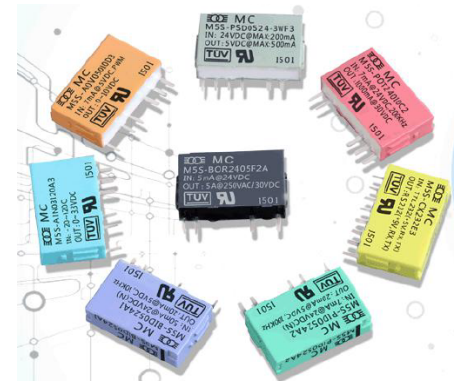


## M5S modular I/O components

Modular components with integrated circuits aiming at versatile operation in industrial systems like regulators or programmable logic controllers.

### Connection of electronics and industrial control

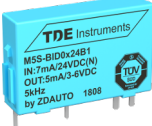
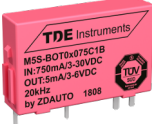
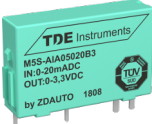
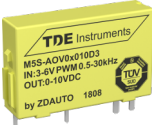
The modules are a connecting element between electronics on one side as well as the world of industrial control on the other side. The modules are completely sealed, water proof, fire proof and dust proof.



### Universal wiring diagram for full flexibility

A universal wiring diagram allows all M5S I/O modules to be interchangeable without the need to change the internal or external wiring. By plugging different modules, customer specific input/output configurations can be achieved as well as the addition of functions to already rolled-out devices.

### Overview (Standard modules are underlined)

|   |  |  |
|---|--|--|
| Digital input - „BI“/“PI“<br>   | Switches, voltage detection                          | <u>BID0324A1</u> , <u>BID0524A1</u> , <u>BID0324B1</u> ,<br><u>BID0524B1</u> , BIA0324B5, BIA0524B5,<br>BIA03110B5, BIA05110B5, BIA03220B5,<br>BIA05220B5  |
|   | Pulses up to 200 kHz                                 | PID0324A2, PID0524A2,<br>PID0324B2, PID0524B2  |
| Digital output - „BO“/“PO“<br> | DC switch output                                     | <u>BOT03750C1b</u> , <u>BOT05750C1b</u> ,<br><u>BOT03750D1b</u> , <u>BOT05750D1b</u> ,<br>BOT0315E1b, BOT0515E1b,<br>BOT0315F1b, BOT0515F1b  |
|   | AC switch output                                     | <u>BOS03800E2Zb</u> , <u>BOS05800E2Zb</u>  |
|   | Pulses up to 200 kHz                                 | POT0315C2b, POT0515C2b,<br>POT0315D2b, POT0515D2b  |
| Analogue input - „AI“<br>      | 20 mA analogue signal                                | <u>AIA03020A3</u> , <u>AIA05020A3</u> ,<br><u>AIA03020B3</u> , <u>AIA05020B3</u> ,<br><u>AIA03020C4</u> , <u>AIA05020C4</u>  |
|   | 10 Volt analogue signal                              | <u>AIV03010A3</u> , <u>AIV05010A3</u> ,<br><u>AIV03010B3</u> , <u>AIV05010B3</u> ,<br><u>AIV03010C4</u> , <u>AIV05010C4</u>  |
|   | Temperature sensors<br>type N, type J, type K, Pt100 | <u>AIN03120A3</u> , <u>AIN05120A3</u> , <u>AIJ03600A3</u> ,<br><u>AIJ05600A3</u> , <u>AIK031200A3</u> , <u>AIK051200A3</u> ,<br><u>AIP03600A3</u> , <u>AIP05600A3</u> , <u>AIP03600B3</u> ,<br><u>AIP05600A3</u> |
| Analogue output - „AO“<br>     | 20 mA analogue signal                                | <u>AOA03020C3</u> , <u>AOA05020C3</u> ,<br><u>AOA03020D3Ab</u> , <u>AOA05020D3Ab</u>   |
|   | 10 Volt analogue signal                              | <u>AOV03010C3</u> , <u>AOV05010C3</u> ,<br><u>AOV03010D3Ab</u> , <u>AOV05010D3Ab</u>   |

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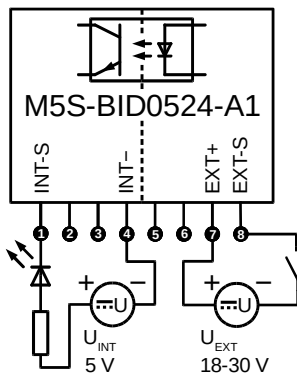
|   |    |
|---|----|
| M5S digital input - „BI“/“PI“.....                  | 3  |
| M5S digital output - „BO“/“PO“.....                 | 4  |
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## M5S digital input - „BI“/“PI“

- For detection of switch states, pulses or encoder signals
- Galvanic isolation via optocouplers
- Open collector output

### M5S-BID0324A1, M5S-BID0524A1

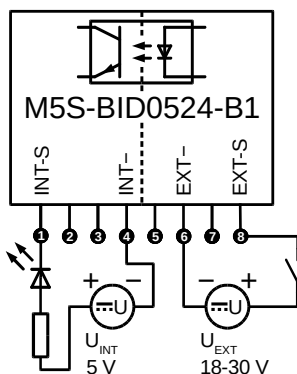
| Description                | Internal circuit |         |                 | Isolation | External circuit |                            |
|----------------------------|------------------|---------|-----------------|-----------|------------------|----------------------------|
|                            | Version          | Signal  | Voltage/current |           | Signal           | Voltage/current            |
| DC optocouple binary input | BID03            | 0-5 kHz | 3.3 V/8 mA DC   | Yes       | 0-5 kHz, source  | 18-30 V DC, 7 mA @ 24 V DC |
|                            | BID05            | 0-5 kHz | 5 V/8 mA DC     |           |                  |                            |



| Signal                |                      |
|-----------------------|----------------------|
| ←                     |                      |
| <b>Pin 1 (Output)</b> | <b>Pin 8 (Input)</b> |
| Active low            | Active low           |
| Passive               | Passive              |

### M5S-BID0324B1, M5S-BID0524B1

| Description                | Internal circuit |         |                 | Isolation | External circuit |                            |
|----------------------------|------------------|---------|-----------------|-----------|------------------|----------------------------|
|                            | Version          | Signal  | Voltage/current |           | Signal           | Voltage/current            |
| DC optocouple binary input | BID03            | 0-5 kHz | 3.3 V/8 mA DC   | Yes       | 0-5 kHz, sink    | 18-30 V DC, 7 mA @ 24 V DC |
|                            | BID05            | 0-5 kHz | 3.3 V/8 mA DC   |           |                  |                            |



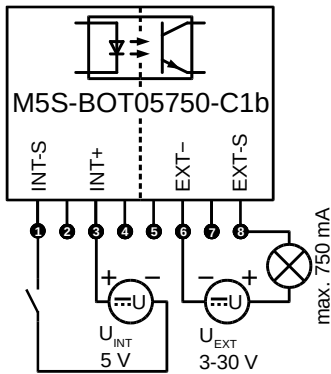
| Signal                |                      |
|-----------------------|----------------------|
| ←                     |                      |
| <b>Pin 1 (Output)</b> | <b>Pin 8 (Input)</b> |
| Active low            | Active high          |
| Passive               | Passive              |

### M5S digital output - „BO“/“PO“

- For control of relays, lamps, buzzers or other signaling devices
- Galvanic isolation via optocouplers
- Solid state relay or transistor output

### M5S-BOT03750C1b, M5S-BOT05750C1b

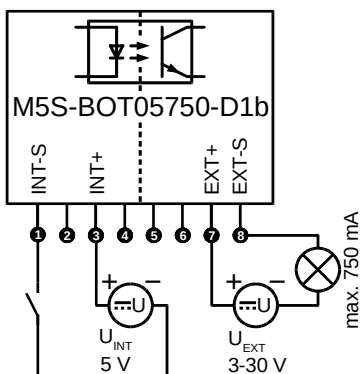
| Description                       | Internal circuit |         |                 | Isolation | External circuit |                  |
|-----------------------------------|------------------|---------|-----------------|-----------|------------------|------------------|
|                                   | Version          | Signal  | Voltage/current |           | Signal           | Voltage/current  |
| Optocouple with transistor output | BOT03            | 0-5 kHz | 3.3 V/5 mA DC   | Yes       | 0-5 kHz, sink    | 3-30 V/750 mA DC |
|                                   | BOT05            | 0-5 kHz | 5 V/5 mA DC     |           |                  |                  |



| Signal        |                |
|---------------|----------------|
| →             |                |
| Pin 1 (Input) | Pin 8 (Output) |
| Active low    | Active low     |
| Passive       | Passive        |

### M5S-BOT03750D1b, M5S-BOT05750D1b

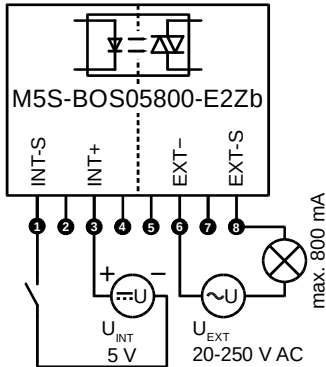
| Description                       | Internal circuit |         |                 | Isolation | External circuit |                  |
|-----------------------------------|------------------|---------|-----------------|-----------|------------------|------------------|
|                                   | Version          | Signal  | Voltage/current |           | Signal           | Voltage/current  |
| Optocouple with transistor output | BOT03            | 0-5 kHz | 3.3 V/5 mA DC   | Yes       | 0-5 kHz, source  | 3-30 V/750 mA DC |
|                                   | BOT05            | 0-5 kHz | 5 V/5 mA DC     |           |                  |                  |



| Signal        |                |
|---------------|----------------|
| →             |                |
| Pin 1 (Input) | Pin 8 (Output) |
| Active low    | Active high    |
| Passive       | Passive        |

### M5S-BOS03800E2Zb, M5S-BOS05800E2Zb

| Description                                | Internal circuit |          |                 | Isolation | External circuit |                          |
|--|------------------|----------|-----------------|-----------|------------------|--------------------------|
|  | Version          | Signal   | Voltage/current |           | Signal           | Voltage/current          |
| SSR binary output,<br>zero-cross switching | BOS03            | 0-100 Hz | 3.3 V/5 mA DC   | Yes       | 50-60 Hz, AC     | 20-250 V,<br>1-800 mA AC |
|  | BOS05            | 0-100 Hz | 5 V/5 mA DC     |           |                  |                          |



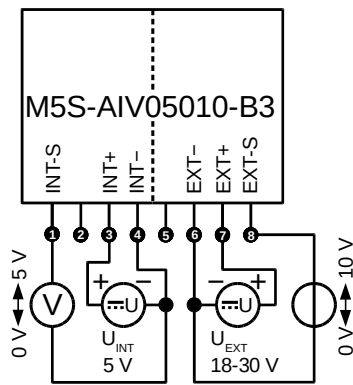
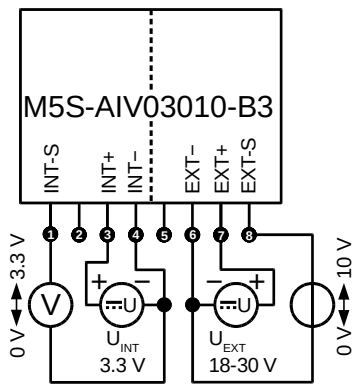
| Signal        |                |
|---------------|----------------|
| →             |                |
| Pin 1 (Input) | Pin 8 (Output) |
| Active low    | Active low     |
| Passive       | Passive        |

### M5S analogue input - „AI“

- For measurement of analogue signals, potentiometers, temperature sensors as well as other current or voltage sources
- Optional: isolated or non-isolated signal
- Multi function: DC voltage/current as well as different types of temperature sensors

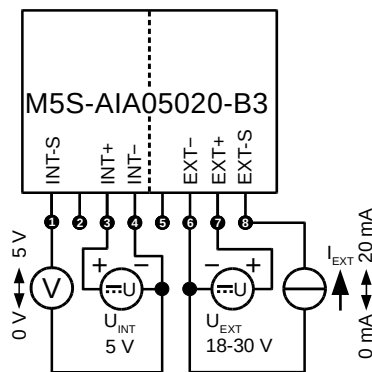
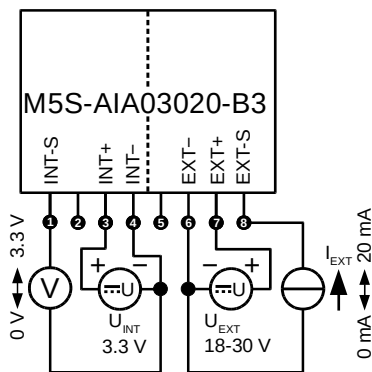
#### M5S-AIV03010B3, M5S-AIV05010B3

| Description                     | Internal circuit |            |                | Isolation | External circuit |                     |
|---------------------------------|------------------|------------|----------------|-----------|------------------|---------------------|
|                                 | Version          | Signal     | Supply         |           | Signal           | Supply              |
| Analogue input voltage isolated | AIV03            | 0-3.3 V DC | 3.3 V/10 mA DC | Yes       | 0-10 V DC        | 18-30 V<br>30 mA DC |
|                                 | AIV05            | 0-5 V DC   | 5 V/10 mA DC   |           |                  |                     |



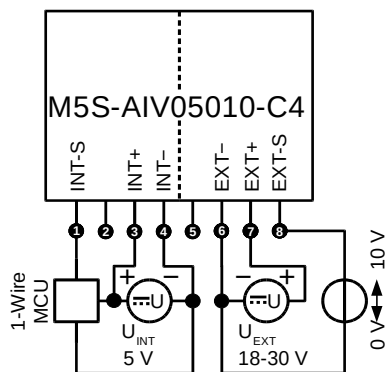
#### M5S-AIA03020B3, M5S-AIA05020B3

| Description                     | Internal circuit |            |                | Isolation | External circuit |                     |
|---------------------------------|------------------|------------|----------------|-----------|------------------|---------------------|
|                                 | Version          | Signal     | Supply         |           | Signal           | Supply              |
| Analogue input current isolated | AIA03            | 0-3.3 V DC | 3.3 V/10 mA DC | Yes       | 0-20 mA DC       | 18-30 V<br>30 mA DC |
|                                 | AIA05            | 0-5 V DC   | 5 V/10 mA DC   |           |                  |                     |



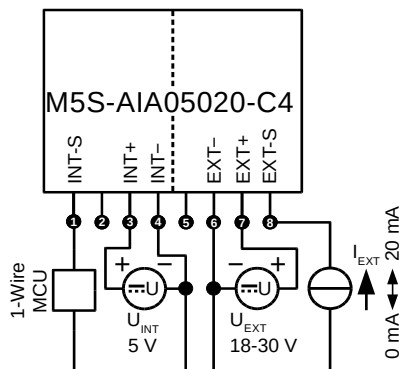
### M5S-AIV03010C4, M5S-AIV05010C4

| Description                             | Internal circuit |                               |                | Isolation | External circuit |                     |
|---|------------------|-------------------------------|----------------|-----------|------------------|---------------------|
|   | Version          | Signal                        | Supply         |           | Signal           | Supply              |
| Analogue input voltage isolated, 1-Wire | AIV03            | 3.3 V 1-Wire serial interface | 3.3 V/10 mA DC | Yes       | 0-10 V DC        | 18-30 V<br>30 mA DC |
|   | AIV05            | 5 V 1-Wire serial interface   | 5 V/10 mA DC   |           |                  |                     |



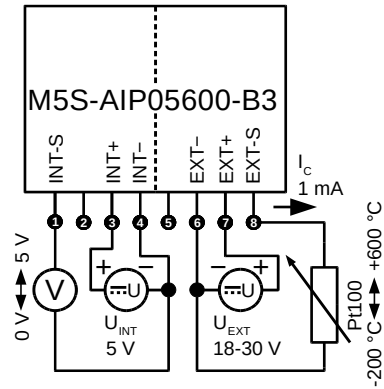
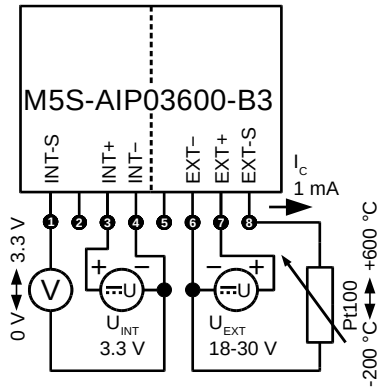
### M5S-AIA03020C4, M5S-AIA05020C4

| Description                             | Internal circuit |                               |                | Isolation | External circuit |                     |
|---|------------------|-------------------------------|----------------|-----------|------------------|---------------------|
|   | Version          | Signal                        | Supply         |           | Signal           | Supply              |
| Analogue input current isolated, 1-Wire | AIA03            | 3.3 V 1-Wire serial interface | 3.3 V/10 mA DC | Yes       | 0-20 mA DC       | 18-30 V<br>30 mA DC |
|   | AIA05            | 5 V 1-Wire serial interface   | 5 V/10 mA DC   |           |                  |                     |



### M5S-AIP03600B3, M5S-AIP05600B3

| Description   | Internal circuit |            |                | Isolation | External circuit                 |                     |
|---|------------------|------------|----------------|-----------|----------------------------------|---------------------|
|   | Version          | Signal     | Supply         |           | Signal                           | Supply              |
| Analogue input temperature sensor<br>Pt100 isolated | AIP03            | 0-3.3 V DC | 3.3 V/10 mA DC | Yes       | Pt100<br>2-wire<br>-200 - 600 °C | 18-30 V<br>30 mA DC |
|   | AIP05            | 0-5 V DC   | 5 V/10 mA DC   |           |                                  |                     |



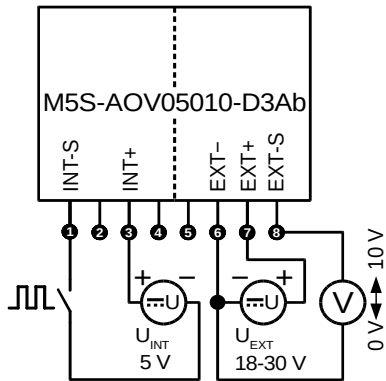


### M5S analogue output - „AO“

- For the control of speed regulators, heating regulators or other voltage/current measuring devices.
- Optional: isolated or non-isolated signal
- Analogue signals: 10 V, 20 mA

### M5S-AOV03010D3Ab, M5S-AOV05010D3Ab

| Description                      | Internal circuit |                   |                | Isolation | External circuit |                     |
|----------------------------------|------------------|-------------------|----------------|-----------|------------------|---------------------|
|                                  | Version          | Signal            | Supply         |           | Signal           | Supply              |
| Analogue output voltage isolated | AOV03            | PWM               | 3.3 V/10 mA DC | Yes       | 0-10 V DC        | 18-30 V<br>30 mA DC |
|                                  | AOV05            | 0-100% duty cycle | 5 V/10 mA DC   |           |                  |                     |

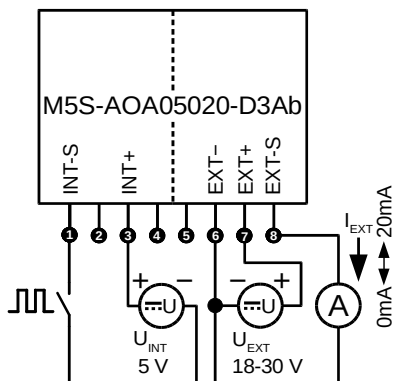


| Signal        |                |
|---------------|----------------|
| →             |                |
| Pin 1 (Input) | Pin 8 (Output) |
| Active low    | 10 V           |
| Passive       | 0 V            |

Valid frequency range for internal circuit signal (input signal): 1-10 kHz

### M5S-AOA03020D3Ab, M5S-AOA05020D3Ab

| Description                      | Internal circuit |                   |                | Isolation | External circuit |                     |
|----------------------------------|------------------|-------------------|----------------|-----------|------------------|---------------------|
|                                  | Version          | Signal            | Supply         |           | Signal           | Supply              |
| Analogue output current isolated | AOA03            | PWM               | 3.3 V/10 mA DC | Yes       | 0-20 mA DC       | 18-30 V<br>30 mA DC |
|                                  | AOA05            | 0-100% duty cycle | 5 V/10 mA DC   |           |                  |                     |



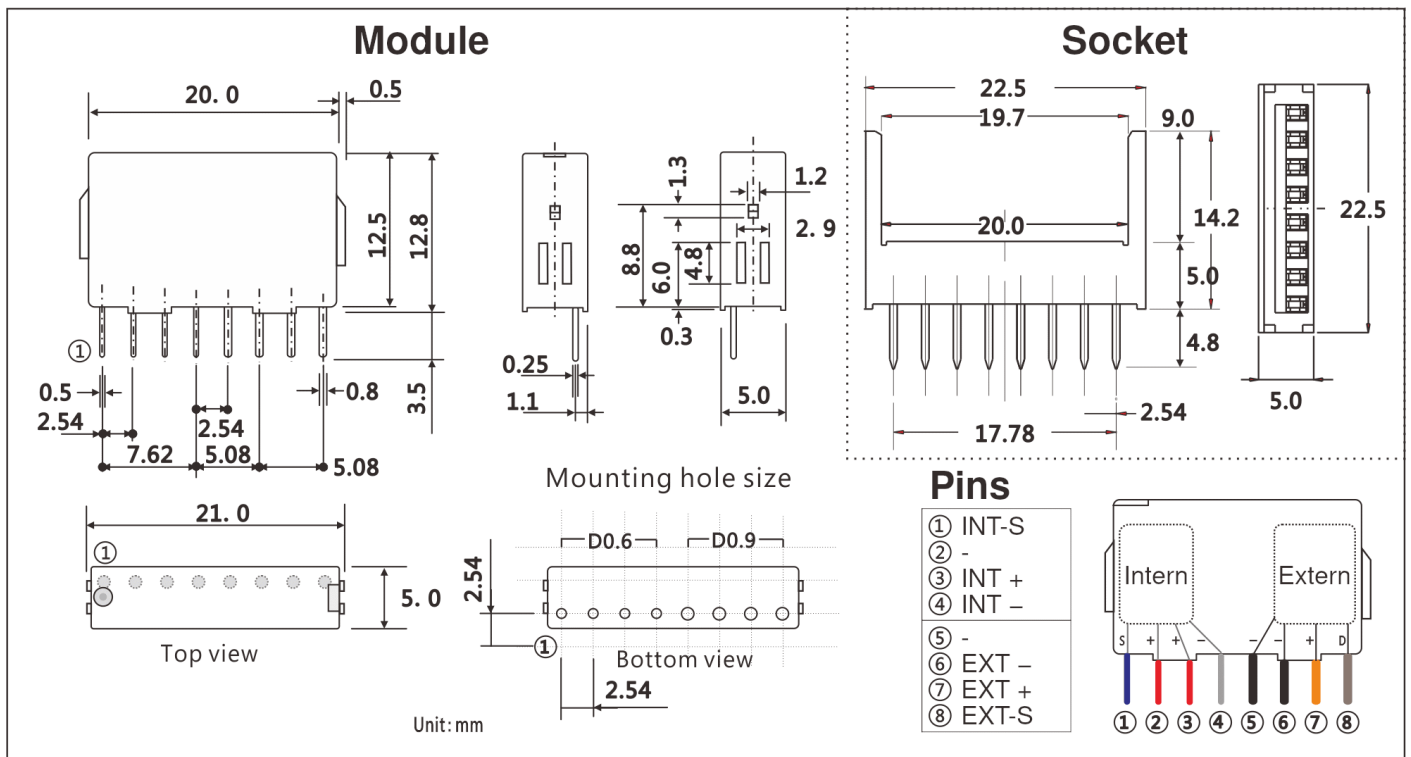
| Signal        |                |
|---------------|----------------|
| →             |                |
| Pin 1 (Input) | Pin 8 (Output) |
| Active low    | 20 mA          |
| Passive       | 0 mA           |

Valid frequency range for internal circuit signal (input signal): 1-10 kHz

## Signal description

| Signal | Name                     | Description  |
|--------|--------------------------|--|
| INT-S  | Internal signal          | Internal connection to the microcontroller, can be used as GPIO (BI, PI, BO, PO modules) or PWM (AO modules). If supported by the microcontroller, also analogue signals (ADC or DAC) (AI, AO modules) or 1-wire serial interface (AI modules), for microcontrollers that do not have ADC functions. |
| INT+   | Internal positive supply | Internal power supply from the microcontroller, e.g. 3.3 V or 5 V  |
| INT-   | Internal negative supply | Ground of the internal supply circuit  |
| EXT-   | External negative supply | Ground of the external supply circuit  |
| EXT+   | External positive supply | External power supply, mostly 24 V DC  |
| EXT-S  | External signal          | External signal. This is where the external signals like switching signals, switched loads, temperature sensors, analogue sensors or analogue control inputs are connected.  |

## Dimensions [mm]



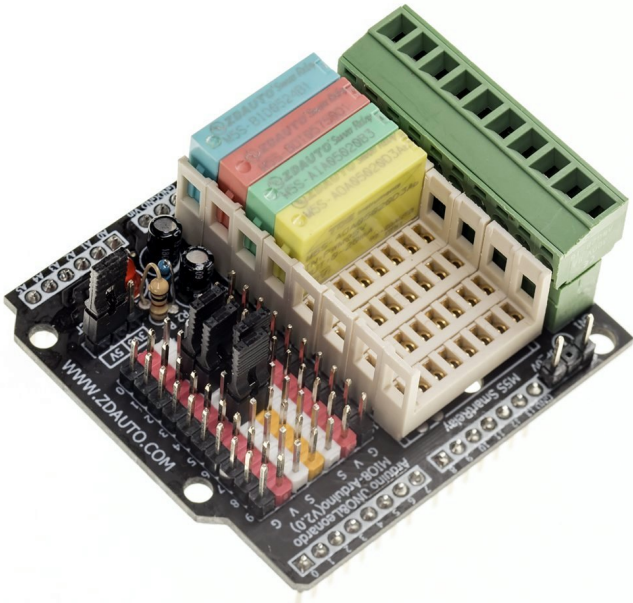
## Evaluation boards for Arduino and Raspberry Pi

Using the evaluation boards, the functionality of M5S I/O modules can be explored easily. The M5S I/O modules allow switching of external circuits and input of external circuits with higher voltages than directly allowed on the Arduino/ Raspberry Pi, e.g. 24 V or 230 V (depending on the specific M5S I/O module version).

### Features

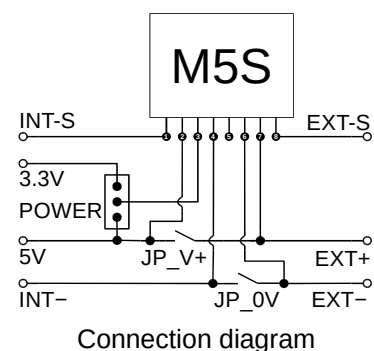
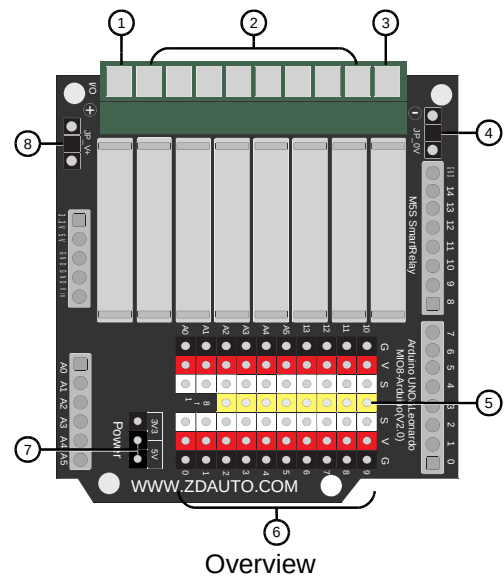
- 8 sockets for M5S modules
- Terminal blocks for external circuit (EXT-S) and external power supply, e.g. 24 V DC
- Pin header for internal circuit (INT-S)
- Configuration and pin mapping of internal circuit to processor pins via jumper cables
- Isolated circuit possible if only isolated M5S modules are used

## MIO-UNO: Arduino UNO M5S I/O Shield



### Pin assignment

- 1: (EXT+) External circuit +, connected to all pins 7 of the M5S modules
- 2: (EXT-S-1..8) External signals 1 - 8 (pin 8 of each M5S)
- 3: (EXT-) External circuit -, connected to all pins 6 of the M5S modules
- 4: JP\_0V connects external circuit - to internal power supply - (common ground)
- 5: (INT-S-1..8) Internal signals 1 - 8 (pin 1 of each M5S)
- 6: Connector field
  - G: Internal power supply -
  - V: Internal power supply +
  - S: Signal pin of Arduino
- 7: POWER connects the voltage rail of the Arduino with all pins 3 of the M5S modules (supply of M5S):
  - Pin 1-2: 3.3 V
  - Pin 2-3: 5 V
- 8: JP\_V+ connects external circuit + with internal 5 V power supply. (CAUTION, only for external voltage 5 V!)



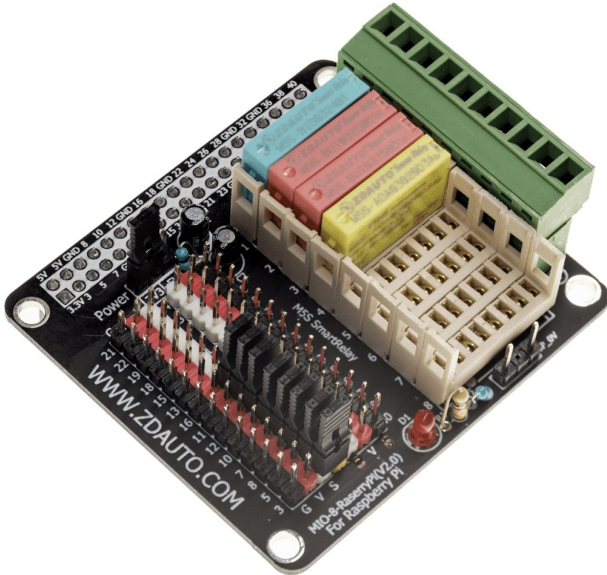
## Application wiring diagrams (examples)

Arduino pins and M5S pins need to be connected by jumpers or jumper cables.

|  |   |
|--|---|
|  |   |
| <p>Detecting a voltage of 24 V DC.<br/>Input wiring diagram BID0524B1.<br/>M5S 1 connected to Arduino digital pin 2.</p>   | <p>Switching a load with a maximum voltage of 24 V DC and a maximum current of 750 mA.<br/>Output wiring diagram BOT05750D1b.<br/>M5S 2 connected to Arduino digital pin 3.</p> |
|  |   |
| <p>Measuring an analogue current ranging from 0 to 20 mA with voltage supply 24 V DC.<br/>Input wiring diagram AIA05020B3.<br/>M5S 3 connected to Arduino analogue pin A4.</p> | <p>Output of an analogue current ranging from 0 to 20 mA with voltage supply 24 V DC.<br/>Output wiring diagram AOA05020D3Ab.<br/>M5S 4 connected to Arduino digital pin 5.</p> |

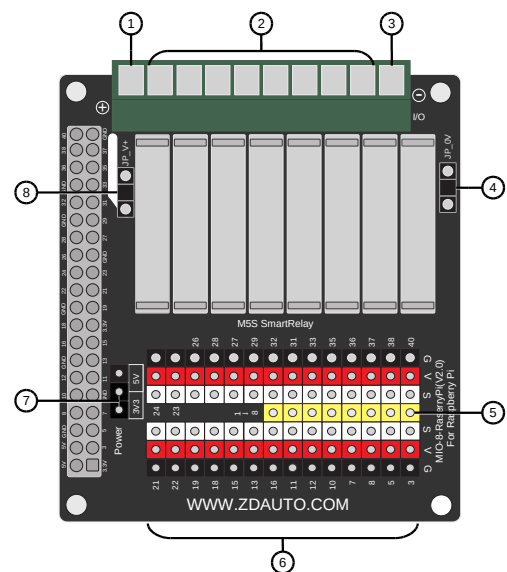
## MIO-RASPBERRYPI: Raspberry Pi M5S I/O HAT

Supports all Raspberry Pi models with a 40-pin GPIO interface, e.g. Pi 1 Model B+, Pi 3 Model B.

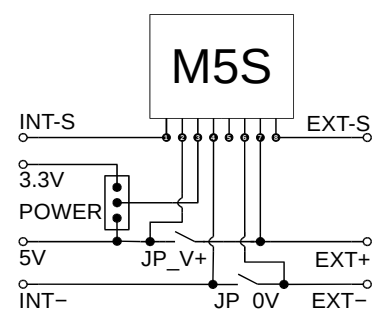


### Pin assignment

- 1: (EXT+) External circuit +, connected to all pins 7 of the M5S modules
- 2: (EXT-S-1..8) External signals 1 - 8 (pin 8 of each M5S)
- 3: (EXT-) External circuit -, connected to all pins 6 of the M5S modules
- 4: JP\_0V connects external circuit - to internal power supply - (common ground)
- 5: (INT-S-1..8) Internal signals 1 - 8 (pin 1 of each M5S)
- 6: Connector field
  - G: Internal power supply -
  - V: Internal power supply +
  - S: Signal pin of Raspberry Pi
- 7: POWER connects the voltage rail of the Arduino with all pins 3 of the M5S modules (supply of M5S):
  - Pin 1-2: 3.3 V
  - Pin 2-3: 5 V (should not be used!)
- 8: JP\_V+ connects external circuit + with internal 5 V power supply (CAUTION, only for external voltage 5 V!)



Overview



Connection diagram

## Application wiring diagrams (examples)

Raspberry Pi pins and M5S pins need to be connected by jumpers or jumper cables.

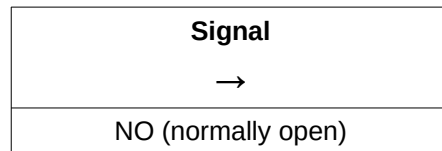
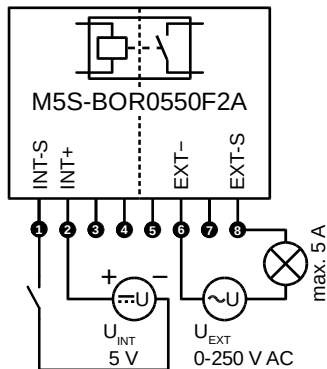
|   |   |
|---|---|
|   |   |
| <p>Detecting a voltage of 24 V DC.<br/>Input wiring diagram BID0324B1.<br/>M5S 1 connected to Raspberry Pi pin 16 (GPIO23).</p>   | <p>Switching of a load with a maximum voltage of 24 V DC<br/>and a maximum current of 750 mA.<br/>Output wiring diagram BOT03750D1b.<br/>M5S 2 connected to Raspberry Pi pin 11 (GPIO17).</p> |
|   |   |
| <p>Switching of a load with a maximum voltage of 24 V DC<br/>and a maximum current of 750 mA.<br/>Output wiring diagram BOT03750D1b.<br/>M5S 2 connected to Raspberry Pi pin 12 (GPIO18).</p> | <p>Output of an analogue current ranging from 0 to 20 mA<br/>with voltage supply 24 V DC.<br/>Output wiring diagram AOA03020D3Ab.<br/>M5S 4 connected to Raspberry Pi pin 10 (GPIO15).</p>    |

## M5S mechanical relays – „BOR“

- For switching higher currents with a low switching frequency
- Relay driver circuit at the input (INT) required
- Dry, gold-plated silver alloy contact at the output (EXT)
- Galvanic isolation

### M5S-BOR0550F2A, M5S-BOR2450F2A

| Description         | Internal circuit |         |                 | Isolation | External circuit |
|---------------------|------------------|---------|-----------------|-----------|------------------|
|                     | Version          | Signal  | Voltage/current |           | Voltage/current  |
| Relay binary output | BOR05            | 0-20 Hz | 5 V/25 mA DC    | Yes       | 250 V, 0-5 A AC  |
|                     | BOR24            | 0-20 Hz | 24 V/5 mA DC    |           | 30 V, 0-3 A DC   |



Usage with the evaluation boards is not recommended, as a current of 25 mA is required.

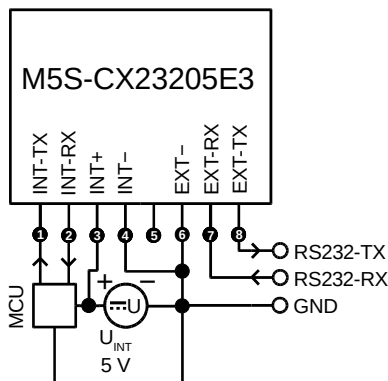


## M5S communication modules - „CX“

- These modules can be used to address different communication interfaces.
- The communication modules use 2 signal pins on the control side as opposed to the I/O modules, each using 1 signal pin.
- TX/RX wiring on the control side
- Optional: isolated or non-isolated signal
- RS232, RS422, RS485, USB, LAN, CAN
- Not usable with the evaluation boards for Arduino and Raspberry Pi

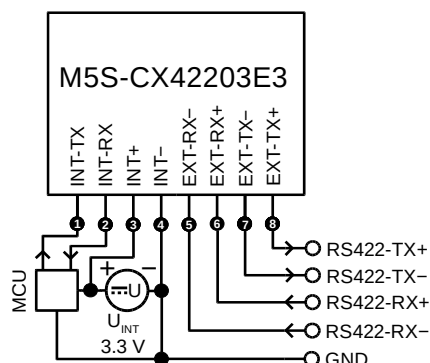
### M5S-CX23203E3, M5S-CX23205E3

| Description                             | Internal circuit |             |               | Isolation | External circuit      |                     |
|---|------------------|-------------|---------------|-----------|-----------------------|---------------------|
|   | Version          | Signal      | Supply        |           | Signal                | Supply              |
| RS232 communication module non-isolated | CX23203          | 0-3.3 V TTL | 3.3 V/5 mA DC | No        | ± 9 V RS232 interface | Via internal supply |
|   | CX23205          | 0-5 V TTL   | 5 V/5 mA DC   |           |                       |                     |



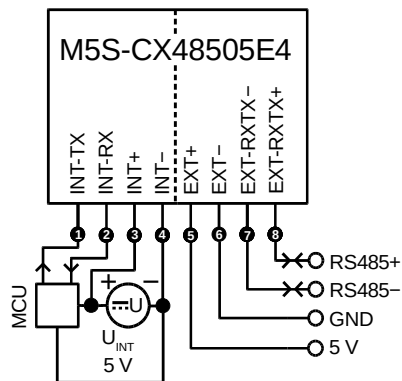
### M5S-CX42203E3, M5S-CX42205E3

| Description                             | Internal circuit |             |               | Isolation | External circuit                         |                     |
|---|------------------|-------------|---------------|-----------|--|---------------------|
|   | Version          | Signal      | Supply        |           | Signal                                   | Supply              |
| RS422 communication module non-isolated | CX42203          | 0-3.3 V TTL | 3.3 V/5 mA DC | No        | 5 V differential voltage RS422 interface | Via internal supply |
|   | CX42205          | 0-5 V TTL   | 5 V/5 mA DC   |           |  |                     |



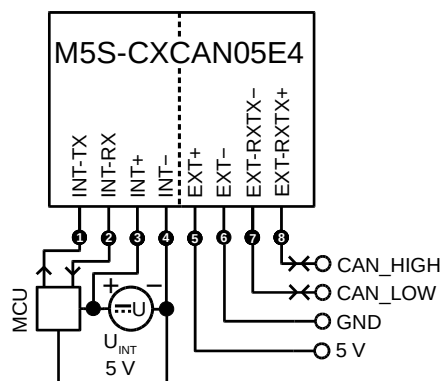
### M5S-CX48503E4, M5S-CX48505E4

| Description                         | Internal circuit |             |               | Isolation | External circuit                         |              |
|-------------------------------------|------------------|-------------|---------------|-----------|--|--------------|
|                                     | Version          | Signal      | Supply        |           | Signal                                   | Supply       |
| RS485 communication module isolated | CX48503          | 0-3.3 V TTL | 3.3 V/5 mA DC | Yes       | 5 V differential voltage RS485 interface | 5 V/ 8 mA DC |
|                                     | CX48505          | 0-5 V TTL   | 5 V/5 mA DC   |           |  |              |



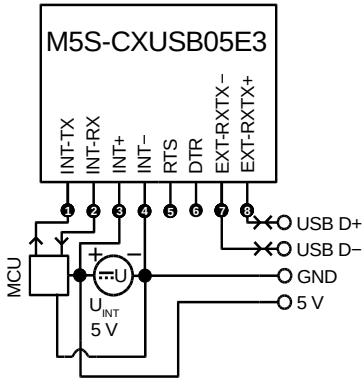
### M5S-CXCAN03E4, M5S-CXCAN05E4

| Description                       | Internal circuit |             |               | Isolation | External circuit |              |
|-----------------------------------|------------------|-------------|---------------|-----------|------------------|--------------|
|                                   | Version          | Signal      | Supply        |           | Signal           | Supply       |
| CAN communication module isolated | CXCAN03          | 0-3.3 V TTL | 3.3 V/5 mA DC | Yes       | CAN interface    | 5 V/ 8 mA DC |
|                                   | CXCAN05          | 0-5 V TTL   | 5 V/5 mA DC   |           |                  |              |



### M5S-CXUSB03E3, M5S-CXUSB05E3

| Description                           | Internal circuit |             |               | Isolation | External circuit |                     |
|---------------------------------------|------------------|-------------|---------------|-----------|------------------|---------------------|
|                                       | Version          | Signal      | Supply        |           | Signal           | Supply              |
| USB communication module non-isolated | CXUSB03          | 0-3.3 V TTL | 3.3 V/5 mA DC | No        | USB interface    | Via internal supply |
|                                       | CXUSB05          | 0-5 V TTL   | 5 V/5 mA DC   |           |                  |                     |



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