

RFXSensor

RF transmitters

For

1-Wire sensors

www.rfxcom.com

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1. FEATURES

The RFXSensor unit is a wireless battery or DC adapter powered temperature sensing transmitter with one hard-wired temperature sensor and optional sensors. There are 3 different RF units and 3 different additional sensors available.

The RFXSensor unit uses one of two user-selectable sensitivity and transmission rates; *high* and *low*.

When the *high* rate setting is used the RFXSensor unit will measure the temperature for each attached sensor every minute and report any changes of .5 degrees C or higher. If a change of .5 degrees or higher has not been detected for 40 minutes the current temperature will be transmitted as a keep-alive or heartbeat signal. This setting allows for frequent temperature updates but will consume more power and result in a shorter battery life.

When the *low* rate setting is used the RFXSensor unit will measure the temperature for each attached sensor every 5 minutes and report any changes of 1 degree C or higher. If a change of 1 degree or more has not been detected for 80 minutes the current temperature will be transmitted as a keep-alive or heartbeat signal. This setting provides less frequent temperature updates but will provide the longest battery life.

The **RFXSensor Type 1** (discontinued) unit employs a built in DS18B20 temperature sensor which is able to measure temperatures from -55°C to +125°C (-67°F to +257°F) with an accuracy of ±0.5°C between -10°C to +85°C. The operating range is -10°C to +45°C. One additional temperature sensor DS18B20 or DS18B20 IC can be connected.

The **RFXSensor Type 2** (discontinued) unit employs a built in DS2438 temperature sensor which is able to measure temperatures from -40°C to +85°C (-40°F to +185°F) with an accuracy of ±2°C between -10°C to +85°C. The operating range is -10°C to +45°C. An optional internal HIH4000 Humidity sensor can be ordered. One Additional Humidity Sensor or one Additional Barometer Sensor or one Additional Temperature Sensor DS2438 or one Additional Temperature Sensor DS18B20 or one DS18B20 IC can be connected.

The **RFXSensor Type 3** unit has the same specifications as the Type 2 unit with the exception that up to 7 additional sensors can be connected.

The RFXSensor Type 1 and 2 unit is powered by a 9 Volt battery. It is also possible to connect an external DC power of 7-12 volt to the battery clip. It is advised to power the RFXSensor Type 3 unit by an external 7-12 volt DC source.

The additional sensors are small boxes with 1 or more sensors inside and a terminal block for the 1-Wire cable.

The **Additional Temperature Sensor DS18B20** has a DS18B20 temperature sensor inside. The **Additional Temperature Sensor DS2438** has a DS2438 temperature sensor inside. The A/D input of the DS2438 is accessible and there is a connection point for this input on the PCB available. The A/D input can be used to create your own solution.

The **Additional Humidity Sensor** has a HIH4000 humidity sensor and a DS2438 temperature sensor inside.

The **Additional Barometer Sensor** has a MPXA4115 pressure sensor and a DS2438 temperature sensor inside.

The additional sensor(s) can be connected to the RFXSensor unit with a standard 3.5mm - 3 pole jack connector.

The RFXSensor unit transmits a 32 bit RF data packet (three times for redundancy) with each temperature change as described below. This data format can be received by the RFXCom receiver or W800RF32 receiver. When used with the proper software the temperature and optional sensor data can be remotely decoded and displayed or used to control other devices.

The software to interpret the data packet can be user written or standard home automation software like Homeseer and the ACRF plug-in can be used.

Each sensor has an address, which is added to the base address of the RFXSensor unit to form a complete RF address. Up to 32 RFXSensor Type-1 or 2 or up to 8 RFXSensor Type-3 transmitters can be used at the same time within range of each other, allowing up to 64 total 1-Wire devices to be deployed.

The base address of each RFXSensor unit can be changed by the user.

2. Available RFXSensor devices.

2.1. RF transmitter for 1-Wire sensors, Type 1 (discontinued)

- Build in DS18B20 temperature sensor,
- 3 pole – 3.5 mm input for an additional RFXCOM Temperature sensor DS18B20,
- Battery powered,
- 310MHz or 433.92MHz transmitter.

2.2. RF transmitter for 1-Wire sensors, Type 2 (discontinued)

- Build in DS2438 temperature sensor,
- 3 pole – 3.5 mm input for an additional RFXCOM sensor,
- Optional build in HIH4000 humidity sensor.
- Battery powered,
- 310MHz or 433.92MHz transmitter.

2.3. RF transmitter for 1-Wire sensors, Type 3

- Build in DS2438 temperature sensor,
- 3 pole – 3.5 mm input for up to 7 additional RFXCOM sensors,
- Optional build in HIH4000 humidity sensor,
- An external DC power is advised,
- 310MHz or 433.92MHz transmitter.

2.4. Optional Humidity Sensor for RFXSensor Type-2 or 3.

The optional humidity sensor is available for the RFXSensor Type 2 and 3 devices. The + of the humidity sensor (see Figure 1) should be inserted at the side where the text "IC3" is on the PCB.

Formula to calculate RH:

$$RH = (((A/D \text{ voltage} / \text{supply voltage}) - 0.16) / 0.0062) / (1.0546 - 0.00216 * \text{temperature})$$

2.5. Additional Temperature Sensor DS18B20

This is a small box 50x35x15mm with a DS18B20 temperature sensor inside. There is a terminal block (screw) inside to connect the 3 wires (VDD, DQ, GND) of the 1-Wire cable.

Solder a 3 pole - 3.5mm jack connector to a 3 wire cable and connect the other end of the cable to the terminal block. If more sensors are to be connected connect the cable then from each sensor to the other. A star topology is not advisable. The total length of the 1-Wire cable can be at least 10 meters long.

2.6. Additional Temperature Sensor DS2438

This is a small box 50x35x15mm with a DS2438 temperature sensor inside. There is a terminal block (screw) inside to connect the 3 wires (VDD, DQ, GND) of the 1-Wire cable.

Solder a 3 pole - 3.5mm jack connector to a 3 wire cable and connect the other end of the cable to the terminal block. If more sensors are to be connected connect the cable then from each sensor to the other. A star topology is not advisable. The total length of the 1-Wire cable can be at least 10 meters long.

2.7. Additional Humidity Sensor

This is a small box 50x35x15mm with a HIH4000 and a DS2438 temperature sensor inside. There is a terminal block (screw) inside to connect the 3 wires (VDD, DQ, GND) of the 1-Wire cable.

Solder a 3 pole - 3.5mm jack connector to a 3 wire cable and connect the other end of the cable to the terminal block. If more sensors are to be connected connect the cable then from each sensor to the other. A star topology is not advisable. The total length of the 1-Wire cable can be at least 10 meters long.

Formula to calculate RH:

$$RH = ((A/D \text{ voltage} / \text{supply voltage}) - 0.16) / 0.0062) / (1.0546 - 0.00216 * \text{temperature})$$

2.8. Additional Barometer Pressure Sensor

This is a small box 50x35x15mm with a MPXA4115 barometer pressure sensor and a DS2438 temperature sensor inside. There is a terminal block (screw) inside to connect the 3 wires (VDD, DQ, GND) of the 1-Wire cable.

Solder a 3 pole - 3.5mm jack connector to a 3 wire cable and connect the other end of the cable to the terminal block. If more sensors are to be connected connect the cable then from each sensor to the other. A star topology is not advisable. The total length of the 1-Wire cable can be at least 10 meters long.

Formula to calculate hPa: $hPa = ((A/D \text{ voltage} / \text{supply voltage}) + 0.095) / 0.0009$

3. Connect your own device to the A/D input.

The user can connect a device to the A/D input of the DS2438. The voltage produced by the connected device needs to be in the range from 0 up to 10Volts maximum.

Also a linear 10K potentiometer can be connected to the connection points for the humidity sensor. The position of the potentiometer will then be linear with the measured voltage.

The measured value is transmitted in the same format as used with the Humidity and Barometer sensor.

4. How to reset an RFXSensor.

Push the reset button short and gently with a little pin. The reset button is behind the small hole next to the LED.

5. How to change the RFXSensor base address.

1. Start the RFreceiver program.
2. Insert a 3mm metal pin into the jack connector for the additional sensor so that the connection points 3 (GND) and 2 (DQ) are in contact with each other.
3. Reset the RFXSensor unit. After 2 seconds the incremented address is transmitted and is visible in the RFreceiver screen.
Reset the RFXSensor again until the required address is reached.
4. Remove the metal pin.
5. Connect the external sensors if appropriate.
6. Reset the RFXSensor unit.

The base address is incremented by 8 for an RFXSensor type 1 or 2 unit and by 32 (20 hex) for an RFXSensor Type 3 unit, each time you push the reset button of the RFXSensor and a metal pin is inserted into the jack connector.

Important: Execute the steps 4, 5 and 6 and that order!

Note: the address will also be incremented with each reset if the DQ line has a short circuit in the 1-Wire cable to ground!

6. How to change the sampling rate.

6.1. **Fast sampling rate. (default) (Battery consuming!!!!)**

To select the fast sampling rate pin 8 must be connected to pin 14. By default those pins are connected by a red wire. This red wire is accessible in the battery compartment.

This mode is battery consuming but gives a high accuracy.

This results in a fast sampling rate of 1 minute. An RF packet is transmitted if a temperature change of 0.5 degrees Celsius is detected.

Every 40 minutes an alive RF packet will be transmitted.

6.2. **Low sampling rate.**

To select the low sampling rate remove the connection between pin 8 and pin14 by cutting the red wire (not the battery red wire) in the battery compartment. After cutting the wire the RFXSensor must be reset to set the low sampling rate mode.

This mode is battery saving but less accurate.

This results in a low sampling rate of 5 minutes. An RF packet is transmitted if a temperature change of 1 degree Celsius is detected.

Every 80 minutes an alive RF packet will be transmitted.

7. Battery Low indication.

The RFXSensor Type 2 and 3 units will transmit the measured supply voltage of each connected DS2438. If the voltage drops below 4.5Volt then also a battery low info packet is transmitted for this DS2438 sensor.

8. Power consumption.

Transmitter in rest	16uA
Transmitter active (for about 150ms / 5 minutes)	40mA

9. 1-Wire connection.

The RF transmitter has a 3 pole 3.5mm input for a jack connector connected to the PCB.

Connections:

Signal	RFXSensor PCB	3.5mm jack	60010-13 Ext sensor	60014 sensor wire color
select sampling rate GND = fast (default) Open = slow	Pin 8			
GND	Pin 14	3- screen	GND	not isolated
+9V input	Pin 6			
1-Wire DQ signal	Pin 7	2- middle	DQ	blue
1-Wire VDD	Pin 1	1- top	Vdd	transparent or white
+5V output	Pin 13			

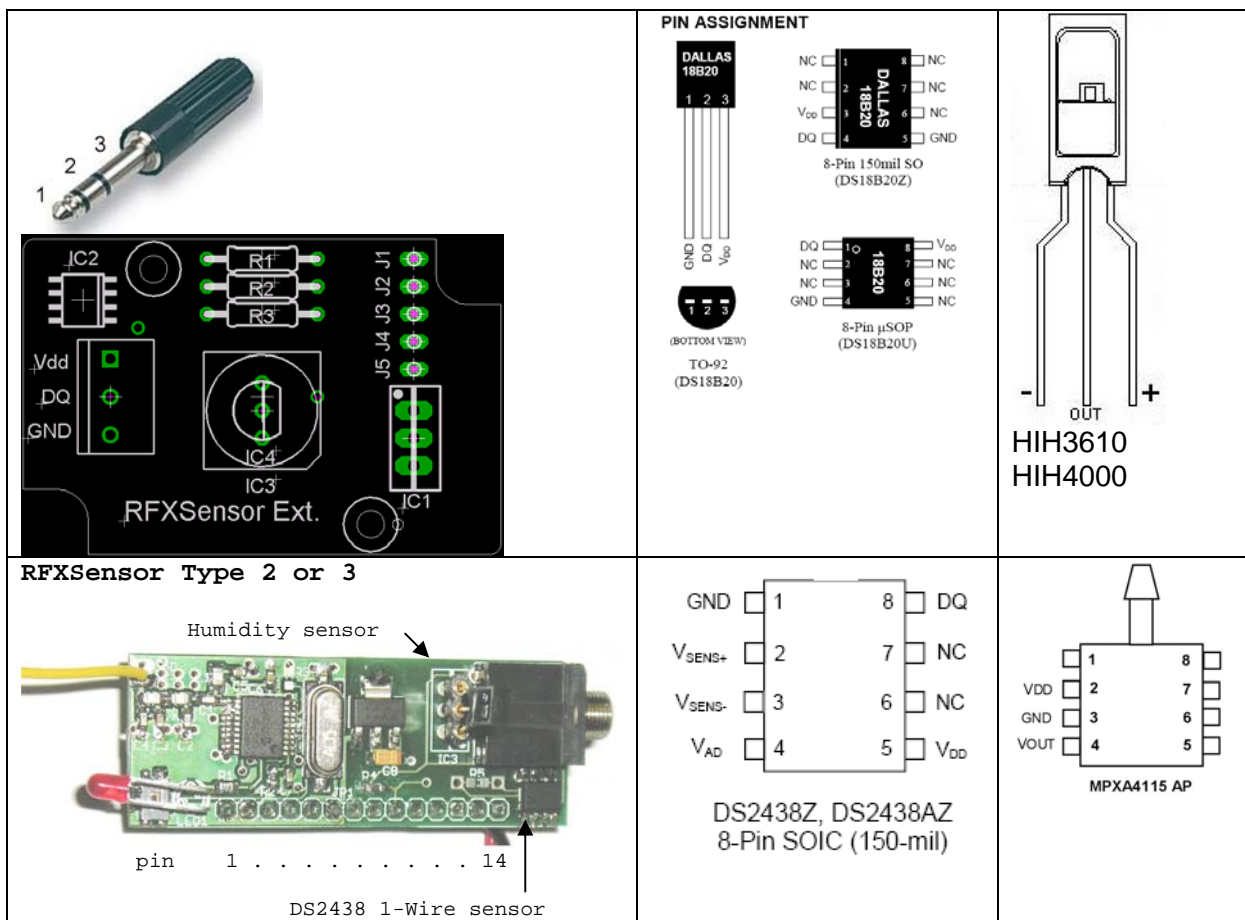


Figure 1

The 1-wire cable can be extended up to 10 meters. (or longer, to be tested by the user)
For more information about the 1-wire interface see <http://www.maxim-ic.com/1-Wire.cfm>

The 1-Wire sensors are automatically detected during initialization of the RFXSensor device.
Disconnect the power of the unit and press reset before adding or removing a 1-Wire sensor!
When the new sensor is connected or the sensor is disconnected the power can be connected again.

10. RF data packet format.

Message examples:

```
00F01609 RFXSensor addr:00F0/ 0 Temp:22
02F23DEE RFXSensor addr:02F2/ 2 supply voltage 0x1EF x 10mV = 4.95Volt
01F1202A RFXSensor addr:01F1/ 1 potmeter middle position 0x101 x 10mV =2.57Volt
```

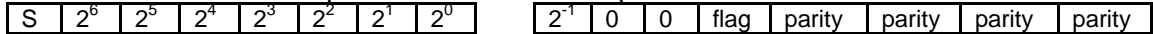
Message length 32 bits (decimal)

Byte 1 and 2 = address. Byte 2 = byte 1 with the complement of the upper nibble (bit 7-4).

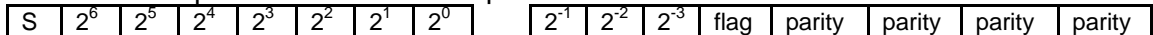
Byte 3 and 4:

If flag is 0

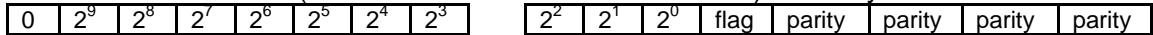
DS18B20 sensor Temperature sensor in steps of 0.5 C



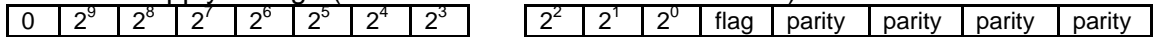
DS2438 Temperature sensor in steps of 0.125 C



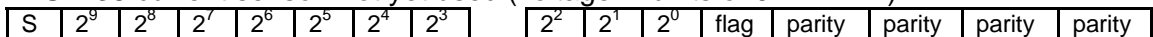
DS2438 A/D sensor (0 to 10V with a resolution of 10mV) humidity/barometer sensor



DS2438 supply voltage (0 to 10V with a resolution of 10mV)



DS2438 current sensor not yet used (voltage in units of 0.2441mV)



If flag is 1

Byte 3:

Info codes:

- 01 = sensor addresses incremented
- 02 = battery low detected (Type 2 and 3 only)
- 03 = conversion not ready, 1 retry is done (Type 2 and 3 only)

Error codes:

- 81 = no 1-wire device connected
- 82 = 1-Wire ROM CRC error
- 83 = 1-Wire device connected is not a DS18B20 or DS2438
- 84 = no end of read signal received from 1-Wire device
- 85 = 1-Wire scratchpad CRC error
- 86 = temperature conversion not ready in time (Type 2 and 3 only)
- 87 = A/D conversion not ready in time (Type 2 and 3 only)

Byte 4:

0001pppp pppp= parity bits

Byte 1 is 1st byte of sensor address

Byte 2 is 2nd byte of sensor address

Byte 3 measured temperature, humidity, voltage etc.
or error/info code

Byte 4 bit7-5 = lower 3 bits of the measured value,
bit 4 is error/info flag,
bit 3-0 is 4 bits parity
4bits parity is complement of:
byte 1 bit 7-4 + byte 1 bit 3-0 + byte 2 bit 7-4 + byte 2 bit 3-0 +
byte 3 bit 7-4 + byte 3 bit 3-0 + byte 4 bit 7-4

11. RF initialization packed.

The unit will start sending an initialization sequence when the power is connected or a reset is done.

11.1. RFXSensor Type

The first 3 packets are the indication of the RFXSensor Type, sampling rate and version:

Type-1 sends RFX<version>, (hex 524658)

Type-2 sends RF2<version>, (hex 524632)

Type-3 sends RF3<version>. (hex 524633)

Followed by 2 packets indicating the sensor number and the internal serial number of this sensor.

11.2. RFXSensor version

If the version >= hex 80 it indicates that the slow sampling rate is selected. The other bits indicate the version number.

11.3. Init of an RFXSensor Type-1 with 1 sensor connected:

2052465808 RFX and hex 08 indicates fast sampling, version 8
2052465808
2052465808
2853454E0028 SEN0 = Sensor 0 is type 28 (28=DS18B20 26=DS2438)
30534ACA000000 Internal serial number of this sensor

11.4. Init of an RFXSensor Type-2 with 1 sensor connected:

2052463289 RF2 and hex 89 indicates slow sampling, version 9
2052463289
2052463289
2853454E0026 SEN0 = Sensor 0 is type 26 (28=DS18B20 26=DS2438)
30333B54000000 Internal serial number of this sensor

11.5. Init of an RFXSensor Type-3 with 2 sensors connected:

2052463309 RF3 and hex 09 indicates fast sampling, version 9
2052463309
2052463309
2853454E0026 SEN0 = Sensor 0 is type 26 (28=DS18B20 26=DS2438)
30B8E272000000 Internal serial number of this sensor
2853454E0426 SEN4 = Sensor 4 is type 26 (28=DS18B20 26=DS2438)
307FB57B000000 Internal serial number of this sensor

12. Warning:

RF signals are possible disturbed and it has not been justified for this equipment at uses in circumstances where life-threatening or dangerous situations are possible.

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