

R60 Aviation Band PLL Receiver Kit Manual V5.2

Basic introduction:

This kit is dedicated to receiving calls between airplanes and towers. With a good antenna (VHF section Yagi antenna), it can receive calls between various types of airplanes and towers within about 100km in an open area.

The design of this kit was originally created by "Kit Home", and the current version was formed after many debugging.

The hardware version described in this article is V5.0, and the board name is HM00ABRB_5.



Main indicators:

Power supply: 12V (recommended to use linear regulated power supply or battery)

Antenna: 50-ohm, unbalanced

Typical receiving current: 110mA

Receiving frequency: covering 118MHz-136MHz

Working mode: AM

Circuit principle:

See the picture on the last page of this document. The signal received by the antenna first enters the BPF. The function of this band-pass filter is to ensure that the 118MHz-136MHz signal can enter the MMIC high power amplifier behind, while other signals are attenuated to the greatest extent. The signal after filtering and amplification by NE5204 enters NE602 for mixing. At the same time, the PLL generator circuit in the shielding cover on the board outputs the local oscillator to NE602, which is designed to cover 118+10.7MHz to 136+10.7MHz. Because this machine is a superheterodyne machine, Coupled with the suppression of the previous band-pass filter, it finally ensures full coverage of the 118MHz-136MHz signal.

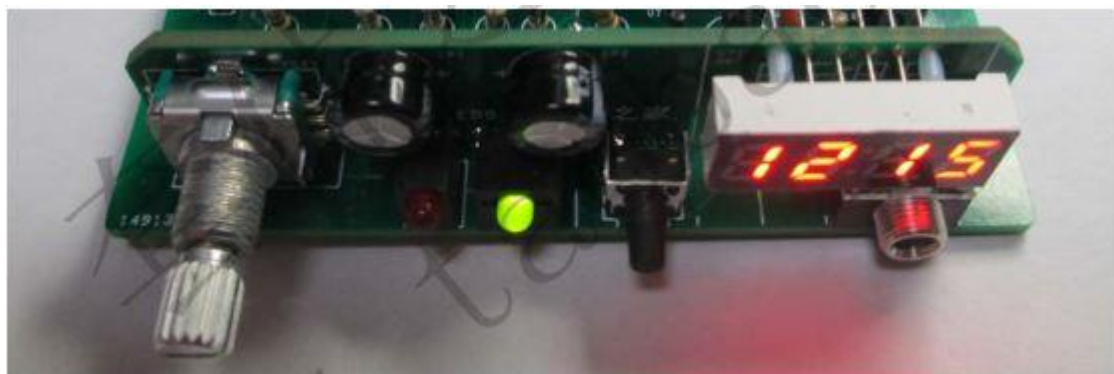
The intermediate frequency of this machine is 10.7MHz. The signal mixed by NE602 is sent to the ceramic filter of 10.7MHz. Its function is to filter out the irrelevant signal generated by mixing, and then send the signal to TA7640 for further intermediate frequency amplification. The amplified signal, the audio signal after the amplitude modulation network detection, is amplified by LM386 and then sent to the earphone for output.

Component selection:

All capacitors less than 1000pF are high-frequency ceramics, capacitors greater than 1uF are aluminum electrolytic capacitors, and all resistors are 1/4W 5% fixed resistance.

Welding reminder:

The indicator board needs to be welded with digital tubes, encoders and other plug-ins. After the installation is complete, as picture shown:



Note that there are 4pcs white round tubes about 3mm high in the kit, which are used to fix the height when welding digital tubes.

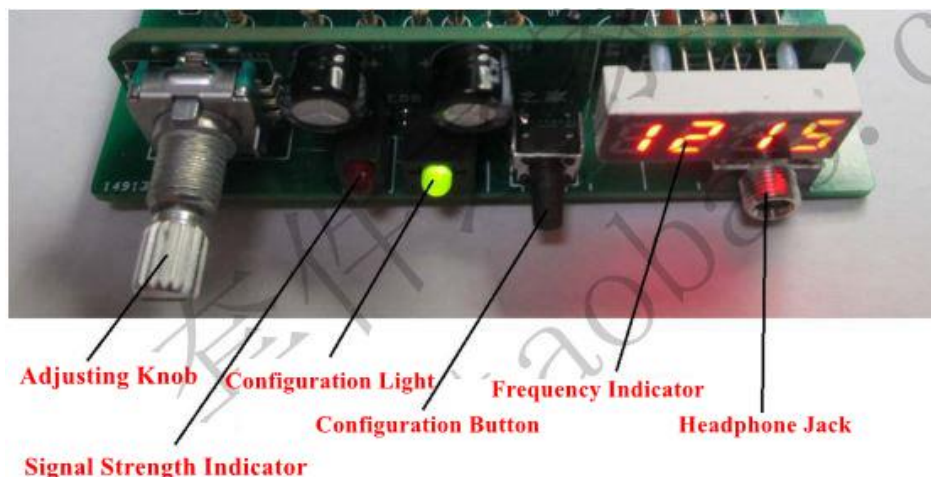


Production and debugging:

Before installing all components, use a multimeter to test all transistors, resistors, and capacitors. Then install all components according to the circuit diagram and the markings on the PCB. Generally, install from low to high. At the same time, install sockets for the integrated circuits, which can effectively avoid soldering the core integrated circuits. Everything is in order. After checking, connect the power supply, and the positive and negative polarity of the power supply must not be wrong. Plug the Walkman earphone into the earphone socket and you should hear white noise. Touch the 2 feet of NE5204 with your hand, the earphone noise will increase, indicating that the receiving function is basically normal. Then connect a piece of cord of about 60 cm to the antenna, and you will hear the noise increase significantly, which means that the RF channel is basically no problem.

The parts to be debugged on this machine are L 1, L 2 and T 1. In the absence of a meter, it is recommended to find a 125MHz crystal oscillator, supply it with power, connect the clock to a piece of wire, and then adjust the frequency of the machine to 125.0MHz, and then carefully adjust L1, L2 and T1 to achieve the strongest and clearest signal.

The default power-on frequency of this machine is 121.5MHz, which is a general emergency frequency. If the surrounding environment permits, you can also connect the antenna and directly listen to this signal to adjust L1, L2 and T1.



The power plug requirements for this machine are as follows:

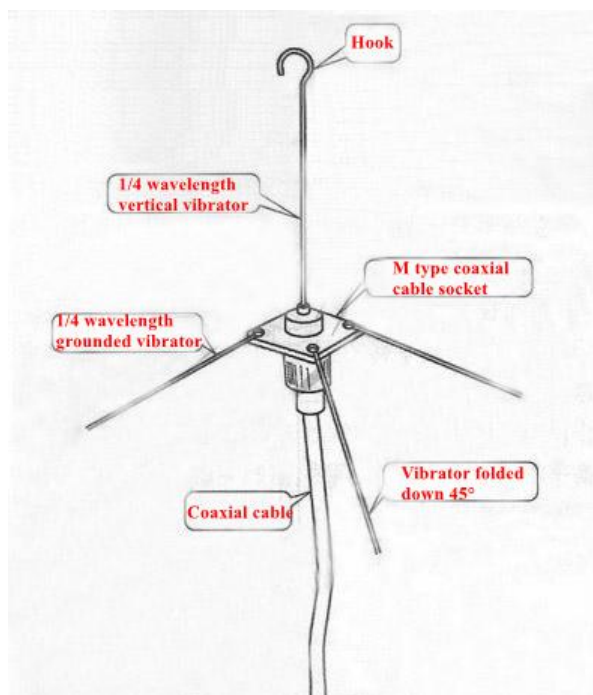


Using Method:

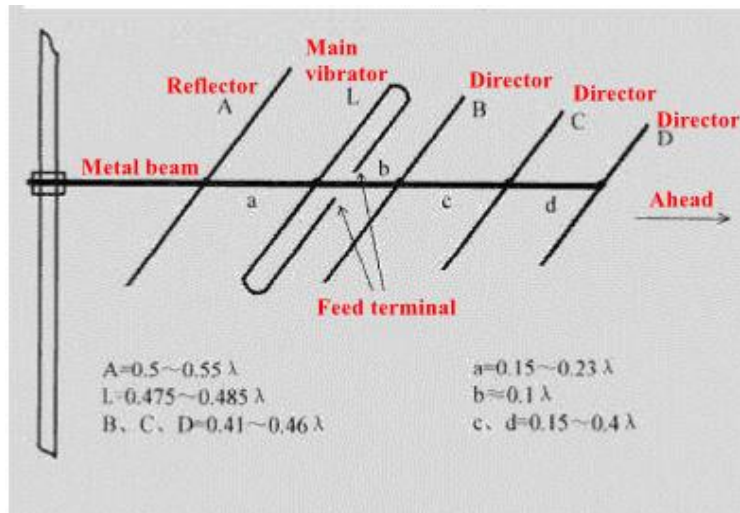
Because VHF is already close to a straight line, if there is a radar in the VHF band, the VHF communication cannot be blocked. You need to pay more attention to this when listening to the tower signal. It is better to listen to the signal of the aircraft entering and exiting the field. Because the aircraft is close to the airport at a height of several hundred to several kilometers, the signal can cover a long distance. At the same time, for better results, it is recommended to use an externally mounted antenna, such as a 1/4-wavelength (about 60 cm) GP antenna, or use a better VHF section Yagi antenna! In short, you need to appropriately match the antenna according to the actual environment to achieve good results!

The specific antenna installation reference is as follows:

For beginners, it is recommended to use GP antenna or Yagi antenna, these two antennas are relatively simple and very suitable for homemade. The figure below is the GP antenna (GP antenna is the abbreviation of planar grounded antenna, this kind of antenna is also called vertical ground network antenna, is a commonly used vertical polarization omnidirectional antenna. It consists of vertical radiating elements and 3-4 horizontal The GP antenna is composed of an extended vibrator. The GP antenna has a simple structure and is easy to set up. It does not need a rotator. It is generally used as a fixed radio antenna.) Several metal rods and an M seat are easy to manufacture.



The picture below shows the Yagi antenna, which has good directivity and high gain. It is recommended to do this if possible.



The metal beam is perpendicular to the polarization direction of the electric field in the end-fire direction, so it will not have a significant impact on the antenna radiation field. Insulators can also be used! In the figure, λ is the wavelength, and the lengths of the director, reflector and main oscillator, A, b, c, d spacing are calculated separately and then assembled.

Chassis installation:

The circuit board can be conveniently placed in a standard aluminum case with a size of 88mm*30mm*120mm (this case is not included in this kit).

Instructions for use:

After normal power-on, the configuration LED light will glow green, and the digital tube will display numbers, indicating that the encoder is in frequency adjustment mode (default mode). At this time, select the encoder, and you can see that the number on the right will change continuously, such as 1215 for 121.5MHz.



The machine defaults to 100KHz stepping when it is powered on, and it displays 1215 or 121.5MHz (1215*100KHz).

Press the adjusting knob once to switch to 10KHz steps. Since there are only 4 digits, the highest digit 1 will not be displayed. It will display 215.0, which is 121.50MHz ($12150 \times 10\text{KHz}$). Turn the adjusting knob at this time to press 10KHz steps. If you need to return To 100KHz step, short press the adjusting knob.

Press the configuration button, after release, the configuration LED light will glow red, indicating that the encoder is in volume adjustment mode, and the default display is 2_10 after power-on. The last two digits represent the volume level. The machine can be set to 0-25. The larger the number, the greater the volume. .

Press the knob again to display 4_33, which is the 25MHz clock frequency offset setting. The default setting is 33 and the unit is 100Hz.




The default frequency is $25000000\text{Hz} + 33 \times 100\text{Hz}$. If you find that the receiving frequency has an error, you can use a frequency meter to measure the PLL board


Use the 25MHz clock frequency and adjust the clock frequency deviation according to the test value.

In the configuration mode, if you no longer press the key or twist the encoder, the machine will automatically return to the frequency adjustment mode after about 3 seconds. At the same time, after finishing the frequency or volume adjustment 3 seconds, the machine will automatically write the currently set frequency and volume into the internal EEPROM, and use it directly next time it is powered on.

In addition, this unit is equipped with a red tuning indicator, which will light up after receiving a signal (about -90dBm).

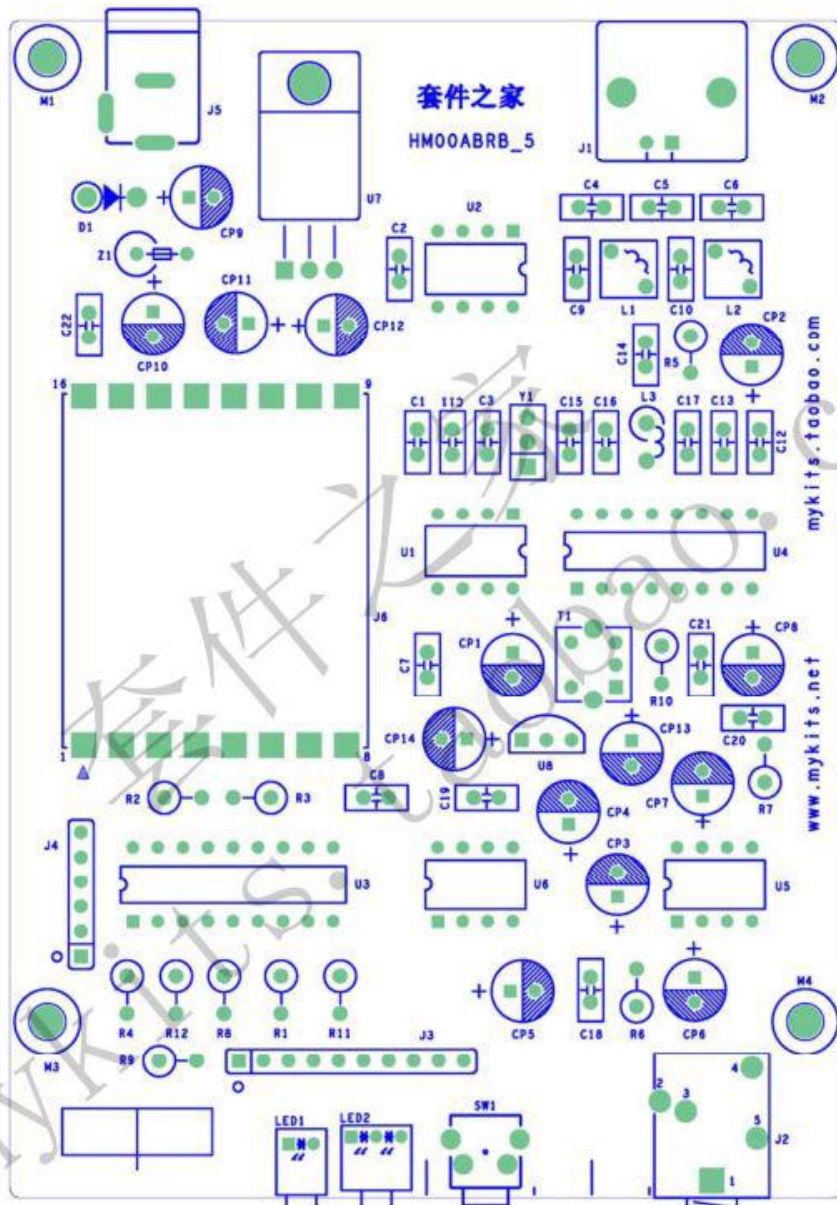
Component list

1/4W fixed resistors		
R1,R2,R3,R4	10K	
R5,R6,R7	10	
R8,R9,R11,R12	1K	
R10	47K	
Magnetic beads, inductors, transformers		
L1,L2	5X5-4.5T	
T1	7X7-10.7MHz	
Z1	In-line magnetic beads	
Ceramic capacitor		
C1,C2,C3,C13,C14,C15,C16, C18,C19,C20,C22	0.1uF(104)	
C4,C9,C12,C17,C21	0.01uF(103)	
C5,C7	8.2pF	
C6	2.7pF	
C8	100pF	
C10,C11	15pF	
Electrolytic capacitor		
CP1,CP3,CP4,CP5,CP8	10uF /25V	
CP2,CP6,CP7,CP9,CP10,C11,CP12,CP13,CP14	100uF /25V	
Transistor		
D1	1N4001	
LED1	3mm LED	With tube socket
LED2	Common Cathode LED	With tube socket
Integrated circuit		
U1	NE602 (DIP8)	With IC socket

U2	PIC18F1320 (DIP18)	With IC socket
U3	NE5204 (DIP8)	With IC socket
U4	TA7640 (DIP16)	With IC socket
U5	LM386 (DIP8)	With IC socket
U6	FM62429 (DIP8)	With IC socket
U7	7805 (TO220)	
U8	78L05 (TO92)	
Ceramic filter		
Y1	10.7MHz	 <p>Please pay attention to the pin direction: printed on the surface of the device. Facing the reader, pin 1 is on the right</p>
Other components		
J1	BNC(Q9) socket	
J2	3.5mm stereo jack	SPK (plug in headphones)
J3	CON6 pin	MCU programming port
J4	Power outlet	Light board connection pin
J5	CON10 pin	
SW1	Touch switch	
PCB circuit board x 1		
Light board x 1		
Display boardx1 (plus 1pcs rotary encoder, 470u/6.3V electrolytic capacitor 2pcs)		

Attention: After arrival, please check if there are any omissions in the device. If you have any questions, please contact us.

Circuit Board Assembly Drawing



Attention:

Please pay attention to pin 1 of Y1, it cannot be installed wrong!

Color ring resistance and ceramic capacitor identification

Color ring resistance, the most common are 5% accuracy and 1% accuracy, 5% accuracy is 4 color rings, 1% accuracy is 5 color rings, the reading method is as follows:

Resistance color ring comparison table

4-ring	5-ring	6-ring
10K, 0.5%	470K, 1%	2.2K, 0.1%
		15PPM

Temperature coefficient PPM/°C									
100	50	15	25	10	5	1			
Error %									
±1%	±2%		±0.5%	±0.25%	±0.1%	±0.05%	±5%	±10%	
Multiplier (V)									
1	10	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁹
Representative value									
0	1	2	3	4	5	6	7	8	9

The capacitance of ceramic chip capacitors is generally in pF (10⁻¹² power F) as the unit, and some products are directly labeled, such as 1000p, 220p, etc.; more are expressed in exponents, such as 102, 221, the first two digits is the effective number of capacitance, the last digit is the number added with zeros, such as 102 means the effective number is 10, 2 means add 2 more 0s, that is 1000pF; 221 means the effective number 22, 1 means add the following one 0, which is 220pF.



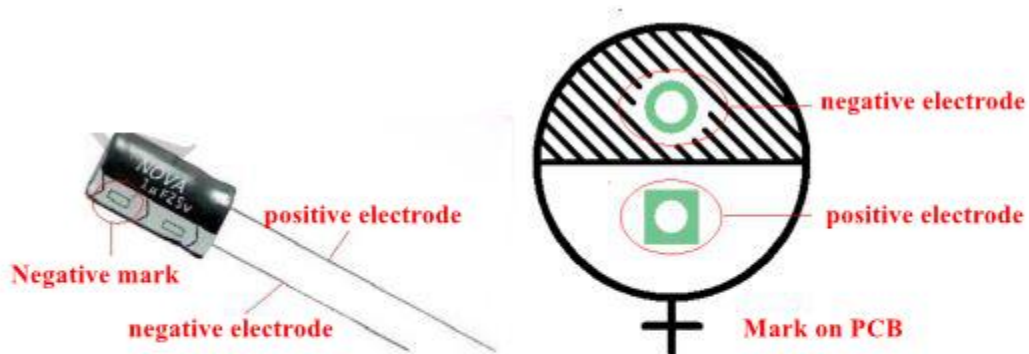
Mark 62, it is 62pF



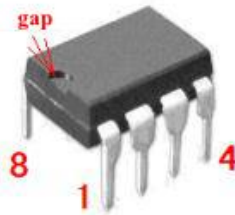
Mark 102, it is 1000pF

Polarity of electrolytic capacitor:

Electrolytic capacitors have positive and negative polarity. When inserting the PCB board for installation, please make sure that the positive and negative poles correspond correctly. Please do not install wrongly.



IC identification:

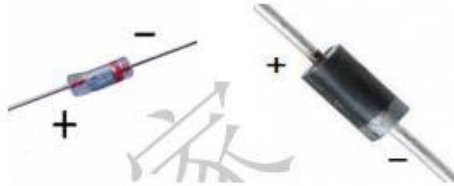


8-pin straight pin arrangement

Identification of transistors

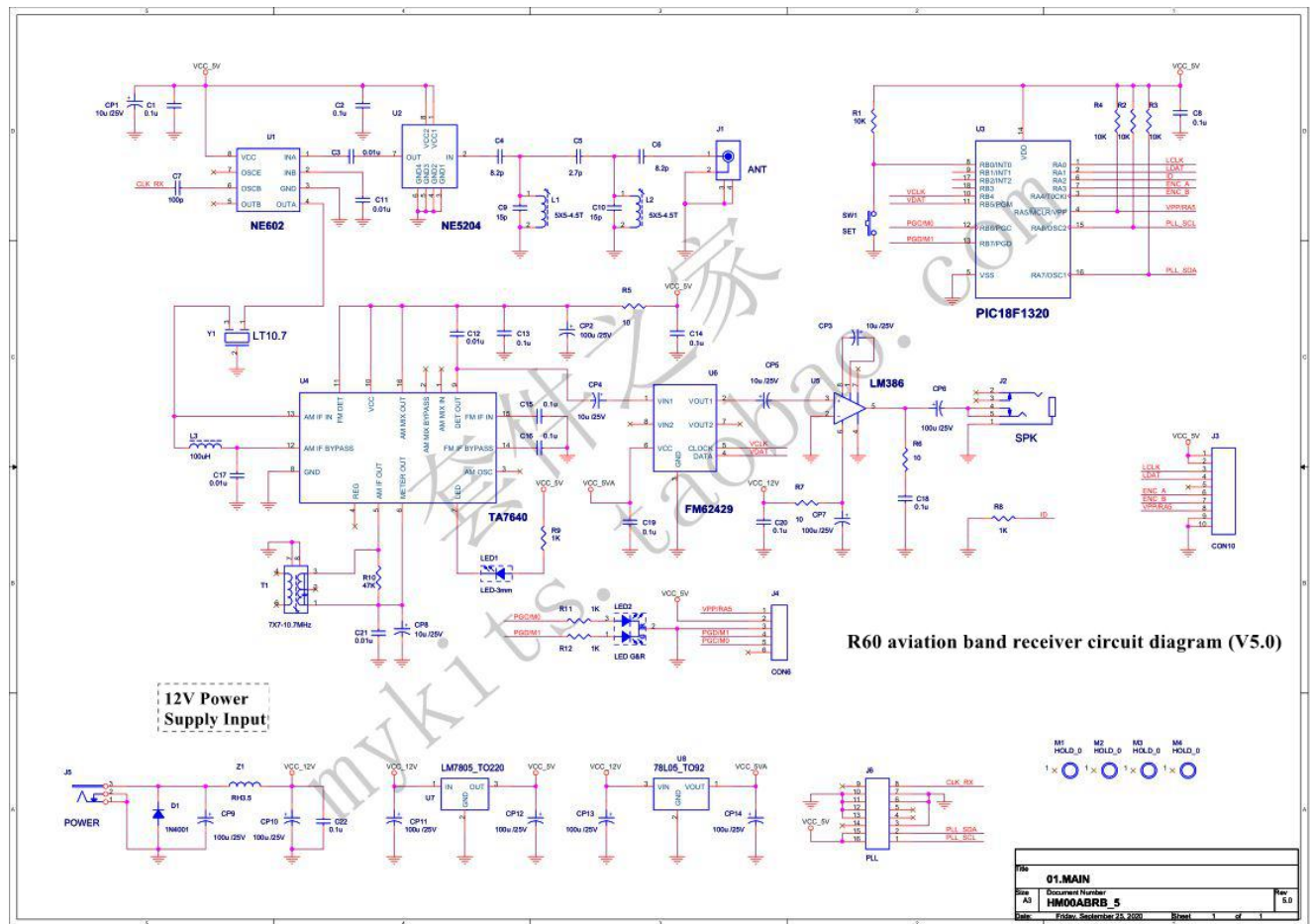


TO92 package's pin arrangement



AS119 +/-polarity

1N4001 +/-polarity



R60 aviation band receiver circuit diagram (V5.0)