



Profibus Interface User Manual Polycold Cryochiller

200989 Revision D

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1 Introduction and Overview

This document describes the interface between the Polycold Profibus slave operating on the Polycold Cryochiller product and a Profibus master.

1.1 High Level Profibus Description

Profibus, Process Field Bus, is a standard field bus communication protocol that was developed in Germany. It is most commonly used in Europe.

Field bus is a family of industrial network protocols used for real-time distributed control. A field bus is typically used to link a PLC with individual sensors and valves where the PLC is the master and the sensors and valves are the slave devices.

A detailed description of Profibus is beyond the scope of this document so a brief description is provided.

- Profibus DP, Distributed Processing, is used to monitor and operate sensors and actuators on slave devices from a master controller in a factory automation environment.
- There are three versions of Profibus DP: V0, V1 and V2.
- DP V0 provides cyclical exchange of factory data.
- The Polycold Cryochiller slave interface uses DP V0 exclusively.

This protocol differs from serial interfaces in many ways, but, in general, it is intended to send a stream of data, often called a telegram, very rapidly between machines on a factory floor.

- A data stream containing outputs is sent from the master to a slave.
- The slave processes the outputs and returns a data stream consisting of inputs to the master.
- Profibus is most suitable for monitoring data such as Temperatures.
- Profibus is least suited for configuring equipment such as Equipment configuration parameters that are very seldom changed.

1.2 Polycold Implementation

The Polycold application contains a Profibus Manager that maintains a Profibus slave application. This application has two threads of execution.

- One thread constantly updates and caches data required for the Profibus modules.
- The other thread monitors the Profibus driver waiting for a master to interrogate the slave for this information.

When there is no master, the data is updated infrequently (once per second). When a master is present, the data is updated frequently but not exceeding the DSP's update rate (once per 100ms).

1.3 GSD Files and Module Configuration

The master and slave share a common **GSD** (General Station Description) file that defines the data that is transferred between the two nodes along with equipment description, protocol configuration and limitations.

2 Data Definition

2.1 Polycold Data

2.1.1 Data I/O Perspective

Data I/O in Profibus is from the perspective of the Master.

Inputs are values being sent from the Polycold Slave to a Profibus Master (i.e. a get command).

Outputs are values being sent from the Profibus Master to the Profibus Slave (i.e. set command).

The data exchanged between a Profibus Master and the Polycold Profibus Slave is listed in the Data Table below.

2.1.2 Reserved Values

This data includes several reserved values that are not used at this time but may be added in the future. Reserving the values allows future software upgrades to the Polycold application to include this data in the data exchange without the customer needing to modify their module configuration. Any GSD file updates will be naming only, which means Polycold updates to the data would be backwards compatible with the original GSD file.

2.1.3 Outputs

Output Values (Sets) are only processed by Polycold Slave if the Polycold SystemControlMode Input is set to Profibus (6). SystemControlMode can only be set from the Polycold unit itself, using the "SYSTEM_CONTROL_MODE" host command, or by making the Polycold unit default to remote control mode (6) from the HMI (TOP MENU->CONFIGURATION->CONTROL CONFIG ->LOCAL/REMOTE->DEF REMOTE MODE) or using "SYSTEM_CONTROL_MODE_DEF" host command.

If the SystemControlMode is not set to Profibus (6), the other outputs are ignored because the Profibus Master is commanding the Profibus Slave to set outputs that Profibus does not have permission to set on the Polycold Slave.

The Profibus Slave checks the status of outputs before implementing them and only implements the command if it is not already commanded. Example: If the Polycold Slave is already in STANDBY mode the Polycold Slave will not continuously command the unit to transfer to that mode.

2.1.4 Inputs

Input values are constantly updated and cached by the Profibus Slave. These values are immediately returned when the Profibus Master ends a telegram.

2.1.5 Data Table (inputs and outputs)

I/O Type	Data Name	Data Size	Description or Comparable Command
Input	ActiveAlarmStatus	4 bytes	Equivalent to: \$ACTIVE_ALARMS,2
Input	SensorValueValidStatus	4 bytes	Equivalent to: \$SENSOR_SNAPSHOT,? Param #1
Input	SensorFaultStatus	4 bytes	Equivalent to: \$FAULT_STATUS,?
Input	TC1	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC2	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC3	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC4	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC5	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC6	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC7	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC8	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC9	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC10	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC11	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC12	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC13	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC14	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC15	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC16	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC17	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC18	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC19	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	TC20	2 bytes	TC in Celsius including 1/10 (ex. 301 = 30.1)
Input	Reserved	2 bytes	n/a
Input	Reserved	2 bytes	n/a
Input	Reserved	2 bytes	n/a
Input	Reserved	2 bytes	n/a
Input	Reserved	2 bytes	n/a
Input	PT1	2 bytes	Pressure (PSI) Suction
Input	PT2	2 bytes	Pressure (PSI) Discharge
Input	PT3	2 bytes	Pressure (PSI) Not Used
Input	Line Voltage	2 bytes	Volts
Input	Reserved	2 bytes	n/a
Input	ValveStatusMask	4 bytes	Equivalent to: \$SENSOR_SNAPSHOT,? Param #36
Input	SystemControlMode	1 byte	Equivalent to: \$SYSTEM_CONTROL_MODE,? Local (0), Ethernet (1), RS232 (2), Legacy(4), DeviceNet (5), Profibus (6), Web Gui (7)

Input	System Status	1 byte	0x1 = Compressor Off, 0x3 = Compressor ON 1 st bit is unit state (Always 1), 2 nd bit is compressor state and remaining bits are 0. The values represent ON(1) or OFF(0) for each bit.
Input	Circuit1OperatingStatus	1 byte	Equivalent to: \$OPERATING_MODE,?
Input	Circuit2OperatingStatus	1 byte	Equivalent to: \$OPERATING_MODE,?
Input	Reserved	1 byte	n/a
Input	24 Volt System Status	1 byte	1st bit UNIT_OK Unit OK indicator, 1 = okay 2nd bit PWR_OK Power OK indicator, 1 = ON 3rd bit RMTCTRL_ACT 1 = remote control is active 4th bit LCLCTRL_ACT 1 = local control is active 5th bit STPT_RELAY1 1= Setpoint relay #1 is active 6th bit STPT_RELAY2 1= Setpoint relay #2 is active 7th bit Not Used 8th bit Not Used
Input	24 Volt Legacy Remote	1 byte	1st bit CKT1_COOL_ACT 1 = cool CKT1 is active 2nd bit CKT1_DEFR_ACT 1= defrost CKT1 is active 3rd bit CKT1_DEFCPLT 1= defrost CKT1 is complete 4th bit CKT2_COOL_ACT 1 = cool CKT2 is active 5th bit CKT2_DEFR_ACT 1= defrost CKT2 is active 6th bit CKT2_DEFCPLT 1= defrost CKT2 is complete 7th bit Not Used 8th bit Not Used
Input	Reserved	1 byte	n/a
Output	Reserved	1 byte	n/a
Output	System Status	1 byte	0x1 = Turn Compressor OFF 0x3 Turn Compressor ON 1 st bit is unit state (Always 1, ignored), 2 nd bit is compressor state and remaining bits must be 0. The only valid settings are ON(1) or OFF(0) for each bit.
Output	Circuit1 Operating Status	1 byte	Equivalent to: \$OPERATING_MODE,x
Output	Circuit2 Operating Status	1 byte	Equivalent to: \$OPERATING_MODE,x
Output	Reserved	1 byte	n/a
Output	Reserved	1 byte	n/a
Output	Reserved	1 byte	n/a
Output	Reserved	1 byte	n/a

2.2 GSD File

The GSD file defines the equipment and the data that is exchanged. The GSD file is created for the slave device and provided to the Master device to allow the Master to know how to communicate with the slave.

The key values for Polycold that are registered with Profibus International organization are listed in the table below. These are defined in the GSD file and must not be changed.

GSD File Attribute	Value	Description
Vendor_Name	Edwards Vacuum	Company name.
Model_Name	MaxCool	Equipment model name.
Revision	0.0.3	Registered with Profibus International Revision corresponds to GSD
Ident_Number	0x0D59	Permanently assigned identification for all Polycold units

2.3 Modules

The GSD file data is grouped in modules. A primary goal is to eliminate or greatly minimize the requirement for updating the GSD file and application software.

Each module has a configuration value that indicates the size of the data it contains and if it is input or output. Some modules are reserved and could be populated in later versions of the Polycold Slave. The updates would be to add descriptive names in place of the reserved names. The original GSD will still function correctly.

There are nine modules of data in the MaxCool1.GSD file that must be loaded in order on the master. These modules correspond to the GSD file and are show below taken directly from the GSD file.

All 9 MaxCool1.GSD modules must be configured in the order shown in the Module Table on the Profibus Master. MaxCool Cryochiller Profibus implementation is not a modular station.

2.3.1 Module Table

Ordered list of modules in the MaxCool1.GSD

Order	Module Name	Values
1	Get_BitStatus	AlarmStatus, SensorValueValidStatus, SensorFaultStatus
2	Get_TC1-TC8	TC1 - TC8
3	Get_TC9-TC16	TC9 - TC16
4	Get_TC17_TC20	TC17 - TC 20 and Reserved1
5	Reserved_1	Reserved2-5
6	Get_Pressure	PT1 - PT3
7	Get_Voltage_Valves	LineVoltage, Reserved6, ValveStatusMask
8	GetSystemStatus	SysControlMode, SysStatus, Circ1OpStatus, Circ2OpStatus, 24V_System, 24V_Circuit, Reserved 9-10
9	SetSystemStatus	ReservedOut1, SetSysStatus, SetCirc1OpStatus, SetCirc2OpStatus, ReservedOut2-5

2.3.2 Module Configuration

Each module has a configuration value that defines the size and type of data and if the data is output or input. The configuration is defined in the GSD File with each module.

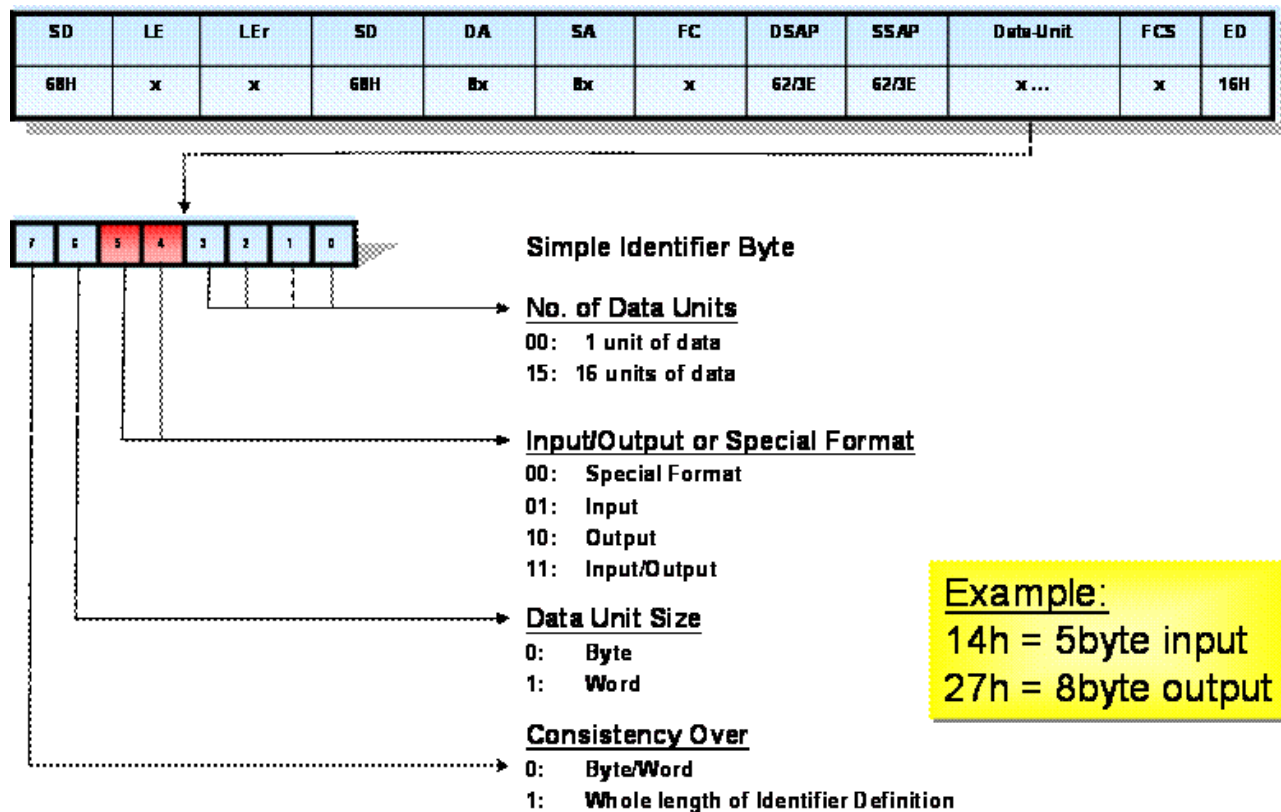
Example from GSD file where 0x27 is the configuration for module 9:

Module="SetSystemStatus" 0x27

The complete configuration for all 9 modules shown below is:

"0x1B, 0x57, 0x57, 0x54, 0x17, 0x52, 0x53, 0x17, 0x27"

The individual module configuration value is referred to as the Data Unit in a Profibus telegram and is calculated based on the consistency, data unit size, I/O, and size as shown below:



If the values change, it will require a modification to Profibus Slave software and the GSD file. This is being avoided by using reserved values in the GSD with data types that are the most likely expansions.

The Profibus Slave application has the capability to modify the module configuration without a software update and it saves the configuration in nonvolatile memory. This allows issuing a modified GSD file without changing the slave application image but would be extremely unlikely because the slave application would need to provide the data that matches the GSD file. This is a safety mechanism for some unforeseen failure.

2.4 Identification Number

Polycold has a unique identifier called **Ident Number** in the GSD file assigned by the Profibus International organization that identifies the equipment and Edwards Vacuum as the manufacturer. The identification number is known by the system's Profibus Driver and by the Master from the GSD file. The number must match or communication will fail.

2.5 Master

A Profibus Master can communicate with the Polycold Slave by importing the Polycold GSD file and configuring the 9 modules identified in this document and in the GSD file in the order they are listed.

All 9 MaxCool1.GSD modules must be configured in the order shown in the Module Table on the Profibus Master. MaxCool Cryochiller Profibus implementation is not a modular station.

The Profibus Master must set the slave address to a value that matches the slave it wishes to communicate with. The default Profibus Slave application address is 7.

The Profibus Master may set the speed to any value up to a maximum of 12Mbps.
(Note: Profibus 3-12Mbps support requires MaxCool Application Software v1.4.0.3 or higher, MaxCool1.GSD file, and MaxCool PCBA #189900-0008 or newer)

The master may then send telegrams using the configuration from the GSD file to monitor the Polycold Slave. The outputs and inputs are described in the data section above.

2.6 Slave (Polycold Application)

The Polycold Slave is part of the Polycold application and is always running if the Polycold unit has been configured for the Profibus interface.

The Polycold Slave's address is configurable by the **PROFIBUS_PARAMS, ADDRESS,n** host command. The 'n' parameter is the desired address or a '?' to query the current address. The Profibus Slave driver is reset if the address is changed. The address must be unique on the Profibus network.

The Polycold Slave's address is also configurable via the HMI Menu. Follow the path of TOP MENU -> CONFIGURATION SET COMM PARAMS -> PROFIBUS -> ADDRESS. This is available on software versions 1.3.0.2 and above. Available options are dependent on software version.

NOTE:

The Polycold Slave's Address, should only be changed while there is no active Master connection/data transfer to the Polycold Slave.

To ensure a correct Address change, it is strongly recommended that the Profibus cable connection be removed from the Polycold Slave Unit while the Polycold Slave Address is being changed. Once the Polycold Slave Address has been changed, the Profibus cable may be reconnected to the Polycold Unit.

The full command definition appears below.

The Profibus Slave's module configuration should not be modified. However, a command is available if that becomes necessary using the **PROFIBUS_PARAMS, MOD_CFG,n** host command. The 'n' is either a '?' to query the current configuration or a string of hexadecimal values representing the desired configuration.

The current Profibus network speed that the Profibus Slave is using can be queried via the **PROFIBUS_PARAMS,SPEED,?** host command.

The Profibus Slave uses a Profibus driver and is in a state of waiting to receive a command from a master. When no Profibus Master is present, the Profibus Slave updates its data infrequently and uses very few system resources.

When a Profibus Master is present on the network, the Profibus Slave reads the master's request and handles the hand shake at the driver level. The Profibus Slave application responds when it receives the Profibus Master's request by processing the outputs and returning the inputs.

Command **'PROFIBUS_PARAMS'** Profibus parameters

Purpose:	Get the Profibus Speed and Get/Set the Profibus Slave Address	
Parameter(s):	,SPEED,? or ,ADDRESS,? or ,ADDRESS,[address] [speed] is READ ONLY: - 0 = 9.6k - 1 = 19.2k - 2 = 45.45k - 3 = 93.75k - 4 = 187.5k - 5 = 500k - 6 = 1.5M - 7 = 3M - 8 = 6M - 9 = 12M [address] is 1 - 125	
Published:	Yes	
Return Value:	[A] or [A][speed] or [A][address]	
Default Value:	[speed] = 0 [address] = 7	
Min: [speed] = 0 Read Only [address] = 1	Max: [speed] = 9 Read Only [address] = 125	
Security Level:	Get: 1	Set: 3
Example:	"PROFIBUS_PARAMS,SPEED,?" Get the Profibus Slave Speed	
Interface	RS-232, Ethernet	

2.7 Baud Rate Detection

The Profibus Slave provides automatic baud rate detection thru the Profichip hardware and supports baud rates up to 12 Mbps. The Profibus Master may use any baud rate up to the maximum 12 Mbps.

2.8 Handshake

2.8.1 Diagnostics

The Profibus Slave uses a 6 byte diagnostic telegram that is handled by the Profichip hardware and has no application specific data. An exchange between Profibus Master and Profibus Slave takes place to determine if the Profichip hardware is ready to communicate.

2.8.2 Parameter

After diagnostics are complete, the Profibus Master sends the module configuration telegram that contains the module configuration of the data that it wants to exchange based on the GSD file definitions. The Profibus Slave validates the data it expects to progress to the next step.

2.8.3 Data Exchange

After the parameters have been validated, the Profibus Master sends it's outputs (refer to the data table) to the Profibus Slave. The Profibus Slave reads the outputs and returns the inputs from the data table that also align with the outputs in the GSD file.