ARF05
User Guide

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SA au capital de 345.000 euros – SIRET 430 190 496 00017 – RCS Grenoble – NAF 322A

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: ARF05
Product Number(s): ARF6899 – ARF7356
Product options:

conforms to the RTTE Directive 99/5/EC :

EMC: conformity is proven by compliance to the standard EN 301489 according to the requirements of EMC 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): 3.

Restrictions :
- CE marking applies only to End Products: Because this equipment is only a subassembly, conformity testing has been reduced (equipment has been design in accordance to standards but full testing is impossible). Manufacturer of End Products, based on such a solution, has to insure full conformity to be able to CE label marking.

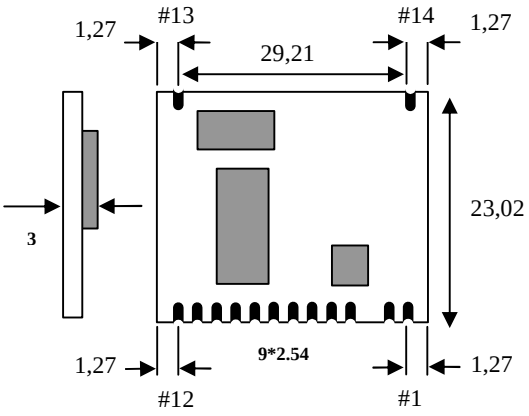
Crolles, March 23rd, 2006

VINCENT Hervé / Quality manager

GENERAL USE

The ARF05 radio module is a **single-channel FSK transceiver** for digital RF transmission using the **433.05-434.79 MHz** waveband, the **869.4-869.65 MHz** waveband or the **902-928 MHz** waveband.
It enables **two-directional half-duplex digital links** to be achieved with a transmission rate up to **40KBps** in Manchester encoding.
The ARF05 develops a power about 12 mW on 50 Ω in transmission mode.
The radiated powers are then about 10 mW when a 17-cm whip antenna is used with 433,92 MHz transceiver or 8 mW when a 8-cm whip antenna is used with 869,525 MHz (915 MHz) transceiver.
This transmitter is compatible with any wideband FM receiver accepting a frequency deviation of ± 50 kHz.
In receipt mode, the sensitivity is better than 1.25µV for 12 dB SINAD (about 10^{-2} BER) i.e. –105dBm.
The receiver is compatible with any transmitter that respects these bandwidths and deviations (consult us if a transmitter other than the ARF05 is used).
The ARF05 transceiver is composed of "raw" radio components, the transmission protocol (data encoding/decoding) and programming of the radio module has to be performed by the associated logical unit.
The use of a whip antenna is compulsory to obtain good performances, a slight shortening is however possible. (Consult us).

DIMENSIONS – PIN ASSIGNMENTS



1-ANTENNA
2-RF GND
3-PWRDN : Standby (if PWRDN = VDC).
4-RXTX / : Mode choice Transmitter (0V) or Receiver (VDC).
5-DATA : Configuration data input/output
6-CLOCK : Configuration clock input
7-EN : Configuration validation input
8-RESET/
9-DATA IN-OUT : Transmitted data input/output
10-RSSI : Receipt level output
11-VDC : 2.5 to 5V power supply
12-GND : 0V ground
13-GND : 0V ground
14-GND : 0V ground

- The dimensions are given in millimetres.
- SMD pads pitch is 2.54 mm.

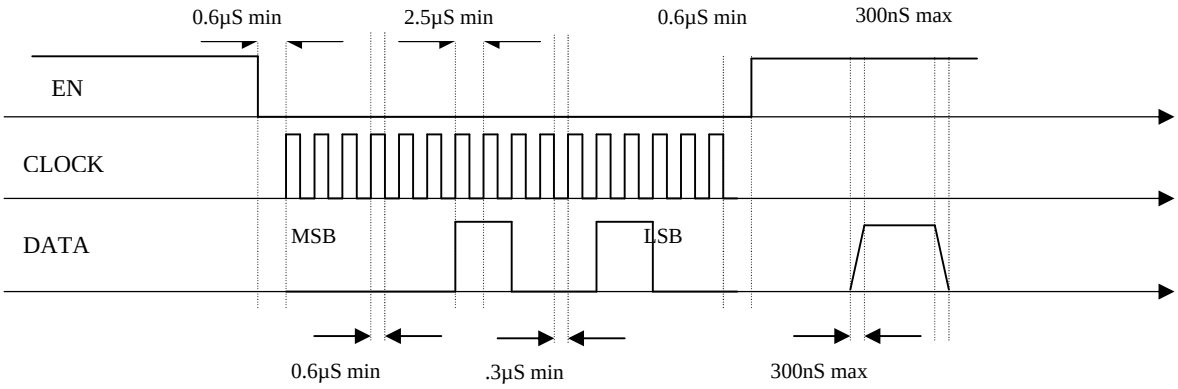
Notes:

- The interface with the mother board has to be achieved through copper pads on both PCB sides. No component can be located under the module when using SMD mounting.

- The radio module is supplied by an external source connected between VDC and GND. The supply voltage must be chosen in the 2.5-5V range.

PROGRAMMING (OPTIONAL)

The ARF05 has an "extended operation" mode that enables to reach its maximum transmission rate or to reduce its transmission power or sensitivity. The transceiver will then have to be configured (different internal registers). This configuration is to be performed by means of a 3-wire serial bus (DATA, CLOCK, ENABLE). **Without a configuration, the transceiver operates in default mode.**
Each word is programmed starting with the most significant bit (MSB) and each bit is loaded on the clock rising front. For this programming, low level corresponds to GND and high level corresponds to VDC.



Programming in "fast transmission" mode.

The ARF05 module can work at up to 40Kbps in Manchester. For this, a **16-bit** word has to be sent **(see table below)** on the 3-wire bus (EN, CLOCK, DATA) according to the timing diagrams indicated in the previous paragraph.

Transmission rate	**Word to be sent** **16 bits**
40 kbps Manchester (*)	**(0388)**hex
Return to 12 kbps Manchester (default mode)	**(0318)**hex or RESET

(*) Take care! Switching to fast mode results in a loss of about 6dB sensitivity. This mode must therefore only be used for applications requiring a transmission rate higher than 12kbps Manchester.

Programming in "range attenuation" mode.

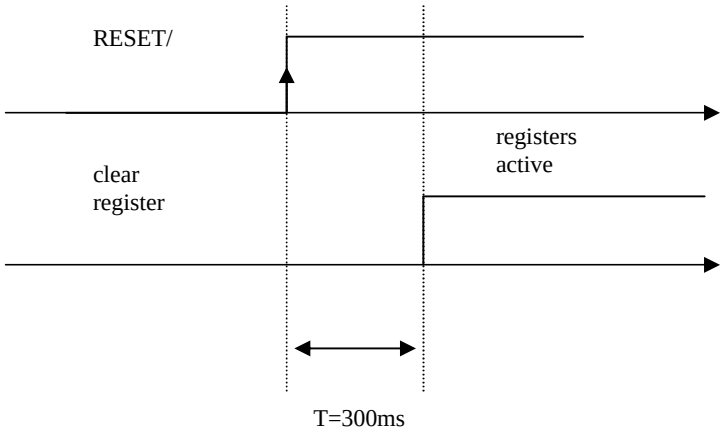
The transmission power and receipt sensitivity of the ARF05 modules can be attenuated by programming (see table below). This mode enables minimising the consumption on the transmitter and/or receiver side for short-range applications running on battery.

Transmission rate	Word to be sent 24 bits
Transmission power attenuation (*)	**(0004F8)**hex
Receipt sensitivity reduction (about 5dB)	**(0004E9)**hex
Return to default mode (no attenuation)	**(0004F9)**hex or RESET

Take care! Attenuation depends on the operating voltage of the module. From about 4dB in 5V, it amounts to about 12dB at 3V.

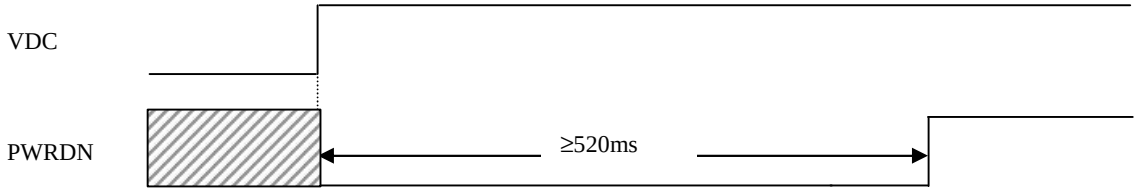
RESET

The module is provided with an automatic reset system on power-up of the module (reset registers), it is therefore not necessary to connect this pin to the VDC potential (integrated pull-up).
Automatic reset on power-up takes about 300ms, no frames and no serial data should be sent during this period.
This time is identical in case of an external action on the RESET/ pin.



« POWER DOWN » MODE

Enables the product to be sampled via the PWRDN pin (transceiver valid if PWRDN = 0 / standby if PWRDN = 1).
If a pull-down resistor is used, it must be less than 220 Ohms! ! !
TAKE CARE! On standby (PWRDN = 1), pin 4 (RxTx) must be pulled to 0 and the 3-wire bus (DATA/CLOCK/EN) be left on high impedance.
NB: In case of switching to standby after power-up, the timing diagram below must be respected to integrate automatic reset.

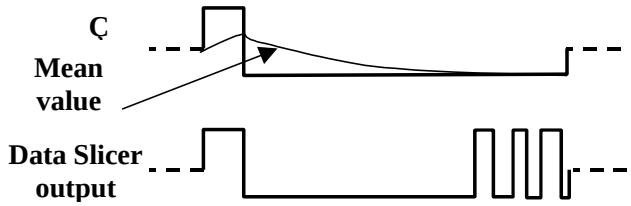


PROTOCOL

The modulating signals (DATA IN-OUT pin) must have a frequency between **0.2KHz and 12KHz (default mode) or 0.2KHz and 40kHz (extended – fast transmission mode).**
Frequencies lower and higher than this band cannot be transmitted. This means that the link cannot transmit constant states having a duration longer than 500µs.

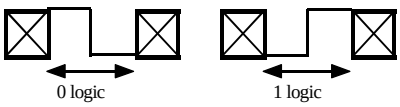
Bit encoding level

Most conventional hardwired serial links transmit bytes asynchronously using an NRZ encoding (1 logic bit = 1 electrical state). As a result, the spectrum occupation of the signals generated this way is about one decade. Furthermore, sampling of the bytes received this way assumes perfect synchronisation of decoding on the start bit.



In case of radio transmission, you'd better limit the spectrum of the signals to be transmitted as much as possible, particularly for low frequencies, even if this involves increasing the main frequency. Moreover, you'd better have the synchro reset on each transmitted bit; receivers are in fact the cause of large duty cycle errors on the electrical states.
The following bit encoding should therefore be preferred:

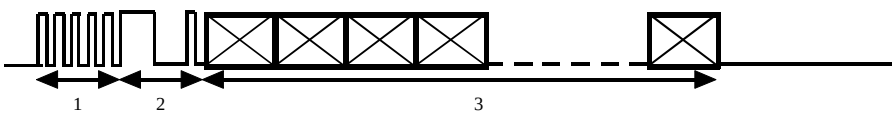
Manchester or two-phase:



Frame encoding level

Once the bits have been encoded, they must then be transmitted according to a frame structure; the radio link is very sensitive to binary flow breaks which can only be minimised by "serialising" the bytes.

A conventional frame structure is set out below:

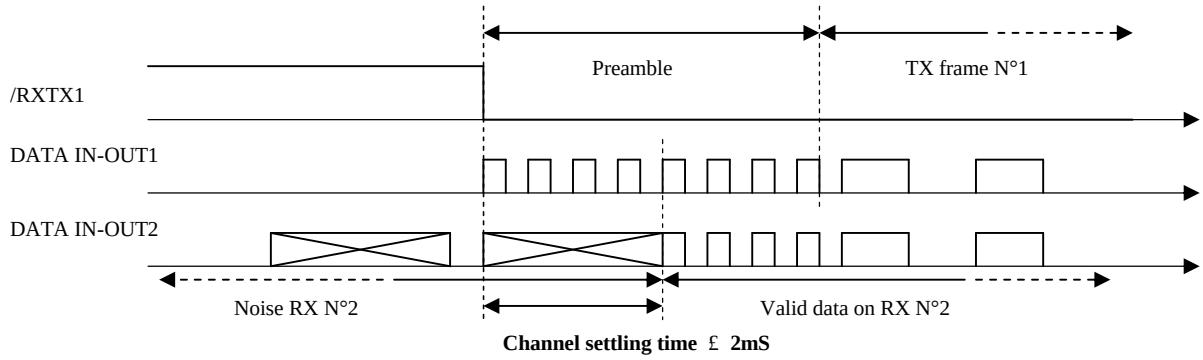


1 **Preamble**: Electrical succession 101010… to set the receiver polarisations and compensate the channel settling time.
2 **Sync. pattern**: Electrical pattern marking the start of the useful data by a break in the binary flow of the preamble.
3 **Useful part**: Succession of bytes encoded at bit level.

Radio channel management.

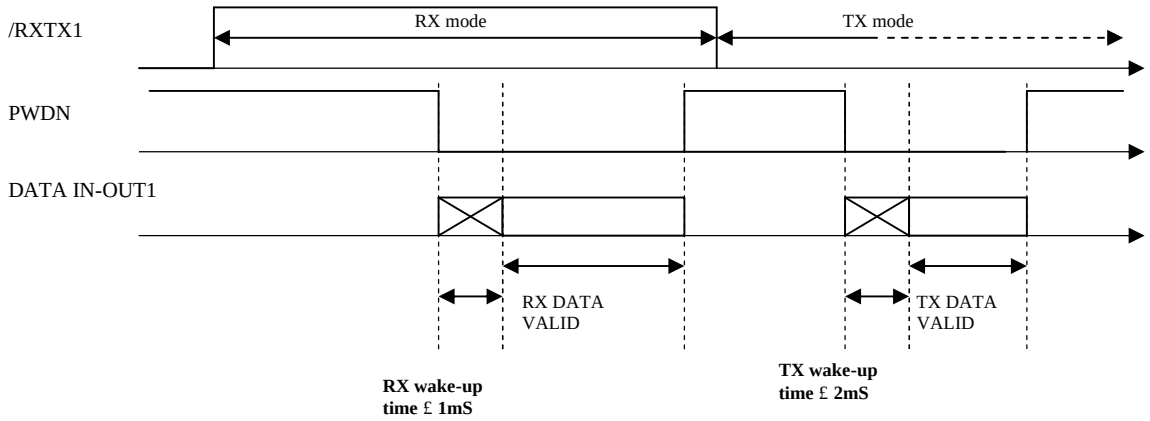
Radio channel settling.

This feature corresponds to the time required to obtain the first valid bits on receipt on an ARF05 #2 (DATA IN-OUT 2) after transmission of a frame from another remote ARF05 #1 module (DATA IN-OUT 1).



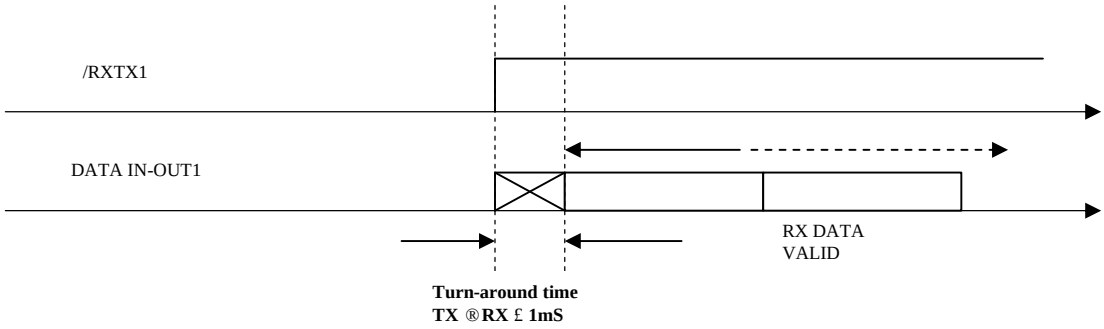
Wake-up time (Starting time).

This feature corresponds to the time required to switch from Stand-by mode (low consumption) to 'active' mode (TX or RX).

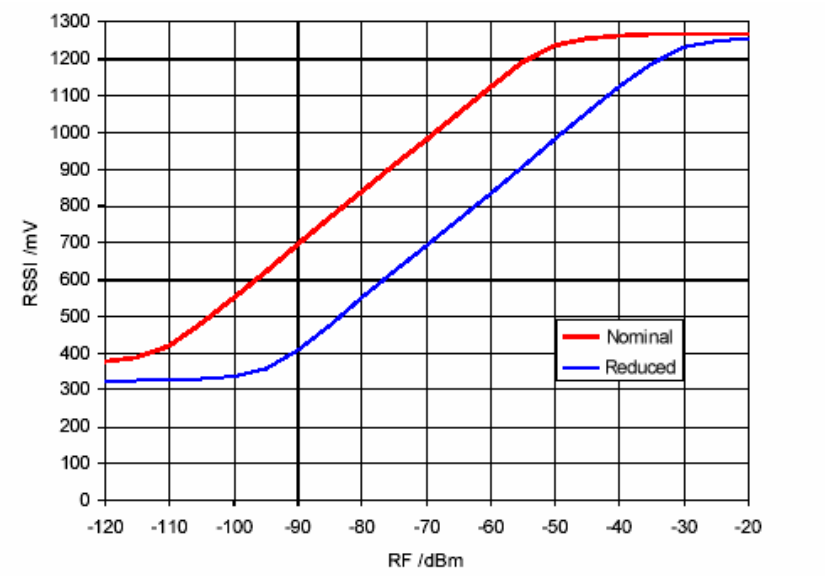


Transceiver turn-around.

This feature corresponds to the time required to switch from valid transmission to valid receipt or vice-versa on the same piece of equipment, and therefore to a change of state of the control input TX_RX.



RSSI



The graph above (VDC=3V) gives a correspondence between the value of the RSSI and the received power level.

Beware:

-The RSSI level remains an indicator that has to be used with precaution due to the important dispersions between ICs. The curve presented above may therefore undergo slight variations from one product to another. These dispersions are also greatly dependent on the operating temperature of the ARF05.

- The RSSI level may also indicate the presence of a jammer in the channel used. Therefore, examining the RSSI alone is no gurarantee of good detection of a useful signal from a remote transmitter. The identity of the transmitter also has to be ensured by analysing the frames received.

RSSI is a necessary but not sufficient condition to get a correct receipt.

SPECIFICATIONS

	433.92 MHz	869.525 MHz (915 MHz)
TRANSMITTER		
Frequencies	433.92MHz	869.525MHz (915 MHz)
Power developed (/ 50 ohms) @ 3V	8 dBm	6 dBm
Power developed (/ 50 ohms) @ 5V	12dBm	10dBm
Modulation	2FSK+-50kHz	2FSK+-50kHz
Current consumption @ 3V	15mA	15mA
Current consumption @ 5V	20mA	20mA
RECEIVER		
Technology	Homodyne	Homodyne
Frequencies	433.92MHz	869.525MHz (915 MHz)
Sensitivity (to S/N)	1.25µv (-105dBm)	1.25µv (-105dBm)
Demodulation	2FSK+-50kHz	2FSK+-50kHz
Bandwidth	2MHz front end, 150kHz back end	2MHz front end, 150kHz back end
Digital output	0/VCC	0/VCC
Current consumption @ 3V	14mA	14mA
Current consumption @ 5V	17mA	17mA
TRANSCEIVER		
Operating voltage	From 2.1 to 5.5V	From 2.1 to 5.5V
Standby current	<1uA	<1uA
Transmission rate	0.2kHz-12kHz (standard mode) 0.2kHz-40kHz (extended mode)	0.2kHz-12kHz (standard mode) 0.2kHz-40kHz (extended mode)
Transmitter wake-up time	≤2mS	≤2mS
Receiver wake-up time	≤1mS	≤1mS
TX to RX turn-around time	≤1mS	≤1mS
RX to TX turn-around time	≤1mS	≤1mS
Channel settling time	≤2mS	≤2mS
Operating temperature	-20°C to +70°C	-20°C to +70°C

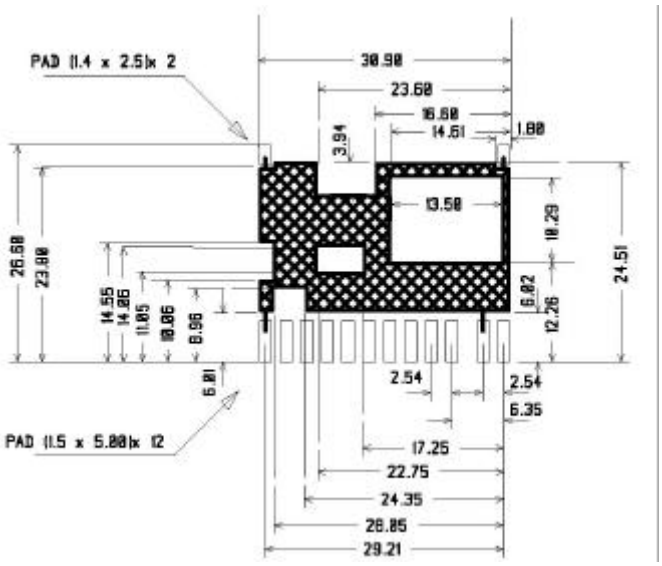
Versions: ARF6899A Transceiver 433.92 MHz SMD version
ARF 6899B Transceiver 433.92 MHz COMCLIP version
ARF 7356A Transceiver 869.525 MHz SMD version
ARF 7356B Transceiver 915 MHz SMD version

INTEGRATION

Daughter board:

The interface with the mother board has to be achieved through copper pads on both PCB sides. No component can be located under the module when using SMD mounting (see the following footprint).

The daughter board **ARF6899B** can be fitted directly in a motherboard electronic system by means of "COMCLIP" connectors mounted on the radio module (see dimensions and pin assignments).



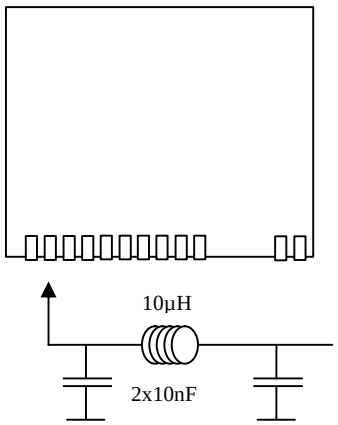
Recommended footprint for SMD integration (dimensions in millimetres)

The mother board can be used to transfer the antenna output by means of a 50Ω microstrip line. This line is formed by a 2.5mm-wide printed track (for 1.6 mm FR4) which must be located above a continuous ground plane (the HF cold point is to be connected as close as possible to this plane). Avoid running close to a digital path!

EMC aspect:

When integrating a radio element in an electronic system, the mother board has to be provided with a ground plane as continuous as possible.
The GND and GND RF signals of the module are to be connected as close as possible to this plane. This module should be fitted on the ground plane side, opposite from the tracks.

Due to the presence of a receipt part (for the transceiver), pay attention when integrating the ARF05 module. Incorporating a receiver of good sensitivity alongside a high-speed digital part requires a succinct power supply filtering as described below:



GND as short as possible,
Wide tracks

A RECEIVER WITHOUT SQUELCH GENERATES NOISE ON OUTPUT IN THE ABSENCE OF A RECEIPT SIGNAL. THIS DOES NOT MEAN IN ANY WAY THAT IT IS POLLUTED BY INTERFERENCE; THE DATA WILL BE "CLEAR" WHEN RECEIPT TAKES PLACE.