Corvus eco

high resolution positioning controller

Manual

About this documentation

This manual provides detailed information about the hardware and software features of the Corvus-eco controller. This includes specifications, functions, installation and connector description.

The Venus-1 programming language is described in a separate part of the controller documentation.

Symbols in this documentation

To clarify the content following symbols are used.

Symbol	Description
	Warning. This information must be observed strictly.
	Important information.
	Indicates that this function can be enabled with a release code.
	This function must be installed from the factory personal or experts.
Venus-1	Venus-1 commands are indicated with this formatting style.

TABLE 1:Symbols and their meaning

Chapter 1

Introduction

Presentation of the controller

Corvus-eco

Corvus eco with a built in joystick

Technology

Corvus-eco is a complete high resolution stepping motor controller/driver combination for alternatively 2 or 3 axes.

Corvus-eco is equipped with a 32-bit, 133MHz Risc processor working with a Real-Time-Operating-System (RTOS) for scalable performance and high precision synchronized control.
For Closed Loop control a digital PID control loop updates all axes with a cycle time of 250 µs for precise and accurate positioning.
A extremely micro-step resolution up to 690.000 steps/rev. provides ultra-smooth stepper positioning capability and a very constant velocity profile tracking for challenging positioning applications.

Low impedance MosFet motor drivers guarantee high motor performance and a cool driver electronics.

Motion types

Corvus-eco provides point-to-point, jogging, linear interpolated moving and also velocity controlled moves with the possibility of on the fly velocity updates.
Software limits can be set to improve the systems safety.
A advanced limit switch teach-in procedure determines the working range and ensures the precision of homing.

Resolution, velocity and acceleration

The elaborated controller technology enables a low-noise positioning and an extremely high stepping resolution. In the programmable mode, a positioning resolution of 1,5 nm is achieved.
The resolution in the joystick mode is 23.2 fm (femtometer).
Due to the high computing power Corvus-eco has a high speed and acceleration dynamic from 15nm/s until 25mm/s (pitch =1mm.)
Linear- or sin²-accelerations modes are also supported.

Options

Corvus-eco is supplied with a great variety of options.
See Table 2, “Function survey,” page 12.

Communication

RS-232 or USB

Programming

Corvus-eco is programmed with ASCII command language Venus-1. For easy motion programming the controller supports native units such as µm, mm, inch, m, mm/s, mm/s²

Manual operation

For manual operation a analog joystick interface is provided. Additionally Corvus-eco is available with a build in joystick.

Firmware update

To keep the Corvus-eco firmware always up to date the controller firmware can be easily updated.

Function survey

The following table summarizes the functions of the Corvus-eco motion controller/driver.

Features	Standard / Option
• Axis-1, Axis-2	• Standard
• Axis-3	• Option / Code
• 24V motor driver voltage	• Standard
• Max. motor phase current: 1.5A	• Standard
• Max. motor driver resolution: 1.5nm	• Standard
• Motor revolution (200 step motor): 15 rev/s	• Standard
• Motor revolution (200 step motor): 25 rev/s	• Option / Code
• Joystick operation for external joystick	• Standard
• Joystick operation with internal joystick	• Special order code
• ASCII command language	• Standard
• Motion macro execution	• Standard
• Error correction 1D, open loop and closed loop	• Standard
• Sin²- acceleration (s-curve)	• Standard
• Closed Loop (RS422 inputs)	• Option / Code
• Closed Loop (1Vss inputs)	• Option / Code / Hardware
• 2 Limit switch inputs	• Standard
• Digital I/O, 3 inputs / 3 outputs	• Option / Code
• Trigger out function, max. 4 kHz, resolution=250µs	• Option / Hardware
• Position capture input, max. 1.000 position data	• Option / Code
• Motor enable/disable input	• Option / Hardware
• Firmware update capability	• Standard
• RS-232 interface	• Standard
• USB interface	• Option / Hardware

Table 2. Function survey

Standard: Basic configuration.
Option / Code: Release code required.
Option / Hardware: Additional hardware required.
Option / Code / Hardware: Additional hardware required + release code required.

Chapter 2

Starting up

Safety notice

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

In no event will the manufacturer be liable for direct, indirect, special, incidental, or consequential damages arising out the use of inability to use the product or documentation, even if advised of the possibility of such damages.

Declaration by the manufacturer

The company

PI miCos GmbH
Freiburger Strasse 30
D-79427 Eschbach

declares that the product:

Corvus-eco

intended use:

Positioning Controller

meet the following directives and standards:

Directive 73/23/EEC
Electrical Apparatus
Low Voltage Directive

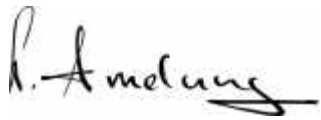
Directive 89/336/EEC
Electromag. compatibility

European Standards:

EN61010-1 (08.2002)
EN61326-1
EN61000-3-2, EN61000-3-3

Remarks:

Initial operation of the Corvus-eco controller sold by us is not permitted until it has been assured that the machine/system, in which our Controller is installed, complies with the EU machine guidelines.



Lucius Amelung (Managing Director)
Eschbach, 06.06.2006

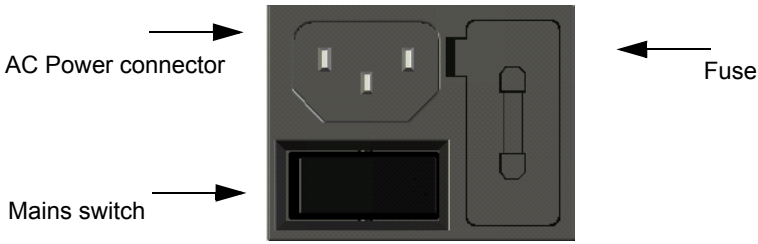
Mains supply

Universal input voltage

Corvus-eco is ready for connection to the mains.
The integrated power supply unit has a wide range voltage input which adapts the controller automatically to input voltages from AC 90V up to AC 250V.

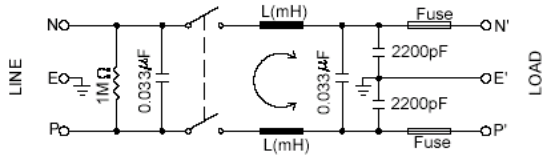
Mains protection

The mains side is protected by a standard 250V/ 3A fuse
It is located in the power entry module and accessible from the outside.



Line filter

A line filter protects the controller from common-mode and differential -mode interferences.



Motor connection

Axes designation and assignment

Motor connectors are designated as Axis-1, Axis-2, Axis-3. They consequental were not labeled as X-Y-Z because this assignment is determined by the application.
The controller is equipped with two axes by default.
Axis-3 is optional available.

Motor types

Corvus-eco supports 2-Phase DC stepping motors with step angle 0.9 or 1.8°. Maximum phase current = 1.5A

We recommend Hybrid motors. This motors have 200 rotor teeth and rotate at 1.80 step angles. Other hybrid motors are available in 0.9ºand 3.6º step angle configurations. Because they exhibit high static and dynamic torque and run at very high step rates, hybrid motors are used in a wide variety of industrial applications.

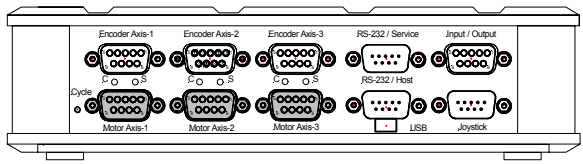


Figure 1: Corvus-eco motor connectors

Motor characteristics

The following stepper motor parameters are important.

- Step Angle
- Current per Phase
- Resistance per Phase
- Inductance per Phase
- Lead Wires

The motor torque during operation depends on the speed and has to be taken from the motor characteristic curve.

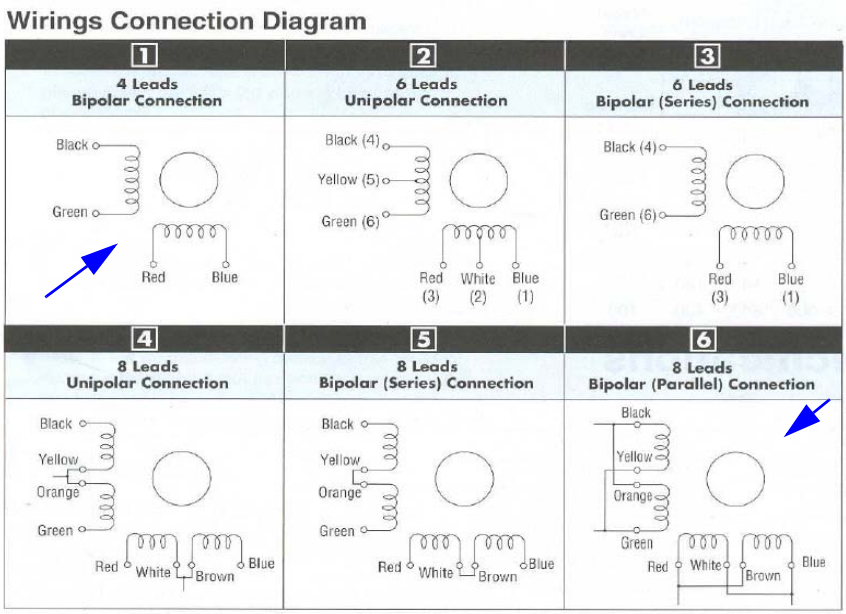
Typical values:

Step Angle	Current per Phase	Resistance per Phase
0.9°, 1.8°, 3.6°	up to 1.5A	up to 10R

Inductance per Phase	Lead wires
up to 5mH	4 / 8

Motor wirings

Following table shows different motor wirings.
We recommend Type 1 and Type 6.
The diagrams are taken from a "Oriental Motor" data sheet.

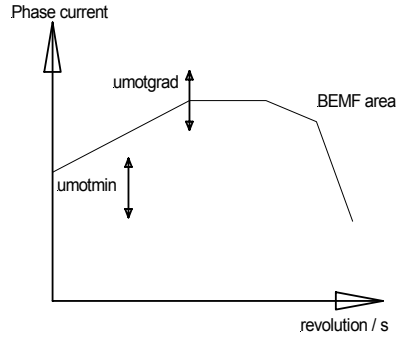


Commands to adapt the controller to different motor types

To adapt the motor driver to the motors the following Venus-1 commands are provided:

setumotmin	Determines the phase current if the motor stand-still. This affects the holding torque and power consumption at the motors.
setumotgrad	Determines the phase current and moving torque if the motor is moving.
setpolepairs	Adapts controller to polepairs of the different motor types. 0.9° Hybridmotor polepairs = 100 1.8° Hybridmotor polepairs = 50

More informations see in the Venus-1 manual.



Above diagram describe the typical stepper motor behavior. The motor torque depends in the BEMF (back-electromotive-force) area on the revolutions / torque characteristic of the motor.
At lower and medium step rates the settings of umotmin and umotgrad are dominant for the motor characteristic.

Measures against system resonances

The combination of a motor and the involved mechanical drive components are forming a typical spring/mass system that can oscillate if the damping of the mechanics is insufficient.
Stepper motors resonance appearances are possible. In a worst case situation the stepping motor will stall with a whistling sound.

An effective countermeasure against this kind of resonances are damping elements which are for typically installed on the extended motor shaft.
For precision position tasks we always recommend the use of this damping measure.

A cause for resonances are often overdimensioned motors. In this case we suggest to reduce the torque via the motor parameter umotmin/umotgrad or choosing a more suitable motor.

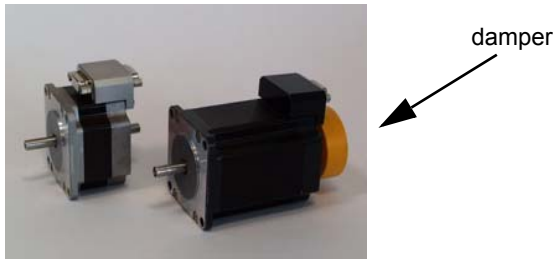


Figure 2: Motor with and without damper

Motor cable

If the motor cables are 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 4m it can be necessary to adapt cable losses by a modified configuration of the motor parameters ***setumotmin*** and ***setumotgrad.***

For the EMC-compatible fitting of the cable, a total shielding is prescribed whereby the cable shield is connected to the housing.
The DSUB-9 motor connector should have a metal case. The fasten nuts of the DSUB connectors of the controller are equipped with an UNC4-40 thread.

Upon request we manufacture motor cables according to customer´s demands.

An incorrect wiring of the motor connection can damage the controller.

Figure 3: Shielded motor cable with metal connector housing

Limit switches

Limit switch inputs

Corvus-eco provides 2 limit switch inputs for each axis.
The inputs are situated at the motor connector. The switch inputs are designated due to their function as ***cal*** limit switch input or as ***rm*** limit switch input.
The limit switch function is directly linked to these inputs; no other function can be assigned to them.

Limit switch functions

Following limit switch functions are available:

- **teach-in of lower limit switches (Venus-1 command *cal*)**

The controller moves all axes simultaneously in negative direction until the cal limit switches are reached.

- **teach-in of upper limit switches (Venus-1 command *rm*)**

The controller moves all axes simultaneously in positive direction until the rm limit switches are reached.

- **teach-in the limits of a single axis**

The controller moves a selected axis to the cal or rm limit switch. Details see chapter "Functions"

Limit switch types

Corvus-eco supports the following limit switch types:

- **mechanical switches**
- **inductive proximity switches**
- **photo sensors**

5V (default) or 12V (upon request) are also available at the motor connector to supply the switches.

Limit switch wiring

Corvus-eco supports NPN and PNP limit switch wiring. Default setting is NPN.

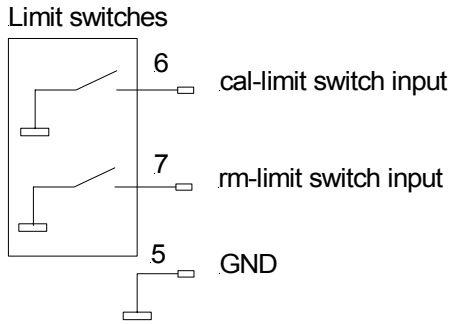
The settings NPN to PNP can only be changed from the factory personal or from authorized experts.

Function of limit switch types:

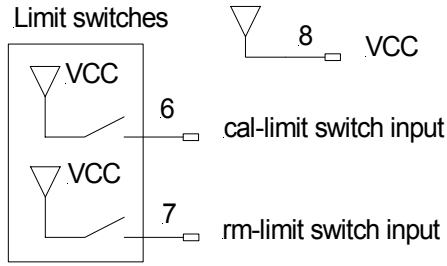
- **NPN = the limit switch closes or opens to Ground**
- **PNP = the limit switch closes or opens to VCC**

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

NPN
factory setting

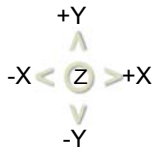


PNP



Joystick operation

General remarks



For joystick operation the controller is working independent from a host control unit (subject the controller settings must not be changed)
Motor moving is controlled from the deflection of the joystick axes, this allows a very sensitive and intuitive positioning of the motors.

Figure 4: FJ Joystick with speed buttons

Joystick axes assignment

The axis of the joystick are assigned to the axis of the controller as follows:

Joystick axes	Controller axes
X-Knob	Axis-1
Y-Knob	Axis-2
Z-Knob	Axis-3

Joystick button speed

Two parallel wired push buttons are provided at the joystick to activate a second joystick velocity.
This velocity is valid as long as one buttons is pressed.

The second joystick speed can be defined with the Venus-1 command ***setnjoyspeed***

Relevant Venus-1 commands for the joystick operation

Command	Description
setjoyspeed	max. joystick velocity valid for all axes
set**n**joyspeed	max. joystick velocity each axis separately
setjoy**b**speed	max. joystick velocity if button is pressed valid for all axes
setmanaccel	manual acceleration valid for all axes

Notices for the joystick mode

- **During power up the zero value of the joystick axes are checked. Due this, the joystick axes may not be deflected this time.**
  If the zero value of a joystick axis is out of a determined value, the manual mode for this axis is disabled.

- **If the joystick is disconnected during a manual positioning, the axes are stopped immediately.**
  The joystick mode remains active.

- **For safety reasons the joystick will be switched off automatically if a programmed move is performed.**
  Afterwards the joystick has to be switched on.

Programmed mode

For program controlled operation a programming host has to be connected with the controller.
Corvus-eco provides the following programming interfaces:

- **RS-232 interface**
  It is not necessary to install a driver to communicate with the Corvus-eco RS-232 interface.

- **USB interface**
  This communication assumes a driver installation.
  The installation procedure for Windows 2000 and Windows XP is described in this manual.

Initial operation of the RS-232 connection

Testing the RS-232 connection

- **Testing with WinPos**

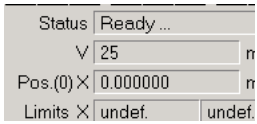
WinPos16 LT is added for free to each controller. It is qualified to execute all functions of the controller and can be used to check the RS-232 connection.

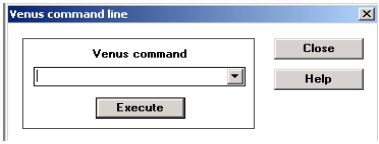
Procedure step by step:

- **Connect RS-232 cable to PC and controller**
- **Switch on the controller**
- **Start WinPos**
- **Select Com Port, choose correct port settings**

"Connecting" WinPos
WinPos automatically communicates with the controller while it is reading the controller settings.
If Status "Ready" is displayed, the RS-232 communication is well established.

- **It is now possible to open the Venus command line to execute Venus-1 commands.**





Details see in the WinPos manual.

Trouble shooting

- **The RS-232 cable, included in the delivery, should preferably be used. If the cable is in-house produced the correct wiring has to be ensured. See connection diagram in Chapter "Connectors"**

- **The interface configurations of the control unit has to correspond accurately with the following settings.**

• Data bits	• 8
• Stop bits	• 1
• Parity	• no
• Handshake	• no
• Baudrate	• 57600

- **If the delivered RS-232 cable is used with an additional interface adapter, please verify if this adapter does not modify the RS-232 wiring.**

- **The serial interface of the control unit may not be occupied by other programs.**

USB-Interface

USB interface driver

Corvus-eco is equipped with an internal USB to RS-232 interface that uses the well established controller chip FT232AM (FT232BL) from FDI.
To operate with this interface a virtual Com Port must be installed.
Virtual COM port (VCP) drivers cause the USB device to appear as an additional COM port available to the PC. Application software can access the USB device in the same way as it would access a standard COM port.
VCP drivers are available which allow the FT232BL device to work with the following operating systems:

- **Windows XP x64**
- **Windows Server 2003 x64**
- **Windows XP**
- **Windows Server 2003**
- **Windows 2000**
- **Windows ME**
- **Windows 98**
- **Linux**
- **Mac OS X**
- **Mac OS 9**
- **Mac OS 8**
- **Windows CE.NET (Version 4.2 and greater)**

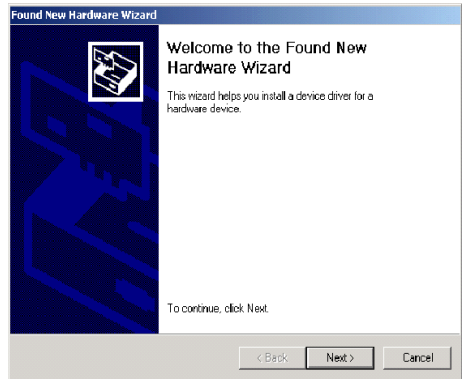
Driver link

The following link provides actual drivers:
http://www.ftdichip.com/Drivers/VCP.htm

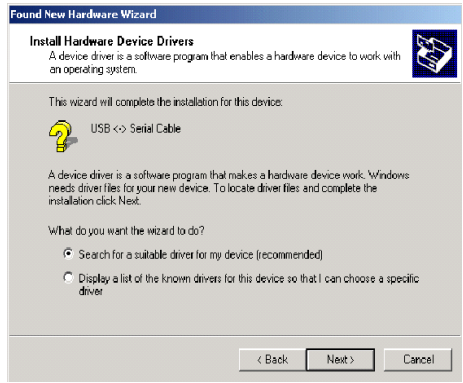
Installing VCP drivers for Windows 2000

To install VCP drivers for a FT232AM device under Windows 2000, follow the instructions below:

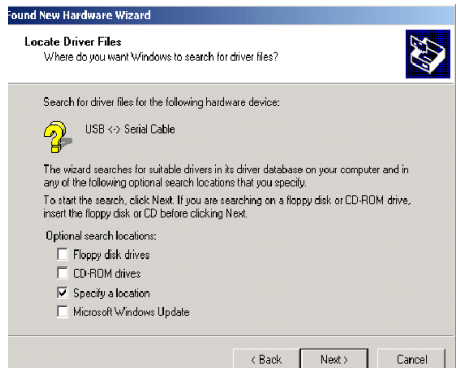
- **If a device of the same type has been installed on your machine before and the drivers that are about to be installed are different from those installed already, the original drivers need to be uninstalled.**
- **Download the latest available VCP drivers from the FTDI website and unzip them to a location on your PC.**
- **Connect the Corvus-eco to a spare USB port on your PC. This will launch the Windows Found New Hardware Wizard. Click "Next" to proceed with the installation.**



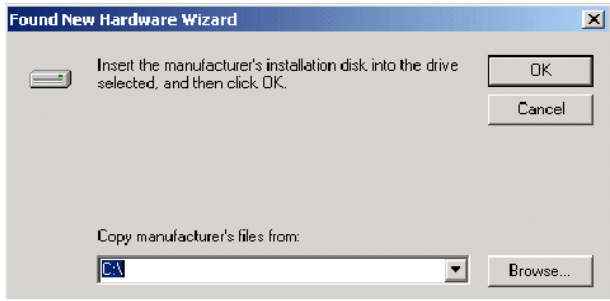
- **Select "Search for a suitable driver for my device (recommended)" as shown below and then click "Next".**



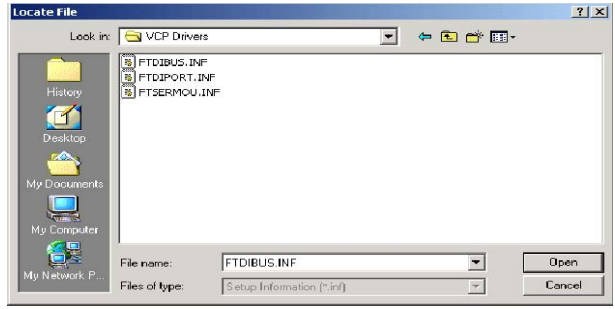
- **Check the box next to "Specify a location" and uncheck all others as shown below.**



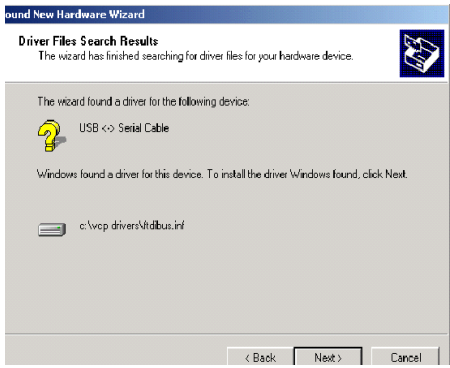
- **Clicking "Next" displays a dialog box for you to enter to the location of the drivers.**



- **Click "Browse" to display an open file dialog box.**

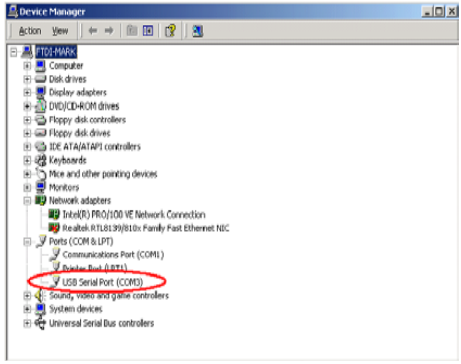


- **Locate the folder containing the latest drivers downloaded from the FTDI website above and click "Open", then click "OK". The PC autoselects the correct INF file, in this case FTDIBUS.INF. Once Windows has found the required driver.INF file, click "Next" to proceed.**



- **Windows should then display a message indicating that the installation was successful. Click "Finish" to complete the installation. This has installed the serial converter. The COM port emulation driver must be installed after this has completed.**

- **After clicking "Finish", the Found New Hardware Wizard will continue by installing the COM port emulation driver. The procedure is the same as that above for installing the serial converter driver, except the PC will autoselect the FTDIPORT.INF file.**
- **Open the Device Manager (located in "Control Panel\System" then select the "Hardware" tab and click "Device Manager…") and select "View > Devices by Type". The device appears as an additional COM port with the label "USB Serial Port".**



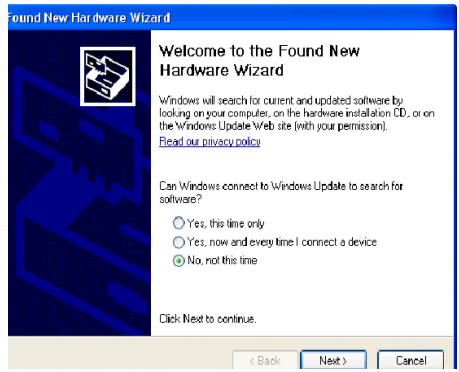
Installing VCP drivers for Windows XP

To install VCP drivers for a, FT232AM device under Windows XP and XP SP1, follow the instructions below:

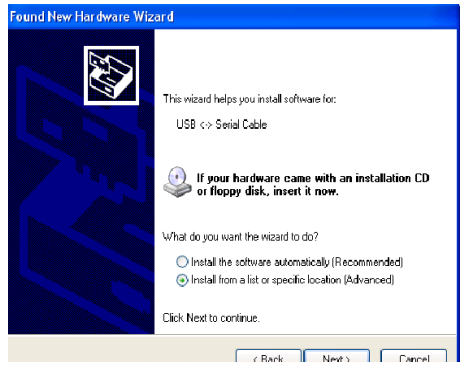
- **If a device of the same type has been installed on your machine before and the drivers that are about to be installed are different from those installed already, the original drivers need to be uninstalled.**

- **Download the latest available VCP drivers from the FTDI website and unzip them to a location on your PC.**

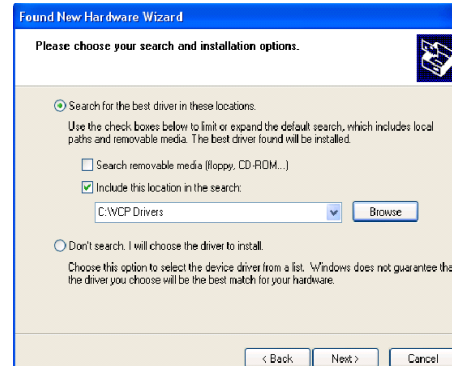
- **If you are running Windows XP or Windows XP SP 1, temporarily disconnect your PC from the Internet. This can be done by either removing the network cable from your PC or by disabling your network card by going to the "Control Panel\Network and Dial-Up Connections", right clicking on the appropriate connection and selecting "Disable" from the menu. The connection can be re-enabled after the installation is complete. This is not necessary under Windows XP**
- **SP 2 if configured to ask before connecting to Windows Update. Windows XP SP 2 can have the settings for Windows Update changed through "Control Panel\System" then select the "Hardware" tab and click "Windows Update".**
- **Connect the Corvus-eco to a spare USB port on your PC. This will launch the Windows Found New Hardware Wizard. If there is no available Internet connection or Windows XP.**
  SP 2 is configured to ask before connecting to Windows Update, the screen below is shown. Select "No, not this time" from the options available and then click "Next" to proceed with the installation. If there is an available Internet connection, Windows XP will silently connect to the Windows Update website and install any suitable driver it finds for the device in preference to the driver manually selected.



- **Select "Install from a list or specific location (Advanced)" as shown below and then click "Next".**

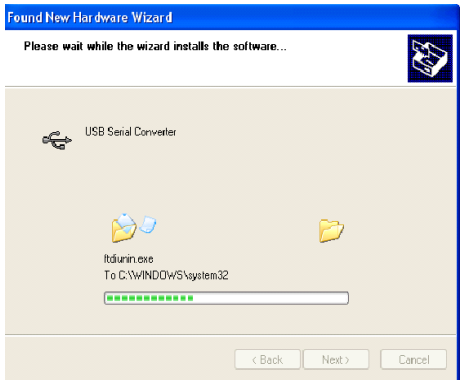


- **Select "Search for the best driver in these locations" and enter the file path in the combo-box ("C:\VCP Drivers" in the example below) or browse to it by clicking the browse button. Once the file path has been entered in the box, click next to proceed.**

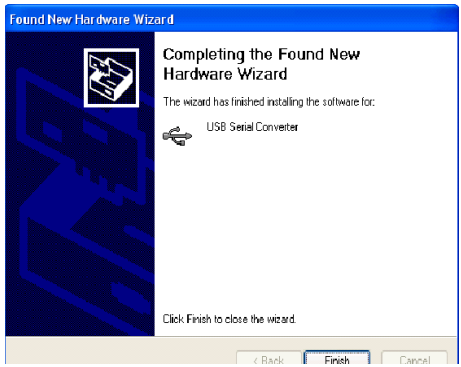


- **If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed, the following screen will be displayed. Click on "Continue Anyway" to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear.**

- **The following screen will be displayed as Windows XP copies the required driver files.**

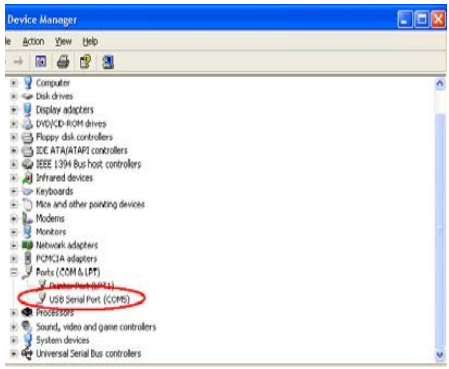


- **Windows should then display a message indicating that the installation was successful. Click "Finish" to complete the installation. This has installed the serial converter. The COM port emulation driver must be installed after this has completed.**



- **After clicking "Finish", the Found New Hardware Wizard will continue by installing the COM port emulation driver. The procedure is the same as that above for installing the serial converter driver.**

- **Open the Device Manager (located in "Control Panel\System" then select the "Hardware" tab and-click "Device Manger") and select "View > Devices by Type". The device appears as an additional COM port with the label "USB Serial Port".**



Chapter 3

Functions

Programming mode

Corvus-eco is programmed via the RS-232 or USB interface. The command language is Venus-1.

The principle of the host control

There are reading commands and writing commands.
Writing commands execute the activities. Reading commands are used to check the controller configuration resp. the current state.
An automatic status reply message can be generated by a combination of commands, see example.

During a positioning task is executed, the status of the controller and the current coordinates can be replied.

The Venus-1 command language is described in a second part of the Corvus-eco documentation.

Venus-1 controller commands (examples)

System commands

save parameters:
save

restart controller:
reset

Configuration commands

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

Example: switching on the 2nd axis

1 2 setaxis

Positioning commands

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

Example:
Absolute move, all axes are moved to the coordinates below
1.204 4.01 3.4 move

Relative move,
0.001 0.002 0.001 r

Status commands

System status:
st

Status of the digital inputs:
getin

Actual position read out
pos

More information see in manual "Venus-1 command language"

Automatic status reply

The following command sequence must be sent to the controller to cause the controller to send a status reply automatically.

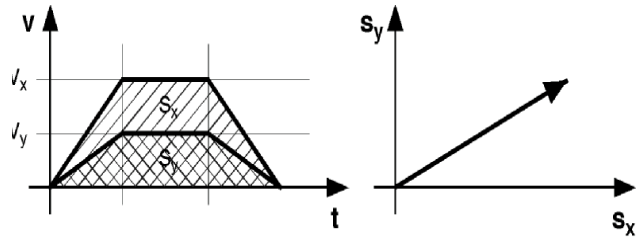
Example:

```
10 12 4 m   // move to the desired coordinates
0 0 0 r     // no operation command, locks interpreter
               until it is executed
st          // command will reply status
               if interpreter is unlocked
```

Motion control functions

Linear interpolation

In the programmed positioning mode the axes are linear interpolated and a so-called vector move is executed.
In doing so, the involved axes are synchronized that way that the time of acceleration and the time of deceleration are equal.
A cross table with the axes x and y executes thereby a straight movement.



Velocity and acceleration

The settings 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_{lim}

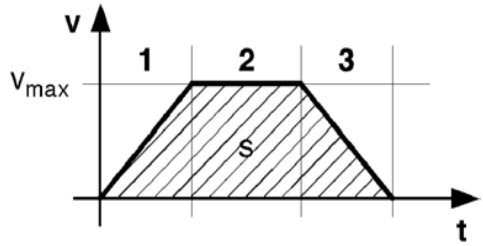
$$v = \frac{s}{s_{lim}} \text{ Þ } v_{lim}$$

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

Velocity profile of a linear acceleration function

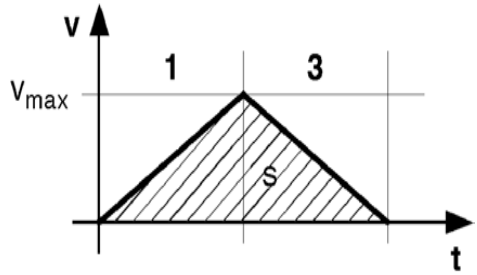
The movement profile of a programmed move which is produced with a linear acceleration function has the form of a trapezium. The area under the curve corresponds to the covered distance ***s*** and the pitch of the curve corresponds to the acceleration ***a***.
See v/t graph below.

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



Movement profile of short distances

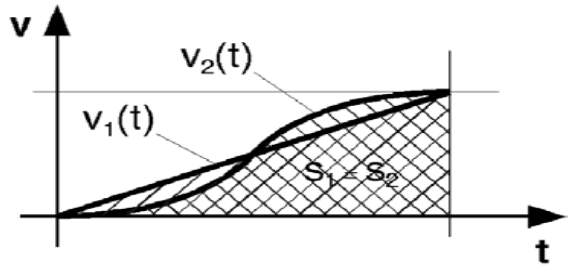
The graph below shows the positioning of a short distance. It can not always be guaranteed here that the axis reaches it's maximum velocity.
The movement profile has the form of a isosceles triangle.



Movement profile of the sin²-acceleration function

For the sin²-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 this profile.

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



Positioning with the joystick

The joystick mode allows a very sensitive positioning of the axes with an analog joystick.

This movement is velocity controlled and caused by the deflection of the joystick.
The larger the deflection, the larger the velocity. In joystick mode the axes can be moved independently.

The position resolution with the joystick is enormous.
The internal calculation works with 32 bit and reaches a resolution of theoretically **23.2 fm** (femtometer).

Joystick button speed

The two parallel wired push buttons of the joystick can switch to a freely definable second joystick velocity.
This velocity is valid as long as one of the buttons are pressed.

Relevant commands:

Command	Description
setjoyspeed	max. joystick velocity valid for all axes
set**n**joyspeed	max. joystick velocity each axis separately
setjoy**b**speed	max. joystick velocity if button is pressed valid for all axes
setmanaccel	manual acceleration valid for all axes

Notices for the joystick mode

- **During power up the zero values of the joystick axes are checked. Due this, the joystick axes may not be deflected this time.**
  If zero value of a joystick axis is out of a determined value, the manual mode for this axis is disabled.

- **If the joystick is disconnected during a manual positioning, the axes are stopped immediately.**
  The joystick mode remains active.

- **For safety reasons the joystick will be switched off automatically if a programmed move is performed.**
  Afterwards the joystick has to be switched on.

Closed-Loop function

This function enables the operation in a feedback control mode.
Therefore the actual position is monitored by a measuring system and looped back to the controller.

Depending on the type of the measuring system the function has the following advantages.

- Increasing the repeatability
- Improvement of the absolute accuracy
- Step monitoring
- Load compensation during the movement and a standstill
- Improved controlling behavior
- Supports fast and high precise positioning procedures using the closed loop function " in-window "
- Enables high precision measuring functions
- Increases precision of the "trigger out function"
- Increases precision of the "position capture function"

Supported measuring systems

Corvus supports the following measuring systems:

- Digital encoder (RS422 differential)
- Analog encoder (1 Vpp differential)
- Marzhauser MR 500 measuring system

Digital encoder interface

The interface supports square wave pulse trains and their inverted pulse trains. The encoder interface is also provided with a reference signal input.

Technical data:

Encoder signal input	RS422 differential
Encoder index input	RS422 differential
Max. input frequency	20 MHz
Max. input resolution	0.233 nm (233fm)

Analog encoder interface with sin/cos module

Each axis can be supplied with a sin/cos module. This module is a independent hardware data interface for sinusoidal encoder signals. The input signal is internal multiplied.
The modules are available with a 12 Bit or 16 Bit data acquisition interface.

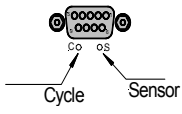
Technical data:

Input signal	1Vpp, differential
Reference mark	1 Vpp, differential
Max. input frequency	500 kHz
Multiplication factor of signal interpolation	12 Bit module: 12,865 16 Bit module: 205,884

To calculate the maximum positioning resolution of the sin/cos module, the cycle time of the measurement signal period must be divided by the multiplication factor.

The driver electronics supports a resolution up to 1nm

Status LED´s



Cycle LED	Status
active	Hardware ok
not active	Hardware error

Sensor LED	Status
active	No sensor available or sensor error
not active	Sensor ok

Related commands:

Command	Description
setcloop	enables closed loop mode
setscaleinterface	configurates sin/cos module
setclperiode	adapts to the encoder types
setclfactor	adapts to the encoder types
setscaletype	configurates sin/cos modules
setclpara	configurates PID controller
refmove	executes moves to reference mark

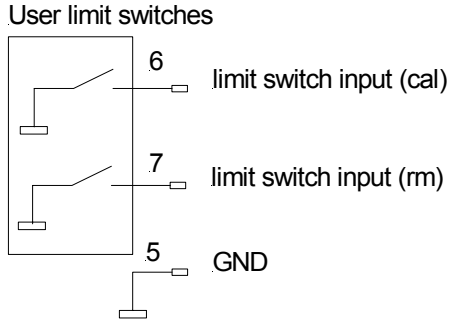
Limit switches

Corvus-eco provides two hardware limits for each axis.
This limits a very useful to protect the mechanical system.
In the following the limit switch teach-in procedure is de-criped. See also in Chapter "Installation".

- **Programmed broadcast limit-switch teach-in**
  All axes are moved to the limits simultaneously.

- **Programmed single axis limit-switch teach-in**
  The limit teach-in can be performed for each axis separately.

- **Manual teach-in**
  Limit-switch teach-in by the use of a joystick.



Broadcast limit-switch teach-in

With the Venus-1 commands ***cal*** and ***rm*** all active axis are moved synchronous to the "cal" or "rm" limit switches.
Synchronous means the axes are starting at the same time to move simultaneous to the minus (cal) or plus direction (rm).

If the limit switches of one direction are switched, the axes are moving automatically in the opposite direction until the switches are released. At this point the limit-switch teach in of one direction is complete.

The limit-switch movement can be aborted with the command ***Ctrl+c***.

During the broadcast limit-switch teach-in the Venus-1 command interpreter is blocked, no other commands except the abort command ***Ctrl+c*** will be executed.
Nevertheless the controller continues to receive commands in it´s command FIFO. These commands are successive executed after a limit-switch teach-in procedure is completed.

Single axis limit-switch teach-in

With the Venus-1 single axis command ***ncal*** and ***nrm*** the limit-switch teach-in can be performed for each axis separately.

Contrary to the broadcast limit-switch teach-in, the Venus-1 interpreter is not blocked during the limit-switch procedure.

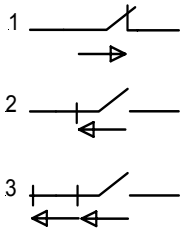
Related Venus-1 commands:

Command	Description
cal	moves all axes to the minus limit-switch direction
ncal	moves a single axis to the minus limit-switch direction
rm	moves all axes to plus limit-switch direction
nrm	moves a single axis to the plus limit-switch direction
setcalvel	setting-up the velocities of the "cal" limit-switch procedure
setncalvel	setting-up the velocities of a "cal" single axis limit-switch procedure
setrmvel	setting-up the velocities of the "rm" limit-switch procedure
setnrmvel	setting-up the velocities of a "rm" single axis limit-switch procedure

Programmed limit-switch teach-in in detail

In the following pages the procedure of the programmed limit switch teach-in is described in detail.

The procedure is divided in at least two successive movements for each axis.

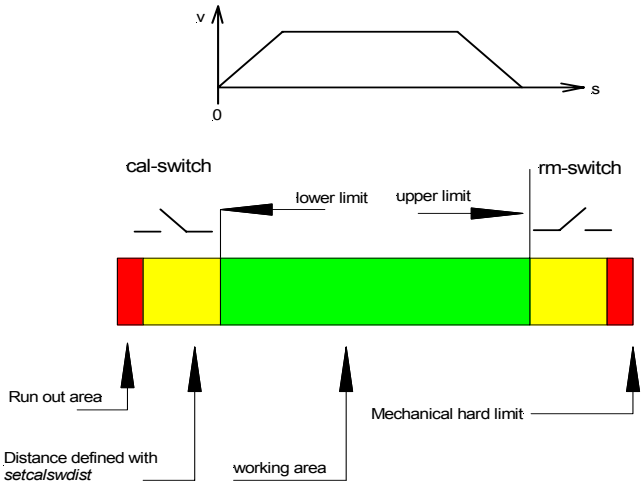


1. The axis moves to the limit switch until the limit switch is activated.

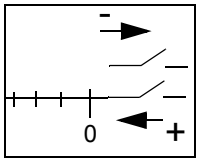
2. The axis moves in the opposite direction until the limit switch is released.

3. If defined an additional move is performed to the opposite direction (see command ***setcalswdist***).

If the limit-switch teach-in procedure is performed for each direction, the working area is determined. In regular conditions further on all movements will be ramped down and terminated at the limit borders without activating the limit switches again.

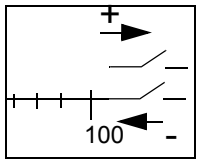


Limit register, position counter and motor direction



With command ***cal*** or ***ncal*** the controller moves in minus direction to the cal limit-switch(es). The cal limit-switch procedure defines the origin while the position counter and the lower limit register is cleared to zero. The upper limit register is set to it´s maximum value of 16.383mm.

After teaching-in the cal limit-switch, a movement to coordinates less than zero is only possible if the cal limit-switch is disabled and the lower limit value is changed to negative values with the command ***setlimit***.
The origin can be changed subsequently with the command ***setpos***.



With command ***rm*** or ***nrm*** the controller moves in plus direction to the rm limit switch(es).
The rm limit-switch procedure, registers the maximum working range to the rm limit-switch.

After teaching-in the rm limit-switch, a movement to coordinates upper than the registered maximum range is only possible, if the rm limit-switch is disabled and the range limit value is changed to larger values with command ***setlimit***.

For safety reasons it is not possible to save the registered limit switch coordinates permanently.

Manually teaching-in the limits

The limits can be determined manually by the use of the joystick. This procedure is similar to the programmed limit-switch teach-in.

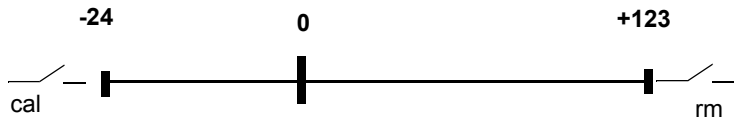
Limit switch teach-in with the joystick in detail

The axis must be manually moved until the limit-switch is active, then moved out of the switch until it is inactive. At this point the limit is registered.

If all limits are teached-in, the working area is determined. In regular conditions further on all movements will be ramped down and terminated at the limits, without activating the limit switches again.

Point of origin if limits are manually determined

Contrary to the programmed limit-switch movement, the manual teach-in does not clear the position counter.
The origin is automatically set to zero at power up and can be changed individually with the command ***setpos.***
It is also possible to change the limits with command ***setlimit***.



Important notices

- To determine the limits in the programmed mode, it is essential to execute the ***cal*** or ***ncal*** procedure first, because this procedure clears the position counter and the limit registers.

- The velocities to execute the limit switch movements has to be chosen very carefully because:

  The motors are interrupted immediately if the limit-switches are activated, this causes a back electromotive force (bemf) that can reset the controller

  To much speed can bring the axis in collision with the the mechanical limits.

  To achieve a good repeatability of the determined limit coordinates, especially the velocity for moving out of the limit-switches should be chosen as small as possible.

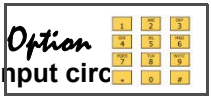
- The broadcast limit switch teach-in procedure blocks the Venus-1 interpreter for all other commands except Ctrl+c.

- For safety reasons the determined limits can not be stored permanently.

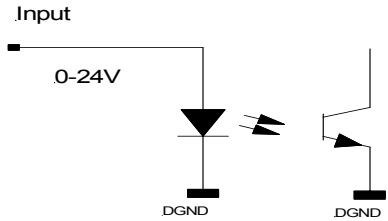
- Software limits can be defined additionally. See command ***setnlimit***.

Digital inputs / outputs

For individual controlling tasks Corvus is supplied with an input/output interface with 3 digital inputs and 3 digital outputs.



The input voltage range of the digital inputs is between 0 to 24V.
The inputs are optically isolated but not DC-isolated.

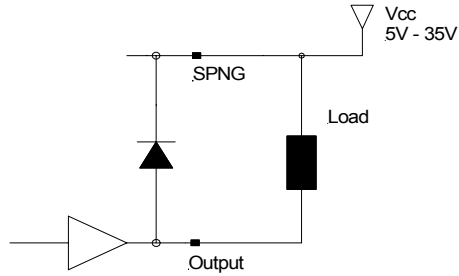


Technical data:

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 maximum current capacity of each output is 500 mA.



The total output current of all outputs may not exceed 1000 mA.

Related Venus-1 commands:

Command	Description
setout	generates signal output
getin	input signal detection
setinfunc	safety function configuration

Input / output functions

The following functions are realised with the digital inputs/output interface at connector "input/output"

Output signal generation

The command ***setout*** generates digital output signal at Pin´s 4, 8, 9.

Input signal detection

The command ***getin*** reads the binary state of the data inputs at Pin‘s 2, 6, 7.

Safety function

The function ***setinfunc*** uses an input signal (Pin 4,8,9) to lock a specified axis completely or restrict their moving range depending on the direction.
This function is works independently from the limit-switch function.

User output voltages

To supply external devices, Corvus-eco provides the user-voltages +5V or +12V. These voltages are protected with a electronic fuse.
The fuse elements are self-resetable this means the electric circuit is closed again after a while when the overload situation is removed.

Technical data:

User voltage	Max. output current
5V (default)	1A
12V (upon request)	0.3A

Chapter 4

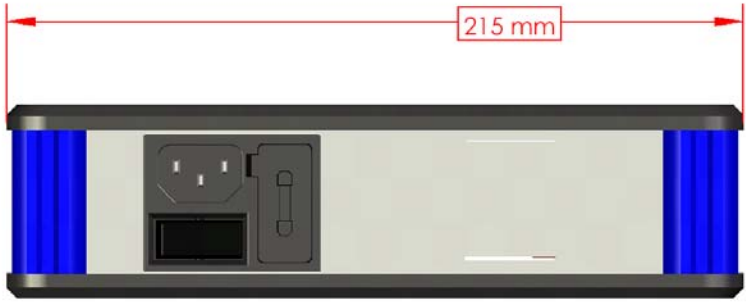
Technical data

Specifications

Number of axes	• 2 or 3
Phase current	• 0.2A...1,5A
Velocity max. Velocity min.	• 15 mm/s (if pitch = 1mm) • 15.26 nm/s
Acceleration max. Acceleration min.	• 1m/s² • 15.26 nm/s²
Supported motors	• Stepper motor, 2-phases or 3-phases
Programming	• ASCII command language Venus-1 • Windows user interface (WinPos) • Software library (dll)
Resolution programming mode	• 1.5 nm
Resolution joystick mode	• 0.233 nm
Positioning modes	• Absolute, relative, vector, error correction • speed controlled with on the fly velocity updates • Limit move algorithm • Origin move algorithm
Acceleration modes	• linear (trapezoid), sin² s-curve)
Processor	• 32 Bit Risc Processor
Operating system	• Real Time Operating System (RTOS)
Motor driver	• Digital, MOS-FET technology
Communication	• RS-232 up to 57600 Baud • USB (option)
Limits	• 2 x limit switch inputs for each axis (isolated) • 1x origin switch input • Voltage setting to supply switches: 5V (12 V upon request)
Input/Outputs (Option)	• 3 x digital inputs • 3 x digital outputs

User Output power	• +5V, 1000 mA (default) • +12V, 300 mA (upon request)
Closed Loop interface	• 1Vpp • RS422 quadrature
RS422 inputs	• 3 Channel differential, incremental, RS422 • Multiplication factor: x4 • Encoder index pulse consideration • Input frequency 20 MHz.
1Vpp inputs	• 3 Channel differential, incremental 1Vpp. • Multiplication factor: x12,865 or x205,884 • Encoder index pulse consideration • Input frequency max. 500 kHz
Safety functions	• Motor disable interface • Isolated relay contact
Accessories	• Analog joystick interface with 2 or 3 axes • Analog joystick with display • Digital encoder handwheel • Handheld Terminal
Trigger Out Function	• Position synchronized output (PSO) • Trigger rate max. 4kHz • Resolution 250µs
Position capture input	• Position capture after trigger input event • Max. position memory: 1.000 coordinates • Max. event capture frequency: 2 kHz • Max. trigger position resolution: 500µs x velocity
Dimensions	• L x W x H: 215 x 225 x 55 (mm)
Motor driver voltage	• 24V
Standards	• RoHS certified

Layout and dimensions



Chapter 5

Releasing options

Releasing options

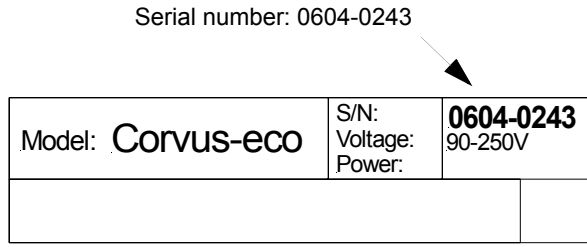
Corvus-eco is equipped with a various number of options which can be easily released from the customer with a so called release code.

Informations to purchase a release code

To purchase an option following informations are essential.

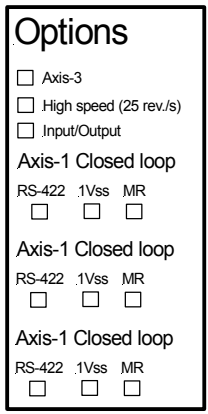
1. Serial number of the controller

The number is fit at the bottom side of the Corvus-eco chassis.



2. Actual released options

The already released options are labeled on the rear side of the controller. The options index can also readout with the command ***getoptions***



Fill out form for release code requests

Controller type	
Serial number	
Desired option	
Already released options	Options ☐ Axis-3 ☐ High speed (25 rev./s) ☐ Input/Output Axis-1 Closed Loop RS422 1Vss MR ☐ ☐ ☐ Axis-2 Closed Loop RS422 1Vss MR ☐ ☐ ☐ Axis-3 Closed Loop RS422 1Vss MR ☐ ☐ ☐
current index ***(getoptions)***	
Date	

TABLE 1: Fill out form for release code requests

Installation procedure

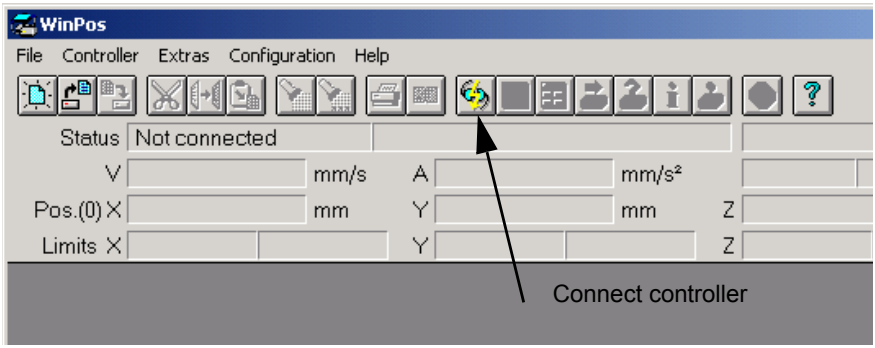
To install an option use WinPos16.
WinPos16 LT is added for free to each controller.

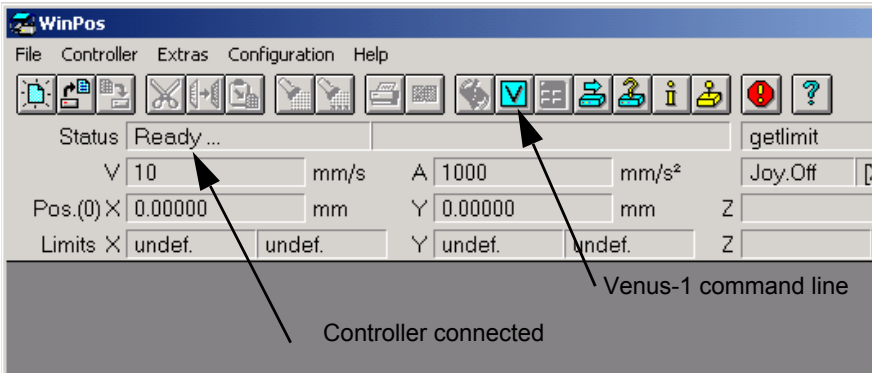
Before using WinPos, please check if your WinPos version is able to release options.
WinPos Version 1.1 with venuscom.dat* dated 14.07.2003 or newer should be used.

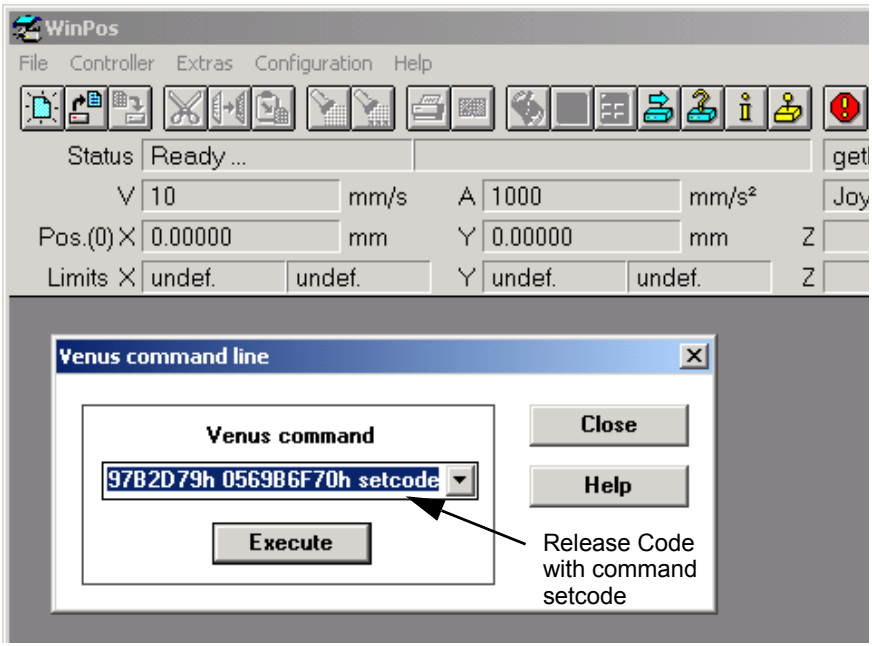
*venuscom.dat is found in the WinPos directory.

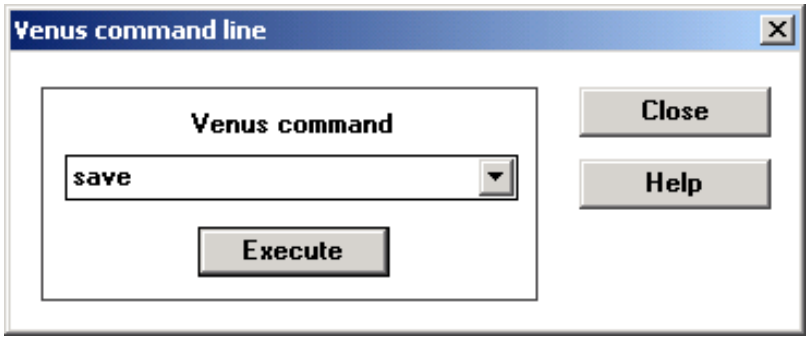
Installation step by step

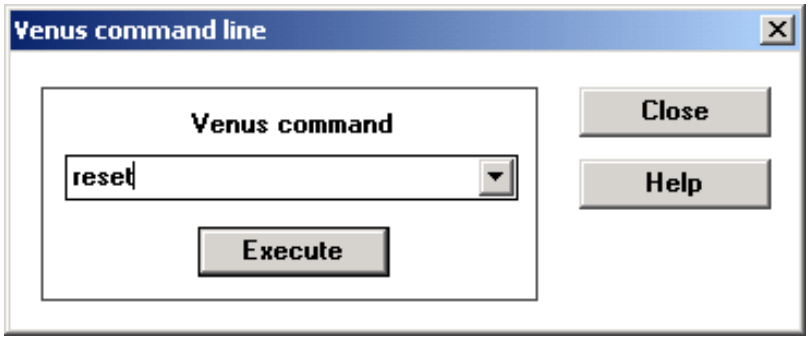
- Connect serial line with Host and controller
- Switch on the controller
- Start WinPos
- Establish a proper communication between WinPos and the controller.
- Open Venus command input line
- Input release code and send it with command ***setcode***
- Input command ***save*** and send it to store release code
- Input command ***reset*** and send it to restart the controller
- Verify released code with command ***getoptions***

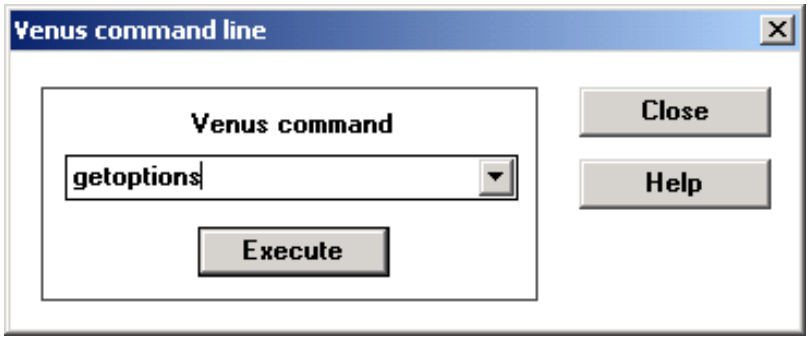



WinPos
File Controller Extras Configuration Help
Status Ready ...
getlimit
V 10 mm/s A 1000 mm/s²
Joy.Off
Pos.(0) X 0.00000 mm Y 0.00000 mm Z
Limits X undef. undef. Y undef. undef. Z
Venus-1 command line
Controller connected


WinPos
File Controller Extras Configuration Help
Status Ready ...
V 10 mm/s A 1000 mm/s²
Pos.(0) X 0.00000 mm Y 0.00000 mm Z
Limits X undef. undef. Y undef. undef. Z
Venus command line
Venus command
97B2D79h 0569B6F70h setcode
Close
Help
Execute
Release Code with command setcode


Venus command line
Venus command
save
Execute
Close
Help


Venus command line
Venus command
reset
Execute
Close
Help


Venus command line
Venus command
getoptions
Execute
Close
Help

Option index table

With the command ***getoptions*** the already released options are replied as a bit coded decimal number from 0 to 1023 as shown in the following table.

Option	***getoptions*** Index	Bit
3 rd. Axis	1	D0
not used	2	D1
not used	4	D2
Input / output	8	D3
not used	16	D4
not used	32	D5
Closed loop axis 1	64	D6
Closed loop axis 2	128	D7
Closed loop axis 3	256	D8
High speed	512	D9

TABLE 2: Option index table

Example:
Options: 3 rd. Axis, Input/Output

getoptions = 8 + 1 = 9

Troubleshooting

- After releasing the option doesn‘t work

Check if the option is released. Use command ***getoptions***.
Before you try again to release the option, please make sure that your release code is correct. A wrong code will disable all options.
In most cases you got the code via E-mail. It is a reasonable way to copy the number from the E-mail into the clipboard and insert it directly in the Venus command line.

- Don‘t forget to send command save after ***setcode***.
- Don‘t forget to send command reset after ***save***.

- During releasing with WinPos you got the message "unknown command ***setcode"***

You are using an older WinPos Version. Ask you dealer for WinPos Version 1.1 with "venuscom.dat"
date code: 14.07.2003 or newer.

Chapter 6

Firmware update

Firmware update

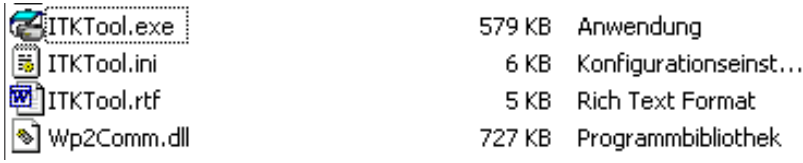
The Firmware update can be easily accomplished with the ITK Update Tool. This is a self-explanatory tool that guides you through the process in three steps.

Update procedure in three steps

1. All controller settings will be read from the controller and stored to disk.
2. A new firmware download is performed.
3. The settings are read from the disk and stored to the controller again.

What do you need to update the controller

1. Update Tool with following files:

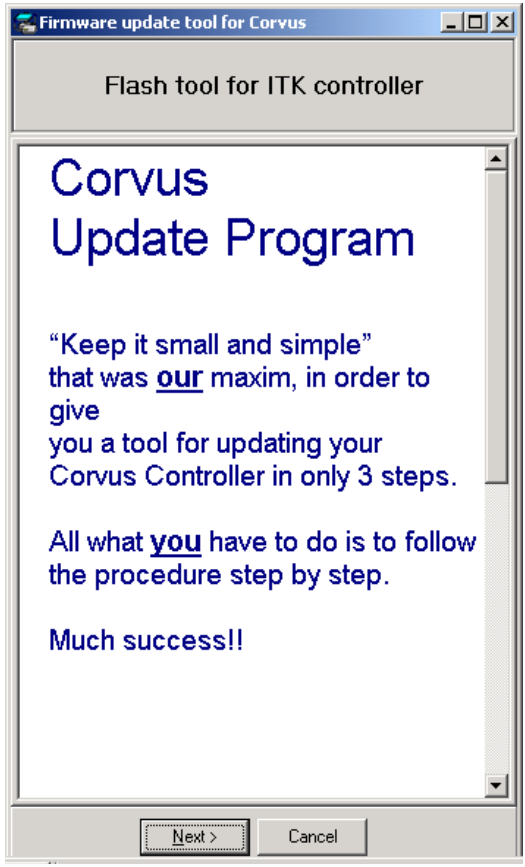


2. New Firmware.bin file
This file can be uploaded from the home page of your dealer or can send you via E-mail.

3. Computer with a 115 kBaud RS-232 interface
The update is executed via the RS-232 Service line.
The baudrate for parameter upload is selectable.
The firmware download is executed with a fixed baudrate of 115kBaud.

4. Socket wrench (5mm)
Tool to remove the cover of the D-type connector "RS-232 Service" at the controller.

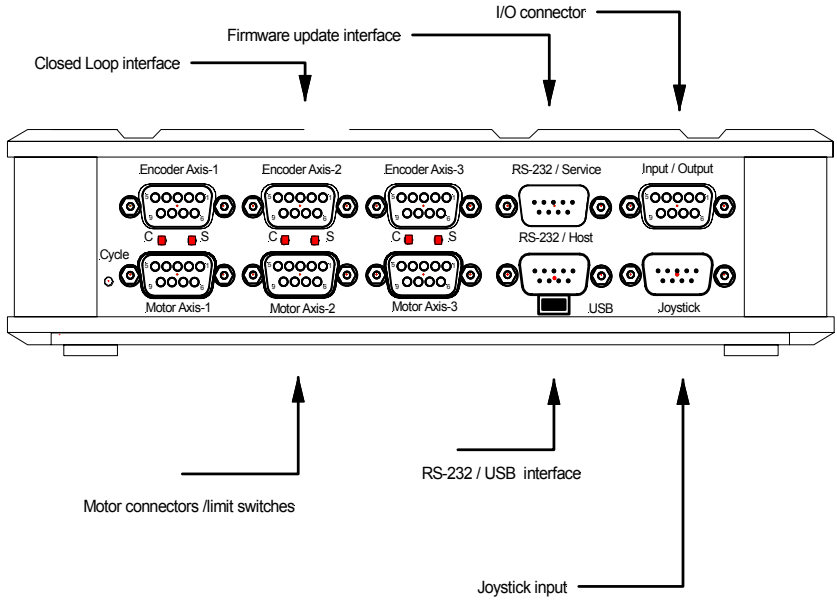
Update Tool


Firmware update tool for Corvus
Flash tool for ITK controller
Corvus
Update Program
“Keep it small and simple”
that was our maxim, in order to give
you a tool for updating your
Corvus Controller in only 3 steps.
All what you have to do is to follow
the procedure step by step.
Much success!!
Next >
Cancel

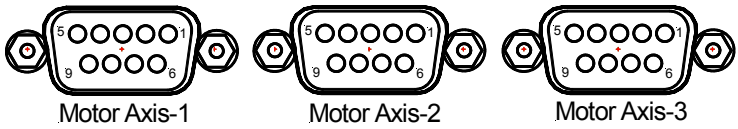
Chapter 7

Connectors

Connectors overview



Motor and limit switch connectors



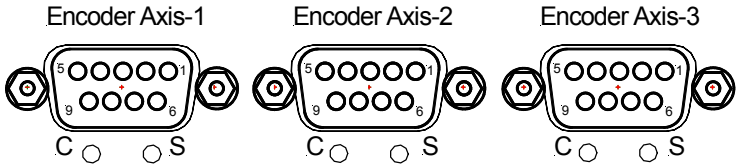
Motor control output and limit switch input a combined in this connectors.

Pin	Name	Description
1	Ph 1A	Motor Phase 1A
2	Ph 1B	Motor Phase 1B
3	Ph 2A	Motor Phase 2A
4	Ph 2B	Motor Phase 2B
5	GND	Ground
6	cal	Limit switch input (negative direction)
7	rm	Limit switch input (positive direction)
8 *	User 5V (12V)	Output voltage 5V (12V)
9		

TABLE 3. Motor connector

* factory setting: 5V
The settings can only be changed from the factory personal or from authorized experts

Digital encoder input



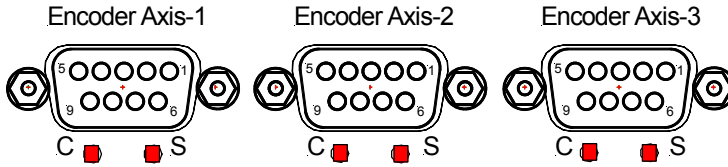
Supports closed loop control with digital RS422 encoders.

Pin	Name	Function
1	Ua 1	Channel A (positive)
2	Ua 2	Channel B (positive)
3	Ua 0	Reference (positive)
4	DGND	GND
5	User 5V*	Encoder supply User output (max. 1000mA)
6	Ua 1-	Channel A (negative)
7	Ua 2-	Channel B (negative)
8	Ua 0-	Reference (negative)
9	Error	Encoder error

TABLE 4. Digital encoder input

*Corvus eco provides the encoder supply for each encoder; the value is fixed.

Analog encoder input



Supports closed loop control with standard analog measurement systems 1Vpp.

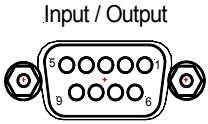
Pin	Name	Function
1	+5V analog	Encoder supply Analog Vcc
2	Event	Event
3	Ua 1 +	sin +
4	Ua 1 -	sin -
5	Ua 2 +	cos +
6	Ua 2 -	cos -
7	Ua 0 +	Reference (positive)
8	Ua 0 -	Reference (negative)
9	AGND	Analog ground

TABLE 5. Analog encoder input

Connector chassis = Digital GND

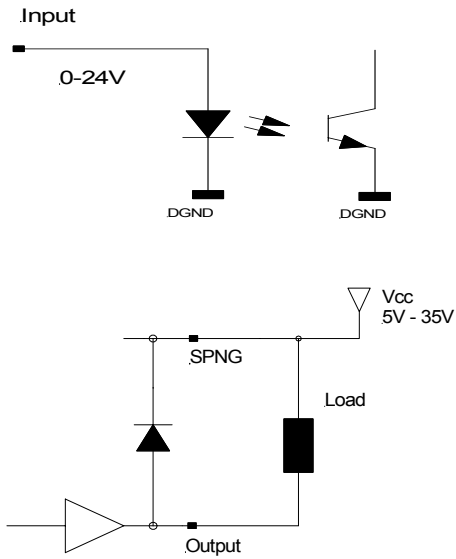
*Corvus-eco provides the encoder supply for each encoder; the value is fixed. Stability has to be achieved for longer supply lines.

Digital input / output

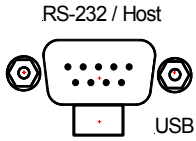


Pin	Name	Function
1	DGND	Digital GND
2	Input 2	Input 2 (0-24V)
3	User +5V	User output
4	Output 2	Output 2 (0-24V)
5	SPNG	SPNG
6	Input 1	Input 1 (0-24V)
7	Input 3	Input 3 (0-24V)
8	Output 3	Output 3 (0-24V)
9	Output 1	Output 1 (0-24V)

TABLE 6. Digital input/output



RS-232 / USB 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 7. RS-232 programming interface

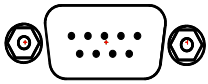
The RS-232 interface is working without flow control.
The handshake signals RTS and CTS are not supported.
DTR and DSR are internal connected.

Pin	Name	Function
1	VCC	USB +5V
2	D-	Corvus data input
3	D+	Corvus data output
4	nc	
5	GND	GND

TABLE 8. USB connector

RS-232 Service interface

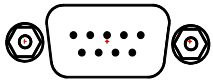
RS-232 / Service



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 9. RS-232 service interface

Joystick interface



Joystick

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 = enables joystick
5	+5V (User)	User output
6	SW	Joystick button
7	GND	GND
8	AGND	analog GND
9	3.3V (analog)	Power

TABLE 10. Joystick interface

Your notices: