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Preparation, Separation,
Filtration & Monitoring Products

Application Note

Controlling the MAS-100 Iso MH® Air Sampler Via Its Digital Inputs and Outputs

Examples of how the sampler can be configured for control via a control box or a PLC with connected HMI

The MAS-100 Iso MH® Multihead Air Sampler is designed principally to be controlled by a computer, typically a laptop on which the C&C software is installed. In controlled environments, however, this is not always practicable—here, it may be preferable to control certain procedures, for example decontamination of the instrument's air flow path and consecutive sampling, without using the computer.

This application note describes two configuration examples that use the digital inputs and outputs of the sampler. The first option, which tends to be better suited for sampling in research, allows control of the instrument via an external control box (**Option 1** in **Figure 1**), while the second option, which is usually preferable in industry settings, allows control via a PLC with a connected HMI (**Option 2** in **Figure 1**). In both cases, it will still be possible to control the sampler via the computer (laptop) when configuration is completed.

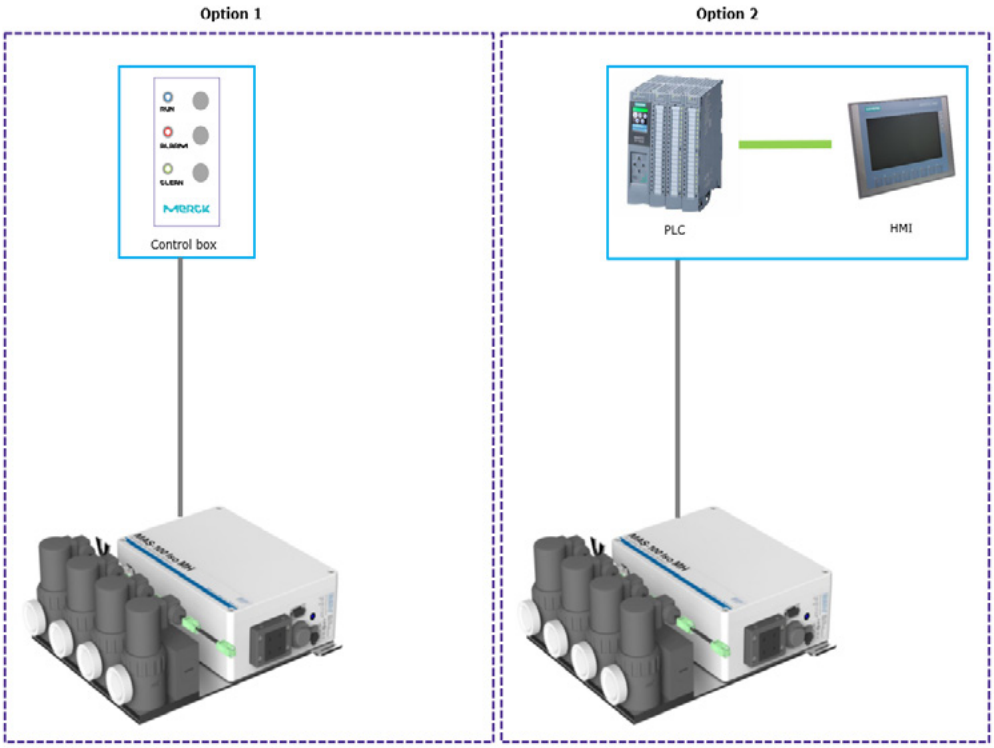

Figure 1: Control of the MAS-100 ISO MH® Air Sampler via control box (left) and via PLC/HMI (right). We do not offer a control box commercially.

Both options require externally supplied additional equipment. Recommendations are given in the respective parts of this application note. Equivalent equipment from different suppliers may also be suitable.

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Note: Hardware configuration should be performed only by personnel that is trained, skilled and experienced at working on electronic equipment.

It is important to be familiar with the functioning of the MAS-100 Iso MH® Sampler by reading the existing documentation.[1] For the PLC/HMI setup with the Siemens hardware as described in Part 4 of this application note, knowledge of and experience with the Siemens SIMATIC TIA Portal are required. The Siemens-specific information mentioned in this documentation may also be interpreted and applied by non-Siemens integrators.[1]

Figure 2 illustrates an automation pyramid. The MAS-100 ISO MH® Air Sampler is at level 0 (Instrumentation) and is connected to level 1 (PLC & HMI) via the PLC or control box.

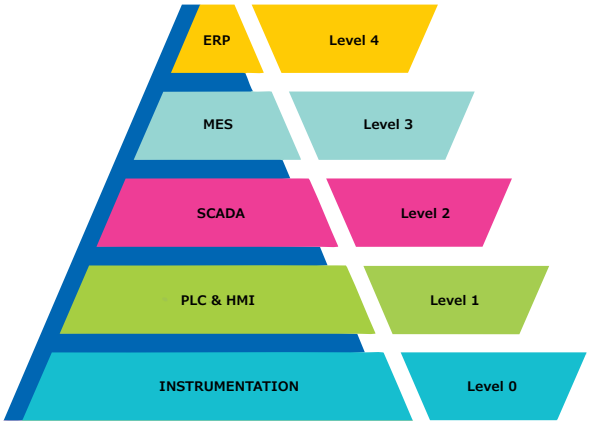


Figure 2: Automation pyramid

For this application note the following test application was highlighted:

- Consecutive sampling, proceeding with sampling from one head to the next. This will be possible not only from the C&C software but also, depending on the option chosen, from either the control box (**Option 1**) or PLC & HMI (**Option 2**).

The procedures are described in four parts:

- For sampler control via control box (**Option 1**), follow the procedures described in Part 1, Part 2 plus Part 3.
- For sampler control via PLC & HMI (**Option 2**), follow the procedures described in Part 1, Part 2 and Part 4.

Part 1 describes how to program the MAS-100 Iso MH® Sampler for remote control using the C&C software. Connecting the MAS-100 Iso MH® Sampler and the necessary wiring are described in **Part 2.** These two parts must be followed, irrespective of whether control by control box or by PLC will be implemented.

- **Part 3** (**Option 1** only) explains how to command and control the MAS-100 Iso MH® Sampler using a simple control box with four buttons.
- **Part 4** (**Option 2** only) suggests how the MAS-100 Iso MH® Sampler can be connected to and controlled by a PLC.

Part 1: Software configuration for consecutive sampling

Here we explain how to configure the MAS-100 Iso MH® instrument for consecutive sampling and run it using the C&C software from MBV.

Note: This procedure was performed on a MAS-100 Iso MH® HW Version 6 Sampler with firmware version 1.2.6 installed, and with the C&C software versions.

- Launch the C&C Software on the computer. You will see the welcome screen (**Figure 3**).

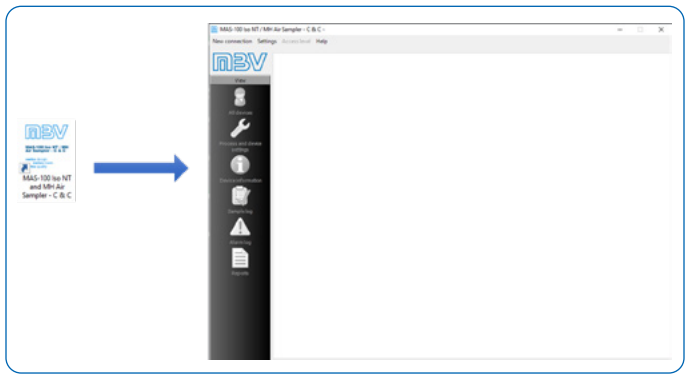


Figure 3: Welcome screen of the C&C software

- Connect the USB cable to the sampler and to the computer (**Figure 4**).

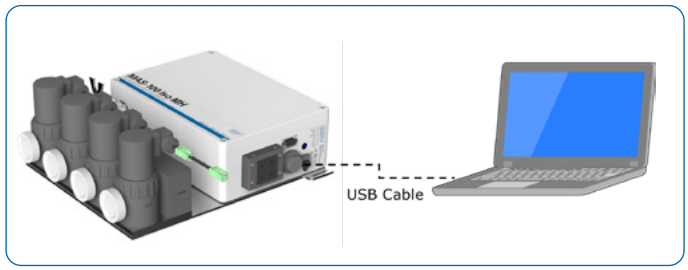


Figure 4: Connecting the MAS-100 Iso MH® Sampler to the computer

- Select your access level (change according to your position) and click “OK” (**Figure 5**).

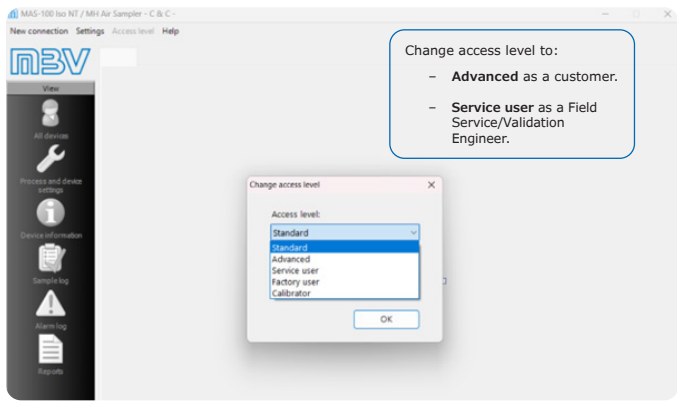


Figure 5: Select access level for the C&C software

- Go to ‘Process and device settings´ (**Figure 6**).

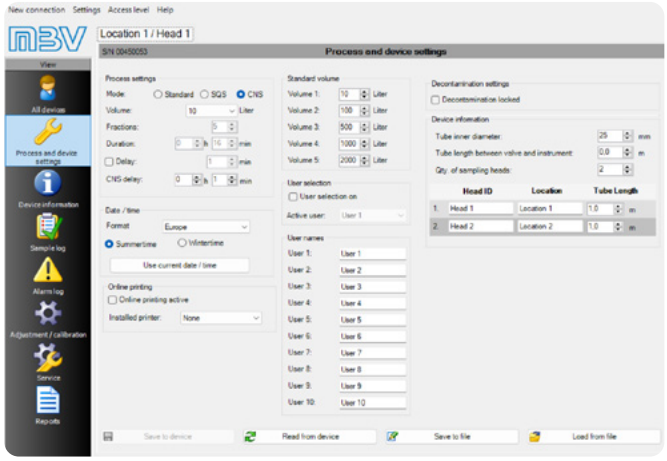


Figure 6: C&C software - Process and device settings

- Enter your process and device settings: In the example in **Figure 7**, two heads are set in CNS mode (consecutive sampling) with 1000 liters of air to be sampled by each head.

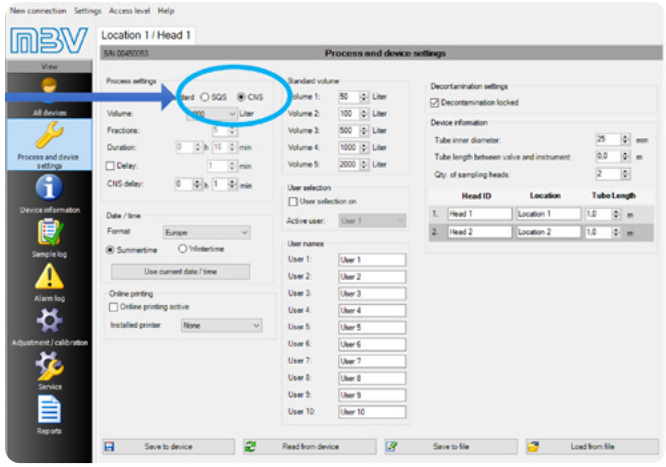


Figure 7: C&C software - CNS mode

- To use the decontamination mode for decontamination to be performed before sampling, uncheck the ´decontamination blocked´ box (**Figure 8**).

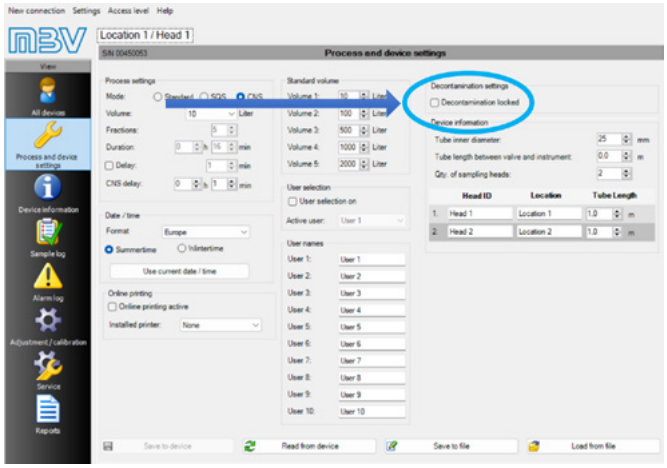


Figure 8: C&C software - Decontamination mode enabled

- Click ´save to device´ at bottom left.

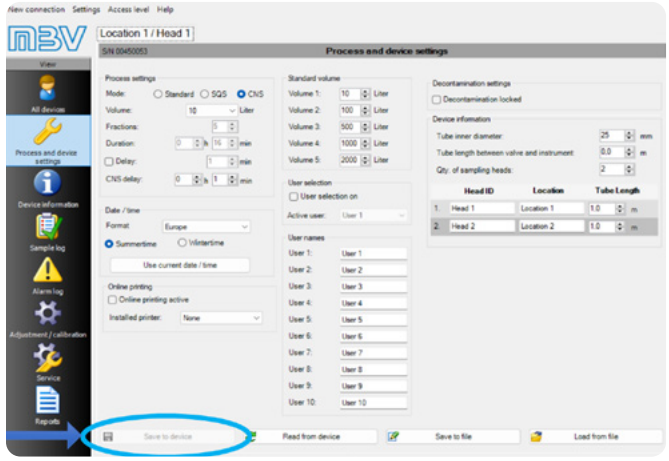


Figure 9: C&C software - Save to device

- The MAS-100 Iso MH® Sampler is now set to the selected parameters. The USB cable can be removed.

Part 2: Wiring the MAS-100 Iso MH® Sampler to connect it to a control box or PLC

This section describes the wiring that must be performed to connect a customer PLC or control box to the MAS-100 Iso MH® Sampler via an M12 cable and three 24 V relays for control and signal monitoring. The relays ensure that the sampler’s digital inputs maintain the same potential and that the sampler is isolated from any external voltage source. The relays are not available from our company. See end of this Part 2 for the required materials and tools.

Note that the wiring explained in this document is only an example. Depending on the required functionality, users may have to wire differently.

The MAS-100 Iso MH® Sampler’s housing must be opened to insert and affix the three relays, for example in the positions shown in **Figure 15**, and to perform the wiring. First remove the dust caps that cover the electrical connectors of the MAS-100 Iso MH® Sampler to prevent the ingress of water and dust. Then open the metallic cover of the sampler to access the various communication ports.

Wiring will be connected to the following sections (boxed red in **Figure 10**):

- X1 – Power
- X2 – Digital outputs

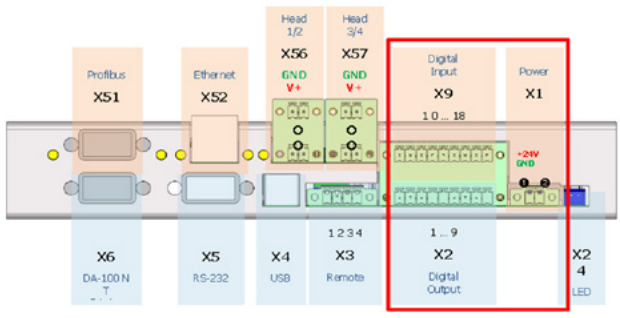


Figure 10: Schematic illustration of the MAS-100 Iso MH® interfaces

Note: Full interface details are available in the file 'MAS-100 Iso MH_UM_Installation_V8.0_en'.

- Schematics (overview)

Affix wiring as shown in Figure 11. The MAS-100 Iso MH® Sampler is connected to a control box or a PLC via an 8-pin M12 cable that connects to the power, to the inputs and—via the three inserted relays—to the outputs of the sampler. The M12 cable goes down to either the control box or the PLC. The wiring colored red and black in Figure 11 is not present in the sampler (see material list **Table 4**).

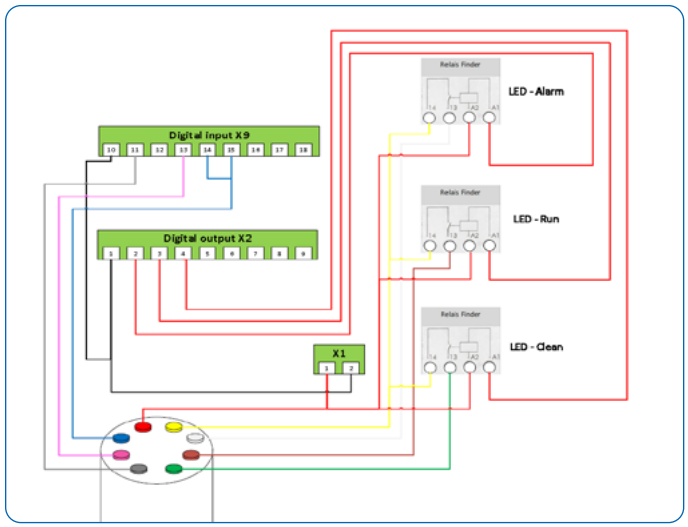


Figure 11: Wiring diagram – Wiring the MAS-100 Iso MH® Sampler and the inserted relays to the M12 cable

Two 8-pin M12 cables (**Figure 12**) are needed: one with a receptacle (female) to connect to the MAS-100 Iso MH® Sampler and one with a plug (male) that will lead to the control box (see Part 3) or the PLC (see Part 4). These two cables are plugged together after their open wiring has been connected to their respective units.

Figure 12: M12 cables to connect to control box or PLC (left) and to the sampler (right), and description of their pins

- Wiring for the MAS-100 Iso MH® Sampler

For details on the wiring of all the digital inputs and outputs, please refer to the MAS-100 Iso MH® Sampler's technical documentation.[1]

(X2) - Digital outputs

The pins used in **Figure 11** are colored blue in **Table 1** and **Table 2.**

Pin No	Channel	Function	Description
1	-	Common ground	-
2	1	Device status	Failure = High Normal operation = Low
3	2	Measurement status	Running = High Stopped Low
4	3	Decontaminiation flow status	Running = High Stopped Low
5	4	State of valve 1.1–1.4	Open = High Closed = Low
6	5	State of valve 2	Sampling: Open = High Closed = Low
7	6	State of valve 2	Decontaminiation: Open = High Closed = Low
8	7	Address bit 0	Bit 1 low or high for valves 1.1/1.2
9	8	Address bit 1	Bit 1 low or high for valves 1.3/1.4

Table 1: MAS-100 Iso MH® Sampler's digital outputs [1: page 41 to page 52]

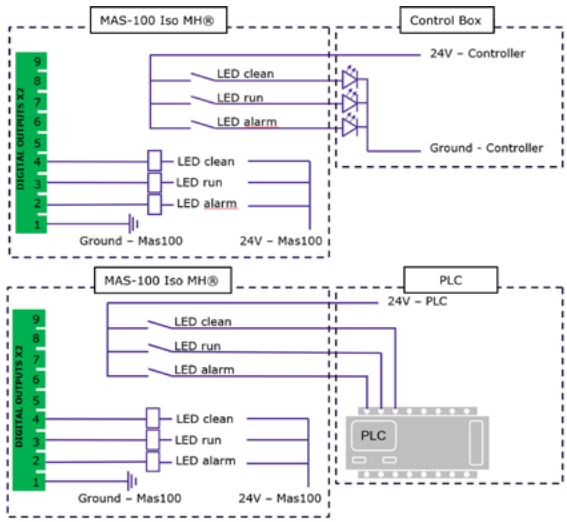


Figure 13: Wiring diagram and function of MAS-100 Iso MH® Sampler's digital outputs (Lower diagram: PLC; Upper diagram: control box)

(X9) - Digital inputs

Pin No	Channel	Function	Description
10	-	Common ground	-
11	1	Start Measurement	Triggered on positive edge
12	2	Abort Measurement	Triggered on positive edge
13	3	Start Decontaminiation flow	Triggered on positive edge
14	4	Abort decontamination flow	Triggered on positive edge
15	5	Alarm acknowledge	Triggered on positive edge
16	6	Reserve	-
17	7	State Bit 0 (MH)	Please read detailed instructions in chapter 7.8.2.3
18	8	State Bit 1 (MH)	Please read detailed instructions in chapter 7.8.2.3

Table 2: MAS-100 Iso MH® Sampler's digital inputs

Figure 14 shows the wiring diagram and function of the MAS-100 Iso MH® Sampler's digital inputs.

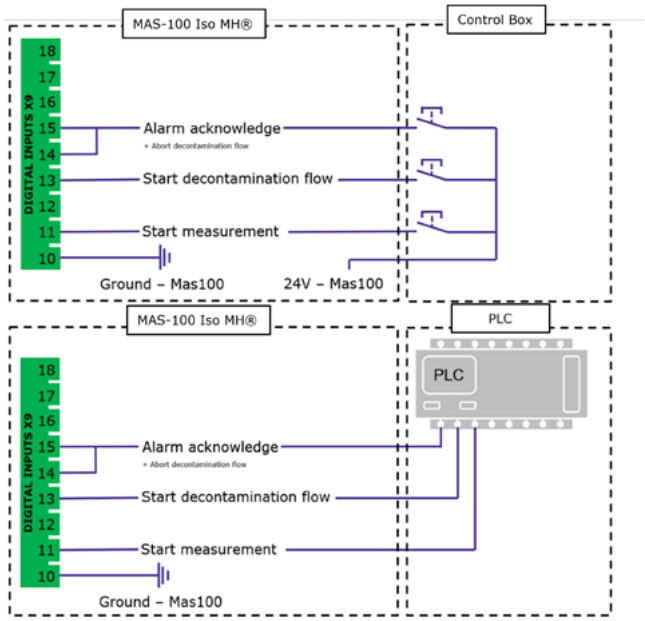


Figure 14: Wiring diagram and function of MAS-100 Iso MH® Sampler's digital inputs (Lower diagram: PLC; Upper diagram: control box)

Figure 15 shows the wiring setup completed within the MAS-100 Iso MH® Sampler.

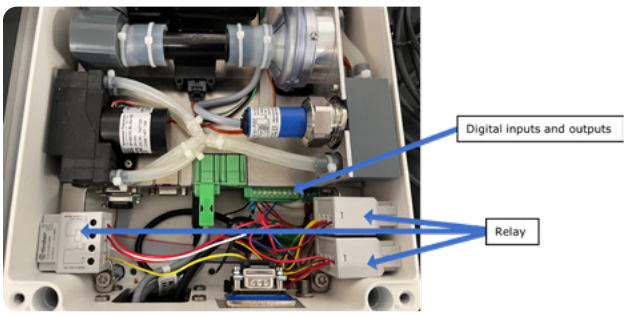


Figure 15: Image of the wiring setup in place within the MAS-100 Iso MH® Sampler.

- Wiring summary

	Pin No	Function	Description
Output	1	Ground	-
	2	Device status	Failure = high, Normal operation = low
	3	Measurement status	Running = high, Stopped = low
	4	Decontamination flow status	Running = high, Stopped = low
Input	10	Ground	-
	11	Start measurement	Triggered on positive edge
	13	Start decontamination flow	Triggered on positive edge
	15	Alarm acknowledge	Triggered on positive edge

Table 3: Wiring summary

The MAS-100 Iso MH® Sampler's incoming and outgoing cables after completion of wiring are shown in **Figure 16**.

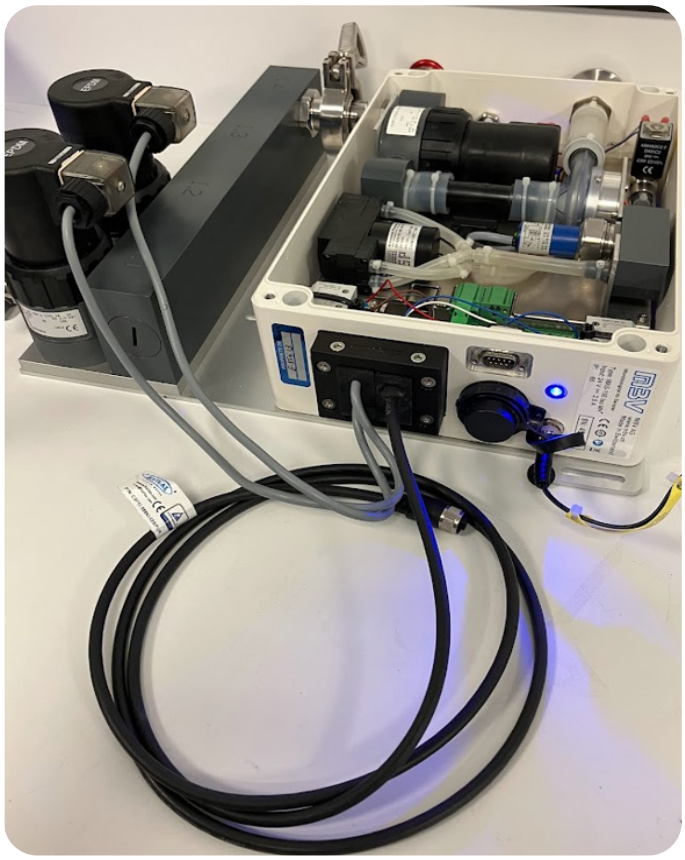


Figure 16: Wiring of incoming and outgoing cables completed on the MAS-100 Iso MH® Sampler

- List of materials

The materials listed in Table 4 are required for the configuration explained in Part 2. They can be purchased from any reliable supplier, for example RS via the website **https://www.rs-online.com.**

Description	Quantity	RS* Reference code
M12 Male Straight Connector to Unterminated 8 Wire 2 m Cable Black PUR	1	**2067639**
M12 Female Straight Connector to Unterminated 8 Wire 2 m Cable Black PUR	1	**2067628**
Finder Switch Box Power Relay, 24 V dc Coil, 12 A Switching Current, SPST	3	**8002792**
MC 1,5/9-STF-3,81 Mini-Combicon, Phoenix Contact.	2	**8028772**
Cable tie	2	**1703873**
Red Cable (see Figure 11)	1	**210-1251**
Black Cable (see Figure 11)	1	**210-1252**

Table 4: Required equipment for Part 2; * available via **https://www.rs-online.com/** (recommended supplier)

Tools needed:

Generic tools for wiring electrical assemblies, for example screw drivers, cutting pliers, crimping pliers, round terminal crimp box including crimp.

Part 3: Control of the sampler via a control box (Option 1)

To demonstrate the feasibility of a set-up option for using a control box with only four buttons to control the sampler, a control box was used that is pre-wired and has two internal AAA batteries. Its purpose is to control the MAS-100 Iso MH® Sampler. We do not offer a control box commercially.

To perform sampling, the control box must be connected to the MAS-100 Iso MH® Sampler by inserting the plug of the control box's M12 cable (**Figure 12**, left) into the receptacle of the sampler's M12 cable (**Figure 12**, right).

- Switch on the control box

Press the button to switch on. The button's LED turns green.

Figure 17: Control box - Button ON

If the green LED does not come on when the button is pressed, open the box (6 rear positioning screws) and change the batteries.

- Start air sampling (push "Run" button)

Press the "Run" button to start air sampling. Once started, the LED turns white.

Figure 18: Control box – White LED indicates air sampling has started

The "Run" LED turns white when air sampling starts. Shutdown will occur automatically when the operation programmed in the MAS-100 Iso MH® Sampler has been completed. There is no way to stop the instrument from the control box.

- Sampler decontamination flow

Press the "Clean" button to start the decontamination flow. Its LED turns green.

Figure 19: Control box – Clean (decontamination) in progress

During the decontamination cycle of the isolator the internal pump of the sampler aspirates the decontamination gas. The time required for decontamination of each sampling head is calculated by the instrument based on the pneumatic parameters of the piping layout.

- Alarm acknowledgement

When the LED turns red and the buzzer sounds, press the "Alarm" button.

Figure 20: Control box - Alarm acknowledgement

In the event of an alarm, for example due to a disturbance of the decontamination gas flow, the "Alarm" LED turns red. To acknowledge the alarm, press the "Alarm" button. Once acknowledged, the indicator light goes out and the audible signal is silenced. It is subsequently possible to restart instrument decontamination.

Part 4: PLC Control (Option 2)

For the setup with the Siemens hardware as described in this part, it is important to be familiar with the Siemens SIMATIC TIA Portal. The Siemens-specific information mentioned in this documentation may also be interpreted and applied by non-Siemens integrators.[1]

To perform sampling this way, the PLC must be connected to the MAS-100 Iso MH® Sampler by inserting the plug of the PLC's M12 cable (**Figure 12**, left) into the receptacle of the sampler's M12 cable (**Figure 12**, right).

In this example of connecting the MAS-100 Iso MH® Sampler to a PLC, a Siemens S7-1500 PLC, KTP700 display and SIMATIC TIA Portal V16 were used.

Materials used in our setup:

- PLC: Siemens S7-1500 CPU1512C-1 PN (Siemens **Cat. No.: 6ES7 512-1CK01-0AB0**)
- Relay output module: S7-1500/ET 200MP DQ 16x230VAC/2A ST Relay (Siemens **Cat. No.: 6ES7522-5HH00-0AB0**)
- HMI: Siemens KTP700 BASIC (Siemens **Cat. No.: 6AV2 123-2GB03-0AX0**)
- Power supply: Siemens PM70W 120/230 VAC (Siemens **Cat. No.: 6EP1332-4BA00**)

• Open and create a new project in Siemens's TIA Portal.

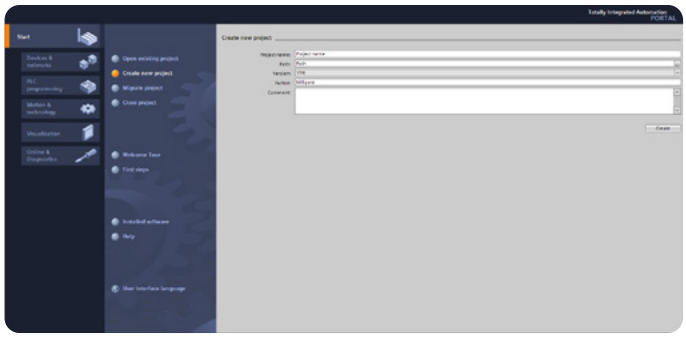


Figure 21: SIMATIC TIA Portal - Start page

• Go to ´Add new device´ and add your PLC and HMI equipment.

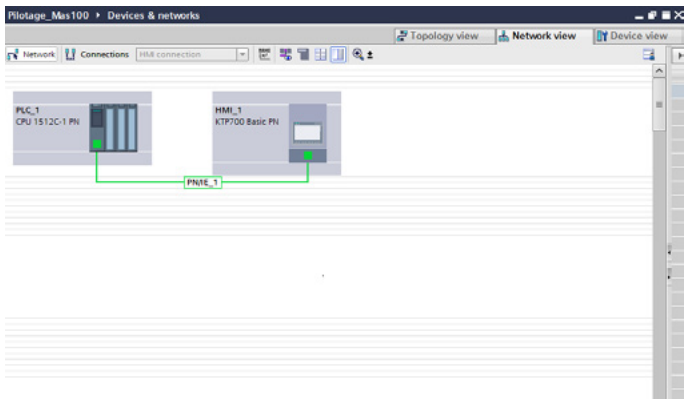


Figure 22: SIMATIC TIA Portal - Devices and networks

Output programming of the PLC:

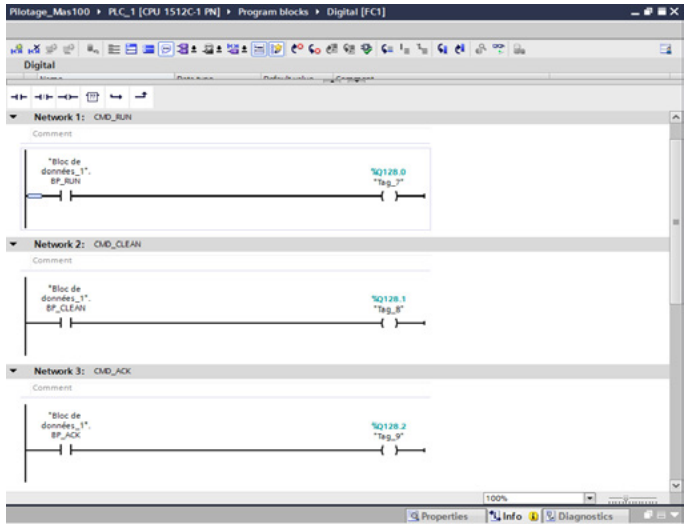


Figure 23: SIMATIC TIA Portal - Actuator program

Input programming:

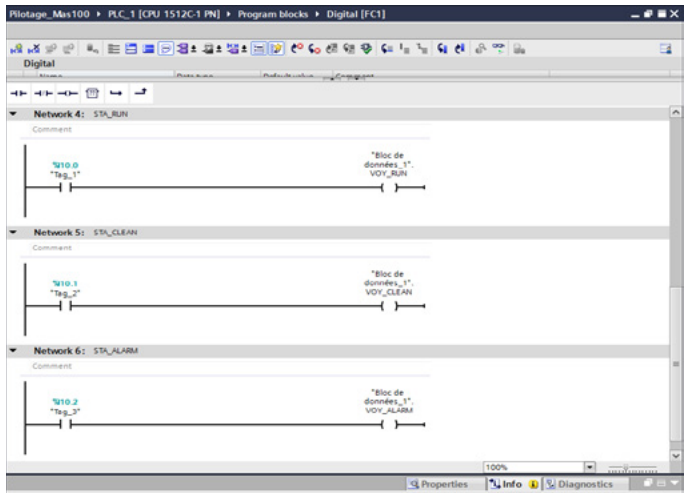
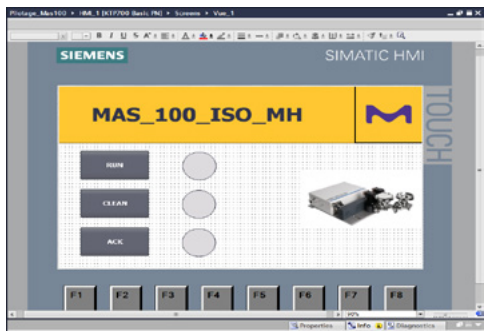


Figure 24: SIMATIC TIA Portal - Status program

The HMI should be programmed to operate the MAS-100 Iso MH® Sampler as a control box (**Figure 25**).



Description:
ACK: Acknowledgement
RUN: Running
CLEAN: Cleaning/decontamination

Figure 25: SIMATIC TIA Portal - HMI programming

PLC installation and wiring to the MAS-100 Iso MH® Sampler

For wiring, refer to the equipment documentation (plc/input/output cards/etc.). In this example, the PLC and the relay card (Siemens relay output module) are used. The LEDs are driven by the PLC inputs, and the MAS-100 Iso MH® Sampler is driven by the relay output module. A relay output card is required to maintain the same common voltage of 24 V. Part (a) CH0/CH1/CH2 (see **Figure 26**) inputs are used for the LEDs.

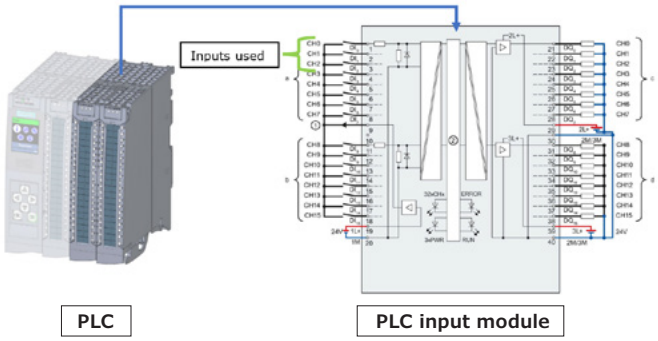


Figure 26: Description of pins used in relay input (left: PLC; right: technical illustration PLC module)

For the LEDs, the CH0/CH1/CH2 relay output section was used.

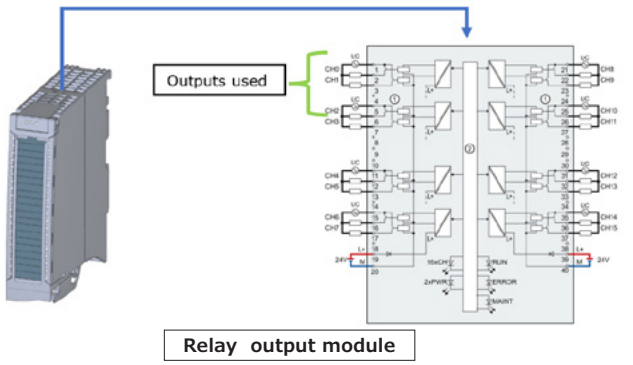


Figure 27: Description of pins used in relay input (left: relay input module, right: technical illustration of the relay module)

Summary

Input module (S7-1500 CPU1512C-1PN I/O X11)

Channel	Apply to
CH0	LED RUN
CH1	LED CLEAN
CH2	LED ALARM

Table 5: Description of input module channels

Output module (S7-1500 CPU1512C-1PN I/O X11)

Channel	Apply to
CH0	RUN COMMAND
CH1	CLEAN COMMAND
CH2	ACKNOWLEDGE ALARMS

Table 6: Description of output module channels

Conclusion

This application note demonstrates the feasibility of connecting the MAS-100 Iso MH® Sampler to a control box or PLC via the sampler's digital inputs and outputs. This connection makes it possible to control the instrument remotely. The two described options exemplify that it is possible to successfully control the sampler for continuous sampling without a computer. Depending on the hardware and software used, customers must adapt the programming and wiring to their needs.

A similar setup is also possible for the MAS-100 Iso NT® Sampler, which has only one sampling head. To adapt the needed connections, it is recommended to refer to the corresponding documentation[2].

Abbreviations

PLC: Programmable logic controller

HMI: Human-machine interface

Simatic TIA PORTAL: A software and tools package developed by Siemens

C&C software: MBV software to configure and run the MAS-100 Iso NT® and MAS-100 Iso MH® Air Samplers

Literature

[1] MAS-100 Iso MH_UM_Installation_V8.0_en.pdf

[2] MAS-100 Iso NT_UM_Installation_V21.0_en.pdf

[3] MAS-100 Iso NT/MH_ V9.0 Communication Manual

[4] MAS-100 Iso NT/MH_ V5.0 Software Manual

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