VECTRON

# Expansion module System bus EM-SYS

06/03

GB

## Frequency Inverter 230 V / 400 V

0.55 kW … 18.5 kW

| | | |
|---|---|---|
| Installation / Machine designation | : | ..... |
| Frequency inverter type | : | ..... |
| Serial-No. | : | ..... |

051-600-063

## General points on the documentation

The present supplement of the documentation is valid for the frequency inverter in the output range 0.55 KW up to 18.5 KW. The information necessary for the assembly and application of the expansion module system bus EM-SYS is documented in this guidance.

For better clarity, the user documentation is structured according to the customer-specific demands made of the frequency inverter.

**Brief instructions**
The brief instructions describe the fundamental steps for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the software configuration of the frequency inverter.

**Operating instructions**
The operating instructions document the complete functionality of the frequency inverter. The parameters necessary for specific applications for adaptation to the application and the extensive additional functions are described in detail.

**Application manual**
The application manual supplements the documentation for purposeful installation and commissioning of the frequency inverter. Information on various subjects connected with the use of the frequency inverter are described specific to the application.

The documentation and additional information can be requested via your local representation of the firm of VECTRON Elektronik. The following pictograms and signal words are used for the purposes of the present documentation:

**Danger**
means a directly threatening danger. Death, serious damage to persons and considerable damage to property will occur if the precautionary measure is not taken.

**Warning**
marks a possible threat. Death, serious damage to persons and considerable damage to property can be the consequence if attention is not paid to the text.

**Caution**
refers to an indirect threat. Damage to people or property can be the result.

**Attention**
refers to a possible operational behavior or an undesired condition that can occur in accordance with the reference text.

**Note**
marks information that facilitates handling for you and supplements the corresponding part of the documentation.

**Warning:** In installation and commissioning, comply with the information in the documentation. You as a qualified person must read the documentation carefully before the start of the activity and obey the safety instructions. For the purposes of the instructions, "qualified person" designates a person acquainted with the erection, assembly, commissioning and operation of the frequency inverters and possessing the qualification corresponding to the activity.

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# 1 General safety and application information

This documentation has been produced with the greatest of care and extensively and repeatedly checked. For reasons of clarity, not all the detailed information on all types of the product and also not every imaginable case of erection, operation or maintenance have been taken into account. If you require further information or if specific problems which are not dealt with extensively enough in the documentation exist, you can request the necessary information via the local representation of the firm of VECTRON Elektronik.
We would also point out that the contents of this documentation are not part of a previous or existing agreement, assurance or legal relationship and are not intended to amend the same. All obligations of the manufacturer result from the underlying purchase contract, which also contains the complete and solely valid warranty regulation. These contractual warranty provisions are neither extended nor limited by the production of this documentation.
The manufacturer reserves the right to correct or amend the contents and the product information as well as omissions without prior notification and assumes no kind of liability for damage, injuries or expenditure to be put down to the aforementioned reasons.

## 1.1 General information

Depending on their protection class, VECTRON frequency inverters can have live, also moving parts as well as hot surfaces during operation.
In the event of inadmissible removal of the necessary covers, improper use, wrong installation or operation, there is the risk of serious damage to persons or property.
In order to avoid serious physical damage or considerable damage to property, only qualified trained personnel may carry out the work for transport, installation, commissioning and maintenance. The norms EN 50178, IEC 60364 (Cenelec HD 384 or DIN VDE 0100), IEC 60664-1 (Cenelec HD 625 or VDE 0110-1), BGV A2 (VBG 4) and national provisions are to be complied with. Qualified persons within the meaning of this principal safety information are people acquainted with the erection, fitting, commissioning and operating of frequency inverters or in possession of qualifications matching their activities.

## 1.2 Proper use

The frequency inverters are electrical drive components intended for installation in industrial plant or machines. Commissioning and start of intended operation are not allowed until it has been established that the machine corresponds to the provisions of the EC machine directive 98/37/EEC and EN 60204. According to the CE sign, the frequency inverters additionally fulfill the requirements of the low-voltage directive 73/23/EEC and the norms EN 50178 / DIN VDE 0160 and EN 61800-2. Responsibility for compliance with the EMC directive 89/336/EEC is with the user. Frequency inverters are available in a limited way and as components exclusively intended for professional use within the meaning of the norm EN 61000-3-2.
With the issue of the UL test sign according to UL508c, the requirements of the CSA Standard C22.2-No. 14-95 have also been fulfilled.
The technical data and the information on connection and ambient conditions can be seen from the rating plate and the documentation and are to be complied with at all costs.

## 1.3 Transport and storage

Transport and storage are to be done in an adequate way in the original packaging. Storage shall be in dry rooms protected against dust and moisture with slight temperature fluctuations. Please observe the climatic conditions according to EN 50178 and the marking on the packaging.
The duration of storage without connection to the admissible reference voltage may not exceed one year.

## 1.4 Handling and positioning

The frequency inverters are to be used according to the documentation, the directives and the norms. Ensure careful handling and avoid mechanical overloading. In transport and handling, do not bend the construction elements or alter the insulation distances. Do not touch any electronic construction elements and contacts. The devices contain construction elements with a risk of electrostatic which can easily be damaged by improper handling. Damaged or destroyed components may not be put into operation as they can be a risk to your health and compliance with the applied norms is not guaranteed.

## 1.5 Electrical connection

In work on the frequency inverters, please observe the applicable norms BGV A2 (VBG 4), VDE 0100 and other national directives. The information in the documentation on electrical installation and the relevant directives are to be observed. Responsibility for compliance with and examination of the limit values of the EMC product norm EN 61800-3 for variable-speed electrical drive mechanisms is with the manufacturer of the industrial plant or machine.
The documentation contains information on installation correct for EMC. The wires connected to the frequency inverters may not be subjected to an insulation test with a high-test voltage without prior wiring measures.

## 1.6 Operation information

Before commissioning and the start of the intended operation, all the covers are to be attached and the terminals checked. Check additional monitoring and protective devices pursuant to EN 60204 and the safety directives applicable in each case (e.g. Working Machines Act, Accident Prevention Directives etc.). Before working on the frequency inverter, the latter must be switched off, and you are not allowed to touch live connections immediately as the capacitors can be charged up. Please observe the information and markings on the frequency inverter.

## 1.7 Maintenance and upkeep

Unauthorized opening and improper interventions can lead to physical injury or damage to property. Repairs on the frequency inverters may only be done by the manufacturer or persons authorized by the latter.

## 2 Introduction

This document describes the methods and possibilities of the system bus in the frequency inverters. The system bus is based on a CAN interface implemented on the expansion modules. This is the expansion module EM-SYS as well as further modules with additional functions to the system bus.

The system bus describes an open transport medium providing a variety of possibilities for exchange of data between the frequency inverters.

For an open transport medium, compliance with standards permitting use in standardized environments is necessary.

For readers of these operating instructions, knowledge of the norms is not necessary! All the methods have been described in such detail that studies of the norms are not necessary.

For the system bus based on the CAN bus, compliance with the norms means that its essential elements are oriented to the conventions of CANopen / CAL. The implementation supports the methods and definitions of **CiA DS301 Version 4.01**. The following properties are to be derived from this:

- **CAN-Interface ISO-DIS 11898** (CAN High Speed), max. 1 MBaud
- **Minimum Boot-Up Capability**
- **Predefined Connection Set**
- **2 SDO-Channels**
- **3 PDO-Channels**
- **Emergency-Message**
- **SYNC-Message**

As a consequence of the compliance of the aforementioned properties, the system bus is able to run under a master according to CANopen or in a CAL system. However, the system bus is also capable of running in an environment without an external master. This is achieved by one frequency inverter being defined as a master and taking on the master functionality.

**Attention:** The configuration of the necessary parameters for the system bus are accessible by a XPI file with the help of the VPlus PC program.
The control unit KP500 does not support this functionality.
If the extension module system bus EM-SYS is installed additionally to a communication module for the field bus connection (CM-232, CM-485 or CM-PDP) in the frequency inverter, the parameterization can be made with the interface adapter KP232.

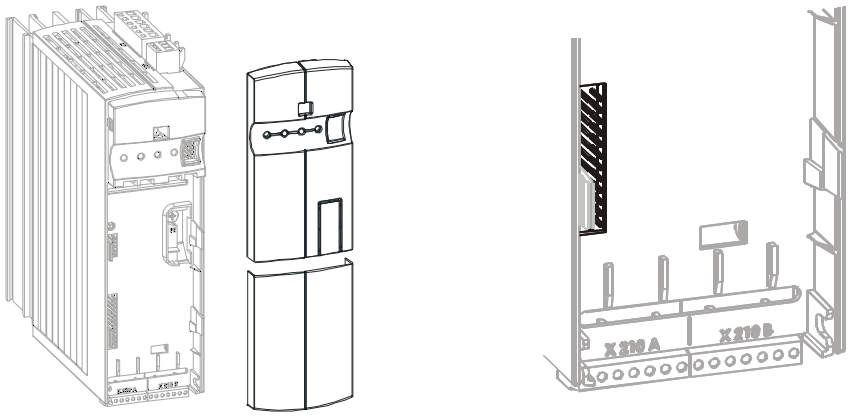
**Caution:** The expansion module system bus EM-SYS is enclosed with the frequency inverter as a separate part and must be fitted by the user. This is described in detail in the following chapter assembly.

## 3 Assembly of the expansion module EM-SYS

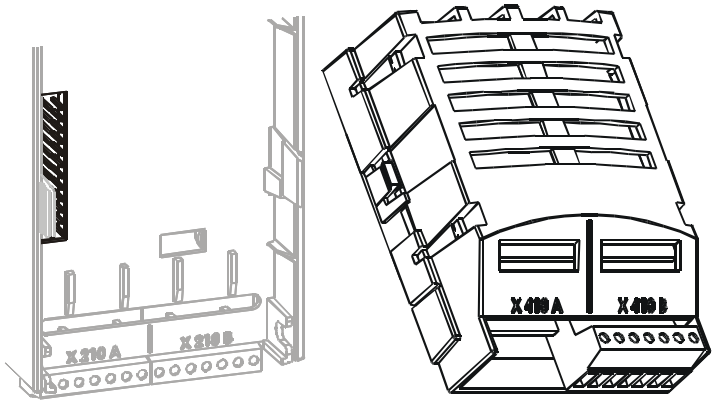
The expansion module EM-SYS is supplied in a housing for assembly on the plug-in sections of the frequency inverter.

**Caution:** Before assembly of the EM-SYS system bus module, the frequency inverter must be switched free of voltage.
Assembly under voltage is not admissible and leads to the destruction of the frequency inverter and / or the expansion module.

In the first step, the covers are to be removed. After this, the plug-in section for the system bus expansion module EM-SYS is accessible.

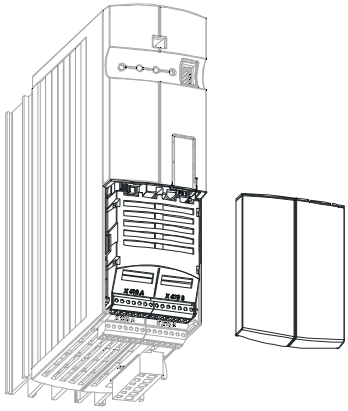



The system bus expansion module EM-SYS can now be inserted.



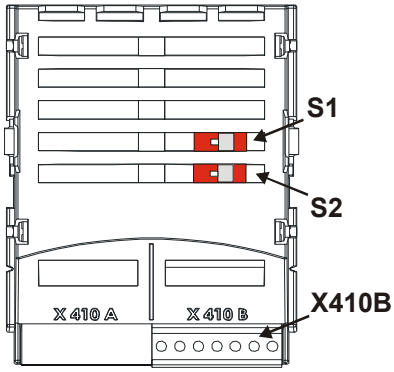

**Caution:** The system bus expansion module EM-SYS module is pre-fitted in a housing. The PCB visible on the back may not be touched, as modules can be damaged by this.

After this, the covers have to be fitted again.



## 4 Socket occupancy/bus termination/line

The CAN connection of the system bus is physically designed according to **ISO-DIS 11898** (CAN High Speed). The bus topology is the line structure.



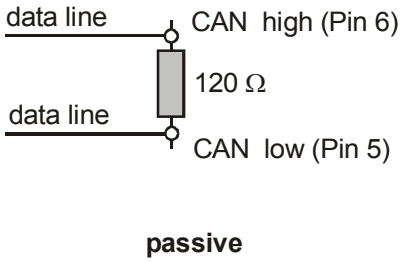

The bus termination necessary on a phase in the physically first and last subscriber can be activated alternatively via two **DIP switches** on the system bus expansion module EM-SYS.

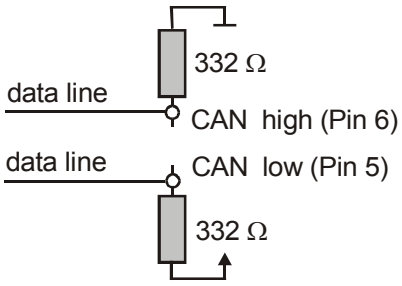
- **S1** forms the normal passive termination.
- Via **S2**, an active termination can be switched, resulting in an improved flank shape of the CAN signals, which leads to an improvement of the signal shapes, especially in an extended system.

The connection of the system bus is done via three terminals of socket **X410B** on the system bus expansion module EM-SYS.

**Attention:** An active termination may only be switched once on a bus system via S2! The additional bus termination has to be done in passiv mode.

**The factory setting for the bus termination is OFF.**




As the controller of the frequency inverters only contains one CAN controller, only a CAN communications module for CANopen (CM-CAN) **OR** an expansion module with system bus such as the system bus expansion module EM-SYS can exist.

**Caution:** If both components are installed (CM-CAN and EM-SYS), a fault message "**F0C22 Hardware configuration"**, which can be acknowledged, is generated.
Both CAN connections are free of function in this case!

| Socket X410B | |
|---|---|
| X410B.1 | - |
| X410B.2 | - |
| X410B.3 | - |
| X410B.4 | CAN_GND |
| X410B.5 | CAN-Low |
| X410B.6 | CAN-High |
| X410B.7 | PE |

For the bus line, the twisted and shielded line is to be used. The screen is to be designed as a harness screen (**not a foil screen**).

**Attention:** The control and data lines are to be laid physically separate from the power lines. The harness screen of the data lines is to be connected to ground (PE) on both sides on a large area and with good conductivity.

## 5 Baud rate setting/line length

The setting of the baud rate must be identical in all subscribers to the system bus. The maximum possible baud rate is based on the overall line length of the system bus. The baud rate is set via the parameter *Baud-Rate* **903**.

| Operation mode | Function | max. Line length / m |
|---|---|---|
| 3 - | 50 kBaud | 1000 |
| 4 - | 100 kBaud | 800 |
| 5 - | 125 kBaud | 500 |
| 6 - | 250 kBaud | 250 |
| 7 - | 500 kBaud | 100 |
| 8 - | 1000 kBaud | 25 |

A baud rate under 50 kBaud, as is defined according to CANopen, is not sensible for the system bus as the data throughput is too low.

The maximum line lengths stated are guidelines. If they are made complete use of, a calculation of the admissible length is to be done on the basis of the line parameters and the bus driver (PCA82C250T).

## 6 Setting node address

A maximum of 63 slave frequency inverters can be operated on the system bus. Each frequency inverter is given a node ID for its unambiguous identification; this ID may only exist once in the system. The setting of the system bus node ID is done via the parameter *Node-ID* **900**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 900 | Node-ID | -1 | 63 | -1 |

Thus, the system bus possesses a maximum number of 63 subscribers (Network nodes), plus one frequency inverter as a master.

**Note:** With the factory setting of parameter *Node-ID* **900** = –1, the system bus is deactivated for this frequency inverter.
If the *Node-ID* **900** = 0 is set, the frequency inverter is defined as a master. Only one frequency inverter on the system bus may be defined as a master.

## 7 Functional overview

To start with, the system bus produces the physical connection between the frequency inverters. Logical communication channels are produced via this physical medium. These channels are defined via the identifiers. As CAN does not possess a subscriber-oriented, but a message-oriented addressing via the identifiers, the logical channels can be displayed via it.

In the basic state (factory setting) the identifiers are set according to the Predefined Connection Set of CANopen. These settings are aimed at one master serving all the channels. In order to be able to build up process data movement via the PDO channels between individual or a number of inverters (transverse movement), the setting of the identifiers in the subscribers has to be adapted.

**Note:** For understanding, it is important to observe that the data exchange is done message-oriented. An frequency inverter can transmit and receive a number of messages, identified via various identifiers.

As a special feature, the properties of the CAN bus mean that the messages transmitted by one subscriber can be received by a number of subscribers simultaneously. The error monitoring methods of the CAN bus result in the message being rejected by all recipients and automatically transmitted again if there is a faulty reception in one receiver.

## 8 Network management

The network management controls the start of all subscribers to the system bus. Subscribers can be started or stopped individually or jointly. For the subscriber identification in a CAL or CANopen system, the slaves generate a starting telegram (boot-up message) on the system bus. In the event of a fault, the slaves automatically transmit a fault message (emergency message).

For the functions of the network management, the methods and NMT telegrams (network management telegrams) defined according to CANopen (CiA DS 301) are used.

## 8.1 SDO channels (parameter data)

Each frequency inverter possesses two SDO channels for the exchange of parameter data. In a slave device, these are two server SDO's, in a device defined as a master a client SDO and a server SDO. Attention must be paid to the fact that only one master for each SDO channel may exist in a system.

**Note:** Only one master can initiate by the system bus an exchange of data via its client SDO.

The identifier assignment for the SDO channels (Rx/Tx) is done according to the Predefined Connection Set.
This assignment can be amended by parameterization, in order to solve identifier conflicts in a larger system in which further devices are on the CAN bus alongside the frequency inverters.

**Attention:** If a system in which an frequency inverter works as a master is produced, the identifier allocations for the SDO channel may not be altered. In this way, an addressing of individual subscribers via the field bus/system bus path of the master frequency inverter is possible.

Parameters are read/written via the SDO channels. Due to the limitation to the SDO Segment Protocol Expedited, which minimizes the handling needed for the exchange of parameters, the transmittable data are limited to the types uint / int / long. This permits a complete parameterization of the frequency inverters via the system bus as all the setting variables and practically all the actual values are displayed by these types of data.

## 8.2 PDO channels (process data)

Each frequency inverter possesses three PDO channels (Rx/Tx) for the exchange of process data.

The identifier assignment for the PDO channel (Rx/Tx) is done by default according to the Predefined Connection Set. This assignment corresponds to an alignment to a central master control.
In order to produce the logical channels between the devices (transverse movement) on the system bus, the amendment of the PDO identifiers for Rx/Tx is necessary.

Each PDO channel can be operated with time or SYNC control. In this way, the operation behavior can be set for each PDO channel:

| Operation mode | Function |
|---|---|
| 0 - deactivated | no exchange of data via the PDO channel (Rx and/or Tx) |
| 1 - time-controlled | Tx-PDO's cyclically transmit according to the time specification<br>Rx-PDO's are read in with Ta = 1 ms and forward the data received to the application |
| 2 - SYNC controlled | Tx-PDO's transmit the data from the application that are then current after the arrival of the SYNC telegram.<br>Rx-PDO's forward the last data received to the application after the arrival of the SYNC telegram. |

For synchronous PDO's, the master (PC, PLC or frequency inverter) generates the SYNC telegram. The identifier assignment for the SYNC telegram is done by default according to the Predefined Connection Set. This assignment can be altered by parameterization.

# 9 Master functionality

An external control or an frequency inverter defined as a master (node ID = 0) can be used as a master. The fundamental tasks of the master are controlling the start of the network (boot-up sequence), generating the SYNC telegram and evaluating the emergency messages of the slaves.
Further, there can be access to the parameterization of all the frequency inverters on the system bus by means of a field bus connection via the client SDO of the master frequency inverter.

## 9.1 Control boot-up sequence, network management

The Minimum Capability Boot-Up method defined according to CANopen is used for the state control of the subscribers (nodes).
This method knows the pre-operational, operational and stopped states.

After the initialization phase, all the subscribers are in the pre-operational state. The system bus master transmits the NMT command **Start-Remote-Node**. With this command, individual nodes or all the nodes can be started together. An frequency inverter defined as a master starts **all** the nodes with **one** command. After receipt of the Start-Remote-Node command, the subscribers change to the operational state, from which time the exchange of process data via the PDO channels is activated.
A master in the form of a PLC/PC can start the subscribers on the system bus individually and also stop them again.

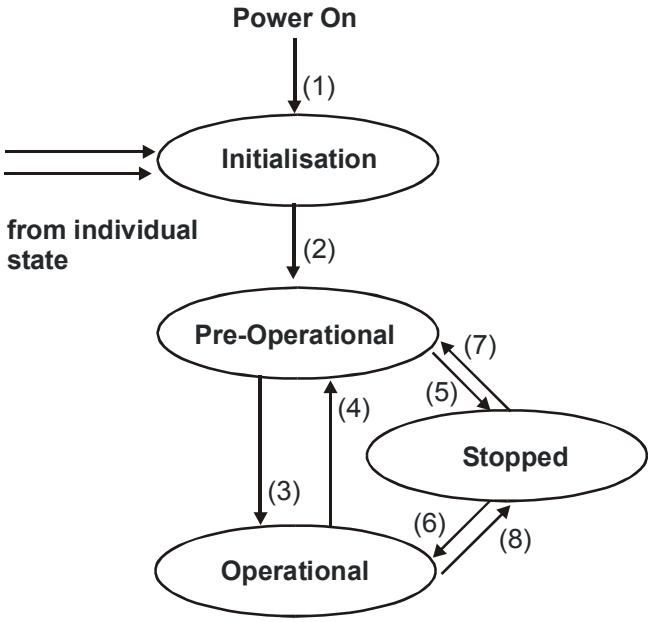
As the slaves on the system bus need different lengths of time to conclude their initialization phases (especially if external components exist alongside the frequency inverters), an adjustable delay for the change to Operational is necessary. The setting is done in an frequency inverter defined as a system bus master via *Boot-Up Delay* **904**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 904 | Boot-Up Delay | 3500 ms | 50000 ms | 3500 ms |

**Properties of the states:**

| State | Propertie |
|---|---|
| Pre-Operational | Parameterization via SDO channel possible<br>Exchange of process data via PDO channel not possible |
| Operational | Parameterization via SDO channel possible<br>Exchange of process data via PDO channel possible |
| Stopped | Parameterization via SDO channel not possible<br>Exchange of process data via PDO channel not possible |

**Note:** Start-Remote-Node is cyclically transmitted with the set delay time by an frequency inverter defined as a system bus master, in order to put slaves added with a delay or temporarily separated from the network back into the Operational state.




After Power On and the initialization, the slaves are in the Pre-Operational state. The transition (2) is automatic. The system bus master (frequency inverter or PLC/PC) triggers the transition (3) to Operational state.
The transitions are controlled via NMT telegrams.

The identifier used for the NMT telegrams is "0" and may only be used by the system bus master for NMT telegrams. The telegram contains two data bytes.

| Byte 0 | Byte 1 |
|---|---|
| CS (Command Specifier) | Node-ID |

Identifier = 0

With the specification of node ID ≠ 0, the NMT command acts on the subscriber selected via the node ID. If the node ID = 0, all the subscribers are addressed.

| Transition | Command | Command Specifier |
|---|---|---|
| (3) , (6) | Start Remote Node | 1 |
| (4) , (7) | Enter Pre-Operational | 128 |
| (5) , (8) | Stop Remote Node | 2 |
| - | Reset Node | 129 |
| - | Reset Communication | 130 |

**Note:** An frequency inverter defined as a system bus master only transmits the command "Start Remote Node" with node ID = 0 (for all subscribers). Transmission of the command is done after completion of the initialization phase and the time delay *Boot-Up Delay* **904** following it.

## 9.2 SYNC telegram, generation

If synchronous PDO's have been created on the system bus, the master must send the SYNC telegram cyclically. If an frequency inverter has been defined as a system bus master, the latter must generate the SYNC telegram. The interval for the SYNC telegram of an frequency inverter defined as the system bus master is adjustable. The SYNC telegram is a telegram without data.

**The default identifier = 128 according to the Predefined Connection Set.**

If a PC or PLC is used as a master, the identifier of the SYNC telegrams can be adapted by parameterization on the frequency inverter. The identifier of the SYNC telegram must be set identically in all subscribers on the system bus.

The setting of the identifier of the SYNC telegram is done via the parameter *SYNC-Identifier* **918**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 918 | SYNC-Identifier | 0 | 2047 | 0 |

The setting "0" results in identifier assignment according to the Predefined Connection Set.

**Attention:** The identifier range 129 ... 191 may not be used as the emergency telegrams can be found there.

The temporal cycle for the SYNC is set on an frequency inverter defined as a system bus master via the parameter *SYNC-Time* **919**.

**Note:** A setting of 0 ms for the parameter *SYNC-Time* 919 means "no SYNC telegram".

## 9.3 Emergency message, reaction

If a slave on the system bus suffers a fault, it transmits the emergency telegram. The emergency telegram marks the node ID for the identification of the failed node via its identifier and the existing fault message via its data contents (8 bytes).

After a fault has been acknowledged on the slave, the latter again transmits an emergency telegram with the data content zero.

The emergency telegram has the identifier 128 + node ID ( = 129 ... 191).

The system bus master evaluates the emergency telegrams of the slaves. Its reaction to an emergency telegram can be set with *Emergency Reaction* **989**.

| Operation mode | Function |
|---|---|
| 0 - Error | The system bus master receives the emergency telegram and switches-off |
| 1 - No Error | Das Emergency Telegramm wird als Warnung angezeigt |

**Operation mode - parameter 989 = 0 – Error**

Behavior of the system bus master in *Emergency Reaction* **989** = 0 / Error:

As soon as the system bus master receives an emergency telegram, it also breaks down and reports the failed subscriber on the basis of its ID via the kind of error. Only the subscriber is reported, not the cause of the error.

The fault message on the system bus master via *Current error* **260** is **21nn** with **nn = node ID** (hexadecimal) of the slave in which a fault switch-off exists.
In addition, the system bus master reports the warning Sysbus (0x2000) via the parameter *Warnings* **270** Bit 13.

If a fault switch-off occurs on a number of slaves, the first slave to transmit its emergency telegram is displayed on the system bus master.

**Operation mode - parameter 989 = 1 – No Error**

Behavior of the system bus master in *Emergency Reaction* **989** = 1 / No Error:

As soon as the system bus master receives an emergency telegram, it reports the warning Sysbus (0x2000) via the parameter *Warnings* **270** Bit 13.

**Note:** In both cases, the Boolean variable SysbusEmergency with source number 730 is set to TRUE in the system bus master. It can be used in the system bus master and (in transmission via a TxPDO) in the slaves for a defined shutdown.
SysbusEmergency is also set if the system bus master breaks down.

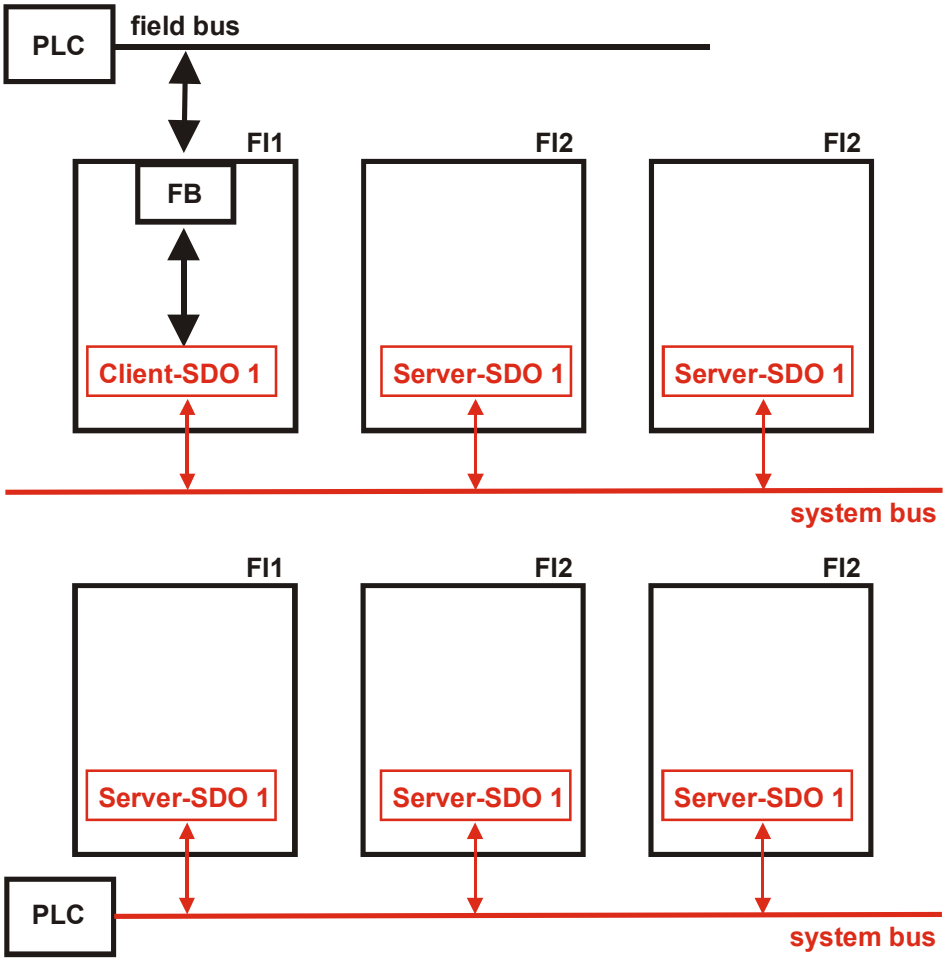
Resetting of SysbusEmergency is done with the fault acknowledgment.

## 9.4 Client SDO (system bus master)

Each subscriber on the system bus can be addressed via the SDO channels. In this way, each subscriber can be addressed and parameterized by one master via its client SDO1. All the parameters of the data types uint/int/long are accessible. String parameters can **not** be processed. If an frequency inverter has been defined as a system bus master, each subscriber on the system bus in this frequency inverter can be addressed by means of a field bus connection (RS232, RS485, Profibus-DP) via its client SDO1.

**Attention:** The second SDO channel SDO2 of the frequency inverters is planned for the parameterization of the frequency inverters via a visualization tool on the system bus.

The service used is SDO Segment Protocol Expedited according to CANopen. An frequency inverter defined as a system bus master automatically generates the correct telegrams. If the SDO channel is operated via a PLC/PC on the system bus, the telegrams must be generated according to the specification.



# 10 Slave functionality

## 10.1 Implement boot-up sequence, network management

### 10.1.1 Boot-up message

After the initialization, each slave on the system bus transmits its boot-up message (heartbeat message).

**Note:** The boot-up telegram has the identifier 1792 + node ID and a data byte with contents = 0x00.

This telegram is of importance if a PLC/PC with CANopen functionality is used as a master. An frequency inverter defined as a system bus master does **not** evaluate the boot-up message.

### 10.1.2 Status control

The identifier used for the NMT telegrams is "0" and may only be used by the system bus master for NMT telegrams. The telegram contains two data bytes.

| Byte 0 | Byte 1 |
|---|---|
| CS (Command Specifier) | Node-ID |

Identifier = 0

With the specification of node ID ≠ 0, the NMT command acts on the subscriber selected via the node ID. If the node ID = 0, **all** the subscribers are addressed.

| Transition | Command | Command Specifier |
|---|---|---|
| (3),(6) | Start Remote Node | 1 |
| (4),(7) | Enter Pre-Operational | 128 |
| (5),(8) | Stop Remote Node | 2 |
| - | Reset Node | 129 |
| - | Reset Communication | 130 |

**Caution:** The reset node and reset communication command specified according to DS 301 lead to a change to Pre-Operational via Initialization in the frequency inverters. There is a new boot-up message.

After a slave has received the command "Start Remote Node", it activates the PDO channels and is ready for the exchange of process data.

## 10.2 Process SYNC telegram

If synchronous PDO's have been created in an frequency inverter, their processing is synchronized with the SYNC telegram. The SYNC telegram is generated by the system bus master and is a telegram without data.

**The identifier is 128 according to the Predefined Connection Set.**

If a PC or PLC is used as a master, the identifier of the SYNC telegram can be adapted by parameterization on the frequency inverter. The identifier of the SYNC telegram must be set identically for all subscribers on the system bus.

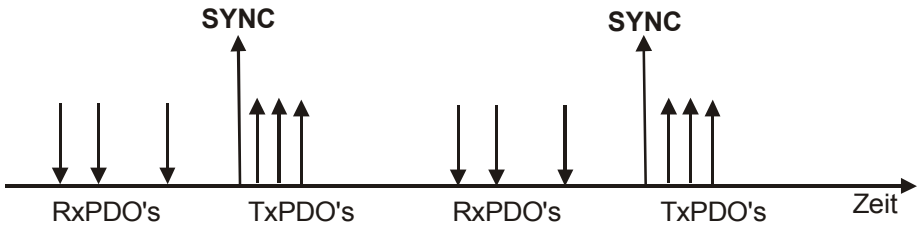
**Attention:** The identifier range 129 ... 191 may not be used as the emergency telegrams can be found there.

The setting of the identifier of the SYNC telegram is done via the parameter *SYNC-Identifier* **918**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 918 | SYNC-Identifier | 0 | 2047 | 0 |

The setting "0" results in the identifier assignment according to the Predefined Connection Set.

The data of the Rx-PDO's are forwarded to the application after the arrival of the SYNC telegram. At the same time, the transmission of the Tx-PDO's with the currently available data from the application is triggered.




This method enables pre-occupancy of set points in the system bus subscribers and a synchronous / parallel take-over of the data.

## 10.3 Emergency message, fault switch-off

As soon as a fault switch-off occurs in a slave frequency inverter, the emergency telegram is transmitted. The emergency telegram marks the node ID for the identification of the failed node via its identifier and the existing fault message via its data contents (8 bytes).

The emergency telegram has the identifier 128 + node ID.

After a fault acknowledgment, another emergency telegram is transmitted, with the data content (Byte 0 ...7) being set to zero this time. This identifies the subscriber's repeated readiness for operation. If a further fault occurs subsequently, it is transmitted in a new emergency telegram.

The acknowledgment sequence is based on the definitions according to CANopen.

Data contents of the emergency telegram:

| Emergency telegram | | |
|---|---|---|
| **Byte** | **Value** | **Meaning** |
| 0 | 0x00 | low-byte Error-Code |
| 1 | 0x10 | high-byte Error-Code |
| 2 | 0x80 | Error-Register |
| 3 | 0 | - |
| 4 | 0 | - |
| 5 | 0 | - |
| 6 | 0xnn | internal Error-Code, low-byte |
| 7 | 0xmm | internal Error-Code, high-byte |

Bytes 0, 1 and 2 are firmly defined and compatible with CANopen.
Bytes 6/7 contain the product specific VECTRON error code.

Error-Code = 0x1000 = general error
Error-Register = 0x80 = manufacturer-specific error

The explanation and description of the product specific VECTRON error code you find in the appendix " Fault messages".

## 10.4 Server SDO1/SDO2

The communication channel for the exchange of parameter data is the SDO channel. Communication works according to the client/server model. The server is the subscriber holding the data (here the frequency inverter), the client the subscriber requesting or wanting to alter the data (PLC, PC or frequency inverter as system bus master).

For the frequency inverter, two server SDO channels have been implemented. The first SDO channel **SDO1** is used for the parameterization of the PLC/PC as a master or frequency inverter with field bus connection as a system bus master. The second SDO channel **SDO2** is reserved for a visualization tool for parameterization. An exchange of data can only be implemented by the master via a client SDO.

The SDO channels are stipulated for the server SDO's via identifiers according to the Predefined Connection Set to CANopen. As CANopen only provides for and defines one SDO channel in the Predefined Connection Set, the second SDO channel can be deactivated.
In addition, the number of system bus subscribers ad and the adjustable node ID are limited to 63.

**Identifier assignment according to the Predefined Connection Set:**

Identifier Rx-SDO = 1536 + Node-ID (Node-ID = 1 ... 127, Identifier = 1537 ... 1663)
Identifier Tx-SDO = 1408 + Node-ID (Node-ID = 1 ... 127, Identifier = 1409 ... 1535)

**Identifier assignment for SDO1/SDO2 compatible with the Predefined Connection Set:**

Identifier Rx-SDO1 = 1536 + Node-ID (Node-ID = 1 ... 63, Identifier = 1537 ... 1599)
Identifier Tx-SDO1 = 1408 + Node-ID (Node-ID = 1 ... 63, Identifier = 1409 ... 1471)

Identifier Rx-SDO2 = 1600 + Node-ID (Node-ID = 0 ... 63, Identifier = 1600 ... 1663)
Identifier Tx-SDO2 = 1472 + Node-ID (Node-ID = 0 ... 63, Identifier = 1472 ... 1535)

This corresponds to the factory settings of the frequency inverters for the SDO's.
The node ID = 0 for SDO2 is the system bus master.

**Attention:** The SDO2 must be deactivated in a CANopen system in order not to generate any compatibility problems.

If an frequency inverter has been defined as the system bus master, the above settings for the SDO1 must be maintained in all the frequency inverters. In this way, access to the parameterization of the frequency inverters via a field bus connection on the master frequency inverter is possible.
The client SDO1 in the master frequency inverter addresses the server SDO1 of the slaves via the above identifiers.

**Attention:** The identifiers for a visualization tool on the second SDO channel SDO2 cannot be changed.

If a PC or a PLC is used as a master, the identifiers of the **Rx/Tx-SDO1** can be adapted by parameterization on the frequency inverter.

**Attention:** In free assignment of identifiers, there may not be any double occupancy !
The identifier range 129 ... 191 may not be used as the emergency telegrams can be found there.

The setting of the identifiers of the RxSDO1 is done via the parameter *RxSDO1-Identifier* **921**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 921 | RxSDO1-Identifier | 0 | 2047 | 0 |

The setting of the identifiers of the TxSDO1 is done via parameter number **922**.

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 922 | TxSDO1-Identifier | 0 | 2047 | 0 |

Setting "0" results in identifier assignment according to the Predefined Connection Set.

The second SDO channel can be deactivated via the *SDO2 Set Active* **923**.

| Operation mode | Function |
|---|---|
| 0 - SDO2 deactivated | Communication channel deactivated |
| 1 - SDO2 activated | Communication channel activated for the visualization tool |

**The identifier assignment for the second SDO channel is always to the specification:**

Identifier Rx-SDO2 = 1600 + Node-ID
Identifier Tx-SDO2 = 1472 + Node-ID

**Note:** In this way, firm identifiers via which communication takes place are available for the visualization tool.

# 11 Communication channels, SDO1/SDO2

## 11.1 SDO telegrams (SDO1/SDO2)

The service used for the exchange of parameter data is **SDO Segment Protocol Expedited**. The data (type uint, int, long) are exchanged in a telegram.

Access to the parameters in the frequency inverters with a statement of parameter number and data set is displayed via the addressing defined for object access pursuant to the specifications of CANopen via Index/Sub-Index.
Index = parameter number / Sub index = data set.

The data to be transmitted have a length of 2 bytes for uint/int and 4 Bytes for long. For simplification and standardization, 4 bytes are always transmitted.

The data are on the bytes 4 ... 7 of the SDO telegram.
- uint/int variables are transmitted in bytes 4 and 5 with the bytes 6 and 7 = 0.
- long variables are transmitted in bytes 4 ... 7.

**Writing parameters:**

Client ➔ Server SDO Download (expedited)

| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x22** | LSB | MSB | 0xnn | LSB | | | MSB |
| uint/int | | | | LSB | MSB | 0x00 | 0x00 |
| long | | | | LSB | ... | ... | MSB |

Server ➔ Client Download Response ➔ Writing process free of errors

| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x60** | LSB | MSB | 0xnn | 0 | | | |

Server ➔ Client Abort SDO Transfer ➔ Writing process faulty

| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x80** | LSB | MSB | 0xnn | Code | 0 | 0 | 0 |

In a faulty writing process, the error code is stated in Byte 4 (see table failure codes).

**Caution:** Control byte 0x22 for the identification "SDO Download expedited" does not consider the bits "s" (data size indicated) and "n" (number of bytes not containing data). If set, they are ignored. The user is responsible for the number of bytes matching the type of data.

**Reading parameters:**

Client ➔ Server SDO Upload (expedited)

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x40** | LSB | MSB | 0xnn | 0 | | | |

Server ➔ Client Upload Response ➔ Reading process free of errors

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x42** | LSB | MSB | 0xnn | LSB | | | MSB |
| uint/int | | | | LSB | MSB | 0x00 | 0x00 |
| long | | | | LSB | ... | ... | MSB |

Server ➔ Client Abort SDO Transfer ➔ Reading process faulty

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Ctrl. byte | Parameter number | | Data set | Data | | | |
| **0x80** | LSB | MSB | 0xnn | Code | 0 | 0 | 0 |

In a faulty reading process, the error code is stated in Byte 4 (see table failure codes).

**failure codes**

| Code | Description |
|---|---|
| 1 | inadmissible parameter figure |
| 2 | inadmissible data set |
| 3 | parameter not readable |
| 4 | parameter not writable |
| 5 | reading error EEPROM |
| 6 | writing error EEPROM |
| 7 | checksum error EEPROM |
| 8 | parameter cannot be written during running drive |
| 9 | values of the data sets differ |
| 10 | parameter of wrong type |
| 11 | unknown parameter |
| 12 | BCC error in VECTRON bus protocol |
| 15 | unknown error |
| 20 | system bus subscriber not available<br>only in access via field bus connection |
| 21 | string parameter not admissible<br>only in access via VECTRON bus protocol |

Errors marked in the table are generated by the field bus side, not in the Abort SDO Transfer of the system bus.

## 11.2 Communication via field bus connection (SDO1)

If an frequency inverter has been defined as the system bus master and equipped with a field bus interface, access to the parameterization of all the subscribers in existence on the system bus is possible by means of this field bus interface via the first SDO channel (SDO1). An extension has been created in the protocol frame of the field buses for this purpose.

**Attention:** The prerequisite for this mechanism is that the identifier setting for the first SDO channel (SDO1) corresponds to the Predefined Connection Set.
The parameter addressed must also be existent in the system bus master.

### 11.2.1 Profibus-DP

If an object with communication channel (PKW) is used in Profibus-DP, access to all the other subscribers on the system bus can be done via it. The structure of the communication channel permits an additional addressing of a system bus subscriber. This is done by the use of an unused byte in the communication channel.

**Communication channel PKW**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| PKE | | Index | - | Data | | | |
| AK/SPM | Parameter number | Data set | Node-ID system bus | | | | |

Byte 3 is used to transmit the node ID of the required subscriber on the system bus. If Byte 3 = 0, the master frequency inverter of the system bus is being addressed itself. The display is binary (0 ... 63).

### 11.2.2 RS232/RS485 with VECTRON bus protocol

In the VECTRON bus protocol, there is a byte in the telegram header that is always transmitted with 0 as a standard feature.

**ENQUIRY**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Address | 0 | p | n | n | n | ENQ |
| | Node-ID system bus | Data set | Parameter number | | | |

**SELECT**

| 0 | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Address | STX | 0 | p | n | n | n | ... |
| | | Node-ID system bus | Data set | Parameter number | | | |

Byte 1 in the Enquiry and Byte 2 in the Select telegram are not defined and are used to transmit the node ID of the required subscriber on the system bus. If this byte = 0, the master frequency inverter of the system bus itself is being addressed. The display is ASCII corresponding to the conventions for the display of the address in the VECTRON bus protocol.

**Note:** If there is an NAK fault message, the error is to be read out from the system bus master with node ID = 0 via parameter 11!

Display of node ID system bus in the VECTRON bus protocol:

| System bus Node-ID | | | | | |
|---|---|---|---|---|---|
| **System bus address** | **(ASCII-) character** | **HEX value** | **System bus address** | **(ASCII-) character** | **HEX value** |
| 1 | A | 41 | 31 | _ | 5F |
| 2 | B | 42 | 32 | ` | 60 |
| 3 | C | 43 | 33 | a | 61 |
| 4 | D | 44 | 34 | b | 62 |
| 5 | E | 45 | 35 | c | 63 |
| 6 | F | 46 | 36 | d | 64 |
| 7 | G | 47 | 37 | e | 65 |
| 8 | H | 48 | 38 | f | 66 |
| 9 | I | 49 | 39 | g | 67 |
| 10 | J | 4A | 40 | h | 68 |
| 11 | K | 4B | 41 | i | 69 |
| 12 | L | 4C | 42 | j | 6A |
| 13 | M | 4D | 43 | k | 6B |
| 14 | N | 4E | 44 | l | 6C |
| 15 | O | 4F | 45 | m | 6D |
| 16 | P | 50 | 46 | n | 6E |
| 17 | Q | 51 | 47 | o | 6F |
| 18 | R | 52 | 48 | p | 70 |
| 19 | S | 53 | 49 | q | 71 |
| 20 | T | 54 | 50 | r | 72 |
| 21 | U | 55 | 51 | s | 73 |
| 22 | V | 56 | 52 | t | 74 |
| 23 | W | 57 | 53 | u | 75 |
| 24 | X | 58 | 54 | v | 76 |
| 25 | Y | 59 | 55 | w | 77 |
| 26 | Z | 5A | 56 | x | 78 |
| 27 | [ | 5B | 57 | y | 79 |
| 28 | \ | 5C | 58 | z | 7A |
| 29 | ] | 5D | 59 | { | 7B |
| 30 | ^ | 5E | 60 | \| | 7C |
| | | | 61 | } | 7D |
| | | | 62 | ~ | 7E |
| | | | 63 | □ | 7F |

# 12 Process data channels, PDO

## 12.1 Identifier assignment process data channel

The process channel for the exchange of process data under CANopen is the PDO channel. Up to three PDO channels with differing properties can be used in one device.

The PDO channels are defined via identifiers according to the Predefined Connection Set to CANopen:

Identifier 1. Rx-PDO = 512 + Node-ID
Identifier 1. Tx-PDO = 384 + Node-ID

Identifier 2. Rx-PDO = 768 + Node-ID
Identifier 2. Tx-PDO = 640 + Node-ID

Identifier 3. Rx-PDO = 1024 + Node-ID
Identifier 3. Tx-PDO = 896 + Node-ID

This corresponds to the factory settings of the frequency inverters for the Rx/Tx-PDO‘s. This occupancy is aligned to an external master (PLC/PC) serving all the channels.
If the PDO channels are used for a connection of the frequency inverters amongst one another, the identifiers are to be set accordingly by parameterization.

**Attention:** In free assignment of identifiers, there may not be any double occupancy!
The identifier range 129 ... 191 may not be used as the emergency telegrams can be found there.

Setting of the identifiers of the Rx/TxPDO’s:

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 924 | RxPDO1 Identifier | 0 | 2047 | 0 |
| 925 | TxPDO1 Identifier | 0 | 2047 | 0 |
| 926 | RxPDO2 Identifier | 0 | 2047 | 0 |
| 927 | TxPDO2 Identifier | 0 | 2047 | 0 |
| 928 | RxPDO3 Identifier | 0 | 2047 | 0 |
| 929 | TxPDO3 Identifier | 0 | 2047 | 0 |

Setting "0" results in the identifier assignment according to the Predefined Connection Set.

## 12.2 Operation modes process data channel

The transmit/receive behavior can be time controlled or controlled via a SYNC telegram. The behavior can be parameterized for each PDO channel.

**Tx-PDO's** can work time controlled or SYNC controlled. A time controlled TxPDO transmits its data at the interval of time set. A SYNC controlled TxPDO transmits its data after the arrival of a SYNC telegram.

**RxPDO's** in the time controlled setting forward the received data to the application immediately. If an RxPDO has been defined as SYNC controlled, its forwards its received data to the application after the arrival of a SYNC telegram.

**Settings TxPDO1/2/3**

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 930 | TxPDO1 Function | 0 | 2 | 0 |
| 931 | TxPDO1 Time | 1 ms | 50000 ms | 8 ms |
| 932 | TxPDO2 Function | 0 | 2 | 0 |
| 933 | TxPDO2 Time | 1 ms | 50000 ms | 8 ms |
| 934 | TxPDO3 Function | 0 | 2 | 0 |
| 935 | TxPDO3 Time | 1 ms | 50000 ms | 8 ms |

| Operation mode | Function |
|---|---|
| 0 - Not Active | No data are sent |
| 1 - Controlled by time | In the cycle of the adjusted time interval the data are sent |
| 2 - Controlled by SYNC | To arrival of a SYNC telegram the data are sent |

**Settings RxPDO1/2/3**

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 936 | RxPDO1 Function | 0 | 1 | 0 |
| 937 | RxPDO2 Function | 0 | 1 | 0 |
| 938 | RxPDO3 Function | 0 | 1 | 0 |

| Operation mode | Function |
|---|---|
| 0 - Controlled by time | The receive data are passed on immediately |
| 1 - Controlled by SYNC | After arrival of a SYNC telegram the received data are passed on |

**Note:** In the "controlled by time" operation mode, there is a polling of the received data with the trigger cycle of Ta = 1 ms.

## 12.3 Timeout monitoring process data channel

Each frequency inverter monitors its received data for whether they are updated within a defined time window. The monitoring is done onto the SYNC telegram and the RxPDO channels.

**Monitoring SYNC / RxPDO‘s**

| Parameter | | Setting | | |
|---|---|---|---|---|
| **No.** | **Description** | **Min.** | **Max.** | **Fact. sett.** |
| 939 | SYNC Timeout | 0 ms | 60000 ms | 0 ms |
| 941 | RxPDO1 Timeout | 0 ms | 60000 ms | 0 ms |
| 942 | RxPDO2 Timeout | 0 ms | 60000 ms | 0 ms |
| 945 | RxPDO3 Timeout | 0 ms | 60000 ms | 0 ms |

Setting 0 means no timeout monitoring.

**Attention:** There is only monitoring for the SYNC telegram if at least one RxPDO or one TxPDO channel is defined as SYNC controlled.

If a timeout period is exceeded, the frequency inverter breaks down and reports one of the faults:

**F2200 System bus Timeout SYNC**

**F2201 System bus Timeout RxPDO1**
**F2202 System bus Timeout RxPDO2**
**F2203 System bus Timeout RxPDO3**

## 12.4 Communication relationships of the process data channel

Regardless of the process data to be transmitted, the communication relationships of the process data channels must be defined. The connection of PDO channels is done via the assignment of the identifiers. The identifiers of Rx-/Tx-PDO must match in each case.

**There are two principal possibilities:**

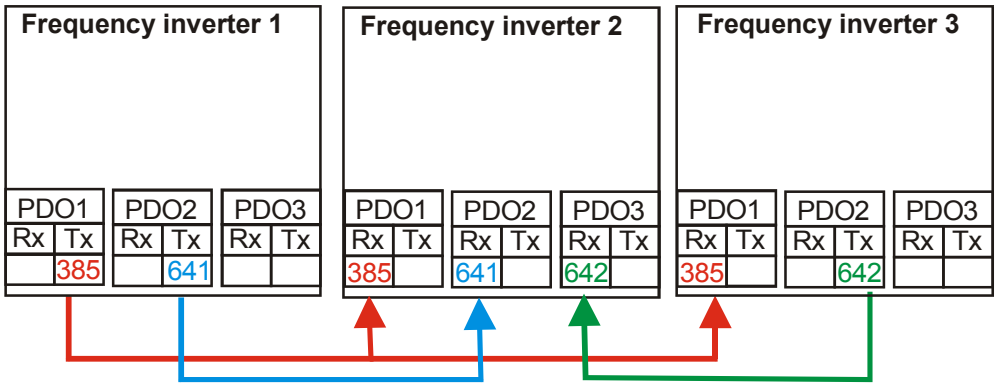
- **one** Rx-PDO to **one** Tx-PDO (one to one)
- connect **several** Rx-PDO's to **one** TxPDO (one to many)

This process is documented in a tabular form via a **communication relationship list**.

**Example:**

| **Frequency inverter 1** | | **Frequency inverter 2** | | **Frequency inverter 3** | |
|---|---|---|---|---|---|
| PDO | Identifier | PDO | Identifier | PDO | Identifier |
| **TxPDO1** | **385** | TxPDO1 | | TxPDO1 | |
| RxPDO1 | | **RxPDO1** | **385** | **RxPDO1** | **385** |
| **TxPDO2** | **641** | TxPDO2 | | **TxPDO2** | **642** |
| RxPDO2 | | **RxPDO2** | **641** | RxPDO2 | |
| TxPDO3 | | TxPDO3 | | TxPDO3 | |
| RxPDO3 | | **RxPDO3** | **642** | RxPDO3 | |

**Attention:** All the TxPDO's used must have differing identifiers !!! The Identifier must be clear in the system bus network.



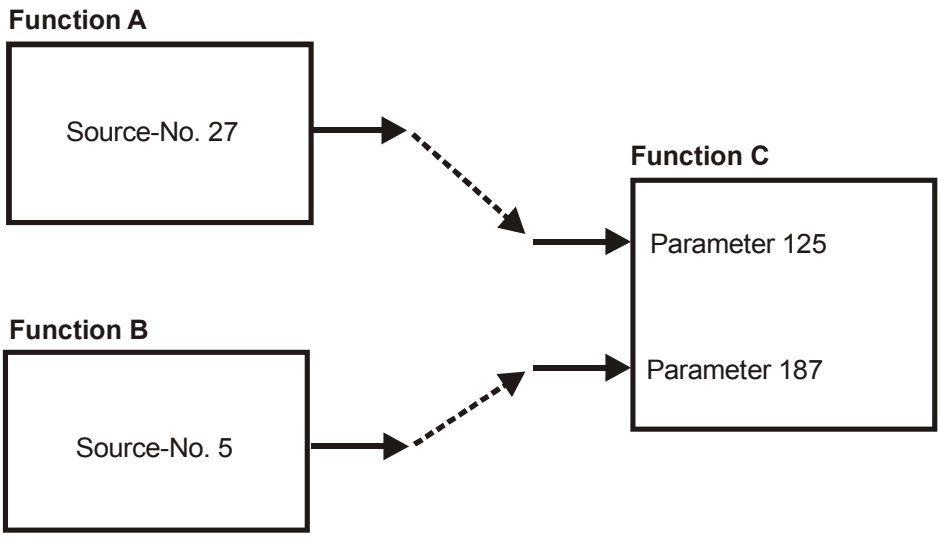
## 12.5 Virtual links

A PDO telegram contains 0 ... 8 data bytes according to CANopen. A mapping for any kind of objects can be done in these data bytes.

For the system bus, the PDO telegrams are firmly defined with 8 data bytes. The mapping is not done via mapping parameters as with CANopen, but via the method of sources and links.

Each function provides its output data via a source. These sources are defined via source numbers. The input data of functions are defined via parameters. The link of a data input to a data output is done via the assignment of parameters to source numbers.

**Example 1:**



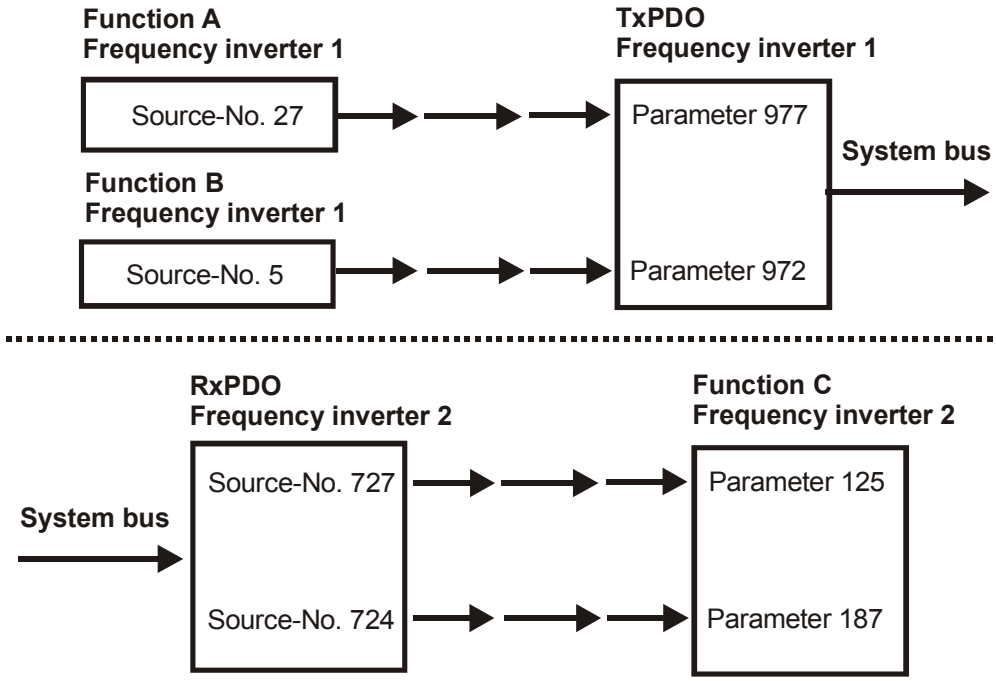

In example 1, the two inputs of function C are linked to the outputs of the functions A and B. The parameterization for this connection is thus:

**Function C**

Parameter 125 = Source-No. 27
Parameter 187 = Source-No. 5

For the system bus, the input data of the TxPDO's are also displayed as input parameters and the output data of the RxPDO's as sources.

**Example 2:**




Example 2 displays the same situation as Example 1. But now, the functions A and B are in frequency inverter 1 and function C in frequency inverter 2. The connection is done via a TxPDO in frequency inverter 1 and a RxPDO in frequency inverter 2. Thus, the parameterization for this connection is:

**Frequency inverter 1**

Parameter 977 = Source-No. 27
Parameter 972 = Source-No. 5

**Frequency inverter 2**

Parameter 125 = Source-No. 727
Parameter 187 = Source-No. 724

As the links with the system used exceed the device limits, they are termed "virtual links".

The virtual links with the possible sources are related to the Rx/TxPDO channels. For this purpose, the eight bytes of the Rx-/TxPDO's are defined structured as inputs and sources. This exists for each of the three PDO channels.

**Each transmit PDO and receive PDO can be occupied as follows:**

**4 boolean variables**

**or**

**4 unit/int variables**

**or**

**2 long variables**

**or**

**a mixture paying attention to the available bytes**

**Assignment data type / number of bytes:**

| Assignment | |
|---|---|
| **Data type** | **Length** |
| boolean | 2 Bytes |
| uint/int | 2 Bytes |
| long | 4 Bytes |

### 12.5.1 Input parameters of the TxPDO's for data to be transmitted

The listed parameters can be used to stipulate the data that are to be transported there for each position in the TxPDO telegrams. The setting is done in such a way that a source number is entered for the required data in the parameters.

| TxPDO1 Byte | P.-No. boolean input | TxPDO1 Byte | P.-No. uint/int input | TxPDO1 Byte | P.-No. long input |
|---|---|---|---|---|---|
| 0 | **946** | 0 | **950** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **954** |
| 2 | **947** | 2 | **951** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **948** | 4 | **952** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **955** |
| 6 | **949** | 6 | **953** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

| TxPDO2 Byte | P.-No. boolean input | TxPDO2 Byte | P.-No. uint/int input | TxPDO2 Byte | P.-No. long input |
|---|---|---|---|---|---|
| 0 | **956** | 0 | **960** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **964** |
| 2 | **957** | 2 | **961** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **958** | 4 | **962** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **965** |
| 6 | **959** | 6 | **963** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

| TxPDO3 Byte | P.-No. boolean input | TxPDO3 Byte | P.-No. uint/int input | TxPDO3 Byte | P.-No. long input |
|---|---|---|---|---|---|
| 0 | **966** | 0 | **972** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **976** |
| 2 | **967** | 2 | **973** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **968** | 4 | **974** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **977** |
| 6 | **969** | 6 | **975** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

**Note:** Depending on the selected data information the percentages values are displayed via the uint / int inputs!

With this method, there are up to three possibilities for a meaning of the contents of the individual bytes. Each byte may only be used for one possibility.

To ensure this, the processing of the input links is derived from the setting. If an input link has been set to the fixed value of zero, it is **not** processed.

**The settings for the fixed value zero are:**

| | | | |
|---|---|---|---|
| Source = | 7 | (FALSE) | for boolean variables |
| Source = | 9 | (0) | for uint, int, long variables |

This is simultaneously the factory setting.

**Examples boolean source**

| boolean source | |
|---|---|
| **Source** | **Data** |
| 6 | TRUE |
| 7 | FALSE |
| 70 | Contact input 1 |
| 71 | Contact input 2 |
| 72 | Contact input 3 |
| 161 | Running message |
| 163 | Nominal figure reached |
| 164 | Set frequency reached (P. 510) |

**Examples unit/int source**

| unit/int source | |
|---|---|
| **Source** | **Data** |
| 9 | 0 |
| 63 | Reference percentage 1 |
| 64 | Reference percentage 2 |
| 52 | Percentage MFI1 |
| 133 | Output percentage ramp |
| 137 | Output reference percentage channel |
| 138 | Output actual percentage channel |
| 740 | Control word |
| 741 | State word |

**Examples long source**

| long source | |
|---|---|
| **Source** | **Data** |
| 9 | 0 |
| 0 | Output frequency ramp |
| 1 | Fixed frequency 1 |
| 5 | Reference line value |
| 62 | Output frequency reference value channel |
| 50 | Reference frequency MFI1 |

### 12.5.2 Source numbers of the RxPDO's for received data

Equivalent to the input links of the TxPDO's, the received data of the RxPDO's are displayed via sources or source numbers. The sources existing in this way can be used in the frequency inverter via the local input links for the data targets.

| RxPDO1 Byte | Source No. boolean value | RxPDO1 Byte | Source No. uint/int value | RxPDO1 Byte | Source No. long value |
|---|---|---|---|---|---|
| 0 | **700** | 0 | **704** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **708** |
| 2 | **701** | 2 | **705** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **702** | 4 | **706** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **709** |
| 6 | **703** | 6 | **707** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

| RxPDO2 Byte | Source No. boolean value | RxPDO2 Byte | Source No. uint/int value | RxPDO2 Byte | Source No. long value |
|---|---|---|---|---|---|
| 0 | **710** | 0 | **714** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **718** |
| 2 | **711** | 2 | **715** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **712** | 4 | **716** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **719** |
| 6 | **713** | 6 | **717** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

| RxPDO3 Byte | Source No. boolean value | RxPDO3 Byte | Source No. uint/int value | RxPDO3 Byte | Source No. long value |
|---|---|---|---|---|---|
| 0 | **720** | 0 | **724** | 0 | |
| 1 | Boolean1 | 1 | Word1 | 1 | **728** |
| 2 | **721** | 2 | **725** | 2 | |
| 3 | Boolean2 | 3 | Word2 | 3 | Long1 |
| 4 | **722** | 4 | **726** | 4 | |
| 5 | Boolean3 | 5 | Word3 | 5 | **729** |
| 6 | **723** | 6 | **727** | 6 | |
| 7 | Boolean4 | 7 | Word4 | 7 | Long2 |

With this method, there are up to three possibilities for a meaning of the contents of the individual bytes. Each byte may only be used for one possibility.

**Note:** Depending on the selected data information the percentages values are displayed via the uint / int inputs!

### 12.5.3 Example of virtual links

| Frequency inverter 1 | | | | Frequency inverter 2 | | |
|---|---|---|---|---|---|---|
| **Source - No.** | **Input link** | **TxPDO1 Byte** | | **RxPDO1 Byte** | **Source - No.** | **Target** |
| Control word **740** | 950 | 0 | → | 0 | 704 | Control input, control word **99** |
| | | 1 | | 1 | | |
| | | 2 | | 2 | | |
| | | 3 | | 3 | | |
| Output reference frequency channel **62** | 955 | 4 | → | 4 | 709 | Ramp input, reference line value **137** |
| | | 5 | | 5 | | |
| | | 6 | | 6 | | |
| | | 7 | | 7 | | |

Parameter 950 = Source No. 740
Parameter 955 = Source No. 62

Parameter 99 = Source No. 704
Parameter 137 = Source No. 709

The control word of frequency inverter 1 is connected with the control word of frequency inverter 2. In this way, both frequency inverters can be operated synchronously via the remote control. The output of the reference value channel of frequency inverter 1 is placed on the input of the ramp of frequency inverter 2. In this way, both frequency inverters have a joint reference value source and are given highly precise reference values in internal notation.

As an extension, a number of frequency inverters can also exist on the receive side (Rx), these then being supplied with data parallel and simultaneously.

The input link not used in the TxPDO1 of frequency inverter 1 is on ZERO and is thus not served.

For reasons of clarity, as also for the communication relationships, the display in tabular form is necessary as a support.

## 13 Control parameters

For the monitoring of the system bus and the display of the internal states, two control parameters are provided. There is a report of the system bus state and a report of the CAN state via two actual value parameters.

The parameter *Node-State* **978** gives information about the Pre-Operational, Operational, Stopped state. A PDO transfer is only possible in the Operational state. The state is controlled by the system bus master (PLC / PC / frequency inverter) via NMT telegrams.

The parameter *CAN-State* **979** gives information about the state of the physical layer. If there are transmission errors, the state changes from OKAY to WARNING until the cancellation of the communication with BUS-OFF. After BUS-OFF, the CAN controller is automatically re-initialized and the system bus started again.

**Note:** If the BUS-OFF state occurs, the frequency inverter breaks down with "**F2210 BUS-OFF"**.

After Bus-OFF, the system bus in the frequency inverter is completely reinitialized. There is a new boot-up message from the subscriber and an emergency telegram with the Bus-OFF message is transmitted. The change of state of the subscriber to Operational is done by the Start-Remote-Node telegram cyclically sent by the system bus master.

| Actual values of the system bus | | |
|---|---|---|
| **No.** | **Description** | **Function** |
| 978 | Node-State | 1 - Pre-Operational<br>2 - Operational<br>3 - Stopped |
| 979 | CAN-State | 1 - OKAY<br>2 - WARNING<br>3 - BUS-OFF |

## 14 Handling of the parameters of the system bus

As soon as the system bus expansion module EM-SYS exists in an frequency inverter, the actual value parameters for system state and bus state are activated and can be observed in the actual value menu **VAL** of the control unit KP500 or with the VPlus PC program in the menu **Actual values \ Systembus**.

**Note:** The actual value parameters are on control level 3 and are thus available for the user at any time.

All the setting parameters for the configuration of the system bus are not directly accessible for the user. For defined customer applications, pre-defined XPI files can be generated by VECTRON for the VPlus PC program, with which the necessary parameters are visible for the user. The application-relevant variables are then available in these XPI files.

**Note:** XPI files can be read in addition to the loaded parameter information of the frequency inverter into the VPlus PC program.
In the menu of the software under the point Edit you find the command "Read in XPI file".

The method of working via an XPI file is used because deep interventions in the system that can lead to serious problems in the application with an untrained user are possible via the system bus. The XPI files give the user a selection list pre-defined by VECTRON.

**Attention:** The configuration of the necessary parameters for the system bus are accessible by a XPI file with the help of the VPlus PC program.
The control unit KP500 does not support this functionality.
If the expansion module system bus EM-SYS is installed additionally to a communication module for the field bus connection (CM-232, CM-485 or CM-PDP) in the frequency inverter, the parameterization can be made with the interface adapter KP232.

Experienced users have complete access to all the existing sources and possible input links with the XPI file of the active functions. The selection depends on the selected configuration and control procedure.

The display of the system bus parameters in use of the XPI file is designed according to the following structure:

**System bus**

| | | |
|---|---|---|
| **Basic Settings** | 900 | Node-ID |
| | 903 | Baud-Rate |
| **Master Functions** | 904 | Boot-Up Delay |
| | 919 | SYNC-Time |
| **SYNC-Identifier** | 918 | SYNC-Identifier |
| **SDO1-Identifier** | 921 | RxSDO1-Identifier |
| | 922 | TxSDO1-Identifier |
| **SDO2 Set Active** | 923 | SDO2 Set Active |
| **PDO-Identifier** | 924 | RxPDO1-Identifier |
| | 925 | TxPDO1-Identifier |
| | 926 | RxPDO2-Identifier |
| | 927 | TxPDO2-Identifier |
| | 928 | RxPDO3-Identifier |
| | 929 | TxPDO3-Identifier |
| **TxPDO-Function** | 930 | TxPDO1 Function |
| | 931 | TxPDO1 Time |
| | 932 | TxPDO2 Function |
| | 933 | TxPDO2 Tome |
| | 934 | TxPDO3 Function |
| | 935 | TxPDO3 Time |
| **RxPDO-Function** | 936 | RxPDO1 Function |
| | 937 | RxPDO2 Function |
| | 938 | RxPDO3 Function |
| **Timeout** | 939 | SYNC Timeout |
| | 941 | RxPDO1 Timeout |
| | 942 | RxPDO2 Timeout |
| | 945 | RxPDO3 Timeout |
| **TxPDO1 Objects** | 946 | TxPDO1 Boolean1 |
| | 947 | TxPDO1 Boolean2 |
| | 948 | TxPDO1 Boolean3 |
| | 949 | TxPDO1 Boolean4 |
| | 950 | TxPDO1 Word1 |
| | 951 | TxPDO1 Word2 |
| | 952 | TxPDO1 Word3 |
| | 953 | TxPDO1 Word4 |
| | 954 | TxPDO1 Long1 |
| | 955 | TxPDO1 Long2 |
| **TxPDO2 Objects** | 956 | TxPDO2 Boolean1 |
| | 957 | TxPDO2 Boolean2 |
| | 958 | TxPDO2 Boolean3 |
| | 959 | TxPDO2 Boolean4 |
| | 960 | TxPDO2 Word1 |
| | 961 | TxPDO2 Word2 |
| | 962 | TxPDO2 Word3 |
| | 963 | TxPDO2 Word4 |
| | 964 | TxPDO2 Long1 |
| | 965 | TxPDO2 Long2 |
| **TxPDO3 Objects** | 966 | TxPDO3 Boolean1 |
| | 967 | TxPDO3 Boolean2 |
| | 968 | TxPDO3 Boolean3 |
| | 969 | TxPDO3 Boolean4 |
| | 972 | TxPDO3 Word1 |
| | 973 | TxPDO3 Word2 |
| | 974 | TxPDO3 Word3 |
| | 975 | TxPDO3 Word4 |
| | 976 | TxPDO3 Long1 |
| | 977 | TxPDO3 Long2 |

**Actual values**

| | | |
|---|---|---|
| **System bus** | 978 | Node-State |
| | 979 | CAN-State |

# 15 Ancillaries

For the planning of the system bus according to the drive tasks in question, there are ancillaries in the form of tables.

**The planning of the system bus is done in three steps:**

1. Definition of the communication relationships
2. Production of the virtual links
3. Capacity check

The priority assignment of the identifiers is relevant for the definition of the communication relationships. Data that are to be transmitted with a higher priority must be given low identifiers. This results in the message with the higher priority being transmitted first with a simultaneous access of two subscribers to the bus.

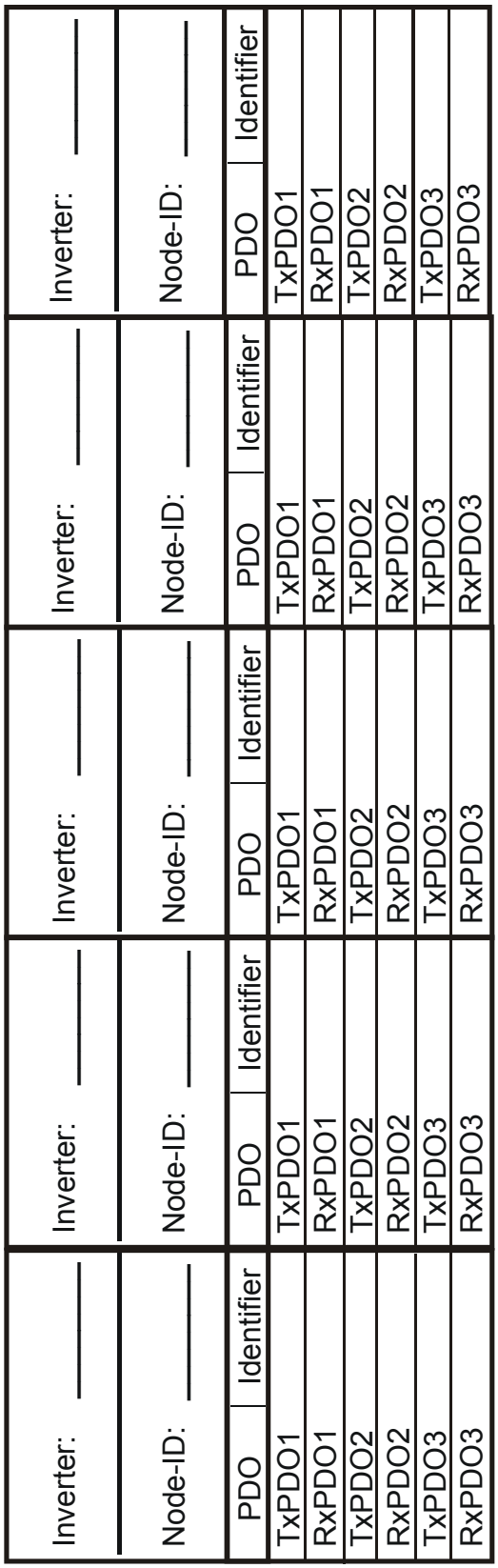
**Note:** The recommended identifier range for the communication relationships via the PDO channels is 385 ... 1407.

The identifiers below 385 are used for the NMT telegrams (boot-up sequence, SYNC telegram) and emergency message.

The identifiers above 1407 are used for the SDO channel for parameterization.

## 15.1 Definition of the communication relationships

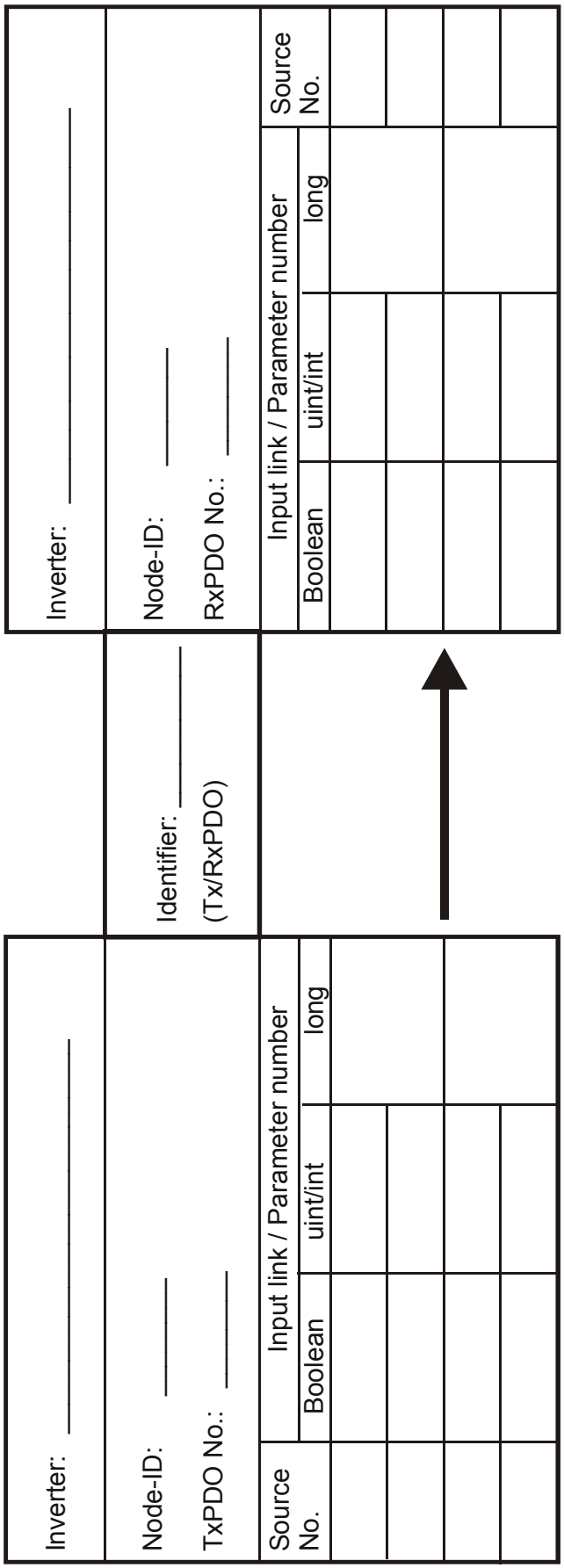
The communication relationships are planned and documented with the help of the table. The table is available as the Microsoft Word file "kbl.doc".



| Inverter: _____ | | Inverter: _____ | | Inverter: _____ | | Inverter: _____ | |
|---|---|---|---|---|---|---|---|
| Node-ID: _____ | | Node-ID: _____ | | Node-ID: _____ | | Node-ID: _____ | |
| PDO | Identifier | PDO | Identifier | PDO | Identifier | PDO | Identifier |
| TxPDO1 | | TxPDO1 | | TxPDO1 | | TxPDO1 | |
| RxPDO1 | | RxPDO1 | | RxPDO1 | | RxPDO1 | |
| TxPDO2 | | TxPDO2 | | TxPDO2 | | TxPDO2 | |
| RxPDO2 | | RxPDO2 | | RxPDO2 | | RxPDO2 | |
| TxPDO3 | | TxPDO3 | | TxPDO3 | | TxPDO3 | |
| RxPDO3 | | RxPDO3 | | RxPDO3 | | RxPDO3 | |

## 15.2 Production of the virtual links

The virtual links are planned and documented with the help of the table. The table is available as the Microsoft Word file "vvk.doc".



## 15.3 Capacity planning of the system bus

Each PDO telegram possesses a constant useful data content of 8 Bytes. According to worst case, this results in a maximum telegram length of 140 bits. The maximum telegram run time of the PDO's is thus stipulated via the set baud rate.

| Capacity planning | |
|---|---|
| **Baud rate / kBaud** | **Telegram run time / µs** |
| 1000 | 140 |
| 500 | 280 |
| 250 | 560 |
| 125 | 1120 |
| 100 | 1400 |
| 50 | 2800 |

As a function of the set baud rate and the transmission interval of the TxPDO's selected, the following bus loads results:

| Capacity of the system bus | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Baud rate / kBaud** | **Bus load as a function of the transmission for one TxPDO in %** | | | | | | | | | |
| | **1ms** | **2ms** | **3ms** | **4ms** | **5ms** | **6ms** | **7ms** | **8ms** | **9ms** | **10ms** |
| **1.000** | 14 | 7 | 4.7 | 3.5 | 2.8 | 2.3 | 2 | 1.8 | 1.6 | 1.4 |
| **500** | 28 | 14 | 9.3 | 7 | 5.6 | 4.7 | 4 | 3.5 | 3.1 | 2.8 |
| **250** | 56 | 28 | 18.7 | 14 | 11.2 | 9.3 | 8 | 7 | 6.2 | 5.6 |
| **125** | 112 | 56 | 37.3 | 28 | 22.4 | 18.7 | 16 | 14 | 12.4 | 11.2 |
| **100** | 140 | 70 | 46.7 | 35 | 28 | 23.3 | 20 | 17.5 | 15.6 | 14 |
| **50** | 280 | 140 | 93.3 | 70 | 56 | 46.7 | 40 | 35 | 31.1 | 28 |

**Attention:** A bus load >100% means that a telegram cannot be dispatched completely between two transmission times.

**Such a setting is not admissible!**

This observation must be done for each TxPDO. The sum of all the TxPDO's decides on the entire bus load. The bus load must be designed in such a way that any telegram repetitions for transmission errors are possible without exceeding the bus capacity.

**Note:** To facilitate capacity planning, an Microsoft Excel file with the name "Load_Systembus.xls" is available.

### 15.3.1.1 Load_Systembus.xls

The capacity planning are planned and documented with the help of the table. The work sheet table is available as the Microsoft Excel file "Load_Systembus.xls".

| Load system bus | |
|---|---|
| **Baud rate [kBaud]: 50, 100, 125, 250, 500, 1000** | **1000** |

| Frequency inverter | TxPDO number | Ta [ms] | Load [%] |
|---|---|---|---|
| 1 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 2 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 3 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 4 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 5 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 6 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 7 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| 8 | 1 | 1 | 14 |
| | 2 | 1 | 14 |
| | 3 | 1 | 14 |
| 9 | 1 | 1 | 14 |
| | 2 | 1 | 14 |
| | 3 | 0 | 0 |
| 10 | 1 | 0 | 0 |
| | 2 | 0 | 0 |
| | 3 | 0 | 0 |
| **Total load [%]** | | | **70** |

In the table, the set baud rate is entered from the parameter *Baud-Rate* **903** in kBaud. For each frequency inverter, the set time for the transmission interval (e. g. *TxPDO1 Time* **931**) in ms is entered for the TxPDO being used at the time. In the column **Load** the bus load caused by the individual TxPDO appears, under **Total Load** the entire bus load.

**For the bus load (Total load) the following limits have been defined:**

**≤ 80 % ➔ OKAY**
**80 ... 90 % ➔ CRITICAL**
**> 90 % ➔ NOT POSSIBLE**

# 16 Parameter list

The parameter list is structured according to the menu branches of the operating unit. For better clarity, the parameters have been marked with pictograms:

The parameter is available in the four data sets

☑ The parameter value is set by the SET-UP routine

⊗ This parameter cannot be written in the operation of the frequency inverter.

## 16.1 Actual values

| Actual values of the system bus | | | | |
|---|---|---|---|---|
| **No.** | **Description** | **Unit** | **Display range** | **Chapter** |
| 978 | Node-State | - | 1 ... 3 | 13 |
| 979 | CAN-State | - | 1 ... 3 | 13 |

## 16.2 Parameter

| System bus | | | | |
|---|---|---|---|---|
| **No.** | **Description** | **Unit** | **Setting range** | **Chapter** |
| 900 | Node-ID | - | -1 ... 63 | 6 |
| 903 | Baud-Rate | - | 3 ... 8 | 5 |
| 904 | Boot-Up Delay | ms | 3500 ... 50000 | 9.4 |
| 918 | SYNC-Identifier | - | 0 ... 2047 | 9.2 |
| 919 | SYNC-Time | ms | 0 ... 50000 | 10.2 |
| 921 | RxSDO1-Identifier | - | 0 ... 2047 | 10.4 |
| 922 | TxSDO1-Identifier | - | 0 ... 2047 | 10.4 |
| 923 | SDO2 Set Active | - | 0 ... 1 | 10.4 |
| 924 | RxPDO1-Identifier | - | 0 ... 2047 | 12.1 |
| 925 | TxPDO1-Identifier | - | 0 ... 2047 | 12.1 |
| 926 | RxPDO2-Identifier | - | 0 ... 2047 | 12.1 |
| 927 | TxPDO2-Identifier | - | 0 ... 2047 | 12.1 |
| 928 | RxPDO3-Identifier | - | 0 ... 2047 | 12.1 |
| 929 | TxPDO3-Identifier | - | 0 ... 2047 | 12.1 |
| 930 | TxPDO1 Function | - | 0 ... 2 | 12.2 |
| 931 | TxPDO1 Time | ms | 0 ... 50000 | 12.2 |
| 932 | TxPDO2 Function | - | 0 ... 2 | 12.2 |
| 933 | TxPDO2 Time | ms | 0 ... 50000 | 12.2 |
| 934 | TxPDO3 Function | - | 0 ... 2 | 12.2 |
| 935 | TxPDO3 Time | ms | 0 ... 50000 | 12.2 |
| 936 | RxPDO1 Function | - | 0 ... 1 | 12.2 |
| 937 | RxPDO2 Function | - | 0 ... 1 | 12.2 |
| 938 | RxPDO3 Function | - | 0 ... 1 | 12.2 |
| 939 | SYNC Timeout | ms | 0 ... 60000 | 12.3 |
| 941 | RxPDO1 Timeout | ms | 0 ... 60000 | 12.3 |
| 942 | RxPDO2 Timeout | ms | 0 ... 60000 | 12.3 |
| 945 | RxPDO3 Timeout | ms | 0 ... 60000 | 12.3 |

| System bus | | | | |
|---|---|---|---|---|
| **No.** | **Description** | **Unit** | **Setting range** | **Chapter** |
| 946 | TxPDO1 Boolean1 | - | 0 ... 999 | 12.5.1 |
| 947 | TxPDO1 Boolean2 | - | 0 ... 999 | 12.5.1 |
| 948 | TxPDO1 Boolean3 | - | 0 ... 999 | 12.5.1 |
| 949 | TxPDO1 Boolean4 | - | 0 ... 999 | 12.5.1 |
| 950 | TxPDO1 Word1 | - | 0 ... 999 | 12.5.1 |
| 951 | TxPDO1 Word2 | - | 0 ... 999 | 12.5.1 |
| 952 | TxPDO1 Word3 | - | 0 ... 999 | 12.5.1 |
| 953 | TxPDO1 Word4 | - | 0 ... 999 | 12.5.1 |
| 954 | TxPDO1 Long1 | - | 0 ... 999 | 12.5.1 |
| 955 | TxPDO1 Long2 | - | 0 ... 999 | 12.5.1 |
| 956 | TxPDO2 Boolean1 | - | 0 ... 999 | 12.5.1 |
| 957 | TxPDO2 Boolean2 | - | 0 ... 999 | 12.5.1 |
| 958 | TxPDO2 Boolean3 | - | 0 ... 999 | 12.5.1 |
| 959 | TxPDO2 Boolean4 | - | 0 ... 999 | 12.5.1 |
| 960 | TxPDO2 Word1 | - | 0 ... 999 | 12.5.1 |
| 961 | TxPDO2 Word2 | - | 0 ... 999 | 12.5.1 |
| 962 | TxPDO2 Word3 | - | 0 ... 999 | 12.5.1 |
| 963 | TxPDO2 Word4 | - | 0 ... 999 | 12.5.1 |
| 964 | TxPDO2 Long1 | - | 0 ... 999 | 12.5.1 |
| 965 | TxPDO2 Long2 | - | 0 ... 999 | 12.5.1 |
| 966 | TxPDO3 Boolean1 | - | 0 ... 999 | 12.5.1 |
| 967 | TxPDO3 Boolean2 | - | 0 ... 999 | 12.5.1 |
| 968 | TxPDO3 Boolean3 | - | 0 ... 999 | 12.5.1 |
| 969 | TxPDO3 Boolean4 | - | 0 ... 999 | 12.5.1 |
| 972 | TxPDO3 Word1 | - | 0 ... 999 | 12.5.1 |
| 973 | TxPDO3 Word2 | - | 0 ... 999 | 12.5.1 |
| 974 | TxPDO3 Word3 | - | 0 ... 999 | 12.5.1 |
| 975 | TxPDO3 Word4 | - | 0 ... 999 | 12.5.1 |
| 976 | TxPDO3 Long1 | - | 0 ... 999 | 12.5.1 |
| 977 | TxPDO3 Long2 | - | 0 ... 999 | 12.5.1 |
| 989 | Emergency Reaction | - | 0 ... 1 | 9.3 |

# 17 Annex

## 17.1 Fault messages

The various control functions and methods and the hardware of the frequency inverter contain functions that continuously monitor the application. In addition ones to the messages documented in the manual the following fault messages are activated by the system bus expansion module EM-SYS.

| Fault messages | | | |
|---|---|---|---|
| **Fault type** (high-Byte, hexadecimal) | | **Specifier** (low-Byte, hexadecimal) | |
| 21 | Malfunction message in system bus master with malfunction in system bus slave | nn | nn = Node-ID des Slaves (hex) |
| 22 | Communication fault of the system bus | 00 | Timeout SYNC-Telegramm |
| | | 01 | Timeout RxPDO1 |
| | | 02 | Timeout RcPDO2 |
| | | 03 | Timeout RxPDO3 |
| | | 10 | Bus-OFF |

Alongside the fault messages stated, there are further fault messages, however they are only used for internal purposes and are not listed here. If you receive fault messages which are not listed here, please contact us by phone.

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