HM-23A020 User Guide

Product Overview

The HM-23A020 is an SoC RF data transmission module that integrates a 32-bit Cortex-M33 core with an ultra-low power RF transceiver. It features ultra-low power consumption, high sensitivity, long-distance communication, and high cost-effectiveness.

This product offers a wide range of serial port baud rate options, multiple channel selections, various low-power operation modes, and a fast wake-up mechanism. Parameters such as serial baud rate and transmission power can be configured online.

The module operates at two frequency bands, 868MHz and 915MHz, supporting standard serial baud rates ranging from 2.4kbps to 256kbps.

Product Features

- 32-bit ARM® Cortex®-M33 core with 78 MHz maximum operating frequency
- Up to 256 kB of flash and 32 kB of RAM
- Strong anti-interference capability, suitable for complex interference environments.
- Reception sensitivity: -110dBm at 10kbps for 868MHz
- Operating frequencies: 868MHz, 915MHz
- Power supply voltage range: 1.71V-3.8V
- Transmission operating current: 75mA at +20dBm
- Reception operating current: 5mA at 868MHz
- Deep sleep current: ≤1.2μA

Applications

- Automatic meter reading
- Home security and building automation
- Wireless sensor nodes and industrial monitoring
- ISM band data communication
- Short-distance wireless data transmission
- Wireless sensor networks

Product Highlights

- Ultra-low sleep current of 1.2μA

- Multiple configurable channels, GFSK modulation

- Maximum transmission power: +20dBm, Minimum: -10dBm

- Customizable low-power operation modes

- 1.2km transmission range (9.6Kbps)

- Supports large data stream transmission

Product Pin Configuration

Table 1. HM-23A020 Pin Configuration

Pin	Name	Type	Description
PA8	RXD	I	Serial data RX (internal pull-up)
PA7	TXD	O	Serial data TX (internal pull-up)
RESET	RESET	I	Hardware reset pin, active low
PB1	PB1	I	Configuration/wake-up pin
VCC	VCC		Power supply
GND	GND		Ground
RFOUT	RFOUT	O	RF output
PC2	PC2	O	Module status
PC3	PC3	O	Frame error indicator pin
PC0	PC0	I	Mode setting 1
PC1	PC1	I	Mode setting 2
SWDIO	SWDIO	IO	NC
SWCLK	SWCLK	I	NC
PA0	PA0	O	RF flag pin

Electrical Parameters

Test Conditions: Power Supply 3.3V, Temperature 25°C

Table 2. Electrical Parameters

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Operating Frequency	Fc	HM23A020-868S2	860		876	MHz
		HM23A020-915S2	907		923	MHz
Modulation	MOD			GFSK		
RX Sensitivity	S	868MHz 1.2Kbps		-113		dBm

		915MHz 1.2Kbps		-113		dBm
Serial Data Rate	DR		2.4	9.6	256	Kbps
Operating Voltage	VDD		1.71	3.3	3.8	V
RX Current	IRx	868MHZ		5		mA
		915MHZ		5		mA
TX Current	ITx	868MHZ +20dbm		75		mA
		915MHZ +20dbm		73		mA
Sleep Current	ISleep			1.2		uA
Operating Temperature	TOP		-40		+85	°C

Product Usage Instructions

The HM-23A020 utilizes a 32-bit ARM Cortex-M33 core with a maximum operating frequency of 78MHz, up to 256kB of Flash, and 32kB of RAM. The module features an ultra-low power RF transceiver, providing high sensitivity, long-range communication, and high cost-effectiveness, with a maximum transmission power of +20dBm.

The default factory serial baud rate is 9600bps, with an internal dual 255-byte buffer. The serial baud rate automatically matches the corresponding air rate. The maximum air transmission data frame size is 255 bytes, and if user data exceeds this length, only the first 255 bytes will be transmitted.
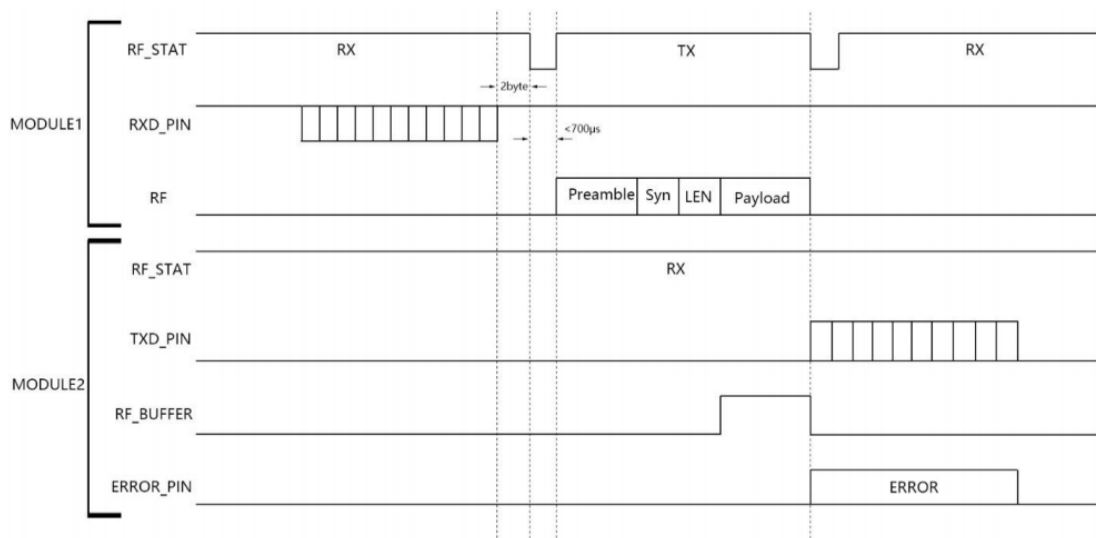
The product supports up to 32 channels with a step size of 500KHz, covering the following frequency ranges:

- 860~876 MHz (Center frequency: 868 MHz)
- 907~923 MHz (Center frequency: 915 MHz)

Packet Format

Preamble	Syncword	Header	Payload	CRC

Sequence charts

Operating Modes

The module has four operating modes, which can be toggled via different voltage levels on PC0 and PC1:

PC0	PC1	Mode	Description
1	1	Normal Mode	This mode is a normal high-performance operating state. The RF remains in RX mode at all times. When data is received, it is immediately transmitted through the serial port. If data is received from the serial port, the RF switches to TX mode to transmit the data packet.
0	1	Wake-up Mode	This mode is the wake-up mode, used for sending data to modules in low-power states. It is similar to the normal operating mode, except that the transmission includes an extended preamble. This results in longer transmission times, which depend on the low-power cycle set by the user.
1	0	Low Power Mode	This mode is the low-power state, where serial reception is disabled, meaning data cannot be sent to the module, only received. In this mode, the RF alternates between Sleep and RX in a periodic cycle, with the duration of each state determined by the user's low-power cycle and air rate settings. When data is received in this mode, the PC2 status pin outputs a high signal for 5ms before the data is transmitted via the serial port.

0	0	Sleep Mode	In this mode, the module enters sleep mode. Both serial input and output are disabled, and the RF remains in Sleep mode. To wake up the module, a negative pulse needs to be applied to the wake-up pin PB1.

The four modes can be freely switched between by changing the voltage levels of two pins. When switching from Sleep Mode or Low Power Mode to another mode, the pin voltage levels must be adjusted first, and then a negative pulse should be applied to the wake-up pin to wake up the module and switch to the desired state. The module status pin PC2 remains high in Normal Mode and Wake-up Mode, while it stays low in Low Power Mode and Sleep Mode. Users can monitor the status of this pin to determine whether the module has successfully switched modes.

Mode Switching Time

Current Mode	Target Mode	Switching Time
Normal Mode	Low Power Mode	217μs
Low Power Mode	Normal Mode	<= Low Power Cycle
Normal Mode	Sleep Mode	200μs
Sleep Mode	Normal Mode	310μs

Since Wake-up Mode is nearly identical to Normal Mode, the switching time between Wake-up Mode and other modes is the same as that of Normal Mode. The transition time between Wake-up Mode and Normal Mode can be ignored. Wake-up Mode is mainly used to allow a module in Low Power Mode to receive data and is generally used in combination with Low Power Mode. Because the MCU enters sleep mode in Low Power Mode, the longest switching time from Low Power Mode to another mode is equal to the Low Power Cycle duration. When entering Sleep Mode, lowering PC0 before PC1 can reduce the switching time.

Communication Timing For Wake-up Mode and Low Power Mode
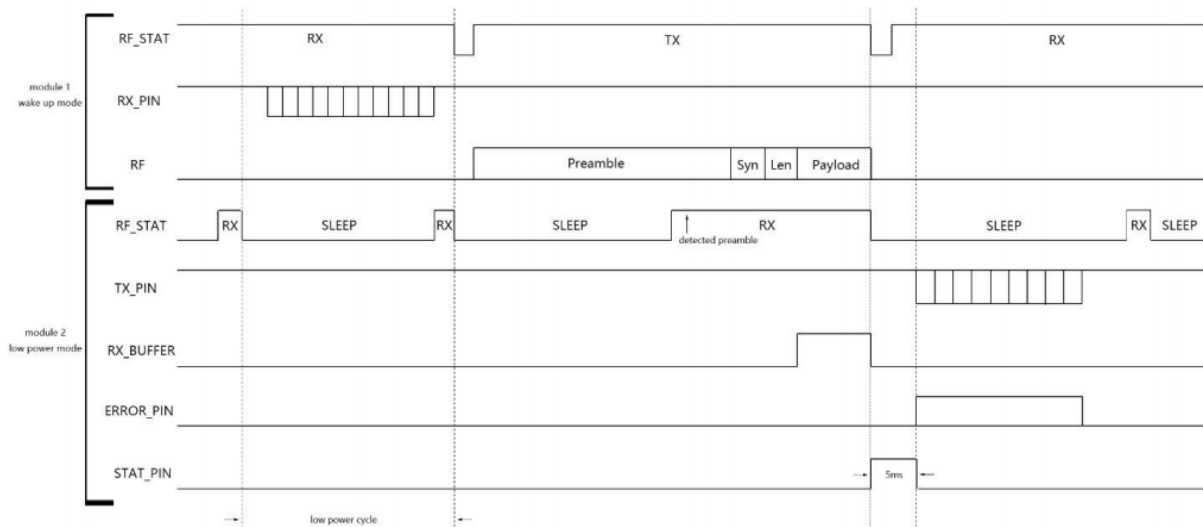
Module Configuration

The module supports online configuration by pulling the PB1 pin low to enter configuration mode (only available in Normal Mode and Wake-up Mode). In configuration mode, the serial baud rate is fixed at 9600bps.

Configuration is done by sending HEX sequences, and the module provides six configurable parameters:

1. Serial baud rate

2. Channel

3. Transmission power

4. Low-power wake-up cycle

5. PA0 status output

6. Sync word

After configuration is complete, pulling the PB1 pin high will apply the new settings. Configurations can be stored in internal Flash memory, and the module will retain the saved settings after power cycling.

Factory default settings:

- Serial baud rate: 9600bps

- Channel: 16

- Transmission power: +20dBm

- Sync word: 0xCACA

- Default low-power cycle: 1 second

HEX sequence of Command

0x5a	0x36	CMD	Parameter	Chksum

Where CMD is one byte, Parameter varies in length, and Chksum is the checksum of CMD + Parameter.

Name	CMD	Parameter
Baud rate of serial port	0x30	1 byte parameter 0x04：2400bps 0x05：4800bps 0x06：9600bps 0x07：19200bps 0x08：38400bps 0x09：57600bps 0x0A：115200bps 0x0B：256000bps
Channel	0x31	1 byte parameter 0x00-0x1F：channel 0 ~ channel 32
PA0 output Status	0x34	1 byte parameter 0x01：Preamble detected 0x02：Syncword detected 0x03：Recived Packet 0x04：Send Packet Done 0x09：STATE_IS_RX 0x0A：STATE_IS_TX
Low-power wake-up cycle	0x36	1 byte parameter 0x0032-0x07D0：50ms~2s with 1ms step (MSB First) Maximum Sleep Cycle Limitations at Certain Air Data Rates: 256000bps：<=0.2s 115200bps：<=0.5s 57600bps：<=1.0s 38400bps：<=1.5s

Tx power	0x38	1 byte parameter 0x00~0x1E：-10dbm~20dbm with 1dbm step
Sync word	0x39	2 bytes parameter 0x0000-0xFFFF
Read Configuration	0x50	1 byte parameter ANY
Set Configuration	0x51	8 bytes parameter Parameter Sequence: Serial Baud Rate+Channel+Transmission Power+Low-Power Cycle+PA0 Output Status+ Sync Word
Save configuration	0x52	1 byte parameter ANY
Version	0x53	1 byte parameter ANY

The module will reply with the execution result of the command in HEX format after each command is sent：

0x5a	0x36	REPLY	[Parameter]

		REPLY	Parameter
Successful		0x60	Version read: Software version Other commands: None
Failed		0x61	None
Configuration		0x62	Used to reply to configuration read commands; Reply sequence: Serial rate + channel + transmit power + low power cycle + PA0 output + sync word

The serial rate corresponds to the air data rate.

Serial rate	Air data rate
2400bps	2400bps
4800bps	4800bps

9600bps	9600bps
19200bps	19200bps
38400bps	38400bps
57600bps	57600bps
115200bps	115200bps
256000bps	256000bps

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