

**UM02506**

**RHF1SFE2**

**V1.0.3**

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## Document information

<b>Info</b>	<b>Content</b>
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<b>Abstract</b>	RHF1SFE2 Equipment user manual to help users quickly get started using modules

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## **1 Foreword**

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RHF1SFE2 is the fourth generation intelligent fire extinguisher monitoring terminal launched by RisingHF Network (Shenzhen) Co., Ltd. The product adopts an ultra-low power main control module RHF0M0E5, which integrates various high-performance sensors, including three-axis acceleration sensors, dedicated air pressure sensors, TOF distance sensors, and NTC temperature sensors, to achieve comprehensive perception and intelligent monitoring of the fire extinguisher status. The device supports battery power supply and long-distance wireless communication, with high reliability, low power consumption, and easy deployment, providing an efficient and convenient solution for intelligent management of fire extinguishers, widely applicable to various public places and industrial environments.

## **2 Product description**

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RHF1SFE2 is an intelligent terminal device designed specifically for fire extinguisher status monitoring. It monitors the internal pressure, pressure changes, ambient temperature, and temperature fluctuations of the fire extinguisher in real-time, while tracking the device's movement status and obstacle distance, achieving comprehensive monitoring. Once an abnormal situation is detected, the system will immediately trigger an alarm and report information, significantly improving the convenience and safety of fire extinguisher management.

## 3 Function Description

The device supports two working modes: sleep mode and active mode. In the activated state, the device defaults to using ABP communication mode (the difference between ABP and OTAA modes mainly lies in the registration method of nodes on the server side, and it is necessary to ensure that the server configuration is consistent before switching communication modes). Easy installation, users only need to correctly fix the device on the fire extinguisher, and the system will automatically activate to start real-time monitoring of the fire extinguisher status and surrounding environmental parameters. The equipment will report monitoring data according to the set cycle, and automatically trigger an alarm and report to the backend system when abnormal situations are detected, ensuring the safety and convenient and efficient management of firefighting equipment.

### 3.1 Sleep

- **Working status of the device in sleep mode**

- In sleep mode, only the pressure sensor polls the pressure data with a 5-second cycle

- **Normal installation of wake-up devices**

- When the device is in sleep mode and correctly installed in a fire extinguisher with normal air pressure, the device will automatically activate. After activation, the buzzer will sound three times to indicate that the current state is active. (The default normal pressure value is greater than 1000Kpa)

- **Manually wake up the device**

- When the device is in sleep mode, it can be manually activated by triggering it with a magnet for 4 seconds to 8 seconds. After activation, the buzzer will sound three times to indicate that the device is currently in an active state.

- **Attention**

- During the initialization process after device activation, the device will perform battery voltage detection. When the battery capacity is below 30%, the buzzer will not work.
- After device activation, the device will upload a heartbeat data packet once.
- During deployment, it is necessary to ensure that the device is in sleep mode before deployment and installation, in order to trigger the normal installation and activation of the device.

### 3.2 Active mode

#### 3.2.1 The workflow of the device in activated state

- **Pressure sensor:** Polling every 5 seconds
- **NTC temperature sensor:** Polling every 5 seconds
- **battery voltage:** Polling once every hour
- **Three axis acceleration sensor:** Always in standby mode, waiting for movement to trigger interrupt
- **TOF module:** Polling and collecting data every 10 minutes
- **Measurement of equipment tilt angle:** Polling and collecting data every 10 minutes

## 3.3 Alarm logic

### 3.3.1 Air pressure alarm(12):

- Quick leak alarm
  - Trigger condition: Within a single 5-second polling cycle, the air pressure drops more than the preset value of 40Kpa
  - Response: Immediately beep once, report alarm information: **00xxxxxxxxxx0F1202**
  - **0F**: ALERT command word, indicating warning
  - **12**: Pressure command word
  - **02**: Rapid Threshold Exceedance Warning(Quick leak Alarm)
  - **xxxxxxxx**: Sensor data, in the same order as the periodic reporting data in the following text
- Slow gas leakage alarm
  - Trigger condition: Accumulated decrease in air pressure exceeding the preset value within 24 hours
  - Response: Immediately beep once, report alarm information: **00xxxxxxxxxx0F1203**
  - **0F**: ALERT command word, indicating warning
  - **12**: Pressure command word
  - **03**: Slow Threshold Exceedance Warning(Slow gas leakage Alarm)
- Low air pressure alarm
  - Trigger condition: When the detected air pressure is lower than the preset value
  - Response: Immediately beep and report alarm information: **00xxxxxxxxxx0F1201**
  - **0F**: ALERT command word, indicating warning
  - **12**: Pressure command word
  - **01**: Below Lower Threshold Warning(Low air pressure Alarm)
  - Attention: When the alarm state is not eliminated, the device will repeat the alarm action every 10 minutes.

### 3.3.2 Temperature alarm(10):

- High temperature alarm
  - Trigger condition: The current temperature is higher than the preset maximum temperature value
  - Response: Immediately beep once, report alarm information: **00xxxxxxxxxx0F1000**
  - **0F**: ALERT command word, indicating warning
  - **10**: Temperature command word
  - **00**: Exceeds Upper Threshold Warning (High Temperature Alarm)
  - Attention: The device will repeat the alarm action every 10 minutes
- Rapid heating alarm
  - Trigger condition: The temperature rises above the preset value within 5 seconds

- Response: Immediately beep once and report the alarm information: `00xxxxxxxxxx0F1002`
- `0F`: ALERT command word, indicating warning
- `10`: Temperature command word
- `02`: Rapid Threshold Exceedance Warning (Rapid Temperature Rise Alarm)

### 3.3.3 Location alarm(14)

- Motion alarm
  - Trigger condition: Two movements detected within 20 seconds (based on the accelerometer)
  - Response: beep once, immediately report the alarm information: `00xxxxxxxxxx0F1404`
  - `0F`: ALERT command word, indicating warning
  - `14`: Move Command Word
  - `04`: Sensor Interrupt Triggered Warning (Movement Alarm)
- Tilt alarm
  - Trigger condition: The tilt angle of the device is greater than the tilt threshold within 20-30 minutes
  - Response: beep once, immediately report the alarm information: `00xxxxxxxxxx0F1400`
  - `0F`: ALERT command word, indicating warning
  - `14`: Move Command Word
  - `00`: Exceeds Upper Threshold Warning (Tilt Alarm)

### 3.3.4 Blocking alarm(98)

- Trigger alarm: An alarm will be triggered if an object is detected within the preset distance from the device for two consecutive times. Response: beep once, immediately report the alarm information: `00xxxxxxxxxx0F9801`
- `0F`: ALERT command word, indicating warning
- `98`: Distance command word
- `01`: Obstructive warning
- Attention: In the alarm state, the device will repeatedly sound the alarm every 10 minutes

### 3.3.5 Low voltage alarm

- Trigger condition: When the battery voltage is lower than the voltage value of 30% of the battery capacity
- 响应: 立即上报报警信息: `00xxxxxxxxxx0F9501`
- `0F`: ALERT command word, indicating warning
- `95`: Voltage command word
- `01`: Low voltage warning

- Attention: In the alarm state, the device will repeatedly sound the alarm every hour

### 3.3.6 Periodic reporting

- Logical explanation: After successfully reporting data (including alarm reporting), the device will re time the heartbeat cycle. When the timer reaches the preset cycle, the device will report data again.
- For example, data: 00 11 09 4C 04 6D D0 07 14
- 00: CFRM command word, representing compressed data frame format
- 1109: HEX:0x0911 = DEC:2321 Represent 23.21°C
- 4C04: HEX:0x044c = DEC:1100 Represent 1100Kpa
- 6D: HEX:0x6D = DEC:109 quantity of electricity=109 / 254 = 42.91% (When the battery is 100% charged, the value is 254, which is 0xFE. When the battery is 100% charged, the value is 254, which is 0xFE)
- D007:HEX:0x07D0 = DEC:2000 Represent 2000mm
- 14:HEX:0x14 = DEC:20 indicates the device tilt angle is 20° .

## 4 Set instruction parsing (NS, AT instructions)

### 4.1 Reporting cycle setting

#### ➤ NS distribution settings

- If the set cycle is less than or equal to 8 hours
- Instruction: 9D6054 (Set reporting cycle to 6 hours)
- **9D**: Cycle setting command code
- **6054**: HEX: 0x5460 = DEC: 21600 = 21600/3600 = 6 hours
- If the set cycle is greater than 8 hours
- instruction: **9DC07B** (Set the reporting cycle to 12 hours)
- **9D**: Cycle setting command code
- **C07B**: HEX: 0x7BC0 = DEC: 31680 -> [(31680 - 28800) \* 5 + 28800] / (60 \* 60) = 12hours
- response: **0E9D** (Setting successful) 、 **0D9D** (Setting failed)
- **0E**: Setting successful、 **0D**: Setting failed

#### ➤ AT Instruction settings

- When setting AT commands, there is no need for step-by-step calculation, and the maximum reporting interval is 59 hours (devices that set parameters beyond 59 hours will report according to the default cycle of 59 hours)
- AT command: **\xff\xff\xff AT+APP=ULPRD,21600**(Set the reporting cycle to **6 hours**)
- **\xff\xff\xff**: Wake-up Pro
- **AT+APP=ULPRD**: Set reporting cycle instruction
- **21600**: 21600 / (60 \* 60) = 6 hours
- AT command: **\xff\xff\xff AT+APP=ULPRD,43200**(Set the reporting cycle to **12 hours**)
- As explained above
- Query the reporting cycle AT command of the current device: **\xff\xff\xff AT+APP=ULPRD**
- return value: **+APP: ULPRD:86400** (86400 is the reporting cycle unit in seconds)

### 4.2 Pressure parameter setting

#### ➤ NS distribution settings

- Set the minimum value to 1000Kpa and the slow release step size to 50Kpa
- command: **1202E803** (Set the minimum value to 1000Kpa)
- **12**: Air pressure command code
- **02**: Set minimum value function code
- **E803**(The last four): HEX: 0x03E8 = DEC: 1000Kpa
- command: **12043200** (Set the slow leakage step size to 50Kpa)
- **12**: Air pressure command code
- **04**: Set slow leakage step function code
- **3200**: HEX: 0x0032 = DEC: 50Kpa
- response: **0E12** (Setting successful) 、 **0D12** (Setting failed)
- **0E**: Setting successful、 **0D**: Setting failed

- **AT command settings**
- command: `\xff\xff\xff AT+APP=AP,1000,50` (Set the minimum value to `1000Kpa`, with a slow leakage step size of `50Kpa`)
- `\xff\xff\xff`: Wake-up Pro
- `AT+APP=AP`: Set pressure parameter command
- `1000`: This position is the minimum value for setting the device's air pressure
- `50`: This position is used to set the monitoring step size for slow leakage of equipment
- Query the current device air pressure parameter AT command: `\xff\xff\xff AT+APP=AP`
- return value: `+APP: AP:112 MIN:1000 STEP:50` (`AP` For the most recent read air pressure value, `MIN` For the current set minimum air pressure value, `STEP` For the currently set monitoring slow leakage step size)

### 4.3 Temperature parameter setting

- **NS distribution settings**
- Set the maximum temperature to 55 degrees Celsius and monitor the rapid temperature increase with a step size of 5 degrees Celsius
- command: `10017C15` (Set the maximum temperature to 55 degrees Celsius)
- `10`: Temperature command code
- `01`: Set maximum temperature function code
- `7C15`: HEX: 0x157C = DEC: 5500 -> 55degrees Celsius
- command: `1004F401` (Set the step size for rapid temperature rise monitoring to 5 degrees Celsius)
- `10`: Temperature command code
- `04`: Set fast heating step function code
- `F401`: HEX: 0x01F4 = DEC: 500 -> 5degrees Celsius
- response: `0E10` (Setting successful) , `0D10` (Setting failed)
- `0E`: Setting successful, `0D`: Setting failed
- **AT command setting**
- command: `\xff\xff\xff AT+APP=TEMP,55,5` (Set the maximum temperature to 55 degrees Celsius and the rapid heating step size to 5 degrees Celsius)
- `\xff\xff\xff`: Wake-up Pro
- `AT+APP=TEMP`: Set temperature parameter command
- `55`: This position is the parameter location for the maximum temperature value
- `5`: This position is the step parameter position for rapid temperature rise monitoring
- Query the temperature parameter AT command of the current device: `\xff\xff\xff AT+APP=TEMP`
- Return value: `+APP: TEMP:26.0 MAX:55.0 STEP:5.0` (`TEMP` For the most recent temperature measurement value, `MAX` The current highest temperature parameter for the device, `STEP` The step size parameter for the current rapid heating of the device)

## 4.4 TOF Sensor parameter settings

- **NS distribution settings**
  - Set the threshold for obstacle distance as 1000mm
  - command: **9802E803** (Set the distance threshold for obstacles as 1000mm)
  - **98**: Obstacle distance command code
  - **02**: Function Code for Setting the Obstacle Distance Lower Limit
  - **E803**: HEX: 0x03E8 = DEC: 1000 mm
  - response: **0E98** (Setting successful) 、 **0D98** (Setting failed)
  - **0E**: Setting successful、 **0D**: Setting failed
- **AT command setting**
  - command: **\xff\xff\xff AT+APP=TOF,1000**
  - **\xff\xff\xff**: Wake-up Pro
  - **AT+APP=TOF**: Set distance threshold instruction
  - **1000**: This position is the distance threshold parameter
- **Query the parameter settings of the current TOF sensor:** **\xff\xff\xff AT+APP=TOF**
  - return value: **+APP: TOF:900 MIN:1000** (**TOF** For the most recent distance data、 **MIN** Parameters for the current obstacle threshold of the device)
  - The parameter range is 0-2000mm

## 4.5 Equipment tilt angle parameter setting

- **NS issues data**
  - Set the device tilt angle threshold to 35°
  - command: **140123** (Set the alarm threshold for device tilt angle to 35° )
  - **14**: Tilt angle command code
  - **01**: Function Code for Setting the Tilt Angle Upper Limit
  - **23**: HEX: 0x23 = DEC: 35°
  - response: **0E14** (Setting successful) 、 **0D14** (Setting failed)
  - **0E**: Setting successful、 **0D**: Setting failed
- **AT command setting**
  - command: **\xff\xff\xff AT+APP=ACC,35**
  - **\xff\xff\xff**: Wake-up Pro
  - **AT+APP=ACC**: Set angle threshold command
  - **35**: This position is the distance threshold parameter
- **Query the current device tilt angle parameter:** **\xff\xff\xff AT+APP=ACC**
  - return value: **+APP: ANGLE:90 SET\_ANGLE:35** (**ANGLE** For the latest device tilt angle data、 **SET\_ANGLE** Alarm threshold for the tilt angle of the set device)

## 4.6 Device sleep state setting

- **NS issues data**
  - command: **0500** (Set the device to sleep mode)

- **05**: Status setting command code
- **00**: Sleep Command
- response: **0E05** (Setting successful) 、 **0D05** (Setting failed)
- **0E**: Setting successful、 **0D**: Setting failed
- **AT command setting**
- command: **\xff\xff\xff\xff at+disapp**
- **\xff\xff\xff**: Wake-up Pro
- **at+disapp**: Device sleep command

## 4.7 Multiple parameters are issued simultaneously

- **NS issues data**
- For example, setting: tilt angle+maximum temperature value+reporting cycle
- command: **14012310017C159D6054**
- response: **0E140E100E9D**
- **0E14**: Represents successful setting of tilt angle
- **0E10**: Represents successful temperature parameter setting
- **0E9D**: Set the reporting cycle as
- Other parameters can also be set by issuing parameter setting instructions simultaneously in the above manner
- For example, resetting all parameters (reporting cycle of 6 hours, minimum air pressure of 1000Kpa, slow leakage step size of 50Kpa, maximum temperature of 55 degrees Celsius, rapid heating step size of 5 degrees Celsius, obstacle distance threshold of 1000mm, equipment tilt angle of 35 degrees):
- **9802E803120432001202E80310017C151004F4011401239D6054**
- response: **0E 98 0E 12 0E 12 0E 10 0E 10 0E 14 0E 9D**

## 4.8 NS actively queries sensor data

- **The format of the query frame for querying data is:** **04 + sensor 1 Command code + sensor 2 Command code+ ……**
- 04: Inquiry function code
- The sensor command codes are respectively: temp **0x10**、 air pressure **0x12**、 distance **0x98**、 quantity of electricity **0x95**、 angle **0x14**
- **Using Logic**
- The data from the above 5 sensors can be obtained separately or multiple times, and the data sequence of the device response corresponds one-to-one with the data sequence of the command code
- **Single sensor inquiry:** **0498** (Inquire about the data from the distance sensor)
- response: **04D007**
- **D007**:HEX:0x07D0 = DEC:2000 The distance is represented as 2000mm
- The separate inquiries for other sensors are the same as above

- **Multiple sensors simultaneously inquire:** 0410951214 (The order is as follows: the first is inquiring about temperature, the second is inquiring about electricity, the third is inquiring about air pressure, and the fourth is inquiring about angle)
- response: 045E0BFEE80314
- The data order in the response frame corresponds to the data order in the inquiry frame, so the first data in the response frame is temperature data, the second is electricity data, the third is air pressure data, and the fourth is angle data
- 5E0B: HEX: 0x0B5E = DEC: 2910 -> 29.10°C
- FE: HEX: 0xFE = DEC: 254 -> 254 / 254 = 100% (The current device battery level is 100%)
- E803: HEX: 0x03E8 = DEC: 1000Kpa (The current device air pressure is 1000Kpa)
- 14: HEX: 0x14 = DEC: 20° (The current tilt angle of the device is 20°)
- The rest of the inquiry combinations are the same as above

## 4.9 NS queries device information

- Inquiry frame for querying information
- Inquiry frame: 0407
- 04: Inquiry function code
- 07: Equipment detailed information command
- response: 04 90 03 10 06 9D 80 9D 02 10 12 95 98
- 04: Inquiry function code
- 90: Version information instruction
- 031006: HEX:0x061003 = BIN:0000 0110 0001 0000 0000 0011 => (Hardware Master Version bit20-18 = BIN:001 = DEC:1、Hardware sub version bit17-16 = BIN:10 = DEC:2、Software Master Version bit15-12 = BIN:0001 = DEC:1、Software sub version number bit11-8 = BIN:0000 = DEC:0、Software patch version number bit7-0 = BIN:00000011 = DEC:3) => (Hardware version V1.2, software version V1.0.3)
- 9D: Report cycle command code
- 809D: Consistent with the analysis of cycle parameters mentioned earlier (reporting cycle setting)
- 02: The CMD compression order of the reported data represents the CMD order during periodic reporting
- 10129598: 10:temperature + 12:air pressure + 95:quantity of electricity + 98:Obstacle distance
- Query version information
- Query version information separately: 0490
- response: 04031006
- The analysis is consistent with the previous text
- Order of reporting data
- Query the order of data upload separately: 0402
- Response 0410129598
- The analysis is consistent with the previous text

## 5 Other functional parameters

### 5.1 power consumption

- **Active state power consumption**
  - Under normal operating conditions with log output turned off, 24-hour reporting cycle, and no alarms, the average power consumption is below 60 microamperes when activated
  - In the activated state, the average power consumption under normal operating conditions with log output turned off, a 12 hour reporting cycle, and no alarms is below 64 microamperes
- **Standby power consumption**
  - In standby mode, the average power consumption is below 14 microamperes when the log output is turned off and there is no trigger

### 5.2 low-voltage state

- When the voltage is lower than 30% of the battery capacity, the buzzer will not work. Report low voltage alarm with a cycle of one hour

### 5.3 Charging protection

- When the device is in an environment of 0-45 degrees Celsius, the charging function is turned on normally
- The charging function will be turned off when the device is below 0 degrees Celsius and above 45 degrees Celsius

### 5.4 Setting of frequency plan, channel, and LOAR mode

- Use AT command: `\xff\xff\xff\xff at+dr=AS923` (Modify the frequency plan to AS923)
- Use AT command: `\xff\xff\xff\xff at+ch=num, 0-7` (Change to 0~7 channels)
- Use AT command: `\xff\xff\xff\xff at+mode=abp` (Change to ABP mode)
- Use AT command: `\xff\xff\xff\xff at+mode=otaa` (Change to OTAA mode)

### 5.5 DFU upgrade

- Use AT command: `\xff\xff\xff\xff at+dfu=on` (Put the device into DFU upgrade mode)
- After the device enters DFU mode normally, it will periodically print "C" to indicate that the device is waiting for firmware release

The device is upgraded using Ymodem mode and automatically restarts after the transfer is completed

### 5.6 Device activation

- The device supports two activation modes, and manual activation is suitable for debugging and other scenarios. In actual installation and deployment, it is necessary to ensure that the device is in a sleep state before installation, in order to trigger automatic activation of the device.

## 6 Frequently asked questions

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Q: In activation mode, the device does not upload information normally

A:

- Check if the frequency plan and channel settings are correct
- Check if the serial port is outputting normally to determine if the device is running
- Use the serial port to check if the air pressure data in the log is correct. If the log shows AP: 8388, it indicates that the air pressure sensor communication is abnormal and the device connection needs to be checked. If the connection is normal, it indicates that the air pressure sensor has failed

Q: How to turn off obstacle monitoring alarms in environments where device deployment does not require obstacle monitoring

A: Set the obstacle distance threshold to 0 using AT commands or gateway commands

Q: Activation mode device cannot access the network

A:

- Please check if the gateway has been deployed around the device and is working on the same frequency band as the device's settings
- Please check if the device has successfully registered OTAA mode to the NS server
- Power on the device again to accelerate the network connection speed
- Detecting environmental background noise and eliminating equipment, setting the frequency band without interfering signals

Q: There is no sound when the device is powered on in activation mode

A: Update the new battery to eliminate power failure caused by a battery level below 30%. Confirm that the device is powered on normally

Q: Activation mode device releases pressure without warning

A:

- Confirm if the device is already online
- Reinstall the pressurized steel cylinder on the device, the buzzer sounds three times, and wait for it to be reconnected to the network for testing
- Reinstall the pressurized steel cylinder onto the equipment, but the buzzer does not respond and the pressure sensor is damaged

Q: The ambient temperature rises rapidly and then continues to exceed 55 degrees, but the equipment shows no response

A:

- Confirm if the device is already online
- Shake the device to check the reported heartbeat data and whether the device temperature exceeds the high temperature warning threshold

The NTC sensor is placed inside the casing and has a slow response to temperature. When the ambient temperature rises, the temperature rise of the device does not exceed 5 degrees within 5 seconds

Q: Why does the tilt angle of the device not reach the preset value trigger the device tilt alarm

A:

- Confirm if the equipment is installed correctly. During installation, the equipment should be perpendicular to the ground and parallel to the vertical direction of the fire extinguisher tank

Q: Activate mode data downlink configuration device, device unresponsive

A:

- In activated mode, the device is in CLASSA mode and cannot receive downlink data in real-time
- Shake the device and wait for it to complete data reporting, then check if the device has been successfully configured

## Revision record

V1.0.3 2025-05-07

-Adaptation to Protocol Document Version 1.8

V1.0.2 2025-04-22

-Add response frame explanation for gateway issued parameters

V1.0.1 2025-04-16

-Add tilt alarm, tilt angle query, and threshold parameter settings

V1.0.0 2025-04-14

- first draft

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