FläktGroup®

Compact controller for Modbus 227PM-MB

FläktGroup compact controller 227PM-MB is a complete unit comprising of an actuator for Modbus, including a dynamic differential pressure sensor for pressure-dependent control and a user interface with a 3-digit display which makes it possible to monitor pressure and set values without external equipment.
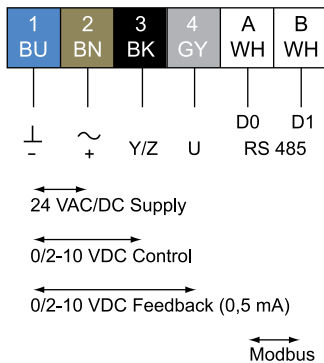
The controller can be operated via Modbus or with analogue signal, which is set to a standard value of 0 - 10V on delivery. To change operating range to 2 - 10 V see Setting the values, quick reference guide.

The controller can also be force controlled via closing contacts (timer, presence detector, etc.) to override the set min or max pressure. It is also possible to use the controller with a constant air pressure function.

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Connection diagram

Actuators are provided with color coded and numbered wires (1 m).

1 BU	2 BN	3 BK	4 GY	A WH	B WH

D0 D1

⊥   ∼   Y/Z   U   RS 485
–   +

24 VAC/DC Supply

0/2-10 VDC Control

0/2-10 VDC Feedback (0,5 mA)

Modbus

1 = BU = Blue
2 = BN = Brown
3 = BK = Black
4 = GY = Grey
A = WH = White
B = WH = White

Length:
1000 mm

Strand cross section:
4 x 0,75 mm^2
2 x 0,38 mm^2

Wiring

Observe polarity on secondary of transformers. All common and signal (–) must be connected in line. Incorrect polarity can cause controller damage or operation error. Provide overload protection for line voltage and disconnect as required. Consider voltage drops when connecting multiply actuators in parallel.

Modbus is wired according to 2-wire RS-485 rules. There can be up to 128 devices on one bus (Modbus load 1/4.) The wiring should be done using a twisted pair cable, such as Datajamak 2x(2+1)x0.24. The signal grounds of all devices on the same bus should be connected together. The bus should form a daisy chain, with the cable running from one device to the next without branches (max. branch length 10 m). The maximum bus length is 800 m. The bus should be terminated at both ends using 120 Ω resistors. The bus cable should be connected to wires A and B in the same way at every device on the bus. The terminating resistors at both ends of the bus should be connected between wires A and B.
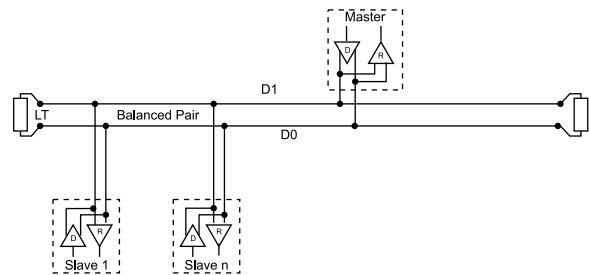
If necessary to eliminate interference, the shield of the twisted pair cable can be connected to protective ground. The connection should be made only at one end of the shield, for example always to the cable coming from the controller.

Modbus factory settings

Transmission mode	RTU
Address	1
Transfer rate	19200 bps
Data bits	8
Parity	Even
Stop bits	1
Delay	0 ms
Response time	10 ms + delay

User interface

On the cover of the actuator there are two selectors, value selector (1) and function selector (2).

Also there is the 3-digit display (3) to show selected functions, values and units.

Setting the values, quick reference guide

When the actuator is connected to power supply, settings can be made with the selectors using, for example, a screw driver.

1. Select pressure unit: A dot on the upper-right or lower-right corner of the display indicates which unit is used, Pa or in-H2Ox10-3.

If there is need for change, turn the function selector until it points to "Pres/Unit".

Then turn the value selector until the dot on the display toggles to the other position. After the selection the display flashes three dashes (- - -) twice for indication that the new setting is stored.

2. Setting up Pmax: Turn the function selector until it points to "Pmax". Then turn the value selector until the desired pressure is shown on the display. After the selection the display flashes twice for indication that the new Pmax setting is stored.

3. Setting up Pmin: Turn the function selector until it points to "Pmin". Then turn the value selector until the desired pressure is shown on the display. After the selection the display flashes twice for indication that the new Pmin is stored.

4. Select input signal range: Turn the function selector until it points to "Mode". The currently valid range is shown on the display, 0-n for 0–10 V or 2-n for 2–10 V. If there is need of change, turn the value selector until the desired range is shown on the display.

After the selection the new range is saved and the display flashes twice for indication.

Functions, detailed description

1. Value selector

The value selector allows the changing of values. The position of the arrow shows the value set. The changes are displayed as soon as the selector is moved ±10° from its position.

By turning the selector clockwise or counterclockwise the corresponding values are shown.

2. Function Selector

The function selector allows choosing the function depending on its position. If there is no function selected the display will show three dashes(- - -).
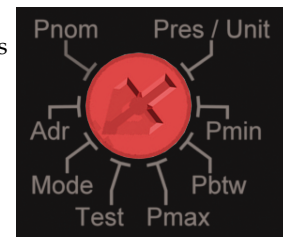
Pres / Unit

Shows the pressure in Pa or inH_2Ox10^{-3}; Diag is for diagnostic purposes. The reading is also obtained with the feedback signal U.

The display starts flashing if the actuator hits an end stop before the desired pressure has been set.

An overflow (measuring pressure difference higher than 300 Pa) is indicated on the display by a small circle.

Turning the value selector allows unit selection.
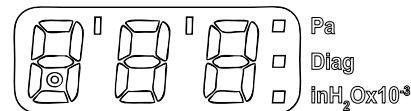
Dot on the upper-right corner of the display: the unit of pressure used is Pa.

Dot on the lower-right corner of the display: the unit of pressure used is inH_2Ox10^{-3}.

Pmin

Allows to set the desired minimum pressure for the external reference signal Y=0V/2V by turning the value selector. The selected value is shown on the display in Pa or inH_2Ox10^{-3}.

Pmax

Allows to set the desired maximum pressure for the external reference signal Y=10V by turning the value selector. The selected value is shown on the display in Pa or inH_2Ox10^{-3}.

Test

Opens the diagnose menu. All outside input signals on the Y wire are neglected and the controller only operates

according to the selected override function. All override functions are disabled after a time-out of 10 hours.

The display toggles after the selection of the function between pressure (8s showing time) and the function (2s showing time). OFF-mode toggles with Y-signal.

Selecting another function will disable the Diag function and set it automatically to OFF.

The appropriate symbols are toggled as indicator.

[display: oP] Pa Diag inH₂Ox10⁻³	oP(en) opens the actuator
[display: cL] Pa Diag inH₂Ox10⁻³	cL(ose) closes the actuator
[display: Hi] Pa Diag inH₂Ox10⁻³	Hi(gh) forces the actuator to P_{max}
[display: Lo] Pa Diag inH₂Ox10⁻³	Lo(w) forces the actuator to P_{min}
[display: on] Pa Diag inH₂Ox10⁻³	on Test mode is switched on. The actuator stays in the current position.
[display: oFF] Pa Diag inH₂Ox10⁻³	oFF Test mode is switched off. The actuator starts controlling according to external signal Y.

Mode

Allows to set the input signal range (0…10V or 2…10V) by turning the value selector. The feedback signal range of U corresponds to Y.

[display: 0 - n] Pa Diag inH₂Ox10⁻³	0-n signal range is 0-10V
[display: 2 - n] Pa Diag inH₂Ox10⁻³	2-n signal range is 2-10V

Adr

Selecting the Modbus address.

Pnom

Is used to compensate length of measuring tube. If the tube is longer than 10 m, contact FläktGroup technical support.

Input signals (analog)

Note that control signals are ignored if Modbus control is activated (see register no 123).

The input signal Y allows to control the actuator according to the selected mode of operation.

In mode 0…10VDC the input signal Y matches to the following pressures:

$$P_{act} = P_{min} + \frac{Y}{10VDC} \cdot (P_{max} - P_{min})$$

and the pressures match to

Y = 0VDC as (Pmin) and Y = 10VDC as (Pmax)

$$Y = 10VDC \cdot \frac{P_{act} - P_{min}}{P_{max} - P_{min}}$$

In mode 2…10VDC the input signal Y matches to the following pressures:

$$P_{act} = P_{min} + \frac{Y - 2VDC}{8VDC} \cdot (P_{max} - P_{min})$$

and the pressures match to

Y = 2VDC as (Pmin) and Y = 10VDC as (Pmax)

$$Y = 2VDC + 8VDC \cdot \frac{P_{act} - P_{min}}{P_{max} - P_{min}}$$

Mode 2…10VDC includes a special feature to close when the input signal Y = 0VDC.
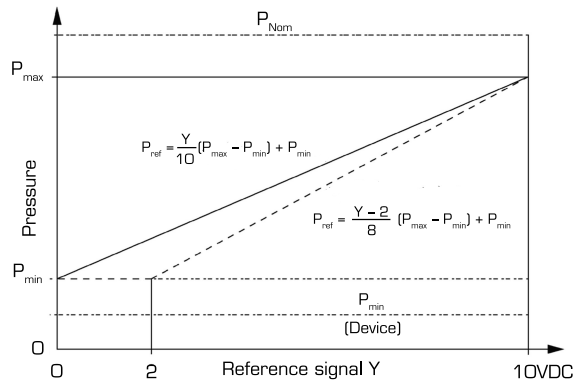
See also Fig 1. "Reference Signal Y"

Fig. 1. Reference signal Y

Output signals (analog)

In mode 0…10VDC the output signal U matches to the following pressures:

$$U = 10\text{VDC} \cdot \frac{P_{act}}{300Pa} \quad\quad U = 10\text{VDC} \cdot \frac{P_{act}}{1.2inWC}$$

and to calculate the actual pressure Pact from the feedback signal U:

$$P_{act} = P_{nom} \cdot \frac{U}{10\text{VDC}}$$

In mode 2…10VDC the output signal U matches to the following pressures:

$$U = 2\text{VDC} + 8\text{VDC} \cdot \frac{P_{act}}{300Pa}$$

$$U = 2\text{VDC} + 8\text{VDC} \cdot \frac{P_{act}}{1.2inWC}$$

and to calculate the actual pressure Pact from the feedback signal U:

$$P_{act} = 300\,Pa \cdot \frac{U - 2\text{VDC}}{8\text{VDC}}$$

$$P_{act} = 1.2\,inWC \cdot \frac{U - 2\text{VDC}}{8\text{VDC}}$$

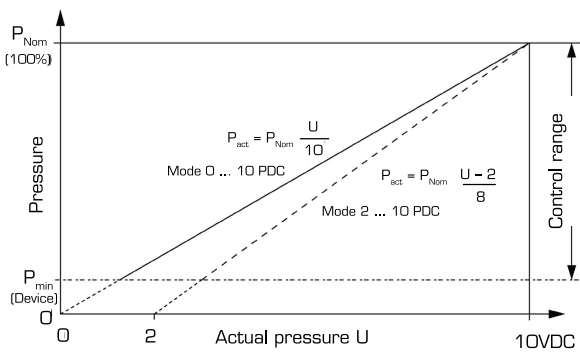See also Fig 2. "Actual pressure U"

Fig. 2. Actual pressure U

Forced controls

Note that control signals are ignored if Modbus control is activated (see register no 123).

The controller can be force controlled to the following positions via closing contacts (see fig. 3):

(Open) Y= pos. rectified half wave from 24VAC supply

(Close) Y= connected to ground conductor of 24 VAC supply (only with mode 2-10 VDC)

(Pmax) Y= full wave from 24VAC supply

(Pbtw) Y= neg. rectified half wave from 24VAC supply
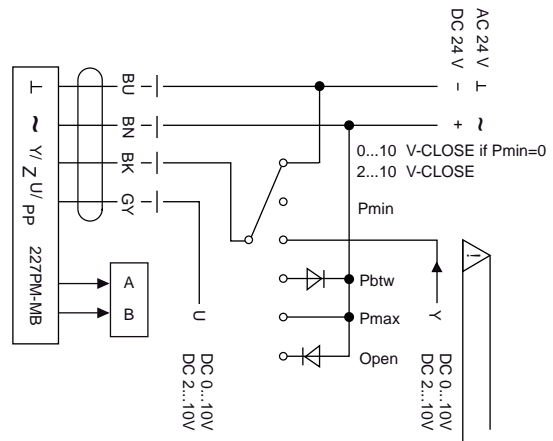
(Pmin) Y= disconnected

Fig. 3. Forced control functions

## Setting the controller to a constant pressure

The controller can be set to a constant pressure neglecting all analog inputs Y. This functionality can be used as an advanced diagnostic function.

To activate this function Pmax needs to be set to 0.

The Diag dot on the display appears and the controller uses Pmin as the constant pressure to control to. Use the Pmin function to set desired constant pressure.

Display

The display (3) uses 7-segment numbers in full 3-digits. Additional signs include a small circle, three square dots and two rectangular slashes.
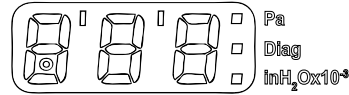
The square dots are used with the externally printed text to visualize certain functions or units (Pa, inH_2Ox10^{-3}). It is meant to denote the unit of the value shown in the display. In the shown case it could be Pa, inH_2Ox10^{-3} or activated Diag (diagnostic function).

An overflow (differential pressure above 300Pa or 1.2 inH_2Ox10^{-3}) is indicated in the display by a small circle at the first digit.

If the controller tries to match reference and actual pressures, this is shown as flashing dot of the chosen unit.

If the controller cannot meet reference and actual pressure, there will be a stop, and the complete display starts flashing to indicate this problem.

See following examples:

1 Pa

10 Pa

100 Pa
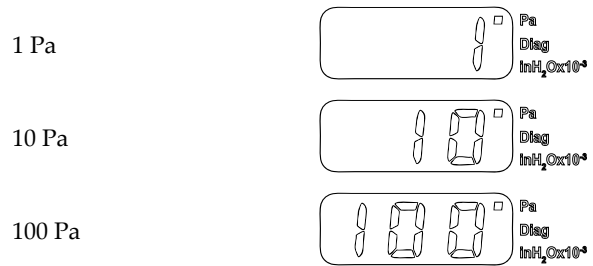
Technical data

Power supply	24 VAC/VDC ± 20%, 50/60 Hz
Over voltage	Up to 40 VDC, max. 5 sec.
Power consumption	4 VA/5Nm, 4.5 VA/10Nm
Input signal	Proportional to [P_{min} … P_{max}] 0 - 10 / 2 - 10 VDC, or 0 - 20 / 4 - 20 mA with 500 Ω resistor and override controls
Input impedance	>50 kΩ
Feedback signal	0 - 10 / 2 - 10 VDC proportional to air pressure
Permissible ambient - working temperature - storage temperature - humidity	0 °C to 50 °C (32 °F to 122 °F) -20 °C to 80 °C (-4 °F to 176 °F) 5-95% RH, non-condensing

Dimensions
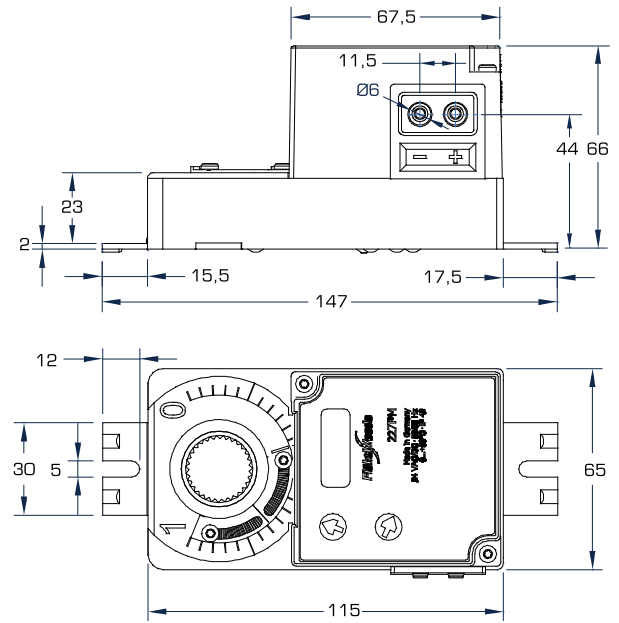
Modbus settings

The address can be selected from the range 1–247. With the function selector in the "adr" position, select the desired address using the value selector.

Hardware settings can be changed by setting the function selector to "adr" and then turning the value selector until the parameter "2in" is displayed. This opens up a sub-menu, which is indicated by a small circle on the display.

Navigating the Modbus sub-menu

With the pointer at "adr", hardware settings can be made as shown in the tables below.

For the program version 2.43 (and newer):

Display number	baudrate	parity	stop bits
1	9600	none	2
2	9600	even	1
3	9600	odd	1
4	19200	none	2
5	19200	even	1
6	19200	odd	1
7	38400	none	2
8	38400	even	1
9	38400	odd	1

Version 2.43 is introduced since January 2014.

For the program version 2.41 (and older):

Display number	baudrate	parity	stop bits
1	9600	even	1
2	9600	even	2
3	9600	odd	1
4	9600	odd	2
5	19200	even	1
6	19200	even	2
7	19200	odd	1
8	19200	odd	2
9	38400	even	1
10	38400	even	2
11	38400	odd	1
12	38400	odd	2

With the pointer at "Pnom", a delay can be set:

Some master devices require a delay when switching from transmission mode to reception mode. This response delay is added to 3.5 characters at the end of the message. The delay time is adjustable in steps of 3 ms, the maximum being 765 ms.

With the pointer at "Mode", the actual position 0–255 (0–100 %) is shown.

The pointer at "Test" = on, start adaption.

"Pmax","Pbtw","Pmin" are not in use.

With the pointer at "Pres / Unit", the main menu is displayed again.

Modbus frame

address	funktion code	data	CRC	end
1 byte	1 byte	N * 1 byte	2 byte (CRC_Lbyte, CRC_Hbyte	3,5 char

Address: between 1-247

Function codes:

function code	name	description
03h	read hold. register	device parameter/ actual values read (integer/float)
06h	write single register	device parameter single word write

The data types, that are used of each register can be found in the parameter tables.

CHAR is a 8 bit integer value. The CHAR value use the lbyte of a word register.

BYTE is a 8 bit integer value. The BYTE value use the lbyte of a word register.

WORD is a 16 bit integer value. The WORD value use the lbyte and the hbyte of a word register (except as explicitly noted otherwise).

CRC: according to "Modbus over serial line specification and implementation guide" v1.02.

End: message frames are separated by a silent interval of at least 3,5 character time.

Modbus registers

Operation values

Number	Name	Address	Data type	Value range	r/w	Description
1	setpoint	0	WORD	0…10000	r/w	setpoint [%] 0 … 100.00 matched on Pmin and Pmax Pmin = 0% Pmax = 100% see register number 123: '0': setpoint is read only
2	overide control	1	WORD	0…4	r/w	overide control '0' - - - '1' open '2' close '3' min '4' max '5' between (SW 2.43 and newer)
3	command	2	WORD	0…4	r/w	command '0' - - - '1' adaption '2' - - - '3' - - - '4' controller reset
4	device ID	3	WORD	0…3	r	device ID '0' - - - '1' standard actuator '2' VAP '3' fire damper
5	relative position	4	WORD	0…10000	r	relative position [%] 0 … 100.00 65535 = this function is not supported
6	absolute position	5	WORD	0…65000	r	absolute position [°] [mm] 0 … 650.00 65535 = this fuction is not supported
7	relative pressure	6	WORD	0…10000	r	Pressure [%] 0 … 100.00
8	absolute pressure	7	WORD	0…65535	r	Pressure [Pa] [$H_2O \times 10^{-3}$]
9	sensor value	8	WORD	[mV] 0..10000	r	external sensor value [mV] 0 … 10000

Service values

The values are used only when commissioning the damper or monitoring status. Do not write values constantly to the Service registers.

Number	Name	Address	Data type	Value range	r/w	Description
101	serial number 1	100	WORD	101..9912	r	serial number JJMM
102	serial number 2	101	WORD	100..3123	r	serial number DDHH
103	serial number 3	102	WORD	01..59599	r	serial number MMSSX X = test number
104	software version	103	WORD	1..65535	r	software version
105	service information	104	WORD	0..65535	r	See table status-register
106	min value relative	105	WORD	0..10000	r/w	min value [%] 0 .. 100.00
107	max value relative	106	WORD	0…10000	r/w	max value [%] 0 .. 100.00
108	sensor type	107	WORD	0…4	r/w	sensor type '0' - - - '1' active sensor [mV] '4' Digital 0/1
109	bus fail position	108	WORD	0..2	r/w	bus fail position '0' last set point, no bus monitoring '1' at timeout position close, bus monitoring timeout 120 seconds '2' at timeout position open, bus monitoring timeout 120 seconds
121	min value absolute	120	WORD	0..65535	r/w	min value [Pa] [$H_2O \times 10^{-3}$]
122	max value absolute	121	WORD	0..65535	r/w	max value [Pa] [$H_2O \times 10^{-3}$]
123	signal set point	122	WORD	0…1	r/w	input signal set point '0' analog signal Y '1' communication via Modbus register number 1

Modbus registers

Status register

bit	function/status	
0	0 = Everything Ok. 1 = The checksum of KAT1 eeprom area is corrupt. It has not been correctly written to this area.	–> The actuator can't work.
1	0 = Everything Ok. 1 = The checksum of KAT2 eeprom area is corrupt. It has not been correctly written to this area.	–> The actuator can't work.
2	0 = The KAT1 area is lock. Every write access is denied. 1 = The KAT1 area is free for writing.	–> Free access to area KAT1
3	0 = The KAT2 area is lock. Every write access is denied. 1 = The KAT2 area is free for writing.	–> Free access to area KAT2
4	0 = Everything Ok. 1 = Fatal Error Bit0 or Bit1 or both have an error.	–> The actuator can't work.
5	0 = Everything Ok. No blockage. 1 = The actuator has detected a blockage.	–> The actuator stopped.
6	0 = Everything Ok. 1 = The actuator has detected a seepage flow.	–> The actuator drive into position close.
7	0 = The actuator has stopped. 1 = The actuator is driving.	