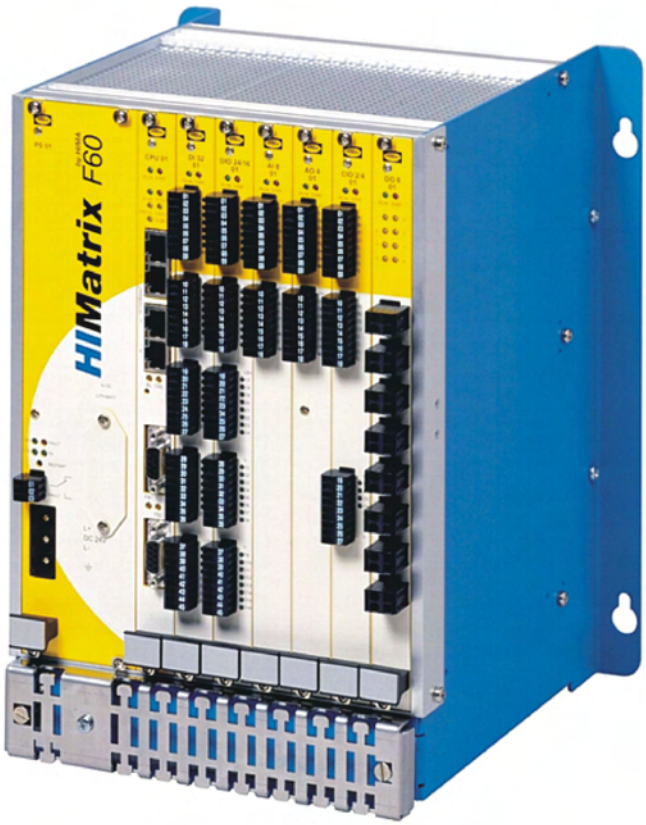
# HIMatrix

## Safety-Related Controller

# AO 8 01 Manual




HIMA Paul Hildebrandt GmbH + Co KG
Industrial Automation

Rev. 2.00

HI 800 197 E

All HIMA products mentioned in this manual are protected by the HIMA trade-mark. Unless noted otherwise, this also applies to other manufacturers and their respective products referred to herein.

HIMax®, HIMatrix®, SILworX®, XMR® and FlexSILon® are registered trademarks of HIMA Paul Hildebrandt GmbH + Co KG.

All of the instructions and technical specifications in this manual have been written with great care and effective quality assurance measures have been implemented to ensure their validity. For questions, please contact HIMA directly. HIMA appreciates any suggestion on which information should be included in the manual.

Equipment subject to change without notice. HIMA also reserves the right to modify the written material without prior notice.

For further information, refer to the HIMA DVD and our website at `http://www.hima.de` and `http://www.hima.com`.

© Copyright 2013, HIMA Paul Hildebrandt GmbH + Co KG

All rights reserved

## Contact

HIMA contact details:

HIMA Paul Hildebrandt GmbH + Co KG

P.O. Box 1261

68777 Brühl, Germany

Phone: +49 6202 709-0

Fax: +49 6202 709-107

E-mail: info@hima.com

| Revision index | Revisions | Type of change | |
|---|---|---|---|
| | | technical | editorial |
| 1.00 | Added: Configuration with SILworX | X | X |
| 2.00 | Added: SIL 4 certified according to EN 50126, EN 50128 and EN 50129, Chapter 4.1.3 | X | X |
| | | | |
| | | | |

# Table of Contents


1 Introduction 5

1.1 Structure and Use of this Manual 5

1.2 Target Audience 6

1.3 Formatting Conventions 7

1.3.1 Safety Notes 7

1.3.2 Operating Tips 8

2 Safety 9

2.1 Intended Use 9

2.1.1 Environmental Requirements 9

2.1.2 ESD Protective Measures 9

2.2 Residual Risk 10

2.3 Safety Precautions 10

2.4 Emergency Information 10

3 Product Description 11

3.1 Safety Function 11

3.1.1 Safety-Related Analog Outputs 11

3.1.1.1 Switch Positions 11

3.1.1.2 Analog Output Values 12

3.1.1.3 Reaction in the Event of a Fault 12

3.1.1.4 Worst Case Reaction Time 12

3.2 Equipment, Scope of Delivery 13

3.3 Type Label 13

3.4 Structure 14

3.4.1 Block Diagram 14

3.4.2 Front View 15

3.4.3 Status Indicators 16

3.5 Product Data 17

4 Start-up 18

4.1 Installation and Mounting 18

4.1.1 Mounting and Removing the Modules 18

4.1.2 Connecting the Analog Outputs 19

4.1.3 Cable Plugs 19

4.1.4 Mounting the AO 8 01 in Zone 2 20

4.2 Configuration 21

4.2.1 Module Slots 21

4.3 Configuration with SILworX 22

4.3.1 Parameters and Error Codes for the Output 22

4.3.2 Analog Outputs 22

4.3.2.1 Tab: **Module** 22

4.3.2.2 Tab: **AO 8: Channels** 23

**4.4 Configuration with ELOP II Factory 24**
4.4.1 Configuring the Outputs 24
4.4.2 Signals and Error Codes for the Output 24
4.4.3 Analog Outputs 25

**5 Operation 27**

**5.1 Handling 27**
**5.2 Diagnosis 27**

**6 Maintenance 28**

**6.1 Faults 28**
**6.2 Maintenance Measures 28**
6.2.1 Loading the Operating System 28
6.2.2 Proof Test 28

**7 Decommissioning 29**

**8 Transport 30**

**9 Disposal 31**

**Appendix 33**

**Glossary 33**
**Index of Figures 34**
**Index of Tables 35**
**Index 36**

# 1 Introduction

This manual describes the technical characteristics of the module and its use. It provides information on how to install, start up and configure the module.

## 1.1 Structure and Use of this Manual

The content of this manual is part of the hardware description of the HIMatrix programmable electronic system.

This manual is organized in the following main chapters:

- Introduction
- Safety
- Product Description
- Start-up
- Operation
- Maintenance
- Decommissioning
- Transport
- Disposal

The HIMatrix F60 is available for the programming tools SILworX and ELOP II Factory. Which programming tool can be used, depends on the processor operating system of the HIMatrix F60, refer to the following table:

| Programming tool | Processor operating system | Communication operating system |
|---|---|---|
| SILworX | CPU OS V7 and higher | COM OS V12 and higher |
| ELOP II Factory | CPU OS up to V6.x | COM OS up to V11.x |

Table 1: Programming Tools for HIMatrix F60

In the manual, the differences are specified by using:

- Separated chapters
- Tables differentiating among the versions

**Projects created with ELOP II Factory cannot be edited with SILworX, and vice versa!**

The manual usually refers to the plug-in cards of the modular controller F60 as *modules*. *Modules* is also the term used in SILworX.

Additionally, the following documents must be taken into account:

| Name | Content | Document number |
|---|---|---|
| HIMatrix System Manual Compact Systems | Hardware description of the HIMatrix compact systems | HI 800 141 E |
| HIMatrix System Manual Modular System F60 | Hardware description of the HIMatrix modular system | HI 800 191 E |
| HIMatrix Safety Manual | Safety functions of the HIMatrix system | HI 800 023 E |
| HIMatrix Safety Manual for Railway Applications | Safety functions of the HIMatrix system using the HIMatrix in railway applications | HI 800 437 E |
| SILworX Online Help | Instructions on how to use SILworX | - |
| ELOP II Factory Online Help | Instructions on how to use ELOP II Factory, Ethernet IP protocol | - |
| SILworX First Steps | Introduction to SILworX using the HIMax system as an example | HI 801 103 E |
| ELOP II Factory First Steps | Introduction to ELOP II Factory | HI 800 006 E |

Table 2: Additional Relevant Documents

The latest manuals can be downloaded from the HIMA website at www.hima.com. The revision index on the footer can be used to compare the current version of existing manuals with the Internet edition.

## 1.2 Target Audience

This document addresses system planners, configuration engineers, programmers of automation devices and personnel authorized to implement, operate and maintain the modules and systems. Specialized knowledge of safety-related automation systems is required.

## 1.3 Formatting Conventions

To ensure improved readability and comprehensibility, the following fonts are used in this document:

| | |
|---|---|
| **Bold** | To highlight important parts.<br>Names of buttons, menu functions and tabs that can be clicked and used in the programming tool. |
| *Italics* | For parameters and system variables |
| `Courier` | Literal user inputs |
| RUN | Operating state are designated by capitals |
| Chapter 1.2.3 | Cross references are hyperlinks even though they are not particularly marked. When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position. |

Safety notes and operating tips are particularly marked.

### 1.3.1 Safety Notes

The safety notes are represented as described below.
These notes must absolutely be observed to reduce the risk to a minimum. The content is structured as follows:

- Signal word: warning, caution, notice
- Type and source of risk
- Consequences arising from non-observance
- Risk prevention

**⚠ SIGNAL WORD**

**Type and source of risk!**
**Consequences arising from non-observance**
**Risk prevention**

The signal words have the following meanings:

- Warning indicates hazardous situation which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or modest injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

**NOTE**

**Type and source of damage!**
**Damage prevention**

### 1.3.2 Operating Tips

Additional information is structured as presented in the following example:

| | |
|---|---|
| i | The text corresponding to the additional information is located here. |

Useful tips and tricks appear as follows:

| | |
|---|---|
| **TIP** | The tip text is located here. |

# 2 Safety

All safety information, notes and instructions specified in this document must be strictly observed. The product may only be used if all guidelines and safety instructions are adhered to.

This product is operated with SELV or PELV. No imminent risk results from the product itself. The use in Ex-zone is permitted if additional measures are taken.

## 2.1 Intended Use

HIMatrix components are designed for assembling safety-related controller systems.

When using the components in the HIMatrix system, comply with the following general requirements.

### 2.1.1 Environmental Requirements

| Requirement type | Range of values [1] |
|---|---|
| Protection class | Protection class III in accordance with IEC/EN 61131-2 |
| Ambient temperature | 0...+60 °C |
| Storage temperature | -40...+85 °C |
| Pollution | Pollution degree II in accordance with IEC/EN 61131-2 |
| Altitude | < 2000 m |
| Housing | Standard: IP20 |
| Supply voltage | 24 VDC |

[1] The values specified in the technical data apply and are decisive for devices with extended environmental requirements.

Table 3: Environmental Requirements

Exposing the HIMatrix system to environmental conditions other than those specified in this manual can cause the HIMatrix system to malfunction.

### 2.1.2 ESD Protective Measures

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace devices.

**NOTE**

**Device damage due to electrostatic discharge!**

- **When performing the work, make sure that the workspace is free of static, and wear an ESD wrist strap.**
- **If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.**

## 2.2 Residual Risk

No imminent risk results from a HIMatrix system itself.

Residual risk may result from:

- Faults related to engineering
- Faults related to the user program
- Faults related to the wiring

## 2.3 Safety Precautions

Observe all local safety requirements and use the protective equipment required on site.

## 2.4 Emergency Information

A HIMatrix system is a part of the safety equipment of a site. If a device or a module fails, the system enters the safe state.

In case of emergency, no action that may prevent the HIMatrix systems from operating safely is permitted.

# 3 Product Description

The AO 8 01 is a module for the modular F60 HIMatrix system.

The module can be inserted in the F60 subrack's slot 3...8. Slots 1 and 2 are reserved for the power supply module and central module, respectively.

The safety-related analog AO 8 01 system has 8 outputs with a 12-bit resolution. Each group of 8 safety-related outputs is galvanically separated from the other output pairs and the supply voltage.

On the module, the outputs can be either configured as current outputs or voltage outputs.

The module has been certified by the TÜV for safety-related applications up to SIL 3 (IEC 61508, IEC 61511 and IEC 62061), Cat. 4 and PL e (EN ISO 13849-1) and SIL 4 (EN 50126, EN 50128 and EN 50129).
Further safety standards, application standards and test standards are specified in the certificates available on the HIMA website.

## 3.1 Safety Function

If a module fault occurs, the affected outputs are de-energized.

### 3.1.1 Safety-Related Analog Outputs

To configure the analog outputs as a voltage or current outputs, each channel of the AO 8 01 module has a DIP switch with 6 functions located on the printed circuit board (PCB), next to the front plate. The switches are arranged top-down following the the order of channels 1...8.

The switches are set individually prior to starting up the module and in accordance with the following table:

#### 3.1.1.1 Switch Positions

| Switch function | Output voltage 0...±10 V | Output current 0...+20 mA |
|---|---|---|
| 1 | OFF | ON |
| 2 | OFF | ON |
| 3 | OFF | ON |
| 4 | ON | OFF |
| 5 | ON | OFF |
| 6 | ON | OFF |

Table 4: Switch Positions

### 3.1.1.2 Analog Output Values

Depending on which device type (…FS1000,…FS2000) has been selected, different values must be taken into account in the logic for the *Value [INT]* - > signal variable (SILworX) and for the *AO[0x].Value* system signal (ELOP II Factory) to get identical output values.

| Value range in the application | Output voltage | Output current |
|---|---|---|
| Device version FS1000 | | |
| 0 | 0.0 V | 0.0 mA |
| +1000 | +10.0 V | +20.0 mA |
| -1000 | -10.0 V | 0.0 mA |
| Device version FS2000 | | |
| 0 | 0.0 V | 0.0 mA |
| +2000 | +10.0 V | +20.0 mA |
| -2000 | -10.0 V | 0.0 mA |

Table 5: Output Values of the Analog Outputs

Every two analog outputs are galvanically connected to one another (output 1 and 2, output 3 and 4, output 5 and 6, output 7 and 8).

The analog outputs are designed to retain the metrological accuracy for 10 years. A proof test must be performed every 10 years.

### 3.1.1.3 Reaction in the Event of a Fault

If the module detects a discrepancy between the read back value of the output signal and the configured value, the defective output is switched off via the safety switches.

The module activates the *ERR* LED.

The error code allows the user to configure additional fault reactions in the user program.

### 3.1.1.4 Worst Case Reaction Time

The worst case reaction time $WDT_{AO}$ is 12 ms.

To determine the worst case reaction time of the analog outputs, add the double watchdog time of the AO CPU (2 * $WDT_{AO\text{-}\mu C}$) to the double watchdog time (2 * $WDT_{CPU}$), see safety manual (HI 800 023 E).

## 3.2 Equipment, Scope of Delivery

The following table specifies the available component:

| Designation | Description |
|---|---|
| AO 8 01 | Module with 8 analog outputs |

Table 6: Available Component

## 3.3 Type Label

The type plate contains the following details:

- Product name
- Bar code (1D or 2D code)
- Part no.
- Production year
- Hardware revision index (HW Rev.)
- Firmware revision index (FW Rev.)
- Operating voltage
- Mark of conformity

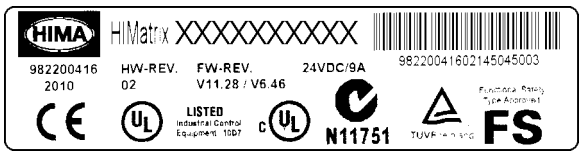
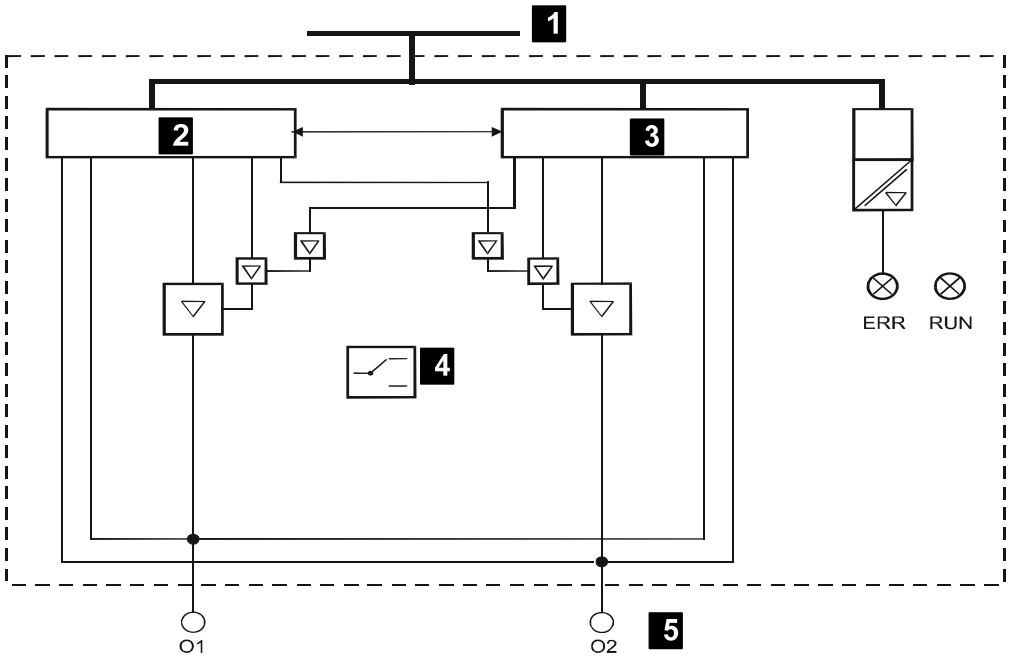



Figure 1: Sample Type Label

## 3.4 Structure

This chapter describes the layout and function of the module.

### 3.4.1 Block Diagram




1 I/O Bus
2 A/D Microcontroller
3 A/D Microcontroller
4 Voltage/Current Switch
5 8 Output Channels

Figure 2: Block Diagram

### 3.4.2 Front View

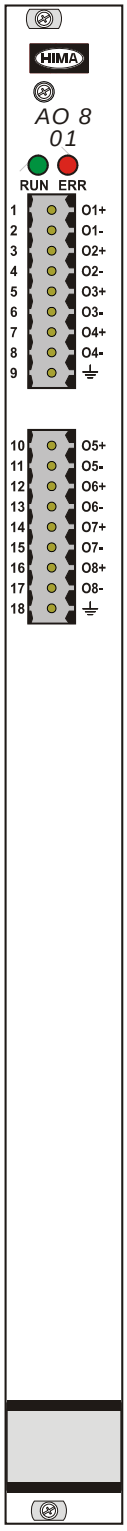



Figure 3: Front View

### 3.4.3 Status Indicators

| LED | Color | Status | Description |
|---|---|---|---|
| RUN | Green | On | Operating voltage present |
| | | Off | No operating voltage |
| ERR | Red | On | Module faulty or external faults<br>Reaction as dictated by the diagnosis |
| | | Off | No module faults and / or no channel faults |

Table 7: Status Indicators

## 3.5 Product Data

| General | |
|---|---|
| Operating voltage | 24 VDC, -15...+20 %, $r_{PP} \leq 15$ %,<br>from a power supply unit with safe insulation,<br>in accordance with IEC 61131-2 |
| Operating data | 3.3 V / 130 mA<br>5 V / 280 mA<br>24 V / 630 mA |
| Ambient temperature | 0...+60 °C |
| Storage temperature | -40...+85 °C |
| Space requirement | 6 RU, 4 HP |
| Weight | 280 g |

Table 8: Product Data

| Analog outputs | |
|---|---|
| Number of outputs | 8 analog outputs (each two outputs are galvanically separated from the other pairs and from the supply voltage). |
| Nominal range | 0...±10 V or<br>0...+20 mA |
| Operating range | 0...±10.25 V or<br>0...+21 mA |
| Output resistor | ≤ 600 Ω (current operation)<br>> 1 kΩ (voltage operation) |
| Digital resolution | 12-bit |
| Measurement accuracy at 25 °C, max. | ±0.3 % of final value |
| Metrological accuracy on full temperature, max. | ±1 % of final value |
| Temperature coefficient, max. | ±0.02 %/K of final value |
| Safety-related accuracy, max. | ±1 % of final value |

Table 9: Specifications for the Analog Outputs

# 4 Start-up

To start up the module, it must be mounted, connected and configured in the programming tool.

## 4.1 Installation and Mounting

The module is mounted in the subrack of the modular HIMatrix F60 system.

When laying cables (long cables, in particular), take appropriate measures to avoid interference, e.g., by separating the signal lines from the power lines.

When dimensioning the cables, ensure that their electrical properties have no negative impact on the measuring circuit.

### 4.1.1 Mounting and Removing the Modules

To mount and remove the modules, the connection cable clamp terminals must be unplugged.

Additionally, personnel must be protected from electrostatic discharge. For details, refer to Chapter 2.1.2.

#### Mounting the Modules

**To mount a module into the subrack**

1. Insert the module as far as it can go – without jamming it – into the two guiding rails which are located on the housing's upper and lower part.
2. Apply pressure to the upper and lower extremity of the front plate until the module plugs snap into the backplane socket.
3. Secure the module with the screws located on upper and lower extremity of the front plate.

The module is mounted.

#### Removing the Modules

**To remove a module from the subrack**

1. Remove the plugs from the module front plate.
2. Release the locking screws located on the upper and lower extremity of the front plate.
3. Loosen the module using the handle located on the lower part of the front plate and remove it from the guiding rails.

The module is removed.

### 4.1.2 Connecting the Analog Outputs

The outputs are connected using 9-pole connectors with numbered terminals. The terminal pins on the front plate of the module have the same numbered sequence to avoid invalid connections.

i Each unused analog output channels configured as current outputs, must be short-circuited to the assigned ground.

Use the following terminals to connect the analog outputs:

| Terminal | Designation | Function |
|---|---|---|
| 01 | O1+ | Analog output 1 |
| 02 | O1- | Ground output 1 |
| 03 | O2+ | Analog output 2 |
| 04 | O2- | Ground output 2 |
| 05 | O3+ | Analog output 3 |
| 06 | O3- | Ground output 3 |
| 07 | O4+ | Analog output 4 |
| 08 | O4- | Ground output 4 |
| 09 | ⏚ | Ground / shielding |
| Terminal | Designation | Function |
| 10 | O5+ | Analog output 5 |
| 11 | O5- | Ground output 5 |
| 12 | O6+ | Analog output 6 |
| 13 | O6- | Ground output 6 |
| 14 | O7+ | Analog output 7 |
| 15 | O7- | Ground output 7 |
| 16 | O8+ | Analog output 8 |
| 17 | O8- | Ground output 8 |
| 18 | ⏚ | Ground / shielding |

Table 10: Terminal Assignment for the Analog Outputs

### 4.1.3 Cable Plugs

Cable plugs attached to the pin headers of the module are used to connect to the field zone. The cable plugs are included within the scope of delivery of the HIMatrix modules.

| Connection to the field zone | |
|---|---|
| Number of cable plugs | 2 pieces, nine poles, screw terminals |
| Wire cross-section | 0.2…1.5 $mm^2$ (single-wire)<br>0.2…1.5 $mm^2$ (finely stranded)<br>0.2…1.5 $mm^2$ (with wire end ferrule) |
| Stripping length | 6 mm |
| Screwdriver | Slotted 0.4 x 2.5 mm |
| Tightening torque | 0.2…0.25 Nm |

Table 11: Cable Plug Properties

### 4.1.4 Mounting the AO 8 01 in Zone 2

(EC Directive 94/9/EC, ATEX)

The module is suitable for mounting in zone 2. Refer to the corresponding declaration of conformity available on the HIMA website.

When mounting the device, observe the special conditions specified in the following section.

#### Specific Conditions X

1. Mount the HIMatrix F60 controller in an enclosure that meets the EN 60079-15 requirements and achieves a type of protection of at least IP54, in accordance with EN 60529. Provide the enclosure with the following label:

   **Work is only permitted in the de-energized state**

   Exception:
   If a potentially explosive atmosphere has been precluded, work can also performed when the controller is under voltage.
2. The enclosure in use must be able to safely dissipate the generated heat. The maximum power dissipation of the AO 8 01 module is 21 W.
3. The 24 VDCpower must come from a power supply unit with safe isolation. Use power supply units of type PELV or SELV only.
4. Applicable standards:

| | |
|---|---|
| VDE 0170/0171 Part 16, | DIN EN 60079-15: 2004-5 |
| VDE 0165 Part 1, | DIN EN 60079-14: 1998-08 |

Pay particular attention to the following sections:

| | |
|---|---|
| DIN EN 60079-15: | |
| Chapter 5 | Design |
| Chapter 6 | Terminals and cabling |
| Chapter 7 | Air and creeping distances |
| Chapter 14 | Connectors |
| DIN EN 60079-14: | |
| Chapter 5.2.3 | Equipment for use in zone 2 |
| Chapter 9.3 | Cabling for zones 1 and 2 |
| Chapter 12.2 | Equipment for zones 1 and 2 |

The module is additionally equipped with the label represented below:

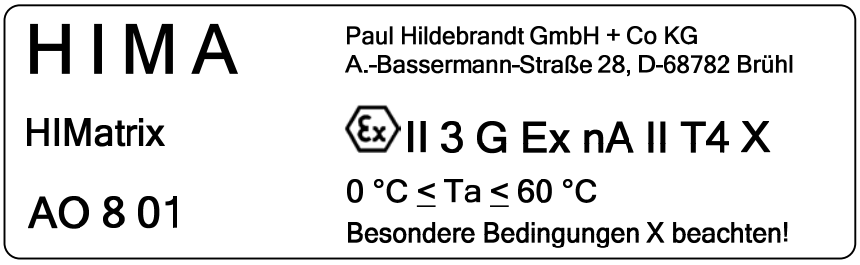



Figure 4: Label for Ex Conditions

## 4.2 Configuration

The module can be configured using a programming tool, SILworX or ELOP II Factory. Which programming tool should be used, depends on the revision status of the operating system (firmware):

- SILworX is required for CPU OS V7 and higher.
- ELOP II Factory is required for CPU OS up to V6.x.

i How to switch between operating systems is described in Chapter *Loading Operating Systems* of the system manual for the modular F60 system (HI 800 191 E).

### 4.2.1 Module Slots

Slots 1 and 2 on the F60 subrack are reserved for the PS 01 power supply module and the central module, respectively. Any type of I/O modules can be plugged in to slots 3...8.

The module slots in SILworX and ELOP II Factory are numbered as follows:

| Module | Slot on the rack | Slot in SILworX | Slot in ELOP II Factory |
|---|---|---|---|
| PS 01 | 1 | - | - |
| CPU/COM | 2 | 0/1 | - |
| I/O | 3 | 2 | 1 |
| I/O | 4 | 3 | 2 |
| I/O | 5 | 4 | 3 |
| I/O | 6 | 5 | 4 |
| I/O | 7 | 6 | 5 |
| I/O | 8 | 7 | 6 |

Table 12: Module Slots

i
- The PS 01 power supply module is not configured.
- CPU and COM are both on the central module. In the programming tools, however, they are represented as separate items.

## 4.3 Configuration with SILworX

In the Hardware Editor, the controller is represented with the following modules:

- one processor module (CPU)
- one communication module (COM)
- 6 slots available for I/O modules

To insert I/O modules, drag them from the module list onto an available slot.

Double-click the module to open the Detail View with the corresponding tabs. The tabs are used to assign the global variables configured in the user program to the system parameters of the corresponding module.

### 4.3.1 Parameters and Error Codes for the Output

The following tables specify the system parameters that can be read and set for the outputs, including the corresponding error codes.

In the user program, the error codes can be read using the variables assigned within the logic.

The error codes can also be displayed in SILworX.

### 4.3.2 Analog Outputs

The following tables present the statuses and parameters for the output module in the same order as given in the Hardware Editor.

#### 4.3.2.1 Tab: **Module**

The **Module** tab contains the following system parameters:

<table>
<tr><th>System parameter</th><th>Data type</th><th>R/W</th><th>Description</th></tr>
<tr><td>AO.Error Code</td><td>WORD</td><td>R</td><td>Error codes for the analog output channels
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Module fault</td></tr>
<tr><td>0x0002</td><td>FTT test: Error while checking coefficients</td></tr>
<tr><td>0x0004</td><td>No communication to AO module, PES faulty</td></tr>
</table></td></tr>
<tr><td>Module Error Code</td><td>WORD</td><td>R</td><td>Module error code
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0000</td><td>I/O processing, if required with errors, see other error codes</td></tr>
<tr><td>0x0001</td><td>No I/O processing (CPU not in RUN)</td></tr>
<tr><td>0x0002</td><td>No I/O processing during the booting test</td></tr>
<tr><td>0x0004</td><td>Manufacturer interface operating</td></tr>
<tr><td>0x0010</td><td>No I/O processing: invalid configuration</td></tr>
<tr><td>0x0020</td><td>No I/O processing: fault rate exceeded</td></tr>
<tr><td>0x0040/<br>0x0080</td><td>No I/O processing: configured module not plugged in</td></tr>
</table></td></tr>
<tr><td>Module SRS</td><td>UDINT</td><td>R</td><td>Slot number (System.Rack.Slot)</td></tr>
<tr><td>Module Type</td><td>UINT</td><td>R</td><td>Type of module, target value: 0xFB04 [64 260$_{dez}$]</td></tr>
</table>

Table 13: SILworX - System Parameters for Analog Outputs, **Module** Tab

### 4.3.2.2 Tab: **AO 8: Channels**

<table>
<tr><th>System parameter</th><th>Data type</th><th>R/W</th><th>Description</th></tr>
<tr><td>-> Error code [DWORD]</td><td>DWORD</td><td>R</td><td>Error codes for the analog output channels
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0000 0001</td><td>CPU F60: AO module error</td></tr>
<tr><td>0x0000 0002</td><td>CPU F60: Faulty monotonicity counter</td></tr>
<tr><td>0x0000 0004</td><td>CPU F60: Faulty secure addressing</td></tr>
<tr><td>0x0000 0008</td><td>CPU F60: CRC faulty</td></tr>
<tr><td>0x0000 0010</td><td>CPU F60: Faulty WD time in ADyC</td></tr>
<tr><td>0x0000 0020</td><td>CPU F60: Impossible to communicate with ADyC</td></tr>
<tr><td>0x0000 0040</td><td>CPU F60: Current operating state of AO (current / voltage) does not match initial state</td></tr>
<tr><td>0x0000 0080</td><td>CPU F60: AO [0x].Value out of the specified range</td></tr>
<tr><td>0x0001 0000</td><td>ADyC: Error while reading back</td></tr>
<tr><td>0x0004 0000</td><td>ADyC: Error with analog supply voltage</td></tr>
<tr><td>0x0008 0000</td><td>ADyC: Error with test of safety switches</td></tr>
<tr><td>0x0080 0000</td><td>ADyC: Two safety switches faulty</td></tr>
<tr><td>0x0200 0000</td><td>ADyC: Initialization of ADyC</td></tr>
<tr><td>0x1000 0000</td><td>ADyC: Error due to temperature overrun</td></tr>
<tr><td>0x2000 0000</td><td>ADyC: Warning due to temperature overrun</td></tr>
<tr><td>0x8000 0000</td><td>CPU F60: Redundant ADyC channel indicates error</td></tr>
</table></td></tr>
<tr><td>Value [INT] -></td><td>INT</td><td>W</td><td>Output value of AO channels (device version: FS1000):<br>Current characteristic curve: 0…+1000 (0…+20 mA)<br>Current characteristic curve: -1000…0 (0 mA)<br><br>Before being normalized, the values are checked for plausibility and limited to the valid range.<br>Current characteristic curve:<br>▪ Values < 0: are limited to 0<br>▪ Values > 1000: are limited to 1000<br>Voltage characteristic curve:<br>▪ Values < -1000: are limited to -1000<br>▪ Values > 1000: are limited to 1000<br>Output value of AO channels (device version: FS2000):<br>Voltage characteristic curve: -2000...+2000 (-10...+10 V)<br>Current characteristic curve: 0...+2000 (0...+20 mA)<br>Current characteristic curve: -2000...0 (0 mA)<br><br>Before being normalized, the values are checked for plausibility and limited to the valid range.<br>Current characteristic curve:<br>▪ Values < 0: are limited to 0<br>▪ Values > 2000: are limited to 2000<br>Voltage characteristic curve:<br>▪ Values < -2000: are limited to -2000<br>▪ Values > 2000: are limited to 2000</td></tr>
</table>

| System parameter | Data type | R/W | Description |
|---|---|---|---|
| Channel Used [BOOL] -> | BOOL | W | Channel configuration:<br>1 = operating<br>0 = not operating |
| Mode [UINT] -> | UINT | W | Channel current or voltage measurement:<br>0 Voltage characteristic curve<br>1 Current characteristic curve |

Table 14: SILworX - System Parameters for Analog Outputs, **AO 8: Channels** Tab

## 4.4 Configuration with ELOP II Factory

### 4.4.1 Configuring the Outputs

The signals previously defined in the Signal Editor (Hardware Management) are assigned to the individual channels (outputs) using ELOP II Factory. Refer to the system manual for the modular F60 system or the online help for more details.

The following chapter describes the system signals used for assigning signals in the controller.

### 4.4.2 Signals and Error Codes for the Output

The following tables specify the system signals that can be read and set for the outputs, including the corresponding error codes.

In the user program, the error codes can be read using the signals assigned within the logic.

The error codes can also be displayed in ELOP II Factory.

### 4.4.3 Analog Outputs

<table>
<tr><th>System signal</th><th>R/W</th><th>Description</th></tr>
<tr><td>Mod.SRS [UDINT]</td><td>R</td><td>Slot number (System.Rack.Slot)</td></tr>
<tr><td>Mod. Type [UINT]</td><td>R</td><td>Type of module, target value: 0xFB04 [64 260$_{dez}$]</td></tr>
<tr><td>Mod. Error Code [WORD]</td><td>R</td><td>Module error code
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0000</td><td>I/O processing, if required with errors, see other error codes</td></tr>
<tr><td>0x0001</td><td>No I/O processing (CPU not in RUN)</td></tr>
<tr><td>0x0002</td><td>No I/O processing during the booting test</td></tr>
<tr><td>0x0004</td><td>Manufacturer interface operating</td></tr>
<tr><td>0x0010</td><td>No I/O processing: invalid configuration</td></tr>
<tr><td>0x0020</td><td>No I/O processing: fault rate exceeded</td></tr>
<tr><td>0x0040/<br>0x0080</td><td>No I/O processing: configured module not plugged in</td></tr>
</table></td></tr>
<tr><td>AO.Error Code [WORD]</td><td>R</td><td>Error codes for the analog output channels
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Module fault</td></tr>
<tr><td>0x0002</td><td>FTT test: Error while checking coefficients</td></tr>
<tr><td>0x0004</td><td>No communication to AO module, PES faulty</td></tr>
</table></td></tr>
<tr><td>AO[xx].Error Code [DWORD]</td><td>R</td><td>Error codes for the analog output channels
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0000 0001</td><td>CPU F60: AO module error</td></tr>
<tr><td>0x0000 0002</td><td>CPU F60: Faulty monotonicity counter</td></tr>
<tr><td>0x0000 0004</td><td>CPU F60: Faulty secure addressing</td></tr>
<tr><td>0x0000 0008</td><td>CPU F60: CRC faulty</td></tr>
<tr><td>0x0000 0010</td><td>CPU F60: Faulty WD time in ADyC</td></tr>
<tr><td>0x0000 0020</td><td>CPU F60: Impossible to communicate with ADyC</td></tr>
<tr><td>0x0000 0040</td><td>CPU F60: Current operating state of AO (current / voltage) does not match initial state</td></tr>
<tr><td>0x0000 0080</td><td>CPU F60: AO [0x].Value out of the specified range</td></tr>
<tr><td>0x0001 0000</td><td>ADyC: Error while reading back</td></tr>
<tr><td>0x0004 0000</td><td>ADyC: Error with analog supply voltage</td></tr>
<tr><td>0x0008 0000</td><td>ADyC: Error with test of safety switches</td></tr>
<tr><td>0x0080 0000</td><td>ADyC: Two safety switches faulty</td></tr>
<tr><td>0x0200 0000</td><td>ADyC: Initialization of ADyC</td></tr>
<tr><td>0x1000 0000</td><td>ADyC: Error due to temperature overrun</td></tr>
<tr><td>0x2000 0000</td><td>ADyC: Warning due to temperature overrun</td></tr>
<tr><td>0x8000 0000</td><td>CPU F60: Redundant ADyC channel indicates error</td></tr>
</table></td></tr>
</table>

| System signal | R/W | Description |
|---|---|---|
| AO[xx].Value [BOOL] | W | Output value of AO channels (device version: FS1000):<br>Voltage characteristic curve: -1000...+1000 (-10...+10 V)<br>Current characteristic curve: 0...+1000 (0...+20 mA)<br>Current characteristic curve: -1000...0 (0 mA)<br><br>Before being normalized, the values are checked for plausibility and limited to the valid range.<br>***Current characteristic curve:***<br>▪ Values < 0: are limited to 0<br>▪ Values > 1000: are limited to 1000<br>***Voltage characteristic curve:***<br>▪ Values < -1000: are limited to -1000<br>▪ Values > 1000: are limited to 1000<br><br>Output value of AO channels (device version: FS2000):<br>Voltage characteristic curve: -2000...+2000 (-10...+10 V)<br>Current characteristic curve: 0...+2000 (0...+20 mA)<br>Current characteristic curve: -2000...0 (0 mA)<br><br>Before being normalized, the values are checked for plausibility and limited to the valid range.<br>***Current characteristic curve:***<br>▪ Values < 0: are limited to 0<br>▪ Values > 2000: are limited to 2000<br>***Voltage characteristic curve:***<br>▪ Values < -2000: are limited to -2000<br>▪ Values > 2000: are limited to 2000 |
| AO[0x].Mode [USINT] | W | Channel current or voltage measurement:<br>0 Voltage characteristic curve<br>1 Current characteristic curve |
| AO[x].Used [BOOL] | W | Channel configuration:<br>1 = operating<br>0 = not operating |

Table 15: ELOP II Factory - System Signals for the Analog Outputs

# 5 Operation

The AO 8 01 can only operate together with a F60 controller. No specific monitoring is required.

## 5.1 Handling

Handling of the module during operation is not required.

## 5.2 Diagnosis

A first diagnosis results from evaluating the LEDs, see Chapter 3.4.3.

The module diagnostic history can also be read using the programming tool.

# 6 Maintenance

No maintenance measures are required during normal operation.

If a failure occurs, the defective module or device must be replaced with a module or device of the same type or with a replacement model approved by HIMA.

Only the manufacturer is authorized to repair the device or module.

## 6.1 Faults

Refer to Chapter 3.1.1.3, for more information on the fault reaction of the analog outputs.

**NOTE**

**If a failure occurs, the module must be replaced to ensure the plant's safety.**

A module may only be replaced while the power is switched off.

i Modules may not be removed or inserted during operation.

The instructions specified in Chapter 4.1.1 must be observed when replacing an existing module or installing a new one.

## 6.2 Maintenance Measures

The following measures are required for the modular F60 system:

- Load the operating system, if a new version is required
- Perform the proof test

### 6.2.1 Loading the Operating System

HIMA is continuously improving the operating system of the F60 central module. HIMA recommends to use system downtimes to load the current version of the operating system into the F60 controller.

Refer to the release list to check the consequences of the new operation system version on the system!

The operating system is loaded using the programming tool.

Prior to loading the operating system, the F60 controller must be in STOP (displayed in the programming tool). Otherwise, stop the controller.

For more information, refer to the programming tool documentation and the system manual for the modular F60 system (HI 800 191 E).

### 6.2.2 Proof Test

HIMatrix devices and modules must be subjected to a proof test in intervals of 10 years. For more information, refer to the safety manual (HI 800 023 E).

# 7 Decommissioning

Remove the supply voltage of the PS 01 supply module to decommission the module. Afterwards pull out the pluggable screw terminal connector blocks for inputs and outputs and the Ethernet cables.

# 8 Transport

To avoid mechanical damage, HIMatrix components must be transported in packaging.

Always store HIMatrix components in their original product packaging. This packaging also provides protection against electrostatic discharge. Note that the product packaging alone is not suitable for transport.

# 9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned HIMatrix hardware. Upon request, a disposal agreement can be arranged with HIMA.

All materials must be disposed of in an ecologically sound manner.

# Appendix

## Glossary

| Term | Description |
|---|---|
| ARP | Address resolution protocol: Network protocol for assigning the network addresses to hardware addresses |
| AI | Analog input |
| AO | Analog output |
| COM | Communication module |
| CRC | Cyclic redundancy check |
| DI | Digital input |
| DO | Digital output |
| ELOP II Factory | Programming tool for HIMatrix systems |
| EMC | Electromagnetic compatibility |
| EN | European norm |
| ESD | Electrostatic discharge |
| FB | Fieldbus |
| FBD | Function block diagrams |
| FTT | Fault tolerance time |
| ICMP | Internet control message protocol: Network protocol for status or error messages |
| IEC | International electrotechnical commission |
| MAC address | Media access control address: Hardware address of one network connection |
| PADT | Programming and debugging tool (in accordance with IEC 61131-3), PC with SILworX or ELOP II Factory |
| PE | Protective earth |
| PELV | Protective extra low voltage |
| PES | Programmable electronic system |
| R | Read: The system variable or signal provides value, e.g., to the user program |
| Rack ID | Base plate identification (number) |
| Interference-free | Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed *interference-free* if it does not distort the signals of the other input circuit. |
| R/W | Read/Write (column title for system variable/signal type) |
| SELV | Safety extra low voltage |
| SFF | Safe failure fraction, portion of faults that can be safely controlled |
| SIL | Safety integrity level (in accordance with IEC 61508) |
| SILworX | Programming tool for HIMatrix systems |
| SNTP | Simple network time protocol (RFC 1769) |
| SRS | System.rack.slot addressing of a module |
| SW | Software |
| TMO | Timeout |
| W | Write: System variable/signal is provided with value, e.g., from the user program |
| $r_{PP}$ | Peak-to-peak value of a total AC component |
| Watchdog (WD) | Time monitoring for modules or programs. If the watchdog time is exceeded, the module or program enters the ERROR STOP state. |
| WDT | Watchdog time |

## Index of Figures

**Figure 1: Sample Type Label 13**

**Figure 2: Block Diagram 14**

**Figure 3: Front View 15**

**Figure 4: Label for Ex Conditions 20**

## Index of Tables


| | | |
|---|---|---|
| Table 1: | Programming Tools for HIMatrix F60 | 5 |
| Table 2: | Additional Relevant Documents | 6 |
| Table 3: | Environmental Requirements | 9 |
| Table 4: | Switch Positions | 11 |
| Table 5: | Output Values of the Analog Outputs | 12 |
| Table 6: | Available Component | 13 |
| Table 7: | Status Indicators | 16 |
| Table 8: | Product Data | 17 |
| Table 9: | Specifications for the Analog Outputs | 17 |
| Table 10: | Terminal Assignment for the Analog Outputs | 19 |
| Table 11: | Cable Plug Properties | 19 |
| Table 12: | Module Slots | 21 |
| Table 13: | SILworX - System Parameters for Analog Outputs, Module Tab | 22 |
| Table 14: | SILworX - System Parameters for Analog Outputs, AO 8: Channels Tab | 24 |
| Table 15: | ELOP II Factory - System Signals for the Analog Outputs | 26 |

## Index

block diagram ..... 14
diagnosis ..... 27
fault reaction
  analog inputs ..... 12
front view ..... 15
safety function ..... 11
specifications ..... 17

HIMA Paul Hildebrandt GmbH + Co KG
P.O. Box 1261
68777 Brühl, Germany
Phone: +49 6202 709-0
Fax: +49 6202 709-107
E-mail: info@hima.com Internet: www.hima.com

(1334)

HI 800 197 E © by HIMA Paul Hildebrandt GmbH + Co KG