	NATIONAL STANDARD OF THE RUSSIAN FEDERATION	**GOST R 55533-2013**

Global navigation satellite system

ROAD ACCIDENT EMERGENCY RESPONSE SYSTEM

Test methods for wireless communication modules of in-vehicle emergency call system

Official Edition
English Version Approved by Interstandard

Foreword

1 DEVELOPED by Non-Profit Partnership "Promotion of Development and Use of Navigation Technologies" (NP "GLONASS")

2 SUBMITTED by Technical Committee for standardization TC 363 "Radio navigation"

3 APPROVED AND INTRODUCED by Decree No. 598-ст, dated 28.08.2013, of the Federal agency on technical regulating and metrology

4 INTRODUCED FOR THE FIRST TIME

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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Date of Introduction — 2014—01—01

1 Scope

This Standard applies to in-vehicle emergency call systems that constitute structural components of the ERA-GLONASS accident emergency response system, and are intended for installation on wheeled vehicles of Categories M and N in accordance with the requirements of [1].

The Standard defines the methods that shall be used when the wireless communication modules included in an in-vehicle emergency call system (device) are tested for the purpose of conformity assurance to the requirements for GSM, UMTS and in-band modems established in GOST R 54620 as well as in [1], [2], [3] and [4].

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 53801-2010 Federal communications. 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

N o t e — 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.

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3 Terms and definitions

The terms defined in GOST R 53801, as well as the following terms with their respective definitions are used for the purposes of this Standard:

3.1 **in-vehicle emergency call system/device;** (IVS): System/device installed on a wheeled vehicle of a relevant Category and used to evaluate vehicle location, speed and movement direction based on the signals generated by the GLONASS Global Navigation Satellite System (GNSS) 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.

N o t e s

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].

3.2 **frame**: Time interval equal to 20 ms corresponding to a single AMR or FR speech frame which contains 160 time slices at a sampling rate of 8 kHz.

N o t e — a single time slice is taken to be equal to 125 μs in duration.

3.3

minimum set of data; (MSD): Set of data transmitted by the in-vehicle emergency call system/device in case of a road accident, including location and movement parameters of the affected vehicle, accident time, vehicle VIN-code and other information necessary for emergency response. [GOST R 54620-2011, clause 3.1.1]

3.4

operator of ERA-GLONASS emergency response system (system operator): Legal entity carrying out activities related to ERA-GLONASS operation, in particular, to processing of data stored in the ERA-GLONASS database. [GOST R 54620-2011, clause 3.1.9]

3.5

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 (hereinafter referred to as "GLONASS") and provides for dispatching of messages about road traffic accidents or other emergencies on the RF roads to emergency services. N o t e — The ERA-GLONASS System is analogous to the European eCall system, and is harmonised with it in regard to main functional features: the use of in-band modem as the main data transmission tool, content and format of mandatory data transmitted in the MSD, logical procedures for initiation and termination of duplex voice communication between the system operator and the persons present in the vehicle cabin. [GOST R 54620-2011, clause 3.1.12]

3.6 in-band modem: Modem that enables data transmission within the scope of the established voice connection.

4 Designations and abbreviations

The following designations and abbreviations are used in this Standard:

IVS-modem — In-vehicle emergency call system (device) considered as a test object implementing the in-band modem functionality;

PCM — Pulse-Code Modulation;

RLA — Regulatory Legal Act that sets out the requirements that apply to the tools used for wireless mobile communication;

PC — Personal Computer;

IVS-GSM — In-vehicle emergency call system (device) considered as a test object implementing the GSM modem functionality;

IVS-UMTS — In-vehicle emergency call system (device) considered as a test object implementing the UMTS modem functionality;

AMR — Adaptive Multi Rate (the standard of adaptive encoding with a variable bitrate of sound files which is intended for signal compression in the speech frequency range);

BER — Bit Error Ratio;

CPICH — Common Pilot Channel;

CRC — Cyclic Redundancy Code;

DPCH — Dedicated Physical Channel;

DPCCH — Dedicated Physical Control Channel;

DPDCH — Dedicated Physical Data Channel;

EDGE — Enhanced Data Rate for GSM Evolution;

EVM — Error Vector Magnitude;

FoM — Figure of Merit;

GSM — Global System for Mobile communications;

GPRS — General Packet Radio Service;

HSCSD — High Speed Circuit Switched Data;

HSDPA — High Speed Downlink Packet Access;

HS-DPCCH — High Speed Dedicated Physical Control Channel;

ACK/NACK — Acknowledgment/no acknowledgment (as regards the reception of data blocks over a high speed dedicated physical control channel);

HS-PDSCH — High Speed Physical Downlink Shared Channel;

HS-SCCH — High Speed Secondary Control Channel;

I_{or} — Power spectral density of a signal received downstream at the antenna connector of the subscriber terminal;

IMEI — International Mobile Station Equipment Identity;

ISDN — Integrated Services Digital Network;

MNO — Mobile Network Operator;

OCNS — Orthogonal Code Noise Signal (applied for network loading simulation);

P-CCPCH — Primary Common Control Physical Channel;

P-CPICH — Primary Common Pilot Channel;

PICH — Pilot Channel;

PSTN	— Public Switched Telephone Network;
Qqualmin	— Minimum permitted quality rating of received signals
Qrxlevmin	— Minimum permitted level rating of received signals
RACH	— Random Access Channel;
REF I_{or}	— Reference I_{or} (reference power spectral density of a signal received downstream at the antenna connector);
REFSENS	— Reference Sensitivity;
RF	— Radio Frequency;
PRACH	— Physical Random Access Channel;
RSCP	— Received Signal Code Power;
R_x	— Receiver;
S-CCPCH	— Secondary Common Control Physical Channel;
SCH	— Synchronisation Channel consisting of Primary and Secondary synchronisation channels;
SIM	— Subscriber Identity Module (SIM-card);
SNR	— Signal-to-Noise Ratio;
TFCI	— Transport Format Combination Indicator;
TPC	— Transmit Power Control;
T_x	— Transmitter;
UMTS	— Universal Mobile Telecommunications System;
USB	— Universal Serial Bus;
USIM/UICC	— Subscriber Identity Module for UMTS/Universal Integrated Circuit Card.

5 General

5.1 The conformity of wireless communication modules (GSM modem, UMTS modem and in-band modem) to the requirements of GOST R 54620, [1], [2], [3], and [4] shall be verified within the scope of the tests for an in-vehicle emergency call system (device) those modules belong to.

5.2 The test methods detailed in Sections 6, 7 and 8 may be used for mandatory conformity assurance of an IVS (in regard to functionality of communication modules included in it) in the forms of conformity verification that are provided for in the legislation of the Russian Federation pertaining to communication, and adopted in the ensuing regulatory legal acts.

5.3 IVS tests shall take place in testing laboratories (centres) accredited in accordance with the procedure that has been established in the RF legislations for communication and for accreditation as well as in other RF regulatory legal acts adopted in virtue of the said legislations.

5.4 The test results are included in a test and measurement report where the following is specified:

a) designation, location, telephone, fax and e-mail of testing laboratory (centre);

c) test conditions;

d) description of test and measurement techniques with a reference to a normative document;

e) testing equipment and measuring instruments used in tests;

f) list of sections (clauses and subsections) of RLA that contains the requirements included in the conformity assessment checklist, and the results of conformity assessment for each particular requirement;

g) decision as to whether the item under test meets the stated requirements;

h) title, name and signature of the person who conducted the tests and measurements;

i) title, name and signature of the head of the testing laboratory (centre), affixed with the seal of the laboratory (centre);

j) date of tests and measurements, issue data, and report registration number.

6 Methods used in tests of in-vehicle emergency call system (device) with respect to implementation of GSM modem functions

6.1 Test item

6.1.1 The test item shall be an IVS-GSM sample in part of IVS hardware/software solutions implementing the functionality of the wireless GSM communication module that is included in the IVS and rated for operation at frequencies 900/1800 MHz.

6.1.2 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 manufacturer's QC. Based on the results of sampling, an Act shall be compiled in the form specified in Appendix A.

6.2 Purpose of tests

6.2.1 The tests are aimed at the verification of IVS-GSM conformity to the requirements established in GOST R 54620 (subsection 8.3), [1] and [2].

6.3 Scope of tests

6.3.1 Three IVS-GSM samples shall be submitted to tests after their sampling in accordance with 6.1.2, equipped and completed as per GOST R 54620 (sections 5 and 21, respectively).

Where justified, the number of samples may be decreased as agreed with the testing laboratory.

6.3.2 During the IVS-GSM tests, the conformity is checked against the requirements established for:
- IVS-GSM functional properties and characteristics;
- IVS-GSM electric parameters.

The list of IVS-GSM parameters and functional properties to be checked, the sections of RLA [2] that establish the requirements for them, and the clauses of subsections 6.6 and 6.7 that define the respective test and measurement methods are specified in Table 1.

T a b l e 1 — List of IVS-GSM tests for verification of conformity to established requirements

Parameter (functional property) to be checked	Requirements of [2]	Test method
IVS-GSM electric parameters		
Level of spurious emissions	22	6.6.2
Level of spurious emissions at IVS-GSM antenna connector, in active mode	22	6.6.2.1
Level of spurious emissions at IVS-GSM antenna connector, in standby mode	22	6.6.2.2
Level of spurious emissions from IVS-GSM body without antenna connector, in active mode	22	6.6.2.3
Level of spurious emissions from IVS-GSM body without antenna connector, in standby mode	22	6.6.2.4
Parameters pertaining to frequency and phase in static RF channel, maximum output power, power control levels of transmitting device, synchronisation of transmitted packets, and sensitivity of receiving device	23.1	6.6.3
Levels of IVS-GSM out-of-band emissions due to modulation	23.4	6.6.4
Levels of IVS-GSM out-of-band emissions due to transients during transmitter power switches	13.8	6.6.5

Table 1 (continued)

Parameter (functional property) to be checked	Requirements of [2]	Test method
IVS-GSM functional parameters		
Availability of IMEI number	18	6.7.1
Performance of procedures for call receiving; establishing, maintaining and closing GSM-900 connections; ensuring stability of established GSM-900 connection in cases of channel switchover and of transition to GSM-1800 sub-band	20	6.7.2
Performance of procedures for calling and call receiving; establishing, maintaining and closing GSM-1800 connections; ensuring stability of established GSM-1800 connection in cases of channel switchover and of transition to GSM-900 sub-band	20	6.7.3

6.4 Test conditions and test procedure

6.4.1 The IVS-GSM parameters and functional properties subject to verification in tests shall be checked in normal and in extreme (operating) conditions.

6.4.2 The parameters subject to the requirements established in [2] shall be checked in normal and in extreme (i.e., simultaneous influence of limiting operating temperatures and limiting power supply voltages) conditions.

Normal climatic conditions:

- ambient air temperature: from 15 °C to 30 °C;
- relative humidity: from 20 % to 80 %;
- atmospheric pressure: from 84 to 106.7 kPa (from 630 to 800 Hg mm).

Extreme conditions:

- maximum temperature: not less than 55 °C;
- minimum temperature: not greater than minus 10 °C.

For IVS-GSM powered from a built-in accumulator, the tests shall be carried out at the rated voltage of the accumulator.

Mechanical impacts:

- broadband vibration in (5 ... 20) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3;
- broadband vibration in (20 ... 500) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3 at a 20 Hz frequency and at 3 dB/octave rise above it;

6.4.3 During the tests, an IVS-GSM may be within the following range of its operating temperatures in accordance with the requirements of GOST R 54620 (subsection 13.2.):

- maximum operating temperature: 85 °C;
- minimum operating temperature: minus 40 °C.

6.4.4 Only persons who have passed the safety training and qualified for a safety group not less than 3 in regard to operation with electrical installations rated up to 1000 V may be admitted to operation with testing equipment.

6.4.5 In preparation to tests, the safety (electrical safety, fire safety, etc.) activities as well as the ones related to grounding, metal coating and electrical insulation specified in the documentation for measuring instruments shall be completed.

6.4.6 The following steps shall be taken prior to tests.

6.4.6.1 Turn on the GSM system simulator, and prepare it for operation in accordance with the requirements of its operating documents.

6.4.6.2 Connect the IVS-GSM sample under test to the power supply, and turn on the IVS-GSM.

6.4.6.3 Make sure that the subscriber identification parameters of the ERA-GLONASS operator's virtual network for cellular mobile communication are set in the SIM-card of the IVS-GSM sample under test.

6.4.7 The safety requirements established in GOST R 12.1.019, GOST 12.1.030 and GOST 12.3.019 as well as in [5] shall be observed during the tests.

6.5 Requirements for testing equipment and measuring instruments used in tests

6.5.1 The system simulator of GSM-900/1800 mobile communication networks (hereinafter referred to as the "system simulator") shall meet the requirements of [10 (section A5.3 (Appendix A5))]:

6.5.1.1 The system simulator shall be capable of transmitting standard RF GSM-900/1800 signals modulated by information, service, calling and control digital streams to the IVS-GSM sample under test so as to ensure normal IVS-GSM operation in tests of for all types.

6.5.1.2 The system simulator shall be capable of receiving RF signals from the IVS-GSM, measuring all RF signal parameters, analysing demodulated digital streams, evaluating the probability of errors in them, and identifying the IVS-GSM response to the transmitted commands.

6.5.1.3 The system simulator shall include such functional units as spectrum analyser, protocol analyser and RF level meters.

6.5.1.4 The system simulator shall be controlled from the personal computer.

6.5.1.5 Each type of tests requires generation of a signal set that is sent to the IVS-GSM, and a reference signal set that is used for comparison with the signals received from the IVS-GSM. All these signals shall be stored in memory of the hardware/software complex, and read by commands corresponding to the selected type of measurements.

6.5.1.6 The system simulator shall belong to a measuring instrument type approved in accordance with the RF legislation on ensuring the uniformity of measurements, shall be included in the Federal information fund on ensuring the uniformity of measurements and provided with a check certificate valid as of the date the tests are performed.

6.5.1.7 The hardware and software parameters of the system simulator shall be suitable for its connection with the RF I/O of the IVS-GSM through its antenna interface.

The following operations shall be completed for automatic conformity check of parameters against the requirements specified in [2]:

1) transmission of commands and test digital data streams required for IVS-GSM operation in test mode to the antenna interface of the IVS-GSM under test in dedicated control and data channels;

2) reception of RF signal from the IVS-GSM, assessment of signal parameters, analysis of demodulated digital streams, evaluation of errors in streams, and identification of IVS-GSM response to the transmitted commands;

3) generation of a test signal set transmitted to the IVS-GSM;

4) generation of a reference signal set for comparison with the signals received from the IVS-GSM.

6.5.1.8 Connection between the system simulator and the IVS-GSM under test is established using the basic connection setup and loopback test procedure programmed in the system simulator.

After the connection between the system simulator and the IVS-GSM under test is established, the system simulator display shall, in addition to any other data, indicate the IMEI of the IVS-GSM under test.

6.5.1.9 The parameters of the frequency channels used for IVS-GSM checks are listed in Table 2.

T a b l e 2 — Parameters of frequency channels

Designation of frequency channel range	GSM-900	Extended GSM-900	GSM-1800
Bottom frequency channel	1 —5	975 — 980	513 — 523
Medium frequency channel	60 — 65	60 — 65	690 — 710
Top frequency channel	120 — 124	120 — 124	874 — 884

6.5.2 For the tests of those IVS-GSM that are not equipped with an antenna connecter, a shielded non-contact antenna coupler with a calibrated "antenna/system simulator" link of the following properties:

6.5.2.1 Standing wave factor for flexible cable:

- in the frequency range from 770 to 870 MHz: not greater than 5.0;

- in the frequency range from 870 to 960 MHz not greater than 3.5;

- in the frequency range from 1.7 to 2.2 GHz not greater than 3.5.

6.5.2.2 Flexible cable coupling factor:

- in the frequency range from 770 to 960 MHz (GSM): from 5 to 8 dB;

- in the frequency range from 1.7 to 2.2 GHz (UMTS): from 10 to 15 dB.

6.5.2.3 Shielding efficiency as to antenna connection: above 50 dB.

6.5.3 A screened anechoic chamber is used in the IVS-GSM tests where the required measurement accuracy can not be ensured due to high levels of extraneous electromagnetic fields in the test location.

The chamber shall support the tests in the frequency range from 30 MHz to 12.75 GHz.

6.5.4 The climatic chamber specifications shall be as follows:

- temperature range: from minus 10 °C to plus 55 °C;

- air humidity range: from 45 % to 90 %.

N o t e — The interior volume of the chamber is determined by the dimensions of the IVS-GSM samples under test.

6.5.5 A bench for mechanical impact tests of equipment shall be suitable for the tests of IVS-GSM samples of up to 1000 g in weight, and of dimensions not less than 250 × 150 × 250 mm when packaged.

6.6 Methods of IVS-GSM tests in regard to electric parameters

6.6.1 The electric parameters of the IVS-GSM are checked using the system simulator where the test signals in IVS-GSM direction are generated along with the commands controlling the IVS-GSM test mode and the content of a common signal transmitted by the IVS-GSM when the transmitter and receiver parameters are verified. After the system simulator is switched to a particular test mode, the required signal content in both directions and the signal exchange protocols for test connection setup and maintenance are configured in the system simulator and the IVS-GSM automatically.

6.6.2 Checking level of spurious emissions

6.6.2.1 Checking level of spurious emissions at IVS-GSM antenna connector in active mode

1) Wire the IVS-GSM antenna connector through a calibrated high frequency splitter to the system simulator and to the spectrum analyser.

2) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

3) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

4) Using the system simulator, set frequency channel 62 and send an IVS-GSM command requesting the highest transmission power.

5) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

6) Using the spectrum analyser, measure the spurious emission levels with the IVS-GSM in active mode for GSM-900 taking power level measurements for any discrete signal spectrum component at a 50 Ohm load, above the level 6 dB higher than the ones indicated in [2 (Table 7.1 (Appendix 7))].

7) Check the levels in a frequency range from 100 kHz to 12.75 GHz.

8) Switch to frequency channel 698.

9) Measure the spurious emission levels with the IVS-GSM in active mode for GSM-1800.

In the above measurements, use a five-pole synchronous tuneable filter of the parameters specified in Table 3 to measure the peak power. Select a single active frame for measurements at any frequency.

T a b l e 3 — Requirements for specifications of five-pole synchronous tuneable filter used for checks of spurious emission levels at IVS-GSM antenna connector in active mode

Frequency band	Carrier frequency de-tuning	Filter pass band	Video band
100 kHz —50 MHz	—	10 kHz	30 kHz
50 —500 MHz	—	100 kHz	300 kHz
500 MHz — 12.75 GHz, excluding transmission frequency bands: GSM-900: (890 —915) MHz; Extended GSM: (880 —915) MHz; GSM-1800: (1710 — 1785) MHz; and receive frequency bands: (925 — 960) MHz; (1806 — 1880) MHz.	From 0 to 10 MHz; $\geq$ 10 MHz. $\geq$ 20 MHz; $\geq$ 30 MHz. (de-tuning from transmit band edge)	100 kHz; 300 kHz. 1 MHz; 3 MHz. —	300 kHz; 1 MHz. 3 MHz; 3 MHz. —
in transmit frequency band: GSM-900: (890 —915) MHz; Extended GSM: (880 — 915) MHz; GSM-1800: (1710 - 1785) MHz	from 1.8 to 6 MHz > 6 MHz (de-tuning from carrier frequency)	30 kHz 100 kHz	100 kHz 300 kHz
- N o t e — The bands 925 — 960 MHz and 1805 — 1880 MHz are excluded as they are checked in transmitter tests.			

6.6.2.2 Checking level of spurious emissions at IVS-GSM antenna connector in standby mode

1) Wire the antenna connector of the IVS-GSM under test through a calibrated HF splitter to the system simulator and to the spectrum analyser.

2) Set the system simulator to GSM-900 mode.

3) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

4) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

5) Using the spectrum analyser, measure the spurious emission levels with the IVS-GSM in standby mode for GSM-900 taking power level measurements for any discrete signal spectrum component at a 50 Ohm load, above the level 6 dB higher than the ones indicated in [2 (Table 7.2 (Appendix 7))].

6) Check the levels in a frequency range from 100 kHz to 12.75 GHz.

7) Switch the system simulator to GSM-1800 mode.

8) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

9) Measure the spurious emission levels with the IVS-GSM in active mode for GSM-1800.

In the above measurements, use a five-pole synchronous tuneable filter of the parameters specified in Table 4 to measure the peak power. Select a single active frame for measurements at any frequency.

T a b l e 4 — Requirements for specifications of five-pole synchronous tuneable filter used for checks of spurious emission levels at IVS-GSM antenna connector in standby mode

Frequency band	Filter bandwidth	Video band
from 100 kHz to 50 MHz	10 kHz	30 kHz
from 50 MHz to 12.75 GHz	100 kHz	300 kHz

6.6.2.3 Checking level of spurious emissions from body of IVS-GSM with no antenna connector, in active mode

1) Place the IVS-GSM under test into a shielded non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Wire the antenna connector of the non-contact coupler through a calibrated HF splitter to the system simulator and to the spectrum analyser.

3) Calibrate the transfer factor of the link between the IVS-GSM and the spectrum analyser input.

4) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

5) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

6) Using the system simulator, set frequency channel 62 and send an IVS-GSM command requesting the highest transmission power.

7) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

8) Close the cover of the non-contact antenna coupler.

9) Using the spectrum analyser, measure the spurious emission levels with the IVS-GSM in active mode for GSM-900 taking power level measurements for any discrete signal spectrum component at a 50 Ohm load, above the level 6 dB higher than the ones indicated in [[1 ((Table 7.4) Appendix 7)].

10) Check the levels in a frequency range from 30 MHz to 4 GHz.

11) Switch to frequency channel 698.

12) Measure the spurious emission levels with the IVS-GSM in active mode for GSM-1800.

In the above measurements, use a five-pole synchronous tuneable filter of the parameters specified in Table 4 to measure the peak power. Select at least one active frame for measurements at any frequency.

T a b l e 5 — Requirements for specifications of five-pole synchronous tuneable filter used for checks of spurious emission levels from body of IVS-GSM with no antenna connector, in active mode

Frequency band	Carrier frequency de-tuning	Filter pass band	Video band (approximate)
(30 —50) MHz	—	10 kHz	30 kHz
(50 —500) MHz	—	100 kHz	300 kHz
from 500 MHz to 4 GHz,	(0 — 10) MHz; ≥ 10 MHz.	100 kHz; 300 kHz.	300 kHz; 1 MHz.
excluding transmission frequency bands: P-GSM: (890 — 915) MHz; E-GSM: (880 — 915) MHz; GSM: (1710 — 1785) MHz	≥ 20 MHz ≥ 30 MHz (de-tuning from transmit band edge)	1 MHz 3 MHz	3 MHz 3 MHz
In frequency band: GSM-900: (890 — 915) MHz; Extended GSM: (880 — 915) MHz; GSM-1800:(1710 — 1785) MHz	(1.8 —6) MHz > 6 MHz (de-tuning from carrier frequency)	30 kHz 100 kHz	100 kHz 300 kHz

6.6.2.4 Checking level of spurious emissions from body of IVS-GSM with no antenna connector, in standby mode

1) Place the IVS-GSM under test into a shielded non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Wire the antenna connector of the non-contact coupler through a calibrated HF splitter to the system simulator and to the spectrum analyser.

3) Calibrate the transfer factor of the link between the IVS-GSM and the spectrum analyser input.

4) Switch the system simulator to GSM-900 mode.

5) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

6) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

7) Close the cover of the non-contact antenna coupler.

8) Using the spectrum analyser, measure the spurious emission levels with the IVS-GSM in standby mode for GSM-900 taking power level measurements for any discrete signal spectrum component at a 50 Ohm load, above the level 6 dB higher than the ones indicated in [2 ((Table 7.5) Appendix 7)].

9) Check the levels in a frequency range from 30 MHz to 4 GHz.

10) Switch the system simulator to GSM-1800 mode.

11) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

12) Measure the spurious emission levels with the IVS-GSM in active mode for GSM-1800.

In the above measurements, use a five-pole synchronous tuneable filter of the parameters specified in Table 6 to measure the peak power. Select a single active frame for measurements at any frequency.

T a b l e 6 — Requirements for specifications of five-pole synchronous tuneable filter used for checks of spurious emission levels from body of IVS-GSM with no antenna connector, in standby mode

Frequency band	Filter bandwidth	Video band
(30 — 50) MHz	10 kHz	30 kHz
50 MHz —4 GHz	100 kHz	300 kHz

6.6.3 Checking parameters pertaining to frequency and phase in static RF channel, maximum output power, power control levels of transmitting device, synchronisation of transmitted packets and sensitivity of receiving device

6.6.3.1 GSM-900 mode:

1) Wire the antenna connector of the IVS-GSM under test to the system simulator. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Connect the data port of the system simulator to the data port of the host computer.

3) Turn on the host computer, and launch the system simulator control utility.

4) In the utility settings, set GSM-900 mode, specify initial "antenna/system simulator" link data, list of tests to be performed as well as upper and lower limits of measured parameters, then run the utility.

5) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

6) Using the system simulator, initiate a call to IVS-GSM and answer it by setting the IVS-GSM off-hook.

7) The subsequent checks are performed automatically, and the resulting report that will appear on the computer screen will include the measured parameter values: frequency and phase in static RF channel, maximum output power, power control levels of the transmitting device, synchronisation of the transmitted packet, sensitivity of the receiving device, as well as the data indicating whether the measured parameters correspond to the ones specified in the initial settings.

8) Print the test records for their inclusion in the test report.

6.6.3.2 GSM-1800 mode:

1) Wire the antenna connector of the IVS-GSM under test to the system simulator. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Connect the data port of the system simulator to the data port of the host computer.

3) Turn on the host computer, and launch the system simulator control utility.

4) In the utility settings, set GSM-1800 mode, specify initial "antenna/system simulator" link data, list of tests to be performed as well as upper and lower limits of measured parameters, then run the utility.

5) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

6) Using the multi-purpose RF tester connected to the IVS-GSM, enter number 1234567890 and initiate a call with the system simulator.

7) The subsequent checks are performed automatically, and the resulting report that will appear on the computer screen will include the measured parameter values: frequency and phase in static RF channel, maximum output power, power control levels of the transmitting device, synchronisation of the transmitted packet, sensitivity of the receiving device, as well as the data indicating whether the measured parameters correspond to the ones in specified the initial settings.

8) Print the test records for their inclusion in the test report.

6.6.3.3 The parameters pertaining to the frequency and phase in static RF channel, maximum output power, power control levels of the transmitting device, synchronisation of the transmitted packet and sensitivity of the receiving device shall be checked:

a) for 8PSK modulation (EDGE):

1) in accordance with [10 (clause 13.17)] — for IVS-GSM receiver;

2) in accordance with [10 (clause 14.18.1.1c)] — for IVS-GSM transmitter;

b) in multi-slot operation mode (HSCSD and GPRS):

1) in accordance with [10 (clause 13.16)] — for IVS-GSM receiver;

2) in accordance with [10 (clause 14.16.1.1a)] — for IVS-GSM transmitter.

6.6.4 Checking levels of out-of-band IVS-GSM emissions due to modulation

6.6.4.1 Checking levels of out-of-band IVS-GSM emissions due to modulation in GSM-900 mode

1) Wire the antenna connector of the IVS-GSM under test through a calibrated HF splitter to the system simulator and to the spectrum analyser. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Turn on the system simulator in GSM-900 mode.

3) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

4) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

5) Using the system simulator, set frequency channel 62.

6) Send an IVS-GSM command requesting the highest transmission power.

7) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

8) Using the spectrum analyser, measure the out-of-band IVS-GSM emission levels due to modulation for GSM-900 in accordance with [1 ((Table 10.1) Appendix 10)].

9) Set power level 19.

10) Repeat the measurements specified in 8) for the lowest transmission power level.

11) Repeat the measurements specified in 6) through 10) for bottom and top frequency channels.

6.6.4.2 Checking levels of out-of-band IVS-GSM emissions due to modulation in GSM-1800 mode

1) Wire the antenna connector of the IVS-GSM under test through a calibrated HF splitter to the system simulator and to the spectrum analyser. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Turn on the system simulator in GSM-1800 mode.

3) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

4) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

5) Using the system simulator, set frequency channel 698.

6) Send an IVS-GSM command requesting the highest transmission power.

7) If the IVS-GSM is equipped with an auxiliary low-range receive/transmit device rated for 2.4 GHz, switch it to transmission at the highest power.

8) Using the spectrum analyser, measure the out-of-band IVS-GSM emission levels due to modulation for GSM-1800 in accordance with [1 ((Table 10.2) Appendix 10)].

9) Set power level 19.

10) Repeat the measurements specified in 8) for the lowest transmission power level.

11) Repeat the measurements specified in 6) through 10) for bottom and top frequency channels.

6.6.4.3 The out-of-band component levels of the IVS-GSM due to modulation shall be checked in accordance with [10 (clause 3.17.4)] for 8PSK modulation (EDGE), and in accordance with [10 (clause 3.18.4)] for multi-slot operation (HSCSD and GPRS).

6.6.5 Checking levels of out-of-band IVS-GSM emissions due to transients during transmitter power switches

6.6.5.1 Checking levels of out-of-band IVS-GSM emissions due to transients during transmitter power switches in GSM-900 mode

1) Wire the antenna connector of the IVS-GSM under test through a calibrated HF splitter to the system simulator and to the spectrum analyser. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Connect the sync output of the system simulator to the external sync input of the spectrum analyser. Switch the spectrum analyser to standby mode waiting for external sync signals.

3) Turn on the system simulator in GSM-900 mode.

4) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

5) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

6) Using the system simulator, set frequency channel 62.

7) Send an IVS-GSM command requesting the highest transmission power.

8) Send a command requesting the transmission power switch to the next lower level.

9) Using the spectrum analyser, measure the out-of-band IVS-GSM emission levels due to transients during transmitter power switches for GSM-900 in accordance with [2 ((Table 11.1) Appendix 11)].

10) Repeat the measurements twice decreasing the power by two levels successively.

11) Set power level 19.

12) Send a command requesting the transmission power switch to the next higher level.

13) Repeat the measurements three times increasing the power by three levels successively.

14) Repeat the measurements specified in 7) through 13) for bottom and top frequency channels.

6.6.5.2 Checking levels of out-of-band IVS-GSM emissions due to transients during transmitter power switches in GSM-1800 mode

1) Wire the antenna connector of the IVS-GSM under test through a calibrated HF splitter to the system simulator and to the spectrum analyser. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Connect the sync output of the system simulator to the external sync input of the spectrum analyser. Switch the spectrum analyser to standby mode waiting for external sync signals.

3) Turn on the system simulator in GSM-1800 mode.

4) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

5) Using the multi-purpose RF tester connected to the IVS-GSM, enter an arbitrary number and start the wireless exchange with the system simulator.

6) Using the system simulator, set frequency channel 698.

7) Send an IVS-GSM command requesting the highest transmission power.

8) Send a command requesting the transmission power switch to the next lower level.

9) Using the spectrum analyser, measure the out-of-band IVS-GSM emission levels due to transients during transmitter power switches for GSM-1800 in accordance with [2 ((Table 11.2) Appendix 11)].

10) Repeat the measurements twice decreasing the power by two levels successively.

11) Set power level 15.

12) Send a command requesting the transmission power switch to the next higher level.

13) Repeat the measurements three times increasing the power by three levels successively.

14) Repeat the measurements specified in 7) through 13) for bottom and top frequency channels.

6.6.5.3 The out-of-band component levels due to transients during IVS-GSM transmitter power switches shall be checked in accordance with [10 (clause 3.17.4)] for 8PSK modulation (EDGE) and in accordance with [10 (clause 3.18.4)] for multi-slot operation (HSCSD and GPRS).

6.7 Methods of IVS-GSM tests in regard to functional parameters and properties

6.7.1 Checking availability of International Mobile Station Equipment Identity (IMEI)

1) Wire the IVS-GSM antenna connector to the system simulator. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network. On the system simulator screen, take note of the IMEI code read from the IVS-GSM.

3) Log out of the test network and enter "*#06#" on the multi-purpose RF communication tester connected to the IVS-GSM.

Read the IMEI code on the RF communication tester screen.

4) Compare the IMEI code read by the system simulator with the one displayed on the tester screen.

6.7.2 Checking performance of procedures used for call receiving; establishing, maintaining and closing GSM-900 connections; ensuring stability of established GSM-900 connection in cases of channel switchover and of transition to GSM-1800 sub-band

1) Wire the IVS-GSM antenna connector to the system simulator. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

3) Using the system simulator, start the procedure used to call the IVS-GSM, with the bottom frequency channel selected in the band under test (channel 1 for GSM, channel 975 for E-GSM).

4) When the call from the system simulator arrives at the IVS-GSM, set the IVS-GSM off-hook and establish a wireless data link between the simulator and the IVS-GSM using test GSM signals with Gaussian minimum-shift keying.

5) Using the system simulator, send an IVS-GSM command requesting the highest transmission power, which is power level 5 for GSM-900.

6) Check the stability of wireless communication for 1 min.

7) Using the system simulator, send a command for switching to frequency channel 62 (medium frequency GSM-900 channel) and check the stability of wireless communication for 1 min.

8) Using the system simulator, send a command for switching to frequency channel 124 (top frequency GSM-900 channel) and check the stability of wireless communication for 1 min.

9) Using the system simulator, send a command for switching to frequency channel 512 (bottom frequency GSM-1800 channel) and check the stability of wireless communication for 1 min.

10) Repeat the procedure of 5) through 9) three times.

11) Release the connection by hanging up from the IVS-GSM side.

6.7.3 Checking performance of procedures used for calling and call receiving; establishing, maintaining and closing GSM-1800 connections; ensuring stability of established GSM-1800 connection in cases of channel switchover and of transition to GSM-900 sub-band

1) Wire the IVS-GSM antenna connector to the system simulator. If the IVS-GSM has no antenna connector, use a non-contact antenna coupler with the calibrated "antenna/system simulator" link.

2) Turn on the IVS-GSM, wait until the software loading is complete and the IVS-GSM is logged in the test network.

3) Using the system simulator, start the procedure used to call the IVS-GSM, with the bottom frequency channel selected in the band under test (channel 512).

4) When the call from the system simulator arrives at the IVS-GSM, set the IVS-GSM off-hook and establish a wireless data link between the simulator and the IVS-GSM using test GSM signals with Gaussian minimum-shift keying.

5) Using the system simulator, send an IVS-GSM command requesting the highest transmission power. For GSM-1800, power level 0.

6) Check the stability of wireless communication for 1 min.

7) Using the system simulator, send a command for switching to frequency channel 669 (medium frequency GSM-1800 channel) and check the stability of wireless communication for 1 min.

8) Using the system simulator, send a command for switching to frequency channel 885 (top frequency GSM-1800 channel) and check the stability of wireless communication for 1 min.

9) Using the system simulator, send a command for switching to frequency channel 1 (bottom frequency GSM-900 channel) and check the stability of wireless communication for 1 min.

10) Repeat the procedure of 5) through 9) three times.

11) Release the connection from the system simulator side.

7 Methods used in tests of in-vehicle emergency call system (device) with respect to implementation of UMTS modem functions

7.1 Test item

7.1.1 The test item shall be an IVS-UMTS sample in part of IVS hardware/software solutions implementing the functionality of the wireless UMTS communication module that is included in the IVS and intended for operation in 900 and 2000 MHz bands with duplex frequency separation and frequency-code separation of wireless channels.

7.1.2 Samples submitted to tests shall be selected by an employee of the testing laboratory (certification body) from a batch of finished products that has been accepted by the manufacturer's QC. Based on the results of sampling, an Act shall be compiled in the form specified in Appendix A.

7.2 Purpose of tests

7.2.1 The tests are aimed at the verification of IVS-UMTS conformity to the requirements established in GOST R 54620, [2], [3] and [4].

7.3 Scope of tests

7.3.1 Three IVS-UMTS samples shall be submitted to tests after their sampling in accordance with 7.1.2, equipped and completed as per GOST R 54620 (sections 5 and 21, respectively).

During the IVS-UMTS tests, the conformity is checked against the requirements established for:

- IVS-UMTS electric parameters;

- IVS-UMTS functional properties and characteristics.

7.3.3 The list of IVS-UMTS parameters and functional properties to be checked for 2000 MHz band, the sections of RLA [3] that establish the requirements for them, and the clauses of subsections 7.5 and 7.6 that define the respective test methods are specified in Table 8.

7.3.4 The IVS-UMTS test methods for 900 MHz frequency band that are intended for verification of conformity to the requirements established in [4] are analogous to those described in 7.5 and 7.6.

T a b l e 8 — List of IVS-UMTS tests for verification of conformity to established requirements

Parameter (functional property) to be checked	Requirements of [3]	Test method
IVS-UMTS electric parameters		
Maximum permitted power for different IVS-UMTS classes	13.1, 17	7.5.6
Maximum permitted carrier frequency deviation of subscriber device transmitter from value set by base station or from rated carrier frequency value of frequency channel	13.2, 17	7.5.7
Maximum permitted deviation of actual transmitter power from values determined by level of pilot-signal received from base station and by data received from it	13.3, 17	7.5.8
Maximum permitted values of power control parameters in case of inner loop power control	13.4	7.5.9
Minimum permitted value of output power set in IVS-UMTS using outer and inner loop control	13.5, 17	7.5.10
Maximum permitted transmitter on/off delay upon reception of power control signals of quality below/above established threshold	13.6	7.5.11
Maximum permitted IVS-UMTS power radiated with transmitter turned off	13.7, 17	7.5.12
Permitted temporal variations of radiated power during IVS-UMTS transmitter on/off switches	13.8	7.5.13
Permitted limits of radiated power attenuation in adjacent frequency channels	13.9	7.5.14
Permitted limits of spurious emission of IVS-UMTS	13.10	7.5.15
Maximum permitted value of error vector magnitude	13.11, 17	7.5.16
Maximum permitted value of peak error in code region	13.12, 17	7.5.17
Maximum permitted bit error rate (BER) at signal level of −117 dBm at receiver antenna input (reference level of receiver sensitivity)	14, 17	7.5.18
Maximum transmitter power of auxiliary device built-in into IVS-UMTS	15	7.5.19
IVS-UMTS functional parameters		
Availability of road accident emergency services using IVS-UMTS with subscriber identity module/card (USIM/UICC)	16	7.6.2
Ensuring IVS-UMTS access to transport services of UMTS network	12.1	7.6.3

7.4 Test conditions and test procedure

7.4.1 The IVS-UMTS parameters and functional properties subject to verification in the tests shall be checked in normal and in extreme (operating) conditions.

7.4.2 The following normal conditions shall be maintained during the tests:

a) for influencing climatic factors:

- ambient air temperature, °C: 25 ± 10;

- relative humidity, %: 65 ± 15;

- atmospheric pressure, kPa (Hg mm): 84 ... 107 (630 ... 800).

b) for influencing mechanical factors ([3] (Appendix 9):

- broadband vibration in (5 — 20) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3;

- broadband vibration in (20 — 500) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3 at a 20 Hz frequency and at 3 dB/octave rise above it;

7.4.3 During the tests, an IVS-UMTS may be within the following range of its operating temperatures in accordance with the requirements of GOST R 54620 (subsection 13.2.):

- maximum operating temperature: 85 °C;

- minimum operating temperature: minus 40 °C.

7.4.4 The tests shall be carried out by persons certified in accordance with the established procedure.

7.4.5 Only persons who have passed the safety training and qualified for a safety group not less than 3 in regard to operation with electrical installations rated up to 1000 V may be admitted to operation with testing equipment.

7.4.6 In preparation to tests, the safety (electrical safety, fire safety, etc.) activities as well as the ones related to grounding, metal coating and electrical insulation specified in the operating documentation for measuring instruments shall be completed.

7.4.7 The requirements of GOST 12.1.019, GOST 12.1.030, GOST 12.3.019 and [5] shall be observed during the tests.

7.4.8 The recommended test equipment is listed in Table 9.

T a b l e 9 — Recommended test equipment

Designation of test equipment	Required functions and specifications
UMTS system simulator	Supported system simulator functions: - SDH interfaces including STM-1, STM-1/4, STM-1/4/16; - PDH interfaces (E3, E4); - measurements at ATM levels; - data transfer interfaces of V series; - Ethernet interfaces (10/100/1000 Mbit/s); - IP-channel statistics; - testing Ethernet-stacked VLAN; - testing Ethernet MPLS; - testing Ethernet VoIP (H.323 and SIP); - testing frame relay; - analysis of GSM/GPRS and ISDN alarms.
Shielded anechoic chamber	Frequency range: from 30 MHz to 12.75 GHz
Measuring antenna	Narrow-beam directional antenna rated for (1900—2100) MHz range
Filter for GSM	Feed-through selective rejection filter rated for (890—960) MHz/100W
Spectrum analyser	Frequency range: from 1000 Hz to 5 GHz. Dynamic range, not worse than: - third-order intercept point (TOI): not greater than 25 dBm; - 1 dB compression point: not less than 13 dBm. Adjacent channel leakage ratio (3GPP signal): not less than 84 dB, with noise correction. Support of digital demodulation measurements in the range not less than 20 MHz.

Table 9 (continued)

Designation of test equipment	Required functions and specifications
Circulator	Directional signal splitter for 10 dB
Climatic chamber	Temperature range: from minus 50 °C to 90 °C Humidity range: from 20 % to 90 %
Test bench for mechanical impact tests	For tests of equipment of weight up to 1 kg

7.4.9 The system simulator shall enable the following operations that are necessary for automatic checks of IVS-UMTS parameters against the requirements specified in [3]:

1) sending RF signals modulated by service, calling, control and test data streams required for IVS-UMTS operation in test mode to the antenna interface of the IVS-UMTS under test, in three frequency channels selected for testing (bottom (B), medium (M) and top (T));

2) receiving IVS-UMTS RF signals, assessing RF signal parameters, analysing demodulated digital streams, evaluating probability of errors in them, and identifying IVS-UMTS response to transmitted commands;

3) generating a set of test signals to be sent to IVS-UMTS;

4) generating a set of reference signals to be compared with those received from IVS-UMTS.

Connection between the system simulator and the IVS-UMTS under test is established using the basic connection setup and loopback test procedure programmed in the system simulator.

After the connection between the system simulator and the IVS-UMTS under test is established, the system simulator display shall, in addition to any other data, indicate the IMEI of the IVS-UMTS under test.

7.4.10 The parameters of the frequency channels used for IVS-UMTS checks are listed in Table 10.

T a b l e 10 — Parameters of frequency channels

Designation of frequency channel range	Channel number	Carrier frequency, MHz
Bottom frequency channel (B)	10564	1922.6
Medium frequency channel (M)	10700	1946.4
Top frequency channel (T)	10836	1977.4

7.4.11 The measuring instruments used in tests (system simulator, measuring antenna, spectrum analyser) shall be of a type approved in accordance with the RF legislation on ensuring the uniformity of measurements, shall be included in the Federal information fund on ensuring the uniformity of measurements and checked as of the date the tests are performed.

7.4.12 The testing equipment (climatic chamber and mechanical bench) shall be supplied with an approval certificate as per GOST R 8.568.

7.5 Methods of IVS-UMTS tests in regard to electric parameters

7.5.1 The electric parameters of the IVS-UMTS are checked using the system simulator responsible for generation of test signals transmitted to the IVS-UMTS and commands used to control the IVS-UMTS test mode and the content of a common signal sent by the IVS-UMTS transmitter during the checks of transmitter and receiver parameters. After the system simulator is switched to a particular test mode, the required signal content in both directions and the signal exchange protocols for test connection setup and maintenance are configured in the system simulator and the IVS-UMTS automatically.

When the connection is established, a signal covering the following physical code channels is transferred from the system simulator to the IVS-UMTS: CPICH, P-CCPCH, SCH, S-CCPCH, PICH, and DPCH.

7.5.2 During the measurements intended for checks of transmitter and receiver parameters not related to HSDPA mode, a reference test signal of parameters listed in Table 11 is transferred from the system simulator to the IVS-UMTS.

T a b l e 11 — Parameters of reference test signal

Code channels	Level/level ration
Composite Io channel	minus 93 dBm
CPICH	CPICH_Ec/DPCH_Ec = 7 dB
P-CCPCH	P-CCPCH_Ec/DPCH_Ec = 5 dB
SCH	SCH_Ec/DPCH_Ec = 5 dB
PICH	PICH_Ec/DPCH_Ec = 2 dB
DPCH	minus 103.3 dBm

7.5.3 In the measurements intended for checks of transmitter and receiver parameters not related to HSDPA mode, an IVS-UMTS logical test interface is created whereby a signal of parameters described in Table 12 is transferred from the IVS-UMTS to the system simulator.

T a b l e 12 — Parameters of signal transferred from IVS-UMTS to system simulator

Channel	Parameters	Value
DPDCH	Data rate	12.2 kbit/s
DPDCH	Channel rate	60 kbit/s
DPCCH	Channel rate	15 kbit/s
DPCCH	Slot format	#i0 -
DPCCH/DPDCH	Level ratio	minus 5.46 dB
TFCI	Repeat	23 %

7.5.4 The parameters of a signal transferred from the system simulator to the IVS-UMTS when the connection is established for checks of transmitter parameters are listed in Table 13.

T a b l e 13 — Parameters of signal transferred from system simulator to IVS-UMTS

Code channels	Level with respect to Ior
P-CPICH Ec/Ior	minus 10 dB
P-CCPCH and SCH Ec/Ior	minus 12 dB
PICH Ec/Ior	minus 15 dB
DPCH_Ec/Ior	minus 5 dB
OCNS_Ec/Ior	minus 3.1 dB
HS-PDSCH	off
HS-SCCH_1	off

7.5.5 In the measurements intended for checks of transmitter parameters in HSDPA mode, a signal of parameters listed in Table 14 is transferred from the system simulator to the IVS-UMTS.

T a b l e 14 — Parameters of signal transmitted from system simulator to IVS-UMTS in HSDPA mode

Code channel	Parameter	Value with respect to Ior	Note
P-CPICH	P-CPICH_Ec/Ior	minus 10 dB	—
P-CCPCH	P-CCPCH_Ec/Ior	minus 12 dB	—
SCH	SCH_Ec/Ior	minus 12 dB	Includes P- and S-SCH, power divided between them
PICH	PICH_Ec/Ior	minus 15 dB	—
DPCH	DPCH DPCH_Ec/Ior	Test specific	Reference measuring channel with a rate of 12.2 kbit/s (voice)
DPCH	DPCH DPCH_Ec/Ior	Test specific	Reference measuring channel with a rate of 12.2 kbit/s (voice)
HS-SCCH	HS-SCCH_Ec/Ior	Test specific	—
HS-PDSCH	HS-PDSCH_Ec/Ior	Test specific	—
OCNS	Noise simulator for orthogonal channels	Test specific[1]	Added to signal in order to equalise overall power level

N o t e — [1] The test includes six code channels with the following code numbers and relative levels in dB, respectively: 122/0; 123/-2; 124/-2; 125/-4; 126/-1; 127/-3.

7.5.6 Evaluating maximum permitted power for different IVS-UMTS classes

7.5.6.1 The maximum output power of the IVS-UMTS is checked using the UMTS system simulator in the B, M and T frequency channels when the UMTS module operates in the mode where the high-speed downlink data transmission (HSDPA) is disabled as well as in the mode where the HSDPA is enabled.

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.6.2 Checking IVS-UMTS maximum output power with HSDPA disabled

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish the IVS-UMTS connection to the system simulator following the instructions on the system simulator display, and send a reference measuring signal of parameters listed in Table 15 from the system simulator to the IVS-UMTS.

T a b l e 15 — Parameters of reference measuring signal

Code channels	Level/level ration
Composite Io channel	minus 93 dBm
CPICH	CPICH_Ec/DPCH_Ec = 7 dB
P-CCPCH	P-CCPCH_Ec/DPCH_Ec = 5 dB
SCH	SCH_Ec/DPCH_Ec = 5 dB
PICH	PICH_Ec/DPCH_Ec = 2 dB
DPCH	minus 103.3 dBm

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) Send TPC commands from the system simulator to the IVS-UMTS so as to increase the power up to the maximum value.

5) Send a command from the system simulator to the IVS-UMTS for transmission of a reference measuring uplink signal to the simulator, with the signal parameters specified in Table 16.

T a b l e 16 — Parameters of reference measuring uplink signal

Channel	Parameter	Value
DPDCH	Data rate	12.2 kbit/s
DPDCH	Channel rate	60 kbit/s
DPCCH	Channel rate	15 kbit/s
DPCCH	Slot format	#i0 -
DPCCH/DPDCH	Level ratio	minus 5.46 dB
TFCI	Repeat	23 %

6) From the system simulator, send a command for measuring the maximum IVS-UMTS power in the band near 4 MHz in frequency channels B, M and T.

7) Place the IVS-UMTS into the climatic chamber and repeat the measurement of the IVS-UMTS maximum output power in frequency channel M at the limiting temperature values. An IVS-UMTS powered from an external power supply is tested at the limiting values of its supply voltage.

8) Increase the ambient temperature to 5 °C above the highest permitted value, and measure the IVS-UMTS maximum output power in frequency channel M.

9) The test result is considered satisfactory if the measured power corresponds to the rated power declared by the manufacturer, within the tolerance limits listed in Table 17 for a given IVS-UMTS class in normal and extreme conditions, and also at an ambient temperature exceeding the permitted limit.

T a b l e 17 — Rated value of maximum output power

Power class	Power, dBm	Tolerance, dB
Power class 1	33	+1/-3
Power class 2	27	+1/-3
Power class 3	24	+1/-3
Power class 4	21	+2/-2

7.5.6.3 Testing IVS-UMTS in HSDPA mode

In conditions where the HS-DPCCH is not transmitted, the maximum output power of the IVS-UMTS in HSDPA mode is checked using the procedure specified in 7.5.6.2 (steps 1 through 6).

In conditions where the HS-DPCCH is transmitted, the maximum output power of the IVS-UMTS is checked in accordance with the following procedure:

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.2 (Appendix B).

2) Establish HSDPA connection following the instructions on the system simulator display and sending a signal of content and parameters listed in Table 18 from the system simulator to the IVS-UMTS.

T a b l e 18 — Content and parameters of signal in IVS-UMTS direction in HSDPA mode

Code channels	Level relative to Ior, dB
P-CPICH Ec/Ior	minus 10
P-CCPCH and SCH Ec/Ior	minus 12
PICH Ec/Ior	minus 15
DPCH_Ec/Ior	minus 5
OCNS_Ec/Ior	minus 3.1

3) From the system simulator to the IVS-UMTS, send a reference measuring downlink HSDPA signal of content and parameters specified in Table 19, while from the IVS-UMTS to the system simulator, send a reference measuring uplink signal of a rate equal to 12.2 kbit/s (Table 16) and a composite high-speed channel signal HS-DPCCH ACK/NACK;

T a b l e 19 — Content and parameters of reference measuring downlink HSDPA signal

Code channel	Parameter	Value with respect to Ior	Note
P-CPICH	P-CPICH_Ec/Ior	minus 10 dB	
P-CCPCH	P-CCPCH_Ec/Ior	minus 12 dB	
SCH	SCH_Ec/Ior	minus 12 dB	Includes P- and S-SCH, power divided between them
PICH	PICH_Ec/Ior	minus 15 dB	
DPCH	DPCH DPCH_Ec/Ior	Defined by values β_c, β_d, β_{hs}** used in test	Reference measuring channel with a rate of 12.2 kbit/s (voice)
HS-SCCH	HS-SCCH_Ec/Ior	--"--	
HS-PDSCH	HS-PDSCH_Ec/Ior	--"--	
OCNS	Noise simulator for orthogonal channels*	--"--	Added to signal in order to equalise overall power level
N o t e * — Consists of six code channels with the following code numbers and relative levels in dB, respectively: 122/0; 123/-2; 124/-2; 125/-4; 126/-1; 127/-3; ** — (β_c — power factor of DPCCH control channel; β_d — power factor of DPDCH data channels; β_{hs} — power factor of HS-DPCCH channel.			

The power factor ratios for data channels β_d, control channel β_c and HSDPCH β_{hs} are set as specified in Table 20.

T a b l e 20 — Values β_c, β_d, β_{hs} for check of maximum output power during HS-DPCCH transmission

β_c	β_d	β_c/β_d	β_{hs}
1/15	15/15	1/15	2/15
12/15	15/15	12/15	24/15
13/15	15/15	13/15	26/15
15/15	8/15	15/8	30/15
15/15	7/15	15/7	30/15
15/15	—	15/0	30/15

4) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input, then switch the IVS-UMTS to "mode 2" for loopback test in HSDPA mode, and start the loopback test.

5) To set the values of β_c, β_d, β_{hs} in accordance with Table 20, send a "TRANSPORT CHANNEL RECONFIGURATION" message from the system simulator.

6) From the system simulator to the IVS-UMTS, send power control commands for power increase until the IVS-UMTS transmitter power reaches its maximum level.

7) Start HSDPA data transmission from the system simulator.

8) Measure the maximum IVS-UMTS power.

9) Repeat the above measurement for the values β_c, β_d, $\beta c/\beta_d$, β_{hs} listed in Table 20.

10) Place the IVS-UMTS into the climatic chamber and repeat the measurement of the IVS-UMTS maximum output power in frequency channel M at the limiting temperature values.

If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of its supply voltage.

The test result is considered satisfactory if the measured power corresponds to the rated power declared by the manufacturer, within the tolerance limits listed in Table 21 for a given IVS-UMTS class in normal and extreme conditions.

T a b l e 21 — Maximum output power during HS-DPCCH transmission

Ratio β_c to β_d for any values of β_{hs}	Power class 3		Power class 4	
	Power, dBm	Tolerance, dB	Power, dBm	Tolerance, dB
$1/15 \leq \beta_c/\beta_d \leq 12/15$	+24	+1/-3	+21	+2/-2
$13/15 \leq \beta_c/\beta_d \leq 15/8$	+23	+2/-3	+20	+3/-2
$15/7 \leq \beta_c/\beta_d \leq 15/0$	+22	+3/-3	+19	+4/-2

7.5.7 Evaluating maximum permitted carrier frequency deviation of IVS-UMTS module transmitter from values set by base station or from rated carrier frequency values of frequency channels

7.5.7.1 The deviation of the IVS-UMTS transmitter carrier frequency from the value set by a base station or from the rated carrier frequency value of a channel is checked in channels B, M and T.

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.7.2 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data channel connection following the connection setup procedure and the instructions output on the system simulator display. Set the RF interface parameters specified in Table 15 with the values DPCH_Ec and Ior corrected according to Table 22.

T a b l e 22 — RF interface parameters for frequency deviation measurements

Channel parameter	Value	Unit
DPCH_Ec	minus 117	dBm/3.84 MHz
Ior	minus 106.7	dBm/3.84 MHz

Set the power level of other physical downlink code channels relative to DPCH_Ec as per Table 15.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) From the system simulator to the IVS-UMTS, send power control commands for power increase until the IVS-UMTS transmitter power reaches its maximum level.

5) Send a command to the system simulator for frequency error measurement.

6) Place the IVS-UMTS into the climatic chamber and repeat the frequency error measurement in frequency channel M at the limiting temperature values. If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of its supply voltage.

7) Repeat the frequency error measurement in frequency channel M under exposure to sinusoidal vibration.

The test result is considered satisfactory if the measured relative carrier frequency deviation of the IVS-UMTS transmitter from the carrier frequency of the signal received from the base station, or from the rated carrier frequency of the channel does not exceed $\pm(0.1$ ppm $+ 10$ Hz).

7.5.8 Maximum permitted deviation of actual IVS-UMTS transmitter power from values determined by level of pilot-signal received from base station and data received from it

7.5.8.1 An approximate value of the IVS-UMTS transmitter power is set by internal loop adjustment according to the measured level of the received CPICH pilot signal and to the data in this signal. In this test, the radiated power difference from the value set by the CPICH pilot signal is determined.

7.5.8.2 The transmitter power deviation from the values defined by the pilot-signal level from the base station and the date from it is checked in frequency channels B, M and T.

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.8.3 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Set the initial downlink channel parameters at the received CPICH_RSCP > minus 85 dBm in accordance with Table 23.

T a b l e 23 — Downlink channels with no DPCH channel transmission

Physical channel	Level
Sum of code channels	Ior = -93 dBm (for this test)
CPICH	CPICH_E_c/I_{or} = -3.9 dB
P-CCPCH	P-CCPCH_E_c/I_{or} = -8.3 dB
SCH	SCH_E_c/I_{or} = -8.3 dB
PICH	PICH_E_c/I_{or} = -8.3 dB
S-CCPCH	S-CCPCH_E_c/I_{or} = -5.3 dB

3) In the system simulator, set the cell parameters corresponding to Table 24.

T a b l e 24 — Parameter settings for service cell

Parameter	Units	Cell 1
UTRA RF Channel Number	—	Channel 1
Qqualmin	dB	-24
Qrxlevmin	dBm	-115
UE_TXPWR_MAX_RACH	dBm	21

4) Turn on the IVS-UMTS;

5) After the IVS-UMTS registers and enters standby mode, configure the signal sent by the system simulator to the IVS-UMTS as required in order to measure the deviations of the actual IVS-UMTS transmitter power from the power assigned for a CPICH channel.

6) Connect the IVS-UMTS with the system simulator following the instructions on the system simulator display and using the channel parameters specified in 5).

7) Set the output transmission level of the system simulator so that the I_{or} value is equal to minus 25 dBm/3.84 MHz at the IVS-UMTS input.

8) Send a command to the system simulator requesting it to measure the maximum IVS-UMTS transmission power for the initial RACH preamble, and compare the result with minus 37.7 dBm assigned for a CPICH channel.

9) Repeat the measurements 8) for signal levels at the signal simulator output within the dynamic range limits of the receiver equal to minus 65.7 dBm/3.84 MHz and minus 106.7 dBm/3.84 MHz, and compare the measured values of the maximum IVS-UMTS transmitter power with minus 14 dBm and plus 9 dBm assigned for a CPICH channel.

10) Place the IVS-UMTS into the climatic chamber and repeat the above measurements at the limiting temperature values. If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of its supply voltage.

7.5.8.4 The test result is considered satisfactory if the measured actual transmitter power deviates from the values defined by the level of the pilot-signal and the data received from the base station by no more than ±9 dB at both normal and limiting temperature and supply voltage values, and meets the requirements of [3 (clause 13.3)].

7.5.9 Permitted values of power control parameters in case of inner loop power control

7.5.9.1 In the case of internal loop power control, power control parameters are checked in frequency channels B, M and T.

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.9.2 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data channel connection following the instructions on the system simulator display.

3) Set the uplink power control algorithm in the system simulator to "algorithm 2" mode.

4) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

5) Using the system simulator, send a command for setting the IVS-UMTS output power in the range minus (10 ± 9) dBm as measured at the IVS-UMTS antenna connector. This is achieved by adjustment of the downlink signal level (I_{or}) such that the required output power is obtained by internal loop power control and/or transmission of the respective downlink TPC command from the system simulator.

6) From the system simulator, send a sequence of at least 30 and at most 60 TPC commands starting at a frame boundary, ending after an integer number of frames, and complying with the following requirements:

a) sets of 5 successive TPC "0" or "1" commands at the start of the 1st, 6th or 11th frame slots are not permitted for transmission;

b) at least one set of 5 successive TPC "0" commands does not appear at the start of the 1st, 6th or 11th frame slots;

c) at least one set of 5 successive TPC "1" commands does not appear at the start of the 1st, 6th or 11th frame slots.

7) Send a command to the system simulator for measurements of the maximum IVS-UMTS power in each slot. The permitted difference limits between the average power values in adjacent slots are listed in Table 25 for TPC_cmd "0". The permitted limits of average power variations over ten successive slots are listed in Table 26 for TPC_cmd "0" (region A in Figure 1).

T a b l e 25 — Permitted difference limits for average power in adjacent slots

TPC_cmd	Transmitter power control limits (dB)					
	Step 1 dB		Step 2 dB		Step 3 dB	
	Lower	Upper	Lower	Upper	Lower	Upper
+1	+0.4	+1.6	+0.85	+3.15	+1.3	+4.7
0	-0.6	+0.6	-0.6	+0.6	-0.6	+0.6
-1	-0.4	-1.6	-0.85	-3.15	-1.3	-4.7

T a b l e 26 — Permitted difference limits for average power over ten successive slots for TPC_cmd "0"

TPC_cmd set	Transmitter power control limits after 10 identical sets of TPC_cmd (dB)				Transmitter power control limits after 7 identical sets of TPC_cmd (dB)	
	Step of 1 dB		Step of 2 dB		Step of 3 dB	
	Lower	Upper	Lower	Upper	Lower	Upper
+1	+7.7	+12.3	+15.7	+24.3	+15.7	+26.3
0	-1.1	+1.1	-1.1	+1.1	-1.1	+1.1
-1	-7.7	-12.3	-15.7	-24.3	-15.7	-26.3
0,0,0,0, +1	+5.7	+14.3	—	—	—	—
0,0,0,0, -1	-5.7	-14.3	—	—	—	—
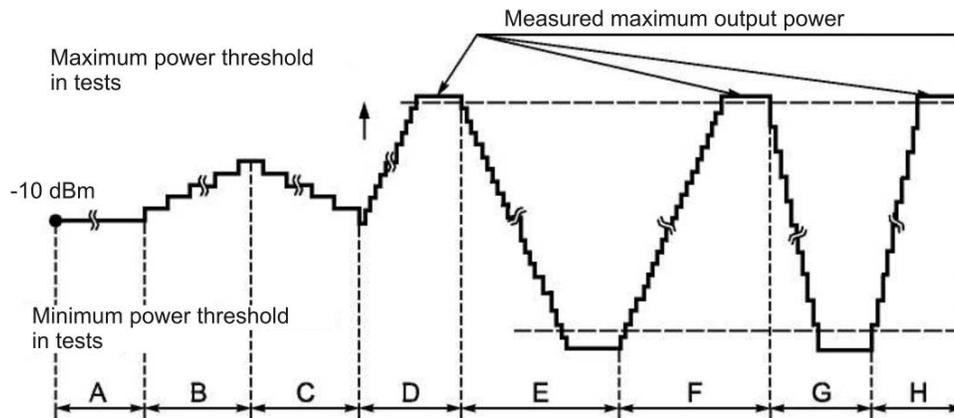
Figure 1

8) From the system simulator, send a sequence of 50 TPC commands consisting of "1". Each fifth command must be "TPC_cmd+1" with a step size of 1 dB, and the remaining ones must be "TPC_cmd 0".

9) Send a command to the system simulator for power measurements in each slot. The permitted difference limits between the average power values in adjacent slots are listed in Table 25. The permitted limits of average power variations over fifty successive slots are specified in Table 26 for "TPC_cmd {0,0,0,0,+1}" (region B in Figure 1).

10) From the system simulator, send a sequence of 50 TPC commands consisting of "0".

11) Send a command to the system simulator for power measurements in each slot. The permitted difference limits for the average power in adjacent slots are specified in Table 25.

12) From the system simulator, send a sequence of 50 TPC commands consisting of "0". Each 5th command must be "TPC_cmd -1" with a step size of 1 dB, and the remaining ones must be "TPC_cmd -0". The permitted limits of average power variations over fifty successive slots are specified in Table 26 for "TPC_cmd {0,0,0,0,-1}" (region C in Figure 1).

13) Set the uplink power control algorithm in the system simulator to "algorithm 1".

14) From the system simulator, send TCP command sequences consisting of "1" until the measured IVS-UMTS output power exceeds the maximum power threshold (region D in Figure 1).

15) From the system simulator, send a sequence of at least 160 TPC commands consisting of "0". The permitted limits of average power variations over ten successive slots are specified in Table 26 for "TPC_cmd {0,0,0,0,-1}" (region E in Figure 1).

16) From the system simulator, send a sequence of at least 160 TPC commands consisting of "1". The permitted difference limits between the average power values in adjacent slots are listed in Table 25 for "TPC_cmd +1" with a step size of 1 dB (region F in Figure 1). The permitted limits of average power variations over ten successive slots for "TPC_cmd +1" command set with a step size of 1 dB are specified in Table 26.

17) From the system simulator, send a "PHYSICAL CHANNEL RECONFIGURATION" message with a command for setting the uplink power control step to 2 dB (power control "algorithm 1" is not changed).

18) From the system simulator, send sequences of at least 85 TCP commands consisting of "0" until the measured IVS-UMTS output power reaches the minimum power threshold (region G in Figure 1). The permitted limits of average power variations over ten successive slots are specified in Table 26 for "TPC_cmd -1" command set with a step size of 2 dB.

18) From the system simulator, send TCP command sequences consisting of "1" until the measured IVS-UMTS output power exceeds the maximum power threshold (region H in Figure 1). The permitted limits of average power variations over ten successive slots for "TPC_cmd +1" command set with a step size of 2 dB are specified in Table 26.

The power variations measured during the above inner loop power control operations are shown in Figure 1.

7.5.9.3 The test result is considered satisfactory if the requirements specified in 7), 9), 11), 12), 15), 16), 18), 19) 7.5.9.2 are met.

7.5.10 Minimum permitted value of output power set in IVS-UMTS using outer and inner loop control

7.5.10.1 The minimum permitted value of the IVS-UMTS output power is checked in frequency channels B, M and T.

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.10.2 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data channel connection following the instructions on the system simulator display.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) From the system simulator, send TCP commands for decreasing the IVS-UMTS transmitter power until it achieves the minimum level.

5) From the system simulator, send a command for IVS-UMTS power measurement.

6) Place the IVS-UMTS into the climatic chamber and repeat the measurement of the IVS-UMTS minimum output power in frequency channel M at the limiting temperature values. If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of the supply voltage.

7.5.10.3 The test result is considered satisfactory if the measured output power is less than minus 49 dBm for normal and limiting temperatures and power supply voltages.

7.5.11 Maximum permitted transmitter on/off delay upon reception of power control signals of quality below/above established threshold

7.5.11.1 The test arrangement is shown in Figure B.1 (Appendix B).

7.5.11.2 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data channel connection following the instructions on the system simulator display.

3) Set the system simulator parameters of IVS-UMTS connection that are required to check that the transmitter is switched off when it receives power control signals of a quality lower than the specified threshold.

4) From the system simulator, send a command to IVS-UMTS requesting the setup of loopback from the receiver output to the transmitter input.

5) From the system simulator, send TPC power control commands to the IVS-UMTS for power increase until the IVS-UMTS transmitter power reaches its maximum level.

6) Change the level of the test signal sent to the UMTS in accordance with the time chart shown in Figure 2. During this process, measure the radiated IVS-UMTS signal level.
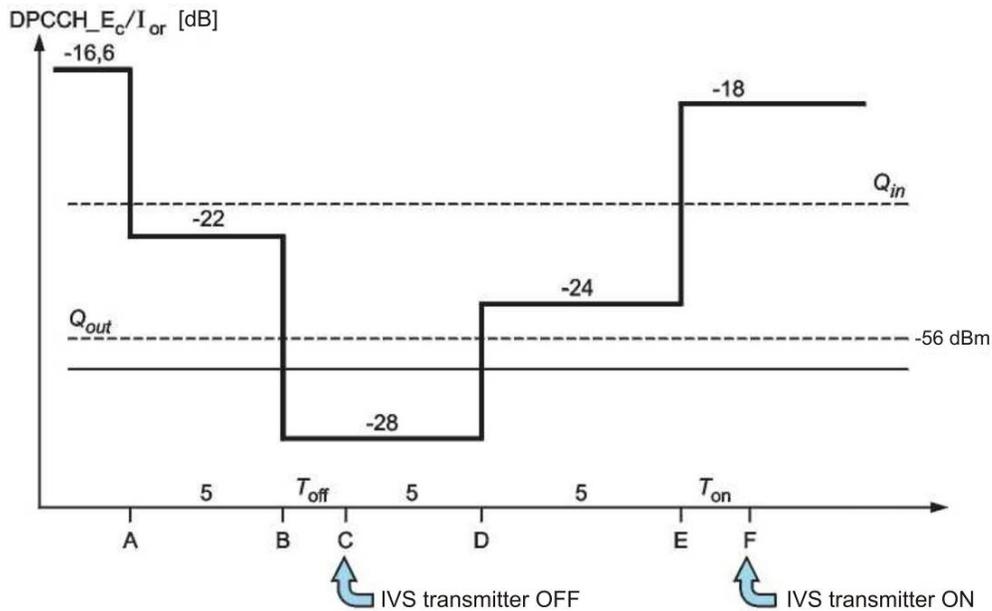
Figure 2

Q_{out} is the low threshold of the received signal quality. If the quality index of the received signal falls below Q_{out}, the IVS-UMTS transmitter will turn off.

Q_{in} — Q_{out} is the hight threshold of the received signal quality. If the quality index of the received signal exceeds Q_{out}, the IVS-UMTS transmitter will turn off.

7.5.11.3 The test result is considered satisfactory if:

1) during the time period from A to B (see Figure 2), the IVS-UMTS transmitter is not turned off;

2) 200 ms after point B, the system simulator confirms that the IVS-UMTS transmitter is off. The system simulator controls the transmitted IVS-UMTS power for 5 s and confirms that the IVS-UMTS transmitter does not turn on during this time and remains off over the time interval from B to E;

3) signal power at the transmitter output does not exceed the value of minus 56 dBm, and the system simulator waits for 200 ms after point E and then confirms that the IVS-UMTS transmitter is turned on.

7.5.12 Maximum permitted IVS-UMTS power radiated with transmitter turned off

7.5.12.1 The tests are carried out to verify that the maximum radiation power of the IVS-UMTS (when the transmitter is off) conforms to the requirements of [3 (clause 13.7)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.12.2 Test procedure

The test is carried out in accordance with 7.5.13.

7.5.13 Permitted variation limits of radiated power during IVS-UMTS transmitter on/off switches

7.5.13.1 The tests are carried out to verify that the variation limits of the radiation power over time (when the IVS-UMTS transmitter is turned on/off) conform to the requirements of [3 (clause 13.8)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.13.2 Test procedure:

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data channel connection following the instructions on the system simulator display.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) Set the test cell parameters of the system simulator as specified in Tables 27 and 28.

T a b l e 27 — Test cell parameters

Parameter	Units	Cell 1
Cell type	—	Service cell
UTRA channel number	—	Channel 1
Qqualmin	dB	-24
Qrxlevmin	dBm	-115
U E_TXPWR_M AX_RACH	dBm	21

T a b l e 28 — Test parameters of system simulator used to check that radiated power corresponds to time mask (ON/OFF)

Parameter	Power class 1	Power class 2	Power class 3	Power class 4	Units
Ior	-106.7	-106.7	-106.7	-106.7	dBm/3.84 MHz
CPICH_RSCP	-110	-110	-110	-110	dBm
Primary P-CPICH DL downlink channel power	+19	+ 19	+19	+19	dBm
Uplink noise level	-86	-92	-95	-98	dBm
Rated power of IVS-UMTS transmitter	+33	+27	+24	+21	dBm

5) Use the system simulator to measure the radiated IVS-UMTS power (with the transmitter off) on a preamble interval of the first and the next two RACH channels ignoring transients. Use the first RACH preamble to determine the preamble arrival time for the next RACH channel.

6) Use the system simulator to measure the IVS-UMTS radiation power (with the transmitter off) through a filter of the "root raised cosine" type, over 2368 chips before the transient 25 us section (96 chips) to the RACH preamble, where the transmitter is switching off. Then use that filter to measure the IVS-UMTS radiation power (with the transmitter off) over 2368 chips after the transient 25 us section (96 chips) from the RACH preamble, where the transmitter was switching on (Figure 2). The permitted limits of the power measured with the transmitter turned on are listed in Table 17 for the respective IVS-UMTS class.

The power with the transmitter off shall not exceed minus 56 dBm.

7) Place the IVS-UMTS into the climatic chamber and repeat the measurement of the IVS-UMTS power in frequency range M with the transmitter off for the limiting temperature values. If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of its supply voltage.

7.5.13.3 The test result is considered satisfactory if:

1) the transmitter power on/off time dependence is within the masks shown in Figures 3 and 4;

2) in power on state, the transmitter power is within the limits indicated in Table 17 for the respective IVS-UMTS class;

3) in power off state, the transmitter power is less than minus 56 dBm for normal and limiting temperatures and power supply voltages.
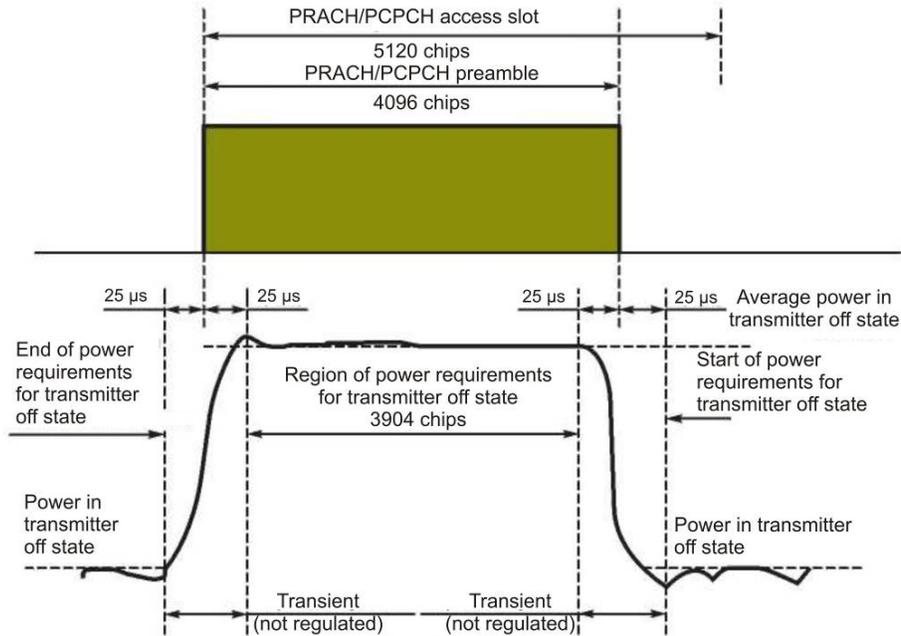
Figure 3
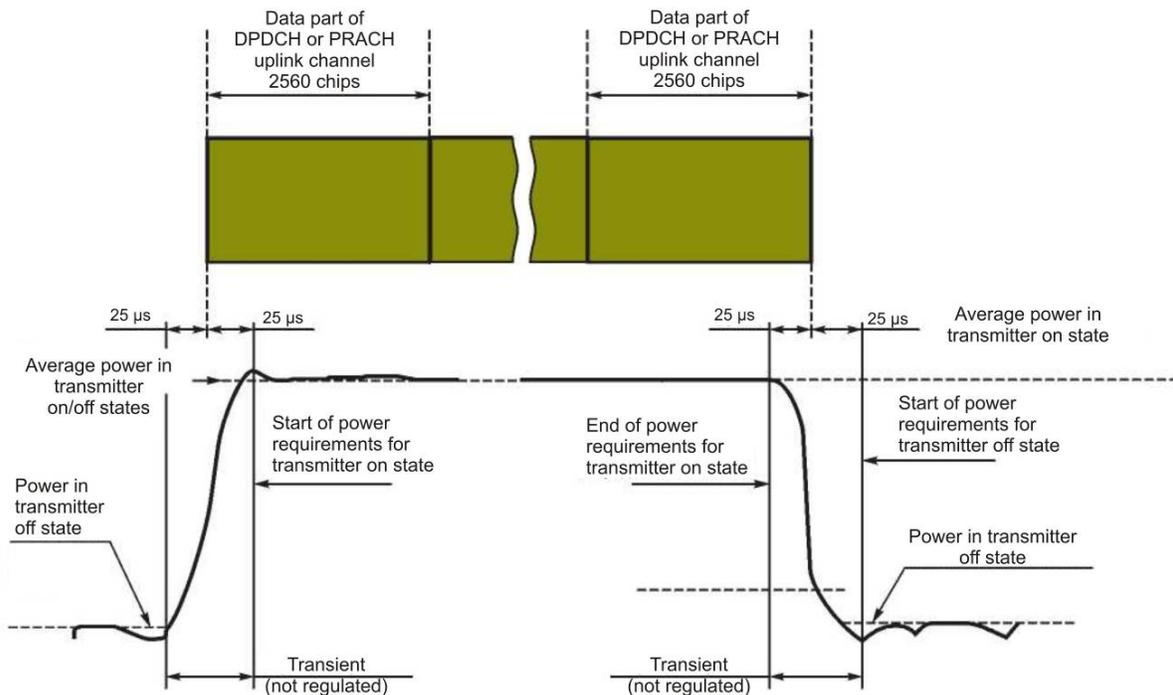
Figure 4

7.5.14 Permitted limits of radiated power attenuation in adjacent frequency channels

7.5.14.1 The test is intended to verify that the attenuation of the power radiated in adjacent frequency channels complies with the requirements of [3 (clause 13.9)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.14.2 Test procedure for IVS-UMTS not supporting HSDPA mode

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data connection between the system simulator and the IVS-UMTS following the instructions on the system simulator display.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) From the system simulator, send TCP commands to the IVS-UMTS for increasing the power until it reaches its maximum value.

5) Measure the radiated power of the IVS-UMTS through the "root raised cosine" filter.

6) Use the same filter to measure the radiated power of the IVS-UMTS in the bands of adjacent frequency channels separated from the operating channel by ±5 MHz and ±10 MHz.

7) Calculate the ratio of the power values measured in 5) and 6), and compare them to the minimum permitted attenuation values listed in Table 29.

T a b l e 29 — Minimum permitted attenuation of radiated power in adjacent channels

Frequency difference between adjacent channels	Minimum permitted attenuation of radiated power in adjacent channels relative to carrier, dBs
+5 MHz or -5 MHz	32.2
+10 MHz or -10 MHz	42.2

7.5.14.3 Test procedure for IVS-UMTS in HSDPA mode

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.2 (Appendix B).

2) Establish an HSDPA connection between the system simulator and the IVS-UMTS following the instructions on the system simulator display.

3) Set the RF interface parameters in accordance with Tables 17 and 18.

4) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input, and start the loopback test.

5) Using the system simulator, set one of the values β_c, β_d or β_{hs} in accordance with Table 20;

6) From the system simulator to the IVS-UMTS, send power control commands to increase the power until it reaches its maximum value.

7) From the system simulator to the IVS-UMTS, send a command to start HSDPA data transmission.

8) Measure the radiated power of the IVS-UMTS through the "root raised cosine" filter. Ignore the measurement results for transient periods.

9) Use the same filter to measure the radiated power of the IVS-UMTS in the bands of adjacent frequency channels separated from the operating channel by ±5 MHz and ±10 MHz.

10) Calculate the ratio of the power values measured in 8) and 9), and compare them to the minimum permitted attenuation values listed in Table 29.

11) Repeat the above measurements for the β_c, β_d and β_{hs} combinations listed in Table 20.

7.5.14.4 The test result is considered satisfactory if the radiated power attenuation in adjacent channels for the said β_c, β_d, β_{hs} combinations is not less than the one specified in [3 (clause 13.9)].

7.5.15 Permitted limits of spurious emission of IVS-UMTS

7.5.15.1 The test is intended to verify that the levels of spurious emissions correspond to the requirements of [3 (clause 13.10)].

The test arrangement is shown in Figure B.3 (Appendix B).

7.5.15.2 Test procedure:

1) Connect the system simulator and the spectrum analyser to the IVS-UMTS through the circulator as shown in Figure B.3 (Appendix B).

2) Establish a data channel connection following the instructions on the system simulator display.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) From the system simulator to the IVS-UMTS, send power control commands for power increase until the IVS-UMTS transmitter power reaches its maximum level.

5) Using the system simulator, send a command requesting the spectrum analyser to scan the frequency range with the measuring filter parameters specified in Tables 30 and 31 and to evaluate spurious emissions in the mentioned frequency ranges.

T a b l e 30 — Main requirements regarding spurious emissions

Frequency range	Measuring band	Minimum requirement
9 kHz ≤ f < 150 kHz	1 kHz	-36 dBm
150 kHz ≤ f < 30 MHz	10 kHz	-36 dBm
30 MHz ≤ f < 1000 MHz	100 kHz	-36 dBm
1 GHz ≤ f < 12.75 GHz	1 MHz	-30 dBm

T a b l e 31 — Additional requirements regarding spurious emissions

Frequency range	Measuring band	Emission level, dBm
(921—925) MHz	100 kHz	-60
(925—935) MHz	100 kHz	-67
(935—960) MHz	100 kHz	-79
(1805—1880) MHz	100 kHz	-71
(2110—2170) MHz	3.84 MHz	-60

7.5.15.3 The test result is considered satisfactory if the spurious emission levels of the IVS-UMTS do not exceed the values specified in [3 (clause 13.10)].

7.5.16 Maximum permitted value of error vector magnitude (EVM)

7.5.16.1 The test is intended to verify that the EVM value corresponds to the requirements specified in [3 (clause 13.11)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.16.2 Test procedure

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data connection in frequency channel B following the instructions on the system simulator display.

3) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

4) From the system simulator to the IVS-UMTS, send power control commands to increase the power (at a step of 1 dB) until the IVS-UMTS transmitter power reaches its maximum value as per Table 17.

5) From the system simulator, send a command to measure and calculate the EVM value.

6) Set the IVS-UMTS power level equal to minus 20 dBm, or send power control commands to the IVS-UMTS requesting the power decrease (with a step of 1 dB) until the IVS-UMTS output power becomes equal to minus (20 dBm ± 1 dB).

7) Repeat the operations described in 5).

8) Repeat the operations described in 2) through 6) for frequency channels M and T.

9) Place the IVS-UMTS into the climatic chamber and repeat the measurement of EVM IVS-UMTS in frequency channel M at the limiting temperature values. The tests are carried out at the limiting values of the power supply voltage.

10) Repeat the EVM measurements for frequency channel M under exposure to the mechanical impacts specified in [3 (Appendix 9)].

7.5.16.3 Test procedure for IVS-UMTS in HSDPA mode

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.2 (Appendix B).

2) Establish an HSDPA connection in frequency channel B following the instructions on the system simulator display.

3) Set the RF interface parameters in accordance with Tables 17 and 18.

4) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input, set the IVS-UMTS in "mode 2" for HSDPA loopback, and start the loopback test.

5) To set the values of β_c, β_d, β_{hs} in accordance with Table 20, send "TRANSPORT CHANNEL RECONFIGURATION" messages from the system simulator.

6) From the system simulator to the IVS-UMTS, send power control commands to increase the power (at a step of 1 dB) until the IVS-UMTS transmitter power reaches its maximum value as per Table 17.

7) Send a command to the system simulator requesting it to start HSDPA data transmission to the IVS-UMTS.

8) Send a command to the system simulator requesting it to measure and calculate the EVM value.

9) Set the transmission power level to minus 20 dBm, or send power control commands from the system simulator to the IVS-UMTS requesting the power decrease with a step of 1 dB until the IVS-UMTS transmitter power becomes equal to minus (20 dBm ± 1 dB).

10) Repeat the measurements specified in 8).

11) Repeat the above measurements for different β_c, β_d, β_{hs} combinations included in Table 20.

12) Repeat the measurements specified in 3) through 11) in frequency channels M and T.

13) Place the IVS-UMTS into the climatic chamber and repeat the measurement of EVM in frequency channel M at the limiting temperature values.

If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of the supply voltage.

14) Repeat the EVM measurement in frequency channel M under exposure to vibration impacts.

7.5.16.4 The test result is considered satisfactory if the measured EVM values do not exceed 17.5 % as specified in [3 (clause 13.11)] for the limiting temperature and power supply voltage values as well as under vibration impacts.

7.5.17 Maximum permitted value of peak error in code region

7.5.17.1 The test is intended to verify that the peak error value in the code region corresponds to the requirements of [3 (clause 13.12)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.17.2 Test procedure:

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Establish a data connection following the instructions on the system simulator display.

3) Set the RF test parameters in accordance with Table 32.

T a b l e 32 — Test parameters

Parameter	Level/state	Units
Uplink signal	Multi-code	—
Data rate	2-384	kbit/s
Power control step	1	dB

4) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

5) From the system simulator to the IVS-UMTS, send power control commands to increase the power until the IVS-UMTS transmitter power reaches its maximum value.

6) Send a command to the system simulator requesting it to measure and calculate the peak error value in the code region.

7) Set the IVS-UMTS power level equal to minus 20 dBm, or send power control commands to the IVS-UMTS requesting the power decrease with a step of 1 dB until the IVS-UMTS output power becomes equal to minus 20 dBm ± 1 dB.

8) Repeat the operations described in 5) and 6).

9) Repeat the measurements specified in 5) through 7) for frequency channels M and T.

10) Place the IVS-UMTS into the climatic chamber and repeat the measurement of the IVS-UMTS peak error in the code region using frequency channel M and the limiting temperature values.

If the IVS-UMTS is powered from an external power supply, the test is performed at the limiting values of the supply voltage.

7.5.17.3 The test result is considered satisfactory if the measured peak error values in the code region do not exceed minus 15 dB as specified in [3] (clause 13.12) for the limiting temperature and power supply voltage values.

7.5.18 Maximum permitted BER at signal equal level of −117 dBm at receiver antenna input (reference level of receiver sensitivity)

7.5.18.1 The test is intended to verify that the BER at the reference sensitivity conforms to the requirements of [3 (clause 14)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.18.2 Test procedure:

1) Connect the system simulator to the IVS-UMTS as shown in Figure B.1 (Appendix B).

2) Set the initial channel conditions with respect to the received CPICH_RSCP exceeding minus 85 dBm.

3) Set the effective power level in downlink physical channels as specified in Table 15. Set the cell parameters in accordance with Table 33.

T a b l e 33 — Cell parameters

Cell type	Units	Service cell
UTRA channel number	—	Channel 1
		Level
Qqualmin	dB	-24
Qrxlevmin	dBm	-79
UE_TXPWR_MAX_RACH	dBm	21
CPICH_ Ec	dBm/3.84 MHz	-60

4) Turn on the IVS-UMTS.

5) Establish a data connection following the instructions on the display of the PC connected to the system simulator.

6) Set the level of the DPCH_Ec<REFSENS> signal to minus 117 dBm/3.84 MHz, and the value of the <REF I_{or} > parameter, to minus 106.7 dBm/3.84 MHz;

7) Send a command from the system simulator to the IVS-UMTS requesting the setup of loopback from the IVS-UMTS receiver output to the IVS-UMTS transmitter input.

8) From the system simulator to the IVS-UMTS, send power control commands for power increase until the IVS-UMTS transmitter power reaches its maximum level.

9) If the IVS-UMTS includes an auxiliary low-range receive/transmit device, the transmitter of that device is turned on at its maximum transmission power.

10) On the system simulator, measure the BER of the DPCH channel received by the IVS-UMTS.

11) Place the IVS-UMTS into the climatic chamber and repeat the measurement of BER in frequency channel M at the limiting temperature values. Use the maximum power supply voltages in the IVS-UMTS tests.

7.5.18.3 The test result is considered satisfactory if the measured BER at the DPCH input signal level equal to the reference sensitivity does not exceed 0.001 as specified in [3 (clause 14)].

7.5.19 Maximum transmitter power of auxiliary device built-in into IVS-UMTS

7.5.19.1 The test is intended to verify that the power of transmitter present in an auxiliary device built-in into the IVS-UMTS meets the requirements specified in [3 (clause 15)].

The test arrangement is shown in Figure B.1 (Appendix B).

7.5.19.2 Test procedure

1) Wire the antenna output of the transmitter of the auxiliary device built-in into the IVS-UMTS to the broadband power meter with an averaging time at least five times greater than the cycle period of transmitter signals.

2) Turn on the transmitter at its maximum radiation power of standard test signals.

3) Record the power meter readings.

7.5.19.3 The test result is considered satisfactory if the measured power does not exceed 2.5 mW.

7.5.20 Levels of spurious emissions

No dedicated measurements are required because the total spurious emissions of the IVS-UMTS transmitter and of the auxiliary device transmitter are measured during the spurious emission test of the IVS-UMTS (see 7.5.15).

7.6 Methods of IVS-UMTS checks in regard to functional parameters

7.6.1 For IVS-UMTS functional parameters subject to the requirements of [3 (clauses 12 and 16)], an integrated check is carried out in a real UMTS network, in operation modes declared by the manufacturer. In addition to each particular functional parameter (availability, continuity and integrity), their interaction is analysed during that check.

7.6.2 Availability of road accident emergency services using IVS-UMTS with subscriber identity module/card (USIM/UICC)

7.6.2.1 The test is intended to verify that that the USIM/UICC functions conform to the requirements of availability during operation in a UMTS network of the MNO, as specified in [3 (clause 16)].

7.6.2.2 Test procedure

Turn on the IVS-UMTS and check that a built-in SIM-card enables the access to the emergency response service registered for that card, within the range of a given UMTS network.

7.6.2.3 The test result is considered satisfactory if the SIM-card built-in into the IVS-UMTS supports the calls of emergency response services.

7.6.3 Ensuring IVS-UMTS access to transport services of UMTS network

7.6.3.1 The test is intended to verify that the requirements specified in [3 (clause 12.1)] are met for IVS-UMTS functions enabling the IVS-UMTS access to transport services of the UMTS network.

7.6.3.2 Test procedure:

1) Turn off the IVS-UMTS and make sure that its network registration completes successfully.

2) Check that the outgoing call succeeds after an emergency call is initiated from the IVS-UMTS under test (by pressing the emergency call button on the user interface module of the IVS under test). Make sure that the call is dispatched correctly, acoustic information signals "Dialup control", "Busy", "Subscriber outside service area" etc. are received, voice communication is set up, and a comfort telephone conversation is possible. Repeat this operation four or five times.

3) Check that the connection is established for an incoming call. For this purpose, enter the number of the IVS-UMTS on the system simulator and make sure that the call is dispatched, voice communication is established, and a comfort telephone conversation is possible. Repeat this operation four or five times.

The test result is considered satisfactory if the above telephony operations with outgoing and incoming calls have completed at a failure rate not exceeding the one permitted for a given UMTS network.

8 Methods used in tests of in-vehicle emergency call system (device) with respect to implementation of in-band modem functions

8.1 Test item

8.1.1 The test item shall be an IVS-modem in part of IVS hardware/software solutions that implement the functionality of a wireless in-band modem included in the IVS; when paired with an in-band modem on the ERA-GLONASS (system operator) side, it ensures reliable MSD transmission to the system operator using voice channels of cellular and PSTN networks. The overall operation flowchart of in-band IVS and operator side modems is shown in Figure C.1 (Appendix C).

Each of the two modems includes a receiver and a transmitter unit. In combination, they create a communication level for applications and for interaction with the system operator.

8.1.2 Samples submitted to tests shall be selected by a representative of the testing laboratory (certification body) from a batch of finished products that has been accepted by the manufacturer's QC. Based on the results of sampling, an Act shall be compiled in the form specified in Appendix A.

8.2 Purpose of tests

8.2.1 The tests are aimed at the verification of the IVS-modem conformity to the requirements established in 8.5 as well as in GOST R 54620 (subsection 8.6), [6], [7] and [8].

8.3 Scope of tests

8.3.1 Three IVS-modem samples shall be submitted to tests after their sampling in accordance with 8.1.2, equipped and completed as per GOST R 54620 (sections 5 and 21, respectively).

Where justified, the number of samples may be decreased as agreed with the testing laboratory.

8.3.2 During the IVS-modem tests, the performance of the receiver and transmitter implementations in the modem shall be checked.

The list of IVS-modem parameters and functional properties to be checked is specified in Table 34.

8.4 Test conditions and test procedure

T a b l e 34 — List of IVS-modem tests

Test type as regards IVS-modem parameter (functional property) to be checked	Test method
Measuring MSD transmission time for AMR-FR and GSM-FR codecs	8.6.2
Measuring MSD transmission time for AMR-12.2 and FR codecs	8.6.3
Measuring MSD transmission time for GSM-HR codec	8.6.4
Measuring MSD transmission time for voice codecs in presence of white noise in channel	8.6.5
Measuring MSD transmission time for various values of PCM signal gain	8.6.6
Checking absence of false emergency call detection due to signalling tones at receiver input of IVS-modem	8.6.7
Testing transmission/reception of PUSH messages from/to IVS-modem	8.6.8
Testing reception of HLACK messages	8.6.9

8.4.1 The IVS-modem parameters and functional properties subject to verification in the tests shall be checked in normal and in extreme (operating) conditions.

8.4.2 The following normal conditions shall be maintained during the tests:

a) in regard to influencing climatic factors:

- ambient air temperature, °C   —   25 ± 10;
- relative humidity, %   —   65 ± 15;
- atmospheric pressure, kPa (Hg mm)   —   84 ... 107 (630 ... 800);

b) in regard to influencing mechanical impacts — [3 (Appendix 9)]:

- broadband vibration in (5 ... 200) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3;

- broadband vibration in (20.. 500) Hz band at vibration acceleration spectrum density of 0.96 m^2/s^3 at a 20 Hz frequency and a 3 dB/octave rise above it.

8.4.3 During the tests, an IVS-modem may be in the following range of operating temperatures in accordance with the requirements of GOST R 54620 (subsection 13.2.):

- maximum operating temperature: 85 °C;
- minimum operating temperature: minus 40 °C.

8.4.4 The tests shall be carried out by persons certified in accordance with the established procedure.

8.4.5 Only persons who have passed the safety training and qualified for a safety group not less than 3 in regard to operation with electrical installations rated up to 1000 V may be admitted to operation with testing equipment.

8.4.6 In preparation to tests, the safety (electrical safety, fire safety, etc.) activities as well as the ones related to grounding, metal coating and electrical insulation specified in the operating documentation for measuring instruments shall be completed.

8.4.7 The requirements of GOST 12.1.019, GOST 12.1.030, GOST 12.3.019, and [5] shall be observed during the tests.

8.4.8 The following testing equipment and measuring instruments are used for IVS-modem tests:

- modem located on the ERA-GLONASS system operator side, included in the system simulator, and compliant with the requirements of [6], [7] and [8];

- multi-purpose RF communication tester enabling the parameter checks against the requirements of GOST R 54620 (subsection 8.6).

8.4.9 The simulator software shall be installed on a PC or a debug module under control of a multi-task real-time operating system.

8.4.10 A set of libraries for enhancement of functional capabilities of the operating system shall include the following software modules (plug-ins):

- TCP/IP plug-in — implements the TCP/IP stack;
- Internet plug-in — enables operation with the network protocols;
- plug-in including both utilities required to assess interference affecting the module and various cryptographic libraries for data encryption and for support of cryptographic protocols;
- plug-in for support of Lua interpreted programming language;
- plug-in for GNSS module control.

8.4.11 The hardware and software used in the tests shall

1) support:

- TCP/IP protocols stack;
- data transmission rate from 300 baud to 115 kbaud;
- 3GPP WCDMA (FDD), 3GPP HSPA and GSM/GPRS/EDGE technologies;
- automatic selection of data transmission rates up to 115 kbit/s;
- AMR and GSM voice codecs.

2) be equipped with:

- at least 8 I/O ports;
- analogue audio inputs (balanced and unbalanced);
- digital audio interface;
- output ringer;
- RF interface;

- RS-232, GPIB, USB 2.0 and Ethernet 10/100 Base-T interfaces;

- tone signal simulator and analyser;

- signal frequency generator (AF);

- speech encoder/decoder;

- spectrum analyser;

- audio signal generator and analyser.

3) enable:

- output signal power amplification (gain);

- noise detection;

- generation of noise signals.

8.4.12 A multi-purpose RF communication tester shall support signal generation and measurements at various signal-to-noise levels, signal power factors and amplitudes (signal gain values).

8.4.13 The hardware and software specifications of the system simulator shall include an interface for interaction with the IVS-modem I/O and enable automatic checks of parameters against the requirements specified in 8.5. Connection between the system simulator and the IVS-modem under test shall be established using the basic connection setup and loopback test procedure programmed in the simulator.

8.4.14 Measuring instruments used in the tests shall conform to GOST R 8.568-97.

8.5 Basic requirements for IVS-modem performance

8.5.1 The maximum MSD size shall not exceed 140 bytes.

8.5.2 The average MSD transmission time MSD (FoM) in each individual transmission test shall not exceed 200 s.

8.5.3 For the subset of error-free tests within the full scope of the test program that pertain to all AMR-FR and GSM-FR codecs, the average MSD transmission time shall not exceed 2.95 s.

8.5.4 For the subset of error-free tests within the full scope of the test program that pertain to AMR 12.2 and FR codecs, the average MSD transmission time shall not exceed 2 s.

8.5.5 For the subset of error-free tests within the full scope of the test program that pertain to GSM-HR codec, the average MSD transmission time shall not exceed 18 s for the channels with compression at C/I ratios from 10, 7 and 4 dB.

8.5.6 At least 100 tests per channel shall be completed to assess the average MSD transmission time.

8.5.7 For the subset of non-error-free tests within the full scope of the test program, the average MSD transmission time shall not exceed 2.95 s provided that the SNR of AWGN is equal to 10 dB.

8.5.8 The average MSD transmission time MSD (FoM) shall not exceed the values specified in Table 35 for the relevant PCM signal gain/attenuation attenuation factors.

8.5.9 The minimum performance requirements presented in Table 35 may only be applied if an IVS-modem and an in-band modem of the system operator are configured for manual emergency calls.

T a b l e 35 — Gain and maximum MSD transmission time for various PCM signal testing setups

Gain, dB	Signal scaling factor	Permitted average transmission time limit, s
-12	0.25	2.95
-6	0.5	2.95
+6	2.0	2.95
+12	4.0	3.30

8.5.10 The CRC shall be checked for each MSD in any test within the scope of the full test program.

8.5.11 Not a single MSD transmission fault may occur for the full test program duration, i.e., none of the MSD transmission times may exceed 200 s

8.5.12 The IVS-modem receiver shall not falsely detect a communication setup message from the system operator when a test tone file is used at the modem input.

8.5.13 At most five SEND messages shall be sufficient to switch the tone modem receiver at the operator side to "Push" mode. The test shall be carried out in test conditions specified for the official test program in a file "official_test_configuration_file.txt".

8.5.14 Each IVS-modem receiver shall be capable of detecting a HLACK acknowledge for at most five HLACK messages from high-level applications.

The test shall be carried out in test conditions specified for the official test program in a file "official_test_configuration_file.txt".

8.6 Test methods for checks of IVS-modem transmitter and receiver performance

8.6.1 Scope of tests

IVS-modem performance testing shall be carried out to verify that the average MSG transmission time corresponds to the normative values specified in [6] and [9].

The average MSG transmission time is used to assess the waveform properties of a signal leaving the demodulator, and to check that the FEC decoder operates correctly.

The transmission time is defined as an interval from the moment when the IVS-modem transmitter writes the first non-zero fragment to an uplink channel to the moment when the MSD message is properly decoded by the modem of the system operator.

The average MSG transmission time for each individual test during testing is limited by 200 s.

This means that if the MSD has not been received correctly after 200 s, the transmission attempt is aborted, and the transmission time is taken equal to 200 s. In this case, such attempt is recorded as a failed one. The minimum number of tests within the scope of this testing shall be 100.

8.6.2 Measuring MSD transmission time for AMR-FR and GSM-FR codecs

8.6.2.1 The test is intended to verify that that the average MSD transmission time for various AMR and GSM-FR speech codec versions does not exceed the maximum permitted MSD transmission time. For all bitrates of AMR and GSM-FR codecs, the average MSD transmission time shall not be greater than 2.95 s. The minimum number of tests within the scope of this testing shall be 100.

The test arrangement is shown in Figure C.2 (Appendix C).

8.6.2.2 Test procedure

1) Connect the measuring equipment (tester) to the IVS-modem as shown in Figure C.2 (Appendix C).

2) Turn on the measuring equipment.

3) Set the required bitrate for the AMR speech codec (after all tests with the AMR codec are complete, do the same for the GSM voice codec);

4) Connect the tester to the IVS-modem transmitter output in order to control output PCM frames. The first non-zero PCM frame after the initialisation is used to start a time counter of MSD message delivery. The tester counts the number of output frames, and increments that counter by 20 ms for each frame. The time counter stops when either the system operator sends a message to the tester notifying that the MSD has been received completely, or after expiration of a 200 s time interval (200×50 frames of the IVS-modem). The time counter value is a sought-for value of the MSD transmission time.

5) Send a test MSD message from the measuring equipment to the in-band modem input.

6) Check that the message has been received on the system operator side and transferred with no errors. A bitwise comparison is made for this purpose between the received and the transmitted reference (test) MSD. The comparison result is stored in the Success_failure_flag column, and may take two values: "YES" or "NO" (with "YES" corresponding to successful transfer, and "NO" to a failed one). The received MSD is stored in the Received_MSD column. All the above data are stored in the measuring equipment.

7) Perform at least 100 tests for each AMR codec bitrate.

8) The test results shall be processed and presented in the form shown in Table 36.

T a b l e 36 — Test results for AMR and GSM-FR codecs

Codec	Bitrate, kbit/s	Full rate flag	Average transmission time, s	Number of measurements	Percentile 95%	Maximum value, s	Number of failures
AMR_10.20	10.20	FR					
AMR_7.95	7.95	FR/HR					
AMR_7.40	7.40	FR/HR					
AMR_6.70	6.70	FR/HR					
AMR_5.90	5.90	FR/HR					
AMR_5.15	5.15	FR/HR					
AMR_4.75	4.75	FR/HR					
GSM_FR	FR	FR					

8.6.2.3 The IVS-modem test result (for an AMR or GSM-FR speech codec) is deemed satisfactory if the average MSD transmission time does not exceed the standardised value of 2.95 s in normal climatic conditions.

8.6.3 Measuring MSD transmission time for AMR-12.2 and FR codecs

8.6.3.1 The test is intended to verify that the average MSD transmission time for various AMR 12.2 and FR speech codec versions does not exceed the maximum permitted MSD transmission time. For given AMR bitrates, the average MSD transmission time shall not be greater than exceed 2 s. The minimum number of tests during this testing shall be 100.

The test arrangement is shown in Figure C.2 (Appendix C).

8.6.3.2 Test procedure

1) Connect the measuring equipment (tester) to the IVS-modem as shown in Figure C.2 (Appendix C).

2) Turn on the measuring equipment.

3) Set the required bitrate for the AMR speech codec.

4) Connect the tester to the IVS-modem transmitter output in order to control output PCM frames. The first non-zero PCM frame after the initialisation is used to start a time counter of MSD message delivery. The tester counts the number of output frames, and increments that counter by 20 ms for each frame. The time counter stops when either the system operator sends a message to the tester notifying that the MSD has been received completely, or after expiration of a 200 s time interval (200×50 frames of the IVS-modem). The time counter value is a sought-for value of the MSD transmission time.

5) Send a test MSD message from the measuring equipment to the in-band modem input.

6) Check that the message has been received on the system operator side and transferred with no errors. A bitwise comparison is made for this purpose between the received and the transmitted reference (test) MSD. The comparison result is stored in the Success_failure_flag column, and may take two values: "YES" or "NO" (with "YES" corresponding to successful transfer, and "NO" to a failed one). The received MSD is stored in the Received_MSD column. All the above data are stored in the measuring equipment.

7) Perform at least 100 tests for each AMR codec bitrate.

8) The test results shall be processed and presented in the form shown in Table 37.

T a b l e 37 — Test results for AMR-12.2 and FR codecs

Codec	Bitrate, kbit/s	Full rate flag	Average transmission time, s	Number of measurements	Percentile 95%	Maximum value, s	Number of failures
AMR_12.20	12.20	FR					
AMR_FR	FR	FR					

8.6.3.3 The IVS-modem test result (for an AMR 12.2 or FR speech codec) is deemed satisfactory if the average MSD transmission time does not exceed the standardised value of 2 s in normal climatic conditions.

8.6.4 Measuring MSD transmission time for GSM-HR codec

8.6.4.1 The test is intended to verify that the average MSD transmission time for the GSM-HR speech codec does not exceed to the maximum permitted MSD transmission time. For this codec, the average MSD transmission time shall not be greater than 18 s. The minimum number of tests during this testing shall be 100.

The test arrangement is shown in Figure C.2 (Appendix C).

8.6.4.2 Test procedure

1) Connect the measuring equipment (tester) to the IVS-modem as shown in Figure C.2 (Appendix C).

2) Turn on the measuring equipment.

3) Configure the GSM-HR voice codec so that the signal power level (C/I) in this channel is C/I = 10 dB for the first group of tests, C/I = 7 dB for the second, and C/I = 4 dB for the third one. The testing is also envisaged when there are no disturbances in the channel, i.e. no errors occur during MSD transmission.

4) Connect the measuring equipment to the IVS-modem transmitter output in order to control output PCM frames. The first non-zero PCM frame after the initialisation is used to start a time counter of MSD message delivery. The tester counts the number of output frames, and increments that counter by 20 ms for each frame. The time counter stops when either the system operator sends a message to the tester notifying that the MSD has been received completely, or after expiration of a 200 s time interval (200×50 frames of the IVS-modem). The time counter value is a sought-for value of the MSD transmission time.

5) Send a test MSD message from the measuring equipment to the in-band modem input.

6) Check that the message has been received on the system operator side and transferred with no errors. A bitwise comparison is made for this purpose between the received and the transmitted reference (test) MSD. The comparison result is stored in the Success_failure_flag column, and may take two values: "YES" or "NO" (with "YES" corresponding to successful transfer, and "NO" to a failed one). The received MSD is stored in the Received_MSD column. All the above data are stored in the measuring equipment.

7) Perform at least 100 tests for each signal-to-noise value.

8) The test results shall be processed and presented in the form shown in Table 38.

T a b l e 38 — Test results for GSM-HR codec

Channel configuration	Average transmission time, s	Number of measurements	Percentile 95%	Maximum value, s	Number of failures
C/I = 4 dB					
C/I = 7 dB					
C/I = 10 dB					
Error free					

8.6.4.3 The IVS-modem test result (for a GSM-HR speech codec) is deemed satisfactory if the average MSD transmission time for each of considered C/I values does not exceed the standardised value of 18 s in normal climatic conditions.

8.6.5 Measuring MSD transmission time for voice codecs in presence of white noise in channel

8.6.5.1 The test is intended to verify that the average MSD transmission time for AMR and GSM speech codecs in conditions of white noise of an SMR equal to 10 dB does not exceed the maximum permitted MSD transmission time. It implies that the noises that may occur in a PSTN analogue line are taken into account. The average MSD transmission time shall not exceed 2.95 s in this test. At least 100 tests for each AMR and GSM codec bitrate shall be carried out for different channel characteristics within the scope of this testing.

The test arrangement is shown in Figure C.3 (Appendix C).

8.6.5.2 Test procedure

1) Connect the measuring equipment (tester) to the IVS-modem and to the in-band modem on the system operator side as shown in Figure C.3 (Appendix C).

2) Turn on the measuring equipment.

3) Apply white noise of 10 dB SNR to the receiver input of the modem on the operator side. The noise is added to the PCM data stream.

4) Configure the speech codec for various signal parameters.

5) The signal parameters at the receiver input of the in-band modem on the operator side are listed in Table 39.

T a b l e 39 — Input signal properties for different speech codecs

Codec, channel property	Standard frequency deviation	Codec, channel property	Standard frequency deviation
Full Rate, 7 dB	1223	AMR7.95, 7 dB	1067
Full Rate, 10 dB	1190	AMR7.95, 10 dB	1059
Full Rate, 13 dB	1167	AMR7.40, 7 dB	988
Full Rate, 16 dB	1156	AMR7.40, 10 dB	971
Full Rate, clean	1181	AMR6.70, 7 dB	954
Full Rate, RSSI	1149	AMR5.90, 4 dB	931
AMR 12.20, 7 dB	1112	AMR5.90, 7 dB	953
AMR 12.20, 10 dB	1129	AMR5.15,4 dB	836
AMR 12.20, 13 dB	1092	AMR 5.15, 7 dB	854
AMR 12.20, clean	1130	AMR 4.75, 1 dB	737
AMR 10.20, 7 dB	1045	AMR 4.75, 4 dB	762
AMR 10.20, 10 dB	1052	AMR 4.75, 7 dB	770
AMR 10.20, 13 dB	994	AMR4.75, RSSI	771

6) Connect the measuring equipment to the IVS-modem transmitter output in order to control output PCM frames. The first non-zero PCM frame after the initialisation is used to start a time counter of MSD message delivery. The tester counts the number of output frames, and increments that counter by 20 ms for each frame. The time counter stops when either the system operator sends a message to the tester notifying that the MSD has been received completely, or after expiration of a 200 s time interval (200×50 frames of the IVS-modem). The time counter value is a sought-for value of the MSD transmission time.

7) Send a test MSD message from the measuring equipment to the in-band modem input.

8) Check that the message has been received on the system operator side and transferred with no errors. A bitwise comparison is made for this purpose between the received and the transmitted reference (test) MSD. The result of such comparison is stored in the Success_failure_flag column, and may take two values: "YES" and "NO" ("YES" for successful transfer, "NO" for a failed one). The received MSD is stored in the Received_MSD column. All the above data are stored in the measuring equipment.

9) Perform at least 100 tests for each speech codec bitrate and different channel parameter values.

10) The test results shall be processed and presented in the form shown in Table 40.

T a b l e 40 — Test results for voice codecs

Codec, channel property	MSD transmission time, s				
	White noise, SNR=10 dB				
	Average transmission time, s	Percentile 95 %	Maximum value, s	Number of measurements	Number of failures
Full Rate, 7 dB					
Full Rate, 10 dB					
Full Rate, 13 dB					
Full Rate, 16 dB					
Full Rate, clean					
Full Rate, RSSI = -100 dBm					
AMR 12.20, 7 dB					
AMR 12.20, 10 dB					
AMR 12.20, 13 dB					
AMR 12.20, clean					
AMR 10.20, 7 dB					
AMR 10.20, 10 dB					
AMR 10.20, 13 dB					
AMR 7.95, 7 dB					
AMR7.95, 10 dB					
AMR 7.40, 7 dB					
AMR 7.40, 10 dB					
AMR6.70, 7 dB					
AMR 5.90, 4 dB					
AMR 5.90, 7 dB					
AMR5.15,4 dB					
AMR5.15, 7 dB					
AMR 4.75, 1 dB					
AMR4.75, 4 dB					
AMR4.75, 7 dB					
AMR 4.75, RSSI = -100 dBm					

8.6.5.3 The IVS-modem test result for AMR and GSM speech codecs is deemed satisfactory if the average MSD transmission time does not exceed the standardised value of 2.95 s in normal climatic conditions.

8.6.6 Measuring MSD transmission time for various values of PCM signal gain

8.6.6.1 The test is intended to verify that the average MSD transmission time does not exceed its maximum permitted value when different values of signal gain and signal scaling factor are applied to input PCM signals (at the modem receiver on the system operator side). In this test, the average MSD transmission time shall not exceed the values specified in Table 41 (third column). At least 100 tests for each gain shall be carried out for each gain value within the scope of this testing.

The test arrangement is shown in Figure C.4 (Appendix C).

8.6.6.2 Test procedure

1) Connect the measuring equipment (tester) to the IVS-modem and to the in-band modem on the system operator side as shown in Figure C.4 (Appendix C).

2) Turn on the measuring equipment.

3) Measure the signal gain and the signal scaling factor in the PCM data stream prior to sending data to the receiver input of the modem on the system operator side. In this procedure, the 16-bit PCM data values shall be amplified/attenuated at a constant gain (see Table 41), and then the modified PCM stream shall be routed to the receiver input of the modem on the system operator side. Signals of a level outside the range of 16-bit PCM (minus 32768 to plus 32767) shall be cut off.

T a b l e 41 — Gain values and average MSD transmission time

Signal gain, dB	Signal scaling factor	Maximum permitted average transmission time, s
-12	0.25	2.95
-6	0.5	2.95
+6	2.0	2.95
+ 12	4.0	3.20

4) Connect the measuring equipment to the IVS-modem transmitter output in order to control output PCM frames. The first non-zero PCM frame after the initialisation is used to start a time counter of MSD message delivery. The tester counts the number of output frames, and increments that counter by 20 ms for each frame. The time counter stops when either the system operator sends a message to the tester notifying that the MSD has been received completely, or after expiration of a 200 s time interval (200×50 frames of the IVS-modem). The time counter value is a sought-for value of the MSD transmission time.

5) Send a test MSD message from the measuring equipment to the in-band modem input.

6) Change the signal gain and the signal scaling factor.

7) Check that the message has been received on the system operator side and transferred with no errors. A bitwise comparison is made for this purpose between the received and the transmitted reference (test) MSD. The result of such comparison is stored in the Success_failure_flag column, and may take two values: "YES" and "NO" ("YES" for successful transfer, "NO" for a failed one). The received MSD is stored in the Received_MSD column. All the above data are stored in the measuring equipment.

8) Perform at least 100 tests for each signal gain and each signal scaling factor.

9) The test results shall be processed and presented in the form shown in Table 42.

T a b l e 42 — Test results for various levels of signal gain

Gain, dB	Signal scaling factor	Average transmission time, s	Percentile 95 %	Maximum value, s	Number of measurements	Number of failures
-12	0.25					
-6	0.5					
+6	2.0					
+12	4.0					

8.6.6.3 The result of the IVS-modem test for gain changes is deemed satisfactory if the average MSD transmission time does not exceed the value specified in Table 40 for normal climatic conditions.

8.6.7 Checking absence of false emergency call detection due to signalling tones at receiver input of in-band modem

8.6.7.1 The test is intended to verify that no false detection of emergency calls occurs when signalling tones are present at the receiver input of the IVS-modem. For this purpose, a modem simulator is connected to the IVS-modem input. At least 100 tests shall be carried out within the scope of this testing.

The test arrangement is shown in Figure C.5 (Appendix C).

8.6.7.2 Test procedure

- load the test data from the file "EU_DTMF_tones.rawpcm" with recorded test tones to the modem simulator. The test file "EU_DTMF_tones.rawpcm" is included in [6]. The test tones are transmitted in error-free AMR 12.2 kbit/s encoding;

- disable discontinuous transmission (DTX) when the test tone transmission is initiated;

- repeat the test at least 100 times.

8.6.7.3 The result of the in-band modem test for false emergency call detections due to signalling tones at its receiver input is deemed satisfactory if no false operation has occurred for 100 test transmissions in normal climatic conditions.

8.6.8 Testing bandwidth for PUSH message transmission/reception from/to IVS-modem

8.6.8.1 The test is intended to verify that no false detection of emergency calls occurs when signalling tones are present at the receiver input of the IVS-modem. For this purpose, a tester connected to the IVS-modem is used. At least 100 tests shall be carried out within the scope of this testing.

The test arrangement is shown in Figure C.6 (Appendix C).

8.6.8.2 Test procedure

1) Connect the in-band modem tester to the console connector of the IVS-modem.

2) Switch the IVS-modem and the modem on the system operator side to PUSH mode.

3) From the tester, send a command to the IVS-modem transmitter instructing it to transmit a request to the receiver of the modem on the system operator side.

4) The IVS-modem transmitter sends the above request (switching to PUSH mode).

5) The IVS-modem receiver gets an acknowledgement from the modem on the system operator side confirming that the latter is ready to receive an MSD ("START") message.

6) The IVS-modem sends an "Ok!" message to the tester if no more than five transmission requests have been sent from the IVS-modem to the modem on the system operator side before the "START" reply is received from it. Otherwise, a "Timeout" message arrives.

7) The number of tests shall be at least 100.

8.6.8.3 The result of in-band modem bandwidth checks for sending PUSH and receiving PULL requests is deemed satisfactory if no more than five "START" messages from the IVS-modem have been received upon the reception of PULL request (i.e., a "START" message) from the modem on the system operator side, and the IVS-modem transmitter has not entered standby mode.

8.6.9 Testing reception of HLACK messages

8.6.9.1 The test is intended to verify that the IVS-modem receiver is able to reliably acquire at most five HLACK messages from the modem on the operator side upon successful MSD transmission. This test is performed for conditions included in the "official_test_configuration_file.txt", using a tester connected to the IVS-modem. At least 100 tests shall be carried out within the scope of this testing.

The test arrangement is shown in Figure C.7 (Appendix C).

8.6.9.2 Test procedure

1) Connect the in-band modem tester to the console connector of the IVS-modem.

2) Switch the IVS-modem and the modem on the system operator side to PUSH mode.

3) From the tester, send a control command to the IVS-modem transmitter instructing it to transfer test files to the receiver of the modem on the system operator side.

4) The IVS-modem transmitter sends the test files (MSD message) to the receiver of the modem on the system operator side. If the MSD is received successfully, the in-band modem on the operator side sends a low level acknowledgement LL-ACK followed by a high level acknowledgement HLACK.

5) The IVS-modem receiver detects the file reception acknowledgements by analysing the HLACK messages received from the modem on the system operator side.

6) The IVS-modem sends an "Ok!" message to the tester if no more than five HLACK messages are required for reliable confirmation that the test files have been received. Otherwise, "Timeout" or "Fail" messages arrive.

7) The number of tests shall be at least 100.

8.6.9.3 The result of the in-band modem test for reliable IVS-modem reception of acknowledgments from the transmitter of the modem on the system operator side upon successful MSD message transmission is deemed satisfactory if the number of HLACK acknowledgment messages is not greater than five.

Appendix A
(normative)

Format of Act of Sampling for tests of in-vehicle emergency call systems (devices)

ACT OF SAMPLING

_____
(product designation)

1. Name and subordination of product manufacturer enterprise _____
_____

2. Name of organisation (subdivision) where products have been sampled _____
_____

3. Product type designation _____
(mass production, batch of particular size

_____ batch size _____
or production unit)

4. Title of document underlying product manufacture _____

5. Purpose of product submission to tests _____

6. Sampling location _____ date _____

No. of samples _____

7. Visual inspection results _____

8. No. of document _____

and date of sample acceptance by testing laboratory _____

9. Sampling performed using "maximum impartiality sampling" method as per GOST 18321; samples sealed

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

11. Samples shipment date to TL _____

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

Representative of Applicant   **Representative of Testing Laboratory**

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

Appendix B
(normative)

Structural flowcharts of test beds and connections for tests of in-vehicle emergency call systems (devices) as regards implementation of UMTS modem functions
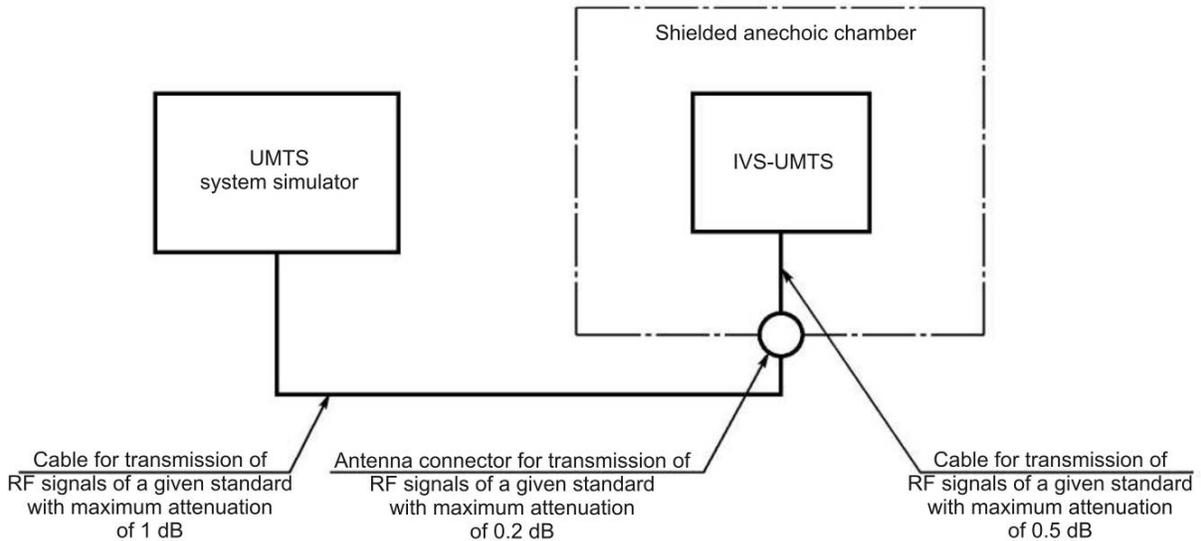
Figure B.1 — Arrangement for IVS-UMTS tests using UMTS system simulator
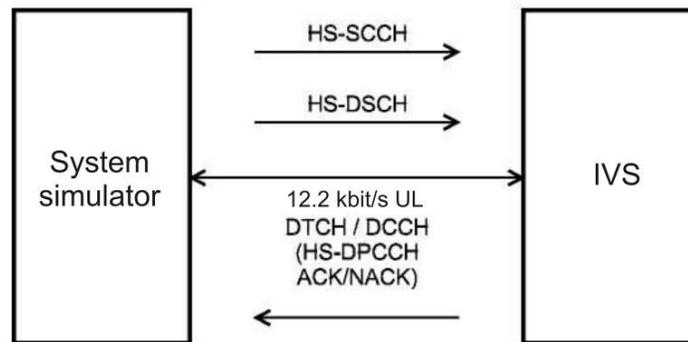
Figure B.2 — Arrangement for IVS-UMTS tests pertaining to evaluation of maximum output power in HSDPA mode
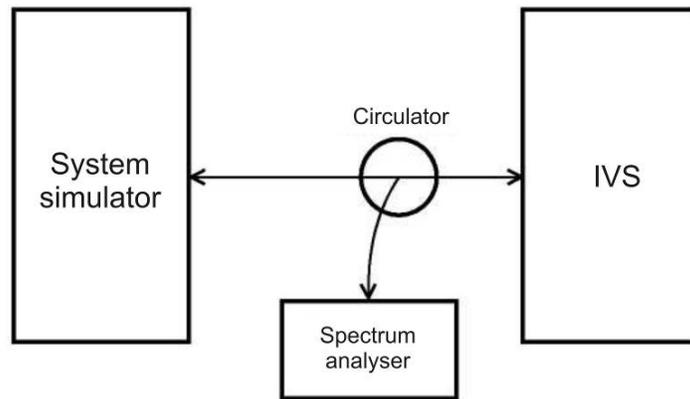
Figure B.3 — Arrangement for IVS-UMTS tests pertaining to evaluation of maximum permitted levels of IVS-UMTS out-of-band emissions

Appendix C
(normative)

Structural flowcharts of test beds and connections for tests of in-vehicle emergency call systems (devices) as regards implementation of in-band modem functions
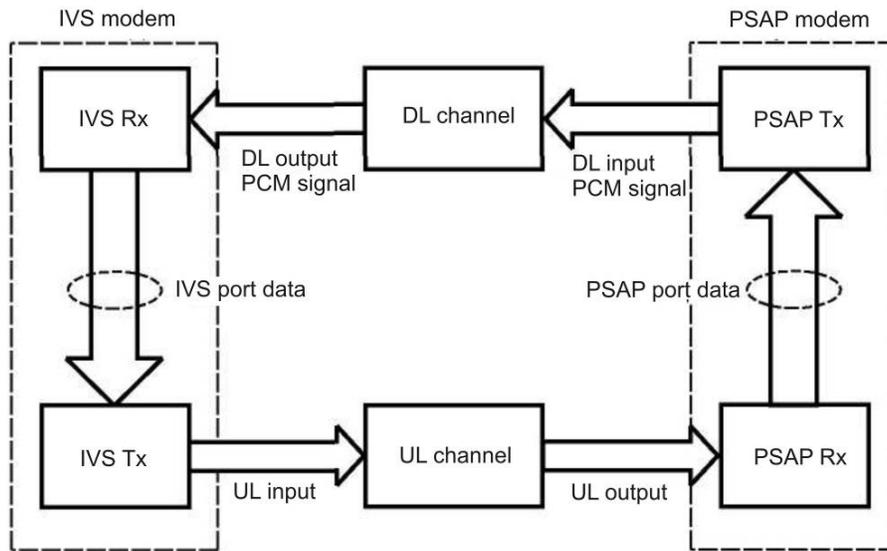
Figure C.1 — General flowchart of in-band modem operation
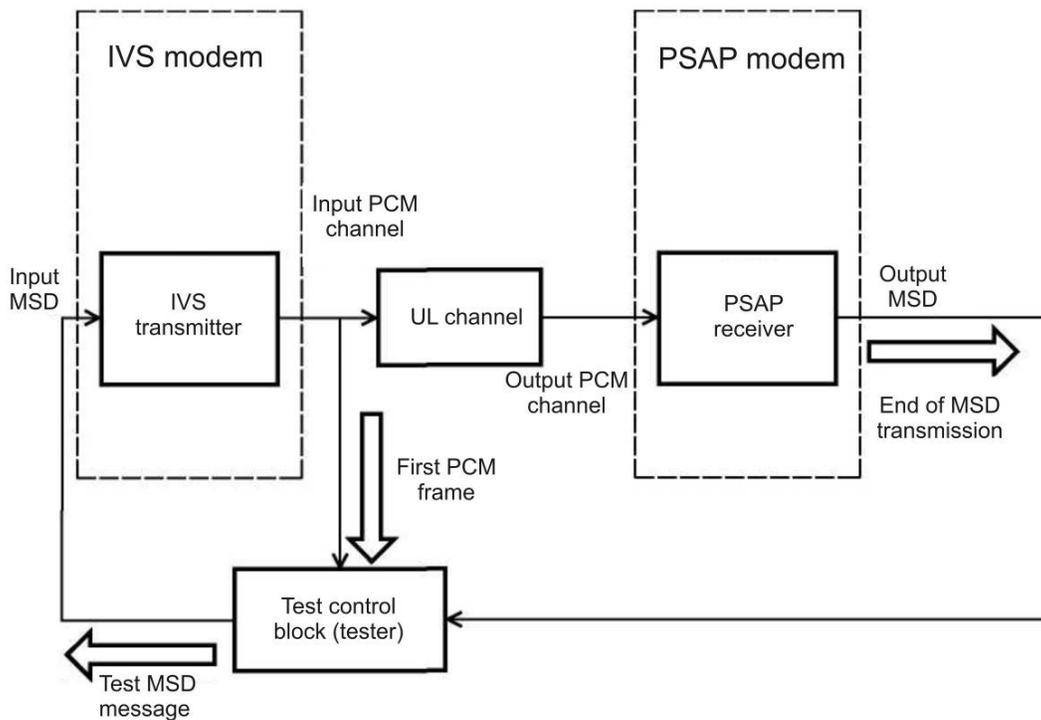
Figure C.2 — General test arrangement for evaluation of average MSD transfer time
for various AMR and GSM-FR speech codecs
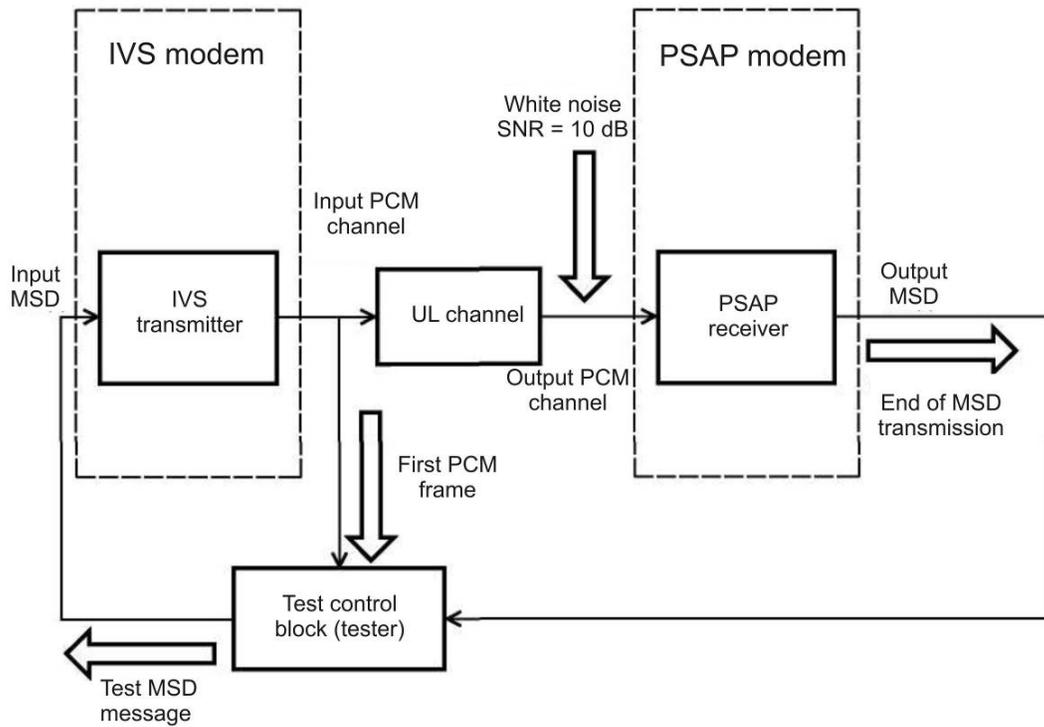
Figure C.3 — General test arrangement for testing under exposure to white noise
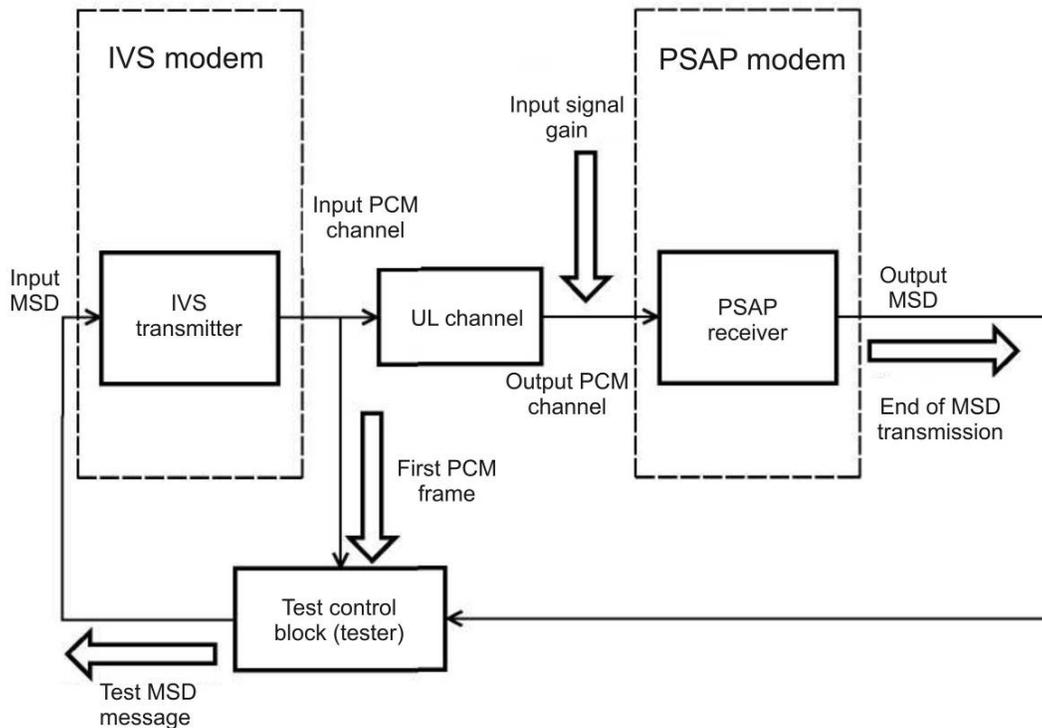
Figure C.4 — General test arrangement for measurement of MSD transmission time
for different values of PCM signal gain
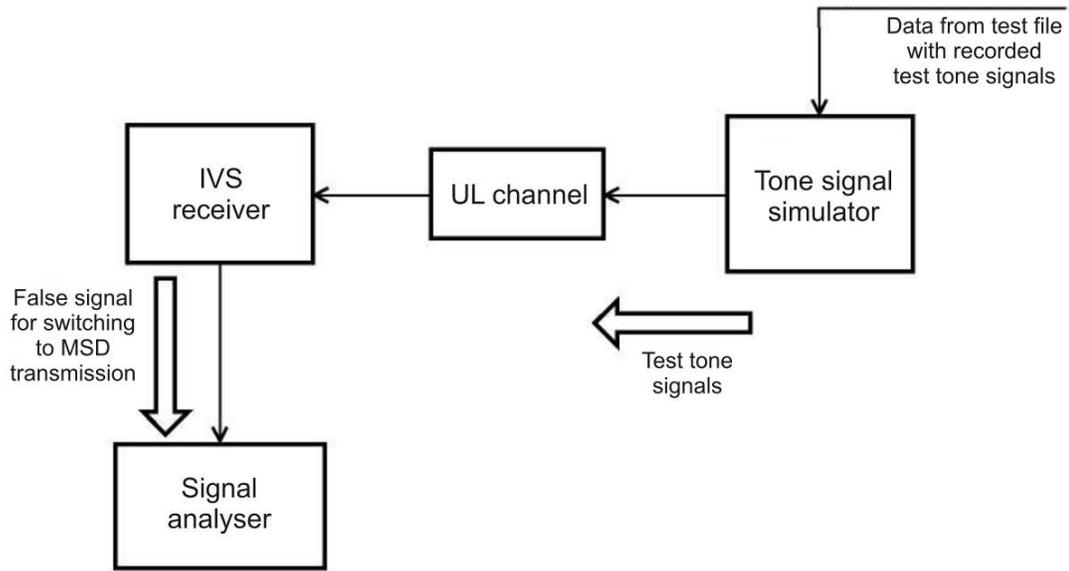
Figure C.5 — General test arrangement for check of false emergency call detection with signalling tones present on receiver input of in-band modem
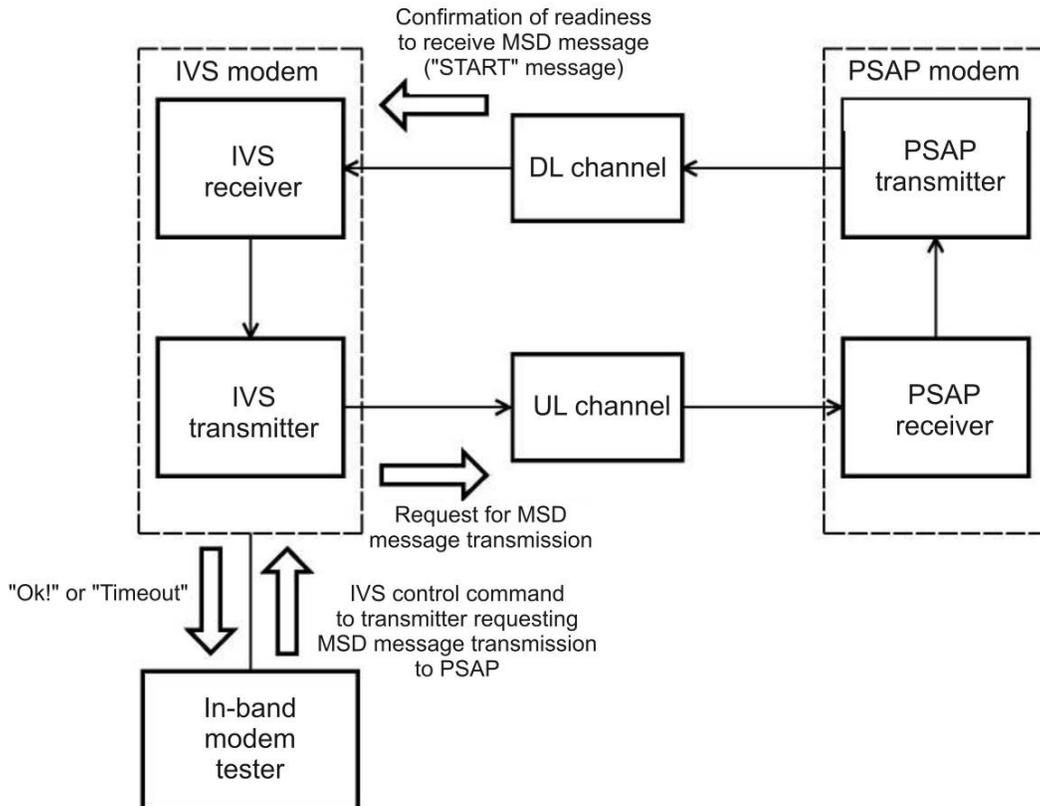
Figure C.6 — General test arrangement for check of PUSH message transmission/reception from/to in-band IVS modem
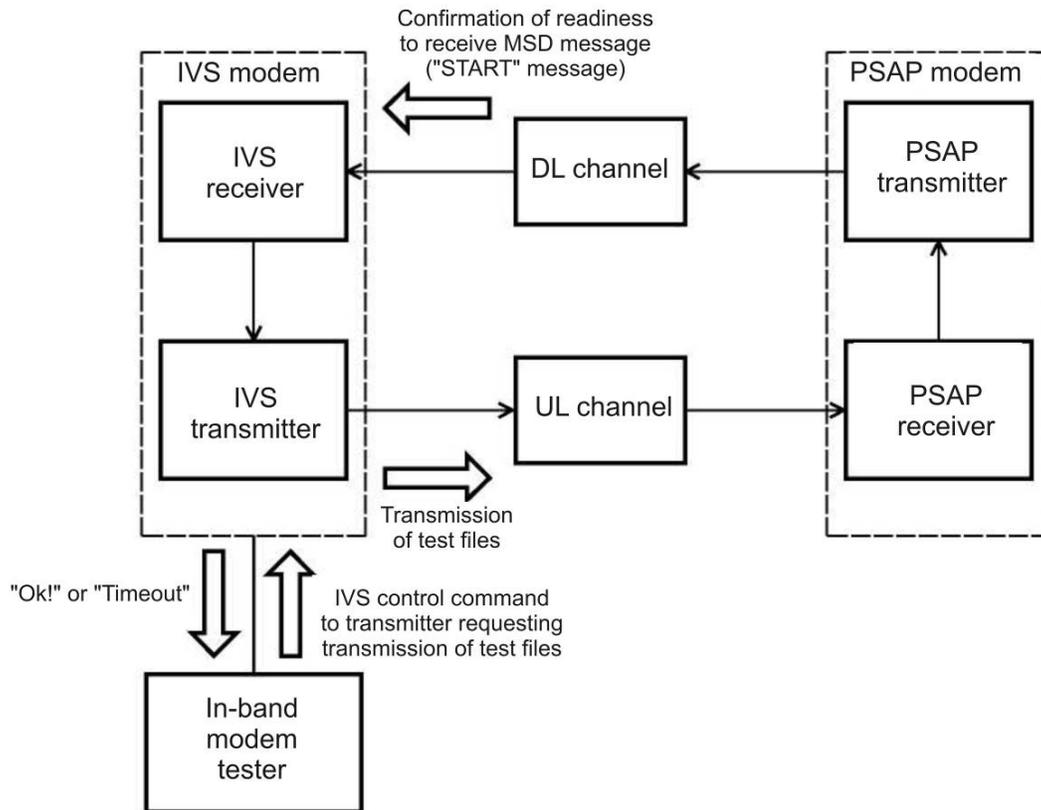
Figure C.7 — General test arrangement for check of HLACK message reception

Bibliography

[1] ТР ТС 018/2011   Technical Regulation of the Customs Union "On safety of wheeled vehicles"

[2] Regulations for use of subscriber stations (subscriber RF stations) in GSM-900/1800 mobile communication networks (approved by Order No. 21, dated 19.02.2008, of Ministry of information technologies and communications of the Russian Federation).

[3] Regulations for use of subscriber terminals in UMTS mobile communication networks with duplex frequency separation and frequency-code separation of RF channels operating in 2000 MHz band (approved by Order No. 100, dated 27.08.2007, of Ministry of information technologies and communications of the Russian Federation).

[4] Regulations for use of subscriber terminals in UMTS mobile communication networks with duplex frequency separation and frequency-code separation of RF channels operating in 900 MHz band (approved by Order No. 257, dated 13.10.2011, of Ministry of information technologies and communications of the Russian Federation).

[5] ПОТ РМ-016—2001 Inter-branch guidelines on occupational safety (safety rules) during
   РД 153-34.0-03.150-00 operation of electrical installations.

[6] ETSI TS 126 269   Digital cellular telecommunications system (Phase 2+); Universal Mobile
   (3GPP TS 26.269) Telecommunications System (UMTS); eCall data transfer; In-band modem
             solution; Conformance testing.

[7] ETSI TS 126 267   Digital cellular telecommunications system (Phase 2+); Universal Mobile
   (3GPP TS 26.267) Telecommunications System (UMTS); eCall data transfer; In-band modem
             solution; General description.

[8] ETSI TS 126 268   Digital cellular telecommunications system (Phase 2+); Universal Mobile
   (3GPP TS 26.268) Telecommunications System (UMTS); eCall data transfer; In-band modem
             solution; ANSI-C reference code.

[9] EN 16062   Intelligent transport systems — eSafety — eCall high level application
             requirements (HLAP).

[10] 3GPP TS 51.010-1 Technical Specification Group GSM/EDGE Radio Access Network; Digital
   V10.3.0 (2012-12) cellular telecommunications system (Phase 2+); Mobile Station (MS)
             conformance specification; Part 1: Conformance specification; Release 10.