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**ROAD ACCIDENT EMERGENCY RESPONSE
SYSTEM**

**Test methods for navigation modules of in-vehicle emergency
call systems**

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Foreword

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The rules of this standard application are established in GOST R 1.0-2012 (section 8). Information on the amendments to this standard is published in the annual (as of January, 1st, of the current year) information index «National standards» and the official text of the amendments and corrections is published in the monthly information index «National standards». In case of revision (replacement) or cancellation of this standard an appropriate notice will be published in the nearest release of the monthly issued information index «National standards». The appropriate information, notice and texts shall also be placed in the general-use information system — on official site of Federal Agency of Technical regulating and metrology in Internet (gost.ru)

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NATIONAL STANDARD OF THE RUSSIAN FEDERATION**Global Navigation Satellite System****ROAD ACCIDENT EMERGENCY RESPONSE SYSTEM****Test methods for navigation modules of in-vehicle emergency call systems**

Date of Introduction — 2014—01—01**1 Scope**

This Standard applies to in-vehicle emergency call systems/devices equipped with built-in navigation modules for Global Navigation Satellite Systems (GNSS).

This Standard defines the test methods that shall be used to check the conformity of navigation modules to the requirements of GOST R 54620 in part of navigation performance and properties.

The test methods specified in the Standard may be used for mandatory conformity assurance of an in-vehicle emergency system/device in regard to the requirements of Technical Regulations [1] and [2], or for acceptance tests of various kinds.

This Standard may also be used for conformity assessment of navigation performance and properties of satellite navigation equipment as to the requirements specified in [1], [2] and [3].

2 Normative references

The following standards are referred to in this Standard:

GOST R 8.568-97 State system for ensuring the uniformity of measurements. Verification of testing equipment. General principles

GOST R 12.1.019-2009 Occupational safety standards system. Electrical safety. General requirements and nomenclature of kinds of protection

GOST R 51794-2008 Global navigation satellite system and global positioning system. Coordinate systems. Methods of transformations for determined points coordinate

GOST R 52230-2004 Electrical equipment for vehicles and tractors. General specifications

GOST R 52928-2010 Global navigation satellite system. Terms and definitions

GOST R 54620-2011 Global navigation satellite system. Road accident emergency response system. In-vehicle emergency call system. General technical requirements

GOST 12.1.030-81 Occupational safety standards system. Electric safety. Protective conductive earth, neutralling

GOST 12.3.019-80 Occupational safety standards system. Electrical tests and measurements. General safety requirements

GOST 18321-73 Statistical quality control. Item random sampling methods

Note — When using this standard it is expedient to check the validation of the reference standards in the general-use information system — on official site of Federal Agency on Technical regulating and Metrology in Internet or according to the annual information index «National standards» which is published as of January, 1st, of current year, and according to releases of monthly issued information index «National standards» in the current year. If a reference standard which the dated reference is provided to is replaced, it is recommended to use a version of this standard with the above specified year of approval (acceptance). If after the approval of this standard an amendment is inserted in a reference standard which the dated reference is provided to, and this amendment regards the provision referred to, it is recommended to apply this provision without regard to this amendment. If a reference standard is cancelled without a replacement, it is recommended to apply the provision which refers to it to a part which does not engage this reference.

3 Terms, definitions, designations and abbreviations

3.1 The terms defined in GOST R 52928, as well as the following terms with their respective definitions are used for the purposes of this Standard:

3.1.1 **in-vehicle emergency call system/device; (IVS):** System (device) installed on a wheeled vehicle of a relevant Category and used to evaluate vehicle location, velocity and movement direction data based on the signals generated by the GLONASS Global Navigation Satellite System (GNSS) either alone or in cooperation with other active GNSS, to transmit messages containing vehicle data in automatic (system) or manual (device) mode when a road accident or an accident of other type occurs, and to ensure duplex voice communication with emergency services over wireless mobile communication networks.

Notes:

1 In-vehicle emergency call systems are intended for Category M1 or N1 vehicles of permitted design weight less than 2.5 t.

2 In-vehicle emergency call devices are intended for Category M1 or N1 vehicles of permitted design weight above 2.5 t, as well as for Category M2, M3, N2 and N3 vehicles.

3 In case of road accidents or accidents of other type, in-vehicle emergency call systems are capable of transmitting vehicle data messages in manual mode as well.

4 In case of road accidents or accidents of other type, an in-vehicle emergency call device may also be capable of transmitting vehicle data messages in automatic mode. The types of accidents to be detected automatically and the timing parameters of the automatic message transmission function implemented in the device are established in [1], [2].

3.1.2 **satellite navigation equipment:** Hardware and software facility installed on a vehicle in order to determine current location, movement direction and velocity of that vehicle based the signals generated by the GLONASS Global Navigation Satellite System jointly with other active GNSS, to exchange data with additional on-board equipment, and to communicate information over wireless mobile communication networks.

3.1.3 **GNSS navigation module (navigation receiver):** Component part of an in-vehicle emergency call system intended for evaluation of current vehicle coordinates and movement parameters (direction and velocity) and of time values based on the signals from GLONASS, GPS and other GNSS systems.

Note — Navigation modules included in the IVS may be either built-in into the IVS, or external with respect to it (embedded in an electronic unit of other in-vehicle system or device installed on the vehicle).

3.1.4

accident emergency response system (ERA-GLONASS System): Automated Federal and State Navigation Information System which operates using the signals from the Global Navigation Satellite System of the Russian Federation (GLONASS) of standard precision and provides for dispatching of messages about road traffic accidents or other emergencies on the roads of the Russian Federation to emergency services.

Note — The ERA-GLONASS System is analogous to the European eCall system currently in development, and is harmonised with it in regard to its main functional features (the use of in-band modem as the main data transmission tool, unified content and format of mandatory data transmitted in the MSD for road accidents, uniform procedures for initiation and termination of duplex voice communication with the persons in the vehicle cabin, etc.).

[GOST R 54620-2011, clause 3.1.12]

3.1.5 cold start mode: State of GNSS navigation module where the system time, location coordinates, GNSS almanac, and ephemerides of navigation spacecrafts are not known.

Note — The above pertains to location coordinates of the phase centre of a GNSS antenna connected to the navigation module.

3.1.6 test mode: IVS operation mode intended for inspection of IVS functional properties and parameters when the system/device is in service on the vehicle, or when the tests of various kinds are being performed for the IVS.

3.2 The following designations and abbreviations are used in this Standard:

C/A	— Pseudo-random code used in GPS GNSS navigation signals accessible for a wide range of civil consumers;
CS	— Coordinate System;
DTM	— NMEA-0183 Protocol sentence containing data on the coordinate system in use;
GGA	— NMEA-0183 Protocol sentence containing time, location and usability data in the navigation fix;
GLONASS	— Global Navigation Satellite System of the Russian Federation;
GPS	— Global Navigation Satellite System used in the United States of America;
GSA	— NMEA-0183 Protocol sentence containing satellites data in the navigation fix;
GSM	— Global System for Mobile communications (global digital standard for cellular mobile communications);
GSV	— NMEA-0183 Protocol sentence containing data on the satellites in view;
NCE	— Navigation Consumer Equipment;
NS	— Navigation Signals;
NSC	— Navigation Spacecraft;
OD	— Operating Documents;
OM	— Operation Manual;
PC	— Personal Computer;
PDOP	— Position Dilution of Precision (geometric precision of the GNSS consumer's special location);
PIRTR	— NMEA-0183 Protocol query for change of location and time output parameters;
PZ-90	— State Geocentric Coordinate System "Earth parameters as of the year 1990";
RAM	— Random Access Memory;
RMC	— NMEA-0183 Protocol sentence containing the recommended minimum set of navigation data;
RMS	— Root-Mean-Square deviation;
RS	— Recommended Standard;
SIM	— Subscriber Identity Module (SIM-card);
SP	— Standard-Precision navigation signals in GLONASS that are accessible for a wide range of civil consumers;
SPSW	— Special-Purpose Software;
SS	— Simulation Script;
USB	— Universal Serial Bus;
VH	— Vehicle;
VNA	— Vector Network Analyser;

VTG — NMEA-0183 Protocol sentence containing the ground track and speed data;
 WGS-84 — World Geodetic (coordinate) System.

4 General

4.1 The item under test shall be an IVS with a navigation module (a GNSS navigation receiver) and a GNSS antenna which govern the navigation performance and properties of the system under test.

4.1.1 The total number of IVS test samples shall be at least three.

4.1.2 Each IVS shall be submitted to tests in part of the delivery set defined in GOST R 54620 (section 5) and accompanied with the OM and the relevant software (on electronic media).

4.1.3 The documents accompanying each IVS shall include:

- device serial number;
- hardware version of platform;
- software version;
- device vendor identifier.

Note — The original copy of the OM containing the above data shall be presented for tests.

4.1.4 The navigation module (GNSS navigation receiver) shall use the NMEA-0183 Protocol format (RMC, GGA, VTG, GSA, DTM and GSV sentences) [5] to output its measured navigation data to external devices. The IVS setup procedure for outputting the said data to external devices shall be described in the OM.

4.1.5 The samples submitted to tests shall be selected by an authorised representative of the testing laboratory (certification body) from a batch of finished products that has been accepted by the QC of the manufacturer. Sampling results shall be recorded in the Act of the form corresponding to Appendix A.

4.2 Purpose of tests

The tests are intended to assess the conformity of IVS navigation performance and properties governed by the navigation module included in it to the requirements of GOST R 54620 (subsection 8.1).

4.3 Test conditions

4.3.1 Each IVS shall be tested in test mode.

4.3.2 The tests shall be carried out in normal climatic conditions characterised by the following values of climatic factors as per GOST R 52230 (subsection 4.2):

- air temperature: (25 ± 10) °C;
- relative humidity: from 45 to 80 %;
- atmospheric pressure: from 84.0 to 106.7 kPa (from 630 to 800 Hg mm).

Note — During the tests, the sample may be exposed to temperatures within the range of operating temperatures indicated in the OD.

4.3.3 The IVS under test shall be powered from an on-board vehicle network simulator. The IVS "on/off" test procedure described in the respective clauses of section 5 for test methods corresponds to the vehicle ignition "on/off" procedure, and shall involve using the toggle or other type of switch powering up (powering down) the on-board network simulator.

4.3.4 No maintenance operations shall be carried out for samples during the tests.

4.3.5 The test conditions are stated in the respective clauses of section 5 dealing with the test methods.

4.3.6 The testing equipment, auxiliary equipment and measuring instruments used for IVS tests pertaining to GNCC navigation modules are listed in Table B.1 (Appendix B). Other analogous tools may be used instead of those specified in Table B.1 provided that they are capable of ensuring the required accuracy when the properties of the satellite navigation equipment are measured.

4.4 The occupational safety requirements for the tests are as follows:

- test activities of all types shall be conducted in accordance with [4];

- measuring instruments and testing equipment used in tests may be turned on only after their external grounding is connected;

- connection and disconnection of cables, devices and measuring instruments is only permitted when the power for all devices included in the testing apparatus is turned off, and the item under test is disconnected from all power circuits.

The requirements of GOST R 12.1.019, GOST 12.1.030 and GOST R 12.3.019 as well as the safety requirements of the OD for the IVS, measuring and testing equipment shall be observed during the tests.

4.5 Scope of tests (checks)

The scope and recommended order of tests (checks) are specified in Table 1.

Each sample submitted to tests is subject to all test types listed in Table 1.

Note — The order of checks may be changed provided that the conditions and the schedule described in the respective section for test techniques remains the same.

Table 1 — Scope and recommended order of tests

Type of test (check)	Requirement as per GOST R 54620	Subsection number
Checking that navigation signals of standard precision in L1 band of GLONASS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components	8.1.2, 8.1.5	5.1
Checking that navigation signals of standard precision in L1 band of GPS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components	8.1.3, 8.1.4	5.2
Checking that navigation signals of standard precision in L1 band of GLONASS and GPS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components	3.1.1	5.3
Checking that navigation parameters data may be output to external devices in NMEA-0183 format	8.1.15	5.4
Checking receiver autonomous integrity monitoring (RAIM) algorithm	8.1.4	5.5
Checking that navigation parameters may be determined in PZ-90 and WGS-84 coordinate systems	8.1.6	5.6
Estimating error in evaluation of plane view coordinates and altitude in autonomous static mode	8.1.7	5.7
Estimating error in evaluation of plane view coordinates, altitude and velocity in dynamic mode	8.1.7	5.8
Checking minimum time interval of observation data updates	8.1.8	5.9
Checking time to restore tracking signals of working NSC constellation after tracking fault caused by blockage	8.1.9	5.10
Evaluating time of navigation fix in cold start mode	8.1.10	5.11
Evaluating sensitivity of GNSS navigation module in: – GNSS signal search mode (locking); – GNSS signal hold mode (tracking)	8.1.11	5.12

Table 1 (continued)

Type of test (check)	Requirement as per GOST R 54620	Subsection number
Checking that data output rate may be changed in required range using GNSS_DATA_RATE setup parameter	8.1.12, 8.1.13	5.13
Checking minimum elevation (cut-off angle) for navigation spacecrafts	8.1.14	5.14
Checking power-off time of navigation module (GNSS navigation receiver) after ignition is turned off	8.1.16	5.15
Checking conformity to requirements of intended use under exposure to harmonic interference	8.1.17	5.16
Checking that GNSS signals may be tracked under exposure to pulse interference	8.1.18	5.17

4.6 If special software is used to calculate the errors in evaluation of location coordinates and velocity by the navigation module during the tests, then the programs used for such calculations shall be based on the formulas specified in section 5.

4.7 Testing equipment used shall be certified as per GOST R 8.568 and provided with a certificate of approval valid for the period of tests.

4.8 All testing devices shall be operational, and shall be accompanied with a type approval certificate (in case of measuring instruments).

4.9 Measuring instruments be verified (and have either verification certificates, or verification marks applied to the device or stamped in the OD; the verification period thereof shall not expire during the period of tests).

4.10 Reporting test results

A test and measurement report shall be compiled based on the results of the tests (checks). The report shall include the following information:

- designation, location, telephone, fax and e-mail of testing laboratory (centre);
- identification of item under test;
- test conditions;
- description of test and measurement techniques with a reference to this Standard;
- list of testing equipment and measuring instruments used in tests;
- measurements results in regard to navigation performance and properties of the GNSS navigation module included in the IVS;
- list of sections (clauses and sub-clauses) of normative documents (GOST R, etc.) that contain the requirements the conformity was checked against, and conformity assessment results pertaining to each particular requirement;
- conclusion on conformity of the item under test to the requirements specified;
- title, name and signature of employee who completed the tests and measurements;
- title, name and signature of director of test laboratory (centre), affixed with the seal of that laboratory (centre);
- date of tests and measurements, issue date, and report registration number.

5 Test methods

5.1 Checking that navigation signals of standard precision in L1 band of GLONASS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components

5.1.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.1.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, then use the OM and the developer's software to configure the navigation module for reception of GLONASS signals only.

Note — Hereinafter the wording "turn on the IVS" refers to the procedure specified in 4.3.3.

5.1.3 Prepare the simulator for operation as described in the OM. Start the script that simulates GLONASS signals only and uses the motion path parameters listed in Table C.2.

5.1.4 The test shall be considered successful if the location coordinates and velocity components have been determined, and have been proved suitable for viewing on the PC.

5.2 Checking that navigation signals of standard precision in L1 band of GPS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components

5.2.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.2.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, then use the OM and the developer's software to configure the navigation module for reception of GPS signals only.

5.2.3 Prepare the simulator for operation as described in the OM. Start the script that simulates GPS signals only and uses the motion path parameters listed in Table C.2.

5.2.4 The test shall be considered successful if the location coordinates and velocity components have been determined, and have been proved suitable for viewing on the PC.

5.3 Checking that navigation signals of standard precision in L1 band of GLONASS and GPS GNSS may be received and processed in order to determine vehicle coordinates and its velocity components

5.3.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.3.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, then use the OM and the developer's software to configure the navigation module for reception of GLONASS and GPS signals.

5.3.3 Prepare the simulator for operation as described in the OM. Start the script that simulates GLONASS and GPS signals, and uses the motion path parameters listed in Table C.2.

5.3.4 The test shall be considered successful if the location coordinates and velocity components have been determined, and have been proved suitable for viewing on the PC.

5.4 Checking that navigation parameters data may be output to external devices in NMEA-0183 format

5.4.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.4.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, then use the OM and the developer's software to configure the navigation module for reception of GLONASS and GPS signals. Configure this module for output of NMEA-0183 sentences (RMC, GGA, VTG, GSA and GSV as per [5]).

5.4.3 Prepare the simulator for operation as described in the OM. Start the script that simulates GLONASS/GPS signals, and uses the motion path parameters listed in Table C.1.

5.4.4 Connect the IVS to the PC using an appropriate interface. Analyse the capability of receiving navigation data using NMEA-0183 Protocol [5].

5.4.5 The test results shall be considered satisfactory if the navigation data may be received using NMEA-0183 Protocol [5].

5.5 Checking receiver autonomous integrity monitoring (RAIM) algorithm

5.5.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.5.2 Using the GLONASS/GPS simulator software, create a simulation script using the parameters listed in Table C.1 such that the simulated errors in ephemeris and timing data for any of the three GLONASS/GPS navigation spacecrafts would occur 10 min after the script is started.

5.5.3 Run the simulation script described above.

5.5.4 After 10 min of script execution, use the specific GNSS navigation module software to check sure that no NSC signals are received while the ephemeris and timing errors are simulated.

5.5.5 The test results shall be considered satisfactory if the requirement of 5.5.4 is satisfied.

5.6 Checking that navigation parameters may be determined in PZ-90 and WGS-84 coordinate systems

5.6.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.6.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, then use the OM and the developer's software to configure the navigation module for reception of GLONASS signals and for output of navigation parameters in the PZ-90 coordinate system.

Note — The use of the PIRTR sentence is permitted to set a coordinate system for operation [5].

5.6.3 Prepare the simulator for operation as described in its OM. Start the SS for GLONASS signals only, with the motion path parameters as indicated in Table C.1.

5.6.4 Check that the navigation parameters have been properly calculated using GLONASS signals, and are displayed in PZ-90 coordinate system (DTM sentence as per [5]).

5.6.5 Configure the navigation module for output of NMEA-0183 Protocol sentences (GGA, RMC, VTG, GSA and GSV as per [5]) at a rate of 1 Hz.

5.6.6 Record the messages delivered by the navigation module until the selected SS is stopped.

5.6.7 Repeat the test procedures of 5.6.1—5.6.5 using WGS-84 as an operating coordinate system.

5.6.8 From each data array recorded as per 5.6.6, select 50 GGA (RMC) sentences corresponding to the same time moments.

5.6.9 Following GOST R 51794, convert the values obtained in the coordinate system used to take these measurements, to another system.

5.6.10 Compare the coordinates obtained in the test with their converted values making provisions established in GOST R 54620 (clause 8.1.7) for the permitted tolerance for location evaluation results.

5.6.11 The test results shall be considered satisfactory if the coordinate array obtained in the tests matches the calculated one.

5.7 Estimating error in evaluation of plane view coordinates and altitude in autonomous static mode

5.7.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.7.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, and use the developer's software to check that the navigation module is configured for reception of GLONASS as well as GPS signals, and the GNSS_MIN_ELEVATION setup parameter is set to 5 degrees. Configure the navigation module for output of NMEA-0183 Protocol sentences (GGA, RMC, VTG, GSA and GSV as per [5]) at a rate of 1 Hz.

Note — The output rate of navigation messages delivered by the navigation module of the IVS is set using the GNSS_DATA_RATE setup parameter.

5.7.3 Prepare the simulator for operation as described in its OM. Start the SS for GLONASS signals only, using the simulation parameters as indicated in Table C.1.

5.7.4 Once a navigation fix is received after the SS is started, ensure that the messages from the GNSS navigation module are recorded in a file until the selected SS is stopped.

5.7.5 Extract GGA (RMC) data from the above file that pertain to location coordinates obtained in the tests: latitude (B), longitude (L) and altitude (H).

5.7.6 Calculate the systematic error in evaluation of coordinates over the stationary intervals. For example, use Eq. (1) and (2) for B (latitude):

$$\Delta B(j) = B(j) - B_{\text{нст}j}, \quad (1)$$

$$dB = \frac{1}{N} \cdot \sum_{j=1}^N \Delta B(j), \quad (2)$$

where $B_{\text{нст}j}$ is the actual value of B coordinate at j -th time moment, in arc s;
 $B(j)$ is the B coordinate value evaluated by the navigation module at j -th time moment, in arc s;
 N is the number of GGA (RMC) sentences received from the navigation module in the tests.

The systematic errors for L (longitude) and H (altitude) are calculated analogously.

Note — The altitude values shall be calculated in metres.

5.7.7 Using Eq. (3), calculate the root-mean-square deviation of the coordinate results, e.g., for B coordinate use the following expression:

$$\sigma_B = \sqrt{\frac{\sum_{j=1}^N (B(j) - dB)^2}{N - 1}}, \quad (3)$$

The RMS values for L and H are calculated in the same manner.

5.7.8 Using (4) and (5), convert the errors calculated for the longitude and the latitude from arc seconds to metres:

- for latitude:

$$dB (m) = 2 \cdot \frac{a(1 - e^2)}{(1 - e^2 \sin^2 \varphi)^{3/2}} \cdot \frac{0,5'' \cdot \pi}{180 \cdot 3600''}, \quad (4)$$

- for longitude:

$$dL (m) = 2 \cdot \frac{a \cdot \cos \varphi}{\sqrt{1 - e^2 \sin^2 \varphi}} \cdot \frac{0,5'' \cdot \pi}{180 \cdot 3600''}, \quad (5)$$

where a is the major axis of the ellipsoid, m;

e is the first eccentricity;

φ is the current latitude, radians.

5.7.9 Using Eq. (6) and (7), calculate the error in evaluation of plane view coordinates and of altitude, correspondingly (with a confidence probability of 0.95):

$$\Pi_{\text{план}} = \sqrt{dB^2 (m) + dL^2 (m)} + 2 \cdot \sqrt{\sigma_B^2 (m) + \sigma_L^2 (m)}, \quad (6)$$

$$\Pi_H = dH + 2\sigma_H, \quad (7)$$

5.7.10 Repeat the test procedures 5.7.3—5.7.9 using the SS for GPS signals only and the simulation parameters indicated in Table C.1.

5.7.11 Repeat the test procedures 5.7.3—5.7.9 using the SS for the signals of the combined GLONASS/GPS constellation and selecting the simulation parameters as shown in Table C.1.

5.7.12 Repeat the test procedures 5.7.2—5.7.11 for other IVS samples submitted for tests.

5.7.13 Calculate average values of (6) and (7) over the total number of IVS samples tested.

5.7.14 Connect the GNSS antenna included in the system to the sample under test, and switch the navigation module to reception of signals coming from the respective GNSS. Repeat the test procedures 5.7.4—5.7.13 in real time so that the navigation signals are transmitted from the antenna located at a geodetic point (check point) in response to real signals of:

- GLONASS;
- GPS;
- GLONASS/GPS.

Note — The navigation module shall be switched to signals from the respective GNSS or from the combined GNSS NSC constellation using the technique described in the OM for the IVS.

5.7.15 The test results shall be deemed satisfactory if the coordinate and altitude errors obtained during the tests do not exceed (with a confidence probability of 0.95) the values permitted in GOST R 54620 (clause 8.1.7).

5.8 Estimating error in evaluation of plane view coordinates, altitude and velocity in dynamic mode

5.8.1 Assemble the circuit shown in Figure E.1 (Appendix E).

5.8.2 Prepare the IVS for operation as described in the OM. Turn on the IVS, and use the developer's software to make sure that the navigation module is configured for reception of GLONASS and GPS signals, and that the GNSS_MIN_ELEVATION setup parameter is set to 5°.

Configure the navigation module for output of NMEA-0183 Protocol sentences (GGA, RMC, VTG, GSA and GSV as per [5]) at a rate of 1 Hz.

Note — The output rate of navigation messages delivered by the navigation module of the IVS is set using the GNSS_DATA_RATE setup parameter.

5.8.3 Prepare the simulator for operation as described in its OM. Start the SS for speed-up to the maximum velocity which is specified in the OM for the IVS under test while simulating GLONASS signals only (Table C.2).

5.8.4 Once a navigation fix is received after the SS is started, ensure that the messages output by the GNSS navigation module are recorded in a file until the selected SS is stopped.

5.8.5 Extract those message data from the above file that pertain to coordinates evaluated by the navigation module (latitude, longitude, altitude) and to velocity.

5.8.6 Using Eq. (1)—(7), calculate the error in evaluation of plane view coordinates and of altitude (with a confidence probability of 0.95).

5.8.7 Using Eq. (8)—(10), calculate the systematic error and the root-mean-square deviation of resulting velocity:

$$\Delta V(j) = V(j) - V_{\text{uctj}}, \quad (8)$$

$$dV = \frac{1}{N} \cdot \sum_{j=1}^N \Delta V(j), \quad (9)$$

$$\sigma V = \sqrt{\frac{\sum_{j=1}^N (V(j) - dV)^2}{N - 1}}, \quad (10)$$

where V_{uctj} is the actual velocity at j -th time moment, m/s;

V_j is the measured velocity at j -th time moment, m/s;

N is the number of RMC (VTG) sentences received from the navigation module during the tests.

5.8.8 Using Eq. (11), calculate the error in evaluation of velocity (with a confidence probability of 0.95):

$$\Pi_V = dV + 2\sigma_V \quad (11)$$

5.8.9 Set the mode where GPS signals only are simulated by the SS for speed-up to the maximum velocity, and carry out the procedures 5.8.4—5.8.8.

5.8.10 Set the mode where signals of the combined GLONASS and GPS constellation are simulated by the SS for speed-up to the maximum velocity, and carry out the procedures 5.8.4—5.8.8.

5.8.11 Repeat the test procedures 5.8.2—5.8.10 for remaining IVS samples submitted for tests.

5.8.12 Take average values for the quantities obtained from Eq. (6), (7) and (11) using the SS for speed-up to the maximum velocity (Table C.2 (Appendix C)), with respect to the total number of the IVS samples under test.

5.8.13 Repeat the test procedures 5.8.2—5.8.12 for movement simulation scripts with manoeuvring (Table C.3 (Appendix C)) and for movement in blockage zones as well as in poor-reception zones of navigation signals (Table C.4 (Appendix C)).

5.8.14 Take averages of the quantities obtained from Eq. (6), (7) and (11) for dynamic mode with respect to the total number of simulation scripts executed for such mode.

5.8.15 The IVS test results in dynamic mode shall be deemed satisfactory if the errors obtained in the resulting plane view coordinates, altitude and movement velocity do not exceed (with a confidence probability of 0.95) the values permitted in GOST R 54620 (clause 8.1.7).

5.9 Checking minimum time interval of observation data updates

5.9.1 Analyse the file containing the results of tests as per 5.8. Confirm that no identical coordinate values exist for adjacent (with respect to a time frame) GGA sentences.

5.9.2 The test result shall be considered satisfactory if the requirement 5.9.1 holds.

5.10 Checking time to restore tracking signals of working NSC constellation after tracking fault caused by blockage

5.10.1 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the GNSS module is configured for reception of GLONASS and GPS signals.

5.10.2 Connect the GNSS antenna to the IVS.

5.10.3 Wait for a navigation fix to be received by the navigation module of the IVS.

5.10.4 Disconnect the antenna from the IVS (i.e. from its navigation module) and reconnect it again after 20 to 60 s.

Using a stopwatch, measure the time interval between the moment when the antenna is disconnected and reconnected and the moment when an indication that the tracking from the working NSC constellation has resumed appears in the interface program dialog (once the first navigation fix is received after the connection of the antenna).

5.10.5 Repeat the test procedure 5.10.4 for at least 30 times.

5.10.6 Based on the sampled measurement results, calculate the average time required to restore the tracking signals from the working NSC constellation after the IVS leaves the blockage zone, for all IVS samples submitted to tests.

5.10.7 The test result shall be considered satisfactory if the average time to restore the tracking of signals from the working NSC constellation after such tracking is stopped due to blockage does not exceed 5 s after the NSC visibility is recovered.

5.10.8 Using the IVS developer's software and the OM, configure the navigation module of the IVS for reception of GLONASS signals only, and repeat the test procedures 5.10.2—5.10.7.

5.10.9 Using the IVS developer's software and the OM, configure the navigation module of the IVS for reception of GPS signals only, and repeat the test procedures 5.10.2—5.10.7.

5.11 Evaluating time of navigation fix in cold start mode

5.11.1 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the GNSS module is configured for reception of GLONASS and GPS signals.

5.11.2 Clear the navigation module RAM from all NSC ephemerides and constellation almanacs.

5.11.3 Connect the GNSS antenna to the IVS. Using a stopwatch, measure the time interval from the moment when the antenna is connected to the moment when the interface program dialog with the navigation fix appears.

5.11.4 Repeat the tests as per 5.11.2 and 5.11.3 for at least 30 times.

5.11.5 Based on the sampled measurement results, calculate the average time required to receive the navigation fix in cold start mode (where no almanac, ephemerides, time and coordinates are known) for all IVS samples submitted to tests.

5.11.6 Using the IVS developer's software and the OM, configure the navigation module of the IVS for reception of GLONASS signals only, and repeat the tests as per 5.11.2—5.11.5.

5.11.7 Using the IVS developer's software and the OM, configure the navigation module of the IVS for reception of GPS signals only, and repeat the tests as per 5.11.2—5.11.5.

5.11.8 The test result shall be considered satisfactory if the average time calculated as described in 5.11.5 does not exceed 60 s.

5.12 Evaluating sensitivity of GNSS navigation module in GNSS signal search (locking) mode and in GNSS signal hold (tracking) mode

5.12.1 Turn on the vector network analyser. Calibrate the VNA as described in its OM.

5.12.2 Assemble the circuit shown in Figure E.2.

5.12.3 Set zero signal path attenuation on attenuators. Measure the frequency response for a given signal path in the L1 band of GLONASS/GPS GNSS. Record the average path transmission factor $K_{\text{п_тракт}}$ in [dB] in this frequency band.

5.12.4 Assemble the circuit shown in Figure E.3.

5.12.5 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the navigation module is configured for reception of GLONASS and GPS signals. Clear the navigation module RAM from all NSC ephemerides and GNSS almanac so as the cold start conditions of the navigation module are achieved.

5.12.6 Set the signal path attenuation on attenuators equal to 110 dB. Prepare the simulator for operation as described in its OM. Start the script for simulation of GLONASS/GPS signals using the parameters of Table C.1. Set the output power $P_{\text{сигн}}$ of the simulator equal to 150 dBW.

5.12.7 Check that the date, time and coordinates are reset in the interface program dialog.

5.12.8 Decrease the signal path attenuation setting on attenuators in 1 dB steps (increase the navigation signal power on the navigation module input) until the IVS acquires a navigation fix. Record the attenuator readings $A_{\text{атт}}$ and calculate the sensitivity $P_{\text{мин}}$ of the navigation module from Eq. (12) taking into account the transmission factor of the signal path.

Note — Switch the attenuators at least each 120 s to monitor whether the navigation fix output by the navigation module of the IVS is available.

$$P_{\text{мин}} = P_{\text{сигн}} + P_{\text{п_тракт}} + A_{\text{атт}}. \quad (12)$$

5.12.9 Set the signal path attenuation on attenuators such that the signal on the antenna input of the IVS is equal to minus 160 dBW. Wait for 15 min to allow the navigation module to collect the ephemerides of the working NSC and of the GNSS almanac.

5.12.10 Increase the signal path attenuation setting on attenuators in 1 dB steps (decrease the navigation signal power) until the navigation fix is reset. Taking into account the initial transmission factor of the signal path, record such GNSS signal level on the antenna input of the IVS that resulted in the last navigation fix of the GNSS module in hold (tracking) mode.

5.12.11 The test results shall be considered satisfactory if the GNSS signal level on the antenna input of the IVS does not exceed minus 163 dBW in search mode as recorded in 5.12.8, and minus 188 dBW in hold (tracking) mode as recorded in 5.12.10, for each IVS submitted to tests.

5.13 Checking that data output rate may be changed in required range using GNSS_DATA_RATE setup parameter

5.13.1 Assemble the circuit shown in Figure E.4.

Notes

1. It is recommended to combine these tests with the tests described in 5.8.
2. If the navigation module of the IVS does not support changing the output rate of navigation data, the tests are carried out in accordance with 5.13.2—5.13.5.
3. If the navigation module of the IVS supports changing the output rate of navigation data, the tests are carried out in accordance with 5.13.2—5.13.8 after the tests of navigation performance for the combined GLONASS/GPS constellation are completed as per 5.8.

5.13.2 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the GNSS module is set up for reception of GLONASS and GPS signals. Configure the navigation module for output of NMEA-0183 sentences (GGA, RMC, GGA, VTG, GSA and GSV) as per [5]) at a rate of 1 Hz.

Note — The output rate of navigation messages delivered by the navigation module of the IVS is set using the GNSS_DATA_RATE setup parameter.

5.13.3 Turn on the oscilloscope and set it up for signal reception in the specified frequency band.

5.13.4 Prepare the simulator for operation as described in its OM. Start the SS for speed-up to the maximum velocity which is specified in the OM for the IVS under test while simulating GLONASS and GPS signals (Table C.2 (Appendix C)).

5.13.5 Once a navigation fix is received, use the oscilloscope to check that the output rate of the navigation module data corresponds to the configured value.

5.13.6 Stop the SS, and change the value of the GNSS_DATA_RATE parameter in the navigation module settings, e.g., set it to 2 Hz.

5.13.7 Start the SS and use the oscilloscope to check that the output rate corresponds to that value.

5.13.8 Repeat the steps 5.13.6 and 5.13.7 with GNSS_DATA_RATE set to 5 and to 10 Hz.

5.13.9 The test results shall be considered satisfactory if the data output rate settings of 1, 2, 5 and 10 Hz are possible using the GNSS_DATA_RATE parameter, for each IVS submitted to tests.

5.14 Checking minimum elevation (cut-off angle) for navigation spacecrafts

- 5.14.1 Assemble the circuit shown in Figure E.1 (Appendix E).
- 5.14.2 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the navigation module is configured for GNSS GLONASS and GPS signals.
- 5.14.3 Using the developer's software, set the GNSS_MIN_ELEVATION parameter (minimum NSC elevation, or cut-off angle) to 5°.
- 5.14.4 Prepare the simulator for operation as described in its OM. Using the script for simulation of GLONASS/GPS signals (Table C.1), find a navigation satellite from among descending spacecrafts (either GLONASS or GPS) such that the time moment t_1 when an elevation of 5° is reached will be most close to the SS start-up time. Record this time and the satellite identifier it corresponds to.
- 5.14.5 Start the SS for GLONASS/GPS systems using the parameters listed in Table C.1.
- 5.14.6 Observe the selected NSC on the PC screen and check that it is excluded from processing at the time moment coinciding with t_1 (as indicated by a GSA sentence). Stop the script.
- 5.14.7 Using the developer's software, set GNSS_MIN_ELEVATION (minimum NSC elevation, or cut-off angle) to 15°.
- Repeat the steps 5.14.4—5.14.6 taking t_1 for the SS start-up moment.
- 5.14.8 The test results shall be considered satisfactory if the cut-off angle of all selected NSC corresponds to the configured values (5°, 15°) for all IVS submitted to tests.

5.15 Checking power-off time of navigation module (GNSS navigation receiver) after ignition is turned off

- 5.15.1 Prepare the IVS for operation as described in the OM. Turn on the IVS. Switch the developer's software to viewing and editing of IVS setup parameters.
- 5.15.2 Check and record the GNSS_POWER_OFF_TIME setting for the IVS under test. Enter a new value for GNSS_POWER_OFF_TIME equal to 10 s.

Note — This parameter shall have been set to 500 ms initially (see GOST R 54620, Appendix A).

- 5.15.3 Turn off the IVS, and use a stopwatch to record its actual power-off time as observed by the state of the system status indicator.
- 5.15.4 Make sure that the power-off time is set to a value specified in 5.16.2 for all IVS samples submitted to tests.
- 5.15.5 Enter the initial setting for GNSS_POWER_OFF_TIME as described in 5.15.1—5.15.2.

Note — The step 5.15 is optional for systems in standard configuration (GOST R 54620, clause 8.1.6).

5.16 Checking conformity to requirements of intended use under exposure to harmonic interference

- 5.16.1 Assemble the circuit shown in Figure E.5.
- 5.16.2 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the GNSS module is configured for reception of GLONASS and GPS signals.
- 5.16.3 Prepare the simulator for operation as described in its OM. Set the power of useful signals equal to minus 161 dBW.
- 5.16.4 Prepare the harmonic interference generator for operation in accordance with its OM.
- 5.16.5 To check the operation using GLONASS signals of standard precision in L1 band, repeat the tests specified in 5.1, 5.5, 5.7, 5.8, 5.9, 5.10 and 5.11 by applying, in succession, the harmonic interference within the ranges of threshold values indicated in Table D.1.
- 5.16.6 The test results shall be deemed satisfactory if each IVS submitted to tests complies with the requirements of intended use in GLONASS mode for all harmonic disturbances shown in Table D.1.
- 5.16.7 Repeat the tests specified in 5.2, 5.5, 5.7, 5.8, 5.9, 5.10 and 5.11 for the case of operation using GPS signals by applying, in succession, the harmonic interference within the ranges of threshold values indicated in Table D.2.

5.16.8 The test results shall be deemed satisfactory if each IVS submitted to tests complies with the requirements of intended use in GPS mode for all harmonic disturbances shown in Table D.2.

5.17 Checking that GNSS signals may be tracked under exposure to pulse interference

5.17.1 Assemble the circuit shown in Figure E.5.

5.17.2 Prepare the IVS for operation as described in the OM. Turn on the IVS. Using the developer's software, make sure that the GNSS module is configured for reception of GLONASS and GPS signals.

5.17.3 Prepare the simulator for operation as described in its OM. Set the power of useful signals equal to minus 161 dBW.

5.17.4 Wait for 15 min, and check that the GNSS module has switched to NSC tracking mode for the working GNSS constellation.

5.17.5 Prepare the pulse interference generator for operation in accordance with its OM.

5.17.6 Apply impulse interference of the following properties:

- frequency range — from 1565.42 MHz to 1609.36 MHz for GLONASS/GPS;
- threshold value of interference signals (peak pulse power) — minus 10 dBW;
- pulse duration — ≤ 1 ms;
- pulse duty ratio — ≥ 10 .

5.17.7 Check for 15 min that the tracking information for an NSC from the working constellation is being updated in the interface program dialog, and GLONASS/GPS location data are arriving.

5.17.8 The test results shall be deemed satisfactory if each IVS submitted to tests has demonstrated no interruption in tracking of NSC signals from the GLONASS/GPS constellation under pulse interferences.

Appendix A
(normative)

Sampling report form

SAMPLING REPORT

_____ (product designation)

1 Name of product manufacturer, its subordination _____

2 Name of sampler organisation (subdivision) _____

3 Product type designation _____
 _____, batch size _____
 _____ (mass production, batch of particular size
 or production unit)

4 Title of document underlying product manufacture _____

5 Purpose of products submission to tests _____
 _____ date

6 Sampling location _____

No. of samples _____

7 Visual inspection results _____

8 Document No. _____
 and date of sample acceptance by TL _____

9 Samples taken using "maximum impartiality sampling" method as per GOST 18321, and sealed

10 Samples packaged _____
 _____ (packaging and/or transport containers)

11 Samples shipment date to TL _____

12 Samples shipped to TL by _____
 _____ (by courier, mail, etc.)

Representative of Applicant

Representative of Testing Laboratory

 (signature) (full printed name) (signature) (full printed name)

Appendix B
(normative)

List of measuring instruments, testing and auxiliary equipment

Table B.1 — List of measuring instruments, testing and auxiliary equipment

Designation of testing equipment	Technical requirements for testing equipment		Recommended model (type) of testing equipment
	Measuring range	Measurement error	
Geodetic point	Coordinates to be expressed in Systems of Earth geodetic parameters as of 1990 (PZ-90) and WGS-84	Maximum deviation of coordinates transmitted from network of geodetic points: 0.1 m. Average RMS error in evaluation of coordinates with respect to geodetic points in PZ-90 & WGS-84 coordinate systems: not greater than 0.1 m	Geodetic point
GNSS antenna	Range of operation frequencies: 1570—1610 MHz; Gain: 41 dB; Interference factor in L1 band of GNSS: not greater than 3.5 dB	Error in gain measurements: ± 2.5 dB	Antenna assembly from the set NCE GNSS GLONASS/GPS "БРИЗ-МВ" 14Ц814.ТДЦК. 461513.004
Low-noise amplifier	Frequency range: from 950 to 2150 MHz; Interference factor: not greater than 2.0 dB; Amplification: 24 ± 2 dB	—	ZRL-2150+ low-noise amplifier
Power supply	D.C. voltage setting range: from 0.1 to 30 V Output voltage current: not less than 3 A	$\Pi\Gamma_0 \pm 3 \%$ $\Pi\Pi_1 \pm 1 \%$	ATH-2031 power supply
Simulator of GLONASS and GPS signals	Number of simulated signals: at least 16	Maximum RMS with respect to random component of basic error in unsolicited generation of NSC distance signals for GLONASS/GPS: - in phase of long-distance code: 0.1 m; - in carrier phase: 0.001 m; - in pseudo-velocity: 0.005 m/s.	Simulators of signals transmitted by GLONASS/GPS navigation satellite systems: - CH-3803M; - CH-3805M; - GSS6300.
Digital stopwatch	Maximum count range: 9 h 59 min 59.99 s	Daily variation at (25+5)°C: not greater than +1.0 s. Time sampling resolution: 0.01 s.	"ИНТЕГРАЛ С-01"
Vector network analyser	Frequency range: 300 kHz ... 4 GHz Dynamic range: (minus 85 ... 40) dB	$\Pi\Gamma_F 1 \cdot 10^{-6}$ $\Pi\Gamma_A (0.1 \dots 0.5)$ dB	Rohde & Schwarz ZVB-4 vector network analyser

Table B.1 (continued)

Designation of testing equipment	Technical requirements for testing equipment		Recommended model (type) of testing equipment
	Measuring range	Measurement error	
Attenuator	Dynamic range: (0 ... 11) dB	$\Pi\Pi \pm 0.5 \text{ dB}$	HP 8494A attenuator
Attenuator	Dynamic range: (0 ... 110) dB	$\Pi\Pi \pm 0.5\text{dB}$	HP 8496A attenuator
Signal generator	Frequency range: (1 ... 2) GHz; Dynamic range: (minus 150 ... minus 5) dBW	$\Pi\Pi_{\text{F}} 1 \cdot 10^{-6}$ $\Pi\Pi_{\text{A}} (0.5 \dots 0.9) \text{ dB}$	Rohde & Schwarz SMBV100A and SMB100A vector signal generators
Oscilloscope	Min. bandwidth: 2 GHz; Sampling rate: not less than 40 GHz; Dynamic range: from 1 mV to 3 V.	$\Pi\Pi_{\text{T}} \pm 1 \cdot 10^{-6}$ $\Pi\Pi_{\text{A}} \pm 3 \%$	Agilent Technologies DSO80204B oscilloscope
<p>Note — The use of other equipment types is permitted provided that they are capable to ensure the required accuracy of measurements in the specified range.</p>			

Appendix C
(normative)

Basic parameters of scripts used for simulation of GLONASS and GPS signals

T a b l e C.1 — Basic parameters of script for simulation of fixed spatial location

Simulated parameter	Value
SS run time, hh:mm:ss	01:00:00
IVS location in: - WGS-84 CS; - PZ-90	Central Russia Central Russia
Parameters of NS transmission medium: - troposphere; - ionosphere	Standard "Autumn" Model
PDOP geometry factor	≤ 4
Simulated signals	- GLONASS (L1 frequency range, SP code); - GPS (L1 frequency range, C/A code); - GLONASS/GPS
Minimum RF signal power - GLONASS - GPS	minus 161 dBW; minus 158.5 dBW
Number of simulated NSC	- at least 8 NSC for GLONASS; - at least 8 NSC for GPS

T a b l e C.2 — Basic parameters of script for simulation of speed-up to maximum velocity

Simulated parameter	Value
SS run time, hh:mm:ss	01:00:00
IVS initial point in: - WGS-84 CS; - PZ-90	Central Russia Central Russia
IVS movement model: - speed-up to maximum velocity, km/h - acceleration, g	250 2
Parameters of signal transmission medium: - troposphere; - ionosphere	Standard "Autumn" Model
PDOP geometry factor	≤ 4
Simulated signals	- GLONASS (L1 frequency range, SP code); - GPS (L1 frequency range, C/A code); - GLONASS/GPS
Minimum RF signal power - GLONASS - GPS	minus 161 dBW; minus 158.5 dBW
Number of simulated NSC	- at least 8 NSC for GLONASS; - at least 8 NSC for GPS

Table C.3 — Basic parameters of script for simulation of movement with manoeuvring

Simulated parameter	Value
SS run time, hh:mm:ss	02:00:00
IVS initial point in: - WGS-84 CS; - PZ-90	Central Russia Central Russia
IVS movement model: - velocity, m/s; - radius of turns, m; - acceleration at turns, m/s ²	Movement with manoeuvring 10 500 0.2
Parameters of NS transmission medium: - troposphere; - ionosphere	Standard "Spring" Model
PDOP geometry factor	≤ 4
Simulated signals	- GNSS GLONASS (L1 frequency range, SP code); - GNSS GPS (L1 frequency range, C/A code); - GNSS GLONASS/GPS
Minimum RF signal power - GNSS GLONASS - GNSS GPS	minus 161 dBW minus 158.5 dBW
Number of simulated NSC	- at least 8 NSC for GLONASS; - at least 8 NSC for GPS

Table C.4 — Basic parameters of script for simulation of movement in blockage and poor reception zones of navigation signals

Simulated parameter	Value
SS run time, hh:mm:ss	01:20:00
IVS initial point in: - WGS-84 CS; - PZ-90	Central Russia Central Russia
IVS movement model: - maximum velocity, m/s	Movement with manoeuvring 10
NS radio visibility: - signal visibility intervals, s; - no signal intervals, s	300 600
Parameters of NS transmission medium: - troposphere; - ionosphere	Standard "Spring" Model
PDOP geometry factor	≤ 4
Simulated signals	- GNSS GLONASS (L1 frequency range, SP code); - GNSS GPS (L1 frequency range, C/A code); - GNSS GLONASS/GPS
Minimum RF signal power - GNSS GLONASS - GNSS GPS	minus 161 dBW minus 158.5 dBW
Number of simulated NSC	- at least 8 NSC for GLONASS; - at least 8 NSC for GPS

Appendix D
(normative)

Threshold values of harmonic interference for GLONASS and GPS signals

T a b l e D.1 — Threshold values of harmonic interference in operation using GLONASS SP L1 signals

Frequency, MHz	Threshold interference levels, dBW
$F < 1540$	minus 15
$1540 < F \leq 1562$	linear fall from minus 15 to minus 50
$1562 < F \leq 1583$	linear fall from minus 50 to minus 90
$1583 < F \leq 1593$	linear fall from minus 90 to minus 140
$1593 < F \leq 1609$	minus 140
$1609 < F \leq 1613$	linear rise from minus 140 to minus 80
$1613 < F \leq 1626$	linear rise from minus 80 to minus 60
$1626 < F \leq 1670$	linear rise from minus 60 to minus 15
$F > 1670$	minus 15

T a b l e D.2 — Threshold values of harmonic interference in operation using GPS signals

Frequency, MHz	Threshold interference levels, dBW
$F < 1525$	minus 15
$1525 < F \leq 1565$	linear fall from minus 50 to minus 140
$1565 < F \leq 1585$	minus 140
$1585 < F \leq 1610$	linear rise from minus 140 to minus 60
$1610 < F \leq 1626$	linear rise from minus 60 to minus 50
$1626 < F \leq 1670$	linear rise from minus 50 to minus 15
$F > 1670$	minus 15

Appendix E (normative)

Connection diagrams used for tests

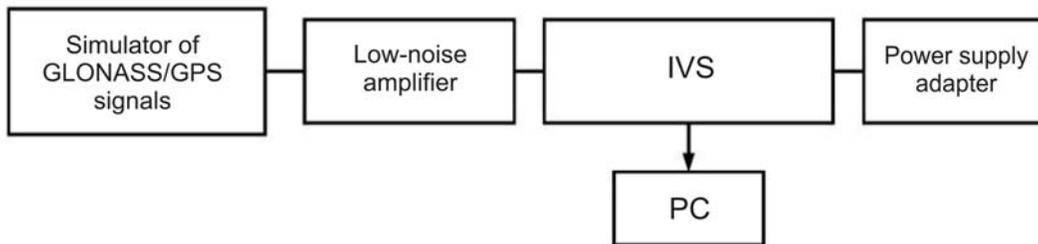


Figure E.1 — Test bench arrangement

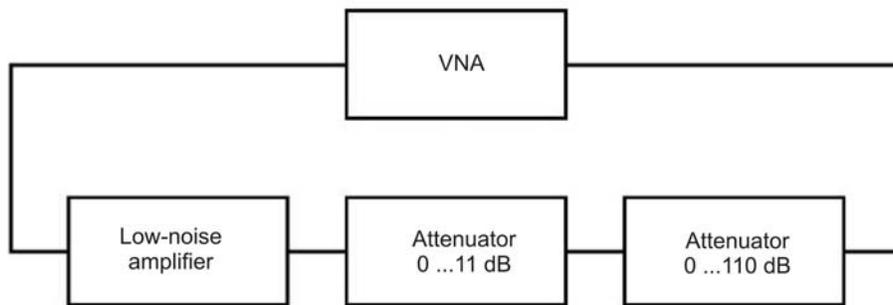


Figure E.2 — Arrangement for signal path calibration

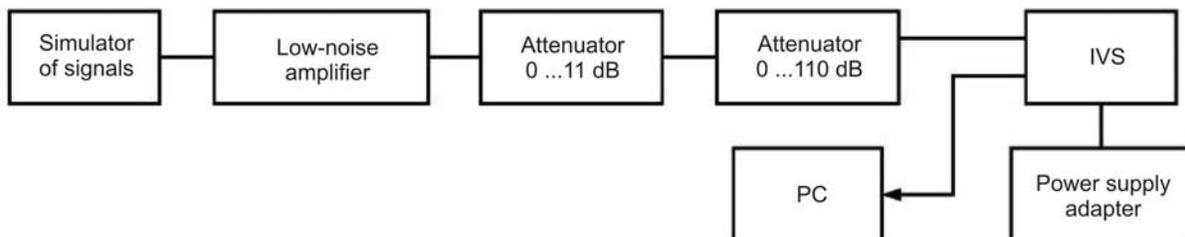


Figure E.3 — Arrangement for evaluation of GNSS module sensitivity

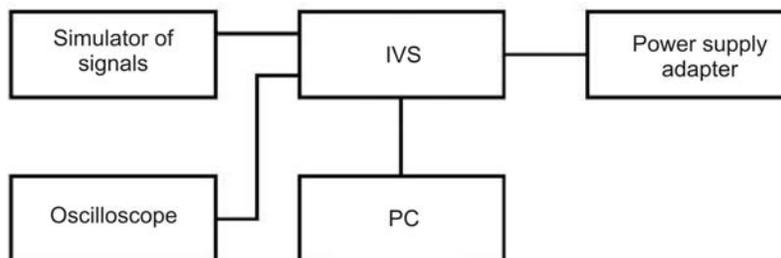


Figure E.4 — Test bench arrangement

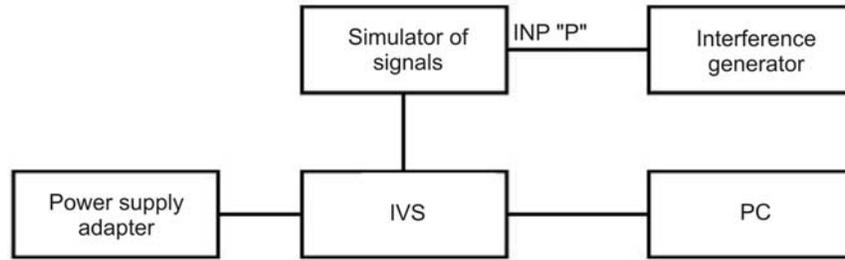


Figure E.5 — Test bench arrangement

N o t e — INP "P" is the RF port of the simulator of signals where external interference signals are input.

Bibliography

- [1] Technical Regulation "On safety of wheeled vehicles" (approved by Order of the RF Government No. 720 dated September 10, 2009)
- [2] TP TC 018/2011 Technical Regulation of the Customs Union "On safety of wheeled vehicles"
- [3] Order of the RF Ministry of Transport No. 285 dated July 31, 2012 "On approval of requirements for navigation equipment operating based on signals of GLONASS or GLONASS/GPS systems and intended for mandatory equipping of Category M vehicles used for commercial passenger transportation and of Category N vehicles used for transportation of dangerous cargoes"
- [4] ППОТМ-016-2001 Inter-branch guidelines on occupational safety during operation of electrical
PД153-34.0-03.150-00 installations
- [5] IEC 61162-1 (2010) Maritime navigation and radio communication equipment and systems —
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