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# Corvus

*high resolution positioning controller*

# Manual

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# About this documentation

This documentation is written for the positioning controller Corvus.

Therein all technical data and functions are described. Information about the IEEE-488 interface and the operation of the Touch Terminal is available in a separate documentation.

The English version of Venus-1 is in preparation and not added to this documentation.

## Symbols in this documentation

To clarify the content following symbols are used.





Symbol	Description
	Warning. The informations must be observed strictly
	Hint.
	This function can be released with a release code.
	This function must be installed from the factory personal or experts.
<b>Venus-1</b>	Venus-1 command

Table 1. Symbols

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# Chapter 1

## Introduction



## Presentation of the controller

### Number of axes

- Corvus is a complete stepping motor controller for alternatively 2 or 3 axes and torques up to 1.5 Nm.

### Power concept

- The controller is offered in several power classes. The power concept "distributed power" provides the opportunity to focus the power output on one axis and with it the advantage that bigger stepping motors can also be controlled with the lowest Corvus power class (50W).

### Motor controlling concept

- With 48V motor voltage Corvus produces enough torque, also at a high number of motor revolutions.  
In comparison with the traditional stepping motor controller technology, the motors connected to Corvus cause clearly less power dissipation and as a result of that they remain colder.

### Resolution, velocity, acceleration

- The elaborated controller technology enables a very low-noise positioning and at the same time an extremely high stepping resolution. In the programmable mode an endposition resolution of 1nm is achieved, the minimum step increment is 15.26nm. The resolution in the joystick mode is 23.2fm (femtometer).
- Due to the high computing power Corvus has a high speed and acceleration dynamic. The minimum speed amounts to 15.26nm/s, the controller tops 45 revolutions/s.
- For all axes Corvus offers linear- or  $\sin^2$ -acceleration. The  $\sin^2$ -acceleration function is indispensable for the controller technology of vibration sensitive systems which demand a highly dynamic positioning.

### **Closed Loop function**

- The closed-loop mode enables the monitored and controlled positioning for the highest precision demanded. Corvus supports optic and magnetic length measuring systems.

### **Hardware**

- The complete control logic is space-saving placed on one circuit board, including the power unit.  
A 32-bit processor with 133 Mhz has the control and its power capacity is supported by a real-time operating system. With a 8-Mbyte flash store, 2-Mbyte SRAM and up to 32-Mbyte DRAM, Corvus offers a hardware platform in which the future is integrated.

### **Communication interfaces**

- The communication concept is also progressive. Corvus has several interfaces. A RS-232 interface with up to 115 kbaud, a CAN-bus interface, an IEEE-interface and as a peculiarity a 10 Mbit ethernet interface with TCP/IP stack.  
The ethernet interface enables the intranet network of an arbitrary number of controller and is the door for the remote control via internet.

### **Diagnostic**

- Support for the service offers the LED-diagnostics system. 20 light-emitting diodes inform the user about the momentary operating state of the controller.

### **Operation, Programming, Update an Upgrade, Software tools**

- For the position display and the operation without any PC or terminal, the controller can be equipped with a touch-display.
- The program controlled operation works via the approved interpreter language Venus-1.  
Corvus is nearly 100% software compatible with the predecessor controller multicontrol, mc-compact or mc-3000.
- The update of the firmware can be executed on site. That way the controller can always be kept up to date. With the possibility to release functions subsequently, Corvus grows with the standard.
- In support of the software developer an API is available. API signifies "application programming interface" and permits the use of a specified amount of system functions of the controller.

## Function survey

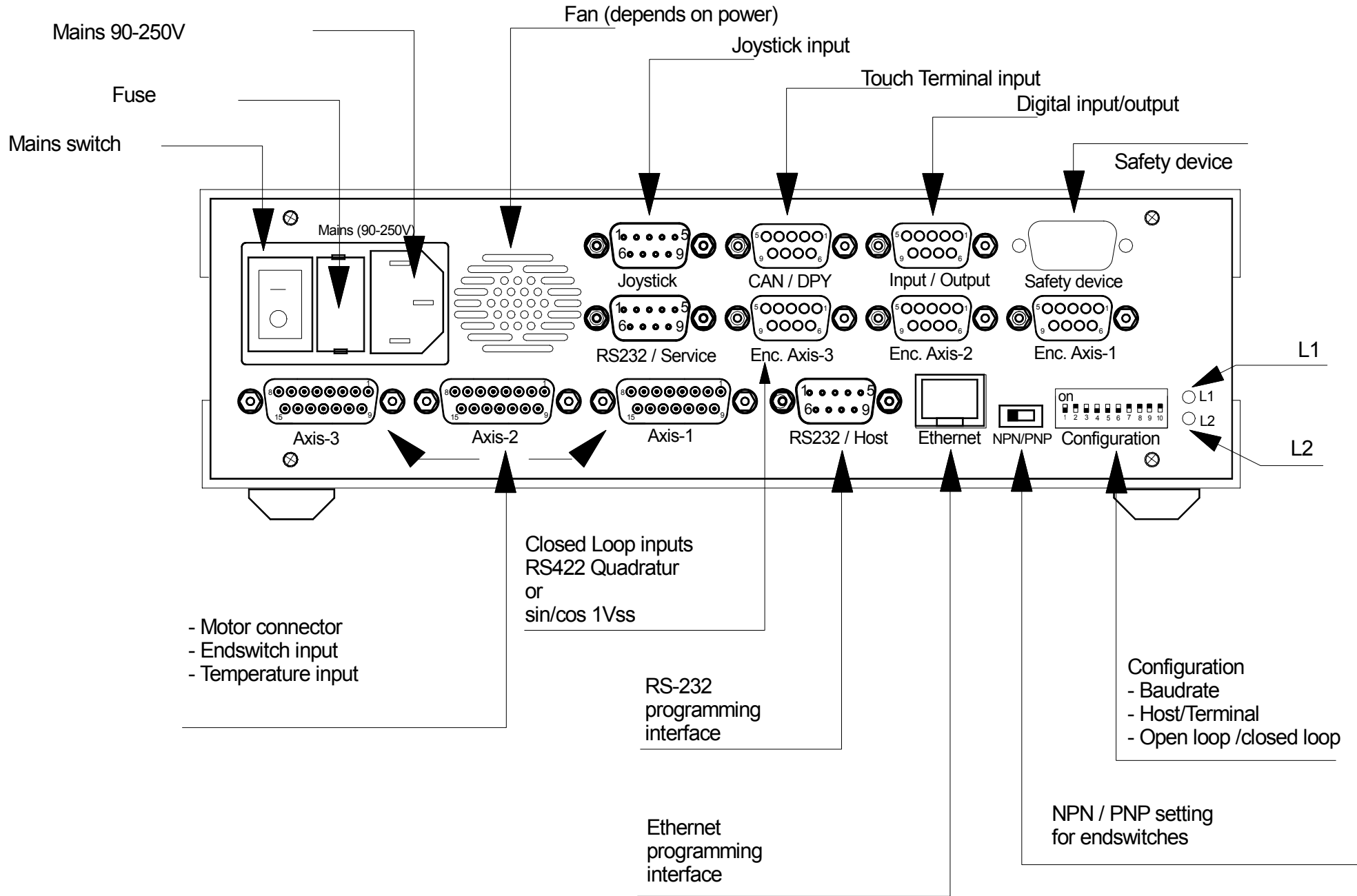
Functions	Standard / Option
• Axes 1,2	• Standard
• Axis 3	• Option / Code
• Phase current: until 2.5A	• Standard
• Velocity: until 45 U/s	• Standard
• Resolution: > 15,26nm	• Standard
• Power classes: 50W, 100W, 500W	• 50W Standard
• Joystick operation	• Standard
• Host controlled Venus-1 command language	• Standard
• Terminal operation	• Standard
• Error correction 1D	• Standard
• sin <sup>2</sup> - acceleration (s-curve)	• Standard
• Closed Loop operation digital Encoder input	• Option / Code
• Closed Loop operation sin/cos 1Vss input	• Option / Hardware
• Digital I/O, 3 Inputs / 3 Outputs	• Option / Code
• Digital I/O 8 Inputs / 8 Output	• Additional Hardware
• Analog I/O	• On request
• 24V switched power output for motor break circuits	• Option / Hardware
• Motor enable/disable for each axis	• Option / Hardware
• Display with touch function	• Option / Hardware
• Firmware update via RS-232	• Standard
• RS-232 Interface until 115kBaud	• Standard
• CAN-Bus Interface	• Option / Hardware
• IEEE-Interface (GBIP)	• Option / Hardware
• Ethernet Interface with TCP/IP Stack on Board	• Option / Code

Table 2. Function survey

**Standard:** Standard configuration

**Option / Code:** Can be released with code

**Option / Hardware:** Hardware modification or additional hardware modules



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# Chapter 2

## Installation

## Safety notice



The controller is developed, produced, checked and documented in consideration of the relevant standards. If it is used according to regulations, there are no dangers for persons and things. Use according to regulations implies that the device is solely used in the way that is described in here and that the stated safety advices are followed.



# Declaration by the manufacturer



The company

**ITK Dr. Kassen GmbH  
Beim Eberacker 3  
D-35633 Lahnau**

declares, that the product:

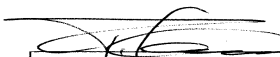
**Corvus**  
**Positioning controller**

meets following standards or is compliant:

**Safety requirements:**  
IEC1010-1, EN61010-1

**Emission standards:**  
DIN/VDE 0871 curve B  
EMV: IEC 801, EN50081, EN50082-1

Lahnau, January 2002



**Dr. Falko Kassen**, Director  
ITK  
D-35633 Lahnau  
Tel.: +49 64 41-6 50 05-0  
Fax: +49 64 41- 6 50 05-29

Director

## Mains supply

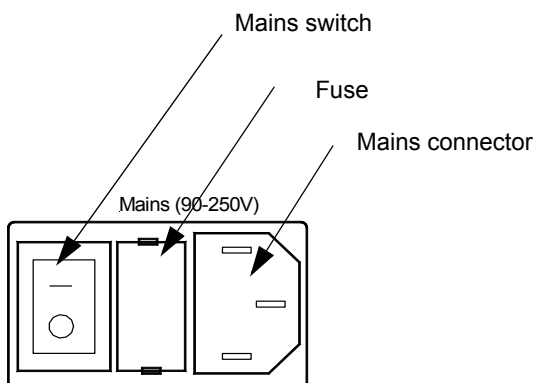
### Universal input voltage

Corvus is in each offered model always ready for mains connection. For the setting-up operation the case has not to be opened.

The integrated power supply unit has a wide range voltage input which adapts itself automatically to the input voltage range of 90-250V.

### Mains protection

A safety fuse in the mains connector protects the controller. The protection is accessible from the outside.





# Motor connection

## Axes designation

The axes designation is axis-1, axis-2 and axis-3. They consciously were not designated as x-y-z coordinates, because this assignment is determined by the application.

Axis-1 and axis-2 belong to the standard equipment of the device.

For the joystick there is the following determination:

Axis-1	X
Axis-2	Y
Axis-3	Z

## Motor types

The motors are connected to the motor connections axis-1 to axis-3.

Two-phase or three-phase stepping motors for bipolar controller technology are supported.

"Motor connection and endswitch" on page 95.

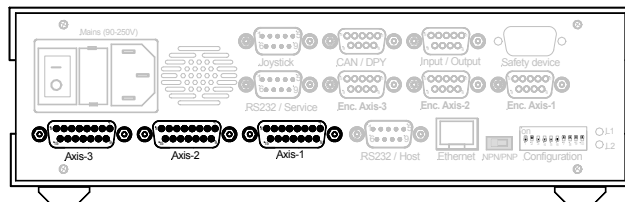


Figure 3: Corvus motor connection

### Motor characteristics

The typical motor characteristics are the holding torque, the step angle, the maximum phase current, the poles and the inductivity. The torque is dependent on the number of revolutions per minute and has to be taken from the motor characteristic line.

Recommended values:

Phase current	Inductivity	Polepairs	step angle
1,2A - 2.5A	0.8mH - 4mH	25/50/ 100	3.6° / 1.8° / 0.9°

### Commands for the motor adaptation

The adaptation of the controller to the motors is done via the programming interface.

The following Venus-1 commands are therefor concerned:

<b><i>setumotmin</i></b>	The motor setting command <i>umotmin</i> affects the phase current when the motor is holding. As a result it determines holding torque and power consumption.
<b><i>setumotgrad</i></b>	The motor setting command <i>umotgrad</i> determines the phase current and torque during the motor is moving.
<b><i>setpolepairs</i></b>	Adapts controller to polepairs of the different motor types. 0.9° Hybridmotor polepairs = 100 1.8° Hybridmotor polepairs = 50

You'll find further comments on this commands in the manual *Venus-1 command language*.

## Measures for system resonances

The combination of a motor and other drive components form a typical spring-mass-system.

If the normal damping of the mechanics is insufficient it can lead under inauspicious circumstances to resonance appearances. In the last resort the stepping motor jerks to a stop with a wailing sound.

An effective countermeasure are resonance absorbing elements which are for example installed on the extended motor shaft.

For exacting position tasks we always recommend the use of this damping measure.

A cause for resonances are often overdimensioned motors. In this case it can make sense to reduce the torque via the motor parameter resp. by choosing a more suitable motor.

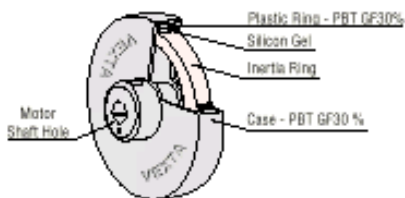


Figure 4: Motor damper

## Motor cable

Motor cables are by request produced by us according to customized demands.

If the motor cable is in-house produced, cable cross-section, cable length and shielding have to be considered.

The cable cross-section has to be adapted to the phase current. The cable cross-section should be calculated based on the maximum phase current per motor phase.

For cables longer than 4 meters it can be necessary to adapt cable losses by a modified configuration of the motor parameters **setumotmin** and **setumotgrad** or to make up for these losses by an enlarged cross-section.

For the EMC-compatible fitting of the cable a total shielding is prescribed whereby the cable shield is connected to the case. The DSUB-15 motor connector should have a metal case. The fasten nuts of the DSUB connectors of the controller have an UNC4-40 thread.



**An incorrect wiring of the motor connection can result in a defect of the controller.**



*Figure 5: Shielded motor cable with metal connector housing*

## Endswitches

### Endswitch inputs

For each axis there are respectively two endswitch inputs available.

The endswitch connections are situated in the respective motor connector. The switch inputs are designated due to their function as cal-endswitch input or as rm-endswitch input.

The endswitch functions supported by Corvus are linked to these inputs; no other function can be assigned to them.

### Endswitch functions

There are the following endswitch functions:

- **move to the cal-endswitch (Venus-1 command *cal*)**

The controller positions towards negative position values until the cal-endswitch is reached.

- **move to the rm-endswitch (Venus-1 command *rm*)**

The controller positions towards positive position values until the rm-endswitch is reached.

## Endswitch types

Corvus supports the following endswitch types:

- **mechanic switches (*opener / closer*)**
- **inductive proximity switches NPN / PNP**
- **photo sensors**

For the supply of electronic switches, 5V and 12V are available in the motor connector.

See "User output voltage" on page 63.

## Configuration for PNP/NPN/*opener/closer*

With the changeover switch on the back of the controller Corvus is configured to the NPN or PNP endswitch type.



- **NPN = the endswitch closes or opens towards ground**
- **PNP = the endswitch closes or opens to VCC**

The function *opener* or *closer* is determined with the Venus-1 command **setsw** and is saved with **save**.

### Endswitch wiring

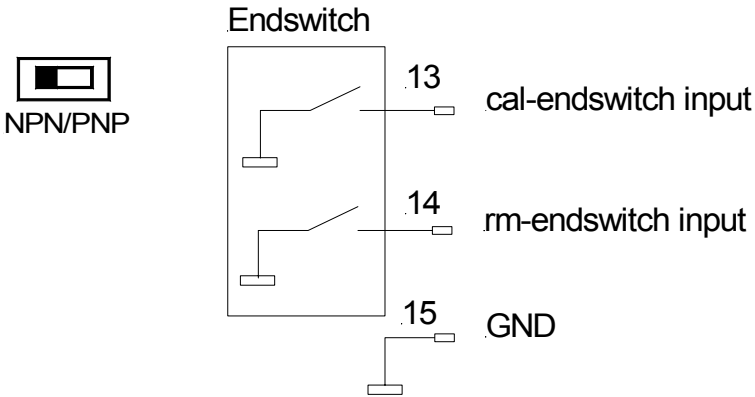


Figure 6: NPN endswitch wiring

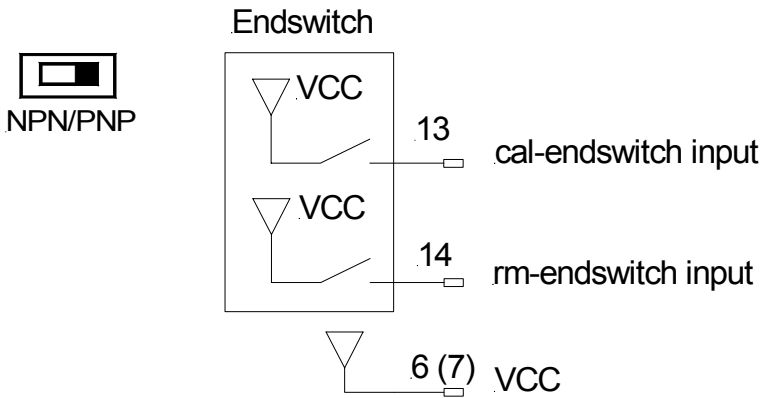


Figure 7: PNP endswitch wiring

# Joystick mode

## General remarks



In the joystick mode the positioning is executed independent from a host control unit.

The turning or the deflection of the joystick enables a sensitive and high resolvent positioning of the motors.

The joystick can in addition be equipped with a touch-terminal. In doing so there is the possibility to display the position of all axes and to execute further operation functions.



Figure 8: FJ Joystick with Speed buttons

## Axes assignment

Joystick	Axes assignment
X	Axis-1
Y	Axis-2
Z	Axis-3



## Configuration of the controller for the joystick mode

The following configurations have to be executed for the joystick mode:

- **determining the joystick velocity**
- **determining the button-speed**
- **determining the joystick acceleration**
- **switching on the joystick mode**

So that the made configurations also remain valid after switching off the controller, these parameters have to be saved.



Display of the joystick function

## Important notices for the joystick mode

- **The joystick has to be connected when the controller is switched on.**
- **The joystick may not be deflected when the controller is switched on.**
- **For safety reasons an active joystick is always switched off after a "programmed move" and has to be switched on again afterwards.**



## Programmed mode

For the program controlled operation a control unit (host) has to be connected. The operation can work via the following interfaces:

- **RS-232 interface**
- **Ethernet interface**
- **IEEE-interface**

Command language is named Venus-1.

The function of these commands is described in the second part of this manual.

## Setting-up operation of the RS-232 connection

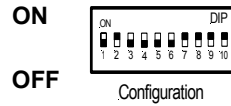
### Important notices

- The delivered cable should preferably be used. The correct wiring has to be minded if it is in-house produced.
- See "RS-232 / host interface" on page 96.
- The interface configurations of the control unit have to correspond accurately with the configurations of Corvus.
- If there are problems you have to check if so-called interface adapters, which possibly have falsified the wiring, have been set in.
- The interface of the control unit may not be occupied by other active programs.
- The configuration of the RS-232 operation mode, host mode or terminal mode, has to be adapted to the application. See "DIP-Switch configuration".
- The closed-loop mode should not be activated at first setting-up operation. See "DIP-switch configuration".
- For the test of the RS-232 connection the diagnostics display RX/TX on the front should be used.

### RS-232 interface configuration

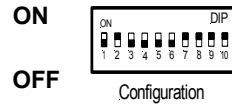
• Data bits	• 8
• Stop bits	• 1
• Parity	• no
• Handshake	• no
• Baudrate	• *9600,19200, 57600,115200 * Factory setting

### Configuration of the baudrate



Dip-Switch 1	Dip-Switch 2	Baudrate
• OFF	• OFF	• 9600
• OFF	• ON	• 19200
• ON	• OFF	• 57600
• ON	• ON	• 115200

### Closed-loop / terminal or host mode,



Dip-Switch 3	Function
• ON	• Closed Loop active
• OFF	• Closed Loop off

Dip-Switch 6	Function
• ON	• Terminal Mode after power on
• OFF	• Host Mode after power on

## Test of the RS-232 connection

Some test measures which shall help to execute the function test of the RS-232 connection are explained below.

- **Testing via the LED-diagnostics display**

While receiving and transmitting ASCII signs via the RS-232 interface the displays RxD resp. TxD flash. It must be pointed out that during the transmission of few data the display possibly only flashes short. An attentive observation is therefore necessary.

- **Testing the transmission with the command *reset***

If the connection between host and controller works, the controller is restarted with reset. Thereby the diagnostics display is visibly switched off shortly and there is an audible signal at the same time.

- **Testing with WinPos**

WinPos LT is added for free to each controller and is qualified for getting to know all functions of the controller. A test of the RS-232 connection is automatically executed during the connection establishment.

The most important configurations in WinPos:

- **connecting the controller with the PC**
- **configuring host mode**
- **switching on the controller**
- **starting WinPos**
- **configuring interface and baudrate**
- **"connecting" WinPos**
- **opening Venus command line and testing commands**

## Connection with the hyperterminal

A terminal connection via the RS-232 interface or the ethernet interface can be established with the program hyperterminal. The controller therefor has to be switched into the terminal mode. See "Closed-loop / terminal or host mode" on page 24. A complete operation of the controller via the Venus-1 command input is possible with that program.

This program is therefore not only suited for the test of the interface connection but is also suited for operating and configuring the controller with simple means which are available for everybody.

The program hyperterminal is added to the windows versions 95/98/NT and is normally to be found under:

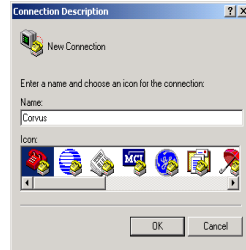
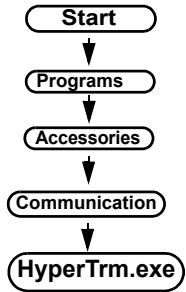
**Start>programs>accessories>communication**

You can also get the product for free under the following address:

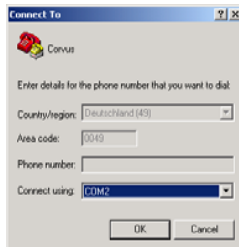
[http://www.hilgraeve.com/products/index.html#Hyper Terminal Private Edition.](http://www.hilgraeve.com/products/index.html#Hyper_Terminal_Private_Edition)

You have to pay attention to the licence agreements.

### Configurations of the hyperterminal for the RS-232 interface



- **Start Hyperterminal.exe.**
- **Determining the name of the configuration in which the configurations shall be saved. Example: Corvus.ht**

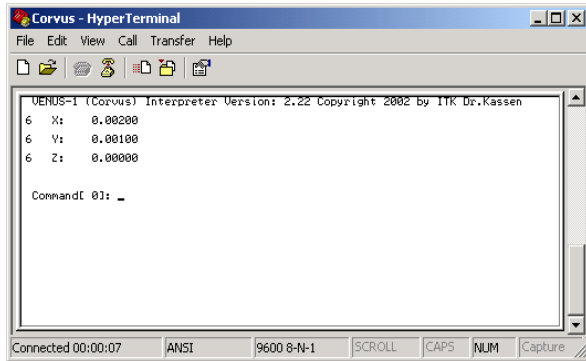


- **indicating the used interface.**
- **making interface configurations.**
- **closing and saving the session.**
- **switching off Corvus and setting DIP-switch to terminal mode.**
- **opening hyperterminal with the saved configurations, for example: Corvus.ht.**
- **switching on the controller. After that a screen mask with position display and command input line is automatically transmitted via the controller to the terminal.**

(Continuation see next page)

- the commands are entered in the input line according to the requirements of the Venus-1 manual and are executed with <enter>.

- 
- 
- 



Changes in the interface configurations of the terminal program are only adopted if the program is **offline**. The configuration local echo is not necessary, the sign echo is transmitted by the controller.



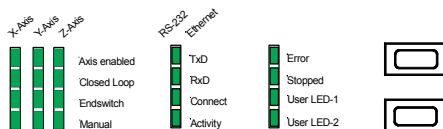
# Programming via the ethernet interface

The ethernet interface is an optional function of the controller. The extension is possible per a release code. The command language Venus-1 is also used for the programming and the effect of terminal and host mode is valid as well.

## Notices for the setting-up operation

To operate the controller via the ethernet, the following requirements have to be fulfilled:

- **The option ethernet has to be released.**  
**Testing with Venus-1 command *getoptions*.**
- **Connection to an existing network via a hub or directly with a network card.**
- **Determining an IP-address and saving in the controller. Subnetmask is 255.255.255.0**
- 
- **The program for the operation of the controller has to be configured to the protocol "telnet".**
- **Checking the interface activity.**  
**(Attention: you'll also have a display if the function is not released)**
- **Testing the connection with the function "ping".**  
**See following page.**



Displays the activity of ethernet traffic.

## Testing the ethernet connection

To test the connection of the controller with the network, Windows offers the test function "ping".

It is normally used to check the performance of a network connection and can also be used as a fundamental function test.

This function is executed as follows:

### Start > programs > accessories > prompt

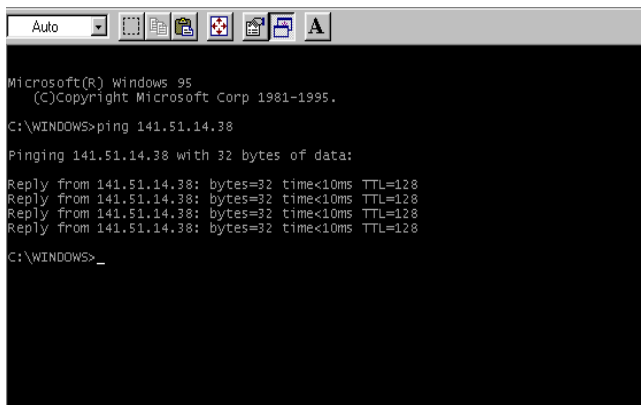
The command "ping" and the IP-address of the controller are entered in the input line.

Example:

Subnetmask: 255.255.255.0

ping 141.51.14.38

If the connection works, the controller delivers the answer below.

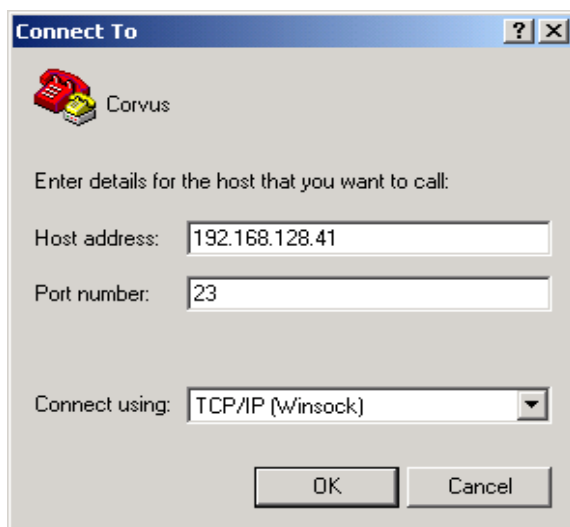


## Ethernet connection with the hyperterminal

Hyperterminal supports in addition to the RS-232 protocol also TCP/IP and is for this reason qualified for operating Corvus via the ethernet interface.

Instead of the Com interface the IP-address of the controller has to be indicated here.

The further operation does not differ from the RS-232 connection.



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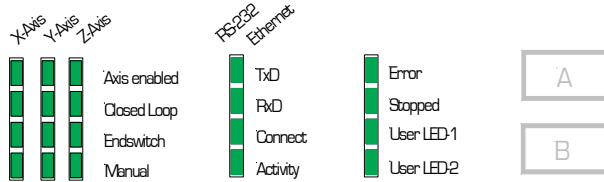
# Chapter 3

## Functions

# LED-diagnostics display









By dint of the diagnostics display at the front, important configurations and operation states of the controller can be surveyed at a glance.

Active states are displayed by shining LEDs. Blinking displays give additional tips which are explained in the function explanations.



## Functions of the LED-displays

Axis-1  
Axis-2  
Axis-3

-  Axis enabled      Display of the configuration **setaxis**.  
The display flashes if the axis is switched on. The display blinks if the function of the axes is restricted by outside influences.
  
-  Closed-Loop      Display of the configuration **setcloop**.  
The display flashes if the closed-loop function is switched on. The display blinks if a target window has been activated and the position is outside of the target window.
  
-  Endswitch      Display of the endswitch function.  
The display flashes if the endswitch is activated.
  
-  Manual      Display of the configuration **joystick**.  
The display flashes if the joystick is switched on.
  
  
-  TxD      Display of the RS-232 data transmission.  
The display flashes if Corvus transmits data.
  
-  Rx      Display of the RS-232 data transmission.  
The display flashes if Corvus receives data.
  
-  Connect      Display of the ethernet data connection.  
The display flashes if there is an ethernet connection.  
Attention:  
The display also flashes if the ethernet interface is not released.
  
-  Activity      Display of the ethernet data traffic.  
Here is not only displayed the data traffic of the controller but the whole network traffic.

- Error            Error display.  
The display flashes if an error has occurred.  
The error code can be read with the command **gme** or **ge**.
- Stopped        Status of the command execution.  
The display flashes if the command interpreter is ready to receive a new command.  
This display is switched off in the joystick mode.
- USER LED1    The display can be switched on and off with push-button A. If the LED is switched on, status bit D2 is produced.  
See command **status**.
- USER LED2    (no function)

## Push-button A and B

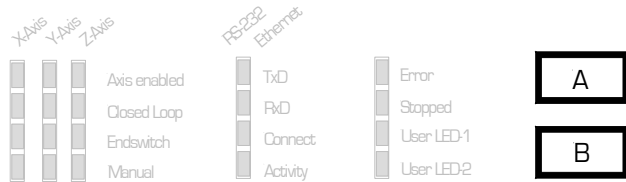
Push-button A and push-button B offer switch functions which can be used for controlling purposes in coaction with the application software.

Presently only push-button A is supported.

The switch state of push-button A is displayed from the outside by User LED1. The evaluation by the application software is done via the command **status**.

### Remark:

Push-button A is compatible to the function key "online" like it was used for the controller MultiControl-2000.





## Endswitch functions

### Working range and coordinate system

As a basis for the positioning, each controller needs a coordinate origin and for safety reasons the information of the maximum working range within which the positioning can take place.

The in Corvus implemented endswitch functions calculate the origin and the maximum working range and save those for the period of the operation.

The working range is defined by hard- or soft limits.

The hard limits are endswitches, soft limits are limitations which can be determined program technically.

The endswitches can be registered programmed by command or manually with the joystick.



**HINWEIS!**

For safety reasons the coordinate origin and the determined maximum movement range get lost while switching off the controller and have to be recalculated resp. programmed after a restart.

### Endswitch inputs

Corvus supports two endswitches per motor axis. The endswitch connections are in the respective motor connector.

These switch inputs are designated due to their function as **cal-** or **rm-** endswitch input.

The endswitch functions are dedicated to these inputs. See "endswitches" on page 17.

## Programmed endswitch movement

With the commands **cal** and **rm** a synchron positioning of all active axes to their endswitches is started. The activation of the axes is done with the command **setaxis**.

Synchron means that the axes are started simultaneously and are driven in the endswitches.

As soon as all endswitches are activated, the axes are again driven simultaneously out of the endswitches. Therewith the endswitch movement is completed.

The endswitch movement can be aborted with the command **Ctrl+c**. During the endswitch movement the interpreter is blocked for all further commands.

A position reply message during the endswitch movement is only received in terminal mode. See manual Venus-1.



**HINWEIS!**

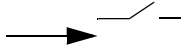

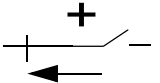
During the endswitch movement no other commands except the abort command **Ctrl+c** can be executed.

The controller can continue to receive data and saves these in the command FIFO. These commands are executed when the endswitch movement is completed.

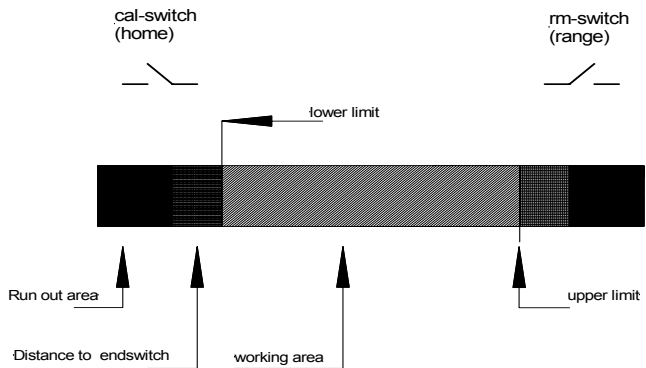
### Programmed endswitch movement in detail

The fundamental procedure of the programmed endswitch movement is described below.

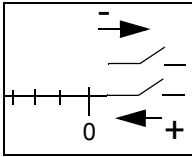
The endswitch movement is divided in at least two successive positionings:

-  1. The controller positions until the endswitch is activated and stops immediately.  
The endswitch diagnostics LED flashes.
-  2. The controller positions again out of the endswitch until this one is inactive.  
The endswitch diagnostics LED extinguishes.
-  3. With the command **setcalswdist** an additional distance to the endswitches can be determined.

The endswitches are always outside of the working range and are not again activated by the controller in the regular mode. With the command **getlimit** the registered coordinates are read.

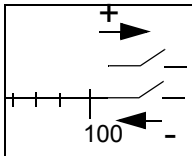


### Endswitch movement to the cal-endswitch



The controller positions all active axes towards negative position values. At the end of the cal-endswitch movement the position is set to zero and the origin is firstly determined there. The positioning of coordinates less than zero is no longer possible. The origin can be changed subsequently with the command **setpos**.

### Endswitch movement to the rm-endswitch



The controller positions all active axes towards positive position values. The position at the end of the rm-endswitch movement is the maximum movement range for the controller. A positioning beyond this point is no longer possible. The limit can subsequently be minimized with the command **set-limit**.



**HINWEIS!**

The coordinate configurations are not saved for safety reasons and have to be recalculated after each restart.

## Endswitch movement with the joystick

By the use of the manual positioning with the joystick, the endswitches can also be detected. The procedure resembles the programmed endswitch movement.

### Endswitch movement with the joystick in detail

The controller is positioned with the joystick in the endswitch until this one is activated. After that it is positioned out of the endswitch until this one is again inactive.

The position before the endswitch is registered as the movement limit and can neither in the manual nor in the programmed mode be run over afterwards.

### Working range and coordinate system

In opposition to the programmed endswitch movement, the controller does not determine an origin during the manual endswitch movement.

The point of origin could be given here already before the endswitch movement by the command.

If an origin is not determined before the manual endswitch move, the mechanic position at switching on the controller is the origin.

A reassignment of the coordinate origin is subsequently possible.



## Notices for the endswitch move



HINWEIS!

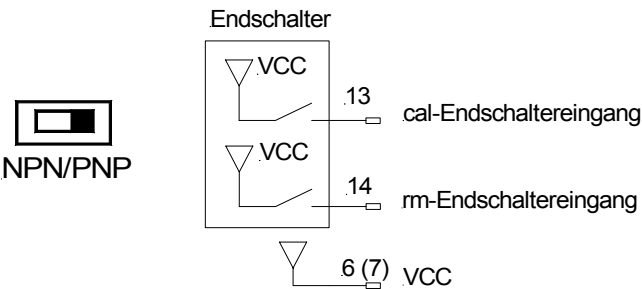
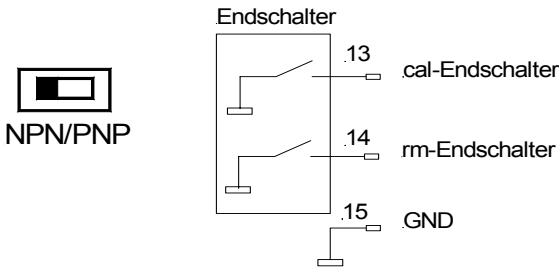
- To calculate the working range and to determine the coordinate system, the origin has to be calculated first (cal). After that the maximum movement range (rm).
- The velocity for the movement to the endswitch has to be chosen that way that within the deceleration distance there will not be a collision with the mechanics. This is first of all valid for the endswitch movement with the joystick.
- To achieve a good reproducibility of the limits, the velocity for the move out of the endswitch should be chosen as small as possible.
- During the endswitch move the command interpreter is blocked for all commands except the abort command Ctrl+c. A position reply message is only received in terminal mode.
- For safety reasons the movement range and the configurations of the coordinate system are not saved. They have to be recalculated and determined after each restart.

# Endswitch wiring

With the changeover switch at the back of the controller, Corvus is configured to **NPN**- or **PNP**- endswitch type.

- **NPN = the endswitch closes or opens towards ground**
- **PNP = the endswitch closes or opens to VCC**

The function *opener* or *closer* is determined with the Venus-1 command **setsw** and is saved with **save**.



## Positioning with the joystick

The joystick mode allows a very sensitive positioning of all axes via a joystick.



The movement is velocity controlled and is produced by the deflection of the joystick.

The larger the deflection the higher the velocity. In joystick mode the axes can be moved independently. It does not exist an interdependence of the axes in this mode like it exists in the programmed mode.

The position resolution with the joystick is enormous.

The internal calculation works with 32 bit and reaches thereby a resolution of theoretically **23.2 fm** (femtometer)!

### Joystick button speed

With the two paralleled push buttons of the joystick, a freely definable second joystick velocity can be activated.

This velocity is valid as long as one of these push buttons is pushed.

### Configuration of the joystick

Command	Description
setjoyspeed	maximum joystick velocity
setjoybspeed	maximum joystick velocity if button is pressed
setmanaccel	manual acceleration



## Notices for the joystick mode



HINWEIS!

- During the phase of switching on the controller, the zero position of each axis of the joystick is checked. The joystick may not be deflected during this time. If there is a zero position outside of an internally determined tolerance window, the manual mode for the relevant axis is switched off.
- The zero position is also checked when the joystick shall be switched on during the running mode.
- If the joystick is disconnected during a manual positioning, the axes are immediately stopped. The joystick mode remains active.
- During the programmed positioning the joystick mode is switched off for safety reasons. It has to be switched on again afterwards.

## Programmed positioning

The programmed positioning is run via the RS-232 interface or the ethernet interface. The command language is Venus-1.

The principle of software control is easy:

There are reading and writing commands. Writing commands execute the activities, the configuration resp. the current state is checked with reading commands.

An automatic status reply message can be received by a combination of commands.

During a positioning, the status, the position and the error storage can be read out at the same time.

In the manual **Venus-1** the possibilities of programming are described in detail.

## Venus-1 syntax and examples

The following command groups are distinguished:

- **system commands**
- **configuration commands**
- **positioning commands**
- **status commands**

### System commands

save parameters:

**save**

restart controller:

**reset**

### Configuration commands

[parameter] \_ [axis index] \_ [command] \_

Example: switching on the 2<sup>nd</sup> axis

**1 2 setaxis**

### Positioning commands

[axis 1] [axis 2] [axis 3] **move**

Example:

Positioning all three axes to the coordinates below (absolute move)

**1.204 4.01 3.4 move**

### Status commands

System status:

**st**

Status of the digital inputs:

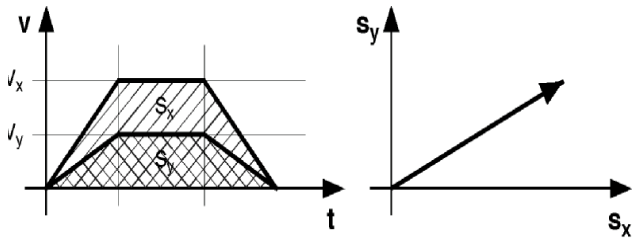
**getin**

### Axes interpolation

In the programmed positioning the axes are linear interpolated, i.e., a so-called *vector move* is executed.

In doing so the involved axes are synchronized that way that the phase of acceleration and the phase of deceleration are equal.

A cross table with the axes x and y executes thereby a straight movement.



### Velocity and acceleration

The indication of the velocity and the acceleration always refers to the axis with the longest moving distance. It is also called the limiting axis.

The velocity of the other axes v is a result of the ratio of the moving distance of these axes to the moving distance of the limiting axis s<sub>lim</sub>

$$v = \frac{s}{s_{lim}} \cdot v_{lim}$$

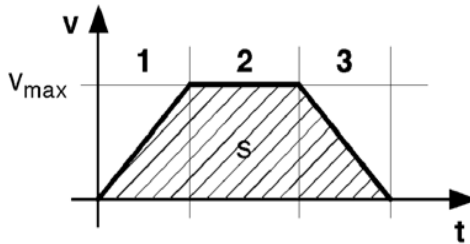
The acceleration of the other axes is a result of their maximum velocities.

### Velocity profile of a linear acceleration function

The movement profile of a programmed move which is produced with a linear acceleration function has the form of a trapezium. The area under the curve corresponds to the covered distance  $s$  and the pitch of the curve corresponds to the acceleration  $a$ .

See v/t graph below.

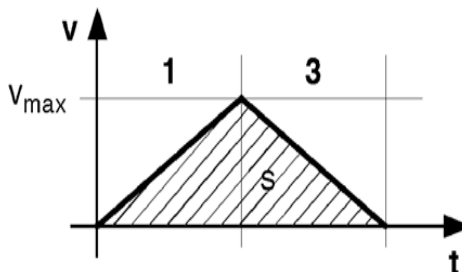
- 1 = accelerated move
- 2 = continuous move
- 3 = decelerated move



### Movement profile of short distances

The graph below shows the positioning of a short distance. It can not always be guaranteed here that the axis reaches its maximum velocity.

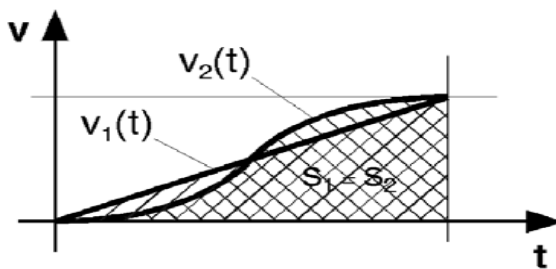
The movement profile has the form of a isosceles triangle.



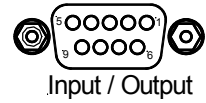
## Movement profile of a $\sin^2$ -acceleration function

For the  $\sin^2$ -acceleration the torque is not provided abruptly but in form of a sine curve. A very soft start and deceleration of the motor is achieved with it.

As the acceleration is raised in the lower to average speed range it does not lead to an extension of the positioning process.



# Digital inputs / outputs



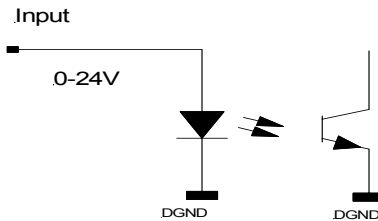
For individual controlling tasks and special tasks, Corvus has three digital inputs and three digital outputs. These are fed to a 9pol DSUB connector at the front panel.

The input / output functions are supported by the Venus-1 commands **setout**, **getout**, **getin** and **getinfunc**.

## Input circuit

The input voltage range of the digital inputs lies between 0 and 24V.

The inputs are optically isolated but not DC-isolated.

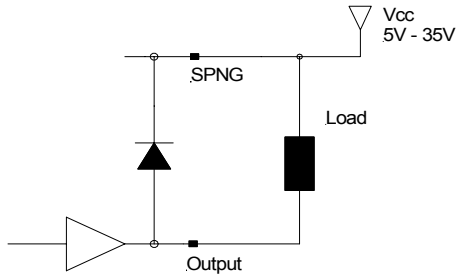


## Technical data:

Input voltage	Identified as
0 - 2 V	0
3 - 24 V	1

### Output circuit

The output driver has a darlington circuit with open-collector output which is also qualified for switching inductive loads. The current carrying capacity of the outputs is 500 mA.



**The total current of all outputs should never exceed 1000 mA.**



# Configuration switch



Configuration

Switch	Function
1	• RS-232 Baudrate
2	• RS-232 Baudrate
3	• Closed Loop On/OFF
4	• no function
5	• no function
6	• Host Mode / Terminal Mode
7	• no function
8	• no function
9	• no function
10	• no function

TABLE 9. Configuration switch functions



Setting	Function
NPN	<ul style="list-style-type: none"> <li>• NPN function of endswitches is assumed</li> <li>• All inputs are closed to GND if active.</li> </ul>
PNP	<ul style="list-style-type: none"> <li>• PNP function of endswitches is assumed</li> <li>• All inputs are switched to VCC if active.</li> </ul>

TABLE 10. Endswitch setting with hardware switch NPN/PNP

## Input / Output functions

In the following the functions which can be realised with the digital in- or outputs are described.

### Produce an output signal

The command **setout** switches a signal to the outputs Dout1 - Dout2.

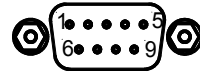
### Read an input signal

The command **getin** reads the binary state of the data inputs Din1 - Din3.

### Limitation of movement

Via an externally produced signal at the digital inputs Din1-Din3 it is possible to block selected axes completely or to restrict their moving range depending on the direction. The function is activated with the Venus-1 command **setinfunc**.

# Safety device



Safety device



The interface "safety device" enables switching off the motor power stage. In addition there are two floating connections of a relay which can be used for a safety circuit or other controlling tasks.

## Switching off the motor

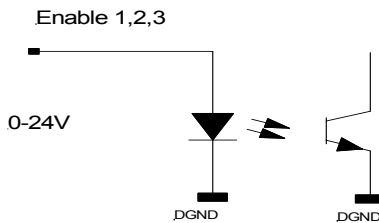
Switching off the motor affects the hardware of the motor power stage and is independent from the software.

You can switch off the power stage of each single axis. In doing so the signal switches all motor phases of an axis in the high-impedance state.

A switch off is reported as a machine error. See Venus-1 command **gme**.

Switching on the motors again is only possible by a restart of the controller or with the command **reset**.

The inputs are optically isolated but not DC-isolated.



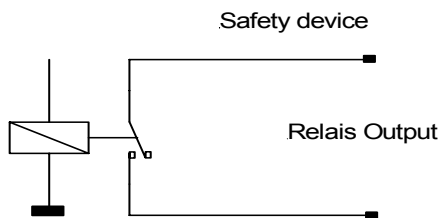
### Technical data:

Input voltage	Status of motor driver
0 - 2 V	Motor driver is disabled
3 - 24 V	Motor driver is active

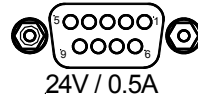
## Relay

The floating contact is closed 2 seconds after switching on the controller.

The contact opens while switching off the controller or if the command **reset** is executed.



## Output voltage module



With the output voltage module Corvus delivers a floating 24V output voltage which is switched via the Venus-1 command **setout**.

This function can be used for example for the holding voltage of a motor brake.

The maximum output current is 0.5A.

### Function description:

After switching on the controller, the voltage module is disconnected and 0V is applied to the output.

The output voltage is switched on by the command **1 1 setout** and is switched off by **0 1 setout**. The status query is done by **getout**.

The voltage is also switched off with the command **reset**.



If the switched voltage is used for controlling a motor brake it is the job of the user to check if therewith a safe operation can be guaranteed.

## User output voltages

For the power supply of external devices, Corvus provides the user-voltages +5V and +12V. These voltages are saved with their nominal current.

The safety elements are self-resetable fuse, i.e., the electric circuit is closed again after removing the overload and after a convalescence.

### Technical data:

User voltage	Max. output current
5V	1A
12V	0.3A



If more power output is needed for the supply of external devices, this is available by an add-on DC-DC module.

## Closed-loop function

The function closed-loop enables the operation of the axes in closed-loop.

At this a position registered by a measuring system is delivered to the controller and is used for the calculation of the position.

Depending on the measuring system there are some advantages for the stepping motor positioning:

- **safety by step monitoring**
- **increasing the repeatability**
- **improvement of the absolute accuracy**
- **load compensation during the move and a standstill**
- **improved controlling behavior**
- **support of fast and highly precise positioning procedures by the "in-window" function**
- **measuring function realisable**

## Connections

The connection of the measuring systems is on the back of the controller. The connections are labeled with Enc.Axis-1, Enc.Axis-2 and Enc.Axis-3.

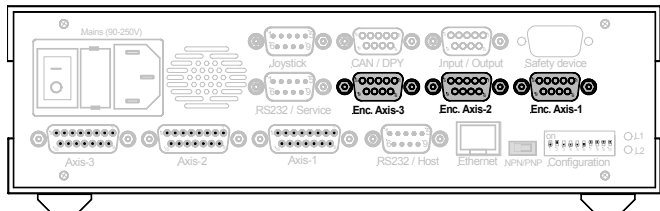


Figure 11: Closed loop inputs are shown

## Supported measuring systems

Corvus supports the following measuring systems:

- **A/B quadrature with RS422 signal output**
- **sin/cos, 1Vss**

### A/B quadrature measuring input



The A/B quadrature interface supports differential RS422 measuring signals with reference signal.

This function is supported by the Venus-1 commands **setclfactor**, **setref**, **setclpara**, **refremove** and **set-*cl*oop**.

#### Technical data:

Input signals	RS422 Standard
Reference mark	Supported
Max input frequency	10 Mhz

### SIN/COS interface 12 bit / 16 bit



The SIN/COS interface is an independent module which has been developed for the evaluation of very fast positioning signals.

The module is equipped with a very fast signal processor that executes the data acquisition and the interpolation of the measuring data.

The options 12-bit and 16-bit are available.

For the closed-loop positioning, for each axis is respectively one module needed.

#### Technical data:

Input signals	1Vss, differential
Reference mark	Supported
Max. input frequency	
Resolution	12 Bit or 16Bit



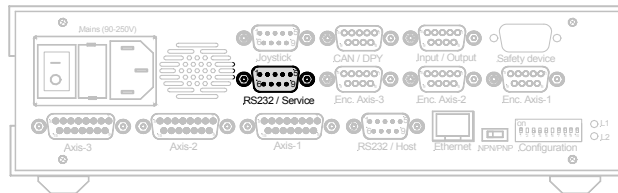
## Firmware update

The software of each device is called firmware. It checks all internal functions of the controller.

By dint of a service program, which can be operated easily, the firmware of the controller can be updated with low effort via the service interface and it is not necessary to open the device for that.

The firmware update offers the following advantages:

- **augmentation of the availability by the easy update on site.**
- **older devices stand to benefit from the further development by this update.**
- **problems in the firmware can be fast eliminated.**



.....

# Chapter 4

## Interfaces

# Interfaces concept

Corvus has the following programming interfaces:

- **RS-232**
- **Ethernet**
- **IEEE Interface**

If more interfaces are available, they can be used at the same time. Data reply messages are always transmitted to the interface from which the data query came.

The IEEE-488 interface is realized with an additional hardware. The description of this interface function is made in a separate documentation.

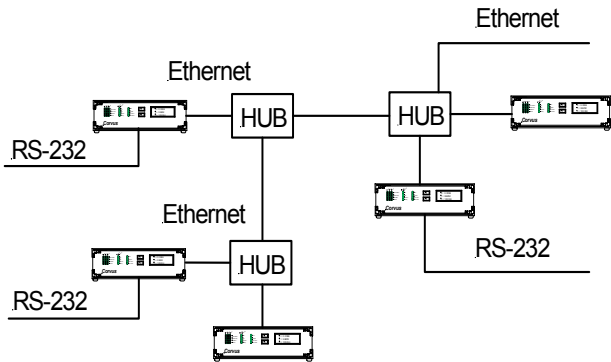


Figure 12: Corvus network topology

## Communication with Terminal or Host Mode

For communication via RS-232, Ethernet and IEEE-488 Terminal mode or Host mode can be selected.

In the terminal mode Corvus sends automatically data to the host for example a screen mask with position display and Venus-1 command entry.

In the host mode the controller is sending data only if these are queried.

See to "Connection with the hyperterminal" on page 30.

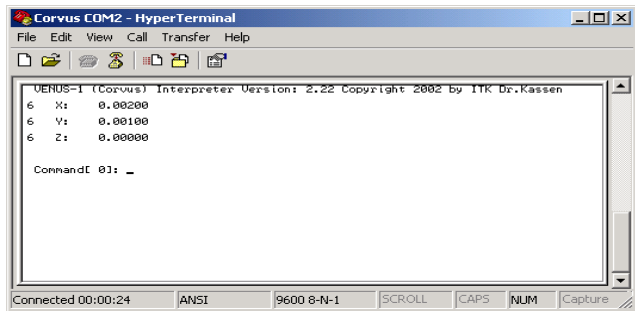


Figure 13: Screen shot of Microsoft Hyperterminal

## Configuration of Terminal or Host Mode

The setting terminal or host mode is defined either with DIP-Switch 6 or with the Venus-1 command **0 mode / 1 mode.**



Configuration

Figure 14: DIP-Switch 6 defines Terminal or Host mode

Dip-Switch 6	Function
ON	Terminal Mode
OFF	Host Mode

The setting of the DIP-Switch is dominant. That means, a stored setting could be overwritten with the Dip-Switch setting.

## RS-232 Interface

The RS-232 interface is the standard programming interface of Corvus.

The transmitting rate is variable in four steps and is configured with DIP-Switches which are at the rear of the controller.

### RS-232 interface configuration

Data bits	8
Stop bits	1
Parity	no
Protocol	no

### Baudrate

Dip-Switch1	Dip-Switch 2	Baudrate
OFF	OFF	9600
OFF	ON	19200
ON	OFF	57600
ON	ON	115200



Configuration

Figure 15: DIP-Switch

## Ethernet interface



Corvus can be enlarged with a 10-base Ethernet interface, so that the programming is possible via a network. Each Corvus has a network connection, so that the functionality can be activated later.

The Venus-1 command **getoptions** checks the released functions.

### General informations about Ethernet

Ethernet is a widely spread and producer independent technology with which data can be transmitted with a velocity of 10 Mbits/s or 100 Mbits/s in Local Area Network (LAN).

### Topology

The specification allows different network topologies of which tree and ring topology are shown below:

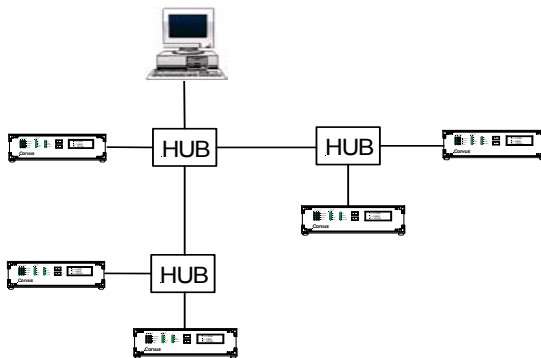
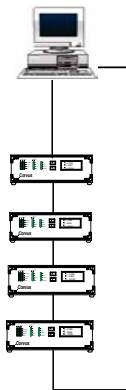


Figure 16: Ethernet network topology with Corvus



*Figure 17: Ethernet loop topology with Corvus*



## TCP / IP

Corvus Ethernet interface supports the protocol layers **TCP** and **IP**. They are also known as the so-called TCP/IP stack. Corvus is equipped with the interface of the modern communication technology which has penetrated into all areas of technology and is without doubt part of the industry standard.

The hardware of this technology is cheap and well-tested. This interface is part of all modern software products in the area of data communication or will be part of them in future. The advantage of that is a complete compatibility between hard- and software products. This leads to a considerable improvement of productivity.

The TCP/IP- protocol uses a number of well-known applications which are normally known as the terms below:

- **ftp**
- **telnet**
- **e-mail**
- **http**

## Hardware address (MAC-address)

Each device in a network which can independently produce data packets needs an unmistakable hardware-address, the so-called MAC-address (Media Acces Control-address).

This address is centrally administered to guarantee that it is only one time distributed worldwide.

MAC-address is programmed in the controller and can not be changed.

The address format consists of 6 byte in Hex-code, divided by a colon.

Example: 00:08:63:01:A2:B3

The Ethernet hardware address of each Corvus can clearly be identified.

The Venus-1 command ***getmacadr*** reads out this address.

## IP-address

If data packets shall be clearly addressed, in the internal network or in the internet, there is another address needed, the IP-address.

Like each telephone-connection can worldwide be clearly identified by its local area code number and telephone number, each device which is connected to a network can also clearly be addressed from the outside.

This address format consists of four numbers between 0 and 255 which are divided by a full stop.

Example: 134.109.72.64

Any IP-address can be stored in Corvus. It is written with the Venus-1 command **setipadr** and **save**, the command **getipadr** reads it back.

Factory setting is: 192.168.128.41

Example: 190 170 12 23 **setipadr**

The digits are divided by space!



**HINWEIS!**

It depends on the address structure of the respective network, which IP-address can be assigned for Corvus and it should be assigned by the responsible network administrator.

## Sub Mask

Submask adress = 255.255.255.0

At the moment not adjustable.

## Port-address

The IP-address is not the only information that you need to claim the services of a network participant. Different services can be offered via the TCP/IP-protocol (and that is why it is so widely spread).

The distant computer has to be advised about what the querying computer wants. That happens via the so-called ports. A query is always put to a fixed port number.

By that the distant computer knows what is requested and it can pass the query on to the appropriate program.

This detail is normally hidden for the user, as he mostly works with a fixed program which only claims a fixed service of other computers. Without knowing it he has chosen the port address by choosing the program for using the service and the program knows then, which port address offers the service.

Corvus supports **port 23** and with it the service **telnet**.

## Corvus Ethernet data summary

Connector	RJ45
Data	10 MBit/s
Protocol	TCP/IP
IP adress	arbitrary
MAC	Hardware
Submask adress	255.255.255.0
Port	23

.....

# Chapter 5

## Device concept

## Components of the controller

The controller consists of the following components:

- **Case**
- **Controller and Motor driver electronic**
- **Diagnostics display**
- **Power supply**
- **Operating system and firmware**

## Case variants

The modular composition of the controller makes possible a flexible case concept which allows different models. The following case variants are offered as standard.

- **Table top housing TT**
- **Cabinet mounted CM**
- **19" Rack, 2U / 3U**

Custom specific changes are possible.

### Table top housing TT

Chromated aluminum table housing with anodized front and back, is additionally equipped with a durable cover. Punched side plates make the passive ventilation possible. High performance devices receive an fan. Display variants are possible.

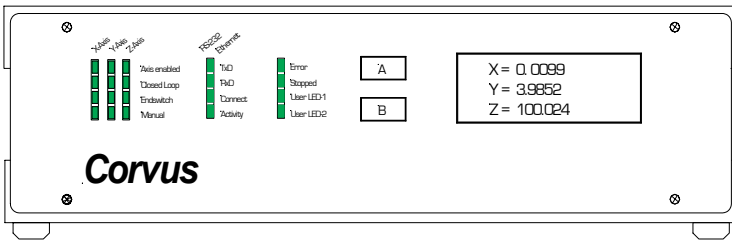


Figure 18: Front view of Corvus TT

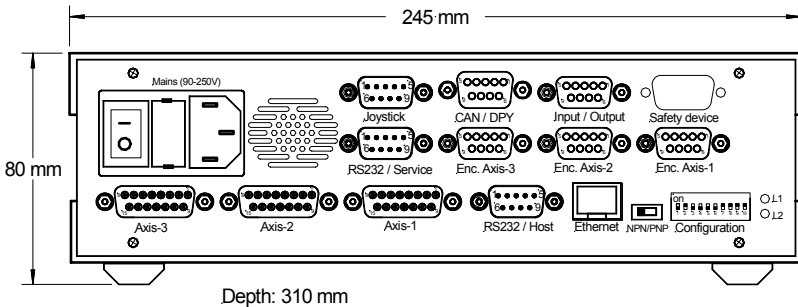
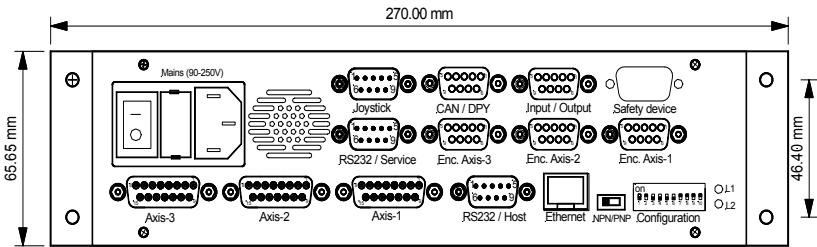


Figure 19: Rear view of Corvus TT



### Cabinet mounting case CM

This case is designed for the assembly in a cabinet. It is equipped with a larger front panel for mounting possibilities. Other mounting designs are also possible.



Tiefe: 300mm

Figure 20: Rear view of Corvus CM

### 19" Rack 2 U / 3U

Chromated aluminum table housing with anodized front and back panel. The mounting plates are at the front side. 3 U version is not shown.

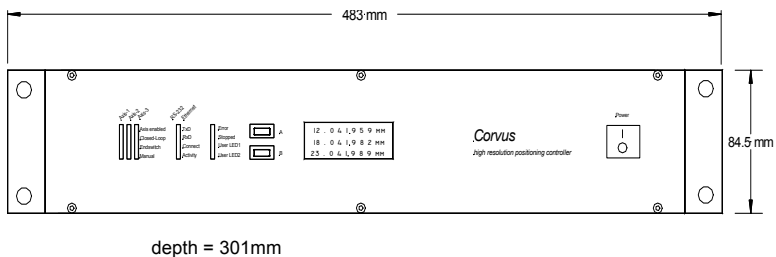


Figure 21: Front view of Corvus 19", 2U

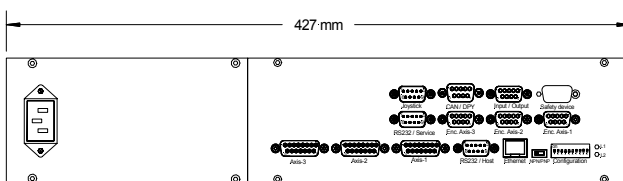


Figure 22: Rear view of Corvus 19", 2U

## Controller and motor driver electronic

The Corvus board is high integrated and equipped with the most modern components. Control part and motor-stages are accommodated on one board.

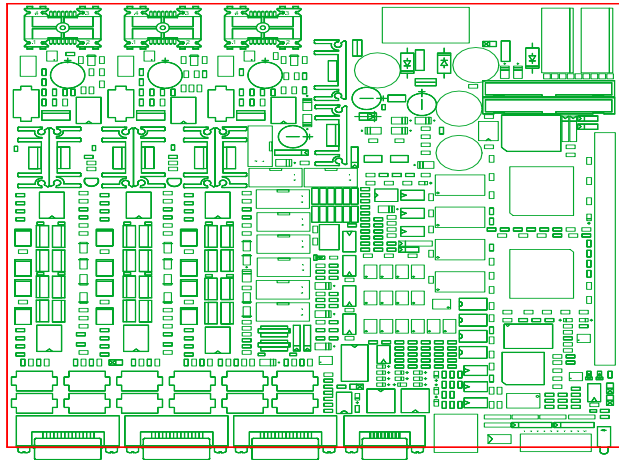


Figure 23. Corvus electronic board

### Parts of the board

• CPU (133 Mhz)	• RS-232 Interface
• Dual Port Bus	• Analog- / Digital conversion
• Flash Memory	• Closed Loop RS422 Interface
• DRAM Memory	• Input/Output
• SRAM Memory	• Temperature measurement
• Ethernet Interface	• Power distribution
• CAN-Bus Interface	• Motor current sensing
• SPI-Interface	• Motor driver circuit

## Diagnostic Display

The display- and operate-element at the front is part of the standard equipment of Corvus.

The most important operation states of the controller are shown with 20 LEDs.

Two buttons allow manual input functions.

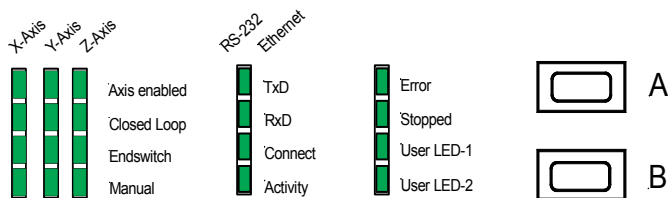


Figure 24. Diagnostic display

## Power supply

Corvus is able to support varying stepper motors with different power classes. Adjustment is also made with the power supply. Standard equipment is 50W.

In the following table all Corvus power classes and case variants are summarized.

Power	Case variants	Fan
• 50 W	• TT, CM, 19" (2U/3U)	• no
• 100W	• TT, CM, 19" (2U/3U)	• yes
• 150 W	• 19" (2U, 3U)	• yes
• 240 W	• 19" (3U)	• yes
• 500 W	• 19" (3U)	• yes

TT = Table top, CM= cabinet mounted,  
19"= Rack 2U or 3 U

## **Operation system and firmware**

Corvus is equipped with a real-time operating system. This concept allows an extremely fast reaction time of the software and has built up a solid basis for a high-end controller which can combine high resolution positioning, a highly developed communication and efficient special functions.

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# Chapter 6

## Technical data

## Overview

Number of axes	<ul style="list-style-type: none"> <li>• 2 or 3</li> </ul>
Phase current	<ul style="list-style-type: none"> <li>• until 2,5A</li> </ul>
velocity max. velocity min.	<ul style="list-style-type: none"> <li>• 45 rounds/ s</li> <li>• 15.26 nm/s</li> </ul>
acceleration max. acceleration min.	<ul style="list-style-type: none"> <li>• 1m/s<sup>2</sup></li> <li>• 15.26 nm/s<sup>2</sup></li> </ul>
Motor Power	<ul style="list-style-type: none"> <li>• 48V/ 50W (Standard)</li> <li>• 48V/ 75W</li> <li>• 48V/ 100W</li> <li>• 48V/ 500W (only with 2U or 3 U Rack)</li> </ul>
Supported motors	<ul style="list-style-type: none"> <li>• Stepper motor, 2-Phases or 3-Phases, bipolar,</li> </ul>
Programming	<ul style="list-style-type: none"> <li>• ASCII commands Venus-1</li> <li>• Windows user interface</li> <li>• Software library (dll)</li> </ul>
Resolution in program- ming mode	<ul style="list-style-type: none"> <li>• 15.26 nm</li> </ul>
Resolution in Joystick mode	<ul style="list-style-type: none"> <li>• 23.7 fm (femto meter)</li> </ul>
Positioning modes	<ul style="list-style-type: none"> <li>• Absolute, relative, vector, error correction</li> </ul>
Acceleration modes	<ul style="list-style-type: none"> <li>• linear (trapezoid), sin<sup>2</sup> (s-curve)</li> </ul>
Closed Loop	<ul style="list-style-type: none"> <li>• sin/cos 1Vss or RS422 quadrature</li> </ul>
Processor	<ul style="list-style-type: none"> <li>• 32 Bit Risc Processor</li> </ul>
Operating system	<ul style="list-style-type: none"> <li>• Real-time operating system</li> </ul>
Motor driver	<ul style="list-style-type: none"> <li>• Digital MOS-FET</li> </ul>
Communication	<ul style="list-style-type: none"> <li>• RS-232 Host or Terminal until 115kBaud.</li> <li>• Ethernet, 10BaseT with TCP/IP Stack</li> <li>• CAN-Bus</li> <li>• IEEE-488</li> </ul>



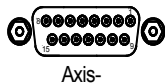
Inputs / Outputs	<ul style="list-style-type: none"> <li>• 3 x endswitch inputs</li> <li>• 3 x Digital inputs</li> <li>• 3 x Digital outputs</li> <li>• 2 x Analog inputs 0-10V</li> <li>• 2 x Analog outputs 0-1V</li> <li>• 3 x Temperature inputs (-25°C until 100°C)</li> </ul>
Output power	<ul style="list-style-type: none"> <li>• +5V, 1000 mA</li> <li>• +12V, 300 mA</li> <li>• +24V, switchable as motor break (option)</li> <li>• +48V, Power output (option)</li> </ul>
Digital inputs for position measurement.	<ul style="list-style-type: none"> <li>• 3 x RS422 Quadrature (option)</li> <li>• Reference mark supported</li> <li>• Input frequency 10 Mhz.</li> </ul>
Analog inputs for position measurement	<ul style="list-style-type: none"> <li>• 3x sin/cos 1Vss (option)</li> <li>• Reference mark supported</li> <li>• Input frequency</li> </ul>
Safety functions	<ul style="list-style-type: none"> <li>• Motor disable (option)</li> <li>• Relay contacts (option)</li> </ul>
Display with touch terminal	<ul style="list-style-type: none"> <li>• Graphic-Display with terminal function</li> <li>• User menu, 10 key input (option)</li> </ul>
Input keys	<ul style="list-style-type: none"> <li>• 2</li> </ul>
Diagnostic display	<ul style="list-style-type: none"> <li>• 20 LED</li> </ul>
Accessories	<ul style="list-style-type: none"> <li>• Joystick, 2 with 3 axes</li> <li>• Joystick with graphic display / Terminal function</li> <li>• Handwheel</li> </ul>
Functions	<ul style="list-style-type: none"> <li>• Soft trigger out (option)</li> <li>• Real-time trigger out (option)</li> </ul>
Case variants	<ul style="list-style-type: none"> <li>• Table top</li> <li>• Cabinet mounted</li> <li>• Rack</li> </ul>
Power supply	<ul style="list-style-type: none"> <li>• 90-250V (wide range input)</li> </ul>
Standards	<ul style="list-style-type: none"> <li>• IEC 1010-1, EN61010-1, EN55011 EN50082-1</li> </ul>

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# Chapter 7

## Connectors

## Motor connector



Pin	Name	Description
1	Ph 1A / U	Motor phase 1 A
2	Ph 1B / W	Motor phase 1 B
3	Ph 2A / V	Motor phase 2 A
4	Ph 2B	Motor phase 2 B
5	Ref	Reference switch
6	User +5V	User power supply
7	User +12V	User power supply
8	Temp In	Temperature input
9	Ph 1A / U	Motor phase 1 A -> (Pin 1)
10	Ph 1B / W	Motor phase 1 B -> (Pin 2)
11	Ph 2A / V	Motor phase 2 A -> (Pin 3)
12	Ph 2B	Motor phase 2 B -> (Pin 4)
13	cal	Endswitch input cal (lower limit)
14	rm	Endswitch input rm (upper limit)
15	GND	Ground

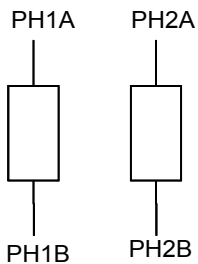
TABLE 25. Motor connector of one axis

## Motor wiring

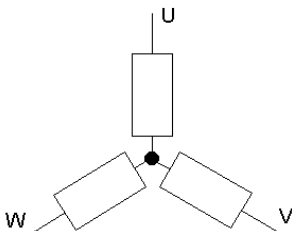
The adjustment to the different motor types is accomplished with the following Venus-1 commands:

- ***setphases***
- ***setumotmin***
- ***setumotgrad***
- ***setpolepairs***

### Stepper motor with 2-phases



### Stepper motor with 3-phases



# RS-232 programming interface

This interface is used for the standard programming mode  
T



Pin	Name	Function
1	nc	nc
2	RxD	Corvus data input
3	TxD	Corvus data output
4	DTR	Connected with Pin6
5	GND	GND
6	DSR	Connected with Pin4
7	RTS	
8	CTS	
9		

TABLE 26. RS-232 programming interface



**HINWEIS!**

The RS-232 interface is working without flow control.  
The handshake signals RTS and CTS are not supported.  
DTR and DSR are internal connected.

# RS-232 service interface

This interface is used for the firmware update.



Pin	Name	Function
1	nc	nc
2	RxD	Corvus Data input
3	TxD	Corvus Data output
4	DTR	Connected with Pin6
5	GND	
6	DSR	Connected with Pin4
7		
8		
9		

TABLE 27. RS-232 service interface

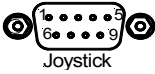
# Ethernet interface



Pin	Name	Function
1	TxD+	Corvus data output
2	TxD-	Corvus data output
3	RxD+	Corvus data input
4		
5		
6	RxD-	Corvus data input
7		
8		
9		

TABLE 28. Ethernet interface

# Joystick input



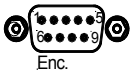
Pin	Name	Function
1	Axis-1 (X)	Analog input 0-3.3V
2	Axis-2 (Y)	Analog input 0-3.3V
3	Axis-3 (Z)	Analog input 0-3.3V
4	Joystick enable	Enable input GND = enable
5	+5V (User)	User output
6	SW	Joystick Button
7	GND	GND
8	AGND	analog GND
9	3.3V (analog)	Power

TABLE 29. Joystick input



# Encoder input

Used for Closed Loop control via digital encoders

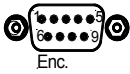


Pin	Name	Function
1	Ua 1	Channel A (positive)
2	Ua 2	Channel B (positive)
3	Ua 0	Reference (positive)
4	DGND	GND
5	+5V (User)	User output
6	Ua 1-	Channel A (negative)
7	Ua 2-	Channel B (negative)
8	Ua 0-	Reference (negative)
9	Error	Encoder error

TABLE 30. Encoder input

## Sin/cos 1Vss input

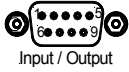
Used for Closed Loop control with analog measurement systems



Pin	Name	Function
1	+5V analog	Analog Vcc
2	Event	Event
3	Ua 1 +	sin +
4	Ua 1 -	sin -
5	Ua 2 +	cos +
6	Ua 2 -	cos -
7	Ua 0 +	Reference (positive)
8	Ua 0 -	Reference (negative)
9	AGND	Analog ground

TABLE 31. Sin/cos 1Vss input

## Digital input / output



Pin	Name	Function
1	DGND	Digital GND
2	Input 2	Input 2 (0-24V)
3	User +5V	User output
4	Output 2	Output 2 (0-24V)
5	SPNG	SPNG
6	Input 1	Input 1 (0-24V)
7	Input 3	Input 3 (0-24V)
8	Output 3	Output 3 (0-24V)
9	Output 1	Output 1 (0-24V)

TABLE 32. Digital input / output

## Safety device



Pin	Name	Function
1	REL1	Relay Pin1
2	DGND	Digital GND
3	User +5V	User output
4	Enable 3	Enable axis-3
5	Enable 1	Enable axis-1
6	REL2	Relay Pin2
7	User GND	GND
8	Enable 2	Enable axis-2
9	User +12V	User output

TABLE 33. Safety device connector



**HINWEIS!**

If the safety connector is not installed the motor axis are enabled internally.