ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

Measurement and Analysis of Antagonistic Signal Based on Multistage Station Interference

Meng Zhiguo[1], Jiang Lin[2] and Liu Yuguo[3]

[1,3]School of Information Technology, Guangdong Industry Polytechnic, Guangzhou 510300,China
[2]School of Foreign Language, Guangdong Industry Polytechnic, Guangzhou 510300,China
E-mail: 2004106091@gdip.edu.cn

ABSTRACT*: Against a common interfere cause of the base station, measuring imbalance about engineering installation or improper adjustable, TDD multistage area stations that is covered links coverage and reverse coverage can bring about interference capacity reduction. Based on the data analysis and mode recognition, the modulation distribution system adjust downlink coverage same as the uplink coverage. GUP will set up as a gain benchmark that have not host uplink noise and have not interferes to the base station. According to the uplink gain GUP setting, the gain downward GDOWN will be set up. After tuning control multistage confrontational stand of the interference signal measurement with Game Theory, it can effectively solve the mutual interference of the transmitted power nodes under ensuring the system coverage effect, to improve the efficiency of network energy utilization, and to reduce the energy consumption of the system.*

KEYWORDS: *Multistage Station Interference, Mode Recognition, Optimization Testing, Game Theory*

1 Overview

If the uplink output noise is too large to interfere with the base station, if the amplifier is not linear enough to cause excessive interference with the base station, if the downlink interconnection products are put into the uplink interference with the base station and if the isolation degree of the transceiver antenna is not enough to cause self-excitation interferences with the base station, the system must be adjusted and tested. The problems existing in multi-stage stations include quality reasons, human factors, etc., which lead to the rise dropped call rate in the communication system.

In serious cases, large areas cannot log in and cannot make calls. Improper installation or testing of the project will also cause the imbalance of the upstream

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

and downstream links in the multi-level station coverage area, leading to the difference between the forward coverage area and the reverse coverage area, and thus causing problems such as dropped calls, single passes, crossing areas and switching.

2 Analysis of electronic interference at multi-stage stations

2.1 system function required

According to the needs of the system, the control part includes the main controller CPU, automatic interference detection module, clock module, pyroelectricity detection module, remote control transceiver module, photosensitized detection module, sub plug-in control module, LCD1602 display module and acousto-optic alarm module. The basic block diagram of the system is shown in Fig.1.

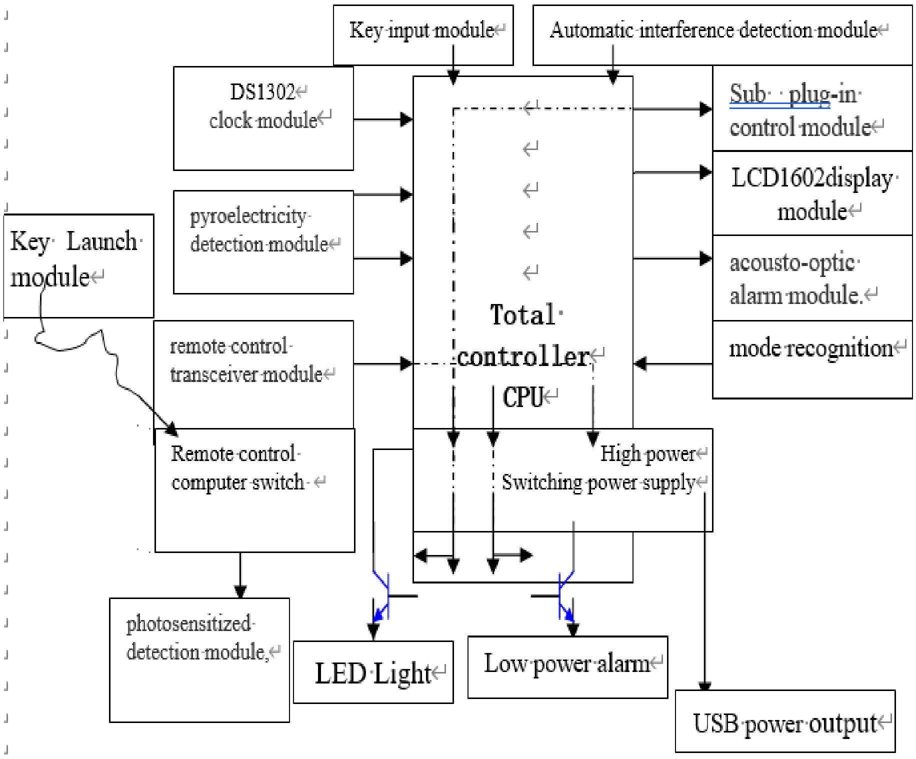

Fig.1 The basic block diagram of the system

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

2.2 CPU module selection

In scheme one, FPGA is adopted as the controller of the system. FPGA has the characteristics of fast speed, high stability, good expansion performance and small size, and can provide rich logical units and I/O resources. However, the cost of FPGA is relatively high, the arithmetic operation ability is not strong, and considering that the speed required by the design of this system is not high, too many I/O port resources are not fully utilized, which will lead to a decrease in cost performance. Therefore, we give up the choice of adopting FPGA as the controller.

In the second scheme, the enhanced STM microcontroller is adopted as the controller of the system.STM32F103 and STM32F107 are adopted. Among them, STM32F107 serves as the total control CPU, and this MCU is a single-cycle MCU with high operation rate, strong anti-interference ability and low power consumption. With 7 ports, a total of 112 I/O port resources, plus the MCU arithmetic operation ability, flexible software programming, can cooperate with the MCU C language to achieve a variety of flexible control.

Overall consideration, the final adoption is the second scheme as the master controller module, as the nerve center of the whole system, is responsible for the normal operation of each module in the system. In addition, as the overall controller, in addition to the CPU module, it also integrates the necessary human-computer interaction interface, including LCD1602 liquid crystal display and button module, as well as some other clock modules, thermistor human body induction, temperature detection, buzzer alarm module and so on. Here are some of them.

The CPU module of the overall controller adopts STM32F107. This MCU is a single clock/machine cycle (1T) MCU designed and produced by macro crystal technology. It is a microcontroller with high speed/low power consumption/super anti-interference. For Internal integration of high reliable reset circuit, high-speed communication, intelligent control, strong interference occasions, moreover, STM32F107 can provide up to 112 I/O ports. In this system, the shortage of I/O port resources caused by more control units is readily solved.

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

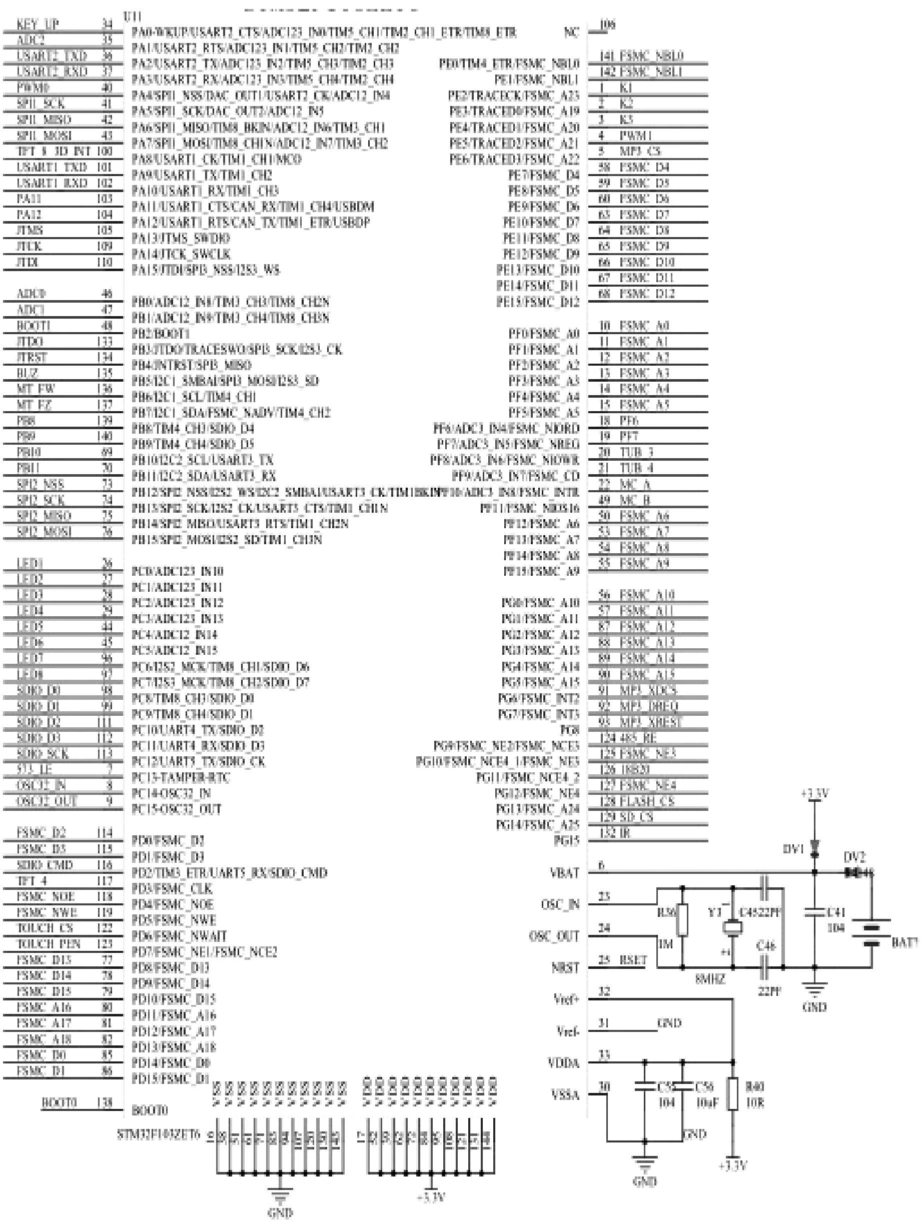

Fig.2 The circuit schematic diagram

The circuit schematic diagram of CPU module is shown in fig. 2.It includes three basic circuits: clock crystal oscillator circuit, reset circuit and power supply. There is

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

also the I/O connection between the modules, which will be explained in detail below, but I won't go into details here.

2.3 selection of photosensitive detection module

The scheme one uses photodiode, photodiode by PN section of the dark current size of the diode on or off. When there is no light, there is a small saturated reverse leakage current, i.e. dark current, at which time the photodiode is cut off. When exposed to light, the saturated reverse leakage current increases greatly, forming photocurrent, which varies with the intensity of incident light. According to this principle can be realized ambient light street lamp switch. It has the advantages of high sensitivity, fast response, good linearity, strong anti-interference ability and low price.

In the second scheme, the ambient luminosity change is detected by photosensitive resistance, which is a resistor made of semiconductor photoelectric effect and whose value changes with the intensity of incident light. Incident light intensity, the resistance decreases, incident light is weak, the resistance increases. Therefore, it can be used for light control, but its disadvantage is that current still flows through the photosensitive resistor when it is not working, and its sensitivity is greatly affected by environmental factors such as humidity and temperature, resulting in a decrease in sensitivity.

2.4 selection of clock module

The first scheme adopts IIC protocol chip PCF8563.This chip is small in size and pin, USES IIC communication protocol, occupies less IO port, but has more control over chip reading and writing, and the reading and writing procedure is relatively strict.

The second scheme adopts DS1302 clock chip. DS1302 is a special clock chip produced by Dallas. It is simple to read and write data. Moreover, the internal battery trickle charging circuit can automatically charge the rechargeable battery.

By comparison, DS1302 clock chip is adopted as the design. Clock module, main IC USES Dallas DS1302.Features of this clock chip:

- Clock counting function, on which can be on the second, minute, hour, day, month, week, year count, year count up to 2100 years.
- There are 31*8 bits of extra data store
- Minimum I/O pin transmission, controlled by three pins
- Operating voltage: 2.0-5.5v
- Operating current less than 320nA (2.0v)
- Read-write clock registers or internal RAM can be in single-byte or burst mode
- Compatible with TTL (5.0v)
- Add backup power function, which can carry on trickle charge through VCC1;Dual power supply. Backup power can be either a battery or an ultra-capacitor (0.1f or more) that can be recharged with a 3.6v battery from an

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

older computer mother-board. If the outage is short (a few hours or days), a common electrolytic capacitor with a smaller leakage factor can be used instead.100uF can guarantee a normal travel time of 1 hour.

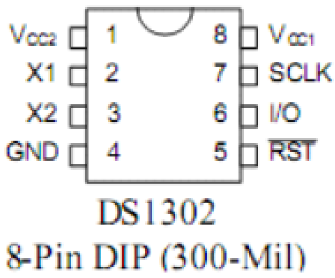

Fig. 3 DS1302 pin diagram

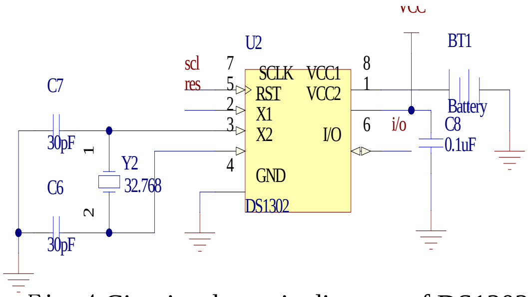

Fig. 4 Circuit schematic diagram of DS1302

Circuit schematic diagram of DS1302 clock module is shown in figure 4. BT1 is a nickel metal hydride rechargeable battery with a 3.7v voltage of 80mAH capacity, which can be self-charged when connected with VCC1.SCL, res and IO are signal clock line, reset line and data line respectively, which are connected with GPIOC4, GPIOC 5 and GPIOC 6 pins of CPU, namely three-wire control.

2.5 selection of remote control module

Scheme one adopts infrared remote control transceiver module. This module is simple in design and relatively low in price. But the biggest disadvantage is the high requirement of direction, can not cross the wall, table and other obstacles, and the remote control distance is relatively short.

The second scheme adopts wireless superheterodyne transceiver module. This wireless module has a strong anti-interference ability and a long effective distance (generally, up to 10 to 15 meters) due to the use of superheterodyne receiving module. Moreover, it has no directional requirements and is suitable for remote control in the case of any Angle and obstacles. In household remote control very convenient and practical.

2.6 power module selection

The first scheme is to select a three-terminal stabilized voltage power supply. The voltage stability of this power module is high, and the ripple coefficient can be very small, that is Suitable for the occasion of high power requirements. But the disadvantage is the low power efficiency.

Option 2: switch power module. The biggest advantage of this power module is its high power efficiency and the removal of the heavy transformer, so it is small in size and light in weight. In the scheme, CPU and other modules do not have high requirements on power supply, and the plug-in control module needs to be standby

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

for a long time, which requires high efficiency of power supply. In addition, because of the system, driving pumps, LED lighting lamps and other modules require higher power, the switch power with higher power efficiency is the first choice.

2.7 wireless transceiver module

Wireless transceiver module is one of the sub-modules of the system which is more practical. In the process of using the system after completion, it is found that it is very practical and convenient to switch on and off the computer, audio and desk lamp by remote control. The subsystem includes keychain transmitter module, superheterodyne receiver module, computer switch module, and the above mentioned plug-and-row control module is also connected to it.

(1) key-chain transmission module. The key link type radio transmitting component used in this system is a kind of beautiful key mouth type miniature transmitter, which can be hung on the key ring at ordinary times.

This keychain type transmission module is A four-channel remote control transmission module. It has four transmission buttons, A, B, C and D, and A light emitting diode in front to indicate the status of the key. Press the next button, and the LED will flash. The circuit in the transmitter module includes carrier frequency oscillator, control key, digital code and 12V power supply. Digital coding using PT2262 encoding integrated circuit, eight address code (A0 ~ A7, namely 1 ~ 8 feet) in the internal circuit has hung up, pick up is the power supply, grounding selection of three different states, namely not to repeat coding, there are 38 = 6561 only transmitter of coding and decoding integrated circuit in the receiving module address code at all at the same time, can be used. Thus, the problem of crosstalk between different transceiver modules is solved.

(2) superheterodyne receiving module. There are many types of wireless receiving modules, such as superregenerative, superheterodyne and receiving components equipped with relays. The superregenerative circuit is simple and cheap, but it has poor anti-interference ability and short remote control distance. Superheterodyne receiving module is selected in this system. See figure 5 for the real object. The super-heterodyne receiving module is of high price, but has strong temperature adaptability, stable and reliable work, strong anti-interference ability, good product consistency, receiving sensitivity of -101db, and low local vibration radiation, which is in line with the industrial use specifications, suitable for all-weather work in complex signal radiation environment, especially suitable for the more developed areas in Guangdong.

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

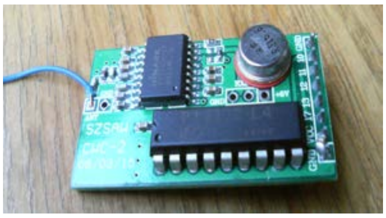

Fig. 5 wireless module

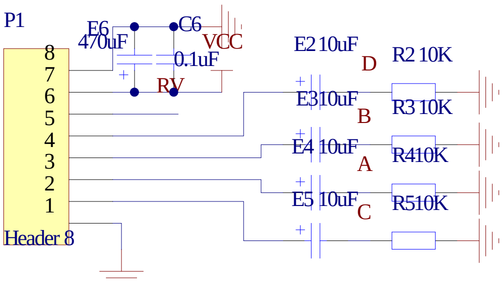

Fig. 6 wireless receiving circuit

In the system, the wireless receiving circuit is shown in figure 6. Because the output is latched super-heterodyne receiver module, the decoding chip of data output terminal 2, 3, 4, 5 feet corresponding transmitter button C, A, B and D, when press the button C transmitter, corresponding receiving module, output level 2 feet and decoding chip output n 6 feet also output high level, loosen the button C, 2 feet can still maintain A high level, but the VT feet restore low level. If other keys, such as A, are pressed again, then the 3-pin corresponding to the receiving module and the decoded are effective, VT pin outputs high level, and the 2-pin recovers low level. After releasing the key A, the 3-pin can still maintain high level, while the VT foot resumes low level. Thus, the 2, 3, 4, 5 pin output relationship is called interlock, or interlock.

This interlock has the advantage of providing a steady-state signal that can be output directly to drive the appliance. The steady-state signal is not needed because the signal is processed by a single chip microcomputer. However, a 10uF electrolytic capacitor and a 10K resistor are connected to the ground at the output end of the receiver, which is similar to the reset circuit of the single chip microcomputer. Such a jump signal can be in line with the need to drive the computer switch machine, about a delay of 200 ~ 300 milliseconds, so that the computer can be stable boot, shutdown, the following will be described in detail.

C button is responsible for the computer switch on and off, B button is responsible for the high-power start/stop, D button is responsible for the power on/power off of the plug and discharge, and A button is suspended without connection.

2.8 Thermoluminescent human body induction module

This module is one of the main sensors used in the system, as shown in figure 7. Its main function is to sense whether someone is nearby, and then automatically give a series of controls, such as whether the LCD liquid crystal display, LED lamp is on or not.The module adopts infrared pyroelectric processing chip BISS0001 for signal processing and finally sends it to the CPU of the general controller.The pin diagram of the chip and the real object are shown in figure 8.

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

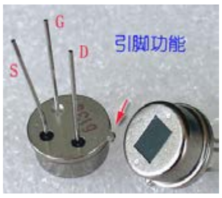

Fig.7 Pyroelectric infrared sensor

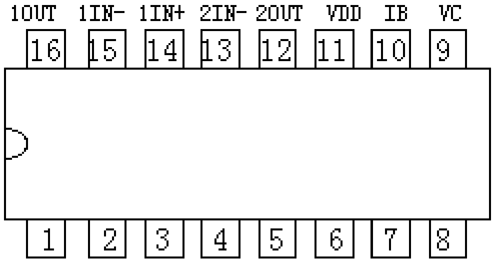

Fig.8 BISS0001 pin diagram

BISS0001 is a sensor signal processing integrated circuit with high performance. It is equipped with pyroelectric infrared sensor and a small number of external components to form a passive pyroelectric infrared switch. It can automatically and quickly open all kinds of incandescent lamp, fluorescent lamp, buzzer, automatic door, electric fan, dryer and automatic wash basin and other devices, especially suitable for enterprises, hotels, shopping malls, storeroom and family corridor, corridor and other sensitive areas, or for the safety area of automatic lighting, lighting and alarm system.

3 Balance measurement of the multistage interference

Nowadays, in addition to more and more intelligent electronic equipment development direction, more attention is paid to green environmental protection, green energy saving. This is also the system design standard. Switching power supply design is adopted in the system to improve power utilization and reduce unnecessary extra loss. There is also the use of LED lighting source, which is on line with the future green lighting design direction. In addition to the low power consumption CPU programming, the system has a certain degree of intelligent control ability, more green energy-saving characteristics.

Game theory is widely used in many areas, is the study of multi-agent node under the particular condition restriction, mutual influence, interaction behavior, control strategy and algorithm into the multistage confrontational stand interference signal measurement control. It can effectively solve the problem of interference between node transmission power, etc, to help us in maximal profit under the premise of considering network, to improve the network energy use efficiency, to reduce the system energy consumption. Multistage stations are equipped with mainly couplers, power divider and combiner, indoor antenna, feeder and other devices and cables, antennas. The following analysis of certain active system is widely used to input, output, noise, relationship between noise coefficient NF and gain G, base and the base station's receiver noise (white noise or background noise) value problem determination, etc.

The system noise coefficient is expressed as NF, and the power gain is expressed as G. Psi is the input signal power of the system, and Pso is the output signal power of the system, so G= Pso /Psi. PNi is the white noise input of the system (kTB is specified), and PNo is the output noise of the system (including the sum of G PNi

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

and the noise power of the system itself at the output).Noise coefficient NF is defined as

$$= \frac{P_{No}}{G \cdot P_{Ni}} = \frac{P_{No}}{G \cdot kTB}$$

Therefore, the noise power at the output end of the system is $P_{No} = kTB \cdot NF \cdot G$ .If dB is used to represent the noise level of the system output, then $P_{No}(dBm) = 10\log(kTB)(dBm) + NF(dB) + G(dB)$

For typical wireless mobile systems, the carrier signal bandwidth is set at 200kHz,

then: $P_{No} = -174(dBm/Hz) + 10\log(200 \times 10^3) + NF + G$

$= -121 + NF + G\ (dBm)$

When the noise level PNo at the output end of the system is converted to the input end, it is called the thermal noise base power at the input end (or receiving end) of the system, whose value is equal to (set NF=5dB):10log (kTB) +NF (dB) = -121 +5 = -116 dBm. In order to leave a certain allowance, the base noise level is set as -120dbm.

At the input equivalent impedance, input impedance Ri for amplifier measurement signal first to a 1MΩ series resistance, into the high impedance signal source, measured the no-load voltage U1 with audio voltmeter, and then closed the signal source connected to the amplifier input K, at this time, the milli-volt table reading fell to U2, use the $R_i = [U_1/(U_1 - U_2)] \times 1M\Omega$ formula to calculate again can. Output power P and pass band f, nonlinear distortion coefficient adjustment. Testing equipment have oscilloscope, function generator, distortion measurement instrument. Examples of test results are shown in table 1.

Table 1 Test results shown Vin =5mV (peak-peak)

f/Hz	1	10	100	1K	10K	20K	50K	100K
γ_{in}	3.0%	1.0%	0.33%	0.32%	0.35%	0.51%	0.62%	0.58%
γ_{out}	0.45%	0.40%	0.32%	0.32%	0.50%	0.63%	0.71%	2.0%
γ	0.21%	0.083%	0.061%	0.121%	0.37%	0.42%	0.66%	1.03%
V_{out}/V	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.0
P_{out}/W	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.0

Measuring equipment of noise power have oscilloscope. Test result: effective value of ac noise is 3.8 mV, so P noise is

$$(3.8 \times 10^{-3})^2 / R_L = 1.805\mu W$$

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

Efficiency test equipment have oscilloscope, digital multi-meter, function generator. Test results: the equivalent current IE= 0.312A and the equivalent output power voltage Uo= 9.3v are not available under the premise of rated power. It is known that: dual power supply UE = $\pm 12V$, load equivalent resistance RL=8 Ω. Machine efficiency is 72.6%.

P power supply =2UE $\times I_E = 2\times 12\times 0.312W = 15.0W$

P output equivalent power = $U_0{}^2 / R_L = 9.3^2 / 8W = 10.89W$

The measurement accuracy test is done with sampling circuit. More computing power to power supply: P = 15.0 W, power supply power output equivalent power for: P = 10.89 W output equivalent power and efficiency is: $\eta =$ 72.6, the sampling circuit, correction of RMS, analog-to-digital conversion is calculated by computer power supply power for: P = 15.88 W, P output equivalent power 1 = 10.97 W, efficiency is: $\eta =$ 69.0. By the reasonable range, available sampling circuit measurement error is: $\pm(100\% - \eta_1/\eta) = \pm$ 3.6%.

Attenuation test equipment of band stop filter at 50Hz have oscilloscope and function generator. Test attenuation measured at 50Hz, the results: is 7.2db.

The main reason for the interference of uplink noise to the base station is that the uplink output noise level of multi-stage stations is too large. After the uplink space loss, the noise level to the base station port of the communication source exceeds the white noise level of the base station receiver (taking -120dbm, also known as base noise or background noise), and then the interference will be caused.

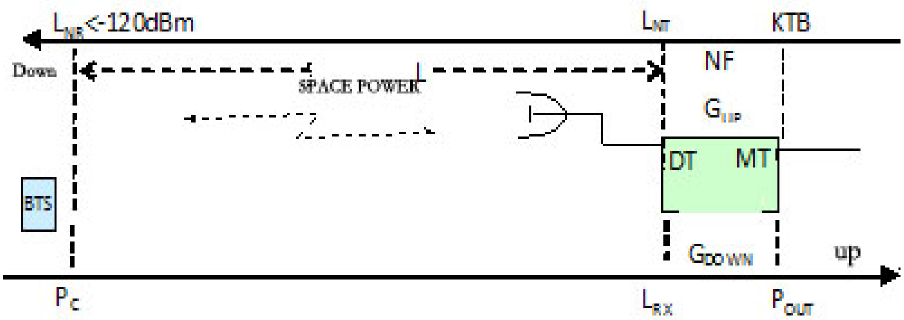

Fig 9. Interference analysis of uplink noise to base station

As shown in Fig. 9, to obtain the uplink noise level LNT of the uplink output port of the multi-stage station.LNT (dBm) = 10log (kTB) (dBm) +NF (dB) + GUP (dB) = -174 (dBm/Hz) +53+NF+ GUP = -121+NF+ GUP (dBm), where k is boltzmann constant (38 ± 10-23), T is absolute temperature (300K as normal temperature), B is carrier signal bandwidth of the communication system (200kHz), NF is multi-stage station uplink noise coefficient, and GUP is multi-stage station

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

uplink gain.LNR is the noise level that LNT reaches the receiving port of signal source base station through space loss. In order to avoid interfering with the base station, LNR is required to be less than -120dBm[9].

In the figure, the downlink parameter PC is the output power of the source base station, LRX is the received signal level of the multi-stage station receiving port, POUT is the downlink output power of the multi-stage station, and GDOWN is the downlink gain of the multi-stage station. Since the uplink noise level LNT of multilevel stations is related to the uplink gain GUP of multilevel stations, too large GUP will inevitably lead to higher LNR. For example, LNR higher than the white noise level -120dBm of the base station receiver will inevitably interfere with the base station.

The derivation is as follows: since LNR = LNT - L,Space loss L = PC -- LRX, So LNR = LNT - (PC -- LRX) = -121+NF+GUP- (PC -- LRX) < -120dBm.

When GUP < 1 -- NF + (PC -- LRX), multi-stage stations will not interfere with the base station. Set GUPmax =1 -- NF + (PC -- LRX), then the downlink gain of multi-stage stations GDOWN = Pout-- LRX.

Considering the problem of upstream and downstream balance, GUP = min (GUP max, GDOWN) is taken as the uplink gain value of multi-stage stations, which not only guarantees that the multi-stage stations will not interfere with the base station, but also maintains the principle of upstream and downstream balance.

4. Test anti-interference of the multistage base station

Based on the above calculation and model test, in order to achieve the opening on the distribution system, the down link balance, concise says, is to make distribution system downlink coverage is the same as the uplink coverage, to host uplink noise does not interfere with the base station as a benchmark to set up gain GUP, according to the uplink gain setting GUP downward gain Gdown (generally higher than upward 5 dB) at this time. Specific engineering operation steps:

Measure the input power RX (dBm) of the input port of the host, set the output power Pout (dBm) of the host according to the design requirements, and obtain the downlink gain Gdown. At this time, the uplink gain GUP is also determined. Generally, the host uplink of indoor distribution system is initially set as GUP= Gdown-5

Measuring unit upside noise level PNO, according to the RX, base station transmission power PC (CDMA: 33 dBm, GSM: 40 dBm), base station antenna gain generally take 14 dBi. Because LP is same from the base station to the donor antenna and downside loss, liked LP = (PC + 14) - RX, noise to reach to the base station LNT = PNO - LP, noise arrived to the base station is not higher than 120dBm.

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

If the above requirements are not met, the uplink gain GUP will been turn lower and the uplink noise level PNO of the host will been measured until the requirements are met.

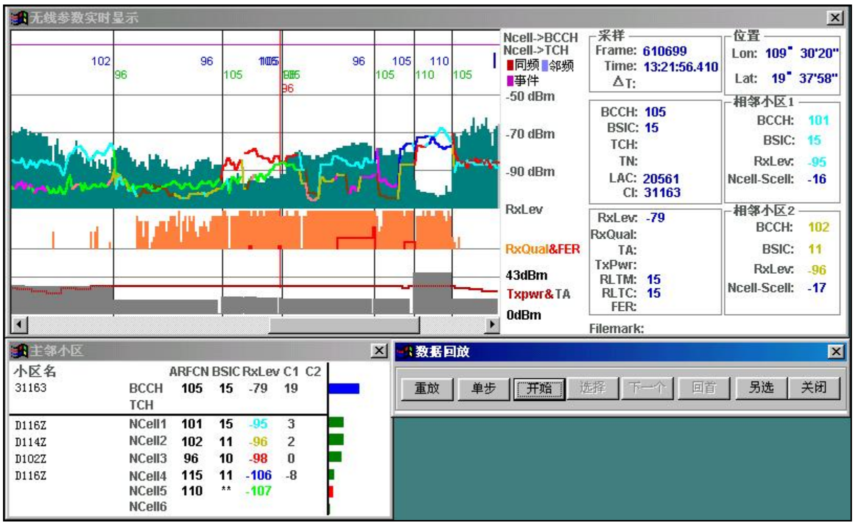

Fig. 10 Field intensity diagram under severe interference

The measured field intensity figure is shown in Fig. 10, which reflects that the signal is strong but the communication quality is poor, and the main reason is interference to see if there are adjacent cells in the same frequency or . Check the surrounding terrain to see if there is any self-interference caused by the complex terrain or interference caused by too much signal reflection. For example, on the bridge, the water has a great impact on the signal quality. Whether to choose the cell signal with a longer distance, because the coverage is too large, the interference is relatively large. Interference with other radio waves which is generally difficult to identify the source of the interference.

For forensic engineering effect, covering areas to talk on the phone, road test to see whether the desired coverage effect, and analyze the interferences with is to base station, at the same time to cover edge to dial, test, check to see if the fringes switch to normal, view the presence of a single, mobile phone signal and not be able to set aside, or from outside the network is dialed the phone, with or without notice is not in service area, without the above phenomenon, again on the test data from the network, check the presence of abnormal data from the general engineering data, view the presence of normal reception level and higher transmission power. Such situation is generally caused by complex indoor structure, severe rapid fading, severe non-uniform signal distribution before coverage, excessive power design of host, unreasonable design of distribution system, unreasonable antenna distribution and other reasons. It is still considered normal when coverage requirements and network technical requirements are met.

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

The above are the general steps and methods for the upper and lower balance of engineering survey. It is based on multiple data and network parameters and combined with the coverage requirements of distribution system analysis and measurement. Lower the downlink gain appropriately and repeat the previous step until the upper and lower cover areas are the same size.

5 Conclusions

To make full use of base station signals, to use less active amplifiers, minimize the accumulation of noise levels, and it can ensure that the noise level (inter-modulation and superposition of noise levels) at the base station entrance is less than -104dBm. Considering the future capacity expansion and dual-frequency signal coverage, all passive devices, which has such as couplers, power dividers, antennas, feeders and connectors, are broadband devices, and a certain power margin what is reserved in the design. Combined with the complex structure of multilevel interference, the function and decoration of the antenna feeder system are considered comprehensively. Considering the reliability to increase the number of antennas appropriately, to reduce the output power of each pair of antennas, and to ensure that the output level of downlink signal to each pair of antennas is ≤30dBm.The number, position and output power of antennas, and the required coverage range what are comprehensively considered to ensure the uniform distribution of signals.

Acknowledgement

This paper is supported by 2019 college students innovation and entrepreneurship training program. (NO.1083319007)

References

[1] Blanco Celia, Janzen Evan, Pressman Abe, Saha Ranjay,Chen Irene A. Molecular Fitness Landscapes from High-Coverage Sequence Profiling.[J]. Annual review of biophysics48:4-18(2019)
[2] Kumari Komal, Jain Sheetal, Dhar Anirban. Computationally efficient approach for identification of fuzzy dynamic groundwater sampling network. [J]. Environmental monitoring and assessmen191(5).310-316(2019)
[3] Zhang yuping. Communication principle and technology[M]. Beijing: chemical industry press, 2009;
[4] Mohammad Mohammadi,Ashkan Mohammadi Rozbahani,Mahdi Montazeri. Multi criteria simultaneous planning of passive filters and distributed generation simultaneously in distribution system considering nonlinear loads with adaptive bacterial foraging optimization approach[J]. International Journal of Electrical Power and Energy Systems79.253-262(2016)
[5] Ma fangfang. Principle and engineering technology of digital mobile communication system. Higher education press(2003)

ISSN 2706-655X Vol.2, Issue 2: 1-15, DOI: 10.25236/IJFET.2020.020201

[6] Wang xinguo, zhang xinming, Chen guoliang. Cross-layer routing of wireless sensor network with limited time delay and energy efficiency [J]. Software science Newspaper, 22 (7), 16-26-1640(2011)
[7] Zeng fanzai, Chen miao-miao, luo Juan, li ren-fa, deng fan. An energy-efficient node tracking algorithm for wireless sensor network [J]. Journal of communications, 36(1):81-84(2009)
[8] Shi ren, jia chuanjiang, liang huanhuan. An improved dv-hop localization algorithm for wireless sensor networks [J]. Sensor technology Newspaper, 24 (1): 83-87(2011)
[9] Chen Jiawen, Cheng Chao, Planning and design of indoor distribution system [D], Graduation Project Set (2010)
[10] Jandecy Cabral Leite,Ignacio Pérez Abril, Manoel Socorro Santos Azevedo. Capacitor and passive filter placement in distribution systems by nondominated sorting genetic algorithm-II[J]. Electric Power Systems Research143.482-489(2017)