Limited Liability Company

"Electronic Technologies and Metrological Systems"

Electrodynamic Shaker Validation using ZETLAB Hardware and Software

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1 Introduction

This document is based on GOST 250151.3-83 “Equipment for electrodynamic vibration tests. Validation methods”, meets the requirements of GOST 25051.4-83 “Equipment for electrodynamic vibration tests” and is a standard of ETMS, LLC.

The document contains rules for using the "Shaker Validation" program in the certification of electrodynamic shakers.

The Shaker Validation program is a part of ZETLAB software.

2 Hardware and software composition

You will need the following for operation:

- PC (laptop)
- ZET 038 FFT spectrum analyzer
- primary transducers: one three-unit and three single-unit accelerometers (or six single-unit accelerometers three of which to be installed on orthogonal edges of AM51 magnet cube)
- ZETLAB software with the Shaker Validation program

3 Preparing for work

Connect ZET 038 FFT spectrum analyzer to the computer via an Ethernet interface.

For detailed information on ZET 038 FFT spectrum analyzer operation, refer to "Multi-Channel Data Collection Controllers. ЭТМС.411168.008 РЭ. Operation manual". The document is available on www.zetlab.com, at the following link (QR-code)

In the ZET 038 FFT spectrum analyzer settings, set (if necessary) sampling rate: ADC: 50 kHz, DAC: 100 kHz.

Install the primary transducers (accelerometers) on the vibration unit table at measurement points.

Place the primary transducer whose signal is to be used as a reference control channel as close to the center of the vibration unit being certified as possible, while the primary transducers involved in measuring the irregularity of distribution shall be distributed evenly along the table perimeter.

When installing the primary transducers (accelerometers), ensure electric insulation of their bodies from the vibration unit table surface using, for instance, Kapton tape.

Connect the primary transducers (accelerometers) to the ZET 038 FFT spectrum analyzer input.

Configure the control channel parameters of the ZET 038 FFT spectrum analyzer according to the specifications of the primary transducers (accelerometers) connected to the respective inputs.

The control channel parameters are configured in the "Properties" windows of the Device Manager program.

Configure the "P" parameters (control channel orientation) for all the control channels used for the certification in accordance with the orientation of the primary transducers installed.

Fig. 3.1 "P" parameter, control channel orientation

The symbol "↑" is for the control channels of the primary transducers installed along the vibration direction; symbols "→" and "↗" are for the control channels of the orthogonally installed primary transducers.

4 Shaker Validation Operation Rules

4.1 Opening and closing program window

To open the program window (*Fig. 4.1*), activate the Shaker Validation program on the ZETLAB control panel, in Metrology menu.

To close the Validation Characteristics program window, activate the "" symbol in the right upper corner of the window.

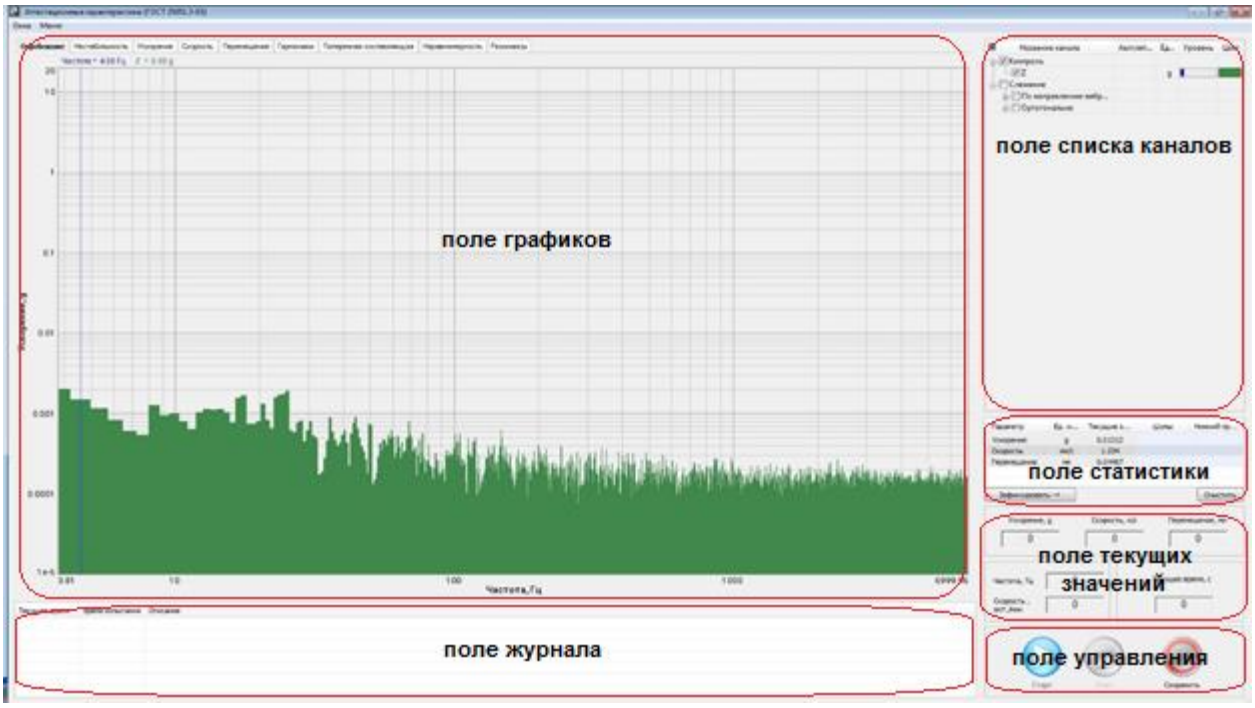

Fig. 4.1 Validation Characteristics window

4.2 Program parameter configuration

The parameters required to use the program are configured in the Settings window (*Fig. 4.2*).

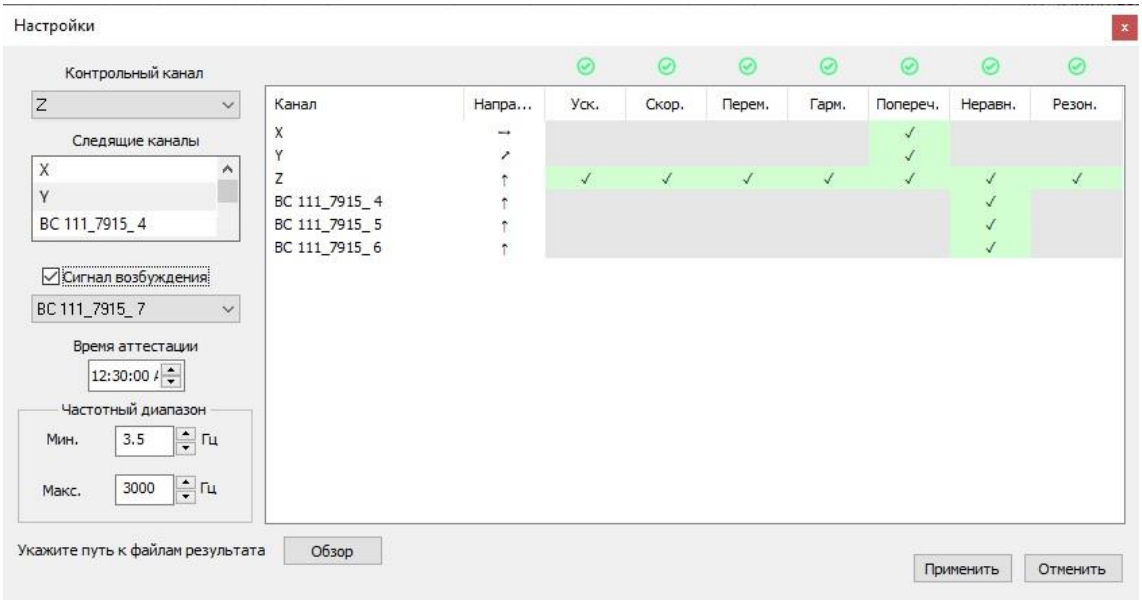

Fig. 4.2 Settings window

To switch to the Setting window, select Setting in the Menu section (of the Validation Characteristics program).

The Control Channel parameter defines which of the available control channels will be used as a reference.

The Tracking Channels window contains a list of available control channels (except for the one selected as a reference).

Activation of the Tracking Channels window will open the Channel Selection window, where you can remove (if necessary) any channels from the program.

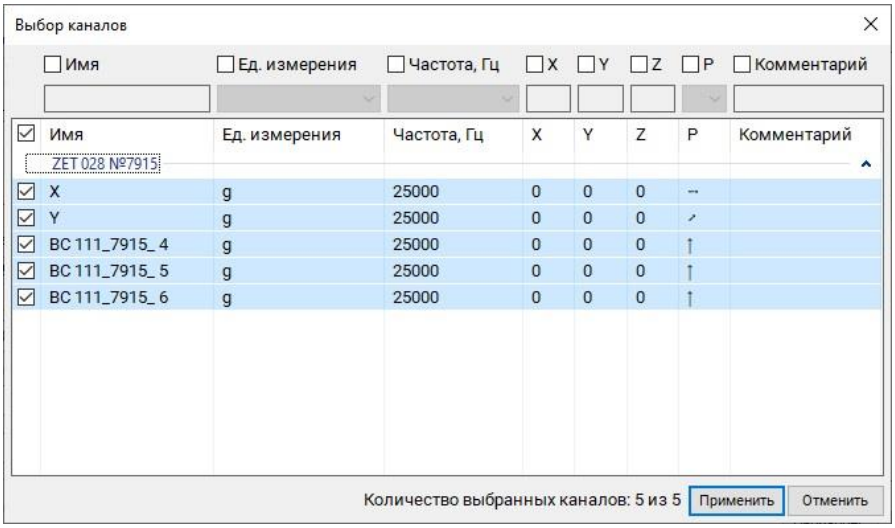

Fig. 4.3 Channel Selection window

By activating the Excitation signal parameter, you can select a control channel used as a reference in resonance analysis (see Section 6.10).

The Excitation signal parameter is used by the program only for calculations for the Resonances tab.

The Validation time parameter defines the duration of measuring when determining acceleration and frequency instability (see Section 6.5).

The Validation time parameter is mainly used for determining the time interval for signal generation stability testing, however, in measuring other values, make sure that this duration is not less than the duration required for a single pass along the certification range for the sine signal oscillation with a given frequency sweep rate.

The Frequency range parameter defines the frequency range in which the program will record signals and perform measurements.

The Frequency range parameter shall be configured in accordance with the frequency range of the vibration unit being certified.

The right pane of the Settings window contains an area for controlling the selected channels to ensure their correctness and sufficiency for measuring.

The measuring channel selected as a control (the Z channel is taken as an example) is used for all types of measurements.

The measuring channels orthogonal to the reference channel (the X and Y channels in the example) are used for measuring the Transverse Component.

The channels having the same direction with the control channel (e.g., VS 111_7915_4, VS 111_7915_5, and VS 111_7915_6 in the example) are used for measuring the "Unevenness of distribution".

The channel selected as the excitation signal (e.g., VS 111_7915_7) shall be measured in V/mV and used for resonance frequencies detection.

If the software detects any missing or excessive channels for the required calculations, then the red symbol "x" will be displayed for the type of measurement with the inconsistent number of channels.

4.3 Program window

The validation characteristics program window (Figure *Fig. 4.1*) has several tabs to determine different types of measurements for certification. The relationship between the tabs and certification checkpoints is shown inTable 5.1.

The results are displayed in the following areas of the Validation characteristics program window:

- chart area
- event log area
- channel list area
- statistics area
- current values area
- current values area.

The chart area shows the recorded (at the end of the certification stage) graphical information (depending on the tab selected). To save the graphical information, click the Save button in the control area.

The graphical information will be saved only for the currently selected tab.

The log area displays information on the program operation stage.

In the channel list area, the available control channels are divided into three statuses:

- control (corresponds to a control channel selected in the program configuration as the reference one)
- along vibration direction (corresponds to the channels from the primary transducers oriented along the control channel)

- orthogonal to vibration direction (corresponds to the control channels from the primary transducers orthogonal to the control).

By activating (in the channel list area) a control channel ID (☑), you can visualize the graphical information relevant to that channel in the chart area.

Activation of control channel graphical information is not available on "Testing", "Harmonics", "Unevenness", "Instability", and "Resonances" tabs.

The statistics area (depending on the tab selected) displays numeric values of certification results for the relevant tab.

In the current values area, you can control the certification stage processes. The following numeric values are displayed in the area: accelerations, velocities, displacement, frequencies, oscillation rates, and current duration.

The control area contains buttons: Start, Stop, and Save.

The Start button enables the measuring mode (for each certification stage individually). The Start button disables after clicking on it and enables only on completion (termination) of a certification stage, or after clicking the Stop button.

The certification stage is started by clicking the Start button and after detecting the actuating signal on the control channel. The certification stage is completed after detecting the excitation signal loss in the control channel, or by clicking the Stop button

With the Stop button, you can disable the measuring mode at any time.

The Save button is for saving (in .dtu) the recorded graphical information for the active (selected) tab and the relevant information from the statistics area (in .xls).

4.4 Chart number line scaling

Use the mouse for the number line scaling.

To scale the number line, place the pointer to the chart number line; the pointer (depending on the number line position) will change its appearance:

- for horizontal axes: ↔ , ⇹ , ← , → ;
- for vertical axes: ↕ , ⇳ , ↑ , ↓ , ⤢ .

Symbols ↔ and ↕ mean elongation, and symbols ⇹ and ⇳ mean squeezing of the relevant chart number line. Symbols ← and → mean "move to the left or right, for the horizontal axis", while symbols ↑ and ↓ mean "up and down, for the vertical axis".

After selecting the mouse pointer relevant to the required scaling action, perform the scaling by either left-clicking or by scrolling the mouse wheel.

For automatic scaling of the vertical axis within the registered value range (displayed within the chart horizontal axis), place the mouse pointer on the number line crossing point; the pointer will look like .

5 Validation operations

The certification of vibration unit according to GOST 25051.3-83 and the tabs of the Shaker Certification program to be used are shown in Table 5.1.

Table 5.1 Vibration unit certification according to GOST 25051.3-83

Standard item No. GOST 25051.3-83	Name of operation	Shaker certification program tab	Item No. of the document
4.2	Visual examination	—	6.2
4.3	Safety check	—	6.3
4.4	Testing	"Testing"	6.4
4.5	Vibration acceleration and frequency instability determination	"Instability"	6.5
4.6	Acceleration, vibration displacement (hereinbelow as displacement), and frequency range determination	"Testing" "Acceleration" "Velocity"[1] "Displacement"	6.6
4.7	Acceleration and (or) displacement harmonic factor determination	"Harmonics"	6.7
4.8	Transverse component factor determination	"Transverse Component"	6.8
4.9	Irregularity of distribution determination	"Distribution"	6.9
4.10	Determination of the suspension member resonance frequency and the first resonance frequency of the movable system	"Resonances"	6.10
4.11	Determination of the stray magnetic field inductance over the shaker table	—	6.11
4.12	Determination of the vibration noise on the shaker table	"Testing"	6.12
4.13	Determination of the shaker table temperature fluctuation	—	6.13
4.14	Determination of error limits for acceleration and (or) displacement maintaining at the reference point	"Acceleration" "Velocity"[1]; "Displacement"	6.14
4.15	Determination of error limits for acceleration and displacement repetition error at the reference point	—	6.15
4.16	Check of the unit operation under a load applied along the line perpendicular to the shaker's running axis	"Harmonics"	6.16
4.17	Check of the unit operation under loading with a permissible moment of the load eccentricity.	"Harmonics"	6.17
4.18	Determination of the frequency repetition error limit	"Instability"	6.18

[1] In case of certification by profiles with limited vibration velocity

6 Vibration generator system validation

6.1 General

During the operations, various load masses and various signal sources are used on the shaker table (*Table 6.1*).

Table 6.1

Document Item No.	Load Mass on Shaker Table	Signal Source for Measurements
5.4	0	control accelerometer channel
5.5	m_{nom}	control accelerometer channel
5.6	0; $0.25m_{nom}$	control accelerometer channel
5.7	0	control accelerometer channel
5.8	0; m_{nom}	control accelerometer channel two channels of accelerometers orthogonal to the reference
5.9	0	control accelerometer channel three channels of accelerometers parallel to the control
5.10	0; $0.25m_{nom}$	control accelerometer channel vibration unit's standard control system excitation channel
5.12	0	control accelerometer channel
5.14	0; m_{nom}	control accelerometer channel
5.15	0	control accelerometer channel
5.16	$0.25m_{nom}$; m_{nom}	control accelerometer channel
5.17	$0.25m_{nom}$; m_{nom}	control accelerometer channel
5.18	0	control accelerometer channel

6.2 Visual examination

1. During the visual examination of the vibration generator system, check it for mechanical damage.

2. The vibration generator system to be certified shall be supplied with operational documentation.

3. The vibration generator system completeness, location, and installation shall comply with the operation documentation.

6.3 Safety check

The vibration generator system shall comply with GOST 12.2.007.0-75 "Occupation safety standards system. Electrical equipment. General safety requirements" and PUE, "Electrical Installation Regulations".

6.4 Testing

1. The vibration generator system test includes checking for network interference (50 Hz) and the generation by the vibration generator system of a test excitation signal at a given frequency. On the testing stage, the correct display and activation of alarm and indication on the vibration generator system is checked.

2. Testing shall be performed with no load on the shaker table and with a primary transducer (accelerometer) installed in the center of the table, with the control channel used as a reference.

3. To check for the network interference (50 Hz), switch to the “Testing” tab.

4. Make sure that there is no significant level of network interference (discrete values at 50 Hz frequency and its harmonics exceed the noise level more than 10 times) at the spectrum chart (*Fig. 6.1*). In case of a significant level of network interference (*Fig. 6.2*), check grounding of the FFT spectrum analyzer and equipment being certified, and take the relevant measures to decrease the network interference.

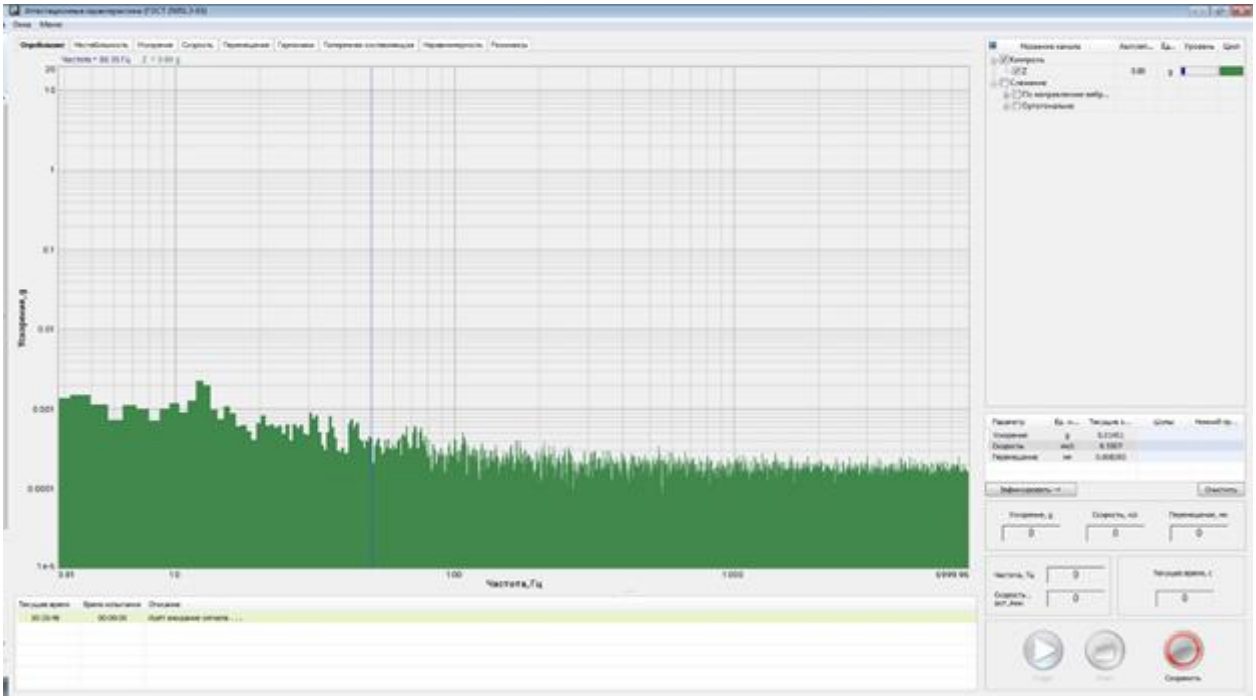

Fig. 6.1 Testing tab. Spectrum at no network interference

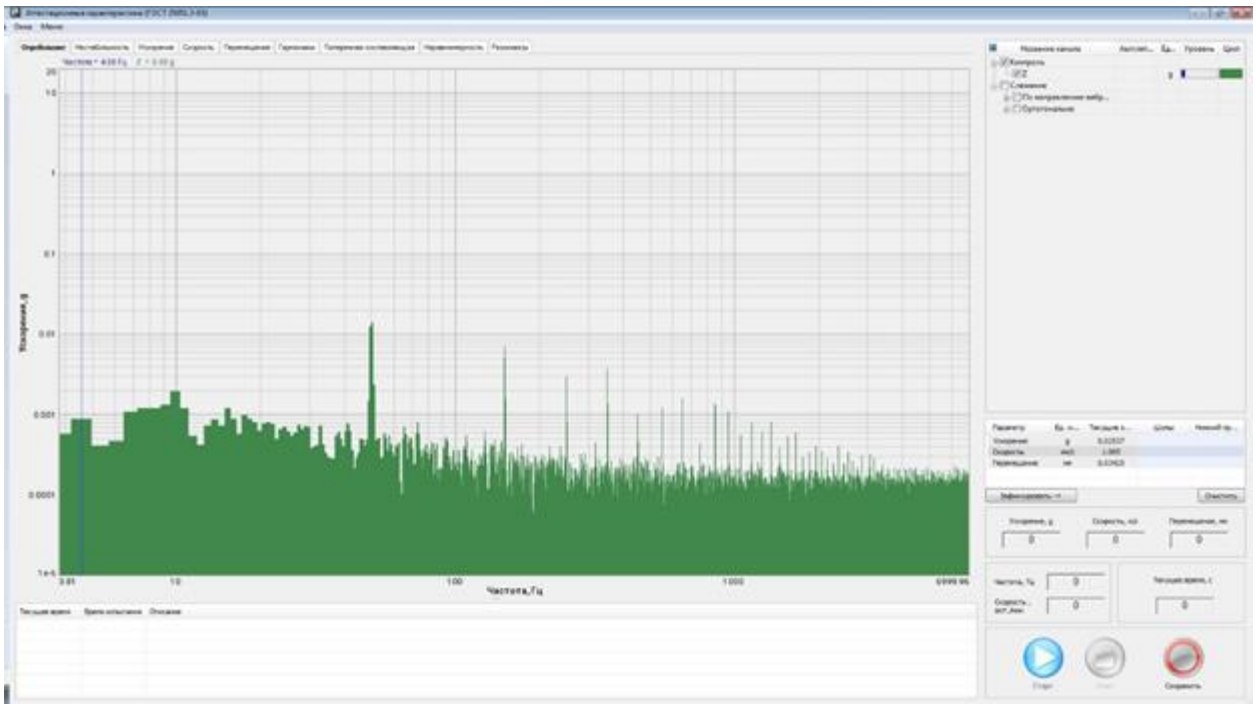

Fig. 6.2 Testing tab. Spectrum with network interference

5. To check the passage of the test actuating signal using the standard control system of the vibration generator system being certified, set a sinusoidal test signal at 400 Hz and 1 g amplitude.

6. Make sure that the discrete component appeared on the spectrum chart (*Fig. 6.3*) at the given test signal frequency and amplitude.

Acceleration values on the spectrum chart on the Testing tab are given as RMSV (Fig. 4.2).

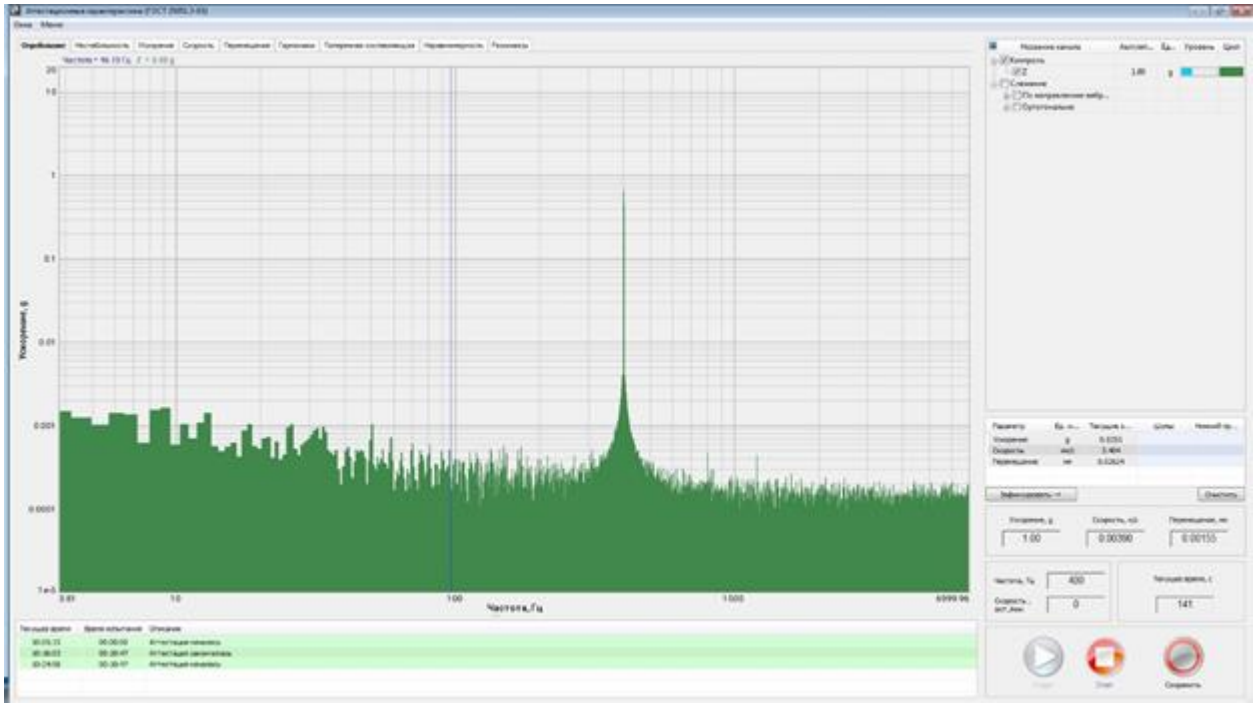

Fig. 6.3 Testing tab. Spectrum chart with test signal present

6.5 Acceleration and frequency instability determination

1. Acceleration and frequency instability shall be determined at the rated mass load on the shaker table and with the control accelerometer installed in the center.

2. To determine acceleration and frequency instability, turn on the measuring mode by clicking the Start button.

3. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal at 400 Hz and amplitude 0.7 of the upper rated (certified) acceleration limit.

4. At the end of measuring, the results obtained will be displayed (in numerical and graphical form) on the Instability tab (*Fig. 6.4*).

To ensure correct calculation of the maximum deviation, input manually the start and end values of the calculation interval to exclude the testing start and end mode ranges (ranges of the control signal increase and decrease).

Measuring duration is determined by the Validation time parameter configured in the Settings window (Fig. 4.2)

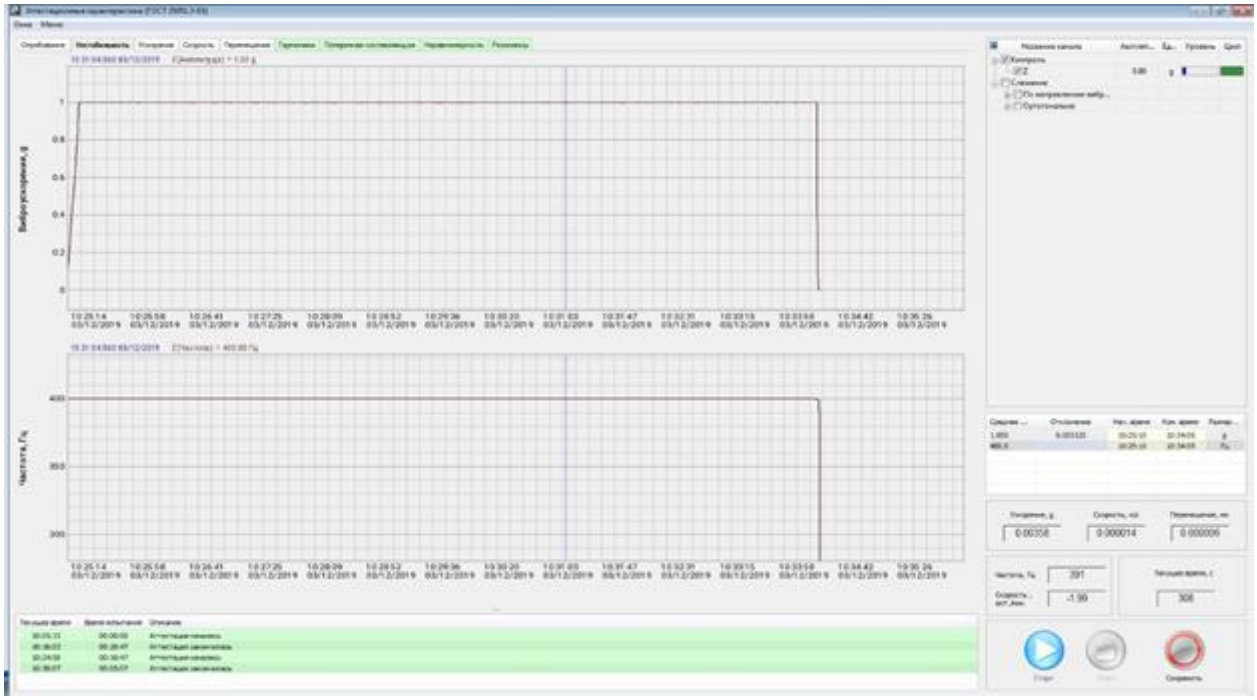

Fig. 6.4 Instability tab

6.6 Acceleration, displacement, and frequency range determination

1. Acceleration and frequency ranges shall be determined both in the absence of any load on the shaker table and with a load mass equal to ¼ of the shaker table load, and with a control accelerometer installed in the center.

2. Lower limits, reproducible acceleration, and travel levels shall be measured according to Section 5.12 of this manual.

3. To determine the upper limits of acceleration, travel, and frequency ranges, turn on the measuring mode by clicking the Start button.

4. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to the upper (certified) limits of displacement and acceleration as per GOST 25051.3-3, section 4.6.

5. At the end of the sinusoidal signal oscillation within the rated frequency range, the certification results recorded will be displayed on Acceleration (Fig. 6.5), Velocity (*Fig. 6.6*), and Displacement (*Fig. 6.7*) tabs (in numerical and graphical forms).

Cyan highlight shows the region for which the program calculates the "Deviation" parameter (see Statistics area). If required, the calculation region may be adjusted manually by setting the initial and final frequencies in the Statistics area.

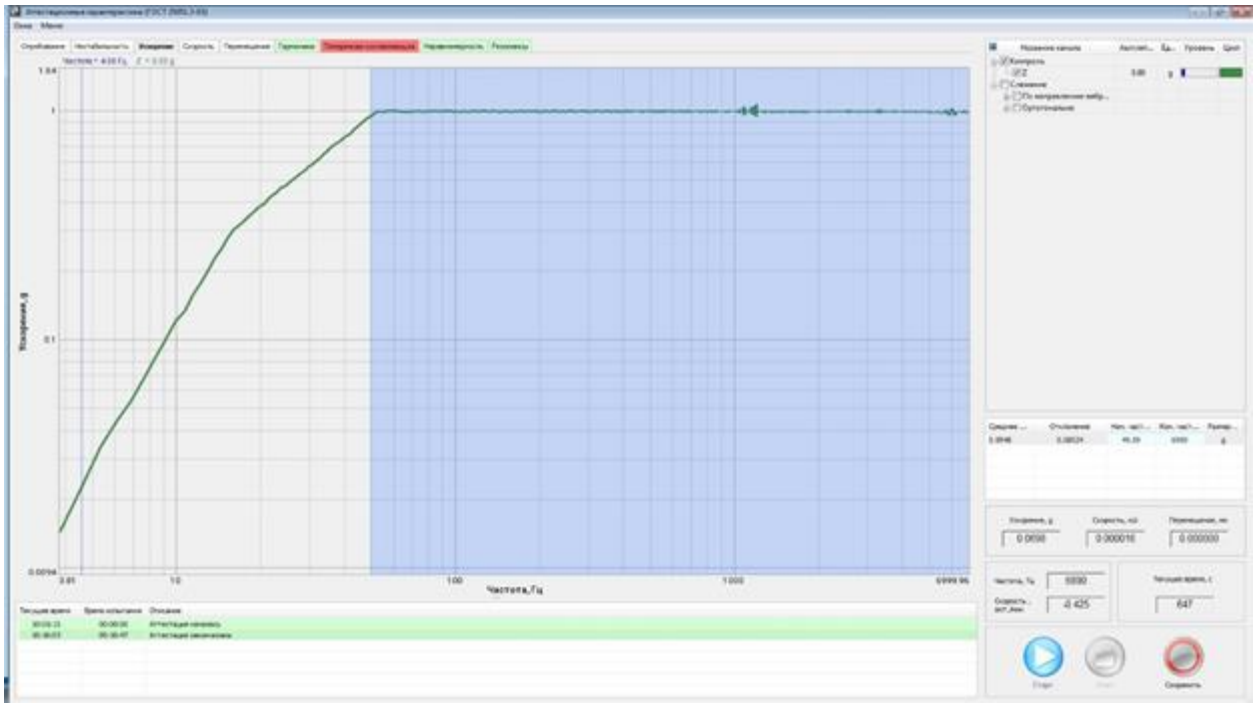

Fig. 6.5 Acceleration tab

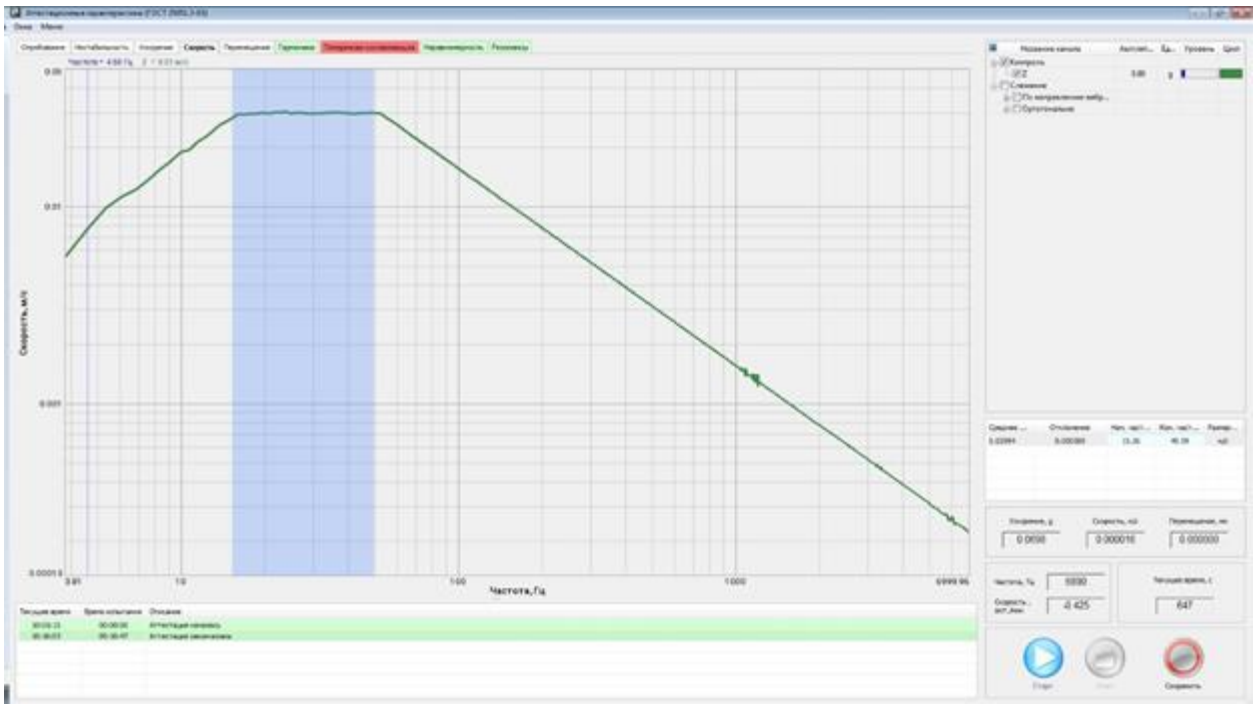

Fig. 6.6 Velocity tab

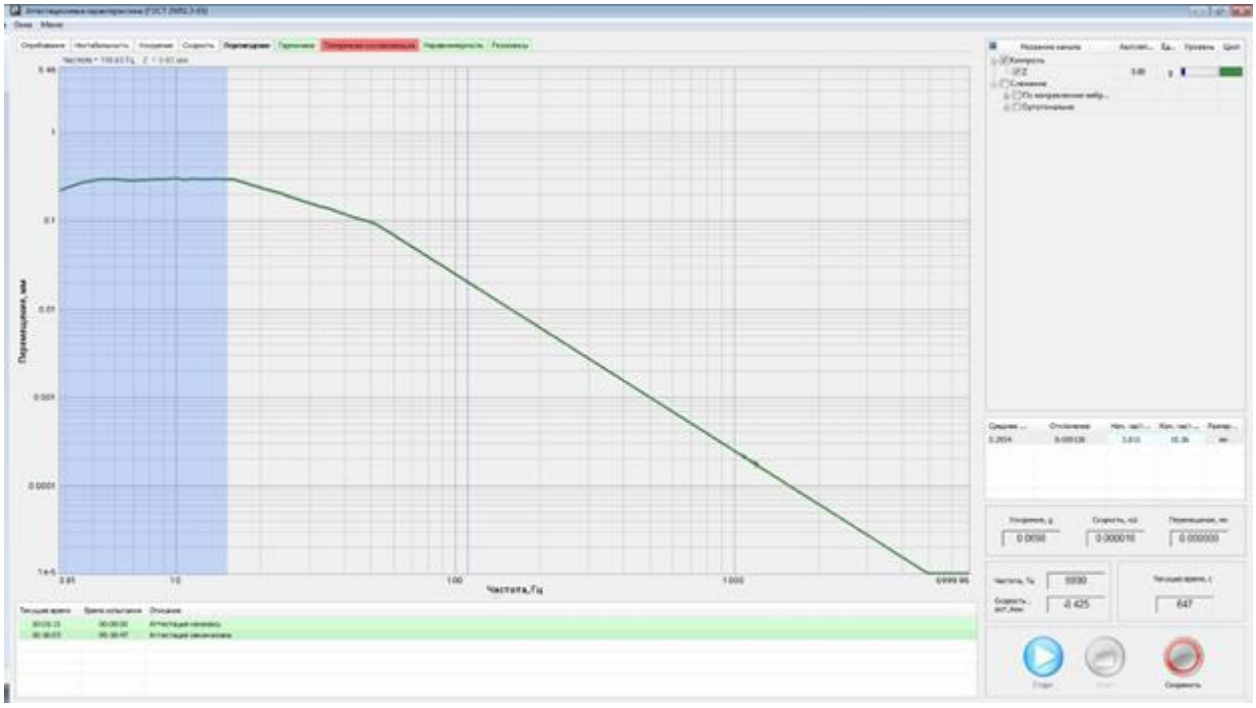

Fig. 6.7 Displacement tab

6.7 Acceleration and/or displacement harmonic factor determination

1. The harmonic factor may be determined jointly with Section 6.6 subject to the load absence on the shaker table and a control accelerometer installed in the center of the shaker.

2. To determine acceleration and/or displacement harmonic factor, turn on the measuring mode by clicking the Start button.

3. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to the upper (certified) limits of displacement and acceleration as per GOST 25051.3-83, section 4.7.

4. At the end of the sinusoidal signal oscillation within the rated frequency range, the results recorded will be displayed (in numerical and graphical forms) on the Harmonics tab (*Fig. 6.8*).

The red background of the tab name means that the requirements of section 1.2 of GOST 25051.4-83 are not met. In this case, the upper frequency of the range being certified shall be decreased manually to the level where the requirements of section 1.2 of GOST 25051.4-83 is met, after that, the tab name background will turn green.

The cyan area in the chart area shows the range from 0.7 to the upper value of the range being certified.

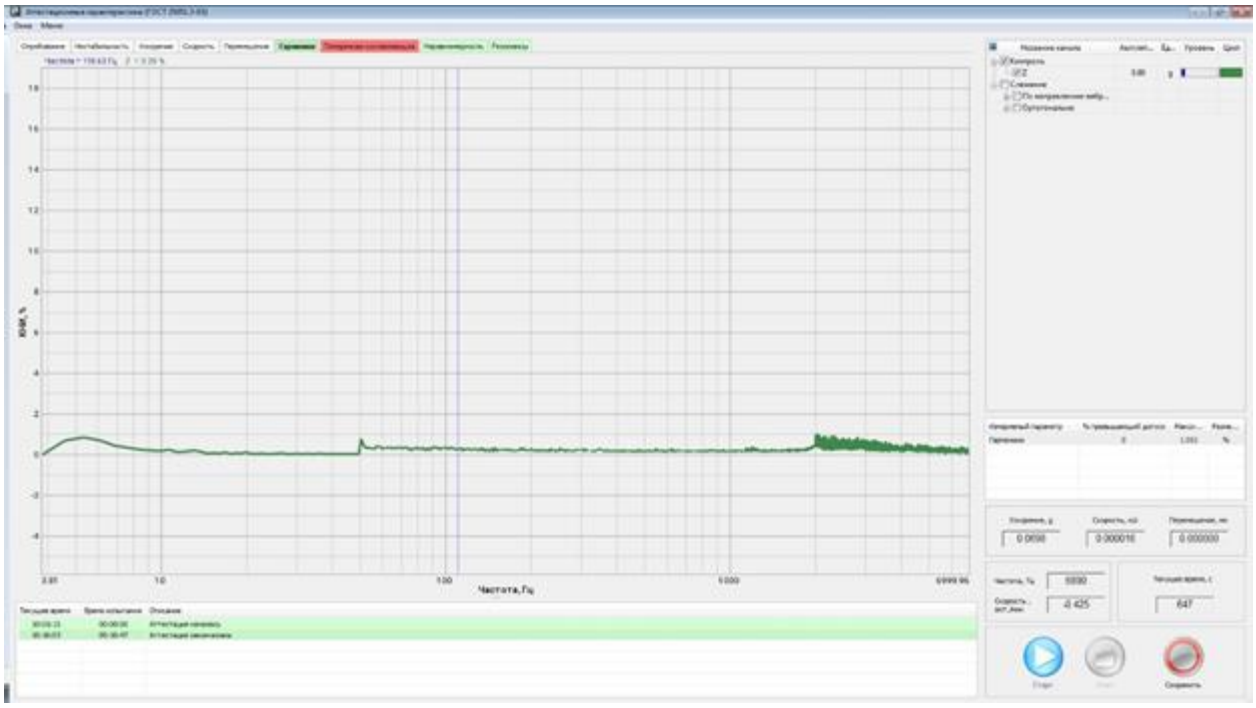

Fig. 6.8 Harmonics tab

6.8 Transverse component factor determination

1. The transverse component factor may be determined jointly with Section 6.6subject to the load absence on the shaker table and using a three-component accelerometer installed in the shaker table center. The transverse component factor with load mass on the shaker table equal to the rated load mass is determined on a case-by-case basis.

2. To determine the transverse component factor, turn on the measuring mode by clicking the Start button.

3. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to at least 0.3 of the upper (certified) limits of displacement and acceleration as per GOST 25051.3-3, section 4.8.

4. At the end of the sinusoidal signal oscillation within the rated frequency range, the results recorded will be displayed (in numerical and graphical forms) on the Transverse Component tab (*Fig. 6.9*).

The red background of the tab name means that the requirements of section 1.2 of GOST 25051.4-83 are not met. In this case, the upper frequency of the range being certified shall be decreased manually to the level where the requirements of section 1.2 of GOST 25051.4-83 is met, after that, the tab name background will turn green.

The cyan area in the chart area shows the range from 0.7 to the upper value of the range being certified.

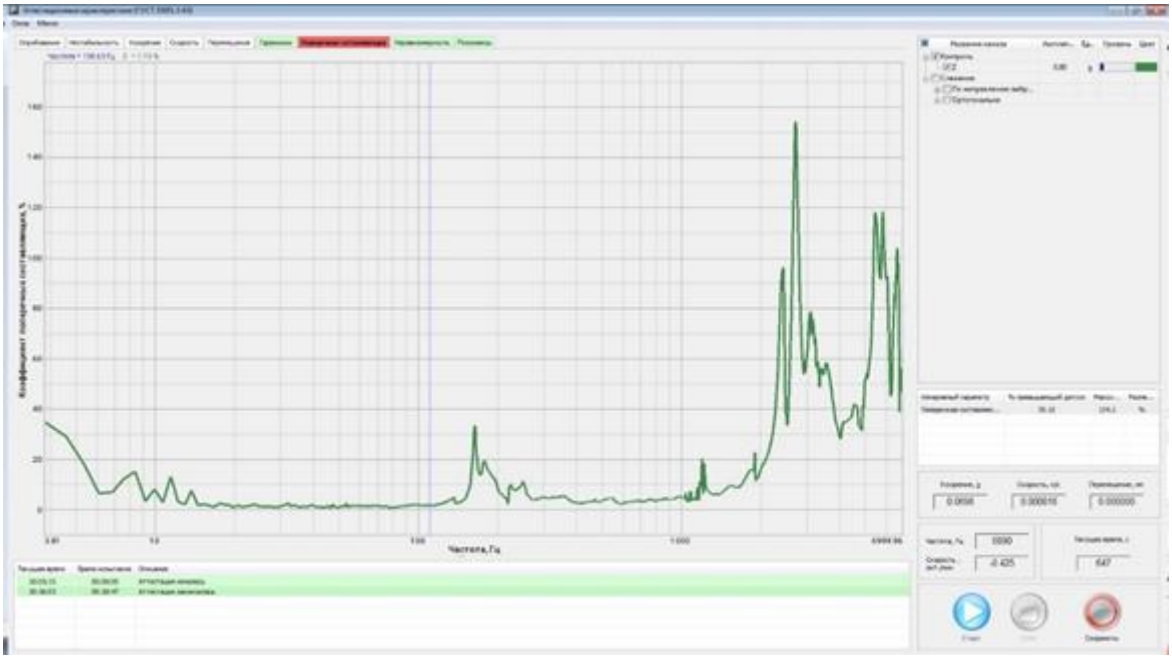

Fig. 6.9 Transverse Component tab

6.9 Irregularity of distribution determination

1. Irregularity of distribution may be determined jointly with Section 6.6 using a control accelerometer installed in the shaker table center, as well as at least three accelerometers installed evenly along the table perimeter and in the absence of a load on the shaker table.

2. To determine the irregularity of distribution, turn on the measuring mode by clicking the Start button.

3. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to at least 0.3 of the upper (certified) limits of displacement and acceleration as per GOST 25051.3-83, section 4.9.

4. At the end of the sinusoidal signal oscillation within the rated frequency range, the results recorded will be displayed (in numerical and graphical forms) on the Distribution Over Table tab (*Fig. 6.10*).

The red background of the tab name means that the requirements of section 1.2 of GOST 25051.4-83 are not met. In this case, the upper frequency of the range being certified shall be decreased manually to the level where the requirements of section 1.2 of GOST 25051.4-83 is met, after that, the tab name background will turn green.

The cyan area in the chart area shows the range from 0.7 to the upper value of the range being certified.

Fig. 6.10 Unevenness of Distribution tab

6.10 Determination of the suspension member resonance frequency and the first resonance frequency of the movable system

1. The suspension member resonance frequency and the first resonance frequency of the movable system shall be determined using a control accelerometer installed in the shaker table center, at the mass of the load equal to zero and 0.25 of the rated load mass.

2. Connect an actuating signal (generator output) of the vibration generator system's standard control system to a free input (control channel) of the ZET 038 FFT spectrum analyzer (using a BNC triple adapter and a BNC-BNC cable).

3. In the program settings (*Fig. 4.2*), enable the Excitation Signal parameter and select the ZET 038 FFT spectrum analyzer's control channel which the actuating signal output of the standard control system is connected to (in the example, the channel is named "Reference").

4. To determine the resonance frequency and the first resonance frequency of the movable system, turn on the measuring mode by clicking the Start button.

5. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to at least 0.3 of the upper (certified) limits of displacement and acceleration as per GOST 25051.3-83, section 4.9.

6. At the end of the sinusoidal signal oscillation within the rated frequency range, determine the resonance frequency of the suspension member and the first resonance frequency of the movable system on the Resonances tab (*Fig. 6.11*).

If required, adjust the resonance frequency values manually in the Statistics area.

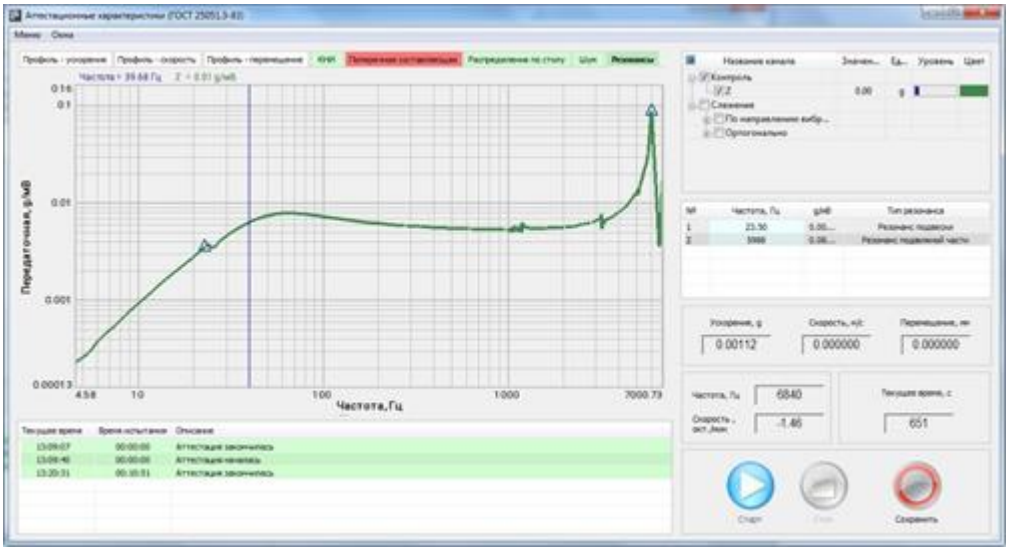

Fig. 6.11 Shaker Validation program, Resonances tab

6.11 Determination of the stray magnetic field inductance over the shaker table

1. Stray magnetic field inductance shall be determined with polarizing and de-polarizing coils power supply on and in the absence of the actuating signal using magnetic flux density measuring instrument or a milli-flux meter with certified measuring coils.

2. Magnetic flux density shall be measured at points 20 mm above the shaker table surface, along the radius: in the center, at 0.5 R and R distances from the shaker table center, where R is the table radius.

3. According to GOST 25051.4-83, standards and (or) specifications for a unit or a shaker of certain type shall indicate the maximum level of the stray magnetic field inductance over the shaker surface. In case of any requirements regarding the stray magnetic field compensation, the magnetic inductance over the shaker surface shall not exceed 0.001 T.

6.12 Determination of the vibration noise on the shaker table

1. Vibration noise may be determined in the absence of a load on the vibration unit table and with a control accelerometer installed in the shaker center. The measurement shall be performed with the vibration generator system turned on but with no excitation signal.

2. To determine the vibration noise on the shaker table, switch to the Testing tab.

3. Make sure there is no significant level of network interference (discrete at 50 Hz frequency and its harmonics exceed the noise level more than 10 times) at the spectrum chart (*Fig. 6.2*).

4. Click the Fix button; lower limits of the vibration acceleration, vibration velocity, and vibration displacement will be calculated (*Fig. 6.12*).

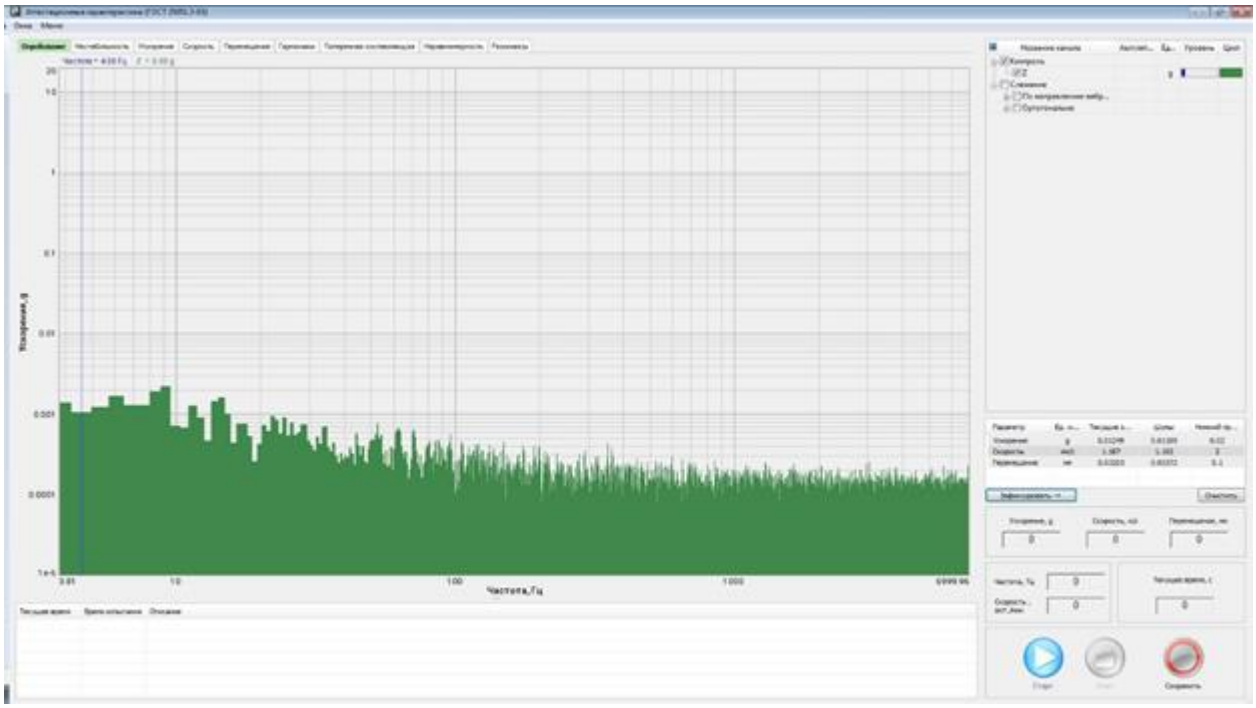

Fig. 6.12 Shaker Validation program, Noise tab

6.13 Determination of the shaker table temperature fluctuation

1. Shaker table temperature fluctuation shall be determined at the nominal mass load on the shaker and with the control accelerometer installed in the center.

2. Shaker table temperature fluctuation (ΔT) shall be calculated in centigrade degrees using the following formula:

$$\Delta T = T_K - T_H$$

where T_K and T_H are shaker table temperature at the end and at the beginning of the operation as per 6.5 obtained using surface temperature measuring instruments.

3. To measure the temperature, attach a thermometer's sensing element to the shaker table and measure as per GOST 25051.3-83, section 4.13.

6.14 Determination of error limits for acceleration and/or displacement maintaining at the control point

1. Error limits for acceleration and/or displacement maintaining shall be determined with a control accelerometer installed in the center of the table, at the load mass on the shaker table equal to zero, and at the load mass on the shaker table equal to the rated mass.

2. To determine error limits for acceleration and/or displacement maintaining, turn on the measuring mode by clicking the Start button.

3. Using the standard control system of the vibration generator system being certified, set a sinusoidal signal with frequency oscillation within the rated (certified) frequency range and amplitude equal to 0.7 of the upper (certified) limits of displacement and acceleration as per GOST 25051.3-83, section 4.14.

4. t the end of the sinusoidal signal oscillation within the rated frequency range, the certification results recorded will be displayed on Acceleration (*Fig. 6.13*, Velocity, and Displacement tabs (in numerical and graphical forms).

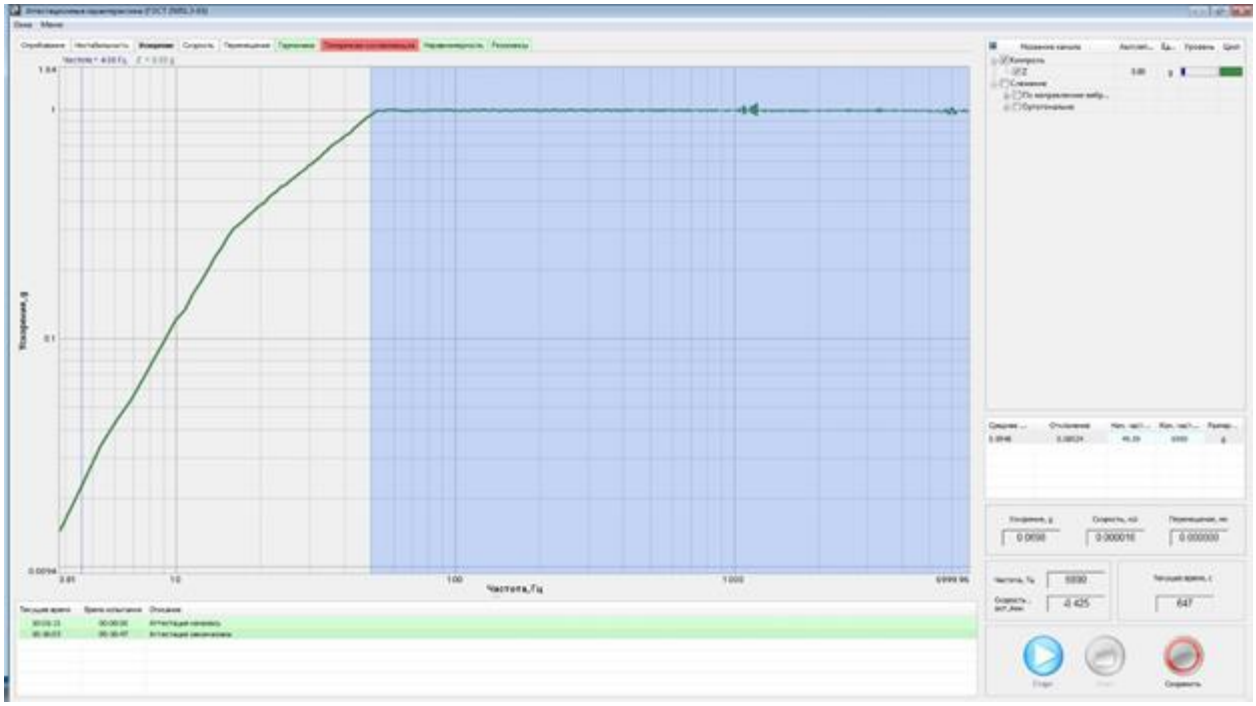

Fig. 6.13 Acceleration tab

6.15 Determination of error limits for acceleration and displacement repetition error at the control point

1. Acceleration and displacement repetition error limits at the control point are determined by calculations using the results of measurements with no load on the shaker table and with a control accelerometer installed in the table center.

2. Acceleration (displacement) repetition permissible error limits are evaluated as a percentage with confidence probability of 0.9 using the following formula:

$$\delta = \pm 0{,}95\sqrt{\delta_0^2 + \delta_{АЧХ}^2 + \delta_Г^2 + \delta_П^2 + \delta_t^2}$$

where

δ_0 – main vibration passage relative error limit;

$\delta_{АЧХ}$ – vibration passage AFR distortion limit;

$\delta_Г$ – additional measurement error limit due to higher harmonics as a percentage at the measurement of the parameter mean-square value measurement using the following formula:

$$\delta_Г = \left(\sqrt{1 + K_{ГК}^2} - 1\right) \cdot 100\%$$

$K_{ГК}$ - maximum distortion factor at the control point within the frequency range, relative units;

$\delta_П$ – additional measurement error limit due to transverse components measured using the following formula:

$$\delta_П = K_{ПК} \cdot K_{ОП}$$

$K_{ПК}$ - a maximum ratio of the transverse components at the control point within the frequency range, in %;

$K_{ОП}$ - relative transverse bearing change conversion ratio, relative units;

δ_t - additional measurement error limit for the shaker table temperature determined as a percentage using the following formula:

$$\delta_t = K_t \cdot \Delta T$$

where K_t is the bearing change temperature sensitivity ratio.

3. According to GOST 25051.4-83, the measured value of the repetitive acceleration in case of a ±10 % supply voltage variation shall not exceed 0.25 of the acceleration repetition permissible error limit.

6.16 Checking unit operation under a load applied along the line perpendicular to the shaker's running axis

1. Check the unit operation under a load applied along the line perpendicular to the shaker's running axis in accordance with the methods set forth in the regulatory and technical documentation for the unit.

2. In the absence of the relevant requirements in the regulatory and technical documentation for the unit, the ratio of the harmonic shall be checked according to Section 6.7 hereof in the mode of horizontal vibration repetition (at the horizontal position of the shaker's movable part) with an equivalent load equal to 0.25 of the rated load or with 100 kg load when the weight of the equivalent load equal to 0.25 of the rated mass exceeds 100 kg.

3. According to GOST 25051.4-83, the permissible moments of the limit load applied along the line perpendicular to the shaker's running axis and due to an eccentricity of the load applied along the shaker's running axis shall be specified in the standards and (or) technical specification for the unit and (or) shaker of specific types.

6.17 Checking unit operation under loading with a permissible moment of the load eccentricity

1. Check the unit operation bu loading it with a permissible moment of the load due to the load eccentricity in accordance with the methods set forth in the regulatory and technical documentation for the vibration generator system.

2. In case of no relevant requirements in the regulatory and technical documentation for the vibration generator system, the ratio of the harmonic shall be determined by performing the operation as per Section 6.7 hereof with a load equivalent attached to the shaker with its symmetry axis parallel to the shaker's running axis and displaced from it to a distance of e to be calculated in meters using the following formula:

$$e = \frac{M}{P}$$

where M is the maximum permissible moment due to the load eccentricity, N·m,

P, is the load equivalent weight, N.

3. According to GOST 25051.4-83, the permissible moments of the limit load applied along the line perpendicular to the shaker's running axis and due to an eccentricity of the load applied along the shaker's running axis shall be specified in the standards and (or) technical specification for the unit and (or) shaker of specific types.

6.18 Determination of the frequency repetition (setting) error limit

1. Frequency repetition (setting) error limit shall be determined in the absence of a load on the shaker table and with a control accelerometer installed in the center of the table.

2. Frequency repetition error shall be measured by performing the operations as per Section 6.5. When performing measurements, use the vibration generator system's standard control system to set the sinusoidal signal as per GOST 25051.3-83, section 4.18.