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RECEIVING AND DATA ACQUISITION SYSTEMS OF RT-32 FOR VLBI OBSERVATIONS

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Radiotelescope RT-32 is a fully steerable 32-m parabolic antenna located at Irbene and belonging to Ventspils International Radio Astronomy Centre (VIRAC). Currently, the work on upgrading and repair of its receiving hardware and data acquisition systems is of high priority for the VIRAC.

One of the main scientific objectives for the VIRAC Radioastronomical observatory is VLBI (very long baseline interferometry) observations in centimetre wavelengths in collaboration with world VLBI networks, such as European VLBI network (EVN), Low Frequency VLBI network (LFVN), and others.

During the last years the room in the secondary focus of telescope was reconstructed, and several new receivers were installed. Currently, RT-32 observations are carried out in four different bands: 92 cm, 18 cm, 6 cm, and 2.5 cm. First three of them are already successfully employed in diversified VLBI experiments. The receiver on 2.5 cm band has only one linear polarized chain and is used mainly for the methanol maser single dish observations.

The apparatus system of RT-32 is equipped with two independent VLBI data acquisition systems: TN-16, and DBBC in combination with MK5b. Both systems are employed in interferometric observations depending on the purpose of experiment and the enabled radiotelescopes.

The current status of RT-32, the availability of its receiving and data acquisition units for VLBI observations and the previous VLBI sessions are discussed.

Key words: *VLBI; data acquisition system, receiver, radioastronomy; radiotelescope.*

1. INTRODUCTION

Ventspils International Radioastronomy Centre was established in 1994 by the decision of Latvian Academy of Sciences (LAN) with the aim to develop the research directions in radioastronomy and astrophysics. The instrumental base for the centre comprised two fully steerable parabolic antennas, RT-16 and RT-32 (i.e. with the mirror diameter 16 m and 32 m). The telescopes were built in the 60-es of the last century and used for military purposes. By the time of VIRAC establishment both the antennas had been in fully inoperable state. The reconstruction and instrumental refurbishment carried out by the VIRAC engineering team made it possible to use radiotelescope RT-32 for the international-scale fundamental and applied research in the field of radioastronomy. The most important aspect of this work is participation of RT-32 in the VLBI (Very Long Baseline Interferometry) international experiments [1].

Since 2010, the VIRAC staff has been involved in the European Social Fund's (ESF) project "Receiving, transmitting and processing technologies of signals related to artificial Earth satellites", which allowed speeding-up significantly the upgrading activities related to RT-32 as to its fitting with appropriate VLBI receiving and recording equipment. Now, a special focal room in the radiotelescope secondary focus is fully refurbished, with the receiving systems for the frequency range 327 MHz to 12 GHz installed and tuned. A set of recording equipment has already been assembled, which allows recording the signal into two channels with a bandwidth up to 1 GHz each. The new recording system provides a high stability of the time frame, which is prerequisite for the VLBI observations. In 2012, radiotelescope RT-32 took part in 15 successful international VLBI sessions.

At present, the task of maintaining the RT-32 antenna operable as well as upgrading its receiving equipment and ensuring reliable work in the VLBI experiments remains a priority line for the VIRAC team.

2. RECEIVING SYSTEMS OF RADIOTELESCOPE RT-32

The project of research into space debris in which more than 20 VIRAC researchers are involved was a significant contribution to the development of the centre as a whole, making it possible to widen the range of tasks to be solved. Accordingly, a need emerged to refurbish more actively the RT-32 receiving and recording equipment.

At the current stage, the priority scientific objectives for the centre are:

- investigation into the motion parameters of the objects (space debris, satellites, asteroids) in the near-Earth space and the planets;
- studying the Earth's ionosphere;
- studying the solar radio emission;
- observations in the international VLBI-networks, including the European VLBI network (EVN).

To achieve these objectives it is possible to use the following receiving systems:

- 327 MHz (92 cm, P band) – primary focus;
- 1.6 GHz (18 cm, L band) – secondary focus;
- 5 GHz (6 cm, C band) – secondary focus;
- 6.9–9.3 GHz (3.7–4.2 cm) – secondary focus;
- 12 GHz (2.3 cm, X band) – secondary focus.

As can be seen from the above list, except for the receiving system 327 MHz all receivers are installed in the secondary focus. As a rule, the preparation for the observations in these bands requires the mounting of a suitable feed after removing the previously installed as well as connection and calibration of the high-frequency (RF) unit. For example, changing the operating frequency usually takes from several hours to one day.

The receiving system for the 12 GHz frequency band is designed to register the linearly polarized signals and used for observations of methanol masers and the Sun in radiometric mode.

The spectro-polarimetric receiving complex for 6.9–9.3 GHz band consists of a broadband feed in the range 2–18 GHz, a multi-spectral polarimeter (which receives signals in the right and left circular polarization), and a data acquisition unit. The system is designed for spectral polarimetric observations of microwave emission of the upper chromosphere, the transient region, and the lower corona of the Sun. The main tasks of spectroscopic polarimetric observations using this complex are associated with investigation into the behaviour of atmosphere in the solar active regions [2].

The receiving units at 327 MHz, 1.6 GHz and 5 GHz are more versatile and designed for the use in VLBI observations. The frequency bands of 327 MHz and 1.6 GHz are employed extensively in the VLBI experiments intended for studying the ionosphere and solar activity. The receiving system for the 5 GHz band is mainly engaged for the location of space debris and in the EVN experiments.

2.1. Receiving system for the 327 MHz frequency band

The receiving system is composed of a feed, an RF-unit, and a power supply. The feed (previously owned by Westerbork Observatory) is designed to receive radiation in two linear polarizations in the 327 MHz band. Due to the very low efficiency of the radiotelescope at 327 MHz with this feed when it was mounted in the secondary focus on top of the cabin, it was necessary to install it in the primary focus. Because the primary focus (F = 11.5 m) is located above the hyperbolic secondary mirror, the feed was installed on a carrying rod (Fig. 1, left). The distance from the feed to the axis of the mirror is ~ 2 m, the distance from the focal plane of reflector is 0.5 m, and the slope angle is 6–7º. Since the feed is rigidly mounted on the supporting girder, neither angle adjustment nor displacement along the focal axis was needed.

Fig. 1. Receiving system for the 327 MHz frequency band.
Left: the feed mounted at the primary focus. Right: RF-unit with a separate power supply.

The RF-unit can be placed in the secondary focal room at observation of solar radio emission, because in this case the level of received signal is high enough. For increasing the antenna gain when weak signals are being received, the RF-unit is attached close to the feed on the carrier rod.

Table 1

Characteristics of RT-32 receiving systems available for VLBI observations

Receiving system for the 327 MHz frequency band	
Feed	Primary focus with offset RCP or LCP
BWHP	~ 2.3°
Frequency range	310–350 MHz
Noise temperature	100 K (LNA 70–80 K)
RF filter bandwidth	40 MHz
Intermediate frequency	150–190 MHz
Gain	more than 50 dB
RF-unit power supply voltage	12.2 V
Gain Flatness	±3 dB
Number of channels	1 (RCP or LCP)
Synchronization	5 MHz, 1–3 V
Local oscillator frequency (internal)	500 MHz
Receiving system for the 1.6 GHz frequency band	
Feed	4-helix array, RCP; Secondary focus
BWHP	20′
Frequency range	1400–800 MHz
Central frequency	1600 MHz (feed antenna)
Noise temperature	120 K
Number of channels	1 (RCP)
Intermediate frequency	130–190 MHz
Intermediate frequency bandwidth	60 MHz
External Local Oscillator R&S SMP 04	1420 MHz; 1440 MHz; 1500 MHz; 10 dB
External Local Oscillator synchronization	5 or 10 MHz
Power supply	Internal: ±15 V; +5 V
LNA gain	20 dB
IF gain	21 dB
Receiving system for the 5 GHz frequency band	
Feed	Horn; RCP and LCP; Secondary focus
BWHP	7.8′
Frequency range	4700–5500 MHz
Central frequency	4875 MHz
Noise temperature	44 K (with cryogenic cooling) 100 K (“warm”)
Number of channels	2 (RCP and LCP)
RF filter bandwidth	500 MHz
Intermediate Frequency width	350 MHz
Intermediate Frequency	100–450 MHz
External Local Oscillator R&S SMP 04	4600 MHz; 4840 MHz; 13 dB
External Local Oscillator synchronization	5 or 10 MHz
Amplification of the IF to the level	~ –20 dBm
Power supply (two independent blocks)	+24 V; +3.5 V; current and voltage stabilizer for LNA HEMT’s

The RF receiver unit is composed of a low-noise amplifier (LNA) with the noise temperature of 70–100 K, a mixer, an amplifier of intermediate frequency (IF) and a first local oscillator. To transform to the right or left circular polarization (RCP or LCP) from linear components, a microwave circulator is put on the RF-unit input and fastened inside the block.

The voltage of 12.2 V for powering the RF-unit is fed from the power supply located in the focal room. In addition to the input signal from the feed, a 5 MHz reference clock signal from a hydrogen maser is fed to the receiver. The output IF signal (150–190 MHz) enters the video-converter and recording systems in the laboratory room.

Parameters of the receiving system for 327 MHz band are given in Table 1.

The main problem at placing the feed in a point displaced from the main focus is to determine the misalignment of electrical and geometrical axes of the antenna. For this purpose the observations of radio sources CygA and CasA were made. The average misalignment derived from the measurements is 6.22º in elevation (error 2.9%), and 6.55º in azimuth (error 2.5%). Thus, for observations in the 327 MHz band the following adjustments in the antenna pointing model were required:

- in the elevation: $\Delta\Theta_h = 6.22º$;
- in the azimuth: $\Delta\Theta_{az}/\cos h$, where h is the angle of elevation, $\Delta\Theta_{az}$=6.55º.

The beam width at half power (BWHP) is ~ 2.3º in both coordinates. Due to the large feed displacement from the focal point the beam is broadened, with its shape highly distorted (becoming asymmetric).

2.2. Receiving system for the 1.6 GHz frequency band

In the spring of 2012, radiotelescope RT-32 was equipped with a new receiving system for the 1.6 GHz frequency band. The system was developed and implemented by the VIRAC specialists within the project related to the studies of artificial satellites in the near-Earth space [3]. Since one of its tasks was to evaluate the effect of ionosphere on the radio-wave propagation and its influence on the accuracy at determination of the object trajectories, the receiving system was meant for the reception of signals from the satellites of GPS and GLONASS navigation systems, which operate at the central frequencies 1575 MHz and 1602 MHz, respectively.

The receiving system is composed of a feed based on four helical antennas with the maximum sensitivity ~1600 MHz and intended for receiving signals in the right circular polarization, and an RF-unit. The feed is mounted in the secondary focus of antenna and connected to the RF-unit by a flexible cable about 2 m long.

The RF-unit (fixed in the secondary focal room) is assembled from standard components (*Mini-Circuits* Co.) and composed of a low-noise amplifier (frequency range 1400–1800 MHz, noise temperature ~ 120 K), filters, a mixer, and an IF amplifier. The signal generator *Rohde&Schwarz* (R&S) SMP 04 is used as the local oscillator (LO) synchronized by the hydrogen frequency standard. The power of active components in the RF-unit is provided by a built-in power supply. The general view of the feed and RF-unit is presented in Fig. 2 (for other parameters of the receiving system see Table 1).

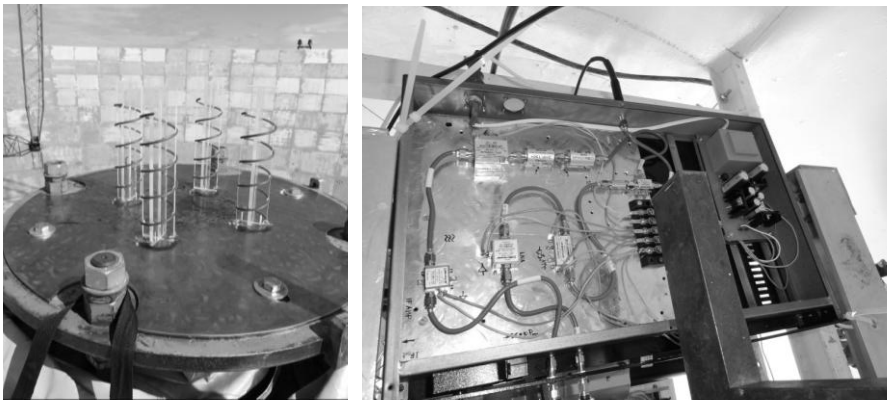

Fig. 2. Receiving system for the 1.6 GHz frequency band: helical antennas designed for RCP reception mounted in secondary focus (left); RF-unit fixed in secondary focus room (right).

2.3. Receiving system for the 5 GHz frequency band

The receiver for the 5 GHz band was produced in the early 1990s for Medicina (a radioastronomical observatory), where it was mounted in the secondary focal room and used until 2008. After dismantling, the receiving system was handed over to the VIRAC. At present, the receiver is placed in the secondary focal room of radiotelescope RT-32 at Irbene. To operate under proper conditions the receiver needs cryogenic equipment (currently missing but to be purchased and installed in 2013). The receiver is used in a "warm" mode, which, although significantly reduces the sensitivity of the system, still allows successful participation in the experiments on VLBI location of space debris.

As the irradiator, a horn antenna fixed in the secondary focus is used. The feedhorn is connected to the receiver through a waveguide equipped with the input for injected calibration signals. The received signal through the waveguide arrives at the polarizer and enters the orthomode transducer (OMT), which performs radiation splitting into the right- and left-polarized components. In the receiver no cooling for the polarizer and the OMT is provided.

After amplification and filtering, the signals in the 500 MHz bandwidth in both polarizations are amplified by a second cascade (not cooled) and fed to the input of mixer. When mixed with a local oscillator signal, the useful signal is transferred to a lower frequency in the upper side band 100–450 MHz. The amplification of each IF signal is performed up to the level of –20 dBm. An example of the IF spectrum from one of the channels is shown in Fig. 4. A signal generator R&S SMP 04 is used as the local oscillator. For each of the two receiver channels there are used separate independent power supplies, which stabilize +24 V and +3.5 V voltages as well as the drain current & voltage and the gate voltage for the HEMT low-noise pre-amplifier transistors. This allows using one of the receiver channels even at failure of the receiver or one of the power supplies.

Since the receiver is rigidly connected to the irradiator, for adjusting the feed position a fastening system for the receiver equipment has been designed and mounted in the secondary focal room of antenna. This system allows shifting the position of receiver by ~ 20 cm in all three axes, with the positioning accuracy within 1 mm and the stiffness of the overall assembly maintained (Fig. 3, left).

Additional information about the parameters of the receiving system for the 5 GHz band is presented in Table 1.

Fig. 3. The receiver system for the 5 GHz frequency band: cryogenic receiver mounted in the secondary focal room (left) and connected with a waveguide to the feedhorn in the secondary focus of radiotelescope RT-32 (the right).

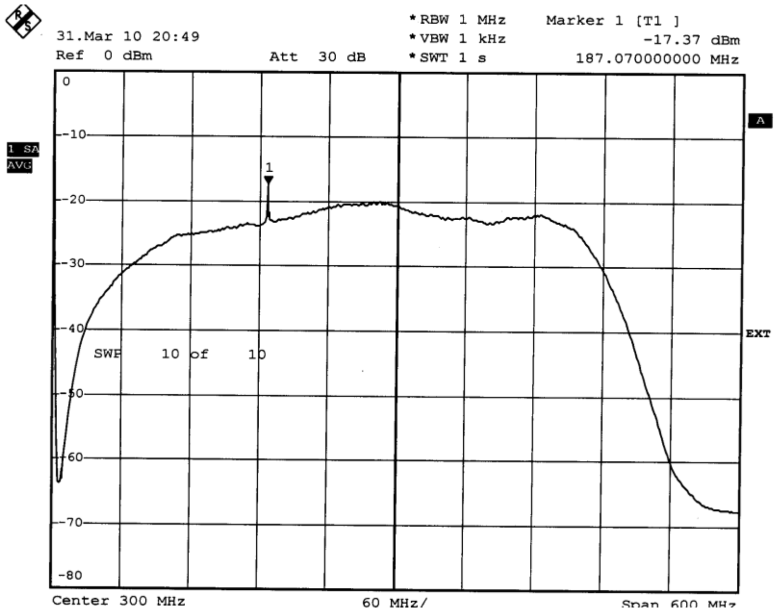

Fig. 4. IF spectrum from the LCP channel output of 5 GHz receiver.
The IF bandwidth is 100–450 MHz, the local oscillator frequency is set to 4600 MHz.
The peak corresponds to the test signal at the frequency 4787.07 MHz.

3. DATA ACQUISITION SYSTEMS FOR VLBI OBSERVATIONS

For digitalization and registration of the received signal, at the RT-32 two independent systems are used: TN-16 – the NIRFI terminal for signal record with a sampling frequency up to 16 MHz (developed at the Radiophysical Research Institute, Nizhny Novgorod) and DBBC (the digital base band converter developed in the last decade at the Institute of Radioastronomy, Noto) as a generic, modular radioastronomical data acquisition architecture to be used inside the European VLBI community [4].

3.1. Data acquisition system TN-16

Terminal TN-16 is designed for conversion of the analogue signal into a digital in one-bit quantization and data transfer to the PC parallel input. The terminal is to be used in combination with standard computers with Windows operating system. The information input to PC is implemented with a digital IO board PCI-7200 (*ADLINK* Technology Inc.). The PCI-7200 board set includes a library of routines for C++, Delfi and BASIC compilers which define the recording format.

Requirements for the input and output signals are determined by the characteristics of frequency converter and the technical parameters of PCI-7200:

- parameters of the input signal: amplitude 0.1–1.5 V, frequency bandwidth 50–8000 kHz;
- parameters of the output signal: parallel digital code in 32-bit words, level of TTL 0.5–4.0 V.

The signals applied at the inputs of TN-16: the analogue input signal, the clock signal (up to 16MHz), the 1PPS (pulse-per-second) reference signal from the hydrogen frequency standard and 5V from DC voltage.

The current version of the data acquisition system at Irbene with the use of TN-16 limits the recorded signal bandwidth to 2 MHz, which is determined by the video-converter at IF transfer to the low-frequency band.

The general view of the system is shown in Fig. 5.

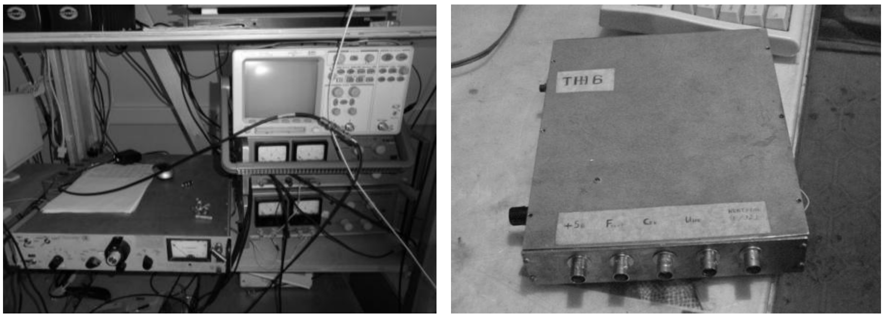

Fig. 5. Video-converter (left), and the data registration system TN-16 (right).

3.2. Data acquisition system DBBC & Mk5b

The second system for digitizing and recording has a wider range of features: a broad frequency band (up 3.5 GHz), a high-speed data interface (up to 4 GS/s), and a high quantization level (up to 8 bits). It consists of two units: DBBC complemented with Mk5b (Mark5b). The DBBC was developed by the Institute of Radioastronomy (Noto) to increase the sensitivity of EVN, expanding the full observed bandwidth by means of numerical methods. In RT-32 the second-generation digital base band converter (DBBC2) is used.

The DBBC unit is composed of a base box (containing power supply, control computer, clock distribution and JTAG interface), and a stack of small modular boards, which can be composed according to the user needs. The first and the last modules in the system (FILA boards) provide the control signal distribution, a DAC for monitoring, and electric interface to the standard VSI bus to the VLBI data recorder.

Between the two FILA boards four ADC boards and four CORE2 (processing) boards are stacked. The ADC modules contain a single high-speed ADC, and the CORE modules have a single field programmable gate array (FPGA). The modules can be upgraded without changing the rest of the system. The current version uses 2 GS/s ADC for the ADC2 module and Virtex5 XC5VLX220 FPGA for the CORE2 processing module.

Each ADC board receives its input from an analog conditioning module. The module (directly controlled by the control processor) contains basically a set of filters from which one of its possible Nyquist sampling bands could be selected, an isolation amplifier and a programmable attenuator [5].

DBBC2 can simultaneously handle up to four IF channels. The input signal has a bandwidth of 512 MHz or 1024 MHz, and a sample rate of 1024 MHz or 2048 MHz, respectively, derived from atomic standard. The digitized signal is fed to Mk5b by VSI-H interface. Since the Mk5b model installed at the observatory is equipped with only one VSI-H cable, it is possible to record only two inputs – IFa and IFb. Each IF is processed by CORE2 board and split into four channels with the maximum bandwidth up to 32 MHz (16 MHz upper side band and 16 MHz lower side band). Digitization is done using 8-bit quantization, with subsequent conversion to the 2-bit quantization. For its operation, DBBC requires the following input signals: 10 MHz reference and 1PPS (supplied by hydrogen frequency standard). For control of the input signal, the internal synchronization and sampled band DBBC is fitted with the following outputs: "RF out" and "RF monitor" for each of the four conditioning modules, "1 PPS out", "10 MHz out", "AnalogOut" (which allows checking all sampled channels), and "80 Hz signal" to switch on/off the noise diode in the receiver's circuit.

The Mk5b system (connected to DBBC through VSI-H cable) is used for recording the sampled data flow. It is developed as the first Gbps VLBI data system based on the magnetic-disk technology. Incorporating primarily low-cost PC-based components, the Mk5b system supports the data rates up to 1024 Mbps, recording to an array of inexpensive removable IDE/ATA disks. For synchronization, Mk5b uses 1PPS and 32MHz signals obtained through VSI-H interface from the DBBC. The maximum writing speed available in the existing configuration is 1 Gbps. The data recording is performed on the standard IDE hard drives integrated in a disk pack. At Irbene, for data recording two disk packs with 16 disks (total 6.4 TB space) are available [6].

The general view of the system is shown in Fig. 6.

Fig. 6. Digital Base Band Converter (left) and Mark5b (right).

4. RT-32 CONNECTIONS OF RECEIVING AND RECORDING EQUIPMENT FOR VLBI OBSERVATIONS

The connection scheme developed for the VLBI observations and including the receiving and recording systems described above is shown in Fig. 7. The scheme is intended for the following:

- experiments on the location of space debris in the near-Earth space using the 5 GHz receiving system;
- VLBI experiments related to the studies of ionosphere by raying with the radio-signals from navigation satellites; research on the solar microwave emission; and VLBI observations of the radio-sources for measuring the parameters of radio interferometers and antenna calibration (327 MHz and 1.6 GHz);
- VLBI radio-astronomical observations within the EVN (1.6 GHz and 5 GHz).

The DBBC & Mk5b are used in EVN observations as the main recording components. In other experiments, the independent connection of the two registration systems is provided to improve the reliability during debugging of the equipment – in particular, of the analog videoconverter coupled with TN-16, and DBBC together with Mk5b.

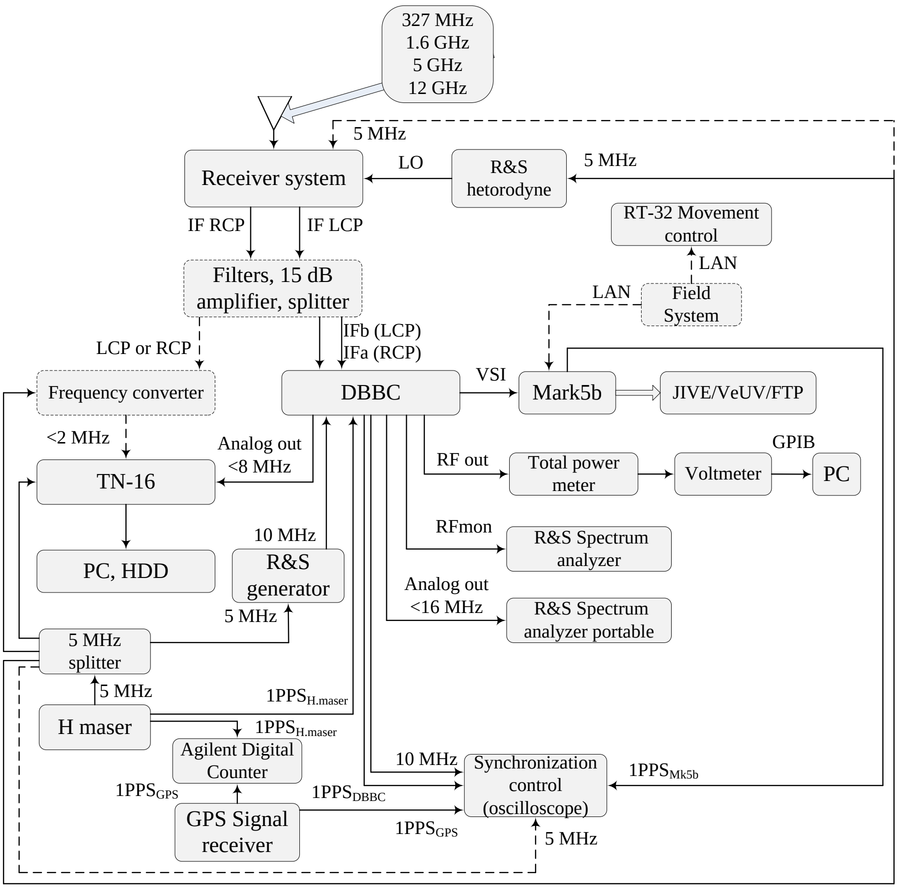

Fig. 7. Connection scheme of receiving and recording equipment for VLBI experiments at RT-32. The dotted line shows the units used occasionally.

In some of the experiments it is required that there is a wider band than that obtained from the outdated analog video-converter. A connection scheme was tested for TN-16 unit fed from DBBC analog output, which allows the recorded bandwidth to be increased up to 8 MHz. It should be noted that the DBBC analog output is designed primarily for monitoring the operation of equipment, and it has significant additional interference. According to the results of experimental tests, such connection is acceptable for registration of powerful signals (e.g. the radiation of navigation satellites, the solar flare emission, etc.). At reception of weak signals, e.g. radioastronomy sources, the detection of useful signal against the noise background is rather difficult.

Two spectrum analyzers, R&S FSP and R&S FSH8, connected respectively to the DBBC outputs RFmon and AnalogOut are used in the reception chain of RT-32 for checking the received signal. The use of monitoring equipment allows for the real-time control of IF spectrum of RCP and LCP channels and of one sampled channel. Apart from that, for monitoring a signal's full power a Mini-Circuits Power detector ZX47-50+ is used, which is connected to the DBBC RFout. The signal obtained in the range from 0 to 2 V is supplied to a digital voltmeter, and then through the GPIB interface it goes to a PC fitted with the software designed for visualization and data recording of the total power.

The sampled signal from DBBC is fed to Mk5b through the VSI interface and recorded on the internal disk packs, after which it can be sent to the VLBI data correlation centres (JIVE, VUC, NIRFI, and others) via a dedicated 1Gbit optical line. The control of Mk5b recording and of the telescope movements is carried out by software "Field System".

The VLBI observations require precise synchronization of the received and sampled data and linking to the exact timestamps. As the frequency and time standard for RT-32 an active hydrogen maser Quartz CH1-75A is used, which generates a reference frequency of 5 MHz and a 1PPS signal, while Symmetricom XLI Time and Frequency system is employed for setting and checking the time scale. This system generates one-second pulses based on the signals from GPS satellites. In addition, it has an NTP-server providing accurate time transfer to all devices of the telescope via a local area network (LAN). To control the synchronization of the acquisition system, a four-channel oscilloscope R&S RTO 1014 is applied, which displays the PPS signals from GPS, DBBC, Mk5b, 10 MHz from DBBC and 5 MHz from hydrogen frequency and time standard. In the case when one of the devices loses synchronization, this will be easily detected on the oscilloscope's display.

5. CONCLUSIONS

Currently, radiotelescope RT-32 is equipped with all the necessary receiving equipment for 327 MHz, 1.6 GHz, 5 GHz frequencies and the systems for recording signals on the frequencies up to 1 GHz in each of the four channels. Therefore, RT-32 can successfully participate in various VLBI experiments on these frequencies.

During 2012, 15 VLBI-sessions were carried out on various tasks (including eight EVN-experiments) using the Irbene radio telescope. The relevant experiments were as follows:

- two experiments related to the research of ionosphere and Sun activity at 327 MHz;
- five VLBI-experiments on the artificial ionosphere turbulence produced by a heating facility “SURA” at sounding the medium by 1.6 GHz navigational satellite signals; also, one test experiment in this range was carried out as part of the EVN Network Monitoring Experiments (NME);
- two VLBI-radar experiments on location of space debris objects and planets, and several EVN-sessions at 5 GHz.

Results obtained in these experiments show that radiotelescope RT-32 is able to successfully participate in regular international VLBI experiments.

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RT-32 UZTVERŠANAS UN DATU REĢISTRĀCIJAS SISTĒMAS VLBI NOVĒROJUMIEM

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K o p s a v i l k u m s

Radioteleskops RT-32 ir Ventspils Starptautiskajam Radioastronomijas Centram (VSRC) piederoša pilnas piedziņas 32 m diametra paraboliskā antena. Pašreiz visaktuālākie VSRC veicamie darbi ir saistīti ar RT-32 uztverošās aparatūras un datu reģistrēšanas sistēmas labošanu un modernizāciju.

Viens no radioastronomiskās observatorijas galvenajiem zinātniskajiem uzdevumiem ir sevišķi lielas bāzes interferometriskie (VLBI) novērojumi centimetru viļņu garumu diapazonā sadarbībā ar pasaules VLBI tīkla partneriem, tādiem kā Eiropas VLBI tīkls, Zemo frekvenču VLBI tīkls (LFVN) un citiem.

Pēdējos gados rekonstruēta teleskopa sekundārajā fokusā izvietotā uztvērēju telpa un tajā uzstādīti vairāki jauni uztvērēji. Pašreiz radioteleskops ļauj veikt novērojumus četros viļņu garumu diapazonos: 92 cm, 18 cm, 6 cm un 2.5 cm. No minētajiem pirmie 3 jau tiek veiksmīgi izmantoti dažādos VLBI eksperimentos. 2.5 cm uztvērējam ir tikai viens lineārās polarizācijas kanāls, kuru izmanto galvenokārt metanola māzeru novērojumiem viena teleskopa režīmā.

RT-32 aparatūru veido divas neatkarīgas VLBI datu reģistrācijas sistēmas: TN-16 un DBBC kopā ar Mark5b. Abas sistēmas izmanto interferometriskajos novērojumos atkarībā no eksperimentu mērķa un radioteleskopa iespējām.

Aplūkots Irbenes RT-32 radioteleskopa pašreizējais statuss, tā VLBI novērojumiem piemērotās uztveršanas un datu reģistrācijas iekārtas, kā arī notikušajās VLBI sesijās uzkrātā pieredze.