СИГНАЛ–Т

ST 111

EMF DETECTOR

Specification and User's Guide

Contents

1 INTRODUCTION

This User's Guide contains information necessary for correct operation and maintenance of the ST111. Before operating your ST 111, read this User's Guide carefully and consult it every time you have questions about the operation of the unit

The information in this User's Guide is subject to change without prior notice

The manufacturer reserves the right to change the product's specifications in such a manner not worsening or reducing the product's functionality.

2 PURPOSE

ST111 is designed for:

- detecting and localization of radio-wave radiation devices (RD))
- identification of cellular standards (Mobile phones and radio modems of GSM 900, 1800, data transmission devices of «BLUETOOTH» and «WLAN» standards and wireless microcellular phones of DECT standard.

- measurement of analog signal frequency with constant carrier frequency. Selection of scan threshold and range is provided.

Round the clock monitoring of radio environment while registering the information on the detected signals in non-volatile memory of the unit.

Special software application «ST111 Analyzer» extends unit configuring possibilities, visualizing and saving the data.

3 SPECIFICATIONS

3.1 Frequency range 1, MHz	50-25000
3.2 Frequency range 2, MHz	2500-7000
3.2 Threshold input sensitivity, dBm, less than	-75 (50 MHz) -70 (1500 MHz) -50 (2500 MHz)
3.3 Threshold sensitivity, W/cm^2, less than	$2\text{-}10^{-10}$ (2500-7000 MHz)
3.4 Frequency range of frequency meter, MHz	50-2500
3.3 Sensitivity of frequency meter, dBm	-35 (50 MHz) -50 (1500 MHz) -20 (2500 MHz)
3.4 Inaccuracy of frequency measuring, %	0.005
3.4 Dynamic range of indication 1, dB	55
3.4 Dynamic range of indication 2, dB	30
3.5 Indication	color TFT display 169X128
3.6 Internal power supply	Li-pol acc. battery 3.6V
3.7Consumption current, mA, less than	110
3.8 Dimension, mm	90x54x21
3.9 Weight, kg, less than	0.13
3.10 Gross weight, kg	0.25

4 COMPLETE SET

The product includes the following components:

1 Main unit
2 HF antenna
3 USB cable
4 Charger/power supply
5 USB flash drive with software and «Technical description and operating manual»

5 DEVICE AND OPERATING PRINCIPLES

Principle of operation of ST 111 is based on wideband demodulation of electrical field. Frequency meter provides frequency measuring of stable signal.

Identification of digital data transfer signals is performed on basis of analysis of fixed frequency ranges and time parameters of detected signal.

Graphic and digital information is displayed on color TFT display.

Sound signals including the detected signal is reproduced by built-in sound source or headphones.

The device is controlled with help of six-button membrane keyboard.

5.1 OPERATING MODES

ST111 operates in two main modes: «**SEARCH**» and «**MONITORING**».

Additional modes include: «**LOG VIEW**» and «**OSCILLOGRAPH**»

5.1.1 **«SEARCH»** mode is intended for search and detection of RD location.

5.1.2 «**MONITORING**» mode is intended for independent operation of the device on pre-set conditions with registering the information on the detected signals in log of events.

5.1.3 «**LOG VIEW**» mode is intended for viewing the log of events taking place in the result of the unit running in «**MONITORING**» mode. Time of the event, duration, type of the event and level of signal is indicated. The classification of the events by time, duration or signal level is provided.

5.1.3 «**OSCILLOGRAPH**» mode is intended to view the oscillogram of detected signal (signal analysis in time range) with digital output about duration of the signals. Manual and automatic setting of the signal amplitude and trace and also marker measurements of signal parameters are provided.

5.2 SERIAL NUMBER AND INTEGRITY SEAL

On the back of the block is a nameplate. The following information is written on it by metallography: type of device, serial number and manufacturer logo.

5.3 PACKAGING

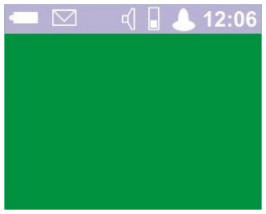
For transportation and st oring the unit components are placed in a box made of corrugated cardboard with the dimensions of 130X75X73 mm.

For convenience and safety of the unit components packing, the foamed polyurethane inserts are provided.

6 OPERATING THE ST 111

6.1 DISPLAY AND CONTROLS

6.1.1 INDICATION



Displaying of the operation results is performed on the color graphical TFT display having 160x128 resolution.

Indication, which is common for all the operational modes:

Indicator of power supply condition (see item 6.2)

Operation with «ST111 Analyzer» software with USB connection

Mute

Preset volume level (for volume control see item 6.1.2)

Indicator of scheduled operation in «**MONITORING**» mode

6.1.2 CONTROLS

Supply switch, located on the side of the main unit.
The following message will appear after switching-on of ST111 for a shirt moment:
"ST111 Version X.X", where X.X - is the installed firmware version number.

Control keys functions:

Font color	White	Yellow
PWR/MODE	Sequential choice of working modes «**SEARCH**», «**MONITORING**»	
ZERO	Set of indication limits in «**SEARCH**» mode	Back to the previous MENU item. Moving between bank of the events in **«LOG VIEW»** mode, exit from **«LOG VIEW»** mode. Manual choice of vertical scanning range or zeroing of the marker value in «**OSCILLOGRAPH**» mode.
SENS EXIT	Set of indication scales sensitivity	Exit from MENU and OSCILLOGRAPH mode, marker measurements
VOL+ VOL–	Volume control	Moving between MENU items, events in **«LOG VIEW»** mode Choice of horizontal scanning range or marker movement in «**OSCILLOGRAPH**» mode.
MENU	MENU enter	Confirmation of choice Enter into marker measurements in «**OSCILLOGRAPH**» mode.

Scheduled switching-on/switching-off function is provided. Shedule parameters are set in submenu «**System**» - «**Time..**» - «**Shedule..**» (see table 4). After setting Scheduled switching-on/switching-off function the «» icon will appear. Before using this function Real-time clock should be set («**system..**» - «**Time..**» - «**Set clock..**»). After switching off the device, all set points will be reseted.

6.2 POWER SUPPLY

ST111 is powered by a built-in Li-Pol rechargeable battery, external power supply/charger and USB port of PC

At built-in rechargeable battery running its status is represented by icon.

When the battery is fully charged it is indicated by a filled battery pictogram. When the battery is almost completely discharged, the battery indicator will turn from solid to blinking outline.
When the battery level is too low, the display will show "BATTERY DISCHARGED" for ten seconds.
An average operation time of the detector with a fully charged battery is approximately 12 hours.

6.2.1 Battery charge

Connect power supply/charger to USB port of ST111. Power supply/charger should be connected to 220V. The charging process will correspond to the constant glow of the indicator " " located on the side of the main unit. Full charge time when the device is off is about 4 hours, when it is on - up to 5 hours.

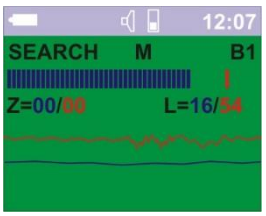
6.3 FIRST TURNING ON

Attach the SHF antenna to the main unit.
Turn on the device
If the text "BATTERY DISCHARGED" appears on the display, you will need to charge it (see item 6.2.1.).

6.4 OPERATING IN SEARCH MODE

At the first switching **«SEARCH»** mode is automatically activated. Choice of the operating mode is made by pressing PWR/MODE button.

Indicators on the top line of the green field:



- Mode name: **«SEARCH»**
- Chosen sensitivity of the indication scale. «**L**» - low (full scale 55dB), «**M**» - medium (full scale 35dB) и «**H**» - high (full scale 15dB). The choice is made by pressing SENS EXIT button. This choice doesn't effect on sensitivity of the device, only on the representation of signal level indication.
- Inscription «**B1**» - by default. This inscription informs about chosen frequency range of the device.
- Possible options:
  - «**B1**» -range 1 (50- 2500MHz). Signal reception is done by HF antenna.
  - «**B2**» - range 2 (2500-7000MHz) Signal reception is done by SHF antenna.
  - «**B12**» - Simultaneous detection and representation of information about both ranges on a display.

  Range selection is done in submenu «Range..».
  Also, in this place, the inscription "ZERO" appears for a short time when setting the zero level of the scales.

Under is 32-segmental graphic indicator of detected signals level. Integral power of radio-frequency radiation source is displayed with blue color, impulse component level of radio-frequency radiation source is displayed with red color.

Under the graphic indicator line numerical indicator of zero level and current level signal is located

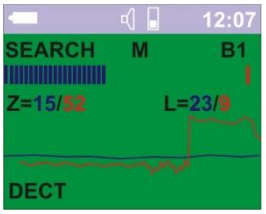
After first turning on zero level value (equal to 0) is displayed: «**Z=00/00**». Zero level for constant component is designated by blue color, red color is for impulse component6 similarly to color division of graphical indicator.

Numerical values after «L» letter- current signals level. Set of indication limit related to the current level of radio signals (background diminution signal subtraction) is realized by pressing ZERO button. Simultaneously you will see a message «ZERO» and for a short time and the clearance of indicators will happen showing new numerical values.

On the picture you can see, that signal level values are closed to zero «L=**01**/**00**» and zero level values took the value of signals before pressing the ZERO button.

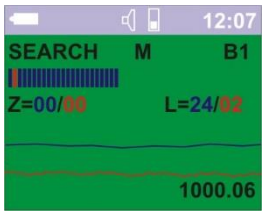
After each set of the "zero point" the scale of indicators will change by the leftover principle. For example, if the absolute value is 24 dB, the scale of indication will become linear distributed between 24 and 55 dB (approximately 1dB for each segment), if the absolute value of zero level is 12 dB, then 1.5 dB on each segment.

Cancellation of indication limit set with indication zeroing is provided by pressing button during the indication of the message «ZERO».

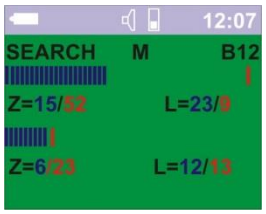


Under numerical level values **diagram of signal level change in time** is displayed. 30 sec value is setted by default. This value can be changed in «Recorder..» menu.

Under the diagram identified protocols of data transfer or signal frequency is located. On picture- DECT and 1000MHz (on picture 1000.06)



You should remember that only constant in time signal is indicated – blue scale and sensitivity of the frequencymeter is at least 10 times lower then input sensitivity of the device. That's why frequency indication will be done when signal level is at least 20 dB(blue 24 number on picture)



In ST111 simultaneous display of 2 frequency range signals is provided. For that option you should choose «**B12**» in «**Range...**» submenu. Diagram displaying is absent in this case.

6.4.1 WORKING SEQUENCE IN SEARCH MODE

If possible, turn off all legal radio emission sources including WLAN routers and PC modules, DECT base station and terminals(phones).

Set the indication limit. This operation to be repeated in one of the premises nearest to the checked room, in which the level of background signal doesn't differ much from the level in the checked room, and placement of RD is not reasonable. If in the place of setting the indication limit numerical value level of any scale is close to 60 and all scale segments of blue or red indicator are in extreme right position, it means that signal is higher than the upper limit of the dynamic range of the device and there is will be no further level measurement. It can happen for example if ST111 is in the immediate vicinity from WLAN router.

When ST111 approaches RD, the number of colored indication level sectors will increase depending on frequency and type of signal (red – impulse component of the signal dominates, blue – constant dominates). Such interpretation of signals is rather conditional and is realized for comfortable work with ST111.

For example, DR signals for constant frequency 430 MHz and power of 10 mW is detected from 1m distance (with threshold of 20 dB), DECT phone is detected from 0,5m distance.

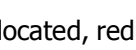
Detection range of cellular phones is depending on:

- Used standard 2G 900MHz or 1800MHz, 3G or 4G. Which of the listed standards will be used depends from many different factors and, in general, poorly predictable. ST111 does not identify standards 3G and 4G (no «GSM» inscription in the lower line of the display. Detecting of this kind of signals is possible only on the position of single red segment of the level scale.
  Detecting or RD using 3G standard, from several centimeters to 0.5m. 2G up to meters.
- Distance from base stations. As bigger the distance, higher the emission level of the phone and respectively larger the detection range.

It should be noted that modern cellular phone is working on transfer:

- *At the moment of connecting with the base station.*
- *In general, in the presence of an audio signal in audio section of the phone (conversation) after connection.*
- *During data transfer (SMS).*

All other time phone is working as a receiver. No emission- no detection.

In case if RD doesn't located, reduce sensitivity of the indication scales – pressing 

button. Minimal value- «**L**». Then set zero level regarding to the given signal level by pressing 

button and continue searching.

Identification of identified data transfer protocol or signal frequency, at one moment, is possible only for the most powerfull signal from all the received by the device signals.

The signal identified by the amplitude detector is sent to headphones or built-in oscillator sound source for acoustic control.

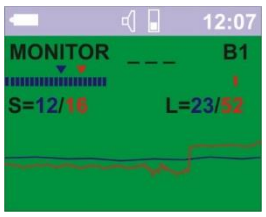
For signal identification you can also use «**OSCILLOGRAPH**» mode. It can be used, for example, to see formed digital sequence on the background of hindering signals.

During the signal analysis of the second range should be considered that input filter is not ideal and signals of relatively bigger level of first range (WLAN 2.4GHz) can be reflected on the indicator of the first range.

6.5 OPERATING IN MONITORING MODE

Sensitivity of indication scale can't be changed in this mode

Choice of this mode is performed by pressing PWR/MODE button, inscription «**MONITOR**» should appear at the upper left corner of the display. The first five seconds after switching to this mode in the upper right corner of indicator a five-second countdown will be seen. This period of time provides measurement of electromagnetic field peak level. These measurements serve as basis for automatic configuration respectively to the alarm level. This alarm level is shown as a triangles over the level scales. Change of that value is made from submenu «MONITOR» - «Event..» - «Alarm level». At default it is equal to 10dB.



The threshold is displayed as triangles above the level scales and in numerical terms (in the figure: "S = 12/16"). The current value of the signal level is "L = 23/52".

Additionally implemented threshold setting for signals to 2G, WLAN, DECT. The threshold, in this case, is the sum of the signal level close to the absolute maximum sensitivity value and the relative value selected in the "MONITOR" MENU - "Event setting" - "Signal" - "Sensitivity set ..".

There is no indication of these levels on the indicator.

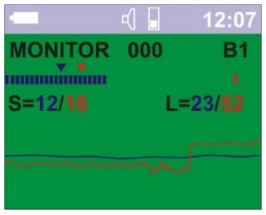
When selecting submenu "MONITOR" - "Set. Events .. "-" Frequency capture "provides the ability to detect a signal when the frequency counter is triggered.

The software "ST111 Analyzer" has more extensive options for configuring the product in this mode.

When the signal exceeds the preset threshold, the full-screen inscription "**ALARM**" is displayed for five seconds. At the end of this interval, the full-screen caption changes to the "Alarm" caption in the upper left corner of the indicator. (This display option is set by default. For display options see "Table 1").

Three spaces «**_ _ _**» means, that information record in log of events is prohibited.

For information about detected signal record in log of events permission submenu "log" and tick in front of "record" inscription by pressing button. **.** Icon **"_ _ _"** will change by event counter **«000»** and «**MONITOR**» inscription will start to blink.



Events that happened during one period of monitoring are recorded in separate bank

There are 9 banks. Bank number 1 always has the newest events, number 9 – the oldest. When all banks are full, events from bank 9 are erased. Maximum number of the events in one bank is 999.

If signal level drop is lower than a threshold level, new signal record is able only after time delay, which is bigger than a value, set in submenu "**log**"-«Delay event». This delay can be interpreted a time interval, during which from the moment of new signal appearing all other level changes will be considered as one signal. It is done for preventing the log of events from unjustified filling of one signal information, for example, because of short-term screening of the radio source.

To exclude records on detected and identified signals GSM, DECT BLUETOOTH or WLAN go to submenu "Monitor .." - "Event .. "-" Signal .. "and uncheck in the standard which record is not needed.

6.6 OPERATING IN LOG VIEW MODE

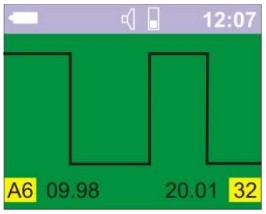
For review of detected signals choose «Log..»- «View». If the log is empty, the message: «PROTOCOL IS EMPTY» will appear on the display.

Switching between banks is performed using ZERO button (BANK XX/YY, XX – number of bank, YY –number of used banks).
The bank with the most recent events will have the lowest number.

Use buttons VOL+ VOL– for switching between events, located at the higher right part of the screen XX/YY, XX- number of event, YY - number of events in bank). The events are numbered according to the inputted parameters of classification (configured through MENU).
If you choose sorting by a parameter other than time in the Menu, the message "Sorting." may appear briefly on the screen. Please Wait."

Date, real time(if set), duration of the event, frequency range, copy of graphic indicator from MONITORING mode at the moment of signal detection, signal frequency or data transfer standard (GSM on figure) is displayed.
To exit the Event Log view mode, press SENS EXIT button.

6.7 OPERATING IN OSCILLOGRAPH MODE



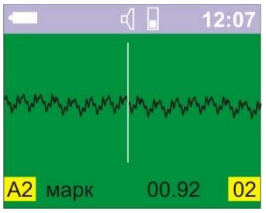
In this mode you can see the oscillogram of detected signal. On the picture signal with duration of 10ms and period of 20ms is shown (numerical values are displayed on the lower line of the display, with given measurement error– 09.98 and 20.01ms)

The set of automatic vertical scanning value choice is performed in this mode (sign «**A**» in lower left corner of the display and chosen relative value (from 1 to 7)).
Manual horizontal scanning value choice is performed by pressing continuously button ZERO (sign «**P**» in lower left corner)
For returning in automatic choice press SENS EXIT button.

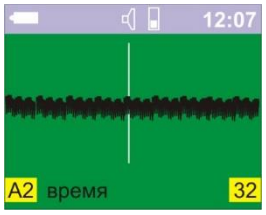
Horizontal scanning value choice is made by pressing VOL+ and VOL– buttons between the following values: 2, 4, 8 and 32 ms

When repeating pressing MENU button the switching-over between three sub-modes of the marker changes happens: "mark", "time" and "shift" with appearing of the of the same name inscription in the lower line of the display.

In mark measurements mode is provided with memorizing (freezing) of oscillogram with 32 ms length and 5120 counts



In sub-mode of mark measurements it is possible to provide measurement of each segment viewed on the display. By pressing VOL+ and VOL– buttons it is possible to move marker relatively to "zero" value including corresponding indication of the measured time segment digital value in the lower part of display.



In sub-mode "time" the possibility of horizontal scanning value changing by pressing VOL+ and VOL– buttons with corresponding changes for numerical value at the lower right corner of the display

In sub-mode "shift" the "scrolling" of whole recorded segment is provided by pressing VOL– VOL+ buttons and in range of 32 ms. (value at the lower right corner of the display)

By pressing the ZERO button all positions of the marker line are setted to zero. That allows to measure relative time intervals. Exit – press MENU button.

To continue dynamic indication button SENS EXIT has to be pressed.
Exit from **«OSCILLOGRAPH»** mode is possible by pressing SENS EXIT butto

6.8 MENU

To enter the MENU, press the MENU button, for exit - SENS EXIT button.

Use VOL+ VOL– buttons to highlight the required menu item:

«OSCILLOGRAPH» - Entering the «**OSCILLOGRAPH**» mode

«Range..» - Choosing of displayed frequency ranges and frequencymeter settings.

«Monitor..» - «**MONITORING**» mode settings (See table 1)

«Log..» - **«LOG VIEW»** settings (See table 2)

«System..» - main settings (See table 3)

«Recorder» - Switch on/off signal level changes displaying, depending on time as well as setting time interval to be displayed 0.5/2/10/20 or 60 minutes.

Choice confirmation – repeated pressing the MENU button.

TABLE 1

Monitor			
Option	Description	Value	Default setings
Event.. Setting of the events by which alarm indication is made	**Alarm level** Setting of relative alarm level limit	From 1 to 60 dB With step 1dB	20dB
	Freq capture Signal detection with identified frequency value	Chosen/Not chosen	Not chosen
	Signal Allow to record of identified standard GSM, DECT, BLUETOOTH and WLAN signals	Chosen/Not chosen	Chosen GSM, DECT
	Set sens.. Choise of sensitivity for GSM, DECT and WLAN standards	High, medium, low	Medium
	Event delay Setting of duration between the events, which should be recorded in a log as two different events	From 1 to 120 sec with step 1 sec	8 sec
Indication of alarm type setting	**Display** Full-screen message «ALARM» is indicated	Chosen/Not chosen	Chosen
	Alarm capture Indication of «ALARM» message stays until one of the buttons is pressed		Not chosen
	Vibro Activating vibrating alert (Optional)		

TABLE 2

	LOG		
View	Log view enter		
Record	Allowance/prohibition of record in EVENT LOG		
Sort…	Classification of records in log by one of the attributes	By time – in fact no classification, because the events appear in time	Chosen
		By level – classification by maximum level in decreasing order	Not chosen
		By type of signal	Not chosen
		By length – classification by event length in decreasing order	Not chosen
Delete all	Erasing of all information about events. Additional question will appear: Are you sure? SENS EXIT - Yes, ANOTHER BUTTON - cancel". После операции появится сообщение "Протокол удален". If the erase cannot be provided, an automatic erase of the bank with the oldest information will happen when the memory is full.		

TABLE 3

System				
Option	**Description**	**Value**		**Defaut settings**
Language	**Language** Language choice for information displaying	English / Russian		Russian
Indication	**Brightness** Level of brightness settings	from 10 to 100% with step 10		50
	Display switch off Time setting for automatic display switching off after the last button press	(from 8 sec to 2 min, with step 8 sec) Extreme position of mark means 99 min 99 sec		99.99
	Automatic display switch off When the signal detected, the display will switch on (if switched off)	Chosen/Not chosen		Chosen
	Sound signals Sound signal confirming the pressing of button. Periodical sound signal when phrase "BATTERY IS LOW" appears. Alternate sound signal in the case of signal detecting	Chosen/Not chosen		Chosen
Time	**Schedule** Setting of working schedule in AUTOMATIC mode Setting time in hours (from 0 to 23) for one-time or daily switching on the AUTOMATIC MODE for defined period of time. The detected signals are recorded in a separate bank.	Time set	Time of switch on. By default 9 a.m.	Not chosen
			Time of switch off. By default 5 p.m.	
		Daily		Not chosen
	Clock set Date and time set	Sequential setting: HOURS (×), MINUTES (M), SECONDS (Ñ), DAY (Ä) and MONTH (M). After each setting you should press ENTER to move on the next position		
	PC Synchronization Automatic synchronization with PC clock while transferring any information	Chosen/Not chosen		Chosen
	Correction setting Daily correction of clock movement setting	from - 2 min to + 2 min with discretization one second per day		00:00.
Default settings	All parameters of the device take default settings			

7 WORKING WITH A COMPUTER

To begin the work, download the latest version from the manufacturer Web-site. Connect the main block to the computer with USB cable that comes with the detector. When prompted to install the device driver choose the installation path. BE SURE TO confirm the installation by agreeing with the prompt.

7.1 «ST111Analyzer» SOFTWARE

This software is intended to:

- time graphic display of data and the results of operation of the ST 111;

- the ST 111 remote full control using PC;

- extended settings assignment for MONITORING mode;

- load and display of text and graphical information of the operation of the ST 111 in MONITORING mode (Event Log);

7.2 FIRMWARE UPDATING

Select the appropriate firmware version from the http://signal-t.ru/eng/files/ manufacturer website

Connect the ST111 to the computer using the USB cable. When prompted for driver installation, enable the installation. Run the installer. Check the download process on the computer screen.

8 SOME LIMITATIONS AND RECOMMENDATIONS

8.1 Use the original packaging for storing and transporting the ST 111 set.
For long-term storing, keep it in a closed, heated room with a temperature.
When transporting the unit in the original packaging, take measures to prevent it from blows or excessive pressure.

8.2 After the unit has been exposed to temperatures below –5C (23 F) for prolonged periods (over 4 hours), turn it on only after making sure there are no visible traces of condensation.

8.3 When operating the ST 111 try to protect it from concentrated moisture (rain, drizzle, and snow).

8.4 Prevent the LCD from prolonged exposure to direct sunlight.

9 WARRANTY INFORMATION

9.1 The manufacturer guarantees that the unit will comply with the specifications for a period of 12 months beginning from the day of purchase.
9.2 The manufacturer will carry out repairs of the unit and its accessories or replace them if they malfunction or if the functioning will not comply with the stated specifications free of charge during the guarantee period.
9.3 This warranty only covers free-of-charge repair or adjustment of faults that are not the result of improper use, failure to follow the usage tips and recommendations stated in the User's Guide, improper storage
9.4 The manufacturer provides postwarranty service

10 QUALITY CONTROL CERTIFICATE

The «ST110» manufacture №_____ is produced according to the specifications, accepted and approved as ready for operation.

Q.C. chief

_____ _____
signature full name

_____
Year, month, day