



SIMA² Master Station
for AUMA actuator controls
MODBUS RTU und MODBUS Loop
with
MODBUS RTU, MODBUS TCP/IP to DCS



Read operation instructions first.

- Observe safety instructions.

Purpose of the document:

This document contains information for the commissioning staff of the host and DCS software engineers. It will provide support for host integration of SIMA2 Master Station via the Modbus interfaces.

Reference documents:

- Operation instructions (assembly and commissioning) on the SIMA2 Master Station

Reference documents can be downloaded from the Internet (www.auma.com) or ordered directly from AUMA (refer to <Addresses>).

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1. Safety instructions

1.1. Basic information on safety

Standards/directives	Our products are designed and manufactured in compliance with recognised standards and directives. This is certified in a Declaration of Incorporation and an EU Declaration of Conformity. The end user or the contractor must ensure that all legal requirements, directives, guidelines, national regulations and recommendations with respect to assembly, electrical connection, commissioning and operation are met at the place of installation. They include among others applicable configuration guidelines for digital communication interfaces.
Safety instructions/warnings	All personnel working with this device must be familiar with the safety and warning instructions in this manual and observe the instructions given. Safety instructions and warning signs on the device must be observed to avoid personal injury or property damage.
Qualification of staff	Assembly, electrical connection, commissioning, operation, and maintenance must be carried out by suitably qualified personnel authorised by the end user or contractor of the plant only. Prior to working on this product, the staff must have thoroughly read and understood these instructions and, furthermore, know and observe officially recognised rules regarding occupational health and safety.
Commissioning	Prior to commissioning, it is important to check that all settings meet the requirements of the application. Incorrect settings might present a danger to the application, e.g. cause damage to the valve or the installation. The manufacturer will not be held liable for any consequential damage. Such risk lies entirely with the user.
Operation	Prerequisites for safe and smooth operation: • Correct transport, proper storage, mounting and installation, as well as careful commissioning. • Only operate the device if it is in perfect condition while observing these instructions. • Immediately report any faults and damage and allow for corrective measures. • Observe recognised rules for occupational health and safety. • Observe national regulations. • The housing heats up during operation. The ventilation slots must not be covered to ensure sufficient air circulation.
Protective measures	The end user or the contractor are responsible for implementing required protective measures on site, such as enclosures, barriers, or personal protective equipment for the staff.
Maintenance	To ensure safe device operation, the maintenance instructions included in this manual must be observed. Any device modification requires prior consent of the manufacturer.

1.2. Range of application

The SIMA² Station is designed for controlling and monitoring AUMA actuators. Availability of fieldbus communication to the actuators can be considerably increased thanks to manifold redundancy options. All these redundancy options are monitored during running operation by SIMA² thanks to efficient troubleshooting mechanisms allowing to introduce countermeasures if required and to automatically switch without delay to alternative communication channels or communication systems. Operation of other field devices or actuators require projecting and must be agreed with AUMA.

Other (software) applications using SIMA² explicit (written) confirmation by the manufacturer.

No liability can be assumed for inappropriate or unintended use.

Observance of these operation instructions is considered as part of the device's designated use.

1.3. Warnings and notes / symbols and text design

Warnings and notes

The following warnings draw special attention to safety-relevant procedures in these operation instructions, each marked by the appropriate signal word (DANGER, WARNING, CAUTION, NOTICE).



Indicates an imminently hazardous situation with a high level of risk. Failure to observe this warning results in death or serious injury.



Indicates a potentially hazardous situation with a medium level of risk. Failure to observe this warning could result in death or serious injury.



Indicates a potentially hazardous situation with a low level of risk. Failure to observe this warning could result in minor or moderate injury. May also be used with property damage.



Potentially hazardous situation. Failure to observe this warning could result in property damage. Is not used for personal injury.

Arrangement and typographic structure of the warnings



Type of hazard and respective source!

Possible consequence(s) in case of non-observance (option)

- Measures to avoid the danger
- Further measure(s)

Safety alert symbol  warns of a potential personal injury hazard.
The signal word (here: DANGER) indicates the level of hazard.

Symbols and further notes in the text

The following references and symbols are used in these instructions:

Information The term **Information** preceding the text indicates important notes and information.

2. Important terms (terminology)

This chapter includes the key designations and the terminology required for the basic understanding of SIMA² installations. All other designations are explained in the respective chapters.

Information	The simplified term SIMA ² is used to refer to the SIMA ² Master Station.
AUMA redundancy	As an alternative to loop redundancy, the fieldbus connection to the actuators can also be designed as line topology. In this case, two separate fieldbus cables are installed in line topology to each actuator and the actuators are configured for AUMA redundancy I.
Auto configuration	Automated procedure during commissioning of loop redundancy whereby the fieldbus addresses are automatically assigned on the basis of the actuator sequence within the loop.
Host	Superordinate automation system. Also referred to as DCS or SCADA.
Hot standby System redundancy	If two SIMA² subsystems are jointly operated, this redundant configuration is designated as hot standby system redundancy. Both SIMA² subsystems can either be located in a joint housing or in two separate housings. In this version, both SIMA² subsystems are identified by SIMA A or SIMA B. Each of these two SIMA² subsystems functions completely independently of the other subsystem, since each system is equipped with an own power supply, an own CPU sub-assembly as well as separate multi-touchscreens. In standard operation, SIMA A always adopts system control while SIMA B is working in standby mode, continuously monitoring the overall system. If SIMA A fails, SIMA B takes over control and thus ensures the complete function including the communication to the actuators and the host.

When selecting the configuration with separate housings, up to four loops are supported. In turn, the configuration with one joint housing only supports one loop.

Figure 1: Hot standby system redundancy in separate housings (example)

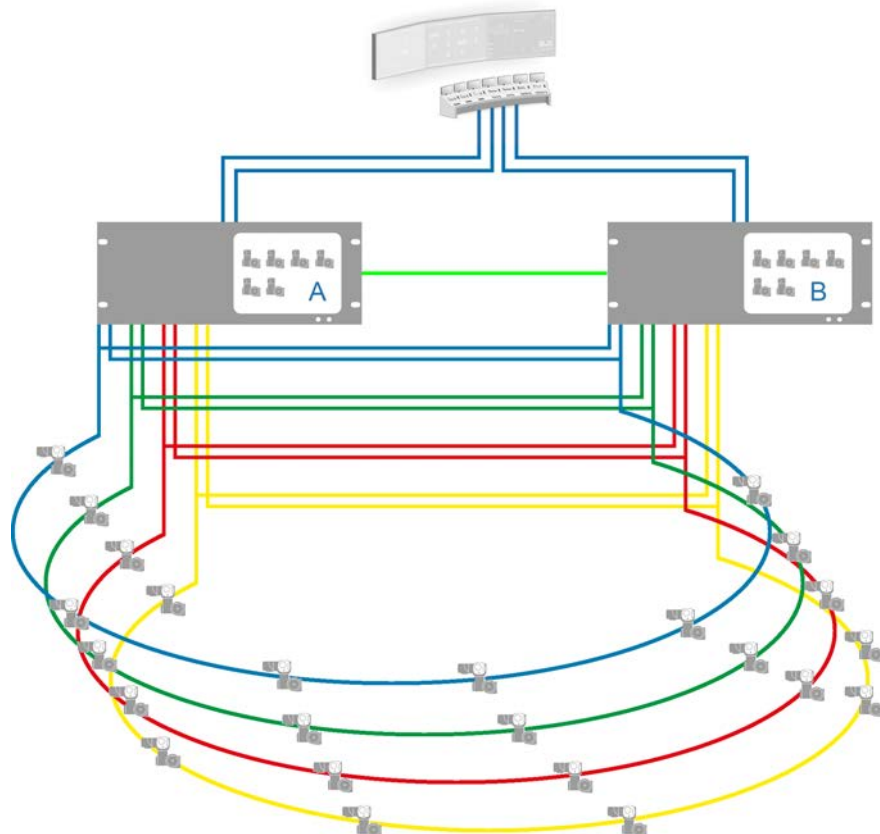
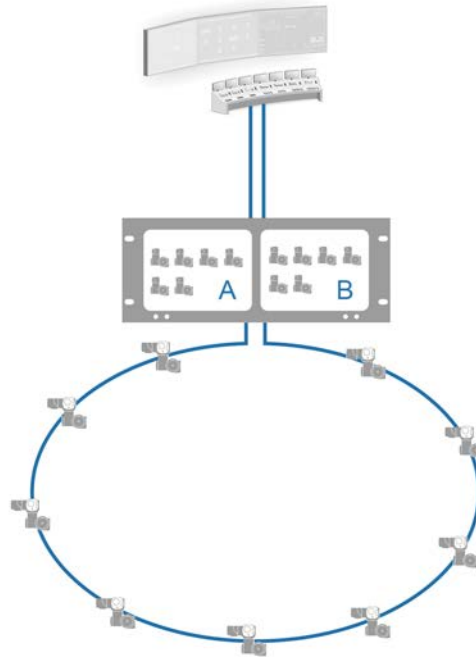


Figure 2: Hot standby system redundancy in a joint housing (example)



Live list The live list contains the slave addresses of all field devices available on the Modbus network.

Network Physical arrangement of actuators connected to SIMA² (line topology or loop topology). Combined with Modbus RTU, up to 247 actuators are supported for each SIMA² network.

Loop redundancy A fieldbus is routed from the SIMA² to the first actuator and then to the next actuator until reaching the last actuator and back to SIMA², thus arranged in loop configuration. In case of interruption or short-circuit within the loop system, communication to the actuators is maintained.

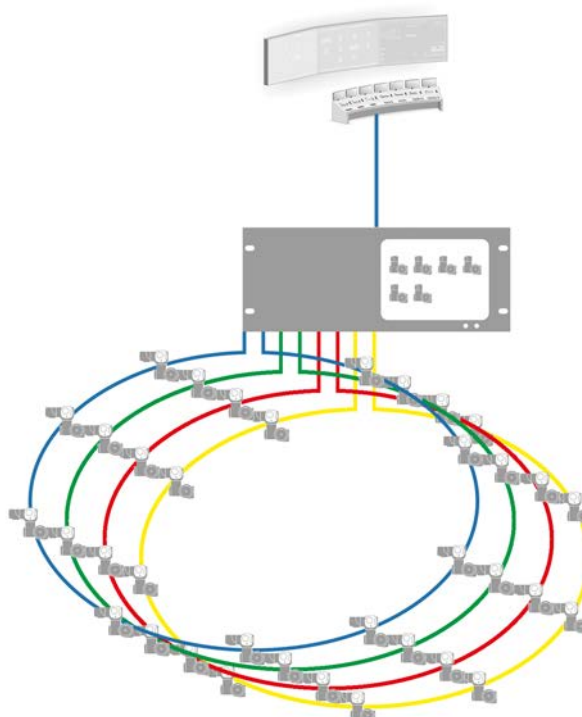
SIMA² Master Station The SIMA² Master Station communicates to the field actuators using a standardised fieldbus protocol. This protocol is used by SIMA² to transmit the respective operation commands to the connected actuators. In turn, they send their respective status signals to the SIMA² at cyclic intervals. Both actuator signals and diagnostic information of SIMA² and the used communication interfaces are visualised by means of an integrated web server and the multi-touchscreen at SIMA².

Generally, SIMA² communicates via a standardised communication protocol with a host receiving all essential status signals and issuing the operation commands to SIMA² for transmission to the individual actuators. Both, communication to actuators and communication to the host can be arranged in redundant topology. In addition, the SIMA² Master Station as such can be arranged in redundant topology.

SIMA² Master Station offers easy, fast and detailed diagnostics of all connected actuators, the interfaces as well as self-diagnostics. It further allows data concentration of actuator feedback signals to relieve the host, a stand-alone mode as well as protocol conversion and manages all redundancy properties.

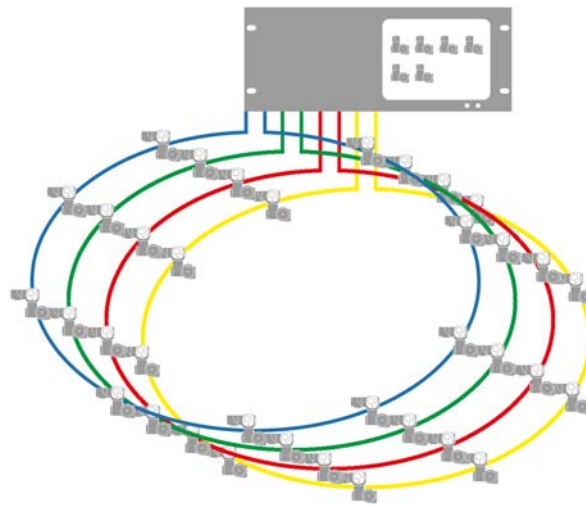
Depending on the configuration, SIMA² Master Station is composed of one or two SIMA² subsystems. Up to 4 networks are possible for each SIMA².

Figure 3: Single Master Station



SIMA² subsystem	Typically, a SIMA ² subsystem consists of a power supply unit, a multi-touchscreen, CPU sub-assembly and the interfaces required for communication to the actuators and to the host. For hot standby system redundancy, two separate SIMA ² subsystems are used. The version without hot standby system redundancy only consists of one SIMA ² subsystem and is also named single master station.
SIMA A / SIMA B	SIMA A or SIMA B is a clear designation of both physical SIMA ² subsystems when SIMA ² is arranged in hot standby system redundancy.
Single Master Station	SIMA ² in non-redundant version with only one SIMA ² subsystem for fieldbus communication. For a Single Master Station, the multi-touchscreen is always located on the right housing side.
Stand-alone mode	In sites without superordinate automation system (host), SIMA ² is deployed in the so-called stand-alone mode. Operation commands for the actuators are specified manually by the user either via the multi-touchscreen or via the integral web server. Status or diagnostic signals of actuators are visually monitored by the user.

Figure 4: Stand-alone mode (example)



Cycle time Time required for requesting feedback signals from all actuators connected via Modbus RTU.

3. General information about Modbus

For exchange of information among automation systems and the connected decentralised field devices, using digital communication systems such as Industrial Ethernet or serial fieldbus systems is state-of-the-art. Thousands of applications have proved impressively that, in comparison with conventional technology, cost savings of up to 40 % in wiring, commissioning, and maintenance are achieved by using fieldbus technology. While in the past, the protocols used were often manufacturer specific and incompatible with other fieldbus systems, the systems implemented today are exclusively open and standardized. This means that the user does not depend on individual suppliers and can choose within a large product range the most suitable product at the most competitive price.

Modbus is an open fieldbus system used successfully throughout the world. The first Modbus solution was initiated as early as 1979. Since then, Modbus has developed into a real standard. Meanwhile, Modbus has also been standardised by the IEC 61158 and IEC 61784 fieldbus standards. This standardization ensures that the investments by manufacturers and users are protected to the best possible degree and the user no longer depends on one manufacturer. The application range includes automation in the areas of manufacturing, processing, and building.

3.1. Basic characteristics

	Modbus defines the technical and functional features of a communication system used for interconnecting distributed digital automation devices. Modbus distinguishes between master and slave devices.
Master devices	Master devices control data traffic on the bus. A master is allowed to send messages without an external request. Masters are also called "active devices" in the Modbus protocol.
Slave device	Slave devices such as AUMA Modbus actuators or the SIMA ² are peripheral devices. They do not have bus access rights, i.e. they may only acknowledge received messages or, at the request of a master, transmit messages to that master. Slaves are also called "passive devices".

3.2. Modbus basic functions

Modbus uses a master-slave technique where only the master can initiate a transaction. The slaves respond by supplying the requested data in a response to the master or by executing the action requested in the query.

The Modbus telegram from the master contains the slave address, a function code defining the requested action, a data field, and a CRC field. The Modbus slaves' response message contains fields confirming the requested action and possibly the requested data as well as a CRC field.

If an error occurs during reception of the telegram or if the slave is unable to perform the requested action, the slave will generate an error telegram and send it as response to the master.

Modbus TCP/IP is based on the client-server model. The Modbus data telegram described above is completed with additional information (MBAP header) and embedded into an Ethernet frame without CRC field.

3.3. Communication technology

- **Modbus RTU:**
 - RS-485 twisted wire pair
 - Baud rate: 9.6 kbit/s – 115.2 kbit/s
- **Modbus TCP/IP:**
 - Ethernet IEC IEEE 802.3
 - 10/100/1000 Base-Tx (automatic baud rate recognition)

3.4. Access mode

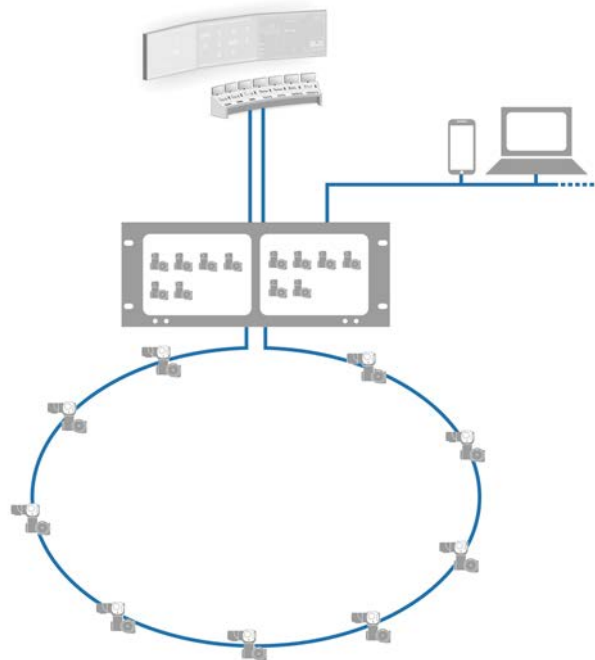
- **Modus RTU:**
 - Master-slave data exchange via request-response cycle (polling procedure).
 - Mono-master system
- **Modbus TCP/IP:**
 - Client-server model with request-response cycle

4. SIMA² communication interfaces

4.1. Overview

SIMA² communicates with the connected actuators by means of a standardised fieldbus protocol. SIMA² communicates with the connected actuators by means of a standardised fieldbus protocol. These interfaces are described in the following.

Figure 5: SIMA² system overview (example)



4.2. Modbus interface to actuators

Modbus allows slave addresses 1 – 247. Address “0” is used for a broadcast signal (applicable for all connected actuators).

To increase system availability, SIMA² supports the redundancy concepts AUMA Redundancy I (redundant line topology) and loop redundancy. Two Modbus interfaces are available in both cases.

The physical interface is based on a two-wire cable in compliance with the RS-485 standard.

The time required to read the necessary information from all connected actuators depends on the previously selected baud rate, the requested information and the number of actuators. The subsequent table comprises typical cycle times for requesting the valve position and important actuator status information.

The basic properties of the Modbus RTU communication to the actuators can be set at the SIMA². The following options are available:

Baud rate:	115,2 kbit/s, 57,6 kbit/s, 38,4 kbit/s, 19,2 kbit/s or 9,6 kbit/s
Parity	Even, odd or none
Number of stop bits:	1 or 2

Default setting:

Baud rate: 115.2 kbit/s
 Parity Even
 Number of stop bits: 1

Table 1: Typical cycle times

Typical cycle times (approx.) [ms]			
Baud rate [kbit/s]	Number of actuators		
	20	40	60
115.2	300	600	900
57.6	400	800	1,200
38.4	500	1,000	1,500
19.2	700	1,400	2,000
9.6	1,100	2,200	3,300

Table 2: Transmission time

Baud rate [kbit/s]	Transmission time for one actuator [ms]
115.2	15
57.6	20
38.4	25
19.2	35
9.6	55

It is recommended to preserve the default settings since an optimum communication performance is achieved without reducing the cable length. For individual cases, the settings can be adjusted.

Information

Ensure that each Modbus address is assigned only once to the actuators and that baud rate and parity between actuators and Master Station are identical.

With the subsequent further **Connection settings**, it is possible to additionally adapt the Modbus RTU communication to the actuators:

Connection monitoring

Each actuator must respond within this time with valid Modbus RTU telegrams to the Modbus RTU requests of SIMA² to ensure that communication is not signalled as faulty.

Default setting: 5,000 ms

HSA (Highest Station Address)

HSA corresponds to the highest slave address to which SIMA² sends Modbus RTU telegram requests (all field devices with higher slave addresses will not be addressed by SIMA²). For optimum performance, the HSA value should be selected to correspond to the highest Modbus RTU slave address available within the network.

Default setting: HSA = 50

Retries

The number of retries defines the maximum number of faulty telegrams which can be tolerated by SIMA² prior to signalling a Modbus communication loss of a participant.

Default setting: Retries = 3

Maximum cycle time

The maximum cycle time defines the maximum time between two Modbus telegrams to a Modbus participant. This time is considered as soon as the Modbus tunneling is enabled (Enable Modbus tunneling = active) while the Modbus tunnel progressive mode is disabled simultaneously (Modbus tunnel progressive mode = inactive).

Default setting: Maximum cycle time = 5,000 ms

Advanced settings The subsequent further configuration parameters are available in **Advanced settings**:

Dead band position feedback signal

This setting allows stabilisation of the position feedback signal displayed within the HMI (Human Machine Interface) and transmitted to the host by updating the value if it is higher than the selected dead band.

Default setting: Dead band position feedback signal = 0 %

Enable Modbus tunneling

Enabled tunnelling allows acyclic access to the parameters, the diagnostic and maintenance data of actuators with AUMA AC 01.2 actuator controls by means of the AUMA CDT software (Commissioning and Diagnostic Tool in the latest version) which is communicating via an Ethernet connection with SIMA².

Default setting: Enable Modbus tunneling = inactive

Modbus tunnel progressive mode

If this mode is enabled, the Modbus tunnel requests are transmitted immediately after receipt to the actuators. If the mode is disabled, transmission is performed following the cyclic data request while considering the selected setting for the maximum cycle time.

Default setting: Modbus tunnel progressive mode = inactive

Using the optimised Modbus protocol

When optimising is enabled, the operation commands are transmitted with each Modbus request and the feedback signals with the Modbus response. Thus, the interjection of the operation commands within the running cycle for requesting the feedback signals become obsolete. The cycle time remains constant in spite of receiving new operation commands and communication efficiency is increased.

Information This setting may only be enabled, if all connected participants support this optimisation (requires AUMA AC .2 actuator controls with firmware version ≥ 05.07.00)

Default setting: Using the optimised Modbus protocol = inactive

Time synchronisation

If time synchronisation is enabled, the clock information of SIMA² is periodically (1 min) transmitted to the connected actuators.

Information This setting may only be enabled, if all connected participants support the time synchronisation.

Default setting: Time synchronisation = inactive

Interface settings includes the subsequent further parameters:

Fieldbus type

This parameter defines the network fieldbus protocol. The following settings are available:

None, Modbus or Profibus

The settings must match the communication interface supported by SIMA² and the actuator.

Default setting: Fieldbus type = Modbus

Redundancy

This is used to configure the type of the redundant fieldbus communication. The following settings are available:

- No redundancy (single line)
For single channel (non-redundant) communication to the actuators.
- Full line redundancy
For a redundant communication to the actuators with time and logic separation of both communication channels

- Cable redundancy TX1
Redundant communication to the actuators. One channel is passive and only used if a fault has been detected on the active channel.
- Cable redundancy TX2
Redundant communication to the actuators. Both channels are used to send chronologically synchronised data telegrams.
- Loop redundancy
Redundant communication to the actuators via Modbus RTU using a loop-type network structure.

The setting must be selected in compliance with the redundancy configuration as supported by the actuators.

Default setting: Redundancy = Loop redundancy

Connection port A / B

This setting is used to set the SIMA² communication connecting port.

Default setting: Connection port A / B in accordance with the indications on the wiring diagram

Additional timeout delay

An additional timeout delay may be set with this parameter. This can be useful in applications for which the default timeout period is not sufficient while waiting for a response by the field devices. The additional timeout delay is added to the default timeout period.

Default setting: Additional timeout delay = 0 ms

4.3. Modbus interface to the host

Communication to the subordinate host is made via the Modbus protocol.

To increase system availability, SIMA² also supports redundant communication to the DCS. Two Modbus interfaces are available in this case. Both channels can be used for communication irrespective of each other.

When using Modbus RTU, the physical interface is based on a two-wire cable in compliance with RS-485 standard, when using Modbus TCP/IP, it is based on Ethernet.

Connection monitoring

Both, connection via Modbus RTU and via Modbus TCP/IP is monitored for available Modbus communication. If no valid Modbus telegram has been received by the host within the monitoring time selected via connection monitoring parameter, the host connection is represented as inactive within HMI of SIMA² (= grey). For active Modbus communication to the host, the connection within HMI is represented in green.

Setting range of connection monitoring parameter: 1,000 – 1,800,000 ms (30 min).

Default setting: Connection monitoring = 1,000 ms

Specialities for Modbus RTU communication

A two-wire cable according to RS-485 standard has been used for communication via Modbus RTU. SIMA² slave address, baud rate and the Modbus data format can be set at the SIMA².

Available settings:

Slave address	1 – 247
Baud rate:	115.2 kbit/s, 57.6 kbit/s, 38.4 kbit/s, 19.2 kbit/s or 9.6 kbit/s
Parity	Even, odd or none
Number of stop bits:	1 or 2

Default setting:

Baud rate: 115.2 kbit/s
Parity Even
Number of stop bits: 1

When dealing with only one network of SIMA², addressing is made via the slave address provided here. All other possibly available networks (SIMA² supports up to 4 networks) are addressed in compliance with the following rules:

Table 3: Addressing of Modbus RTU

Information addressing of SIMA ² of each of the up to 4 networks is made via a specific Modbus RTU slave address:
Network 1: Slave address
Network 2: Slave address +1
Network 3: Slave address +2
Network 4: Slave address +3

When using Modbus RTU to the host, the subsequent additional Modbus diagnostic functions are supported.

Table 4: Modbus RTU diagnostic functions

Function	Function code (decimal)	Description
Diagnostic	08	Reads diagnostic data. • 00 00 Loopback • 00 10 (0AHex) Clear Counters and Diagnostic Register • 00 11 (0BHex) Return Bus Message Count • 00 12 (0CHex) Return Bus Communication Error Count • 00 13 (0DHex) Return Bus Exception Error Count • 00 14 (0EHex) Return Slave Message Count • 00 15 (0FHex) Return Slave No Response Count • 00 16 (10hex) Return Slave NAK Count • 00 17 (11hex) Return Slave Busy Count • 00 18 (12hex) Return Character Overrun Count

For redundancy, the following applies:

The same settings (slave address, baud rate, parity and number of stop bits) are applicable for both channels.

Particularities for Modbus TCP/IP communication

Connection is made via Ethernet cable (minimum Cat.5) in compliance with RJ-45 standard (TIA-568A/B). Transmission rates of 10/100/1,000 Mbit/s are supported (automatic detection).

IP address and subnet mask can be set at the SIMA². Factory setting for the TCP port in Modbus communication is 502 and the Modbus TCP Unit ID is set to 1. Both parameters can be adapted according to the host requirements.

If only one SIMA² network is available, the addressing is made via the set port and the Unit ID. All other possibly available networks (SIMA² supports up to 4 networks) are addressed in compliance with the following rules:

Table 5: Addressing for Modbus TCP/IP

SIMA ² information addressing from any of the up to 4 networks is made via a specific TCP port in combination with a specific Unit ID (basic factory setting: Port = 502, Unit ID = 1)
Network 1: TCP port with Unit ID
Network 2: TCP port +1 with Unit ID, alternatively: TCP port with Unit ID +1
Network 3: TCP port +2 with Unit ID, alternatively TCP port with Unit ID +2
Network 4: TCP port +3 with Unit ID, alternatively TCP port with Unit ID +3

Timeout Modbus TCP/IP

SIMA² simultaneously supports up to 5 active connections for each TCP port. Each of these connections are monitored for activity using the "Timeout Modbus TCP/IP". Once the timeout has elapsed, e.g. based on missing or failing TCP communication, the TCP connection is aborted and thus, the port is available for a new connection.



One connection is required for the multi-touchscreen. Consequently, four remaining connections are available for system integration.

Setting range of Timeout Modbus TCP/IP parameter: 1,000 – 1,800,000 ms (30 min)

Default setting: Timeout Modbus TCP/P = 30,000 ms

4.3.1. Overview on Modbus protocol content

To commission a Modbus slave, typically no special master configuration via configuration file is required.

The Modbus data transfer is based on an application protocol comprising essentially a function code with offset address and user data.

Table 6: Supported Modbus function for communication between SIMA² and host

Modbus function	Function code (decimal)	Description
Write Single Coil	05	Sets an individual bit to 1 or 0. In case of broadcasting, this applies to all connected slaves.
Write Multiple Coils	15	Sets several subsequent bits to 1 or 0. In case of broadcasting, this applies to all connected slaves.
Read Coil Status	01	Reads the status of individual output bit information of SIMA ² . Broadcasting is not supported.
Write Single Register	06	Writes data to an individual Holding Register (16 bit). In case of broadcasting, this applies to all connected slaves.
Write Multiple Registers	16	Writes data into consecutive Holding Registers. In case of broadcasting, this applies to all connected slaves.
Read Input Registers	04	Reads the content of Input Data Registers (16 bit) from SIMA ² . Broadcasting is not supported.
Read Holding Registers	03	Reads the contents of the Holding Registers (15 bit) from SIMA ² . Broadcasting is not supported.
Read Input Status	02	Reads the content of Input Status bits (1 bit) from SIMA ² . Broadcasting is not supported.

Configurable offsets of Modbus functions

The Modbus offset addresses for the Modbus functions can be configured for each of the four subsequently represented Modbus function groups. Thus, the Modbus mapping can be shifted in compliance with the host requirements within the Modbus address space. (Start address = 0).

Default setting:

Offset Input Register = 0

Offset Discrete Inputs = 0

Offset Holding Register = 0

Offset Coils = 0

All indications contained in this manual in combination with Modbus offset addresses are based on this default setting.

Table 7: Valid address offsets for the Modbus communication between SIMA² and host

Modbus function	Permissible offset addresses (hexadecimal)	Permissible offset addresses (decimal)	Remark
Write Single Coil (05) Write Multiple Coils (15) Read Coil Status (01)	0x0000 – 0x07B7 0x0BB8 – 0x1B4B	0 – 1975 3000 – 6987	Writing and reading coils (discrete outputs for control of the actuators connected to the SIMA ² . Reading the status of discrete feedback signals of SIMA ² ¹⁾
Write Single Register (06) Write Multiple Registers (16) Read Holding Registers (03)	0x0000 – 0x0208 0x0BB8 – 0x195D	0 – 520 3000 – 6493	Writing and reading Holding Registers which control the function of SIMA ² and connected actuators. Reading the status information of SIMA ² and connected actuators ²⁾
Read Input Status (02)	0x0000 – 0x0F93	0 – 3987	Reading the status of discrete feedback signals of SIMA ² and the connected actuators.
Read Input Register (04)	0x0000 – 0x0DA5	0 – 3493	Reading the status information of SIMA ² and connected actuators.

- 1) Copy of data from Read Input Status (02) if this function was activated using the parameter **Map input data to output address range**.
- 2) Copy of data from Read Input Register (04) if the function was activated using the parameter **Map input data into the output address range**.

SIMA² protocol format

Besides the start addresses, basic arrangement of data content can be configured within the Modbus mapping. The following settings can be selected:

Version 0:

This setting is used as soon as SIMA² is to be connected to host systems, which has been configured for the previous version of SIMA Master Station in combination with Simasoft version < 2.xx. For further details regarding the layout of data content while using the SIMA protocol format version 0, please contact AUMA.

Version 1:

Basic setting: All indications included in this manual are based on this setting.

Version 2:

Provided for future extensions.

Default setting: SIMA protocol format = version 1

Advanced settings

The subsequent further configuration parameters are available in **Advanced settings**:

Use auto reset coils

As soon as the “Auto Reset Coils” function has been activated, SIMA² resets all other possibly still active OPEN, CLOSE or STOP commands upon receipt of a “Write Single Coil” telegram with OPEN, CLOSE, STOP or ESD command.

Information

It is not possible to reset the ESD command by another command. The RESET command is automatically reset after receipt and processing.

Default setting: Use auto reset coils = active

Map input data into the output address range

This parameter allows copying the data accessible via Modbus functions 02 and 04 into the address range of Modbus function 01 or 03. Consequently, using the Modbus function 02 and 04 is not required.

Default setting: Map input data into the output address range = inactive

Passive SIMA responds to host commands with Exception

This parameter determines the response behaviour of the passive SIMA when using a Modbus TCP/IP communication to the host. In case the “Passive SIMA responds to host commands with Exception” parameter is activated, the passive SIMA answers the received Modbus requests with exception 01. When deactivating the parameter, the received Modbus requests are not answered.

Default setting: Passive SIMA responds to host commands with Exception = inactive.

Adding No communication to Fault

When activating the “Adding No communication to Fault” parameter, the “fault” signal is set for a fault signal issued by the actuator or a communication loss to the actuator. If this function is deactivated, the “Fault” signal is only set if the actuator issues a fault signal.

Default setting: Adding No communication to Fault = inactive

4.3.2. Host (output) commands to SIMA² (via Holding Register)

Table 8:

Modbus function	Function code (decimal)	Offset address	Data content
Write Single Register	06	0	Output command actuator 1, part 1
Write Multiple Register	16	1	Output command actuator 1, part 2
Read Holding Register	03	2	Output command actuator 2, part 1
		3	Output command actuator 2, part 2
		(<Addr>-1)*2	Output command actuator <Addr>, part 1
		(<Addr>-1)*2 + 1	Output command actuator <Addr>, part 2
		492	Output command actuator 247, part 1
		493	Output command actuator 247, part 2
		520	Output command SIMA ² part1
		3000 – 6493	As soon as the setting “Map input data into the output address range” is activated, an identical copy of the available feedback signals via Read Input Register (function code = 04) is available within this address range.

Information SIMA² supports up to 247 actuators. All actuator addresses are within the range of 1 – 247.

Since generally the actuator addresses are assigned in ascending order (without gaps), all output commands of all actuators are available in a consistent block within the Modbus memory of SIMA². This simplifies communication between host and SIMA² if the “Write Multiple Registers” function is used and increases the efficiency of Modbus communication when accessing the data.

Integration of third party devices via Modbus RTU into SIMA² is supported as soon as the “Activate third party device integration” parameter is activated: (default setting: Third party device integration = inactive). The formal communication description to third party devices is explicitly defined in the SIMA² configuration file. For this, the control signals of the third party device is integrated into the mapping of the “Write Single/Multiple Register” (function code = 06/16) or “Read Holding Register” (function code = 03).

For details on integration of third party devices, please contact AUMA.

Description of actuator data content with address x

Table 9: Actuator output command <Addr> part 1 (for actuator with address “1”, the offset address is “0”):

Bit	Designation	Value	Description
Bit 15	- reserved -		
Bit 14	- reserved -		
Bit 13	ESD command	1	The ESD function configured at the actuator (= EMERGENCY function) is triggered.
Bit 12	STOP command	1	STOP command, the actuator suspends its travel.

Bit	Designation	Value	Description
Bit 11	RESET command	1	Certain signals can be reset using this command (e.g. PTC tripping device and torque faults).
Bit 10	SETPOINT command	1	Run to setpoint. The setpoint is transmitted within output command part 2.
Bit 9	CLOSE command	1	Operation command in direction CLOSE.
Bit 8	OPEN command	1	Operation command in direction OPEN.
Bit 7 – bit 4	- reserved -		
Bit 3	PVST command	1	The PVST function configured at the actuator is triggered.
Bit 2	Enable CLOSE	1	Enables operation command in direction CLOSE
Bit 1	Enable OPEN	1	Enabling operation command in direction OPEN
Bit 0	Enable LOCAL	1	Actuator operation via local controls is enabled.

Only one bit may be set between bits 8 – 10 (OPEN, CLOSE or SETPOINT command). Otherwise the actuator stops issuing the “Not ready REMOTE” signal.

Bit 11 (RESET command) is used to reset buffered and inactive signals (e.g. “Thermal fault” after motor cooling down or “Torque fault” once the excessive torque has been remedied.

As soon as bit 10 (SETPOINT command) is set, the pertaining setpoint is transmitted to the actuator from part 2 of the output command.

Table 10: Actuator output command <Addr> part 2 (for actuator with address “1”, the offset address is “1”):

Bit	Designation	Description
Bit 15 – bit 8	Setpoint position high byte	The setpoint position has to be transmitted as value of 0 – 1,000 per mil.
Bit 7 – bit 0	Setpoint position low byte	The setpoint position has to be transmitted as value of 0 – 1,000 per mil.

Description for SIMA² data content

Table 11: Output command SIMA part 1 (offset address = 520):

Bit	Designation	Value	Description
Bit 15 – bit 1	- reserved -		
Bit 0	Redundancy switch-over	1	Redundancy switch-over is triggered.

With redundancy switch-over on output command SIMA part 1, a switch-over of the active roles from SIMA A to SIMA B and vice versa can be triggered when executing the hot-standby system redundancy. The switch-over is executed for each write process of this output command while redundancy switch-over is activated (bit 0 = 1).

4.3.3. Host (output) commands to SIMA² via coils)

Table 12:

Modbus function	Function code (decimal)	Offset address	Data content
Write Single Coil	05	0	Output command actuator 1 - OPEN command
Write Multiple Coils	15	1	Output command actuator 1 - CLOSE command
Read Coil Status	01	2	Output command actuator 1 - SETPOINT command
		3	Output command actuator 1 - RESET command
		4	Output command actuator 1 - STOP command
		5	- reserved -
		6	Output command actuator 1 - ESD command
		7	- reserved -
		8	Output command actuator 2 - OPEN command
		9	Output command actuator 2 - CLOSE command
		10	Output command actuator 2 - SETPOINT command
		11	Output command actuator 2 - RESET command
		12	Output command actuator 2 - STOP command
		13	- reserved -
		14	Output command actuator 2 - ESD command
		15	- reserved -
		(<Addr>-1)*8	Output command actuator< Addr> OPEN - command
		(<Addr>-1)*8 + 1	Output command actuator< Addr> - CLOSE command
		(>Addr>-1)*8 + 2	Output command actuator< Addr> - SETPOINT command
		(>Addr>-1)*8 + 3	Output command actuator< Addr> - RESET command
		(>Addr>-1)*8 + 4	Output command actuator< Addr> - STOP command
		(>Addr>-1)*8 + 6	Output command actuator< Addr> - ESD command
		1968	Output command actuator 247 - OPEN command
		1969	Output command actuator 247 - CLOSE command
		1970	Output command actuator 247 - SETPOINT command
		1971	Output command actuator 247 - RESET command
		1972	Output command actuator 247 - STOP command
		1973	- reserved -
		1974	Output command actuator 247 - ESD command
		1975	- reserved -
		3000 – 6987	As soon as the “Map input data into the output address range” setting is activated, an identical copy of the available feedback signals via Read Input Status (function code = 02) is available within this address range.

Only one of the “OPEN command”, “CLOSE command” or “SETPOINT command” coils may be set per telegram. Otherwise, the actuator will respond with the “Not ready REMOTE” signal and stop.

Buffered and no longer active signals (e. g. “Thermal fault” after cooling down of the motor or “Torque fault”, once excessive torque is no longer present) are reset using the RESET command coil.

As soon as the “SETPOINT command” coil has been set the respective setpoint of the output command part 2 ([page 19, Output command actuator <Addr>, part 2](#)) is transmitted to the actuator.

When setting the “Use auto reset coils = active” function, the contents of other coils will be influenced as follows when changing coils via the “Write Single Coils” function:

- Operation commands OPEN, STOP or CLOSE will delete all other possibly set operation commands OPEN, STOP or CLOSE
- An ESD command deletes all other possibly set operation commands OPEN, STOP or CLOSE.
- Other operation commands have no impact on the ESD command.

The "Use auto reset coils = inactive" setting (default setting) has no impact on other coils. The RESET command is always automatically reset.

4.3.4. SIMA² feedback signals to the host (via Read Input Register)

Table 13:

Modbus function	Function code (decimal)	Offset address	Data content
Read Input Register	04	0	Input information actuator 1 part 1
		1	Input information actuator 1 part 2
		2	Input information actuator 1 part 3
		3	Input information actuator 2 part 1
		4	Input information actuator 2 part 2
		5	Input information actuator 2 part 3
		(<Addr>-1)*3	Input information actuator <Addr> part 1
		(<Addr>-1)*3 + 1	Input information actuator <Addr> part 2
		(<Addr>-1)*3 + 2	Input information actuator <Addr> part 3
		738	Input information actuator 247 part 1
		739	Input information actuator 247 part 2
		740	Input information actuator 247 part 3
		800	Input information SIMA ² part 1
		801	Input information SIMA ² part 2
		805	For loop redundancy only: Position of the last available actuator on channel A
		806	For loop redundancy only: Position of the last available actuator on channel B
		807	For loop redundancy only: Address of the last available actuator on channel A
		808	For loop redundancy only: Address of the last available actuator on channel B
		810	Discrete input signals of SIMA ² (only for SIMA ² equipped with digital inputs)
		811	System inputs of SIMA ² (only for SIMA ² equipped with digital inputs)
		812	ESD states of SIMA ² (only for SIMA ² equipped with digital inputs)
		820	Number of available actuators SIMA A – channel A (only if SIMA A is active)
		821	Number of available actuators SIMA A – channel B (only if SIMA A is active)
		822	Number of available actuators SIMA B – channel A (only if SIMA B is active)
		823	Number of available actuators SIMA B – channel B (only if SIMA B is active)
		1024	Live list 1
		1025	Live list 2
		x + 1023	Live list x
		1270	Live list 247
			Actual position of actuators (value range 0 – 1,000 per mil):
		2000	Actual position actuator 1
		2001	Actual position actuator 2
		2000+<Addr>-1	Actual position actuator <Addr>

Modbus function	Function code (decimal)	Offset address	Data content
		2246	Actual position actuator 247
		Analogue inputs 1 and 2 of the connected actuators:	
		3,000	Analogue input 1 actuator 1
		3001	Analogue input 2 actuator 1
		3002	Analogue input 1 actuator 2
		3003	Analogue input 2 actuator 2
		3000+ (<Addr>-1)*2	Analogue input 1 actuator <Addr>
		3000+ (<Addr>-1)*2 + 1	Analogue input 2 actuator <Addr>
		3492	Analogue input 1 actuator 247
		3493	Analogue input 2 actuator 247

Information Integration of third party devices via Modbus RTU into SIMA² is supported as soon as the “Activate third party device integration” parameter is activated: (default setting: Third party device integration = inactive). The formal communication description to third party devices is explicitly defined in the SIMA² configuration file. The feedback signals of the third party devices are integrated in to the mapping of the Read Input Registers (function code = 04).
For details on integration of third party devices, please contact AUMA.

Table 14: Input information actuator <Addr> part 1:

Bit	Designation	Value	Description
Bit 15	Fault	1	Contains the result of an OR disjunction of all fault indications. The actuator cannot be operated. 1)
Bit 14	Warning	1	Contains the result of an OR disjunction of all warning signals.
Bit 13	Running CLOSE	1	An operation command in direction CLOSE is executed: CLOSE command or SETPOINT command (process representation output). This bit remains also set during operation pauses (e.g. due to the dead time or the reversing prevention time).
Bit 12	Running OPEN	1	An operation command in direction OPEN is executed: OPEN command or SETPOINT command (process representation output). This bit remains also set during operation pauses (e.g. due to the dead time or the reversing prevention time).
Bit 11	Not ready REMOTE	1	Contains the result of a disjunction (OR-operation) of all "Not ready REMOTE" signals. The actuator cannot be operated from REMOTE. The actuator can only be operated via the local controls.
Bit 10	Setpoint position reached	1	The position setpoint is within max. error variable (outer dead band). Is only signalled if the SETPOINT command (process representation output) is set.
Bit 9	End position CLOSED	1	For limit seating: Limit switch operated in direction CLOSE. For torque seating: Torque switch and limit switch operated in direction CLOSE.
Bit 8	End position OPEN	1	For limit seating: Limit switch operated in direction OPEN. For torque seating: Torque switch and limit switch operated in direction OPEN.
Bit 7	Torque switch CLOSE	1	Torque switch operated in direction CLOSE.
Bit 6	Torque switch OPEN	1	Torque switch operated in direction OPEN.
Bit 5	Limit switch CLOSED	1	Limit switch operated in direction CLOSE.
Bit 4	Limit switch OPEN	1	Limit switch operated in direction OPEN.
Bit 3	Selector switch in position LOCAL	1	Selector switch is in position LOCAL.

Bit	Designation	Value	Description
Bit 2	Selector switch position in REMOTE	1	Selector switch is in position REMOTE.
Bit 1	Phase failure	1	A phase failure was detected.
Bit 0	Thermal fault	1	Motor protection tripped.

- 1) When activating the "Adding No communication to Fault" function, the fault signal is set for a fault signal issued by the actuator "Fault" or a communication loss to the actuator. If this function is deactivated (factory setting), the signal is only set if the actuator issues a fault signal.

Table 15: Input information actuator <Addr> part 2:

Bit	Designation	Description
Bit 15 – bit 8	Actual position high byte	Actual position (0 – 1 000 per mil)
Bit 7 – bit 0	Actual position low byte	Actual position (0 – 1 000 per mil)

Table 16: Input information actuator <Addr> part 3:

Bit	Designation	Value	Description
Bits 12 – 15	- reserved -		
Bit 11	I/O interface	1	I/O interface signal is active.
Bit 10	FQM signal active	1	At least one FQM signal out of the following signals is active: FQM FailSafe Error , FQM FailSafe init , FQM FailSafe Active
Bit 9	Handwheel active	1	Manual operation is active (handwheel is engaged); optional signal (only available for actuators with handwheel activation)
Bit 8	ESD behaviour active	1	ESD function (EMERGENCY function) active.
Bit 4 – bit 7	- reserved -	1	- reserved -
Bit 3	SIMA control active	1	SIMA ² has control priority. The host can therefore no longer control the actuators but only read their feedback signals.
Bit 2	Communication via channel B	1	The actuator is available via channel B. ¹⁾
Bit 1	Communication via channel A	1	The actuator is available via channel A. ¹⁾
Bit 0	No communication	1	The actuator is neither available via channel A nor via channel B.

- 1) For loop redundancy: If the SIMA² communication to the actuators is fault-free, bit 1 and bit 2 are set to "1", since the actuator is reached via both channels (from both sides).

Table 17: Input information SIMA part 1 (offset address 800):

Bit	Designation	Value	Description
Bit 15	Loop break	1	At least one fault (e. g. cable break or short circuit) has occurred within the Modbus loop, preventing fault-free communication across the loop. The position of the two actuators preceding and following the fault location is stored in the Input Registers with offset addresses 805 and 806.
Bit 14	Redundancy link SIMA A <> SIMA B is Ok.	1	Communication between SIMA A and SIMA B is Ok.
Bit 13	SIMA B – channel B: Live list Ok.	1	Number of available actuators (SIMA B – channel B) corresponds to the specified number of actuators
Bit 12	SIMA B – channel A: Live list Ok.	1	Number of available actuators (SIMA – channel A) corresponds to the specified number of actuators
Bit 11	SIMA A – channel B: Live list Ok.	1	Number of available actuators (SIMA A – channel B) corresponds to the specified number of actuators
Bit 10	SIMA A – channel A: Live list Ok.	1	Number of available actuators (SIMA A – channel A) corresponds to the specified number of actuators
Bit 9	SIMA B host communication	1	SIMA B communicates with the host
Bit 8	SIMA A host communication	1	SIMA A communicates with the host
Bit 7	SIMA B – channel B active	1	SIMA B sends operation commands via channel B to the actuators
Bit 6	SIMA B – channel A active	1	SIMA B sends operation commands via channel A to the actuators
Bit 5	SIMA A – channel B active	1	SIMA A sends operation commands via channel B to the actuators
Bit 4	SIMA A – channel A active	1	SIMA A sends operation commands via channel A to the actuators
Bit 3	SIMA B – channel B Ok.	1	For SIMA B, there are no faults on channel B to the actuators

Bit	Designation	Value	Description
Bit 2	SIMA B – channel A Ok.	1	For SIMA B, there are no faults at channel A to the actuators
Bit 1	SIMA A – channel B Ok.	1	For SIMA A, there are no faults on channel B to the actuators
Bit 0	SIMA A – channel A Ok.	1	For SIMA A, there are no faults on channel A to the actuators

Table 18: Input information SIMA part 2 (offset address 801):

Bit	Designation	Value	Description
Bit 15	SIMA B – channel B: no host communication	1	No communication to the host via SIMA B – channel B
Bit 14	SIMA B – channel A: no host communication	1	No communication to the host via SIMA B – channel A
Bit 13	SIMA A – channel B: no host communication	1	No communication to the host via SIMA A – channel B
Bit 12	SIMA A – channel A: no host communication	1	No communication to the host via SIMA A – channel A
Bit 11	SIMA B – channel B: no actuator communication	1	No communication to the actuators via SIMA B – channel B
Bit 10	SIMA B – channel A: no actuator communication	1	No communication to the host via SIMA B – channel A
Bit 9	SIMA A – channel B: no actuator communication	1	No communication to the actuators via SIMA A – channel B
Bit 8	SIMA A – channel A: no actuator communication	1	No communication to the actuators via SIMA A – channel A
Bit 7	Warning FOC actuators	1	Only for FO cable connection of the actuators: An FOC warning is present at least at one of the actuators connected via FOC
Bit 6	Wrn FOC coupler	1	Only for FO cable connection of the actuators: An FOC warning is present at the FOC coupler of the SIMA ²
Bit 5	- reserved -		
Bit 4	SIMA ² collective fault	1	A collective fault signal has occurred: • SIMA² system is not ready (input information SIMA part 2, bit 2 = 0) or control priority SIMA² • Loop break (input information SIMA part 1 bit 15 = 1) or • Redundancy link SIMA A <> SIMA B is defective (input information SIMA part 2, bit 14 = 0) or • Fault during communication to the actuators (input information SIMA part 1 bits 0, 1, 2, or 3 = 0)
Bit 3		1	At least one of the connected actuators cannot be controlled by the host since its control was changed over to the HMI of SIMA ² .
Bit 2	SIMA ² system is ready	1	Communication to the actuators is possible via at least one channel
Bit 1	SIMA B is active	1	Only for hot standby system redundancy: SIMA B is active and SIMA A monitors the communication to the actuators.
Bit 0	SIMA A is active	1	Only for hot standby system redundancy: SIMA A is active and SIMA B monitors the communication to the actuators.

Table 19: For loop redundancy only: Position of the last available actuator on channel A (offset address = 805):

Bit	Designation	Description
Bit 15 – bit 8	High byte	- reserved -
Bit 7 – bit 0	Low byte	Position of the last available actuator on channel A

Table 20: For loop redundancy only: Position of the last available actuator on channel B (offset address = 806):

Bit	Designation	Description
Bit 15 – bit 8	High byte	- reserved -
Bit 7 – bit 0	Low byte	Position of the last available actuator on channel B

Table 21: For loop redundancy only: Address of the last available actuator on channel A (offset address = 807):

Bit	Designation	Description
Bit 15 – bit 8	High byte	- reserved -
Bit 7 – bit 0	Low byte	Address of the last available actuator on channel A

Table 22: For loop redundancy only: Address of the last available actuator on channel B (offset address = 808):

Bit	Designation	Description
Bit 15 – bit 8	High byte	- reserved -
Bit 7 – bit 0	Low byte	Address of the last available actuator on channel B

Table 23: If SIMA² is equipped with digital inputs: discrete input signals of SIMA² (offset address = 810)

Bit	Designation	Value	Description
Bit 15	Discrete input 16	1	SIMA ² discrete input 16 is active
Bit 14	Discrete input 15	1	SIMA ² discrete input 15 is active
Bit 13	Discrete input 14	1	SIMA ² discrete input 14 is active
Bit 12	Discrete input 13	1	SIMA ² discrete input 13 is active
Bit 11	Discrete input 12	1	SIMA ² discrete input 12 is active
Bit 10	Discrete input 11	1	SIMA ² discrete input 11 is active
Bit 9	Discrete input 10	1	SIMA ² discrete input 10 is active
Bit 8	Discrete input 9	1	SIMA ² discrete input 9 is active
Bit 7	Discrete input 8	1	SIMA ² discrete input 8 is active
Bit 6	Discrete input 7	1	SIMA ² discrete input 7 is active
Bit 5	Discrete input 6	1	SIMA ² discrete input 6 is active
Bit 4	Discrete input 5	1	SIMA ² discrete input 5 is active
Bit 3	Discrete input 4	1	SIMA ² discrete input 4 is active
Bit 2	Discrete input 3	1	SIMA ² discrete input 3 is active
Bit 1	Discrete input 2	1	SIMA ² discrete input 2 is active
Bit 0	Discrete input 1	1	SIMA ² discrete input 1 is active

Table 24: If SIMA² is equipped with digital inputs: System messages of SIMA² (offset address = 811)

Bit	Designation	Value	Description
Bit 15 – bit 10	- reserved -		
Bit 9	Fault FOC coupler	1	Only for FO cable connection of the actuators: An FOC warning is present at the FOC coupler of the SIMA ² .
Bit 8	Wrn FOC coupler	1	Only for FO cable connection of the actuators: An FOC warning is present at the FOC coupler of the SIMA ² .
Bit 7 – bit 6	- reserved -		
Bit 5	Power supply failure	1	A power supply fault has occurred (option).
Bit 4	Fuse monitoring	1	A fault of the fuse element has occurred (option)
Bit 3	Fan monitoring	1	A fault of the control cabinet fan has occurred (option).
Bit 2	Cabinet humidity	1	The cabinet humidity is outside the permissible range (option).
Bit 1	Cabinet temperature	1	The cabinet temperature is outside the permissible range (option).
Bit 0	Cabinet door open	1	The door of the control cabinet is not closed (option).

Table 25: If SIMA² is equipped with digital inputs: ESD states messages of SIMA² (offset address = 812)

Bit	Designation	Value	Description
Bit 15 – bit 8	- reserved -		
Bit 7	ESD group 8	1	ESD group 8 is active
Bit 6	ESD group 7	1	ESD group 7 is active
Bit 5	ESD group 6	1	ESD group 6 is active
Bit 4	ESD group 5	1	ESD group 5 is active
Bit 3	ESD group 4	1	ESD group 4 is active
Bit 2	ESD group 3	1	ESD group 3 is active
Bit 1	ESD group 2	1	ESD group 2 is active
Bit 0	ESD group 1	1	ESD group 1 is active

Table 26: Number of available actuators SIMA A – channel A (offset address = 820):

Bit	Designation	Description
Bit 15 – bit 8	High byte	
Bit 7 – bit 0	Low byte	Number of available actuators SIMA A – channel A (only if SIMA A is active, otherwise 0)

Table 27: Number of available actuators SIMA A – channel B (offset address = 821):

Bit	Designation	Description
Bit 15 – bit 8	High byte	
Bit 7 – bit 0	Low byte	Number of available actuators SIMA A – channel B (only if SIMA A is active, otherwise 0)

Table 28: Number of available actuators SIMA B – channel A (offset address = 822):

Bit	Designation	Description
Bit 15 – bit 8	High byte	
Bit 7 – bit 0	Low byte	Number of available actuators SIMA B – channel A (only if SIMA B is active, otherwise 0)

Table 29: Number of available actuators SIMA B – channel B (offset address = 823):

Bit	Designation	Description
Bit 15 – bit 8, high byte	High byte	
Bit 7 – bit 0, low byte	Low byte	Number of available actuators SIMA B – channel B (only if SIMA B is active, otherwise 0)

Table 30: Live List 1-247 (first offset address = 1024):

Bit	Description
Bit 15 – bit 8, high byte	- reserved -
Bit 7 – bit 0, low byte	Slave address of the actuator

All actuators are listed which have been found on a least one of the available channels during the “Update live list” or “Read loop configuration” command.

The addresses are not sorted but are stored according to the connection order within the loop in the respective live list registers.

4.3.5. SIMA² feedback signals to the host (via Read Input Status)

The discrete feedback signals from SIMA² the host can be configured.

Apart from the start value of the offset address, also the data contents can be adapted according to the host requirements. Both the number as well as the selection of the discrete feedback signals per actuator can be configured. The number of discrete feedback signals per actuator can be set between 6 and 12; for each feedback signal, you may select between 35 discrete signals.

Default setting:**Number of discrete inputs per field device = 6:****Discrete input 1 = Error****Discrete input 2 = End position OPEN****Discrete input 3 = End position CLOSED****Discrete input 4 = Selector switch REMOTE****Discrete input 5 = Torque switch OPEN****Discrete input 6 = Torque switch CLOSE**

The representation in the following table is based on this configuration.

Table 31:

Modbus function	Function code (decimal)	Offset address	Description
Read Input Status	02	0	Actuator 1: Fault
		1	Actuator 1: End position OPEN
		2	Actuator 1: End position CLOSED
		3	Actuator 1: Selector sw. REMOTE
		4	Actuator 1: Torque sw. OPEN
		5	Actuator 1: Torque sw. CLOSED
		6	Actuator 2: Fault
		7	Actuator 2: End position OPEN
		8	Actuator 2: End position CLOSED
		9	Actuator 2: Selector sw. REMOTE
		10	Actuator 2: Torque sw. OPEN
		11	Actuator 2: Torque sw. CLOSED
		(<Addr>-1)* (number of discrete inputs per field device)	Actuator: <Addr>Fault
		(<Addr>-1)* (number of discrete inputs per field device) +1	Actuator <Addr>: End position OPEN
		(<Addr>-1)* (number of discrete inputs per field device) +2	Actuator <Addr>: End position CLOSED
		(<Addr>-1)* (number of discrete inputs per field device) +3	Actuator <Addr>: Selector sw. REMOTE
		(<Addr>-1)* (number of discrete inputs per field device) +4	Actuator <Addr>: Torque sw. OPEN
		(<Addr>-1)* (number of discrete inputs per field device) +5	Actuator <Addr>: Torque sw. CLOSED
		1476	Actuator 247: Fault
		1477	Actuator 247: End position OPEN
		1478	Actuator 247: End position CLOSED
		1479	Actuator 247: Selector sw. REMOTE
		1480	Actuator 247: Torque sw. OPEN
		1481	Actuator 247: Torque sw. CLOSED
		Binary inputs DIN1-4 of connected actuators	
		3000	Actuator 1: digital input 1
		3001	Actuator 1: digital input 2
		3002	Actuator 1: digital input 3
		3003	Actuator 1: digital input 4
		3004	Actuator 2: digital input 1
		3005	Actuator 2: digital input 2
		3006	Actuator 2: digital input 3
		3007	Actuator 2: digital input 4
		3000+ (<Addr>-1)*4	Actuator <Addr> digital input 1
		3001+ (<Addr>-1)*4	Actuator <Addr> digital input 2
		3002+ (<Addr>-1)*4	Actuator <Addr> digital input 3
		3003+ (<Addr>-1)*4	Actuator <Addr> digital input 4

Modbus function	Function code (decimal)	Offset address	Description
		3984	Actuator 247: digital input 1
		3985	Actuator 247: digital input 2
		3986	Actuator 247: digital input 3
		3987	Actuator 247: digital input 4

The content of offset addresses 0 – 2963 can be configured: The 6 – 12 discrete feedback signals per actuator can be configured with a signal out of the selection of 35 signals:

Table 32: Signal selection

No.	Description
1	Thermal fault
2	Phase failure
3	Selector sw. REMOTE
4	Selector sw. LOCAL
5	Limit switch OPEN
6	Limit switch CLOSED
7	Torque switch OPEN
8	Torque switch CLOSE
9	End position OPEN
10	End position CLOSED
11	Setpoint position reached
12	Not ready REMOTE
13	Running OPEN
14	Running CLOSE
15	Warnings
16	Fault
17	Torque fault OPEN
18	Torque fault CLOSE
19	Input DIN1
20	Input DIN2
21	Input DIN3
22	Input DIN4
23	Communication loss
24	Communication loss or fault
25	Actuator available
26	Actuator runs
27	- reserved (value 0)-
28	Warning 24 V DC external
29	Actuator stopped (neither Running OPEN nor Running CLOSE)
30	Torque fault (Torque fault OPEN or Torque fault CLOSE)
31	No reaction
32	Handwheel active
33	Running LOCAL
34	Running REMOTE
35	Handwheel operation
36	I/O interface

No.	Description
37	Interlock active
38	Service active
39	PVST active

5. Technical data

Information The following tables include standard and optional features. For detailed information on the customer-specific version, refer to the order-related data sheet. The technical data sheet can be downloaded from the Internet in both German and English at <http://www.auma.com> (please state the order number).

5.1. Technical data SIMA² Master Station

General information		
SIMA ² Master Station for controlling and supervising AUMA actuators and for easier integration into host systems.		
Features and functions		
Housing	Standard:	Housing for installation in 19" systems Dimensions: 4 HE/84 TE Integral 7" multi-touchscreen as user interface
	Options:	Housing for installation on control cabinet mounting plate Dimensions (W x H x D): 483 x 177 x 340 mm Desktop housing with front handle and knuckle feet
Power supply Mains frequency	Standard:	1-phase AC current: 110 – 240 V AC +/-10 %, 50/60 Hz +/-10 %
	Option:	DC current: 24 V DC, approx. 1 A
Type of connection (customer connections)	Standard:	Connection via IEC device plug (type C14) at the housing rear
	Option:	Lateral arrangement of IEC device plug (type C14) Required for installation on control cabinet mounting plate
Power consumption	Approx. 20 W per SIMA ² subsystem For redundant version (hot standby system redundancy) approx. 2 x 20 W	
Supported field devices	The following AUMA actuators can be connected to SIMA²: - Multi-turn actuators (SA .2, SAR .2, SAV .2, SARV .2) or part-turn actuators (SQ .2, SQR .2) in combination with AC 01.2 or ACV 01.2 actuator controls - Multi-turn actuators (SAEx .2, SAREx .2, SAVEx .2, SARVEx .2) or part-turn actuators (SQEx .2, SQREx .2) in combination with ACExC 01.2 bzw. ACVExC 01.2 actuator controls - Multi-turn actuators of TIGRON type range - Multi-turn actuators of the iMatic (DiM(Ex), DiMR(Ex)) type range as well as part-turn actuators of the DPiM(Ex) type range - Multi-turn actuators of type range SEVEN - Globe valve of SVC and SVM type ranges - Part-turn actuators of type ranges SGC and SGM - Actuators of the PROFOX type range Other field devices with Modbus RTU interface on request	
Communication to field devices	Communication to the actuators is established via RS-485 with Modbus RTU - Use of twisted, screened RS-485 copper cable in compliance with IEC 61158 - RS-485 ports accessible from the front side (hidden by hinged fold-out front doors) Modbus RTU: - Fieldbus termination can be activated at the RS-485 communication interfaces - Connection of the RS-485 communication cables via spring clamp terminals: Cross section of spring clamp terminals: - Single strand: 0.08 – 2.5 mm² - Fine stranded: 0.25 – 2.5 mm², with wire end sleeves up to 1.5 mm² - Modbus RTU communication parameters: - Supported baud rate: 0.3 – 115.2 kbit/s - Supported transmission formats: 8 data bits, 1 or 2 stop bits; parity: even, odd or none.	
	Options:	SIMA² supports up to two different, galvanically and logically separated fieldbus networks to the actuators with the following characteristics: - Two single-channel line topology or one redundant line topology - Cable length without repeater max. 1.2 km, with repeater approx. 10 km - Number of actuators: without repeater max. 32, with repeater max. 126

Features and functions		
Communication between SIMA ² and host	Standard:	Without integration into a superordinate automation system (stand-alone mode): SIMA ² is operated in stand-alone mode; the operation commands for the AUMA actuators are entered manually by the operator via the user interface.
	Options:	Modbus RTU in single-channel or redundant version • Communication to the host is established via RS-485 with Modbus RTU • Fieldbus termination can be activated at the RS-485 communication interfaces • Use of twisted, screened RS-485 copper cable in compliance with IEC 61158 • Connection of the RS-485 communication cables via spring clamp terminals accessible from the front side (hidden by hinged fold-out front doors) Cross section of spring clamp terminals: - Single strand: 0.08 – 2.5 mm² - Fine stranded: 0.25 – 2.5 mm², with wire end sleeves up to 1.5 mm² Configuration of the Modbus RTU communication parameters (baud rate, transmission format, slave address) is made via the HMI user interface. Supported baud rates: 0.3 – 115.2 kbit/s Supported transmission formats: 8 data bits, 1 or 2 stop bits; parity: Even, Odd or None. Supported Modbus function codes: • 01 Read Coil Status • 02 Read Input Status • 03 Read Holding Registers • 04 Read Input Registers • 05 Force Single Coils • 06 Preset Single Registers • 15 (0x0F) Force Multiple Coils • 16 (0x10) Preset Multiple Registers • 08 Diagnostics - 00 00 Loopback - 00 10 (0AHex) Clear Counters and Diagnostic Register - 00 11 (0BHex) Return Bus Message Count - 00 12 (0CHex) Return Bus Communication Error Count - 00 13 (0DHex) Return Bus Exception Error Count - 00 14 (0EHex) Return Slave Message Count - 00 15 (0FHex) Return Slave No Response Count - 00 16 (10Hex) Return Slave NAK Count - 00 17 (11Hex) Return Slave Busy Count - 00 18 (12Hex) Return Character Overrun Count Modbus TCP/IP in single-channel or redundant version • Communication via host is established via Ethernet, 10 Base-T or 100 Base-T (IEEE 802.3) using Modbus TCP/IP • Up to four simultaneous Modbus TCP/IP connections • 10/100 Mbit/s Configuration of the Modbus TCP/IP communication parameters (IP address and subnet mask, port as well as Unit ID) is made via the HMI user interface. Communication in Modbus data format via TCP/IP protocols For redundant version: Connection to identical or to different subnets possible (option). Supported Modbus function codes: • 01 Read Coil Status • 02 Read Input Status • 03 Read Holding Registers • 04 Read Input Registers • 05 Force Single Coils • 06 Preset Single Registers • 15 (0x0F) Force Multiple Coils • 16 (0x10) Preset Multiple Registers

Features and functions	
Hot standby system redundancy (option)	For redundant applications, SIMA² can be implemented as redundant configuration. Two separate SIMA² subsystems permanently monitor each other. In case of failure of one SIMA² subsystem, the redundant subsystem takes over control (only available in combination with Modbus RTU as communication protocol between SIMA² and the actuators). Continuous mutual monitoring of the two SIMA² subsystems is established via an Ethernet synchronisation cable Versions: - Hot standby system redundancy of SIMA² within a single housing - Compact design (requires mounting space for just one SIMA² housing) - Two complete SIMA² subsystems, each with a 7" multi-touchscreen are located within the housing - Redundant power supply, separately for each SIMA² subsystem - Supports up to two RS-485 Modbus RTU communication interfaces to the actuators, e.g. appropriate for two single-channel line topologies or one redundant line or loop topology. - Hot standby system redundancy of SIMA² in two separate housings - Requires mounting space for two SIMA² housings - Each of the two housings is equipped with a complete SIMA² subsystem including 7" multi-touchscreen and power supply - Supports up to eight RS-485 Modbus RTU communication interfaces to the actuators which can be used in up to four different communication networks, e.g. suitable for up to four single-channel line topologies or up to four redundant line or ring.
Dual operation (option)	For applications with space constraints inside the control cabinet, two galvanically and logically isolated SIMA² subsystems can be located within a joint housing. Version: - Compact design (requires mounting space for just one SIMA² housing) - Two complete SIMA² subsystems, each with a 7" multi-touchscreen are located within the housing - Separate power supply, separately for each SIMA² subsystem - Supports up to two RS-485 Modbus RTU communication interfaces each to the actuators, e.g. appropriate for two single-channel line topologies or one redundant line or loop topology
System interface	The number of available RS-485 and Ethernet interfaces depends on the number of fieldbus networks, the type of communication to the host and the selected redundancy model. At least one Ethernet port (RJ45) is available for diagnostics or for integrating the optional OPC UA server within an automation network, two further USB ports are used for transmitting configuration and diagnostic data.
Operating and monitoring	Display and operation functions of the HMI: - Control and status indication of the connected AUMA actuators - Status indication of the communication to the actuators and to the host - Operation, configuration and diagnostics of SIMA² and the respective interfaces Standard: User interface languages: English and German (can be changed during operation) SIMA² offers various access facilities to the HMI. Standard: Operation via the integral 7" multi touchscreen Features: - Resolution: WVGA, 800 x 480 Pixel - Colours: 16.7 million - Brightness: usually 500 cd / m² - Contrast: typically 600:1 - Observation angle: usually 60 – 70° Option: Access to the web based HMI user interface using remote stations via Ethernet (network connection: RJ45 port), enabling the connection of the following components: - External work stations, PCs, laptops via LAN connection - External tablets, smartphones via WLAN connection The responsive web design of the HMI is optimised for use in combination with Google Chrome and Mozilla Firefox browser.
Cooling	Passive cooling without fan (maintenance-free)

Functions of the SIMA² software

Web based user interface for operating and monitoring SIMA ²	Automatic display of the most important status information of SIMA ² as well as the connected actuators immediately after switching on (once commissioning and definition of the system configuration is complete).
	Password-protected access to settings and entry of manual operation commands for the actuators.
	Control of connected actuators.
	Visualisation of feedback from connected actuators.
Actuator identification via the user interface	Optional specification of the individual designation for each actuator.
Adapting the communication characteristics via the HMI user interface	Setting the communication between SIMA ² and actuators (e.g. redundancy, baud rate, parity, number of actuators, highest field device address).
	Setting the communication between SIMA ² and DCS (baud rate, parity, number of stop bits, address, monitoring time, IP address, subnet mask, port, unit ID).
Communication monitoring	Monitoring and visualising the communication status with the host
	For redundant communication to the host: Two communication channels with equal access rights.
Redundancy functions	Support, monitoring and management of redundant communication to the DCS (option), and the redundant communication to the actuators (option). Upon occurrence of a fault, the function is immediately adopted by the redundant communication channel or the redundant system without any interference.
Gateway function	Administration of different communication protocols of the DCS and the actuators (e.g.: Modbus TCP/IP <> Modbus RTU or Profibus DP or)
	Implementation of various solutions for communication to the DCS and communication to the actuators (e.g. single-channel communication for DCS <> redundant line topology to the actuators)

Data interface to host

Output data from the DCS to the SIMA ²	Output data (operation commands) to the actuators connected to SIMA ²
Input data from the SIMA ² to the DCS	Input data (feedback signals) from the connected actuators as well as additional status information of SIMA ² : • Communication status to the actuators • Communication status to the host • Number of currently available actuators • Deviation from the planned number of actuators

Service conditions

Enclosure protection according to EN 60529	IP20 (higher enclosure protection on request)
Ambient temperature	–20 °C to +50 °C (higher ambient temperatures on request)
Humidity	5 % to 90 % (non-condensing)

Options and accessories

RS-485 overvoltage protection	Protection of RS-485 communication interface against overvoltages
Digital inputs	6 or 12 inputs Nominal voltage 24 V DC, type 1 input characteristics (according to EN 61131-2), current consumption approx. 3.75 mA. Suitable for e.g. discrete control signals for activating the ESD function, for control cabinet monitoring functions or enabling the HMI, etc.)
Digital outputs	2 change-over contacts, 240 V AC/5 A, 24 V DC/5 A Suitable for e.g. configurable alarm output
Front handle and knuckle feet	Appropriate for 19" pull out systems and bench housing
Project-specific control cabinet	Customised basic Rittal IT, 19" rack (800 x 800 x 2,200 mm)
Project-specific software programming	On request
Project design	On request

Further information	
Weight	Approx. 9 kg
EU Directives	Low Voltage Directive 2014/35/EU EMC Directive 2014/30/EU

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AUMA Riester GmbH & Co. KG

P.O. Box 1362

DE 79373 Muellheim

Tel +49 7631 809 - 0

Fax +49 7631 809 - 1250

info@auma.com

www.auma.com