

Technical Standard for the PillAerator and the BrainBox



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1 Scope Of Application

This technical standard establishes the requirements for the installation of the Pillaerator turbo compressor and the conditions to be observed during operation. It also defines the ways available in the standard to integrate the Pillaerator/Pillaerators with and without BrainBox in PLC provided by the customer and it determines the standard for communication/data exchange with a PLC provided by the customer.

The technical standard defined here is binding and constitutes part of our offers and order confirmations. Any other agreements will only be accepted if expressly specified and recorded in the order negotiations and confirmed in writing by both parties. Changes to the scope of service and delivery are possible after the order confirmation has been sent through a supplementary offer and order, although this may result in the originally confirmed delivery times and/or dates losing their validity.

2 Installation Conditions

The casing of the Pillaerator corresponds to protection type IP 21. The unit may only be indoors installed out of direct sunlight and with sufficient air conditioning to ensure the specified operating ambient temperature range.

Dimensions and weight are specified on the dimension and data sheet.

If the Pillaerator sucks the process air from the room where it is installed, it must be ensured that said room has a sufficient amount of air (see characteristic data). It must be ensured that the air quality corresponds to Table 1 for both the process air and the standard atmosphere ambient air.

For Pillaerators HP4000, MP6000 and LP8000, the thermal output to be dissipated from drive components of max. 10 kW up to ambient/cooling air inlet temperatures of approx. 35 °C is routed out (into the installation site) via the integrated air/water cooler. For types HP9000, MP12000 and LP14000 the thermal output to be dissipated is approx. 20 kW, which is routed out via the air/water cooler at ambient/cooling air inlet temperatures of approx. 35 °C, see Table 3 and Table 5.

This causes the temperature in the installation site to increase **if sufficient air conditioning is not present**. If the specified cooling air inlet temperature is exceeded, an external supply of cooling water is necessary, see Table 3 and Table 5. The max. operating ambient temperature permitted must not be exceeded!

Noise emissions:

The evaluated sound pressure level of a Pillaerator at 1 m distance from the compressor cabinet is ≤80 dB(A) (under free-field conditions). Prerequisite for this is that the pressure-side pipeline is insulated and does not contribute to the noise emissions. The sound pressure level in the pipeline is significantly higher depending on the Pillaerator type.

3 Ambient Conditions:

Air Quality: Standard atmosphere, see Table 1
 Perm. operating ambient temperature: -10 °C – 35 °C
 (max. 40°C see remarks Table 3 and Table 5)
 +0 °C – 55 °C (only with installed cooling device)
 Perm. operating ambient humidity: 15 % – 95 %
 Maximum installation height: 0 – 1000 m above sea level without power reduction
 1000 - 2000 m, from 1000 m 1 % power reduction per 100 m
 Perm. intake temperature of process air: -30 °C – 55 °C

Permitted contamination of process and ambient air with chemically active substances in accordance with DIN EN 60721-3-3:

Chemically Active Substance	Unit	Mean Value	Limit Value
Sulfur dioxide SO ₂	[mg/m ³]	0,3	1,0
Hydrogen sulfide H ₂ S	[mg/m ³]	0,1	0,5
Chlorine Cl	[mg/m ³]	0,1	0,3
Hydrogen chloride HCl	[mg/m ³]	0,1	0,5
Hydrogen fluoride HF	[mg/m ³]	0,01	0,03
Ammonia NH ₃	[mg/m ³]	1,0	3,0
Ozone O ₃	[mg/m ³]	0,05	0,1
Nitrogen oxides NO _x (in equivalent values to nitrogen dioxide)	[mg/m ³]	0,5	1,0
Dust content	[mg/m ³]	≤ 5	≤ 5

Table 1: Permitted contamination of process and ambient air with chemically active substances in accordance with DIN EN 60721-3-3

4 Operating different compressors on one manifold

It is possible to combine the different variants of the PillAerator turbo compressor with each other and with compressors of different types on one pipeline. The following items must be observed in order to ensure common operation:

- The minimum distances behind the check valve, as indicated in the dimensions sheet, must be maintained.
- The manifold must be chosen to be large enough so that the flow velocity in the pipeline after joining the individual lines is not greater than within the individual lines. That is: $\text{area of manifold} \geq \text{total of areas of individual pipelines}$
- The process air of the individual compressors may not meet in opposing directions.

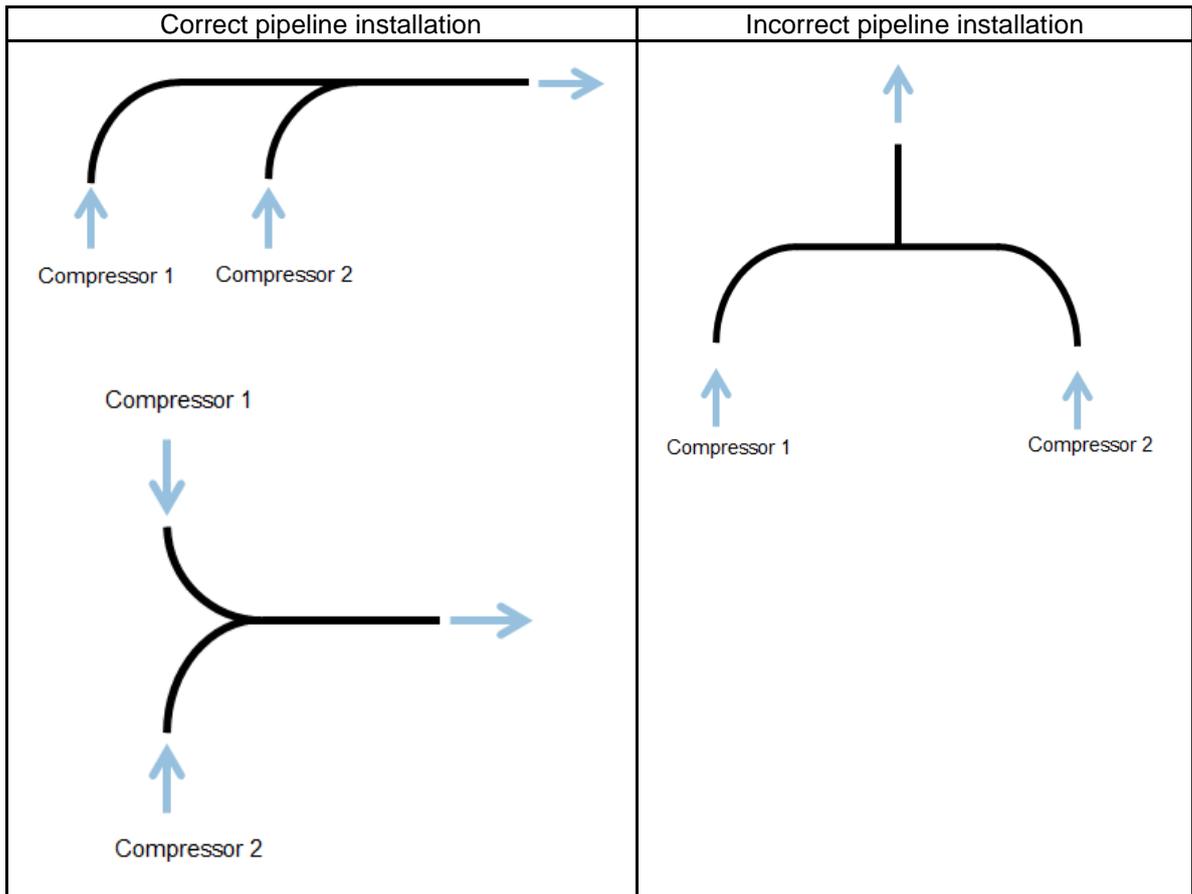
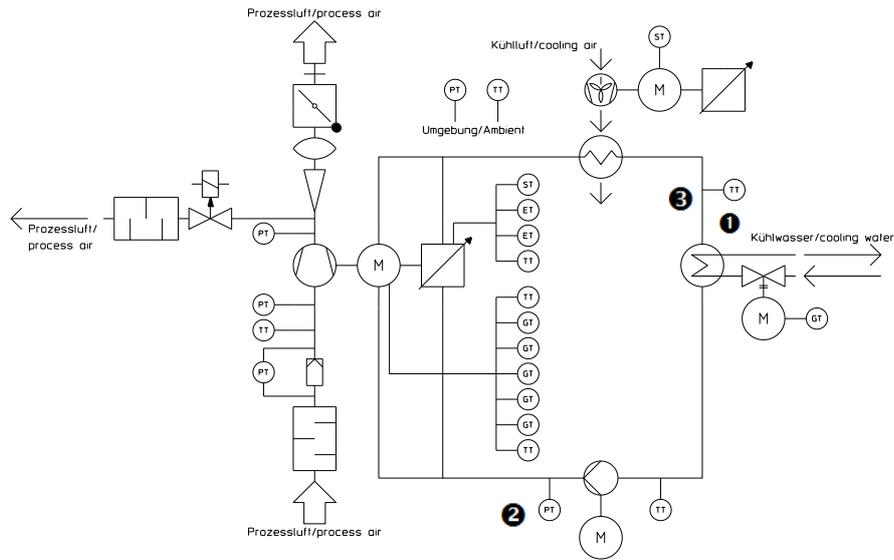


Figure 1: Pipeline Installation

- When connecting another compressor, the compressors already running must have sufficient distance from the surge limit. It is recommended to select the start-up speed or the volumetric flow which occurs at this speed (see characteristic diagram) as the minimum speed or minimum volumetric flow when connecting.
- The pressure regulation control mode and external actual value control are not recommended when using a manifold. The volumetric flow control represents the safest method for operating multiple compressors on a manifold.

5 P&ID



Kennbuchstaben fuer Instrumentenkennzeichnung nach ISO 3511		
Letter code for identification of instrument functions acc. ISO 3511		
Erstbuchstabe First letter		Folgebuchstabe (Reihenfolge I R C T O S Z A) Succeeding letter (sequence I R C T O S Z A)
Mess- oder andere Eingangsgrösse Measured or inihaling variable	Ergänzungsbuchstabe Modifier	Anzeige oder Ausgabe Funktion Display or output function
E elektrische Grösse All electrical variables	elektrische Grösse All electrical variables	
G Position, Stellung Gauging, position or length		
P Druck Pressure or vacuum		
S Geschwindigkeit, Drehzahl Speed or frequency		Steuerungs-Schaltfunktion Switching
T Temperatur Temperature		Uebertragen Transmitting

Figure 2: P&ID

According to different versions the P&ID may deviate in the following points.

- ❶ The external cooling water connexions are an option
- ❷ Pressure transmitter or pressure switch
- ❸ Temperature transmitter existent/inexistent

6 Connections

6.1 Electrical Connections

Attention: For PillAerators, no earth leakage circuit breakers can be used due to high levels of earth leakage current.

Connected voltage:

Standard:

3 ~ 400 V AC / 50 Hz, PE, clockwise rotating field
(alternatively TN-C system also possible),

North American version:

3 ~ 480 V AC / 60 Hz, PE, clockwise rotating field
(alternatively TN-C system also possible)
(Please inquire for different supply voltage!)

6.1.1 HP4000, MP6000 und LP8000:

Connected power:

180 kVA

Standard nominal current:

260 A

Nominal current of North American version:

220 A

Maximum cable cross section per phase:

according DIN VDE 0298-4, depending cable type, cable length, laying system, allowable cable temperature, e. g.:
single conductor copper, static wiring system in air with contact: 120 mm²

Maximum cable cross section:

finely stranded conductor 300 mm²
Stranded conductor with sleeve 240 mm²

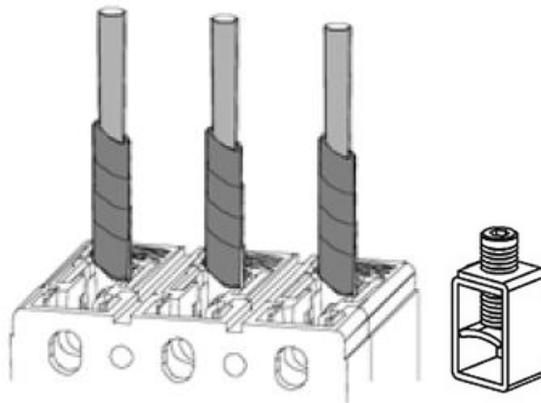


Figure 3: electrical connections HP4000, MP6000 and LP8000

6.1.2 HP9000, MP12000 und LP14000:

Connected power:

360 kVA

Standard nominal current:

520 A

Nominal current of North American version:

435 A

Maximum cable cross section per phase:

according DIN VDE 0298-4, depending cable type, cable length, laying system, allowable cable temperature, e. g.:
single conductor copper, static wiring system in air with contact: 240 mm²

Maximum cable cross section:

4 x 240 mm²

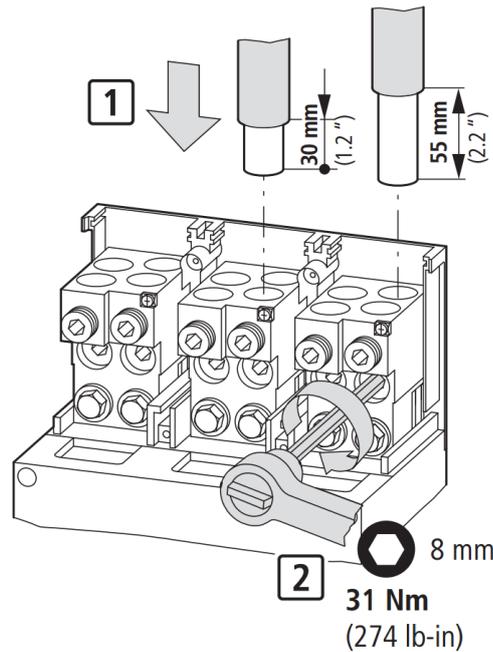


Figure 4: electrical connections HP9000, MP12000 and LP14000

The cable cross section required for the respective connected power depends on the cable type used, the laying system and the actual cable length.

6.2 External Cooling Water Connection

From an operating ambient temperature of approx. 35 °C, cooling water is to be provided by the client at the connection points marked in the operating manual, in accordance with the following requirements:

Water quality: Industry, salt, brackish water
 Cooling water pH value: 5 – 8.5
 Connection pressure: min.: 1 bar
 max.: 4 bar

The client must equip the cooling water inflow with a filter with a mesh size of 0.5 mm.

6.2.1 HP4000, MP6000 und LP8000:

Inflow temperature: 5 – 35 °C (cooling air temperature 40 °C, see Table 3)
 Cooling water connection: 18L male thread
 Inflow: max. 25 l/min

6.2.2 HP9000, MP12000 und LP14000:

Inflow temperature: 5 – 30 °C (cooling air temperature 40 °C, see Table 5)
 Cooling water connection: 28L male thread
 Inflow: max. 50 l/min

6.3 Determination of maximum permissible Cooling Air and Cooling Water Temperatures at full Load

6.3.1 for HP4000, MP6000 und LP8000

Air/water cooler		
Power loss:	10	kW
Flow	30	l/min
Air flow:	2,4	kg/s
P ₀₁ :	1,0	kW/K
Medium:	water/glycol 77/23	
c _p (water):	4,183	kJ/kg/K
c _p (glycol):	2,4	kJ/kg/K
c _p res:	3,94	kJ/kg/K
Flow temperature:	40	°C
Δt (coolant)	5,08	K

Water / water cooler		
Power loss:	10	kW
Flow:	30	l/min
Cooling water:	25	l/min
P ₀₁ :	0,66	kW/K
Medium:	water	
c _p (water):	4,183	kJ/kg/K

Table 2: Performance Data Air-Water Cooler and Water-Water Cooler for HP4000, MP6000 and LP8000

Power loss at full load P _v (kW)	Return temp. t _R (°C)	Power loss a/w cooler P _{v1} (kW)	Air inlet temp. t _{LE} (°C)	Air outlet temp. t _{LA} (°C)	Temp. water after a/w cooler t _z (°C)	Power loss w/w cooler P _{v2} (kW)	Cooling water inlet temperature t _{KWE} (°C)	Cooling water outlet temperature t _{KWA} (°C)	Feed temp. t _v (°C)
10	45,1	10	35,1	39,2	40,0	0	40,0	40,0	40
10	45,1	8	37,1	40,4	41,0	2	38,0	39,1	40
10	45,1	6	39,1	41,6	42,0	4	36,0	38,3	40
10	45,1	4	41,1	42,7	43,0	6	34,0	37,4	40
10	45,1	2	43,1	43,9	44,1	8	31,9	36,5	40
10	45,1	0	45,1	45,1	45,1	10	29,9	35,7	40

Table 3: Maximum permissible cooling air and cooling water temperatures for HP4000, MP6000 and LP8000

Note:

Table 2 indicates the maximum permissible cooling air and cooling water temperatures when splitting the cooling efficiency needed at full load between both coolers. **Attention: Cooling air temperatures ≥ 40 °C (highlighted grey) require a cooling unit for the switch cabinet if the cooling air is taken directly from the installation site.**

Example:

At a cooling air inlet temperature of approx. 41 °C the air/water cooler reaches a cooling efficiency of approx. 4 kW. The remaining 6 kW have to be conducted by the water/water cooler. In order to reach this, the cooling water temperature can only be 34 °C at most.

6.3.2 for HP9000, MP12000 und LP14000

Air/water cooler		
Power loss:	20	kW
Flow	76	l/min
Air flow:	2,7	kg/s
P ₀₁ :	1,47	kW/K
Medium:	water/glycol 77/23	
c _p (water):	4,183	kJ/kg/K
c _p (glycol):	2,4	kJ/kg/K
c _{p,res} :	3,94	kJ/kg/K
Flow temperature:	40	°C
Δt (coolant)	4,4	K

Water/water cooler		
Power loss:	22	kW
Flow:	76	l/min
Cooling water:	50	l/min
P ₀₁ :	0,8	kW/K
Medium:	water	water
c _p (water):	4,183	kJ/kg/K

Table 4: Performance Data Air-Water Cooler and Water-Water Cooler for HP9000, MP12000 and LP14000

Power loss at full load	Return temp.	Power loss a/w cooler	Air inlet temp.	Air outlet temp.	Temp. water after a/w cooler	Power loss w/w cooler	Cooling water inlet temp.	Cooling water outlet temp.	Feed temp.
P _v (kW)	t _R (°C)	P _{v1} (kW)	t _{LE} (°C)	t _{LA} (°C)	t _z (°C)	P _{v2} (kW)	t _{KWE} (°C)	t _{KWA} (°C)	t _v (°C)
20	44,0	20	34,9	39,1	40,0	0	40,0	40,0	40
20	44,0	16	36,7	40,1	40,8	4	36,6	37,7	40
20	44,0	12	38,6	41,1	41,6	8	33,2	35,5	40
20	44,0	8	40,4	42,0	42,4	12	29,8	33,2	40
20	44,0	4	42,2	43,0	43,2	16	26,4	31,0	40
20	44,0	0	44,0	44,0	44,0	20	23,0	28,7	40

Table 5: Maximum permissible cooling air and cooling water temperatures for HP9000, MP12000 and LP14000

Note:

Table 5 indicates the maximum permissible cooling air and cooling water temperatures when splitting the cooling efficiency needed at full load between both coolers. **Attention: Cooling air temperatures ≥ 40 °C (highlighted grey) require a cooling unit for the switch cabinet if the cooling air is taken directly from the installation site.**

Example:

At a cooling air inlet temperature of approx. 38 °C the air/water cooler reaches a cooling efficiency of approx. 12 kW. The remaining 8 kW have to be conducted by the water/water cooler. In order to reach this, the cooling water temperature can only be 33 °C at most.

6.4 Connection of Ductwork on Pressure Site

The following components can be sourced from PillAerator GmbH or have to be provided by the customer in the indicated quality. A deviation from the alignment is possible upon request.

6.4.1 for HP4000, MP6000, LP8000

The discharge side must be connected from left to right as shown in Figure 5 with the following components.

Components

Part	Designation	Dimension	Standard	Material
1	Bolts	M16x55	DIN 933	A4-70
2	Housing flange			G-AISI 7 Mg
3	Small seal			AFM-30
4	Washers	A17	DIN 125	A4-70
5	Nuts	M16	DIN 934	A4-70
6	Transition piece			1.4301
7	Bolts	M20x55	DIN 933	A4-70
8	Large seal			AFM-30
9	Washers	A21	DIN 125	A4-70
10	Nuts	M20	DIN 934	A4-70
11	Capacitor			1.4571/1.0038
12	Bolts	M20x100	DIN 931	A4-70
13	Check valve			C22.8/1.4571/FPM
14	Washers	A21	DIN 125	A4-70
15	Nuts	M20	DIN 934	A4-70
16	Discharge line (customer)			

Table 6: Components to connect HP4000, MP6000 and LP8000 pressure site

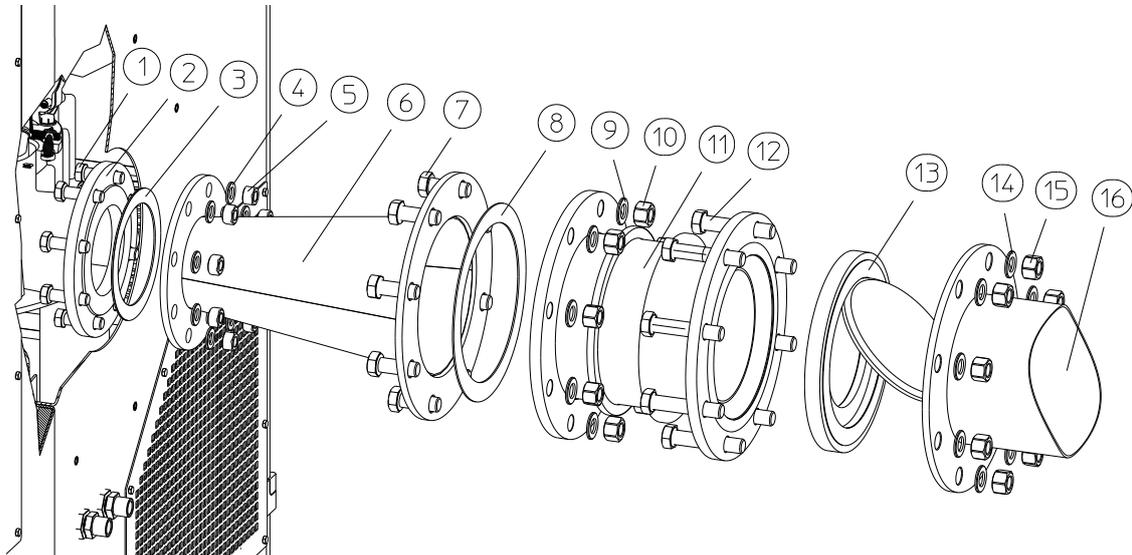


Figure 5: Connection of the discharge line HP4000, MP6000, LP8000

6.4.2 for HP9000, MP12000, LP14000

The discharge side must be connected from left to right as shown in Figure 6 with the following components.

Components

Part	Designation	Dimension	Standard	Material
1	Bolts	M16x65	DIN 933	A4-70
2	Housing flange			G-AISI 7 Mg
3	Small seal			AFM-30
4	Washers	A17	DIN 125	A4-70
5	Nuts	M16	DIN 934	A4-70
6	Transition piece			1.4301
7	Nuts	M24	DIN 934	A4-70
8	Washers	A25	DIN 125	A4-70
9	Large seal			AFM-30
10	Bolts	M24x80	DIN 931	A4-70
11	Capacitor			1.4541/1.0038
12	Bolts	M24x140	DIN 931	A4-70
13	Check valve			C22.8/FPM
14	Washers	A25	DIN 125	A4-70
15	Nuts	M24	DIN 934	A4-70
16	Discharge line (customer)			
17	Nuts	M20	DIN 934	A4-70
18	Washers	A21	DIN 125	A4-70
19	End plates			1.4571
20	Bolts	M24x160	DIN 931	A4-70
21	Bolts	M24x100	DIN 931	A4-70
22	Threaded bolt	M20	DIN 934	A4-70

Table 7: Components to connect HP9000, MP12000 and LP14000 pressure site

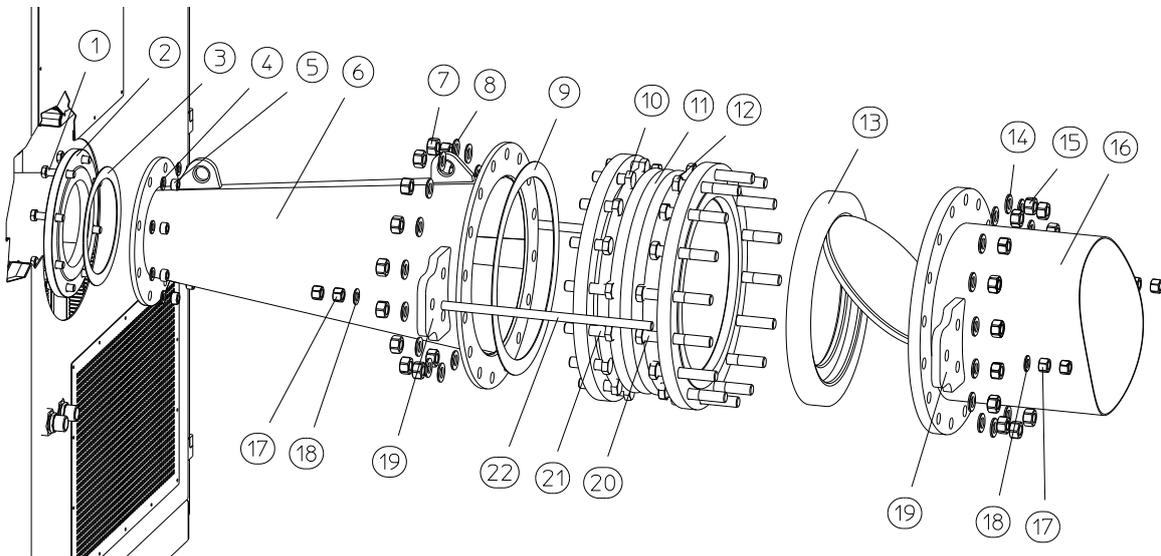


Figure 6: Connection on discharge side HP9000, MP12000, LP14000

6.5 Integration in the Emergency Off circuit

The following options are available to the user in order to integrate the PillAerator into the customer's Emergency Off wiring.

Emergency Off						
Option	Function		HP4000, MP6000, LP8000		HP9000, MP12000, LP14000	
	Emergency Off button Compressor	Emergency Off button Customer system	Wire bridges to be removed	Terminals to be connected	Wire bridges to be removed	Terminals to be connected
1	Stops this compressor	Inactive	none	none	none	none
2	Stops this compressor	Stops all compressors	7-8 11-12	7/8 to customer's normally open contacts channel 1 11/12 to customer's normally open contacts channel 2	1-6 2-8	1/6 to customer's normally open contacts channel 1 2/8 to customer's normally open contacts channel 2
3	Stops all compressors	Stops all compressors	5-6 7-8 9-10 11-12	6/7 to customer's Emergency Off button channel 1 10/11 to customer's Emergency Off button channel 2 5/8 to customer's normally open contacts channel 1 9/12 to customer's normally open contacts channel 2	1-6 2-8 3-7 4-5	1/4 to customer's Emergency Off button channel 1 2/3 to customer's Emergency Off button channel 2 5/6 to customer's normally open contacts channel1 7/8 to customer's normally open contacts channel2

Table 8: Emergency Off Options

NOTE A combination of the individual Emergency Off options is not possible.

The following options are available for the Emergency Off acknowledgment function.

Emergency Off Acknowledgment						
Option	Function		HP4000, MP6000, LP8000		HP9000, MP12000, LP14000	
	Emergency Off acknowledgment button compressor	Emergency Off acknowledgment button Customer system	Wire bridges to be removed	Terminals to be connected	Wire bridges to be removed	Terminals to be connected
1	Acknowledges this compressor	Inactive	none	none	none	none
2	Inactive	Acknowledges all compressors	13-14 15-16	13/16 to customer's normally open contacts	9-12 10-11	9/10 to customer's normally open contacts
3	Acknowledges all compressors	Acknowledges all compressors	13-14 15-16	13/16 to customer's normally open contacts 14/15 to customer's acknowledgment button	9-12 10-11	9/10 to customer's normally open contacts 11/12 to customer's acknowledgment button

Table 9: Emergency Off Acknowledgment Options

NOTE A combination of the individual Emergency Off acknowledgment options is not possible.

The wiring of the Emergency Off circuit is shown for Emergency Off option 3 and Emergency Off acknowledgment option 3 for both sizes in Figure 7.

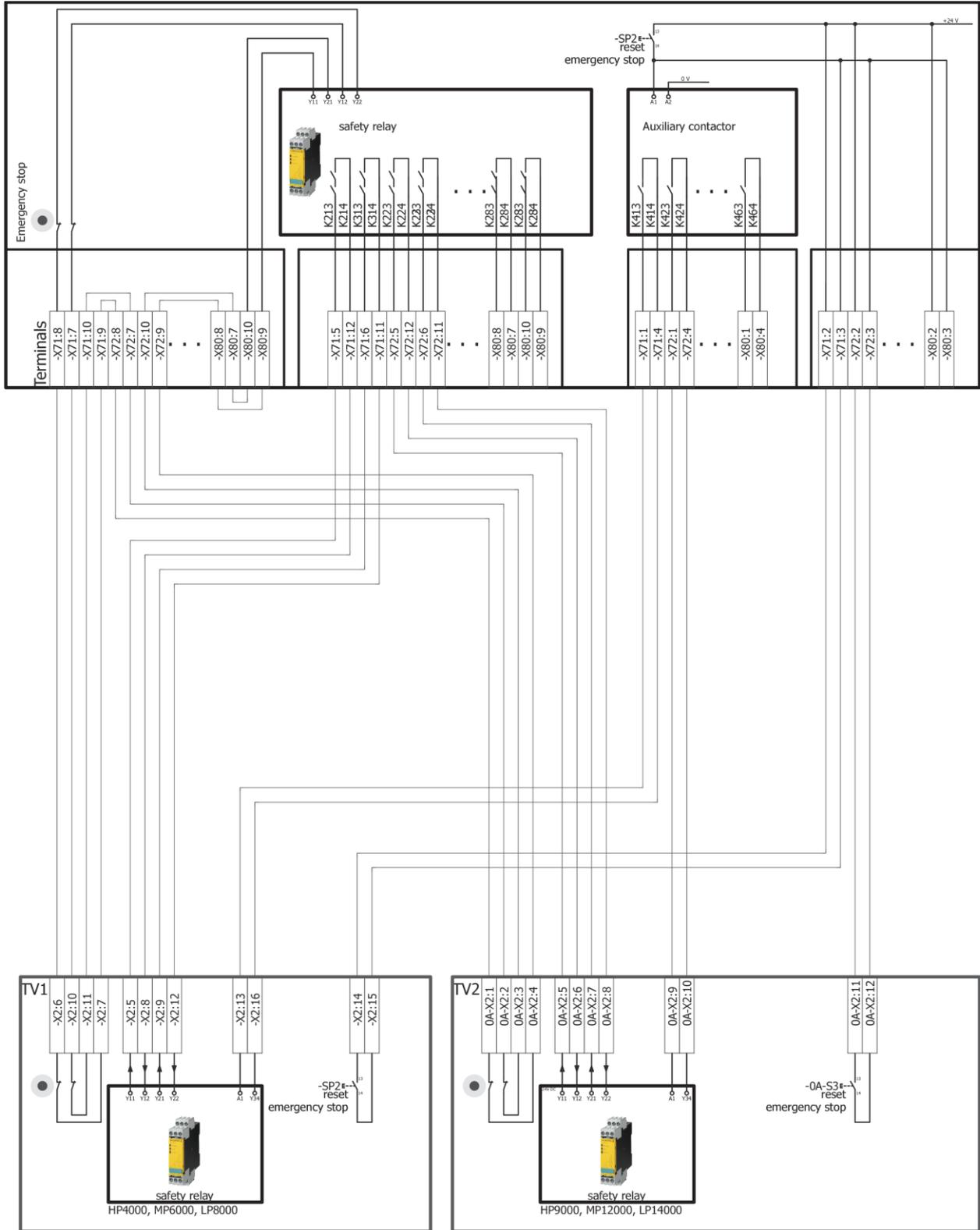


Figure 7: Wiring diagram, Emergency Off and Emergency Off acknowledgement

7 PillAerator Incorporation in a Client-installed System Control

The PillAerator comes as standard with one analog and one Profibus DP interface for controlling and monitoring. The desired interface can be activated on the HMI (operating display) (see operating manual). A connection via both interfaces at the same time is not possible.

Its default configuration is the interface specified on the order.

7.1 Analog Interfaces

Table 8 shows the signal scope, terminal assignment and signal type of the analog interface. The analog interface is described in detail in the operating manual.

The set point value definition can/must be assigned and scaled to the respective required controller (pressure, volume flow or external actual value) or a speed controller on the PillAerator control unit, see operating manual.

No.	Signal designation	Terminal		Signal type
		HP4000, MP6000, LP8000	HP9000, MP12000, LP14000	
1	Start	X5.1, X5.2	X5.1, X5.2	DC24V
2	Set point value	X6., X6.2	X5.4, X5.5, X5.6, X5.7	4..20 mA
3	Actual value	X6.3, X6.4	X5.9, X5.10, X5.11, X5.12	4..20 mA
4	System ready for operation	X5.3, X5.4	X5-40: 3/4	DC24..120V / 5A o. AC24..230V /5A
5	System in operation	X5.11, X5.12	X5-44: 3/4	DC24..120V / 5A o. AC24..230V /5A
6	Group warning	X5.5, X5.6	X5-41: 3/4	DC24..120V / 5A o. AC24..230V /5A
7	Group fault	X5.7, X5.8	X5-42: 3/4	DC24..120V / 5A o. AC24..230V /5A
8	Warning, performance limit	X5.9, X5.10	X5-43: 3/4	DC24..120V / 5A o. AC24..230V /5A
9	Fault, surge limit	X5.13, X5.14	X5-45: 3/4	DC24..120V / 5A o. AC24..230V /5A
10	Fault, inlet temperature	X5.15, X5.16	X5-46: 3/4	DC24..120V / 5A o. AC24..230V /5A
11	Emergency stop, push-botton channel 1 from external	X2.6, X2.7	0A-X2: 1/4	24 VDC
12	Emergency stop, push-botton channel 2 from external	X2.10, X2.11	0A-X2: 2/3	24 VDC
13	Emergency stop, external con-tactor enabling channel 1	X2.5, X2.8	0A-X2: 5/6	24 VDC
14	Emergency stop, external con-tactor enabling channel 2	X2.9, X2.12	0A-X2: 7/8	24 VDC
15	Emergency stop reset, from external	X2.13, X2.16	0A-X2: 9/10	24 VDC
16	Emergency stop reset, transfer with push-botton to external	X2.14, X2.15	0A-X2: 11/12	24 VDC

Table 10: Signal scope, terminal assignment and signal type of the analog interface

Note:

The signals No. 4-10 are provided with logic 1 in the standard. This means that the corresponding poten-tial-free output relays have activated when the event occurs.

Other signals cannot be provided via the analog interface. If an additional scope of data is re-quired than this is only possible by using the Profibus interface.

7.2 Profibus DP Incorporation

In the standard configuration, the control unit is configured as a slave with the Profibus DP address 11. If several PillAerators are delivered as one order, the DP addresses for the further PillAerators will be incremented by one (12, 13, 14...). **The allocated DP address is specified on the labeling strip on the CPU (K1).**

Table 11 and Table 12 show the addresses and data that are read (input) and written (output) via the Profibus by default. **It must be ensured that the peripheral input and output range of the compressor controller begins with 1000.**

Table 11 shows the input addresses and data read from the PillAerator (slave) via the Profibus. It must be ensured that the address 1002 is used to allocate the set point value in accordance with the selection (speed, pressure flow, volume flow or external actual value control mode) made on the HMI (operating panel) through the client-installed Master and that the set point value is scaled accordingly on the HMI (control panel). The external actual value is read from the Master with the address 1006 if the 'External actual value control' mode is activated.

Profibus PillAerator - Standard				
Address of the Profibus interface: 11				
Block	I/O	Size:	Consistency	Local PB address
2	Output	32 Byte	Total	1000
4	Output	8 Byte	Total	1032 Reserved for internal use
5	Output	10 Byte	Total	1040
6	Output	16 Byte	Total	1056
Block	I/O	Size:	Consistency	Local PB address
1	Input	14 Byte	Total	1000
3	Input	8 Byte	Total	1032 Reserved for internal use
Local PB address	Type	Description		Block
1000.0	BOOL	Start When TRUE, then PillAerator controller enabled		1
1000.1	BOOL	Reset When TRUE, then reset current fault		1
1001.7	BOOL	Life bit (0,5 Hz) The life bit switches between TRUE and FALSE at a clock rate of 0.5 Hz. Operation via Profibus is not possible without the life bit		1
1002	REAL	Set point value [0 - 100 %] Set point value as per the selection on the user interface (speed, pressure, volumetric flow or external actual value)		1
1006	REAL	Actual value [0 - 100 %] If "external actual value" mode is selected on the user interface, this value is used for control		1

Table 11: Profibus input addresses and data

Table 12 shows the output addresses and data provided in the standard configuration on the Profibus from the PillAerator (slave).

It has to be observed, that:

- The baud rate for the Profibus is set to **1.5 MBit** by default and can only be changed by a PillAerator GmbH technician.
- **The same baud rate of 1.5 MBit/s is set on the customer's PLC.**
- There is a cycle time of ≤ 1 s on the customer's PLC so that the state change of the live bit described below is securely registered. If this should not be the case, this is interpreted by the PillAerator PLC as a **failure of the Profibus connection**.
- the address 1001.7 is used to receive the life bit. If within a period of 2 seconds no alternation of the life bit takes place, than the Profibus connection is considered as interrupted. In this case the PLC of the PillAerator generates a fault and all connected PillAerators are stopped. If the Profibus connection is again available the occurred fault message has to be acknowledged.

- the address 1028 is used to provide the time of operation (second accurate) of the PillAerator on the Profibus
- the address 1040 is used to provide the warnings **encoded bit wise** on the Profibus, see also comments in chapter 7.2, table 9 and listing of warnings in the operation manual)
- the address range 1042 – 1048 is used to provide the fault messages **encoded bite wise** on the Profibus, see also comments in chapter 7.2, table 9 and listing of fault messages in the operation manual.

Profibus PillAerator - Standard				
Address of the Profibus interface: 11				
Block	I/O	Size:	Consistency	Local PB address
2	Output	32 Byte	Total	1000
4	Output	8 Byte	Total	1032 Reserved for internal use
5	Output	10 Byte	Total	1040
6	Output	16 Byte	Total	1056
Block	I/O	Size:	Consistency	Local PB address
1	Input	14 Byte	Total	1000
3	Input	8 Byte	Total	1032 Reserved for internal use
Local PB address	Type	Description		Block
1000.0	BOOL	On TRUE, if the PillAerator is running.		2
1000.1	BOOL	Ready for operation TRUE, if the plant is ready.		2
1000.2	BOOL	Group warning TRUE, if warnings are queued		2
1000.3	BOOL	Group fault TRUE, if faults are queued		2
1000.6	BOOL	Bypass closed TRUE, if the bypass valve is closed.		2
1000.7	BOOL	External enabled TRUE, if external enabled (digital input) is selected on the control panel		2
1001.0	BOOL	Warning performance limit reached TRUE, if the warning limit is reached		2
1001.1	BOOL	Fault performance limit reached TRUE, if the performance fault limit is reached		2
1001.2	BOOL	Pump limit fault reached TRUE, if the actual volume flow drops below the volume flow defined by the pump limit		2
1001.3	BOOL	Fault, inlet temperature too high TRUE, if the fault limit of the inlet temperature is exceeded		2
1001.5	BOOL	DP_On Start- / Stop via Profibus TRUE, if Start- / Stop via Profibus is selected on the control panel.		2
1001.6	BOOL	DP set point value via Profibus TRUE, if set point value via Profibus is selected on the control panel.		2
1001.7	BOOL	Life bit (0,5 Hz) The life bit switches between TRUE and FALSE at a clock rate of 0.5 Hz.		2
1002	REAL	External set point [0 - 100 %] Indicates the external set point at the Profibus.		2
1006	REAL	Speed [%] Actual speed of all running PillAerators in % of max. speed.		2
1010	REAL	Motor current [A] Actual motor current of all running servo drive controllers in summation.		2
1014	REAL	Motor power [kW] Actual motor power from the servo drive controller		2
1018	REAL	Pressure [bar] Measured pressure difference at outlet		2
1022	REAL	Volume flow [m ³ /s] Calculated volume flow at outlet		2
1026	INT	Density [kg/m ³] Calculated density at inlet		2
1028	DINT	Operating hours [s] Operating hours (exact to the second)		2
1040	WORD	Warnings Warnings (list in the operating manual)		5
1042	WORD	Faults 1 Fault messages (list in the operating manual)		5
1044	WORD	Faults 2 Fault messages (list in the operating manual)		5
1046	WORD	Faults 3 Fault messages (list in the operating manual)		5
1048	WORD	Faults 4 Fault messages (list in the operating manual)		5
1058	REAL	Filter contamination [%] Contamination level of the filter in%. 100% corresponds to the warning threshold. See operating manual.		6
1062	REAL	Inlet temperature [°C] Measured temperature at compressor inlet		6
1068	WORD	Faults 4 Fault messages (list in the operating manual)		6

Table 12: Profibus output addresses and data

Other signals can only be implemented and provided via the Profibus interface through a software extension. An extension of the scope of data requires precise specification from our sales staff and testing and release by the development department. An extension or modification (signal inversion) of the Profibus interface will incur a charge. If this is required, please contact our sales department.

8 BrainBox Incorporation in a Client-installed System Control

The Brainbox comes with one analog and one Profibus DP interface for controlling and monitoring. The desired interface can be activated on the HMI (operating display) (see operating manual).

Its default configuration is the interface specified on the order.

8.1 Analog Interfaces

Table 13 shows the signal scope, terminal assignment and signal type of the analog interface. The analog interface is described in detail in the operating manual.

The set point value definition can/must be assigned and scaled to the respective required controller (pressure, volume flow or external actual value) - see operating manual.

No.	Signal	Terminal	Signal
1	Enabling signal	80X1.1 u. 80X1.2	DC24V
2	Set point value	50X1.1 u.50 X1.2	4..20 mA
3	Actual value	50X1.3 u. 50X1.4	4..20 mA
4	System ready for operation	80X1.4, 80X1.5, 80X1.6	DC24..120V / 5A o. AC24..230V /5A
	System in operation	80X1.19, 80X1.20, 80X1.21	DC24..120V / 5A o. AC24..230V /5A
5	Group warning	80X1.7, 80X1.8, 80X1.9	DC24..120V / 5A o. AC24..230V /5A
6	Group fault	80X1.10, 80X1.11, 80X1.12	DC24..120V / 5A o. AC24..230V /5A
7	Fault power limit	80X1.16, 80X1.17, 80X1.18	DC24..120V / 5A o. AC24..230V /5A
8	PillAerator ON	80X1.19, 80X1.20, 80X1.21	DC24..120V / 5A o. AC24..230V /5A
9	Emergency stop push-botton from PillAerator 1	070X71:7, 070X71:8 070X71:9, 070X71:10	DC24V
10	Emergency stop push-botton from PillAerator 2	070X72:7, 070X72:8 070X72:9, 070X72:10	DC24V
11	Emergency stop push-botton from PillAerator 3	070X73:7, 070X73:8 070X73:9, 070X73:10	DC24V
12	Emergency stop push-botton from PillAerator 4	070X74:7, 070X74:8 070X74:9, 070X74:10	DC24V
13	Emergency stop push-botton from PillAerator 5	070X75:7, 070X75:8 070X75:9, 070X75:10	DC24V
14	Emergency stop push-botton from PillAerator 6	070X76:7, 070X76:8 070X76:9, 070X76:10	DC24V
15	Emergency stop push-botton from PillAerator 7	070X77:7, 070X77:8 070X77:9, 070X77:10	DC24V
16	Emergency stop push-botton from PillAerator 8	070X78:7, 070X78:8 070X78:9, 070X78:10	DC24V
17	Emergency stop push-botton from PillAerator 9	070X79:7, 070X79:8 070X79:9, 070X79:10	DC24V
18	Emergency stop push-botton from PillAerator 10	070X80:7, 070X80:8 070X80:9, 070X80:10	DC24V
19	Emergency stop reset from PillAerator 1	070X71:2, 070X71:3	DC24V
20	Emergency stop reset from PillAerator 2	070X72:2, 070X72:3	DC24V
21	Emergency stop reset from PillAerator 3	070X73:2, 070X73:3	DC24V
22	Emergency stop reset from PillAerator 4	070X74:2, 070X74:3	DC24V
23	Emergency stop reset from PillAerator 5	070X75:2, 070X75:3	DC24V
24	Emergency stop reset from PillAerator 6	070X76:2, 070X76:3	DC24V
25	Emergency stop reset from PillAerator 7	070X77:2, 070X77:3	DC24V
26	Emergency stop reset from PillAerator 8	070X78:2, 070X78:3	DC24V
27	Emergency stop reset from PillAerator 9	070X79:2, 070X79:3	DC24V

No.	Signal	Terminal	Signal
28	Emergency stop reset from PillAerator 10	070X80:2, 070X80:3	DC24V
29	Emergency stop to PillAerator 1	070X71:5, 070X71:6 070X71:11, 070X71:12	DC24V
30	Emergency stop to PillAerator 2	070X72:5, 070X72:6 070X72:11, 070X72:12	DC24V
31	Emergency stop to PillAerator 3	070X73:5, 070X73:6 070X73:11, 070X73:12	DC24V
32	Emergency stop to PillAerator 4	070X74:5, 070X74:6 070X74:11, 070X74:12	DC24V
33	Emergency stop to PillAerator 5	070X75:5, 070X75:6 070X75:11, 070X75:12	DC24V
34	Emergency stop to PillAerator 6	070X76:5, 070X76:6 070X76:11, 070X76:12	DC24V
35	Emergency stop to PillAerator 7	070X77:5, 070X77:6 070X77:11, 070X77:12	DC24V
36	Emergency stop to PillAerator 8	070X78:5, 070X78:6 070X78:11, 070X78:12	DC24V
37	Emergency stop to PillAerator 9	070X79:5, 070X79:6 070X79:11, 070X79:12	DC24V
38	Emergency stop to PillAerator 10	070X80:5, 070X80:6 070X80:11, 070X80:12	DC24V
39	Emergency stop reset to PillAerator 1	070X71:1, 070X71:4	DC24V
40	Emergency stop reset to PillAerator 2	070X72:1, 070X72:4	DC24V
41	Emergency stop reset to PillAerator 3	070X73:1, 070X73:4	DC24V
42	Emergency stop reset to PillAerator 4	070X74:1, 070X74:4	DC24V
43	Emergency stop reset to PillAerator 5	070X75:1, 070X75:4	DC24V
44	Emergency stop reset to PillAerator 6	070X76:1, 070X76:4	DC24V
45	Emergency stop reset to PillAerator 7	070X77:1, 070X77:4	DC24V
46	Emergency stop reset to PillAerator 8	070X78:1, 070X78:4	DC24V
47	Emergency stop reset to PillAerator 9	070X79:1, 070X79:4	DC24V
48	Emergency stop reset to PillAerator 10	070X80:1, 070X80:4	DC24V

Table 13: Signal scope, terminal assignment and signal type of the analog interface

Note:

The signals no. 4-8 are provided with logic 1 in the standard. This means that the corresponding potential-free output relays have activated when the event occurs.

Other signals cannot be provided via the analog interface. If an additional signal scope is required, this is only possible after incorporating the BrainBox via the Profibus.

8.2 Profibus DP Incorporation

Table 14 shows the input addresses and data read from the Brainbox (slave) via the Profibus.

It has to be observed, that:

- the address 502 is used to allocate the set point value in accordance with the selection (speed, pressure flow, volume flow or external actual value control) made on the HMI (operating panel) through the client-installed Master and that the set point value is scaled accordingly on the HMI (control panel).
- the address 506 is used to read the external actual value from the Master, if the 'External actual value control' mode is activated.

Profibus addresses PillAerator BrainBox- Standard				
Address of the PROFIBUS Interface: 10				
Block	I/O	Size:	Consistency	Local PB address
2	Output	32 Byte	Total	500
3	Output	10 Byte	Total	540
4	Output	16 Byte	Total	556
Block	I/O	Size:	Consistency	Local PB address
1	Input	14 Byte	Total	500
Local PB address	Type	Description		Block
500.0	BOOL	Start Set TRUE to enable PillAerator controller		1
500.1	BOOL	Reset Set TRUE to reset current fault		1
501.7	BOOL	Life bit (0.5 Hz) The life bit switches between TRUE and FALSE at a clock rate of 0.5 Hz. Operation via Profibus is not possible without the life bit		1
502	REAL	Set point value [0 - 100 %] Set point value as per the selection on the user interface (speed, pressure, volumetric flow or external actual value)		1
506	REAL	Actual value [0 - 100 %] If "external actual value" mode is selected on the user interface, this value is used for control		1

Table 14: Profibus input addresses and data

Table 16 shows the output addresses and data provided in the standard configuration on the Profibus from the Brainbox (slave).

It has to be observed, that:

- The baud rate for the Profibus is set to **1.5 MBit** by default and can only be changed by a PillAerator GmbH technician.
- **The same baud rate of 1.5 MBit/s is set on the customer's PLC.**
- There is a cycle time of ≤ 1 s on the customer's PLC so that the state change of the live bit described below is securely registered. If this should not be the case, this is interpreted by the PillAerator PLC as a **failure of the Profibus connection**.
- The target value corresponding to the selection (speed, pressure, volumetric flow rate or external actual value control) made on the HMI (control panel) is provided by the customer's master under the address 502 and the target value is correspondingly scaled on the HMI (control panel).
- The address 506 is used to read the external actual value from the master when "external actual value control" mode is activated.
- the address 556 is used to provide an identifier on the Profibus, which can take the values of 0 - X. X is equal to the number of activated and connected PillAerators to the BrainBox. The identifier is determined by activation sequence (see manual) on the BrainBox.
- the summarized readings of the motor current (address 510), the motor power (address 514), the flow rate (address 522) and the averaged readings of the pressure (address 518) and the density (address 526) are provided to the Profibus, if the identifier is 0 (BrainBox).
- the individual data of each activated and connected PillAerator to the Brainbox are provided to the Profibus, if the identifier is equal 1 – X. The identifier is incremented by one up to X and then starts again with 0, as soon as the data of all active PillAerators have been send.
- the address 501.7 is used to receive the life bit. If within a period of 2 seconds no alternation of the life bit take place, than the Profibus connection is considered as interrupted. In this case the PLC of the BrainBox generates a fault and all connected PillAerators are stopped. If the Profibus connection is available again the occurred fault message has to be acknowledged.

- the address 528 is used to provide the time of operation (second accurate) of the BrainBox on the Profibus
- the address 540 is used to provide the warnings **encoded bit wise**. The identifier (address 566) has to be observed! The identifier (see above) indicates which PLC has originated the actual warning. If the identifier=0, than the actual warnings are originated by the BrainBox. If the identifier is 1 – X, than the warning is originated by the active PillAerator. The correlation of the bit information and the actual warnings is given in the operation manual. Example see Table 15.

Identifier	Address 540, LSB (Warning not active or active)	Warning message according operation manual	Warning caused by
0	00000000 o. 00000001	Function venting coolant is active	BrainBox
0	00000000 o. 00000010	Bypass in manual operation	BrainBox
0	00000000 o. 00000100	Compressor at speed limit	BrainBox
1	00000000 o. 00000001	Function venting coolant is active	PillAerator 1
2	00000000 o. 00000010	Bypass in manual operation	PillAerator 2
3	00000000 o. 00000100	Compressor at speed limit	PillAerator 3

Table 15: Example bit-wise encoded warnings

- the address range 542 – 548 is used to provide the fault messages **encoded bite wise**. The identifier (address 566) has to be observed! The transfer is carried out analog to the warning transfer according above mentioned example. The only difference is the scope information. The encoding uses in total 4 words or in total 8 bytes resulting in 64 encoded fault messages for the Brainbox and each PillAerator.

Profibus addresses PillAerator BrainBox- Standard				
Address of the PROFIBUS Interface: 10				
Block	I/O	Size:	Consistency	Local PB address
2	Output	32 Byte	Total	500
3	Output	10 Byte	Total	540
4	Output	16 Byte	Total	556
Block	I/O	Size:	Consistency	Local PB address
1	Input	14 Byte	Total	500
Local PB address	Type	Description		Block
500.0	BOOL	On TRUE, if the PillAerator is running.		2
500.1	BOOL	Ready for operation TRUE, if the PillAerator is ready FALSE, if a fault is present or if the PillAerator is started		2
500.2	BOOL	Group warning TRUE, if warnings are queued		2
500.3	BOOL	Group fault TRUE, if faults are queued		2
500.6	BOOL	Bypass closed TRUE, if the bypass valve is closed.		2
500.7	BOOL	External enabled TRUE, if external enabled (digital input) is selected on the control panel		2
501.0	BOOL	Warning performance limit reached TRUE, if the performance warning limit is reached		2
501.1	BOOL	Fault, performance limit reached TRUE, if the performance fault limit is reached		2
501.2	BOOL	Fault, Surge limit reached TRUE, if the actual volume flow drops below the volume flow defined by the pump limit		2
501.3	BOOL	Fault, inlet temperature too high TRUE, if the fault limit of the inlet temperature is exceeded		2
501.5	BOOL	DP_On Start- / Stop via Profibus TRUE, if Start- / Stop via Profibus is selected on the control panel.		2
501.6	BOOL	DP set point value via Profibus TRUE, if set point value via Profibus is selected on the control panel.		2
501.7	BOOL	Life bit (0.5 Hz) The life bit switches between TRUE and FALSE at a clock rate of 0.5 Hz.		2
502	REAL	External set point [0 - 100 %] Indicates the external set point at the Profibus.		2
506	REAL	Speed [%] Actual percentage speed of the activated PillAerators. Attention: if identifier=0 only!		2
510	REAL	Motor current [A] Actual summarized / individual motor current of all running drives. Observe identifier!		2
514	REAL	Motor power [kW] Actual summarized / individual motor power of all running drives. Observe identifier!		2
518	REAL	Pressure [bar] Measured pressure difference at outlet (averaged / individual reading of all PillAerators) Observe identifier!		2
522	REAL	Volume flow [m³/s] Volume flow at outlet, summarized / individual reading of all running PillAerators Observe identifier!		2
526	INT	Density [kg/m³] Calculated density at inlet, averaged / individual reading of all running PillAerators Observe identifier!		2
528	DINT	Operating hours [s] Operating hours (exact to the second) of the whole system Observe identifier!		2
540	WORD	Warnings Warnings (list in the operating manual) Observe identifier!		3
542	WORD	Faults 1 Fault messages (list in the operating manual) Observe identifier!		3
544	WORD	Faults 2 Fault messages (list in the operating manual) Observe identifier!		3
546	WORD	Faults 3 Fault messages (list in the operating manual) Observe identifier!		3
548	WORD	Faults 4 Fault messages (list in the operating manual) Observe identifier!		3
556	INT	Identifier 0, BrainBox, 1-10 PillAerator		4
558	REAL	Filter contamination [%] Contamination level of the filter in%. 100% corresponds to the warning threshold. See manual. Attention: not considered if identifier=0		4
562	REAL	Inlet temperature [°C] Temperature at compressor inlet. Attention: not considered if identifier=0		4
566.0	BOOL	Status – Integrated Attention: not considered if identifier=0!		4
566.1	BOOL	Status – Activated Attention: not considered if identifier=0!		4
566.2	BOOL	Status – Ready to start		4
566.3	BOOL	Status – Running		4
568	WORD	Faults 5 Fault messages (list in the operating manual) Observe identifier!		4

Table 16: Profibus output addresses and data

Other data can only be implemented and provided via the Profibus interface through software extension. An extension of the scope of data requires precise specification from our sales staff and testing and approval by the development department. If this is required, please contact our sales department. An extension or modification (signal inversion) of the Profibus interface will incur a charge. If this is required, please contact our sales department. Changes regarding addresses, address ranges and/or data scope require precise specification through our sales staff and may be offered as a separate service.

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