**KUHNKE**

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Hard copy product catalogues, and CDROMs have been published describing Kuhnke Pneumatics, Solenoids, Relays and Electronics; some divided into different books. A list of current publications is available on this web site or from our sales offices. Some may be available for download, but as substantially larger files.

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**Important Note**

The information shown in these documents is for guidance only. No liability is accepted for any errors or omissions. The designer or user is solely responsible for the safe and proper application of the parts, assemblies or equipment described.

# KUHNKE

# Kuhnke
# Instruction Manual
## LPP Valve Island 770 DP
## Valve Island with PROFIBUS DP

E 660 GB                    DRAFT 10/04 / 101.492

**PROFI®**
PROCESS FIELD BUS
**BUS**

# Introduction

# 1 Introduction

Kuhnke has always worked in the pneumatic and electronic sectors of industrial automation.

For a long time, the company has been dedicated to inventing and manufacturing the milestones of the two technologies that have influenced the development of what now goes by the name of "Pneumotronics".

Significant examples would be "SMART" - an ISO-standard pneumatic cylinder that integrates both the power and logic of pneumatics - the sensor technology and an ASi control unit which integrates all the rest, i.e. the ASi-controlled AirBox valve and the inputs for the integrated sensors.

This manual describes the way to use our new valve island with a PROFIBUS interface.

It is divided into two main sections:

- electronics, where PROFIBUS is briefly described and the instructions for electrical set-up and wiring are provided,

- pneumatics, where the pneumatic functions and connections are described.

The manual therefore has a double objective: it is both a competent reference for experts in one of the two technologies, and also a brief introduction to the other field.

# 2 Reliability, Safety

## 2.1 Application

Kuhnke products are designed as operating resources for use in industrial environments.

All other applications need to be discussed with the factory first. The manufacturer will not accept any liability if their products are not used as intended. The risk shall be borne by the operator alone. The use as intended includes that you read and apply all information and instructions contained in this manual.

## 2.2 Target Group

This instruction manual contains all information necessary for the use of the described product (control device, control terminal, software, etc.) according to instructions. It is written for design, project planning, servicing and commissioning experts. A comprehensive knowledge of automation technology is compulsory to properly understand and make practical use of technical descriptions, instructions for use and particularly of danger and warning notices.

## 2.3 Reliability

Reliability of Kuhnke products is brought to the highest possible standards by extensive and cost-effective means in their design and manufacture.

These include:

- selecting high-quality components,
- quality agreements with our suppliers,
- measures for the prevention of static charge during the handling of MOS circuits,
- worst case planning and design of all circuits,
- visual inspections at various stages of fabrication,
- computer-aided tests of all assembly groups and their interaction in the circuit,
- statistical assessment of the quality of fabrication and of all returned goods for the immediate taking of appropriate corrective actions.

## 2.4 Symbols

Despite the measures described in chapter 2.3, the occurrence of faults or errors in electronic control units - even if most highly improbable - must be taken into consideration.

Please pay particular attention to the additional notices which we have marked by symbols throughout this instruction manual. While some of these notices make you aware of possible dangers, others are intended as a means of orientation. They are described further down below in descending order of importance.

### 2.4.1 Danger

*This symbol warns you of dangers which may cause death or grievous bodily harm if operators fail to implement the precautions described.*

### 2.4.2 Attention

*This symbol draws your attention to information you must take a look at to avoid malfunctions, possible material damage or dangerous states.*

### 2.4.3 Note

*This symbol draws your attention to additional information concerning the use of the described product. It may also refer you to information to be found elsewhere (e.g. in other manuals).*

### 2.4.4 Under Construction

*This symbol tells you that the function described was not or not fully available at the time this document went to press.*

### 2.4.5 Instruction

*Wherever you see these symbols in the left margin, you will find a list of steps instructing you to take the appropriate computer or hardware actions.*

*They are intended as a means of orientation wherever working steps and background information alternate (e.g. in tutorials).*

## 2.5 Safety

Our products normally become part of larger systems or installations. The information below is intended to help you integrate the product into its environment without dangers to humans or material/equipment.

*To achieve a high degree of conceptual safety in planning and installing an electronic controller, it is essential to exactly follow the instructions given in the manual because wrong handling could lead to rendering measures against dangers ineffective or to creating additional dangers.*

## 2.5.1 Project Planning and Installation

- 24 VDC power supply: generate as electrically safely separated low voltage. Suitable devices are, for example, split transformers constructed in compliance with European Standard EN 60742 (corresponds to VDE 0551).

- In case of power breakdowns or power fades: the program structure is to ensure that a defined state at restart excludes all dangerous states.

- Emergency switch-off installations must comply with EN 60204/IEC 204 (VDE 0113). They must be effective at any time.

- Safety and precautions regulations for qualified applications have to be complied with.

- Please pay particular attention to the notices of warning which, at relevant places, will make you aware of possible sources of dangerous mistakes or faults.

- Relevant standards and VDE regulations are to be complied with in every case.

- Install control elements in a way that excludes their unintended operation.

- Lay control cables in a way that avoids interference (inductive or capacitive) which could influence controller operation or its functionality.

## 2.5.2 Maintenance and Servicing

- Precautions regulation VBG 4.0 must be observed when measuring or checking a controller in a power-up condition. This applies to section 8 (Admissible deviations when working on parts) in particular.

- Repairs must be carried out by specially trained Kuhnke staff only (usually in the main factory in Malente). Warranty expires in every other case.

- Spare parts:

- Only use parts approved of by Kuhnke. Only genuine Kuhnke modules must be used in modular controllers.

- Modular systems: Always plug or unplug modules in a power-down state. You may otherwise damage the modules or (possibly not immediately recognisably!) inhibit their functionality.

- Always dispose of any batteries and accumulators as hazardous waste.

# 2.6 Electromagnetic Compatibility

## 2.6.1 Definition

Electromagnetic compatibility is the ability of a device to function satisfactorily in its electromagnetic environment without itself causing any electromagnetic interference that would be intolerable to other devices in this environment.

Of all known phenomena of electromagnetic noise, only a certain range occurs at the location of a given device. It is defined in the relevant product standards.

The design and immunity to interference of programmable logic controllers are internationally governed by standard
IEC 61131-2 which, in Europe, has been the basis for European Standard EN 61131-2.

*Refer to IEC 61131-4, User's Guideline, for general installation instructions to be complied with to ensure that hardware interface factors and the ensuing noise voltages are limited to tolerable levels.*

## 2.6.2 Interference Emission

Interfering emission of electromagnetic fields, HF
compliant to EN 55011, limiting value class A, Group 1

*If the controller is designed for use in residential areas, high-frequency emissions must comply with limiting value class B as described in EN 55011.*
*Fitting the controller into an earthed metal cabinet and equipping the supply cables with filters may be appropriate means of maintaining the relevant limiting values*

## 2.6.3 General Notes on Installation

As component parts of machines, facilities and systems, electronic control systems must comply with valid rules and regulations, depending on their field of application.

General requirements concerning the electrical equipment of machines and aiming at the safety of these machines are contained in Part 1 of European Standard EN 60204 (corresponds to VDE 0113).

*For safe installation of our control system please observe the information contained in the next chapters (→ 2.6.4 ff).*

## 2.6.4 Electrical Immission Safeguard

Connect the control system to the protective earth conductor to eliminate electromagnetic interference. Practice best cable routing.

## 2.6.5 Cable Routing and Wiring

Keep power circuits separate from control circuits:

- DC voltages        60 V ... 400 V
- AC voltages        25 V ... 400 V

Joint laying of control circuits is allowed for:

- shielded data signals
- shielded analogue signals
- unshielded digital I/O lines
- unshielded DC voltages < 60 V
- unshielded AC voltages < 25 V

## 2.6.6 Location of Installation

Exclude any and all impediments due to temperature, dirt, impact, vibration or electromagnetic interference.

### 2.6.6.1 Temperature

Consider heat sources such as general heating of rooms, exposure to direct sunlight, heat accumulation in assembly rooms or control cabinets.

### 2.6.6.2 Contamination

Use suitable casings to avoid possible negative influences due to humidity, corrosive gas, liquid or conducting dust.

### 2.6.6.3 Impact and Vibration

Consider possible influences caused by motors, compressors, transfer lines, presses, ramming machines and vehicles.

### 2.6.6.4 Electromagnetic Interference

Consider electromagnetic interference from various sources near the location of installation: drives, switching implements, switching thyristors, radio-controlled appliances, welding equipment, arcing, switch-mode power supplies, inverters/converters.

## 2.6.7 Particular Sources of Interference

### 2.6.7.1 Inductive Actuators

Switching off inductances (such as from relays, contactors, solenoids or switching magnets) produces overvoltages. It is mandatory to throttle these noise voltages to an admissible dimension.
Reducing elements may be diodes, Z-diodes, varistors or RC elements. Refer to the technical details provided by the manufacturer or supplier of the actuators to know exactly which model, variant or setting you need.

# 3 Installation and Wiring
# Pneumatic

As indicated in the preface, this manual is intended for both pneumatic and electronic operators. It was considered useful to include a short introduction to air technology, paying particular attention to pneumatic valves, not forgetting the fundamentals of air treatment. The idea was to make our islands easy to use even for those who have little experience of applied pneumatics.

## 3.1 Permitted Uses

The LPP valve islands described in this manual have been designed and built for the activation of pneumatic actuators in combination with components approved by Kuhnke. LPP valve islands must be used only while the product is still in its original state, without modifications, in perfect technical condition and in full compliance with the specified pressure and temperature limits, electrical parameters etc.

## 3.2 Compressed Air Treatment

Although treated at the moment of its production, the air is still not ready for direct utilisation. For more Information see Catalogue P 636 D/GB chapter "technical information".

### 3.2.1 Regulating the Operating Pressure

First of all, the pressure supplied to the machine must be regulated and stabilised. Due to the fact that the central air supply unit is connected to all the lines in the system, the absorption of the air varies unpredictably as a result of:

- the absorption of the various applications. To obviate this problem, the operating pressure is kept higher than is necessary and recommended for the various sections of the system.
- calibration of the compressor's pressure switch: there are significant differences between cut-in pressure, cut-out pressure and line pressure
- losses due to faulty seals or incorrect connections, cocks etc.

☞ *The purpose of the pressure regulator is to stabilise the machine pressure at a value always and in every case lower than the line pressure*

## 3.2.2 Filter and Condensate Separator

Secondly, a filter must be fitted to clean the air. The compressor unit normally carries out an initial air treatment, but this is not sufficient. The following can in fact still be present in the air:

- Residues from the compressor unit
- Oxides and other impurities coming from the air lines
- Humidity

Thus, prior to using the compressed air, it is essential to fit one or two filters. Whereas modern pneumatic valves have a remarkable performance, they also depend on a high degree of working precision. Impurities which older systems could work with (40 μm) can no longer be accepted with modern products. Filtering to 5 μm today is standard. If the air transport network is modern and 'clean', it is enough to fit a single filter with suitable filtering capacity. If not, it may easily be damaged by the comparatively high degree of impurities. Hence the necessity of fitting two filters one after the other: the first one traps the larger particles whereas the second ones catches the finer.

## 3.2.3 Lubricator

Compressed air produces movement. The moving parts must be lubricated in order to be able to perform their job consistently over time.

For this reason, it used to be common practice to fit a Venturi device in the maintenance unit to spray an oil suspension into the compressed air.

Modern technology has enabled the pneumatic designer to deploy combinations of seals and grease which make this lubrication no longer necessary.

*Kuhnke Pneumatic Components does **not** recommend the use of lubricators with LPP700 valves and the cylinders to be used in conjunction with them.*

Please take into account that whereas a lubricator does not damage the products, it still carries the following disadvantages:

- Once used, it can never be removed: the oil, in fact, removes the grease from the component
- The oil used needs to be perfectly adapted to the application because different oils could lead to the component jamming
- The lubricator bowl must be constantly checked to avoid the oil running out and causing the problems mentioned above.

## 3.3 Pneumatic Connections

The valve island has the two parallel functions of a) diverting the air to the consumers as instructed by the controller and b) venting the system.

The baseplate provides the ports through which the valves are directly supplied with air and vented.

The applications are fitted directly to the valve body.

### 3.3.1 Main Connections of the Baseplate

The baseplate, in which valves and electronics are housed, contains two series of 1/4" ports at its two far ends. Their function is to supply the air to the valves and to discharge the exhaust air.

Port numbering is governed by ISO regulations as follows:

| Number | Function |
|--------|----------|
| 1 | Compressed air inlet |
| 3 | Exhaust air discharge, corresponds to No. 3 on the valve, equivalent valve No.1 of the 3/2 double valve. |
| 5 | Exhaust air discharge, corresponds to No.5 on the valve, equivalent valve No.2 of the 3/2 double valve. |

To find the corresponding ports on our baseplate, refer to the diagram below:
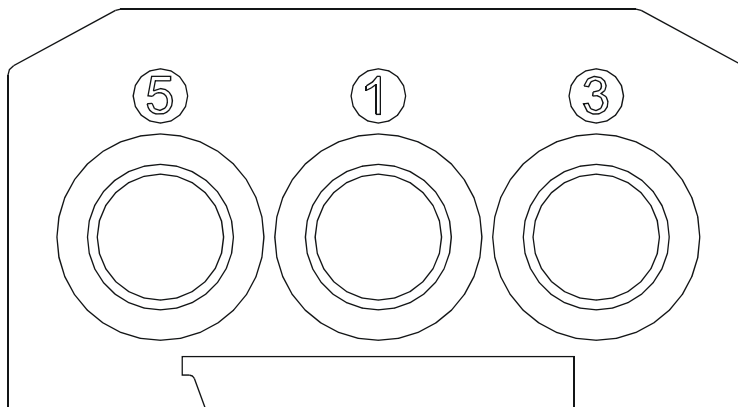


### 3.3.2 Connecting the Valves

The LPP-series valve islands are available in two different versions, which differ in the way the pneumatic consumers are connected:

- Screw-type port threaded 1/8" G
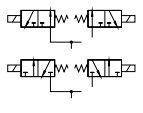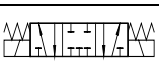- Push-in pneumatic connector for $\varnothing_e$ 6 mm tube
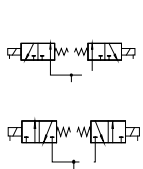
☞ *For further details, and for the corresponding order codes, consult catalogue P 636 D/GB*

## 3.3.3 Pneumatic Functions

Valves with a wide range of pneumatic functions can be fitted to the LPP island, so that the majority of operating needs can be satisfied.

The table illustrates them briefly. For further details and codes, consult catalogue P 636 D/GB

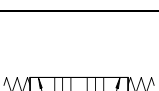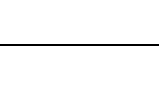| Symbol | Description | No. of coils |
|---|---|---|
| | Two independent 3-way 2-position solenoid valves incorporated into a single valve body. They are available, interchangeably, as NO (Normally Open) and NC (Normally Closed) types | 2 |
| | Monostable 5-way 2-position valve | 1 |
| | Bistable 5-way 2-position valve | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are blocked → centres closed | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are connected to the exhausts → centres open | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are connected to the air supply → centres pressurised | 2 |
| | Two independent 3-way 2-position solenoid valves incorporated into a single valve body. They are available, interchangeably, as NO (Normally Open) and NC (Normally Closed) types The valves are equipped with two additional ports so that the control air can be supplied externally. This allows the use of low pressures on the supply mains. | 2 |
| | Monostable 5-way 2-position valve. The valves are equipped with two additional ports so that the control air can be supplied externally. This allows the use of low pressures on the supply mains. | 1 |
| | Monostable 5-way 2-position valve. The valves are equipped with two additional ports so that the control air can be supplied externally. This allows the use of low pressures on the supply mains. | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are blocked → centres closed. The valves are equipped with two additional ports so that the control air can be supplied externally. This allows the use of low pressures on the supply mains. | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are connected to the exhausts → centres open The valves are equipped with two additional ports so that the control air can be supplied externally. This allows the use of low pressures on the supply mains. | 2 |
| | 5-way 3-position valve. In the central, stable position (which it assumes in the absence of a command) the outputs are connected to the air supply → centres pressurised The valves are equipped with two additional ports to supply the control air externally. This allows the use of low pressures on the supply mains. | 2 |

☞    *The solenoid valves with 2 coils must be mounted immediately next to the BUS module.*

☞    *It is possible to fit extra baseplates for the purpose of supplying different feeds to the valves mounted on them. Even if no valves are attached, every baseplate connected takes up an electrical position.*

☞    *In order to choose the correct valve size and design for your projects, we strongly recommend that you either contact a Kuhnke dealer or use the appropriate configuration software.*

## 3.4 Valve Island Hardware Design

The LPP valve island is made up of two logical blocks
(see the illustration below):

- The right/left input terminal assembly (see → 3.3.1 )
  (the right one has also the function of support of the electronic)

- The baseplates for housing the pneumatic valves
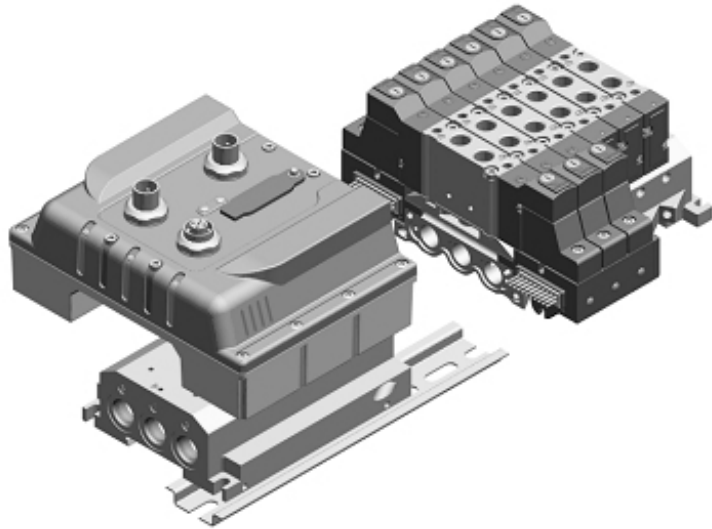


Assembling these components requires skill in order to guarantee the degree of protection of the valves (IP65).  It is however possible to work on the valve island to add/remove valve positions and for any other operation which may prove necessary.

To find the relevant instructions, refer to catalogue P xx.yy/04 as necessary.

☞     *Never dismantle the electronics from the baseplate. The resistance to electromagnetic interference is guaranteed only if this is assembled in the factory*

## 3.5 Mounting the Valve Island

☞ *Always disconnect the unit from the compressed air and electrical mains before doing any installation or maintenance work.*

The LPP valve island can be installed in two different ways:

- On the DIN rail ('omega')
- Directly on the wall

☞ *Always make the earth connection (see illustration)*

## 3.5.1 Mounting on the DIN "Omega" Rail

This method of mounting is recommended for 'light' applications, such as inside switching cabinets.

☞ *Whenever hostile conditions, such as vibrations or impact, must be expected during operation, wall mounting is strongly recommended.*

Proceed as follows to attach the island to the DIN rail (refer to the illustration below):

* Make sure that the mounting surface can support the valve island in the target configuration
* Fit the "omega" rail (top hat rail to standard EN50222 – 35x7.5). Be sure to leave sufficient space for the electric cables and the pneumatic tubing
* Check that the fixing grub-screws (1), (2) and (3) are in place in the baseplate
* Fit the baseplate onto the DIN rail
* Tighten the fixing grub-screws to a torque of 1.3 Nm

For demounting, repeat the operations in reverse.
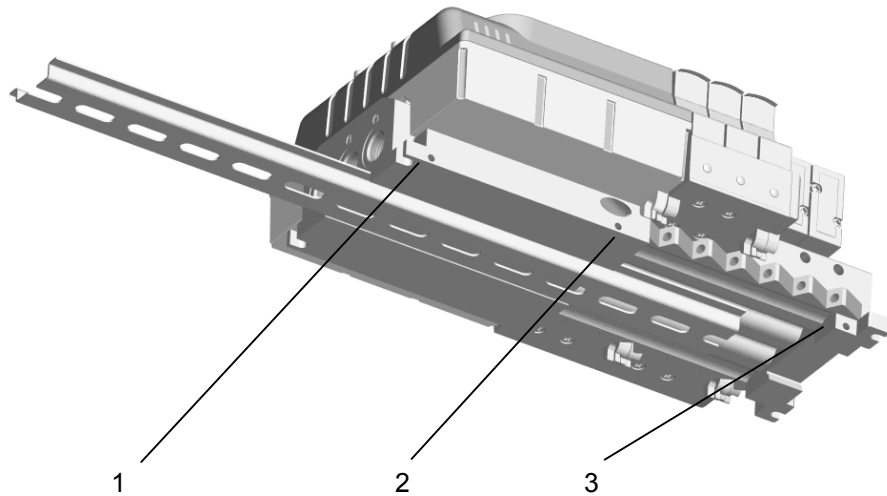
## 3.5.2 Wall Mounting

For mounting the valve island on a wall, use the holes provided in the ends of the island, and follow the instructions in the illustration. Use four M5 screws of suitable length for the application, tightening torque is 1 Nm
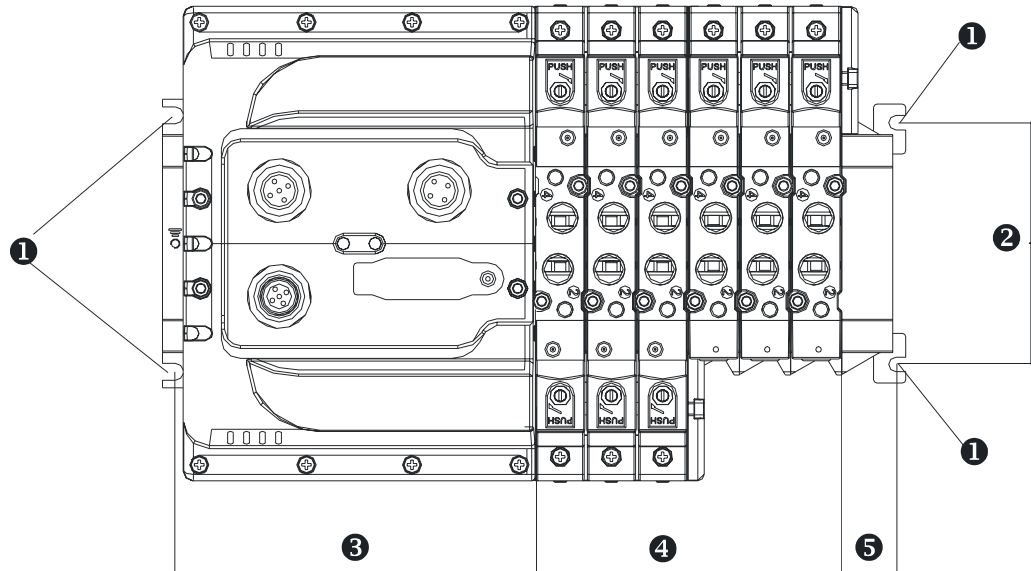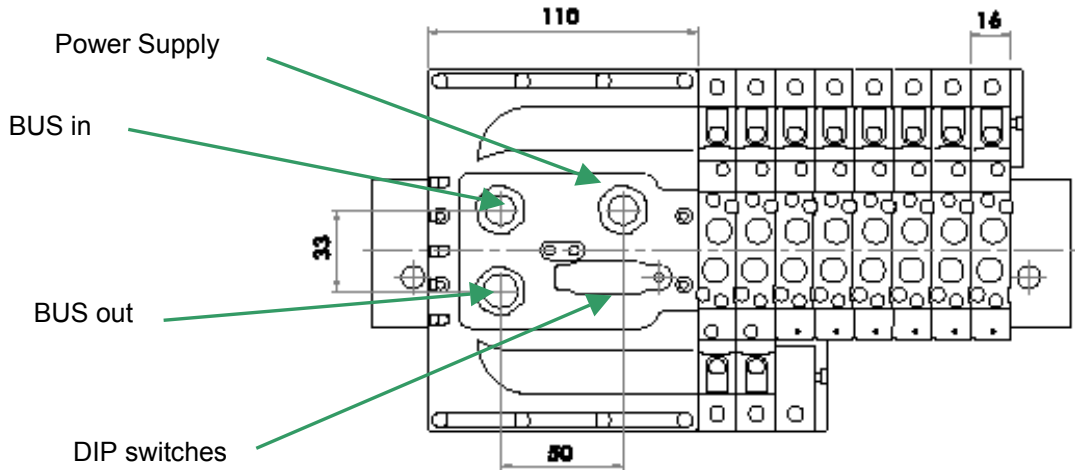


| number | description |
|--------|-------------|
| 1 | 4 holes for fixing to the wall |
| 2 | 75 mm |
| 3 | 116 mm |
| 4 | 16 mm x number of baseplates |
| 5 | 16 mm |

# 4 Installation and Wiring
   Electronics

## 4.1 Connectors



## 4.2 Setting the Station Number

LPP VALVE ISLAND 770 has a series of DIP switches accessible through a special hole in the housing. The DIP switches are used to set the station number in a **BCD-coded** format. Device IDs can range between 1 and 99. The next Figure illustrates the switch settings required to reproduce station address 13. The decimal number "13" is the same as the BCD-coded binary number 0001 0011.

| Switch | | | | | | | | Station address |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| off | off | off | off | off | off | off | off | ⚠ Not allowed! |
| off | off | off | off | off | off | off | on | 1 |
| off | off | off | off | off | off | on | off | 2 |
| off | off | off | off | off | off | on | on | 3 |
| | | | | | | | | etc. |
| off | off | off | on | off | off | on | on | 13 |
| off | off | off | off | off | off | off | off | etc. |
| off | off | off | on | off | on | on | off | 16 |
| | | | | | | | | etc. |
| on | off | off | on | on | off | off | off | 98 |
| on | off | off | on | on | off | off | on | 99 |

## 4.3 Communication Speed

The communication speed of the slave automatically adjusts itself to that of the PROFIBUS-DP master connected. The device supports all speeds specified by the applicable standard, i.e. up to 12 Mbit/s.

## 4.4 Power Supply Connection

Power to the unit is supplied through a male 4-pin connector. The following Figure illustrates the pin wiring and the signals transferred by the individual wires.
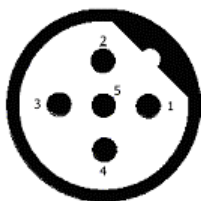
Pin wiring:
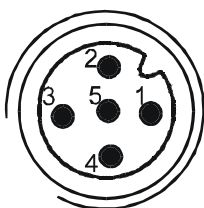
| Pin | Function |
|-----|----------|
| 1 | +24 VDC supply to **system and inputs** |
| 2 | +24 VDC supply to **outputs** |
| 3 | 0 V |
| 4 | 0 V |

The control and load circuits are electrically insulated. Whereas pins 2 and 4 are separated, pins 1 and 3 are not.
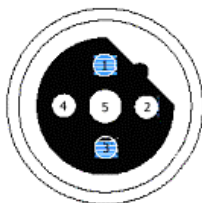
## 4.5 PROFIBUS Network Connection

Two connectors (5-pin male and 5-pin female) are the ports through which the unit connects to the PROFIBUS. The following figures illustrates the pin wiring and the signals transferred by the individual wires.

Bus in (male)

Pin wiring:

| Pin | Function |
|-----|----------|
| 1 | VP (+5Vdc) |
| 2 | RxD / TxD-N |
| 3 | DGND |
| 4 | RxD / TxD-P |
| 5 | Shield |

Bus out (female)

*The PROFIBUS line is optoisolated from the rest of the circuit.*

# 4.6 LED Indicators

The unit features 2 LEDs in compliance with EN50170 specifications.

## LED "RUN"

| LED | Description |
|---|---|
| On | PROFIBUS communication controller ok |
| Flashing red | PROFIBUS communication controller error |

The LED "RUN" is off while the machine is resetting.

## LED "BUS FAULT"

LED "BUS FAULT" indicates the status of the PROFIBUS-DP slave.

| LED (Colour: yellow) | BESCHREIBUNG |
|---|---|
| On | No PROFIBUS communication (cable failure or master not found)Master vorhanden) |
| Off | Data exchange with the master ok |

# 5 Quick Start

This chapter details the configuration procedures required to add a LPP Valve Island 770 unit to a PROFIBUS network using marketable PROFIBUS network configurators. While section 5.1 explains the configuration process in Siemens' Step 7 environment, section 5.2 does the same for KUBES, Kuhnke's proprietary configuration tool.

## 5.1 Configuration with a Siemens-S7 PLC as the Master

This section describes how to slave-network a LPP Valve Island 770 unit with a Siemens PROFIBUS master configured using Siemens' STEP 7 software (version 5.1, SP 6).

### 5.1.1 Installing the GSD File

- To add the unit's GSD file to the catalogue of PROFIBUS-DP devices, run Step 7 and open a project whose DP master is a S7 PLC. Run the Hardware Configurator and choose [Tools | Install new GSD file] from the menu.
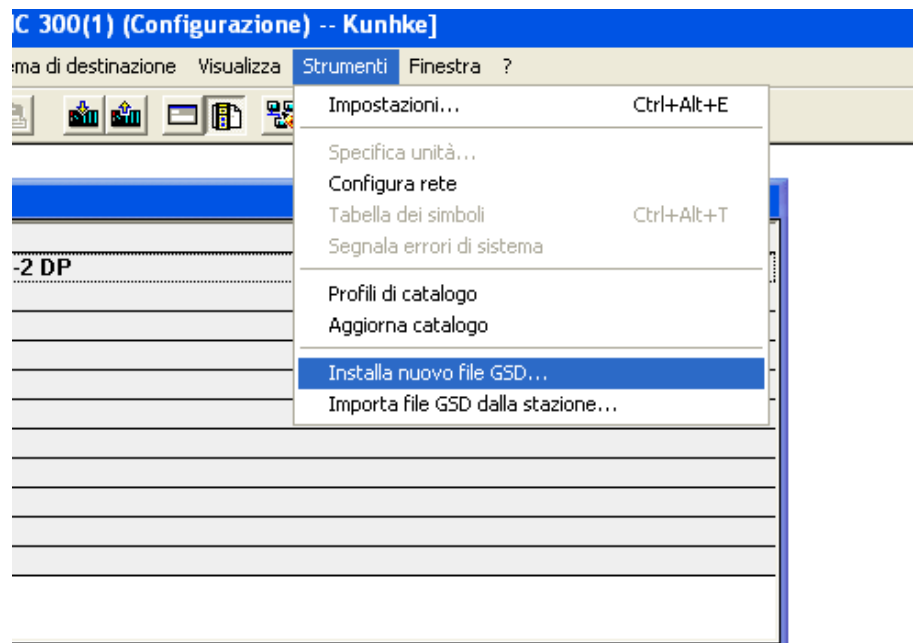


A file selection dialogue pops up which allows you to set the name of and path to the appropriate GSD file to be installed. At the same time as installing the GSD file, the software adds the unit to the catalogue of PROFIBUS-DP devices. In the Step 7 environment, it is located down branch "Other devices | I/O".
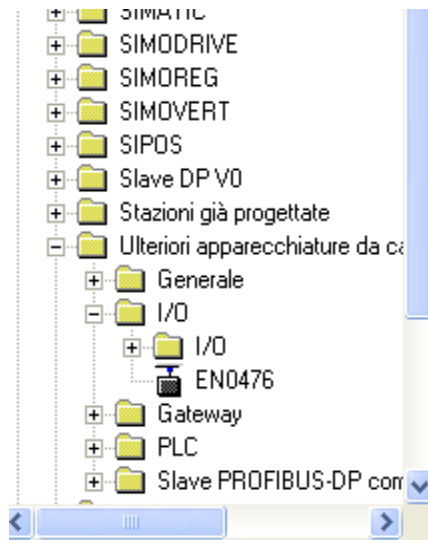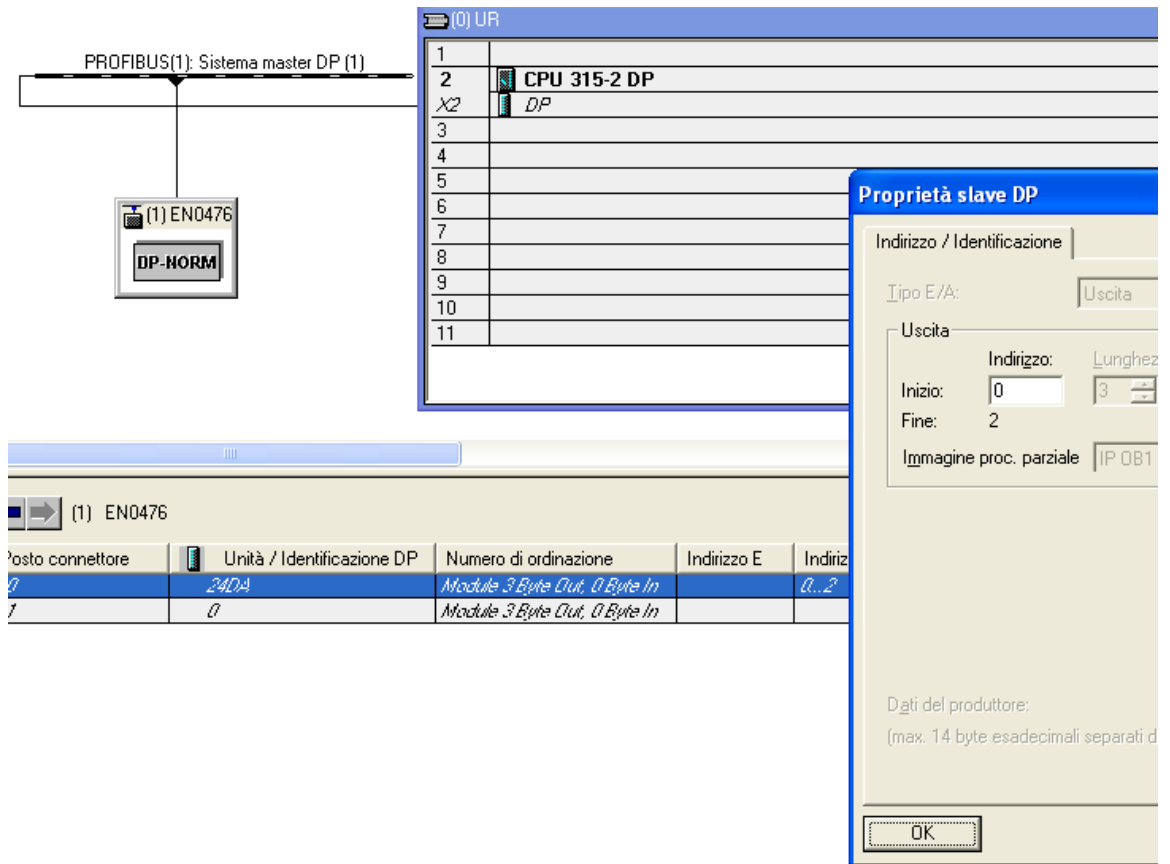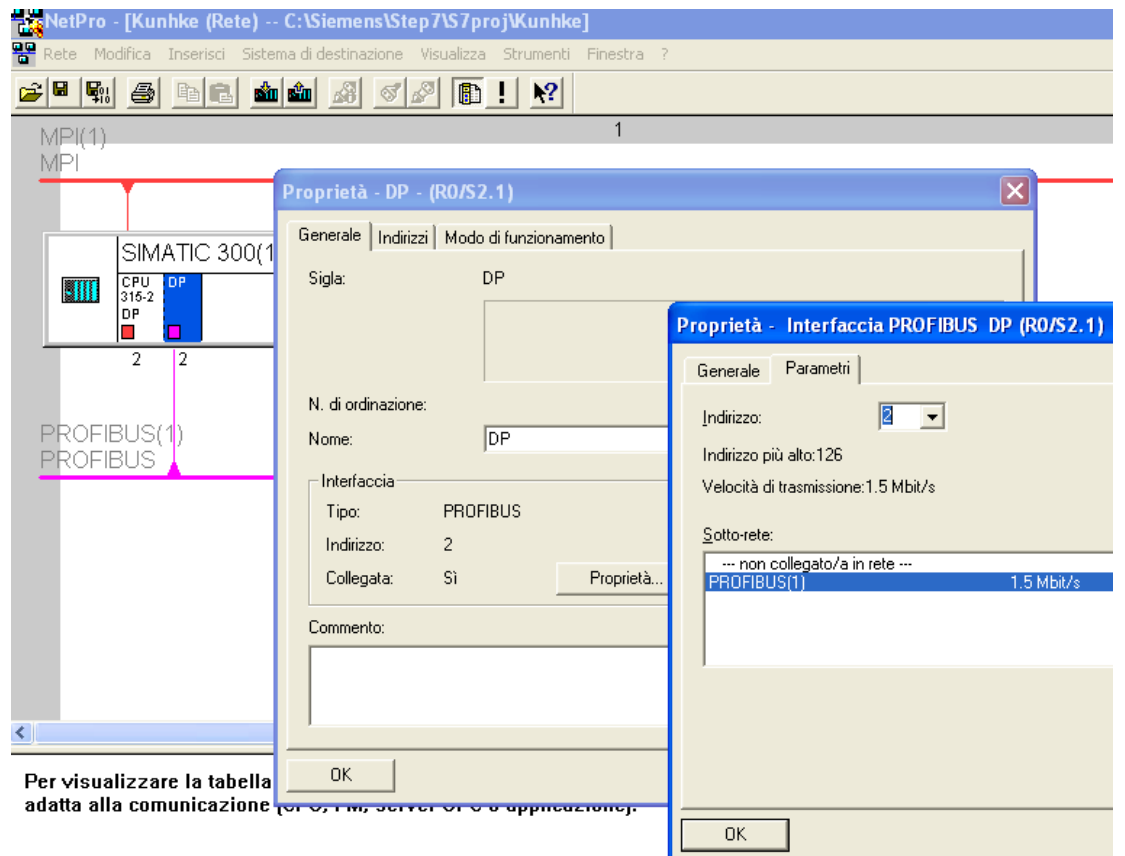
- Return to the network project and add a PROFIBUS-DP master module or CPU to it. For the purposes of our example, we picked a CPU S7 315-2 DP from the catalogue.
- The next step is to add LPP VALVE ISLAND 770 to the PROFIBUS network: run the NetPro network configurator, select "LPP VALVE IS-LAND 770" from the catalogue and drag & drop it onto the PROFIBUS-DP master station that you wish to connect it to.
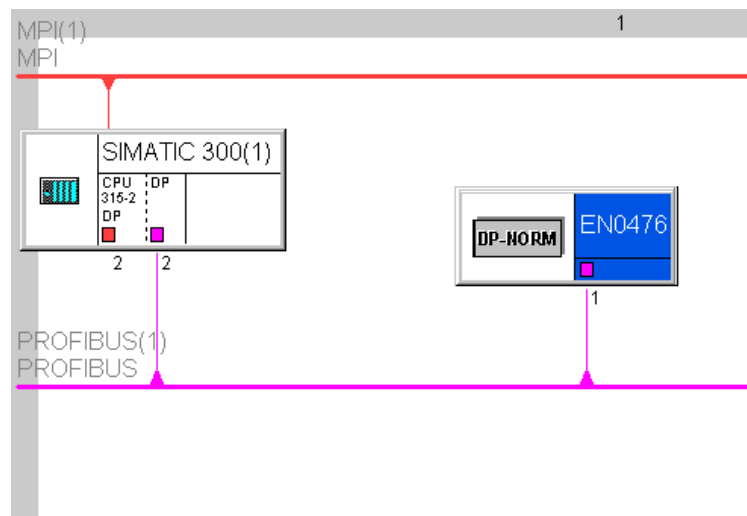


- Now that the device is part of the PROFIBUS network you can double-click on its icon to run the hardware configurator. It allows you to trans-fer the unit's output address mapping to the PLC. The figure below il-lustrates how the three bytes of the device are mapped onto the first three output bytes of the PLC.

PROFIBUS(1): Sistema master DP (1)

(1) EN0476

DP-NORM

(0) UR

| 1 | |
| 2 | CPU 315-2 DP |
| X2 | DP |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |

**Proprietà slave DP**

Indirizzo / Identificazione

Tipo E/A:       Uscita

Uscita

     Indirizzo:    Lunghez

Inizio:    0     3

Fine:     2

Immagine proc. parziale   IP OB1

Dati del produttore:

(max. 14 byte esadecimali separati d

OK

(1) EN0476

| Posto connettore | Unità / Identificazione DP | Numero di ordinazione | Indirizzo E | Indiriz |
|---|---|---|---|---|
| 0 | 24DA | Module 3 Byte Out, 0 Byte In | | 0...2 |
| 1 | 0 | Module 3 Byte Out, 0 Byte In | | |

To adapt the network parameters (communication speed, network proper-
ties, ...), change screens to display the NetPro configuration tool and double-
click on the DP master. A window opens allowing you to change the network
parameter settings.

**NetPro - [Kunhke (Rete) -- C:\Siemens\Step7\S7proj\Kunhke]**

Rete   Modifica   Inserisci   Sistema di destinazione   Visualizza   Strumenti   Finestra   ?

MPI(1)
MPI

SIMATIC 300(1

CPU 315-2 DP   DP

2    2

PROFIBUS(1)
PROFIBUS

**Proprietà - DP - (R0/S2.1)**

Generale | Indirizzi | Modo di funzionamento

Sigla:       DP

N. di ordinazione:

Nome:       DP

Interfaccia

Tipo:       PROFIBUS

Indirizzo:     2

Collegata:    Sì       Proprietà...

Commento:

OK

**Proprietà - Interfaccia PROFIBUS DP (R0/S2.1)**

Generale | Parametri

Indirizzo:     2

Indirizzo più alto:126

Velocità di trasmissione:1.5 Mbit/s

Sotto-rete:

--- non collegato/a in rete ---
PROFIBUS(1)       1.5 Mbit/s

OK

**Per visualizzare la tabella**
**adatta alla comunicazione (CP 0, FM, server CP 0 o applicazione).**

# 5.2 Configuration Using KUBES and a Kuhnke PLC as the Master

This section describes how to use KUBES, the programming environment for Kuhnke PLCs, for adding LPP VALVE ISLAND 770 to a DP network.

## 5.2.1 Configuring the PROFIBUS Network

If the master of the PROFIBUS network is a Kuhnke PLC, run VEBES to configure the network. To run VEBES, open a KUBES project and choose [Execute | Vebes] from the menu. The configuration tool sets the parameters of the network, the network stations and their interconnections. You have the option to add several PROFIBUS-DP masters to the same network and assign a separate set of slaves to every one of them. The program also expands the process chart of the project by adding the remote inputs and outputs of the PROFIBUS devices to it. Afterwards, the variables of the user program can operate on the remote data just like on the local data.

## 5.2.2 Setting the PROFIBUS Parameters

- To set the network parameters of the master PLC, choose [Line | Bus Parameters] or click on ⌛.

The window below is displayed, allowing you to set the speed, protocol (LPP VALVE ISLAND 770: DP) and the watchdog timeout. The latter is used by the slave to detect any faults in the communication with the master station. Specifically, the master transmits the watchdog timeout to the slave at the time of parameterisation. During normal operation, the slave checks the polling interval against the watchdog timeout. If the master fails to send a polling frame within that time, the slave goes into Reset mode.

## 5.2.3 Adding a New Station to the GSD Catalogue

- To add new device types to the database of stations available for network configuration, choose [Station | Create GSD Catalogue] from the menu. The window below is displayed:
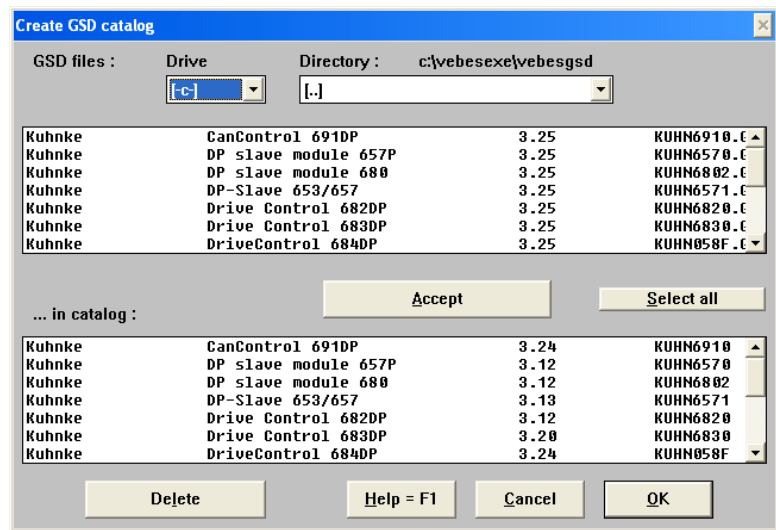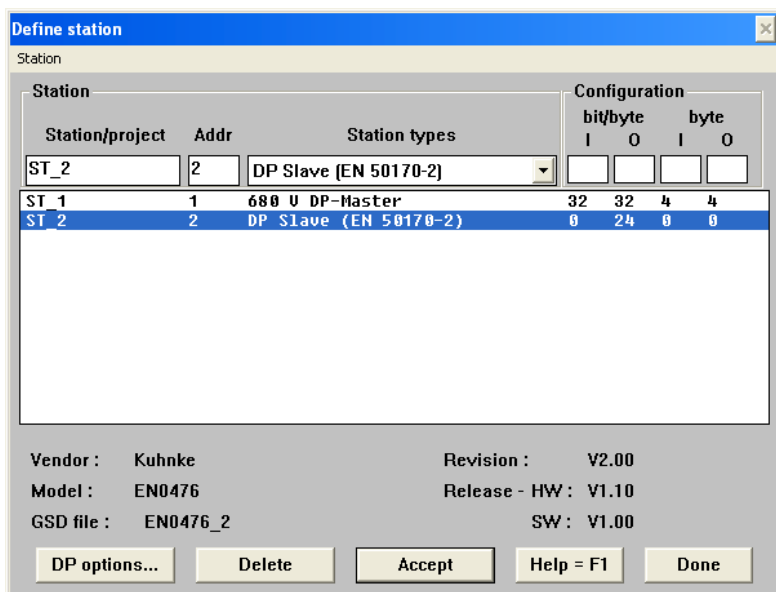


- Choose a drive and directory to set the path to the GSD file of the new station. Click on "Accept" to add the device to the list on the bottom window pane.

## 5.2.4 Defining the Network Stations

- Choose [Line | Station] or click on ⊞ to select the stations to be added to the network and to set their parameters as necessary. The window below is displayed:

- Locate the box underneath "Station/project" and type a name for the station into it. Then move on to the box labelled "Addr" and specify the station address. Finally, select the type of station from the "Station types" list.

- If all the entries are correct, click on "Accept" to actually add the station to the network. Click to select the station entry, then click on "DP options". A configuration dialog is displayed:
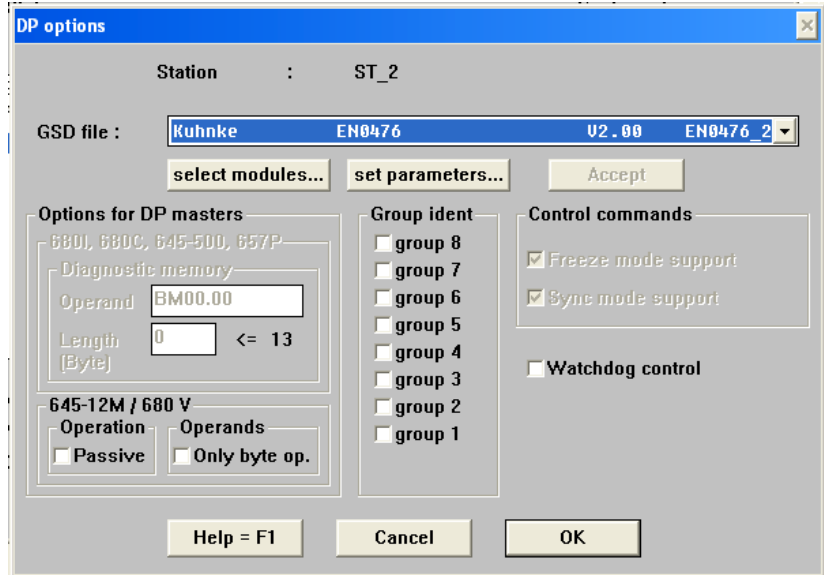


Use this dialog to select the appropriate GSD file and to define a DP group that the LPP VALVE ISLAND 770 is to belong to (for multicast type messages: Freeze and Sync). Another option is to enable the station's Watchdog Control.

## 5.2.5 Defining the Connections

- Choose [Line | Connection Process Chart] from the menu or click on  to define the connections between the stations previously added to the network (multiple DP masters are supported). The following window pops up:
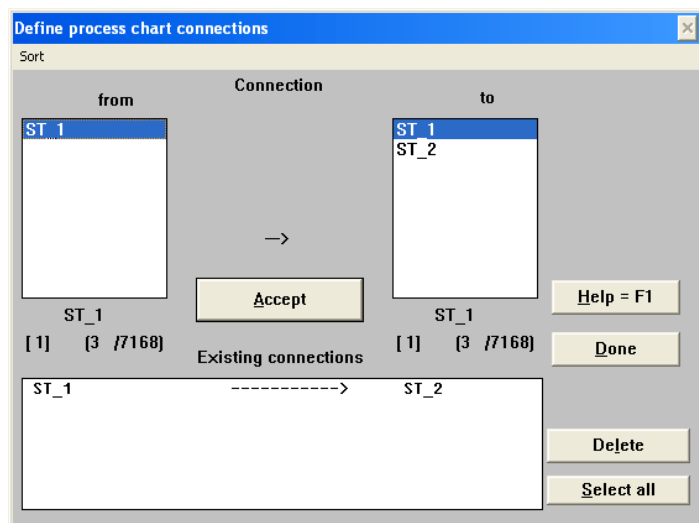
- Select the two stations and click on "Accept". This establishes the logical links between the stations (in this case assigning one slave to one master). Every network can be made up of multiple DP or FMS masters and the slave stations associated with every one of them. In the above example, DP master station "ST_1" is connected to DP slave station "ST_2".

## 5.2.6 Using the PROFIBUS Addresses in the KUBES Project

- When all configuration settings have been made, choose [To Kubes | With Project] from the menu to return to the KUBES project screen.

- Choose [Edit | Symbol Table] from its menu bar or click on 🔳 to verify that and how the PROFIBUS addresses are used by the project. The following dialog appears:



- Choose [Selection] to open another window. Here you can assign "talking" symbol names to any of the addresses as appropriate:



All that is left to do is to transfer the configuration into the master station where it is activated the next time the controller goes into <RUN> mode.

# 6 PROFIBUS

## 6.1 Introduction

The following basics apply to every PROFIBUS-DP network:

- Every slave is associated with just a single master.
- A network can be expanded to contain a Class 2 master for bus diagnosis.
- The address range allowed for each slave is 244 byte.
- During normal operation, a slave can disconnect from the network without impediment to the operation of the other slaves.
- The network architecture is defined when configuring the master.
- The Profibus User Organisation (PNO) assigns every slave device a unique manufacturer ID.

## 6.2 Normative Reference

The PROFIBUS standard (DIN 19 245) was published in 1991 and turned into a European norm (EN 50 170) in 1996. The standard regulations are supplemented by the technical specifications contained in the device profiles and guidelines published by PNO (Profibus User Organization).

## 6.3 Bus Access and Data Transfer

The PROFIBUS protocol distinguishes between two types of bus access:

- Passive stations (slaves) are cyclically polled by a master.
- Active stations (masters) make up a token ring.

The token passing technique ensures that master stations have full access to the bus within a set interval of time. Communication between active and passive stations is governed by a master/slave model. As long as the master has the token it has unrestricted access to the slaves assigned to it. Masters can send point-to-point frames to a particular slave, multicast frames to several slaves or broadcast frames to all slaves.

The PROFIBUS data communication methodology differs with regard to the physical means used for data transfer:

- electrical networks use shielded, twisted-pair cables attached to the RS-485 port,
- optical networks in keeping with PNO directives use optical fibre lines.

# 6.4 Bus Topology

The actual architecture of the bus depends on the physical connection media and on the hierarchy of the network stations (master/slave). PROFIBUS supports the following topologies:
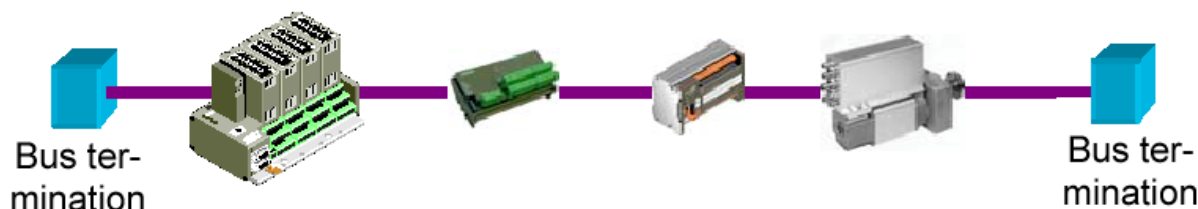
- Line architecture
- Tree architecture

Line architectures are the most simple form of bus topology. Standard configurations consist of up to 32 stations connected to every line. If repeaters are installed to refresh the signals, a larger number of stations can be connected, the network extended over a greater distance and tree or star architectures can be implemented.

## 6.4.1 Line Architecture

A line configuration can consist of several lines interconnecting by means of repeaters. In that case, every line classifies as a segment with its own name. The total number of repeaters in one segment depends on the type of repeater used. There are two main types, i.e., regenerating (active) repeaters and non-regenerating (passive) repeaters.

When building line structures with pasive repeaters, any two stations of the same segment must have no more than three passive repeaters between them. In the case of active repeaters, there is no restriction as to the number of connections. Passive repeater designs are limited to a maximum of four lines going through three repeaters. Every repeater is a bus station of its own, the difference to other stations being that, whereas it consumes one of the available hardware positions, it is not assigned a PROFIBUS address.



A bus line as shown in above figure is a standard solution for covering large distances where the maximum number of stations is of minor importance.

## 6.4.2 Tree Architecture

The idea of a tree architecture is to further split up the different lines. The resulting bus can therefore have more than four lines to it. However, the quality of the bus line between any two stations entirely depends on the strength of the signal. Consequently, as before, a maximum of three repeaters is allowed if passive repeaters are installed. The number of stations in a tree architecture is limited to 126 stations. Address number 127 is reserved for the broadcast messages sent to all stations. Figure 1.4.2 shows an example of a tree architecture.
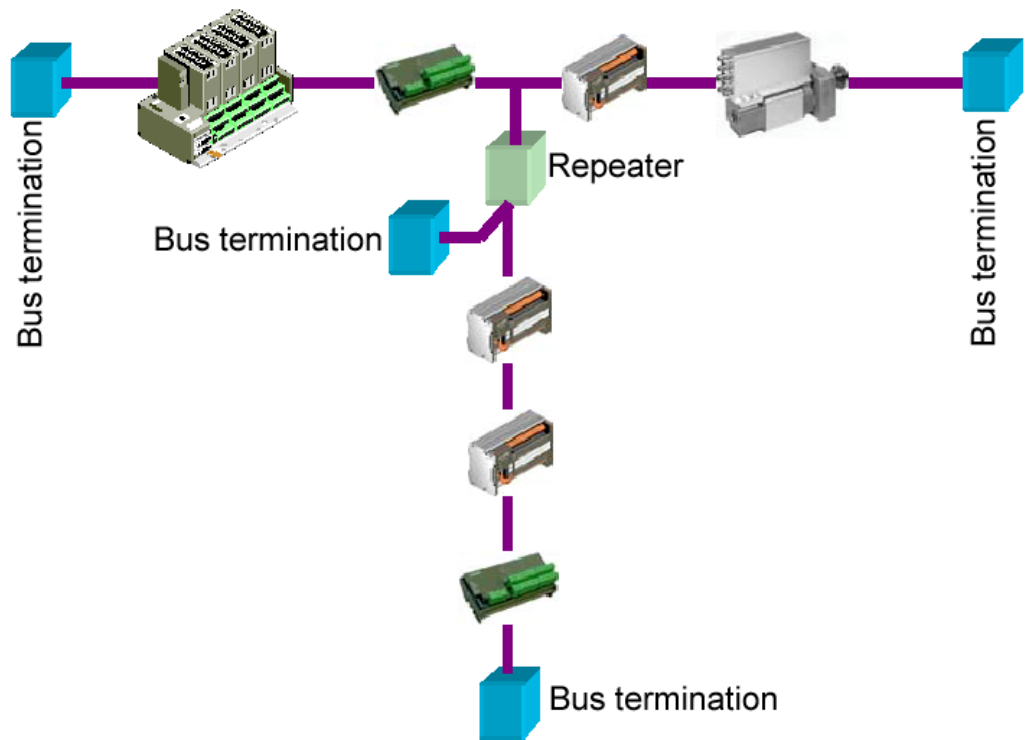
## 6.5 Communication Speed (Baud Rate) and Distance

The maximum length of a PROFIBUS network depends on the communication speed selected. Figure 1.5 summarises the available bus length options with regard to the speed setting and the number of repeaters installed:

| Baud Rate [kBd] | Maximum Distance [m] | | | |
|---|---|---|---|---|
| | No Repeater | 1 Repeater | 2 Repeaters | 3 Repeaters |
| 9,6 | 1200 | 2400 | 3600 | 4800 |
| 19,2 | 1200 | 2400 | 3600 | 4800 |
| 93,75 | 1200 | 2400 | 3600 | 4800 |
| 187,5 | 1000 | 2000 | 3000 | 4000 |
| 500 | 400 | 800 | 1200 | 1600 |
| 1500 | 200 | 400 | 600 | 800 |
| 12000 | 100 | 200 | 300 | 400 |

The first column specifies the maximum length of a single segment without a repeater being installed.

## 6.6 Wiring and Terminations

According to standard EN50170, part 8-2, the bus cable (shielded twisted pair) qualifies as cable type A. The next Table lists the key characteristics of this cable.

| Parameter | Value |
|---|---|
| Resistance | 135 $\Omega$ ..165$\Omega$ (3 .. 20 MHz) |
| Capacity | < 30 pF/m |
| Loop resistance | <= 110 $\Omega$ /km |
| Min. cross section | > 0,34 mm² |
| Min. diameter | > 0,64 mm |

The two cores of the PROFIBUS cable are normally labelled A and B. Whereas there is no rule as to the colour coding of the two cables, colour usage must be consistent throughout the network.

If a cable with a red and a green core is used, you would normally say

Green = Cable A,

Red = Cable B.

# 6.7 PROFIBUS-DP Network Configuration

To configure the PROFIBUS network, proceed as follows:

- Load the GSD file either running the configurator or the system used to program the master
- Configure the PROFIBUS-DP master: set the communication speed, the highest network station address (HSA), and the master's station address
- Set the slave I/O and their addresses
- Adapt the slave's DIP switch settings to reflect the unit's station address
- Transfer the configuration to the DP master
- Program the DP master: read access to the PROFIBUS inputs, write access to the PROFIBUS outputs
- Activate the system

# 7 Appendix

## 7.1 GSD File

The PROFIBUS configurator needs the GSD file to correctly configure the slave station and add it to the network. The file contains a formal description of how the DP slave acts in the network. Specifically, it contains information about transfer speeds, various bus parameters and other properties of the unit. Key significance is attached to the information regarding the data made available by the slave as well as the inputs and outputs that can be addressed via the network.

## 7.2 Technical Data

**Basic Data**

Type ........................................................... compact synthetic material case on metal plate
   Protection ................................................ IP 65 (if connectors and coding switch are covered)

**Admissible ambient conditions**

   Ambient temp. no operation ...................... -10...+55 °C
   Ambient temp. during operation ............... 0...50 °C

**Power supply**

   System and inputs.................................... 24 V DC -10%/+10%
   Connection technique............................... 12 mm round plug connectors, male

**Local status indication**

   LED "RUN" ............................................. LED red
   LED " BUS FAULT " ................................. LED yellow

**Communication Interface**

Field bus ...................................................... PROFIBUS DP
   Baud rates ............................................... automatically, up to12 Mbaud
   Potential separation.................................. yes
   Connection technique............................... 2 round plug connectors, 12 mm (in compliance with draft directive DR-303-1 of CANopen version 1.0 of 10 Oct. 1999
     Bus in .................................................. male
     Bus out ............................................... female
   Station address ....................................... 1...99 (set via pins 1 to 8 of coding switch)
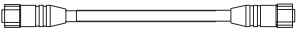
## 7.2.1 Hardware Version LPP Valve Island 770

| 03/2003 | Hardware version 0, Ver. 1.0 |
|---------|------------------------------|
|         |                              |
|         |                              |
|         |                              |

# 7.3 Order Specifications

module monostable PROFIBUS .......................................................................................... 77.050.0070
module bistable PROFIBUS ............................................................................................... 77.050.0071

## 7.3.1 Accessories PROFIBUS

| Picture | Description | 0,3 m | 1,0 m | 5,0 m |
|---|---|---|---|---|
| | Power cable 24 V, M12 | 77.061.0300 | 77.061.1000 | 77.061.5000 |
| | PROFIBUS, straight connector single sided , M12 | - | 77.081.1000 | 77.081.5000 |
| | PROFIBUS, straight connector double sided , M12 | - | 77.082.1000 | 77.082.5000 |
| | PROFIBUS, 90° connector single sided , M12 | | 77.083.1000 | 77.083.5000 |
| | PROFIBUS, 90° connector double sided , M12 | 77.084.0300 | 77.084.1000 | 77.084.5000 |

## 7.4 References

| Title / Subject | Number | Source |
|---|---|---|
| PROFIBUS-DP | E 611 GB | Kuhnke |
| Catalogue, Pneumatic | P 636 D/GB | Kuhnke |

# 7.5 Sales & Service

Please visit our Internet site to find a comprehensive overview of our sales and service network including all the relevant addresses. You are, of course, always welcome to contact our staff at the main factory in Malente or at sales headquarters in Neuhausen:

## 7.5.1 Main Factory in Malente

Kuhnke GmbH
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Phone +49-45 23-4 02-0
Fax +49-45 23-40 22 47
E-mail sales@kuhnke.de
Internet www.kuhnke.de

## 7.5.2 Sales Germany

Kuhnke GmbH
Sales Germany
Strohgäustr. 3
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Fax +49-71 58-90 74 80
E-mail sales@kuhnke.de
Internet www.kuhnke.de

# 7.6 Index