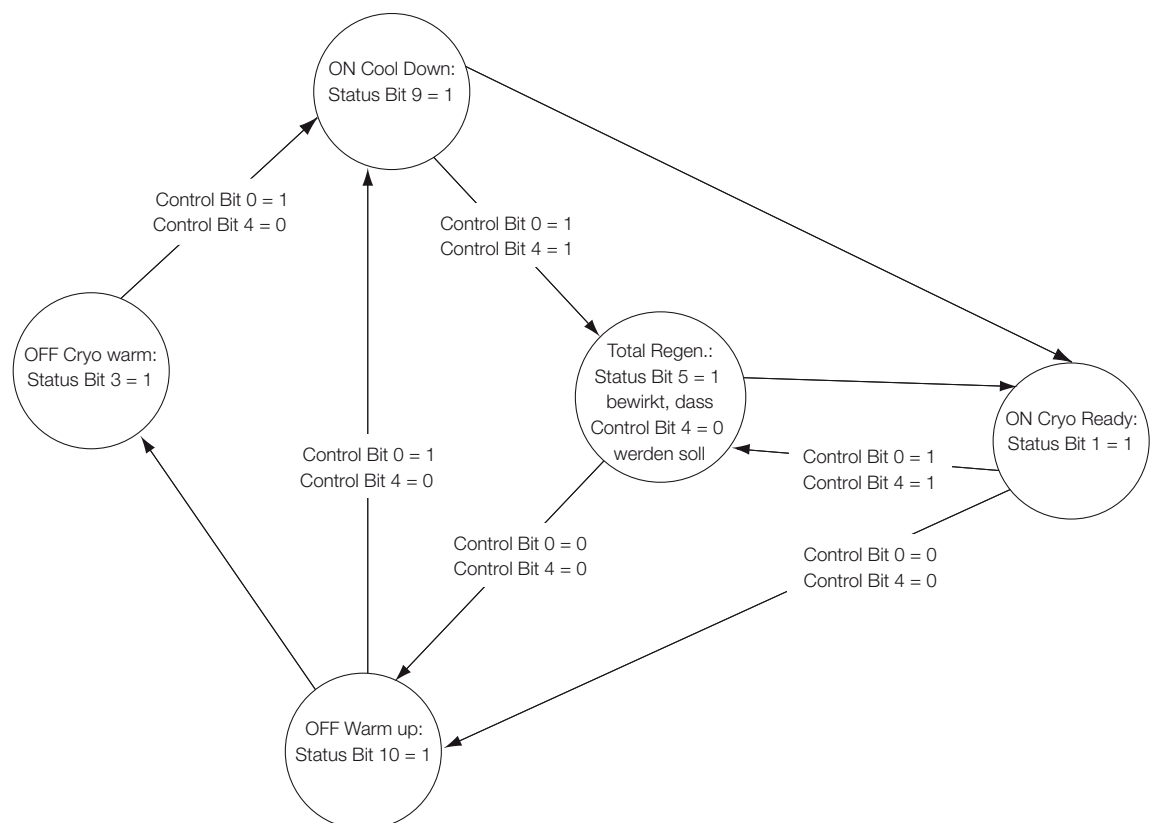


COOLVAC

ProfiBus module

Operating Instructions 300358931_002_A2

Part Number
844000V1



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Installation and operation of the COOLVAC SC is described in the Operating Instructions for the pump system, for example GA12145 for the COOLVAC ClassicLine.
Described in these Operating Instructions is only the ProfiBus interface of the ProfiBus module.

Original installation and operating instructions.

Obligation to Provide Information

Before installing and commissioning the COOLVAC ProfiBus module, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Oerlikon Leybold Vacuum **COOLVAC ProfiBus module** has been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. The pump **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

NOTICE



DANGER



WARNING



CAUTION



NOTICE



Figures

The references to figures, e.g. (4/2) consist of the consecutive Fig. No. and the Item No. in that order.

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

Safety information

0 Important Safety Information

WARNING



0.1 Hazards in Connection with Safety-related Measures and Precautions

- 1 The instrument has been developed and tested in accordance with the state-of-the-art, the European Standards EN 61000-6-2 and 61000-6-4, the EC Directive EMC (2004/108/EC) and other applicable safety engineering standards. Even so when using this instrument dangers need to be expected when the instrument is operated by personnel not qualified respectively when the instrument is improperly operated or not used in agreement with the specified conforming utilisation.
 - 2 Comply with the information provided in these Operating Instructions in order to prevent endangering life and health of the operator or third persons, to prevent impairing functioning and quality of the instrument, as well as to prevent endangering material assets of the user.
 - 3 Besides observing the information provided in these Operating Instructions and the binding accident prevention rulings which apply at the operating site, additionally observe the expert regulations relating to safe and professional working.
 - 4 The operator must ensure that every person ordered with installing, respectively erecting, first-time commissioning, operating and maintenance of the instrument has read and fully understood the information provided in these Operating Instructions.
 - 5 Conversions and modifications to the instrument not described in these Operating Instructions are prohibited for safety reasons. Such unauthorised modifications will render any manufacturer's liability void as to the therefrom resulting injury to persons and damage to property.
 - 6 Have the instrument operated and maintained only by trained and duly authorised personnel familiarised with the instrument and instructed as to the dangers.
 - 7 The operator must prevent unauthorised persons from operating the instrument.
 - 8 At least once per shift the operator must inspect the instrument as to any externally apparent damage or deficiencies. The officer of the operator must be informed immediately as to any changes including the operational behaviour which are found and which impair safety.
-

0.2 Electric Hazards

- 1 Do not disconnect any protective earth connections. By including all subassemblies in the protective earth scheme of the instrument fault currents are prevented from flowing through instrument sections in the event of a malfunction.
- 2 If for repair or other work protective earth connections need to be disconnected, these must be re-established immediately after having completed such work.
- 3 Deficiencies like loose connections, charred or corroded cables need to be repaired as soon as these are detected.
- 4 Have the instrument installed in an electrical cabinet and integrated within the electrical system of a vacuum system only by an expert working in agreement with VDE guidelines. Such work must only be done after the instrument and the related system have been reliably deenergised.
- 5 Disconnect the ProfiBus module from the mains power (at the power supply) before making any connections. Since dangerous voltages may nonetheless be encountered, the housing may only be opened by a duly qualified electrician.

WARNING



0.3 Risk of Damaging the Instrument

- 1 When improperly connecting the wiring to the output of the instrument, a then occurring short-circuit may destroy the instrument.

NOTICE



ProfiBus DP

1 ProfiBus DP

In a ProfiBus DP system, a difference is made between master and slave units. Here the master units control all traffic. They transmit data to the related slaves and request data from these. It is possible to run one or several masters in a system.

The COOIVAC ProfiBus module is a slave unit and thus respond to requests from the master, and it supply data exclusively after having received a request to do so from the master.

For more information on the ProfiBus system:

"The Rapid Way to ProfiBus",

Manfred Popp, ProfiBus Nutzerorganisation e.V. Heid-und-Neu-Str. 7
D-76131 Karlsruhe

Germany

P/N: 4.072

1.1 Description of the Interface

At both ends of the bus a terminating resistor is required. Such a terminator can be activated in the modul. The Profibus module has been prepared for installation on a hat rail.

Supplied Equipment

ProfiBus module for installation on a hat rail, RS 232 cable 3 m.

Standards

ProfiBus DP V0 corresponding to IEC 61158-2 and IEC 61784 Type 3

Protocol

In accordance with ProfiBus profile for variable fast revolving drive units Profile No.3; Version 2.0

Transmission rates and cable lengths

(see also the standards)

Transmission rate (kBit/s)	max. segment (m)
9.6-93.75	1200
187.5	1000
500	400
1500	200
3000-12000	100

The baud rate is set automatically. The following baud rates are supported:

9.6 k Baud	19.2 k Baud	45.45 k Baud	
93.75 k Baud	187.5 k Baud	500 k Baud	
1.5 M Baud	3 M Baud	6 M Baud	12 M Baud

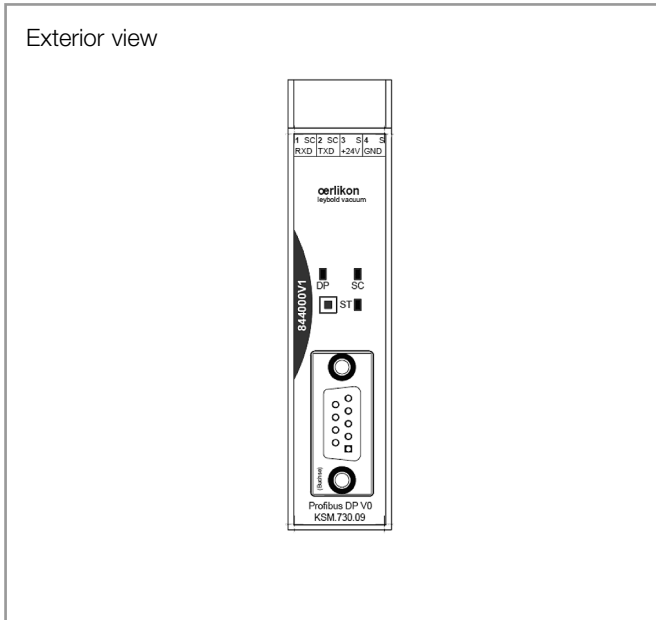


Fig. 1.1 Position of the LEDs on the Profibus module

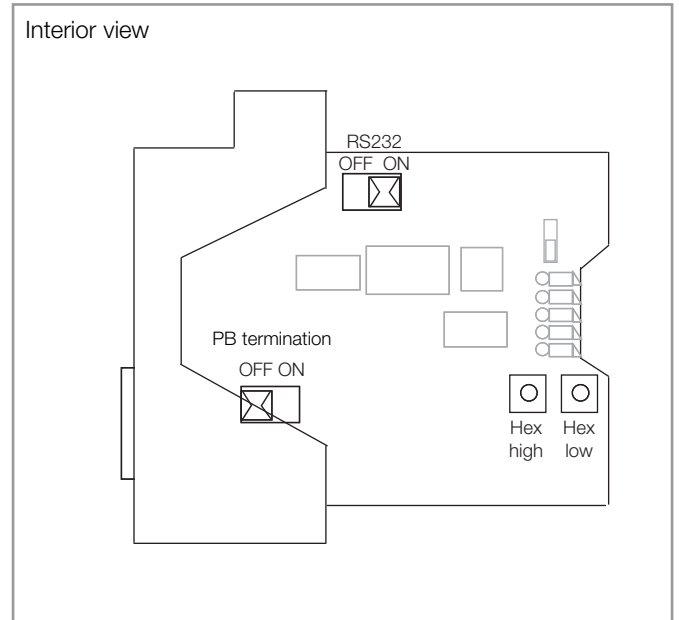


Fig. 1.2 Position of the addresses in the Profibus module
PB termination resistor to OFF, RS 232 set to ON

Address range	Hex \$01 ... \$7D (selectable via switch) Hex\$7E software selectable
corresponding to	decimal 1 ... 126
Voltage level	see standards
Interface connection	Sub-D 9-way socket on the side of the instrument (female)
Thread	UNC4-40

The Profibus watchdog function has not been implemented.

1.2 Operation of the LEDs

LED SC

off	Ready for operation, no internal malfunction
red, steady	No RS232 link to the SC

LED ST

off	Unit is exchanging Profibus data
yellow, flashing	Unit is in clear mode, waiting for Profibus master initialisation
red, steady	Internal error
red, flashing	Profibus address is outside the valid range

LED DP

off	Unit is offline
green, steady	Unit is exchanging Profibus data

Connection

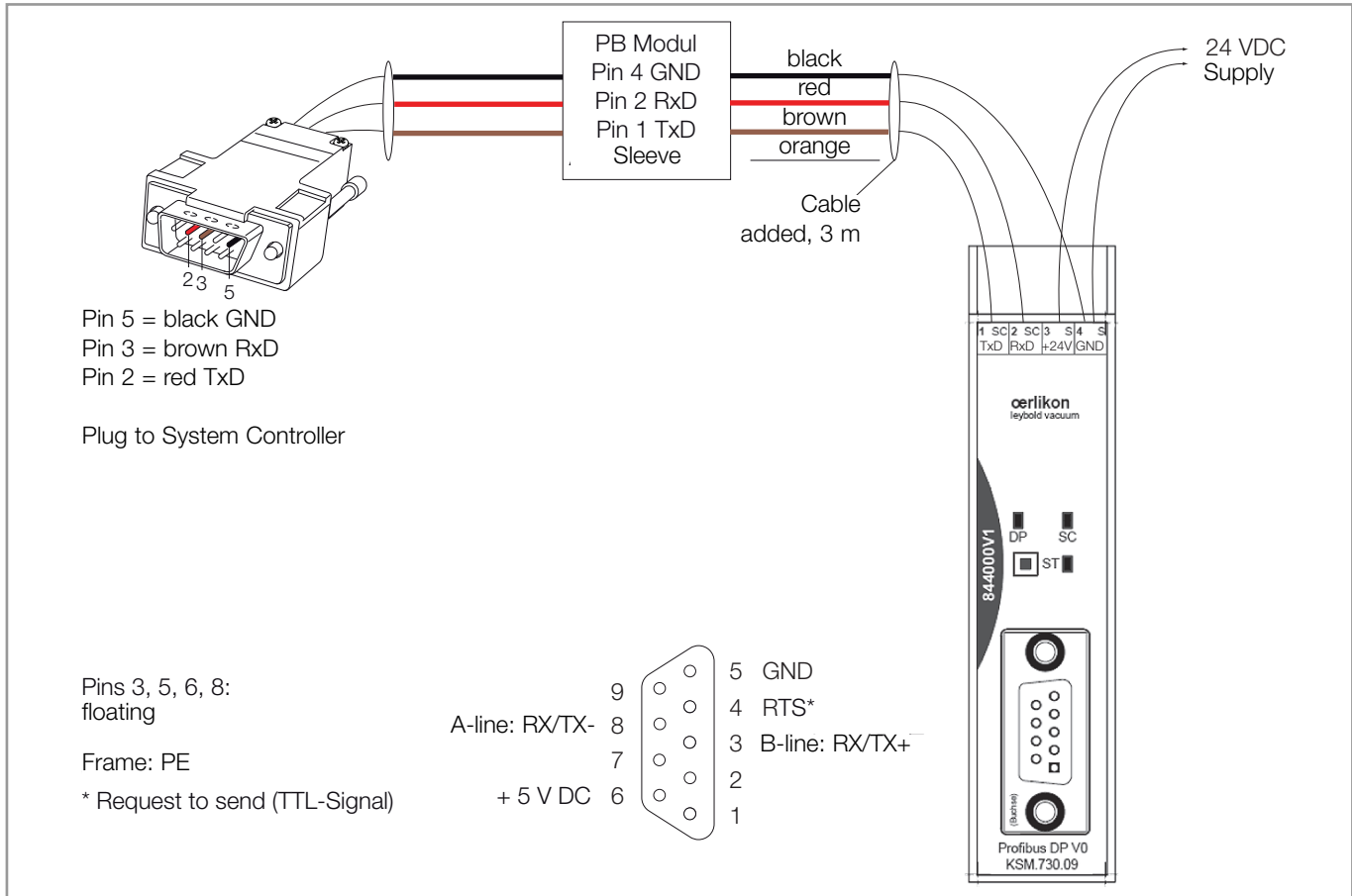


Fig. 2 Connections of the Profibus module and Assignment for the socket

2 Connection

WARNING



Disconnect the Profibus module from the mains (at the power supply) before making any connections. Since dangerous voltages may nonetheless be encountered, the housing must be opened only by a qualified electrician.

The Profibus module has been prepared for installation on a hat rail. Connect the Profibus via the Profibus module. Connect the RS232 connection of the Profibus module at the rear of the COOLVAC SC using the supplied cable. The connection of a terminating resistor is required at the ends of the bus line. This may be provided externally by way of a special plug or by enabling the internal terminating resistor within the Profibus module.

Set the COOLVAC SC (P/N 844230) to a baud rate of 9600 and the interface to "Remote" so that the communication will be directed to the Profibus module.

Line type SIEMENS-SINEC-L2 bus line

P/N 6XV1830-0AH10

Address

A new address setting is enabled when the power is switched on again.

Example: Address 43dez. = 2Bhex.

3 Description of the Telegram

Two types of protocol (PPO types) have been implemented. In the following only the payload data are described. Data which serve communication purposes (data link layer, layer 2 acc. to OSI, for example, start byte and addressing etc.) are processed automatically in the background by the ProfiBus.

3.1 PPO Type 1

Length of the payload data block: 6 words = 12 bytes = 0xF3, 0xF1 (see 3.3 GSD File)

Byte No.	Abbreviation	Description	Read access on pump	Write access on pump	Response from COOLVAC ProfiBus
0-1	PKE	Parameter number and type of access		Value (see 4.1)	
2	IND	Parameter index		0 (not used)	
3	–	reserved		0	
4-7	PWE	Parameter value	0	Value	Value
8-9	PZD1: ZSW STW	Status and control bits and pump address		Value (see 4.2)	
10-11	PZD2: HIW HSW	Main actual value and setpoint for temperature T1 and T2*	0	0	Value (K)

* normally HIW ≠ HSW

3.2 PPO Type 6 (Leybold-specific)

Length of the payload data block: 1 word = 2 byte identifier = 0x00, 0xF0 (see 3.3 GSD file)

Byte No.	Abbreviation	Description	Read access on pump	Write access on pump	Response from COOLVAC ProfiBus
0-1	PZD1: ZSW STW	Status and control bits and pump address		Value (see 4.2)	

3.3 GSD File (Example)

Documented in the GSD file are the parameters of the ProfiBus DP interface. The file format has been defined in the standard so that project tools from different manufacturers can be used. The current GSD file is available from Leybold upon request. In addition the contents of the GSD file have been documented in the following.

```
=====
; Leybold ProfiBus Interface for Cryo Controller.
; Model : Cryo Controller
; Description : ProfiBus Interface based on HMS ANYBUS-IC ProfiBus DP Slave Interface
; Language : English
; Date : 01. February 2006
; Author : HMS Industrial Networks, M.Thiel Leybold
;
=====

#ProfiBus_DP                                MaxTsdrr_500      = 100
GSD_Revision      = 2                        MaxTsdrr_1.5M    = 150
                                                         MaxTsdrr_3M      = 250
                                                         MaxTsdrr_6M      = 450
                                                         MaxTsdrr_12M     = 800

; Device identification
Vendor_Name       = "Leybold GmbH"
Model_Name        = "Cryo controller"
Revision          = "Version 0.9"
Ident_Number      = 0x1804
Protocol_Ident    = 0          ; DP protocol
Station_Type      = 0          ; Slave device
FMS_supp          = 0          ; FMS not supported
Hardware_Release  = "Version 1.02" ; HMS ABIC PDP
Software_Release  = "Version 1.00" ; HMS ABIC PDP

; Supported hardware features
Redundancy        = 0          ; not supported
Repeater_Ctrl_Sig = 2          ; TTL
24V_Pins          = 0          ; not connected
Implementation_Type = "SPC3"

; Supported DP features
Freeze_Mode_supp  = 1          ; supported
Sync_Mode_supp    = 1          ; supported
Auto_Baud_supp    = 1          ; supported
Set_Slave_Add_supp = 1          ; supported

; Used bitmap
; Bitmap_Device = "CL2000_0"
; Cryo normal
; Bitmap_Diag   = "CL2000_1"
; Cryo diagnostic
; Bitmap_SF     = "CL2000_2"
; Cryo special case

; Maximum polling frequency
Min_Slave_Intervall = 1          ; 100 us
; Maximum supported sizes
Modular_Station     = 1          ; modular
Max_Module           = 1
Max_Input_Len        = 12
Max_Output_Len       = 12
Max_Data_Len         = 24
Modul_Offset         = 1

; Supported baudrates
9.6_supp            = 1
19.2_supp           = 1
45.45_supp          = 1
93.75_supp          = 1
187.5_supp          = 1
500_supp            = 1
1.5M_supp           = 1
3M_supp             = 1
6M_supp             = 1
12M_supp            = 1

; Maximum responder time for supported baudrates
MaxTsdrr_9.6        = 60
MaxTsdrr_19.2       = 60
MaxTsdrr_45.45      = 250
MaxTsdrr_93.75      = 60
MaxTsdrr_187.5      = 60

Fail_Safe           = 1          ; state CLEAR accepted

Slave_Family        = 0@Leybold
Max_Diag_Data_Len   = 6

; Definition of modules
Module="PPO 1" 0xF3, 0xF1
EndModule
Module="PPO 6" 0x00, 0xF0
EndModule

=====
```

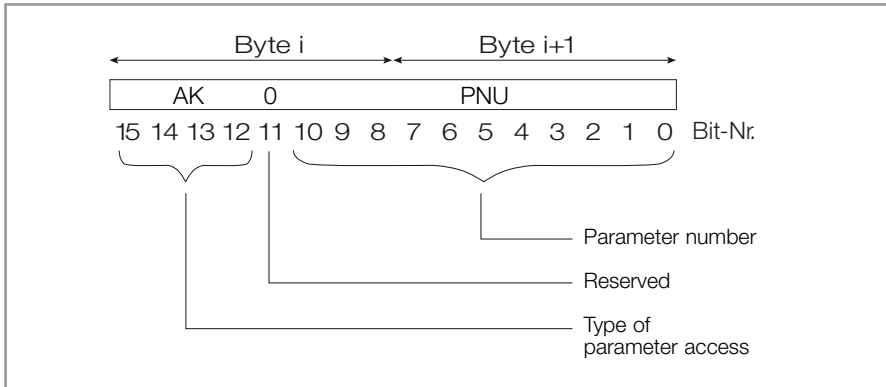


Fig. 4 PKE: parameter number and type of access (for PPO type 1 only)

4 Description of PKE, IND, Control and Status Bits

4.1 PKE: Parameter Number and Type of Access

The parameter number is sent when accessing the COOLVAC ProfiBus module and also in the response of the COOLVAC ProfiBus module.

The receiver is provided with information on the parameter value PWE: size, field value or individual value, read or write.

PKE, IND, Bits

Type of Parameter Access to the ProfiBus module (Query Designator)					Type of Parameter Response from the ProfiBus module (Query Designator)				
Bit number					Bit number				
15	14	13	12		15	14	13	12	
0	0	0	0	No access	0	0	0	0	No response
0	0	0	1	Parameter value requested	0	0	0	1	16 bit value is sent
					0	0	1	0	32 bit value is sent
0	0	1	0	Write a 16 bit value	0	0	0	1	16 bit value is sent
Further responses									
					0	1	1	1	The ProfiBus module can not run the command
					1	0	0	0	During a write access: no permission to write

Byte-Nr.	0	1	2	3	4	5	6	7	8	9	10	11
Example	Parameter identifier		Indices		Parameter value				Control word Status word		Main setpoint Main actual value	
Description of the test	PKE		IND		PWE				PZD1		PZD2	
MASTER → SLAVE Main setpoint. OFF,OFF Pumpe #1, No Enable ProzessData, No Enabl. Main Value, lesen Para. 514 (T1 ist)	0001 0010	0000 0010	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 1000	0000 0000	0000 0000	0000 0000
Hex	12	02	00	00	00	00	00	00	08	00	00	00
SLAVE → MASTER Main act. val T1 =100k, T2 =12K Pumpe #1, Cryo Ready, Power up1Para 514 = 03E7 = 99.9K	0001 0010	0000 0010	0000 0000	0000 0000	0000 0000	0000 0000	0000 0011	1110 0111	0000 1000	0000 0011	0110 0100	0000 1100
Hex	12	02	00	00	00	00	03	E7	08	03	64	0C

4.2 Status and Control Bits

(Status and Control Word) ProfiBus PPO-Type 1 and 6

Control and status bits are transmitted/received each time when being accessed.

4.2.1 Control Word (PZD1, STW) = 16 Control Bits

Is sent to the pump for each access.

Bit No.	Default status	Description
0	0	1 = Start (ON Cooldown); 0 = Stopp (OFF warm up) Start/Stop is only run, provided ■ no error is present and ■ Bit 10 is active (=1).
1		Reserved
2		PPO1 und PPO6 reserved
3		Reserved
4	0	1 = Start total regeneration is only run, provided ■ no error is present and ■ Bit 10 is active (=1).
5	0	1 = Start fast regeneration is only run, provided ■ no error is present and ■ Bit 10 is active (=1)..
6		Enables main setpoints T1 and T2 (only, when PPO Type 1 is used) is only run, provided ■ no error is present and ■ Bit 10 is active (=1).
7	0	Reserved
8		Reserved
9		Reserved
10	0	Enables process data (changes to bit 0, 4, 5 and 6 only accepted, provided bit 10 is set)
11		Cryopump address Bit 0
12		Cryopump address Bit 1
13		Cryopump address Bit 2
14		Cryopump address Bit 3
15		Cryopump address Bit 4

PKE, IND, Bits

Operating Explanations

The signals “High vacuum gate valve closed” and “Backing pump running” at the plug CUSTOMER I/O of the pump module PM need to be present at least five seconds before the occurrence of a command (ON, OFF, total regeneration (TR)). In the event of a malfunction no switching actions can be processed.

Between the switching actions ensure a break of at **least three seconds**.

Switching on and off

To switch on and cool down, set bit 0 of the control word (PZD1, STW) to 1, to switch off set bit 0 to 0.

Total regeneration

For a total regeneration with subsequent re-cooling set bit 4 of the control word for some seconds to 1 and thereafter to 0 again. Bit 0 must here remain set to 1.

When in the status CRYO READY a total regeneration was accidentally started, then this can be revoked within the first 2 minutes. For this, set bit 0 to 0 and after three seconds to 1 again.

Do not cool down the pump with bit 0 set to 0 by means of a “pulse” 0 → 1 → 0 on bit 4 from the status CRYO WARM/OFF. This will result in an undefined controller status.

Behaviour of bits 1 and 2 of the status word (PZD1, ZSW)

When in the cryo pump the temperature CRYO READY T1 or CRYO READY T2 is exceeded then the cryo pump will change from the status CRYO READY to the status ON COOL DOWN. This causes bit 1 CRYO READY to change to 0 and at the same time bit 2 “Forevacuum pressure required” is set to 1 even though the pressure in the cryo pump and the vacuum chamber may still be below $5 \cdot 10^{-4}$ mbar. For this reason we recommend not to use bit 1 and bit 2 of the status word alone to control the backing pump or the high vacuum valve, but instead use additionally the vacuum gauges in the vacuum chamber and the signal of the built in silicon diode (temperature T2, cf. for example 4.3, Parameter 515). Moreover, in this case the software step remains stopped at a 9.0 (cf. 4.3, parameter 521, value 090).

Under all circumstances avoid increasing the temperature T2 as measured by the silicon diode to values above 20 K since this might release gases collected earlier at the cold surface of the second stage which in turn would cause a rapid and uncontrolled increase of T2. In this case you will possibly have to run a total regeneration so as to be able to return the cryo pump back to the status of CRYO READY.

Bit 5 of the status word is only set to 1 provided regeneration has been initiated by means of bit 4 of the control word. If the cryo pump is switched off through bit 0 of the control word it is initially regenerated, however, bit 5 of the control word is not present.

Moreover, bit 5 of the control word may briefly disappear during the total regeneration process although the pump has not again attained the status of CRYO READY.

For all switching actions generally bit 10 of the control word (PZD1, STW) must be set to 1 as otherwise the commands are not accepted.

Behaviour of bit 5 of the status word (PZD1,

Parameter

4.2.2 Status Word (PZD1, ZSW) = 16 Status Bits

Is sent together with each response from the cryo pump.

Bit No.	Description
0	1 = Power up, 0 = Power reset done (depending on parameter number 513 for PPO type 1 only)
1	1 = Active operation; cryo ready
2	1 = Forevacuum is needed
3	1 = OFF Cryo warm
4*	1 = Cryo Error is pending
5	1 = Total regeneration active
6	1 = Fast regeneration active
7	1 = Communication error (cryo internal network)
8	1 = Command cannot be run
9	1 = ON Cool down
10	1 = OFF warm up
11	Cryopump address Bit 0
12	Cryopump address Bit 1
13	Cryopump address Bit 2
14	Cryopump address Bit 3
15	Cryopump address Bit 4

* Bit 4 "Cryo error" will also be present when having selected in the service mode of the COOLVAC SC a "COOLVAC reset" = step 999.

4.3 Parameter List

Param.	Value; Description	Range; PB Value	Unit	Default Value	Type	Standard Access	Protected Access
1	Unit identifier (not a cryo controller command)	0 ... 2 ¹⁶	-	501	u16	r	r
513	Status 1 Bit 0 = pump motor ON/OFF Bit 1 = rough valve Open/Close Bit 2 = purge valve (not used) Bit 3 = TC1 ON/OFF Bit 4 = TC2 (not used) Bit 5 = Power On Reset Bit 6 = always 1 Bit 7 = always 0	0 ... 255	-	-	u16	r	r
514	Get 1st stage temperature	0 ... 3500	0.1	-	u16	r	r
515	Get 2nd stage temperature	0 ... 3500	0.1	-	u16	r	r
516	Get pump pressure in mtorr	0 ... 10000000	0.1	-	u32	r	r
517	Regeneration control 0 = Abort Regen, Restart Pump 1 = Start Full Regen	0 ... 2	-	-	u16	w	w
518	Cryo pump EIN = 1 AUS = 0	0 / 1	-	-	u16	w	w
519	Power fail recovery flag 0 = Cryo Ready 1 = Cooldown 2 = Regeneration	0 ... 2	-	-	u16	r	r
520	Error Code 0 = No error 1 = Collective fault at Coolvac 2 = Timer overrun 3 = Regeneration manual cancelled	0 ... 3	-	-	u16	r	r
521	Regeneration program step 000 = Cryo OFF warm 010 = Warm up 030 = TR rough to base 040 = FR rough to base 060 = Cool down 090 = Regeneration completed 100 = TR warm up 110 = Active warm up RP reserve 140 = TR warm up 150 = Active warmup RP not reserve 160 = TR warm up 180 = ROR 190 = Active ROR RP reserve 191 = TR ROR 192 = Active ROR RP not reserve 200 = TR rough to base 210 = TR rough to base / Wait 220 = TR cool down 220 = TR cool down 230 = Active warm up RP reserve	0 ... 999	0.1	-	u16	r	r

PKE, IND, Bits

Param.	Value; Description	Range; PB Value	Unit	Default Value	Type	Standard Access	Protected Access
	510 = FR rough to base 520 = FR rough to base 530 = FR switch to total regen 540 = FR cool down 560 = FR cool down 640 = FR warm up 650 = FR warm up 999 = Regen aborted						
522	Get 1st stage temp min setpoint	0 ... 3500	1	-	u16	r	r
522	Set 1st stage temp min setpoint	0 ... 3500	1	-	u16	w	w
523	Get 2nd stage temp min setpoint	0 ... 3500	1	-	u16	r	r
523	Set 2nd stage temp min setpoint	0 ... 3500	1	-	u16	w	w
527	Status 2 Bit 0 = setpoint 1 on Bit 1 = setpoint 2 on Bit 3 = 1st stage temp. Control	0 ... 255	-	-	u16	r	r
	T1 T2 S2 (ASCII)						
	off off @						
	65 off I						
	off 10 R						
	65 10 [
528	Status 3 (not used) Bit 0 = pump phase 1 Bit 1 = pump phase 2	0 ... 255	-	-	u16	r	r
529	Pump operating hours	0 ... 2 ³²	-	-	U32	r	r
532	Software version of pump module	1 ... 2 ¹⁶	-	-	u16	r	r
533	Serial number	1 ... 2 ³²	-	-	u16	r	r
538	Reads remaining 3 characters of pump serial number (if any exist)	1 ... 2 ¹⁶	-	-	u16	r	r
548	Get h since last full regen	1 ... 2 ¹⁶	-	-	u16	r	r
549	Get h since last fast regen	1 ... 2 ¹⁶	-	-	u16	r	r
550	Get AC power status	1 ... 2 ¹⁶	-	-	u16	r	r

4.4 Examples for 16 Bit Control Words (PPO-Typ 1 and 6)

Deci - mal- value	Hexa- decimal- value	15	Bit No. to		0	Description
0	0000h	0000	0000	0000	0000	No control through this interface, all other bits disabled
3072	0c00h	0000	1100	0000	0000	Control pump adr. 01 through this interface,, no start
3073	0c01h	0000	1100	0000	0001	Control pump adr. 01 through this interface,, ON cool down
3089	0c11h	0000	1100	0001	0001	Control pump adr. 01 through this interface, pump ON, total regeneration ON
2051	0803h	0000	1000	0000	0011	Pump adr. 01, ON cryo ready, power up with parameter 513 not yet confirmed.
10276	2824h	0010	1000	0010	0100	Pump adr. 05, total regeneration active, forevacuum needed
14361	3819h	0011	1000	0001	1001	Pump adr. 07, pump with error, status OFF cryo warm, power up with parameter 513 not yet confirmed.
18578	4892h	0100	1000	1001	0010	Pump adr. 09, pump with error, status cryo ready, power up with parameter 513 already confirmed..

Is sent to the ProfiBus module during each access.

PKE, IND, Bits

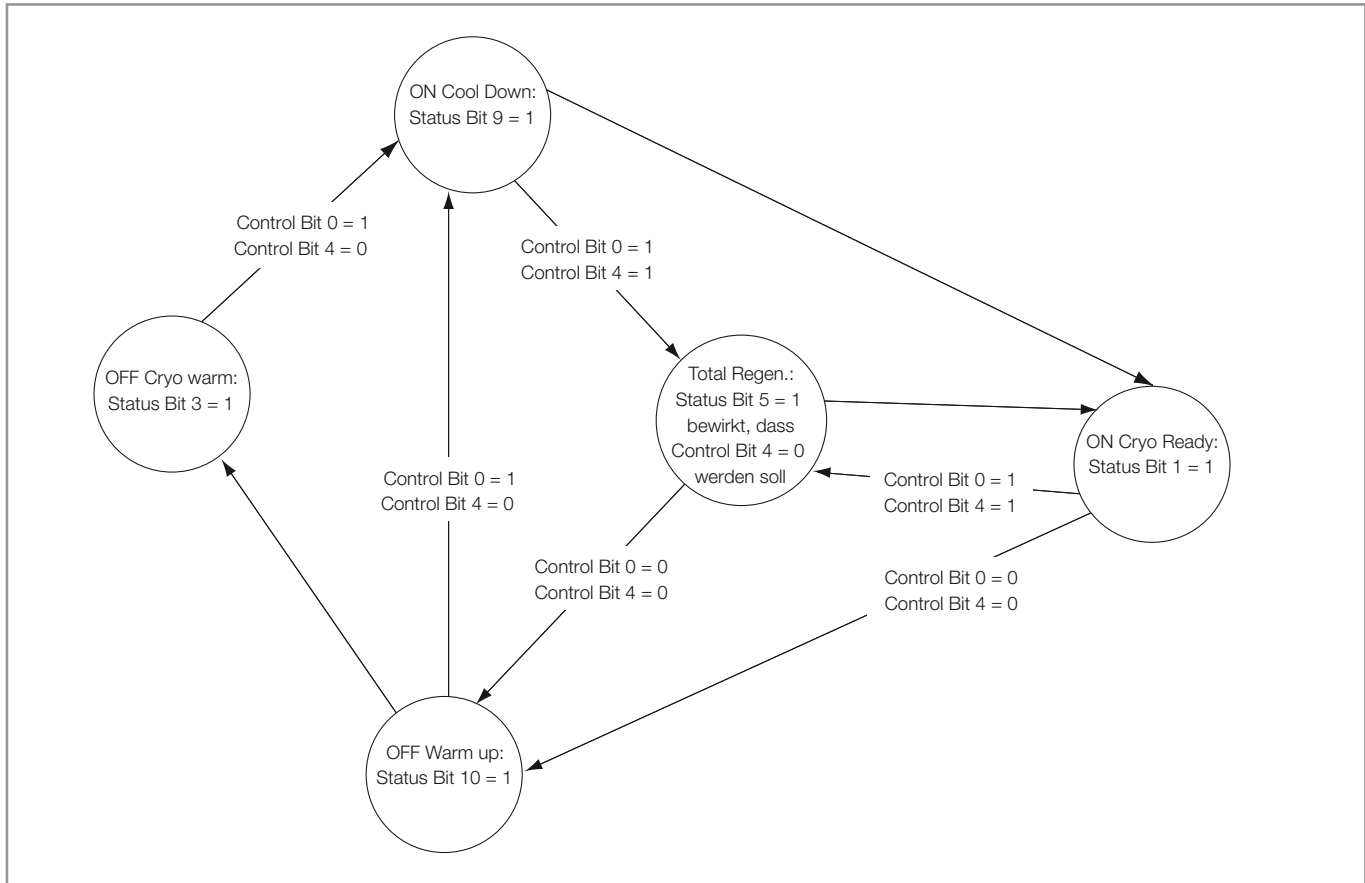


Fig. 5 Status diagram of the pump control arrangement

**PZD2 Main Setpoint (HSW)
(PPO Type 1 or Parameter 522 and 523 as well)
Temperature Thresholds T1 and T2**

Deci- mal- value	Hexa- decimal- value	15	Bit No. to	0	Description
T1min = 35K T2min = OFF	2300h	0010	0011	0000 0000	Main setpoint T1min and T2min from Master to Slave

**PZD2 Hauptistwert (HIW)
(PPO Type 1 or Parameter 514 and 515 as well)
Temperature measurement data T1 and T2**

Deci- mal- value	Hexa- decimal- value	15	Bit No. to	0	Description
T1 = >255K T2 = 119	FF77h	1111	1111	0111 0111	Main setpoint T1 and T2 from Slave to Master (range 0 - 255K!)

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