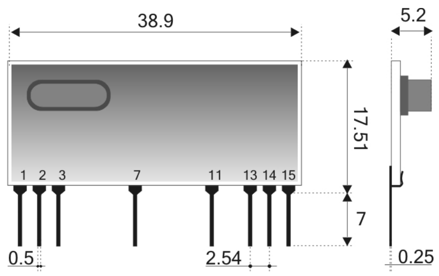
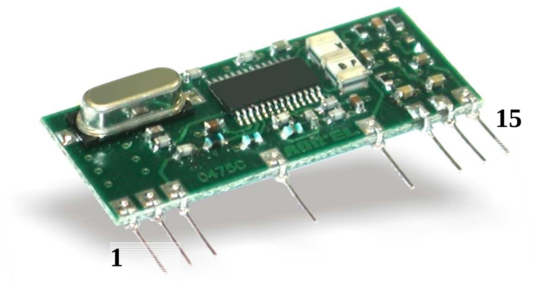
RX 4MM5 RECEIVER

The RX 4MM5 super-heterodyne receiver requires 5V of supply voltage and is designed to recover sequences of digital data transmitted via AM OOK modulation at 433,92 MHz.
Its main feature is the very high sensitivity (equal to –114 dBm) and the frequency image rejection obtained through a new circuital technique. The RX 4MM5 provides an RSSI output that implies the distance information from the correspondent transmitter and gives the measure of the received RF power.

PIN-OUT





CONNECTIONS

Pin 1	**N.C.**	Not connected.
Pin 2-7	**Ground**	GND
Pin 3	**Antenna**	Antenna input, impedance 50 ohm.
Pin 11	**AGC On-Off**	Automatic gain control selection. Logic level 0: automatic gain control ON. Logic level 1: automatic gain control OFF. Always max sensitivity.
Pin 13	**RSSI OUT – Test Point**	RSSI output proportional to the amplitude of the input signal.
Pin 14	**Data output**	Data output from the receiver. Normally low if no RF signal is detected.
Pin 15	**+V$_s$**	Positive voltage supply.

RX 4MM5 Technical Features

	Min	Typical	Max	Unit	Note
Reception frequency		433.92		MHz	
Supply Voltage Vs	4,5	5	5,5	V	
Supply Current		5,8	7	mA	
RF Sensitivity	-110	-114	-115	dBm	See note 1
IF bandwidth @ -3dB		280		KHz	
Interference rejection at ±10MHz	60			dB	
Output square wave		2	3	KHz	
Logic output low level			gnd+0,4	V	See note 3
Logic output high level	V_s-0,6V			V	See note 3
Spurious RF emission in antenna			-60	dBm	
Switch-on time			0,3	s	See note 2
Operating temperature range	-20		+80	°C	
Dimensions	38,9 x 17.51 x 5.2 mm				

NOTA 1: Sensitivity obtained through an RF generator with 100% modulation.
NOTA 2: By switch on time is meant the time required by the receiver to assume the declared characteristics from the very moment the power supply is applied.
NOTA 3: Values obtained with 10KΩ maximum load applied.

Pin 11 AGC On-Off

The RX 4MM5 receiver is endowed with a pin designed to enable the automatic gain control. Setting at a low level the AGC ON-OFF pin, the automatic gain control is on: now it is possible to correctly decode RF signals received with an RF power included in the range [-114dBm, 0dBm] that means that the RX 4MM5 accepts the largest dynamics of the received waveform (that is up to 0 dBm).
If you put a logic high level on pin 11 the automatic gain control is disabled and the receiver works always with the maximum sensitivity. If the RF power is lower than a threshold the RX 4MM5 works with a linear behaviour while if the input power is higher than the same threshold the receiver works in the saturation zone. This behaviour can be exploited if you need the distance indication of the receiver from its correspondent transmitter. The following indications handle with the RSSI output with automatic gain control disabled.

Pin 13 RSSI Output

In Fig. 1 it's depicted the behaviour of the voltage at the RSSI output in function of the power of the input signal with the automatic gain control disabled (pin 11 at a logic high level). The diagram has been obtained applying at the antenna input (pin 3) the 99% AM modulated signal coming from an RF generator made up of a 1 KHz square waveform and putting a 10 µF capacitor between pin 13 and GND. The RSSI output has a linear behaviour in correspondence with an RF power up to –40 dBm ca., after which it assumes the saturation value of 2,2V. In the linear zone the RSSI output is directly proportional to the RF power: the voltage at pin 13 can be then used as a measure of the intensity of the received signal and to recover the distance from the transmitter. When the RSSI output assumes a constant value, the received signal is no more directly proportional and only a proximity information can be extracted. The maximum distance of the transmitter from its receiver can be calculated as the RF power at which the RSSI output changes its values up to the saturation voltage. The distance over which the receiver works in the saturation zone is in theory 4m ca. (transmitting and receiving antennas on line of sight and 0dBm transmitted power, typical RF power of the handheld transmitters) and depends on the presence of obstacles placed in the middle of the radio link that cause multipath and reflections. Therefore the RSSI represents a measure of distance untill it has a linear behaviour and a proximity information when it assumes the saturation voltage (useful if you need to monitor accesses).

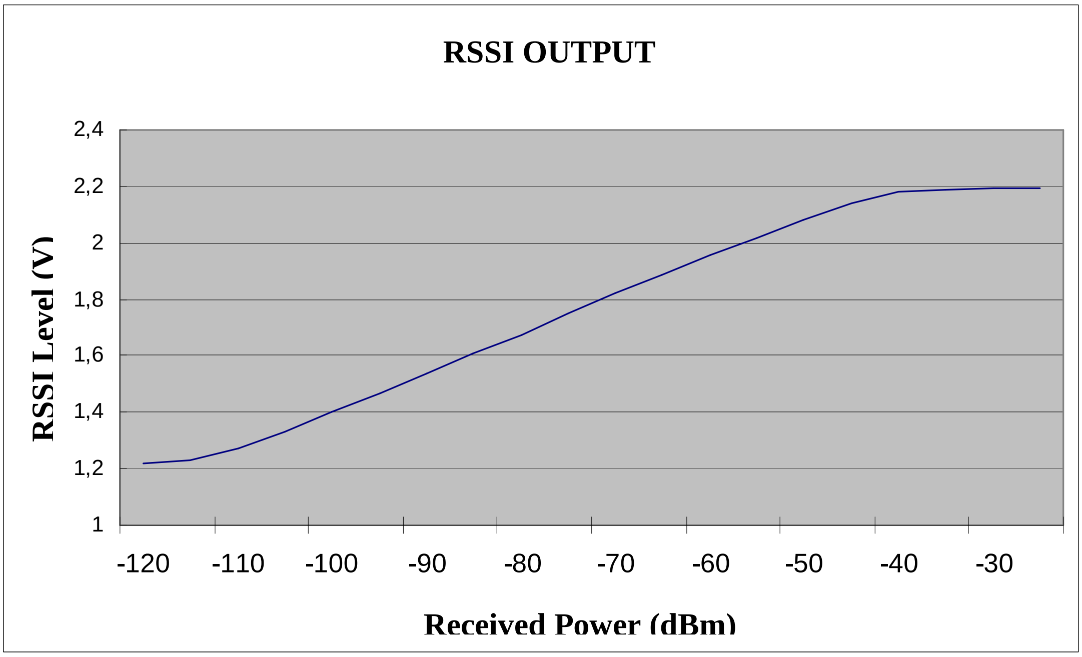


Fig. 1 - RSSI output with AGC disabled

Device usage

In order to take advantage of the performances described in the technical specifications and to comply with the operating conditions which characterize the Certification, the receiver has to be fitted up on a printed circuit, considering what follows.

5V DC SUPPLY:

1. The receiver must be supplied by a very low voltage source, safety protected against short circuits. Maximum voltage variations allowed: ± 0,5 V.
2. De-coupling, next to the receiver, by means of a ceramic capacitor of minimum 100.000 pF value.

Ground:

It must surround at the best the welding area of the receiver. The circuit must be double layer, with throughout vias to the ground planes, approximately each 15 mm.
It must be properly dimensioned, specially in the antenna connection area, in case a radiating whip antenna is fitted in it (an area of approximately 50 mm radius is suggested.)

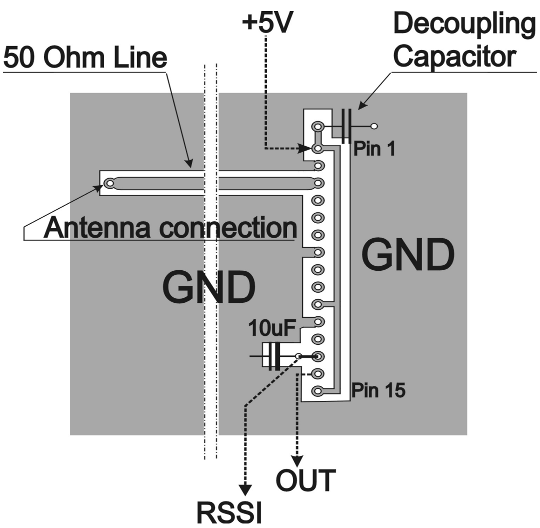


Fig.2 Suggested layout for the device's correct usage

50 Ohm Line:

1. It must be as shorter as possible.
2. 1,8 mm wide for 1 mm thick FR4 printed circuits and 2,9 mm wide for 1,6 mm thick FR4 printed circuits. On the same side it must be kept 2mm away from the ground.
3. On the opposite side a ground circuit area must be present.

Antenna connection:

It may be utilized as the direct connection point for the radiating whip antenna. It is deeply suggested to put a 100nH inductance from pin 3 to ground in order to protect the device from the electrostatic discharges.
It can bear the connection of the central wire of a 50 Ω coaxial cable. Be sure that the braid is welded to the ground in a close point.

Antenna

1. A whip antenna, 16.5mm long and approximately 1 mm dia, brass or copper wire made, must be connected to the RF input of the receiver.
2. The antenna body must be kept straight as much as possible and must be free from other circuits or metal parts (5cm minimum suggested distance).
3. It can be utilised both vertically or horizontally (the previous is highly suggested), providing that connection point between antenna and receiver input is surrounded by a good ground plane.

N.B: As an alternative to the above mentioned antenna it is possible to use the whip model manufactured by Aurel (see related Datasheet and Application Notes).
By fitting whips too different from the described ones, the EEC Certification is not assured.

Other components:

1. Keep the receiver separate from all other components of the circuit (more than 5mm).
2. Keep particularly far away and shielded all microprocessors and their clock circuits.
3. Do not fit components around the 50 Ohm line. At least keep them at 5 mm distance.
4. If the antenna connection is directly used for a radiating whip connection, keep at least a 5 cm radius free area. In case of coaxial cable connection, 5 mm radius will suffice.

Notes about the antenna isolation:

In order to obtain the best performances from the receiver and to comply with the security rules requested by the Certification, electrical and mechanical protection of the receiver has to be guarantee by the User by means of suitable enclosures and applying the appropriate isolation techniques. The use of the receiver is planned to be inside housings that assure the overcoming of the provision EN 61000-4-2, not directly applicable to the module itself.
In particular, it is at the user's care the isolation of the external antenna connection and of the antenna itself since the RF input of the receiver is not built to directly bear the electrostatic charges foreseen by the above mentioned provision.
Aurel suggests to use an air coil inductance connected between the antenna pin and GND in order to unload towards ground possible electrostatic discharges.
The inductance's value has to be appropriately chosen in order not to modify the antenna performances.
For example, for receivers working at 434MHz, it can be used a 100 nH inductance with the following features:

- Number of turns 8
- internal diameter 3mm
- thread diameter 0,5mm