

ST121
SIGNAL IMITATOR

TECHNICAL DESCRIPTION AND
OPERATING MANUAL

Introduction

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Introduction

Before starting your work with "ST121" carefully read this instruction and save it for further use as a handbook.

Any information in this manual can be changed fully or partially without further notice.

1 GENERAL DESCRIPTION

1.1 Purpose of the device and main capabilities

Imitator of signals "ST121" is designed for generation of signals imitating data transmission channels of special technical means for data gathering.

"ST121" allows generation of:

- Radio signals with user set frequency value in 100 – 6000MHz range, and variable output power of AM and FM, signals with FHSS, DSSS and PULSE.
- Signals imitating data transmission standards (GSM, DECT, BLUETOOTH и WLAN).
- HF and LF signals in the 220v power lines and low current lines.
- IR signal with LF signal modulation and selection of subcarrier frequency.
- Sound and ultrasound signals with user defined frequency or with frequency values corresponding to octave and third-octave filters and direct connection of speakers to the ST121 output socket.
- Low frequency magnetic field.
- Imitation of nonlinear transition in wire lines.

1.2 ST121 Contents

1. Main module
2. HF antenna
3. "RJ-45" cable
4. "220V" cable
5. "3/RJ-45" cable
6. Power supply/charger 5V/1A
7. Technical description and operating manual

1.3 Main module description

Main block is an independent device which allows signal generation and emission as well as nonlinear transition for nonlinear transition detector testing.

Work results will be shown on a graphical colored LCD display with 160X128 resolution.

Device is controlled with rotary knob.

Turning off/on is done by the power switch.

Power is provided by internal Li-Polymer battery or power supply.



1. Charging indicator
2. "5V" power socket
3. Power switch
4. LF socket - output of low frequency signal amplifier in 0.01-120kHz range. Speakers should be plugged here
5. RF/UHF socket - output for radio signals in 100-6000MHz range
6. Rotary knob
7. IR emitter
8. Location of magnetic field emitter



9. "RJ-45" socket – output for signal in 0.01-20000kHz range
10. "220V" socket – output for signal in 30-20000kHz range




1.4 ST121 Power supply

Battery status icon is located in upper-right corner of main menu screen. Fully colored icon  corresponds to fully charged battery, uncolored crossed with line  - discharged.

1.4.1 Battery charging

To charge internal battery, connect power supply. State of power switch has no effect on charging.

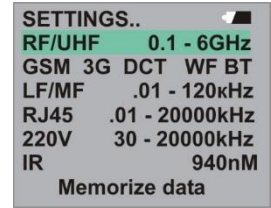
Charging is indicated by constant glow of indicator «**CHRG**» (Pic. 1 Pos. 1) and animated battery status icon . Full charge time is approximately 6 hours. When charging is finished indicator will stop glowing and device will continue to maintain its charge level.

1.5 Operation modes

After turning the device on you will see the main menu (Pic. 2).
Selection in MENU is done by the ROTARY KNOB rotation, confirmation - press ROTARY KNOB.

Exiting in previous submenu - press ROTARY KNOB and hold for no less than 3 seconds.

If "**SETTINGS**" submenu is selected, you will see general device settings.



Picture 1

Setting	Description	Value	Default value
Set freq step	Selection of frequency-tuning step	10, 100, 1000, 10000, 100000Hz	100000Hz
Indicate	Sets the brightness for display	from 10 to 100% with step 10	50
Language	Language selection	English (Английский)/Russian (Русский)	Russian
Fact. defaults	Returns all the settings to the default value		

Selection of the "**Memorize data**" in MENU allows saving current settings (shown on screen) before turning device off – signal source, frequency, modulation, output power. If this option is selected on the next startup, device will load in saved mode, bypassing the main MENU.

If submenu «**HF/SHF 0.1-6 GHz**» is selected in main MENU, you will see the submenu (Pic. 3) which allows you to work with signals in 0.1-6 GHz range outputted through "HF-SHF" socket intended for RF antenna.

Setting altering can be achieved using ROTARY KNOB with step selected in "SETTING." submenu. Default value is 10 MHz.

If "**Modulation OFF**" is selected it will change carrier signal modulation type: AM or FM as well as FHSS (Frequency Hopping Spread Spectrum), DSSS (Direct-Sequence Spread Spectrum) and PULSE.

If AM or FM is selected, "**Frequency**" option will appear allowing selection of modulation signal frequency (for AM and FM modulation). "**Deviation**" option will appear for FM allowing selection of highest deviation for modulated signal frequency from value of its carrier frequency.

If FHSS is selected there will be 3 options available: "**Frequency**" – frequency of hopping, "**Band**" - bandwidth of hopping, "**Channel**" - number of hopping channels.

If DSSS is selected, 1 option will be available: "**Band**" - allowing selection of signal's bandwidth.

If PULSE is selected, 2 options will be available: "**ON xx.xx s**"- allowing selection of signal length and "**OFF xx.xx s**" - interval between signals.

Output power can be selected in the last item. Power value is given in dBm and mW. Minimum and maximum values are different for different frequencies.

If this item is highlighted, you can press and hold ROTARY KNOB for 2 second to toggle signal generation ON or OFF.



Picture 2

If "**GSM 3G DECT WF BT**" submenu is selected in main MENU you will see the submenu which allows work with signals imitating data transmission standards: "GSM" - GSM900, "3G" - Third generation of mobile telecommunications, "DECT" - Digital Enhanced Cordless Telecommunications as well as data transmission standards in 2.4GHz frequency range: "WF" - Wireless local area network (Wi-Fi) and "BT" - Bluetooth. (Pic. 4)



Picture 3

It is possible to select a standard required to be imitated as well as output power.

Carrier frequency, band of signal and time parameters of radio impulse are imitated.

If "**LF/MF.01-120kHz**" submenu is selected in main MENU, you will see the submenu which allows work with acoustic and ultrasound signals in 0.01-120kHz frequency range outputted through "LF" socket. It also turns magnetic field emitter on. Position of this emitter is marked on the front panel as: "**MF**". In this case stray emission of radio-electronic devices is imitated (cell phones, recorders etc.). (Pic. 5)



Picture 4

"LF" (TRS 3.5") socket is an output for low frequency amplifier and intended for speakers (Pic. 6) There are three options for carrier frequency selection:

- Random selection of frequency
- Frequencies corresponding to the octave filter.
- Frequencies corresponding to third octave filter.



Picture 5

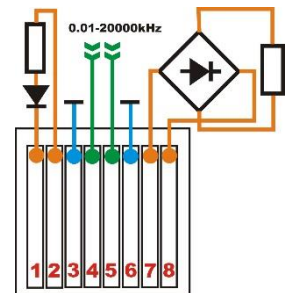
With selection of item "**Modulation OFF**" it is possible to select modulation of carrier signal: FM, AM or PWM.

If AM or FM is selected, "**Frequency**" option will appear allowing selection of modulation signal frequency (for AM and FM modulation). "**Deviation**" option will appear for FM allowing selection of highest deviation for modulated signal frequency from value of its carrier frequency

If PWM is selected two options will appear: "**Frequency**" allowing selection of frequency of impulse and "**Ratio**" allowing selection of interval between impulses.

Power is changed in % of maximum power.

If "**RJ-45 .01-20000kHz**" submenu is selected in main MENU, you will see the submenu which allows work with signals in 0.01-20000kHz range outputted through "RJ-45" socket to "4-5" pair (Pic. 7). Pair "3-6" used as device's "ground" which allows for asymmetrical connection to the line. Cable "3/RJ-45" is used for such connection. Black wires are connected to the "ground" and red to the "4-5" pair.



Picture 6

With selection of line "**Modulation OFF**" it is possible to select modulation of carrier signal: FM, AM or PWM.

If AM or FM is selected "**Frequency**" option will appear allowing selection of modulation signal frequency (for AM and FM modulation). "**Deviation**" option will appear for FM allowing selection of highest deviation for modulated signal frequency from value of its carrier frequency

If PWM is selected two options will appear: "**Frequency**" allowing selection of frequency of impulse and "**Ratio**" allowing selection of interval between impulses.

Power is changed in % of maximum power.

If "**220V 30-20000kHz**" submenu is selected in main MENU, you will see the submenu which allows work with signals in 30-20000kHz range outputted through "220V" socket to the power lines. This allows to fully imitate data transmission channel in 220V lines.

With selection of line "**Modulation OFF**" it is possible to select modulation of carrier signal: FM, AM or PWM.

If FM is selected "**Frequency**" option will appear allowing selection of modulation signal frequency. "**Deviation**" option will appear for FM allowing selection of highest deviation for modulated signal frequency from value of its carrier frequency

If PWM is selected two options will appear: "**Frequency**" allowing selection of frequency of impulse and "**Ratio**" allowing selection of interval between impulses.

Power is changed in % of maximum power.

If "**IR 940nm**" submenu is selected in main MENU, you will see the submenu which allows work with IR emitter located on the front panel (Pic. 1 Pos. 7).

With selection of line "**Modulation OFF**" it is possible to select modulation of carrier signal: FM, AM or PWM.

If AM or FM is selected "**Frequency**" option will appear allowing selection of modulation signal frequency (for AM and FM modulation). "**Deviation**" option will appear for FM allowing selection of highest deviation for modulated signal frequency from value of its carrier frequency

If PWM is selected two options will appear: "**Frequency**" allowing selection of frequency of impulse and "**Ratio**" allowing selection of interval between impulses.

Power is changed in % of maximum power.

Nonlinear element

There are nonlinear elements connected to the contact pairs "1-2" and "7-8" of "RJ-45" socket in order to imitate nonlinearity in the wireline (Pic. 7).

2 RESTRICTIONS AND RECOMMENDATIONS

2.1 Transport and store ST121 in standard package.

For prolonged storing you should use closed, warm compartment with temperature 10-35C and humidity no more than 80%.

Transport with caution and try to avoid physical interference with standard package.

2.2 After prolonged (more than 4 hours) stay of the device in cold (less than -5C) it only should be turned on if there is no evidence of condensate on the device.

2.3 Do not expose LCD display to the direct sunlight.

3 TECHNICAL SPECIFICATIONS

"HF-SHF" socket

Frequency range, MHz	100-6000
Frequency-tuning step, kHz	10, 100, 1000, 10000, 100000
Signal level, dBm	-42 – +14*
Stray harmonics, dBm	
100-200MHz	-15
200-700, 1100-1500MHz	-45
800-1000, 1600-6000MHz	-30
Signal	Sinusoidal, DSSS ,FHSS, PULSE
Modulation	AM, FM
Data transmission standards imitation	GSM, 3G, DECT, WLAN, BLUETOOTH
Modulation frequency, kHz	0.5, 1, 1, 5, 15
AM depth, %	70
FM Deviation, kHz	5, 20, 100, 300, 600
Nonlinear distortion of modulating signal, no more than, %	15
FHSS Bandwidth of Hopping, MHz	1, 6, 10, 20, 50, 100
FHSS Number of Hopping Channels	25, 50, 125, 250
FHSS Frequency of hopping, Hz	1, 2, 4, 8
DSSS Bandwidth, MHz	0.3, 0.5, 1, 2, 4
PULSE Signal transmission time, sec	0.0001- 99
PULSE Signal accumulation time, sec	0.01-5999

*Variation range depends on signal frequency and selected standard

"RJ-45" socket

Frequency range, kHz	0.01-20000
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Maximum signal amplitude, V	3.5
Modulation	AM, FM, PWM
Modulation frequency, kHz	0.5, 1, 1, 5, 15
AM depth, %	15
FM Deviation, kHz	5, 20, 100, 300
Frequency of PWM signal, Hz	1, 10, 40 и 100
PWM Duty cycle	1, 5, 10

"220V" socket

Frequency range, kHz	30-20000
Maximum signal amplitude, V	3.5
Maximum input voltage, V	380
Modulation	FM, DSSS
Modulation frequency, kHz	0.5, 1, 1, 5, 15
FM Deviation, kHz	5, 20, 100, 300
Frequency of PWM signal, Hz	1, 10, 40 и 100
PWM Duty cycle	1, 5, 10

"IR" emitter

Wave length, nm	940
Subcarrier frequency range, kHz	0.01- 5000
Stray harmonics, dBm	30
Output power, mW	0.5
Modulation	AM, FM, DSSS
Modulation frequency, kHz	0.5, 1, 5, 10, 15
AM depth, %	15
FM Deviation, kHz	5, 20, 100, 300
Frequency of PWM signal, Hz	1, 10, 40 и 100
PWM Duty cycle	1, 5, 10

"LF" socket

Socket	Symmetrical
Frequency range, kHz	0.01-120
Maximum output power, W	0.7 (power supply), 0.3 (internal battery)
Power levels, %	7.5, 14, 20, 32, 50, 65, 80, 100
Impedance, Ω	8
Frequency-tuning step, kHz	1, 10, 100, 1000
Octave filters frequency values, Hz	32, 63, 125, 250, 500, 1000, 2000, 4000, 6000, 16000, 31500 63000
Third octave filters frequency values, Hz	32, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000, 20000, 25000, 31500, 40000, 50000, 63000, 80000, 100000,
Nonlinear distortion, no more than, %	1
Modulation	AM, FM, DSSS
Modulation frequency, kHz	0.5, 1, 1, 5, 15
AM depth, %	15
FM Deviation, kHz	5, 20, 100, 300
Frequency of PWM signal, Hz	1, 20
PWM Duty cycle	1, 5, 10

Magnetic field emitter «MF»

Equivalent magnetic moment of magnetic field source with frequency 1kHz, $A \cdot m^2$

Power levels	100%	$2 \cdot 10^{-4}$
	7.5%	$2 \cdot 10^{-5}$

Power

Power supply Li-Polymer battery, 2.2A/h or 220V power supply

Maximum current consumption, mA 500

Main module dimensions, mm 110X60X28

4 LIFE TIME AND MANUFACTURER'S WARRANTY

4.1 Life time

Recommended life time is 7 years from the day of delivery to the customer.

4.2 Manufacturer's warranty

4.2.1 Manufacturer warranties that ST121 matches technical requirements as long as consumer will follow exploitation, transportation and storage regulations stated in this instruction.

Warranty period - one year from the day of delivery to the customer.

4.2.2 During warranty period manufacturer will provide free of charge repairs as long as consumer will follow exploitation, transportation and storage regulations stated in this instruction.

5 CERTIFICATE OF ACCEPTANCE

ST121 device. Certified № _____ is manufactured according to the technical requirements, accepted and verified as working unit.

Stamp Place

year, month, day

WARRANTY CARD

CARD № 1

For warranty repair (maintenance) ST121

Serial _____ Manufactured _____
Manufacturer's stamp

Sold _____ Date " " _____ 20 ____ г.
(vendor's identification)

Salesman _____ Vendor's stamp
(signature)

CARD STUB № 1

For warranty repair (maintenance) ST121

Serial _____ Date _____

Executor _____
(Family name, signature)