RAK5801 WisBlock 4-20mA Interface Module Datasheet

Overview

Description

The RAK5801 WisBlock IO module, was designed to be part of a production-ready IoT solution in a modular way and must be combined with a WisBlock Core and a Base module.

The RAK5801 is a 4-20mA current loop extension module that allows the users to make a IoT solution for analog sensors with 4-20mA interface. This module converts the 4-20mA current signal into voltage range supported by the WisBlock Core module (MCU) for further digitalization and data transmission.

The RAK5801 module features two input channels of 4-20mA. Inside, a high precision operational amplifier is used for signal amplification and conversion and supports a wide range of operating temperatures.

This module integrates a 12V power supply, which can be used to power external sensors. The RAK5801 can be connected to 2-wire, 3-wire or 4-wire types of 4-20mA sensor. The module external interface is reached by a fast crimping terminal that allow connection for the 4-20mA sensors (including power) and to I2C bus. The fast crimping terminals can be used without the need of special tools, which simplifies the installation process on the field.

Features

- Two 4-20mA analog inputs.
- WisBlock IO interface, compatible with multiple WisBlock Core modules, such as RAK4631.
- 0.005mA conversion accuracy.
- Supports low power consumption mode. The module can be powered off by the WisBlock Core module for saving energy during idle periods.
- 12V output to power external sensors.
- Reserved I2C expansion interface.
- Fast crimping terminals.
- Designed with a 2kV ESD protection level.
- Small dimensions of 35mm x 25mm.

Specifications

Overview

The overview discusses the block diagram of the board. It also shows the installation mechanism on how to mount the board into the baseboard.

Block Diagram

The RAK5801 module was designed to convert 4-20mA current signals into voltage signals by applying a sampling resistor. As shown in Figure 1, the input current signal from the sensor is conditioned by an operational amplifier to match the level supported by the ADC input of an MCU where the signal is digitized.

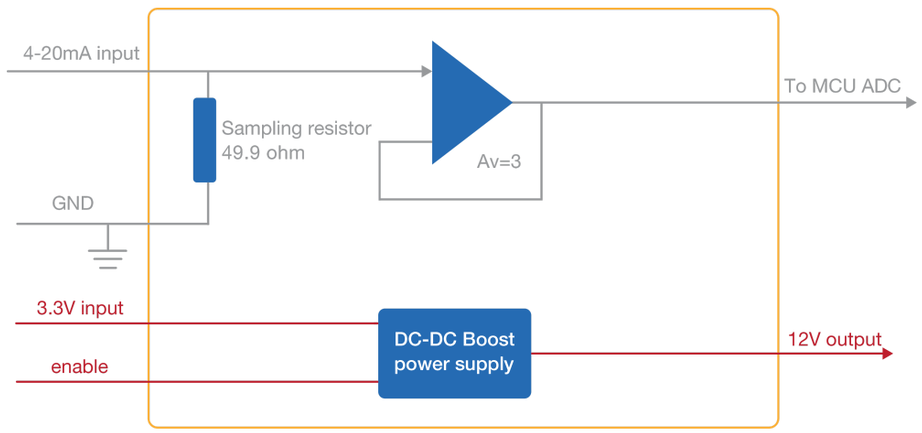

Figure 1: RAK5801 Block Diagram

Once the signal is digitalized, the user can recover the original current value by applying the following formula:

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I = U/149
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Where **U** is the ADC reading and **I** the sensor current.

As shown in Figure 1, the module provides an output of 12V for powering passive 4-20mA sensors. This 12V output is boosted by an internal DC-DC booster. The enable pin allows to control the power conversion module and set the RAK5801 module into a low power consumption mode.

Installation

Mounting Mechanism

The RAK5801 module is part of the WisBlock IO category, which connects to the baseboard through the IO slot. The installation method is shown in the Figure 2.

1. Keep the RAK5801 module parallel to the baseboard, and gently place and plug WisConnector into the IO slot receptacle of the baseboard. The IO slot has an outer silkscreen on it to assist with the alignment. At this point, apply force evenly along the module and press again. There will be a sound to confirm the successful completion of the attachment process.

> 📝 **NOTE:**
>
> For detailed instructions, refer to the WisBlock Installation Guide.

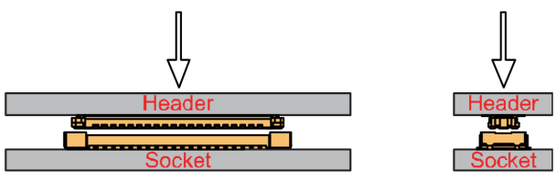


Figure 2: WisConnector

2. Secure the RAK5801 module with **3 x M1.2 x3 pan head screws** as shown in Figure 3 below.

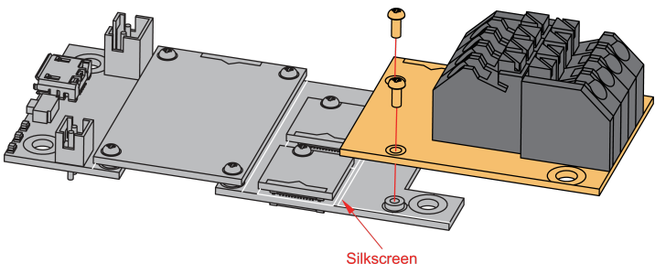


Figure 3: RAK5801 mounting mechanism on a WisBlock Base module

RAK5801 Fast Crimping Terminal Mechanism

The RAK5801 features a fast-crimping terminal connector to simplify and ensure the wiring process on the fields. The fast-crimping terminal can support cable with a width between 20 AWG to 24 AWG. The usual stripping length is around 6 to 7 mm.

As shown in Figure 4, during the crimping process, the user should first press down and maintain the spring head of the crimping terminal firmly, then insert the stripped cable head into the corresponding connector’s hole. Once inserted correctly, then release the spring head, and the crimping process is completed.

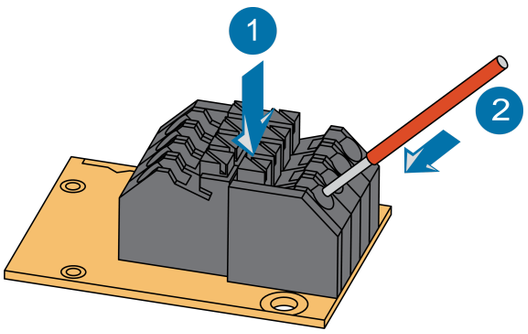


Figure 4: RAK5801 Sensor Connector

Hardware

The hardware specification is categorized into four parts. It discusses the pinouts of the board and its functionalities and diagrams.

Device Specification

The following table shows the parameters and the description of the RAK5801 WisBlock 4-20mA Interface Module:

Parameter	Description
Analog Input Interface	2 channels of 4-20mA
Analog Sampling Resolution	0.005mA
Analog Sampling Accuracy	1%
Analog Maximum Input Current	25mA (There is a risk to burn the circuit surpassing this limit)
Analog Port ESD Protection Level	2kV HBM
Current Sampling Resistor	49.9 Ω
Operational Amplifier Gain	3.0
Input Voltage	3.0V – 3.6V
Output Voltage	12V
Output Current	Maximum 30mA
Operating Temperature	-30° C ~ 65° C
Storage Temperature	-40°C ~ 85°C
Module Dimensions	35x25mm

Pin Definition

This section covers the pin number of the sensor connector, the definition, and the functionalities of each pin shown in a tabular representation.

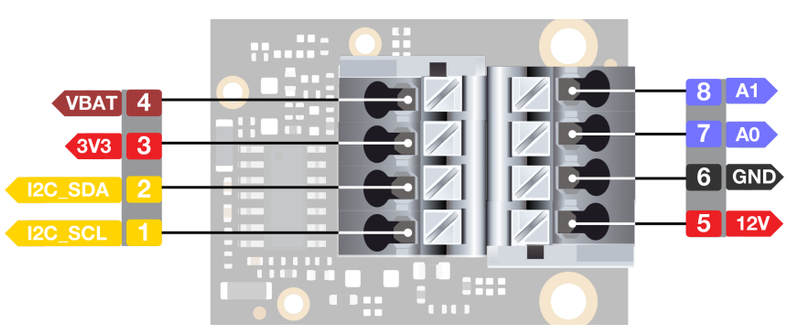


Figure 5: RAK5801 Sensor Connector

Pin Number	Function Description
1	SCL of the I2C interface
2	SDA of the I2C interface
3	3V3 output
4	VBAT, Battery output
5	12V output for external sensors
6	GND
7	Analog input 0
8	Analog input 1

Figure 6 shows the pin order for the IO connector of the module. Through this connector, the RAK5801 module is attached to the WisBoard baseboard.

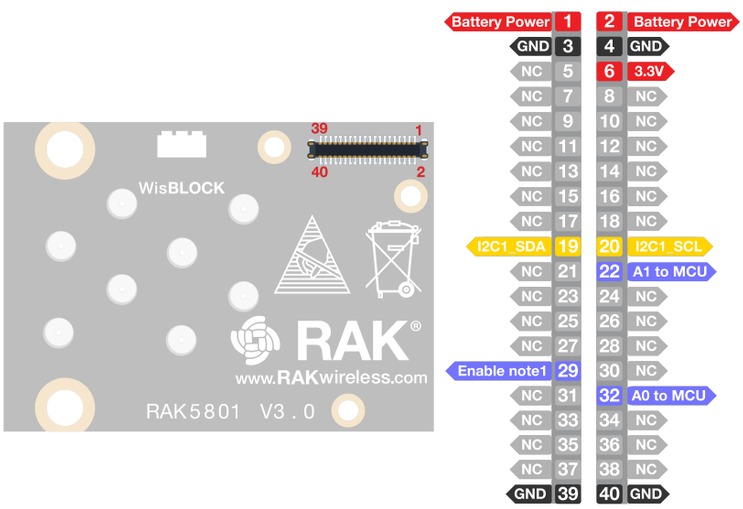


Figure 6: RAK5801 Internal WisIO Connector

The functionalities of each pins of the WisIO connector are tabulated below.

Pin Number	Description	Pin Number	Description
1	Battery Power	2	Battery Power
3	GND	4	GND
5	NC, reserved for 3V3	6	3.3V Power
7	NC	8	NC
9	NC	10	NC
11	NC	12	NC
13	NC	14	NC
15	NC	16	NC
17	NC	18	NC
19	SDA for I2C1	20	SCL for I2C1
21	NC	22	Analog to MCU
23	NC	24	NC
25	NC	26	NC
27	NC	28	NC
29	Enable note1	30	NC
31	NC	32	Analog0 to MCU
33	NC	34	NC
35	NC	36	NC
37	NC	38	NC
39	GND	40	GND

> 📝 **NOTE:**
>
> This signal controls the dc-dc power supply on RAK5801, before capturing analog signal, please set this pin to high to enable power for RAK5801.

Mechanical Characteristics

Board Dimensions

Refer to Figure 7 below for the mechanical dimensions of the RAK5801 module.

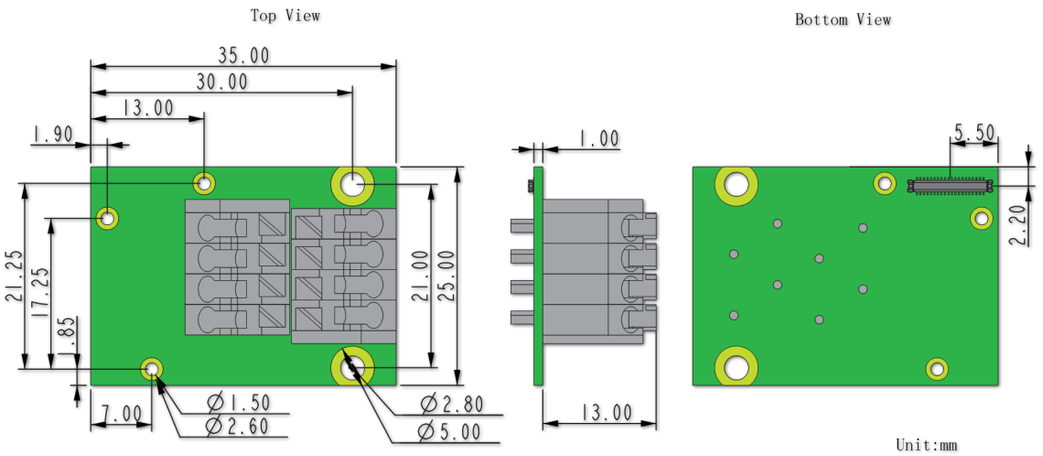
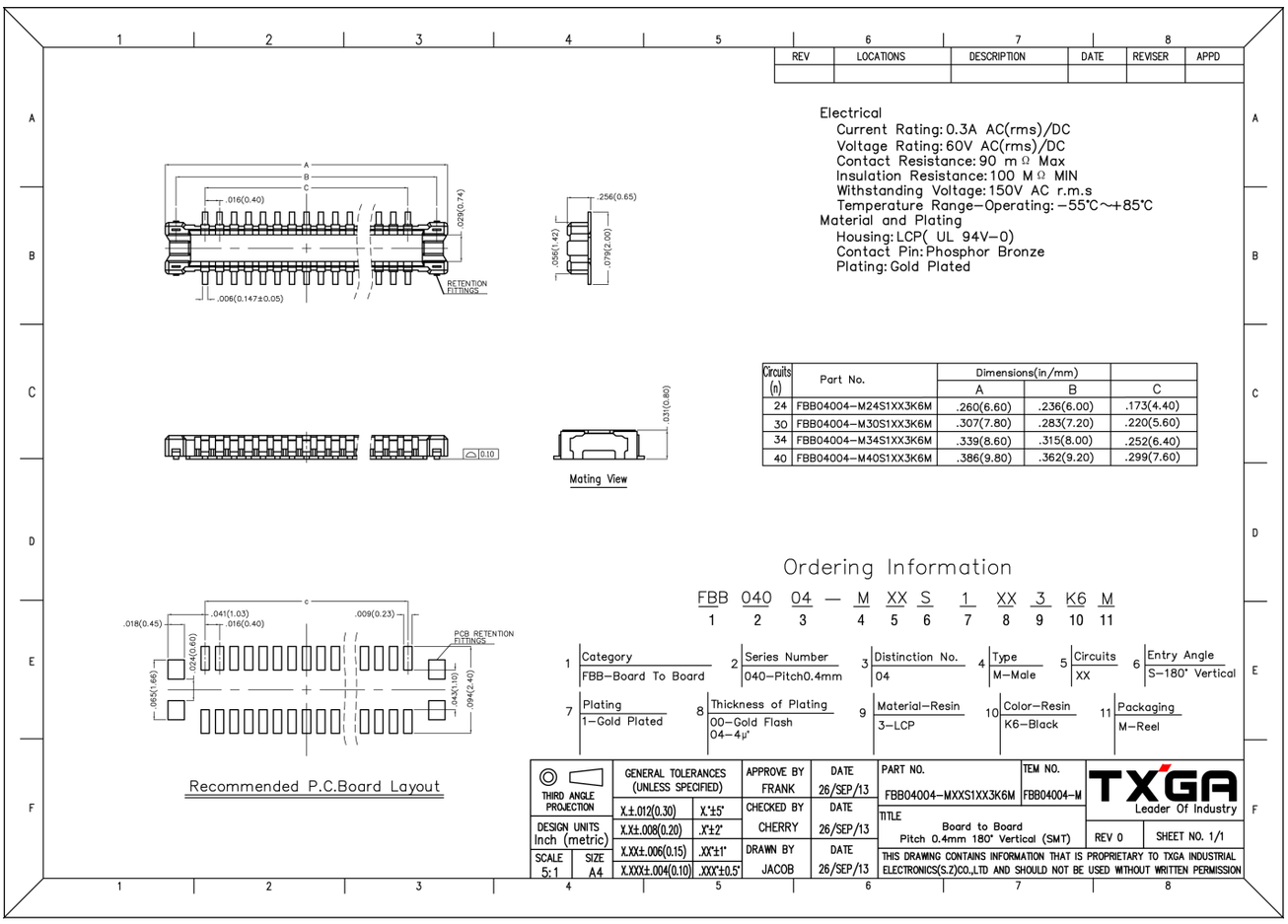


Figure 7: RAK5801 Mechanical Dimensions

WisConnector PCB Layout



Circuits (n)	Part No.	Dimensions(in/mm) A	B	C
24	FBB04004—M24S1XX3K6M	.260(6.60)	.236(6.00)	.173(4.40)
30	FBB04004—M30S1XX3K6M	.307(7.80)	.283(7.20)	.220(5.60)
34	FBB04004—M34S1XX3K6M	.339(8.60)	.315(8.00)	.252(6.40)
40	FBB04004—M40S1XX3K6M	.386(9.80)	.362(9.20)	.299(7.60)

Figure 8: WisConnector PCB footprint and recommendations

Schematic Diagram

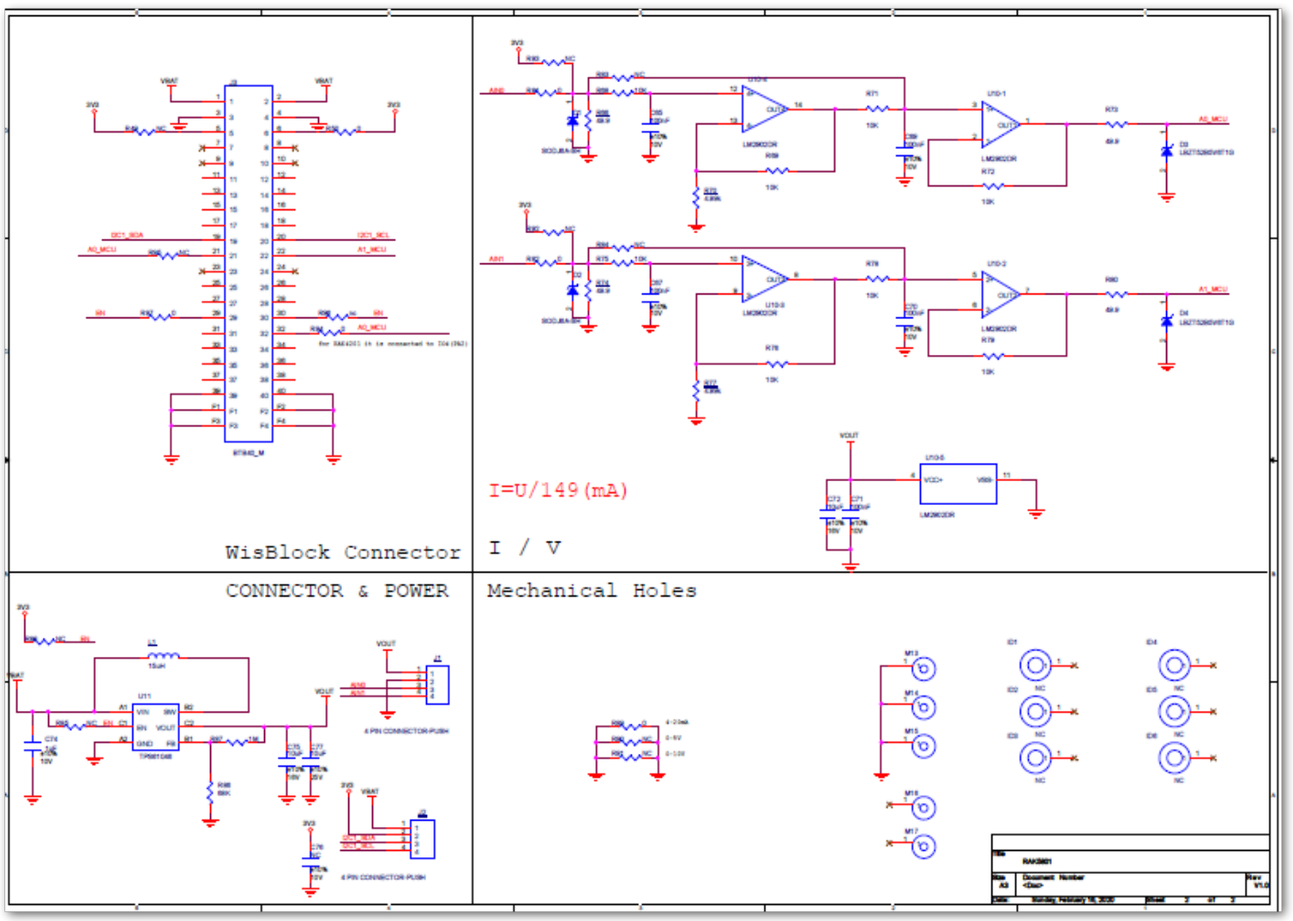


Figure 9: RAK5801 Schematic Diagram

Typical Application

Two-wire sensor

For 2-wires 4-20mA sensor，as shown in Figure 10,

1. Connect sensor（+）to VCC (Pin5) of RAK5801
2. Connect sensor (-) to AIN0 or AIN1 of the RAK5801 module.

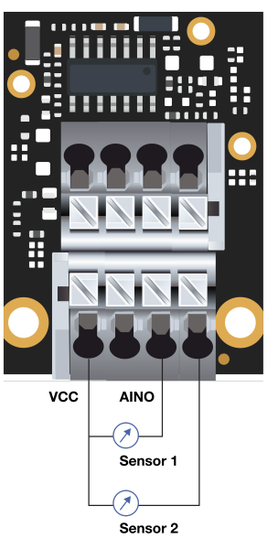


Figure 10: RAK5801 with 2-wires 4-20mA sensor.

Four-wire Sensor

For 4-wires sensor, as shown in Figure 11

1. Use an external power supply to the power the sensor.

2. Connect the output of the sensor to AIN0 or AIN1 of RAK5801.

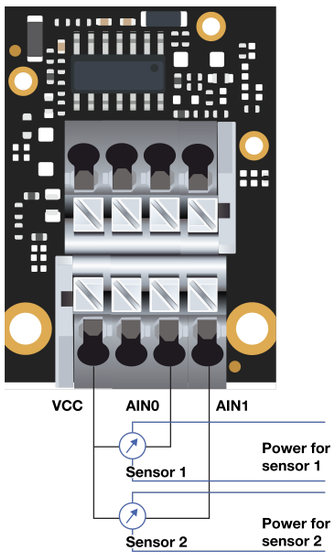


Figure 11: RAK5801 with 4-wires 4-20mA sensor.

WisBlock Compatability

Since a WisBlock module can be combined with a variety of different functional modules, the pin functions of the MCU are multiplexed, so the interface expansion module for each specific function may need to be properly adapted for the WisBlock. The compatibility details of the RAK5801 module are as shown in the Table below:

WisBlock Module	Adaptable Module	Description
WisBase Base board	RAK5005/RAK5005-O	RAK5801 is designed to be assembled in the IO slot of RAK5005-O baseboard.
WisBlock Core Module	RAK4631	RAK5801 is compatible with RAK4631.
	RAK4201	Please select RAK4201L-ADC for the low band or RAK4201H-ADC for the high band.
	RAK4202	Please refer to Note 2 for hardware adaptions to the RAK5005-O and RAK5801.
	RAK4261	Please refer to Note 3 for hardware adaptions to the RAK5005-O and RAK5801.

> 📝 **NOTE 1: The RAK5801+RAK4601**
>
> The RAK5801 is not compatible with RAK4601. The main reason is because RAK4601 doesn’t expose any ADC pin through the RAK5005-O baseboard.

📝 NOTE 2: RAK5801+RAK4202+RAK5005-O

In order to combine a RAK5801 module, a RAK4202 (WisBlock Core module), and the RAK5005-O, the following modification must be introduced:

- In RAK5005-O, remove the R7. The R7 resistor is shown in **Figure 12.**
- In RAK5801, remove R94 to R95, and use PA0 of STM32L151 to read the analog data of the channel “analog0”, and use PA2 of STM32L151 to read the analog data of Channel analog1. **Figure 13** shows the resistors R94 and R95 on the RAK5801 module.

This combination has the following restrictions:

- The adapted RAK5005-O module will not able to sense the battery voltage anymore.

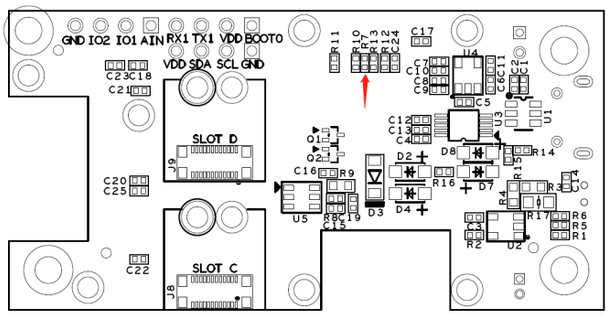


Figure 12: R7 on RAK5005-O

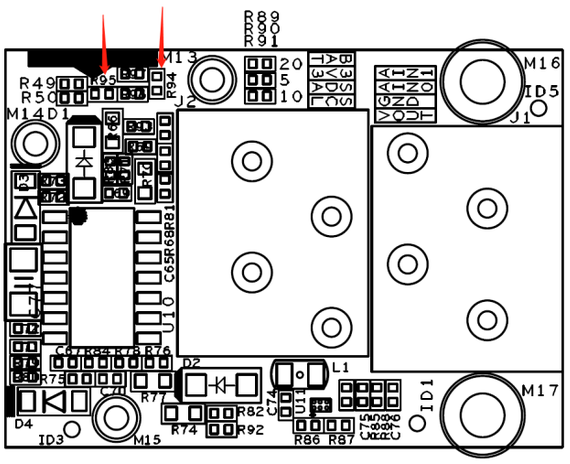


Figure 13: R94 and R95 on RAK5801.

📝 NOTE 3: RAK5801+RAK4261+RAK5005-O

In order to combine a RAK5801 module, a RAK4261(WisBlock Core module), and the RAK5005-O, the following modification must be introduced:

- In RAK5005-O, remove the R7. See Figure 12.
- In RAK5801, remove R94 to R95 (see Figure 13), and use PA08 of ATSAMR34 to read the analog data of the channel “analog0”, and use PA09 of ATSAMR34 to read the analog data of Channel analog1.

This combination has the following restrictions:

- The adapted RAK5005-O module will not able to sense the battery voltage anymore.