if a particular value needs to be used (e.g. altitude above sea level, weather forecast, channel), this value can be programmed in menu item ´value´. It is also possible, by simply clicking on the ´Reference´ option here, to use the measured value ´Atmospheric pressure´ to compensate other sensors connected to the same ALMEMO® device. This programs abbreviation ´*P´ in the designation of measuring channel ´D AP´ thus ensuring that this measured value is always available in the ALMEMO® device for the purpose of atmospheric pressure compensation.(see Manual, 6.3.6).

3.3 Averaging period (smoothing)

All measured values on the primary channels are internally scanned all the time at the individual refresh rate. (see 12.4) If measuring conditions make these values too unstable an averaging period can be entered in the menu automatically for both primary channels; measured values will then be smoothed by a sliding average.

4. The products

ALMEMO® D6 atmospheric pressure sensor with temperature compensation	FDAD12SA
ALMEMO® D6 temperature / humidity sensor with plug-in sensor element	FHAD460
Same as above with plug-in sensor in plastic housing 36 mm x 8 mm Ø	FHAD462
Same as above stainless steel tube with protective cap	FHAD464x
Same as above with connecting cable 5 meters	FHAD46xL05
Same as above with connecting cable 10 meters	FHAD46xL10
Spare sensor element, digital, adjusted for FHAD 46	FH0D46
Spare sensor element, digital, adjusted for FHAD 46-2	FH0D462
ALMEMO® D6 temperature / humidity sensor, pressure-tight up to 16 bar	FHAD467
ALMEMO® D6 temperature / humidity sensor, FHAD 46-C, pluggable sensor element	FHAD46C0
Same as above Pluggable sensor in plastic housing 36mm x 8Ø	FHAD46C2
Same as above stainless steel tube with protective cap	FHAD46C4x
Same as above with connection cable 5m	FHAD46CxL05
Same as above with connection cable 10m	FHAD46CxL10
Multisensormodul, digital, abgeglichen für FHAD 46-C	FH0D46C
Multisensormodul, digital, abgeglichen für FHAD 46-C2	FH0D46C2
ALMEMO® D6 temperature / humidity sensor FHAD 46-C, pressure-tight up to 16 bar	FHAD46C7
ALMEMO® D6 digital temperature / humidity sensor with atmospheric pressure compensation	FHAD36RS
Same as above with connecting cable 5 meters	FHAD36RSL05
ALMEMO® D6 NTC psychrometer with atmospheric pressure compensation	FNAD46x
ALMEMO® D6 infra-red temperature sensor	FIAD432
ALMEMO® D6 NTC temperature sensor	ZAD040FS
ALMEMO® D6 hot-wire thermoanemometer 2 m/s with atmospheric pressure compensation	FVAD35TH4
ALMEMO® D6 hot-wire thermoanemometer 20 m/s with atmospheric pressure compensation	FVAD35TH5
ALMEMO® D6 rotating vanes	FVAD15xxxx
ALMEMO® D6 heat flow plate with temperature compensation	FQADx
ALMEMO® D6 CO_2 sensor with atmospheric pressure compensation	FYAD00CO2x
ALMEMO® D6 high-precision pressure sensor	FDAD33/35
ALMEMO® D6 color temperature sensor	FLAD23CCT

Accessories

Intelligent ALMEMO® extension cable for sensors (xx meters)	ZA9090VKCxx
USB adapter cable with link 6 to 12 V, 200 mA, baud rate 115.2 kbaud	ZA1919AKUV

ALMEMO® D6 sensors, the individual variants

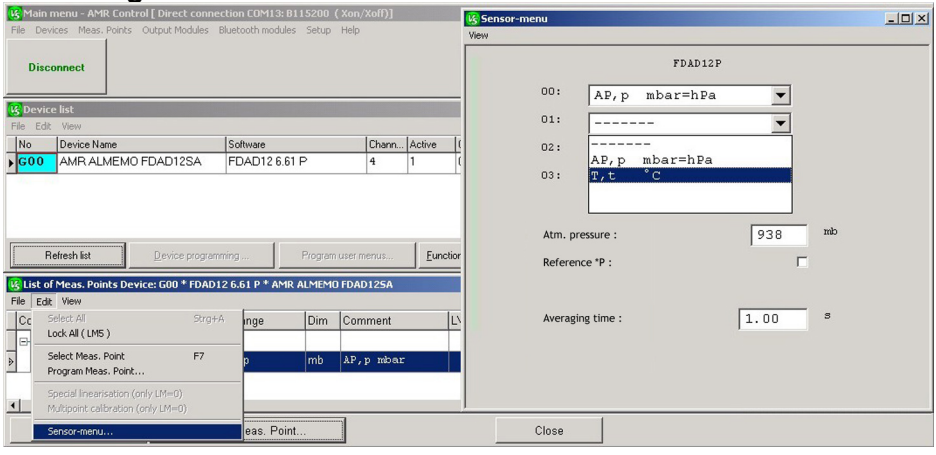
5. D6 atmospheric pressure sensor FDAD12

The atmospheric pressure sensor comprises a digital, fully adjusted and temperature-compensated absolute pressure sensor. Atmospheric pressure can be configured as a measuring channel with a reference function; the measured value can then also be used by the measuring instrument to compensate other sensors.

5.1 Measuring ranges preset at our factory

Description	Range		Exp	Meas. range	Units	Resolution
1. Atmospheric pressure AP, p	B-01	DIGI	-1	300...1100.0	mb	0.1 mb

5.2 Configuration on a PC via the sensor menu



5.2.1 Configurable measuring ranges

Initially the ranges for the measuring channels can be configured from a list of two ranges (* factory default settings). If required the same ranges can be configured again on the 2 remaining channels in order e.g. to display measured values in alternative units. The temperature channel can also be deleted if it is not needed.

Description	Range		Exp	Meas. range	Units	Resolution
1. * Atm. pressure AP, p	B-01	D p	-1	300.0...1100.0	mb	0.1 mb
2. Temperature T, t	B-02	D t	-1	-10.0... +60.0	°C	0.1 K

This menu also displays that atmospheric pressure which will, if the user clicks on the ´Reference´ option, be used to compensate other sensors on the same ALMEMO® device.

5.3 Technical data

Operative range	300 to 1100 mbar, -10.0 to +60.0 °C
Measuring ranges	Atmospheric pressure 300 to 1100 mbar Accuracy ±2.5 mbar (700 to 1100 mbar, at 23 °C ±5K) Temperature -10.0 to +60.0 °C Accuracy ±2 K (0 to +60 °C)
Refresh rate	1 second for all channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 9600 baud up to 921 kbaud)
Supply voltage	6 to 13 VDC
Current consumption	4 mA
Sleep mode on the device	Possible (for extensions a 1s delay is necessary)

6. D6 temperature / humidity sensor FHAD46

The FHAD46 comprises a fully adjusted digital capacitive sensor which can be exchanged at any time without any loss in accuracy. For automatic pressure compensation, an air pressure sensor is installed. The humidity quantities are calculated from the real measurable variables - temperature, relative humidity, atmospheric pressure - on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor ´fw(t,p)´ for real mixed gas systems). The measuring range and accuracy of this system are thus much greater than with earlier sensors. The measured atmospheric pressure can also be used in the ALMEMO® measuring instrument as reference atmospheric pressure.

6.1 Measuring ranges preset at our factory

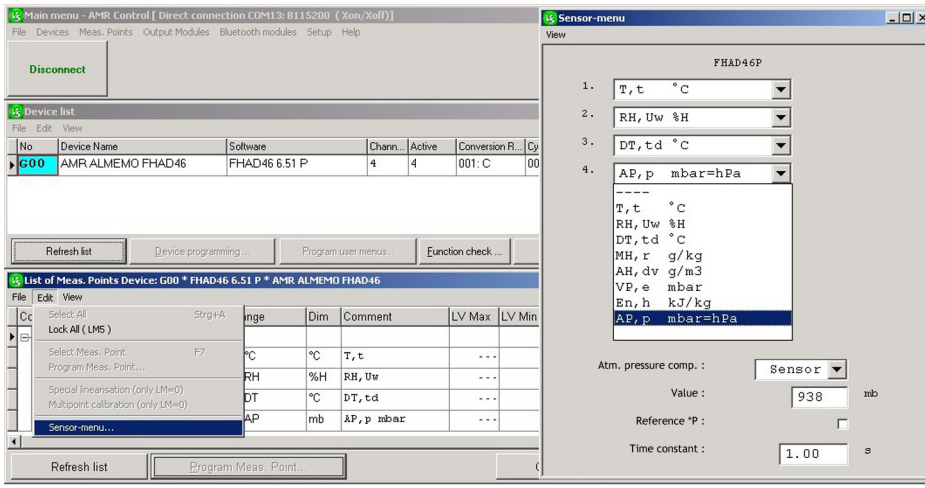
Description	Range		Exp.	Measuring range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-2	-20..+80.00+	°C	0.01 K
2. Relative humidity RH, Uw	B-02	DIGI	-1	5... 98.0	%H	0.1 % rH
3. Dew point DT, td	B-03	DIGI	-1		°C	0.1 K
4. Atm. press. AP, p (optional)	B-08	DIGI	-1	300...1100.0	mb	0.1 mb

+ The measuring range depends on the sensor type. (see data sheet)

The new D6 humidity ranges (see 7.2.1) can be partly configured on the device itself; for this purpose the appropriate ALMEMO® standard ranges ´H DT´, ´H AH´, H VP´, ´H En´ must have been programmed accordingly. ´DIGI´ will replace these ranges automatically with the new ones.

Please note that new ranges ´D dv´ or ´D p´ may be lost in this process. They can then only be restored via the PC.

6.2 Configuration on a PC via the sensor menu



6.2.1 Configurable measuring ranges

Initially the ranges for the four measuring channels can be configured from a list of eight ranges (* factory default settings).

Description	Range		Exp.	Measuring range	Units	Resolution
1. * Temperature T, t	B-01	D t	-2	-20..+80.00[+]	°C	0.01 K
2. * Rel. humidity RH, U_w	B-02	D Uw	-1	5... 98.0	%H	0.1 % rH
3. * Dew point DT, t_d	B-03	D td	-1		°C	0.1 K
4. (*) Mixture MH, r mit LK	B-04	D r	-1		gk	0.1 g/kg
5. Abs. humidity AH, d_v	B-05	D dv	-1		gm	0.1 g/m³
6. Vapor pressure VP, e	B-06	D e	-1		mb	0.1 mb
7. Enthalpy En, h mit LK	B-07	D h	-1		kJ	0.1 kJ/kg
8.(*) Atm. press. AP, p (optional)	B-08	D p	-1	300...1100.0	mb	0.1 mb

[+] The measuring range depends on the sensor type.(see data sheet)

The range, the units (2 characters), and a designation are programmed automatically; this designation comprises the familiar abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the newer symbols defined in VDI/VDE 3514.

6.2.2 Technical data

Operative range	The temperature depends on the sensor type. Humidity 5 to 98 % RH
Measuring ranges	Temperature -20 to +80 °C Accuracy ±0.3 K at 23°C±5K ±0.4 K at 10 to 40°C ±1.3 K at -20 to 80 °C Reproducibility: typ. ± 0.1K Humidity 5 to 98 % RH Accuracy ±1.8 % RH at 23 °C ±5K, 20 to 90 % RH ±2.3%RH at 23°C±5K, 10..<20%rH Hysteresis: typ ± 1% RH. Atmospheric pressure 300 to 1100 mbar Accuracy ±2.5 mbar (700 to 1100 mbar) at 23°C±5K Calculated quantities see 7.2.1
Atm. pressure compensation	0 to 6500 mbar (programmable)
Refresh rate	2 seconds for all four channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud
Supply voltage	6 to 13 VDC
Current consumption	5 mA
Sleep mode on the device	Possible (for extensions a 1s delay is necessary)

7. D6 temperature / humidity sensor FHAD46C

D6 temperature / humidity sensors FHAD46C are based on the fully adjusted Multi-sensor module FH0D46-Cx; this comprises a capacitive temperature / humidity sensor, a barometric atmospheric pressure sensor, and an EEPROM. (see Figure 7-1) This means that the Multi-sensor module can be replaced or adjusted quickly and easily without any loss in accuracy. The Multi-sensor module incorporates a unique serial number designed to exclude any risk of incorrect replacement; this serial number can be displayed via the sensor menu. (see Figure 7-1) The barometric atmospheric pressure sensor is used to determine atmospheric pressure directly at the measuring location. On this basis atmospheric pressure compensation can then be performed automatically in the ALMEMO® connector. Information stored in the integrated EEPROM ensures that the Multi-sensor module can be adjusted quickly and easily. The humidity variables are calculated from the real measurable variables - temperature, relative humidity, atmospheric pressure - on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor 'fw(t,p)' for real mixed gas systems). The measuring range and accuracy of this system are thus much greater than with earlier sensors. The measured atmospheric pressure can also be used in the ALMEMO® measuring instrument as reference atmospheric pressure (see 3.2).

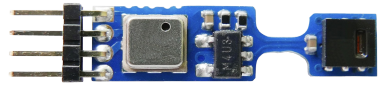


Figure 7-1 Multi-sensor module FH0D46-C

7.1 Measuring quantities and ranges - factory default settings

Description	Range		Exp.	Measuring range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-2	-20..+80.00+	°C	0.01 K
2. Rel. humidity RH, U_w	B-02	DIGI	-1	5... 98.0	%H	0.1 % rH
3. Dewpoint DT, t_d	B-03	DIGI	-1		°C	0.1 K
4. Atm. pressure AP, p	B-08	DIGI	-1	300...1100.0	mb	0.1 mb

+ The measuring range depends on the sensor type. (see data sheet)

Providing the appropriate ALMEMO® standard quantities 'H DT', 'H AH', 'H VP', 'H En' have been programmed accordingly, the D6 humidity ranges can be configured partly on the device itself. 'DIGI' will substitute these ranges automatically with the new ones. (see 7.2.1).

Please note that in this process new ranges 'D dv' or 'D p' may be lost.
They can then only be restored via the PC.

7.2 Configuration on a PC via the sensor menu

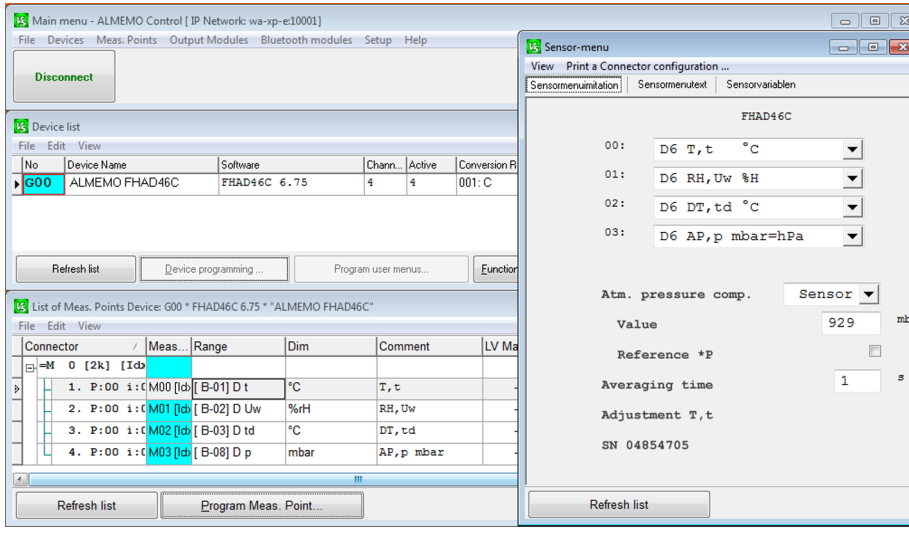


Figure 7-2 Sensor menu FH0D46-C

7.2.1 Configurable measuring quantities and ranges

The quantities and ranges for the four measuring channels can be configured from a list of eight possible variants. (* factory default settings):

Designation	Quantity	Exponent	Measuring range	Units	Resolution
1. * Temperature T, t	B-01 D t	-2	-20..+80.00[+]	°C	0.01 K
2. * Rel. humidity RH, U_w	B-02 D Uw	-1	5... 98.0	%H	0.1 % rH
3. * Dewpoint DT, t_d	B-03 D td	-1		°C	0.1 K
4. Mixture MH, r with PC	B-04 D r	-1		gk	0.1 g/kg
5. Abs. humidity AH, d_v	B-05 D dv	-1		gm	0.1 g/m^3
6. Vapor pressure VP, e	B-06 D e	-1		mb	0.1 mb
7. Enthalpy En, h mit LK	B-07 D h	-1		kJ	0.1 kJ/kg
8. * Atm. pressure AP, p	B-08 D p	-1	300...1100.0	mb	0.1 mb

[+] The measuring range depends on the sensor type. (see data sheet)

The quantity, range, units (2 characters), and a comments text are programmed automatically; these use the abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the symbols more recently defined in VDI/VDE 3514.

7.2.2 Technical data

Operative range	Temperature (depending on sensor type) Humidity 5 to 98 % RH	
Measuring quantities and ranges	Temperature	-20 to +80 °C
	Accuracy	5 to +60 °C typical ±0.2K
		5 to +60 °C maximum ±0.4 K
		-20 to +80 °C maximum ±0.7 K
	Reproducibility	typical ±0.1 K
	Humidity	5.0 to 98.0 % RH
	Accuracy	10 to 90 % RH maximum ±2.0 % RH at 23 °C ±5 K
		5 to 98 % RH maximum ±4 % RH at 23 °C ±5 K
	Hysteresis	typical ±1 % RH
	Atmospheric pressure	300 to 1100 mbar
	Accuracy	±2.5 mbar (700 to 1100 mbar) at 23 °C ±5 K
	Calculated quantities	see 7.2.1
Atmospheric pressure compensation	0 to 6500 mbar (programmable)	
Refresh rate	1 second for all four channels	
Connector colors	2 colors, light gray and dark gray, red lever	
Standard baud rate	115.2 kbaud	
Supply voltage	6 to 13 VDC	
Current consumption	3 mA	
Sleep mode on the device	Possible (for extensions a 1-second delay is necessary)	

The operating conditions are explained in Figure 7-3.

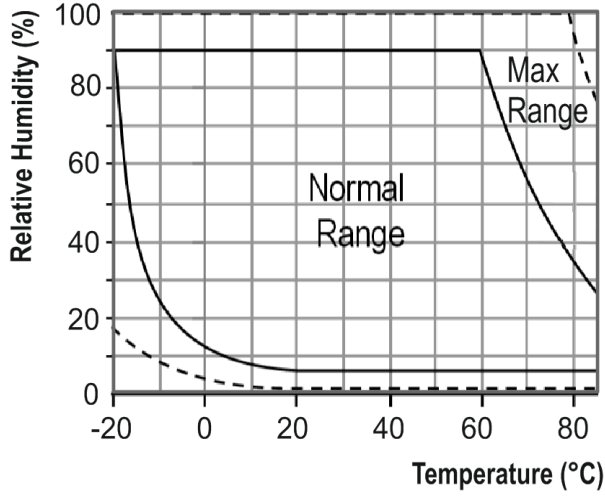


Figure 7-3 Operating conditions FHAD46C

8. D6 temperature / humidity sensor FHAD467

Humidity sensor FHAD467 is much the same as type FHAD46 (see 7.) - with the exception that it is specially designed for use in compressed air pipes up to 16 bar. In cases involving a pressure-dependent variable pressure compensation can be performed by specifying the appropriate atmospheric pressure up to 16 bar. This amount can also be displayed as a channel with range ´D Cp´. (see Table 8.2.1 ´with PC´)

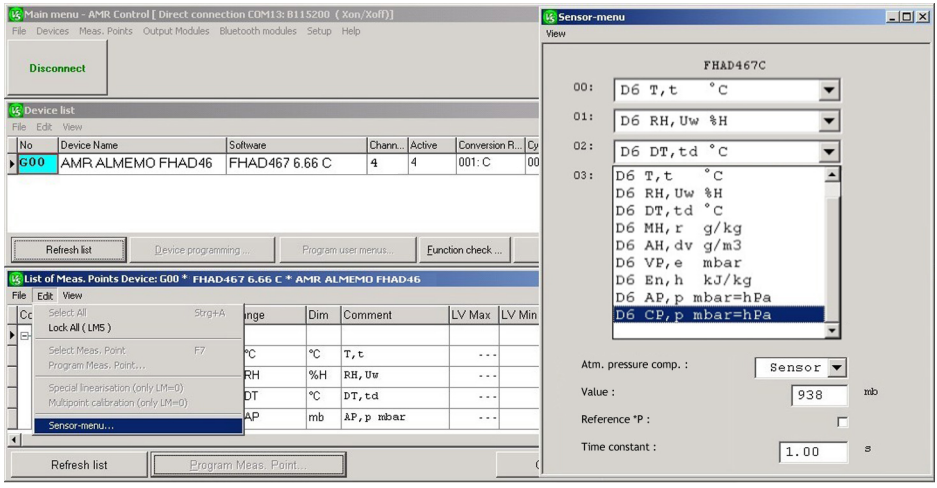
8.1 Measuring ranges preset at our factory

Description	Range		Exp.	Measuring range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-2	-20..+80.00	°C	0.01 K
2. Rel. Humidity RH, U_w	B-02	DIGI	-1	5... 98.0	%H	0.1 % rH
3. Dew point DT, t_d	B-03	DIGI	-1		°C	0.1 K

The new D6 humidity ranges can be partly configured on the device itself; however, the appropriate ALMEMO® standard ranges ´H DT´, ´H AH´, H VP´, ´H En´ must have been programmed accordingly. ´DIGI´ will replace these ranges automatically with the new ones..

Please note that new ranges ´D dv´ or ´D p´ may be lost in this process. They can then only be restored via the PC.

8.2 Configuration on a PC via the sensor menu



8.2.1 Configurable measuring ranges

The ranges for the four measuring channels can be configured from a list of nine ranges (* factory default settings).

Description	Range		Exp.	Measuring range	Units	Resolution
1. *Temperature T, t	B-01	D t	-2	-20..+80.00	°C	0.01 K
2. *Rel. Humidity RH, U_w	B-02	D Uw	-1	5... 98.0	%H	0.1 % rH
3. *Dew point DT, t_d	B-03	D td	-1		°C	0.1 K
4. (*)Mixture MH, r mit LK	B-04	D r	-1		gk	0.1 g/kg
5. Abs. humidity AH, d_v	B-05	D dv	-1		gm	0.1 g/m³
6. Vapor pressure VP, e	B-06	D e	-1		mb	0.1 mb
7. Enthalpy En, h mit LK	B-07	D h	-1		kJ	0.1 kJ/kg
8. * Atm. pressure AP, p	B-08	D p	-1	300...1100.0	mb	0.1 mb
9. Atm. pressure comp. CP, p	B-09	D Cp	0		mb	1 mb

The range, the units (2 characters), and a designation are programmed automatically; this designation comprises the familiar abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the symbols more recently defined in VDI/VDE 3514

8.3 Technical data

Operative range	Temperature	5 to 98% RH
Measuring ranges	Temperature	-20 to +80 °C
	Accuracy	±0.3 K at +23°C ±5K
		±0.4K at 10...40°C
		±1.3K at -20...80°C
	Reproducibility	typical ±0.1 K
	Humidity	5.0..98.0%RH
	Accuracy	±1.8%rH at 23°C±5K, 20..90%rH
		±2.3%rH bei 23°C±5K, 10..<20%rH
	Hysterese:	typical ±1%RH
	Atm. pressure:	300..1100mbar
	Accuracy:	±2.5mbar (700..1100mbar)
		at 23°C±5K
	Calculated quantities	see 8.2.1
Atm. pressure compensation	300 to 16000 mbar (programmable)	
Refresh rate	2 seconds for all four channels	
Connector colors	2 colors, light gray and dark gray, red lever	
Baud rate Standard	115.2 kbaud	
Supply voltage	6 to 13 VDC	
Current consumption	5 mA	
Sleep mode on the device	possible (for extensions a 1-second wakeup delay is necessary)	

9. D6 temperature / humidity sensor FHAD46C7

Humidity sensor FHAD46C7 is much the same as type FHAD46C. (see chapter 7) However, it is specially designed for use in compressed air pipes up to 16 bar. In cases involving a pressure-dependent variable pressure compensation can be performed by specifying the appropriate atmospheric pressure up to 16 bar. (see Table 9.2.1 'with PC') This amount can also be displayed as a channel with range 'D Cp'.

9.1 Measuring quantities and ranges - factory default settings

Designation	Quantity		Exponent	Measuring range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-2	-20..+80.00	°C	0.01 K
2. Rel. humidity RH, U_w	B-02	DIGI	-1	5... 98.0	%H	0.1 % rH
3. Dewpoint DT, t_d	B-03	DIGI	-1		°C	0.1 K

Providing the appropriate ALMEMO® standard quantities 'H DT', 'H AH', 'H VP', 'H En' have been programmed accordingly, the D6 humidity ranges can be configured partly on the device itself. 'DIGI' will substitute these ranges automatically with the new ones.

Please note that in this process new ranges 'D dv' or 'D p' may be lost. They can then only be restored via the PC.

9.2 Configuration on a PC via the sensor menu

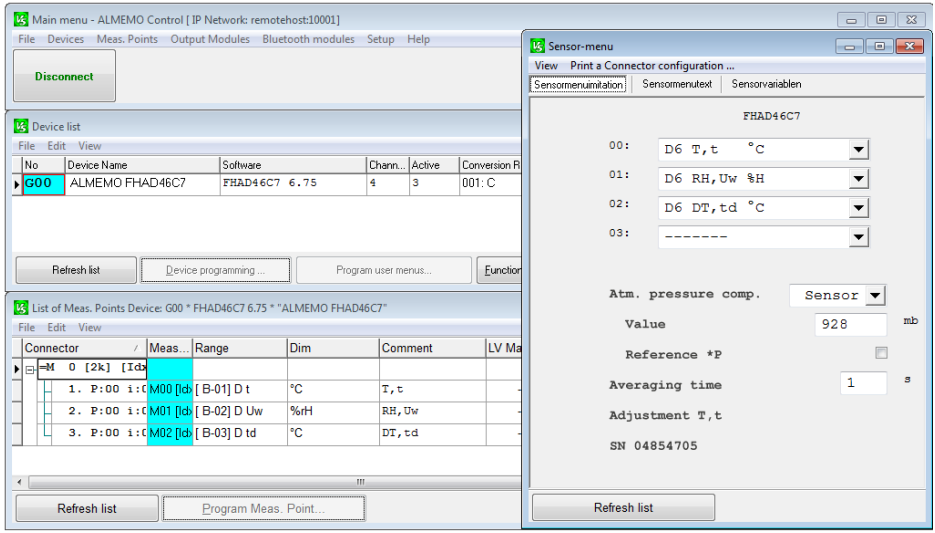


Figure 9-1 Sensor menu FH0D46-C7

9.2.1 Configurable measuring quantities and ranges

The quantities and ranges for the four measuring channels can be configured from a list of eight possible variants. (* factory default settings):

Designation	Quantity		Exponent	Measuring range	Units	Resolution
1. * Temperature T, t	B-01	D t	-2	-20..+80.00	°C	0.01 K
2. * Rel. humidity RH, U_w	B-02	D Uw	-1	5... 98.0	%H	0.1 % rH
3. * Dewpoint DT, t_d	B-03	D td	-1		°C	0.1 K
4. Mixture MH, r mit LK	B-04	D r	-1		gk	0.1 g/kg
5. Abs. humidity AH, d_v	B-05	D dv	-1		gm	0.1 g/m^3
6. Vapor pressure VP, e	B-06	D e	-1		mb	0.1 mb
7. Enthalpy En, h mit LK	B-07	D h	-1		kJ	0.1 kJ/kg
8. Atm. pressure AP, p	B-08	D p	-1	300...1100.0	mb	0.1 mb
9. Atm. pressure CP, p	B-09	D Cp	0		mb	1 mb

The quantity, range, units (2 characters), and a comments text are programmed automatically; these use the abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the symbols more recently defined in VDI/VDE 3514.

9.2.2 Technical data

Operative range	Temperature -20 to +80 °C, Humidity 5 to 98 % RH
Measuring quantities and ranges	Temperature -20 to +80 °C
	Accuracy 5 to +60 °C typical ±0.2 K
	5 to +60 °C maximum ±0.4K
	-20 to +80 °C, maximum 0.7 K
	Reproducibility typical ±0.1 K
	Humidity 5.0 to 98.0 % RH
	Accuracy 10 to 90 % RH maximum ±2.0 % RH at 23 °C ±5 K
	5 to 98 % RH maximum ±4 % RH at 23 °C ±5 K
	Hysteresis typical ±1 % RH
	Atmospheric pressure (sensor) 300 to 1100 mbar
	Accuracy ±2.5 mbar (700 to 1100 mbar) at 23 °C ±5 K
	Atmospheric pressure (manual) 300 to 16000 mbar
	Calculated quantities see 9.2.1
Atmospheric pressure compensation	0 to 16000 mbar (programmable)
Refresh rate	1 second for all four channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud
Supply voltage	6 to 13 VDC
Current consumption	3 mA
Sleep mode on the device	Possible (for extensions a 1-second delay is necessary)

The operating conditions are explained in 7.2.2, Figure 9-3.

10. D6 temperature / humidity sensor FHAD36R

The FHAD36R comprises a fully adjusted digital capacitive sensor which can be exchanged at any time without any loss in accuracy. For the purpose of automatic atmospheric pressure compensation an atmospheric pressure sensor is integrated as standard. The humidity quantities are calculated from the real measurable variables - temperature, relative humidity, atmospheric pressure - on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor ´fw(t,p)´ for real mixed gas systems). The measuring range and accuracy of this system are thus much greater than with earlier sensors. The measured atmospheric pressure can also be used in the ALMEMO® measuring instrument as reference atmospheric pressure. (see 3.3.1).

10.1 Measuring ranges preset at our factory

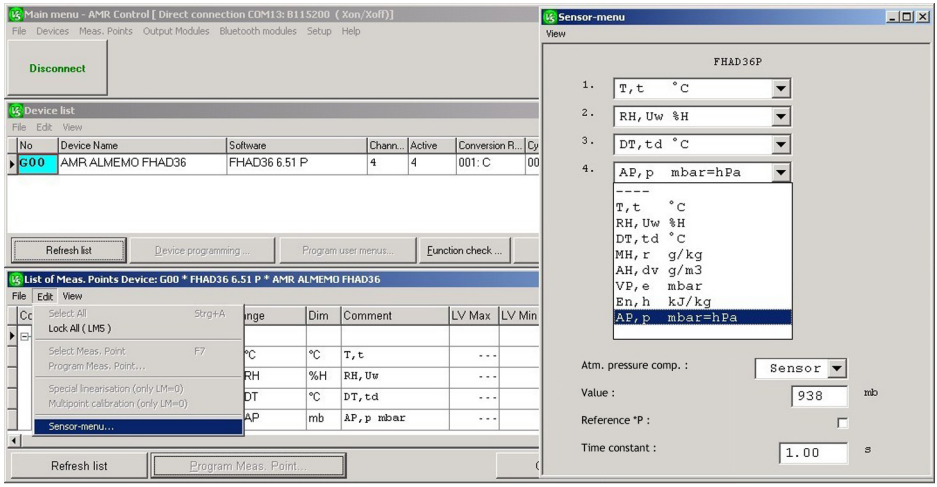
Description	Range		Exp.	Measuring range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-2	-100..+200.00[+]	°C	0.01 K
2. Rel. Humidity RH, U_w	B-02	DIGI	-1	0... 100.0	%H	0.1 % rH
3. Dew point DT, t_d	B-03	DIGI	-1	-64.8..+100.0	°C	0.1 K
4. Atm. pressure AP, p	B-08	DIGI	-1	300...1100.0	mb	0.1 mb

[+] The measuring range depends on the sensor type. (see data sheet)

The new D6 humidity ranges (see 7.2.1) can be partly configured on the device itself; for this purpose the appropriate ALMEMO® standard ranges ´H DT´, ´H AH´, H VP´, ´H En´ must have been programmed accordingly. ´DIGI´ will replace these ranges automatically with the new ones.

Please note that new ranges ´D dv´ or ´D p´ may be lost in this process. They can then only be restored via the PC.

10.2 Configuration on a PC via the sensor menu



10.2.1 Configurable measuring ranges

Initially the ranges for the four measuring channels can be configured from a list of eight ranges (* factory default settings).

Description	Range		Exp.	Measuring range	Units	Resolution
1. * Temperature T, t	B-01	D t	-2	-100..+200.00+	°C	0.01 K
2. * Rel. humidity RH, U_w	B-02	D Uw	-1	0... 100.0	%H	0.1 % rH
3. * Dew point DT, t_d	B-03	D td	-1	-64.8..+100.0	°C	0.1 K
4. * Atm. pressure AP, p	B-08	D p	-1	300...1100.0	mb	0.1 mbar
5. Mixture MH, r mit LK	B-04	D r	-1	0...6500.0	gk	0.1 g/kg
6. Abs. humidity AH, d_v	B-05	D dv	-1	0... 596.3	gm	0.1 g/m³
7. Vapor pressure VP, e	B-06	D e	-1	300...1100.0	mb	0.1 mbar
8. Enthalpy En, h mit LK	B-07	D h	-1	0...6500.0	kJ	0.1 kJ/kg

+ The measuring range depends on the sensor type. (see data sheet)

The range, the units (2 characters), and a designation are programmed automatically; this designation comprises the familiar abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the newer symbols defined in VDI/VDE 3514.

10.3 Technical data

Operative range	The temperature depends on the sensor type.
Measuring ranges	Temperature -100 to +200 °C* Accuracy ±0.2 K at 23 °C ±5 K Humidity 0 to 100 % RH Accuracy ±1.3 % RH at 23°C ±5 K Atmospheric pressure 300 to 1100 mbar Accuracy ±2.5 mbar (in range 700 to 1100 mbar) at 23°C±5K Calculated quantities see 8.2.1
Atm. pressure compensation	0 to 6500 mbar (programmable)
Refresh rate	1 second for all four channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 1200baud up to 921kbaud)
Supply voltage	6 to 13 VDC
Current consumption	approx. 12 mA
Sleep mode on the device	Possible (for extensions a 1s delay is necessary)

* Persistent use in the high-temperature range (>170 °C) may incur a loss in accuracy and / or damage to the measuring cell.

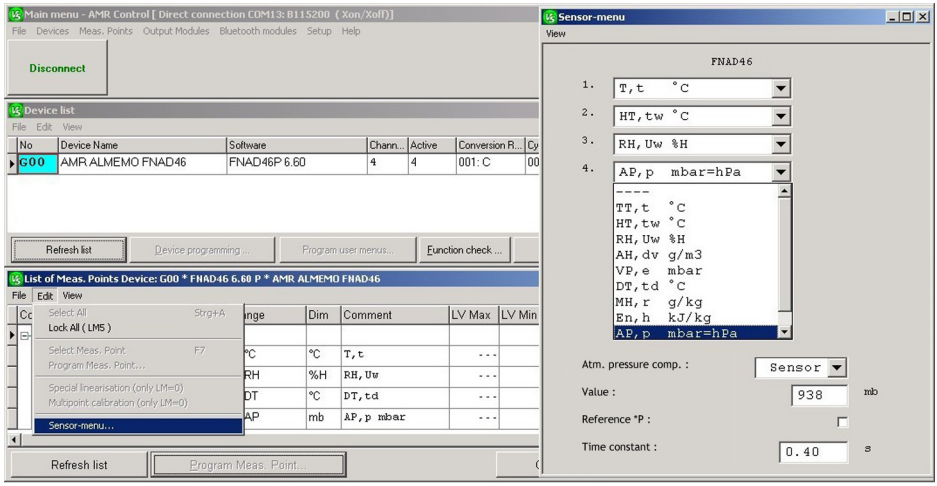
11. D6 Psychrometer FNAD46-3

Digital sensor FNAD46-3 uses high-precision NTC sensors with an accuracy level of 0.1 K; these can be exchanged without any loss in accuracy. Temperatures are acquired using an integrated 24-bit A/D converter. For the purpose of automatic atmospheric pressure compensation an atmospheric pressure sensor is integrated as standard. The humidity quantities are calculated from the primary channels, i.e. real measurable variables - dry temperature, humid temperature, atmospheric pressure - on the basis of formulae as per Dr. Sonntag and the enhancement factor as per W. Bögel (correction factor ´fw(t,p)´ for real mixed gas systems). The measuring range and accuracy of this system are thus much greater than with earlier sensors. The measured atmospheric pressure can also be used in the ALMEMO® measuring instrument as reference atmospheric pressure.

11.1 Measuring ranges preset at our factory

Description	Range		Exp	Meas. range	Units	Resolution
1. Dry temperature TT, t	B-01	DIGI	-2	0..+90.00	°C	0.01 K
2. Humid temperatur HT, t_w	B-09	DIGI	-2	0..+90.00	°C	0.01 K
3. Rel. humidity RH, U_w mit LK	B-02	DIGI	-1	10... 100.0	%H	0.1 % rH
4. Atm. pressure AP, p	B-08	DIGI	-1	300...1100.0	mb	0.1 mb

11.2 Configuration on a PC via the sensor menu



11.2.1 Configurable measuring ranges

Initially the ranges for the four measuring channels can be configured from a list of nine ranges (* factory default settings).

Description	Range		Exp	Meas. range	Units	Resolution
1. * Dry temperatur TT, t	B-01	D t	-2	0..+90.00	°C	0.01 K
2. * Humid temperatur HT, t_w	B-09	D tw	-2	0..+90.00	°C	0.01 K
3. * Rel. humidity RH, U_w mit LK	B-02	D Uw	-1	10... 100.0	%H	0.1 % rH
4. * Atm. pressure AP, p	B-08	D p	-1	300...1100.0	mb	0.1 mbar
5. Dew point DT, t_d mit LK	B-03	D td	-1	-64.8..+100.0	°C	0.1 K
6. Mixture MH, r mit LK	B-04	D r	-1	0...6500.0	gk	0.1 g/kg
7. Abs. humidity AH, d_v mit LK	B-05	D dv	-1	0... 596.3	gm	0.1 g/m³
8. Vapor pressure VP, e mit LK	B-06	D e	-1	300...1100.0	mb	0.1 mbar
9. Enthalpy En, h mit LK	B-07	D h	-1	0...6500.0	kJ	0.1 kJ/kg

The range, the units (2 characters), and a designation are programmed automatically; this designation comprises the familiar abbreviations listed in tables issued by the Deutscher Wetterdienst (German Meteorological Service) and the newer symbols defined in VDI/VDE 3514.

11.2.2 Configuration of the Steinhart-Hart coefficients

On page 2 of the sensor menu, the Steinhart-Hart coefficients A (coeff. A), B (coeff. B), C (coeff. C) and D (coeff. D) can be configured for connecting customer-specific NTCs. For this purpose, the channel interlock must be reduced to level 0. The following formula is the basis for the calculation.

$$\frac{1}{T} = A + BlnR + C(lnR)^2 + D(lnR)^3$$

Via the check mark **coefficient normalized R/R25** the formula can be calculated either with R, or with R/R25.

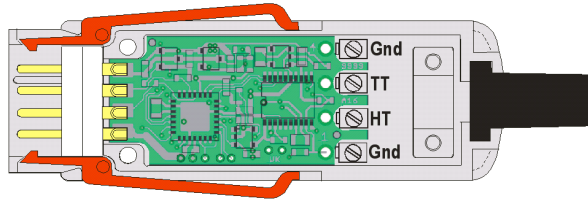
The **Reference R25** field is also used to enable the connection of NTCs with R25≠10 kOhm. However, this requires a new adjustment of the plug, which can only be carried out at the factory.

Individual range limits can be entered via the input fields **T Min and T Max**.

The **RESET** button cancels all settings and restores the factory Steinhart-Hart coefficients and range limits.

11.3 Sensor connection

With stationary psychrometer FNAD846-3 the two NTC sensors for dry temperature (TT) and humid temperature (HT) are clamped to the appropriate terminals ´TT-Gnd´ and ´HT-Gnd´.



With hand-held psychrometer FNAD846 the sensors are soldered to the plug circuitry and thus powered via the ALMEMO® device.

11.4 Technical data

Psychrometer

Operative range	10 to 100 % RH
Hand-held psychrometer:	up to 60 °C (no ice)
Psychrometer FNAD8463:	up to 90 °C (no ice)

For more technical data see the ALMEMO® Manual 3.3.3.2

Atmospheric pressure sensor

Measuring range	300 to 1100 mbar
Accuracy	±2.5 mbar (at 700 to 1100 mbar, at 23°C±5K)

D6 sensors

Inputs	Two NTC sensors
Measuring range TT and HT	0.00 to +90.00 °C
Accuracy	±0.05 K
Temperature drift	0.004 % / K
Calculated humidity quantities	Ranges as per the formulae with no additional error see 9.2.1
Atm: pressure compensation	0 to 6500 mbar (programmable)
Refresh rate	0.4 seconds for all four channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 9600 baud up to 921 kbaud)
Supply voltage	6 to 13 VDC
Current consumption	4 mA (with psychrometer 20 mA)

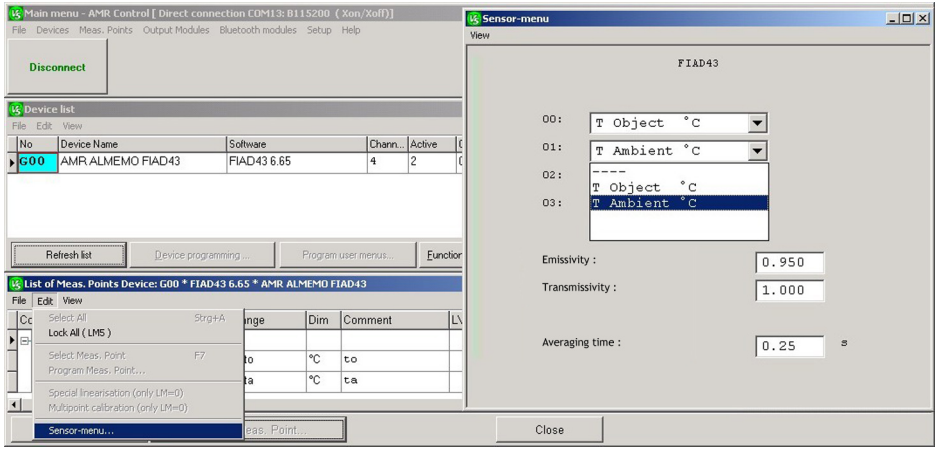
12. D6 infra-red temperature sensor FIAD43

Sensor FIAD43 comprises an adjusted digital infra-red sensor. All the electronics used for ambient temperature measurement and for temperature calculation is housed in the probe head; the sensor can thus handle ambient temperatures up to 120 °C without the need for cooling.

12.1 Measuring range preset at our factory

Description	Range	Exp	Meas. range	Units	Resolution
Object temperature to	B-01 DIGI	-1	-40.0...+600.0	°C	0.1 °C

12.2 Configuration on a PC via the sensor menu



12.2.1 Configurable measuring ranges

Initially the ranges for the measuring channels can be configured from a list (* factory default settings). The sensor's ambient temperature can be activated on the 2nd channel or a 2nd temperature channel can be used in order e.g. to display measured values in alternative units.

Description	Range	Exp	Meas. range	Units	Resolution
1. * Object temperature to	B-01 D to	-1	-40.0...+600.0	°C	0.1 °C
2. ~ Ambient temperature ta	B-02 D ta	-1	-10.0...+120.0	°C	0.1 °C

~ The range can also be activated via the ALMEMO® device itself.

12.2.2 Emissivity and transmittance

The emissivity of a measured object (see Manual, 3.1.5) is important in ensuring reliable measured results; this material-dependent variable (factory default 0.95) can be set either in the sensor menu or in the normal V6 sensor programming. If the latter method is used and an infra-red sensor is connected, ´gain correction´ will be replaced by ´emission´, so that emissivity can be programmed here in the normal way.
If a protective window is being used, these calculations may also have to take account of transmittance (factory default 1.00). However, this quantity can only be set in the sensor menu.

12.3 Technical data

Operative range	Probe head	-10 to +120 °C
Measuring ranges	Temperature	-40.0 to +600.0 °C
	Accuracy	±1 % of measured value or ±1 K
	Temperature coefficient	±0.5 K / K or ±0.05 % / K
Refresh rate	0.25 seconds for all channels	
Connector colors	2 colors, light gray and dark gray, red lever	
Standard baud rate	115.2 kbaud (freely selectable from 9600 baud up to 921 kbaud)	
Supply voltage	6 to 13 VDC	
Current consumption	4 mA	
Sleep mode on the device	Possible (for extensions a 1s delay is necessary)	

13. D6 NTC temperature sensor ZAD040FS / FS2

D6 NTC sensor connector ZAD040-FS/FS2 incorporates a dedicated 24-bit A/D converter; it can record the temperature of one or two high-precision NTC sensors (accurate to 0.1 K and with a resolution of 0.01 K or even 0.001 K). Linearization accuracy can be ignored because calculation is on a formula basis. Since the sensor does not depend on an evaluating unit for its overall accuracy, it can also undergo multi-point adjustment and independent calibration.

13.1 Measuring range preset at our factory

ZAD040-FS

Description	Range		Exp	Meas. range	Units	Resolution
1. Temperature T,t	B-01	DIGI	-2	-50..+125.00	°C	0.01 K

ZAD040-FS2

Description		Range		Exp	Meas. range	Units	Resolution
1. Temperature T, t (Ntc)	Kl. Ntc-Gnd	B-01	DNtc	-2	-50..+125.00	°C	0.01 K
2. Temperature T, t (Ntc2)	Kl. Ntc2-Gnd	B-02	DNt2	-2	-50..+125.00	°C	0.01 K

13.2 Configuration on a PC via the sensor menu

In addition to the first Ntc-range, a second one can be activated if required or a range with higher resolution can be selected. So that customer-specific NTCs can also be adapted, it is possible to enter customer-specific Steinhart-Hart coefficients and range limits.

13.2.1 Configurable measuring ranges

Description		Range		Exp	Meas. range	Units	Resolution
1. Temperature T, t (Ntc)	Kl. Ntc-Gnd	B-01	DNtc	-2	-50..+125.00	°C	0.01 K
2. Temperature T, t (Ntc2)	Kl. Ntc2-Gnd	B-02	DNt2	-2	-50..+125.00	°C	0.01 K
3. Temperature T, t (Ntc3)	Kl. Ntc-Gnd	B-03	DNt3	-3	-20..+65.000	°C	0.001 K

13.2.2 Configuration of the Steinhart-Hart coefficients

On page 2 of the sensor menu, the Steinhart-Hart coefficients A (coeff. A), B (coeff. B), C (coeff. C) and D (coeff. D) can be configured for connecting customer-specific NTCs. For this purpose, the channel interlock must be reduced to level 0. The following formula is the basis for the calculation.

$$\frac{1}{T} = A + BlnR + C(lnR)^2 + D(lnR)^3$$

Via the check mark **coefficient normalized R/R25** the formula can be calculated either with R, or with R/R25.

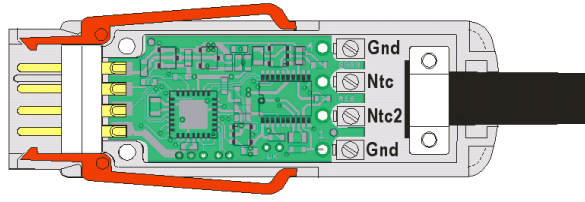
The **Reference R25** field is also used to enable the connection of NTCs with R25≠10 kOhm. However, this requires a new adjustment of the plug, which can only be carried out at the factory.

Individual range limits can be entered via the input fields **T Min and T Max**.

The **RESET** button cancels all settings and restores the factory Steinhart-Hart coefficients and range limits.

13.3 Sensor connection

The NTC sensors are clamped to the appropriate terminals NTC-Gnd and NTC2-Gnd.



13.4 Technical data

Operative range	Temperature depending on sensor type
Temperature sensor	NTC type N, Accuracy ±0.1 K at 0 to +70 °C
Measuring ranges	-50 to +125 °C, Accuracy ±0.05K at -50 to 100 °C -20.000 to 65.000 °C, Accuracy ±0.02K at -20 to 65 °C
Temperature drift	40ppm/K
Nominal temperature	23 °C ±2 K
Precision class	AA
Refresh rate	0.3 seconds for 2 channels
Connector colors	2 colors, light gray and dark gray, red lever
Baud rate Standard	115.2 kbaud (1200 baud to 921 kbaud, selectable)
Supply voltage	6 to 13 VDC
Current consumption	4 mA

14. D6 hot-wire thermoanemometer FVAD35

Hot-wire thermoanemometers are especially suitable for measuring low-level air flows even in cramped and restricted conditions. The primary measuring channels on this ALMEMO® D6 sensor are the real measurable variables - flow, temperature, atmospheric pressure. In the range 0 to +50 °C flow velocity is both temperature-compensated and, by means of a standard atmospheric pressure sensor integrated in the ALMEMO® plug, also pressure-compensated. The overall accuracy of this sensor is thus outstanding. The measured atmospheric pressure can also be used in the ALMEMO® measuring instrument as reference atmospheric pressure. (see 3.3.1).

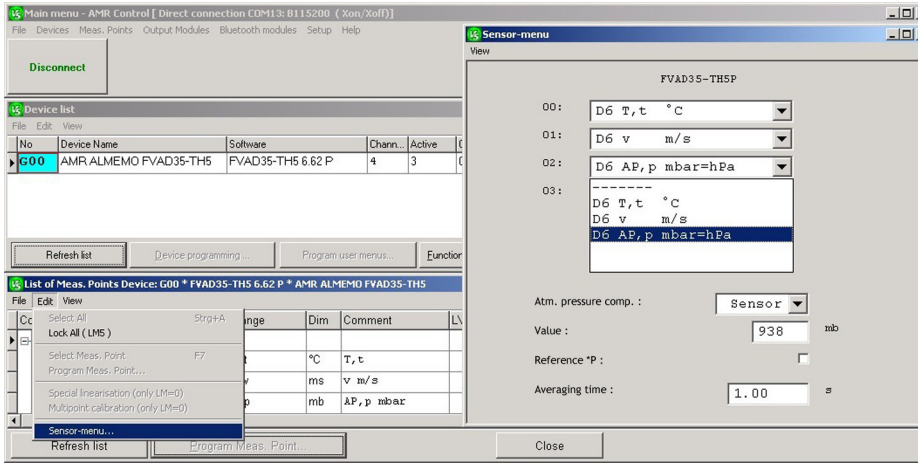
14.1 Measuring ranges preset at our factory

Description	Range		Exp	Meas. range	Units	Resolution
1. Temperature T, t	B-01	DIGI	-1	-20..+70.00	°C	0.1 K
2. Flow, v with PC (TH4)	B-02	DIGI	-3	0.08... 2.000+	m/s	0.001 m/s
2. Flow, v with PC (TH5)	B-02	DIGI	-2	0.2... 20.00+	m/s	0.01 m/s
3. Atm. pressure AP, p	B-03	DIGI	-1	300...1100.0	mbar	0.1 mbar

+ **Measuring range and resolution depend on sensor type.**

The flow velocity of hot-wire thermoanemometers is inversely proportionate to atmospheric pressure ($v = v_m * 1013/p_m$); i.e. a 10% deviation (912 mbar) from normal pressure (1013 mbar) already causes a measuring error of 10 percent. The ALMEMO® plug on such D6 sensors incorporates as standard therefore an atmospheric pressure sensor which always and automatically provides the flow with atmospheric pressure compensation (PC) - even if the channel is deactivated. (see 3.3.1).

14.2 Configuration on a PC via the sensor menu



14.2.1 Configurable measuring ranges

Description	Range		Exp	Meas. range	Units	Resolution
1. * Temperature T, t	B-01	D t	-1	-20..+70.00	°C	0.1 K
2. * Flow, v with PC (TH4)	B-02	D v	-3	0.08... 2.000+	m/s	0.001 m/s
2. * Flow, v with PC (TH5)	B-02	D v	-2	0.2... 20.00+	m/s	0.01 m/s
3. * Atm. pressure AP, p	B-03	D p	-1	300...1100.0	mbar	0.1 mbar

14.3 Technical data

Operative range	-20 to +70 °C
Flow	
FVAD35-TH4	
Measuring range	0.080 to 2 000 m/s
Accuracy	±(0.04 m/s +1% of meas. val.)
	±0.5% of meas. val. / °C (0.3 to 2m/s)
FVAD35-TH5	
Measuring range	0.20 to 20.00 m/s
Accuracy	±(0.2 m/s +2% of measured value)
	±0.3% of measured value / °C (0.3 to 20 m/s)
Response time	<1.5 seconds
Temperature compensation	0 to +50 °C
Temperature	
Measuring range	-20.0 to +70.0 °C
Accuracy	±0.7 °C at 0 to +50 °C
Response time	10 seconds
Atmospheric pressure	
Measuring range	300 to 1100 mbar
Accuracy	±2.5 mbar (in range 700 to 1100 mbar, at 23°C±5K)
Compensation range	0 to 6500.0 mbar (programmable)
Probe dimensions	Diameter 6 mm Flow aperture approx. 10 x 3 mm
Connector	
Connector colors	2 colors, light gray and dark gray, red lever
Refresh rate	0.5 seconds for all three channels
Standard baud rate	115.2 kbaud (freely selectable from 9600 baud up to 921 kbaud)
Power supply	
Supply voltage	6 to 13 VDC
Current consumption	40 mA

15. D6-Thermo anemometer FVAD05-TOKx

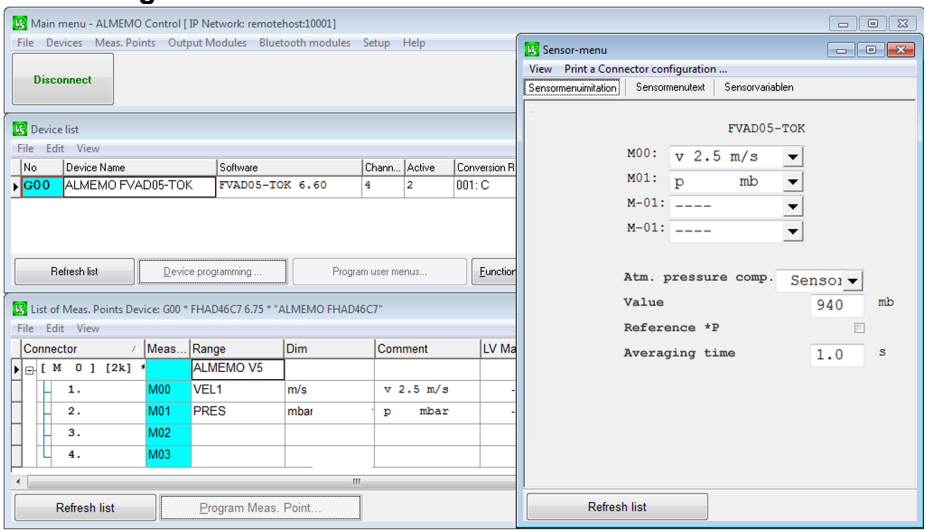
Thermo anemometers are especially qualified for recording low air flows also in restricted space conditions. The digital ALMEMO® D6 sensor features the primary measuring channels (real measurable variables) flow and atmospheric measurement. The flow velocity will be atmospheric pressure compensated via a standard atmospheric pressure sensor (integrated in the ALMEMO® plug). As a result, the overall accuracy of the measuring transducer is excellent. In addition, the measured atmospheric pressure can be used as a reference atmospheric pressure in the ALMEMO® measuring device.

15.1 Measuring ranges upon delivery

Designation	Range	Exp	Measuring range	Dim	Resolution
1. flow, v 2.5 m/s	B-01 DIGI	-3	0,050 to 2.500	m/s	0.001 m/s
2. atmospheric pressure AP, p	B-03 DIGI	-1	300 to 1100.0	mbar	0.1 mbar

The flow velocity of a thermo anemometer is inversely proportional to the atmospheric pressure ($v=v_m*1013/p_m$), which means that already 10 percent deviation (912 mbar) from the normal pressure result in a measurement error of 10 percent. Therefore the D6 sensors are equipped with an atmospheric pressure sensor integrated in the ALMEMO® plug as standard. This atmospheric pressure sensor automatically serves for atmospheric pressure compensation of the flow at all times even if the channel has been deactivated. Alternatively, the atmospheric pressure can be manually entered in the sensor menu and can be used as compensation pressure by switching from sensor to manual.

15.2 Configuration on the PC via the sensor menu



15.2.1 KConfigurable measuring ranges

Designation	Range		Exp	Measuring range	Dim	Resolution
1. *flow, v 2.5 m/s	B-01	DIGI	-3	0.050 to 2.500	m/s	0.001 m/s
2. flow, v 1.0 m/s	B-02	DIGI	-3	0.050 to 1.000	m/s	0.001 m/s
3. *atmospheric pressure AP, p	B-03	DIGI	-1	300 to 1100.0	mbar	0.1 mbar
4. voltage, Volt	B-04	DIGI	-3	0.000 to 10.000	V	0.001 V

In case the flow measuring range is changed in the ALMEMO® plug, the corresponding measuring ranges must also be changed in the sensor. For more information on this procedure, please check the enclosed sensor documentation.

15.3 Technical data

Flow:

Measuring range:	see under 15.2.1
Resolution:	0.001 m/s
Accuracy:	± (3% of measured value + 1% of final value + 2 digits)
Nominal temperature:	23 °C +/- 2 K
Response time t63:	5 s

Atmospheric pressure:

Measuring range:	300 to 1100 mbar
Accuracy:	± 2.5 mbar (in the range of 700 to 1100 mbar) at 23°C±5K
Compensation range:	automatically in the range of 700 to 1100 mbar
Plug colors:	2 colors. light and dark grey, red levers
Refresh rate:	0.1 seconds. For both channels
Averaging time:	0.1 to 10.0 s (default value: 1.0 s)
Baud rate standard:	115.2 kBd (9600 Bd to 921 kBd selectable)
Supply voltage:	6 to 13 VDC
Current consumption:	8 mA

For further technical data, refer to the data sheet.

16. D6 rotating vanes

D6 sensor FVAD15 has an integrated amplifier and can operate with various rotating vanes; it can record the frequency of the rotating vane to a resolution of 0.01 Hz. If a further rotating vane is connected via the adapter cable, the appropriate range must be programmed on the PC. (see below) In addition to the D6 velocity ranges 4 frequency ranges can also be programmed.

The operating radius of these sensors when connected to a measuring instrument can be extended by means of universal extension cables ZA9090-VKCxx; measured values and connector programming can then be transmitted interference-free in serial form via RS485 driver. To operate in sleep mode a 1-second wakeup delay is required.

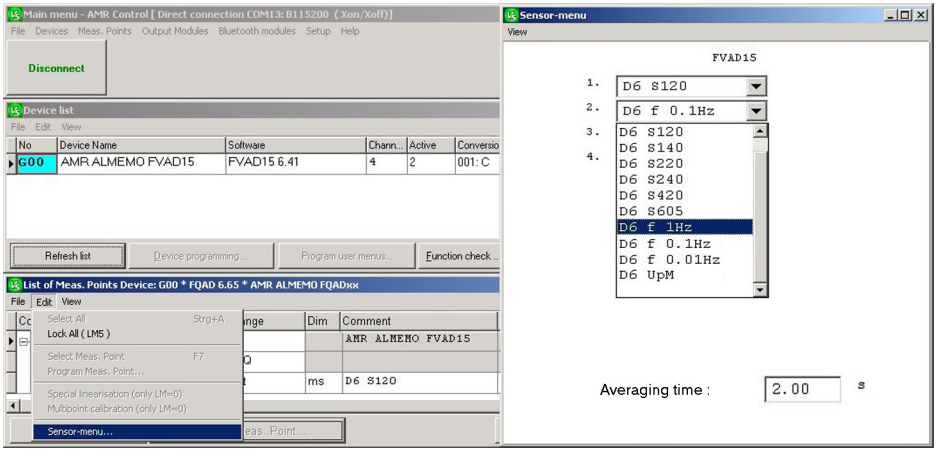
16.1 Measuring ranges preset at our factory

Description	Range	Exp	Meas. range	Units	Resolution
1. example D6 S120, v	B-01 DIGI	-2	0..+20.00	m/s	0.01 m/s

On the measuring instrument via menu item 'Sensor programming' it is also possible to configure the following function channels : Batt, Mess, Alrm, Diff, Max, Min, M(t), n(t), M(n), Flow, Time

However, when connected directly to the PC, these cannot be used. The advisory note ´! unusable´ will be displayed.

16.2 Configuration on a PC via the sensor menu



Initially, depending on the rotating vane type, only 1 measuring range is programmed (* factory default settings). However, if so required, this range can be changed and additional ranges for frequency and rpm can also be configured on the 4 measuring channels.

16.2.1 Measuring ranges

Description	Range	Cut	Exp	Type	Meas. range	Units
1. * D6 S120, v	B-01	D120	-2	FVAD15-S120	20.00	m/s
2. * D6 S140, v	B-02	D140	-2	FVAD15-S140	40.00	m/s
3. * D6 S220, v	B-03	D220	-2	FVAD15-S220	20.00	m/s
4. * D6 S240, v	B-04	D240	-2	FVAD15-S240	40.00	m/s
5. * D6 L420, v	B-05	D420	-2	FVAD15-MA1	20.00	m/s
6. * D6 L605, v	B-06	D605	-2	FVAD15-WM1	5.00	m/s
7. D6 f 1Hz	B-07	D f0	0		65000	Hz
8. D6 f 0.1Hz	B-08	D f1	-1		6500.0	Hz
9. D6 f0.01Hz	B-09	D f2	-2		650.00	Hz
10. D6 rpm	B-10	Drpm	0		65000	rm

However, the measuring range cannot be reprogrammed if it has been corrected using calibration values or multi-point adjustment.

16.3 Technical data

Type	Accuracy	Meas. range	Resolution
FVAD15-S120	±1% of final value ±1.5% of measured value	0.4...+20.00 m/s	0.01 m/s
FVAD15-S140	±1% of final value ±1.5% of measured value	0.5...+40.00 m/s	0.01 m/s
FVAD15-S220	±1% of final value ±3% of measured value	0.6...+20.00 m/s	0.01 m/s
FVAD15-S240	±1% of final value ±3% of measured value	0.7...+40.00 m/s	0.01 m/s
FVAD15-MA1	±0.5% of final value ±1.5% of measured value	0.2...+20.00 m/s	0.01 m/s
FVAD15-SMA1	±1% of final value ±1.5% of measured value	0.2...+20.00 m/s	0.01 m/s
FVAD15-WM1	±2% of final value ±3.5% of measured value	0.04...+5.00 m/s	0.01 m/s

Operative range	-20 to +140 °C
Refresh rate	0.5 seconds for all four channels
Averaging period	2 seconds
Connector colors	2 colors, light gray and dark gray, red lever
Baud rate Standard	115.2 kbaud (1200 baud to 921 kbaud, selectable)
Supply voltage	6 to 13 VDC
Current consumption	4.5 mA
Sleep mode on the device	possible (for extensions a 1-second wakeup delay is necessary)

17. D6 rotating vanes FVAD15H

The ALMEMO® D6 sensor FVAD 15-H serves for measuring unidirectional and bidirectional flow velocities in gases and liquids. You can either select the medium and enter the density via the sensor menu on the V7 device or directly on the PC by means of the adapter cable ZA 1919 AKUV.

The design is extremely compact and is particularly suitable for mobile measurements in air-conditioning and ventilation applications. The probe head has an aero-dynamically optimized shape and protected bearings.

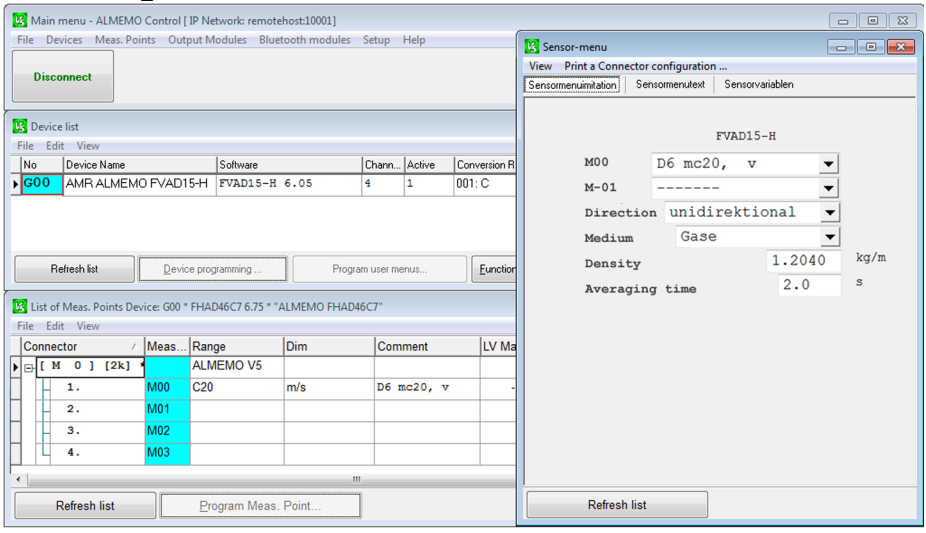
The high-resolution acquisition of the frequency signal and the directional detection of the flow take place in the ALMEMO® D6 plug. When leaving our factory, the ALMEMO® plug is preprogrammed with one measuring channel (flow in m/s). In addition, further measuring channels are available and can be selected via the sensor menu.

17.1 Measuring ranges upon delivery

The measuring range for the flow velocity will be configured in accordance with the connected rotating vane (probe heads: mc/mn/md with the ranges 20/40/80/120 m/s).

Designation	Range		Exp	Measuring range	Dim	Resolution
1. * D6 mc20, v	B-01	DIGI	-2	0.00 to 22.50	m/s	0.01 m/s

17.2 Configuration on the PC via the sensor menu



Depending on the type of rotating vane, initially only 1 measuring range is programmed (* factory default setting). If needed, this range can be changed, and on the 4 measuring channels additional ranges such as frequency or revolutions per minute can be configured (see table below).

Direction:	Unidirectional* or bidirectional
Medium:	Gases* or liquids
Density:	0.0500 to 6.5000 kg/m^3 Default value: 1.2040 kg/m^3(air at 20 °C and sea level height).
	Notice: The density correction only works for gases. If liquids is set as a medium, the line "density" will be hidden in the sensor menu.
Averaging time:	2.0 to 100.0 s (default value: 2.0 s)

17.2.1 Configurable measuring ranges

Designation	Range		Exp	Measuring ranges	Dim	Resolution
1**.** * D6 mc20, v	B-01	DIGI	-2	0.00 to 22.50	m/s	0.01 m/s
2. D6 mc40, v	B-02	DIGI	-2	0.00 to 45.00	m/s	0.01 m/s
3. D6 mc80, v	B-03	DIGI	-2	0.00 to 90.00	m/s	0.01 m/s
4. D6 mc120, v	B-04	DIGI	-2	0.00 to 135.00	m/s	0.01 m/s
5. D6 mn20, v	B-05	DIGI	-2	0.00 to 22.50	m/s	0.01 m/s
6. D6 mn40, v	B-06	DIGI	-2	0.00 to 45.00	m/s	0.01 m/s
7. D6 mn80, v	B-07	DIGI	-2	0.00 to 90.00	m/s	0.01 m/s
8. D6 mn120, v	B-08	DIGI	-2	0.00 to 135.00	m/s	0.01 m/s
9. D6 md20, v	B-09	DIGI	-2	0.00 to 22.50	m/s	0.01 m/s
10. D6 md40, v	B-10	DIGI	-2	0.00 to 45.00	m/s	0.01 m/s
11. D6 md80, v	B-11	DIGI	-2	0.00 to 90.00	m/s	0.01 m/s
12. D6 md120, v	B-12	DIGI	-2	0.00 to 135.00	m/s	0.01 m/s
13. D6 f 1Hz	B-13	DIGI	0	0 to 65000	Hz	1 Hz
14. D6 f 0.1 Hz	B-14	DIGI	-1	0.0 to 6500.0	Hz	0.1 Hz
15. D6 f 0.01 Hz	B-15	DIGI	-2	0.00 to 650.00	Hz	0.01 Hz
16. D6 rpm	B-16	DIGI	0	8 to 65000	rpm	1 rpm

17.3 Technical data

Max. resolution:	0.01 m/s
Refresh rate:	0.5 sec. for all 4 channels
Averaging time:	2 sec. (configurable from 2 to 100 sec. via the sensor menu)
Frequency measurement	0 to 3000.0 Hz, resolution: 0.01Hz
Nominal temperature	23 °C +/- 2 K
measuring ranges	see under 17.2.1
Plug colors:	2colors: light and dark grey, red levers
Baud rate standard:	115.2 kBd (1200Bd to 921kBd selectable)
Supply voltage:	6 to 13 V DC
Current consumption:	8 mA
Sleep mode of the device:	possible (in case an extension cable is used, a 1 second delay is necessary)

For further technical data, refer to the data sheet.

18. D6 heat flow sensor FQAD00

D6 heat flow sensor FQAD00 incorporates its own 24-bit A/D converter; it measures the output voltage of the heat flow plate and the temperature on a high-precision NTC sensor (accurate to 0.1 K). This temperature is used to actively compensate the temperature of the heat flow plate. The temperature coefficient and the adjustment factor for the heat flow density can be programmed in the sensor menu.

18.1 Measuring ranges preset at our factory

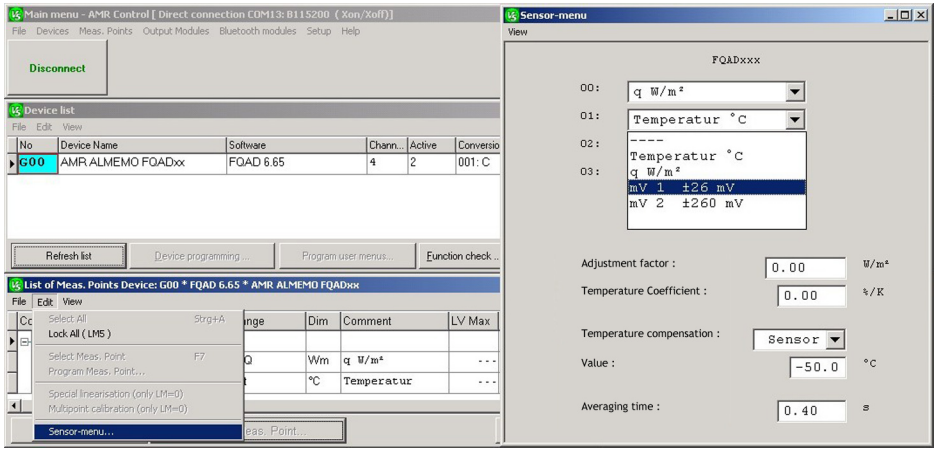
Description	Range		Exp	Meas. range	Units	Resolution
1. Heat flow φ_q	B-02	DIGI	-1	-2000.0..+2000.0	Wm	0.1 W/m²
2. ~ Temperature T, t	B-01	DIGI	-2	-40..+80.00	°C	0.01 K

~ The range can also be activated via the ALMEMO® device itself.

If the user prefers that a particular measuring range should not be displayed it can be switched off, deactivated, and reactivated in the usual way via the ALMEMO® device.

18.2 Configuration on a PC via the sensor menu

Initially the ranges for the four measuring channels can be configured from a list of four ranges (* factory default settings).



18.2.1 Configurable measuring ranges

Description	Range		Exp	Meas. range	Units	Resolution
1. * Temperature T, t	B-01	D t	-2	-40..+80.00	°C	0.01 K
2. * Heat flow φ_q	B-02	D Q	-1	-2000.0..+2000.0	Wm	0.1 W/m²
3. Voltage U 26mV	B-03	D U1	-3	-26..+26.000	mV	0.001 mV
4. Voltage U 260mV	B-04	D U2	-2	-260..+260.00	mV	0.01 mV

18.2.2 Heat flow coefficient

To measure heat flow density either one of two voltage measuring ranges can be used, 0 to 26 mV and 0 to 260 mV. To scale the voltage when measuring heat flow density the heat flow coefficient must have been programmed in the sensor menu as ´Adjustment factor´ . This can be found in the sensor protocol provided by the heat flow plate

manufacturer. As part of the complete package with measuring module and heat flow plate this factor is already programmed on leaving our factory. The system selects the appropriate voltage measuring range automatically on the basis of the heat flow coefficient.

18.2.3 Temperature measurement and compensation

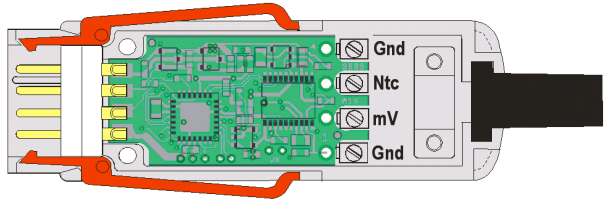
The heat flow coefficient is also affected by temperature. Sensors incorporate therefore a temperature sensor as standard. The temperature coefficient for Ahlborn heat flow plates is as follows :

Silicone plates	-0.17 % / K
Plastic plates	-0.12 % / K

This coefficient will be pre-entered automatically in the sensor menu but can be modified at any time. The nominal temperature is 23 °C.
If the heat flow plate does not incorporate its own temperature sensor, the plate temperature can also be entered manually in the sensor menu.

18.3 Sensor connection

The two sensors for heat flow (mV) and temperature (NTC) are clamped to the appropriate terminals ´mV-Gnd´ and ´NTC-Gnd´.



18.4 Technical data

Operative range	The temperature depends on the sensor type.
Heat flow sensor	Accuracy of the calibration value 5% at +23 °C
Temperature sensor	NTC type N, Accuracy ±0.5 K at 0 to +80 °C
Measuring ranges	Temperature -50 to +125 °C Accuracy ±0.05 K at 50 to 100 °C Heat flow 0 to 26.000 mV or 0 to 260.00 mV Calculated quantities see 12.2.1
Precision class A/D converter	AA System accuracy ±0.02% ± 2 digits TC 0.003 % / °C
Refresh rate	0.4 seconds for all four channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 1200baud up to 921kbaud)
Supply voltage	6 to 13 VDC, Current consumption 4 mA

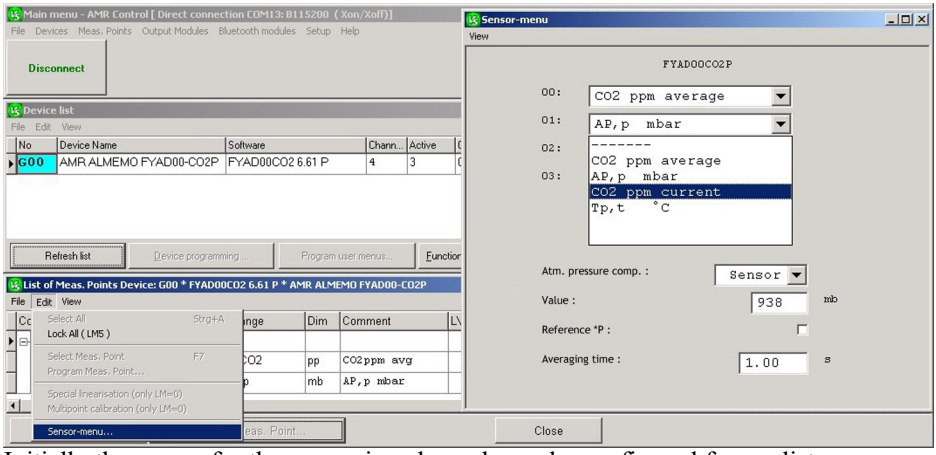
19. D6 CO_2 sensor FYAD00-CO2

Sensor FYAD00-CO2 measures CO_2 concentrations from 0 to 10000 ppm; it uses a 2-beam infra-red cell. Measured CO_2 values are affected by atmospheric pressure; an integrated atmospheric pressure sensor performs the necessary compensation. A delay of 180 seconds is required after sleep mode before a reliable average value can be obtained.

19.1 Measuring ranges preset at our factory

Description	Range		Exp	Meas. range	Units	Resolution
1. CO_2-concentration with PC	B-01	DIGI	0	0..+10000.	pp	1 ppm
2. Atm. pressure	B-02	DIGI	-1	300.0..1100.0	mb	0.1 mb

19.2 Configuration on a PC via the sensor menu



Initially the ranges for the measuring channels can be configured from a list (* factory default settings).

19.2.1 Configurable measuring ranges

Description	Range		Exp	Meas. range	Units	Resolution
1. * CO_2 ppm avg	B-01	DCO2	0	0...10000.	pp	1 ppm
2. * Atm. pressure AP,p	B-02	D p	-1	300...1100.0	mb	0.1 mb
3. ~ CO_2 ppm	B-03	dCO2	0	0...10000.	pp	1 ppm
4. ~ Temperature Tp,t	B-04	D t	-1	-40.0... +60.0	°C	0.1K

~ The range can also be activated via the ALMEMO® device itself.

The standard CO_2 range ´DCO2´ is averaged over 11 measured values for the primary value (range ´CCO2´, measuring time 15 seconds) (total measuring time 165 seconds).

19.3 Technical data

Measuring ranges	CO_2 0 to 10000 ppm Accuracy < ± (100 ppm +5% of measured value) Atmospheric pressure 300 to 1100 mbar Accuracy ±2.5 mbar (700 to 1100 mbar, at 23°C±5K)
Atm. pressure compensation	0 to 6500 mbar (programmable)
Current measuring time (dCO2)	15 seconds
Total measuring time for averaging over 11 values (DCO2)	165 seconds
Refresh rate	1 second for all channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 1200 baud up to 921 kbaud)
Supply voltage	6 to 13 VDC
Current consumption	17 mA

20. D6 high-precision pressure transducer FDAD33/35

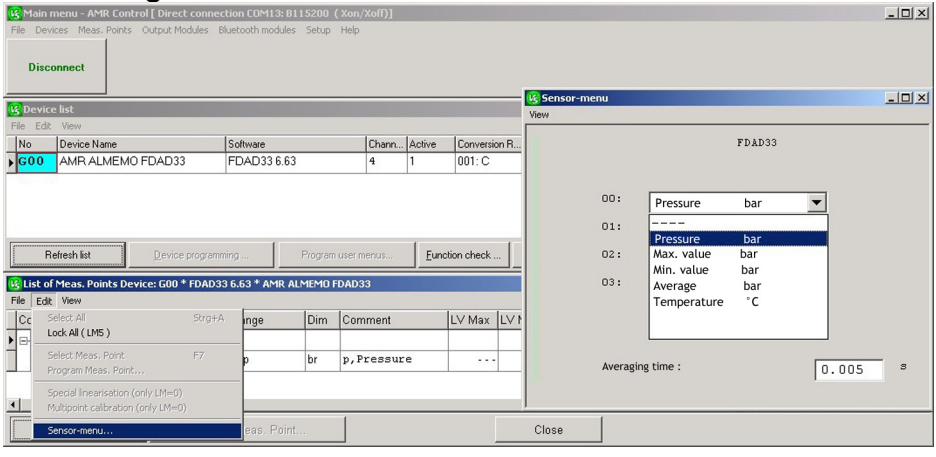
Digital piezo-resistive D6 high-precision pressure transducers FDAD33/35 combine great speed with high resolution. Temperature-dependence and non-linearity are eliminated by means of mathematical compensation; this ensures a high level of accuracy.

20.1 Measuring ranges preset at our factory

Description	Range		Exp	Meas. range	Units	Resolution
Pressure, p, Pressure	B-01	DIGI	-3	0..+1.000[+]	br	0.001 br

[+] The measuring range and resolution depend on the sensor type. (see data sheet)

20.2 Configuration on a PC via the sensor menu



Initially the ranges for the measuring channels can be configured from a list (* factory default settings).

20.2.1 Configurable measuring ranges

Description	Range		Exp	Meas. range	Units	Resolution
1. * Pressure	B-01	D p	[+]	[+]	br	[+] br
2. ~ Max. value	B-02	DMax	[+]	[+]	br	[+] br
3. ~ Min. value	B-03	DMin	[+]	[+]	br	[+] br
4. Average	B-04	DAvg	[+]	[+]	br	[+] br
5. Temperature	B-05	D t	-2		°C	0.01

[+] The measuring range and resolution depend on the sensor type. (see data sheet)

[~] The range can also be activated via the ALMEMO® device itself.

20.2.2 Measuring functions

To fully exploit the sensor's higher operating speed measuring functions ´Maximum value´, ´Minimum value´, and ´Average value´ are available. These values are acquired at 200 mops (measuring operations per second); they are formed and output in all measured value scans (continuous or cyclic) in synchrony with the scan of the 1st sensor channel (normally measured pressure).

20.3 Technical data

Measuring ranges	Pressure depending on type (see data sheet) Resolution 0.002 % full-scale (FS) Accuracy ±0.05 % full-scale (FS) (+10 to +40 °C), ±0.1 % full-scale (FS) (-10 to +80 °C) Temperature -40 to +120 °C Resolution 0.01 K
Sensor's measuring rate	200 mops (measuring operations per second)
Setting time	0.6 seconds
Delay after sleep mode	1 second
Refresh rate	0.005 seconds for all channels
Connector colors	2 colors, light gray and dark gray, red lever
Standard baud rate	115.2 kbaud (freely selectable from 1200 baud up to 921 kbaud)
Supply voltage	6 to 13 VDC
Current consumption	approx. 11 mA

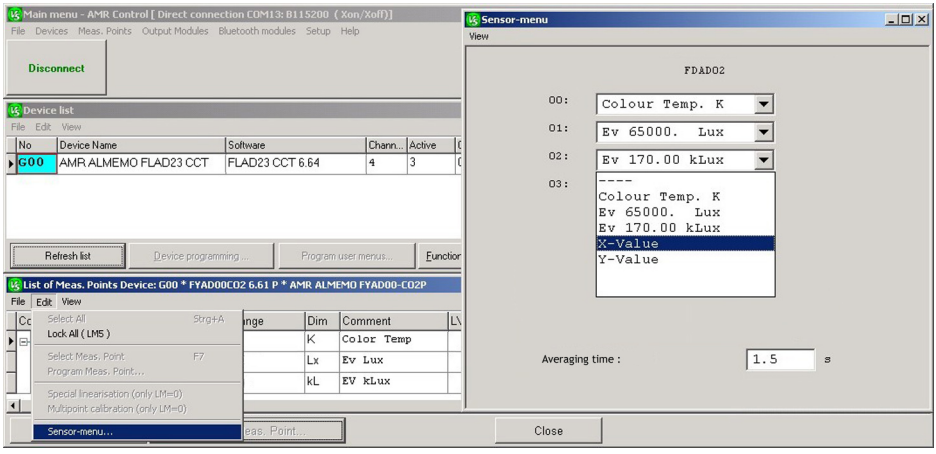
21. D6 color temperature sensor FLAD23CCT

D6 color temperature sensor FLAD23CCT incorporates a TrueColor transducer which delivers measured values RGB in digital form for the primary colors - red, green, blue. The 3 color sensors are adapted to the standard spectral curves as per CIE and DIN. On the basis of these values the color point is calculated in terms of coordinates X and Y within the RGB color space. The closest color temperature, i.e. the correlated color temperature (CCT) can then be read out from a table in degrees Kelvin. On a further sensor channel the illuminance can be obtained in lux (lx) or kilolux (klx).

21.1 Measuring ranges preset at our factory

Description	Range	Exp	Meas. range	Units	Resolution
1. Color temperature	B-01 DIGI	0	0..30000	K	1 K
2. Illuminance	B-02 DIGI	0	0..65000	Lx	1 Lux

21.2 Configuration on a PC via the sensor menu



The ranges for the measuring channels can be configured from a list of ranges (* factory default settings).

21.3 Configurable measuring ranges

Description	Range	Exp	Meas. range	Units	Resolution
1.*Color temperature	B-01 DCCT	0	0...30000.	K	1 K
2.*Illuminance	B-02 kEv0	0	0...65000.	Lx	1 Lux
3. Illuminance	B-03 kEv2	-2	0...170.00	kL	0.01 kLux
4. X-value	B-04 D X	-4	0...1.0000	X	0.0001
5. Y-value	B-05 D Y	-4	0...1.0000	Y	0.0001

21.4 Technical data

Spectral sensitivity	380 to 720 nm	
Sensor system	TrueColor (MAZeT®), 3 sensors on 1 chip	
Amplifier IC	8 stages with automatic adjustment	
Meas.range V lambda	MB1	0 to 65000 lx (factory setting)
	MB2	0.00 to 170.00 klx
Accuracy	< 10% (in range 120 to 170000 lx)	
Measuring range CCT	54 to 30000 K	(at 120 to 170000 lx)
Accuracy	< 10% (in range 1600 to 17000 K)	
Coordinates resolution	< 0.005	
Cosine correction	8 mm diffuser disc	
Cosine error	< 3%	
Measuring time	< 3 seconds	
Refresh rate	1.5 seconds for all channels	
Setting time	3 seconds	
Wakeup delay after sleep mode	3 seconds	
Operating temperature	-10 to +40 °C	
Standard conditions	+23 °C ± 3 K, 0 to 90 % RH (non-condensing)	
Sensor dimensions	140 x 25 mm	
Connector colors	2 colors, light gray and dark gray, red lever	
Baud rate Standard	115.2 kbaud (1200 baud to 921 kbaud, selectable)	
Supply voltage	6 to 13 VDC	
Current consumption	approx. 4 mA	

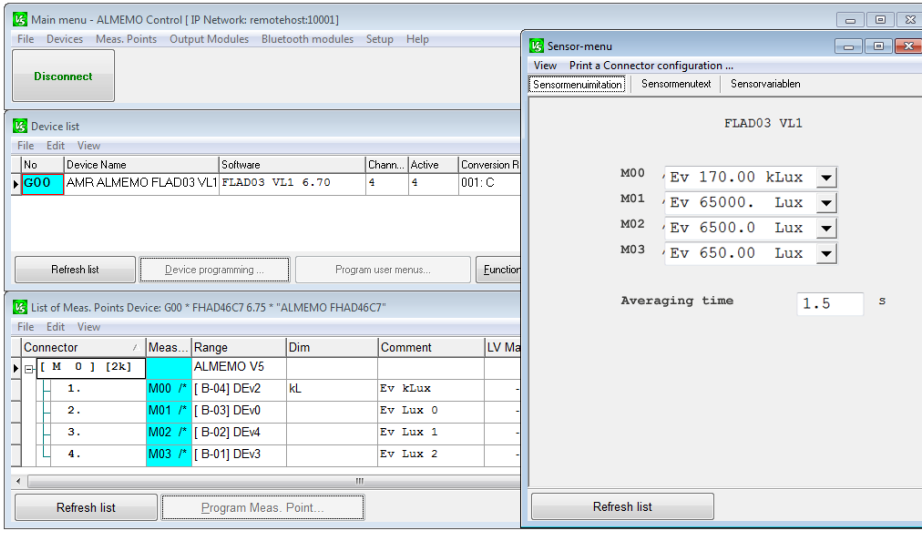
22. D6 V-lambda-radiation sensor FLAD03VL1

The D6 V-lamda radiation sensor FLAD03VL1 serves to measure the spectral range of the visible light. The wavelength range extends from the end of the UV spectrum at 400 nm to the beginning of the IR range at 720 nm with a maximum at 555 nm. The spectral sensitivity of the receiver is extremely well adapted to the sensitivity of the human eye and complies with the device class B as per DIN 5032. The determined illuminance in "LUX" can directly be converted into the irradiance "W/ m²". The ALMEMO® D6 sensor features 4 sensor channels: one for the kilolux range and three other channels with various resolutions for the lux range.

22.1 Measuring ranges upon delivery

Designation	Range		Exp	Measuring range	Dim	Resolution
1. Ev kLux	B-01	DIGI	-2	0 to 200,00	kL	0,01 kLux
2. Ev Lux 0	B-02	DIGI	0	0 to 65000	Lx	1 Lux
3. Ev Lux 1	B-03	DIGI	-1	0 to 6500,0	Lx	0,1 Lux
4. Ev Lux 2	B-04	DIGI	-2	0 to 650,00	Lx	0,01 Lux

22.2 Configuration on the PC via the sensor menu



The measuring ranges of the measuring channels can be configured according to a list of ranges (*factory default settings):

22.2.1 Configurable Measuring ranges

Designation	Range		Exp	Measuring range	Dim	Resolution
1. *Ev kLux	B-01	DIGI	-2	0 to 200,00	kL	0,01 kLux
2. *Ev Lux 0	B-02	DIGI	0	0 to 65000	Lx	1 Lux
3. *Ev Lux 1	B-03	DIGI	-1	0 to 6500,0	Lx	0,1 Lux
4. *Ev Lux 2	B-04	DIGI	-2	0 to 650,00	Lx	0,01 Lux

22.3 Technical data

Spectral sensitivity:	380 nm to 720 nm
Maximum spectral sensitivity	555 nm
Sensor system:	Si / interf. filter
Amplifier IC:	8 levels with automatic adaption
Measuring range V-lambda:	0.02 lx to 200.00 kl MB1: 0.00 to 200.00 kl MB2: 0 to 65000 lx MB3: 0.0 to 6500.0 lx MB4: 0.00 to 650.00 lx
Accuracy:	< 5% absolute
Cos-correction:	error f2 < 2.0 %
V-lambda adaption:	< 3 %
Linearity:	< 1 %
Switch-on time:	< 1 s
Switch-off time:	< 1 s
Diffuser:	PTFE
Weight:	approx. 50g
Measuring time:	< 3 s
Refresh rate:	1.5 sec. for all channels
Setting time:	3 s
Wakeup delay:	3 s
Operating temperature:	-20 °C to +60 °C
Nominal conditions:	23 °C ± 3K 0 to 90% RH (non-condensing)
Sensor dimensions:	33 mm x 28 mm
Plug colors:	2 colors: light and dark grey, red levers
Baud rate standard:	115.2 kBd (1200Bd to 921kBd selectable)
Supply voltage:	6 to13 VDC
Current consumption:	approx. 4 mA

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