Polygon Technologies
Reg. No. 2003/027/995/23

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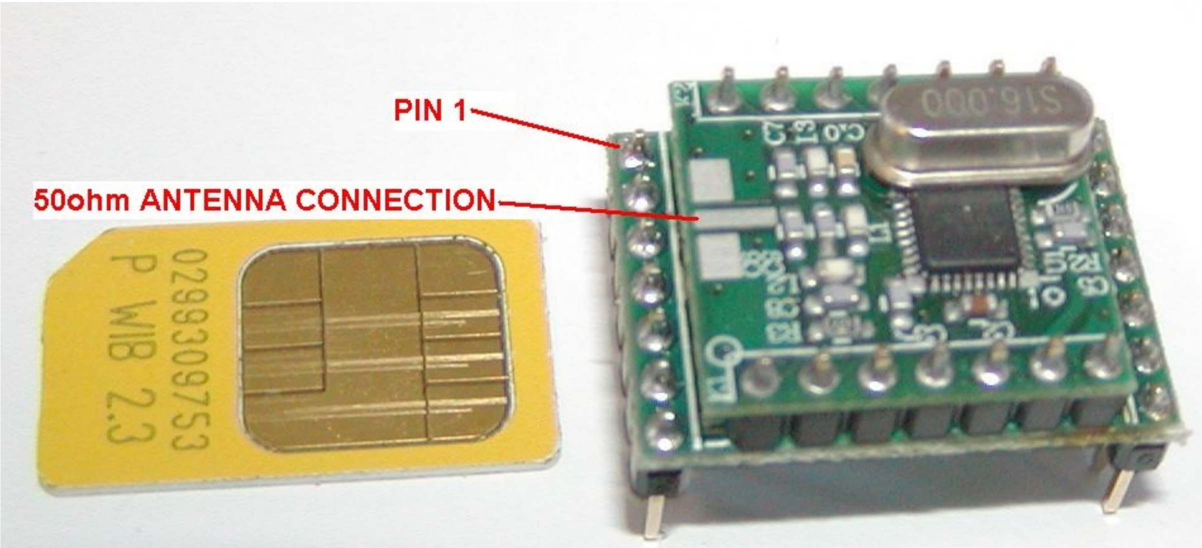
Configurable RF-OEM Device Manual
Document Version: 1.5
For Firmware Version: 2.00



note: Sim-card for size comparison only

1. Introduction

The RF-OEM module consists of a controller board and the nRF905-Cxxx Carrier board. The nRF905-Cxxx is a carrier board for the popular nRF905 Transceiver chip from Nordic Semiconductor. See the nRF905-Cxxx datasheet at www.pteq.net, and also the nRF905 chip datasheet available from Nordic Semiconductor. The RF-OEM Board is intended to convert TTL serial data to and from the RF link. Two of these modules can be used together to establish a serial link. The nRF905-Cxxx Module has an output pad for the connection of a coaxial 50ohm cable to a suitable antenna. The module provides interface pins for RX and TX LEDs, as well as all other signals required for operation.

2. Specifications

Supply Voltage	3.3V x 2
Max Supply Current	36mA
Range (line of sight)	20-30m indoors, 300m line of sight outdoors. 1Km or more with directional antenna
Data Rate (over the air)	200kbps
Effective Throughput	14kbps

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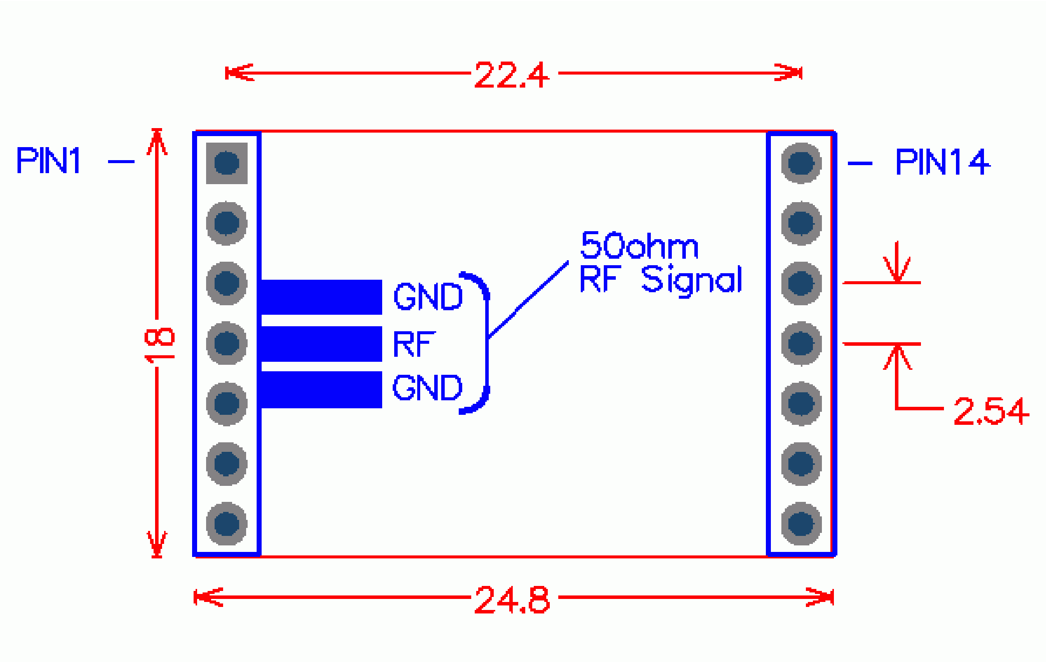
3. Pin Connections

Pins are numbered anticlockwise, starting at the pin with the square pad.



Module height is 12mm (from surface of host PCB to top of the module).
The 50ohm RF connection is on the top PCB of the dual-PCB module.

Pinout:

Pin No	***Signal***	***Type***
1	VCC	POWER (3.3v)
2	NC	NO CONNECT
3	NC	NO CONNECT
4	NC	NO CONNECT
5	RESET	INPUT/OUTPUT
6	GND	POWER
7	Force9600	INPUT
8	GND	POWER
9	VCCRF	POWER (3.3v)
10	TXD	OUTPUT
11	RXD	INPUT
12	RXLED	OUTPUT
13	TXLED	OUTPUT
14	CONFIG	INPUT

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4. Pin Descriptions

POWER Pins (pins 1,6,8,9)

VCCRF Supplies the RF parts of the module, while VCC Supplies the digital parts of the module. They can be fed from the same 3.3v supply, if the supply is relatively noise-free. It is recommended to place decoupling capacitors (~100nF) close to the module at each of the VCC and VCCRF pins.

RESET Signal (pin 5)

The reset pin is controlled internally, to reset the on-board microcontroller. Pull this pin low to force a reset of the module. Normally, this pin can be left unconnected.

UART Signals (pins 10,11 – TXD, RXD)

These pins can connected directly to a host microcontroller's UART. If the host microcontroller is running at 5v, it is recommended that a 1K resistor be placed in series with the RXD pin11. The TXD pin can be connected directly to a 5v-powered host microcontroller, provided that the RXD input of said microcontroller will ALWAYS be an input.

LED Signals (pins 12,13)

These pins provide signals to drive LEDs directly, to indicate received and transmitted packets. These signals source current to the LEDs, and have no internal current-limiting resistors added. It is recommended that a 220ohm resistor is placed in series with each LED, with the anode facing towards the module. These signals will both be active upon power-up, for a short while, and then go inactive. The active (high) state is held until initialization is completed. The host may commence sending data or commands via the serial interface as soon as these signals go inactive after power-on. The typical wake-up time is in the order of 30ms. The RX LED signal may be used to enable/disable RF485 line drivers, since it becomes active before serial data appears on the TX pin, and goes inactive after the data has been sent from the TX pin.

Control signals (pins 7,14)

These pins control the module.
The FORCE9600 pin, if pulled low, will force the serial interface to a baudrate of 9600.
Releasing the FORCE9600 pin will allow the module to use the saved baudrate. The FORCE9600 pin will be obeyed at all times, regardless of the status of the CONFIG pin. The CONFIG pin, if pulled low, places the module in configuration mode, and allows the RF parameters to be updated via the serial interface. If the baudrate is changed during configuration, and FORCE9600 is not active, then the new baudrate will be active after the parameters have been saved using the 'X' command.
These pins have internal pull-ups. Ideally, these pins should be driven from an open-collector output. If these pins are connected to a 5v-powered host, it is important that the host never drives 5v signals into these pins. The host should pull the line low, or leave the pin in a high-impedance state to be pulled high internally.

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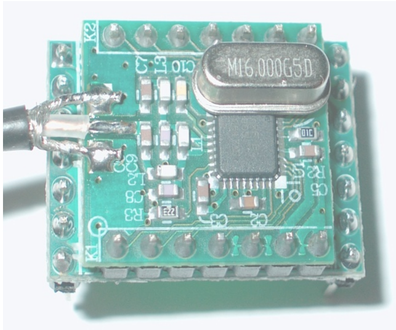
50 Ohm Output

The 50 ohm output pads are provided for the user to connect either RF connectors or coaxial cable directly. Edge mounted SMA or MMCX connectors (among others) fit nicely on the pads. Alternatively, one can solder coaxial cable directly to the pads as in the picture below.



5. Default Parameters:

The modules are shipped with the following parameters:

Baudrate: 9600
Databits: 8
Parity: None
RX Address: 10
TX Address: 10
Frequency Channel: 117 (868.2MHz)
RF Power Level: +10dBm
TimeOut: 20ms
1Byte Mode: Disabled (0)

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6. Configuration

As soon as the CONFIG pin is made active, the module will send a simple ASCII menu via the serial interface at the selected baudrate. The menu is as follows:

```
CONFIG MODE
H -MENU
G -RANGE (433/900)
F -FREQ MHz
C -FREQ CHAN
T -TXA
R -RXA
W -PWR
M -TIMEOUT
B -BAUDRATE
D -DATABITS
A -PARITY
L -1BYTEMODE
P -READ RAM
X -SAVE
```

The following gives an explanation for each item in the menu

H -MENU

Sending the ASCII character 'H' will repeat the sending of the menu strings.

G -RANGE

Sending the ASCII character 'G' will start a short dialog to enable the frequency range to be changed. The module is supplied with either a 433MHZ or a 868/915MHz RF Section, and this parameter should be set to the correct range according to which type of module it is. Setting the wrong range will not damage the module, and it will operate at the range indicated by the parameter, but output power and Receiver sensitivity will be greatly reduced.

```
1: 900MHz
0: 433MHz
```

The module expects 1 character, either '0' (for 433MHz) or '1' (for 868/915MHz). If the value is within range, the module will return "OK".

F -FREQ Mhz

Sending the ASCII character 'F' will start a short dialog to enable the frequency to be changed by specifying a frequency explicitly.

```
Enter New Freq: (xxx.xMHz) [844.8-928MHz]
___._MHz
```

The module expects 4 characters for the frequency (9000 for 900.0MHz). If the entered value is out of range, the module will respond with "**ERR**".

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C -FREQ CHAN

Sending the ASCII character 'C' will start a short dialog to enable the frequency to be changed by specifying a channel number.

```
Enter New Channel no: (0-416)
___
```

The module expects 3 characters for the channel number (117 for channel 117). If the entered value is out of range, the module will respond with "**ERR**".

T -TXA

Sending the ASCII character 'T' will start a short dialog to change the Transmit address. (Address to which all transmitted data will be sent)

```
Enter New Address: (0-127)
___
```

The module expects 3 characters for the new address (117 for address 117). If the entered value is out of range, the module will respond with "**ERR**".

R -RXA

Sending the ASCII character 'R' will start a short dialog to change the Receive address. (Address at which this module will listen for new messages) The dialog is identical to that of the TXA command.

W -PWR

Sending the ASCII character 'W' will start a short dialog to change the transmitting power level of the module.

```
Select Power:
0:-10dBm
1:-2 dBm
2: 6 dBm
3: 10dBm
```

The module expects a single character (**1**,**2** or **3**) to select the appropriate power level.

M -TIMEOUT

Sending the ASCII character 'M' will start a short dialog to change the timeout period. (see section on "smart packet sending")

```
Enter New TimeOut: (5-100ms)
___ms
```

The module expects 3 characters for the timeout period (117 for 117ms). If the entered value is out of range, the module will respond with "**ERR**".

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B -BAUDRATE

Sending the ASCII character 'B' will start a short dialog to select a baudrate for the UART.

```
Select BaudRate
1 =1200
2 =2400
3 =4800
4 =9600
5 =14400
6 =19200
```

The module expects a single character (`'1','2','3','4','5'` or `'6'`) to select the appropriate baudrate.

D -DATABITS

Sending the ASCII character 'D' will start a short dialog to select the number of databits for the UART.

```
DataBits:
7: 7b
8: 8b
```

The module expects a single character (`'7'` or `'8'`) to select the appropriate baudrate.

A -PARITY

Sending the ASCII character 'A' will start a short dialog to select the parity options for the UART.

```
Parity:
0: None
1: Even
2: Odd"
```

The module expects a single character (`'0','1','2'`) to select the appropriate parity mode.

L -1BYTEMODE

Previously called “compatibility mode”
Sending the ASCII character 'L' will start a short dialog to enable or disable compatibility mode.

```
Enable? (Y/N)
```

The module now expects a '**N**' or '**Y**' character to be sent. If a '**Y**' is received, compatibility mode will be enabled. If a '**N**' is received, compatibility mode will be disabled.

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P -READ RAM

Sending the ASCII character 'P' will read the current parameters as stored in SRAM.

```
==== READ PARAMETERS: ====
BaudRate=9600
RX Addr =10
TX Addr =0
Channel =117 (F=868200KHz)
RF Pwr  =+10dBm
TimeOut =20
Compat  =0
```

If there are unsaved parameters, there will be a warning at the end of the report:

```
EEPROM NOT UPDATED!
```

X -SAVE

Sending the ASCII character 'X' will save all parameters in SRAM to EEPROM storage. When any parameter is changed, the change will only be saved in non-volatile storage only after the 'X' command has been executed. If there are unsaved parameters, the TX and RX LEDs will be flashing.

After the 'C' command has completed, the module will return a "**OK**" message

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7. Compatibility mode

Version 1.00 of the firmware is not compatible to V1.2, due to changes in the messaging protocol. (see the section on “smart packet sending”) V1.3 has an extra “Compatibility mode” parameter that, when enabled, will cause the module to conform to V.100 protocols, and facilitate interoperability. If the compatibility mode is disabled, the module will use the updated protocol (compatible to V1.2).
The compatibility mode should be enabled when the modules are used to interconnect a PLC system running the Modbus protocol.

8. Antenna Tuning:

Since firmware Version 1.2, the device will transmit a continuous unmodulated carrier signal, while in configuration mode. This can be used for antenna tuning or output power measurements. The frequency and power of the signal will be equal to the parameters that where set up when the device powered up. Therefore, if you change the frequency or output power in configuration mode, you will need to disconnect and re-apply power in order for the changes to have an effect on the unmodulated carrier.

9. Transmit and receive addresses:

The nRF905 chip allows four bytes for each of the sending and receiving addresses. The sending (TX) address is the address of the module to which all outgoing messages are addressed. The receiving (RX) address is the address of this module, and is the address to which all incoming messages must be addressed in order for them to be received correctly. The firmware of the RS232-RF module takes the 0-127 range of the entered address parameter, and converts this into a 4 byte address that will be used to configure the nRF905 device on power up. Both RX and TX addresses use this principle. The way that these addresses are converted is as follows:

Address byte 3 = address as entered by user
Address byte 2 = inverted address as entered by user (all 0 bits are set, all 1 bits are cleared)
Address byte 1 = address as entered by user, divided by 4
Address byte 0 = address as entered by user, multiplied by 4

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10. Full-duplex operation

The RF link is half-duplex. Full duplex operation is emulated by using buffers and "listen-before-transmit" methods. Sending and receiving of data at once is not recommended, since the protocol will not always be able to handle all possible timing combinations. 95% of the time, seemingly simultaneous receiving and transmitting is done without any corruption, especially when the devices are handling low levels of throughput. The device does not offer any built-in acknowledgement services. It is therefore strongly recommended that the serial protocol used be error-tolerant. A simple protocol that makes provision for retry and acknowledgement will suffice.

11. Buffers

The device features 256-byte buffers for receive and transmit. The user must take care not to overflow these buffers, or data loss will occur. If the unit is configured for an interface baudrate of 19200 or higher, the host interface is delivering bytes faster than what the RF link can handle the data. This will cause the data to be buffered. If the user sends too much data at a time, the buffer will fill up and overflow.

12. SmartPacket™ Sending

The nRF905 device allows for a packet size to be configured. This is the number of payload bytes that each packet will contain. To obtain a transparent link, it is normally necessary to specify a packet size of 1. This works well, but is not really suitable, because the resultant bandwidth is very low.

Since V1.1 of the firmware, an intelligent packeting system was adopted. The unit will wait for a full packet of 32 bytes to be assembled before transmitting. If there is not enough bytes available at the end of the timeout period, the device will send what it has, and the receiver has the ability to discard the "garbage" extra bytes that the packet was filled up with. This timeout period can be set via the parameter called "Timeout". The SmartPacket Feature allows the user the full use of the available bandwidth by using 32byte packets, while still allowing small pieces of data to be transmitted without any serious penalties. Smart packet sending can be disabled since V1.3 by setting the "compatibility" parameter to '1', which will make the module compatible to older firmware versions.

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13. NRF905 Register contents

Some users require the RF-OEM module to be able to communicate to their own in-house systems. The following information details the setup of the nRF905 chip to make this possible.

Following is a description of each parameter available on the nRF905 RF Configuration register, and how each parameter is set up in the RF232 product. You need the nRF905 datasheet to make sense of this.

CH_NO: Channel number as set in configuration mode
HFREQ_PLL: Selects 433/900MHz operation. RF232 product sets this to "1"
PA_PWR: Selects power level. RF232 uses the level as set up in configuration mode.
RX_RED_PWR: Reduces current in RX mode . RF232 product sets this to "0"
AUTO_RETRAN: Retransmit contents in TX register if TRX_CE and TXEN are high. RF232 product sets this to "1".
RX_AFW: RF232 product sets this to "100"
TX_AFW: RF232 product sets this to "100"
RX_PW: RX Payload Width. RF232 product sets this to 32 if compatability mode is OFF. Otherwise, it sets this to "1".
TX_PW: RX Payload Width. RF232 product sets this to 32 if compatability mode is OFF. Otherwise, it sets this to "1".
RX_ADDRESS:
Address byte 3 = address as entered by user in configuration mode
Address byte 2 = inverted address as entered by user (all 0 bits are set, all 1 bits are cleared)
Address byte 1 = address as entered by user, divided by 4
Address byte 0 = address as entered by user, multiplied by 4

UP_CLK_FREQ: Output clock. RF232 product sets this to "00"
UP_CLK_EN: Output clock enable. RF232 product sets this to "0"
XOF: Crystal Frequency. RF232 product sets this to "011" - for 16MHz
CRC_EN: CRC Check enable. RF232 product sets this to "1"
CRC_MODE: RF232 product sets this to "1" (16bit CRC)