KECHUANG CREATOR LEAGUE

User Manual of Scalar Network Analyzer

100KHz ... 3GHz KC901H

Hardware's Version V2.5 Software Version V2.8

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Introduction

The development of KC901H aims at providing radio technological workers with a multimeter of radiofrequency that solves problems on the spot. As a result, the main function of KC901H is scalar network analysis with extensional functions of spectrum, field strength and signal generator. Spending on exterior is reduced while the expense of circuit is no spared so as to get the maximum practicality. The price is set based on the principle of commonweal that benefits amateurs in noncommercial use.

◆Main Features*

The frequency range is as high as 3GHz

The stepped frequency of entire domain is 1Hz

The test range is 110dB

The test uncertainty is less than 3dB

Tracking receiver and narrowband detection are used

Multifunction, compact and portable

* in accordance with Chapter Seven Technical parameters

◆Main Functions

Transmission test (debugging diplexer and filter, testing amplifier and inspecting the directivity of antennas)

Reflection test (examining quality of antenna system and feeder system, tracking receiver is used to prevent the surrounding noise)

Spectrum display and field strength detection (inspecting radio station emission performances and searching for interference sources)

◆Recommended Applications

KC901H is designed for debugging RF devices, such as diplexer, filter, amplifier, splitter, combiner, and testing standing wave of antennas and insertion loss of feeders. Properly Increase the number of external attenuator so as to debug the loop of RF transmitter and receiver. In most bands, field strength measurement, interference lookup, locating the cable's fault point and speed factor

measurement are all allowed.

KC901H particularly apply to Periodic examine every part of projects or DIY works on the spot. It promotes working efficiency, ease carrying burden as well as improve quality of works. It can serve as a regular apparatus for technicians in professional Communication Engineering and radio and TV emission stations. In addition, it gives a hand to radio amateurs.

◆Acceptance and Check

When accept the apparatus, it is necessary to confirm the integrity of package. First step is to read introduction of user manual and check the apparatus.

A standard packing includes:

KC901H host 1

Charger 1

Strap 1

User manual 1

Check up all items, and make sure of no damaged appearance. Examine whether screws of host loose and unusual sound heard as shaking. Without exceptional cases, the apparatus can start by pressing POWER. Read through user manual before use it.

◆Safety Notes

When the apparatus absorbs water or unusual sound is heard, do not start it up.

During thunderstorms, it must not be used to test outdoor equipments like antenna and cable. With someone watching, it is allowed to be connected with DUT (device under test).

It mustn't be used to test active devices when it charges with main supply charger. It should charge with earth connection.

Pay attention to earth connection of DUT to prevent electric shock. Equipotential touching is necessary before connection to avoid static electricity damages the apparatus and DUT.

With no one watching, charging is no allowed. The apparatus charges and starts up away from inflammables and explosives. Do not cover the apparatus and charger with any goods.

It is prohibited of use in places surrounded by inflammable and explosive gases

or dust.

Generally the allocative strap meets the demand of users; however, more anti-falling measures should be taken to enable working in height.

Do not pack the apparatus with tools into toolbox. Be careful of doing harm to the occupants and equipments when place it on the car or bus.

Take notice of the temperature range of storage and usage. Do not place it on vehicle under sun exposure.

KC901H must neither dispense jamming nor be used for purposes that are illegal or harmful to others. When it is linked with any antenna or shield undesirable DUT, the interference with radio service is supposed to be avoided. People with cardiac pacemakers or other intrusive electronic equipments should use with caution. Be on guard of electromagnetic emission influence on medical equipments in the hospital. Use in operation room or ICU is not allowed.

As you take a plane, you must carry it with you. Firstly field strength mode should be set at the frequency o f 435MHz, and then turn off the power.

The containing Lithium battery's capacity is19.5 Wh.

Please place it out of the reach of children. When KC901H is lent, the user should urge the borrower to read user manual and inform the borrower of safety notes.

◆Important Statement

KC901H is neither a commercialized product nor a vector analyzer. It is unable to solve all problems for the research o f RF circuit. It is unable to meet the demands for appearance and details of all users. Even though we have done our best to make it practical, convenient and useful, defects still exit. We are willing to take your suggestions.

To the full extent of the law, KeXinshe is nor responsible for the loss beyond the prize of KC901H under any circumstances. We take no responsibility for any indirect loss and losses in terms of time, business, inconvenience, profit and abuse. Maintenance, replacement or returning product and the purchase prize are the only remedial measures we can take. Kexinshe only take responsibility for the product within the guarantee period.

Under any circumstances, we do not guarantee its applicability, reliability and Security for purposes of commerce, industry and military.

* * *

Origin: Chengdu, Sichuan Province, China.

Chapter One. Quick Guide

It is easy to get familiar with the operation of KC901H within one or two days.

Please charge your KC901H for three hours before use. If hissing noise is heard while charging, it is normal. Firstly, please paste the keyboard cover (if it is available). Secondly, install the strap. Finally, remove the protective films from the screen. We also provide you with glass screen protector. So there is no necessary of pasting screen protector which could reduce visibility under the sun.

How to Carry and Hold

The strap is unilateral designed. When using it, please take it off from your shoulder, adjust the strap to the maximum length, and wear the strap slantingly as well as straightly. For convenience the screen is expected to be towards your body. In addition, you can plug two ends into one hang hole. The strap should be shorten and slung over shoulder when running with it, and prevent injury to the body.

KC901H is designed to be held with left hand and be handling with right hand. When standing to operate, please hold your hands at the upper-left, thumb the knob and place the bottom against your stomach. To connectors, hold testing attachments (such as antenna) and use the keyboard with right hand.

The cursor can be switched by pressing the knob. If CENT, SPAN or REF is pressed, you can switch the above setting by pressing the knob before existing setup.

Keyboard and Power Switch

Chart one shows keyboard functional layout of KC901H. To press the power switch momentarily at the bottom left, the apparatus will shift between ON and OFF. After the boot, the testing mode menu is shown. The main setting is consistent with last time.

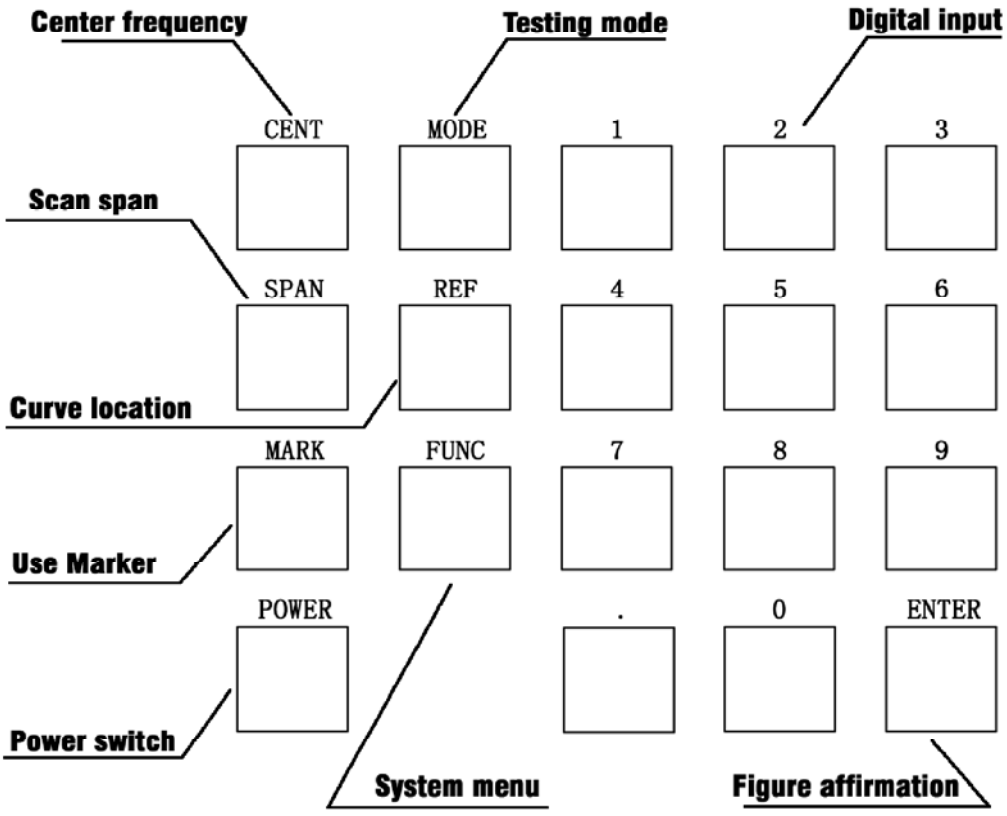


Chart 1. The Keyboard of KC901H

Layout

Chart two displays functional zoning of the screen. All the figures on the top are reading values except battery voltage indication. The first line below the coordinate graphs shows parameters like center frequency and scan span. The second line is system state showing the current mode, the running state and issues which should be paid attention to. The Setup menu is at the bottom.

In the measurement mode menu, S11 is reflection test; S21 is transfer test; Gen is the source; SPEC is spectrum l view; FIELD shows field intensity(（insertion loss included）. Choose the one you need. If it is unnecessary to switch mode, press MODE to the current menu.

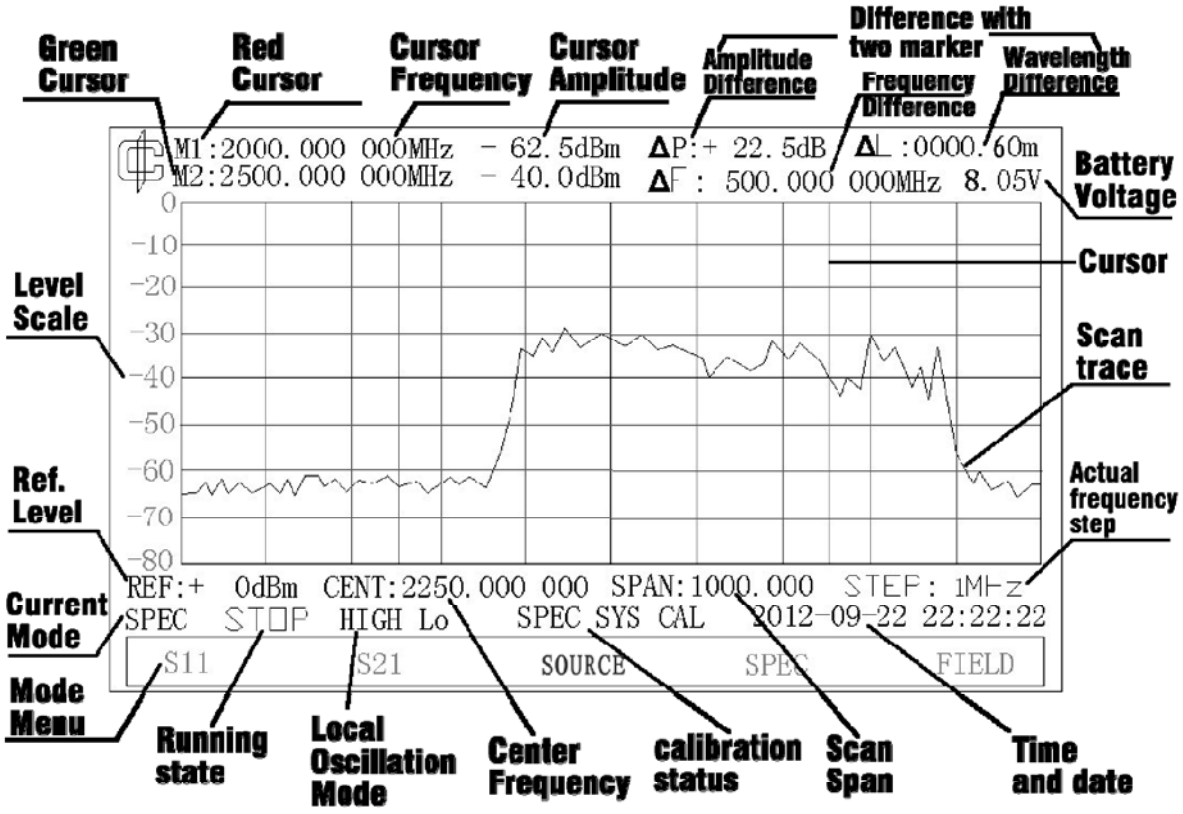


Chart 2. The Display Interface (Spectrum Mode after Boot)

Functions and Typical Applications

Five kinds of basic function: reflection test(S11) , transfer test(S21), signal generator(GEN), Spectral View(SPEC) ,filed intensity(FILED). Signal generator, spectral view and field intensity are informal functions.

Reflection test has two ways of display. One is return loss(LOSS), and another is standing wave(SWR). Two sub functions of transfer test: amplitude-frequency characteristics figure (S21) and measurement of insertion loss. The entry of Insertion loss test (GEN ON) is set in field intensity mode so as to keep consistent with common test receivers.

RF signals of given frequency can be generated by SOURCE mode and output from Port 1. Its amplitude is adjustable in a certain range by a built-in attenuator. This built-in attenuator is also an Amplitude Shift Keying (ASK) modulator. If the modulator is employed to adjust the output amplitude, the occupied attenuation cannot be used for modulating. So, the modulation depth and the output attenuation are mutually exclusive. The output attenuation is larger, the smaller the modulation depth.

The typical application of **Reflection Test (S11)** is testing the standing wave of antenna. You should choose the left port. Combined with advanced usage knowledge, S11 can also be used to test the length and speed factor of cables.

Access: MODE and then press S11.

The typical application of **S21** is testing amplitude-frequency characteristics of filter or amplifier and gains of antenna. The left port is to output signal, and the right one is to input.

Access: MODE and then press S21.

Insertion Loss Test is a special type of transfer test, characterized by high respond speed. As a result, it applies to the accurate adjustment of filter and amplifier as well as testing gains of antenna.

Access: firstly MODE, and then press FIELD, finally GEN ON.

GEN produces a millwatts signal, with an application of transmitting weak signals to the air to determine the sensibility of radio station from a close distance, particularly the sensibility of relay station. It is handier to use the small signal for experienced users. More externally connected attenuators further develop the applications of signal source.

Access: MODE and then press SOURCE.

The typical application of **SPEC** is monitoring the occupancy and the interference of band and debugging circuits which producing RF signals except 45 MHz。KCSA-R100 is connected to find unidentified emission source.

Access: MODE and then press SPEC.

FIELD applies to not only testing field strength coverage but also searching the amplitude of RF. The port of 901H is capable of DC isolation so as to externally connect probes to directly search the signal value of receiver and transmitter. It is necessary to match impedance and concatenate attenuator when detecting transmitter. As long as experiences are got, FIELD is used to detect emission the radio station to find fault in time.

Access: MODE and then press FLELD.

Selecting Function into Testing Mode

When the apparatus begins to run, a default functional menu is presented at the bottom of the screen. Choose a test pattern needed. MODE turns the screen back to the functional menu to change functions. The apparatus shifts between functional menu and the current menu by using MODE a couple of times.

Enter S11 and SWR into SWR mode. If the system calibration of S11 is in OFF CALL, ON CALL should be pressed to start firstly.

***Options on menu shows the action taken after pressed. When FAST is seen, pressing the key is to go to FAST.**

Adjustment of Running State

The default only scan once and turns into **STOP** immediately soon after apparatus started up. Manual starting should be taken to start scan. To select a function needed or **MODE** once to enter the mode menu that includes startup option.

There are SINGLE and RUN (STOP) on the left of the mode menu.

SINGLE: Single scan. Every time the key is pressed, the apparatus scans once.

RUN: Free scan. It turns into STOP as it scans continuously.

STOP: Stop scan. The screen prompts STOP. When the scan of current screen is finished, it changes into STOP mode.

* When it operates free scan, **SINGLE** is useless.

* In STOP mode, it scans once automatically when the main parameter settings are altered.

* There are only **RUN** and **STOP** in FIELD.

Local Oscillation Mode Setting

Local oscillations in both SPEC mode and FIELD mode are used to judge mirror effect.

Low Lo: low local oscillation. If local oscillating frequency is lower than the measured frequency, mirror-image jam is caused by the lower frequency.

High Lo: high local oscillation. If local oscillating frequency is higher, mirror-image jam is caused by the higher one.

If a signal appears in the same position whatever the local oscillating mode is, it is likely to be there really. If it disappears in any mode, it must be false. Appearing on the low Lo while disappearing on the high Lo, the signal frequency is determined by subtracting 90MHz from the appearing frequency. Appearing on the high Lo while disappearing on the low Lo, the signal frequency is determined by adding the appearing frequency and 90MHz up.

If the height of background noise differs in modes, the priority is the lower one.

* Local oscillation mode is ineffective below 100MHz and above 2800MHz.

** Not entirely, some spurious responses, like intermodulation, may exist.

Basic Testing Parameters Setting

Basic testing parameters consist of the center frequency, scan span, reference level and the drawing pace of frequency.

When setting the center frequency, you should firstly press **CENT** and then type on the numeric keyboard. You can adjust with dial wheel when the new frequency closes to the current one. In a clockwise direction, the frequency increases. On the contrary, it decreases.

When setting the scan width, you should firstly press **SPAN**, and then follow the steps above.

When setting the reference level, you should firstly press **REF**, and then either dial wheel or select " – "and "+".

To set the step of frequency, you should select **MAX STEP** on the left of **FUNC** menu. In general, please set 1MHz. The apparatus will choose a proper STEP automatically according to scan width.

On the mode menu of S21, 20dB/div or 10dB/div switches the amplitude of ordinate.

Field Strength Mode Setting

The actual measurement is the level of input port, the field strength will be obtained by the input level and antenna factor. Antenna factor is mainly relevant with frequency and antenna gain. The apparatus should get the antenna gain in order to obtain the accurate reading of field.

After enter the FIELD mode, you should press **ANT GAIN** on the right side. Firstly Select " +/- ",and then input the antenna gain on numeric keyboard.

The item in the middle decides the refresh time of reading in levels of FAST, MIDDLE and SLOW. MIDDLE is recommended. The refresh time of Table S not disturbed by the setting is used to observe instantaneous changes of signal intensity.

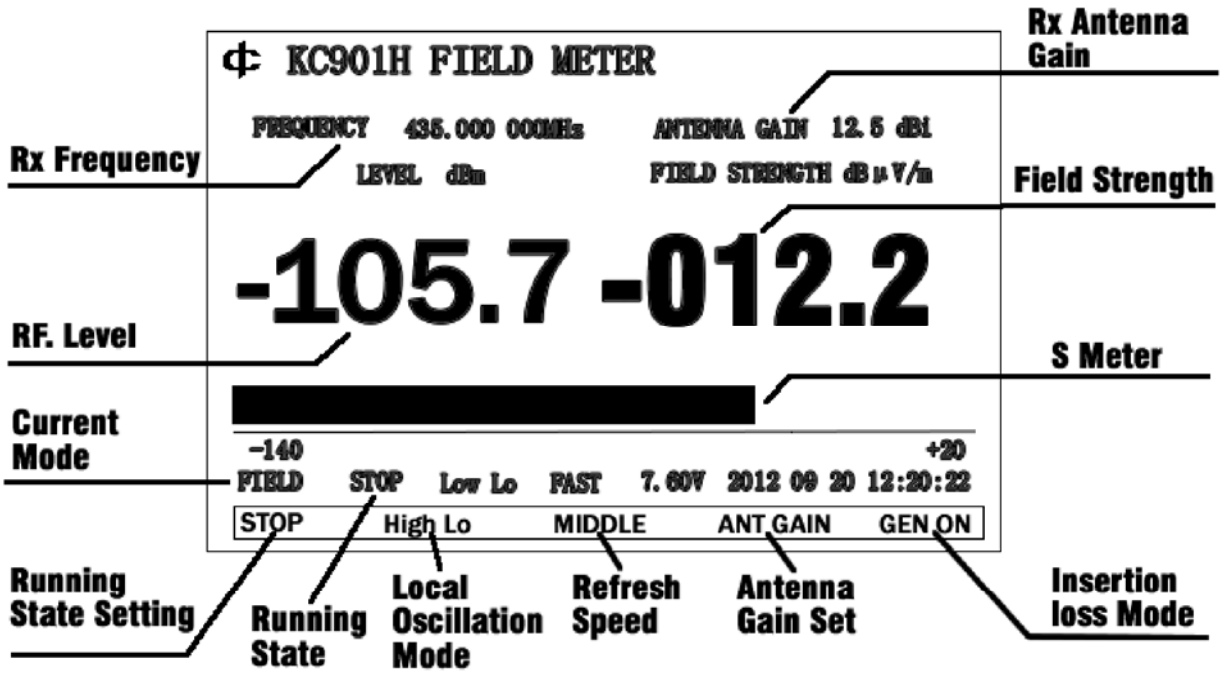


Chart 3: Field Mode (only for illustration, please refer to the actual display)

Insertion Loss Test Mode

Insertion loss is the system of single frequency of S21. It is essential test of S21, whereas only a single point frequency is tested. The respond speed of insertion loss higher than that of S21 is appropriate for the accurate adjustment of filter and diplexer.

After entering the FIELD test mode, **GEN ON** on the right of the menu means starting signal input. To select **GEN ON** into the display of insertion loss test. On the left of the screen, you will see that the reading is still absolute level value. While on the right, it has been relative value. Connect the RF port with testing cable, select LEVEL SHIFT to adjust the relative level value into zero. Next, you link testing cable to the device under test. Now, the reading on the right side is the value of insertion loss.

In insertion loss test, do a tentative adjustment of local oscillation. The smaller reading should be taken.

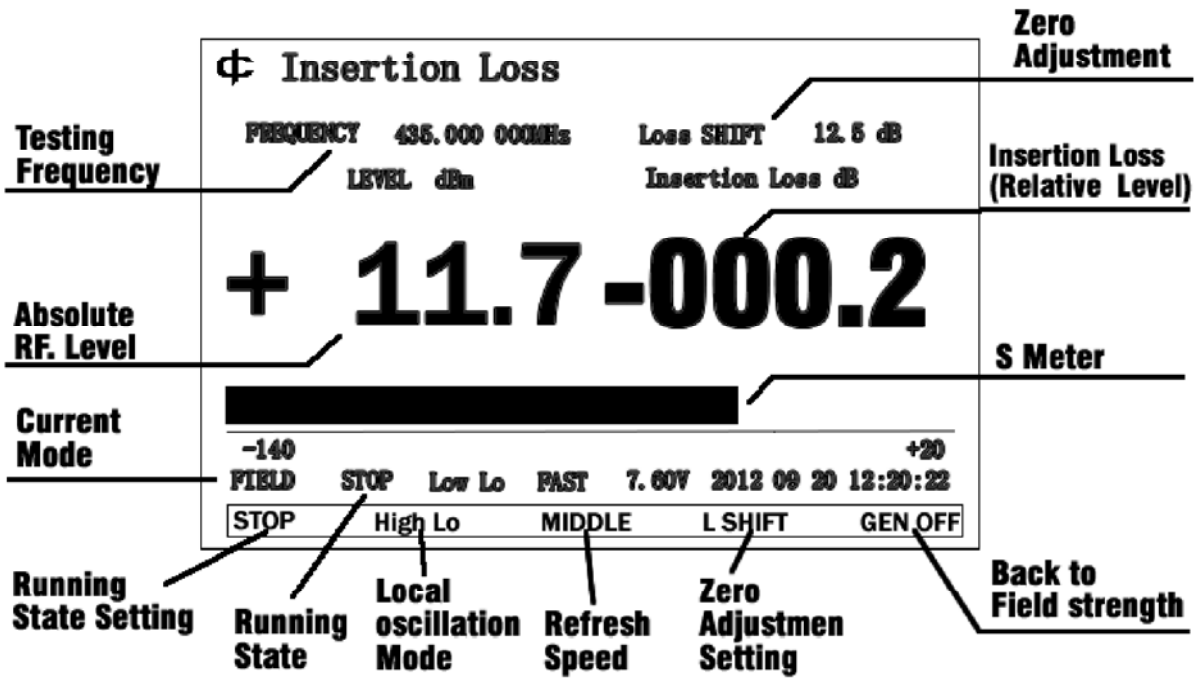


Chart 4 Display of the insertion loss test

Signal generator Setting

The basic parameters consist of carrier frequency, output decrement, modulation frequency and modulation depth. The function of signal generator is not guaranteed.

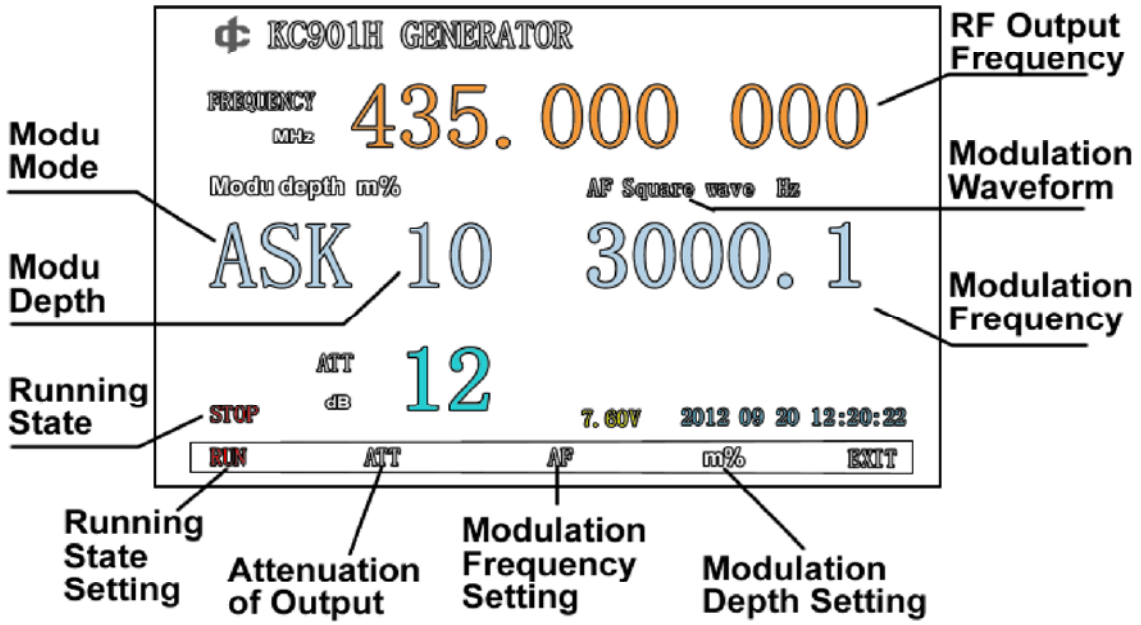


Chart 5. The display of Signal Source and Settings

This chapter illustrates the common working knowledge of KC901H. More details of operate instruction, please refer to Chapter Three.

Chapter Two. Abbreviations

The English system is used in KC901H with a great number of English abbreviations of proper names in radiofrequency testing. Here is an introduction of the frequently used abbreviations.

S parameter is the scattering parameter of RF network. Sab is the power relationship between exit (port a) and incident (port b). (vector analysis phase relation)

S_{11}: The relation between the incident signal from port 1 and the reflected signal from port 1 (via DUT) is return loss measured in decibel value. In radio communication, return loss is converted into SWR. SWR=1.0 stands for no reflection.

S_{21}: The relation between the incident signal from port 1 and the signal output from port 2(via DUT) is insertion loss or gain.

dB is named logarithmic relationship , a way to present quantitative relation . definition: dB=20log（V2/V1）and dB=10log（P2/P1）. In terms of voltage

dBm , the abbreviation of dBmW, is a power unit. **0dBm=1mW，30dBm** means **1000mW=1W**. dBm is the bigger unit with big negative numbers in open circuit test, for example -90dBm=0.000000001mW=1pW.

dBμ, the abbreviation of dBμV, is a voltage unit. **dBμ=1μV，60 dBμ=1000μV=1mV，120dBμ=1V**.

KC901H adopts the 50 ohm characteristic impedance. As impedance is known, power will be calculated with the application of ohms law once voltage is got and vice versa. It is easy to calculate if the representation of a logarithm is employed. **0dBm=107dBμ（Z=50Ω） and dBμ=dBm+107（Z=50Ω）** are important quantitative relations.

MODE is the test mode of KC901H to test S11, S21, SPEC and FIELD.

CENT (center) shows the center frequency which is the frequency of center line.

Span is the scanning width. The stop frequency minus the start frequency is span. The gap between the center frequency and the start frequency or the stopl frequency is equal to half of span. If span=zero is set, KC901H will only work in the center frequency. At the same time, spectra will show the changed trend of signal amplitude.

RBW is analyzing bandwidth that is approximately equals the pass bandwidth of IF filter of receiver.

Step is frequency drawing pace. As the frequency synthesis technology is employed, step is the pace in discrete scanning. Step should be shorter than the analyzing bandwidth or the bandwidth of detail sections of DUT; otherwise the skipped frequency will be missed. It takes some time to scan in small step, so it is necessary to weigh pros and cons. The step numerical can be set by users to limit the MAX STEP. Meanwhile the system limits scan points less than 100,000. As span is decreased, the system will adopt the step as small as possible.

If accuracy is more important than speed, the step can be decreased by hand. In most cases, 1MHz is suggested.

REF is reference level. In spectrum mode, REF is the level value of the line on the top of the picture frame. If REF=0dBm, the signal level is 0dBm as soon as the spectrum arrives at the peak. REF is related to IF gain. As REF decreases, IF gain increases. The smaller REF is taken when testing the weak signal. The bigger REF is taken when testing the strong signal. If REF is small and signal is too strong, IF may overload even the amplifier will burn down. In S21 mode, IF gain adjusts automatically according to signal no matter how REF changes.

In S test mode, REF displays the relative level on the top of the picture frame.

M、mark（marker）：Cursor. The two cursors of KC901H vary in colors. The frequency corresponding to the cursor shows on the top of window, and the level (or S parameter) display

RUN/STOP controls on-off of scan. RUN is the abbreviation of the FREE RUN. After it is pressed, the KC901H will keep scanning. And the scanning will stop after STOP is pressed. Under the situation of STOP, it will scan a screen and then stops after SINGLE (single scan) is pressed. And in the situation of STOP, the RF part which the most power-hungry part of KC901H is power off. This can significantly save energy.

As soon as the apparatus STOP, automatic initialization setting of RF part should be done next time starting it. Do not STOP once user calibration starts.

The others:

Abbreviation	Meaning	Abbreviation	Meaning
power，PWR	Power switch， power port	INT CAL	Using intersystem Calibration data
APO	Automatic poweroff	Lo	Local oscillator
ANT GAIN	Antenna gain	Low Lo	Low local oscillator mode
BEEP ON	Opening key tone	OFFCAL	No calibration used
BL	Screen brightness	ON CAL	Calibration used
CAL	Calibration	SINGLE	Single scan
FUNC	Functional menu	SOURCE	Source, output port
HOLD	Holding spectrum line	SPEC	Spectrum display
High Lo	High local oscillator mode	ALC	Automatic(output) level control

Chapter Three. Basic Operations

Test Mode Setting

Test mode is available by pressing the MODE key. When you chose the one you need, the apparatus will swift to the menu.

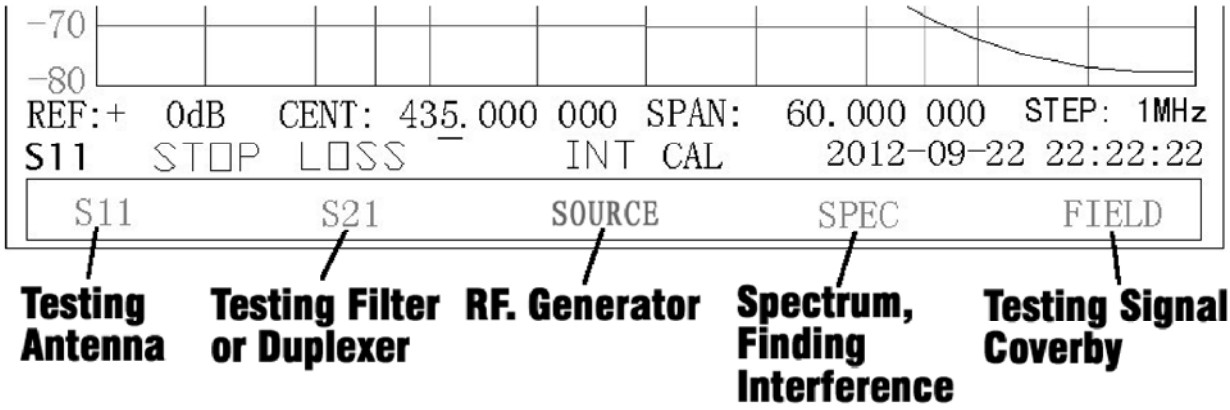


Chart 6 ： Display of 901H after MODE

Two displays of S11: Loss and SWR

A Switch in the middle of the menu in S11 shown in Chart 7:

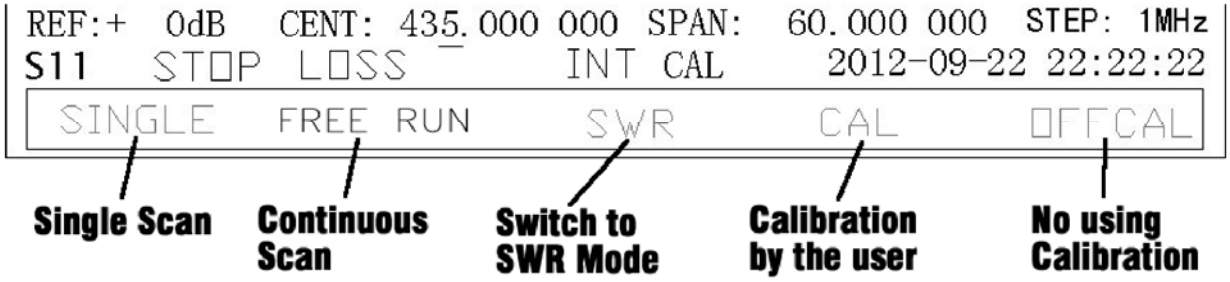


Chart 7 ： Menu of S11 mode, a switch of SWR and Loss in the middle of the menu

Press MODE to the mode menu. When in other menus, MODE is to return to the previous menu.

Precautions

The output power of KC901H may be over 10mW. Do not interfer radio service when installing the external antenna.

Center frequency Setting

Press **CENT** into the center frequency setting menu. Every time "-<-"、"->-" is used; the center frequency has an eighth-screen translation to locate the spectral line immediately.

Key board can be used to input frequency. Firstly, type figures of MHz. After typing the decimal point, you move to type figures of KHz and Hz. You can ENTER to affirm the frequency. Once the inputting digits are insufficient, the apparatus will fill out "0".Poked wheel is used to do vernier adjustment, and the pace is linked with SPAN.

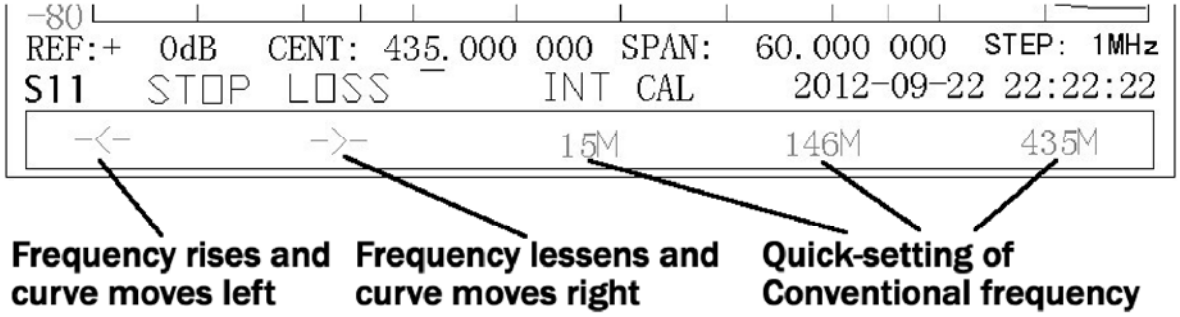


Chart 8: the Menu of CENT

Frequency Span Setting

Press **SPAN** into its menu. The frequency span is either quickly selected or inputted. Poked wheel is used to do vernier adjustment, and the step is linked with SPAN. The step is wider as SPAN increases. After setting of frequency and frequency span is finished, the apparatus will load system calibration parameters in a few seconds.

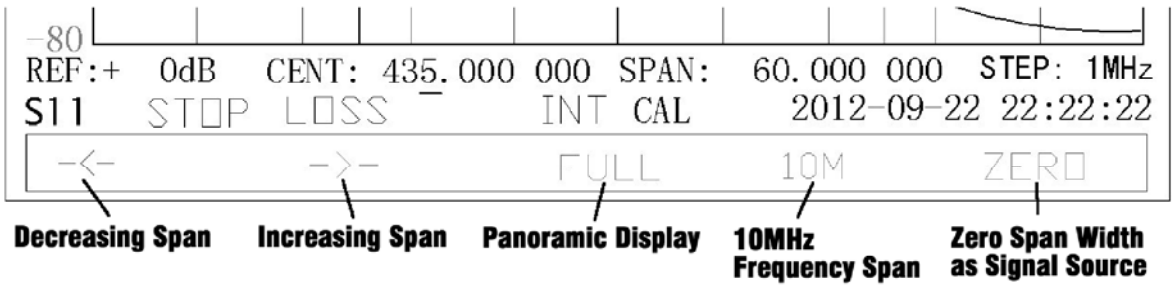


Chart 9: the Menu of SPAN

Reference Level Setting

Press REF into reference level setting menu. The meanings of reference level vary in test modes. In spectrum mode, the reference level should be set slightly bigger than the signal being test after the signal being estimated.

In S21 mode, the test result is a relative value which REF refers to. 10dB is suggested to be set, and it will be adjusted as the test goes on.

Poked wheel or "+"、"-"in menu is used to set REF, and stepper is +10dB.

In S21 mode, when AGC operates automatically and the chain between REF and IF gain is unlocked, observe the spectral line out of indication range by adjusting REF.

Two display types in S11 test mode: log(loss) and SWR. REF of log is suggested to be +10dB. REF is invalid in SWR.

*In spectrum mode, REF is linked with IF gain. In other modes, REF is only related to display and IF gain adjusts automatically according to signal.

Usage of Cursor

Press **MARK** into cursor menu. When MAX PEAK is selected, the cursor will search for the maximum (used in spectrum mode) of spectral line in indication range. Poked wheel is used as position regulation of cursor. Either M1/M2 in soft menu or poked wheel shifts the activated cursor that is highlighted. Select C=M（center=marker）to move spectral line to the center of the screen.

The reading of cursor is on the top of the screen. ⊿P is level difference between M1 and M2, and ⊿λ is wavelength difference between M1 and M2.

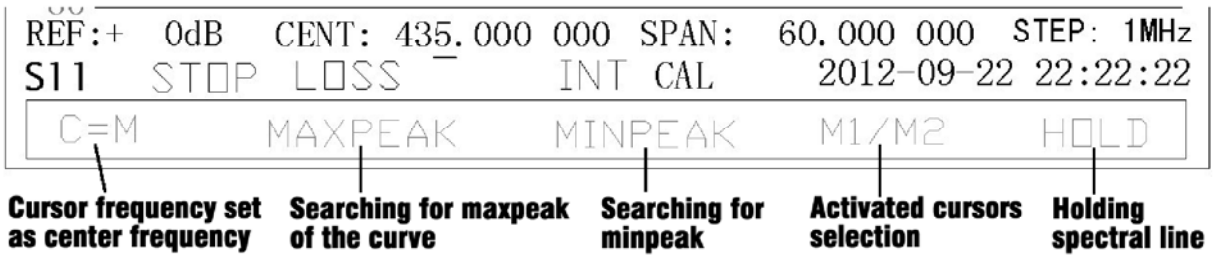


Chart 10: the Menu of Marker

Holding Spectrum Line

Single press HOLD in cursor menu, the apparatus suspends refresh display and the spectrum line remains the same. Press HOLD again, it resumes refresh. In HOLD mode, the spectrum being displayed does not be stored, so it will disappear as power off. Once measurement parameters are changed, it will exit from HOLD mode automatically.

HOLD function and STOP function have no similarity. In HOLD mode, the apparatus suspends refresh display but not suspends scanning, thus it does not save any power. HOLD function is employed in occasions when the user does

want to stop scanning (avoid loss of user calibration data).

Frequency step setting

Frequency step is the coordinate interval between two adjacent scan points. Step influences scanning accuracy and scanning speed which are automatically weighed by the apparatus. The auto selected step will be long as span is long, which results in omission of signal between two scan points. That is to say, under some circumstances, auto selected range requires restraint. Setting step actually constraints the maximum of auto selection. For example, when SPAN is 500MHz, the default STEP approximates 1MHz.if MAX STEP is set as 1 KHz, the apparatus scans 50,000 points with a 1 KHz step. When SPAN=1MHz, the auto selected step approximates 2 KHz. If MAX STEP is set as 1MHz, the apparatus scans at an interval of 2 KHz.

Way to setting step: press FUNC before select MAX STEP. Choose one of the five optional values.

Once scan points is more than 100,000, it makes no sense. Later versions have kept the max scan points within 100,000. In most cases, MAX STEP should be set as 1MHz.

System setting

FUNC is system setting menu. It determines step, SAVE, READ, TIME, APO (auto power off) and BL (screen brightness). Enter system setting in field mode is suggested.

SYS, the subordinate menu of FUNC, is only accessible to system information for the user. Debug interface is accessible to authorized maintenance crews and manufacturer, not to the user.

Dial wheel setting

Do not stop holding F1 when turning on the power until entering dial wheel setting menu. Press keys corresponding to right and left to change directions. The left is used more often.

Restoring factory settings

Do not stop Holding MODE to turn on the power until enter restoring factory settings menu. After Pressing key of set option, the apparatus will purge user data.

Date and time setting

Press FUNC firstly and then select TIME menu, next press SYS TIME. Date and time should be input via keyboard once, the form is like: 20120825223000. The system will store automatically as soon as input finishes.

Automatic shut setting

Firstly press FUNC and NEXT, and then select TIME menu, finally select APO menu. If APO ON occurs on the left of menu, automatic shut does not start. If the time shows, automatic shut starts, which can be turned off by APO OFF. "+" and"-"adjust the time in range of 3…30 min. When STOP state changes automatic shut setting, RUN once to put it into effect.

Functions of Ports

KC901H has two external RF ports. One is the output port of sweep oscillator; another is the input port of tracking receiver. In KC901H, there is another tracking receiver, the port of which is directly linked to the reverse detection port of directional electric bridge.

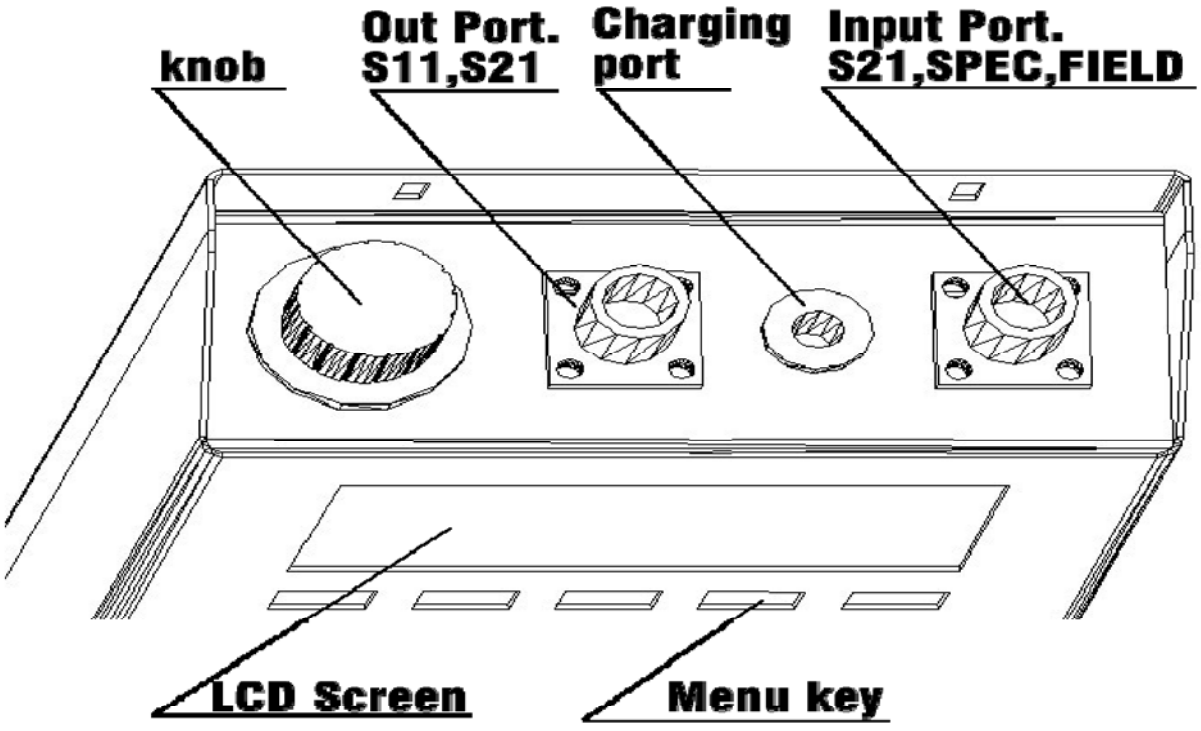


Chart 11: layout of port

Chapter Four. User Calibration and Preparations before Test

Because KC902H is designed for engineering application, it is important to reduce operation procedures. Normalization of its ports has been finished, therefore direct use is allowed in most cases. As a result of temperature variation, the curve may deviate after power on in the field. In common engineering applications, it is not necessary to calibrate KC901H as long as the testing result is helpful to analyze and solve problems.

Cables and a great number of connectors, indispensable to test, cause insertion loss. With time going by and the temperature changing, performance of KC901H may drift. All those disadvantages have negative impact on test, the user can do calibration as occasion requires.

User's Calibration is a temporary measure. Once setup parameters changes or the apparatus reboots, loss of calibration data is inevitable.

Notes

Please ensure that the apparatus is in RUN mode and do not press STOP before you operate calibration. Otherwise the data just prepared will be cleared next time RUN mode starts. Pressing CAL in STOP mode for the first time equals to pressing RUN.

4.1 Calibration before Testing S21

If DUT is small and light, one of the ports can be directly linked to the apparatus, although it is no a good habit. On that occasion, one more cable constitutes testing system. If DUT is big or the connectors do no match each other, two RF cables are needed.

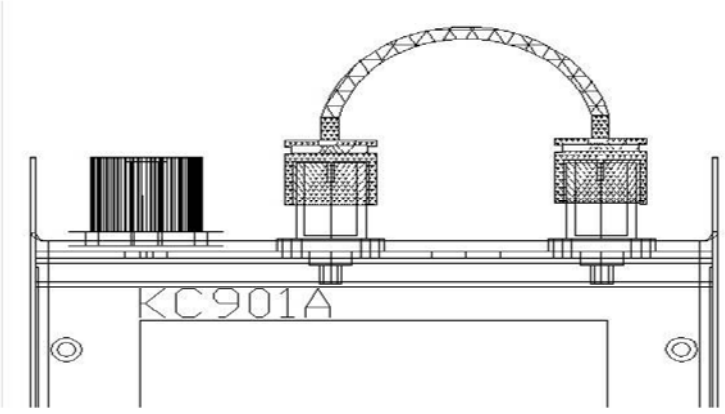


Chart 12A: Connection with one cable

As for one cable, it should be bridged over the two ports before test (chart12A). As for two cables, them should be connected with a connector of good quality and bridged over the two ports(chart 12B).

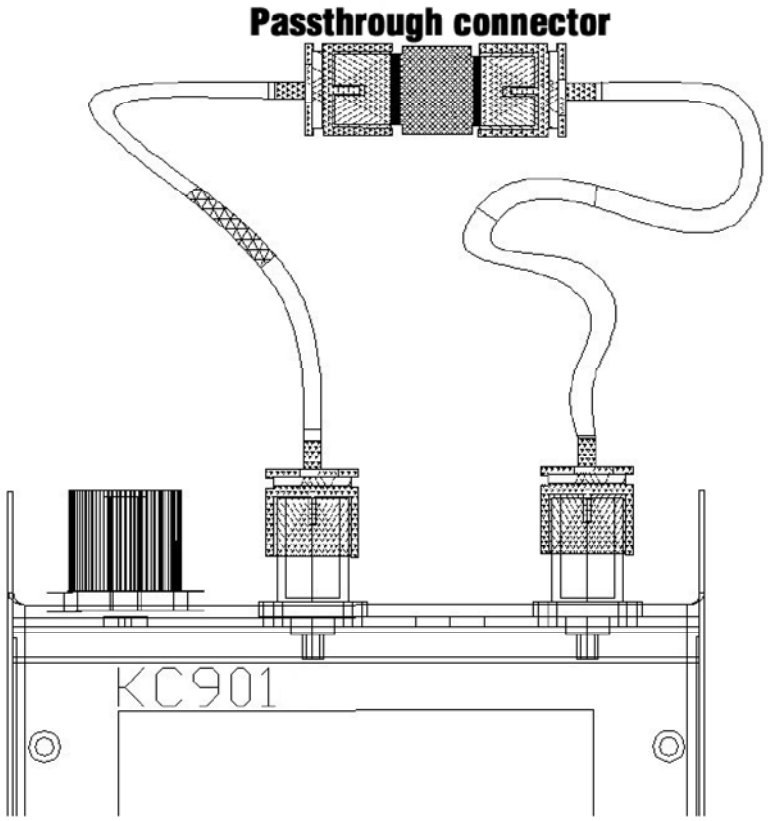


Chart 12B: Connection of Two Cables

Operating steps of User's calibration:

（1） Enter S21 mode, select **RUN** to scan, Please CAL→(2)connect cables→（3）select CAL, press FUNC to calibrate →（4）wait a moment, CALED means calibration finishes.

If many series cables in different locations appear in on system, a single series calibration is suitable.

When testing power amplifier, connect an attenuator with the output port in series. If it is a little signal amplifier, connecting an attenuator with the input port in series is imperative. Once the output power 0f KC901H is more than 10mW, little signal amplifiers will be burned down. Before that kind of test, it is suggested that all the attenuators should be connected with cables in series to operate calibration.

User's calibration parameters do not be kept. Frequency variation or reboot resets factory default calibration parameters. Change SPAN and CENT as well as press STOP/RUN to replace the new calibration parameters with factory default ones. OFFCAL implies that any calibration could not be used.

Notes

Calibration modifies only the current frequency and attachments being used. Calibration should be restarted if the testing frequency and cables are changed.

Precautions

When testing active circuits (amplifier), you must connect attenuator with the output port to limit the inflowing level within 20dBm in unexpected situations.

4.2 Calibration before Testing S11

Although there are two display modes in S11 function, only one calibration is necessary because of the same data being shared in two modes. With stored factory default calibration data, no calibration is in need in S11 function, because it is designed for observation tendency not for accurate measurement. In cases of logarithmic unable return-to-zero, open-circuit curve of SWR lower than 5.0, DUT being connected with long cables and emergency usage in instrument failure, calibration is suggested.

OFF CAL is permitted in log mode. Calibration can not be turned off in SWR mode so as to avoid unusual function of curve. In latter versions, OFF CAL is limited.

Simple Calibration

Without leakage correction, Log display mode is only in need of simple calibration. Firstly, set the other parameters according to demands for test. Secondly, open the output port. Thirdly, press MODE→S11→CAL. When promoted, press FUNC to go on till calibration finishes. No simple calibration in SWR mode.

Standard Calibration

SWR mode needs standard calibration. Firstly, set the proper frequency parameter. Secondly, select CAL in SWR menu. Thirdly, when the apparatus indicates standard load, install a 50Ω fictitious load on output port. Fourthly, press FUNC to start calibration. Fifthly, connect Open and press FUNC. And then connect short following the prompts. Finally, press FUNC. CALED occurs in the screen as all calibrations are done.

For the sake of integrity of data, no dropout is permitted during calibration.

The qualities of load, open circuit and shorting device must be suitable. Return loss of load should be less than -40dB and SWR of open circuit and shorting device should be more than 50.

KC901H is a scalar apparatus. When the return loss under test is less than bridge directivity, calibrations of open circuit and shorting circuit can be both replaced by suspending port. Fictitious load is addictive. This method is recommended in engineering practice.

Even though the calibration of another end of cable has been done, it is not a good choice to test devices by long cables. SWR makes no sense, if cable loss > 2dB (antennas under 1GHz) and cable loss>1dB (antennas over 1GHz). In that case, please use high directing SW bridge.

Notes

With practical experiences, the user needs to recognize the vectorial resultant errors. When observe the variation tendency of return loss, pay more attention to the small numbers slowly emerging and small numbers in isolation. Be cautious of extreme minimums and periodic low ebbs. Periodic fluctuation peaks link into a curve closed to the validity.

4.3 Necessary Preparations

4.3.1 Check up battery power before brings the apparatus outdoor. After power on, switch to SPEC mode to observe voltage. If voltage>8.0V, it takes one hour to run out of power. It is strongly advised to set a 3min auto power off in case that the battery runs out. For long time outdoor work, either a charger or a vehicle power supply connector should be prepared. In wildness, an external battery pack is needed.

4.3.2 For frequent field work or under poor working conditions, please paste button film to cover the small gap preventing dust and water-drops away.

KC901H should be carried with a waterproof suitcase to prevent from rain and water. The specialized suitcase for KC901H is advised.

4.3.3 Proper attenuator should be prepared for testing transmitter and amplifier. A 10dB attenuator is ready to be installed on input port.

4.3.4 When testing antenna in places with lots of antennas, a terminal wattmeter is used to test inductive power of the antenna which should not be more than 0.1W. Usually, several sets of antennas are concentrated on the same

tower, inducing strong transmit power through space coupling .Too strong RF power induced from the antenna under test are bound to burn down the apparatus.

4.3.5 If short-wave antennas are erected near high voltage lines and substations testing induced voltage, not more than 15V, with multimeter Alternating Current .It is strongly suggested that the shield of coaxial line should be earthing nearby.

4.3.6 If RF signal of circuit board is tested by a probe, outside protective shield of testing cable should be connected with power earthing of circuit. It is dangerous to do suspension test that may burn out KC901H and board under test.

4.3.7 KC901H can be used during charging, but testing active devices are banned. If the test is inevitable, an equipotential bonding between power earthing of KC901H and power earthing of DUT is needed to avoid damage to DUT and the apparatus.

4.3.8 The standard strap is only suitable for general use. Firm safety rope and packing bag should be prepared for working in height to avoid accidental falling.

Chapter Five. Common Testing Methods

5.1 Quick Adjustment of Duplexer

A duplexer is an important part of a repeater. The insertion loss and isolation ratio of a duplexer are directly relative to the overall function of a repeater. KC901H can provide an isolation of exceeding 100dB operation range under regular VHF/UHF frequency band conditions and a duplexer can be adjusted at its best performance under the supervision of KC901H.

Prepared accessories for usage:

A fictitious load 50Ω, 2 RF Cables (with good shield and reliable connector assembly) and necessary RF connector assembly.

Recommended equipment of accessories: A high-pass filter of 100 MHz cut-off frequency (KC9506) and an attenuator of 10dB.

It is preferred to fix KC901H on the worktable.

Debugging tools:

Socket wrench with a hole in center, screwdriver. Fix the be-adjusted diplexer on the worktable if possible.

Here is an introduction of debugging steps by taking six-cavity duplexer as an example that works on the principle of notch filter.

Adjust the KC901H to S21 mode, and adjust the center and span of the apparatus so that frequency band can cover the original frequency and new frequency of duplexer. The REF can be adjusted to 0dB or +10dB (change the REF and ordinate span according to the position of curve. When the ordinate span reaches 20dB/div, the minimum REF can be only 20dB.). Adjust the Max step to 1MHz and open ON CAL. Move mark1 and mark 2 respectively to near the new receiver frequency and transmitter frequency.

Please use the apparatus to test the insertion loss (S21) RF cable first, then sway connection cable and connector lightly to look at if the curve dithers while testing in order to make sure there is no poor contact. The insertion loss of cable should be as small as possible, if the REF exceeds 3dB or is unstable, maybe there is malfunction with the cable. The quality of cable should be good enough to provide with excellent screen.

Clean the socket of the duplexer, then connect the output port of KC901H to the TX in-port of duplexer(usually marked “high”), next connect the in-port of the apparatus to the ANT(antenna) port, and connect the fictitious load to the RX

output port (usually marked “low”)(chart 13).

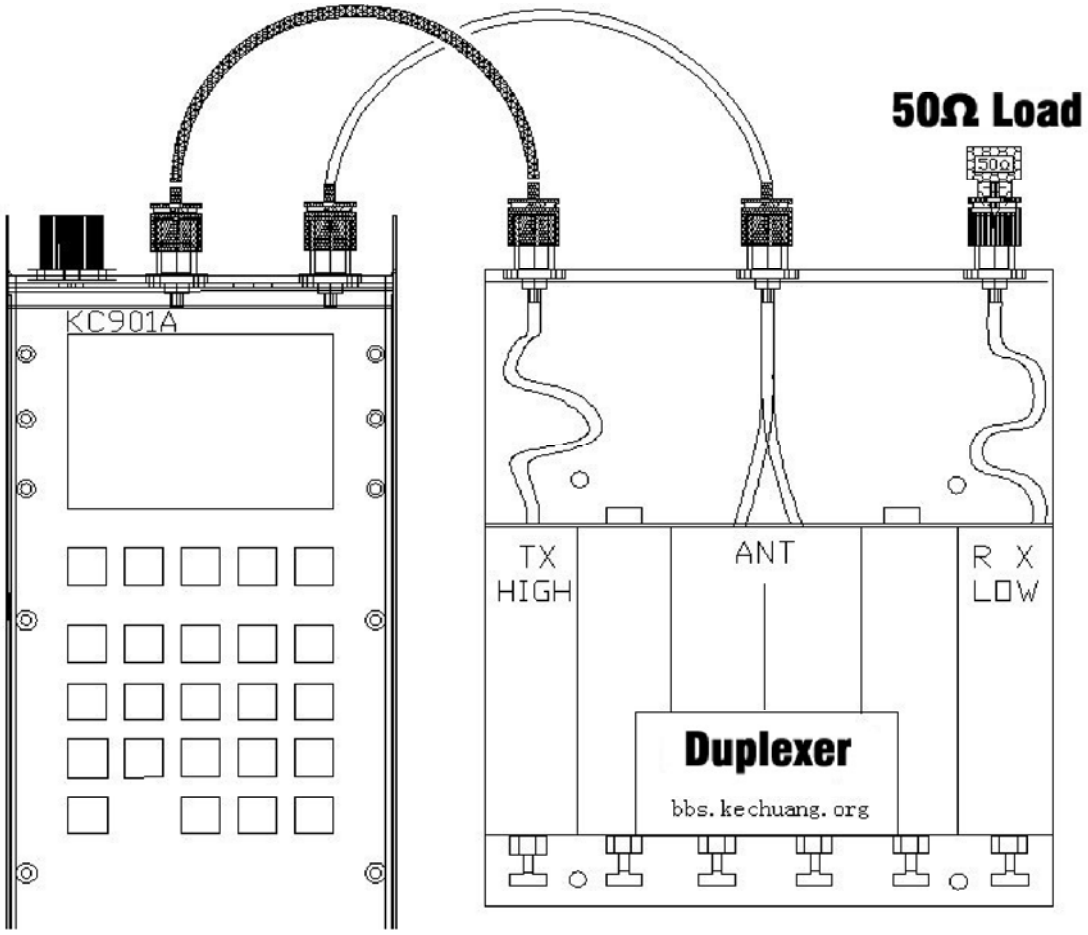


Chart13： Example for Connection Method of Duplexer Test

Adjust the three screws near the TX port to move the trough to mark1 indicated position until they overlap. Then take turns to slightly adjust screws under the supervision of S indication until the reading is the minimum (the maximum negative). Normally, the reading should reach or exceed-60dB. At this moment, mark1 means the HIGH isolation ratio and mark2 means the HIGH insertion loss.

Connect the output port of KC901H to RX port of duplexer, still connect the input port to the ANT port, and connect the fictitious load to the TX port. Adjust the three screws near the RX port to move the trough to mark2 indicated position until they overlap smoothly. Then repeatedly adjust the three screws from center to RX side until the mark2 indication is the minimum (the maximum negative). Normally, the reading should less than -60dB.

If necessary, reset the CENT, REF of the apparatus to reduce span so that the part of curve can be magnified. Adjust the mark1,2 position more accurately and at the mean time, connect testing cable with straight thread connector to go on

with S21 through calibration.

Connect the output port of Apparatus to TX port of duplexer, and then connect the fictitious load to the RX port. Next repeatedly adjust the three screws from middle to TX side to keep the mark1 minimum reading. Normally, the reading should less than -70dB, good quality duplexer can reach -90dB. At this moment, the S reading of Mark2 means the insertion loss of duplexer transmit signals.

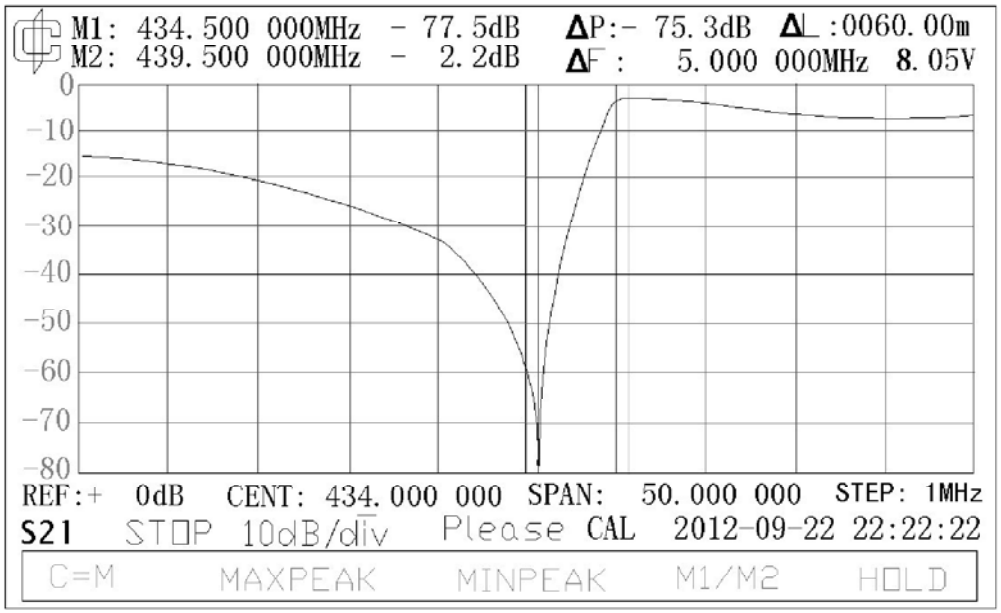


Chart 14: Typical curve of HIGH side of duplexer, the isolation ratio 77.5dB, insertion loss 2.2dB

Connect the output port of Apparatus to RX port of duplexer, then connect the fictitious load to the TX port. Slightly adjust the three screws near the RX side to keep the mark2 minimum reading. Normally, the reading should be less than -70dB, Read the S reading of mark1, which means the insertion loss of duplexer transmit signals.

Sometimes the two sides reading data of duplexer affect with each other, so it is necessary to adjust the three crews repeatedly until the restrain reading data reach or exceed -70dB. It is preferred to try to obtain better reading. After repeated adjustments, if the restrain reading data does not less than -70dB or the insertion loss is less than 3dB, maybe there is some malfunction with the duplexer or the duplexer does not adapt to the new frequencies.

Connect the 3-10dB attenuator to the in-port of the apparatus in series to improve the degree of test accuracy. If there is doubt about the shape of the curve, connect the attenuator in series to retest.

Notes

Some duplexers are designed for usage as "broadband", that is, allow to be used around the range of 1MHz, the stop-band curve should be adjusted to step-shaped, and the attenuation degree is normally 50dB. This kind of duplexers is not recommended to use unless it is necessary to use changeable frequency.

Do not adjust the restrain curve of the duplexer into a too sharp shape. Reduce SPAN to 1MHz, observe the bottom of the curve, the width should exceed 100 KHz. If the curve is too sharp, the cusp of the curve may drift out the used frequency while the temperature or the match condition of ANT changes.

If there is a contradiction between insertion loss and attenuation, attenuation on the RX side should be primarily guaranteed. Appropriately turn down the relay station power so that to reduce the requirement for attenuation. This should abide by the principle of "Adjust TX toward inside and Adjust **RX** toward outside"; try to keep balance of insertion loss.

For the duplexer whose coupling degree can be adjusted by screw, adjust the coupling screws. (All of adjustable screws can be replaced by long screws if they are not long enough.) If the entering length of screws is too long, the Qfactor of duplexer is lowered, and the isolation ratio becomes worse. Dismantle the extended solenoid of the duplexer in case of emergency.

When the Insertion Loss is lower than 2dB, it is unnecessary to test the SWR of duplexer. If the insertion loss can not be turned down, S11 test can be tried (connect the fictitious load to the non test port rather than to the in-port of the apparatus.), tentatively adjust and compare the reading with others, try to control the SWR under 1.5dB.

Please screw and fix the screws during the adjustments to keep the reading data stable.

Notes

When asked to adjust the attenuation degree over 70dB, connect the high-pass filter (KC9506) in tandem to the testing circuit. The connection of KC9506 can enable the testing range to reach or exceed 100dB .

If conditions permit, connect in tandem a attenuator (around 10dB) to the testing circuit to improve match condition so that the testing results of the attenuation curve are more accordant with the practical situation.

During the period of precise adjustment of duplexer, it is preferred to try insertion loss testing mode. Pay attention to change to vibration mode and choose the one with lower reading data.

5.2 ANT and Feeder Tests

5.2.1 SWR Test for ANT

When ANT is to be tested, the apparatus should be adjusted to S11 mode, choose SWR display or return loss (LOG, loss), settle down center and span, the testing operator should be away from ANT.

The SW of AN is easy to be affected by the surround environment. So it is better to choose a wide outdoor field, such ad rooftop. The length of the feeder should be as short as possible, disconnect the feeder from the end which connects the ANT. Contain the feeder for calibration. When the feeder is too long, the testing result will be small. If the feeder reduces by over 5dB, the test can not be done by principle.

Notes

The overall length of feeder and ANT should avoid being the integral multiples of the 1/ 4 length of testing frequency. If it can not be avoid, be carful enough about the fake resonance points. If such resonance points appear at both sides periodically, these resonance points should be seriously considered as fake ones.

In industrial application we often want to know the SW value, that is the value of SW showed at the transmitter port. Under this circumstance，test directly at the feeder port. If the tester wants to know return loss (RL) of ANT though the feeder but short of instruments to calibrate the other end of feeder pot, please test the insertion loss of feeder. After testing the RLs of the feeder and overall ANT, subtract 2 times of the insertion loss of feeder.

Notes

KC901H is a constant parameter testing apparatus, therefore theoretically can not eliminate directional measurement deviation aggravated by vectorial resultant. When the tested RL is close to directional property of bridge, logarithmic law should not be used. SWR mode will automatically draw a similar curve according to a certain of mathematical method, but this curve just offer for your reference.

5.2.2 Test for Antenna Gain and Antenna Pattern

Utilizing the function of S21 (or insertion loss) of KC901H, together with another set of antenna to obtain the horizontal antenna radiation pattern or front

to back ratio. If there is another set of known-parameter antenna, then the antenna gain can be tested.

Testing environment: Microwave anechonic chamer or standard testing field. A level open area, the size should be larger than 20 times of the wavelength. For the antenna of over UHF frequency range, smooth and level rooftop can also be the testing environment.

Equipments:

2 antenna supports, one has a rotary table, if the condition is limited, rotate the antenna support manually. The height of the antenna supporters should suit to the designed usage conditions of antenna. By principle, the height should be longer than the 2 times of working wavelength. It is better if the distance between the two antenna supports is larger than 10 times of the working wavelength.(For example, the very long working wavelength of antennas of short wave, it is allowable to appropriately decrease the distance between the two antenna supporters). If necessary, take more times of tests by changing the distance, and take the average number to eliminate the impacts cause by ground reflection. According to the distance between the two antenna supporters, prepare ling enough cables; try to keep the apparatus and tester a distance more than 10 times of wavelength form antenna. Besides to-be-tested antenna, prepare another known-antenna gain antenna for reference.

Method:

Install testing antenna and to-be-tested antenna on the supporters (chart 15). At first, make certain direction of to-be-tested antenna (predict the main flap direction or mark a direction) aim at the testing antenna, then set the apparatus S21mode and input testing frequency. Normally, choose the narrower span such as 1MHz. Furthermore calibrate the apparatus, turn the curve sheet into zero. Next, rotate the to-be-tested antenna with a certain angle at intervals. Write down S reading (dB number). At last, draw dots on the angle- antenna gain graph thus to obtain the direction graph of the to-be-tested antenna. For unidirectional antenna, the difference of S reading data of the main flap direction and back flap is the back ratio.

The above test can also be done by utilizing insertion loss testing mode. At first, set FIELD mode, press **GE** T **ON** button to start insertion loss test, then press L SHIFT button, input an appropriate number to turn the insertion loss reading into zero. The insertion loss reading means the same as the S reading in S21 mode.

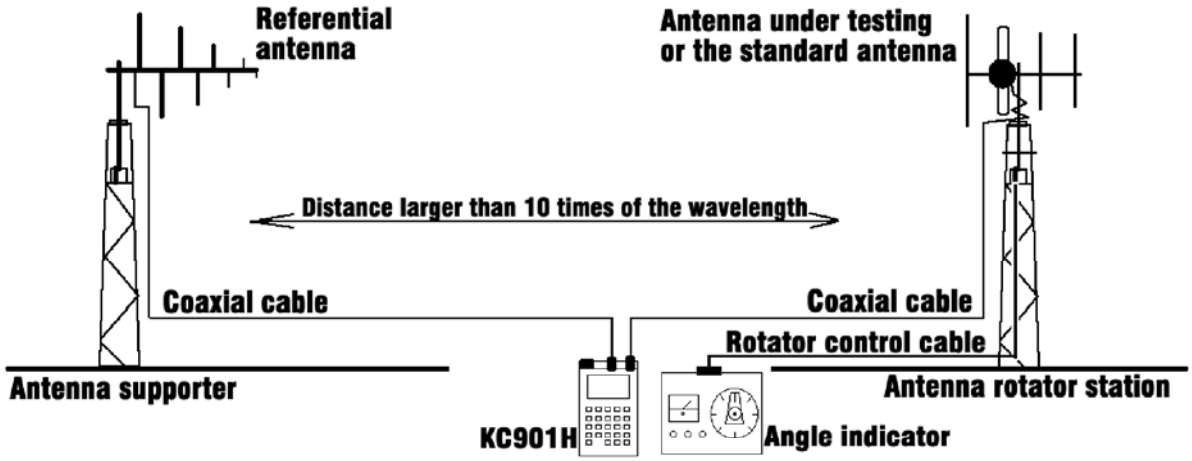


Chart 15, Antenna gain test in an open area

If the tester wants to test the antenna gain, it is necessary to install the known-antenna-gain antenna for reference unto the to-be-tested antenna supporters, adjust the orientations of the referential antenna and testing antenna(make the referential antenna's given direction aim at the testing antenna), then go on user calibration under S21 mode. Then keep the settled reading of the apparatus invariant, and then change the referential antenna into the to-be-tested antenna to test, write down the reading of different angle S reading. At this time, the obtained reading plus the referential antenna gain, this is the antenna gain of different angles.

If the tester contained many frequencies direction graphs and antenna gains, repeat the above steps by changing the different frequencies.

It needs a long time to test antenna, in case of loss of user calibration reading, please make sure that the apparatus is powered enough or connected to the charger and turn off the self-shut down function during the test. While testing, the tester should be away from the antenna, if it is necessary to rotate to-be-tested antenna manually. After rotation, the tester should walk away from the antenna and then read the data.

Use two KC901Hs; setting one signal mode, another one FIELD mode, this helps to build a single frequency point scalar net testing system, used in the setting of 2 far distant antennas. Of course, the one KC901H for transmit can be replaced by a transmitter of good stability.

The isolation ratio of the method is superior to the internal isolation ratio of single apparatus, thus this method can meet the requirement of high dynamic range test.

5.2.3 Insertion Loss Test by One Port Method

Sometime the feeder is installed, but we can connect the two ends of the feeder to the KC901H for S21 test. Under this circumstance, we can connect 2 KC901Hs to the two ends of the feeder respectively for test. If there is only one KC901, it is still feasible to test the insertion loss of feeder. The detailed method is as the followings:

Set the apparatus S11 mode, choose frequency reading data, and set the display mode as RL (loss dB), and go on simple calibration of the output port. Connect the apparatus to the feeder, set the other end of the feeder not connected with anything else and short circuit one time respectively. Use cursor to read and write down the RL to-be-tested frequency points (avoid the peak reading). The linear average of the two times reading are about 2 times of the insertion loss of the feeder. As for lower than 500MHz, open circuit test is enough, and take the peak point -3dB as the actual appropriate RL. Before utilizing this method, the insertion loss of the feeder should better be estimated, it is better that the insertion loss is lower than the 1/4 og the bridge specificity.

5.2.4 Testing Speed Factor of Coaxial Cable

Speed factor is an important index for coaxial cable, playing a role in making coaxial omnidirectional antennas and equalizers. Speed factor largely depends on dielectric constant of insulating medium between the outer conductor and the inner conductor of cable. It takes sometime to measure the permittivity. It is handy to get speed factor by KC901H.

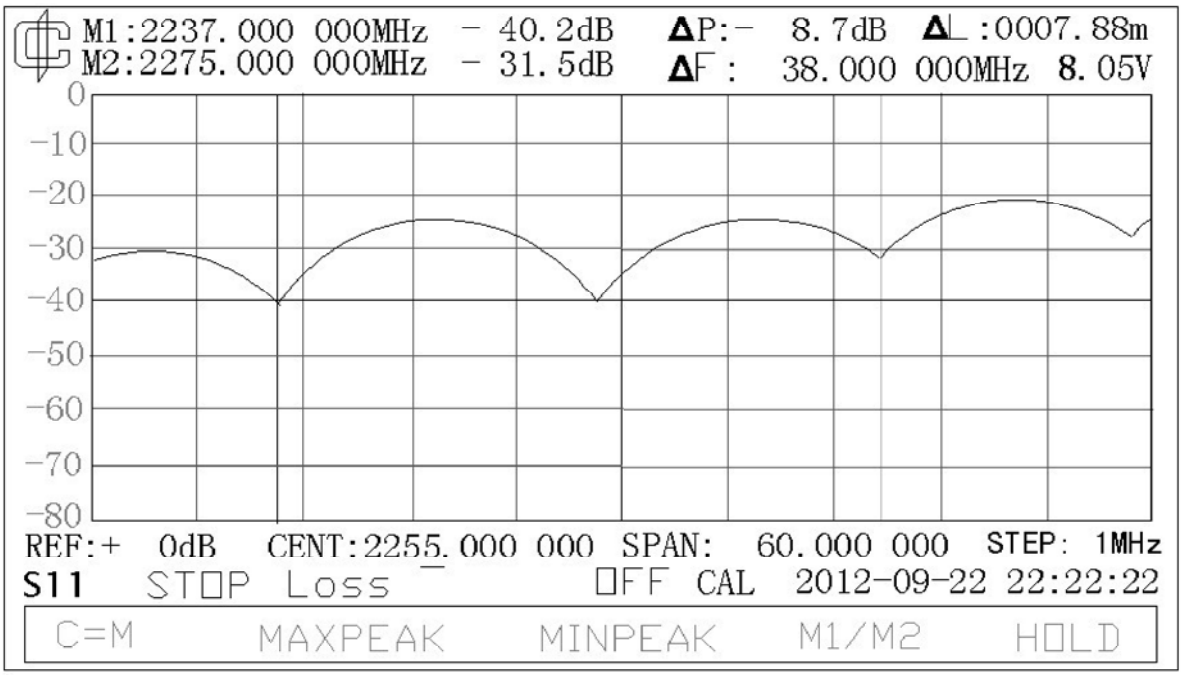


Chart 16: The typical method of measuring electric length

In S11 logarithmic mode, frequency is set as 1GHz or higher and span is set as 500MHz.taking a long coaxial cable (longer than 10 meters),install N（Pin） connector on one end linked to KC901H and cut off and keep another end open. Observe the wavy curve on the screen and adjust span to make two or more periods of fluctuation clear. If waves are not obvious, please Change center frequency and chose the most obvious band for test. Use cursor to get significant periodic features as measuring points to read the total length of two consecutive peaks. the difference between wavelength △λ（△L） is the electric length of coaxial cable. Speed factor is total length of coaxial cable divided by the electric length. Reduce span to occupy the whole screen with measuring length to minish reading error. In chart 16, if span is50MHz, the result will be more accurate.

The method in reverse can be used to measure coaxial cable length as well as terminal short circuit. The seemingly nonsense method is significant. If the measuring length is much shorter than the actual length, there is trouble with cable. The measuring length is the electrical distance between the user and fault location, which is a common method to locate fault. When operate fault location with KC901H, please connect matched load to terminal.

5.2.5 External Directional Bridge Expanding Test Range

The directionality of external bridge of KC901H is limited and the influence of source reflex error is considerable because of the limited size. A higher directional bridge should be connected externally when testing large return loss. Both The input end and the reversed output end of directional bridge should be connected with an attenuator over 10dB in series. And then connect them to output port of the apparatus. In addition, connect the reversed output end to input port of the apparatus. In S21 mode, connect open circuit or short circuit calibrating device on reflection plane and calibrate S21.

It is necessary to Connect connect an attenuator over 10dB in series to both at the input end and the reversed output end of directional bridge, which reduce matching errors.

5.3 Spectrum Display

KC901H strengthens properties of the input channel to provide the basic spectrum display.

Notes

KC901h is a network analyzer, so the test result of spectrum is only for reference.

Precautions

The input port of KC901H permits a limiting level of +20dBm and a limiting DC voltage 15V. The apparatus is bound to get damaged if the standard is disobeyed. When testing transmitter and amplifier, an appropriate attenuator must be concatenated to control the limiting values.

Notes

+20dBm is the limiting level not damaging the apparatus, but KC901H is responsive to a maximum of +13dBm. The proper level is not more than +6dBm. Connect an attenuator externally when test the large signal.

Notes

Mirror image interferes with the spectrum mode. Connect an appropriate filter to the input port in series to operate monitor function. When test shortwave spectrum.

Local oscillation mode（High Lo/Low Lo）identifies mirror response. If a signal disappears after local oscillation mode starts, it is a spurious response. A local oscillation mode of the lower noise level should be chose among different modes. When the frequency is lower than 100MHz or higher than 2800MHz, local oscillation mode setting is useless.

Enter spectrum display mode via MODE—SPEC. If the concerned span is too narrow, set CENT and SPAN according to need. Set REF based on intensity of the signal under test. REF＜-40dBm when searching for weak signal. Unless conditions permit, scan piece by piece in narrow span.

5.3.1 Searching for Interference Source

Wihin the uninterference frequency band by mirror image (switch to local oscillation mode to avoid the image interference), use KC901H with directional antenna to search for interference source by Amplitude method.

After entering spectrum mode, set center at frequencies probably interfered. Span is set at small value (for example 1MHz). On the weak interference condition REF should be set to -40dBm. Do not stop Adjusting direction of antenna and polarization mode to search for interference signal until the most obvious bulge emerges in the center of spectra. After measuring the directional azimuth angle of antenna by magnetic compass trace out directional line. In the same way, get another line at another point. The intersection point of two lines is

presumably to be where the source locates.

Preserve an angle of 60—120° (close to 60°)between the linking line of two measuring points and one directional line(Line of bearing,LOB.,chart 17) .

Keep the measuring point in height to avoid block by buildings. When approaching to the source, adjust REF based on the intensity or adopt the field mode. Move in the direction of the strongest interference and keep approaching to the source. Generally speaking, the amplitude should be over 70dBμ （-37dBm）when approaching to the Interference source.

Connect a band-pass filter between the apparatus and antenna to improve the reliability of test. In a helical structure or cavity structure, band-pass frequency of the filter can be adjusted under the supervision of KC901H before using. When testing weak signal, it is practical to connect a low-noise amplifier between the filter and the apparatus.

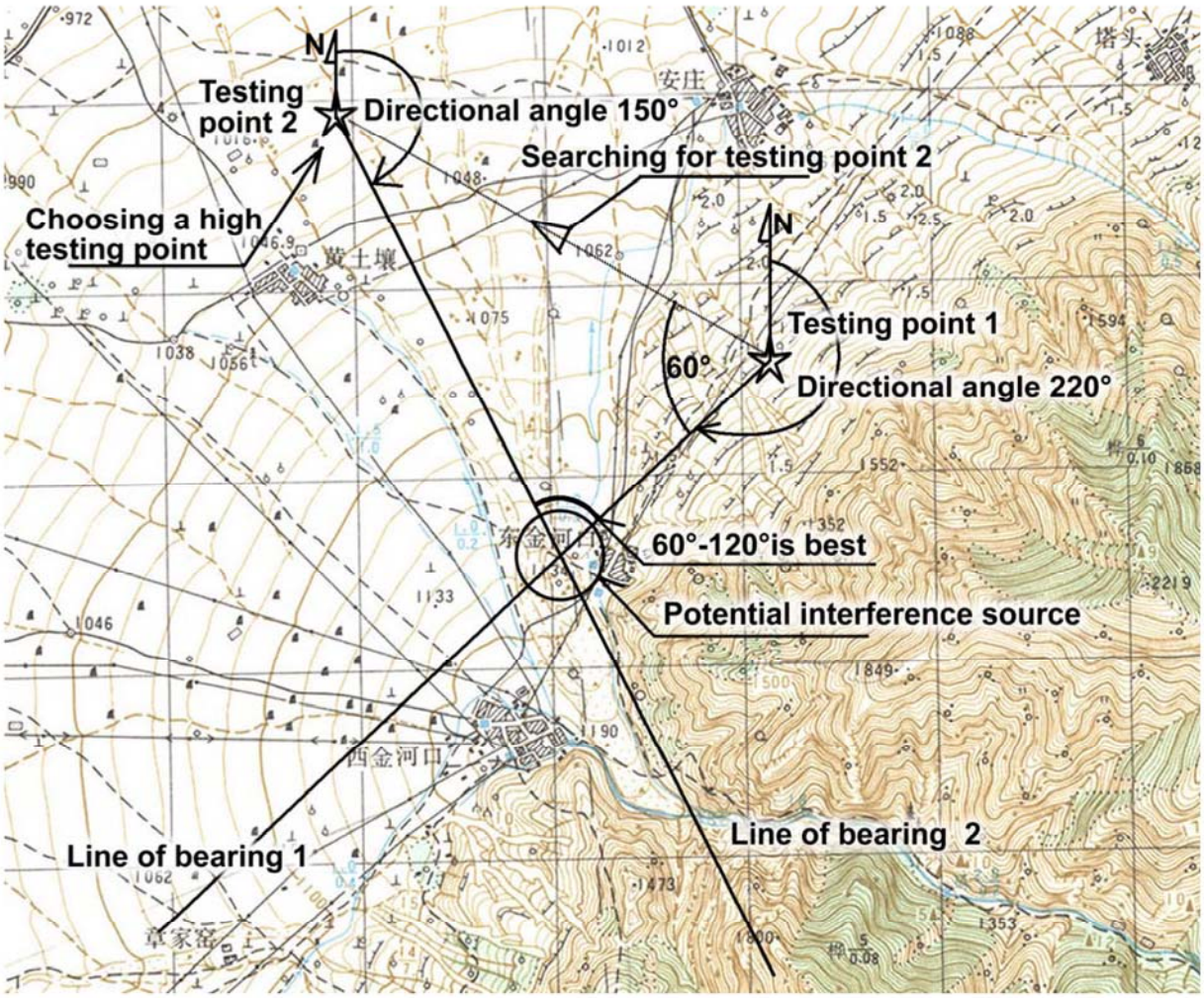


Chart 17. An example of cross location and diagramming method

Locating the interference source is a task combined with theory, experience and technology no matter what kind of apparatus is used. Practices increase efficiency. Because of diffraction and reflection of signal, there are many

illusory directions in tests in cities and mountainous areas.

*when the signal is weak, field mode has higher response speed in searching for interference source. When the signal is strong, it is easier to judge distance of the source by analyze noise in spectrum mode.

* In order to measure transmitting field strength around radio station antennas, field function is necessary. IF gain of spectrum function is manually setted, so it may be influenced by strong signal due to improper set-up.

* KC901H is not suitable to searching for interferences of public mobile communication systems（GSM，CDMA）.

Precautions

Without permission, do not use KC901H to monitor the spatial frequency spectrum of non-working frequency. It should not be revealed even it is measured by accident.

5.3.2 Measuring Frequency

Roughly observe the frequency of unknown signal by spectrum display function.

1. In spectrum mode, set scanning range based on the potential frequency range of unknown signal. For example, if the unknown signal is transmitted from VHF interphone, the scanning range can be set between 150MHz and 160MHz.

2. After entering mark menu, search for the maximum peak by MAXpeak function.

3. And then, select C=M (center=marker) on mark menu and move the peak to the center of the screen. Next, decrease span and measure the bulge of frequency accurately.

Generally speaking, peak frequency is approximately equal to the unknown signal frequency. RBW (15 KHz) is relatively wide, so the shape of IF filter will be seen without a modulation of the signal. Regard the midline frequency (not the maximum) as the measuring frequency.

In general, the spectrum analysis is much more sensitive than a spectrometer. If the unknown signal can trigger the spectrometer, reading is more than -37dBm in KC901H by using the same antenna. When REF is +20dBm, it is easier to judge.

5.4 Testing Crystal Filter

The basic methods of testing duplexer and crystal filter are the same as testing other passive devices. The only difference is that the characteristic impedance of KC901H is 50ohm but the characteristic impedance of crystal filter is not 50ohm. The mismatch of impedance will change the shape of filter, so the preparation is to realize the impedance match.

The impedance of crystal filter is usually from hundreds of ohms to thousands of ohms. 800ohms and 1200ohms are common. Methods of transform high impedance into 50ohm are in the following:

1. Use a transformer

2. Use Gamma L-C match circuit

3. Use T、Π resistance network

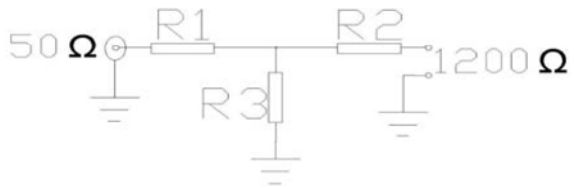
Using transformer is a classic method not only transforming impedance but also transforming between balance and imbalance. when testing the crystal filter of 800ohm, two RF transformers o f a impedance ratio of 1：16 should be prepared. The input port and the output port of KC901H are expected to be connected to the low impedance end of transformer. The high impedance end should be connected to the filter. If input of the crystal is imbalanced, the secondary end and the primary end of transformer should be grounded together. When testing crystal filter of low frequency, the transformer can be be made by the user. Turn radio is the square root of transformation radio.

Buy a RF transformer for wired wound to test crystal filter of high frequency.

For testing high frequency circumstance the RF transformer can be available in the store.

Γ L-C circuit is the frequently-used match circuit. Small volume, low cost and low loss are its advantages. The disadvantage is that it is only suitable for narrow band. Calculating the impedance and frequency are necessary as for self-made circuit.

T、Π resistance network with a large insertion loss are infrequently used for match. However, resistance is the only one needed. It is frequently used for test with advantages of low cost and quick establishment. The calibration function of KC901H eliminates the insertion loss as well as compresses the test range.



This is the circuit diagram of T- resistance network. The circuit consists of three resistors. Taking a 1200Ω crystal filter as an example, impedance from R1 is 50Ω and the impedance R2 is1.2KΩ.

The deducing method is as follow:

If R_0=50Ω，R_x=1200Ω，L: attenuation ratio（output power / input power, linear value）. According to Kirchhoff Law:

$$(1+L)=\frac{(R_1+R_3)}{R_0}-\frac{(R_2+R_3)L}{R_x}$$

$$R_0=R_1+\frac{R_3(R_2+R_x)}{(R_2+R_x)+R_3}$$

$$R_x=R_2+\frac{R_3(R_0+R_1)}{(R_0+R_1)+R_3}$$

by simultaneous solution:

$$R_1=\frac{1+L}{1-L}R_0-R_3$$

$$R_2=\frac{1+L}{1-L}R_X-R_3$$

$$R_3=\frac{2\sqrt{LR_0R_x}}{1-L}$$

L is in fact an unknown value, so we assume a value but not at random. R1 is a small value in lower impedance, so R1≥0 can be the controlling index.

The impedance difference is large and L is small, so the approximate relationship is as following:

$R_1 \approx R_0-R_3$

$$R_3 \approx 2\sqrt{LR_0R_X}$$

$R1 \geq 0$

Thus we have

$$2\sqrt{LR_0R_X} < R_0$$

$$L \prec \frac{R_0}{4R_x}$$

In other words, L is at least four times less than impedance variation.

Variation =1/24， L=1/100（ attenuation amount :20dB）:

$R1=1.01R_0/0.99-R_3$

$R2=1.01Rx/0.99-R_3$

$$R3=\frac{2\sqrt{0.01R_0R_x}}{0.99}$$

R_0 and R_x have their values, ∴

$R3=49.5\Omega$

$R1=1.5\Omega$

$R2=1174.7\Omega$

If the resistance is not standard, try to roughly make up a standard value of R3 to get L and choose other values.

Calculate and make the corresponding matching network based on input impedance and output impedance of the crystal filter. Connect the two ports by short circuit before calibration. After that, Normalization the insert loss of testing circuit to zero. Finally access the crystal to start test.

Testing system should be routed and grounded to decrease the influence o f distributed parameter. This method is applied to the test for other devices (no 50ohm). If DUT is balance input and balance output, operate unbalance—balance transformation. Using transformer is a typical method. This kind of impedance matching does not provide reactive component. If DUT requires external matching capacitance, please match it according to the manual.

Chapter Six. Maintenance

KC901 does not need special maintenance in regular use and storage. Because it is a sophisticated electronic instrument, the user should pay attention to the following aspects:

1. The apparatus should be settled inside in a pack or a suitcase during the long distance transportation. A baldric should be used while on-the-go to avoid falling off, collision or putting together with other construction tools. The connector must be removed during transportation and carrying unless necessary. It is forbidden to use testing cable as handle.

2. Flexible cable should be used to switch while testing heavy devices or connecting thick feeder.

3. While installing the plug-ins, please point the position, plug in carefully, shake lightly and screw slowly. Screw the thread tightly when feeling the core needle has been already inserted into the core hole. Both hands should operate to screw the thread, with one hand holding the body part of the plug-ins to avoid revolve of the plugs, another hand revolving the exterior helicoil. Revolve of the whole plug should be avoided, otherwise lifespan of the RF connector will be dramatically shortened and also cable will be damaged. Pay attention to check before stalling plug-ins at construction. If the core needle protrudes too long, curve or lant, stalling should be done after repair of the core needle, otherwise the interface will be stretched.

4. The apparatus should be avoided of being exposed in the rain or water inflow. The apparatus should be put inside the suitcase or be prevented from rain in rainy days. Turn the power off immediately if clean water flows in; fling out the water though the bottom part and blow dry it in a ventilated place. If dirty water flows in, fling out the dirty water and send it back to the factory for repair. Waterproof suitcase is suggested to be equipped if the apparatus is often in the open air.

5. The apparatus should be sealed with plastic bag if the operator enters in a room with central heating from the outside in winter. If there is dew formation on the apparatus, then the apparatus should be put near the radiator to be dried, then the apparatus can be powered on. But it is necessary to pay attention to the temperature.

6. Charging stops automatically when it is full in 3 hours. Take charger town when the battery is full, and set to STOP mode with a voltage around 8.4V. Charging during using time is allowed, but a long-term floating is banned. It is no good for maintaining good battery life if power shortage warming appears or power off.

7. If the apparatus is not long-term needed, the battery should be full for storage. During that time, it is better to charge once in one month or at least three months.

8. Do not keep the apparatus close to high-powered transmitting antenna. Do not kept interphone close to transmission. Too strong electromagnetic radiation may damage the apparatus. Testing field in microwave oven is banned.

9. No using ray to irradiate and sterilize KC901H, because ionizing radiation may do harm to the apparatus. Even any weak laser will damage the display screen. Keep it away from EMP bomb, Electric Billy, Marx Generator and tesla coil that are going to burn down the apparatus.

10. Period of verification of KC901H is one year. It is better to send it to manufacturer for calibration and verification. Please contact the factory for technical support, if it is far out of alignment.

11. The warranty period for the host is one year, and for the connector assembly, coder and battery charger is 6 months. Any missing or visibly damaged parts are not included in the quality warranty after delivery. Services besides the above dates of are not regarded as the extension of the warranty period.

12. It is forbidden to dismantle the case arbitrarily during warrant period. If it is necessary to change the glasses or batteries of display after the warranty period, please dismantle according to the method below:

Disassembly of KC901H

Chart 18 shows how to disassemble enclosure. Firstly remove two screws at the bottom and slightly widen the gap. Secondly, push up the lower cover for 1cm. thirdly, holding onto two tips of upper cover, uncover it. Be careful of ribbon wire on the left. Dislocation between the upper and lower cover should not be more than 2cm.

Way to change glass: firstly, remove wire from circuit board in the upper cover. Secondly, remove six screws and detach the board from the cover. Thirdly, remove four screws and the plate to change glass. During installment, keys should align with holes in upper cover. Finally, tighten the screws. These disassembly and assembly methods do not apply to trial version. Please contact us for further information.

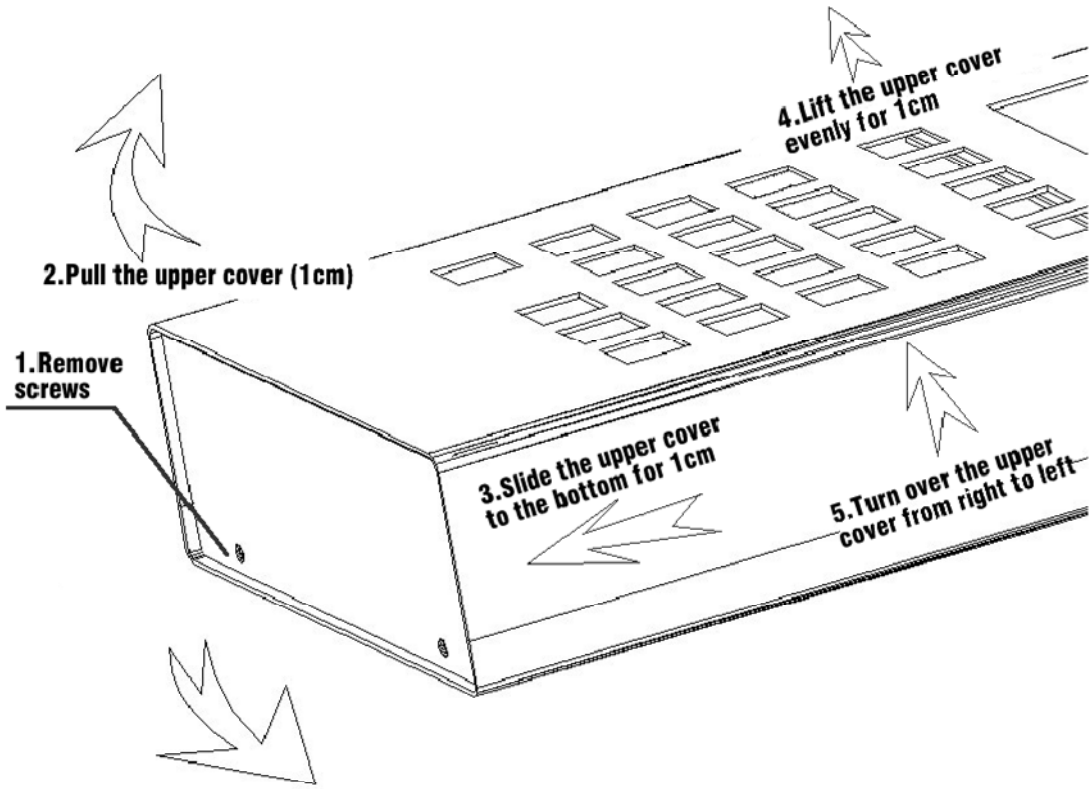


Chart 18: How to disassemble enclosure

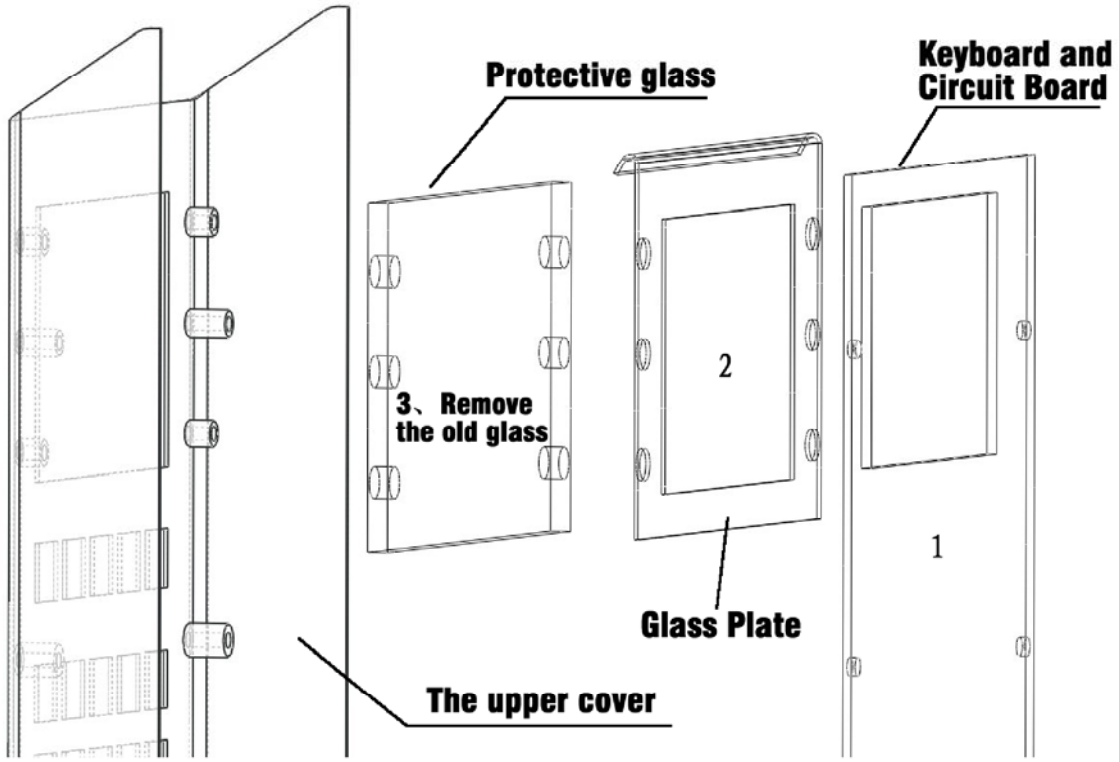


Chart 19: How to Change Screen Protective Glass

Chapter Seven. Technical parameters

Frequency range:

Transmission test 100 KHz…3GHz (0…100 kHz is allowed)

Reflex test 1.5MHz…3GHz (0…1.5MHz is allowed)

Output level (typical value):

+7dBm or 5mW（1MHz——2GHz）

+0dBm（2——3GHz）

Input sensitivity:

superior to -107dBm or 1μV（50KHz——1GHz）

superior to -87dBm or 10μV（1——2.2GHz）

Damaged level:

all the RF ports DC15V，+20dBm

Test range 0f S21 (typical value):

110dB（1MHz——1GHz，about 60dB in 100KHz ， about 120dB in 435MHz）

80dB（1——2.2GHz），60dB（2.2——2.5GHz）

Resolution:

Frequency is 1Hz, level is 0.1 dB

(Typical value,@25℃,battery voltage≥7.5V)

±1.5dB（spectrum measurement，REF=20dBm）

±3dB（spectrum mode and field mode）

±（1+0.05L）dB（in S21test，when calibration is directly connected and insertion loss L≤60dB）

+2dB，-3dB*（loss，simple calibration, 25MHz≤f≤1GHz，6dB≤RL≤18dB）

*No guarantees. Use external bridge to meet more requirements referring to 5.2.5

Internal bridge directionality（typical valuc）：

18dB（3MHz——15MHz，1.2GHz——2GHz）

30dB（15MHz——1.2GHz）

16dB（2GHz——3GHz）

Frequency stability:

±1ppm/year@25℃

Supply voltage:

11.5V…32V（external power ）；7.2…8.4V（battery）

105V…230V，50/60Hz（power adapter input）

Battery endurance（typical value，@25℃）：

3hours（spectrum ,field, signal source)；1hour（S21 or S11 includes insertion loss test）

20hours （in STOP mode，BL=1）

Humiture range：

0…45℃（normal temperature range ）

10%…90%R.H.，no condensation

size：

230×113×46mm（length, width , height ）

weight（including battery)：

Net weight of host <1.5kg

Total weight ≈2.0kg