Jetter automation



User Manual

JVM-104 - HMI

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Significance of this User Manual

This document is an integral part of the JVM-104:

- Keep this document in a way that it is always at hand until the JVM-104 will be disposed of.
- Pass this document on if the JVM-104 is sold or loaned/leased out.

In any case you encounter difficulties to clearly understand the contents of this document, please contact Jetter AG.

We would appreciate any suggestions and contributions on your part and would ask you to contact us at the following e-mail address: info@jetter.de. Your feedback will help us produce manuals that are more user-friendly, as well as address your wishes and requirements.

This document contains important information on the following topics:

- Transport
- Mounting
- Installation
- Programming
- Operation
- Maintenance
- Repair

Therefore, you must carefully read, understand and observe this document, and especially the safety instructions.

In the case of missing or inadequate knowledge of this document Jetter AG shall be exempted from any liability. Therefore, the operating company is recommended to obtain the persons' confirmation that they have read and understood this manual in writing.

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1 Safety instructions

Introduction

This chapter informs the user of basic safety instructions. It also warns the user of residual dangers, if there are any.

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Basic safety instructions

Introduction

This device complies with the valid safety regulations and standards. Jetter AG attaches great importance to the safety of the users.

Of course, the user should adhere to the following regulations:

- Relevant accident prevention regulations
- Accepted safety rules
- EC guidelines and other country-specific regulations

Intended conditions of use

Usage according to the intended conditions of use implies operation in accordance with this User Manual.

The device has been designed for use in commercial vehicles and mobile machines. The device JVM-104 is an HMI with integrated controller for exchange of data with peripheral devices.

The HMI JVM-104 meets the requirements of the European Automotive EMC Directive for electric/electronic subassemblies.

Operate the JVM-104 only within the limits set forth in the technical specifications. Because of its low operating voltage, the JVM-104 is classified as a SELV (Safety Extra-Low Voltage) system. Therefore, the HMI JVM-104 is not subject to the EU Low Voltage Directive.

Usage other than intended

The device must not be used in technical systems which to a high degree have to be fail-safe, such as, for example, in ropeways and airplanes.

The JVM-104 is no safety-related part as per Machinery Directive 2006/42/EC. This device is not qualified for safety-relevant applications and must, therefore, NOT be used to protect persons.

If you intend to operate the device at ambient conditions not being in conformity with the permitted operating conditions, please contact Jetter AG beforehand.

Personnel qualification

Depending on the life cycle of the product, the persons involved must possess specific qualifications. The qualifications required to ensure safe handling of the device at different phases of the product life cycle are listed below:

Product life cycle	Minimum qualification
Transport/storage:	Trained and instructed personnel with knowledge in handling electrostatically sensitive components
Mounting/installation:	Specialized personnel with training in electrical/automotive engineering, such as automotive mechatronics fitters
Commissioning/ programming:	Trained and instructed experts with profound knowledge of, and experience with, automotive/automation technology, such as automotive engineers for mobile machinery
Operation:	Trained, instructed and assigned personnel with knowledge in operating electronic devices for mobile machinery
Decommissioning/ disposal:	Specialized personnel with training in electrical/automotive engineering, such as automotive mechatronics fitters

Modifications and alterations to the module	**For safety reasons, no modifications and changes to the device and its functions are permitted.** Any modifications to the device not expressly authorized by Jetter AG will result in a loss of any liability claims to Jetter AG. **The original parts are specifically designed for the device. Parts and equipment from other manufacturers have not been tested by Jetter AG and are, therefore, not released by Jetter AG.** The installation of such parts may impair the safety and the proper functioning of the device. Any liability on the part of Jetter AG for any damages resulting from the use of non-original parts and equipment is excluded.
Transport	The JVM-104 contains electrostatically sensitive components which can be damaged if not handled properly. To exclude damages to the JVM-104 during transport it must be shipped in its original packaging or in packaging protecting against electrostatic discharge. ▪ Use an appropriate outer packaging to protect the JVM-104 against impact or shock. ▪ In case of damaged packaging inspect the device for any visible damage. Inform your freight forwarder and Jetter AG.
Storing	When storing the JVM-104 observe the environmental conditions given in the technical specification.
Repair and maintenance	The operator is not allowed to repair the device. The device does not contain any parts that could be repaired by the operator. If the device needs repairing, please send it to Jetter AG.
Disposal	When disposing of devices, the local environmental regulations must be complied with.

2 Product description and design

Introduction

This chapter covers the design of the device, as well as how the order reference is made up including all options.

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Product description

The HMI JVM-104

The JetView of the mobile automation series 104 is a compact full-graphics HMI. The HMI JVM-104 is extremely versatile thanks to its compact design and the integrated controller. The JVM-104 has especially been designed for use in the harsh environment of commercial vehicles and mobile machines.

The HMI can be operated in all light conditions, due to the backlit keys and the light sensor, which automatically adapts the brightness of the display to the brightness of the surroundings.

Product features

The features of this product are listed below:



- Display: 3.5" TFT, 350 cd/m^2
- Resolution: QVGA (320 x 240 pixels)
- Touchscreen
- 4 function keys (lighted)
- 1 digipot with pushbutton function
- Adjustable background lighting
- Adjustable night-lighting
- Loudspeaker
  Volume: 83 dB at a distance of 10 cm at resonance frequency of 2,670 Hz
  Adjustable frequency and volume
- Powerful programming language JetSym STX
- Fast ARM11 CPU
- Non-volatile registers 30,000
- RAM: 128 MBytes
- Flash memory: 512 MBytes
- 1 Ethernet port
- 1 CAN-2.0B interface
- 2 multi-purpose inputs, configurable
  - Digital input
  - Voltage and current measuring
  - Frequency measuring, counter function
- 4 multi-purpose inputs/outputs, configurable
  - Digital input (active-low)
  - Digital output up to 2.5 A
  - PWM output
  - H-bridge
- 1 USB port (2.0)

Accessories

The accessories are provided in the fastening kit. It includes a fastening bracket, a sealing ring and the corresponding screws and nuts.

Item no.	Quantity	Description
60880138	1	Fastening kit

Scope of delivery

The following items are included in the scope of delivery of the JVM-104:

Item no.	Quantity	Description
10001027	1	HMI JVM-104
60878547	1	Installation manual

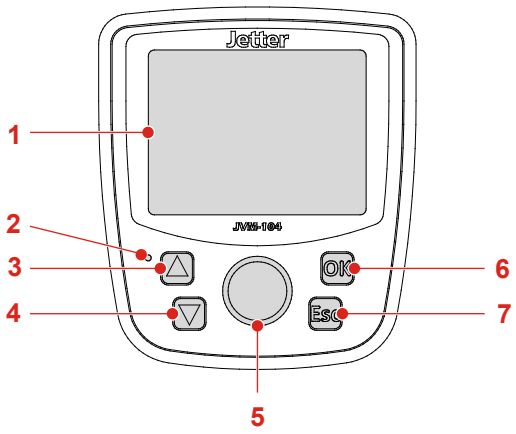
Parts and interfaces

Introduction

This chapter describes the parts and interfaces of the JVM-104.

Front panel of the JVM-104

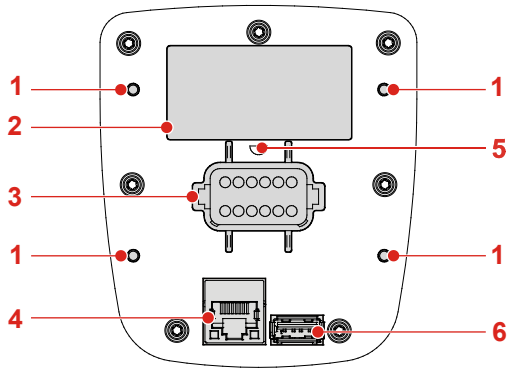
The HMI JVM-104 provides a touchscreen of an active surface of 3.5". The illustration shows the front panel of the HMI with all its control elements.



Number	Part	Description
1	TFT display	Active surface, touchscreen
2	Brightness sensor	Senses the surrounding brightness
3	Input key UP	Key with background lighting
4	Input key DOWN	Key with background lighting
5	Digipot	Rotary and pushbutton
6	Input key OK	Key with background lighting
7	Input key ESC	Key with background lighting

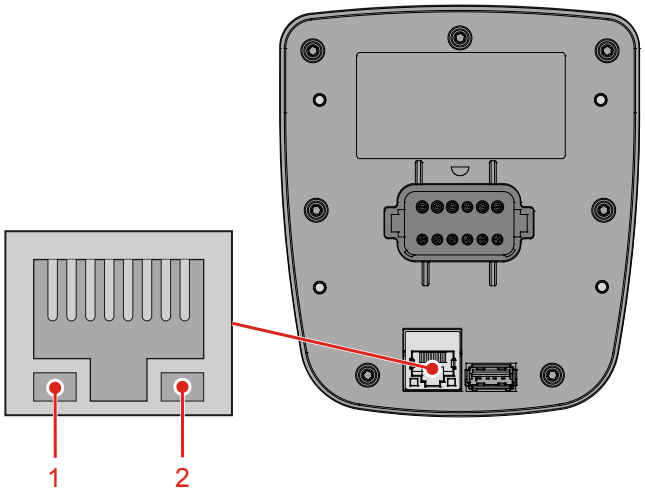
Rear panel of the JVM-104

The illustration shows the rear panel of the HMI with all its connections and the nameplate.



Number	Part	Description
1	Screw holes	For fastening the HMI. Max depth: 12 mm
2	Nameplate	
3	Deutsch connector	Housing for a 12-pin Deutsch connector (female)
4	Ethernet jack	Transfer rate: 10 mbps, 100 mbps
5	PV	Protective vent
6	USB jack	USB 2.0 with host

LEDs on the bottom side The illustration below shows the status LEDs of the RJ45 jack:



Number	Part	Description
1	LED (amber)	Blinks when active
2	LED (green)	Lights up when connection has been established

Order reference

Order reference

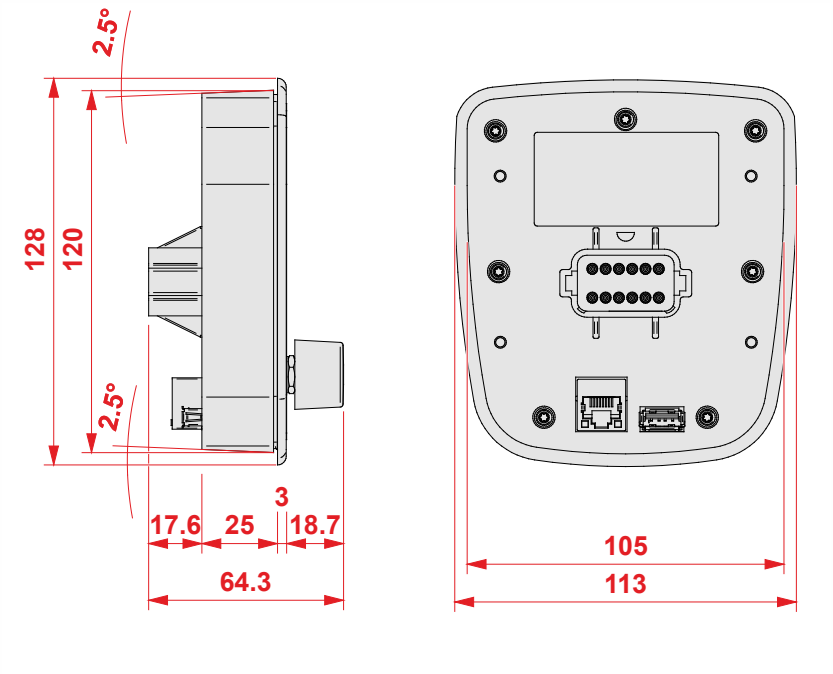
The HMI JVM-104 can be ordered from Jetter AG using the following item number:

Item no.	Order reference
10001027	JVM-104-K00-O02

Physical dimensions

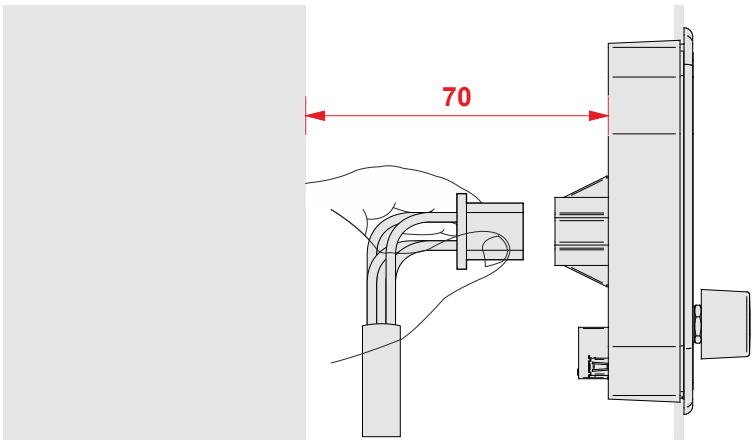
Physical dimensions

The illustration below shows the physical dimensions of the JVM-104 in millimeters.



Space required for installation and service

The illustration shows the space required for the HMI JVM-104. It is stated in millimeters.



Ensure there is enough space around the housing for servicing requirements.

- It should be possible to disconnect the connectors at any time.

3 Identifying the JVM-104

Purpose of this chapter

This chapter supports you in retrieving the following information about the JVM-104:

- Hardware revision
- Electronic data sheet (EDS). Numerous manufacturing-related data are stored to the EDS.
- Software versions

Prerequisites

To be able to identify technical data about the HMI JVM-104 the following prerequisites must be fulfilled:

- The HMI is connected to a PC.
- The programming tool JetSym 5.1.2 or higher is installed on the PC.

Information for hotline requests

If you wish to contact the hotline of Jetter AG in case of a problem, please have the following information on the JVM-104 ready:

- Serial number
- OS version of the HMI
- Hardware revision

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3.1 Identification by means of the nameplate

Introduction

Each HMI JVM-104 can be identified by its nameplate attached to its enclosure. If you wish to contact the hotline of Jetter AG in case of a problem, please have information on the hardware revision and serial number ready.

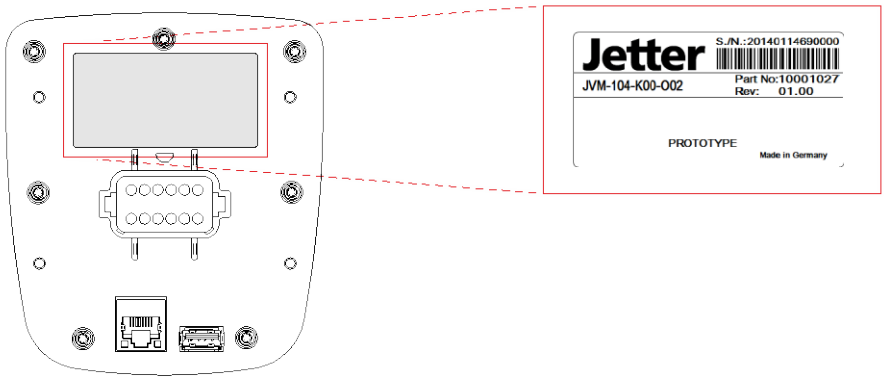
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Nameplate

Position of the nameplate

The location of the nameplate on the rear panel of the JVM-104 is shown below.



Nameplate

The nameplate of a JVM-104 contains the following information:



Number	Description
1	Product name
2	Serial number
3	Item number
4	Hardware revision

3.2 Version registers

Introduction

The operating system of the JVM-104 provides several registers which let you read out the version numbers of the OS and its components. If you wish to contact the hotline of Jetter AG in case of a problem, please have this information ready.

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Software versions

Introduction

The JVM-104 features software with unique version numbers which can be read out via special registers.

Format of software version numbers

The software version number of the JVM-104 is a four-figure value.

1	.	2	.	3	.	4

Element	Description
1	Major or main version number
2	Minor or secondary version number
3	Branch or intermediate version number
4	Build version number

Released version

A released version can be recognized by both Branch and Build having got value 0.

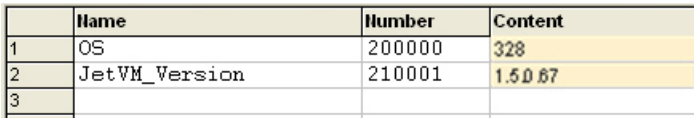
Overview of registers

The following registers let you read out the software versions:

Register	Description
200000	Operating system version
210001	Version of the STX interpreter for the STX application program (JetVM version)

Version numbers in JetSym setup

The following screenshot shows a JetSym setup window displaying version registers. To have the version number displayed in the setup window of JetSym, select the format **IP address**.



	Name	Number	Content
1	OS	200000	328
2	JetVM_Version	210001	1.5.0.67
3			

Retrieving information from the device web site

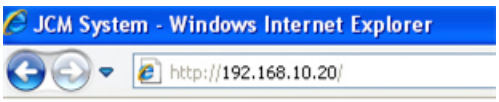
Introduction

The device web site in Internet Explorer shows all properties and version numbers of your device. It also lets you configure the Ethernet and the CANopen® interfaces.

Accessing the device web site

To have the device web site displayed on your PC, enter the **current** IP address of the device in the Internet Explorer.

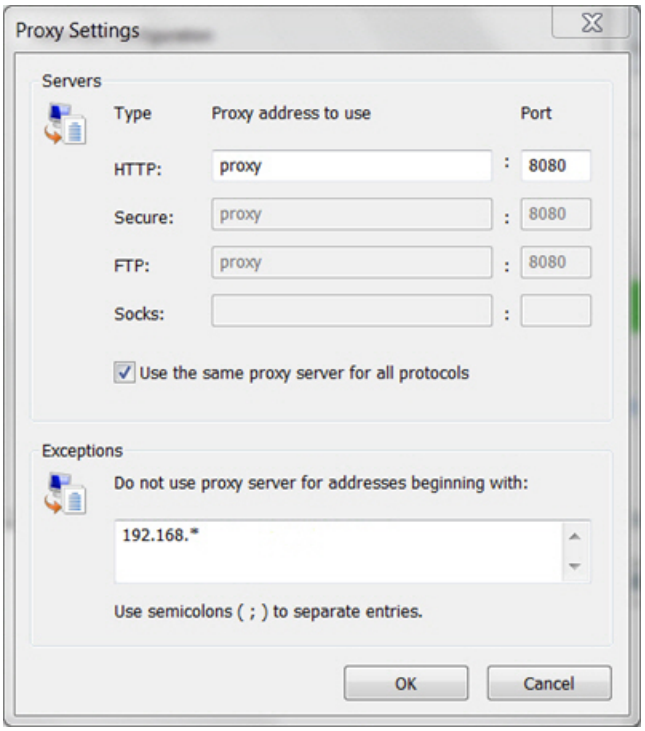
Example:



Prerequisites

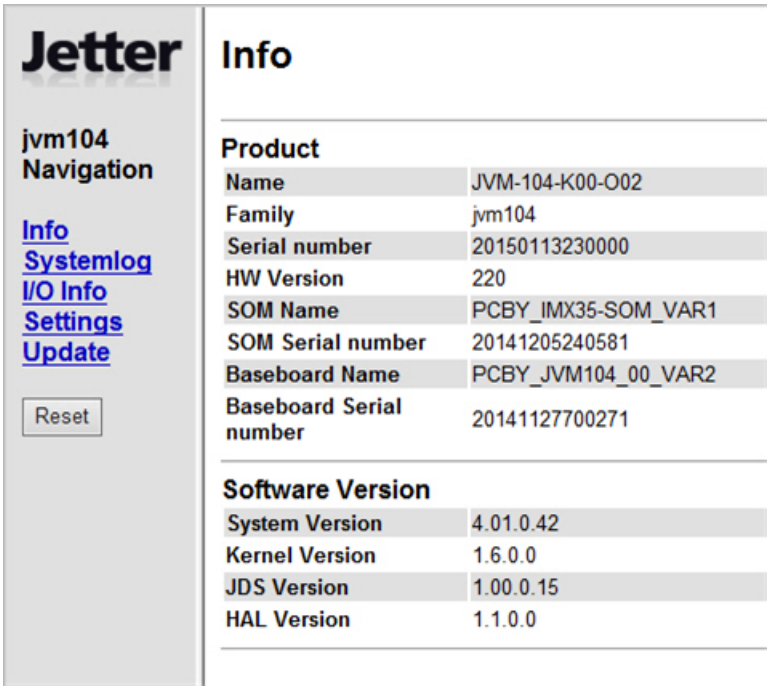
To enter the IP address in the range of exceptions of the Internet Explorer, proceed as follows:

Step	Action
1	Click menu item **Tools** and open the dialog **Internet options**.
2	Go to tab **Connections** and click the button **LAN settings.**
3	In section **Proxy Server** click the button **Advanced**.
⇨	The dialog **Proxy Settings** opens.
4	In the **Exceptions** pane of the dialog **Proxy Settings,** enter IP address **192.168.***, as is shown in the illustration below.



Info page

The page **Info** lets you retrieve the following information:



4 Mounting and installation of the JVM-104

Purpose of this chapter

This chapter describes the installation of the JVM-104 in the vehicle as regards the following points:

- Planning the wiring of a JVM-104
- Installation
- Configuration of the IP interface for the JVM-104

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4.1 Interfaces

Introduction

The HMI JVM-104 is equipped with the following interfaces:

- DEUTSCH connector
- Ethernet port
- USB port

DEUTSCH connector

The DEUTSCH connector has the following functions:

- Power supply of the JVM-104
- Power supply for higher load currents
- Multi-purpose inputs
- Multi-purpose outputs
- CANopen® bus interface: CAN 1
- Recognition of the ignition

Ethernet port

The function of the RJ45 jack is as follows:

- Ethernet port to a PC
- Ethernet port to other devices, such as a controller

USB port

The USB port serves the following purposes:

- Updating the system via USB flash drive
- Interface for USB flash drives providing additional memory
- Interface for USB devices, such as mouse or keyboard

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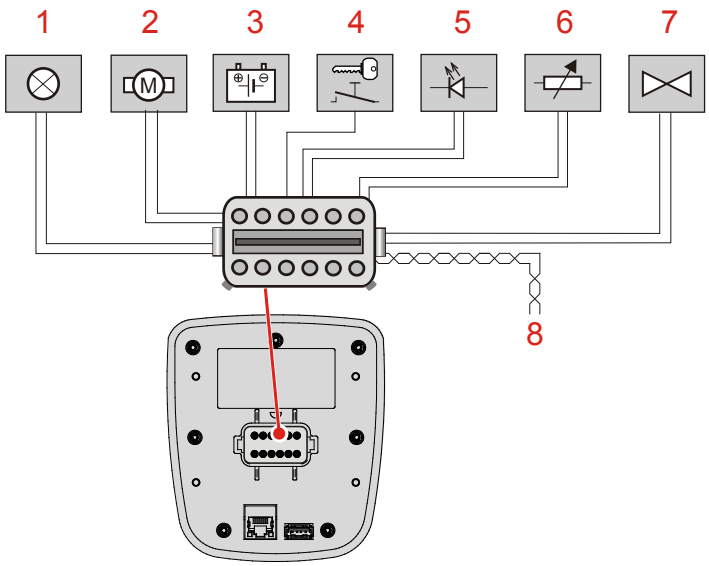
Example - Wiring

Introduction

The following examples shows how to connect a JVM-104.

Example

The illustration shows an example of a wiring layout.



Number	Description
1	Output, e.g. lamp
2	Output to control a motor
3	Power supply (battery)
4	Ignition lock
5	Output to control the display LEDs
6	Input, e.g. for reading out analog values from a filling level sensor
7	Output, e.g. to control a valve
8	CANopen® bus

Connecting the power supply

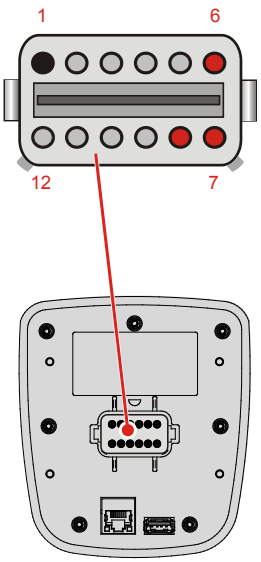
Purpose of the connector

This connector is also used for the following peripheral devices:

- Power supply
- Multi-purpose inputs
- Multi-purpose outputs
- CAN communication
- Recognition of the ignition

Pinout of the power supply connector

The diagram shows the pinout of the power supply and ignition connector (viewing the cable side):



The pinout is as follows:

Pin	Description	Terminal number in vehicles
1	Reference potential (GND)	Terminal # 31
6	Power supply UB for logic circuits Voltage: DC 12 V or DC 24 V Power consumption: 2 A max.	Terminal # 30
7	Power supply UB_PA for multi-purpose outputs of the HMI Voltage: DC 12 V or DC 24 V Power consumption: 10 A max.	Terminal # 30
8	Ignition (+)	Terminal # 15

Technical specifications - Power supply UB

Parameter	Description
Rated voltage	DC 12 V or DC 24 V
Permissible voltage range UB	DC 8 V ... DC 32 V, to ISO 7637
Permissible voltage range - Ignition	DC 5 V ... DC 32 V
Maximum current	2 A
Load dump protection	DC 70 V max.
Typical current consumption logic circuit (UB)	170 mA at DC 12 V 90 mA at DC 24 V
Power consumption	Approx. 2 W
Integrated protective functions	Protection against polarity reversal, overloading, voltage surges

Technical specifications - Voltage supply UB_PA

Parameter	Description
Rated voltage	DC 12 V or DC 24 V
Permissible voltage range UB_PA	DC 8 V ... DC 32 V
Permissible voltage range - Ignition	DC 5 V ... DC 32 V
Maximum current	10 A
Load dump protection	DC 70 V max.
Integrated protective functions	Protection against polarity reversal

Important note on supply voltage

Pin 7 of the DEUTSCH connector is configured for higher currents. Configure the wire size for pin 7 accordingly.

Note on ignition

To start the JVM-104, pin 8 (ignition +) must be connected with pin 6. The ignition (+) control signal is issued when the key is in position *Ignition ON*.

Note on current consumption

When the JVM-104 is energized, the current consumption is temporarily higher. To guarantee reliable power-up of the JVM-104, supply at least three times as much power as would typically be needed.

Mating parts

Compatible mating parts for the 12-pin DEUTSCH connector are as follows:



Manufacturer	DEUTSCH
Manufacturer item number - Housing	DT06-12S
Manufacturer item number - Wedgelock	W12S
Manufacturer item number - Crimp contact (receptacle)	0-462-201-16141
Wire size:	1.0 ... 1.5 mm^2 (AWG 18 ... 16)

Connecting the multi-purpose inputs

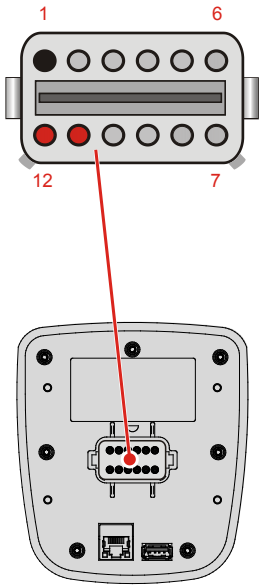
Functions of the multi-purpose inputs

The following functions are available:

- Analog
  - Voltage measuring
  - Current measuring
- Digital
  - Digital input
  - Frequency measurement
  - Counter function

Pinout of the multi-purpose inputs

The diagram shows the pinout of the connector for the multi-purpose inputs (viewing the cable side): Pin 1 for the reference potential is also color-coded.



The pinout is as follows:

Pin	Description
1	Reference potential (GND)
11	Multi-purpose input MFQE1
12	Multi-purpose input MFQE2

Analog functions

The following measurements of analog input parameters can be made:

- Voltage measuring
- Current measuring

The application program lets you switch multi-purpose inputs MFQE1 and MFQE2 between voltage and current measuring.

Technical specifications - Voltage measuring

Parameter	Description
Measuring range	DC 0 V ... DC 15 V
Input resistance	50 kΩ
Resolution	12 bits
Electrical isolation	None

Technical specifications - Current measuring

Parameter	Description
Measuring range	DC 0 mA ... DC 20 mA
Sensing resistor	120 Ω
Resolution	12 bits
Overcurrent trip	Yes
Electrical isolation	None

Digital functions

The following digital functions are available:

- Digital active-high input
- Frequency measurement
- Counter function

Technical specifications - Digital inputs, MFQE

Parameter	Description
Type of inputs	Active-high input
Operating point ON:	2.0 V min.
Operating point OFF:	1.0 V max.
Input resistance	50 kΩ
Maximum input frequency	1 Hz
NAMUR sensor evaluation	To be activated via software
Electrical isolation	None

Technical specifications - Frequency measurement

Parameter	Description
Measuring range	0.1 Hz ... 10 kHz
Accuracy	99.9 %
Input resistance	20 kΩ
Typical input current	1 mA max.
Maximum input frequency	10 kHz max.
Period measurement resolution:	1 µs
Adjustable gate times for gate time measuring	1 ms ... 10 s
Duty cycle frequency input	35 µs min.
Operating point ON:	4.7 V min.
Operating point OFF:	2.5 V max.

Technical specifications - Counting function

Parameter	Description
Measuring range	0.1 Hz ... 10 kHz
Resolution	0.1 %
Counting range	32 bits
Operating point ON:	4.7 V min.
Operating point OFF:	2.5 V max.

Mating parts

Compatible mating parts for the 12-pin DEUTSCH connector are as follows:



Manufacturer	DEUTSCH
Manufacturer item number - Housing	DT06-12S
Manufacturer item number - Wedgelock	W12S
Manufacturer item number - Crimp contact (receptacle)	0-462-201-16141
Wire size:	1.0 ... 1.5 mm^2 (AWG 18 ... 16)

Connecting the multi-purpose outputs

Functions of the multi-purpose outputs

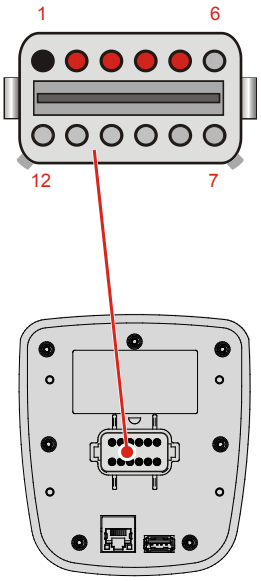
The following functions are available:

- Digital output
- Digital input
- PWM output
- H-bridge

The application program lets you switch between the available functions of the multi-purpose outputs PA1 to PA4.

Connecting the multi-purpose outputs

The diagram shows the pinout of the connector for the multi-purpose outputs (viewing the cable side): Pin 1 for the reference potential is also color-coded.



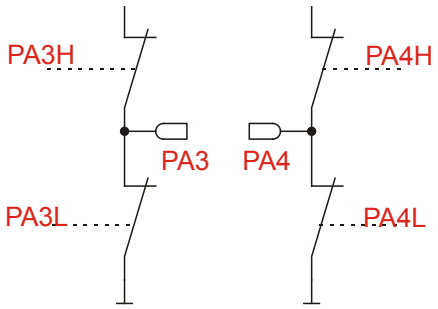
The pinout is as follows:

Pin	Description
1	Reference potential (GND)
2	Multi-purpose output PA1
3	Multi-purpose output PA2
4	Multi-purpose output PA3
5	Multi-purpose output PA4

Pinout of the H-bridge

The H-bridge is assigned to the following outputs:

- Multi-purpose output PA3
- Multi-purpose output PA4



For programming, switch the H-bridge to the desired direction:

- Anti-clockwise rotation: PA3H and PA4L
- Clockwise rotation: PA4H and PA3L

Technical specifications - Digital input PAx

Parameter	Description
Type of input	Active-high input
Rated voltage	UB_PA - 10 %
Operating point ON:	DC 1.6 V max., > 3.5 mA
Operating point OFF:	DC 4.0 V min., < 0.5 mA
Internal pull-up resistor	NAMUR: 1 kΩ, 8.2 V
Electrical isolation	None

Technical specifications - Digital output

Parameter	Description
Maximum output current per channel	2.5 A
Rated voltage	Supply voltage UB_PA
Diagnostics	Overcurrent, short circuit, cable breakage
Overcurrent evaluation	Adjustable currenttrip
Maximum latency: Switching between output and input	500 ms
Maximum total current	The total current of all outputs must not exceed 8 A.Otherwise it is cut off after 500 ms. If the total current exceeds 10.5 A, the outputs shut off immediately.

Technical specifications - PWM output

Parameter	Description
PWM frequency	100 Hz ... 1 kHz
Resolution of pulse control factor (duty cycle)	0.1 %
Accuracy of pulse control factor (duty cycle)	+/- 42 ns
Maximum rated voltage	Supply voltage UB_PA
Switching frequency	100 Hz ... 1kHz
Protective circuitry	Overvoltage, overcurrent
Diagnostics	Overcurrent, cable breakage
Maximum total current	The total current of all outputs must not exceed 8 A. Otherwise it is cut off after 500 ms. If the total current exceeds 10.5 A, the outputs shut off immediately.

Technical specifications - H-bridge

Parameter	Description
Maximum rated current	Battery voltage, DC 32 V max.
Maximum output current	2.5 A
Peak current	~ 5 A, max. 500 ms
Current measuring accuracy	+/- 20 %
Switching frequency (1/period length)	100 Hz ... 1 kHz
Frequency accuracy	+/- 42 ns
Resolution of pulse control factor (duty cycle)	0.1 %
Diagnostics	Overcurrent

Mating parts

Compatible mating parts for the 12-pin DEUTSCH connector are as follows:



Manufacturer	DEUTSCH
Manufacturer item number - Housing	DT06-12S
Manufacturer item number - Wedgelock	W12S
Manufacturer item number - Crimp contact (receptacle)	0-462-201-16141
Wire size:	1.0 ... 1.5 mm^2 (AWG 18 ... 16)

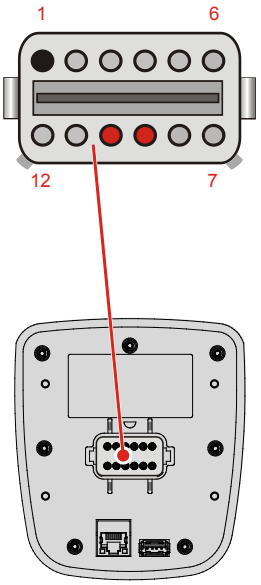
Related topics

- **Multi-purpose outputs PA3 and PA4 functioning as H-bridges**
  (see page 194)

CAN interface

Pinout of the CANopen® bus

The diagram shows the pinout of the connector for the CANopen® bus (viewing the cable side): Pin 1 for the reference potential is also color-coded.



The pinout is as follows:

Pin	Description
1	Reference potential (GND)
9	CAN_1_L
10	CAN_1_H

Technical specifications - CAN interface

Parameter	Description
Baud rate	250 kBaud ... 1 MBaud
Bus terminating resistor	None
External bus termination	120 Ω
Connector specifications	Twisted pair conductors, unshielded

Bus terminating resistor

The JVM-104 has not got an integrated bus terminating resistor.

Twisting

The CAN_L and CAN_H cable pairs must be twisted.

Specification - CAN bus cable

Parameter	Description
Core cross-sectional area	1000 kBaud: 0.25 … 0.34 mm^2 500 kBaud: 0.34 … 0.50 mm^2 250 kBaud: 0.34 … 0.60 mm^2
Cable capacitance	60 pF/m max.
Resistivity	1000 kBaud: 70 Ω/km max. 500 kBaud: 60 Ω/km max. 250 kBaud: 60 Ω/km max.
Number of cores	2
Twisting	CAN_L and CAN_H cables are twisted pairwise

Cable lengths

The maximum permitted cable length depends on the baud rate used and the number of CANopen® devices connected.

Baud rate	Cable length	Stub length	Total stub length
1000 kBaud	25 m max.	0.3 m max.	1.5 m
500 kBaud	100 m max.	5 m max.	30 m
250 kBaud	250 m max.	10 m max.	60 m

Mating parts

Compatible mating parts for the 12-pin DEUTSCH connector are as follows:

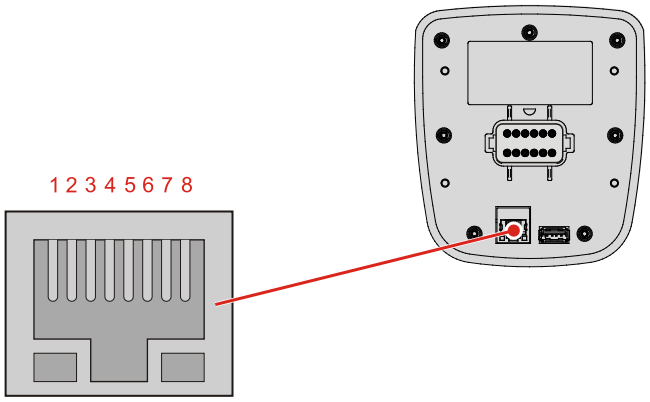


Manufacturer	DEUTSCH
Manufacturer item number - Housing	DT06-12S
Manufacturer item number - Wedgelock	W12S
Manufacturer item number - Crimp contact (receptacle)	0-462-201-16141
Wire size:	1.0 ... 1.5 mm^2 (AWG 18 ... 16)

Ethernet port

Pin assignment of the Ethernet port

The diagram below shows the pin assignment of the connector jack for the Ethernet cable:



Technical specifications - Ethernet

Parameter	Description
Type of terminal	RJ45 Ethernet jack
Number of ports	1
Bit rate	10 Mbit/s, 100 Mbit/s
Auto-crossover	Yes

Ethernet cables

For connecting devices to the Ethernet interface, you can order the following cables separately from Jetter AG :

Item no.	Item
60537500	Patch cable 1:1, 1 m gray Hirose, Cat 5e, shielded
60854512	Patch cable 1:1, 2 m gray Hirose, Cat 5e, shielded
60854514	Patch cable 1:1, 5 m gray Hirose, Cat 5e, shielded
60854515	Patch cable 1:1, 10 m gray Hirose, Cat 5e, shielded

USB port

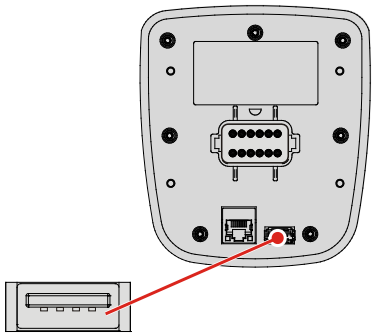
Functions of the USB port

The USB port supports the following functions:

- Connecting input devices such as mouse or keyboard
- Storing to and loading data from a USB flash drive
- Updating the operating system

USB port

The illustration shows the USB port:



Technical specifications - USB flash drive

Parameter	Description
Power supply	5 V, 500 mA max.
USB port	USB host interface, USB 2.0
Short-circuit capability	Yes Transient short-circuit current: ~ 0.8 A

4.2 Installing the JVM-104

Introduction

This chapter describes how to install the JVM-104.

Contents

Topic	Page
Installation	47

Installation

Introduction

This chapter describes how the HMI JVM-104 is to be installed.

Selecting a place for installation

Select a suitable place for the device to be installed.
The place where the device is to be installed must meet the following requirements:

- The installation surface must be level.
- The installation surface should be no more than 5 mm thick.
- The installation location must allow air to circulate.
- The installation location must be accessible for servicing.
- The installation location must be of sufficient size.

Avoiding unsuitable installation locations

Do not install the device in locations that do not meet the a.m. requirements.
The following installation locations are unsuitable for mounting the HMI:

Unsuitable installation location	Reason
Outdoor installation	The HMI must not be exposed to rain or a jet of water. Therefore, do not use a steam jet or other such devices to clean the HMI.
Unventilated installation location	The HMI could overheat as heat builds up.
Installation location close to heat-sensitive materials	The materials could become warped or misshapen as a result of heat produced by the HMI.
Uneven installation surfaces	The installation surface could become misshapen when fitting the HMI. Fastening is unstable and precarious.

Ergonomic principles

Consider ergonomic principles.
Select a user-friendly place for installation:

- The controls must be easy to reach.
- The HMI screen must be easy to read.

Avoid installation locations that are unsuitable from an ergonomic point of view:

- Extreme angles, which could make it difficult to see the HMI
- Unsuitable lighting conditions with reflection and glare
- Concealed installation locations that are difficult for the user to access

Accessories

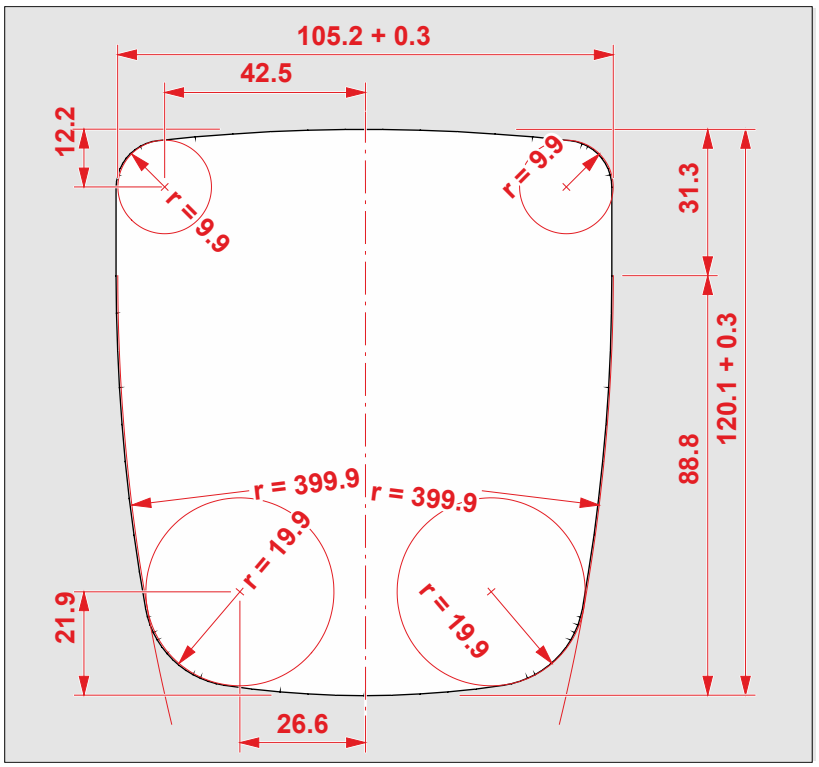
The accessories are provided in the fastening kit. It includes a fastening bracket, a sealing ring and the corresponding screws and nuts.

Item no.	Quantity	Description
60880138	1	Fastening kit

Preparing for installation

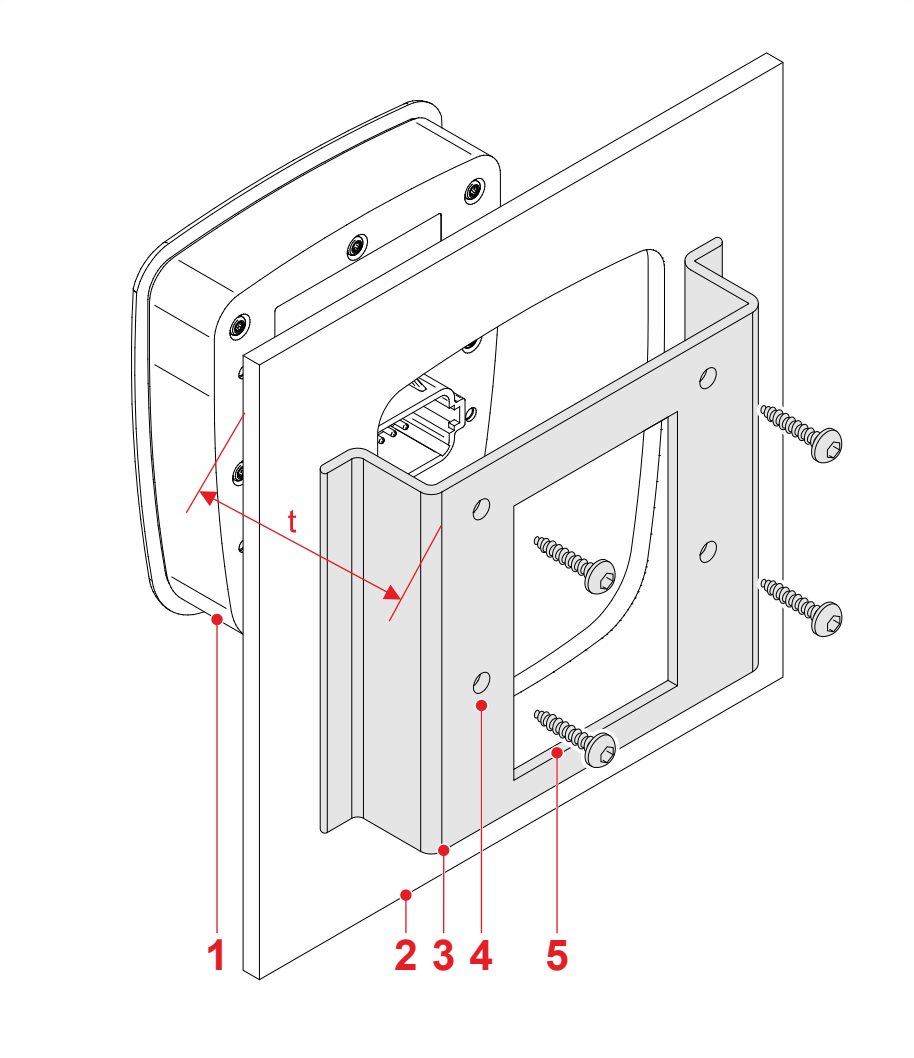
Make a fitting opening in the panel.

The illustration shows the shape of the opening and the dimensions in millimeters:



Installing the HMI

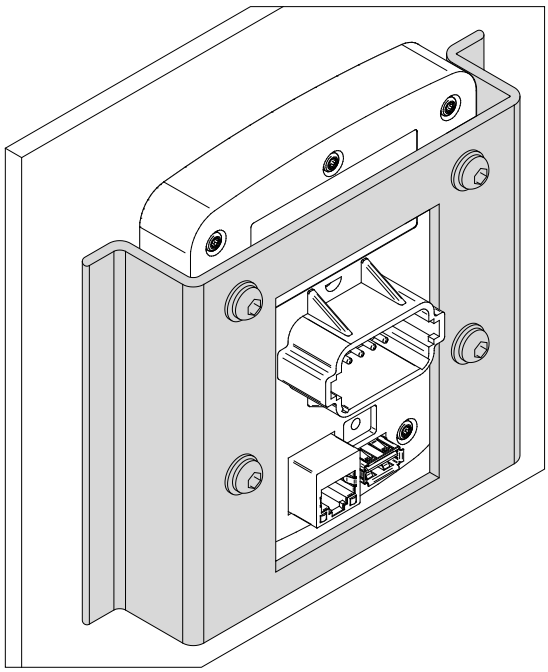
The illustration shows how to install the device.



Number	Description
1	JVM-104
2	Panel with opening for accommodating the HMI
3	Fastening bracket with opening for the connectors
4	4 x screw holes for screwing down the JVM-104
5	4 x self-tapping screw Screw size: 4 x 9 + t Tightening torque: 1.6 Nm ± 10 % Maximum screw-in depth: 12 mm

Step	Action
1	Insert the HMI into the front of the opening in the panel.
2	Hold the fastening bracket against the panel from the rear. To this end, the connectors must be seen through the opening of the fastening bracket.
3	Screw the HMI, together with the fastening bracket, onto the panel. The stud torque should be 1.6 Nm ± 10 %.

The illustration shows the installed HMI JVM-104.

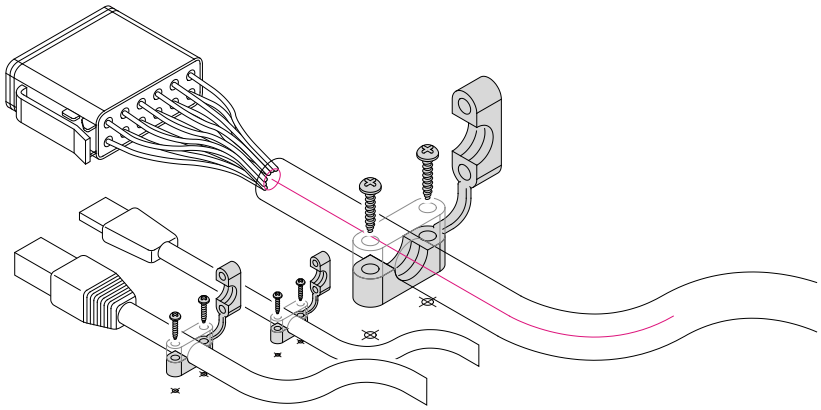


Installing the strain relief

Install strain reliefs for the connecting cables.

Take care to leave enough space for the connectors.

Connectors must not be obstructed, so that they can be removed in the event of a service requirement.



4.3 IP configuration

Introduction

This chapter covers the IP configuration for the HMI JVM-104. The following parameters can be set:

- IP address of the HMI
- Subnet mask
- IP address of default gateway
- IP address of DNS server
- HMI name
- IP port number for the JetSym debugger
- Basic port number for communication via JetIP

Required engineer's skills

To carry out the IP configuration of the JVM-104, knowledge of IP networks is required, such as

- IP addressing (IP address, port number, subnet masks etc.)

Contents

Topic	Page
Factory settings	53
The configuration memory	54
Configuration registers	55
Setting the IP address during runtime	56
Making settings on the device web site	57

Factory settings

Introduction

Before the HMI JVM-104 is shipped, various parameters are set to a certain value.

The parameters can be changed by the user.

Factory settings

Parameter	Value
IP address of the HMI	192.168.10.15
Subnet mask	255.255.255.0
IP address of default gateway	0.0.0.0
IP address of DNS server	0.0.0.0
Name of the platform	JVM-C02
IP port number for debugger	52000
IP port number for JetIP	50000
Password of the user *admin*	admin

The configuration memory

Introduction

The HMI retrieves the parameters for initializing the IP interface from the configuration memory during the boot process. The user can access the data stored in the configuration memory in the following ways:

- The web interface lets you read out data and make changes to them.
- Registers let you read out data and make changes to them.

Enabling conditions

The HMI reads data located in the configuration memory only during the boot process. If you make changes to the configuration memory, reboot the HMI for these changes to take effect. Only this way these changes take effect.

If you change the IP address during runtime, this modification immediately takes effect. However, changes made during runtime are not remanent.

Default values

Before the HMI uses data from the configuration memory, it checks them for plausibility. If entries are invalid or absent, the HMI uses the following default values:

Parameter	Default value
IP address of the controller	192.168.10.15
Subnet mask	255.255.255.0
IP address of default gateway	0.0.0.0
IP address of DNS server	0.0.0.0
Name of the platform	JVM-C02
Suffix type of the name	0
IP port number for debugger	52000
IP port number for JetIP	50000

Related topics

- **Configuration registers** (see page 55)

Configuration registers

Introduction

Configuration registers grant you read or write access to the parameters of the IP configuration. A range of registers holds the data contained in the configuration memory. Another range contains the parameters used for initializing the IP interface.

Register numbers

The register number is calculated by adding the number of the module register (MR) to the number of the basic register.

HMI	Data range	Type of access	Basic register number	Register numbers
JVM-104	Configuration memory	Read/ write	101100	101100 ... 101165
	Currently used parameters	Read only	101200	101200 ... 101265

Configuration registers

The following table lists the registers of both ranges and the respective functions:

Register	Description
MR 0	IP address of the device
MR 1	Subnet mask
MR 2	IP address of the gateway to other subnets
MR 3	IP address of the Domain Name Server
MR 32	Type of the automatically generated suffix is attached to the device name
MR 33 through 51	Device name
MR 64	IP port for OS update and communication between devices
MR 65	IP port for debugger/setup in JetSym

Related topics

- **The configuration memory** (see page 54)

Setting the IP address during runtime

Introduction

The IP interface is initialized by the settings in the configuration memory during the boot process.

The following settings can also be changed via registers to be non-remanent:

- IP address of the HMI
- Subnet mask
- IP address of default gateway

Important note

The settings made during runtime do not change the parameters in the configuration memory. At de-energizing the controller, your settings will be lost.

Overview of registers

Register	Description
104531	IP address of the HMI
104532	Subnet mask
104533	IP address of default gateway

Setting IP addresses and subnet mask

To set the IP address and the subnet mask, proceed as follows:

Step	Action
1	Enter the value 0.0.0.0 into 104533.
2	Enter the value 0.0.0.0 into 104532.
3	Enter the desired IP address of the JVM-104 into 104531.
4	Enter the desired subnet mask into register 104532.
5	Enter the desired IP address of the default gateway into 104533.

Result:

The settings are completed. Communication is possible again.

Related topics

- **The configuration memory** (see page 54)

Making settings on the device web site

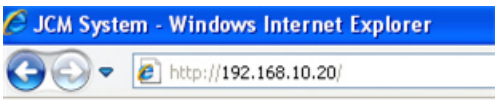
Introduction

The device web site in Internet Explorer shows all properties and version numbers of your device. It also lets you configure the Ethernet and the CANopen® interfaces.

Accessing the device web site

To have the device web site displayed on your PC, enter the **current** IP address of the device in the Internet Explorer.

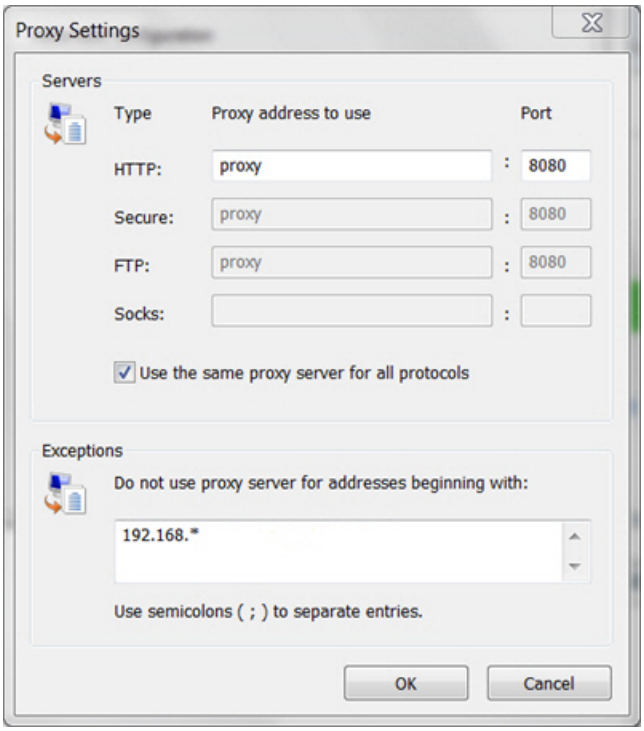
Example:



Prerequisites

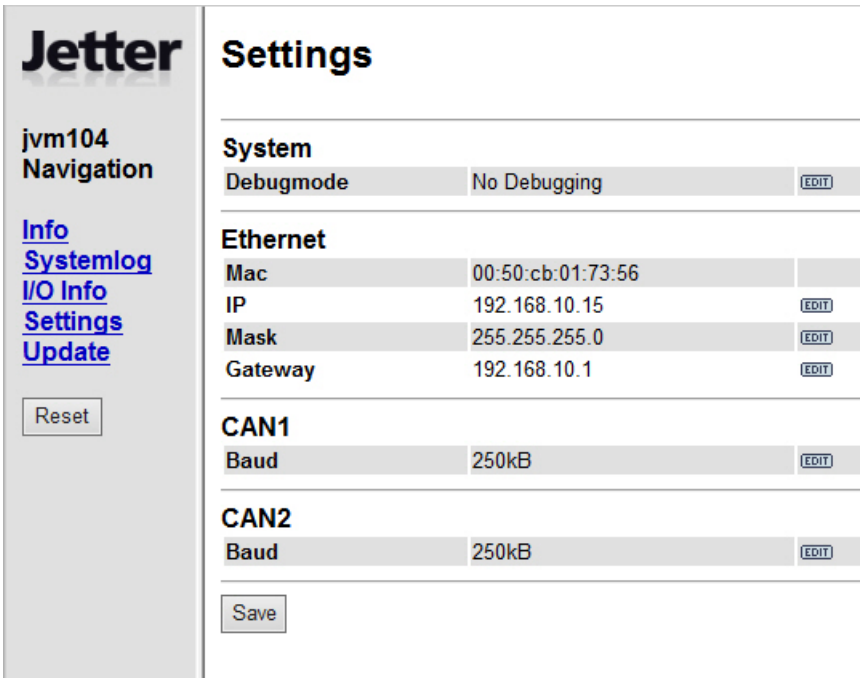
To enter the IP address in the range of exceptions of the Internet Explorer, proceed as follows:

Step	Action
1	Click menu item **Tools** and open the dialog **Internet options**.
2	Go to tab **Connections** and click the button **LAN settings.**
3	In section **Proxy Server** click the button **Advanced**.
⇨	The dialog **Proxy Settings** opens.
4	In the **Exceptions** pane of the dialog **Proxy Settings,** enter IP address **192.168.***, as is shown in the illustration below.



Settings page

The page **Settings** lets you configure both, the Ethernet and the CANopen® interface.



The table below lists the steps for setting the IP address (example):

Step	Action
1	In line **IP** click the button **Edit**.
⇨	The edit box for the IP address opens. IP 192.168.10.20
2	Enter the new IP address into the edit box.
3	Confirm your input by clicking the button ✓. To undo your input, click the button Undo. ✗.
4	Click the button **Save.**
⇨	This will save all the settings.
5	Power cycle the device.

Result: The device can be reached at the new IP address.

5 Initial commissioning

Purpose of this chapter

This chapter describes how to commission the JVM-104 and covers the following topics:

- Initial commissioning in JetViewSoft
- Initial commissioning in JetSym

JetViewSoft is a SCADA system and JetSym is a programming tool. Both have been developed by Jetter AG.

For more information refer to the Online Help in JetSym or JetViewSoft.

Minimum requirements

These instructions for initial commissioning apply to JetSym version 5.1.2 or higher and JetViewSoft version 4.0.2 or higher.

Contents

Topic	Page
Preparatory work and first insight into programming with JetSym STX	60
Configuring a project for the ER-STX-CE platform	63
ER-STX-CE platform - Programming	77

5.1 Preparatory work and first insight into programming with JetSym STX

Introduction

This chapter covers the preparatory work for commissioning the JVM-104. It also provides a first insight into the programming language JetSym STX.

Contents

Topic	Page
Preparatory work for initial commissioning	61
Programming in the programming language JetSym STX	62

Preparatory work for initial commissioning

Ethernet connection with the controller

The JVM-104 in delivered condition has got IP address 192.168.10.15. Configure the Ethernet interface of your PC so that it is able to communicate with the JVM-104 via this IP address.

Requirement for power-up

The JVM-104 only powers up if the supply voltage +UB is applied to the ignition (+).

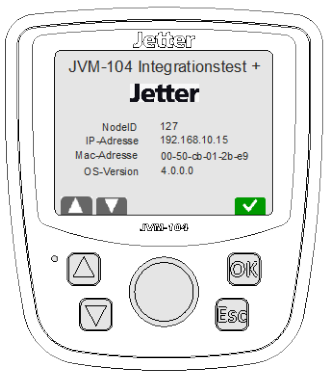
Skipping the application program during power-up

If, during power-up, you press the keys ▼ and **OK** simultaneously, you prevent the application program from being launched.

During software development stage it may happen that the device does not react after boot-up. This condition, however, lets you access the device using FTP or JetSym.

Default display

The default application program launched on the JVM-104 after power-up displays the following input mask on the display.



The node ID displayed is the address of the CANopen® bus 1 set in the JVM-104. This address can be set by the keys ▲ and ▼ .

Key ▲ increases the address in steps of 1.

Key ▼ decreases the address in steps of 1.

The IP address, MAC address and OS version are also displayed.

Programming in the programming language JetSym STX

Introduction

JetViewSoft lets you create visualization applications for use on the following platforms:

- PC systems
- HMIs for industrial applications
- HMIs for mobile applications

JetSym STX lets you access visualization objects and control their representation on the HMI. The programming language JetSym STX lets you program the HMI as if it were a controller. The compiled programs can be processed in the HMI without the need for an external controller. This is made possible by the STX interpreter and the graphical runtime environment JVER (JetView Embedded Runtime). Both form an integral part of the HMI's operating system.

JetSym STX program

The program below just causes an internal variable within a loop to be doubled to value 20. This example shows how JetSym STX can be used.

```
Task MiniExample AutoRun
Var
    i, j : Int;
End_Var;
    j := 1;
    // j is being run through within a loop up to value 1024
    For i := 1 To 10 Do
      j := j * 2;
    End_For;
End_Task;
```

Program location

When you load the compiled program to the HMI, JetSym creates in the directory *\App* a folder and names it after the project. JetSym stores the application program to this folder. The file name of the application program comprises of the project name and the extension **.es3**. Path and file names are always converted into lower case letters.

The file **start.ini** is automatically created on program download. It defines which application program is to be loaded.

5.2 Configuring a project for the ER-STX-CE platform

Introduction

This chapter describes how to create and configure in JetViewSoft and JetSym a visualization project for the ER-STX-CE platform.

Contents

Topic	Page
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Creating and configuring a visualization project in JetSym	69

Creating and configuring a visualization project in JetViewSoft

Introduction

JetViewSoft lets you create visualization files for the JVM-104 and upload them to the HMI. This topic covers the following:

- Creating a project in JetViewSoft
- Defining the project settings.
- Creating visualization files and uploading them to the HMI.

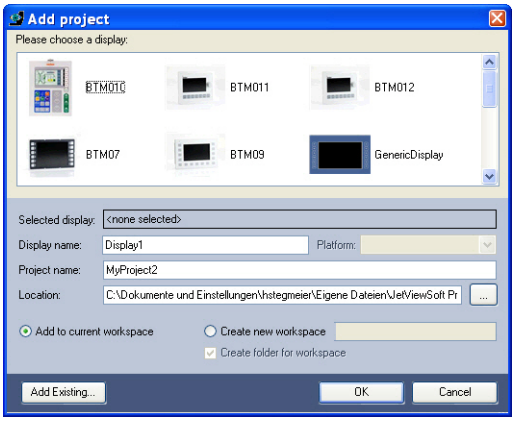
Prerequisites

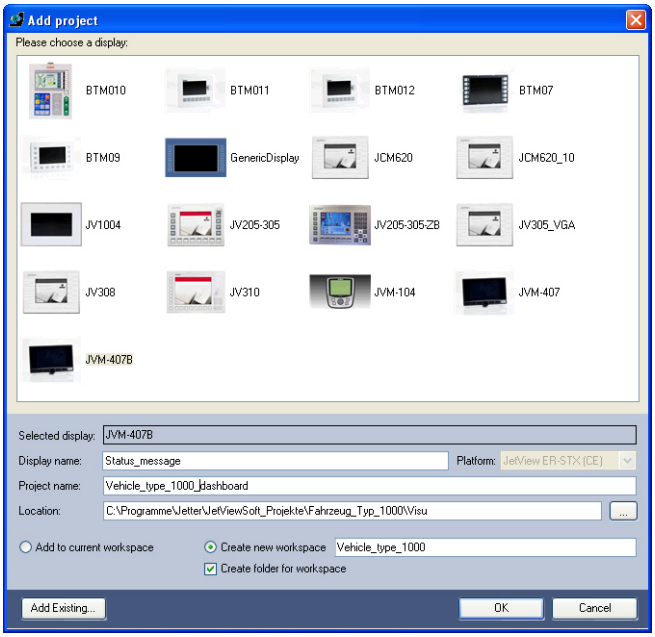
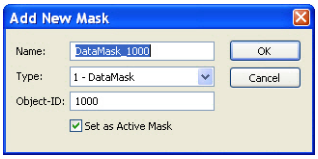
The following prerequisites must be fulfilled:

- JetViewSoft must be installed on the PC.
- JetViewSoft must be licensed (see Online Help in JetViewSoft).
- An active Ethernet connection between the PC and the HMI has been set up.

Creating a project

To create a new project for the HMI in JetViewSoft, proceed as follows:

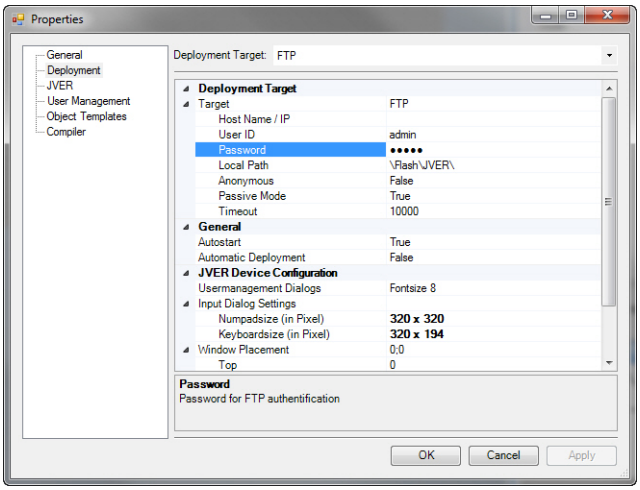
Step	Action
1	Start JetViewSoft
2	Open the **File** menu. Select menu item **New Project**. **Result:** The following dialog box opens: 
3	Select in **Selected display:** the HMI used. To do so, click on the image of the corresponding HMI.
4	In **Display name**, select a program-internal name for the HMI. You can add one or more HMIs to a project.
5	If the list box **Platform** isn't grayed out, select **JetView-ER-STX(CE)**.
6	In **Project name**, enter the name of the project.
7	If necessary, change the project menu path under **Location**. For the sake of clarity, the end of the path name should be *\Visu*.
8	Enter the name of the workspace into **Workspace**.

Step	Action
⇨	The screenshot below shows an example of the completed dialog box:  **Important note:** The names must not contain blanks. Otherwise, it will be difficult to delete the visualization files at a later date.
9	Confirm your settings by clicking **OK**. **Result:** The dialog box closes and the **Add New Mask** dialog box opens. 
10	Enter the name of the first DataMask into the box **Name**. Leave all other settings unchanged This mask is automatically the active mask when launching the HMI.
11	Confirm the settings by clicking **OK**.

Result: Creation of the project is completed.

Making the deployment settings

In order to be able to transfer the visualization files created with JetViewSoft to the HMI, the required deployment settings need to be made:

Step	Action
1	Open the **Project** menu. Select menu item **Properties**. **Result**: The dialog box of the same name opens.
2	Open the **Deployment** pane from the navigation panel on the left-hand side of the dialog box. 
3	Select in **Deployment Target** the option **FTP**. To do so, click on **Target**.
4	Click on the + sign next to **Target** to expand the setting options. Or just double-click **Target**.
5	Enter the IP address of the HMI into the box **Host Name/IP**. The default IP address of a JVM-104 is **192.168.10.15**.
6	Enter the user name into the box **User ID**. The default user is *admin*.
7	Enter the password into the box **Password**. The default password is *admin*.
8	Into the box **Local Path**, enter *\App\projectname*. Where *projectname* is a placeholder representing the actual name of the project (in lowercase letters).
9	Confirm your settings by clicking **OK**.

Result: The deployment settings have now been made and you can transfer the files to the HMI.

Transferring a project to the HMI

To create a JetViewSoft project and to transfer it to the HMI, proceed as follows:

Step	Action
1	Create a screen mask using the available objects (rectangles, ellipses, etc.). Once these objects have been transferred, they can be seen on the HMI.
2	Open the **File** menu. Select the menu item **Save all**.
3	Press the **[F7]** key for a project build. **Result:** JetViewSoft compiles the project files as long as no error occurs.
4	Open the **Build** menu. Select menu item **Deploy**. Another way is to enter the shortcut **[CTRL] + [F5]**. **Result:** JetViewSoft transfers the files to the HMI.
5	In order to make the HMI read in the visualization files, restart it.

Result: The files of your JetViewSoft project have been stored to the directory *\App\projectname* on the HMI. The HMI shows the start screen.

Missing visualization application

If there is no visualization application on the device, the display shows the following message:



The folder **Data** is empty. That is, there is no visualization application and no JVER (JetView Embedded Runtime) on the device. If JVER is not running (desktop background is visible), communication with JetSym is not possible.

Remedy: Use JetViewSoft to upload a visualization application to the device.

IOP file as visualization application on the HMI

In delivered condition, the HMI may already include a visualization application with an ***.iop** file stored to the folder **Data**.

This is also the case, if the CAN bus node ID must be set.

Result: The HMI will not display your visualization application.

Remedy:

Step	Action	
1	**If ...**	**... then ...**
	... the file **\App\visual.iop** or **\Data\visual.iop** exists,	... delete or rename this file.
2	**If ...**	**... then ...**
	... the file **\App\JetViewERS.cfg** exists, ...	... delete or rename this file.
⇨	The visualization application developed for the ER-STX-CE platform is displayed.	

Related topics

- **Initial commissioning in JetSym** (see page 69)

Creating and configuring a visualization project in JetSym

Introduction

The programming tool JetSym STX lets you create visualization applications for the HMI JVM-104. This topic covers the following:

- Creating a project in JetSym STX
- Configuring the controller hardware
- Including the visualization library JVER-STX
- Creating a program that can be compiled and transferred to the HMI

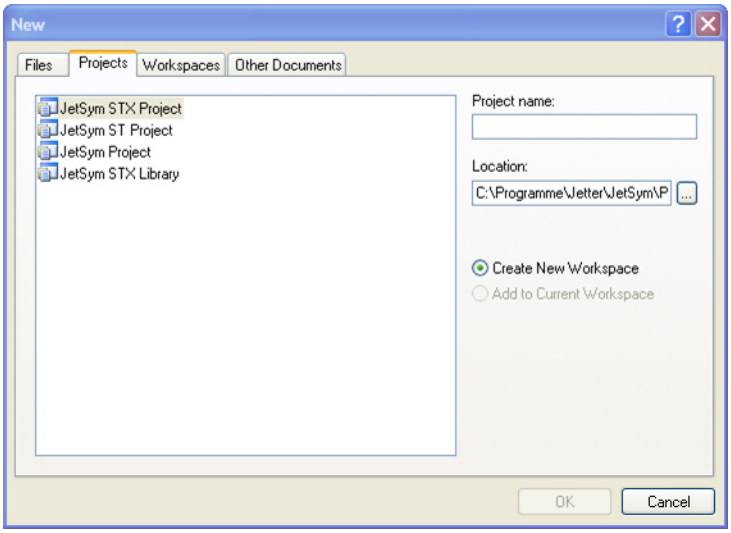
Prerequisites

The following requirements must be satisfied:

- JetSym has been installed on the PC used.
- JetSym has been licensed (see online help in JetSym).
- The controller has been connected to the same network as the PC.
- An active Ethernet connection between controller, HMI, and PC has been established.
- Initial commissioning in JetViewSoft has been completed.

Creating a project

To create a new programming project in JetSym, proceed as follows:

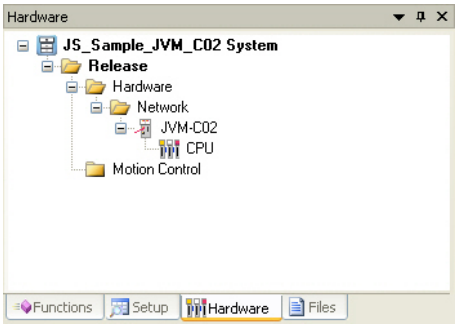
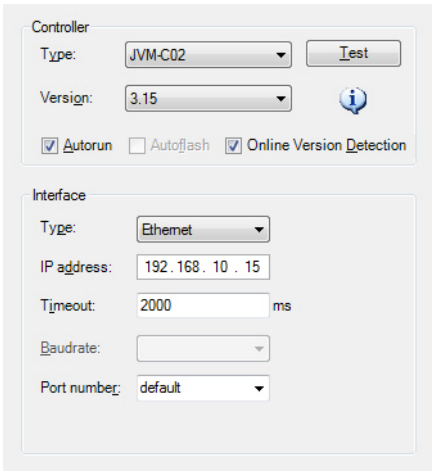
Step	Action
1	Launch JetSym.
2	Open the menu **File**. Select menu item **New**. **Result:** The dialog box **New** opens. 
3	Select **JetSym STX project** as the project type.
4	Enter the project name.

Step	Action
5	Select the path. It is recommended to store project files within a JetViewSoft project to the folder **STX**. **Example:** *C:\Programs\Jetter\JetViewSoft_Projects\VehicleType_1000\Visu\VehicleType_1000\VehicleType_1000_Dashboard\STX* **Advantage:** The JetSym project files are located in the same folder as the file **VisualInterface.stxp** created by JetViewSoft.
6	Confirm your settings by clicking **OK**.

Result: Creation of the project is completed.

Configuring the hardware

To establish a connection between JetSym and the HMI, you need to configure the hardware.

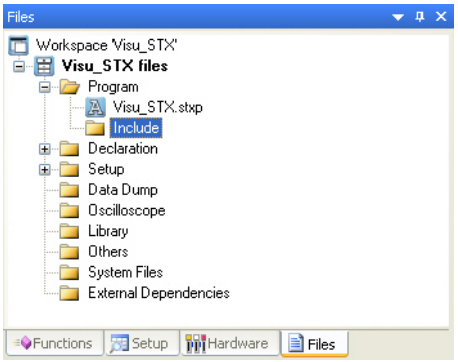
Step	Action
1	Navigate to the tab **Hardware** and click it. 
2	Fully expand the **Hardware tree**.
3	If you wish to set JVM-C02 as HMI or set interface parameters, double-click **CPU**. **Result:** The dialog box **Configuration** opens. 
4	From **Controller/Type**, select JVM-C02.

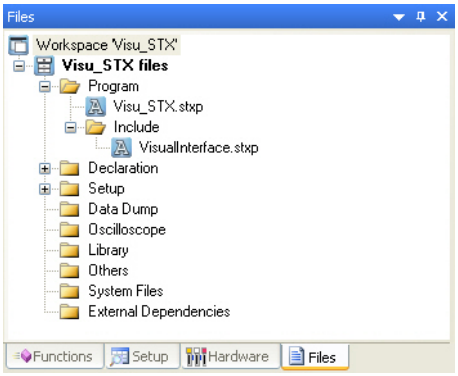
Step	Action
5	From **Interface/Type**, select Ethernet.
6	Enter the IP address of the HMI into the box **Interface/IP address**.
7	Test the connection with JVER running by pressing the button **Test**. If the connection test fails, check the IP address and the Ethernet connection with the JVM-104.
8	Save your settings using the shortcut **[Ctrl] + [S]**.

Result: The hardware settings have been configured in JetSym.

VisualInterface.stxp - Include in the project

In order for the description of the objects and masks included in the visualization application to be available for programming, the file **Visualinterface.stxp** must be included as follows:

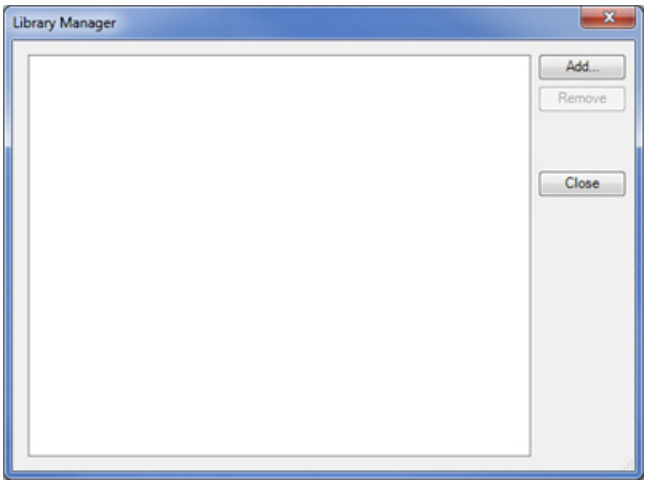
Step	Action
1	Switch to the view **Files**. 
2	Expand the folder **Program**.
3	Click on the folder **Include** and open the shortcut menu (by pressing the right mouse button).
4	Select the shortcut menu entry **Add Files to Directory**. **Result:** An Explorer window for selecting a file opens.
5	Navigate to the **STX** folder of the JetViewSoft project. The default location for this is at *[Project location]/ Name of the JetViewSoft project/STX*.
6	Select here the file **VisualInterface.stxp**.

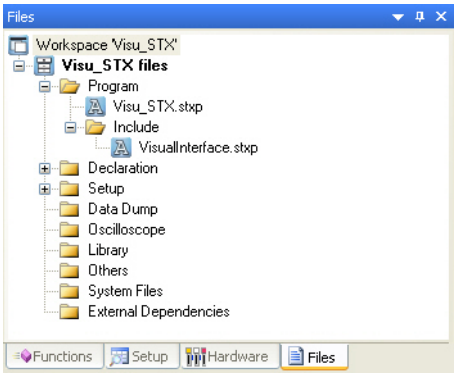
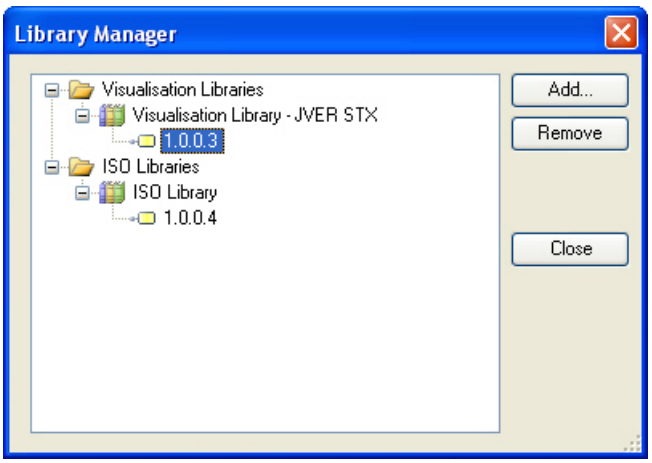
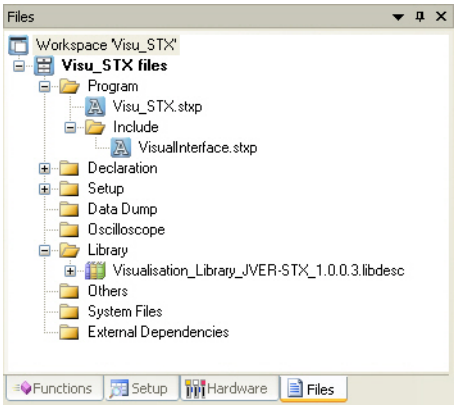
Step	Action
7	Click the button **Open**. 

Result: The file **VisualInterface.stxp** is now included into the project.

Including a library

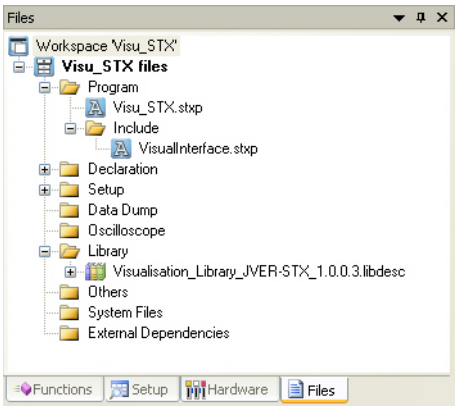
For the library with its visualization functions to be available in JetSym, you have to include it as follows:

Step	Action
1	Open the menu **Tools**. Select menu item **Library Manager**.
⇨	The dialog box of the same name opens. 
2	Click the button **Add**. **Result:** An Explorer window opens in the **Lib** folder of the JetSym installation.
3	Select the file **Visualisation_Library_1.0.0.3.libpackage** or an up-to-date version of this library.
4	Click the button **Open**. **Result:** The library file has now been integrated into the library manager. So, you can now include the library into your JetSym project.

Step	Action
5	Switch to the view **Files**. 
6	Select the folder **Library**. Open the shortcut menu by pressing the right mouse button.
7	Select menu item **Add Libraries...**. **Result:** JetSym opens the Library Manager.
8	Select the visualization library and click the button **Select**. 
⇨	

Creating a compilable program

To create and compile an executable program, proceed as follows:

Step	Action
1	Switch to the view **Files**. 
2	Double-click the program file. The program file has the same name as the project, plus the extension **stxp**. **Result:** The program file opens in the JetSym editor.

3	Enter the following program code.
	Mind this when giving the Include instruction.
	`#Include "VisualInterface.stxp";`
	
	`Function OnKeyDown(KeyCode:long, Flags:long)`
	`End_Function;`
	`Function OnKeyUp(KeyCode:long, Flags:long)`
	`End_Function;`
	
	`Task Main Autorun`
	`End_Task;`

4	Press the **[F7]** key to trigger the build process for this project. **Result:** The visualization functions and the VisualInterface header file are now available for programming.

Result:

You can expand the program now. In **IntelliSense** (**Ctrl + Space bar**), the visualization functions and the information from the VisualInterface header file are now available. You can **transfer** the program to the HMI by the shortcut **[Strg] + [F5]**. However, the program has no function as yet.

Functions `OnKeyDown` and `OnKeyUp`

The functions `OnKeyDown` and `OnKeyUp` let you trigger, for example, visualization commands when a key is pressed or released. The operating system returns a specific key code to the function depending on what key you press.

The following key codes, for example, are assigned to the keys **[UP]**, **[DOWN]**, **[OK]** and **[ESC]**:

Key	Key code	Constant
▲	0x26	KEY_UP
▼	0x28	KEY_DOWN
OK	0x0D	KEY_RETURN
ESC	0x1B	KEY_ESCAPE

The file **VISU_Defines.stxp** holds the key codes assigned to individual keys as constants. This lets you use constants in the application program.

A sample STX program is listed below:

```
#include "VisualInterface.stxp"

Function OnKeyDown(KeyCode:LONG, Flags:Long)
Case KeyCode Of
KEY_UP: VisuCmdAttribute(Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_26000);
Break;
KEY_DOWN: VisuCmdAttribute(Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_26001);
Break;
KEY_RETURN: VisuCmdAttribute(Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_26002);
Break;
KEY_ESCAPE: VisuCmdAttribute(Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_26003);
Break;
End_Case;
End_Function;
```

Recommendations

It is advisable to use for **Ellipse_4000** and **FillAttribute_26000** object names that are more descriptive. This makes it easier to find these objects and to assign them properly. Instead of *FillAttribute_26000* you could name it, for example, *FillAttribute_White*.

Blanks or special characters (ä, ö, ü, ß, -, ...) are not allowed for object names.

JetViewSoft lets you enter object names in the properties pane of the corresponding object. JetViewSoft incorporates this object name and the object ID into the file **VisualInterface.stxp**. Then, you can use the object name and ID in the program.

Related topics

- **Initial commissioning in JetViewSoft** (see page 64)

5.3 ER-STX-CE platform - Programming

Introduction

This chapter consists of the following two parts:

- Entering data via digipot on the HMI
- Making changes to visualization objects through visualization commands (VisuCommands) from within the application program.

Prerequisites

This description applies to the platform JetView ER-STX-CE/PC.

Additional information

For more information refer to the JetSym and JetViewSoft online help.

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Using visualization commands to manipulate visualization objects	82

Entering data via digipot

Introduction

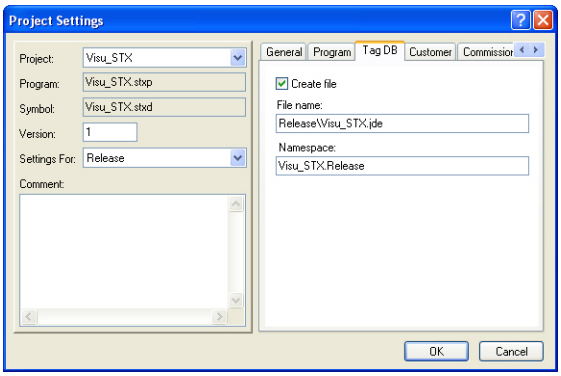
A few lines of program code enable you to enter data via digipot on the HMI. These data are then available in a JetSym STX application program.

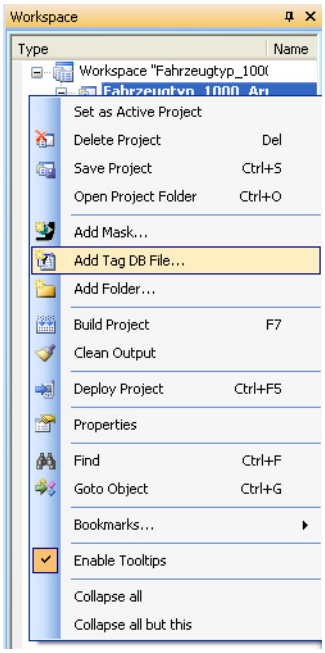
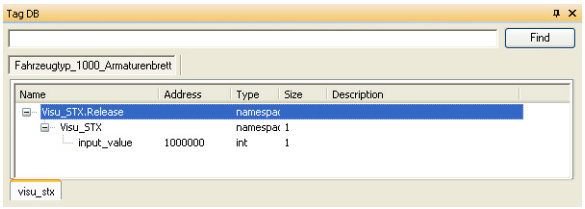
Entering data via digipot

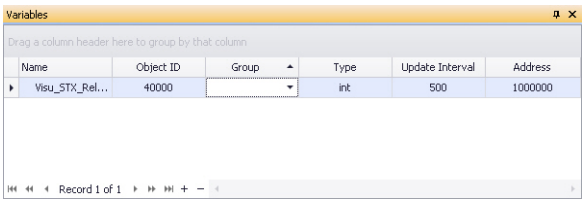
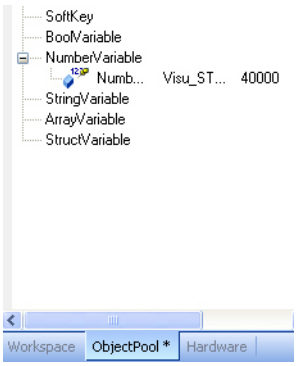
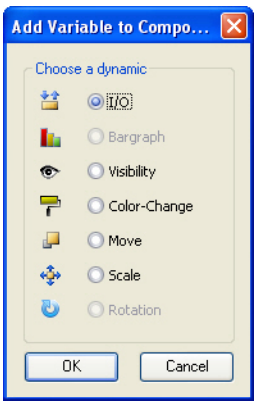
To enter data via digipot, proceed as follows:

Step	Action

1	Declare the variables in the JetSym STX program using [export jde].
	
	`Task Visu_STX Autorun`
	`Var`
	`input_value: Int At %VL 1000000 [export jde];`
	`End_Var;`
	`End_Task;`

2	In JetSym navigate to **Project Settings** and the tab **TagDB**. Here, tick the checkbox **Create file**. 
3	Open the **Build** menu. Select menu item **Build**. Another way is to press the key **[F7]**.
⇨	During the build process JetSym will then create a TagDB file with the extension *.jde. This file holds the declarations of all variables. **Storage location:** JetSym creates a folder named **Release**. JetSym stores the file to this folder.

Step	Action
4	Embed the TagDB file into your JetViewSoft visualization project. To this end, activate the shortcut menu in the workspace and click on **Add TagDB File...** . 
⇨	JetViewSoft displays the variables declared in the TagDB file in the TagDB window. 
5	Use Drag&Drop to drag a variable into the window **Variables**.

Step	Action
⇨	JetViewSoft creates a variable of the type *Number Variable* as an object. This is how the window **Variables** looks like:  This is what the tab **ObjectPool** looks like:  If the TagDB file contains controller information, JetViewSoft creates a controller and links it with the variables.
6	Use Drag&Drop to drag the variable from the window **Variables** or **ObjectPool** to the visualization object **Edit Numeric**. When the PLUS sign appears, release the mouse button. **Result:** A link between visualization object and variable has been created.
7	Select the corresponding dynamic feature, such as I/O.  **Result:** JetViewSoft adds the variable and dynamic feature to the object properties.

Step	Action
8	In JetSym and JetViewSoft, carry out the commands **Build** and **Deploy**. **Result:** The application is now available on the HMI.
9	Restart the HMI.

Result:

The HMI shows the start screen. Now, you can use the digipot to enter a value in the object **Edit Numeric**.

If you enter in the JetSym setup pane register number R 1000000, JetSym displays the set value.

Using visualization commands to manipulate visualization objects

Introduction

Visualization commands are functions included in the JetSym visualization library. These function can be invoked in the JetSym STX program. Thus, visualization commands let you manipulate visualization objects directly from within the JetSym STX program. The description below shows how to change, for example, the fill color of an ellipse using the corresponding visualization command.

Components of the visualization library

All available commands have been declared in the file **VISU_Functions.stxp**. Predefined data types, such as the color as RGB value, attributes and key codes have been declared in the file **VISU_Defines.stxp**. Both files form an integral part of the visualization library.

Prerequisites

For the compiler to compile the following program without errors, add the program code listed below to the sample programs:

```
#Include "VisualInterface.stxp";

Function OnKeyDown (KeyCode:long, Flags:long)
End_Function;
Function OnKeyUp (KeyCode:long, Flags:long)
End_Function;
```

Task 1

The application program is to control the color change of an ellipse through the fill color attribute. After 5 seconds the fill color is to change from red to blue and after another 5 seconds back from blue to red.

Task 1 - Solution

The application program invokes the function **VisuCmdAttribute()** at regular intervals (cycles).

Task 1 - JetSym STX program

```
Var
    Flag:    Bool At %MX 1;
End_Var;

Task Visu_STX Autorun
Flag := FALSE;
Loop
    If Flag = FALSE Then
        Flag := TRUE;
    ELSE
        Flag := FALSE;
    End_If;

Case Flag Of
    TRUE:  VisuCmdAttribute (Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_Blue);
    Break;
    FALSE: VisuCmdAttribute (Ellipse_4000,
ELLIPSE_ATTR_FILLATTRIBUTE, FillAttribute_Red);
    Break;
```

```
End_Case;

Delay(T#5s);
End_Loop;
End_Task;
```

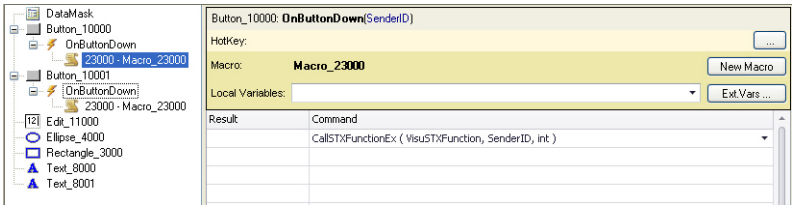
Task 2

When a certain button is activated (Button_10000), the fill color of a rectangle object is to change to red.

When a second button is activated (Button_10001), the fill color of the same rectangle object is to change to blue. The digipot is used to activate the buttons.

Task 2 - Solution

Assign in JetViewSoft the event **OnButtonDown** to both buttons. When this event occurs, the macro function **CallSTXFunctionEx()** is invoked.



In the application program, a function has been declared which in turn executes a visualization command. In the given case it is the function **VisuSTXFunction()**.

The SenderID holds the information which button has been pressed. A case instruction is used to retrieve this information.

Task 2 - JetSym-STX program

```
Function VisuSTXFunction (SenderID : long)

Case SenderID Of
    Button_10000: VisuCmdAttribute (Rectangle_3000;
RECTANGLE_ATTR_FILLATTRIBUTE, FillAttribute_Red);
    Break;
    Button_10001: VisuCmdAttribute (Rectangle_3000;
RECTANGLE_ATTR_FILLATTRIBUTE, FillAttribute_Blue);
    Break;
End_Case;
End_Function;

Task Visu_STX Autorun

End_Task;
```

Note

Once you have selected the macro function **CallSTXFunctionEX()** in a macro object, this function with its name is declared in the file **VisualInterface.stxp** as **forward**.

6 CANopen® STX API

Introduction

This chapter describes the STX functions of the CANopen® STX API.

The CANopen® standard

CANopen® is an open standard for networking and communication, for instance, in the automobile sector.

The CANopen® protocol has been further developed by the CiA e.V. (CAN in Automation) and works on the physical layer with CAN Highspeed in accordance with ISO 11898.

Documentation

The CANopen® specifications can be obtained from the **CiA e.V. http://www.can-cia.org** homepage. The key specification documents are:

- CiA DS 301 - This document is also known as the communication profile and describes the fundamental services and protocols used under CANopen®.
- CiA DS 302 - Framework for programmable devices (CANopen® Manager, SDO Manager)
- CiA DR 303 - Information on cables and connectors
- CiA DS 4xx - These documents describe the behavior of a number of device classes in, what are known as, device profiles.

Application

These STX functions are used in communication between the JVM-104 and other CANopen® nodes.

Note: Take into account the point of view!

In this chapter we use the point of view from the higher-level controller, whereas in the document CiA DS 301 the point of view from the devices is used.

This is why you need, for example, a PDO-RX macro to invoke the function `CanOpenAddPDORx()`.

Terms and abbreviations

In this chapter, the following terms and abbreviations are used:

Term	Description
Node ID	Node identification number of the device: This ID lets you address the device.
NMT	Network management - Netzwerkmanagement
ro	Read only access
rw	Read/write access

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STX function: CanOpenInit()

Introduction

The function `CanOpenInit()` lets you initialize one of the CAN busses. The JVM-104 then automatically sends the heartbeat message every second with the following communication object identifier (COB-ID): Node ID + 0x700.

Function declaration

```
Function CanOpenInit(
    CANNo:Int,
    NodeID:Int,
    const ref SWVersion:String,
) :Int;
```

Function parameters

The function `CanOpenInit()` has got the following parameters.

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
NodeID	Node ID of the given device	1 ... 127
SWVersion	Reference to own software version This software version is entered into the index 0x100A in the object directory.	String up to 255 characters

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters
-3	Initialization has not worked
-4	The JX2 system bus driver is activated

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

This function lets you initialize CAN bus 0. The JVM-104 has node ID 20 (0x14).

```
Result := CanOpenInit(0, 20, 'Version: 01.00.0.00');
```

Operating principle

During initialization, the JVM-104 processes the following process steps:

Step	Description
1	First, the bootup message is sent as a heartbeat message.
2	As soon as the JVM-104 goes into **pre-operational** status, it sends the heartbeat message **pre-operational**.

Access to the object directory

If the JVM-104 is in **pre-operational** state, it lets you access the object directory using SDO.

NMT messages

After initialization, NMT messages can be sent and received. The own heartbeat status can be changed with the function `CanOpenSetCommand`.

Related topics

- **STX function CanOpenSetCommand** (see page 89)

STX function: CanOpenSetCommand()

Introduction

The function `CanOpenSetCommand()` lets you change the heartbeat status of the device itself and of all other devices (NMT slaves) on the CAN bus.

Function declaration

```
Function CanOpenSetCommand(
    CANNo:Int,
    iType:Int,
    Value:Int,
) :Int;
```

Function parameters

The function `CanOpenSetCommand()` has got the following parameters:

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
iType	Command selection	See table below.

iType	Description: Value
CAN_CMD_HEARTBEAT	Only the own heartbeat status is changed. Selecting heartbeat states: CAN_HEARTBEAT_STOPPED (0x04) CAN_HEARTBEAT_OPERATIONAL (0x05) CAN_HEARTBEAT_PREOPERATIONAL (0x7F)
CAN_CMD_NMT	The heartbeat status is changed for all other devices or for a specific device on the CAN bus. Selecting heartbeat states (NMT master): CAN_NMT_OPERATIONAL (0x01) or CAN_NMT_START (0x01) CAN_NMT_STOP (0x02) CAN_NMT_PREOPERATIONAL (0x80) CAN_NMT_RESET (0x81) CAN_NMT_RESETCOMMUNICATION (0x82)
CAN_CMD_TIME_CONSUMER	This command lets you set the device to ready-to-receive state to allow time synchronization via CAN bus (CAN ID 0x100). Refer to document by CiA e.V. DS301 V402 *Selecting Synchronization*, page 59. CAN_TIME_CONSUMER_DISABLE = 0 CAN_TIME_CONSUMER_ENABLE = 1
CAN_CMD_TIME_PRODUCER	The time is published on the CAN bus. For more information on the structure refer to document DS301 by CiA e.V., CAN ID 0x100: CAN_TIME_PRODUCER_SEND = 1 (for sending TIME_OF_DAY once)

Note

The macro function `CAN_CMD_NMT_Value(NodeID, CAN_CMD_NMT)` is used to select the command CAN_CMD_NMT.

Values from 0 to 127 are permitted for the node ID parameter. 1 to 127 is the node ID for a specific device. If the command is to be sent to all devices on the CAN bus, use the parameter `CAN_CMD_NMT_ALLNODES(0)`.

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

Return value

This function sends the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters Command not known

How to use this function (example 1)

Task: Set the own heartbeat status to **operational**.

```
Result := CanOpenSetCommand(0, CAN_CMD_HEARTBEAT,
CAN_HEARTBEAT_OPERATIONAL);
```

How to use this function (example 2)

Task: Set the own heartbeat status and the status of all other devices on the CAN bus to **operational**.

```
Result := CanOpenSetCommand(0, CAN_CMD_NMT,
CAN_CMD_NMT_Value(CAN_CMD_NMT_ALLNODES, CAN_NMT_OPERATIONAL));
```

How to use this function (example 3)

Task: Set the heartbeat status of the device with the node ID 60 (0x3C) to **operational**.

```
Result := CanOpenSetCommand(0, CAN_CMD_NMT, CAN_CMD_NMT_Value(60,
CAN_NMT_OPERATIONAL));
```

How to use this function (example 4)

Task: Enable time synchronization via CAN bus (CAN ID 0x100).

```
Result := CanOpenSetCommand(0, CAN_CMD_TIME_CONSUMER,
CAN_TIME_CONSUMER_ENABLE);
```

How to use this function (example 5)

Task: Publish the time on the CAN bus.

```
Result := CanOpenSetCommand(0, CAN_CMD_TIME_PRODUCER,
CAN_TIME_PRODUCER_SEND);
```

STX function: CanOpenUploadSDO()

Introduction

The function `CanOpenUploadSDO()` lets you access a particular object in the object directory of the message recipient and read the value of the object.

Data is exchanged in accordance with the SDO upload protocol. Supported transfer types are **segmented** (more than 4 data bytes) and **expedited** (up to 4 data bytes).

Function declaration

```
Function CanOpenUploadSDO(
    CANNo:Int,              // Number of the bus line
    NodeID:Int,             // Device ID
    wIndex:Word,
    SubIndex:Byte,
    DataType:Int,           // Type of the data to be received
    // Data length for the global variable DataAddr
    DataLength:Int,
    // Global variable into which the received value is entered
    const ref DataAddr,
    ref Busy: Int,          // Status of the SDO transmission
) :Int;
```

Function parameters

The `CanOpenUploadSDO()` function has got the following parameters:

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
NodeID	Node ID of the message recipient	1 ... 127
wIndex	Index number of the object	0 ... 0xFFFF
SubIndex	Subindex number of the object	0 ... 255
DataType	Type of data to be received	2 ... 27
DataLength	Data length of the global variable DataAddr	
DataAddr	Global variable into which the received value is to be entered	
Busy	Status of the SDO transmission	

Return value

This function sends the following return values to the higher-level program.

Return value	
0	OK
-1	Error in checking parameters
-2	Device in **Stop** status
-3	DataType is greater than DataLength
-4	Insufficient memory

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

DataType parameter

The following data types can be received.

Byte types	CANopen® format	Jetter format
1	CANOPEN_INTEGER8 CANOPEN_UNSIGNED8	Byte
2	CANOPEN_INTEGER16 CANOPEN_UNSIGNED16	Word
3	CANOPEN_INTEGER24 CANOPEN_UNSIGNED24	-
4	CANOPEN_INTEGER32 CANOPEN_UNSIGNED32 CANOPEN_REAL	Int
5	CANOPEN_INTEGER40 CANOPEN_UNSIGNED40	-
6	CANOPEN_INTEGER48 CANOPEN_UNSIGNED48 CANOPEN_TIME_OF_DAY CANOPEN_TIME_DIFFERENCE	-
7	CANOPEN_INTEGER56 CANOPEN_UNSIGNED46	-
8	CANOPEN_INTEGER64 CANOPEN_UNSIGNED64 CANOPEN_REAL64	-
n	CANOPEN_VISIBLE_STRING CANOPEN_OCTET_STRING CANOPEN_UNICODE_STRING CANOPEN_DOMAIN	String

Busy parameter

After successfully calling up the function, the **Busy** parameter is set to SDOACCESS_INUSE. With an error in transmission, **Busy** is set to SDOACCESS_ERROR. With a successful transmission, the function returns the number of bytes transmitted.

Busy - Error codes

With an error in transmission, **Busy** returns an error code. The following error codes are available:

SDOACCESS_STILLUSED

Another task is communicating with the same node ID.

SDOACCESS_TIMEOUT

The task has been timed out because the device with the specified node ID is not responding.

If the specified node ID does not respond within 1 second, the timeout bit is set.

SDOACCESS_ILLCMD

The response to the request is invalid.

SDOACCESS_ABORT

Access to the device with the specified node ID was aborted.

SDOACCESS_SYSERROR

General internal error

Macro definitions

The following macros have been defined in connection with this function:

SDOACCESS_FINISHED (busy)

This macro checks whether communication has finished.

SDOACCESS_ERROR (busy)

This macro checks whether an error has occurred.

How to use this function

```
Result := CanOpenUploadSDO(
    0,                              // CANNo
    66,                             // NodeID
    0x100A,                         // wIndex
    0,                              // SubIndex
    CANOPEN_STRING,                 // DataType
    sizeof(var_Versionstring),      // DataLength
    var_Versionstring,              // DataAddr
    busy);                          // Busy
```

JetSym STX program

In the following example, the manufacturer's software version is read from the CANopen® Object Directory of the device with the addressed node ID.

```
Const
    CANNo = 0;              // Number of the bus line
    NodeID_Node_0 = 10;     // Device ID of node 1
    NodeID_Node_0 = 66;     // Device ID of node 2
End_Const;

Var
    busy: Int;
    Versionstring: String;
    Objectindex: Word;
    Subindex: Byte;
    Result: Int;
End_Var;


Task Example_UploadSDO autorun

Var
    SW_Version: String;
End_Var;

SW_Version := 'v4.3.0.2004';

// Initializing CAN 0
CanOpenInit(CANNo,              // Number of the bus line
            NodeID_Node_0,      // Node ID
            SW_Version);        // Manufacturer's software version

// All nodes on the CAN bus are in PREOPERATIONAL state

// Request manufacturer's software version per SDO
Objectindex := 0x100A;
Subindex := 0;
```

```
Result:= CanOpenUploadSDO(CANNo,         // Number of the bus line
                 NodeID_Node_1,          // Node ID
                 Objectindex,            // wIndex
                 Subindex,               // SubIndex
                 CANOPEN_STRING,         // DataType
                 sizeof(Versionstring), // DataLength
                 Versionstring,          // DataAddr
                 busy);                  // Busy

// Checking the command for successful execution
If (Result == 0) Then

    // Waiting until communication is completed
    When SDOACCESS_FINISHED(busy) Continue;

    // Checking for errors
    If (SDOACCESS_ERROR(busy)) Then
        // Troubleshooting
    End_If;
End_If;

//      ...
//      ...
//      ...

End_Task;
```

STX function: CanOpenDownloadSDO()

Introduction

The function `CanOpenDownloadSDO()` lets you access a particular object in the Object Directory of the message recipient and specify the value of the object. Data is exchanged in accordance with the SDO upload protocol. Supported transfer types are **segmented** or **block** (more than 4 data bytes) and **expedited** (up to 4 data bytes).

Function declaration

```
Function CanOpenDownloadSDO(
    CANNo:Int,              // Number of the bus line
    NodeID:Int,             // Device ID
    wIndex:Word,
    SubIndex:Byte,
    DataType:Int,           // Type of the data to be sent
    // Data length of the global variable DataAddr
    DataLength:Int,
    // Global variable holding the value to be sent
    const ref DataAddr,
    ref Busy: Int,          // Status of the SDO transmission
) :Int;
```

Function parameters

The `CanOpenDownloadSDO()` function has got the following parameters:

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
NodeID	Node ID of the message recipient	1 ... 127
wIndex	Index number of the object	0 ... 0xFFFF
SubIndex	Subindex number of the object	0 ... 255
DataType	Type of data to be sent	2 ... 27
DataLength	Data length of the global variable DataAddr	
DataAddr	Global variable into which the value to be sent is to be entered	
Busy	Status of the SDO transmission	

Return value

This function sends the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters
-2	Device in **Stop** status (own heartbeat status)
-3	DataType is greater than DataLength
-4	Insufficient memory

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

DataType parameter

The following data types can be received.

Byte types	CANopen® format	Jetter format
1	CANOPEN_INTEGER8 CANOPEN_UNSIGNED8	Byte
2	CANOPEN_INTEGER16 CANOPEN_UNSIGNED16	Word
3	CANOPEN_INTEGER24 CANOPEN_UNSIGNED24	-
4	CANOPEN_INTEGER32 CANOPEN_UNSIGNED32 CANOPEN_REAL	Int
5	CANOPEN_INTEGER40 CANOPEN_UNSIGNED40	-
6	CANOPEN_INTEGER48 CANOPEN_UNSIGNED48 CANOPEN_TIME_OF_DAY CANOPEN_TIME_DIFFERENCE	-
7	CANOPEN_INTEGER56 CANOPEN_UNSIGNED46	-
8	CANOPEN_INTEGER64 CANOPEN_UNSIGNED64 CANOPEN_REAL64	-
n	CANOPEN_VISIBLE_STRING CANOPEN_OCTET_STRING CANOPEN_UNICODE_STRING CANOPEN_DOMAIN	String

Busy parameter

After successfully calling up the function, the **Busy** parameter is set to SDOACCESS_INUSE. With an error in transmission, **Busy** is set to SDOACCESS_ERROR. With a successful transmission, the function returns the number of bytes transmitted.

"Busy" error codes

With an error in transmission, Busy returns an error code. The following error codes are available:

SDOACCESS_STILLUSED

Another task is communicating with the same node ID.

SDOACCESS_TIMEOUT

The task has been timed out because the device with the given node ID is not responding.

If the specified node ID does not respond within 1 second, the timeout bit is set.

SDOACCESS_ILLCMD

The response to the request is invalid.

SDOACCESS_ABORT

Access to the device with the specified node ID was aborted.

SDOACCESS_BLKSIZEINV

Communication error with Block Download

SDOACCESS_SYSERROR

General internal error

Macro definitions

The following macros have been defined in connection with this function:

SDOACCESS_FINISHED (busy)

This macro checks whether communication has finished.

SDOACCESS_ERROR (busy)

This macro checks whether an error has occurred.

How to use this function

```
Result := CanOpenDownloadSDO(
    0,                              // CANNo
    68,                             // NodeID
    0x1017,                         // wIndex
    0,                              // SubIndex
    CANOPEN_WORD,                   // DataType
    sizeof(var_Heartbeat_time),     // DataLength
    var_Heartbeat_time,             // DataAddr
    busy);                          // Busy
```

JetSym STX program

In the following example, the heartbeat time is entered in the CANopen® object directory of the device with the addressed node ID.

```
Const
    CANNo = 0;              // Number of the bus line
    NodeID_Node_0 = 10;     // Node ID of node 1
    NodeID_Node_0 = 68;     // Node ID of node 2
End_Const;

Var
    busy: Int;
    Heartbeat_time: Int;
    Objectindex: Word;
    Subindex: Byte;
    Result: Int;
End_Var;


Task Example_DownloadSDO autorun

Var
    SW_Version: String;
End_Var;

SW_Version := 'v4.3.0.2004';

// Initializing CAN 0
CanOpenInit(CANNo,            // Number of the bus line
            NodeID_Node_0,    // Device ID of the node
            SW_Version);      // Manufacturer's software version

// Setting the node with ID NodeID_Node_1 on the CAN bus to
// PREOPERATIONAL state
CanOpenSetCommand(CANNo, CAN_CMD_NMT_Value(NodeID_Node_1,
CAN_CMD_NMT), CAN_NMT_PREOPERATIONAL);

// Changing the heartbeat time of the addressed device via SDO
Objectindex := 0x1017;
Subindex := 0;
Result:= CanOpenDownloadSDO(CANNo,  // Number of the bus line
                  NodeID_Node_1,          // Node ID
                  Objectindex,            // wIndex
                  Subindex,               // SubIndex
                  CANOPEN_WORD,           // DataType
                  sizeof(Heartbeat_time), // DataLength
                  Heartbeat_time,         // DataAddr
                  busy);                  // Busy

// Checking the command for successful execution
If (Result == 0) Then
```

```
    // Waiting until communication is completed
    When SDOACCESS_FINISHED(busy) Continue;

    // Checking for errors
    If (SDOACCESS_ERROR(busy)) Then
    // Troubleshooting
    End_If;
End_If;

// Resetting all devices on the CAN bus to OPERATIONAL status
CanOpenSetCommand(CANNo, CAN_CMD_NMT_Value(CAN_CMD_NMT_ALLNODES,
CAN_CMD_NMT), CAN_NMT_OPERATIONAL);

//      ...
//      ...
//      ...

End_Task;
```

STX function: CanOpenAddPDORx()

Introduction

The function `CanOpenAddPDORx()` lets you specify which process data, sent by other CANopen® devices, must be received.

Process data can be received only when a CANopen® device is sending them.

Notes

- Only if the CANopen® devices on the bus are in state **operational**, the PDO telegram is transmitted.
- The smallest time unit for the event time is 1 ms.
- The smallest time unit for the inhibit time is 1 ms.

Function declaration

```
Function CanOpenAddPDORx(
    CANNo:Int,              // Number of the bus line
    CANID:Int,              // CAN identifier
    // Starting position of data to be received
    BytePos:Int,
    DataType:Int,           // Data type of the data to be received
    // Data length of the global variable VarAddr
    DataLength:Int,
    // Global variable into which the received value is entered
    const ref VarAddr,
    // Cycle time for receiving a telegram
    // Event time
    EventTime: Int,
    // Minimum interval between two received messages
    // Inhibit time
    InhibitTime: Int,
    Paramset: Int,          // Bit-coded parameter
) :Int;
```

Function parameters

The `CanOpenAddPDORx()` function has got the following parameters:

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
CANID	CAN identifier 11-bit CAN identifier 29-bit	0 ... 0x7FF 0 ... 0x1FFFFFFF
BytePos	Starting position of data to be received	0 ... 7
DataType	Data type of data to be received	2 ... 13, 15 ... 27
DataLength	Data length of the global variable VarAddr	
VarAddr	Global variable into which the received value is entered	
EventTime	Time lag between two telegrams (> InhibitTime)	

Parameter	Description	Value
InhibitTime	Minimum time lag between two telegrams received (< EventTime)	
Paramset	Bit-coded parameter	

Return value

This function sends the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters
-3	DataType is greater than DataLength
-4	Insufficient memory

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

Note: Take into account the point of view!

In this chapter we use the point of view from the higher-level controller, whereas in the document CiA DS 301 the point of view from the devices is used.

This is why you need a PDO-RX macro to invoke the function `CanOpenAddPDORx()` from the controller.

CANID parameter

The **CANID** parameter is used to transfer the CAN identifier. The CAN identifier is generated with a macro. The CAN identifier depends on the node ID of the other communicating user and on whether it is a PDO1, PDO2, PDO3 or PDO4 message.

Macro definitions:

```
#Define CANOPEN_PDO1_RX (NodeID)    ((NodeID) + 0x180)
#Define CANOPEN_PDO2_RX (NodeID)    ((NodeID) + 0x280)
#Define CANOPEN_PDO3_RX (NodeID)    ((NodeID) + 0x380)
#Define CANOPEN_PDO4_RX (NodeID)    ((NodeID) + 0x480)

#Define CANOPEN_PDO1_TX (NodeID)    ((NodeID) + 0x200)
#Define CANOPEN_PDO2_TX (NodeID)    ((NodeID) + 0x300)
#Define CANOPEN_PDO3_TX (NodeID)    ((NodeID) + 0x400)
#Define CANOPEN_PDO4_TX (NodeID)    ((NodeID) + 0x500)
```

Example for calling up the macro:

CANOPEN_PDO2_RX (64)

⇨ The resulting CAN identifier is: 2C0h = 40h + 280h

Default CAN identifier distribution

For CANopen® the following CAN identifier distribution is predefined. In this case, the node number is embedded in the identifier.

11-bit identifier (binary)	Identifier (decimal)	Identifier (hexadecimal)	Description
000000000000	0	0	Network management
000100000000	128	80h	Synchronization
0001xxxxxxxx	129 - 255	81h - FFh	Emergency
0011xxxxxxxx	385 - 511	181h - 1FFh	PDO1 (tx)
0100xxxxxxxx	513 - 639	201h - 27Fh	PDO1 (rx)
0101xxxxxxxx	641 - 767	281h - 2FFh	PDO2 (tx)
0110xxxxxxxx	769 - 895	301h - 37Fh	PDO2 (rx)
0111xxxxxxxx	897 - 1023	381h - 3FFh	PDO3 (tx)
1000xxxxxxxx	1025 - 1151	401h -47Fh	PDO3 (rx)
1001xxxxxxxx	1153 - 1279	481h - 4FFh	PDO4 (tx)
1010xxxxxxxx	1281 - 1407	501h - 57Fh	PDO4 (rx)
1011xxxxxxxx	1409 - 1535	581h - 5FFh	Send SDO
1100xxxxxxxx	1537 - 1663	601h - 67Fh	Receive SDO
1110xxxxxxxx	1793 - 1919	701h - 77Fh	NMT error control
xxxxxxxx = Node number 1 - 127			

DataType parameter

The following data types can be received.

Byte types	CANopen® format	Jetter format
1	CANOPEN_INTEGER8 CANOPEN_UNSIGNED8	Byte
2	CANOPEN_INTEGER16 CANOPEN_UNSIGNED16	Word
3	CANOPEN_INTEGER24 CANOPEN_UNSIGNED24	-
4	CANOPEN_INTEGER32 CANOPEN_UNSIGNED32 CANOPEN_REAL	Int
5	CANOPEN_INTEGER40 CANOPEN_UNSIGNED40	-
6	CANOPEN_INTEGER48 CANOPEN_UNSIGNED48 CANOPEN_TIME_OF_DAY CANOPEN_TIME_DIFFERENCE	-
7	CANOPEN_INTEGER56 CANOPEN_UNSIGNED46	-
8	CANOPEN_INTEGER64 CANOPEN_UNSIGNED64 CANOPEN_REAL64	-
n	CANOPEN_VISIBLE_STRING CANOPEN_OCTET_STRING CANOPEN_UNICODE_STRING CANOPEN_DOMAIN	String

Paramset parameter

The following parameters can be transferred to the function. Several parameters can be linked together using the Or function.

CANOPEN_ASYNCPDORTRONLY

Receive asynchronous PDOs by sending an RTR frame to the sender (after each expired EventTime). If there is no response to RTR frames, the request time increases to five times the EventTime.

CANOPEN_ASYNCPDO

Receive asynchronous PDOs.

CANOPEN_PDOINVALID

PDO not received. Disk space is reserved.

CANOPEN_NORTR

PDO cannot be requested by RTR (Remote Request).

Only if CANOPEN_ASYNCPDORTROnly has been set, an RTR is sent.

CANOPEN_29BIT

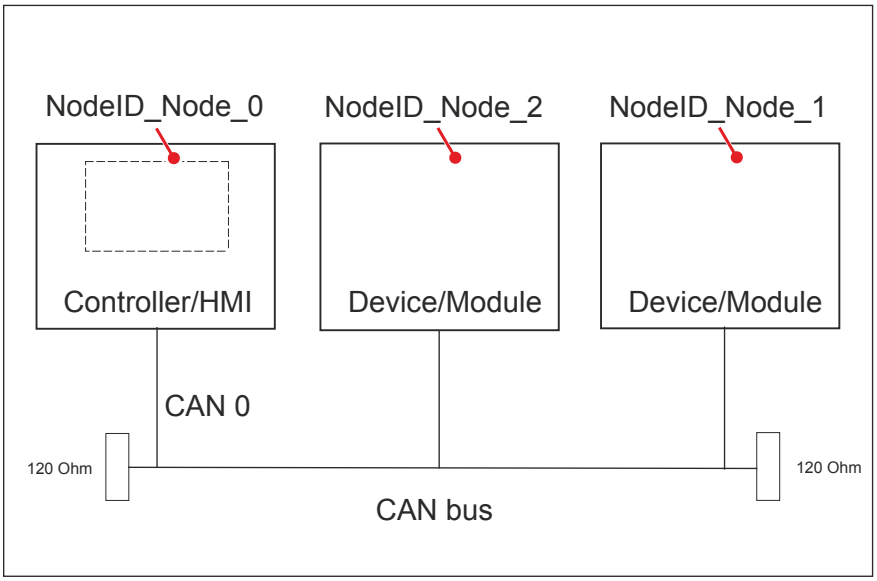
Use 29-bit identifier
Default: 11-bit identifier

How to use this function

```
Result := CanOpenAddPDORx(
    0,                                      // CANNo
    662,                                    // CANID
    0,                                      // BytePos
    CANOPEN_DWORD,                          // DataType
    sizeof(var_Data_1_of_Node_1),           // DataLength
    var_Data_1_of_Node_1,                   // VarAddr
    1000,                                   // Event time
    10,                                     // Inhibit time
    CANOPEN_ASYNCPDO | CANOPEN_NORTR);      // Paramset
```

JetSym STX program

JVM-104 with node ID 10 wants to receive a PDO from two CANopen® devices with node ID 64 and 102. The function `CanOpenAddPDORx()` is invoked for this purpose. After running the program, the JVM-104 receives cyclic PDO telegrams.




```
Const
    CANNo = 0;              // Number of the bus line
    NodeID_Node_0 = 10;     // Device ID of node 1
    NodeID_Node_1 = 64;     // Device ID of node 2
    NodeID_Node_2 = 102;    // Device ID of node 3
    Event_Time = 1000;      // Event time in ms
    Inhibit_Time = 10;      // Inhibit time in ms
End_Const;
```

```
Var
    Data_1_of_Node_1: Int;
    Data_2_of_Node_1: Int;
    Data_1_of_Node_2: Int;
End_Var;


Task main autorun

Var
    SW_Version: String;
End_Var;

SW_Version := 'v4.3.0.2004';

// Initializing CAN 0
CanOpenInit(CANNo,            // Number of the bus line
            NodeID_Node_0,    // Node ID
            SW_Version);      // Manufacturer's software version

// Entering process data to be received
CanOpenAddPDORx(
    CANNo,                              // Number of the bus line
    CANOPEN_PDO2_RX(NodeID_Node_1),     // CANID
    0,                                  // BytePos
    CANOPEN_DWORD,                      // DataType
    sizeof(Data_1_of_Node_1),           // DataLength
    Data_1_of_Node_1,                   // VarAddr
    Event_Time,                         // Event time
    Inhibit_Time,                       // Inhibit time
    CANOPEN_ASYNCPDORTRONLY);           // Paramset

CanOpenAddPDORx(
    CANNo,                              // Number of the bus line
    CANOPEN_PDO2_RX(NodeID_Node_1),     // CANID
    4,                                  // BytePos
    CANOPEN_DWORD,                      // DataType
    sizeof(Data_2_of_Node_1),           // DataLength
    Data_2_of_Node_1,                   // VarAddr
    Event_Time,                         // Event time
    Inhibit_Time,                       // Inhibit time
    CANOPEN_ASYNCPDORTRONLY);           // Paramset
```

```
CanOpenAddPDORx(
    CANNo,                                  // Number of the bus line
    CANOPEN_PDO3_RX(NodeID_Node_2),         // CANID
    0,                                      // BytePos
    CANOPEN_BYTE,                           // DataType
    sizeof(Data_1_of_Node_2),               // DataLength
    Data_1_of_Node_2,                       // VarAddr
    Event_Time,                             // Event time
    Inhibit_Time,                           // Inhibit time
    CANOPEN_ASYNCPDO | CANOPEN_NORTR); // Paramset

// All nodes on the CAN bus are in PREOPERATIONAL state

// Setting all nodes on the CAN bus to OPERATIONAL state
CanOpenSetCommand(CANNo, CAN_CMD_NMT_Value(CAN_CMD_NMT_ALLNODES,
CAN_CMD_NMT), CAN_NMT_START);

// As of now, PDO telegrams are received/sent
// from the higher-level controller
//      ...
//      ...
//      ...

End_Task;
```

STX function: CanOpenAddPDOTx()

Introduction

By calling up the `CanOpenAddPDOTx()` function, process data can be deposited on the bus.

However, that should not mean that other CANopen® devices on the bus can also read this process data.

Notes

- Only if the CANopen® devices on the bus are in state **operational**, the PDO telegram is transmitted.
- As soon as there are any changes to the process data, another PDO telegram is transmitted immediately.
- The smallest time unit for the event time is 1 ms.
- The smallest time unit for the inhibit time is 1 ms.
- Any unused bytes of a telegram are sent as null.

Function declaration

```
Function CanOpenAddPDOTx(
    CANNo:Int,              // Number of the bus line
    CANID:Int,              // CAN identifier
    BytePos:Int,            // Starting position of the data to be sent
    DataType:Int,           // Data type of the data to be sent
    // Data length of the global variable VarAddr
    DataLength:Int,
    // Global variable holding the value to be sent
    const ref VarAddr,
    // Cycle time for sending a telegram
    // Event time
    EventTime: Int,
    // Minimum interval between two transmitted messages
    // Inhibit time
    InhibitTime: Int,
    Paramset: Int,          // Bit-coded parameter
) :Int;
```

Function parameters

The `CanOpenAddPDOTx()` function has got the following parameters:

Parameter	Description	Value
CANNo	CAN bus number	0 ... CANMAX
CANID	CAN identifier 11-bit CAN identifier 29-bit	0 ... 0x7FF 0 ... 0x1FFFFFFF
BytePos	Starting position of data to be sent	0 ... 7
DataType	Data type of data to be sent	2 ... 13, 15 ... 27
DataLength	Data length of the global variable VarAddr	
VarAddr	Global variable into which the value to be sent is entered	

Parameter	Description	Value
EventTime	Time lag between two telegrams (> InhibitTime)	
InhibitTime	Minimum time lag between two telegrams to be sent (< EventTime)	
Paramset	Bit-coded parameter	

Return value

This function sends the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters
-3	DataType is greater than DataLength
-4	Insufficient memory

CANNo parameter

This parameter specifies the number of the CAN interface. CANNo = 0 is assigned to the first interface. The number of CAN interfaces depends on the device. For information on the maximum number of CAN interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

CANID parameter

The **CANID** parameter is used to transfer the CAN identifier. The CAN identifier is generated with a macro. The CAN identifier depends on the node ID of the other communicating user and on whether it is a PDO1, PDO2, PDO3 or PDO4 message.

Macro definitions:

```
#Define CANOPEN_PDO1_RX (NodeID)    ((NodeID) + 0x180)
#Define CANOPEN_PDO2_RX (NodeID)    ((NodeID) + 0x280)
#Define CANOPEN_PDO3_RX (NodeID)    ((NodeID) + 0x380)
#Define CANOPEN_PDO4_RX (NodeID)    ((NodeID) + 0x480)

#Define CANOPEN_PDO1_TX (NodeID)    ((NodeID) + 0x200)
#Define CANOPEN_PDO2_TX (NodeID)    ((NodeID) + 0x300)
#Define CANOPEN_PDO3_TX (NodeID)    ((NodeID) + 0x400)
#Define CANOPEN_PDO4_TX (NodeID)    ((NodeID) + 0x500)
```

Example for calling up the macro:

CANOPEN_PDO2_RX (64)

⇨ The resulting CAN identifier is: 2C0h = 40h + 280h

Default CAN identifier distribution

For CANopen® the following CAN identifier distribution is predefined. In this case, the node number is embedded in the identifier.

11-bit identifier (binary)	Identifier (decimal)	Identifier (hexadecimal)	Description
000000000000	0	0	Network management
000100000000	128	80h	Synchronization
0001xxxxxxxx	129 - 255	81h - FFh	Emergency
0011xxxxxxxx	385 - 511	181h - 1FFh	PDO1 (tx)
0100xxxxxxxx	513 - 639	201h - 27Fh	PDO1 (rx)
0101xxxxxxxx	641 - 767	281h - 2FFh	PDO2 (tx)
0110xxxxxxxx	769 - 895	301h - 37Fh	PDO2 (rx)
0111xxxxxxxx	897 - 1023	381h - 3FFh	PDO3 (tx)
1000xxxxxxxx	1025 - 1151	401h -47Fh	PDO3 (rx)
1001xxxxxxxx	1153 - 1279	481h - 4FFh	PDO4 (tx)
1010xxxxxxxx	1281 - 1407	501h - 57Fh	PDO4 (rx)
1011xxxxxxxx	1409 - 1535	581h - 5FFh	Send SDO
1100xxxxxxxx	1537 - 1663	601h - 67Fh	Receive SDO
1110xxxxxxxx	1793 - 1919	701h - 77Fh	NMT error control
xxxxxxxx = Node number 1 - 127			

DataType parameter

The following data types can be received.

Byte types	CANopen® format	Jetter format
1	CANOPEN_INTEGER8 CANOPEN_UNSIGNED8	Byte
2	CANOPEN_INTEGER16 CANOPEN_UNSIGNED16	Word
3	CANOPEN_INTEGER24 CANOPEN_UNSIGNED24	-
4	CANOPEN_INTEGER32 CANOPEN_UNSIGNED32 CANOPEN_REAL	Int
5	CANOPEN_INTEGER40 CANOPEN_UNSIGNED40	-
6	CANOPEN_INTEGER48 CANOPEN_UNSIGNED48 CANOPEN_TIME_OF_DAY CANOPEN_TIME_DIFFERENCE	-
7	CANOPEN_INTEGER56 CANOPEN_UNSIGNED46	-
8	CANOPEN_INTEGER64 CANOPEN_UNSIGNED64 CANOPEN_REAL64	-

Byte types	CANopen® format	Jetter format
n	CANOPEN_VISIBLE_STRING CANOPEN_OCTET_STRING CANOPEN_UNICODE_STRING CANOPEN_DOMAIN	String

Paramset parameter

The following parameters can be transferred to the function. Several parameters can be linked together using the Or function.

CANOPEN_ASYNCPDORTRONLY
Send asynchronous PDOs by receiving an RTR frame.
This feature is not yet supported at the moment.

CANOPEN_ASYNCPDO
Send asynchronous PDO.

CANOPEN_PDOINVALID
PDO not sent. The required disk space is reserved.

CANOPEN_NORTR
PDO cannot be requested by RTR (Remote Request).

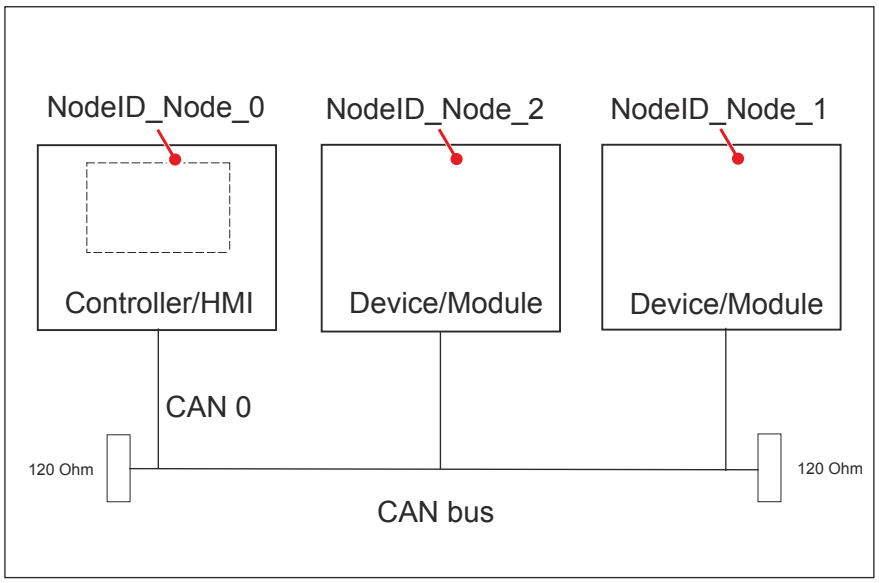
CANOPEN_29BIT
Use 29-bit identifier
Default: 11-bit identifier

How to use this function

```
Result := CanOpenAddPDOTx(
    0,                                  // CANNo
    842,                                // CANID
    0,                                  // BytePos
    CANOPEN_DWORD,                      // DataType
    sizeof(var_Data_1_of_Node_3),       // DataLength
    var_Data_1_of_Node_3,               // VarAddr
    1000,                               // Event time
    100,                                // Inhibit time
    CANOPEN_ASYNCPDO | CANOPEN_NORTR);  // Paramset
```

JetSym STX program

JVM-104 sends process data to two CANopen® devices with the node ID 74 and 112. After running the program and in the case of changes, the JVM-104 sends cyclic PDO telegrams every 3,000 ms (event time). As a maximum, the PDO telegram is sent every 10 ms (inhibit time).




```
Const
    CANNo = 0;              // Number of the bus line
    NodeID_Node_0 = 10;     // Device ID of node 1
    NodeID_Node_1 = 74;     // Device ID of node 2
    NodeID_Node_2 = 112;    // Device ID of node 3
    Event_Time = 3000;      // Event time in ms
    Inhibit_Time = 100;     // Inhibit time in ms
End_Const;

Var
    Data_1_of_Node_1: Int;
    Data_2_of_Node_1: Int;
    Data_1_of_Node_2: Byte;
End_Var;


Task main autorun

Var
    SW_Version: String;
End_Var;

SW_Version := 'v4.3.0.2004';

// Initializing CAN 0
CanOpenInit(CANNo,              // Number of the bus line
            NodeID_Node_0,      // Node ID
            SW_Version);        // Manufacturer's software version
```

```
// Send data per PDO
CanOpenAddPDOTx(
    CANNo,                              // Number of the bus line
    CANOPEN_PDO2_TX(NodeID_Node_1),     // CANID
    0,                                  // BytePos
    CANOPEN_DWORD,                      // DataType
    sizeof(Data_1_of_Node_1),           // DataLength
    Data_1_of_Node_1,                   // VarAddr
    Event_Time,                         // Event time
    Inhibit_Time,                       // Inhibit time
    CANOPEN_ASYNCPDORTRONLY);           // Paramset

CanOpenAddPDOTx(
    CANNo,                              // Number of the bus line
    CANOPEN_PDO2_TX(NodeID_Node_1),     // CANID
    4,                                  // BytePos
    CANOPEN_DWORD,                      // DataType
    sizeof(Data_2_of_Node_1),           // DataLength
    Data_2_of_Node_1,                   // VarAddr
    Event_Time,                         // Event time
    Inhibit_Time,                       // Inhibit time
    CANOPEN_ASYNCPDORTRONLY);           // Paramset

CanOpenAddPDOTx(
    CANNo,                                  // Number of the bus line
    CANOPEN_PDO3_TX(NodeID_Node_2),         // CANID
    0,                                      // BytePos
    CANOPEN_BYTE,                           // DataType
    sizeof(Data_1_of_Node_2),               // DataLength
    Data_1_of_Node_2,                       // VarAddr
    Event_Time,                             // Event time
    Inhibit_Time,                           // Inhibit time
    CANOPEN_ASYNCPDO | CANOPEN_NORTR);      // Paramset

// All nodes on the CAN bus are in PREOPERATIONAL state

// Setting all nodes on the CAN bus to OPERATIONAL state
CanOpenSetCommand(CANNo, CAN_CMD_NMT_Value(CAN_CMD_NMT_ALLNODES,
CAN_CMD_NMT), CAN_NMT_START);

// As of now, PDO telegrams will be transmitted from the devices with
node ID 74
// and 112.
//      ...

End_Task;
```

Heartbeat monitoring

Introduction

The heartbeat protocol is for monitoring the activity of communication partners. If the inactivity exceeds the set interval (Heartbeat consumer time), the status is set to **offline**.

The application program lets you define heartbeat functions, such as

- Displaying information to the user
- Rebooting the device
- Ignoring process data

Prerequisites

Heartbeat monitoring is available only for specific devices and its availability depends on the OS version.

Device	OS version
FMC-01	1.18.1.00 or higher
JVM-C02	4.00.0.00 or higher
JCM-350	1.09.0.215 or higher
JCM-620	JVER bersion 3.2.2.645 and JetVM version 3.04.0.00 or higher

Registers for heartbeat monitoring

Heartbeat monitoring uses the following registers:

Register	Description	Data type	Attributes
40x001	Own heartbeat status of the device; Value range: 0 = Bootup 4 = Stopped 5 = Operational 127 = Preoperational 255 = Offline (default value)	Int	ro (read only)
40x100	The heartbeat status of all monitored node IDs has changed. Value range: 0 = False 1 = True	Bool	rw (read and write)
40x101 ... 40x227	Heartbeat status of nodes with ID 1 ... 127; value range: 0 = Bootup 4 = Stopped 5 = Operational 127 = Preoperational 255 = Offline (default value)	Byte	ro
40x229 ... 40x355	Heartbeat timeout of nodes with ID 1 ... 127; value range: 0 ... 65535 [ms]	Word	rw

In the register number, the letter **x** represents the number of the CAN bus line used: x = 0 ... CANMAX.

Launching heartbeat monitoring

To launch heartbeat monitoring, proceed as follows:

Step	Action
1	Enable heartbeat monitoring: Enter the timeout value into the corresponding register. This value must range between 1 and 65535 [ms]. Example: For CAN 0 and node ID 1: Enter a timeout value of 3000 [ms] into register 400229.
2	Define in your application program how the device is to respond to individual values in the heartbeat status register. When the state in register 40x101 ... 40x227 changes, the value in register 40x100 changes to 1 (true).
3	Reset the value in register 40x100 to zero (false). This step ensures that subsequent changes in register 40x101 ... 40x227 can be displayed.

Heartbeat monitoring starts on receipt of the first heartbeat (including bootup message). The DLC (Data Length Code) of the heartbeat message must be 1.

Terminating heartbeat monitoring

To terminate heartbeat monitoring, proceed as follows:

Step	Action
1	Disable heartbeat monitoring: Enter a timeout value of 0 [ms] into the timeout register.

Emergency message

When a heartbeat timeout is detected, an emergency message is sent automatically.

On receipt of the next heartbeat message, the emergency message is reset.

Example:

The following emergency message is tripped:

Reference	Value
Error code	0x8130
Error Register	0x81
Manufacturer error	0x00,NodeID,0x00,0x00,0x00

The message on the CAN bus looks as shown below:

- Own NodeID 5
- Monitored NodeID 1
- ID: 0x85 DLC = 8 Data: 0x30 0x81 0x81 0x00 0x01 0x00 0x00 0x00

Emergency message Rx

The declaration of the emergency message Rx consists of the following elements:

```
CanOpenAddEmergencyRx(
    CANNo:Int,          // Number of the bus line
    NodeID:Int,         // Node ID
    // Status, number of valid messages
    ref stCanOpenEmergencyStat:CanOpenEmergencyStat,
    // Array holding the emergency messages
    ref CanOpenEmergencyMSG:CanOpenEmergencyArray,
    ):int
```

Example:

The above program lines must be included into the corresponding tasks of your application program. The example below shows an emergency message from a device with node ID 21.

```
...
// Initializing the CAN bus once.

...

// Defining global variables
Var
    stCanOpenEmergencyMsg : ARRAY[5] of CanOpenEmergencyMsg;
    stCanOpenEmergencyStat : CanOpenEmergencyStat;
End_Var;

stCanOpenEmergencyStat.lBuffer := sizeof(stCanOpenEmergencyMsg);
iRet:= CanOpenAddEmergencyRx(0,                         // CANNo.
                             21,                        // NodeID
                             stCanOpenEmergencyStat,    // Status
                             stCanOpenEmergencyMsg);    // Array

...
```

The above program lines produce the following result:

When the device with node ID 21 receives an emergency message, the value in register 400100 switches from 0 to 1 (true).

Reset this value always to 0 (false). In doing so, you make sure that new emergency messages are displayed.

Emergency message Tx

The declaration of the emergency message Tx consists of the following elements:

```
CanOpenAddEmergencyTx(
    // Number of the bus line
    CANNo:int,
    // For error code see CiA DS 301 V4.02 page 60
    // or CiA DS 4xx (device profile)
    ErrorCode:word,
    // Error register (object 0x1001)
    ErrorRegister:byte,
    // 5 bytes can be used at the user's discretion
    ManufacturerArray:ByteArray5,
    // True = An error has occurred
    // False = Error has been cleared (acknowledged)
    bSet:bool
    ):Int;
```

CANopen® object dictionary for JVM-104

Supported objects

The operating system of JVM-104 supports the following objects:

Index (hex)	Object (code)	Object name	Type	Attributes
1000	VAR	Device type	Unsigned32	ro (read only)
1001	VAR	Error register	Unsigned8	ro
1002	VAR	Manufacturer status	Unsigned32	ro
1003	ARRAY	Pre-defined error field	Unsigned32	ro
1008	VAR	Manufacturer device name	String	const
1009	VAR	Manufacturer hardware version	String	const
100A	VAR	Manufacturer software version	String	const
100B	VAR	Node ID	Unsigned32	ro
1017	VAR	Producer heartbeat time	Unsigned16	rw (read & write)
1018	RECORD	Identity	Identity	ro
1200	RECORD	Server 1 - SDO parameter	SDO parameter	ro
1201	RECORD	Server 2 - SDO parameter	SDO parameter	rw
1203	RECORD	Server 3 - SDO parameter	SDO parameter	rw
1203	RECORD	Server 4 - SDO parameter	SDO parameter	rw

Device Type object (index 0x1000)

The structure of the **Device Type object** is shown in the following table.

Index	Subindex	Default	Description
0x1000	0	0x0000012D	Device type (read-only)

Error Register object (index 0x1001)

The function `CanOpenAddEmergencyTx()` lets you set the bits in this register.

The structure of the **Error Register object** is shown in the following table.

Index	Subindex	Default	Description
0x1001	0	0	Error register (read-only)

This object implements the CANopen® error register functionality.

The following error messages may appear:

- Bit 0 = Generic error
- Bit 1 = Current error
- Bit 2 = Voltage error
- Bit 3 = Temperature error
- Bit 4 = Communication error (overrun, error state)
- Bit 5 = Specific device profile error
- Bit 6 = Reserved (always 0)
- Bit 7 = Manufacturer-specific error

Pre-defined Error Field object (index 0x1003)

The structure of the **Pre-defined Error Field object** is shown in the following table.

Index	Subindex	Default	Description
0x1003	0	0	Number of errors entered in the array's standard error field
	1	0	Most recent error 0 indicates no error
	2 ... 254	-	Earlier errors

This object shows a history list of errors that have been detected by the JVM-104. The maximum length of the list is 254 errors. The list content is deleted on restart.

Composition of standard error field

2-byte LSB: Error code

2-byte MSB: Additional information

Manufacturer Device Name object (index 0x1008)

The structure of the **Manufacturer Device Name object** is shown in the following table.

Index	Subindex	Default	Description
0x1008	0	JVM-104	Hardware name

Manufacturer Hardware Version object (index 0x1009)

The structure of the **Manufacturer Hardware Version object** is shown in the following table.

Index	Subindex	Default	Description
0x1009	0		OS version of the device

Manufacturer Software Version object (index 0x100A)

The structure of the **Manufacturer Software Version object** is shown in the following table.

Index	Subindex	Default	Description
0x100A	0		Software version of the application program that runs on the JVM-104

The entry in this index is made via the parameter **SWVersion** of the STX function `CanOpenInit()`.

Node ID object (index 0x100B)

The structure of the **Node ID object** is shown in the following table.

Index	Subindex	Default	Description
0x100B	0		Node ID of the given device

Producer Heartbeat Time object (index 0x1017)

The structure of the **Producer Heartbeat Time object** is shown in the following table.

Index	Subindex	Default	Description
0x1017	0	1,000 [ms]	Heartbeat time

CANopen® registers - JVM-104

The table below lists the JVM-104 registers associated with the CANopen® Object Dictionary.

The letter x in the register number represents the CAN bus number ranging from 0 ... CANMAX.

Register number	Description	Value range	Attributes	Data type
40x000	Own node ID	1 ... 127	rw (read & write)	Int
40x001	Own heartbeat status	0 = Bootup 4 = Stopped 5 = Operational 127 = Preoperational 255 = Offline	ro (read only)	Int
40x002		Refer to object 0x1001	ro	Int
40x019			ro	Int (IP format)

Register number	Description	Value range	Attributes	Data type
40x020			rw	Int
40x021			rw	Int
40x022			rw	Int
40x023			rw	Int
40x030			rw	Int
40x100			rw	bool
40x400			rw	bool
40x101 ... 40x227	Node ID 1 ... 127 Status	0 = Bootup 4 = Stopped 5 = Operational 127 = Preoperational 255 = Offline (default)	ro	byte
40x229 ... 40x355	Node ID 1 ... 127 timeout	0 ... 65535 ms	rw	word

7 SAE J1939 STX API

Introduction

This chapter describes the STX functions of the SAE J1939 STX API.

The SAE J1939 Standard

SAE J1939 is an open standard for networking and communication in the commercial vehicle sector. The focal point of the application is the networking of the power train and chassis. The J1939 protocol originates from the international Society of Automotive Engineers (SAE) and works on the physical layer with CAN high-speed according to ISO 11898.

Application

These STX functions are used in communication between the controller JVM-104 and other ECUs in the vehicle. As a rule, engine data, such as RPM, speed or coolant temperature are read and displayed.

Documentation

The key SAE J1939 specifications are:

- J1939-11 - Information on the physical layer
- J1939-21 - Information on the data link layer
- J1939-71 - Information on the application layer vehicles
- J1939-73 - Information on the application layer range analysis
- J1939-81 - Network management

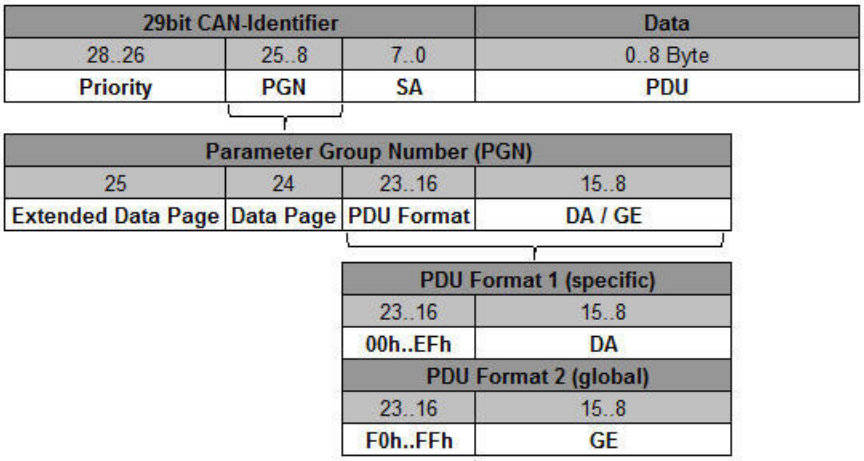
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Content of a J1939 message

Content of a J1939 message

The following diagram shows the structure of a J1939 message:



Abbreviation	Description
DA	Destination Address
GE	Group Extensions
PDU	Protocol Data Unit
PGN	Parameter Group Number
SA	Source Address

Meaning of the Parameter Group Number (PGN)

The PGN is a number defined in the SAE J1939 standard that groups together several SPNs into a meaningful group. The PGN is part of the CAN identifier. The 8-byte data (PDU) contain the values of individual SPNs.

The example below shows a PGN 65262 (0xFEEE):

PGN 65262 - ET1 **Engine Temperature 1**

Part of the PGN	Value	Comment
Transmission Repetition Rate	1 s	
Data Length	8	
Extended Data Page	0	
Data Page	0	
PDU Format	254	
PDU Specific	238	PGN supporting information
Default Priority	6	
Parameter Group Number	65262	in hex: 0xFEEE

Start position	Length	Parameter name	SPN
1	1 byte	Engine Coolant Temperature	110
2	1 byte	Engine Fuel Temperature 1	174
3 - 4	2 bytes	Engine Oil Temperature 1	175
5 - 6	2 bytes	Engine Turbocharger Oil Temperature	176
7	1 byte	Engine Intercooler Temperature	52
8	1 byte	Engine Intercooler Thermostat Opening	1134

STX Function SAEJ1939Init()

Introduction

Calling up the `SAEJ1939Init()` function initializes one of the CAN busses (not CAN 0 as this is reserved for CANopen®) for use with the J1939 protocol. From then on, the JVM-104 has got the SA (Source Address) assigned by the function parameter mySA. Thus, it has got its own device address on the bus.

Function declaration

```
Function SAEJ1939Init(
    CANNo:Int,
    mySA:Byte,
) :Int;
```

Function parameters

The `SAEJ1939Init()` function comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
mySA	Own source address	0 ... 253

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters
-3	Insufficient memory for SAE J1939

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

Initializing CAN bus 1. The JVM-104 has got Node SA 20 (0x14). The JVM-104 can now send messages with the set SA (and only these messages).

```
Result := SAEJ1939Init(1, 20);
```

Address Claiming

Address Claiming has not been implemented.

STX function SAEJ1939SetSA()

Introduction

The function `SAEJ1939SetSA()` lets you change the own SA (Source Address) during runtime.

Function declaration

```
Function SAEJ1939SetSA(
    CANNo:Int,
    mySA:Byte,
) :Int;
```

Function parameters

The function SAEJ1939SetSA() comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
mySA	New SA	0 ... 253

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

Changing the SA during runtime.

Result := SAEJ1939SetSA(1, 20);

Important note!

Messages are immediately sent/received using the new SA.

STX function SAEJ1939GetSA()

Introduction

The function `SAEJ1939GetSA()` lets you determine your own SA (Source Address).

Function declaration

```
Function SAEJ1939GetSA(
    CANNo:Int,
    ref mySA:Byte,
) :Int;
```

Function parameters

The function `SAEJ1939GetSA()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
mySA	SA currently set	0 ... 253

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

This function returns the currently set SA.

```
Result := SAEJ1939SetSA(1, actual_SA);
```

STX function SAEJ1939AddRx()

Introduction

Calling up the function `SAEJ1939AddRx()` prompts the JVM-104 to receive a specific message. This message is sent from another bus node. The address of this bus node is transferred to this function as a bySA parameter. If the message is not sent, the value received last remains valid. Cyclical reading continues until the function `SAEJ1939Init()` is called up again.

Function declaration

```
Function SAEJ1939AddRx(
    CANNo:Int,
    IPGN:Long,
    bySA:Byte,
    BytePos:Int,
    BitPos:Int,
    DataType:Int,
    DataLength:Int,
    const ref VarAddr,
    ref stJ1939:TJ1939Rx
    EventTime: Int,
    InhibitTime: Int,
) :Int;
```

Function parameters

The function `SAEJ1939AddRx()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
IPGN	PGN Parameter Group Number	0 ... 0x3FFFF
bySA	Source Address of message sender	0 ... 253
BytePos	Starting position of bytes of data to be received	1 ... n
BitPos	Starting position of bits of data to be received	1 ... 8
DataType	Data type of data to be received	1 ... 3, 10 ... 16
DataLength	Volume of data for the global variable VarAddr	
VarAddr	Global variable into which the received value is entered	
TJ1939Rx	Control structure	
EventTime	Time lag between two telegrams (> InhibitTime)	Default value: 1,000 ms
InhibitTime	Minimum time lag between two telegrams received (< EventTime)	Default value: 100 ms

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

DataType parameter

All allowed data types are listed below:

Byte types	Bit types	
1	-	SAEJ1939_UNSIGNED8 SAEJ1939_BYTE
2	-	SAEJ1939_UNSIGNED16 SAEJ1939_WORD
4	-	SAEJ1939_UNSIGNED32 SAEJ1939_DWORD
n	-	SAEJ1939_STRING
-	1	SAEJ1939_1BIT
-	2	SAEJ1939_2BIT
-	3	SAEJ1939_3BIT
-	4	SAEJ1939_4BIT
-	5	SAEJ1939_5BIT
-	6	SAEJ1939_6BIT
-	7	SAEJ1939_7BIT

Control structure TJ1939Rx

```
TJ1939Rx: Struct
// Status of received message
            byStatus      : Byte;
// Priority of received message
            byPriority    : Byte;
           End_Struct;
```

How to use this function

```
Result := SAEJ1939AddRx (
    1,
    0xFEEE,
    0x00,
    2
    0
    SAEJ1939_BYTE,
    sizeof(var_Fueltemp),
    var_Fueltemp,
    struct_TJ1939Rx_EngineTemperatureTbl,
    1500,
    120);
```

JetSym STX program

The device JVM-104 with the own SA of 20 wants to receive and display the current fuel temperature. The parameters **InhibitTime** and **EventTime** are not explicitly specified when calling up the function. In this case, the default values are used. The controller for capturing the fuel temperature has got SA 0. In practice, the address of the controller can be found in the engine manufacturer's documentation.

The fuel temperature has the SPN 174 and is a component (byte 2) of the PGN 65262 Engine Temperature 1.

```
#Include "SAEJ1939.stxp"

Var
    bySAEJ1939Channel  : Byte;
    own_Source_Address : Byte;

// PGN 65262 Engine Temperature 1
    Fueltemp  : Byte;
    EngineTemperatureTbl : TJ1939Rx;
End_Var;

Task main autorun

// Initializing CAN 1
bySAEJ1939Channel := 1;
own_Source_Address := 20;
SAEJ1939Init (bySAEJ1939Channel, own_Source_Address);

// Receiving the fuel temperature value
SAEJ1939AddRx (bySAEJ1939Channel, 65262, 0x00, 2, 1, SAEJ1939_BYTE,
sizeof(Fueltemp), Fueltemp, EngineTemperatureTbl);

End_Task;
```

Engine manufacturer's manual

For information on the data (priority, PGN, SA and data byte structure) refer to the manual provided by the engine manufacturer.

STX function SAEJ1939AddTx()

Introduction

Calling up the function `SAEJ1939AddTx()` prompts the JVM-104 to cyclically send a specific message via the bus.

Cyclical sending continues until the function `SAEJ1939Init()` is called up again.

Date are sent once the event time has elapsed or the given variables have changed and inhibit time has elapsed.

Function declaration

```
Function SAEJ1939AddTx(
    CANNo:Int,
    IPGN:Long,
    BytePos:Int,
    BitPos:Int,
    dataType:Int,
    DataLength:Int,
    const ref VarAddr,
    ref stJ1939:TJ1939Tx
    EventTime: Int,
    InhibitTime: Int,
) :Int;
```

Function parameters

The function `SAEJ1939AddTx()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
IPGN	PGN Parameter Group Number	0 ... 0x3FFFF
BytePos	Starting position of the byte of data to be sent	1 ... n
BitPos	Starting position of the bit of data to be sent	1 ... 8
dataType	Data type of data to be sent	1 ... 3, 10 ... 16
DataLength	Volume of data for the global variable VarAddr	
VarAddr	Global variable into which the value to be sent is entered	
TJ1939Tx	Control structure	
EventTime	Time lag between two telegrams (> InhibitTime)	Default value: 1,000 ms
InhibitTime	Minimum time lag between two telegrams received (< EventTime)	Default value: 100 ms

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

DataType parameter

All allowed data types are listed below:

Byte types	Bit types	
1	-	SAEJ1939_UNSIGNED8 SAEJ1939_BYTE
2	-	SAEJ1939_UNSIGNED16 SAEJ1939_WORD
4	-	SAEJ1939_UNSIGNED32 SAEJ1939_DWORD
n	-	SAEJ1939_STRING
-	1	SAEJ1939_1BIT
-	2	SAEJ1939_2BIT
-	3	SAEJ1939_3BIT
-	4	SAEJ1939_4BIT
-	5	SAEJ1939_5BIT
-	6	SAEJ1939_6BIT
-	7	SAEJ1939_7BIT

Control Structure TJ1939Tx

```
TJ1939Tx : Struct
// Status of sent message
            byStatus      : Byte;
// Priority of sent message
            byPriority    : Byte;
          End_Struct;
```

How to use this function

```
Result := SAEJ1939AddTx (
    1,
    0xFEEE,
    0x00,
    2
    0
    SAEJ1939_BYTE,
    sizeof(var_Fueltemp),
```

```
    var_Fueltemp,
    struct_TJ1939Tx_EngineTemperatureTbl,
    1500,
    120);
```

JetSym STX program

Redefining the priority.

Priority value 0 has the highest priority, priority value 7 has the lowest priority. A message with priority 6 can be superseded by a message with priority 4 (if the messages are sent at the same time). The parameters **InhibitTime** and **EventTime** are not explicitly specified when calling up the function. In this case, the default values are used.

```
#Include "SAEJ1939.stxp"

Var
    bySAEJ1939Channel  : Byte;
    own_Source_Address : Byte;

// PGN 65262 Engine Temperature 1
    Fueltemp  : Byte;
    EngineTemperatureTbl : TJ1939Tx;
End_Var;

Task main autorun

// Initializing CAN 1
bySAEJ1939Channel := 1;
own_Source_Address := 20;
SAEJ1939Init (bySAEJ1939Channel, own_Source_Address);

// PGN 65262 Engine Temperature
// Setting a new priority
EngineTemperatureTbl.byPriority := 6;
SAEJ1939AddTx (bySAEJ1939Channel, 65262, 0x00, 2, 1, SAEJ1939_BYTE,
sizeof(Fueltemp), Fueltemp, EngineTemperatureTbl);

End_Task;
```

Engine manufacturer's manual

For information on the data (priority, PGN, SA and data byte structure) refer to the manual provided by the engine manufacturer.

STX function SAEJ1939RequestPGN()

Introduction

Calling up the function `SAEJ1939RequestPGN()` sends a request to the DA (Destination Address) following a PGN.

This function is terminated only if a valid value has been received or the timeout of 1,250 ms has elapsed.

To obtain the value of the requested message its receipt must be scheduled using the function `SAEJ1939AddRx ()`.

This function must constantly be recalled in cycles.

Function declaration

```
Function SAEJ1939RequestPGN(
    CANNo:Int,
    byDA:Byte,
    ulPGN:Long,
    byPriority:Byte,
) :Int;
```

Function parameters

The function `SAEJ1939RequestPGN()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
byDA	Destination Address Address from which the message is requested	0 ... 253 The own SA cannot be used
ulPGN	PGN Parameter Group Number	0 ... 0x3FFFF
byPriority	Priority	0 ... 7 Default value 6

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	Message has been received
-1	Timeout, as no reply has been received

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

DataType parameter

All allowed data types are listed below:

Byte types	Bit types	
1	-	SAEJ1939_UNSIGNED8 SAEJ1939_BYTE
2	-	SAEJ1939_UNSIGNED16 SAEJ1939_WORD
4	-	SAEJ1939_UNSIGNED32 SAEJ1939_DWORD
n	-	SAEJ1939_STRING
-	1	SAEJ1939_1BIT
-	2	SAEJ1939_2BIT
-	3	SAEJ1939_3BIT
-	4	SAEJ1939_4BIT
-	5	SAEJ1939_5BIT
-	6	SAEJ1939_6BIT
-	7	SAEJ1939_7BIT

How to use this function

```
Result := SAEJ1939RequestPGN (
    1,
    0x00,
    0xFEE5,
    5);
```

JetSym STX program

JVM-104 with own SA of 20 wants to request the PGN 65253 *Engine Hours* from an engine control unit with the SA 0. The SPN 247 *Engine Total Hours of Operation* should be read from this PGN. It is therefore necessary to register receipt of the SPN 247 by calling up the function `SAEJ1939AddRx()`.

The parameter **byPriority** is not explicitly specified when calling up the function. In this case, the default value is used.

```
#Include "SAEJ1939.stxp"

Var
    bySAEJ1939Channel  : Byte;
    own_Source_Address : Byte;

// PGN 65253 Engine Hours, Revolutions
    EngineTotalHours  : Int;
    EngineHoursTbl : TJ1939Rx;
End_Var;
```

```
Task main autorun

// Initializing CAN 1
bySAEJ1939Channel := 1;
own_Source_Address := 20;
SAEJ1939Init (bySAEJ1939Channel, own_Source_Address);

// Engine Hours, Revolutions  -- on Request
SAEJ1939AddRx (bySAEJ1939Channel, 65253, 0x00, 1, 0,
SAEJ1939_DWORD, sizeof(EngineTotalHours), EngineTotalHours,
EngineHoursTbl, 5000, 150);

// Required for a cyclical task
TaskAllEnableCycle ();
EnableEvents;

End_Task;


Task t_RequestPGN_5000 cycle 5000

Var
    Return_value : Int;
End_Var;

// Requesting total machine operating hours
Return_value := SAEJ1939RequestPGN (bySAEJ1939Channel, 0x00,
65253);

If Return_value Then
      Trace ('PGN Request failed');
End_If;

End_Task;
```

STX function SAEJ1939GetDM1()

Introduction

Calling up the function `SAEJ1939GetDM1()` requests the current diagnostics error codes (also see SAE J1939-73 No. 5.7.1). The corresponding PGN number is 65226. This function must constantly be recalled in cycles.

Function declaration

```
Function SAEJ1939GetDM1(
    CANNo:Int,
    bySA:Byte,
    ref stJ1939DM1stat:TJ1939DM1STAT
    ref stJ1939DM1msg:TJ1939DM1MSG
) :Int;
```

Function parameters

The function `SAEJ1939GetDM1()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
bySA	Source Address of message sender	0 ... 253 The own SA cannot be used
stJ1939DM1stat	lStatus lMsgCnt lBuffer	Lamp status Number of received messages Size of variable stJ1939DM1msg
stJ1939DM1msg	lSPN byOC byFMI	Error code Error counter Error type

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

stJ1939DM1stat.lStatus **Default**: 0xFF00

Type	Byte	Bit group	Description
Status	1	8 - 7	Malfunction Indicator Lamp Status
		6 - 5	Red Stop Lamp Status
		4 - 3	Amber Warning Lamp Status
		2 - 1	Protect Lamp Status
Flash	2	8 - 7	Flash Malfunction Indicator Lamp
		6 - 5	Flash Red Stop Lamp
		4 - 3	Flash Amber Warning Lamp
		2 - 1	Flash Protect Lamp

Type	Byte	Bit group Value	Description
Status	1	00	Lamps off
		01	Lamps on
Flash	2	00	Slow Flash (1 Hz, 50 % duty cycle)
		01	Fast Flash (2 Hz or faster, 50 % duty cycle)
		10	Reserved
		11	Unavailable / Do Not Flash

stJ1939DM1msg

Default value:
ISPN = 0
byOC = 0
byFMI = 0
For older controllers (grandfathered setting):
ISPN = 524287 (0x7FFFF)
byOC = 31 (0x1F)
byFMI = 127 (0x7F)

How to use this function

```
Result := SAEJ1939GetDM1(
    1,
    0x00,
    stdm1stat_pow,
    stdm1msg_pow,);
```

JetSym STX program

By calling up the function `SAEJ1939GetDM1()`, the JVM-104 requests the current diagnostics error code (PGN 65226).

```
#Include "SAEJ1939.stxp"

Var
    bySAEJ1939Channel  : Byte;
    own_Source_Address : Byte;
    stdm1stat_pow : TJ1939DM1STAT;
    stdm1msg_pow : Array[10] of STJ1939DM1MSG;
    MyTimer : TTimer;
End_Var;

Task main autorun

// Initializing CAN 1
bySAEJ1939Channel := 1;
own_Source_Address := 20;
SAEJ1939Init (bySAEJ1939Channel, own_Source_Address);

TimerStart (MyTimer, T#2s);

Loop

When (TimerEnd (MyTimer)) Continue;

// Requesting diagnostics error codes DM1 POW
stdm1stat_pow.lBuffer := sizeof (stdm1msg_pow);
SAEJ1939GetDM1 (bySAEJ1939Channel, 0x00, stdm1stat_pow,
stdm1msg_pow);

TimerStart (MyTimer, T#2s);

End_Loop;

End_Task;
```

STX function SAEJ1939GetDM2()

Introduction

Calling up the function `SAEJ1939GetDM2()` requests the diagnostics error codes that preceded the current ones (also see SAE J1939-73 No. 5.7.2). The corresponding PGN number is 65227.

Function declaration

```
Function SAEJ1939GetDM2(
    CANNo:Int,
    bySA:Byte,
    ref stJ1939DM2stat:TJ1939DM2STAT
    ref stJ1939DM2msg:TJ1939DM2MSG
) :Int;
```

Function parameters

The function `SAEJ1939GetDM2()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
bySA	Source Address of message sender	0 ... 253 The own SA cannot be used
stJ1939DM2stat	lStatus lMsgCnt lBuffer	Lamp status Number of received messages Size of variable stJ1939DM2msg
stJ1939DM2msg	lSPN byOC byFMI	Error code Error counter Error type

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

stJ1939DM2stat.lStatus **Default**: 0xFF00

Type	Byte	Bit group	Description
Status	1	8 - 7	Malfunction Indicator Lamp Status
		6 - 5	Red Stop Lamp Status
		4 - 3	Amber Warning Lamp Status
		2 - 1	Protect Lamp Status
Flash	2	8 - 7	Flash Malfunction Indicator Lamp
		6 - 5	Flash Red Stop Lamp
		4 - 3	Flash Amber Warning Lamp
		2 - 1	Flash Protect Lamp

Type	Byte	Bit group Value	Description
Status	1	00	Lamps off
		01	Lamps on
Flash	2	00	Slow Flash (1 Hz, 50 % duty cycle)
		01	Fast Flash (2 Hz or faster, 50 % duty cycle)
		10	Reserved
		11	Unavailable / Do Not Flash

stJ1939DM2msg

Default value:
ISPN = 0
byOC = 0
byFMI = 0
For older controllers (grandfathered setting):
ISPN = 524287 (0x7FFFF)
byOC = 31 (0x1F)
byFMI = 127 (0x7F)

How to use this function

```
Result := SAEJ1939GetDM2(
    1,
    0x00,
    stdm2stat_pow,
    stdm2msg_pow,);
```

JetSym STX program

By calling up the function `SAEJ1939GetDM2()`, the JVM-104 requests the current diagnostics error codes (PGN 65227).

```
#Include "SAEJ1939.stxp"

Var
    bySAEJ1939Channel  : Byte;
    own_Source_Address : Byte;
    stdm2stat_pow : TJ1939DM2STAT;
    stdm2msg_pow : Array[10] of STJ1939DM2MSG;
End_Var;

Task main autorun
// Initializing CAN 1
bySAEJ1939Channel := 1;
own_Source_Address := 20;
SAEJ1939Init (bySAEJ1939Channel, own_Source_Address);

// Required for a cyclical task
TaskAllEnableCycle ();
EnableEvents;
End_Task;


Task t_RequestPGN_5000 cycle 5000

Var
     Int;
End_Var;

// Requesting diagnostics error codes DM2 POW
stdm2stat_pow.lBuffer := sizeof (stdm2msg_pow);
Return_value := SAEJ1939GetDM2 (bySAEJ1939Channel, 0x00,
stdm2stat_pow, stdm2msg_pow);

If Return_value Then
    Trace ('DM2 Request failed');
End_If;

End_Task;
```

STX function SAEJ1939SetSPNConversion()

Introduction

Calling up the function `SAEJ1939SetSPNConversion()` determines the configuration of bytes in the message, which is requested using function `SAEJ1939GetDM1()` or `SAEJ1939GetDM2()`. In other words, this function lets you specify the conversion method.

Function declaration

```
Function SAEJ1939SetSPNConversion(
    CANNo:Int,
    bySA:Byte,
    iConversionMethod:Int,
) :Int;
```

Function parameters

The function `SAEJ1939SetSPNConversion()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
bySA	Source Address of message sender	0 ... 253
iConversionMethod	Conversion method	1 ... 4 4: Automatic detection 2: Default

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

```
Result := SAEJ1939SetSPNConversion(
    1,
    0xAE,
    4);
```

STX Function SAEJ1939GetSPNConversion()

Introduction

Calling up the function `SAEJ1939GetSPNConversion()` ascertains the currently set conversion method.

Function declaration

```
Function SAEJ1939SetSPNConversion(
    CANNo:Int,
    bySA:Byte,
    iConversionMethod:Int,
) :Int;
```

Function parameters

The function `SAEJ1939GetSPNConversion()` comprises the following parameters:

Parameter	Description	Value
CANNo	CAN channel number	1 ... CANMAX
bySA	Source address of message sender	0 ... 253
iConversionMethod	Conversion method	1 ... 4 4: Automatic detection 2: Default

Return value

This function transfers the following return values to the higher-level program.

Return value	
0	OK
-1	Error when checking parameters

CANNo parameter

This parameter specifies the number of the SAEJ1939 interface. CANNo = 1 is assigned to the first interface. The number of SAEJ1939 interfaces depends on the device. For information on the maximum number of SAEJ1939 interfaces (CANMAX) refer to the chapters *Technical Specifications* and *Quick Reference* in the corresponding manual.

How to use this function

```
Result := SAEJ1939GetSPNConversion(
    1,
    0xAE,
    actual_conversion_method);
```

8 File system

Introduction

This chapter describes the file system of the JVM-104. The file system lets you access files located on the internal flash disk or an USB flash drive.

When problems occur, a good understanding of the file system is very helpful.

Note

Exercise extreme caution when dealing with the file system, at least with system files. Failure to do so may render your device inoperative. It may even refuse to boot.

Some files may be protected against read/write access or deletion. This is normal behavior. Some of these files are virtual files, such as firmware images, or protected files, such as EDS files.

File categories

The files of the file system are categorized as follows:

- System directories or system files used by the operating system
- Files which are at the user's disposal

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8.1 Directories

System directories

The system directories cannot be deleted. System directories even survive formatting.

Directory	Description
\System	■ System configuration ■ System information ■ Splash screen (boot image) ■ Screenshot
\USB	■ Root directory of the USB flash drive
\App	■ Directory for applications
\Data	■ Directory for data
\Windows	■ Windows CE system directory
\	■ RAM disk drive

Contents

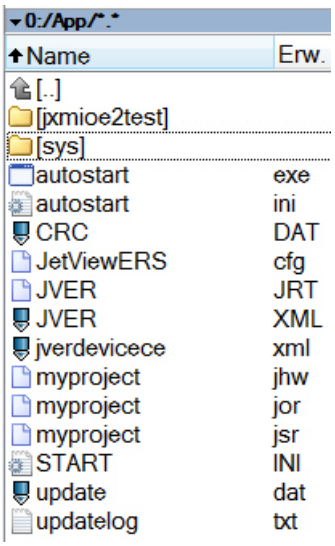
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Directories

Directory *\App*

\App

This directory holds application and visualization data. In this example, the STX application is stored in the folder **jxmioe2test.**



The data is based on the new CE platform. This platform does not use *.iop files. JetViewSoft creates several visualization files instead.

Note:
Copy all application and visualization files to the folder **App** and not to the folder **Data**. Failure to do so will slow down the boot process, see directory *\Data*.

start.ini

This text file defines which application will be started.

\App\sys

This directory holds the interpreter of the STX programming language and of the visualization software. **Do not make any changes here!**

autostart.xxx

This application lets you update the operating system. **Do not make any changes here!**

updatelog.txt

This is a log file which is created during an OS update.

Directory *Data*

Data

This directory holds the HMI's bulk data. The HMI lets you store parameter or configuration files to this directory.

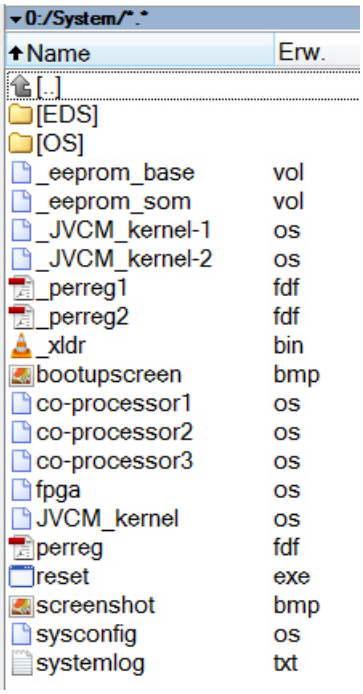
Important Note!

Larger amounts of data can be stored to this data partition. To speed up system launch, this partition will be mounted a short instance, if needed, after launching the STX application. Therefore, the STX application must not be stored to this partition.

Directory *System*

System

This directory holds system-relevant files, such as the kernel, co-processor firmware, configuration data, EDS, etc.



bootupscreen.bmp

This file is a 16-bit bmp file (r5, g6, b5) which is displayed while the device is booting.

You may create an image of your own and replace this file.

co-processor1

This virtual file holds the firmware of a hidden co-processor controlling most of the interactions with the user (buttons, buzzer, background lighting, etc.).

reset.exe

If you delete this file, the HMI reboots immediately. You can use this function in batch files, for example, which, after complete processing, require automatic rebooting.

Directory *USB*

USB

When you insert a USB flash drive into the HMI, a dynamic directory named *\USB* is created. When no data storage medium is inserted, this directory is not visible.

Directory *Windows*

Windows

This subdirectory holds the Windows CE files. **Do not make any changes here!**

8.2 Properties

Introduction

This chapter covers the properties of the file system. The description distinguishes between the internal flash disk and the USB flash drive.

General properties

The following properties apply to the internal flash disk and USB flash drive:

- 8 files max. to be opened simultaneously
- When the HMI creates a file, it assigns its date and time.
- Date, time, and file size are not available for all system files.

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Flash disk - Properties

Capacity

The following disk space is available to the user:

Parameter	Value
Flash disk capacity	512 MBytes
Size of folder **App** (of the a.m. capacity)	64 MBytes
Size of folder **Data** (of the a.m. capacity)	368 MBytes

Properties

The internal flash disk drive has got the following further properties:

- Up to 7 directory levels and 1 file level are allowed.
- Upper- and lower-case are not distinguished.
- Directory and file names are permitted to have a total length of 63 characters.
- All characters except "/" and ".." are permitted for directory and file names
- The location of the folders **App** and **Data** is on the flash disk drive.

USB flash drive - Properties

Capacity

The available capacity depends on the USB flash drive used:

Parameter	Value
Tested capacities	256 MByte ... 8 GByte

Properties

The USB flash drive has got the following properties:

- The USB flash drive must be compatible with FAT 16 or FAT 32.
- Directory and file names of 260 characters' length max. can be used.
- Differentiation between upper and lower case.
- The following characters are not allowed in directory and file names: "/", "\", ":", "*", "?", "<", ">" and "|"
- There is no user/access administration.

Jetter AG cannot guarantee the proper functioning of all USB flash drives available on the market.

9 FTP server

Introduction

The FTP server allows access to directories and files using an FTP client. The files can be stored to the following storage media:

- Internal flash disk
- USB flash drive

This chapter covers the login process and describes the commands supported by the FTP server.

FTP clients

The user has the option of using a command line FTP client, which comes with many PC operating systems, or graphic FTP tools.

Number of possible connections

The FTP server on the JVM-104 is able to manage up to four FTP connections simultaneously.

Any additional FTP client, which tries to connect with the FTP server, will get no response to its request for establishing a connection.

Supported commands

The FTP server supports standardized commands. For more information refer to:

- WIKIPEDIA
- Google; search for FTP and commands
- FTP server help menu; connect with FTP server and enter the command *help* or *help binary*.

If you do not wish to care about commands, use an FTP program, such as TotalCmd.

Required programmer's skills

To be able to use the functions described in this chapter, the programmer must be familiar with the following subjects:

- The file system of the controller
- IP networks
- Commands

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Logon

Logon

To be able to access the file system via FTP, the FTP client must log on when the connection is established.

- As **Server Name** enter the IP address of the device.
- As **User Name** enter your user name, e.g. admin.
- As **Password** enter your password, e.g. admin.

Factory settings

The factory settings of the JVM-104 include one user account:

NAME=admin
PW=admin

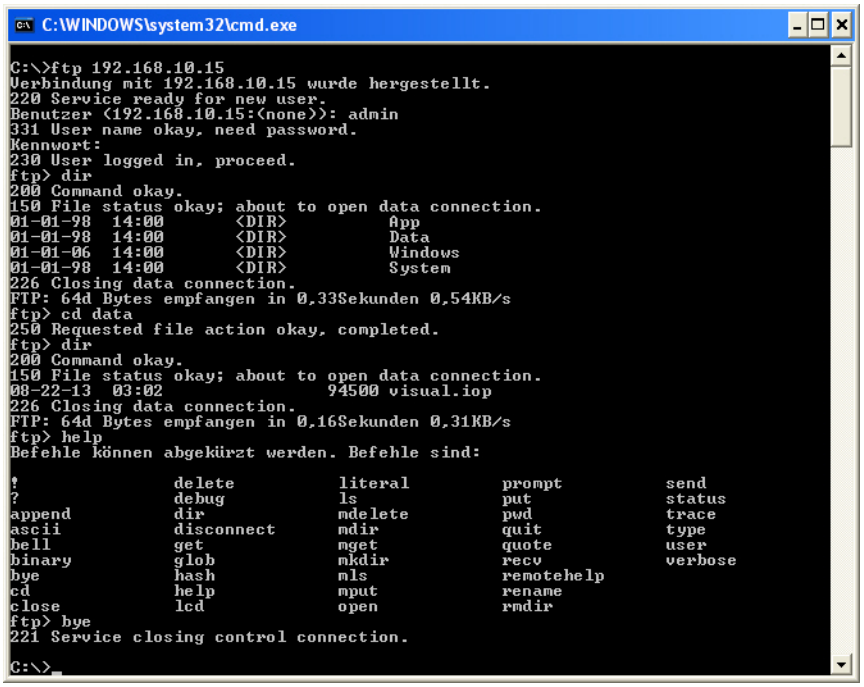
Example: Windows FTP client

Task

Carry out the following tasks using an FTP client, for example, the one which comes with Windows XP:

- Launch the FTP client by opening a connection and entering the IP address.
- Log on as user *admin* with password *admin*.
- Use *dir* to display the content of the current directory.
- Enter *cd app* to change to directory *app*.
- Use *dir* to display the content of the current directory.
- Enter *help* to view all available commands.
- Terminate the session and the FTP client using the command *bye*.

Action



10 Programming

Purpose of this chapter

This chapter is for supporting you in programming the HMI JVM-104 in the following fields of activity:

- Programming additional functions

Prerequisites

To be able to program the HMI JVM-104 the following prerequisites must be fulfilled:

- The HMI is connected to a PC.
- On the PC, the JetSym programming software has been installed.

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Abbreviations, module register properties and formats

Abbreviations

The abbreviations used in this document are listed in the table below:

Abbreviation	Description
R 100	Register 100
MR 150	Module register 150

Module register properties

Each module register is characterized by certain properties. Most properties are identical for many module registers - the value after reset is always zero, for example. In the following description, module register properties are mentioned only if a property deviates from the following default properties.

Module register properties	Default property for most module registers
Access	Read/write
Value after reset	0 or undefined (e.g. release number)
Takes effect	Immediately
Write access	Always
Data type	Integer

Numerical formats

The numerical formats used in this document are listed in the table below:

Notation	Numerical format
100	Decimal
0x100	Hexadecimal
0b100	Binary

JetSym sample programs

The notation for sample programs used in this document is listed in the table below:

Notation	Description
`Var, When, Task`	Keyword
`BitClear();`	Commands
`100 0x100 0b100`	Constant numerical values
`// This is a comment`	Comment
`// ...`	Further program processing

10.1 Memories - Overview

Introduction

The JVM-104 features several types of program and data memories. There is, for example, volatile memory. Volatile memory loses its content at switching off. Non-volatile memory keeps its content even when the power supply is off.

This chapter gives an overview of the available memory.

Contents

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Operating system memory

Introduction	The OS is stored to a non-volatile flash memory in the CPU. Therefore, the OS can be executed immediately after the device is powered up.
Properties	▪ Internal flash memory for storing OS data ▪ Internal volatile RAM for storing OS data
Memory access	▪ The user is not allowed to directly access the OS memory. ▪ To modify the OS, it must be updated.
Related topics	▪ **OS update** (see page 248)

File system memory

Introduction	The file system memory is for storing data and program files.
Properties	▪ Non-volatile ▪ Internal flash disk size: 368 MBytes ▪ Size of the USB flash drive: 256 MByte to 8 GByte
Memory access	▪ By operating system ▪ By JetSym ▪ Via FTP connection ▪ By browser (via HTTP server) ▪ By means of file commands from within the application program

Application program memory

Introduction

By default, the application program (STX script) is uploaded from JetSym to the HMI and is stored to it.

Properties

- Stored as file within the file system
- Default directory *app**program name*
- Files may also be stored to other directories (or USB flash drive)

Memory access

- By operating system
- By JetSym
- Via FTP connection
- By means of file commands from within the application program

Related topics

- **Application program** (see page 257)

Memory for volatile application program variables

Introduction

Volatile variables are used to store data which need not be maintained when the JVM-104 is de-energized.

Properties

- Global variables which are not assigned to permanent addresses (not %VL or %RL)
- Local variables
- Variables are stored in a compact way.
- Variables are initialized with value 0 when they are created.

Memory access

- By JetSym
- From the application program

JetSym STX program

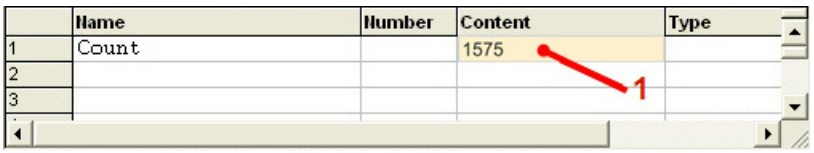
The following program increments the content of a global variable by one every 2 s.

```
Var
    Count:    Int;
End_Var;

Task Inkrement Autorun
    Loop
        Inc(Count);
        Delay(T#2s);
    End_Loop;
End_Task;
```

Setup pane

The JetSym setup pane displays the content of the variable.



Number	Description	Function
1	Present content of the variable	The content of the variable is incremented by one every two seconds.

Memory for non-volatile application program registers

Introduction

Non-volatile registers are used to store data which must be maintained when the JVM-104 is de-energized.

Properties

- Global variables which are assigned to permanent addresses (%VL)
- Register variables always occupy 4 bytes.
- Register variables are not initialized by the operating system.
- Number of register variables: 30,000
- Register numbers: 1000000 ... 1029999

Memory access

- By JetSym
- By browser (via HTTP server)
- From HMIs
- From the application program
- From other controllers

JetSym STX program

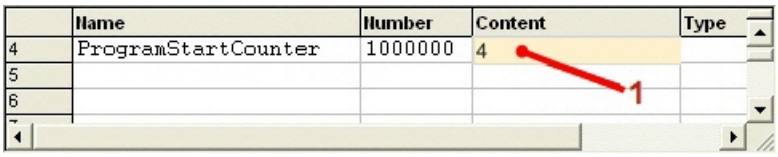
The following program increments the content of a register variable every time the application program is started. This way, the number of program starts is counted.

```
Var
    ProgramStartCounter:    Int At %VL 1000000;
End_Var;

Task Work Autorun
    ProgramStartCounter := ProgramStartCounter + 1;
    Loop
        // ...
    End_Loop;
End_Task;
```

Setup pane

The JetSym setup pane displays the content of the register variable.



Number	Description	Function
1	Present content of the register variable	The content of the register variable is incremented by one every time the program is started.

Memory for non-volatile application program variables

Introduction

Non-volatile variables are used to store data which must be maintained when the JVM-104 is de-energized.

Properties

- Global variables which are assigned to permanent registers (%RL)
- Variables are stored in a compact way.
- Size: 120,000 bytes
- Register numbers: 1000000 ... 1029999

Memory access

- By JetSym
- From HMIs
- From the application program

JetSym STX program

The following program increments the content of four non-volatile variables every second.

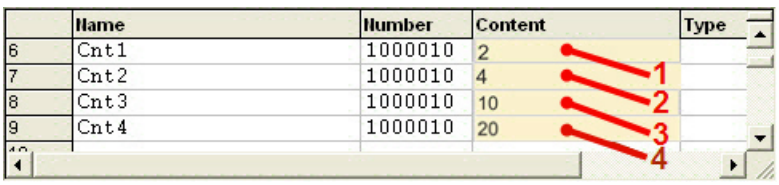
The working range of the counters is between 0 and 255 (variable type: byte). For these four variables the four bytes of register 1000010 are used.

```
Var
    Cnt1, Cnt2, Cnt3, Cnt4:    Byte At %RL 1000010;
End_Var;

Task Count4 Autorun
    Loop
        Inc(Cnt1);
        Inc(Cnt2, 2);
        Inc(Cnt3, 5);
        Inc(Cnt4, 10);
        Delay(T#1s);
    End_Loop;
End_Task;
```

Setup pane

The JetSym setup pane displays the content of the variable. As the type of the four counters is byte, this will result in counter overflow after a relatively short time:



Number	Description	Function
1	Current content of the variable Cnt1	The content of the variable is incremented by one every second.
2	Current content of the variable Cnt2	The content of the variable is incremented by two every second.
3	Current content of the variable Cnt3	The content of the variable is incremented by five every second.
4	Current content of the variable Cnt4	The content of the variable is incremented by ten every second.

Special registers

Introduction

Special registers let you control OS functions and retrieve status information.

Properties

- Global variables which are assigned to permanent addresses (%VL)
- When the operating system is launched, special registers are initialized using default values.
- Register numbers: 100000 ... 999999

Memory access

- By JetSym
- By browser (via HTTP server)
- From HMIs
- From the application program
- From other controllers

JetSym STX program

The following program uses the special register to store the digipot value. In this program, the background lighting for the JVM-104 is dimmed by using the digipot. An upper and lower limit for the digipot is specified for this purpose. If you press the pushbutton, full background lighting is activated.

```
Var
    Digipot_Count    :  Int At %VL 363000;
    Digipot_Limit_min:  Int At %VL 363002;
    Digipot_Limit_max:  Int At %VL 363003;
    Digipot_Button   :  Int At %VL 363001;
    BackgroundLighting: Int At %VL 364000;
End_Var;

Task Main Autorun
    Digipot_Count := 0;
    Digipot_Limit_max := 17;
    Digipot_Limit_min := 0;


    Loop
      If Digipot_Button Then
                BackgroundLighting := 255;
            Else BackgroundLighting := Digipot_Count * 15;
      End_If
    End_Loop
End_Task;
```

Flags

Introduction

Flags are one-bit operands. This means they can either have the value TRUE or FALSE.

Properties of user flags

- Global variables which are assigned to permanent addresses (%MX)
- Non-volatile
- Quantity: 256
- Flag numbers: 0 ... 255

Properties of overlaid user flags

- Global variables which are assigned to permanent addresses (%MX)
- Non-volatile
- Overlaid by registers 1000000 through 1000055
- Quantity: 1,792
- Flag numbers: 256 ... 2047

Properties of special flags

- Global variables which are assigned to permanent addresses (%MX)
- When the operating system is launched, special flags are initialized using their default values.
- Quantity: 256
- Flag numbers: 2048 ... 2303

Memory access

- By JetSym
- From HMIs
- From the application program

JetSym STX program

In the program listed below, a flag is set when the user presses KEY_UP. If KEY_DOWN is pressed, the flag is reset. As long as this flag is set, special register 364000 (background lighting) is incremented. Incrementing of the special register continues until the flag is reset.

```
Var
    Flag1:              Bool At %MX 1;
    Key_Up:               Bit  At %XL 361000.3;
    Key_Down:             Bit  At %XL 361000.2;
    Background_Light:     Int  At %VL 364000;
End_Var;

Task Main Autorun
    Flag1:= False;
    Loop
        If Key_Up Then
            Flag1 := True;
        ElseIf Key_Down Then
            Flag1 := False;
        End_IF;
```

```
            If Flag1 Then
                Inc(Background_Light);
                Delay(T#100ms);
            End_If;
        End_Loop;
    End_Task;
```

10.2 Controls and ignition

Introduction

This chapter covers the programming of controls, ignition and switching off delay for the JVM-104.

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Input keys

Introduction

The HMI JVM-104 has got four input keys: **[UP]**, **[DOWN]**, **[OK]** and **[ESC]**. These input keys are user-programmable.

Special registers

In register 361000 of the JVM-104, there is a bit-coded map of the input keys which can be used for programming them.

The following registers are available for programming these input keys:

Register	Description
361000	Bit-coded map of the input keys
361000.0	**Input key [OK]** Bit 0 = 1: Key **[OK]** is pressed.
361000.1	**Input key [ESC]** Bit 1 = 1: Key **[ESC]** is pressed.
361000.2	**Input key [DOWN]** Bit 2 = 1: Key **[DOWN]** is pressed.
361000.3	**Input key [UP]** Bit 3 = 1: Key **[UP]** is pressed.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

Description:

In the following sample program, the input keys are continuously retrieved in one task. Pressing one or more keys changes the background lighting of the display or the night lighting of the keys.

```
Var
    btnKey_Ok:    Bit At %XL 361000.0;
    btnKey_Esc:   Bit At %XL 361000.1;
    btnKey_Dwn:   Bit At %XL 361000.2;
    btnKey_Up:    Bit At %XL 361000.3;

    dispBackLed :        Int At %VL 364000;
    dispButtonBackLed :  Int At %VL 364001;
End_Var;
```

```
Task Main Autorun
    Loop
        If btnKey_Up Then
            // Half brightness of background lighting
            dispBackLed := 127;
        End_If;
        If btnKey_Dwn Then
            // Full brightness of background lighting
            dispBackLed := 255;
        End_If;
        If btnKey_Esc Then
            // Full brightness of night key lighting
            dispButtonBackLed := 255;
        End_If;
        If btnKey_Ok Then
            // Turn off night lighting of the keys
            dispButtonBackLed := 0;
        End_If;
        Delay(T#100ms);
    End_Loop;
End_Task;
```

Digipot

Introduction

The JVM-104 has a digipot with pushbutton feature, which offers a convenient input option. The following provides details of the digipot's special registers with a corresponding sample program.

Digipot registers

The following special registers exist for the digipot:

Register	Description
363000	This register holds the current count value. If you turn the digipot, the count value increments or decrements. The following rule applies: ■ **Turning the digipot clockwise** = incrementing the register ■ **Turning the digipot counter-clockwise** = decrementing the register
363001	Bit 0: 0 = Pusbutton not pressed Bit 0: 1 = Pusbutton pressed
363002	This register lets you specify the lower limit for the digipot reading. If you continue turning the digipot counter-clockwise, register 363000 remains at this minimum value.
363003	This register lets you specify the upper limit for the digipot reading. If you continue turning the digipot clockwise, register 363000 remains at this maximum value.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

In the following sample program, the background lighting for the JVM-104 is dimmed using the digipot. An upper and lower limit for the digipot is specified for this purpose. If you press the pushbutton, full background lighting is activated.

```
Var
    Digipot_Count    :  Int At %VL 363000;
    Digipot_Limit_min:  Int At %VL 363002;
    Digipot_Limit_max:  Int At %VL 363003;
    Digipot_Button   :  Int At %VL 363001;
    BackgroundLighting: Int At %VL 364000;
End_Var;

Task Main Autorun
    Digipot_Count := 0;
    Digipot_Limit_max := 17;
    Digipot_Limit_min := 0;
```

```
    Loop
      If Digipot_Button Then
                BackgroundLighting := 255;
            Else BackgroundLighting := Digipot_Count * 15;
      End_If
    End_Loop
End_Task;
```

Ignition and shutdown delay

Introduction

This chapter covers the ignition and the function `Shutdown()`.

Special registers

The special register 361100 of the JVM-104 is responsible for prompting ignition. Here, the following applies:

If ...	... then ...
Bit 0 = 0:	... ignition is ON and voltage is applied to terminal 15 IGNITION (+).
Bit 0 = 1:	... ignition is OFF. Ignition is switched off and no voltage is applied to terminal 15 IGNITION (+).

Default ignition function

The HMI has the following default settings in connection with ignition:

If ...	... and ...	... then ...
... voltage is applied to the HMI, ...	... the ignition is off, ...	... the HMI does not boot up.
... voltage is applied to the HMI, ...	... the ignition is on, ...	... the HMI boots up.
... the HMI is powered on, ...	... the ignition is switched off (not the power supply), ...	... the HMI remains switched on.

Shutdown() function - Options

Notwithstanding the default ignition function, the `Shutdown()` function provides the following options:

- The HMI can be explicitly shut down.
- The HMI can be restarted.

Function declaration

```
Function Shutdown(Reboot:Bool) :Bool;
```

Function parameters

The `Shutdown()` function has the following parameters:

Parameter	Description	Value
Reboot	System restart: System shutdown:	True False

Return value

This function transmits the following return values to the higher-level program.

Return value	
0	OK
-1	Ignition is still switched on

Note

If the ignition is still switched on, the device will not be switched off. However, the HMI can be restarted. Such a restart is carried out irrespective of the fact that the ignition is on.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

If you switch off the vehicle's ignition, in the sample program the function `Shutdown()` is carried out after a delay of 3 seconds. The **Reboot** parameter for the `Shutdown()` function has the value **false**. This means that the device will switch off.

```
Var
    Ignition: Int At %VL 361100;
End_Var;

Task Ign Autorun
    Loop
     When Ignition Continue;
            Delay(3000);
            Shutdown(False);
    End_Loop;
End_Task;
```

10.3 Multi-purpose inputs/outputs

Introduction

This chapter covers programming the multi-purpose inputs and outputs of the JVM-104. The special registers of the HMI have got the functions listed below:

- Programming multi-purpose inputs
- Programming multi-purpose outputs
- Retrieving the hardware and software version for I/O functions

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Multi-purpose inputs - Status and commands

Introduction

The table below lists the functions of the multi-purpose inputs:

- Voltage measuring
- Current measuring
- Digital active-high input
- Frequency measuring
- Counting mode

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual inputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	1	Multi-purpose input MFQE1
x	2	Multi-purpose input MFQE2

Example

x = 2 for multi-purpose output 2. The overtemperature is given in R 601020000.7.

Register overview - Multi-purpose inputs

Each of the multi-purpose inputs MFQE1 and MFQE2 has got the following registers:

Register	Description
6010x0000	Status (bit-coded)
6010x0001	Command (bit-coded)
6010x0002	Analog value in µA/mV
6010x0003	Frequency [gate time]/period [µs]/count value [increments]
6010x0004	Digital value of the active-high input
6010x0005	Gate time in ms within frequency metering

R6010x0000

Status register of the multi-purpose input MFQEx

R 6010x0000 shows the status of the multi-purpose input MFQEx.

Meaning of the individual bits	
Bit 0	**Overcurrent**
	1 = Triggered by a current > 2500 mA.

Bit 7	**Overtemperature**
	1 = Overtemperature is present
Bit 14	**Multi-purpose input MFQEx is ...**
	0 = Multi-purpose input MFQEx is activated
	1 = Multi-purpose output MFQEx is deactivated

Register properties	
Access	Read
Reset	Command: Activate multi-purpose input x

R 6010x0001

Command register for multi-purpose input MFQEx, bit-coded

The command register lets you set various operating modes and configure the input MFQEx.

MFQEx commands, bit-coded	
Bits 7 ... 4:	
0000 =	Frequency measurement using gate time
0011 =	Counting mode
0100 =	Period time measuring, 10 s timeout
0101 =	Period time measuring, 1 s timeout
0110 =	Period time measuring, 100 ms timeout
Bit 9:	
0 =	Voltage measuring
1 =	Current measuring
Bit 12:	
0 =	Activate pull-up resistor
1 =	Deactivate pull-up resistor

Multi-purpose inputs - Analog functions

Introduction

The multi-purpose inputs of the HMI JVM-104 have got the following analog features:

- Voltage measuring
- Current measuring

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual inputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	1	Multi-purpose input MFQE1
x	2	Multi-purpose input MFQE2

Example

x = 2 for multi-purpose output 2. The overtemperature is given in R 601020000.7.

R 6010x0002

Analog value of multi-purpose input MFQEx

The register value results from measuring the analog value at multi-purpose input x.

Register properties		
Values	Configuration of voltage measuring	0 mV ... 15,000 mV
	Configuration of current measuring	0 µA ... 20,000 µA

Register properties	
Access	Read

Activating voltage or current measuring

The command register for the multi-purpose input MFQEx is bit-coded. By setting several bits, you issue several commands simultaneously.

Example:

By issuing command 0x1200, you activate the input, set the mode to current measuring and deactivate the pull-up resistor of the input.

You can activate voltage or current measuring for multi-purpose input MFQEx as follows:

Step	Action	
1	Activate the input: To this end, enter value 0 into R 6010x0001.	
2	You can activate a pull-up resistor at the input.	
	If ...	**... then ...**
	... you want to activate the pull-up resistor,	... clear bit 12: BitClear(R 6010x0001, 12);
	... you want to deactivate the pull-up resistor,	... set bit 12: BitClear(R 6010x0001, 12);
3	Select the measuring mode:	
	If ...	**... then ...**
	... you want to measure a voltage,	... clear bit 9: BitClear(R 6010x0001, 9);
	... you want to measure a current,	... set bit 9: BitClear(R 6010x0001, 9);

Note

If you activate the HMI, the multi-purpose input MFQEx is active, too.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

The following example explains how to make use of the multi-purpose input MFQE1 for voltage measuring and the multi-purpose input MFQE2 for current measuring.

```
Var
    // MFQE1: Input 1
    MFQE1_Command:    Int At %VL 601010001;
    MFQE1_Value:      Int At %VL 601010002;
    // MFQE2: Input 2
    MFQE2_Command:    Int At %VL 601020001;
    MFQE2_Value:      Int At %VL 601020002;
End_Var;

Task Main Autorun
// Activate input MFQE1
MFQE1_Command := 0;
// Input MFQE1 in voltage measuring mode
BitClear(MFQE1_Command, 9);
```

```
// Activate input MFQE2
MFQE2_Command := 0;
// Input MFQE2 in current measuring mode
BitSet(MFQE2_Command, 9);

Loop
    Trace('Voltage value at MFQE1 ' + IntToStr(MFQE1_Value) + '
mV.$n');
    Trace('Current value at MFQE2 ' + IntToStr(MFQE2_Value) + '
mA.$n');
    Delay(T#100ms);
End_Loop;
End_Task;
```

Multi-purpose inputs - Digital functions

Introduction

The multi-purpose inputs of the HMI JVM-104 have got the following digital features:

- Digital input
- Frequency measurement
- Counting mode

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual inputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	1	Multi-purpose input MFQE1
x	2	Multi-purpose input MFQE2

Example

x = 2 for multi-purpose output 2. The overtemperature is given in R 601020000.7.

R 6010x0003

Frequency value of multi-purpose input MFQEx

Depending on the configuration, this register displays the frequency, the period or a count value of the multi-purpose input x.

Register properties		
Values	Configuration of frequency measuring	0.1 Hz ... 10 kHz
	Configuration of period time measuring	10 s ... 100 ms
	Configuration of increment counting	32 bits

Register properties	
Access	Read

R 6010x0004

Digital value at multi-purpose input MDQEx

The register value results from measuring the digital value at multi-purpose input x.

The digital input is an active-high input.

Register properties		
Values	Input x < 1.0 V	Low-level
	Input x > 2.0 V	High-level

R 6010x0005

Gate time for frequency measuring at input MFQEx

The register value lets you set a gate time for frequency measuring.
For frequency measuring, set a gate time unequal zero.

Register properties	
Values	100 ms ... 10 s
Value after reset	1,000 (1 s) 0: Deactivated

Activating frequency/period measuring or counter function

The command register for the multi-purpose input MFQEx is bit-coded. By setting several bits, you can issue several commands simultaneously.

You can activate frequency or period measuring or the counting function for multi-purpose input MFQEx as follows:

Step	Action	
1	Activate the input: To this end, enter value 0 into R 6010x0001.	
	If ...	**... then ...**
	... you want to measure a frequency with gate time,	... write as gate time a value unequal zero to R 6010x0005. Activate frequency measuring by writing value 0x0040 to R 6010x0001,
	... you want to count increments,	... write value 0x0030 to R 601x0001.
	... you want to measure a period,	... write value 0x0040 to R 601x0001.
⇨	The result is contained in R 6010x0003.	

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

The following example explains how to make use of the multi-purpose input MFQE1 for increment measuring and of MFQE2 for frequency measuring with gate time.

```
Var
    // MFQE1: Input 1
    MFQE1_Command:    Int At %VL 601010001;
    MFQE1_Freq:       Int At %VL 601010003;

    // MFQE2: Input 2
    MFQE2_Command:    Int At %VL 601020001;
    MFQE2_Freq:       Int At %VL 601020003;
    MFQE2_GateTime:   Int At %VL 601020005;
End_Var;

Task Main Autorun
// Activating measuring of increments at MFQE1:
MFQE1_Command := 0x0030;
// Measuring a frequency at MFQE2
MFQE2_Command := 0x0040;
// Setting a gate time of 1 s at MFQE2:
MFQE2_GateTime := 1000;

Loop
    // Issuing values
    Trace('Inkrements: ' + InttoStr(MFQE1_Freq) + '$n');
    Trace('frequency in Hertz: : ' + InttoStr(MFQE2_Freq) + '$n');
    Delay(T#300ms);
End_Loop;
End_Task;
```

Multi-purpose outputs - Status and commands

Introduction

The table below lists the functions of the multi-purpose outputs:

- Current measuring
- Digital output, adjustable as high-side or low-side output
- Output of PWM signals
- Operation as H-bridge

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual outputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	3	Multi-purpose output PA1
x	4	Multi-purpose output PA2
x	5	Multi-purpose output PA3
x	6	Multi-purpose output PA4

Example:

x = 5 for multi-purpose output PA3. To activate the digital output of PA3 enter command 0x0008 into R 601050001.

Register overview - Multi-purpose outputs

Each of the multi-purpose outputs PA1 to PA4 has got the following registers:

Register	Description
6010x0000	Status (bit-coded)
6010x0001	Command (bit-coded)
6010x0002	PWM pulse control factor (duty cycle) in steps of 0.1 %
6010x0005	Measured current of output PAx in mA
6010x0006	PWM frequency in Hz
6010x0007	Adjustable overcurrent limit in mA

R6010x0000

Status register of the multi-purpose outputs PA1 to PA4

In R 6010x0000 the HMI reports the status of multi-purpose outputs PA1 to PA4.

Meaning of the individual bits	
Bit 0	**Overcurrent of H-side**
	1 = Overcurrent detection has tripped

Bit 3	**Overcurrent of L-side**
	1 = Overcurrent detection has tripped
Bit 6	**Cable breakage (open load)**
	1 = A cable breakage is present
Bit 7	**Overtemperature**
	1 = Overtemperature is present
Bit 14	**Multi-purpose output is ...**
	0 = Multi-purpose output PAx is active
	1 = Multi-purpose output PAx is deactivated
Bit 15	**Hardware protection has tripped**
	1 = Hardware protection has tripped due to overcurrent/short circuit

Register properties	
Access	Read
Reset	Command: Activate multi-purpose output x
Value after reset	0x00000040 (if no device has been connected)

R 6010x0001

Command register for multi-purpose outputs PA1 to PA4, bit-coded

The command register lets you set various operating modes and configure the respective PAx output.

PAx commands, bit-coded	
Bits 1 ... 0:	**Operating mode of the output**
00 =	Output PAx as digital output
01 =	Output PAx as PWM output
Bits 3 ... 2:	
00 =	Output PAx as input
01 =	Output PAx as low-side output
10 =	Output PAx as high-side output
11 =	Output PAx as low-side output
Bit 15:	
0 =	Activate output
1 =	Deactivate output

Multi-purpose outputs - Analog functions

Introduction

The multi-purpose outputs of the HMI JVM-104 have got the following analog features:

- Current measuring
- Setting the limit of the overcurrent

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual outputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	3	Multi-purpose output PA1
x	4	Multi-purpose output PA2
x	5	Multi-purpose output PA3
x	6	Multi-purpose output PA4

Example:

x = 5 for multi-purpose output PA3. To activate the digital output of PA3 enter command 0x0008 into R 601050001.

6010x0005

Measured current PAx in mA

This register displays the current measured at output PAx in mA. This current measuring is only valid, if PAx is configured as output.

Register properties	
Values	0 ... 2,300
Unit	Milliampere

Register properties	
Access	Read

6010x0007

Adjustable overcurrent limit for the output PAy

This register lets you set the limit of the overcurrent. If the current at output PAx exceeds this limit, output PAx is deactivated and bit 0 is set in R 6010x0000.

Register properties	
Values	0 ... 2,500
Unit	Milliampere
Value after reset	0 represents a maximum current of 2.5 A

Activating the digital output and measuring the current

The command register for the multi-purpose output PAx is bit-coded. By setting several bits, you issue several commands simultaneously.

Example:

Command 0x0004 activates the output as digital low-side output.

To measure the output current and set the permitted overcurrent limit, proceed as follows:

Step	Action
1	Set the limit of the overcurrent: R 6010x0007 := 1,000;
2	Activate the output as digital output and, for example, as low-side output: R 6010x0001 := 0x0004;
3	Retrieve the current from R 6010x0005 in mA.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

The example below shows how to cyclically measure the current of digital output PA3 in mA:

```
Var
    // PA3: Output 3
    PA3_Command:            Int At %VL 601050001;
    PA3_Current_Value:      Int At %VL 601050005;
End_Var;

Task Main Autorun
// Activate output PA3 as low-side output
PA3_Command := 0x0004;

Loop
    Trace('Current value at PA1 ' + IntToStr(PA3_Current_Value) +
' µA.$n');
    Delay(T#100ms);
End_Loop;
End_Task;
```

Multi-purpose outputs - Digital functions

Introduction

The multi-purpose outputs of the HMI JVM-104 have got the following digital features:

- Digital input
- Digital output
- PWM output

Placeholder x

Placeholder x is for clearer representation. The table below shows how placeholders are used to address individual outputs. Throughout this chapter the following rules apply:

Placeholder	Value	Description
x	3	Multi-purpose output PA1
x	4	Multi-purpose output PA2
x	5	Multi-purpose output PA3
x	6	Multi-purpose output PA4

Example:

x = 5 for multi-purpose output PA3. To activate the digital output of PA3 enter command 0x0008 into R 601050001.

6010x0002

PWM pulse control factor (duty cycle) for output PAx

This register lets you set the value of the PWM pulse control factor (duty cycle) while the PWM output is active.

Register properties	
Value for input	0 ... 1000
Unit	0.1 %

6010x0006

PWM frequency in Hz for output PAx

This register lets you set the PWM frequency to be output by the PAx output in PWM mode.

Register properties	
Values	100 ... 1,000
Unit	Hertz

Activating the digital PWM output

The command register for the multi-purpose output PAx is bit-coded. By setting several bits, you issue several commands simultaneously.

Example:

Command 0x0005 activates the PWM output as digital low-side output.

Activate the PWM output PAx as follows: First set the PWM pulse control factor (duty cycle) and the PWM frequency:

Step	Action
1	Set the PWM pulse control factor (duty cycle) to 60 %: R 6010x0002 := 600;
2	Set the PWM frequency to 300 Hz: R 6010x0006 := 300;
3	Activate the PWM output PAx as low-side output, for example. R 6010x0001 := 0x0005;

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

The example below shows how to activate multi-purpose output PA4 as PWM output:

```
Var
    // PA4: PWM output 4
    PA4_Command:            Int At %VL 601060001;
    PA4_PWM_Duty_Cycle:     Int At %VL 601060002;
    PA4_PWM_Freq:           Int At %VL 601060006;
End_Var;

Task Main Autorun
// Activating output PA4 as low-side and PWM output
PA4_Command := 0x0005;

Loop
//
//
    Delay(T#100ms);
End_Loop;
End_Task;
```

Activate output PAx as digital input

Enter command 0x0000 inro R 6010x0001. Output PAx now takes over the function of a digital input In this case, bit 0 has no significance.

Multi-purpose outputs PA3 and PA4 functioning as H-bridges

Introduction

The HMI JVM-104 lets you control multi-purpose outputs PA3 and PA4 as H-bridges.

Programming

To control an output as H-bridge, the program must include the following steps:

Clockwise rotation:

Step	Action
1	Activate the low-side output of PA3. R 601050001 := 0x0005;
2	Set PA3 to a PWM pulse control factor (duty cycle) of 100 %. R 601050002 := 1000;
3	Activate the high-side output of PA4: R 601060001 := 0x0009;
4	Set PA4 to the desired PWM pulse control factor (duty cycle), e.g. 50 %. R 601060002 := 500;
⇨	The H-bridge in clockwise rotation is configured with a 50 % pulse control factor (duty cycle).

Anti-clockwise rotation:

Step	Action
1	Activate the low-side output of PA4. R 601060001 := 0x0005;
2	Set PA4 to the PWM pulse control factor (duty cycle) of 100 %. R 601060002 := 1000;
3	Activate the high-side output of PA3. R 601050001 := 0x0009;
4	Set PA3 to the desired PWM pulse control factor (duty cycle), e.g. 40 %. R 601050002 := 400;
⇨	The H-bridge in anti-clockwise rotation is configured with a 40 % pulse control factor (duty cycle).

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program:

```
Task H_bridge Autorun

Const
LS_ON = 0x0005;
HS_ON = 0x0009;
End_Const;

Var
    PA3_Command:           Int At %VL 601050001;
    PA3_PWM_Duty_Cycle:    Int At %VL 601050002;
    PA4_Command:           Int At %VL 601060001;
    PA4_PWM_Duty_Cycle:    Int At %VL 601060002;
End_Var;

// Clockwise rotation
// Activating low-side output PA3:
PA3_Command := LS_ON;
// PA3 PWM pulse control factor (duty cycle) 100 %:
PA3_PWM_Duty_Cycle := 1000;
// Activating high-side output PA4:
PA4_Command := HS_ON;
// Desired PWM pulse control factor (duty cycle), e.g. 50 %
PA4_PWM_Duty_Cycle := 500;
// Now, the motor is rotating in clockwise direction

// Stop the motor
PA4_PWM_Duty_Cycle := 0;
Delay(T#2s);

// Anti-clockwise rotation
// Activating low-side output PA4:
PA4_Command := LS_ON;
// PA4 PWM pulse control factor (duty cycle) 100 %:
PA4_DutyCycle := 1000;
// Activating high-side output PA3:
PA3_Command := HS_ON;
// Desired PWM pulse control factor (duty cycle), e.g. 40 %
PA3_DutyCycle := 400;
// Now, the motor is rotating in anti-clockwise direction
End_Task;
```

Related topics

- **Connecting the H-bridge** (see page 38)

10.4 Runtime registers

Introduction

The JVM-104 provides several registers which are incremented by the operating system at regular intervals.

Application

These registers can be used to easily carry out time measurements in the application program.

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Description of the runtime registers

Register overview

The device is equipped with the following runtime registers:

Register	Description
R 201000	Application time base in milliseconds
R 201001	Application time base in seconds
R 201002	Application time base in R 201003 * 10 ms
R 201003	Application time base units for R 201002
R 201004	System time base in milliseconds
R 201005	System time base in microseconds

R 201000

Application time base in milliseconds

Every millisecond this register is incremented by one.

Register properties	
Values	-2,147,483,648 ... 2,147,483,647 (overflowing)

R 201001

Application time base in seconds

Every second this register is incremented by one.

Register properties	
Values	-2,147,483,648 ... 2,147,483,647 (overflowing)

R 201002

Application time base in application time base units

Every [R 201003] * 10 ms this register value is incremented by one. Using the reset value 10 in register 201003, this register is incremented every 100 ms.

Register properties	
Values	-2,147,483,648 ... 2,147,483,647 (overflowing)

R 201003 **Application time base units for R 201002**

This register contains the multiplier for runtime register R 201002.

Register properties	
Values	1 ... 2,147,483,647 (* 10 ms)
Value after reset	10 (--> 100 ms)
Enabling conditions	After at least 10 ms

R 201004 **System time base in milliseconds**

Every millisecond this register value is incremented by one.

Register properties	
Values	-2,147,483,648 ... 2,147,483,647 (overflowing)
Type of access	Read

R 201005 **System time base in microseconds**

Every microsecond this register value is incremented by one.

Register properties	
Values	-2,147,483,648 ... 2,147,483,647 (overflowing)
Type of access	Read

Sample program - Runtime registers

Task

Measure how much time it takes to store variable values to a file.

Solution

Before storing the values, set register 201000 to 0.

Once the values have been stored, you can see from this register how much time it took to store the values [in milliseconds].

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

```
Var
    DataArray:    Array[2000] Of Int;
    File1:        File;
    WriteTime:    Int;
    WriteIt:      Bool;

    MilliSec:     Int At %VL 201000;
End_Var;

Task WriteToFile Autorun
    Loop
        // Resetting the start flag
        WriteIt := False;
        // Waiting for user to set start flag
        When WriteIt Continue;

        // Opening the file in write mode
        // If there is no file available, a new file
        // is created
        If FileOpen(File1, 'Test.dat', fWrite) Then

            // Setting the application time base register to zero
            MilliSec := 0;

            // Writing the data array into the file
            FileWrite(File1, DataArray, SizeOf(DataArray));

            // Registering the run time
            WriteTime := MilliSec;
            FileClose(File1);

            // Displaying the run time
            Trace(StrFormat('Time : %d [ms]$n', WriteTime));
```

```
            Else
                // Displaying the error message
                Trace('Unable to open file!$n');
            End_If;
        End_Loop;
    End_Task;
```

10.5 Monitoring interface activities

Introduction

Several Ethernet servers have been integrated into the HMI to make variables used within the application program accessible from outside. These servers support several protocols on different interfaces. The servers do not require any programming in the application program, but process requests from external clients on their own.

This chapter explains one possibility for detecting from within the application program whether communication with the servers takes place through these interfaces.

Monitored interface activities

The following interface activities can be monitored:

- JetIP server via Ethernet interface
- STX debug server via Ethernet interface

Purpose

The monitoring function for interface activities is used, amongst others, for the following scenarios:

- Plants requiring process visualization to ensure safe operation. They can be transferred into a save state if communications fails.
- When the service technician connects an HMI, the application program automatically displays additional status information.

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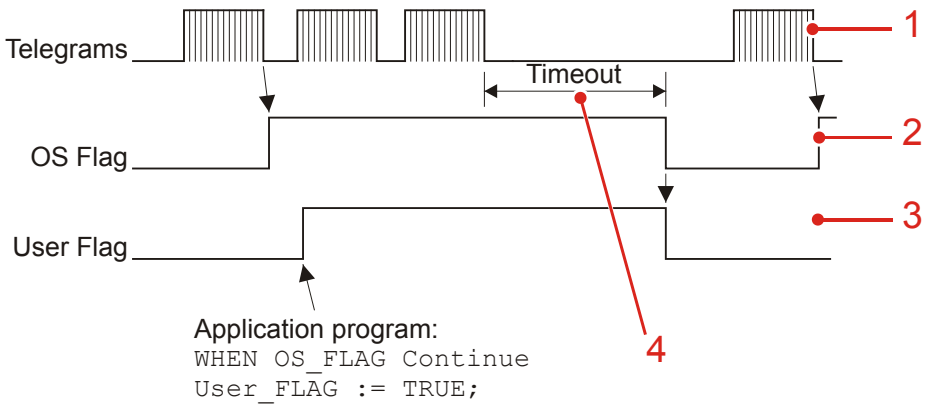
Operating principle

Introduction

The application program monitors the activity of a client communicating with a server of the device JVM-104 by means of two special flags and one special register per interface.

Overview

The illustration below shows the interdependence between interface activity and the two special flags, as well as the special register:



Number	Element	Description
1	Telegrams	The client places requests to the server.
2	OS flag	OS flag set by the device JVM-104 after receiving a request
3	User flag	You must set the user flag in the application program once the device has set the OS flag.This indicates that the connection has temporarily been disrupted even if the device resets the OS flag very quickly.
4	Timeout	Time of inactivity after which the OS resets both special flags. This time can be set in a special register.

Description

Interface activities are monitored as follows:

Step	Description
1	Enter the desired value into the timeout register of the application program. This way, the monitoring mode is activated as well.
2	When the controller receives the next telegram, the device JVM-104 sets the corresponding OS flag.
3	If the OS flag has been set, the application program also sets the respective user flag.
4	Each new telegram causes the timeout to restart.
5	If telegrams cease to arrive, both special flags are reset by the controller upon expiry of the timeout interval.

Step	Description
6	The application program detects that the device has reset the special flags and therefore takes appropriate action.
7	When further telegrams start arriving, the device sets the corresponding OS flag. The user flag, however, remains reset.

Programming

Registers/flags - Overview

For interface monitoring, the device provides the following registers and flags:

Timeout registers

Register	Interface	Application
R 203000	JetIP (Ethernet)	■ Visualization ■ Networking
R 203005	STX debugging (Ethernet)	■ JetSym via Ethernet

Special flags

Flag	Interface	Application
F 2088	JetIP (Ethernet)	OS flag
F 2089		User flag
F 2098	STX debugging (Ethernet)	OS flag
F 2099		User flag

R 203000

Timeout in the case of JetIP (Ethernet)

This register contains the timeout for the JetIP server (Ethernet) in milliseconds.

Register properties	
Values	0 ... 2,147,483,647 [ms]
Value after reset	0 (monitoring disabled)

R 203005

Timeout in the case of STX debugging (Ethernet)

This register contains the timeout for the STX debug server (Ethernet) in milliseconds.

Register properties	
Values	0 ... 2,147,483,647 [ms]
Value after reset	0 (monitoring disabled)

Enabling the monitoring function

To enable monitoring of interface activities, proceed as follows:

Step	Action
1	Enter the desired value into the timeout register of this interface.
2	Wait until the HMI has set the OS flag of this interface.
3	Set the corresponding user flag.

Detecting a timeout

To detect a timeout, proceed as follows:

Step	Action	
1	Enable monitoring of interface activities (see above).	
2	Wait until the device has reset the application-specific flag of this interface. **Result:** A timeout has occurred.	
3	Check the corresponding OS flag.	
	If ...	**... then ...**
	... the OS flag is set,	... the connection was temporarily disrupted.
	... the OS flag is reset,	... the connection is still disrupted.

10.6 User-programmable IP interface

The user-programmable IP interface

The user-programmable IP interface allows to send or receive any data via Ethernet interface on the JVM-104 using TCP/IP or UDP/IP. When using this feature, data processing is completely carried out by the application program.

Applications

The user-programmable IP interface allows the programmer to carry out data exchange via Ethernet connections which do not use standard protocols, such as FTP, HTTP, JetIP or Modbus/TCP. The following applications are possible:

- Server
- Client
- TCP/IP
- UDP/IP

Required programmer's skills

To be able to program user-programmable IP interfaces the following knowledge of data exchange via IP networks is required:

- IP addressing (e.g. IP address, port number, subnet mask)
- TCP (e.g. connection establishment/termination, data stream, data backup)
- UDP (e.g. datagram)

Restrictions

For communication via user-programmable IP interface, the programmer must not use any ports which are already used by the operating system of the controller. Therefore, do not use the following ports:

Protocol	Port number	Default value	User
TCP	Depending on the FTP client	20	FTP server (data)
TCP	21		FTP server (controller)
TCP	23		System logger
TCP	80		HTTP server
TCP	From the file /EMAIL/email.ini	25, 110	E-mail client
TCP	502		Modbus/TCP server
TCP, UDP	1024 - 2047		Various
TCP, UDP	IP configuration	50000, 50001	JetIP
TCP	IP configuration	52000	Debug server

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10.6.1 Programming

Introduction

The user-programmable IP interface is used to carry out data exchange between application program and network client via TCP/IP or UDP/IP connections. For this purpose, function calls are used. These function calls are included in the programming language of the JVM-104. To program this feature proceed as follows:

Step	Action
1	Initializing the user-programmable IP interface
2	Open connections
3	Transfer data
4	Terminate the connections

Technical data

Technical data of the user-programmable IP interface:

Feature	Description
Number of connections	20
Maximum data size	4,000 byte

Restrictions

While the controller JVM-104 is processing one of the functions of the user-programmable IP interface, tasks having called the functions should not be stopped through `TaskBreak` or restarted through `TaskRestart`.

Failure to do so could result in the following errors:

- Connections do not open
- Data loss during sending or receiving
- Connections remain open unintentionally
- Connections are closed unintentionally

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Initializing the user-programmable IP interface

Introduction

This function must be initialized each time the application program is launched.

Function declaration

```
Function ConnectionInitialize():Int;
```

Return value

The following return value is possible:

Return value	
0	Always

How to use this function

The function is used and its return value assigned to a variable for further utilization in the following way:

```
Result := ConnectionInitialize();
```

Operating principle

The device JVM-104 processes this function in the following steps:

Step	Description
1	The device JVM-104 closes all open connections of the user-programmable IP interface.
2	The device JVM-104 initializes all OS-internal data structures of the user-programmable IP interface.

Related topics

- **Establishing a connection** (see page 210)
- **Terminating a connection** (see page 219)
- **Sending data** (see page 214)
- **Receiving data** (see page 216)

Establishing a connection

Introduction

Before data can be sent or received, a connection has to be established. Here, the following criteria have to be discerned:

- Which transaction log (TCP or UDP) has to be used?
- Is it a client or a server that has to be installed?

Function declaration

```
Function ConnectionCreate(ClientServerType:Int,
                          IPType:Int,
                          IPAddr:Int,
                          IPPort:Int,
                          Timeout:Int):Int;
```

Function parameters

Description of the function parameters:

Parameter	Value	Comment
`ClientServerType`	Client = 1 = CONNTYPE_CLIENT Server = 2 = CONNTYPE_SERVER	
`IPType`	UDP/IP = 1 = IPTYPE_UDP TCP/IP = 2 = IPTYPE_TCP	
`IPAddr`	Valid IP address	Required only for TCP/IP client
`IPPort`	Valid IP port number	Will be ignored for UDP/IP client
`Timeout`	0 ... 1,073,741,824 [ms]	0 = infinitely

Return value

If the return value was positive, the connection could be established. If the returned value was negative, an error occurred and the connection could not be established.

Return value	
> 0	A positive return value must be stored in a variable. It must be made available as a handle at activating the functions `Send data`, `Receive data`, and `Terminate connection`.
-1	Error during connection set-up
-2	Internal error
-3	Invalid parameter
-8	Timeout

Using this function with a TCP/IP client

If a client is to establish a TCP/IP connection to a server, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionCreate(CONNTYPE_CLIENT,
                           IPTYPE_TCP,
                           IP#192.168.75.123,
                           46000,
                           T#10s);
```

Functioning principle with a TCP/IP client

The task stops at the program line until the connection is established or the specified timeout has elapsed. This function is processed in the following steps:

Step	Description	
1	The device JVM-104 tries to establish a TCP/IP connection via port 46000 to the network client with IP address 192.168.75.123.	
2	**If ...**	**... then ...**
	the network client has accepted the connection,	the function is terminated and a positive value is returned as handle for further access to the connection.
	the connection could not be established and the timeout of 10 seconds has not elapsed yet,	step 1 is carried out.
	an error has occurred or the timeout has elapsed,	the function is terminated and a negative value is returned.

Using this function with a TCP/IP server

If a server is to establish a TCP/IP connection to a client, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionCreate(CONNTYPE_SERVER,
                           IPTYPE_TCP,
                           0,
                           46000,
                           T#100s);
```

Functioning principle with a TCP/IP server

The task stops at the program line until the connection is established or the specified timeout has elapsed. This function is processed in the following steps:

Step	Description	
1	The device JVM-104 sets up TCP/IP port 46000 for receiving connection requests.	
2	**If ...**	**... then ...**
	the network client has established a connection,	no further connection requests to this port are accepted, the function is terminated and a positive value is returned as handle for further access to the connection.
	the connection could not be established and the timeout of 100 seconds has not elapsed yet,	the system waits for a connection to be established.
	an error has occurred or the timeout has elapsed,	the function is terminated and a negative value is returned.

Using this function with a UDP/IP client

If a client is to establish a UDP/IP connection to a server, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionCreate(CONNTYPE_CLIENT,
                           IPTYPE_UDP,
                           0,
                           0,
                           0);
```

Functioning principle with a UDP/IP client

UDP is a connectionless communication mode. For this reason, the device JVM-104 opens only one communication channel for sending data to a network client. This function is processed in the following steps:

Step	Description	
1	The device JVM-104 sets up a UDP/IP communication channel for sending data.	
2	**If ...**	**... then ...**
	no error has occurred,	the function is terminated and a positive value is returned as handle for further access to the connection.
	an error has occurred,	the function is terminated and a negative value is returned.

Using this function with a UDP/IP server

If a server is to establish a UDP/IP connection to a server, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionCreate(CONNTYPE_SERVER,
                           IPTYPE_UDP,
                           0,
                           46000,
                           0);
```

Functioning principle with a UDP/IP server

UDP is a connectionless communication mode. For this reason, the device JVM-104 opens only one communication channel for receiving data from a network client. This function is processed in the following steps:

Step	Description	
1	The device JVM-104 sets up a UDP/IP communication channel at port 46000 for receiving data.	
2	**If ...**	**... then ...**
	no error has occurred,	the function is terminated and a positive value is returned as handle for further access to the connection.
	an error has occurred,	the function is terminated and a negative value is returned.

Related topics

- **Terminating a connection** (see page 219)
- **Sending data** (see page 214)
- **Receiving data** (see page 216)
- **Initializing the user-programmable IP interface** (see page 209)

Sending data

Introduction

Data can be sent via a previously established TCP/IP connection or via a UDP/IP connection of a client.

Via UDP/IP connection of a server data cannot be sent, but only received.

Function declaration

```
Function ConnectionSendData(IPConnection:Int,
                            IPAddr:Int,
                            IPPort:Int,
                            Const Ref SendData,
                            DataLen:Int):Int;
```

Function parameters

Description of the function parameters:

Parameter	Value	Comment
`IPConnection`	Handle	Return value of the function `ConnectionCreate()`
`IPAddr`	Valid IP address	Required only for UDP/IP client
`IPPort`	Valid IP port number	Required only for UDP/IP client
`SendData`	Address of the data block to be sent	
	1 ... 4,000	Data block length in bytes

Return value

The following return values are possible:

Return value	
0	Data have been sent successfully.
-1	Error when sending, e.g. connection interrupted.
-3	Invalid handle, e.g. sending via a UDP/IP server.

Using this function with a TCP/IP connection

If data are to be sent via a TCP/IP connection, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionSendData(hConnection,
                             0,
                             0,
                             SendBuffer,
                             SendLen);
```

Functioning principle with a TCP/IP connection

When using TCP/IP, data are sent via a previously opened connection. Therefore, specification of the IP address and IP port number is not required anymore and can be ignored in the function.

In the following cases, the task is not processed further after issuing the function call:

- The data have been sent and their reception confirmed.
- An error has occurred.

Using this function with a UDP/IP client

If, with a client, data are to be sent via a UDP/IP connection, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionData(hConnection,
                         IP#192.168.75.123,
                         46000,
                         SendBuffer,
                         SendLen);
```

Functioning principle with a UDP/IP client

With UDP/IP there is no connection between two given network clients. Therefore, with each function call data can be sent to another client or another port. The task will pause at the function call until the data are sent.

You will not get any acknowledgment of the remote network client having received the data.

Related topics

- **Initializing the user-programmable IP interface** (see page 209)
- **Establishing a connection** (see page 210)
- **Terminating a connection** (see page 219)
- **Receiving data** (see page 216)

Receiving data

Introduction

Data can be sent via a previously established TCP/IP connection or via a UDP/IP connection of a server.

Via UDP/IP connection of a client data cannot be received, but only sent.

Function declaration

```
Function ConnectionReceiveData(IPConnection:Int,
                               Ref IPAddr:Int,
                               Ref IPPort:Int,
                               Ref ReceiveData,
                               DataLen:Int,
                               Timeout:Int):Int;
```

Function parameters

Description of the function parameters:

Parameter	Value	Comment
`IPConnection`	Handle	Return value of the function `ConnectionCreate()`
`IPAddr`	Address of a variable for saving the IP address of the sender	Required only for UDP/IP server
`IPPort`	Address of a variable for saving the IP port number of the sender	Required only for UDP/IP server
`ReceiveData`	Address of the data block to be received	
`DataLen`	1 ... 4,000	Maximum data block length in bytes
`Timeout`	0 ... 1,073,741,824 [ms]	0 = infinitely

Return value

The following return values are possible:

Return value	
> 0	Number of received data bytes
-1	Error when receiving data, e.g. connection interrupted.
-3	Invalid handle, e.g. receiving data via a UDP/IP client.
-8	Timeout

Using this function with a TCP/IP connection

If data are to be received via a TCP/IP connection, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionReceiveData(hConnection,
                                Dummy,
                                Dummy,
                                ReceiveBuffer,
                                sizeof(ReceiveBuffer),
                                T#10s);
```

Functioning principle with a TCP/IP connection

When using TCP/IP, data are sent via a previously opened connection. Therefore, specification of the IP address and IP port number is not required any more and can be ignored in the function.

In the following cases, the task is not processed further after issuing the function call:

- The data have been received
- An error has occurred

In case of a TCP/IP connection, data are transmitted as data stream.

The device JVM-104 processes this function in the following steps:

Step	Description	
1	The device JVM-104 waits until data have been received, but no longer than the specified timeout.	
2	**If ...**	**... then ...**
	the timeout has elapsed or the connection has been terminated,	the function is exited and an error message is issued.
	data have been received,	they are copied to the receiving buffer given along with the data (but not exceeding the amount given along with the data). Then, the function continues with stage 3.
3	**If ...**	**... then ...**
	more data have been received than could have been copied into the receiving buffer,	these are buffered by the JVM-104 to be fetched by further function calls.
4	The function is exited and the number of data, which have been copied into the receiving buffer, is returned.	

Using this function with a UDP/IP server

If, with a server, data are to be received via a UDP/IP connection, you can invoke the function and assign the return value of a variable for further evaluation as follows:

```
Result := ConnectionReceiveData(hConnection,
                                IPAddr,
                                IPPort,
                                ReceiveBuffer,
                                sizeof(ReceiveBuffer),
                                T#10s);
```

Functioning principle with a UDP/IP server

In the following situations, the task is not processed further after issuing the function call:

- All data have been received.
- An error has occurred.

In case of a UDP/IP connection, data are transmitted as datagram.
The controller processes this function in the following steps:

Step	Description	
1	The device JVM-104 waits until all data of a datagram have been received, but no longer than the specified timeout.	
2	**If ...**	**... then ...**
	the timeout has elapsed or the connection has been terminated,	the function is exited and an error message is issued.
	data have been received,	they are copied to the receiving buffer given along with the data (but not exceeding the amount given along with the data). Then, the function continues with stage 3.
3	**If ...**	**... then ...**
	... more data have been received than could be copied into the receiving buffer - that is, if the sent datagram is too large,	... these data are discarded.
4	The sender's IP address and IP port number are transferred into the variables which are given along with the data.	
5	The function is exited and the number of data, which have been copied into the receiving buffer, is returned.	

Related topics

- **Initializing the user-programmable IP interface** (see page 209)
- **Establishing a connection** (see page 210)
- **Terminating a connection** (see page 219)
- **Sending data** (see page 214)

Terminating a connection

Introduction

Clear all connections which are no longer required as the number of concurrently opened connections is limited.

Function declaration

```
Function ConnectionDelete(IPConnection:Int):Int;
```

Function parameters

Description of the function parameters:

Parameter	Value	Comment
`IPConnection`	Handle	Return value of the function `ConnectionCreate()`

Return value

The following return values are possible:

Return value	
0	Connection terminated and deleted
-1	Invalid handle

How to use this function

This way, you can invoke the function and assign its return value to a variable for further utilization:

```
Result := ConnectionDelete(hConnection);
```

Related topics

- **Establishing a connection** (see page 210)
- **Sending data** (see page 214)
- **Receiving data** (see page 216)
- **Initializing the user-programmable IP interface** (see page 209)

10.6.2 Registers

Introduction

This chapter describes the registers of the JVM-104 which contain the current connection list of the user-programmable IP interface. These registers can be used for debugging or diagnostic purposes. However, they can't be used for other functions such as establishing or terminating a connection.

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Register numbers

Introduction

Data of one connection each are displayed within the registers of a coherent register block. The basic register number of this block is dependent on the controller.

Register numbers

Controller	Basic register number	Register numbers
JC-340, JC-350, JC-360, JC-360MC	350000	350000 ... 350007
JC-940MC	350000	350000 ... 350007
JVM-407, JVM-407B	350000	350000 ... 350007
JVM-104	350000	350000 ... 350007

Determining the register number

In this chapter only the last figure of a register number is specified, for example MR 1. To determine the complete module register number, add to this figure the basic register number of the corresponding device, for example 350000.

Register overview

Register	Description
MR 0	Selecting a connection
MR 1	Type of connection
MR 2	Transport protocol
MR 3	IP address
MR 4	IP port number
MR 5	State
MR 6	Number of sent bytes
MR 7	Number of received bytes

Register description

Introduction

The operating system manages the established connections in a list. Module register MR 0 *Selection of a connection* is used to copy connection details into other registers of a register block.

MR 0

Selecting a connection

Connections are selected by writing values to this register. Read access to this register is used to display whether the following registers contain connection details.

Module register properties		
Reading values	0	Connection exists
	-1	Connection does not exist

Module register properties		
Writing values	0	Address the first connection in the list
	> 0	Address the next connection in the list
	< 0	Address the previous connection in the list

MR 1

Type of connection

The value in this register shows whether the connection is a client or a server connection.

Module register properties		
Values	1	Client
	2	Server

MR 2

Transport protocol

The value in this register shows whether TCP or UDP is used as transport protocol.

Module register properties		
Values	1	UDP
	2	TCP

MR 3 **IP address**

The value in this register shows the configured IP address.

Module register properties	
Values	0,0,0,0 ... 255,255,255,255

MR 4 **IP port number**

The value in this register shows the configured IP port number.

Module register properties	
Values	0 ... 65,535

MR 5 **State**

The value in this register shows status the connection is currently in.

Module register properties		
Values	0	Connection terminated
	1	Connection is being established
	2	Connection is established
	3	TCP/IP server: Waiting for connection request from client
	4	Internal usage

MR 6 **Number of sent bytes**

The value in this register shows the number of data bytes sent via the given connection. Since this is a signed 32-bit register and the sent bytes are added each time, the number range may be exceeded from the positive maximum value to the negative maximum value.

Module register properties	
Values	-2,147,483,648 ... 2,147,483,647

MR 7

Number of received bytes

The value in this register shows the number of data bytes received via the given connection. Since this is a signed 32-bit register and the received bytes are added each time, the number range may be exceeded from the positive maximum value to the negative maximum value.

Module register properties	
Values	-2,147,483,648 ... 2,147,483,647

10.6.3 Sample programs

Introduction

This chapter contains sample programs for implementing a server and a corresponding client which will use TCP/IP for communication.

Both sample programs can be applied to the HMI JVM-104.

Due to the platform-independent implementation of the user-programmable IP interface these sample programs can be used for other configurations without modification.

Use case

The use case is a Jetter AG controller or HMI communicating with a device from a third-party manufacturer. The user-programmable IP interface lets you make protocol adjustments in the application program of the Jetter AG device.

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Server

Task

A server is to receive a data block with a given number of characters and to return the received data to the client.

Solution

Programming a server for the user-programmable IP interface. The server communicates via TCP/IP.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

```
Const
  TCP_PORT = 52100;
  MSG_LEN  = 4000;
End_Const;

Var
  // Handle as return value of the function "Establishing
  // a connection"
  ConnHandle      : Int;

  // Transmit buffer
  SendBuf         : Array[MSG_LEN] Of Char;
  // Receive buffer
  RecvBuf         : Array[MSG_LEN] Of Char;

  ResConnInit     : Int;
  ResConnCreate   : Int;
  ResConnReceive  : Int;
  ResConnSend     : Int;

  ConnTimeOut     : Int;
  RecvTimeOut     : Int;

  // Amount of receive errors
  RecvErrors      : Int;
  // Amount of transmit errors
  SendErrors      : Int;
  // Counter of correct communication transmissions
  CommCnt         : Int;

  AmountToReceive : Int;
```

```
  // Dummy
  NotUsed          : Int;
End_Var;


Task TCPserver Autorun

  Var
    RecvTimer      : Timer;
    ReceiveCnt     : Int;
  End_Var;

  // Timeout for connection
  ConnTimeOut := T#5s;
  // Timeout when receiving a data packet
  RecvTimeOut := T#5s;

  // Amount of data to be received
  AmountToReceive := MSG_LEN;

  // Terminate all connections, initialize the data structures
  ResConnInit := ConnectionInitialize();

  If ResConnInit >= 0 Then

    Trace('Server running.$n');

    While (True) Do

      // Connection attempt
      ResConnCreate := ConnectionCreate
                       ( CONNTYPE_SERVER,
                         IPTYPE_TCP,
                         0,
                         TCP_PORT,
                         ConnTimeOut );

      If ResConnCreate > 0 Then

        Trace('Connection established.');
        // Save the return value (handle)
        ConnHandle := ResConnCreate;

        // Repeat, while the connection exists
        Loop

// Set up a timeout for completely transmitting the data packet
          TimerStart(RecvTimer, RecvTimeOut * 5);
          // Initialize the counter for the received data
          ReceiveCnt := 0;
```

```
// Repeat, until all expected data have been received
// Otherwise, retry until timeout
        While ReceiveCnt < AmountToReceive
            And Not TimerEnd(RecvTimer) Do

          ResConnReceive := ConnectionReceiveData
                              ( ConnHandle,
                                NotUsed,
                                NotUsed,
                                RecvBuf[ReceiveCnt],
                                SizeOf(RecvBuf),
                                RecvTimeOut );

          If ResConnReceive > 0 Then
            // A value has been received, increment the counter
            ReceiveCnt := ReceiveCnt + ResConnReceive;
          Else
            // Error during reception
            ResConnReceive := -1;
            // Increment the error counter value
            Inc(RecvErrors);
            // Exit the loop
            Exit;
          End_If;
        End_While;

// At this point, implement the server function
// In this example, the received data are returned
        If ReceiveCnt Then
          // Copy the data from the receiving buffer to the
          // transmit buffer
          MemCopy(SendBuf,RecvBuf,SizeOf(SendBuf));
          ResConnSend := ConnectionSendData
                           ( ConnHandle,
                             0,
                             0,
                             SendBuf,
                             ReceiveCnt );
          If ResConnSend < 0 Then
            // Increment the error counter value
            Inc(SendErrors);
          End_If;
        End_If;

        If ResConnSend >= 0 And ResConnReceive >= 0 Then
          // No error --> Counter OK to increment
          Inc(CommCnt);
        Else
          // Exit the loop
          Exit;
        End_If;
```

```
        End_Loop;

        If ConnHandle > 0 Then
          // Terminate the connection
          ConnectionDelete(ConnHandle);
          // Handle is no longer valid
          ConnHandle := 0;
          Trace('Connection closed.$n');
        End_If;

      End_If;

  // Wait shortly for another connection to be tried
      Delay(T#3s);

    End_While;

  Else
    Trace('ConnectionInitialize() failed, server stopped !$n');
  End_If;

End_Task;
```

Related topics

- **Client** (see page 230)

Client

Task

A client is to send a data block with a given number of characters and to return the data received from the server.

Solution

Programming a client for the user-programmable IP interface. The client communicates via TCP/IP.

Software versions

The sample program has been tested for compliance with the following software versions:

- JetSym version 5.2
- HMI JVM-104, OS version 4.01

For more information on programming by STX, please turn to the online help in JetSym.

JetSym STX program

```
Const
  TCP_ADDR = IP#192.168.10.210;
  TCP_PORT = 52100;
  MSG_LEN  = 4000;
End_Const;

Var
  // Handle as return value of the function "Establishing
  // a connection"
  ConnHandle      : Int;
  // Transmit buffer
  SendBuf         : Array[MSG_LEN] Of Char;
  // Receive buffer
  RecvBuf         : Array[MSG_LEN] Of Char;
  ResConnInit     : Int;
  ResConnCreate   : Int;
  ResConnReceive  : Int;
  ResConnSend     : Int;
  ConnTimeOut     : Int;
  RecvTimeOut     : Int;

  // Amount of receive errors
  RecvErrors      : Int;
  // Amount of transmit errors
  SendErrors      : Int;
  // Counter of correct communication transmissions
  CommCnt         : Int;
  AmountToReceive : Int;
  SendDelay       : Int;

  // Dummy
  NotUsed         : Int;
End_Var;
```

```
Task TCPclient Autorun

  Var
    RecvTimer     : Timer;
    ReceiveCnt    : Int;
  End_Var;

  // Timeout for connection
  ConnTimeOut := T#5s;
  // Timeout via receiving a data package
  RecvTimeOut := T#5s;

  // Amount of data to be received
  AmountToReceive := MSG_LEN;
  SendDelay       := T#500ms;

  // Terminate all connections, initialize the data structures
  ResConnInit := ConnectionInitialize();

  If ResConnInit >= 0 Then

    Trace('Client running.$n');

    While (True) Do

      // Connection attempt
      ResConnCreate  := ConnectionCreate
                          ( CONNTYPE_CLIENT,
                            IPTYPE_TCP,
                            TCP_ADDR,
                            TCP_PORT,
                            ConnTimeOut );

      If ResConnCreate > 0 Then

        Trace('Connection established.');
        // Save the return value (handle)
        ConnHandle := ResConnCreate;

        // Repeat, while the connection exists
        Loop

          ResConnSend := ConnectionSendData
                           ( ConnHandle,
                             0,
                             0,
                             SendBuf,
                             AmountToReceive );
```

```
        If ResConnSend < 0 Then
          // Increment the error counter value
          Inc(SendErrors);
        End_If;

// Timeout for completely transmitting the data packet
// to be set up
        TimerStart(RecvTimer, RecvTimeOut * 5);
        // Initialize the counter for the received data
        ReceiveCnt := 0;

// Repeat, until all expected data have been received
// Otherwise, retry until timeout
        While ReceiveCnt < AmountToReceive
            And Not TimerEnd(RecvTimer) Do

          ResConnReceive := ConnectionReceiveData
                              ( ConnHandle,
                                NotUsed,
                                NotUsed,
                                RecvBuf[ReceiveCnt],
                                SizeOf(RecvBuf),
                                RecvTimeOut );

          If ResConnReceive > 0 Then
            // A value has been received, increment the counter
            ReceiveCnt := ReceiveCnt + ResConnReceive;
          Else
            // Error during reception
            ResConnReceive := -1;
            // Increment the error counter value
            Inc(RecvErrors);
            // Exit the loop
            Exit;
          End_If;
        End_While;

        If ResConnSend >= 0 And ResConnReceive >= 0 Then
          // No error --> Counter OK to increment
          Inc(CommCnt);
          Delay(SendDelay);
        Else
          // Exit the loop
          Exit;
        End_If;

      End_Loop;

      If ConnHandle > 0 Then
        // Terminate the connection
        ConnectionDelete(ConnHandle);
```

```
            // Handle is no longer valid
            ConnHandle := 0;
            Trace('Connection closed.$n');
          End_If;

        End_If;

    // Wait shortly for another connection to be tried
        Delay(T#3s);

      End_While;

    Else
      Trace('ConnectionInitialize() failed, client stopped !$n');
    End_If;

End_Task;
```

Related topics

- **Server** (see page 226)

11 Automatic copying of controller data

Introduction

This chapter describes the Autostart feature which lets you copy data within the JVM-104. To this end, you can create a command file which is then stored along with the data to a USB flash drive. This command file is then automatically processed when the USB flash drive is inserted.

Functions within the local file system

The Autostart function executes the following functions:

- Creating directories
- Deleting directories
- Copying files
- Deleting files

Areas of application

There are the following main application scopes for the Autostart function:

- Where remote control is not possible
- Where there is no PC on site
- Where the operator is not able or should not be allowed to make modifications to the plant

The following actions can be taken using the Autostart function:

- Modification to the application program
- Modification to the application data
- Modification to the controller configuration
- Updating the operating system (JVM-104)

Prerequisites

For automatic copying of controller data, the following prerequisites must be fulfilled:

- The programmer is familiar with the file system.

Definition

In this description, *Complete Name* means the name of the file or directory including the complete path.

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11.1 How it works

Introduction

This chapter describes how to load and execute the Autostart function.

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Loading the Autostart function

Introduction

The Autostart function can only be executed while the JVM-104 is booting (i.e. after startup).

Prerequisites

You have created the command file and stored it to the respective directory.

	Value	Comment
File name	autostart.bat	All lower case letters
Directory - USB	\USB\	Root directory on the USB flash drive

Loading the Autostart function

To load the Autostart function, proceed as follows:

Step	Action
1	Switch the device OFF.
2	Insert the USB flash drive into the USB port.
3	Switch the device ON.

Result: The device boots and loads the Autostart file.

Executing the Autostart function

Introduction

During the boot process in Autostart mode the device executes the commands contained in the command file.

Executing the Autostart function

When executing Autostart commands, the OS of the JVM-104 proceeds as follows:

Step	Description
1	The device loads the file **\USB\autostart.bat** from the USB flash drive.
2 ... n	The device processes the commands in ascending order.

Terminating the Autostart mode

Introduction

The last command in the file autostart.bat terminates the Autostart mode.

Restart

As an option, you can trigger a reset. To this end, enter the following command as last line into the command file: del \System\reset.exe.

Terminating the Autostart mode

To terminate the Autostart mode, proceed as follows:

Step	Action
1	Remove the USB flash drive.

11.2 autostart.bat - Structure

Introduction

This chapter covers the structure of the file **autostart.bat** and the available commands.

File structure

The command file is a text file with command and comment lines:

- You can insert blank lines as required.
- Start comment lines by *REM*.

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Available commands

Introduction

In these sections you can specify commands which are then executed by the Autostart function.

Processing commands

The Autostart function processes the commands in descending order. Furthermore, this function lets you insert jumps into the processing order. A jump is defined by the keyword `goto` and a destination. The destination must be preceded by a colon (:).

- A simple jump is defined as follows:
  `goto` end
  {skipped block}
  :end
- A conditional jump is defined as follows:
  `if` {condition} `goto` end
  {skipped block}
  :end

Available commands

The syntax of these commands is in line with the standard Windows® command line syntax. For more information on the command syntax refer to http://msdn.microsoft.com/en-us/library/ee499728%28v=winembedded.60%29.aspx

A command listing can be found here

Example of a command file

Task

New functions are to be added to an installed JVM-104. To this end, the following modifications are required:

- Operating system update
- New application program
- New values for some of the registers

Solution

You copy the required files to a USB flash drive and create a command file for the Autostart function.

USB flash drive - Content

The USB flash drive contains the following files:

- The file **autostart.bat**
- The new OS
- A .da file containing the new register values
- A file **start.ini** and a .es3 file containing the new application program

Command file

```
@echo off
if not exist \app\autostart.exe goto end
if exist \app\update.ini goto end
if exist \app\usb_update_process_marker goto dm
echo \data\update\jvm_ce0_1.00.0.04.os >\app\update.ini
md \data\update
copy \%1\jvm_ce0_1.00.0.04.os \data\update\jvm_ce0_1.00.0.04.os
echo >\app\usb_update_process_marker
md \app\progtest
copy \%1\progtest\progtest.es3 \app\progtest\progtest.es3
copy \%1\register.da \app\register.da
del \System\reset.exe
goto end
:dm
del \app\usb_update_process_marker
:end
```

11.3 Data files

Introduction

This chapter covers the data file containing register and flag values to be read by the device.

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File format

Format

The data file consists of the following elements:

- Pure text file
- Each entry must be in a separate line of text
- Each line must be terminated by carriage return/line feed
- Comment lines must be preceded by ";"
- Each data file is to start with the entry *SD1001*.

Data lines

A data line consists of the following elements:

- ID of the variable at the beginning of the line
- Now follows the number of the variable separated by a blank or tab
- Then follows the value of the variable separated by a blank or tab

Variable ID	Variable type
FS	Flags
RS	Integer register
QA	Floating-point registers

Example

```
SD1001
; Data File - Jetter AG
;
; Registers 1000000 ... 1000005
RS    1000000    12345
RS    1000001    2
RS    1000002    -1062729008
RS    1000003    502
RS    1000004    50
RS    1000005    3
QS    1009000    3.14
;
; Flags 10 ... 13
FS    10    0
FS    11    1
FS    12    1
FS    13    0
```

Automatically loading data file information

Mechanical operation

The JVM-104 is able to retrieve a data file before the application program is launched.

Prerequisites

The data file must be named **register.da** and stored to the folder **app**.

Procedure

The table below shows how the device retrieves data file information:

Step	Description
1	If the data file **register.da** has been stored to the folder **app**, the device detects this file on its next launch.
2	The device retrieves the file.
3	The device maps the values to the registers.
4	Once the device has retrieved the file, it deletes the data file.
5	The device loads the application program.

12 Operating system update

Introduction

Jetter AG are continuously striving to enhance the operating systems for their HMIs. Enhancing means adding new features, upgrading existing functions and fixing bugs.

This chapter describes how to carry out operating system updates.

Downloading an operating system

You can download operating systems from the Jetter AG **homepage http://www.jetter.de**. You get to the OS files for download at *Mobile Automation - Support - Downloads* or by clicking on the quick link *Operating System Download* on the website of the corresponding HMI.

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12.1 Updating the operating system of an HMI

Introduction

This chapter describes how to update the OS of the JVM-104. There are several options to transfer the OS file to the device:

- From within the programming tool JetSym
- Via FTP connection
- Via JCM system
- Via directory *\App*

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OS update by means of JetSym

Introduction

The programming tool JetSym offers an easy way to transfer an OS file to the JVM-104.

Prerequisites

- An OS file for the JVM-104 is available.
- The device is connected via Ethernet to the PC.
  The number of the device in the configuration memory is set as IP basic port number for JetIP communication.
- The controller must not be de-energized during the OS update process.

Updating the OS

To update the OS, proceed as follows:

Step	Action
1	Select in the JetSym menu **Build** the menu item **Update OS.** **Result:** The file selection dialog opens.
2	Select the new OS file here. **Result:** In JetSym, a confirmation dialog opens.
3	Launch the OS upload by clicking the button **Yes**.
4	Wait until the update process is completed.
5	To activate the transferred OS, re-boot the device.

Operating system update via FTP

Introduction

Using an FTP client an OS file can be transferred to the device JVM-104.

Prerequisites

- An OS file for the JVM-104 is available.
- An FTP connection to the device has been established.
- The operating system of the JVM-104 is running.
- The controller must not be de-energized during the OS update process.

Updating the OS

To update the OS, proceed as follows:

Step	Action
1	Establish an FTP connection to the JVM-104.
2	Log in with administrator rights.
3	Navigate to the directory *\App*.
4	Transfer the OS file.
5	Wait until the transfer process is completed.
6	Use a text editor and create on your PC a configuration file named config.ini.
7	Enter into this file the path and the name of the OS file on the device, e.g. **\app\jvm_ce0_1.00.0.07.os**.
8	Copy this file into the directory *\App*.
9	Clear the FTP connection.
10	To activate the transferred OS, re-boot the device.
11	The new OS is being installed. Wait at least one minute.
12	Restart the device.

Operating system update via USB

Introduction

A USB flash drive lets you transfer an OS file to the device JVM-104.

Prerequisites

- An OS file for the JVM-104 is available.
- The operating system of the JVM-104 as of version 4.01.0.44 is running.
- The controller must not be de-energized during the OS update process.

Contents of the batch file

The batch file **autostart.bat** must have the following contents:

```
@echo off
if not exist \app\autostart.exe goto end
if exist \app\update.ini goto end
if exist \app\usb_update_process_marker goto dm
\app\sys\testregistry AUTOSTART AutoCopy == 0
if ERRORLEVEL 1 goto end
echo \data\update\jvm_ce0_1.00.0.04.os >\app\update.ini
if not exist \data\update md \data\update
@cmd /c start \App\sys\jvcm_si 102
copy \%1\jvm_ce0_1.00.0.04.os \data\update\jvm_ce0_1.00.0.04.os
echo >\app\usb_update_process_marker
del \System\reset.exe
goto end
:dm
del \app\usb_update_process_marker
:end
```

When using devices **without** any operating keys, you must delete the following commands from the batch file **autostart.bat**.

```
\app\sys\testregistry AUTOSTART AutoCopy == 0
if ERRORLEVEL 1 goto end
```

Updating the OS

To update the OS of devices being equipped **with** keys, proceed as follows:

Step	Action
1	Copy the OS file to your USB flash drive. This drive must be FAT formatted.
2	Create a batch file on the USB flash drive and name it **autostart.bat**. Contents of the batch file: See above.
3	Replace all entries **jvm_ce0_1.00.0.04** with the actual name of the OS file.
4	Switch the device JVM-104 OFF.
5	Insert the USB flash drive into the JVM-104.
6	Switch the device JVM-104 ON.
7	Simultaneously press the first and the third key before starting the application program.

Step	Action
⇨	The device switches to update mode and displays the following dialog text: *Please select update source:* *Press [F1] for USB update | Press [F3] for SD update*
8	Press the corresponding key.
⇨	The device continues the dialog as follows: *Preparing update* *Please do not remove the update device* *Update will be performed after restart*
⇨	About 10 seconds later the device automatically launches the update process.
⇨	When the update is completed, the device displays the following text: *Update completed* *Please wait*
⇨	Now, the device automatically reboots and starts the application.

To update the OS of devices **without** keys, proceed as follows:

Step	Action
1	Copy the OS file to your USB flash drive. This drive must be FAT formatted.
2	Create a batch file on the USB flash drive and name it **autostart.bat**. Contents of the batch file: See above.
3	Replace all entries **jvm_ce0_1.00.0.04** with the actual name of the OS file.
4	Insert the USB flash drive into the JVM-104. This can be done while the device is running.

Result: The OS is being installed.

Update - Chronological order

The table below lists the update steps in chronological order:

Step	Description
1	The files are transferred.
2	The device is reset.
3	The files are installed.
4	The device is reset.
5	The application appears.

Log file for documentation purposes	The update process is documented in the file **\App\update.log**.

OS update via website of the device

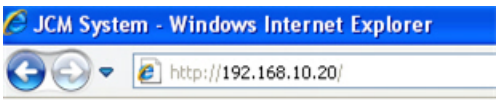
Introduction

The device web site in Internet Explorer shows all properties and version numbers of your device. It also lets you configure the Ethernet and the CANopen® interfaces.

Accessing the device web site

To have the device web site displayed on your PC, enter the **current** IP address of the device in the Internet Explorer.

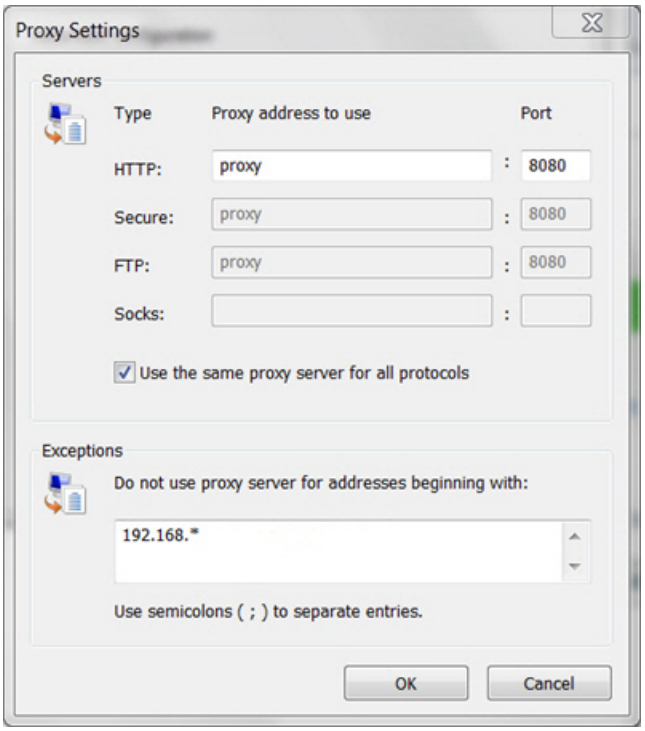
Example:



Prerequisites

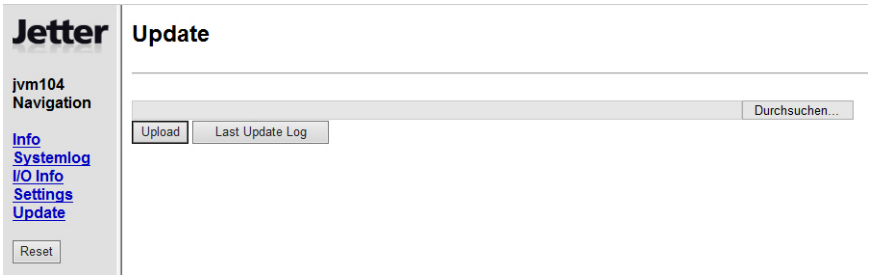
To enter the IP address in the range of exceptions of the Internet Explorer, proceed as follows:

Step	Action
1	Click menu item **Tools** and open the dialog **Internet options**.
2	Go to tab **Connections** and click the button **LAN settings.**
3	In section **Proxy Server** click the button **Advanced**.
⇨	The dialog **Proxy Settings** opens.
4	In the **Exceptions** pane of the dialog **Proxy Settings,** enter IP address **192.168.***, as is shown in the illustration below.



Update page

The page **Update** lets you select an OS file (*Browse...*) and copy it to the device (*Upload*).



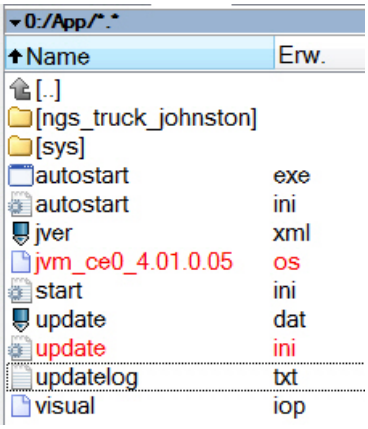
If you click the button **Last Update Log**, the history of the last update is displayed. This lets you detect possible errors.

Operating system update via \App

Procedure

Copying update files into the directory *\App* lets you easily update the operating system. To update the OS, proceed as follows:

Step	Action
1	Enter the name of the file collection into the file **update.ini**. Otherwise the update will not work.
2	Copy the file collection or OS and the file **update.ini** into the directory *\App*.
3	Restart the device.
⇨	**Autostart.exe** detects the update during the boot process, installs the files and restarts the device. **Important!** Do not interrupt this process.
4	Open the file **updatelog.txt** to make sure that the update has completed without errors.



13 Application program

Introduction

This chapter describes how to store the application program in JVM-104. The user determines the program that is to be executed.

Required programmer's skills

This chapter requires knowledge on how to create application programs in JetSym and how to transmit them via the file system of the JVM-104.

Contents

Topic	Page
Application program - Default path	258
Loading an application program	259

Application program - Default path

Introduction

When uploading the application program from JetSym to the controller, this program is stored as a file to the internal flash disk. The device enters the path and file name into the file **\App\start.ini**.

Path and file name

In the directory *\App*, JetSym, by default, creates a subdirectory and assigns the project name to it. Then, JetSym stores the application program to this subdirectory assigning the extension **.es3** to it. Path and file names are always converted into lower case letters.

\App\start.ini - Structure

This file is a text file with one section holding two entries:

Element	Description
[Startup]	Section name
Project	Path to the application program file, relative to *\App*
Program	Name of the application program file

Example:

```
[Startup]
Project = test_program
Program = test_program.es3
```

Result: The application program is loaded from the file **\App\test_program\test_program.es3**.

Loading an application program

Introduction

At reboot of the application program via JetSym or booting the JVM-104, the application program is loaded and executed via the file system.

Loading process

The application program is loaded by the JVM-104's OS as follows:

Step	Description
1	The OS reads the file **/App/start.ini** from the internal flash disk.
2	The OS evaluates the **Project** entry. It contains the path leading to the application program file.
3	The OS evaluates the **Program** entry. It contains the program name.
4	The OS loads the application program from the file **<Project>\<Program>**.

14 Quick reference JVM-104

Corresponding OS version

This quick reference summarizes in brief the registers and flags of the HMI JVM-104 running OS version 4.01.

Default address on the CANopen® bus

Default address of the JVM-104:
Node ID: 127 (0x7F)

Maximum number of CANopen® interfaces

Maximum number of CAN interfaces: 1
CANMAX: 0

Maximum number of SAE J1939 interfaces

Maximum number of CAN interfaces: 0
CANMAX: 0

Registers - General overview

100000 ... 100999	Electronic Data Sheet (EDS)
101000 ... 101999	Configuration
104000 ... 104999	Ethernet
106000 ... 106999	CAN
108000 ... 108999	CPU/backplane
200000 ... 209999	General system registers
210000 ... 219999	Application program
230000 ... 239999	Networking via JetIP
260000 ... 269999	RemoteScan
270000 ... 279999	Modbus/TCP
290000 ... 299999	E-mail
310000 ... 319999	File system/data files
350000 ... 359999	User-programmable IP interface
360000 ... 369999	Display
1000000 ... 1029999	Application registers (remanent)

I/Os - General overview

Input keys

361000 ... 361007	Bit-coded map of input keys

Flags - General overview

0 ... 255	Application flags (remanent)
256 ... 2047	Overlaid by registers R 1000000 through 1000055
2048 ... 2303	Special flags

Electronic Data Sheet (EDS)

100500	Interface (0 = CPU, 4 = Base board)
100600	Internal version number
100601	Module ID
100602 ...	Module name (register string)
100612	
100613	PCB revision
100614	PCB options

Production

100700	Internal version number
100701 ...	Serial number (register string)
100707	
100708	Day
100709	Month
100710	Year
100711	TestNum.
100712	TestRev.

Features

100800	Internal version number
100801	MAC Address (Jetter)
100802	MAC address (device)

Electronic name plate (device as a whole)

Production

100900	Internal version number
100901 ...	Serial number (register string)
100907	
100708	Day
100709	Month
100710	Year
100950	Internal version number
100951	Module ID
100952 ...	Module name (register string)
100962	
100965	Config ID
100966	Vendor ID
100967	Variant ID
100968	Type ID
100992	Navision ID
100993	FBG version

Configuration

From system configuration

101100	IP address (rw - remanent)
101101	Subnet mask (rw - remanent)
101102	Default gateway (rw - remanent)

Used by the system

101200	IP address
101201	Subnet mask
101202	Default gateway

Ethernet

IP

104531	Current IP address (rw - temporary)
104532	Current subnet mask (rw - temporary)
104533	Current default gateway (rw - temporary)

CAN

106000	Baud rate CAN 1
106001	Node ID CAN 1

Flash memory

107501	30: Read present flash disk statistics 99: Clear flash disk statistics
107510	Available sectors
107511	Used sectors
107512	Blocked sectors
107513	Free sectors
107520	Size of the flash disk in bytes

107521	Used memory in bytes
107522	Blocked memory in bytes
107523	Free memory in bytes

CPU hardware

108015	Voltage of backup battery (e.g. for clock) 0 = Data not valid 1 = Supply voltage is OK Once the power supply has been restored, enter 1 into this register.

System information

108500 ... 108509	JetVM-DII version string
108510 ... 108519	Version string of the host application
108520 ... 108529	File name of the host application
108530 ... 108539	OS version (string)
108570	CPU type
108571	Number of CPUs
108573	Physical RAM
108574	Free physical RAM
108575	Memory utilization (in %)
108581	Screen width (in pixels)
108582	Screen height (in pixels)
108590	HID version

USB flash drive

109000	Bit 0 = 1: Data medium is available Bit 1 = 1: Data medium is ready
109001	1 = Data medium is write-protected (only valid if R 109000 = 3)
109002	Size in MBytes

General system registers

200000	OS version (major * 100 + minor)
200001	Application program is running (bit 0 = 1)
200008	Error register (identical with 210004) Bit 8: Illegal jump Bit 9: Illegal call Bit 10: Illegal index Bit 11: Illegal opcode Bit 12: Division by 0 Bit 13: Stack overflow Bit 14: Stack underflow Bit 15: Illegal stack Bit 16: Error when loading the application program Bit 24: Timeout - Cycle time Bit 25: Timeout - Task lock Bit 31: Unknown error
200168	Bootloader version (IP format)
200169	OS version (IP format)
201000	Runtime register in milliseconds (rw)
201001	Runtime register in seconds (rw)
201002	Runtime register in R 201003 Units (rw)
201003	* 10 ms units for R 201002 (rw)
201004	Runtime register in milliseconds (ro)
201005	Runtime registers in microseconds (ro)
202930	Web status (bit-coded) Bit 0 = 1: FTP server available Bit 1 = 1: HTTP server available Bit 2 = 1: E-mail available Bit 3 = 1: Data file function available Bit 4 = 1: Modbus/TCP has been licensed Bit 5 = 1: Modbus/TCP available Bit 6 = 1: Ethernet/IP available
202960	Password for system command register (0x424f6f74)
202961	System command register
202980	Error history: Number of entries
202981	Error history: Index
202982	Error history: Entry
203000	Interface monitoring: JetIP
203005	Interface monitoring: Debug server
203100 ... 203107	32-bit overlaying - Flag 0 ... 255
203108 ... 203123	16-bit overlaying - Flag 0 ... 255
203124 ... 203131	32-bit overlaying - Flag 2048 ... 2303
203132 ... 203147	16-bit overlaying - Flag 2048 ... 2303
209700	System logger: Global enable
209701 ... 209739	Enabling system components

Application program

210000	Application program is running (bit 0 = 1)
210001	JetVM version
210004	Error register (bit-coded) Bit 8: Illegal jump Bit 9: Illegal call Bit 10: Illegal index Bit 11: Illegal opcode Bit 12: Division by 0 Bit 13: Stack overflow Bit 14: Stack underflow Bit 15: Illegal stack Bit 16: Error when loading the application program Bit 24: Timeout - cycle time Bit 25: Timeout - task lock Bit 31: Unknown error
210006	Highest task number
210007	Minimum program cycle time
210008	Maximum program cycle time
210009	Current program cycle time
210011	Current task number
210050	Current program position within an execution unit
210051	ID of the execution unit being processed
210056	Desired total cycle time in µs
210057	Calculated total cycle time in µs
210058	Maximum time slice per task in µs
210060	Task ID (for R210061)
210061	Priority for task [R210060]
210063	Length of scheduler table

210064	Index in scheduler table
210065	Task ID in scheduler table
210070	Task ID (for R210071)
210071	Timer number (0 ... 31)
210072	Manual triggering of a timer event (bit-coded)
210073	End of cyclic task (task ID)
210074	Command for cyclic tasks
210075	Number of timers
210076	Timer number (for R210077)
210077	Timer value in milliseconds
210100 ... 210199	Task state
210400 ... 210499	Task - Program address
210600	Task ID of a cyclical task (for R210601)
210601	Processing time of a cyclical task in per mil figure
210609	Task lock timeout in ms -1: Monitoring disabled
210610	Timeout (bit-coded) Bit 0 -> Timer 0, etc.

Networking via JetIP

230000	JetIP/TCP server: Number of open connections
230001	JetIP/TCP server: Mode
230002	JetIP/TCP server: Time
232708	Timeout in milliseconds
232709	Response time in milliseconds
232710	Amount of network errors
232711	Error code of last access 0 = No error 1 = Timeout 3 = Error message of the remote station 5 = Invalid network address 6 = Invalid amount of registers 7 = Invalid interface number
232717	Max. number of retries
232718	Number of retries

Modbus/TCP

272702	Register offset
272704	Input offset
272705	Output offset
278000 ... 278999	16-bit I/O registers overlaid by virtual I/Os 20001 ... 36000

E-mail

292932	IP address of the SMTP server
292933	IP address of the POP3 server
292934	Port number of the SMTP server
292935	Port number of POP3 server
292937	Status of e-mail processing
292938	Task ID - E-mail

File system/data file function

312977	Status of file operation
312978	Task ID

User-programmable IP interface

Reading out the connection list

350000	Last result (-1 = no connection selected)
350001	1 = Client; 2 = Server
350002	1 = UDP; 2 = TCP
350003	IP address
350004	Port number
350005	Connection state
350006	Number of sent bytes
350007	Number of received bytes

Application registers

1000000 ... 1005999	32-bit integer (remanent)

CAN-PRIM registers

200010500	CAN-PRIM status
200010501	CAN-PRIM command register
200010502	Message box number
200010503	FIFO buffer occupancy
200010504	FIFO data
200010506	Global receiving mask
200010507	Global receive ID
200010510	Box status register
200010511	Box configuration register
200010512	CAN ID
200010513	Number of data bytes
200010514 ... 200010521	Data bytes

Display

Input keys

361000 ... 361007	Bit-coded map of input keys e.g. bit 0 1 = Key 1 is pressed
361000.0	KEY_OK
361000.1	KEY_ESC
361000.2	KEY_DOWN
361000.3	KEY_UP

Ignition (IGN)

361100	Bit 0: 0 = Ignition ON 1 = Ignition OFF

Digipot

363000	Present count value
363001	Digipot key
363002	Minimum count value
363003	Maximum count value

Display

364000	Background lighting
364001	Night-lighting of keys
364003	Brightness sensor

Visualization

365100	Language selection according to ID

Special flags for networks

2075	Error in networking via JetIP

Special flags - Interface monitoring

2088	OS flag - JetIP
2089	User flag - JetIP
2098	OS flag - Debug server
2099	User flag - Debug server

32 combined flags

203100	0 ... 31
203101	32 ... 63
203102	64 ... 95
203103	96 ... 127
203104	128 ... 159
203105	160 ... 191
203106	192 ... 223
203107	224 ... 255

16 combined flags

203108	0 ... 15
203109	16 ... 31
203110	32 ... 47
203111	48 ... 63
203112	64 ... 79
203113	80 ... 95
203114	96 ... 111
203115	112 ... 127
203116	128 ... 143
203117	144 ... 159
203118	160 ... 175
203119	176 ... 191
203120	192 ... 207
203121	208 ... 223
203122	224 ... 239
203123	240 ... 255

32 combined special flags

203124	2048 ... 2079
203125	2080 ... 2111
203126	2112 ... 2143
203127	2144 ... 2175
203128	2176 ... 2207
203129	2208 ... 2239
203130	2240 ... 2271
203131	2272 ... 2303

16 combined special flags

203132	2048 ... 2063
203133	2064 ... 2079
203134	2080 ... 2095
203135	2096 ... 2111
203136	2112 ... 2127
203137	2128 ... 2143
203138	2144 ... 2159
203139	2160 ... 2175
203140	2176 ... 2191
203141	2192 ... 2207
203142	2208 ... 2223
203143	2224 ... 2239
203144	2240 ... 2255
203145	2256 ... 2271
203146	2272 ... 2287
203147	2288 ... 2303

Overlaid application registers/flags

1000000	256 ... 287
1000001	288 ... 319
1000002	320 ... 351
1000003	352 ... 383
1000004	384 ... 415
1000005	416 ... 447
1000006	448 ... 479
1000007	480 ... 511
1000008	512 ... 543
1000009	544 ... 575
1000010	576 ... 607
1000011	608 ... 639
1000012	640 ... 671
1000013	672 ... 703
1000014	704 ... 735
1000015	736 ... 767
1000016	768 ... 799
1000017	800 ... 831
1000018	832 ... 863
1000019	864 ... 895
1000020	896 ... 927
1000021	928 ... 959
1000022	960 ... 991
1000023	992 ... 1023
1000024	1024 ... 1055
1000025	1056 ... 1087
1000026	1088 ... 1119
1000027	1120 ... 1151
1000028	1152 ... 1183
1000029	1184 ... 1215
1000030	1216 ... 1247
1000031	1248 ... 1279
1000032	1280 ... 1311
1000033	1312 ... 1343
1000034	1344 ... 1375
1000035	1376 ... 1407
1000036	1408 ... 1439
1000037	1440 ... 1471
1000038	1472 ... 1503
1000039	1504 ... 1535
1000040	1536 ... 1567
1000041	1568 ... 1599
1000042	1600 ... 1631
1000043	1632 ... 1663
1000044	1664 ... 1695
1000045	1696 ... 1727
1000046	1728 ... 1759
1000047	1760 ... 1791
1000048	1792 ... 1823
1000049	1824 ... 1855
1000050	1856 ... 1887
1000051	1888 ... 1919
1000052	1920 ... 1951
1000053	1952 ... 1983
1000054	1984 ... 2015
1000055	2016 ... 2047

System function

For reasons of compatibility, the system functions are listed below. In JetSym STX, use the corresponding JetSym STX functions instead of system functions.

4	Conversion from BCD to HEX
5	Conversion from HEX to BCD
20	Square root
21	Sine
22	Cosine
23	Tangent
24	Arc sine
25	Arc cosine
26	Arc tangent
27	Exponential function
28	Natural logarithm
29	Absolute value
30	Separation of digits before and after the decimal point
50	Sorting register values
60	CRC generation for Modbus RTU
61	CRC check for Modbus RTU
65/67	Reading register block via Modbus/TCP
66/68	Writing register block via Modbus/TCP
80/85	Initializing RemoteScan
81	Starting RemoteScan
82	Stopping RemoteScan
90	Writing a data file
91	Appending a data file
92	Reading a data file
96	Deleting a data file
110	Sending an e-mail
150	Configuring NetCopyList
151	Deleting NetCopyList
152	Sending NetCopyList

JetSym STX functions

System function	Corresponding JetSym STX function
4	Function Bcd2Hex(Bcd: Int): Int;
5	Function Hex2Bcd(Hex: Int): Int;
50	Function QSort(DataPtr: Int, ElementCnt: Int, ElementSize: Int, SortOffset: Int, SortType: STXBASETYPE, SortMode: QSORTMODE): Int;
60	Function ModbusCRCgen(FramePtr: Int, Length: Int): Int;
61	Function ModbusCRCcheck(FramePtr: Int, Length: Int): Int;
65/67	Function ModbusReadReg(Const Ref MbParam: MODBUS_PARAM): Int;
66/68	Function ModbusWriteReg(Const Ref MbParam: MODBUS_PARAM): Int;
80/85	Function RemoteScanConfig(Protocol: RSCAN_PROTOCOL, Elements: Int, Const Ref Configuration: RSCAN_DSCR): Int;
81	Function RemoteScanStart(Protocol: Int): Int;
82	Function RemoteScanStop(Protocol: Int): Int;
90/91	Function FileDAWrite(Const Ref FileName: String, Const Ref Mode: String, VarType: DAWRITE_TYPE, First: Int, Last: Int): Int;
92	Function FileDARead(Const Ref FileName: String): Int;
110	Function EmailSend(Const Ref FileName: String): Int;
150	Function NetCopyListConfig(IPAddr: Int, IPPort: Int, Const Ref List: TNetCopyLinstL): Int;
151	Function NetCopyListSend(Handle: Int): Int;
152	Function NetCopyListDelete(Handle: Int): Int;

15 Quick reference of JVM-104 - Multi-purpose inputs/outputs

Corresponding OS version

This quick reference summarizes the registers of the **multi-purpose I/Os** on the JVM-104 from OS version 4.01 or higher.

Registers - General overview

General registers of the internal I/O board

601000000	Hardware identification
601000001	Hardware version (displayed in IP format)
601000003	Software version (displayed in IP format)
601000013	Complete the number of CRC errors
601000014	Number of firmware errors since the last restart
601000015	CPU temperature in 1 °C
601000016	Voltage supply of logic circuit in mV
601000020	Error code of the device
601000021	Software module being the source of the error

Multi-purpose input MFQE1

601010000	Status MFQE1
601010001	Command MFQE1
601010002	Analog value in µA/mV
601010003	Frequency [gate time]/period [µs]/count value [increments]
601010004	Digital value at the input
601010005	Gate time in ms within frequency metering

Multi-purpose input MFQE2

601020000	Status MFQE2
601020001	Command MFQE2
601020002	Analog value in µA/mV
601020003	Frequency [gate time]/period [µs]/count value [increments]
601020004	Digital value at the input
601020005	Gate time in ms within frequency metering

Multi-purpose output PA1

601030000	Status PA1
601030001	Command PA1
601030002	PWM pulse control factor (duty cycle) in steps of 0.1 %
601030004	Digital value at the output
601030005	Measured current PA1 in mA
601030006	PWM frequency in Hz
601030007	Adjustable overcurrent limit in mA

Multi-purpose output PA2

601040000	Status PA2
601040001	Command PA2
601040002	PWM pulse control factor (duty cycle) in steps of 0.1 %
601040004	Digital value at the output
601040005	Measured current PA2 in mA
601040006	PWM frequency in Hz
601040007	Adjustable overcurrent limit in mA

Multi-purpose output PA3

601050000	Status PA3
601050001	Command PA3
601050002	PWM pulse control factor (duty cycle) in steps of 0.1 %
601050004	Digital value at the output
601050005	Measured current PA3 in mA
601050006	PWM frequency in Hz
601050007	Adjustable overcurrent limit in mA

Multi-purpose output PA4

601060000	Status PA4
601060001	Command PA4
601060002	PWM pulse control factor (duty cycle) in steps of 0.1 %
601060004	Digital value at the output
601060005	Measured current PA4 in mA
601060006	PWM frequency in Hz
601060007	Adjustable overcurrent limit in mA

Multi-purpose input MFQEx

Placeholders are used for these register numbers.
The following rule applies:
x = 1 for multi-purpose output 1 (as of 601010000)
x = 2 for multi-purpose output 2 (as of 601020000)

6010x0000	**Status**	
	Bit 0 = 1:	Overcurrent triggered by current > 2500 mA in the current measuring mode
	Bit 7 = 1:	Overtemperature
	Bit 14 = 0:	Multi-purpose input MFQE1 is active
	Bit 14 = 1:	Multi-purpose input MFQE1 is deactivated
6010x0001	**Commands, bit-coded**	
	Bit 7 ... 4:	
	0000	Frequency measurement using gate time
	0011	Counting mode
	0100	Period time measuring, 10 s timeout
	0101	Period time measuring, 10 s timeout
	0110	Period time measuring, 100 ms timeout
	Bit 9:	
	0	Voltage measuring
	1	Current measuring
	Bit 12:	
	0	Deactivate pull-up resistor
	1	Activate pull-up resistor
6010x0002	Analog value in µV/mA	
6010x0003	Frequency [gate time]/period [µs]/count value [increments]	
6010x0004	Digital value at the input	
6010x0005	Gate time in ms within frequency metering	

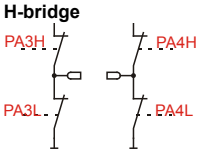
Multi-purpose output PA1 ... PA4

Placeholders are used for these register numbers. If, for example, two similar functions are shifted by an offset, searching becomes easier.
The following rule applies:
x = 3 for multi-purpose output 1 (as of 601030000)
x = 4 for multi-purpose output 2 (as of 601040000)
x = 5 for multi-purpose output 3 (as of 601050000)
x = 6 for multi-purpose output 4 (as of 601060000)

6010x0000	**Status**	
	Bit 0 = 1:	Overcurrent of H-side
	Bit 3 = 1:	Overcurrent of L-side
	Bit 6 = 1:	Cable breakage (open load)
	Bit 7 = 1:	Overtemperature
	Bit 14 = 0:	Multi-purpose output PAx is active
	Bit 14 = 1:	Multi-purpose output PAx is deactived
	Bit 15 = 1:	Hardware protection has tripped
6010x0001	**Commands, bit-coded**	
	Bit 1 ... 0:	

	00	Activate output as digital output x
	01	Activate output as PWM output x
	Bit 3 ... 2	
	00	Output PAx as input
	01	Output PAx as low-side output
	10	Output PAx as high-side output
	11	Output PAx as low-side output
	Bit 15:	
	0	Activate output PAx
	1	Deactivate output PAx
6010x0002	PWM pulse control factor (duty cycle) in steps of 0.1 %	
6010x0004	Digital value at output PAx	
6010x0005	Measured current PAx in mA	
6010x0006	PWM frequency in Hz	
6010x0007	Adjustable overcurrent limit in mA	

H-bridge



H-bridge outputs	
PA3H	Output 1
PA3L	Output 1
PA4H	Output 2
PA4L	Output 2

H-bridge, clockwise rotation:
Steps

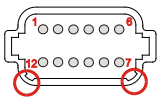
1	PA3: Activate low-side output: R 601050001 :=0x0005;
2	PA3: Set PWM pulse control factor (duty cycle) to 100 %: R 601050002 := 1000;
3	PA4: Activate high-side output: R 601060001 :=0x0009;
4	PA4: Set pulse control factor (duty cycle) to 50 %: R 601060002 := 500;

H-bridge, anti-clockwise rotation
Steps

1	PA4: Activate low-side output: R 601060001 :=0x0005;
2	PA4: Set PWM pulse control factor (duty cycle) to 100 %: R 601060002 := 1000;
3	PA3: Activate high-side output: R 601050001 :=0x0009;
4	PA4: Set pulse control factor (duty cycle) to 50 %: R 601050002 := 500;

Assignment: 12-pin DEUTSCH connector DT06-12S

View on the rear side of the HMI



Pin	Description
1	Reference potential (GND)
2	Multi-purpose output PA1
3	Multi-purpose output PA2
4	Multi-purpose output PA3
5	Multi-purpose output PA4
6	Power supply UB for logic circuits Voltage: DC 12 V or DC 24 V Maximum current: 2 A
7	Power supply UB_PA for multi-purpose outputs Voltage: DC 12 V or DC 24 V Maximum current: 10 A
8	Ignition
9	CAN_1_L
10	CAN_1_H
11	Multi-purpose input MFQE1
12	Multi-purpose input MFQE2

Appendix

Introduction

This appendix contains electrical and mechanical data, as well as operating data.

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A: Interfaces

Introduction

The HMI JVM-104 is equipped with the following interfaces:

- DEUTSCH connector
- Ethernet port
- USB port

DEUTSCH connector

The DEUTSCH connector has the following functions:

- Power supply of the JVM-104
- Power supply for higher load currents
- Multi-purpose inputs
- Multi-purpose outputs
- CANopen® bus interface: CAN 1
- Recognition of the ignition

Ethernet port

The function of the RJ45 jack is as follows:

- Ethernet port to a PC
- Ethernet port to other devices, such as a controller

USB port

The USB port serves the following purposes:

- Updating the system via USB flash drive
- Interface for USB flash drives providing additional memory
- Interface for USB devices, such as mouse or keyboard

Contents

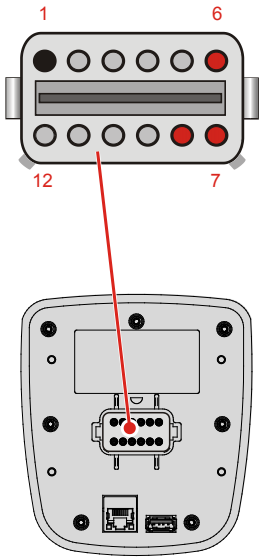
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Pinout - Overview

Power supply

This chapter describes the pinout of the connector for the power supply.

The diagram shows the pinout of the power supply and ignition connector (viewing the cable side):



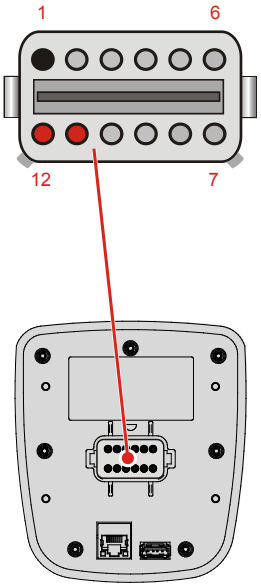
The pinout is as follows:

Pin	Description	Terminal number in vehicles
1	Reference potential (GND)	Terminal # 31
6	Power supply UB for logic circuits Voltage: DC 12 V or DC 24 V Power consumption: 2 A max.	Terminal # 30
7	Power supply UB_PA for multi-purpose outputs of the HMI Voltage: DC 12 V or DC 24 V Power consumption: 10 A max.	Terminal # 30
8	Ignition (+)	Terminal # 15

Multi-purpose inputs

This chapter describes the pinout of the connector for the multi-purpose inputs.

The diagram shows the pinout of the connector for the multi-purpose inputs (viewing the cable side): Pin 1 for the reference potential is also color-coded.



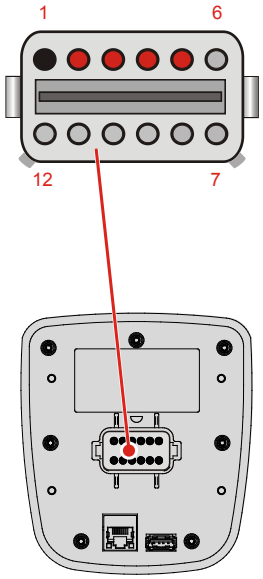
The pinout is as follows:

Pin	Description
1	Reference potential (GND)
11	Multi-purpose input MFQE1
12	Multi-purpose input MFQE2

Multi-purpose outputs

This chapter describes the pinout of the connector for the multi-purpose outputs.

The diagram shows the pinout of the connector for the multi-purpose outputs (viewing the cable side): Pin 1 for the reference potential is also color-coded.



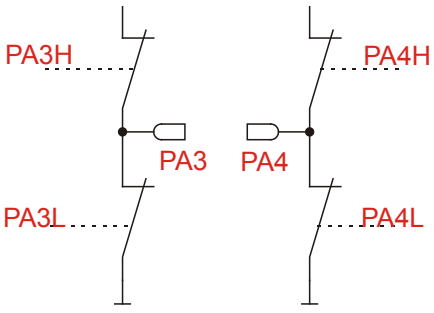
The pinout is as follows:

Pin	Description
1	Reference potential (GND)
2	Multi-purpose output PA1
3	Multi-purpose output PA2
4	Multi-purpose output PA3
5	Multi-purpose output PA4

Pinout of the H-bridge

The H-bridge is assigned to the following outputs:

- Multi-purpose output PA3
- Multi-purpose output PA4

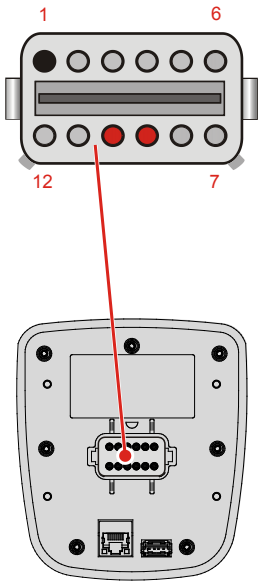


When setting up the program, switch PA3H and PA4L and PA4H and PA3L to the desired direction, that is, anti- clockwise and clockwise.

CAN interface

This chapter describes the pinout of the connector for the CAN interface.

The diagram shows the pinout of the connector for the CANopen® bus (viewing the cable side): Pin 1 for the reference potential is also color-coded.



The pinout is as follows:

Pin	Description
1	Reference potential (GND)
9	CAN_1_L
10	CAN_1_H

B: Technical data

Introduction

This chapter contains information on electrical and mechanical data, as well as on operating data of the JVM-104.

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Technical specifications

Technical specifications - Power supply UB

Parameter	Description
Rated voltage	DC 12 V or DC 24 V
Permissible voltage range UB	DC 8 V ... DC 32 V, to ISO 7637
Permissible voltage range - Ignition	DC 5 V ... DC 32 V
Maximum current	2 A
Load dump protection	DC 70 V max.
Typical current consumption logic circuit (UB)	170 mA at DC 12 V 90 mA at DC 24 V
Power consumption	Approx. 2 W
Integrated protective functions	Protection against polarity reversal, overloading, voltage surges

Technical specifications - Display

Parameter	Description
Display	3.5" TFT LCD flat screen monitor
Brightness	LED backlight (white), typ. 350 cd/m^2
Display resolution	320 x 240 pixels

Technical specifications - CAN interface

Parameter	Description
Baud rate	250 kBaud ... 1 MBaud
Bus terminating resistor	None
External bus termination	120 Ω
Connector specifications	Twisted pair conductors, unshielded

Max. number of CANopen® ports

Parameter	Description
Max. number of CAN ports	1
CANMAX	0

Max. number of SAEJ1939 ports

Parameter	Description
Max. number of CAN ports	0
CANMAX	0

Technical specifications - USB flash drive

Parameter	Description
Power supply	5 V, 500 mA max.
USB port	USB host interface, USB 2.0
Short-circuit capability	Yes Transient short-circuit current: ~ 0.8 A

Technical specifications - Ethernet

Parameter	Description
Type of terminal	RJ45 Ethernet jack
Number of ports	1
Bit rate	10 Mbit/s, 100 Mbit/s
Auto-crossover	Yes

Memory configurations

Parameter	Description
Number of remanent registers	30,000
Remanent memory for variables	120,000 bytes
Flash disk: Total memory Folder **App** Folder **Data**	 512 MBytes 64 MBytes 368 MBytes

Multi-purpose inputs/outputs - Technical specifications

Technical specifications - Voltage supply UB_PA

Parameter	Description
Rated voltage	DC 12 V or DC 24 V
Permissible voltage range UB_PA	DC 8 V ... DC 32 V
Permissible voltage range - Ignition	DC 5 V ... DC 32 V
Maximum current	10 A
Load dump protection	DC 70 V max.
Integrated protective functions	Protection against polarity reversal

Technical specifications - Digital inputs, MFQE

Parameter	Description
Type of inputs	Active-high input
Operating point ON:	2.0 V min.
Operating point OFF:	1.0 V max.
Input resistance	50 kΩ
Maximum input frequency	1 Hz
NAMUR sensor evaluation	To be activated via software
Electrical isolation	None

Technical specifications - Voltage measuring

Parameter	Description
Measuring range	DC 0 V ... DC 15 V
Input resistance	50 kΩ
Resolution	12 bits
Electrical isolation	None

Technical specifications - Current measuring

Parameter	Description
Measuring range	DC 0 mA ... DC 20 mA
Sensing resistor	120 Ω
Resolution	12 bits
Overcurrent trip	Yes
Electrical isolation	None

Technical specifications - Frequency measurement

Parameter	Description
Measuring range	0.1 Hz ... 10 kHz
Accuracy	99.9 %
Input resistance	20 kΩ
Typical input current	1 mA max.
Maximum input frequency	10 kHz max.
Period measurement resolution:	1 µs
Adjustable gate times for gate time measuring	1 ms ... 10 s
Duty cycle frequency input	35 µs min.
Operating point ON:	4.7 V min.
Operating point OFF:	2.5 V max.

Technical specifications - Counting function

Parameter	Description
Measuring range	0.1 Hz ... 10 kHz
Resolution	0.1 %
Counting range	32 bits
Operating point ON:	4.7 V min.
Operating point OFF:	2.5 V max.

Technical specifications - Digital input PAx

Parameter	Description
Type of input	Active-high input
Rated voltage	UB_PA - 10 %
Operating point ON:	DC 1.6 V max., > 3.5 mA
Operating point OFF:	DC 4.0 V min., < 0.5 mA
Internal pull-up resistor	NAMUR: 1 kΩ, 8.2 V
Electrical isolation	None

Technical specifications - Digital output

Parameter	Description
Maximum output current per channel	2.5 A
Rated voltage	Supply voltage UB_PA
Diagnostics	Overcurrent, short circuit, cable breakage
Overcurrent evaluation	Adjustable currenttrip
Maximum latency: Switching between output and input	500 ms
Maximum total current	The total current of all outputs must not exceed 8 A.Otherwise it is cut off after 500 ms. If the total current exceeds 10.5 A, the outputs shut off immediately.

Technical specifications - PWM output

Parameter	Description
PWM frequency	100 Hz ... 1 kHz
Resolution of pulse control factor (duty cycle)	0.1 %
Accuracy of pulse control factor (duty cycle)	+/- 42 ns
Maximum rated voltage	Supply voltage UB_PA
Switching frequency	100 Hz ... 1kHz
Protective circuitry	Overvoltage, overcurrent
Diagnostics	Overcurrent, cable breakage
Maximum total current	The total current of all outputs must not exceed 8 A. Otherwise it is cut off after 500 ms. If the total current exceeds 10.5 A, the outputs shut off immediately.

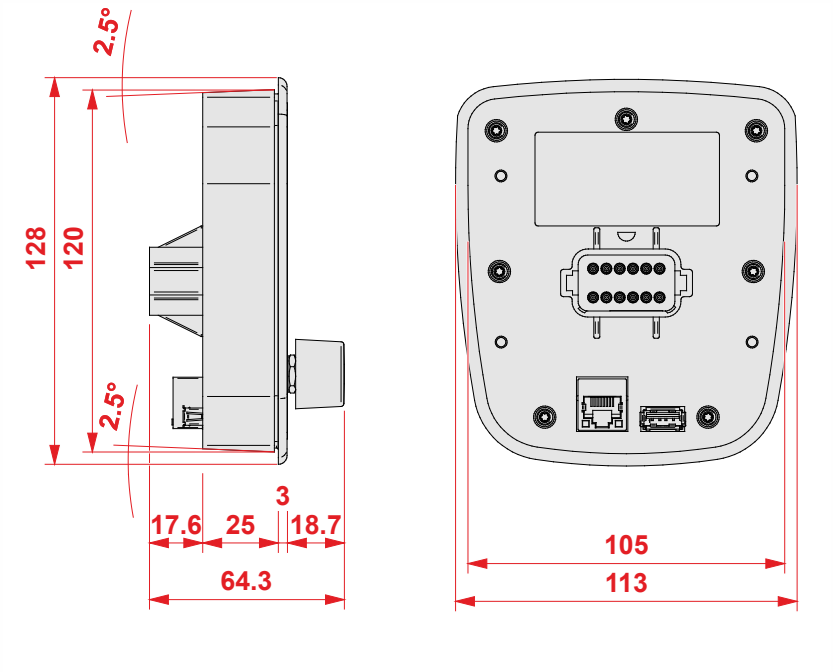
Technical specifications - H-bridge

Parameter	Description
Maximum rated current	Battery voltage, DC 32 V max.
Maximum output current	2.5 A
Peak current	~ 5 A, max. 500 ms
Current measuring accuracy	+/- 20 %
Switching frequency (1/period length)	100 Hz ... 1 kHz
Frequency accuracy	+/- 42 ns
Resolution of pulse control factor (duty cycle)	0.1 %
Diagnostics	Overcurrent

Physical dimensions

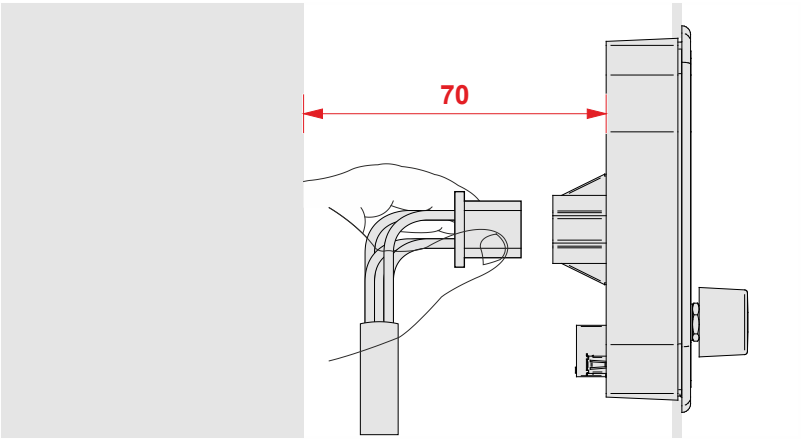
Physical dimensions

The illustration below shows the physical dimensions of the JVM-104 in millimeters.



Space required for installation and service

The illustration shows the space required for the HMI JVM-104. It is stated in millimeters.



Ensure there is enough space around the housing for servicing requirements.

- It should be possible to disconnect the connectors at any time.

Operating parameters - Environment and mechanics

Environment

Parameter	Value	Standard
Operating temperature range	-20 ... +60 °C	
Storage temperature range	-20 ... +70 °C	ISO 16750-4 DIN EN 60068-2-1 DIN EN 60068-2-2
Air humidity	10 ... 95 % Do not use a steam jet or other such devices to clean the JVM-104.	DIN EN 61131-2
Climate test	Humid heat	ISO 16750-4
Pollution degree	2	DIN EN 61131-2
Installation location	The JVM-104 must be installed in the driver's cab.	

Mechanical parameters

Parameter	Value	Standard
Vibration	Broadband noise, 10 Hz/0.005 $(m/s^2)^2$/Hz 200 Hz/0.02 $(m/s^2)^2$/Hz 300 Hz/0.01 $(m/s^2)^2$/Hz 350 Hz/0.002 $(m/s^2)^2$/Hz Duration: 3x24 h	To DIN EN 60068-2-64
Shock resistance	Sinusoidal half wave, 30 g (300 m/s^2), 18 ms, 3 shocks in all 6 orientations	To DIN EN 60068-2-27
Degree of protection	Front: IP65 Rear: IP20	DIN EN 60529

Operating parameters - EMC

Voltage testing at UB and UB_PA

The voltage testing results comply with DIN EN 16750-2.

EMC - Emitted interference

Parameter	Value	Standard
Emitted interference to e1	Frequency band 400 ... 1,000 MHz, limit 63 dB (µV/m), constant	DIN EN 55025
Emitted interference to CE	0.15 ... 0.5 MHz, 66 ... 56 dB (µV) QP DC supply 0.5 ... 5 MHz, 56 dB (µV) QP 5 ... 30 MHz, 60 dB (µV) QP	DIN EN 55011-DC
	30 ... 230 MHz, 30/40 dB (µV/m) enclosure 230 ... 1,000 MHz, 37/47 dB (µV/m)	DIN EN 55011-HF

EMC - Immunity to interference

Parameter	Value	Standard
Immunity to interference to CE	10 V/m over 80 % of the frequency band	DIN EN 61000-4-3
	2/1 kV data 4/2 kV power	DIN EN 61000-4-4
	± 1 kV line/ground ± 0.5 kV line/line	DIN EN 61000-4-5
	10 V, 0.15 ... 80 MHz, 80 % AM sine 1 kHz	DIN EN 61000-4-6
ESD	Discharge through air: Test peak voltage 8 kV Contact discharge: Test peak voltage 4 kV	DIN EN 61000-4-2

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