

CANopen

Gateway Server DS309-3

User Manual

```

[12] 1 2 r 0x1008 0 vs
[12] DS309-Gateway port GmbH
[13] _port_set verbose 0xff
[13] OK
[14] 32 enable heartbeat 1200
> 32 ERROR 205 Boot up
> 32 ERROR 202 Heartbeat started
> 32 ERROR 204 new NMT state 1
[15] _port_set master 1
[15] OK
> USER LSS 1 unconfigmyred dev
[16] 0
[16] OK
[17] _port_lss identity 0x34 12
[17] OK
[18] _port_lss identity 0x34 12
[myblack] OK
[19] _port_lss identity 0x34 1234
[19] OK
[20] _port_lss switch_sel 0x34 12345 1 1
[20] OK

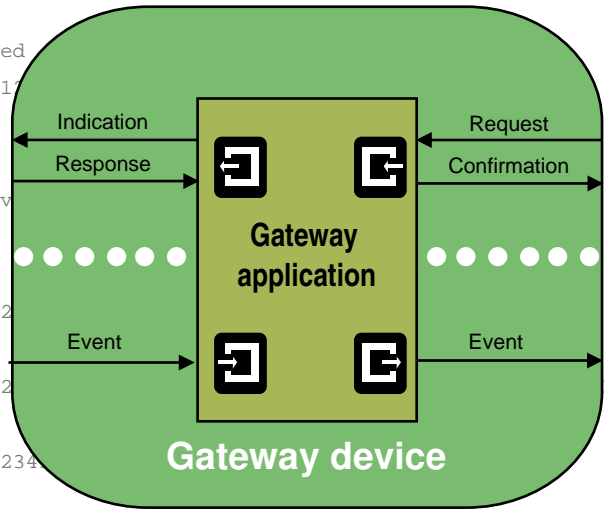
[510] 1 set rpdo 1 0x200 event 2 u8 u32
[510] OK
[511] info tpdo
[511] 1 0x200 event 1 u8, 2 0x300 event 2 u32 u32

[530] info version
[530] 52 410640 4.2 0 3 1.00 0.0

```

CANopen

TCP



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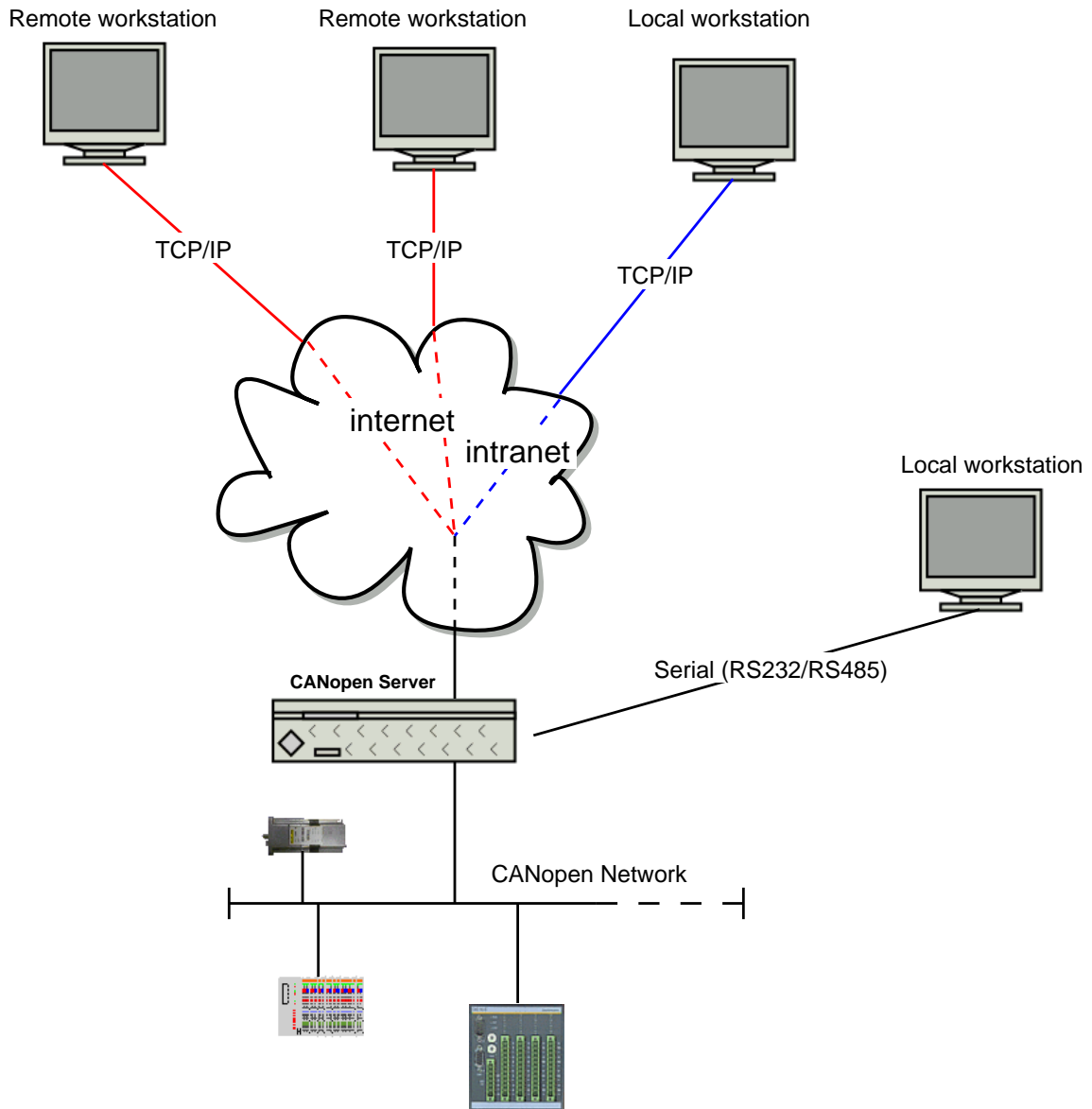
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1. Overview

The CANopen Gateway Server implements the protocol DS309-3. It can be accessed from a remote workstation or locally.



1.1. Features

| Service | Instances | |
|--------------------|---------------|-----------------------------|
| | Full version | Starterkit |
| SDO-Client | 127 | 2(*) |
| SDO-Server | 1 | 1 |
| PDO-Producer | 512 | 1,2 |
| PDO-Consumer | 512 | 1,2 |
| EMCY-Consumer | 127 | 127 |
| Heartbeat-Consumer | 127 | 2 (*) |
| Time-Producer | X | - |
| Time-Consumer | X | - |
| NMT-Master | X | X |
| LSS-Master | X | - |
| Domain Size | 15 MByte (**) | 1 MByte (**) |
| TCP/Clients | 10 | 2 |
| Other | - | automatic exit after 1 hour |

(*) Node id 32 or 64 can be accessed.

(**) EtherCAN: 128 kByte, one domain transfer at a time

See appendix 1 for the complete object directory.

Note: The performance of the CANopen Gateway Server depends on the used CAN interface hardware. Especially at high bus load and high baud rates some CAN messages may be lost.

1.2. Installation and Start

1.2.1. CAN driver

The CANopen Gateway Server accesses the CAN interface card by means of a layer 2 driver. This driver has to be installed before using the CANopen Server. For installation of the driver please refer to the delivered driver manual.

[EMS Wunsche](http://www.ems-wuensche.com) <<http://www.ems-wuensche.com>>

[I+ME Actia](http://www.ime-actia.de) <<http://www.ime-actia.de>>

[Kvaser](http://www.kvaser.com) <<http://www.kvaser.com>>

[Sontheim](http://www.sontheim-industrie-elektronik.de) <<http://www.sontheim-industrie-elektronik.de>>

[Janz](http://www.janztec.com) <<http://www.janztec.com>>

The most current list of supported hardware can be requested at service@port.de.

1.2.2. Command line options

1.2.2.1. Common options

| Option | Argument | Description | Default value |
|--------|----------|---|---------------|
| -p | port | - TCP/IP port | 7234 |
| -b | baud | - CAN Baudrate (*) | 125 |
| -n | id | - Node-ID of CANopen Gateway Server | 6 |
| -H | time | - start producing HB frames at start-up | 0 |
| -R | | - Don't send NMT PREOP ALL at exit | |
| -D | device | - CAN device/channel, e.g. can1 | |
| -V | | - Version | |
| -S | | - Server mode | |
| -L | filename | - Path of licence file | |

(*) values for baudrate: 20, 50, 125, 250, 500, 1000

When the CANopen Gateway Server is started without option **-S** it runs in command line mode. Commands can be entered interactively from command line, then, and sequence numbers can be omitted. In command line mode the CANopen Gateway Server processes the initialization file `m4d_ini.cmd`. This ASCII file contains DS309-3 commands. Lines starting with `#` are comments and are not executed. It can be tailored to match the application needs.

1.2.2.2. Options for Linux, EtherCAN, IGW900

| Option | Description |
|--------|------------------------|
| -s | Timer resolution in ms |

1.2.2.3. Options for EMS Wunsche CPC

Option **-D** specifies the channel given in the configuration file `C:\Windows\cpconf.ini` which is located in the Windows system directory.

1.2.2.4. Options for Peak

| Option | Description |
|--------|---|
| -i | Interface 1 - USB 2 - Parallel Dongle |
| -I | Interrupt for parallel dongle |
| -B | I/O base address for parallel dongle |

1.2.2.5. Options for Kvaser

Option -D specifies the card channel. The card channel can be obtained with the "Kvaser Hardware Configuration" tool.

2. Definitions

Command

controls the CANopen Gateway Server and interacts with CANopen devices. It may have a long form and a short form. The short form is a one or two letter abbreviation of the long form. The long form is obtained by concatenating the short form and the string enclosed in brackets "[", "]".

Datatypes

| Syntax | CANopen Type | Supported |
|--------|-------------------------------------|-----------|
| b | Bool | ✓ |
| u8 | Unsigned8 | ✓ |
| u16 | Unsigned16 | ✓ |
| u24 | Unsigned24 | ✓ |
| u32 | Unsigned32 | ✓ |
| u24 | Unsigned40 | ✓ |
| u48 | Unsigned48 | ✓ |
| u56 | Unsigned56 | ✓ |
| u64 | Unsigned64 | ✓ |
| i8 | Integer8 | ✓ |
| i16 | Integer16 | ✓ |
| i24 | Integer24 | ✓ |
| i32 | Integer32 | ✓ |
| i24 | Integer40 | ✓ |
| i48 | Integer48 | ✓ |
| i56 | Integer56 | ✓ |
| i64 | Integer64 | ✓ |
| r32 | Real32 | ✓ |
| r64 | Real64 | ✓ |
| t | Time of day (two arguments: day ms) | ✓ |
| td | Time difference | - |
| vs | Visible string | ✓ |
| os | Octet string | ✓ |
| us | Unicode string | ✓ |
| d | Domain | ✓ |

Visible strings can have a maximum length of 127 bytes. If the string contains "white-spaces" it has to be enclosed in double quotes.

Octet and unicode strings and domain data are base64 encoded. The encoded octet and unicode string can have a maximum length of 127 bytes. Domain data up to 1 mega byte is supported.

2.1. Commands

Commands are communicated as case insensitive ASCII strings. Numbers are represented in manner of the C programming language:

```

100      - decimal, starting with a number
0x64     - hexadecimal, starting with the string 0x
1.22     - float
.22e10   - float
22e3     - float

```

2.1.1. Command Request

A command is composed of tokens separated by whitespaces and closed with a CRLF. All commands are confirmed. Each command starts with a 4 byte sequence number which is enclosed by square brackets. The sequence number is followed by net and node of the CANopen device. Both numbers are optional (see Set default network/node).

In BNF notation a command defines as follows:

```

<command-request> ::= "["<sequence>"]" [[<net>] <node>] <command>
<sequence>       ::= UNSIGNED32
<net>            ::= UNSIGNED8
<node>           ::= UNSIGNED8
<command>        ::= <command-specifier> | <compound-command>
<compound-command> ::= <command-specifier> <parameter>
<parameter>      ::= <value> | <command-parameter>
<compound-parameter> ::= <value> <parameter>

```

Net and node numbers are starting with 1. The value 0 is used to address all nodes and all networks.

2.1.2. Command Response

The CANopen Gateway Server responds with the same sequence number at the first position as given by the request. This number shall be given in decimal format.

```

<command-response> ::= "["<sequence>"]" <response>
<response>         ::= <value> | <error-string> | <emcy-list> | "OK"
<error-string>     ::= "Error:" <error code>
<error-code>       ::= <internal-error-code> | <sdo-abort-code>
<emcy-list>        ::= [<emcy1> " " ..<emcy254>]
<emcyN>            ::= UNSIGNED32

```

Allowed internal-error-codes (IEC) are listed below:

| IEC | Message text |
|-----|---|
| 100 | request not supported |
| 101 | syntax error |
| 102 | Request not processed due to internal state |

| IEC | Message text |
|-----|---------------------|
| 200 | lost Guarding Msg |
| 201 | lost connection |
| 202 | Heartbeat started |
| 203 | Heartbeat lost |
| 204 | new NMT state |
| 205 | Boot up |
| 300 | CAN passive |
| 301 | CAN bus off |
| 302 | CAN overflow |
| 303 | CAN buffer overflow |
| 304 | CAN init |
| 305 | CAN active |
| 400 | PDO already used |
| 401 | PDO length exceeded |

2.1.3. Event triggered messages

Messages due to errors in the CANopen network or the occurrence of communication objects using the producer-consumer principle (PDO, EMCY) shall not use a sequence number.

```
<event-triggered-message> ::= [[net] node] <event-specifier> <parameter>
<event-specifier> ::= "EMCY" | "ERROR" | "SYNC" | <pdo-event> |
"USER" <user-event>
<pdo-event> ::= [net] "PDO" <parameter>
<user-event> ::= <lss-event> <block-event>
<lss-event> ::= "LSS" <parameter>
<block-event> ::= "BLOCK" <parameter>
```

The content of event-triggered messages is described within the command description that enables the specific service.

3. Network access command specification

3.1. SDO access commands

3.1.1. Upload SDO

Command syntax

```
[[net] node] r[ead] <index> <subindex> <datatype>
```

Accesses the remote device via SDO read messages.

Domain data have to be passed bas64 encoded. See also "SDO Block event" and Appendix: Examples.

3.1.2. Download SDO

Command syntax

```
[[net] node] w[rite] <index> <subindex> <datatype> <value>
```

Accesses the remote device via SDO write messages.

3.1.3. Configure SDO timeout

Command syntax

```
[[net] node] set sdo_timeout <ms>
```

The SDO timeout time is used to abort a SDO transfer when there is no device with the given node id. SDO timeout times are node specific. In order to set one SDO timeout for all nodes node id 0 can be used.

A timeout is measured between each SDO request and confirmation.

3.1.4. SDO Block Event

Command syntax

```
[net] [node] USER BLOCK <current> <maximum>
```

With SDO domain down/upload the server indicates progress of the current transmission with the SDO Block Event. On an SDO Upload it is required that the SDO server provides correct size information. The current argument is the number of blocks that have been transmitted/received. The maximum argument is the number of total blocks that have to be transmitted or received.

3.2. PDO access commands

3.2.1. Configure RPDO command

Command syntax

```
[net] set RPDO <nr> <COB-ID> <tx-type> <nr-of-data> <datatype1>[..datatype64>]
```

<tx-type> ::= "rtr" | "event" | "sync<0..240>"

Setup a PDO for receiving data. The datatype maps to an object in the object directory. On reception of an RPDO the RPDO Event is triggered. The receive PDO is seen from the side of the CANopen Gateway Server.

A PDO can be deactivated by writing using value 0x80000000 for the cob.



TCP/IP clients do not have separate namespaces for PDO, i.e. if client 1 has setup PDO 1 and 2 and a client 2 connects and also sets up PDO 1 and 2 it alters the PDO definition of client 1.

It is allowed to set all possible COB-Id. No extra checking is carried out. This means that if the same COB-ID is used for RPDO and TPDO it may happen that no PDO is received.

3.2.2. Configure TPDO command

Command syntax

```
[net] set tpdo <nr> <COB> <tx-type> <nr-of-data> <datatype1>[..datatype64>]
```

Setup a PDO for sending data. The datatype maps to an object in the object directory. The transmit PDO is seen from the side of the CANopen Gateway Server.

A PDO can be deactivated by writing using value 0x80000000 for the cob.



TCP/IP clients do not have separate namespaces for PDO, i.e. if client 1 has setup PDO 1 and 2 and a client 2 connects and also sets up PDO 1 and 2 it alters the PDO definition of client 1.

It is allowed to set all possible COB-Id. No extra checking is carried out. This means that if the same COB-ID is used for RPDO and TPDO it may happen that no PDO is received.

3.2.3. Read PDO data command

Command syntax

```
[net] r[ead] p[do] <nr>
```

Requests PDO via an RTR CAN message. A Receive RTR-PDO has to be setup first.

3.2.4. Write PDO data command

Command syntax

```
[net] w[rite] p[do] <nr> <nr-of-data> <value1>[..<value64>]
```

Sends given data with a PDO. The PDO has to be setup before.

3.2.5. RPDO Event

Command syntax

```
[net] PDO <nr> <nr-of-data> <value1>[..<value64>]
```

A PDO was received. The mapped data is given as arguments formatted as decimal values. The PDO has to be setup, previously.

3.3. CANopen NMT commands

The CANopen Gateway Server has linked any other CANopen device a node id itself (see command line parameters). Node id 0 and 0x80 have special meanings. A NMT command to node id 0 addresses all CANopen nodes in the network including the server. A NMT command to node id 0x80 addresses all CANopen nodes in the network excluding the server. The server remains in the NMT state that was issued before.

3.3.1. Start Node

Command syntax

```
[[net] node] start
```

Sends the OPERATIONAL command.

3.3.2. Stop node

Command syntax

```
[[net] node] stop
```

Sends the STOPPED command.

3.3.3. Set node Preoperational

Command syntax

```
[[net] node] preop[erational]
```

Sends the PREOPEATIONAL command.

3.3.4. Reset node

Command syntax

```
[[net] node] reset node
```

Sends the RESET NODE command.

In case a SDO transfer is currently in progress that was started by another TCP client then "Reset node" is not carried out. If the SDO transfer was started by the TCP client that also sent the "Reset node" command the SDO transfer is aborted and the reset is carried out.

Note: With node number 0 the gateway is reset, too, i.e. the PDO configuration is lost.

3.3.5. Reset communication

Command syntax

```
[[net] node] reset comm[unication]
```

Sends the RESET COMMUNICATION command.

See also Reset Node Siehe auch Knoten zurücksetzen

3.3.6. Enable node guarding

Command syntax

```
[[net] node] enable guarding <guardingtime> <lifetimefactor>
```

Activates the node guarding error control mechanism. If the master doesn't receive a response of the slave in the given time it sends the event triggered message ERROR 200 or ERROR 201.



Accuracy of the Guarding depends on the timer resolution. On Linux platforms it can be adjusted with the command line parameter '-s'. On Windows it is fixed.

3.3.7. Disable node guarding

Command syntax

```
[[net] node] disable guarding
```

Deactivates the node guarding error control mechanism.

3.3.8. Enable heartbeat

Command syntax

```
[[net] node] enable heartbeat <heartbeattime>
```

Start heartbeat detection on the CANopen Gateway Server. It is checked that heartbeat messages are received in the given time. If a heartbeat message is not received an event triggered ERROR message is sent. The time is given in milliseconds.

The heartbeat time of the producer has to be set with a separate SDO Download Command.



Accuracy of the Guarding depends on the timer resolution. On Linux platforms it can be adjusted with the command line parameter '-s'. On Windows it is fixed.

3.3.9. Disable heartbeat

Command syntax

```
[[net] node] disable heartbeat
```

Stop heartbeat detection on the CANopen Gateway Server.

3.3.10. Error control Event

Command syntax

```
[[net] node] ERROR <internal-error-code>
```

On detection of NMT errors or CAN errors this message is sent to a connected client.

3.4. Device Failure management

3.4.1. Read device error command

NOT implemented

3.4.2. Emergency Event

Command syntax

```
[[net] node] EMCY <emcy-code> <error-register> <m-error-code>
```

<m-error-code> ::= <UNSIGNED8> <UNSIGNED8> <UNSIGNED8> <UNSIGNED8> <UNSIGNED8>

On reception of a CANopen EMCY message this message is sent.

Note: Reception has to be enabled. See command extension.

3.5. CANopen interface configuration commands

3.5.1. Initialize gateway

Command syntax

```
[net] init <bitrate>
```

Sets the bitrate the CANopen Gateway Server is working with. The bitrate can be given as value or table index of the default CANopen table.

| <u>Bitrate</u> | <u>Table index</u> |
|----------------|--------------------|
| 1000 | 0 |
| 800 | 1 |
| 500 | 2 |
| 250 | 3 |
| 125 | 4 |
| reserved | 5 |
| 50 | 6 |
| 20 | 7 |
| 10 | 8 |
| Autobaud | 9 |

Autobaud is not supported.

3.5.2. Store configuration

Command syntax

```
[net] store <specifier>
```

NOT implemented.

3.5.3. Restore configuration

Command syntax

```
[net] restore <specifier>
```

NOT implemented.

3.5.4. Set heartbeat producer

Command syntax

```
[net] set heartbeat <ms>
```

Start sending heartbeat messages of the CANopen Gateway Server. The time is given in milliseconds.

3.5.5. Set node id

Command syntax

```
[net] set id <value>
```

NOT supported. Can only be set at start. See commandline options

3.5.6. Start emergency consumer

See port extension.

3.5.7. Stop emergency consumer

See command extension.

3.6. Gateway management commands

3.6.1. Set default network

Command syntax

```
[net] set network <value>
```

Set default network. When set the network parameter can be omitted at following commands.

3.6.2. Set default node id

Command syntax

```
[net] set node <value>
```

Set default remote node id. When set the node parameter can be omitted at following commands.

3.6.3. Get version

Command syntax

```
info version
```

Request version of the CANopen Gateway Server. The version is given in the format:

```
<version-string> ::= <vendor-id> <product-code>  
                    <version-high>.<version-low> <serial-number>  
                    <network-class> <protocol-version>  
                    <implementation-class>
```

4. Command Extensions

The standard DS309-3 allows user specific commands and event triggered messages. All extensions provided by the port CANopen Gateway Server are prepended with the prefix: `_port_`. Exception are the info commands since it is already available.

The CANopen Gateway Server allows multiple TCP/IP connections. This can be problematic if two clients don't know from each other and send NMT commands like start and preop. To handle this situation one client can set a master flag and thus restrict others that way that they can not send NMT or LSS commands. However, to be compliant with the standard this only works with port specific commands. The "normal" DS309-3 commands do not know of the master flag.

Especially for multiclient environments the CANopen Gateway Server provides `register` commands to hook up on a running server and register for already configured PDO, heartbeat, nodeguarding, EMCY and TIME services.

4.1. Status and Configuration

4.1.1. Set master

Command syntax

```
_port_set master <0|1>
```

Activate master mode for TCP/IP client. The master flag can only be set from one client.

4.1.2. Set verbose response

Command syntax

```
_port_set verbose 0xff
```

Show verbose error messages.

4.1.3. Get default network

Command syntax

```
info net[work]
```

Shows default network used for commands.

4.1.4. Get default node

Command syntax

```
info node
```

Shows default node used for commands.

4.1.5. Get Build information

Command syntax

```
info build
```

Returns a string that contains the build date, version and additional information.

Example

```
5.3.10, Nov 13 2012, CPC-PCI can4linux,
```

4.1.6. Get CANopen node Id of server

Command syntax

```
info id
```

Returns CANopen node Id of the server. See also command line parameters.

4.1.7. Get CAN bitrate

Command syntax

```
info bitrate
```

Returns CAN bitrate of the server.

4.1.8. Get SDO timeout

Command syntax

```
[node] info sdo_timeout
```

Shows the node specific SDO timeout. A value of 0 for node is not allowed.

4.1.9. Get TPDO setup

Command syntax

```
info tpdo
```

Shows the TPDO configuration in form of a comma separated list. <pdoNr> <cobId> <nrOfElements> <datatype1> .. <datatypeN>[, <pdoNr> <cobId> <nrOfElements> <datatype1> .. <datatypeN>]

4.1.10. Get RPDO setup

Command syntax

```
info rpdo
```

Shows the RPDO configuration in form of a comma separated list. <pdoNr> <cobId> <nrOfElements> <datatype1> .. <datatypeN>[, <pdoNr> <cobId> <nrOfElements> <datatype1> .. <datatypeN>]

4.2. SDO

4.2.1. Register SDO Server Write Indikation

Command syntax

```
_port_reg sdoserverind
```

Register for receiving of SDO Server Write Indikation
The indication is called for all objects at manufacturer area.

Numeric values are indicated as:

SDOSERV <index>:<subindex> size: <len> data: <value>

Non-Numeric values are indicated as:

SDOSERV <index>:<subindex> b64size: <len> data: <data>

<data> are codes as b64.

4.2.2. Unregister SDO Server Write Indikation

Command syntax

```
_port_unreg sdoserverind
```

Unregister for receiving of SDO Server Write Indikation

4.3. PDO

4.3.1. Register PDO

Command syntax

```
_port_reg rpdo <pdoNr>
```

Register for receiving an RPDO.

4.3.2. Unregister PDO

Command syntax

```
_port_unreg rpdo <pdoNr>
```

Unregister an RPDO.

4.4. NMT-Master

4.4.1. Register Nodeguarding

Command syntax

```
[net] [node] _port_reg guarding
```

Register for receiving Nodeguarding events. Events are only sent when a protocol violation has occurred.

4.4.2. Unregister Nodeguarding

Command syntax

```
[net] [node] _port_unreg guarding
```

Stop receiving nodeguarding events.

4.4.3. Register heartbeat

Command syntax

```
[net] [node] _port_reg heartbeat
```

Register for receiving heartbeat events. Events are only sent when a protocol violation has occurred or a new heartbeat start was detected.

4.4.4. Unregister heartbeat

Command syntax

```
[net] [node] _port_unreg heartbeat
```

Stop receiving heartbeat events.

4.4.5. Register emergency

Command syntax

```
[net] [node] _port_reg emcy
```

Register for receiving an emergency events.

4.4.6. Unregister emergency

Command syntax

```
[net] [node] _port_unreg emcy
```

Stop receiving emergency events.

4.4.7. Enable Sync Producer

Command syntax

```
_port_enable sync <cobid> <sync-cycle_in_us> [<sync_counter>]
```

Start sending SYNC messages. The master flag has to be set for this command. SYNC cycle time is specified in micro seconds.

4.4.8. Disable Sync Producer

Command syntax

```
_port_disable sync
```

Stop sending SYNC messages. The master flag has to be set for this command.

4.5. LSS Master

The CANopen Gateway Server can configure LSS slaves with the LSS commands. For all commands the master flag has to be set. The CANopen Gateway Server own identity object can be read with the `info version` command.

It is recommended that LSS services should be carried out in STOPPED state.

4.5.1. Switch Selective

Command syntax

```
[net] _port_lass switch_sel <vendorId> <product> <revision> <serialNo>
```

Set single LSS slave in CONFIGURATION state.

4.5.2. Switch global

Command syntax

```
[net] _port_lass switch_glob <0|1>
```

Set complete network in CONFIGURATION or OPERATION state.

4.5.3. Configuration of node id

Command syntax

```
[net] _port_lss set_node <nodeId>
```

Set the node id of an LSS slave.

4.5.4. Request node

Command syntax

```
[net] _port_lss get_node
```

Get the node id of an LSS slave.

4.5.5. Identify LSS slaves

Command syntax

```
[net] _port_lss identity <vendorId> <product> <rev lo> <rev hi>  
                        <serial low> <serial hi>
```

Scans the network for nodes that are in the given address range.

4.5.6. Bitrate Configuration

Command syntax

```
[net] _port_lss set_bitrate <sl_table_sel> <sl_table_idx>  
                          [<gw_table_sel> <gw_table_idx>]
```

Set the new bitrate of an LSS slave. The LSS slave has to be in state CONFIGURATION.

The first two parameter define the bitrate of the LSS slave. The last two parameter define the bitrate of the CANopen Gateway Server. They are used when autobaud is to be set at the LSS slaves.

| Bitrate | Table index |
|----------|-------------|
| 1000 | 0 |
| 800 | 1 |
| 500 | 2 |
| 250 | 3 |
| 125 | 4 |
| reserved | 5 |
| 50 | 6 |
| 20 | 7 |

| | | |
|----------|--|---|
| 10 | | 8 |
| Autobaud | | 9 |

Only table 0, the standard CANopen table, is supported by the CANopen Gateway Server.

4.5.7. Bitrate activation

Command syntax

```
[net] _port_lss activate_bitrate <time>
```

Activates the bitrate. The CANopen Gateway Server responds after 2 * time is elapsed. The time is given in milli seconds.

4.5.8. Store Configuration

Command syntax

```
[net] _port_lss store
```

On reception of this command the LSS slave saves the bitrate and node id. The LSS slave has to be in CONFIGURATION state.

4.5.9. Identify unconfigured LSS slaves

Command syntax

```
[net] _port_lss identity_non_cfg
```

Invokes all unconfigured LSS slaves to send a message. On reception of this message the CANopen Gateway Server will send the LSS event.

4.5.10. LSS Event

Command syntax

```
USER LSS <no>
```

On detection of an unconfigured LSS slave the CANopen Gateway Server sends the LSS Event.

| no | Description |
|----|------------------------------|
| 1 | unconfigured device detected |

4.6. Miscellaneous

Manchmal ergibt sich die Notwendigkeit ohne Bezug auf CANopen, ohne ein PDO zu konfigurieren, einen beliebigen CAN Frame zu senden. Dazu kann das Kommando

`_port_wr` benutzt werden. *Command syntax*

```
_port_wr <cob-id> <type> <length> <data0> ... <data7>
```

| | |
|--------|------------------------------------|
| length | number of bytes |
| type | Frame specifier, 2 characters |
| | first character, frame format |
| | [sS] standard or base frame format |
| | [xX] extended base frame format |
| | second character, frame type |
| [dD] | data frame |
| [rR] | RTR frame |

5. Appendix

5.1. Object Directory Overview

| Index (hex) | Object | Name | Type | Access |
|-------------|--------|------------------------------------|----------------|--------|
| 1000 | VAR | Device Type | UNSIGNED32 | const |
| 1001 | VAR | Error Register | UNSIGNED8 | ro |
| 1018 | VAR | Identity Object | IDENTITY | const |
| 1002 | VAR | Manufacturer Status Register | UNSIGNED32 | ro |
| 1003 | ARRAY | Pre-defined Error Field | UNSIGNED32 | ro |
| 1005 | VAR | COB-ID SYNC | UNSIGNED32 | rw |
| 1006 | VAR | Communication Cycle Period | UNSIGNED32 | rw |
| 1007 | VAR | Synchronous Window Length | UNSIGNED32 | rw |
| 1008 | VAR | Manufacturer Device Name | VISIBLE_STRING | const |
| 1009 | VAR | Manufacturer Hardware Version | VISIBLE_STRING | const |
| 100A | VAR | Manufacturer Software Version | VISIBLE_STRING | const |
| 100C | VAR | Guard Time | UNSIGNED16 | rw |
| 100D | VAR | Life Time Factor | UNSIGNED8 | rw |
| 1010 | ARRAY | Store Parameter Field | UNSIGNED32 | rw |
| 1011 | ARRAY | Restore Default Parameters | UNSIGNED32 | rw |
| 1012 | VAR | COB-ID Time Stamp | UNSIGNED32 | rw |
| 1013 | VAR | High Resolution Time Stamp | UNSIGNED32 | rw |
| 1016 | ARRAY | Heartbeat Consumer Entries | UNSIGNED32 | rw |
| 1017 | VAR | Producer Heartbeat Time | UNSIGNED16 | rw |
| 1019 | VAR | Synchronous counter overflow value | UNSIGNED8 | rw |
| 1028 | ARRAY | Emergency Consumer | UNSIGNED32 | rw |
| 1200 | ARRAY | Server SDO Parameter | UNSIGNED32 | rw |

| Index (hex) | Object | Name | Type | Access |
|-------------|--------|--|---------------|--------|
| 1201 | ARRAY | Server SDO Parameter | UNSIGNED32 | rw |
| 1280 - 12FF | ARRAY | Client SDO Parameter | SDO_PARAMETER | rw |
| 1400 - 143F | ARRAY | Receive PDO Communication Parameter 1 | PDO_COMM_PARA | rw |
| 1600 - 163F | ARRAY | Receive PDO Mapping Parameter 1 | PDO_MAPPING | rw |
| 1800 - 183F | ARRAY | Transmit PDO Communication Parameter 1 | PDO_COMM_PARA | rw |
| 1A00 - 1A3F | ARRAY | Transmit PDO Mapping Parameter 1 | PDO_MAPPING | rw |
| 1F50 | ARRAY | Download Program Data | DOMAIN | rw |
| 1F51 | ARRAY | Program Control | UNSIGNED8 | rw |
| 1F80 | VAR | NMT Startup | UNSIGNED32 | rw |
| 1F81 | ARRAY | Slave Assignment | UNSIGNED32 | rw |
| 1F82 | ARRAY | Request NMT | UNSIGNED8 | rw |
| 1F83 | ARRAY | Request Guarding | UNSIGNED8 | rw |
| 1F84 | ARRAY | Device Type Identification | UNSIGNED32 | rw |
| 1F85 | ARRAY | Vendor Identification | UNSIGNED32 | rw |
| 1F86 | ARRAY | Product Code | UNSIGNED32 | rw |
| 1F87 | ARRAY | Revision Number | UNSIGNED32 | rw |
| 1F88 | ARRAY | Serial Number | UNSIGNED32 | rw |
| 1F89 | VAR | Boot Time | UNSIGNED32 | rw |
| 2000 | ARRAY | UNSIGNED8 PDOs | UNSIGNED8 | rw |
| 2001 | ARRAY | UNSIGNED16 PDOs | UNSIGNED16 | rw |
| 2002 | ARRAY | UNSIGNED32 PDOs | UNSIGNED32 | rw |
| 2003 | ARRAY | INTEGER8 PDOs | INTEGER8 | rw |
| 2004 | ARRAY | INTEGER16 PDOs | INTEGER16 | rw |
| 2005 | ARRAY | INTEGER32 PDOs | INTEGER32 | rw |
| 2006 | ARRAY | REAL32 PDOs | REAL32 | rw |
| 2007 | ARRAY | UNSIGNED24 PDOs | UNSIGNED24 | rw |

| Index (hex) | Object | Name | Type | Access |
|--------------------|---------------|-----------------------------------|----------------|---------------|
| 2008 | ARRAY | UNSIGNED40 PDOs | UNSIGNED40 | rw |
| 2009 | ARRAY | UNSIGNED48 PDOs | UNSIGNED48 | rw |
| 200A | ARRAY | UNSIGNED56 PDOs | UNSIGNED56 | rw |
| 200B | ARRAY | UNSIGNED64 PDOs | UNSIGNED64 | rw |
| 2100 | ARRAY | Short Message Ser- vice Object | VISIBLE_STRING | rw |
| 2200 | VAR | ostring | OCTET_STRING | wo |

5.2. Examples

All examples have been carried out in commandline mode.

SDO Access

Access several indices of a CANopen node.

```
COM Shell > 32 r 0x1018 0 u32
```

```
COM Shell > [0] 0x4
```

```
COM Shell > 32 r 0x3000 0 u8
```

```
COM Shell > [0] 0x0
```

```
COM Shell > 32 w 0x3000 0 u8 12
```

```
COM Shell > [0] OK
```

```
COM Shell > 32 r 0x3000 0 u8
```

```
COM Shell > [0] 0xc
```

Set default node id. Access numerical values and string values.

```
COM Shell > set node 32
```

```
[0] OK
```

```
COM Shell > r 0x3000 0 u8
```

```
COM Shell > [0] 0xc
```

```
COM Shell > w 0x3010 0 i8 0xff
```

```
COM Shell > [0] OK
```

```
COM Shell > r 0x3010 0 i8
```

```
COM Shell > [0] -1
```

```
COM Shell > w 0x3010 0 i8 0xf9
```

```
COM Shell > [0] OK
```

```
COM Shell > r 0x3010 0 i8
```

```
COM Shell > [0] -7
```

```
COM Shell > r 0x1008 0 vs
```

```
COM Shell > [0] S16-LINUX
```

```
COM Shell > r 0x1008 0 os
```

```
COM Shell > [0] UzE2LUxJTLVYAAAAAAAAAAAAAAAAA=
```

Read a domain value.

```
COM Shell > w 0x2002 0 "test1.dat"
```

```
[0] ERROR 101 Syntax Error - Bad Para Count
```

Write a domain value.

The raw data has to be converted to base64 format. The Linux-Tool base64 is used for this.

```
COM Shell > w 0x2002 0 vs test1.dat
COM Shell > [0] OK
> echo 'Hello World!' | base64
SGVsbG8gV29ybGQhCg==
COM Shell > w 0x2000 0 d SGVsbG8gV29ybGQhCg==
```

```
[0] OK
```

```
COM Shell > r 0x2000 0 d
COM Shell > 32 USER BLOCK 1 1
```

```
[0] MTIzMTIzMTIzMTIzMTIzMTIzMTIzMTIzMTIzMQ==
```

PDO Konfiguration

Initialize PDO 1 and deinitialize PDO 1. Initialize PDO 2 and start network.

```
COM Shell > set rpdo 1 0x181 event 1 u8
[0] OK
```

```
COM Shell > set rpdo 1 0x80000181 event 1 u8
[0] OK
```

```
COM Shell > set rpdo 2 0x181 event 1 u8
[0] OK
```

```
COM Shell > 0 start
[0] OK
```

Reception of PDO 2. Switch off verbose error message. Initialize PDO 3. Switch on verbose error message. Initialize PDO 3.

```
COM Shell > PDO 2 1 0xaa
```

```
COM Shell > _port_set verbose 1
[0] OK
```

```
COM Shell > set rpdo 3 0x182 event 2 u8
[0] ERROR 100
```

```
COM Shell > _port_set verbose 0xff
[0] OK
```

```
COM Shell > set rpdo 3 0x182 event 2 u8
[0] ERROR 100 Syntax Error - Invalid data
```

```
COM Shell > set rpdo 3 0x182 event 2 u8 u16
[0] OK
```

NMT Error control

Error control with Heartbeat. Node is switched off and started again (Boot up). Node has change NMT state.

```
COM Shell > 32 enable heartbeat 1200
[0] OK
```

```
COM Shell > 32 ERROR 203 Heartbeat lost
```

```
32 ERROR 205 Boot up
```

```
32 ERROR 202 Heartbeat started
```

```
COM Shell > 32 ERROR 204 new NMT state 127
```

Emergency

Switch on reception of emergency messages.

```
COM Shell > 32 _port_reg emcy
[0] OK
```

```
32 EMCY 0xff00 0x81 0xaa 0x0 0x12 0xaf 0x0
```

LSS node configuration

Switch on verbose error messages. Set master flag. LSS Event received. Change to NMT state STOPPED (recommended). Start identifying LSS slave. Switch LSS slave into configuration mode

```
COM Shell > _port_set verbose 0xff
[0] OK
```

```
COM Shell > _port_set master 1
[0] OK
```

```
COM Shell > USER LSS 1 unconfigured device(s) detected
```

```
COM Shell > 0 stop
[0] OK
```

```
COM Shell > _port_lss identity 0x34 12345 0 2 0 2
[0] OK
```

```
COM Shell > _port_lss identity 0x34 12345 0 1 0 1
[0] OK
```

```
COM Shell > _port_lss identity 0x34 12345 1 1 1 1
```

[0] OK

COM Shell > _port_lass switch_sel 0x34 12345 1 1

[0] OK

Request node id. Set node id and check it. Switch to operation mode. Change to NMT state peroperational. Access node with SDO commands.

COM Shell > _port_lass get_node

[0] 255

COM Shell > _port_lass set_node 32

[0] OK

COM Shell > _port_lass get_node

[0] 32

COM Shell > _port_lass switch_glob 0

[0] OK

COM Shell > 0 preop

[0] OK

COM Shell > 32 r 0x1018 1 u32

COM Shell > [0] 0x34

COM Shell > 32 r 0x1018 2 u32

COM Shell > [0] 0x3039

COM Shell > 32 r 0x1018 3 u32

COM Shell > [0] 0x1

COM Shell > 32 r 0x1018 4 u32

COM Shell > [0] 0x1

COM Shell > 32 w 0x2000 0 u8 1

COM Shell > [0] ERROR 0x06010002 Access Error - write a read only object

COM Shell > 32 r 0x2000 0 u8

COM Shell > [0] 0x20

Gateway management

Setup PDO and request configuration. Request version information. Request default node. Request SDO timeout from default node. Request SDO timeout from node 32.

COM Shell > set rpdo 2 0x181 event 1 u8

[0] OK

COM Shell > info rpdo

```
[0] 2 0x181 event 1 u8
```

```
COM Shell > set tpdo 1 0x200 event 1 u8
```

```
[0] OK
```

```
COM Shell > set tpdo 2 0x300 event 2 u32 u32
```

```
[0] OK
```

```
COM Shell > info tpdo
```

```
[0] 1 0x200 event 1 u8, 2 0x300 event 2 u32 u32
```

```
COM Shell > info version
```

```
[0] 52 410640 4.2 0 3 1.00 0.0
```

```
COM Shell > info node
```

```
[0] 127
```

```
COM Shell > info sdo_timeout
```

```
[0] 1000
```

```
COM Shell > 32 set sdo_timeout 1500
```

```
[0] OK
```

```
COM Shell > 32 info sdo_timeout
```

```
[0] 1500
```

Transmission of layer-2 CAN frames

The example shows how the command `_port_wr` can be used to send raw CAN frames.

```
COM Shell > _port_wr 0x1111 xd 4 1 2 3 4
```

```
[0] OK
```

```
COM Shell > _port_wr 0x1111 sr 5
```

```
[0] OK
```

```
COM Shell > _port_wr 0x1111 sd 3 10 16 0xaa
```

```
[0] OK
```

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