

*Visualisation/HMI*

# Driver Configuration for MADAP Studio and Win Studio



Edition

# 102

*Visualisation/HMI*

# Driver Configuration for MADAP Studio and Win Studio

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# Contents

	Page
<b>1</b>	<b>Safety Instructions</b> ..... <b>1-1</b>
1.1	Intended use ..... 1-1
1.2	Qualified personnel ..... 1-2
1.3	Safety markings on components ..... 1-3
1.4	Safety instructions in this manual ..... 1-4
1.5	Safety instructions for the described product ..... 1-5
1.6	Documentation, software release and trademarks ..... 1-6
<b>2</b>	<b>System Introduction</b> ..... <b>2-1</b>
2.1	Installation directories ..... 2-1
2.1.1	MADAP Studio ..... 2-1
2.1.2	Win Studio ..... 2-2
2.2	MADAP Studio tools ..... 2-3
2.3	To start MADAP Studio ..... 2-4
<b>3</b>	<b>LogWin</b> ..... <b>3-1</b>
3.1	Read and write groups ..... 3-2
3.2	Serial communication ..... 3-4
<b>4</b>	<b>Development Environment</b> ..... <b>4-1</b>
4.1	Driver worksheet ..... 4-2
4.1.1	Header definitions ..... 4-4
4.1.2	Data definitions ..... 4-13
4.2	Communication Parameters ..... 4-20
4.2.1	BUEP ..... 4-20
4.2.2	TCP/IP ..... 4-21
4.3	OPC Client Configuration ..... 4-26
4.3.1	OPC Client Runtime ..... 4-29
<b>5</b>	<b>Read/Write Group Status</b> ..... <b>5-1</b>
5.1	BUEP communication ..... 5-1
5.2	TCP/IP communication ..... 5-1
<b>6</b>	<b>Network Basics</b> ..... <b>6-1</b>
6.1	Ethernet ..... 6-1
6.2	Data network components ..... 6-1
6.2.1	Hubs ..... 6-1
6.2.2	Switches ..... 6-3
6.2.3	End devices: PCs, servers, controls ..... 6-3
6.2.4	Cabling ..... 6-4
6.2.5	Standard protocols ..... 6-4
6.2.6	Structure of IP addresses ..... 6-5
6.3	Network settings ..... 6-7
6.3.1	Panel Configurator ..... 6-7
6.3.2	WinSPS ..... 6-7
6.3.3	PC network cards ..... 6-9
6.4	Possible error sources in the network ..... 6-10

<b>7</b>	<b>OPC Technology .....</b>	<b>7-1</b>
7.1	Call up OPC .....	7-1
7.1.1	Hardlock/soft licence .....	7-1
7.1.2	IP address and target control port .....	7-2
7.1.3	Start with OPC client .....	7-2
7.1.4	Interface .....	7-2
7.2	OPC data .....	7-3
7.2.1	Restrictions .....	7-3
7.2.2	Data .....	7-3
<b>A</b>	<b>Appendix .....</b>	<b>A-1</b>
A.1	Abbreviations .....	A-1
A.2	Index .....	A-2

# 1 Safety Instructions

Before you start working with the software, 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 Intended 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 EMC Directives (89/336/EEC, 93/68/EEC and 93/44/EEC)
  - the Low-Voltage Directive (73/23/EEC)
  - the 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**  
**D 60498 Frankfurt/Germany**

This instruction manual is specifically designed for operation and maintenance personnel. They require special skills in handling the production units.

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 78-600. Please also visit our website: <http://www.boschrexroth.de>.

### 1.3 Safety markings on components



DANGER! High voltage!



DANGER! Corrosive battery acid!



CAUTION! Electrostatically sensitive devices (ESD)!



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 or 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.

★ This asterisk symbol indicates that the manual is describing an activity which the user will be required to perform.

## 1.5 Safety instructions for the described product

---

**DANGER**

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

---

**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.

---

## 1.6 Documentation, software release and trademarks

### Relevant documentation

The present manual can be seen as an add-on to the manual 'WinStudio/Indusoft Web Studio Technical Reference Manual', order no. 1070 072 272. It provides the user with comprehensive information about Bosch Rexroth specific additions, drivers, and communication links of the software Win Studio / InduSoft Web Studio.

Overview of available manuals:


Manuals	Language	Order no.
MADAP Studio Startup Manual	GB	1070 072 225
MADAP Studio for Programmers and Project Designers	GB	1070 072 168
PCL, Programming and Operation	GB	1070 072 189
MADAP Studio for System or Machine Operators	GB	1070 072 167

 **In this manual the floppy disk drive always uses drive letter A:, and the hard disk drive always uses drive letter C:.**

Special keys or key combinations are shown enclosed in pointed brackets:

- Named keys: e.g., <Enter>, <PgUp>, <Del>
- Key combinations (pressed simultaneously): e.g., <Ctrl> + <PgUp>

### Release

 **The descriptive information contained in this manual applies to:**  
**Software versions:   MADAP Studio   from V1.0**  
**Win Studio        from V1.0**

### Trademarks

All trademarks referring to software that is installed on Bosch Rexroth 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.

## 2 System Introduction

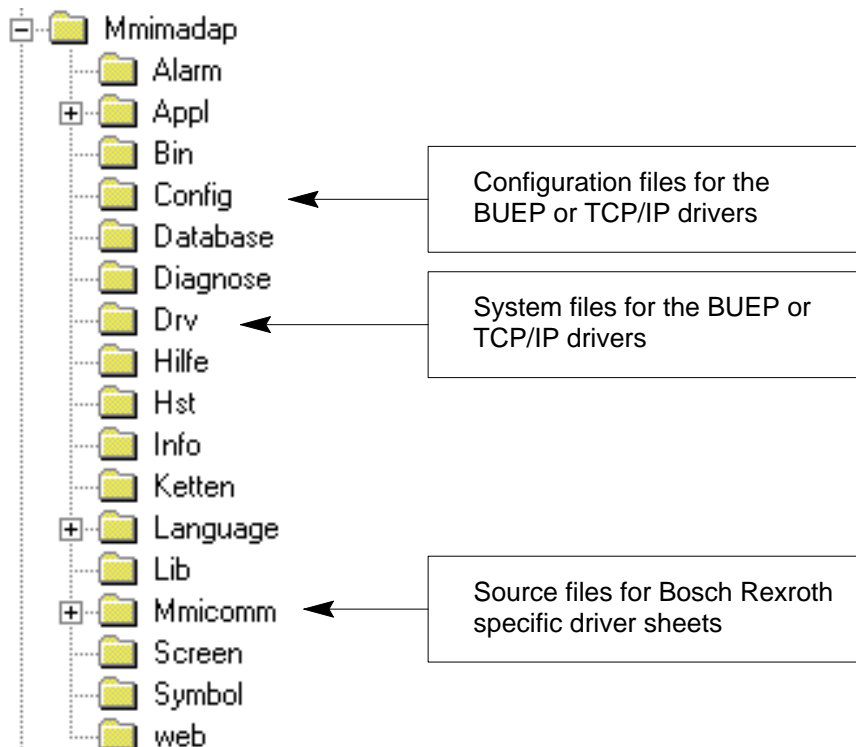
MADAP Studio is a visualisation software used for controlling, operating and diagnosing machines and systems with sequence controls. This software also includes the functions of a development tool. These different functions can be activated with appropriate licences.

Win Studio is a separate development tool for creating HMI applications (human machine interface).

### 2.1 Installation directories

The installation routine from MADAP Studio (cf. MADAP Studio Startup Manual, 1070 072 225) has created the 'MMIMADAP' directory on the hard disk. All application files and system modules for MADAP Studio and Win Studio are saved in this directory.

#### 2.1.1 MADAP Studio



The following folders are of relevance for the drivers:

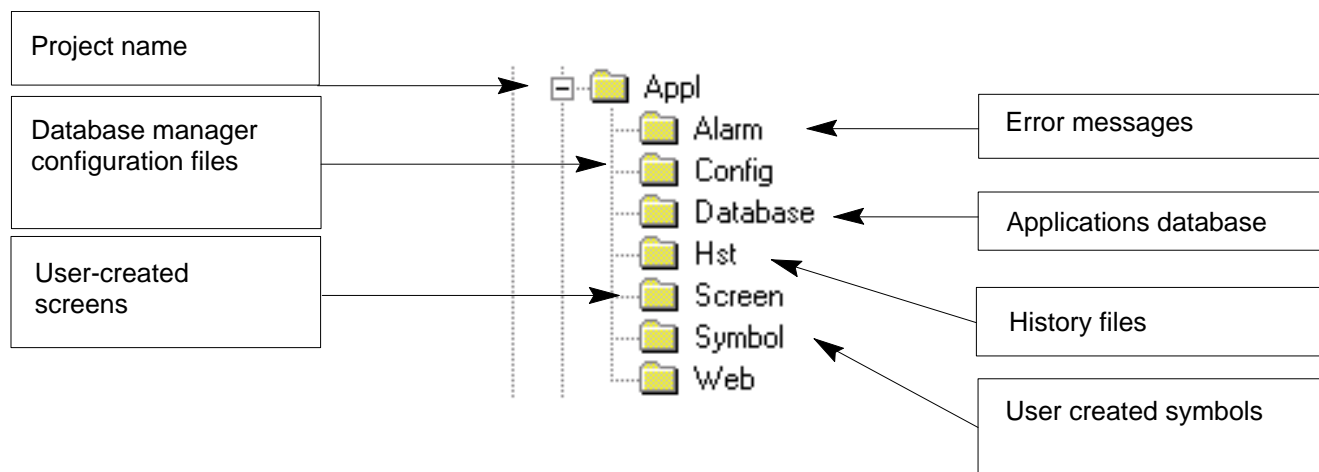
- Config  
Files for communication settings (driver sheets etc.). The 'Indusoft Studio' tool is used to create driver sheets.
- Drv  
System folder for drivers. Contains all system files for Bosch Rexroth drivers (BUEP, TCP/IP).
- MMIComm  
Sources for the 'Panel Configurator' tool, for internal use only.

## 2.1.2 Win Studio

The installation directory for Win Studio can be created anywhere within the installation routine. The preset directory is C:\Programme\Bosch\WinStudio. Projects created with Win Studio are saved in the C:\WinStudio Projects default directory. Alternatively, users can enter a path of their choice when saving projects.

Further information on installing Win Studio can be found in the "Win Studio / InduSoft Web Studio Technical Reference Manual" manual, order no. 1070 072 272.

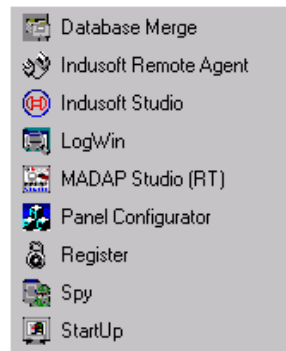
A project directory has the following structure:



## 2.2 MADAP Studio tools

All tools needed for configuration are integrated in the MADAP Studio software.

MADAP Studio tools are:

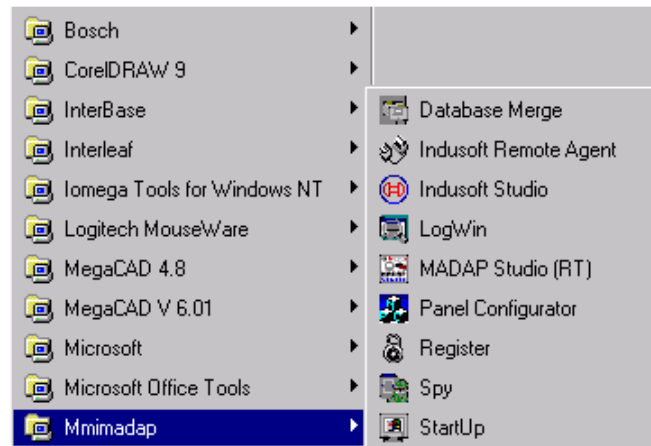


- Database Merge: To merge two databases together.
- Indusoft Remote Agent: To establish a connection over TCP/IP if the application is created and executed on different computers.
- Indusoft Studio: To open the development environment, e.g. for creating and integrating user screens, see Chapter 4.
- LogWin: System monitor for error localisation, see Chapter 3.
- MADAP Studio (RT): To start runtime.  
☞ **To start runtime with tasks set in project status including step sequence diagnosis and advanced report system.**
- Panel Configurator: Configuration and connection between the MADAP Studio runtime and the PLC, see 'MADAP Studio, Startup Manual', order no. 1070 072 225
- Register: To license MADAP Studio, see 'MADAP Studio, Startup Manual', order no. 1070 072 225.
- Spy: Supports application development with direct read/write access to variable values in the database.
- StartUp: To start runtime with tasks set in the project status without step sequence diagnosis or applied report system. Icons are used to display tasks in the taskbar, see Chapter 4.3.1 also.

## 2.3 To start MADAP Studio

Start MADAP Studio tools with:

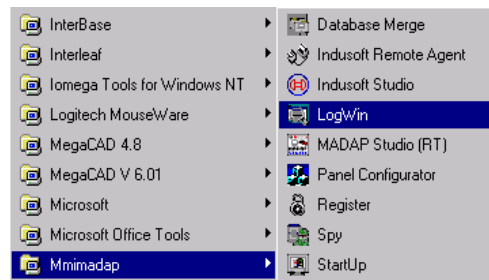
- Windows start button [Start]
- [Programs] [Mmimadap], then select the tool you want.



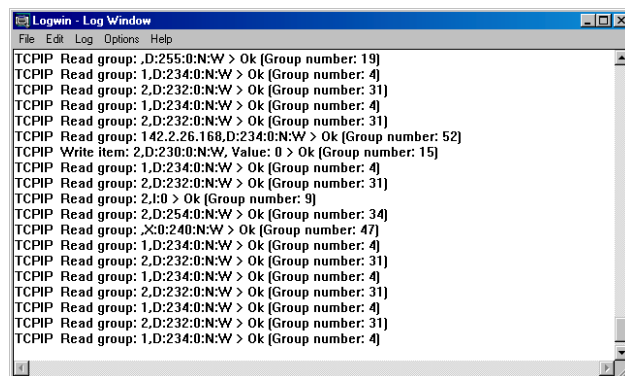
## 3 LogWin

'LogWin' is a system monitor for localising errors, e.g. communication errors.

- ★ Open 'Logwin Log Window' system monitor with [Programmes] [Mmimadap] [LOGWin].



The 'Logwin Log Window' will appear:



The current read and write groups are displayed immediately as the system operates independently of the active frames and always requests data from the PLC.

### 3.1 Read and write groups

```

LogWin - Log Window
File Edit Log Options Help
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: .D:255:0:N:W > Ok [Group number: 19]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 142.2.26.168.D:234:0:N:W > Ok [Group number: 52]
TCP/IP Write item: 2,D:230:0:N:W, Value: 0 > Ok [Group number: 15]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 2,I:0 > Ok [Group number: 9]
TCP/IP Read group: 2,D:254:0:N:W > Ok [Group number: 34]
TCP/IP Read group: .X:0:240:N:W > Ok [Group number: 47]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]
TCP/IP Read group: 1,D:234:0:N:W > Ok [Group number: 4]
TCP/IP Read group: 2,D:232:0:N:W > Ok [Group number: 31]

```

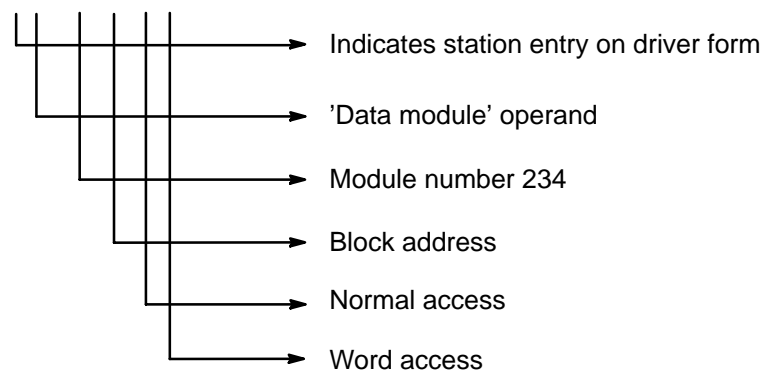
Each line represents a read or write group.

An example configuration of a read/write group:

TCP/IP : TCP/IP driver

Read group/  
Write group : Information on read/write group

1,D:234:0:N:W>OK : The PLC operand, that has been read



Group number : Driver form number: the read group is controlled with this number

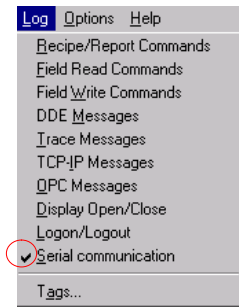
Possible causes if error numbers appear instead of 'OK':

- Wrong IP address set  
Launch Panel Configurator. Check IP address and change, if necessary or check TCP/IP network environment, see Chapter 6.3 also.

- Wrong subnet mask  
Check TCP/IP network properties and change IP address, if necessary, see Chapter 6.3 also.
- Faulty cable  
Check that the cable on the control panel and PLC is functioning and is connected properly to the Ethernet module. Check the interconnected hubs or switches.
- Data module is not present in PLC  
Use the data module numbers in the LogWin monitor to check which data module should be transferred. Check in the PLC programme whether the data module is present.
- No MADAP Studio project loaded on the control  
Load valid MADAP Studio project on the PLC. All PLC modules (e.g. MADAP Studio and DB217–DB255 system modules) are launched from the control.

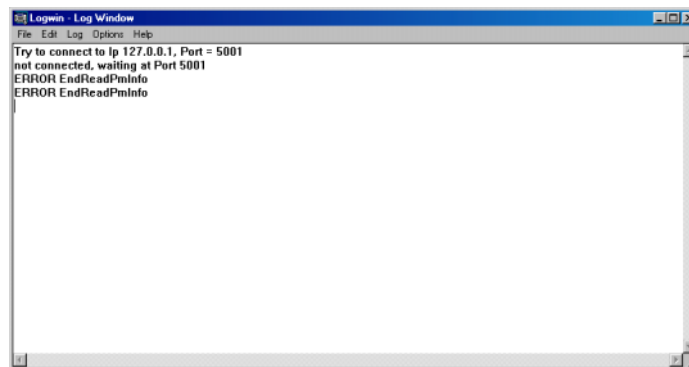
## 3.2 Serial communication

- ★ Select 'Serial communication' option from the menu to log driver behaviour on startup.



Example:

Connection to a non-existent PLC over local PLC

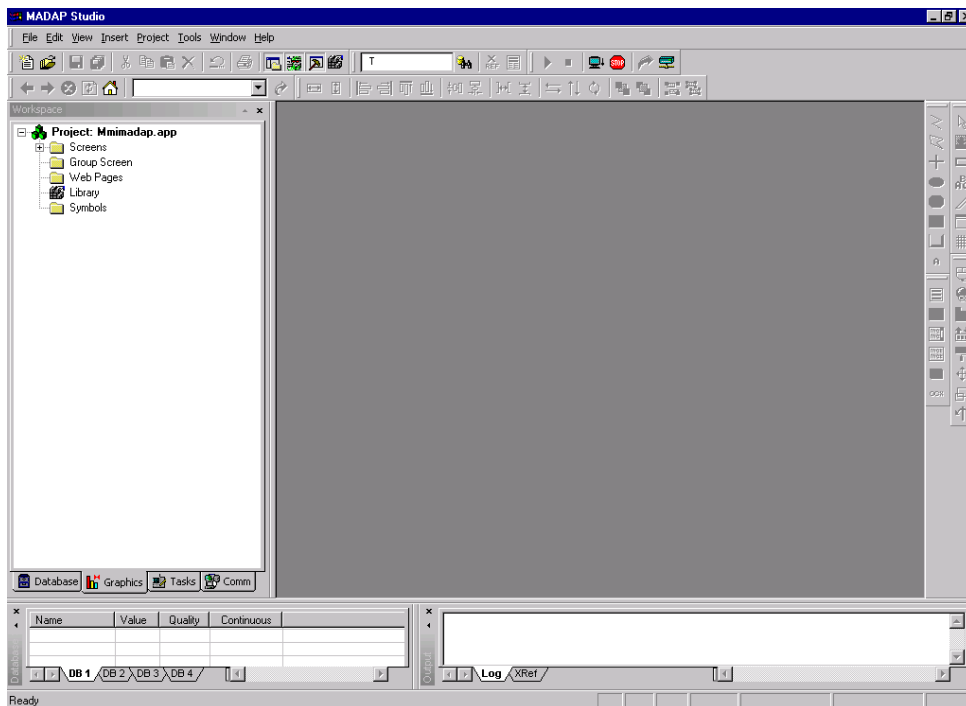


A startup sequence is activated on driver start:

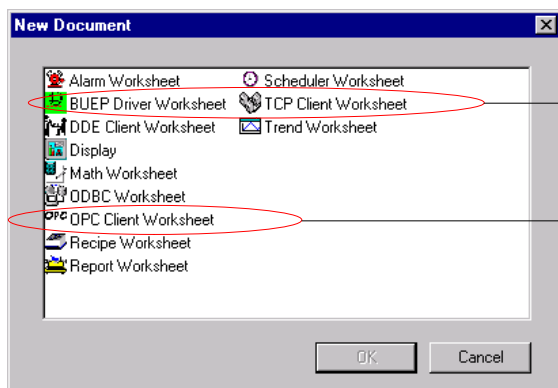
1. The driver attempts to establish contact with the local PLC over the local PLC interface. This has not been successful in the example above as the PLC is possibly inactive.
2. The driver tries to contact the local PLC over port 5001 ('UDP1' WinPanel setting). This attempt has been unsuccessful in this example.
3. The driver waits for communication in port 5001. The driver is and remains active. The driver starts to communicate as soon as the PLC is active.

# 4 Development Environment

Go to [Programmes], [Mmimadap] and [Indusoft Studio] to open the MADAP Studio development environment. This programme contains development tools for creating HMI applications (HMI = Human Machine Interface), see 'Technical Reference Manual', order no. 1070 072 272.



Click [Insert] and then [Document...] in the menu bar to open new worksheets.



Other ways of opening worksheets:

see Section 4.1

see Section 4.3

## 4.1 Driver worksheet

Data from the PLC needed for the application must be defined in driver worksheets.

Driver worksheets can be used to:

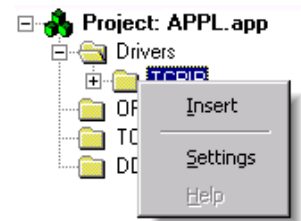
- allocate data from the PLC to variables
- write back variable values in the PLC.

### Create new worksheet

A new driver worksheet can be created:

- with the [Insert] and [Document...] menu options, see Page 4-1.
- to the left of the 'Workspace' window in the 'COMM' tag with:
  - Insert (depending on the driver setting BUEP or TCP/IP)

Click 'Settings' to call up the driver configuration, see Section 4.2.



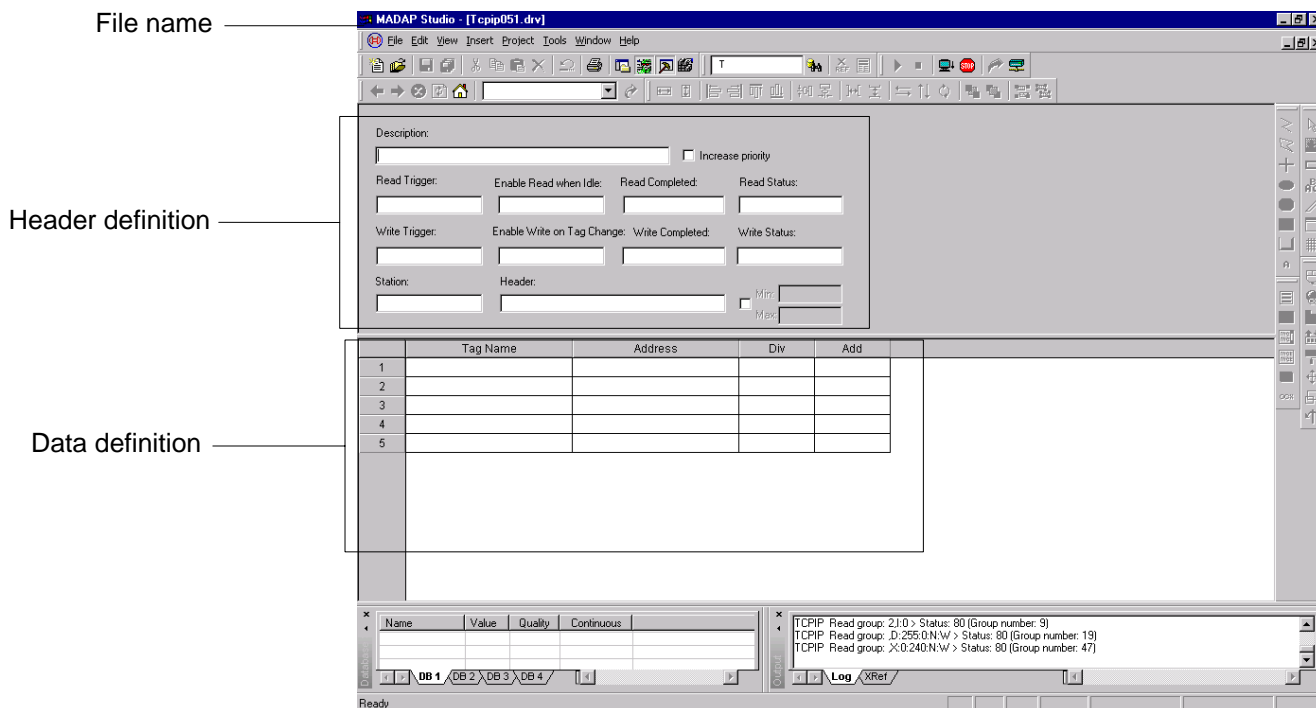
### Open existing worksheet

An existing driver worksheet can be opened:

- with an icon, BUEP or TCP/IP, depending on the driver setting



The driver worksheet (TCP/IP in the screenshot below) is divided into two sections, i.e. 'header and data definitions':



**The driver worksheet is identical for both BUEP and TCP/IP communication types. You will be explicitly informed in the event the boxes are completed differently.**

The driver configurator automatically generates the file name for the worksheet. It always selects the next available file name starting from TCP/IP/BUEP001.DRV.

**In MADAP Studio, a number of driver worksheets (TCP/IP.DRV/BUEP.DRV) are allocated by the system. The first available form name is used for the new driver worksheet.**

## 4.1.1 Header definitions

You can define your own data communication in the 'header definition' section. You can select definitions for both read and write tasks. Status information is displayed for every communication event.

### Description

- ★ Enter text that describes the current driver worksheet.

The text is then displayed in the form overview. 'Description' has no control function.

### Increase read priority

A write group with data transferred from the application to the PLC has a higher priority than a read group.

- ★ Click 'Increase read priority' to assign the same priority to read and write groups. If a read request is pending, the read group will now be the next group to be processed.
- ☞ **First check whether it is absolutely necessary to assign the same priority to read and write groups in order to avoid data communication congestion.**

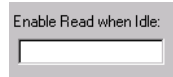
### Read Trigger

- ★ Enter any variable. A read group is then executed if the variable contents change.

The advantage is that read groups can only be coordinated by the user. This serves to control data volume and bus load.

This function is used if data is needed when opening or closing screens, when a key is pressed or in a time control.

### Enable Read when Idle

A screenshot of a configuration window titled "Enable Read when Idle:" with a single text input field below it.

- ★ Enter any variable or a statistical numerical value.

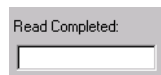
If the variable content or statistical numerical value is  $\neq 0$ , the system will constantly submit a read request. However, this will only be executed provided there are no other higher-priority groups being processed. Therefore, the transfer time cannot be calculated. It can take up to a number of seconds depending on the application running.

Advantage: No control mechanisms need to be set up. This function is used e.g. with general messages that are needed regardless of the current screen.

- ☞ **If this option is activated for every form, e.g. with 1, this can cause the system to slow down considerably as a read request is executed on every run.**

### Read Completed

Once each read group has been completed, the driver designates entered variables with 0 or 1 alternately.

A screenshot of a configuration window titled "Read Completed:" with a single text input field below it.

### Read Status

'Read Status' is used when the current group status is to be called up and evaluated in the application.


A screenshot of a configuration window titled "Read Status:" with a single text input field below it.

- ★ Enter an 'Integer' variable.

The driver writes the current group status in this variable. (Possible status, see Chapter 5.)

## Write Trigger

'Write Trigger' is used when complete data records need to be entered by pressing keys, e.g. new formula parameters.

A screenshot of a software interface showing a label 'Write Status:' followed by a rectangular input box.

- ★ Enter any variable.

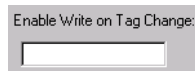
A write group is executed if the variable contents change.

Advantage: When a trigger is activated, all data defined in a driver worksheet (up to 1200 bytes with TCP/IP) are transferred in one single group to the PLC. This serves to control data volume and bus load.

## Enable Write on Tag Change

If the variable content or statistical numerical value is  $\neq 0$ , the system constantly checks whether defined variables have changed in MADAP Studio. If there have been any changes made, the new value is entered in the PLC.


'Enable Write on Tag Change' is used e.g. with acknowledgement functions or user entries.

A screenshot of a software interface showing a label 'Enable Write on Tag Change:' followed by a rectangular input box.

- ★ Enter any variable or statistical numerical value in the 'Enable Write on Tag Change' box.

 **Any newly entered values from a control are ignored to avoid an immediate write-back in the control. With content changes, variables that have been exclusively changed over the driver will therefore not participate in write groups.**

Advantage: No control mechanisms need to be set up.

 **A write group is executed for every variable changed. To change more than 5 variables at the same time, it is better to activate a 'Write Trigger'.**

## Write Completed

Once each read group has been completed, the driver designates entered variables with 0 or 1 alternately.

## Write Status

- ★ Enter an 'Integer' variable to call up and evaluate the current group status.

The driver writes the current group status in this variable. (Possible status, see Chapter 5.)

## Station field

### BUEP

No parameter needs to be entered as there is a point-to-point connection between the PC control panel and the PLC.

### TCP/IP

The partner's IP address is always needed for this communication between the PC control panel and the PLC. Enter this address in the 'Panel Configuration' menu option. This ensures that all communication data are exchanged with one single PLC.

- ★ If data from another PLC are to be read or written, enter the IP address of the other PLC in the 'Station' field.

The entry can either be static, e.g. 142.2.3.130 or dynamic, e.g. {IPAddress}.

A dynamic entry requires a 'String' variable (a character string is also acceptable). The variable contents must comply with the following conventions:

- The IP address must be 32 bits in length.
- It must be entered in 4 groups of numbers which range from 0 to 255.
- The groups of numbers must be separated with a dot.

Static IP address

Dynamic IP address

## Header

All configured variables in the 'data definition' section refer to one operand from a certain type of control. This is specified in the 'Header' box under the default option.



The header displays the following syntax and this order must not be altered:

[Operand type]:[D no.]:[Block address of ZS]:[Masking]:[Format]

### BUPEP

- Operand type:

I = Inputs

O = Outputs

M = Markers


D = Data module

C = Data buffer

d = Data field

- Data module no.:

If the operand type D = data module has been selected, the number of modules (ranging from 0 to the maximum number of data modules to be read or written) is entered in the data module no.

 **For the maximum number of data modules, refer to the individual system control manuals.**

If another operand type has been selected, a digit (e.g. 0) should be entered instead of the data module no.

- Block address of the PLC:

The block address entered depends on the type of PLC connected.

CL350/CL400 = 240

CL500/ZS0 = 0

CL500/ZS1 = 8

CL500/ZS2 = 16

CL500/ZS3 = 24

- Masking:

 **Masking is only possible with transfers from the PC control panel to the PLC.**

Enter 'M' (Mask) for bit transfer or 'N' (Normal, i.e. without masking).

- Format:

The format details refer to the entire data definition section.

B = Byte

W = Word

D = Double word

Example:

CL350/CL400, input, PLC address 0, no masking, data field in word format

Header entry: E:0:240:N:W

#### TCP/IP

- Operand type:

I = Inputs

O = Outputs


M = Markers

D = Data module

F = Data field

- Data module no.:

If the operand type D = data module has been selected, the number of modules (ranging from 0 to the maximum number of data modules to be read or written) is entered in the data module no.

 **For the maximum number of data modules, refer to the individual system control manuals.**

- ZS block address:

The block address entered depends on the type of PLC connected.

CL400 = 240

CL500/ZS0 = 0


CL500/ZS1 = 8

CL500/ZS2 = 16

CL500/ZS3 = 24


CL550 Without function, enter '0'

PCL Without function, enter '0'

 **If the block address 240 is entered when using a PCL, the driver worksheets can also be used for a CL400 without having to make any changes.**

- Masking:

'N' (Normal) for 'no masking', 'M' (Mask) for bit transfer.

 **Always enter 'N' for 'no masking'**

- Format:

The format details refer to the entire data definition section.

B	=	Byte	
C	=	Char	
W	=	Word	without sign
I	=	Word	with sign
D	=	Double word	with sign
R	=	Real	32 bits
L	=	Real	64 bits
Sn	=	String	with details of the number of characters, e.g. S10 = string with 10 characters (max. of 64 characters are possible)
S	=	String	without details of the number of characters. 64 characters are set.

Examples:

CL400, data module 100 in word format, no masking

Header entry: D:100:240:N:W

CL500, ZS2, data field in byte format, no masking

Header entry: F:0:16:N:B  
(data module no. without function)

PCL, E in double word format, no masking

Header entry: E:0:240:N:D  
(data module no. without function)

### Variable data entries

All data entries in the Header box can be set to default using variables.



**It is difficult to search for errors made in header entries with variables. The 'LogWin' tool is needed to locate errors in multiple worksheets, see Chapter 3.**

- ★ Enter the variables in curly brackets.

Header:
D:{DB_Nr}:{ZS_Nr}:N:W

The data module and ZS number definitions are made in the variables. These variables must be declared as 'Integers' in the database, i.e. they can only accept full numbers (positive and negative).

#### Variable operand type

The operand type can be kept variable. A string variable (variable that can accept character strings) is needed however.

- ★ Enter operand in curly brackets.

Header:

#### Variable header definition

The complete header definition can be entered in a 'String' variable. This provides a flexible and dynamic access to different data sources with one common driver worksheet.

Header:

### Checkbox

- ★ Click the checkbox to set the defined variables to a configured default value range.

Min:

Max:

- ★ Enter the minimum and maximum value, see Page 4-18 also.

Min:

Max:

### 4.1.2 Data definitions

Specific PLC addresses are assigned to the variables in the 'data definition' section. A table should be created for the address assignments.

	Tag Name	Address	Div	Add
1				
2				
3				
4				
5				

For Help, press F1

#### Tag Name

Tag Name

- ★ If you have variable contents that are to be exchanged with the PLC, enter this variable in the 'Tag Name' column.

The variant must exist in the MADAP Studio database. The following types of variables are permissible:

- Simple variable, e.g. test
- Array item, e.g. test[4]
- Class item, e.g. test[8].value0

#### Address

Address

A PLC address is assigned to the defined variable in the 'Address' column.

 **Note the selected operand type in the header entry.**

#### BUPEP

If the data are transferred in the 'Byte' or 'Word' format, it is sufficient to enter the PLC address. This address must correspond to the header entry.



With data bit transfer, the bit address should be separated with a dot.



 **Note the masking in the header entry.**

If a masking has been configured, a bit data transfer is possible for:

- 1 byte
- 1 data word
- 8 Boolean variants in 'Byte' format
- 16 Boolean variables

An unlimited number of Boolean variables can be read.

### TCP/IP

If just one address is entered, the global format defined in the header entry is used for this address.

Other formats can be assigned to the address by separating each format with a colon. Possible formats are:

- B = Byte
- C = Char
- W = Word, without sign
- I = Word, with sign
- D = Double word, with sign
- R = Real, 32 Bit
- R = Real, 64 Bit
- Sn = with details of the number of characters, e.g. S10 = string with 10 characters (max. of 64 characters are possible)
- S = without details of the number of characters. 64 characters are set.

Example:

	Tag Name	Address
1	test[0]	0
2	test[1]	1:B
3	test[2]	2:C
4	test[3]	4:W
5	test[4]	4:I
6	test[5]	8:D
7	test[6]	12:R
8	test[7]	16:L
9	test[8]	24:S20

Global definition in the header entry is active

Byte addresses

Word addresses

Double word addresses

8 byte addresses

String with 20 characters

The diagram shows a table with 9 rows and 3 columns. The columns are labeled 'Tag Name' and 'Address'. The first column contains numbers 1 through 9. The second column contains 'test[0]' through 'test[8]'. The third column contains '0', '1:B', '2:C', '4:W', '4:I', '8:D', '12:R', '16:L', and '24:S20'. To the right of the table, there are six text boxes with arrows pointing to specific rows: 'Global definition in the header entry is active' points to the first row; 'Byte addresses' points to the second row; 'Word addresses' points to the fourth row; 'Double word addresses' points to the sixth row; '8 byte addresses' points to the eighth row; and 'String with 20 characters' points to the ninth row.

☞ **All word addresses must be dividable by 2, all double word and real addresses by 4 and all long real addresses by 8 (WinSPS conventions). Otherwise, the transferred values are defective. The syntax of these addresses is not checked.**

A maximum of 1200 bytes of useful data can be transferred with each driver worksheet. This data can be processed in one single group if read or write triggers are used.

Up to 4096 entry lines are available in the data definition section on the driver worksheet. If more lines are needed, another driver worksheet with the same headers but with different data definitions needs to be created.

Addresses can be either static or dynamic:

static	dynamic				
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Address</th> </tr> <tr> <td style="text-align: center; padding: 2px;">0</td> </tr> </table>	Address	0	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Address</th> </tr> <tr> <td style="text-align: center; padding: 2px;">{DynamischeAdresse}</td> </tr> </table>	Address	{DynamischeAdresse}
Address					
0					
Address					
{DynamischeAdresse}					

With dynamic addresses, selected addresses are transferred from one address range without a driver worksheet being created for every address.

Syntax:  
{Variable}, but the variable must be an 'Integer'.

An addition command can be attached to addresses to allow dynamic calculations. This means that a section (sum of various addresses) can be transferred from one address range.

	Tag Name	Address
1	test[0]	{DynamischeAdresse}
2	test[1]	{DynamischeAdresse}+2
3	test[2]	{DynamischeAdresse}+4
4	test[3]	{DynamischeAdresse}+6
5	test[4]	{DynamischeAdresse}+8
6	test[5]	{DynamischeAdresse}+10

The operand format can be assigned to these addresses as required.

	Tag Name	Address
1	test[2]	{DynamischeAdresse}+4:D

**Non-linear address definitions**

Linear address definitions are not obligatory.

	Tag Name	Address
1	test[0]	100
2	test[1]	0
3	test[2]	34
4	test[3]	2
5	test[4]	500
6	test[5]	346

### Reading intermediate addresses

The driver always transfers the complete range of addresses (between the lowest and highest addresses) with a read group. If just 2 addresses are entered, e.g. 0 and 1198, 1200 bytes are read.

	Tag Name	Address
1	test[0]	0
2	test[1]	1189

### Writing intermediate addresses

The driver always transfers the complete range of addresses (between the lowest and highest addresses) with a write group with Write Trigger. If just 2 addresses are entered, e.g. 0 and 1198, all PLC addresses between these two addresses are written with the value 0.

	Tag Name	Address
1	test[0]	0
2	test[1]	1189




All PLC addresses between 0 and 1198 are set to 0.

### Bit assignment

The driver supports the direct assignment of PLC bit addresses to 'Boolean' variables (either yes = logic 1 or no = logic 0). The bit addresses need to be determined with a decimal point.

	Tag Name	Address
1	test[0]	10.0
2	test[1]	10.15


 Bit assignment functions with read only.

 Bit write access is only possible in 'Byte' format. Replace 'N' (no masking) in header entry with 'M' for masking (a group cannot be changed with one single command).

### Using spaces to create blocks

In order to ensure data transparency, blocks can be created using spaces.

	Tag Name	Address
1	test[0]	100:W
2	test[5]	200:W
3	test[10]	50:W
4		
5		
6	test[1]	8:D
7	test[6]	112:R
8	test[11]	56:R
9		

 **A maximum address range of 1200 bytes of useful data can be transferred per group.**

**Div**

Div

A scale setting can be specified in the 'Div' column. With a read group, the PLC value is divided by the Div value. When writing, the variable value is multiplied with the Div value.

Example:

A real value in the application should be converted into an integer in the PLC.

Application:            Variable    = 234.5  
 PLC:                    Value        = 2345

★ Enter 10 in the Div column.

Div
10

When writing, the current variable content is multiplied by 10 (234.5 \* 10 = 2345).

When reading, the PLC value is divided by 10 (2345 / 10 = 234.5) and assigned to the variables.

**Add**

Add

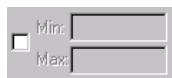
In the 'Add' column, an addition sign can be assigned to a read group or a subtraction sign can be assigned to a write group.

Formula:

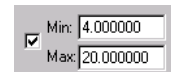
Read:                    Variable    = (PLC value / Div) + Add  
 Write:                    PLC value = (Variable – Add) \* Div

### Min./Max. checkbox

With this function, you can set the defined variables to a configured default value range.



If this function is active, the description in the definition table will change.



	Tag Name	Address	Min	Max
1	Test[0]	0		
2	Test[1]	2	10.000000	100.000000
3	Test[2]	4		
4				
5				

### Example

Transfer a variable (calculated on the control panel and within the value range of 0-10.00 V) from MADAP Studio to the PLC with a default value of between 4-20 mA.

The value range of variables in the database must be set to 0-10.

- ★ Open the database and select the variable you want.



Application Database			
	Name	Size	Type
1	test	2	Real

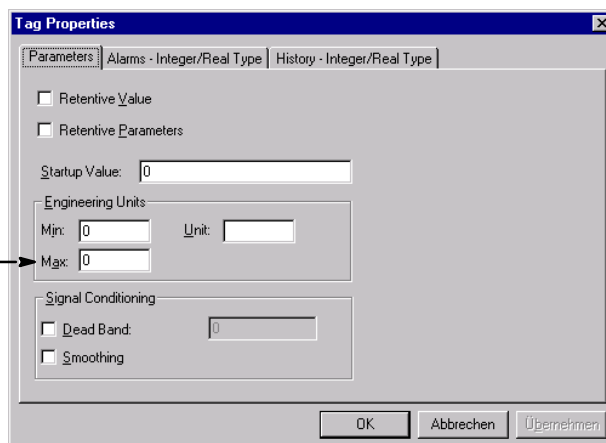
The parameter definition for the variable can be selected in the top section of the database.

- ★ Click the following button to open the selected variables in the parameter list.



The 'Parameter' window will then appear.

- ★ Enter the value 10 below 'Engineering Units' in the 'Max:' box.



Values outside the 0 to 10 range are rejected by the system.

As the Min./Max. checkbox is selected and the min/max ranges are set to 4–20, the system transfers the test[0] variable as default to the PLC.

Rules for writing:

$$PLC = Tag_{Appl} * (\Delta Max/Min_{PLC} / \Delta Max/Min_{Appl}) + PLC_{min}$$

- PLC : Value received in the PLC
- Tag<sub>Appl</sub> : Application variable on PC
- ΔMaxMin<sub>PLC</sub> : Value range of checkbox in the driver worksheet
- ΔMaxMin<sub>Appl</sub> : Value range of parameter variable range in the database
- PLC<sub>min</sub> : Minimum value of checkbox in the driver worksheet

Example:

The variable in the database has a value of 5.

Conversion in PLC value:  $PLC = 5 * (16/10) + 4 = 12$

Rules for reading:

$$Tag_{Appl} = (PLC - PLC_{min}) * (\Delta Max/Min_{Appl} / \Delta Max/Min_{PLC})$$

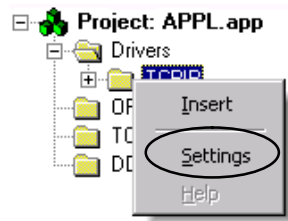
- PLC : Value in the PLC
- Tag<sub>Appl</sub> : Application variable on PC
- ΔMaxMin<sub>PLC</sub> : Value range of checkbox in the driver worksheet
- ΔMaxMin<sub>Appl</sub> : Value range of parameter variable range in the database
- PLC<sub>min</sub> : Minimum value of checkbox in the driver worksheet

Example:

The variable in the PLC has a value of 16.

Conversion in application:  $Tag = (16 - 4) (10 / 16) = 7.5$

## 4.2 Communication Parameters



- ★ Call up the driver configuration with the 'Settings' menu option.

The 'Communication Parameters' window displays the current driver configuration.

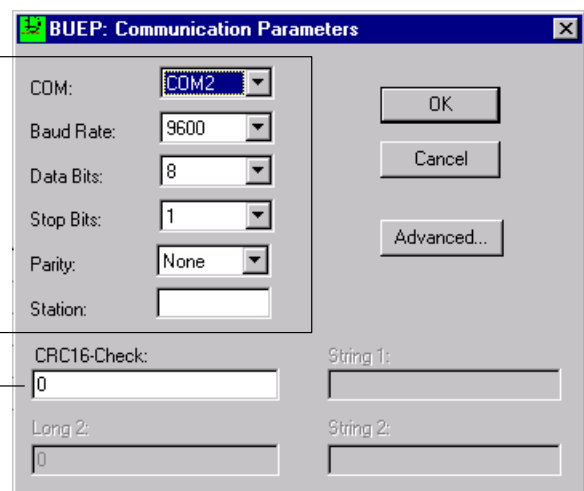
### 4.2.1 BUEP

#### Current configuration

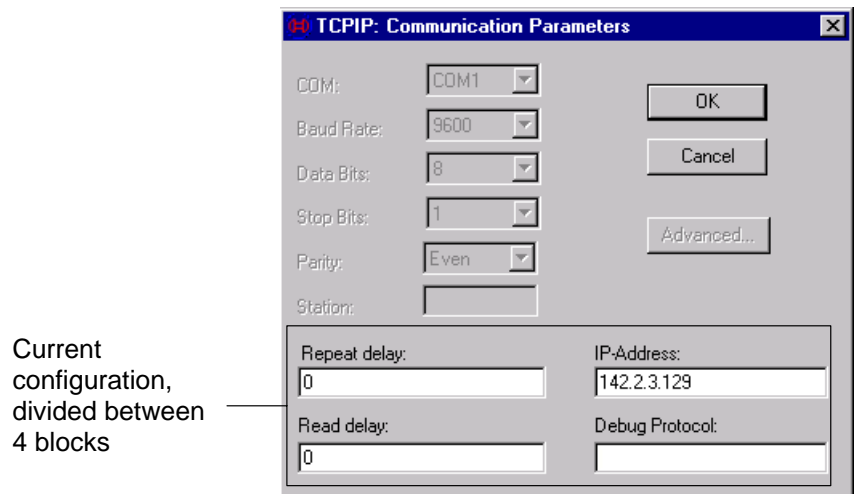
Serial connection:  
Transfer speed:  
Data length in bits:  
Number of stop bits:  
Parity (type of error check  
when transferring data):

COM2  
9600 Baud  
8  
1  
None

Block checksum



## 4.2.2 TCP/IP



### Repeat delay

If a read/write group has been started but the system is not responding, the group will be reactivated once the time specified in the 'Repeat delay' box has lapsed (read/write).

Repeat delay:	0
---------------	---

Time unit : ms

Max. value : 65.535

Default : 0 represents 1000 ms

**☞ If the time value is changed, it is necessary to monitor the entire system.**

The following needs to be checked:

- PLC cycle time

If this is e.g. 50 ms, it is useless to enter values that are lower than this current cycle time. Reason: The driver always exchanges data once at the end of every cycle (in the I/O image). If the time is lower than the current cycle time, unnecessary repeats are executed which increase the bus load considerably.

Rule: Number of control panels \* PLC cycle time < Repeat delay

- Bus load

If there are frequent collisions in the network, the group transfer time and the group response time will be longer. If the repeat time is too short, unnecessary repeats are executed which cause the bus load to increase.

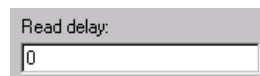
**☞ It is usually not necessary to change the default setting.**

'Repeat delay' does not indicate how many groups are processed a minute. The communication quality depends entirely on the application (PC and PLC), network load and system setting of MADAP Studio.

### Read delay

With 'Read delay', it is possible to determine the system response time. The system can use the time between the start and the response for different tasks.

 **The time set must always be lower than the current cycle time of the PLC.**



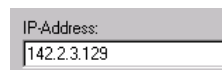
Read delay:  
0

Time unit : ms  
Max. value : 65.535  
Default : 0 represents 1000 ms

 **It is usually not necessary to change the default setting.**

### IP Address

The IP address is needed to establish communication between partners over TCP/IP. The PLC (server) is always entered under 'IP-Address'. The control has already been set in the 'Panel Configurator' tool, see Chapter 6.3 also.

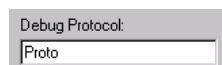


IP-Address:  
142.2.3.129

### Debug Protocol


Communication protocols can be made using the 'Debug Protocol' option. If there is no entry in this box, the system will not log any transfer data.

★ Enter 'Proto' in this box to log communications.



Debug Protocol:  
Proto

The driver creates the 'TCPIPProtocol.txt' file in the 'C:\Temp' temporary directory on the hard disk. The communication tasks are logged here.

 **The entry or deletion of 'Proto' is applied once the driver is rebooted.**

Date	Time	From	R/W	Com	SubCom	Offset	Len	TelNr	Rep	Error	
<	19.10.2001 10:42:52:0482	-	127.0.0.1	- W	DM	00e6	001e	0002	029a	4	-
<	19.10.2001 10:42:52:0732	-	127.0.0.1	- W	DM	00e6	001e	0002	029a	5	-
<	19.10.2001 10:42:53:0043	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	0	-
<	19.10.2001 10:42:53:0293	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	1	-
<	19.10.2001 10:42:53:0543	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	2	-
<	19.10.2001 10:42:53:0794	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	3	-
<	19.10.2001 10:42:54:0044	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	4	-
<	19.10.2001 10:42:54:0295	-	127.0.0.1	- R	PLC	0000	0000	0008	029b	5	-
<	19.10.2001 10:42:54:0605	-	127.0.0.1	- R	ID	0100	0000	0008	029c	0	-
<	19.10.2001 10:42:54:0855	-	127.0.0.1	- R	ID	0100	0000	0008	029c	1	-
<	19.10.2001 10:42:55:0106	-	127.0.0.1	- R	ID	0100	0000	0008	029c	2	-
<	19.10.2001 10:42:55:0356	-	127.0.0.1	- R	ID	0100	0000	0008	029c	3	-
<	19.10.2001 10:42:55:0606	-	127.0.0.1	- R	ID	0100	0000	0008	029c	4	-
<	19.10.2001 10:42:55:0857	-	127.0.0.1	- R	ID	0100	0000	0008	029c	5	-
<	19.10.2001 10:42:56:0167	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	0	-
<	19.10.2001 10:42:56:0418	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	1	-
<	19.10.2001 10:42:56:0668	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	2	-
<	19.10.2001 10:42:56:0918	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	3	-
<	19.10.2001 10:42:57:0169	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	4	-
<	19.10.2001 10:42:57:0419	-	127.0.0.1	- W	DM	00e6	001e	0002	029d	5	-
<	19.10.2001 10:42:57:0729	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	0	-
<	19.10.2001 10:42:57:0980	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	1	-
<	19.10.2001 10:42:58:0230	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	2	-
<	19.10.2001 10:42:58:0481	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	3	-
<	19.10.2001 10:42:58:0731	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	4	-
<	19.10.2001 10:42:58:0981	-	127.0.0.1	- R	DM	00e6	0000	0076	029e	5	-
<	19.10.2001 10:42:59:0292	-	127.0.0.1	- R	BUS	3300	0000	0060	029F	0	-

The transfer data are subdivided into:

- Transfer direction
  - < Group is sent from the control panel.
  - > Group confirmation is received from the control panel.
- Date
  - Group processing date
- Time
  - Group processing times, the actual transfer time is calculated from the difference between < and >.
- From
  - IP-address of the partner addressed by the control panel
- R/W
  - R Read group from the control panel to the communication partner
  - W Write group from the control panel to the communication partner
- COM
  - Group contents, e.g. PLC operand or control information

Possible entries:

COM	Meaning
BUS	Status of the connected field bus, for internal use only
DF	Data field
DM	Data module
ID	Control ID, for internal use only
I	Input

M	Marker
Q	Output
S	System range
SM	Special marker
PCL	Control in run/stop mode, for internal use only

- SubCom  
Data module number when a data module is entered in the Com column
- Offset  
Start address of the selected operand in the group
- Len  
Group length
- TelNr  
Telegram number which must run in a linear direction, otherwise data loss
- Rep  
Number of group repeats. A maximum of 5 repeats are possible before the group is rejected. The number of repetitions is set and cannot be changed.
- Error message
  - No error message is possible when sending groups
  - 0000, when no error has been recognised with a group response
  - Other error numbers, see Chapter 5, group status.

**CAUTION**

The 'Debug Protocol' function can result in performance losses of the PC. Further, if this function is activated continuously, the capacity of the hard disk can be exhausted and proper use of the MADAP Studio software will be impossible.

Use this function only in exceptional cases and for a short period of time!

---

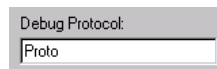
**With PCL,**

it can be set that the 'K4 UDP2' channel is exclusively used for the connection between visualisation and control. No other communication is sent along this channel.

Condition:

- K4 UDP2 must be selected.

- ★ Enter 5001 to force communication on UDP2.



- 5001 is displayed in the 'Debug Protocol' box in the 'Communication Parameters' window.

### 4.3 OPC Client Configuration

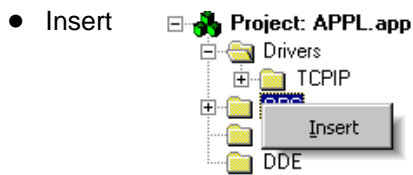
 For detailed information on OPC-technology, see Chapter 7.

The following need to be configured for an OPC client worksheet:

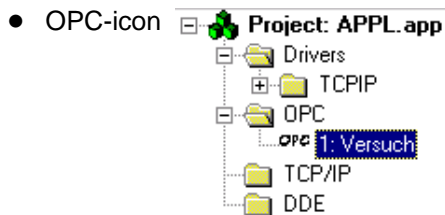
- Server identifier
- Communications parameter
- Tags

A new OPC client worksheet can be created:

- with the [Insert] and [Document...] menu options, see Page 4-1.
- to the left of the 'Workspace' window in the 'COMM' tag with:



An existing OPC client worksheet is opened with:



Opcc1001.opc
\_ \_ X


Description:	Server Identifier:	Disable:
<input type="text"/>	<input type="text"/>	<input type="text"/>
Read Update Rate (ms):	Percent Deadband:	Status:
<input type="text"/>	<input type="text"/>	<input type="text"/>
Remote Server Name:		
<input type="text"/>	<input type="button" value="Browse..."/>	

	Tag Name	Item	Scan
1			▼
2			▼
3			▼
4			▼
5			▼

## ★ Complete boxes.

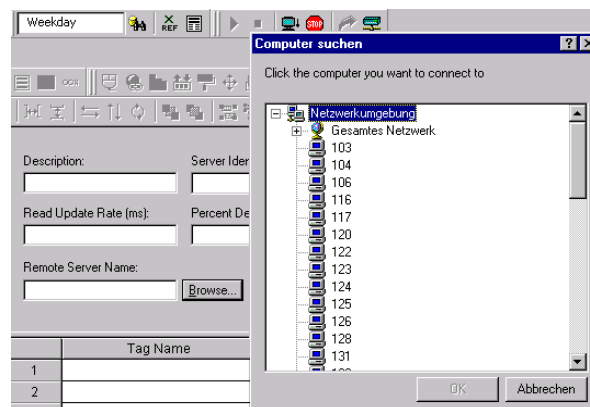
- Description: Used for documentation purposes only and has no control function.
- Server identifier: Select server over identifier.

- Disable: Enter variable or constant.  
If the variable or constant has a value of  $\neq 0$ , no communication with the OPC server is possible.
- Read Update Rate (ms): Enter rate at which the data have been updated.  
An '0' entry means the fastest possible speed is applied.
- Percent Deadband: Enter percent deviation, which the data need to exceed for the server to emit a message.

 **This function is not supported by the Bosch OPC server.**

- Status: Status information

- Remote Server Name: In the event the OPC server is running on another computer. Click the 'Browse' button to select the computer.



	Tag Name	Item	Scan
1			
2			
3			
4			
5			

- Tag Name: Enter variable whose contents are to be exchanged with the PLC.  
Possible variables are:
  - Marker
  - Data Module
  - Data Field
  - Inputs
  - Outputs
  - Special Marker
- Item: Other formats can be assigned by separating each format with a colon.  
Possible formats are:
  - C = Char, Byte with sign VT\_I1
  - B = Byte VT\_U1
  - Xn = Bit access, with 'n' as the bit number (0 to 7) VT\_BOOL
  - Sn = with details of the number of characters, e.g. S10 = string with 10 characters (default: 32) VT\_BSTR
  - I = Word, with sign VT\_I2
  - W = Word, without sign VT\_UI2
  - L = Double word, with sign VT\_I4
  - F = Floating-point value, simple (4 bytes) VT\_R4
  - D = Floating-point value, double exact (8 bytes) VT\_R8

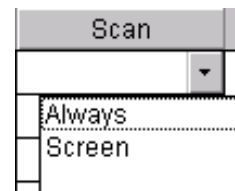
Examples:

- M:32:X3            Bit 3 in marker byte 32
- DF:1024:L         Double word in data field from byte 1024
- DF:10:32:X4       Bit 4 in data word 32 of data module 10
- M:0:S24           String from marker byte 0

- Scan:

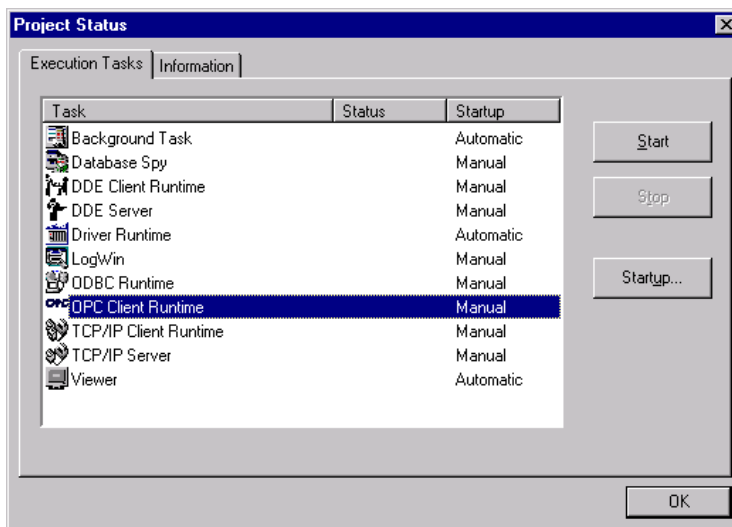
The following entries can be selected under 'Scan':

- Always =            Data are always updated
- Screen =            Data are only updated, if a screen, in which the variable is displayed, is open

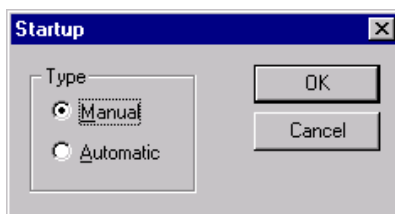


### 4.3.1 OPC Client Runtime

Go to [Project] and [Status] to set whether 'OPC Client Runtime' should be automatically or manually activated with the 'Project Status' window.



★ Click the 'Startup' button to open the 'Startup' window.



★ Select the type of start and confirm with 'OK'.

The following icon appears in the taskbar:



★ To close the OPC client module, right click on the icon and select 'Exit'.

 **The same procedure can be used to select the startup setting for all other worksheets.**

## 5 Read/Write Group Status

Detailed list of error codes which can occur during writing as well as reading tasks.

### 5.1 BUEP communication

Status	Cause
1	Data group contains zero elements Solution: Check data group for zero elements
2	ENQ (Enquiry) error message
3	Error message
4	Data group too large Solution: Reduce the number of data
5	Block checksum error

### 5.2 TCP/IP communication

System errors based on network problems:

Status	Cause
0	No error
16	With hardware control, COM-E refuses the telegram → block address has not been entered or it is incorrect. Solution: Configure control panel with 'Panel Configuration'. Check the header entry on the user driver worksheets. The third entry is the block address.
80	Control is not responding
81	Control reports incorrect data: Value from data word is requested → Marker word supplies answer. Incorrect data amount
1000	No variables and address entries in the driver worksheet.
1001	Operand size or group length exceeded > 1,200 bytes, e.g. address entry with data module > 510 Solution: Observe the difference between the last address – first address =< 1200 or check the operand size.
1003	No IP address in TCPIP.TFC file. Solution: Can be set manually via Driver Configurator; or better: Call 'Panel Configurator' and enter the correct IP address.

Status	Cause
1004	No communication possible as WindowsNT network environment is set incorrectly, e.g. participant's IP addresses have different subnet masks.  Solution: See Chapter 6.
1005	The control cannot be found following driver startup.  Solution: Configure communication with the 'Panel Configuration' tool. If this error persists, the problem lies in the network environment, see Chapter 6.
1008	There is a defective line in the definition block. This can be a missing variable, an undefined index item in the 'Tag' column or an incorrect address in the 'Address' column, e.g. :WF.  Solution: Add variable to the database (via the Database Manager) or use existing variables, enter the correct address, see Chapter 4.
1009	Masked data transfer (M:0:0:M:B) with 'Write Trigger'.  Solution: Only use driver worksheet for 'write on tag change' writing, see Chapter 4.1.1.
1010	Incorrect data type with masked data transfer, e.g. Header: M:0:0:M:B Address: 0.0-0.7; 1.0-1.7 ...
1020 to 1027	Communication failed as PLC is disconnected or cable is defective.  Solution: Check PLC with correctly loaded project in run mode (slide switch?) or check cable connection, see Chapter 6
1028	Variable entered in the driver worksheet does not exist, see Status 1028.
1029	No valid field bus description file (only with PCL or CL550).  File contains descriptions of the individual bus slaves, e.g. slave 5 I/O's loader.

Error codes as a result of protocol-related causes:

Status	Cause
33281	COM-E module cannot be found.  Solution: Check the PLC system table with WinSPS.
33312	'Control in Stop' command is not possible.  Solution: The control is in stop mode. Switch to 'Run', e.g. with the slide switch on the ZS.
33313	'Control in Run' command is not possible.  Solution: The control is in run mode. Switch to 'Stop', e.g. with the slide switch on the ZS.
33318	Data module number too large.  Solution: Enter a data module number in the TCPiPxxx.DRV driver worksheet, which corresponds to the PLC type specified within the correct value range, see Chapter 4.1.1.

Status	Cause
33319	<p>There is no data module.</p> <p>Solution: Load a correct MADAP Studio project on the control and check that there are no invalid data module numbers entered in the user driver worksheets (second position in the header entry), see Chapter 4.1.1.</p>
33320	<p>Data module limits violated.</p> <p>Solution: Check the end addresses for the data module communication in the user driver worksheets. The end address must not exceed the module size in the PLC, see Chapter 4.1.1.</p>
33399	<p>Error while sending TCP/IP.</p> <p>Solution: Too many modules want to communicate with the PLC via TCP/ IP, e.g. WinSPS, BoschCom, multiple MADAP Studio or similar. Close modules that you do not need.</p> <p>Incorrect IP address set.</p> <p>Solution: Enter the correct IP address with the 'Panel Configuration' tool, see Chapter 6.3.</p> <p>There is no network.</p> <p>Solution: Check the network environment, see Chapter 6.</p>
33400	<p>Error while reading TCP/IP.</p> <p>Solution: See Status 33399.</p>
39032	<p>Incorrect control or block address selected.</p> <p>Solution: Select the correct control with 'Panel Configuration', see Chapter 6.3.</p>
39296	See Status 39032.
51696	See Status 39032.
55976	See Status 39032.

Notes:

## 6 Network Basics

This chapter will explain the terms 'Ethernet', 'TCP/IP' and 'Network settings'. It provides a basic introduction and serves to help users find their way around the system environment and to locate any errors.

### 6.1 Ethernet

Ethernet refers to the physical layer of a network used to connect the computer, PLC etc. All participants in the Ethernet network work on the same cable and share the maximum bandwidth.

The Ethernet network allows:

- Common use of resources, e.g. printer, memory etc.
- Central programming and maintenance of connected control components.
- Exchange of information in the form of process data.
- Remote diagnosis.

### 6.2 Data network components

#### 6.2.1 Hubs

- Synonyms: Star coupler, concentrator, multi-port repeater, distributor
- Tasks: To send data, received at one port, to all other ports.  
To regenerate amplitudes, signals and cycles.
- Network access: CSMA/CD (Carrier Sensing Multiple Access Technology with Collision Detection) with shared Ethernet

- Functional principle:** All participants in the network listen for a carrier signal. This signal indicates that data is being transferred. If the participants do not sense a signal, they know that the channel is free and they can send data. If two participants attempt to send data simultaneously, the signal activity increases. The participants interpret this increase in activity as data collision. They interrupt data transfer and wait until they can restart transferring data. This delay is calculated randomly which means the length of the delay is different for each participant. As a result, it can be assured that the second transfer will be successful.
- Shared network:** From a statistical viewpoint, the bandwidth is divided into segments and each segment supports a certain number of participants, see table below.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>● Inexpensive</li> <li>● Easy handling</li> <li>● Usually 'plug and play'</li> </ul>	<ul style="list-style-type: none"> <li>● The more participants send, the more likely collisions will occur and the less bandwidth can be used. Rule of thumb: approx. 40% can be used in the Office Net, approx. 8% can be used in industrial automation.</li> <li>● Planning: approx. 20 participants per segment in the Office Net, a maximum of 40 participants (if needed) in the industrial network due to lower data quantities.</li> <li>● Maximum segment extension: 4500 m</li> <li>● Segment extension is reduced due to installed components.</li> <li>● For larger distances, the network has to be subdivided using switches.</li> </ul>

## 6.2.2 Switches

- **Synonyms:** Bridges, MAC-Level bridges
  
- **Tasks:**
  - To send data received at one port to the other port connected to the target station. If the target address is unknown, the packet is sent to all other ports.
  
  - To learn the MAC addresses and ports of the connected stations.
  
  - To filter any collisions, collision products and faulty packets from the network thus relieving the load of the entire network.
  
- **Network access:**
  - To segments in half-duplex mode (it is not possible to send and receive simultaneously) via CSMA/CD.
  - Between switches and full-duplex compatible stations (simultaneous sending and receiving) without CSMA/CD.
  
  - Switched network: The full bandwidth is available for each port.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>● Inexpensive with up to 10 Mbit/s</li> <li>● Easy handling, usually 'plug and play'</li> <li>● Filter provides safety functions</li> <li>● VLAN functions for controlling the flood of broadcasts (virtual LANs)</li> <li>● If necessary, link redundancy with 'Spanning Tree'</li> </ul>	<ul style="list-style-type: none"> <li>● Extensive configuration if multiple functions are used</li> <li>Autonegotiation: Disconnect, if possible and if the partner connection is known</li> </ul>

## 6.2.3 End devices: PCs, servers, controls

All communicating end devices must be equipped with a network connection:


- PLC CL550 ZS550, COMMAP
- PLC CL500 COM-E
- PLC CL350/CL400 COM-E
- PCL WindowsNT-compatible network card
- Control panel or PC WindowsNT-compatible network card

These components are equipped with an RJ45 plug to which the Twisted-Pair network cable is connected.

## 6.2.4 Cabling

The Twisted-Pair cable has established itself as the standard cable (made from two insulated copper wires that are twisted together).

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Normally used already</li> <li>• Inexpensive</li> <li>• Flexible use</li> <li>• Preferred</li> <li>• Interference immunity higher than for coax cable, symmetrical data transfer</li> </ul>	<ul style="list-style-type: none"> <li>• Range &lt; 100 m</li> <li>• More extensive cabling work involved than for coax</li> <li>• Without exterior shield low resistance to electromagnetic influences</li> </ul>

Technical data			
Types	UTP (unshielded) STP (shielded)		
Impedance	100 or 150 $\Omega$		
Maximum shielding	11.5 db/10 MHz		
Pin assignment (RJ45)	Pin	MDI	MDI-X
	1	Tx+	Rx+
	2	Tx-	Rx-
	3	Rx+	Tx+
	4		
	5		
	6	Rx-	Tx-
	7		
	8		
 <b>Always use 8-wire cable (STP), category 5!</b>			

## 6.2.5 Standard protocols

The following protocols are used for the data exchange between network participants:

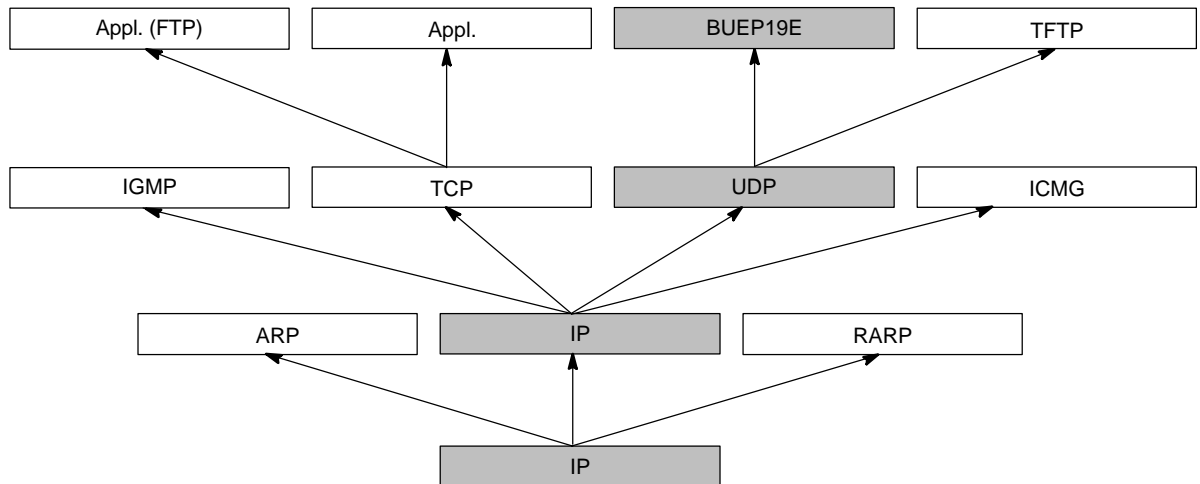
- IP Internet Protocol
- TCP Transmission Control Protocol
- UDP User Datagram Protocol
- BUEP19E Bosch Transfer Protocol 19E

The UDP protocol is used for communication between the PLC and the PC control panel. Like TCP, this protocol also works on the TCP-IP transport layer. UDP can, however, communicate data faster than TCP.

UDP is the data container for the internal BUEP19E control protocol.

The Bosch BUEP19E transfer protocol builds a point-to-point-connection between the control and the control panel. From a user's viewpoint, all BUEP19E objects are data ranges in modules.

Overview of the protocol layers:



## 6.2.6 Structure of IP addresses

Each network card in the computer and in the controls has its own IP address. This address is 32 bits in length and divided into 4 number groups separated with a dot. Each number group ranges from 0 to 255.

Example: 121.2.64.229

An IP address is subdivided into a network (Net-ID) and a node address (Host ID). The network address represents the subnet. The node address is used to address a participant within a subnet.

There are 5 address classes depending on the size of the network:

Class	Designation	Address range
A	1 byte network and 3 byte node addresses	1.0.0.1 to 126.255.255.254
B	2 byte network and 2 byte node addresses	128.0.0.1 to 191.255.255.254
C	2 byte network and 2 byte node addresses	192.0.0.1 to 223.255.255.254
D	Special addresses: <ul style="list-style-type: none"> <li>• Loopback addresses</li> <li>• Multicast addresses</li> <li>• Broadcast addresses</li> </ul>	127.0.0.1 to 127.255.255.254 224.0.0.0 to 255.255.255.254 255.255.255.255
E	Reserved	

 **The IP addresses in the address ranges of classes A, B and C are suitable for addressing the communication modules.**

Every communication-compatible component in a network can be reached with the IP address. A subnet mask is also linked to this address and this mask has the same form as an IP address.

The subnet mask must be identical for all participants in one network. This enables the participants to know that they belong to the same network. The subnet mask is also used to determine the possible size of a network. In other words, so-called subnets can be defined.

Communication via IP addresses is set up as follows:

- If the network participants are located within the same subnet, the communication packets are exchanged directly.
- If the IP address is in another subnet, an attempt is made to forward the data packets via routers (computers that connect different network segments together). In other words, if there is no router in the network, data communication is impossible.

The following rule applies:

If the result of the AND-link between the subnet mask and the target IP address produces the local subnet address, the data packet remains within the local network. If any other results are produced, the packet is sent to the subnet router.

**Example:**

Computer address: 142.2.30.70

Subnet mask: 255.255.0.0

Subnet router address: 142.2.0.100

Target address: 142.3.12.7 → Data packet is sent to router

Target address: 142.2.20.21 → Data packet remains in its own subnet

## 6.3 Network settings

The following parameters have to correspond to ensure that the MADAP Studio Runtime and the PLC can communicate via the TCP/IP:

- in the Panel Configurator
- in WinSPS
- in the PC network cards

### 6.3.1 Panel Configurator

The first step is to configure the MADAP Studio Runtime with the 'Panel Configurator' tool, see 'MADAP Studio, Startup Manual', order no. 1070 072 225.

Enter the IP address of the PLC with which the MADAP Studio Runtime is to communicate.

### 6.3.2 WinSPS

The PLC must also contain this IP address in the Ethernet module.

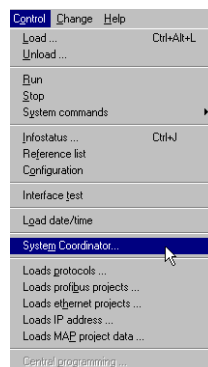
- ★ Call up the 'WinSPS' software.

- ★ Click the 'Editor' button.



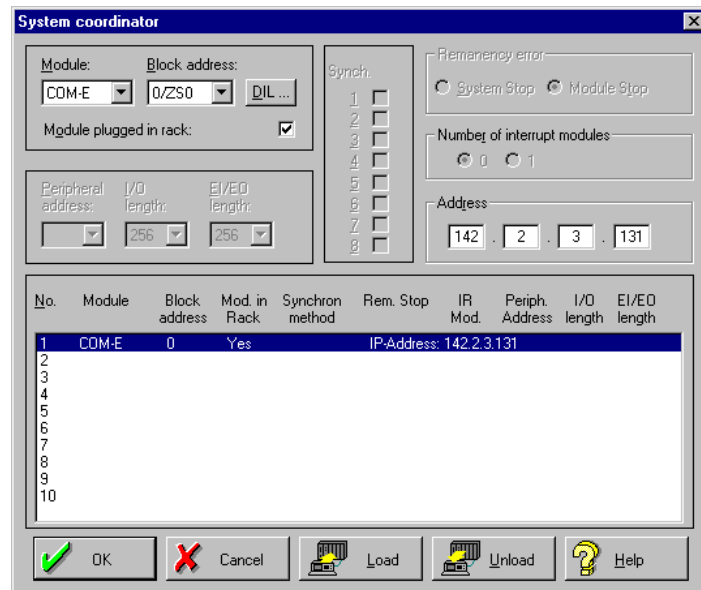
#### CL400/CL350 CL500

- ★ Go to the 'Control' menu option and select the 'System Coordinator'.



The system table will open.

A COM-E module with the selected IP address must appear in the system table. Otherwise, the IP address must be adjusted to the COM-E module.



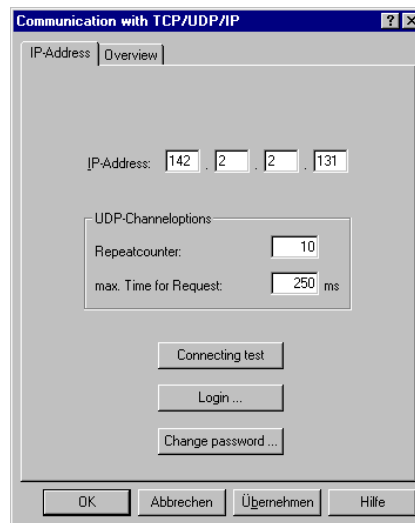
- ★ Highlight the COM-E module and change the IP address in the 'Address' entry box above the table.

## CL550

- ★ Go to the 'Control' menu option and select the 'Central Programming' function.



The 'Communication with TCP/UDP/IP' window appears.

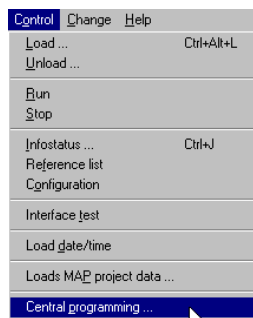


The IP address of the ZS module must be identical.

- ★ If not, select the IP address of the ZS module required.

## PCL

- ★ Go to the 'Control' menu option and select the 'Central Programming' function.



The IP address of the PCL must be identical.

- ★ If not, change the IP address accordingly.

### 6.3.3 PC network cards

- ★ Go to 'Control Panel' and select 'Network' settings.  
A list of the installed network components is displayed.
- ★ Select the TCP/IP connection properties for the network card to be used for communication.
- ★ Click the 'Properties' button.

The IP address of the control panel, on which the MADAP Studio Runtime is running, must be in the same subnet as the IP address of the PLC.

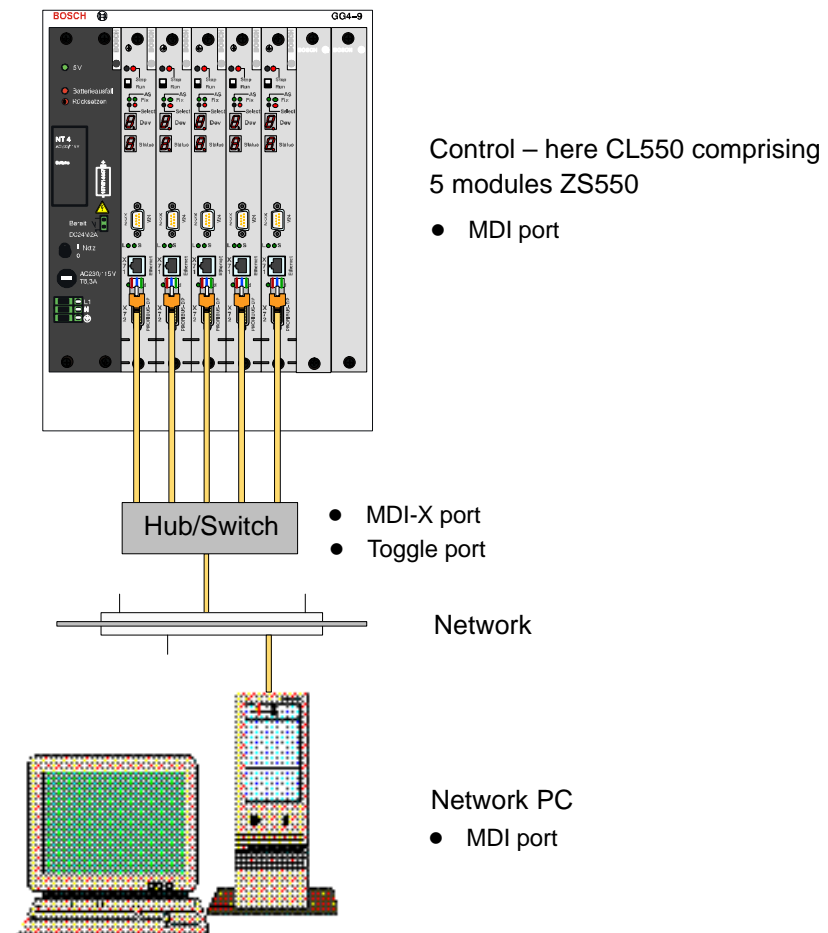
**Example:**

- IP address of PLC: 142.2.3.131
- IP address of control panel: 142.2.3.130
- Subnet mask on the control panel: 255.255.0.0

Byte 1 and Byte 2 are identical, i. e. both IP addresses are in the same subnet and communication takes place within the local network.

☞ **A router can be used to extend communication to other subnetworks, see Section 6.2.6.**

## 6.4 Possible error sources in the network



**Module/PLC**

Module/PLC is not running

- Network settings have not been entered or are incorrect, see Section 6.3?
- DIP switch is not set correctly?
- System has not been started up?
- Module has no IP address ('U' display)?

**Physical network connection**

There is no network connection.

- Are the link LEDs on the module and on the corresponding hub port switched on?
- Are all components connected?

	MDI	MDI-X
MDI	crossed cable	straight cable
MDI-X	straight cable	crossed cable

- Correct settings on the network card?
  - Full duplex (FDX) or half duplex (HDX)
  - 10 Mbit or 100 Mbit
- Defective connection cable?

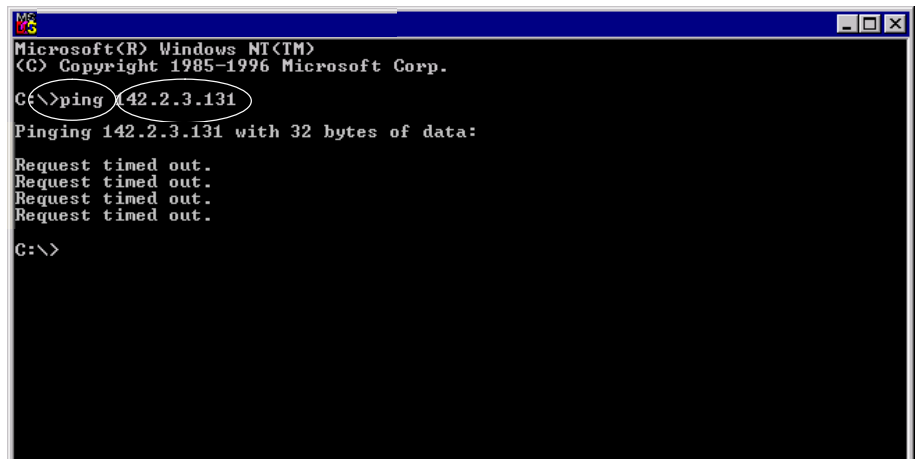
**Logic network connection**

Is there a logic network? Does the module react to a ping?

- ★ Call up [Programmes] [Command Prompt] via the WindowsNT desktop.
- ★ Enter [Ping] command and IP address of the partner.

**No communication**

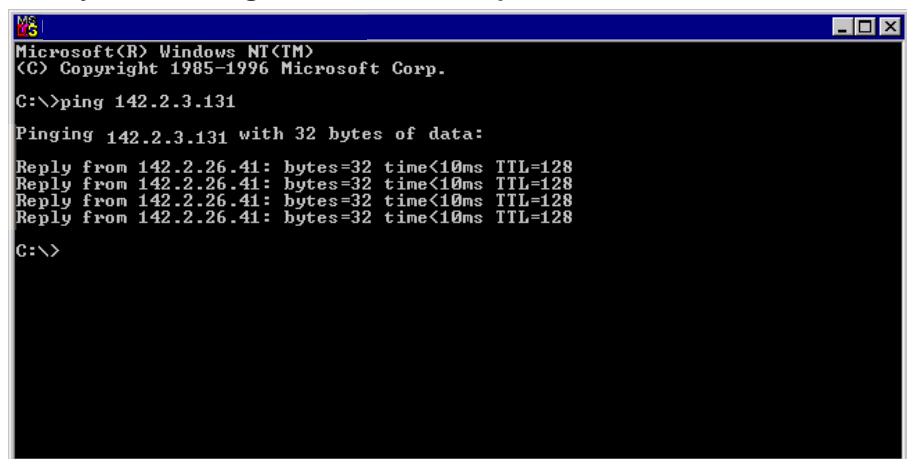
A timeout message appears indicating a general network problem.



Possible errors:

- IP address is not correctly entered on the module.
- The modules have been swapped and the old modules are still in the ARP list.
- Wrong subnet mask, see Section 6.2.6.
- IP address of sender and receiver are different in the subnet mask and there is no default gateway.
- Subnetworks of the sender and receiver are not connected or are defective.

### Physical and logic communication possible



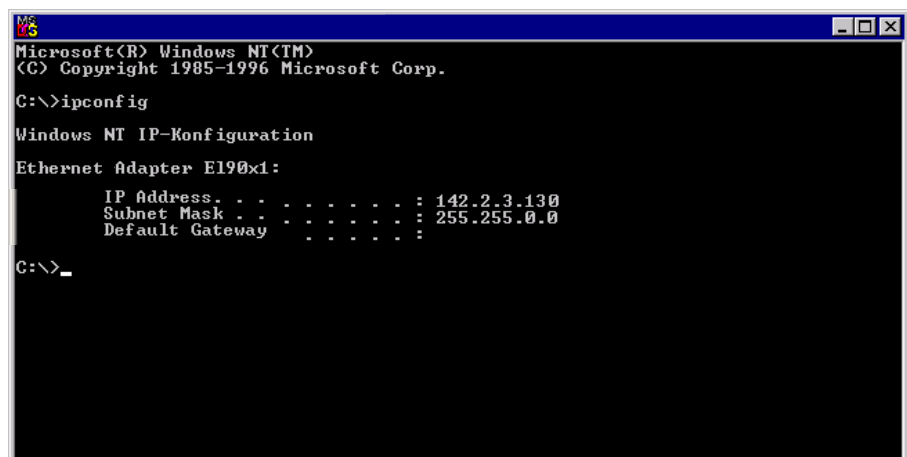
```

Microsoft(R) Windows NT(TM)
(C) Copyright 1985-1996 Microsoft Corp.
C:\>ping 142.2.3.131
Pinging 142.2.3.131 with 32 bytes of data:
Reply from 142.2.26.41: bytes=32 time<10ms TTL=128
Reply from 142.2.26.41: bytes=32 time<10ms TTL=128
Reply from 142.2.26.41: bytes=32 time<10ms TTL=128
Reply from 142.2.26.41: bytes=32 time<10ms TTL=128
C:\>

```

If the exact IP configuration is not known:

- ★ Call up [Programmes] [Command Prompt] via the WindowsNT desktop.
- ★ Enter [IP Config] command.



```

Microsoft(R) Windows NT(TM)
(C) Copyright 1985-1996 Microsoft Corp.
C:\>ipconfig
Windows NT IP-Konfiguration
Ethernet Adapter E190x1:
    IP Address. . . . . : 142.2.3.130
    Subnet Mask . . . . . : 255.255.0.0
    Default Gateway . . . . . :
C:\>_

```

- ★ Enter [IP Config/all] command to retain all system data.

```

Microsoft(R) Windows NT(TM)
(C) Copyright 1985-1996 Microsoft Corp.

C:\>ipconfig/all

Windows NT IP-Konfiguration

Host Name . . . . . : bt150_wm
Primary DNS Suffix . . . . . :
Node Type . . . . . : Broadcast
IP Routing Enabled. . . . . :
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . :

Ethernet Adapter E190x1:

Description . . . . . : 3Com 3C90x Ethernet Adapter
Physical Address. . . . . : 00-10-5A-F8-00-EE
DHCP Enabled. . . . . : No
IP Address. . . . . : 142.2.3.130
Subnet Mask . . . . . : 255.255.0.0
Default Gateway . . . . . :

C:\>

```

## Application programme

Possible errors:

- Does the application programme have contact to communication partners?
- IP address of sender and receiver are different in the subnet mask and there is no default gateway.
- Subnetwork connections of the sender and receiver do not exist or are incorrect.
- Is the control panel correctly set with the 'Panel Configurator'? See Section 6.3.

## Network technology

Possible errors:

- Network cabling structure
  - Data cable is alongside electrical cables.
  - Data paths are too long.
- Network cabling
  - Missing or incorrect data cable shielding
  - The wire pairs have become untwisted during installation work.
  - The stipulated distances to the connection terminals have been exceeded while laying the data cable.
- Used network components
  - Use of individual components in compliance with cat. 5 without entire system being in compliance with cat. 5
- Network load
  - Data distributor is not earthed.
  - Earth loops between data distributor and end devices
- Environmental conditions (EMC)

Notes:

## 7 OPC Technology

OPC technology can be integrated into the Bosch Rexroth controls. This technology is now recognised as standard in the industry.

This type of communication is not linked to a programming language but provides access to control data from Basic, VBA (Excel, Access), VBScript, Jscript as well as C++, Delphi and HTML. An OPC client is, however, needed first.

Each Scada system usually has an OPC client but it is not difficult to develop your own client.

A simple test can be executed with the OPC client supplied by Factory Soft.

There are 6 OPC servers integrated with WinTools:

File name (.exe)	Name visible to the client
BOSCHOPC.EXE	CLOPC.CLOPC.1
BOSCHOPC1.EXE	CLOPC1.CLOPC.1
BOSCHOPC2.EXE	CLOPC2.CLOPC.1
BOSCHOPC3.EXE	CLOPC3.CLOPC.1
BOSCHOPC4.EXE	CLOPC4.CLOPC.1
BOSCHOPC5.EXE	CLOPC5.CLOPC.1

### 7.1 Call up OPC

The application can be parameterised with a call switch. These switches can be stored in the 'BoschOPC.INI' file or can be directly attached when called.

#### 7.1.1 Hardlock/soft licence

Use the '/H' switch to select either a hardlock or soft licence:

- '/H': (default) find hardlock licence
- '/h': find soft licence

## 7.1.2 IP address and target control port

The Bosch Rexroth OPC server and OPC client run on the same computer; Ethernet provides the connection to the target PLC. It is therefore necessary to provide the system with an IP address. The local host address '127.0.0.1' is set as default.

The SoftPLC PCL and CL550 work on different port addresses. This is why the PCL port address also needs to be indicated (default is 5002):

- /I111.222.111.111 (target IP address)
- /P5015 (port address for CL550)
- /P5002 (port address for PCL)

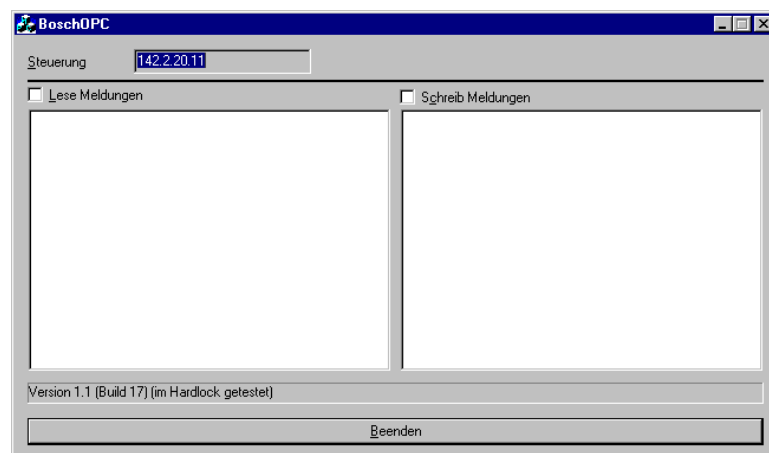
 **There should be no changes made to the DCOM security settings with this communication path.**

## 7.1.3 Start with OPC client

If the OPC server is not explicitly started, an OPC client can force the OPC server to start. As the call switches are needed here, there should be a valid 'BoschOPC.ini' file stored in the OPC server directory.

## 7.1.4 Interface

The interface displays the control to which the OPC server is connected and the version installed. You can use the **Lese Meldungen (Read Messages)** and **Schreib Meldungen (Write messages)** checkboxes to monitor command traffic.



The active OPC clients are informed when the server is to be shutdown.

## 7.2 OPC data

This chapter describes which data can be read from the PLC, how many data entries are permitted and the important points to note on data syntax.

### 7.2.1 Restrictions

The data are divided into different groups in an OPC server. It is the task of the OPC client to decide which data belong in which group.

Due to control conditions, the following restrictions apply:

The total number of data is limited to 16k (from Version 1.2, previous number 2048). Each OPC group may only comprise 255 data entries.

### 7.2.2 Data

There are basically two ways of accessing data in the PLC:

- Absolute
- Symbolic

'Absolute' means access via an absolute operand. This includes the following:

- *Marker*
- *Data Module*
- *Data Field*
- *Inputs*
- *Outputs*
- *Special Marker*

'Symbolic' means a selection from a data list stored in the PLC. This is saved in the control by WinSPS (Version 3.02 and later).

The syntax for absolute access is simple; ':' is used to separate entries.

- For data modules: DM:<Data module number>: <Start address>:<Type>
- Otherwise: <Operand>:<Start address>:<Type>

 **Start address refers to an offset in the relevant operand range.**

Permissible types are:

Type code	COM data type	Designation
C	VT_I1	BYTE with sign (from Version 1.2)
B	VT_U1	BYTE
Xn	VT_BOOL	Bit access, with 'n' as the bit number (0 to 7)
Sn	VT_BSTR	String access, 'n' is the number of characters (default: 32)
I	VT_I2	WORD with sign (from Version 1.2)
W	VT_UI2	WORD (2 BYTE) from Version 1.2, previously as WORD with sign
L	VT_I4	Double word with sign
F	VT_R4	Simple floating-point value (4 BYTE)
D	VT_R8	Double precision floating-point value (8 BYTE)

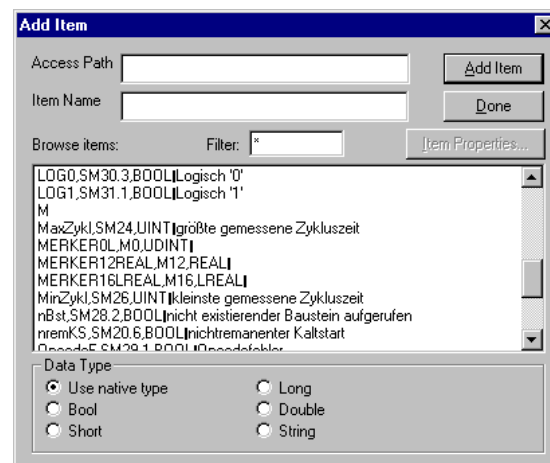
Examples:

M:32:X3	Bit 3 in marker byte 32
DF:1024:	Double word in data field from byte 1024
DB:10:32:X4	Bit 4 in data word 32 of data module 10
M:0:S24	String from marker byte 0

## Symbolic access

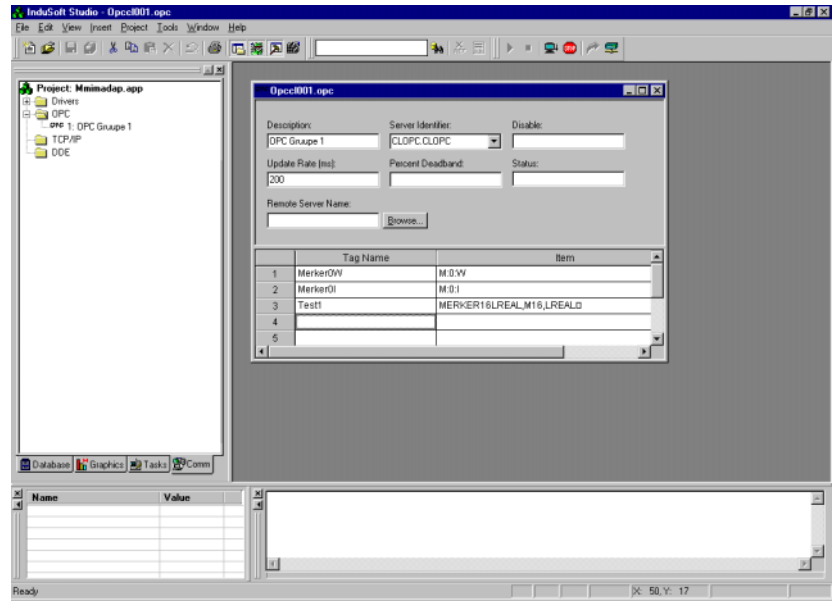
Each OPC server is equipped with the 'Browse' function, i. e. it can report its data to an OPC client on request.

The supplied OPC client will display the data in the following window:



Select an entry to add data to the OPC group.

A group in the OPC client from the 'Win Studio/Indusoft Web Studio' visualisation software will display the following:



Notes:

# A Annex

## A.1 Abbreviations

<b>Abbreviation</b>	<b>Description</b>		
BUEP	BOSCH Transmission Protocol, code independent data transmission	IP	Internet Protokoll
CSMA/CD	Carrier Sense Multiple Access with Collision Avoidance	LAN	Local Area Network
ESD	Electro-Static Discharge Abbreviation for all terms relating to electro-static discharge, e.g. ESD protection, ESD hazards, etc.	PE	Protective Earth
		STP	Shielded Twisted-pair Cable
		TCP	Transmission Control Protocol
		UDP	User Datagram Protocol, TCP/IP protocol on transport layer
		UTP	Unshielded Twisted-pair Cable

## A.2 Index

- A**  
 Add, 4–17  
 Address  
   BUEP, 4–13  
   Dynamic, 4–15  
   Static, 4–15  
   TCP/IP, 4–14
- B**  
 Basics, Ethernet, 6–1
- C**  
 Cabling, 6–4  
 Call up OPC, 7–1  
 Checkbox, 4–12  
 Checkbox, min./max., 4–18  
 Communication Parameters, 4–20  
   BUEP, 4–20  
   TCP/IP, 4–21  
 Config, 2–2
- D**  
 Data definitions, 4–13  
 Data entries, Variable, 4–11  
 Debug Protocol, 4–22  
 Description, 4–4  
 Div, 4–17  
 Documentation, 1–6  
 Driver worksheets, 4–2  
 Drv, 2–2
- E**  
 EMC Directive, 1–1  
 Emergency–STOP–devices, 1–5  
 Enable Read when Idle  
   BUEP, 4–5  
   TCP/IP, 4–5  
 Enable Write on Tag Change, 4–6  
 End devices, 6–3  
 Error sources  
   Application programme, 6–13  
   Logic network connection, 6–11  
   Module/PLC, 6–11  
   Network technology, 6–13  
   Physical network connection, 6–11  
 Error sources in the network, 6–10  
 ESD, A–1, A–1  
 Ethernet, 6–1
- F**  
 Floppy disk drive, 1–6
- H**  
 Hard disk drive, 1–6  
 Header  
   BUEP, 4–8  
   TCP/IP, 4–9  
   Header definition, 4–4  
     Variable, 4–12  
 Hub, 6–1
- I**  
 Increase read priority, 4–4  
 Installation directory  
   MADAP Studio, 2–1  
   Win Studio, 2–2  
 Installation routine, 2–1  
 IP address, 4–22  
   Dynamic, 4–7  
   Static, 4–7  
   Structure, 6–5
- L**  
 Low–Voltage Directive, 1–1
- M**  
 MADAP Studio development environment, 4–1  
 MADAP Studio folder, 2–2  
 Measuring or testing procedures, 1–5  
 MMIComm, 2–2
- N**  
 Network settings, 6–7
- O**  
 OPC, 7–1  
 OPC Client, Configuration, 4–26  
 OPC client, 7–2  
   Runtime, 4–29  
   Worksheet, 4–26  
 OPC data, 4–26, 7–3  
 OPC server, 7–4  
   Symbolic access, 7–4  
 OPC technology, 7–1  
 Operand type, Variable, 4–12
- P**  
 PE, A–1, A–1
- Q**  
 Qualified personnel, 1–2
- R**  
 Read Completed, 4–5  
 Read delay, 4–22  
 Read groups, 3–1  
 Read Status, 4–5  
 Read Trigger, 4–4  
 Read/write group status, 5–1  
   BUEP, 5–1  
   TCP/IP driver  
     Network problems, 5–1  
     Protocol–related reasons, 5–2  
 Release, 1–6  
 Repeat delay, 4–21

Routers, 6-6  
Runtime task, 4-29

**S**

Safety instructions, 1-4  
Safety markings, 1-3  
Standard operation, 1-1  
Standard protocol  
    BUEP19E, 6-4  
    IP, 6-4  
    TCP, 6-4  
    UDP, 6-4  
Startup, 4-30  
Station field  
    BUEP, 4-7  
    TCP/IP, 4-7  
Status information, 4-7, 4-27  
    TCP/IP, 4-5  
Subnet masks, 6-6  
Switch, 6-3  
System monitor, 3-1

**T**

Tag Name, 4-13  
Tools, 2-3  
Trademarks, 1-6

**W**

Windows start button, 2-4  
Write Completed, 4-7  
Write groups, 3-1  
Write Status, 4-7  
Write Trigger, 4-6

Notes:



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