

### 3. ALMEMO®- Sensors

On ALMEMO® measuring instruments, with some 65 measuring ranges, it is now possible to directly connect an even greater number of sensors / transducers and to read out the exact measured values with immediate effect - without having first to make appropriate settings on the device. All standard sensors with an ALMEMO® connector usually have the measuring range, units, and any necessary scaling already programmed. The associated measuring channels are activated automatically and then appropriately set by the sensor. A mechanical coding system ensures that sensors and output modules can only be connected to the correct sockets and in the correct positions. The following Sections describe in further detail how to use such sensors and how to connect your own sensors.

#### 3.0 General

With analog sensors the electrical signal is acquired and evaluated according to the measuring range in the device itself. There are also digital sensors; these are mostly for digital signals and are assigned the measuring range "DIGI". These have their own microcontroller incorporated in the connector; this edits the measured values and sends the results to the measuring instrument in digital form via the I2C bus. A sensor in the new digital ALMEMO® D series has two interfaces and can thus also be operated independently as a stand-alone device in its own right; (see Section 3.0.1).

All ALMEMO® sensors are adjustable; i.e. a sensor's correction values can be permanently stored in the connector itself; (see Section 6.3.10). If your connector has an enlarged EEPROM (E4), multi-point correction is also possible; (see Section 6.3.13). With DKD and factory calibrations such deviations can be stored in the connector as correction values with immediate effect; (DKD = Deutscher Kalibrier-Dienst = German calibration service).

##### 3.0.1 Digital ALMEMO® D6 sensors

The new digital ALMEMO® D6 modules incorporate not only an I2C interface integrated in the plug but also a 2nd serial interface. The D series can thus not only be connected to any ALMEMO® device and operate as a sensor but also, with its own address and standard ALMEMO® protocol, be scanned and networked as a stand-alone device in its own right. Nearly all ALMEMO® sensor functions are supported; internal ranges can be freely configured. For the primary measuring channels themselves an adjustment function and internal smoothing with programmable time constant are provided - but, unlike V6 devices, these do not necessarily have to be programmed as measuring channels. The measured values can, however, still be accessed by function channels. Sensors whose variables depend on atmospheric pressure may - as an option - incorporate their own atmospheric pressure sensor, thus permitting automatic pressure compensation. Atmospheric pressure can be configured in the usual way as a measuring channel with a reference function; this measured value can then be used in the measuring instrument to compensate other sensors too. (see 6.3.6)

## Uses

### 1 Normal digital sensor - on any ALMEMO® device

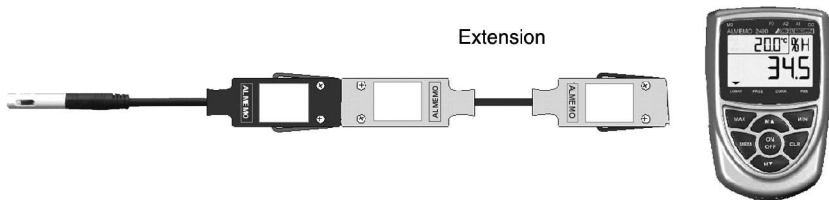
The sensor, using measuring range 'DIGI', supplies digital raw values, which can then be processed in the device itself as usual according to sensor data stored in the EEPROM. The sensor is powered via the measuring instrument.



3

### 2 Extension

The operating radius of these sensors when connected to a measuring instrument can be extended by means of universal extension cables ZA9090-VK-Cxx; data can then be transmitted interference-free in serial form via an RS485 driver. Raw values from the sensor can also be transmitted to the measuring instrument and processed there according to the stored sensor data.



### 3 Direct connection to a PC via the serial interface

The ALMEMO® D6 module can be connected directly to the PC using USB link adapter cable ZA1919-AKUV. This setup is used primarily for configuring the module. (see below) In this setup the module operates as an ALMEMO® device using the standard protocol and processes all sensor data accordingly. A microcontroller incorporated in the adapter cable automatically sets the power supply, baud rate, and device address that the sensor requires. The baud rate to the PC is normally 115.2 kbaud. However, the modules themselves can - for particularly time-critical applications - be operated at up to 921 kbaud.

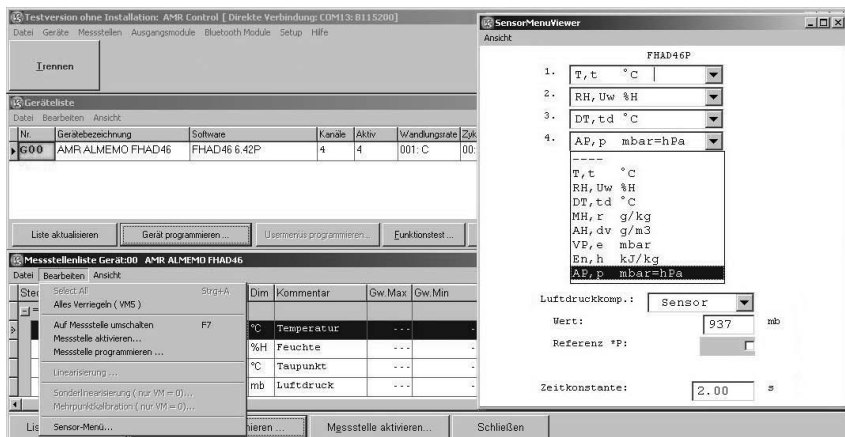


Measured data can be acquired simultaneously from several modules via various interfaces; however, in this case the Wincontrol software will be needed.



In order to operate simultaneously with other modules and devices in a network all modules must be set to the same baud rate and each be assigned its own unique address xx. This is programmed on the sensor via a terminal using the command f9 Gxx. However, only one module can be connected at one time; several connected at the same time would cause address duplicates.

New functions or measuring ranges - not programmed via the ALMEMO® devices - can be configured via a menu stored in the sensor; to do this the AMR-Control software will be needed (at least V.5.14.0.274). The 'Sensor menu' is located in the measuring points list under 'Edit'.



The following table lists the measuring ranges available for 4 measuring channels and the currently available sensors. Primary measuring channels are marked with “\*”.

D6 measuring ranges	Designation	Units	FHAD46 FHA- D36R	FNAD46	FDA- D16SA	FVA- D35THx	FYAD00- CO2	FDA- D02R
Temperature	T, t	°C	●*		●*	●		
Dry temperature	TT, t	°C		●*				
Humid temperature	HT, tw	°C		●*				
Relative humidity	RH, Uw	%H	●*	●				
Absolute humidity	AH, dv	g/m³	●	●				
Dew point	DT, td	°C	●	●				
Mix	MH, r	g/kg	●	●				
Enthalpy	En, h	kJ/kg	●	●				
Vapor pressure	VP, e	mbar	●	●				
Atmospheric pressure	AP, p	mbar	o	●	●*	●	●	

D6 measuring ranges	Designation	Units	FHAD46 FHA- D36R	FNAD46	FDA- D16SA	FVA- D35THx	FYAD00- CO2	FDA- D02R
Flow	v	m/s				●*		
CO <sub>2</sub> concentration	CO2	%					●*	
Pressure	p	bar						●*
10 refrigerants	t', t"	°C						●

### Interface commands supported (see Chapter 7, Identification <sup>D6</sup>)

#### Outputs

Information list: Ranges, baud rates

Configuration menu

Internal: Adjustment, time constant, ranges

#### New commands

P60

P61

P69

#### Inputs

Programming the device address

f9 Gxx Only one device at the interface !

Baud rate setting

f1 bx (see P60)

3

### 3.0.2 Sensor overview

Sensor / transducer	Sensor type	ALMEMO connector		Abbreviation Units	
	Order no.	Type	Order no.		
Resistance-based temperature sensors					
Pt100-1, 4 conductors	FP Axxx	Normal	ZA 9030-FS1	P104	°C
Pt100-2, 4 conductors	FP Axxx	Normal	ZA 9030-FS2	P204	°C
Pt1000-1, 4 conductors (with element flag 1)		Normal	ZA 9030-FS4	P104	°C
Pt1000-2, 4 conductors (with element flag 1)		Normal	ZA 9030-FS5	P204	°C
Ni100 4 conductors		Normal	ZA 9030-FS3	N104	°C
Ni1000 4 conductors		Normal	ZA 9030-FS6	N104	°C
Ntc type N	FN Axxx	Normal	ZA 9040-FS	Ntc	°C
2 x NTC type N		Normal	ZA 9040-FS2	Ntc	°C
NTC type N 0,001K*		Normal	ZA 9040-SS3	Ntc3	°C
KTY 84 *		Normal	ZA 9040-SS4	KTY	°C
YSI 400 *			ZA 9641-SS	NtcY	°C
Thermocouples					
NiCr-Ni (K)	FT Axxx	Thermo	ZA 9020-FS	NiCr	°C
NiCr-Ni (K) Measuring module, el. isol., 4 kV <sup>D</sup>		Module	ZA D950-ABK	DIGI	°C
NiCroSil-NiSi (N)		Thermo	ZA 9020-FSN	NiSi	°C
Fe-CuNi (L)		Thermo	ZA 9000-FSL	FeCo	°C
Fe-CuNi (J)		Thermo	ZA 9000-FSJ	IrCo	°C
Cu-CuNi (U)		Thermo	ZA 9000-FSU	CuCo	°C
Cu-CuNi (T)		Thermo	ZA 9000-FST	CoCo	°C
PtRh10-Pt (S)	FS Axxx	Normal	ZA 9000-FSS	Pt10	°C
PtRh13-Pt (R)		Normal	ZA 9000-FSR	Pt13	°C
PtRh30-PtRh6 (B)		Normal	ZA 9000-FSB	EL18	°C
AuFe-Cr		Normal	ZA 9000-FSA	AuFe	°C
W5Re - W26Re (C)*		Normal	ZA 9000-SSC	Wr26	°C
Heat flow W/m²	FQ Axxx	Normal	ZA 9007-FS	mV 2	W/m²

## Sensor overview

<b>DC Voltage</b>					
55 millivolts DC	Normal	ZA 9000-FS0	mV		mV
26 millivolts DC	Normal	ZA 9000-FS1	mV 1		mV
260 millivolts DC	Normal	ZA 9000-FS2	mV 2		mV
2.6 volts DC	Normal	ZA 9000-FS3	Vo1t		V
26 volts DC	Divider	ZA 9602-FS	Vo1t		V
2 x 26 volts DC (without el. isol.)	Divider	ZA 9602-FS2	Vo1t		V
<b>Differential measurement, sensor supply voltage 7..9V</b>					
Difference 55 millivolts DC	Normal	ZA 9000-FS0D	D 55		mV
Difference 26 millivolts DC	Normal	ZA 9000-FS1D	D 26		mV
Difference 260 millivolts DC	Normal	ZA 9000-FS2D	D260		mV
Difference 2.6 volts DC	Normal	ZA 9000-FS3D	D2.6		V
<b>Differential amplifier for measuring bridges Sensor supply 5 V stable</b>					
Difference 55 millivolts DC	Bridge	ZA 9650-FS0	D 55		mV
Difference 26 millivolts DC Amplification=10	Bridge	ZA 9650-FS1V	D260		mV
Difference 260 millivolts DC Amplification=10	Bridge	ZA 9650-FS2V	D2.6		mV
Difference 2.6 Volt DC	Bridge	ZA 9650-FS3	D2.6		V
<b>Differential measurement Sensor supply voltage with DC/DC 12 V</b>					
Difference 55 millivolts DC	V12	ZA 9600-FS0V12	D 55		mV
Difference 26 millivolts DC	V12	ZA 9600-FS1V12	D 26		mV
Difference 260 millivolts DC	V12	ZA 9600-FS2V12	D260		mV
Difference 2.6 volts DC	V12	ZA 9600-FS3V12	D2.6		V
Difference 26 volts DC	V12divider	ZA 9602-FS3V12	D2.6		V
<b>Quick-action, overload-proof DC measuring module, electr. isolated , 4 kV</b>					
2.0 volts DC 1kHz	Module	ZA 9900-AB2	DIGI		V
20 volts DC 1kHz	Module	ZA 9900-AB3	DIGI		V
200 volts DC 1kHz	Module	ZA 9900-AB4	DIGI		V
400 volts DC 1kHz	Module	ZA 9900-AB5	DIGI		V
<b>DC</b>					
32 milliamperes DC	Shunt	ZA 9601-FS1	mA		mA
Percent (4-20mA DC)	Shunt	ZA 9601-FS2	%		%
2 x 32 milliamperes DC (without electr. isolation)	Shunt	ZA 9601-FS3	mA		mA
2 x Percent (4-20mA DC) (without electr. isolation)	Shunt	ZA 9601-FS4	%		%
<b>Differential measurement, sensor supply voltage 7 to 9 V</b>					
Difference 32mA	Shunt	ZA 9601-FS5	mA		mA
Difference Percent	Shunt	ZA 9601-FS6	%		%
<b>Differential measurement Sensor supply voltage with DC/DC 12 V</b>					
Difference 32mA	V12Shunt	ZA 9601-FS5V12	mA		mA
Difference % (4 - 20%)	V12Shunt	ZA 9601-FS6V12	%		%
<b>Quick-action, overload-proof DC measuring module, electr. isolated , 4 kV</b>					
20 mA DC 1kHz	Module	ZA 9901-AB1	DIGI		mA
200 mA DC 1kHz	Module	ZA 9901-AB2	DIGI		mA
2 Amp. DC 1kHz	Module	ZA 9901-AB3	DIGI		A
10 Amp. DC 1kHz	Module	ZA 9901-AB4	DIGI		A
<b>Resistance</b>					
500 ohms	Normal	ZA 9003-FS	Ohm		Ω
5000 ohms (with element flag 1)	Normal	ZA 9003-FS2	Ohm		Ω
50 ohms *	Normal	ZA 9003-SS3	Ohm1		Ω
110 kohms *	Normal	ZA 9003-SS4	Ohm4		Ω
<b>AC Voltage</b>					
260 millivolts AC (without electrical isolation)	Cable	ZA 9603-AK1	mV 2		mV
2.6 volts AC (without electrical isolation)	Cable	ZA 9603-AK2	Vo1t		V

26 volts AC (without electrical isolation)		Cable	ZA 9603-AK3	Volt	V
<b>Quick-action, overload-proof AC measuring module, electr. isolated , 4 kV</b>					
130 millivolts AC TRMS		Module	ZA 9903-AB1	DIGI	mV
1.3 volts AC TRMS		Module	ZA 9903-AB2	DIGI	V
13 volts AC TRMS		Module	ZA 9903-AB3	DIGI	V
130 volts AC TRMS		Module	ZA 9903-AB4	DIGI	V
400 volts AC TRMS		Module	ZA 9903-AB5	DIGI	V
<b>Bestell-Nr.</b>		<b>Typ</b>	<b>Bestell-Nr.</b>		
<b>AC: Quick-action, overload-proof AC measuring module, electr. isolated , 4 kV</b>					
1 A AC TRMS		Module	ZA 9904-AB1	DIGI	A
10 A AC TRMS		Module	ZA 9904-AB2	DIGI	A
<b>Digital signals</b>					
Frequency		Cable	ZA 9909-AK1U	Freq	Hz
rpm		Cable	ZA 9909-AK4U	Freq	Um
Pulses / measuring cycle		Cable	ZA 9909-AK2U	PULS	
Digital inputs		Cable	ZA 9000-EK2	Inp	%
Digital interface		Cable	ZA 9919-AKxx	DIGI	%
<b>Infrared sensors</b>					
Infrared 4	-30 to +100 °C	FI A628-4	Normal	ZA 9008-FS4	Ir 4 °C
Infrared 6	0 to 500 °C	FI A628-6	Normal	ZA 9008-FS6	Ir 6 °C
<b>Capacitive humidity sensor with NTC</b>					
1. Temperature NTC type N	FH A646	Normal	ZA 9046-FS	Ntc	°C
2. Relative humidity				% rH	%H
x Dew-point temperature				H DT	°C
x Mixture ratio				H AH	gk
with pressure compensation (PC)					
x Partial vapor pressure				H VP	mb
x Enthalpy with PC				H En	kJ
1. Temperature NTC type N	FH A646-C			Ntc	°C
2. Relative humidity with TC				HcrH	%H
1. Temperature NTC type N	FH A646-R			Ntc	°C
2. Relative humidity with TC				H rH	%H
Diameter 5 mm					
<b>Capacitive humidity sensor with NiCr-Ni</b>					
1. NiCr-Ni (K)		Thermo	ZA 9026-FS	NiCr	°C
2. Relative humidity				% rH	%H
<b>Psychrometers</b>					
1. NTC type N	FN A846	Cable	ZA 9846-AK	Ntc	°C
2. Relative humidity with PC				P RH	%H
x Dew-point temperature with PC				P DT	°C
x Mixture ratio with PC				P AH	gk
x Enthalpy with PC				P En	kJ
x Partial vapor pressure with PC				P VP	mb
x Humid temperature				P HT	°C
<b>Material moisture sensor</b>					
1. Humidity in construction materials	FH A696-MF	Normal		D2.6	B%
2. Humidity in wood				D2.6	H%
x Humidity in paper				D2.6	P%
<b>Rotating vanes</b>					
Snap-on head, normal, 20 m/s	FV A915-S120	Cable	ZA 9915-AKS1	S120	m/s
Snap-on head, normal, 40 m/s	FV A915-S140	Cable	ZA 9915-AKS2	S140	m/s
Snap-on head, micro, 20 m/s	FV A915-S220	Cable	ZA 9915-AKS3	S220	m/s

## Sensor overview

Snap-on head, micro, 40 m/s	FV A915-S240	Cable	ZA 9915-AKS4	S240	m/s
Macro, 20 m/s	FV A915-SMA1	Cable	ZA 9915-AK5	L420	m/s
Water micro, 5 m/s	FV A915-WM1	Cable	ZA 9915-AK6	L605	m/s
<b>Turbine flow meter</b>	FV A915-VR	Counter	ZA 9909-AK1	Freq	m/s
<b>Thermoanemometer</b>					
1. Temperature	FV A645-THx	Normal		D2.6	°C
2. Flow				D2.6	m/s
1. Flow, 40 m/s with TC and PC	FD A602-M1K	Modul		L840	m/s
2. Dynamic pressure, 2000 Pa				Vol1t	Pa
1. Flow, 90 m/s with TC and PC	FD A602-M6	Modul		L890	m/s
2. Dynamic pressure, 6800 Pa				Vol1t	Pa
pressure transducers Barometer	FD A612-MA	Modul		Vol1t	mb
Pressure transducer, 0.1 to 1000 bar, 0.5%	FD 8214	Cable	ZA8214-AK	D2.6	br
Pressure transducer, 2.5 to 100 bar, 1%	FD A602-L	Cable		D2.6	br
1. Pressure transducer, 10 to 30 bar, 1%	FD A602-LxAK	Cable		D2.6	br
2. Temperature, refrigerant, R22, R23, R134a, R404a, R407c, R410, R417a, R507*				R 22	°C
<b>Tachometer probes</b>					
Tachometer probe, analog	FU A619	Divider	ZA 9019-FS	Vol1t	Um
Tachometer probe, digital	FU A919-2	Counter		Freq	Um
<b>Light sensors</b>					
1. 26000 lux	FL A613-VL	Normal		mV 2	Lx
2. 260 kLux				mV 2	kL
<b>pH probes</b>					
pH probe	FY A8PH-xx	Cable	ZA 9610-AKY4	D2.6	pH
1. Temperature NTC type N	FY A8PH-xx	Cable	ZA 9640-AKY4	Ntc	°C
2. pH probe with TC				D2.6	pH
Redox probe	FY A8RX-xx	Cable	ZA 9610-AKY5	D2.6	mV
<b>Conductivity probe</b>					
1. NTC type N	FY A641-LF	Normal		Ntc	°C
2. Conductivity, with TC				LF	mS
<b>O<sub>2</sub> probe for solute oxygen in water</b>					
1. NTC type N	FY A640-O2	Normal		Ntc	°C
2. O <sub>2</sub> saturation, with TC and PC				O2-S	%
3. O <sub>2</sub> concentration, with TC				O2-C	mg
<b>O<sub>2</sub> sensor for gases</b>	FY A600-O2	Normal		mV 2	%
<b>CO<sub>2</sub> sensor for gases</b>	FY A600-CO2	Normal		C02	%

**TC = Temperature compensation PC = Atmospheric pressure compensation**

\* Special measuring ranges see 2.2.

° ALMEMO D sensor see 3.0.1