INTERBUS

User Manual
Peripherals Communication Protocol (PCP)

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Revision:	B
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This manual is valid for:

PCP Software	Version 4.0
Firmware	Version ≥ 4.0

5334B

PHOENIX CONTACT

Please Observe the Following:

In order to guarantee the safe use of your device in every situation, we specify that you carefully read the manual. The following notes give you information on how to use this manual.

Requirements on the User Group

The use of products described in this manual is oriented exclusively to qualified application programmers and software engineers familiar with automation safety concepts and applicable national standards. Phoenix Contact assumes no liability for erroneous handling or damage to products from Phoenix Contact or external products resulting from disregard of information contained in this manual.

Explanations of Symbols Used

The *attention* symbol refers to erroneous handling which could lead to damage to the hardware or software, or to personal injury. Personal injury is understood to be any bodily harm in indirect connection with dangerous process peripherals. The symbol is always located to the left of the tagged text.

Text marked in this way informs you of system-related conditions that must absolutely be observed to achieve error-free operation. In addition, the *hand* symbol gives you tips and advice on the efficient use of hardware and software optimization.

The *text* symbol refers to detailed sources of information (manuals, data sheets, literature, etc.) on the subject matter, product, etc. This text also provides helpful information for the orientation in the manual.

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Statement of Legal Authority

Contents

Section 1

This section provides information on

– INTERBUS data types
– INTERBUS transmission methods

1 Data Transmission within the Sensor/Actuator Area

With augmenting automation the number of sensors and actuators is increasing at the same time as manufacturing processes are becoming more and more complex. Using conventional parallel wiring for a complex control process, pushes the costs for cables, installation, startup, and service up. Thus, an up-to-date control concept requires the following:

– an economic solution with bus systems that allow serial data transmission and reduce overall costs of parallel wiring,
– an open and non-proprietary networking concept that can easily be linked to already existing control systems, as well as
– flexibility with regard to future changes or extensions.

INTERBUS meets all of these requirements. This fieldbus was especially designed for signal transmission within the sensor/actuator area.

1.1 Bus Access Methods

Master/slave method

INTERBUS uses the master/slave method for data transmission.

Master

The master is the device in the network that actively coordinates and controls the bus access. It transmits data to all devices and receives data from all devices. In addition, the master is the interface to all higher control levels. It is called controller board.

Slaves

Slaves are various devices connected to the master via the bus. As all slaves have equal rights, questions of priority do not arise.

1.2 Topology

Ring topology

All devices – master and slaves – are connected in a ring topology. The ring is formed with several lines within a cable.

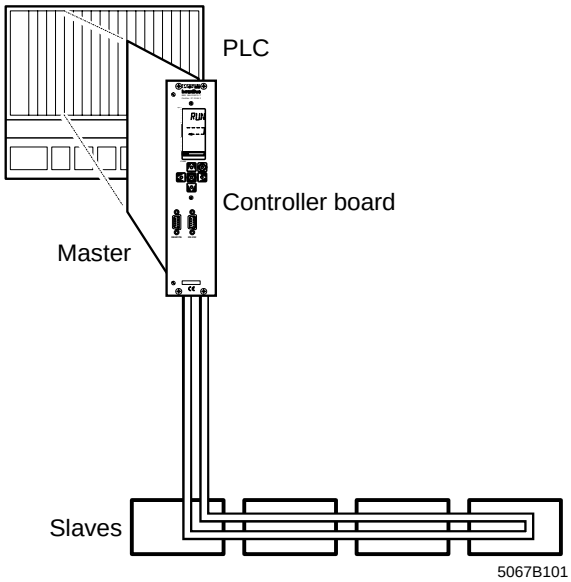

Figure 1-1 INTERBUS ring topology

1.3 INTERBUS Data Types

Process data

Various I/O devices are used within the sensor/actuator area. Among these are simple devices such as valves and switches processing only a few bits of information. The information provided is process data that is, for example, state information on motor speed, switch settings, etc. Process data is highly dynamic, i.e., it changes continuously and must always be updated. Process data is time-critical and must be transmitted quickly and cyclically between the sensors/actuators and controlling units. Transmission is equidistant, i.e. there are always the same time intervals. The information content of process data comprises only a few bits, e.g. the information 1 or 0 of a valve.

Parameter data

In addition, there are intelligent devices, e.g., frequency inverters, operating and indicating elements or controllers. Aside from process data, these devices exchange larger data quantities with the higher-level control system. This data is parameter data which, for example, is used when starting up machines and systems, when converting production facilities or in the case of errors. In contrast to process data, parameter data seldom changes, i.e., it is less dynamic and must seldom be updated. Parameter data is cyclical data, to be transmitted only if required. As parameter data does not directly influence the inputs and outputs and is rarely subjected to change, the requirements made on the transmission rate of parameter data are lower than in the case of process data. The information content of parameter data in the sensor/actuator area ranges between a few and some hundred bytes per data record.

1.4 Process Data Channel and Parameter Data Channel

Process data and parameter data is transmitted in the INTERBUS system via two independent data transmission channels, i.e., the process data channel and the parameter data channel. This additionally optimizes the data transmission. Depending on the function, it is not required that every device supports both channels. However, intelligent devices such as frequency inverters which transmit both process data and parameter data do require both channels.

Process data channel

The process data channel allows to access cyclically transmitted process data. The application program is provided with an image of the current inputs. The application program, in turn, stores the output data that is transmitted to the outputs via the process data channel. With this direct memory access, it is possible to avoid complex service access procedures.

Parameter data channel

The parameter data channel transmits data if necessary. The parameter data channel is integrated into the transmission protocol.

Additional services, i.e. network management services, are required for the non-proprietary configuration, maintenance, and startup of the INTERBUS system.

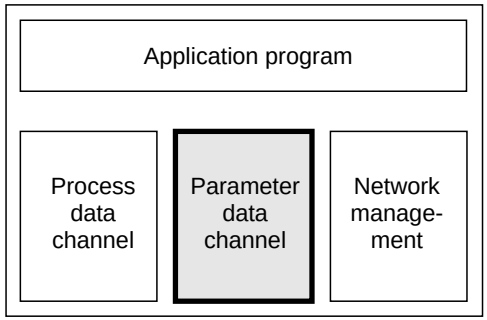

Figure 1-2 Process data channel and parameter data channel

1.5 Communication Interface

Communication services for data exchange

To enable intelligent devices of an INTERBUS system to communicate with each other, it is required to determine the way in which data is transmitted. In factory automation, the "Manufacturing Message Specification (MMS)" ISO standard has gained general acceptance. MMS provides an exactly defined set of communication services used for handling administrative tasks, identification and status inquiries, communication-related activities and productive data transmission.

MMS was designed for networks which, with regard to hierarchy, are located above the INTERBUS level. In the sensor/actuator area, however, there are other requirements in the foreground, e.g. short cycle times. Also, when compared to higher levels, the requirements are reduced. For INTERBUS, the MMS scope has been reduced to relevant services in compliance with these requirements. However, the basic structure has not been affected.

PMS services for the sensor/actuator area

The "Peripherals Message Specification (PMS)" is tailored to the sensor/actuator area. PMS is a user interface according to the international MMS model located at layer 7 of the OSI reference model. The PMS communication services allow to access parameter data.

Open communication

The standardized PMS communication services ensure that the same communication interface is used for all devices. In this way, devices of different manufacturers can be operated within one network and open communication is possible. The specification of a subset of the functional range - e.g. for an application area that does not need all services - is referred to as a communication profile.

1.6 INTERBUS Transmission Protocol

Summation frame method

In the INTERBUS system, all physical system devices are considered to be only one logical device. With every cycle, the entire information of process data is transmitted simultaneously to all devices within one summation frame. Owing to the transmission position of individual information units within the summation frame, every device can recognize its data and accept it.

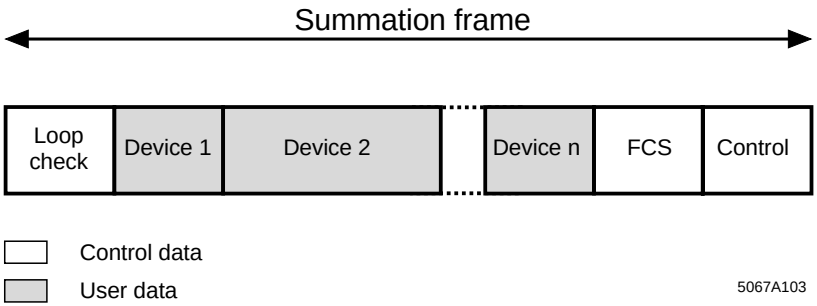

Figure 1-3 Summation frame protocol

Full-duplex operation

The ring topology of the INTERBUS system allows full-duplex operation, that means it is possible to transmit and receive data at the same time. With this operation method, the transmission capacity is doubled and data transmission is very efficient.

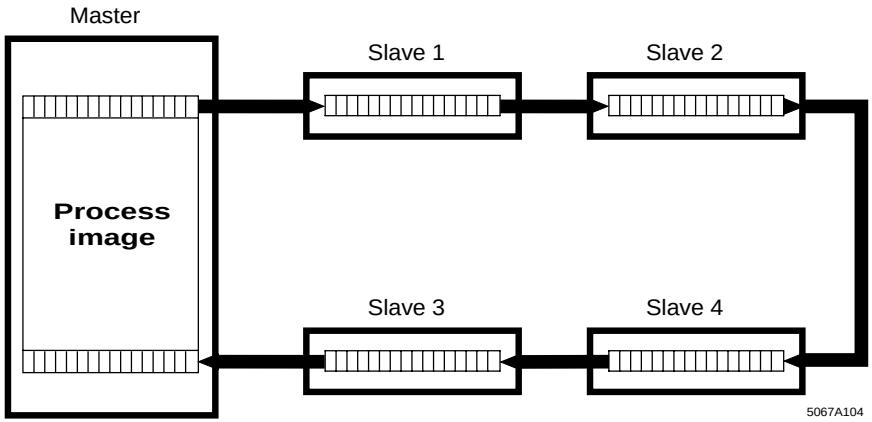

Figure 1-4 Structure of an INTERBUS system

Hybrid transmission method

However, not only process data but also parameter data must be transmitted via the summation frame. If, in the configuration phase, the frame length is set to the maximum information of parameter data to be transmitted, the frame will not be fully utilized in most of the cycles. In addition, the transmission time will increase by decreasing the efficiency of the system at the same time. The summation frame method has therefore been modified for INTERBUS: gaps are left at those positions where devices exchanging data are addressed. If parameter data is to be transmitted, the parameter block will be decomposed into individual segments that are as long as the gap. The following segment lengths are available: 1 word, 2 words, and 4 words. One of these segments will be transmitted with every cycle until the total parameter block has been transmitted. The segments of data are then rejoined at the receiving end.

The simultaneous transmission of both process data and parameter data is referred to as a hybrid transmission method.

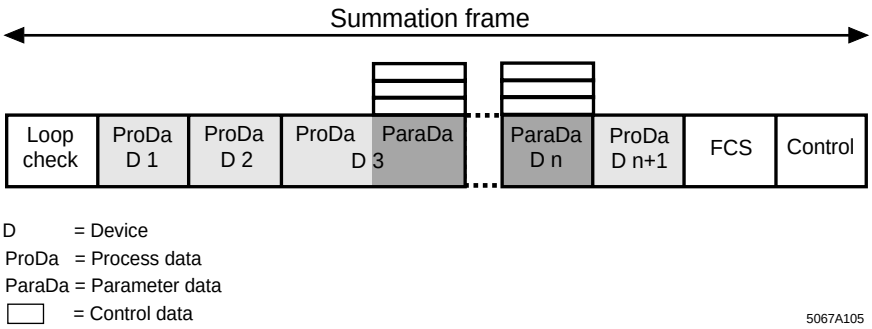

Figure 1-5 Hybrid transmission method

Peripherals Communication Protocol (PCP)

In INTERBUS, the "Peripherals Communication Protocol (PCP)" is responsible for decomposing parameter data into individual segments and composing it after transmission. The PCP protocol software supplies the services required for connection establishment and abort as well as for data transfer. The PMS includes the formal description of these services. In this way, both data types can be transmitted in parallel without affecting each other.

Section 1 deals with the communication via the parameter data channel.

Section 2 explains terms that are required to understand PCP communication.

Section 3 shows how PCP communication is carried out with all commands and parameters required.

Section 4 gives a systematic overview of error messages, error causes and measures for error elimination.

Section 5 describes the IBS CMD SWT parameterization and diagnostic software tool used for communication.

Section 6 lists all services with their corresponding parameters.

Section 2

This section provides information on

– different device parameters
– basic terms of PCP communication
– tasks of communication services

2 Communication between INTERBUS Devices

2.1 Application Example

To clarify the basic terms used in communication, let us assume the following real PCP application:

Together with other field devices, a frequency inverter (FI) is connected to a PLC via a controller board. The characteristics of the devices are standardized according to the DRIVECOM Power Transmission Profile (Profile No. 21).

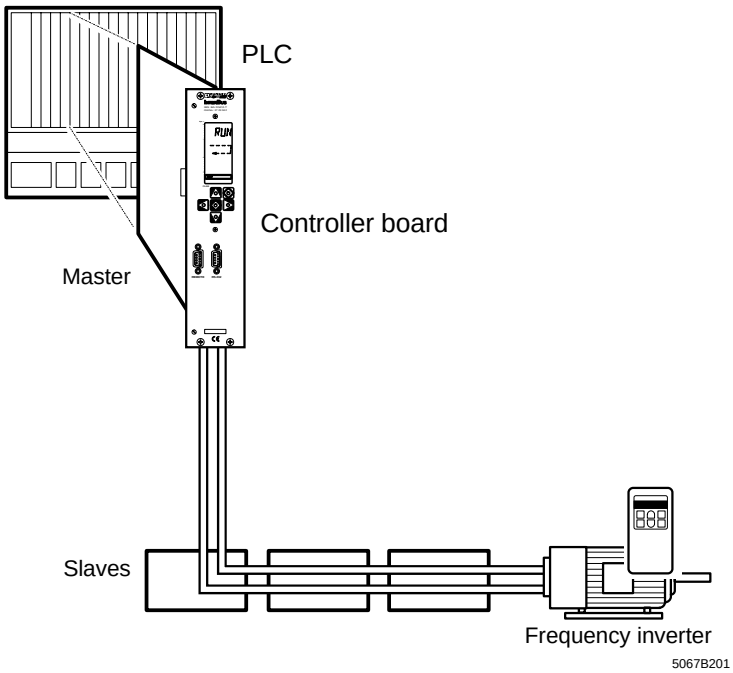

Figure 2-1 Application example

Device parameters

Device parameters are data of intelligent field devices (PCP devices) that are required within the startup phase of machines and systems. After they have been entered once, they only need to be modified in the case of re-parameterization or error. The parameters are pre-configured and can be taken from the device manufacturer's documents.

Parameters of a frequency inverter

As an electrical drive controller, a frequency inverter is characterized by the fact that changes of a process variable (rotational speed, position, and moment) are caused by analog or digital signals. To adapt the drive controller and the motor to the process in an optimum way, additional information is required. Aside from the setpoint information, the frequency inverter requires information on motor parameters, admissible minimum and maximum rotational speed, maximum rotational speed change during acceleration and deceleration, starting ramp, starting current, etc.

All of this additional information forms the device-specific parameters that can be changed via the parameter data channel. The following explanations exclusively refer to these device parameters. Parameters of process variables are not taken into account.

2.1.1 Process Data Descriptions

The parameter values of all PCP devices are used for communication via the parameter data channel - they are the process data descriptions. Each parameter has a number, the index, to distinguish individual parameters during communication.

Object dictionary (OD)

The object dictionary (OD) - a standardized list - includes the index together with the description of parameter characteristics. Each PCP device that exchanges information via the parameter data channel has its own object dictionary.

Index

The index is the address of the communication object. It is required to identify the object. Other PCP devices can address the communication object at this address.

Table 2-1 Object description (example)

	Object description (OD)		
Index	**Type**	**Object**	**Name**
...	...	...	...
60 $4A_{hex}$	Ramp	Record	Speed quick stop
60 $4B_{hex}$	Integer16	Array	Setpoint factor
...	...	...	...

2.1.2 Object Description

The object description includes all characteristics of the object such as data type, object type, names, etc.

Object types

A difference is made between various object types:

Simple variable

– Objects of the simple variable type.
Examples: measured values, time or status of a device.

Array

– Objects of the array type, i.e., several similar objects of the simple variable type that are combined to one object. Each element can be individually accessed.
Example: a series of similar measured values.

Record

– Objects of the record type, i.e., several different objects of the simple variable type that are combined to one object. Just like the array type, each element of a record can be individually accessed.
Example: combination of data within a measuring protocol that includes the measured value as well as additional information, e.g., the time of measurement.

Program invocation

– Objects of the program invocation type, i.e., executable program sequences.

2.2 Call/Response Method

Access to device parameters

Device parameters are accessed via a call/response method: A device sends a request to another device. The device requesting this service is the client. The device that carries out the request is the service provider, the server.

Application processes

Both client and server are application processes that run on respective devices. Application processes are all activities of a PCP device within the system, except for the real tasks such as controlling a motor.

Client/server model

With INTERBUS, the master and the slaves can carry out functions of both client and server.

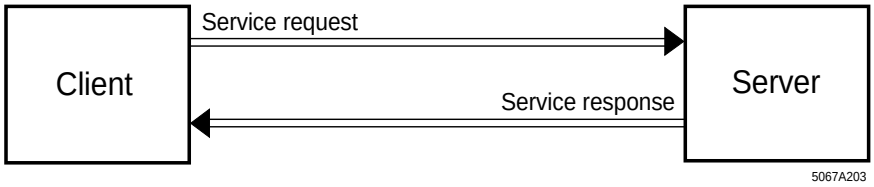

Figure 2-2 Client/server model

Based on our example, one task (application process A) of the automation device could be to transmit parameters (e.g. speed acceleration) to the frequency inverter. The frequency inverter receives the new speed acceleration and converts it correspondingly (application process B).

Communication services

The client and server use communication services for service request and execution.

If, in our example, the parameter value for the speed acceleration is to be transmitted to the frequency inverter, a write command must be used, i.e., the Write_Service.

2.2.1 Service Primitives

(Service) Primitives

A service is divided into individual primitives (basic operations of the service).

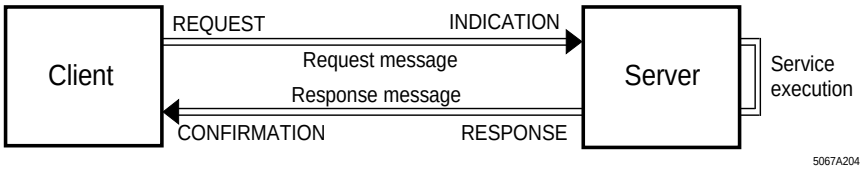

Figure 2-3 PCP primitives (confirmed services)

Request

First, the client sends a service request to the server. In the application example, the automation device requests, for example, to transmit a parameter value to the frequency inverter.

Indication

This request is indicated to the server as a service input. In the application example, the input of a parameter value is indicated to the frequency inverter.

Response

The server executes the service. Afterwards, it sends a service response to the client. In the application example, the frequency inverter is responsible for the new parameter setting. It sends a response that it received the parameter value and carried out the new setting.

Confirmation

The service execution is indicated to the client as a service confirmation. In the application example, the parameter transmission to the frequency inverter is confirmed to the automation device.

The bus transmits the information content in the form of a message (PDU = Protocol Data Unit).

2.2.2 Confirmed/Unconfirmed Services

A call/response method in compliance with the above model is referred to as a confirmed service. In addition, there are unconfirmed services where the service request is executed but a confirmation will not be returned.

An example of an unconfirmed service that is transmitted from the client to the server is a connection abort. An example of an unconfirmed service initiated by the server, i.e. in the opposite direction, is the information report.

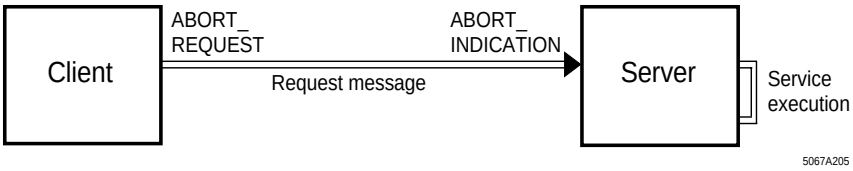

Figure 2-4 Unconfirmed services

Invoke_ID

In the case of confirmed services, the service request and the respective service confirmation are provided with a reference code, the Invoke_ID.

Access protection

The manufacturer can provide access protection for data that should only be available to determined devices, i.e., access rights to communication objects are limited for certain devices. Access protection can be realized by defining

– access groups. Not all of them are allowed to access certain communication objects.
– passwords. A device can only access a communication object with the password defined for this communication object.

Additionally, services can be differentiated within access protection, e.g. general read access for all devices, but write access only for a determined group.

Information about whether and in which form access protection exists for a communication object is stored in the object description.

2.3 Exchange of Device Parameters

Communication relationships

To exchange data between two INTERBUS PCP devices, it is required to establish a logical connection between them first. Logical connections of this type are called communication relationships. Communication relationships are established between application processes.

Communication relationship list (CRL)

The controller board generates a list for every PCP device specifying all permitted communication relationships independent of their time of use. This communication relationship list (CRL) stores the connection type as well as context conditions - the connection parameters - by which the communication relationship can be established. The CRL can manually be changed if required.

The logical connections configured in the communication relationship list allow a smooth data exchange between two communication devices. Before information is exchanged, the connection parameters (context conditions) of both communication partners are checked for consistency during connection establishment.

Communication reference number (CR)

The communication relationship list is divided into several lines. Every permissible communication relationship has a number, the communication reference number (CR). Thus, the communication relationship is clearly coded. A clear code is required to distinguish the individual devices. The INTERBUS controller board automatically numbers the devices when initializing the INTERBUS system. According to the physical bus configuration, it assigns the numbers beginning with two.

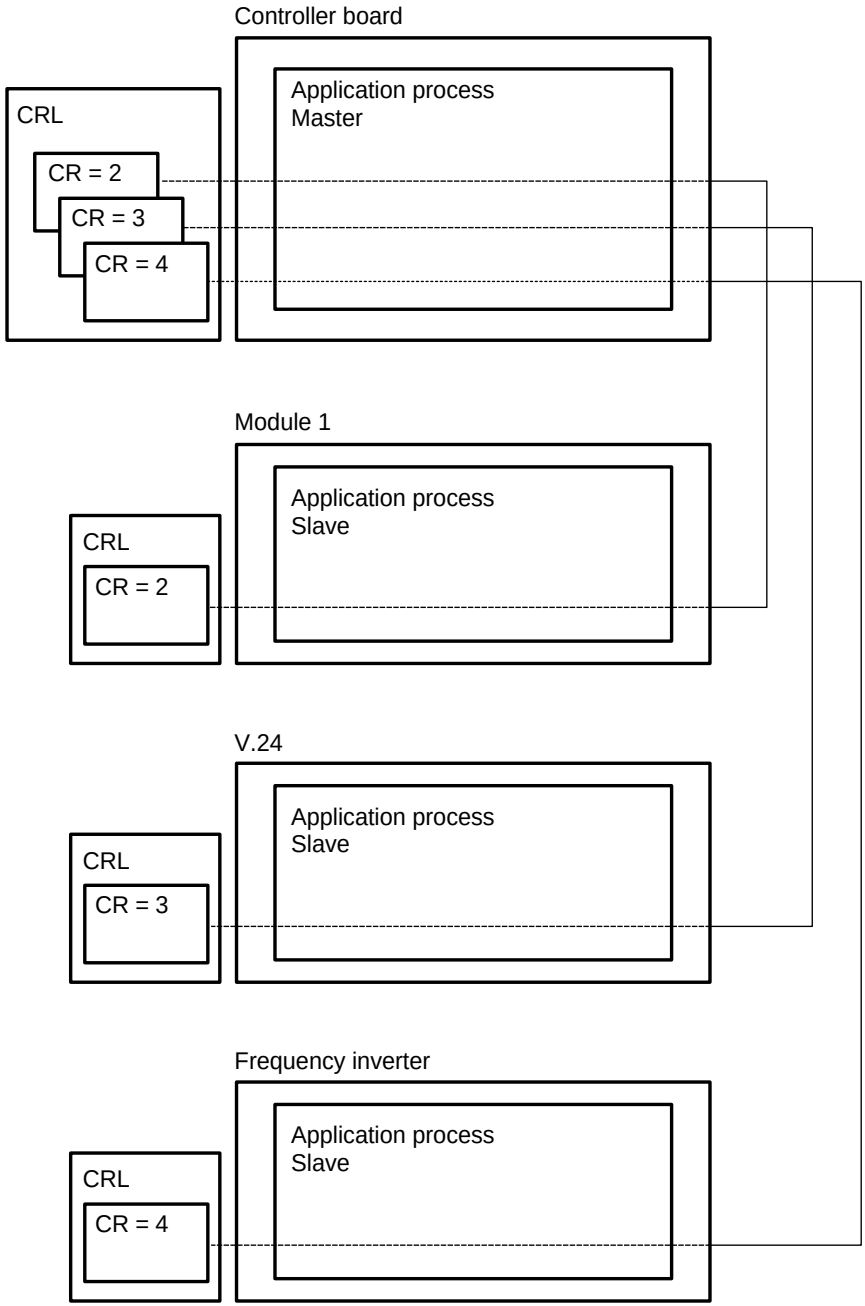

Figure 2-5 Relationship between CRL, CR, and application process

In addition to the CR, each CRL line contains complete details of the connection parameters.

Table 2-2 CR connection parameters

	Connection parameters		
CR	Size of the send buffer Low-Prio	Size of the receive buffer Low-Prio	Supported PMS services

Some attributes of the CRL entry are not supported by INTERBUS. They are only provided for reasons of compatibility to Profibus and are assigned standard values. The system automatically enters the CR during initialization.

CR: For the local application process, the communication reference is a clear identification for the communication relationship.

Size of the send buffer Low-Prio: This attribute contains the maximum possible length of the PDU in transmitting direction with low-priority that can be processed in this communication relationship.

Size of the receive buffer Low-Prio: This attribute contains the maximum possible length of the PDU in receiving direction with low-priority that can be processed in this communication relationship.

Supported PMS services: This attribute informs about which services are supported in this communication relationship.

2.4 Communication Services

The Peripherals Communication Protocol (PCP) offers the user several standardized PMS services that can be divided into three groups:

– User services
– Administration services
– Management services

Section 6 describes the PMS services in detail. The application example is continued in Section 3. The handling of the PMS services and check mechanisms of the Peripherals Communication Protocol are initiated through the "Initiate" service.

2.4.3 Overview of PMS Services

User services

An application process accesses the communication objects via the user services. The user services comprise the following PMS services:

– Start	Starting a program (after a reset) on a PCP device.
– Stop	Stopping a program.
– Reset	Resetting a program.
– Resume	Restarting a program after a stop.
– Write	Setting variables (device parameters) of a PCP device.
– Read	Reading variables (device parameters) of a PCP device.
– Information_Report	Unconfirmed transmission of a parameter.
– Download Services	Data transfer from the client to the server Services: "Initiate_Download_Sequence", "Download_Segment", and "Terminate_Download_Sequence".
– Upload Services	Data transfer from the server to the client. Services: "Initiate_Upload_Sequence", "Upload_Segment", and "Terminate_Upload_Sequence".

– Request_Domain_Upload
  Requesting the automatic data transfer from the server to the client.
– Read_ / Write_With_Name
  Reading/Writing an object that is not explicitly described in the PMS object dictionary.

Administration services

Administration services are used to exchange information via communication objects. The administration services comprise the following PMS services:

– Status – Reading the device status (operating state)/ application state (communication state).
– Identify – Reading the manufacturer's name, type, version.
– Get_OD – Reading the object description.

Management services

The management services allow and secure the operation of the communication system. These services include the establishment and abort of a connection.

– Initiate – Establishing a connection.
– Abort – Aborting a connection.
– Reject – Rejecting an inadmissible service.

2.4.4 Systematics of Supported User Services

Representation

The supported user services of a PCP device are represented within a bit pattern of 48 bits in hexadecimal notation. The bits 0 ... 23 indicate the supported services as a client, bits 24 ... 47 as a server. Of these 48 bits, only some are actually used.

Bits 3, 4, 8, 27, 28, and 32 represent several services.

All unused bits, as well as the bits of the unsupported services are set to "0". If the service is supported, the bits used are set to "1".

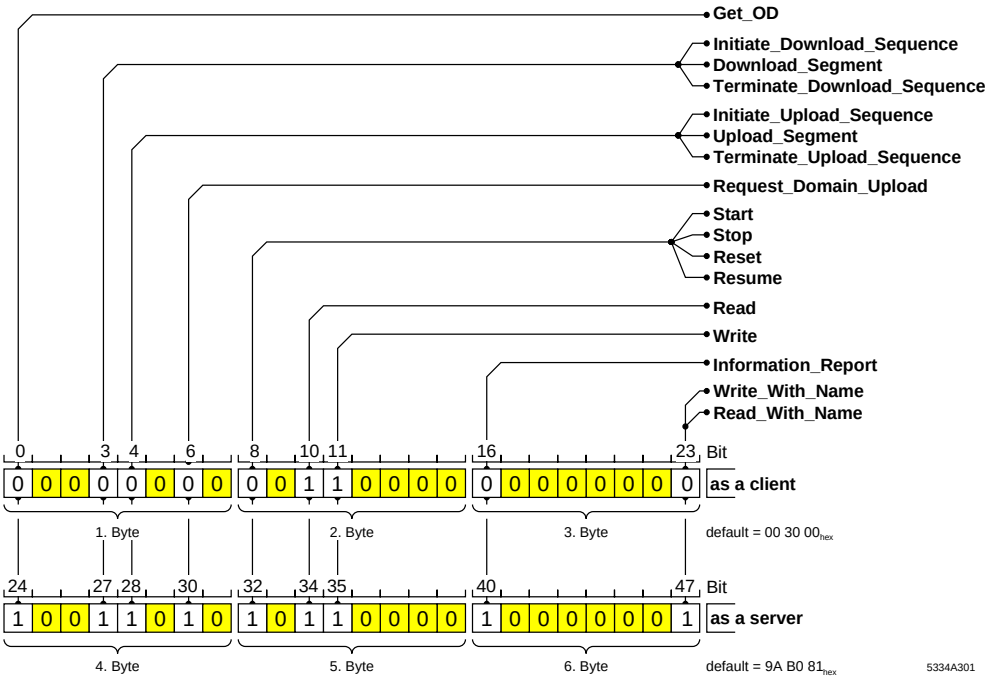

Figure 2-6 Systematics of the supported user services

Example

In the application example, the controller board supports the services "Get_OD", "Read", and "Write" as a client and all services as a server.

Thus, the bit pattern is as follows:

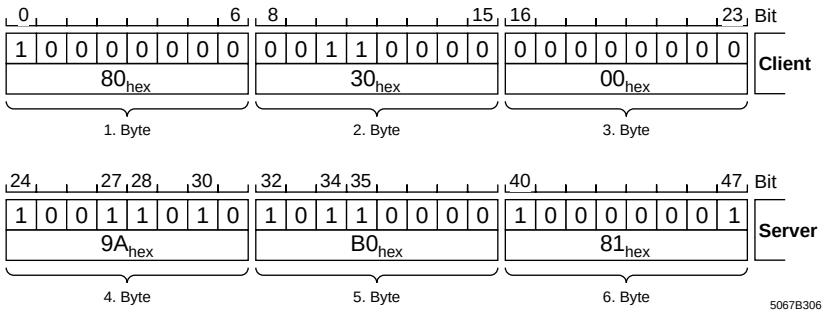

Figure 2-7 Bit pattern of the supported services of the controller board

Entry in the CRL

In the CRL, each of these 8-bit patterns is represented in hexadecimal notation. In the application example, the entry for the supported services in the CRL of the controller board is called "frequency inverter":

... | 80 30_{hex} | 00 $9A_{hex}$ | B0 81_{hex}

Coding [hex]	Start	Stop	Reset	Resume	Read	Write	Information_Report	Get_OD	Initiate_Download_Sequence	Download_Segment	Terminate_Download_Sequence	Initiate_Upload_Sequence	Upload_Segment	Terminate_Upload_Sequence	Read_With_Name	Write_With_Name	Request_Domain_Upload
00 00 00	—				—	—	—	—	—			—			—		—
00 30 00	**—**				**X**	**X**	**—**	**—**	**—**			**—**			**—**		**—**
00 30 01	—				X	X	—	—	—			—			X		—
00 80 00	X				—	—	—	—	—			—			—		—
00 B0 00	X				X	X	—	—	—			—			—		—
00 B0 01	X				X	X	—	—	—			—			X		—
18 30 00	—				X	X	—	—	X			X			—		—
18 80 00	X				—	—	—	—	X			X			—		—
18 80 81	X				—	—	X	X	X			X			X		—
80 00 80	—				—	—	X	X	—			—			—		—
80 30 80	—				X	X	X	X	—			—			—		—
80 80 00	X				—	—	—	X	—			—			—		—
80 80 80	X				—	—	X	X	—			—			—		—
80 B0 00	X				X	X	—	X	—			—			—		—
80 B0 80	X				X	X	X	X	—			—			—		—
9A B0 81	**X**				**X**	**X**	**X**	**X**	**X**			**X**			**X**		**X**

Key X The service is supported.
— The service is **not** supported.

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Figure 2-8 Combination options of the services

Figure 2-8 lists the most frequently used combination options of the services in hexadecimal notation. If one of these combinations is in the first three bytes, it is possible to read the client services. If a combination is between byte 4 and 6, it is possible to read the server services.

2.4.5 Adaptation of Supported Services

All services that can be processed by the controller board and the PCP device as both client and server have to be compared and adapted.

As a client the PCP device must not support more services than the server communication partner.

However, as a server a device can support more services than the client communication partner.

Section 3

This section provides information on the

– step-by-step PCP communication startup using an example

3 Starting up Communication

There are several ways to start up communication:

– For some controller boards, there are pre-written function blocks by which the services can be called. For all other controller boards, the required service calls are to be integrated into the application program.
– The IBS CMD SWT G4 software tool from Phoenix Contact. This tool can be used for all Generation 4 host systems. It is the simplest way to establish and test a communication connection via command codes.

Independent of the tools used, this section describes the **systematics of communication** by means of service primitives. In Section 5, there is a description of how communication can be easily carried out with the IBS CMD SWT G4 software.

Communication phases

INTERBUS supports connection-oriented (1 - 1) communication relationships. The connection-oriented communication is divided into three phases:

– Connection establishment
– Data transfer
– Connection abort

Connection establishment phase

In the connection establishment phase, a PCP device functioning as a client tries to establish a communication connection to a PCP device functioning as a server. During process, the context conditions - the connection parameters - that are determined in the communication relationship lists of both devices are checked. If the context conditions correspond to each other, the data transfer phase will be initiated. Otherwise, the connection establishment will be aborted with an error message.

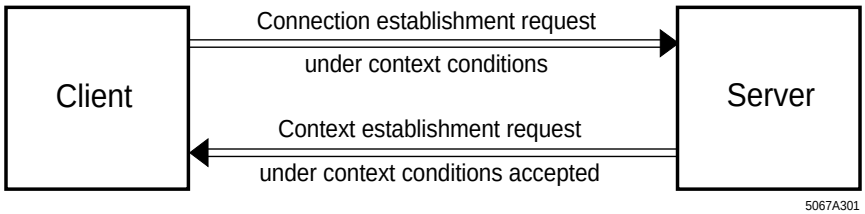


Figure 3-1 Connection establishment phase

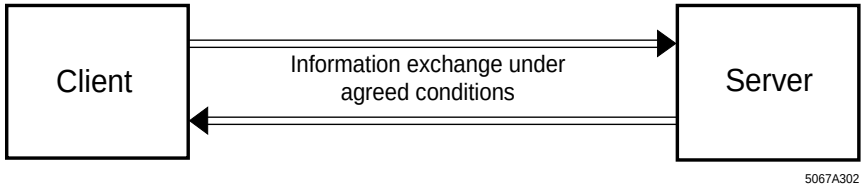


Figure 3-2 Data transfer phase

During the data transfer phase, the PCP devices exchange data under context conditions. The connection continues to exist until it is intentionally aborted or a communication error occurs.

Connection abort phase

After the data exchange has been completed, the connection can be terminated by a connection abort. In the case of a communication error, the connection would be automatically aborted. Thereafter, the data exchange can only be carried out after a renewed connection establishment.

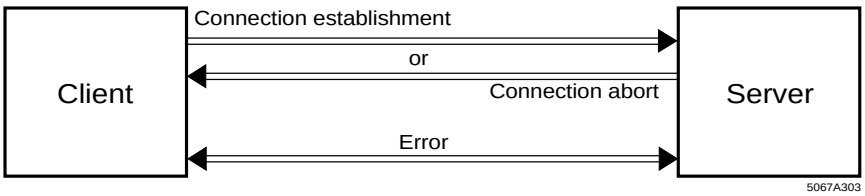


Figure 3-3 Connection abort phase

3.1 Information on the Application Example

In our application example, a frequency converter is to be parameterized. Before a parameter can be transmitted, a connection between the controller board and the frequency inverter has to be established. This step is initiated by the application process of the controller board functioning as a client.

Example configuration

Communication startup is illustrated on the basis of a very simplified bus configuration.

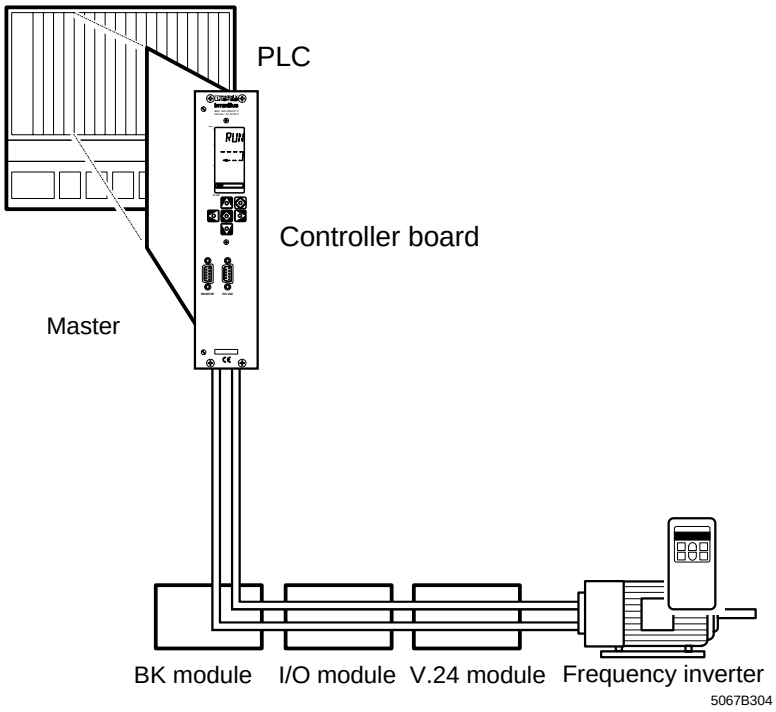


Figure 3-4 Bus configuration example

There are four devices connected to the bus. The third and fourth device are communication modules: a V.24 module and a frequency inverter. The services are transmitted and received via a PLC.

Changing the speed acceleration

In the application example, the set parameter value is to be modified for the speed acceleration of the frequency inverter. The speed acceleration parameter indicates the slope of the starting ramp. The parameter consists of the quotient of the two subparameters "delta speed" and "delta time" and is to be set to 100 rpm.

The data type is "Record":

– an Unsigned 32 data type (4 bytes delta speed, value between 0 and 4 295 967 295) and
– an Unsigned 16 data type (2 bytes delta time, value between 0 and 65 535).

In the application example, the frequency inverter is a device corresponding to the DRIVECOM Power Transmission Profile 21. The parameters that can be accessed are described in an object dictionary that was preconfigured by the manufacturer and does not need any further processing. Please refer to the device documentation for the required information on the individual objects.

Example:
Extract from the device description of a frequency inverter

Speed acceleration (60 48 hex)

Data format:	*Ramp structure (index 21_{hex})* *Subindex 1: Unsigned 32* *Numerator, delta speed in rpm* *Subindex 2: Unsigned 16* *Denominator, delta time in sec*
Meaning:	*Startup time referred to delta speed. The parameter is mapped to the starting ramp via the ramp-min frequency inverter function (L-C12). If the denominator is 0, the ramp is switched off.*
Factory setting:	*Ramp is switched off.* *Numerator = 0* *Denominator = 0*

In our example, only the controller board has client functionality. All other devices are dedicated server devices. As a client, they cannot access ob-

jects of the controller board or other PCP devices. In the example, the controller board initializes all of the described communication activities.

During startup of the controller board a default CRL is automatically created. In this CRL, the context conditions for the data transfer - the connection parameters - with the other PCP devices are determined. In our example, the following CRL is assumed:

Example CRL of a controller board

02_{hex} (Number of entries)
... [Reserved area]
02_{hex} (CR: communication relationship to the V.24 module)
...
40_{hex} (Maximum length of a PDU in transmitting direction: 64 bytes)
40_{hex} (Maximum length of a PDU in receiving direction: 64 bytes)
8030_{hex} (Supported services: as a client, Get_OD,
080_{hex} Read and Write are supported; as a server, Get_OD,
$B080_{hex}$ Start, Stop, Read, Write, Information_Report)
...
03_{hex} (CR: Communication relationship to the frequency inverter)
...
40_{hex} (Maximum length of a PDU in transmitting direction: 64 bytes)
40_{hex} (Maximum length of a PDU in receiving direction: 64 bytes)
8030_{hex} (Supported services: as a client, Get_OD,
0080_{hex} Read and Write are supported; as a server, Get_OD,
$B080_{hex}$ Start, Stop, Read, Write, Information_Report)

The manufacturer preconfigures the CRL of the frequency inverter.

CRL of the frequency inverter

01_{hex} (Number of entries)
... [Reserved area]
02_{hex} (CR: communication connection to the controller board)
...
64_{hex} (Maximum length of a PDU in transmitting direction: 100 bytes)
64_{hex} (Maximum length of a PDU in receiving direction: 100 bytes)
0000_{hex} (Supported services:
0000_{hex} as a client, no service;
3000_{hex} as a server, Read and Write)

At first, the CRLs are not visible. If there are discrepancies between the CRLs, an error message is indicated during connection establishment.

Section 3.3.2 "Initiate_Confirmation Service Confirmation" explains how these discrepancies can be eliminated.

Sequence

To allow the speed acceleration parameter to be changed,

1. initialize the INTERBUS system.
2. start data transmission (Start Data Transfer).
3. establish the connection with the Initiate_Request command. If an error message is indicated (Initiate_Confirmation negative), the error must be removed with the Load_CRL_Attribute_Loc_Request command.
4. write the set value for the speed acceleration via the parameter data channel. In order to show how parameter values of objects can be read out, in our example, the preset value should first be read with a Read_Request before the new value is written. In general, this must not be carried out before a Write_Request.
5. abort the connection with the Abort_Request. This connection need only be aborted when the controller board is switched off or before a reset. Otherwise, an error message will be put out during the next connection establishment.

The flowchart schematically shows the procedure.

Section 3.6 includes a description of how the default communication references can be changed with the Load_CRL_Attribute_Loc_Request, as far as this is required after a modification or extension of the system.

3.2 Flowchart

From the client's point of view, the diagram shows the steps within an application program for communication processing:

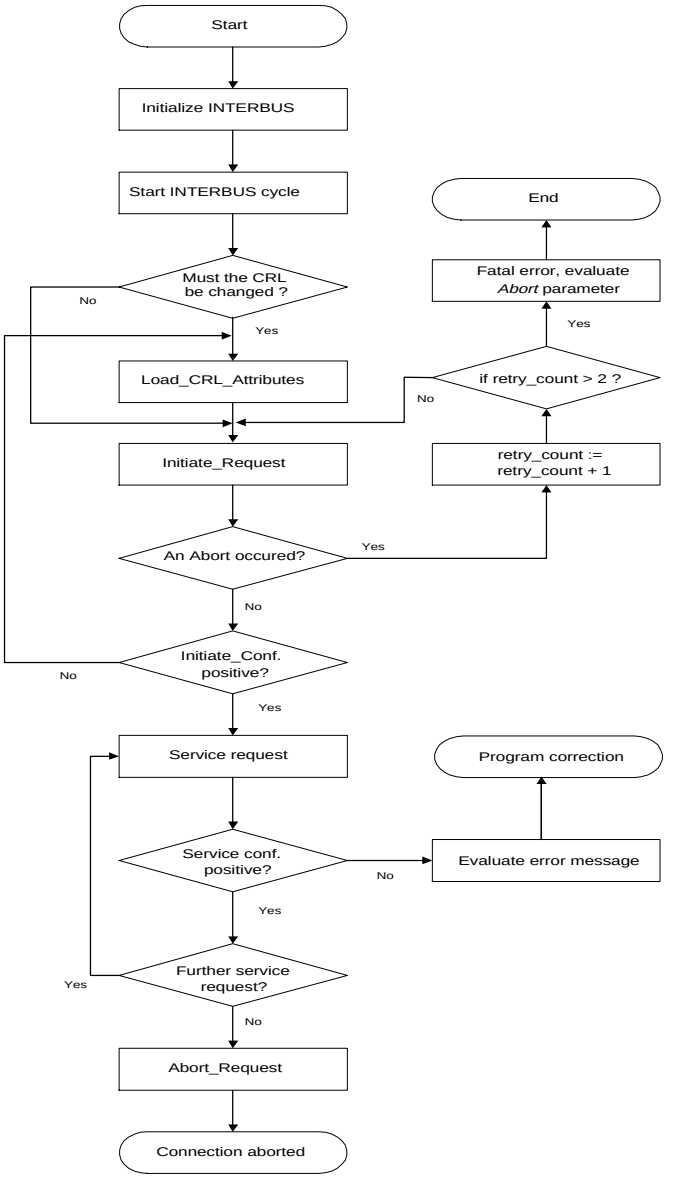


Figure 3-5 Starting up communication

3.3 Establishing a Connection

Before establishing a connection, use the "Initiate" service. In the service request, it is required to indicate the communication reference number (CR) of the application process of the communication partner, i.e. of the server to be called.

After checking the reliability of the connection establishment, the server indicates the success or failure of the connection establishment with the service response *Initiate_Response*. Thus, the program takes two possibilities into account:

1. The connection is established. For this, the "Initiate_Confirmation" with positive result is provided.
2. The automatic test mechanisms detect that a connection establishment is inadmissible, as the entries in the two CRLs do not correspond to each other. For this, the "Initiate_Confirmation" with negative result is provided. The negative message includes error codes that must be evaluated.

3.3.1 *Initiate_Request* Service Request

Syntax: **Initiate_Request** **00 8B$_{hex}$**

Word 1	Command_Code		00 8B$_{hex}$
Word 2	Parameter_Count		00 02$_{hex}$
Word 3	—	Communication_Reference	00 03$_{hex}$
Word 4	Password	Access_Groups	00 00$_{hex}$

Bit	15 8	7..... 0

Key:

Command_Code: Command code of the service request:
008B$_{hex}$ for "Initiate_Request".

Parameter_Count: Number of subsequent data words:
0002$_{hex}$ for two subsequent data words (*Communication_Reference* and *Password* | *Access_Groups*).

Communication_Reference:
Communication reference number of the communication relationship between controller board and frequency inverter.

Password: A password was defined for this communication relationship to access device objects. Please refer to the device documentation for the password. There is no password required for communication objects that are defined in the DRIVECOM Power Transmission Profile 21. Therefore, the value 00$_{hex}$ must be used.

Access_Groups: The controller board is assigned to a determined access group for which an access authorization for objects of the frequency inverter is specified. Please refer to the device documentation for the *Access_Groups* value. For communication objects that are defined in the DRIVECOM Power Transmission Profile 21, there is no access protection provided via access groups. Therefore, the value 00$_{hex}$ must be used.

3.3.2 *Initiate_Confirmation* Service Confirmation

After processing the service request "Initiate_Request", the system puts out the service confirmation "Initiate_Confirmation". This message shows whether the connection establishment was successful (positive message).

If the connection establishment was unsuccessful, a negative message will be put out. A negative message is indicated by the *Result* parameter unequal to zero.

Syntax **Initiate_Confirmation** **$808B_{hex}$**

Positive message — Example:

			Example:
Word 1	Message_Code		$80\ 8B_{hex}$
Word 2	Parameter_Count		$00\ 06_{hex}$
Word 3	—	Communication_Reference	$00\ 03_{hex}$
Word 4	Result (+)		$00\ 00_{hex}$
Word 5	Version OD		$00\ 00_{hex}$
Word 6	Profile		$00\ 21_{hex}$
Word 7	Protection	Password	$FF\ 00_{hex}$
Word 8	Access_Groups	—	$00\ 00_{hex}$

Negative message — Example

			Example
Word 1	Message_Code		$80\ 8B_{hex}$
Word 2	Parameter_Count		$00\ 08_{hex}$
Word 3	–	Communication_Reference	$00\ 03_{hex}$
Word 4	Error_Class	Error_Code	$00\ xx_{hex}$
Word 5	Additional Code		$00\ 00_{hex}$
Word 6	Send_Buffer_Size		
Word 7	Receive_Buffer_Size		
Word 8	Services_Supported (1)	Services_Supported (2)	
Word 9	Services_Supported (3)	Services_Supported (4)	
Word 10	Services_Supported (5)	Services_Supported (6)	

Bit	15 8	7..... 0

Key:	Message_Code:	Message code for service confirmation: $808B_{hex}$ for "Initiate_Confirmation".
	Parameter_Count:	Number of subsequent parameters (here: 6 data words).
	Comm._Reference:	Communication reference number of the communication relationship between controller board and frequency inverter.
	Result (+):	0000_{hex} indicates a positive result.
	Version_OD:	Version number of the object directory. This parameter is device-specific and is read by the system from the object dictionary.
	Profile:	Identification of the device profile, i.e., the number or the application-specific profile is indicated. In this example, the Power Transmission Profile 21 is used, the value is therefore 0021_{hex}.
	Protection:	Includes the "Access_Protection_Supported" attribute from the device documentation of the frequency inverter. The parameter indicates whether the access rights of the frequency inverter are checked during object access. As this is the case in the example, the value FF_{hex} (= true) is shown.
	Password:	Manufacturer-specific but generally not used. In the example, the entry is therefore 00_{hex}.
	Access_Groups:	Manufacturer-specific but generally not used. In the example, the entry is therefore 00_{hex}.
	Error_Class:	Contains the error message classification of the "Initiate" service (00_{hex}).
	Error_Code:	There are three causes leading to an error message: 01_{hex} The send and receive buffers of the controller board and the frequency inverter do not match in size. 02_{hex} The supported services of both devices do not match. 04_{hex} The application program rejects the

service; the error cause is manufacturer-specific. Please refer to the device documentation. The device may not be ready for operation.

Additional_Code: Contains manufacturer-specific information on the error cause (*Error_Code* = 04_{hex}). For the error codes 01_{hex} and 02_{hex} (*Error_Code*), the parameter is always set to the value 0000_{hex}.

Send_- / Receive_Buffer: The buffer sizes of the frequency inverter are indicated in the bits 7 ... 0 of the *Send_Buffer* and *Receive_Buffer* parameters. Each buffer comprises 100 bytes (64_{hex}). The bits 15 ... 8 are not supported.

Services_Supported: Coding of the supported services that can be processed by the frequency inverter. The coding is carried out with 6 bytes indicating which services are carried out by the device as a client (1st to 3rd byte) and which as a server (4th to 6th byte).

In the following, the causes for the error messages "*Error_Code* = 01_{hex}" and "*Error_Code* = 02_{hex}", as well as their removal are described on the basis of the application example.

Causes for the error code 01_{hex}

Error cause

The "*Error_Code* = 01_{hex}" error message means that the send and receive buffer of the controller board and frequency inverter do not match.

Error removal

The send buffer of the controller board must be less than or equal to the receive buffer of the device - in this case, the frequency inverter.

The receive buffer of the controller board must be greater than or equal to the send buffer of the device.

In our example, the send buffer of the controller board, with 64 bytes, is smaller than the receive buffer of the frequency inverter, thus meeting the requirements.

The receive buffer of the controller board is 64 bytes (40_{hex}). It is smaller than the send buffer of the frequency inverter with 100 bytes (64_{hex}) and has therefore caused the error message.

The surest way to avoid another error message is to set the values of both buffer sizes of the controller board to the values of the device, in this case to 100 bytes (64_{hex}).

The "Load_CRL_Attribute_Loc" service allows to change the buffer sizes of the CRL (see "Changing the Buffer Size of the Controller Board" on Page 3-17).

Causes for the error code 02_{hex}

Error cause

The "*Error_Code* = 02_{hex}" error message means that the supported services of the controller board and the device (here the frequency inverter) do not match.

Error removal

The supported services must be adapted to each other. This process requires background information. First, it is required to become familiar with the systematics of the coding and adaptation of the supported services (*Services_Supported* parameter, see Section 2.4).

In the example, the controller board supports the services "Get_OD", "Read" and "Write" as a client and all services as a server. The corresponding entry in the CRL is as follows:

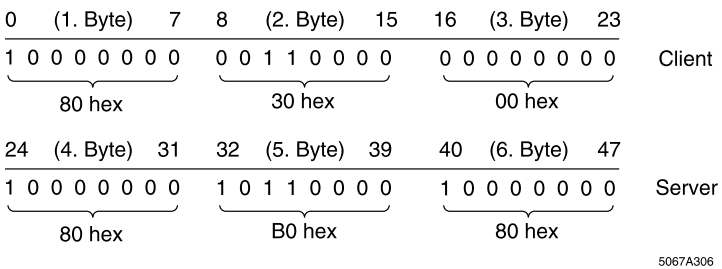


Figure 3-6 Services of the controller board (example)

The services that can be processed by the controller board and the frequency inverter either as a client or as a server must be compared and adapted to each other.

Service comparison of the frequency inverter and controller board

Table 3-1 Service comparison of the frequency inverter as a client and the controller board as a server

Get_OD	Start, Stop, Reset, Resume	Read	Write	Information_ report	
–	–	–	–	–	Frequency inverter Client
X	X	X	X	X	Controller board Server

All of the supported services indicated in the client line must also be supported in the server line. In this case, there are no problems as the controller board supports all services as a server and the frequency inverter supports none as a client.

Table 3-2 Service comparison of the controller board as a client and the frequency inverter as a server

Get_OD	Start, Stop, Reset, Resume	Read	Write	Information_ Report	
X	–	X	X	–	Controller board Client
–	–	X	X	–	Frequency inverter Server

The controller board supports the "Get_OD" service as a client but the frequency inverter does not support it as a server. This causes the error message.

To remove the error, the "Get_OD" service as a client must be switched off on the controller board. To do this, use the "Load_CRL_Attribute_Loc" service (see "Adapting the Controller Board and Frequency Inverter" on Page 3-19).

3.3.3 Changing the Buffer Size of the Controller Board

Syntax: **Load_CRL_Attribute_Loc_Request** **02 64_{hex}**

Word 1	Command_Code	02 64_{hex}
Word 2	Parameter_Count	00 04_{hex}
Word 3	Attribute_Code	00 xx_{hex}
Word 4	Entry_Count	00 01_{hex}
Word 5	Communication_Reference	00 03_{hex}
Word 6	Attribute_Value	00 64_{hex}

Bit	15 0

Key:

Command_Code: Command code for the service request: 0264_{hex} "Load_CRL_Attribute_Loc_Request".

Parameter_Count: Number of subsequent parameters (here: 4 data words).

Attribute_Code: Code for the parameter to be changed. Enter:
$000E_{hex}$ for send buffer (*Send_Buffer*).
0010_{hex} for receive buffer (*Receive_Buffer*).

Entry_Count: Counter that indicates for how many devices a new attribute must be set at the same time (here: 0001_{hex}, as only the entry *Communication_Reference* = 3 is to be changed.

Comm._Reference: Communication reference of the device.

Attribute_Value: Setting for the attribute selected with the *Attribute_Code* parameter. The attribute can consist of several words (here: 0064_{hex} for a send buffer length of 100 bytes).

If the size of the receive buffer should be changed, enter the value 10_{hex} for the *Attribute_Code* parameter and the desired buffer value in the *Attribute_Value* field.

It is possible to change the same attribute on several devices at the same time. For this, set the value of the *Entry_Count* parameter to the corresponding number of devices and indicate the communication reference and attributes for each device.

After successful processing of the service request "Load_CRL_Attribute_Loc_Request", the service confirmation "Load_CRL_Attribute_Loc_Confirmation" will be returned.0

Load_CRL_Attribute_Loc_Confirmation **82 64_{hex}**

Syntax: Positive message

Word 1	Message_Code	82 64_{hex}
Word 2	Parameter_Count	00 01_{hex}
Word 3	Result (+)	00 00_{hex}

Bit	15 8	7..... 0

Key:

Message_Code: Message code for the service confirmation:
82 64_{hex} "Load_CRL_Attribute_Loc_ Confirmation".

Parameter_Count: Number of subsequent parameters:
0001_{hex} For 1 data word.

Result (+): 0000_{hex} Indicates a positive result.

3.3.4 Adapting the Controller Board and Frequency Inverter

The supported services of the frequency inverter can be found in the service confirmation "Initiate_Confirmation":
– 00 00 00_{hex}: No services as a client.
– 00 30 00_{hex}: "Read" and "Write" services as a server.
For services of the controller board, please refer to the example CRL on Page 3-7:
– 80 30 00_{hex}: "Get_OD", "Read" and "Write" services as a client.
– 9A B0 81_{hex}: All services as a server.
The "Load_CRL_Attribute_ Loc" service allows to adapt the supported services of the controller board and frequency inverter.

Syntax: **Load_CRL_Attribute_Loc_Request** **02 64_{hex}**

Word 1	Command_Code	02 64_{hex}
Word 2	Parameter_Count	00 04_{hex}
Word 3	Attribute_Code	00 12_{hex}
Word 4	Entry_Count	00 01_{hex}
Word 5	Communication_Reference	00 03_{hex}
Word 6	Attribute_Value	00 80_{hex}

Bit | 15 0

Key:

Command_Code:	Command code for the service request: 0264_{hex}.
Parameter_Count:	Number of subsequent parameters: 0004_{hex} For 4 data words.
Attribute_Code:	Code for the parameter to be changed. Enter: 00 12_{hex} For supported services.
Entry_Count:	Number of devices to be changed: 0001_{hex} For 1 device.
Comm._Reference:	Communication reference of the device: 0003_{hex} For the frequency inverter.
Attribute_Value:	Setting of the attribute selected in the *Attribute_Code* parameter: 0080_{hex} For the *Get_OD_Long* attribute.

3.4 Exchanging Parameter Data

To explain how parameter data is exchanged, the example of the frequency inverter is used.

First, the speed acceleration is read out with the "Read" service (see "Reading the Speed Acceleration" on Page 3-21).

Then, the speed acceleration is set to 100 rpm with the "Write" service (see "Changing the Speed Acceleration" on Page 3-24).

3.4.1 Reading the Speed Acceleration

Use the "Read" service to read the parameter data of the frequency inverter (e.g. speed acceleration).

Syntax: **Read_Request** **00 81_{hex}**

Word 1	Command_Code		00 81_{hex}
Word 2	Parameter_Count		00 03_{hex}
Word 3	Invoke_ID	Comm._Reference	00 03_{hex}
Word 4	Index		60 48_{hex}
Word 5	Subindex	–	00 00_{hex}

Bit	15 8	7..... 0

Key:

Command_Code: Command code for the service request:
0081_{hex} For "Read_Request".

Parameter_Count: Number of subsequent parameters:
0003_{hex} For 3 data words.

Invoke_ID: Job number for parallel services (default value: 00_{hex}).

Comm._Reference: Number of the communication relationship between controller board and frequency inverter (here: 03_{hex}).

Index: Index assigned to the object according to the device documentation:
6048_{hex} For the "speed acceleration" object.

Subindex: Indicates whether the entire object or only an element is to be read. According to the device documentation, the "speed acceleration" object consists of the subsequent elements:
00_{hex} Entire object.
01_{hex} "Delta speed" element.
02_{hex} "Delta time" element.

It is possible to transmit the service request "Read_Request" to several devices one after the other without having to wait for service confirmations. However, a second service request must not be sent to the same device before the first service request has been confirmed.

After processing the service request, the system puts out a message that indicates whether the result is positive:

Read_Confirmation **80 81$_{hex}$**

Syntax:

Message with positive result

Word1	Message_Code	80 81$_{hex}$
Word 2	Parameter_Count	00 06$_{hex}$
Word 3	Invoke_ID | Communication_Reference	00 06$_{hex}$
Word 4	Result (+)	00 00$_{hex}$
Word 5	— | Length	00 06$_{hex}$
Word 6	Data [1] | ...	00 14$_{hex}$
Word 7	... | ...	00 00$_{hex}$
Word 8	... | Data [6]	00 01$_{hex}$

Message with negative result

Word 1	Message_Code	80 81$_{hex}$
Word 2	Parameter_Count	00 03$_{hex}$
Word 3	Invoke_ID | Comm._Reference	00 03$_{hex}$
Word 4	Error_Class | Error_Code	06 07$_{hex}$
Word 5	Additional_Code	00 00$_{hex}$

Bit	15 8	7..... 0

Key:

Message_Code:	Message code for the service confirmation: 8081_{hex} for "Read_Confirmation".
Parameter_Count:	Number of subsequent parameters in the frequency inverter example: 6 data words in the case of a positive result, 3 data words in the case of a negative result.
Invoke_ID:	Job number for parallel services (default value = 00_{hex}).

Comm._Reference:	Number of the communication relationship between controller board and frequency inverter: 03_{hex}.
Result (+):	0000_{hex} Indicates a positive result.
Length:	Indicates the size of the data field. In this example, the entire "speed acceleration" object is to be read out. It consists of 4 bytes "delta speed" (data type Unsigned 32) plus 2 bytes "delta time" (data type Unsigned 16). The value 06_{hex} represents the size of the data field. If only "delta time" is read out, the size of the data field would be 02_{hex}. Then, the "parameter counter" would be 04_{hex}.
Data:	Indicates the set values for the speed acceleration.
Error_Class / Code:	Indicates the error cause. A negative result is indicated in the *Error_Class* / *Error_Code* fields with a value unequal to 0. For example, *Error_Class* = 06_{hex} with *Error_Code* = 07_{hex} means that the object does not exist.
Additional_Code:	Detailed information on the error cause. It can vary from profile to profile; please refer to the device documentation.

Section 4 provides an error overview of the *Error_Class* and *Error_Code* parameters. These error messages are identical for all certified devices. If an error message cannot be found in Section 4, please refer to the device documents where all error messages are described for the individual services.

3.4.2 Changing the Speed Acceleration

Use the "Write" service to change the parameter data of the frequency inverter (e.g. the speed acceleration).

Syntax: **Write_Request** **00 82_{hex}**

Word 1	Command_Code	00 82_{hex}
Word 2	Parameter_Count	00 06_{hex}
Word 3	Invoke_ID | Comm._Reference	00 03_{hex}
Word 4	Index	60 48_{hex}
Word 5	Subindex | Length	00 06_{hex}
Word 6	Data [1] | ...	00 00_{hex}
Word...	... | ...	00 64_{hex}
Word...	... | Data [6]	00 01_{hex}
Bit	15 .....8 | 7..... 0	

Key:

Command_Code: Command for the service request:
0082_{hex} For "Write_Request".

Parameter_Count: Number of subsequent data words. In this case, the number of parameters depends on whether the entire object or only a part of the object is to be changed. In the example, the entire speed acceleration that consists of three user data words is to be changed. The value is therefore 0006_{hex}.

Invoke_ID: Job number in the case of parallel services (default value: 00_{hex}).

Comm._Reference: Number of the communication relationship between controller board and frequency inverter: 03_{hex}.

Index: Index assigned to the object to be changed according to the device documentation.
6048_{hex} Speed acceleration of the frequency inverter.

Subindex:	It it is possible to change either one element or the entire object in the case of objects consisting of several elements not only when reading a device parameter, but also when writing it. If only one element is to be changed the subindex assigned to that element must be indicated here. As in our example the entire object is to be changed, enter the value 00_{hex}.
Length:	Indicates the number of subsequent data bytes. In the example, the entire object is to be changed. It consists of 4 bytes "delta speed" (data type Unsigned 32) and 2 bytes "delta time" (data type Unsigned 16). The data field comprises 6 bytes, therefore the value 06_{hex}. If only "delta time" is changed, the value would be 02_{hex}. In this case, the "parameter counter" value would be 04_{hex}, the "Subindex" value 02_{hex}.
Data:	Here, the actual user data is entered - in this case, the value to be written. As the speed acceleration is to be set to 100 rpm, the user data consists of 6 bytes (3 user data words). They are entered in the ascending order of the subindexes (subindex 1, subindex 2, etc.): 4 bytes "delta speed" (00 00 00 64_{hex}) and 2 bytes "delta time" (00 01_{hex}). If only "delta time" is changed, the entry would be 00 01_{hex}.

When the frequency inverter has processed the service request, i.e. when the value has been written, the frequency inverter returns the result to your application (service confirmation "Write_Confirmation"). The service confirmation includes an identification as to whether the execution was successful.

Syntax: **Write_Confirmation** **80 82_{hex}**

Message with positive result

Word 1	Message_Code	80 82_{hex}
Word 2	Parameter_Count	00 02_{hex}
Word 3	Invoke_ID | Comm._Reference	00 03_{hex}
Word 4	Result (+)	00 00_{hex}

Message with negative result

Word 1	Message_Code	80 82_{hex}
Word 2	Parameter_Count	00 03_{hex}
Word 3	Invoke_ID | Comm._Reference	00 03_{hex}
Word 4	Error_Class | Error_Code	06 07_{hex}
Word 5	Additional_Code	00 00_{hex}

Bit	15 8	7..... 0

Key:

Message_Code:	8082_{hex}	Message code for the service confirmation.
Parameter_Count:	0002_{hex}	Number of subsequent words.
Invoke_ID:	00_{hex}	Job number for parallel services (default value).
Comm._Reference:	03_{hex}	Number of the communication relationship between controller board and frequency inverter.
Result (+):	0000_{hex}	Indicates a positive result.

Error_Class/Code: Error cause. For example, *Error_Class* = 06_{hex} with *Error_Code* = 05_{hex} means that a parameter was indicated with an inadmissible value.

Additional_Code: Detailed information on the error cause. It can vary from profile to profile; please refer to the device documentation. In the DRIVECOM Power Transmission Profile 21, the *Additional_Code* = 12 means that the "Data" parameter is too long, e.g. if seven bytes instead of six bytes are to be written to the object.

Section 4 provides an error overview of the *Error_Class* and *Error_Code* parameters. These error messages are identical for all certified devices. If an error message cannot be found in Section 4, please refer to the device documents where all error messages are described for the individual services.

3.5 Aborting the Connection

An existing communication connection should be aborted when quitting the application program or a reset is carried out on the controller board. If, in these cases, the connection is not aborted, there might be an abort message when the user program is restarted. This abort message indicates that the connection to the remote device was still established.

As long as the bus is running, communication connections do not have to be aborted.

After an error, an automatic connection abort initiated by the bus system can be carried out. In this case, an "Abort ID" and "Reason Code" will be put out informing about the cause of the connection abort (see Section 4.1).

If you want to abort a connection yourself, use the "Abort" service. It is one of the unconfirmed services, i.e., no abort confirmation is sent back. This service is called with the service request "Abort_Request".

Syntax: **Abort_Request** **08 $8D_{hex}$**

Word 1	Command_Code		08 $8D_{hex}$
Word 2	Parameter_Count		00 02_{hex}
Word 3	–	Comm._Reference	00 03_{hex}
Word 4	Reason_Code	Abort_Detail_Length	00 00_{hex}

Bit	15 8	7..... 0

Key:

Command_Code:	$088D_{hex}$	Command code for the service request.
Parameter_Count:	0002_{hex}	Number of subsequent words.
Comm._Reference:		Communication reference between controller board and frequency inverter (here: 03_{hex}).
Reason_Code:		Cause for the connection abort (default = 00_{hex}).
Abort_Detail_Length:		Not used (00_{hex}).

3.6 Changing Default Communication References

The communication references (CR) for individual communication devices are automatically assigned according to their sequence within the physical bus configuration. If you change or expand the system, the bus configuration and possibly the communication references of already existing devices will change since they are now installed at another position. In this case, you must change the communication references for these devices in the application program. To avoid this extra work, it is possible to change the automatically assigned communication references.

In the example configuration, an additional communication device as well as an additional I/O module are connected to the bus between the V.24 module and the frequency converter. The frequency inverter is automatically assigned the CR 04_{hex}, the new device the CR 03_{hex}.

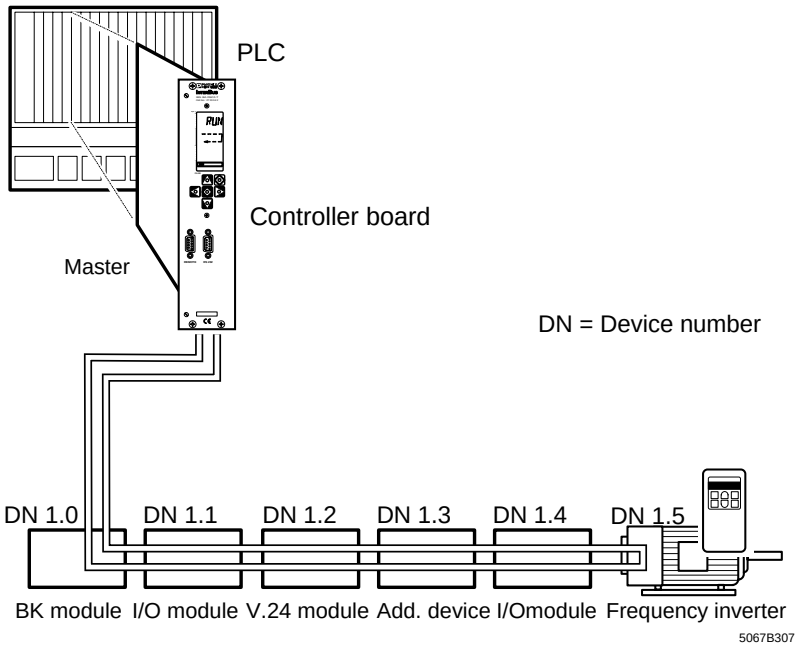


Figure 3-7 Expanded configuration example

To change the default communication references, it can be determined that the frequency inverter retains CR 03_{hex} and the new device is assigned CR 04_{hex}.

For this, use the "Load_CRL_Attribute_Loc" service. On transmitting the service, the new communication references of all communication devices are transmitted to the controller board, i.e., the logical addresses of the communication devices within the INTERBUS system are transmitted.

The "Load_CRL_Attribute_Loc" service do not belong to the PMS scope, but to the services of the Peripherals Network Management 7 (PNM7).

Syntax: **Load_CRL_Attribute_Loc_Request** **02 64_{hex}**

Word 1	Command_Code	02 64_{hex}
Word 2	Parameter_Count	00 06_{hex}
Word 3	Attribute_Code	00 02_{hex}
Word 4	Entry_Count	00 02_{hex}
Word 5	Communication_Reference	00 03_{hex}
Word 6	Attribute_Value	01 05_{hex}
Word 7	Communication_Reference	00 04_{hex}
Word 8	Attribute_Value	01 03_{hex}

Bit	15 0

Key:

Command_Code: 02 64_{hex} Command code for the service request.

Parameter_Count: Number of subsequent parameters (here 6 data words).

Attribute_Code: Code for the parameter to be changed. Enter: 0002_{hex} For the communication reference.

Entry_Count: The *Entry_Count* parameter is 0002_{hex}, as two list entries are to be entered.

Comm._Reference: The communication reference of the additional module is to be changed to 0004_{hex}, the communication reference of the frequency inverter to 0003_{hex}.

Attribute_Value: To enable the controller board to assign a corresponding communication reference to each device, the device number must also be entered (here: 0105_{hex} for CR 03_{hex} and 0103_{hex} for CR 04_{hex}).

Section 4

This section provides information on

- error messages of the PCP communication as well as
- error causes and removal

4 Communication Error Messages

If a service cannot be carried out as planned, an internal error message is generated.

There are three different groups of error messages:

– Error messages that occur in connection with a connection abort. Internally, an "Abort" service is transmitted (Abort_Indication).
– Error messages resulting from the rejection of the transmitted service via the "Reject" service (Reject_Indication).
– Error messages after transmission of confirmed services that cannot be executed.

In all cases, information will be given on the error cause by parameter values of the service confirmation or indication. This allows to evaluate and remove the error.

When using the IBS CMD SWT G4 software for communication and the direct command execution (see Section 5), the error message will immediately be displayed on the screen. Otherwise, the error message is entered in a data area (e.g., data block) on the host system that can be evaluated in the application program.

This section provides an overview of all possible parameter values of the error messages from the above-mentioned three groups, information on their causes and how to remove the error.

4.1 Error Messages of the Abort Service after Connection Abort

If an already existing connection is aborted internally by the "Abort" service due to an error, the cause of the abort is indicated by several parameters.

4.1.1 Structure of an Abort Service

Syntax: **Abort_Indication**

			Example:
Word 1	Command_Code		48 $8D_{hex}$
Word 2	Parameter_Count		00 03_{hex}
Word 3	—	Comm._Reference	00 03_{hex}
Word 4	Locally_Generated	Abort_Identifier (ID)	FF 01_{hex}
Word 5	Reason_Code	Abort_Detail_Length	02 00_{hex}
...	Abort_Detail (1)	...	—
Word n	...	Abort_Detail (n)	—

Bit	15 8	7 0

Key:

Command_Code	"Abort_Indication" service primitive.
Parameter_Count	Number of following words.
Comm._Reference	Communication reference between controller board and remote device.
Locally_Generated	Indicates whether the error was detected on the local or remote device. 00_{hex} Detected on the remote device. FF_{hex} Detected on the local device.
Abort_ID/Reason_Code	Indicate the error cause. In the example: "Inadmissible/faulty service received". The possible values are described in the listing of the "Abort_Identifier (ID) and Reason_Code" messages. With *Abort_ID* = 00_{hex}, the application program generates the connection abort.

Abort_Detail_Length	Number of following Abort_Detail words.
Abort_Detail	00_{hex} Not indicated. 03_{hex} Error occurred during transmission. Please refer to the device documentation for the meanings of other values.

4.1.2 Meanings of Error Messages in the *Abort_Identifier* (ID) and *Reason_Code* Parameters

The following overview includes all error codes in the *Abort_ID* | *Reason_Code* parameters and indicates measures for error removal.

00_{hex} | 01_{hex} (Disconnect)

Meaning: The application program of the PCP device disconnected the connection.

Cause: —

Remedy: Please inform the manufacturer of the PCP device.

01_{hex} | 01_{hex} (CRL Error)

Meaning: Incorrect CRL entry.

Cause: The control system transmitted the service request "Initiate_Request" but the CRL for the device does not exist yet or the CR is not assigned to a device.

Remedy: Check the CR entries in CRL.

01_{hex} | 02_{hex} (User Error)

Meaning: The PCP device received an inadmissible or faulty service.

Cause: 1st possibility: The connection was already established. You tried to establish the connection a second time with the service request "Initiate_Request". This caused the connection abort.

2nd possibility: You transmitted a service without first establishing the connection.

Remedy: 1st possibility: Re-establish the connection.

2nd possibility: Establish the connection and transmit the service again.

01_{hex} / 03_{hex} ... 09_{hex}, 10_{hex} (System Error)

Meaning: Error on the PCP device.

Cause: —

Remedy: Inform the manufacturer of the PCP device.

01_{hex} | 13_{hex} (No CRL Available)

Meaning: No CRL available.

Cause:
- A CRL was not yet loaded.
- An existing connection was aborted as you reloaded the CRL.

Remedy: Configure a CRL and establish the connection again.

02_{hex} | 00_{hex} (LLI Context Check Fail)

Meaning: The connection parameters between your controller board and the PCP device are incompatible.

Cause: On the device, the number of parallel services or the connection monitoring is configured differently from the controller board.

Remedy: Correct the corresponding parameters in the CRL of the controller board.

02_{hex} | 01_{hex} (Invalid LLI PDU)

Meaning: Inadmissible service in the connection establishment/abort phase.

Cause: The device received a PCP service (e.g., Read or Write) although the connection was not established.

Remedy: Establish the connection.

02_{hex} | 02_{hex} (Invalid LLI PDU)

Meaning: Inadmissible service in the data transfer phase.

Cause: You switched off the control system without first aborting the connection. Therefore, there was still a connection to the communication partner. A new connection establishment with the "Initiate" service failed. The connection was aborted.

Remedy: Re-establish the connection with the "Initiate" service.

02_{hex} | 08_{hex} (Local Error)

Meaning: System error.

Cause: —

Remedy: Inform the manufacturer of the PCP device.

02_{hex} | 09_{hex} (Associate Timeout)

Meaning: The timeout for the connection establishment has expired.

Cause: 1st possibility: Defective device.

2nd possibility: INTERBUS inactive.

Remedy: 1st possibility: Exchange device.

2nd possibility: Set INTERBUS to the RUN state.

02_{hex} / 11_{hex} (Invalid LLI PDU)

Meaning: Invalid service during the connection abort phase.

Cause: You attempted to re-establish the connection during a connection abort.

Remedy: Wait approx. 30 to 100 ms before a new connection establishment. (The timeout depends on the number of INTERBUS modules.)

02_{hex} / 12_{hex}, 14_{hex} (Invalid LLI PDU)

Meaning: System error.

Cause: —

Remedy: Inform the manufacturer of the PCP device.

03_{hex} | 02_{hex} (Remote Resource)

Meaning: The receive buffer on the PCP device is full.

Cause: The PCP device does not respond or exist.

Remedy: Check the remote address in the CRL.

03_{hex} | 11_{hex} (PDL Timeout)

Meaning: The internal communication confirmation was not received within the time-out.

Cause: The PCP device could be defective.

Remedy: Inform the manufacturer of the PCP device.

03_{hex} | 12_{hex} (PDL Disconnect)

Meaning: Multiple error during error transmission.

Cause: Unsuccessful synchronization of PCP devices.

Remedy: Repeat the service after approx. 30 to 100 ms. (The timeout depends on the number of INTERBUS modules.) If the error occurs several times, there will be a system error. In this case, inform the manufacturer.

03_{hex} / 14_{hex}, 15_{hex} (PDL Invalid)

Meaning: System error.

Cause: —

Remedy: Inform the manufacturer of the PCP device.

03_{hex} | 20_{hex} (PDL Cycle Error)

Meaning: Serious bus error.

Cause: —

Remedy: Check the cabling. Ensure the fail-safety of the bus (see Installation Manual).

4.2 Error Messages of the Reject Service

The Reject_Code indicates why the PDU (message) was rejected.

4.2.1 Structure of the Reject Service

Syntax: **Reject_Indication**

			Example:
Word 1	Message_Code		48 $8E_{hex}$
Word 2	Parameter_Count		00 03_{hex}
Word 3	—	Comm._Reference	00 05_{hex}
Word 4	Detected_Here	Original_Invoke_ID	FF 00_{hex}
Word 5	Reject_PDU_Type	Reject_Code	01 02_{hex}
Bit	15 8	7 0	

Key:

Message_Code: "Reject_Indication" service primitive.

Parameter_Count: Number of following words.

Comm._Reference: Communication reference between controller board and remote devices.

Detected_Here: Indicates whether the error was detected on the local or remote device.

- 00_{hex} An error (Reject_PDU Type 2) occurs on the server during service response and the maximum message length has been exceeded (Reject_Code 5).
- FF_{hex} The error was detected by the local device (the controller board).

Original_Invoke_ID: Invoke_ID of the rejected PDU.

Reject_PDU_Type: Type of the rejected PDU. The following types are differentiated:

- 01_{hex} Confirmed Request PDU: Error within the service request of a confirmed service.
- 02_{hex} Confirmed Response PDU: Error within the service response of a confirmed service.

	03_{hex} Unconfirmed PDU: error in the service request of an unconfirmed service.
	04_{hex} Not recognized PDU type.
Reject_Code:	The possible values of this parameter are described in Section 4.2.2 "Meanings of Error Messages in the Reject_Code Parameter".

4.2.2 Meanings of Error Messages in the *Reject_Code* Parameter

The following overview includes all error codes in the *Reject_Code* parameter and indicates measures for error removal.

01_{hex} (Invoke_ID Exists)

Meaning: The Invoke_ID already exists.

Cause: A parallel service was transmitted with the same Invoke_ID.

Remedy: Use a free Invoke_ID.

02_{hex} (Max. Services Overflow)

Meaning: Too many service requests have been transmitted to a device.

Cause: A second service request was transmitted to a device prior to the service confirmation of the first service request. It is also possible that a CR was assigned twice.

Remedy: After receiving the confirmation, send the service request again.

Check if the CR exists several times.

03_{hex} (Service Not Supported Connection-Oriented)

Meaning: The service is not supported as a client.

Cause: A service was used in the application program that is not configured within the CRL.

Remedy: Add the service via the "Load_CRL_Attribute_Loc" service to the supported client services.

05_{hex} (PDU Size)

Meaning: The maximum message length (PDU size) was exceeded.

Cause: You either sent the "Write" or "Write_With_Name" service. However, the service used has too much data for the PCP device.

Remedy: Check the length parameter in the object description of the device.

07_{hex} (Max. Unconfirmed Services Overflow)

Meaning: The maximum number of confirmed services was exceeded.

Cause: The first service sent is not yet processed internally (only in the case of unconfirmed services).

Remedy: Send the service again.

4.3 Descriptions of Service-Specific Error Messages

In PCP versions 2.0 and above, the same service is generated for positive and negative messages. To check whether it is a positive or negative message, the fourth word of the message must be evaluated. If it is unequal to zero, an error has occurred, i.e. an error message was returned. If the parameter is equal to zero, there is a positive message.

4.3.1 Example: Structure of the Read Service (Service Confirmation) with Negative Result

Syntax: **Read_Confirmation** Example:

Word 1	Message_Code		80 81_{hex}
Word 2	Parameter_Count		00 03_{hex}
Word 3	Invoke_ID	Comm._Reference	00 04_{hex}
Word 4	Error_Class	Error_Code	06 05_{hex}
Word 5	Additional_Code		00 00_{hex}

Bit	15 8	7 0

Key:

Message_Code:	Code of the service confirmation.
Parameter_Count:	Number of following words.
Invoke_ID:	Job number for parallel services. Default value: $00_{hex.}$
Comm._Reference:	Communication relationship between controller board and remote device.
Error_Class :	Error type.
Error_Code:	Specification within the error type. If one or both parameters are unequal to 0, an error occurred.
Additional_Code:	Provides additional manufacturer-specific information on the error cause (see device manual).

4.3.2 Meanings of Error Messages in the *Error_Class* and *Error_Code* Parameters

The following overview includes all error codes within the *Error_Code* | *Error_Class* parameters and informs about measures for error removal.

00_{hex} | 01_{hex} (Max. PDU Size Insufficient)

Meaning: The sizes of the send and receive buffer of both communication devices do not match.

Cause: —

Remedy: Adapt the buffer sizes of the controller board to that of the communication partner via the "Load_CRL_Attribute_Loc_Request" service.

00_{hex} | 02_{hex} (Feature Not Supported)

Meaning: The desired service is not supported.

Cause: The supported services of both communication devices do not match.

Remedy: Change the supported services of the controller board with the "Load_CRL_Attribute_Loc" service.

00_{hex} | 04_{hex} (User Initiate Denied)

Meaning: This error message is manufacturer-specific.

Cause: —

Remedy: Refer to the device documentation.

05_{hex} | 01_{hex} (State Conflict)

Meaning: A start or stop command has been transmitted twice.

Cause: The error only occurs during the "Start" or "Stop" service: As the start or stop has already been executed, the service cannot be executed again.

Remedy: No measure necessary.

05_{hex} | 05_{hex} (Service Parameter)

Meaning: In the case of the Access_Specification parameter, an inadmissible value was indicated or access was carried out with a name that was too long.

Cause: The error only occurs in the case of the Get_OD service.

Remedy: Refer to the device documentation for valid values and send the service again.

06_{hex} | 02_{hex} (Hardware Fault)

Meaning: Access to the object has failed due to a hardware fault.

Cause: For example: missing I/O voltage.

Remedy: Remove the hardware fault.

06_{hex} | 03_{hex} (Object Access Denied)

Meaning: The object has limited access rights.

Cause: Possibly the object can only be read but not written to or it is password-protected.

Remedy: Refer to the object description for access rights.

06_{hex} | 05_{hex} (Object Attribute Inconsistent)

Meaning: A service parameter was indicated with an inadmissible value.

Cause: For example: a false length indication or an inadmissible subindex.

Remedy: Check the parameters by means of the object description and send the service again with the corrected values.

06_{hex} | 06_{hex} (Object Access Unsupported)

Meaning: The service used cannot be applied to this object.

Cause: Example: a program sequence can be started or stopped but not read.

Remedy: Refer to the object description for services that are admissible for this object.

06_{hex} | 07_{hex} (Object Non-Existent)

Meaning: The object does not exist.

Cause: Probably the "Index" parameter has a wrong value.

Remedy: Check the object index by means of the object description and send the service again.

08_{hex} | 00_{hex} (Application Error)

Meaning: Device-specific error message; no communication error.

Cause: —

Remedy: Please refer to the device documentation.

09_{hex} | xx_{hex} (Firmware Error)

Meaning: For the description of this error message, please refer to the general INTERBUS documentation "Firmware Services and Error Messages". In the Section "Error Codes for User Errors", all error codes of the error class 09_{hex} are indicated under the code $09xx_{hex.}$

Cause: —

Remedy: Please refer to the device documentation.

Section 5

This section provides information on

– application possibilities of the IBS CMD SWT software
– the startup and text of PCP communication

5 PCP Operation with IBS CMD SWT G4 Software

The IBS CMD G4 program offers a user-friendly INTERBUS user interface for INTERBUS controller boards with PLCs and industrial computers or IBM-compatible PCs. To operate IBS CMD G4, only a few host-specific information is required.

PCP commands can be used in three ways:

1. By a PLC when using corresponding functions.
2. In C the high-level programming language for the PC.
3. Via the IBS CMD G4 software during the configuration phase and for diagnostics.

This manual does not refer to any special hardware. The operation of the C and PLC software interface is described in the respective manuals. This section describes how PCP operates with the IBS CMD G4 software tool. For detailed IBS CMD G4 operational notes, please refer to the corresponding user documentation.

Selecting the controller board

Start IBS CMD G4. First create a new project. Then, set the type of your controller board.

To activate the context menu, mark the "Controller Board" icon by clicking it with the left mouse button. Thereafter, click the right mouse button.

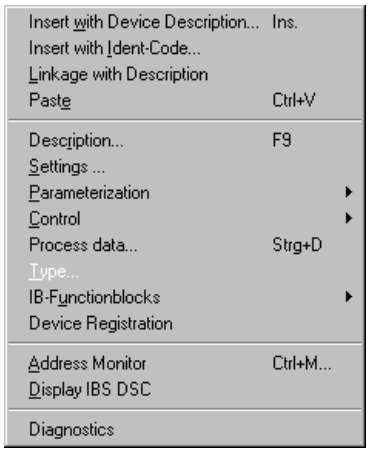


Figure 5-1 Context menu

Then, you can select the "Type" menu. Select the corresponding controller board.

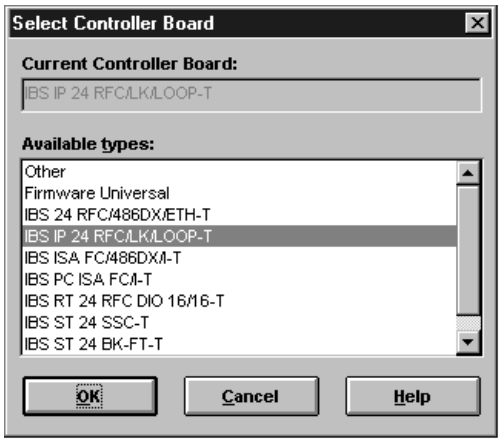


Figure 5-2 Selecting the controller board

Reading in the bus configuration

Mark the "Configuration Frame" icon with the left mouse button. Activate the context menu with the right mouse button and select the "Read Again" menu option. The connected bus configuration will be illustrated on the screen.

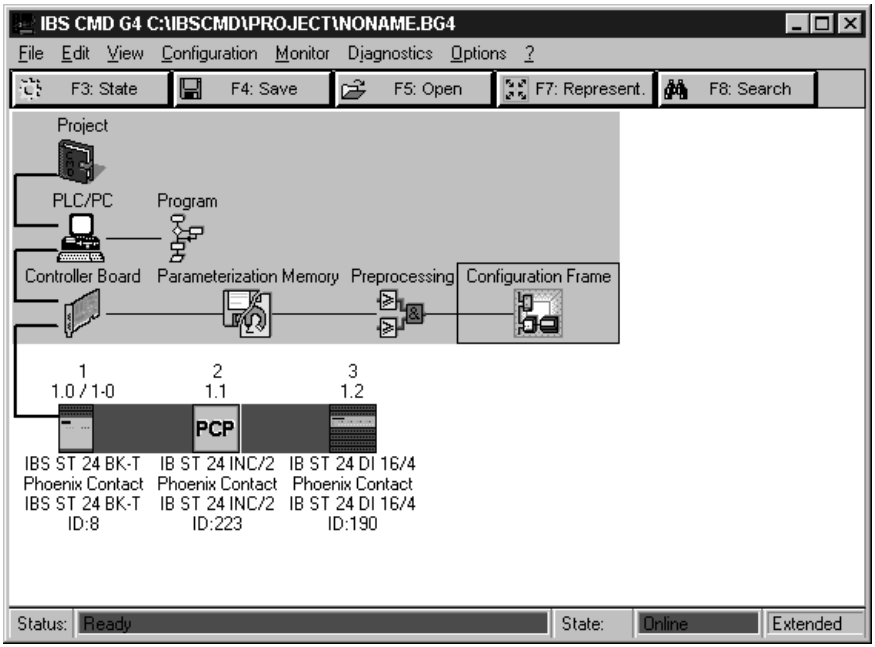


Figure 5-3 Reading in the bus configuration

Starting data transmission

Mark the "Controller Board" icon with the left mouse button and activate the context menu with the right mouse button.

Select the "Control" menu. Start data transmission on the bus with "Start data transmission".

Sending PCP commands

Mark the "Controller Board" icon with the left mouse button and activate the context menu with the right mouse button.

Select the "Control" menu with the left mouse button. Select "Other" to activate the action editor.

With the left mouse button click on the arrow symbol beside the "Name" selection field. Another dialog box opens where you can select your service:

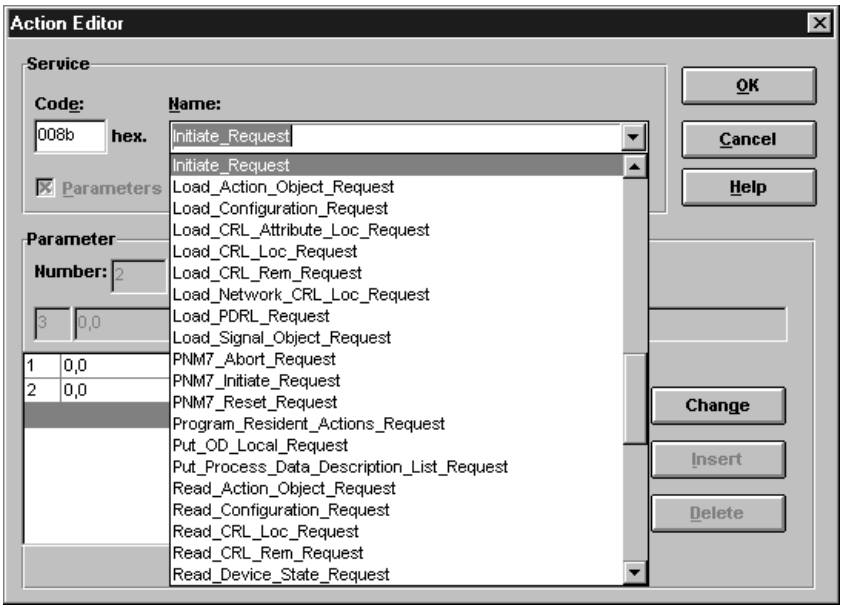


Figure 5-4 Selecting the service

To select the required service, click the left mouse button. Of course, it is also possible to select the service by entering the corresponding service code.

Entering parameters

After selecting the desired service (here: "Initiate" service to establish a communication connection) you must enter the service parameters. Please take care that IBS CMD G4 accepts the entry of the parameter counter. Thus, you must only enter the parameters (e.g., CR, password, etc.) in the bottom part of the dialog box. For the bus configuration indicated, the "Initiate" service will be as follows:

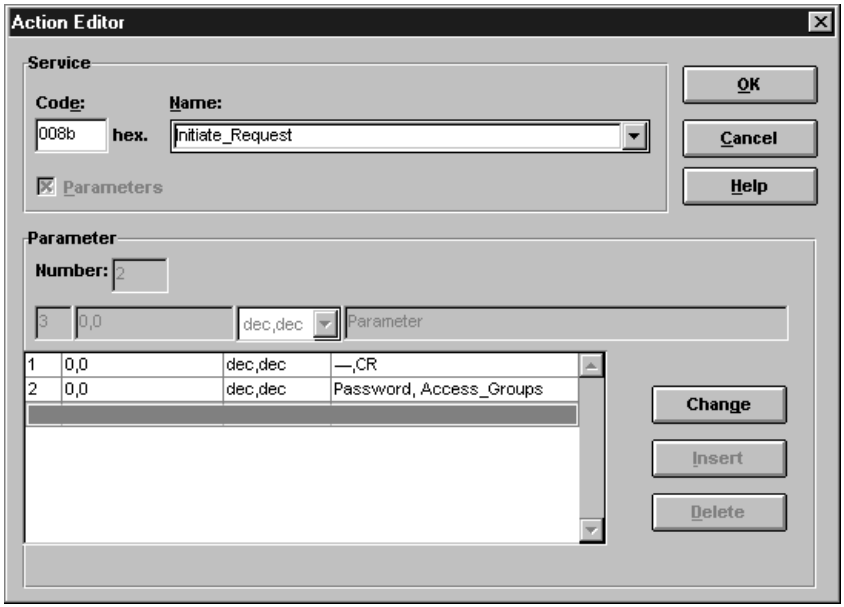


Figure 5-5 Action editor

To send the service, click on "OK" with the left mouse button.

Changing device settings

To change the settings of a PCP device, send the "Write" service. For this, proceed in the same as way as if sending the "Initiate" service. The "Action Editor" dialog box is as follows:

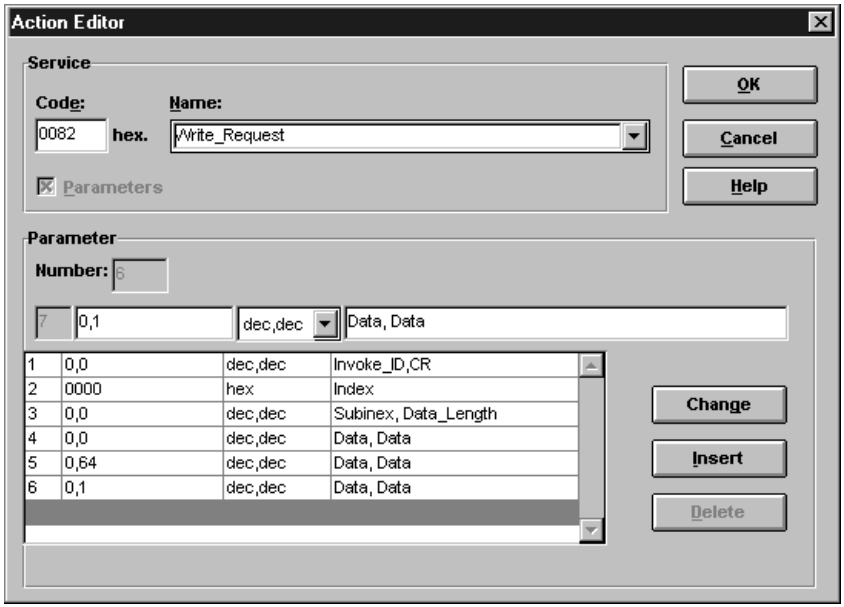


Figure 5-6 Changing the settings of a PCP device

Now you can send other services such as "Read", "Write", ...

Aborting the PCP connection

Terminate the connection to a PCP device by sending the "Abort" service.

Section 6

This section provides information on the

– functionality of PCP services
– call syntax by means of examples

6 Description of Communication Services

6.1 Overview of PCP Services

Table 6-1 Table of commands and messages

Code	Services	Page
00 81_{hex}	Read_Request	6-13
40 81_{hex}	Read_Indication	6-16
C0 81_{hex}	Read_Response	6-17
80 81_{hex}	Read_Confirmation	6-14
00 82_{hex}	Write_Request	6-19
40 82_{hex}	Write_Indication	6-22
C0 82_{hex}	Write_Response	6-23
80 82_{hex}	Write_Confirmation	6-21
00 83_{hex}	Start_Request	6-24
40 83_{hex}	Start_Indication	6-26
C0 83_{hex}	Start_Response	6-27
80 83_{hex}	Start_Confirmation	6-25
00 84_{hex}	Stop_Request	6-29
40 84_{hex}	Stop_Indication	6-31
C0 84_{hex}	Stop_Response	6-32
80 84_{hex}	Stop_Confirmation	6-30
08 85_{hex}	Information_Report_Request	6-105
48 85_{hex}	Information_Report_Indication	6-106
00 86_{hex}	Status_Request	6-98
80 86_{hex}	Status_Confirmation	6-99
00 87_{hex}	Identify_Request	6-101
80 87_{hex}	Identify_Confirmation	6-102
00 88_{hex}	Get_OD_Request	6-95
80 88_{hex}	Get_OD_Confirmation	6-96
00 89_{hex}	Resume_Request	6-34
40 89_{hex}	Resume_Indication	6-36
C0 89_{hex}	Resume_Response	6-37
80 89_{hex}	Resume_Confirmation	6-35

Table 6-1 Table of commands and messages

Code	Services	Page
00 $8A_{hex}$	Reset_Request	6-38
40 $8A_{hex}$	Reset_Indication	6-40
C0 $8A_{hex}$	Reset_Response	6-41
80 $8A_{hex}$	Reset_Confirmation	6-39
00 $8B_{hex}$	Initiate_Request	6-7
40 $8B_{hex}$	Initiate_Indication	6-11
C0 $8B_{hex}$	Initiate_Response	6-12
80 $8B_{hex}$	Initiate_Confirmation	6-8
08 $8D_{hex}$	Abort_Request	6-107
48 $8D_{hex}$	Abort_Indication	6-108
48 $8E_{hex}$	Reject_Indication	6-109
00 90_{hex}	Initiate_Download_Sequence	6-55
40 90_{hex}	Initiate_Download_Sequence	6-57
00 90_{hex}	Initiate_Download_Sequence	6-58
80 90_{hex}	Initiate_Download_Sequence	6-58
00 91_{hex}	Download_Segment	6-60
40 91_{hex}	Download_Segment	6-62
00 91_{hex}	Download_Segment	6-64
80 91_{hex}	Download_Segment	6-64
00 92_{hex}	Terminate_Download_Sequence	6-66
40 92_{hex}	Terminate_Download_Sequence	6-68
00 92_{hex}	Terminate_Download_Sequence	6-70
80 92_{hex}	Terminate_Download_Sequence	6-70
00 93_{hex}	Initiate_Upload_Sequence	6-72
40 93_{hex}	Initiate_Upload_Sequence	6-74
00 93_{hex}	Initiate_Upload_Sequence	6-75
80 93_{hex}	Initiate_Upload_Sequence	6-73
00 94_{hex}	Upload_Segment	6-77
40 94_{hex}	Upload_Segment	6-79
00 94_{hex}	Upload_Segment	6-81
80 94_{hex}	Upload_Segment	6-78

Table 6-1 Table of commands and messages

Code	Services	Page
00 95_{hex}	Terminate_Upload_Sequence	6-83
40 95_{hex}	Terminate_Upload_Sequence	6-85
00 95_{hex}	Terminate_Upload_Sequence	6-87
80 95_{hex}	Terminate_Upload_Sequence	6-84
00 96_{hex}	Request_Domain_Upload_Request	6-88
40 96_{hex}	Request_Domain_Upload_Indication	6-91
C0 96_{hex}	Request_Domain_Upload_Response	6-92
80 96_{hex}	Request_Domain_Upload_Confirmation	6-89
00 97_{hex}	Write_With_Name_Request	6-47
40 97_{hex}	Write_With_Name_Indication	6-49
C0 97_{hex}	Write_With_Name_Response	6-50
80 97_{hex}	Write_With_Name_Confirmation	6-48
00 98_{hex}	Read_With_Name_Request	6-42
40 98_{hex}	Read_With_Name_Indication	6-44
C0 98_{hex}	Read_With_Name_Response	6-45
80 98_{hex}	Read_With_Name_Confirmation	6-43
00 $A0_{hex}$	PNM7_Initiate_Request	6-115
80 $A0_{hex}$	PNM7_Initiate_Confirmation	6-116
08 $A1_{hex}$	PNM7_Abort_Request	6-123
48 $A1_{hex}$	PNM7_Abort_Indication	6-124
00 $C1_{hex}$	Service_Execution_Remote_Request	6-118
80 $C1_{hex}$	Service_Execution_Remote_Confirmation	6-122
02 64_{hex}	Load_CRL_Attribute_Loc_Request	6-113
82 64_{hex}	Load_CRL_Attribute_Loc_Confirmation	6-114

6.2 PCP Services with All Four Service Primitives

The PCP services allow to

– establish a connection (Initiate)

– read and write parameter values (Read and Write)

– start and stop application programs of remote devices (Start, Stop, Reset, and Resume).

In this section, every PCP service is described with its four service primitives. The services of this group are most frequently used for communication.

6.2.1 *Initiate* Service

Task:

The "Initiate" service establishes a connection between two communication partners. During connection establishment the settings on both devices are checked for consistency, i.e., send and receive buffer sizes and supported services.

Syntax:

Initiate_Request **$008B_{hex}$**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Password	Access_Groups

Bit	15 8	7 0

Key:

Command_Code: $008B_{hex}$ Command code of the service request.

Parameter_Count: 0002_{hex} Number of subsequent words.

Comm._Reference: $00xx_{hex}$ Communication reference between controller board and remote device.

Password: Password defined to access device objects. Please refer to the device documentation for the password. In some profiles, there are no passwords provided. In this case, use the value 00_{hex}.

Access_Groups: Manufacturer-specific assignment of the controller board to an access group. In some profiles, there are no access groups provided. In this case, use the value 00_{hex}.

Syntax: **Initiate_Confirmation** **$808B_{hex}$**

Positive message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	—	Comm._Reference
Word 4	Result (+)	
Word 5	Version	
Word 6	Profile	
Word 7	Protection	Password
Word 8	Access_Groups	–

Negative message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	—	Communication_Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Codes	
Word 6	Send_Buffer_Size	
Word 7	Receive_Buffer_Size	
Word 8	Services_Supported [1]	Services_Supported [2]
Word 9	Services_Supported [3]	Services_Supported [4]
Word 10	Services_Supported [5]	Services_Supported [6]

Bit	15 8	7 0

Key:

Message_Code: $808B_{hex}$ Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0006_{hex} Positive message.
0008_{hex} Negative message.

Communication_Reference:
$00xx_{hex}$ Communication reference between controller board and remote device.

Result (+): 0000_{hex} Indicates a positive result.

Version: Version number of the object dictionary with two bytes. It is device-specific and read out by the system from the object dictionary, e.g., 0000_{hex}.

Profile: Identification of the device profile, i.e., the number of the application-specific profile is indicated ($xxxx_{hex}$).

Protection: Contains the "Access_Protection_Supported" attribute from the device documentation. This parameter indicates whether the access rights are checked when accessing device objects.
FF_{hex} Access rights are checked (true).
00_{hex} Access rights are not checked (false).

Password: It is manufacturer-specific but generally not used. In this case, the "Password" parameter has the value 00_{hex}.

Access_Groups: Manufacturer-specific assignment of the controller board to an access group. In some profiles, there are no access groups provided. In this case, the "Access_ Groups" parameter has the value 00_{hex}.

Error_Class: 00_{hex} Contains the error class classification of the "Initiate" service.

Error_Code: Specifies the error:
01_{hex} The send and receive buffers of both devices do not match in size.
02_{hex} The supported services of both devices do not match.
04_{hex} The service is rejected by the application program; the error cause is manufacturer-specific.

Additional_Code: Manufacturer-specific information on the error cause:
$xxxx_{hex}$ Please refer to the device documentation. The device may not be ready for operation.
0000_{hex} If the "Error_Code" parameter contains the error codes 01_{hex} or 02_{hex}.

Send_Buffer_Size / Receive_Buffer_Size:
: Buffer sizes (send/receive buffer) of the remote device. Bits 15 ... 8 of the parameters are not supported.

Services_Supported:
: Coding of the supported services that can be processed by the remote device. The coding is always carried out in 6 bytes (see Section 4.3 "Systematics of Supported User Services" on Page 2-14).

Syntax: **Initiate_Indication** **$408B_{hex}$**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	—	Comm._Reference
Word 4	Version	
Word 5	Profile	
Word 6	Protection	Password
Word 7	Access_Groups	–
Bit	15 8	7 0

Key:

Message_Code: $408B_{hex}$ Message code of the service input.

Parameter_Count: Number of subsequent words (0004_{hex}).

Comm._Reference: Communication reference between controller board and remote device ($00xx_{hex}$).

Version: Version number of the object dictionary with two bytes. It is device-specific and read out by the system from the object dictionary, e.g., 0000_{hex}.

Profile: Identification of the device profile, i.e., the number of the application-specific profile is indicated ($xxxx_{hex}$).

Protection: Contains the "Access_Protection_Supported" attribute from the device documents. This parameter indicates whether access rights are checked when accessing device objects:
FF_{hex} Access rights are checked (true).
00_{hex} Access rights are not checked (false).

Password: It is manufacturer-specific but generally not used. In this case, the value 00_{hex} must be used.

Access_Groups: Manufacturer-specific assignment of the controller board to an access group. In some profiles, there are no access groups provided. In this case, the value 00_{hex} value.

Syntax: **Initiate_Response** **$C08B_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Result (+)	
Word 5	Access_Groups	Password

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	—	Comm._Reference
Word 4	—	Err_Code

Bit	15 8	7 0

Key:

Command_Code: $C08B_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0003_{hex} Positive response.
0002_{hex} Negative response.

Comm._Reference: Communication reference between controller board and remote device ($00xx_{hex}$).

Result (+): Indicates a positive result (0000_{hex}).

Password: Password defined to access device objects. Please refer to the device documentation for the password. In some profiles, there are no passwords provided. In this case, the value 00_{hex} must be used.

Access_Groups: Manufacturer-specific assignment of the controller board to an access group. In some profiles, there are no access groups provided. In this case, the value 00_{hex} must be used.

Error_Code: Specifies the error:
04_{hex} This service is rejected by the application program, the error cause is manufacturer-specific.

6.2.2 *Read* Service

Task:

The "Read" service allows to read out object values of a PCP device. With arrays and records, you can select if the entire object or only one element of the object is to be read out.

A "Read_Request" service request can be sent to serveral devices, one after the other, without having to wait for the service confirmations. However, a second device request must not be sent to the same device prior to the acknowledgement for the first service request was received.

Syntax: **Read_Request** **0081_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	
Word 5	Subindex	–

Bit	15 8	7 0

Key:

Command_Code:	0081_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0003_{hex}).
Invoke_ID:	Job number for parallel services (default value = 00_{hex}). These parallel services must be supported by the respective device. Please refer to the device documentation.
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index assigned to the object which is to be read out according to the device documentation. The index is the logical address of the object. Please refer to the device documentation for the index.
Subindex:	Every object element (array or record) is assigned to a subindex, i.e., a logical subaddress. Please refer to the device documentation. If the entire object is to be read out, enter the value 00_{hex}.

Syntax: **Read_Confirmation** **8081_{hex}**

Positive message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 5	–	Length
Word 6	Data (1)	
Word...	...	
Word n	Data (n)	

Negative message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8081_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive message (i.e., number of data words plus 3).
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+) 0000_{hex} Indicates a positive result.

Length: Number of subsequent data bytes. It depends on the object read out, e.g., whether only one element or the entire object was read out ($00xx_{hex}$).

Data:	Here, the actual user data is entered, i.e., the read values for the object.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Read_Indication** **4081_{hex}**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	
Word 5	Subindex	–
Bit	15..... 8	7 0

Key:

Message_Code:	4081_{hex} Message code for the service input.
Parameter_Count:	Number of subsequent words (0003_{hex}).
Invoke_ID:	Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 00_{hex}).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index assigned to the object which is to be read out according to the device documentation. The index is the logical address of the object. Please refer to the device documentation for the index ($xxxx_{hex}$).
Subindex:	Every object element (array or record) is assigned to a subindex, i.e., a logical subaddress. Please refer to the device documentation. If the entire object is to be read out, enter the value 00_{hex}.

Syntax: **Read_Response** **$C081_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 5	–	Length
Word 6	Data (1)	
Word...	...	
Word n	Data (n)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C081_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive response (number of data words plus 3).
0003_{hex} Negative response.

Invoke_ID: Job number for parallel services (default value = 0). These parallel services must be supported by the respective device. Please refer to the device documentation.

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Length: Number of subsequent data bytes. It depends on the object read out, e.g., whether an element or the entire object was read out ($00xx_{hex}$).

Data:	Here, the actual user data is entered, i.e., the read values for the object.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.2.3 *Write* Service

Task:

The "Write" service changes the set device parameters of an object. New values can be written. With arrays and records, you can select if only one element or the entire object is to be changed.

Syntax:

Write_Request **0082_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	
Word 5	Subindex	Length
Word 6	Data	
Word...	...	
Word...	...	

Bit	15 8	7 0

Key:

Command_Code:	0082_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words ($00xx_{hex}$).
Invoke_ID:	Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index assigned to the object which is to be written according to the device documentation. The index is the logical address of the object. Please refer to the device documentation for the index ($xxxx_{hex}$).
Subindex:	Every object element (array or record) is assigned to a subindex, i.e., a logical subaddress. Please refer to the device documentation. If the entire object is to be written, enter the value 00_{hex}.

Length:	Number of subsequent data bytes. It depends on the written object, e.g., whether an element or the entire object was written ($00xx_{hex}$).
Data:	Here, the actual user data is entered, i.e., the user data to be re-written for the object.

Syntax: **Write_Confirmation** **8082_{hex}**

Positive message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8082_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between the controller board and the remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Write_Indication** **4082_{hex}**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	
Word 5	Subindex	Length
Word 6	Data	
Word ..	...	

Bit	15 8	7 0

Key:

Message_Code:	4082_{hex} Message code of the service input.
Parameter_Count:	Number of subsequent words ($00xx_{hex}$).
Invoke_ID:	Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index assigned to the object which is to be written according to the device documentation. The index is the logical address of the object. Please refer to the device documentation for the index ($xxxx_{hex}$).
Subindex:	Every object element (array or record) is assigned to a subindex, i.e., a logical subaddress. Please refer to the device documentation. If the entire object is to be written, enter the value 00_{hex}.
Length:	Number of subsequent data bytes. It depends on the written object, e.g., whether an element or the entire object was written ($00xx_{hex}$).
Data:	Here, the actual user data is entered, i.e., the user data to be re-written for the object.

Syntax: **Write_Response** **$C082_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C082_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.2.4 *Start* Service

Task:

The "Start" service allows to start a program at a remote device. The program starts from the beginning after the service is called.

Syntax:

Start_Request **0083_{hex}**

Word 1	Command_Code
Word 2	Parameter_Count
Word 3	Invoke_ID | Comm._Reference
Word 4	Index

Bit	15 8	7 0

Key:

Command_Code:	0083_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Start_Confirmation** **8083_{hex}**

Positive message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	Additional_Code	PI_State

Bit	15 8	7 0

:

Message_Code: 8083_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive message.
0004_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.
PI_State:	Indicates the program state: 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state. 03_{hex} Running – The program is running. 04_{hex} Stopped – The program is stopped.

Syntax: **Start_Indication** **4083_{hex}**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	

Bit	15 8	7 0

Key:

Message_Code:	4083_{hex} Message code of the service input.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Start_Response** **$C083_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	Additional_Code	PI_State

Bit	15 8	7 0

Key:

Command_Code: $C083_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0004_{hex} Negative response.

Invoke_ID: Job number for parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.
PI_State:	Indicates the program state: 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state. 03_{hex} Running – The program is running. 04_{hex} Stopped – The program is stopped.

6.2.5 *Stop* Service

Task:

The "Stop" service brings the running program of a remote device to a halt but does not reset it to the beginning.

Syntax: **Stop_Request** **0084_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	

Bit	15 8	7 0

Key:

Command_Code:	0084_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be stopped. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Stop_Confirmation** **8084_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 6	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	PI_State	–

Bit	15 8	7 0

Key:

Message_Code: 8084_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive message.
0004_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result: 00 00 Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

PI_State: Indicates the program state:

- 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state.
- 03_{hex} Running – The program is running.
- 04_{hex} Stopped – The program is stopped.

Syntax: **Stop_Indication** **4084_{hex}**

Word 1	Message_Code
Word 2	Parameter_Count
Word 3	Invoke_ID | Comm._Reference
Word 4	Index

Bit	15 8	7 0

Key:

Message_Code: 4084_{hex} Message code of the service input.

Parameter_Count: Number of subsequent words (0002_{hex}).

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Index: Index of the program sequence to be stopped. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Stop_Response** **$C084_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	PI_State	–

Bit	15 8	7 0

Key:

Command_Code: $C084_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0004_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result: 00 00 Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.
PI_State:	Indicates the program state: 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state. 03_{hex} Running – The program is running. 04_{hex} Stopped – The program is stopped.

6.2.6 *Resume* Service

Task:

The "Resume" service restarts a program that was stopped with the "Stop" service.

Syntax:

Resume_Request **0089_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	

Bit	15 8	7 0

Key:

Command_Code:	0089_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Resume_Confirmation** **8089_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	PI_State	-

Bit	15 8	7 0

Key:

Message_Code: 8089_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive message.
0004_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.
PI_State:	Indicates the program state: 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state. 03_{hex} Running – The program is running. 04_{hex} Stopped – The program is stopped.

Syntax: **Resume_Indication** **4089_{hex}**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	

Bit	15 8	7 0

Key:

Message_Code:	4089_{hex} Message code of the service input.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Resume_Response** **$C089_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C089_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 00 00 Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.2.7 *Reset* Service

Task:

The "Reset" service resets a program to its output state. Then, it must be re-started with the "Start" service.

Syntax: **Reset_Request** **$008A_{hex}$**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Index	

Bit	15 8	7 0

Key:

Command_Code:	$008A_{hex}$ Command code of the service request.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Reset_Confirmation** **$808A_{hex}$**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 6	PI_State	–

Bit	15 8	7 0

Key:

Message_Code: $808A_{hex}$ Message code of the service confirmation.

Parameter_Count: Number of subsequent words (0002_{hex}).

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

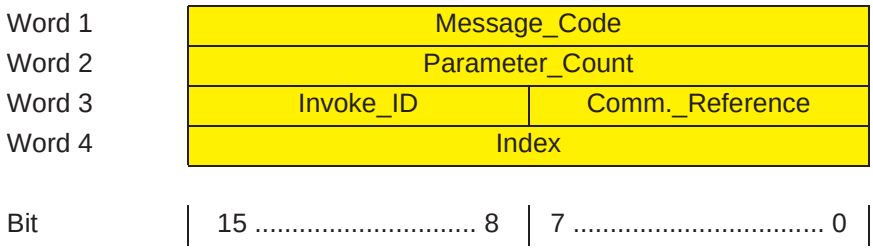
Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.
PI_State:	Indicates the program state: 02_{hex} Idle – After power up and program end the predefined program sequences change to the idle state. 03_{hex} Running – The program is running. 04_{hex} Stopped – The program is stopped.

Syntax: **Reset_Indication** **$408A_{hex}$**



Key:

Message_Code:	$408A_{hex}$ Message code of the service input.
Parameter_Count:	Number of subsequent words (0002_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Index:	Index of the program sequence to be started. The index corresponds to the logical address of the program sequence within the object dictionary. Please refer to the device documentation for the index ($xxxx_{hex}$).

Syntax: **Reset_Response** **$C08A_{hex}$**

Positive response:

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response:

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C08A_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.2.8 *Read_With_Name* Service

Task:

The "Read_With_Name" service reads out object values or data type descriptions of a PCP device, although these variables are not explicitly described in the PMS object dictionary. Addressing is carried out via the variable name only. With arrays and records, individual elements can be accessed optionally with an element name.

Syntax:

Read_With_Name_Request **0098_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Variable_Name_Length	Variable_Name (1)
...	...	Variable_Name (n)
...	Element_Name_Length	Element_Name (1)
...	...	Element_Name (n)
Word n	Access_Choice	—

Bit	15 8	7 0

Key:

Command_Code:	0098_{hex}	Command code of the service request.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Variable_Name:		Variable to be read.
Element_Name:		Element of an array / component of a structure (Record) (*Element_Name_Length* = 0, i.e., no element name).
Access_Choice:	00_{hex}	Read the variable value.
	01_{hex}	Read the data type description.

Syntax: **Read_With_Name_Confirmation** **8098_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
...	Data (1)	...
Word n	...	Data (n)

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8098_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

More_Follows: Indicates that more data is to be read from the client.

Data: Variable data / data type description of the variables.

Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Read_With_Name_Indication** **4098_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Variable_Name_Length	Variable_Name (1)
...	...	Variable_Name (n)
...	Element_Name_Length	Element_Name (1)
...	...	Element_Name (n)
Word n	Access_Choice	—

Bit	15 8	7 0

Key:

Message_Code:	4098_{hex}	Message code of the service input.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Variable_Name:		Variable to be read.
Element_Name:		Element of an array / component of a structure (Record) (*Element_Name_Length* = 0, i.e., no element name).
Access_Choice:	00_{hex}	Read the variable value.
	01_{hex}	Read the data type description.

Syntax: **Read_With_Name_Response** **$C098_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
...	Data (1)	...
Word n	...	Data (n)

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C098_{hex}$ Command code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

More_Follows: Indicates that more data is to be read from the client.

Data: Variable data / data type description of variables.

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.2.9 *Write_With_Name* Service

Task:

The "Write_With_Name" service writes values or data type descriptions to object variables, although the object is not explicitly described in the PMS object dictionary. Access is via the variable name only. With arrays and records, individual elements can be accessed optionally with an element name.

Syntax:

Write_With_Name_Request **0097_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Variable_Name_Length	Variable_Name (1)
...	...	Variable_Name (n)
...	Element_Name_Length	Element_Name (1)
...	...	Element_Name (n)
...	Access_Choice	More_Follows
...	Data_Length	Data (1)
Word n	...	Data (n)

Bit	15 8	7 0

Key:

Command_Code:	0097_{hex}	Command code of the service request.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Variable_Name:		Variable to be read.
Element_Name:		Element of an array / component of a structure (Record) (*Element_Name_Length* = 0, i.e., no element name).

Access_Choice:	00_{hex}	Read the variable value.
	01_{hex}	Read the data type description.
More_Follows:		Indicates that more data is to be read from the client.
Data		Variable data / data type description of the variables.

Syntax: **Write_With_Name_Confirmation** **8097_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code:	8087_{hex}	Message code of the service confirmation.
Parameter_Count:		Number of subsequent words:
	0002_{hex}	Positive message.
	0003_{hex}	Negative message.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex}	Indicates a positive result.

Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Write_With_Name_Indication** **4097_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Variable_Name_Length	Variable_Name (1)
...	...	Variable_Name (n)
...	Element_Name_Length	Element_Name (1)
...	...	Element_Name (n)
...	Access_Choice	More_Follows
...	Data_Length	Data (1)
Word n	...	Data (n)

Bit	15 8	7 0

Key:

Message_Code:	4097_{hex}	Message code of the service input.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Variable_Name:		Variable to be read.
Element_Name:		Element of an array / component of a structure (Record) (*Element_Name_Length* = 0, i.e., no element name).

Access_Choice:	00_{hex}	Read the variable value.
	01_{hex}	Read the data type description.
More_Follows:		Indicates that more data is to be transmitted from the client.
Data		Variable data / data type descriptions of the variables.

Syntax: **Write_With_Name_Response** **$C097_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code:	$C097_{hex}$	Command code of the service response.
Parameter_Count:		Number of subsequent words:
	0002_{hex}	Positive response.
	0003_{hex}	Negative response.
Invoke_ID:		Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:		Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex}	Indicates a positive result.

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3 Domain Management

A domain is a memory area of the PCP device consisting of either programs or data. The data type of a domain is an octet string. The maximum length of this octet string is determined in the "Domain" object description (see "Get_OD" service.

The data transmission from the client (in general the controller board) to the server (in general a PCP-capable INTERBUS device) is referred to as a download. Correspondingly, the data acceptance from the server to the client is referred to as an upload. Only one download or one upload can be carried out per domain.

Services

The following services are required to carry out a download or an upload:
- Initiate_Download_Sequence
- Download_Segment
- Terminate_Download_Sequence
- Initiate_Upload_Sequence
- Upload_Segment
- Terminate_Upload_Sequence

Download sequence
(see Figure 6-1)

The client initiates the data transfer **(1)** to the server with the "Initiate_Download_Segment" service. The server receives the index / name of the domain into which the data is to be transmitted.

Thereafter, the server becomes active and requests the data transfer from the client with the "Download_Segment" service **(2).** This service should be repeated as long as the client indicates the existence of further data with the service confirmation.

When the client has no more data, the server terminates the data transfer with the "Terminate_Download_Sequence" service **(3)**.

Upload sequence
(see Figure 6-2)

The client initiates the data transfer **(1)** from the server to the client with the "Initiate_Upload_Sequence" service. The server receives the index / name of the domain from which the data is to be transmitted.

Thereafter, the client requests the data transfer from the server with the "Upload_Segment" service **(2)**. This service should be repeated as long as the server confirms the existence of further data with the confirmation.

When the server has no more data, the client terminates the data acceptance with the "Terminate_Upload_Sequence" service **(3)**.

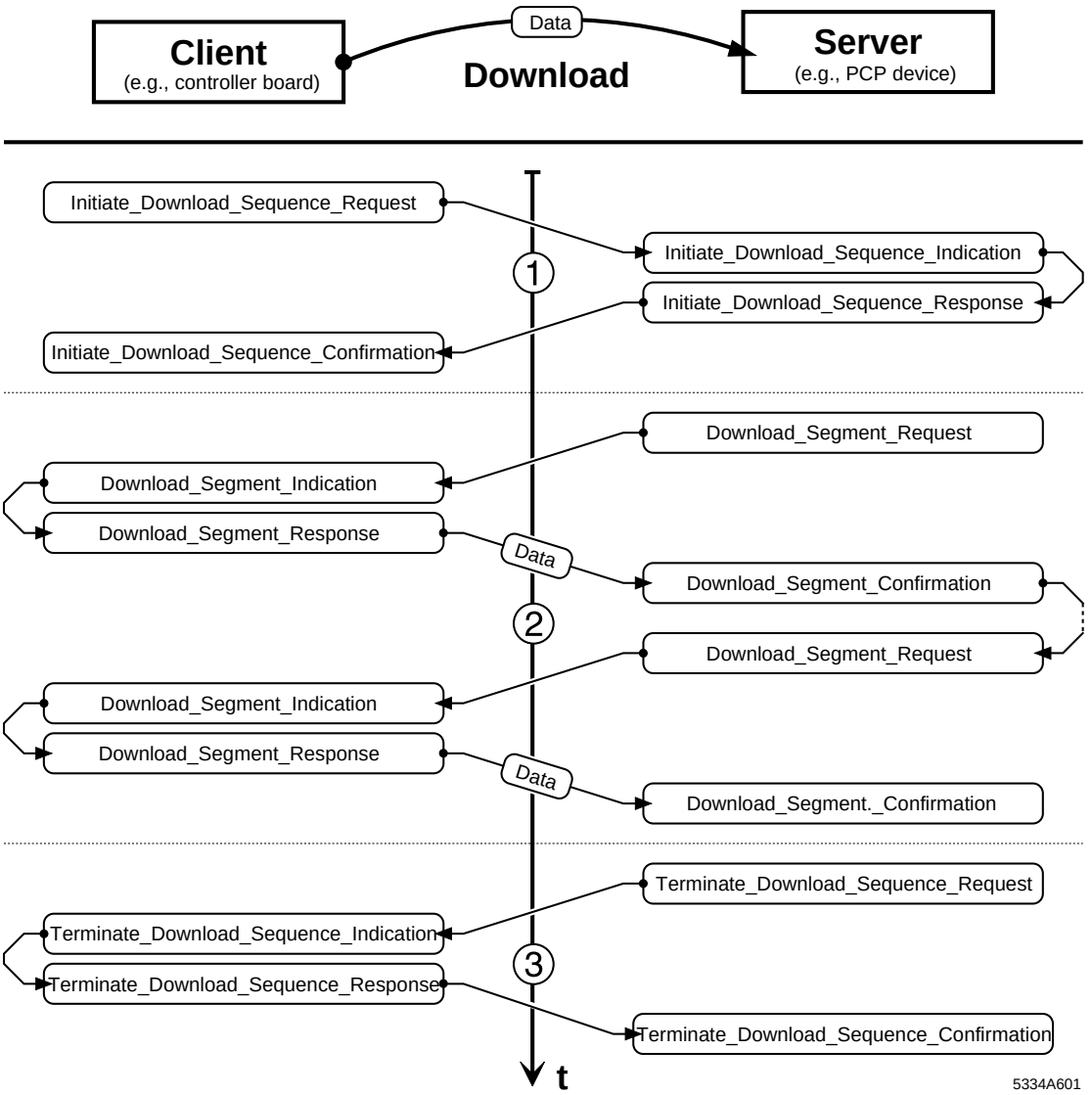


Figure 6-1 Data download into a domain (flowchart)

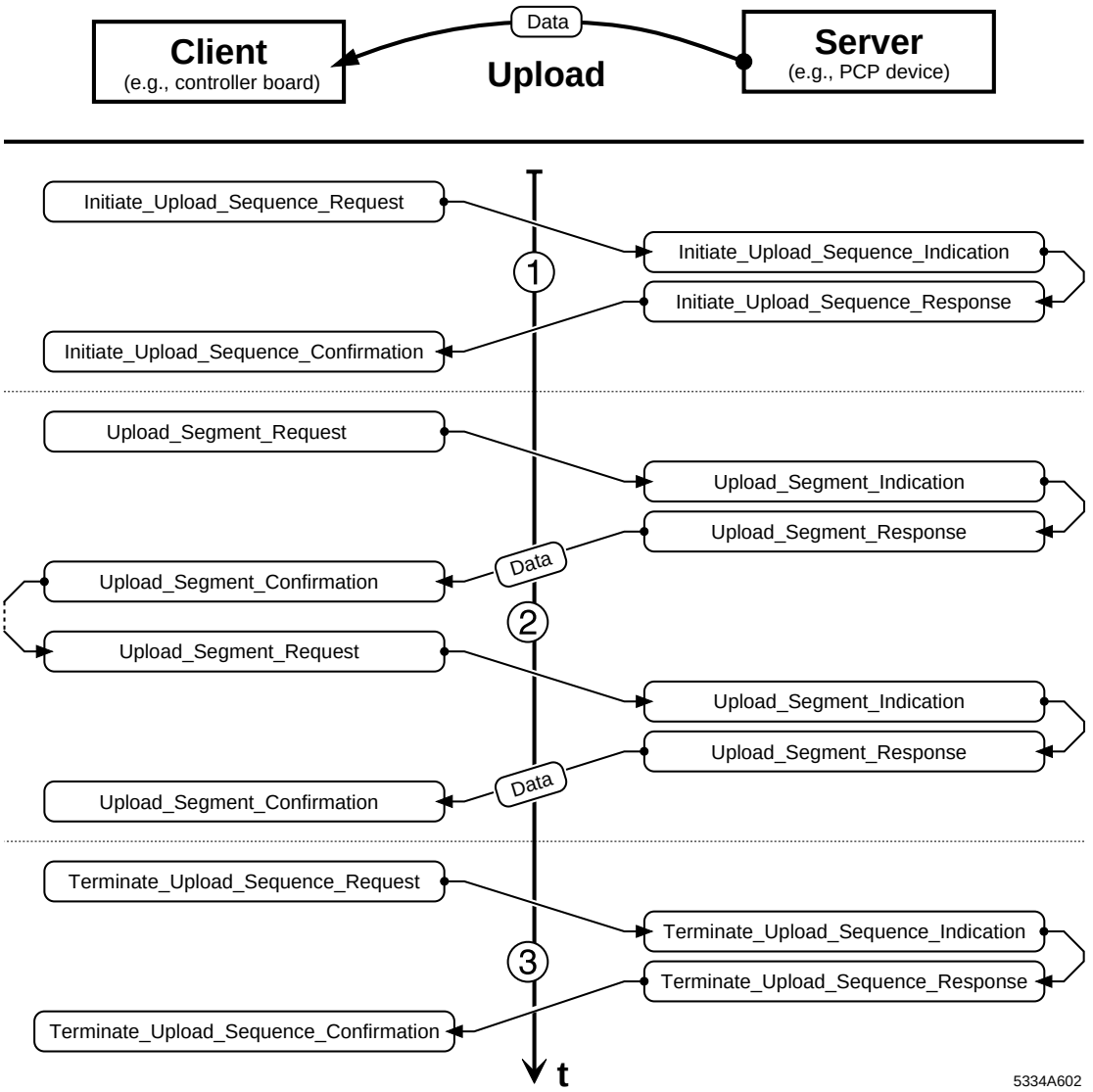


Figure 6-2 Data upload from a domain (flowchart)

6.3.1 *Initiate_Download_Sequence* Service

Task:

The client initiates the data transfer from the client to the server (download) with the "Initiate_Download_Sequence" service. The server receives the index / name of the domain into which the data is to be transmitted.

Syntax:

Initiate_Download_Sequence_Request **0090_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	—	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code: 0090_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words:
0002_{hex} Addressing via index.
$00xx_{hex}$ Addressing via name.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Initiate_Download_Sequence_Confirmation** **8090_{hex}**

Positive message

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code:	8090_{hex} Message code of the service confirmation.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive message. 0003_{hex} Negative message.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.

Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Initiate_Download_Sequence_Indication** **4090_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	—	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Message_Code:	4090_{hex} Message code of the service input.
Parameter_Count:	Number of subsequent words: 0002_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Initiate_Download_Sequence_Response** **$C090_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code:	$C090_{hex}$ Command code of the service response.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive response. 0003_{hex} Negative response.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.2 *Download_Segment* Service

Task:

The "Download_Segment" service carries out the data transfer from the client to the server. The server requests the service ("Request" primitive); the data is stored on the server with a service confirmation ("Confirmation" primitive).

Syntax:

Download_Segment_Request **0091_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	—	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code:	0091_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words: 0002_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Access_Spec: Indicates if the domain is addressed via the index or its name.
00_{hex} Index (index of a domain).
01_{hex} Domain name.

Index or Name: Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Download_Segment_Confirmation** **8091_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
Word 6	Data [1]	...
Word 7	...	Data [n]

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8091_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.
More_Follows:	Indicates that the server must request more data from the client.
Data	Data to be transmitted from the client to the server (download data).
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Download_Segment_Indication** **4091_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	—	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:	Message_Code:	4091_{hex} Message code of the service input.
	Parameter_Count:	Number of subsequent words: 0002_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
	Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
	Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
	Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
	Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Download_Segment_Response** **$C091_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
Word 6	Data [1]	...
Word 7	...	Data [n]

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C091_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

More_Follows: Indicates that the server must request more data from the client.

Data: Data to be transmitted from the client to the server (download data).

Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.3 *Terminate_Download_Sequence* Service

Task:

The "Terminate_Download_Sequence" service terminates the data transfer sequence from the client to the server. The server requests the service ("Request" primitive).

Syntax:

Terminate_Download_Sequence_Request **0092_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	Final_Result	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code: 0092_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words:
0003_{hex} Addressing via index
$00xx_{hex}$ Addressing via name.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Final_Result:	Indicates to the client if the server has terminated the data transfer (download) successfully. 00_{hex} Unsuccessful data transfer. FF_{hex} Successful data transfer.
Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Terminate_Download_Sequence_Confirmation** **8092_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code:	8092_{hex} Message code of the service confirmation.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive message. 0003_{hex} Negative message.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Terminate_Download_Sequence_Indication** **4092_{hex}**

Addressing via index

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
	Final_Result	Access_Spec (= 00_{hex})
Word n	Index	

or addressing via name

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Message_Code:	$408B_{hex}$ Message code of the service input.
Parameter_Count:	Number of subsequent words: 0003_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Final_Result:	Indicates to the client if the server has terminated the data transfer (download) successfully. 00_{hex} Unsuccessful data transfer. FF_{hex} Successful data transfer.
Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Terminate_Download_Sequence_Response** **$C092_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C092_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.4 *Initiate_Upload_Sequence* Service

Task:

The client initiates the data transfer form the server (upload) with the "Initiate_Upload_Sequence" service. The server receives the index / name of the domain from which the data is to be transmitted from the server to the client.

Syntax:

Initiate_Upload_Sequence_Request **0093_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code: 0093_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words:
0003_{hex} Addressing via index.
$00xx_{hex}$ Addressing via name.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Access_Spec: Indicates if the domain is addressed via the index or its name.
00_{hex} Index (index of a domain).
01_{hex} Domain name.

Index or Name: Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Initiate_Upload_Sequence_Confirmation** **8093_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8093_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Initiate_Upload_Sequence_Indication** **4093_{hex}**

Addressing via index

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Message_Code:	4093_{hex} Message code of the service input.
Parameter_Count:	Number of subsequent words: 0003_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Initiate_Upload_Sequence_Response** **$C093_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code:	$C093_{hex}$ Command code of the service response.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive response. 0003_{hex} Negative response.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.5 Upload_Segment Service

Task:

The "Upload_Segment" service carries out the data transfer from the server to the client. The "Confirmation" service primitive provides the client with data.

Syntax:

Upload_Segment_Request **0094_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code: 0094_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words:
0003_{hex} Addressing via index.
$00xx_{hex}$ Addressing via name.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Access_Spec: Indicates if the domain is addressed via the index or its name.
00_{hex} Index (index of a domain).
01_{hex} Domain name.

Index or Name: Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Upload_Segment_Confirmation** **8094_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
Word 6	Data [1]	...
Word 7	...	Data [n]

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8094_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0001_{hex} Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.
More_Follows:	Indicates that the client must request more data from the server.
Data	Data to be transmitted from the server to the client (upload data).
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Upload_Segment_Indication** **4094_{hex}**

Addressing via index

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:	Message_Code:	4094_{hex} Message code of the service input.
	Parameter_Count:	Number of subsequent words: 0003_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
	Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
	Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
	Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
	Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Upload_Segment_Response** **$C094_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	
Word 5	More_Follows	Data_Length
Word 6	Data [1]	...
Word 7	...	Data [n]

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C094_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0001_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

More_Follows: Indicates that the server must transmit more data to the client.

Data: Data to be transmitted from the client to the server (upload data).

Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.6 *Terminate_Upload_Sequence* Service

Task:

The "Terminate_Upload_Sequence" service terminates the data transmission sequence from the server to the client.

Syntax:

Terminate_Upload_Sequence_Request **0095_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:

Command_Code: 0095_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words:
0003_{hex} Addressing via index.
$00xx_{hex}$ Addressing via name.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Final_Result:	Indicates to the client if the server has terminated the data transfer (upload) successfully. 00_{hex} Unsuccessful data transfer. FF_{hex} Successful data transfer.
Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Terminate_Upload_Sequence_Confirmation** **8095_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code:	8095_{hex} Message code of the service confirmation.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive message. 0003_{hex} Negative message.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).)

Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Terminate_Upload_Sequence_Indication** **4095_{hex}**

Addressing via index

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 00_{hex})
Word 5	Index	

or addressing via name

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Final_Result	Access_Spec (= 01_{hex})
Word 5	Name_Length	Name [1]
...	Name [2]	...

Bit	15 8	7 0

Key:	Message_Code:	4095_{hex} Message code of the service input.
	Parameter_Count:	Number of subsequent words: 0003_{hex} Addressing via index. $00xx_{hex}$ Addressing via name.
	Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
	Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
	Final_Result:	Indicates to the client if the server has terminated the data transfer (upload) successfully. 00_{hex} Unsuccessful data transfer. FF_{hex} Successful data transfer.
	Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
	Index or Name:	Contains the index or the name of the domain into which alphanumeric data is to be written. A name can have up to 12 characters.

Syntax: **Terminate_Upload_Sequence_Response** **$C095_{hex}$**

Positive response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	

Negative response

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code: $C095_{hex}$ Command code of the service response.

Parameter_Count: Number of subsequent words:
0002_{hex} Positive response.
0003_{hex} Negative response.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.3.7 *Request_Domain_Upload* Service

Task:

This service enables the INTERBUS device (server) to upload data from the controller board (client). In the request, the INTERBUS device optionally indicates in which file on the controller board (client) the (upload) data is to be written.

The request will be confirmed only after successful upload.

Syntax:

Request_Domain_Upload_Request **0096_{hex}**

Addressing via index

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	
Word 6	Additional_Info_Length	Additional_Information [1]
...	Additional_Information [2]	...

or addressing via name

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 6	Name_Length	Name [1]
...	Name [2]	...
Word k	Additional_Info_Length	Additional_Information [1]
...	Additional_Information [2]	

Bit	15 8	7 0

Key:

Command_Code: 0096_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words (00 05_{hex}).

Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Access_Spec:	Indicates if the domain is addressed via the index or its name. 00_{hex} Index (index of a domain). 01_{hex} Domain name.
Index or Name:	Enter the alphanumeric index or name of the domain to be uploaded. A name can have up to 12 characters.
Additional_Information:	Includes additional information on the domain name. For example, a file name can be included. The user determines and manages the assignment between domain name and file name.

Syntax: **Request_Domain_Upload_Confirmation** **8096_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code:	8096_{hex}	Message code of the service confirmation.

Parameter_Count:	Number of subsequent words: 0002_{hex} Positive message. 0003_{hex} Negative message.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).
Result (+):	0000_{hex} Indicates a positive result.
Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

Syntax: **Request_Domain_Upload_Indication** **4096_{hex}**

Addressing via index

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 00_{hex})
Word 5	Index	
Word 6	Additional_Info_Length	Additional_Information [1]
...	Additional_Information [2]	...

or addressing via name

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	—	Access_Spec (= 01_{hex})
Word 6	Name_Length	Name [1]
...	Name [2]	...
Word k	Additional_Info_Length	Additional_Information [1]
...	Additional_Information [2]	

Bit	15 8	7 0

Key:

Message_Code: 4096_{hex} Message code of the service input.

Parameter_Count: Number of subsequent words (0002_{hex}).

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Access_Spec: Indicates if the domain is addressed via the index or its name.
00_{hex} Index (index of a domain).
01_{hex} Domain name.

Index or Name: Enter the alphanumeric index or name of the domain to be uploaded. A name can have up to 12 characters.

Additional_Information:	Includes additional information on the domain name. For example, a file name can be included. The user determines and manages the assignment between domain name and file name.
Meaning:	Report of the service execution.

Syntax: **Request_Domain_Upload_Response** **$C096_{hex}$**

Positive response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	

Negative response

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Command_Code:	$C096_{hex}$ Command code of the service response.
Parameter_Count:	Number of subsequent words: 0002_{hex} Positive response. 0003_{hex} Negative response.
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Result (+):	00 00 Indicates a positive result.
Error_Class / Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.4 Services with Automatic Response

On the server side, the services "Get OD", "Status", and "Identify" are processed and automatically responded by an internal PCP entity. They are not accessible to the application process of the remote device and, therefore, only consist of the service primitives "Request" and "Confirmation".

6.4.1 *Get OD* Service

Task:

With the "Get OD" service, one or more object descriptions can be read out. To read out the entire object dictionary, the "Get OD" service must be used repeatedly, depending on the size of the OD. The service confirmation can be very extensive, depending on the objects to be read out and their size. However, this service is not required if the device documentation is available which includes the object descriptions. Nevertheless, when using this service, please refer to the PCP Reference Manual for the evaluation of the service confirmation.

Syntax:

Get_OD_Request **0088_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	All_Attributes	Access_Spec.
Word 5	Index or Name	

Bit	15 8	7 0

Key:

Command_Code: 0088_{hex} Command code of the service request.

Parameter_Count: Number of subsequent words (0003_{hex}).

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

All_Attributes: Selection between the object description in short or long form.

Access_Specification: Indicates which object is to be accessed.

- 01_{hex} Index of an object
- 02_{hex} Name of a variable
- 05_{hex} Name of a program sequence (PI)
- 07_{hex} Objects are read out from this start index onwards.

Index or Name: Enter the alphanumeric index or name of the domain to be uploaded. A name can have up to 12 characters.

Syntax: **Get_OD_Confirmation** **8088_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 4	More_Follows	Length
Word 5	Object_Description (1)	
...	...	
Word n+4	Object_Description (n)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8088_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

More_Follows:	Indicates that the size of the requested object descriptions is larger than the send buffer during access via the start index and that, therefore, not all requested data can be read out. 00_{hex} No further data. FF_{hex} There are more values available that can be read out with a repeated Get_OD. When accessing via index or names, the value is always 00_{hex}.
Length:	Number of subsequent data bytes. It depends on the written object, e.g., whether an element or the entire object was read out (00 xx_{hex}).
Object_Description:	To evaluate the object description, please refer to the Reference Manual.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.4.2 *Status* Service

Task:

The "Status" service transmits the current operating state and the current state of the remote device.

Syntax:

Status_Request **0086_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference

Bit	15 8	7 0

Key:

Command_Code:	0086_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0001_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Syntax: **Status_Confirmation** **8086_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Result (+)	
Word 5	Physical_Status	Logical_Status
Word 6	Length	String of local detail
Word n	...	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8086_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0005_{hex} Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Logical_Status: 00_{hex} The device is ready to communicate.
02_{hex} At the moment, the device cannot process all configured services.

Physical_Status:	Indicates the operating state of the device: 00_{hex} Ready for operation. 01_{hex} Partly ready for operation. Manufacturer-specific message. Please refer to the device documentation. 02_{hex} Not ready for operation. 03_{hex} Maintenance required.
Length:	Number of subsequent data bytes. It depends on the object read out, e.g., whether an element or the entire object was read out ($00xx_{hex}$).
String of local detail:	Provides more detailed information on the operating state. The parameter values vary from profile to profile. Please refer to the device documentation.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.4.3 *Identify* Service

Task:

The "Identify" service checks which devices are connected with each other and reads out the "ID plates" of the individual devices. The "ID plates" indicate the name of the manufacturer, the device name and the revision number of the device.

Syntax: **Identify_Request** **0087_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference

Bit	15 8	7 0

Key:

Command_Code:	0087_{hex} Command code of the service request.
Parameter_Count:	Number of subsequent words (0001_{hex}).
Invoke_ID:	Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).
Comm._Reference:	Communication reference between controller board and remote device (xx_{hex}).

Syntax: **Identify_Confirmation** **8087_{hex}**

Positive message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference.
Word 4	Result (+)	
Word 5	Length	Manufacturer´s_Name
...	...	
	Length	Device_Name
	...	
...	Length	Revision
Word n	...	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Invoke_ID	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 8	7 0

Key:

Message_Code: 8087_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
$00xx_{hex}$ Positive message.
0003_{hex} Negative message.

Invoke_ID: Job number of parallel services. These parallel services must be supported by the respective device. Please refer to the device documentation (default value = 0).

Comm._Reference: Communication reference between controller board and remote device (xx_{hex}).

Result (+): 0000_{hex} Indicates a positive result.

Length: $00xx_{hex}$ Number of subsequent data bytes of a name.

Manufacturer´s_Name:	Device manufacturer´s name (alphanumeric).
Device_Name:	Device name (alphanumeric).
Revision:	Revision number of the device.
Error_Class/Code:	Error cause; see Section 4.3 "Descriptions of Service-Specific Error Messages" on Page 4-13. These error messages are identical for all certified devices. If this section does not include the error message, please refer to the device documentation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.5 Unconfirmed Services

The "Information Report" and "Abort" services are unconfirmed services. Thus, they only consist of the basic operations (primitives) "Request" and "Indication". The "Abort" service can occur in both directions - from client to server in the case of a direct connection abort as well as from server to client in the case of an error. The "Information Report" service only occurs in one direction when, for example, an alarm state is to be indicated to the master from a simple device.

6.5.1 *Information Report* Service

Task:

The "Information Report" service is a message from a server to the client without a prerequest by the master. The service is generated by the application program when, for example, an alarm state has to be reported.

Syntax:

Information_Report_Request **0885_{hex}**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	_	Comm._Reference
Word 4	Index	
Word 5	Subindex	Length
Word 6	Data	
Word n	---	

Bit	15 8	7 0

Key:

Command_Code:	0885_{hex}	Command code of the service request.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words.
Comm._Reference:	$00xx_{hex}$	Communication reference between controller board and remote device.
Index:		Index of the program sequence to be started. The index corresponds to the logical address of the program sequence in the object dictionary. Please refer to the device documentation for the index (xx xx_{hex}).
Subindex:		A subindex - a logical subaddress - is assigned to each element of an object (array or record). Please refer to the device documentation for the subindex. If the entire object is to be written, enter the value 00_{hex}.
Length:		Indicates the number of subsequent data bytes. It depends on the object's value to be transmitted.
Data:		Here, the actual user data is entered, i.e., the values to be re-written for the object.

Syntax: **Information_Report_Indication** **4885_{hex}**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Index	
Word 5	Subindex	Length
Word 6	Data	
Word n	---	

Bit	15 8	7 0

Key:

Message_Code:	4885_{hex}	Message code of the service input.
Parameter_Count:	$00xx_{hex}$	Number of subsequent words:
Comm._Reference:	$00xx_{hex}$	Communication reference between controller board and remote device.

Index: Index of the program sequence to be started. The index corresponds to the logical address of the program sequence in the object dictionary. Please refer to the device documentation for the index (xx xx_{hex}).

Subindex: A subindex - a logical subaddress - is assigned to each element of an object (array or record). Please refer to the device documentation for the subindex. If the entire object is to be written, enter the value 00_{hex}.

Length: Indicates the number of subsequent data bytes. It depends on the object's value to be transmitted.

Data: Here, the actual user data is entered, i.e., the values to be re-written for the object.

6.5.2 *Abort* Service

An existing communication connection should be aborted when quitting the application program or a reset is carried out on the controller board. If, in these cases, the connection is not aborted, there might be an abort message when the application program is restarted. This abort message indicates that the connection on the remote device was still established.
As long as the bus is running, communication connections do not have to be aborted.
After an error, an automatic connection abort initiated by the bus system can be carried out. In this case, an "Abort_ID" and a "Reason_Code" will be put out informing about the cause of the connection abort (see Section 4.1).
If you want to abort a connection yourself, use the "Abort" service. It is one of the unconfirmed services, i.e., no abort confirmation is sent back.

Syntax: **Abort_Request** **$088D_{hex}$**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Reason_Code	Abort_Detail_Length
Word 5	Abort_Detail (1)	...
Word n	...	Abort_Detail (n)

Bit	15 8	7 0

Key:

Command_Code:	$088D_{hex}$ Command code of the service request.
Parameter_Count:	Number of subsequent words (xx xx_{hex}).
Comm._Reference:	Communication reference between controller board and remote device (00 xx_{hex}).
Reason_Code:	Error cause. Section 4.1 "Error Messages of the Abort Service after Connection Abort" lists the error causes and removal measures.
Abort_Detail_Length:	Number of subsequent Abort_Detail words. Default value = 00_{hex}.
Abort_Detail:	Not used; entry 00_{hex}.

Syntax: **Abort_Indication** **$488D_{hex}$**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Locally_Generated	Abort_Identifier (ID)
Word 5	Reason_Code	Abort_Detail_Length
Word 6	Abort_Detail (1)	...
Word n	...	Abort_Detail (n)

Bit	15 8	7 0

Key:

Message_Code: $488D_{hex}$ Message code of the service input.

Parameter_Count: Number of subsequent words (00 xx_{hex}).

Comm._Reference: Communication reference between controller board and remote device (00 xx_{hex}).

Abort_ID: Error cause. See Reason_Code.

Reason_Code: Error cause. Section 4.1 "Error Messages of the Abort Service after Connection Abort" lists the error causes and removal measures.

Abort_Detail_Length: Number of subsequent Abort_Detail words.

Abort_Detail:
- 00_{hex} Not indicated.
- 03_{hex} Error occurred during transmission.

Locally_Generated: Indicates if the error was detected on the local device.
- 00_{hex} Detected on the remote device.
- 01_{hex} Detected on the local device.

6.6 Service Rejection with the *Reject* Service

An inadmissible message, that cannot be transmitted, is rejected internally with the *Reject_Code*. Possible reasons for rejection are inadmissible data types or messages that are too long and do not fit into the buffer. After a reject, a message is put out. The service therefore only has the basic operation "Indication".

Syntax: **Reject_Indication** **$488E_{hex}$**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Detected_Here	Original_Invoke_ID
Word 5	Reject_PDU_Type	Reject_Code

Bit	15 8	7 0

Key:

Message_Code: $488E_{hex}$ Message code of the service input.

Parameter_Count: 0003_{hex} Number of subsequent words.

Comm._Reference: 0005_{hex} Communication reference between controller board and remote device.

Detected_Here: Indicates whether the error was recognized locally (= 01_{hex}) or remotely (= 00_{hex}).

- 00_{hex} An error (Reject_PDU_Type 2) occurs on the server during service response and the maximum message length was exceeded (Reject_Code 5).
- 01_{hex} The error was detected on the local device (controller board).

Original_Invoke_ID: Invoke_ID of the rejected PDU.

Reject_PDU_Type: Type of the rejected PDU. The following types are differentiated:

- 01_{hex} Confirmed Request PDU: Error within in the service request of a confirmed service.
- 02_{hex} Confirmed Response PDU: Error within the service response of a confirmed service.

	03_{hex} Unconfirmed PDU: Error within the service request of an unconfirmed service.
	04_{hex} Not recognized PDU type.
Reject_Code:	Table 4-2 describes the values of the Reject_Code parameter.

6.7 PNM7 Services

6.7.1 Overview

The INTERBUS concept offers two types of communication relationships. Both are handled via the mechanism "service request - service confirmation". On the one hand, these are the PMS services of PCP such as Read, Write, etc. On the other hand, these are the PNM7 services used for controlling the INTERBUS operating system, the firmware. As these services are used to manage INTERBUS, they are called management services or PNM7 services.

To carry out the network management, the following services are required:

– Load_CRL_Attribute_Loc
– PNM7_Initiate
– PNM7_Abort
– Send_Execute_Remote
  (only when controlling a system coupler as of firmware 4.30)

6.7.2 *Load_CRL_Attribute_Loc* Service

The "Load_CRL_Attribute_Loc" service is used to change the communication relationship list (see previous sections). The following attributes can be changed:

Table 6-2 CRL entries: Attribute size and code

CRL entry	Attribute size	Attribute code
Remote_Address	Byte	02_{hex}
Max_PDU_Sending_Low	Byte	$0E_{hex}$
Max_PDU_Receiving_Low	Byte	10_{hex}
ACI	Double Word	$0B_{hex}$
Services_Supported	6-byte string	11_{hex}
– Services_Supported (1)	Byte	12_{hex}
– Services_Supported (2)	Byte	13_{hex}
– Services_Supported (3)	Byte	14_{hex}
– Services_Supported (4)	Byte	15_{hex}
– Services_Supported (5)	Byte	16_{hex}
– Services_Supported (6)	Byte	17_{hex}

Key:

Remote_Address:	The remote address (address of remote bus device) is preset to the communication reference of a device minus 1. Should the communication reference of a device be changed, the remote address must also be changed.
Max_PDU_Send._L.:	Indicates the size of the send buffer.
Max_PDU_Rec._Low:	Indicates the size of the receive buffer.
ACI:	Connection control (timeout). 00 00 00 00 = switched off (default). FF FF FF FF = switched on.
Services_Supported:	This byte indicates the services supported as a client and server.

Syntax: **Load_CRL_Attribute_Loc_Request** **0264_{hex}**

Word 1	Command_Code
Word 2	Parameter_Count
Word 3	Attribute_Code
Word 4	Entry_Count
Word 5	Communication_Reference 1
Word 6	Attribute_Value 1
...	...
...	Communication_Reference *n*
Word *n*	Attribute_Value *n*

Bit	15 0

Key:

Command_Code: 0264_{hex} Command code of the service request.

Parameter_Count: $00xx_{hex}$ Number of subsequent parameters.

Attribute_Code: $00xx_{hex}$ Code of the attribute to be changed (see Table 6-2). The same attribtue is changed on all PCP devices listed.

Entry_Count: Number of PCP devices where the attribute is to be changed (simultaneously).

Communication_Reference 1 ... Communication_Reference *n*: Communication references of PCP devices where the attribute is to be changed.

Attribute_Value 1 ... Attribute_Value *n:* New attribute value for the device.

Syntax: **Load_CRL_Attribute_Loc_Confirmation** **8264_{hex}**

Positive message:

Word 1	Message_Code
Word 2	Parameter_Count
Word 3	Result (+)

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	Error_Class	Error_Code
Word 4	Additional_Code	
Word 5	Error_Communication _Reference	–

Bit	15 8	7 0

Key:

Message_Code: 8264_{hex} Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0001_{hex} Positive message.
0003_{hex} Negative message.

Result (+): 0000_{hex} Indicates a positive result.

Error_Class/Code: Error cause:
05 05 $_{hex}$ Wrong Attribute_Code.
06 01 $_{hex}$ Invalid CRL attribute.
06 02 $_{hex}$ The Communication_Reference does not exist.
06 04 $_{hex}$ CRL not available.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

Error_Comm._Ref.: Faulty Communication_Reference.

6.7.3 *PNM7_Initiate* Service

Remote management connections

The "PNM7_Initiate" service is used to establish a remote management connection. In general, the user only utilizes the management connection from its host computer (PC or PLC) to the INTERBUS controller board or from an external computer via a V.24 interface to the INTERBUS controller board.

These are local management connections, i.e., both communication partners are physically located at the same place. Now, INTERBUS has made it possible to use system couplers. A system coupler is an INTERBUS module that - like a standard I/O module - is provided with a slave interface. In addition, the system coupler has a master interface which enables it to open its own lower-level bus. The data of the lower-level bus can be transmitted to the higher-level bus; the data can be optionally pre-processed.

Remote control of system couplers

To control this kind of system coupler it would be of advantage to use the central controller board instead of having to operate the system coupler locally. To achieve this, it is required to use a remote management connection established with the "PNM7_Initiate" service.

This management connection only allows to transmit PNM7 services. PMS services (PCP services) cannot be transmitted. Thus, services such as "Start_Data_Transfer", "Alarm_Stop", etc., can be sent with the remote management connection. The system coupler is virtually remote-controlled.

Syntax: **PNM7_Initiate_Request** **$00A0_{hex}$**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference

Bit	15 8	7 0

Key:

Command_Code:	$00A0_{hex}$	Command code of the service request.
Parameter_Count:	0001_{hex}	Number of subsequent words.
Comm._Reference:	xx_{hex}	Communication reference between controller board and system coupler.

The user is only required to preset the value of the system coupler's communication reference to which the connection is to be established. The "Parameter_Count" parameter always has the value 1.

Syntax: **PNM7_Initiate_Confirmation** **$80A0_{hex}$**

Positive message:

Word 1	Message-Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Result (+)	

Negative message:

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	
Word 5	PNM7_ PDU_Sending_Low	PNM7_ PDU_Receiving_Low
Word 7	PNM7_ Services_Supported (1)	PNM7_ Services_Supported (2)
Word 8	PNM7_ Services_Supported (3)	PNM7- Services_Supported (4)
Word 9	PNM7_ Services_Supported (5)	PNM7_ Services_Supported (6)

Bit	15 8	7 0

Key:

Message_Code: $80A0_{hex}$ Message code of the service confirmation.

Parameter_Count: Number of subsequent words:
0001_{hex} Positive message.
0007_{hex} Negative message.

Comm._Reference: Communication reference between controller board and system coupler (xx_{hex}).

Result: 0000_{hex} Indicates a positive result.

Error_Class:	00_{hex}	Contains the error class classification of the "Initiate" service.
Error_Code:	Specifies the error:	
	01_{hex}	The send and receive buffers of both devices do not match in size.
	02_{hex}	The supported services of both devices do not match.
	04_{hex}	The service is rejected by the application program; the error cause is manufacturer-specific. Please refer to your device documentation. The device may not be ready for operation.
Additional_Code:	Manufacturer-specific information on the error cause. Please refer to the device documentation. (It is always 00 00_{hex} in the case of the Error_Codes 01 and 02.)	
PNM7_PDU_S._Low:	Size of the send buffer.	
PNM7_PDU_R._Low:	Size of the receive buffer.	
PNM7_Services_Supp.:	Supported services.	

6.7.4 *Service_Execution_Remote* Service

After establishing a management connection with the "PNM7_Initiate" service, firmware services can be remotely executed in the system coupler.

For this, the "Service_Execution_Remote" service (SER service) was introduced. With this SER service, all services that, in general, are locally executed in the controller board, are packed and sent to the (remote) system coupler. In the system coupler, the services are unpacked and processed as usual.

In the system coupler, the service confirmation of the (remotely) executed service is also packed within the SER service. The structure of a service confirmation, packed within the SER service, is identical to the corresponding service confirmation of a local service.

Syntax: **Service_Execution_Remote_Request** **$00C1_{hex}$**

Word 1	SER_Command_Code
Word 2	Parameter_Count
Word 3	Communication_Reference
Word 4	**Remote_Service**
	...

Bit	15 8	7 0

Key:

Command_Code:	$00C1_{hex}$	Command code of the service request.
Parameter_Count:	xx xx_{hex}	Number of subsequent words for the entire SER service.
Comm._Reference:	xx_{hex}	Communication reference between the controller board and the system coupler where the services are to be executed (remotely).
Remote_Service:		Includes data (Command_Code, Parameter_Count, ...) of the packed service.

Example

All entries printed in bold correspond to the service that should be processed in the system coupler.

Note that the currently used firmware services cannot be used with the system coupler.

All services used to configure the IBS ST 24 SSC-T module must not be packed within the SER service. These services are:

– Initiate_Load_Configuration (0306_{hex})
– Complete_Load_Configuration ($030A_{hex}$)
– Terminate_Load_Configuration (0308_{hex})
– Control_Parameterization ($030E_{hex}$)

At the moment, the user is provided with the entire range of firmware commands except for the services mentioned above. All diagnostic data offered by an INTERBUS master are accessible by the packed commands. In addition, configurations can be checked as well as groups switched on and off.

The "Alarm_Stop" service (1303_{hex}) should be carried out from the controller board in the system coupler with the communication reference CR = 6. To do this, the following service must be executed in the controller board.

Syntax:

"Alarm_Stop" SER service (example)

Word 1	SER_Command_Code	$00C1_{hex}$
Word 2	SER_Parameter_Count	0003_{hex}
Word 3	Communication_Reference	0006_{hex}
Word 4	**Command_Code**	1303_{hex}
Word 5	**Parameter_Count**	0000_{hex}

Bit	15 8	7 0

Key:

SER_Command_Code: Command code for the service request "Service_Execution_Remote_Request".

SER_Parameter_Count: Number of subsequent words for the entire SER service.

Communication_Reference: Communication reference between the controller board and remote-controlled system coupler.

Command_Code: Command code for the "Alarm_Stop" service packed within the SER service (see general firmware documentation).

Parameter_Count: Number of subsequent words for the packed service.

Thereafter, INTERBUS can be re-started with the services "Activate_Configuration" (0711_{hex}) and "Start_Data_Transfer" (0701_{hex}) (see general firmware documentation).

Syntax:

"Start_Data_Transfer" SER service (example)

Word 1	SER_Command_Code	$00C1_{hex}$
Word 2	SER_Parameter_Count	0003_{hex}
Word 3	Communication_Reference	0006_{hex}
Word 4	**Command_Code**	0701_{hex}
Word 5	**Parameter_Count**	0000_{hex}

Bit	15 0

Key:

SER_Command_Code: Command code for the service request "Service_Execution_Remote_Request".

SER_Parameter_Count: Number of subsequent words for the entire SER service.

Communication_Reference: Communication reference between controller board and the remote-controlled system coupler.

Command_Code: Command code of the "Start_Data_Transfer" service packed within the SER service (see general firmware documentation).

Parameter_Count: Number of subsequent words for the packed service.

In the above examples, the value for the "Parameter_ Count" parameter is zero. However, it can also have another value indicating that other parameters will follow.

Syntax: **Service_Execution_Remote_Confirmation** **$80C1_{hex}$**

Positive message:

Word 1	SER_Message_Code
Word 2	SER_Parameter_Count
Word 3	Communication_Reference
Word 4	Result (+)
	Remote_Service
	...

Negative message:

Word 1	SER_Message_Code	
Word 2	SER_Parameter_Count	
Word 3	Communication_Reference	
Word 4	Error_Class	Error_Code
Word 5	Additional_Code	

Bit	15 .....8.	7..... 0

Key:

SER_Message_Code: $80C1_{hex}$ Message code of the service confirmation.

SER_Parameter_Count: Number of subsequent words for the entire SER service.
$xxxx_{hex}$ Positive message.
0003_{hex} Negative message.

Comm._Reference: $00xx_{hex}$ Communication reference between controller board and system coupler.

Result: 0000_{hex} Indicates a positive result.

Remote_Service Includes the service confirmation of the service executed in the lower-level bus system ($xxxx_{hex}$).

Error_Class/Code: Error cause.

Additional_Code: Manufacturer-specific information on the error cause. Please refer to the device documentation.

6.7.5 *PNM7_Abort* Service

The "PNM7_Abort" service is used to abort an existing management connection.

Syntax: **PNM7_Abort_Request** **$08A1_{hex}$**

Word 1	Command_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Abort_Detail_Length	Abort_Detail (1)
Word 5	...	...
Word n	...	Abort_Detail (n)

Bit	15 8	7 0

Key:

Command_Code:	$08A1_{hex}$ Command code of the service request.
Parameter_Count:	Number of subsequent words (xx xx_{hex}).
Comm._Reference:	Communication reference between controller board and remote device (00 xx_{hex}).
Reason_Code:	Error cause. Section 4.1 "Error Messages of the Abort Service after Connection Abort" lists the error causes and measures for their removal.
Abort_Detail_Length:	Number of subsequent Abort_Detail words. Default value = 00_{hex}.
Abort_Detail:	Not used; entry 00_{hex}.

Syntax: **PNM7_Abort_Indication** **$48A1_{hex}$**

Word 1	Message_Code	
Word 2	Parameter_Count	
Word 3	–	Comm._Reference
Word 4	Locally_Generated	Abort_Identifier (ID)
Word 5	Reason_Code	Abort_Detail_Length
Word 6	Abort_Detail (1)	...
Word n	...	Abort_Detail (n)

Bit	15 8	7 0

Key:

Message_Code: $48A1_{hex}$ Message code of the service input.

Parameter_Count: Number of subsequent words (00 xx_{hex}).

Comm._Reference: Communication reference between controller board and remote device (00 xx_{hex}).

Abort_ID: Error cause. See Reason_Code.

Reason_Code: Error cause. Section 4.1 "Error Messages of the Abort Service after Connection Abort" lists the error causes and measures for their removal.

Abort_Detail_Length: Number of subsequent Abort_Detail words.

Abort_Detail:
- 00_{hex} Not indicated.
- 03_{hex} Error occurred during transmission.

Locally_Generated: Indicates if the error was detected on the local device.
- 00_{hex} Detected by the remote device.
- 01_{hex} Detected by the local device.

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A 3 Glossary

Application process Part of an application program used to carry out a particular task.

Client →*Client/server model*

Client/server model The client as a service requester issues jobs in order to use the functions of other communication devices. A server is a service provider that makes its functions available to the client. →*Communication services* are available to the client for issuing jobs.

Communication object Data that is exchanged between two devices, e.g., measured values, program parts, device parameters, etc. The data is described in the →*Object dictionary* of a device. It can be accessed by other devices.

Communication profile →*Profile*

Communication reference (CR) Number that is assigned to the communication relationship between two devices. It characterizes the address of the logical connection. With INTERBUS, the CR is between 2 and 64.

Communication relationship Establishes the logical connection between two →*devices*. Requirement for this is the physical possibility of communication, i.e., both devices must be connected to each other via the network.

Communication relationship list (CRL) A list in which the connection parameters of the communication relationship between two devices are stored. During connection establishment, the connection parameters in both CRLs are checked for compatibility. The relevant connection parameters are the send and receive buffer sizes as well as the supported services. Instead of "connection parameters", one also speaks of suitable "context conditions".

Communication services Services used for connection establishment and abort as well as for data exchange between two devices.

Context conditions Conditions by which a connection can be established; they are specified by the connection parameters entered in the communication relationship list.

CR	→*Communication reference*
CRL	→*Communication relationship list*
Device	Functional unit with its own address that is connected to a fieldbus. →*Local device* →*Remote device*
Hybrid transmission method	Simultaneous transmission of →*process data* and →*parameter data.*
Idle	Time in which no data is transmitted on a data line; idle state.
INTERBUS	High-speed bus for sensors/actuators.
Local device	The device that is the central point of looking at things. In relation to this device, all other devices of the bus system are "remote devices".
Manufacturing Message Specification (MMS)	ISO standard of communication services with which administrative tasks, identification and status prompts, communication-related activities as well as productive data transmission are carried out. MMS has been designed for networks that are located hierarchically above the sensor/actuator level.
Master	→*Master/slave method*
Master/slave method	Access method during data exchange: There exists only one central station (master) that controls the bus access. All other stations (slaves) may only send a message when requested to do so by the master.
MMS	→*Manufacturing Message Specification*
Object dictionary (OD)	Dictionary of all →*communication objects* of a device, containing all details on each individual object. Other devices can access an object via the index that is assigned to the object.
OD	→*Object dictionary*
Parameter data	Data that seldom changes and must therefore only be transmitted when required.
PCP	→*Peripherals Communication Protocol*

PDU	→*Protocol Data Unit*
Peripherals Communication Protocol (PCP)	INTERBUS protocol software. A PCP-compatible device is able, with the aid of →*PMS services*, to exchange communication data with other PCP devices.
Peripherals Data Unit (PDU)	Protocol data unit. The information that is exchanged is bundled for transmission into protocol data units, or "message packets". The size of the PDU depends on the size of the transmit or receive buffer.
Peripherals Message Specification (PMS)	Subset of the →*MMS communication services*, specially adapted to the sensor/actuators area.
Peripherals Network Management services (PNM7)	INTERBUS management functions. Like the PMS services, these are also based upon international ISO standards.
PMS services	→*Peripherals Message Specification*
PNM7	→*Peripherals Network Management*
Process data	Time-critical state information of simple devices that continually changes and must be continually updated. It must be transmitted quickly and at regular intervals.
Profile	Application-specific limitations of the scope of function of services, e.g. the DRIVECOM Power Transmission Profile.
Protocol	A set of conventions. It defines data formats and control procedures for communication between devices and processes.
Receive buffer high/low	Memory that temporarily stores data that are transmitted by another device. The letters "h" and "l" stand for "high prio" (high priority) and "low prio" (low priority) characterizing the priority level with which service requests are transmitted. A high priority data transmission is not supported by INTERBUS. However, the parameters are available due to reasons of compatibility to Profibus.
Remote device	Device that is observed from the point of view of a →*local device* and is seen by this local device to be "remote".

Ring topology

Network topology in which the cable forms a closed ring; all devices are connected to the bus system in this ring, whereby the ring is formed by several lines within a cable. The data is transmitted through all devices.

Send buffer high/low

Memory that temporarily stores data transmitted by another device. The letters "h" and "l" stand for "high prio" (high priority) and "low prio" (low priority) characterizing the priority level with which service requests are transmitted. A high priority data transmission is not supported by INTERBUS; however, the data is available due to reasons of compatibility to INTERBUS.

Server

→*Client/server model*

Slave

→*Master/slave method*

Summation frame

Transmission method in which all physical devices are treated as if they were one logical device: all process data is transmitted simultaneously to all devices during a cycle. On the basis of the temporal location of the information in the summation frame, each device can accept the data that is determined for it.

Topology

The way in which a network is structured, e.g. a bus, ring, or star network.
→*Ring topology*

Transmission protocol

→Protocol

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No matter how small your contribution we will deal with any hint or comment and add it to the documentation if possible.

Therefore, please fill in the form overleaf and fax it to us or send us your comments, suggestions for improvement, etc. to the following address:

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