

National System of Satellite Communication and Broadcast
Of the Republic of Belarus

TECHNICAL OPERATION RULES

The second edition

Minsk 2018

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1. DEFINITIONS

Operator – the National System of Satellite Communication and Broadcast of the Republic of Belarus (BELINTERSAT trademark)

User – satellite capacity services consumer who has the contract with the Operator

ES – earth station

EIRP – Equivalent Isotropically Radiated Power

COCC – Communications Operations Control Center. Operator's department that controls the usage of the satellite capacity

ESVA – Earth Station Verification Acceptance Test

RP – radiation pattern (or antenna pattern)

2. GENERAL INFORMATION

This document regulates ES access to BELINTERSAT-1 satellite capacity.

User is responsible for all necessary licenses and permissions from the authorities regulating the radio frequency usage in the ES location area.

Satellite capacity access is allowed for Fixed Satellite Services stations only.

In order to use BELINTERSAT-1 satellite capacity User's ES must be operable in the following frequencies:

5900 MHz– 6400 MHz uplink, 3600 MHz – 4200 MHz downlink;

12.75 GHz – 13.0 GHz uplink, 11.2 GHz – 11.45 GHz downlink;

14.25 GHz – 14.5 GHz uplink, 10.95 GHz – 11.2 GHz downlink.

Operator can change the Technical Operation Rules unilaterally.

The current version of these rules is published on Operator's official website www.belintersat.com

3. ANTENNA SYSTEM REQUIREMENTS

3.1 ANTENNA POINTING

All User antennas shall be able to be precise pointed in Azimuth and Elevation angles.

For User antennas equipped with auto tracking devices the beacon frequencies are given below:

Beam	Band	Downlink Frequency and Polarisation
Global	C	4194 MHz (RHCP), 4195.6 MHz(LHCP)
European	Ku	11445 MHz (H)
African	Ku	11194 MHz (V), 11197 MHz (H)

3.2 POLARISATION

User's ES antennas shall be able to operate with circular or linear polarization depending on used frequency band.

All User's ES antennas shall be able to transmit and receive in orthogonal polarizations simultaneously (for example, transmit in horizontal and receive in vertical polarization).

ES that works with linear polarization is to have the ability to adjust polarization at least by 1° steps.

3.3 CROSS-POL ISOLATION

User's antenna cross-pol isolation (for both uplink and downlink) shall be:
 for ES operating in C-band – at least 20 dB (axial ratio shall not exceed 1.22);
 for ES operating in Ku-band – at least 30 dB.

As an exception, Operator can approve ES access with lower cross-pol isolation values upon conditions of maximal EIRP reducing. Operator concludes the final decision based on the ES tests results.

3.4 SIDELOBES LEVEL

It is mandatory that User's antenna radiation pattern sidelobe peaks levels were such that the antenna gain G at least 90% of maximal peaks should not exceed:

G	Θ
For antennas $D/\lambda < 50$	
29 – 25 log θ , dBi	$\theta_{\min} \leq \theta \leq 48^\circ$
- 3,5 dBi	$\theta > 48^\circ$
For antennas $D/\lambda \geq 50$	
29 – 25 log θ , dBi	$\theta_{\min} \leq \theta \leq 20^\circ$
- 3,5 dBi	$20^\circ < \theta \leq 26.3^\circ$
32 – 25 log θ , dBi	$26.3^\circ < \theta \leq 48^\circ$
- 10 dBi	$\theta > 48^\circ$

where

G – antenna gain relative to an isotropic radiator, dBi;

Θ – angle between the main beam axis and current direction, degrees;

Θ_{\min} - 1° or $(100 \lambda/D)^\circ$, depending on higher value;

λ – wavelength;

D – antenna size.

3.5 ANTENNA POINTING STABILITY

In order to avoid interfering adjacent satellites the antenna main lobe axis shall not deviate more than $\pm 0,4^\circ$ from nominal direction, e.g. operating state and paying attention to all relevant disturbances, including wind speed of 72 km/h (45 mph) and higher (at which the antenna would possible have to operate).

4. TRANSMISSION CHAIN REQUIREMENTS

4.1 TRANSMISSION CHAIN CONTROL

All ES (operated by either remote or local control) shall stop the transmission immediately once it is required by COCC.

4.2 FREQUENCY VARIATION

The acceptable transmitter frequency variation is expressed in ppm ($N \times 10^6$) and calculated according to the formula:

$$\frac{\Delta f}{f_n * 10^6} \leq N$$

where

Δf – difference between the measured and assigned frequencies, Hz;
 f_n – assigned frequency, Hz.

The acceptable transmitter frequency variation shall be:

0,3 x 10⁶ for wideband systems;
0,2 x 10⁶ for systems that use single channel per carrier.

For ES single channel per carrier means the transmission of one telephone or data channel on one separate carrier; wideband system means transmission of multichannel or television signal on one separate carrier.

4.3 OUTPUT POWER LEVEL

ES should not exceed the maximum EIRP level specified by Operator in Transmission Plan.

The available output power control range should be at least 15 dB from the initially set level.

4.4 OUTPUT POWER VARIATION

When the intermediate frequency signal level on transmitter input is constant, the acceptable transmitter output power is:

±0,5 dB from the initially set level within 24 h.

In case of adverse weather conditions it is forbidden to increase the power flux density by more than 1.5 dB from the level for the clear sky.

5. ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

5.1 SPURIOUS EMISSIONS LEVEL

Spurious emissions level on transmitter output, measured within the bandwidth of 4 kHz should be at least (43+P) dB less than the transmitter output power (P, dBW) or 60 dB, whichever is less.

5.2 OUT-OF-BAND EMISSIONS SPECTRAL DENSITY

Out-of-band emissions spectral density (as a function of frequency) should be lower than the highest inband density (measured within 4kHz bandwidth) by the amount given by the following expression:

$$40 \log \left(\frac{F}{50} + 1 \right) \quad \text{dBsd},$$

where

F – frequency shift from the boundary of the total allocated bandwidth, expressed in percentage of allocated bandwidth. It is noted that the area of out-of-band radiation starts at the boundaries of the total allocated bandwidth.

dBsd – decibels relative to the maximum value for the power spectral density (PSD) within the allocated bandwidth. The maximum value of PSD of a random signal is calculated by averaging power in the reference bandwidth, which is chosen in such a way, that it maximizes the result of averaging.

5.3 Off-axis Equivalent Isotropically Radiated Power level

For ES operated in C-band:

At any φ angle, which is 2,5° or more off the main lobe axis of ES antenna, the EIRP density in any direction within 3° of geostationary orbit shall not exceed:

Off-axis angle	Max EIRP per 4 kHz
$2,5^\circ \leq \varphi \leq 7^\circ$	$(32 - 25 \log \varphi)$ dBW
$7^\circ \leq \varphi \leq 9,2^\circ$	11 dBW
$9,2^\circ \leq \varphi \leq 48^\circ$	$(35 - 25 \log \varphi)$ dBW
$48^\circ \leq \varphi \leq 180^\circ$	-7 dBW

For ES operated in Ku-band:

At any φ angle, which is $2,5^\circ$ or more off the main lobe axis of ES antenna, the EIRP density in any direction within 3° of geostationary orbit shall not exceed:

Off-axis angle	Max EIRP per 4 kHz
$2,5^\circ \leq \varphi \leq 7^\circ$	$(39 - 25 \log \varphi)$ dBW
$7^\circ \leq \varphi \leq 9,2^\circ$	18 dBW
$9,2^\circ \leq \varphi \leq 48^\circ$	$(42 - 25 \log \varphi)$ dBW
$48^\circ \leq \varphi \leq 180^\circ$	0 dBW

5.4 INTERMODULATION PRODUCTS LEVEL

The spectral density of intermodulation products on transmitter output shall not exceed:

21 dBW/4 kHz for uplink transponders in C-band,
16 dBW/4 kHz for uplink transponders in Ku-band.

5.5 OUTPUT SIGNAL SUPPRESSION

While the ES transmitter is in TRANSMIT INHIBIT status (carrier suppression), EIRP shall not exceed 4 dBW in any 4 kHz bandwidth within the allocated bandwidth.

6. EARTH STATION TEST PROCEDURES

ES test process for the access to BELINTERSAT-1 satellite includes:

- earth station verification (ESVA) test;
- access to the satellite capacity (Line-up test).

6.1 EARTH STATION VERIFICATION PROCEDURE

The purpose of ESVA procedure is to verify antenna and RF parameters of an earth station under test using the COCC facilities. The ESVA Test client software is used for tests.

In order to arrange an ESVA test, the User should contact COCC, which will give instructions throughout the procedure. The COCC contact information is given in chapter 7 of this document as well as in the transmission plan.

In case of a communication failure between the subscriber and COCC, the testing should be intermitted and the transmitter of the ES under test should be *immediately* turned off. The testing may be resumed only when communication is restored.

For time optimization and in order to avoid queues caused by unpreparedness of the subscriber's facilities or staff for testing, COCC may reschedule the procedure for another time agreed upon and start working with other subscribers in que.

Any signal transmission from the ES to the Belintersat-1 geostationary satellite should be initiated only after authorization from the COCC.

Before the test, ES antenna should be pointed to the orbital position of the BELINTERSAT-1 satellite and the transmitter must be in inhibit mode (RF Inhibit: Enable).

During the ES test, transmission in the direction of the orbital position of the BELINTERSAT-1 satellite should be enabled only during the testing.

The list of measured ES parameters is as follows:

Frequency and EIRP Stability, note – this item may be excluded for standard VSAT stations and ES's without auto tracking function;

Narrow- and wide-lobe antenna transmission patterns, note – this item is excluded for ES's without motor drive;

Transmit cross-polarization isolation, note – this item is mandatory.

Important: before the beginning of tests, the ES antenna must be pointed precisely at the satellite using beacon signals (see section 3.1) or control signal from the monitoring station. For the best results the antenna alignment procedure should be performed when the satellite is in the Center of Box. Information about the Center of Box time is possible to obtain in COCC.

6.1.1 FREQUENCY AND EIRP STABILITY

Before the frequency and EIRP stability testing ES should be tested for cross-pol discrimination.

During the frequency and EIRP stability test ES staff may be requested:

- transmit an unmodulated carrier with the lowest possible power on the frequency and polarization assigned for the test under control of COCC;
- according to COCC instructions slowly adjust the power level step-by-step;
- wait for the completion of testing and turn off the carrier.

6.1.2 TRANSMIT ANTENNA PATTERN MEASUREMENT

COCC takes measurements of transmit antenna pattern in both azimuth and elevation directions and in two ranges (narrow – 3 degrees, wide – 16 degrees), as well as measurements of the cross-polarization antenna pattern in narrow range (3 degrees).

Before the measurement transmit antenna pattern the ES antenna should be precisely pointed to the satellite using beacon signal or control signal from monitoring station, and locked. The polarizer adjustments should be made under COCC instructions. Antenna rotation speed in both azimuth and elevation must be accurately measured and reported to COCC in advance.

ES technical staff during the antenna pattern measurement must:

- transmit unmodulated carrier with the lowest possible power on the frequency and polarization assigned for the test under COCC control;
- according to COCC instructions slowly adjust the power step-by-step;
- release the azimuth and elevation brakes and slew the antenna counter-clock wise until the limits specified by COCC;

- after COCC command start moving the antenna clock-wise with constant speed;
- inform COCC at moment when the antenna passes 2 degrees of its trajectory. This point measurement affects the accuracy of the radiation pattern measurement significantly;
- continue observing the antenna slewing through the main beam center until the limit specified by COCC;
- after COCC command stop the antenna movement, set the antenna to initial position (the main beam center) and lock up the brakes;
- stop the transmission.

6.1.3 TRANSMIT ANTENNA CROSS-POLARIZATION ISOLATION

Before the measurement transmit antenna pattern the ES antenna should be precisely pointed to the satellite using beacon signal or control signal from monitoring station, and locked. The polarizer adjustments should be made under COCC instructions.

ES technical staff during the antenna cross-polarization isolation measurement must:

1. Transmit an unmodulated carrier with the lowest possible power on the frequency and polarization assigned for the test;
2. According to COCC instructions slowly adjust the power step-by-step;
3. Slew the antenna until the limit specified by COCC;
4. After COCC command remove the transmitted carrier by turning on carrier inhibit mode;
5. Switch the transmitted polarization to the cross-pol;
6. Bring up the carrier again;
7. After COCC command remove the transmitted carrier by turning off carrier inhibit mode;
8. Repeat steps 3-7 as long as specified by COCC.

6.2 EARTH STATION ACCESS TO SATELLITE CAPACITY

The purpose of access to satellite capacity procedure is to verify the radiated power of ES under using COCC facilities and establishing of a nominal level for further operation. CSM/CSM-R software is being used for this test.

Access to satellite capacity can only be granted by COCC. While performing this procedure, COCC validates the access request and checks the transmission parameters.

During the access to satellite capacity COCC checks:

- ES registration code;
- frequency slot allocation;
- uplink polarization settings;
- cross-polarization isolation level;
- carrier power level.

During the access procedure ES staff may be requested to:

- rotate / adjust transmit antenna polarizer;
- transmit the carrier with the different power (both modulated and unmodulated).

In order to obtain access to the satellite capacity User should contact COCC in advance to have enough time to pass the whole procedure, including cross-polarization test. Otherwise, there may be time delays before access is granted.

It is very important that User informs COCC about any ES equipment modifications or reconfigurations.

Before calling COCC for line-up procedure the ES staff must ensure the following:

- the antenna is properly pointed (for optimal performance antenna pointing should be performed while the satellite in the center of the box) using satellite beacons or control signal from monitoring station;
- all uplink equipment is switched on, heated up, stable, and tuned to the proper frequency;
- the transmitter is in standby mode with maximum attenuation;

- there are no undesirable signals in the allocated frequency band.

During the initial activation ES staff shall stick the following order:

1. Contact COCC. COCC contact information is given in Chapter 7 of this document, as well in the transmission plan.
2. According to COCC instructions set up the necessary frequency and transmit an unmodulated carrier with the lowest possible level.
3. After COCC command adjust polarization or any other signal parameters if necessary.
4. Once the cross-polarization test is finished, modulate the carrier.
5. According to COCC instructions slowly increase the power step-by-step up to the nominal level.
6. Provide ES staff emergency contacts.

Important: do not change the power, frequency, polarization, antenna pointing or replace any transmitting equipment without informing COCC and receiving permission to do so.

If User is instructed by COCC to stop the transmission then User must execute it immediately without any discussion.

7. PROCEDURE FOR OBTAINING ACCESS TO SATELLITE

To obtain access to the capacity of the Belintersat-1 satellite, user must fill out the following documents:

1. Application for capacity allocation (Appendix 1).
2. In case of using ES with the satellite "Belintersat-1" for the first time - Application for approval to access (Appendix 2).

The completed documents should be sent to COCC@belintersat.com no later than a day before the planned start of the use of the frequency resource.

After considering the documents provided by the User, the Operator produces a transmission plan (Appendix 3), which establishes the parameters for accessing the satellite's frequency-energy resource.

8. CONTACTS

COCC is an only contact point for testing an ES, for the starting and ending of the transmission, for changing the transmission parameters:

<i>E-mail:</i>	COCC@belintersat.com
<i>Phone/fax:</i>	+375 17 169 66 99
<i>Mobile:</i>	+375 29 315 68 50



Appendix 1

The application for capacity allocation

Customer:	Contact information:
Service:	Beam/Band/ Polarization:
Required Bandwidth, MHz:	
Start Date (dd/mm/yyyy):	End Date (dd/mm/yyyy):
Uplink Frequency range, MHz:	Downlink Frequency range, MHz:
Forward link expected MODCOD:	Return link expected MODCOD:
Other requirements:	
Signature:	Date:

FOR INTERNAL USE

Notes:	Signature:
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Thank you for your request.

Please, send this form to COCC@belintersat.com

The National System of Satellite Communication and Broadcast of The Republic of Belarus 220012, The Republic of Belarus, Minsk, Kulman, 2

COCC phone: +375 29 315 68 50



Appendix 2

APPLICATION FOR APPROVAL TO ACCESS THE BELINTERSAT-1 SPACE SEGMENT

1 GENERAL INFORMATION	
Company	Network Operation Centre
Company name _____	Operator name _____
Country _____	Company position _____
City _____	24/7 contact number _____
Address _____	E-mail _____
ZIP _____	
Tel. _____	
E-mail _____	
Earth station	
ES code _____	
ES address _____	
2 TESTED IN OTHER SATELLITE SYSTEM	
Eutelsat <input type="checkbox"/>	Note
Intelsat <input type="checkbox"/>	Please add certificate of conformity if yours
SES <input type="checkbox"/>	ES have been tested earlier
Untested <input type="checkbox"/>	
3 EQUIPMENT TECHNICAL PARAMETERS	
Antenna Specifications:	
Manufacturer _____	Polarization _____
Model number _____	Diameter, m _____
Autotracking system availability _____	
Transmit Specifications:	Receive Specifications:
Frequency range, MHz _____	Frequency range, MHz _____
Antenna Gain (min, max), dBi _____	Antenna Gain (min, max), dBi _____
Polarization isolation _____	Polarization isolation _____
Type of HPA _____	LNA/LNB noise temperature, K _____
Max output power of HPA, W _____	G/T (min, max), dB/K _____
Max EIRP, dBW _____	

**Please, send this form to COCC@belintersat.com,
tech@belintersat.com**

The National System of Satellite Communication and Broadcast of The Republic of Belarus 220012, The Republic of Belarus, Minsk, Kulman, 2

COCC phone: +375 29 315 68 50

Contract on satellite capacity lease # _____ dated of _____, 20__.

Service Order # _____ dated of _____, 20__.

Appendix 3

Effective from	
Valid till	
Replacement of	

TRANSMISSION PLAN # _____

№	Transponder	Uplink ES Code	Sybmol rate (Msps)	MODCOD	Transmission mode	Central frequency (MHz)		Allocated BW (MHz)
						uplink	downlink	
1								

CUSTOMER'S ES PARAMETERS

№	ES Code	Country	Town	Antenna size (m)	Location (DD.MM.SS)		Contact information for emergency communication (tel./fax/e-mail)
					Latitude	Longitude	
1							

A time of work should be coordinate for a day before start working.

Customer _____	Operator's COCC _____	Operator _____
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COCC (24/7)

+375 17 169 66 99, +375 29 315 68 50