

# ARF53 EU 869 MHz User Guide



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# DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN45014



Manufacturer's name: **ADEUNIS R.F.**

Manufacturer's address: Parc technologique PRE ROUX IV  
283 rue Louis NEEL  
38920 CROLLES - FRANCE

declares that the product

Product Name: ARF53  
Product Number(s): ARF7474  
Product options:

complies to the RTTE Directive 99/5/EC:

EMC: conformity is proven by compliance to the standard EN 301489 according to the Directive 89/336/EEC.

Safety: conformity to the standard EN 60950 according to the requirements of Low Voltage Directive 73/23/EEC.

Radio: conformity is proven by compliance to harmonised standard EN 300220 covering essential radio requirements of the RTTE directive.

Notes: - Conformity has been evaluated according to the procedure described in Annex III of the RTTE directive.

- The use of the spectrum is harmonised by the fact that the product never falls in one of the restrictions listed in appendix 3 (Annex 1, band E) of the CEPT recommendation 70-03.
- Receiver class (if applicable): 2.

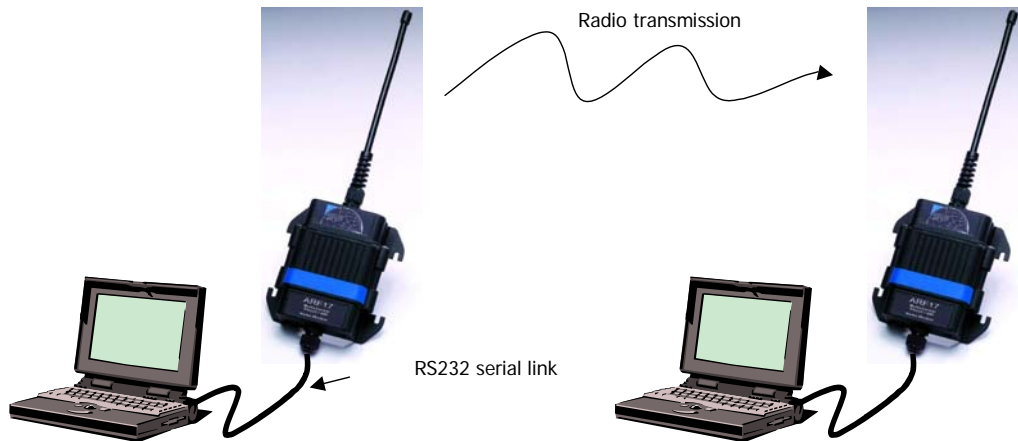
Crolles, March 12<sup>th</sup>, 2007

VINCENT Hervé / Quality manager

A handwritten signature in black ink, appearing to be 'V. Hervé', written over a thin horizontal line.

## OVERVIEW

The modem converts data from a serial link into a radio frame to be sent to a similar piece of equipment.

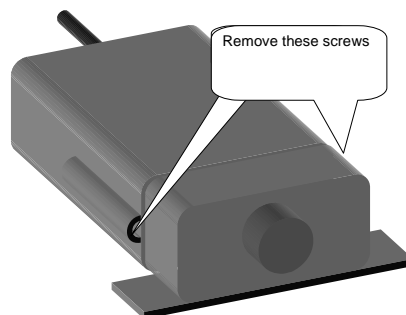


The operating parameters of these modems (serial link, radio management...) can be updated through commands on the serial link.

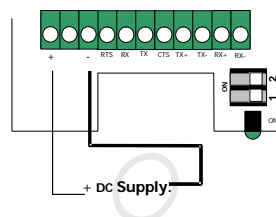
The products are available either in card version to be integrated in an assembly or as an IP65 chip. In the IP65 case, the products are fixed with the fixing lugs onto the top (antenna) and bottom (stuffing box) of the casing (4 screws not provided).

## PRODUCT POWER SUPPLY

To perform wiring of these products, the bottom part of the housing (part with stuffing box) has to be opened by unscrewing the two stainless steel screws on each side.



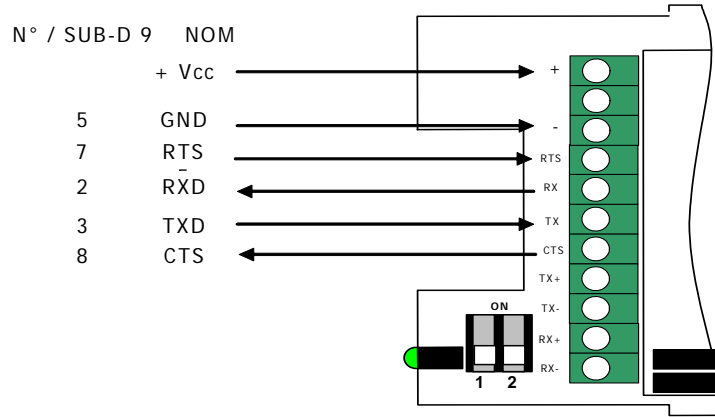
The ARF53 range products are supplied from a DC voltage source. This voltage source must be 4,5V minimum and must not exceed 36 Vdc.



# SERIAL LINK WIRING

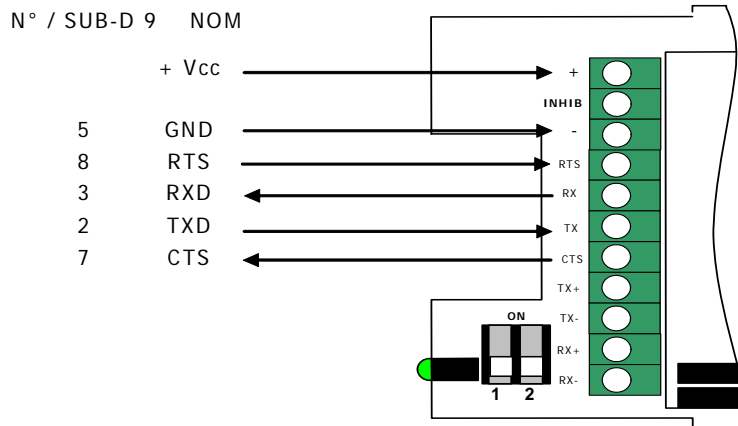
- **MODEM / DTE RS232**

This is for example the case of a modem connected to a PC. RTS and CTS are required only if flow control is used.



- **DCE RS232**

This is for example the case of a modem connected to a measuring device. RTS and CTS are required only if flow control is used.



- **RS485 wiring**

The RS485 bus wiring needs only two wires (TX+ is connected to RX+ and TX- is connected to RX- on the PCB)

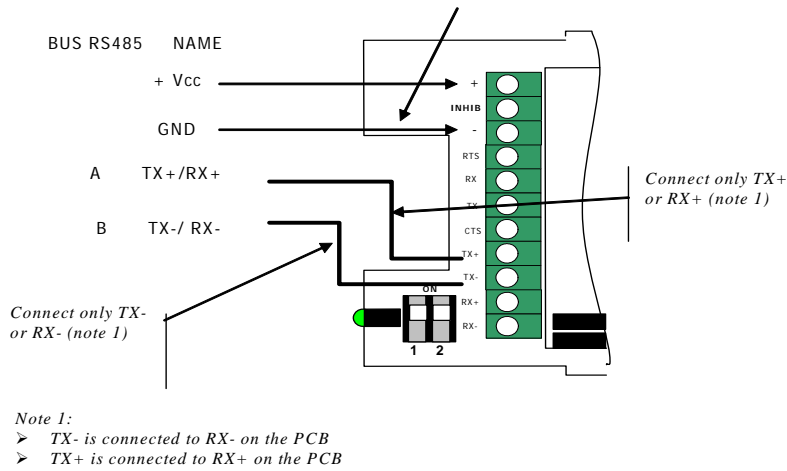


Figure 1: RS485 wiring

In order to activate the RS485 management the SW1.1 switch MUST be ON and the S215 value MUST be 1 (see the following table).

**WARNING:** the SW1.1 switch is read only at the power-up. Changing the SW1.1 switch when the modem is already running will not be taken in account.

Table 1: R485/232 configuration settings

S215 value	SW1.1	Note
1	ON	RS485 control lines management
1	OFF	RS232 configuration
0	Ignored	RS232 configuration

By default the DE and RE lines are asserted LOW, allowing receiving character from the RS485 differential bus. The DE and RE lines are asserted HIGH only when one or several characters have to be transmitted over the RS485 differential bus: when a radio frame is demodulated, the lines are asserted HIGH and then the data extracted from the radio frame are sent to the module TXD line and therefore to the RS485 differential bus. When the last character has been transmitted over the RS485 differential bus, the lines are asserted LOW.

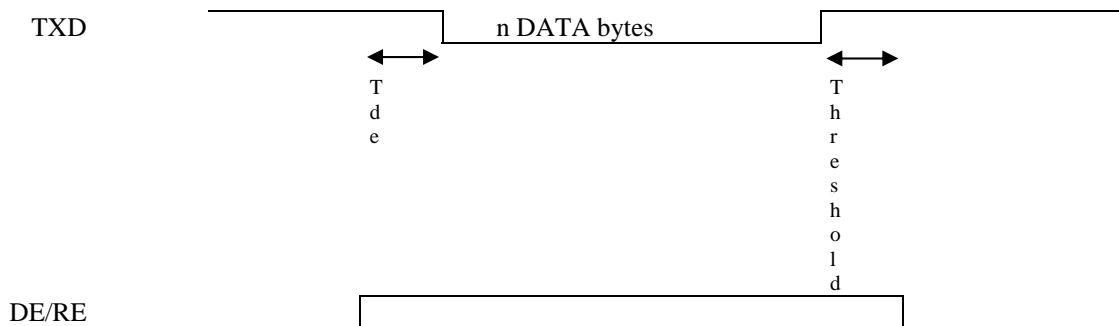


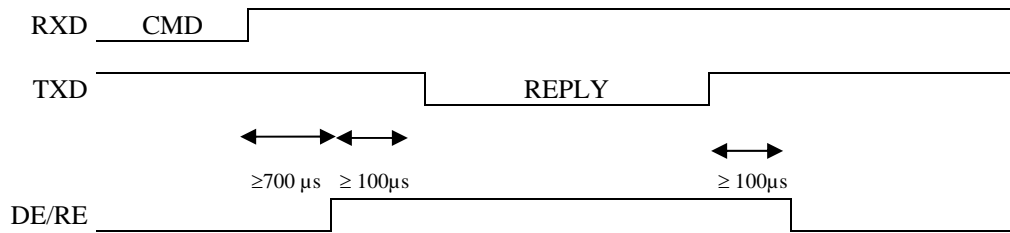
Figure 2: DE/RE timing when data are sent over the serial link

Threshold: minimum = 1  $\mu$ s

Tde: set according to the S219 register value (see table hereafter)

S219	0	1	2	3	4	5	10	20	40	60	80
Tde min	15 $\mu$ s	35 $\mu$ s	65 $\mu$ s	135 $\mu$ s	150 $\mu$ s	190 $\mu$ s	330 $\mu$ s	600 $\mu$ s	1.1 ms	1.7 ms	2.3 ms

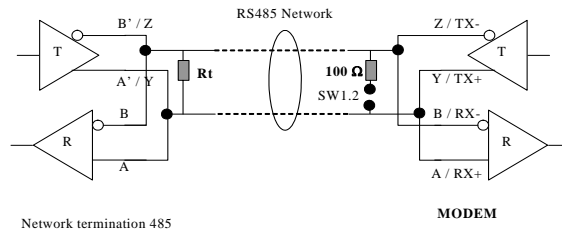
In command mode, a reply is sent back (on the TXD line) according to the following DE/RE timing:



The RS485 link needs to be adapted (each side). The modem includes a 100 $\Omega$  termination resistor:

- SW1.2 = ON, the resistor is connected between A and B (respectively RX+ and RX-)
- SW1.2 = OFF, the resistor is not connected between A and B.

If the modem is ending the RS485 bus, SW1.1 must be ON.



- **RADIO COMMUNICATION**

## 869 MHz VERSION

This modem has several channels over the 863-870 MHz Band that can be selected using AT commands, distributed in Wide Band and Narrow Band.

Wide Band channel:

- 1 Wide Band channels
- 57.6 kbit/s “air rate”
- channel spacing: 500 kHz
- Sensitivity: - 105 dBm
- Adjacent channel rejection: see chapter

Narrow Band channel:

- 3 Narrow Band channels
- 10 kbit/s “air rate”
- channel spacing: 100 kHz
- Sensitivity: - 110 dBm
- Adjacent channel rejection: see chapter

This module is designed to operate according to CEPT/ERC/REC 70-03 recommendation. This recommendation has been drawn up by the European Radio communications Committee (ERC) under CEPT.

- **Radio channels**

## 869 MHz VERSION

The Wide Band channel are selected according to the following table:

Channel S200	Frequency (MHz)
1	869,525

*Figure 3: Wide band channels*

The 3 Narrow Band channels are selected according to the following table:

Channel S200	Frequency (MHz)
19	869,450
84	869,525
85	869,600

*Figure 4: Narrow Band channels*

- Channel adjustment

The S200 register allows choosing the desired channel and the associated radio rate (see ).

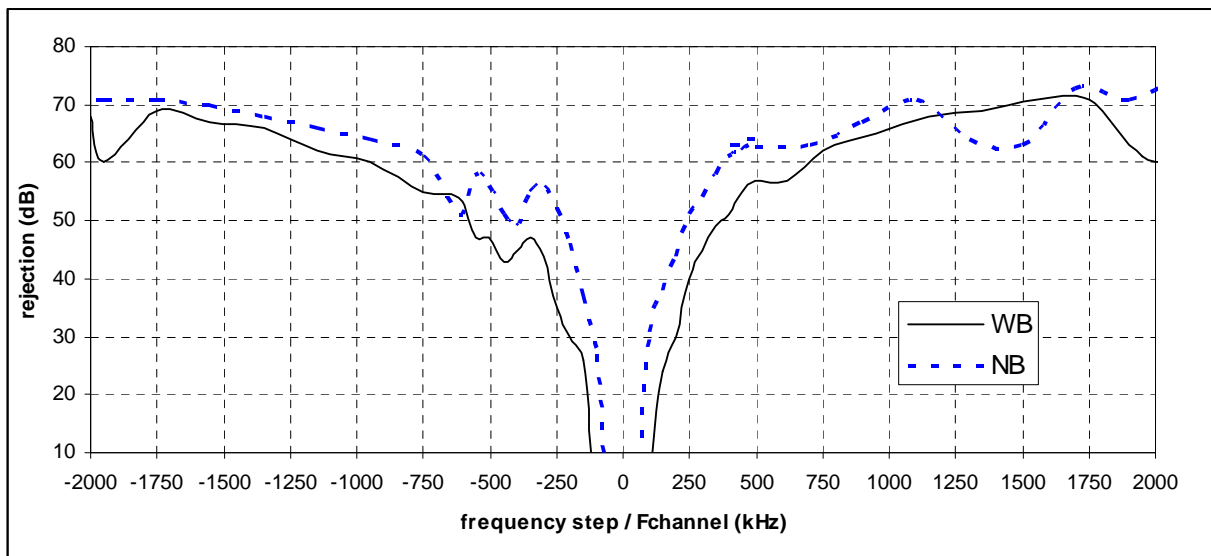
- Radio rate selection

For 869 MHz version, the Radio rate selection is automatically done when setting the channel number:

- If you choose a channel number  $\geq 14$  (Narrow Band), the radio rate will automatically switch to 10 kbit/s.
- If you choose a channel number  $< 14$ , the module will operate in the Wide Band configuration. The radio rate will switch automatically to 57600 bit/s.

- Channel rejection

The graph below shows the typical channels rejection in WideBand (WB) and NarrowBand (NB) modes.



Particular attention is required for product installation. In the case where several links must work in the same area (independently of the channel positions), the minimum distance between 2 products belonging to different radio links is 3 meters. Even with this precaution (depending of the product environment), channel rejection could be reduced.

## TRANSCEIVER OPERATING MODE

Two operating modes are available:

1. Command mode (usage of AT commands)
2. Transceiver or normal mode (serial data are transmitted on radio link)

At power up the transceiver is in transceiver mode; it is able to send / receive data to / from the radio link according to its current parameter configuration.

- Command mode

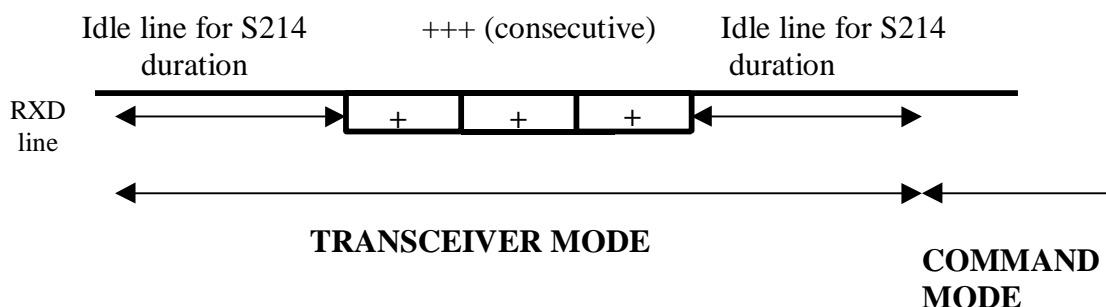
The command mode is used to read and update the modem configuration registers using AT command.

In command mode, the radio is inhibited (reception and transmission), excepted when using test command.

**Entering command mode:** issues on the serial link a +++ sequence. The sequence of 3 consecutive + characters is accepted only if no character have been seen before and after the +++ sequence. Register (S214) defines the silence duration.

**Tips 1:** if you are using a terminal (such as Hyperterm), you have to send the +++ sequence using a text file (first create a text file containing only the +++ characters, and then use in Hyperterm the command “Send text file” in the “Transfer menu”)

**Tips 2:**



**Exiting command mode** (return back in transceiver mode): send the serial command  
`ATO <cr>`

- Transceiver mode

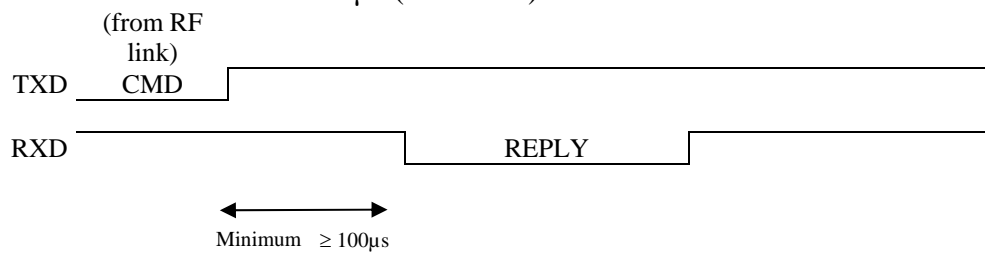
In transceiver mode, two protocols are available:

1. Transparent mode, without flow control.
2. Addressed mode, with flow control (see register S216)

The communication is always half-duplex. The radio transmission is processed prior to the radio reception (when the transceiver is sending a radio frame, it is not able to decode any incoming radio frame).

If no data are sent on the serial link, the modem is waiting for radio reception. Each radio frame sent by another modem is received and the validated data extracted from the radio

frame are sent on the serial link. When the last character has been sent on the serial link, it is possible to send an answer at least 100 µs (minimum) after the end of this last character.



All the data received on the serial link are encapsulated in a radio frame. The radio frame format depends on the used protocol.

When acting as transceiver, the radio frame transmission always starts under the following conditions:

- Detection of a silence on the serial link (greater than S217) after the reception of the latest character.
- Or when the number of received characters from the serial link is higher or equal to the maximum radio frame size (S218).
- *Transparent mode*

In transparent mode, the modem acts as a wire serial link. It means that alternately, the modem sends on the radio the data received from the serial link and sends on the serial link the data received from the radio.

The radio frame format is:

- <Preamble><synchro>DATA <postambule>.  
Preamble, synchronisation and postambule are used for the radio reception.

- **ADDRESSED MODE**

In transmission mode, data received on the serial link are sent on the radio link with the following format:

- <Preamble><synchro><Address> DATA <postambule>.  
Preamble, synchronisation and postambule are used for the radio reception.
- The Address field is set up with S256 value (LSB first).

In reception mode: The <Address> field of the radio frame is checked with the reception address (S252)

- If the radio frame address matches the transceiver reception address (S252), DATA (and only DATA) are transmitted on the serial link
- Otherwise received data are silently discarded.

- *Transceiver state machine*

When operating in transceiver mode the 'RF transmission' state machine is:

**Idle state of the transceiver:** by default the transceiver is waiting for incoming data on the RS232 link and for incoming radio frame on the radio link.

The RS232 link has a higher priority than the radio link (if a radio frame is demodulated

meanwhile some RS232 characters are detected on the serial link, the radio frame will be discarded and the RS232 incoming data will be processed).

**Processing incoming RS232 data:** the incoming RS232 data are internally buffered. The buffered data are **sent in a radio frame** (the RF modulation is started) when almost one of the following conditions occurs:

- if a break (silence greater than S217 timeout) is detected on the incoming serial flow (no more data to be sent).

- if the radio buffer size is reached (the number of buffered characters are equal or greater than the S218 size).

**Processing incoming radio frame:** the valid data are extracted from the incoming radio frame and internally buffered. The buffered data are sent on the fly to the RS232 module output.

## AT COMMANDS

- Description

**AT commands are interpreted only when the transceiver is in Command mode.**

**Command:** are used to read and update the modem parameters

- A command starts with the 2 ASCII 'AT' characters. 'AT' means 'Attention' follow with one or several characters or other data.
- Each command is ended with <cr> (carriage return).
- In the same command, the time between 2 characters must be less than 10s.

**Response:** is sent back for each command on the serial link. The answer is:

- 'O'<cr> (ASCII character 0x4F) for accepted command (or OK command)
- 'E'<cr> for error
- Specific string when specified

- Set of commands

Commands	Description
	<b><u>Operating mode selection</u></b>
ATO	Return back to transceiver mode.
<silence>+++<silence>	Command mode activation. The +++ sequence must be preceded and followed by a calibrated silence (no other character)
	<b><u>Registers management</u></b>
ATSn?	Displays the Sn register content where n represents the register number. The response has the following format: Sn=y<cr><lf>
ATSn=m	Sets the Sn register value with 'm'. n represents the register number..
AT&W	Saves the new register configuration in EEPROM. Each time you switch on the modem, the EEPROM configuration will be loaded in the modem registers.
AT/S	Displays all register values. The response has the following format: Sxxx=y<cr><lf> for each register.
AT/V	Software version display. The response has the following format: Adeunis RF Versatile Modem II 868 MHz 500mW Vxx.yy<cr><lf>
ATR	Restore the register default values
	<b><u>Test modes</u></b>
ATT1	Pure Carrier (data=0) transmission using current channel. The output of this mode is achieved by reception of any character on the serial link.
ATT2	Pure Carrier (data=1) transmission using current channel. The output of this mode is achieved by reception of any character on the serial link.
ATT3-ATT6	Modulation using current channel. The output of this mode is achieved by reception of any character on the serial link. ATT3: 0.9 KHz modulation ATT4: 3.6 KHz modulation ATT5: 14.4 KHz modulation ATT6: 28.8 KHz modulation

- Register description

The register value could be updated using the ATSn=m<cr> command and displayed using ATSn?<cr> command.

At power-up, the previous transceiver configuration is restored from E2PROM (non volatile) to RAM. The registers are located in RAM registers, any modification is performed on RAM registers: To save current register configurations, it is necessary to use the AT&W<cr> command (If not, the updated parameters are lost in case of power shortage).

The registers are shared in 2 types: read only (R) or read/write (R/W)

Type	Register	Function	Description	Default value	Note
			Radio management		
R/W	S200	Channel number	Radio channel for 896 MHz version : From '0' up to '13', Wide Band channel. From '14' up to '83', Narrow Band channel.	<b>1</b>	3
R/W	S202	Command mode, auto-exit	Automatic command mode exit 0 : (no specific management), the command mode will be exited only when an ATO command is issued.  From 1 to 60 : timeout in second. → If no activity (no character, command reception) is detected in command mode for the programmed timeout, the command mode will be exited. The module is back to transceiver mode	<b>0</b>	
R/W	S204	Preamble duration	Preamble duration, unit ms From 4 up to 50	<b>4</b>	4
R/W	S217	Serial timeout for radio	Serial timeout before starting radio transmission, unit ms. From 3 up to 240.	<b>3</b>	1
R/W	S218	Radio frame length	Size of the radio frame (from 1 up to 240). When this size is reached: the transceiver sends a radio frame The RTS signal is activated (pull to VDD) <b>only</b> if the module is operating in the addressed mode.	<b>128</b>	
R	S230	RSSI level	Displays the reception level of the latest received message. Response: S230=-xxx dBm<cr><lf> with xxx decimal value  Example S230=-80 dBm	<b>None</b>	
R/W	S231	RF OUT level	Adjusts the RF out level  0 => 20 dBm (100 mW) 1 => 23 dBm (200 mW) 2 => 27 dBm (500 mW)	<b>2</b>	
			Serial link		

Type	Register	Function	Description	Default value	Note
R/W	S210	Baudrate	Serial link rate in bits/s '0': 600 '1': 1 200 '2': 2 400 '3': 4 800 '4': 9 600 '5': 19 200 '6': 38 400 '7': 57 600	<b>4</b>	1,2,5
R/W	S211	Data length	'7' : 7 bits '8' : 8 bits	<b>8</b>	5
R/W	S212	Parity	'1' : none '2' : even '3' : odd	<b>1</b>	5
R/W	S213	Stop bits	'1' : 1 stop bit '2' : 2 stop bit	<b>1</b>	5
R/W	S214	Command timeout	Time out duration for detecting the +++ pattern, unit ms. From 3 up to 240.	<b>3</b>	1
R/W	S215	Interface type	'0' : RS232 only '1' : RS232 or RS485 (managed DE/RE lines)	<b>1</b>	
R/W	S216	Handshake	'0' : hardware, RTS ( <b>restricted</b> to addressed protocol) '2' : none	<b>2</b>	
R/W	S219	RS485 delay	Delay between DE activation and the first RS485 transmitted byte From 0 up to 160	<b>3</b>	
			Protocol		
R/W	S220	Protocol	'1' = transparent mode '6' = <b>addressed</b>	<b>6</b>	
R/W	S252	Reception address	From 0 up to FFFF Used in addressed protocol only, for filtering incoming frame		
R/W	S256	Transmission address	From 0 up to FFFF Used in addressed protocol only, added to out coming frame		
			Miscellaneous		
R/W	S232	Power management	0 disable modes 1 immediately enter standby mode 2 enable low power down mode	<b>0</b>	

Note 1: when a serial speed change is requested, the S214 and S217 registers values are automatically set to a value greater or equal than the duration of three characters in the requested speed (13 ms for 2400 bauds, 7 ms for 4800, 3 ms otherwise).

Note 2: streaming mode without flow control. Be careful → using a serial rate greater to the radio rate must produce character losts if the flow control is not used.

If the radio rate is equal to the serial rate, the radio frame is longer than the serial frame, due to radio protocol overhead; but the radio overhead will be generated only when the radio transmission begins → this overhead will be absorbed by internal buffer size.

For example, if the current radio rate is 10 kbit/s, a serial rate of 9 600 should be used without flow control, while using a serial rate of 19 200 (with 10 kbit/s for the radio rate) will produce data overrun.

For avoiding character lost, you should:

1. use the flow control (addressed mode with hardware handshake)
2. or use a serial rate lower or equal to the radio rate
3. or limit the size of serial data to the maximum size of the internal buffer (S218).

Note 3: (S200 register) see chapt. and chapt.

Note 4: The preamble duration is linked to the current radio rate. For high speed radio rate (Wide Band) the preamble duration is adjusted to 4ms while for low speed rate (Narrow Band) the preamble duration is adjusted to 10ms.

The minimum preamble values are:

	<b>Minimum preamble value</b>
WB channel (high radio rate)	4 ms
NB channel (low radio rate)	10 ms

In NB configuration the S204 register value could be set to a value lower than 10ms. In this case, the module prevents using this incorrect preamble length with an automatic adjustment to 10ms.

Note 5: when changing the serial link configuration (rate, parity, stop bit...), the answer is done using the old serial link format, the next command must be sent using the new serial format.

Note 6: the S232 register is not applicable

# SPECIFICATIONS

## General technical characteristics

	<b>869 MHz version</b>
Operating temperature	-30 to +70 °C
Power supply	4,5 to 36 Volts (integrated regulator)
Size	145x100x40 mm
Number of channels	1 WB channel and 3 NB channels
Modulation	FSK
Packaging	IP65 Box with integrated or remote antenna

## Transmitter

	<b>869 MHz version</b>
Programmable Frequencies	869,450 – 869,525 – 869,600 MHz
Programmable Radiated RF power	up to 27 dBm (500 mW).
Tx / Rx consumption	3 W / 0,27 W

## Receipt

	<b>869 MHz version</b>
Receiver Sensitivity	Down to -110 dBm for BER 10-3
Radio data rate	from 10000 or 57600 bps
RSSI	available through AT commands

## Protocol

	<b>869 MHz version</b>
Serial data rate	from 600 to 57600 bauds (programmable through AT commands)
Serial ports	TxD, RxD, RTS, CTS. Standard configuration : RS232 port. The RS485 configuration is performed through AT commands
Setup and configuration	through Hayes commands
Modes	Transparent or Addressed mode, full custom firmware on demand
Embedded protocol	ADEUNIS-RF enhanced and versatile RF communications manager
Embedded profiles	Multimode modem
Standards compliance	EN 300-220 and EN 301-489 (full certified modem)
Range	up to 6 Km

## REFERENCES

	<b>869 MHz version</b>
• Modem RS232/RS485 – IP65 box :	ARF7474D
• Modem RS232/485- IP65 box with external antenna(*) :	ARF7474F
• Modem USB – IP65 box :	ARF7474H
• Modem USB –IP65 box with external antenna(*) :	ARF7474J

## GLOSSARY

TBD	To Be Defined
NC	Not Connected
NU	Not Used
FHSS	Frequency Hopping Spread Spectrum
FIFO	First In First Out
WB	Wide Band
NB	Narrow Band

## ANNEX : Firmware updates

Firmware	Updates

Document	Updates