

Kit A16

August 15, 2002.

This is a condensed version of the Automicro General Manual where we have retained general information and information specifically relating to the Tx and Rx modules we are using and selling. We have deleted much of the other information on their other modules. Kit A16 consists of the following 4-button transmitter and receiver units.

TX **4312RSA(A1)** 434 MHz

RX **3302D4-15(2A1)** 434 MHz.

We are using these in Kit 180. Get the extensive documentation from

<http://www.kitsrus.com/pdf/k180.pdf>

which gives more information than that given here. Also read

<http://www.kitsrus.com/pdf/an662.pdf>

<http://www.kitsrus.com/pdf/an665.pdf>

on details of KEELOQ technology. Note the Tx unit comes preassembled with the battery included.

Our kit is slightly different to the one in the article. (We have used different transistors and a different brand of relay.) The article and kit design are used by permission of Silicon Chip and Oatley Electronics resp.

RX-3302D RF Receiver W/Decoder Operation Manual

1. Introduction

This is a series of radio frequency receiver modules which can facilitate the OEM designers to design their applications in remote control in the quickest way. The circuit is designed with SMD components and the module size is small enough to be able to be fitted in many remote control applications. Decoder software, transmitter code learning and nonvolatile memory have all been integrated in. The decoder software available are:

- A. Rolling code using Microchip encoder HCS200 or HCS300 series.**
- B. Fixed code using PT-2260 series encoder.**

There are the following versions:

1) RX-3302D2: For 2-button transmitters.

2) RX-3302D4: For 2 or 4 button transmitters.

There are 3 more pins than the D2 version:

Pin # 9: VPP, for factory programming only. No connection is needed.

Pin #10: D2, for button #3

Pin #11: D3 , for button #4

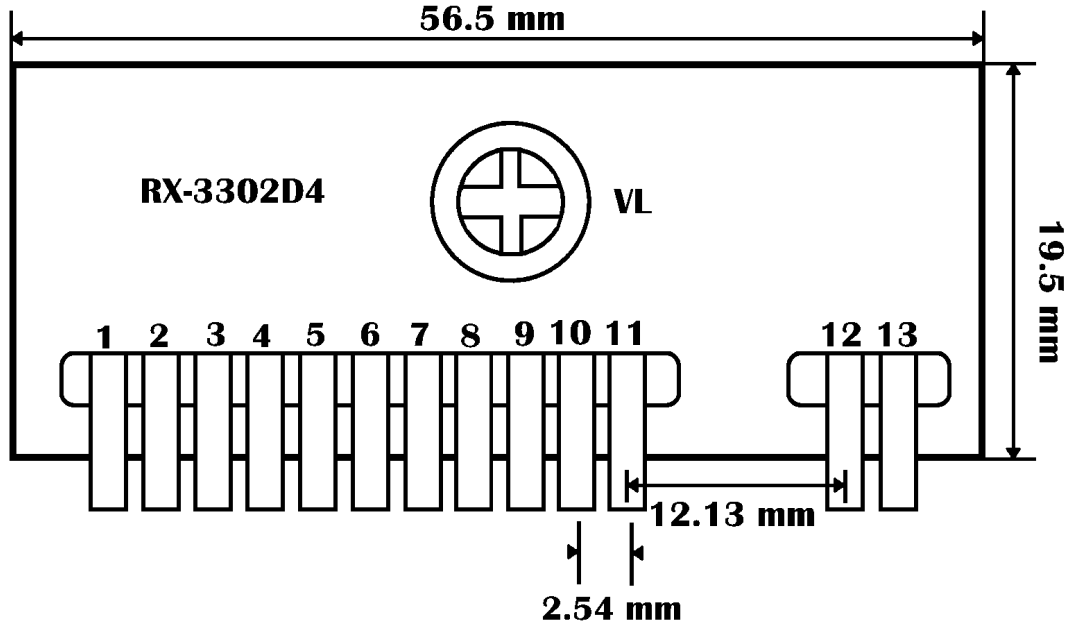
D means decoder.

For RX-3302D, the decoder function has

been implemented in the on-board microprocessor. Besides, the code learning process has also been implemented. Thus it relieves the system's design load on the remote control part totally.

There are rolling code and fixed code variations which will be explained later.

RX-3302D4 is an RF module with the following pin-outs and dimension:



- PIN 1 : GND
- PIN 2 : Digital Output
- PIN 3 : VCC (5V DC)
- PIN 4 : Linear Output (For Testing)
- PIN 5 : Valid Time, for 2A1 version, don't care
For 2Q1 version, this pin can be connected to a buzzer so that it can indicate if code learning is successful. This application will be very convenient if the control receiver unit is installed in a hidden position.
- PIN 6 : D0
- PIN 7 : Learning Acknowledge
- PIN 8 : D1
- PIN 9 : VPP, for factory programming only, no connection.
- PIN 10 : D2
- PIN 11 : D3
- PIN 12 : ANT (Antenna)
- PIN 13 : GND

Dimension of RX-3302D4: 56.5 mm X 19.5 mm

◆ Comparison Table: (Versus our RX Series)

Model	SR/SH mode	POWER	CPU+ EEPROM	SENSITIVITY	POWER CONSUMPTION	Modulation
RX-3302	SR	+5V DC	---	- 103dBm	1.60mA	AM
RX-3301	SR	+5V DC	---	- 103dBm	1.93mA	AM
RX-3302L	SR	+5V DC	---	- 98dBm	0.33 mA	AM

RX-3304	SR	+5V DC	---	- 100dBm	2.7mA	AM
RX-3302R/F	SR	+5V DC	YES	- 105dBm	3.1mA	AM
RX-3302D	SR	+5V DC	YES	- 105dBm	2.7mA	AM
RX-4303D	SH	+5V DC	---	- 110dBm	5.1mA	AM
RXF-4303D	SH	+5V DC	YES	- 100dBm	6.2mA	FM

Note:

SR: Super-Regenerative SH: Super-Heterodyne

AM: Amplitude Modulation FM: Frequency Modulation

2. Functionality Difference:

There are 2 major application types involved:

2.1 For rolling code application:

■ RX-3302D

RX-3302D includes the decoder CPU (PIC16C505) and the EEPROM (93C46 or 93C56 or 93C66 or 93LC76 or 93LC86) on board. The code learning function has been built in.

The main microprocessor can be programmed transparently without caring about the code learning programming and the rolling code programming.

For RX-3302D, there are following receiver models (Decoder Version 2A1):

For matching our 2-button rolling code transmitters (A1 type) :

- ★ RX-3302D2-15 (for 15 users, W / 93C46)
- ★ RX-3302D2-63 (for 63 users, W / 93C66)
- ★ RX-3302D2-127 (for 127 users, W / 93LC76).
- ★ RX-3302D2-255 (for 255 users, W / 93LC86).

For matching our 2 or 4-button rolling code transmitters (A1 type):

- ★ RX-3302D4-15 (for 15 users, W / 93C46).
- ★ RX-3302D4-31 (for 31 users, W / 93C56).
- ★ RX-3302D4-63 (for 63 users, W / 93C66).
- ★ RX-3302D4-127 (for 127 users, W / 93LC76).
- ★ RX-3302D4-255 (for 255 users, W / 93LC86).

All our AM rolling code transmitters with 2~4 buttons from Automicro with A1 label can work with RX-3302D.

■ Frequency Bandwidth

RX-3302D: 434MHz, LC, 4MHz Bandwidth.

■ Programming the Main Microprocessor and RX-3302D2:

1. For rolling code:

Using TX-3315 (S) / TX-3312R / TX(F)-3313R /TX-3316R(S) (W / HCS-200 or HCS-301 from Microchip, programmed with our version A1) with two buttons but 3 commands available.

	VT	D0	D1
When button #1 is being pressed	Don't Care	HIGH	LOW
When button #2 is being pressed	Don't Care	LOW	HIGH
When button #1 & #2 are being pressed	Don't Care	HIGH	HIGH

D0 and D1 will become HIGH as long as the proper button is being pressed, i.e., D0 will be HIGH if button #1 is being pressed and D1 will be HIGH if button #2 is being pressed. VT will be HIGH as long as any of D0 or D1 is HIGH, but VT can be ignored by the programming.

■ Programming the Main Microprocessor using RX-3302D4 and TX-4311R / TX-4314R / TX-4313R(S) /TX-4312R(S) (W / HCS-301 from Microchip, programmed with version A1) of 4-button transmitter, there are extra six double-button commands available in addition to four single-button commands.

	VT	D0	D1	D2	D3
When button #1 is being pressed	Don't Care	HIGH	LOW	LOW	LOW
When button #2 is being pressed	Don't Care	LOW	HIGH	LOW	LOW
When button #3 is being pressed	Don't Care	LOW	LOW	HIGH	LOW
When button #4 is being pressed	Don't Care	LOW	LOW	LOW	HIGH
When button #1 and #2 are being pressed	Don't Care	HIGH	HIGH	LOW	LOW
When button #1 and #3 are being pressed	Don't Care	HIGH	LOW	HIGH	LOW
When button #1 and #4 are being pressed	Don't Care	HIGH	LOW	LOW	HIGH
When button #2 and #3 are being pressed	Don't Care	LOW	HIGH	HIGH	LOW
When button #2 and #4 are being pressed	Don't Care	LOW	HIGH	LOW	HIGH
When button #3 and #4 are being pressed	Don't Care	LOW	LOW	HIGH	HIGH

Each D0, D1,D2 or D3 will become HIGH as long as the proper button is being pressed. VT will be HIGH as long as any of D0 or D1 or D2 or D3 is HIGH, but VT can be ignored by the programming.

+ Notes:

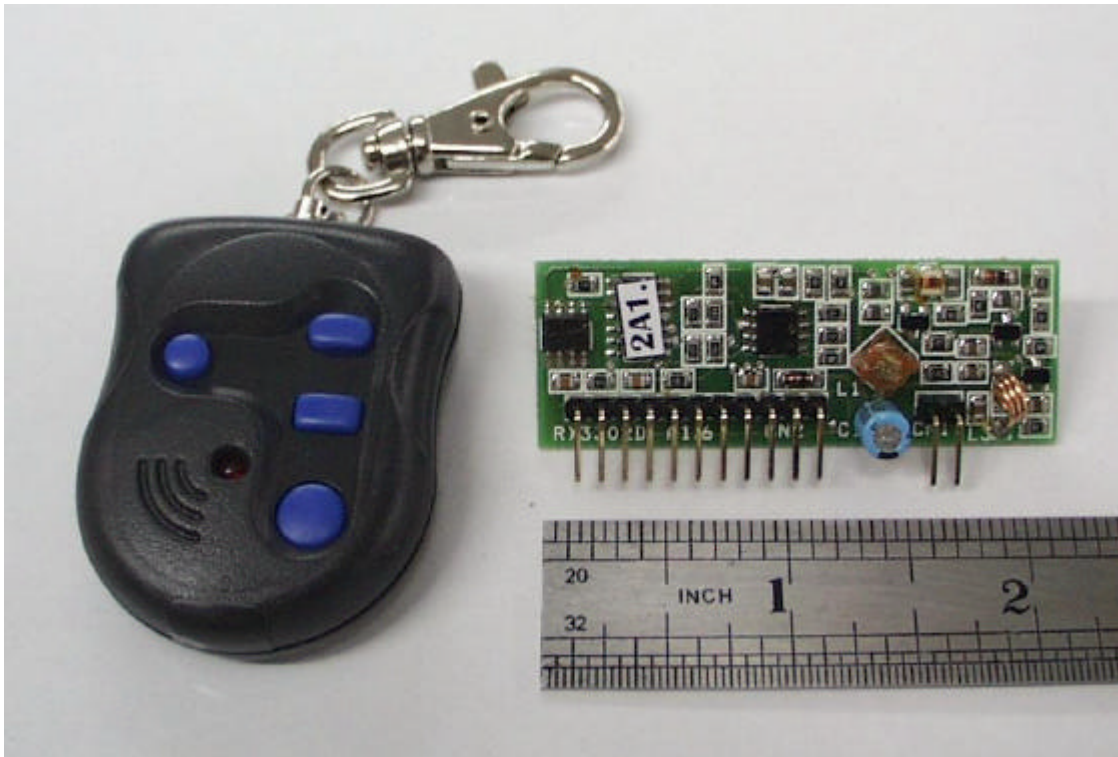
For our rolling code transmitters, we have the following labels on the encoders (HCS200 or HCS300 or HCS301):

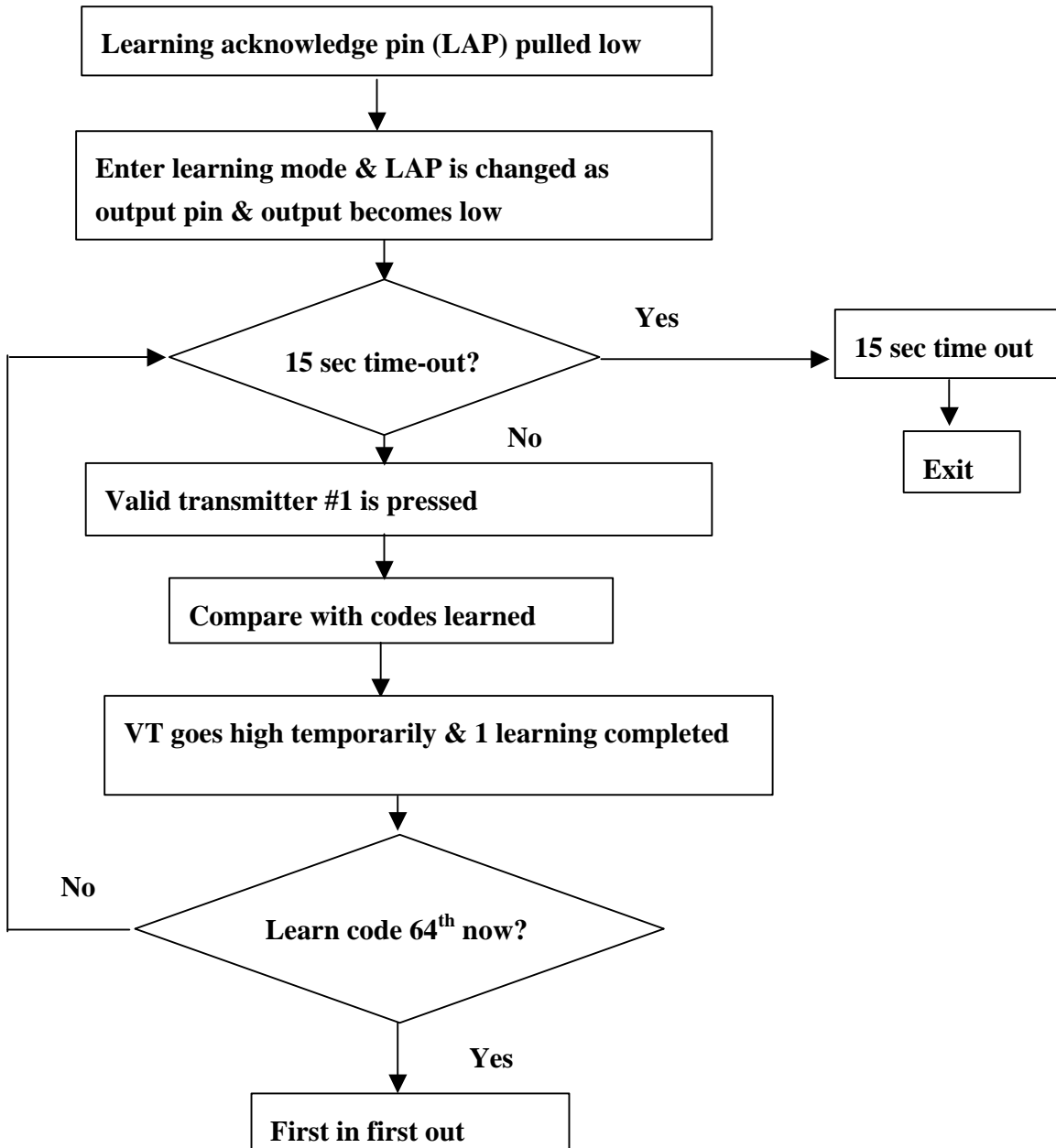
- ★ A1: For RX-3302R/D, RX(F)-4303D, CS-04R2, CS-04R4, CS-281, CS-28, CS-20CR
- ★ B1: For CS-04R, CS-04G, CS-06
- ★ C1, W1...: For OEM customers with their specific manufacturer codes.

■ Learning Mode (For RX-3302D):

The LA (Learning Acknowledge) pin will be at HIGH normally and acts as an input. If this pin is put to LOW temporarily by a tact switch, then it remains at LOW and becomes an output for 15 only seconds during which a transmitter code can be learned if button #1 of any of our applicable transmitters is pressed. After 15 seconds of period expires, then this pin restores to HIGH again.

+ Note that only button #1 can be used for code learning.





If 15 seconds of period is not long enough for learning all the transmitters, then the 2nd or the 3rd cycle of learning can be done until all the transmitters (up to 15 or 31 or 63 or 127 or 225 depending on which model of RX-3302D) is learned.

If you want to erase all the transmitters learned, then please put the LA (Learning Acknowledge) pin to LOW for more than 10 seconds, then all the prior codes learned will be erased completely.

☞ Note that if the same transmitter is learned twice, it will be treated as only one transmitter without wasting any of the memory slot.

Regarding synchronization between RX-3302D and each rolling-code transmitter, if more than 16 times that the receiver has not received the signals transmitted from each rolling-code transmitter, then the receiver needs one extra signal from the transmitter for synchronization.

☞ Note that there are the following software versions for the rolling code models:

1. 2A1: Standard version.
2. 2B3: Besides the standard features, it has an additional feature as follows:
Pressing two buttons of any transmitter learned earlier for more than 4 seconds, then the system will enter transmitter code learning mode. This is good if the learning button is not easily accessible after installation.

Both versions can use pin #5 (VT) instead of pin #7 (LA) for indicating the status of the code learning process. Pin #5 can be connected to a buzzer via a transistor so that it can facilitate the code learning process as follows:

- 1) Press the learn button, then the buzzer beeps once indicating that 15 seconds of code learning process starts.
- 2) Press any unlearned transmitter will beep the buzzer as long as the button is being pressed.
- 3) Up to 15 transmitters can be learned in one or more learning cycles for the 15-user version.
- 4) If more than 15 transmitters are learned, then FIFO happens which means that the 16th learned transmitter will replace the first transmitter learned.
- 5) When 15 seconds of learning cycle ends, the buzzer will beep twice.
- 6) You can delete all the codes learned earlier by pressing the learning button for more than 8.3 seconds and the buzzer will beep all along in this period. When the buzzer stops, all the transmitters codes learned are also deleted.

3. RX-3302D Features

- Using Microchip hopping technology
- Work with HCS series of encoders
- Support two-button, 3 functions or 4-button, 11 functions transmitters.
- Unique key generation algorithm for every customer.
- No user programming required for either the rolling code or fixed code.
- Up to 15 / 31 / 63 / 127 / 255 transmitters can be learned.
- On-chip 4 Mhz RC oscillator.
- 16C505 SMD

4. APPLICATIONS

- Automotive remote entry systems
- Automotive alarm systems
- Automotive immobilizer
- Gate and garage door openers
- Electronic door locks
- Identity tokens
- Burglar alarm systems

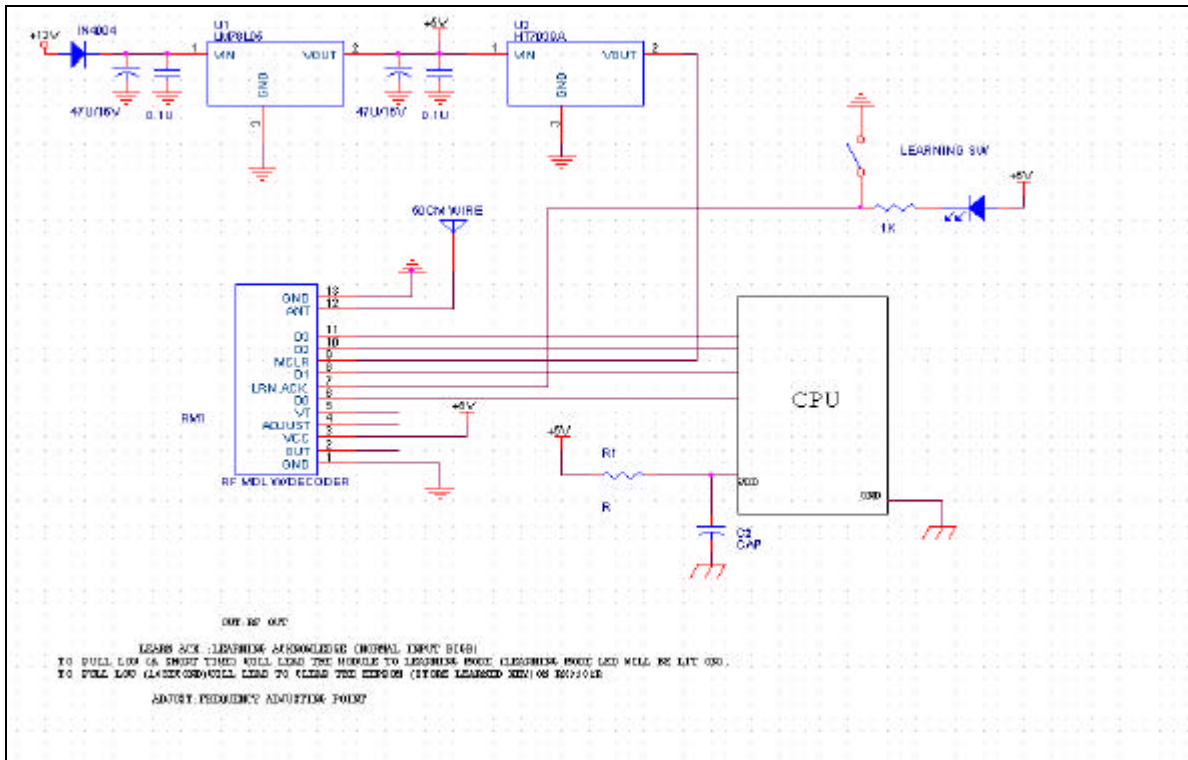
5. Descriptions

In RX-3302D(2A1), the built-in 16C505 is a code hopping decoder designed for secure Remote Keyless Entry (RKE) systems. The RX-3302D utilizes the patented Microchip code hopping system and high security learning mechanisms to make this a canned solution when used with our rolling-code transmitters to implement a unidirectional remote control keyless entry system.

The key generation algorithm is programmed into the 16C505 decoder in protected mode and can not be read out of the device. Transmitter keys and synchronization counter are stored in its external EEPROM (93C46 or 93C56 or 93C66 or 93LC76 or 93LC86).

The RX-3302D operates over a range of 5.0 ~ 5.5 V. The decoder employs automatic baud rate. The decoder contains sophisticated error checking algorithm to ensure only valid codes are accepted and correct information are written into its external EEPROM.

6. Simple Application Board Circuit



Application notes:

1. The power circuit for VCC is recommended to use a regulator such as 78L05 and a capacitor at least 47µF so that ripple can be reduced.
2. If the microprocessor is working with high speed crystal, then RX-4303D is recommended because the radiation is too strong.
3. Note that there are different grounds in the above circuits.
The ground of the RF receiver module is analog and the ground of the CPU is analog.
The analog ground is very sensitive to noise, thus it should not be mixed to digital ground in the PCB layout circuit.
4. For PCB layout, the ground of this receiver module to the power ground should be as short as possible. In between, no other grounds are allowed to join in. The receiver module is analog and it is very sensitive and prone to noise interference. The ground of the microprocessor or operation amplifier should go a separate path to power ground.
5. There are Design Kit for this module from us which can facilitate you to design your product by using this receiver module in similar way.

7. Noise Immunization

This RF receiver is sensitive to RF noise in the passband because the desired transmitter signals are at very low power levels. Some common noise sources are microprocessors, brush-type motors and high-speed logic circuits. If the rise time and fall time of the clock in a microprocessor are fast enough to produce harmonics in the frequency range of the receiver input and the harmonics fall within the passband of the receiver, then special care must be taken to reduce the level of the harmonic at the antenna port of the receiver. Based on above analysis, the following actions have to be taken:

- A. Microprocessor choice:
Choose those microprocessors which has lowest rise time and lowest fall time, if available.
- B. Brush-type motor choice:
Choose those brush-type motors which has spark suppression built in or better not to use such type of motors.
- C. Logic circuits choice:
High speed logic circuits generates noise similar to microprocessors. Thus better to choose those circuits with the lowest rise time and the lowest fall time, if available.
- D. Place the receiver and its antenna as far from the noise source as possible.
- E. During PCB layout, keep line lengths at a minimum that carry high speed logic signals or supply brush type motors. Such lines work like antennas that radiate the unwanted noise.
- F. If possible, enclose the noise source in a grounded metal box and use RF-decoupling on the input/output lines.
- G. It is advisable to use separate voltage regulator for the RF receiver. If the same voltage regulator has to be used for cost purpose, then a decoupler circuit is recommended so that high frequency noise can be screened.
- H. The ground path from the receiver module should go directly to the power ground, in between, no other ground paths can join in, otherwise, noise will be introduced in and receiver function will be greatly influenced.

8. Recommended Antenna

Suitable antennas are suitable to the success of low-power wireless application. There are some key points on applying the antennas:

- A, Antenna should be placed on the outside of the product. And try to place the antenna on the top of the product.
- B. Antenna can't be placed inside a metal case because of its shielding effect.
- C. Antenna design involves expensive test equipments such as vector network analyzer and calibrated test antenna. Unless you have access to these equipments, the use to an antenna consultant is recommended.
- D. In most indoor locations, dead spots can be found where reception is difficult. These dead spots are due to multiple transmission paths existing between two points because of reflections off metal objects such as steel beams or metal doors. They happen when the path lengths effectively differs by an odd half-wavelength. This explains the phenomenon when you find that at some locations the reception effect is very poor, but beyond that the reception becomes normal.
- E. 50-Ohm antenna is recommended for the best matching.
- F. For 434MHz application, antenna length = 17 cm.