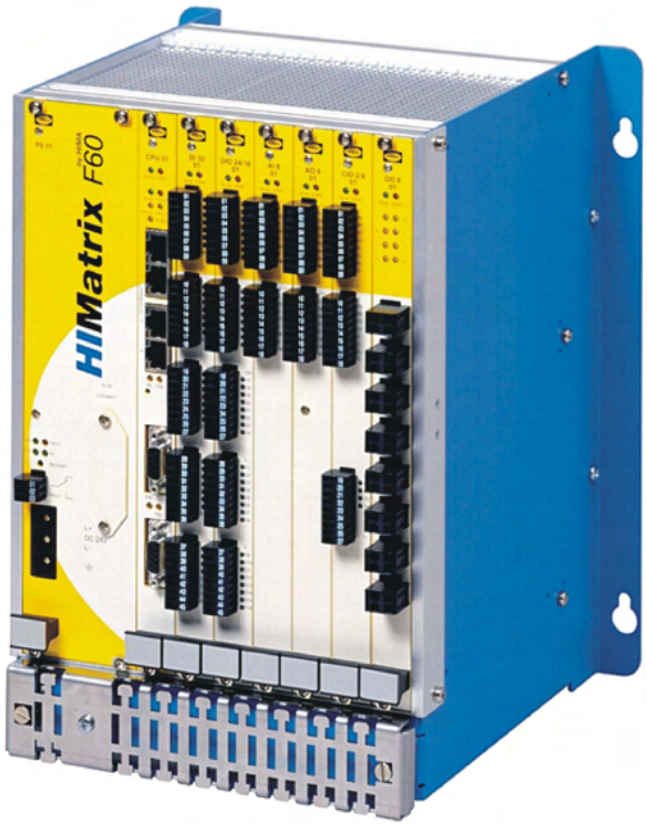
HIMatrix

Safety-Related Controller

MI 24 01 Manual



HIMA Paul Hildebrandt GmbH + Co KG
Industrial Automation

Rev. 1.00

HI 800 209 E

3 Product Description

MI 24 01 is a plug-in module for the modular F60 HIMatrix system.

The MI 24 01 module has 24 digital input channels. The analog inputs AI are inputs for measuring currents of 0/4...20 mA. The digital inputs DI can be used with proximity switches in accordance with EN 60947-5-6, safety proximity switches or contacts (wired with resistors).

i Analog and digital inputs cannot be used simultaneously, but one or the other depending on the channel configuration

Ensure proper configuration of the inputs. Each channel must be configured individually.

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

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 (EN 954-1) and PL e (EN ISO 13849-1). Further safety standards, application standards and test standards are specified in the certificate available on the HIMA website.

3.1 Safety Function

The module is equipped with safety-related inputs that can be used as analog or digital inputs.

3.1.1 Safety-Related Analog Inputs

The analog inputs are inputs for measuring currents of 0/4...20 mA.

3.1.1.1 Reaction in the Event of a Fault

If the module detects a fault on an analog input, the *AI.Error Code* system parameter > 0 is set. In case of module faults, the *Mod. Error Code* system parameter > 0 is set.

In both cases, the device activates the *ERR* LED.

In addition to the analog value the error code must be evaluated. The analog value must be configured to ensure a safety-related reaction.

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

3.1.2 Safety-Related Digital Inputs

The digital inputs of the module operate as analog inputs, but return digital values due to the configuration of switching thresholds.

3.1.2.1 Reaction in the Event of a Fault

If the module detects a fault on a digital input, the user program processes a low level in accordance with the de-energized to trip principle.

The module activates the *FAULT* LED.

In addition to the channel signal value, the user program must also consider the corresponding error code.

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

3.2 Equipment, Scope of Delivery

The H 7032 and the H 7033 are not included within the scope of delivery of MI 24 01.
The following list specifies the available components and the corresponding part numbers:

Designation	Description	Part no.
MI 24 01	Plug-in module with 24 analog inputs or inputs for proximity switches	98 2200115
H 7032	Filter and protective module for connecting two-wire transmitters to the HIMatrix MI 24 up to SIL 3.	99 4703202
H 7033	Filter and protective module for connecting three-wire transmitters to the HIMatrix MI 24 up to SIL 3.	99 4703302

Table 4: Part Numbers

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

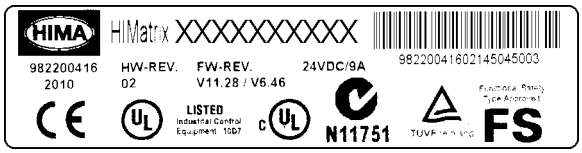
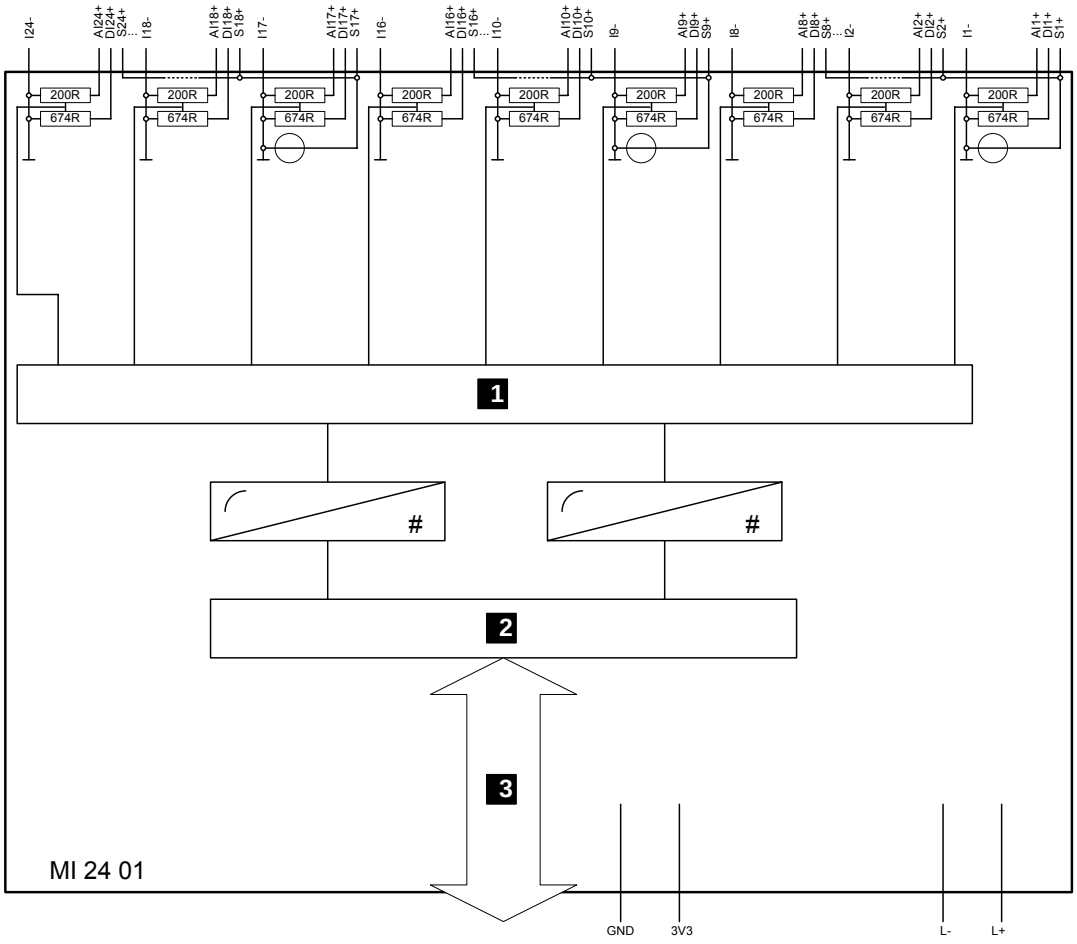


Figure 1: Sample Type Label

3.4 Assembly

This chapter describes the layout and function of the plug-in module.

3.4.1 Block Diagram



1 Multiplexer
2 I/O Module
3 I/O Bus

Figure 2: Block Diagram

3.4.2 Front View

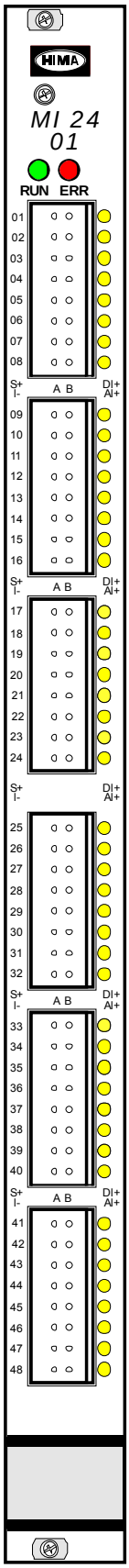


Figure 3: Front View

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 Reaction as dictated by the diagnosis
		Off	No module faults and / or no channel faults

Table 5: Status Indicators

3.4.4 I/O LEDs

LED	Color	Status	Description
I 1...24	Yellow	On	Use as DI: The related channel is active (energized). Use as AI: The upper limit has been achieved.
		Off	Use as DI: The related channel is inactive (de-energized). Use as AI: The low limit has been achieved.

Table 6: I/O LEDs

The status of the digital input signals is displayed by LEDs located on the front plate next to the terminal plugs. The second LED for each terminal pin, is not used (see Chapter 4.1.4).

3.4.5 Outputs for Transmitter and Proximity Switch Supply

To supply the external (analog and digital) sensors, the module has 24 outputs divided into 3 groups:

Group	Outputs	Maximum total current
Group 1	Channels 1...8	200 mA
Group 2	Channels 9...16	200 mA
Group 3	Channels 17...24	200 mA

Table 7: Outputs for Transmitter and Proximity Switch Supply

The supply outputs are short-circuit-proof. Within a group, the current of 200 mA can be distributed as required. The transmitter supply is switched off if its total current is exceeded. If the overload disappears within 30 seconds, the supply is switched on again. If the overload is still present after 30 seconds, the module attempts to restart the supply in intervals of 60 seconds.

Short transient interferences (< 5 ms) do not cause the transmitter supply to switch off.

If an external supply is used or is faulty, the module measurement input may be overloaded and permanently damaged. If the measurement input is overloaded over a longer time period, the zero and final values must be checked. For this reason, HIMA recommends to use the internal module supply and to configure it using the corresponding signal (*Transmitter Used [BOOL]* set to TRUE).

The transmitter supply is also switched off if the module's transmitter supply is used (*Transmitter Used [BOOL]* -> set to TRUE) and the module's measurement input is overloaded. The module attempts to restart the supply in intervals of 60 seconds. Switching off the transmitter supply means that all the outputs of this group are switched off. This also applies to transient overloads (e.g., by connecting a transmitter). If these cases occur, the *Transmitter Used [BOOL]* -> signal must be set to FALSE for the duration of the failure, e.g., by forcing the signal or by configuring a time function in the user program.

If the module is in STOP, no monitoring for overload is performed, even if *Transmitter Used [BOOL] ->* is set to TRUE.

The current limiting voltage outputs can be switched between 8.2 VDC and 26 VDC. The switching value must be set individually for each output. An operating voltage must be selected even if it is not used, otherwise the module enters the error state with invalid configuration. The outputs cannot be forced and may only be defined during the parameter setting.

The voltage limits of the outputs are safely monitored. If the error limits are exceeded, an error bit is set.

For supplying a channel, the voltage output assigned to the input must be used (e.g., S1+ with AI1+).

3.5 Product Data

General	
Number of inputs	24, configurable as: ▪ Analog current inputs 0/4...20 mA ▪ Digital signal inputs for proximity switches, e.g., in accordance with EN 60947-5-6, safety proximity switches or contacts wired with resistors
Operating voltage	24 VDC, -15 %...+20 %, $w_{ss} \leq 15$ %, provided by a power supply unit with safe isolation in accordance with IEC 61131-2 requirements.
Operating data	3.3 VDC / 0.3 A 24 VDC / 1.5 A
Max. permanent overload	50 mA / 10 V
max. overload duration (short-circuit S+ → AI+)	60 ms
Data format	Integer
Ambient temperature	0 °C...+60 °C
Storage temperature	-40 °C...+85 °C
Space requirement	6 RU, 4 HP
Weight	580 g

Table 8: Product Data

Analog Inputs	
Inputs	24 (unipolar, non-galvanically isolated)
Nominal range	0...20 mA
Operating range	-1...25 mA
Input resistance	200 Ω
Digital resolution	12-bit
Measurement accuracy at 25 °C, max.	±0.2 % of final value
Measurement accuracy on full temperature range, max.	±0.5 % of final value
Temperature coefficient, max.	±0.0086 %/K of final value
Safety-related accuracy, max	±1 % of final value
Measured value refresh	once per F60 cycle
Sampling time	approx. 45 µs per channel

Table 9: Specifications for the Analog inputs

Analog inputs, default values		
Open-circuit and short-circuit monitoring	Freely configurable values, e.g.,	
	LB[1)] 3.6 mA (360 digits)	Parameter *Limit Value LOW [INT] ->*
	LS[2)] 21 mA (2100 digits)	Parameter *Limit Value HIGH [INT] ->* (in accordance with NE 43)
[1)] LB = open-circuit [2)] LS = Short-circuit		

Table 10: Default Values for the Analog Inputs

Digital Inputs	
Inputs	24 unipolar ground I-, non-galvanically isolated from one another, analog measurement processing
Nominal range	0...20 mA, freely configurable switching threshold
Nominal input resistance	674 Ω
Nominal short-circuit current with proximity switch supply	12.2 mA
Delay time L → H H → L	2 x cycle time F60

Table 11: Specifications for Digital Inputs

Digital inputs, default values	
Proximity switch in accordance with EN 60947-5-6: Switching threshold L → H Switching threshold H → L Open-circuit Short-circuit	The values must be configured and verified for the proximity switch in use: 1.7 mA (170 digits), parameter *Hysteresis HIGH [INT] ->* 1.5 mA (150 digits), parameter *Hysteresis LOW [INT] ->* 0.125 mA (13 digits), parameter *Limit Value LOW [INT] ->* 8.5 mA (850 digits), parameter *Limit Value HIGH [INT] ->*
Safety proximity switches in accordance with EN 60947-5-6 Switching threshold L → H Switching threshold H → L Open-circuit Short-circuit	The values must be configured and verified for the proximity switch in use: 1.9 mA (190 digits), parameter *Hysteresis HIGH [INT] ->* 1.7 mA (170 digits), parameter *Hysteresis LOW [INT] ->* 0.125 mA (13 digits), parameter *Limit Value LOW [INT] ->* 5.5 mA (550 digits), parameter *Limit Value HIGH [INT] ->*
Contacts wired with resistors (1 k/10 k): Switching threshold L → H Switching threshold H → L Open-circuit Short-circuit	The values must be configured and verified for the contact in use: 1.7 mA (170 digits), parameter *Hysteresis HIGH [INT] ->* 1.5 mA (150 digits), parameter *Hysteresis LOW [INT] ->* 0.125 mA (13 digits), parameter *Limit Value LOW [INT] ->* 8.5 mA (850 digits), parameter *Limit Value HIGH [INT] ->*

Table 12: Default Values for the Digital Inputs

Supply outputs	
Nominal voltages	8.2 VDC / 26 VDC, switchable for each group
Tolerance	± 5 %
Safely monitored limits Range 8.2 V Range 26 V	 7.6 V...8.8 V, (tolerance range: 7.3...9.1 V) 24.3 V...27.7 V, (tolerance range: 24.0...28.0 V)
Current limiting	> 200 mA (0 V each group) the output is switched off

Table 13: Specifications for the Supply Outputs

4 Start-Up

To start up the controller, 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.

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 rack

1. Insert the module as far as it can go – without jamming it – into the two guiding rails which are located on the upper and lower part of the enclosure.
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 rack

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.

---

i The inputs of the MI 24 01 must not be wired redundantly.

---

i Inputs that are not being used need not be terminated. However, no open wire may be connected.

4.1.2 Analog Inputs

Only shielded cables may be connected to the analog inputs. Each analog input must be connected to a twisted pair of wires. The shielding must be connected to the controller and the sensor housing and earthed on one end to the controller side to form a Faraday cage.

The cable length depends on its resistor. Typically, the maximum total resistance permitted (cable + additional resistors) is 250 Ω:

$$R_B = \frac{U_{TC} - U_{Tmin}}{I_{max}} - R_E = \frac{24\ V - 14\ V}{21.5\ mA} - R_E \approx 250\ \Omega$$

U_{TC} Switch-off threshold for monitoring the transmitter supply voltage

U_{Tmin} Minimum supply voltage for the transmitters

I_{max} maximum measuring current

R_E Input resistor of the analog input (approx. 200 Ω)

Number of input channels	Measurement procedure	Current	Range of values in the application
24	unipolar [1)]	Nominal value: 0…20 mA	0…2000
		Operating value: -1…24 mA	-100…2500
[1)] Measurement with fixed ground			

Table 14: Range of Values for the Analog Inputs

The analog inputs are designed to retain the metrological accuracy for 10 years. A recalibration must be carried out every 10 years.

4.1.3 Digital Inputs

Only shielded cables may be connected to the digital inputs. Each digital input must be connected to a twisted pair of wires. The shielding must be connected to the controller and the sensor housing and earthed on one end to the controller side to form a Faraday cage.

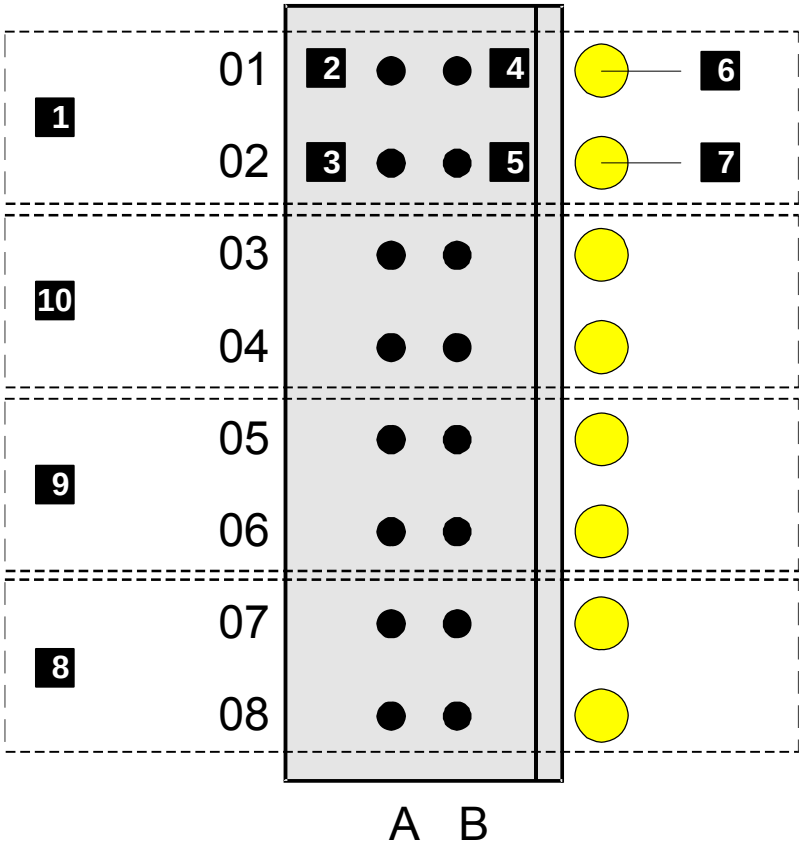
The cable length depends on its resistor: The maximum total resistance permitted is < 50 Ω in accordance with EN 60947-5-6.

The status of the inputs is displayed via LEDs that are controlled by the user program: the LED is activated with high level.

In the event of STOP or ERROR STOP, the LEDs are no longer operated by the user program.

4.1.4 Pin Designation

The pin designation consists of column designation (A, B) and row designation (01, 02, 03, ...).



1 Terminal Pin Channel 1
2 Terminal A 01: Supply 1 (S1+)
3 Terminal A 02: Ground 1 (I1-)
4 Terminal B 01: Digital Input 1 (DI1+)
5 Terminal B 02: Analog Input 1 (AI1+)
6 Status LED Channel 1
7 LED without Function
8 Terminal Pin Channel 4
9 Terminal Pin Channel 3
10 Terminal Pin Channel 2

Figure 4: Pin Designation for the MI 24 01 Module

4.1.5 Pin Assignment for the MI 24 01 Module

Pin assignment of group 1: channels 1…8:

Pin designation	Function, channel	Description
A 01	S1+	Supply channel 1 (for channels 1...8)
A 02	I1-	Ground channel 1
B 01	DI1+	Digital input 1
B 02	AI1+	Analog input 1
A 03	S2+	Supply channel 2 (for channels 1...8)
A 04	I2-	Ground channel 2
B 03	DI2+	Digital input 2
B 04	AI2+	Analog input 2
A 05	S3+	Supply channel 3 (for channels 1...8)
A 06	I3-	Ground channel 3
B 05	DI3+	Digital input 3
B 06	AI3+	Analog input 3
A 07	S4+	Supply channel 4 (for channels 1...8)
A 08	I4-	Ground channel 4
B 07	DI4+	Digital input 4
B 08	AI4+	Analog input 4
Pin designation	Function, channel	Description
A 09	S5+	Supply channel 5 (for channels 1...8)
A 10	I5-	Ground channel 5
B 09	DI5+	Digital input 5
B 10	AI5+	Analog input 5
A 11	S6+	Supply channel 6 (for channels 1...8)
A 12	I6-	Ground channel 6
B 11	DI6+	Digital input 6
B 12	AI6+	Analog input 6
A 13	S7+	Supply channel 7 (for channels 1...8)
A 14	I7-	Ground channel 7
B 13	DI7+	Digital input 7
B 14	AI7+	Analog input 7
A 15	S8+	Supply channel 8 (for channels 1...8)
A 16	I8-	Ground channel 8
B 15	DI8+	Digital input 8
B 16	AI8+	Analog input 8

Table 15: Pin Assignment of Channels 1...8

Pin assignment of group 2: channels 9...16:

Pin designation	Function, channel	Description
A 17	S9+	Supply channel 9 (for channels 9...16)
A 18	I9-	Ground channel 9
B 17	DI9+	Digital input 9
B 18	AI9+	Analog input 9
A 19	S10+	Supply channel 10 (for channels 9...16)
A 20	I10-	Ground channel 10
B 19	DI10+	Digital input 10
B 20	AI10+	Analog input 10
A 21	S11+	Supply channel 11 (for channels 9...16)
A 22	I11-	Ground channel 11
B 21	DI11+	Digital input 11
B 22	AI11+	Analog input 11
A 23	S12+	Supply channel 12 (for channels 9...16)
A 24	I12-	Ground channel 12
B 23	DI12+	Digital input 12
B 24	AI12+	Analog input 12
Pin designation	Function, channel	Description
A 25	S13+	Supply channel 13 (for channels 9...16)
A 26	I13-	Ground channel 13
B 25	DI13+	Digital input 13
B 26	AI13+	Analog input 13
A 27	S14+	Supply channel 14 (for channels 9...16)
A 28	I14-	Ground channel 14
B 27	DI14+	Digital input 14
B 28	AI14+	Analog input 14
A 29	S15+	Supply channel 15 (for channels 9...16)
A 30	I15-	Ground channel 15
B 29	DI15+	Digital input 15
B 30	AI15+	Analog input 15
A 31	S16+	Supply channel 16 (for channels 9...16)
A 32	I16-	Ground channel 16
B 31	DI16+	Digital input 16
B 32	AI16+	Analog input 16

Table 16: Pin Assignment of Channels 9...16

Pin assignment of group 3: channels 17..24:

Pin designation	Function, channel	Description
A 33	S17+	Supply channel 17 (for channels 17...24)
A 34	I17-	Ground channel 17
B 33	DI17+	Digital input 17
B 34	AI17+	Analog input 17
A 35	S18+	Supply channel 18 (for channels 17...24)
A 36	I18-	Ground channel 18
B 35	DI18+	Digital input 18
B 36	A18I+	Analog input 18
A 37	S19+	Supply channel 19 (for channels 17...24)
A 38	I19-	Ground channel 19
B 37	DI19+	Digital input 19
B 38	AI19+	Analog input 19
A 39	S20+	Supply channel 20 (for channels 17...24)
A 40	I20-	Ground channel 20
B 39	DI20+	Digital input 20
B 40	AI20+	Analog input 20
Pin designation	Function, channel	Description
A 41	S21+	Supply channel 21 (for channels 17...24)
A 42	I21-	Ground channel 21
B 41	DI21+	Digital input 21
B 42	AI21+	Analog input 21
A 43	S22+	Supply channel 22 (for channels 17...24)
A 44	I22-	Ground channel 22
B 43	DI22+	Digital input 22
B 44	AI22+	Analog input 22
A 45	S23+	Supply channel 23 (for channels 17...24)
A 46	I23-	Ground channel 23
B 45	DI23+	Digital input 23
B 46	AI23+	Analog input 23
A 47	S24+	Supply channel 24 (for channels 17...24)
A 48	I24-	Ground channel 24
B 47	DI24+	Digital input 24
B 48	AI24+	Analog input 24

Table 17: Pin Assignment of Channels 17...24

4.1.5.1 Surges on Digital Inputs

Due to the short cycle time of the HIMatrix systems, a surge pulse as described in EN 61000-4-5 can be read in to the digital inputs as a short-term high level.

The following measures ensure proper operation in environments where surges may occur:

1. Install shielded input wires
2. Activate noise blanking: a signal must be present for at least two cycles before it is evaluated.

i Activating noise blanking increases the response time of the HIMatrix system!

i The measures specified above are not necessary if the plant design precludes surges from occurring within the system.

In particular, the design must include protective measures with respect to overvoltage, lightning, earth grounding and plant wiring in accordance with the relevant standards and the instructions specified in the System Manual (HI 800 141 E or HI 800 191 E).

4.1.6 Mounting the MI 24 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.

Special Conditions X

1. Mount the F60 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 MI 24 01 module is 16 W.
3. The MI 24 01 must be supplied with 24 VDC 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:

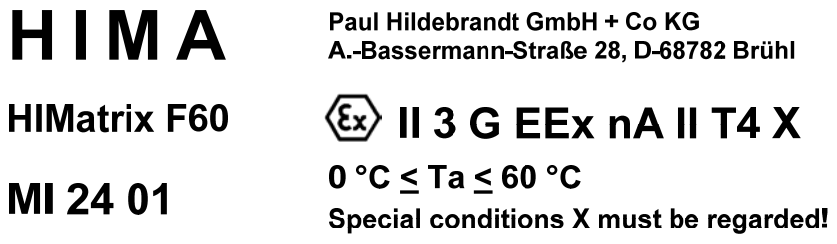


Figure 5: Label for Ex Conditions

4.1.7 Power Dissipation of the MI 24 01

The power dissipation resulting from the measurement checks performed on the MI 24 01 in idle state is:

24 V x 230 mA = 5.5 W (power dissipation in idle state)

The following chapter examines how the power dissipation varies if transmitters or proximity switches are connected.

4.1.7.1 Connecting an Active Transmitter

Based on the specifications for the analog inputs, the following values result:

Maximum current for each channel: 25 mA
Nominal input resistor: 200 Ω

These values lead to a power dissipation on the internal shunt of:

$P_{Vinternal}$ = 0.125 W (shunt power dissipation)

For each channel, the power dissipation with active transmitter is therefore:

$P_V = P_{Vinternal}$ = 0.125 W

4.1.7.2 Connecting a Passive Transmitter

Power provided to the MI 24 module:

24 V x 990 mA = 23.8 W

Electrical power of 24 transmitter supplies:

24 x 26 V x 25.5 mA = 16 W

Power dissipation in idle state: 5.5 W

Therefore, the following power dissipation remains for the 24 transmitter supply channels:

23.8 W – 16 W – 5.5 W = 2.3 W.

Which means that each transmitter supply channel has the following power dissipation:

P_{VT} = 0.1 W (transmitter supply channel)

Additionally, the power converted on the internal shunt is for each channel:

$P_{Vinternal}$ = 0.125 W

The power dissipation if a passive transmitter is connected is therefore:

$P_V = P_{VT} + P_{Vinternal}$ =0.1 W + 0.125 W = 0.225 W

4.1.7.3 Connecting Proximity Switches (Contact Wired with Resistors)

The following specifications apply to a proximity switch (see digital inputs):

Supply voltage: 8.2 V
Nominal input resistor: 674 Ω

Power dissipation for each proximity switch:

P_V = 8.2 V x 8.2 V / 674 Ω = 0.1 W

4.2 Configuration

The MI 24 01 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):

- ELOP II Factory is required for operating system versions prior to 7.
- SILworX is required for operating system version 7 and beyond.

i ELOP II Factory is required to load a new operating system (version 7 or beyond) into a controller with a CPU operating system version prior to 7. SILworX is then required once the loading procedure is completed.

4.2.1 Module Slots

Slots 1 and 2 on the F60 module rack are reserved for the PS 01 power supply module and CPU 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 18: Module Slots

i
- The PS 01 power supply module is not configured.
- CPU and COM are both on the F 60 CPU 01 module. In the programming tools, however, they are represented as separated items.

4.2.2 Line Control

Line control is not possible for the MI 24 01 module, e.g., on EMERGENCY STOP inputs complying with Cat. 4 in accordance with EN 954-1.

However, the digital and analog inputs can be configured for detecting short-circuits or open-circuits as follows:

- Definition of the values for the parameters:
  Limit Value LOW [INT]-> (low limit for a valid low level with a digital signal, upper limit for the under scale range with an analog signal) and
  Limit Value HIGH [INT]-> (upper limit for a valid high level with a digital signal, low limit for the over scale range for an anolog signal).
- Evaluation of the parameters -> *Underflow [BOOL]* (open-circuit) and -> *Overflow [BOOL]* (short-circuit) compared to these limit values performed in the user program.

4.3 Configuring a Module with SILworX

In the Hardware Editor, the F60 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 Inputs and Outputs

The following tables specify the system parameters that can be read and set for the inputs and 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 and Digital 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 **Module** Tab:

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>MI.Error Code</td><td>WORD</td><td>R</td><td>Error codes for all analog inputs
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Module fault</td></tr>
<tr><td>0x0004</td><td>MOT test: time monitoring of conversion</td></tr>
<tr><td>0x0008</td><td>FTT test: Walking bit of data bus faulty</td></tr>
<tr><td>0x0010</td><td>FTT test: Error while checking coefficients</td></tr>
<tr><td>0x0020</td><td>FTT test: Operating voltages faulty</td></tr>
<tr><td>0x0040</td><td>A/D conversion faulty (DRDY_LOW)</td></tr>
<tr><td>0x0080</td><td>MOT test: Cross links of MUX faulty</td></tr>
<tr><td>0x0100</td><td>MOT test: Walking bit of data bus faulty</td></tr>
<tr><td>0x0200</td><td>MOT test: Multiplexer addresses faulty</td></tr>
<tr><td>0x0400</td><td>MOT test: Operating voltages faulty</td></tr>
<tr><td>0x0800</td><td>MOT test: Measuring system (characteristic) faulty (unipolar)</td></tr>
<tr><td>0x1000</td><td>MOT test: Measuring system (final values, zero point) faulty (unipolar)</td></tr>
<tr><td>0x8000</td><td>A/D conversion faulty (DRDY_HIGH)</td></tr>
</table></td></tr>
<tr><td>Module Error Code</td><td>WORD</td><td>R</td><td>Error codes for the module
<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: wrong configuration</td></tr>
<tr><td>0x0020</td><td>No I/O processing: fault rate exceeded</td></tr>
<tr><td>0x0040/ 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: 0xF609 [62985_{dez}]</td></tr>
<tr><td>Transmitter. Error Code</td><td>WORD</td><td>R</td><td>Error codes for the transmitter unit
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Fault in the transmitter supply</td></tr>
<tr><td>0x0400</td><td>FTT test 1: Temperature threshold exceeded</td></tr>
<tr><td>0x0800</td><td>FTT test 2: Temperature threshold exceeded</td></tr>
</table></td></tr>
</table>

System parameter	Data type	R/W	Description
Transmitter[0x].Error Code	BYTE	R	Error codes for each transmitter group Coding: Description 0x01: Module fault of transmitter supply 0x02: Overcurrent of transmitter supply 0x04: Low voltage of transmitter supply. 0x08: Overvoltage of transmitter supply.
Transmitter Voltage[0x]	USINT	W	Switching of the transmitter supply for each group: 1 8.2 V 2 26.0 V

Table 19: SILworX-System Parameters for Analog and Digital Outputs, **Module** Tab

4.3.2.2 **MI 24 01_1: Channels** Tab

The **MI 24 01: Channels** tab contains the following system parameters.

System parameter	Data type	R/W	Description
-> Error Code	BYTE	R	Error codes for the analog input channels Coding: Description 0x01: Fault in the analog input module 0x02: Limit values exceeded (*MI[xx].Overflow*, *MI[xx].Underflow*) 0x04: A/D converter faulty or measured values invalid 0x08: Measured value out of the safety-related accuracy 0x10: Measured value overflow 0x20: Channel not operating 0x40: Address error of both A/D converters 0x80: Configuration of the hysteresis faulty
-> Value [INT]	INT	R	Analog value of the channel [INT] from 0...2000 (0...20 V). The validity depends on *MI[xx].Error Code*
-> Value [BOOL]	BOOL	R	Boolean value of the channels 1...24 in accordance with hysteresis. The validity depends on *MI[xx].Error Code*
Channel Used [BOOL]	BOOL	W	Channel configuration: 1 = operating 0 = not operating
Hysteresis LOW [INT] ->	INT	W	Upper limit for low level of *MI[xx].DI Value*
Hysteresis HIGH [INT] ->	INT	W	Low limit for HIGH level of *MI[xx].DI Value*
Limit Value LOW [INT] ->	INT	W	Use as DI: Low limit for a valid low level Use as AI: Upper limit for an under scale range
Limit Value HIGH [INT] ->	INT	W	Use as DI: Upper limit for a valid high level Use as AI: Low limit for an over scale range
Transmitter Used [BOOL] ->	BOOL	W	MI channel used with transmitter supply: TRUE = used FALSE = not used
-> Underflow [BOOL]	BOOL	R	The value of *MI[xx].AI Value* is less than *MI[xx].Limit Value LOW* The validity depends on *MI[xx].Error Code*
-> Overflow [BOOL]	BOOL	R	The value of *MI[xx].AI Value* is greater than *MI[xx].Limit Value HIGH* The validity depends on *MI[xx].Error Code*

Table 20: SILworX-System Parameters for Analog and Digital Outputs, **MI 24 01_1: Channels** Tab

4.4 Configuring a Module Using ELOP II Factory

4.4.1 Configuring the Inputs and Outputs

The signals previously defined in the Signal Editor (Hardware Management) are assigned to the individual channels (inputs and outputs) using ELOP II Factory. Refer to the System Manual for Compact Systems 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 Inputs and Outputs

The following tables specify the system signals that can be read and set for the inputs and 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 and Digital Inputs

<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: 0xF609 [62985_{dez}]</td></tr>
<tr><td>Mod. Error Code [WORD]</td><td>R</td><td>Error codes for the module
<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: wrong configuration</td></tr>
<tr><td>0x0020</td><td>No I/O processing: fault rate exceeded</td></tr>
<tr><td>0x0040/
0x0080</td><td>No I/O processing: configured module not plugged in</td></tr>
</table></td></tr>
<tr><td>MI.Error Code [WORD]</td><td>R</td><td>Error codes for all analog inputs
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Module fault</td></tr>
<tr><td>0x0004</td><td>MOT test: time monitoring of conversion</td></tr>
<tr><td>0x0008</td><td>FTT test: Walking bit of data bus faulty</td></tr>
<tr><td>0x0010</td><td>FTT test: Error while checking coefficients</td></tr>
<tr><td>0x0020</td><td>FTT test: Operating voltages faulty</td></tr>
<tr><td>0x0040</td><td>A/D conversion faulty (DRDY_LOW)</td></tr>
<tr><td>0x0080</td><td>MOT test: Cross links of MUX faulty</td></tr>
<tr><td>0x0100</td><td>MOT test: Walking bit of data bus faulty</td></tr>
<tr><td>0x0200</td><td>MOT test: Multiplexer addresses faulty</td></tr>
<tr><td>0x0400</td><td>MOT test: Operating voltages faulty</td></tr>
<tr><td>0x0800</td><td>MOT test: Measuring system (characteristic) faulty (unipolar)</td></tr>
<tr><td>0x1000</td><td>MOT test: Measuring system (final values, zero point) faulty (unipolar)</td></tr>
<tr><td>0x8000</td><td>A/D conversion faulty (DRDY_HIGH)</td></tr>
</table></td></tr>
<tr><td>MI[xx].Error Code [BYTE]</td><td>R</td><td>Error codes for the analog input channels
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x01</td><td>Fault in the analog input module</td></tr>
<tr><td>0x02</td><td>Limit values exceeded (MI[xx].Overflow, MI[xx].Underflow)</td></tr>
<tr><td>0x04</td><td>A/D converter faulty or measured values invalid</td></tr>
<tr><td>0x08</td><td>Measured value out of the safety-related accuracy</td></tr>
<tr><td>0x10</td><td>Measured value overflow</td></tr>
<tr><td>0x20</td><td>Channel not operating</td></tr>
<tr><td>0x40</td><td>Address error of both A/D converters</td></tr>
<tr><td>0x80</td><td>Configuration of the hysteresis faulty</td></tr>
</table></td></tr>
<tr><td>MI[xx].AI Value [INT]</td><td>R</td><td>Analog value of the channel [INT] from 0...2000 (0...20 V).
The validity depends on MI[xx].Error Code</td></tr>
<tr><td>MI[xx].Used [BOOL]</td><td>W</td><td>Channel configuration:
1 = operating
0 = not operating</td></tr>
<tr><td>MI[xx].DI Value [BOOL]</td><td>R</td><td>Boolean value of the channels 1...24 in accordance with hysteresis
The validity depends on MI[xx].Error Code</td></tr>
</table>

System Signal	R/W	Description
MI[xx].Hysteresis LOW [INT]	W	Upper limit for low level of *MI[xx].DI Value*
MI[xx].Hysteresis LOW [INT]	W	Low limit for HIGH level of *MI[xx].DI Value*
MI[xx].Transmitter Used [BOOL]	W	MI channel used with transmitter supply: TRUE = used FALSE = not used
Transmitter Voltage[xx] [USINT]	W	Switching of the transmitter supply for each group: 1 8.2 V 2 26.0 V
Transmitter. Error Code [WORD]	R	Error codes for the transmitter unit Coding | Description 0x0001 | Fault in the transmitter supply 0x0400 | FTT test 1: Temperature threshold exceeded 0x0800 | FTT test 2: Temperature threshold exceeded
Transmitter[xx]. Error Code [BYTE]	R	Error codes for each transmitter group Coding | Description 0x01 | Module fault of transmitter supply 0x02 | Overcurrent of transmitter supply 0x04 | Low voltage of transmitter supply. 0x08 | Overvoltage of transmitter supply.
MI[xx].Undeflow [BOOL]	R	The value of *MI[xx].AI Value* is less than *MI[xx].Limit Value LOW* The validity depends on *MI[xx].Error Code*
MI[xx].Overflow [BOOL]	R	The value of *MI[xx].AI Value* is greater than *MI[xx].Limit Value HIGH* The validity depends on *MI[xx].Error Code*
MI[xx].Limit Value LOW [INT]	W	Use as DI: Low limit for a valid low level Use as AI: Upper limit for an under scale range
MI[xx].Limit Value HIGH [INT]	W	Use as DI: Upper limit for a valid high level Use as AI: Low limit for an over scale range

Table 21: ELOP II Factory-Digital and Analog Input System Signals

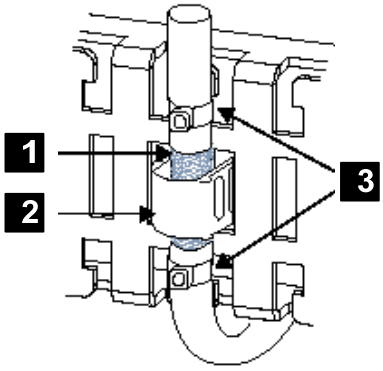
4.5 Connection Variants

In the following examples, external devices are connected to the inputs of the MI 24 01 module. All cables are shielded and the shielding is connected to the F60 earth grid.

4.5.1 Connecting the Shielding to the F60 Earth Grid

The cables are led vertically downwards and secured with 2 cable straps to the earth grid guide.

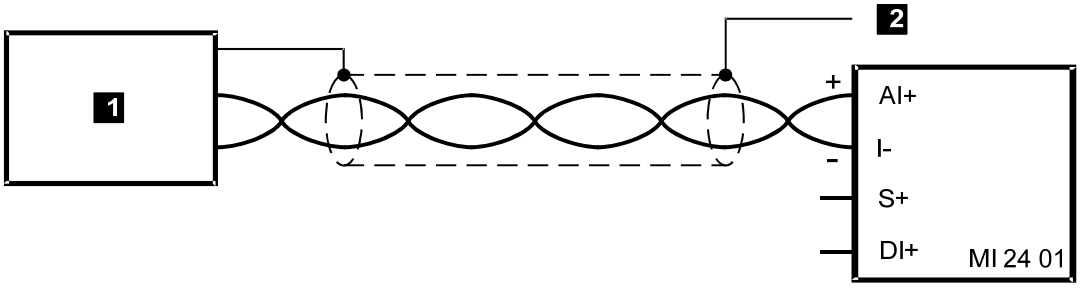
Each cable shielding is connected to the earth grid with a clip. To this end, place the clip over the area of the blank cable shielding and apply pressure to both sides in the earth grid oblong holes until the earth grid snaps into position.



1 Cable Shielding
2 Earth Clamp
3 Cable Straps

Figure 6: Connection of the Shielding to the F60 Earth Grid

4.5.2 Connection Example



1 Current Source
2 F60 Earth Grid

Figure 7: Connection with a current source