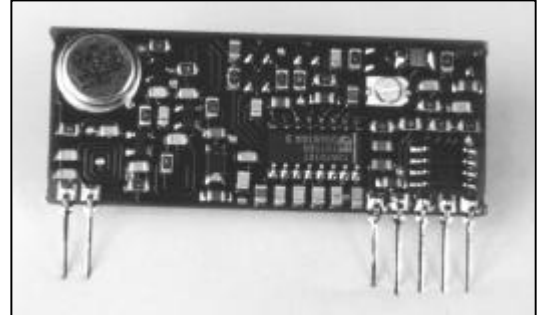


## FEATURES

- SELECTIVE DOUBLE CONVERSION SUPERHET.
- LOW POWER
  - ⇒ 13mA CONTINUOUS,
  - ⇒ 130uA POWER SAVE MODE.
- FAST ENABLE TIME;
  - ⇒ 'A' VERSION <3mS.
  - ⇒ 'F' VERSION <1mS.
- WIDE SUPPLY VOLTAGE, 4.5 - 9 VOLTS.
- ANALOGUE & DIGITAL OUTPUT.
- HIGH DATA RATES (up to 5Kbps).
- CARRIER DETECT OUTPUT.
- AVAILABLE AS EITHER 418 OR 433MHz.



## APPLICATIONS

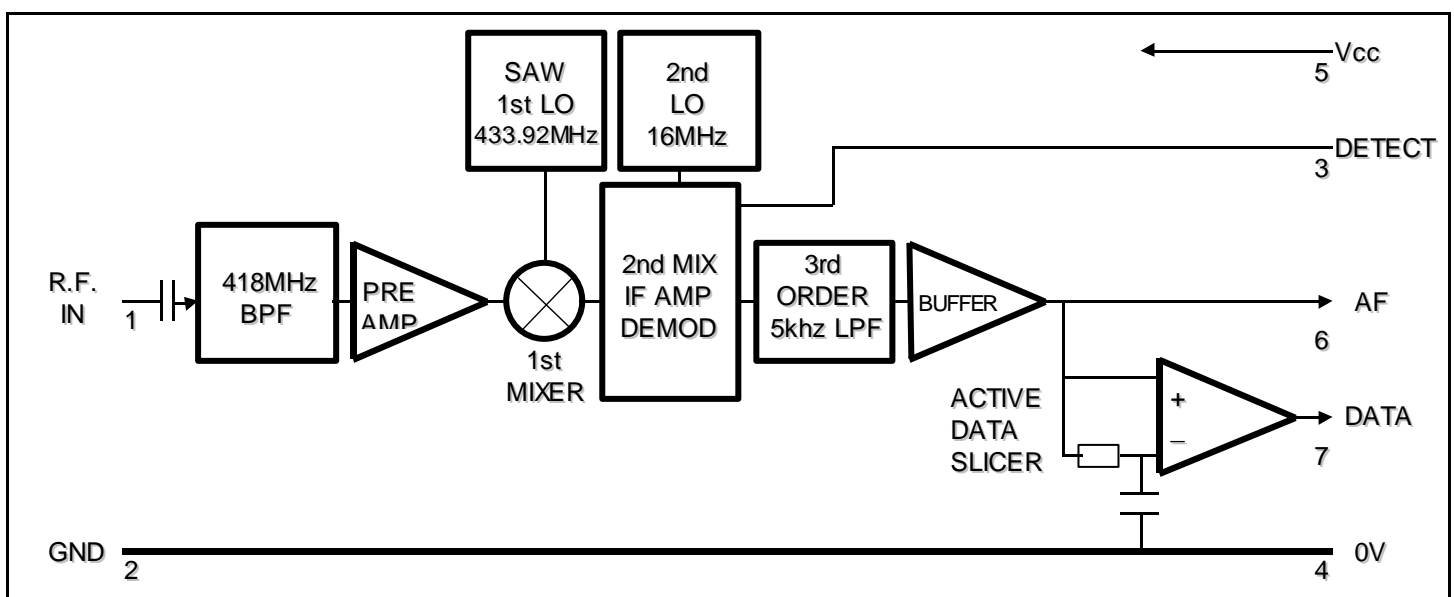
- REMOTE SWITCHING SYSTEMS
- REMOTE DATA COMMS
- PAGERS
- ALARM SYSTEMS
- GARAGE DOOR OPENERS
- REMOTE TELEMETRY

## GENERAL DESCRIPTION

The R.F. Solutions FMRX1 - XXX range of Radiometrix Receivers are compact board SIL Modules which can be used to capture R.F. data from an FM transmitter such as the RFS FMTX-1 (see RF Solutions FM Transmitter Module data sheet FMTX1-XxXX). When used as a remote control system, up to 200 metres range can be achieved.

The Receiver may also be supplied as a bare board or as a custom solution unique to customer specific requirements. Please contact R.F. Solutions for further information.

## BLOCK DIAGRAM



## PIN DESCRIPTION

| Pin No | Name     | Description   |
|--------|----------|---|
| 1      | R.F. IN  | Connects to the Receiver antenna. Has nominal 50Ω impedance and is capacitively isolated from internal circuit.   |
| 2      | R.F. GND | Should be connected to any ground plane against which the antenna works. (Internally connected to pin 4).   |
| 3      | DETECT   | May be used to derive a carrier detect to enable external circuit when a signal is being received. If the detect function is unused connect a 10kΩ resistor to Vcc (pin 5).   |
| 4      | 0 VOLT   | Ground for Supply.  |
| 5      | Vcc      | Supply Voltage. Note; Must be a clean supply (<2mV pk-pk ac), stable and free of high frequency digital noise. A supply filter is recommended unless the module is driven from its own regulated supply.  |
| 6      | AF       | FM Demodulator output. It has a standing DC bias of approx. 2 volts and may be used to drive analogue data detectors such as modem IC's or DTMF decoders. Can drive load impedances down to 2kΩ and up to 100pF.  |
| 7      | DATA     | Digital output from the internal data slicer (true data as fed to the Transmitter's Data input). Output is a squared version of the AF signal (pin 6). This signal is used to drive external digital decoders. Can drive load impedances down to 1kΩ and up to 1nF. |

## FUNCTIONAL DESCRIPTION

This receiver module is a double conversion FM Superhet with a data slicer driven by the AF output. Additionally, a fast acting carrier detect signal is available to indicate to external circuits that a signal is present. This signal is extremely useful when implementing duty cycle power save circuits or to indicate to external logic that a signal is being received. It is internally derived from the degree of noise quieting due to the presence of a received carrier.

The receiver is designed to work with the matching transmitter (FMTX). With the addition of simple antenna the pair may be used to transfer serial data up to 200 metres. The range of the system depends upon several factors, principally the type of antenna employed and the operating environment. The 200m quoted range is a reliable operating distance over open ground using 1/4 whip antenna at both ends of the link at 1.5 metres above ground. Smaller antenna, interference or obstacles (e.g. buildings) will reduce the reliable working range (down to 30 metres in extreme cases). Increased antenna height, slow data or a larger receive antenna will increase the range.

**Warning** - Don't be tempted to adjust the trimmer on the module, it controls the receive frequency and can only be correctly set-up with an accurate RF signal generator.

## MODULE MOUNTING CONSIDERATIONS

1. The module may be mounted vertically or bent horizontal to the motherboard.
2. No conductive items should be placed within 4mm of the module's component side, to prevent detuning.
3. Observe RF layout practice between the module and it's antenna, i.e <10mm unshielded track, use 50Ω microstrip or coax for >10mm.
4. It is good practice to earth plane all unused area around the module.
5. Mount as far as possible from high frequency interference sources. Microprocessors with external busses are especially incompatible with sensitive radio receivers and should be kept at least 1 metre from the receive antenna. Single chip microcontrollers are much less of a problem.
6. In some applications it is advantageous to locate the receiver and it's antenna away from the main equipment. This avoids interference problems and allows for flexibility in the siting of the receive antenna for optimum RF performance.

### **DETECT OUTPUT (Pin 3)**

This output of the module may be used in several ways:-

1. Connecting to Vcc (pin 5) with a 47k $\Omega$  resistor unmutes the AF and DATA outputs for normal operation.
2. Pulled down to 0 volts with a 47K $\Omega$  mutes the AF and DATA outputs (both go to 0 volts).
3. To drive the base of a PNP transistor (see Test Circuit) to derive a logic compatible carrier detect.
4. For duty cycle power saving control where battery life needs to be maximised (e.g. in portable equipment).  
By pulsing the decoder on/off the average supply current may often be reduced by a factor of 20 or more, depending on the system requirements. The data detect output is valid 1.5ms (2.5ms worst case) after application of the supply, and is used to inhibit the power saving while data decoding is being completed.

### **INTERNAL DATA SLICER (Pin 7)**

This is a CMOS compatible data output, normally used to drive a digital decoder IC or a microprocessor performing the data decoding. The data slicer in the receive module is designed to accept data with a wide range of pulse widths and mark-space ratio's. See specification table for limiting values.

The data slicer has a 10ms transient response time. This is the settling time of the adaptive comparator, i.e. the first 10ms of signal may be corrupt at the data output.

### **A.F. OUTPUT (Pin 6)**

This is the FM demodulator's output after buffering and filtering. Since it is taken before the data slicer in the module, it may be used to drive external data slicers/demodulator's in cases where the internal data slicer is not suitable. This is the case where an analogue subcarrier is being employed, e.g. 2-tone AFSK or DTMF tones. In these cases the AF output is used to drive the FSK/DTMF decoder directly. The AF output is also a very useful test point for monitoring signals or interference. The AF output is DC coupled to the FM demodulator, thus the DC level varies with the frequency of the incoming signal.

### **SUPPLY REQUIREMENTS**

The module requires a clean supply. Noise and 'hash' in the 5 to 500 kHz band and 16MHz +/- 1MHz must be <2mV. We recommend a 10 $\mu$ F capacitor and 10 $\Omega$  series feed resistor in cases where the cleanness of the supply is in doubt.

### **ANTENNA DESIGN**

The positioning of the antenna is of the utmost importance and is an important factor in the determining system range, the following notes should assist in obtaining optimum performance:-

Keep it clear of other metal in the system. This applies particularly to the 'hot' (top) end of the antenna. The best position by far is sticking out of the top of the product, but if this is not possible for practical or ergonomic reasons a compromise may be needed. If an internal antenna must be used, try to keep it away from other metal components, particularly larger components such as transformers, batteries and PCB tracks or the earth plane. The space around the antenna is as important as the antenna itself.

Keep the antenna away from interference sources. Bad interference can easily reduce system range by a factor of 5. High speed logic is one of the worst sources; fast logic edges have harmonics which extend into the UHF band, and PCB tracks can radiate these harmonics most efficiently. Single chip microcontrollers and ground planed logic boards reduce this problem significantly.

For more detail information on antenna design, please see RF Solutions product catalogue.

**ABSOLUTE MAXIMUM RATINGS ALL RECEIVER MODULES**

|                                  |                         |
|----------------------------------|-------------------------|
| Supply Voltage (Vcc to GND)..... | -0.3 to +10 Volts.      |
| RF Input Pin 1.....              | 0dBm.                   |
| Any input or output Pin.....     | -0.3 to +Vcc, +/- 10mA. |
| Storage Temperature.....         | -40 to +100° Celsius.   |
| Operating Temperature.....       | -10 to +55° Celsius.    |

**TECHNICAL SPECIFICATION FOR FM-RX1-418A & FM-RX1-433A RECEIVER**

Ambient temperature = 20° Celsius. Supply Voltage Vcc = 5.0 Volts. (Circuit as shown, "Test Circuit")

| ELECTRICAL CHARACTERISTICS      | MIN  | TYPICAL | MAX  | DIMENSION | SEE NOTE |
|---------------------------------|------|---------|------|-----------|----------|
| Supply Voltage                  | 4.5  | 5.0     | 9.0  | V         |          |
| Supply Current                  | 11   | 14      | 17   | mA        |          |
| Relative Frequency (FM-RX1-418) | -    | 418.0   | -    | MHz       |          |
| Relative Frequency (FM-RX1-433) | -    | 433.92  | -    | MHz       |          |
| Sensitivity for 20dB S/N        | -    | 0.5     | 1.0  | μV        | 2        |
| Overall Frequency Accuracy      | -100 | 0       | +100 | kHz       | 1        |
| Carrier Detector Threshold      | -    | 0.5     | 2.0  | μV        |          |
| R.F. Input Impedance            |      | 50      |      | Ω         |          |
| LO Leakage                      |      | -57     |      | dBm       |          |
| IF Bandwidth                    |      | 250     |      | kHz       | 3        |
| AF Output Level                 |      | 500     |      | mVpp      | 2,3      |
| AF Bandwidth, 3dB               | DC   |         | 5    | kHz       | 3        |
| Frequency / Voltage Conversion  |      | 10      |      | mV/kHz    |          |
| Data output: Logic Low          | 0    | 0.2     | 0.8  | V         | 4        |
| Logic High                      | 3.5  | 3.8     | 5    | V         | 4        |
| Data Bit Duration               | 0.2  |         | 20   | mS        | 6        |
| Data Mark : Space               | 5    |         | 66   | %         | 7        |
| Data Settling Time              |      | 10      | 15   | mS        | 8        |
| Enable Time                     |      | 1.5     | 2.5  | mS        | 3, 9     |
| Signal Detect Time              |      | 0.3     | 0.5  | mS        | 3,10     |

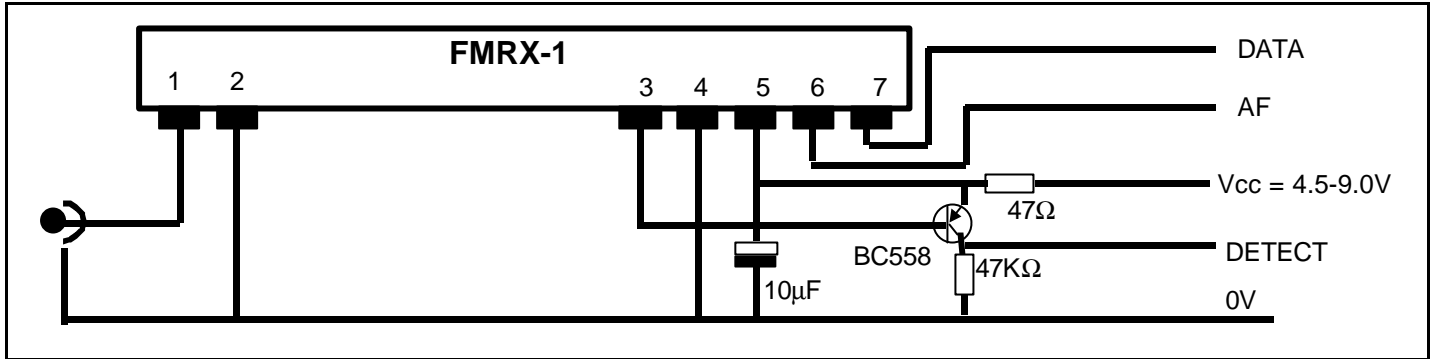
**TECHNICAL SPECIFICATION UNIQUE TO FM-RX1-418F & FM-RX1-433F**

| ELECTRICAL CHARACTERISTICS             | MIN | TYPICAL | MAX | DIMENSION | SEE NOTE |
|--|-----|---------|-----|-----------|----------|
| Sensitivity for 20dB S/N               | -   | 1.0     | 2.0 | μV        | 2        |
| Carrier Detector Threshold             | -   | 2.0     | 4.0 | μV        |          |
| AF Bandwidth, 3dB                      | DC  |         | 20  | kHz       | 3        |
| Data Bit Duration                      | .05 |         | 2   | mS        | 6        |
| Data Mark : Space                      | 20  |         | 80  | %         | 7        |
| Data Settling Time (min preamble time) |     |         | 5   | mS        | 8        |
| Enable Time                            |     |         | 1   | mS        | 3, 9     |
| Signal Detect Time                     |     |         | 0.3 | mS        | 3,10     |

**NOTES**

- Over supply and temperature range.
- + / - 25kHz deviation, 1kHz tone.
- 3μV input.
- 1mA sink.
- 1mA source.
- Time between data transmissions
- Time (high) / Time (low) X 100%, averaged over any 20mS period
- Time from valid carrier detect to stable output data output.
- From application of supply to carrier detect low
- From application of signal to carrier detect low.

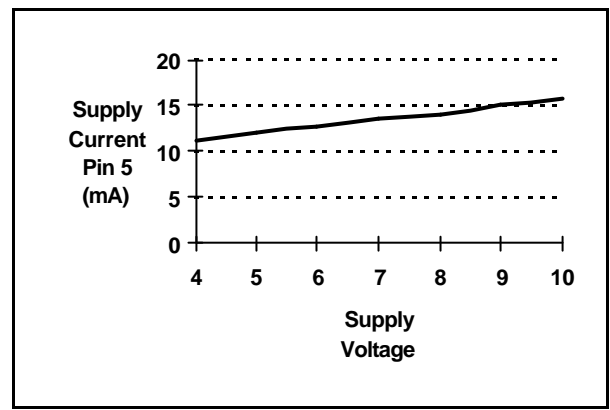
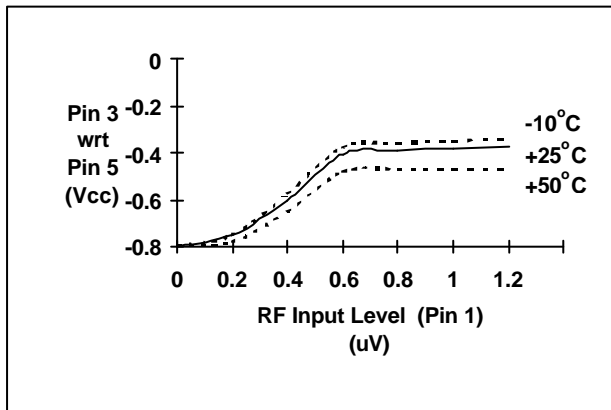
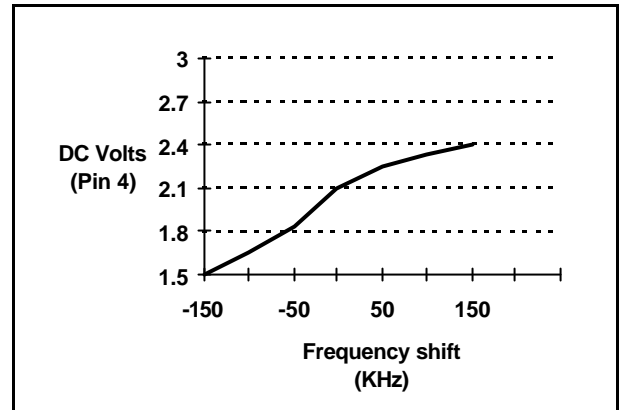
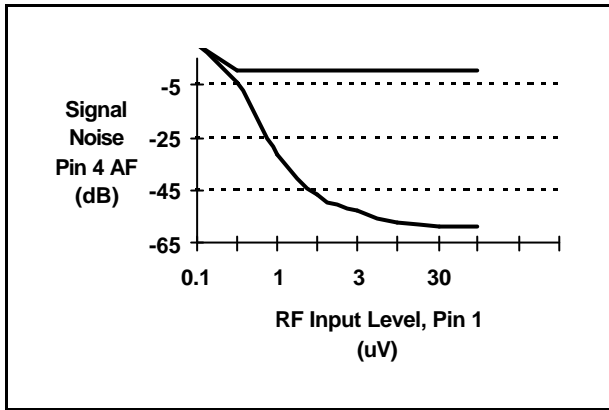
**TEST CIRCUIT**



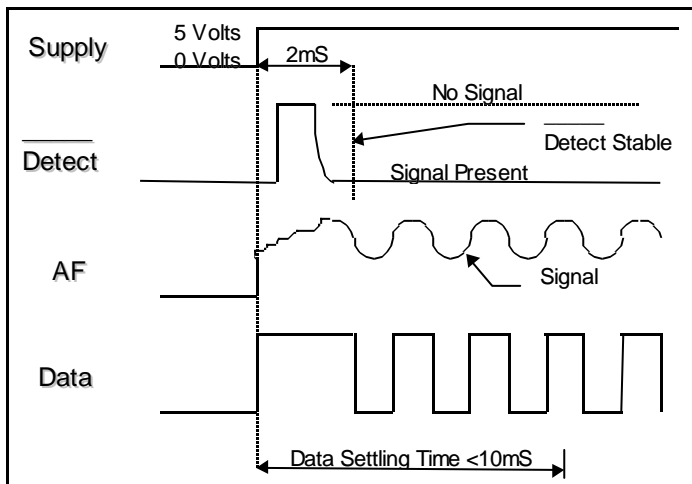
**PERFORMANCE CHARACTERISTICS**

Circuit = Test Circuit  
 Ambient Temperature = 20 °C.  
 Supply Voltage = +5.0Volts.(unless otherwise stated)

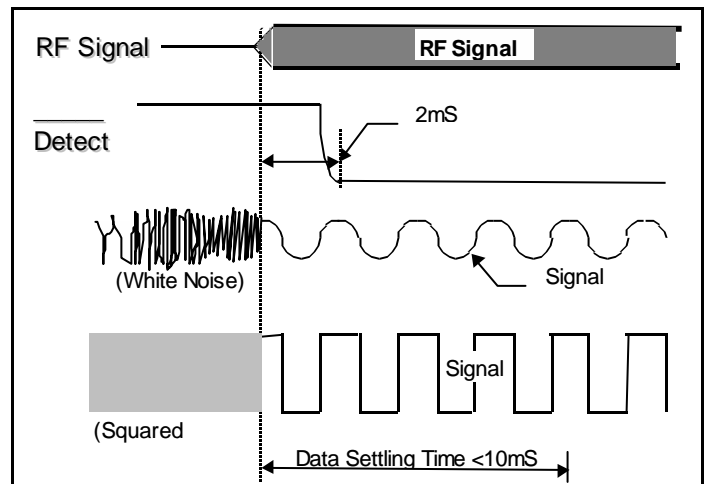
**TIMING WAVEFORMS**



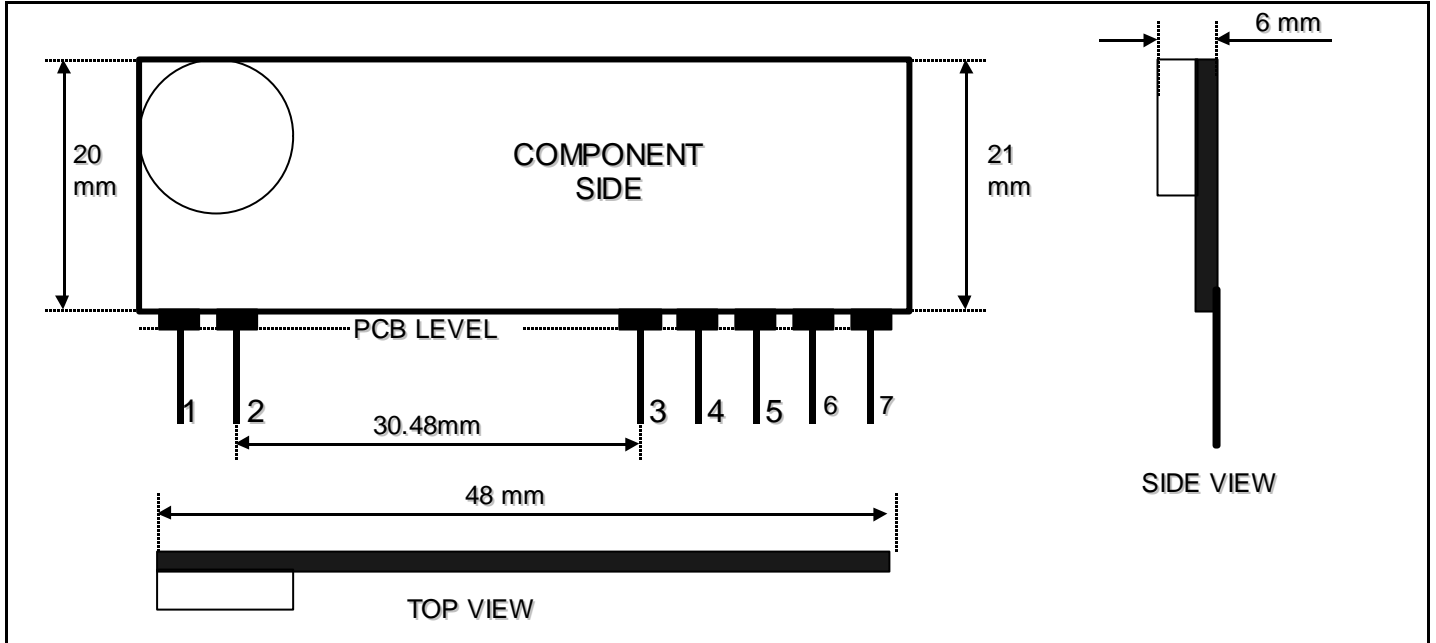
**Power- Up Timing**



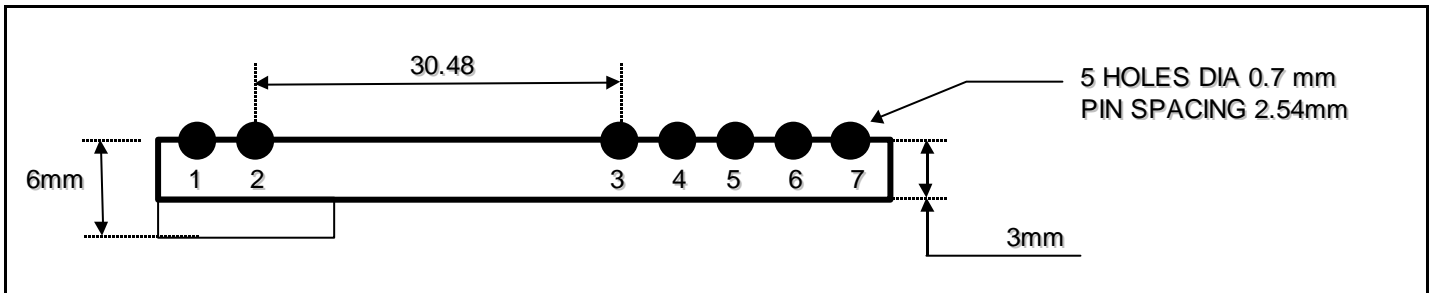
**Signal Timing**



**MECHANICAL DETAILS**



**PCB MOUNTING DETAIL (TOP VIEW)**



| PART No     | DESCRIPTION                                   |
|-------------|---|
| FM-RX1-418A | Receiver, Single Channel, 5Kbps.              |
| FM-RX1-418F | Receiver, Single Channel, 5Kbps. Fast Version |
| FM-RX1-433A | Receiver, Single Channel, 5Kbps.              |
| FM-RX1-433F | Receiver, Single Channel, 5Kbps. Fast Version |

Should you require further assistance, please call;

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**Email : [sales@rfsolutions.co.uk](mailto:sales@rfsolutions.co.uk) <http://www.rfsolutions.co.uk>**

*RF Solutions is a member of the Low Power Radio Association.*

RF module data appears courtesy of Radiometrix Ltd, Southall, Middlesex, England.



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