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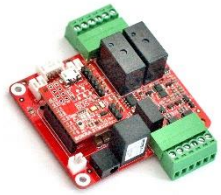
I2C 2RO+2DI Pro

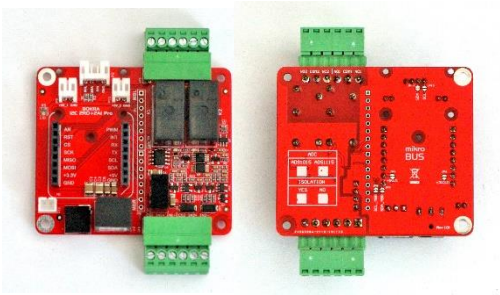
The **BOKRA I2C 2RO+2AI Pro** modules are professional modules with two Omron G5Q-14 relays and two analog input channels based on an ADC from Texas Instruments (either ADS1115-Q1 or ADS1015).



The relays have a maximum switching current of 3A at a voltage of 250 VAC or 30 VDC. The type of switch is SPDT. Galvanic isolation - individual. An electrical insulation strength of 4 kV VAC (within 1 minute between the coil and the contacts) and 1 kV VAC (within 1 minute between the contacts of the same polarity) is ensured.

The relay is controlled via the I^2C interface using the PCA9536DP,118.

The **BOKRA I2C 2RO+2AI Pro** modules allow you to measure two 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 2RO+2AI 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).

Main applications of the module:

- Chemical and refining industry
- Infotainment systems
- PLC and Data Acquisition Systems (DAS)
- Agriculture and agribusiness
- Transport
- PID controllers and actuators

BOKRA I2C 2RO+2AI Pro features

- PCA9536DP chip with I^2C bus for relay control
- Grove connector for external module with I^2C bus
- Compatible with major well-known microcontrollers
- 2 SPDT relays
- Current consumption of each relay is less than 80mA
- Characteristics for resistive load:
  - 3A 30VDC
  - 3A 250VAC
- Dielectric strength:
  - 4 kV VAC, for 1 minute between coil and contacts
  - 1 kV VAC, for 1 minute between contacts of the same polarity

- Two modifications differing in ADC resolution (12 bits for ADS1015, 16 bits for ADS1115)
- The type of ADC used is ΔΣ (delta sigma)
- 2 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.
- The address PCA9536DP on the mikroBUS interface is fixed, 1000001x
- The ADC address on the mikroBUS interface is fixed, 1001011x
- Programmable Gain Amplifier (PGA)
- 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 I^2C 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

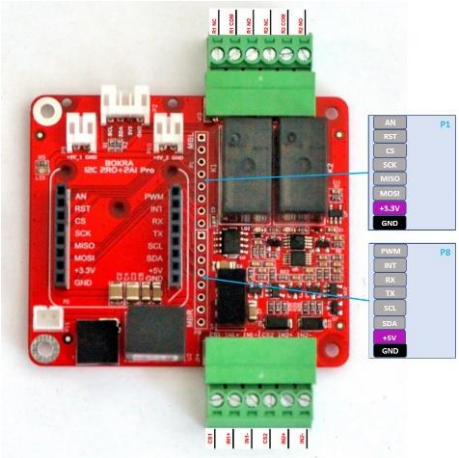
Using the mikroBUS slot.

BOKRA I2C 2RO+2AI 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 I^2C interface. It is necessary that the installed SoM had pull-up resistors on the I^2C 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 2RO+2AI Pro module**.



Power Supply - via J1 or P11 connector.

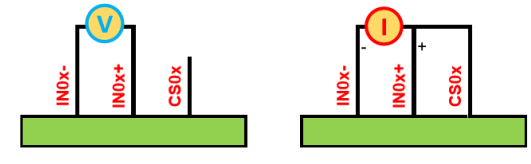
P11 can also be used to transfer input power to another module.

P9 and P10 connectors are intended for transferring 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 this module in the mikroBUS slot), or to receive I^2C interface signals from the main module / device of the system (master).

It is possible to communicate with the Module via the I^2C interface through an external connector physically located under the mikroBUS slot.

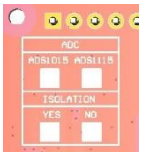
Connection diagram of voltage and current signals:



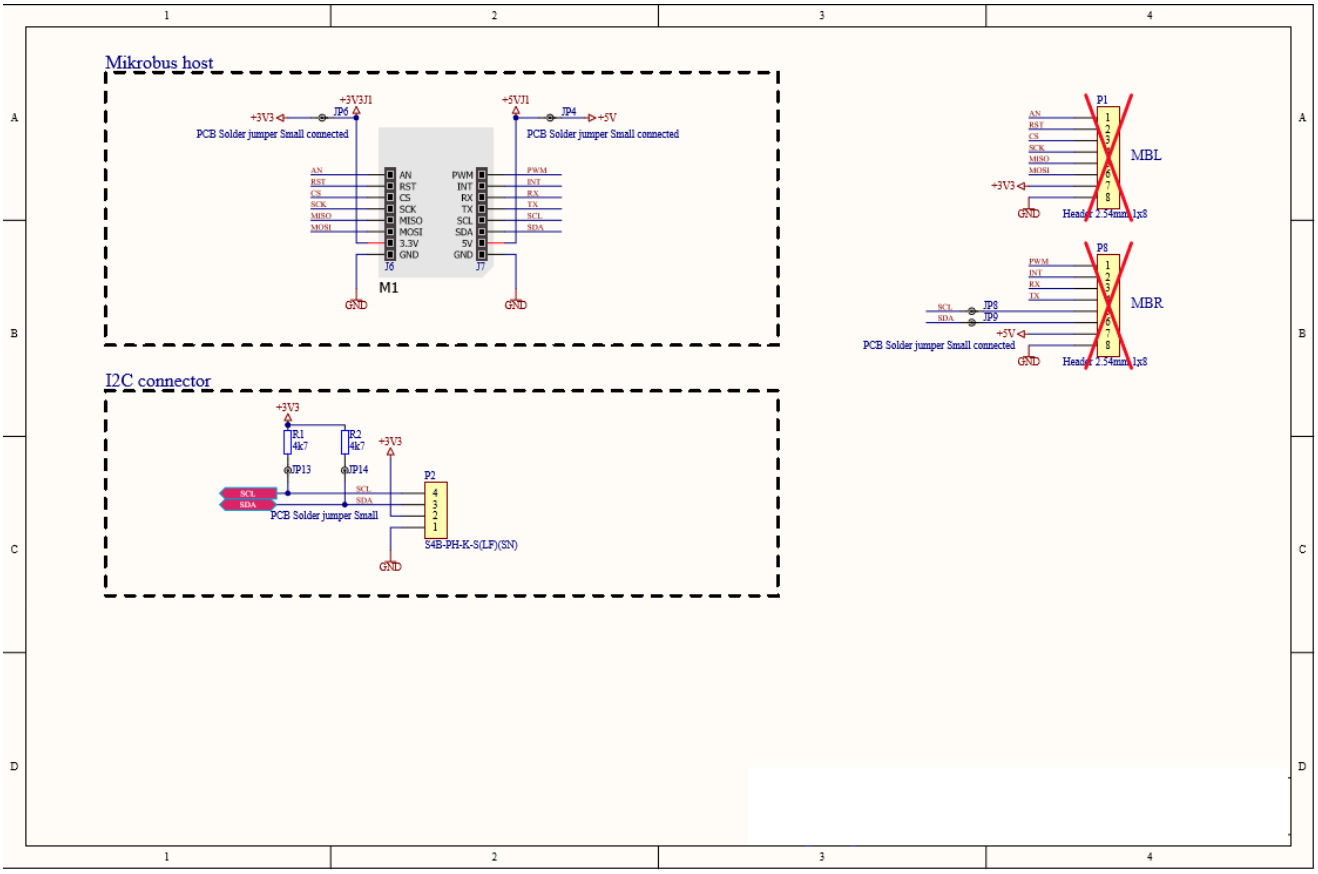
This figure shows the commutation for both voltage measurement and current measurement. Such switching commutation can be done for any channel, regardless of switching for other channels.

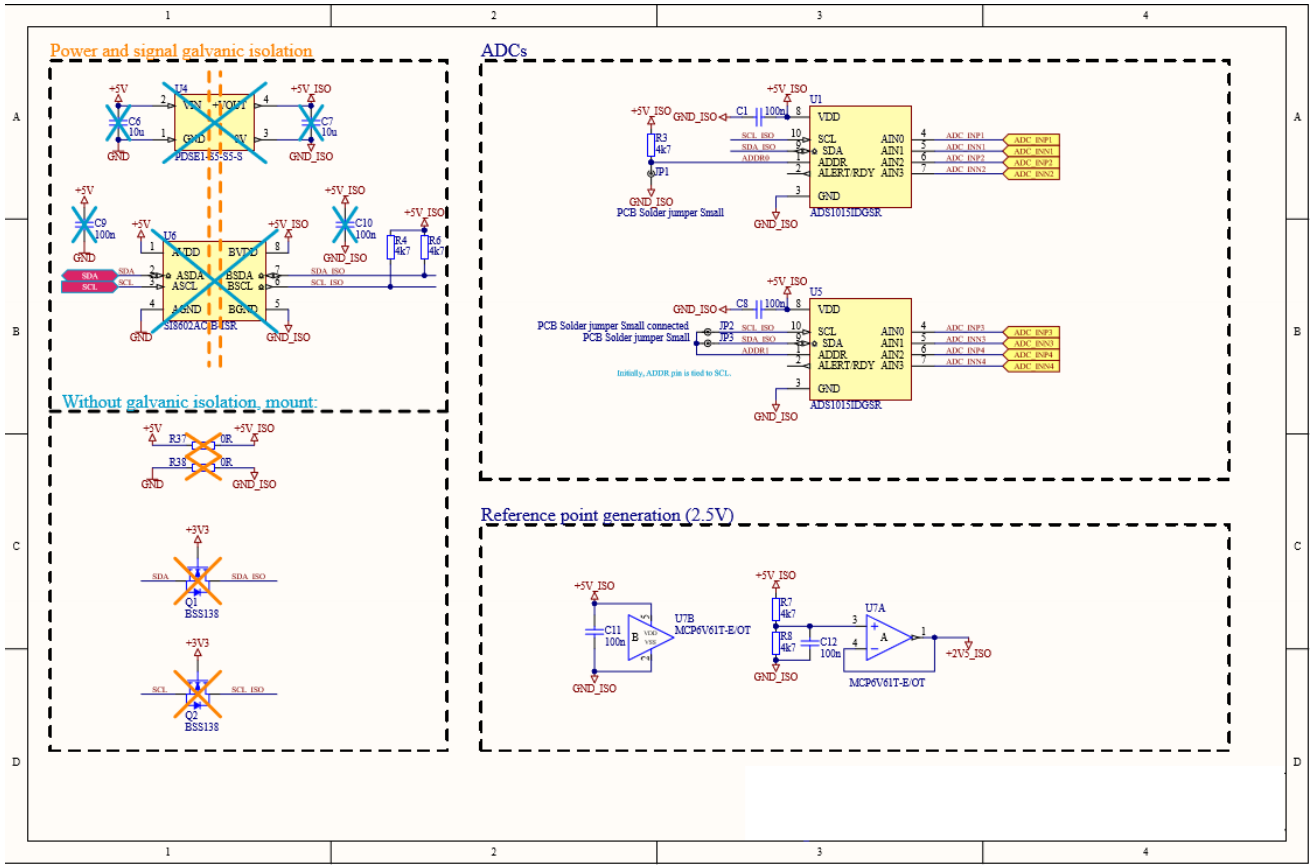
Commutation should be done on the plug part of the terminal block through which the measured signals are supplied.

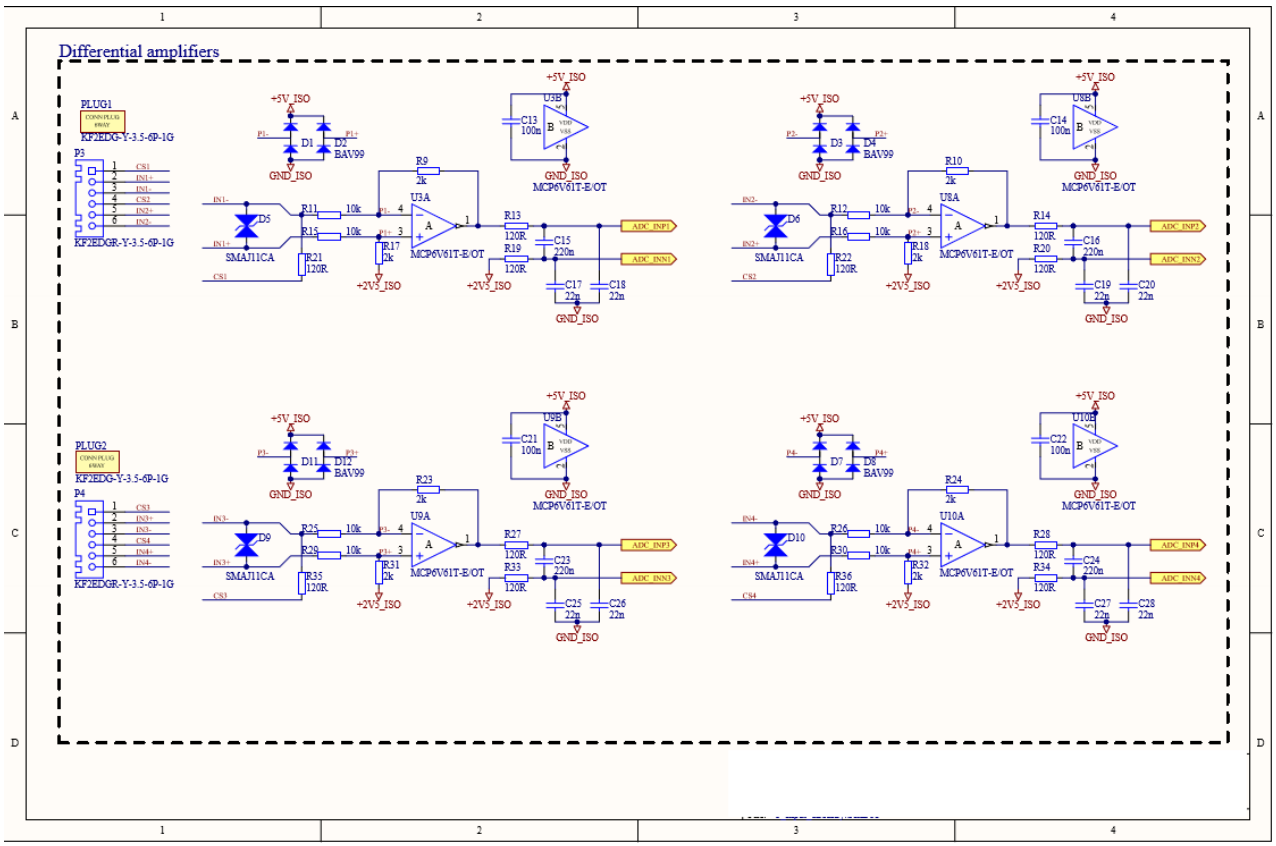
The version of the Module (the type of ADC and the presence/absence of isolation) are indicated on its bottom side:

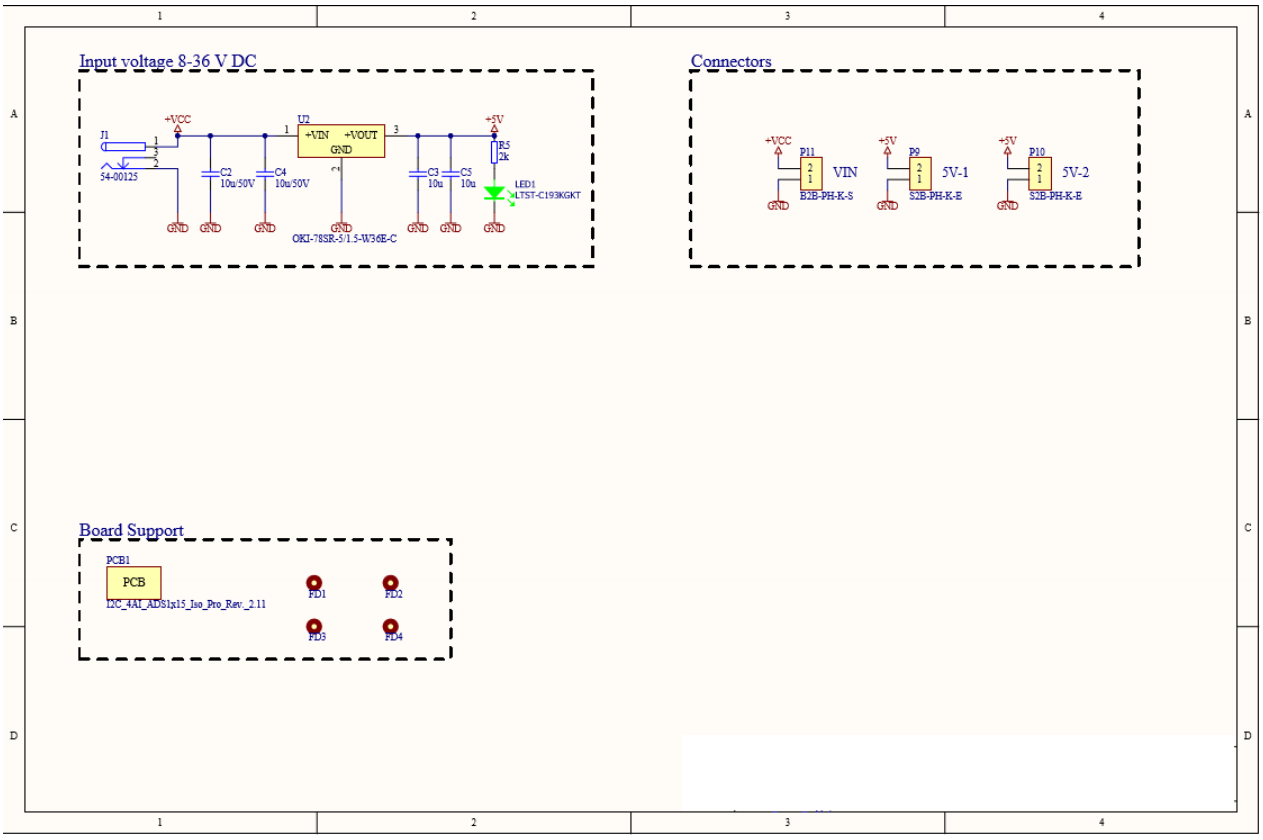


BOKRA I2C 2RO+2AI Pro schematic:






Differential amplifiers
PLUG1
KF2EDG-Y-3.5-6P-1G
P3
KF2EDGR-Y-3.5-6P-1G
PLUG2
KF2EDG-Y-3.5-6P-1G
P4
KF2EDGR-Y-3.5-6P-1G
+5V_ISO
GND_ISO
+2V5_ISO
D1
D2
BAV99
D3
D4
BAV99
D7
D8
BAV99
D11
D12
BAV99
D5
D6
D9
D10
SMAJ11CA
U3A
U8A
U9A
U10A
U3B
U8B
U9B
U10B
MCP6V61T-E/OT
R9
R10
R23
R24
R11
R12
R25
R26
R13
R14
R27
R28
R15
R16
R29
R30
R17
R18
R31
R32
R21
R22
R35
R36
R19
R20
R33
R34
120R
C13
C14
C21
C22
100n
C15
C16
C23
C24
220n
C17
C18
C19
C20
C25
C26
C27
C28
22n
ADC_INP1
ADC_INN1
ADC_INP2
ADC_INN2
ADC_INP3
ADC_INN3
ADC_INP4
ADC_INN4


Input voltage 8-36 V DC
J1
54-00125
+VCC
U2
+VIN
+VOUT
GND
OKI-78SR-5/1.5-W36E-C
+5V
R5
2k
LED1
LTST-C193KGKT
C2
10u/50V
C4
10u/50V
C3
10u
C5
10u
GND
Connectors
P11
VIN
B2B-PH-K-S
P9
5V-1
S2B-PH-K-E
P10
5V-2
S2B-PH-K-E
Board Support
PCB1
PCB
I2C_4AI_ADS1x15_Iso_Pro_Rev_2.11
FD1
FD2
FD3
FD4