

富满微电子集团股份有限公司  
FINE MADE MICROELECTRONICS GROUP CO., LTD.

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## **FM5821-2020 User Guide**

### **5.8GHz Microwave Motion sensor**

# FM5821 User Guide

## Description

FM5821-2020 is a miniaturized 5.8G radar sensor module made by FM, with a size of 20mm by 20mm. It is equipped with the FM5821 radar sensor chip, developed by FM, which integrates 5.8G RF microwave transmit and receive circuits and an IF amplifier circuit. The sensor also has a small, integrated antenna developed by FM, which makes it suitable for use in light fixture modules due to its small size and high performance. It is irreplaceable in detecting human movement and intelligent sensing scenarios and is therefore widely used in the smart home, Internet of Things, and intelligent lighting markets.

## Radar Sensor's illustration

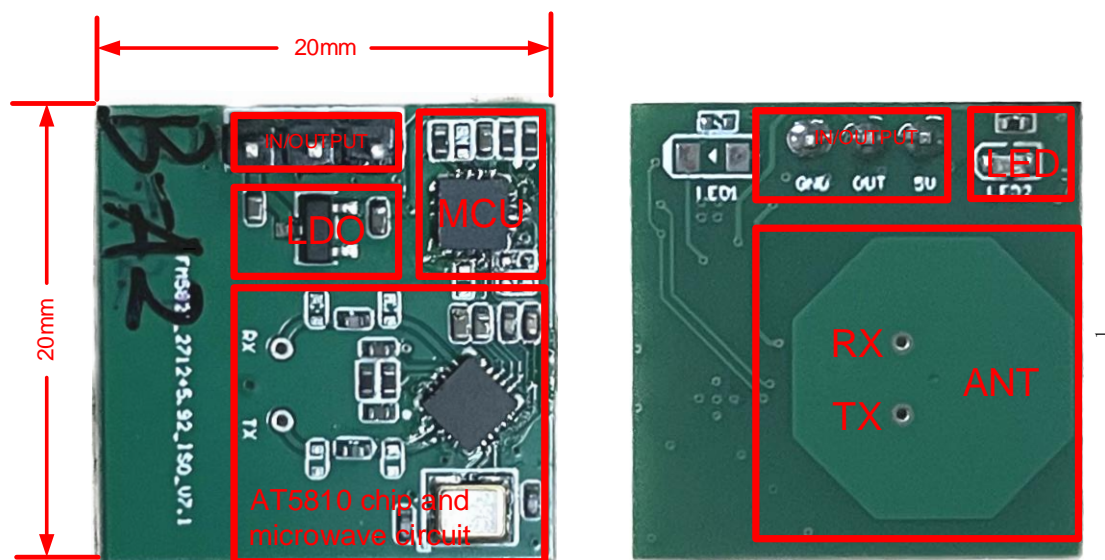


Figure 1 FM5821-2020 Radar Sensor

## Input and Output Interface

FM5821-2020 can be embedded in end product with three contact PINs, the PIN space is 2.54mm/2.00mm, below is the detail description about the interface

Pin Name	Function	Note
VCC	Power supply	LDO is not attached by default, VCC is 5V, the default power consumption of the module is 17mA
GND	Ground PIN	s
OUT	Output control	Output is 5V TTL by default, could be PWM if needed

## Specifications

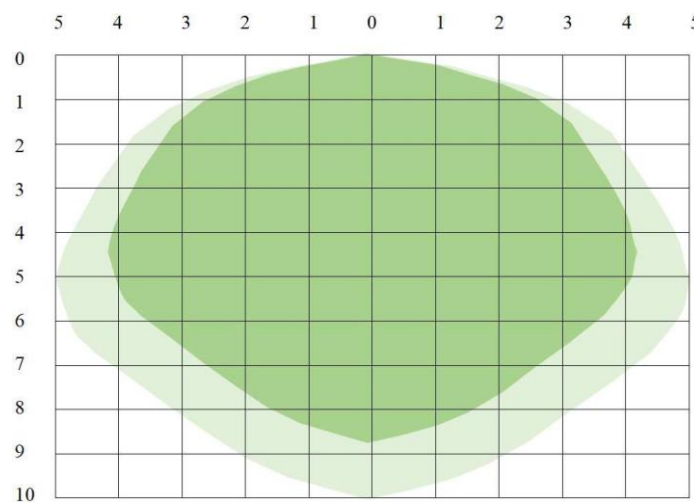
Parameters	Min.	Typical	Max.	Unit	Note
Frequency		5800		MHz	
TX Power		-6		dBm	
Input VCC	4.5	5	5.5	V	Without external LDO
Output High Level		5		V	
Output Low Level		0		V	
Current		17	18	mA	
Mounting Height		3	10	M	Can be tuned if needed
Detection Radius		5	10	M	Related to mounting height
Hold time		10		S	Can be tuned if needed
Daylight sensor		10		Lux	Can be tuned if needed
Operating TEMP	-30		105	° C	

## Radar signal processing

The FM5820 radar sensor chip is mounted on the FM5821-2020. After completing the power-on operation, the MCU initializes the chip through the I2C interface, configuring parameters such as the transmission frequency and receiving gain. This allows the chip to collect and extract the intermediate frequency signal of the human body's motion through the antenna, and then the MCU acquires the intermediate frequency signal through the ADC, and outputs the GPIO signal according to the amplitude and frequency of the intermediate frequency signal.

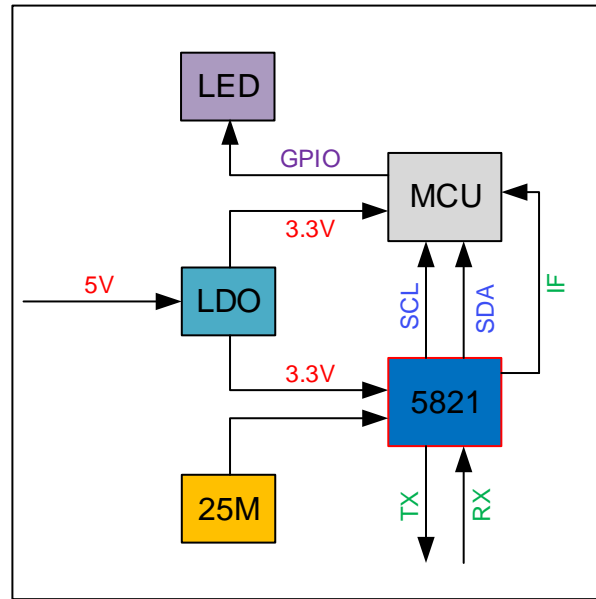
## Detected distance

The detection distance of the radar sensor module depends on the sensitivity of receiving mobile signals. This can be controlled by the MCU on the module. The maximum linear detection distance is 10m. The actual detection distance of the hoisting depends on the height of the hoisting and the angle of detection. In the case of extremely high sensitivity, self-excitation may occur, so the sensitivity needs to be configured according to the actual use requirements. The following figure is a schematic diagram of the detection range of the radar in the case of a straight line. The dark area is the high-sensitivity area. In this area It is easy to detect human movement in the interior, the lighter the color, the lower the receiving sensitivity



**Figure 2 FM5821-2020 Radar Sensor detection pattern**

## Block Diagram & Description



**Figure 3 FM5821-2020 Radar Sensor Block Diagram**

The input 5V voltage is converted to a 3.3V voltage by the LDO, which powers both the MCU and the 5821. The 25M crystal oscillator provides a clock signal for the 5821 digital circuitry to function properly. The MCU configures the 5821's registers through the I2C protocol, and the 5821 receives sensing signals through its TX RX radio frequency channels, transmitted via the antenna. The output IF signal is then collected by the MCU's ADC module and, after being judged by the MCU, a GPIO signal is output to the LED.

## Installation Notes

1. Do not place any metal objects in front of the antenna. Thin plastic and glass are acceptable, but keep a gap of at least 2mm between the antenna and the cover.
2. When there are multiple radar sensors in the same space, position the antennas parallel to each other, with a minimum gap of 1m between the sensors.
3. Power frequency can interfere with radar signal, so keep the LED driver away from the antenna and do not place it directly in front of it.
4. The sensor has a power consumption of approximately 35mA. Ensure that the LED driver has a current-driving capability of at least 50mA.

## FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20

cm between the radiator and your body.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other

antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following:

“Contains Transmitter Module “FCC ID:2BAY5FM5831-1919”

## **Requirement per KDB996369 D03**

### **2.2 List of applicable FCC rules**

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

**Explanation:** This module meets the requirements of FCC part 15C (15.247). It specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

### **2.3 Summarize the specific operational use conditions**

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

**Explanation:** The product antenna uses an irreplaceable antenna with a gain of 4.87dBi

### **2.4 Single Modular**

If a modular transmitter is approved as a "Single Modular," then the module manufacturer is responsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A Single Modular manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited



module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This Single Modular procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited

module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

**Explanation:** The module is a single module.

## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna); b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) Production test procedures for ensuring compliance

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

**Explanation:** The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID:2BAY5FM5831-1919

## **2.7 Antennas**

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type").

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.

The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The product antenna uses an irreplaceable antenna with a gain of 4.87dBi

## **2.8 Label and compliance information**

Grantees are responsible for the continued compliance of their modules to the FCC rules. This

includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:** The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BAY5FM5831-1919

## **2.9 Information on test modes and additional testing requirements**

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Fine Made Micro Co., Ltd. can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

## **2.10 Additional testing, Part 15 Subpart B disclaimer**

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product

as being Part 15

Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.