

Energy management function at adsorption dryer PDAD

Application note for use of the energy management function at adsorption dryer PDAD. Explanation, use and layout of purge air regulation for reducing air consumption.

PDAD-...-...



TitleEnergy management function at adsorption dryer PDAD
Version 1.10
Document number 100152
Original de
AuthorFesto

Last saved on 20. September 2017

Copyright notice

This documentation is the intellectual property of Festo AG & Co. KG, which also holds exclusive copyrights. Any modification of the content, duplication or reprinting of this documentation, as well as distribution to third parties, are only permissible with the express consent of Festo AG & Co. KG.

Festo AG & Co KG reserves the right to make modifications to this document in whole or in part. All brand names and product names are trademarks or registered trademarks of their respective owners.

Legal notice

Hardware, software, operating systems and drivers may only be used for the applications described and only in conjunction with components recommended by Festo AG & Co. KG.

Festo AG & Co. KG does not accept any liability for damages arising from the use of any incorrect or incomplete information contained in this documentation or any information missing therefrom.

Defects resulting from improper handling of devices and modules are excluded from the warranty.

The data and information specified in this document should not be used for the implementation of safety-relevant functions for the protection of personnel and machinery.

No liability is accepted for claims for damages arising from failure or malfunctioning. Otherwise, the stipulations concerning liability set forth in the terms and conditions of delivery, payment and use of software of Festo AG & Co. KG, which can be found at www.festo.com or can be supplied upon request, shall apply.

None of data contained in this document represent guaranteed characteristics in the legal sense, particularly with regard to functionality, condition or quality.

The information in this document serves only as basic information for the implementation of a specific, hypothetical application and is in no way intended as a substitute for the operating instructions of the respective manufacturers or design and testing of the respective application by the user.

The respective operating instructions for Festo products can be found at www.festo.com/sp.

Users of this document (function and application) must themselves verify that all of the functions described herein also work correctly within the application. Even after examining this document and using the specifications contained herein, users are nevertheless solely responsible for their own applications.

Table of contents

| | | |
|----------|--|-----------|
| 1 | Utilised components, documentation..... | 4 |
| 1.1 | Utilised components..... | 4 |
| 1.2 | Documentation..... | 4 |
| 2 | Description and purpose of the application note | 5 |
| 2.1 | Introduction to the subject matter..... | 5 |
| 2.2 | PDAD functions..... | 6 |
| 2.3 | Reasonably foreseeable misuse | 7 |
| 2.4 | Environment used in..... | 7 |
| 2.5 | User groups | 7 |
| 2 | Layout of purge air regulation for reducing air consumption..... | 8 |
| 3.1 | Nature of the task..... | 8 |
| 2.2 | Use of a manual switch for purge regulation | 9 |
| 2.3 | User of a dew point transmitter and a process regulator for purge regulation | 10 |
| 2.4 | Use of a simple pressure switch for purge regulation | 11 |
| 2.5 | Use of a pressure sensor for purge regulation | 13 |
| 2.6 | Establishing a connection between switching device and the energy management contact at the PDAD . | 14 |
| 3 | Safety..... | 17 |

1 Utilised components, documentation

1.1 Utilised components

| Type/name | Software/firmware version | Date of manufacture |
|------------------------------|---------------------------|---------------------|
| PDAD-...-... | All | All |
| Manual electric switch | -- | -- |
| dew point sensor/transmitter | -- | -- |
| Pressure switch | -- | -- |
| Pressure sensor | -- | -- |

Table 1: Utilised components

1.2 Documentation

This application note is intended to supplement existing documents to include the energy management function.

Catalogue documentation

https://www.festo.com/cat/en-gb_gb/data/doc_engb/PDF/EN/PDAD_EN.PDF

Operating instructions:

https://www.festo.com/net/en-gb_gb/SupportPortal/Downloads/385765/464376/PDAD_2017-01g_8068816g1.pdf

Animation:

https://www.festo.com/net/en-gb_gb/SupportPortal/Flash/378325/376353/en/index.htm

--> Further documents and publications regarding this subject can be found at the [Support Portal](#) operated by Festo AG & Co. KG.

2 Description and purpose of the application note

2.1 Introduction to the subject matter

The adsorption dryer PDAD is used to reduce the pressure dew point to -70°C for corresponding use, e.g. handling powders, in climatized rooms and in the pharmaceuticals and chemicals industries.

Brief explanation:

Adsorption (from the Latin adsorpio, from adsorbere (“draw in”) is the designation for the enrichment of substances from gases or liquids at the surface of a solid, generally at the interface (matter) between two phases.

Adsorption dryers draw the moisture out of the compressed air through the use of a drying agent. While adsorption takes place in the first container, regeneration takes place in the second container at the same time. The cycle times are stored in the electronic controller. Pressure dew points within a range of -20 to -70°C are achieved with standard products. Various hot and cold processes are available for regeneration.

The cold regeneration process is used by the adsorption dryer PDAD:

For the purpose of regeneration, a portion of the already dried compressed air is caused to flow through the previously used container cartridge and is then vented to the atmosphere.

- + Simple technology
- + Minimal investment costs
- Compressed air consumption
- High operating costs

2.2 PDAD functions

Due to requirements for minimal power consumption, the PDAD is equipped with an energy management function. This makes it possible to set up purge air regulation with corresponding interconnection in order to reduce air consumption. The PDAD also includes an RJ45 interface for connecting a PC directly via a network cable (Ethernet). With the help of software matched to the serial number, the dryer's setting can be accessed and changed, and errors can be read out if applicable.

These functions are integrated, but they're not described in the operating instructions. The software is neither provided by Festo nor is it available, because the device can be damaged in the event of incorrect settings.

The PDAD is also equipped with an alarm connection which is described in the operating instructions. A visual or acoustic remote alarm system can be connected outside of the dryer via this connection (type C DIN plug). In the event of a malfunction or if service is required, the alarm relay is switched (NO contact) and red LEDs simultaneously indicate the error at the display panel. The alarm relay is reset when the error has been eliminated, but only after the current switching cycle has been completed or the control device has been reset after a cartridge change.

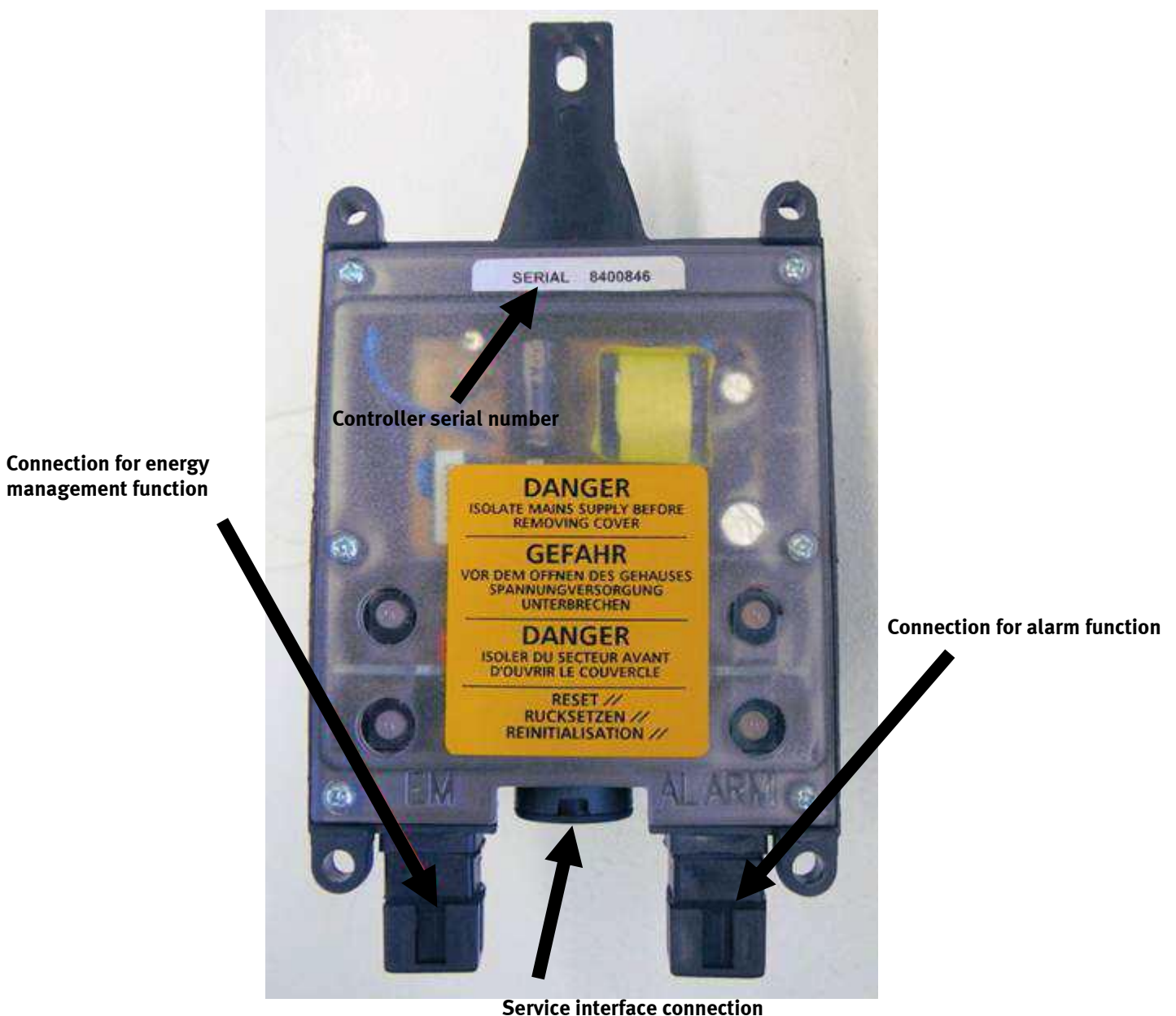


Figure 0: PDAD functions – overview of connections at the controller

2.3 Reasonably foreseeable misuse

This application note describes the layout and the benefits of the energy management function. It can be used to shut down the purge air function when little or no air is required.

It's very important to understand that the purge function can **only** be shut down at times when little or no air is required. If this function is shut down at any other time, the drying agent cartridges may be permanently damaged thus resulting in the loss of drying performance, and possibly a mechanical defect as well. The cartridges may never be entirely saturated!

In any case, checking must be conducted for continuously flawless functioning because the dryer might otherwise fail, or errors might occur within the process or the application!

The function of the RJ45 interface for direct connection of a PC via a network cable (Ethernet) is not described because the software is not supplied with the product, and there are too many hazards associated with incorrectly configured device parameters. The function and use of the alarm connection are described in the official operating instructions.

2.4 Environment used in

- Industrial environment
- Applications with minimal or sporadic air consumption with correspondingly specified pressure dew points, e.g. in laboratories

2.5 User groups

- Specialists in the field of pneumatics
- Specialists in field of electrical engineering
- Sales engineers at Festo AG & Co. KG

2 Layout of purge air regulation for reducing air consumption

3.1 Nature of the task

Regenerative dryers have to eject a portion of the process air in order to remove the moisture which accumulates inside them. During times when only small amounts of air are required, this loss is unnecessary and thus undesirable. In many cases the compressor runs nearly uninterruptedly in order to compensate for the dryer's purge air loss.

Example: The compressor for central compressed air preparation is started up again and again due to the purge air function and the associated pressure drop, although no air consumption is required for the application. Compressor start-up results in noise – in some cases disagreeably at night. The temperature in the room might also rise, so that applications with low pressure dew points may be influenced.

The adsorption dryer PDAD is equipped with an energy management function by means of which the purge function can be shut down during times when little or no air is required. The dryer's regulator is equipped with a set of easily accessible contacts with which the solenoid valves (which regulate the dryer's purge function) can be shut down, thus resulting in zero air loss at via dryer.

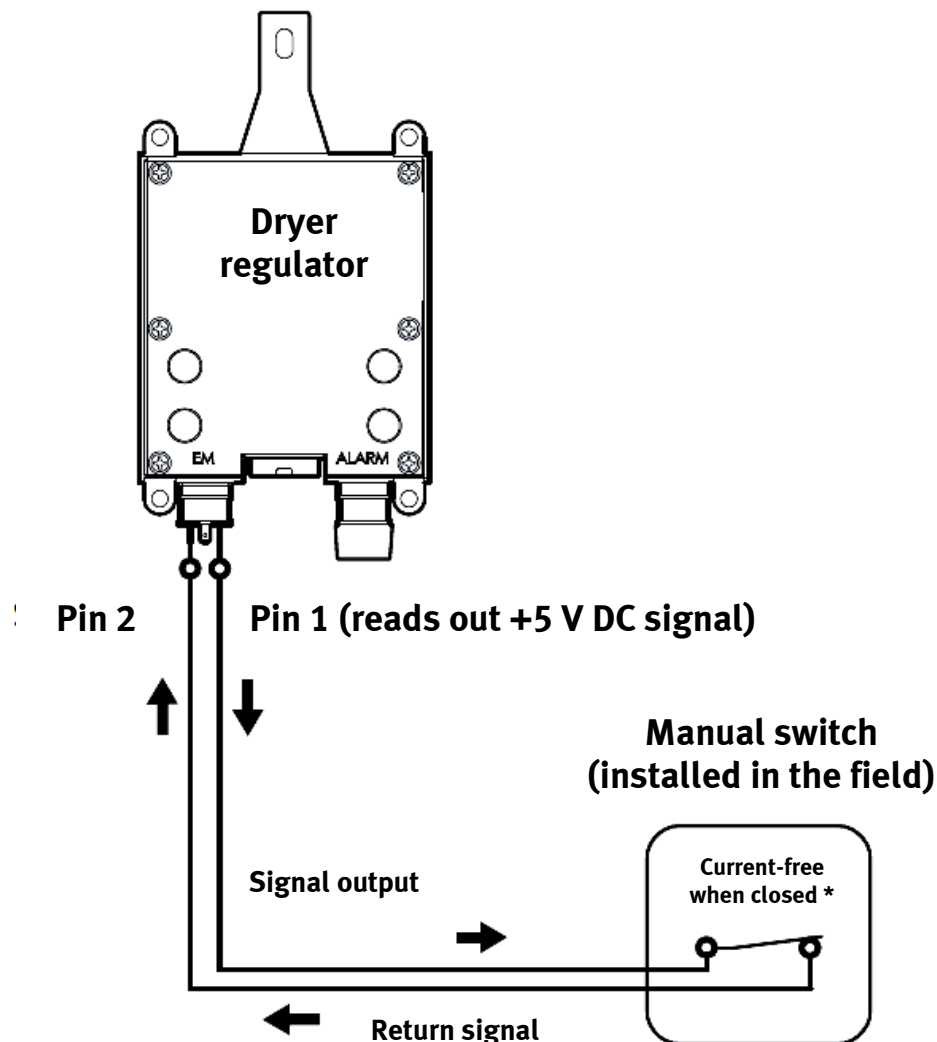
In order to makes use of this function, the operator must provide a switching system with acceptable logic which informs the dryer when little or no air is required. Several examples of frequently used switching systems are provided in the following pages (with varying complexity).

2.2 Use of a manual switch for purge regulation

This is the simplest setup. When air is not used downstream from the dryer, the purge function is shut down by means of a manual switch. This layout is frequently used in systems which act upon the point of consumption (point-of-use or POU systems). For example, if the dryer is only used to supply suitably dried air to a certain machine or application, the dryer is only needed when the machine is running and can be shut down either manually or possibly via additional contacts in the machine's on/off switch.

It's very important to understand that the purge function can **only** be shut down at times when little or no air is required. If this function is shut down at any other time, the drying agent cartridges may be permanently damaged thus resulting in the loss of drying performance, and possibly a mechanical defect as well. The cartridges may never be entirely saturated!

The following drawing (figure 2) shows how the above mentioned components might be connected for regulation of a dryer's purge function. Please note that specific details regarding the components are manufacturer-independent – the manufacturer's specifications must be complied with in any case.



*** Current-free when closed – open to deactivate the purge function**

Figure 2: Use of a manual switch for purge air regulation

2.4 Use of a simple pressure switch for purge regulation

Many compressors are furnished with pressure switches which include additional contacts, by means of which the dryer's purge function can be shut down when the compressor is in the discharged state. Unfortunately, many of these switches have considerable dead zones or a large hysteresis (difference or reset point between the charge (on) and discharge (off) settings, which in most cases cannot be changed). The amount of air which can flow through the dryer while the compressor is being discharged must be taken into consideration, because it may be considerable (in particular if the hysteresis is large or the receiver is very moist).

A separate pressure switch is often a better alternative, because the user can adjust it independently of the compressor's pressure switch. The following applies when selecting a separate pressure switch: the smaller the hysteresis the better. If a separate pressure switch is used, the dryer is wired to the contacts at the pressure switch which are closed in the absence of current. When the switch is activated (figure 3: e.g. at an overpressure of 6.55 bar or 95 psi), the purge function is shut down until the pressure switch is once again released (in this example at an overpressure of 6.2 bar or 90 psi). The point at which the switch is released can be adjusted in accordance with the system.

If it's determined that the dew point drops to an unacceptable level, the point at which the switch is released must be increased. Please note that many pressure switches have a fixed hysteresis value, in which case the activation and deactivation points change in correspondence to each other.

It's very important to understand that the purge function can **only** be shut down at times when little or no air is required. If this function is shut down at any other time, the drying agent cartridges may be permanently damaged thus resulting in the loss of drying performance, and possibly a mechanical defect as well. The cartridges may never be entirely saturated! **Fundamentally, the solution with a simple pressure switch is critical with regard to constant dew point reduction.**

Figure 4 on page 11 shows how the above mentioned components might be connected for regulation of a dryer's purge function. Please note that specific details regarding the components are manufacturer-independent – the manufacturer's specifications must be complied with in any case.

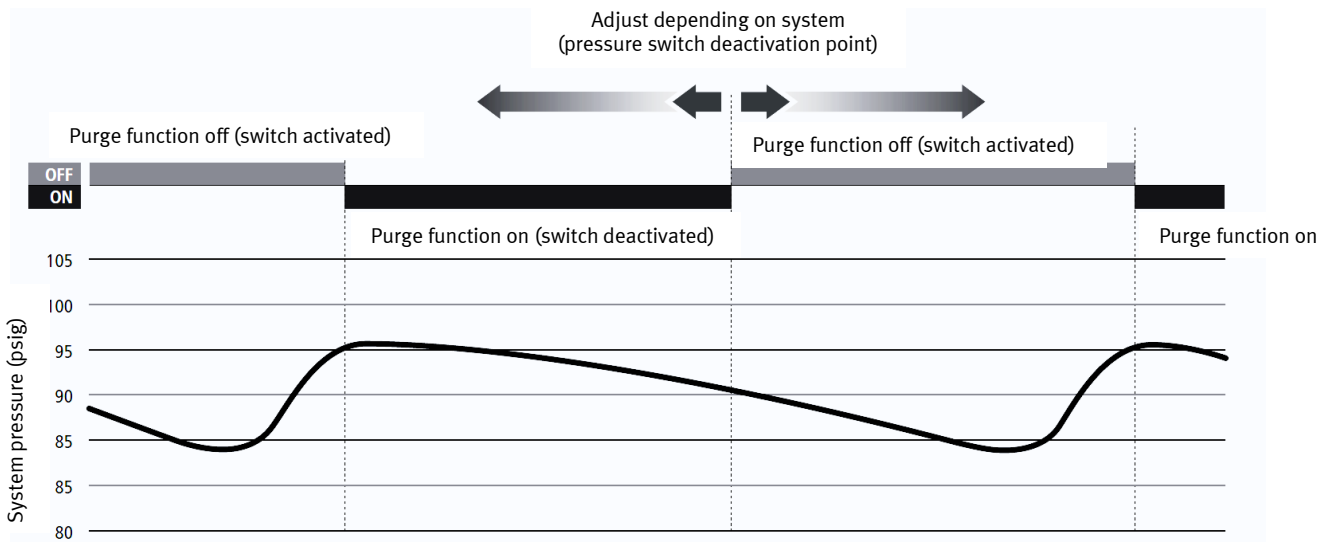
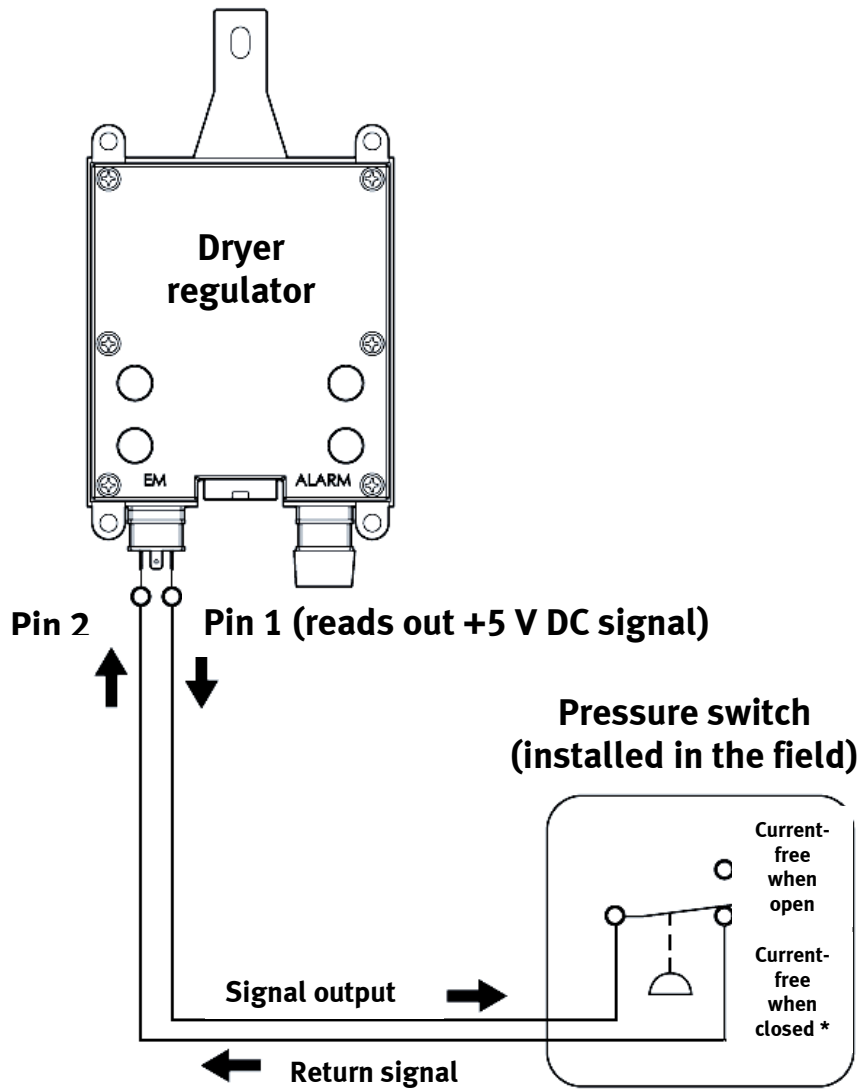


Figure 3: Adjustment of the simple pressure switch or pressure sensor



*** Current-free when closed – open to deactivate the purge function**

Figure 4: Use of a simple pressure switch for purge regulation

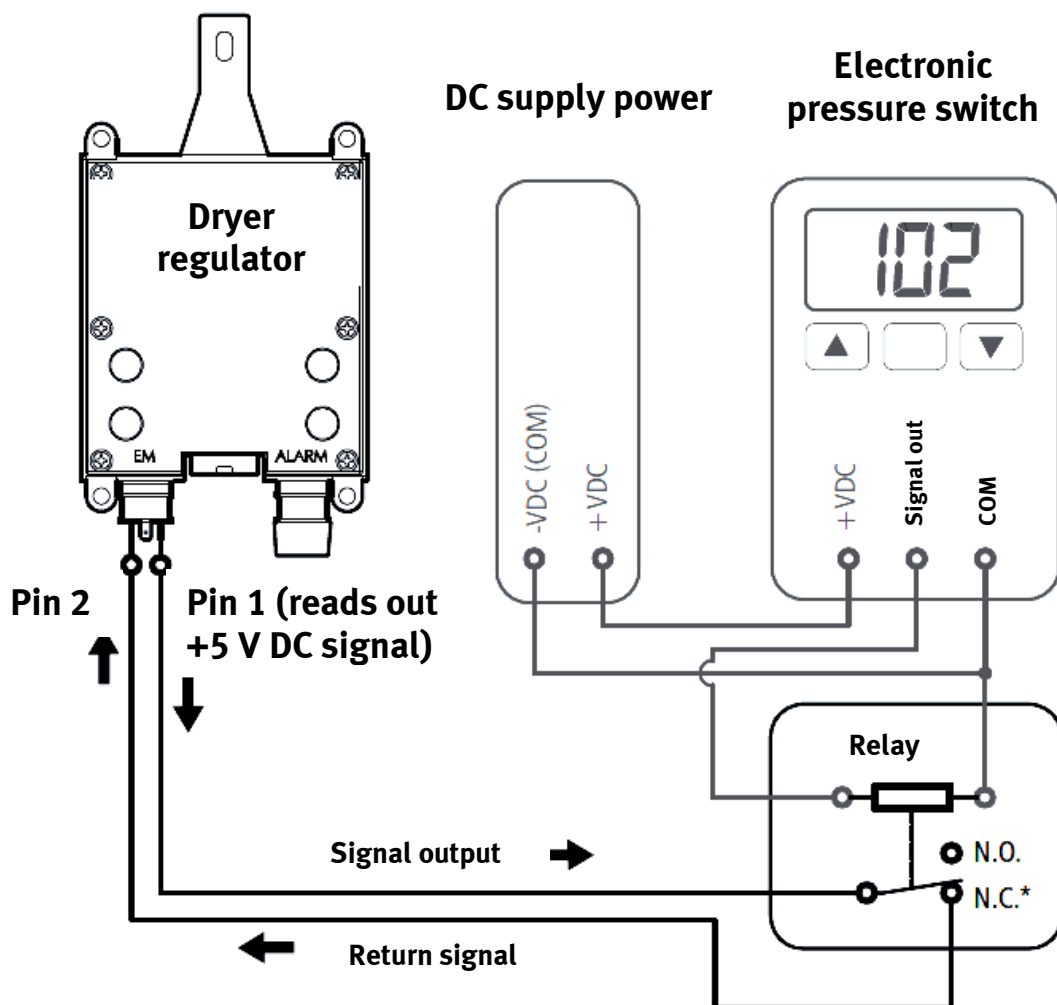
2.5 Use of a pressure sensor for purge regulation

If a pressure sensor is used, it's best to use a programmable variant. In the final analysis, this type of pressure sensor is a pressure transmitter and a process regulator in a single component. Although a programmable pressure sensor is a bit more expensive than a simple mechanical pressure switch, it can be much more favourably configured. Hysteresis can typically be reduced or eliminated, which permits immediate reaction to changes in system pressure which determine air flow.

If a pressure sensor is used, the dryer is wired to the contacts of a switching relay which are closed in the absence of current. When the pressure sensor is activated (figure 3, page 10: e.g. at an overpressure of 6.55 bar or 95 psi), the purge function is shut down via the relay contact until the pressure sensor's output drops out again at the selected pressure value (in this example at an overpressure of 6.2 bar or 90 psi). The point at which the switch is released can be adjusted in accordance with the system.

It's very important to understand that the purge function can **only** be shut down at times when little or no air is required. If this function is shut down at any other time, the drying agent cartridges may be permanently damaged thus resulting in the loss of drying performance, and possibly a mechanical defect as well. The cartridges may never be entirely saturated! **Fundamentally, the solution with a pressure sensor is critical with regard to constant dew point reduction.**

The following drawing shows how the above mentioned components might be connected for regulation of a dryer's purge function. Please note that specific details regarding the components are manufacturer-independent – the manufacturer's specifications must be complied with in any case.



*** Current-free when closed – open to deactivate the purge function**

Figure 6: Use of a pressure sensor for purge regulation (this setup is only an example and the configuration can be changed depending on the application)

2.6 Establishing a connection between switching device and the energy management contact at the PDAD

The adsorption dryer is shipped with activated purge air function as a default setting, i.e. purge air is also active at times when little or no purge air is required. There's a plug inserted into the socket for the energy management function (EM) to this end with pre-set jumper (see figures 7 and 8).

This jumper establishes a permanent connection between terminals 1 and 2 at the DIN plug which corresponds to an activated purge air function.



Figure 7: PDAD default status – DIN plug with pre-set jumper connected to EM contact



Figure 8: PDAD default status – jumper between terminals 1 and 2 in the insert of the DIN plug

The jumper must be removed in order to use the EM function. Terminals 1 and 2 at the EM socket are then connected to the NC contact of the corresponding switching device (manual switch, directly to a pressure switch or a relay). When the manual switch, the pressure switch or the relay contact is opened, purge air is deactivated.

The dryer should be removed from service before conversion or integration. In order to remove the device from service, disconnect it from supply power and compressed air supply, and fully depressurise it.

Connection procedure:

1. Remove the DIN plug from the EM contact.
2. Insert a small screwdriver into the small depression at the edge of the insert and press the insert out of the external sleeve of the DIN plug (see figure 9).

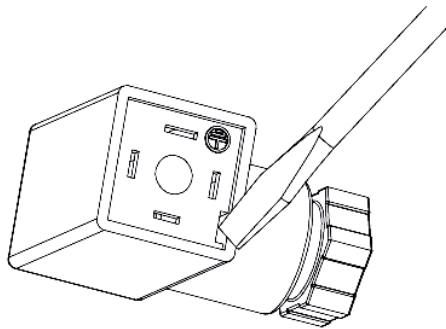


Figure 9: Removing the insert from the DIN plug

3. Remove the jumper between terminals 1 and 2 (see figure 10).

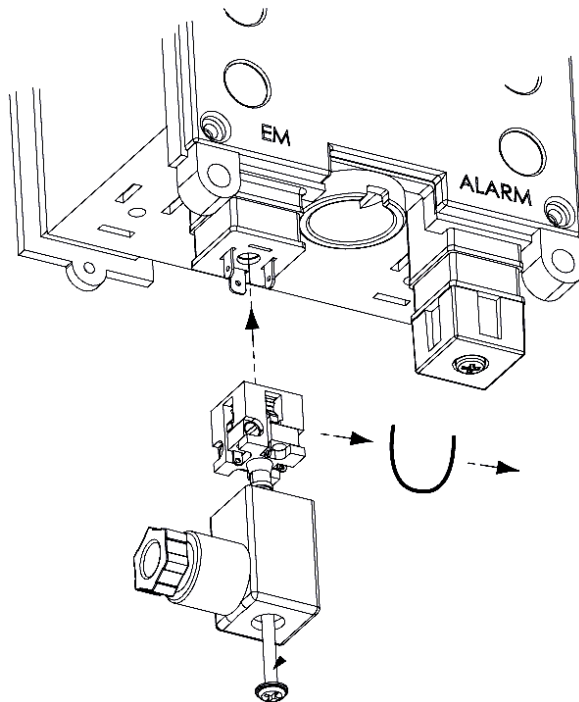


Figure 10: Removing the jumper from the DIN plug

4. Connect external switching logic (NC contact of the manual switch, the pressure switch or on the relay) to terminals 1 and 2 in the plug insert of the DIN plug. Make sure that the wires and cables are correctly stripped and that good insulation is assured through the cable gland!
5. Measure continuity between the two wires if possible with a measuring instrument, in order to ensure that the switch is current-free in the closed position. Check for correct switching function if possible as well. A 5 V DC signal is read out from terminal 1 during operation which is fed to terminal 2 via the NC contact, by means of the EM function can be activated or deactivated.
6. Carefully pull the cable back through the sleeve until the insert snaps back into the housing of the DIN plug. Observe the direction in which the cable throughfeed must point.
7. Insert the DIN plug back into the energy management connection at the dryer and screw it tight, making sure that the sealing ring is correctly seated. The protective conductor terminal is somewhat wider than terminals 1 and 2. Make sure that the socket plug is correctly aligned.

The selected cable to the switching logic ...

- must have at least 2 conductors. Additional conductors may be useful in the event that a conductor is broken. Conductors can be changed without having to lay a new cable.
 - may not have a wire cross-section of any greater than 1.5 sq. mm (recommended) in order to freely fit into the DIN plug insert.
 - should have an outside diameter of no more than 6 mm. Larger diameters don't fit well into the cable gland of the DIN plug for the energy management function.
 - should demonstrate insulation characteristics which are suitable for the conditions of use.
8. Restart the dryer in accordance with the operating instructions.
 9. Test the energy management function (switch manually or by adjusting the switching points) without yet discharging compressed air! Recommendation: shut-off device (2/2 function) downstream from the PDAD
 10. If reliable functioning is assured, slowly open the shut-off device and release compressed air to the application.
 11. Renewed testing and long-term observation of the EM function, as well as adjustment of the switching points during normal operation. Pressure, as well as the pressure dew point, should not drop to below the minimum requirement!

Supplementary notes for the operating instructions:

The use of an ideal air reservoir downstream from the PDAD smooths pulsation caused by discharging air.

The pressure dew point to be achieved is based on the flowing quantity of air. Consequently, a higher pressure dew point is achieved with a lower flow velocity. On the other hand, a higher or excessively high flow rate may result in a reduced pressure dew point. For this reason, the table values listed in the catalogue should always be complied with. The dischargeable flow rate is listed there depending on the size of the PDAD, operating pressure, the available amount of air and the required pressure dew point.

3 Safety

Festo expressly excludes any and all liability or responsibility for damages and/or injuries which result from disregarding these operating instructions.

The device may only be used for its intended purpose. The cold regenerative adsorption dryer may only be used for the intended purpose of drying pressurised air under the conditions described in section 11 of these operating instructions.

Any other use of the device is deemed use for other than the intended purpose. Festo is not liable for damages which result from use for other than the intended purpose.

The following safety regulations must be adhered to strictly:

- These operating instructions must be kept at the product's installation site as a print-out or copy.
- Repair work conducted on the device may only be carried out by personnel authorised by Festo.
- Operating, repair and maintenance personnel must be familiar the following information:
 - Accident prevention regulations
 - Safety information (general and device-specific)
 - Device safety equipment
 - Measures to be implemented in case of emergency
- It's the responsibility of the installation technician to ensure that the cables to and from the dryer are suitable for the task, correspond to all applicable laws and have been subjected to visual inspections and testing before commissioning. All cables must be secured in an appropriate manner.
- The device must be removed from service before conducting any maintenance or repair work. Operators and other personnel are exposed to hazards if work is carried out on a running device. In order to remove the device from service, disconnect it from supply power and compressed air supply, and fully depressurise it.
- Only trained specialists who are familiar the electrical requirements of the device as described in these operating instructions, and the respective safety rules and regulations, are permitted to conduct work on the device's electrical components and power supply.
- Use suitable, correctly dimensioned tools that are in good condition to carry out any work on the device.
- Use accessories and spare parts from the manufacturer only. There is no guarantee that non-original spare parts are designed and manufactured to correspond to the safety and operating requirements of the device. Festo assumes no liability for device faults which result from the use of unapproved spare parts.
- Use suitable, safe work platforms or other secure work access options to carry out installation work above head height.
- Do not make any design changes to the product. Changes and modifications may only be carried out by Festo.
- All faults or defects which might impair safety must be eliminated before using the device.
- Utilised objects and materials must be correctly disposed of in accordance with local laws and regulations. This applies in particular to the drying agent cartridges.