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The Technological Research on Automobile Distance Measuring Devive at High Speed

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Abstract: **This paper discussed the practical mechanism of automobile distance measuring device when the automobile is running at high speed. The mechanism successfully utilized the measuring frequency/fixed frequency transmitting principle to achieve the research of project technology. We studied the possibility of technological development of electronic products in automobile industry through the trial on the function and characteristic of automobiles' safety travel. The implementation of the entire design can solve the problem of false warning on angle measuring capability in automobile anti-collision system and anti-disturbance in complicated environment in a certain degree. Therefore, the automobile is equipped with better auto control ability when traveling at high speed in forecasting and collision protection.**

Keywords: Measuring frequency/fixed frequency transmitting principle; TDM distance measuring device; False warning problem; Automobile anti-collision system; Initiative safety system

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1. Introduction

Although the road condition unceasingly is improving, but still could not avoid on the road the automobile crowded present situation, in addition the vehicle speed gradually enhanced, the malignant traffic accident all had the possibility occurrence as necessary, this will give the people and the society has brought the huge life and the property damage. The automobile high speed range finder installment technology, can provide avoids the automobile collision the possibility, this also will be we must develop in not the far future, in advance this technical --automobile high speed range finder installment technology, universal equipment in automobile .

The automobile collision avoidance system is one kind may send out the seeing and hearing alarm signal and the automatic control survey control device in advance to the pilot. Through installs it on the automobile, can survey the pedestrian, the vehicles immediately which the attempt approaches the automobile body or periphery the obstacle and can to the driver and the passenger sends out the collision the danger signal, urges the driver even to put aside the driver to take the emergency automatic control measure, the processing special dangerous situation, avoids losing.

Presently, although various countries' all research initiative safety system, how but can solve the false warning problem well, throughout takes the research the direction. Proved through the massive research material that, must effectively solve the above problem, the high speed range finder equipment must have the following function:

(1) The goal angle information regarding removes the false warning is essential, this product must have the take a bearing function.

(2) Is easy to produce the resistance to interference strong complex transmitting message, the coordination real-time highly effective signal processing and the goal examination algorithm, solves the false warning problem.

Because the automobile in the middle of the high speed travel process, must be able to judge it regarding the front obstacle to be opposite to the automobile spatial dimensional orientation, can around, about, the about obstacle avoid; But behind then only must judge it and about is away from with automobile around then. Therefore may use the TDM metering equipment to realize the automobile in the middle of the high speed travel process, accurately promptly to the environment object survey distance, and calculates conforms to the automobile high speed movement rule requirement, controls the automobile correlation automatic equipment, completes the auto safety travel the goal.

2. Methods

This plan adopts to the vehicle in front of installs three frequency measurements receiving and dispatching system and between each other to assume is vertical to the horizontal plane isosceles triangle symmetrical front of a train distribution, behind the vehicle installs two frequency measurements receiving and dispatching system, assumes is vertical to the level symmetrical tailstock distribution. After five receiving and dispatching system with whole set installment arrives, surveys with TDM is apart from the installment separately to be possible to monitor, to calculate the automobile high speed rate process middle distance obstacle the position, the immediate issue control command, controls the automobile correlation automatic equipment.

2.1. Tdm Range Findgr Installment Principle

The TDM receive module input for the F/B2 installment by the frequency measurement rate signal, is defers to the heterodyne type receive module the basic principle work way to provide. Its core part was the signal after enters the receive module to pass through a transformation, it is folded by the frequency measurement rate a lower intermediate frequency, the entire process was completes through the mixer.

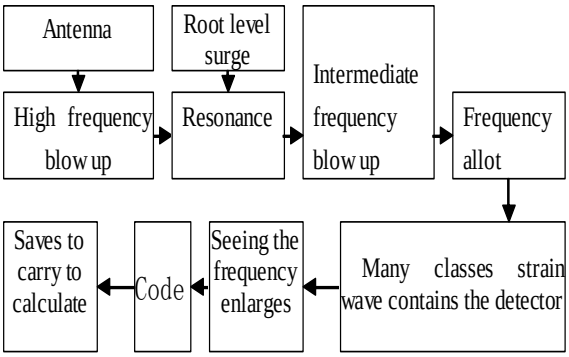

Figure 1. Heterodynes types receive module basic composition.

Describes the heterodyne type receive module work process with the simple mathematics:

Supposes the signal is:

$$S = A_1 \sin(\omega_1 t + \phi_1) + A_2 \sin(\omega_2 t + \phi_2)$$

----(2.1.1)

This surge is:

$$L = A_L \sin(\omega_L t + \phi_L) \quad (1)$$

The mixing is multiplications and takes its result to compare the low frequency component the process, leaves out in the physical process the mixing loss factor, the use triangle product and the difference formula, obtains the intermediate frequency output equation:

$$I = A_1 A_L \cos[(\omega_1 - \omega_L)t + (\phi_1 - \phi_L)] + A_2 A_L \cos[(\omega_2 - \omega_L)t + (\phi_2 - \phi_L)] \quad (2)$$

The ideal mixing is a linear substitution.

The heterodyne type receive module most important technology characteristic is can be located in the wider high frequency range the signal to transform to the fixed frequency range smaller intermediate frequency in, thus is advantageous for to the signal carries on the enlargement or the choice. The frequency and the band width fixed intermediate frequency filter possibly makes the performance comparatively to be better, satisfies TDM the receive module overall function and the performance request. Thus, caused the receive module only in frequency domain on to open with 512MHZ to the 768MHZ scope intermediate-frequency bandwidth the equally great intermediate frequency small window.

Therefore, inspires in the known TDM receive module book the frequency and the intermediate frequency, may obtain this window in frequency domain on position. When the TDM receive module receives the signal, it should fall in this window, uses this window the center frequency expression signal frequency, and thus completes the frequency measurement work.

2.2. Multi-Channels Frequency Measurement Principle Design Analysis

What this design uses is the filter makes the frequency scope transformation the frequency measurement method. The frequency measurement scope stipulated which the frequency shunt divides Cheng Duoge the channel, again uses the comparison processing electric circuit to enable a frequency the signal only to fall a channel in the concept, thus obtains that channel frequency to measure the signal the frequency.

With this methods design receive module frequency measurement installment, its ideal high frequency component makes the frequency to transform to the scope should be one kind of function value only takes 0 or 1 transformation, its essential component is the frequency divider, it has an input port, many outputs port, the signal will act according to its frequency to output on the different output port. Basic principle composition like Figure 2 shows.

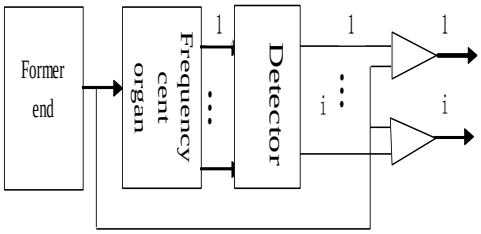

Figure 2. Multi-channels frequency measurement basic composition.

Because the actual frequency divider response is unable is two values, therefore in this kind of receive module, should use a comparator, outputs the frequency divider the signal to do with another group nonstop signal the intensity to compare, only has when the frequency divider output signal and the reference signal compare, when the signal strength is bigger, only then produces the effective signal output. Also as a result of the neighboring two channels, their public boundary frequency, cannot achieve strictly in the project is same, generally uses causes the neighboring frequency range overlap means which the above comparison produces, if park Figure 3 shows, produces the frequency measurement dish n -1 channel with the frequency divider n channel Did this not only has avoided the boundary superposition question, moreover because the channel quantity was bigger than the frequency divider to pass the magical skill, enable the frequency measurement the precision slightly to have the enhancement.

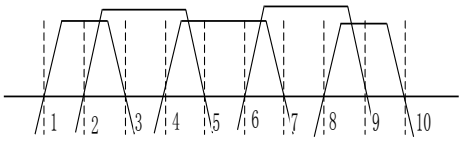

Figure 3. The project channel produces the principle hints.

In the above basic principle, whether uses for to judge through some filter transmission band signal quite strong electric circuit, should be very simple; after we only needed this channel to output serve as after the detection signal and another group the reference the signal separately to add to the differential amplifier, the counter- two inputs port are good. When the differential amplifier output for positive, indicated the filter corresponds the channel outputs the signal strength is bigger, then will determine this channel to have the signal, or will trigger produces this channel to have the signal the mark. But this project use survey frequency situation: Signal generally for impulse modulation.

2.3. Channel Filter Analysis

The frequency divider designs a one kind of port input, the multi- ports output the high frequency component, each output port has corresponded the certain frequency range. In the center frequency band scope, in the project uses minute many power shunts, adds on a corresponding filter again in each group out-port. This structure is such like figure 4 shows in the TDM installment frequency measurement.

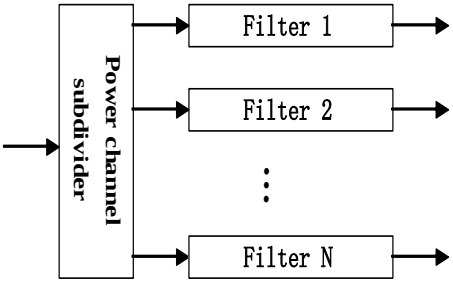

Figure 4. The power shunt adds the frequency division which the filter composes.

Very obvious, regarding such frequency divider, it inserts in the engineering aspect to the signal damages is at least the theory which a minute many power shunts necessity exists inserts damages, regarding minute 40 filters, this will be 16dB. This regarding intermediate frequency by-pass frequency divider, because the intermediate frequency amplifier price is low, may use the supersonic amplification the gain counterbalance component to insert damages. Uses this kind of structure in the intermediate frequency commonly used sound surface wave filter, although single sound surface wave filter itself inserts damages (10~30dB) not slightly, but the distinction structure filter rectangular coefficient may do well, again adds the rising tone surface wave filter volume to be smaller, when design generally certainly does not insert the component damages regards as the application the barrier.

2.4. Frequency Spectrum Distortion Analysis

In project application therefore needs to survey the frequency, mostly is because the signal existence time is very short, in other words the signal is the pulse -like. This kind of signal itself objectively has the frequency spectrum is not a dot frequency, but will be section of spectral lines, its frequency span and the pulse width concern. Take the ideal rectangular pulse as an example, when its pulse width τ, is not difficult to calculate, its frequency spectrum as follows:

$$F(j\omega) = \int_{-\tau/2}^{\tau/2} f(t) \bullet \exp(-j\omega t) \bullet dt \tag{3}$$

When f (t) is the frequency is the f0 simple harmonics wave duration, F (jω) take ω0=2πf0 as a center, in proportion to:

$$\tau \bullet Sa(x) = \tau \bullet \frac{\sin(x)}{x} \tag{4}$$

Among

$$x = \frac{(\omega - \omega_0)\tau}{2} \tag{5}$$

When such signal through pass band infinite width receive module, its envelope cannot have the distortion. If the process detection, we can obtain the signal envelope still will be an ideal rectangle. But, any receive module pass band width all cannot be infinite. Senate map-read figures 5, if we let in the signal frequency spectrum perform the oblique line the part through the receive module, makes the inverse transformation computation, we may obtain the signal the envelope are:

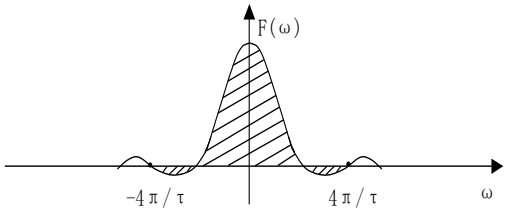

Figure 5. Rectangles envelopes signal frequency spectrum.

$$f(t) = \frac{1}{2\pi} \int_{-4\pi/\tau}^{4\pi/\tau} F(\omega) \exp(j\omega t) \bullet d(\omega - \omega_0)$$
$$= \frac{1}{\pi} \int_{-2\pi}^{2o} \frac{\sin(x)}{x} \cos(x \frac{t}{\tau/2}) \bullet dx \tag{6}$$

Attention, this is an ideal mathematical analysis situation, therefore around output pulse profile full

symmetry, the signal appeared the pulse arrived before the output, this was cannot appear in the project. If we thought such signal envelope may regard as is basic has not had the distortion, or the project permission is considered not big distorted the condition, then, we are the request in fact, when the signaling frequency is f_0, the receive module pass band should contain from $f_0 - \frac{2}{\tau}$ to the $f_0 + \frac{2}{\tau}$ this kind of frequency range. In other words, the channel filter each filter pass band width generally is not smaller than $\frac{4}{\tau}$. Draws it becomes the chart, its result like figure 6 shows

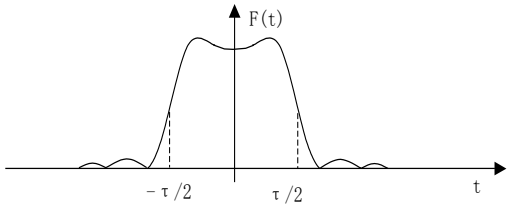

Figure 6. Signal host frequency spectrum correspondence envelope.

2.5. Frequency Measurements Codes

The TDM survey frequency receive module, in has completed the frequency after the scope transformation, the receive module front part unit output generally all produces some kind of numerical code, behind it also needs to connect the code electric circuit, its duty is contains the front part the frequency information the numeral to do the certain transformation, really produces frequency code, codes the electric circuit generally to contain two parts of contents:

① Or does not turn the non- binary code on behalf of the value size code represents the frequency size the binary code;

② Has many units when the front part, produces unified by many precisions different code synthesis frequency code.

Uses any principle code, its goal all is has some kind of rule the input to turn the significance explicit output. In project, if must display looks up the table encoded simplicity, all inputs, simply will serve as the address, completely will not consider its possible physics significance. Then, the installment has Pbit the input, the table address position is Pbit, this table reality big young fellow is 2p. Take the figure 7 situations as the example, the input altogether is 10bit, the table aggregate capacity is 1,024, but, needs the output merely is 64, considered the high position code boundary the project error, the design possibly can use the input address has 5 times to be big, also some 310 addresses are only effective. Along with the memory capacity expansion, for instance said 16M, the corresponding address position is 24bit.

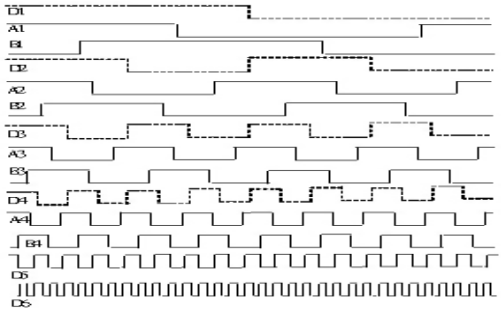

Figure 7. Non- error corrections codes. Attention: The TDM installment decides the frequency launch principle is the above reversion process analysis.

2.6. Tdm Module Development Technology Realization

First, with decides the frequency launching system in the TDM frequency measurement in the second level of design technology route foundation, to F/B2 installment principle design and project。At the same time, carries on the module conformity design, reduces the component and the air wire connection quantity and increases the control pitch point on each module.

Next, regarding inserts declines the processor control unit, the use control system can carry on the automatic/manual calibration, real-time reports to the police with the breakdown demonstrated that, prepares the enhancement to use and to service the prompt effect. Also must simplify the control system design for this, chooses the belt to save the function as far as possible the program control component. But the microprocessor uses I2C and the SPI main line design with various functions module between, like this namely reduced the hardware demand quantity which the system wiring and outside supposes, also may make the equipment to enhance the automatic survey and the control immediate ability.

2.6.1. Projects Plans

The F/B2 function division is three main functions modules: The survey frequency combination and decides the frequency launch combination, and through inserts the declining machine control system, carries on the automatic survey control.

TDM installment control functional block diagram composition as follows:

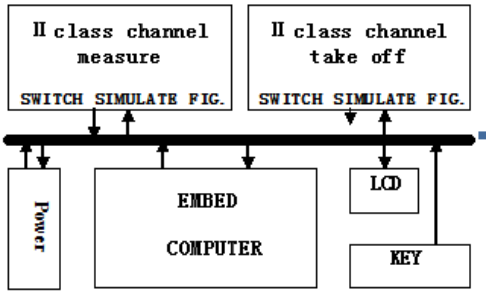

Figure 8. TDM installment control principle block diagram.

(1) Frequency measurement channel design

Uses the numeral frequency synthesizer (DDS) to take the standard the reference pulse supply oscillator, it may produce 512~768MHz to divide into 40 center frequencies the standard reference pulse signal, in inserts declines the processor under the control, separately puts through the frequency measurement channel the wonderful/partner input channel, passes through match which the wonderful/partner program control weakens, enters various channels amplifier to enlarge, after delivers the closed circuit balance, again enters the power amplifier through the program control weaken match, impels 40 groups power dividers to enter 40 groups filters choices frequency, and separately enters the program control logarithm detection comparison unit, transforms 40 group balanced peak-to-peak value signal, again passes through two levels of channels protections combination-piece, Completes 40 groups channels video amplification code and the system numerical control signal production, its peak-to-peak value and width standard frequency measurement code 0—2—1 … 0—2—40 forms originally exert the out-port which the F/B2 module installs Ⅲ 6 (on) on the coupling, for next level of installments information analysis processing use. This time inserts declines the processor to have to complete self-checking, to check against the authoritative text, the operation, the diary and function and so on program control data storage. After it the monitoring evacuation adjustment condition, the numeral frequency synthesizer (DDS) the supply oscillator off-line knock off, the frequency measurement channel module come on the line, monitors and reports to the police the condition.

M1 module composition:

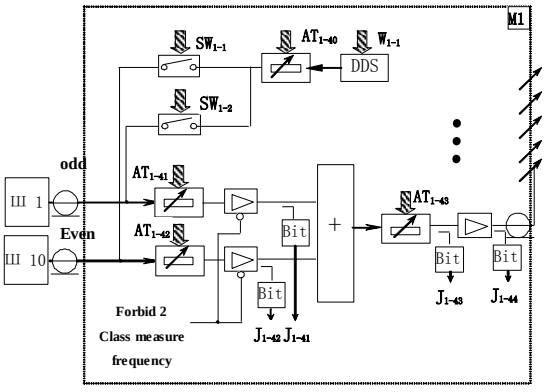

Figure 9. Electric circuit function diagram.

M3 Module composition:

Are partial regarding the M3 module numeral, uses the high density the programmable logical component (CPLD) ALTERA 7000S series chip to carry on the design. The M3 module composition and the function are after the upper level of 40 channels detection video gain, enters two levels of channels protections combination piece (40 channels video amplification code), joins the CPLD module the threshold installment input end (each group of 4 channels). When the video amplification signal appears when the corresponding input, the threshold installment has the peak-to-peak value and the width standard frequency measurement code 0—2—1 … 0—2—40 forms exert the F/B2 installment Ⅲ 6 (on) on the coupling to output.

M2 module composition:

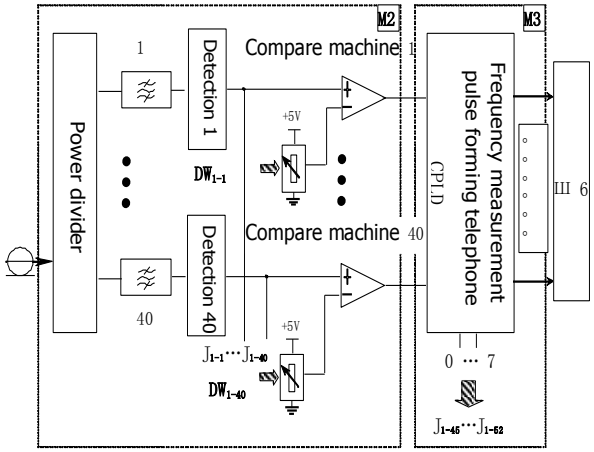

Figure 10. Electric circuit function diagram.

Has the signal in two levels of several channels, then only uses the signal comparatively early express to start the threshold to the channel two frequencies neighboring channels clear signal record. When realizes this work principle, the tracer signal each channel all forbids the record to possess other channels besides two frequencies neighboring channels the signal. Similarly, if the signal is recorded in with is forbidden besides two frequencies in the channel neighboring channel any other channels, then itself also all forbids the tracer signal in each channel.

According to the above basic principle, separately realizes the enlargement and the reshaping channel module in the CPLD interior and "the prohibition ΦH", "the prohibition ΦB".The pulse forms the electric circuit function module. Again realizes in the periphery electric circuit elects to pass the pulse and the replacement pulse forms the electric circuit and shoots along with the actuation electric circuit and so on, can meet the design requirements. The pulse forms the electric circuit function module.

(2) Decides the frequency channel design

Through inserts declines the processor the control, causes the radio frequency signal to have the source oscillator to shake. In its frequency band, outputs the radio frequency signal continual frequency spectrum. After two levels of supersonic amplifications and two levels of program control weakens and the balanced control, the continual frequency spectrum enters the power amplifier to enlarge. Meanwhile chooses the frequency from 40 groups power distributions to 40 groups filters in, again separately enters the program control attenuator to be balanced. Inserts declines the

processor to control the coupling again and the F/B2 module installs Ⅲ 6 (down), Ⅲ 7 (down). Exerts 210 decide in the frequency control signal five time pulse code: 1A-2-1…1A-2-40，2A-2-1…2A-2-40，1B-2-1…1B-2-40，2B-2-1…2B-2-40，3B-2-1…3B-2-40and 1A、2A、1B、2B、3B the signals, add to the microwave matrix M40×5 switch on. Puts through 40 groups to input /5 group output, each group of frequency spectra after two levels of center frequency difference levels enlargements and two levels of program control weakens equilibrium and match. Realization in 512 MHz--768MHz operating frequency scope 40 different center frequency. The band width is 6.4MHz or 256MHz. Fixed frequency spectrum signal in five ports any or two, three, four, five outputs, also may cause the standard value signal which willfully five independent frequency spectra signals simultaneously reappears. Decides the frequency launch channel is the five ports outputs frequency spectrum. Level of surveys frequencies and decide frequency launching device processing for the F/B2 module installment before. Inserts declines the processor to complete self-checking, to check against the authoritative text, the operation, the diary and function and so on program control data storage. After the evacuation adjustment condition, decides the frequency channel to be possible to enter the normal work, to monitor and reports to the police the condition.

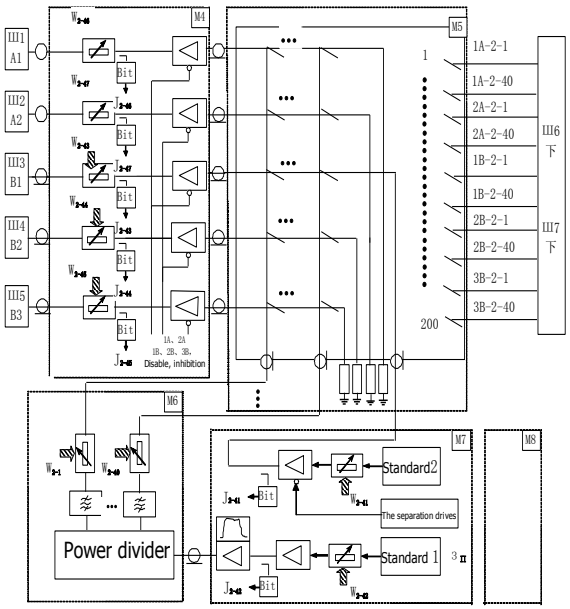

Figure 11. Electric circuits functions diagram.

(3) The connection technical design

This inserts declines the processor control module, is through is measured to various channels corresponding each other between check-drop, the output examination value examination, realizes to in the module installment program control attenuator, the amplifier, the comparator and the digital potentiometer and so on, waited for the adjustment unit the automatic correction, simultaneously also needs to act according to by the measuring point result and the automatic control situation completes to the module installment channel and the correlation unit failure detection.

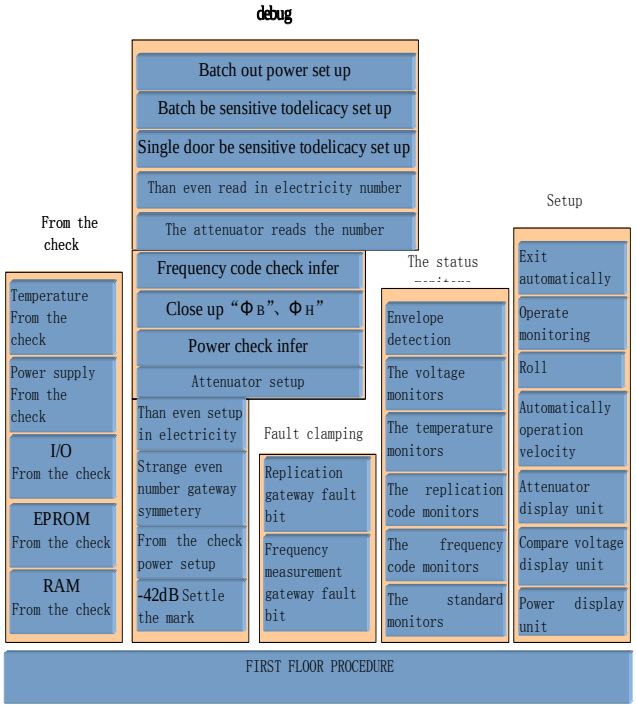

Figure 12. Charts software programming frame chart.

Frequency measurement channel control unit: Mainly is the use multichannel change-over switch and inserts declines the A/D switch which the processor brings, completes to 40 groups channels outputs peak-to-peak value signal examination, and separately gathers as well as passes through 40 comparators output signal data, and brings E2PROM according to the actual situation through the SPI main line the digital potentiometer series connection, completes 40 groups comparators the reference voltages automatic control and the corresponding signal memory; Simultaneously also must complete the gain through the serial data transmission way to in the channel 4 program control attenuator the automatic control, saves its adjustment value to I2C in main line serial E2PROM. After prepares the equipment to fall the electricity the data loss, simultaneously also contains some auxiliary switch quantities the control.

Decides the frequency channel control unit: The same frequency measurement channel control unit function has same many place, it needs to use the multichannel change-over switch to complete 50 group A/D to transform, and through the data serial way, completes to 45 groups program control attenuators automatic gain control as well as the corresponding data memory.

Man-machine connection unit: Mainly is carries on keying waveform processing, the operation control, the system active status as well as and reports to the police

the control in the LCD display control, the control algorithm realization, and decides the frequency launch channel control unit with the survey frequency channel control unit the exchange of information, the transmission and so on.

(4) Control system software design

This system software integrated development environment is based on the Windows environment under development platform, its collection to the source program edition, the assembly, the counter-assembly and the entire software simulation debugging to a body, the function is complete, easy to operate.

Because in this operating system involves software work load extremely big, therefore accounts for the length to be more below, therefore this article only produces each link software design program flow diagram.

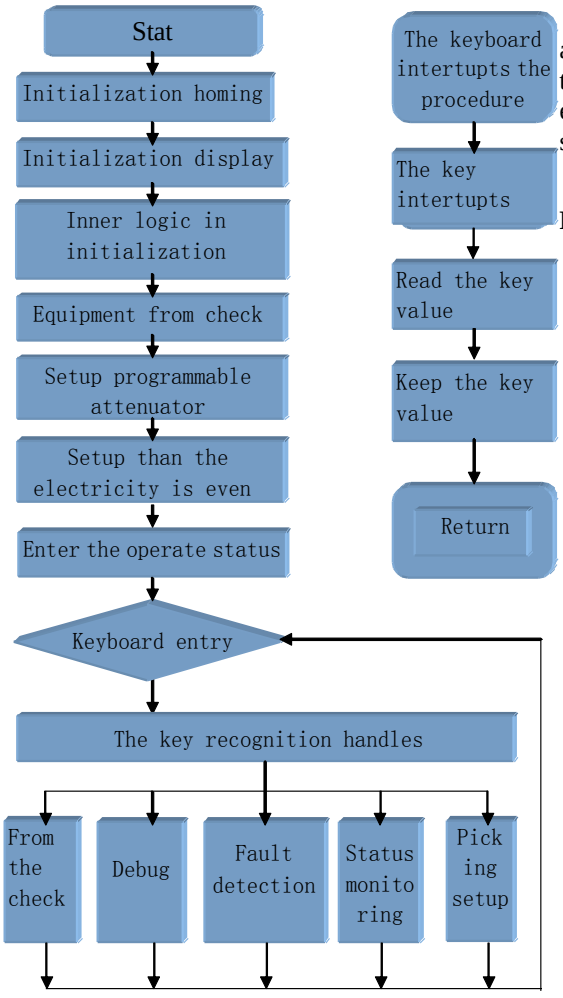

Figure 13. Software main regulations flow chart.

(5) Structural design

The aluminum alloy engine case is advantageous to the electromagnetic screen and the protection, in addition in the box uses "the la" the character district, forms box 工 our independent small metals engine cases. This is advantageous to the system has the different function module, can works together when the different small metal engine case, mutually reduces the disturbance. Causes the entire machine electromagnetic screen guarantee input/output signal the quality, internal independent shield part also plays the isolation to disturb the electrical signal the role.

3. Conclusions

This article successfully utilized the survey frequency/to decide the frequency launch principle to realize the project technology research, realized the athletic facilities survey through the design to be away from the installment in the automobile travel protection and the security reliability and the correlation control point design, caused when in advance the automobile high speed travel strengthened the initiative security performance.

Although so, because in the middle of the automobile travel process is relating person's safety, therefore its performance also waits for further enhances, strengthens the overall system the absolute security, then carries on the promotion to it.

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