GPACERS LORA MODULE USER GUIDE
MODEL: GPM-RF2021

VERSION : V2021.1

Gpacers Technology

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PREFACE

IMPORTANT NOTES

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

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- Technical Support – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Gpacers consultant program member listing
- Business of Gpacers – Product selector and ordering guides, latest Gpacers press releases, listing of seminars and events, listings of Gpacers sales offices, distributors and factory representatives

CUSTOMER SUPPORT

Users of Gpacers products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the Gpacers website.

Technical support is available through the website at: https://www.gpacers.com/home/technical-support/

DOCUMENT LAYOUT

This document describes how to use the Gpacers LoRa module as a demonstration to show how it works. The document is organized as follows:

- Chapter 1. "INTRODUCTION" – This chapter describes the module and presents the technical specification and features.
- Chapter 2. "HARDWARE DESCRIPTION " – This chapter describes the hardware requirements for getting started with the module.
- Chapter 3. "METHOD OF OPERATION" – This chapter describes the firmware programming requirements for transceiver functions with the module.

FCC WARNING

FCC 15b devices (15.105)

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.

FCC Part 15.21 information for user

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

FCC Part 15.19

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

- **Modular Approval OEM INTEGRATION INSTRUCTIONS:**

This device is intended only for OEM integrators under the following conditions: 1) The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and 2) the transmitter module may not be co-located with any other transmitter or antenna. As long as conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

- **IMPORTANT NOTE:**

In the event that these conditions cannot be met (for example certain laptop configurations or colocation with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the End Product (including the transmitter) and obtaining a separate FCC authorization.

- **USERS MANUAL OF THE END PRODUCT:**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user‘s manual of the End product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

- **Part 15 Subpart B disclaimer**

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.

FCC WARNING

- **LABEL OF THE END PRODUCT:**

THE END PRODUCT MUST BE LABELED IN A VISIBLE AREA WITH THE FOLLOWING " Contains FCC ID: 2ARB9-GPM-RF2021 ". THE FOLLOWING FCC PART 15.19 STATEMENT MUST ALSO BE AVAILABLE ON THE LABEL: THIS DEVICE COMPLIES WITH PART 15 OF 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.

- **MOBILE DEVICE**

THIS EQUIPMENT COMPLIES WITH FCC RADIATION EXPOSURE LIMITS SET FORTH FOR AN UNCONTROLLED ENVIRONMENT. THIS EQUIPMENT SHOULD BE INSTALLED AND OPERATED WITH MINIMUM DISTANCE 20CM BETWEEN THE RADIATOR & YOUR BODY.

Chapter 1. Introduction

1.1 OVERVIEW

The Gpacers LoRa module is a Low-Power Long Range LoRa Technology Transceiver Module, need to build-up the MCU firmware before use.

The module provides the following interfaces for various applications:

- The 22x I/O port of the connectors configured by firmware of MCU can be used for high/low output to control the receiver, LNA, transmitter, PA functions , or converted into serial USART/SPI/I2C control signals to communicate with different peripheral devices to be integrated in user's system, such as: OLED, GPS module, LED, Wi-Fi module... Etc.
- Use 1 magnet to power on/off the whole module through one hall switch.
- 4 port of the connectors can output 3.3V output power.
- Use 1~4 magnet to control the i/o port of MCU through drv5032 hall switch, used as external control switches to activate the desired functions such as receiver or transmitter function.

1.2 FEATURES

The Gpacers LoRa module has the following features:

- 868/915 MHz high-frequency antenna secured on SMA connector.
- Microchip MCU firmware programming by through holes.
- Long range RF transceiver function of Semtech LoRa technology.
- 18dB LNA and 32dB PA available for receiver and transmitter function.
- Using external magnets for ON/OFF control of Power supply and application functions Control.
- 22 I/O ports including 4 serial USART/SPI/I2C and 3.3V output power for peripherals control.

1.3 TECHNICAL SPECIFICATION

RF modulation	Lora
RF frequency	920.5~924.5 MHz
Transmission power	27 dBm(Max)
Working Temperature	-20°C ~60°C
Power input	DC 3.7 V
Dimensions (H x W) Antenna (H x D)	80x44 mm Antenna: 66x8 mm

CHAPTER 2. HARDWARE DESCRIPTION

2.1 BLOCK DIAGRAM

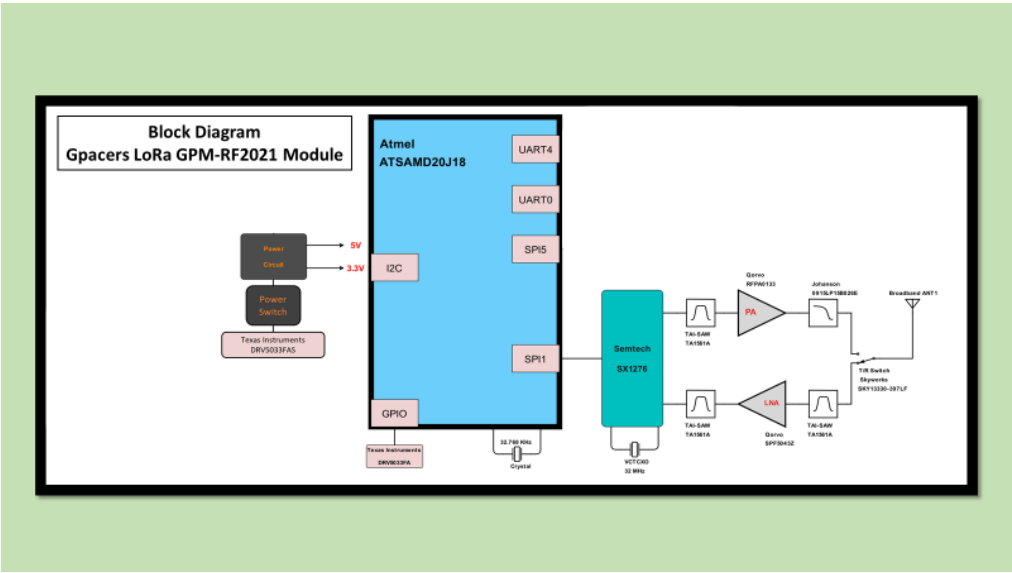
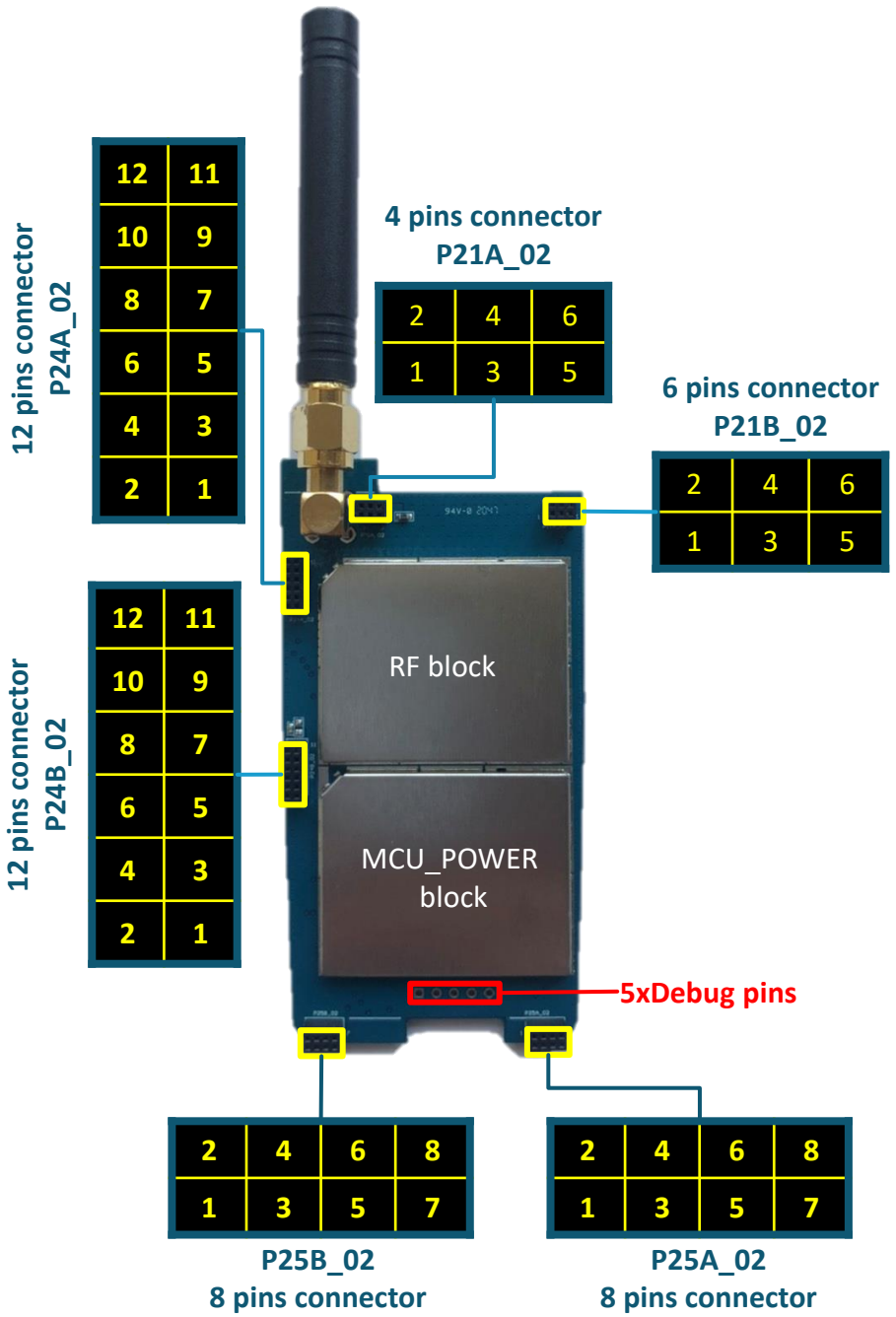


Figure 2-1 Block diagram

2.2 FRONTSIDE OF BOARD

The frontside of board shown in Figure 2-2 contains RF and MCU_POWER block, provides 6 connectors, 52 pins in total, 1 RF antenna and a set of 5xDebug pins.

Figure 2-2 Frontside of board



2.3 BACKSIDE OF BOARD

The backside of board shown in Figure 2-3 supports using external magnets for ON/OFF control of power supply and application functions control.

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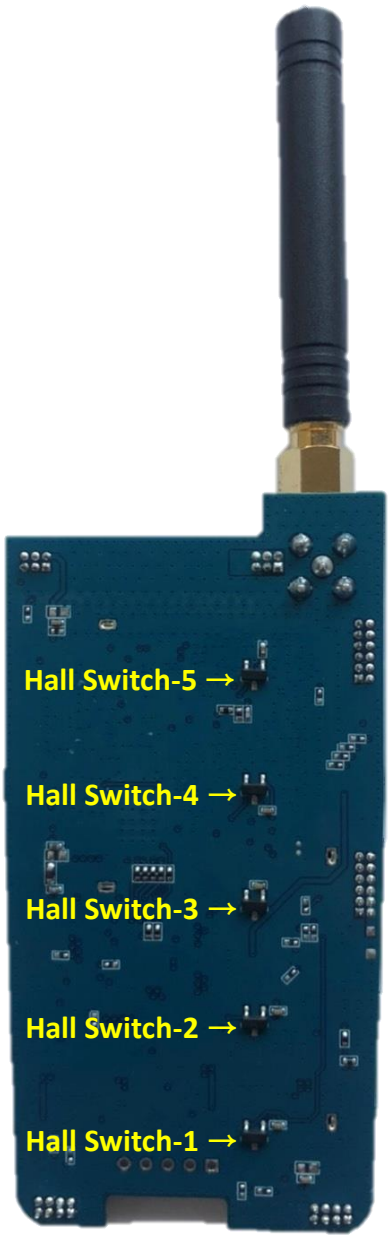
Figure 2-3 Backside of board



Chapter 3. Method of operation

3.1 PIN MAPPING BETWEEN MCU AND LORA TRANSCEIVER

The module contains MCU ATSAMD20J18A to control Lora transceiver SX1276, LNA Qorvo SPF-5043Z and PA Qorvo RFPA0133. The pin to pin mapping is shown as Table 3-1, Table 3-2 and Table 3-3.

Pin of ATSAMD20J18A	Pin of SX1276
PA16	MISO
PA17	SCK
PA19	MOSI
PA18	SS
PA21	DIO0
PA20	DIO1
PB17	DIO2
PB16	DIO3
PA25	RF_RESET

Table 3-1 Pin mapping between MCU and LoRa transceiver

Pin of ATSAMD20J18A	Pin of RFPA0133
PB14	PD
PA12	G8
PB15	G16
PA08 = high	RFPA0133 power off
PA08 = low	RFPA0133 power on

Table 3-2 Pin mapping between MCU and PA

Pin of ATSAMD20J18A	Pin of SPF-5043Z
PA24 = low	SPF-5043Z power off
PA24 = high	SPF-5043Z power on

Table 3-3 Pin mapping between MCU and LNA

3.2 PIN MAPPING BETWEEN MCU AND CONNECTORS

There are 52 pins of 6 connectors shown in Figure 2-2. 22 of the 52 pins configured by firmware of MCU can be used for high/low output to control the receiver, LNA, transmitter, PA functions , or converted into serial USART/SPI/I2C control signals to communicate with different peripheral devices to be integrated in user's system, such as: OLED, GPS module, LED, Wi-Fi module... Etc.

Depend on the peripherals, the user can use the Microchip studio to conduct the firmware program incorporating with external control through magnets. Table 3-4 indicates the pin mapping required for firmware programming.

Connector	Pin no.	Pin of MCU	Type	Description
P21A_02	1~6	GND	-	GND
P21B_02	1	PB13	I/O	ATSAMD20J18A MCU I/O port
	2	VCC_P3V3	O	After feed in 3.3~5V DC battery power to the pin V_IN and (1) place a magnet on Hall Switch-1 or (2) pull up pin 3V3_EN_1 to VIH, pin VCC_P3V3 will output 3.3V DC power.
	3	PB12	I/O	ATSAMD20J18A MCU I/O port
	4	PB10	I/O	ATSAMD20J18A MCU I/O port
	5	GND	-	GND
	6	PB11	I/O	ATSAMD20J18A MCU I/O port
P24A_02	1	PB22	I/O	ATSAMD20J18A MCU I/O port
	2	PB23	I/O	ATSAMD20J18A MCU I/O port
	3	PA22	I/O	ATSAMD20J18A MCU I/O port
	4	PA27	I/O	ATSAMD20J18A MCU I/O port
	5	PA23	I/O	ATSAMD20J18A MCU I/O port
	6	PA28	I/O	ATSAMD20J18A MCU I/O port
	7~10	GND	-	GND
	11~12	3V3_EN_1	I	VIH : 2.5~4.2 V, VIL : 1.35~0V ; Pull up to VIH to power on the module.
P24B_02	1	PB03	I/O	ATSAMD20J18A MCU I/O port
	2,4,6	V_IN	I	Here to feed in battery 3.3~5V DC power
	3	PB02	I/O	ATSAMD20J18A MCU I/O port
	5	PB01	I/O	ATSAMD20J18A MCU I/O port
	7	PB00	I/O	ATSAMD20J18A MCU I/O port
	8,10,12	GND	-	GND
	9	PB31	I/O	ATSAMD20J18A MCU I/O port
	11	VCC_P3V3	O	After feed in 3.3~5V DC battery power to the pin V_IN and (1) place a magnet on Hall Switch-1 or (2) pull up pin 3V3_EN_1 to VIH, pin VCC_P3V3 will output 3.3V DC power.
P25A_02	1,3,5	GND	-	GND
	2	PB09	I/O	ATSAMD20J18A MCU I/O port
	4	PA04	I/O	ATSAMD20J18A MCU I/O port
	6	PA05	I/O	ATSAMD20J18A MCU I/O port
	7	PA07	I/O	ATSAMD20J18A MCU I/O port
	8	PA06	I/O	ATSAMD20J18A MCU I/O port
P25B_02	1,3,5,7	GND	-	GND
	2,4	VCC_P3V3	O	After feed in 3.3~5V DC battery power to the pin V_IN and (1) place a magnet on Hall Switch-1 or (2) pull up pin 3V3_EN_1 to VIH, pin VCC_P3V3 will output 3.3V DC power.
	6	PB07	I/O	ATSAMD20J18A MCU I/O port
	8	PB08	I/O	ATSAMD20J18A MCU I/O port

Table 3-4 Pin mapping of connectors

3.3 POWER ON THE MCU AND LORA TRANCEIVER

There are two ways to power on the MCU and Lora transceiver.

After feed in 3.3~5V DC battery power to the pin V_IN and

(1) place a magnet on Hall Switch-1 or

(2) pull up pin 3V3_EN_1 to VIH(2.5~4.2V).

When the MCU is powered on, the power output pin VCC_P3V3 will be activated as well.

Table 3-5 specifies the technical maximum ratings of above operations.

Pin Name	Parameter	Max	Typical	Min	Unit
V_IN	Input battery power supply	5	4.2	3.3	V
Hall Switch	High magnetic threshold operate point	±1.5	±3	±4.8	mT
	Low magnetic threshold release point	±0.5	±1.5	±3	mT
3V3_EN_1	VIH	4.2	3.3	2.5	V
3V3_EN_1	VIL	1.35	0	0	V

Table 3-5 Technical maximum ratings

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V_IN	Hall Switch-1	3V3_EN_1	VCC_P3V3
0	w/o magnet	0	off
0	w/o magnet	1	off
0	with magnet	0	off
0	with magnet	1	off
1	w/o magnet	0	off
1	w/o magnet	1	on
1	with magnet	0	on
1	with magnet	1	on

Table 3-6 Control logic of power supply to the module.

3.4 USING HALL SWITCH AS EXTERNAL FUNCTION CONTROL

The Module adopts TI Hall switch drv5032, which can switch MCU I/O pin high/low status and power ON/OFF function with magnet.

Hall switch	Type	Function
Hall Switch-1	IN	After feed in 3.3~5V DC battery power to the pin V_IN and (1) place a magnet on Hall Switch-1 or (2) pull up pin 3V3_EN_1 to VIH, pin VCC_P3V3 will output 3.3V DC power.
Hall Switch-2	IN	The user can place a magnet on the switch to modify the high/low status of MCU pin PB07 for peripherals control.
Hall Switch-3	IN	The user can place a magnet on the switch to modify the high/low status of MCU pin PA02 for peripherals control.
Hall Switch-4	IN	The user can place a magnet on the switch to modify the high/low status of MCU pin PA03 for peripherals control.
Hall Switch-5	IN	The user can place a magnet on the switch to modify the high/low status of MCU pin PB04 for peripherals control.

Table 3-7 Hall switches control functions

3.5 PIN MAPPING BETWEEN MCU AND DEBUG PIN

ATMEL-ICE is used to edit, debug and burn firmware. Please refer to Figure 3-1 to link the Debug pins and ATMEL-ICE with cable when developing firmware.

Figure 3-1 Debug pin mapping