



## RF-232 Multi-Channel RS-232 Serial RF Transceiver

The RF-232 subassembly is a multi-channel serial radio transceiver. This device accepts and outputs standard serial data at one of three selectable data rates. The serial data rate is configured via two jumpers SP1 and SP2, which are located on the circuit board. The RF-232 transceiver offers 10 user configurable operating channels on the 433MHz and the 868MHz models, and 169 user configurable operating channels on the 900MHz model. Output power is also user programmable to -8, -2, +4 or +10dBm. The operating channels and output power can be programmed through a series of simple AT commands sent to the transceiver through the serial port when it is in command mode. Monitoring of channel occupation, or received signal strength, can also be performed through simple commands sent to the device. The RF-232 is compatible with both the RF-USB transceiver and the RF-SDS Serial to Ethernet and Ethernet to Serial Transceivers.

PCB Version



Packaged Version



### Features

- DB9 connector
- Configured as a DCE
- 3 selectable data rates: 9600, 19200 and 38400 bps
- 10 selectable operating channels: 433-434MHz model and 868MHz model
- 169 selectable operating channels: 902-928MHz model
- User adjustable output power from -8 to +10dBm
- -104dBm sensitivity
- Transparent data throughput
- Wide supply range: 8V to 25V
- LED indicators for receive, transmit and power
- Available with or without an enclosure
- Fully compatible with the RF-USB transceiver, the RF-SDS Ethernet transceiver and the AT-XTR-903 radio transceiver modules

### Typical Applications

- Data transferring from remote locations
- Data acquisition
- Robotics
- Instruments monitoring
- Remote control applications

## Connections

PIN	DB9	Signal Direction
1	NC	
2	SD (Send Data)	Output
3	RD (Receive Data)	Input
4	NC	
5	GND	
6	NC	
7	NC	
8	NC	
9	NC	

The RF-232 is configured as a DCE and connects to a DTE device, such as the serial port on a personal computer, using a straight through RS-232 extension cable. When connecting to another DCE configured device, a null modem (cross-over) configured cable must be used.

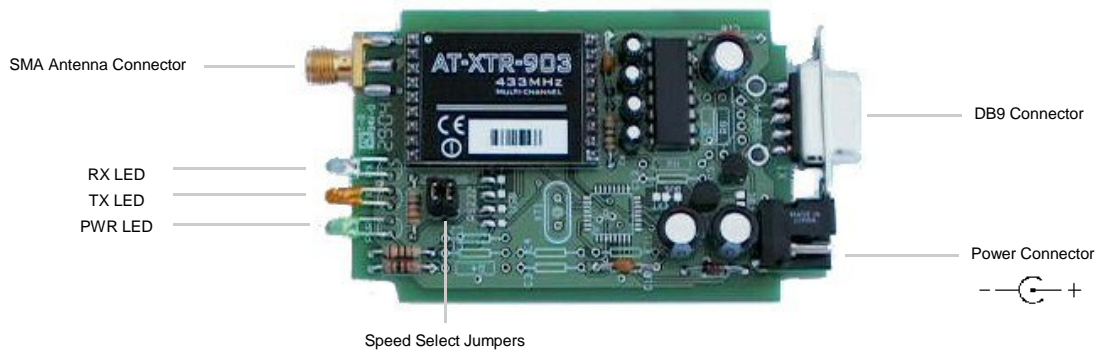
## Technical Characteristics

Absolute Limits	
Operating Temperature	-20 °C to +70 °C
Storage Temperature	-40 °C to +100 °C
Supply Voltage	8V to 25V

	Min.	Typ.	Max.	Units
<b>DC values</b>				
Current (rx mode)		38		mA
Current (tx mode @ -8 dBm)		30		mA
Current (tx mode @ 10 dBm)		46		mA
<b>RF</b>				
Modulation Type		GFSK		
Frequency Band	902.17 to 927.98			MHz
Rx Sensitivity		-104		dBm
Tx Max Power Output	-8		10	dBm
<b>Performance</b>				
Input Bit Rate <sup>1</sup>	9600, 19200 and 38400			bps
Outdoor range		200 / 600		M / Ft
Available Channels			169	
Channel Spacing		153.6		KHz
<b>Timing</b>				
TX to RX			20	ms
RX to TX			20	ms
<b>Default Values (without user programming)<sup>2</sup></b>				
Operating Channel		902.17		MHz
Tx Output Power		10		dBm

<sup>1</sup> Input signal consists of 1 start bit, 8 data bits and 1 stop bit, no parity.

<sup>2</sup> Default values are factory configured. May be changed with AT command programming.



## Data Rate Configuration

The data rate is selected by setting the jumpers located on the circuit board which are labeled SP1 and SP2. The following truth table shows the possible combinations:

SP1	SP2	I/O Data Rate
N	N	9600
I	N	19200
N	I	38400
I	I	TEST Mode

Note — I: jumper IS installed, N: jumper NOT installed

**Test mode** is entered into at power-up when SP1 and SP2 are jumpered. In this mode, the carrier frequency is continuously modulated by a 20KHz pseudorandom data sequence. The test mode may be put to good use when setting up the link and may be used in conjunction with the RSSI read command. (see command mode for details on reading the RSSI value). To exit the test mode, SP1 and SP2 must be reconfigured under a power off state.

A different degree of redundancy and protection is associated with the RF packet according to the selected speed. This means that slower data rate results in a higher level of reliability and/or longer communication distance.

## Command Mode (RF Module)

Command mode allows the user to configure the main parameters which change the module's operating conditions, such as selecting a new operating frequency channel or setting the RF output power to a desired value. Programming is carried out via simple AT commands. To enter the command mode, the following data string must be sent to the unit via the USB port:

- 3 consecutive ASCII plus characters (+++) without pauses.

Within 35ms, the module will respond with **OK<CR><LF>** string to confirm it is in Command mode. (<CR> represents 'Carriage Return') (<LF> represents 'Line Feed')

Programming information is stored in 16 available registers (from 1 to 16). Some of these are available only for read operations, whilst others are available for read/write operations.

The syntax to read a value stored in a register is as follows:

**ATSx<CR><LF>** (x= register 1, ..., 16)

Assuming that the command was issued correctly, the answer to this command is the value of the contents of the register. For a command issued with errors, the following answer is returned:

**ERROR<CR><LF>**

To change the value of parameter in a register, the following syntax is used:

**ATSx=Y<CR><LF>** (x= 1, ..., 16) , Y= value to be inserted

A command issued correctly will receive **OK<CR><LF>** response. If the command contained a syntax error or if the value that was entered to be written is an unacceptable parameter for that register, an **ERROR<CR><LF>** response will be received.

All the values written into registers are volatile and will be lost when the module is powered OFF, unless they were previously saved into the EEPROM memory available in the embedded microprocessor. In this case, the modified values will be non-volatile and will be retained even if the module's power supply is cycled.

The command for non-volatile saving of ALL the values in register is:

**ATWR<CR><LF>**

To exit Command Mode and return the transceiver to normal operating , the following command is issued:

**ATCC<CR><LF>**

When in Command mode, it is possible to include multiple commands in a single command line by separating each command by a comma (,) operator. With following command line, for example, register 3 is set to value 2, the change is permanently saved and the Command Mode is exited:

**Example: ATs3=2,WR,CC <CR><LF>**  
**OK<CR><LF>**

As shown in the above example, the prefix -AT- is only used once in the beginning of the command of line and not required for the following commands which are separated with the comma operator.

Command chaining is possible only for write operations. If used in read operations, an "ERROR" message will be returned as in the following example:

**Example: ats1,cc <CR><LF>**  
**ERROR <CR><LF>**

Commands are not case sensitive, so either uppercase or lowercase characters may be used.

Refer to **Appendix A.** for details on register values and possible configurations.

## Appendix A – Register Programming

Different operating characteristics of the transceiver, such as RF channel selection, RF emitted power, etc..., can be programmed by the user through setting special parameters in 16 available registers. The following information provides the meaning and programming possibilities for each register. The current AT-XTR-903 transceiver modules implement 4 out of 16 registers - registers 1,2,3 and 16. Only these registers will be described, the remaining registers are reserved for possible future enhancements.

### Register 1 - FREQUENCY BAND

This register is READ ONLY and will supply information relating to the module's operating RF band. The AT-XTR-903 transceiver modules are available in three different models, 433MHz, 868MHz and 915MHz .

Command	Values	Read (R) / Write (W)
ATS1	0 =433-434 MHz	R
	1 =868-870 MHz	
	2 =902-928 MHz	

#### Example 1: Reading the operational band of the module

```
+++OK<CR><LF>
ATS1<CR><LF>
0<CR><LF>          (note: 0 = 433-434MHz band)
```

#### Example 2:

```
+++OK<CR><LF>
ATS1=2<CR><LF>
NO ACCESS<CR><LF>
```

Syntax Error: This register is available for Read only!

### Register 2 – RF CHANNEL

This register is available for read and write operations. It allows to get feed backs of the RF frequency (channel) setting for both receiving and transmitting circuits. Makes it possible to "write" a different frequency (channel).

Command	Values	Read (R)/ Write (W)
ATS2	0 = 902.17 MHz 1 = 902.32 MHz 2 = 902.48 MHz 3 = 902.63 MHz 4 = 902.78 MHz ... ... ... ... 169 = 927.27 MHz	R/W

**Example 1: Reading the configured RF channel (433,5 MHz)**

```
+++OK<CR><LF>  
ATS2<CR><LF>  
2<CR><LF>
```

**Example 2: Selecting channel 8 as the operating frequency (434,42 MHz)**

```
+++OK<CR><LF>  
ATS2=8<CR><LF>  
OK<CR><LF>
```

**Register 3 – EMITTED RF POWER**

This register is available for read and write operations. With the read command, feedback is given about the RF output power emitted from the module's transmitter section. The write command and enables the user to configure the transmitter section for the preferred RF output power.

Command	Values	Read (R)/ Write (W)
ATS3	0 = - 8 dBm 1 = - 2 dBm 2 = + 4 dBm 3=+10 dBm	R/W

**Example 1: Reading the configured RF output power (-2 dBm)**

```
+++OK<CR><LF>  
ATS3<CR><LF>  
1<CR><LF>
```

**Example 2: Setting RF output power to +10 dBm**

```
+++OK<CR><LF>  
ATS3=3<CR><LF>  
OK<CR><LF>
```

**Register 16 – RSSI (Received Strength Signal Indicator)**

The register is read only and will supply a numeric value proportional to the RF Field Strength sensed from the receiving circuitry. The range of possible values returned from the register are 0 through 9. Reading register 16 starts a process of analysis of the RF channel that the module is programmed to operate on. This routine has a fixed duration of 200ms and the analysis result is given after this period. The analysis period should be allowed to run its course without interruption through issuing another command. The signal strength command is useful for determining possible channel occupation or for setting up the link in conjunction with the TEST mode.

Command	Values	Read (R)/ Write (W)
ATS16	0 = Minimum Field Strength 1 2 3 4 5 6 7 8 9 = Maximum Field Strength	R

**Example 1: Reading Field Strength (strong received signal)**

```
+++OK<CR><LF>
ATS16<CR><LF>
9<CR><LF>
```

**Example 2: Reading Field Strength (very weak or no received signal)**

```
+++OK<CR><LF>
ATS16<CR><LF>
0<CR><LF>
```

**Example 3: Syntax Error: register is read only!**

```
+++OK<CR><LF>
ATS16=3<CR><LF>
ERROR<CR><LF>
```

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