OPERATING MANUAL

Compressor Management System
Airleader EASY

1 – 4 compressors

(Manufacturer independent screw-, piston-, inverter-, VSD- or other displacement compressors)

Version 3.0 - 13/06/2018

Manufacturer:

No communication
- Module/compressor currentless or
- No RS485 BUS-connection or
- Wrong module address

Not ready to run
- Module/compressor are powered
- but no „READY“-Signal (compressor locally shut off)

Ready to run
- Compressor will run at „LOAD“-signal from EASY

Load
- Compressor runs in „LOAD“-mode
- Compressor sends „MOTOR-RUNNING“-signal

Unload
- Compressor runs in „UNLOAD“-mode
- Compressor sends “MOTOR RUNNING”-signal

FAULT
- Compressor sends “FAULT”-signal

Service Mode
- No „READY“-signal
- EASY does not switch Compressor to “LOAD”

ATTENTION
- Compressor gets „LOAD“-signal from EASY, but
- Motor standstill – check compressor! (internal pressure set to low, local operating enabled?)

0 Programming Notes

compressors				
No.	1	2	3	4
Type				
m^3/min				

pressure				
pressure range PR	P_{min}	P_{max}	P_{alarm}	
1.				bar
2.*				bar

rank order (priority 1 - 4)				
rank order RO	compr. 1	compr. 2	compr. 3	compr. 4
1.				
2.*				

timer*													
switch point SP	weekday							time hh:mm	compressors on/off	PR	RO	relay R1	relay R2
1	M	T	W	T	F	S	S						
2	M	T	W	T	F	S	S						
3	M	T	W	T	F	S	S						
4	M	T	W	T	F	S	S						
5	M	T	W	T	F	S	S						
6	M	T	W	T	F	S	S						
7	M	T	W	T	F	S	S						
8	M	T	W	T	F	S	S						
9	M	T	W	T	F	S	S						
10	M	T	W	T	F	S	S						
11	M	T	W	T	F	S	S						
12	M	T	W	T	F	S	S						
13	M	T	W	T	F	S	S						
14	M	T	W	T	F	S	S						
15	M	T	W	T	F	S	S						
16	M	T	W	T	F	S	S						

PR = pressure range RO = rank order *only WEB **Server** programmable!

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2 Technical Specifications

2.1 Electrical Data

Supply voltage:	power supply unit 100 ... 240 V AC, 1 phase / N / PE, 50 ... 60 Hz controller 24 V = DC
Power input:	24 V / 60 W / 2,5 A
Line-fuse:	6 ... 16 A
Built-in buffer battery:	3,3 V (CR 2032)
Electrical cable connection:	screw-type terminals up to 1,5 mm^2
Cable connection (body):	9 x PG 19 strain-relieved 1 x network female connector
Digital outputs:	**2** x 24 V max. 10 mA (for electronic relays/optocoupler) - common fault compressors + accessories - Pmin Alarm (pressure low)
Digital inputs:	**5** x 24 V DC from **controller** for *(key switches at door) - START* = compressors ON/OFF - MANUAL* = compressors operate on local mode - CLOCK* = clock timer ON/OFF (bypassed) - 2. pressure range - 2. ranking order max **12** x 24 V DC, with max 4 **compressor connecting modules** for - compressor FAULT, MOTORRUNNING und READY signals max **6** (opt. 12) x 24 V DC with max 2 (opt. 4) **accessory connecting modules** for - FAULT or OPERATING signals
Analogue inputs:	**2** x 4-20 mA / 24 VDC from **controller** for - pressure transducer - free usage (e. g. dew point, energy consumption (kW), Ampère meter, Flow meter, vibration meter, differential pressure, universal sensor) max **8** x 4-20 mA with **compressor connecting modules** for - 2 x compressor data each (e. g. inverter signal, kW, Ampère meter, oil temperature, vibration meters, etc.) max **4** (opt. 8) x 4-20 mA with **accessory connecting modules** for - 2 x free usage each (e. g. dew point, energy consumption (kW), Ampère meter, Flow meter, vibration meter, differential pressure, universal sensor)
Interfaces:	**WiFi-module** (WLAN Hotspot) with integrated WEB-Interface **2 x RS 485** BUS cable to connection modules **1 x RJ 45** network connection **2 x USB** software updates, data export

2.2 Pneumatic Data

Pressure range (transducer included):	0 – 16 bar	standard

0 – 2,5 bar	(option)
0 – 50 bar	(option)
0 – 100 bar	(option)
0 – 400 bar	(option)
1000 – 0 mbar vacuum	(option)

2.3 Ambient conditions

Nominal temperature range:	0°C ... + 40°C
storage temperature range:	5°C ... + 70°C
EMC compatibility:	noise immunity: EN 50082---2 noise emission: EN 50081---2

2.4 Display und operating elements

Display:	3,5 inch colour display	
Key switch:	START	= compressors ON/OFF
	MANUAL	= compressors operate on local mode
	CLOCK	= clock timer ON/OFF (bypassed)

2.5 Scope of delivery

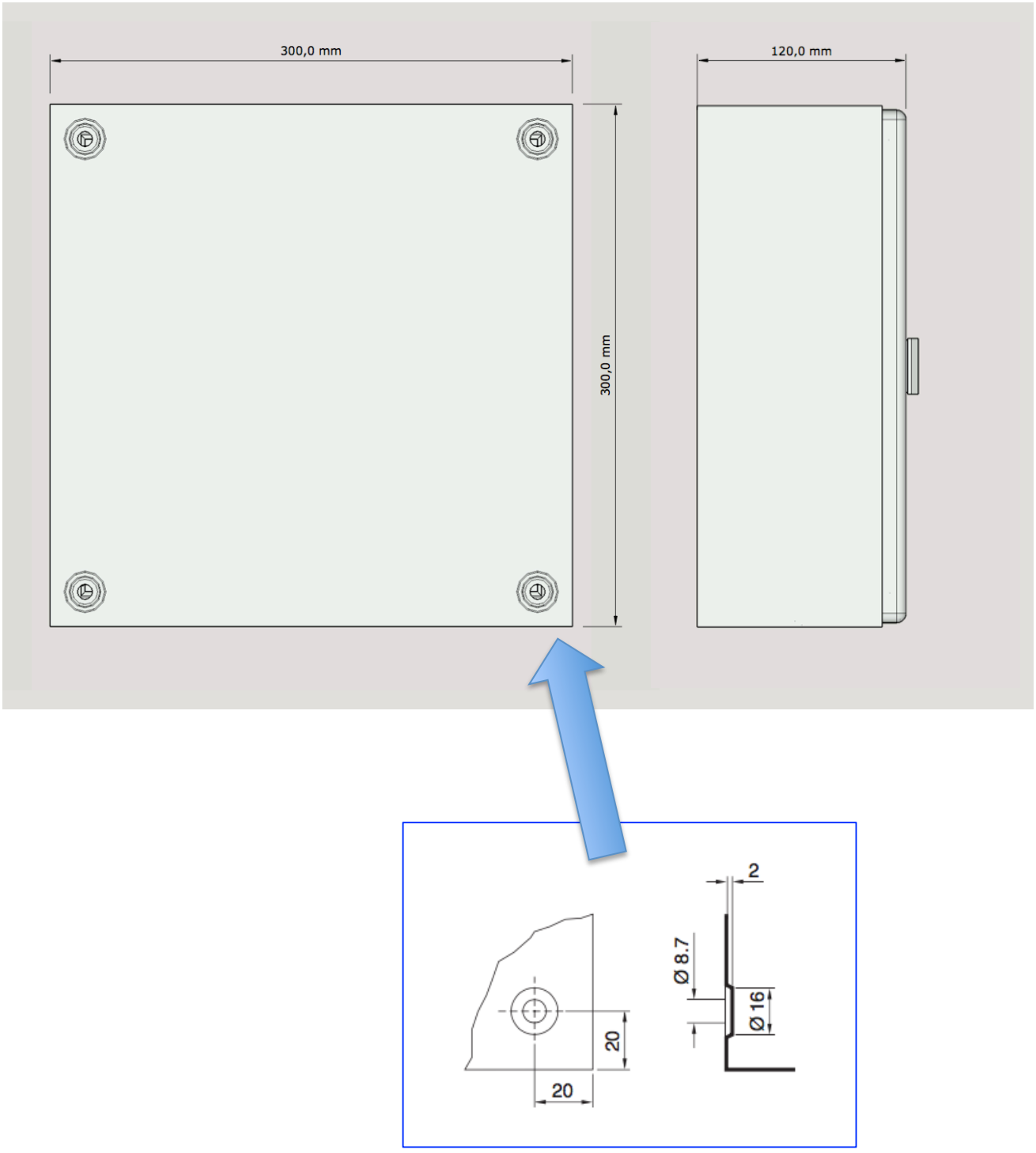
- Airleader EASY switch case mounted incl. cable fittings
- Precision-**pressure transducer**
- **24 V DC power supply** installed and wired
- **Male connector set** to connect sensors, meters, relays, switches and connection modules
- Printed version of **this manual**
- CD-ROM **with WEB-Server** und manuals

2.6 Switch case

Material:	steel plate powder coated
Protection class:	IP 65 according DIN 40 050 (IEC 529)
Dimensions	**300 x 300** x 120 mm (W x H x D)
Weight	est. 6,5 kg

2.7 Dimensions for wall mounting

(all dimensions in mm)



3 Safety Regulations

Before operating and before carrying out any work on the compressor management system, read this operating manual and follow its instructions.

3.1 Symbol- and note declaration

ATTENTION!

This symbol is found in all safety instructions in this manual that could endanger the life and limb of people. Observance of these instructions and careful behavior are particularly important in these cases. All safety instructions must also be passed on to other users. In addition to the instructions in this manual, the general safety and accident prevention regulations must be taken into account.

This symbol is placed in the locations of the operating instructions which must be observed in particular in order to comply with the guidelines, regulations, instructions and the correct sequence of work and to prevent damage to and destruction of the compressor management system and / or other system components.

NOTE!

This symbol indicates important information about the product, the handling of the product or the relevant part of the documentation, which should be given special attention.

This symbol indicates activities to be performed by the user.

3.2 General information

Before carrying out work on electrical systems, the following measures must be carried out in the indicated order:

1. Switch off all poles
2. Secure against restart
3. Check that there is no voltage

4 Functional Characteristics

General

AIRLEADER EASY controls up to 4 compressors according to demand. It only runs as many compressors as necessary, unnecessary idling is avoided; the station operates with maximum efficiency.

Depending on network air volume and compressor dynamics, a pressure band of only +/- 0.15 bar can be realized with minimum switching frequencies: this is the highest energy efficiency and at the same time smooth use of the compressors.

Airleader EASY is the little brother of the Airleader MASTER and fully compatible - both in terms of compressor connection and visualization! All functions of the proven Airleader MASTER are also available at EASY.

As an economical variant, it is used in smaller compressor stations, where the wish to increase efficiency is indeed present, but the “larger” air management systems do not pay off quickly enough.

In the basic version, up to 4 compressors - one of them can be regulated (VSD – variable speed drive / frequency inverter) - and 2 accessory modules can be connected. Additional software allows up to 2 VSD and 4 accessory modules to be operated.

Airleader EASY is configured via a web interface - either wired via the ETHERNET connection or via the built in WiFi WLAN hotspot with smart devices (laptop, pad, smartphone).

All settings required for operation can be made.

Standard WEB server visualization

Further settings, such as 2nd pressure range, 2nd ranking order and time switch can be made via the Airleader Online WEB server.

The Airleader visualization shows very clearly how it runs the compressed air system - whether good or bad! Inefficient compressors are thereby unmasked, and you can act accordingly against efficiency damaging compressors!

NOTE! The WEB server visualization is standard and comes with a data carrier. In case of loss or update, the web server can be downloaded from our homepage for free:

http://www.airleader.de/index.jsp?lang=de&site=login

The WEB server is installed on a customer-owned server, thus ensuring that the data remains with the customer.

The data is stored redundantly in the hardware memory of the Airleader so that server interruptions or subsequent installation of the web server does not lead to data loss.

Airleader EASY automatically optimizes up to 4 compressors

and adapts itself to changes by autonomic learning. Through iterative computational processes, Airleader EASY permanently and automatically determines the network dynamics, the network volume and other parameters. Complex fine-tuning, retracting, adjusting, etc. is completely eliminated!

Easy handling

Only the compressors free air delivery FAD and the desired pressure range have to be entered. Ready - everything else is managed by Airleader EASY.

Airleader EASY monitors ancillary components

The monitoring of ancillary equipment such as dryers, filters, drains, etc. are also possible and, in case of failure, notify the operator.

ISO 50.001

Real energy balancing (ISO 50.001) by means of Ampere / kW measurement in the compressors is provided as standard.

Regardless of manufacturer

All compressors, according to current compressed air consumption, automatically build a production-adjusting unit. It ensures that only the most efficient combination of compressors produces the compressed air needed for production, regardless of manufacturer. The compressor combination works with meaningful hysteresis calculation, with minimal load-idle switching cycles and thus lowest idle times. Instead of idling the big compressors, the right combination runs under load with the smallest compressor switching.

Pressure range control

Airleader EASY takes care to keep the costs as low as possible. By connecting several distributed pressure sensors, far away site areas can be monitored and integrated into the control pressure. If a running compressor within the pressure range is faulty or is turned off for maintenance, its performance will be immediately replaced by one or more other compressors.

8-fold, self-learning calculation depth

It ensures the dynamic adaptation of the compressors to the compressed air consumption. In different lengths of time windows, the compressed air consumption and dynamics are continuously calculated and evaluated. As necessary, the right compressor combination will be switched. Unnecessary switching operations are prevented.

Base load change for even utilization

Compressors of the same capacity run the same operating hours, taking into account the engine running times. If a predetermined time offset is reached, the compressors are replaced without pressure drop within the pressure range.

Rank levels allow interventions

Manually selectable ranks allow the compressors to work with different priorities.

This feature is often used for heat recovery compressors (preferred priority) or reserve compressors (low priority). Compressors at the same rank, work automatically depending on consumption.

Speed controlled compressors (VSD) are actively integrated

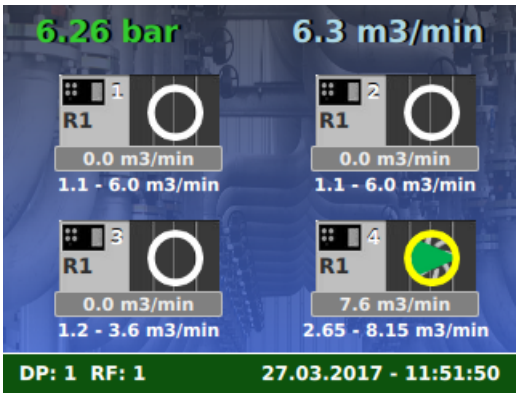
via analogue output, the VSD sends the compressor speed information to Airleader EASY. Programmable control limits can be used to hide inefficient areas individually so that the controlled compressor can always drive in its energy-efficient speed range.

20 years integrated data storage

while recording every second and store the average of 10 seconds of all compressor states, sensor values and messages into the internal storage of Airleader EASY. These can be read out at any time by using an USB stick. When connecting to the network, all data is parallel transferred into the Web visualization and permanently synchronized to the customers server.

5 Commissioning and operation

5.1 The Airleader EASY Display



The display of the EASY control shows the current states of the compressors, for VSD compressors additionally the variable delivery quantity, as well as the network pressure and the current total consumption.

The footer displays information about the currently selected pressure range (PR) and current ranking order (RO).

A pulsating colour indicates that the controller is in operation.

5.2 Procedure commissioning

The commissioning of the compressor management system is best carried out according to the following procedure:

1. Install WEB server on customer computer (server) - in time! (Usually network administrator required!)
2. Install the Airleader EASY and connect to the power supply.
3. Attach the pressure sensor and connect it to the Airleader (-> pressure gauge in the Airleader display).
4. Program the Airleader EASY (see chapter 5.4). The display shows "No communication" in all programmed compressors
5. Install connection modules (CM) one after the other in compressors and put into operation:
    a. Switch compressor (Power supply) OFF.
    b. Establish bus connection.
    c. CM addressing via DIP switches, compressors: 1-4, accessories: 17-18 (optional 20).
    d. Only then connect the power supply to CM – switch compressor ON and perform bus check: display must show the symbol "NOT READY" for this compressor.
    e. Switch compressor OFF again.
    f. Establish contacts S, M, B, load and remote (and analogue signals, if required), see also separate document "Circuit Diagram Examples"
    g. Switch compressor ON.
    h. From this moment the compressor is controlled by Airleader! (-> compressor status display),
    i. Next compressor (go back to **a.** above).
6. If available, install additional sensors and connect to Airleader analogue input 2 or analogue input at the connection module as well as fault / operating messages to the digital input oft the connection modules.
7. Programming of timer, rankings, sensor measurement ranges and alarm values.
8. Configure web visualization of the WEB server (designate compressors and sensors, etc.)

5.3 WEB-Interface and WEB-Server

Basically, a difference must be made between the **Web interface** and the **WEB server**.

NOTE! The **Web Interface** is inside the controller hardware and provides direct contact and programming of the basic functions and is sufficient for commissioning. It also changes the fixed IP address of EASY to the customers' value so that the **WEB server** can reach the controller.

NOTE! The **WEB server** (on the enclosed CD) is in effect the Airleader operating and visualization interface and must be installed on a customers' server computer. Only then the extensive information, statistics and the time history of the compressor operating modes can be viewed, retrieved and forwarded to higher-level systems (EMS, PLC, GLT, etc.). **Only via the WEB server** the advanced functions, such as the time switch, the 2nd pressure range, the 2nd rank level and the base load change of the same sized compressors, can be programmed.

WEB server installation: See separate operating instructions "WEB server installation"

If the WEB server cannot be installed in advance, commissioning is still possible with the help of smartphones, tablets, or notebooks (see next chapter 5.4).

5.4 Contacting and programming via the web interface (LAN / WLAN)

The **Web Interface** of the Airleader EASY can be reached via 2 ways

1. **Via LAN (Ethernet):**

IP:	192.168.0.130	(default settings)
Subnet:	255.255.255.0	
Gateway:	192.168.0.1	
Request:	http://192.168.0.130	

The default settings usually must be adapted to the local/customers' IT rules.

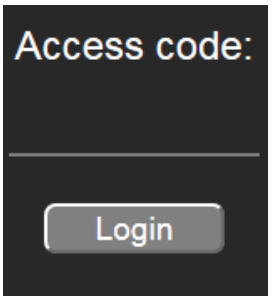
2. **Via WLAN (WiFi):**

Airleader EASY acts as a WLAN hotspot and logs in to the WLAN network

SSID:	**Easy-0601-XXXXXXXX**	**(serial number 8 digits)**
Password :	**airleader**	

After successful connection, you can call the interface via a browser. The settings are:

IP:	192.168.4.1
Request:	http://192.168.4.1
Access code:	1 2 3 4 5

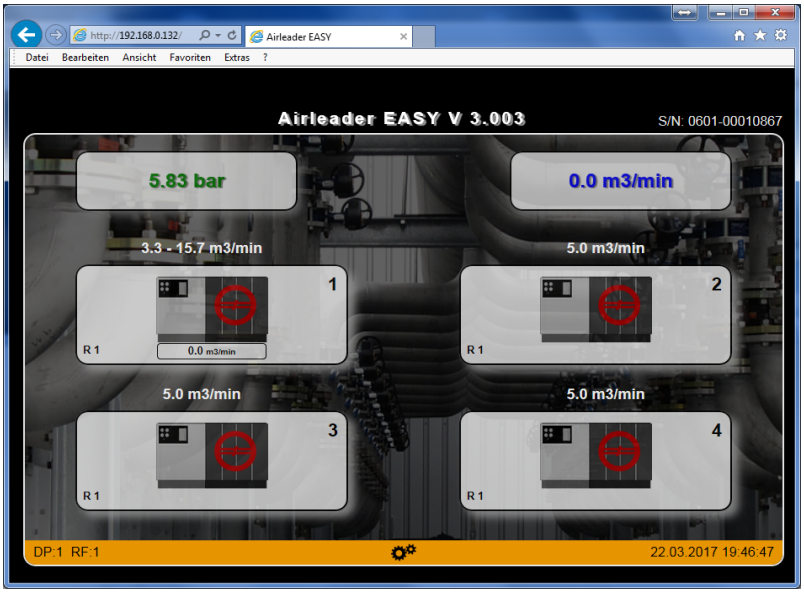


Every WLAN-capable device (laptop, tablet, smartphone) with a web browser is suitable for connection.

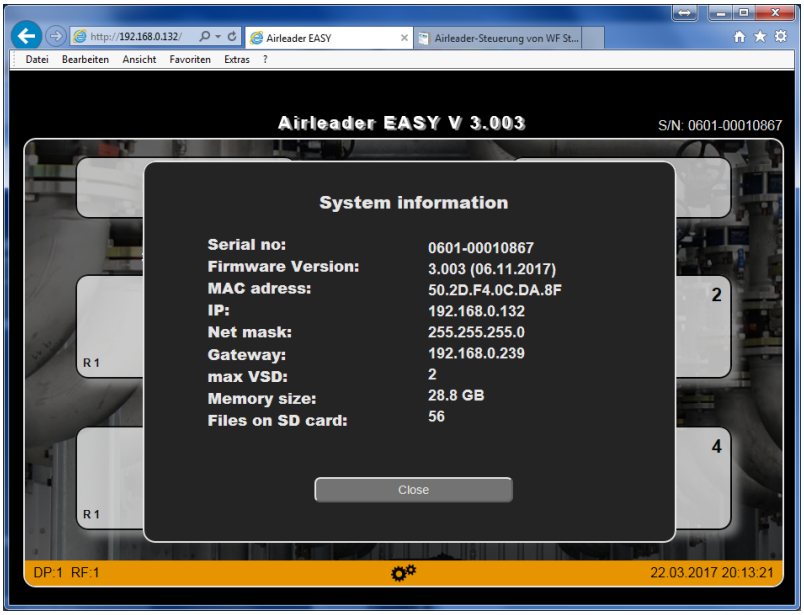
NOTE! **For security reasons the access code can be changed and the WLAN can be switched off** (see chapter 5.8.9 *Miscellaneous (upgrade, restart, additional functions, cable break, codes, power failure))*

5.5 The main view in the Web Interface

Entering the default IP address will display the main view.



5.6 Accessing System Information and Network Settings



One click on the "S/N:" signs at the upper right edge shows you the system information.

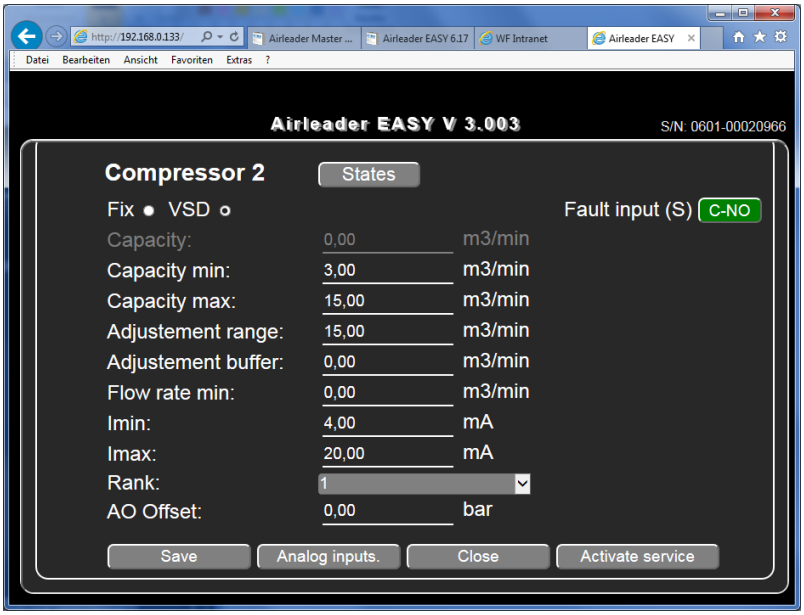
Here, the version number, network settings, and various other values of the system are listed.

5.7 Enter Compressor Data (Ranking Order #1)

Via the main view of the web interface, the compressors are configured. Clicking on a compressor icon displays the settings dialog for the compressors.

Here all data for the selected compressor are entered.

First, the **compressor type** must be specified!



Depending on whether a **VSD or fix speed** compressor is selected, different fields are active.

The picture shows the fields for a VSD compressor. (See Chapter 7 The VSD Compressor and Its Control Range)

To enter the delivery capacity of the compressor in m³/min, the **key switch START must be set to "0"**

The selection of the **rank** here always concerns the priority of the compressor in the ranking order #1. (A 2nd ranking order can be programmed via the WEB-server)

A click on the "Status" button displays the current operating mode and analogue signals while the control is running.

The fault input (S) for the compressor fault message can be used to secure cable break. The button "C-NO" or "C-NC" reverses the input logically, so that a fault is not triggered when the + signal is present, but when no signal is present.

5.7.1 Frequency Inverter Signal (from VSD compressor to AIRLEADER)

The **speed signal** is usually provided by the frequency inverter (VSD) (4-20 mA) and must be electrically isolated via a isolating amplifier.

NOTE! The limits for the minimum and maximum speed in milliamps [mA] must be precisely determined and entered here at **Imin** and **Imax**, otherwise an incorrect conversion into m³/min will occur and the controller cannot work correctly!

If no frequency inverter signal is available, an ampere loop with 4-20 mA output can be used in the compressor power supply - a isolating amplifier is not necessary. This method is somewhat inaccurate.

NOTE! **Helping tool:** When the controller is switched on and the WEB server is installed, there is a "Adjustment aid for VSD compressors" under the menu item "Settings" - "General" at the bottom right. Here the respective minimum and maximum Milliampère [mA] values are stored (peak hold). Now the VSD compressor must run once at minimum and maximum flow rate and the **Imin** and **Imax** values are available.

5.7.2 AO Offset: Pressure Signal (from AIRLEADER to VSD compressor)

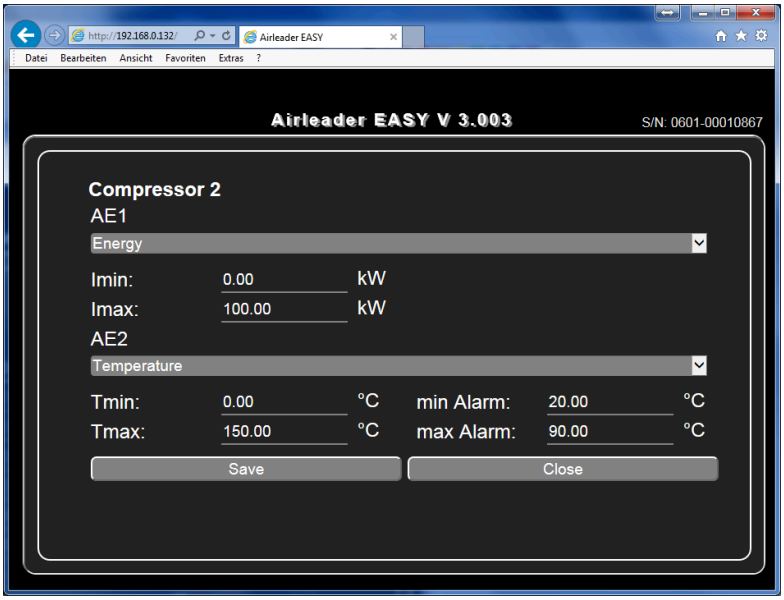
In order to prevent excessive pressure range spread (Pmin - Pmax) due to pressure drops between the control pressure sensor Airleader and the VSD compressor control pressure sensor, in most cases an external pressure connection must be made to the VSD compressor (see chapter 7.4 *Remote Pressure Integration).*

Nevertheless, with 2 or more VSD compressors (due to differences in the analogue inputs), pressure readings may differ, which makes synchronous running difficult.

The parameter **AO OFFSET** can be used to raise or lower the external pressure signal in 0.01 bar increments to adjust the levels.

5.7.3 Additional Compressor Sensors (analogue inputs compressor module)

A click on the button "**analogue input**" opens the dialog for the analogue inputs of the compressor module.



Depending on the selected compressor type, 1 or 2 analogue inputs are available for additional sensors.

Connected sensors are defined here (type, measuring range, alarm limits).

See picture e.g. compressor 2:

AE 1: kW measurement
(Sensor measuring range 0-100 kW)

AE 2: oil temperature measurement
(Sensor measuring range 0-150 ° C,
Alarm at below 20 ° C and above
90 ° C)

NOTE! At VSD compressors, the analogue input AE 1 is permanently assigned to the speed signal.

5.7.4 Switch compressor into maintenance mode

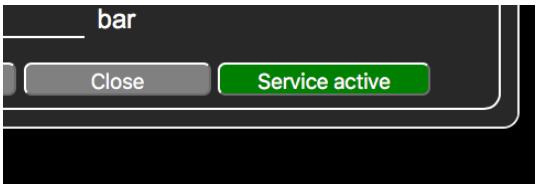
In this window, the compressor can also be switched to maintenance mode via the "**Activate maintenance**" button. The signal "ready", which the compressor normally delivers, is thereby artificially deactivated and the compressor is no longer selected by the Airleader EASY.

If, at this moment, the compressor is running “LOAD”, the relay R2 on the compressor module falls back to "UNLOAD" and the compressor stops (after going to idle, if necessary).

Only the READY signal is removed and the airleader will no longer select the compressor.

Should the communication to the compressor module be lost, the compressor goes into its on-site operation and can then run on its own.

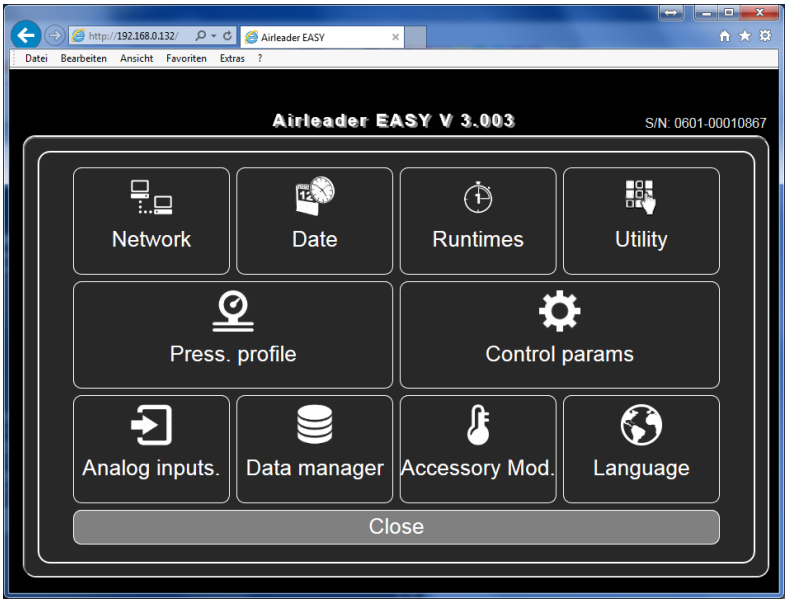
There are precautions to be taken to ensure that this does not happen.



The grey "**Activate Service**" button changes to "**Service active**" and turns green. Another click on this button ends the maintenance mode and the compressor can be immediately re-selected by the Airleader.

In the Airleader display the maintenance symbol appears on the selected compressor.

5.8 Adjustments



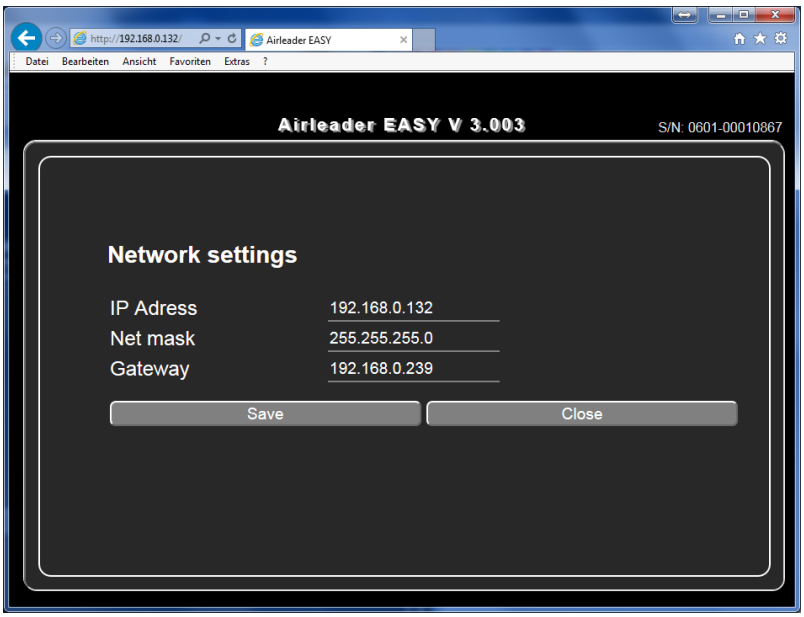
Clicking on the gearbox at the footer of the main screen opens in the settings menu.

The settings menu provides access to all sub-areas.

From here the following settings will be accessible:

- Network Settings
- Date / time settings
- Running hours
- Miscellaneous (upgrade, restart, additional functions)
- Pressure range settings
- Control Parameters
- Analogue inputs (controller)
- File Manager
- Accessory module settings (additional analogue and digital inputs)
- Language

5.8.1 Network Settings



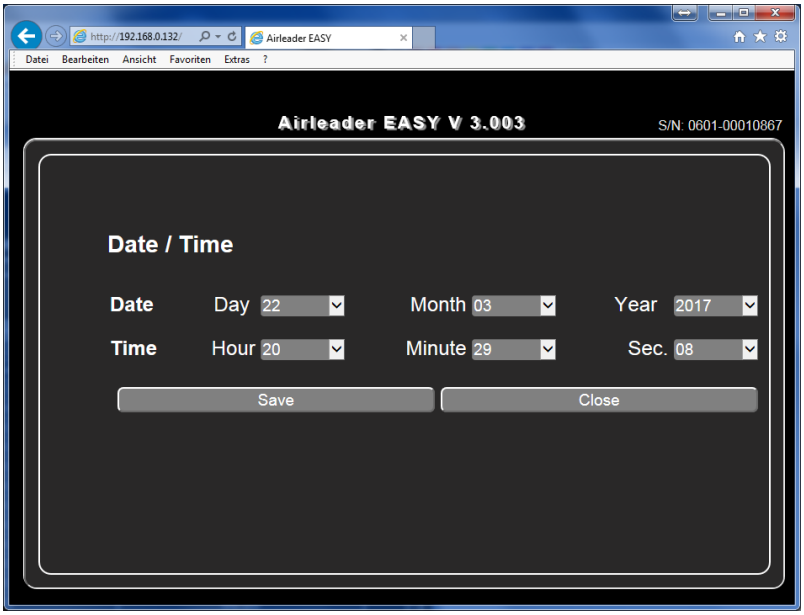
All network parameters are set here.

- **fixed IP address**
- **subnet mask**
- **standard gateway**

All values refer to the Ethernet interface (WEB server).

NOTE! **The network parameters for WLAN (Web Interface) are fixed**. Thus, the Airleader EASY always remains available!

5.8.2 Date / Time Adjustment



Enter date and time. The input is only required once. Date and time are battery-buffered.

5.8.3 Setting the Operating Pressure (pressure range 1, security zones, delay times)

Pmin, Pmax:

All compressors connected to the Airleader EASY will work in a common pressure range, which is set here. Here, **Pmin** is the lower set point, in the compressors usually switched on and **Pmax** the upper set point at which compressors usually switched off (idle).

Since Airleader EASY operates on a consumption-dependent basis, exactly the right compressor size is always switched at the set points in order to keep the pressure between **Pmin** and **Pmax** as long as possible and to minimize the switching cycles.

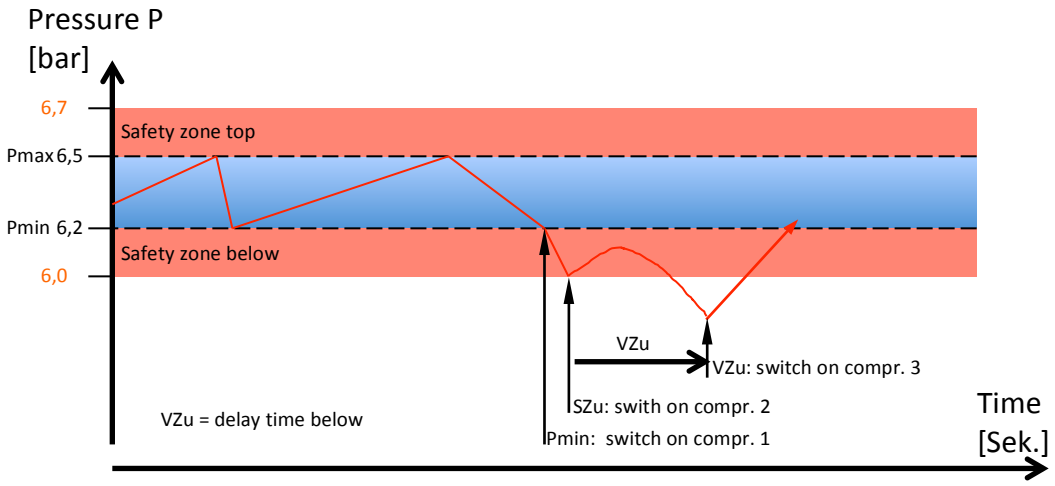
Security zones:

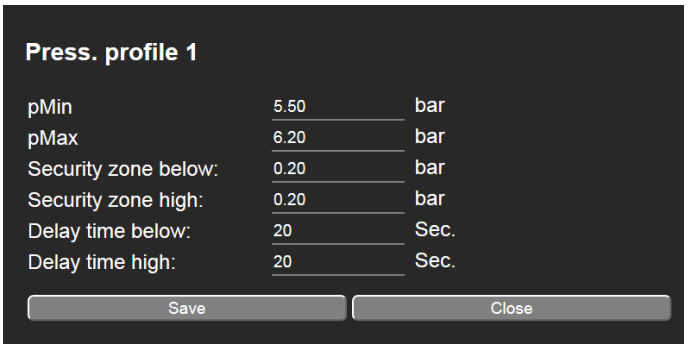
In order to capture sudden consumption events or too small pressure vessels, there is a security zone above and below the set points: If the pressure continues to drop (in spite of a first switched correctly compressor) (e. g. because a larger load entered at the moment), then over the border of the security zone below (SZu) then the next compressor is switched on.

Delay Time

If the pressure after expiration of the delay time below (VZu) has not increased after SZu was exceeded, another compressor is switched on. This happens until the pressure is back in the safety zone.

Similarly, with Pmax, the safety zone at the top and the delay time at the top are moved, except that accordingly compressors are switched off.



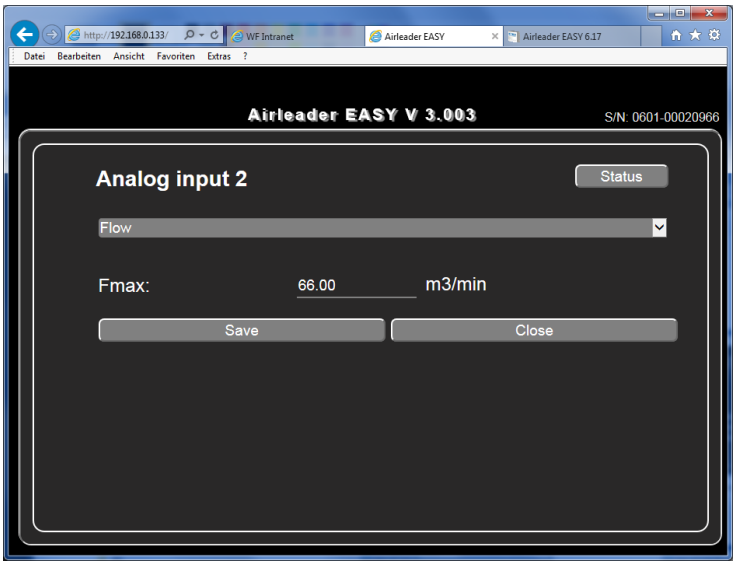


Settings for the pressure range 1 as well as – valid **for all profiles** – security zones and delay times.

The settings of the safety zone and the delay times should only be changed after consulting the manufacturer.

Pressure range 2 can only be programmed via the WEB server and not via the WEB interface (WiFi)!

5.8.4 Controller Analogue Input 2



Settings for the analogue input AE2 **directly on the controller**.

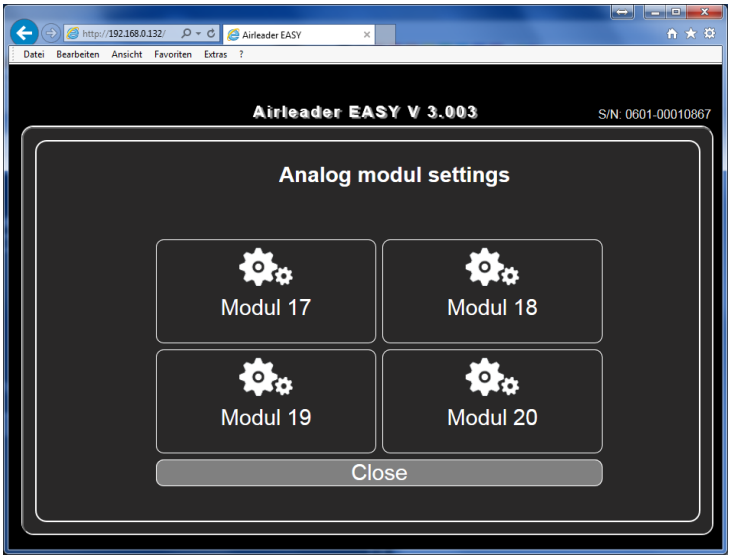
Measuring elements with 4-20 mA output can be connected to this input. B .:

- kW measurements
- Flow rate
- Pressure dew point
- Room temperature
- Differential pressure filter / treatment
- Residual oil content
- Heat meter for heat recovery

The status of the input can be displayed in real time via the STATUS button.

5.8.5 Accessory Module Settings (additional analogue and digital inputs)

As standard **2 accessory modules** can be connected to the Airleader EASY via RS 485-BUS. Optionally 2 more, means a **maximum of 4 accessory modules**, can be connected. The accessory modules are identical to the compressor modules and only differ by DIP switch addressing.



Each accessory module disposes:

- **2 analogue inputs** (4-20 mA)
  for sensors,
- **3 digital inputs**
  for fault or operational messages,
- **2 potential-free switch contacts**
  as alarm for the analogue inputs
  or
  as a timer programmable output.

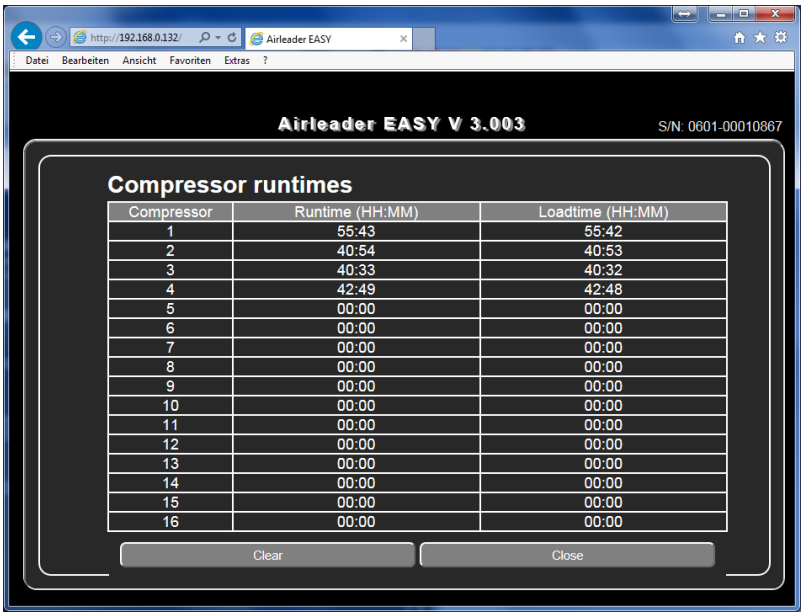
Furthermore,

- **1 analogue output** (4-20 mA) of either
  the control pressure
  or
  the average pressure (Pmin + Pmax) / 2
  as setpoint for VSD compressors.

Here, for example, with one accessory module can be monitored the room temperature and the filter differential pressure, as well as a dryer fault message, a condensate failure and an operating message (fan, pump, etc.).

If the adjustable limit value of an analogue sensor is exceeded or if there is a fault, the common fault contact of the Airleader EASY is switched and an e-mail, SMS or FAX message is issued (Alarm and Service Management option).

5.8.6 Operating hours

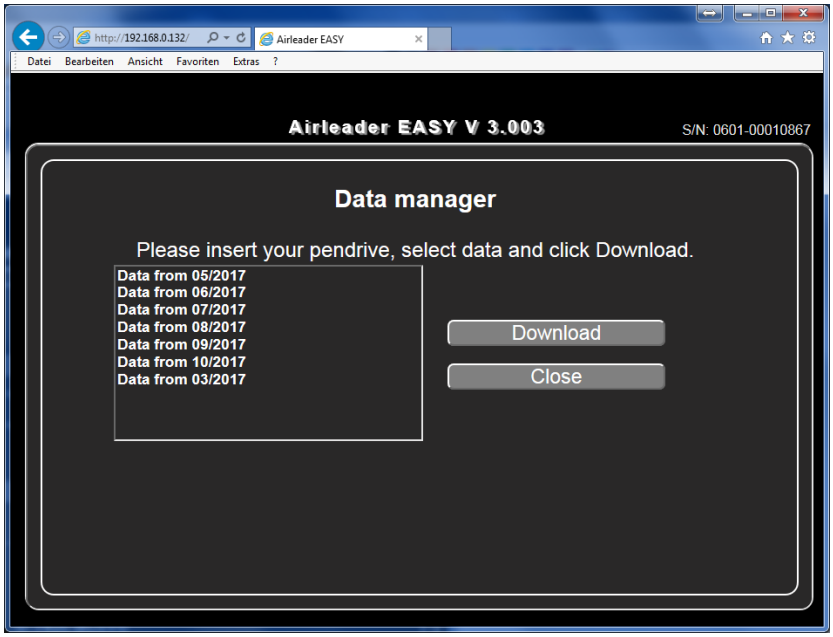


Here the total hours of operation (runtime) and the full load hours (loadtime) since commissioning the Airleader are recorded.

They can be deleted and then start at 0.

This is e. g. useful if there is no base load change under same compressors because of a high difference of operating hours.

5.8.7 Data export to USB stick



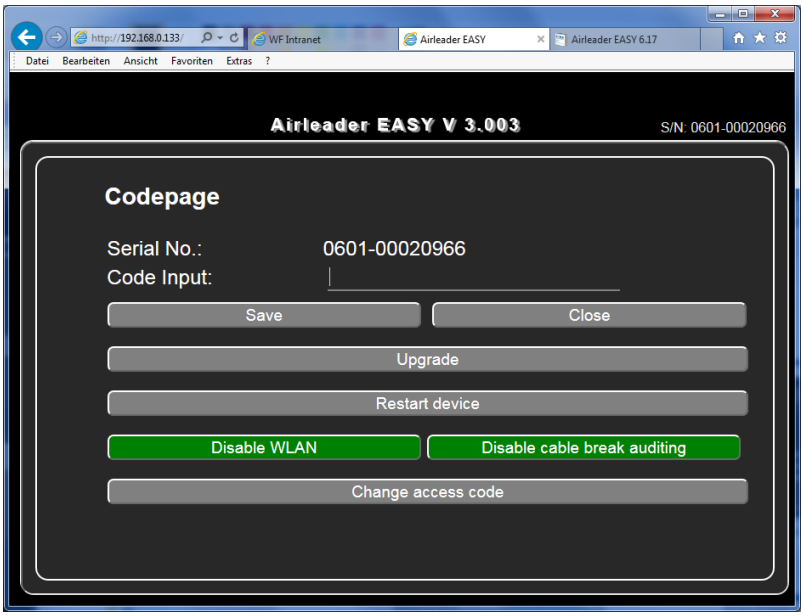
Recorded data can be loaded monthly on a USB stick.

The data is stored on the stick in a subdirectory named after the serial number.

5.8.8 Language

Currently German and English are available. More languages will be part of later firmware upgrades.

5.8.9 Miscellaneous (upgrade, restart, additional functions, cable break, codes, power failure)



Upgrades

Firmware upgrades are easy – only by connecting an USB stick, and clicking the UPGRADE button.

Restart

With the RESTART DEVICE button the controller can be restarted without interruption. A restart takes about 4 seconds.

Turn off Wi-Fi

For security reasons, it may be necessary to disable the Wi-Fi, which is done with the Disable WLAN button. The deactivation also survives a reboot (restart, power failure)!

Cable break monitoring for control pressure sensor

The Airleader EASY is equipped as **standard with a cable break tracing** for the control pressure: In the event of an interruption or short-circuit, the system immediately switches to MANUAL operation.

Otherwise an interruption or short-circuit of the control pressure signal would lead to malfunctions:

- 0 bar (interruption) - all compressors will run on load until internal safety shutdown or safety valve blow off.
- 16 bar (short circuit) - all compressors will stop.

In cases of service or commissioning it could be useful to force certain situations by pressure = 0 bar or pressure = 16 bar. Then cable break monitoring can be deactivated and reactivated here. The deactivation of the cable break monitoring does **not** survive a reboot.

Special Functions (Code Input)

Special functions can be enabled in this area via the input field **"Code Input".** This includes:

- 2. VSD compressor
- 2 additional accessory modules
- MOD-Bus TCP connection
- Special pressures

Appropriate activation codes are available from the manufacturer.

Change access code

The default access code is set to 1 2 3 4 5 and can be adjusted using the "**Change access code**" button.

Power failure

All compressors immediately go to their individual operation setup.

Power failure <30 seconds:

The state before the power failure is recovered.

Power failure ≥ 30 seconds:

After the power returns, first all compressors that supply a run signal are switched to load. Then - if the pressure is above Pmax - every 20 seconds a compressor switched off, starting from the smallest, until the pressure is again between Pmin and Pmax.

6 The RS-485 Connection Module

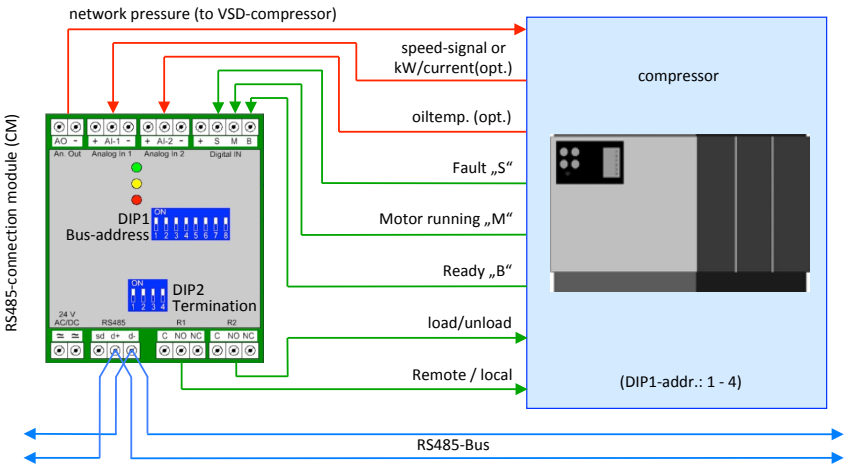
The **RS-485 connection module** is the connecting element between the controller and the compressed air system. This universal module is used both for controlling compressors and for monitoring the peripherals.

The **RS-485 connection module** is connected to the controller via a BUS cable (UNITRONIC BUS FD P L2 / FiP). All connection modules are connected in series and addressed via **DIP switch 1**. DIP switch 2 is used to activate the terminating resistor when the module is at the BUS end.

Although both DC and AC power supply is possible, it is recommended to use a stabilized power supply to avoid failures.

6.1 As Compressor Module (module 1 - 4)

The module is the same for all compressors, no matter which manufacturer, type and whether controlled by pressure switch or microcontroller. To avoid external voltages and induced currents, the module must be installed in the compressor's own control cabinet.

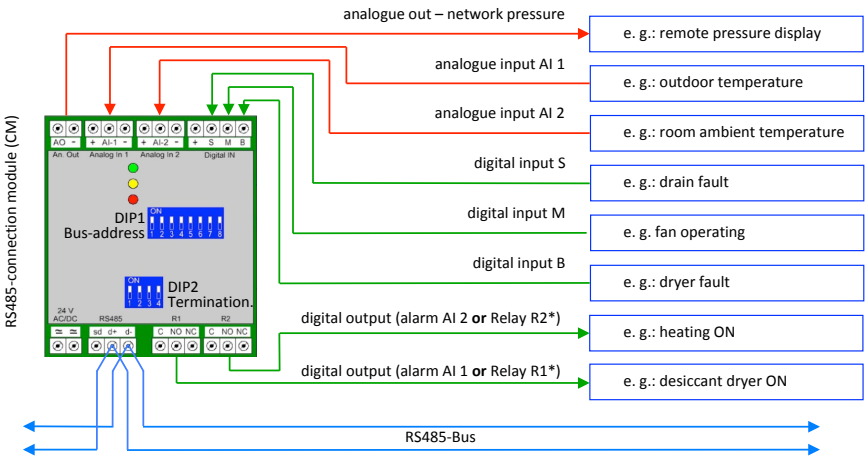


Adresses 1 – 4

Trained specialist personnel should do the placing of the contacts.

Schematics for usual compressors can also be downloaded from the manufacturers website www.airleader.de

6.2 As Accessory Extension Module (modules 17 and 18, optional 17 to 20)



Addresses 17-18 (OPTION: 17-20)

Up to **4** (opt .: 8) additional **analogue sensors** can be connected here, e. g. pressure sensors far out in the factory for pressure averaging.

Up to **6** (opt .: 12) **digital inputs** available for messages (fault, operation).

The **2 relay outputs** can be used as alarm outputs for the analogue inputs **or** as timer programmable outputs.

7 The VSD compressor and its speed control range

A speed controlled compressor (VSD) is not as efficient as a comparable fixed speed compressor running under load! This is due to the fact that

- a frequency converter has losses
- the air end rarely runs at the optimum speed
- the motor is operating at a lower efficiency out of the rated speed.

These individual efficiency degradations add up and decrease between 5% and 35% efficiency, depending on the operating point, compared to a fixed speed base load compressor of the same size.

Therefore:

The poor efficiency of a regulated compressor is only legitimated with improved overall station efficiency because of reduced idle and fewer switching operations!

This is only guaranteed if the regulated compressor is designed correctly taking into account the existing compressors.

A second (and each additional) VSD compressor worsens the overall balance!

Exceptions:

A second VSD compressor is

a) Weekend compressor
b) Reserve compressor

and never runs together with the first.

7.1 Correct compressor dimensioning (regulation range)

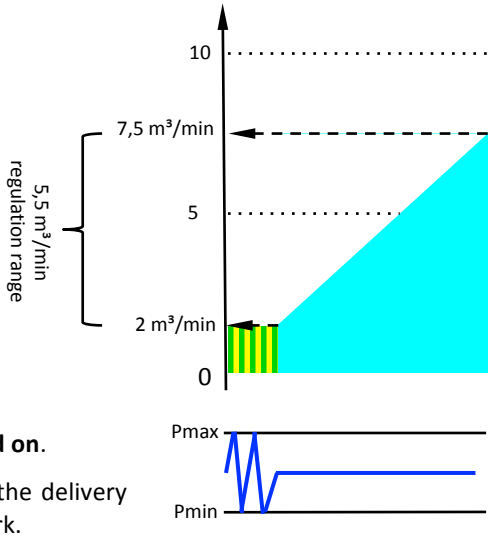
The size of the **regulation range (RR)** is important for the correct dimensioning of the speed controlled compressor. The rule area is defined as follows:

RR = delivery quantity at max. Speed - delivery quantity at min. Speed

Example:

55 kW VSD compressor (2 – 7,5 m^3/min @ 6,5 bar)

RR = 7,5 – 2,0 = 5,5 m^3/min



Without entering the **control parameters** (see chapter 5.7 Enter Compressor Data (Ranking Order #1)), the compressor will run as follows:

Within the speed control range, the pressure in the network remains constant.

Below the minimum delivery rate, the compressor will cycle or idle while the pressure is within the pressure range set by Airleader (Pmax - Pmin)

If consumption **exceeds the maximum delivery** of the compressor, then the pressure drops to Pmin and **another** correct sized **compressor is switched on**.

If possible, a smaller compressor is switched off at the same time, so that the delivery quantity **difference** of the two compressors covers the demand of the network.

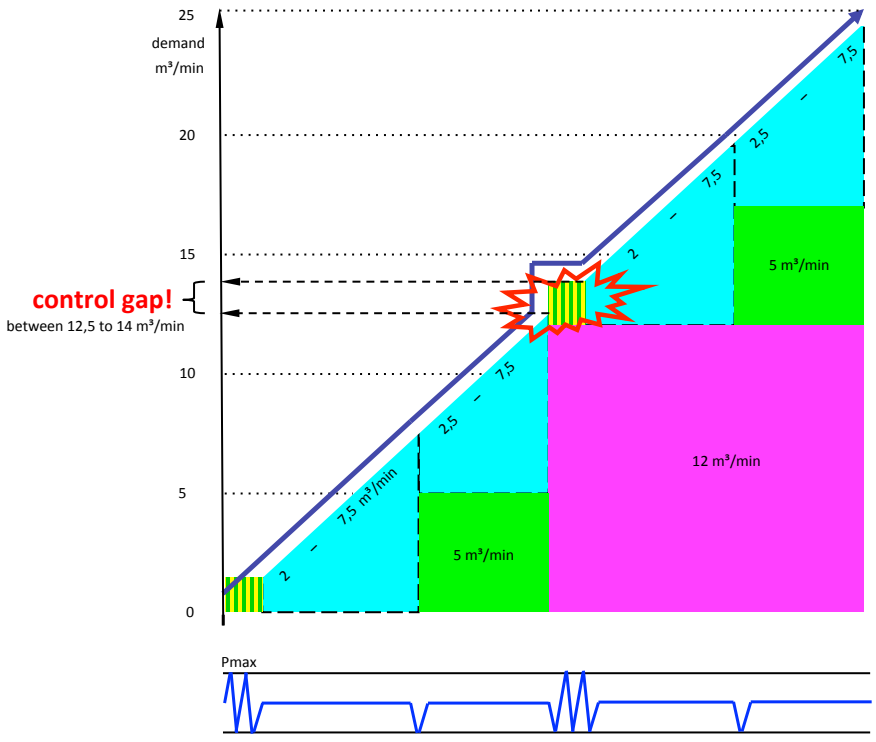
As a result, the pressure increases again and the speed controlled compressor reduces its delivery quantity by the added delivery quantity.

It is important that the **added delivery volume** fits well into the control range - so that it **is not too big**! The target is the operation in the middle range of the total delivery capacity of the VSD compressor, since it's there where the highest efficiency takes place.

Is the **amount added too large**, because e. g., if there is no small fix speed compressor, or the regulated compressor is too small, the VSD compressor runs near minimum delivery and will be uneconomical.

NOTE!

If the **added delivery quantity** is approximately equal to or even **greater than the VSD capacity range SCR**, so-called **control gaps** occur, that means consumption ranges in which the system comes to oscillation - in particular without an Airleader.



The result is, the VSD compressor falls below its minimum delivery and the pressure rises to Pmax, where the just switched on compressor will switch off again. Consequently the VSD compressor rises to full power from standstill or idle, but is still not sufficient and the just switched off compressor will again switch on.

This "game" is repeated every second or minute. Only when the consumption changes out of the gap, then the VSD compressor can regulate again. That can go on for hours or days and is an energetical catastrophe and hardware damaging.

This cannot be eliminated by any control and is a fatal dimensioning error!

If the compressed air receivers are adequately dimensioned, Airleader can prevent the permanent interchange of the compressors by running the fixed speed compressor permanently and clocking onlythe VSD compressor, because it is the smaller one (with its minimum delivery quantity).

NOTE!

Rule of thumb:

*The fix speed compressor should have **half the size** of the VSD. The 3rd compressor can then have the same size - but not bigger! - as the VSD compressor. The consumption-dependent switching by Airleader ensures that the compressors are switched on and off in stages, so that there is the most suitable delivery quantity rise from one to the other combination.*

Other compressors must be dimensioned so that the delivery quantity difference is not greater than half the maximum delivery quantity of the regulated compressor.

If the compressors are well dimensioned according this rule, then the VSD compressor can be operated in its most economical range. So it needs not (but can use if necessary) the whole speed control range – running for hours or days at the upper or lower speed limit are neither economical nor good for the compressor operation.

For this purpose, control parameters REGULATION RANGE MAX (RRmax) and REGULATION BUFFER (RB) are provided which can be set separately for each VSD compressor on the Airleader.

7.2 Control parameters (REGULATION RANGE MAX and REGULATION BUFFER)

With the REGULATION RANGE max (**RRmax**) and the REGULATION BUFFER (**RB**), control limits for the VSD compressor can be defined.

Advantages:

- The VSD compressor works mainly in the economic speed control range
- The fix speed compressor's switching is dynamic instead of touching the Pmin and Pmax limits

This requires that fix speed compressors should fit into the speed control range plus a hysteresis when switched on or off (see chapter 7.1).

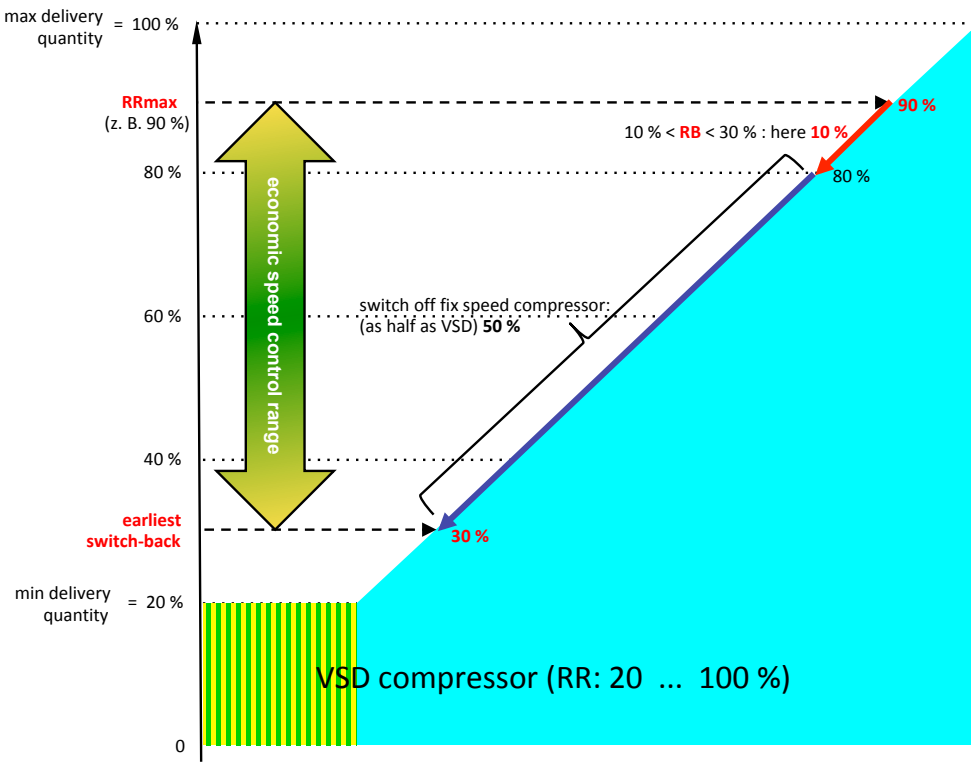
The **RRmax** limits the speed at the upper end, comparable to the beginning of the "red area" in a car's revolution meter. Airleader observes a certain time exceeding the limit and then turns on a compressor, so that the VSD compressor can regulate down again. (Trend: consumption continues to rise).

The **RRmax** narrows the control range upwards, but prevents nervous switching when speed exceeded above for a short time.

Useful values, depending on the compressor, are between 75-99% of the maximum delivery of the VSD compressor. If **RRmax = 100%**, means equal the maximum delivery quantity, then the **parameter is switched off**.

The **RRmax** can only accept values within the speed control range: *(minimum delivery quantity + 10% of max. delivery quantity) < **RRmax** < (max. delivery quantity)*. If values are outside, an automatic correction to the nearest range end value will be done).

The **RB** defines the **switch-back point** and prevents the VSD compressor from running close to the minimum delivery quantity for a long time. This is usually the most uneconomical area – both from an energy and maintenance point of view.



Airleader observes a certain time the speed falling below the limit and then switches off a compressor, so that the VSD compressor can regulate to higher, more economical speed. (Trend: consumption continues to decrease).

The **RB** restricts the control range downwards, but prevents nervous switching when speed decrease below for a short time.

The **RP** can only set values of *10 ... 30% of the max. delivery quantity*.

(If values outside the valid range are entered, an automatic correction to the nearest range end value will be done).

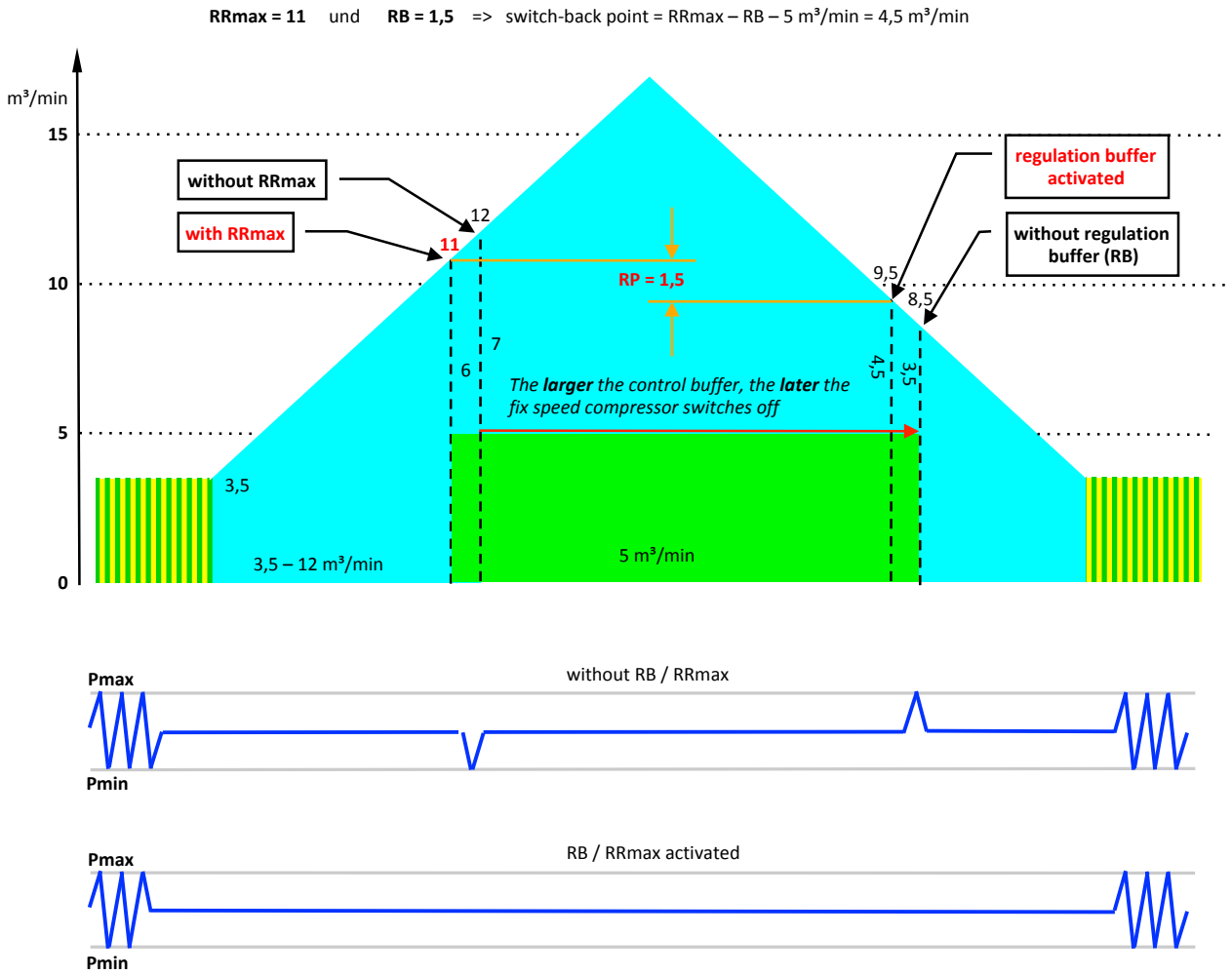
Requirement:

A fix speed compressor fits in the range: *min. delivery quantity < fix speed < **RRmax - RB** -15% hysteresis!*

Example:

Compressor 1: speed regulated 3,5 – 12,0 m^3/min VSD

Compressor 2: fix speed 5,0 m^3/min



When using the control parameters **RRmax** and **RB**, the fix speed compressors are switched dynamically - without touching Pmin and Pmax!

7.3 Control parameter (FLOW RATE MIN)

The VSD compressor with decreasing consumption will run alone, even if the consumption drops below its minimum delivery quantity.

In this case, it clocks - depending on the manufacturer and type - either in the load-off or load-idling mode. This is not really critical, in the first case a frequency converter acts like a soft starter, in the second case, the idle mode operates hardware smoothly. Modern compressors are designed for this use.

From an energy and maintenance point of view, however, operation at or below the lower control limit is less efficient. The better way is to operate – if present – a small fix speed compressor, which delivers about 25 ... 30% of the maximum delivery volume of the regulated compressor.

So it is not necessary to program the time switch, where the compressor priorities can be changed only time-dependent. This can be done by the parameter FLOW RATE MIN consumption-dependent.

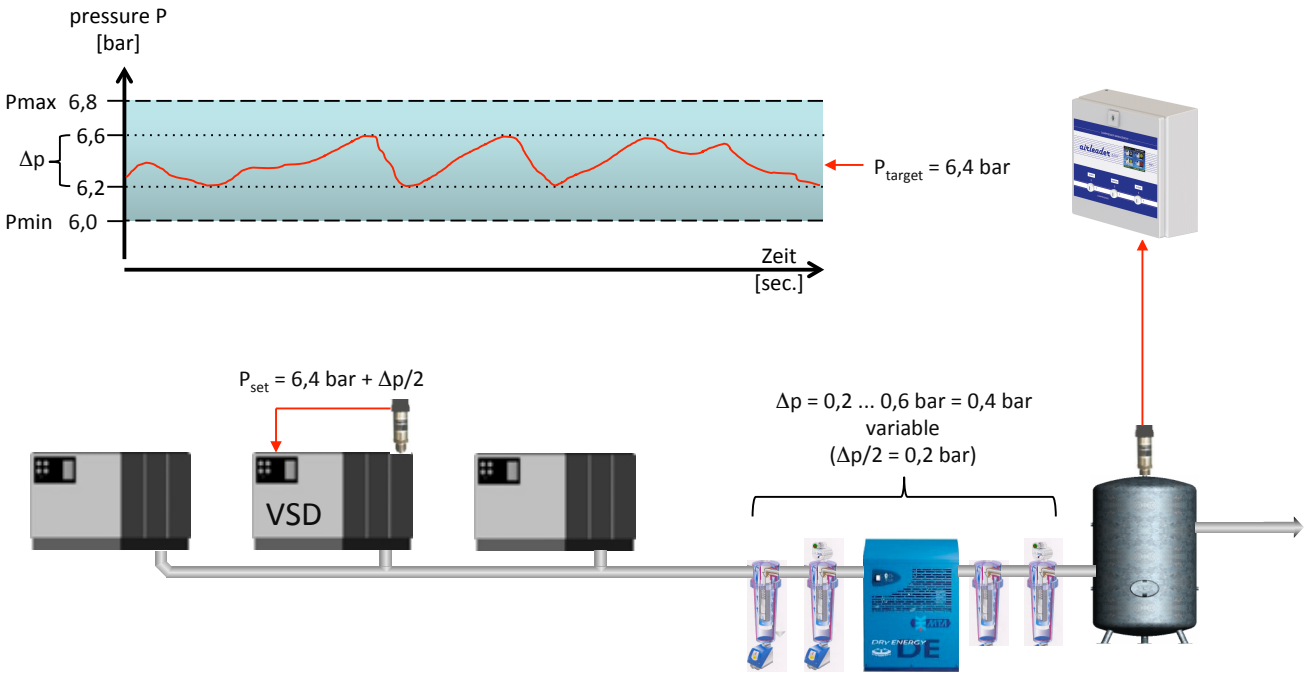
If the consumption falls below VOLUME FLOW MIN then Airleader switches off the VSD compressor. The Airleader gets then one of the remaining compressors adequate this for consumption. The return to the regulated compressor is done with a reset hysteresis.

If the parameter is entered too large, it is automatically adjusted to the appropriate compressor.

Setting the **FLOW RATE MIN = 0 m³/min** causes the **parameter is ineffective**, the VSD compressor runs as described at the beginning of the chapter.

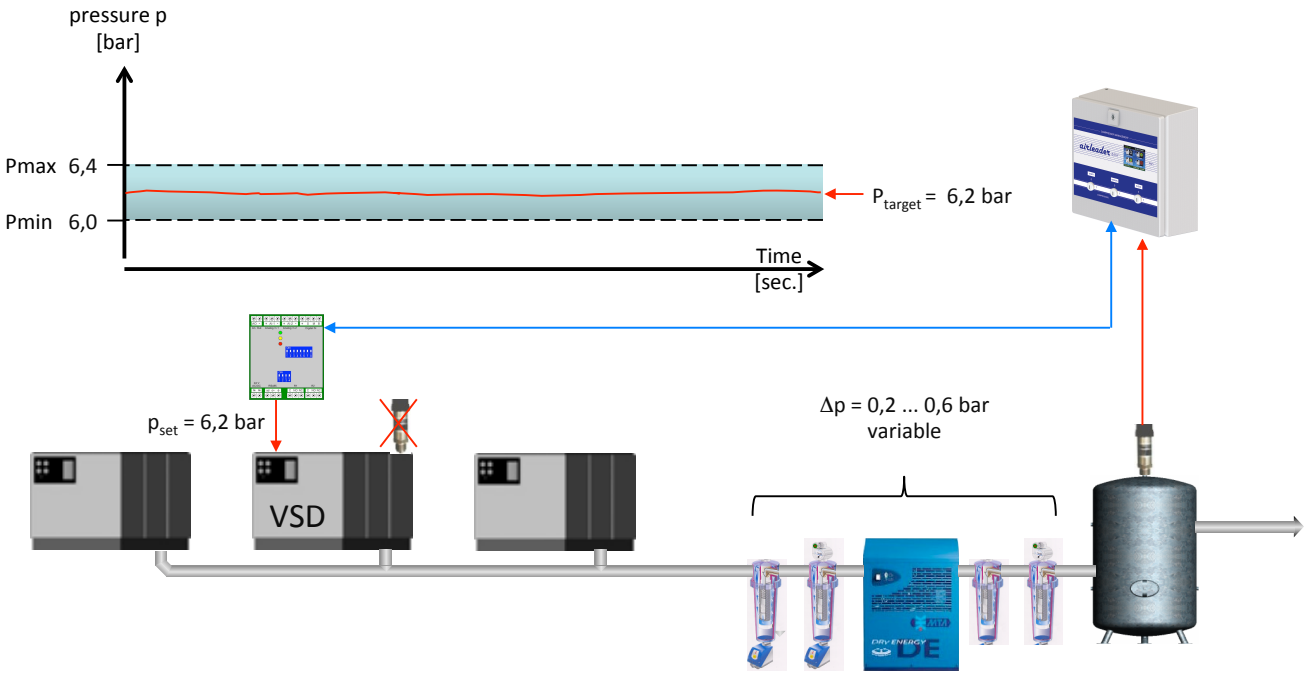
7.4 Remote Pressure Integration

Pressure drops via the treatment (dryer and filter) or the pipeline network behind to the VSD compressor resulting in variable pressure differences between the internal pressure transmitter of the VSD compressor and the pressure transmitter of the Airleader to be connected to the customer's site pipe work. Then a precise control within lowest pressure limits is not possible.



The Airleader control parameters **Pmax – Pmin**, determining the control pressure range, **must be set to a larger range** (+ ΔP). This works mostly- **but not in terms of an energy-efficient operation.**

To ensure efficient operation, it is possible and recommended to use the **aireader control pressure** (which can also be averaged from several network-side pressure sensors) **instead of the internal VSD system pressure** to control the speed regulated compressor.



The Airleader control pressure is a 4 - 20 mA signal at the analogue output AO of the RS 485 connection module within the compressor. The analogue signal can be scaled according to the pressure range of the compressors pressure transducer via the menu. By default 4 .. 20 mA = 0 .. 16 bar are pre-set.

The compressor actually delivers the pressure displayed in the Airleader plus the pressure difference Δ p!

NOTE!

For some compressors, a safety shutdown may occur if the pressure difference between compressor output and network pressure is too high! Therefore, and because of better energy efficiency, the pressure drop over the treatment and the pipelines should be kept as low as possible.

It is useful to switch between the Airleader control pressure and the FU pressure sensor via the relay contact R1 (remote / local) of the RS485 connection module (if necessary with an additional auxiliary relay). In case of manual operation (Airleader shut down) or bus failure, connection module or Airleader error, running with the compressor's own pressure transmitter is guaranteed

Another parameter “OFFSET” can be used to raise or lower this signal in 0.01 bar increments. (See Chapter 5.7.2 *AO Offset: Pressure Signal (from AIRLEADER to VSD compressor).* Sometimes this is necessary if 2 speed controlled compressors indicate different values for the same input pressure signal.

8 Rank (R) and Ranking Order (RO)

8.1 Rank

By default, each compressor is rank 1. So the compressors have the same priority and Airleader can choose from **all compressors** depending on their consumption.

For some cases it is necessary that compressors should preferably run, e. g. if equipped with heat recovery systems. Then all other compressors without heat recovery will be ranked 2nd.

For other cases certain compressors should only be switched on in an emergency situation, but otherwise may not run, because they are old or need to repair. Then these compressors are placed in second place.

The compressors within a rank are controlled according to consumption. If the performance of all compressors within a rank is insufficient, the compressors of the next rank will be switched according to consumption.

WARNING! **Assignment of ranks can limit the airleader functionality (e. g. the consumption-based control)**

8.2 Ranking Order (RO)

The ranks of the compressors will be defined in the compressor menu (see chapter 5.7 *Enter Compressor Data (Ranking Order #1)*) and represent the priorities within **the ranking order 1 (RO 1)**

A further **ranking order 2 can only be defined via the WEB server** (see chapter 5.3 *WEB-Interface and WEB-Server*) and is activated on 3 kinds: software switch within the visualization, the internal switch clock or a digital input on the Airleader.

NOTE! **Ranking order 2 cannot** be programmed **via the WEB interface** (WiFi).

Example 1: **Compressors A + C with heat recovery** (HR) are only **preferred in winter** by ranking order 2, activated by the digital input (e. g. external switch, switching thermometer or PLC).

	compressor			
	with HR A	B	with HR C	D
Rank Order 1	1	1	1	1
Rank Order 2	1	2	1	2

Ranking Order 1: summer
Ranking Order 2: winter

Example 2: **Compressor D is old** and should only be switched in an emergency case. He is supposed to **warm up once a week** to avoid damage due to long time shut off. Rank order 2 is activated by the timer once a week for 1 hour, then switched back to Rank 1.

	compressor			
	A	B	C	emergency D
Rank Order 1	1	1	1	2
Rank Order 2	2	2	2	1

Ranking Order 1: normal operation
Ranking Order 2: warm up emergency compressor (1 hour once a week)

9 Key Switches

9.1 START

Key switch = **1:**

Compressors ON: compressors managed by AIRLEADER

Key Switch = **0:**

Compressors OFF: compressors turn OFF or turn to IDLE and then OFF

9.2 MANUAL

Key switch = **1:**

Manual (on-site) operation via compressor internal pressure switching points

The relays R1 and R2 on the connection modules of all "load" running compressors turn immediately – all others with a time delay – into normal state. This means, the compressors turn from REMOTE to ON SITE operation, controlled by the compressor's own pressure switching points. After a short time all compressors will run **without** being remote controlled by the **airleader**.

(In this state, however, the airleader records all available data - except for the compressor states "load" and "idle".)

Key switch = **0:**

Automatic-operation with Airleader

All currently running compressors (signal “motor running”!) immediately turn to "load", because at this time there is no knowledge about the condition “load” or “idle” and the smallest compressor will switched off. Usually the pressure is higher than the Airleader pressure ranges, so the Airleader switches off compressors as programmed.

9.3 CLOCK

Key switch = **1:**

Timer active: The time switch is used to control different ranking orders (RO) and pressure ranges (PR) as well as to switch the compressors on and off.

Key switch = **0:**

Timer off: Airleader controls according to the basic profiles (pressure range 1 and ranking order 1).

10 Timer

The timer is programmed via the **WEB server** (see chapter 5.3 *WEB-Interface and WEB-Server*) and activated via the key switch "CLOCK" on the Airleader.

NOTE **The timer cannot be programmed via the WEB interface** (WiFi).

The following functions can be controlled time-dependent:

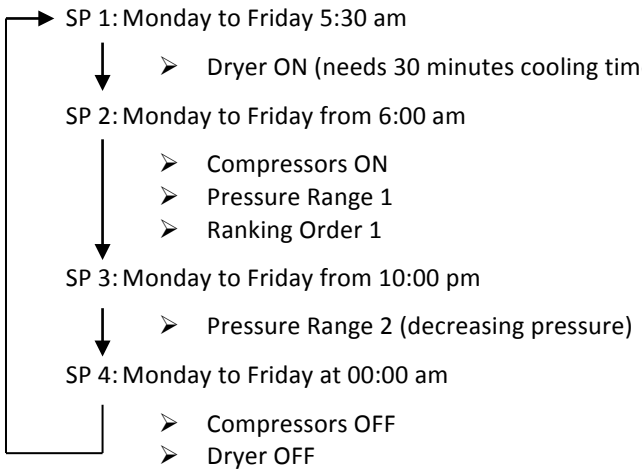
- Switch compressors ON / OFF
- 2 pressure ranges, for time-dependent pressure adjustment
- 2 ranking orders, for time-dependent ranking change
- 2 switching contacts on RS 485 extension modules (relay R1, R1), for switching operations (option)

The pressures for the 2nd pressure range and the compressor priorities of the 2nd rank must be configured beforehand via the WEB server (see chapter 5.3 WEB-Interface and WEB-Server).

Previous notes of all settings that are to be programmed may helpful, so that no programming errors occur.

Up to 16 switching points (SP) can be programmed.

Example:



If outside the timer programming compressed air is required, turning OFF the key switch “CLOCK” deactivates the timer. Then all basic settings become active (compressors ON, pressure range 1, ranking order 1, relays R1 and R2 at normal)

11 Options

The following options are available. Please contact your supplier or the manufacturer.

11.1 Second VSD Compressor and 4 x RS 485 Extension Modules

The basic configuration of Airleader EASY includes the connection of **one** speed regulated compressor. A 2nd speed regulated compressor is connectable if this option is chosen. The integration is analogous to the first one.

This option also includes the maximum of 4 RS 485 extension modules instead of 2.

11.2 Ethernet Bridge (Bus Connection with LAN)

If no connection by BUS cable can be made for remote compressors or sensors, a connection via an existing network is possible.

With this option, an **IP-Link** module is available in the Airleader EASY, which operates the RS 485 BUS via the RJ45 network socket in the network.

At the remote site, of course, an on-site network connection and a corresponding **IP-Link** module is required. For this purpose, the control manufacturer offers ready configured and wired switch boxes with power supply unit, **IP-Link** module and one or more connection modules.

11.3 Relay Contacts R1 and R2 at RS 485 Connection Module

Default:

The relays R1 and R2 on the RS 485 connection module are normally used for controlling the compressors (address 1 - 4 as compressor module) **or** (address 17 and 18, optionally 17 – 20, as accessory module) as alarm output for the analogue inputs AI 1 and AI 2.

Option:

The function of the relays R1 and R2 in the accessory modules (address 17 and 18, optionally 17 – 20) can be used as a switching output of the timer, which is WEB server programmable.

This is useful for controlling accessories such as dryers or main valves.

11.4 OPC Server

The OPC Server provides the process data of the Airleader once a second as OPC objects. The OPC client accesses the data provided by the OPC server for displaying in central building control systems.

Today, OPC is the standard for manufacturer-independent communication in automation technology. Without OPC, two devices for data exchange required precise knowledge of the communication possibilities of the other party. With OPC, it is sufficient to write an OPC-compliant driver for each device exactly once.

The Airleader OPC driver can be easily integrated into arbitrarily large control and monitoring systems, such as **Sauter NovaPro, WinCC, Kieback & Peter, Wonderware, Web Factory, ACRON (Videc)**, etc. or even energy management system software such as. B. **MESSDAS, FRAKO, ECON Solutions**.

11.5 MOD-Bus Server

The Modbus server provides all relevant compressed air station data in a standardized protocol description via an open protocol. The data is available at the network interface RJ-45.

General data

- Compressed air consumption
- Network pressure
- Additional analogue sensors on the master module

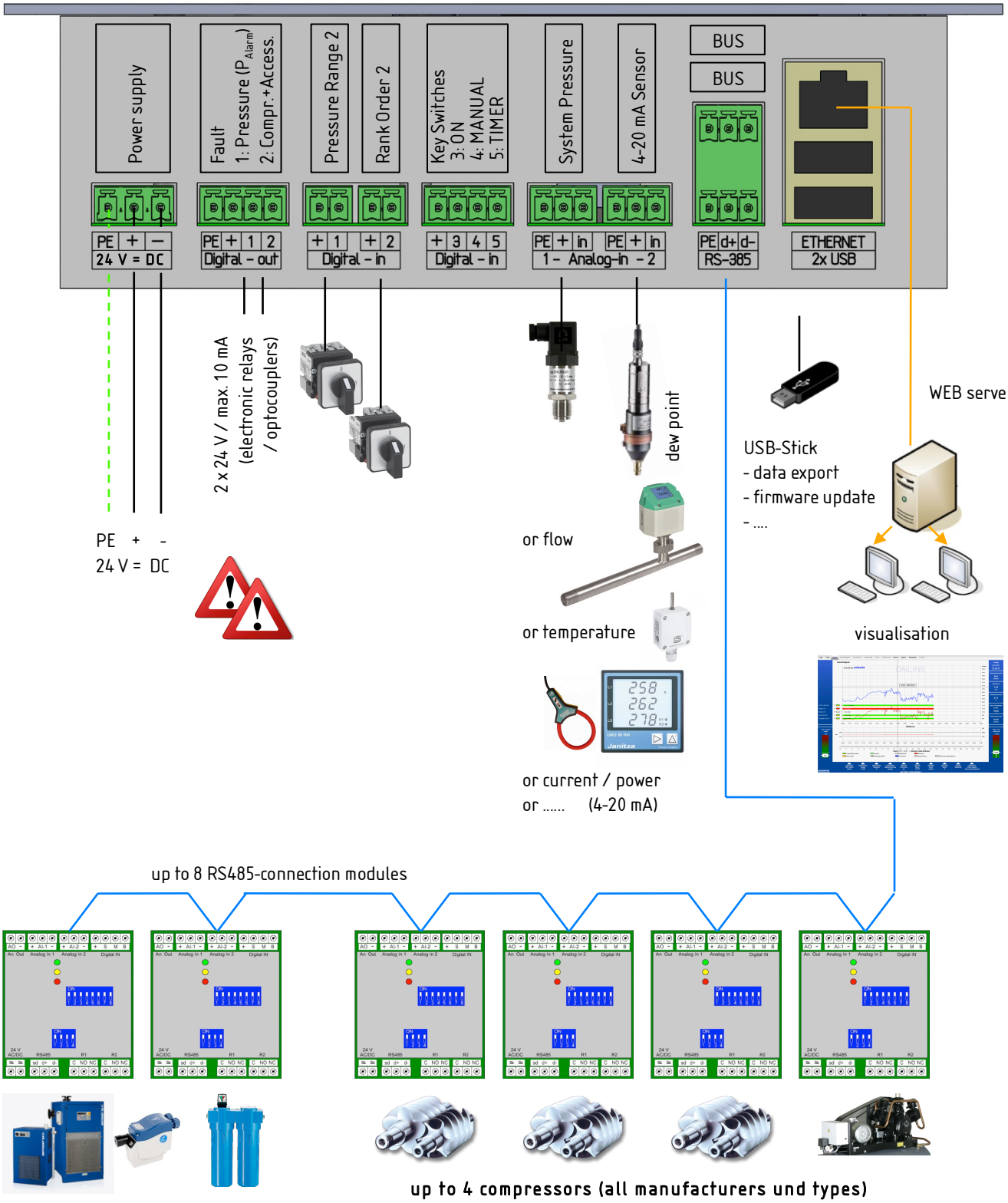
Data of the compressors

- Load
- Motor run
- Ready to operate
- Fault
- Current consumption
- Temperature or similar (if sensors are connected to the analogue inputs)

Data from the accessory connection modules

- Fault message or run message of the connected devices
- Analogue sensors connected to the analogue inputs

12 Connection Overview



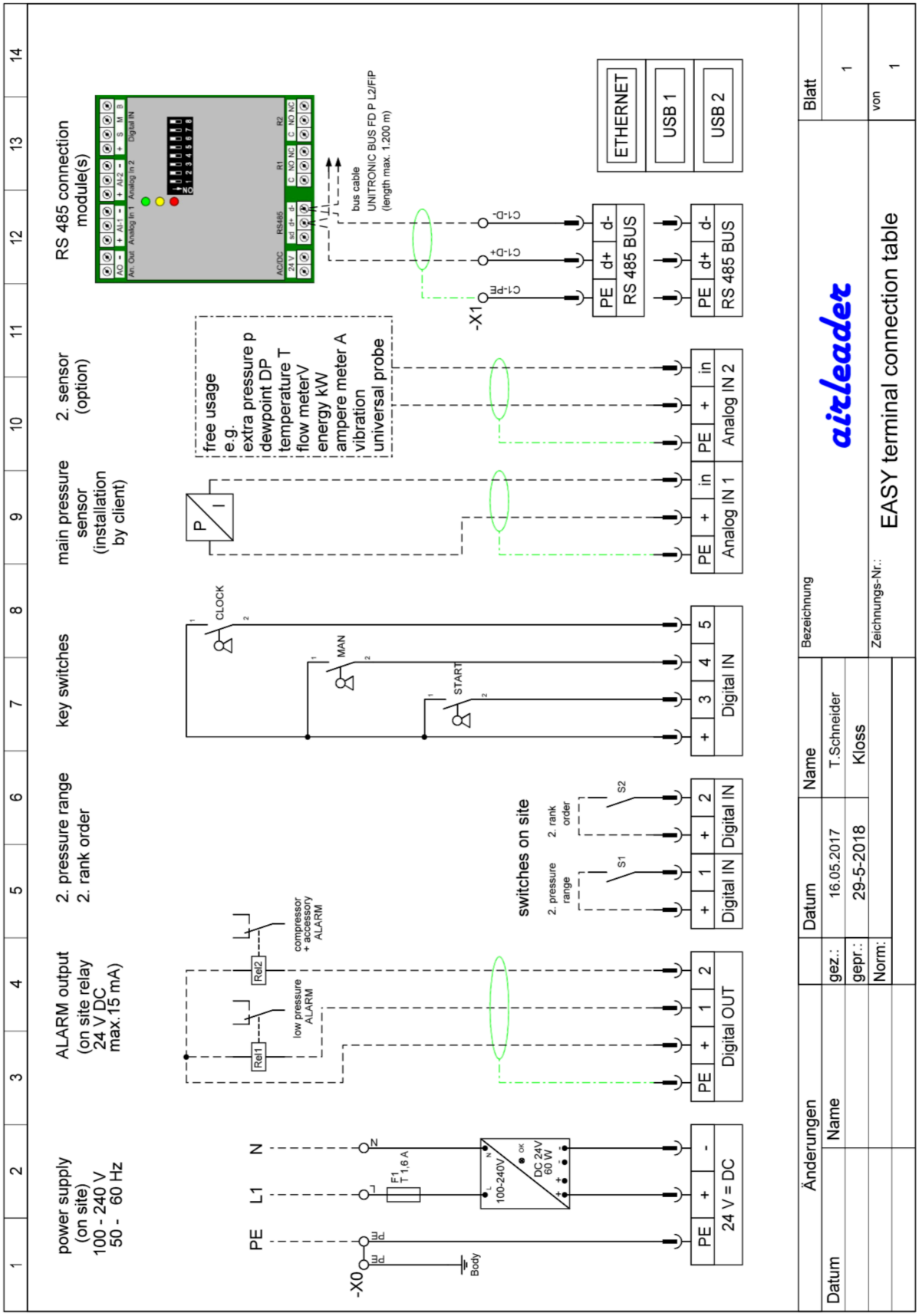
Accessory monitoring:

up to 6 (option 12) fault or operation message (filter, dryer, drains, pumps, vents, ...)

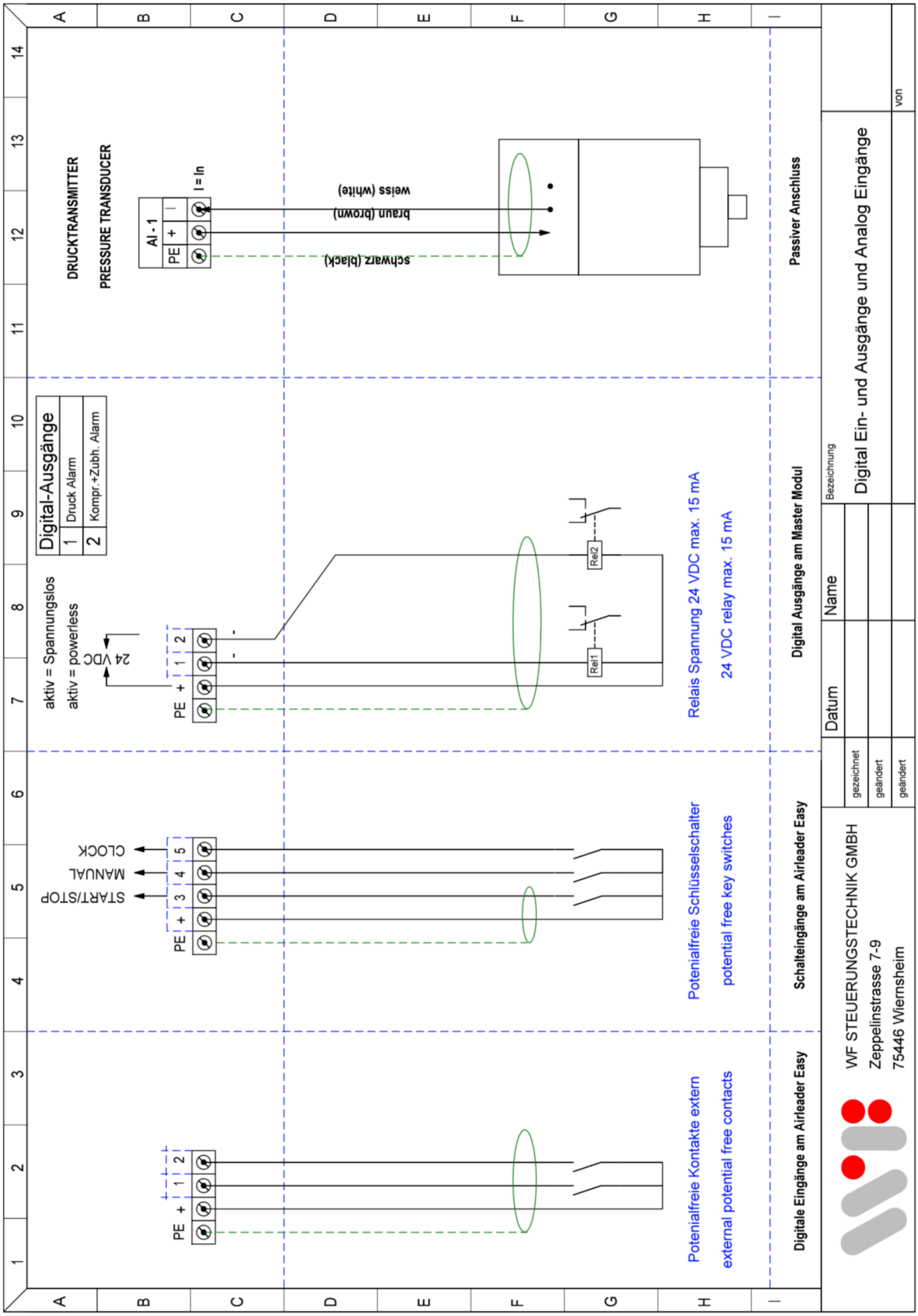
up to 4 (option 8) sensor analogue inputs (pressure, dew point, temperature, bearing vibration, power, flow, ...)

13 Electrical Installation

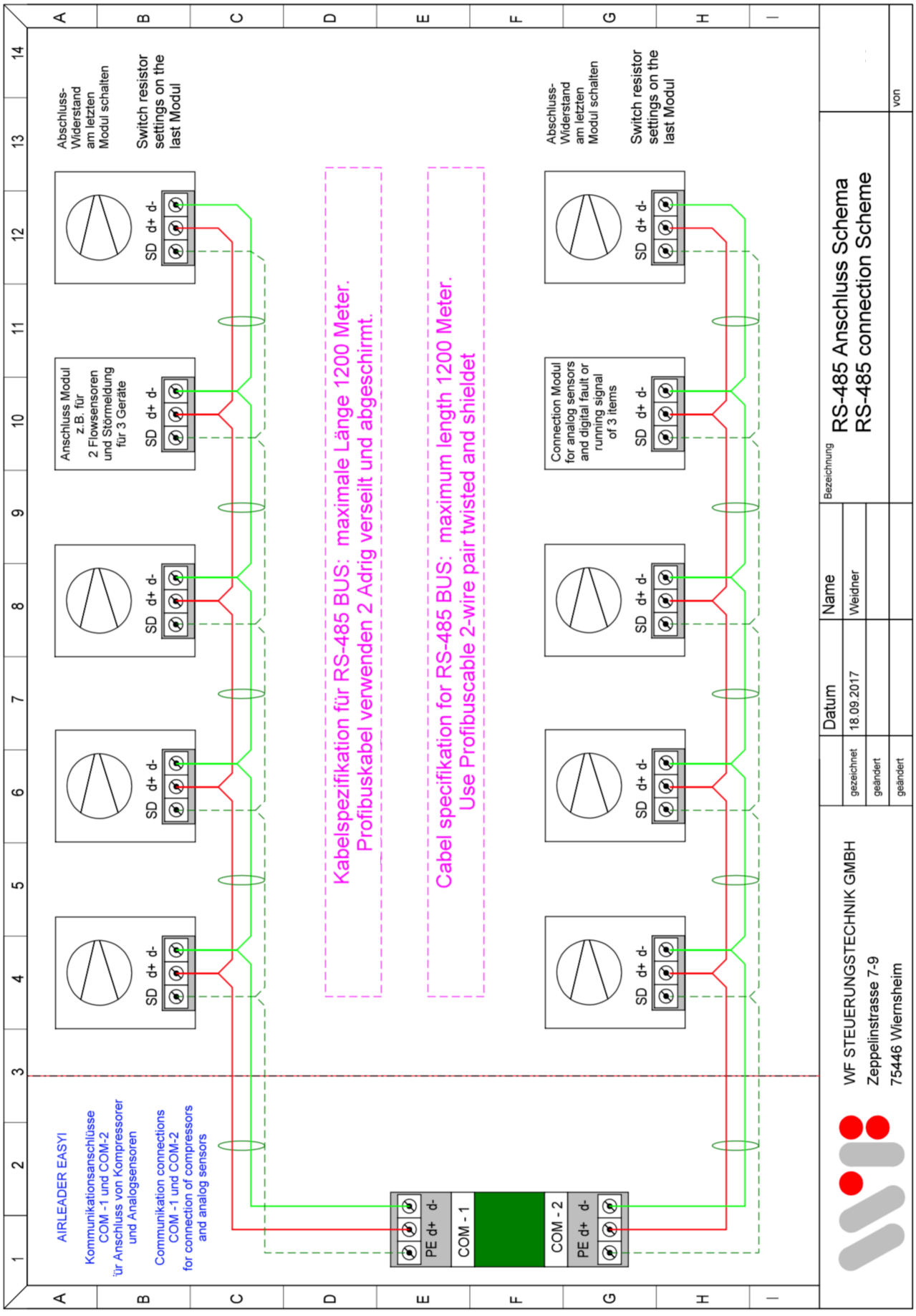
13.1 EASY: Terminal Connection Diagram



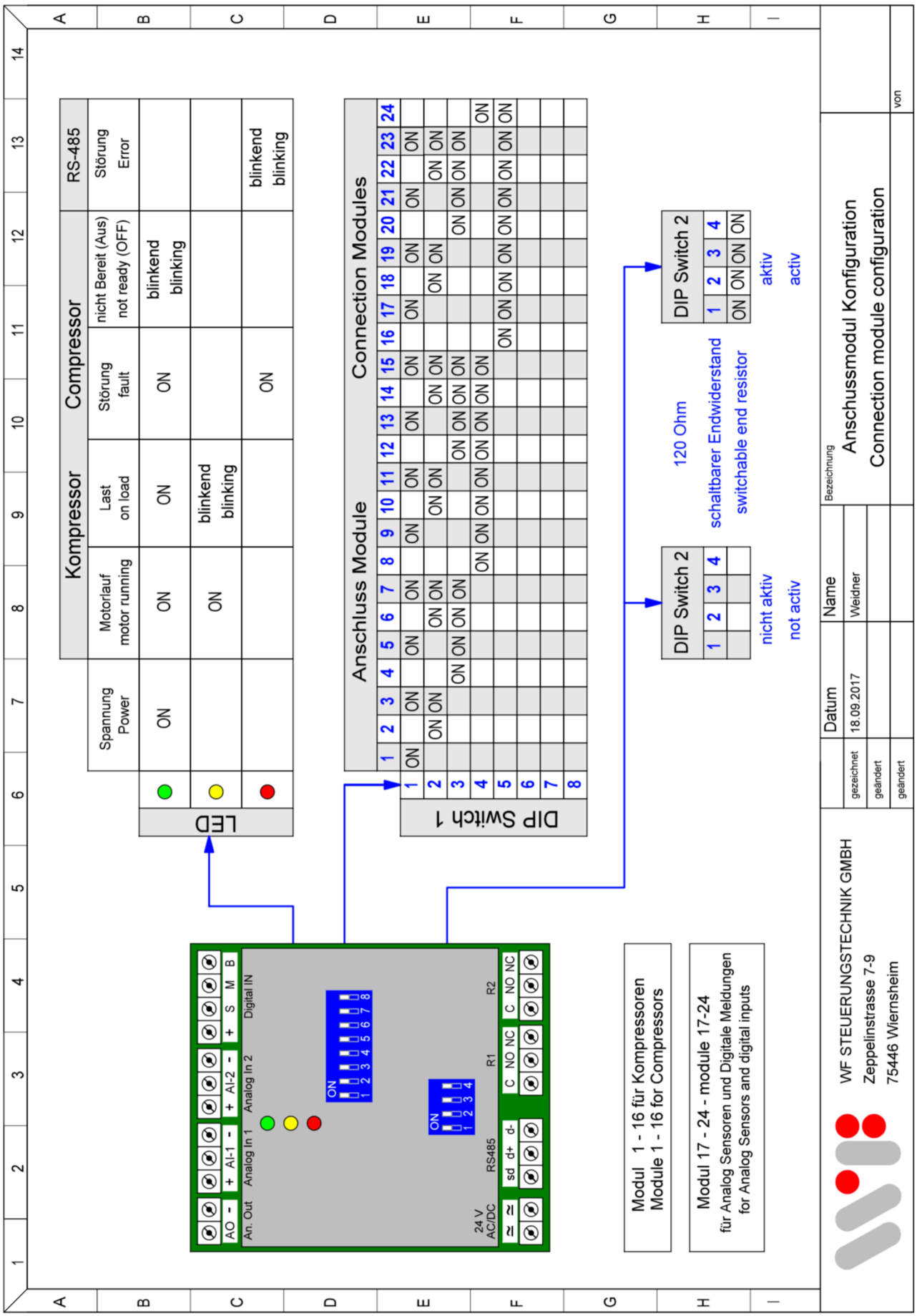
13.2 EASY: Analogue In and Digital In and Out



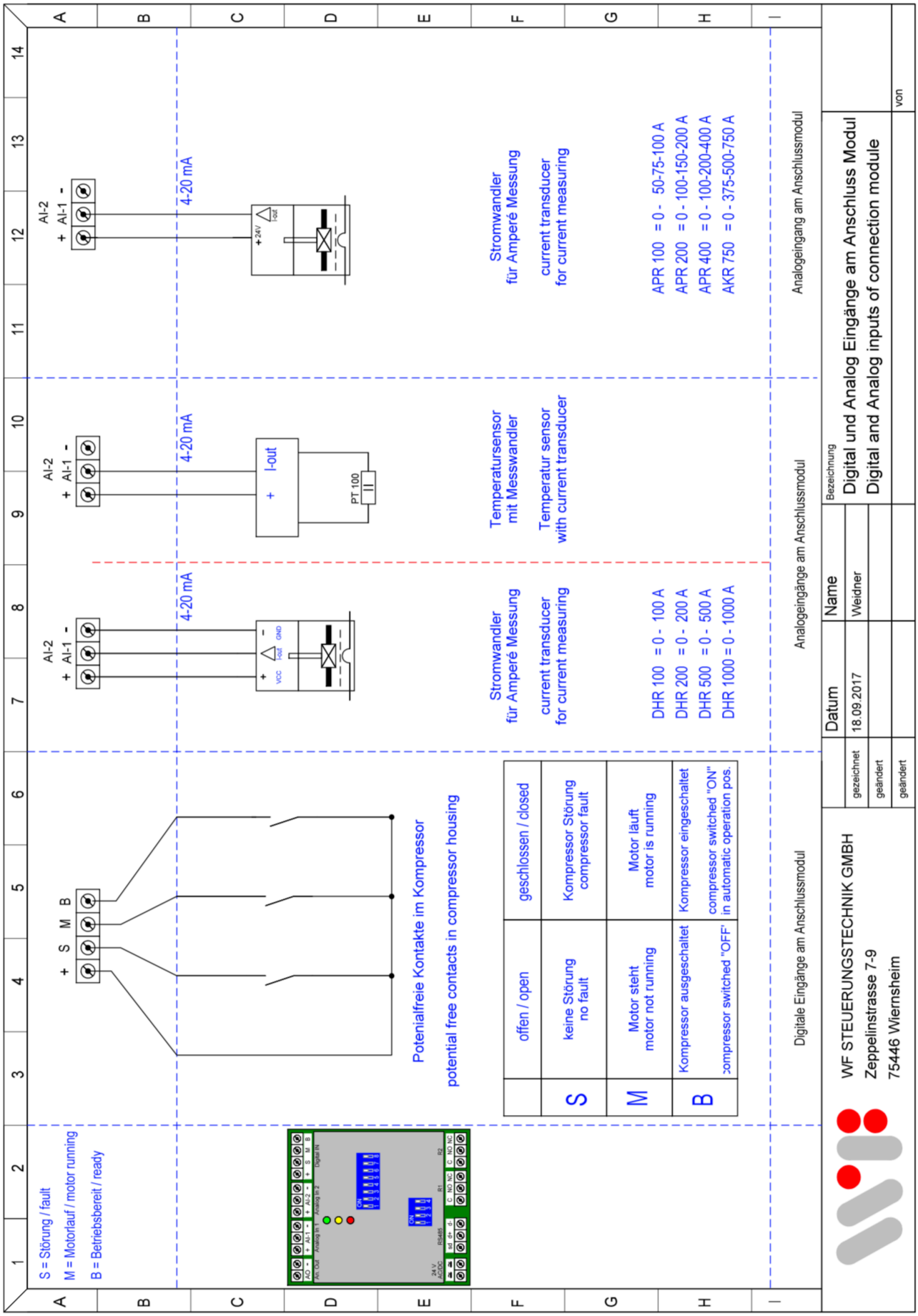
13.3 RS-485 Connection Module: Bus Connection Scheme



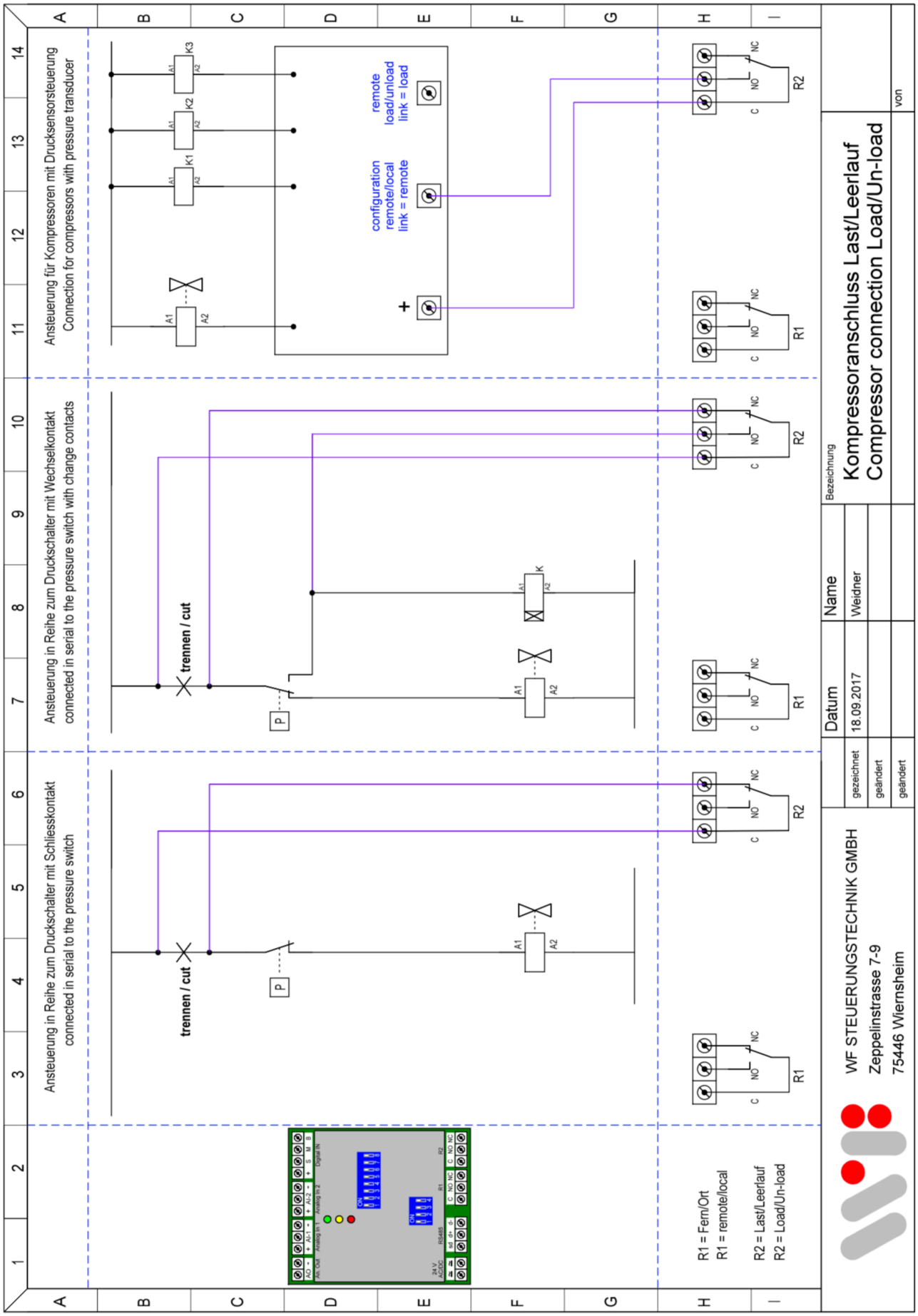
13.4 RS-485 Connection Module: Configuration



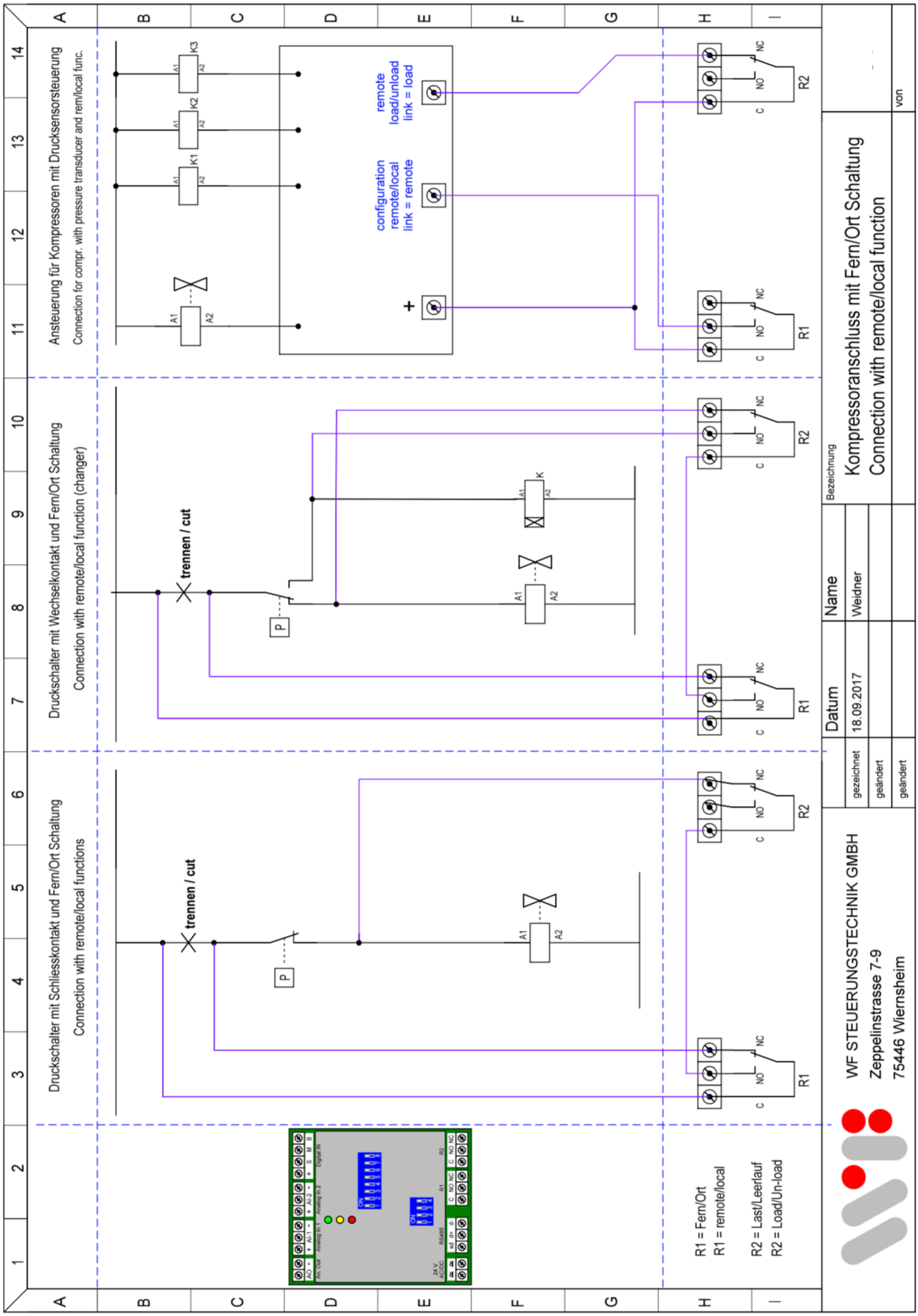
13.5 RS-485 Connection Module: Digital and Analogue Inputs



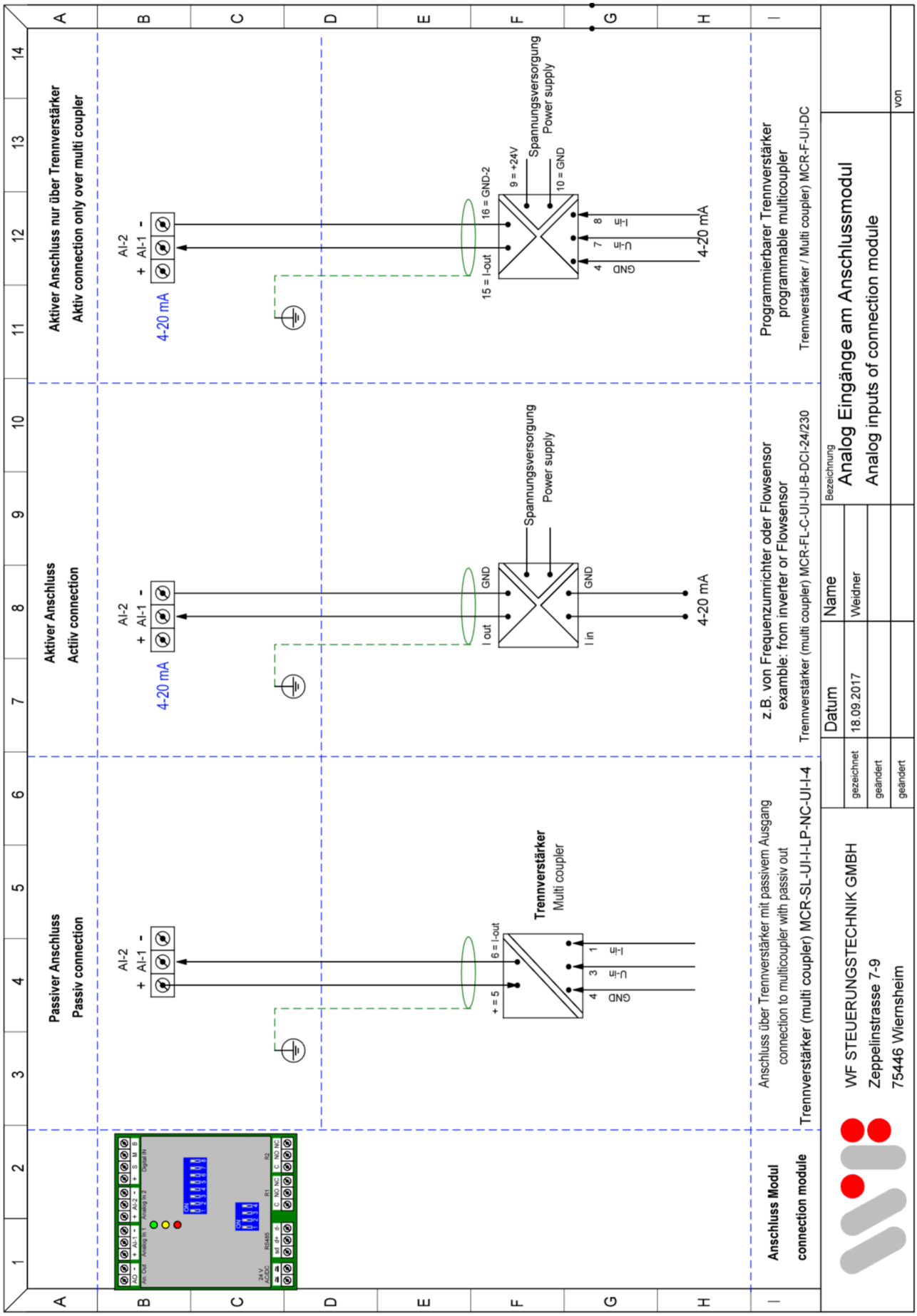
13.6 RS-485 Connection Module: Compressor Connection LOAD / UNLOAD



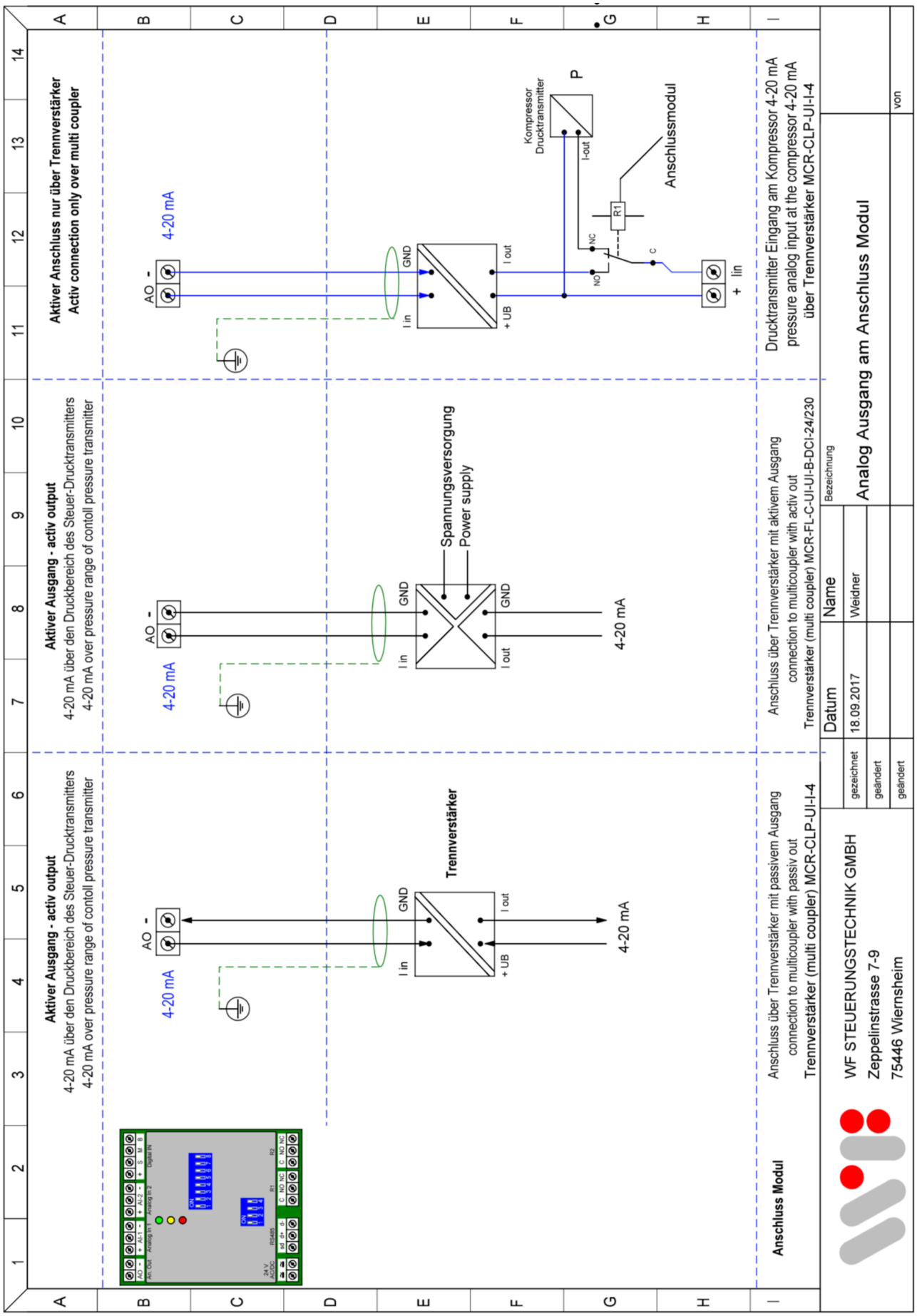
13.7 RS-485 Connection Module: Compressor Connection REMOTE / LOCAL



13.8 RS-485 Connection Module: Analogue Input with Isolation Amplifier



13.9 RS-485 Connection Module: Analogue Out



14 On-site work and example installation

On-site work (if relevant):

1. **Mount the Airleader control cabinet and supply it with power (230 V) and connect to the network (ETHERNET).**
2. **Install Web Server Visualization (IT Dept.).**
3. **Install main pressure transmitter and any other sensors supplied into the compressed air system.**
4. **Attach switch box(es) and supply with power (230 V).**
5. **Install connection modules, isolation amplifiers (VSD) and power supplies in compressor, supply with power (230 V).**
6. Install the Amp-converter (1-phase) ready for operation and place it on the first connection module AI 1.
7. Install the kW measuring device (3-phase) ready for operation in compressors (sheet metal cut out!) with current transformers, circuit breaker and voltage measurement.
8. Install the contact temperature sensor (compressor stage outlet) and the JUMO transmitter in oil-cooled compressors and place them on the first connection module AI 2.
9. Attach the vibration sensor to each compressor (compressor stage) (M8 thread in the direction of vibration) and place it on the second connection module AI 1.
10. Install heat recovery components (heat meter, 2 temp. Sensors, volume flow sensor (cold side)), electrically connect, signal line on Airleader component.
11. **Place cables (follow specifications) into the control cabinets, if necessary, double signals required by the customer.**
12. **Establish RS485 bus connection.**

Cable specification:

Bus cable:

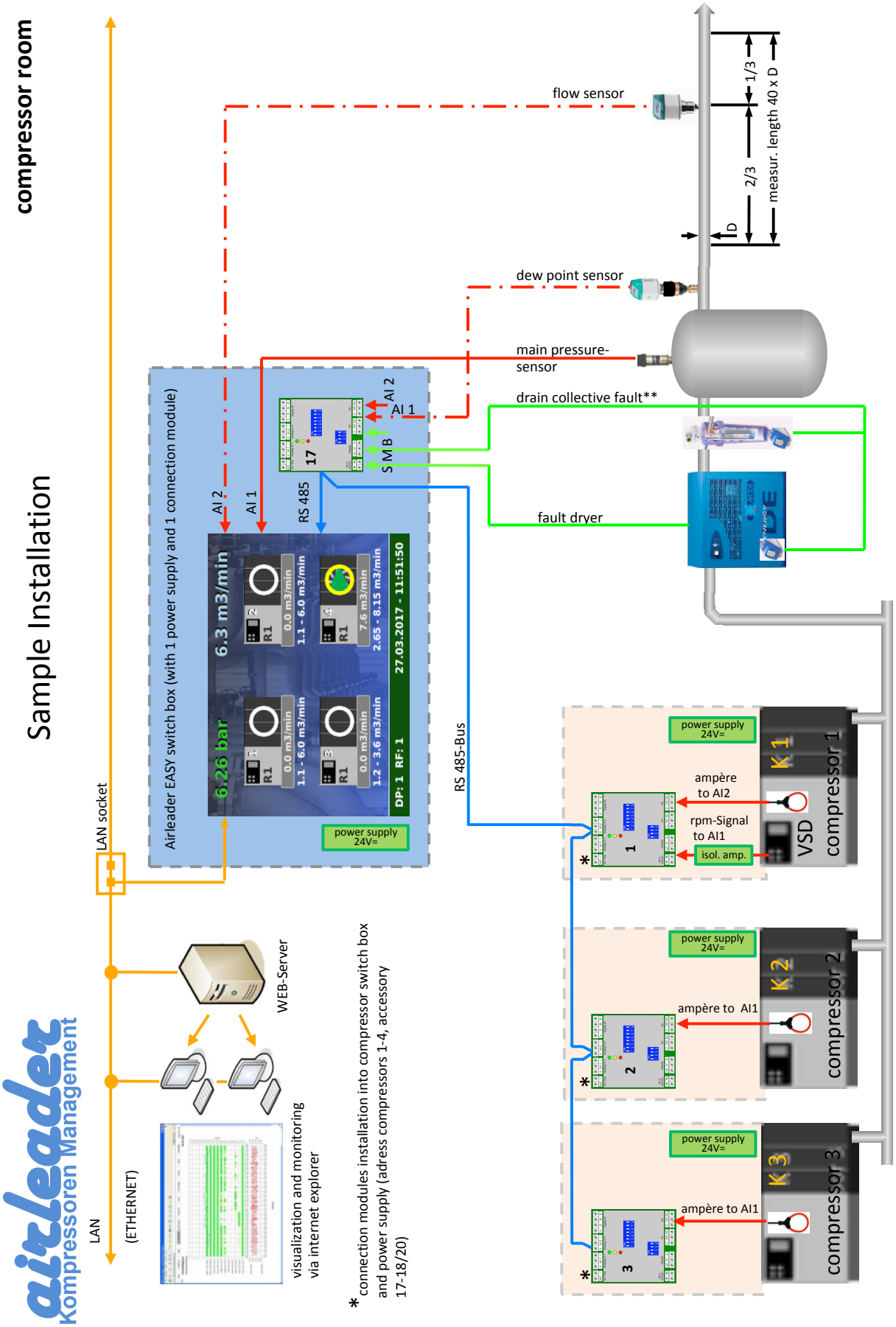
UNITRONIC BUS FD P L2/FiP
from Airleader ⟶ RS485-Module (compressor, switch box)

Signal cable:
LIYCY 2x 0,34 mm² to 2x 0,5 mm²
from Airleader ⟶ pressure transducer, temp.-sensor

Signal- u. supply cable:
LIYCY 4x 0,34 mm² to 4x 0,5 mm²
flow-/dew point-sensor ⟶ Airleader (or switch box w. supply)

Fault or operating mode cable:
LIYY 2x 0,5 mm²

LAN-cable:
network cable, patch-cable


compressor room
Sample Installation
flow sensor
1/3
2/3
measur. length 40 x D
D
dew point sensor
main pressure-sensor
drain collective fault**
fault dryer
AI 2
AI 1
S M B
17
RS 485
Airleader EASY switch box (with 1 power supply and 1 connection module)
6.3 m3/min
6.26 bar
DP: 1 RF: 1
27.03.2017 - 11:51:50
power supply 24V=
LAN socket
RS 485-Bus
power supply 24V=
ampère to AI2
rpm-Signal to AI1
isol. amp.
K 1
VSD compressor 1
ampère to AI1
K 2
compressor 2
K 3
compressor 3
WEB-Server
LAN
(ETHERNET)
visualization and monitoring via internet explorer
* connection modules installation into compressor switch box and power supply (adress compressors 1-4, accessory 17-18/20)
airleader Kompressoren Management

15 CE – Declaration of Conformity

WF STEUERUNGSTECHNIK GMBH

CE

Declaration of Conformity

We hereby,

WF Steuerungstechnik GmbH
Zeppelinstr. 7-9
D 75446 Wiernsheim
Germany

declare that the hereunder specified equipment

AIRLEADER EASY	*Type 0601*
AIRLEADER Master II	*Type 2402*
AIRLEADER connection module	*Type 4702*
Airleader pressure transmitter	*Type DTH*

is in conformity with the European agreed standards

EN 61000-4-2	Criteria B
EN 61000-4-3	Criteria A
EN 61000-4-11	Criteria B
EN 61000-4-4	Criteria B
EN 61000-4-5	Criteria B
EN 61000-4-6	Criteria A

Wiernsheim, on 1st December 2017

Werner K. Weidner

airleader

WF STEUERUNGSTECHNIK GMBH

WF Steuerungstechnik GmbH

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