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KC908 100 kHz…4/6/10.8/18.6/33 GHz
Handheld Monitor Receiver / Real-Time Spectrum Analyzer / Signal Source

User Manual

Applicable to Software Version V3.0 and Later, Sixth Edition, July 2023
(Trial)

Gain New Skills in 2 Hours

Kexinshe



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Applicable to Software Version V3.x, Hardware Version V1

Trial

(The software may be continuously upgraded; for reference only.)

Kexinshe

Summary

This book briefly introduces the basic concepts and design philosophy of miniature reconnaissance receivers / spectrum analyzers. By explaining the structure, signal path, and control logic of the KC908 analyzer, it analyzes the operating procedures and precautions for this series of reconnaissance instruments. Reading this book will help users understand the operating methods and the principles behind them, making it easier to apply the knowledge flexibly and use the equipment properly.

KC908 Monitor Receiver User Manual

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1. Overview

KC908 is a multifunction RF test instrument. It can both receive signals and generate signals. In receive applications, it can measure spectrum and field strength, and can demodulate and monitor common signals. For less common signals, it can record raw data (quadrature data / IQ data) for later analysis. In output applications, it can generate the required test signals for experimental verification and for servicing other equipment.

The essential principle of the receiver is the same as that of an ordinary radio receiver: it amplifies and processes signals at a specified frequency and extracts useful information from them. A radio receiver is concerned only with the audio carried by the signal, whereas a test instrument must also be concerned with signal level and various technical characteristics.

As a reconnaissance instrument, it must be able to discover signals quickly. KC908 differs from a traditional swept spectrum analyzer. It divides the frequency range to be measured into several small segments, acquires one segment at a time, and then performs a Fast Fourier Transform (FFT) to obtain the spectrum of that segment. The different segments are stitched together to form a panoramic spectrum.

This approach is both fast and accurate. For example, at 5 kHz frequency-measurement accuracy, KC908 can measure a 3 GHz frequency span per second. This is equivalent to scanning 120,000 channels of 25 kHz bandwidth in one second. Such speed is beyond the capability of a traditional "fast-scan receiver."

This speed is still far from the theoretical limit, because tuning and data processing both require time. In fact, when FFT is used for measurement at 5 kHz accuracy, the theoretical time required is only 0.1 ms regardless of the frequency range. However, current technology can approach this target only when the frequency range is relatively small. More precisely, the theoretical speed can be approached within the real-time bandwidth. Because a handheld device is limited by size and power consumption, the real-time bandwidth cannot be very wide. When the measured frequency range exceeds the real-time bandwidth, stitching is required. In that case, the instrument must wait for locking and tuning, as in a traditional receiver, and these operations are much slower than FFT.

KC908 also includes a signal source with the same frequency coverage as the receiving range (up to 6 GHz on the KC908T). It can output constant-amplitude signals or simply modulated signals. By playing waveform files, it can also output more complex digital modulation. The signal-source output level can be adjusted over a wide range. At most frequencies, it can reach above 10 dBm and can be attenuated to below -70 dBm. In reconnaissance applications, this function is suitable for field verification of other instruments and direction finders, such as determining whether the sensitivity of other equipment is normal.

KC908 is based on software-defined radio (SDR) principles and can operate independently, normally without an external computer. For more complex analysis, it can also be connected to a computer through the USB 3.0 Interface. The instrument supports common community SDR software such as HDSDR and can be connected to the open-source radio software platform GNU Radio.

1.1、Operating Principle

To reduce complexity, the instrument processes signals by combining superheterodyne and zero-IF technologies. In other words, for the frequency ranges where the zero-IF transceiver performs well, zero-IF processing is used directly. For other frequencies, mixing is used to shift the signal to a fixed frequency, where it is then processed by the zero-IF transceiver.

As the name implies, zero-IF technology means that the intermediate frequency is zero. It is still a type of heterodyne receiver/transmitter and still uses hardware such as a local oscillator and mixer. For a

receiver, a mixer converts the RF signal to a fixed intermediate frequency before subsequent processing. For a transmitter, the process is the reverse: the mixer converts the intermediate frequency to RF before output. In this case, however, the intermediate frequency is zero, also referred to as DC.

For example, when receiving an 878.5 MHz signal, the local oscillator frequency must also be set to 878.5 MHz. After the mixer, the output is DC. Any signal carrying information has bandwidth and cannot be a pure 878.5 MHz signal. Signals slightly offset from 878.5 MHz are converted into lower-frequency AC signals and mixed with the DC component mentioned above. Together, these are referred to as the baseband signal.

It is easy to see that, because the intermediate frequency is zero, signals on one side of 878.5 MHz will always be converted to negative frequencies. This energy does not disappear automatically; instead, it is mixed into the positive-frequency side on the other side and cannot be distinguished. This can be understood by interchanging the local oscillator and the signal. For example, both 878.4 MHz and 878.6 MHz, when mixed with an 878.5 MHz local oscillator, produce 0.1 MHz. In actual engineering, two mixers and two local oscillators are used simultaneously, with a 90-degree phase difference between the two local oscillators. This produces two intermediate-frequency signals that differ by 90 degrees in phase, known as quadrature (IQ) signals. Although I or Q alone contains mixed positive and negative frequencies, the ambiguous components have opposite phase and can cancel each other, making it possible to distinguish positive from negative frequencies. The degree of this separation is called **image rejection**. This is only an intuitive explanation; a more accurate understanding requires mathematical formulas and is beyond the intended difficulty level of this manual.

Sampling the signals described above produces digital IQ signals. In KC908, the digital IQ signal bandwidth is 40 MHz to 45 MHz. Applying FFT to this signal produces the spectrum. The center of this spectrum is DC, with positive and negative frequencies distributed on both sides. Because the baseband signal is generated by an analog mixer, local oscillator leakage cannot meet the extremely high requirements of spectrum analysis. Therefore, a strong signal peak appears at the center of the spectrum display, and the noise is relatively high near the center. To solve this problem, the instrument discards one sideband of the FFT result and the portions with poor performance, and uses only 15 MHz of bandwidth for display. This is the origin of the effective real-time bandwidth of 15 MHz. If the sweep width is greater than the effective real-time bandwidth, the local oscillator scans in 15 MHz steps and the results are stitched together.

The zero-IF receiver range of KC908 differs by model. The KC908A range is 0.75 GHz to 6 GHz, while the KC908B/U/V/W range is 500 MHz to 6 GHz.

Because the frequency coverage is wide, KC908 uses several preselectors in the front end to prevent excessive total energy from external signals from overloading the receiver and to improve anti-interference performance. Traditional spectrum analyzers usually do not have such preselectors in the lower frequency ranges. For models in which both ports can receive signals (KC908A/B), the preselector segmentation method differs between the two ports. The right port (Port 2) is usually used. Specific operating techniques are described later. Although a large portion of the RF circuit area is occupied by preselectors, the instrument’s size still limits the filtering to a very preliminary level. Therefore, in complex interference environments, additional external filters may be used.

The zero-IF transmitter, that is, the signal-source function, operates in the reverse direction from the receiver. The digital circuitry first generates digital IQ signals. After digital-to-analog conversion, these become analog baseband signals and are used by an upconverter to modulate RF. The frequency range of the zero-IF transmitter is 1 GHz to 6 GHz (4.2 GHz for the KC908U). If output outside this range is required, the signal is shifted by mixing.

Digital signal processing is jointly implemented by the FPGA and MCU. During signal demodulation, the FPGA performs another frequency conversion on the digital IQ signal to allow strict filtering. KC908 demodulation bandwidth ranges from 150 Hz to 300 kHz, suitable for analysis of most

private-network signals. For wider demodulation bandwidth, raw digital IQ signals can be transferred to a computer through the USB 3.0 Interface, with IQ signal bandwidth up to 40 MHz.

Because the spectrum is generated by FFT stitching, the display differs significantly from that of a traditional swept spectrum analyzer, and some concepts also differ. The resolution bandwidth (RBW) is no longer the bandwidth of a resolution filter; instead, it is the equivalent resolution bandwidth of the windowed Fourier transform. Due to limited computing resources, at a given sweep width the RBW can be set only within a certain range and cannot be set too small or too large. For time-varying signals that are wider than the real-time bandwidth, samples on the two sides of a stitching point are taken at different times, so the amplitude at the stitching point may change abruptly.

Signal shapes may also differ greatly from those displayed by a swept spectrum analyzer. For example, for the spectrum of an FM signal, KC908 displays the peak value (or average value, depending on the setting) of all frequencies within the real-time bandwidth during the previous display refresh period. It does not produce the “illusion” caused by left-to-right scanning, where only one frequency can be scanned at any instant. Therefore, signal-analysis experience developed from such “illusions” on traditional spectrum analyzers may no longer be valid.

However, a real-time spectrum analyzer does not necessarily reveal the “truth” either, mainly because time resolution has limits. In simple terms, even if 10,000 FFT operations can be performed per second, no display can refresh 10,000 times per second and no human eye can clearly perceive 10,000 frames per second. Regardless of how much data is available, it must ultimately be combined in some way into several tens of frames per second for display. This combining process is referred to as “detection.” The “detector mode” setting determines the combining rule, such as taking the maximum value of each frequency point frame by frame, or averaging the results of all frames. As a result, the displayed screen cannot represent the “instantaneous” state of the signal and is therefore no longer the “truth.”

For a changing signal, the truth can only be expressed by a time-domain waveform or mathematical formula. This is because FFT requires many samples, for example 2048 samples, to achieve high frequency resolution. Collecting these samples takes time, and the signal may already have changed during that interval. Even so, compared with swept-spectrum measurement, real-time spectrum measurement is usually much closer to the “truth.”

Second, the displayed frequency resolution also has limits. A single FFT frame produces thousands of data points. After stitching, the number of data points increases further and may even reach hundreds of thousands. However, the KC908 horizontal axis can display at most 800 pixels, and no display can show hundreds of thousands of lines. This means that each pixel represents many frequencies. How these frequencies are “represented” is also a problem solved by detection. In KC908, the peak value of all frequencies corresponding to each horizontal pixel is displayed **to ensure that signals are never missed.** This is the principle followed by a reconnaissance instrument. However, this method may also make certain frequency- or phase-modulated signals appear to be stable signals. When analyzing a single signal, reduce the frequency width as much as possible, change the detector mode, and, if necessary, **set the detector mode to Sample** to identify the signal.

1.2、Basic Functions

(1) Receiver
(2) Spectrum Analyzer
(3) Signal Source

1.3、Practical Functions

(1) Frequency measurement accuracy better than 10 kHz at any sweep width, allowing accurate

signal-frequency reconnaissance with a single operation
(2) Automatic statistics of strong signals, convenient for close-range reconnaissance
(3) Channel memory, 999CH
(4) Analog and digital radio demodulation
(5) Recording of IQ and audio to a TF Card
(6) Level tone, convenient for pedestrian tracking
(7) High audio volume, suitable for noisy environments

1.4、Application Areas

KC908 can be used in the same application areas as traditional handheld spectrum analyzers and field-strength analyzers, and it provides better results for digital, pulsed, and unstable signals, such as magnetron output.

(1) Radio reconnaissance and monitoring, interference search, transmitter tracking, and hidden-transmitter detection
(2) Maintenance of radio and electromagnetic-environment monitoring systems
(3) Professional communications engineering and IoT engineering
(4) Radar and satellite earth stations
(5) Industrial microwave engineering

1.5、Demodulation Modes

（1）Analog Demodulation

CW (A1A), AM, LSB, USB, FM (PM), IQ

Analog demodulation is a standard function. It outputs analog audio, or the audio can be recorded as a WAV audio file.

（2）Digital Radio Demodulation

Digital radio demodulation includes standard, optional, or customized functions.
Standard: D-STAR, YSF, P25, NXDN, etc. (MBE vocoder).

Options: DMR, PDT, Tetra, etc. DMR and Tetra are also provided as standard functions in the civil and commercial frequency bands (136-174 MHz and 400-470 MHz).

Customization: Uncommon protocols or protocols requiring special vocoders require customized development. The user must provide intellectual property authorization. The development period is usually 3 to 6 months.

Digital-demodulation support depends not only on the protocol, but also on the vocoder. For ease of description, vocoders are first grouped in the table below. Vocoders in the same group have the same support status.

Vocoder Group	Vocoder Type
A	AMBE (2.4k, 2.45k, 4.4k, etc., interleaved / non-interleaved)
B	IMBE
C	SELP1.5、SELP1.7、SELP1.8
D	ST24、F100*
E	ACELP

The following table lists support status.

●standard support ○standard support in civil/commercial frequencies △optional support
◇ customizable ×not supported // not applicable

Digital System	Bandwidth	Sub-mode	Modulation	Vocoder Group & Support				
				A	B	C	D*	E
DMR	12.5k	Trunking	C4FM	○△	//	△	◇	//
		2 Time Slot		○△	//	△	◇	//
		1 Time Slot		○△	//	△	◇	//
dPMR	6.25k		C4FM	●	//	△	◇	//
P25	6.25k	PHASE1	C4FM	//	●	//	//	//
	12.5k	PHASE2	QPSK	◇	//	×	×	//
NXDN	6.25k		C4FM	●	//	◇	◇	//
	12.5k		C4FM	◇	//	×	×	//
Tetra	25k	Trunking 4 Time Slot	¼πQPSK	//	//	//	//	○△
	25k	Direct 2,4 Time Slot	¼πQPSK	//	//	//	//	◇
	25k	Trunking	FMT	//	//	//	//	×
YSF	12.5k	V、D	C4FM	●	//	//	//	//
	12.5k	VFR	C4FM	●	//	//	//	//
PDT	12.5k	Trunking	C4FM	◇	//	△	◇	//
	12.5k	Direct	C4FM	◇	//	△	◇	//
D-STAR	12.5k	DV	GMSK	●	//	//	//	//

Protocols not listed in the table may be customized for some types, provided that the user supplies authorization and technical materials.
All encrypted modes are unsupported or require customization. No decryption function is provided.

1.6、Key Specifications[1]

The design goal of KC908 is convenience and practicality rather than high performance. Even so, its specifications are sufficient for most situations.

Item	Minimum	Typical	Maximum	Remarks
Frequency Range	100kHz		33GHz[2]	Can be set to 0 Hz
Spectrum Analyzer / Receiver (Port 2)				
Real-time Bandwidth	1kHz	Continuously adjustable	15MHz	
Resolution Bandwidth[3]	1Hz	Continuously adjustable	2MHz	Can be set to 8 MHz
Demodulation Bandwidth	150Hz	Continuously adjustable	200kHz/300kHz	
Demodulation Modes	CW/AM/LSB/USB/FM/PM/IQ/YSF/DSTAR			Digital demodulation is optional
100%POI [4]			210µs	When SPAN = 15 MHz
Level Measurement Range			+20dBm	
Level Uncertainty		1.5dB		
Noise Floor		-120dBm		@12kHzBW,Avg.
Overall Noise Figure		13dB		1 GHz, at maximum gain
Third-order Intercept Point		-42dBm		REF=-70dBm
		46dBm		REF=20dBm
First Image Rejection	50dB	70dB		
IQ Image Rejection		50dB		
Residual Response[5]		-110dBm		Port open, >1 MHz
		-90dBm		Port connected to whip antenna
Spurious Response		-50dBc		
Signal Source (Port 1)				
Level Range[6]	-80dBm		10dBm	1 dB steps
Level Uncertainty		2dB		
Modulation Modes	AM/FM/PM			
General				
Battery Life		4h		
Operating Weight		908g		

Notes:

1. Only parameters commonly of concern are selected for reader reference. For detailed parameters, see the technical specifications table.
2. Depends on the specific version. For order numbers and corresponding upper frequency limits, see the product overview.
3. The settable resolution bandwidth (RBW) range depends on the real-time bandwidth used and is determined by the instrument.
4. “Intercept” is defined as **accurate measurement**. Signals shorter by 1 to 2 orders of magnitude can be discovered.
5. The instrument generates EMI during operation. If the antenna is too close to the instrument, it may be affected by the instrument’s own EMI. The residual response specification was measured in an anechoic chamber using a 0.2 m whip antenna placed 1 m from the main unit and oriented in the same direction as the main unit.
6. The output level range varies slightly by version and frequency. On the 18.6 GHz version, all usable

frequencies can reach 13 dBm.

1.7、Differences Between KC908 Versions

KC908 is available in five models. KC908A and KC908B belong to the standard-series sequence; KC908U, KC908V, and KC908T belong to the economy-series sequence.

The standard-series models provide transmit and receive capability on each port. They can compare the amplitude difference and phase difference between signals applied to the two input ports. The signal source on Port 1 can operate up to 10.8 GHz or 18.6 GHz, matching the frequency range of Port 2.

The economy-series models are simplified. They provide receive capability on one port and signal-source output on the other port. The maximum frequency of the signal source does not exceed 6 GHz, making these models easier to popularize.

For KC908U and KC908V, the left port (Port 1) provides signal-source output, and the right port (Port 2) is the receive port. The signal source and receiver cover the same frequency range. For KC908T, the left port is also the signal-source output port, with a frequency range of 100 kHz to 6 GHz.

For the receive section, except for sensitivity and anti-interference performance, other specifications in the same frequency band are similar.

The typical sensitivity of the standard series is 1 dB to 3 dB better than that of the economy series.

Below 3 GHz, the anti-interference performance of the economy series is slightly improved compared with the standard series, although the difference is difficult to notice. Because the simplified circuitry leaves more internal space, the preselectors in the economy series have been adjusted. Below 30 MHz, the preselector scheme for the spectrum analyzer function is the same as that of the standard series. For the receiver function within this range, the band is divided into two segments, with the segment boundary at 3 MHz, to suppress low-frequency interference. A preselector is also added in the 500 MHz to 1000 MHz band, slightly improving anti-interference performance.

For the reasons described above, when measuring the shortwave band in receiver mode, if the spectrum display covers frequencies outside the preselector passband, the out-of-band response may appear uneven. For example, when CENT = 5 MHz and SPAN = 10 MHz, signals below 3 MHz may appear weaker.

For the signal source section, the maximum output level of KC908U/V/T is 3 dB to 13 dB lower than that of KC908A/B. As frequency increases, the maximum output level gradually decreases, reaching approximately 0 dBm at 6 GHz.

Model	Port 1 Function	Port 1 Frequency Range	Port 2 Function	Port 2 Frequency Range
KC908A	Receiver / Spectrum Analyzer	100kHz-6GHz	Receiver / Spectrum Analyzer	100kHz-10.8GHz
	Signal Source	100kHz-10.8GHz	Signal Source	80MHz-6GHz
KC908B	Receiver / Spectrum Analyzer	100kHz-6GHz	Receiver / Spectrum Analyzer	100kHz-18.6GHz
	Signal Source	100kHz-18.6GHz	Signal Source	80MHz-6GHz
KC908U	Signal Source Only	100kHz-4.3GHz	Receiver / Spectrum Analyzer	100kHz-4.3GHz
KC908V	Signal Source Only	100kHz-6GHz	Receiver / Spectrum Analyzer	100kHz-6GHz

KC908T	Signal Source Only	100kHz-6GHz	Receiver / Spectrum Analyzer	100kHz-33GHz

KC908U and KC908V use SMA female connectors. All other models use male connectors compatible with the 2.92 mm standard.

KC908U/V are equipped with limiters and therefore provide better port survivability, suitable for rougher operating conditions. Except for KC908T, the RF ports of all models include ESD protectors and can withstand typical human-body electrostatic discharge levels.

2、Device Layout and Controls

The figure on the next page describes the functions of the external parts of the KC908. The RF ports are located on the top of the instrument. The left side mainly contains data ports and adjustment knobs. The speaker and microphone are located below the front panel. The other sides of the instrument have no functional interfaces.

2.1、Top Panel

Two RF ports are located on the top of the instrument. The left port is Port 1 and the right port is Port 2. The functions of the two ports are marked below the ports. An indicator located between the two ports indicates the currently selected port.

KC908A/B/T use K-type male connectors, commonly known as 2.92 connectors, and are compatible with the SMA standard. Because KC908U/V operate at lower frequencies, they use SMA female connectors. The connectors are mounted directly on the circuit board, with the circuit board, metal shielding, and instrument enclosure jointly providing mechanical support. The port shell is fairly robust and can withstand a long-term bending moment of up to 1 Nm. However, the center pin is fragile. The total force in the bending direction must not exceed 1 N or 0.02 Nm, whichever is smaller. The maximum tightening torque of the port is 0.7 Nm. During use, tightening firmly by hand is sufficient.

CAUTION

Use a flexible cable or antenna to avoid applying excessive leverage to the port. Never drag the instrument by the cable or antenna. Remove the antenna or cable when the instrument is not in use to prevent port damage caused by accidental impact. The connector must be of good quality, with a compliant and non-skewed center pin, to avoid bending the pin and causing poor contact with the circuit board. Do not rotate the center pin during connection.

2.1.1、1Port 1 — Left Port

This port supports frequency output from 100 kHz to 4/6/10.8/18.6 GHz. KC908A/B also support frequency input from 100 kHz to 6 GHz. The output includes the required filtering. On KC908A/B, a synchronously tuned filter is used above 6 GHz. If the left port has receive capability, it only uses a simple preselector.

The left port is mainly used as the output port. It can output RF signals over the full frequency range and provides a relatively high output level.

For KC908A/B, the left port is also used to connect the GPS antenna.

2.1.2、2Port 2 — Right Port

This port supports frequency input from 100 kHz to 4/6/10.8/18.6/33 GHz. KC908A/B also support

frequency output from 80 MHz to 6 GHz.

The right port is mainly used as the receive port and includes a segmented preselector.

For KC908A/B, the range below 6 GHz is divided into seven segments, while a tracking preselector is used above 6 GHz. KC908U/V use segmented preselectors. KC908T uses a tracking preselector throughout the 6 GHz to 33 GHz range.

If Port 2 (right port) has output capability, it can output a weaker RF signal.

All receive channels include a 30 dB attenuator in 10 dB steps and a 40 dB variable-gain preamplifier in 20 dB steps. The total front-end gain adjustment range reaches 70 dB, allowing fine adjustment of input/output signal strength.



2.1.3、Port Limits

The short-term maximum input power (average value) of both ports is 20 dBm. Exceeding this level will damage the instrument.

The permitted continuous input power (average value) is 10 dBm. However, at frequencies below 100 kHz, the input power should preferably not exceed 0 dBm, otherwise there is still a small probability of damage.

At frequencies above 10 MHz, when the attenuator is set to at least 10 dB, the maximum pulse peak power must not exceed 30 dBm, with a pulse width within 100 μs.

CAUTION

Although both ports include ESD protectors, the protection capability cannot be very strong because of the wide RF bandwidth and other factors. The protection is intended only for typical human-body electrostatic discharge under ordinary conditions. Human-body discharge in dry weather may destroy the port. Avoid outdoor use or connection to an outdoor antenna during thunderstorms. When connecting an external shortwave antenna, be aware of the hazards of antenna static electricity. Before use, short the antenna to discharge it. Avoid use in strong wind. When using a large shortwave antenna, an external DC-grounded high-pass filter should be used to protect the instrument. Suppression better than 30 dB below 500 kHz is recommended.

When connecting a circuit under test, first make contact between the connector shield (shell) and the instrument, so that the circuit under test and the instrument are at the same electrical potential.

2.2、Left Side Panel

KC908 has two charging ports, both of which can charge the instrument. A charging indicator is located between the two charging ports. When a charger is inserted through the round jack, the indicator should light red, indicating that charging is in progress. When a charger is inserted through the USB port, the indicator should first light red, indicating that slow charging has started. If it later lights blue, fast charging through the USB port is in progress. A green light indicates full charge. Rapid flashing indicates charging failure, and the suitability of the charger should be checked.

2.2.1、12 V Charging Port

This charging port supports a charging voltage of 9 V to 26 V. The recommended charging voltage is 12 V. It may be connected directly to 12 V, 13.8 V, or 24 V vehicle batteries. The charging current of the 12 V Charging Port can reach up to 2 A. If the instrument is powered on while charging, the current may reach 2.5 A. The instrument can be fully charged in approximately 3 hours.

For long-term powered operation, the 12 V Charging Port should be used for continuous power supply. A supply voltage of 12 V to 18 V is preferred, with airflow cooling. In general, KC908 is not recommended for year-round continuous operation. If continuous powered operation for more than 30 days is required, the battery should be removed. After the battery is removed, the external power supply must be stable enough to withstand the large inrush current at startup (5 A), otherwise the instrument may not operate normally.

2.2.2、USB Charging Port

To reduce the need to carry a dedicated charger, KC908 supports USB charging and can be charged with an ordinary mobile-phone charger or power bank. The USB Charging Port uses a Type-C connector

and supports most fast-charging protocols. The maximum charging voltage can reach 20 V, with a maximum current of 3 A. The instrument can automatically adjust the charging current according to the voltage drop rate of the charger, allowing compatibility with most mobile-phone chargers. If the output capability of the charger is insufficient, the charging current may be lower than 500 mA.

The time required for USB charging depends on the charger. If fast charging is supported, the instrument may be fully charged in as little as 2 hours. If fast charging is not supported, at least 10 hours is usually required. If the instrument is powered on while charging, the battery will still be consumed; charging only extends the operating time. When no battery is installed, the USB Charging Port cannot support powering on the instrument. KC908 is compatible with PD 3.0, QC 3.0, and UFP protocols, but no guarantee is provided for fast-charging support with specific charger brands or models.

Whether the 12 V Charging Port or USB Charging Port is used, keep the instrument away from flammable and explosive materials during charging, and do not leave it unattended. When the ambient temperature is higher than 35 °C or ventilation is poor, charging is permitted only while the instrument is powered off.

2.2.3、USB 3.0 Interface

This interface is used only for outputting high-speed IQ signals. Detailed operating instructions are provided separately in the SDR software connection guide.

2.2.4、USB-OTG Interface

This interface follows the USB 2.0 standard and supports OTG. It is usually used to control dedicated accessories. It may be converted to a LAN port through a USB/RJ45 adapter.

This port can provide a 5 V, 500 mA power output. Do not connect any device that exceeds this current or short-circuit the port.

2.2.5、Key and TTL Output Port

This 3.5 mm interface can be connected to a manual key or automatic key for sending telegraphy. It is also used to output level control signals for controlling dedicated accessories, such as a transmit/receive switch.

KEY1 and KEY2 are used for connecting the key. When using a manual key, the key contact should be connected between KEY1 and GND. When using an automatic key, the two key contacts should be connected to KEY1, KEY2, and GND respectively. The key drive voltage is 1.8 V.



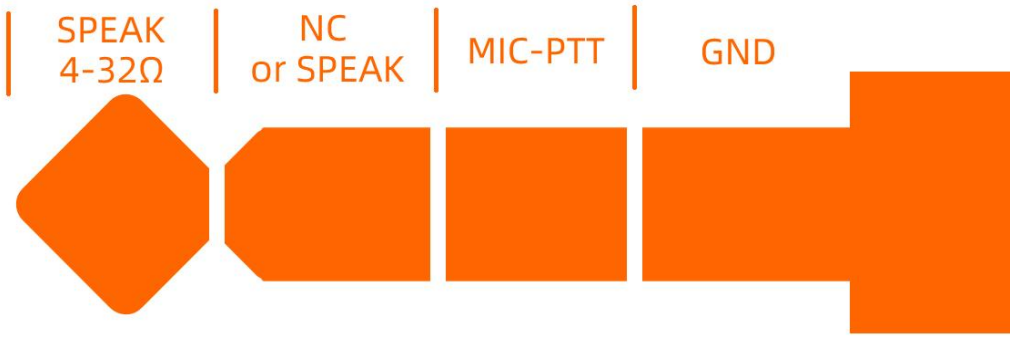
LVCMOS is used to output a control signal. The high level is approximately 3.3 V, referenced to GND.

This port is purely a level output port. Only an external key or controlled peripheral may be connected. Do not back-feed signals into this port, otherwise damage may occur.

2.2.6、Hand Microphone/Speaker Port

This port is used to connect an external speaker or a hand microphone. The audio signal output here has passed through a power amplifier and can reach up to 1.5 W into a 4 Ω load. The speaker impedance must not be lower than 4 Ω. In early products, only the contact at the tip of the plug was connected to the audio amplifier output. In later products, the last two sections were changed to stereo output for binaural use. **Therefore, a four-section (TRRS) plug must be used.** Do not short Ring 1 (the second ring) to ground.

The pin definition for this plug is shown below.



Common two-way-radio hand microphones that follow this wiring standard can be used. When using an ordinary electret microphone or dynamic microphone, connecting the MIC between MIC-PTT and GND causes the instrument to recognize that PTT is pressed. The microphone sensitivity is approximately 50 mV. The speaker is connected between SPEAK and GND. When using earphones, the actual volume depends on the earphone type. Always reduce the volume before inserting the plug to avoid hearing damage. After the plug is inserted, whether the internal speaker is automatically disabled can be configured in software (FUNC → System Settings → Speaker).

Note that this port does not support other signal inputs. Do not back-feed large external signals into this port.

2.2.7、Knobs

KC908 has two knobs on the left side. The upper knob is a multifunction knob, and its function changes depending on the current operating step. For example, after pressing the RF key, the upper knob adjusts frequency by default. This knob can also be pressed to confirm an input or move the cursor.

The lower knob is used only for audio control. Pressing the knob activates the adjustment item. Under different setting states, it is used to adjust volume, squelch, level tone pitch (level tone center point), and other audio settings. Repeatedly pressing the knob switches among the currently valid audio setting items.

2.2.8、TF Card Slot

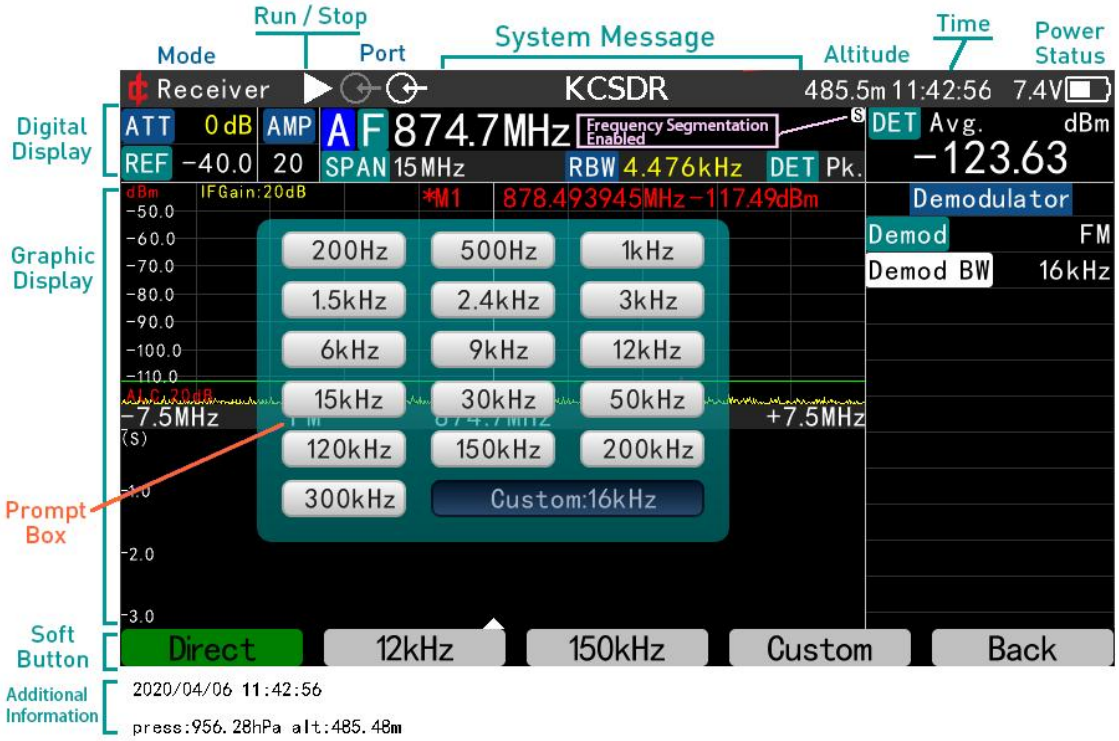
The instrument supports TF cards up to 32 GB for storing data and loading firmware. For convenient data saving at any time, it is recommended to keep a TF card inserted. If IQ data needs to be saved, a high-speed TF card is recommended.

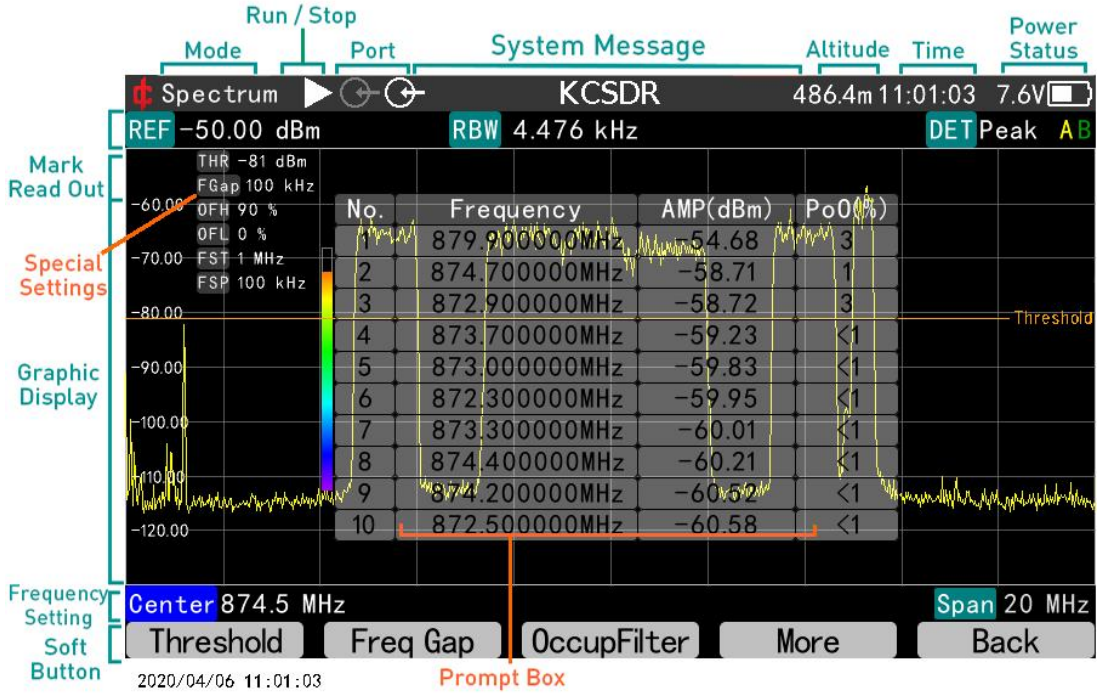
2.3、Front Panel

The front panel is the main user interface. It includes the display, keypad, multifunction knob, speaker, and microphone pickup.

2.3.1、Display

The display is divided into several commonly used areas and generally keeps a similar style. The figure below shows the area division in receiver mode and spectrum mode.



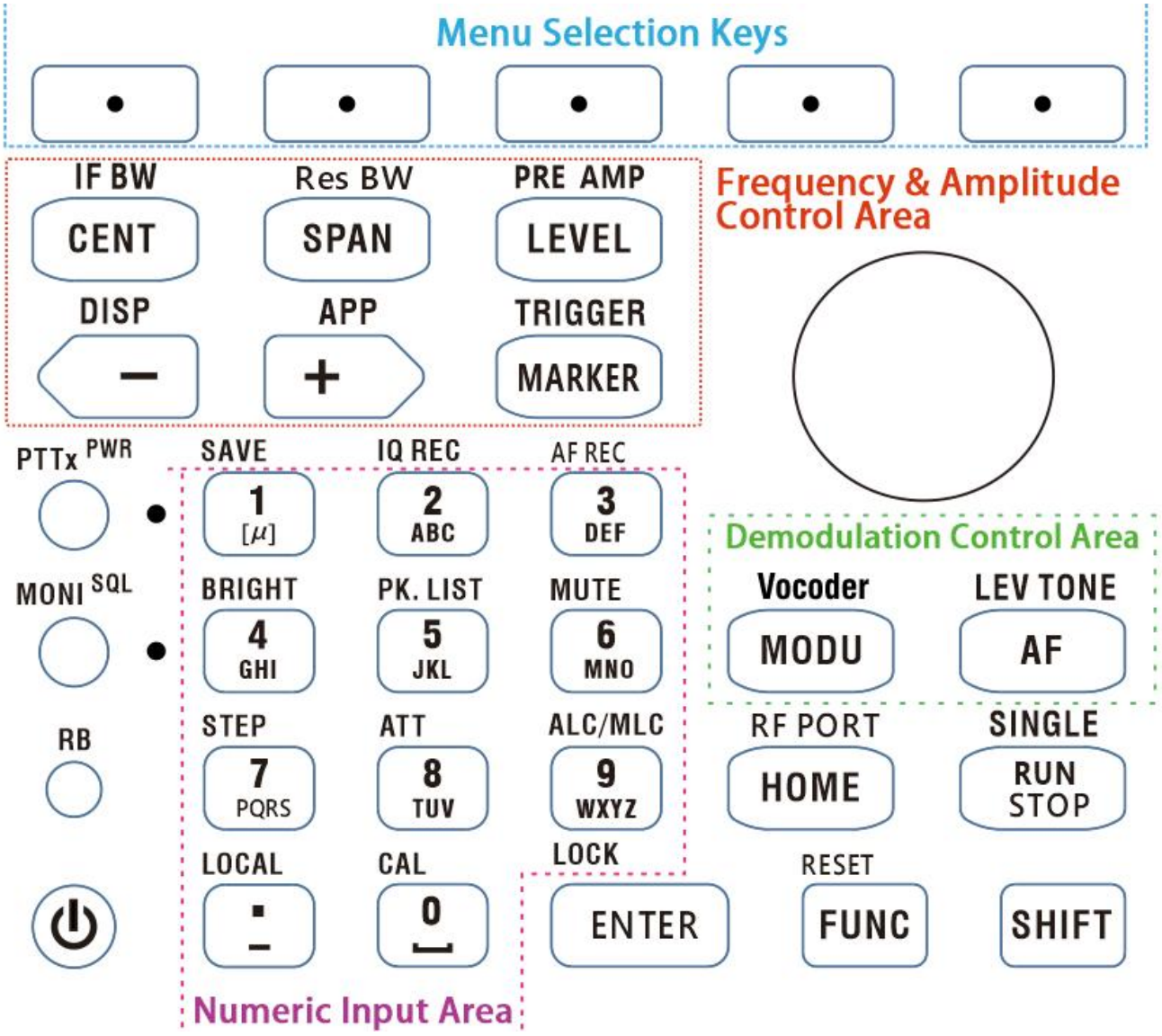


KC908 uses a 3.5-inch color LCD with a resolution of 800 × 480 pixels. The display has backlighting and can also reflect a small amount of external light, allowing it to remain readable under direct sunlight. The display is protected by semi-tempered glass at least 1.5 mm thick, which is more wear-resistant than plastic.

There is no need to apply a protective film to the screen. If the screen glass becomes dirty, first brush away any hard sand or grit from the surface, then wipe it with ordinary soft tissue. Wiping with water or alcohol gives better results, but do not use excessive liquid to avoid seepage into gaps and the keypad. If the glass is cracked or scratched, be especially careful to avoid injury from broken glass. During replacement, the entire panel must be replaced; the glass cannot be replaced separately.

2.3.2、Keypad

The keypad is divided into three main areas: menu selection keys for operating soft menus, function setting keys for adjusting functions, and numeric keys for entering values. The keypad layout is shown in the figure below.



The primary key functions are listed in the table below.

CENT	Set the center frequency.
SPAN	Set the sweep width (horizontal axis).
LEV	Set amplitude parameters (vertical axis), such as reference level and gain.
MARK	Use markers.
MODU	Receiver mode: set demodulation parameters.
	Spectrum mode: can also be used to set markers.
AF	Receiver mode: set audio-related parameters.
	Spectrum mode: can also be used to set sweep width.
HOME	Select a function; switch between the function selection menu and the home page of the current function.
RUN/STOP	Start or stop operation. Stopping operation saves power.
FUNC	System settings.
PWR	POWER, power switch.
SHIFT	Shortcut key. Press SHIFT first, then another key to use the secondary function.
RB	Hard reboot. Current settings are not saved, and previous data is not cleared.
PTTx	Transmit key. When pressed, the signal source starts output.
MONI	Monitor key. When pressed, all squelch is temporarily disabled; squelch resumes when released.

The power switch is designed to take effect after being held for 0.5 s. The “+” and “-” keys generate one operation when pressed briefly; when held for more than 0.5 s, they become repeated operations for continuous frequency or marker adjustment. Other keys generate only one operation each time they are pressed.

Secondary keypad functions (shortcuts)

Some frequently used functions are placed in deeper menus for logical clarity. Shortcuts are provided for these functions.

To use a shortcut, press SHIFT first. After the red “SHIFT” indication appears near the upper-right area of the screen, press the key corresponding to the secondary function.

The secondary key functions are as follows:

IF BW	Open the intermediate frequency bandwidth (demodulation bandwidth) adjustment dialog.
Res BW	Open the resolution bandwidth adjustment dialog.
PRE AMP	Switch preamplifier gain.
DISP	Adjust the proportion occupied by the waterfall display (effective in receiver mode).
APP	Open the utility menu.
TRIGGER	Open the trigger menu for the corresponding mode.
SAVE	Capture a screenshot; in some functions, data is also saved.
IQ REC	Record IQ signals. Effective only in receiver mode. The recording bandwidth is related to the demodulation bandwidth.
AF REC	Record audio. Effective only in receiver mode when demodulation is enabled.
BRIGHT	Adjust screen brightness. Repeated operation cycles through several commonly used brightness levels.
PK.LIST	Quickly enable the peak list function (spectrum mode).

MUTE	Mute. Applies only to receive demodulation.
STEP	Open the frequency step quick setting dialog.
ATT	Adjust the attenuator. Repeated operation cycles through commonly used attenuation values.
ALC/MLC	Switch gain mode. This function has been removed in newer software versions.
Local	Force switching to local operation when in a remote connection state.
CAL	Calibration. Effective in certain modes where user calibration is permitted.
LOCK	Lock or unlock the keypad and knobs. The locked range depends on the settings.
Vocoder	Open the vocoder selection dialog.
TONE	Quickly turn the level tone on or off.
PORT	Quickly switch the RF port.
SINGLE	Pause. Press RUN/STOP once to run once.
RESET	Restore default settings, without clearing stored channels.
PWR	Adjust transmit power. Effective only when the corresponding option is installed.
SQL	Quickly turn squelch on or off.

2.4、Battery

KC908 uses four 18650 lithium batteries. The maximum voltage of each cell is 4.2 V, and the total capacity is approximately 50 Wh.

The batteries are located in the middle layer, with circuit boards on both sides, and cannot be replaced quickly. To extend operating time, use a power bank or a dedicated backup battery module.

The procedure for replacing or removing the batteries is as follows:

(1) Turn off the power. (2) Insert the special tool under the external threaded sleeve of the RF port and remove the outer sleeve assembly. Thread-locking compound may have been applied to this nut; try slowly and do not use force. (3) Remove the shock-absorbing rubber pads at the four corners, if present. (4) Remove the rear cover of the instrument. (5) Disconnect all visible data ribbon cables. (6) Remove the larger screws on the circuit board. Do not remove the smaller screws. After moving the circuit board to confirm that it is completely loose, (7) use a hooked tool to lift the circuit board from the end away from the RF port until it is slightly higher than the edge of the housing. (8) Withdraw the RF port from the housing in the direction opposite the RF port and remove the circuit board; the batteries will then be visible. During the operation, protect the data ribbon cables and connectors.

To ensure battery life, the capacity of each cell should be greater than 3200 mAh. Batteries of the same model and the same batch must be used. Before installation, confirm that the voltage difference among the four cells is less than 50 mV. The batteries must be of good quality; use genuine qualified products from reputable manufacturers. Power cells are preferable for safety and to reduce imbalance after use. During normal operation, the instrument temperature may reach 60 °C. If used at the maximum ambient temperature of 55 °C, the battery temperature may exceed 80 °C. Low-quality batteries may create a hazard. Install all four cells as quickly as possible; do not delay for too long, to avoid imbalance caused by some cells being connected earlier than others.

Before reassembly, first check whether the RF ports on the circuit board are misaligned. The RF connector shell should fit tightly against the side of the circuit board with no gap. If misalignment is present, reinstall it properly and tighten firmly. (1) Reinstall the circuit board and arrange the ribbon cables in place. (2) Reinstall the circuit-board screws without tightening them, and press the circuit

board firmly into the housing with your fingers. (3) Reinstall and tighten the sleeve assemblies on the RF ports at the same time. (4) Tighten the screws on the circuit board. (5) Connect the data ribbon cables, power on the instrument to confirm normal operation, and then (6) close the rear cover.

2.5、Reference Clock and Internal Ports

KC908 uses a TCXO as its main clock. The TCXO consumes very little power, but its short-term stability is only about 10 ppb (pk.), which produces an instantaneous drift of 100 Hz at 10 GHz. When RBW < 100 Hz, FFT processing requires many sampling points, and the frequency may already have drifted during sampling. When observing a CW signal, this may appear as an irregular band-shaped spectrum. The TCXO frequency can be calibrated. To do so, enable **reference clock adjustment (Ref Clock Adj)** in the system settings, then observe a known signal in the receiver function, or generate a signal in the signal source function and measure it with another instrument. Fine-adjust the clock according to the on-screen prompts until the frequency is accurate.

There are two hidden internal ports for reference clock input and output. They can be seen in the lower-right area after removing the rear cover of the instrument. The connectors are IPX connectors. The reference clock frequency is 20 MHz.

2.6、GPS Receiver (KC908B Only; This Function Is Not Open)

The instrument has a built-in GPS receiver for receiving time and position signals.
To use the GPS function, set “GPS” to “On” in the system settings screen.
After GPS is enabled, a blinking satellite icon immediately appears in the information bar at the top of the display, indicating that GPS is enabled but not locked. After GPS lock is achieved, the satellite icon changes from blinking to steady.

The position and time data received by GPS can be viewed in the horizon indicator screen in the APP menu. These data can be appended to stored data tables or screenshots. To include longitude and latitude data in screenshots, find “Screenshot Additional Information” in the system settings screen and set it to “On”.

The instrument reference clock cannot be disciplined by GPS.
The system time can be synchronized to GPS time. After GPS is locked, go to the “Time” setting item in the FUNC screen and tap “Sync to GPS” in the soft menu.

GPS Antenna

The left-side port of the instrument also serves as the GPS antenna input port. Before using the GPS function, connect a GPS antenna. After GPS is enabled, if another function uses the left-side port, GPS will be temporarily disabled.

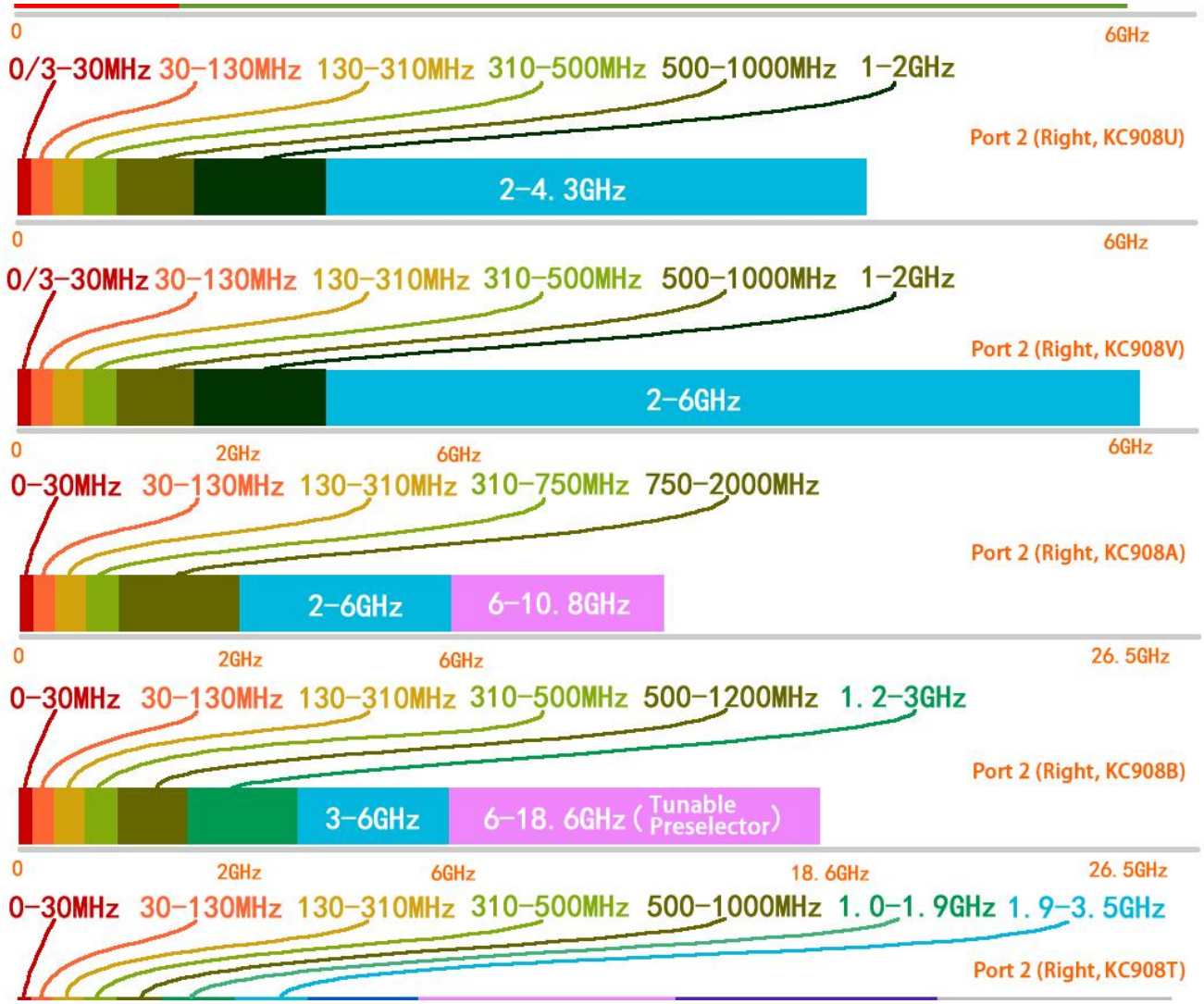
The instrument is not highly sensitive when receiving GPS signals, mainly because the left-side port is not dedicated to GPS reception and must also support other functions. Therefore, a GPS antenna with good performance should be used.

If the operating area is mainly open, flat outdoor terrain, a low-gain passive antenna may be used as the GPS antenna, with the main lobe pointing toward the sky. In general, a whip antenna or monitoring antenna for the 1575 MHz band can receive signals.

If the operating area is in a city, mountainous terrain, or another location with heavy obstruction, an active antenna is recommended. KC908 ports do not include a bias tee, so choose an active antenna powered by an external power supply or one with a built-in battery.

2.7、Preselector

The instrument contains preselectors, but the two ports differ. The left-side port is simple (the left-side port of KC908U/V/T has no receive function), while the right-side port is more complex. The figure below shows the preselector arrangement.



3、Measurement Modes

This chapter briefly introduces the various modes of the instrument so that you can understand the overall capabilities and make the correct choice for each application scenario. Later chapters describe the basic operating logic of the instrument. Selecting the proper mode and using the correct operating procedure helps solve field problems quickly.

KC908 has multiple measurement modes. Except in a few special cases, the instrument can operate in only one mode at a time. The HOME key (called MODE on older versions; this will not be repeated below) is the mode selection key. Pressing it displays the mode selection menu, where one mode can be selected. The mode selection menu appears only when the HOME key is pressed.

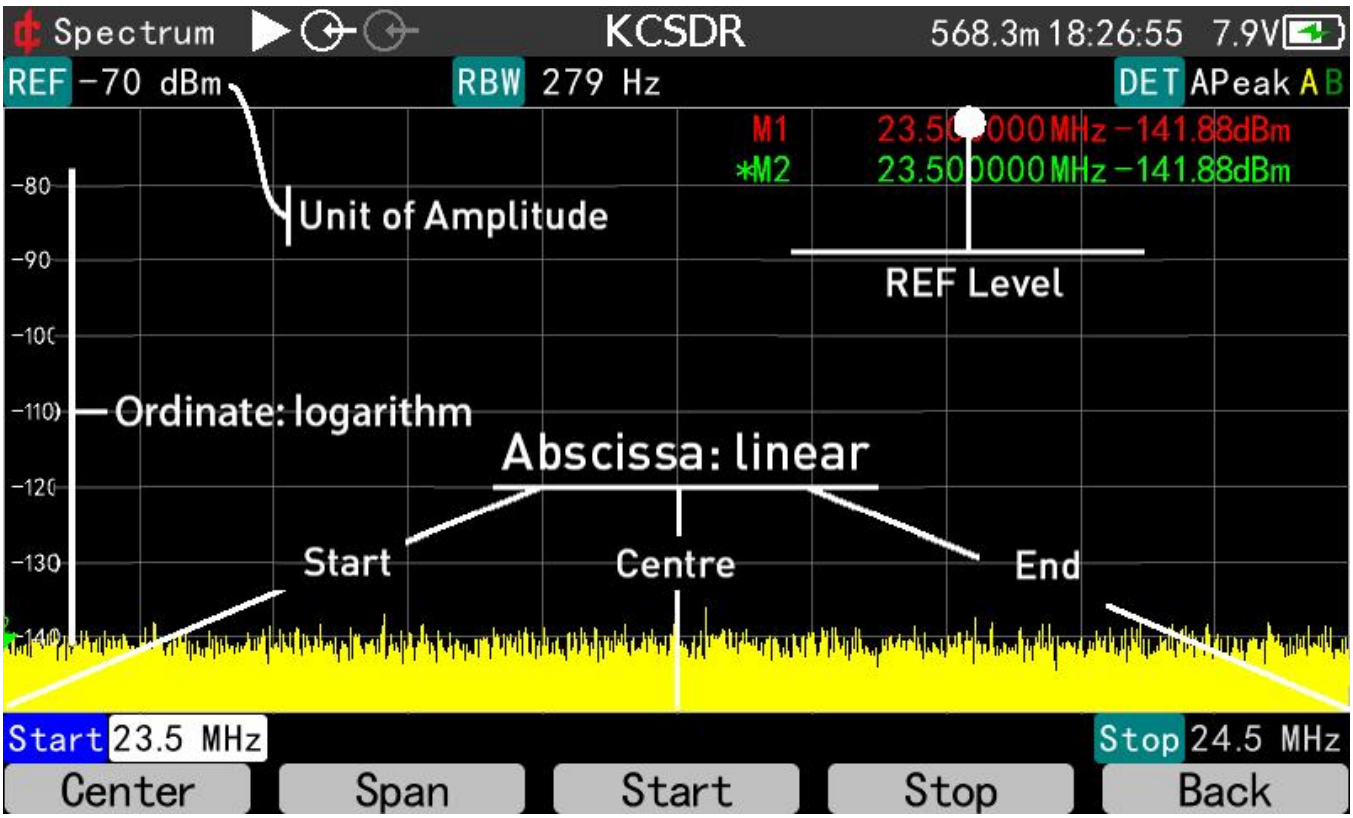
Available modes vary with configuration and version. By default, Spectrum Analyzer, Receiver, and Signal Source modes are included.

3.1、Spectrum Analyzer

A spectrum analyzer displays signals in the frequency domain. The displayed result is called a spectrum. In general, the horizontal axis represents frequency and the vertical axis represents amplitude. The physical meaning is the amplitude of signals at different frequencies.

3.1.1、Horizontal Axis

The unit of frequency is hertz (Hz), which indicates the number of repetitions per second. It was formerly also called cycles per second (C/s). RF signal frequencies are usually high, so larger units such as megahertz (MHz) and gigahertz (GHz) are commonly used.



KC908 uses a linear scale for the horizontal axis. If the leftmost coordinate represents 0 Hz and the rightmost coordinate represents 10 GHz, the center is 5 GHz. Because users often care more about the center frequency, instruments are commonly set using center frequency (CENT or CF) and frequency span (SPAN). The center frequency minus and plus half of the span are the start frequency (leftmost) and stop frequency (rightmost), respectively.

Spectrum mode can use a very wide SPAN. In this case, the spectrum is stitched together from FFT results. Measurement and stitching take time; the larger the SPAN, the longer it takes to refresh one screen. Because of this stitching process, increasing the RBW on KC908 does not significantly speed up the refresh rate.

3.1.2、Vertical Axis

In a spectrum analyzer, amplitude can refer to power, voltage, or current. A spectrum analyzer is a load-type instrument; it measures the power absorbed by its port, or the voltage and current at the port. These parameters are obviously related to the load. According to Ohm’s law, if the load resistance (or

more generally, impedance) is known, the power, voltage, and current on the load are mutually dependent, and measuring any one of them determines the other two. KC908 has a nominal impedance of 50 Ω, so whether it displays power, voltage, or current, the signal amplitude is represented correctly. In radio measurements, power is commonly used, voltage is occasionally used, and current is rarely used. KC908 displays signal power by default.

The unit of power is watt (W), which is a linear unit. In radio measurements, signal amplitudes may differ greatly; one signal may be only 1 nW while a nearby signal may be 1 mW, a difference of one million times. If a linear vertical scale were used, and 1 mm of height represented a 1 nW signal, a 1 mW signal would be 1 km high. No display in the world is that large. Therefore, amplitude is usually converted to a logarithmic representation.

KC908 uses a logarithmic scale for the vertical axis by default. Logarithms represent ratios. For power, 60 dB represents a factor of 10^6, or one million. Since it is a ratio, the denominator matters. In radio measurement, power is customarily expressed in milliwatts (mW), using 1 mW as the denominator. The corresponding logarithmic unit is dBmW, abbreviated as dBm. A power of 1 nW can be expressed as -60 dBm. If one pixel represents 1 dB, then 60 pixels can represent 60 dB, allowing two signals with very different amplitudes to be displayed on one spectrum screen.

An amplitude value expressed logarithmically is usually called a level value.

The instrument can also display linear amplitude. On the second page of the spectrum analyzer main menu, open the “Unit” menu and select a linear unit.

3.1.3、Frequency Settings

The CENT (or RF/CF) key is used to set the center frequency, and the SPAN key is used to set the sweep width.

After pressing the CENT key, the frequency setting menu appears. It includes four options: CENT, SPAN, START, and STOP. After selecting an item, the value can be entered directly or fine-adjusted with the knob.

After pressing the SPAN key, the sweep width setting menu appears, including Full Span, Last Span, Step Set, and ZeroSpan.

KC908’s Full Span function differs from that of a traditional spectrum analyzer. On a traditional spectrum analyzer, selecting Full Span scans the entire supported frequency range, usually from zero to the upper frequency limit. KC908 does not change the center frequency; instead, it sets SPAN to the maximum value available with the current frequency as the center.

3.1.4、Amplitude Settings

LEVEL is used to set amplitude-related parameters, such as reference level, vertical scale division, attenuation, gain, and reference offset.

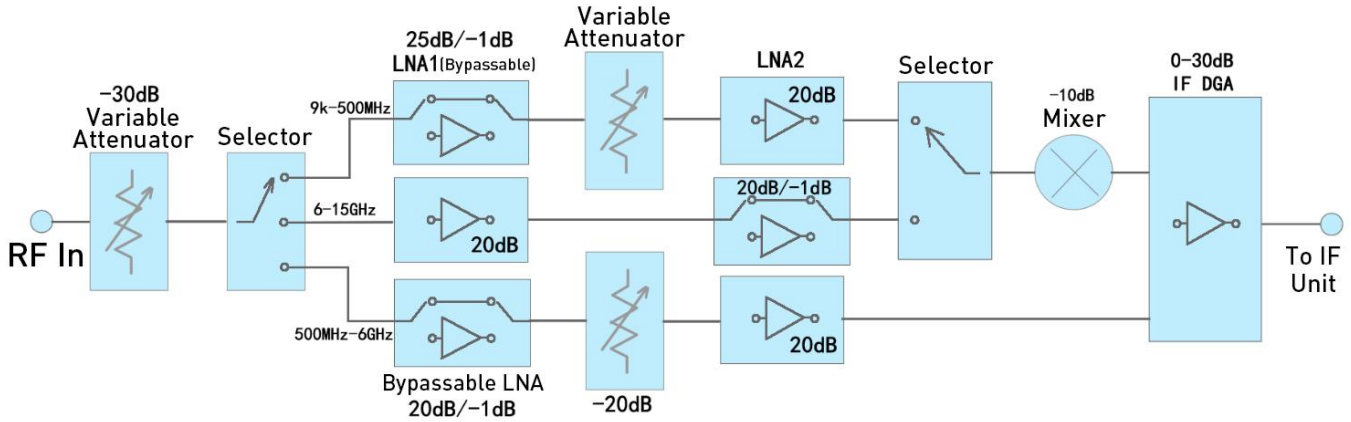
The level represented by the top grid line of the spectrum is called the reference level (REF). This name comes from analog-era spectrum analyzers that used CRT displays, where users counted divisions downward to read the spectrum. In short, REF determines the maximum amplitude that the spectrum display can contain. In principle, REF is linked with the instrument’s attenuator and amplifier. The higher the REF, the greater the attenuation and the lower the gain. To measure large signals, set a high REF; otherwise the signal may overload or even damage the equipment. To measure small signals, set a low REF to obtain a higher signal-to-noise ratio. Changing the reference level moves the trace up or down. Unless you are fully confident, no trace anywhere in the spectrum is allowed to exceed the top of the display frame.

Attenuation and amplification are set automatically by default. The setting parameters and

characteristics are described in the next section. If the automatic selection is unsatisfactory, press LEVEL and set ATT/AMP to manual. After switching to manual, REF is no longer linked with the attenuator and amplifier, so overload must be avoided carefully.

3.1.5、Relationship Between REF, AMP, and Sensitivity

The figure below is a simplified block diagram of the RF front end of KC908A/B, with all filters omitted. Due to the constraints of the overall architecture, KC908 uses a high-gain front-end design. Before the mixer or IF stage, there are two preamplifier stages. Below 6 GHz, the first stage can be bypassed, and the maximum gain is 40 dB. For 6-10.8/18.6 GHz, the second stage can be bypassed, and the maximum gain is 40 dB. Below 6 GHz, the amplifier arrangement of the two ports is exactly the same. Port 1 (left side) has no receive function above 6 GHz.



The gain of the IF amplifier can be digitally adjusted (automatically by the instrument in spectrum mode), over a range of 0-30 dB.

From the above description, up to about 70 dB of amplifier gain can be combined before the ADC. Taking circuit and mixer losses into account, the actual maximum total gain is about 60 dB. Below 6 GHz, there is also a total of 50 dB attenuation. When measuring large signals or when interference is severe, in addition to bypassing amplifiers, the attenuator must also be enabled. The instrument automatically selects appropriate gain and attenuation according to the reference level (REF) setting: it ensures that the instrument does not overload when the signal amplitude is below the reference level, while making a compromise between sensitivity and anti-interference capability under non-overload conditions.

The typical Port 2 gain configurations at different reference levels are shown in the table below. The rows for frequencies below 6 GHz also apply to Port 1. The front ends of KC908U/V/T differ somewhat, but the design concept is similar and is not repeated here.

Reference Level	Frequency Range	Attenuator	LNA1	LNA2	IF	Noise Floor (Typical Example)
20dBm	5kHz~750MHz	40	0	20	0	
	750MHz~6GHz	50	0	20	0	
	6~10.8/18.6GHz	30	20	0	0	
10dBm	5kHz~750MHz	40	0	20	10	
	750MHz~6GHz	40	0	20	0	
	6~10.8/18.6GHz	30	20	0	0	
0dBm	5kHz~750MHz	30	0	20	10	

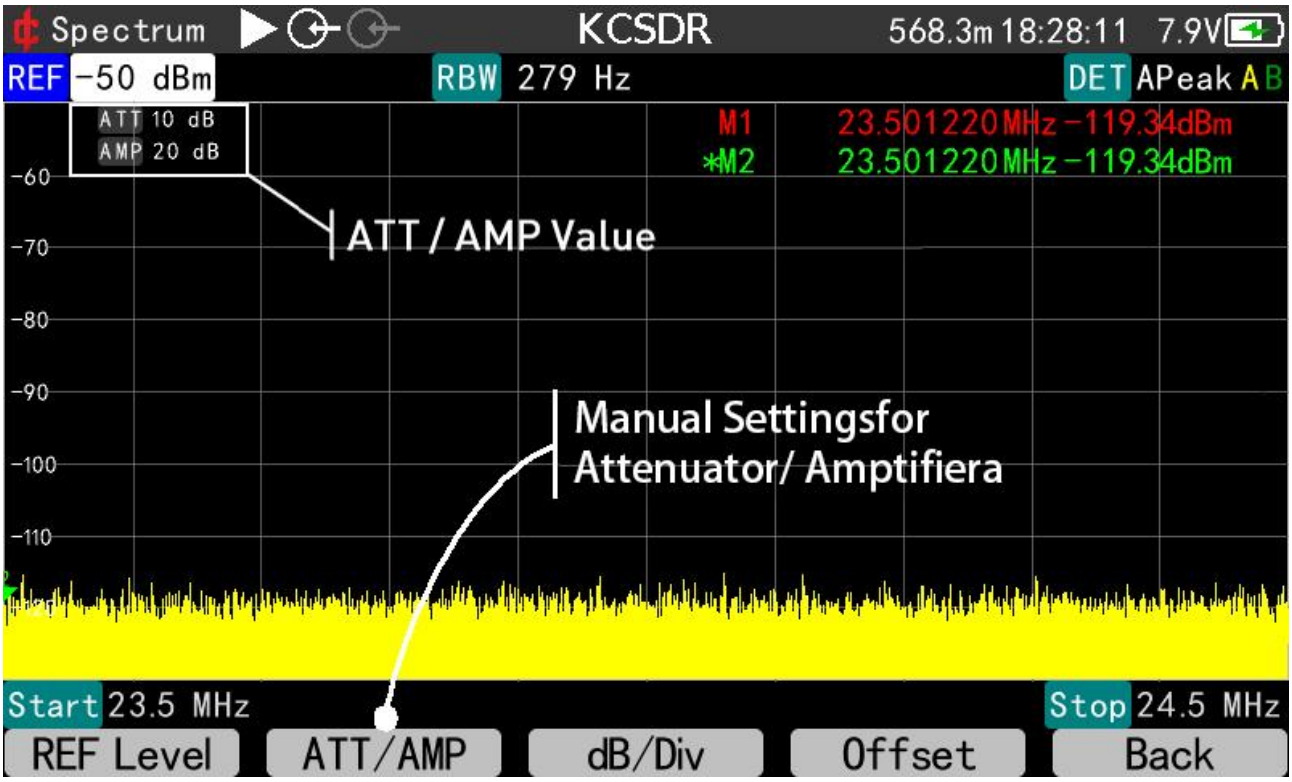
	750MHz~6GHz	30	0	20	0	
	6~10.8/18.6GHz	20	20	0	0	
-10dBm	5kHz~750MHz	20	0	20	10	
	750MHz~6GHz	20	0	20	0	
	6~10.8/18.6GHz	10	20	0	0	
-20dBm	5kHz~750MHz	10	0	20	10	
	750MHz~6GHz	10	0	20	0	
	6~10.8/18.6GHz	0	20	0	0	
-30dBm	5kHz~750MHz	0	0	20	10	
	750MHz~6GHz	0	0	20	0	
	6~10.8/18.6GHz	0	20	0	10	
-40dBm	5kHz~750MHz	0	0	20	20	
	750MHz~6GHz	0	0	20	10	
	6~10.8/18.6GHz	0	20	0	20	
-50dBm	5kHz~750MHz	0	0	20	30	
	750MHz~6GHz	0	0	20	20	
	6~10.8/18.6GHz	0	20	20	10	
-60dBm	5kHz~750MHz	0	20	20	20	
	750MHz~6GHz	0	20	20	10	
	6~10.8/18.6GHz	0	20	20	20	
-70dBm	5kHz~750MHz	0	20	20	30	
	750MHz~6GHz	0	20	20	20	
	6~18.6GHz	0	20	20	30	
-80dBm	5kHz~750MHz	0	20	20	30	
	750MHz~6GHz	0	20	20	30	
	6~10.8/18.6GHz	0	20	20	30	

The attenuator and LNA can also be set manually. After pressing the LEV key, use the ATT and AMP items on the menu. When manual setting is enabled, the status of these two items is displayed in the upper-left area of the spectrum plot.

The instrument has already been balanced for performance when used with a handheld antenna. In areas with a good electromagnetic environment, manual ATT and AMP settings should be avoided. In poor electromagnetic environments, or when using an outdoor antenna, the REF, ATT, and AMP settings may be combined appropriately according to the spectrum display. When manual settings are used, REF is still meaningful because it is linked to IF gain. The anti-interference capability at maximum gain is given in the technical specifications table.

For models on which both ports can receive, the right port should also be used. The left port should be used only when anti-interference performance is not required, or when the right port is faulty.

All amplifiers and attenuators are calibrated. After the configuration changes, the instrument automatically corrects the reading. For example, if the actual total gain is reduced by 25.8 dB at a certain frequency through adjustment, the instrument adds 25.8 dB to the raw data so that the measured signal remains unchanged, provided that the measured signal always stays above the noise floor. The noise floor, however, does not remain unchanged. Because the instrument sensitivity is reduced, the noise floor rises noticeably. Since the noise generated by the amplifier is also reduced accordingly, the noise floor does not rise by exactly 25.8 dB, but by a slightly smaller amount.



Similarly, turning off AMP or increasing ATT does not reduce residual responses caused by internal interference. On the contrary, residual responses may become more obvious because they are no longer masked by amplifier noise.

3.1.6、Mode Settings

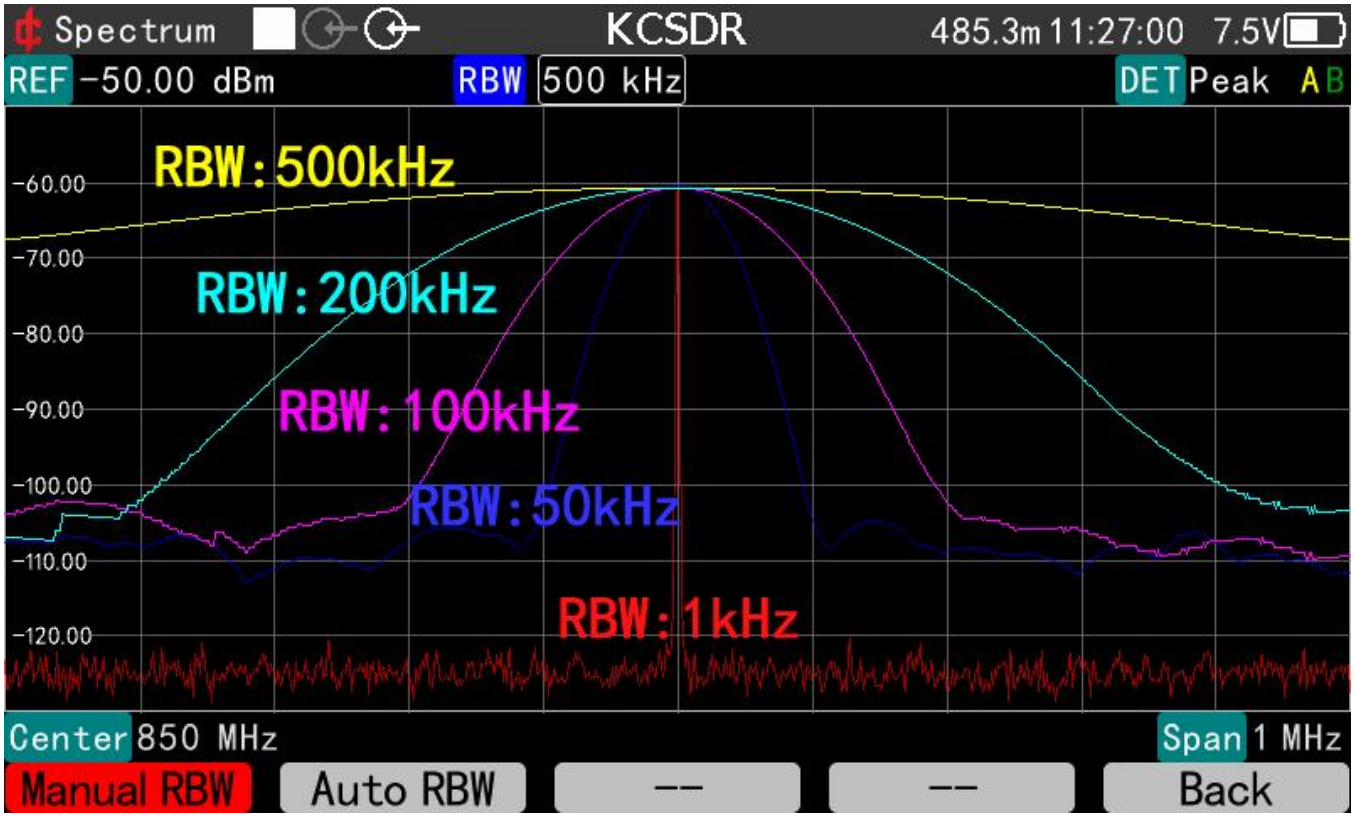
Mode settings are different from mode selection. Once a mode is selected, the mode settings menu becomes the top-level menu for that mode. The spectrum analyzer mode settings menu includes items such as bandwidth, sweep parameters, port selection, markers, traces, peak list, detector mode, and units.

（1）Bandwidth / Sweep

This menu includes resolution bandwidth, sweep time, detector mode, trigger mode, and related settings.

Resolution bandwidth (RBW), also called analysis bandwidth, was originally used to indicate how closely spaced two signals could be while still being resolved. On a swept spectrum analyzer, it is equivalent to the bandwidth of the IF filter. In an FFT spectrum analyzer, two adjacent points of a Fourier series can inherently resolve two different frequencies, so in one sense RBW is equivalent to FFT resolution. However, simply performing an FFT is not enough. If a signal falls exactly between two adjacent points, the readings of both points may be lower than the actual signal, causing an incorrect measurement. To solve this problem, the data must be windowed. As a simple explanation, the instrument calculates the weighted total power of several adjacent points and uses the result as the data for the center point. The cost of this operation is degraded resolution. Different window shapes provide different performance. Since Gaussian filters are conventionally used, KC908 uses a Gaussian window. In this case, RBW represents the equivalent 3 dB bandwidth of the IF filter.

As a simple way to understand it, when measuring a pure single-frequency signal, the spectral line should theoretically be infinitely narrow. In an actual spectrum plot, however, it still has a certain width. If the width of the spectral line is measured at 3 dB below the peak, that width is the RBW.



Obviously, RBW is related to SPAN, the number of FFT points, and the window shape. The smaller the SPAN and the larger the number of FFT points, the smaller the RBW and the stronger the resolving capability. If the number of FFT points and the window shape are fixed, RBW is theoretically related only to SPAN. In other words, for a given SPAN, there is only one RBW. Since this is inconvenient in actual use, the instrument uses the minimum RBW available under the current SPAN by default, while allowing a small range of manual adjustment. In practice, this adjusts the number of FFT points and the window shape.

If SPAN is set very wide, the screen resolution may be worse than the RBW. At that point, each pixel on the horizontal axis represents several frequencies that could otherwise be resolved separately. In extreme cases, one pixel may represent thousands of adjacent frequencies. The question of how one pixel should represent those frequencies is handled by detector mode. For example, Auto Peak places two points in one display column, representing the maximum and minimum values, and connects them with a line segment. When reading with a marker, however, the frequency and amplitude of the maximum point are read.

（2）Markers

The spectrum analyzer has four markers. After pressing the MARKER item in the mode menu, two markers are available on the first menu page, and the remaining markers are under More. Enabled markers are shown with green menu items, and the currently active marker is shown with a red menu item. The markers themselves are distinguished by different colors.

Pressing a marker key on the soft menu, such as MARKER1, opens the function menu for that marker. This menu includes functions such as finding the peak and setting the marker frequency as the center frequency.

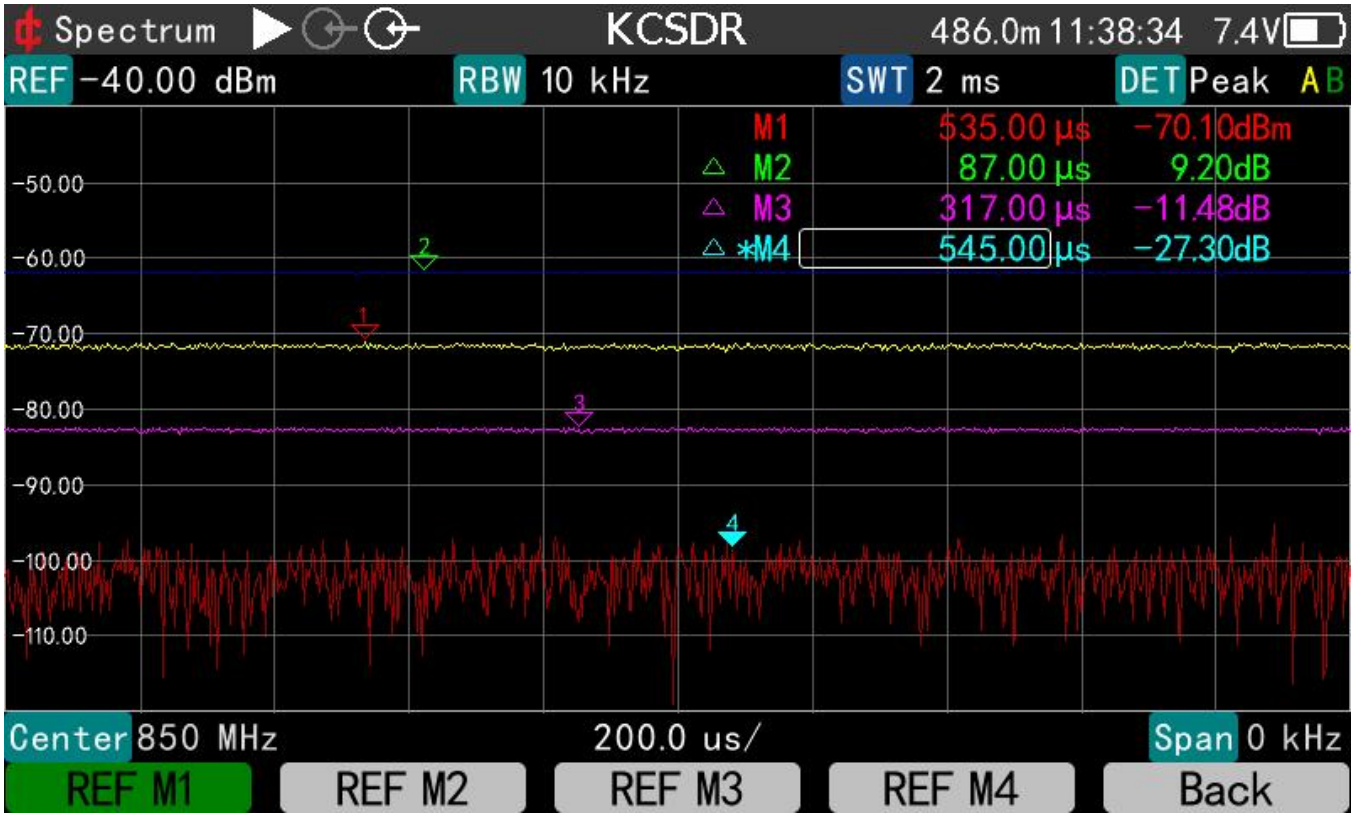


Figure: The spectrum analyzer has four markers, which can be moved to different traces and used for delta measurements.

Go to Receiver is used to switch to Receiver mode and set the marker frequency as the receive frequency.

When automatic peak search is enabled, the marker continuously searches for the highest spectral line on the spectrum plot.

（3） Traces

This menu can enable two working curves, Trace A and Trace B. It can also apply maximum hold, minimum hold, and other operations to the traces. These functions are mainly used to compare spectrum plots and capture transient signals.

Trace A and Trace B may use different REF settings, but their frequency and related parameters are the same.

（4）Peak List

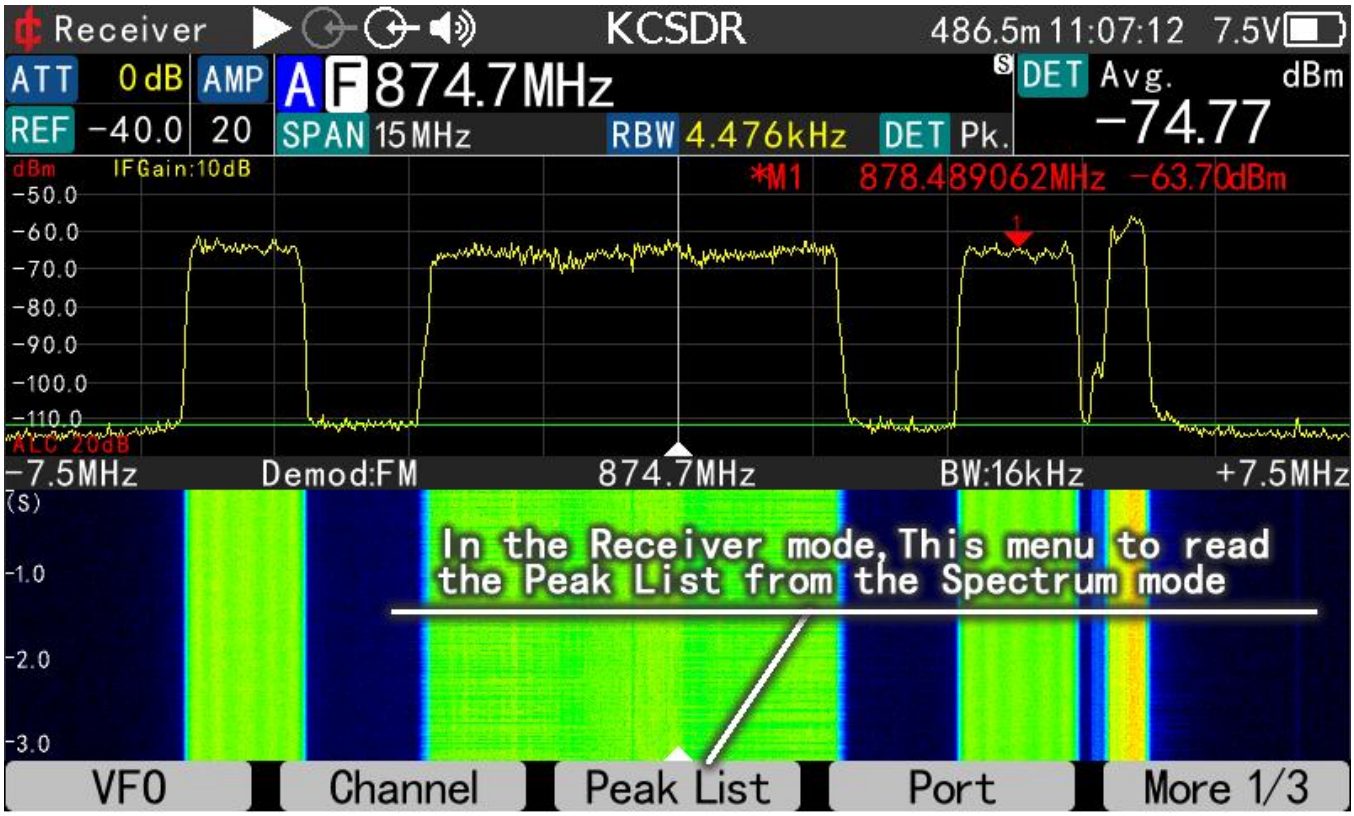
This function automatically searches for strong signals within the spectrum range and displays them in a list.

The peak list actually monitors the top 100 peaks in descending order. The instrument itself displays only 10 of them. The peak list records only frequencies that meet the peak-search settings. If only one signal within the sweep width meets the criteria, the list contains only one row.

The Save List function saves the peak list to the receiver. If a TF Card is inserted, a data-table file is also saved to the TF Card. In Receiver mode, the saved peak list can be recalled.

Note that each save operation clears the previous peak list stored in the receiver, but does not delete the file on the TF Card; it is saved as a new file. In Receiver mode, a peak list stored on the TF Card can

be read. After reading, it overwrites the peak list (P) stored in the instrument.



Peak list settings determine whether the search is complete and accurate. There are five items under Peak Search Settings, described below:

a、Threshold Level

This is similar to squelch. Only signals above this setting are recorded, preventing small signals of no interest from being recorded. When searching for nearby strong signals, it is usually recommended to set this value to -40 dBm.

Adjusting the threshold level deletes records in the list that no longer meet the condition.

b、Frequency Gap

This indicates the minimum required frequency spacing between two peaks. If the spacing between two peaks is smaller than this setting, only the first appearing peak or the larger peak is found; the later appearing or smaller peak is deleted from the list.

The main purpose of this setting is to prevent one wideband multi-peak signal from being misidentified as multiple signals, thereby reducing duplicates.

It is recommended to set this value slightly smaller than the channel spacing of the measured band. For example, for 12.5 kHz-spaced two-way radio communications, set it to 10 kHz. The specific value may be adjusted flexibly for the application scenario. If it is too small, adjacent duplicates appear in the list. If it is too large, signals may be missed.

Adjusting the frequency gap during recording deletes already recorded frequencies that no longer meet the condition.

c、Occupancy Filter

Time occupancy refers to the percentage of time during which a frequency is occupied by a signal. For example, a continuously transmitting control channel has 100% occupancy, while some voice channels used for a daily roll call may have occupancy below 1%.

In many cases, neither continuously present signals nor very occasional signals are of interest. The occupancy filter can be used to remove these unneeded signals.

To use the occupancy filter, set upper and lower thresholds, such as an upper limit of 99% and a lower limit of 1%. The Inside / Outside setting determines whether values between the upper and lower limits are selected, or values outside those limits. For example, if Outside is selected, only signals with occupancy greater than 99% or less than 1% are recorded.

The colored vertical indicator bar on the left side of the peak list visually indicates the effective occupancy-filter range.

d、Amplitude Gap

This indicates how many dB lower the valley between two adjacent peaks must be relative to the lower of the two peaks. If there is no valley that meets this condition between two signal peaks, the instrument considers them to belong to the same signal.

This function is mainly used to prevent wideband signals, especially flat-top wideband signals such as CDMA, from being incorrectly recorded as multiple signals.

A setting of 10 dB is usually recommended. If multi-peak modulated signals cause too many duplicate entries, the amplitude gap may be increased appropriately. However, the amplitude gap must not be higher than the signal-to-noise ratio. For example, when all signals are weak and the noise floor is not even 20 dB below the peak, setting the amplitude gap to 20 dB may cause only the strongest peak to be recorded.

Adjusting the amplitude gap during recording does not delete values that have already been recorded.

e、Frequency Rounding

Due to both signal frequency offset and the frequency-measurement accuracy limit of the instrument, peak frequencies saved in the peak list often have many nonzero trailing digits and are not aligned to common channel spacings such as 25 kHz or 200 kHz. The frequency rounding function trims these trailing digits for easier recording.

In the frequency rounding settings, Rounding Interval specifies the interval used for rounding. For 25 kHz channels, set it to 25 kHz or 12.5 kHz. For FM broadcasting, set it to 50 kHz or 100 kHz. Start Frequency, also called the reference frequency, may be set to any correct integer frequency value. For example, medium-wave broadcast channels use 9 kHz spacing starting from 531 kHz. Setting the start frequency to 531 kHz causes rounding to follow 531, 540, 549, 558, 567, and so on. If the lowest channel frequency of 531 kHz is not remembered, but the integer frequency 639 kHz of China National Radio is known, then 639 kHz may also be used as the start frequency. The instrument then calculates downward from that point to obtain 630, 621, 612, 603, and so on. For frequencies above VHF, the start frequency is usually set to 1 MHz or 1 GHz.

After frequency rounding is enabled, signals within one half of the rounding interval above or below an integer frequency are classified as that integer frequency.

（5）Port Switching

Port switching is used to select the instrument port, either the left port or the right port. Each press toggles once. Port switching is ineffective on the KC908U/V/W.

（6）Antenna Gain

Antenna gain is used to set the total gain of the external antenna and feeder system. After it is set correctly, when switching to the field-strength unit (dBμV/m), the instrument calculates the actual field strength within the resolution bandwidth. Antenna gain and other gain-related settings are collected under the LEVEL menu.

3.2、Receiver / Field-Strength Meter

The receiver is an instrument used to measure signal level and demodulate and monitor signals. Receiver mode can also display a spectrum. It has four major differences from Spectrum mode:

(1) By default, gain and attenuation are not related to the REF setting of the spectrum plot. Instead, they are set automatically according to the signal strength, more precisely according to the total power within the entire sampling bandwidth. Manual setting may also be used.

(2) It provides level or field-strength display. The measurement bandwidth is based on a rectangular filter rather than the Gaussian filter used by the spectrum analyzer.

(3) It provides demodulation. The demodulation frequency equals the center frequency of the spectrum plot or the marker frequency.

(4) The maximum frequency span of the spectrum plot is 15 MHz. It is a real-time spectrum and no longer stitches FFT results together.

3.2.1、VFO

VFO originally referred to a Variable-Frequency Oscillator. In a superheterodyne receiver it means the local oscillator, and it is now commonly used to describe a receiver mode in which the frequency can be freely adjusted, as opposed to channel mode. KC908 follows this convention.

The instrument has two VFOs, VFOA and VFOB. Their settings are independent, and either one may be selected during use. The main purpose of providing two VFOs is to allow quick switching between two frequencies that need to be monitored. The two VFOs cannot operate simultaneously, although this would be possible in principle from a hardware perspective.

In addition to freely setting the frequency, VFO mode can also read channels and the peak list saved by the spectrum analyzer.

To accommodate different frequency-setting habits, both VFOA and VFOB divide the frequency range into several smaller bands. Most settings are independent for each band. When the frequency is switched to another band, the last settings used in that band are applied by default. Frequencies not assigned to a band use the same group of settings.

For example, suppose you are testing broadcast at 101.7 MHz using FM demodulation and 200 kHz bandwidth, and just now you tested voice communication at 8.350 MHz using USB demodulation and 3 kHz bandwidth. If you want to return to 8.350 MHz, simply change the frequency. The instrument automatically sets the demodulation mode to USB and the bandwidth to 3 kHz.

The band division is shown in the following table:

No.	Frequency Range (MHz)		Remarks
	Start (MHz) Inclusive	Stop (MHz) Exclusive	
1	0	1.8	Long wave, medium wave
2	1.8	28	Short wave

3	28	30	Short-wave CB
4	30	76	
5	76	108	FM broadcast
6	108	136	Aviation
7	136	174	
8	320	470	Private network
9	470	520	
10	800	865	Trunked radio
11	865	1050	
12	1200	1300	
13	2400	2500	WIFI
14	Other		

Settings that users usually want to keep consistent, such as volume, display style, and port selection, are global and are not automatically changed when the frequency is switched. Settings closely related to band characteristics, such as span, squelch, and detector mode, are independent for each band.

When VFO segmentation is enabled, an "S" symbol is displayed in the upper-right corner of the frequency window. VFO segmentation can be disabled under FUNC - System Settings.

3.2.2、CHANNEL

CHANNEL, abbreviated as CH, refers to channel mode. It is sometimes also abbreviated as MR, meaning MEMORY mode. KC908 can store 1000 channels. Most settings of each channel, including the port, are independent. However, instant preference settings such as volume and display style are unrelated to the channel.

In CH mode, the frequency and setting parameters can still be adjusted freely, but such adjustments are temporary. Unless they are saved by overwriting the channel, the originally stored values are recalled the next time the same channel is used. When frequency is adjusted temporarily in CH mode, the frequency is no longer divided into bands.

In CH mode, the frequency and setting parameters can be pushed to the VFO

3.2.3、PEAK LIST

PEAK LIST, abbreviated as P, is the peak list saved from Spectrum mode. It is not the peak list on the receiver spectrum plot. See Section 3.1.6.4.

3.2.4、Automatic Gain

The receiver provides automatic gain control from RF through audio. To avoid confusion among setting names, RF and IF gain control is called ALC (automatic level control), while audio gain control is called AGC. In essence, both automatically adjust instrument gain according to RF or audio signal strength.

The receiver front end has a 30 dB variable attenuator in 10 dB steps and a 40 dB variable amplifier in 20 dB steps. The IF stage has a 30 dB adjustable amplifier in 10 dB steps.

In Spectrum Analyzer mode, the combination and value of these amplifiers and attenuators depend on the reference level setting, with a total adjustable gain range of 100 dB.

The receiver not only displays measurement results but also provides audio. In many situations, the user mainly listens and only uses the display as a supplement. In addition, the receiver is often used for

mobile signal searching, where the signal level can vary greatly. Requiring the user to adjust the reference level continuously would be inconvenient.

Therefore, in receiver mode, the instrument automatically adjusts the attenuator, amplifier, and IF gain according to the input signal level by default. This is called signal-following ALC. In earlier firmware versions, the user could force the receiver to adjust gain in the same way as a spectrum analyzer, according to the reference level. This was called reference-following. Since it was of limited practical value and could easily confuse users, newer firmware no longer allows reference-following operation.

The basis for automatic adjustment is the total level over the entire sampling bandwidth. The instrument cannot look only at the signal strength at the receive frequency, because overload may occur outside the demodulation bandwidth. If there is only a weak signal at the receive frequency but a very strong interferer nearby, the instrument may still overload. When the total power level received by the ADC is too high, the instrument tentatively increases attenuation or reduces IF gain until the overload disappears. When the level drops, the instrument reduces attenuation or increases IF gain again to maintain higher sensitivity. To avoid gain oscillation caused by rapid signal fading, the hysteresis range is 20 dB by default and can be set under LEVEL - Gain - Advanced - Hysteresis Range.

RF gain has a significant effect on anti-interference performance. Since it is difficult to fully evaluate the electromagnetic environment within the real-time bandwidth, including all RF gain in automatic adjustment may produce incorrect results. Therefore, the later-stage 20 dB amplifier can be automatically adjusted, while the 20 dB preamplifier (Pre-AMP) must be adjusted manually by the user. Once the preamplifier is enabled, RF gain can no longer be automatically adjusted. In locations with an excellent electromagnetic environment and very weak signals, the preamplifier may be enabled to improve sensitivity; in this state, the RF gain is displayed as 40 dB. The PRE-AMP shortcut key quickly turns the preamplifier on or off.

CAUTION

Because ALC is controlled according to the total level over the entire sampling bandwidth, signal changes outside the displayed region may also trigger ALC action and cause the noise floor to jump.

Because overload may occur before the ADC, adjustment based only on the sampled level may still fail to prevent overload. Unless a detector is added after the preselector, this type of overload cannot be eliminated by ALC. As a supplementary measure, KC908 allows the user to manually specify attenuation or gain. Parameters that are not manually specified remain under automatic adjustment. In harsh electromagnetic environments, the user may manually specify 10 dB or higher attenuation and leave the remaining stages automatic. However, because manual settings are fixed, they may not work well when signals vary frequently. In such cases, gain limits can be enabled.

CAUTION

When operating near high-power transmitters, including unknown strong interference sources, out-of-band interference may block the receiver front end and cause the measured signal to appear falsely weak. During pedestrian direction finding, the direction where the target signal appears strongest may actually be the direction where out-of-band interference is weakest. If the target transmitter and the interferer are at the same location, such as on the same tower or in the same equipment room, this can lead to the opposite direction. When this risk exists, use the spectrum function to view as wide a frequency range as practical to detect strong interference in time. A simpler method is to sacrifice some sensitivity and limit RF gain to 20 dB, which is the factory default. This extreme situation is uncommon, but users should remain alert to it.

Gain Limit

The **Gain Limit** function is located in the Gain/Attenuation - Advanced settings menu. It constrains the maximum gain to help prevent interference outside the displayed range from causing overload. This function consists of three items: minimum attenuation, maximum IF gain, and maximum RF gain.

For example, if minimum attenuation is set to 10 dB, the attenuator will always remain at 10 dB or higher. If the external signal is strong, attenuation may automatically increase to 20 dB or 30 dB. If the external signal is weak, attenuation will only decrease to 10 dB and will not drop to 0. If maximum IF gain is set to 20 dB, the IF gain may automatically decrease to 0 when external signals are strong, but when signals are weak, it will increase only up to 20 dB and not to 30 dB. Unless the user is very familiar with the instrument characteristics, it is generally unnecessary to limit IF gain.

Gain limits do **not affect manual gain settings.** If manual gain settings and gain limits are enabled at the same time, items with manual settings enabled follow the manual settings. Items without manual settings remain automatic and are constrained by the gain limits.

Gain limits are effective only for the receiver function. After gain limits are enabled, a limit indication appears in the lower-left corner of the coordinate display.

The instrument indicates whether ATT and AMP are currently in manual or automatic mode using different colors for their values at the top of the screen. Golden yellow indicates automatic mode. After gain adjustment, the instrument automatically corrects the readings.

When ALC is used, the REF setting only determines the vertical-axis scale of the displayed area and therefore the position of the trace. The color mapping of the waterfall is linked to REF; its start and stop levels cannot be set separately. If the instrument automatically adjusts gain, the waterfall may show sudden color changes because the noise floor has changed.

Audio AGC is enabled by default. It adjusts the total audio power to the configured volume level. In this state, when no signal is present, loud noise may be heard regardless of the demodulation mode. During demodulation, if rising noise interferes with operation, AGC can be turned off from the right-side menu after pressing the AF key. The default time constant of audio AGC is 1 s.

3.2.5、Level / Field Strength

The level is displayed in the upper-right corner. Unlike the marker on the spectrum display, the level value represents the total power within the demodulation bandwidth. Press MODU, enter the demodulation settings, find the **Demodulation Bandwidth option**, and adjust it there. The demodulated signal is extracted using a rectangular filter; even when the demodulation bandwidth is the same as RBW, the level reading may differ from the marker reading.

To measure field strength, set the unit to dBμV/m or dBW/m² and correctly configure the antenna gain. The level/field-strength unit is set in the LEVEL - Unit menu.

3.2.6、Level Tone

The receiver provides a LEVEL TONE function, which uses tone pitch to indicate the signal level. In other words, the tone pitch follows the level reading.

However, the possible level variation range is very large, exceeding 120 dB. If pitch were used to represent such a wide range, it would be almost impossible to perceive any detail. Therefore, the level-tone indication range must be narrowed. KC908 uses an 80 dB indication range. After enabling level tone, the center level should be set correctly.

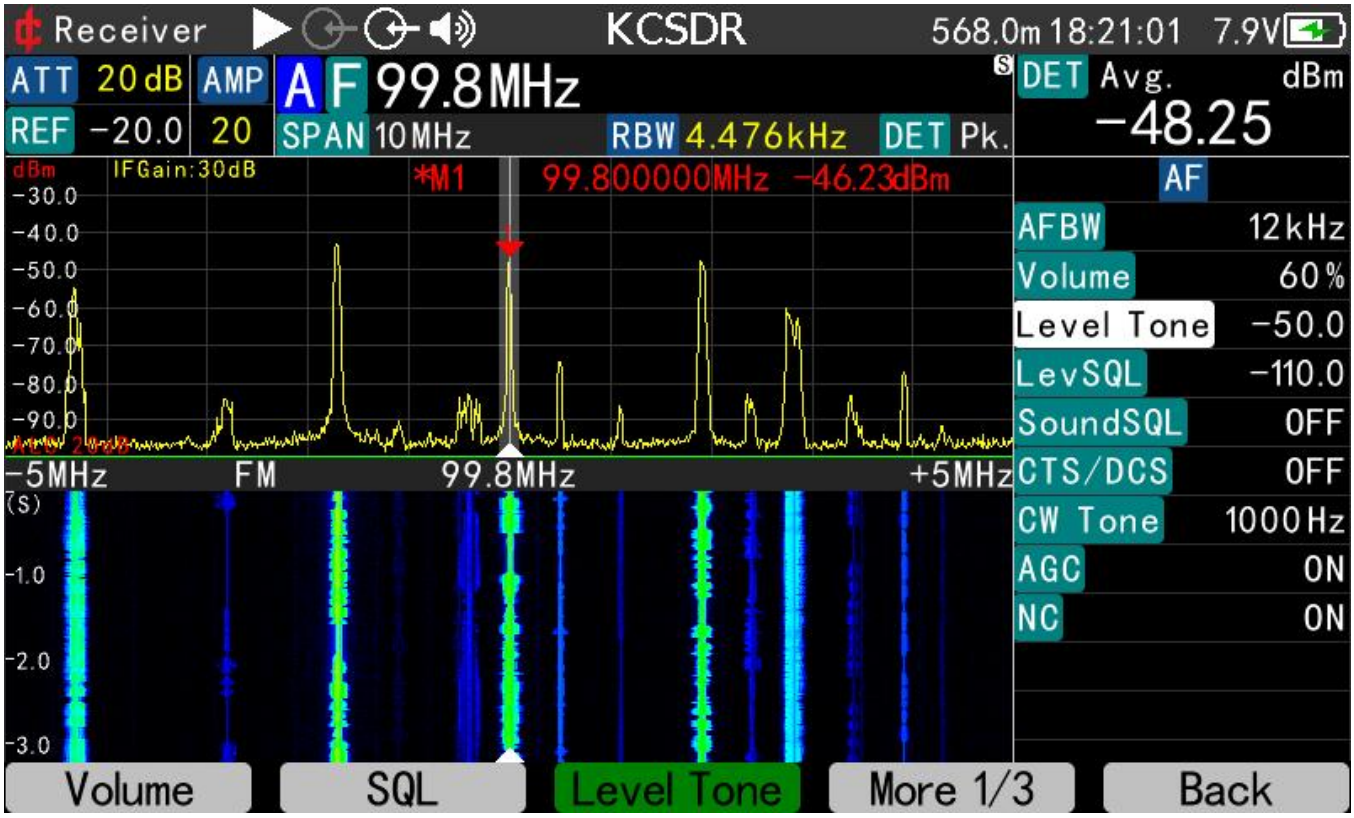


Figure: During pedestrian search, setting the center level close to the current level reading makes changes easier to hear.

When the level varies within ±40 dB around the center value, the tone pitch changes significantly. This change range is already close to the limit of speaker response. When the level is more than 40 dB below the center point, the tone basically no longer changes. If the level is more than 40 dB above the center point, the level tone changes to an intermittent alert. The higher the level, the faster the intermittent alert becomes, reminding the user to raise the level center point. The intermittent alert provides an additional 20 dB indication range.

The level center point can be adjusted with the lower knob. When level tone is enabled, press the knob twice. After three short beeps are heard, the knob has switched to level-center adjustment. If no adjustment is made for 5 s, the knob function automatically returns to volume adjustment.

3.2.7、Squelch and Noise Reduction

KC908 provides squelch functions to mute the audio output when no signal is present or when the signal does not meet specified conditions, thereby avoiding noise disturbance.

The squelch functions include level squelch, voice squelch, continuous tone squelch (CTS), and digital-coded squelch (DCS), and the instrument also provides sub-audio tone analysis.

Level squelch: when the signal level is below the configured value, the audio is muted. Level squelch uses hysteresis comparison, and the default hysteresis range is 2 dB. The configured squelch level is indicated by a green horizontal line on the spectrum display.

Voice squelch: the audio is analyzed, and if only white noise is detected, the audio is muted. Since accurate voice detection is very difficult, this function alone is less effective and should be used together with level squelch. If the signal level is 10 dB higher than the level-squelch setting, audio output is enabled regardless of the voice-squelch decision.

CTS and DCS determine whether to enable audio output based on specific signals or data modulated in the sub-audio range below the speaker response frequency.

The instrument includes CTS and DCS analysis functions. They can be enabled by selecting Analyzer in the CT/DT menu under AF. After enabling the analyzer, the instrument measures and displays the CTS frequency or DCS code in real time. Because DCS may have inverted codes or ambiguity, and CTS may have multiple combinations, several results may sometimes be displayed. The result with the highest probability of being correct is shown on the left.

When the squelch opens the audio output, the speaker icon at the top of the screen lights up.

The noise reducer uses mathematical methods to reduce white noise in audio and improve clarity. To reduce distortion, the noise reduction effect is intentionally mild. If audio is to be output externally for testing, the noise reducer should be turned off.

Audio-related functions such as level tone and squelch are grouped in the audio settings menu, which is opened by pressing the AF key.

3.3、Signal Source

The signal source function can output CW, AM, FM, and PM signals, and it can output digital modulation when connected to GNU Radio. KC908A/B provide signal-source functions on both ports. KC908U/V/W provide signal output only from the left port. Since the left port is the default signal-source port, the following discussion is limited to the left port.

Signals from 100 kHz to 1 GHz are generated by mixing and pass through strict low-pass filters, so they are relatively clean. Signals from 1 GHz to 6 GHz are generated directly by an IQ upconverter; because their purity is acceptable, no additional filtering is applied. Frequencies above 6 GHz are generated by mixing. KC908A has only simple filtering in this range, and the output may contain strong spurious components such as LO leakage, which should be considered during use. KC908B is equipped with a synchronously tuned filter, providing 20 to 40 dB out-of-band rejection. Except for some leakage of strong spurious components such as LO and image signals, other spurious responses are relatively low.

The maximum output level of the signal source varies with frequency, mainly because amplifier saturation power decreases as frequency increases, while circuit loss increases rapidly with frequency. To maximize the available output level, the instrument has a relatively large gain margin. However, near the amplifier saturation power, gain compression is inevitable and difficult to predict. Therefore, signal-source calibration is performed at power backoff. When the user increases the output power near the limit, the instrument only increases the drive power. The actual output level will not increase linearly, and the closer it is to the limit, the smaller the actual increase becomes.

For example, at 13 GHz, calibration is performed when the output level is below -10 dBm. During use, if the drive power is increased further, each 1 dB increase in drive may increase actual output power by only 0.5 dB. The instrument performs curve fitting for output compression, but at higher output levels the fit is difficult to make accurate, and the set value may deviate significantly from the actual value. The deviation may be either higher or lower.

In other words, if output-level accuracy is important, avoid setting the output level too high; keeping it below -10 dBm is recommended. If the main concern is obtaining higher output power, the output level may be increased further, but output-level accuracy should no longer be expected.

When a large output signal is generated, the amplifier operates near saturation and its distortion is relatively high. This produces more harmonics and also adversely affects digital modulation. If the signal source is used to generate digital modulation, it is recommended to back off at least 10 dB from the maximum configurable level at the operating frequency to keep EVM at a better level.

With strong drive, the left port can output relatively high levels, typically 10 dBm or higher below 6 GHz. Above 6 GHz, KC908A/B can reach 10 dBm over most frequencies and may even reach 18 dBm at lower frequencies below 13 GHz. In fact, the final amplifier of KC908A/B can output 23 dBm, but as

frequency increases, circuit loss rises, so the maximum level is far below the amplifier output limit.

The signal source can also output weak signals. When KC908A/B use the right port, the output can be especially low. With an external power attenuator of at least 30 dB, it can be used for radio sensitivity testing. When the left port is used for sensitivity testing, an external attenuator of at least 50 dB is required. Output-level accuracy at small signal levels is generally good, but local amplitude linearity is not ideal. In simple terms, a 1 dB setting change may result in an actual change of 0.3 dB or 2 dB. However, if the setting is adjusted by 10 dB, the error will not become ten times that of a 1 dB adjustment; deviations in different directions tend to cancel each other, and the total deviation is usually within 2 to 3 dB. Therefore, when the output level is very low, such as below -40 dBm, small-step relative values are for reference only.

The instrument is factory-calibrated over an amplitude range with better accuracy, typically a 30 dB interval. Within this range, accuracy is good. If the amplitude is higher or lower than this range, the instrument may display Unlevel.

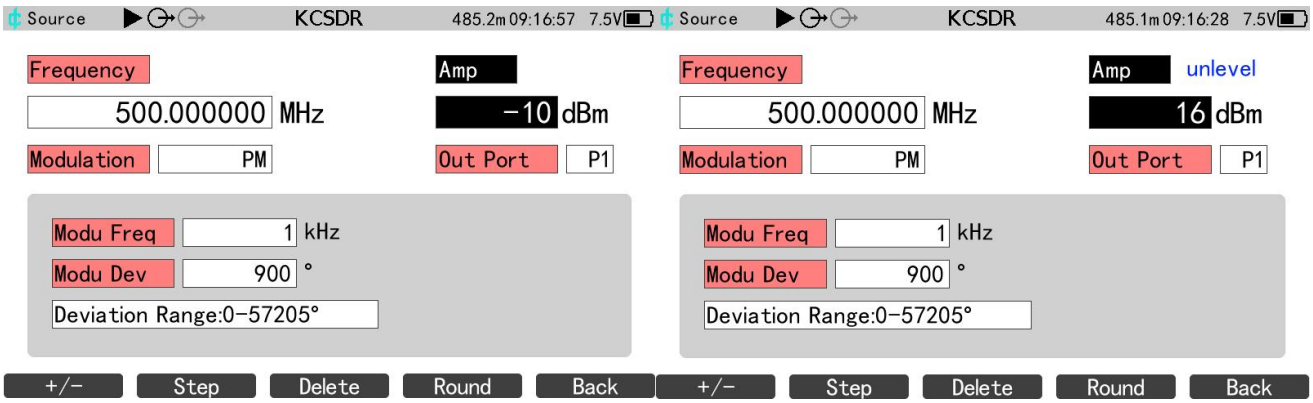


Figure: The left display shows an amplitude within the accurate range. The right display exceeds the accurate range and shows Unlevel, indicating that **the displayed value is unreliable**.

Because the signal source can output relatively high levels, avoid causing interference to radio services during open-area testing.

4、Test Preparation

KC908 has two RF input/output channels and provides multiple functions such as spectrum and field-strength measurement. The required preparation varies depending on the test requirements.

4.1、Battery Level and Charging

Before carrying out a test task, check the battery level in the upper-right corner of the display. If the battery voltage is above 8.2 V, the battery is fully charged. If the voltage is below 7.0 V, the remaining operating time is less than half an hour, and the instrument must be charged.

Power consumption varies with the function in use. Typical battery life after a full charge is shown in the table below.

Function	Frequency Range	Battery Life	Remarks
Spectrum Analyzer	＜500MHz	4h	Amplifier 20 dB, receiver volume 30%

/ Receiver	500MHz-6GHz	5h	
	6-33GHz	4h	
	＞33GHz	3h	
Comparator*	＜500MHz	3h	Amplifier 20 dB
	500MHz-6GHz	3.5h	
Signal Source	＜1GHz	4h	Simple signal source, at maximum output level
	1GHz-6GHz	4.5h	
	6-10.8/18.6GHz	4h	
Stopped		10h	

*Battery life is for reference only. Some functions are optional; the actual instrument configuration shall prevail.

When audio is enabled, battery life is related to volume. At maximum volume, power consumption may increase by 5 W, significantly shortening battery life.

For long-duration operation, prepare a charger or external battery pack. An external battery pack can be homemade, with an output voltage preferably between 12 V and 16.8 V, corresponding to four lithium cells in series. The external battery powers the instrument through the 12 V Charging Port. Every 60 Wh of energy can approximately double the operating time. A power bank with fast-charging capability can also be used.

Using the original charger through the 12 V Charging Port, the charging current is about 1.8 A when the instrument is off, and a full charge takes about 3 h. When a USB charger is used, charging time depends on the charger output capability. A 5 V/1 A charger usually requires 15 h; a 5 V/2 A charger usually requires 10 h. Chargers compatible with fast-charging protocols may charge in a shorter time. The instrument measures voltage and current to analyze the charger characteristics and adjust the charging current appropriately. Even two chargers with the same nominal specifications may require very different charging times. In addition, the length and quality of the charging cable affect charging time. Therefore, if the USB port is used for charging, test the actual charging time in advance to avoid delaying field work.

Standard 12 V (13.8 V) vehicle power sources, such as vehicle batteries, vehicle radio power supplies, and automotive cigarette-lighter outputs, can directly charge the instrument. When charging in a vehicle, a 3 A fuse should be installed in the charging line. In an emergency, a 12 V AC power source may also be used briefly for charging.

When the battery voltage falls below 6.5 V, the instrument issues a low-battery warning and automatically shuts down after one minute. If the user operates the instrument before shutdown, the timer restarts. After automatic shutdown, the instrument can still be powered on briefly.

If the voltage continues to fall below 6.0 V, the instrument completely powers off to protect the battery and cannot be turned on again unless it is charged.

4.2、Connectors

KC908A/B/T use RF receptacles with a 2.92 mm interface inner diameter and a cutoff frequency above 33 GHz. KC908U/V use SMA connectors. The RF receptacles are strongly reinforced, but their structure determines that they cannot withstand large mechanical forces. Users should understand that the connector shell is very rigid, but the center pin is fragile. The main cause of damage is center-pin movement that cannot be seen from the outside. When selecting connectors or adapters, observe the following principles:

(1) It is not recommended to convert directly to a larger connector. For example, when conversion to

an N connector is required, use a flexible cable between the instrument port and the N connector rather than an SMA/N adapter directly attached to the instrument.

(2) When converting to the same or a smaller connector, use a short adapter. The length should not exceed 50 mm; otherwise use a flexible cable as an intermediate connection. Long adapters significantly increase the lever arm and can easily pry the RF receptacle loose.

(3) Use straight adapters rather than right-angle adapters. If a right-angle adapter protrudes beyond the outline of the instrument, it may pry the RF receptacle loose if the instrument is accidentally tipped over.

(4) Use 50 Ω SMA connectors or 2.92 mm connectors. 3.5 mm connectors may also be used, but products from some manufacturers may have poor contact.

(5) Use high-quality plugs. During installation, rotate only the coupling nut and avoid rotating the entire connector. Press the plug body while tightening the coupling nut so the interface is firmly mated. The plug must be tightened before use and must not wobble; otherwise it may pry the center pin loose or cause poor contact between the receptacle and the circuit board. Pay special attention when connecting an antenna directly. Many low-quality antennas have inaccurate interface dimensions or no proper interface at all; when tightened, they can immediately damage the center contact assembly. Some antennas have a rigid outer shell while the center pin can still be pried during bending, creating a serious threat to connector safety.

4.3、Antennas

4.3.1、Outdoor Antennas

When selecting an outdoor antenna, consider lightning protection and electrostatic protection. DC-grounded antennas are relatively safer. When connecting a large shortwave antenna, discharge static electricity first, especially in windy weather.

In complex electromagnetic environments, use narrowband antennas whenever possible. In cities, the total RF power received by a broadband outdoor antenna can be relatively high, often reaching 0 dBm or higher. In this situation, the front end of the instrument may be blocked, causing the noise floor to rise sharply and useful signals to decrease. Increasing the reference level can activate the attenuator and automatically turn off the amplifier. The attenuator may also be manually enabled and the amplifier manually disabled. Port 2 (right port) has better anti-interference performance than Port 1 (left port) and should be used whenever possible.

If necessary, connect a suitable filter in series between the instrument and the outdoor antenna.

4.3.2、Handheld Antennas

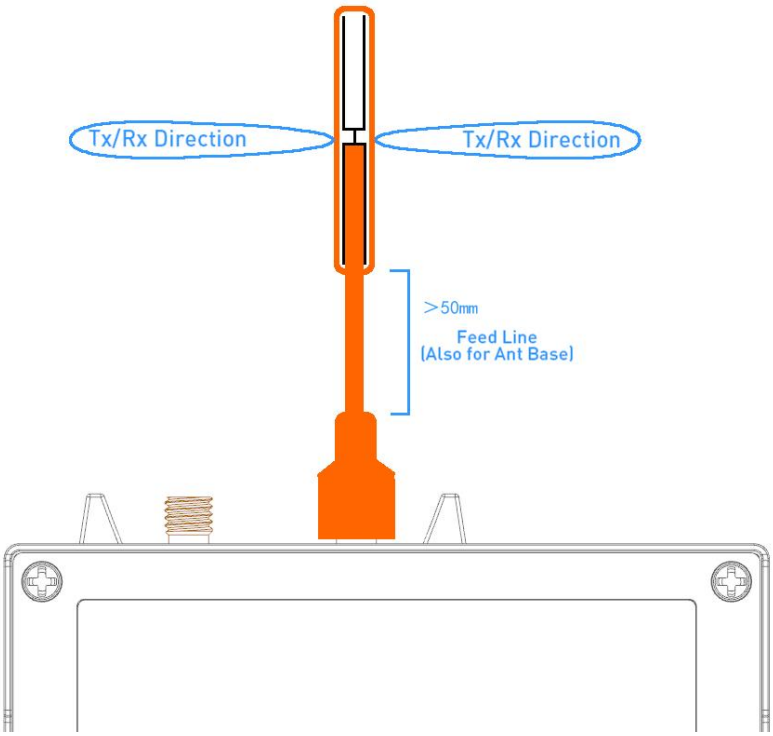
For mobile operation, select a handheld antenna with the appropriate frequency range and gain. In addition, pay attention to isolation between the antenna and the instrument, as well as mechanical stress on the RF port.

To improve power efficiency and reduce size, the instrument contains multiple high-performance switching power supplies. Although dither, shielding, and other measures are used, a small amount of high-frequency radiation is still generated. Although this radiation is far below relevant EMC standards, it is still significantly above the sensitivity of KC908. If the antenna is pointed toward the instrument itself, KC908 will be interfered with by its own EMI.

Most of this radiation first leaks outside the instrument and then forms interference through the antenna; it is not propagated internally through the instrument. When no antenna is connected, only small residual responses from digital circuits are usually visible on the spectrum, and power-supply

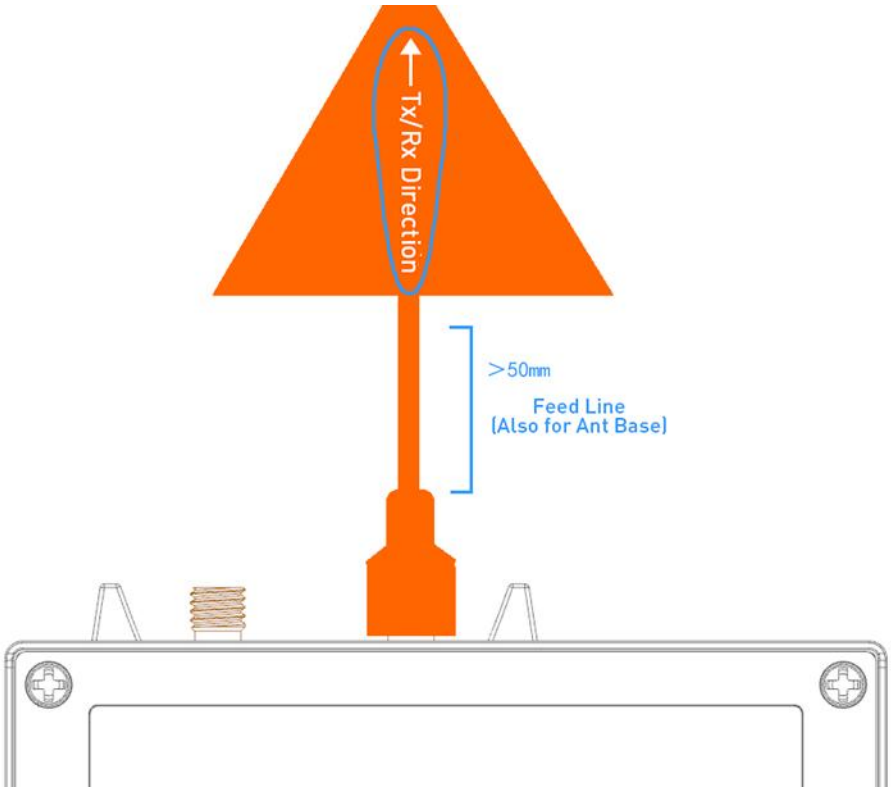
interference rarely appears. Therefore, proper antenna isolation is the main way to reduce interference.

(1) Use a balanced antenna whenever possible. An unbalanced antenna may cause the instrument housing to participate in radiation or reception, increasing interference.



(2) Avoid loaded antennas, especially those with the loading inductor at the antenna base. Inductor coils are sensitive to magnetic fields and will increase interference. Radial helical antennas, or spring antennas, are especially severe in this respect.

(3) The antenna receiving/radiating direction must not point toward the instrument; it should be parallel to or away from the instrument, as shown below.



(4) The base of the antenna handle should be mechanically firm. A soft antenna handle can easily cause the center contact assembly to wobble and pry the RF port loose.

(5) For direction-finding searches, use a soft feed line to connect the handheld antenna. Do not strap the antenna to the body, to avoid injury or connector damage while running.

(6) If field strength needs to be measured, prepare an antenna with known gain and enter the gain into the instrument.

WARNING

Most whip antennas are not DC-grounded. The metal radiator connected to the center pin may even be directly exposed, such as on a telescopic antenna. In this case, electrostatic discharge from the human body or other objects can enter the instrument directly through the metal radiator or be back-fed to ground, which can easily damage the circuit. Avoid using whip antennas with exposed metal parts.

4.4、Holding and Carrying

KC908 is designed for two-handed operation. When operating the keypad, hold the instrument with both hands and operate the keys with your thumbs. When operating the knobs, hold the right side of the instrument with the right hand and turn the knob with the left thumb. When the instrument is carried on a shoulder strap, the knob can be operated with one hand.

The top and bottom of the instrument both have strap lugs for attaching a shoulder strap. Each strap hole can support the full weight of the instrument. The design limit tensile force of each hole is 100 N. The shoulder strap is intended mainly for normal carrying and is not suitable for high-risk scenarios such as work at height or power transmission and distribution maintenance. In high-risk applications, additional measures should be taken to prevent the instrument from falling or other hazards.

The strap holes are small, while the strap is relatively thick. When installing the strap, use tweezers or another small tool to help thread it through. You may also shape the end of the strap with your fingers so it bends slightly and slides out through the strap hole.

It is recommended to use the two lower strap lugs so that the instrument hangs upside down. During use, place the shoulder strap around the neck, with the instrument in front of the abdomen and the display facing outward. When the instrument is lifted, the panel naturally faces the user.

If the two upper strap lugs are used, the display should face inward while worn. With this carrying method, if the user falls, the antenna connected to the instrument can easily stab the body. Therefore, this method is not recommended. The upper strap lugs are only suitable for users who are accustomed to carrying the instrument by hand or across the shoulder.

When running is required, attach the shoulder strap to the lower strap lugs and carry the instrument diagonally across the body.

The instrument is completely not waterproof. If rain or wading is possible, seal it in a transparent plastic bag in advance, but note the adverse effect on heat dissipation. All knob functions can be replaced by keypad operation, so there is no need to expose the knobs. If water exposure cannot be avoided, immediately turn off the instrument and place the left side panel downward. Once water enters the instrument, immediately shake out the accumulated water with the left side panel facing downward and place the instrument in a safe location to dry naturally. Be alert to the risk of battery fire or explosion. If the instrument can no longer start, remove the battery as soon as possible according to the steps in Section 2.4, and then return the battery-free main unit to the manufacturer for repair.

All cover screws must be complete and tightened. The shoulder strap may slowly slip loose and should be checked frequently. When an antenna is connected, keep it away from moving parts and beware of being dragged by other machinery, equipment, or vehicles.

4.5、Understand the Device Under Test and Avoid Instrument Damage

Estimate the condition of the device under test and take sufficient measures to keep the input within the safe range, avoiding damage to the instrument.

(1) Ensure that the antenna and the device under test are insulated from each other, and avoid contact with the device under test.

(2) When using a long antenna, especially a shortwave antenna, beware of low-frequency electromagnetic induction. The instrument power tolerance drops rapidly below 1 MHz. At 100 kHz, input above 0 dBm may cause damage.

(3) Never get too close to a transmitting station. Transmitting with an ordinary handheld radio pressed against the receive antenna may induce 1 W of power. Even at a distance of several tens of centimeters, the instrument may still be damaged.

(4) For closed-loop tests, fully estimate DC voltage, signal level, noise level, and the presence of static electricity. Although the port can withstand 15 V DC, poor contact causing frequent make-break events, or unstable DC voltage itself (equivalent to AC), may impact the instrument front end and cause burnout. The instrument power tolerance differs for different REF settings. When REF is low, damage may occur at 13 dBm (0 dBm below 1 MHz). Note that this is the total power level, not only the observed signal.

(5) If a risk exists or the risk is unclear, use DC blocking, attenuation, filtering, and other protective measures. If necessary, manually set the attenuator to 30 dB first, and then reduce it or set it to automatic after confirming safety.

5、Operating Instructions

KC908 provides many functions, but its operation is designed to be clear and explicit rather than deliberately minimizing the number of menus. To improve usability, the designers set the goals of “usable immediately” and “no need to read the operating instructions,” and carefully designed the operating logic. A user with basic knowledge of RF measurement can usually become proficient after about half an hour of hands-on use.

This manual follows the KC style and assumes by default that the user is professional. It mainly explains the operating logic and the non-obvious points. As for menu structures, looking at the instrument screen is obviously more intuitive than reading the manual, so they are not repeated unnecessarily here.

Switching Between Chinese and English

1. Power on the instrument and wait for it to start up, which takes about 10 seconds.
2. Press the FUNC key. A table appears on the display.
3. Use the wheel to move the white cursor down by one row.
4. Press ENTER. A more complex table appears.
5. Press ENTER. A blue area appears.
6. Rotate the wheel and observe the screen language switching between Chinese and English.
7. Press FUNC to exit.

5.1、Power On / Off

The power key in the lower-left corner of the keypad is used to turn the instrument on and off. Press

and hold it for half a second to take effect.

The power key looks like this:



When shutting down, the instrument saves the settings. When powering on, it restores the state from the previous shutdown by default.

If the instrument freezes, press and hold the power key for 5 seconds to force shutdown.

The RB key is used for hard reboot. When the RB key is pressed, the instrument is completely powered off; when released, power is restored. Since this is direct power removal, unsaved settings will be lost, but saved settings will not be erased.

The RB key does not restore factory settings. To restore factory defaults, press FUNC, enter the System Settings menu, and find Restore Factory Settings.

The instrument has an automatic shutdown function, configured under the FUNC menu.

FUNC key→System Settings→Timed Shutdown

For example, if it is set to 30 min, the instrument automatically shuts down after 30 consecutive minutes without operation. Any operation restarts the timer.

To turn off timed shutdown, enter 0 or use the knob to reduce the time until OFF is displayed.

Settings are saved during automatic shutdown.

5.2、General Operating Habits

5.2.1、Primary Functions

For primary functions, KC908 mainly uses three operating logic patterns:

(1) Menu, possibly with multiple layers -> select -> input or set -> confirm or cancel.

For example, to set demodulation bandwidth: in receiver mode, first press MODU to display the demodulation menu. The menu contains four submenus: On/Off, Demodulation Mode, Demodulation Bandwidth, and Vocoder. Select Demodulation Bandwidth to display the demodulation bandwidth setting menu and activate numeric input. Enter the frequency, and press ENTER or the appropriate unit key to confirm.

(2) Menu, possibly with multiple layers -> turn on or off.

For example, to enable squelch: press AF, select Squelch, then select Level Squelch. Press the On/Off key to toggle between on and off. Enabled options are shown in sky blue.

(3) Menu, possibly with multiple layers -> execute.

For example, to reduce the frequency step: in a numeric setting menu such as frequency, press the divide-by-10 key to reduce the step by a factor of 10. Repeatedly pressing the divide-by-10 key repeats the operation.

5.2.2、Secondary Key Functions

The operation logic for secondary functions, called by SHIFT + another key, is mainly divided into two types:

(1) Quickly call up or activate a setting item. Subsequent operation is the same as for a primary function.

For example, use SHIFT + MODU to quickly open the vocoder setting menu.

(2) Quickly switch a function on or off, or cycle quickly among several commonly used parameters.

For example, use SHIFT + 4 to quickly switch screen brightness. Repeated operation cycles through several common choices.

Some functions can only be turned on or off by SHIFT + key, and have no menu path for switching.

5.2.3、When an Input Error Occurs

For functions involving numeric input, if you enter the wrong value, do not press ENTER. Activating the input again restores the original value. For example, if the frequency is entered incorrectly, pressing CENT before confirmation clears the input and restores the original value.

For items where a long number may be entered, a backspace (DELETE) button usually appears on the soft menu. Each press deletes one digit.

Selection items take effect immediately after being pressed. For example, when setting ATT, pressing 20 immediately sets it to 20 dB. If you press the wrong item, set it again.

5.2.4、HOME Key

The HOME key is used to switch the measurement mode of the instrument and is a commonly used key. No matter what state the instrument is in, pressing HOME displays the measurement mode selection menu or the main menu of the current mode. Pressing HOME repeatedly cycles between these two menus.

The HOME key can be regarded as calling up the top-level menu of the instrument. However, the instrument usually uses the mode main menu as the top-level menu. In other words, each mode is independent, and within a mode, the mode main menu is the highest-level menu.

5.2.5、FUNC Key

This is the system key. Global settings are collected here.

After pressing FUNC, use the wheel or the left/right keys (+ and -) to move the cursor position, and use ENTER to select.

5.2.6、Knob Functions

The instrument has three knobs in total. The large knob on the front panel, also called the wheel, and the small upper knob on the left side have basically the same functions and are collectively called multifunction knobs. The lower knob on the left side is dedicated to audio control.

Items that can be adjusted with a multifunction knob can also be adjusted using the + and - keys on the keypad. The center buttons of the left-side knob and the large knob can both be pressed. In general, pressing the knob is equivalent to pressing ENTER.

The audio control knob can adjust volume, squelch, level-tone center point, and peak-search threshold. The specific adjustment item depends on the current instrument state. Pressing the audio control knob switches among these uses. A prompt tone is emitted after pressing: one short beep means the knob is currently used for volume; two short beeps indicate squelch; three short beeps indicate the level-tone center point. If no operation is performed for 5 consecutive seconds, the audio control knob automatically returns to volume control.

5.2.7、Locking

Press SHIFT + ENTER to lock or unlock the instrument and prevent accidental operation. The lock

function has several configurations, set under FUNC -> System Settings -> Keypad Lock.

(1) Full lock (ALL). All keys and knobs are locked, including RUN/STOP. Only the power key and the keys required for unlocking remain effective.

(2) Lock keypad and function knobs (MOST). The keys and function knobs are locked, but the volume control knob, RUN/STOP, and SHIFT remain effective, and some secondary functions remain effective. The secondary functions that remain effective after locking are simple switching or step functions, such as LCD brightness and recording on/off. They do not include complex operations that require additional key presses.

(3) Lock keypad and large knob (MODERATE). Some secondary functions and the left-side knob remain effective. This is the factory-default setting after restoring factory settings.

(4) Lock keypad only (LIGHT). All knobs remain effective.

(5) Lock knobs only (KNOB). All three knobs are locked. This is usually used when the instrument is sealed in a plastic bag.

After restarting with the power key, the lock setting remains effective.

5.2.8、Custom Parameters

To allow quick setting, some parameters provide preset options. For example, demodulation bandwidth provides several options from 150 Hz to 300 kHz for user selection, but the instrument actually supports continuous adjustment, such as a 3.3 kHz demodulation bandwidth. When a parameter selection screen is opened, if the Custom option is visible, continuous adjustment is supported. Select Custom, enter the number, and select the unit.

5.3、Complete Operating Procedures

This section uses several common test procedures as examples to explain the operating steps and the meaning of those steps. Other procedures can be derived from these examples.

> The following content may look cumbersome, but once you follow it through once, you will understand the operating logic without memorizing it.

5.3.1、Demodulating Audio and Measuring Field Strength

(1) Clarify the test objective and the frequency, bandwidth, and modulation mode of the signal under test.

Assume the objective is to measure the coverage field strength of an FM broadcast signal at 94 MHz, using FM modulation and a bandwidth of 250 kHz.

Different test objectives may require different parameter selections. For FM broadcast, accurate field-strength measurement should use the nominal bandwidth or the value specified by the applicable test standard, usually 200 kHz or 250 kHz. If the bandwidth is selected incorrectly, either energy outside the selected bandwidth will not be detected and the field-strength reading will be low, or out-of-band interference will be included and the reading will be high. If the primary purpose is monitoring audio and roughly observing field strength, the bandwidth can be reduced appropriately, for example to 120 kHz or 150 kHz. During monitoring, the important point is intelligibility. Selecting the smallest bandwidth that does not cause obvious distortion can reduce noise and improve monitoring quality.

(2) Select the port and connect the test antenna. To obtain accurate field strength, an antenna with known gain must be used. If direction finding is the main purpose, the antenna should have clear directivity or a sharp null. If monitoring is the main purpose, the antenna choice can be more flexible.

The instrument has two ports with different functions or performance. **Use the right port for receiving.**

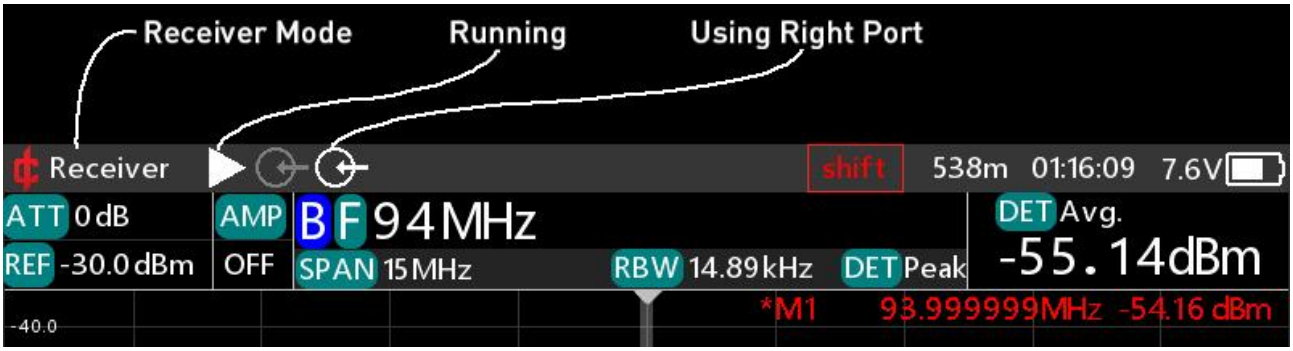
After determining the port to be used, connect the antenna.

(3) Press the **POWER key** for half a second. The instrument emits a startup prompt tone. Wait for the instrument to start. Check whether the upper-left corner of the display is in Receiver mode. If not, press **HOME** and select **Receiver**.

(4) Check whether the port indication corresponds to the selected port. This step can be skipped for KC908U/V/W. If not, press Advanced in the main menu, find PORT, and set it to the right port. The selected port indicator lights, and an indication also appears at the top of the display.

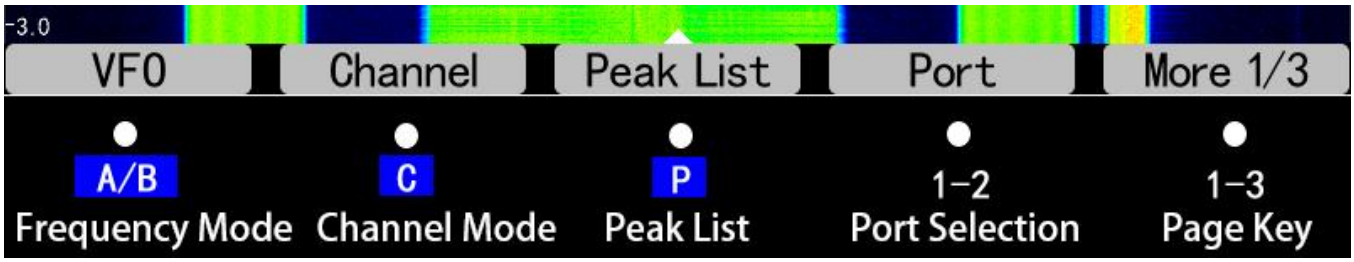
(5) If the instrument is not running, press RUN/STOP to start it. When running, the RUN/STOP key lights green.

The top of the display should be adjusted to the three states indicated below.



(6) Check the instrument frequency. The configurable item is usually shown as white text on a blue-green background. If it is not the desired frequency, set it as follows.

If the frequency to be tested has been stored as a channel, recall the channel by entering it through the CHANNEL option in the mode main menu. After a channel is recalled, the C channel is displayed.



If a peak list was previously saved in spectrum mode, it can be recalled directly from the peak list in the receiver. In the figure above, selecting Peak List enters the P channel, as shown below:



Whether the frequency is recalled from a channel or from the peak list, if you want to temporarily adjust parameters, push it to the **VFO**.

If you want to enter the frequency directly, check whether the current channel is A or B. If not, press VFO in the mode main menu and select either VFOA or VFOB. Here VFOB is selected. The settings of channels A and B are independent, allowing the user to set different frequencies and switch quickly when needed.

In VFO mode, press CENT, enter the desired frequency on the numeric keypad, such as 94, and select the MHz unit. You may also press ENTER, in which case MHz is used as the default unit.

(7) Observe the trace position. If the top of the trace exceeds the display area, increase the reference level (REF). If the top of the trace is still far below the upper edge of the display area, or if the bottom extends beyond the display area, reduce the reference level as appropriate.

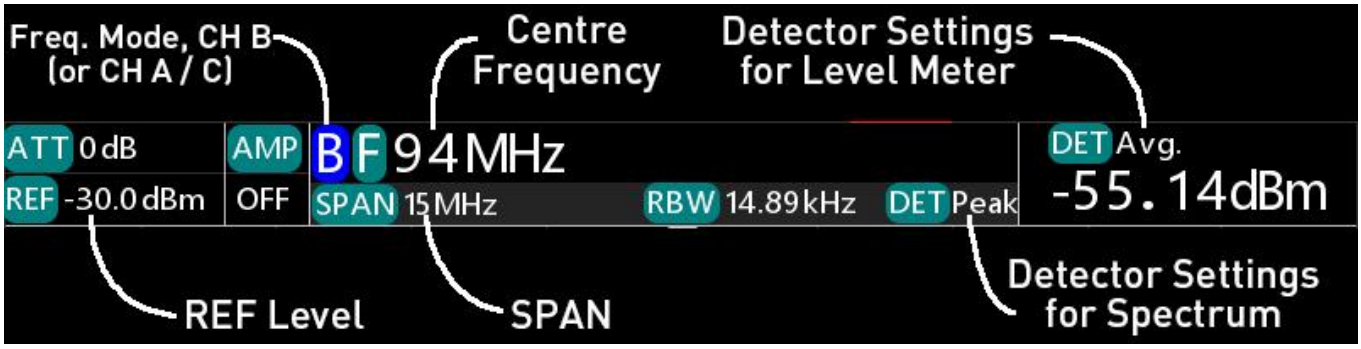
The reference level and all other signal-strength-related settings are in the LEVEL menu. After pressing LEVEL, REF setting is activated by default. You can enter a value, select the sign on the soft menu, and press ENTER to confirm. You may also adjust it with the knob or the left/right keys (+, -).

If the trace is not clipped at the top but the noise floor is high and the signal shape is abnormal, the receiver may be blocked by strong interference. The interference may be outside the displayed spectrum range and cannot be directly observed on the screen. In this case, manually increase attenuation (ATT) or reduce gain (AMP). These options are in the LEVEL - GAIN menu.

(8) Set an appropriate spectrum width (SPAN). Press SPAN to display this setting. In this example, set it to 1 MHz. A smaller width gives higher spectrum resolution, lower noise floor, and slightly better anti-interference performance. Use as small a width as practical. However, at small bandwidths the spectrum noise floor may be extremely low, making residual responses of the instrument, commonly called birdies, more obvious.

After adjusting SPAN, the trace position may change. Repeat the reference-level setting if necessary.

(9) The spectrum display normally uses the Peak detector. The entry point is located in the LEVEL - Advanced menu. Unless the spectrum display is of special concern, such as when using marker readings, this item does not need adjustment.



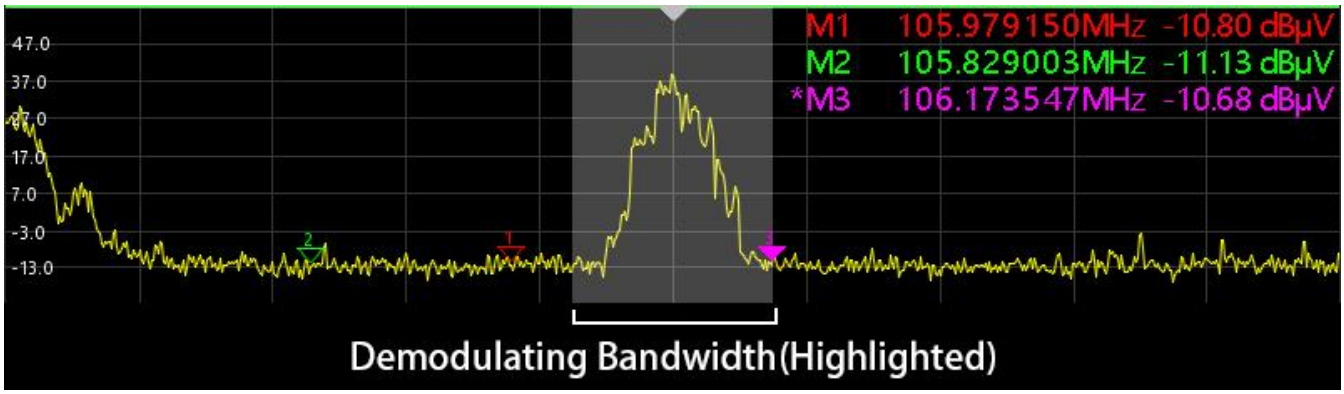
(10) Press MODU to enter the demodulation setting menu. Level measurement parameters are also set in this menu.

First turn on demodulation and set the demodulation mode. In the MODU menu, select DEMOD and adjust it with the knob or the left/right keys. For example, when measuring FM broadcast, set it to FM.

Then set the demodulation bandwidth. In this example, set it to 250 kHz. In the MODU menu, select DEMOD BW and adjust it with the knob or the left/right keys. If the required bandwidth is not listed, select CUSTOM and enter it using the keypad. The demodulation bandwidth is also the detector bandwidth of the level meter.

The highlighted area on the spectrum display indicates the demodulation bandwidth. In the demodulation bandwidth setting mode, this highlight can be turned on or off. If the signal under test is much wider or narrower than the highlighted area, adjust the demodulation bandwidth as appropriate.

In the LEVEL menu - Advanced, enter the DETECTOR menu to set the detector mode of the level meter. If only a rough estimate of the level/field strength is needed, this item can be ignored. If accurate field strength needs to be measured, select the appropriate detector mode based on the modulation type of the signal under test (or according to the relevant standard).

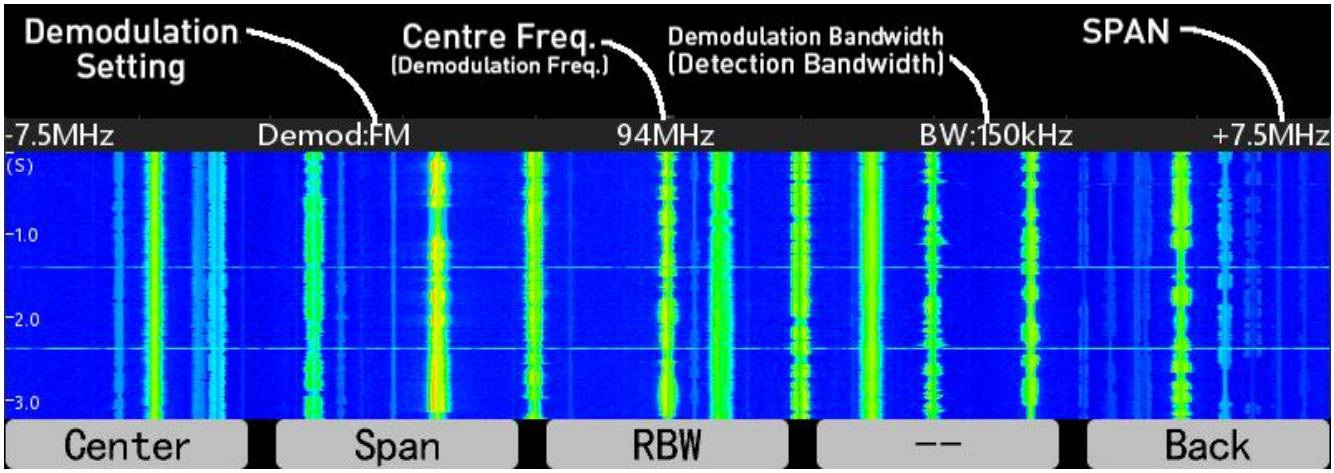


(11) Set the data type for the level meter. Press LEVEL -> Advanced and find the UNIT option. After entering it, select the appropriate unit. If the field strength needs to be displayed directly, select dBµV/m. In the LEVEL menu, find **ANT GAIN** and enter the antenna gain into the instrument. The instrument can then calculate the field strength.

There is also a UNIT setting item on page 3 of the mode main menu. That setting adjusts the unit used for the spectrum display.

(12) Press AF to enter the audio settings and adjust the audio level to an appropriate volume. The lower-left knob may also be used to adjust the volume. If level squelch or the level tone function is enabled, press the knob to switch the parameter being adjusted.

Demodulation parameters are displayed in the middle information bar of the display. When digital demodulation is used, an asterisk (*) after the demodulation parameters indicates that a vocoder not specified by the protocol is being used.



(13) Adjust the antenna to find the position and direction with the maximum field strength, and read the value from the instrument. Press SHIFT+1 to save a screenshot.

*(14) Use the accumulation function (optional) if required by the test standard. This function is located in the LEVEL menu. The Accumulation Method setting also provides options such as peak and average. This is an additional detection process applied after the instrument's own detector. For example, if average detection has already been selected in the MODU menu and Peak is selected in Accumulation Method, the instrument selects the peak value from a number of averaged readings. The accumulation time can be set. For electromagnetic radiation standards, it is typically 360 s (6 minutes).

(15) If the above settings are used frequently, save them as a channel. In the mode main menu, press VFO to enter the VFO menu, then press SAVE to open the channel storage screen. Select the desired

channel number (the default is the smallest free number) and tap Save.

(16) After the test is complete, press POWER to shut down directly. At the next power-on, the instrument will restore the state that was active before shutdown.

5.3.2、Searching for and Measuring Nearby Transmitters

In technical work, you may encounter a situation where a transmitter is known to be nearby and its frequency must be determined. For example, if someone is found using a handheld radio in a public place, the operating frequency needs to be identified immediately and voice demodulation should be attempted. In the past, this task mainly relied on a frequency counter and was called near-field search. It is essentially a receiver servo-controlled by a frequency counter. However, frequency counters have low sensitivity and are easily affected by unwanted transmitters, such as cellular base stations. Using the KC908 Spectrum Analyzer mode provides a better overall balance of speed, sensitivity, anti-interference performance, and frequency measurement accuracy.

(1) Install the antenna, power on the instrument, and enter Spectrum mode (SPECTRUM) through the MODE menu. Press CENT to enter frequency settings. In the preset scenario for this section, handheld radios usually operate in the 300-500 MHz band. Set CENTER to 400 MHz and SPAN to 200 MHz. Alternatively, use START and STOP to set the range to 300-500 MHz.

(2) Nearby signals are usually strong, so reduce the instrument sensitivity. Press LEV, then set REF to -10 dBm or higher.

(3) To determine the transmitter frequency by manually observing the spectrum, use the marker function. Press MARKER to enter the marker menu, press M1 to enable Marker M1 and enter its function menu. Find MORE, enter it, and select **AUTO Peaking**. Then press BACK to return to the Marker M1 function menu.

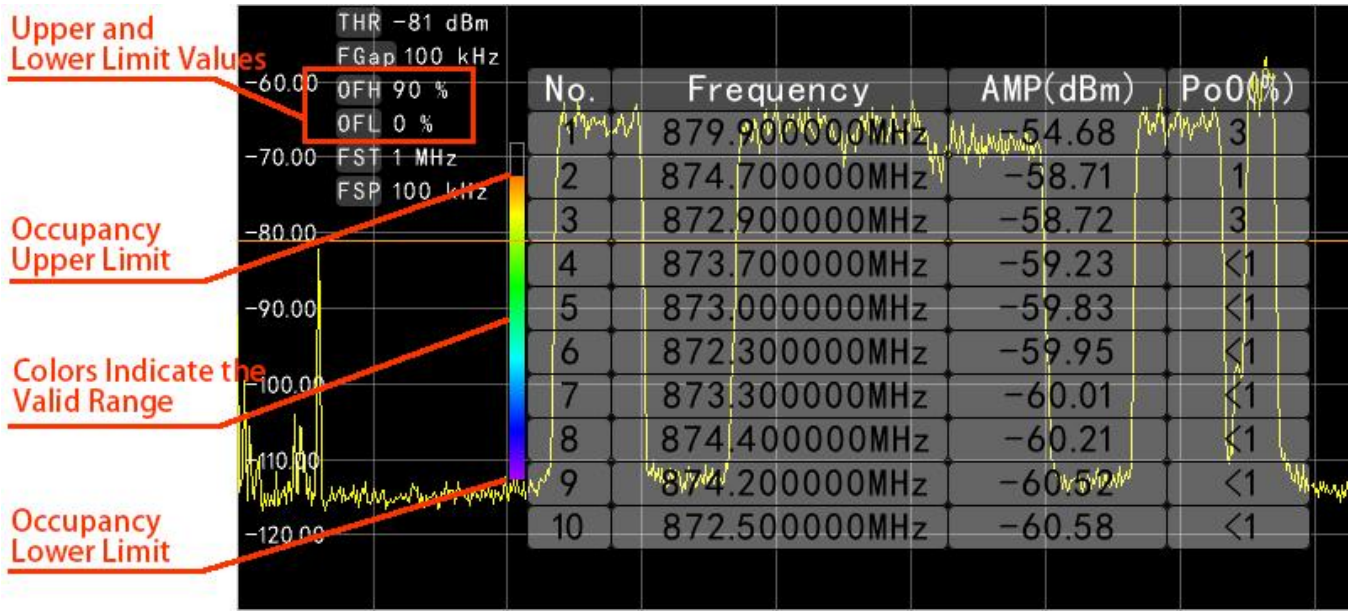
(4) Place your finger on TO RECEIVER and watch the trace. The marker will automatically search for the highest peak at all times.

(5) Because the distance is short, the transmitter of interest is usually strong. At a distance of several tens of meters, it often reaches approximately -30 dBm. If the signal can be detected by a frequency counter, its level may exceed -20 dBm. When such a strong narrowband signal rises out of the spectrum, immediately press TO RECEIVER to set that frequency as the receive frequency. Observe the receiver spectrum display, fine-tune the frequency so the signal is centered, and then adjust the receiver settings to demodulate the signal.

(6) To have the instrument automatically record strong signals observed over a period of time, use the **PEAK TABLE** function. It is located in the mode main menu. After entering it, press ON/OFF to enable the function and the list will appear. If you still need to observe the spectrum manually, use HIDDEN to hide the list while recording continues in the background. Press HIDDEN again to display the list again.

(7) Find **SEARCH SET** and set parameters such as Threshold, FREQ GAP, and LEV GAP. The threshold level is preferably set to -30 dBm. With a quarter-wave whip antenna, this is roughly equivalent to a 1 W handheld radio within 50 m. Set the frequency gap to slightly less than half the channel spacing, such as 10 kHz. Set the level gap to 10 dB or more.

Use Occupancy Filtering appropriately. To exclude frequently transmitting strong signals, set the upper limit to 90% and the lower limit to 0%. After enabling it, observe the colored indicator bar. Except for the top section, the remaining part should be colored.



(8) After some time, check the peak list and determine whether the signal of interest has been captured. If the list already contains a suspected signal, press Save in the soft menu to save the list.

The saved list is stored on the TF card, if inserted, and in the VFO temporary frequency table. In Receiver mode, enter VFO, select Read List, and use the knob or the left/right keys to move among candidate frequencies. These correspond to the top 100 signals saved earlier. Frequencies of interest can be saved separately into the channel list.

If the peak list is used and saved again, the data in the temporary frequency table will be refreshed.

(9) You may also select a frequency of interest directly in the peak list and then switch to Receiver. In this case, the instrument switches to VFOB. The original frequency in channel B will be cleared, while the other settings remain unchanged. The disadvantage of this method is that if another frequency needs to be selected, you must re-enter the peak list function to operate it.

(10) If the signal cannot be demodulated in Receiver mode, press SHIFT+2 to record IQ data for later analysis. A TF Card must be inserted in advance.

6、Frequently Asked Questions

This chapter answers questions that are commonly encountered during use, excluding basic common-knowledge questions. In newer versions of the manual, this section may be expanded.

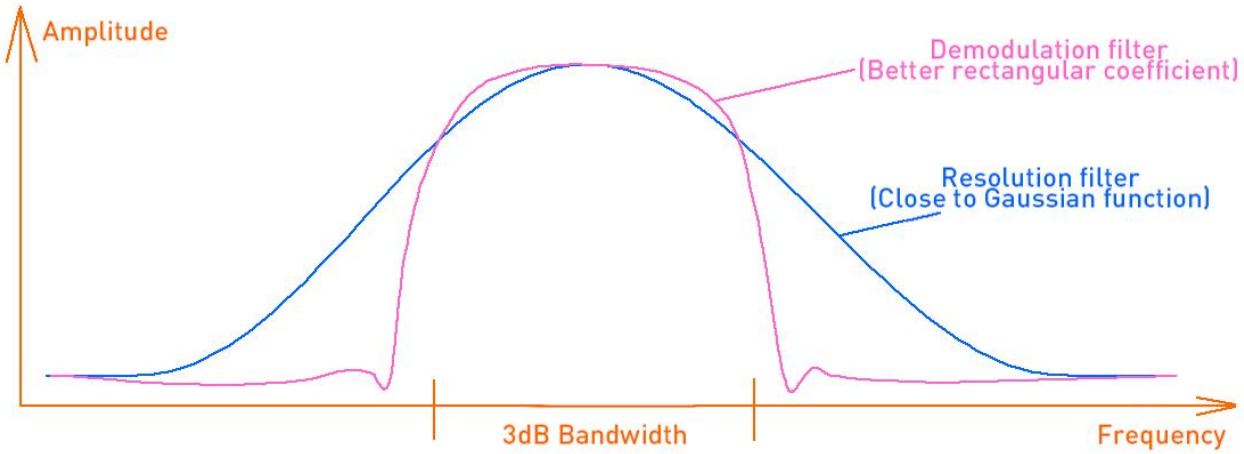
6.1、In Receiver Mode, Why Are the Spectrum Reading and Field-Strength Reading Different?

For KC908, the level value or field-strength value is the total energy within the demodulation bandwidth. The spectrum shows how energy is distributed in the frequency domain. Each point on the spectrum trace approximately represents the energy within the resolution bandwidth (RBW).

In other words, the bandwidth represented by each point on the spectrum may be completely different from the detection bandwidth used for the level reading, and the two are set in different menus. If the bandwidths are different, the collected energy is different, and the readings will necessarily be different.

For narrowband signals, such as an unmodulated carrier, the spectrum reading and the level reading are very close. For wideband signals such as CDMA signals, the spectrum reading and the level reading

may differ significantly, depending on the bandwidth settings. If the spectrum RBW and the demodulation bandwidth (DEMOD BW) are set exactly the same, the two readings will be essentially the same. There may still be a slight difference because the spectrum analyzer uses a Gaussian filter to satisfy certain standards, while demodulation uses a rectangular filter. Their passband shapes differ greatly.



For wideband signals, the larger the resolution bandwidth or demodulation bandwidth, the larger the corresponding reading.

The detector mode for the spectrum and for the level reading can be set separately. If their detector modes are different, the readings will also differ.

6.2、Why Does Squelch Open Even When the Spectrum Is Below the Level Squelch Threshold?

The reason is the same as in the previous section. Level squelch is based on level or field-strength data. The spectrum resolution bandwidth is usually narrower than the demodulation bandwidth, so the spectrum height is lower than the level value. However, when the squelch indication line is marked on the spectrum, it is still displayed according to the squelch setting value. Therefore, the spectrum may appear lower than the indication line while squelch is open.

The greater the difference between demodulation bandwidth and RBW, the larger the error of the squelch indication line. Unless a separate level indicator bar is provided, this contradiction cannot be reconciled on the spectrum display. When setting squelch, pay attention to the level reading.

6.3、Why Is the Refresh Rate Slow When SPAN Is Very Small?

The spectrum resolution of KC908 is linked to SPAN. A smaller SPAN means a smaller RBW. For example, when SPAN = 1 kHz, the resolution is 1 Hz. Measuring a 1 Hz frequency always requires time; the period of a 1 Hz frequency is already 1 second. The principle of FFT also determines that improving frequency resolution requires either more sampling points or lower bandwidth. More sampling points require more time. With a fixed number of sampling points, lower bandwidth means slower data and therefore a longer time to collect the required samples.

For a swept spectrum analyzer, the smaller the RBW, the narrower the resolution filter bandwidth, and the longer it takes for a signal to pass through it. For example, if a filter with a nominal bandwidth of 1

Hz could pass a signal within 0.5 s, it would be able to pass at least a 2 Hz signal, which clearly contradicts the stated bandwidth. In practice, the filter response time is even longer. At high resolution, FFT spectrum analysis is already much faster than swept spectrum analysis.

6.4、Where Do Image Interferences Appear?

In the 0-750 MHz range and above 6 GHz, two types of image interference may exist: first-mixer image interference and second image interference. For the KC908A, the first intermediate frequency is approximately 2.65 GHz, so the image interference point is about 5.3 GHz away from the observed frequency. The level of image interference depends on the preselector performance.

KC908A/B use a high-side local oscillator in the 0-750 MHz frequency range, so images in the 5.3-5.8 GHz range may appear. They are usually more than 60 dB lower than the true signal. Since low-frequency antennas often perform poorly at high frequencies and therefore provide additional image rejection, these images usually have little effect.

Above 6 GHz, KC908A and KC908B use different local-oscillator strategies and preselector configurations.

KC908A uses a low-side local oscillator, so signals in the 0-5.5 GHz range may become image interference. However, this band has a strict preselector that provides at least 50 dB image rejection. For KC908A, the main concern is spurious response introduced by the second and third harmonics of the local oscillator.

KC908B uses a tracking preselector. Its passband is far away from the image interference frequency, so it provides at least 50 dB of image rejection.

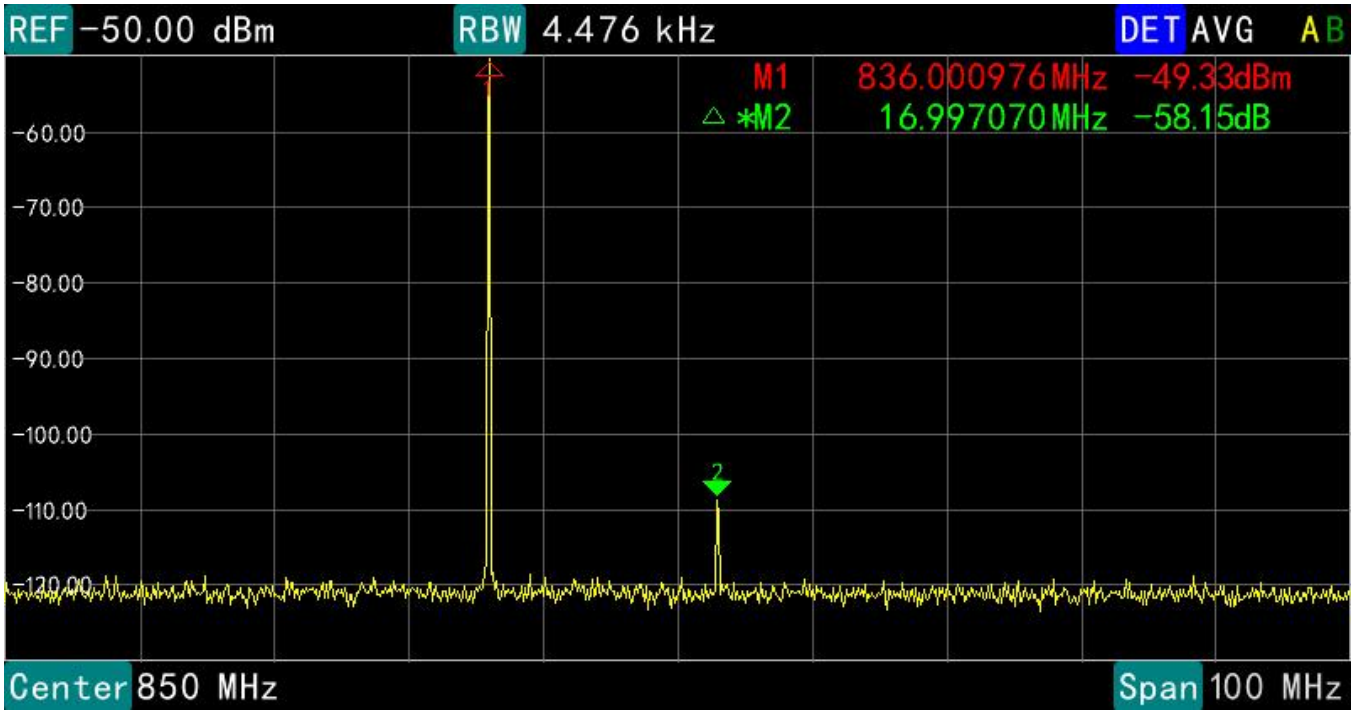
You can preliminarily identify whether a signal is real by adjusting the center frequency and observing the direction and speed of movement of the trace. For example, if the center frequency is increased, a real signal moves toward the left side of the spectrum, while an image moves toward the right side. A real signal moves at the same speed as the change in center frequency, while false responses caused by harmonic mixing often move faster.

Second image interference is inherent to zero-IF receivers. Its rejection is usually about 50 dB, but may occasionally drop to about 30 dB. The second image is often close to the real signal. The typical distance is 6-31 MHz, but at small SPAN values the distance may become closer, with a minimum of about 1 MHz.

In the 750 MHz-6 GHz range, normally only the zero-IF receiver image appears, with characteristics similar to the second image described above.

After long operating periods, second image interference may become more visible. Pausing or restarting the instrument can trigger IQ recalibration and improve rejection. Reducing the input signal, lowering IF gain, or slightly changing the center frequency (CENT) may also help.

The figure below shows an example of second image interference (Marker 2). In this case, the image rejection is approximately 58 dB. After moving the center frequency, the interference can be reduced to -65 dBc. Because the second image is close to the measured signal, avoid mistakenly identifying it as spurious emission during testing. It can be identified by moving the center frequency and observing whether it moves synchronously with the main signal.



6.5、Other Than Image Interference, What Other Interference May Occur?

In addition to image interference, high-order harmonics and intermodulation may also produce false responses, usually below -60 dBc. In actual use, however, because the total energy entering the receiver may be large, the front-end amplifier may operate under unfavorable conditions and the result may be worse. Note that the KC908 front-end low-noise amplifier is always active. Manually turning off amplification by pressing LEV and setting AMP, or setting a higher REF, only greatly reduces the gain of the front-end low-noise amplifier. Therefore, the overall probability of false signals is higher than that of a traditional spectrum analyzer using a direct mixer path.

Of course, because KC908 has a preselector, the situation is better than that of a traditional spectrum analyzer with its preamplifier enabled. This is a compromise between high sensitivity and anti-interference performance. See the third-order intercept point specifications for details.

KC908 itself generates EMI. A small amount of this radiation leaks internally into the receiver, producing residual responses that are usually below -100 dBm. More radiation leaks into the air and may be received back by the instrument's own antenna, especially when a whip antenna is connected directly to the instrument port. This kind of self-radiated and re-received interference may produce significant residual responses.

These residual responses are more conspicuous on KC908 partly because the instrument maintains high sensitivity even at very large sweep widths. For example, at a 1 GHz sweep width, the noise floor can still be as low as -120 dBm (Avg). In this case, residual responses across the entire sweep width become clearly visible. A traditional swept spectrum analyzer at a 1 GHz sweep width usually has a noise floor as high as -80 dBm unless it is deliberately configured otherwise, enough to mask all residual responses.

When a small SPAN is used, such as in Receiver mode, the noise floor is often as low as -130 to -140 dBm, making internally leaked interference easier to notice.

Considering the very small size of KC908 and the difficulty of internal isolation, keep the antenna away from the instrument to reduce this effect.

6.6、Why Does Overload Occur Even When the Signal Does Not Exceed REF?

Real-time spectrum analyzers usually have only relatively wide analog filters. All signals within the passband of the filter are sent to the following stages, resulting in a large total power level. If there are many signals within the passband, the peak of the spectrum may not hit the top of the display, but the sum of all signals may already overload the instrument.

KC908 has an analog bandwidth larger than its real-time bandwidth, typically around 50 MHz. In other words, signals that are not visible on the spectrum display may still cause overload. After overload occurs, the instrument usually gives a warning, but this indication is not completely reliable.

As long as sensitivity requirements can still be met, Spectrum mode should use a higher REF whenever possible. In Receiver mode, disable the preamplifier (set AMP to 20 dB or 0 dB) to prevent overload.

After overload, the spectrum display becomes distorted and many spurious components appear. In this case, reduce the instrument sensitivity by increasing REF, reducing gain, or increasing attenuation (LEV -> GAIN -> ATT) until the display returns to normal.

In addition to ADC overload, the front end of the instrument may also overload, or become blocked. The strong signal causing blocking may be far away from the set frequency. As long as it lies within the relevant preselector passband (see Section 2.7), it may cause blocking. This situation often occurs near base stations or broadcast transmitters. The instrument front end uses high-intercept amplifiers and mixers, at the cost of higher power consumption and heat, so its blocking resistance is still quite strong.

Common symptoms of front-end overload include reduced signal peak level, a 20-30 dB rise in the noise floor, and a large noise-like skirt around a signal that was originally isolated. Try changing the antenna direction or reducing instrument sensitivity. If the noise-like skirt appears and disappears, or the noise floor suddenly drops, overload is indeed occurring.

In complex electromagnetic environments, such as urban rooftops or when using outdoor antennas, manually enable 10-20 dB attenuation and disable amplification to improve overload resistance. For ordinary handheld use, automatic control is still preferred.

Sometimes the noise floor rises indoors, even up to -70 dBm. This is usually not overload, but real interference. Try turning off lights, moving away from electrical equipment, or going outdoors. Indoor interference is especially common with low-quality LED lights from unknown brands.

6.7、Is It Normal for the Housing to Become Very Hot During Operation?

The instrument integrates many high-linearity amplifiers and mixers. High linearity means large current and high power consumption. It also contains high-speed digital circuits with significant computational load, which are major heat sources. The minimum operating power consumption of KC908 is around 10 W, typical power consumption is 12 W, peak power consumption is 16 W, and KC908T is somewhat higher. During charging, in addition to the energy stored in the battery, about 4 W of additional power is dissipated. If the instrument is operated while charging, the housing will inevitably become extremely hot.

This heat raises the housing temperature by 20-35 °C. In summer, the surface temperature may reach 70 °C, which may cause burns. In winter, it may even serve as a hand warmer. This condition was considered in the design, and over-temperature protection is provided. It will not cause obvious damage to the instrument itself, though it may slightly affect battery life and measurement performance. Therefore, there is no need to worry about the instrument, but care must be taken to avoid burns.

Because the instrument contains lithium-ion batteries, overheating may cause the battery to burn or explode. Therefore, it must not be used beyond the allowed temperature range. If the ambient temperature is high, avoid operating the instrument while charging, so as to prevent overheating hazards.

During breaks, press RUN/STOP promptly to pause measurement. This greatly reduces heat generation and extends battery life.

When the internal temperature reaches 60 °C or the processor temperature exceeds 100 °C, the instrument may shut down automatically for protection. It cannot be powered on again until the temperature drops below 60 °C. In this case, cool it with airflow and power it on again after it cools.

Do not wrap the instrument with insulating materials, as this may cause accidents. If it needs to be installed in a poorly ventilated enclosure, installed where the ambient temperature exceeds 40 °C, or operated continuously while charging, provide airflow cooling for the housing or add a heatsink.

[End of Main Text]

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