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Kuhnke  
Instruction Manual  
LPP Valve Island 770 Can  
Valve Island with CANopen

E 661 GB                      DRAFT 10/04 / 101.495



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# 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 CANopen interface.
- It is divided into two main sections:

electronics, where the CAN bus 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*

## 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.

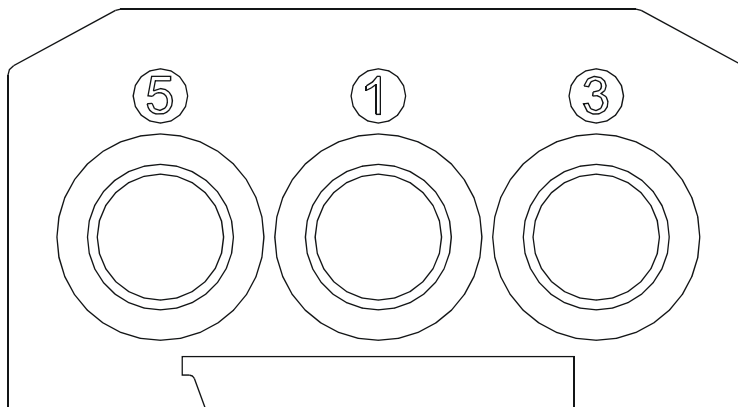
#### 3.3.1 Main Connections of the Baseplate

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

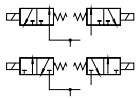


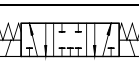
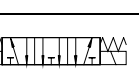
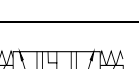
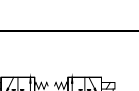
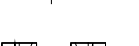
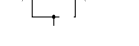
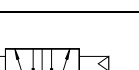
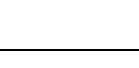



*For further details, and for the corresponding order codes, consult catalogue P 636 D/GB*

### 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.*



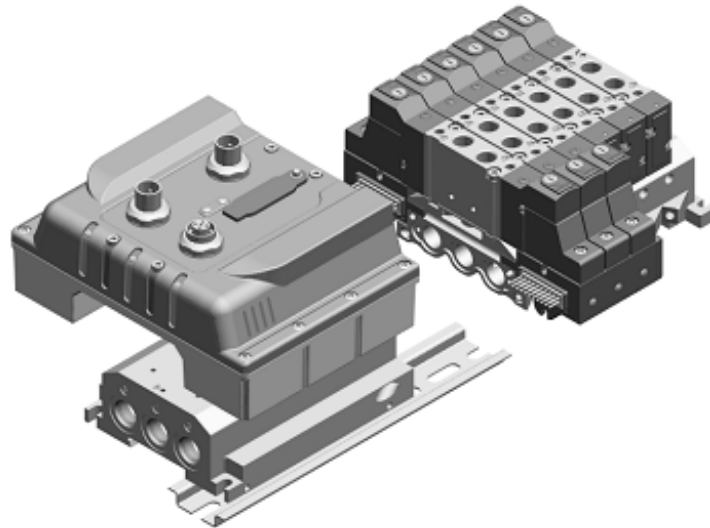
*In order to choose the correct valve size and design for your projects, we strongly recommend that you either contact a Kuhnke dealer or use the appropriate configuration software.*



### 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.

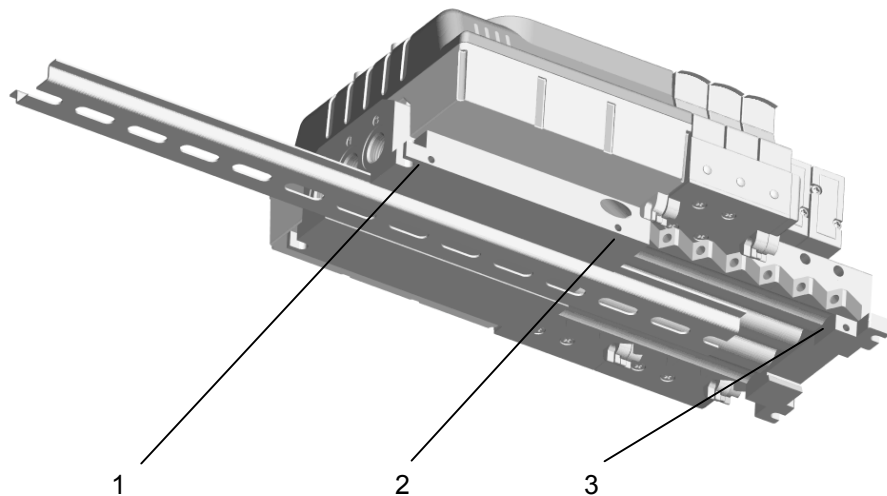


*Whenever hostile conditions, such as vibrations or impact, must be expected during operation, wall mounting is strongly recommended.*

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

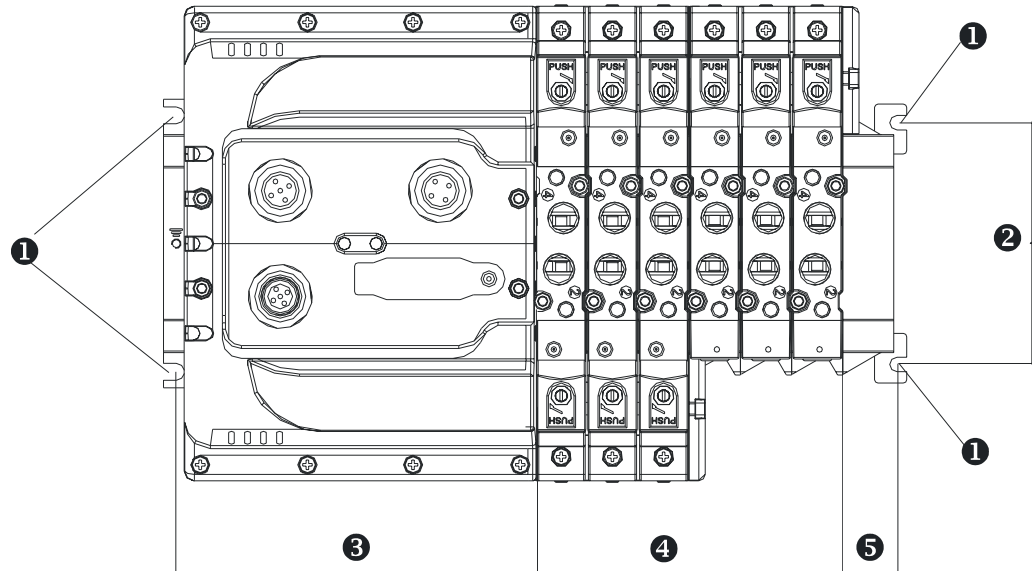
- Make sure that the mounting surface can support the valve island in the target configuration
- Fit the "omega" rail (top hat rail to standard EN50222 – 35x7.5). Be sure to leave sufficient space for the electric cables and the pneumatic tubing
- Check that the fixing grub-screws (1), (2) and (3) are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

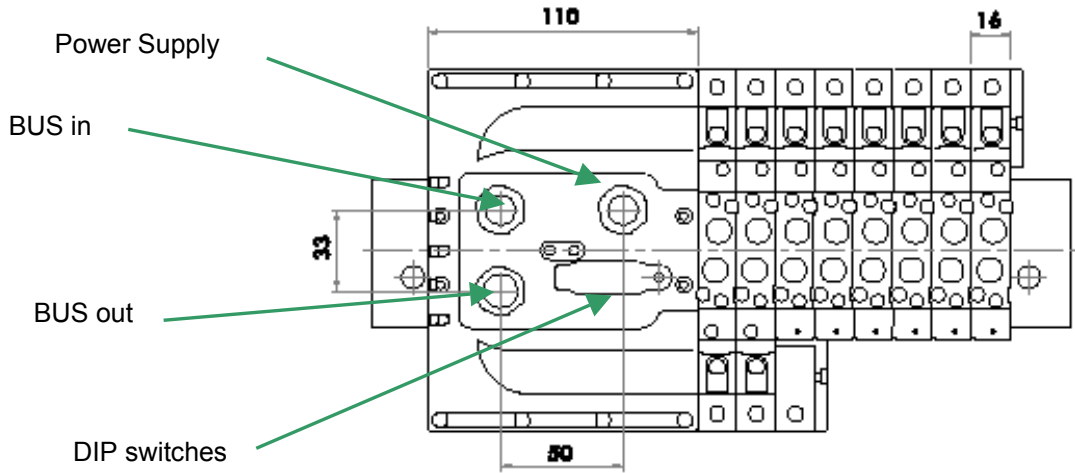
For mounting the valve island on a wall, use the holes provided in the ends of the island, and follow the instructions in the illustration. Use four M5 screws of suitable length for the application, tightening torque is 1 Nm



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 has a series of DIP switches accessible through a special hole in the housing. The DIP switches are used for setting both the station number (ID) and the communication speed (see section 3.1.2). The ID of the unit is used to compute the COB ID of the PDO, SDO and the Emergency objects. The binary position of the DIP switches increases along the row of switches. For example, DIP1 = ON generates ID no. "1", DIP4 = ON generates ID no. "8", etc.

Station IDs can range from 1 to 127. The COB ID is assigned according to the Predefined Connection Set (CiA DS 301, 8.4.1). The following Figure illustrates the DIP switch settings and what station addresses they stand for.

Switch							Station address
1	2	3	4	5	6	7	
off	off	off	off	off	off	off	Not allowed!
<b>on</b>	off	off	off	off	off	off	1
off	<b>on</b>	off	off	off	off	off	2
<b>on</b>	<b>on</b>	off	off	off	off	off	3
							etc.
off	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	126
<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	<b>on</b>	127

### 4.3 Setting the Communication Speed

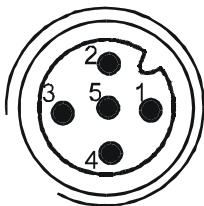
Use the last three DIP switches to set the communication speed. The next Figure illustrates the DIP switch settings and what speeds they stand for.

Switch			Baud rate [kbit/s]
8	9	10	
off	off	off	1000
on	off	off	800
off	on	off	500
on	on	off	250
off	off	on	125
on	off	on	50
off	on	on	20
on	on	on	10

### 4.4 Power Supply

Power to the unit is supplied through a male 4-pin connector. The next Figure illustrates the pin wiring and the signals transferred by the individual wires.

Pin wiring:



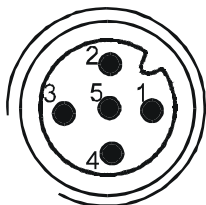
Pin	Function
1	+24 VDC supply to <b>system and inputs</b>
2	+24 VDC supply to <b>outputs</b>
3	0 V
4	0 V

The control and load circuits are electrically insulated. Whereas pins 2 and 4 are separated, pins 1 and 3 are not.

## 4.5 CANopen Network Connection

Two connectors (5-pin male and 5-pin female) are the ports through which the unit connects to the CANopen bus. The next figure illustrates the pin wiring and the signals transferred by the individual wires.

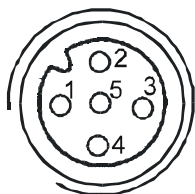
The bus interface (CANopen) consists of two plugs connected in parallel. This gives you an easy means of extending the bus to the next unit or plugging in a termination at the end of the bus.



→ Bus in (male)

Steckerbelegung:

Pin	Function	
1	Cable shield (capacitive connection to GND)	
2	nc	
3	CAN_GND	
4	CAN_H	CiA Draft Standard 301
5	CAN_L	version 3.0



→ Bus out (female)

The CANopen bus is optoisolated from the rest of the circuit. The CAN\_GND signal (pin 3) should normally be attached. If it is not, the network is entirely galvanically insulated. In this case, the transceivers' Common Mode Rejection signal must be strong enough to ensure proper network operation.

## 4.6 LED Indicators

### LED "ERR"

The unit features 2 LEDs in compliance with CiA DS-303-3 specifications. LED "ERR" indicates the physical status of the CAN layer and makes users aware of CAN messages missing (SYNC, GUARD or HEARTBEAT). The LED colour is red. The next table summarises its state and flash codes and what they signify. If several errors occur simultaneously, the highest priority is given to the down most item in the list.

LED	STATUS	DESCRIPTION
Off	No Errors	The slave is functioning properly
Einzelnes Blinksignal	"Limit reached" warning	One of the CAN error counters reached the warning level (too many errors in the packets)
Double flash	Event Control Error	A Guard or Heartbeat error has occurred
On	Bus down	The CAN controller is deactivated.

## LED "RUN"

LED "RUN" indicates the current status of the CANopen slave node. The LED colour is green. The next table summarises its state and flash codes and what they signify:

LED	STATUS	DESCRIPTION
Single flash	STOP	Machine is in STOP mode
Flashing	PREOPERATIONAL	Machine is in PREOPERATIONAL mode
On	OPERATIONAL	Machine is in OPERATIONAL mode

LED "RUN" is off while the machine performs a RESET.

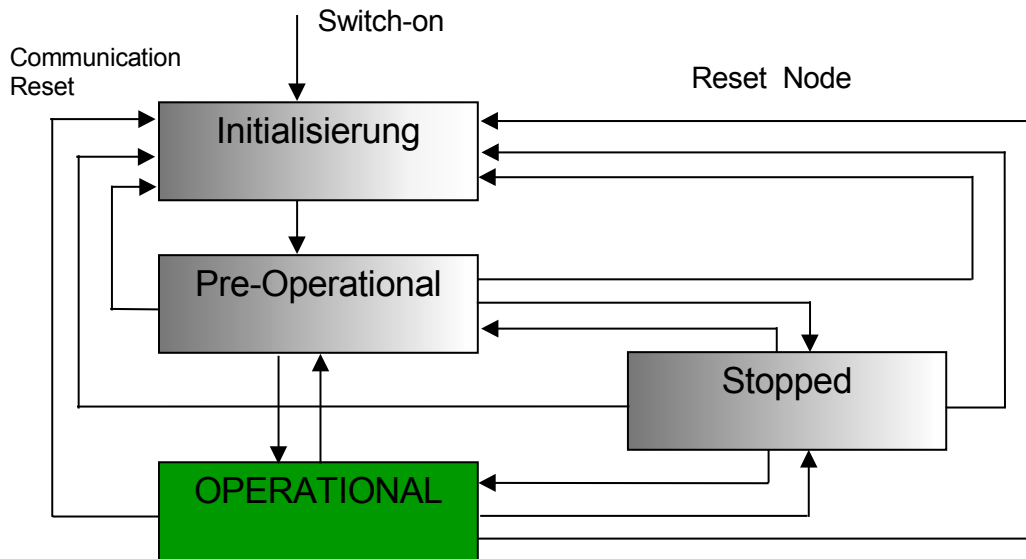


## 5 Operation

This chapter describes the main functions and processes of LPP VALVE ISLAND .

### 5.1.1 Start-up Procedure

After switching on the unit it first is in INITIALISATION mode (see figure 4.1.1, network initialisation and management). At this stage, the application objects and communication objects are assigned. When this has been properly done, the device automatically goes into PRE-OPERATIONAL mode.



In PRE-OPERATIONAL mode, SDOs are sent to start bus communication. At this stage, the SDOs can be used to make the following settings:

- Guard Time and the Life Time Factors
- PDO communication parameters
- PDO Mapping
- Save data

In PRE-OPERATIONAL mode, neither PDO communication nor emergency messages can be transferred.

Automatic transfer of these objects is possible in OPERATIONAL mode only. When STOPPED (sometimes also called PREPARED), all bus communication is interrupted (i.e. SDOs and PDOs are not possible). Only network commands are accepted (e.g., Start Remote Node).

## 5.1.2 Default Connection Settings

Following start-up, the unit can receive objects RPDO1 and RPDO2 with the following IDs:

RPDO1 =200h + Node ID

RPDO2 =300h + Node ID

Run the CANopen network configurator to edit the default connection settings as appropriate.

## 5.1.3 Node Guarding

Node Guarding allows the network administrator (usually the master) to check whether a slave is working properly. In order to find a failed slave, the master sends a frame to the slaves' Guard ID (100Eh). The address is polled at cyclic intervals ("Node Guard Time") using a node-specific RTR frame. The slave returns a Guard frame containing a toggle bit and the slave status. By means of this response frame, the master updates the status information of slave nodes connected properly and in good working order.

## 5.1.4 Life Guarding

While Node Guarding allows the network administrator to detect failed slave stations, the slave can reverse the guarding process to check whether the master is still present. The slave's master monitoring is called Life Guarding. Node Guarding and Life Guarding can be used to detect cable failures or to reset the outputs via the CANopen bus. To enable Life Guarding, the master sets a Guard Time (object 100Ch) and a Life Time Factor (object 100Dh). If the slave does not receive a Guarding frame within the resulting monitoring time (Life Time = Life Time Factor \* Guard Time [ms]), it resets all outputs and detects an interruption of communication with the master.

## 6 Quick Start

This chapter details how the KUBES project set-up and management software is used for LPP VALVE ISLAND configuration. KUBES is the programming environment for the PLCs supplied by Kuhnke. To configure CANopen networks, it runs the PROCANOPEN configuration add-on designed by Vector.

### 6.1 Running the PROCANOPEN Configurator (Vector)

This section describes how to operate LPP VALVE ISLAND in a network configured by means of the ProCANopen utility (Version 4.0.1). For more detailed information about proper installation and use of the program, please refer to the software manual.

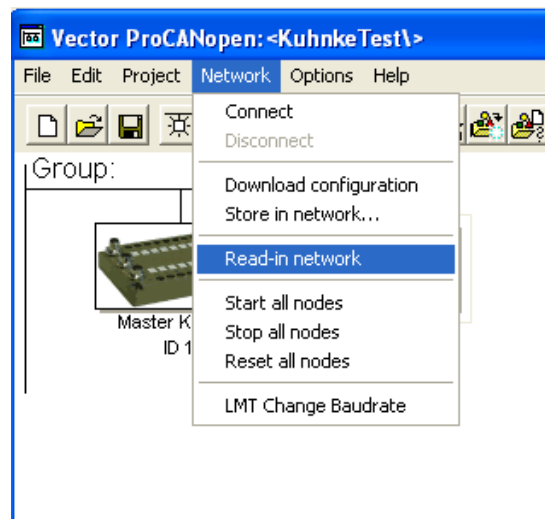
#### 6.1.1 Loading the EDS file in PROCANOPEN

Copy the device's EDS file to folder ...\\...\\EDS contained in the program root. The installer creates this path when the program is installed. Whereas it is possible to store the EDS file in another folder (e.g., if you wish to keep several versions of the software on the same hard disk), you should keep in mind that ProCANopen's "Load Network" function will always search the above path (...\\...\\EDS) for EDS files. The EDS file is delivered with the EN477 package or can be obtained separately upon request.

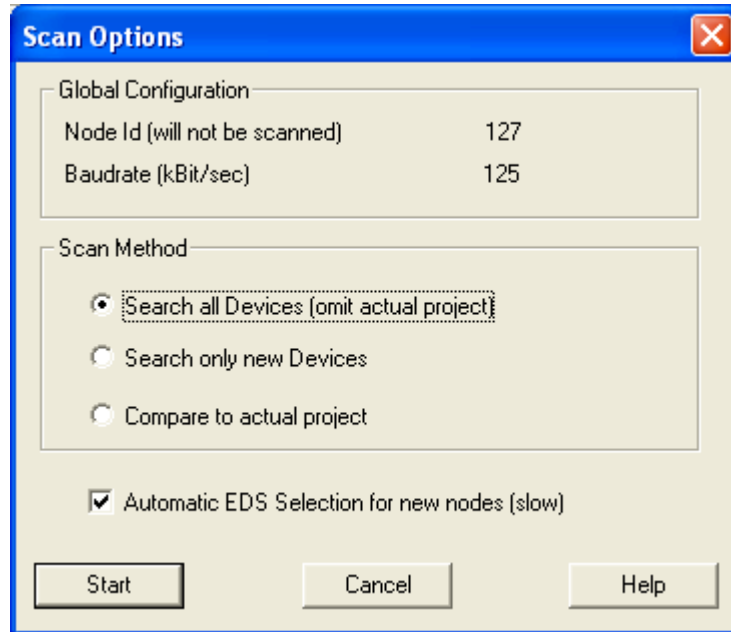
#### 6.1.2 Network Configuration Using PROCANOPEN



- Run ProCANopen and select [Network | Read in Network] to load the configuration of the attached network. ProCANopen assigns address no. 127 as the CAN starting address. For details about the offline configuration procedure, please read section 6.1.3.

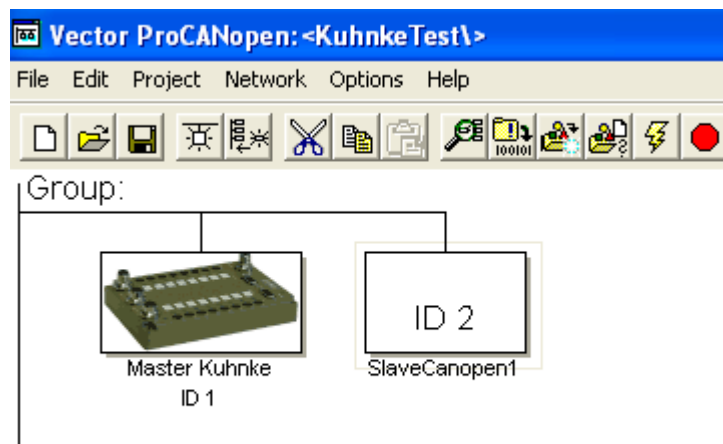


- The next window displayed allows you to specify whether the configurator is to scan the network for all stations connected or just for new stations added to the current project configuration.



- Click on Start to actually load the network configuration. The program afterwards compiles a report listing all the devices it detected. In the case of existing projects, the scan can be limited to finding new stations only. Or you can compare the project configuration with the actual network hardware.

When the configuration has been successfully loaded it is visualised on-screen. The example configuration below consists of a CANopen master (station address 1) and a slave (station address 2).

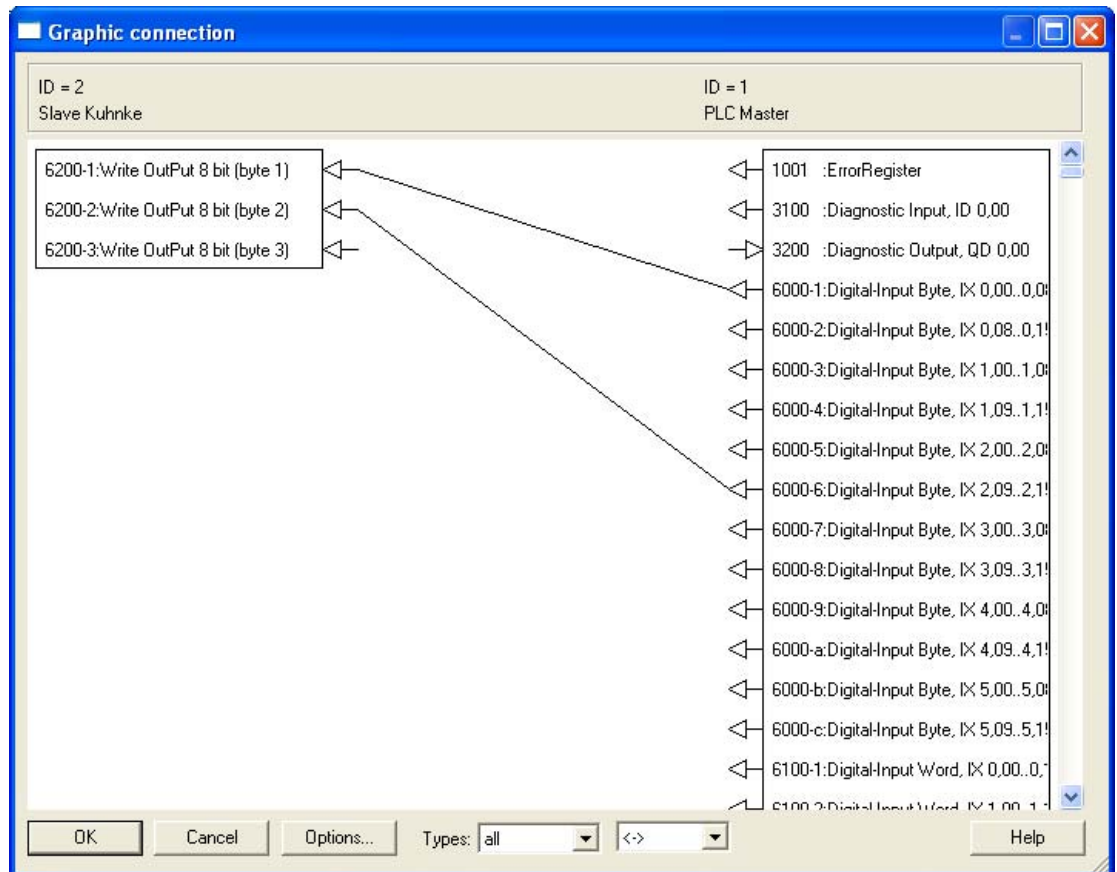


If the program does not find any stations, it may help to check the physical connections and the device settings. If a unit is detected but its EDS file cannot be found, it is shown as an empty rectangle with just the station address in it. Click to activate the rectangle, then right-click and choose the [Configuration] item to select and assign the correct EDS file. Choose "Device Type" and click on "Files" to display a Select File dialog. Browse the structure to set the path to the location of the EDS file you are looking for.

### 6.1.3 Creating Connections

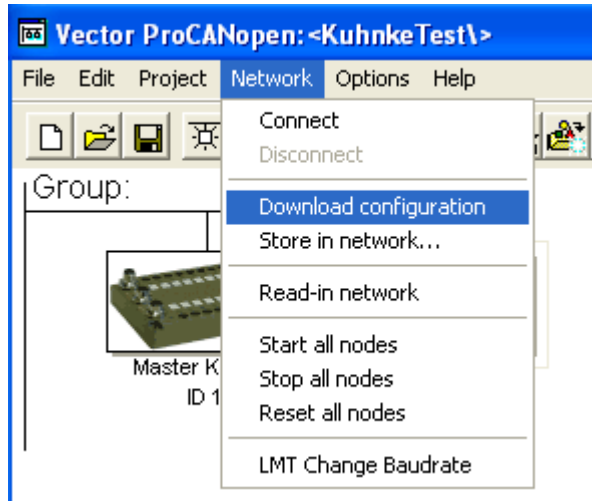


- To set the connections between variables, click to activate the LPP VALVE ISLAND slave, then right-click and choose [Graphic Connection] from the menu. Click to select the device to establish data exchange connections to. On the "Graphic Connection" screen displayed next, use the mouse to draw lines between the variables whose data the two units are to exchange.



In the above example, the slave receives the first and third byte of variable IX0 (first byte) and variable IX2 (second byte).

If using a Kuhnke master, please refer to section **Fehler! Verweisquelle konnte nicht gefunden werden..** Otherwise, if using a different CANopen master, proceed as follows to activate the network configuration. First of all, run the relevant commands to set the properties of the CANopen master; then choose [Network | Download Configuration] from the menu to transfer the configuration into the device.

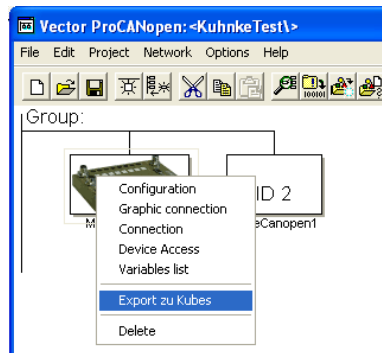


- Select [Network | Start all nodes] from the menu. This will start network data communication. If the configuration is without fault, LED "RUN" moves from a flashing green light (PREOPERATIONAL) to a permanent green light (OPERATIONAL).

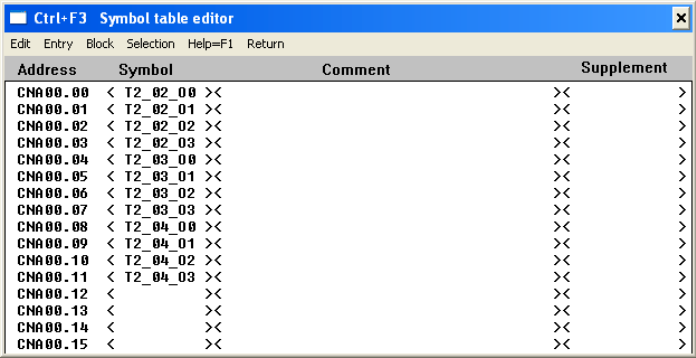
### 6.1.4 Imbedding of the configuration in a KUBES project



- After creating a CANopen network configuration in the ProCANopen environment, run "cobes.exe" to export it to KUBES and transfer it into a Kuhnke PLC. To launch "cobes.exe", click to activate the CANopen master, then right-click and pick [Export to Kubes] from the menu displayed.



- When the program is up and running, select the DCF file created by the CANopen configurator. Choose menu command "Integrate in project" to transfer the configuration into the PLC. At the same time, the variables are added to the KUBES project's symbol table where they can be viewed in the Symbol Table Editor (see next figure).



The screenshot shows a window titled "Ctrl+F3 Symbol table editor" with a menu bar containing "Edit", "Entry", "Block", "Selection", "Help=F1", and "Return". Below the menu bar is a table with four columns: "Address", "Symbol", "Comment", and "Supplement". The table contains 16 rows of data, each representing a variable. The "Address" column contains values from CNA00.00 to CNA00.15. The "Symbol" column contains values like < T2\_02\_00 >, < T2\_02\_01 >, etc. The "Comment" column is empty for all rows. The "Supplement" column contains values like >>, >>, >>, etc. The table is as follows:

Address	Symbol	Comment	Supplement
CNA00.00	< T2_02_00 >		>>
CNA00.01	< T2_02_01 >		>>
CNA00.02	< T2_02_02 >		>>
CNA00.03	< T2_02_03 >		>>
CNA00.04	< T2_03_00 >		>>
CNA00.05	< T2_03_01 >		>>
CNA00.06	< T2_03_02 >		>>
CNA00.07	< T2_03_03 >		>>
CNA00.08	< T2_04_00 >		>>
CNA00.09	< T2_04_01 >		>>
CNA00.10	< T2_04_02 >		>>
CNA00.11	< T2_04_03 >		>>
CNA00.12	< >		>>
CNA00.13	< >		>>
CNA00.14	< >		>>
CNA00.15	< >		>>

Addresses of variables may differ depending on which CANopen port the PLC is attached to (for example, the 691C CPU: DNA through port 1, CNA through port 2).

# 7 CANopen

## 7.1 Introduction

LPP VALVE ISLAND was developed to control 22 digital outputs through a CANopen network. CANopen is an industrial communications network based on the CAN communication protocol.

The CAN protocol (Controller Area Network) was developed in the mid-80s for motor vehicle applications. It describes the communication protocol at the physical and data levels (OSI model layers 1 and 2). It does not specify anything with reference to the higher layers and leaves out the application layer in particular. CANopen fills that gap by being an application-layer protocol based on CAN with respect to the lower layers. CANopen describes the data and services to be communicated and puts the data into different device categories. It is a standard application-layer protocol compliant to CiA DS301 specifications.

CANopen's network management services make it easy to set up and initialise the network. CAN is a multi-master communication system. As opposed to other bus systems, it does not identify the modules connected but the messages (frames) exchanged via the bus. Bus availability allowing, all network stations are authorised to send frames at any time. Conflicts on the bus are resolved by assigning priorities to the messages. CAN always transfers broadcast messages that are assigned varying levels of priority. As all network stations share equal rights, communication is possible even without a master being present on the bus. Although every station autonomously decides about sending a data frame, a remote station can still request it to do so by sending a "remote frame request" message.

The CANopen standard (DS 301) specifies the technical characteristics and functions that an automation device must respect to qualify for network integration. CANopen distinguishes between Client and Server devices. The product described herein is a Server type device.

The following basics apply to every CANopen network:

The bus can contain a maximum of 127 stations.

Every device is described by its own EDS file.

Data communication is based on objects being sent with PDO and SDO messages.

Complex and low-priority services are transferred through SDO messages.

All slaves can send PDO data frames either in an event-controlled or a synchronised fashion.

### Normative reference

The communication profile to CiA DS-301 specifies the rules of device configuration and inter-device communication in real-time environments. For data transfer at layer 2, CANopen refers to ISO 11898 and CAN 2.0 A+B. LPP VALVE ISLAND is based on two standards: a) the CANopen CiA Draft Standard 301, Version 3.0, communication profile including the additions for modular systems; b) the Device Profiles for I/O modules to CiA Draft Standard 401, Version 1.4. Only objects declared in the EDS file are implemented.

### PDO/SDO frames

CANopen implements different communication services according to the different types of communication objects transferred. There are two basic types of objects, i.e. Process Data Objects (PDO) and Service Data Objects (SDO). PDOs contain high-priority real-time data. Every PDO can carry a maximum of 8 data bytes. SDOs contain low-priority system parameters;



thanks to the automatic fragmentation of messages, they are able to carry large amounts of data. Data exchange can be event-controlled or synchronised by messages. Event-controlled communication noticeably reduces the load on the bus, allowing high-speed communication even at a reduced speed of the bus. The system can be operated with both modes being active simultaneously. Service Data Objects are transferred in point-to-point mode. Besides SDOs and PDOs, there are also some other communication objects for:

- synchronising inputs and outputs,
- the boot-up procedure to initialise the bus,
- “life guarding / node guarding”,
- emergency messages.

## Object Dictionary

The object dictionary for a device contains the objects required for configuring the unit. Objects in the dictionary are deactivated if they are not used by the predefined connections set up at the network configuration stage. The SDO objects described in section 1.3 allow access to the object dictionary (read or write parameters).

The objects in the dictionary belong to different categories:

- properties that apply to all CANopen devices (DS 301),
- properties that apply to input/output devices only,
- vendor-dependent properties (does not apply to LPP VALVE ISLAND ).

With the exception of the vendor-dependent objects, the CANopen profile sets a standardised index for accessing the objects. See the Appendix for a brief description of the objects used by LPP VALVE ISLAND . The communication profile supports objects 0x1000 and 0x1018. Other objects available are the objects for setting the PDO communication (Index 0x1400, 0x1600). Object 6200 is the one making reference to the DS401 profile.

## PDO Mapping

For the mapping of the PDO, follow these instructions:



- Ensure that the device is in PRE-OPERATIONAL mode.
- Deactivate the PDO by setting SubID 1 = 80 00 00 00 in the communication object referencing the PDO.
- Enter the index, subindex and length of the application object into the mapping object. Each PDO can carry a maximum of 8 data bytes.
- Enter the communication parameter values, subindex 1-4, into the structure of the communication parameters.
- Put the station into OPERATIONAL mode (Start\_Remote\_Node).

This activates the PDOs.



The next table summarises the available PDO transfer types.

Type No	Cyclic	Acyclic	Synchronous	Asynchronous	RTR Only
0		X	X		
1-240	X		X		
241-251			Reserved		
252			X		
253				X	X
254				X	X
255				X	

**Typ 1-240**

returns the SYNC object number between two PDO transmissions.

**Typ 252**

updates, but does not send, the data following a SYNC frame.

**Typ 253**

updates the data following a RTR frame.

**Typ 254**

is provided for application-specific events of the device.

**Typ 255**

is provided for application-specific events defined in the device profile

## 7.2 Bus Architecture

CAN has a line architecture using a shielded twin-core cable with termination resistors at both ends of the cable. Supported speeds of communication range from 10 kbit/s (>1000 m) to 1 Mbit/s (25 m), depending on the length of the network.

## 7.3 Communication Speed (Baud Rate) and Distance

The maximum length of a CANopen network depends on the communication speed selected. Figure 1.7 illustrates the different options.

Transfer rate	Lead length	Time for one bit
1 Mbit/s	30 m	0,001 ms
800 kbit/s	50 m	0,00125 ms
500 kbit/s	100 m	0,002 ms
250 kbit/s	250 m	0,004 ms
125 kbit/s	500 m	0,008 ms
62,5 kbit/s	1000 m	0,020 ms
20 kbit/s	2500 m	0,050 ms
10 kbit/s	5000 m	0,100 ms



To set the communication speed of LPP VALVE ISLAND , refer to section 4.3

## 7.4 Wiring and Terminations

Both ends of every bus line must have a 120  $\Omega$  termination resistance installed between the CAN\_L (pin 2) and CAN\_H (pin 4) cores. If T connections need to be installed along the main bus, refer to table 1.8 for their maximum length (as specified by ISO/DIS 11898):

Speed	Max. Bus Length	Max. T-stub Length
20 kbit/s	1000 m	7,5 m
125 kbit/s	200 m	3,75 m
500 kbit/s	100 m	0,75 m
1000 Mbit/s	25 m	0,3 m

The following table summarises the points for measuring whether the connections are ok.

Measuring Point	Value	Explanation
Between GND and CAN_L	Infinite	Ok
	0	Short circuit between GND and CAN_L
Between GND and CAN_H	Infinite	Ok
	0	Short circuit between GND and CAN_H
Between CAN_L and CAN_H	ca. 60	Ok, both terminations installed
	ca. 120	Only one termination installed
	< 50	More than 2 terminations installed

## 8 Appendix

### 8.1 EDS File

The CANopen configurator needs the EDS file to correctly configure the node and add it to the network. The file contains a formal description of how the device acts in the network. Specifically, it contains information about transfer speeds, various bus parameters and other properties of the unit.

You will find the EDS File "**Ku\_VI770.EDS**" on the "CD Software and Information" or at [Kuknke.com/Download](http://Kuknke.com/Download).

### 8.2 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 "ERR" ..... LED red / physical status of the CAN layer  
LED "RUN" ..... LED green / current status of the CANopen slave node

#### Communication Interface

Field bus ..... CANopen  
compliance with the CiA DS-301 v4.02 and DS-401 v2.0  
Number of PDOs available ..... 3 Received  
Number of SDOs available ..... 2  
Baud rates ..... 50...1000 kbit/s (einstellbar am Kodierschalter 8...10)  
Transmission medium ..... Shielded copper cable (3 x 0.25 mm<sup>2</sup>)  
Potential separation ..... yes  
Connection technique ..... Male / female round plug  
(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...127 (set via pins 1 to 7 of coding switch)

#### 8.2.1 Hardware Version LPP Valve Island 770






03/2003	Hardware version 0, Ver. 1.0



## 8.3 Order Specifications

module monostable CANopen .....	77.050.0060
module bistable CANopen .....	77.050.0061

### 8.3.1 Accessories CANopen

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
	CANopen, straight connector single sided, M12	-	77.071.1000	77.071.5000
	CANopen, straight connector double sided, M12	-	77.072.1000	77.072.5000
	CANopen, 90° connector single sided, M12		77.073.1000	77.073.5000
	CANopen, 90° connector double sided, M12	77.074.0300	77.074.1000	77.074.5000

## 8.4 Literature

Title / Subject	Number	Source
<b>CANopen</b> ProCANopen configurator and basics	E 615 D	Kuhnke GmbH
<b>CANopen-Spezifikationen</b> Device Profile Drives and Motion Control	DSP 402 V1.1	CAN in Automation

## 8.5 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:

### 8.5.1 Main Factory in Malente

Kuhnke GmbH  
Lütjenburger Str. 101  
D-23714 Malente  
Phone +49-45 23-4 02-0  
Fax +49-45 23-40 22 47  
E-mail [sales@kuhnke.de](mailto:sales@kuhnke.de)  
Internet [www.kuhnke.de](http://www.kuhnke.de)

### 8.5.2 Sales Germany

Kuhnke GmbH  
Sales Germany  
Strohgäustr. 3  
D-73765 Neuhausen  
Phone +49-71 58-90 74-0  
Fax +49-71 58-90 74 80  
E-mail [sales@kuhnke.de](mailto:sales@kuhnke.de)  
Internet [www.kuhnke.de](http://www.kuhnke.de)



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