CL200

R200
Module Description

Edition 101

CL200

R200
Module Description

1070 072 157-101 (96.09) GB

1 Safety Instructions

Before you start working with the module R200, we recommend that you thoroughly familiarize yourself with the contents of this manual. Keep this manual in a place where it is always accessible to all users.

1.1 Proper use

This instruction manual presents a comprehensive set of instructions and information required for the standard operation of the described products.

The products described hereunder

- were developed, manufactured, tested and documented in accordance with the relevant safety standards. In standard operation, and provided that the specifications and safety instructions relating to the project phase, installation and correct operation of the product are followed, there should arise no risk of danger to personnel or property.
- are certified to be in full compliance with the requirements of the
  - COUNCIL DIRECTIVE 89/336/EEC of May 3rd 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility, 93/68/EEC (amendments of Directives), and 93/44/EEC (relating to machinery)
  - COUNCIL DIRECTIVE 73/23/EEC (electrical equipment designed for use within certain voltage limits)
  - Harmonized standards EN 50081–2 and EN 50082–2
- are designed for operation in an industrial environment (Class A emissions). The following restrictions apply:
  - No direct connection to the public low–voltage power supply is permitted.
  - Connection to the medium and/or high–voltage system must be provided via transformer.

  The following applies for application within a personal residence, in business areas, on retail premises or in a small–industry setting:
  - Installation in a control cabinet or housing with high shield attenuation.
  - Cables that exit the screened area must be provided with filtering or screening measures.
  - The user will be required to obtain a single operating license issued by the appropriate national authority or approval body. In Germany, this is the Federal Institute for Posts and Telecommunications, and/or its local branch offices.

⇒ **This is a Class A device. In a residential area, this device may cause radio interference. In such case, the user may be required to introduce suitable countermeasures, and to bear the cost of the same.**

Proper transport, handling and storage, placement and installation of the product are indispensable prerequisites for its subsequent flawless service and safe operation.

1.2 Qualified personnel

This instruction manual is designed for specially trained personnel. The relevant requirements are based on the job specifications as outlined by the ZVEI and VDMA professional associations in Germany. Please refer to the following German–Language publication:
Weiterbildung in der Automatisierungstechnik
Publishers: ZVEI and VDMA Maschinenbau Verlag
Postfach 71 08 64
60498 Frankfurt/Germany

Interventions in the hardware and software of our products not described in this instruction manual may only be performed by our skilled personnel.

Unqualified interventions in the hardware or software or non–compliance with the warnings listed in this instruction manual or indicated on the product may result in serious personal injury or damage to property.

Installation and maintenance of the products described hereunder is the exclusive domain of trained electricians as per IEV 826–09–01 (modified) who are familiar with the contents of this manual.

Trained electricians are persons of whom the following is true:

- They are capable, due to their professional training, skills and expertise, and based upon their knowledge of and familiarity with applicable technical standards, of assessing the work to be carried out, and of recognizing possible dangers.
- They possess, subsequent to several years' experience in a comparable field of endeavour, a level of knowledge and skills that may be deemed commensurate with that attainable in the course of a formal professional education.

With regard to the foregoing, please read the information about our comprehensive training program. The professional staff at our training centre will be pleased to provide detailed information. You may contact the centre by telephone at (+49) 6062 78–258.

1.3 Safety markings on components

DANGER! High voltage!

DANGER! Corrosive battery acid!

CAUTION! Electrostatically sensitive components!

Disconnect mains power before opening!

Lug for connecting PE conductor only!

Functional earthing or low–noise earth only!

Screened conductor only!

1.4 Safety instructions in this manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol warns of the presence of a **dangerous electrical voltage**. Insufficient of lacking compliance with this warning can result in **personal injury.**

DANGER
This symbol is used wherever insufficient or lacking observance of this instruction can result in **personal injury.**

CAUTION
This symbol is used wherever insufficient or lacking observance of instructions can result in **damage to equipment or data files.**

⟹ This symbol is used to alert the user to an item of special interest.

1.5 Safety instructions for the described product

DANGER
Fatal injury hazard through ineffective Emergency–OFF devices! Emergency–OFF safety devices must remain effective and accessible during all operating modes of the system. The release of functional locks imposed by Emergency–OFF devices must never be allowed to cause an uncontrolled system restart! Before restoring power to the system, test the Emergency–OFF sequence!

DANGER
Danger to persons and equipment!
Test every new program before operating the system!

DANGER
Retrofits or modifications may interfere with the safety of the products described hereunder!

The consequences may be severe personal injury or damage to equipment or the environment. Therefore, any system retrofitting or modification utilizing equipment components from other manufacturers will require express approval by Bosch.

DANGEROUS ELECTRICAL VOLTAGE
Unless described otherwise, maintenance procedures must always be carried out only while the system is isolated from the power supply. During this process, the system must be blocked to prevent an unauthorized or inadvertent restart.

If measuring or testing procedures must be carried out on the active system, these must be carried out by trained electricians.

CAUTION
Danger to the module!
Do not insert or remove the module while the controller is switched ON! This may destroy the module. Prior to inserting or removing the module, switch OFF or remove the power supply module of the controller, external power supply and signal voltage!

CAUTION
Only Bosch–approved spare parts may be used!

CAUTION
Danger to the module!
All ESD protection measures must be observed when using the module! Prevent electrostatic discharges!

Observe the following protective measures for electrostatically endangered modules (EEM)!

- The Employees responsible for storage, transport and handling must be trained in ESD protection.
- EEMs must be stored and transported in the protective packaging specified.
- Out of principle, EEMs may be handled only at special ESD work stations equipped for this particular purpose.
- Employees, work surfaces and all devices and tools that could come into contact with EEMs must be on the same potential (e.g. earthed).
- An approved earthing wrist strap must be worn. It must be connected to the work surface via a cable with integrated 1 MW resistor.
- EEMs may under no circumstances come into contact with objects susceptible to accumulating an electrostatic charge. Most items made of plastic belong to this category.
- When installing EEMs in or removing them from an electronic device, the power supply of the device must be switched OFF.

1.6 Trademarks

All trademarks referring to software that is installed on Bosch products when shipped from the factory represent the property of their respective owners.

At the time of shipment from the factory, all installed software is protected by copyright. Software may therefore be duplicated only with the prior permission of the respective manufacturer or copyright owner.

MS–DOS® and Windows™ are registered trademarks of Microsoft Corporation.

PROFIBUS® is a registered trademark of the PROFIBUS Nutzerorganisation e.V. (user organization).

2 R200 Hardware Description

The R200 computer interface module provides both a V.24/20 mA interface and a standard V.24 interface, thereby enabling connection of the CL200 controller with additional Bosch controllers, or with other communicating devices.

2.1 Power Supply

The R200 computer interface module does not require an external power supply. All internally required operating voltages are taken from the power supply module of the CL200 controller.

2.2 Compatibility with the R200P Computer Interface Module

The combined hardware and software concept of the R200 computer interface module provides for tandem operation of the R200 with the R200P computer interface module in the CL200 basic unit.

For addressing the R200 from the PLC program level, special function modules must be integrated into the PLC program.

2.3 Front Panel

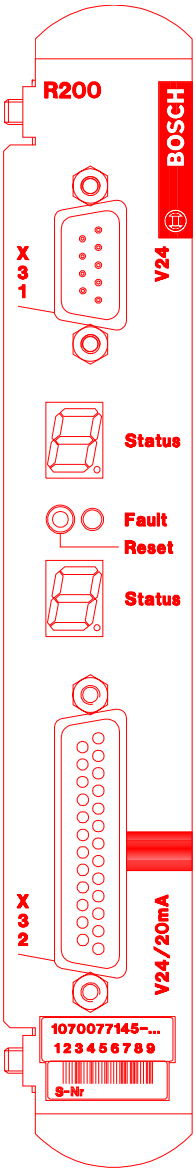


Fig. 2-1 R200 Interface module — Front panel

2.3.1 Status Displays

A status display is provided for each of the two communication channels on the front panel of the R200 computer interface module.

Status displays for channel 1 (V.24 interface) are handled by the top 7-segment display.

Status displays for channel 0 (V.24/20 mA interface) are handled by the bottom 7-segment display.

The following displays are available on the R200:

Bottom display	Top display	Meaning
*	.	Indicates an active, centralised processing job.
*	0 - F	Indicates faulty processing jobs (channel 1)
P	*	No protocol enabled on the channel (channel 0)
.	*	Indicates an active, centralised processing job.
0 - F	*	Indicates faulty processing jobs (channel 1)
0,1,2	-	Three-digit fault code, system fault
0	H	Flash fault
1	H	RAM fault
x	C	System fault

* indicates that this 7-segment display allows a variety of other status codes to be displayed.

2.3.2 Interface Connectors

The front panel of the R200 computer interface module features two interface connectors. The X31 interface connector comprises the V.24 serial interface.

The X32 interface connector comprises the V.24/20 mA interface. For detailed descriptions of the X31 and X32 interfaces, please refer to page 2-5. Both interfaces are used for establishing a point-to-point connection with an external communications-capable device.

2.3.3 Version ID

The version identification (version ID) on the front panel denotes the individual release versions of the module. Each version modification is identified by a white dot.

2.3.4 Labelling Field

The labelling field enables the operator to affix a system-specific identification label to the exterior of the module.

2.4 Slot Assignments

A maximum of 3 intelligent modules may be operated within one PLC system.

The following intelligent modules are currently available:

- R200P
- R200

In the case of the CL200 controller, the GG3 basic unit provides spare slots numbered 3 through 7 for additional modules.

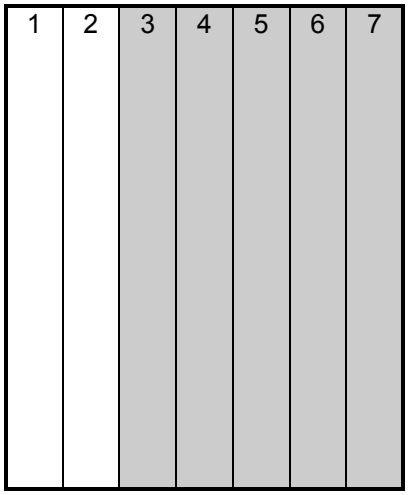


Fig. 2-2 CL200 — Slot assignment in GG3 Basic unit

2.4.1 Reset Button

Pressing the Reset pushbutton causes the operating software of the R200 interface module to be reinitialised, with the following consequences:

- All active processing jobs are cancelled without safety procedure .
- All pending jobs are deleted from the job queue.
- STOP and CLAB requests issued by the module are cleared.

2.5 V.24/20 mA Interface

The V.24/20 mA interface is available on channel 0. It is used for connecting to other devices which also communicate via a V.24 or 20 mA interface.

The following communications protocol options may be used:

- BUEP19E (Bosch standard protocol for secure data transmission)
- BUEP03E (Bosch transmission protocol for free configuration)
- BUEP64 (Siemens 3964R transmission protocol)

2.6 V.24 Interface

The V.24 interface is available on channel 1. It is used for connecting to other devices which also communicate via a V.24 interface.

The following communications protocol options may be used:

- BUEP19E (Bosch standard protocol for secure data transmission)
- BUEP03E (Bosch transmission protocol for free configuration)
- BUEP64 (Siemens transmission protocol 3964R)

2.7 DIP Switch Settings on the R200 Computer Interface Module

All DIP switch settings must be completed prior to start-up of the R200 module.

DIP Switch	Function
S1	Setting the transmission format, setting serial data transmission rate, and specifying control signals for V.24/20 mA interface; selecting transmission protocol.
S2	Setting the transmission format, setting serial data transmission rate, and specifying control signals for V.24/20 mA interface; selecting transmission protocol.
S3	IM number and protocol-specific settings.

Fig. 2-3 DIP switch settings

DIP switch locations:

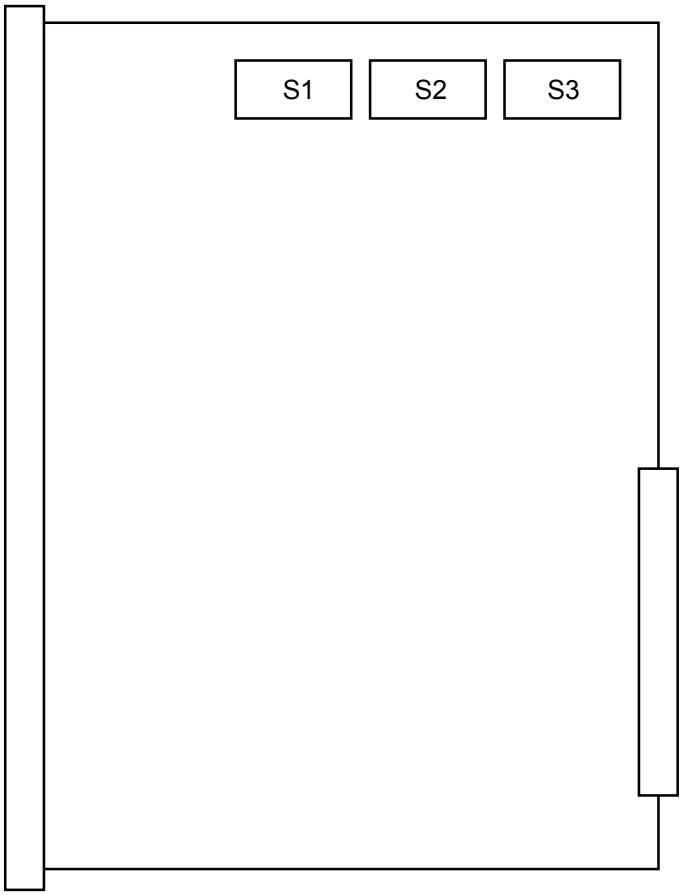


Fig. 2-4 DIP switch locations

2.7.1 V.24/20 mA Interface Control Signals

Switch segment SS8 of the S1/S2 DIP switch selects querying and/or non-querying of the DTR/DSR control signals for the V.24/20 mA interface.

The following settings apply:

SS8 ON - ENABLE control signal query

SS8 OFF - DISABLE control signal query

2.7.2 V.24/20 mA Interface Transmission Speeds

The data transmission speed for the V.24/20 mA interface is selected by setting switch segments SS5 through SS7 on the S1/S2 DIP switch.

SS5	SS6	SS7	Transmission speed
ON	ON	ON	19200 bps
OFF	ON	ON	9600 bps
ON	OFF	ON	4800 bps
OFF	OFF	ON	2400 bps
ON	ON	OFF	1200 bps
OFF	ON	OFF	600 bps
ON	OFF	OFF	57600 bps
OFF	OFF	OFF	38400 bps

Fig. 2-5 V.24/20 mA Interface — Transmission speeds

2.7.3 V.24/20 mA Interface Transmission Format

The transmission format for the V.24/20 mA interface is permanently set to 8 data bits and one stop bit.

The required parity may be selected on segments SS3 and SS4 of DIP switch S1/S2.

The following settings apply:

SS3:

ON - Parity EVEN

OFF - Parity ODD

SS4:

ON - Parity

OFF - No Parity

2.7.4 Protocol Selection

The required protocol for the V.24/20 mA interface may be selected on segments SS1 and SS2 of DIP switch S1/S2.

The following settings apply:

SS1	SS2	Protocol
OFF	OFF	No protocol
ON	OFF	BUEP19E
OFF	ON	BUEP03E
ON	ON	BUEP64

Fig. 2-6 Protocol selection

2.7.5 Intelligent-module ID Number

The intelligent-module ID number (*IM Number*) is set on the S3 DIP switch. The IM Number is determined by switch segments SS1 and SS2.

The intelligent module with the lowest IM Number automatically receives highest priority on the serial peripheral bus.

SS1	SS2	IM Number
OFF	OFF	0
ON	OFF	1
OFF	ON	2
ON	ON	3

Fig. 2-7 IM number selection

2.7.6 V.24 Interface

The signal levels and connector pin assignments conform to VDE Guidelines 2880, Page 2, governing programmable logic controllers, process and data interfaces.

Signal level (data line) :
logical 1 --> -15 V to -3 V
logical 0 --> +3 V to +15 V

Signal level (signal and control line) :
active --> +3 V to +15 V
passive --> -15 V to -3 V

Meaning	Designation	Pin no.	Signal direction
Shielding	Shield	*	
PLC Send data	TxD	2	-->
PLC Receive data	RxD	3	<--
Reference conductor	Signal-Ground	7	
Data Set Ready	DSR	6	<--
Data Terminal Ready	DTR	20	-->

Fig. 2-8 V.24 Interface — Pin assignment (channel 0)

* The shield is connected to the metal shell of the D-SUB connectors.

Meaning	Designation	Pin no.	Signal direction
Shielding	Shield	*	
PLC Send data	TxD	3	-->
PLC Receive data	RxD	2	<--
Reference conductor	Signal-Ground	5	
Data Set Ready	DSR	6	<--
Data Terminal Ready	DTR	4	-->

Fig. 2-9 V.24 Interface — Pin assignment (channel 1)

* The shield is connected to the metal shell of the D-SUB connectors.

2.7.6.1 20 mA Interface

The signal levels and connector pin assignments conform to VDE Guidelines 2880, Page 2, governing programmable logic controllers, process and data interfaces (limitation: max. 27 V blocking voltage). Dependent upon the pin assignment, 20 mA interfaces enable active or passive operation, i.e., with or without power supply.

Line states: logical 1 --> 20 mA
logical 0 --> no current

20 mA interface, active operation

Meaning	Designation	Pin no.	Signal direction
Shielding	Shield	*	
PLC Receive data, +	RxD +	12	<--
PLC Receive data, -	RxD -	24	
PLC Send data, +	TxD +	13	-->
PLC Send data, -	TxD -	25	
Data Set Ready, +	DSR +	14	<--
Data Set Ready, -	DSR -	18	
Reader Control, +	RDRCTL +	16	-->
Reader Control, -	RDRCTL -	21	

Fig. 2-10 20 mA Interface — Pin assignment, active operation

* The shield is connected to the metal shell of the D-SUB connectors.

To use the interface in active (powered) operation, **pins 9** (12 V in) **and 12** (12 V out) **must be bridged**.

20 mA interface, passive operation

Meaning	Designation	Pin no.	Signal direction
Shielding	Shield	*	
PLC Receive data, +	RxD +	22	<--
PLC Receive data, -	RxD -	12	
PLC Send data, +	TxD +	23	-->
PLC Send data, -	TxD -	13	
Data Set Ready, +	DSR +	11	<--
Data Set Ready, -	DSR -	14	
Reader Control, +	RDRCTL +	19	-->
Reader Control, -	RDRCTL -	16	

Fig. 2-11 20 mA Interface — Pin assignment, passive operation

* The shield is connected to the metal shell of the D-SUB connectors.

2.7.7 V.24/20 mA Interface Cable Length Specifications

The maximum permitted interface cable length depends on the baud rate. The following length specifications apply to the twisted-pair, shielded 14 x 0.14 Bosch cable, Bosch no. 1070 910152:

Transmission rate	V.24	20 mA
Baud rate (bps)	m	m
600...4800	15	350
9600	15	300
19200	15	150
38400	15	100
57600	15	50

Fig. 2-12 V.24/20 mA Interface — Cable lengths

It is assumed that there are only slight differences in potential (-2 V < V_{diff} < +2 V) between sending and receiving device (applies only to the V.24 interface).
Do NOT route data transmission lines parallel and adjacent to power lines.

2.8 Module Initialisation Values

The following identifiers and versions within the module initialisation values of the CL200 can be read off for the R200 module:

The module initialisation values for the intelligent modules are located from Word 160 in the system area.

IM number	Start address in the system area
1	Word 160
2	Word 168
3	Word 176

System word	Value		Description	
			HIGH byte	LOW byte
1	0010H		Module type identifier for R200	
2	xx	xx	Hardware version	Firmware version [1]
3	xx	xx	Protocol vers. channel 0 [1]	Protocol channel 0 [2]
4	xxxx		Reserved	
5	xxxx		Reserved	
6	xx	xx	Protocol vers. channel 1 [1]	Protocol channel 1 [2]
7	xxxx		Reserved	
8	xxxx		Reserved	

Permitted values for the individual entries:

1) Version IDs are indicated as follows:

   Version 1.1 --> 11H

   Version 2.3 --> 23H

2) The protocol on the individual channels is coded as follows:

Value	Protocol
0H	No protocol
1H	BUEP19E
2H	BUEP03E
3H	BUEP64

2.9 R200 Specifications

2.9.1 Specifications

Specifications	R200
Interfaces	V.24/20 mA according to VDI 2880 Page 2 only 20 mA isolated active operation also possible
Baud rates	600 to 57600 bps V.24/20 mA interface
Power consumption from 5 V voltage supply	250 mA (when NOT using the 20 mA interface) 0.5 A (when using the 20 mA interface)
Max. no. of modules per controller	3 in the basic unit
Ambient temperature range	5 to +55 °C
Storage temperature range	-25 to +70 °C
Modular width	single
Weight	205 g

Fig. 2-13 R200 — Specifications

2.9.2 EMC Specifications

Interference radiation	
Interference suppression according to DIN EN 50081-2 (Electromagnetic field radiation)	Limit value class A • Frequency 30 to 230 MHz: limit value 40 dB (µV/m) at a distance of 10 m (quasi-peak) • Frequency 230 to 1000 MHz: limit value 47 dB(µV/m) at a distance of 10 m (quasi-peak)
Interference suppression according to DIN EN 50081-2 (Transient; measured at the power transfer point with a 24V/10A Kompetent power supply unit, Type EL5000-10)	Limit value class A • Frequency 0.15 to 0.5 MHz: limit value 79 dB (µV/m) (quasi-peak) • Frequency 0.5 to 30.0 MHz: limit value 47 dB(µV/m) (quasi-peak)
Electromagnetic HF field according to DIN EN 50082-2	Frequency 80 to 1000 MHz: 10 V, 80 % amplitude modulation
Electromagnetic HF field according to DIN EN 50082-2	Frequency 900 MHz: 10 V, pulse modulation, 50 % ON period, Repetition frequency 200 Hz
Electrostatic discharge to accessible housing parts • According to DIN EN 61131-2 • According to DIN EN 50082-2	 Air discharge 15 kV Contact discharge 4 kV
High-speed transients (bursts) according to DIN EN 61131-2 and DIN EN 50082-2	1 kV for serial interfaces
High-frequency coupling to cable according to DIN EN 50082-2	Frequency 0.15 to 80 MHz: 10 V, 80 % amplitude modulation, 150 Ω source impedance

Fig. 2-14 EMC Specifications

3 PLC Interface

The PLC interface provides access to the communications system and requires the following function modules:

- R2REQ
- R2CON

The PLC interface can issue jobs to the R200 (client characteristics of the CL200).

The function modules do not monitor the jobs (time-out).

NOTE –

If the R200 is operated only as a server, function modules are NOT required.

4 R2REQ Function Module

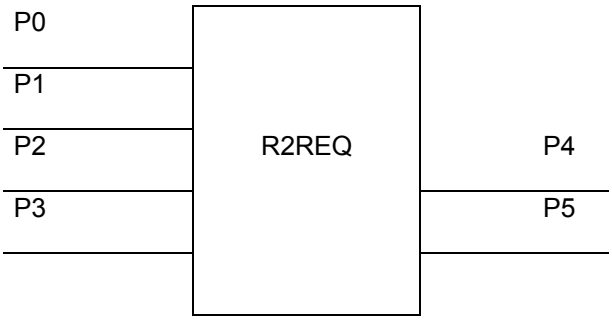
4.1 Characteristic Data

Characteristic data	R2REQ
Module name	R2REQ
Call-up length	16 bytes
Number of parameters	6
Processing time	0.3 ms + 1.6 ms per job
Used markers	None

Fig. 4-1 R2REQ — Characteristic data

4.2 Parameters

The R2REQ function module has four input and two output parameters.



NOTE –

The parameters CANNOT be transferred in the data word.

4.2.1 Input Parameters

Parameter	Att.	Description
P0	W	Data type

This parameter specifies the type of data range. A data range of 16 words is reserved for each job for the protocol-specific parameters. Data modules (44H) and the data field (43H) can be used as data ranges. The user must always reserve 16 words per job for the parameters which are specific to the job.

Parameter	Att.	Description
P1	W	Data type attribute

If P0 specifies a data module as a data area, P1 indicates the data-module number. In other cases P1 is meaningless and should be occupied with FFFFH.

Permitted values are 0 - 255 and FFFFH

Parameter	Att.	Description
P2	W	Byte offset

The start address for the job parameters is specified in the selected data area (only even-numbered addresses are permitted).

Parameter	Att.	Description
P3	W	Job bit array JBA

Each of the 16 bits of this parameter refers to a block of job parameters in the data range specified by P0 through P2.
Bit 0 of P3 therefore refers to the 0 job parameter block, and Bit 15 refers to the 15th job parameter block in the specified data area.
A bit which is set in P3 denotes the start of the job specified in the associated job parameter block.
If several bits are set at the same time, the associated jobs are transferred to the R200 in the same cycle.
When the program cycle has run once on the R2REQ with the set job bits, the job has completely started. The job bits must then again be reset via the respective application program.

4.2.2 Output Parameters

Parameter	Att.	Description
P4	W	Fault message

Basic status and error codes, which the R2REQ identifies when jobs are issued, are entered in this parameter:

- The LOW byte in the P4 contains the status or error code,
- The HIGH byte contains a coded recommendation concerning a response to the fault message.

Error code in the LOW byte:

Code	Meaning
00H	No fault, correct call-up
01H	The P3 parameter JBA (job bit array) is zero
02H	The specified data module does not exist
03H	The specified data area is too short
04H	The specified byte offset is invalid
08H	The P0 parameter is invalid (<> 43H, 44H)

PLC response in the HIGH byte:

Code	Meaning
00H	No fault, correct call-up
01H	Repeat call-up of the R2REQ
02H	Modify PLC program
03H	Modify protocol parameters in the DMB/DF
05H	The program cycle must be rerun on the R2REQ function module
06H	The program cycle must be rerun on the R2CON function module
07H	Select the protocol on CXN

If the R2REQ detects additional fault messages on job start-up, it writes them into the first word of the associated job block.

Parameter	Att.	Description
P5	W	Result bit array RBA

This parameter indicates to the user whether any faults have been identified when the jobs were issued. A job is assigned to each result bit. The assignment corresponds to the P3 for the input parameter. A set result bit indicates that the job which is addressed with the same bit number in P3 could not be issued. In addition, a detailed error code is output in the first word of the associated job block.

4.3 Explanation of Parameters in Data Range

A parameter field of 16 words must be reserved for each job in the data field **DF** or data module **DM**.

The address and offset of this data range are specified with the P0 - P2 parameters for the R2REQ module.

A bit which starts with Bit **0** (zero) is assigned to each parameter field in the job bit array **JBA** and in the result bit array **RBA**.

Example of the associated data area when the P2 parameter (offset) has the value 0:

Job bit of the JBA	Associated data area	Byte addresses
0	DW0 - DW15	0 - 31
1	DW16 - DW31	32 - 63
2	DW32 - DW47	64 - 95
3	DW48 - DW63	96 - 127
4	DW64 - DW79	128 - 159
5	DW80 - DW95	160 - 191
6	DW96 - DW111	192 - 223
7	DW112 - DW127	224 - 255
8	DW128 - DW143	256 - 287
9	DW144 - DW159	288 - 319
10	DW160 - DW175	320 - 351
11	DW176 - DW191	352 - 383
12	DW192 - DW207	384 - 415
13	DW208 - DW223	416 - 447
14	DW224 - DW239	448 - 479
15	DW240 - DW255	480 - 511

Fig. 4-2 R2REQ — List of parameters

The max. 16 job parameters are divided into two groups.

1. Protocol-independent parameters:

Their content is always the same, irrespective of the protocol and/or service which is actuated by the subsequent parameters.

2. Protocol-dependent parameters:

These parameters differ for all protocols and/or services.

4.3.1 Protocol-independent Parameters

Data word	Contents	
	HIGH byte	LOW byte
PW1	PLC response	Error code
PW2	CXN	Channel number
PW3	Job number	

Fig. 4-3 R2REQ — Protocol-independent parameters

PW1

The 0 data word returns the result of the job. Whenever the R2REQ module is called up, the result of the job is transferred to the module.

The result word is divided into HIGH byte (PLC response) and LOW byte (error codes). The error code and PLC response tables are listed below.

Error code (LOW byte)

Code	Meaning
00H	Job transferred without fault to CXN
02H	Job is in the queue
03H	Job acknowledged but not yet confirmed
04H	Wrong channel number
05H	Wrong CXN
06H	Wrong job number
07H	Job cannot be terminated
08H	No free job number on the CXN
20H	CXN not available
24H	Job cannot be entered in queue
30H	Communications fault between FM, ZE200 and communications module
90H	No protocol loaded for selected channel on the CXN

Fig. 4-4 R2REQ — Error codes

PLC response (HIGH byte)

Code	Meaning
00H	Job transferred without fault to CXN
02H	Modify PLC program
03H	Modify protocol parameter in the DM / DF
05H	Rerun program cycle on R2REQ
06H	Rerun program cycle on R2CON

Fig. 4-5 R2REQ — PLC response

PW2

CXN HIGH byte	Channel number LOW byte
0 - 3	0 or 1

This word indicates on which R200 and via which channel this job is to be processed.

The channel number indicates via which module interface the job is to be processed.

PW3

Up to 16 jobs can be started in parallel with the computer interfaces of the CL200. These jobs can be differentiated by the job-number information. Another job with the same job number cannot be started until the previous one has ended. An attempt to run two jobs with same job number will be rejected by the R2REQ with a fault message.

However, several centralised jobs which have different job numbers in one PLC cycle can be started.

The R200 can process up to 16 jobs in parallel. The R200 has 16 job channels for this purpose. The job numbers 0 to 15 are assigned directly to the job channels. Jobs with larger job numbers search for the next free job channel on the R200. Therefore, the job numbers from 0 to 15 should not be mixed with larger job numbers, otherwise jobs may be rejected despite free job channels.

The job numbers can accept a value from **0 to 7FFFH**.

Jobs which have been transferred to the computer interface and are waiting to be processed are deleted from the job queue by the 16th bit of the job number.

The job numbers 12 to 15 are reserved for high-priority jobs. The information on this parameter ensures that this job is given a high priority and is processed accordingly.

4.3.2 Protocol-dependent Parameters

The protocol-dependent parameters are described in Sections 6 BUEP19E Protocol, 7 BUEP03E Protocol and 8 BUEP64 Protocol.

5 R2CON Confirmation Module

5.1 Characteristic Data

Characteristic data	R2CON
Module name	R2CON
Call-up length	16 bytes
Number of parameters	5
Processing time	0.18 ms
Used markers	None

Fig. 5-1 R2CON — Characteristic data

The **R2CON Confirmation** module monitors the centralised jobs. Its function is to return information to the user while the job is processing and after the job has ended. The module retrieves the status and the fault word from the job table and transfers this information to the address which the user indicated as a parameter.

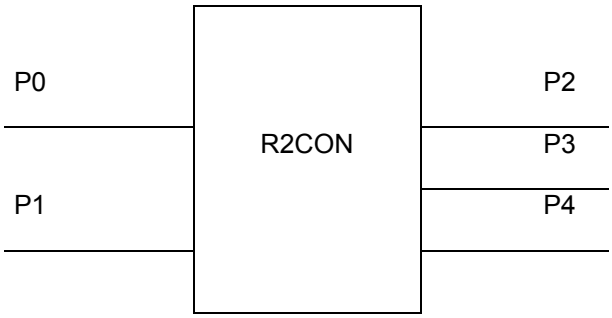
The R2CON confirmation module can be used to acknowledge either only one job per call-up or all fault-free jobs and one defective job. The R2CON retrieves the status and the fault word from the job table and transfers them to the PLC program. However, if all fault-free jobs are acknowledged, the status and the fault word contain only the information which relates to the one permitted defective job.

The R2CON should acknowledge all jobs issued by the R2REQ; the results of the individual jobs are read out.

A new job number cannot be started with this number until the acknowledgement has been read out.

5.2 Parameters

The R2CON function module has two input and three output parameters.



NOTE –

The parameters CANNOT be transferred in the data word.

5.2.1 Input Parameters

Parameter	Att.	Description
P0	W	CXN and channel number

This parameter indicates the CXN and the number of the channel on which the corresponding job has been processed.

HIGH byte = CXN

LOW byte = Channel number

Parameter	Att.	Description
P1	W	Job number (0 to 7FFFH, FFFEH or FFFFH)

Permitted entries are:

- Job numbers from 0 to 7FFFH or
- the FFFFH and FFFEH wildcard characters

Using the information supplied by a job number 0 to 7FFFH, the user selects precisely that job which he would like to acknowledge. A specific job is therefore checked systematically.
The indicated job number is mirrored in the P2 output parameter.

If the FFFEH wildcard character is indicated as a job number, the R2CON function module acknowledges all the jobs (from the interface named by P0) which ended without fault up to this time.
If jobs also ended with faults, the R2CON also acknowledges the defective job which has the highest job number and returns its status and error codes in the output parameters. Any other defective jobs are not acknowledged by this R2CON call-up.
If no job has ended, the value FFFFH is signalled back to the P2 output parameter P2.
If only fault-free jobs have ended, these are all acknowledged and the value FFFEH is signalled back to the P2 output parameter.

If the FFFFH wildcard character is indicated in the P1 parameter, the R2CON acknowledges the job which has been processed by the R200, although this acknowledgement has still not been retrieved. If this applies to several jobs, the job with the highest job number is acknowledged. This job number is then entered in the P2 output parameter. All other jobs are not acknowledged.

5.2.2 Output Parameters

Parameter	Att.	Description
P2	W	Job number

In this parameter the R2CON writes the job number of the job whose status and error codes are in the P3 and P4 output parameters.
If an explicit job number was indicated in P1, this job number is mirrored in the P2.
If no job has ended with P1 = FFFFH according to the parameterisation, the value FFFFH is signalled back to P2 as a job number.
If there is no defective job according to parameterisation of the P1 = FFFEH, however one or more jobs ended without a fault message, the value FFFEH is signalled back to the P2.

Parameter	Att.	Description
P3	W	Status

The current status of the job is output to this word for every program cycle of the R2CON. The current status of the job is indicated in the HIGH byte of this word.

HIGH byte	Meaning
00H	Job ended without fault (concluded)
02H	Job is in the CXN queue
03H	Job ended with fault(s)
04H	No job with this job number being processed

Fig. 5-2 R2CON — HIGH Byte status

The P3 LOW byte supplies a code which aids the user in implementing a suitable procedure should a fault occur (PLC response). This code is not valid until the job has ended.

LOW byte	Meaning
00H	Fault-free operation
01H	Repeat job
02H	Modify PLC program, program error
03H	Check and modify job parameters
05H	Rerun R2REQ program cycle function module
06H	Rerun R2CON program cycle function module
0AH	Check call-up parameter for the R2CON function module
10H	Repeat job; job was terminated by the PLC program or via Reset button
20H	Job fault-free, however it had reduced data length when read

Fig. 5-3 R2CON — LOW Byte status

Parameter	Att.	Description
P4	W	Fault message

If a fault has occurred, i.e. P3 HIGH byte = 03, the detailed error code can be found in P4. These codes require evaluation usually only during start-up or when service procedures are being implemented.

However, the fault message is deleted after one PLC cycle.

HIGH byte = Error class

LOW byte = Error code

Value	Error class
FFH	Function module fault message
0 to FDH	Protocol fault message

6 BUEP19E Protocol

6.1 Introduction

The BUEP19E protocol can be loaded into the R200 and R200P computer interface modules. It transfers data by means of a point-to-point connection.

As a result, data can be exchanged between two computer interface modules or one computer interface module and a central processing unit.

Data can also be exchanged between a computer interface module and a computer.

On the R200 computer interface module the protocol can either be loaded into Channel 0, Channel 1 or simultaneously into both channels. As a result, the user is presented with flexible options regarding the use of the BUEP19E protocol on the computer interface module.

The RST and PST abbreviations occur frequently in this description and are defined as follows:

RST - Requesting station

Specifies the communications partner which starts the protocol job.

PST - Peripheral station

Specifies the communications partner which responds to a received protocol job.

6.2 Protocol-specific Settings

The S3 DIP switch can be defined for the BUEP19E protocol as follows:

Switch	Setting	Meaning	Channel
SS1	-	IM number	-
SS2	-	IM number	-
SS3	ON OFF	peripheral jobs have priority centralised jobs have priority	1
SS4	OFF	reserved	1
SS5	OFF	reserved	1
SS6	OFF	reserved	1
SS7	ON OFF	peripheral jobs have priority centralised jobs have priority	0
SS8	OFF	reserved	0

Fig. 6-1 BUEP19E — S3 DIP Switch settings

NOTE –

When installing the link, ensure that the low priority is assigned to one unit and the high priority is assigned to the other unit.

6.3 Protocol-specific Parameters

The BUEP19E uses protocol-specific parameters to parameterise the data traffic for RST and PST. Each parameter is explained below.

6.3.1 Command Type / Operand Type Parameters

Parameter word	**Contents**	
	HIGH byte	LOW byte
PW4	Type of command	Type of operand
Example	41H	01H
	Output	Word

Fig. 6-2 BUEP19E — Command type / Operand type

6.3.1.1 Command Type Parameter

This parameter indicates the types of commands for the job. There are two types of commands:

'E' (45H) Input into the RST

'A' (41H) Output from the RST

The direction of the jobs always refers to the RST, i.e. an output job (41H --> 'A') transfers data from the RST to the PST and an input job (45H --> 'E') transfers data from the PST to the RST.

If a job is started with a deviating type of command, the job is terminated and a corresponding fault message is returned.

6.3.1.2 Operand Type Parameter

The LOW byte of the parameter specifies the types of operands for the job. Depending on the RST command code, eight different types of operands can be used:

Code	Data type	Number in bytes
00H	Byte	1
01H	Word	2
04H	Byte mask	2
05H	Word mask	4

Fig. 6-3 BUEP19E — Operand type parameter

When selecting the operands, check whether they are also supported by the PST.

6.3.2 RST / PST Command Code Parameter

Parameter word	Contents	
	HIGH byte	LOW byte
PW5	RST command code	PST command code
Example	44H	44H
	Data module	Data module

Fig. 6-4 BUEP19E — RST / PST Command code

In this parameter the RST command code (hex code of the command) is indicated in the HIGH byte and the PST command code is indicated in the LOW byte.

6.3.3 RST Command Attribute

Parameter word	Contents
PW6	RST command attribute
Example	17H
	Data module 23

Fig. 6-5 BUEP19E — RST Command attribute

6.3.4 RST Address — High Part

Parameter word	Contents
PW7	RST address, High part
Example	0H
	ZE200

Fig. 6-6 BUEP19E — RST Address, High part

The block address of the module, to which the RST command refers, is indicated in the PW7 parameter word.

6.3.5 RST Address — Low Part

Parameter word	Contents
PW8	RST address, Low part
Example	32H
	50 bytes

Fig. 6-7 BUEP19E — RST Address, Low part

The byte address (offset) of the utilised command is indicated in the low part of the RST address.

6.3.6 PST Command Attribute

Parameter word	Contents
PW9	PST command attribute
Example	AH
	Data module 10

Fig. 6-8 BUEP19E — PST Command attribute

The field index (for field commands) or the control code (for special commands) of the PST command is indicated in the PST command attribute.

Refer also to the RST command attribute.

6.3.7 PST Address — High Part

Parameter word	Contents
PW10	PST address, High part
Example	F0H
	ZS400

Fig. 6-9 BUEP19E — PST Address, High part

The block address of the module, to which the PST command refers, is indicated in the parameter.

6.3.8 PST Address — Low Part

Parameter word	Contents
PW11	PST address, Low part
Example	46H
	70 bytes

Fig. 6-10 BUEP19E — PST Address, Low part

The byte address (offset) of the utilised command is indicated in the low part of the PST address.

6.3.9 Data Volume Parameter

Parameter word	Contents
PW12	Volume of data (in data types) according to type of operand
Example	28H
	Volume = 40

Fig. 6-11 BUEP19E — Data volume parameter

The volume of data to be transferred, referring to the type of operand, is indicated in the parameter.

If the 'Mask' type of operand is used, the volume of data should be set to 1 The double length (set mask and reset mask) of the type (e.g. word mask) indicated in mask identifier is then always transferred in the sequence low part, high part.

Example:

Data type	PW12	Number in bytes
Byte	3	3
Word	7	14
Byte mask	1	2
Word mask	1	4

6.3.10 Coordination Parameter

Parameter word	Contents	
	HIGH byte	LOW byte
PW13	Coordination sequence point	Field coordination marker
Example	01H	FFH
	RUN	No coordination marker

Fig. 6-12 BUEP19E — Coordination parameter

The coordination parameter consists of a field coordination marker (LOW byte) and coordination sequence point (HIGH byte).

NOTE –

Field coordination marker must always be set to FFH!

CL200 controller used as a PST

The Central Processing Unit Control command in the CL200 system uses only the process coordination marker (PCM):

The PCMs are specified as follows:

00 H System STOP status

01 H System RUN status

05 H EP or STOP

07 H OM1 or STOP

FF H No process coordination

6.4 Command Description for Central Processing Units

The central processing units differentiate between field commands and special commands.

6.4.1 Field Commands

6.4.1.1 System Clock (10H)

Command	Read system clock
Command code	10H
Command attribute	0H
Address, High part	Block address
Address, Low part	Byte address 0 - 6
Operand type	All

Permitted access: Read / Write

Data format :

Byte	Contents
1.	Second
2.	Minute
3.	Hour
4.	Day
5.	Month
6.	Year ---> Base 1900
7.	Weekday

Example: Reading the clock

Command code : 10H

Command attribute : 0H

Address, high : 0H --> ZE200 with block address 0

The entire format of the clock is read / written

Address, low : 0H

Type of operand : 0H

Volume of data : 7H

6.4.1.2 System Area (25H)

Command	System area
Command code	25H
Command attribute	0H
Address, high part	Block address
Address, low part	Byte address 0 - 255
Type of operand	All

Permitted access: Read

Example:

Command code : 25H

Command attribute : 0H

Address, high : 0H --> ZE200 with block address 0

Address, low : 16H --> 16 words are read from byte address 22 of the system area

Type of operand : 01H --> Word

Volume of data : 10H

6.4.1.3 Output Image (41H)

Command	Output image
Command code	41H
Command attribute	0H
Address, high part	Block address
Address, low part	Byte address 0 - 15
Type of operand	All

Permitted access: Read / Write / Bit access

Example:

Command code : 41H

Command attribute : 0H

Address, high : 0H --> ZE200 with block address 0

Address, low : 2H --> The output image bytes A2 and A3 are read / written

Type of operand : 01H --> Word

Volume of data : 1H

6.4.1.4 Data Field (43H)

Command	Data field
Command code	43H
Command attribute	FFFFH
Address, high part	Block address
Address, low part	Byte address 0 - 8k
Type of operand	All

Permitted access: Read / Write / Bit access

Example:

Command code : 43H

Command attribute : FFFFH

Address, high : 0H --> ZE200 with block address 0

Address, low : FF0H --> The DF is read / written from address 4080 to 4111

Type of operand : 0H --> Byte

Volume of data : 20H

6.4.1.5 Data Module without Header (44H)

Command	Data module without header
Command code	44H
Command attribute	DM number 0 - 255
Address, high part	Block address
Address, low part	Byte address 0 - 511
Type of operand	All

Permitted access: Read / Write / Bit access

Example :

Command code : 44H

Command attribute : 2H --> Data module 2

Address, high : 0H --> ZE200 with block address 0

Address, low : F0H --> The DM2 is read / written from address 240 to 303

Type of operand : 0H --> Byte

Volume of data : 20H

6.4.1.6 Input Image (45H)

Command	Input image
Command code	45H
Command attribute	0H
Address, high part	Block address
Address, low part	Byte address 0 - 23
Type of operand	All

Permitted access: Read / Write / Bit access

Example:

Command code : 41H

Command attribute : 0H

Address, high : 0H --> ZE200 with block address 0

Address, low : 13H --> The output image bytes E19 and E20 are read / written

Type of operand : 01H --> Word

Volume of data : 1H

6.4.1.7 Marker (4DH)

Command	Marker
Command code	4DH
Command attribute	0
Address, high part	Block address
Address, low part	Byte address 0 - 191
Type of operand	All

Permitted access: Read / Write / Bit access

Example:

Command code : 44H

Command attribute : 2H --> Data module 2

Address, high : 0H --> ZE200 with block address 0

Address, low : F0H --> The marker bytes M32 to M66 are read / written

Type of operand : 01H --> Word

Volume of data : 11H

6.4.1.8 Timer Actual Value and Status (54H)

Command	Timer actual value and status
Command code	54H
Command attribute	0
Address, high part	Block address
Address, low part	Timer number 0 .. 127
Type of operand	Word

Permitted access: Read / Write

Data format:

T = Actual value

R = Time matrix

Z = Status bit

Read

15 0

Z	0	0	0	R	R	T	T	T	T	T	T	T	T	T	T

Write

15 0

X	X	X	X	R	R	T	T	T	T	T	T	T	T	T	T

6.4.1.9 Counter Actual Value and Status (55H)

Command	Counter actual value and status
Command code	55H
Command attribute	0
Address, high part	Block address
Address, low part	Counter number 0 - 63
Type of operand	Word

Permitted access: Read / Write

Data format :

I = Actual value

Z = Status bit

Read

15 0

Z	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I

Write

15 0

X	X	X	I	I	I	I	I	I	I	I	I	I	I	I	I	I

6.4.2 Special Commands

6.4.2.1 Identification Commands (76H)

Command	Identification command
Command code	76H
Command attribute	Control code
Address, high part	Block address
Address, low part	0
Type of operand	0

Description of the control codes

HIGH byte								LOW byte
7	6	5	4	3	2	1	0	Identification number

Identification number of different FFH number

Bit 0: 0 --> without identification code

1 --> with identification code

Bit 1 - 2 0 reserve

Bit 3: 0 --> without protocol priority

1 --> with protocol priority

Bit 4: 0 --> accept identification number

1 --> do not accept identification number

Bit 5 - 7 0 reserve

Description of the identification codes

Unit identifier (Word) - CL200 : 0100H

Type identifier (Word) - R200 : 10H

R200P : 20H

SW version (Byte) - Binary code

HW version (Byte) - Binary code

Module block address (Word) 100H .. 104H

6.4.2.2 READ Mode (7AH)

Command	Read mode
Command code	7AH
Command attribute	0
Address, high part	Block address
Address, low part	0
Type of operand	0

Permitted access: Read

Description of the read information:

Bit 0	=	0	RUN
	=	1	STOP
Bit 1	=	0	Cold start flag reset
	=	1	Cold start flag set
Bit 2	=	0	Outputs disabled
	=	1	Outputs enabled
Bit 8	=	0	Firmware available
	=	1	Firmware not available
Bit 9	=	0	Firmware loading possible - boot mode
	=	1	Firmware loading disabled

Example:

Command code : 7AH

Command attribute : 0H

Address, high : 0H --> The mode of the ZE200 with block address 0 is read

Address, low : 0H

Type of operand : 0H

Volume of data : 0H

6.4.2.3 CONTROL Module (7AH)

Command	CONTROL module
Command code	7AH
Command attribute	Control code
Address, high part	Block address
Address, low part	0
Type of operand	0

Permitted access: Write

Code	Description
0000H	Switch controller to RUN
0001H	Switch controller to STOP
0002H	Set restart flag
0003H	Reset restart flag
0004H	Disable outputs
0005H	Enable outputs
0006H	Clear entire fixation
0007H	Clear all remanent areas markers, times, counters, but not data field; only in STOP
0107H	Clear markers (only in STOP)
0207H	Clear times (only in STOP)
0307H	Clear counters (only in STOP)
0507H	Clear data field (only in STOP)
0008H	Clear entire reference list (overwrite with FFH; only in STOP)
000BH	Save RAM application program on memory card (only in STOP)
000CH	Save RAM application program in flash (only in STOP)
000EH	Quit boot mode (after loading firmware)
000FH	Put controller into boot mode (only in STOP) Restart with the next reload of the firmware from the PG

Example:

Command code : 7AH

Command attribute : 1H --> STOP control code

Address, high : 0H --> The ZE200 with block address 0 is switched to STOP

Address, low : 0H

Type of operand : 0H

Volume of data : 0H

6.5 Fault Messages

The BUEP19E protocol generates fault information which is divided into three areas:

- PLC response (Byte)
- Error class (Byte)
- Error code (Byte)

The fault information is filed in the R2CON check-back parameters in the following sequence:

P3 parameter

HIGH byte	LOW byte
Status	PLC response

P4 parameter

HIGH byte	LOW byte
Error class	Error code

6.5.1 Status

The current status of the job is specified in the Status by the function module.

Status	Meaning
00H	Job ended without fault
02H	Job being processed
03H	Job ended with fault(s)
04H	No job being processed with this job number

6.5.2 PLC Response

The PLC response should provide the user with information on further procedures.

The following conventions apply:

PLC response	Meaning
00H	No response, job fault-free
01H	Repeat FM job
02H	Program fault, change PLC program
03H	Change protocol parameter
05H	Rerun the program cycle on the R2REQ
06H	Rerun the program cycle on the R2CON
0AH	Check FM parameter
10H	Active job terminated by the user
20H	Job fault-free, however with reduced data length

Fig. 6-13 BUEP19E — PLC Response

6.5.3 Error Class

The error class refers to the generation point of the fault information. The following conventions apply:

Error class	Meaning
00H	Fault-free
30H	System bus
31H	Operating system
32H	PST job implementation
33H	RST job implementation
34H	Protocol sequence
FFH	Fault message from function modules

Fig. 6-14 BUEP19E — Error class

6.5.4 Error Catalogue

Fault information			Meaning
PLC response	Error class	Error code	
00	00	00	Fault-free job
01	30	F0..FF	ZE200 communications fault
01	31	E0..EF	R200 communications fault
01	32	F0..FF	ZE200 communications fault
01	34	05	Protocol cannot be implemented due to an internal protocol fault (RST) - No connection - Faulty connection - Interface hardware not ready - The incoming message cannot be analysed
02	31	10	Module not addressable; the indicated block address has no module number
02	31	97	Command code undefined
02	31	98	Buffer overflow
02	32	02	Memory access fault Faults occurred when RST memory area was accessed. Data incorrectly read or incompletely written
02	32	03	Wrong memory type The type of access for the addressed PST memory is not permitted (e.g. writing to EPROM)
02	32	05	Internal communications fault Fault during the processing of a commands
02	32	20	Unknown command code
02	32	21	Unknown protocol identifier
02	32	23	Invalid coordination marker
02	32	25	Wrong parameter identifier
02	32	26	Block-length fault
02	32	28	Unknown message type
02	32	29	Unknown command type
02	32	3A	Wrong alignment
02	32	3B	Invalid address area
02	32	3C	Invalid parameter
02	32	3D	Invalid operand type
02	32	40	Identification still not implemented
02	32	63	Buffer overflow Data length is larger than the available BUEP19E memory location of 200H bytes
02	32	D2	Coordination marker disabled (occurs only for field coordination)

Fig. 6-15 BUEP19E — Fault messages, Part 1

Fault information			Meaning
PLC response	Error class	Error code	
03	30	21	RUN fault (RST)
03	30	23	Field access prohibited (RST)
03	30	24	Field protection active (RST)
03	30	25	Timer disabled (RST)
03	30	26	Module number too large (RST)
03	30	27	No data module (RST)
03	30	28	Data module too small (RST)
03	30	40	Fault when writing to on-board flash memory
03	30	41	Fault when clearing on-board flash memory
03	30	50	Memory card write-protected
03	30	51	Unknown memory card type
03	30	52	No memory card
03	30	53	Fault when clearing memory card
03	30	54	Fault when reading memory card
03	30	55	Fault when writing to memory card
03	30	56	No memory card hardware
03	30	60	Memory card not for this controller
03	30	61	Memory-card data defective
03	30	62	Save, recover not possible during asynchronous balanced mode
03	30	63	Memory card contains firmware data
03	30	64	No PLC program in RAM
03	30	90	No field defined for this command
03	30	93	Invalid parameter
03	30	95	Fault when writing to the system clock
03	30	96	Fault when reading/writing to the internal peripheral bus
03	30	97	Unknown command code
03	30	98	Buffer overflow
03	30	C1	Command condition not fulfilled
03	30	C2	Unknown coordination

Fig. 6-16 BUEP19E — Fault messages, Part 2

Fault information			Meaning
PLC response	Error class	Error code	
03	32	10	Module not addressable The indicated block address has no module number
03	32	21	RUN fault
03	32	23	Field access prohibited, unauthorised access mode
03	32	24	Field protection active
03	32	25	Timer disabled
03	32	26	Module number too large
03	32	27	No data module
03	32	28	Data module too small
03	32	40	Fault when writing to on-board flash memory
03	32	41	Fault when clearing on-board flash memory
03	32	50	Memory card write-protected
03	32	51	Unknown memory card type
03	32	52	No memory card
03	32	53	Fault when clearing memory card
03	32	54	Fault when reading memory card
03	32	55	Fault when writing to memory card
03	32	56	No memory card hardware
03	32	60	Memory card not for this controller
03	32	61	Memory-card data defective
03	32	62	Save, recover not possible during asynchronous balanced mode
03	32	63	Memory card contains firmware data
03	32	64	No PLC program in RAM
03	32	90	No field defined for this command
03	32	93	Invalid parameter
03	32	95	Fault when writing to the system clock
03	32	96	Fault when reading/writing to the internal peripheral bus
03	32	97	Unknown command code
03	32	98	Buffer overflow
03	32	C1	Command condition not fulfilled
03	32	C2	Unknown coordination
03	33	10	No valid block addr. for the indicated module number
03	33	20	Wrong RST command code
03	33	23	Command for RST larger than 80H
03	33	26	Block-length fault
03	33	29	Wrong command type
03	33	3C	No module type for indicated module number
03	33	3D	Wrong operand type
03	33	47	Wrong data length
03	33	63	Buffer overflow Data length is larger than the available BUEP19E memory location of 200H bytes
10	31	60	Passive job terminated
10	31	61	Active job terminated
20	'Length'		Job fault-free, requested data length <> recommended data length.

Fig. 6-17 BUEP19E — Fault messages, Part 3

7 BUEP03E Protocol

7.1 Introduction

The BUEP03E transfer protocol handles all communication tasks between the CL200 computer interface module and connected peripheral devices, such as code readers, measuring instruments, positioning controllers, intelligent control panels, printer, terminal, etc.

The BUEP03E protocol is loaded onto the R200/R200P module and receives the jobs in the form of commands from the central processing unit.

The BUEP03E protocol consists of several commands. The operator can use these commands to compile a "user-defined" protocol. Such protocols are generated in the form command combinations. As a result, the flexibility of the BUEP03E with respect to a variety of peripheral devices is ascertained.

The BUEP03E protocol enables communication with those peripherals which do not adhere to a specific protocol. This communication procedure is handled by the Receive command which receives all transmitted characters and subsequently presents them to the operator for further interpretation.

7.2 BUEP03E Protocol — Application Areas

The BUEP03E transfer protocol implements the following tasks:

- Receives data from peripherals (e.g. code reader, measuring instruments, etc.) and conveys it to the programmable logic controller (PLC).
- Transmits data from the PLC to the peripherals (e.g. printer, etc.).
- Reduces the burden on both PLC program and PLC programmer by implementing the printer formatting and code conversion tasks on the R200 computer interface module.

The BUEP03E protocol includes the Formatted Output which provides the operator with a simple method of sending the texts, or texts combined with variables, to the printer.

Using the command parameters, the operator specifies the data and data formats to be transmitted to, or received from, the peripheral devices. The resulting commands are then implemented on the R200 computer interface module by means of the R2REQ function module. They enable access to the following data ranges in the PLC.

- Data modules
- Data fields

7.3 Explanation of Terms

UART Receive buffer: The R200 operating system reads all the characters into this buffer via the serial interface. This receive buffer is located on the R200 module.

BUEP03E Receive buffer: The BUEP03E reads the characters from the UART receive buffer and writes them to its own BUEP03E receive buffer, the size of which can be selected from 10 to 256 bytes. This receive buffer is located on the R200 module.

PLC Receive buffer: This receive buffer, defined by the user on the PLC side, accepts the contents from the BUEP03E receive buffer. This buffer is therefore the same size. This receive buffer is located on the central processing unit.

Unrestricted Receive: The receive process receives all characters and writes them to the designated Receive buffer; no conditions are taken into account. The Receive process can be concluded with the monitoring-time overflow or stopped via the Terminate Job command.

Conditional Receive: The receive process can take account of the conditions with regard to start and end identifiers, termination characters, receive-data length and monitoring time. The characters are accepted only under the preset conditions. The receive process can be ended by end identifier(s), receive-data length or monitoring time, or terminated by a termination character or a Terminate Job command.

Receive Mode: The receive features, e.g. start, end identifiers, cancel criteria, data length, number of BCC, etc.

Ring buffer: For the intermediate storage of data. The ring buffer is managed by RD and WR pointers. The WR pointer is counted up to the end of the ring buffer and is then placed at the start of the ring buffer. If the RD pointer stops counting due to data being read out previously, the RD pointer may be overtaken by the WR pointer.

RD pointer: For reading out the data from the ring buffer.

WR pointer: For writing the data to the ring buffer.

User pointer: Situated in the first word of the PLC receive buffer, it indicates the relative position of the character which was received last.

Job parameter list: Specifies command parameters and is addressed by R2REQ-parameters P0 - P2.

Command chain: Links several commands with the Start command via the command position number.

Identifier: Three words which are used for determining the address in the DM or DF.

The words in detail:

1st word: Field type (44H = DM, 43H = DF).

2nd word: Field index (DM = 0-255, DF = FFFFH).

3rd word: Field offset (DM = 0-510, DF = 0-8191 Byte).

Caution: Only the even-numbered byte addresses are permitted.

Control text: Text combined with format instructions.

7.4 Transmission Format

The non-displaying ASCII characters are used to control the protocols. These control characters, like the other data, are written to memory as a hex code by the user. All the data is then output with the Transmit command via the serial interface. The data can be input into the PLC memory either via the PG editor or the PLC program commands. The PG editor only allows the ASCII and hex formats. In both the ASCII and hex formats the addresses are zero-filled up to the word boundaries. A single control character can therefore not be input with the PG editor. The user must edit the required control characters, possibly combined with a text character, as a hex word.

No.	Symbol	Type	Sign	Data field	F
D0	Text	Word	N	5402	H
D2		ASCII	N	ESTE	

Fig.: Inputting text with control characters

The first line is input as a hex word and the second line as ASCII text in the PG editor.

The hex dump of the data in the controller:

02 54 45 53 54 45 ==> STX TEST

ASCII	Hex	Description
STX	02	Start of Text ASCII character
ETX	03	End of Text ASCII character
ETB	17	End of Block ASCII character
CAN	18	Cancel ASCII character
NUL	00	All bits = 0 ASCII character

Fig. 7-1 Control characters — Protocols

ASCII	Hex	Description
CR	0D	Carriage Return ASCII character
LF	0A	Line Feed ASCII character
FF	0C	Form Feed ASCII character
TAB	09	Tabulator ASCII character
ESC	1B	Escape ASCII character

Fig. 7-2 Control characters — General-purpose

The commands execute only the specified tasks and do not analyse the responses of the partner module. Any response to the fault statuses must occur on the PLC side. For example, a data request is transmitted to a peripheral, but is not understood by the latter. This case must be analysed on the PLC side and an appropriate response must be issued.

7.5 Transmission Sequence

7.5.1 Receiving Characters

Two different receive modes can be specified by the Receive Mode command.

a) Unrestricted Receive: The user defines a PLC receive buffer (max. 256 bytes) on the PLC side. When the Receive command activates communication via R2REQ, all characters are received and filed in the BUEP03E receive buffer until

- the monitoring time overflows
- or the job is terminated
- or the receive-data length has been reached.

Unrestricted Receive also facilitates communication with the peripherals which have variable protocol.

A practical case: BUEP03E should receive data from a code reader. However, the code reader transmits the data with a start identifier only during the first transmission. If the transmission has to be repeated, the start identifier would be missing. In practice, this means that the protocol sequences are not always uniform.

In such a case the user can receive all the characters and react accordingly, as indicated on Page 7-29 - Example 1.

b) Conditional Receive: Receive Mode parameters, such as start and end identifiers, termination characters and receive-data length, can also be specified by the Receive Mode command. If these identifiers are recognised in the data flow, the appropriate response is implemented. All received characters (even the control characters) are received in the BUEP03E Receive buffer.

The Data Copy command copies all data from the BUEP03E Receive buffer into the PLC Receive buffer for interpretation by the user.

7.5.2 Transmitting Characters

There are two modes available:

a) Unformatted output: The Transmit command transmits data from a PLC transmit buffer (DM, DF, DB) without conversion by the serial interface. Reformatting is not implemented, i.e. a 0FFH in the memory causes a 0FFH in the line.

Using this procedure the user can easily output self-formulated request and acknowledgement information. For example, if the connected device at the start of the communication requires an STX control character, this can be edited as a hex word (STX = 02H) combined with a text character in the memory which is to be transmitted. This control character is then transmitted with the other data.

b) Formatted output: In some applications (e.g. printer) texts or texts with variables must be output according to the following display types

- Hex
- Decimal
- ASCII characters
- Floating point

The Formatted Output command, described on Page 7-22 fulfils these requirements.

7.6 Receive Buffer

7.6.1 UART Receive Buffer

The data received via the serial interface is first filed in the UART Receive buffer. This Receive buffer is designed as a ring buffer and contains a total of 384 characters. This buffer is managed by the R200 operating system. The characters are read into this buffer via the interface, independent of the BUEP03E protocol. The characters are read out character by character from the BUEP03E log and filed in the BUEP03E Receive buffer. The oldest character is always read out first. The character which indicates the internal RD pointer is read out and the internal RD pointer is moved by one character. The UART Receive buffer can be reset (flushed) if the user issues the Reset Receive Buffer command. Information such as

- Buffer empty
- Character there
- Receive fault

is also available for processing. The receive fault is indicated as a centralised fault (buffer overflow, parity fault). The BUEP03E protocol responds to this fault by issuing a Reset command to the UART Receive buffer and returning a fault message to the user.

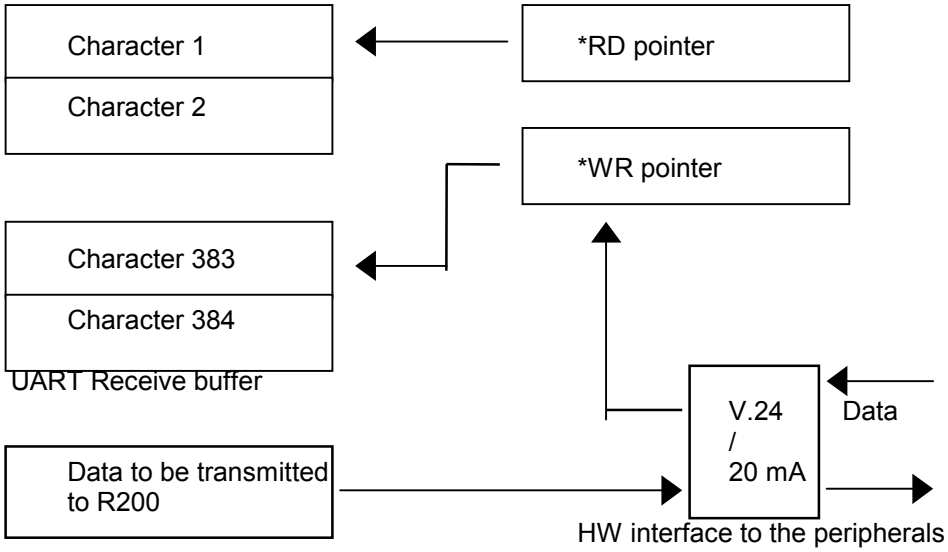
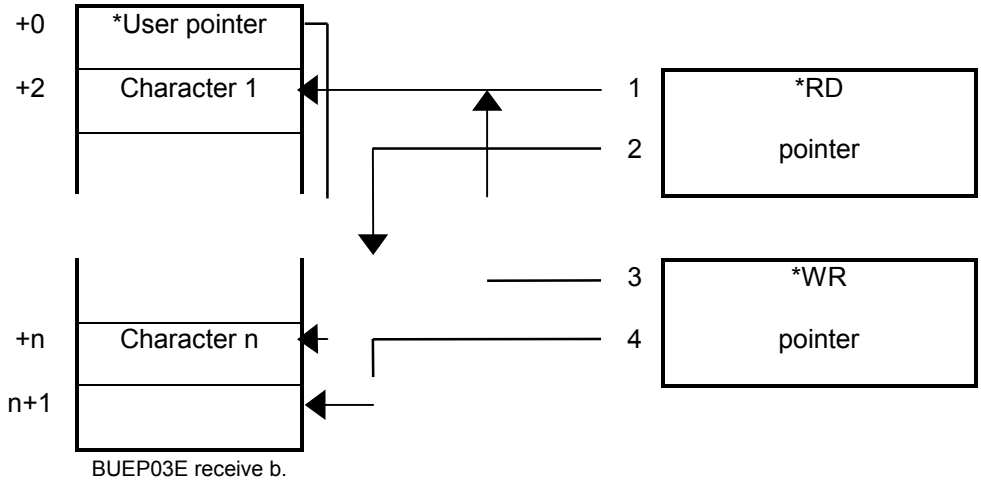


Fig. 7-3 UART Receive buffer

7.6.2 BUEP03E Receive Buffer

The Receive command continually copies data from the UART Receive buffer into the BUEP03E Receive buffer. The user can select the size of this BUEP03E Receive buffer by issuing the Receive command via a parameter, however the size must be within the range of 10 to 256 bytes. Otherwise, a fault message is returned and the BUEP03E Receiver buffer is not applied.

The BUEP03E Receiver buffer is managed as a ring buffer, as long as the user does not influence the RD and WR pointers by issuing the Reset Receive Buffer command. The first word in the defined BUEP03E-Receive buffer is reserved for the user pointer. The user pointer points to the character which was last read in. A maximum of 254 bytes are available for the characters. The user pointer begins with 0 (zero), although "Character 1" is in the third position in the BUEP03E Receive buffer.



1+3 : RD and WR pointers after Reset Receive Buffer has been selected

4 : WR pointer after n-character has been read into the Receive buffer

2 : RD pointer after n-character has been read out of the Receive buffer

2+4 : Read in n-character and output to PLC

Fig. 7-4 BUEP03E — Receive buffer

The RD and WR pointers are required for internal management of the ring buffer. These pointers are always reset with the Receive command and can also be reset at any time by the user with the Reset Receive Buffer command. After being reset, both pointers point to the start of the BUEP03E Receive buffer. If n-characters are now received, the WR pointer is increased by n-characters and points to the next free location in the BUEP03E Receive buffer (n+1). The RD pointer points to the character which was first received until the user has read the data with the Data Copy command. RD and WR pointers are then equal and (RD_Pointer-1) defined as user pointers.

If the characters are not retrieved in time by the user, the WR pointer may overtake the RD pointer, resulting in a loss of data. The user is informed of a data loss when he retrieves the data with the Data Copy command. If this fault occurs, the data is not copied into the PLC Receive buffer and the RD and WR pointers are reset by BUEP03E. When the next Data Copy process occurs, the characters are copied to the head of the PLC memory.

7.6.3 PLC Receive Buffer

The PLC Receive buffer is the same size as the BUEP03E Receive buffer. The received data is collected in this buffer and provided to the user for interpretation.

The Data Copy command writes all the data which is in the BUEP03E Receive buffer into the PLC Receive buffer in one cycle.

7.6.4 Data Exchange Between Receive Buffers

The previous sections explained in detail the internal design and management of the three Receive buffers (UART, BUEP03E and PLC Receive buffers). This section describes how data exchange and data flow has been organised.

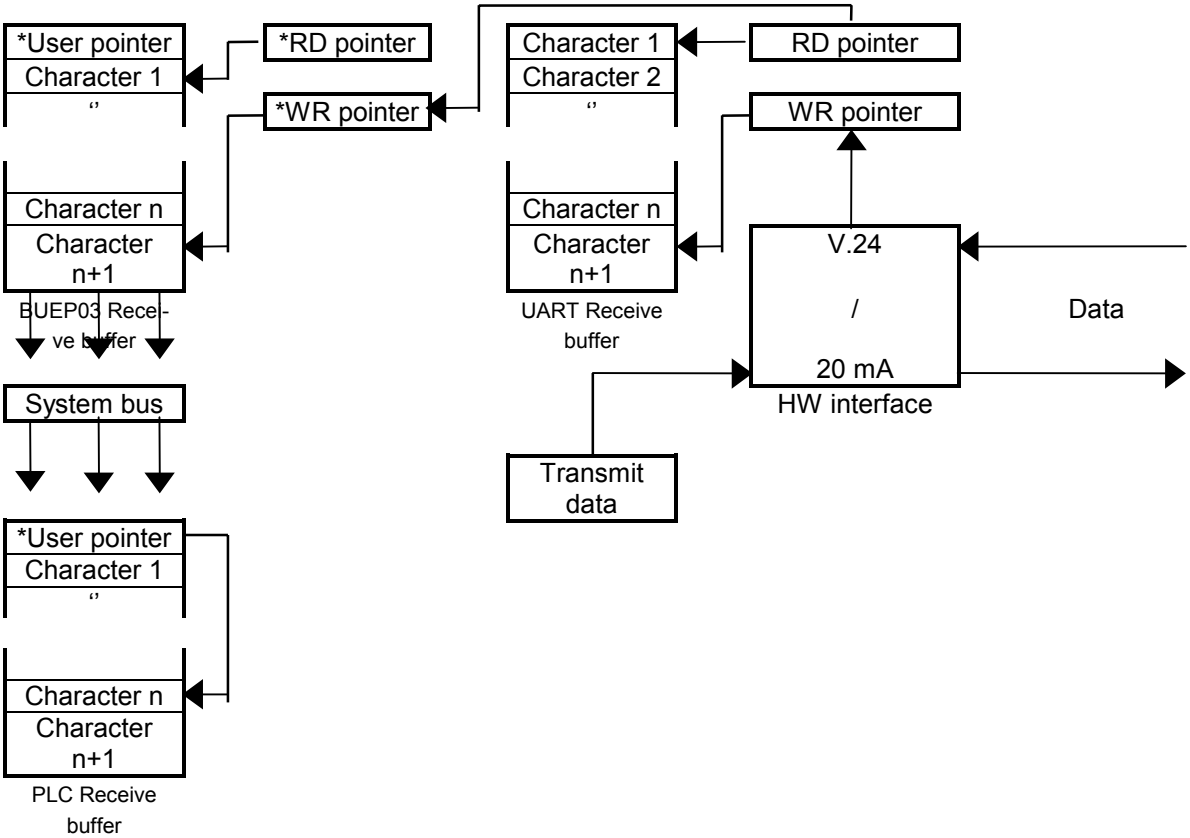


Fig.. 7-5 BUEP03E — Data exchange between Receive buffers

The characters in the UART Receive buffer are read into the BUEP03E Receive buffer character by character. The user can use Data Copy to read all the data which is in the BUEP03E Receive buffer into the PLC Receive buffer.

The Transmit command defines a transmit area on the PLC side. BUEP03E reads this transmit area into a transmit buffer and transmits the data out of this buffer to the serial interface.

7.7 BUEP03E Commands

7.7.1 Command Activation

The BUEP03E protocol incorporates several commands which should be activated by the user for communication purposes. The commands are activated by the R2REQ function module.

The first parameters (P0 - P2) of the R2REQ function module point to a memory (DB, DF) in which the protocol-specific job parameter list has been filed.

Protocol-specific parameters:

PW1 : Result of the job

PW2 : CXN and channel number

PW3 : Job number (0 - 32767)

The user assigns PW4 - PW15 with parameters according to the command.

A command can only be active once at any one time. If the user nevertheless attempts to start a command which is already active, BUEP03E terminates the command and issues a fault message. The BUEP03E protocol ensures that the command, e.g. Receive, cannot be active twice at the same time.

7.7.2 Operating Method

The BUEP03E protocol provides the user with a number of commands These commands then execute the jobs which are required for communication.

The following commands have been defined:

- Start
- Receive
- Transmit
- Reset Receive Buffer
- Data Copy
- Formatted Output
- Receive Mode
- Terminate Job

Each command is indicated by a job parameter list. All these commands are activated by the R2REQ. The Terminate Job command is provided by the R200 system. The remaining commands form the BUEP03E protocol.

In order to be able to activate a peripheral, the user has to execute many of these elementary commands via a function call module. This is a major problem from the point of view of time and management. It would be easier to link several elementary commands together and start them via a function call module. This method of combining commands is explained on Page 7-12.

7.7.2.1 Interlinking via BUEP03E START Command

The associated job parameter lists are filed contiguously one after the other in the PLC memory (DM, DF). Each job parameter list specifies a command (==> job). The sequence of the commands in the PLC memory specify the positions of the commands. Application-specific combinations of the command positions can be stipulated with the Start command.

If the Start command is now started by means of the R2REQ function module, the command chain, indicated via identifiers, is retrieved from BUEP03E and executed according to the stipulated sequence.

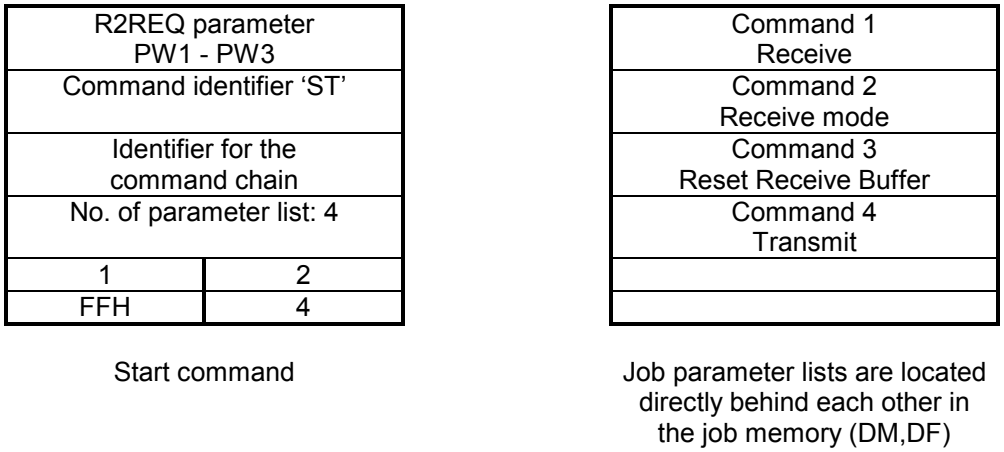


Fig. 7-6 BUEP03E — Interlinking command

The jobs are processed in the following sequence: 2, 1, 4, End

With this method the maximum job memory is restricted to one data module (= 512 bytes). A maximum of 16 commands can be defined per job memory and, depending on the application, can be linked to each other.

This method unloads the system bus by transferring all the job parameter lists once. A command may occur several times in the command chain.

During the active phase of Receive the following individual commands can started parallel to the commenced command chain.

- Data Copy
- Transmit
- Reset Receive Buffer
- Receive Mode
- Formatted Output

Parallel operation is only possible with Receive in the command chain, not in single command mode.

If a fault occurs (e.g. invalid parameters, system bus fault), the command chain is terminated immediately and the fault message is returned with the interlinking depth.

In order to establish a single communication with a peripheral, the interlinking of the following commands must be indicated with the Start command.

- Set Receive mode
- Request data
- Enable Receive
- Acknowledge Receive

The Data Copy command is not inserted into the command chain, but is activated parallel to Receive. The Start command starts the command chain.

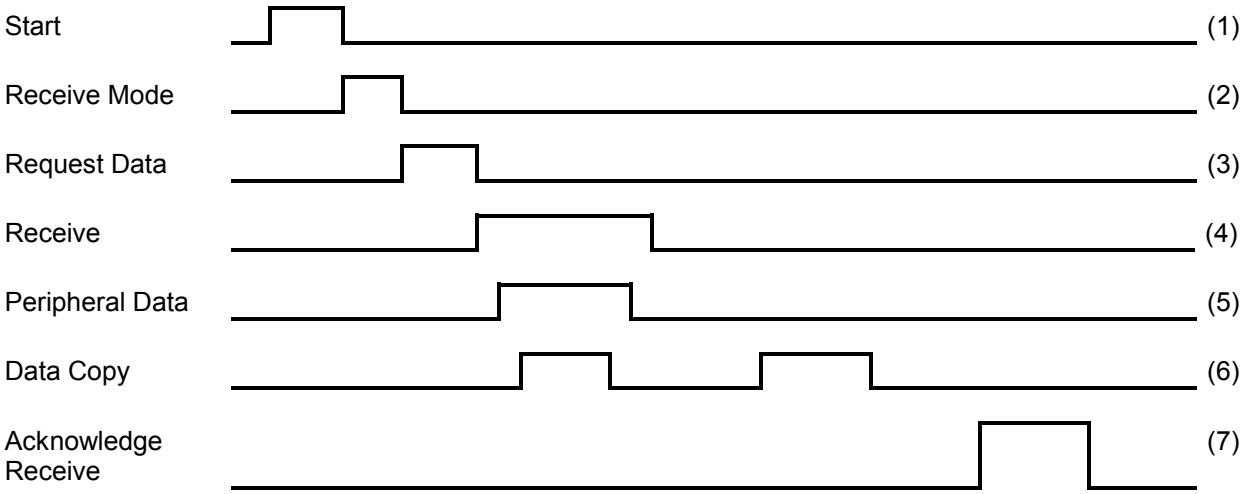


Fig. 7-7 BUEP03E — Chronological sequence of a single communication

(1) Start the command chain

(2) Set Receive mode (end character, Receive-data length).

Do NOT specify a start character, otherwise a peripheral NAK is not recognised as BUEP03E would be waiting for the start character.

(3) Request data by "Transmitting" a control text.

(4) Switch ON the (unrestricted) Receive.

(5) Peripheral responds to the data request by BUEP03E.

(6) At the same time as the receive process, copy the data into the PLC Receive buffer and analyse. There are two options available for this step:

- Peripheral transmits the data after the data request has been successfully received by BUEP03E. The data is retrieved until, e.g. an end identifier is recognised.
- Peripheral transmits, e.g. an NAK and requests a repeat of the data request. In this case either the communication can be terminated with a Terminate Job sequence or the step (3) can be repeated.

(7) Communication is terminated via the stipulated conditions. The received data is checked by the PLC program and positively acknowledged if correct. If a fault occurs, the received data is negatively acknowledged and communication can be restarted at Step (1).

7.7.3 Command Types

This section provides a detailed explanation of the BUEP03E commands and their parameters and lists possible application examples. These examples should be regarded as an introduction to the *BUEP03E Command Language*.

When using the commands, the user should NOT impose unnecessarily high traffic loads on the system bus. High loads can be prevented by skilful use of the commands in program loops and function modules. For example, if a job is complex, the commands should be linked to each other as only one R2REQ call is adequate for activation of the command chain. The data should only be retrieved with the Data Copy commando when required, as there is no point in calling the data until it is available. The data receive times in an ideal case are indicated in the table below. A practical value would be 100 ms for 100 characters at a baud rate of 19200. The 100 characters to be received can therefore be retrieved within 100 ms when the serial interface is operating at a baud rate of 19200.

Baud rate (bps)	Time for one character	Time for 100 characters
19200	0.50 ms	50 ms
9600	1.00 ms	100 ms
4800	2.00 ms	200 ms
2400	4.00 ms	400 ms
1200	8.00 ms	800 ms
600	16.00 ms	1600 ms

Fig. 7-8 BUEP03E — Transfer times

7.7.3.1 START Command

Description: This command defines the execution sequence of a command chain in the PLC memory (DM, DF) and starts this command chain.

Parameter word	Contents	
PW4	Command identifier - ST (Start)	
PW5	Field type	Identifier on the command chain
PW6	Field index	
PW7	Field offset	
PW8	Number (1-14) Number of commands	
PW9	2nd command	1st command
PW10	4th command	3rd command
PW11	6th command	5th command
PW12	8th command	7th command
PW13	10th command	9th command
PW14	12th command	11th command
PW15	14th command	13th command
PW16	reserved	reserved

Fig. 7-9 BUEP03E — Start parameters

Valid position numbers are 1 to 14 and FFH. An FFH as a position number denotes the end of the command chain. If 14 commands have been linked, an end identifier (0FFH) is NOT required.

NOTE –

Changes to the job memory (command memory) are not considered until the next command starts.

7.7.3.2 RECEIVE Command

Description: This command enables data to be received without restriction via the interface and written to the indicated.

Parameter word	Contents
PW4	Command identifier - RX (Receive)

Parameter word	Contents
PW5	Monitoring time in 10 ms matrix

Maximum selectable time (10 ms * 65535) is approximately 10 min. When 0 (zero) is specified, the time monitor is switched OFF. The monitoring time indicates the maximum time between two characters.

NOTE –

The sequence of the monitoring time in the PW5 denotes the normal end of the receive process and not a termination with fault.

If a data copy is attached, a fault 0305H is issued in the status word and 4003H in the fault word, provided a character has not already been received. (Receive buffer empty)

Parameter word	Contents
PW6	PLC Receive buffer size (10-256 bytes)

This parameter specifies the size of the Receive buffer on the R200 module and on the PLC side.

Parameter word	Contents
PW7	Receive-data length (max. 256 bytes)

This parameter can specify, e.g. the length of the data during the Receive process. BUEP03E concludes the Receive process quite normally when the specified number of characters has been reached. At the same time *all received characters* (including control characters) are counted. When the length is 0 (zero) the string-size condition is ignored.

PW8 - PW16 are reserved.

7.7.3.3 TRANSMIT Command

Description: This command enables data to be transmitted from the memory to the peripherals via the interface; the data is output without being converted.

Parameter word	Contents	
PW4	Command identifier - TX (Transmit)	
PW5	Field type	Identifier on the command chain
PW6	Field index	
PW7	Field offset	
PW8	Length of the transmit data in bytes	

Fig. 7-10 BUEP03E — Transmit command parameters

Max. possible length is 512 bytes (= one DM size). For larger quantities of data the user should start several jobs.

PW9 - PW16 are reserved.

7.7.3.4 RESET RECEIVE BUFFER Command

Description: This command enables the internal RD and WR pointers of the BUEP03E and UART Receive buffers to be reset.

Parameter word	Contents
PW4	Command identifier - RS (Reset)
PW5	0: Reset UART Receive buffer 1: Reset UART and BUEP03E Receive buffer

Fig. 7-11 BUEP03E — Reset Receive Buffer command parameters

PW6 - PW16 are reserved.

7.7.3.5 RECEIVE MODE Command

Description: The following modes can be selected with this command:

- Start character
- End character
- Number of BCC
- Termination character
- Marker number for interlinking depth

The selected Receive modes are valid until they are redefined. The Receive modes can be modified within a command chain if the Receive process (Receive command) is inactive. If an attempt is made to modify a receive mode while Receive is active, the process is terminated and a fault message is issued.

The Receive mode values are reset during

- Power ON and when the standby supply is defective or missing
- Loading of the protocol

and remain unchanged during a

- R200 Reset procedure
- Stop/Run procedure

During a "ZS Stop/Run" procedure the R200 operating system terminates all inactive jobs and activates a Terminate Job sequence for active jobs.

An R200 Reset procedure is not registered by the central processing unit.

Basic adjustment of the Receive mode values:

- No start character
- No end character
- No BCC
- No termination character
- Interlinking depth not returned

Job parameter list:

Parameter word	Contents
PW4	Command identifier - MD (Receive mode)

Parameter word	Contents	
PW5	No. of start characters	No. of end characters

End characters:

0 : No end condition

1 : One end character

2 : Two end characters

Start characters:

0 : No start condition

1 : One start character

2 : Two start characters

The start characters may occur in the data flow. If only one end character has been defined, it must NOT occur in the data flow, otherwise the Receive process is terminated. However, if two end characters are defined, any number of end characters may occur in the data flow, provided one end character is not directly behind the other. If one end character is directly behind the other, the Receive process is always terminated.

Parameter word	Contents	
	HIGH byte	LOW byte
PW6	2nd start character	1st start character

These start characters are only considered when the number has been specified in the HIGH byte of PW5, otherwise they are ignored.

Parameter word	Contents	
	HIGH byte	LOW byte
PW7	2nd end character	1st end character

These end characters are only considered when the number has been specified in the LOW byte of PW5, otherwise they are ignored.

Parameter word	Contents		
	HIGH byte	LOW byte	
PW8	Number of BCC	Termination type	No. of termi-nations

No. of termination characters:

0 : No termination characters

1-4 : Number of termination characters

Termination type:

0 : Individual termination characters

1 : All termination characters

Number of BCC:

0 : No BCC characters

1 : One BCC character

2 : Two BCC characters

Termination type 1: The termination process requires that all the defined termination characters occur one behind the other in the data flow.

Termination type 0: One of the defined termination characters in the data flow causes the termination process.

BCC : The Block Check Count has a value of one byte or one word which is formed according to a specific method (e.g. LRC, CRC) via a data record. BCC is formed on the receiver side according to the same method and compared with the received BCC. This method enables any receive faults to be recognised.

BCC can only be expected during the end-character sequence and is in addition to the received data.

Parameter word	Contents	
	HIGH byte	LOW byte
PW9	2nd termination character	1st termination character
PW10	4th termination character	3rd termination character

These termination characters are only considered when the PW7 number has been defined between 1 and 4, otherwise they are ignored.

PW11:

Specifies the marker byte (0 - 255) in which the user wants to have the interlinking depth if a fault or termination occurs. If values are larger than 255, an interlinking depth is not returned. Interlinking depth 1 refers to the first, 2 to the second command in the command chain.

PW12 - PW16 are reserved.

7.7.3.6 DATA COPY Command

Description: This command enables the data which has been read into the BUEP03E Receive buffer to be copied from the PLC program into the PLC Receive buffer. If the BUEP03E Receive buffer is not emptied quickly enough with this command, a data loss may occur which is signalled back. If no new characters have arrived after the last Data copy, the user is informed by a fault message.

The BUEP03E Receive buffer is always copied 1:1 into the PLC Receive buffer. The old data in the PLC Receive buffer is always overwritten by this command.

Parameter word	Contents	
PW4	Command identifier - DC (Data copy)	
PW5	Field type	Identifier
PW6	Field index	on
PW7	Field offset	PLC Receive buffer

Fig. 7-12 BUEP03E — Data Copy command parameters

PW8 - PW16 are reserved.

7.7.3.7 FORMATTED OUTPUT Command

Description: The Formatted Output command enables text, variables or text combined with variables to be output to the printer. This command interprets the control text and associated variables indicated by the parameters (PW5 - PW7). The format instructions have been integrated in the control text and begin with a **%** character. The characters which do not begin with the **%** character appear unchanged in the output. The format instructions ensure the required representation method of the next argument.

The control text is separated from the arguments with a comma. The arguments (variables) are situated one behind the other after the control text (comma) and always begin at the word boundaries. The numerical values of the variables must be copied by the PLC program to the appropriate location after the comma.

The PG editor inserts a 0 (zero) into the control text if the text ends with an odd number. This 0 (zero) is ignored by BUEP03E.

The control text and the arguments may be in a data module, for example. The identifier is passed to this data area with the Formatted Output command.

Possible control text with two arguments (see also Page 7-15 in the Start section - Example 4):

Temperature of %3d degrees is too high by %3d,<Arg1><Arg2>

The printer would print the text

Temperature of 100 degrees is too high by 10 degrees

if the value of Arg1 = 100 and Arg2 = 10. There are as many arguments as there are format instructions. If this is not the case, a fault message is returned.

The Formatted Output command provides the following format instructions:

%+-mu	Decimal number (unsigned)	1 word (0-65535)
%+-md	Decimal number (signed)	1 word (32767-32767)
%#x	Hex number	1 word
%c	Single ASCII character	1 word
%+-m.nf	Floating-point number	2 words
m	: Total number of positions	
n	: Positions after decimal point	
u, d, x, c, f	: Identifiers for format instructions	
+	: Output with sign	
-	: Left-justified output (normal: right-justified)	
+-	: Left-justified and with sign	
#	: Output of hex numbers with leading zeros	

A character variable is in the LOW byte of the word.

A floating-point number is positioned in memory according to the Low-High word principle and is represented with single accuracy.

All numbers are displayed from the **%** character, right or left-justified (see above). A hex number can be displayed with (%#x) or without (%x) leading zeros.

If the actual "%", ",", and "\" characters are to be output, the following control sequences are used:

- **\%** prints a **%** character
- **\,** prints a **,** character
- \\ prints a \ character

Parameter word	Contents	
PW4	Command identifier - FO (Formatted Output)	
PW5	Field type	Identifier on
PW6	Field index	text with
PW7	Field offset	formats and variables

Parameter word	Contents
PW8	Length (control text + arguments) in bytes

The length may be indicated as an estimate, however the estimate must be at least as large as the actual length, i.e. if the actual length of the data is 48 bytes, the estimated length may be indicated as 50 bytes. BUEP03E actually copies 50 bytes from the PLC memory (DM, DF) into the R200 memory, however the actual data itself would be selected from the volume of data in the R200 memory. It is not necessary to count the text precisely to the byte. However, the estimated length should not be excessive (in the case of DM, for example, the max. length always = 512 bytes). On account of the system bus access times, the length should be indicated as accurately as possible.

PW9 - PW16 are reserved.

Floating-point numbers

The floating-point numbers are represented according to two methods. Internal representation specifies how floating-point numbers have been filed in memory. External representation specifies how floating-point numbers are printed or displayed. These methods of representation are explained below.

Examples of external representation:

Constants	Value
23.45e6	$23.45 * 10^{6}$
2.1e-5	$2.1 * 10^{-5}$
-1.23	-1.23

Internal representation according to Siemens:

Signed	23-bit mantissa	Signed	7-bit exponent

2^{31} mantissa * 10^{n} 2^{0}

Internal representation according to IEEE - floating-point format:

Signed	8-bit exponent	23-bit mantissa

2^{31} $2^{(n-127)}$ * mantissa 2^{0}

The floating-point numbers occupy four bytes with single accuracy.

BUEP03E provides the %m.nf format instructions for floating-point numbers.

The specified methods of representation are:

- internal : IEEE format

- external : 50.44e6, 50.44e-6, 1.23, -466.600

The exponents "e6, e-6" are added if the internal number cannot be represented in the indicated format. The values of the above-mentioned numbers would then be: 50.44 * 10^6 and 50.44 * 10^-6.

7.7.3.8 Terminating Jobs

The user has the options, as described below, to conclude a job normally or terminate a job.

Terminate via R2REQ function module

The parameter word (PW3) in the job parameter list has the following structure.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

x = Job number (0 - 7FFFH)

a = 0 --> Start job

a = 1 --> Delete job from the queue (terminate)

It is clear from the above diagram that the job is started from Bit 15 when logic is 0 and terminated from Bit 15 when logic is 1, i.e. the user can start or terminate the job with the same job parameter list. Only Bit 15 must be controlled accordingly. When a job is terminated, only the first three parameters in the job parameter list (PW1 - PW3) are relevant. If the user terminates a job, BUEP03E terminates the command chain and issues a fault message.

A command chain is started via Start with the start command and is terminated via Start with the termination command, as only this command is in the command queue.

Normal conclusion via monitoring time

The Receive command enables a monitoring time to be indicated up to a max. 10 min. If this time elapses during the Receive process, without a character arriving from the peripheral, the Receive process is concluded normally and is possibly stepped-on in the command chain. The time is started with the first character for the Unrestricted Receive process and with the start character for the Conditional Receive process. This time is then reset when the character has been received.

Termination character

The termination characters are specified in the Receive Mode command. Depending on the setting, the Receive process is terminated with a fault message either when single termination characters occur or when all defined termination characters are positioned one behind the other. In this case a command chain is NOT stepped-on.

Normal conclusion via start and end characters

The start and end characters are specified with the Receive Mode command. If the end character(s) occur in the data flow, the Receive process is concluded normally and is possibly stepped on in the command chain.

Normal conclusion via Receive-data length

The length of the data to be received in bytes is specified with the Receive command. In the case of Unconditional (unrestricted) Receive processes, all of the characters transmitted by the peripheral (including control characters) are considered. In the case of a Conditional Receive process, all characters (including control characters) with the start character are considered. The Receive process is concluded normally and is possibly stepped-on in the command chain if the specified number of characters has been received.

7.7.3.9 Summary of BUEP03E Commands

Param. word	Receive	Data Copy	Reset Receive Buffer
PW4	RX	DC	RS
PW5	Monitoring time 0 - 65535 in 10 ms Raster unit	PLC Receive buffer id. Field types 44H=DM, 43H=DF	Reset Receive buffer 0 = UART 1 = UART + BUEP03E
PW6	Size of the PLC receive buffer 10 bytes - 256 bytes	Field index DM = 0-255, DF = FFFFH	
PW7	Receive data length in bytes 1 - 255 0 : no length condition	Field offset DM = 0-510, DF=0-8 kbytes	

Fig. 7-13 BUEP03E — Summary of Commands, Part 1

Param. word	Receive Mode	Transmit	Formatted Output
PW4	MD	TX	FO
PW5	LOW byte : No. of end characters HIGH byte : No. of start characters	Transmit data id. Field type 44H=DM, 43H=DF	Control text id. Field type 44H=DM, 43H=DF
PW6	LOW byte : 1st start character HIGH byte : 2nd start character	Field index DM = 0-255, DF = FFFFH	Field index DM = 0-255, DF = FFFFH
PW7	LOW byte : 1st end character HIGH byte : 2nd end character	Field offset DM = 0-510, DF=0-8 kbytes	Field offset DM = 0-510, DF=0-8 kbytes
PW8	LOW byte r. nibble : No. of terminations LOW byte l. nibble: Termination type HIGH byte : No. of BCC	Transmit data length in bytes 1 - 512 bytes	Length of control text with variables in bytes 1 - 512 bytes
PW9	LOW byte : 1st termination character HIGH byte : 2nd termination character		
PW10	LOW byte : 3rd termination character HIGH byte : 4th termination character		
PW11	Marker byte for interlinking depth # 0-181: none		

Fig. 7-14 BUEP03E — Summary of Commands, Part 2

Param. word	Start		
PW4	ST		
PW5	Command chain id. Field types 44H=DM, 43H=DF		
PW6	Field index DM = 0-255, DF = FFFFH		
PW7	Field offset DM = 0-510, DF=0-8 kbytes		
PW8	Maximum utilised interlinked parameter list no. 1 - 16		
PW9	LOW byte: 1st command HIGH byte: 2nd command		
PW10	LOW byte: 3rd command HIGH byte: 4th command		
	‘’		

Fig. 7-15 BUEP03E — Summary of Commands, Part 3

7.7.4 Examples of BUEP03E Commands

The examples illustrate how the interlinked commands implement effective applications. In theory, any command can be interlinked with any other command. However, commands should be interlinked effectively. For example, the Data Copy command can be completely integrated into the command chain following the Receive command. However, the command is not activated during the Receive process. The Data Copy command should therefore be started, as required, parallel to the Receive command.

The parameter list (16 words each) stands for the examples listed below in the DM10, commencing from DW0, and is started with the FM call in the PLC program.

```
BA-R2REQ,6
P0          44H         ;Data in the data module
P1          10          ;Data module number 10
P2          0           ;Data word number     0
P3          1           ;Only one job parameter list
P4          M0          ;Fault message
P5          M2          ;Result
```

Example 1: Only Unrestricted Receive should be activated with time-monitoring and without interlinking. The parameters are entered in the DM10, commencing from DW0.

```
DW0 - DW4     = reserved for R2REQ
DW6           = 'RX'        Command identifier
DW8           = 10          Monitoring time = 100 ms
DW10              = 100         Size of the PLC Receive buffer = 100
DW12              = 0           No Receive-data length condition
```

The received characters are written to the BUEP03E Receive buffer and can be loaded into the PLC Receive buffer with the Data Copy command at any time.

Example 2: A data area should be transmitted to the interface. The parameters are entered in the DM10, commencing from DW0. The characters to be transmitted are in the DM11, commencing from DW0.

```
DW0 - DW4 = reserved for R2REQ
DW6         = 'TX'        Command identifier
DW8         = K44H        Identifier
DW10            = 11          for
DW12            = 0           Transmit buffer
DW14            = 150         Transmit 150 bytes
```

The 150 bytes written to the DB11, commencing from DW0, are transmitted unchanged.

Example 3: Data should always be received conditionally and then retrieved; the following conditions are defined with the Receive Mode command.
- Two start characters
- Two end characters
- Receive-data length
- Two BCC
- Single termination characters
- Four termination characters

Command 1: Select Mode

DW0 - DW4	=	Reserved for R2REQ
DW6	= 'MD'	Command identifier
DW8	= K0202H	Two start, two end characters
DW10	= 'ss'	Start characters
DW12	= 'ee'	End characters
DW14	= K0214H	Two BCC, single, 4 termination
DW16	= 'aa'	Termination
DW18	= 'aa'	character
DW20	= 100	Return interlinking depth in marker byte 100 if a fault occurs.

Command 2: Unrestricted Receive

DW32 - DW36, DW62	=	Reserved for R2REQ
DW38	= 'RX'	Command identifier
DW40	= 10	Monitoring time = 100 ms
DW42	= 100	Size of the PLC Receive buffer = 100
DW44	= 150	Receive-data length = 150 characters

Command 3: Data Copy

DW64 - DW68, DW94	=	Reserved for R2REQ
DW70	= 'DC'	Command identifier
DW72	= K44H	Identifier
DW74	= 11	for
DW76	= 0	PLC Receive buffer

Command 4: Start

DW96 - DW100, DW126	=	Reserved for R2REQ
DW102	= 'ST'	Command identifier
DW104	= K44H	Identifier
DW106	= 10	for
DW108	= 0	Command chain
DW110	= 2	No. of the job parameter lists which should be transferred
DW112	= K0201H	Co-position number of commands First Receive Mode, then Receive
DW114	= K00FFH	End of command chain

Only the parameter list for the Start command is started with the R2REQ. The other commands in the command chain are started by BUEP03E according to the specified sequence. The "DW112 = K0201H" command sequence specifies that the command with position number 1 (Receive Mode) is executed before 2 (Receive). The Data Copy command is started parallel to the command chain.

Example 4: A simple text combined with variables is output.

DW0 - DW4	= Reserved for R2REQ	
DW6	= 'FO'	Command identifier
DW8	= K44H	Identifier
DW10	= 11	on
DW12	= 0	control text with variables
DW14	= 50	Estimated length of control text + variables in bytes.

The control text and variables are in the DM11, commencing from DW0, e.g.

DW0	Temperature, required %2d degrees, actual %2d degrees,
DW38	20
DW40	25

The output then has the following format:

Temperature, required 20 degrees, actual 25 degrees

7.8 Checkback Signals and Fault Messages

The jobs can be started or terminated with the R2REQ function module.

The R2CON function module monitors the issued jobs. If the job has been ended or terminated, BUEP03E enters the information on the processed jobs into the job table on the ZS module. R2CON reads this information which the user receives in his output parameters (P3, P4).

The R2CON function module has two input and three output parameters (see also the specification for the R2CON function module). These parameters are defined as follows.

P0 (word): CXN and channel number

P1 (word): Job number

P2 (word): Job number

P3 (word): Status

P4 (word): Fault message

P2 (job number) indicates to which job the words P3 (status) and P4 (fault message) have been designated.

The BUEP03E protocol generates fault information which is divided into three areas:

- PLC response (byte)
- Error class (byte)
- Error code (byte)

If commands are interlinked, additional information is required to define the commands in which the fault or job termination has occurred. This information, known as "Interlinking depth", is provided in a marker byte which is indicated in the Receive Mode command.

The fault information is written to the R2CON checkback parameters in the following sequence:

P3 parameter

HIGH byte	LOW byte
Status	PLC response

P4 parameter

HIGH byte	LOW byte
Error class	Error code

7.8.1 Job Status

The current status of the job is specified in the Status by the function module.

Status	Meaning
00H	Job ended fault-free
02H	Job processing
03H	Job ended with fault(s)
04H	No job being processed with this job number

Fig. 7-16 BUEP03E — Job status

7.8.2 PLC Response

The PLC response is intended to provide the user with advice and help on the faults within the fault information.

The following conventions apply:

PLC response	Meaning
00H	No response, job fault-free
01H	Repeat FM job
02H	Program fault, change PLC program
03H	Change protocol parameter
05H	Rerun the program cycle on the R2REQ
06H	Rerun the program cycle on the R2CON
0AH	Check the FM parameter
10H	Active job terminated by the user

Fig. 7-17 BUEP03E — PLC Response

7.8.3 Error Class

The error class refers to the generation point of the fault information. The following conventions apply:

Error class	Meaning
00H	Fault-free
30H	System bus
31H	Operating system
40H	BUEP03E fault messages
FFH	Fault message of the function modules

Fig. 7-18 BUEP03E — Error class

7.8.4 Fault Messages

Fault information			Meaning
PLC response	Error class	Error code	
00	00	00	Fault-free job
01	30	24	Field protected by user
01	30	F0..FF	ZE200 communications fault
01	31	E0..EF	R200 communications fault
01	40	07	Receive active - no mode change
02	31	10	Destination module unknown
02	40	05	Command already active - no start
03	30	26	Module number too large
03	30	27	Module not available
03	30	28	Data module too small
03	30	90	Field type undefined on receiving module
03	30	93	Wrong address alignment
03	40	01	Parameter fault in the job array
03	40	02	Data loss in the BUEP03E Receive buffer
03	40	08	FO - format fault
03	40	09	FO - no or only separator
03	40	0A	FO - too many variables
05	40	03	Receive buffer empty
05	40	06	UART transmit/receive fault
10	31	60	Passive job terminated
10	31	61	Active job terminated
10	40	04	Termination via termination character

Fig. 7-19 BUEP03E — Fault messages

8 BUEP64 Protocol

8.1 Introduction

A frequent application occurring in automated systems is the data exchange between complex or spatially distributed control systems.

This section discusses the BUEP64 protocol (Siemens 3964R protocol) which can be loaded into the R200 and R200P computer modules. The BUEP64 protocol transfers data across a point-to-point connection, as a result of which data can be exchanged between two modules with implemented "3964R" protocol.

The user controls these "3964R“ protocols by means of the R2REQ and R2CON modules:

R2REQ: starts a protocol job;

R2CON: acknowledges started protocol jobs;

The abbreviations **RST** and **PST** occur frequently throughout this documentation and are defined as follows:

RST: Requesting station
specifies the communications partner which starts the protocol job;

PST: Peripheral station
specifies the communications partner which responds to a received protocol job;

8.2 Protocol-specific DIP Switch Settings

The S3 DIP switch can be defined for the BUEP64 protocol as follows:

Switch	Setting	Meaning	Channel
SS1	xx	IM number	
SS2	xx	IM number	
SS3	ON OFF	Peripheral jobs have priority Centralised jobs have priority	1
SS4	ON OFF	Protocol end identifier incl. DLE ETB Protocol end id. always DLE ETX	1
SS5	OFF	Reserved	1
SS6	OFF	Reserved	1
SS7	ON OFF	Peripheral jobs have priority Centralised jobs have priority	0
SS8	ON OFF	Protocol end identifier incl. DLE ETB Protocol end id. always DLE ETX	0

Fig. 8-1 BUEP64 — S3 DIP switch settings

NOTE –

When installing the link, ensure that the low priority is allocated to one device and the high priority to the other device.

8.2.1.1 Protocol End Identifier DIP Switch

The introduction of a selecting option for the protocol end identifier (DLE ETX or DLE ETB) for the R200/R200P is necessitated by the varying end identifiers used by several Siemens-made components:

- the 3964R data transfer controller for the Siemens process computer uses the DLE ETB identifier for transfer completion sequences

- the CP524 and CP525 communication processors (interfaced with a Siemens Simatic controller) use the DLE ETX identifier for all messages

The BUEP64 protocol, which has been implemented on the BOSCH CL300 and PC600 controllers, transmits the DLE ETX identifier, although it accepts both end identifiers when messages are being received.

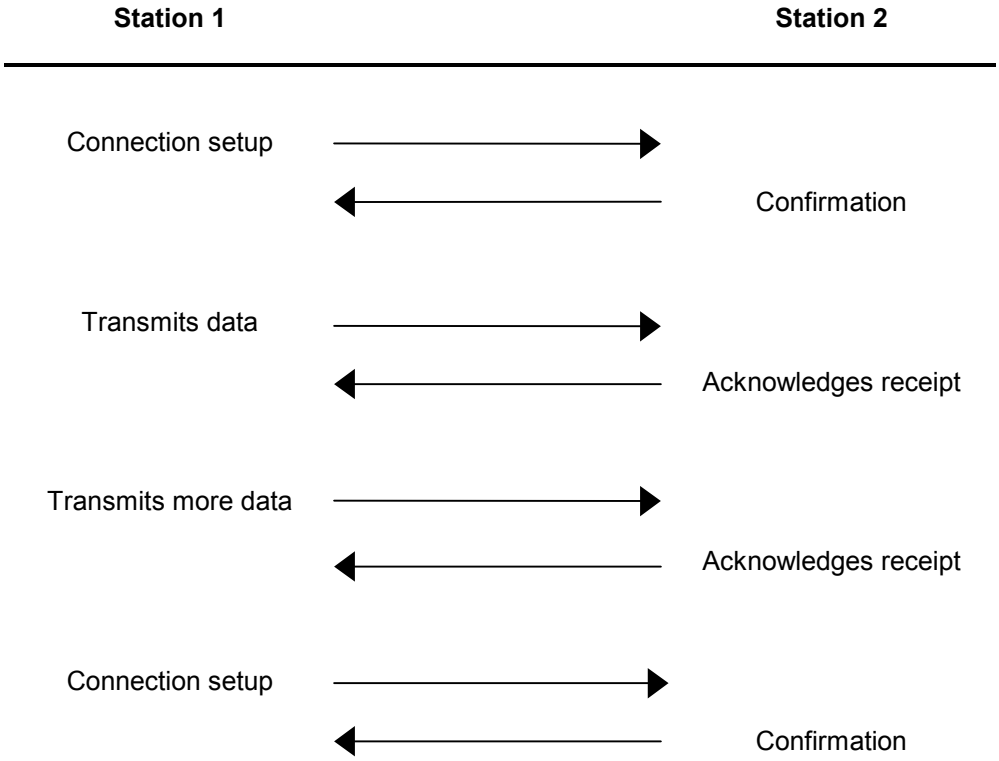
Unlike on any other interface modules, the R200/R200P interface modules enable DIP switch selection of the appropriate end identifier for each intended mode of communication; the R200/R200P is therefore able to communicate with all modules!

To enable interfacing with BOSCH controllers, the end identifier DIP switch (SS4, SS8) is set to OFF (DLE ETX)!

8.3 BUEP64 Transfer Completion Sequence Handling

Information is usually transferred according to the following sequence:

- The connection is established.
- Data blocks, max. 128 data bytes, are transferred.
- Each data block is acknowledged by a subsequent transfer response message.
- The individual blocks are repeated if transfer fault occur.
- After transfer of the final data block, the connection enters an idle state.



Data is requested according to the same procedure.

The 3964R protocol is best divided into two levels.

Interpreter

The Interpreter manages the data exchange and processes and monitors the centralised or decentralised jobs. It establishes a connection with the PLC, processes the data and ensures that data is transferred in blocks. The interpreter recognises faults and signals a defective or fault-free data exchange to the PLC.

The Interpreter calls up the Transfer Routine with all data required for its functioning.

Transfer Routine

The Transfer Routine handles the actual acknowledgement interchange on the line. Once initiated by the Interpreter, the Transfer Routine completes the transfer automatically.

If transfer faults occur, the defective block is repeated. The Transfer Routine signals a fault-free and/or defective data exchange to the Interpreter.

To facilitate understanding of the description of the following sequences, the abbreviations used therein are briefly explained:

RST = Requesting station

PST = Peripheral station

STX = Start of Text, control character for initiating data transfer

ETB = End of Block, control character

ETX = End of Text, control character

BCC = Block Check Character, checksum of the transferred data.

DLE = Data Link Escape, control character.
NOTE – If this identifier occurs as useful data, it is transmitted a 2nd time ==> DLE doubling. DLE doubling is included in the checksum.

CDT = Character Delay Time, maximum time between two characters. This time is monitored by the Receive device (220 ms).

ADT = Acknowledgement Delay Time, maximum time up to confirmation of a control character.
ADT = 2000 ms

RDT = Response Delay Time, maximum time up to the start of a response message or transfer completion sequence (5 - 20 seconds depending on the baud rate).

NAK = Negative Acknowledge, control character, negative response, e.g. if a transfer fault occurs.

BWT = Block Wait Time, max. 4 seconds, max. time until a defective block is repeated.

High / Low priority = Specifies which device has priority control when an access procedure is occurring.

Checksum Secures the data and is transmitted at the end of each block. The block check character BCC is generated from the parity (*) of the information bits of all data bytes (incl. DLE doubling) in a transmitted or received block. The generation begins with the first useful data byte and ends after the DLE ETX character. No restrictions have been specified for the information characters (code-transparent).

* Parity: XO (Exclusive OR) of all data bytes. The result is not complemented.

8.4 SEND Connection Sequence

The requesting station (RST) transmits the STX control character to establish the connection.

If the peripheral station (PST) responds before the acknowledgement delay time elapses with the DLE character, the RST switches over to Transmit Mode.

If the PST responds with the NAK character, with any other character, or if the acknowledgement delay time (ADT) elapses without any response, the connection setup fails.

After a total of three unsuccessful attempts, the procedure is terminated and a fault is signalled to the PLC.

If the connection setup is successful, the data is transmitted to the peripheral device. The peripheral monitors the intervals between the incoming characters.

The interval between two characters must NOT be more than the character delay time (CDT = 220 ms).

When the transmission is complete, the Transfer Routine adds the DLE, ETX and BCC characters as an end identifier and waits for an acknowledgement character. If the peripheral transmits the DLE character within the acknowledgement delay time ADT, the data block has been accepted fault-free. If the response was NAK, any other character, or if the time elapses without any response, the transmission is repeated. After a total of three unsuccessful attempts, the procedure is terminated and a fault is signalled to the PLC.

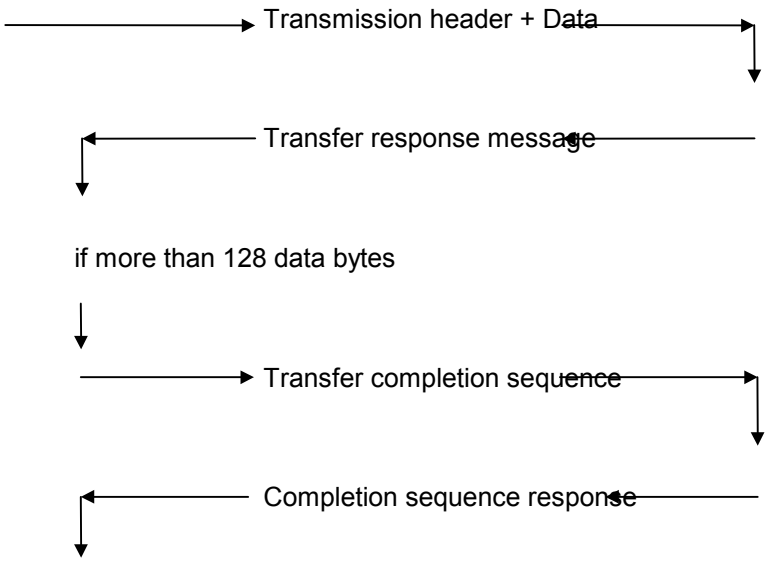
If the peripheral transmits the NAK character during a routine transfer, the current block is terminated and is repeated according to the abovementioned procedure.

Up to 128 useful data bytes can be transferred per message.

If a DLE occurs in the form of useful data, DLE is doubled.

Larger volumes of useful data are transferred in the form of one or more transfer completion sequences.

Transmission of data - Data is usually transmitted in the following sequence:

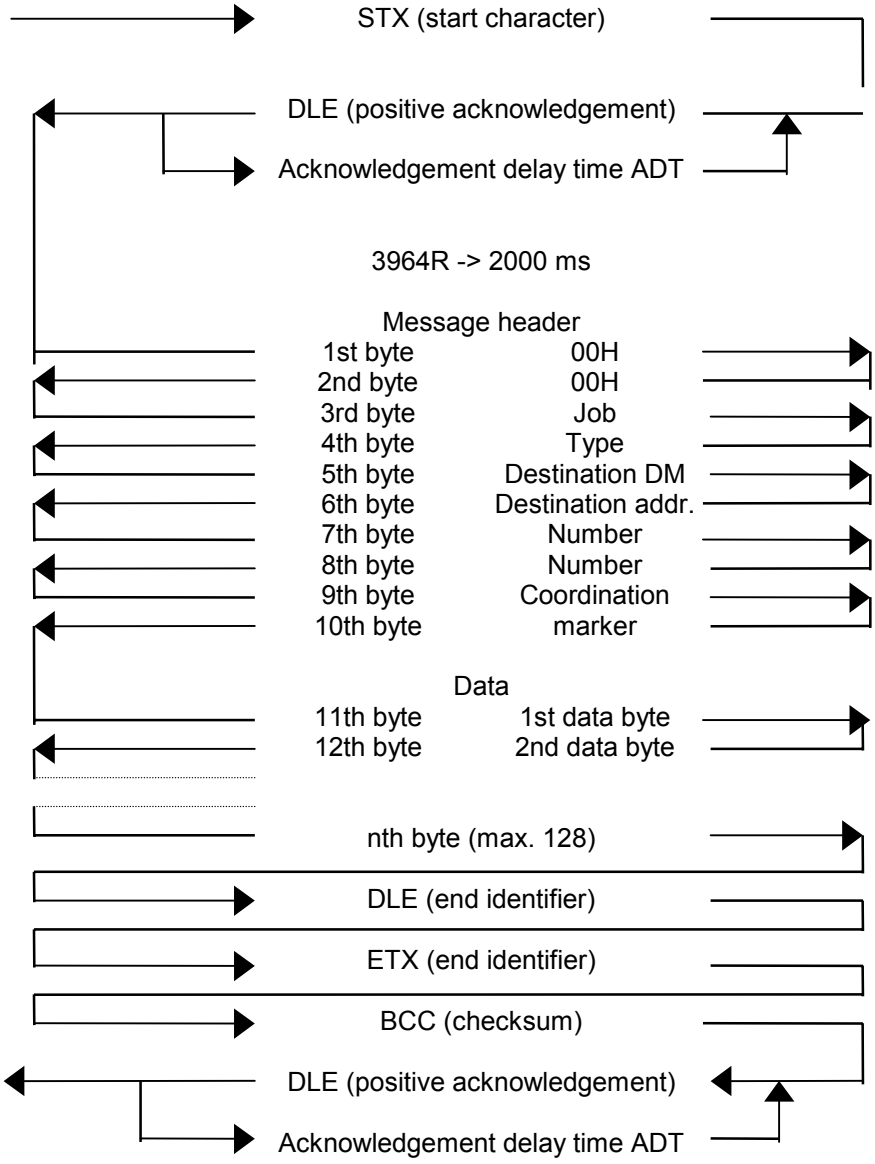


Source types	Transmission header Byte 3,4	Destination types
Data modules	Byte 3: 41H -> 'A' Byte 4: 44H -> 'DB'	Data modules

NOTE –
Only data modules are transferred, as the various operand formats of the individual controller types (CL200, CL400/500, CP525, CL300, PC600) cause misunderstandings.

8.4.1 Detailed SEND Sequence

8.4.1.1 Message Header and Data



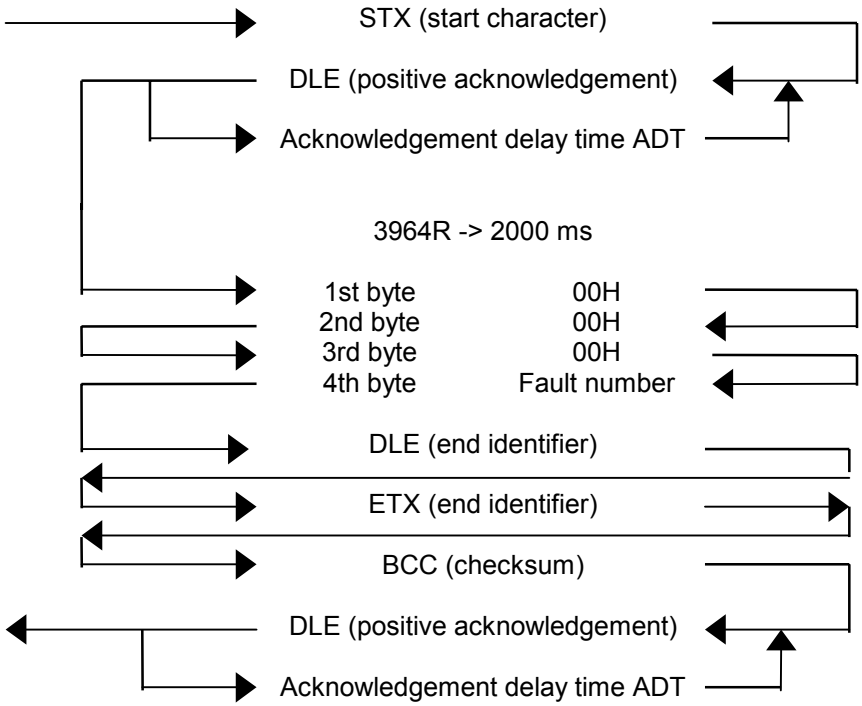
8.4.1.2 Response Message

A response message is expected after a command message has been issued. Depending on the selected baud rate, the following times must be observed:

The monitoring time is dependent on the baud rate (bps).

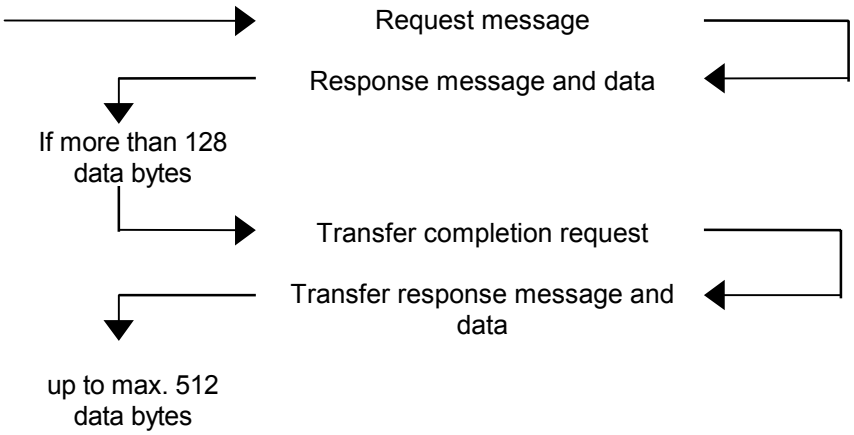
57600 - 1200 = 5 s

600 = 7 s



8.5 Requesting Data (FETCH)

Data is requested in the following sequence:

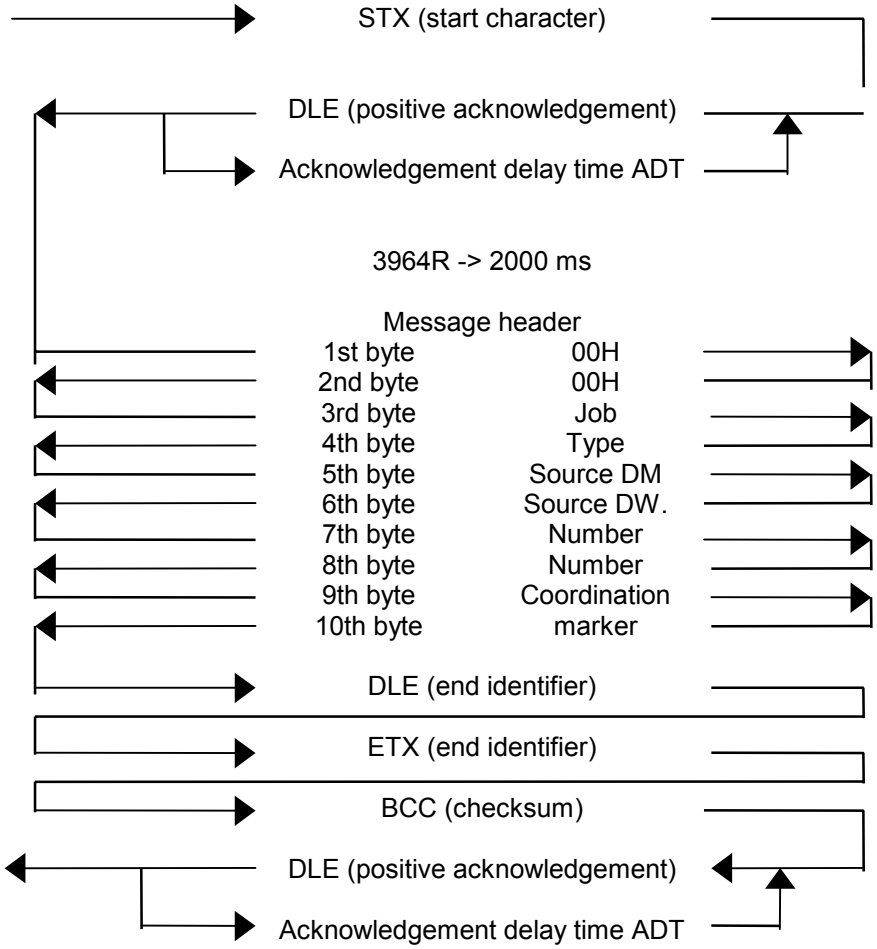


Source types	Message header Byte 3,4	Destination types
Data modules	Byte 3: 45H -> 'E' Byte 4: 44H -> 'DB'	Data modules

NOTE –
Only data modules are transferred!

8.5.1 Detailed REQUEST Sequence

8.5.1.1 Request Message

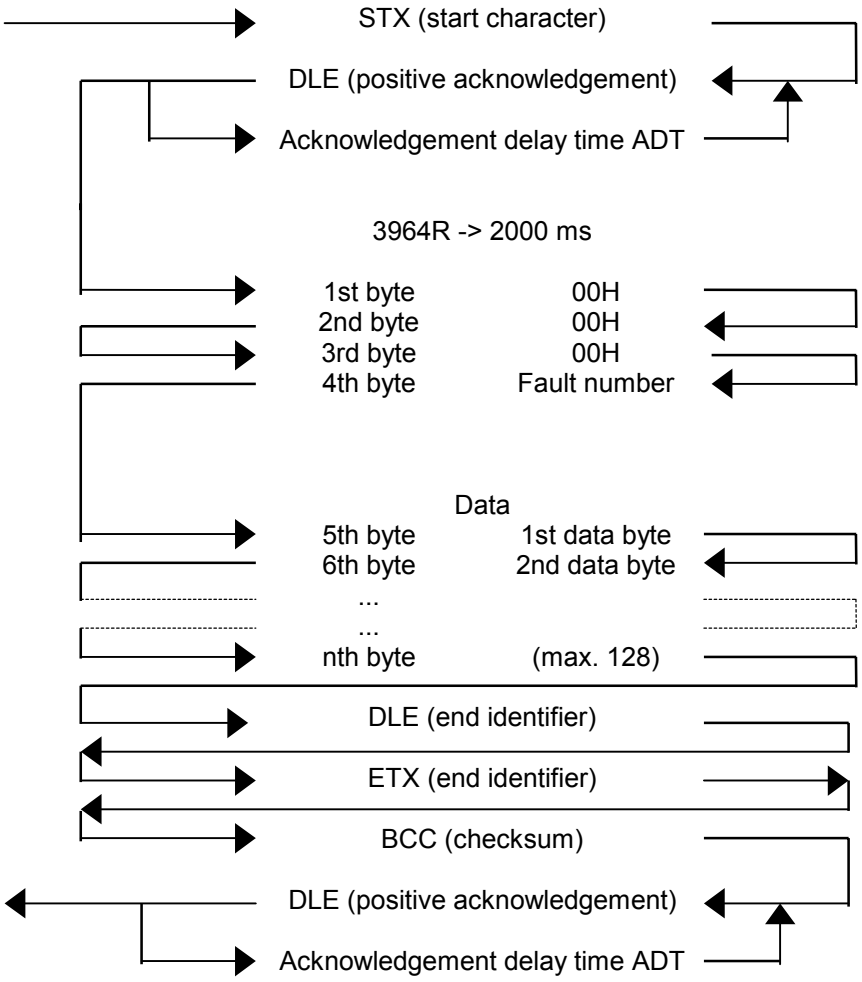


8.5.1.2 Response Message

A response message is expected after a command message has been issued. Depending on the selected baud rate, the following times must be observed:

9600 - 1200 = 5 s

600 = 7 s



8.6 RECEIVE Connection Sequence

If there is no centralised job, the Transfer Routine remains in an idle state. If an STX is now received from the peripheral, a response can be implemented with DLE, i.e. ready-to-receive state is displayed if the Receive buffer is empty.

(All other characters have an NAK as a consequence and the Transfer Routine remains in an idle state).

If the buffer is not ready, another check is implemented after approx. 400 ms to determine whether the buffer is now empty (ADT = max. 550 ms).

If the buffer is still not ready, the connection setup fails. An NAK is transmitted.

The following receive characters are written to the buffer. The character delay time CDT is restarted after each received character. If the CDT elapses without another character being received, NAK is transmitted to the peripheral.

A DLE doubling is recognised as data and the block checksum is generated. A DLE-DLE doubling is simply accepted as useful data.

When the character sequence DLE, ETX and BCC has been recognised, the Transfer Routine ends the Receive process and transmits DLE for a correctly received block or an NAK for an incorrectly received block.

If transmission faults occurred during the Receive process, the Receive process is continued until connection release occurs (DEL, ETX, BCC) and NAK is transmitted. A repeat of the block is expected.

If a new transfer is not started within a block wait time of 4 seconds, or the Receive process was not successful after a total of six attempts, the Transfer Routine terminates the Receive process and signals a fault to the PLC.

8.7 Initialisation Conflict

If a device responds to the start character (STX) by issuing the start character (STX) itself, an initialisation conflict occurs.

The device with the low priority resets its transmit job and signals its ready-to-receive state (DLE).

The low-priority device executes its transmit job following the receive and connection release procedures.

NOTE –
When installing the link, ensure that the low priority is allocated to one device and the high priority to the other device.

8.8 Quasi-Duplex Mode

Strict adherence to the request message - response message is mandatory for the R200!

Bidirectional data in Quasi-duplex mode: if the R200 request messages are not directly answered with the response message from the PST (because the PST first transmits a request message), this R200 status is terminated with a fault message.

8.9 Transmission Message Formats

8.9.1 Transmission Header and Data

The transmission header consists of 10 bytes.

Byte		
1	00 (FF)	Identifier for transmission header (transfer completion sequence header)
2	00	
3	(ASCII)	Command
4	(ASCII)	Command type
5	(High)	Destination or source identifier
6	(Low)	
7	(High)	Data volume
8	(Low)	
9	(High)	Coordination marker
10	(Low)	
11	Data	
12		
.		
.		
n		
n+1	DLE end identifier,	
n+2	ETX/ETB	
n+3	BCC	

Byte designations:

-1- Message identifier 00 (or FF for transfer completion sequence)

-2- Message identifier (00)

-3- Command, SEND = 'A', FETCH = 'E'

-4- Command type, type of data to be transferred

'D' = Data module

-5,6- Destination address for SEND, source address for FETCH

-7,8- Volume of useful data to be transferred in words.

-9,10- Coordination marker

8.9.2 Response Message Structure

Byte		
1	00	Identifier for response message
2	00	
3	00	
4	00	Fault number (0 = no fault)
5		DLE end identifier,
6		ETX
7		BCC

8.9.3 Response Message and Data Structure

Byte		
1	00 (FF)	Identifier for response message (transfer response message)
2	00	
3	00	
4	00	Fault number (0 = no fault)
5		Data
.		
.		
.		
n		
n+1		DLE end identifier,
n+2		ETX
n+3		BCC

8.10 Checkback Signals

The BUEP64 protocol generates fault information which is divided into three areas:

PLC response (byte)

Error class (byte)

Error code (byte)

The fault information is written to the R2CON checkback parameters in the following sequence:

P3 parameter

HIGH byte	LOW byte
Status	PLC response

P4 parameter

HIGH byte	LOW byte
Error class	Error code

8.10.1 Job Status

The current status of the job is specified in the Status by the function module:

Status	Meaning
00H	Job ended fault-free
02H	Job processing
03H	Job ended with fault(s)
04H	No job being processed with this job number

Fig. 8-2 BUEP64 — Job status

8.10.2 PLC Response

The PLC response is intended to provide the user with advice and help on the faults within the fault information.

The following conventions apply:

PLC response	Meaning
00H	No response, job fault-free
01H	Repeat FM job
02H	Program fault, change PLC program
03H	Change protocol parameter
05H	Rerun the program cycle on the R2REQ
06H	Rerun the program cycle on the R2CON
0AH	Check FM parameter
10H	Active job terminated by the user
20H	Job fault-free, however with reduced data length

Fig. 8-3 BUEP64 — PLC response

8.10.3 Error Class

The error class refers to the generation point of the fault information.

The following conventions apply:

Error class	Meaning
00H	Fault-free
30H	System bus
31H	Operating system
32H	PST job execution
33H	RST job execution
34H	Protocol sequence
FFH	Fault message of the function modules

Fig. 8-4 BUEP64 — Error class

8.10.4 Fault Messages

Fault information			Meaning
PLC response	Error class	Error code	
00	00	00	Fault-free job
01	30	F0..FF	ZE200 communications fault
01	31	E0..EF	R200 communications fault
01	32	12	Fault in system command
01	32	16	Transfer completion sequence not equal to command message
01	32	36	Synchronisation fault; e.g. transfer completion sequence precedes command message
01	34	EE	Transfer fault
01	34	F3	Volume of transferred data defective
01	34	F6	Protocol fault
01	34	F7	Time-monitoring fault at protocol level
01	34	F9	Permitted number of attempts exceeded
01	34	FE	Fault while opening the line; received character not equal to DLE
02	31	10	Wrong module number
02	31	97	Unknown command code
02	31	98	Buffer overflow
03	30	23	Field access prohibited The indicated access type (read, write, bit access) is not permitted for the indicated field.
03	30	24	Field protection active Field could not be accessed, as the field has been protected by the user.
03	30	26	Module number too large The indicated module number is larger than the maximum permitted module number for this module type
03	30	27	Module not available The module with the indicated number has not been entered in the reference list
03	30	28	Data module too small/large The address area indicated in the command exceeds the limits of the data module
03	30	90	Field not defined
03	30	93	Invalid parameter
03	30	96	Fault when reading/writing to the internal peripheral bus
03	30	97	Unknown command code
03	30	98	Buffer overflow
03	30	C1	Coordination fault; execute condition not fulfilled
03	30	C2	Coordination fault; unknown coordination point
10	31	60	Passive job terminated
10	31	61	Active job terminated
03	32	0A	Source / destination type not permitted when R200/R200P acts as PST: - Field type not defined on receiver module - Memory not available or wrong type
03	32	0C	Data-type or range fault when R200/R200P acts as PST: - Wrong address alignment - Address fault: address access refused

Fig. 8-5 BUEP64 — Fault messages, Part 1

Fault information			Meaning
PLC response	Error class	Error code	
03	32	10	Fault in the command byte
03	32	14	Data module not permitted when R200/R200P acts as PST: - Data module number too large - Data module not available - Data module too small
02	32	32	Data module blocked by coordination marker when R200/R200P acts as PST: - Access type prohibited (read, write)
03	32	34	Length fault when R200/R200P acts as PST: - Buffer overflow
03	33	01	Module number does NOT exist for indicated block address
03	33	20	Wrong command type (only DM)
03	33	29	Wrong command type (only I/O)
03	33	3D	Wrong operand type (only word)
03	33	EC	Wrong PST-DM word number
03	33	ED	Wrong PST-DM number
03	33	F1	Wrong RST-DM number
03	33	F2	Wrong RST-DM word number
03	33	F3	Volume of data defective
20	Length		Reduced length was transferred

Fig. 8-6 BUEP64 — Fault messages, Part 2

8.11 Job Parameters

A job is specified by 16 parameters. Each parameter has a width of 2 bytes. Data ranges of 16 data words each are available for the job parameters; a maximum of 16 jobs can be parameterised for each call-up of the R2REQ.

The parameter words PW1-PW3 are protocol-independent and job-specific parameters, whereas the parameter words PW4-PW16 contain protocol-specific information.

The parameters can be written to the data module, the data field or the data buffer; the block start address of 16 data words (PW1-PW16) is always an even byte address.

The entries for the 3964R can be defined as follows:

Parameter word	Meaning
PW1	Job result (protocol-independent)
PW2	High byte: CXN (protocol-independent) Low byte: Channel number (protocol-independent)
PW3	Job number (protocol-independent)
PW4	High byte: Command (SEND ‘A’ / FETCH ‘E’) Low byte: Operand type = word
PW5	High byte: Command type RST (‘DM’) Low byte: Command type PST (‘DM’)
PW6	RST address: DM number
PW7	RST address: Block address
PW8	RST address: DM word number
PW9	PST address: DM number
PW10	Free
PW11	PST address: DM number
PW12	Volume of data (in words)
PW13	Coordination marker
PW14	Free
PW15	Free
PW16	RESERVED

Fig. 8-7 BUEP64 — Job parameters

Several examples illustrating parameterisation of various centralised jobs can be found on Page 8-27 ff.

8.11.1 Protocol-specific Parameters (PW4 through PW16)

Data traffic is parameterised by "3964R" for RST **and** PST via the protocol-specific parameters. The individual parameters are explained below.

8.11.1.1 Command / Operand Type — PW4

The protocol provides the SEND and FETCH commands (PW4 HIGH byte):

Parameter word	Contents	
	HIGH byte	LOW byte
PW4	Command type	Operand type
Example	41H	01H
	Send	Word

Fig. 8-8 BUEP64 — Operand type

- SEND --> "A" = 41 hex

  Data is transmitted from the RST to the PST

- FETCH --> "E" = 45 hex

  Data is fetched from the PST and written to the RST

Data exchange between data modules is only permitted when BUEP64 is implemented on the R200/R200P; the operand type (PW4 LOW byte) is fixed for this reason.

- Operand type = WORD (01 hex)

8.11.1.2 RST / PST Command Type — PW5

Parameter word	Contents	
	HIGH byte	LOW byte
PW5	RST command code	PST command code
Example	44H	44H
	Data module	Data module

Fig. 8-9 BUEP64 — RST/PST Command type

Only the "Data module (DM = 44 hex)" command types exist for RST and PST when the 3964R protocol is implemented; the following situations may therefore occur:

- SEND: Transmit data from the RST data module to the PST data module
- FETCH: Fetch data from the PST data module and write it to the RST data module

8.11.1.3 RST Address: DM Number — PW6

Parameter word	Contents
PW6	RST address
Example	AH
	Data module 10

Fig. 8-10 BUEP64 — RST Address: DM Number

The PW6 parameter word indicates the data-module number for the RST; data modules DM0 to DM255 can be addressed.

8.11.1.4 RST Address: Block Address of Central Processing Unit — PW7)

Parameter word	Contents
PW7	RST address
Example	0H
	ZE200

Fig. 8-11 BUEP64 — RST Address: Block address

The block address of the respondent central processing unit is used to address the RST in the CL200 system;

NOTE –
In comparison, the ZE200 on the PST is addressed in the coordination marker (please refer to the description of the *Siemens 3964R Data Transfer Controller*).

8.11.1.5 RST Address: DM Word Number — PW8

Parameter word	Contents
PW8	RST address
Example	0H
	Word 0

Fig. 8-12 BUEP64 — RST Address: DM word number

Like the parameterisation of the PST DM word number (PW9), the RST DM word number is specified in one byte (0,1,2...255), in order not to confuse the user with possibly varying parameter specifications; the word number is converted into the CL200 format (byte address 0, 2, 4 ,6 ....510) within the protocol;

8.11.1.6 PST Address: DM Number — PW9

The PW9 parameter word indicates the data-module number for the PST; data modules DM0 to DM255 can be addressed.

Parameter word	Contents
PW9	PST address
Example	AH
	Data module 10

Fig. 8-13 BUEP64 — PST Address: DM number

8.11.1.7 PST Address: DM Word Number — PW11

1 byte is available in the message for transfer of the DM offset; the offset is therefore specified as a word number (0-255); the word numbers have the following format for the various peripheral controllers:

- CL200 Word number 0, 1, 2, 3 ... 255
- PC600 Word number 0, 1, 2, 3 255
- Siemens Word number 0, 1, 2, 3 ... 255
- CL300 Word number 0, 1, 2, 3 ... 127

Parameter word	Contents
PW11	PST address (word number)
Example	4H
	Word number 4

Fig. 8-14 BUEP64 — PST Address: DM word number

8.11.1.8 Data Volume — PW12

The PW12 parameter word indicates the volume of data which is to be transferred; the specification refers to the operand type (word) specified in PW4 (LOW byte); a maximum of 256 words can be transferred;

Parameter word	Contents
PW12	Volume of data
Example	20H
	32 words

Fig. 8-15 BUEP64 — Data volume

8.11.1.9 Coordination Markers — PW13

The function of the coordination markers is to coordinate the execution of a command on the PST. The command is only executed when the corresponding coordination event is "true"; the coordination sequence point or the field coordination marker "1" must therefore be accessed for the CL200 controller; as far as the other specified controllers are concerned, the addressed coordination marker must be "1" for execution of a coordinated command.

CL200 controller used as a PST

The Central Processing Unit Control command in the CL200 system uses only the process coordination marker:

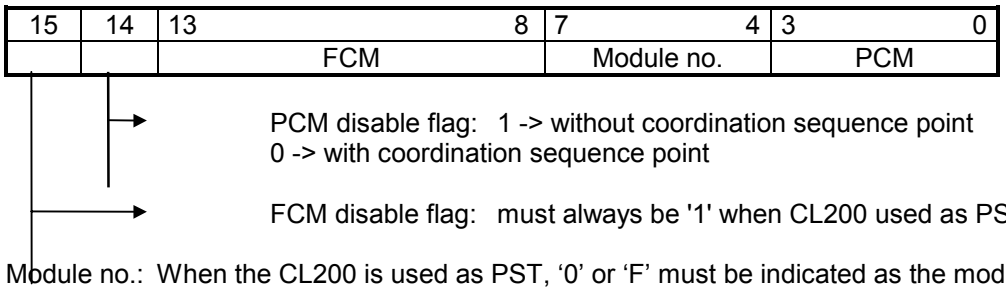
- Process coordination marker (PCM)

The PCMs are specified as follows:

00 H System STOP status
01 H System RUN status
05 H EP or STOP
07 H OM1 or STOP
FF H No process coordination marker

The respondent ZE in the CL200 system is addressed by the ZE (0H or FH) module number which is indicated in the coordination marker. This addressing procedure is based on the *Siemens 3964R Data Transfer Controller specification*;

The process and field coordination markers, as well as the module number, are linked to the "3964R" coordination marker format according to the following schematic:



NOTE –
FFFFH in the coordination marker denotes: Command not coordinated to module no. 0.

NOTE –
If a Siemens controller is used as the RST communications partner, the following restrictions must be considered on account of the parameterisation options in the Siemens controller:

- Only the process coordination markers 0-7 can be parameterised;
- In order to address all the central processing units, they must be indicated with module numbers 1-4 in the SC system configuration table;

CL300 controller used as a PST

The CL300 controller permits a central processing unit to have maximum configuration; it is therefore NOT necessary to specify the CPU number within the coordination marker;

When the Siemens format is observed, the coordination marker has the following appearance:

15	7 4	3 0
Word address	0	Bit number

Where: bit number - 0-15

word address - 0-254

word address 0, 2, 4-254

PC600 controller used as a PST

The PC600 controller permits a central processing unit to have maximum configuration; it is therefore NOT necessary to specify the CPU number within the coordination marker;

When the Siemens format is observed, the coordination marker has the following appearance:

15	7 4	3 0
Word address	0	Bit number

Where: bit number - 0-15

word address - 0-255

word address 0, 1, 2, 3-255

Siemens CP524/CP525 controller used as a PST

When these Siemens controllers are used as a PST, the coordination marker (CM) contains information on the CPU number, the CM byte and the CM bit;

- Byte number of the CM: If no CM is used, FFH must be in this location; the byte number must be within the range of 0-223 for the CP524 and CP525;

- Bit number of the CM: If no CM is used, FH is in this location;

- CPU number: If the number of the respondent CPU is indicated as a number between 1 and 4;

  If no CPU number, but a CM, is indicated, 0H is in this location;

  If no CPU number and no CM are indicated, FH is in this location;

  In both cases all CPUs are possible for the partner;

15	7 4	3 0
Byte number	CPU number	Bit number

8.12 Job Parameterisation Examples

8.12.1 SEND Job (CL200 -> CL300)

9 words, beginning with the byte address 26H (word number 13H), are written, without coordination, from the DM17 data module in the ZS500 with block address 10H to the DM35 data module in the ZE301 from byte address 64H (word number 32H). The transfer is processed by Channel 1 of the R200 with the number 2 (CXN2 see R5INIT parameterisation); the job receives job number 4.

The job is parameterised as follows:

Param. word	Contents	Meaning
PW1	---	No entry
PW2	0201H	CXN2, Channel 1
PW3	4H	Job number 4
PW4	4101H	Output job (SEND) / word
PW5	4444H	RST code : DM PST code: DM
PW6	11H	RST address: DM number 17
PW7	10H	RST address: Block addr. ZS2 = 10H
PW8	13H	RST address: Data-word no. 19
PW9	23H	PST address: Data-word no. 35
PW10	---	No entry
PW11	32H	PST address: Data-word no. 50
PW12	9H	Volume of data: 9 words
PW13	FFFFH	Without coordination
PW14	---	No entry
PW15	---	No entry
PW16	---	No entry

Fig. 8-16 BUEP64 — Example of SEND parameters (CL200 -> CL300)

8.12.2 FETCH Job (CL200 <- CL300)

33 words, beginning with the byte address 1AH (word number DH, see Chap. 9.2), are read from the DM12 data module in the ZE301 and written, without coordination to the DM27 data module in the ZS3 with block address 18H from byte address 50H (word number 28H, see Chap. 9.2).

The transfer is processed by Channel 0 of the R200 with the number 3 (CXN3 see R5INIT parameterisation)

The job receives job number 7.

The job is parameterised as follows:

Param. word	Contents	Meaning
PW1	---	No entry
PW2	0300H	CXN3, Channel 0
PW3	7H	Job number 7
PW4	4501H	Output job (FETCH) / word
PW5	4444H	RST code: DM PST code: DM
PW6	1BH	RST address: DM number 27
PW7	18H	RST address: Block addr. ZS3 = 18H
PW8	28H	RST address: Data word no. 40
PW9	CH	PST address: DM no. 12
PW10	---	No entry
PW11	DH	PST address: Data word no. 13
PW12	21H	Volume of data: 33 words
PW13	FFFFH	Without coordination
PW14	---	No entry
PW15	---	No entry
PW16	---	No entry

Fig. 8-17 BUEP64 — Example of FETCH parameters (CL200 <- CL300)

8.12.3 SEND Job (CL200 -> CL200)

4 words, beginning with the byte address 12H (word number 9H), are written, without coordination, from the DM5 data module in the ZS500 with block address 10H to the DM9 data module in the ZS500 with module number 2 from byte address 24H (word number 12H).

The transfer is processed by Channel 1 of the R200 with the number 2 (CXN2 see R5INIT parameterisation).

The job receives job number 4.

The job is parameterised as follows:

Param. word	Contents	Meaning
PW1	---	No entry
PW2	0201H	CXN2, Channel 1
PW3	4H	Job number 4
PW4	4101H	Output job (SEND) / word
PW5	4444H	RST code: DM PST code: DM
PW6	5H	RST address: DM number 5
PW7	10H	RST address: Block addr. ZS2 = 10H
PW8	9H	RST address: Data-word no. 9
PW9	9H	PST address: DM no. 9
PW10	---	No entry
PW11	12H	PST address: Data-word no. 18
PW12	9H	Volume of data: 9 word
PW13	FF2FH	Without coordination, module number 2
PW14	---	No entry
PW15	---	No entry
PW16	---	No entry

Fig. 8-18 BUEP64 — Example of SEND parameters (CL200 -> CL200

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