A^{RF53}
Data modem

User Guide

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About this document

This guide describes the A^{RF53} devices, their options and accessories.

Declaration of conformity

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 if used and installed according to the user guide available on our web site www.adeunis-rf.com

Product Name: **ARF53**
Product Number(s):   **ARF7474D / ARF7474F / ARF7474H / ARF7474J**
Product options:

complies with the RTTE Directive 99/5/EC:

EMC: conformity is proven by compliance to the harmonized standard EN 301-489
Safety: conformity to the standard EN 60950-1/2001
Radio: conformity is proven by compliance to harmonized standard EN 300-220 covering essential radio requirements of the RTTE directive.

Exposure to radio frequency signals: Regarding the 1999/519/EC recommendation, when using the device, keep the product at least 20 cm from your body.

Notes: - Conformity has been evaluated according to the procedure described in Annex III of the RTTE directive.
     - Receiver class (if applicable): 3.

Crolles, November 6th, 2007
VINCENT Hervé / Quality manager

Download of the user guide

Thank you for having chosen the ADEUNIS RF products.
NOTA : this modem is set up in Narrow Band (channel 19) to optimize the range. The radio data rate is then limited to 10 kBps. To modify these parameters thank you to apply the instructions mentioned on the user guide downloadable on our web site www.adeunis-rf.com
Index   **Products**
Paragraph   **Modems > Data modem**
Print version available upon request
✓   Tel : +33 4 76 92 07 77
✓   Email : arf@adeunis-rf.com

Overview

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

Radio transmission

RS232 serial link
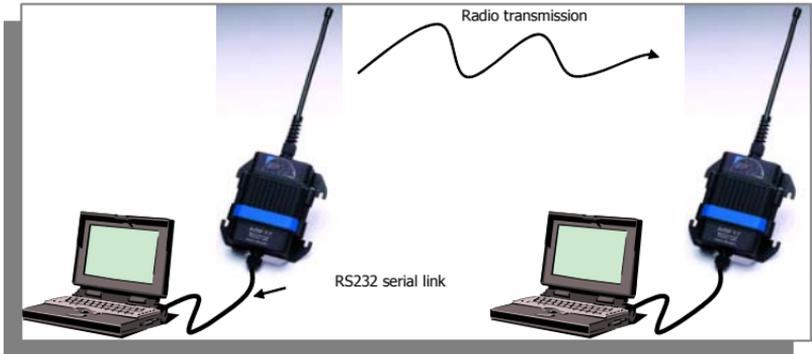
The operating parameters of these modems (serial link, radio management…) can be updated through commands on the serial link.

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.

Remove these screws
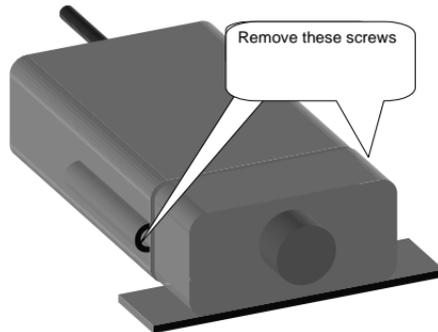
The ARF53 range products are supplied from a DC voltage source. This voltage source must be 4,5V minimum and must not exceed 36 Vdc. Green LED is ON when powered.

RTS RX TX CTS TX+ TX- RX+ RX-

+ DC **Supply:**
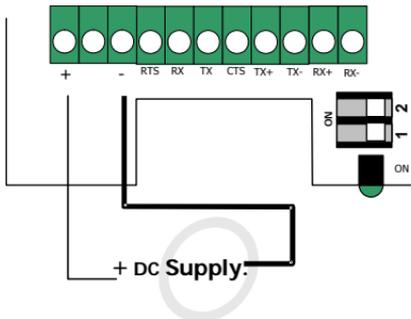
EASY CHECK
Green LED is ON when modem is powered.

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.

N° / SUB-D 9   NOM

+ Vcc

5   GND
7   RTS
2   RXD
3   TXD
8   CTS

+
-
RTS
RX
TX
CTS
TX+
TX-
RX+
RX-

ON
1 2
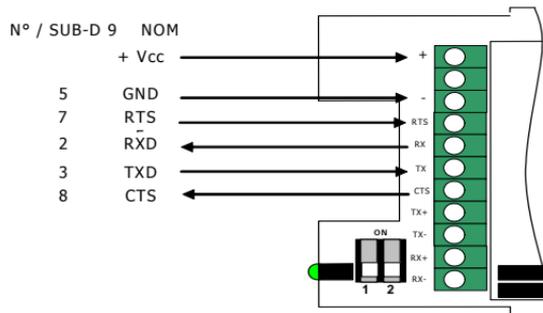
DCE RS232

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.
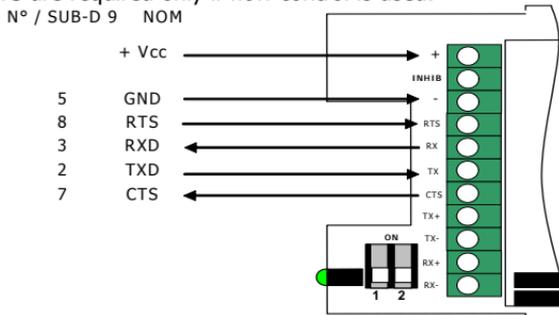
N° / SUB-D 9   NOM

+ Vcc

5   GND
8   RTS
3   RXD
2   TXD
7   CTS

+
INHIB
-
RTS
RX
TX
CTS
TX+
TX-
RX+
RX-

ON
1 2

EASY CHECK
Serial link activity will make the green LED flashing, whatever the selected data rate is right or wrong.

RS485 wiring

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

BUS RS485   NAME

+ Vcc

GND

A   TX+/RX+

B   TX-/ RX-

*Connect only TX+
or RX+ (note 1)*

*Connect only TX-
or RX- (note 1)*

Note 1:
- *TX- is connected to RX- on the PCB*
- *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.

S215 values	SW1.1	Note
1	ON	RS485 control lines management
1	OFF	RS232 configuration
0	ignoré	RS232 configuration

Table 1: R485/232 configuration settings

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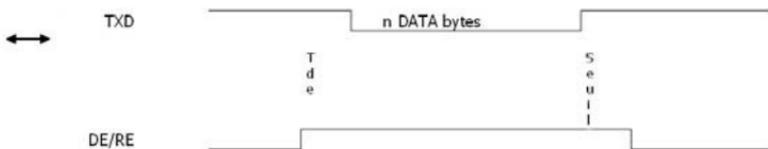
Figure 2 : DE/RE timing when data are sent over the serial link

Threshold: minimum = 1 µs
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 µs	35 µs	65 µs	135 µs	150 µs	190 µs	330 µs	600 µs	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:
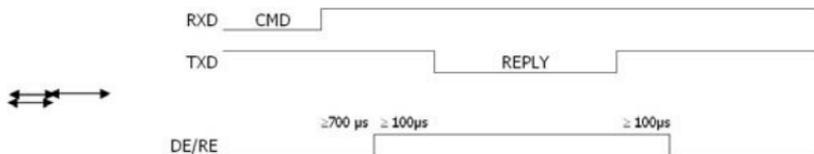
The RS485 link needs to be adapted (each side). The modem includes a 100Ω termination resistor:

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.

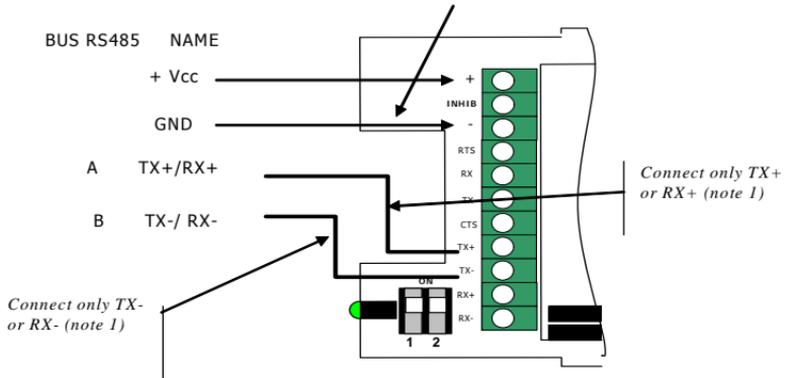If the modem is ending the RS485 bus, SW1.1 must be ON.
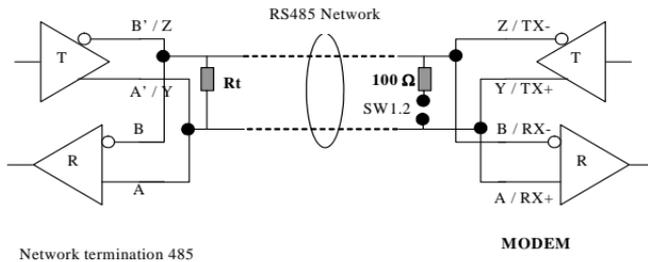
Network termination 485

EASY CHECK

Serial link activity will make the green LED flashing, whatever the selected data rate is right or wrong.

Radio communication

Radio communication

869 MHz version

This modem has several channels over the 869 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 : - 108 dBm
Adjacent channel rejection : see chapter **Erreur ! Source du renvoi introuvable**.

Narrow Band channel:
3 Narrow Band channels
10 kbit/s "air rate"
channel spacing : 100 kHz
Sensitivity : - 112 dBm
Adjacent channel rejection: see chapter **Erreur ! Source du renvoi introuvable**.

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

The S200 register allows choosing the desired channel and the associated radio rate:
The Wide Band channel is selected according to the following table:

Channel S200	Frequency (MHz)
1	869,525

Figure 3 : Wide band channel

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

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 = 1 (Wide Band), the radio rate will automatically switch to 57600 bit/s.
- If you choose a channel number = 19 or 84 or 85, the module will operate in the Narrow Band configuration. The radio rate will switch automatically to 10 kbit/s.

Channel rejection

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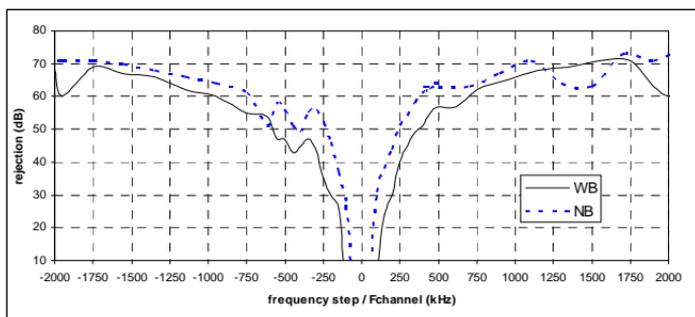
NOTES

Particular attention is required for product installation. In the case where several links must works 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.

RSSI reading

The RSSI (Received Strength Signal Indicator) gives an indication for the received power level on the first channel of the hopping table.
It could be accessed with ATS230?<cr> command.
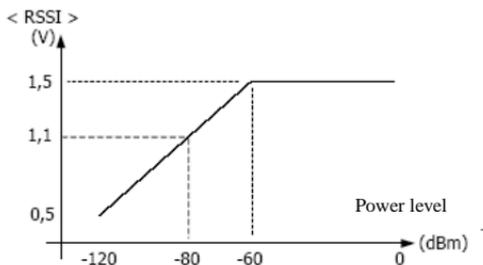
NOTE
The RSSI level is only an indication. Use this level with care due to the dispersion between components.
The schema above could be modified from one to another product. The operating temperature could also have an impact on these dispersions.
The RSSI level could also indicate the potential presence of any jammer in the used channel.
The RSSI is a necessary but not sufficient condition to get a correct reception.

Modem operating mode

Two operating modes are available:
- Command mode (usage of AT commands)
- 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.

NOTE

The AT command can be locked using ATPWD 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
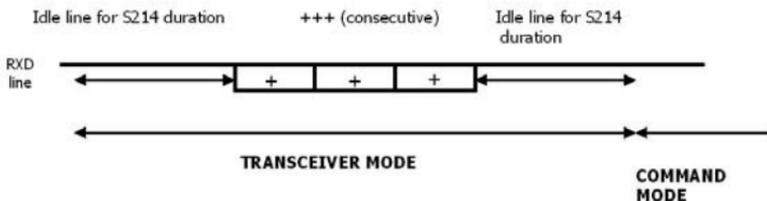
Exiting command mode (return back in transceiver mode): send the serial command
ATO <cr>

EASY CHECK

When receiving a right command, modem will answer:
'O'<cr> (ASCII character 0x4F) for accepted command (or OK command)
'E'<cr> for error

Specific	string	when	specified

Transceiver mode

In transceiver mode, two protocols are available:
- Transparent mode, without flow control.
- 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.
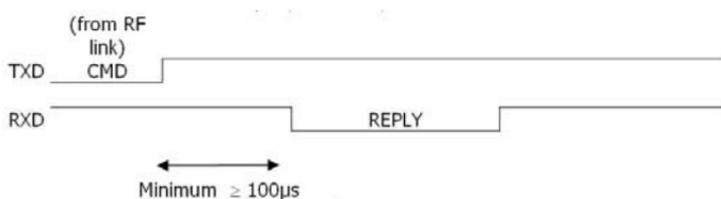
All the data received on the serial link are encapsulated in a radio frame.
The radio frame format depends on the used protocol.

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

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.

EASY CHECK:
When receiving a right command, modem will answer:
'O'<cr> (ASCII character 0x4F) for accepted command (or OK command)
'E'<cr> for error
Specific string when specified

Set of commands

Commands	Description
Operating mode selection	
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)
Registers management	

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 **Be careful**: When restoring USB DC supplied modem regs, S231 - RF power will become "3" which is incompatible with USB power supply.
ATPWD=m	m = pin code (register S205) : unlock all AT commands. m = 0000 : set registers to default value and unlock all AT commands.
	Test modes
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

AT/S is not available for baud rate lower than 2400 bauds

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	Regis-ter	Function	Description	Default value	No te
			Radio management		
R/W	S200	Channel number	Radio channel for 869 MHz version : 1, Wide Band channel. 19, 84 ou 85, Narrow Band channels.	**1**	3
When leaving factory, this modem is set up in **Narrow Band** (channel 19) to optimize the range					
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	**0**	
R/W	S204	Preamble duration	Preamble duration, unit ms From 4 up to 50	**5**	4

Type	Regis-ter	Function	Description	Default value	Note
R/W	S217	Serial timeout for radio	Serial timeout before starting radio transmission, unit ms. From 3 up to 240.	**3**	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) **only** if the module is operating in the addressed mode.	**128**	
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	**None**	
R/W	S231	RF OUT level	Adjusts the RF out level 0 => 20 dBm (100 mW) 1 => 23 dBm (200 mW) 2 => 24,5 dBm (<450 mA for USB power supply) 3 => 27 dBm (500 mW – **Not for USB power supply**)	**3**	
Serial link					
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	**4**	1,2,5

Type	Regis-ter	Function	Description	Default value	Note
R/W	S211	Data length	'7' : 7 bits '8' : 8 bits	**8**	5
R/W	S212	Parity	'1' : none '2' : even '3' : odd	**1**	5
R/W	S213	Stop bits	'1 ' : 1 stop bit '2' : 2 stop bit	**1**	5
R/W	S214	Command timeout	Time out duration for detecting the +++ pattern, unit ms. From 3 up to 240.	**3**	1
R/W	S215	Interface type	'0' : RS232 only '1' : RS232 or RS485 (managed DE/RE lines)	**1**	
R/W	S216	Handshake	'0' : hardware, RTS (**restricted** to addressed protocol) '2' : none	**2**	
R/W	S219	RS485 delay	Delay between DE activation and the first RS485 transmitted byte From 0 up to 160	**3**	
			Protocol		
R/W	S220	Protocol	'1'= transparent mode **'6'= addressed**	**6**	
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	S205	Pin code	Pin code value Value 0000 is not allowed	**1111**	
R/W	S207	Pin code activation	0 pin code disabled 1 pin code enabled	**0**	

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

NOTE 3

:(S200 register) See pages 7 & 8.

NOTE 4

The preamble duration is linked to the current radio rate.

The preamble values are:

	Default preamble value	Minimum preamble value
WB channel (high radio rate)	5 ms	4 ms
NB channel (low radio rate)	20 ms	10 ms

BE CAREFULL

Keep in mind reducing preamble duration below default value will reduce transmission delay but may generate possible frame error rate (up to 1 or 2/1000)!!!

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.

Specifications

General technical characteristics

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 external antenna

Transmitter

Programmable Frequencies	869,450 – 869,525 – 869,600 MHz
Programmable Radiated RF power	Up to 27 dBm (500 mW).
Tx / Rx consumption	3,2 W / 0,27 W

Receiver

Receiver Sensitivity	Down to -112 dBm for BER 10-3
Radio data rate	from 10000 or 57600 bps
RSSI	available through AT commands

Protocol

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 (fully certified modem)
Range	up to 6 Km

References

ARF7474D : Modem RS232/RS485 – IP65 box
ARF7474F : Modem RS232/485- IP65 box with external antenna(*)
ARF7474H : Modem USB – IP65 box
ARF7474J : Modem USB –IP65 box with external antenna(*)

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
00.18	Pin code added

Firmware	Updates
V6.0	Pin code added (LMN)
V4.0	NB configuration when leaving factory
V3.0	RF power update + "EASY CHECK" assertions + Power Mgt suppress
V2.0	Commands update
V1.0	Original version