JX3-MIX1

Multi-Purpose Expansion Module



User Manual

Jetter

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Assignment to Product

This User Manual is an integral part of JX3-MIX1:

Type: _____

Serial #: _____

Year of construction: _____

Order #: _____

CE

To be entered by the customer:

Inventory #: _____

Place of operation: _____

Significance

Significance of this User Manual

The User Manual is an integral part of the device JX3-MIX1:

- It must be kept in a way that it is always at hand, until the device JX3-MIX1 will be disposed of.
- If the device JX3-MIX1 is sold or loaned/leased out, the User Manual has to be passed on.

In any case you encounter difficulties to clearly understand this User Manual, please contact the manufacturer.

We would appreciate any suggestions and contributions on your part and would ask you to contact us by our e-mail address info@jetter.de. This will help us to produce manuals that are more user-friendly and to address your wishes and requirements.

This User Manual contains important information on how to transport, erect, install, operate, maintain and repair the JX3-MIX1.

Therefore, the persons carrying out these jobs must carefully read, understand and observe this User Manual, and especially the safety instructions.

Missing or inadequate knowledge of the User Manual results in the loss of any claim of liability on part of Jetter AG. Therefore, the operating company is recommended to have the instruction of the persons concerned confirmed in writing.

Hazard Levels

Introduction

This topic describes the safety labels and hazard levels used in this manual.

Safety Labels



Signs using this symbol are to warn you of inuries or even death. It is imperative to follow the instructions to prevent hazards.

Hazard Levels

Safety information is classified into the following hazard levels:

Hazard Level	Consequences	Probability
DANGER	Death/severe injury (irreversible)	The hazard is imminent
WARNING	Death/severe injury (irreversible)	Potential occurrence
CAUTION	Slight injury (reversible)	Potential occurrence
CAUTION	Material damage	Potential occurrence

Table of Contents

Hazard Levels 5

1 Safety Instructions 11

Basic Safety Instructions 12
Residual Dangers and Protective Measures 14
Instructions on EMC 15

2 Product Description and Design 17

JX3-MIX1 - Product Description 18
Order Reference / Options 21
Parts and Interfaces of the Module 22
Internal Block Diagrams 23
Minimum Requirements 25
Accessories for the JX3 System 27
Physical Dimensions 28

3 How to Identify the Module 29

Module Versions 30
Electronic Data Sheet (EDS) with JC-3xx 32
Electronic Data Sheet (EDS) with JC-24x 34
Electronic Data Sheet (EDS) with JC-647 and JX6-SB(-I) 36
Example: Reading Out an EDS with JC-3xx 38
Example: Reading Out an EDS with JC-24x 40
Identification by Means of Module Registers 42
Identification via Nameplate 43

4 Mounting and Installation 45

4.1 Interfaces 46
Terminal X61 - Pin Assignment 47
Assignment of Terminal X32 48
Connector Specification - Terminal X62 / X32 49
Connecting Analog Voltage Actuators 50
Connecting Analog Voltage Sensors 52
Connecting a Stepper Motor 54
Hardware Limit and Reference Switches 56
Connecting a Single-Channel Counter 57
Connecting a Dual-Channel Counter 59
4.2 Indicators and LEDs 62
LEDs of JX3-MIX1 Module 63
4.3 Installing, Replacing, and Removing the Module 66
Installing a JX3 Peripheral Module on a DIN Rail 67
Replacing a JX3 Peripheral Module 68
Removing a JX3 Peripheral Module from the DIN Rail 70

5 Initial Commissioning 73

Behavior After Power-Up 74

5.1 Initial Commissioning Along with a JC-3xx ... 75
Initial Commissioning: Analog Output ... 76
Initial Commissioning: Stepper Motor ... 77
Initial Commissioning of Multi-Purpose Inputs/Outputs ... 79
5.2 Initial Commissioning Along with a JC-24x ... 80
Initial Commissioning: Analog Output ... 81

6 Programming 83

Abbreviations, Module Register Properties and Formats ... 84
6.1 Register and I/O Numbering for JX3 Modules ... 86
Registers and Module Registers ... 87
I/O Module Numbers in the JX2 System Bus ... 88
Register and I/O Numbers with JC-24x and JM-D203-JC-24x ... 89
Register and I/O Numbers with JC-3xx ... 90
Register and I/O Numbers for JC-647 with JX6-SB(-I) ... 91
Register and I/O Numbers for JC-800 with JX6-SB(-I) ... 92
Register and I/O Numbers for JC-9xx with JX6-SB(-I) ... 93
6.2 Register Access to JX3 Modules on the JX2 System Bus ... 94
Direct Register Access to JX3 Modules in the JX2 System Bus ... 95
Example: Direct Register Access ... 96
Indirect Register Access to JX3 Modules on the JX2 System Bus ... 97
Example: Indirect Register Access ... 99
Module Registers for Indirect Register Access ... 100
6.3 Pointer to Process Data ... 101
Using Process Data Pointers ... 102
6.4 Analog I/Os ... 104
6.4.1 Analog Inputs ... 105
Converting Analog Values Into Digital Values ... 106
Description of Registers: Reading In Voltages ... 107
Example: Configuring the Analog Input Using a JC-3xx ... 109
Example: Configuring the Analog Input Using a JC-24x ... 111
6.4.2 Analog Output ... 113
Voltage Output ... 114
Register Description: Voltage Output ... 115
Example: A sine is output at X61.AO1 by JC-3xx ... 117
Example: Configuring the Analog Output Using a JC-24x ... 119
6.5 Digital Inputs and Outputs ... 121
Example: Reading Inputs and Switching Outputs with a JC-3xx ... 122
Example: Reading Inputs and Switching Outputs Using a JC-24x ... 125
Example: Reading Inputs and Switching Outputs with a JC-647 ... 127
6.6 Counter Function ... 129
6.6.1 Programming a Single-Channel Counter ... 130
Using a Single-Channel Counter ... 131
6.6.2 Programming a Dual-Channel Counter ... 133
Using a Dual-Channel Counter ... 134
Using a Modulo Counter ... 136
6.6.3 Special Functions of the Counter Module ... 138
Strobe Function ... 139
Example: Strobe Function ... 140
Gate Function ... 142
Example: Gate Function ... 143
Reset Function ... 145
Example: Reset Function ... 146
Edge Evaluation ... 148
Register Description - Counter ... 150

6.7 Stepper Motor 158
Stepper Motor - Properties 159
6.7.1 Referencing 162
Search for Reference to Mode 1 164
Search for Reference to Mode 2 166
Search for Reference to Mode 3 168
Search for Reference to Mode 4 170
6.7.2 Positioning Modes 172
Absolute Positioning 173
Relative Positioning 175
Endless Positioning 177
Modulo Positioning 179
6.7.3 Register Description 180
Stepper Motor: Description of Registers 181
6.8 Additional Features 190
6.8.1 Oscilloscope 191
Start/Stop Recording 192
Continuous Recording 194
Recording Values under Trigger Condition 196
Reading Out the Recorded Values 199
Oscilloscope Register Description 200
Example: Recording and Reading of Values 202
6.9 Status Monitoring via Collective Bits 204
Status Monitoring via Collective Bits 205
Register Description for Collective Bits 207

7 Quick Reference - JX3-MIX1 209

Appendix 213

A: Technical Data 214
Technical Specifications 215
Physical Dimensions 219
Operating Parameters: Environment and Mechanics 220
Operating Parameters: Enclosure 221
DC Power Supply Inputs and Outputs 222
Shielded Data and I/O Lines 223
B: Index 224

1 Safety Instructions

Introduction

This chapter informs the user of general safety instructions and warns of residual dangers, if applicable. Furthermore, it contains information on EMC.

Contents

Topic	Page
Basic Safety Instructions	12
Residual Dangers and Protective Measures	14
Instructions on EMC	15

Basic Safety Instructions

Introduction

This device complies with the valid safety regulations and standards. Special emphasis was given 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 JX3-MIX1 has been designed as a peripheral module for use in machines and is intended for connection to an already existing controller. The JX3-MIX1 is a peripheral module.

The JX3-MIX1 must be operated within the limits given in the technical specifications. The operating voltage of the JX3-MIX1 module is classified as SELV (Safety Extra Low Voltage). Therefore, the JX3-MIX1 is not subject to the EU Low Voltage Directive.

This device is used to control machinery, such as conveyors, production machines, and handling machines.

Usage Other Than Intended

This device must not be used in technical systems which to a high degree have to be fail-safe, e.g. ropeways and aeroplanes.

The JX3-MIX1 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 the device is to be run under ambient conditions which differ from the allowed operating conditions, Jetter AG is to be contacted beforehand.

Personnel Qualification

Depending on the life cycle of the product, the persons involved must possess different qualifications. These qualifications are required to ensure proper handling of the device in the corresponding life cycle.

Product Life Cycle	Minimum Qualification
Transport / Storage:	Trained and instructed personnel with knowledge in handling electrostatic sensitive components.
Mounting / Installation:	Specialized personnel with training in electrical engineering, such as industrial electronics technician.
Commissioning / Programming:	Trained and instructed experts with profound knowledge of, and experience with, electrical / drive engineering, such as electronics engineer for automation technology.
Operation:	Trained, instructed and assigned personnel with knowledge in operating electronic devices.
Decommissioning:	Specialized personnel with training in electrical engineering, such as industrial electronics technician.

Modifications and Alterations to the Device	**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 are not tested on our part, 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.
Transporting JX3 Modules	The JX3 module contains electrostatically sensitive components which can be damaged if not handled properly. To prevent damages to JX3 modules, the JX3 backplane bus has to be attached during transport. This is particularly true for transport via mail. Ship modules only in their original packaging or in packaging protecting against electrostatic discharge so as to prevent them from being damaged. In case of damaged packaging inspect the device for any visible damage. Inform your freight forwarder and the manufacturer, if applicable.
Storing	When storing the JX3-MIX1 observe the environmental conditions given in the technical specification.
Repair and Maintenance	This device must not be repaired by the operators themselves. The device does not contain any parts that could be repaired by the operator. The device must be sent to Jetter AG for repair.
Replacing Modules	During exchange of JX3 modules, degree of protection IP20 is not ensured. Do not touch any electronic components once the JX3 module enclosure has been removed from the JX3 backplane module. Touching the EMC clip may result in damages to this clip and, thus, in lower noise immunity.
Disposal	When disposing of devices, the local environmental regulations must be complied with.

Residual Dangers and Protective Measures

Residual Dangers

Consider the residual dangers mentioned in this chapter when assessing the risks associated with your machine/plant.



WARNING

Warning: Unguarded moving machine parts!

The drive shaft of the motor is to move machine parts or parts with sharp edges.

You could get caught in the rotating drive shaft and incur crushes and cuts.

- Never touch a rotating drive shaft.
- Do not wear lose-fitting clothing.
- Do not wear gloves.

Additional Safety Precautions

- Make sure that appropriate safety precautions have been taken, for instance, a second set of limit switches (interrupting the power supply of the motor) or safety guards.
- Make sure that hazards to persons or material damage are precluded even when the drive starts unintentionally.

Instructions on EMC

Noise Immunity of a System

The noise immunity of a system is determined by the weakest component of the system. For this reason, correct wiring and shielding of cables is of paramount importance.

Measures

Measures for increasing EMC in electric plants:

- The module JX3-MIX1 must be attached to a DIN rail acc. to EN 50022-35 x 7.5.
- Follow the instructions given in Application Note 016 "EMC-Compatible Installation of the Electric Cabinet" published by Jetter AG.

The following instructions are excerpts from Application Note 016:

- On principle, **physical separation** should be maintained between signal and power lines. We recommend spacings greater than 20 cm. Cables and lines should cross each other at an angle of 90°.
- The following line cables must be shielded:
  Analog lines, data lines, motor cables coming from inverter drives (servo output stage, frequency converter), lines between components and interference suppressor filter, if the suppressor filter has not been placed at the component directly.
- Shield cables **at both ends**.
- Unshielded wire ends of shielded cables should be as short as possible.
- The entire shield **must**, in its entire perimeter, be drawn behind the isolation, and then be clamped under an earthed strain relief **with the greatest possible surface area**.

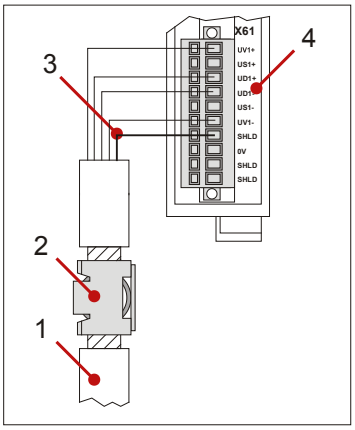
Downloading Application Note 016

You can download Application Note 016 from our **homepage http://www.jetter.de**. In order to download Application Note 016 "EMC-Compatible Installation of Electric Cabinets" browse the following path: Industrial Automation/Support/Downloads/07_application_notes".

Improving the Noise Immunity

To improve the noise immunity, follow the rules listed below:

- Connect the drain wire (3) directly to terminal X61.SHLD and X62.SHLD.
- Use a shield clamp (2) to provide additional grounding of the shield.



Number	Element
1	Line to the analog sensor
2	Shield clamp
3	Drain wire (copper)
4	Connector X61/X62 on the module JX3-MIX1

- Run each sensor line that is to be connected to input X61 or X62 in one or two loops through a ferrite core.
  This measure is necessary to achieve exact measuring results and to minimize external interferences. As ferrite core use a round cable snap ferrite (e.g. 74271222 by Würth Elektronik).
  Tests with an RF injection (10 V/m) resulted in a higher susceptibility to interference.

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.

Contents

Topic	Page
JX3-MIX1 - Product Description	18
Order Reference / Options	21
Parts and Interfaces of the Module	22
Internal Block Diagrams	23
Minimum Requirements	25
Accessories for the JX3 System	27
Physical Dimensions	28

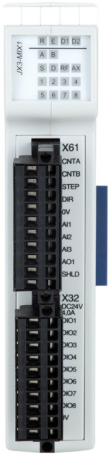
JX3-MIX1 - Product Description

The Module JX3-MIX1

The JX3-MIX1 module is an all-purpose expansion module that allows you to connect analog and digital sensors and actuators.

JX3-MIX1 - Product Features

The features of this product are listed below:



- Counters: Either one dual-channel counter or two single-channel counters up to 50 kHz
- Stepper motor controller; STEP and DIR output signals, 10 kHz max.
- 3 analog inputs
  Input signal 0 ... 10 V, 12-bit resolution
  Accuracy > 99 %
- 1 analog output
  Output signal 0 ... 10 V, 12-bit resolution
  Accuracy > 99 %
- 8 multi-purpose I/Os which can be used as digital input to IEC 61131-2, type 3, pnp transistor, or digital output to IEC 61131-2, 0.5 A, pnp transistor.
- Color of LED sheeting: signal white (RAL 9003)

Additional Features

Additional features of the JX3-MIX1 module are:

- Multi-purpose inputs and outputs: Short-circuit and overtemperature detection
- Counting function with strobe, gate, and reset. This function can be parameterized via multi-purpose I/Os.
- The stepper motor can be controlled by means of external signals via multi-purpose I/Os.
- Pointer to process data
- Output of error conditions
- Oscilloscope function
- Operating system update via JetSym

Description in Accordance with Functional Groups

The JX3-MIX1 module features the following functional groups:

Group	Quantity	Description
Counter	2	Two independent counter inputs which can also be configured as one dual-channel counter Selection of edges: Positive edge, negative edge, both edges The process data pointer is used to read out count values Both counters can be used as modulo counter Strobe Function Gate function Reset function Diagnostics by means of bits
Stepper motor	1	Output of STEP and DIR signals via open drain outputs Several methods of referencing Absolute positioning Relative positioning Endless positioning Response to hardware and/or software limit switches Recording of values via oscilloscope Configuration of ramps and velocity Configuration of limit switch polarity, DIR and STEP level Diagnostics by means of bits Support of modulo axes Destination window monitoring Diagnostics by means of bits
Analog inputs	3	Input signal 0 ... 10 V, 12-bit resolution Values: 0 ... 4.095 Diagnostics by means of bits
Analog output	1	Output signal 0 ... 10 V, 12-bit resolution Values: 0 ... 4.095 Diagnostics by means of bits
Multi-purpose inputs and outputs	8	8 multi-purpose I/Os which can be used as digital input to IEC 61131-2, type 3, pnp transistor, or digital output to IEC 61131-2, 0.5 A, pnp transistor. Multi-purpose inputs and outputs can be parameterized for use with counters and/or stepper motors. **Example**: Hardware limit switch of a stepper motor. Diagnostics by means of bits

Group	Quantity	Description
Counter	2	Two independent counter inputs which can also be configured as one dual-channel counter Selection of edges: Positive edge, negative edge, both edges The process data pointer is used to read out count values Both counters can be used as modulo counter Strobe Function Gate function Reset function Diagnostics by means of bits
Oscilloscope	1	Number of simultaneously recordable channels: 4 Number of values per channel: 150 Module registers - stepper motor: ■ Actual position ■ Actual stepping rate Module registers - analog inputs Module registers - analog output Module registers - multi-purpose I/Os Module registers - counters: ■ Counter reading CNTA ■ Counter reading CNTB Diagnostics by means of bits

Scope of Delivery

The following items are included in the scope of delivery of the JX3-MIX1 module:

Item #	Quantity	Description
10000738	1	JX3-MIX1
60869252	2	10-pin connector, spring cage technology
60870411	10	Terminal labels
60871899	1	Installation Instructions
60870410	1	Keying pins

Order Reference / Options

Order Reference

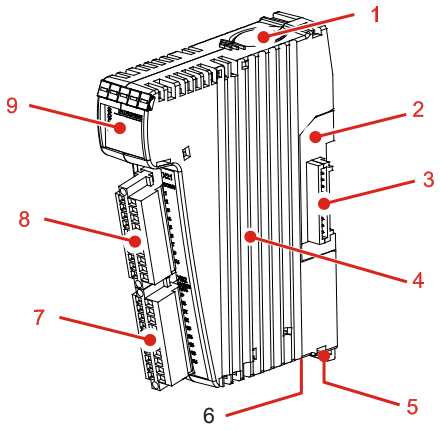
The JX3-MIX module is available in two configurations. You can order them from Jetter AG specifying the corresponding item number.

Part Number	Order Reference	Feature
10000738	JX3-MIX1	■ 2 single-channel counters or ■ 1 dual-channel counter ■ 1 stepper motor output ■ 3 analog inputs ■ 1 analog output ■ 8 digital multi-purpose I/Os ■ 1 oscilloscope
10000887	JX3-MIX2	■ 2 single-channel counters or ■ 1 dual-channel counter ■ 1 stepper motor output ■ 3 analog inputs ■ 1 analog output ■ 4 digital multi-purpose I/Os ■ 1 serial interface RS-232 ■ 1 serial port RS-485, half duplex ■ 1 oscilloscope

Parts and Interfaces of the Module

Parts and Interfaces

The illustration below shows the parts and interfaces of the JX3-MIX1:

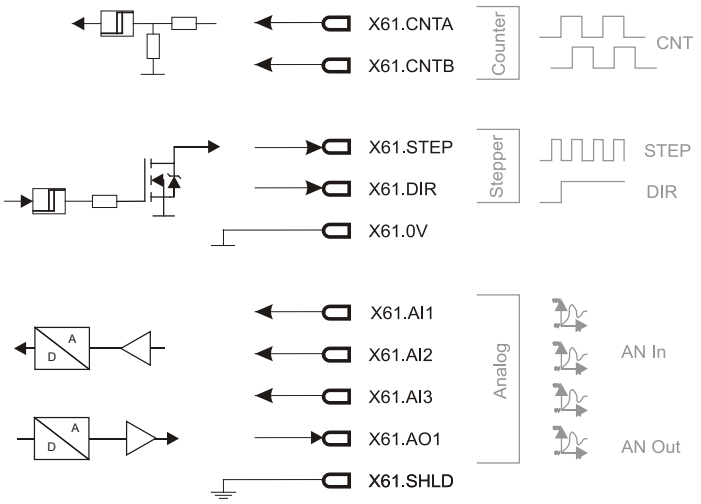


Number	Element	Description
1	Upper latch	Lets you remove the JX3 module enclosure from the JX3 backplane module
2	JX3 backplane module	Connection between JX3 modules; color: blue
3	X119	Connector for additional JX3 modules
4	JX3 module enclosure	Can be removed from the JX3 backplane module; color: light gray
5	DIN rail latch	For removing the JX3 module from the DIN rail.
6	Lower latch	Lets you remove the JX3 module enclosure from the JX3 backplane module (not shown in the drawing)
7	Terminal X61	Terminal for connecting analog/digital I/Os
8	Terminal X32	Terminal for connecting digital I/Os
9	LEDs	Diagnostic and status LEDs

Internal Block Diagrams

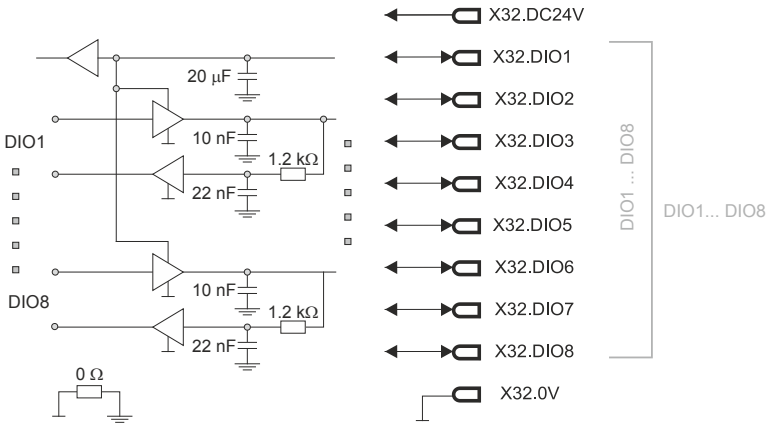
Terminal X61:
Internal Block Diagram

JX3-MIX1 and JX3-MIX2 are equipped with the same terminal X61:



Function	Description
	Counter inputs with voltage divider and Schmitt trigger
Stepper	Stepper motor control output as open drain output
Analog	3 analog-to-digital converters (shown only once) with driver stage
Analog	1 digital-to-analog converter with driver stage

Terminal X32:
Internal Block Diagram



Element	Description
DIO1 ... DIO8	8 multi-purpose inputs/outputs

Minimum Requirements

Introduction

The JX3-MIX1 module is operated in a system consisting of various components by Jetter AG. In order to ensure proper interaction of these components, the operating system used and the programming tool JetSym must have the release numbers listed below.

Configurations

The module JX3-MIX1 can be connected to the following devices/bus systems:

- JetControl 3xx
- Ethernet bus node JX3-BN-ETH
- JX2 system bus of a JetControl 24x via CAN bus node JX3-BN-CAN
- JX2 system bus of a dual-axis controller JM-D203-JC24x via CAN bus node JX3-BN-CAN
- JX2 system bus of a JetControl 647 equipped with a submodule JX6-SB(-I) via CAN bus node JX3-BN-CAN
- JX2 system bus of a JetControl 9xx equipped with a submodule JX6-SB(-I) via CAN bus node JX3-BN-CAN

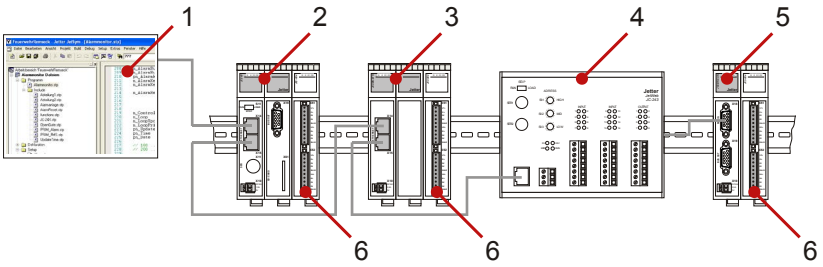
Minimum OS Version

The minimum OS version of the module JX3-MIX1 depends on its hardware revision. The hardware revision can be found on the nameplate of the module. The OS version can be read out from MR 9.

Hardware revision	Minimum OS version
Rev 03.00	V 1.00.0.00 or higher

Minimum Requirements

To be able to use the functions described in this document, the modules, controllers and software must meet the following minimum requirements:



No.	Item	Description	Software version (or higher)
1	JetSym	Programming software	V 3.00
2	JC-3xx	PLC JetControl 3xx	V 1.10.0.00
3	JX3-BN-ETH	Ethernet bus node	V 1.9.0.0
4	JC-24x	PLC JetControl 240	V 3.23
	JC-647	PLC JetControl 647	V 3.50
	JX6-SB(-I)	Submodule for system bus	V 2.18

No.	Item	Description	Software version (or higher)
	JM-D203-JC24x	Dual-axis controller with integrated controller JetControl 240	V 1.12.0.00
5	JX3-BN-CAN	CAN bus node	V 1.06.0.00
6	JX3-MIX1	Multi-purpose expansion module	V 1.00.0.00

Accessories for the JX3 System

Labelling Field

Ten labelling fields are included in the scope of delivery of the JX3-MIX1 module:



Designation	DIV_DEK_5/5_MC-10_NEUT._WS
Jetter item #	60870411
VPE	100 pcs.

Keying Pins

One keying pin is included in the scope of delivery of the JX3-MIX1 module:



Designation	DIV_BL_SL_3.5_KO_OR
Jetter item #	60870410

Strain Relief for BU_10_E_BLZF_GE_RM 3.5



Designation	DIV_BL_3.5_ZE_8
Jetter item #	60870963

End Clamp for DIN Rail



Designation	DIV_CLIPFIX_35
Jetter item #	60863970

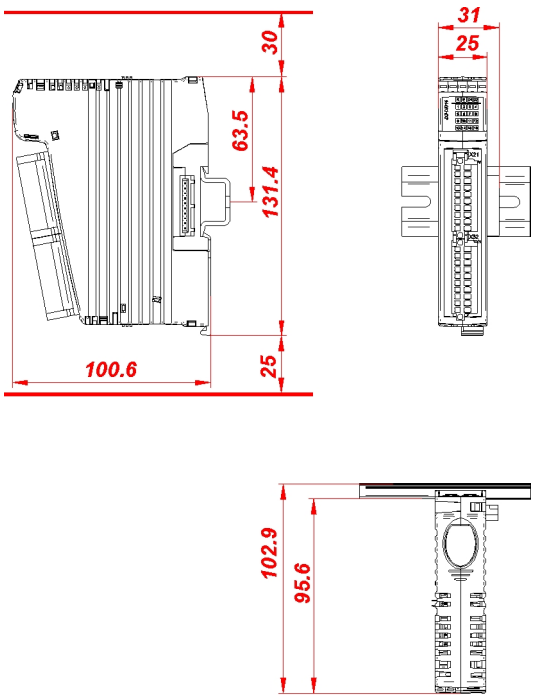
Screw Driver



Type	SD 0.4 x 2.5 - DIN 5264-A
Designation	DIV_SCHRAUBENDREHER_2.5*75
Jetter item #	60871712

Physical Dimensions

Physical Dimensions



Minimum Clearances

At mounting the JX3-MIX1 module, make sure to maintain a minimum clearance above and below. At replacing the module, you can operate the locking mechanisms of the JX3 backplane module using your fingers.

- Minimum clearance above: 30 mm
- Minimum clearance below: 25 mm

Module Width

The JX3-MIX1 module requires a space of 31 mm width. At connecting the JX3-MIX1 module to a JX3 station, the width is increased by 25 mm.

Mounting Position

The mounting position of the JX3-MIX1 module is vertical.

3 How to Identify the Module

Purpose of this Chapter

This chapter supports you in obtaining the following information from the JX3-MIX1 module:

- Determining the revision of this module.
- Electronic data sheet (EDS). Numerous manufacturing-relevant data are stored to EDS.

Prerequisites

To be able to identify the JX3-MIX1 module the following prerequisites must be fulfilled:

- The module JX3-MIX1 is connected to a JetControl PLC.
- The controller is connected to a PC.
- The programming tool JetSym is installed on the PC.
- The minimum requirements regarding modules, controllers and software are fulfilled.

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 module JX3-MIX1 ready:

- Version number in MR 9
- Hardware revision

Module Code

The module code of JX3-MIX1 is 305.

Contents

Topic	Page
Module Versions	30
Electronic Data Sheet (EDS) with JC-3xx	32
Electronic Data Sheet (EDS) with JC-24x	34
Electronic Data Sheet (EDS) with JC-647 and JX6-SB(-I)	36
Example: Reading Out an EDS with JC-3xx	38
Example: Reading Out an EDS with JC-24x	40
Identification by Means of Module Registers	42
Identification via Nameplate	43

Module Versions

Introduction

Every JX3 module contains software of unambiguous version numbers, which can be read out via module registers. You will need the version data, in case you want to turn to the Jetter AG hotline in order to solve a technical problem.

Version Number Format

The version numbers of the JX3-MIX1 modules are displayed by four sections of figures:

1	.	2	.	3	.	4

Element	Description
1	Major, respectively main version number
2	Minor, respectively sub-version number
3	Branch, respectively intermediate version number
4	Build version number

Overview of Registers

The version numbers can be read out of the following module registers:

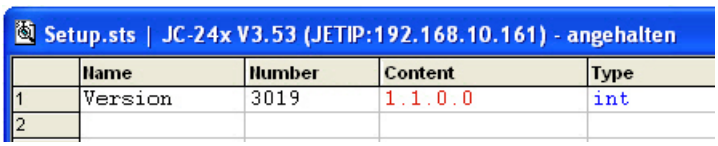
Register	Description
MR 9	Operating system version
MR 32	FPGA version
MR 769	Bootloader version

Released Version

When a version has been released, both branch and build version number is zero.

Version Numbers in the JetSym Setup

In order to display a version number, select the "IP Address" format in the JetSym Setup section.



Version Numbers in the Application Program

In order to display versions in the application program, please use the identifier IP#.

```
Task 0
    // Checking a version
    When
        JX3_Modul.Version = IP#1.1.0.0
    Continue;
    // ...
End_Task;
```

Related Topics

- **Register Description – Identification** (see page 42)

Electronic Data Sheet (EDS) with JC-3xx

Introduction

Numerous production-relevant data are permanently stored to the EDS. The EDS data can be read out from registers of the controller JC-3xx.

Overview of Registers

EDS data can be read out of the following registers:

Register(s)	Description
R 100500	Interface: 1 = Peripheral modules of the JX3 station
R 100501	Module number within the JX3 station
R 100600 ... R 100614	EDS Page 0 - Data
R 100700 ... R 100710	EDS Page 1 - Data

Contents of EDS Page 0

Production-related data can be read from EDS page 0.

Register(s)	Type	Description
R 100600	int	Revision of EDS page 0
R 100601	int	Module code
R 100602 ... R 100612	string	Module name
R 100613	int	Hardware revision
R 100614	int	Hardware revision

Contents of EDS Page 1

Production-related data can be read from EDS page 1.

Register(s)	Type	Description
R 100700	int	Revision of EDS page 1
R 100701 ... R 100707	string	Serial number
R 100708	int	Production date: day
R 100709	int	Production date: month
R 100710	int	Production date: year

Reading an EDS Page

To read an EDS page of a JX3-module connected to a JC-3xx proceed as follows:

Step	Action
1	Select the interface by entering 1 into R 100500.
2	Select the JX3-module by entering the module number into R 100501.
3	Read out EDS data from registers R 100600 ... 100710.

Related Topics

- **Example: Reading Out an EDS with JC-3xx** (see page 38)

Electronic Data Sheet (EDS) with JC-24x

Introduction

Numerous production-relevant data are permanently stored to the EDS. EDS data can be read via special registers. The data are distributed among EDS page 0 and EDS page 1. Only one page at a time can be accessed via registers.

Overview of Registers

EDS data can be read out of the following registers:

Register(s)	Description
R 10040	I/O module number on the JX2 system bus
R 10041	EDS page
R 10041 ... R 10056	EDS Page 0 - Data
R 10041 ... R 10052	EDS Page 1 - Data

Contents of EDS Page 0

Production-related data can be read from EDS page 0. To be able to read out EDS page 0, register R 10041 must contain value 0.

Register(s)	Type	Description
R 10042	int	Revision of EDS page 0
R 10043	int	Module code
R 10044 ... R 10054	string	Module name
R 10055	int	Hardware revision
R 10056	int	Hardware revision

Contents of EDS Page 1

Production-related data can be read from EDS page 1. To be able to read out EDS page 1, register 10041 must contain value 1.

Register(s)	Type	Description
R 10042	int	Revision of EDS page 1
R 10043 ... R 10049	string	Serial number
R 10050	int	Production date: day
R 10051	int	Production date: month
R 10052	int	Production date: year

Reading an EDS Page

To read an EDS page of a JX3-module connected to a JC-24x proceed as follows:

Step	Action
1	Select the JX3 module by entering the I/O module number into R 10040.
2	Select the EDS page by entering the page number into R 10041.
3	Read out EDS data from registers R 10042 ... 10056.

Related Topics

- **Example: Reading Out an EDS with JC-24x** (see page 40)

Electronic Data Sheet (EDS) with JC-647 and JX6-SB(-I)

Introduction

Numerous production-relevant data are permanently stored to the EDS. EDS data can be read via special registers. The data are distributed among EDS page 0 and EDS page 1. Only one page at a time can be accessed via registers.

Overview of Registers

The register numbers for reading the EDS are dependent on the submodule socket number *m* where the JX6-SB(-I) is located:

Register(s)	Description
R 3m10040	I/O module number on the JX2 system bus
R 3m10041	EDS page
R 3m10041 ... R 3m10056	EDS Page 0 - Data
R 3m10041 ... R 3m10052	EDS Page 1 - Data

Contents of EDS Page 0

Production-related data can be read from EDS page 0. To be able to read out EDS page 0, register R 3m10041 must contain value 0.

Register(s)	Type	Description
R 3m10042	int	Revision of EDS page 0
R 3m10043	int	Module code
R 3m10044 ... R 3m10054	string	Module name
R 3m10055	int	Hardware revision
R 3m10056	int	Hardware revision

Contents of EDS Page 1

Production-related data can be read from EDS page 1. To be able to read out EDS page 1, register R 3m10041 must contain value 1.

Register(s)	Type	Description
R 3m10042	int	Revision of EDS page 1
R 3m10043 ... R 3m10049	string	Serial number
R 3m10050	int	Production date: day
R 3m10051	int	Production date: month
R 3m10052	int	Production date: year

Reading an EDS Page

To read out an EDS page proceed as follows:

Step	Action
1	Select the JX3 module by entering the I/O module number into R 3m10040.
2	Select the EDS page by entering the page number into R 3m10041.
3	Read out EDS data from registers R 3m10042 ... 3m10056.

Example: Reading Out an EDS with JC-3xx

Task

In the JetSym setup window EDS data of any JX3 module is to be displayed.

Solution

In a JetSym application program the EDS registers are declared as variables. The variables are then entered into the setup pane.

Sample Configuration

A JX3-xxx module is connected to a JC-3xx controller. The module JX3-xxx is part of a JX3 station and its module number is 2.

JetSym STX Program

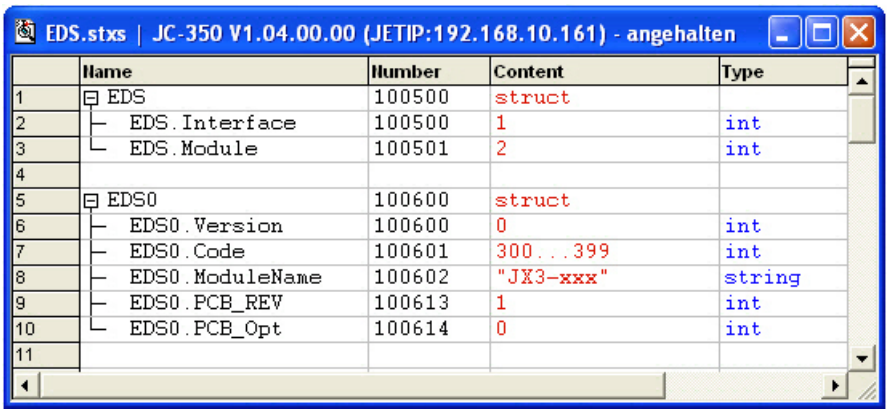
```
Type
    // Defining interface and module number
    JX3_EDS:
    Struct
        Interface : Int;
        Module    : Int;
    End_Struct;

    // Defining EDS page 0
    JX3_EDS_PAGE0:
    Struct
        Version    : Int;
        Code       : Int;
        ModuleName : String[31];
        PCB_REV    : Int;
        PCB_Opt    : Int;
    End_Struct;

    // Defining EDS page 1
    JX3_EDS_PAGE1:
    Struct
        Version    : Int;
        Sernum     : String[19];
        TS_Day     : Int;
        TS_Month   : Int;
        TS_Year    : Int;
    End_Struct;
End_Type;

Var
    EDS  : JX3_EDS At %VL 100500;
    EDS0 : JX3_EDS_PAGE0 At %VL 100600;
    EDS1 : JX3_EDS_PAGE1 At %VL 100700;
End_Var;
```

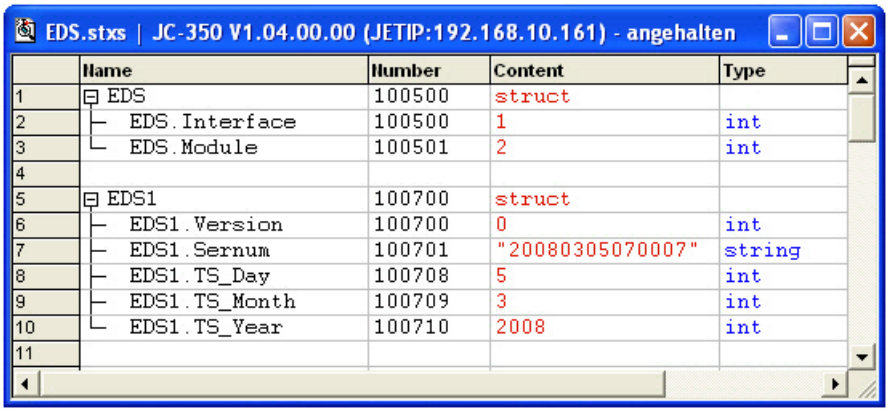
Reading EDS Page 0



	Name	Number	Content	Type
1	EDS	100500	struct	
2	EDS.Interface	100500	1	int
3	EDS.Module	100501	2	int
4				
5	EDS0	100600	struct	
6	EDS0.Version	100600	0	int
7	EDS0.Code	100601	300...399	int
8	EDS0.ModuleName	100602	"JX3-xxx"	string
9	EDS0.PCB_REV	100613	1	int
10	EDS0.PCB_Opt	100614	0	int
11				

Element	Description
EDS.Interface	1 = EDS data of the modules within the JX3 station
EDS.Module	2 = Module number

Reading EDS Page 1



	Name	Number	Content	Type
1	EDS	100500	struct	
2	EDS.Interface	100500	1	int
3	EDS.Module	100501	2	int
4				
5	EDS1	100700	struct	
6	EDS1.Version	100700	0	int
7	EDS1.Sernum	100701	"20080305070007"	string
8	EDS1.TS_Day	100708	5	int
9	EDS1.TS_Month	100709	3	int
10	EDS1.TS_Year	100710	2008	int
11				

Element	Description
EDS.Interface	1 = EDS data of the modules within the JX3 station
EDS.Module	2 = Module number

Example: Reading Out an EDS with JC-24x

Task

In the JetSym setup window EDS data of any JX3 module is to be displayed.

Solution

In a JetSym application program the EDS registers are declared as variables. The variables are then entered into the setup window.

Sample Configuration

A JX3-BN-CAN with a JX3-xxx module is connected to a JC-24x controller. The module JX3-xxx has got I/O module number 2 on the JX2 system bus.

JetSym ST Program

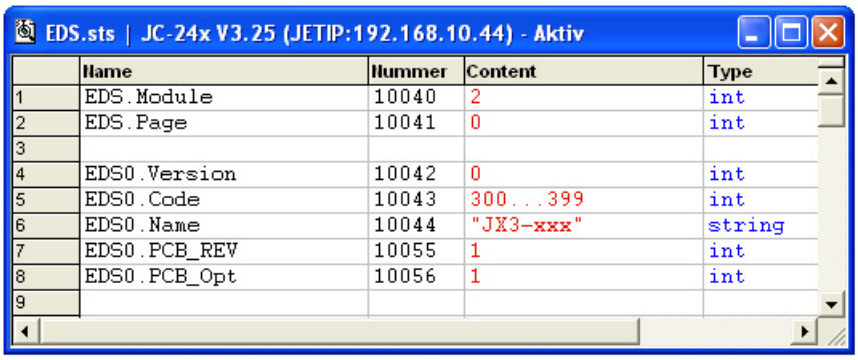
```
Type
    // Defining module number and EDS page
    JX3_EDS:
    Struct
        Module   : Int;
        Page     : Int;
    End_Struct;

    // Defining EDS page 0
    JX3_EDS_PAGE0:
    Struct
        Version  : Int;
        Code     : Int;
        Name     : String[31];
        PCB_REV  : Int;
        PCB_Opt  : int;
    End_Struct;

    // Defining EDS page 1
    JX3_EDS_PAGE1:
    Struct
        Version  : Int;
        Sernum   : String[19];
        TS_Day   : Int;
        TS_Month : Int;
        TS_Year  : Int;
    End_Struct;
End_Type;

Var
    EDS  : JX3_EDS At %VL 10040;
    EDS0 : JX3_EDS_PAGE0 At %VL 10042;
    EDS1 : JX3_EDS_PAGE1 At %VL 10042;
End_Var;
```

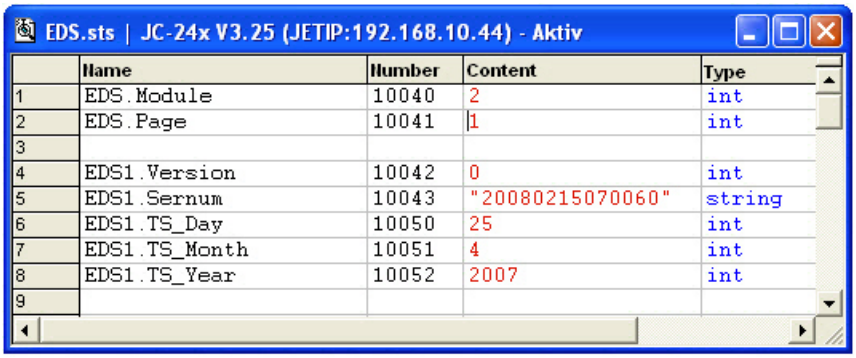
Reading EDS Page 0



	Name	Nummer	Content	Type
1	EDS.Module	10040	2	int
2	EDS.Page	10041	0	int
3				
4	EDS0.Version	10042	0	int
5	EDS0.Code	10043	300...399	int
6	EDS0.Name	10044	"JX3-xxx"	string
7	EDS0.PCB_REV	10055	1	int
8	EDS0.PCB_Opt	10056	1	int
9				

Element	Description
EDS.Module	2 = Module number
EDS.Page	0 = Data of EDS page 0

Reading EDS Page 1



	Name	Number	Content	Type
1	EDS.Module	10040	2	int
2	EDS.Page	10041	1	int
3				
4	EDS1.Version	10042	0	int
5	EDS1.Sernum	10043	"20080215070060"	string
6	EDS1.TS_Day	10050	25	int
7	EDS1.TS_Month	10051	4	int
8	EDS1.TS_Year	10052	2007	int
9				

Element	Description
EDS.Module	2 = Module number
EDS.Page	1 = Data of EDS page 1

Identification by Means of Module Registers

MR 9

Operating System Version

In MR 9, the operating system version of the JX3-MIX1 module is displayed. Via JetSym, another operating system can be transmitted to the JX3-MIX1 module.

Module Register Properties	
Values	Released operating system version: IP#1.0.0.0 ... IP#254.255.0.0
	Bootloader version: IP#255.1.0.0 ... IP#255.255.0.0
Access	Read
Value following a reset	Operating system version

MR 32

FPGA Version

In MR 32, the FPGA version of the JX3-MIX1 module is displayed. A modification of the FPGA version cannot be carried out by the user.

Module Register Properties	
Values	IP#1.0.0.0 ... IP#255.255.0.0
Access	Read
Value following a reset	FPGA version

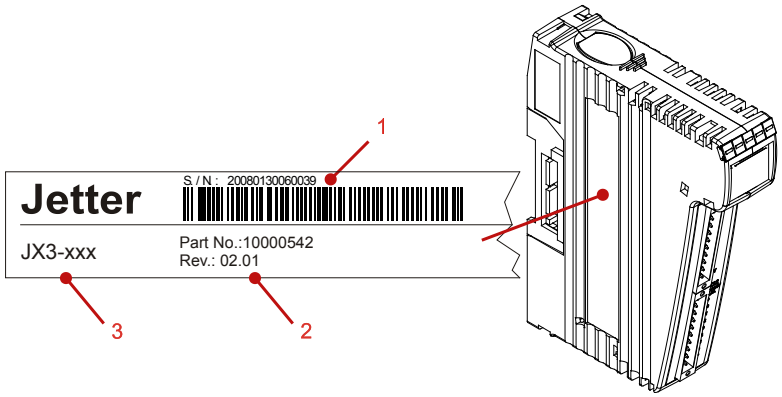
Identification via Nameplate

Introduction

Each JX3 module can be identified by its nameplate attached to its enclosure. You will need the hardware revision data if you have to contact the hotline of Jetter AG in case of a problem.

Nameplate

The nameplate of JX3 modules contains the following information:



Number	Description
1	Serial number
2	Hardware revision
3	Module name

4 Mounting and Installation

Purpose of this Chapter

This chapter is for supporting you in mounting and installing the JX3-MIX1 as regards the following points:

- Planning the wiring of a JX3-MIX1
- Supplying the JX3-MIX1 with power
- Connecting sensors and actuators to the JX3-MIX1
- Description of indicators
- Installation

Contents

Topic	Page
Interfaces	46
Indicators and LEDs	62
Installing, Replacing, and Removing the Module	66

4.1 Interfaces

Terminal X61

The function of terminal X61 is as follows:

- Counter input A and B
- Stepper motor control
- Analog inputs 1 ... 3
- Analog output

Terminal X32

The function of terminal X32 is as follows:

- Multi-purpose inputs and outputs 1 ... 8

Contents

Topic	Page
Terminal X61 - Pin Assignment	47
Assignment of Terminal X32	48
Connector Specification - Terminal X62 / X32	49
Connecting Analog Voltage Actuators	50
Connecting Analog Voltage Sensors	52
Connecting a Stepper Motor	54
Hardware Limit and Reference Switches	56
Connecting a Single-Channel Counter	57
Connecting a Dual-Channel Counter	59

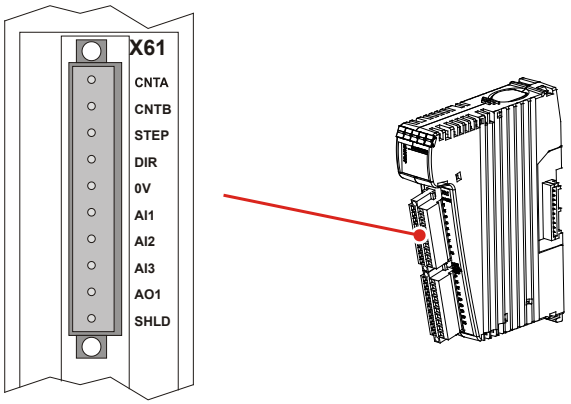
Terminal X61 - Pin Assignment

Interfaces of Terminal X61

Terminal X61 lets you connect the following interface signals to it:

- Digital counter inputs
- Digital stepper motor outputs
- Analog inputs 1 ... 3
- Analog output # 1

Pin Assignment – Terminal X61



Terminal point	Function
CNTA	Counter input A
CNTB	Counter input B
STEP	Open-drain stepper motor output STEP
DIR	Open-drain stepper motor output DIR
0 V	Reference potential
AI1	Voltage input 1, 0 ... +10 V
AI2	Voltage input 2, 0 ... +10 V
AI3	Voltage input 3, 0 ... +10 V
AO1	Voltage output 1, 0 ... +10 V
SHLD	Shield

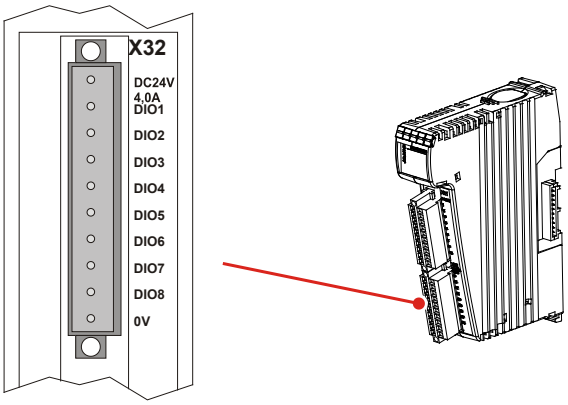
Assignment of Terminal X32

Interfaces of Terminal X32

Terminal X32 lets you connect the following interface signals to it:

- Digital I/Os

Assignment of Terminal X32

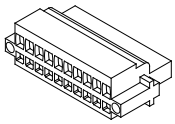


Terminal Point	Function
DC24V 4.0A	Power supply for external actuators DC +24 V
DIO1	Multi-purpose input/output # 1
DIO2	Multi-purpose input/output # 2
DIO3	Multi-purpose input/output # 3
DIO4	Multi-purpose input/output # 4
DIO5	Multi-purpose input/output # 5
DIO6	Multi-purpose input/output # 6
DIO7	Multi-purpose input/output # 7
DIO8	Multi-purpose input/output # 8
0 V	Reference potential

Connector Specification - Terminal X62 / X32

Ordering Data of the Connector

Two 10-pin connectors already belong to the scope of delivery of the JX3-MIX1 module: They can also be ordered individually by the following ordering data:

	Designation	BU_10_BLZF_F_SW_RM3.5
	Jetter item #	60869252

Connector Specification

The connector is specified by the following list:

Connector Specification	
Connector technology	Spring cage connection
Type	10-pin, contact spacing 3.5 mm
Connectible Conductors	
Outer diameter of the isolation	2.90 mm max.
AWG	16 ... 28
Terminal range	0.13 ... 1.5 mm^2
Stripping length	10 mm
Specification Without Wire End Ferrules	
One-wire H05(07) V-U	0.2 ... 1.5 mm^2
Flexible H05(07) V-K	0.2 ... 1.5 mm^2
Specification With Wire End Ferrules	
Bootlace ferrule without sleeve DIN 46228/1	0.2 ... 1.5 mm^2
Bootlace ferrule with sleeve DIN 46228/4	0.2 ... 1.5 mm^2
Crimping tool DIN 46228	PZ 4, PZ 6 ROTO, PZ 6/5

Screw Driver

The fitting screw driver can be ordered from Jetter AG directly.

Type	SD 0.4 x 2.5 - DIN 5264-A
Designation	DIV_SCHRAUBENDREHER_2.5*75
Jetter item #	60871712

Connecting Analog Voltage Actuators

Conductor Design

The design of the conductor for connecting analog signals must meet the following requirements:

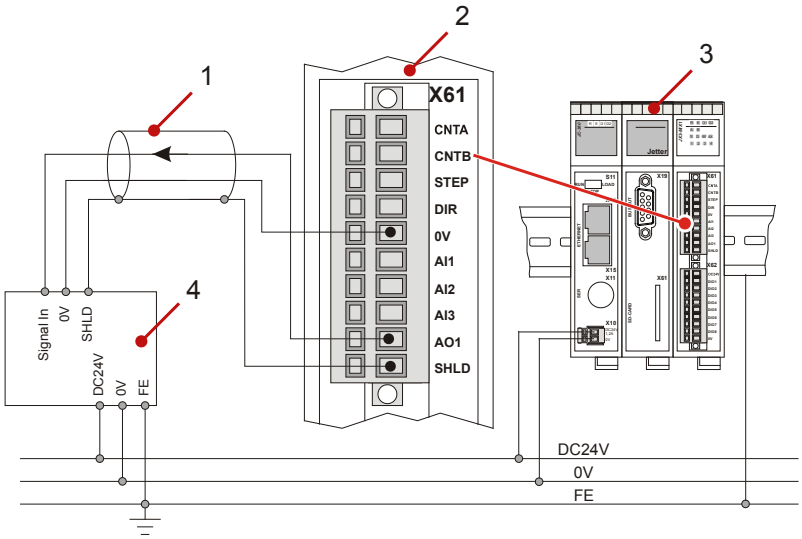
- Shielded cable with 85 % coverage
- Drain wire, tin-coated copper
- Cable cross-section 0.14 mm^2

Power Supply

Voltage actuator and JX3 station can be supplied with power from the same power supply unit (PSU) or from separate PSUs.

Connecting Voltage Actuators

The following illustration shows an actuator connected to analog output AO1.

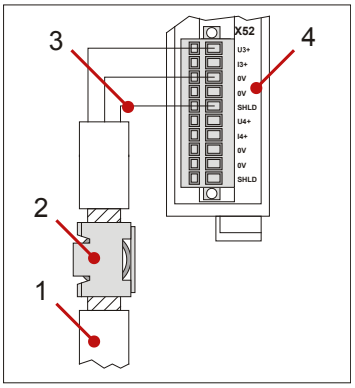


Number	Item
1	Line to the analog actuator
2	Connector X61 on the module JX3-MIX1 (enlarged view)
3	Power supply for the JX3 station and analog actuator
4	Analog actuator with voltage interface

Improving Noise Immunity

For improving the noise immunity, follow the rules listed below:

- Connect the drain wire (3) directly to terminal X61.SHLD.
- Use a shield clamp (2) to provide additional grounding of the shield.



Number	Item
1	Line to the analog actuator
2	Shield clamp
3	Drain wire (copper)
4	Module JX3-MIX1

Related Topics

- **Technical Specifications** (see page 215)

Connecting Analog Voltage Sensors

Conductor Design

The design of the conductor for connecting analog signals must meet the following requirements:

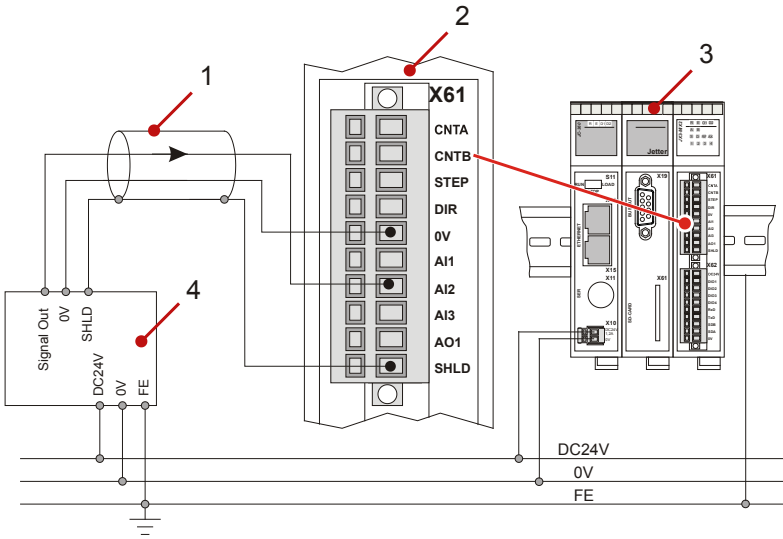
- Shielded cable with 85 % coverage
- Drain wire, tin-coated copper
- Cable cross-section 0.14 mm^2

Power Supply

Voltage actuator and JX3 station can be supplied with power from the same power supply unit (PSU) or from separate PSUs.

Connecting Voltage Sensors

The following illustration shows a sensor connected to analog input AI2.

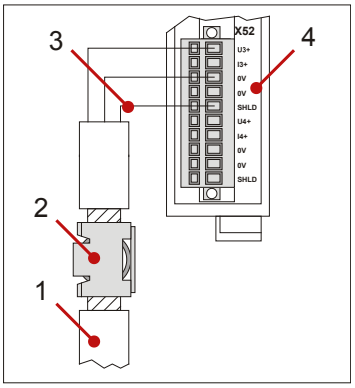


Number	Item
1	Line to the analog sensor
2	Connector X61 (enlarged view)
3	Power supply for the JX3 station and analog sensor
4	Analog sensor with voltage interface

Improving Noise Immunity

For improving the noise immunity, follow the rules listed below:

- Connect the drain wire (3) directly to terminal X61.SHLD.
- Use a shield clamp (2) to provide additional grounding of the shield.



Number	Item
1	Line to the analog sensor
2	Shield clamp
3	Drain wire (copper)
4	Module JX3-MIX1

Related Topics

- **Technical Specifications** (see page 215)

Connecting a Stepper Motor

Power Supply

Stepper motor and JX3 station can be supplied with power from the same power supply unit (PSU) or from separate PSUs.

Conductor Design

The conductor for connecting the stepper motor amplifier must meet the following requirements:

- Shielded cable with 85 % coverage
- Drain wire, tin-coated copper

Depending on their frequency, STEP pulses may interfere with other electronic systems. To minimize noise, use shielded cables.

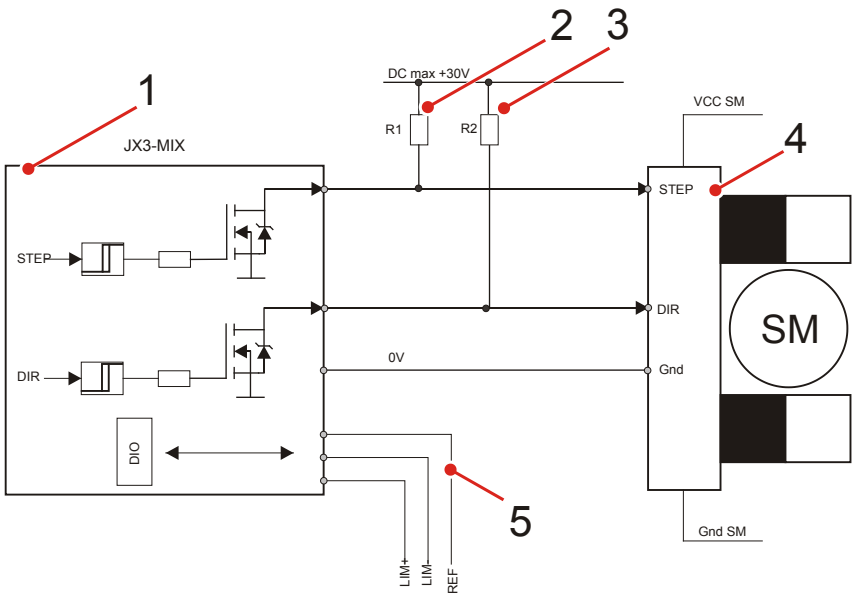
Prerequisites

To be able to operate a stepper motor, an external amplifier is required converting the control signals DIR and STEP into a motion sequence for the corresponding stepper motor. The stepper motor outputs have been designed as open-drain outputs.

Connecting a Stepper Motor

The following illustration shows how to connect a stepper motor.

The module JX3-MIX lets you connect any stepper motor amplifier, thus, any stepper motor. Make sure that the maximum current drawn via pull-up resistors does not exceed 150 mA per channel.



Number	Item
1	Stepper motor control through the module JX3-MIX1
2	External pull-up resistor R1
3	External pull-up resistor R2
4	Stepper motor amplifier (with external power supply)
5	Option: The module JX3-MIX1 lets you parameterize the multi-purpose I/Os to allow connection of hardware limit switches.

Selecting the Best Pull-Up Resistor

Make sure that the maximum current drawn via pull-up resistors does not exceed 150 mA per output.

To select the best resistor, calculate its value according to Ohm's law for a current of 25 mA:

$$R_{opt} = \frac{U}{I} = \frac{24V}{0.025A} = 960\Omega \approx 1k\Omega$$

The maximum resistance is determined by the cycle time. The resistance must not be too high. Otherwise it won't be possible to achieve the minimum pulse width of 2 µs.

- For a voltage of +24 V use a pull-up resistor of 1 kΩ.
- For a voltage of +5 V use a pull-up resistor of at least 200 kΩ.
- Note: The maximum power rating of the resistor must not be exceeded.

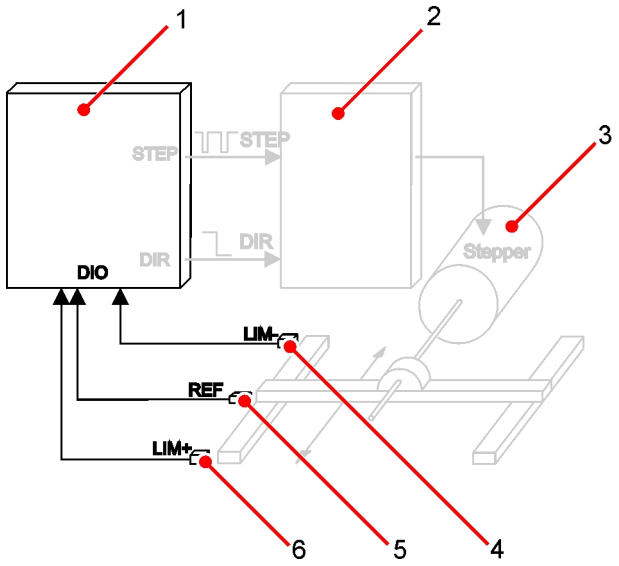
Related Topics

- **Technical Specifications** (see page 215)

Hardware Limit and Reference Switches

Connecting Limit Switches

The module JX3-MIX1 lets you connect hardware limit and reference switches to it. To operate the stepper motor, assign the switches to the inputs of the module.



Number	Item
1	Module JX3-MIX1
2	Stepper motor amplifier
3	Stepper motor
4	Negative limit switch LIM-
5	Reference switch REF
6	Positive limit switch LIM+

The hardware limit switches let you use the stepper motor for linear motion applications. Use the hardware limit switches LIM+ and LIM- to define the range within which the linear axis moves. The system comprising of JX3-MIX1, stepper motor amplifier, stepper motor, and limit switches is set in a way that allows exact positioning once the reference point has been set.

Connecting a Single-Channel Counter

Conductor Design

The design of the conductor for connecting single-channel counters must meet the following requirements:

- Shielded cable with 85 % coverage
- Drain wire, tin-coated copper

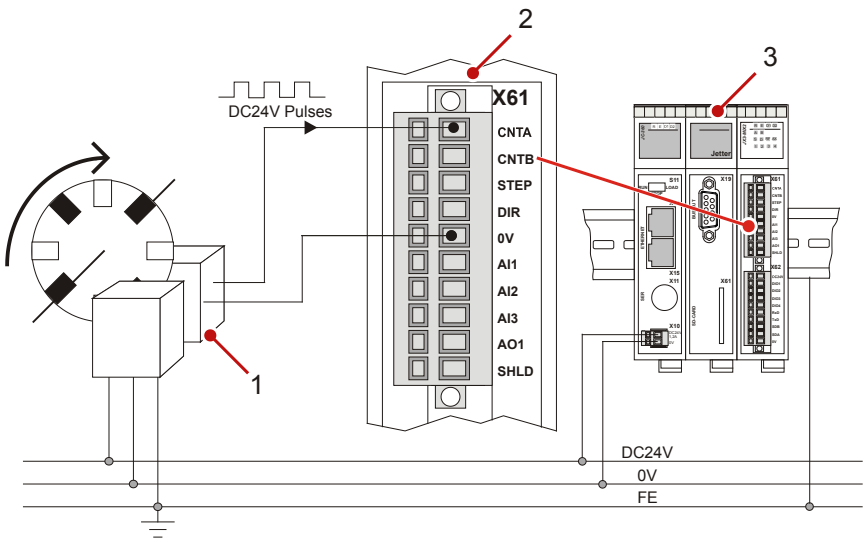
To minimize noise, use shielded cables.

Power Supply

Single-channel counter and JX3 station can be supplied with power from the same power supply unit (PSU) or from separate PSUs.

Connecting a Single-Channel Counter

The following illustration shows a single-channel counter (taking a fork light barrier as an example) connected to counter input CNTA.

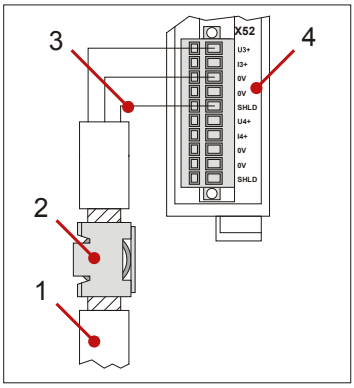


Number	Item
1	Single-channel counter (taking a fork light barrier as an example) with an output signal of 24 V.
2	Connector X61 (enlarged view)
3	Power supply for JX3 station and single-channel counter

Improving Noise Immunity

For improving the noise immunity, follow the rules listed below:

- Connect the drain wire (3) directly to terminal X61.SHLD.
- Use a shield clamp (2) to provide additional grounding of the shield.



Number	Item
1	Cable to the counter
2	Shield clamp
3	Drain wire (copper)
4	Module JX3-MIX1

Related Topics

- **Technical Specifications** (see page 215)

Connecting a Dual-Channel Counter

Conductor Design

The design of the conductor for connecting dual-channel counters must meet the following requirements:

- Shielded cable with 85 % coverage
- Drain wire, tin-coated copper

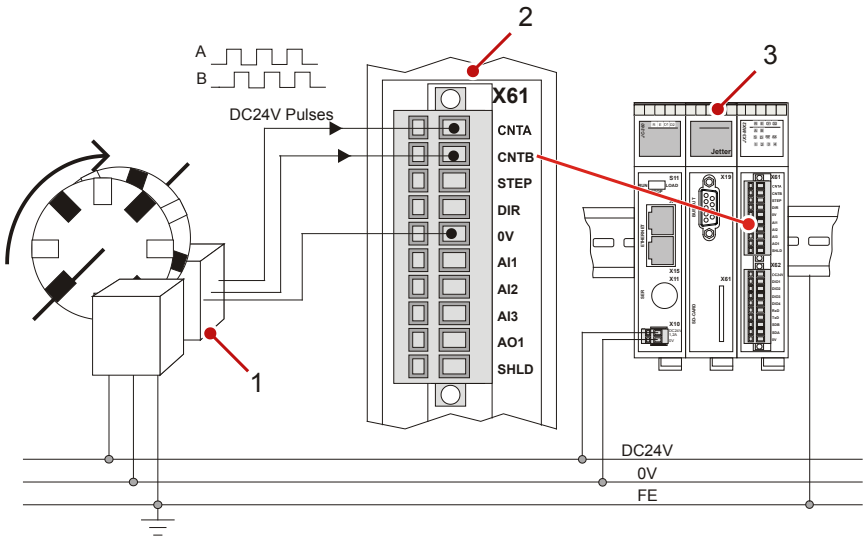
Use shielded cables to minimize noise.

Power Supply

Dual-channel counter and JX3 station can be supplied with power from the same power supply unit (PSU) or from separate PSUs.

Connecting a Dual-Channel Counter

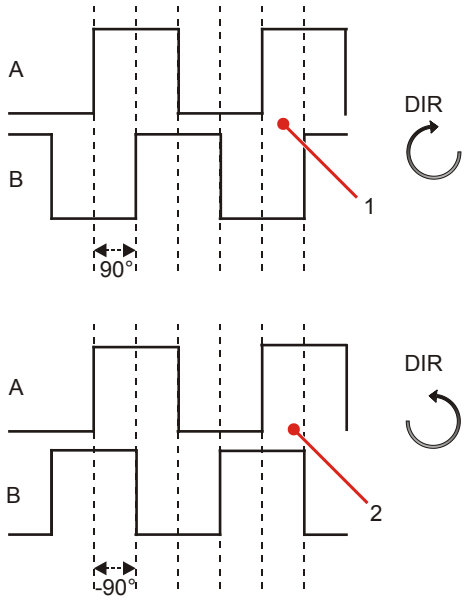
The following illustration shows a dual-channel counter (taking a fork light barrier as an example) connected to counter inputs CNTA and CNTB.



Number	Item
1	Dual-channel counter (taking a fork light barrier as an example) with an output signal of 24 V.
2	Connector X61 (enlarged view)
3	Power supply for JX3 station and dual-channel counter

Dual-Channel Counter Signals

The phase of the two dual-channel counter signals is shifted by +/- 90°.

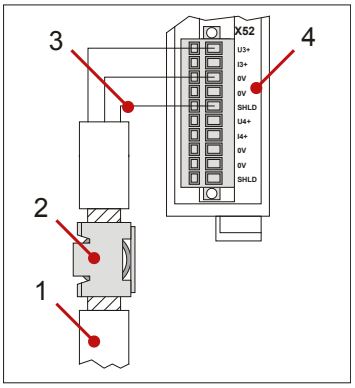


Number	Item
1	Dual-channel counter (also referred to as incremental counter) counting in positive direction
2	Dual-channel counter (also referred to as incremental counter) counting in negative direction

Improving Noise Immunity

For improving the noise immunity, follow the rules listed below:

- Connect the drain wire (3) directly to terminal X61.SHLD.
- Use a shield clamp (2) to provide additional grounding of the shield.



Number	Item
1	Cable to the counter
2	Shield clamp
3	Drain wire (copper)
4	Module JX3-MIX1

Related Topics

- **Technical Specifications** (see page 215)

4.2 Indicators and LEDs

Indicators of JX3-MIX1

The module JX3-MIX1 is equipped with the following LEDs:

- 1 LED indicating that the OS is running
- 1 LED indicating error conditions
- 2 diagnostic LEDs
- 2 LEDs indicating the counter status
- 4 LEDs indicating the stepper motor status
- 8 LEDs indicating the status of the multi-purpose I/Os

Table of Contents

Topic	Page
LEDs of JX3-MIX1 Module	63

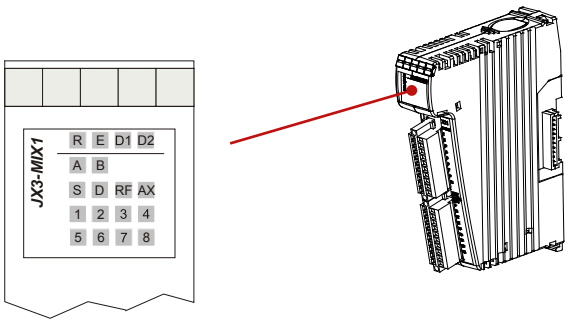
LEDs of JX3-MIX1 Module

Introduction

The module JX3-MIX1 indicates conditions and errors through its LEDs. This feature lets you directly locate an error.

LEDs of JX3-MIX1 Module

The JX3-MIX1 module is equipped with 18 LEDs which indicate conditions and errors.



LED	Color	Description
"R" LED	green	Run LED
"E" LED	red	Error LED
"D1" LED	red	Diagnostic function 1
"D2" LED	red	Diagnostic function 2
A	amber	Status LED for counter A
B	amber	Status LED for counter B
S	amber	Status for LED for stepper motor: Step
D	amber	Status for LED for stepper motor: Direction
SCRL	amber	Status for LED for stepper motor: Reference
AX	amber	Status for LED for stepper motor: Axis
1 ... 8	amber	Status LED for multi-purpose inputs/outputs 1 ... 8

Normal Operating Condition

In normal operating condition, the LEDs of the module JX3-MIX1 indicate the following:

R	E	D1	D2	Normal operating condition
● ON	○ OFF	○ OFF	○ OFF	No error, communication is active

LEDs of JX3-MIX1 Module

The JX3-MIX1 module is equipped with 18 LEDs which indicate conditions and errors.

R	E	D1	D2	State
ON	OFF	OFF	OFF	No error, communication is active
ON	ON	-	-	Communication with the bus node, resp. JC-3xx is not active
ON	-	ON	-	Hardware failure
ON	-	-	1Hz	OS of the module is not valid
ON	-	2Hz	2Hz	OS update is running

With its amber LEDs the module JX3-MIX1 indicates the status of individual I/O signals or a functional group.

Example 1:

- The amber LED "RF" is lit: The reference position of the stepper motor is set.

Example 2:

- The amber LED # 3 is lit: Logic high level applied to multi-purpose I/O DIO3.

LED	State	Description
A	OFF	Logic level of counter input A is low
	ON	Logic level of counter input A is high
B	OFF	Logic level of counter input B is low
	ON	Logic level of counter input B is high
S	OFF	Logic level of STEP signal for stepper motor is low
	ON	Logic level of STEP signal for stepper motor is high
D	OFF	Logic level of DIR signal for stepper motor is low
	ON	Logic level of DIR signal for stepper motor is high
SCRL	OFF	The reference position of the stepper motor is not set
	ON	The reference position of the stepper motor is set
AX	OFF	Stepper motor has not yet reached the destination window
	ON	Stepper motor has reached the destination window
1	OFF	Logic level of multi-purpose I/O DIO1 is low
	ON	Logic level of multi-purpose I/O DIO1 is high
...		
8	OFF	Logic level of multi-purpose I/O DIO8 is low
	ON	Logic level of multi-purpose I/O DIO8 is high

4.3 Installing, Replacing, and Removing the Module

Introduction

This chapter covers installation, replacement and removal of JX3 modules.

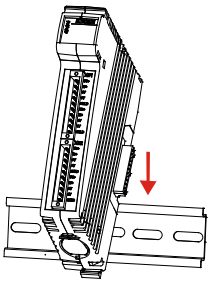
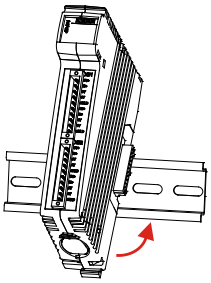
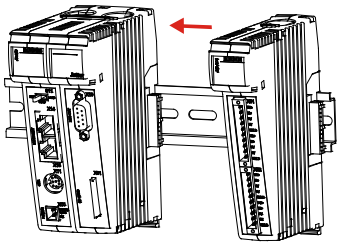
Contents

Topic	Page
Installing a JX3 Peripheral Module on a DIN Rail	67
Replacing a JX3 Peripheral Module	68
Removing a JX3 Peripheral Module from the DIN Rail	70

Installing a JX3 Peripheral Module on a DIN Rail

Installation

To install a JX3 peripheral module on a rail to DIN EN 50022 proceed as follows:

Step	Action	
1		Place the JX3 peripheral module on the upper edge of the DIN rail.
2		Snap the JX3 peripheral module onto the lower edge of the DIN rail.
3		Slide the JX3 peripheral module to the other modules of the JX3 station.

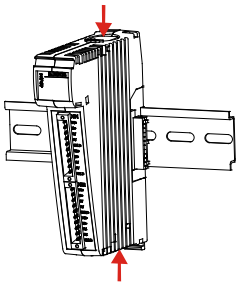
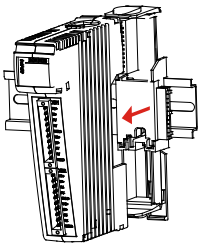
Related Topics

- **Replacing a JX3 Peripheral Module** (see page 68)
- **Removing a JX3 Peripheral Module from the DIN rail** (see page 70)

Replacing a JX3 Peripheral Module

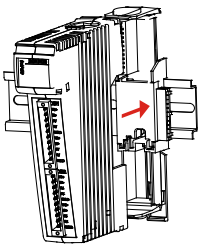
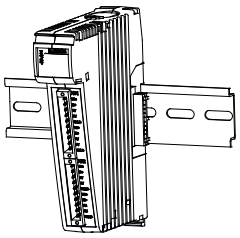
Removing the JX3 Enclosure

To remove the JX3 enclosure of the JX3 peripheral module from the JX3 backplane module proceed as follows:

Step	Action	
1	Remove power from the JX3 station.	
2		Press the upper and lower latches. Keep the latches pressed.
3		Pull off the JX3 enclosure from the JX3 backplane module.

Installing the JX3 Enclosure

To attach the enclosure of the JX3 peripheral module to the JX3 backplane module proceed as follows:

Step	Action	
1		Slide the JX3 enclosure onto the JX3 backplane module until the latches snap into place.
		**Result:** Installation of the JX3 peripheral module to the JX3 backplane module is now completed.

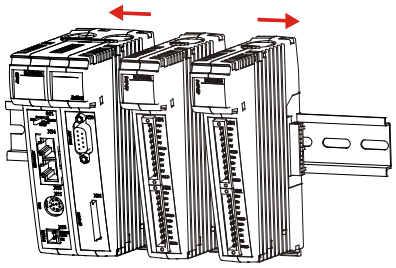
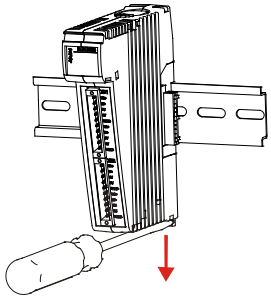
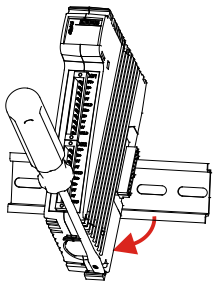
Related Topics

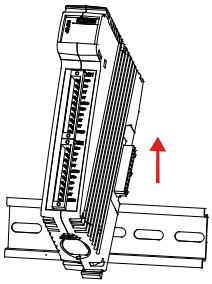
- **Installing JX3 Peripheral Modules on a DIN Rail** (see page 67)
- **Removing a JX3 Peripheral Module from the DIN Rail** (see page 70)

Removing a JX3 Peripheral Module from the DIN Rail

Removing

To remove a JX3 peripheral module from a rail to DIN EN 50022 proceed as follows:

Step	Action
1	Remove power from the JX3 station.
2	Slide the adjacent JX3 peripheral modules aside. By doing so, the JX3 backplane to the other JX3 peripheral modules is disconnected. 
3	Pull down the DIN rail latch. 
4	Swing the lower part of the JX3 peripheral module forward. 

Step	Action
5	Remove the JX3 peripheral module from the DIN rail. 

Related Topics

- **Installing JX3 Peripheral Modules on a DIN Rail** (see page 67)
- **Replacing a JX3 Peripheral Module** (see page 68)

5 Initial Commissioning

Purpose of this Chapter

This chapter summarizes the initial commissioning of the module JX3-MIX1 using the following functions:

- Applying a voltage to analog output OUT1
- Switching a multi-purpose I/O at digital output DIO1
- Connecting a stepper motor and moving the axis to a given position

Prerequisites

To be able to commission the JX3-MIX1 module, the following prerequisites must be fulfilled:

- The module JX3-MIX1 is connected to a JetControl PLC.
- The controller is connected to a PC.
- A suitable stepper motor amplifier and stepper motor are connected to the module JX3-MIX1.
- The programming tool JetSym is installed on the PC.
- The minimum requirements regarding modules, controllers and software are fulfilled.

Contents

Topic	Page
Behavior After Power-Up	74
Initial Commissioning Along with a JC-3xx	75
Initial Commissioning Along with a JC-24x	80

Behavior After Power-Up

Configuration

The system to be commissioned consists of the following components: a JC-350, the modules JX3-MIX1 and JX3-DI16.

Power-Up Behavior

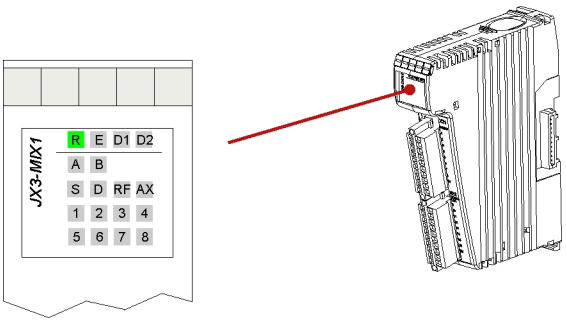
When you power-up the module JX3-MIX1, the following behavior results:

Type of connection	Behavior
Analog output	■ 0 V are applied to the analog output.
Multi-purpose inputs/outputs	■ No voltage is applied to the multi-purpose digital I/Os.
Stepper motor	■ The stepper motor controller does not apply pulses to the STEP output. ■ 0 V are applied to the DIR output.

To output an analog voltage, the module JX3-MIX1 needs not be configured after power-up.

Condition of the LEDs

If commissioning has been completed without error, the condition of the LEDs on the module JX3-MIX1 is as follows:

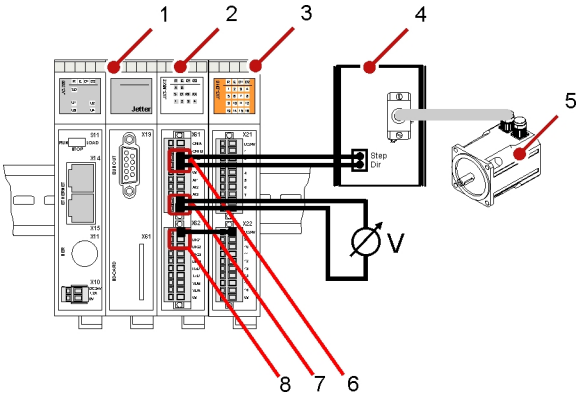


LED	Color	Description
"R" LED	green	Run LED is lit
"E" LED	red	Error LED
"D1" LED	red	Diagnostics 1 LED
"D2" LED	red	Diagnostics 2 LED
A, B, S, D, RF, AX, 1..0.8	amber	Status LEDs

5.1 Initial Commissioning Along with a JC-3xx

Configuration

The initial commissioning is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX1	MIX module, module number 2
3	JX3-DI16	Other JX3 module within the JX3 station
4	Driver	Stepper motor power amplifier
5	Stepper motor	
6	Stepper motor outputs	Stepper motor outputs DIR and STEP
7	Analog output	Analog output DC 0 ... 10 V
8	Multi-purpose inputs/outputs; here: DIO1	24 V input/output

Contents

Topic **Page**
Initial Commissioning: Analog Output 76
Initial Commissioning: Stepper Motor 77
Initial Commissioning of Multi-Purpose Inputs/Outputs 79

Initial Commissioning: Analog Output

Analog Output: Determining the Register Number

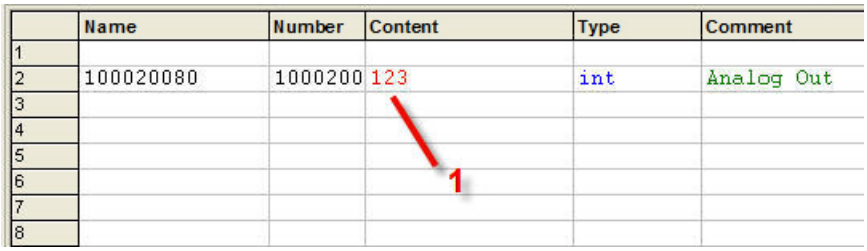
The value of analog output AO1 is assigned to module register MR 80. The register number is made up as shown below:

1	0	0	m	m	0	0	8	0

Item	Description
mm	Module number of the module within the JX3 station: in the given case 02

Analog Output: Using JetSym to Output a Voltage

This example describes how to output a voltage via analog output AO1 using JetSym's Setup pane and register number 100020080:
In the given example: Value 123 corresponds to 30 mV.



Number	Description	Values
1	New value for analog output AO1	0 = 0 V 4,095 = +10 V

Initial Commissioning: Stepper Motor

Stepper Motor: Register Number

The stepper motor register numbers start with the basic address MR 100mm1800.

1	0	0	m	m	1	8	0	0

Item	Description
mm	Module number of the module within the JX3 station: in the given case 02

First Test

For a first test, move the stepper motor axis a fraction of a full revolution. The parameters of a full stepper motor revolution depend on the number of increments specific to the stepper motor amplifier.

If, for instance, the resolution is 1,000 steps per revolution, use 100 steps for the purpose of initial commissioning.

To make the stepper motor advance 100 steps, proceed as follows:

Step	Action
1	Enter the set stepping rate: MR 1803 := 200;
2	Set the reference position manually: MR 1802 := 3; Result: ■ The actual position is set to zero. ■ The reference position of the system (system home) is set.
3	Set a new position: MR 1802 := 150;

JetSym STX Program

```
Var
    Step_State : Int At %VL 100021800;
    Step_Cmd   : Int At %VL 100021801;
    Step_Pos   : Int At %VL 100021802;
    Step_Velo  : Int At %VL 100021803;
End_Var;

Task Move_Stepper
    // Setting the stepping rate of the motor
    Step_Velo := 200;
    // Setting the reference point manually:
    // This instruction sets the actual position
    // as reference point (home position)
    Step_Cmd := 3;
    // New set position
    Step_Pos := 150;
    // Waiting until the motor stops again
    While (Step_State.19) Continue;
    //...
End_Task;
```

Initial Commissioning of Multi-Purpose Inputs/Outputs

Multi-Purpose Inputs and Outputs: Determining the Register Number

Multi-purpose inputs/outputs are combined 16-bit inputs/outputs that grant you bit-coded access to inputs/outputs.

Prerequisite

The power supply DC +24 V is connected to X32.DC24V.

Output

The multi-purpose output of the JX3-MIX1 module has got the following module register number:

1	0	0	0	0	4	2	6	2

Input

The multi-purpose input of the JX3-MIX1 module has got the following module register number:

1	0	0	0	0	4	0	6	2

Multi-Purpose Outputs: Setting the Output as DIO1

In order to set this output as DIO1, enter the value 1 into MR 100004262.

Setting the Output as DIO1

MR 100004262 := 1;

Result:

LED "DIO1" is lit. Output DIO1 lets you control an actuator.

In the given configuration, MR 100004062 (input) contains the same value as MR 100004262 (output).

LED	State	Description
1	ON	Logic level of DIO1 is high

JetSym STX Program

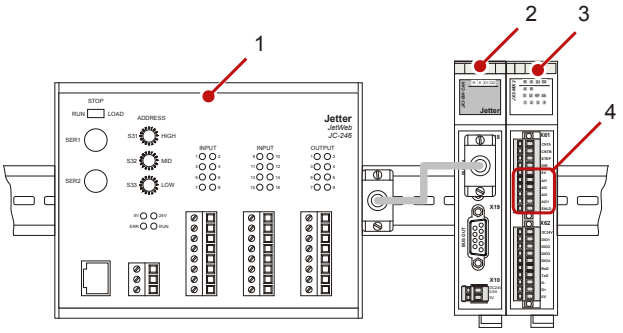
```
Var
    MIX_DIO_IN  : Int At %VL 100004062;
    MIX_DIO_OUT : Int At %VL 100004262;
    JX3_DI16    : Int At %VL 100020256;
End_Var;

Task MIX_Dio_Test
    // Setting output 1
    MIX_DIO_OUT := 1;
    // Reading input 3 (2 ^ 3 = 8)
    While (MIX_DIO_IN AND 8) Continue;
    //...
End_Task;
```

5.2 Initial Commissioning Along with a JC-24x

Configuration

The initial commissioning is based on the following configuration:



Number	Item	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus node for JX2 system bus
3	JX3-MIX1	I/O expansion module (module number 2)
4	X61	Terminal for analog output AO1

Contents

Topic **Page**
Initial Commissioning: Analog Output 81

Initial Commissioning: Analog Output

Determining the Register Number

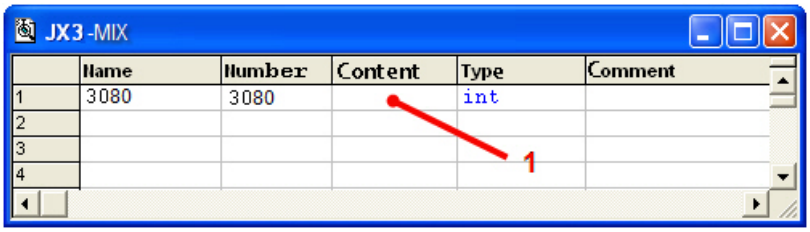
The value of analog output AO1 is assigned to module register MR 80. The register number is made up as shown below:

3	x	8	0

Item	Description
x	I/O module number of the module on the system bus - 2 Here: x = 0

How to Output a Voltage Using JetSym

This example describes how to output a voltage via analog output AO1 using JetSym's Setup pane and register number 3080:



Number	Item	Values
1	New value for analog output AO1	0 = 0 V 4,095 = +10 V

6 Programming

Purpose of this Chapter

This chapter is for supporting you in programming the JX3-MIX1 module in the following fields of activity:

- Determining the register numbers depending on the system configuration.
- Addressing the functional groups: Digital and analog I/Os, counters, stepper motor, at JX3-MIX2: Serial interface
- Programming of additional features and their functions.

Prerequisites

To be able to program the JX3-MIX1 module the following prerequisites must be fulfilled:

- The module JX3-MIX1 is connected to a JetControl PLC.
- The controller is connected to a PC.
- The programming tool JetSym is installed on the PC.
- The minimum requirements regarding modules, controllers and software are fulfilled.

Contents

Topic	Page
Abbreviations, Module Register Properties and Formats	84
Register and I/O Numbering for JX3 Modules	86
Register Access to JX3 Modules on the JX2 System Bus	94
Pointer to Process Data	101
Analog I/Os	104
Digital Inputs and Outputs	121
Counter Function	129
Stepper Motor	158
Additional Features	190
Status Monitoring via Collective Bits	204

Abbreviations, Module Register Properties and Formats

Abbreviations

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

Abbreviation	Description
R 100	Register 100
MR 150	Module register 150

Module Register Properties

Each module register is characterized by certain properties. For many module registers most properties are identical. For example, their value after reset is 0. 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
Type of access	Read / write
Value after reset	0 or undefined (e.g. release number)
Takes effect	Immediately
Write access	Always
Data type	Integer

Start Addresses of Functional Groups

The module JX3-MIX1 consists of several functional groups.

A module register number is assigned to each functional group. These module register numbers end with xx=000 and are used as start address of the group they have been assigned to.

MR	Meaning
0	State of the module as a whole
1	Commands applying to the whole module
2 ... 5	Process data
9	OS version
11xx	Analog input 1
12xx	Analog input 2
13xx	Analog input 3
14xx	Analog output 1
15xx	Counter input CNTA
16xx	Counter input CNTB
18xx	Stepper motor
974x	Oscilloscope

with xx = 00 ... 99

Number Formats

The number formats used in this document are listed in the following table:

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 following table:

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

6.1 Register and I/O Numbering for JX3 Modules

Introduction

The modules supplied by Jetter AG can carry out a great number of functions which can be called up by the user via registers. Each register and each digital input or output has been designated by an unambiguous number.

Usage: Register Number

Register numbers are used in the following cases:

- A module register is to be read or written in the Setup section of JetSym.
- A module register is to be declared as a variable in the application program of JetSym.
- A module register is to be declared as a tag in JetViewSoft.

Usage: I/O Number

I/O numbers are used in the following cases:

- A digital input is to be read in the Setup section of JetSym.
- A digital output is to be read or written in the Setup section of JetSym.
- A digital input or output is to be declared as a variable in the application program of JetSym.
- A digital input or output is to be declared as a tag in JetViewSoft.

Contents

Topic	Page
Registers and Module Registers	87
I/O Module Numbers in the JX2 System Bus	88
Register and I/O Numbers with JC-24x and JM-D203-JC-24x	89
Register and I/O Numbers with JC-3xx	90
Register and I/O Numbers for JC-647 with JX6-SB(-I)	91
Register and I/O Numbers for JC-800 with JX6-SB(-I)	92
Register and I/O Numbers for JC-9xx with JX6-SB(-I)	93

Registers and Module Registers

Definition: Module Registers

By means of module registers, process, configuration and diagnostic data can be read by the JX3-MIX1 module, or written to the module. The module register number is unambiguous within the respective module.

Definition: Registers

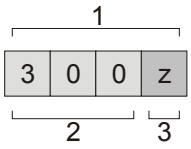
Registers can be accessed directly in the application program of the controller, in a setup pane of JetSym, or via the user interface directly. The register number is unambiguous within the respective system.

Example: Module Register

Via module register 9, the up-to-date operating system version of a JX3-AI4 can be accessed.

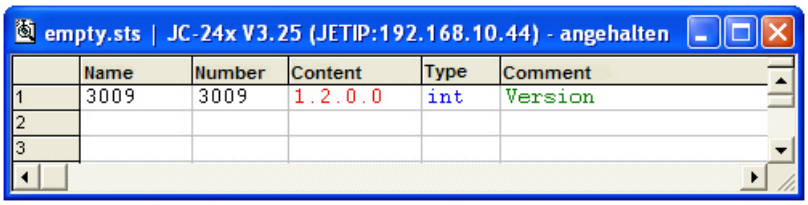
Example: Register

A JX3-AI4 module has been connected to the system bus of a JC- 24x by a JX3-BN-CAN bus head. The module has got I/O module number 2.



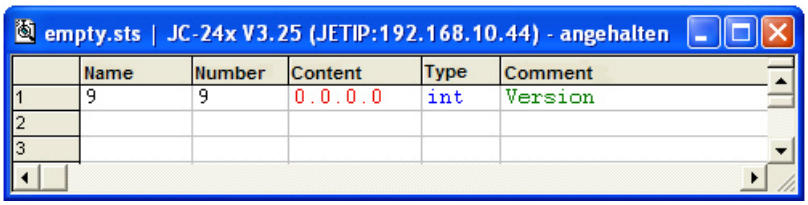
No.	Element	Meaning
1	Register number	Can be used immediately
2	Register prefix	300: for JX3 modules at the system bus of a JC-24x
3	Module register number	z = 9: OS version

In the setup pane of JetSym, the operating system version 1.2.0.0 can be read out via register number 3009 directly.



Counterexample: Module Register

If in the setup pane of JetSym number 9 is entered, the operating system version is not read out.



I/O Module Numbers in the JX2 System Bus

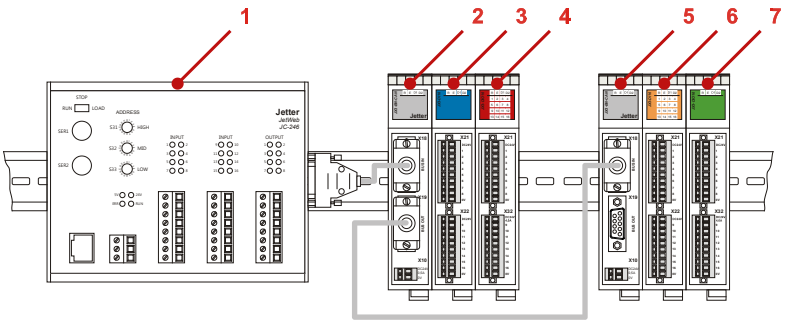
I/O Module Number

Each module in the JX2 system bus is assigned an I/O module number for clear identification. The I/O module number is dependent on the position of the module on the JX2 system bus. Assigning this module number is carried out according to the following rules:

- The controller has always got I/O module number 1.
- JX3-BN-CAN modules are counted separately.
- The first JX3-BN-CAN is assigned I/O module number 33.
- The JX2-PS1 and JX3-PS1 modules are not assigned an I/O module number.
- The first non-intelligent JX2, or JX3 module is assigned I/O module number 2.
- Intelligent JX2 modules, e.g. JX2-SV1, are not assigned an I/O module number.

Example: I/O Module Numbering

Several JX3 modules have been connected to a JC-24x controller via JX2 system bus.



Number	Module	I/O module number
1	JC-24x	1
2	JX3-BN-CAN	33
3	JX3-AO4	2
4	JX3-DIO16	3
5	JX3-BN-CAN	34
6	JX3-DI16	5
7	JX3-AI4	6

Register and I/O Numbers with JC-24x and JM-D203-JC-24x

Register Numbers for JX3 Modules

The register number for JX3 modules with JC-24x and JM-D203-JC-24x is composed as follows:

3	x	x	z

Element	Meaning	Value range
xx	I/O module number in the JX2 system bus - 2	0 ... 30
	At the bus head JX3-BN-CAN	31 ... 61
z	Module register number	0 ... 9

I/O Numbers for JX3 Modules

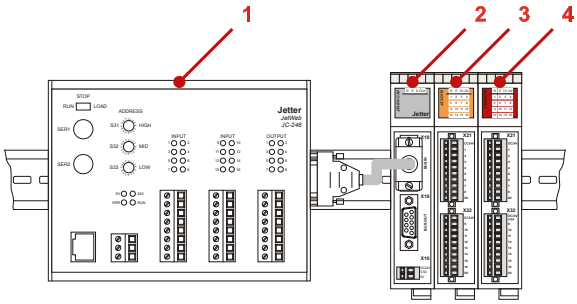
The I/O number for JX3 modules with JC-24x and JM-D203-JC-24x is composed as follows:

x	x	z	z

Element	Meaning	Value range
xx	I/O module number in the JX2 system bus	2 ... 32
zz	I/O number of the module	1 ... 16

Example

Several JX3 modules have been connected to a JC-24x controller.



Number	Module	I/O module number	Register	I/O
1	JC-24x	1	0 ... 1999	101 ... 116
2	JX3-BN-CAN	33	3310 ... 3319	-
3	JX3-DI16	2	3000 ... 3009	201 ... 216
4	JX3-DIO16	3	3010 ... 3019	301 ... 316

Register and I/O Numbers with JC-3xx

Module Numbers of a JX3 Station

The module numbers within a JX3 station are determined as follows:

- The figures of the module numbers are counted from left to right, starting with 1.
- The power supply module JX3-PS1 is not assigned a module number.

Register Numbers for JX3 Modules

The register number for JX3 modules with JC-3xx is composed as follows:

1	0	0	x	x	z	z	z	z

Element	Meaning	Value range
xx	Module number of the module in the JX3 station	02 ... 17
zzzz	Module register number	0000 9999

I/O Numbers for JX3 Modules

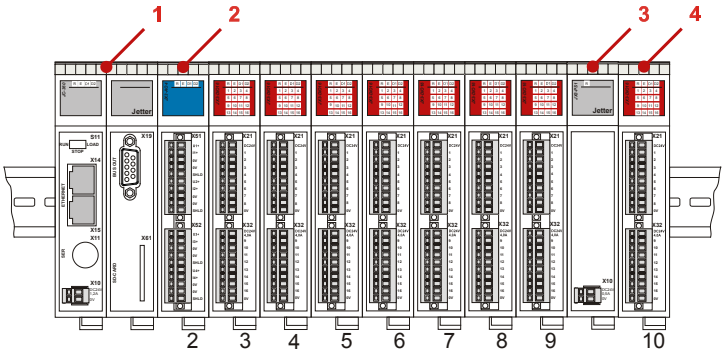
The I/O number for JX3 modules with JC-3xx is composed as follows:

1	0	0	0	0	x	x	z	z

Element	Meaning	Value range
xx	Module number of the module in the JX3 station	02 ... 17
zz	I/O number of the module	1 ... 16

Example

Several JX3 modules have been connected to a JC-3xx controller.



Number	Module	Module number	Register	I/O
1	JC-3xx	1	see JC-3xx documentation	
2	JX3-AO4	2	10002zzzz	1000002zz
3	JX3-PS1	-	-	-
4	JX3-DIO16	10	10010zzzz	1000010zz

Register and I/O Numbers for JC-647 with JX6-SB(-I)

Register Numbers for JX3 Modules

The register number for JX3 modules with JC-647 and JX6-SB(-I) is composed as follows:

3	m	0	3	x	x	z

Element	Meaning	Value range
m	Submodule socket	1 ... 3
xx	I/O module number on the JX2 system bus - 2	0 ... 30
	at the bus head JX3-BN-CAN	31 ... 61
z	Module register number	0 ... 9

I/O Numbers for JX3 Modules

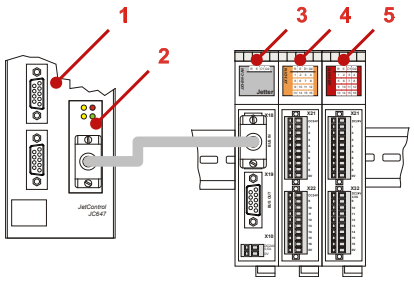
The I/O number for JX3 modules with JC-647 and JX6-SB(-I) is composed as follows:

m1	x	x	z	z

Element	Meaning	Value range
m1	Submodule socket + 1	2 ... 4
xx	I/O module number on the JX2 system bus	2 ... 32
zz	I/O number of the module	1 ... 16

Example

Several JX3 modules have been connected to a JC-647 controller with a JX6-SB(-I) submodule.



Number	Module	I/O module no.	Registers	I/O
1	JC-647	-	Module slot: 1	
2	JX6-SB	-	Submodule socket: 1	
3	JX3-BN-CAN	33	3103310 ... 3103319	-
4	JX3-DI16	2	3103000 ... 3103009	20201 ... 20216
5	JX3-DIO16	3	3103010 ... 3103019	20301 ... 20316

Register and I/O Numbers for JC-800 with JX6-SB(-I)

Register Numbers for JX3 Modules

The register number for JX3 modules with JC-800 and JX6-SB(-I) is composed as follows:

4	C	M	0	3	x	x	z

Element	Meaning	Value range
C	Module board number	1 ... 3
M	System bus module	1 ... 2
xx	I/O module number on the JX2 system bus - 2	0 ... 30
	At the bus head JX3-BN-CAN	31 ... 61
z	Module register number	0 ... 9

I/O Numbers for JX3 Modules

The I/O number for JX3 modules with JC-800 and JX6-SB(-I) is composed as follows:

5	2..3	C	M	x	x	z	z

Element	Meaning	Value range
2..3	Input	2
2..3	Output	3
C	Module board number	1 ... 3
M	System bus module	1 ... 2
xx	I/O module number on the JX2 system bus	2 ... 32
zz	I/O number of the module	1 ... 16

Register and I/O Numbers for JC-9xx with JX6-SB(-I)

Register Numbers for JX3 Modules

The register number for JX3 modules with JC-9xx and JX6-SB(-I) is composed as follows:

2	0	S	Y	0	3	x	x	z

Element	Description	Value range
S	Number of module board	1 ... 5
Y	Number of the JX6-I/O board (JX2 system bus) on the module board	1 ... 2
xx	I/O module number on the JX2 system bus - 2	0 ... 30
	at the bus head JX3-BN-CAN	31 ... 61
z	Module register number	0 ... 9

I/O Numbers for JX3 Modules

I/O numbers for JX3 modules connected to a JC-9xx equipped with a JX6-SB(-I) is composed as follows:

2	0	S	Y	0	x	x	z	z

Element	Description	Value range
S	Number of module board	1 ... 5
Y	Number of the JX6-I/O board (JX2 system bus) on the module board	1 ... 2
xx	I/O module number on the JX2 system bus	02 ... 32
zz	Module specific I/O number	1 ... 16

6.2 Register Access to JX3 Modules on the JX2 System Bus

Introduction

Each JX3 module supports over 10,000 module registers. At the JX2 system bus, access to the 10,000 module registers is made via 10 registers. Eight module registers can directly be accessed by entering a register number. The remaining 9,992 module registers can be accessed in indirect mode via an index register and a value register.

Direct Register Access

The following module registers have been assigned to register numbers directly.

- Status
- Command
- Process data
- Operating system, respectively firmware version

Indirect Register Access

Any remaining module registers of the JX3 module can only be accessed in indirect mode via an index register and a value register.

Contents

Topic	Page
Direct Register Access to JX3 Modules in the JX2 System Bus	95
Example: Direct Register Access	96
Indirect Register Access to JX3 Modules on the JX2 System Bus	97
Example: Indirect Register Access	99
Module Registers for Indirect Register Access	100

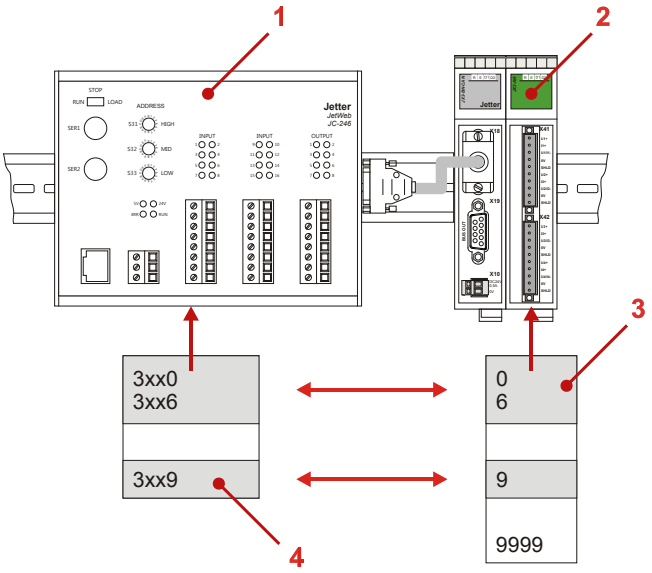
Direct Register Access to JX3 Modules in the JX2 System Bus

Direct Register Access

At direct register access, a module register of the module is directly assigned to a register number. Via this register, the value of the module register can be read and written.

Assignment of the Register Numbers

At direct register access, the module registers have been assigned to the register numbers as follows:



Number	Component	Description
1	JC-24x	Controller
2	JX3-AI4	JX3 module with 10,000 module registers
3	Module registers	Module register numbers of the JX3 module for direct access
4	Register numbers	Register numbers of the controller for direct access

Survey of Direct and Indirect Module Registers

In the following table, the module registers are shown which can be accessed in the JX2 system bus either in direct or in indirect mode.

Module register number	Direct	Indirect
0 ... 6	✓	
7 ... 8		✓
9	✓	
10 ... 9,999		✓

Example: Direct Register Access

Purpose of this Example

This example is to illustrate how module registers are written into directly. The exact function of the power supply used is not relevant.

Task

At a JX3-DIO16, the power supply of the digital outputs are to be controlled at the terminal point X32.DC24V. At a failure of the power supply, an error routine is to be carried out.

Solution

In MR 0 of the JX3-DIO16, a checkup is made if bit 2 has been cleared. After this, the error routine is carried out.

Configuration

The example is based on the following configuration:

Number	Component	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus I/O module number 33
3	JX3-DIO16	Digital I/O module I/O module number 2

JetSym ST Program

```
Var
    // Status register
    State : Int At %VL 3000;
End_Var;

Task 0
    // wait, until power is zero
    When
        BIT_CLEAR(State, 2)
    Continue;
    // Error routine
End_Task;
```

Indirect Register Access to JX3 Modules on the JX2 System Bus

Overview of Registers

At indirect register access, the following module registers are used:

Registers	Description
MR 7	Index for indirect register access
MR 8	Value for indirect register access

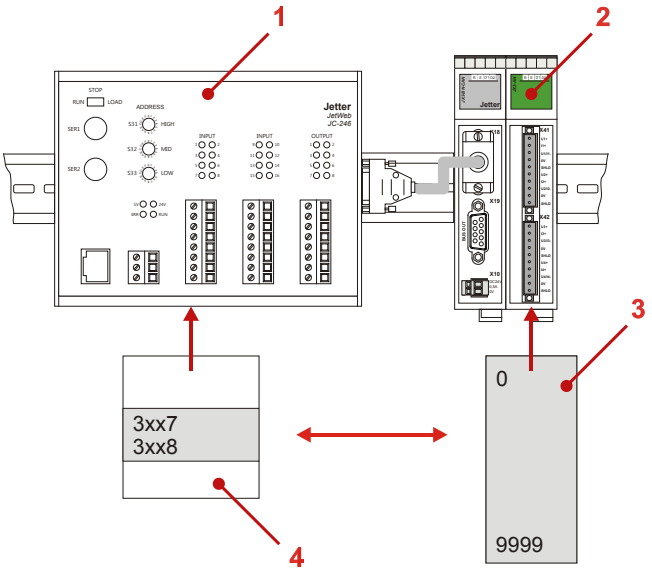
Indirect Register Access

The indirect register access to a module register is carried out via an index and a value register in two steps.

Step	Action
1	Write the number of the module register into MR 7 *Index for Indirect Register Access*.
2	Read, respectively write, the value of the module register, via MR 8 *Value for Indirect Register Access*.

Assignment of the Register Numbers

At indirect register access, the module registers have been assigned to the register numbers as follows:



Number	Component	Function
1	JC-24x	Controller
2	JX3-AI4	JX3 module with 10,000 module registers
3	Module registers	Module register numbers of the JX3 module for indirect access
4	Register numbers	Register numbers of the controller for indirect access

Survey of Direct and Indirect Module Registers

In the following table, the module registers are shown which can be accessed either in direct or in indirect mode:

Module register number	Direct	Indirect
0 ... 6	✓	
7 ... 8		✓
9	✓	
10 ... 9,999		✓

Rules Applying to Indirect Register Access

Please make sure at indirect register access, that MR 7 *Index for Indirect Register Access* is not overwritten by another source.

Please keep to the following rules when applying indirect register access to JX3 modules:

- In the application program, the registers may only be accessed within one task.
- Simultaneous register access from various sources is not permitted.

Possible sources are:

- Various tasks of the application program in the controller
- JetSym setup
- Visualization

Related Topics

- **Register Description for Indirect Register Access** (see page 100)
- **Example: Indirect Register Access** (see page 99)

Example: Indirect Register Access

Purpose of this Example

This example is to illustrate how module registers are written into in indirect mode. The exact function of the digital filters used is not relevant.

Task

On a JX3-DIO16, the digital filters of the inputs IN1 to IN4 are to be set to 16 ms.

Solution

Via MR 263, the filter time is set to 16 ms. Then, the filters are activated via MR 262. All module registers can be accessed in indirect mode.

Configuration

The example is based on the following configuration:

Number	Component	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus I/O module number 33
3	JX3-DIO16	Digital I/O module I/O module number 2

JetSym ST Program

```
Var
    // Index Register
    Index : Int At %VL 3007;
    // Value Register
    Data  : Int At %VL 3008;
End_Var;

Task 0
    // Set index register to MR 263
    Index := 263;
    // Write value 7 to filter time in indirect mode in MR 263
    Data := 7;

    // Set index register to MR 262
    Index := 262;
    // Activate filter for IN 1 .. IN 4 in MR 262
    BIT_SET(Data, 0);
    BIT_SET(Data, 1);
    BIT_SET(Data, 2);
    BIT_SET(Data, 3);

    // ...
End_Task;
```

Module Registers for Indirect Register Access

MR 7

Index for Indirect Register Access

Via MR 7, a module register number for indirect register access is specified.

Module Register Properties	
Values	0 .. 9,999
Value after reset	9

MR 8

Value for Indirect Register Access

Via MR 8, a module register value is read or written.

Module Register Properties	
Values	Dependent on the specified module register number in MR 7

6.3 Pointer to Process Data

Introduction

This chapter describes how to use and program pointers to process data.

Purpose of Process Data Pointers

For compatibility reasons the module JX3-MIX1 provides 10 specific module registers.

Process data pointers are not relevant to controllers of the JetControl 3xx series as this series is able to directly address 10,000 specific module registers.

Process data pointers can be used with the following controllers and are of great importance for them:

- JC-24x
- JC-647 with JX3-BN-CAN

These controllers let you parameterize how data are mapped to module registers 2 ... 5.

Contents

Topic	Page
Using Process Data Pointers	102

Using Process Data Pointers

Introduction

Process data pointers let you assign various input data to permanent module register addresses.
The following elements belong to input data:

- Analog inputs
- Counts
- As-is position or as-is stepper frequency of the stepper motor

The following characteristics apply to JC-2xx or JC647:
Process data pointers let you map data to MR 2 ... MR 4. The analog output is permanently mapped to MR 5.

The following characteristics apply to JC-2xx or JC647:
Process data pointers let you map data to MR 64 ... MR 66. The analog output is permanently mapped to MR 80.

The process data are displayed in MR 2 ... MR 5 and likewise in MR 64 ... MR 66.

Process Data Pointer Registers

Register	Description
MR 800	Pointer to process data. The result is displayed in MR 2 and MR 64.
MR 801	Pointer to process data. The result is displayed in MR 3 and MR 65.
MR 802	Pointer to process data. The result is displayed in MR 4 and MR 66.

Assigning Process Data Pointers

Enter into MR 800 ... MR 802 which data are to be displayed in MR 2 ... MR 4 and MR 64 ... MR 66.

Value	Output
0	Analog input 1 (X61.AI1), converted value
1	Analog input 2 (X61.AI2), converted value
2	Analog input 3 (X61.AI3), converted value
3	Counter A (X61.CNTA), count value
4	Counter B (X61.CNTB), count value
5	As-is stepper motor position
6	Stepper motor speed

Example

MR 2 and MR 64 are to display the count value of single-channel counter A; MR 3 and MR 65 are to display the stepper motor position.

JetSym STX Program

```
Var
    JX3_MIX_ProcDataPointer0    : Int At %VL 100020800;
    JX3_MIX_ProcDataPointer1    : Int At %VL 100020801;
    Counter_A                   : Int At %VL 100020002;
    Counter_A_AlternAccess      : Int At %VL 100020064;
End_Var;
Task Main Autorun
    // ....
    // Initialization
    // ....
    // Mapping:
    JX3_MIX_ProcDataPointer0 := 3;
    JX3_MIX_ProcDataPointer1 := 5;
    // Result:
    // Now, MR 2 displays the count of single-channel counter A
    // and MR 3 the actual stepper motor position
    Loop
        If (Counter_A > 1234567) Then
           // ...
           // Reset counter A
           Counter_A_AlternAccess := 0;
        End_If;
    End_Loop;
End_Task;
```

6.4 Analog I/Os

Introduction

This chapter describes how to implement read access to analog inputs and write access to the analog output.

Applications

The following applications are possible:

- Controlling of analog actuators and processing of readings from analog sensors.

Independence of Analog Inputs and Outputs

Operation of the analog output is independent of the analog inputs.

Each analog input can be configured and operated regardless of the configuration of the other analog inputs.

Contents

Topic	Page
Analog Inputs	105
Analog Output	113

6.4.1 Analog Inputs

Introduction

This chapter describes how to use JetSym to parameterize and read out the three analog inputs of the module JX3-MIX1.

Contents

Topic	Page
Converting Analog Values Into Digital Values	106
Description of Registers: Reading In Voltages	107
Example: Configuring the Analog Input Using a JC-3xx	109
Example: Configuring the Analog Input Using a JC-24x	111

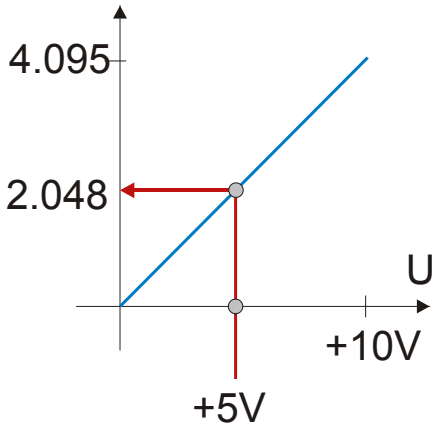
Converting Analog Values Into Digital Values

Converting Voltages Into Digital Values

The analog voltage value converted by the module JX3-MIX1 into a digital value is output without any scaling factor.

To calculate the applied voltage use the formula below (where x = 1 for channel 1 ... x = 3 for channel 3):

$$\text{Voltage} = 10V \cdot \frac{MR1x02}{4095}$$



Reading In Voltages: Example

You want to measure an analog voltage applied to X61.AI2. This voltage is subject to 16-fold averaging.

Prerequisites:

An analog sensor is connected to input X61.AI2.

Our example is based on the following assumptions:

The analog sensor signals a voltage of 4.83 V.

Step	Action
1	Set averaging to 16 fold: Enter value 16 into MR 1206.
2	Read out MR 1202 to obtain the digital value. The value in MR 1202 is 1,978.
3	Convert the digital value in MR 1202 into volts: $U[V] = 10V \cdot \frac{MR1x02}{4095} = 10V \cdot \frac{1.978}{4095} = 4.83V$

Description of Registers: Reading In Voltages

Register Overview

For configuring the user-defined scaling function, the following module registers are used:

Register	Description
MR 1y00	State of analog I/Os (y = 1 ... 4)
MR 1y02	Averaged measured value for analog input y (y = 1 ... 3)
MR 1y06	Enabling/disabling averaging for analog input y (y = 1 ... 3)

MR 1y00

State of analog I/O

In MR 1y00 *State of analog I/O* the module indicates status and error messages for the corresponding analog I/O.

The following applies to module registers (y = 1 ... 4):

1100	Analog input 1
1200	Analog input 2
1300	Analog input 3
1400	Analog output The behavior of analog outputs and inputs is the same.

Bit 4 **Error regarding reference values**

0 = No error

1 = Calibration values could not be read. You are not allowed to acknowledge this error. Send the JX3-MIX1 module to Jetter AG for repair. To this end, contact our hotline.

Bit 6 **Error: Analog I/O**

0 = No error

1 = An error has occurred in the analog submodule. LED D2 indicating the module state is lit. Restart the module. If the module is properly supplied with power and the error persists, send the JX3-MIX1 module to Jetter AG for repair. To this end, contact our hotline.

Bit 25 **Validity of measured values (analog inputs only)**

0 = The average of the analog input is still being calculated.

1 = The values of the analog inputs are valid. The bit is cleared only if

- errors have occurred
- averaging depth has been changed

Module register properties	
Values	Bit-coded
Value after reset	0

MR 1y02

Averaged measured value of the analog input

Register 1y02 outputs an analog value as moving average.

Module register properties		
Bit width		32 bits
Values	0 ... 4.095	für 0 ... 10 V
Value after reset	0	

MR 1y06

Configuration of the average

MR 1y06 is for configuring the averaging of the measured value. The value resulting from averaging is a moving average. With each incoming digitized reading the average of the last 4 or 16 measurements is determined. The averaging function works like a filter.

Enter value 1 into register 1y06 to disable the averaging function.

Module register properties		
Values	1	Averaging is disabled
	4	4-fold averaging
	16	16-fold averaging
Value after reset	16	
Takes effect	Immediately. The state of the internal averaging buffer can be seen from bit 25 in MR 1y01 (y = 1 ... 3).	

Example: Configuring the Analog Input Using a JC-3xx

Task

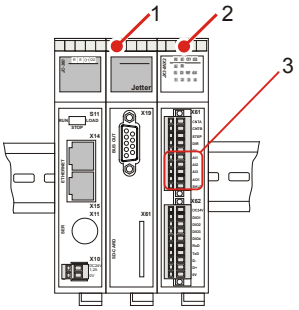
16-fold averaging is to be applied for one of the analog inputs on the module JX3-MIX1.

Solution

Configure the analog input using MR 1y06.

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX1	Multi-purpose expansion module
3	Analog input	In the given example: X61.AI1

JetSym STX Program

```
// Type declaration of module registers
Type
    TYPE_JX3_MIX:
    Struct
        // Averaged digital value of analog input # 1
        Analog_In_1 : Int At 1102*sizeof(Int);
        // Averaging for analog inputs
        Averaging_1: Int At 1106*sizeof(Int);
    End_Struct;
End_Type;

Var
    // Variable declaration of the module JX3-MIX
    JX3MIX_02 : TYPE_JX3_MIX At %VL 100020000;
    // Variable for the content of channel # 1
    Ana_In1 : int;
End_Var;

Task main Autorun
    // Configuring analog input # 1 to use 16-fold averaging
    JX3MIX_02.Averaging_1 := 16;

    // Reading in the measured value after 16-fold averaging
   // from analog input # 1
    Ana_In1 := JX3MIX_02.Analog_In1;

    // ...
End_Task;
```

Example: Configuring the Analog Input Using a JC-24x

Task

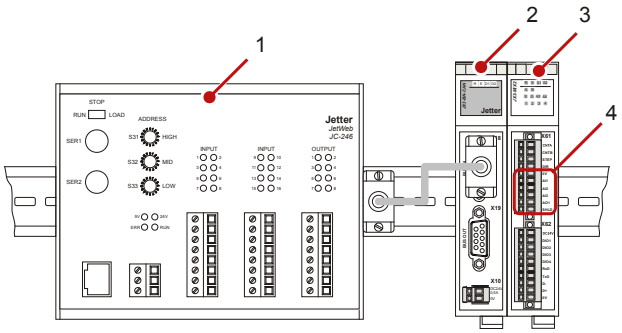
Analog input AI1 on the module JX3-MIX1 is to be used to measure a voltage.

Solution

Use indirect register access to read out the analog input.

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-MIX	Multi-purpose expansion module
4	Analog input AI1	X61.AI1

JetSym ST Program

```
Var
    JX3MIX : Struct
        // State and command MR 0, MR 1
        State       : Int;
        Command     : Int;
        // MR 2, MR 3 data
        DataReg02   : Int;
        DataReg03   : Int;
        zz_Dummy1   : Int;
        zz_Dummy2   : Int;
        zz_Dummy3   : Int;
        // Register for indirect register access MR 7, MR 8
        Index       : Int;
        Data        : Int;
        // OS version in MR 9
        Version     : Int;
    End_Struct At %VL 3000;
    Analog_In_Data : Int;
End_Var;

Task 0
    // Configuring the input to use 4-fold averaging
    JX3MIX.Index := 1106;
    JX3MIX.Data  := 4;
    // ...
    // Reading out the averaged value of input AI1
    JX3MIX.Index := 1102;
    Analog_In_Data  := JX3MIX.Data;
    // ...

End_Task;
```

6.4.2 Analog Output

Introduction

This chapter describes how to use JetSym to parameterize the analog output of the module JX3-MIX1 and how to write values to it.

Applications

The following applications are possible:

- Controlling analog actuators with voltage interface.

Contents

Topic	Page
Voltage Output	114
Register Description: Voltage Output	115
Example: A sine is output at X61.AO1 by JC-3xx	117
Example: Configuring the Analog Output Using a JC-24x	119

Voltage Output

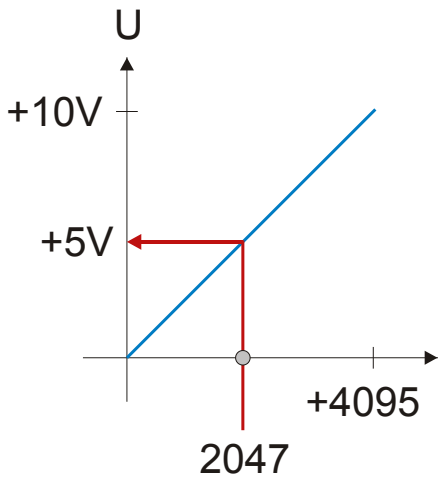
Converting Digital Values into Voltages

The JX3-MIX1 module converts a digital value into a voltage in linear mode.

Conversion is carried out according to the following formula:

$$MR = U \cdot \frac{4095}{10V}$$

User-defined scaling has not been implemented in the module.



Enter value 2,048 to MR 80 to get a voltage of 5.0 V at output X61.AO1.

Example 2: Voltage Output

You want a voltage of 7.24 V to be output.

Step	Action
1	In order to get the desired voltage, calculate the digital value: $MR = 7.24V \cdot \frac{4095}{10V} = 2964.78$
2	Round decimal positions to become an integer. Here: Rounding 2,964.78 renders 2,965.
3	Enter value 2,965 into MR 80.
4	**Result**: You get a voltage of 7,24 V at output X61.AO1.

Register Description: Voltage Output

Register Overview

For voltage output, the following module registers are used:

Register	Description
MR 80	Digital value for analog output AO1
MR 1400	Status register for error states

MR 80

Digital value for analog output AO1

The value in this module register is output as an analog value at terminal X61.AO1.

Module register properties		
Bit width		32 bits
Values	0 ... 4.095	0 ... 10 V
Value after reset	0	

MR 1y00

State of analog I/O

In MR 1y00 *State of analog I/O* the module indicates status and error messages for the corresponding analog I/O.

The following applies to module registers (y = 1 ... 4):

1100	Analog input 1
1200	Analog input 2
1300	Analog input 3
1400	Analog output The behavior of analog outputs and inputs is the same.

Bit 4	**Error regarding reference values** 0 = No error 1 = Calibration values could not be read. You are not allowed to acknowledge this error. Send the JX3-MIX1 module to Jetter AG for repair. To this end, contact our hotline.
Bit 6	**Error: Analog I/O** 0 = No error 1 = An error has occurred in the analog submodule. LED D2 indicating the module state is lit. Restart the module. If the module is properly supplied with power and the error persists, send the JX3-MIX1 module to Jetter AG for repair. To this end, contact our hotline.

Bit 25	**Validity of measured values (analog inputs only)** 0 = The average of the analog input is still being calculated. 1 = The values of the analog inputs are valid. The bit is cleared only if ■ errors have occurred ■ averaging depth has been changed

Module register properties	
Values	Bit-coded
Value after reset	0

Limitation to 0 ... 10 V

The module register is 32 bits wide. You can input values, which are beyond these limits. The JX3-MIX1 module limits these values to an output range of 0 ... 10 V.

Example: A sine is output at X61.AO1 by JC-3xx

Task

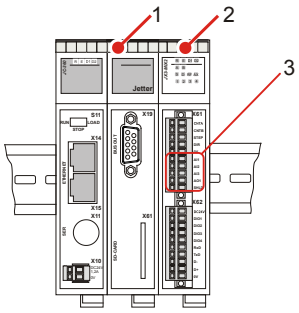
The analog output of the JX3-MIX1 module is to output a sine-shaped voltage at terminal X61.AO1.

Solution

Have data entered into MR 80 by an endless loop. The module outputs these analog voltage values.

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX1	Multi-purpose expansion module
3	Analog output # 1	Voltage range 0 ... +10 V

JetSym STX Program

```
Task Analog_Output

    Const
        c_PI            = 3.141592653589793;
        c_Pts           = 100;
        c_MaxOut        = 4095;
        cT_SineDelay    = T#100ms;
    End_Const;


    Var
        SinePoint:      Int;
        Sine:           Array[c_Pts] of Int;
        ProcessDataOut1: Int at %vl 100020080;
    End_Var;

        // Initialize sine array
    For SinePoint := 0 To c_Pts-1 by 1 Do
        Sine[SinePoint] := Int( (c_MaxOut/2)*sin( (2*c_PI/c_Pts) *
        SinePoint ) + (c_MaxOut/2) );
    End_For;

    // Loop for sine output -
    Loop
        For SinePoint := 0 to c_Pts-1 by 1 Do
            // Set test value
            ProcessDataOut1 := Sine[SinePoint];
            Delay(cT_SineDelay);
        End_For;
    End_Loop;
End_Task;
```

Example: Configuring the Analog Output Using a JC-24x

Task

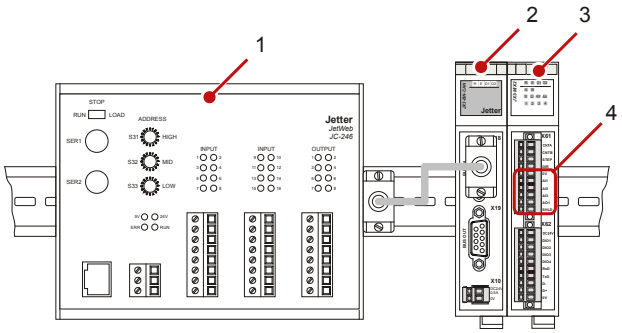
At the analog output of the JX3-MIX1 module, a voltage is to be output.

Solution

A value is written to an analog output via MR 80 to output an analog voltage.

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-MIX	Multi-purpose expansion module
4	Analog output # 1	X61.AO1

JetSym ST Program

```
Var
    JX3MIX : Struct
        // State and command MR 0, MR 1
        State       : Int;
        Command     : Int;
        // MR 2, MR 3 data
        DataReg02   : Int;
        DataReg03   : Int;
        zz_Dummy1   : Int;
        zz_Dummy2   : Int;
        zz_Dummy3   : Int;
        // Register for indirect register access MR 7, MR 8
        Index       : Int;
        Data        : Int;
        // OS version in MR 9
        Version     : Int;
    End_Struct At %VL 3000;
End_Var;

Task 0
    // Output of +5V at analog output AO1
    JX3MIX.Index := 80;
    JX3MIX.Data  := 2047;
    // ...
End_Task;
```

6.5 Digital Inputs and Outputs

Introduction

This chapter describes how to implement read access to digital inputs and write access to digital outputs.

Applications

The following applications are possible:

- Controlling of digital actuators and processing of input signals from digital sensors.
- Interfacing with the counter of the module JX3-MIX1.
- Interfacing with the stepper motor of the module JX3-MIX1 working as limit switch.

Multi-purpose I/Os

A multi-purpose I/O can be used as digital input or digital output. Configuration is not required.

- You can configure as many multi-purpose I/Os as required as digital input or output.
- If a multi-purpose I/O is used as digital input, the related digital output must be disabled (OFF).

Technical Data

Type of input/output	Number of input/output
Multi-purpose I/Os	DIO1 ... DIO8

Reading Back Outputs

Multi-purpose I/Os let you read back the physical state of a digital output via associated digital input.

Contents

Topic	Page
Example: Reading Inputs and Switching Outputs with a JC-3xx	122
Example: Reading Inputs and Switching Outputs Using a JC-24x	125
Example: Reading Inputs and Switching Outputs with a JC-647	127

Example: Reading Inputs and Switching Outputs with a JC-3xx

Task

Digital inputs DIO1 ... DIO8 are to be read out and the digital outputs DIO1 ... DIO3 of the JX3-MIX1 module are to be activated using controllers of the JC-3xx series.

Solution # 1

Declare in JetSym variables of the type bool and assign to them the I/O numbers of the digital inputs/outputs of the module JX3-MIX1.

Solution # 2

Access module register 256 to read all inputs as an entire byte.

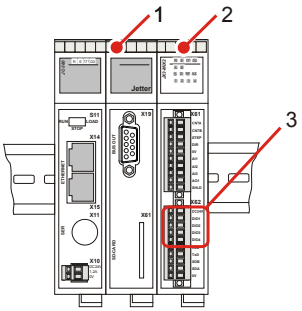
Access module register 512 to write all outputs as an entire byte.

Register	Description
MR 256	Reading DIO1 ... DIO8 as an entire byte; bit-coded
MR 512	Writing DIO1 ... DIO8 as an entire byte; bit-coded
MR 513	ErrorMask; bit-coded: The mask in MR 513 lets you specify which outputs, in fault condition, are set to a defined state via MR 514.
MR 514	ErrorState; bit-coded: MR 514 lets you specify the outputs to be set in the case of a communication error.

To create a mask for inputs and outputs enter in JetSym the corresponding bit pattern for the required I/O using the AND function.

Sample Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller JetControl 3xx
2	JX3-MIX1	Multi-purpose expansion module
3	DIO 1 ... DIO 8	Multi-purpose inputs/outputs DIO1 ... DIO8

I/O Numbers for JX3 Modules

I/O numbers for JX3 modules connected to a JC-3xx consist of the following elements:

1	0	0	0	0	x	x	z	z

Element	Description	Value range
xx	I/O module number on the system bus	02 ... 32
zz	I/O number of the module	01 ... 08

The module JX3-MIX1 is part of a JX3 station and its module number is 2. Coding of the input/output numbers:

Input/output	Module number 2	Input/output number
IN 1	2	100000201
...	2	...
IN 8	2	100000208
OUT 1	2	100000201
...	2	...
OUT 8	2	100000208

JetSym STX Program

```
Var
    // Declaring the inputs
    bi_In1 : Bool At %IX 100000201;
    //...
    bi_In8 : Bool a %IX 100000208;
    // ...
    // Declaring the outputs
    bo_Out1 : Bool At %QX 100000201;
    //...
    bo_Out8 : Bool At %QX 100000208;
    // ...
    Byte_In : Int At %VL 100020256;
    Byte_Out: Int At %VL 100020512;

End_Var;

Task 0 Autorun
    // Polling the inputs
    When
        bi_In1 = True AND
        bi_In4 = False
    Continue;
    // Setting the outputs
    bo_Out1 := True;
    bo_Out2 := True;
    // Resetting the outputs
```

```
    bo_Out3 := False;
    bo_Out4 := False;
    // ...
End_Task;

Task Alternative1
    // Polling the inputs
    When
        Byte_In.0 = True AND
        Byte_In.3 = False
    Continue;
    // Setting the outputs
    Byte_Out.2 := True;
    Byte_Out.1 := True;
    // optional:
    Byte_Out &= 0x55;
    // Resetting the outputs
    Byte_Out.4 := False;
    Byte_Out.3 := False;
    // ...
End_Task;
```

Example: Reading Inputs and Switching Outputs Using a JC-24x

Task

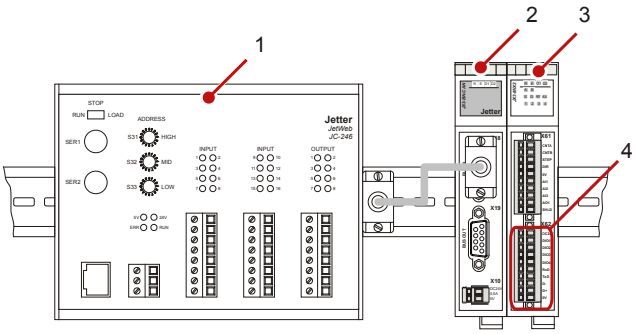
Read the digital inputs DIO1 ... DIO2 and activate the digital outputs DIO3 ... DIO4 of the module JX3-MIX1.

Solution

Declare in JetSym variables of the type bool and assign to them the I/O numbers of the digital inputs/outputs of the module JX3-MIX1.

Sample Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-24x	Controller JetControl 24x
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-MIX1	I/O module number 2
4	DIO1 ... DIO8	Digital inputs/outputs IN 1 ... 8

I/O Numbers for JX3-Modules

I/O numbers for JX3 modules connected to a JC-24x and JM-D203-JC24x consist of the following elements:

x	x	z	z

Element	Description	Value range
xx	I/O module number on the JX2 system bus	02 ... 32
zz	Number of input/output	01 ... 08

Determining Input/Output Numbers

In the given example, the module JX3-MIX1 has got I/O module number 2 on the JX2 system bus. I/O numbers of the digital inputs/outputs are listed below:

Input/output	I/O module number	I/O number
IN 1 / OUT 1	2	IN 201 / OUT 201
...	...	...
IN 8 / OUT 8	2	IN 208 / OUT 208

JetSym ST Program

```
Var
    // Declaring the inputs
    bi_In1 : Bool At %IX 201;
    bi_In2 : Bool At %IX 202;
    // ...
    // Declaring the outputs
    bo_Out1 :Bool At %QX 201;
    bo_Out8 :Bool At %QX 208;
    // ...
End_var;

Task 0
    // Polling the inputs
    WHEN
        bi_In1 = True AND
        bi_In2 = False
    CONTINUE;
    // Setting the outputs
    bo_Out1 := True;
    bo_Out8 := True;
    // Resetting the outputs
    bo_Out1 := False;
    bo_Out8 := False;
    // ...
End_Task;
```

Example: Reading Inputs and Switching Outputs with a JC-647

Task

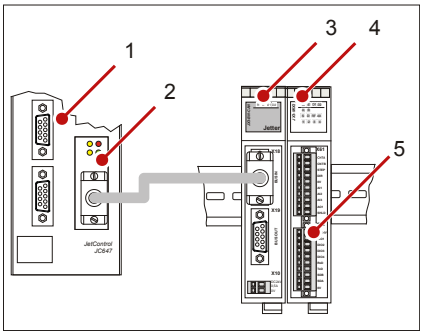
Read the digital inputs DIO1 ... DIO4 and activate the digital outputs DIO5 ... DIO8 of the module JX3-MIX1 using the controller JC-647.

Solution

Declare in JetSym variables of the type bool and assign to them the I/O numbers of the digital inputs/outputs of the module JX3-MIX1.

Sample Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-647	Controller JetControl 647
2	JX6-SB(-I)	Submodule for JX2 system bus: Submodule socket # 2
3	JX3-BN-CAN	Bus head for JX2 system bus
4	JX3-MIX1	Multi-purpose inputs/outputs I/O module number 2
5	IN 1 ... IN 8 OUT 1 ... OUT 8	Digitale inputs IN 1 ... IN 8 and digital outputs OUT 1 ... OUT 8

I/O Numbers for JX3 Modules

I/O numbers for JX3 modules connected to a JC-647 equipped with a JX6-SB(-I) consist of the following elements:

m1	x	x	z	z

Element	Description	Value range
m1	Submodule socket + 1	2 ... 4
xx	I/O module number on the JX2 system bus	02 ... 32
zz	Number of input/output	01 ... 08

Determining Input/Output Numbers

The JX6-SB(-I) submodule is located in socket # 1. I/O numbers of the digital inputs/outputs on the JX2 system bus are listed below:

Input/output	Submodule socket	I/O module number	I/O number
IN 1	1	2	20201
...	...	...	...
IN 8	1	2	20208
OUT 1	1	2	20201
...	...	...	...
OUT 8	1	2	20208

JetSym ST Program

```
Var
    // Declaring the inputs
    bi_In1 : Bool At %IX 20201;
    bi_In2 : Bool At %IX 20202;
    // ...
    // Declaring the outputs
    bo_Out5 : Bool At %QX 20205;
    bo_Out8 : Bool At %QX 20208;
    // ...
End_Var;
    // Polling the inputs
    When
        bi_In1 = True AND
        bi_In2 = False
    Continue;
    // Setting the outputs
    bo_Out5 := True;
    bo_Out8 := True;
    // Resetting the outputs
    bo_Out5 := False;
    bo_Out8 := False;
    // ...
End_Task;
```

6.6 Counter Function

Introduction

This chapter describes, how you can make use of the single/dual channel counter of the JX3-MIX1 module.

Applications

The following applications are possible:

- Digital sensors count tablets in a tablet filling plant.
- A sensor acquires a motor position. This way, losing steps is minimized for the stepper motor.

Independence of the Single-Channel Counters

Each single-channel counter can be configured and operated individually. It is independent of the other single-channel counter.

Interdependency Between Single- and Dual-Channel Counter

Those two counters are interdependent.

- You cannot operate the single- and dual-channel counter simultaneously.
- If a mode changes, all counters are deactivated.

Contents

Topic	Page
Programming a Single-Channel Counter	130
Programming a Dual-Channel Counter	133
Special Functions of the Counter Module	138

6.6.1 Programming a Single-Channel Counter

Introduction

This chapter covers parameterizing and possible applications of the single-channel counter.

Contents

Topic	Page
Using a Single-Channel Counter	131

Using a Single-Channel Counter

Introduction

This chapter provides operating instructions for the single-channel counter of the JX3-MIX1 module.

Prerequisites

You have connected a digital sensor to the JX3-MIX1 module, detecting counting pulses applied to input X61.CNTA or X61.CNTB.

Commissioning of the Single-Channel Counter

To get counts in MR 1y03, configure the module registers:

Step	Action
1	Activate the single-channel counter: Write value 40 to activate the single-channel counter in MR 1y01.
2	Counter enable in the software: Write value 30 to command register MR 1y01 to activate the single-channel counter.
3	**Result**: ■ While count pulses are being registered, you can see changing count values in MR 1y03. ■ The dual-channel counter is deactivated.
4	**Changing the counting direction**: After reset, the module counts in positive direction.

If the counting direction ...	... then ...
is to be changed,	■ write command 32 for positive counting direction to MR 1y01. ■ write command 33 for negative counting direction to MR 1y01.

Where y = 5 represents single-channel counter A, and y = 6 represents single-channel counter B.

JetSym STX Program

```
Task SingleCounter Autorun

Var
    CntA_Status          : Int At %VL 100021500;
    CntA_Command         : Int At %VL 100021501;
    CntA_CntValue        : Int At %VL 100021503;

End_Var;

    // Setting counter module to single-channel counter A and to
single-channel counter B
    CntA_Command := 40;
    // Setting the count value
    CntA_CntValue := 987654321;
    // Enabling single-channel counter
    CntA_Command := 30;
    // Negative counting direction
    CntA_CommAND := 33;
    // Waiting for result to be <0
    When (CntA_CntValue < 0) Continue;
    // Positive counting direction
    CntA_CommAND := 32;
    // ...
End_Task;
```

6.6.2 Programming a Dual-Channel Counter

Introduction

This chapter describes how to set up the dual-channel counter.

Contents

Topic	Page
Using a Dual-Channel Counter	134
Using a Modulo Counter	136

Using a Dual-Channel Counter

Introduction

This chapter provides operating instructions for the dual-channel counter of the JX3-MIX1 module.

Prerequisites

You have connected the JX3-MIX1 module to a digital sensor, which sends counter signals to counting input X61.CNTA or X61.CNTB. The shift between the two counter-signal phases is 90°.

Properties of the Dual-Channel Counter

The dual-channel counter automatically detects the counting direction by evaluating the phase shift of the two count pulses (+ or -90°).

Setup of the Dual-Channel Counter

To get counts in MR 1503, configure the module registers:

Step	Action
1	Activating the dual-channel counter: Write value 41 for "activating the dual-channel counter" to MR 1501
2	Counter enable in the software: To activate the single-channel counter, write value 30 to command register MR 1501.
3	**Result**: ■ While count pulses are being registered, you can see changing count values in MR 1503. ■ The single-channel counter is deactivated.

Change Between Single- and Dual-Channel Counter

When the dual-channel counter is used, MR 1600 ... MR 1699 are deactivated. To return to the single-channel counter, write command 40 to MR 1501. When changing from single- to dual-channel counter or vice versa, all module registers of the counter are cleared.

JetSym STX Program

```
Task DualCounter Autorun

Var
    CntA_Status          : Int at %VL 100021500;
    CntA_Command         : Int at %VL 100021501;
    CntA_CntValue        : Int at %VL 100021503;

End_Var;

    // Setting counter module to dual-channel counter
    CntA_Command := 41;
    // Setting the count value
    CntA_CntValue := 987654321;
    // Enabling the counter
    CntA_Command := 30;
    // ...
End_Task;
```

Using a Modulo Counter

Introduction to Modulo Counting Mode

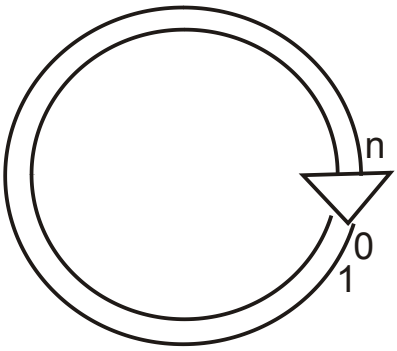
For axes or other rotatory sensors, a counting mode is required which will cyclically return to zero,

The modulo counter can be set to an upper counting limit.

Operating Principle

A modulo counter lets you set an upper maximum counting limit between 1 and +2,147,483,647.

As soon as the counter has exceeded the upper counting limit, it starts counting from zero again.



Increments	Description
n	Maximum of n $Max = 2^{32} - 1$
0	Default counting mode to be started again at value 0
1	Normal counting mode having counted one increment further

Example:

At an indexing round table, the table position is acquired by a rotatory encoder.

After 4,800 increments, the table has rotated 360°.

If you set an upper counting limit of 4,800 increments for the modulo counter of the JX3-MIX1 module, the counter will then count 0 through 4.799 increments.

JetSym STX Program

```
Task ModuloCounter

Var
    CntA_State:          Int At %VL 100021500;
    CntA_Command:        Int At %VL 100021501;
    CntA_Value:          Int At %VL 100021503;
    CntA_ModuloVal:      Int At %VL 100021506;
End_Var;

    // Selecting single-channel counter A
    CntA_Command := 40;
    // Modulo: Setting the upper counting limit
    CntA_ModuloVal := 4800;
    // Enable modulo
    CntA_Command := 60;
    // Enabling single-channel counter
    CntA_Command := 30;
    // ...
    // One increment corresponds to 0.075°
    // 359.925° correspond to 4,799 increments
End_Task;
```

6.6.3 Special Functions of the Counter Module

Introduction

This chapter covers the special functions of the JX3-MIX1 module.

Special Functions

The special functions encomprise:

- Strobe function
- Gate function
- Reset function
- Setting the edge evaluation parameters
- Modulo counter

Contents

Topic	Page
Strobe Function	139
Example: Strobe Function	140
Gate Function	142
Example: Gate Function	143
Reset Function	145
Example: Reset Function	146
Edge Evaluation	148
Register Description - Counter	150

Strobe Function

Introduction

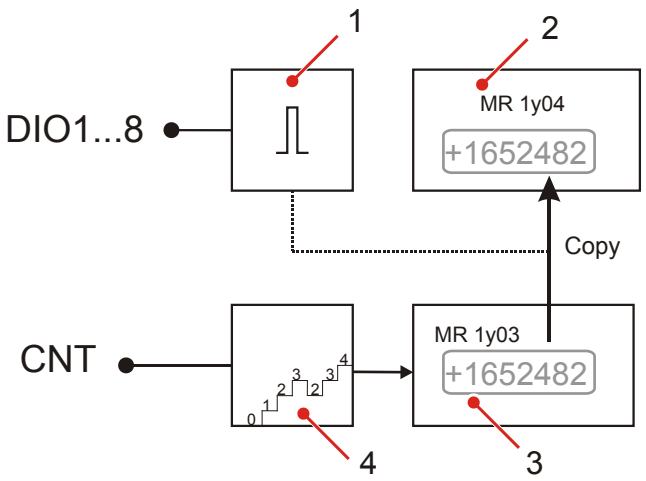
This chapter covers the strobe function.

Application

The strobe function lets you store a count value at a defined point in time.
A hardware pulse at one of the inputs DIO1 ... DIO8 is used to implement this function.

The strobe function can be enabled for

- Single-channel counter at X61.CNTA or X61.CNTB
- dual-channel counter at X61.CNTA and X61.CNTB



Number	Description
1	Strobe signal at input X61.DIO1 ... X61.DIO8 selected through the application program
2	Module register 1y04: Copy of MR1y03 triggered by the strobing signal
3	Module register 1y03: As-is count value
4	Pulses at input CNTA or CNTB which are then converted into count values

Where y = 5 represents single-channel counter A or the dual-channel counter, and y = 6 represents single-channel counter B.

Example: Strobe Function

Task

The actual count of a single-channel counter is to be stored to a variable. This is triggered by an external event, that is, a strobe pulse.

Example:

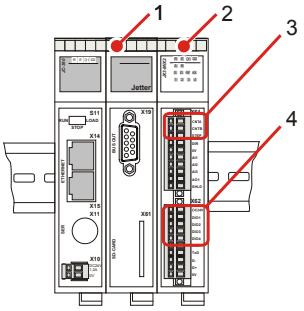
On a round indexing table a mechanical problem occurred. The last position is to be stored. The external "Error" signal is sent via signal line,-which is connected to the JX3-MIX1 module.

Solution

Configure a single-channel counter for channel A. This channel is then linked with the strobe event on one of the digital inputs (in the given case X32.DIO1).

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX	Module JX3-MIX1
3	Counter input	In the given example: X61.CNTA
4	Multi-purpose inputs/outputs DIO1 ... DIO8	In the given example: X32.DIO1

JetSym STX Program

```
Task InitStrobeCnt

Var
    CntA_State:          Int At %VL 100021500;
    CntA_Command:        Int At %VL 100021501;
    CntA_Value:          Int At %VL 100021503;
    CntA_StrobeVal:      Int At %VL 100021504;
    CntA_StrobeAssign:   Int At %VL 100021511;

    StrobeCompare:       Int;
End_Var;


    // Selecting single-channel counter A
    CntA_Command := 40;
    // Allocating strobe input to X32.DIO1
    CntA_StrobeAssign := 1;
    // Enabling single-channel counter
    CntA_Command := 30;
    // Enabling strobe
    CntA_Command := 36;
    // ...
    // When a strobe signal has been received:
    // Save the strobe value
    StrobeCompare := CntA_StrobeVal;
    // ...
End_Task;
```

Gate Function

Introduction

This chapter covers the gate function of the counter module.

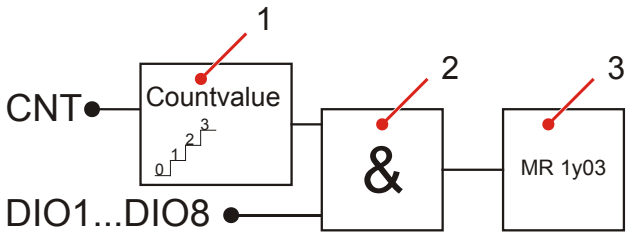
Application

The gate function lets you count events depending on the input state: Counting pulses are accepted only if the logic level of the associated input is 1.

The gate function corresponds to a hardware enable.

The gate function can be enabled for

- single-channel counter at X61.CNTA
- single-channel counter at X61.CNTB
- dual-channel counter at X61.CNTA and X62.CNTB



Number	Description
1	Counter input X61.CNTA or X61.CNTB
2	The counter is enabled only if the logic level of the associated input DIO1 ... DIO8 is high.
3	Module register 1y03: As-is count value

Example: Gate Function

Task

A single-channel counter is to be enabled by an external event.

Example

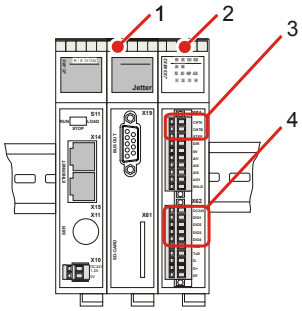
The position of a round indexing table is to be counted only if an enable signal has been issued by a switch.

Solution

Configure a single-channel counter for channel A. This channel is then linked with the gate event on one of the digital inputs (in the given case X32.DIO2).

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX1	Multi-purpose expansion module
3	Counter input	In the given example: X61.CNTA
4	Multi-purpose inputs/outputs DIO1 ... DIO8	In the given example: X32.DIO2

JetSym STX Program

```
Task InitGateCnt

Var
    CntA_State:          Int at %VL 100021500;
    CntA_Command:        Int at %VL 100021501;
    CntA_Value:          Int at %VL 100021503;
    CntA_GateAssign:     Int at %VL 100021510;
End_Var;
    // Selecting single-channel counter A
    CntA_Command := 40;
    // Allocating gate input to X32.DIO2
    CntA_GateAssign := 2;
    // Enabling gate
    CntA_Command := 34;
    // Enabling single-channel counter
    CntA_Command := 30;
    // ...
    //...
End_Task;
```

Reset Function

Introduction

This chapter covers the reset function of the counter.

Application

The reset function lets the user load a counter having got a defined reset value.

The reset is triggered by a hardware pulse.

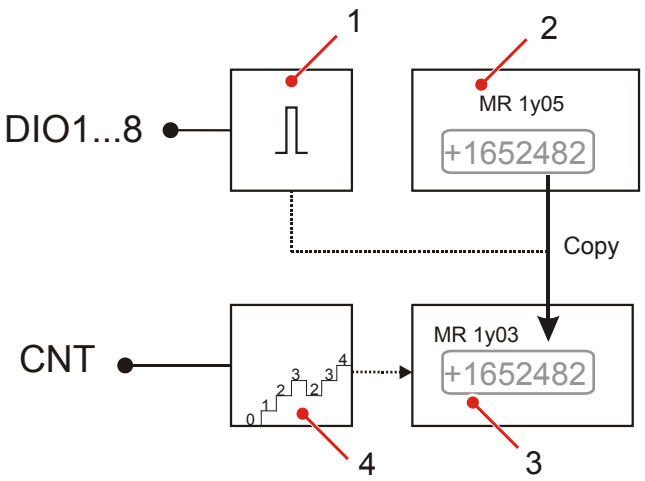
Example

Triggered by an external pulse at a multi-purpose I/O, the counter is to start by reset value +1,652,482 written in MR 1y03.

A hardware pulse will now trigger the value of MR 1y05 to be copied to MR 1y03.

The reset function can be enabled for

- single-channel counter at X61.CNTA
- single-channel counter at X61.CNTB
- dual-channel counter at X61.CNTA and X62.CNTB



Number	Description
1	Reset pulse at input DIO1 ... DIO8 selected through the application program
2	A reset value to be retrieved from a module register
3	Module register 1y03: As-is count value
4	Pulses at input CNTA or CNTB which are then converted into count values.

Example: Reset Function

Task

Triggered by a hardware pulse, the counting value of single-channel counter A is to be replaced by a different value.

Example

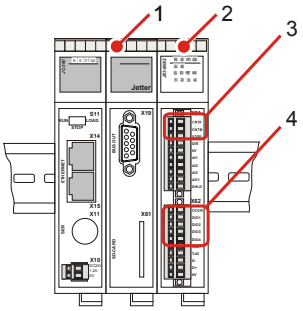
The connected sensor features a zero pulse output. This zero pulse lets you re-calibrate the zero position with each revolution.

Solution

Enter the required reset value into MR 1505 and assign the reset function to input DIO1 ... DIO8.

Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-MIX	Module JX3-MIX1
3	Counter input	In the given example: X61.CNTA
4	Multi-purpose inputs/outputs DIO1 ... DIO8	In the given example: X32.DIO2

JetSym STX Program

```
Task InitResetCnt

Var
    CntA_State:          Int At %VL 100021500;
    CntA_Command:        Int At %VL 100021501;
    CntA_Value:          Int At %VL 100021503;
    CntA_ResetValue:     Int At %VL 100021505;
    CntA_ResetAssign:    Int At %VL 100021512;

End_Var;

    // Selecting single-channel counter A
    CntA_Command := 40;
    // Allocating reset input to X32.DIO3 (zero pulse)
    CntA_ResetAssign := 3;
    // Enabling reset
    CntA_Command := 38;
    // Defining reset value
    CntA_ResetValue := 0;
    // Enabling single-channel counter
    CntA_Command := 30;
    // ...
    //...
End_Task;
```

Edge Evaluation

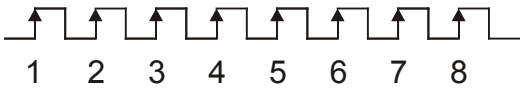
Introduction

Edge detection of the couning pulse can be configured for each single-channel counter individually, regardless of the configuration of the other counters.

Default Setting

After enabling the JX3-MIX1 module, each counter counts by evaluating the rising edge.

Evaluating the Rising Edge

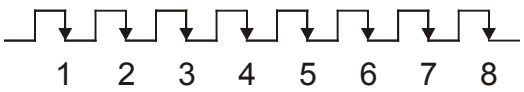


The positive counting pulse renders a rising edge at input X61.CNTA or X61.CNTB.

Command 50 enables evaluation of the rising edge:

Command	
MR 1y01	**50**
where y = 5 represents counter A	
where y = 6 represents counter B	

Evaluating the Falling Edge

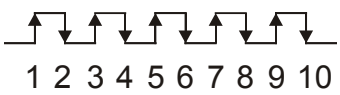


The negative counting pulse renders a falling edge at input X61.CNTA or X61.CNTB.

Command 51 enables evaluation of the falling edge:

Command	
MR 1y01	**51**
where y = 5 represents counter A	
where y = 6 represents counter B	

Evaluating Both Rising and Falling Edge



Acquiring both counting pulses means considering both rising and falling edge at input X61.CNTA or X61.CNTB.

Command 52 enables evaluation of the rising edge:

Command	
MR 1y01 where y = 5 represents counter A where y = 6 represents counter B	**52**

Register Description - Counter

MR 1y00

Counter state

In MR 0, the module signalizes the as-is state of the counter.

Meaning of the individual bits		
Bit 3	**Edge evaluation: Rising edge**	
	1 =	The count is incremented by one, if at the counter input a rising edge is detected.
Bit 4	**Edge evaluation: Falling edge**	
	1=	The count is incremented by one, if at the counter input a rising edge is detected.
Bit 5	**Edge evaluation: Both edges**	
	1 =	The count is incremented by one, if at the counter input a rising or falling edge is detected.
Bit 6	**Force value enabled**	
	1=	The content of register "Force value" is entered into register "Counting value".
Bit 7	**Modulo counting enabled**	
	1 =	The count value ranges between 0 and the upper modulo limit which has been set in register "Modulo value".
Bit 8	**Gate function enabled**	
	1=	The gate function is enabled.
Bit 9	**Strobe function enabled**	
	1=	The strobe function is enabled.
Bit 10	**Reset function enabled**	
	1=	The reset function is enabled.
Bit 11	**Counting direction (only for single-channel counter A and B)**	
	0=	The single-channel counter counts in positive direction.
	1=	The single-channel counter counts in negative direction.
Bit 12	**Counting mode**	
	0=	Counting mode "single-channel counter" is enabled.
	1=	Counting mode "dual-channel counter" is enabled.
Bit 14	**Gate function: The counter is not enabled.**	
	1=	The counter ignores counting pulses at the hardware input due to the gate function.
Bit 15	**Counter enabled**	
	1=	Counter is enabled.

Module register properties	
Type of access	Read
Value after reset	0x00001008

y = 5 for single-channel counter, channel A (at X61.CNTA), and for dual-channel counter (at X61.CNTA and X61.CNTB).
y = 6 for single-channel counter, channel B (at X61.CNTB)

MR 1y01

Command register of counter

MR 1y01 lets you configure functions of the counter.

Command	
20	Enable the forcing function
21	Disable the forcing function
30	Enable counter
31	Disable counter
32	Counting up
33	Counting down
34	Enable gate function
35	Disable gate function
36	Enable strobe function
37	Disable strobe function
38	Enable reset function
39	Disable reset function
40	Enable single-channel counter. The dual-channel counter is disabled if it was enabled. This command can only be entered into MR 1501 (channel A).
41	Enable dual-channel counter Single-channel counters are disabled if one or two single-channel counters were enabled. This command can only be entered into MR 1501 (channel A).
50	Enable rising edge. Applies to single-channel counters only
51	Enable falling edge. Applies to single-channel counters only
52	Enable both edges. Applies to single-channel counters only
60	Enable modulo function
61	Disable modulo function

y = 5 for single-channel counter, channel A (at X61.CNTA), and for dual-channel counter (at X61.CNTA and X61.CNTB).
y = 6 for single-channel counter, channel B (at X61.CNTB)

MR 1y02

Force value

With force function enabled, the force value overwrites the existing count value in MR 1y03. This value is independent of the actual count value. The counter continues to count pulses in the background.

Module register properties		
Values		
Values	-2^31 ... 2^31-1	32-bit signed

where y = 5 represents single-channel counter A (at X61.CNTA), and y = 6 is single-channel counter B (at X61.CNTB)
where y = 5 represents dual-channel counter A (at X61.CNTA and at X61.CNTB)

MR 1y03

Count value

The current count of the respective counter is available in MR 1y03.

Module register properties		
Values		
Sign will be displayed	-2.147.483.648 ... +2.147.483.647	32-bit signed
Modulo counting mode	-2.147.483.648 ... +2.147.483.646	32-bit signed

where y = 5 for dual-channel counter A (at X61.CNTA) and y = 6 for single-channel counter B (at X61.CNTB)
with y = 5 for dual-channel counter A (at X61.CNTA and X61.CNTB)

MR 1y04

Strobe value

MR 1y04 lets you read out the stored count value after a strobe event has occurred.

Module register properties		
Values	-2.147.483.648 ... +2.147.483.647	32-bit signed

where y = 5 for dual-channel counter A (at X61.CNTA) and y = 6 for single-channel counter B (at X61.CNTB)
with y = 5 for dual-channel counter A (at X61.CNTA and X61.CNTB)

MR 1y05

Reset value

The value in MR 1y05 is taken as new count value if the reset function is enabled and a reset event occurs.

Module register properties		
Values	-2.147.483.648 ... +2.147.483.647	32-bit signed

where y = 5 for dual-channel counter A (at X61.CNTA) and y = 6 for single-channel counter B (at X61.CNTB)
with y = 5 for dual-channel counter A (at X61.CNTA and X61.CNTB)

MR 1y06

Modulo value

If you enable the modulo function, the count value is always between 0 and the upper limit preset in MR 1y06.

Module register properties		
Values	0 ... +2.147.483.646	32-bit signed

Type of access	Read and write access
Value after reset	0x7FFFFFF

where y = 5 for dual-channel counter A (at X61.CNTA) and y = 6 for single-channel counter B (at X61.CNTB)
with y = 5 for dual-channel counter A (at X61.CNTA and X61.CNTB)

MR 1y10

Gate index

Gate index in MR 1505 lets you assign the gate function to one of the multi-purpose inputs DIO1 ... DIO8. You can undo previously made assignments of inputs by entering value 0 into MR 1y10. This action will disable the gate function. The gate function must be enabled by additionally issuing command 34.

Module register properties		
Values	0	Assignment of gate function: none
	1	Assignment of gate function: Input 1 (X32.DIO1)
	2	Assignment of gate function: Input 2 (X32.DIO2)

	...	...
	8	Assignment of gate function: Input 8 (X32.DIO8)

MR 1y11

Strobe index

Strobe index in MR 1y11 lets you assign the strobe function to one of the multi-purpose inputs DIO1 ... DIO8. You can undo previously made assignments of inputs by entering value 0 into MR 1y11. This action will disable the strobe function. The strobe function must be enabled by additionally issuing the corresponding command.

Module register properties		
Values	0	Strobe function assignment: none
	1	Strobe function assignment: Input 1 (X32.DIO1)
	2	Strobe function assignment: Input 2 (X32.DIO2)
	...	...
	8	Strobe function assignment: Input 8 (X32.DIO8)

MR 1y12

Reset index

Reset index in MR 1y12 lets you assign the reset function to one of the multi-purpose inputs DIO1 ... DIO8. You can undo previously made assignments of inputs by entering value 0 into MR 1y12. This action will disable the reset function.

Module register properties		
Values	0	Strobe function assignment: none
	1	Strobe function assignment: Input 1 (X32.DIO1)
	2	Strobe function assignment: Input 2 (X32.DIO2)
	...	...

	8	Strobe function assignment: Input 8 (X32.DIO8)

MR 1y13

Polarity

This bit-coded module register lets you configure the polarity of the following functions:

- Gate function
- Strobe function
- Reset function

Here, you set whether a low or high level triggers the function at the corresponding input.

Module register properties		
Values	Bit-coded 0 ... 7	
Bit 0	= 0 = 1	Gate is low-active Gate is high-active
Bit 1	= 0 = 1	Strobe is low-active Strobe is high-active
Bit 2	= 0 = 1	Reset is low-active Reset is high-active

MR 1y20

Counting rate

This module register shows the counting rate, i.d. the number of pulses per time base.

Module register properties		
Values	0 ... 50.000 Single-channel (rising/falling edge)	Hz
	0 ... 100.000 (single-channel, both edges)	Hz
	0 ... 200.000 (dual-channel)	Hz
Formula (counting rate)	∆counting pulses x 1,000 / time base	

MR 1y21

Time base of frequency counter

This module register lets you configure the time base for frequency measurements.

Module register properties		
Values	0 ... 1.000	ms
	Period length in ms	

6.7 Stepper Motor

Introduction

The stepper motor controller of the module JX3-MIX1 lets you control a stepper motor.

When you combine a stepper motor with limit switches, the stepper motor controller lets you implement the following axis configurations:

- Linear axis
- or Modulo axis

Contents

Topic	Page
Stepper Motor - Properties	159
Referencing	162
Positioning Modes	172
Register Description	180

Stepper Motor - Properties

Introduction

Stepper motors are synchronuous motors. The rotor follows a rotating electromagnetic field. The stepper motor is controlled by an open-loop control. Basically, both position and speed are known at any time without further sensors being needed.

Definitions

- A stepper motor controller calculates the control signals and outputs them to the motor.
- A system consisting of stepper motor controller (hardware and software of the module JX3-MIX1), power amplifier and stepper motor is referred to as axis.

Prerequisites

To run a stepper motor, you need the following:

- External power amplifier to control any stepper motor.
- External power source for supplying the power amplifier.

Hint for Proper Operation

- Make sure that the JX3-MIX1, external power amplifier and stepper motor are controlled in a way that prevents it from losing steps.

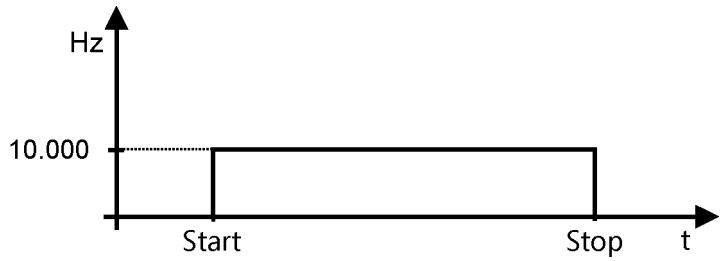
Properties

The properties of the stepper motor controller are as follows:

- The stepper motor output of the module JX3-MIX1 supplies frequency and direction signals for controlling the stepper motor.
- The stepper motor controller of the module JX3-MIX1 internally counts the number of steps that have been output.

Acceleration and Deceleration

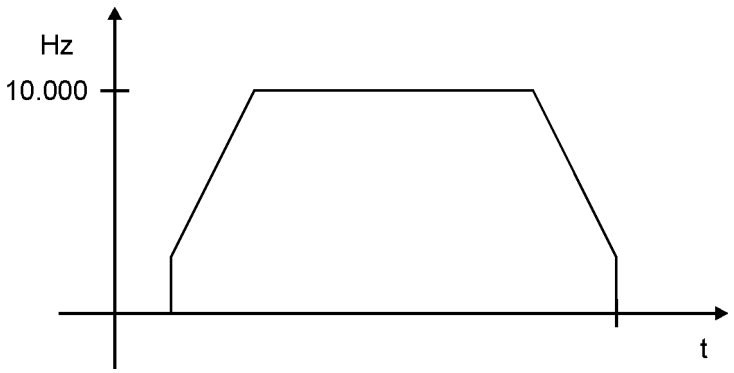
The stepper motor is a slow-acting device. With too high of a acceleration or deceleration rate, the stepper motor is likely to lose steps. Position inaccuracies will occur, or else, the stepper motor will just stop.



To prevent this from happening, take the following into account:

- For starting and stopping, the stepper motor must not be controlled at any higher step frequency than the start/stop frequency.
- The start/stop frequency is the stepping rate, at which the motor will start and stop faultlessly and without losing steps.

The module JX3-MIX1 lets you run a stepper motor using linear motion profiles (ramps).



- The stepping rate is increased linearly to the steepness of the previously defined acceleration ramp up to the frequency of 10,000 (= 10 kHz) which has been set through the positioning instruction.
- The rate will remain at 10 kHz until the positioning algorithm recognises that, according to the previously defined steepness of the deceleration ramp, the deceleration process has to be initiated.
- Deceleration is calculated in such a way that the target position will be approached linearly to the steepnees of the previously defined deceleration ramp.

In the following cases the controller switches automatically from acceleration ramp to deceleration ramp:

- The path is too short.
- The ramps are too flat.
- The set maximum speed will not be reached.

Configuration Options

The module JX3-MIX1 offers a host of setting options for stepper motors:

Setting options	Description
1	Absolute positioning
2	Relative positioning
3	Endless positioning
4	Response to hardware and/or software limit switches
5	Recording of values via oscilloscope
6	Configuration of ramps and velocity
7	Configuration of limit switch polarity, DIR and STEP level
8	Support of modulo axes
9	Destination window monitoring

Technical Specifications

Parameter	Description
Stepping rate of STEP signal	1 Hz ... 10 kHz
Frequency resolution of STEP signal	10 Hz
Pulse width of STEP signal	1 µs
Set position of stepper motor	-2.147.483.648 ... 2,147,483,647 (32 bits)

6.7.1 Referencing

Introduction

This chapter describes the different options when referencing a stepper motor axis.

Why Perform Referencing?

A stepper motor axis must be referenced to ensure exact positioning. A system of limit switches makes sure that the stepper motor exactly and with perfect repeatibility moves to the programmed positions.

However, it is also possible to use a stepper motor for motion tasks without valid referencing.

Types of Referencing

- To reference the stepper motor, you can use the reference switch.
- Automatic referencing triggered by the stepper motor controller. The axis searches for the reference switch to determine the machine's home position (reference zero).
- To reference the stepper motor, you can also use software.

There are four different ways to reference a stepper motor axis.

Mode	Description
1	Referencing in direction of the positive limit switch LIM+
2	Referencing in direction of the negative limit switch LIM-
3	Starting referencing in positive direction towards the positive limit switch. When the limit switch is reached, inversion of the direction and moving to the reference switch.
4	Starting referencing in negative direction towards the negative limit switch. When the limit switch is reached, inversion of the direction and moving to the reference switch.

Machine Referencing: Clearing the Reference

This command triggers manual referencing and clears the status bit "Reference position is valid". Then, the stepper motor can be positioned as usual. If the reference switch is actuated, the actual position is set to zero and the status bit "Reference position set" is set.

Machine Referencing: Setting the Reference

When you issue the command "Set reference" the reference point is immediately set, the actual position is set to zero and the status bit "Reference position is valid" is set. Depending on the diagnostics bit "Stop at reference position", the set position is set to zero and the stepper motor is moved to this position.

Contents

Topic	Page
Search for Reference to Mode 1	164
Search for Reference to Mode 2	166
Search for Reference to Mode 3	168
Search for Reference to Mode 4	170

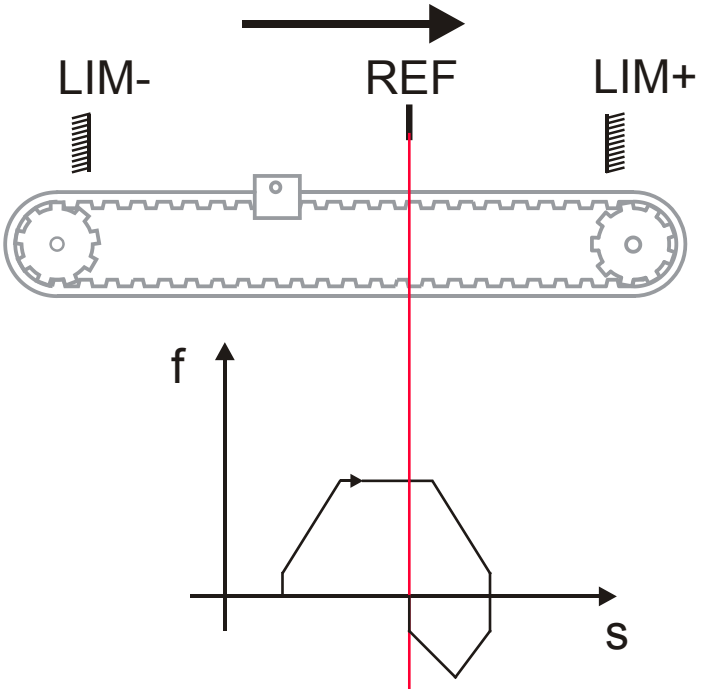
Search for Reference to Mode 1

Referencing Towards Positive Limit Switch

This chapter covers automatic referencing of the stepper motor towards positive limit switch.

Search for Reference to Mode 1

Once the stepper motor reaches the hardware reference switch, it stops using the deceleration ramp and returns to the reference position. If the axis does not find the reference position, it stops at the positive limit switch and signals an error in the status register.



Once the axis has come to a standstill, search for reference is completed.

Status Register 1800

This status register lets you read out the actual state of the axis. The involved status bits are listed below:

Status bit	Description
16	Reference position is valid: If the reference switch has been activated, bit 16 is set to 1. Note: The axis is still moving and approaching the reference position.
19	The axis is at standstill: If the axis has stopped moving, bit 19 is set to 1.
20	Busy bit: If the reference has not yet been approached, bit 20 is set to 1.

Command Register 1801

Command 9 starts search for reference in positive direction (towards positive limit switch).

Command	Description
9	In order to trigger search for reference, enter command 9 into MR 1801.

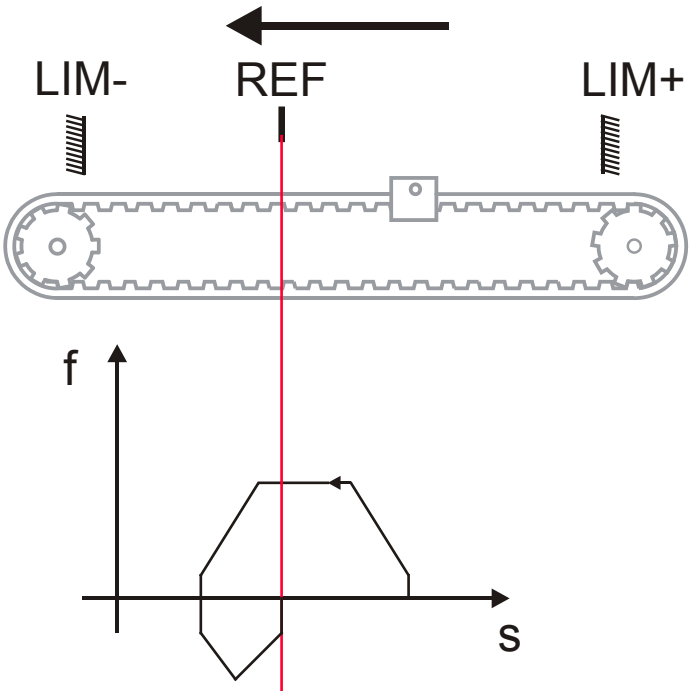
Search for Reference to Mode 2

Referencing Towards Negative Limit Switch

This chapter covers automatic referencing of the stepper motor towards negative limit switch.

Search for Reference to Mode 2

Once the stepper motor reaches the hardware reference switch, it stops using the deceleration ramp and returns to the reference position. If the axis does not find the reference position, it stops at the negative limit switch and signals an error in the status register.



Once the axis has come to a standstill, search for reference is completed.

Status Register 1800

This status register lets you read out the actual state of the axis.

The involved status bits are listed below:

Status bit	Description
16	Reference position is valid: If the reference switch has been activated, bit 16 is set to 1. Note: The axis is still moving and approaching the reference position.
19	The axis is at standstill: If the axis has stopped moving, bit 19 is set to 1.
20	Busy bit: If the reference has not yet been approached, bit 20 is set to 1.

Command Register 1801

Command 10 starts search for reference in positive direction (towards negative limit switch).

Command	Description
10	In order to trigger search for reference, enter command 10 into MR 1801.

Search for Reference to Mode 3

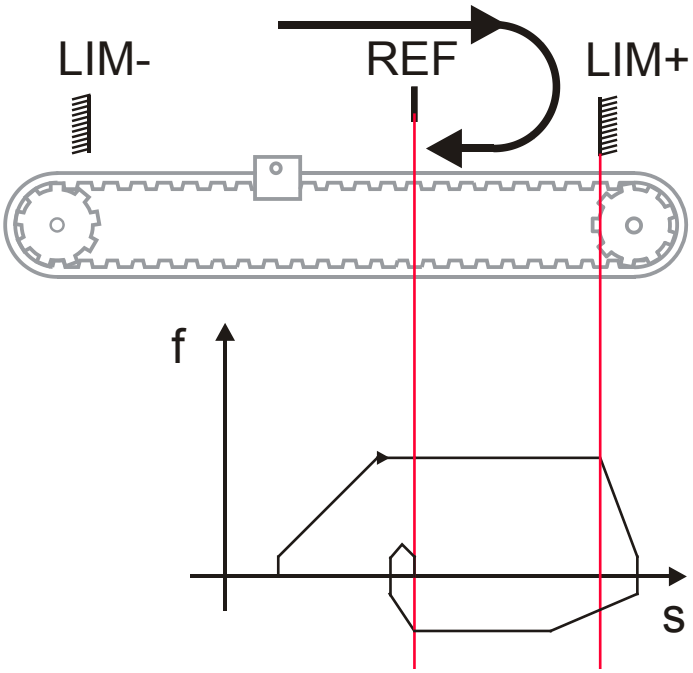
Referencing Towards Positive Limit Switch Without Stop

This chapter covers automatic referencing of the stepper motor towards positive limit switch without stop at the reference switch.

Search for Reference to Mode 3

The stepper motor moves until it reaches the positive limit switch LIM+. Then, it returns to the reference switch.

If the axis does not find the reference position, it stops at the negative limit switch and signals an error in the status register.



Once the axis has come to a standstill, search for reference is completed.

Status Register 1800

This status register lets you read out the actual state of the axis.

The involved status bits are listed below:

Status bit	Description
16	Reference position is valid: If the reference switch has been activated, bit 16 is set to 1. Note: The axis is still moving and approaching the reference position.
19	The axis is at standstill: If the axis has stopped moving, bit 19 is set to 1.
20	Busy bit: If the reference has not yet been approached, bit 20 is set to 1.

Command Register 1801

Command 11 starts search for reference in positive direction (towards positive limit switch).

Command	Description
11	In order to trigger search for reference, enter command 11 into MR 1801.

Search for Reference to Mode 4

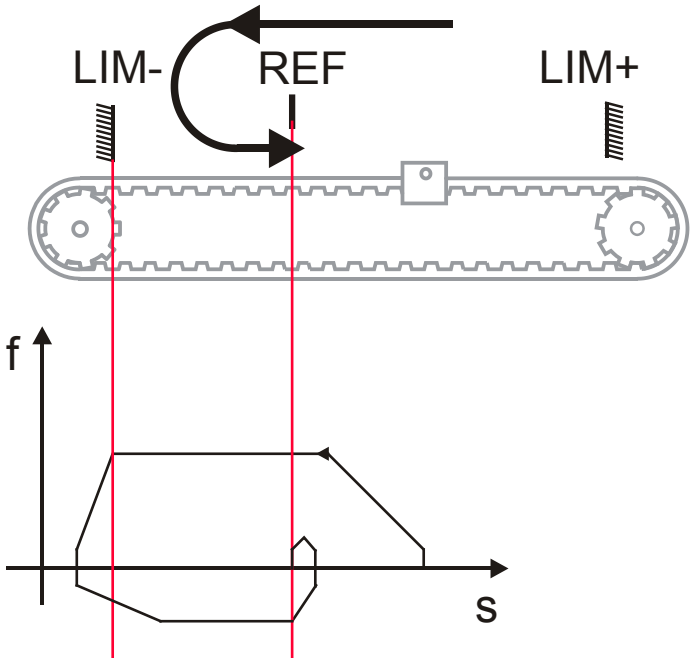
Referencing Towards Negative Limit Switch Without Stop

This chapter covers automatic referencing of the stepper motor towards negative limit switch without stop at the reference switch.

Search for Reference to Mode 4

The stepper motor moves until it reaches the negative limit switch LIM-. Then, it returns to the reference switch.

If the axis does not find the reference position, it stops at the positive limit switch and signals an error in the status register.



Once the axis has come to a standstill, search for reference is completed.

Status Register 1800

This status register lets you read out the actual state of the axis: Read out MR 1800.

The involved status bits are listed below:

Status bit	Description
16	Reference position is valid: If the reference switch has been activated, bit 16 is set to 1. Note: The axis is still moving and approaching the reference position.
19	The axis is at standstill: If the axis has stopped moving, bit 19 is set to 1.
20	Busy bit: If the reference has not yet been approached, bit 20 is set to 1.

Command Register 1801

Command 12 starts search for reference in positive direction (towards negative limit switch).

Command	Description
12	In order to trigger search for reference, enter command 12 into MR 1801.

6.7.2 Positioning Modes

Introduction

This chapter covers the different positioning modes of the stepper motor module.

Positioning Modes

The following stepper motor positioning modes are available:

Positioning mode	Description
1	Absolute positioning mode
2	Relative positioning mode
4	Endless positioning
5	Modulo positioning

Contents

Topic	Page
Absolute Positioning	173
Relative Positioning	175
Endless Positioning	177
Modulo Positioning	179

Absolute Positioning

Properties

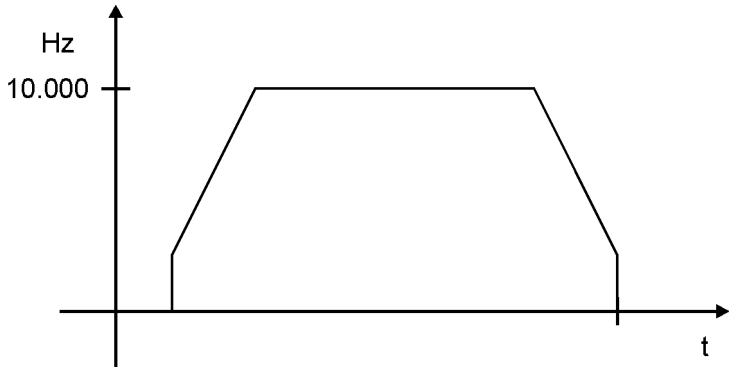
The properties of absolute positioning are as follows:

- This mode lets you move the stepper motor to any position within the range covered by the hardware limit switches.
- The previous position is not taken into account when the axis is moving to the next position.
- Absolute positioning does not work in modulo mode.

Example: Absolute Positioning

Prerequisites:

The stepper motor is correctly connected.



Example:

- The motion profile consists of an acceleration ramp with 2,000 Hz/4 ms and a deceleration ramp with 2,100 Hz/4 ms.
- The negative limit switch LIM- is connected to DIO1.
- The reference switch REF is connected to DIO2.
- The positive limit switch LIM+ is connected to DIO3.
- Search for reference is carried out in mode 1.

Step	Action
1	**Set the nominal stepping rate**: MR 1803 := 200;
2	**Set the acceleration ramp**: MR 1805 := 2000;
3	**Set the deceleration ramp**: MR 1806 := 2100;
4	**Assign the reference switch to one of the multi-purpose I/Os:** MR 1816 := 2;
5	**Assign the positive limit switch to one of the multi-purpose I/Os:** MR 1817 := 3;
6	**Assign the negative limit switch to one of the multi-purpose I/Os:** MR 1818 := 1;

Step	Action
7	**Select "absolute" positioning mode:** MR 1801 := 18;
8	**Start search for reference (in mode 1):** MR 1801 := 9;
9	**Read out the actual state until axis referencing is completed:** `When (MR1800.16) Continue;`
⇨	**Result**: ■ The reference position of the axis is set. ■ Now, you are able to position the axis in absolute positioning mode.

Relative Positioning

Properties

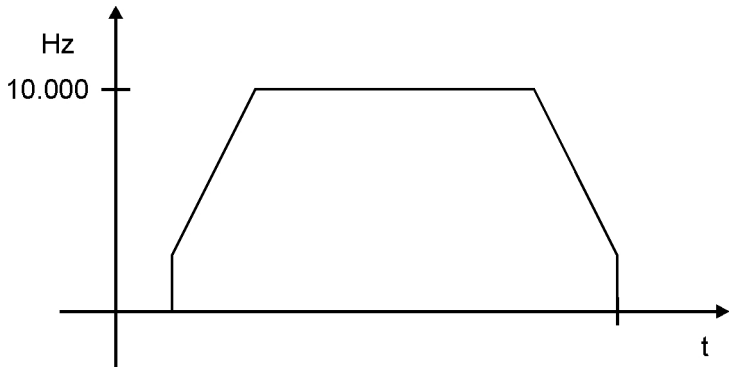
The properties of relative positioning are as follows:

- This mode lets you move the stepper motor to any position within the range covered by the hardware limit switches.
- The previous position is taken into account when the axis is moving to the next position.
- In MR 1802 the new set point position value is added to the old target position. In doing so, the sign is taken into account.

Example: Relative Positioning

Prerequisites:

The stepper motor is correctly connected.



Example:

- The motion profile consists of an acceleration ramp with 1,000 Hz/4 ms and a deceleration ramp with 3,200 Hz/4 ms.
- The negative limit switch LIM- is connected to DIO1.
- The reference switch REF is connected to DIO2.
- The positive limit switch LIM+ is connected to DIO3.
- Search for reference is carried out in mode 3.

Step	Action
1	**Set the nominal stepping rate**: MR 1803 := 200;
2	**Set the acceleration ramp**: MR 1805 := 1000;
3	**Set the deceleration ramp**: MR 1806 := 3200;
4	**Assign the reference switch to one of the multi-purpose I/Os:** MR 1816 := 2;
5	**Assign the positive limit switch to one of the multi-purpose I/Os:** MR 1817 := 3;

Step	Action
6	**Assign the negative limit switch to one of the multi-purpose I/Os:** MR 1818 := 1;
7	**Select "relative" positioning mode:** MR 1801 := 17;
8	**Start search for reference (in mode 3):** MR1801 := 11;
9	**Read out the actual state until axis referencing is completed:** `When (MR1800.16) Continue;`
⇨	**Result**: ■ The reference position of the axis is set. ■ Now, you are able to position the axis in relative positioning mode.

Endless Positioning

Properties

- The previous position is irrelevant when the axis is moving to the next position.
- Right after starting, the stepper motor accelerates up to the nominal-stepping rate and maintains this rate.
- Endless positioning corresponds to a velocity control where the position of the axis is known.
- Endless positioning is aborted by external signals, such as hardware switches or user inputs.

Example: Endless Positioning

Prerequisites:

The stepper motor is correctly connected.

Example:

- The motion profile consists of an acceleration ramp with 1,000 Hz/4 ms and a constant motion at 200 Hz in positive direction.
- The negative limit switch LIM- is connected to DIO1.
- The reference switch REF is connected to DIO2.
- The positive limit switch LIM+ is connected to DIO3.
- Search for reference is carried out in mode 3.

Step	Action
1	**Set the nominal stepping rate**: MR 1803 := 200;
2	**Set the acceleration ramp**: MR 1805 := 1000;
3	**Set the deceleration ramp**: MR 1806 := 3200;
4	**Assign the reference switch to one of the multi-purpose I/Os:** MR 1816 := 2
5	**Assign the positive limit switch to one of the multi-purpose I/Os:** MR 1817 := 3;
6	**Assign the negative limit switch to one of the multi-purpose I/Os:** MR 1818 := 1;
7	**Select positioning mode "Endless in positive direction":** MR 1801 := 56;
8	**Start search for reference (in mode 3):** MR1801 := 11;
9	**Read out the actual state until axis referencing is completed:** `When (MR1800.16) Continue;`

Step	Action
⇨	**Result**: ■ The reference position of the axis is set. ■ Now, endless positioning mode can be started.

Modulo Positioning

Properties

- The previous position is taken into account when the axis is moving to the next position.
- In modulo mode, software and hardware limit switches need not be defined.
- Bit DIR lets you read out the direction.
- When the set modulo position is reached, the actual position is set to zero and counting starts again.
- Modulo positioning is started by entering the corresponding value into MR 1885.
- The actual position of the stepper motor ranges between 0 ... ... (modulo value -1)

Example: Modulo Positioning

Task: Position a round indexing table by means of a stepper motor.

Prerequisites:

The stepper motor is correctly connected.

Example

- The task is to position a round indexing table by means of a stepper motor. One full revolution of the indexing table consists of 4,800 steps.
- Set the modulo value to 4,800. Then, the nominal and actual position will range between 0 ... 4,799.

Step	Action
1	**Set the nominal stepping rate**: MR 1803 := 200
2	**Set the acceleration ramp**: MR 1805 := 1000;
3	**Set the deceleration ramp**: MR 1806 := 3200;
4	**Set the upper modulo limit (modulo value):** MR 1885 := 4800;
⇨	**Result**: These settings let you now move the axis in modulo mode (relative motion).

6.7.3 Register Description

Introduction

This chapter covers all stepper motor registers.

Contents

Topic	Page
Stepper Motor: Description of Registers	181

Stepper Motor: Description of Registers

MR 1800

Stepper motor state

MR 1800 lets you read out the actual stepper motor state.

Meaning of the individual bits		
Bit 0	**Limit switch LIM+ actuated?**	
	= 0,	■ If the axis is moving within the range covered by the hardware limit switches.
	= 1,	■ If the axis has reached the positive hardware limit switch. ■ If the error "Positive software limit switch" occurs. ■ To acknowledge this error: If bit 0 was 1, move the axis away from the hardware limit switch in opposite direction by issueing the corresponding command.
Bit 1	**Limit switch LIM- actuated?**	
	= 0,	■ If the axis is moving within the range covered by the hardware limit switches.
	= 1,	■ If the axis has reached the negative hardware limit switch. ■ If the error "Negative software limit switch" occurs. ■ To acknowledge this error: If bit 1 was 1, move the axis away from the hardware limit switch in opposite direction by issueing the corresponding command.
Bit 2	**Reference switch REF actuated?**	
	= 1,	If the axis has reached the reference switch.
Bit 3	**Software limit switch LIM (+/-) actuated?**	
	= 0,	■ If the axis did not actuate the software limit switch. ■ If the axis is moving away from the software limit switch.
	= 1,	■ If the actual position of the axis moves beyond the software limit switch (in one direction).
Bit 4	**Hardware limit switch LIM (+/-) actuated?**	
	= 0,	■ If the axis did not actuate the hardware limit switch. ■ If the axis is moving away from the software limit switch.
	= 1,	■ If the hardware limit switch is actuated.
Bit 5	**Error: Stepper motor**	
	= 1,	If bit 3, bit 4, or bit 6 in MR 1800 is set.
Bit 6	**Error: Search for reference**	
	= 0,	■ If search for reference has been completed successfully. ■ If the axis is moving away from the (software or hardware) limit switches.

Meaning of the individual bits	
= 1,	■ If a (software or hardware) limit switch is actuated.
Bit 7	**Software limit switch actuated?**
Bit 8	**Stop at the reference position**
= 1,	If the busy bit is "1" and the reference switch has been actuated, the reference position is set to zero and the axis moves to the new absolute position taking into account the reference position.
Bit 9	**Axis type**
= 0	Linear axis
= 1	Modulo axis
Bit 10	**Positioning mode**
= 0	Absolute positioning
= 1	Relative positioning
Bit 11	**Endless positioning enabled?**
Bit 12	**Direction of travel**
	This bit is set depending on the direction of travel and the polarity of the DIR signal.
Bit 16	**Reference position valid?**
	Reference position has been set by software or reference switch.
Bit 17	**AXARR - Has the axis reached the destination window?**
	■ Static value: This bit is set when the destination window has been reached. ■ It remains set until the axis is re-positioned.
Bit 18	**Axis is within the destination window (dynamic bit)**
	This bit is set as long as the actual position is within the destination window.
Bit 19	**Is the stepper motor at standstill?**
Bit 20	**BUSY**
	This bit is set during search for reference and is cleared when errors occur or the reference switch is actuated.
Bit 21	**Is the stepper motor decelerating?**

Module register properties	
Zugriff	Read
Value after reset	0x00080100

MR 1801

Stepper motor - command register

Command register MR1801 lets you configure the stepper motor.

Command	
0	Stop the axis using the set deceleration ramp
1	Enable the software limit switch
2	Disable the software limit switch
3	Set reference point
4	Clear reference point
5	Stop the axis (without decelaration ramp)
9	Automatic search for reference, mode # 1
10	Automatic search for reference, mode # 2
11	Automatic search for reference, mode # 3
12	Automatic search for reference, mode # 4
17	Relative positioning mode
18	Absolute positioning mode
19	Continue interrupted positioning motion
22	Stop at the reference point
23	Do not stop at the reference point
56	Start endless positioning in positive direction
57	Start endless positioning in negative direction

MR 1802

Set position

If you enter a new value into MR 1802 while the axis is moving, the new set position is calculated (in reference to the current position and speed). Then, the axis moves to the new position. In absolute positioning mode, the axis moves to the new absolute set position. In relative positioning mode, the axis moves to the new set position which is added to the current position.

Module register properties		
Values		
	-2.147.483.648 ... 2.147.483.647	32-bit signed

MR 1803

Set stepping rate

If you enter a new stepping rate into MR 1803 while the axis is moving, the controller tries to accelerate/decelerate the stepper motor to the new speed.

Module register properties	
Values	1 ... 10.000

Unit	Hertz [Hz]
Value after reset	1

MR 1804

Polarities

MR 1804 lets you set the polarity of hardware limit switches.

Meaning of the individual bits		
Bit 0	**Reference switch**	
	0 =	Normally closed contact
	1 =	Normally open contact
Bit 1	**Hardware limit switch LIM+, LIM-**	
	0 =	Normally closed contact
	1 =	Normally open contact
Bit 2	**DIR signal**	
	0 =	If a low-level signal is applied to the input: positive direction
	1 =	If a high-level signal is applied to the input: negative direction
Bit 3	**STEP signal**	
	0 =	The output signal is low-active
	1 =	The output signal is high-active

Module register properties	
Type of access	Read
Value after reset	0x0B

MR 1805

Acceleration ramp

MR 1805 lets you set the steepness of the acceleration ramp.

Module register properties	
Values	1 ... 10.000
Unit	Hertz / 4 ms [Hz/4 ms]
Enabling conditions	No effect on ongoing operation. The changed value will be committed to the register only when a new positioning motion is started.
Value after reset	1

MR 1806

Deceleration ramp

MR 1806 lets you set the steepness of the deceleration ramp. The changed value will be committed to the register only when a new positioning motion is started.

Module register properties	
Values	0 ... 10.000
Unit	Hertz [Hz / 4 ms]
Enabling conditions	New positioning motion
Value after reset	1

MR 1807

Destination window

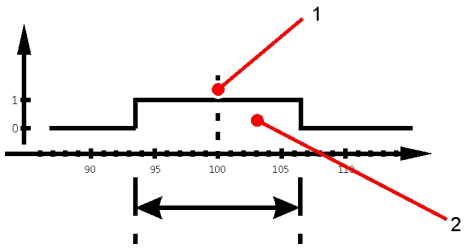
MR 1807 lets you define a destination window around the set position.

Module register properties	
Values	0 ... 2^{31} -1

A destination window lets you accelerate program execution. While the axis is moving to the set position, the next program code is already processed:

```
// When AXARR Then
When (MR_1800.17) Then ....
```

Nevertheless, the axis moves to the exact target position, but the controller does not wait until it is reached. Of course, only then positioning will be completed.



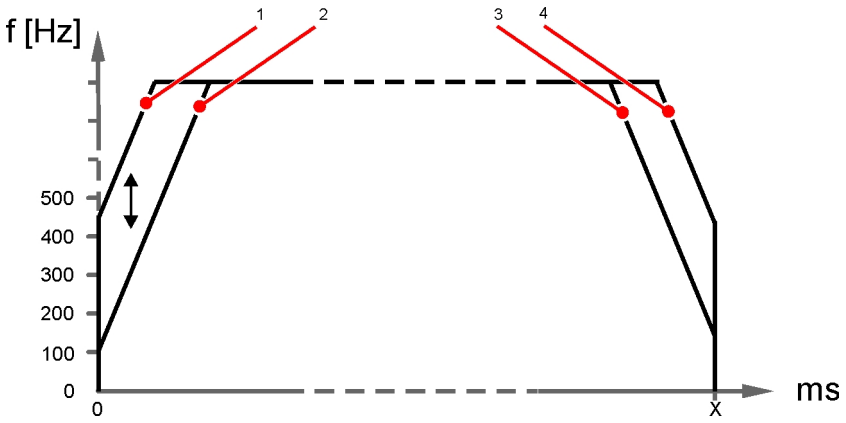
Number	Description
1	Set position 100
2	Width of destination window

MR 1808

Digital offset of stepping rate for acceleration/deceleration

MR 1808 lets you define an acceleration/deceleration ramp offset:

Module register properties	
Values	1 ... 10.000
Unit	Hertz [Hz]
Enabling conditions	When a new positioning motion starts
Value after reset	1



Number	Description
1	Acceleration ramp shifted by offset
2	Original acceleration ramp
3	Original deceleration ramp
4	Deceleration ramp shifted by offset

The digital offset lets you change the steepness of an acceleration or deceleration ramp. The maximum acceleration or deceleration rate varies depending on the stepper motor model.

MR 1809

Actual position

MR 1809 lets you read out the actual position of the axis.

Module register properties		
Values	-2.147 ... +2.147	32-bit signed
Type of access	Read	

MR 1810

Pulse width

MR 1810 lets you set the pulse width of the steps to be output.

Module register properties	
Values	2 ... 1.000.000
Unit	µs
Enabling conditions	With the next step pulse
Value after reset	10

MR 1811

Actual stepping rate

MR 1811 lets you read out the actual stepping rate of the stepper motor.

Module register properties	
Values	0 ... 10.000
Unit	Hertz [Hz]
Type of access	Read

MR 1814

Position of the positive software limit switch

MR 1814 lets you read out or set the position of the positive software limit switch.

Module register properties		
Values	-2.147.483.648 ... 2.147.483.647	32 bits
Enabling conditions	New positioning motion	

MR 1815

Position of the negative software limit switch

MR 1815 lets you read out or set the position of the negative software limit switch.

Module register properties		
Values	-2.147.483.648 ... 2.147.483.647	32 bits
Enabling conditions	New positioning motion	

MR 1816

Assigning REF to a multi-purpose I/O

MR 1816 lets you assign the reference switch to a hardware input (DIO).

Module register properties		
Values	0	not assigned
	1 .. 8 for JX3-MIX1	1 = X32.DIO1 8 = X32.DIO8
	1 ... 4 for JX3-MIX2	1 = X62.DIO1 4 = X62.DIO4
Enabling conditions	Only when the motor is at standstill	

MR 1817

Assigning LIM+ to a multi-purpose I/O

MR 1817 lets you assign the positive hardware limit switch to a hardware input (DIO).

Module register properties		
Values	0	not assigned
	1 .. 8 for JX3-MIX1	1 = X32.DIO1 8 = X32.DIO8
	1 ... 4 for JX3-MIX2	1 = X62.DIO1 4 = X62.DIO4
Enabling conditions	Only when the motor is at standstill	

MR 1818

Assigning LIM- to a multi-purpose I/O

MR 1818 lets you assign the negative hardware limit switch to a hardware input (DIO).

Module register properties		
Values	0	not assigned
	1 .. 8 for JX3-MIX1	1 = X32.DIO1 8 = X32.DIO8
	1 ... 4 for JX3-MIX2	1 = X62.DIO1 4 = X62.DIO4
Enabling conditions	Only when the motor is at standstill	

MR 1868

Last absolute set position

MR 1868 lets you read out the last absolute set position. This module register is very helpful for positioning the axis in relative mode.

Module register properties		
Values	-2.147.483.648 ... 2.147.483.647	32 bits
Type of access	Read	

MR 1885

Modulo position

MR 1885 lets you set the modulo position of the axis.

When you enter a value into this register, the axis switches to modulo mode. In addition, the axis switches to relative positioning mode. Absolute positioning motions are no longer possible. The axis remains in modulo mode until the module will be restarted.

Module register properties	
Values	1 ... 4.294.967.297

6.8 Additional Features

Introduction

Besides module-specific functions, the module JX3-MIX1 has additional cross-module features.

Applications

These additional features let you carry out the following applications:

- Default behavior under fault condition.
- Recording different module register values using the oscilloscope function.
- etc.

Contents

Topic	Page
Oscilloscope	191

6.8.1 Oscilloscope

Introduction

The JX3-MIX1 is equipped with an internal oscilloscope function. By means of the oscilloscope function, you can record values of various module registers.

JetSym

The JetSym programming software JetSym offers possibilities of easily operating the oscilloscope function and of graphically displaying the recorded values.

Technical Data

Parameter(s)	Description
Recording interval	1 ms ... 65,535 ms
Number of channels	max. 4
Number of measuring values per channel	max. 300
Recordable module registers	MR 2: *Digital Value of Analog Output 1* MR 3: *Digital Value of Analog Output 2* MR 4: *Digital Value of Analog Output 3* MR 5: *Digital Value of Analog Output 4*
Module registers to which a trigger condition can be assigned	MR 2: *Digital Value of Analog Output 1* MR 3: *Digital Value of Analog Output 2* MR 4: *Digital Value of Analog Output 3* MR 5: *Digital Value of Analog Output 4*

Applications

The following applications are possible:

- Graphic evaluation of output values for documentation
- etc.

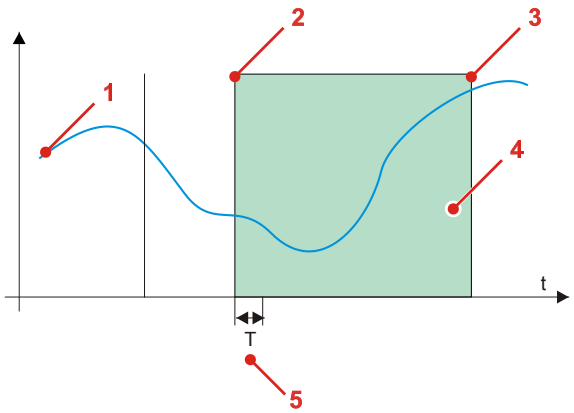
Contents

Topic	Page
Start/Stop Recording	192
Continuous Recording	194
Recording Values under Trigger Condition	196
Reading Out the Recorded Values	199
Oscilloscope Register Description	200
Example: Recording and Reading of Values	202

Start/Stop Recording

Start/Stop Recording

At Start/Stop recording, the JX3-MIX1 module is recording measuring values, until the maximum number of measuring values per channel has been recorded. Start/Stop recording is started by issuing command 1.



Number	Description
1	Values of the module register, out of which recordings are to be made.
2	Start of recording
3	End of recording
4	Recorded values
5	Recording interval

Configuration

Configuring the Start/Stop recording comprises the following steps:

Step	Action	
1	Configure the module registers to be recorded. MR 9741 := 11 ... 14; MR 9742 := Module register number;	
2	Configure the interval to be recorded. MR 9741 := 10; MR 9742 := Interval to be recorded;	
3	Write value 1 into MR 9740 *Command for Oscilloscope*.	
⇨	**Result:** The JX3-MIX1 module starts recording. The JX3-MIX1 module keeps recording values, until the set number of values per channel has been recorded.	
4	Check bit 0 of parameter *State*. MR 9741 := 0;	
	If ...	**... then ...**
	Bit 0 = 0 in MR 9742,	the module has terminated recording.

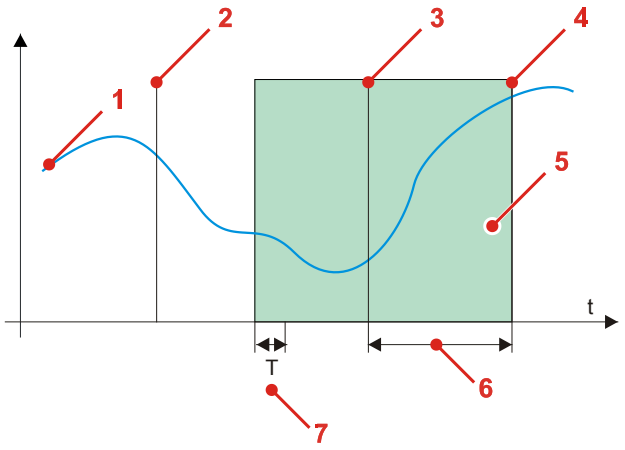
Related Topics

- **Oscilloscope Register Description** (see page 200)
- **Example: Recording and Reading of Values** (see page 202)

Continuous Recording

Continuous Recording

At continuous recording, the JX3-MIX1 module continually records measuring values. After issuing command 2 "Stop", the JX3-MIX1 module continues recording, until the post-buffer is filled with values. To start continuous recording, issue command 4.



Number	Description
1	Values of the module register, out of which recordings are to be made.
2	Start of continuous recording
3	Instance of "Stop" instruction
4	End of recording; the post-buffer is filled with values
5	Recorded values
6	Size of the post-buffer
7	Recording interval

Configuration

Configuration of continuous recording comprises the following steps:

Step	Action
1	Configure the module registers to be recorded. MR 9741 := 11 ... 14; MR 9742 := Module register number;
2	Configure the interval to be recorded. MR 9741 := 10; MR 9742 := Interval to be recorded;
3	Configure the size of the post-buffer. MR 9741 := 30; MR 9742 := Percentage of the max. number of measuring values per channel;

Step	Action	
4	Write value 4 into MR 9740 *Command for Oscilloscope*. **Result:** The JX3-MIX1 module starts recording.	
5	Stop recording by writing value 2 into MR 9740 *Command for Oscilloscope*.	
6	The JX3-MIX1 module further records values, until the post-buffer is filled.	
7	Check bit 0 of parameter *State*. MR 9741 := 0;	
	If ...	**... then ...**
	Bit 0 = 0 in MR 9742,	the module has terminated recording.

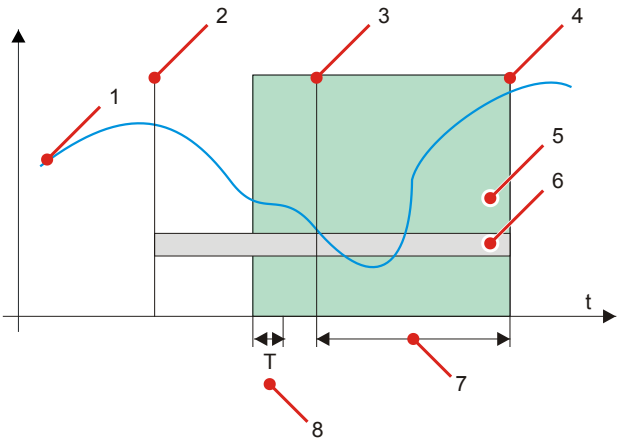
Related Topics

- **Oscilloscope Register Description** (see page 200)
- **Example: Recording and Reading of Values** (see page 202)

Recording Values under Trigger Condition

Recording Values under Trigger Condition

At recording values under trigger condition, the JX3-MIX1 module continually records measuring values. When the trigger condition has been met, recording is continued, until the post-buffer is filled with values. Recording under trigger condition is started by issuing command 3.



Number	Description
1	Values of the module register, out of which recordings are to be made
2	Start of recording with trigger condition
3	Trigger condition has been met
4	End of recording; the post-buffer is filled with values
5	Recorded Values
6	Value Range of the Trigger Condition
7	Size of the Post-Buffer
8	Recording Interval

Trigger Condition

The JX3-MIX1 module checks the trigger condition by the following rules:

- The value for trigger 1 in the module register has to be greater than a configured value.
- The value for trigger 2 in the module register has to be smaller than a configured value.
- There can be different module register numbers for trigger 1 respectively trigger 2.

$$MR[\text{Trigger1}] > VAL[\text{Trigger1}]$$
AND
$$MR[\text{Trigger2}] < VAL[\text{Trigger2}]$$

Element	Description
MR[Trigger1]	Value for trigger 1 in the module register
VAL[Trigger1]	Value for trigger 1
MR[Trigger2]	Value for trigger 2 in the module register
VAL[Trigger2]	Value for trigger 2

Configuration

To configure recording with trigger condition, take the following steps:

Step	Action	
1	Configure the module registers to be recorded. MR 9741 := 11 ... 14; MR 9742 := Module Register Number;	
2	Configure the interval to be recorded: MR 9741 := 10; MR 9742 := Interval to be Recorded;	
3	Configure the size of the post-buffer: MR 9741 := 30; MR 9742 := Percentage of the Max. Number of Measuring Values per Channel;	
4	Configure trigger 1: MR 9741 := 20; MR 9742 := Module Register Number for Trigger 1; MR 9741 := 21; MR 9742 := Value for Trigger 1;	
5	Configure trigger 2: MR 9741 := 22; MR 9742 := Module Register Number for Trigger 2; MR 9741 := 23; MR 9742 := Value for Trigger 2;	
6	Write value 3 into MR 9740 *Command for Oscilloscope*.	
⇨	**Result:** The JX3-MIX1 module starts recording. The JX3-MIX1 module continually checks the trigger condition.	
	If ...	**... then ...**
	the trigger condition has been met,	the JX3-MIX1 module further records values, until the post-buffer is filled.
7	Check bit 0 of parameter *State*. MR 9741 := 0;	
	If ...	**... then ...**
	Bit 0 = 0 in MR 9742,	the module has completed the recording cycle.

Related Topics

- **Oscilloscope Register Description** (see page 200)
- **Example: Recording and Reading of Values** (see page 202)

Reading Out the Recorded Values

Introduction

The JX3-MIX1 module saves the recorded values to a volatile memory range. At deactivating the modules, the values get lost. Even at a recording restart, the values are overwritten.

Reading Out the Recorded Values

For reading out the recorded values, take the following steps:

Step	Action	
1	Check bit 0 of parameter *State*. MR 9741 := 0;	
	If ...	**... then ...**
	Bit 0 = 0 in MR 9742,	the module has terminated recording.
2	Write value 0 into MR 9743 *Index of Recorded Values*. MR 9743 := 0;	
3	By each reading access to MR 9744 *Recorded Values* the next recorded value is read.	
	If ...	**... then ...**
	you have read MR 9744 300 times,	all values recorded to channel 1 are read.
4	Write value 300 into MR 9743 *Index of Recorded Values*. MR 9743 := 300;	
5	By each reading access to MR 9744 *Recorded Values* the next recorded value is read.	
	If ...	**... then ...**
	you have read MR 9744 300 times,	all values recorded to channel 2 are read.
6	Write value 300 into MR 9743 *Index of Recorded Values*. MR 9743 := 600;	
7	By each reading access to MR 9744 *Recorded Values* the next recorded value is read.	
	If ...	**... then ...**
	you have read MR 9744 300 times,	all values recorded to channel 3 are read.
8	Write value 300 into MR 9743 *Index of Recorded Values*. MR 9743 := 900;	
9	By each reading access to MR 9744 *Recorded Values* the next recorded value is read.	
	If ...	**... then ...**
	you have read MR 9744 300 times,	all values recorded to channel 4 are read.

Oscilloscope Register Description

MR 9740

Command for Oscilloscope

The oscilloscope function on the JX3-MIX1 module can be controlled by this module register.

Commands	
1	**Starting a Recording Session** The JX3-MIX1 module starts recording immediately. Recording stops, when the memory for measuring values is full.
2	**Stopping a Recording Session** The JX3-MIX1 module stops recording immediately.
3	**Starting a Recording Session Once a Trigger Condition is Fulfilled** The JX3-MIX1 module starts monitoring the trigger condition. Once the trigger condition is fulfilled, the module starts recording. Recording stops, when the memory for measuring values is full.
4	**Starting Continuous Recording** The JX3-MIX1 module starts recording immediately. Recording is not stopped before issuing the *Stop recording* command.

MR 9741

Parameter Index for the Oscilloscope

Via the parameter index, the parameter in MR 9741 *Parameter Oscilloscope* is selected.

MR 9742

Parameters for Oscilloscope

Via these module registers, the oscilloscope function can be configured.

Index	Parameter(s)
0	**State (Read Only)** Bit 0: 1 = Recording is running Bit 1: 1 = Trigger active
10	**Recording Interval** Value range: 1 ms ... 65,535 ms
11 ... 14	**Module Register Number for Channel # 1 ... 4** Via parameters 11 through 14, the module registers to be recorded by the module are configured.
20	**Module Register Number for Trigger # 1** Number of the module register for trigger condition # 1.

21	**Value for Trigger 1** Value in the module register for trigger condition # 1.
22	**Module Register Number for Trigger # 2** Number of the module register for trigger condition # 2.
23	**Value for Trigger 2** Value in the module register for trigger condition # 2.
30	**Size of the Post-Buffer** Value range: 0 % ... 100 %

MR 9743

Index of the Recorded Values

Via this index, the recorded values are selected.

MR 9744

Recorded Values

Via this module register, the recorded values are read.

Example: Recording and Reading of Values

Task

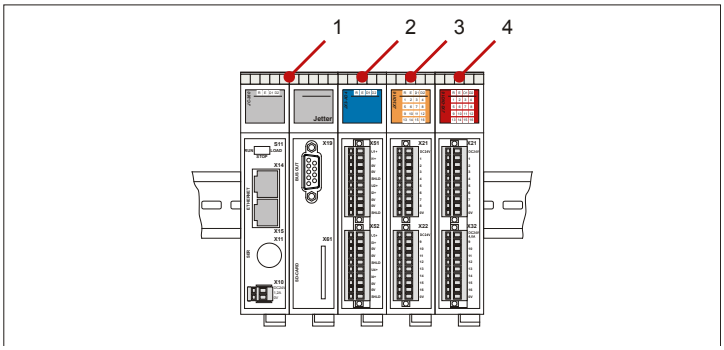
The values at the analog outputs of a JX3-MIX1 module are to be recorded in intervals of 20 ms. After this, the values are stored to the registers of the controller.

Solution

The oscilloscope function of the JX3-MIX1 module records the values. After that, it reads the application program to the controller.

Sample Configuration

This example is based on the following configuration:



Number	Item	Description
1	JC-3xx	Controller
2	JX3-AO4	Analog output module Module # 2
3 ... 4	JX3-xxx	Further JX3 modules

JetSym STX-Program Variable Declaration

```
Type
    TYPE_JX3_AO4_OSCI:
    Struct
        // Module registers of the oscilloscope function
        Command : Int At 4 * 9740;
        ParaIdx : Int At 4 * 9741;
        Para    : Int At 4 * 9742;
        DataIdx : Int At 4 * 9743;
        Data    : Int At 4 * 9744;
    End_Struct;
End_Type;

Var
    JX3_AO4_02 : TYPE_JX3_AO4_OSCI At %VL 100020000;
    // Control register for saving the values
    ValIdx      : Int;
    ValChannel1 : Array[300] Of Int;
    ValChannel2 : Array[300] Of Int;
    ValChannel3 : Array[300] Of Int;
    ValChannel4 : Array[300] Of Int;
End_Var;
```

JetSym STX Program Configuration

```
Task main Autorun
    // Default: MR 2 ... MR 5 are recorded
    // Recording interval up to 20 ms
    JX3_AO4_02.ParaIdx := 10;
    JX3_AO4_02.Para := 20;
    // ...
End_Task;
```

Starting and Reading Out the JetSym STX Program

```
Task main Autorun
    // ...
    // Starting a Recording Session
    JX3_AO4_02.Command := 1;

    // Wait for recording to be ended
    JX3_AO4_02.ParaIdx := 0;
    When
        BitClear(JX3_AO4_02.Para, 0)
    Continue;

    // Set the index to 0
    JX3_AO4_02.DataIdx := 0;
    // Read values of analog output 1
    FOR ValIdx := 0 To 299 Do
        ValChannel1[ValIdx] := JX3_AO4_02.Data;
    End_For;

    // Set the index to 300
    JX3_AO4_02.DataIdx := 300;
    // Read values of analog output 2
    FOR ValIdx := 0 To 299 Do
        ValChannel2[ValIdx] := JX3_AO4_02.Data;
    End_For;

    // Set the index to 600
    JX3_AO4_02.DataIdx := 600;
    // Read values of analog output 3
    FOR ValIdx := 0 To 299 Do
        ValChannel3[ValIdx] := JX3_AO4_02.Data;
    End_For;

    // Set the index to 900
    JX3_AO4_02.DataIdx := 900;
    // Read values of analog output 4
    FOR ValIdx := 0 To 299 Do
        ValChannel4[ValIdx] := JX3_AO4_02.Data;
    End_For;
    // ...
End_Task;
```

6.9 Status Monitoring via Collective Bits

Introduction

The module signalizies the status of the individual analog outputs via collective bits in MR 0 *Module State*.

Benefits

Status monitoring of the analog outputs via collective bits offer the following benefits:

- In the application program, querying MR 0 is sufficient for acquiring the status of all analog outputs.

Statuses Signalized via Collective Bits

The following statuses are signalized via collective bits:

- The lower limit has been fallen below
- The upper limit has been exceeded
- The forcing function is active

Contents

Topic	Page
Status Monitoring via Collective Bits	205
Register Description for Collective Bits	207

Status Monitoring via Collective Bits

Introduction

The module signals the state of the individual analog inputs by means of collective bits in MR 0 *Module State*. This allows to respond to a specific state of an individual analog output by just polling MR 0 from within the application program.

Overview of Registers

For diagnosing the module and the analog outputs, the following module registers are used:

Register	Description
MR 0	Module State
MR 1	Command
MR 1y00	State of analog output y (y = 1 ... 4)

Collective Bits - Signalling

A collective bit in MR 0 *Module State* is set if at least one corresponding status bit in MR 1y00 *State of Analog Output y* has been set.

Signalling by collective bits occurs as follows:

Step	Description	
1	The JX3-MIX1 module signalizes the state of analog output y in MR 1y00 *State of Analog Output y*.	
	If ...	**... then ...**
	the lower limit has been fallen below,	bit 19 is set in MR 1y00.
	the upper limit has been exceeded,	bit 20 is set in MR 1y00.
	forcing has been activated,	bit 23 is set in MR 1y00.
2	The JX3-MIX1 module signals the state of analog output y in MR 0 *Module State* via collective bits.	
	If ...	**... then ...**
	the lower limit has been fallen below,	bit 19 is set in MR 0.
	the upper limit has been exceeded,	bit 20 is set in MR 0.
	forcing has been activated,	bit 23 is set in MR 0.

Acknowledging Collective Bits in the Application Program

Step	Description	
1	The application program detects a set collective bit in MR 0 *Module State*.	
2	The application program checks if bits 19 through 23 in MR 1100 *State of Analog Output 1* have been set.	
	If ...	**... then ...**
	one of bits 19 through 23 is set,	response and writing 6 to bits in MR 1100.
3	The application program checks if bits 19 through 23 in MR 1200 *State of Analog Output 2* have been set.	
	If ...	**... then ...**
	one of bits 19 through 23 has been set,	response and writing 6 to bits in MR 1200.
4	The application program checks if bits 19 through 23 in MR 1300 *State of Analog Output 3* have been set.	
	If ...	**... then ...**
	one of bits 19 through 23 has been set,	response and writing 6 to bits in MR 1300.
5	The application program checks if bits 19 through 23 in MR 1400 *State of Analog Output 4* have been set.	
	If ...	**... then ...**
	one of bits 19 through 23 has been set,	response and writing 6 to bits in MR 1400.
6	The application program deletes collective bits in MR 0 *Module State* by writing command 6 to MR1 *Command*.	

Related Topics:

- **Description of Registers - Collective Bits** (see page 207)

Register Description for Collective Bits

MR 0

Module state

In MR 0 *Module state*, the module signalizes status and error messages of the module.

Meaning of the individual bits		
Bit 0	**Hardware error**	
	1 =	There is a hardware error.
Bit 4	**Error regarding reference values**	
	1 =	The reference values are invalid
Bit 6	**DA converter error**	
	1 =	Error while writing analog output values
Bit 7	**Error regarding internal voltages**	
	1 =	At least one internal auxiliary voltage has exceeded the permitted limits
Bit 19	**Collective bit "The lower limit has been fallen below"**	
	1 =	The value of at least one analog output has fallen below the lower limit. The lower limit is specified in MR 1y08.
Bit 20	**Collective bit "The upper limit has been exceeded"**	
	1 =	The upper limit of at least one analog output has been exceeded. The upper limit is specified in MR 1y09.
Bit 23	**Collective bit "Forcing is active"**	
	1 =	Forcing is active for at least one analog output
Bit 24	**Monitoring of internal voltages**	
	0 =	Monitoring has been deactivated
	1 =	Monitoring is active
Bit 30	**Synchronous data exchange**	
	1 =	Between the JX3-MIX1 module and the bus node, respectively the JetControl 3xx synchronous data exchange takes place.

Module Register Properties	
Type of access	Read
Value after reset	Depending on state and error messages of the module

MR 1

Command

Via MR 1, various functions of the JX3-MIX1 module can be configured.

Commands	
3	**Deactivating monitoring of internal voltages**
4	**Activating monitoring of internal voltages**
5	**Acknowledging hardware errors**
6	**Acknowledging collective bits**

MR 1y00

State of Analog Output y

Via MR 1y00, the module transmits state report of analog output y.

Meaning of the Individual Bits		
Bit 8	**Writing error values**	
	0 =	Under fault condition, write present output value
	1 =	Write analog output value configured under fault condition out of MR 1y10
Bit 19	**Lower limit has been fallen below**	
	1 =	The lower limit configured in MR 1y08 has been fallen below
Bit 20	**The upper limit has been exceeded**	
	1 =	The upper limit configured in MR 1y09 has been exceeded
Bit 23	**The forcing function is active**	
	1 =	Forcing is active for analog output y

Module Register Properties	
Access	Read
Value after reset	0x00000100

7 Quick Reference - JX3-MIX1

Matching OS Version

This quick reference summarizes the registers and I/O numbers of the multifunctional module JX3-MIX1 with OS version 1.00.0.00.

Module Code

For identification purposes, a unique module code is assigned to each JX3 module.
You can read out the module code, for example, in the case of a JC-3xx using R 100002015 and R 100002016.
The module code is also contained in the EDS.
Module code JX3-MIX1: 305

I/O Numbers

JC-3xx	10000xxzz	
	xx	Module number: 02 ... 17
	zz	Module specific I/O number: 01 ... 16
IN / OUT	100000201... 100000216	I/O numbers for module # 02
JC-24x	xxzz	
	xx	I/O module number: 02 ... 32
	zz	Module specific I/O number: 01 ... 16
IN / OUT	201 ... 216	I/O numbers for I/O module # 02
JC-647	m1xxzz	
	m1	Submodule socket + 1: 2 ... 4
	xx	I/O module number: 02 ... 32
	zz	Module specific I/O number: 01 ... 16
IN / OUT	20201 ... 20216	I/O numbers for submodule socket 1 and I/O module # 02
JC-9xx	20SJ0xxzz	
	S	Number of module board: 1 ... 5
	Y	Number of JX6-I/O board: 1 ... 2
	xx	I/O module number: 02 ... 32
	zz	Module specific I/O number: 01 ... 16
IN / OUT	201100201 ... 201100216	I/O numbers for S = 1; J = 1 and I/O module # 02

General Registers of JX3-MIX

0	Module state
1	Module command
2 ... 5	Process data
9	Version
500 ... 599	Error states of multi-purpose I/Os
1100 ... 1199	Analog input 1 (X61.AI1)
1200 ... 1299	Analog input 2 (X61.AI2)
1300 ... 1399	Analog input 3 (X61.AI3)
1400 ... 1499	Analog output 1 (X61.AO1)
1500 ... 1599	Counter input A (X61.CNTA)
1600 ... 1699	Counter input B (X61.CNTB)
1800 ... 1899	Stepper motor
9740 ... 9744	Oscilloscope

Register Numbers

JC-3xx	100xxzzzz	
	xx	Module number: 02 ... 17
	zzzz	Module register number: 0000 ... 9999
JC-24x	3xxz	
	xx	I/O module number - 2: 00 ... 30
	z	Module register number: 0 ... 9
	Only indirect access to additional module registers	
JC-647	3m03xxz	
	m	Submodule position: 1 ... 3
	xx	I/O module number - 2: 00 ... 30
	z :	Module register number: 0 ... 9
	Only indirect access to additional module registers	
JC-9xx	20SJ03xxz	
	S	Number of module board: 1 ... 5
	Y	Number of JX6-I/O board: 1 ... 2
	xx	I/O module number - 2: 00 ... 30
	z	Module register number: 0 ... 9
	Only indirect access to additional module registers	

Module State

0	**Module State**
Bit 0 = 1	Error: Internal voltage reference
Bit 1 = 1	Error: Multi-purpose I/Os
Bit 4 = 1	Error: Serial interface
Bit 5 = 1	Error: Stepper motor
Bit 6 = 1	Error: Analog converter (D/A and A/D)
Bit 16 = 1	Stepper motor: Referencing completed
Bit 17 = 1	Stepper motor: Target window has been reached
Bit 18 = 1	Stepper motor: Window is defined
Bit 19 = 1	Stepper motor: Axis stopped
Bit 20 = 1	Stepper motor: Deceleration ramp is enabled
Bit 25 = 1	Analog I/O: Analog values are valid
Bit 30 = 1	Synchronous data exchange

Module-Specific Command Registers

1	**Command**
6	Clear error of status register 0

Versions/Revisions

9	OS version
32	FPGA revision
769	Bootloader version

Pointer to Process Data

Pointer to process data in MR 800 ... MR 802

Value 0	Averaged value of analog input 1 (X61.AI1)
Value 1	Averaged value of analog input 2 (X61.AI2)
Value 2	Averaged value of analog input 3 (X61.AI3)
Value 3	Reading of counter A
Value 4	Reading of counter B
Value 5	Stepper motor: Actual position
Value 6	Stepper motor: Actual speed

MR 800 <- value. The result is stored to MR 2 and MR 64.
MR 801 <- value. The result is stored to MR 3 and MR 65.
MR 802 <- value. The result is stored to MR 4 and MR 66.

MR 80: The value ranging from 0 ... 4,095 is output as voltage ranging from 0 ... 10 V at analog output X61.AO1.

Analog Input AI1 ... AI3

1y00	State

	Bit 0 = 1:	Error: Analog hardware
	Bit 4 = 1:	Error: Incorrect calibration value
	Bit 7 = 1:	Error: Internal voltages
	Bit 12 = 1:	Validity: Buffer for average values is filled
	Bit 25 = 1:	Validity of measured values
1y01	Command	
	5	Reset error bits of MR 1y00
1y02	AI1...AI3	Averaged reading of the corresponding analog input
1y06	Moving average	
	1	Averaging disabled
	4	4-fold moving average
	16	16-fold moving average

with y = 1 ... 3 for analog input X61.AI1 ... X61.AI3

Analog Output AO1

80	Analog output value
Range	12 bits: 0 ... 4,095
0	corresponds to 0 V at output X61.AO1
4.095	corresponds to 10 V at output X61.AO1
Conversion	$MR = U \cdot \frac{4095}{10V}$

Analog output X61.AO1

Counter Inputs A, B (single- and dual-channel counter)

1y00	State	
	Bit 3 = 1:	Edge evaluation: positive edge
	Bit 4 = 1	Edge evaluation: negative edge
	Bit 5 = 1:	Edge evaluation: both edges
	Bit 6 = 1:	Forcing function enabled
	Bit 7 = 1:	Modulo function enabled
	Bit 8 = 1:	Gate function enabled
	Bit 9 = 1:	Strobe function enabled
	Bit 10 = 1:	Reset function enabled
	Bit 11 = 0	Negative counting direction (single-channel counter only)
	Bit 11 = 1:	Positive counting direction (single-channel counter only)
	Bit 12 = 0	Single-channel counter enabled
	Bit 12 = 1:	Dual-channel counter enabled
	Bit 14 = 1:	Gate function enabled
	Bit 15 = 1:	Counter enabled
1y01	Command	
	20	Enable the forcing function
	21	Disable the forcing function
	30	Enable counter y (counter A: y = 5, counter B: y = 6)
	31	Disable counter y
	32	Counting direction: forward
	33	Counting direction: reverse
	34	Enable gate function
	35	Disable gate function
	36	Enable strobe function
	37	Disable strobe function
	40	Enable single-channel counter, only MR 1501
	41	Enable dual-channel counter, only MR 1501
	50	Enable rising edge
	51	Enable falling edge
	52	Enable both edges
	60	Enable modulo function
	61	Disable modulo function
1y02	Force value	
1y03	Count value	
1y04	Strobe value	
1y05	Reset value	
1y06	Modulo value	
1y10	Allocation of gate to input DIO1 ... DIO8	
1y11	Allocation of strobe to input DIO1 ... DIO8	
1y12	Allocation of reset to input DIO1 ... DIO8	
1y13	Polarity of strobe, gate, reset; bit-coded	
	Bit 0 = 0	Gate is low-active
	Bit 0 = 1	Gate is high-active
	Bit 1 = 0	Strobe is low-active
	Bit 1= 1	Strobe is high-active
	Bit 2 = 0	Reset is low-active
	Bit 2 = 1	Reset is high-active
1y20	Frequency ((Δcounting pulses * 1,000) / MR 1y21	
1y21	Time base for frequency in ms	

where y = 5 represents counter A (X61.CNTA)
where y = 6 represents counter B (X61.CNTB)
where y = 5 represents dual-channel counter A, B (X61.CNTA and X61.CNTB)

Stepper Motor

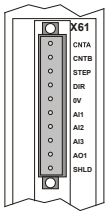
1800	State: Stepper motor	
	Bit 0 = 1:	The positive limit switch is active once the axis has reached the positive hardware or software limit switch.
	Bit 1 = 1:	The negative limit switch is active once the axis has reached the negative hardware or software limit switch.
	Bit 2 = 1:	The reference switch is active
	Bit 3 = 1:	Software limit switch LIM: The actual motor position has exceeded the set position of the software limit switch.
	Bit 4 = 1:	Hardware limit switch LIM: The actual motor position has exceeded the set position of the hardware limit switch.
	Bit 5 = 1:	Error: Stepper motor
	Bit 6 = 1:	Machine referencing error
	Bit 7 = 1:	Software limit switch has been actived
	Bit 8 = 1:	Stop at the reference point
	Bit 9 = 0:	Axis type: Linear
	Bit 9 = 1:	Axis type: Modulo
	Bit 10 = 0:	Absolute positioning
	Bit 10 = 1:	Relative positioning
	Bit 11 = 1:	Endless positioning enabled
	Bit 12 = 0:	DIR: Negative direction of travel (if DIR polarity = 0)
	Bit 12 = 1:	DIR: Positive direction of travel (if DIR polarity = 0)
	Bit 16 = 1:	Reference position is valid
	Bit 17 = 1:	AXARR: Will be set once the destination window is reached
	Bit 18 = 1:	Within the destination window
	Bit 19 = 1:	The axis is at standstill

	Bit 20 = 1:	Busy: Motor is running
	Bit 21 = 1:	Axis is in deceleration ramp
1801	Command	
	0	Stop with programmed decel: Stop with deceleration ramp
	1	Enable the software limit switch
	2	Disable the software limit switch
	3	Set reference
	4	Clearing the reference
	5	Stop without deceleration ramp
	9	Automatic reference run, mode # 1
	10	Automatic reference run, mode # 2
	11	Automatic reference run, mode # 3
	12	Automatic reference run, mode # 4
	17	Positioning mode: Relative positioning
	18	Positioning mode: Absolute positioning
	19	Continue the interrupted positioning motion
	22	Stop at the reference point
	23	Do not stop at the reference point
	56	Start endless positioning in positive direction
	57	Start endless positioning in negative direction
1802	Set position	
1803	Set stepping rate	
1804	Polarities	
1805	Acceleration ramp	
1806	Deceleration ramp	
1807	Destination window	
1808	Start-stop frequency	
1809	Actual position	
1810	Width of STEP pulse	
1811	Actual stepping rate	
1814	Position SW LIM+	
1815	Position SW LIM-	
1816	Assignment of REF to DIO1 ... DIO8	
1817	Assignment of HW LIM+ to DIO1 ... DIO8	
1818	Assignment of HW LIM- to DIO1 ... DIO8	
1868	Last absolute set position	
1885	Overflow position	
1899	Software version of the stepper motor module	

Oscilloscope

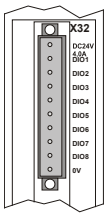
9740	Command
9741	Parameter index
9742	Parameter
9743	Data index
9744	Data

Assignment of Terminal X61



Terminal Point	Description
X61.CNTA	Counter input A
X61.CNTB	Counter input B
X61.STEP	Open-drain stepper motor output STEP
X61.DIR	Open-drain stepper motor output DIR
X61.0V	Reference potential
X61.AI1	Analog input # 1, 0 ... 10 V
X61.AI2	Analog input # 2, 0 ... 10 V
X61.AI3	Analog input # 3, 0 ... 10 V
X61.AO1	Analog output # 1, 0 ... 10 V
X61.SHLD	Shield

Assignment of terminal X32



Terminal Point	Description
X32.DC24v4.0A	Supply voltage +12 VDC
X32.DIO1	Multi-purpose input/output # 1
X32.DIO2	Multi-purpose input/output # 2
X32.DIO3	Multi-purpose input/output # 3
X32.DIO4	Multi-purpose input/output # 4
X32.DIO5	Multi-purpose input/output # 5
X32.DIO6	Multi-purpose input/output # 6
X32.DIO7	Multi-purpose input/output # 7
X32.DIO8	Multi-purpose input/output # 8
X32.0V	Reference potential

Appendix

Introduction

This appendix contains electrical and mechanical data, as well as operating data.

Contents

Topic	Page
Technical Data	214
Index	224

A: Technical Data

Introduction

This section of the appendix contains both electrical and mechanical data, as well as operating data of the JX3-MIX1 module.

Contents

Topic	Page
Technical Specifications	215
Physical Dimensions	219
Operating Parameters: Environment and Mechanics	220
Operating Parameters: Enclosure	221
DC Power Supply Inputs and Outputs	222
Shielded Data and I/O Lines	223

Technical Specifications

Technical Data - Electrical System: Digital Inputs

Parameter	Description
Input current range	2.8 mA ... 4.3 mA
Input resistance	6.7 kΩ
Hardware-related input delay time	< 200 µs
Type	IEC 61131-2 type 3, pnp
Galvanic isolation	None
Input frequency	2.5 kHz (50 % duty cycle)
Operating point OFF (maximum)	5 V (input current max. 1.5 mA)
Operating point ON (minimum)	11 V (input current min. 2.0 mA)
Permissible voltage range	DC -30 V ... +30 V
Galvanic isolation	None

Technical Data - Electrical System: Digital Outputs

Parameter	Description
Load current	Max. 0.5 A per output
Permissible voltage range	DC +24 V -15 % ... + 20 %
Protection against short-circuit, overtemperature	Yes
Protection against polarity reversal	Yes
Protection against overvoltage	In case the module is installed on a grounded top hat rail
Protection against breakage of earthing cable	Yes
Protection against inductive loads	Yes
Short-circuit proof	Yes
Output design	IEC 61131-2 type 3, pnp
Operating point	
OFF (maximum)	3 V
ON (min.)	Vcc - 1.0 V
Response of outputs to overload, overvoltage, overtemperature	Output is pulsing

Technical Data - Electrical System: Counter Inputs

Parameter	Description
Permissible voltage range	DC 0 V ... +24 V (+20 %)
Operating point OFF (maximum)	< 2.0 V
Operating point ON (minimum)	> 15.0 V
Input frequency	50 kHz max. (at 50 % duty cycle)
Dual-channel counter - properties	Quadruple evaluation
Galvanic isolation	None

Technical Data - Electrical System: Analog Inputs

Parameter	Description
Input voltage range	DC 0 ... +10 V
Resolution	12 bits
Accuracy	> 99 % (of effective range)
Input impedance	100 kΩ
Hardware-related input delay time	< 1 ms
Surge withstand capability	DC -30 V ... + 30 V DC
Input frequency	0 ... 50 Hz
Conversion time	< 10 ms
Line length to sensors	0 m ... 20 m
Galvanic isolation	None

Technical Data - Electrical System: Analog Outputs

Parameter	Description
Output voltage range	DC 0 ... +10 V
Resolution	12 bits
Error deviation	< 1 % (of effective range)
Load impedance	> 2 kΩ
Conversion time	< 10 ms
Line length to actors	0 m ... 20 m
Galvanic isolation	None

Technical Specification: Serial Interface

Parameter	Description
Bus termination	None
Galvanic isolation	None
Baud rate accuracy	> 99 %
Interface standards	RS-232, RS-485
Baud rates	2,400 baud 4,800 baud 9,600 baud 19,200 baud 38,400 baud 57,600 baud 115,200 baud
Data formats	7 bits 8 bits
Parity	Even Odd None
Number of stop bits	1 2

Technical Data - Electrical System: Stepper Motor

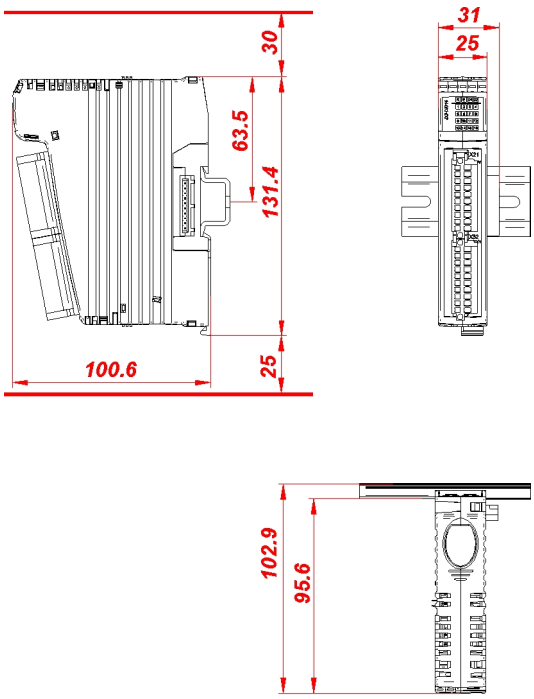
Parameter	Description
Galvanic isolation	None
Design of STEP, DIR outputs	Open drain
Maximum current (STEP and DIR)	Max. 150 mA
Current limitation	None. External current limitation required
Maximum voltage (STEP and DIR)	Max. DC +30 V
Stepping rate of STEP signal	1 Hz ... 10 kHz
Frequency resolution of STEP signal at 10 kHz	10 Hz
STEP signal: Pulse width	Can be set in steps of 1 µs

Data of the JX3 System Bus as of Rev. 03.xx

Parameter	Description
Logic voltage of the JX3 system bus	DC +5 V (-15 %... +10 %)
Current consumption absorbed from the logic voltage of the JX3 system bus	Typically: 70 mA
Additional voltage of the JX3 system bus	DC +24 V (-15 %... +20 %)
Current consumption absorbed from the additional voltage of the JX3 system bus	Voltage outputs, typically 70 mA Current outputs, typically 120 mA
Nominal power absorbed from the JX3 system bus	Voltage outputs, typically 2.03 W Current outputs, typically 3.23 W

Physical Dimensions

Physical Dimensions



Minimum Clearances

At mounting the JX3-MIX1 module, make sure to maintain a minimum clearance above and below. At replacing the module, you can operate the locking mechanisms of the JX3 backplane module using your fingers.

- Minimum clearance above: 30 mm
- Minimum clearance below: 25 mm

Module Width

The JX3-MIX1 module requires a space of 31 mm width. At connecting the JX3-MIX1 module to a JX3 station, the width is increased by 25 mm.

Mounting Position

The mounting position of the JX3-MIX1 module is vertical.

Operating Parameters: Environment and Mechanics

Environment

Parameter	Value	Standard
Operating temperature range	0 ... +50 °C	
Storage temperature range	-40 ... +70 °C	DIN EN 61131-2 DIN EN 60068-2-1 DIN EN 60068-2-2
Air humidity	10 ... 95 %, non-condensing	DIN EN 61131-2
Pollution degree	2	DIN EN 61131-2
Corrosion / Chemical resistance	No special protection against corrosion. Ambient air must be free from higher concentrations of acids, alkaline solutions, corrosive agents, salts, metal vapors, or other corrosive or electroconductive contaminants	
Max. operating altitude	2,000 m above sea level	DIN EN 61131-2

Mechanical Parameters

Parameter	Value	Standard
Free falls withstanding test	Free fall at Shipping packaging: 1 m Product packaging: 0.3 m	DIN EN 61131-2 DIN EN 60068-2-32
Vibration resistance	5 Hz - 9 Hz: 3.5 mm amplitude 9 Hz - 150 Hz : 1 g acceleration: 1 octave/minute, 10 frequency sweeps (sinusoidal), all 3 spatial axes	DIN EN 61131-2 DIN EN 60068-2-6
Shock resistance	15 g occasionally, 11 ms, sinusoidal half-wave, 3 shocks in the directions of all three spatial axes	DIN EN 61131-2 DIN EN 60068-2-27
Degree of protection	IP20	DIN EN 60529
Mounting position	Vertical position, snapped on DIN rail	

Operating Parameters: Enclosure

Electrical Safety

Parameter	Value	Standard
Protection class	III	DIN EN 61131-2
Dielectric test voltage	Functional ground is connected to chassis ground internally.	DIN EN 61131-2
Protective connection	0	DIN EN 61131-2
Overvoltage category	II	DIN EN 61131-2

EMC - Emitted Interference

Parameter	Value	Standard
Enclosure	Frequency band 30 - 230 MHz, limit 30 dB (µV/m) in 10 m Frequency band 230 -1,000 MHz, limit 37 dB (µV/m) in 10 m (class B)	DIN EN 61000-6-3 DIN EN 61000-6-4 DIN EN 55011

EMC - Immunity to Interference

Parameter	Value	Standard
Magnetic field with mains frequency	50 Hz 30 A/m	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-8
RF field, amplitude-modulated	Frequency band 80 MHz - 2 GHz Test field strength: 10 V/m AM 80 % at 1 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-3
ESD	Discharge through air: Test peak voltage 8 kV Contact discharge: Test peak voltage 4 kV Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-2

DC Power Supply Inputs and Outputs

EMC - Emitted Interference

Parameter	Value	Standard
Signal and control interface DC power supply inputs and outputs	Frequency bands: 0.15 to 0.5 MHz, limit 40 to 30 dB 0.5 to 30 MHz, limit 30 dB (class B)	DIN EN 61000-6-3

EMC - Immunity to Interference

Parameter	Value	Standard
RF, asymmetric	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Bursts	Test voltage 2 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4
Voltage surges asymmetric (line to earth) symmetrical (line to line)	tr/th 1.2/50 µs Common-mode interference voltage 1 kV Series-mode interference voltage 0.5 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5

Shielded Data and I/O Lines

EMC - Immunity to Interference

Parameter	Value	Standard
Asymmetric RF, amplitude-modulated	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Bursts	Test voltage 1 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4
Voltage surges, asymmetric (line to earth)	tr/th 1.2/50 µs Common-mode interference voltage 1 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5

EMC - Interference Immunity of Functional Earth Connections

Parameter	Value	Standard
RF, asymmetric	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Bursts	Test voltage 1 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4

B: Index

A

Accessories for the JX3 system - 26
Analog - 47
  Analog Values
    Input - 101
    Output - 109
  Connection
    Actuator - 50
    Sensor - 52

D

Decommissioning - 12
Digital
  Connection
    Actuator - 48
    Sensor - 54, 56, 57, 59
  Digital Values
    Input - 118
    Output - 117
Direct Register Access - 91

E

EDS
  JX3 modules connected to a JC-24x - 34
  JX3 modules connected to a JC-3xx - 32
  JX3 modules connected to a JC-647 - 36
EMC - 15
Examples
  Direct register access - 92
  Indirect register access - 95
  Pointer to Process Data - 98
  Reading Out an EDS with JC-24x - 40
  Reading Out an EDS with JC-3xx - 38
  Using Analog I/Os - 105, 107, 113, 115
  Using DIOs - 118, 121, 123
  Using Stepper Motors - 75

I

I/O module number on the JX2 system bus - 84
I/O Number
  on the JX2 system bus with a JC-24x - 85
  on the JX2 system bus with a JC-647 equipped with JX6-SB(-I) - 87
  on the JX2 system bus with a JM-D203-JC24x - 85
  within a JX3 station equipped with JC-3xx - 86
Identification - 29
Indirect Register Access - 93
Initial Commissioning
  Analog Output - 74, 78
  Multi-Purpose I/Os - 76
  Various PLCs - 73, 77
Installation - 65
  Installing a JX3 peripheral module - 66
Intended Conditions of Use - 12
Interfaces - 47, 48

L

LEDs - 63

M

Minimum Requirements - 24
Modifications - 12
Module Register(s) - 82
Module Registers - Overview - 80
  Definition - 83

N

Nameplate - 43

O

Operating Parameters
  DC Power Supply Inputs and Outputs - 215
  Enclosure - 214
  Environment and Mechanics - 213
  Shielded Data and I/O Lines - 216
Order Reference / Model Variants - 21
Oscilloscope - 184

P

Personnel Qualification - 12
Physical Dimensions - 27
Pointer to Process Data - 98
Power-Up Behavior - 72
Product Description - 18
Programming - 79
Pull-Up - 54

Q

Quick Reference - 203

R

Register Number
  on the JX2 system bus with a JC-24x - 85
  on the JX2 system bus with a JC-647 equipped with JX6-SB(-I) - 87
  on the JX2 system bus with a JM-D203-JC24x - 85
  within a JX3 station equipped with JC-3xx - 86
Register(s) - 83
Removing
  Removing a JX3 peripheral module - 69
  Replacing a JX3 peripheral module - 67
Repair - 12
Representation of Safety Information - 5
Residual Dangers - 14

S

Safety Instructions - 11
Scope of Delivery - 18
Stepper Motor - 54, 153
  Axis Positioning - 165, 166, 170, 172
  Connection - 54, 56
  Referencing - 156

T

Technical Specifications - 209
Terminals
  Terminal X32 - 48
  Terminal X61 - 47

U

Usage Other Than Intended - 12
Using Counters
  Connection - 57, 59
  Read Access - 127, 130

V

Versions - 30

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