

# RAK5811 WisBlock 0-5V Interface Module Datasheet

## Overview

---

### Description

The RAK5811 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. RAKWireless has standardized the way modules are interconnected to the baseboards with the WisBlock IO Connectors. This standard connector is a small high-density connector that not only saves spaces on the circuit boards but also allows to implement high-speed communication bus.

The RAK5811 is 0-5V analog input interface module. The signal is routed through the IO bus to the WisBlock Core module. Inside of the WisBlock Core module, the MCU digitizes the signal and the sampled data is transmitted, for example, via a LoRa transceiver.

The RAK5811 module features two input channels of 0-5V analog signals. Inside, a high-precision operational amplifier, which supports a wide range of operating temperatures, is used for signal amplification and conversion.

In addition, this module integrates a 12V power supply which can be used to power the external sensors. The connection of the 0-5V sensors is done through the fast crimping terminal without the need for special tools, this simplifies the installation process on the field.

### Features

- Two 0-5V analog input channels.
- Support WisBlock IO interface, and is compatible with multiple WisBlock Core modules, such as the RAK4631.
- 10mV conversion accuracy.
- Supports low power consumption mode, the module can be powered off by WisBlock Core module for saving energy during idle periods.
- 12V output to power external sensors.
- Reserved I2C expansion interface.
- Fast crimping terminal to easy connect external components on the field.
- Designed with a 2kV ESD protection level.
- Small dimensions of 35mm x 25mm.

### Specifications

---

#### Overview

The overview shows the realistic view of the RAK5811 module and its block diagram. It also covers the installation mechanism of the module into the baseboard.

#### Block Diagram

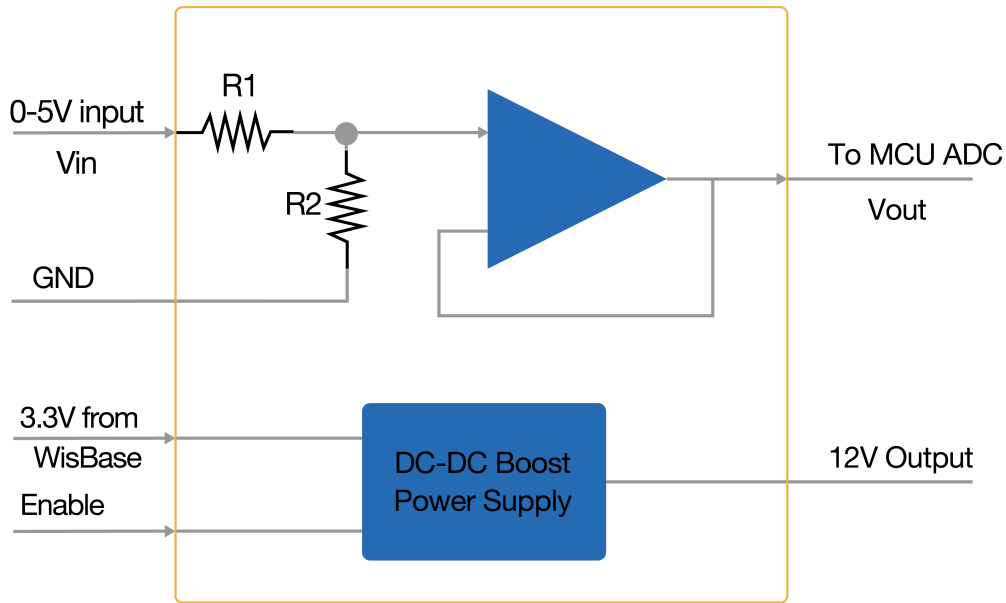


Figure 1: RAK5811 block diagram

In the RAK5811 module, as shown in Figure 1, the 0-5V input signal is connected to operational amplifier by the R1/R2 voltage divider. The operational amplifier output is routed to an analog input of the MCU to be digitalized by an internal ADC. Once the signal is digitalized, the user can recover the original voltage value by applying the following relation:

$$V_{out} = V_{in} * \frac{R2}{R1 + R2}$$

Figure 2: Voltage divider relation

Where  $V_{out}$  is the WisBlock Core read voltage,  $V_{in}$  is the analog input voltage (0-5V). From the voltage divider R1 is 1M  $\Omega$  and R2 is 1.5M  $\Omega$ , so the final relationship is:  **$V_{in} = V_{out} / 0.6$** .

As shown in Figure 1, the module provides an output of 12V to power industrial sensors. This 12V output is boosted by an internal DC-DC booster. The enable pin allows to control the power conversion module and sets the RAK5811 module into a low power consumption mode.

## Installation

### Mounting Sketch

The RAK5811 module is part of the WisBlock IO category, which connects to the baseboard through the IO slot. The installation method is shown in Figure 2:

1. Keep the RAK5811 module parallel to the baseboard, and gently place and plug the WisConnector into the IO slot receptacle of the baseboard. The IO slot has an outer silkscreen 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](#)

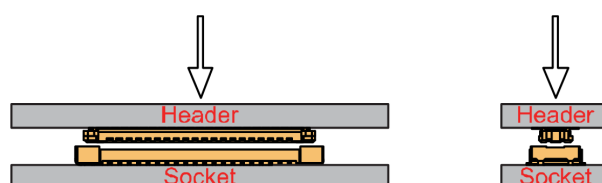


Figure 3: RAK5811 WisConnector

2. Secure the RAK5811 module with 3 x M1.2x3 pan head screws as shown in Figure 3 below:

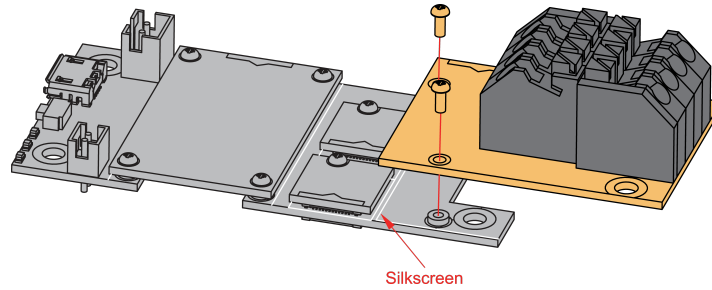


Figure 4: RAK5811 mounting mechanism on a WisBlock Base module

## RAK5811 Sensor Connector Crimping Mechanism

The RAK5811 features a fast-crimping terminal connector to simplify and ensure the wiring process on the fields. The 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 5, 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.

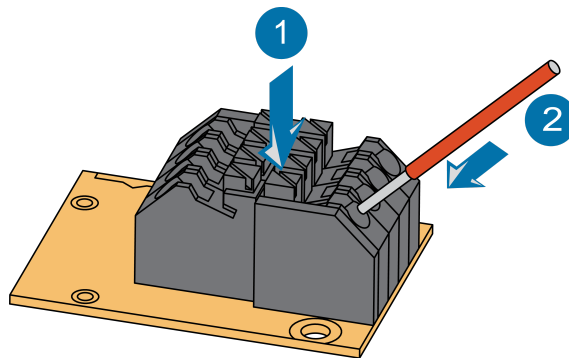


Figure 5: RAK5811 Fast Crimping Terminal

## 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 0-5V
Analog Sampling Resolution	5mV
Analog Sampling Accuracy	1%
Analog maximum input voltage	5.3V (there is a risk to burn the circuit surpassing this limit)
Analog Port ESD Protection Level	2kV HBM
Operational Amplifier Gain	3.0
Input Voltage	3.0V – 3.6V
Input Current	Maximum 100mA
Output Voltage	12V
Output Current	Maximum 30mA
Operating Temperature	-30° C ~ 65° C
Storage Temperature	-40°C ~ 85°C
Module Dimensions	35 x 25 mm

## Pin Definition

This section shows the pin number of the Fast Crimping Terminal of the RAK5811 module.

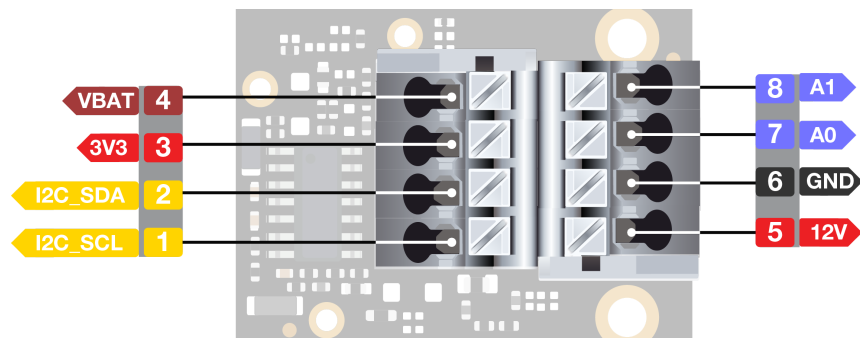


Figure 6: RAK5811 Fast Crimping Terminal

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 7 shows the pin order of the IO connector of the module. Through this connector, the RAK5811 module is attached to the WisBoard baseboard.

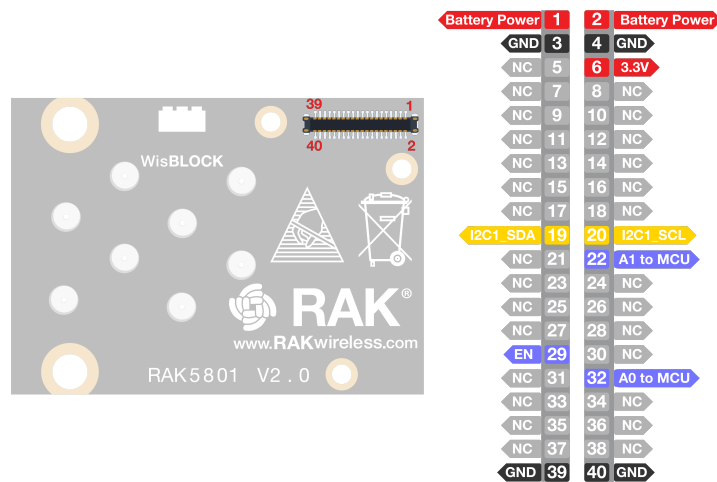


Figure 7: RAK5811 IO connector

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	Analog1 to MCU
23	NC	24	NC
25	NC	26	NC
27	NC	28	NC
29	Enable	30	NC
31	NC	32	Analog0 to MCU
33	NC	34	NC
35	NC	36	NC
37	NC	38	NC
39	GND	40	GND

## Mechanical Characteristics

### Board Dimensions

Figure 8 shows the dimensions of the module RAK5811 module.

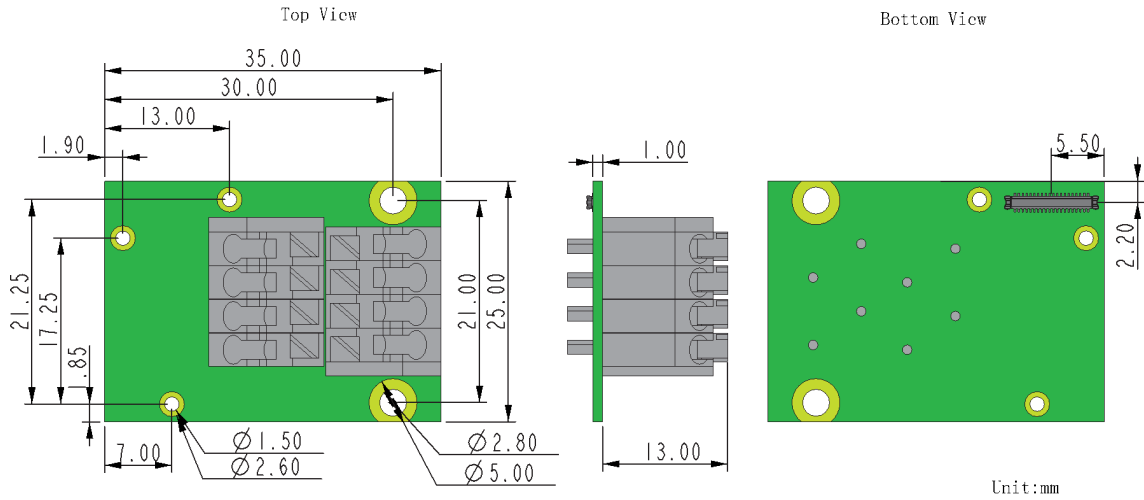


Figure 8: RAK5811 dimensions

## WisConnector PCB Layout

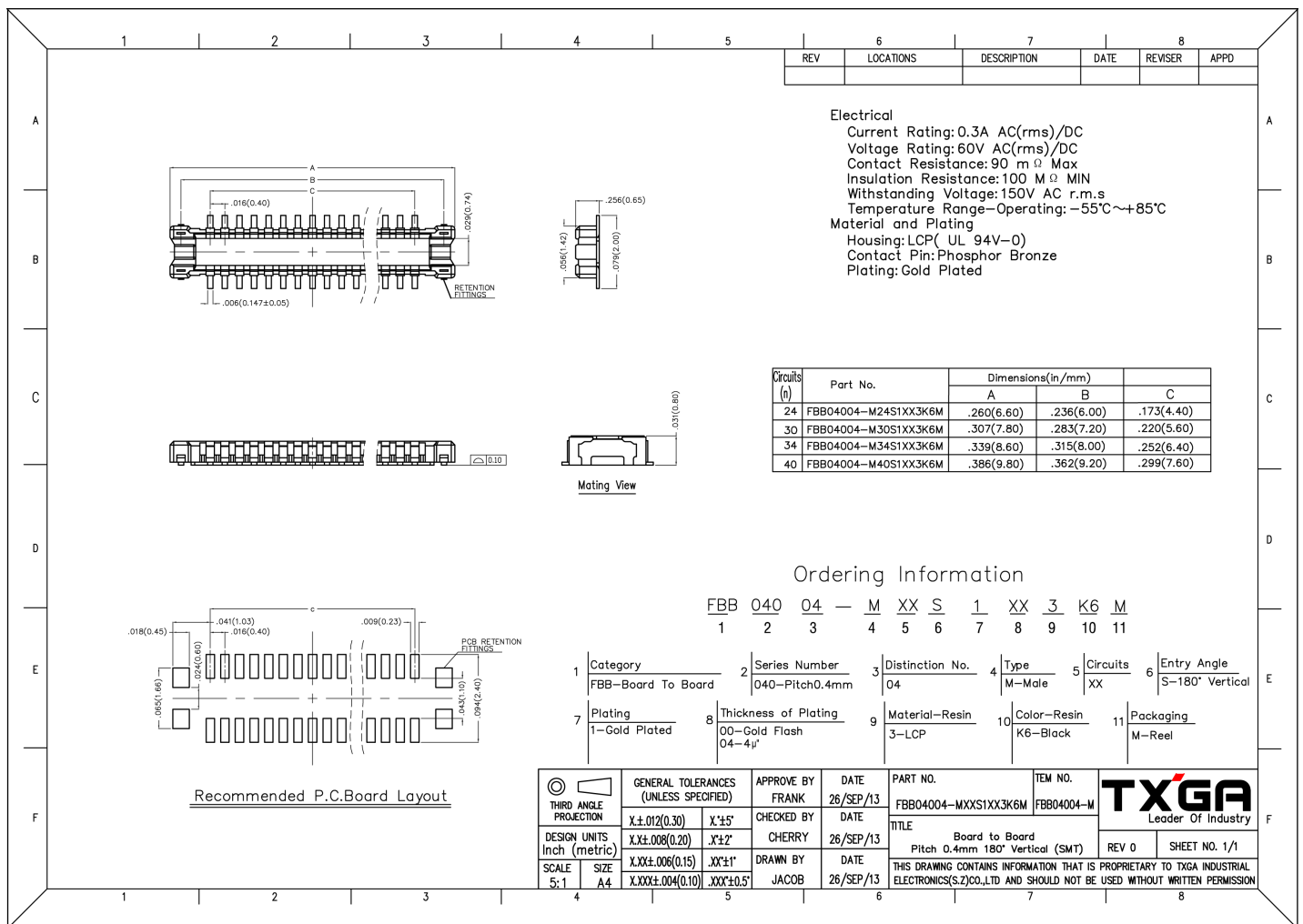


Figure 9: WisConnector PCB footprint and recommendations

## Schematic Diagram

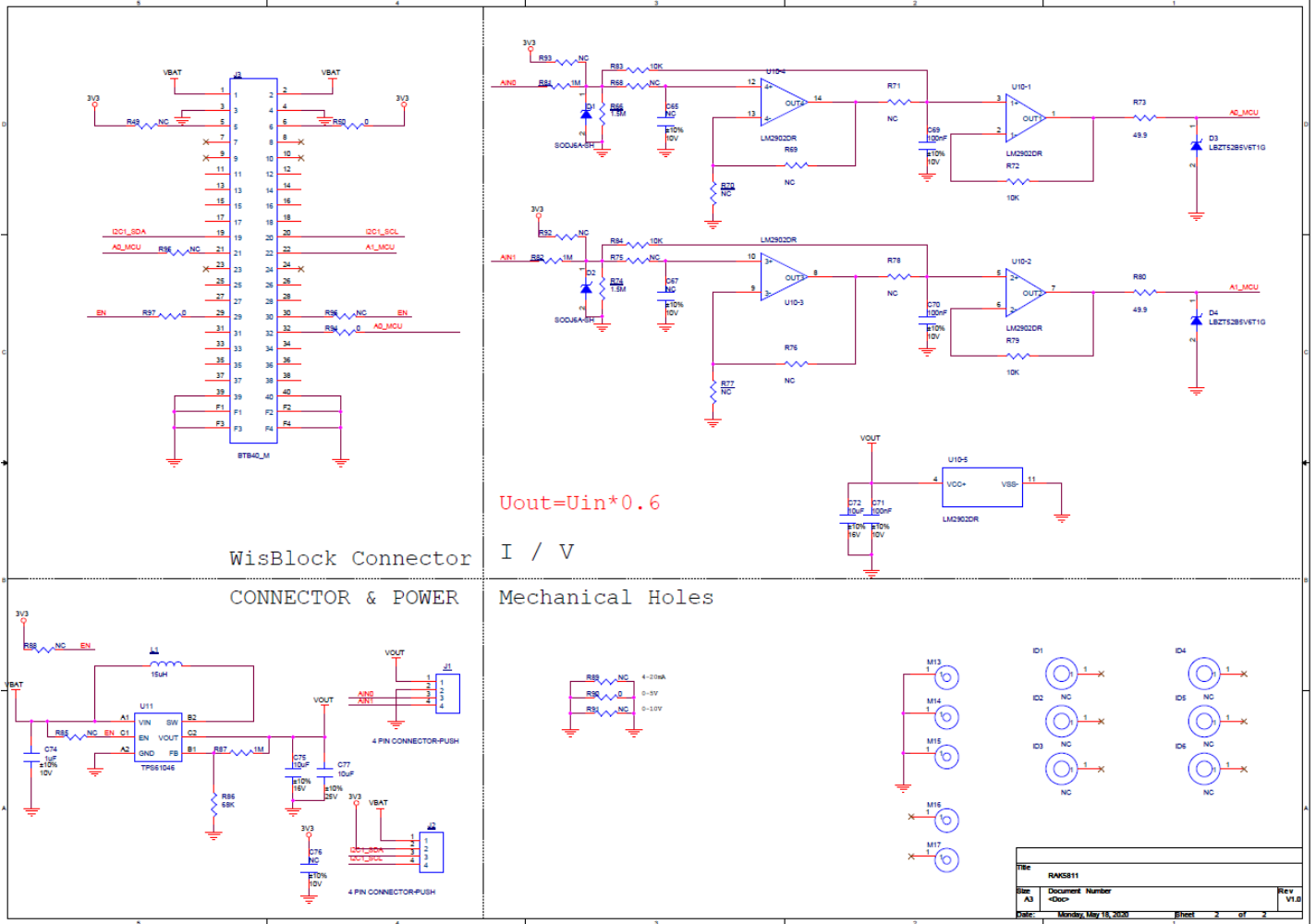


Figure 10: RAK5811 schematic diagram

## Typical Application

A typical application is shown in Figure 11, users can connect up to two 0-5V analog sensors independently.

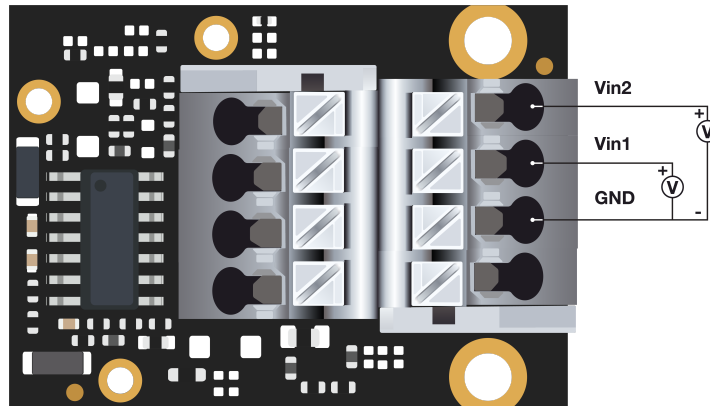


Figure 11: RAK5811 typical application

## WisBlock Compatability

In the ecosystem of the WisBlock, the philosophy is to allow users to combine a WisBlock module of one category with WisBlock module of other categories. This is true in most of cases but it's important to review the compatibility matrix when designing a customized solution. The RAK5811 module are as shown in the Table below:



	Adaptable Module	Description
WisBlock Base board	RAK5005-O	RAK5811 is designed to be assembled in the IO slot of RAK5005-O baseboard.
	RAK4631	RAK5811 is fully compatible with RAK4631.
WisBlock Base board	RAK4201	Please select RAK4201L-ADC for the low band or RAK4201H-ADC for the high band.
	RAK4202	Please refer to Note 2 for hardware adaptations to the RAK5005-O and RAK5811.

**NOTE 1: The RAK5801+RAK4601**

The RAK5811 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 RAK5811 module, a RAK4202 which is a 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 RAK5811, 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 RAK5811 module.

This combination has the following restrictions:

- The adapted RAK5005-O will not support battery power collection.

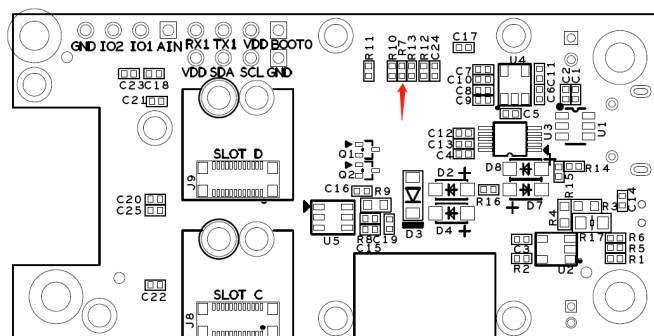


Figure 12: R7 on RAK5005-O

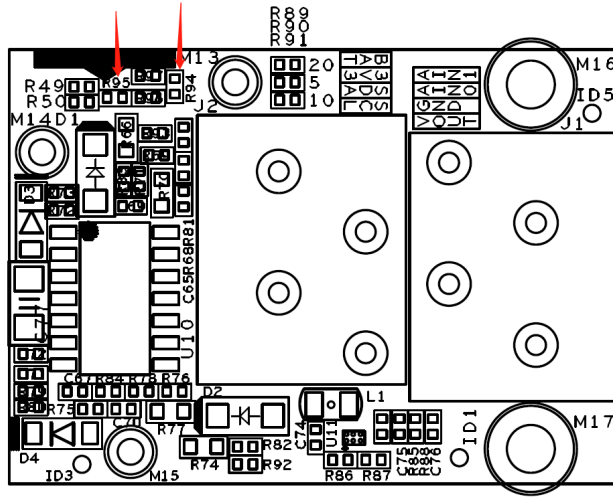


Figure 13: R94 and R95 on RAK5801.

**NOTE 3: RAK5801+RAK4261+RAK5005-O**

In order to combine a RAK5811 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 RAK5811, 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 will not support battery power collection.