Compatable multisystem user equipment of the global navigation satellite systems

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Working Group B, 18 October 2010, Turin, Italy

Joint Stock Company
Institute of Space Device Engineering
GLONASS/GPS constellation, visible SV
Turin, 18.10.2010

Field of view ±80° from zenith
GLONASS/GPS constellation, visible SV
Turin, 18.10.2010

Field of view ±40° from zenith
Average number of the visible SV
Complete constellations; 1000000 points;
equally probable distribution on the earth surface and time (8 days)

\[ \sum = 25.94 \]

\[ \sum = 16.64 \]

\[ \sum = 9.17 \]

\[
\begin{array}{c}
\text{N} \\
8 \\
7 \\
6 \\
5 \\
4 \\
3 \\
2 \\
1 \\
0 \\
\text{Elevation angle, degree}
\end{array}
\]

\[
\begin{array}{c}
\text{GPS} \\
\text{GPS+GLONASS} \\
\text{GPS+GLONASS+GALILEO}
\end{array}
\]
Functions and capabilities:
3 serial ports RS-232 (exchange rate 2400..115200 bit/s) maintain the following exchange protocols dedicated for the reception and transmission mode:
- binary protocol with a capability to transmit raw measurements;
- NMEA0183 symbolic protocol to receive and transmit the navigation data;
- RTCM SC104 reception and transmission of differential correction errors.
Time tagging to be synchronized on the time scale of GLONASS, GPS, UTC, UTC SU.
Time tagging 10Hz capability to be synchronized on the same scales.

Specifications:
GLONASS - L1 band; GPS - L1 band
32 all-in-view receiving channels provided for the channels configured independently for reception:
- GLONASS ITT-code,
- GPS C/A-code,
- WAAS/EGNOS-codes.
Built-in RAIM algorithm: Positioning accuracy of coordinates/altitude in the off-line mode (СКО):
- GLONASS 10 m
- GPS 10 m
Positioning accuracy of coordinates/altitude in the differential mode (СКО):
- 1-3 / 2-5m
Positioning accuracy of a velocity vector:
- GLONASS 0,005 m/s
- GPS 0,005 m/s
Time of initial positioning under cold start - no more than 50 s.
Time restart after short miss of a satellite signal - no more than 5 s.
Update rate of navigation data transmitted - 0,1...10 Hz.
Transmission of navigation data: geodetic coordinate system BLH, rectangular geocentric coordinates XYZ, Gauss-Kruger projection XYH.
Systems of coordinates: PZ-90, CK-42,CK-95, WGS-84, WGS-72, and others (totally 64). Capability to determine an ellipsoid parameter for a user.

Operational performance:
Operation temperature from −40 up to +70°C
Storage temperature from −60 up to +80°C
Humidity 98% (at 25°C);
Single-board miniature GLONASS/GPS 24-channels navigation receiver “CH-4706”

Single-board 24-channels navigation receiver CH-4706 is intended for integrating to different systems. As a navigation sensor, CH-4706 provides current positioning (latitude, longitude, altitude), user velocity vector, as well as current time value through the SNS GLONASS, GPS and SBAS.

The receiver is intended to be applied consisting of the following equipment:
- Antitheft car facilities;
- Base stations for mobile communication;
- Monitoring complexes for vehicular and railway traffic;
- Stations for access WiFi, WiMAX and others;
- Other communication equipment.

Functions and capabilities:
The CH-4706 module comprises:
- Independent channels to receive the signals of SNS GLONASS and GPS, that is requisite for providing an enhanced interference immunity resistance;
- High-quality built-in RAIM algorithms are oriented for low-dynamics objects.

The navigation receiver CH-4706 provides solving of the following tasks:
- Reception and processing of the SNS GLONASS, GPS, SBAS (EGNOS/WAAS/MSAS) signals via the open civil codes CT and C/A at the band of L1;
- Automatic continuous generation of coordinates (latitude, longitude, altitude), current time, course and velocity;
- Displaying the current coordinates on the external facilities in the coordinate system WGS-84, Г3-90, СК-42, СК-95;
- Updating of coordinates with the frequency of 1, 2 and 5 Hz;
- Almanac reception, storage and updating of the SNS GLONASS, GPS and SBAS;
- Data exchange with external systems via the NMEA 0183 protocol (IEC 1162) or via the BINR binary protocol, developed by the design engineering bureau NAVIS;
- Reception and calculation of updated data based on RTCM-104V2.2 recommendations;

Technical characteristics:

| Number of receiving channels: | 24 |
| Mode: All – in – view |
| GLONASS: L1-band (1592-1610 MHz), CT – code |
| GPS/WAAS/EGNOS: L1-band (1575.42 MHz), C/A-code |
| Positioning accuracy (CKO): |
| - Plane coordinates: 3 m |
| - Altitude: 2 m |
| - Time: 50 ns |
| Time to get the navigation parameters, no more: |
| - «cold start»: 90 s; |
| - «warm start»: 30 s; |
| - «hot start»: 15 s; |
| - Reacquisition after signal outage for 20 s: 5 s |
| Module dimensions: 35x35x6 mm |
| Mass, no more: 20 g |
| Performance characteristics: |
| - Operational ambient temperature: from –40 up to +75°C |
| - Operational excessive environmental humidity: 98% (40°C) |
| Interface: |
| - Two ports for input/output RS-232E |
| - Communication protocols: IEC1162 (NMEA0183), BINR, RTCM SC 104 v2.2 |
| - Data rate: up to 38400 bit/s |
| - SPI – interface (SCLK, SDIN, SDOUT) |
Miniature navigation receiver GLONASS/GPS/GALILEO

NV08C-MCM-M - miniature 32-channel navigation receiver of SNS GLONASS/GPS/GALILEO/SBAS with a low energy consumption.

It is a full-featured multichip module based on a high-efficiency NV08CD navigation processor and NV08CA analog micro chip, the additional components are not required, developed to be integrated into small size portable devices such as PDA, PND and others.

WWW.navis.ru
**RIRT**

**Digital correlator family**

**DC16-028 digital correlator**
- implements the hardware signal processing of the standard accuracy signals of GNSS GLONASS (C/T-code), GPS (C/A-code, WAAS, EGNOS, MSAS) during 1 ms.

**DC18-034 digital correlator**
- implements the hardware signal processing of the standard accuracy signals of GNSS GLONASS (C/T-code), GPS (C/A-code, L2C code) WAAS, EGNOS, MSAS during 1 ms.

**DC18-033 digital correlator**
- implements the hardware signal processing of GNSS GLONASS (C/T-code, B2-code), GPS C/A-code, L2 C-code), WAAS, EGNOS, MSAS during 1 ms.

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**Radio-receiving unit family**

**Radio-receiving unit family:** RFIC01, RFIC02, RFIC03 – two channel radio frequency amplifiers-converters with two-bit ADC, a PLL heterodyne frequencies synthesizer and a serial interface.

**RFIC01 radio-receiving unit** performs multiplication of the GLONASS, GPS standard accuracy signals operated at L1, L2-bands and transfers the signals to the low frequency for the subsequent digital processing.

**RFIC02 radio-receiving unit** performs multiplication of the GLONASS, GPS standard and high accuracy signals operated at L1, L2 and transfers them to the low frequency for the subsequent digital processing.

**RFIC03 radio-receiving unit** performs multiplication of the GLONASS, GPS, GALILEO standard accuracy signals operated at L1, L2, L3, L5-bands and transfers the signals to the low frequency for the subsequent digital processing.
Digital chip

Block-diagram of navigation processor (64 channels)

Topology of navigation processor (0.11 µm)
The car multimedia navigator
GLOSPACE SGK-70

### Specifications

<table>
<thead>
<tr>
<th>Type:</th>
<th>stationary.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application:</td>
<td>car.</td>
</tr>
<tr>
<td>Colour touch TFT LCD screen of the size</td>
<td>7&quot; (17.5 cm)</td>
</tr>
<tr>
<td>Screen resolution</td>
<td>480x234 pixels (16 : 9)</td>
</tr>
<tr>
<td>Brightness</td>
<td>450 cd/m²</td>
</tr>
<tr>
<td>Processor</td>
<td>Samsung S3C2440 (400MHz)</td>
</tr>
<tr>
<td>Built-in memory</td>
<td>64 Mbyte (SDRAM)</td>
</tr>
<tr>
<td>OS</td>
<td>MS Windows CE 5.0</td>
</tr>
<tr>
<td>Memory</td>
<td>1 Gbyte complete with micro SD card</td>
</tr>
<tr>
<td>GLONASS Receiver</td>
<td>12 channels</td>
</tr>
<tr>
<td>GPS Receiver</td>
<td>20 channels</td>
</tr>
<tr>
<td>Built-in / remote antenna</td>
<td></td>
</tr>
<tr>
<td>Memory map SD</td>
<td></td>
</tr>
<tr>
<td>Memory 1 Gbyte</td>
<td>complete with micro SD card</td>
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<tr>
<td>GLONAS Receiver</td>
<td>12 channels</td>
</tr>
<tr>
<td>GPS Receiver</td>
<td>20 channels</td>
</tr>
<tr>
<td>USB interface:</td>
<td>USB1.1 Host, USB 1.1 Client</td>
</tr>
<tr>
<td>AV-In input</td>
<td></td>
</tr>
<tr>
<td>Adapter for ear-phones</td>
<td></td>
</tr>
<tr>
<td>Power supply 12 V</td>
<td>2 A</td>
</tr>
<tr>
<td>Dimensions/weight</td>
<td>188x120x35 mm / 400 g</td>
</tr>
</tbody>
</table>

### Functions:

- Contains preloaded maps. A map of Moscow complete with a near Moscow region map (for sale in Moscow)
- Compatible with a pager SMILINK to display traffic jams of roads in real time
- Features pre-programmed points-of-interest considering traffic jams
- Screen brightness adjustable
- Voice guidance
- Built-in MP3 / MPEG4 player:
  - Video VideoFile (AVI, DIVX), MPEG4 File (MP4, M4A), MPEG Movie File (MPEG, MPG, MPG, DTA)
  - Multi Media Format:
    - MPEG Audio File (MP1, MP2, MP3, MPA), Matroska File (MKV, MKA), Ogg Vorbis File (OGG, OGM) Audio
    - Images JPG, TIF, PNG
  - FM-receiver (option)
- Built-in computer games
- Operation manual, network adapter 220 V, car adapter 12 V, bracket to mount on a windshield, commutation cords
Personal navigator
GLONASS/GPS

1. PURPOSE:
   Determination of current coordinates, ground speed and a user routing via the SNS GLONASS/ GPS
   signals, service task solution, calculation of direction angle, storage of significant points and routings, position
   indication in a map

2. Unit comprises:
   - electronic unit with a built-in antenna;
   - external navigation antenna;
   - battery charger – electric power supply;
   - spare accumulator unit.

3. SPECIFICATIONS:

1. Frequency band for receiving channels - L1 (1.6 GHz).
2. Type of satellite signals - GLONASS (ПТ-code) and GPS (C/A-code).
3. Number of independent (parallel) receiving channels - 32.
4. Time off first determination at cold/hot start no more, s - no more 90 / 35.
5. Coordinate update rate - 1 s.
6. Coordinate system - Π3-90, WGS-84, CK-42, CK-95 and system of elevations of Baltic sea.
7. Determination error/ GLONASS , no more
   - location coordinates - 10 m;
   - component of velocity vector - 0.005 m/s.
8. Functions:
   - selection of GLONASS and/or GPS auto-or specified by an operator ;
   - automatic computation, display and delivery of location coordinates, velocity and time values to
     external users;
   - data recording and storage (memory 256 Mbyte, data capacity):
     number of files - 2048;
     coordinates of reference points. - 522000;
     total routing length, mln of points - 3.3;
     duration of data recording, h - 83.8.
9. Interface for data exchange - 2 ports RS-232; by 1 port of RS-485, USB.
11. Continuous operation via 1 accumulator unit - no less 15 h.
13. Power consumed - no more 0.35 W.
14. Mass with accumulator unit - 0.28 kg.
15. Dimensions - 170×70×40 mm.
16. Temperature range - from -30 up to + 55°C.
Personal «HT-1813» navigator of the GLONASS/GPS satellite systems

Personal «HT-1813» navigator of the GLONASS/GPS satellite systems

designed to determine the position coordinates, time, course, velocity, as well as for servicing an individual user on route at any time of year and day.

«HT-1813» provides:
- Signal reception and integrated processing of data from GNSS GLONASS/GPS and SBAS;
- User positioning determination;
- Calculation of trajectory parameters, service problem solving, as well as time and date determination;
- Recording and route display;
- Playback of audio/video files.

Functional capabilities:
Navigation data display on a colored electronic map induced on a display. Communication with external units via the USB communication channel.

The receiver employs a colored interactive display. It is liable to be used in an open ground and within the interior of a mobile object, it operates both via the built-in antenna and external marine or car antenna.
GLONASS/GPS high-precision geodetic equipment

High-precision geodetic equipment is designed for:
• execution of survey works for geodetic networks of various purposes;
• topographical survey and design and survey works;
• database support of land cadastre and monitoring of land use;
• relative determinations of plane coordinates and altitudes

Configuration of geodetic equipment:
• navigation receiver with information storage;
• geodetic antenna with 3 m cable; • radio modem;
• power adapter – charger; • rechargeable battery

Mean square error:
• static mode/fast static mode – 3 mm + 0,5 mm/km/ 5mm + 1,0 mm/km
• RTK mode (up to 10 km) - 10 mm + 1,5 mm/km
• Kinematic mode with postprocessing (up to 10 km) - 10 mm + 1,5mm/km

Navigation receiver characteristics:
• SIS – L1 C/A, L2C GPS, L1 SA, L2 SA GLONASS;
• number of channels – 64;
• frequency of coordinate updating – 1 s;
• maximum time of information storage – 7 days;
• coordinate systems – EP-90.02, WGS-84, SC-42, Gauss-Kruger projection;
• continuous operation time – up to 8 h from internal battery;
• temperature of operation – from -40°C to +50°C.
Motor transport tracking based on the GLONASS/GPS technology

GLOSPACE SGK-T - Satellite Navigation Automobile Tracker

The hardware has been designed and customized for batch production since 2008.

GLOSPACE SGK-T is an automobile tracking logger which provides positioning coordinates upon the GLONASS/GPS signals.

Embedded GSM and GPRS modules provide a compatibility to identify an automobile coordinates and to track its route. Thus, the automobile is monitored permanently.

GLOSPACE SGK-T is recommended for permanent application in cars and trucks.
Personal radio beacon
GL/GPS PARM-406
The hardware has been designed and serially produced since 2007

1. ASSIGNMENT
The PARM-406 personal radio beacon is intended for the definition and transmission of crash scene coordinates, for reduction of search & rescue service to the place of crash.

The radio beacon is primarily recommended for application by search & rescue services, and also by tourists, climbers, geologists, hunters etc.

2. DESCRIPTION
The PARM-406 personal radio beacon comprises:
the GLONASS/GPS receiver with antenna, ПРД-406 and ПРД-121 transmitters, the ANT-ARM antenna, coordinates and service information display, self-contained power supply.

3. CHARACTERISTICS
Carrier frequency: ПРД-406 - 406.028 MHz
ПРД-121 - 121.5 MHz
Power: ПРД-406 – 5,0 W
ПРД-121 – 0,1 W
Frequency instability:
Long-time ± 5 kHz (within 5 years)
Short-time 2х10-9 for 0,1 sec
Message emission period ПРД-406 – 50 s
Message length ПРД-406 – 440/520 ms
Operating temperatures range: -20°C … +55 °C
Time of continuous running:
not less than 24 hours at frequency 406.028 MHz
not less than 48 hours at frequency 121.5 MHz
GLONASS/GPS 24-channels receiver
Weight-dimensions performances: (57х75х172) mm, 420 Gram

4. CONFORMITY TO THE STANDARDS
Personal radio beacon PARM-406 corresponds completely following documents:
- COSPAS-SARSAT Specification C/S T.001
- COSPAS-SARSAT 406 MHz distress beacon type approval standard C/ST.007”
- Standard “CTO-MCC.01-2006” of FSUE "Morsvyazsputnik"
The radio beacon have the COSPAS-SARSAT Type Approval Certificate № 177 yielded in 2007 July 30

5. The design of the personal radio beacon PARM-406 has:
- The diploma of the “RusPatent”
- The diploma of Ministry of Education and Science
- The diploma and Silver medal of 36-th International Salon of Inventions, New Technology & Goods “Geneva-2008”
- The diploma of the “RusPatent”
Use of GLONASS/GPS receiver in search & rescue equipment
GLONASS/GPS constellation, visible SV
North Pole, 18.10.2010

Field of view ±47° from zenith
**Descent module «Soyuz TMA-14,15» search & rescue operations with “ПАРМ-406” GLONASS / GPS**

**Поисково-спасательная работа**

<table>
<thead>
<tr>
<th><strong>Союз ТМА-14</strong> 11.10.2009</th>
<th><strong>Временные характеристики</strong></th>
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</thead>
<tbody>
<tr>
<td>Включение Р/ маяка</td>
<td>8 ч. 47 мин.</td>
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<tr>
<td>Получение сигнала в МКВЦ</td>
<td>9 ч. 01 мин.</td>
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<tr>
<td>Отображение сигнала р/маяка на ГК ЦПС (г. Москва) и ЦУП (г.Королёв)</td>
<td>9 ч. 03 мин.</td>
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Время прохождения сигнала составило – 16 минут

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<tr>
<th><strong>Союз ТМА-15</strong> 01.12.2009</th>
<th><strong>Временные характеристики</strong></th>
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</thead>
<tbody>
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<td>10 ч. 34 мин.</td>
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<tr>
<td>Получение сигнала в МКВЦ</td>
<td>10 ч. 38 мин.</td>
</tr>
<tr>
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<td>10 ч. 42 мин.</td>
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Время прохождения сигнала составило – 08 минут