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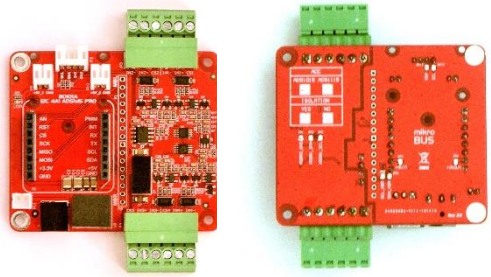
I2C 4AI ADS1x15 Pro

The **BOKRA I2C 4AI ADS1x15 Pro** modules are professional analog input modules based on 16-bit ADS1115 and 12-bit ADS1015 ADC. Compatible with most types of microcontrollers (I^2C interface is used to communicate with them).

The **BOKRA I2C 4AI ADS1x15 Pro** modules allow you to measure four differential analog signals, both voltage and current. The two ADCs installed on the module (either ADS1115-Q1 or ADS1015 from Texas Instruments) are 16 and 12 bits respectively. Type of ADC - ΔΣ (delta-sigma). Voltage measurement ranges: 0-0.5V, 0-5V, 0-10V, ± 0.5V, ± 5V, ± 10V. Current measurement ranges: 0-20mA, 4-20mA, ± 20mA, 0-40mA. Measurement speed: up to 860 measurements per second for ADS1115 and up to 3300 measurements per second for ADS1015.

mikroBUS modules can be installed on the **BOKRA I2C 4AI ADS1x15 Pro** modules, for example, BOKRA SoM Lite or Click® modules from Mikroelekronika.

Input Power: 9-36VDC. The DC-DC converter produces uninsulated power 5VDC, 1,5A. Overvoltage and reverse polarity protection.



In the modification of the Module with isolation, there is not only isolation of the power supply of the analog part of the module (1.5KVDC), but also isolation of communication between the logical and analog parts of the Module via the I^2C interface (3750Vrms).

On the website of the manufacturer of the ADC - Texas Instruments - are some of the main applications:

- Voltage and current monitoring
- Factory Automation and Process Control
- Temperature measurement systems
- Transmission and other sensors
- Battery control
- Infotainment systems

BOKRA I2C 4AI ADS1x15 Pro features

- Two modifications differing in ADC resolution (12 bits for ADS1015, 16 bits for ADS1115)
- The type of ADC used is ΔΣ (delta sigma)
- 4 differential analog input channels
- The range of voltage measurement is:
  0-0,5V, 0-5V, 0-10V,
  ±0.5V, ±5V, ±10V
- The range of current measurement is:
  0-20mA, 4-20mA, ±20mA, 0-40mA
- Measurement speed:
  up to 860 measurements per second for ADS1115;
  up to 3300 measurements per second for ADS1015.
- I^2C interface: 100Khz, 400Khz
- The ADC addresses on the mikroBUS interface are variable. The ADC for AI01 and AI02 channels has the address 1001000x (can be changed to 1001001x using JP1 on the bottom-side of the Module), the ADC

for AI03 and AI04 channels has the address 1001011x (can be changed to 10010101x with JP2 and JP3 at the bottom- side of the Module)

- Programmable Gain Amplifier (PGA)
- Compatible with most types of microcontrollers
- Possibility to install a module with mikroBUS bus:
  - BOKRA modules (SoM Lite series and other modules);
  - Click® modules from MikroElekronika
- Power supply: non-isolated, 9-36VDC
- Two modifications of the module: without isolation and with isolation of the analog part of the module - according to power supply (1.5KVDC) and according to I²C interface signals (using a Si8602 digital isolator chip)
- Overvoltage and reverse polarity protection
- The module size 65 x 56 mm. The format of the module corresponds to the popular format of the Raspberry Pi 3A+, which greatly simplifies its use with the Raspberry Pi.

Calculation of the measured voltage and current

To determine the measured voltage, use the equation:

$$\text{ADCNumber} = 2^{N-1} \times \frac{1}{FSR} \times \frac{2k\Omega}{10k\Omega} \times V_{in}$$

where:

N	-	ADC resolution
FSR	-	positive full-scale input range decided by setting PGA[2:0] bits in config register
V_{in}	-	input voltage

To determine the measured current, use the equation:

$$\text{ADCNumber} = 2^{N-1} \times \frac{1}{FSR} \times \frac{2k\Omega}{10k\Omega} \times 120\Omega \times I_{in}$$

where:

N	-	ADC resolution
FSR	-	positive full-scale input range decided by setting PGA[2:0] bits in config register
I_{in}	-	input current

Below table shows the recommended FSR values (by setting PGA[2:0] bits in config register) to achieve best accuracy for given input ranges. Note that these are just recommended numbers for best accuracy. The user still can use different configurations as long as the ADC input range is not saturated.

Input Source	FSR, V	Analog Full Scale	16-bit max code	12-bit max code
0~10V, ±10V	2.048	±10.240V	±32767	±2047
0~5V, ±5V	1.024	±5.120V	±32767	±2047
0~0.5V, ±0.5V	0.256	±1.280V	±32767	±2047
0~20mA, ±20mA	0.512	21.33mA	±32767	±2047
0-40mA	1.024	42.67mA	±32767	±2047

Using the mikroBUS slot.

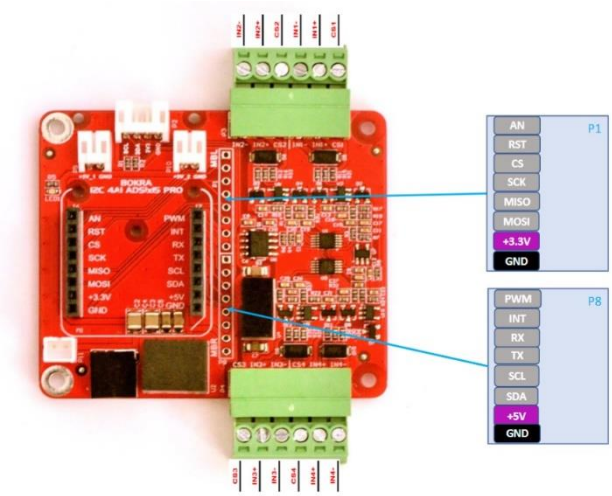
BOKRA I2C 4AI ADS1x15 Pro modules contain a mikroBUS slot, which can be used to install various modules for the mikroBUS, including SoM (System on Module), i.e. modules with microcontroller.

Installing SoM in this Module is used in the following two cases:

1) To build simple devices. In this case, the installed SoM is the main one in the device and controls the analog input on this Module and other modules and/or devices on the I²C interface. It is necessary that the installed SoM had pull-up resistors on the I²C interface. If they are absent, you can turn on and use the pull-up resistors located on the Module.

2) For complex devices with smart analog input. In this case, the installed SoM controls the analog input on this Module and performs certain smart functions, but at the same time it is a slave for some other module on the I2C bus, which is the main one in the device / system. For I^2C, both the installed SoM and the main module are master and the more complex multimaster mode must be used on the I^2C interface. It is desirable that the installed SoM has the option of disabling pull-up resistors on the I^2C.

The following figure shows the **location of elements on the BOKRA I2C 4AI ADS1x15 Pro module**.



Power Supply - Via J1 or P11 connector.

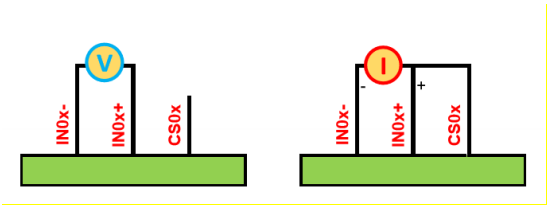
P11 can also be used to transfer input power to another module.

P9 and P10 connectors are intended for receiving on other modules of power supply 5VDC from this Module.

MBL and MBR (P1 and P8) connectors are used to transfer signals to other modules (if a module with SoM is installed on the analog input module in the mikroBUS slot), or to receive I^2C interface signals from the main module / device of the system (master).

Communication with **BOKRA I2C 4AI ADS1x15 Pro** via I^2C interface via an external P3 connector.

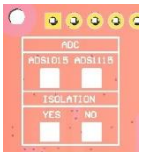
Connection diagram of voltage and current signals:



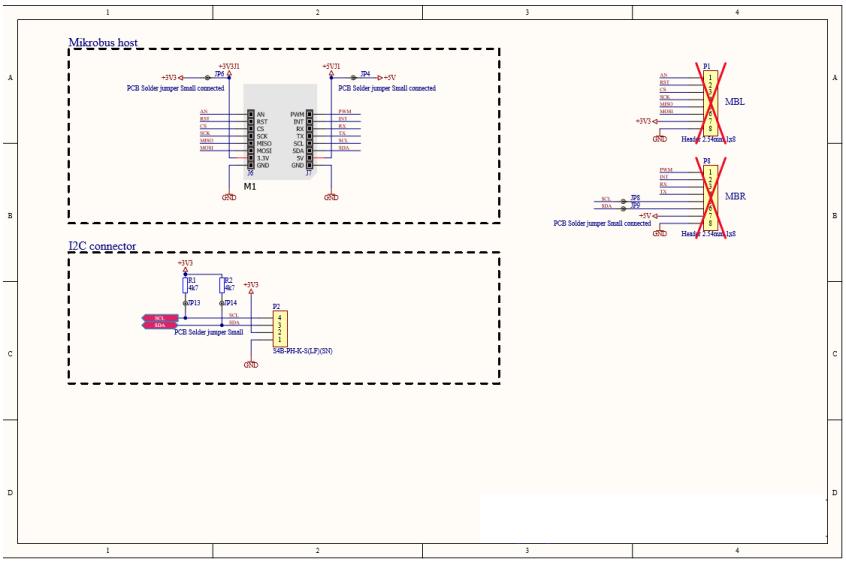
This figure shows the commutation for both voltage measurement and current measurement. Such switching commutation can be done for any channel, regardless of switching for other channels.

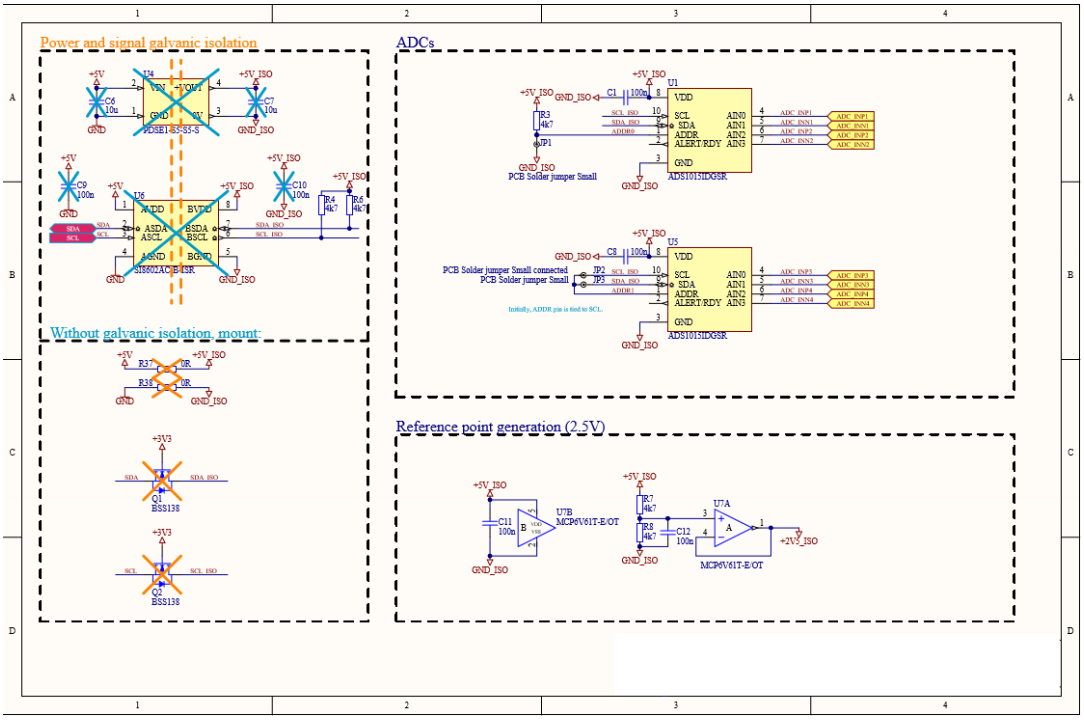
Commutation should be done on the plug part of the terminal block through which the measured signals are supplied.

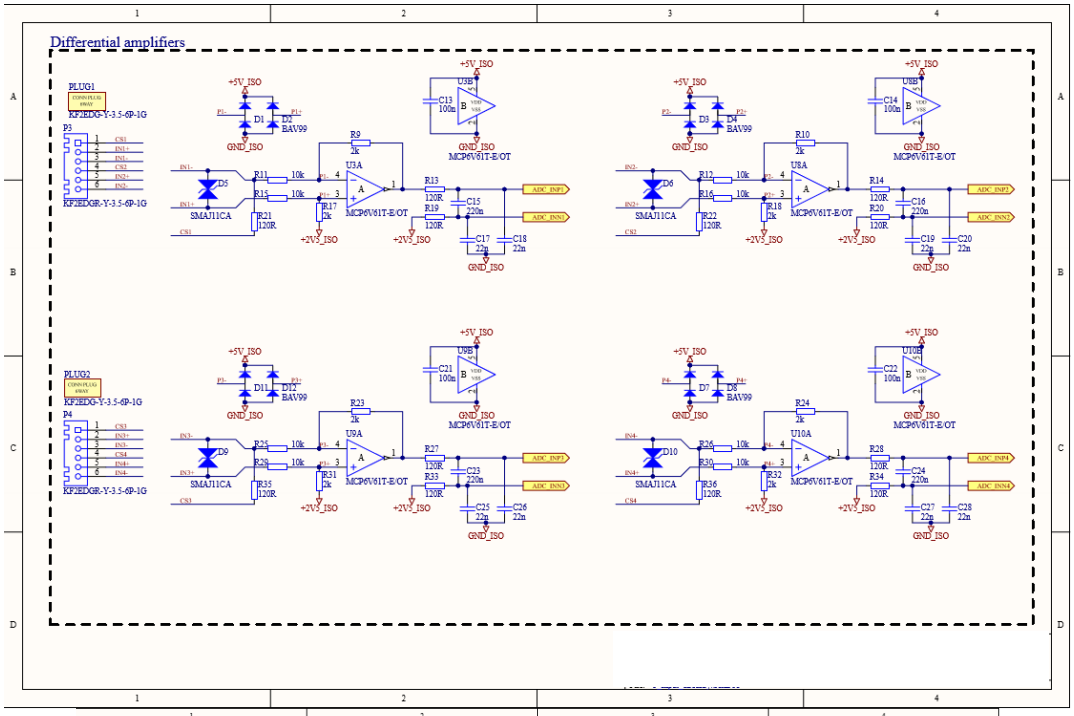
The version of the Module (the type of ADC used and the presence/absence of isolation of the analog part) are indicated on its bottom side:

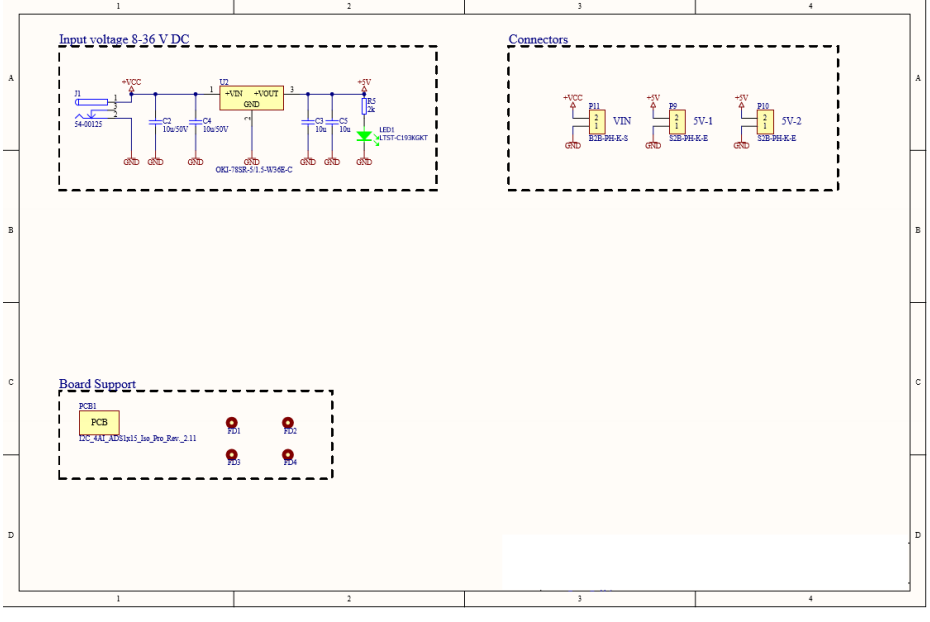


BOKRA I2C 4AI ADS1x15 Pro schematic:




Power and signal galvanic isolation
ADCs
Without galvanic isolation, mount:
Reference point generation (2.5V)


Differential amplifiers


Input voltage 8-36 V DC
Connectors
Board Support