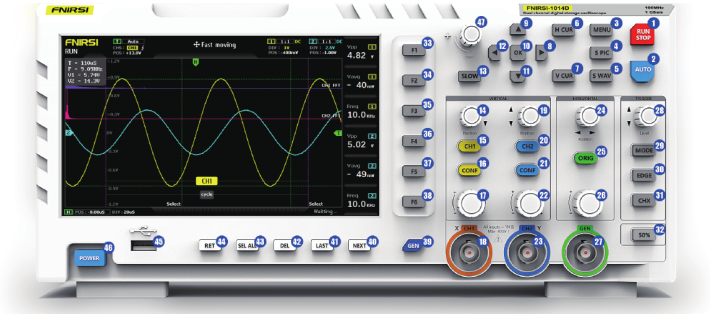
FNIRSI-1014D

Two-in-one digital oscilloscope and signal generator
User manual



When the two channels are used at the same time, the ground clamps of the two probes must be connected together. Never connect them to points of different potential — this will destroy the instrument. The maximum permissible voltage at the BNC input is 400 V.

Importer: Rotorama, s.r.o. · www.rotorama.cz

Contents

1. Product introduction

FNIRSI-1014D is a two-in-one oscilloscope and signal generator launched by FNIRSI, with comprehensive functions and high practicability. It is a cost-effective dual-channel desktop oscilloscope for the maintenance industry and R&D industry.

- The oscilloscope has a real-time sampling rate of **1 GSa/s** and **2× 100 MHz** analog bandwidth.
- Complete trigger function (single / normal / automatic) — it can be used freely both for periodic analog signals and aperiodic digital signals.
- Built-in **DDS function signal generator** and the industry's original chopping output (@ 2.5 Vpp). The frequency step of all signals is 1 Hz. It supports 14 kinds of standard function signals and a customizable chopping signal; the chopping output intercepts part or the whole of the complex signals measured by the oscilloscope as the output signal of the signal generator, and can store up to 1000 customized cut-off signals.
- The built-in high-voltage protection module can tolerate up to **400 V** continuous voltage — no need to worry about the oscilloscope burning when the probe is not moved to the 10x gear.
- Large time base scrolling mode, which can monitor slow level changes.
- Equipped with efficient one-button auto and self-adaptive 25%, 50%, 75% trigger, which can display the measured waveform without complicated adjustment.
- The display is a 7-inch high-definition LCD screen with **800 × 480** resolution.
- Cursor measurement function — the amplitude and frequency parameters can be read manually without reading the background scale unit and quantity, and without conversion, to get the peak value and frequency directly.
- Extremely convenient screen capture and waveform storage function: the built-in **1 GB** storage space can store up to 1000 screen capture pictures + 1000 groups of waveform data. The storage process is simple and fast — to save the current waveform, just one click saves the current data.
- Powerful waveform image manager: thumbnail browsing, viewing, view details, page turning, deleting, and waveform enlarging, reducing and moving are convenient for secondary analysis.
- The fuselage is equipped with a **USB** interface, which can be connected with a computer to share its own screen capture pictures with the computer, which is convenient for secondary analysis.
- The **Lissajous** graphic display function can be used to compare and judge the amplitude, frequency and phase of two groups of signals.
- The **FFT** viewing function can roughly estimate the harmonic components of the signal.

2. Safety warnings

2.1 Serious warnings

1: When the two channels are used at the same time, the ground clamps of the two probes must be connected together. It is strictly forbidden to connect the ground clamps of the two probes to different potentials, especially different potential terminals of high-power equipment or 220 V mains — otherwise the oscilloscope motherboard will be burned. Because the two channels are grounded together, connecting to different potentials will lead to a short circuit of the internal ground wires of the motherboard (this applies to all oscilloscopes).

2: The BNC input of the oscilloscope can withstand 400 V at most. It is strictly forbidden to input more than 400 V in the 1x probe position.

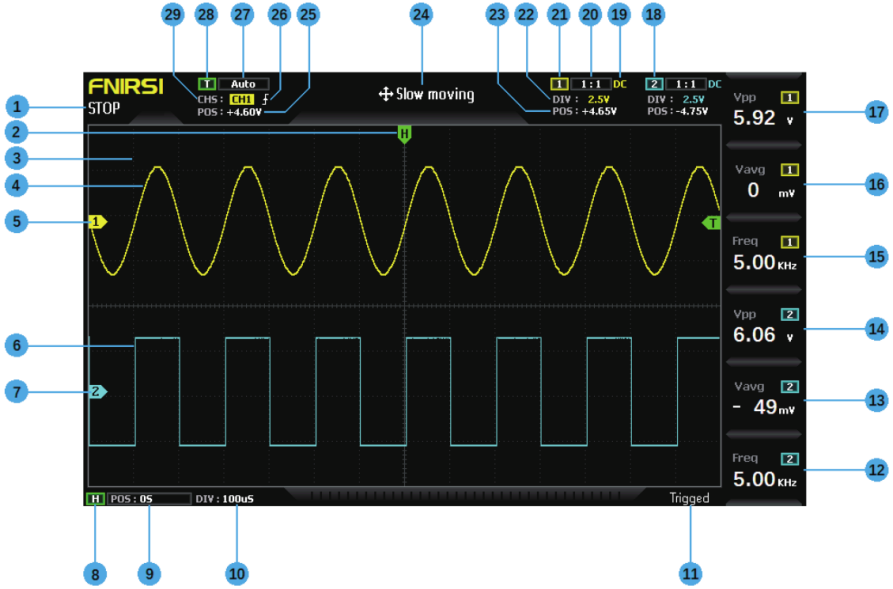
3: The original power supply must be used. It is strictly forbidden to use the power supply or USB of other devices under test. Otherwise, the motherboard ground wire may be short-circuited during the test.

4: A 100x probe (e.g. ultrasonic welding machine, ultrasonic cleaning machine, etc.) or even a 1000x probe (e.g. high-voltage end of a high-frequency transformer, coil of an induction cooker, etc.) must be used to measure high-frequency and high-voltage signals.

2.2 Probes and bandwidth

The bandwidth of the 1x probe is 5 MHz, and the bandwidth of the 10x probe is 100 MHz. When the measured frequency is higher than 5 MHz, the switch on the probe handle needs to be moved to 10x, and the oscilloscope also needs to be set to 10x. Otherwise, the signal will be greatly attenuated — which is the case with all oscilloscopes. This is because the probe cable of the oscilloscope itself has a capacitance as high as 100–300 pF, which is a big capacitance for a high-frequency signal! The signal has already been greatly attenuated when it reaches the input end of the oscilloscope through the probe, and the equivalent bandwidth is 5 MHz. Therefore, in order to match the hundreds of pF of the probe cable, the input end of the probe is attenuated 10 times (the switch in the 10x gear), so that the hundreds of pF capacitance is used precisely for impedance matching. In that case the bandwidth is 100 MHz. Note that only probes with a bandwidth of 100 MHz or above can be used.

3. Screen interface description



Oscilloscope screen layout

1: Run / pause indicator

2: The trigger X position indication arrow — indicates the trigger X point

3: Background grid tick marks

4: Waveform of channel 1

5: Baseline position arrow of channel 1 — the position of 0 V potential

6: Waveform of channel 2

7: Baseline position arrow of channel 2 — the position of 0 V potential

8: Horizontal time base control bar flag

9: Position of the trigger X arrow relative to the system coordinate system

10: Horizontal time base — the length of time represented by one large grid division in the horizontal direction; it is determined by the sampling rate. The larger the time base, the slower the sampling rate, and vice versa

11: Trigger status flag

12: Column 6 measurement parameters — press F6 to select measurement parameters freely

13: Column 5 measurement parameters — press F5 to select measurement parameters freely

14: Column 4 measurement parameters — press F4 to select measurement parameters freely

15: Column 3 measurement parameters — press F3 to select measurement parameters freely

16: Column 2 measurement parameters — press F2 to select measurement parameters freely

17: Column 1 measurement parameters — press F1 to select measurement parameters freely

18: Channel 2 control bar sign

19: Input coupling mode of channel 1 — two options: DC (DC coupling) and AC (AC coupling)

20: Channel 1 probe magnification

21: Channel 1 control bar sign

22: Vertical sensitivity of channel 1 — the voltage represented by one large grid division in the vertical direction

23: Position of the channel 1 baseline arrow relative to the system coordinate system

24: Movement speed of waveform operation — fast movement is used for coarse adjustment, slow movement for fine adjustment

25: Position of the trigger voltage arrow relative to the system coordinate system

26: Trigger edge indicator — arrow up: rising edge trigger, arrow down: falling edge trigger

27: Trigger mode indicator — auto (automatic trigger), single (single trigger) and normal (normal trigger)

28: Trigger control bar flag

29: Trigger channel — ch1 and CH2 options

4. Buttons and connectors

Layout of the instrument controls

1: Run / pause button — click this button to pause sampling at any time

2: One-key automatic adjustment button — click this button and the system will automatically identify the signal and set the system to the best parameters to display this waveform

3: Function menu button — click here to pop up the function menu

4: One-click screen capture button — takes a screen capture of the whole screen and saves it to the internal storage space automatically

5: One-button save waveform button — clicking this button will save all waveform data of the two channels to the internal storage space

6: Time cursor switch button — turns the cursor measurement function on and off

7: Voltage cursor switch key — turns the cursor measurement function on and off

8: System [right] navigation key

9: System navigation key

10: System [OK] navigation key

11: System navigation key

12: System [left] navigation key

13: Move speed button — click this button to switch between fast move and slow move

14: Channel 1 vertical position adjustment knob — rotate clockwise to move up, counterclockwise to move down

15: Channel 1 switch button — turns the waveform display of channel 1 on or off

16: Channel 1 control bar button — pops up the control parameters related to channel 1, which can be selected with the navigation keys or the knob next to it

17: Channel 1 vertical sensitivity adjustment knob — clockwise vertical amplification, counterclockwise vertical reduction

18: Channel 1 signal input port — the measurement range is 0–40 V peak-to-peak; pay attention to the maximum tolerance of 400 V peak-to-peak withstand voltage

19: Channel 2 vertical position adjustment knob — rotate clockwise to move up, counterclockwise to move down

20: Channel 2 switch button — turns the waveform display of channel 2 on or off

21: Channel 2 control bar button — pops up the control parameters related to channel 2, which can be selected with the navigation keys or the knob next to it

22: Channel 2 vertical sensitivity adjustment knob — clockwise vertical amplification, counterclockwise vertical reduction

23: Channel 2 signal input port — the measurement range is 0–40 V peak-to-peak; pay attention to the maximum tolerance of 400 V peak-to-peak withstand voltage

24: Trigger X position adjustment knob — rotate clockwise to move to the right, counterclockwise to the left

25: One-key return to center button — after clicking this button, the channel 1 and channel 2 vertical positions, the trigger X horizontal position and the trigger Y vertical position will return to center

26: Time base adjustment knob — rotated clockwise it reduces the time base (enlarges the waveform horizontally), counterclockwise it increases the time base (reduces the waveform horizontally)

27: DDS signal generator output

28: Trigger voltage Y position adjustment knob — rotate clockwise to move up, counterclockwise to move down

29: Trigger mode switch button — auto, single and normal

30: Trigger edge switch button — rising edge and falling edge

31: Trigger channel switch button — channel 1 and channel 2

32: 50% trigger button — click this button and the system will automatically set the current trigger voltage to 25%, 50% or 75% according to the signal characteristics

33: Measurement parameter selection button of column 1 — after the measurement block diagram pops up, you can select with the navigation keys or the knob next to it

34: Measurement parameter selection button of column 2 — after the measurement block diagram pops up, you can select with the navigation keys or the knob next to it

35: Measurement parameter selection button of column 3 — after the measurement block diagram pops up, you can select with the navigation keys

or the knob next to it

36: Measurement parameter selection button of column 4 — after the measurement block diagram pops up, you can select with the navigation keys or the knob next to it

37: Measurement parameter selection button of column 5 — after the measurement block diagram pops up, you can select with the navigation keys or the knob next to it

38: Measurement parameter selection button of column 6 — after the measurement block diagram pops up, you can select with the navigation keys or the knob next to it

39: Signal generator control bar button — clicking this button will pop up the signal generator parameter control bar; you can select with the navigation keys or the knob next to it

40: [next] button — next page in the picture / waveform / chopping manager

41: [last] button — previous page in the picture / waveform / chopping manager

42: [del] button — delete in the picture / waveform / chopping manager

43: [sel all] button — select all in the picture / waveform / chopping manager

44: [ret] button — return in the picture / waveform / chopping manager

45: USB port for sharing screenshots

46: Power switch — click to start or shut down the instrument

5. Operating instructions (oscilloscope)

Open or close channel 1 / channel 2: click [ch1] / [CH2] to open or close ch1 / CH2.

Turn FFT on or off: click the [conf] button under ch1 or CH2, the parameter control bar of channel 1 / channel 2 will pop up, and then turn FFT on / off with the navigation keys.

Setting the input coupling mode: click [conf] under ch1 or CH2 to pop up the parameter control bar of channel 1 / channel 2, and then switch DC / AC with the navigation keys.

Set the probe input ratio: click [conf] under ch1 or CH2, the parameter control bar of channel 1 / channel 2 will pop up, and then switch to 1x / 10x / 100x with the navigation keys.

Scaling the waveform: rotate the large knob at the bottom left corner of the vertical frame to scale the waveform of channel 1 vertically, and rotate the large knob at the bottom right corner to scale the waveform of channel 2 vertically; rotate the large knob at the bottom of the horizontal frame to scale the waveforms of channel 1 and channel 2 horizontally — clockwise to enlarge, counterclockwise to reduce.

Moving the waveform: rotate the small knob in the upper left corner of the vertical frame to move the waveform of channel 1 vertically, and rotate the small knob in the upper right corner to move the waveform of channel 2 vertically — it moves up clockwise and down counterclockwise; rotate the small knob at the top of the horizontal frame to move the waveforms of channel 1 and channel 2 horizontally — clockwise to the right, counterclockwise to the left. In the process, you can click the [slow] button to select coarse adjustment or fine adjustment.

Adjusting the trigger voltage: rotate the small knob under the trigger frame to adjust the trigger voltage. In this process, you can click the [slow] button to select coarse adjustment or fine adjustment. Pay attention: first turn off the [automatic 50%] trigger in the menu, otherwise the trigger voltage cannot be adjusted.

Set the trigger edge: click [edge] to switch between rising edge and falling edge.

Set auto trigger: click [mode] to switch between auto / single / normal, where auto is the automatic trigger.

Set single trigger: click [mode] to switch between auto / single / normal, where single is the single trigger.

Set normal trigger: click [mode] to switch between auto / single / normal, where normal is the normal trigger.

Pause the display: click the red [run / stop] button in the upper right corner to pause or run.

Automatic waveform adjustment: click the blue [auto] button in the upper right corner to adjust automatically.

Set the slow scan scrolling mode: rotate the big knob under the horizontal frame counterclockwise. When the time base reaches 100 ms, the system will enter the slow scan scrolling mode. The range 100 ms ~ 50 s belongs to the time base of the scrolling mode.

Time cursor measurement: click the [H cur] button to turn on the time cursors, then select the left and right marking lines with the left and right navigation keys, and finally adjust them with the small knob in the upper left corner of the navigation area — the marking lines are moved to the right by clockwise rotation and to the left by counterclockwise rotation.

Voltage cursor measurement: click the [v cur] button to turn on the voltage cursors, then select the upper and lower marking lines with the up and down navigation keys, and finally adjust them with the small knob in the upper left corner of the navigation area — the marking lines are moved upward by clockwise rotation and downward by counterclockwise rotation.

Set the parameters to be displayed: click F1 ~ F6 to pop up the parameter measurement control bar, and select the currently required parameters with the navigation keys or the nearby knob.

Full screen capture: click the [s pic] button to capture the current display. The captured image is saved to the local disk in BMP format.

Save current waveform data: click the [s wav] button to save all waveform data of the opened channels to the local disk.

Adjust the screen brightness: click the [menu] button, navigate to [screen brightness], press the OK key, and finally adjust the screen brightness with the small knob in the upper left corner. 100 is the brightest and 0 is the darkest.

Adjust the background grid brightness: click the [menu] key, navigate to [grid brightness], press the OK key, and finally adjust the grid brightness with the small knob in the upper left corner. 100 is the brightest, and 0 turns off the grid display.

Setting automatic 50% trigger all the time: click the [menu] key, navigate to [automatic 50%], press the OK key, and then select [on] with the navigation keys. After setting, in the automatic trigger mode, at each measurement the system will automatically set the trigger voltage to 25% / 50% / 75% of the peak-to-peak value according to the waveform characteristics.

Horizontal baseline offset calibration: when the probe has been pulled out and the left yellow / cyan indicator arrow and the yellow / cyan horizontal baseline of either channel are not in the same position, calibration is required: first pull out the probe, then click the [menu] key, navigate to [baseline calibration], and then press the OK key to calibrate the baseline.

View the saved screen captures: click [menu], navigate to [picture browse], and then press the OK key to enter the picture thumbnail preview interface, which shows the thumbnails of the captured waveforms. Select a thumbnail with the navigation keys, and then click [OK] to view the screen capture of the waveform in full screen. At the bottom, the control buttons (RET) return, (SEL ALL), (DEL), (last), (next) can be operated.

View the saved waveform data: click the [menu] key, navigate to [waveform browse], and then press the OK key to enter the waveform thumbnail preview interface, which shows the waveform thumbnails. Select a thumbnail with the navigation keys, and then click [OK] to view the waveform in full screen. At the bottom, the control buttons (RET) return, (SEL ALL), (DEL), (last), (next) can be operated.

Delete a saved waveform: click the [menu] key, navigate to [waveform browse], and then press the OK key to enter the waveform thumbnail preview interface, which shows the waveform thumbnails. Select a thumbnail with the navigation keys, and then click the [del] key at the bottom to delete the waveform, or delete it with the key in the full screen view.

Connect the computer to view the screen capture pictures: click the [menu] button, navigate to [USB share] with the navigation keys, and then press the OK key to open the USB share. Then connect the computer with the attached USB cable, and a removable disk (U-disk) will pop up on the computer, on which you can find the saved screen capture pictures. Note: do not edit or rename the files directly on the disk, otherwise the oscilloscope picture manager will not be able to display them.

6. Operating instructions (signal generator)

Switch the waveform type: click the [Gen] button, the signal generator control interface will pop up in the lower right corner of the screen. Then click the [OK] button to switch the green selection box to the [waveform type] position, and then click [up] or [down] on the navigation keys or use the knob in the upper left corner of the navigation area to switch the waveform type.

Adjust the waveform frequency: click the [Gen] button, the signal generator control interface will pop up in the lower right corner of the screen. Then click the [OK] button to switch the green selection box to the [frequency] position, and then click [left] or [right] on the navigation keys to set the position cursor, that is, the digit to be adjusted. After confirming, press [up] or [down] or use the knob in the upper left corner of the navigation area to increase or decrease the value of the current digit, thus changing the frequency.

Adjust the duty cycle of the square wave: the duty cycle setting is only effective for the square wave — it can only be set when the waveform type is square wave; other waveforms have no concept of duty cycle. Click the [Gen] button, the signal generator control interface will pop up in the lower right corner of the screen. Then click the [OK] button to switch the green selection box to the [duty cycle] position, and then rotate the knob in the upper left corner of the navigation area to increase or decrease the duty cycle within 1% ~ 99%.

Capture waveform: capture waveform output means capturing part or the whole of the currently displayed waveform as the output of the signal generator. The captured signal can be saved to the system, and up to 1000 groups of captured signals can be saved. First, click the [menu] button — the function interface will pop up on the left side of the screen. Navigate to the [capture output] position with the navigation keys and open it; two purple boundary lines will pop up on the screen. The waveform within the two boundary lines is the waveform segment to be captured. The word "select" indicates the boundary line currently operated by the knob; you can switch between the lines with the [left] and [right] navigation keys. After setting the boundary lines, you can fine-tune them — click the [slow] key to switch between coarse and fine adjustment. Between the two boundary lines there is the label "channel 1 / Channel 2", which means that the currently captured signal is the channel 1 / channel 2 signal; you can select the channel with the [up] / [down] navigation keys. The left boundary line is marked with a voltage scale, which serves as a reference for the captured wave. If you want to adjust the chopping level position, you can adjust the offset by adjusting the Y position of the channel: for example, if you captured a DC signal and adjust the DC waveform to the +1 V position, then the output is +1 V voltage; adjust it to −1 V, and the output is −1 V voltage. If you want to adjust the sampling amplitude of the chopped wave, you can adjust the vertical sensitivity of the channel to scale the waveform vertically. It is recommended to first amplify the signal amplitude to the maximum (but without cutting the top) and then capture, so that the output

signal will have enough sampling data, the output waveform distortion will be smaller, and the resolution will be higher. If you only capture a very small signal and then enlarge it through the oscilloscope measurement, the waveform will show a very serious ladder phenomenon, because the sampling is insufficient and the effective signal is too little — just like an image which is very small but forcibly enlarged is bound to be fuzzy. After all the parameters are determined, click the [OK] key — the captured signal will be saved to the system disk.

Output the captured waveform as the signal generator: first click the [Gen] button to open the signal generator interface, then click the [OK] button to switch the green selection box to the [waveform type] position, and then click [up] / [down] on the navigation keys to switch it to "self definition". Then click the [Gen] button to exit the signal generator control interface, and click the [MENU] button — the function interface will pop up on the left side of the screen. Navigate to the [output browsing] position and open it: all saved captured signals will be listed on the screen. Move the selection box to the desired signal with the navigation keys and click the [OK] key — the yellow word "output" will pop up in the upper left corner of the waveform, which means that this waveform is the currently selected custom signal. Then click [menu] to exit; the waveform output by the signal generator is now the captured signal. It should be noted that if the captured waveform is a single-cycle waveform (there is exactly one cycle between the two boundary lines), the output frequency of the signal generator is equal to the frequency set by the signal generator. If the captured waveform contains N cycles, the output frequency of the signal generator is N times the set frequency. The trigger voltage should then be adjusted to the edge of the waveform with the minimum number of edges — so that the intersection points between the waveform and the trigger line are the fewest. Otherwise the displayed frequency may be several times the actual frequency: the oscilloscope calculates the frequency from the number of edges crossing the trigger line, so a wrongly positioned edge may also lead to frequency doubling.

7. FAQ and measurement methods

7.1 Analysis of common problems

1: Why can't I turn on the machine after receiving it?

Answer: please check whether the power cord is connected to the oscilloscope and whether the socket is powered. If all is correct, please try another power adapter (a mobile phone charging head). If it still cannot start, please contact customer service for replacement.

2: Why is there no waveform in the test, only one line on the screen?

Answer: please check whether the display has been paused — if so, press the [auto] button once. If not, it may be that the signal source has no signal output, or the probe cable is short-circuited or open-circuited. Please check with a multimeter whether the probe and the signal source are normal.

3: Why is the voltage value 0?

Answer: please adjust the vertical sensitivity and the time base (sampling rate), or press [auto] once, so that at least one clear and complete periodic waveform is displayed, and the top and bottom of the waveform are displayed on the screen completely, without cutting. The voltage value is then correct.

4: Why is the frequency value 0?

Answer: first, it is necessary to ensure that the trigger mode is auto (automatic triggering). If it is still 0 in auto mode, press the [auto] button once. Once at least a clear and complete periodic waveform is displayed on the screen and the waveform is fixed by triggering (the green arrow position is between the top and bottom of the wave shape and the waveform does not shake), the frequency value is correct.

5: Why is the duty cycle 0?

Answer: first, it is necessary to ensure that the trigger mode is auto. If it is still 0 in auto mode, it may be that the trigger line is not adjusted to the waveform. After the trigger line is adjusted to the waveform, the waveform will be fixed. The duty cycle value is correct only after at least one clear periodic waveform is displayed on the screen.

6: Why is AC coupling displayed the same as the DC coupling waveform?

Answer: if the input signal is a symmetrical AC signal (such as domestic 220 V), the AC coupling and DC coupling waveforms are the same. If it is an asymmetric AC signal or a DC pulse signal, the waveform will move up and down when the coupling is switched.

7: Why does the waveform run up and down when testing the signal, and can't be seen clearly, only online and offline beats?

Answer: set the trigger mode to auto and then press the [auto] button once. If it is not solved, the ground clamp of the probe may not be grounded, or the probe clamp end is open-circuit. Please check whether the probe is normal with a multimeter.

8: Why does the test waveform shake around and cannot be fixed?

Answer: the trigger voltage needs to be adjusted — move the green arrow on the right so that the green indicator lies between the top and bottom of the waveform. The waveform is then triggered and fixed. Alternatively, enter the setting menu and turn on "automatic 50%".

9: Why can't we capture sudden pulse waves or digital logic signals?

Answer: adjust the trigger mode to "Normal" or "Single", then adjust the trigger voltage, time base and vertical sensitivity, and finally use the pause.

10: Why does the trigger voltage regulation not respond?

Answer: click menu — turn Auto 50% off.

11: Why do you measure a battery or other DC voltage without a waveform?

Answer: battery voltage is a stable DC signal — it has no curve waveform. In DC coupled mode, adjust the vertical sensitivity and there will be an upward or downward offset straight-line waveform. If it is AC coupling, no matter how you adjust, there is no waveform.

12: Why do we see "card change" when measuring the 220 V power frequency 50 Hz wave?

Answer: if the oscilloscope displays a 50 Hz low-frequency signal, the sampling rate needs to be very low to capture the 50 Hz signal. If the sampling rate is low, the oscilloscope will enter the waiting state, so it will show "card change". All oscilloscopes in the world behave like this when measuring 50 Hz signals — it is not because the oscilloscope itself is stuck.

13: Why is the peak value Vpp more than 600 V and not 220 V or 310 V when measuring the voltage waveform of the city power?

Answer: the city power 220 V is a symmetrical AC signal — the positive peak voltage (maximum value) is +310 V, the negative peak voltage (minimum value) is −310 V, so the peak-to-peak value is 620 V. The effective value is 620 V divided by the switching parameter. The mains 220 V is the effective value; in fact the voltage of the mains fluctuates from 180 to 260 V, so the peak Vpp is in the range of 507–733 V.

14: Why is the measured 220 V mains waveform not a standard sine wave, but distorted?

Answer: in the municipal power grid, there is generally pollution and there are higher-order harmonic components. These harmonics are superimposed on the sine wave and are displayed as a distorted sine wave — this is a normal phenomenon and is irrelevant to the oscilloscope itself.

15: Why is there a large offset between the baseline (0 V) and the left arrow (0 V indication) on the screen under no signal input?

Answer: first pull out the probe, then click the [menu] button, navigate to [baseline calibration], press OK, and wait for the baseline calibration to complete — the baseline and the arrow then coincide.

16: Why is the signal voltage above 5 MHz attenuated significantly, and the bandwidth is only 5 MHz?

Answer: when measuring 5 MHz or more, it is necessary to move the probe to the 10x gear and set the oscilloscope to the 10x input mode. This is because the probe cable of the oscilloscope has a capacitance of up to 100–300 pF, which is a big capacitance for a high-frequency signal! The signal has been greatly attenuated when it reaches the input end of the oscilloscope through the probe, and the equivalent bandwidth is 5 MHz. So in order to match the hundreds of pF of the probe cable, the input end of the probe is decayed 10 times (switch in 10x), and these hundreds of pF capacitors are just used for impedance matching; in that case the bandwidth is 100 MHz. Note that only the supporting 100 MHz probes can be used.

7.2 Test methods of common circuits

Battery or DC voltage measurement

Gear selection: battery voltage is generally below 40 V, other DC voltages are uncertain, so it is necessary to adjust the gear according to the actual situation. If it is higher than 40 V, both probe and oscilloscope are set to the same higher gear.

1: Firstly, the oscilloscope is set to auto trigger mode (auto trigger mode is the default after startup); auto trigger mode is used to test the cycle signal (DC voltage belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to the corresponding gear (default is 1x after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to the corresponding gear.

5: Make sure the battery is powered, i.e. the DC voltage is at the output.

6: Connect the probe clip to the negative battery electrode or the negative DC electrode, and the probe to the battery or DC positive pole.

7: Press [auto] once — the DC electrical signal will be displayed. Then look at the parameter of average value. Note that battery voltage and other DC voltages belong to DC signals: there is no curve waveform, only a line with an up and down offset, and the peak value and frequency of this signal are 0.

Crystal oscillator measurement

Gear selection: a crystal oscillator easily stops oscillating after encountering capacitance. The input capacitance of the 1x probe is up to 100–300 pF, the 10x gear is about 10–30 pF. It easily stops oscillating in the 1x gear, so it is necessary to use the 10x gear — both probe and oscilloscope are set to 10x.

1: Firstly, the oscilloscope is set to auto trigger mode (default after startup); auto trigger mode is used to test the periodic signal (the sine signal of crystal resonance belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to 10x (the default is the 1x gear after startup).

3: The oscilloscope coupling mode is set to AC coupling.

4: Insert the probe and move the switch on the probe handle to 10x.

5: Make sure the crystal board is powered on and running.

6: Connect the probe clip to the ground wire of the crystal oscillator board (negative pole of the power supply), pull off the probe cap — inside it is the needle tip — and contact one of the pins of the crystal oscillator with it.

7: Press the [auto] button once to display the waveform of the crystal oscillation tested. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knobs.

PWM signal measurement of a MOS tube or IGBT

Gear selection: the PWM signal voltage directly driving a MOS tube or IGBT is generally within 10–20 V, the control signal of the PWM front stage is also generally within 3–20 V, and the maximum test of 40 V in the 1x gear is enough. Therefore, it is enough to test the PWM signal with the 1x gear (both probe and oscilloscope are set to 1x).

1: Firstly, the oscilloscope is set to auto trigger mode (auto trigger mode is the default after startup); auto trigger mode is used to test the cycle signal (PWM belongs to the cycle signals).

2: The oscilloscope probe multiplier is set to the 1x gear (default after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Make sure that the main board has PWM signal output at this time.

6: Clip the probe clip to the S-pole of the MOS tube and the probe to the G-pole of the MOS tube.

7: Press the [auto] button once to display the measured PWM waveform. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knobs.

Signal generator output measurement

Gear selection: the output voltage of the signal generator is within 30 V, and the maximum test value of the 1x gear is 40 V, so the output of the test signal generator is in the 1x gear (probe and oscilloscope are set to be 1x).

1: Firstly, the oscilloscope is set to auto trigger mode (the default mode is auto trigger mode after startup); auto trigger mode is used to test the periodic signal (the signal output by the signal generator belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to the 1x gear (default is the 1x gear after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Make sure the signal generator is on and is outputting the signal.

6: Connect the probe clip to the black clip of the signal generator output line, and the probe to the red output line of the signal generator.

7: Press the [auto] button once — the waveform output by the generator will be displayed. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knobs.

Measurement of domestic electricity at 220 V or 110 V

Gear selection: first, you need to buy a 100x probe. Household electric power is generally 180–260 V, the peak-to-peak voltage is 507–733 V. The maximum measurement of 1x is 40 V, the highest value of 10x is 400 V, 100x is 4000 V. The default standard probe is a 10x high-voltage probe, and peak values of only 400 V can be measured. Therefore, a 100x probe shall be provided by itself, and then set to the 100x gear — that is, both probe and oscilloscope shall be switched to the 100x gear.

1: Firstly, the oscilloscope is set to auto trigger mode (auto trigger mode is the default after startup); auto trigger mode is used to test the cycle signal (50 Hz of household electric power belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to 100x (default is the 1x gear after startup).

3: The oscilloscope coupling mode is set to AC coupling.

4: Insert the probe and move the switch on the probe handle to 100X.

5: Ensure that the tested end has a home power output.

6: Connect the probe clip and probe to the 2 wires of household electric power without distinguishing the positive and negative poles.

7: Press the [auto] button once to display the waveform of the household electric power. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knob.

Power ripple measurement

Gear selection: if the output voltage of the power supply is below 40 V, it is set to the 1x gear (both probe and oscilloscope are set to 1x), and to the 10x gear (both probe and oscilloscope are set to the same gear) if they are 40–400 V.

1: Firstly, the oscilloscope is set to auto trigger mode (auto trigger mode is the default after startup); auto trigger mode is used to test the cycle signal (DC voltage belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to the corresponding gear (default is 1x after startup).

3: The oscilloscope coupling mode is set to AC coupling — note that it is really AC coupling.

4: Insert the probe and move the switch on the probe handle to the corresponding gear.

5: Make sure the power is on and voltage output is available.

6: Connect the probe clip to the negative extreme of the power output, and the probe to the positive extreme of the power output, and wait for about 3 seconds, until the yellow line and the left yellow arrow position are in the same position.

7: Press the [auto] button once, and the power ripple will be displayed.

Inverter output measurement

Gear selection: the output voltage of an inverter is similar to that of household electricity, with a peak-to-peak voltage above 500 V. The highest measurement is 40 V in 1X, 400 V in 10x and 4000 V in the 100x gear, and peak values of 400 V can only be measured at the highest with the default standard 10x high-voltage probe. Therefore, a 100x probe shall be provided by itself, and then set to the 100x gear — that is, both probe and oscilloscope shall be switched to the 100x gear.

1: Firstly, the oscilloscope is set to auto trigger mode (the default mode is auto trigger mode after startup); auto trigger mode is used to test the periodic signal (the signal output by the inverter belongs to the periodic signals).

2: The oscilloscope probe multiplier is set to 100x (default is the 1x gear after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to 100X.

5: Ensure the inverter is powered on and voltage output is available.

6: Connect the probe clamp and probe to the output end of the inverter without distinguishing the positive and negative poles.

7: Press the [auto] button once to display the waveform of the inverter. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knobs.

Measurement of a power amplifier or audio signal

Gear selection: the output voltage of a power amplifier is generally below 40 V, and the maximum test of 40 V in the 1x gear is enough (both probe and oscilloscope are set to the 1x gear).

1: First, set the oscilloscope to auto trigger mode (the default is auto trigger mode after startup).

2: The oscilloscope probe multiplier is set to the 1x gear (default is the 1x gear after startup).

3: The oscilloscope coupling mode is set to AC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Ensure that the amplifier is on and is outputting audio signals.

6: Connect the probe clip and probe to the output end of the 2 lines of the amplifier without distinguishing the positive and negative poles.

7: Press the [auto] button once to display the waveform of the output signal. If the waveform after automatic adjustment is too small or too large, the waveform size can be adjusted manually by the knobs.

Measurement of vehicle communication signal / bus signal

Gear selection: the communication signal of an automobile is generally lower than 20 V, and the maximum test for the 1x gear is 40 V, so it is enough to test the vehicle communication signal with the 1x gear (both probe and oscilloscope are set to the 1x gear).

1: Firstly, the oscilloscope is set to normal trigger mode (auto trigger mode is the default after startup). Normal trigger mode is specially used to measure non-periodic digital signals — if auto trigger mode is used, it is impossible to grasp the non-periodic signal.

2: The oscilloscope probe multiplier is set to the 1x gear (default is 1x after startup).

3: The oscilloscope coupling mode is set to AC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Connect the probe clip and probe to two signal lines of the communication line, regardless of positive and negative. If there are multiple signal lines, you need to judge the signal line in advance, or try to select two of them for testing several times.

6: Make sure that there is a communication signal on the communication line at this time.

7: Adjust the vertical sensitivity to 50 mV.

8: Set the time base to 20 μs.

9: Press [50%] once.

10: When there is a communication signal on the communication line, the oscilloscope will capture and display it on the screen. If it cannot be captured, it is necessary to try to adjust the time base (1 ms–100 ns) and the trigger voltage (green arrow) for multiple times.

Infrared remote receiver measurement

Gear selection: the infrared remote control signal is generally 3–5 V, and the maximum test for the 1x gear is 40 V, so it is enough to test the signal with the 1x gear (both probe and oscilloscope are set to the 1x gear).

1: Firstly, the oscilloscope is set to normal trigger mode (auto trigger mode is the default after startup). Normal trigger mode is specially used to measure non-periodic digital signals — auto trigger mode is not able to grasp the non-periodic signal; the infrared remote control signal belongs to the non-periodic digital coding signals.

2: The oscilloscope probe multiplier is set to the 1x gear (default after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Connect the probe clip to the ground end (negative) of the infrared receiver board, and the probe to the data pin of the infrared receiver.

6: Adjust the vertical sensitivity to 500 mV.

7: Set the time base to 20 μs.

8: Turn the trigger red arrow position to the left yellow arrow position at approximately 1 large grid distance.

9: At this time, when the infrared signal is sent by the remote control to the receiver, the waveform will appear on the oscilloscope.

Measurement of an amplification circuit with sensors (temperature, humidity, pressure, Hall, etc.)

Gear selection: generally, the sensor signal is relatively weak, about a few millivolts — this small signal cannot be detected directly by the oscilloscope. There is a signal amplification part on the main board of the sensor. When the output end of the amplifier is found, the oscilloscope can measure the signal after it is amplified. It can be used in the 1x gear (both probe and oscilloscope are set to the 1x gear).

1: First, set the oscilloscope to auto trigger mode (the default is auto trigger mode after startup).

2: The oscilloscope probe multiplier is set to the 1x gear (default after startup).

3: The oscilloscope coupling mode is set to DC coupling.

4: Insert the probe and move the switch on the probe handle to the 1x position.

5: Connect the probe clip to the ground end of the sensor motherboard (negative power supply), find the output end of the amplification part, and connect the probe to the output end.

6: Adjust the vertical sensitivity to 50 mV.

7: Adjust the time base to 500 ms and enter the slow scan mode of the large time base.

8: Move the baseline to the bottom.

9: If the signal line appears at the top, the vertical sensitivity shall be reduced — 100 mV, 200 mV, 500 mV etc. in turn. When the updated signal on the right no longer starts at the top (generally the best is in the middle of the upper and lower part), the signal received by the sensor can be detected.

8. Information for the EU and Czech Market

8.1 Importer and responsible person in the EU

The product is placed on the European Union market by the importer stated below, who is at the same time the responsible person within the meaning of Article 16 of Regulation (EU) 2023/988 of the European Parliament and of the Council on general product safety (GPSR).

Importer / responsible person in the EU	Rotorama, s.r.o.
Company ID (IČO)	051 57 692
VAT ID (DIČ)	CZ05157692
Registered office	Okrajová 1351, 674 01 Třebíč, Czech Republic
E-mail	info@rotorama.cz
Phone	+420 252 252 098
Website	www.rotorama.cz

8.2 Product conformity

CE

- The product bears the **CE** marking and complies with the requirements of the applicable European Union harmonisation legislation.
- A copy of the **EU Declaration of Conformity** is available from the importer at the address stated above or at the e-mail address info@rotorama.cz.
- **Product identification:** the type designation (FNIRSI-1014D) and the serial number are given on the rating label of the device.

8.3 Disposal of electrical equipment

- The crossed-out wheeled bin symbol on the product, its packaging or in the documentation means that at the end of its service life the product **must not be disposed of together with mixed municipal waste**.
- Hand it over at a take-back point for electrical equipment – at a collection yard, at a take-back point of a collective system, or at the retailer when purchasing a new equivalent product. Take-back is free of charge for the end user.
- The obligations under Act No. 542/2020 Coll., on end-of-life products, are fulfilled by the importer through a collective take-back system.
- Proper disposal helps prevent negative impacts on the environment and human health and contributes to the reuse of secondary raw materials.

Through its contractual partner **ASEKOL a.s.**, the company ensures the take-back of waste electrical equipment from households and the separate collection of waste electrical equipment, batteries and accumulators in accordance with the applicable legislation. The customer is entitled to hand over old electrical equipment or a battery or accumulator at any collection point of the above contractual partner. The addresses of these take-back points are listed at www.asekol.cz, www.ecobat.cz and also https://visoh2.mzp.cz/RegistrMistZO/RegistrMistZOPublic/MapaMistZpetOdberu.

9. Warranty and rights arising from defective performance

The rights and obligations of the contracting parties are governed by Czech law, in particular by Act No. 89/2012 Coll., the Civil Code, and Act No. 634/1992 Coll., on consumer protection.

- The seller is liable to the buyer for the product being free of defects on receipt. If the buyer is a consumer, a defect may be notified **within two years of receipt** of the product (Section 2165 of the Civil Code).
- If a defect appears within **one year** of receipt, the product is deemed to have been defective already at the time of receipt (Section 2161(5) of the Civil Code).
- When purchasing online, a consumer has the right to **withdraw from the contract within 14 days** of receiving the goods without giving a reason (Section 1829 of the Civil Code).
- Claims should be made with the retailer from whom you purchased the product. The importer's contact details are given in Chapter 8.1.
- The competent body for out-of-court settlement of consumer disputes is the **Czech Trade Inspection Authority**, Štěpánská 796/44, 110 00 Prague 1, www.coi.cz.