JX3-AO4

Analog Output Module

User Manual

Jetter

60873348

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Address

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Assignment to Product

This User Manual is an integral part of JX3-AO4:

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-AO4:

- It must be kept in a way that it is always at hand, until the device JX3-AO4 will be disposed of.
- If the device JX3-AO4 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-AO4.

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.

Table of Contents

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

Generally Valid 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 includes operation in accordance with this User Manual.

The JX3-AO4 module is a JX3 peripheral module of four analog outputs for connection to analog actuators. It can be connected to the JX3 system bus. The JX3 system bus starts at the JX3-BN-xxx bus head or at the controller JC-3xx. By means of the bus head JX3-BN-CAN, the JX3-AO4 can be connected to the controllers JC-24x und JC-647, as well as to the dual axis controller JM-D203-JC24x. The JX3-AO4 module is supplied with voltage by the JC-3xx controllers or by the modules JX3-BN-XXX and JX3-PS1. This operating voltage is classified as SELV (Safety Extra Low Voltage). Therefore, the JX3-AO4 module is not subject to the EU Low Voltage Directive.

The JX3-AO4 module may only be operated within the limits of the stated data, see chapter **Technical Data** (see page 157).

The 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.

If the device is to be run under ambient conditions which differ from the conditions mentioned in chapter **Operating Conditions** (see page 159), the manufacturer is to be contacted beforehand.

Who may Operate the Device?

Only instructed, trained and authorized persons are permitted to operate this device.

Transport:	Only by personnel with knowledge in handling electrostatically sensitive components.
Installation:	Only by specialists with training in electrical engineering.
Engineering:	Only by trained personnel, as specific know-how of electrical engineering is required.
Commissioning:	Only by specialists with profound knowledge of, and experience with, electrical engineering / drive technology.

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.
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.
Decommissioning and Disposal	The environmental regulations of the respective country must be complied with when decommissioning and disposing of devices on the operating company's premises.
Transporting JX3 Modules	To exclude damages to JX3 modules the JX3 backplane bus has to be attached during transport. This is particularly true for transport via mail.
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.

Instructions on EMI

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 to be Taken

Measures for increasing immunity against EMI in electric plants:

- The JX3-AO4 module has to 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**.

Download of Application Note 016

You can download Application Note 016 from our **homepage http://www.jetter.de**. The path leading to Application Note 016 "EMC-Compatible Installation of Electric Cabinets" is "Industrial Automation - Support - Downloads - english - 7_Miscellaneous - Application Notes".

2 Engineering

Purpose of this Chapter

This chapter is for supporting you when engineering a plant equipped with the JX3-AO4 module in the following fields of activity:

- Planning the wiring between the JX3-AO4 module and the analog actuator
- Selecting the analog actuators
- Connecting the analog actuators to the module JX3-AO4
- Commissioning the JX3-AO4 module in the control cabinet

Contents

Product Description - JX3-AO4

The JX3-AO4 Module

The JX3-AO4 module is a peripheral module for connection of analog actuators. This module is equipped with 4 analog outputs for voltages and currents.

Characteristics

The following list shows the characteristics of this module:

- 4 analog outputs
- Selectable output signals per channel:
  0 V ... +10 V, -10 V ... +10 V,
  0 mA ... 20 mA, 4 mA ... 20 mA
- Resolution: 16 bits
- Accuracy: > 99.5 %
- Color of LED sheeting: sky-blue (RAL 5015)

Additional Features

Additional features of the JX3-AO4 module are:

- User-scalable
- Monitoring and evaluation of limits
- Slave pointer
- Cutting off
- Forcing of analog outputs
- Error values
- Oscilloscope function
- Table function
- Operating system update by means of JetSym

Scope of Delivery

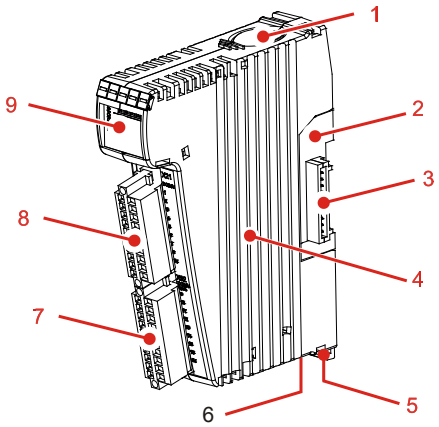
The following items are included in the scope of delivery of the JX3-AO4 module:

Jetter item #	Quantity	Description
10000569	1	JX3-AO4
60869252	2	10-pin connector, spring cage technology
60870411	10	Terminal labels
60871899	1	Installation instruction
60870410	1	Keying pins

Parts and Interfaces of the JX3-AO4 Module

Parts and Interfaces

The JX3-AO4 module features the following parts and interfaces:



Number	Element	Description
1	Upper latch	For removing the JX3 module enclosure from the JX3 backplane module
2	JX3 backplane module	Connection of the JX3 modules, blue
3	X119	Connector for additional JX3 modules
4	JX3 module enclosure	Can be dismounted from the JX3 backplane module, light grey coloring
5	Release lever	For removing the JX3 module from the DIN rail
6	Lower latch	For removing the JX3 module enclosure from the JX3 backplane module Not visible in the illustration
7	Terminal X52	Connection of analog outputs 3 and 4
8	Terminal X51	Connection of analog outputs 1 and 2
9	LEDs	Diagnostics and status display

Minimum Requirements

Introduction

The JX3-AO4 module is operated in a system consisting of various components supplied by Jetter AG. In order to ensure proper interaction of these components, the operating systems used and the programming tool JetSym must have the release numbers listed below.

Configurations

The module JX3-AO4 can be used in the following configurations:

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

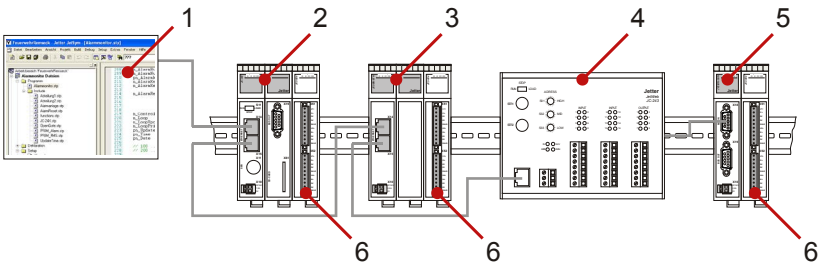
Minimum Requirements of the Operating System

Which is the earliest possible release of the operating system for the JX3-AO4 module is dependent on the hardware revision applied. You will find the hardware revision number on the nameplate fixed to the left cover of the enclosure. The release number of the operating system applied can be read out of MR 9.

Hardware Revision	Earliest Possible Operating System Release
Rev 01.xx.xx	V 1.01.0.00 or higher
Rev 03.xx.xx or higher	V 1.03.0.00 or higher

Minimum Requirements

For the functions described in this document modules, controllers and software have to meet the following minimum requirements:



No.	Element	Function	As of Release No.
1	JetSym	Programming software	V 3.00
2	JC-3xx	PLC JetControl 3xx	In preparation
3	JX3-BN-ETH	Ethernet bus head	In preparation
4	JC-24x	PLC JetControl 240	V 3.23

No.	Element	Function	As of Release No.
	JC-647	PLC JetControl 647	V 3.50
	JX6-SB(-I)	Submodule for system bus	V 2.18
	JM-D203-JC24x	Dual axis controller with PLC JetControl 240	V 1.12.0.00
5	JX3-BN-CAN	CAN bus head	V 1.06.0.00
6	JX3-AO4	Analog output module	V 1.03.0.00

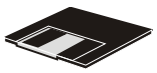
JX3-Modules: List of Documentation

Introduction

Various documents and software tools will support the user when engineering and installing and programming the JX3-AO4 module. These documents and software tools can be downloaded from our **homepage http://www.jetter.de**.

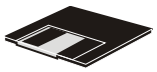
Engineering

When performing engineering tasks, the following documents and files will support you:

	**Data Sheet on the JX3-AO4 Module**
	■ Product description
	■ Technical data
	■ Dimensional drawings
	**User Manual on the JX3-AO4 Module**
	■ The document at hand
	**CAD Data of the JX3-AO4 Module**
	■ 2D illustrations (dxf file)
	■ 3D illustrations (stp file)
	**User Manual on the JC-3xx Control System**
	■ Engineering a JX3 station
	■ Product descriptions of JX3 modules

Engineering at the JX2 System Bus

When engineering a JX3 station on the system bus (JC-24x and JC-647), the following document and software tool will support you:

	**JX2-I/O System - User Information**
	■ System bus topology
	■ Specification of the JX2 System Bus
	■ Product descriptions of JX3-BN-CAN, JX2 modules, IP67 modules and third-party modules
	**System Bus Configurator**
	■ Excel file for designing the system bus
	■ SysBus_Configuration_xxx_e.xls (xxx: Version)

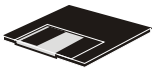
Installation

When installing such modules, the following document will support you:

	**Installation Instruction**
	It is included in the boxed module JX3-AO4 and contains the following information:
	■ Installation of the module on a DIN rail
	■ Terminal assignment
	■ Specification of conductor terminals
	■ Diagnostics via LEDs
	**User Manual on the JX3-AO4 Module**
	■ The document at hand

Programming

When programming the module, the following documents and software tools will support you:

	**User Manual on the JX3-AO4 Module**
	■ The document at hand
	**JX2-I/O System - User Information**
	■ Module numbering system
	■ Diagnostics of the modules on the JX2 system bus
	**JetSym**
	■ Programming tool
	**User Manual of the Controller**
	■ Depending on the controller used, you will need the corresponding manual

Accessories for the JX3 System

Labelling Field

Ten labelling fields are included in the scope of delivery of the JX3-AO4 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-AO4 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

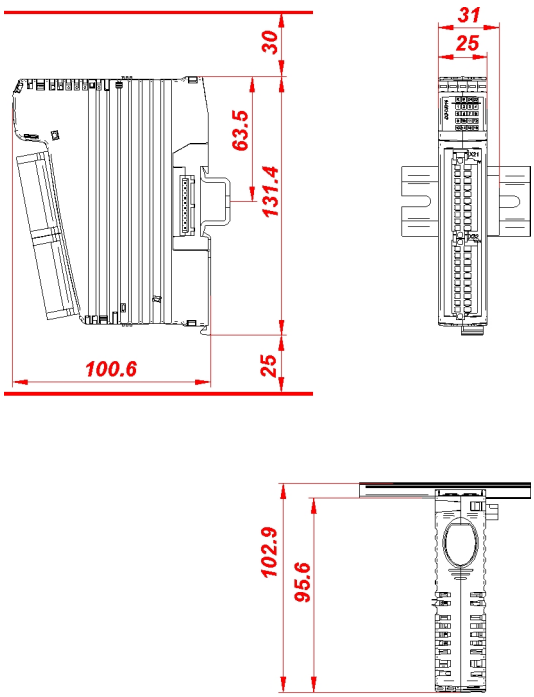
	Designation	DIV_CLIPFIX_35
	Jetter item #	60863970

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-AO4 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-AO4 module requires a space of 31 mm width. At connecting the JX3-AO4 module to a JX3 station, the width is increased by 25 mm.

Mounting Position

The mounting position of the JX3-AO4 module is vertical.

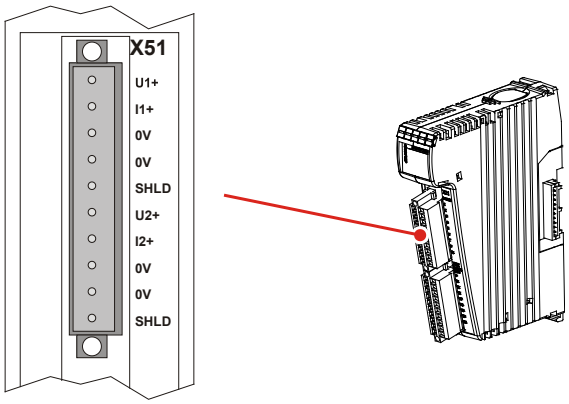
Assignment of Terminal X51

Interfaces of Terminal X51

The signals of the following interfaces are connected to terminal X51:

- Analog output # 1
- Analog output # 2

Assignment of Terminal X51



Terminal Point	Function
U1+	Voltage output 1
I1+	Current output 1
0 V	Reference potential
SHLD	Shielding
U2+	Voltage output 2
I2+	Current output 2
0 V	Reference potential
SHLD	Shielding

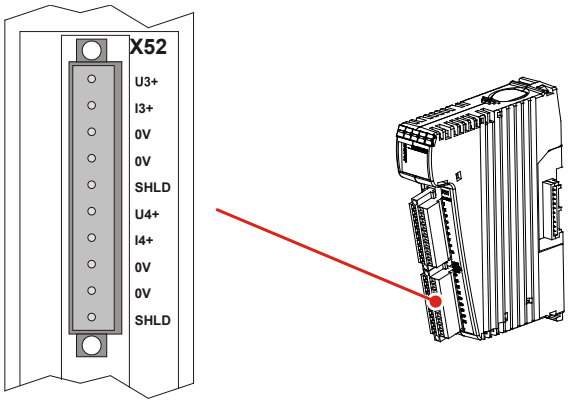
Assignment of Terminal X52

Interfaces of Terminal X52

The signals of the following interfaces are connected to terminal X52:

- Analog output # 3
- Analog output # 4

Assignment of Terminal X52

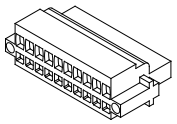


Terminal Point	Function
U3+	Voltage output 3
I3+	Current output 3
0 V	Reference potential
SHLD	Shielding
U4+	Voltage output 4
I4+	Current output 4
0 V	Reference potential
SHLD	Shielding

Specification of the Connectors for Terminals X51 / X52

Ordering Data of the Connector

Two 10-pin connectors already belong to the scope of delivery of the JX3-AO4 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

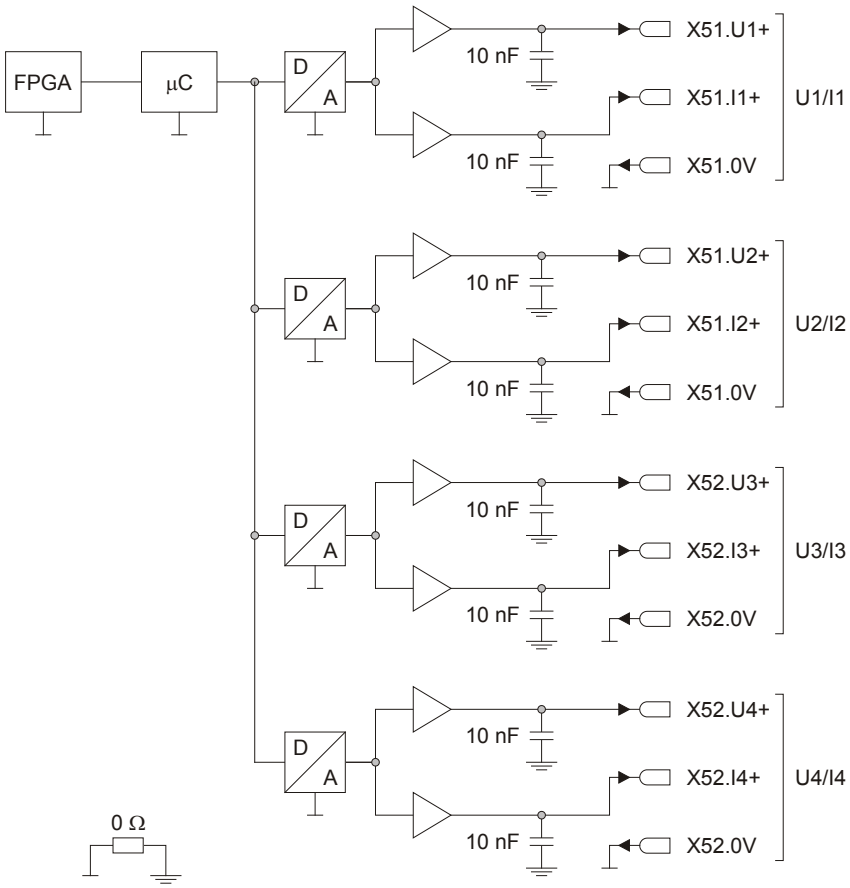
The fitting screw driver can be ordered from Jetter AG directly.

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

Internal Block Diagram

Internal Block Diagram

The JX3-AO4 module is equipped with four DAC for voltages and currents.



Component	Function
FPGA	Communication component
µC	Controller
D/A	Digital-analog converter
10 nF	Capacitor at the analog output

Connecting Voltage and Current Actuators

Constituents of the Cable

The constituents of the cable for connecting analog signals must, by all means, be the following:

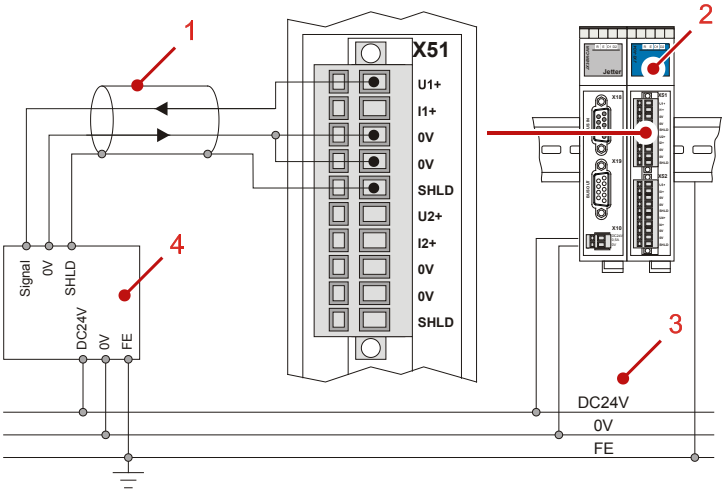
- Shielded line, 85 % covering
- Tinned copper drain wire
- Cable cross section 0.14 mm^2

Voltage Supply

The voltage actuator and the JX3 station can be supplied either by one common power supply or by various power supplies.

Connecting Voltage Actuators

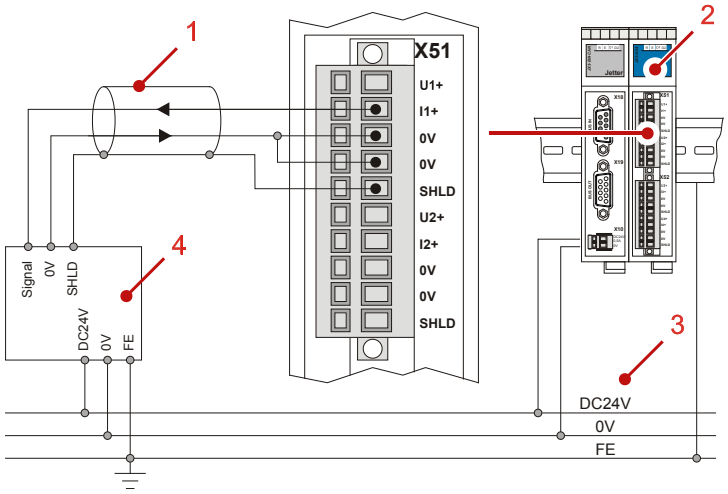
The connection of voltage actuators is identical for all four analog outputs. In the following illustration, a voltage actuator has been connected to analog output 1.



Number	Component
1	Cable leading to the analog actuator
2	Analog output module JX3-AO4
3	Voltage supply for JX3 station and analog actuator
4	Analog actuator with voltage-interface

Connecting Current Actuators

The connection of current actuators is identical for all four analog outputs. In the following illustration, a current actuator has been connected to analog output 1.

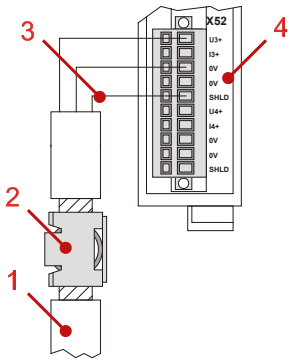


Number	Component
1	Cable leading to the analog actuator
2	Analog output module JX3-AO4
3	Voltage supply for JX3 station and analog actuator
4	Analog actuator with current interface

Improving the Noise Immunity

For improving the noise immunity, please give heed to the following rules:

- Connect the copper drain wire (3) directly at the terminal point X51.SHLD, respectively X52.SHLD.
- Use a shielding terminal (2) for additionally earthing the shield of the wire.



Number	Component
1	Cable leading to the analog actuator
2	Shielding terminal
3	Tinned copper drain wire
4	Analog output module JX3-AO4

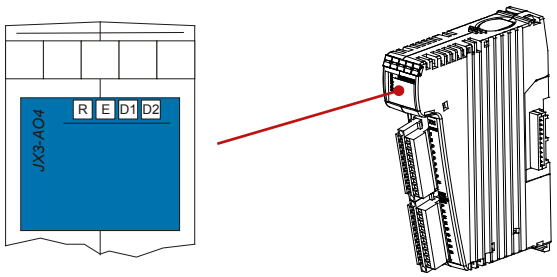
Related Topics

- **Technical Data** (see page 157)

LEDs of the Module JX3-AO4

LEDs of the Module

The JX3-AO4 module signalizes states and errors via LEDs. This feature facilitates spotting an error immediately.



LED	Color	Description
R-LED	green	Run-LED
E-LED	red	Error-LED
D1-LED	red	Diagnose 1-LED
D2-LED	red	Diagnose 2-LED

Normal Operating Condition

The LEDs of the JX3-AO4 module have got the following states during normal operation:

R	E	D1	D2	Normal Operating Condition
ON	OFF	OFF	OFF	No error, communication is active

LEDs of the JX3-AO4 Module

The JX3-AO4 module is equipped with four LEDs to display states and errors.

R	E	D1	D2	State
ON	OFF	OFF	OFF	No error, communication is active
ON	ON	-	-	Communication with the bus head, respectively with the JC-3xx, is not active
ON	-	ON	-	Hardware error
ON	-	-	1Hz	No valid operating system on the module
ON	-	2Hz	2Hz	Operating system update is active

3 Installing, Replacing, and Removing the Module

Introduction

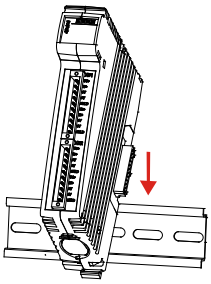
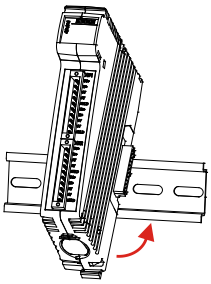
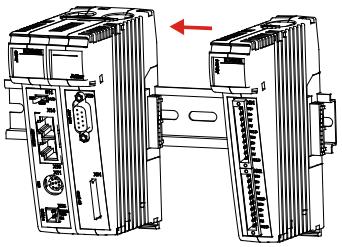
This chapter covers installation, replacement and removal of JX3 modules.

Contents

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.

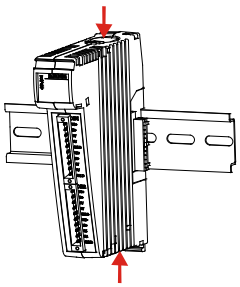
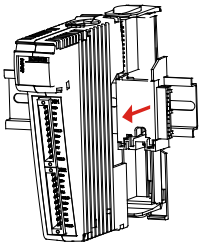
Related Topics

- **Replacing a JX3 Peripheral Module** (see page 32)
- **Removing a JX3 Peripheral Module from the DIN rail** (see page 34)

Replacing a JX3 Peripheral Module

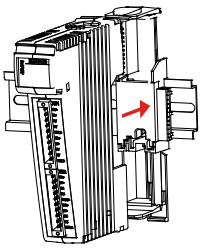
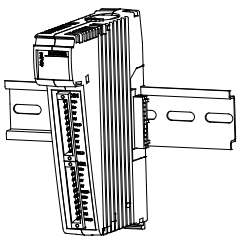
Removing the JX3 Enclosure

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.

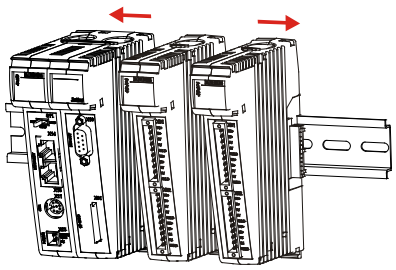
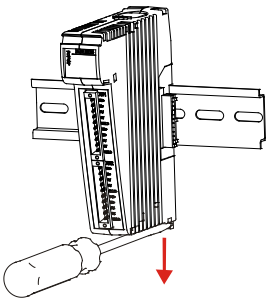
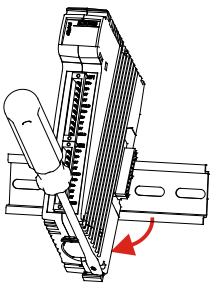
Related Topics

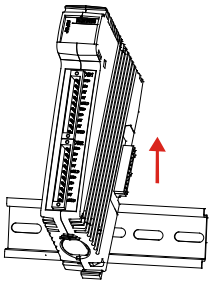
- **Installing JX3 Peripheral Modules on a DIN Rail** (see page 31)
- **Removing a JX3 Peripheral Module from the DIN Rail** (see page 34)

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 31)
- **Replacing a JX3 Peripheral Module** (see page 32)

4 First Commissioning

Purpose of this Chapter

This chapter deals concisely with the first commissioning procedure of the JX3-AO4 module. The following function is to serve as an example:

- Voltage Output at Analog Output OUT 1

Prerequisites

For first commissioning the JX3-AO4 module, the following requirements have to be met:

- The JX3-AO4 module is connected to a JetControl device.
- The controller is linked with a PC.
- On the PC, the JetSym programming software has been installed.
- The minimum requirements regarding module, controllers and software have been met.

Contents

Preparing First Commissioning

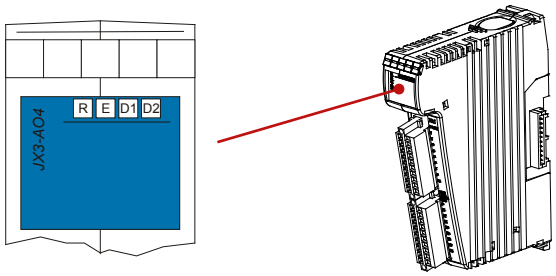
Behavior After Power-Up

In order to output a certain voltage, the JX3-AO4 module need not be configured after power-up. After power-up, the behavior of the four analog outputs is as follows:

- Configured to voltage range -10 V ... +10 V
- At the analog outputs, 0 V is output
- Any additional functions do not influence the output voltage

Status of the LEDs

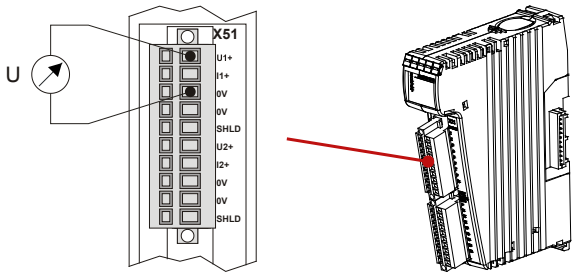
For defect-free commissioning, the LEDs must have the following statuses:



Component	Status	Description
R-LED	green, lit	Logic supply of the module is ok
E-LED	off	Communication active
D1-LED	off	No error detected
D2-LED	off	No error detected

Terminal Points of Analog Output OUT 1

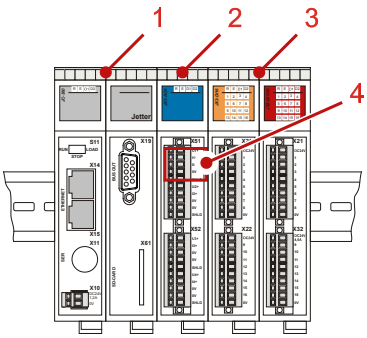
The module outputs the voltage at analog output OUT 1 at terminal points U1+ and 0 V of connector X 51:



First Commissioning by a JC-3xx

Configuration

The first commissioning procedure is based on the following configuration:



Number	Component	Description
1	JC-3xx	Controller
2	JX3-AO4	Analog output module, module number 2
3	JX3 Modules	Further JX3 modules of the JX3 station
4	X51	Terminal for analog output OUT 1

Determining the Register Number

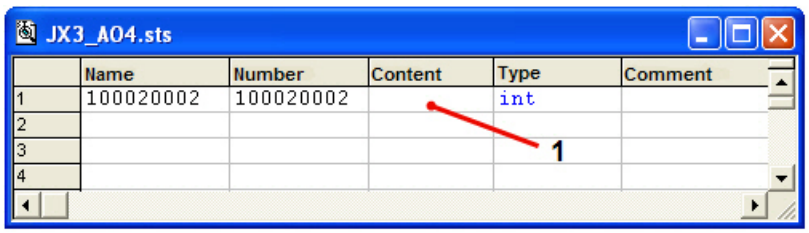
The value of analog output OUT 1 has been assigned to module register MR 2. This register number consists of the following digits:

1	0	0	m	m	0	0	0	2

Element	Meaning
mm	Module number of the module in the JX3 station: here 02

Voltage Output via JetSym

How to output a voltage at analog output OUT 1 via JetSym setup and register number 100020002:

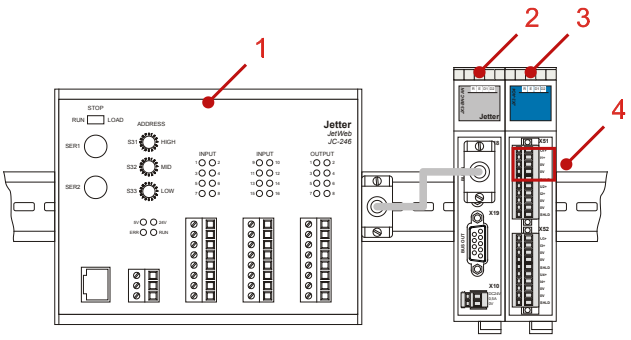


Number	Description	Values
1	New value for analog output OUT 1	0 = 0 V 32767 = +10 V

First Commissioning by a JC-24x

Configuration

The first commissioning procedure is based on the following configuration:



Number	Component	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-AO4	Analog output module, I/O module number 2
4	X51	Terminal for analog output OUT 1

Determining the Register Number

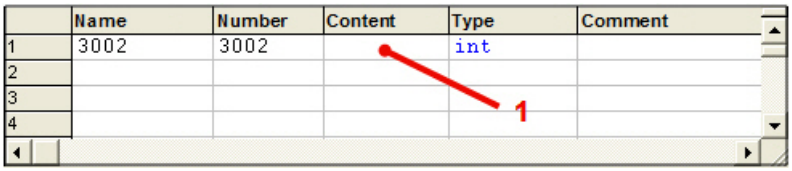
The value of analog output OUT 1 has been assigned to module register MR 2. This register number consists of the following digits:

3	x	x	2

Element	Meaning
xx	I/O module number of the module on the system bus - 2 here: xx = 00

Voltage Output via JetSym

How to output a voltage at analog output OUT 1 via JetSym setup and register number 3002:



Number	Description	Values
1	New value for analog output OUT 1	0 = 0 V 32767 = +10 V

5 Programming

Objective of this Chapter

This chapter supports programming the JX3-AO4 module in the following aspects:

- Determining register numbers dependent on the system configuration
- Output of voltages and currents
- Function and programming of additional functions

Prerequisites

For programming the JX3-AO4 module, the following requirements have to be met:

- The JX3-AO4 module is connected to a JetControl device.
- The controller is linked with a PC.
- On the PC, the JetSym programming software has been installed.
- The minimum requirements regarding module, controllers and software have been met.

Contents

Abbreviations, Module Register Properties and Formats

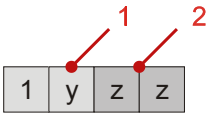
Abbreviations

In the following table, the abbreviations used in this document have been listed:

Abbreviation	Meaning
R 100	Register 100
MR 150	Module register 150

Module Registers with y

The letter y designates module registers, the function of which is identical for all four analog outputs. For y, enter the number of the analog output.



No.	Element	Meaning
1	y = 1 ... 4	Number of the analog output
2	zz = 0 ... 99	Continuous number

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
Access	Read / write
Value following a reset	0, or undefined (e.g. version number)
Takes effect	Immediately
Write access	Always
Data type	Integer

Number Formats

In the following table, the number formats used in this document have been listed:

Presentation	Number 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	Meaning
`Var, When, Task`	Key word
`BitClear();`	Instructions
`100 0x100 0b100`	Constant numeric values
`// this is a comment`	Comment
`// ...`	Further program processing

5.1 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

Registers and Module Registers

Definition: Module Registers

By means of module registers, process, configuration and diagnostic data can be read by the JX3-AO4 module, or written to the module. The module register number is unambiguous within the respective module.

Definition: Registers

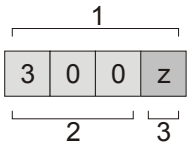
Registers can be accessed directly in the application program of the controller, in a setup pane of JetSym, or via the user interface directly. The register number is unambiguous within the respective system.

Example: Module Register

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

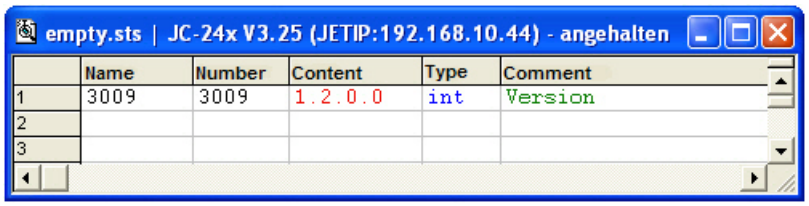
Example: Register

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.



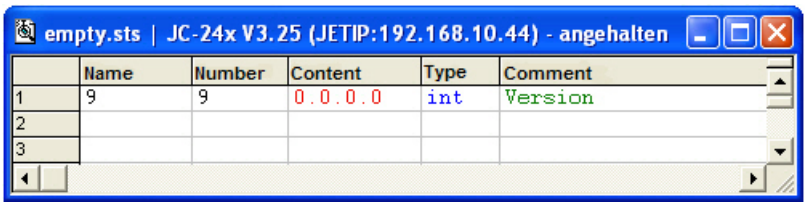
No.	Element	Meaning
1	Register number	Can be used immediately
2	Register prefix	300: for JX3 modules at the system bus of a JC-24x
3	Module register number	z = 9: OS version

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

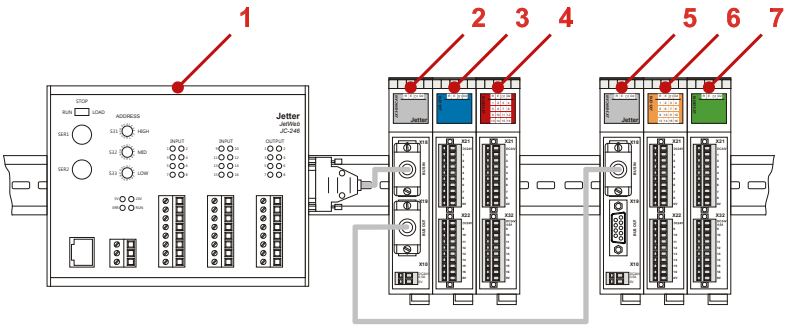
I/O Module Number

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

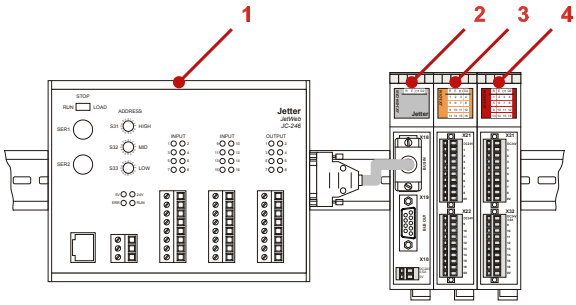
The I/O number for JX3 modules with JC-24x and JM-D203-JC-24x is composed as follows:

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

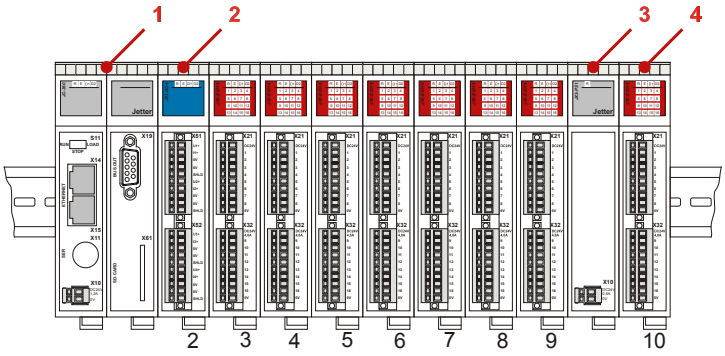
The I/O number for JX3 modules with JC-3xx is composed as follows:

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

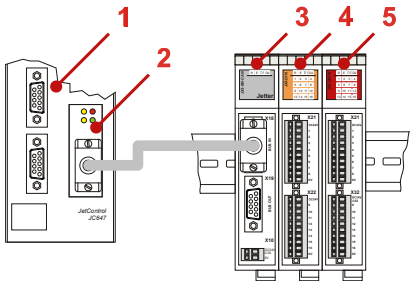
The I/O number for JX3 modules with JC-647 and JX6-SB(-I) is composed as follows:

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

5.2 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

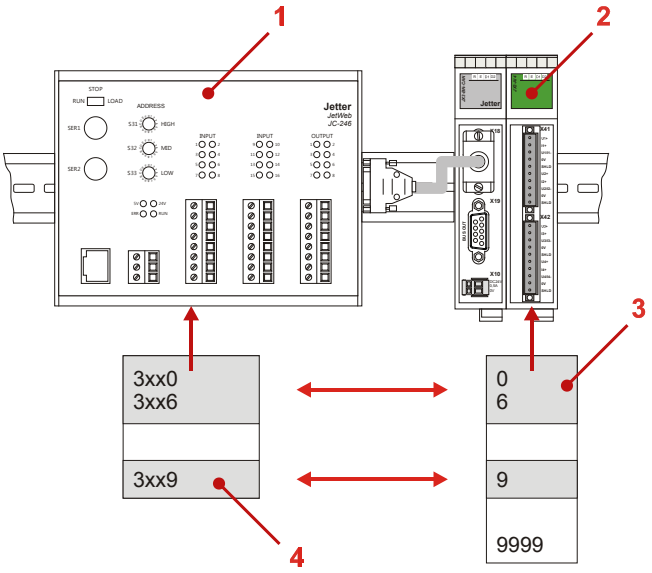
Direct Register Access to JX3 Modules in the JX2 System Bus

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

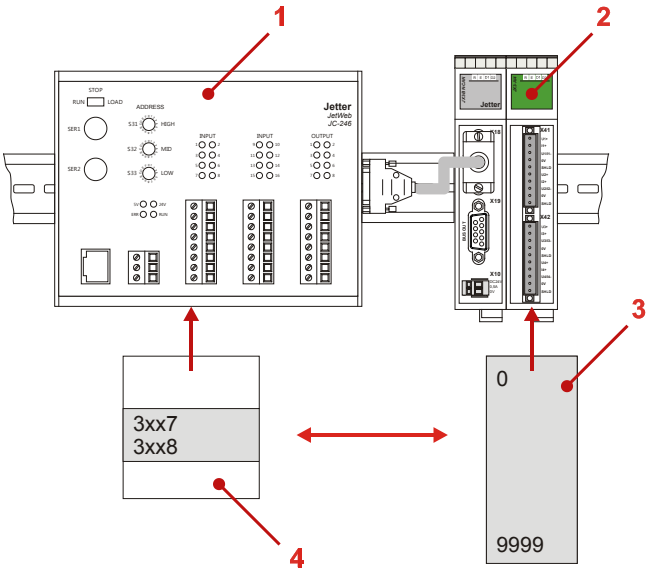
Indirect Register Access

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 58)
- **Example: Indirect Register Access** (see page 57)

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

5.3 Output of Voltages and Currents

Introduction

This chapter is to describe the procedure of voltage and current output at the analog outputs.

Applications

The following applications are possible:

- Control of analog actuators with a voltage or a current interface.

Independence of Analog Outputs

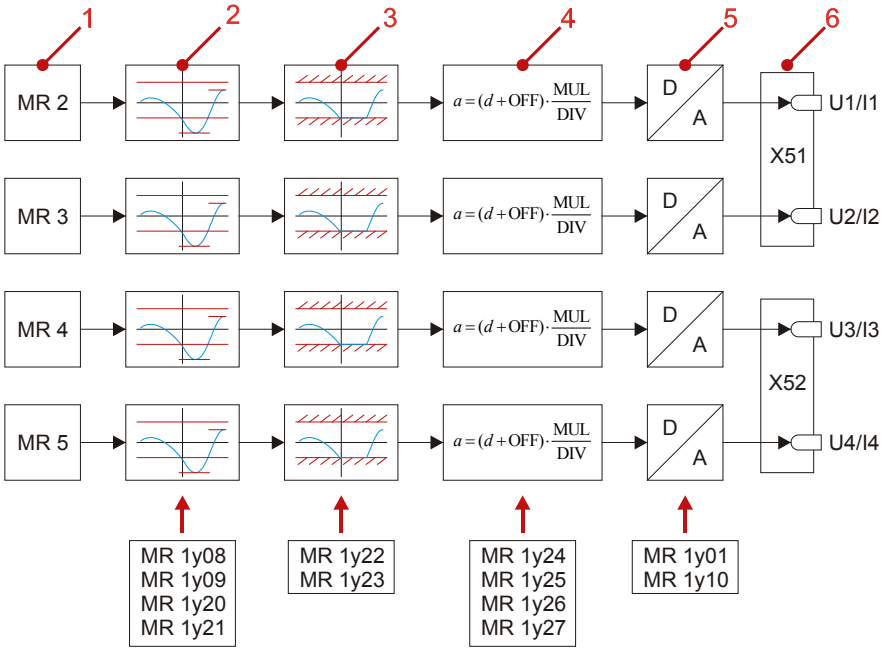
Each analog output can be configured and operated independently of other analog outputs.

Contents

Converting Digital Values into Analog Values

Converting Digital Values into Analog Values Step by Step

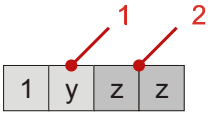
The JX3-AO4 module converts the digital values in module registers 2 to 5 into analog values step by step. Each analog output is operated individually during this process.



Step	Description
1	Writing the analog output value into MR 2 to MR 5 as a digital value
2	Checking the limits and updating the trailing indicators
3	Cutting down the analog values to the configured limits
4	Converting of the analog output value according to the definitions of user-defined scaling
5	Converting the digital value into an analog value
6	Voltage, respectively current is output at terminals X51 or X52

Module Registers with y

The letter y designates module registers, the function of which is identical for all four analog outputs. For y, enter the number of the analog output.



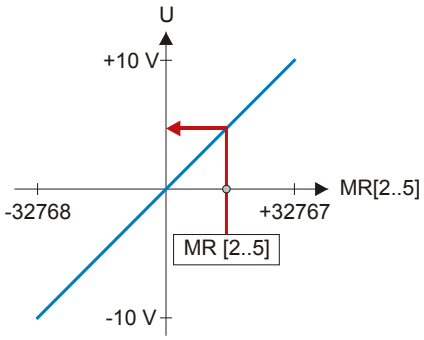
No.	Element	Meaning
1	y = 1 ... 4	Number of the analog output
2	zz = 0 ... 99	Continuous number

Related Topics

- **Output of Voltages** (see page 62)
- **Output of Currents** (see page 64)
- **User-Defined Scaling** (see page 74)
- **Monitoring of Limits** (see page 85)
- **Trailing Indicator** (see page 87)
- **Output of Error Values** (see page 98)

Voltage Output

Converting Digital Values into Voltages



When a voltage range has been configured, the JX3-AO4 module converts a digital value in linear mode into a voltage. Conversion is carried out according to the following formula:

$$MR[2...5] = U \cdot \frac{32767}{10V}$$

If voltage range 0 ... +10 V has been configured, negative voltages are not output.

Overview of Registers

For voltage output, the following module registers are used:

Register	Description
MR 2	Digital value of analog output 1 (y = 1)
MR 3	Digital value of analog output 2 (y = 2)
MR 4	Digital value of analog output 3 (y = 3)
MR 5	Digital value of analog output 4 (y = 4)
MR 1y07	Configuration of analog output y (y = 1 ... 4)

Influence of User-Defined Scaling

After power-up, user-defined scaling is deactivated and thus of no influence on converting digital values in voltages. By means of user-defined scaling, conversion of digital values into voltages can be modified. User-defined scaling is not active before specifying two pairs of points.

Example: Converting Digital Values into Voltages

The following table contains digital values and voltages for the analog output which correspond to these digital values.

Digital value in MR 2 ... MR 5	Voltage range -10 V ... +10 V	Voltage range 0 V ... +10 V
-32.768	-10.0003 V	0 V
-16.383	-4.9998 V	0 V
0	0 V	0 V
+16.383	+4.9998 V	+4.9998 V
+32.767	+10 V	+10 V

Voltage Output

How to output a voltage at an analog output y:

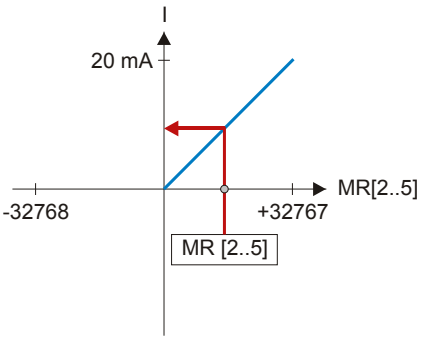
Step	Action	
1	Configure analog output y via MR 1y07.	
	If the voltage range ...	**... then ...**
	is to be -10 V ... +10 V,	MR 1y07 := 1;
	is to be 0 V ... +10 V,	MR 1y07 := 5;
2	Write a digital value for the analog outputs into MR 2 through MR 5.	
	If a new digital value for...	**... then ...**
	Analog output 1 (y = 1),	MR 2 := new digital value.
	Analog output 2 (y = 2),	MR 3 := new digital value.
	Analog output 3 (y = 3),	MR 4 := new digital value.
	Analog output 4 (y = 4),	MR 5 := new digital value.
⇨	**Result:** At the analog output, a voltage is output.	

Related Topics

- **Register Description: Voltage and Current Output** (see page 66)
- **Example: Configuring the Analog Outputs via JC-24x** (see page 70)
- **Example: Configuring the Analog Outputs via JC-3xx** (see page 68)

Current Output

Converting Digital Values into Currents



When a current range has been configured, the JX3-AO4 module converts - in linear mode - a digital value into a current. Conversion is carried out according to the following formula:

$$MR[2...5] = I \cdot \frac{32767}{20mA}$$

Overview of Registers

For current output, the following module registers are used:

Register	Description
MR 2	Digital value of analog output 1 (y = 1)
MR 3	Digital value of analog output 2 (y = 2)
MR 4	Digital value of analog output 3 (y = 3)
MR 5	Digital value of analog output 4 (y = 4)
MR 1y07	Configuration of Analog Output y (y = 1 ... 4)

Influence of User-Defined Scaling

By means of user-defined scaling, conversion of digital values into a current can be modified. After power-up, user-defined scaling is deactivated. User-defined scaling is not active before specifying two pairs of points.

Example: Converting Digital Values into Currents

The following table contains digital values and currents for the analog output which correspond to these digital values.

Digital value in MR 2 ... MR 5	Current range 0 ... 20 mA
< 0	0 mA
0	0 mA
+ 16.383	9.99969 mA
+ 32.767	20 mA

Current Output

How to output a current at analog output y:

Step	Action	
1	Configure analog output y via MR 1y07.	
	If ...	**... then ...**
	thr current range is to be 0 ... 20 mA,	MR 1y07 := 6.
2	Configure the user-defined scaling function. After power-up, user-defined scaling is deactivated.	
3	Write the new digital values for the analog outputs into module registers 2 through 5.	
	If a new digital value for...	**... then ...**
	Analog output 1 (y = 1),	MR 2 := new digital value.
	Analog output 2 (y = 2),	MR 3 := new digital value.
	Analog output 3 (y = 3),	MR 4 := new digital value.
	Analog output 4 (y = 4),	MR 5 := new digital value.
⇨	**Result:** At the analog output, a current is output.	

Related Topics

- **Register Description: Voltage and Current Output** (see page 66)
- **Example: Configuring the Analog Outputs via JC-24x** (see page 70)
- **Example: Configuring the Analog Outputs via JC-3xx** (see page 68)

Register Description: Voltage and Current Output

MR 2

Digital Value of Analog Output 1

The value in this module register is output as an analog value at terminal X51.U1+ respectively X51.I1+.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-32,768 ... 32,767
	Configuration 0 V ... +10 V:	0 ... 32,767
	Configuration 0 mA ... 20 mA:	0 ... 32,767

MR 3

Digital Value of Analog Output 2

The value in this module register is output as an analog value at terminal X51.U2+ respectively X51.I2+.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-32,768 ... 32,767
	Configuration 0 V ... +10 V:	0 ... 32,767
	Configuration 0 mA ... 20 mA:	0 ... 32,767

MR 4

Digital Value of Analog Output 3

The value in this module register is output as an analog value at terminal X52.U3+ respectively X52.I3+.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-32,768 ... 32,767
	Configuration 0 V ... +10 V:	0 ... 32,767
	Configuration 0 mA ... 20 mA:	0 ... 32,767

MR 5

Digital Value of Analog Output 4

The value in this module register is output as an analog value at terminal X52.U4+ respectively X52.I4+.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-32,768 ... 32,767
	Configuration 0 V ... +10 V:	0 ... 32,767
	Configuration 0 mA ... 20 mA:	0 ... 32,767

MR 1y07

Configuration of Analog Output y (y = 1 ... 4)

Via module register 1y07, voltage and current ranges of analog output y are configured.

Module Register Properties		
Values	1:	Configuration for Analog Output y: -10 V ... +10 V
	5:	Configuration for Analog Output y: 0 V ... +10 V
	6:	Configuration for Analog Output y: 0 mA ... 20 mA
Value following a reset	1	

Example: Configuring the Analog Outputs via JC-3xx

Task

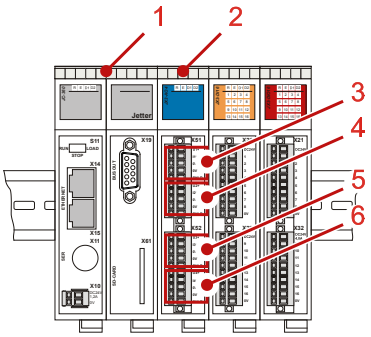
The analog outputs of a JX3-AO4 module are to be configured to various voltage and current ranges.

Solution

After power-up, the analog outputs are configured via MR 1y07 *Configuration Analog Output y*.

Configuration

This example is based on the following configuration:



Number	Element	Description
1	JC-3xx	Controller
2	JX3-AO4	Analog output module Module # 2
3	Analog output 1	Voltage range -10 V ... +10 V
4	Analog output 2	Voltage range 0 V ... +10 V
5	Analog output 3	Current range 0 mA ... 20 mA
6	Analog output 4	Voltage range 0 V ... +10 V

JetSym STX Program

```
// Type declaration of the module registers
Type
    TYPE_JX3_AO4:
    Struct
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int At 2*4;
        AnalogOut_2 : Int At 3*4;
        AnalogOut_3 : Int At 2*4;
        AnalogOut_4 : Int At 2*4;
        // Configuration registers of the analog outputs
        Config_1    : Int At 1107*4;
        Config_2    : Int At 1207*4;
        Config_3    : Int At 1307*4;
        Config_4    : Int At 1407*4;
    End_Struct;
End_Type;

Var
    // Variable declaration of module JX3-AO4
    JX3AO4_02 : TYPE_JX3_AO4 At %VL 100020000;
End_Var;

Task main Autorun
    // Configuration of analog output 1 to -10 V ... +10 V
    JX3AO4_02.Config_1 := 1;
    // Configuration of analog output 2 to 0 V ... +10 V
    JX3AO4_02.Config_2 := 5;
    // Configuration of analog output 3 to 0 mA ... 20 mA
    JX3AO4_02.Config_3 := 6;
    // Configuration of analog output 4 to 0 V ... +10 V
    JX3AO4_02.Config_4 := 5;

    // Output of -5V at analog output 1
    JX3AO4_02.AnalogOut_1 := -5 * 32767 / 10;
    // Output of +5 V at analog output 2
    JX3AO4_02.AnalogOut_2 := 5 * 32767 / 10;
    // Output of 12 mA at analog output 3
    JX3AO4_02.AnalogOut_3 := 12 * 32767 / 20;
    // Output of 10 V at analog output 4
    JX3AO4_02.AnalogOut_4 := 10 * 32767 / 10;

    // ...
End_Task;
```

Example: Configuring the Analog Outputs via JC-24x

Task

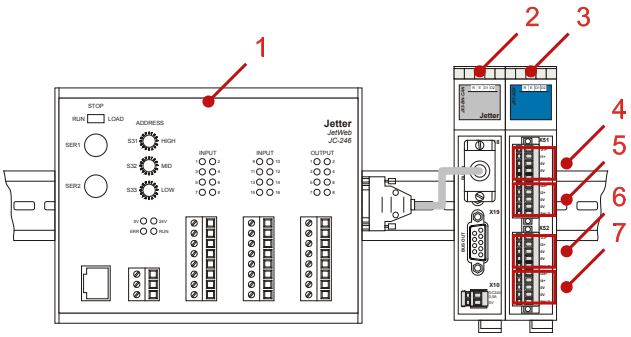
The analog outputs of a JX3-AO4 module are to be configured to various voltage and current ranges.

Solution

After power-up, the analog outputs are configured via MR 1y07 *Configuration of Analog Output y*.

Configuration

This example is based on the following configuration:



Number	Component	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-AO4	Analog output module I/O module number 2
4	Analog output # 1	Voltage range -10 V ... +10 V
5	Analog output # 2	Voltage range 0 V ... +10 V
6	Analog output # 3	Current range 0 mA ... 20 mA
7	Analog output # 4	Voltage range 0 V ... +10 V

JetSym ST Program

```
Var
    JX3AO4 : Struct
        // Status and command MR 0, MR 1
        State       : Int;
        Command     : Int;
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int;
        AnalogOut_2 : Int;
        AnalogOut_3 : Int;
        AnalogOut_4 : Int;
        zz_Dummy    : Int;
        // Registers for indirect register access MR 7, MR8
        Index       : Int;
        Data        : Int;
        // Operating system version MR 9
        Version     : Int;
    End_Struct At %VL 3000;
End_Var;

Task 0
    // Configuration of analog output 1 to -10 V ... +10 V
    JX3AO4.Index := 1107;
    JX3AO4.Data  := 1;
    // Configuration of analog output 2 to 0 V ... +10 V
    JX3AO4.Index := 1207;
    JX3AO4.Data  := 5;
    // Configuration of analog output 3 to 0 mA ... 20 mA
    JX3AO4.Index := 1307;
    JX3AO4.Data  := 6;
    // Configuration of analog output 4 to 0 V ... +10 V
    JX3AO4.Index := 1407;
    JX3AO4.Data  := 5;

    // Output of -5V at analog output 1
    JX3AO4.AnalogOut_1 := -5 * 32767 / 10;
    // Output of +5 V at analog output 2
    JX3AO4.AnalogOut_2 := 5 * 32767 / 10;
    // Output of 12 mA at analog output 3
    JX3AO4.AnalogOut_3 := 12 * 32767 / 20;
    // Output of 10 V at analog output 4
    JX3AO4.AnalogOut_4 := 10 * 32767 / 10;

    // ...
End_Task;
```

5.4 Additional Features

Introduction

For each analog output, various additional features can be configured.

Applications

The following applications can be carried out with the help of additional features:

- Default physical values. The value is converted into the respective analog value on the JX3-AO4 module
- Evaluation of the greatest throughput having been set at a proportional valve
- Monitoring for a certain pressure value having been exceeded at a proportional value
- Limiting the voltage at the analog output
- Default behavior under fault condition
- By means of the oscilloscope function, values of various module registers can be recorded
- etc.

Contents

5.4.1 User-Defined Scaling

Introduction

User-defined scaling offers the possibility to work with physical values. The physical value is converted into the respective analog value on the JX3-AO4 module.

Applications

The following applications can be carried out with the help of user-defined scaling:

- Specification of the flow rate in [ml/min] at connecting a proportional valve
- Specification of speed in [ml/min] at connecting a frequency converter
- etc.

Module Registers with Physical Values

The following module registers contain a physical value at active user-defined scaling:

- MR 2 through 5: Digital value for the analog output
- MR 1y08 and MR 1y09: Upper and lower limit
- MR 1y20 and MR1y21: Upper and lower trailing indicator
- MR 1y22 and MR 1y23: Upper and lower voltage limitations
- MR 1y04: Error value

Dependence of Analog Outputs

User-defined scaling can be configured for each analog output individually.

Contents

Function of User-Defined Scaling

Behavior after Power-Up

After power-up, user-defined scaling is deactivated.

Activating User-Defined Scaling

User-defined scaling is activated by specifying two pairs of points. The JX3-AO4 module then calculates an offset, multiplier and divisor for scaling the digital values.

Calculating the Voltage at Terminal X51/X52

The voltages being output by the JX3-AO4 module at terminals X51/X52, are calculated by the following formula:

$$a_y = \left((d_y + OFFSET) \cdot \frac{MUL}{DIV} \right) \cdot \frac{10V}{32767}$$

Element	Meaning
ay	Voltage at the analog output
dy	Digital value in MR 2 ... MR 5
OFFSET	Internal offset for calculation
MUL	Internal multiplier for calculation
DIV	Internal divisor for calculation

Calculating the Current at Terminal X51/X52

The currents being output by the JX3-AO4 module at terminals X51/X52, are calculated by the following formula:

$$a_y = \left((d_y + OFFSET) \cdot \frac{MUL}{DIV} \right) \cdot \frac{20mA}{32767}$$

Element	Meaning
ay	Current at the analog output
dy	Digital value in MR 2 ... MR 5
OFFSET	Internal offset for calculation
MUL	Internal multiplier for calculation
DIV	Internal divisor for calculation

Operating Principle

User-defined scaling is carried out taking the following steps:

Step	Description
1	Addition of an OFFSET to digital value dy The intermediate result is a 32-bit value
2	Multiplication by factor MUL The intermediate result is a 32-bit value
3	Division by divisor DIV The result is a 16-bit value
4	Converting the digital value into an analog value

Step	Description
5	Output of the analog value ay at analog output y

Related Topics

- **Register Description: User-Defined Scaling** (see page 78)
- **Example: Scaling a Pressure Value via JC-24x** (see page 82)
- **Example: Scaling a Pressure Value via JC-3xx** (see page 80)

Configuring User-Defined Scaling

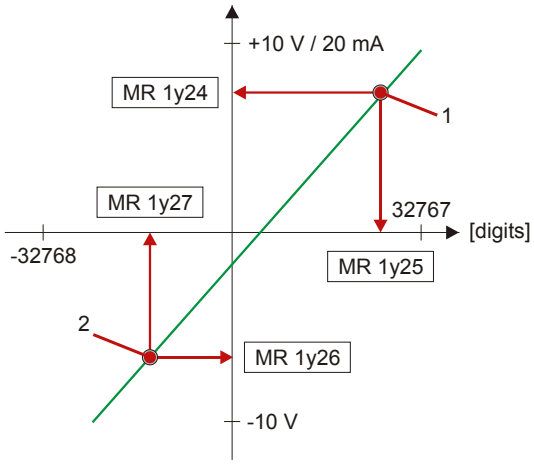
Overview of Registers

For configuration of user-defined scaling, the following module registers are used:

Register	Description
MR 1y24	1. Voltage/current value for analog output y (y = 1 ... 4)
MR 1y25	1. Digital value for analog output y (y = 1 ... 4)
MR 1y26	2. Voltage/current value for analog output y (y = 1 ... 4)
MR 1y27	2. Digital value for analog output y (y = 1 ... 4)

Point Pairs of User-Defined Scaling

Configuration of user-defined scaling is carried out by defining two pairs of points. Each pair of points consists of a voltage respectively current value and a digital value.



Number	Element
1	First pair of points
2	Second pair of points

Configuring User-Defined Scaling

Step	Action
1	Set the first voltage / current value in MR 1y24.
2	Set the first digital value in MR 1y25.
3	Set the second voltage / current value in MR 1y26.
4	Set the second digital value in MR 1y27. Now, the JX3-AO4 module starts calculation of the conversion formula.
⇨	**Result:** User-defined scaling is active.

Related Topics

- **Register Description: User-Defined Scaling** (see page 78)
- **Example: Scaling a Pressure Value via JC-24x** (see page 82)
- **Example: Scaling a Pressure Value via JC-3xx** (see page 80)

Register Description: User-Defined Scaling

MR 1y24

1. Voltage/Current Value for Analog Output y (y = 1 ... 4)

The voltage/current value of the first pair of points is entered into MR 1y24.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-10,000 .. + 10,000 [mV]
	Configuration 0 V ... +10 V:	0 ... + 10,000 [mV]
	Configuration 0 mA ... 20 mA:	0 ... 20,000 [µA]
Value after reset	-10,000	
Takes effect	after writing into MR 1y27	

MR 1y25

1. Digital Value for Analog Output y (y = 1 ... 4)

The digital value of the first pair of points is entered into MR 1y25.

Module Register Properties	
Values	-32,768 ... 32,767
Value after reset	-32,768
Takes effect	after writing into MR 1y27

MR 1y26

2. Voltage/Current Value for Analog Output y (y = 1 ... 4)

The voltage/current value of the second pair of points is entered into MR 1y26.

Module Register Properties		
Values	Configuration -10 V ... +10 V:	-10,000 .. + 10,000 [mV]
	Configuration 0 V ... +10 V:	0 ... + 10,000 [mV]
	Configuration 0 mA ... 20 mA:	0 ... 20,000 [µA]
Value after reset	10,000	
Takes effect	after writing into MR 1y27	

MR 1y27

2. Digital Value for Analog Output y (y = 1 ... 4)

The digital value of the second pair of points is entered into MR 1y27. After writing into MR 1y27, the JX3-AO4 module starts calculation of the conversion formula.

Module Register Properties	
Values	-32,768 ... 32,767
Value after reset	32,767

Example: Scaling a Pressure Value via JC-3xx

Task

By means of a pneumatic proportional valve with a current interface, a pressure of 0 to 6 bar is to be set. The proportional valve controls the pressure to 0 bar, if 4 mA have been connected to the current input. If 20 mA have been connected to the current input, the pressure is controlled to 6 bar.

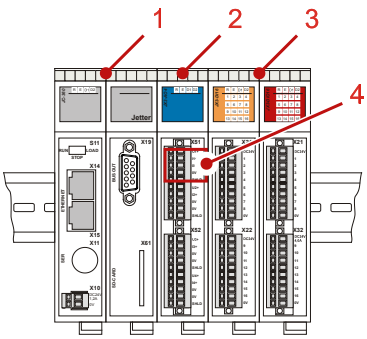
Solution

User-defined scaling on the JX3-AO4 module is configured in a way that the pressure is directly output in millibar as a digital value. Configure user-defined scaling by defining the following pairs of points:

Current Value	Digital Value
MR 1y24 := 4,000 [µA]	MR 1y25 := 0 [mBar]
MR 1y26 := 20,000 [µA]	MR 1y27 := 6,000 [mBar]

Configuration

This example is based on the following configuration:



Number	Element	Description
1	JC-3xx	Controller
2	JX3-AO4	Analog output module, module number 2
3	JX3-xxx	Further JX3 modules
4	X51	Terminal for connecting the proportional valve

Processing the Example Program

The example program is processed in the following sequence:

Step	Description
1	Configuration of the analog output 1 as a current output
2	Configuration of the first pair of points
3	Configuration of the second pair of points
4	Defining a pressure value at the proportional valve

JetSym STX Program

```
// Type declaration of the module registers
Type
    TYPE_JX3_AO4:
    Struct
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int At 2*4;
        AnalogOut_2 : Int At 3*4;
        AnalogOut_3 : Int At 4*4;
        AnalogOut_4 : Int At 5*4;
        // Configuration registers of analog output 1
        Config_1    : Int At 1107*4;
        // Configuration register 1st pair of points
        UserUI1_1   : Int At 1124*4;
        UserDig1_1  : Int At 1125*4;
        // Configuration register 2nd pair of points
        UserUI2_1   : Int At 1126*4;
        UserDig2_1  : Int At 1127*4;
    End_Struct;
End_Type;

Var
    // Variable declaration of module JX3-AO4
    JX3AO4_02 : TYPE_JX3_AO4 At %VL 100020000;
End_Var;

Task main Autorun
    // Configuration of output 1 to 0 ... 20 mA
    JX3AO4_02.Config_1 := 6;

    // set the first pair of points:
    // current = 4000 uA
    JX3AO4_02.UserUI1_1 := 4000;
    // digital value = 0 mbar
    JX3AO4_02.UserDig1_1 := 0;

    // set the second pair of points:
    // current = 20000 uA
    JX3AO4_02.UserUI2_1 := 20000;
    // digital value = 6000 mbar
    JX3AO4_02.UserDig2_1 := 6000;

    // set a pressure of 4 bar
    JX3AO4_02.AnalogOut_1  := 4000;

    //    ...
End_Task;
```

Example: Scaling a Pressure Value via JC-24x

Task

By means of a pneumatic proportional valve with a current interface, a pressure of 0 to 6 bar is to be set. The proportional valve controls the pressure to 0 bar, if 4 mA have been connected to the current input. If 20 mA have been connected to the current input, the pressure is controlled to 6 bar.

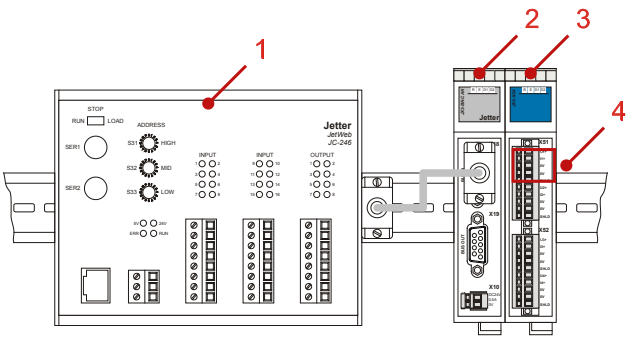
Solution

User-defined scaling on the JX3-AO4 module is configured in a way that the pressure is directly output in millibar as a digital value. Configure user-defined scaling by defining the following pairs of points:

Current value	Digital value
MR 1y24 := 4,000 [µA]	MR 1y25 := 0 [mBar]
MR 1y26 := 20,000 [µA]	MR 1y27 := 6,000 [mBar]

Configuration

This example is based on the following configuration:



Number	Component	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-AO4	Analog output module, I/O module number 2
4	X51	Terminal for connecting the proportional valve

Processing the Example Program

The example program is processed in the following sequence:

Stage	Description
1	Configuration of the analog output 1 as a current output
2	Configuration of the first pair of points
3	Configuration of the second pair of points
4	Defining a pressure value at the proportional valve

JetSym ST Program

```
Var
    JX3AO4 : Struct
        // Status and command MR 0, MR 1
        State       : Int;
        Command     : Int;
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int;
        AnalogOut_2 : Int;
        AnalogOut_3 : Int;
        AnalogOut_4 : Int;
        zz_Dummy    : Int;
        // Registers for indirect register access MR 7, MR8
        Index       : Int;
        Data        : Int;
        // Operating system version MR 9
        Version     : Int;
    End_Struct At %VL 3000;
End_Var;

Task 0
    // Configuration of output 1 to 0 ... 20 mA
    JX3AO4.Index := 1107;
    JX3AO4.Data  := 6;

    // set the first pair of points:
    // current = 4000 uA
    JX3AO4.Index := 1124;
    JX3AO4.Data  := 4000;
    // Digital value = 0
    JX3AO4.Index := 1125;
    JX3AO4.Data  := 0;

    // set the second pair of points:
    // current = 20000 uA
    JX3AO4.Index := 1126;
    JX3AO4.Data  := 20000;
    // digital value = 6000 mbar
    JX3AO4.Index := 1127;
    JX3AO4.Data  := 6000;

    // setting a pressure of 4 bar
    JX3AO4.AnalogOut_1 := 4000;

    //    ...
End_Task;
```

5.4.2 Limit Monitoring, Trailing Indicator, Cutting Off, and Forcing

Introduction

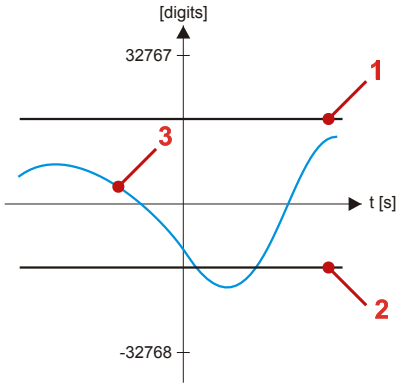
This chapter deals with four additional features of the JX3-AO4 module.

Contents

Monitoring Limit Values

Introduction

For each analog output, the user can set an individual limit. The JX3-AO4 module checks every value in MR 2 to 5 *Digital Value of Analog Output y* for being within the limits.



Number	Description
1	Upper limit, MR 1y09
2	Lower limit, MR 1y08
3	Digital value of analog output y (y = 1 ... 4), MR 2 through 5

Overview of Registers

To configure limit value monitoring, use the following module registers:

Register	Description
MR 0	Module state
MR 1y00	State of analog output y (y = 1 ... 4)
MR 1y08	Lower limit of analog output y (y = 1 ... 4)
MR 1y09	Upper limit of analog output y (y = 1 ... 4)

Operating Principle

The module JX3-AO4 checks the limit values in the following way:

Step	Description	
1	The module is assigned a new value in MR 2 to 5 *Digital Value of Analog Output y*.	
2	The module compares the value within MR 2 through 5 with the limit values in MR 1y08 and 1y09.	
	If the digital value of analog output y ...	**... then ...**
	< MR 1y08,	Bit 19 = 1 is set in MR 0, and Bit 19 = 1 MR 1y00 is set.
	> MR 1y09,	Bit 20 = 1 is set in MR 0, and Bit 20 = 1 MR 1y00 is set.

Configuring the Monitoring of Limit Values

Step	Action
1	Setting the lower limit for the analog output in y MR 1y08.
2	Enter the upper limit for analog output y into MR 1y09.
⇨	**Result:** Now, the JX3-AO4 module checks at regular intervals whether the digital value of the analog module is within the limits.

Acknowledgement of Values Exceeding the Limits

Step	Action
1	Clear bit 19 respectively bit 20 in MR 1y00 *Status of Analog Output y*.
2	Delete bit 19, resp. bit 20 in MR 0 *Module State*.

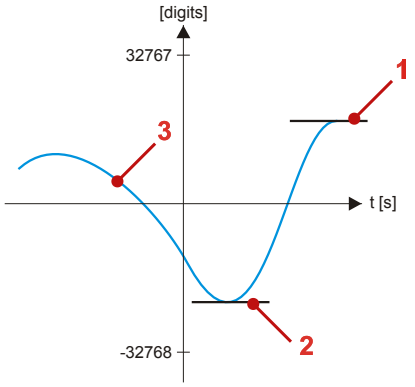
Related Topics

- **Register Description of Additional Features** (see page 93)

Trailing Indicator

Introduction

The JX3-AO4 module checks every value in MR 2 to 5 *Digital value of analog output y*. Both the greatest and smallest value since start-up are stored as trailing indicators. The values of the trailing indicators get lost when the module is switched off.



Number	Description
1	Trailing indicator for peak value, MR 1y21
2	Trailing indicator for minimum value, MR 1y20
3	Digital value of analog output y (y = 1 ... 4), MR 2 through 5

Overview of Registers

For monitoring trailing indicators, the following module registers are used:

Register	Description
MR 1y20	Trailing indicator: Minimum value of analog output y (y = 1 ... 4)
MR 1y21	Trailing indicator: Maximum value of analog output y (y = 1 ... 4)

Operating Principle

The JX3-AO4 module checks the trailing indicators as follows:

Stage	Description	
1	The module is assigned a new value in MR 2 to 5 *Digital Value of Analog Output y*.	
2	**If the digital value of analog output y ...**	**... then ...**
	< MR 1y20 is,	MR 1y20 := Digital Value of Analog Output y.
	> MR 1y21 is,	MR 1y21 := Digital Value of Analog Output y.

Initializing the Trailing Indicators

After power-up, the JX3-AO4 module initializes the trailing indicators for the minimum and maximum value automatically.

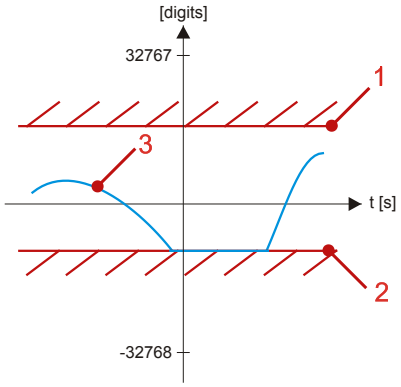
Related Topics

- **Register Description of Additional Features** (see page 93)

Upper and Lower Capping

Introduction

The JX3-AO4 module checks every value in MR 2 to 5 *Digital Value of Analog Output y* for an upper and lower capping value. At exceeding or falling below the capping values, the value is restricted to these.



Number	Description
1	Upper capping, MR 1y23
2	Lower capping, MR 1y22
3	Digital value of analog output y (y = 1 ... 4), MR 2 through 5

Overview of Registers

To monitor cutting off, the following module registers are used:

Register	Description
MR 1y22	Lower capping of analog output y (y = 1 ... 4)
MR 1y23	Upper capping of analog output y (y = 1 ... 4)

Operating Principle

The JX3-AO4 module checks the capping values as follows:

Stage	Description	
1	The module is assigned a new value in MR 2 to 5 *Digital Value of Analog Output y*.	
2	**If the digital value of analog output y ...**	**... then ...**
	< MR 1y22 is,	Digital Value of Analog Output y := MR 1y22.
	> MR 1y23 is,	Digital Value of Analog Output y := MR 1y23.
3	Processing the limited analog output value and output at terminals X51 or X52.	

Behavior after Power-Up

Capping is not active after power-up.

Configuring of Capping Limits

Step	Action
1	For configuring the voltage limitations, write into MR 1y22 *Lower Capping* and into MR 1y23 *Upper Capping*.
⇨	**Result:** Capping is effective immediately.

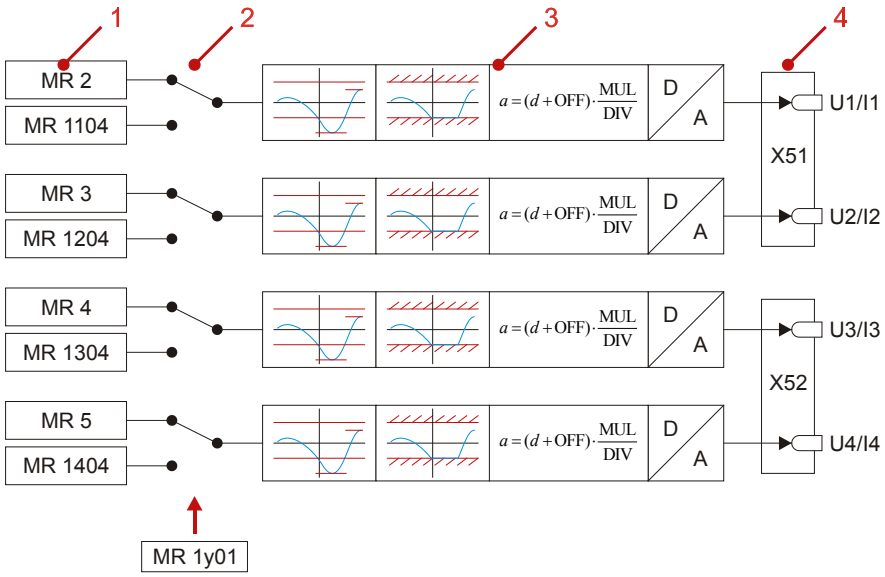
Related Topics

- **Register Description of Additional Features** (see page 93)

Forcing the Analog Outputs

Introduction

At forcing the analog outputs, the JX3-AO4 module outputs a configurable voltage and current value at the analog outputs. This voltage or current value is independent from the value of MR 2 bis 5 *Digital value of analog output y*.



Stage	Description
1	Writing the value of the analog output value as a digital value to MR 2 through MR 5, or the default forcing value to MR 1y04.
2	Activating the forcing function via MR 1y01 *Command for Analog Output y*.
3	Converting digital values into analog values
4	Voltage, respectively current output at terminals X51 or X52

Overview of Registers

For monitoring the forcing process, the following module registers are used:

Register	Description
MR 1y00	Status of analog output y (y = 1 ... 4)
MR 1y01	Command for analog output y (y = 1 ... 4)
MR 1y04	Forcing value of analog output y (y = 1 ... 4)

Activating the Forcing Function

Step	Action
1	Activating the forcing function via MR 1y01 *Command for Analog Output y*. MR 1y01 := 31 **Result:** Bit 23 = 1 is set in MR 0 and MR 1y00
2	Setting the forcing value for the analog output in y MR 1y04.

Deactivating the Forcing Function

Step	Action
1	Deactivating the forcing function via MR 1y01 *Command for Analog Output y*. MR 1y01 := 30 **Result:** Bit 23 = 0 is set in MR 0 and MR 1y00
2	Activating an analog value via MR 2 through 5 *Digital Value of Analog Output y*.

Related Topics

- **Register Description of Additional Features** (see page 93)

Register Description

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-AO4 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 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

MR 1y01

Commands for Analog Output y (y = 1 ... 4)

Via MR 1y01, specific functions are configured for analog output y.

Commands	
20	**Leave the analog value unchanged under fault condition** The value at the analog output remains unchanged.
21	**Output the error value under fault condition** Under fault condition, an analog value is calculated out of MR 1y10 by user scaling. Then, the analog value is output.
30	**Deactivation of forcing** At the analog outputs, the value of MR 2 through 5 is output.
31	**Activation of forcing** At the analog outputs, the value of MR 1y04 is output.

MR 1y04 **Forcing Value for Analog Output y (y = 1 ... 4)**

The forcing value is output at analog output y at active forcing.

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	0

MR 1y08 **Lower Limit of Analog Output y (y = 1 ... 4)**

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	-32,768

MR 1y09 **Upper Limit of Analog Output y (y = 1 ... 4)**

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	32,767

MR 1y20 **Trailing Indicator: Minimum Value of Analog Output y (y = 1 ... 4)**

MR 1y20 contains the lowest digital value that has been output at analog output y so far.

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	32,767

MR 1y21 **Trailing Indicator: Peak Value of Analog Output y (y = 1 ... 4)**

MR 1y21 contains the greatest digital value that has been output at analog output y so far.

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	-32,768

MR 1y22

Lower Capping of Analog Output y (y = 1 ... 4)

The module limits each new digital value for analog output y to the lower capping value.

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	-32,768

MR 1y23

Upper Capping of Analog Output y (y = 1 ... 4)

The module limits each new digital value for analog output y to the upper capping value.

Module Register Properties	
Values	-32,768 ... 32,767
Value following a reset	32,767

5.4.3 Output of Error Values

Introduction

For each analog output, the user can set an error value, respectively a specific behavior under fault condition. Under fault condition, the JX3-AO4 module then outputs the configured value at the analog output.

Fault Condition

Under the following fault condition, the error values are written to the analog outputs:

- No cyclic data exchange with the bus head or the controller

Applications

The following applications can be carried out by means of the error values:

- At a line break between bus head and controller, the JX3-AO4 module outputs a voltage of 0 V to a connected proportional valve. The proportional valve blocks the flow.
- etc.

Contents

Configuring Error Values

Introduction

If the JX3-AO4 module recognizes a fault condition, the module outputs a configurable voltage, respectively a configurable current at the analog outputs.

Under the following fault condition, the error values are written to the analog outputs:

- Interruption of cyclic data exchange with the bus head or controller.

Overview of Registers

For configuring error values, the following module registers are used:

Register	Description
MR 1y00	State of analog output y (y = 1 ... 4)
MR 1y01	Command for analog output y (y = 1 ... 4)
MR 1y10	Error value for analog output y (y = 1 ... 4)

Function

Error values are output in the following stages:

Stage	Description	
1	The JX3-AO4 module recognizes a fault condition.	
2	The module checks the values to be output at analog outputs 1 through 4.	
	If ...	**... then ...**
	the present analog value is to be output, Bit 8 = 0 in MR 1y00,	the analog value at the analog output remains unchanged.
	the error value is to be output Bit 8 = 1 in MR 1y00,	out of the error value in MR 1y10, an analog value is calculated and output by means of user-defined scaling.

Behavior after Power-Up

Under fault condition, 0 V, respectively 0 mA, are output at all analog outputs after power-up.

Configuring Error Values

Step	Action	
1	Specifying the behavior under fault condition via MR 1y01 *Command for Analog Output y*.	
	If in case of an error ...	**... then ...**
	the analog value is to remain unchanged,	MR 1y01 := 20; **Result:** Bit 8 = 0 in MR 1y00.
	a certain value is to be output,	MR 1y01 := 21; and MR 1y10 := Value; **Result:** Bit 8 = 1 in MR 1y00.

Related Topics

- **Register Description - Output of Error Values** (see page 100)
- **Example: Output of Error Values via JC-24x** (see page 104)
- **Example: Output of Error Values via JC-3xx** (see page 102)

Register Description - Output of Error Values

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

MR 1y01

Commands for Analog Output y (y = 1 ... 4)

Via MR 1y01, specific functions are configured for analog output y.

Commands	
20	**Leave the analog value unchanged under fault condition** The value at the analog output remains unchanged.
21	**Output the error value under fault condition** Under fault condition, an analog value is calculated out of MR 1y10 by user scaling. Then, the analog value is output.
30	**Deactivation of forcing** At the analog outputs, the value of MR 2 through 5 is output.
31	**Activation of forcing** At the analog outputs, the value of MR 1y04 is output.

MR 1y10

Error Value for Analog Output y (y = 1 ... 4)

Via MR 1y10, the error value is configured for analog output y.

Module Register Properties	
Values	-32,768 ... 32, 767

Example: Output of Error Values via JC-3xx

Task

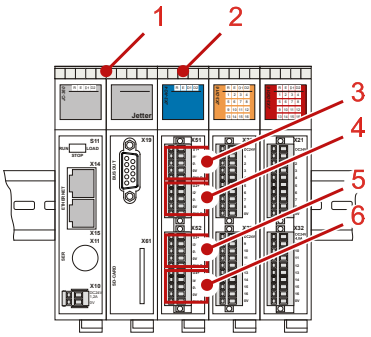
At the analog outputs of a JX3-AO4 module, defined values are to be output when the connection to the controller is interrupted.

Solution

Via MR 1y01 and MR 1y04, the behavior under fault condition and the error values are configured.

Configuration

This example is based on the following configuration:



Number	Element	Description
1	JC-24x	Controller
2	JX3-AO4	Analog output module Module # 2
3	Analog output 1	Under fault condition: 10 V
4	Analog output 2	Under fault condition: unchanged
5	Analog output 3	Under fault condition: 12 mA
6	Analog output 4	Under fault condition: -5 V

JetSym STX Program

```
// Type declaration of the module registers
Type
    TYPE_JX3_AO4:
    Struct
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int At 2*4;
        AnalogOut_2 : Int At 3*4;
        AnalogOut_3 : Int At 4*4;
        AnalogOut_4 : Int At 5*4;
        // Configuration registers of analog output 1
        Command_1   : Int At 1101*4;
        ErrorVal_1  : Int At 1110*4;
        // Configuration registers of analog output 2
        Command_2   : Int At 1201*4;
        ErrorVal_2  : Int At 1210*4;
        // Configuration registers of analog output 3
        Command_3   : Int At 1301*4;
        ErrorVal_3  : Int At 1310*4;
        // Configuration registers of analog output 4
```

```
        Command_4    : Int At 1401*4;
        ErrorVal_4   : Int At 1410*4;
    End_Struct;
End_Type;

Var
    // Variable declaration of module JX3-AO4
    JX3AO4_02 : TYPE_JX3_AO4 At %VL 100020000;
End_Var;

Task main Autorun
    // Configuration of analog output 1: Output an error value
    JX3AO4_02.Command_1  := 21;
    // Error value for analog output 1: 10 V
    JX3AO4_02.ErrorVal_1 := 10 * 32767 / 10;

    // Configuration of analog output 2: unchanged
    JX3AO4_02.Command_2  := 20;

    // Configuration of analog output 3: Output an error value
    JX3AO4_02.Command_3  := 21;
    // Error value for analog output 1: 12 mA
    JX3AO4_02.ErrorVal_3 := 12 * 32767 / 20;

    // Configuration of analog output 4: Output an error value
    JX3AO4_02.Command_4  := 21;
    // Error value for analog output 1: -5 V
    JX3AO4_02.ErrorVal_4 := -5 * 32767 / 10;

    // ...
End_Task;
```

Example: Output of Error Values via JC-24x

Task

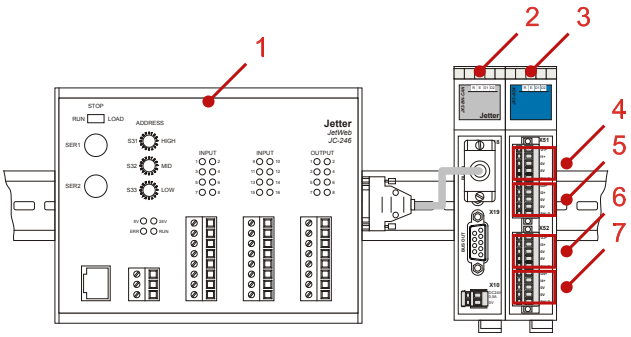
At the analog outputs of a JX3-AO4 module, defined values are to be output when the connection to the controller is interrupted.

Solution

Via MR 1y01 and MR 1y04, the behavior under fault condition and the error values are configured.

Configuration

This example is based on the following configuration:



Number	Element	Description
1	JC-24x	Controller
2	JX3-BN-CAN	Bus head for JX2 system bus
3	JX3-AO4	Analog output module I/O module number 2
4	Analog output # 1	Under fault condition: 10 V
5	Analog output # 2	Under fault condition: unchanged
6	Analog output # 3	Under fault condition: 12 mA
7	Analog output # 4	Under fault condition: -5 V

JetSym ST Program

```
Var
    JX3AO4 : Struct
        // State and command MR 0, MR 1
        State       : Int;
        Command     : Int;
        // Digital value for analog outputs MR 2 .. MR 5
        AnalogOut_1 : Int;
        AnalogOut_2 : Int;
        AnalogOut_3 : Int;
        AnalogOut_4 : Int;
        zz_Dummy    : Int;
        // Registers for indirect register access MR 7, MR8
        Index       : Int;
        Data        : Int;
        // Operating system version MR 9
        Version     : Int;
    End_Struct At %VL 3000;
End_Var;

Task 0
    // ...

    // Configuration of analog output 1: Output an error value
    JX3AO4.Index := 1101;
    JX3AO4.Data  := 21;
    // Error value for analog output 1: 10 V
    JX3AO4.Index := 1104;
    JX3AO4.Data  := 10 * 32767 / 10;

    // Configuration of analog output 2: unchanged
    JX3AO4.Index := 1201;
    JX3AO4.Data  := 20;

    // Configuration of analog output 3: Output an error value
    JX3AO4.Index := 1301;
    JX3AO4.Data  := 21;
    // Error value for analog output 1: 12 mA
    JX3AO4.Index := 1304;
    JX3AO4.Data  := 12 * 32767 / 20;

    // Configuration of analog output 4: Output an error value
    JX3AO4.Index := 1401;
    JX3AO4.Data  := 21;
    // Error value for analog output 1: -5 V
    JX3AO4.Index := 1404;
    JX3AO4.Data  := -5 * 32767 / 10;

    // ...
End_Task;
```

5.4.4 Oscilloscope

Introduction

The JX3-AO4 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:

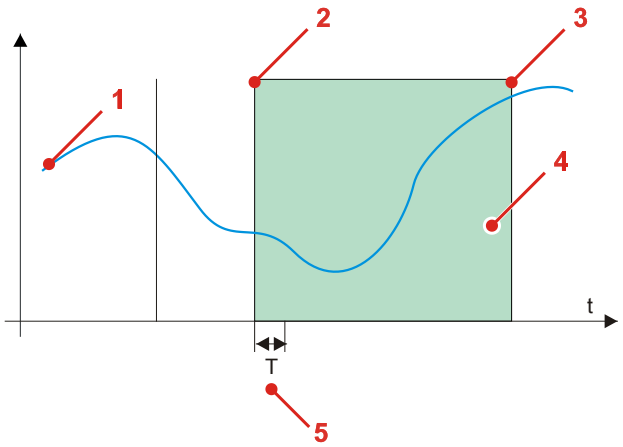
- Graphic evaluation of output values for documentation
- etc.

Contents

Start/Stop Recording

Start/Stop Recording

At Start/Stop recording, the JX3-AO4 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-AO4 module starts recording. The JX3-AO4 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.

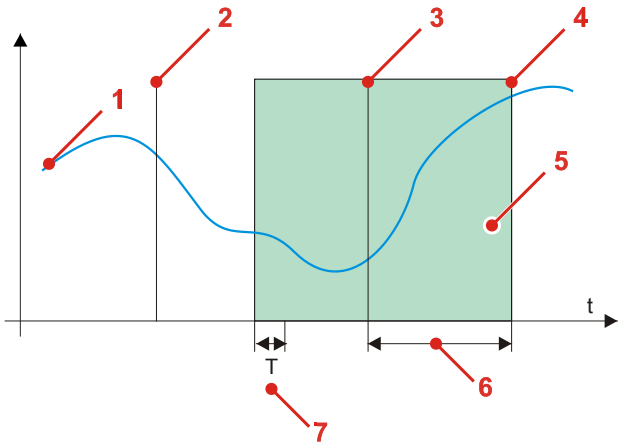
Related Topics

- **Oscilloscope Register Description** (see page 115)
- **Example: Recording and Reading of Values** (see page 117)

Continuous Recording

Continuous Recording

At continuous recording, the JX3-AO4 module continually records measuring values. After issuing command 2 "Stop", the JX3-AO4 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-AO4 module starts recording.	
5	Stop recording by writing value 2 into MR 9740 *Command for Oscilloscope*.	
6	The JX3-AO4 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.

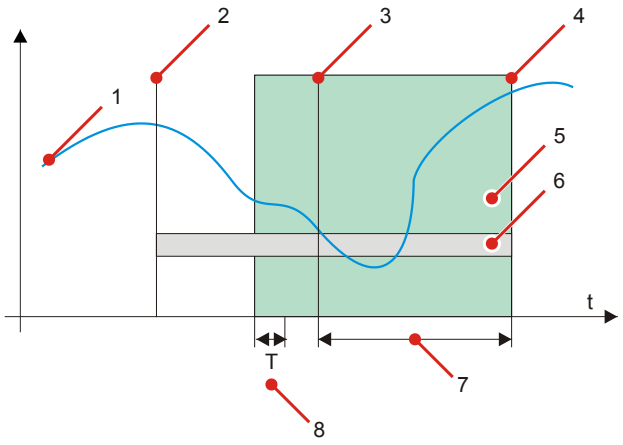
Related Topics

- **Oscilloscope Register Description** (see page 115)
- **Example: Recording and Reading of Values** (see page 117)

Recording Values under Trigger Condition

Recording Values under Trigger Condition

At recording values under trigger condition, the JX3-AO4 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-AO4 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-AO4 module starts recording. The JX3-AO4 module continually checks the trigger condition.	
	If ...	**... then ...**
	the trigger condition has been met,	the JX3-AO4 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 115)
- **Example: Recording and Reading of Values** (see page 117)

Reading Out the Recorded Values

Introduction

The JX3-AO4 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-AO4 module can be controlled by this module register.

Commands	
1	**Starting a Recording Session** The JX3-AO4 module starts recording immediately. Recording stops, when the memory for measuring values is full.
2	**Stopping a Recording Session** The JX3-AO4 module stops recording immediately.
3	**Starting a Recording Session Once a Trigger Condition is Fulfilled** The JX3-AO4 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-AO4 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

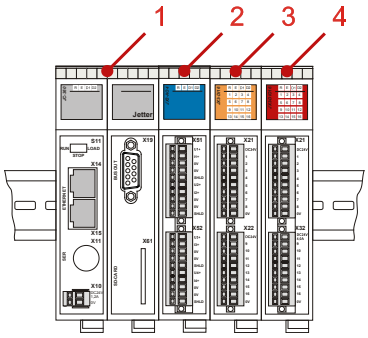
The values at the analog outputs of a JX3-AO4 module are to be recorded in intervals of 20 ms. After this, the values are stored to the registers of the controller.

Solution

The oscilloscope function of the JX3-AO4 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;
```

5.5 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

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-AO4 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-AO4 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 122)

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-AO4 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-AO4 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

6 Locating of Errors

Purpose of this Chapter

This chapter is for supporting you when locating faults of the JX3-AO4 module in the following fields of activity:

- Identifying the root cause of an error.
- Recognizing an error in the application program or in visualization
- Acknowledging an error message

Prerequisites

To be able to locate an error of the JX3-AO4 module the following prerequisites have to be fulfilled:

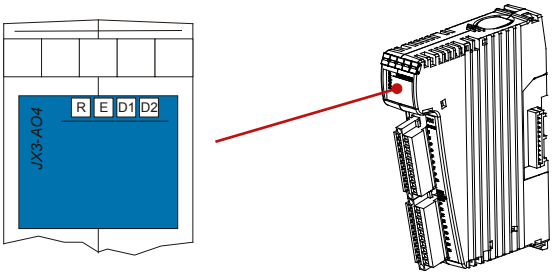
- The JX3-AO4 module is connected to a JetControl device.
- The controller is linked with a PC.
- On the PC, the JetSym programming software has been installed.
- The minimum requirements regarding module, controllers and software have been met.

Contents

LEDs of the Module JX3-AO4

LEDs of the Module

The JX3-AO4 module signalizes states and errors via LEDs. This feature facilitates spotting an error immediately.



LED	Color	Description
R-LED	green	Run-LED
E-LED	red	Error-LED
D1-LED	red	Diagnose 1-LED
D2-LED	red	Diagnose 2-LED

Normal Operating Condition

The LEDs of the JX3-AO4 module have got the following states during normal operation:

R	E	D1	D2	Normal Operating Condition
ON	OFF	OFF	OFF	No error, communication is active

LEDs of the JX3-AO4 Module

The JX3-AO4 module is equipped with four LEDs to display states and errors.

R	E	D1	D2	State
ON	OFF	OFF	OFF	No error, communication is active
ON	ON	-	-	Communication with the bus head, respectively with the JC-3xx, is not active
ON	-	ON	-	Hardware error
ON	-	-	1Hz	No valid operating system on the module
ON	-	2Hz	2Hz	Operating system update is active

Diagnostics of Error Messages via Module Registers

Introduction

The module signalizes error messages in module register 0 *Module State*. Various error messages can be acknowledged via a command.

Overview of Registers

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

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

Signalizing an Error

The JX3-AO4 module signalizes an error as follows:

Stage	Description
1	The JX3-AO4 module recognizes an error and sets the respective error bit in MR 0 *Module State*.
2	The JX3-AO4 module sets bit 0 *Hardware Error* in module register 0.
3	The JX3-AO4 module activates the red D1 LED.
⇨	**Result:** Both the control system and the bus head respond to the error.

Reaction on Error Messages in the Application Program

The application program reacts to an error message through the following stages:

Stage	Description
1	The application program recognizes by means of the controller registers that the JX3-AO4 module has sent an error message.
2	The application program reacts to the error in a way depending on the set error bit in MR 0 Status of the Module.
3	The user deletes the error cause.
4	If possible, the error is either acknowledged, or the module is replaced. The error is acknowledged by MR1 := 5; **Result:** ■ Error bits = 0 in MR 0 ■ The D1 LED at the JX3 module goes out.
5	The user program acknowledges the error messages in the controller and the bus head.

Related Topics

- **Register Description - Locating of Errors** (see page 134)

Error regarding Reference Values

Detecting the Error

After power-up, the JX3-AO4 module reads the reference values for the analog outputs out of an EEPROM and checks them for their validity.

Root Cause of Error

The following condition can lead to this error:

- Defective hardware of the EEPROM

Response of the Module to this Error

The module reacts to the error by passing through the following stages:

Stage	Description
1	Bit 4 Reference value error = 1 in MR 0 Status Module
2	Bit 0 Hardware error = 1 in MR 0 Status Module
3	D1-LED is lit red
4	The module keeps putting out analog values. The accuracy of the analog output values does not correspond to the technical data any more.

Fixing the Root Cause

Fixing the root cause by the user is not possible. Please send the JX3-AO4 module to Jetter AG for repair.

Resetting the Error

Resetting the error is not possible.

Related Topics

- **Register Description - Locating of Errors** (see page 134)

Missing Connection to the Controller

Detecting the Error

The JX3-AO4 module regularly checks the communication with the controller, respectively with the bus head.

Root Cause of Error

The following conditions can lead to this error:

- Voltage drop at the controller
- The lines connecting the module with the controller are broken
- Defective hardware of the bus head

Response of the Module to this Error

The module reacts to the error by passing through the following stages:

Stage	Description
1	Bit 30 Synchronous data exchange = 0 in MR 0 *Module State*
2	At the analog outputs, the configured error values are output.

Fixing the Root Cause

For fixing the root cause, proceed as follows:

Step	Action	
1	Re-establish the connection to the controller.	
2	**If ...**	**... then ...**
	the hardware of the bus head is defective,	send the bus head to Jetter AG for repair.

Resetting the Error

For fixing the root cause, proceed as follows:

Step	Action	
1	**If ...**	**... then ...**
	the bus head is a JX3-BN-CAN,	restart the system bus.

Related Topics

- **Register Description – Locating of Errors** (see page 134)

Invalid Operating System

Detecting the Error

After power-up, the JX3-AO4 module checks, if there is a valid operating system.

Root Cause of the Error

The following conditions can lead to this error:

- Terminating an operating system update
- Hardware error of the JX3-AO4 module

Response of the Module to this Error

The module reacts to the error by passing through the following stages:

Stage	Description
1	The module outputs 0 at the analog outputs.
2	The D2 LED is shortly flashing red.
3	The version number in MR 9 is 255.x.0.0 x: Version of the bootloader

Fixing the Root Cause

For fixing the root cause, proceed as follows:

Step	Action	
1	Carry out an operating system update via JetSym.	
2	**If ...**	**... then ...**
	an operating system update cannot be carried out,	send the JX3-AO4 module to Jetter AG for repair.

Resetting the Error

For resetting the fault, proceed as follows:

Step	Action
1	Restart the JX3 station.

Related Topics

- **Register Description – Locating of Errors** (see page 134)

DAC Error

Detecting the Error

The JX3-AO4 module regularly checks the communication with the DA converters.

Root Cause of Error

The following condition can lead to this error:

- Hardware error of a DAC

Response of the Module to this Error

The module reacts to the error by passing through the following stages:

Stage	Description
1	Bit 6 *DAC error* = 1 in MR 0 *Module State*
2	Bit 0 *Hardware error* = 1 in MR 0 *Module State*
3	D1-LED is lit red
4	The module keeps putting out analog values The analog output value is undefined

Fixing the Root Cause

Fixing the root cause by the user is not possible. Please send the JX3-AO4 module to Jetter AG for repair.

Resetting the Error

The error can be reset via MR 1, command 5. If communication with the DA converters is still faulty, the JX3-AO4 will once more issue the *DAC Error* message.

Related Topics

- **Register Description – Locating of Errors** (see page 134)

Internal Auxiliary Voltages are Faulty

Detecting the Error

The JX3-AO4 module regularly checks the internal auxiliary voltages for keeping the set tolerance.

Root Cause of Error

The following condition can lead to this error:

- Hardware error of the JX3-AO4 module

Response of the Module to this Error

The module reacts to the error by passing through the following stages:

Stage	Description
1	Bit 7 Internal voltages error = 1 in MR 0 Module State
2	Bit 0 Hardware error = 1 in MR 0 Module State
3	D1-LED is lit red
4	The module keeps putting out analog values The accuracy of the analog output values does not correspond to the technical data any more

Fixing the Root Cause

Fixing the root cause by the user is not possible. Please send the JX3-AO4 module to Jetter AG for repair.

Resetting the Error

The error can be reset via MR 1, command 5. If the internal auxiliary voltages still exceed the limits, the JX3-AO4 will once more issue the *Internal Auxiliary Voltages are Faulty* message.

Related Topics

- **Register Description – Locating of Errors** (see page 134)

Register Description: Locating of Errors

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-AO4 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-AO4 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 How to Identify the Module

Purpose of this Chapter

This chapter supports you in obtaining the following information from the JX3-AO4 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-AO4 module the following prerequisites must be fulfilled:

- The module JX3-AO4 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-AO4 ready:

- Version number in MR 9
- Hardware revision

Module Code

The module code of JX3-AO4 is 304.

Contents

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-AO4 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:

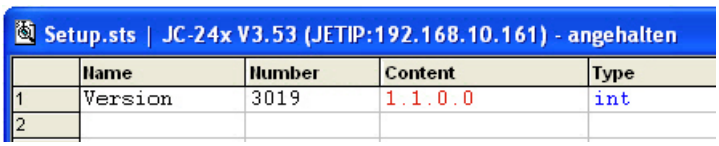
Register	Description
MR 9	Operating system version
MR 32	FPGA version
MR 769	Bootloader version

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 150)

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**

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 148)

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.

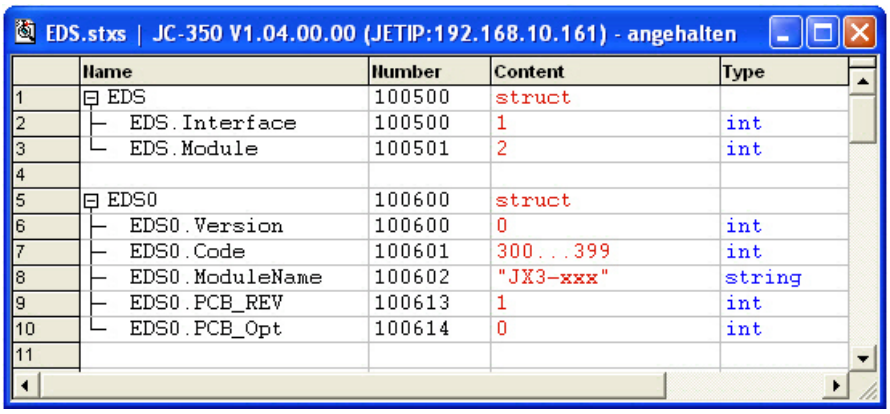
Sample Configuration

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;
```

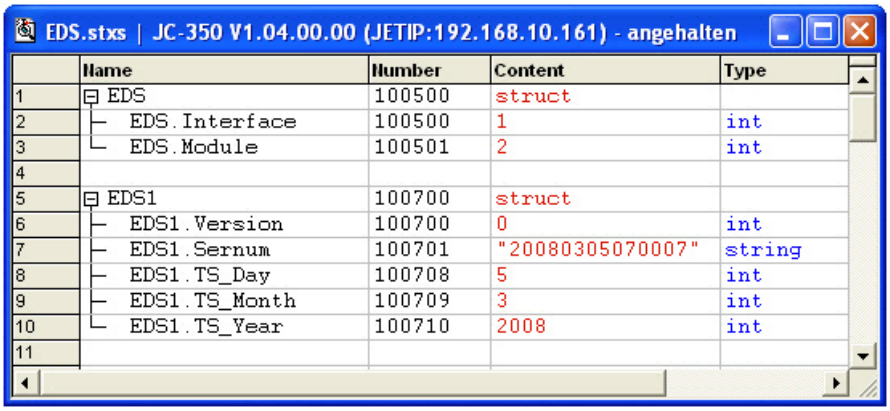
Reading EDS Page 0



	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.

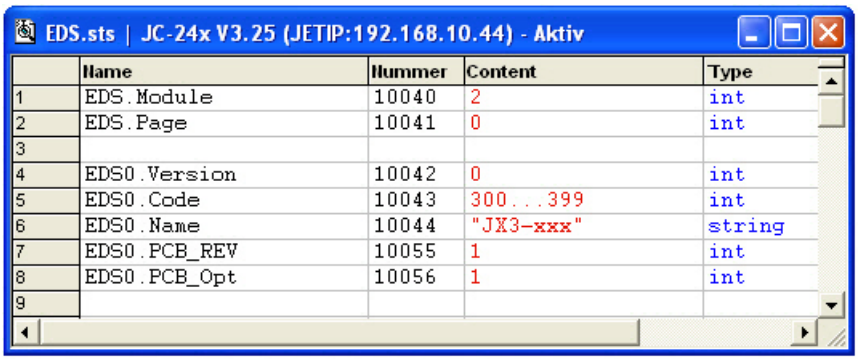
Sample Configuration

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

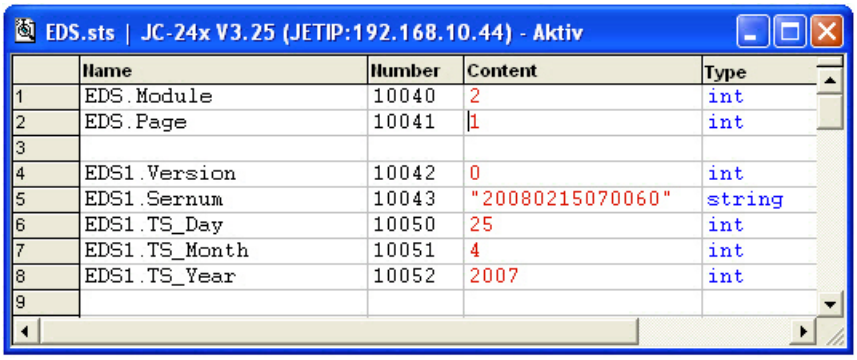
```
Type
    // Defining module number and EDS page
    JX3_EDS:
    Struct
        Module    : Int;
        Page      : Int;
    End_Struct;

    // 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



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

Reading EDS Page 1



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-AO4 module is displayed. Via JetSym, another operating system can be transmitted to the JX3-AO4 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-AO4 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

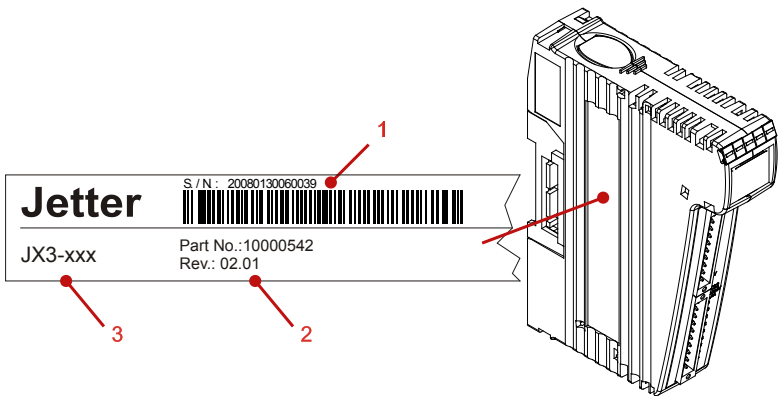
Identification via Nameplate

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

8 Quick Reference - JX3-AO4

Matching OS Version

This quick reference summarizes the registers of the analog output module JX3-AO4 with OS version 1.04.0.00.

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-AO4: 304

General Overview - Registers

0	Module state
1	Module command
2 ... 5	Analog outputs 1 ... 4
9, 32, 257	Versions / Revisions
1100 ... 1199	Configuration of analog output # 1
1200 ... 1299	Configuration of analog output # 2
1300 ... 1399	Configuration of analog output # 3
1400 ... 1499	Configuration of analog output # 4
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	

Meaning of y

y	Number of analog output y = 1 ... 4

Module State

0	**Module state**
Bit 0 = 1:	Hardware failure
Bit 4 = 1:	Error: Calibration values
Bit 6 = 1:	DA converter error
Bit 7 = 1:	Error: Internal voltages
Bit 19 = 1:	Collective bit "Lower limit"
Bit 20 = 1:	Collective bit "Upper limit"
Bit 23 = 1:	Collective bit "Forcing"
Bit 24 = 1:	Monitoring - voltages
Bit 30 = 1:	Synchronous data exchange

Module-Specific Command Registers

1	**Command**
3	Internal voltages - monitoring OFF
4	Internal voltages - monitoring ON
5	Acknowledgement of hardware failures
6	Acknowledgement of collective bits

Analog Outputs

2	Analog output # 1
3	Analog output # 2
4	Analog output # 3
5	Analog output # 4

Versions / Revisions

9	OS version
32	FPGA revision
257	Bootloader version

State of Analog Output y

1y00	**State of analog output y (y = 1 ... 4)**
Bit 8 = 1:	Output of error values is enabled
Bit 19 = 1:	Lower limit exceeded
Bit 20 = 1:	Upper limit exceeded
Bit 23 = 1:	Forcing function enabled

Command for Analog Output y

1y01	**Command for analog output y (y = 1 ... 4)**
20	Leave analog value unchanged in case of error
21	Output error value in case of error
30	Forcing of analog output OFF
31	Forcing of analog output ON

Configuration of Analog Output y

1y07	**Configuration of analog output y (y = 1 ... 4)**
1	-10 V ... +10 V
5	0 V ... +10 V
6	0 mA ... 20 mA

User-defined Scaling

1y24	1. Voltage / current value for analog output y
1y25	1. Digital value for analog output y
1y26	2. Voltage / current value for analog output y
1y27	2. Digital value for analog output y

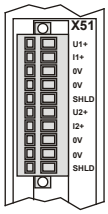
Other Configurations

1y04	Force value for analog output y
1y08	Lower limit of analog output y
1y09	Upper limit of analog output y
1y10	Error value
1y20	Trailing indicator for minimum value of analog output y
1y21	Trailing indicator for maximum value of analog output y
1y22	Lower cap limit
1y23	Upper cap limit

Oscilloscope

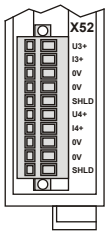
9740	Command
9741	Parameter index
9742	Parameter
9743	Data index
9744	Data

Assignment of Terminal X51



Terminal Point	Signals of analog output # 1
X51.U1+	Voltage output
X51.I1+	Current-controlled output
X51.0V	Reference potential
X51.SHLD	Shielding connection
Terminal Point	**Signals of analog output # 2**
X51.U2+	Voltage output
X51.I2+	Current-controlled output
X51.0V	Reference potential
X51.SHLD	Shielding connection

Assignment of Terminal X52



Terminal Point	Signals of analog output # 3
X52.U3+	Voltage output
X52.I3+	Current-controlled output
X52.0V	Reference potential
X52.SHLD	Shielding connection
Terminal Point	**Signals of analog output # 4**
X52.U4+	Voltage output
X52.I4+	Current-controlled output
X52.0V	Reference potential
X52.SHLD	Shielding connection

Appendix

Introduction

This appendix contains electrical and mechanical data, as well as operating data.

Contents

A: Technical Data

Introduction

This section of the appendix contains both electrical and mechanical data, as well as operating data of the JX3-AO4 module.

Contents

Technical Data

Electrical Data of the Analog Voltage Output

Parameter	Description
Rated output voltage range	-10 V ... +10 V
Load impedance	≥ 2 kΩ
Accuracy	< 0.5 %
Resolution	15 bit + sign
Conversion time DA converter	10 µs
Electrical isolation	none
Short circuit resistance	To reference potential 0 V
Open-circuit resistance	yes

Electrical Data of the Analog Current Output

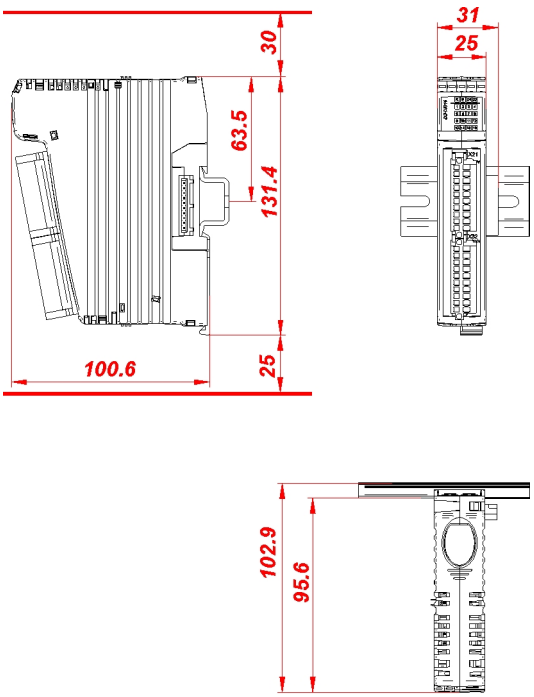
Parameter	Description
Rated current output range	0 ... 20 mA
Load impedance	≤ 450 Ω
Accuracy	< 0.5 %
Resolution	15 bits
Conversion time DA converter	10 µs
Electrical isolation	none
Short circuit resistance	To reference potential 0 V
Open-circuit resistance	yes

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-AO4 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-AO4 module requires a space of 31 mm width. At connecting the JX3-AO4 module to a JX3 station, the width is increased by 25 mm.

Mounting Position

The mounting position of the JX3-AO4 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

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