Instruction Manual

DB03.E Eco

Thermal Flow and Consumption Sensor for Compressed Air and Gases

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Dear Customer,

Thank you for choosing our product.

Before you start up the device please read the operating instructions in full and carefully observe them. The manufacturer cannot be held liable for any damage which occurs as a result of non-observance or non-compliance with this manual.

Should the device be tampered with in any manner other than a procedure which is described and specified in the manual, the warranty is canceled and the manufacturer is exempt from liability.

The device is destined exclusively for the described application.

PKP Prozessmesstechnik GmbH offers no guarantee for the suitability for any other purpose. PKP Prozessmesstechnik GmbH is also not liable for consequential damage resulting from the delivery, capability or use of this device.

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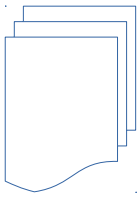
1 Safety instructions



Please check if this instruction manual matches with the product type.

Please observe all notes and instructions indicated in this manual. It contains essential information which must be observed before and during installation, operation and maintenance. Therefore this instruction manual must be read carefully by the technician as well as by the responsible user / qualified personnel.

This instruction manual must be available at the operation site of the flow sensor at any time. In case of any obscurities or questions, regarding this manual or the product, please contact the manufacturer.

WARNING!

Compressed air!

Any contact with quickly escaping air or bursting parts of the compressed air system can lead to serious injuries or even death!

- Do not exceed the maximum permitted pressure range (see sensors label).
- Only use pressure tight installation material.
- Avoid that persons get hit by escaping air or bursting parts of the instrument.
- The system must be pressureless during maintenance work.

WARNING!

Voltage used for supply!

Any contact with energized parts of the product, may lead to a electrical shock which can lead to serious injuries or even death!

- Consider all regulations for electrical installations.
- The system must be disconnected from any power supply during maintenance.
- Any electrical work on system is only allowed by authorized qualified personal.

ATTENTION!

Permitted operating parameters!

Observe the permitted operating parameters, any operation exceeding this parameters can lead to malfunctions and may lead to damage on the instrument or the system.

- Do not exceed the permitted operating parameters.
- Make sure the product is operated in its permitted limitations.
- Do not exceed or undercut the permitted storage and operation temperature and pressure.
- The product should be maintained and calibrated frequently, at least annually.

General safety instructions

- It is not allowed to use the product in explosive areas.
- Please observe the national regulations before/during installation and operation.

Remarks

- It is not allowed to disassemble the product.

ATTENTION!

Measurement values can be affected by malfunction!

The product must be installed properly and frequently maintained, otherwise it may lead to wrong measurement values, which can lead to wrong results.

- Always observe the direction of the flow when installing the sensor. The direction is indicated on the housing.
- Do not exceed the maximum operation temperature at the sensors tip.
- Avoid condensation on the sensor element as this will affect accuracy enormously.

Storage and transportation

- Make sure that the transportation temperature is between -30 ... +70°C.
- For storage and transportation it is recommended to use the

packaging which comes with the sensor.

- Make sure that storage temperature of the sensor is between -10 ... +50°C.
- Avoid direct UV and solar radiation during storage.
- For the storage the humidity must be <90% with no condensation.

2 Registered trademarks

PKP Prozessmesstechnik GmbH®

Registered trademark of PKP Prozessmesstechnik GmbH iTEC

MODBUS®

Registered trademark of the Modbus Organization, Hopkinton, USA

HART®

Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

3 RF exposure information and statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not

installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help
- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

4 Application

The DB03 Eco is the thermal mass flow sensor that is designed to measure the volumetric flow and consumption of compressed air and nitrogen within the permitted operating parameters(Chapter 6 Technical data).

The default unit settings are: volumetric flow in l/min and total Consumption in m^3. Other units can be configured using the service app S4C-FS, which can be downloaded from the Google Play store or our website. For more information see chapter 10.

5 Features

- Inline thermal mass flow sensor virtually independent of pressure and temperature changes
- Process connection G-type thread, DN8, DN15, DN20 and DN25
- Very short response time
- Particularly suitable for measuring at point-of-use flow and consumption of compressed air or N_2
- Integrated display showing volumetric flow
- Choices of output signals:
  - Analogue 4 … 20 mA and pulse output
  - Modbus interface
  - M-Bus interface
- Bluetooth interface for sensor settings (S4C-FS App)
- Configurable through Android devices (S4C-FS App)

6 Technical data

6.1 General data

CE	
Parameters	Standard unit flow: l/min Consumption units: m³ (default)
Reference conditions	ISO1217 20°C, 1000 mbar (Standard-Unit) DIN1343 0°C , 1013.25 mbar (Norm-Unit)
Principle of measurement	Thermal mass flow
Sensor	Glass coated resistive sensor
Ambient temperature /Transport temperature	0 ... +50°C / -30 ... +70°C
Medium conditions	0 ... +50°C, rH<90% no condensation
Operating pressure	0 ... 1.0 MPa
Pressure drop	Maximum pressure drop at the maximum flow of the Standard (S) flow range: • DN8 type : 30 hPa • DN15 type: 100 hPa • DN20 type: 100 hPa • DN25 type: 200 hPa
Casing	Process connection: aluminum alloy Wetted parts: aluminum alloy Top casing: PC + ABS
Protection class	IP54
Dimensions	See dimensional drawing on page 11.
Display	4-digit LED display
Tube diameter	DN8, DN15, DN20, DN25
Process connection	G inner thread ISO 228-1
Weight	0.44 kg (DN8), 0.44 kg (DN15) 0.96 kg (DN20), 0.94 kg (DN25)

6.2 Electrical data

Power supply	15 ... 30 VDC, 120 mA @ 24 VDC

6.3 Output-signals

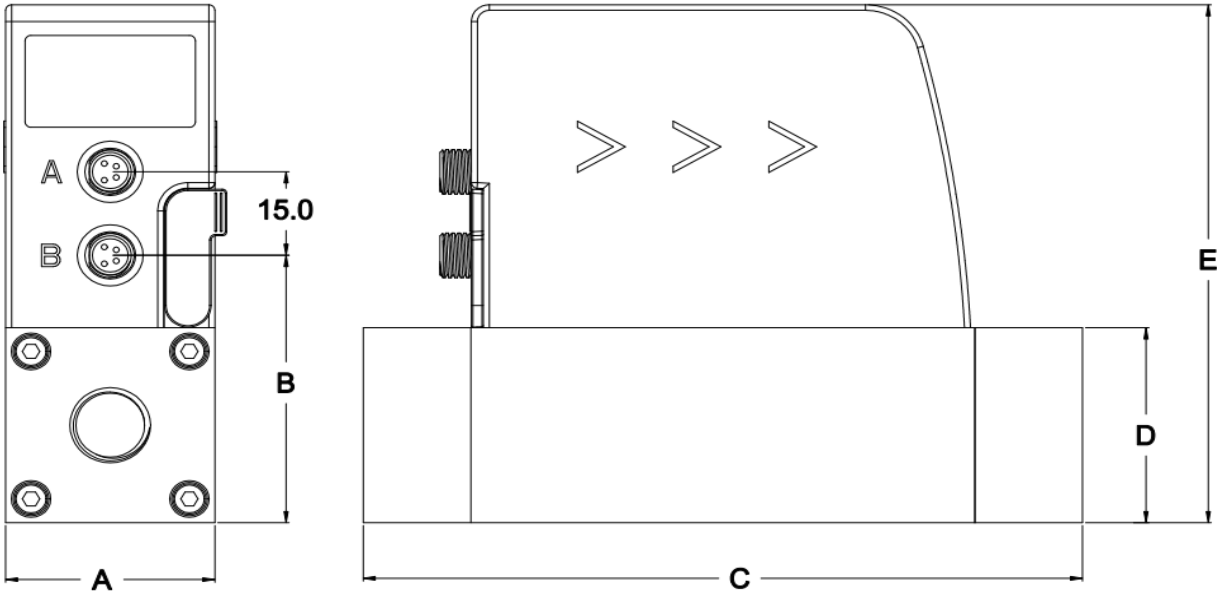
Analogue output	Signal: 4 ... 20 mA, isolated Scaling: 0 to max flow Max load: 250R
Pulse output	1 pulse per m^3, isolated switch, max. 30 VDC, 200 mA (pulse length: 10 ... 120 ms, depends on flow rate)
Modbus output	See section 9.3.

6.4 Accuracy

Accuracy* (at 6 bar, 20°C, rH<40%)	± (3.0% of reading + 0.3% Full Scale)
Temperature coefficient	< 0.1%/K Full Scale
Pressure coefficient	< 0.5% / 0.1 MPa
Turndown ratio	50 : 1
Stated accuracy at	Ambient/process temperature 23°C ± 3°C Ambient/process humidity <90% Process pressure at 0.6 MPa
Repeatability	± 1% of reading
Sampling rate	3 samples per second

* The specified accuracy is valid only within the minimum and maximum flow rates that are stated in section 14.1.

7 Dimensional drawing



	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
DN 8/15	35,0	48,0	120,4	35,0	93,0
DN 20/25	48,0	61,0	178,0	48,0	106,0

8 Installation

DB03 Eco is delivered with following components:

Qty.	Description	Item no.
1	DB03 Eco Thermal mass flow meter	DB03.E.S08 / R08 DB03.E.S15 / R15 DB03.E.S20 / R20 DB03.E.S25 / R25
1 o. 2	5 m cable with M8 connector and open ends Analog + Pulse = 2 cables Modbus = 1 cable	---
1	Instruction manual	---
1	Calibration certificate	---

8.1 Installation considerations

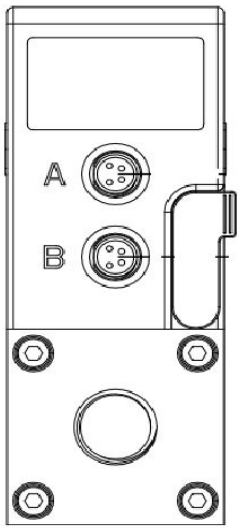
To maintain the accuracy stated in the technical data, the sensor must be installed inline and fitted to tubes with the same diameter. Please note the following:

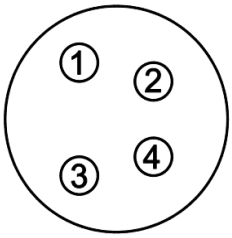
- The sensor is for indoor use only! At an outdoor installation, the sensor must be protected from solar radiation and rain.
- It is strongly recommend not to install DB03 Eco permanently in wet environment which exists usually right after a compressor outlet.

8.2 Electrical connection

The flow sensor comes with two connector plugs “A” and “B”. By default the sensor is delivered with one 5 m cable with a M8 connector on one side and open wires on the other side. To make the DB03 Eco work, one cable connection is sufficient. However, if the pulse output is to be used

or the supply and the signal need to be on separate cables, a second connection cable must be ordered.





Legend to pin assignment

GND:	Ground for Modbus
-VB:	Negative supply voltage
+VB:	Positive supply voltage
I+:	Positive 4 … 20 mA signal
I-:	Negative 4 ... 20 mA signal
D+:	Modbus data +
D-:	Modbus data -
P:	Pulse signal
M:	M-Bus data
NA:	Not Applicable

Pin assignment connector plug M8

Output Version	Connector	Pin 1	Pin 2	Pin 3	Pin 4
Modbus	A	D-	-VB	+VB	D+
	B	D-	GND	GND	D+
Pulse and analog	A	I-	-VB	+VB	I+
	B	I-	P	P	I+
M-Bus	A	M	-VB	+VB	M
	B	M	NA	NA	M
Wire color		brown	white	blue	black

ATTENTION!

Do not screw the M8 plug using force. Otherwise, it may damage the connecting pins.

9 Sensor signal outputs

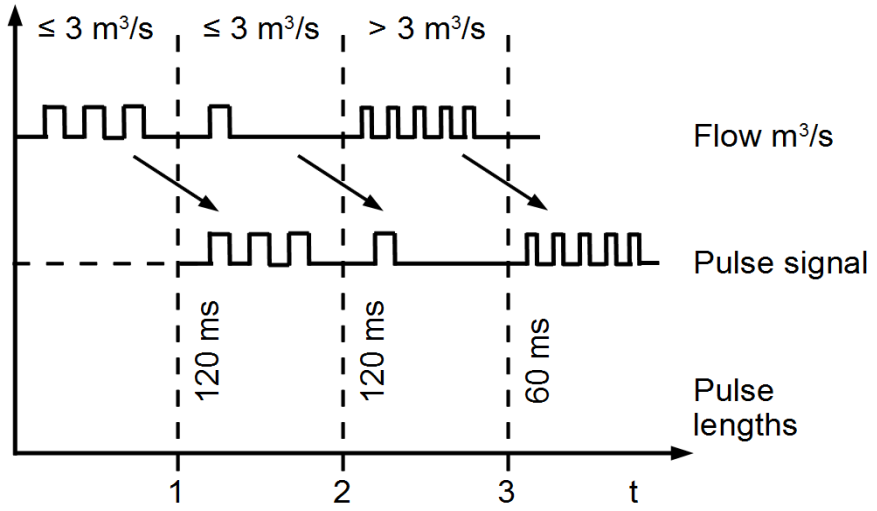
9.1 Analog output

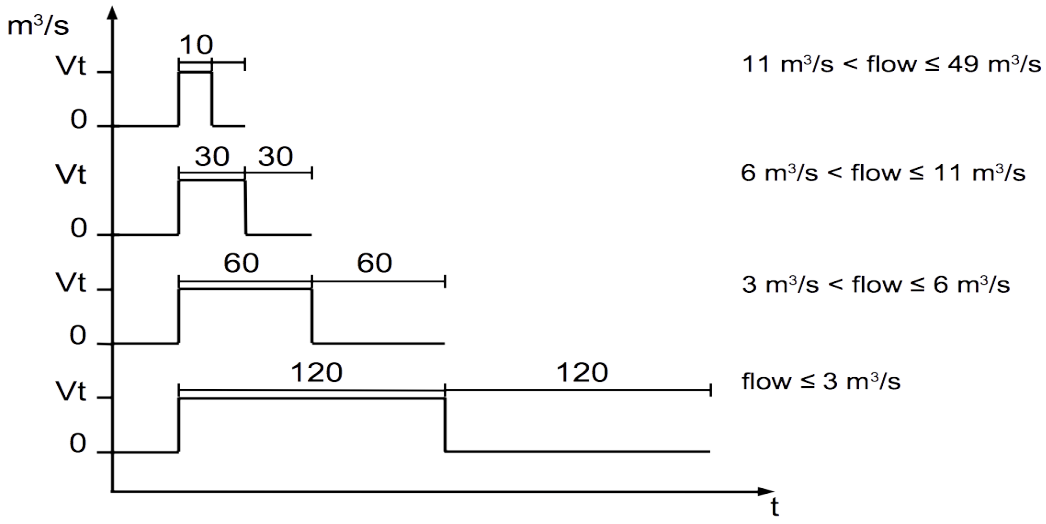
The sensor has an analog output of 4 ... 20 mA. This output can be

scaled to match a desired measuring range. Standard scaling is from 0 to the max flow. The corresponding flow in different pipe sizes can be found in section 14.1.

9.2 Pulse output

The sensor outputs one pulse per a consumption unit. This pulse output can be connected to an external pulse counter to count the total consumption. The number of m^3 per second are summed up and indicated after one second. Pulse length depends on flow rate.



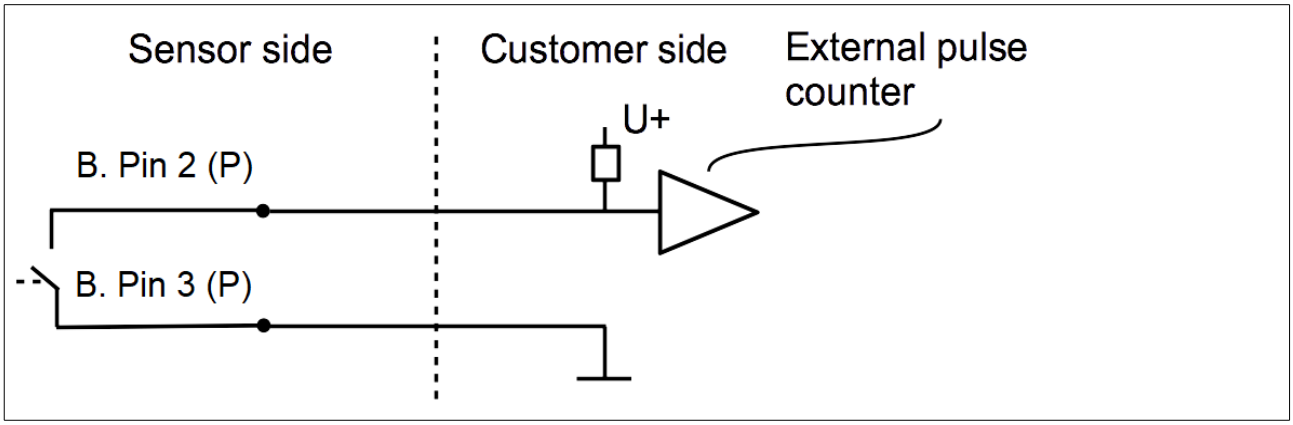


Volumetric flow [m^3/s]	Volumetric flow [m^3/h]	Pulse length [ms]	Max. pulse output per hour
</= 3	</= 10800	120	1080

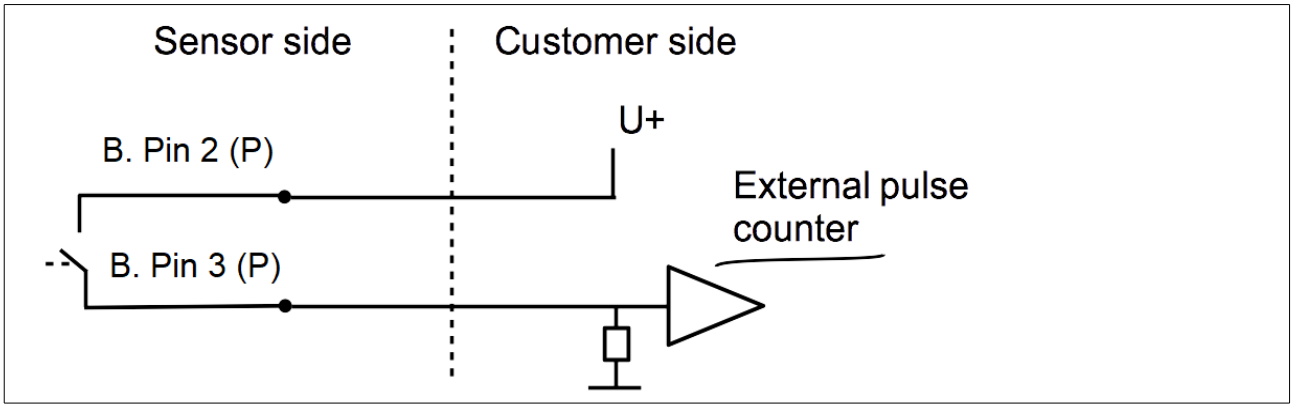
> 3	> 10800	60	2880
> 6	> 21600	30	3960

9.2.1 Pulse Connection Diagram

Variant 1:



Variant 2:



9.3 Modbus output

Mode	: RTU
Baud rate	: 19200
Device address	: last two digits of serial number (please see the calibration certifacte)
Framing / parity / stop bit	: 8, N, 1
Response timeout	: 1 second
Response delay	: 0 ms
Inter-frame spacing	: 7 char

Remarks

- Modbus communication settings can be changed by the service app S4C-FS
- To learn more about Modbus communication, see Appendix B - Modbus communication example and Appendix C - LRC and CRC calculation.

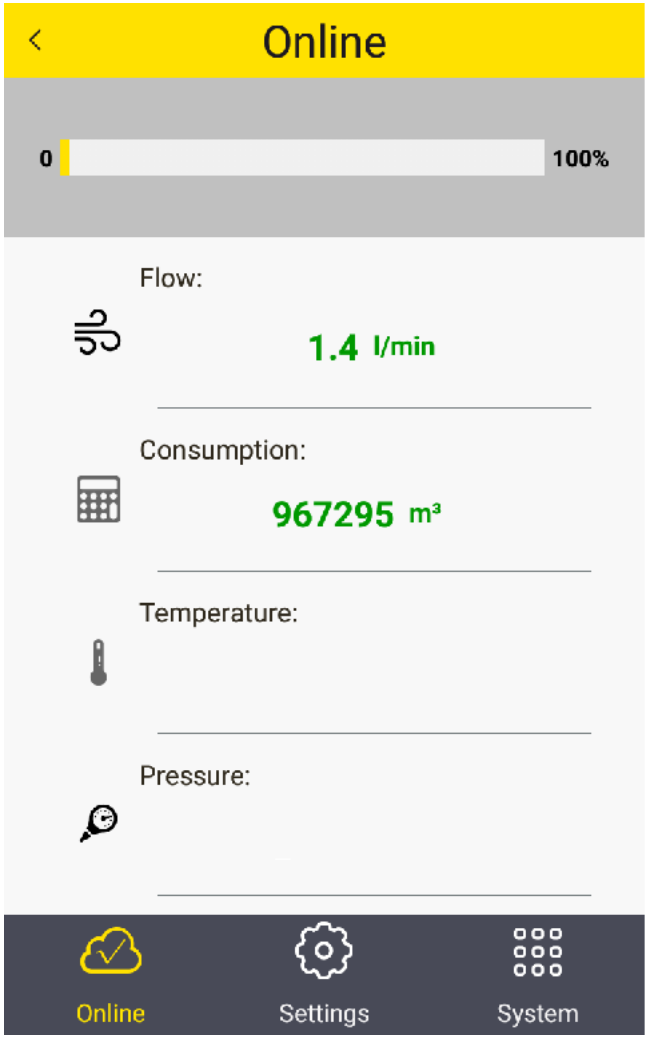
Index	Channel description	Resolution	Format	Length	Modbus address
1	Flow	0,1	FLOAT	4 Byte	6
2	Consumption	1	UNIT32	4 Byte	8

Remarks

- All numbers are in little-endian format.
- Function code: 03.
- The measurement value is always available in the programmed physical unit.

10 Configuration

To change any settings on the DB03 Eco, please download and install the service App **S4C-FS** from the Google Play store or our Website. This App works on any Android system with Bluetooth supported.



To be allowed to change settings, the App needs to scan the QR code on the calibration certificate at first. This ensures that only authorized users can access the sensor settings. For more information about instructions, see the *S4C-FS Instruction and operation manual*.

ATTENTION!

Changes on the settings may lead to wrong measurement results! Contact manufacturer in case you are not familiar with the settings.

11 Calibration

The sensor is calibrated ex work. The exact calibration date is printed on the certificate which is supplied together with the sensor. The accuracy of the sensor is regulated by the on site conditions, parameters like oil, high humidity or other impurities can affect the calibration and furthermore the accuracy. However we recommend to calibrate the instrument at least once per year. The calibration is excluded from the instruments warranty. For this please contact the manufacturer.

12 Disposal or waste

Electronic devices are recyclable material and do not belong in the household waste.
The sensor, the accessories and its packing must be disposed according to your local statutory requirements.
The dispose can also be carried by the manufacturer of the product, for this please contact the manufacturer.

13 Warranty

PKP Prozessmesstechnik GmbH provides a warranty for this product of 24 months covering the material and workmanship under the stated operating conditions from the date of delivery. Please report any findings immediately and within the warranty time. If faults occur during the warranty time PKP Prozessmesstechnik GmbH will repair or replace the defective unit, without charge for labour and material costs but there is a charge for other service such as transport and packing costs.
Excluded from this warranty is:

- Damage caused by:
  - Improper use and non-adherence to the instruction manual.
  - Use of unsuitable accessories.
  - External influences (e.g. damage caused by vibration, damage during transportation, excess heat or moisture).

The warranty is canceled:

- If the user opens the measurement instrument without a direct request written in this instruction manual.
- If repairs or modifications are undertaken by third parties or unauthorized persons.
- If the serial number has been changed, damaged or removed.

Other claims, especially those for damage occurring outside the instrument are not included unless responsibility is legally binding.

Warranty repairs do not extend the period of warranty.

ATTENTION!

Batteries have a reduced warranty time of 12 months.

14 Appendix A - Specifications

14.1 Flow ranges

The measuring ranges of air are stated under the following conditions:

- Standard flow in air
- Reference pressure: 1000 hPa
- Reference Temperature: +20°C

	DN8		DN15		DN20		DN25	
	Min	Max	Min	Max	Min	Max	Min	Max
Standard range (S) in l/min	50	250	20	1000	40	2000	70	3500
Low range (L) in l/min	1	50	4	200	8	400	14	700

The measuring ranges of **N_2** are stated under the following conditions: 0°C and 1013.25 hPa:

	DN8		DN15		DN20		DN25	
	Min	Max	Min	Max	Min	Max	Min	Max
Standard range (S)	4,44	222	17,8	890	35,6	1780	62,2	3110
Low range (L)	0,89	44.5	3,56	178	7,12	356	12,44	622

14.2 Error code

When an error code shows on the LED display, use the following table to identify the error cause.

Error code	Description
Er. 01	Real time clock failure
Er. 02	ADC failure
Er. 04	EEPROM failure
Er. 08	NAND flash failure
Er. 20	Flow sensor failure
Er. 30	Temperature sensor failure
Er. 40	Bluetooth failure

15 Appendix B - Modbus communication example

03 (0x03) Read holding register

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Byte count	1 byte
Starting address Lo	1 byte	Register Hi	1 byte
No. of points Hi	1 byte	Register Lo	1 byte
No. of points Lo	1 byte	:	:
CRC	2 bytes	Register Hi	1 byte
		Register Lo	1 byte
		CRC	2 bytes

05 (0x05) Write single coil

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Coil address Hi	1 byte	Coil address Hi	1 byte
Coil address Lo	1 byte	Coil address Lo	1 byte
Data Hi	1 byte	Data Hi	1 byte
Data Lo	1 byte	Data L	1 byte
CRC	2 bytes	CRC	2 bytes

16 (0x10) Write multiple registers

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Starting address Hi	1 byte
Starting address Lo	1 byte	Starting address Lo	1 byte
No. of registers Hi	1 byte	No. of registers Hi	1 byte
No. of registers Lo	1 byte	No. of registers Lo	1 byte
Byte count	1 byte	CRC	2 bytes
Data Hi	1 byte		
Data Lo	1 byte		
:	:		
Data Hi	1 byte		
Data Lo	1 byte		
CRC	2 bytes		

17 (0x11) Report slave ID

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
CRC	2 bytes	Byte count	1 byte
		Slave ID	2 bytes
		Device run indicator	2 bytes
		Product code	2 bytes
		Product name	20 bytes
		CRC	2 bytes

16 Appendix C - LRC and CRC calculation

LRC generation

The Longitudinal Redundancy Checking (LRC) field is one byte, containing an 8–bit binary value. The LRC value is calculated by the transmitting device, which appends the LRC to the message. The device that receives recalculates an LRC during receipt of the message, and compares the calculated value to the actual value it received in the LRC field. If the two values are not equal, an error results.

The LRC is calculated by adding together successive 8–bit bytes in the message, discarding any carries, and then two's complementing the result. The LRC is an 8–bit field, therefore each new addition of a character that would result in a value higher than 255 decimal simply 'rolls over' the field's value through zero. Because there is no ninth bit, the carry is discarded automatically.

A procedure for generating an LRC is:

1. Add all bytes in the message, excluding the starting 'colon' and ending CRLF. Add them into an 8–bit field, so that carries will be discarded.
2. Subtract the final field value from FF hex (all 1's) to produce the ones–complement.
3. Add 1 to produce the twos–complement.

Placing the LRC into the Message

When the 8–bit LRC (2 ASCII characters) is transmitted in the message, the high–order character will be transmitted first, followed by the low–order character. For example, if the LRC value is 61 hex (0110 0001):

Colon	Addr	Func	Data Count	Data	Data	Data	Data	LRC Hi	LRC Lo	CR	LF
								"6" 0x36	"1" 0x31		

Example: an example of a C language function performing LRC generation is shown below.

The function takes two arguments:

```
unsigned char *auchMsg; /* A pointer to the message buffer containing binary data */
                        /* to be used for generating the LRC,                      */
unsigned short usDataLen; /* The quantity of bytes in the message buffer.          */
```

LRC generation function

```
static unsigned char LRC(unsigned char *auchMsg, unsigned short usDataLen)
 {
       unsigned char uchLRC = 0 ;                          /* LRC char initialized */
       while (usDataLen--)                                 /* pass through message buffer */
             uchLRC += *auchMsg++ ;                        /* add buffer byte without carry */
       return ((unsigned char)(-((char)uchLRC))) ;   /* return twos complement */
}
```

CRC generation

The **C**yclical **R**edundancy **C**hecking (CRC) field is two bytes, containing a 16-bit binary value. The CRC value is first generated by the transmitting device, which appends the CRC to the message. The device that receives recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

There are many ways of calculating a CRC checksum. To ensure correct calculation, please refer to [Reference 1] Modbus over serial line, where detailed descriptions and programming examples are available. Even more information and programming examples in different programming languages can be found on: www.modbus.org searching for CRC.

Below is a short text description of how the CRC is calculated. This description is then followed by a C programming example.

1. Load a 16-bit register with FFFF hex (all 1's). Call this the CRC register.
2. Exclusive OR the first 8-bit byte of the message with the low-order byte of the 16-bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat step 3 (another shift). (If the LSB was 1): Exclusive OR the CRC register with the polynomial value 0xA001 (1010 0000 0000 0001).
5. Repeat steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
6. Repeat steps 2 through 5 for the next 8-bit byte of the message. Continue doing this until all bytes have been processed.
7. The final content of the CRC register is the CRC value.

8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

Placing the CRC into the message

When the 16-bit CRC (two 8-bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

For example, if the CRC value is 1241 hex (0001 0010 0100 0001):

Addr	Func	Data count	Data	Data	Data	Data	CRC Lo	CRC Hi
							0x41	0x12

High-order byte table

```
/* Table of CRC values for high–order byte */
static unsigned char auchCRCHi[] = {
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00,
0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1,
0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
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0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1,
0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80,
0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,0x40
} ;
```

Low-order byte table

```
/* Table of CRC values for low–order byte */
static char auchCRCLo[] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05,
0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA,
0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA,
0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC, 0x14, 0xD4, 0xD5, 0x15,
0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3, 0x11, 0xD1, 0xD0, 0x10, 0xF0,
0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35,
0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B,
```

```
0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA,
0xEE, 0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27,
0xE7, 0xE6, 0x26, 0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60,
0x61, 0xA1, 0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64,
0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA, 0xBE,
0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5, 0x77, 0xB7,
0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90, 0x91,
0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54,
0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99,
0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E,
0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C, 0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46,
0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x80, 0x40
};
 unsigned short CRC16(unsigned char *puchMsg, unsigned short usDataLen){
   unsigned char uchCRCHi = 0xFF;                    /* high byte of CRC initialized
 */
   unsigned char uchCRCLo = 0xFF;                    /* low byte of CRC initialized
 */
   unsigned uIndex ;                                 /* will index into CRC lookup
 table */
   while(usDataLen—)                                 /* pass through message
 buffer */
   {
          uIndex = uchCRCHi ^ *puchMsg++ ;           /* calculate the CRC */
          uchCRCHi = uchCRCLo ^ auchCRCHi[uIndex] ;
          uchCRCLo = auchCRCLo[uIndex] ;
    }
    return (unsigned short int)((uchCRCHi << 8) | uchCRCLo);
 }
```

DB03

Thermal Flow and Consumption Sensor for Compressed Air and Gases

- **low cost series**
- **easy installation, high flexibility, no straight inlet section due to integrated flow conditioner necessary**
- **version Eco for air and N_2**
  Pro for different gases
- **data logger and pressure measurement optional**
- **smartphone Android app for wireless configuration**
- **measuring ranges: 0,5...50 l/min up to 35...3500 l/min**
- **process connection: G ¼ female up to G 1 female**
- **max. pressure: 10 bar**
  max. temperature: 50 °C

Description:

The DB03 thermal mass flowmeters measure the flow and consumption of air and various gases in the process. The medium flows to a heated temperature sensor and thus removes heat energy from the sensor. The energy required to maintain a constant temperature in the sensor is proportional to the flow rate of the medium. The flow rate of the medium can thus be determined reliably and cost-effectively using specially stored calibration curves. An analogue and a pulse output or Modbus/RTU are available for forwarding the measurement results.
Via the smartphone app, the measured values can be read and the device configured at any time. A data logger and a pressure measurement are optionally available.

Typical applications:

The very small design allows installation even in confined process areas. Since no straight inlet section is required due to an integrated flow conditioner, the DB03 can be installed in almost any position.
The DB03 offers a safe and cost-effective consumption measurement and monitoring of e.g. compressed air in pneumatic systems.

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Versions:

E = Eco	P = Pro
for air or N_2	for different gases (see order code)
Measuring: volume flow and total consumption	Measuring: volume flow, total consumption, temperature and pressure (optional)
measuring span 50:1	measuring span 100:1
accuracy: ± 3 % o. RDG.	accuracy: ± 1,5 % o. RDG
response time T_{90}: 1 s	response time T_{90}: 0,1 s
no data logger	with data loger (USB-connection)

Measuring Range Air [l/min]:

	DN 08	DN 15	DN 20	DN 25
Eco Standard	5...250	20...1000	40...2000	70...3500
Eco reduced	1...50	4...200	8...400	14...700
Pro Standard	2,5...250	10...1000	20...2000	35...3500
Pro reduced	0,5...50	2...200	4...400	7...700

Conditions: 1 bar, 20 °C

Measuring Rages Nitrogen N_2 [l/min]:

	DN 08	DN 15	DN 20	DN 25
Eco Standard	4,4...222	17,8...890	35,6...1780	62,2...3110
Eco reduced	0,89...44,5	3,6...178	7,1...356	12,4...622
Pro Standard	2,2...222	8,9...890	17,8...1780	31,1...3110
Pro reduced	0,45...44,5	1,8...178	3,6...356	6,2...622

Conditions: 1013.25 mbar, 0 °C

Measuring Ragenes Oxygen O_2 [l/min]:

	DN 08	DN 15	DN 20	DN 25
Pro Standard	2,4...238	9,5...953	19,1...1907	33,3...3337
Pro reduced	0,5...47,7	1,9...191	3,8...381	6,7...667

Conditions: 1013.25 mbar, 0 °C

Order Code:

Order number: DB03. | E. | S08. | 0. | L.Z. | SI. | A. | 0

Thermal flow and consuption sensor for compressed air and gases

Version:
E = Eco: for air or N_2, measuring span 50:1
P = Pro: for different gases, measuring span100:1, with data logger

Process connection / meas. range*:

standard-range*:	reduced range*:
S08 = G ¼ female	R08 = G ¼ female
S15 = G ½ female	R15 = G ½ female
S20 = G ¾ female	R20 = G ¾ female
S25 = G 1 female	R25 = G 1 female

*see tables measuring ranges

Pressure measurement:
0 = no
1 = measuring range 0...10 bar (for version P only)

Output signal:
A = analogue 4...20 mA and pulses
B = Modbus/RTU (RS-485)

Units:
SI = with SI-units
IM = with imperial units instead of SI units

Gas types:
for version E = Eco:
L.Z = air
N.Z = nitrogen N_2
for version P = Pro (please choose 2. E.g.: L.E.):
L = air
N = nitrogen N_2
C = carbon dioxide CO_2
O = oxygen O_2 (oil and grease-free cleaned)
D = nitrous oxide N_2O
A = Argon Ar
E = natural gas
W = hydrogen H_2 (real gas calibration)
H = Helium He (real gas calibration)
P = propane C_3H_8
X = different gas
Z = no second gas

Options:
0 = without
9 = please specify in plain text

5 m cable with plug conneciton is included in delivery. At version P additionally one USB cable.

Accessories:

Order number: DB03-Z. | T

Accessories for DB03

Description:
N = mains power supply 100...240 VAC / 24 VDC, 0,5 A, 2 m cable with M8 connector
T = T-box for Modbus systems, incl. 2 m cable with M8 connector
S = data analysis software S4A for DB03.P data (free download at www.pkp.de)
H = mobile-service-app S4C (free download at www.pkp.de)
9 = speciality, please specify in plain text

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Technical Data:

Materials:

process connection:	aluminium alloy
wetted parts:	aluminium alloy
housing:	PC + ABS

Process connection: G female thread (ISO 228-1)
DN 08, DN 15, DN 20, DN 25

Process pressure: 0...10 bar

Ambient temperature: 0...50 °C

Transport temperature: -30...+70 °C

Request on medium: 0...50 °C,
< 90 % rH, no condensation

Reference conditions: ISO1217 20°C 1000 mbar
(standard unit l/min)
DIN1343 0°C 1013.25 mbar
(norm unit Nl/min)

Power supply: 18...30 VDC / 120 mA

Analogue output: 4...20 mA

Pulse output: 1 pulse per consumption unit
(m^3 r ft^3), isolated switch,
max. 30 VDC, 200 mA
pulse length: 10...120 ms,
(depending on flow rate)

Modbus output: RS-485 (Modbus/RTU)

LED Display: 4-Digit, flow indication
(for version P pressure
indication optional)

Interface: wireless with service app
(for version P additionally with
USB for data transfer)

Protection class: IP54

Weights:

Process connection:	Eco-Version	Pro-Version
DN 08 (G ¼ IG)	0,44 kg	0,45 kg
DN 15 (G ½ IG)	0,45 kg	0,46 kg
DN 20 (G ¾ IG)	0,96 kg	0,97 kg
DN 25 (G 1 IG)	0,97 kg	0,98 kg

Accuracy:

Accuracy:

DB03.E (Eco):	± 3 % of m.v., ± 0,3 % FS
DB03.P (Pro):	± 1,5 % of m.v., ± 0,3 % FS

Specification for accuracy: ambient / process temp.:
23 °C ± 3 °C
ambient / process humidity:
< 90 %
process pressure: 6 bar

Temperature coefficient: < 0,1 % / K of FS

Pressure coefficient: < 0,5 % / bar

Measuring span:

DB03.E (Eco):	50:1
DB03.P (Pro):	100:1

Repeatability:

DB03.E (Eco):	± 1 % of measured value
DB03.P (Pro):	± 0,5 % of measured value

Sample Rate:

DB03.E (Eco):	3 sample / second
DB03.P (Pro):	10 sample / second

Pressure measurement (optional for version P):

Measuring range:	0...10 bar
Accuracy:	± 1 % of full scale

Data logger for version Pro DB03.P

Memory:	up to 8.000.000 values
Channels:	up to 4: flow, consumption, temperature and pressure
Logger programming:	via app app S4C-FS (free available in google play store)
Reading the logger data:	via Windows® Software S4A via USB

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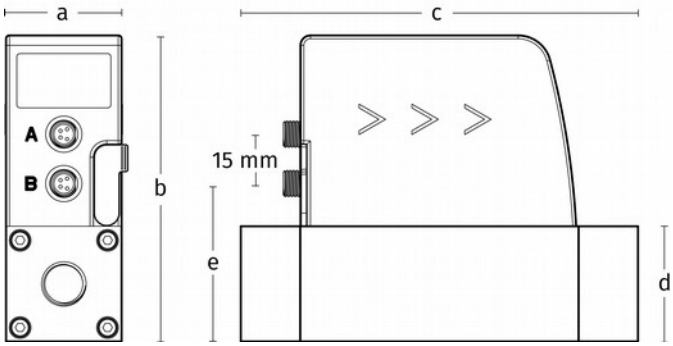
Dimensions:



Dimensions [mm]	a	b	c	d	e
DN 8 / DN 15	35,0	93,0	120,4	35,0	48,0
DN 20 / DN 25	48,0	106,0	178,0	48,0	61,0

Pressure loss:

max. pressure loss at max. flow at standard measuring range S:

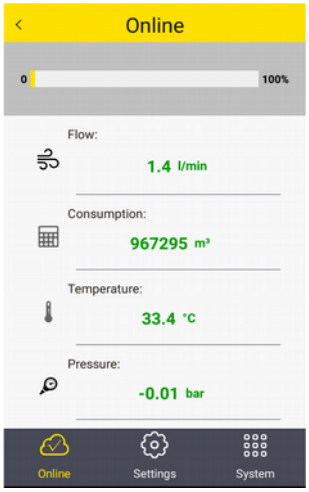
Process connection:	Pressure loss:
DN 08 (G ¼ IG)	30 mbar
DN 15 (G ½ IG)	100 mbar
DN 20 (G ¾ IG)	100 mbar
DN 25 (G 1 IG)	200 mbar

Pulse rates (version Eco and Pro):

Volume flow [m³/s]	Volume flow [m³/h]	Pulse length [ms]	Max. pulses per hour
≦ 3	≦ 10800	120	1080
> 3	> 10800	60	2880
> 6	> 21600	30	3960

Smartphone Service App S4C:

- via Bluetooth-interface
- for android systems
- QR-Code for verification



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