SATELLITE USER GUIDE

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ABBREVIATIONS

ABS	*Asia Broadcast Satellite*
AP	*Antenna Pattern*
AWG	*Antenna Wave Guide*
AZ	*Azimuth*
BW	*Bandwidth*
CW	*Clockwise*
CCW	*Counter Clockwise*
CSC	*Customer Support Center*
EL	*Elevation*
EIRP	*Equivalent Isotropic Radiated Power*
ES	*Earth Station*
ESVT	*Earth Station Verification Test*
HPA	*High Power Amplifier*
IF	*Intermediate Frequency*
LNA	*Low Noise Amplifier*
RF	*Radio Frequency*
SSPA	*Solid State Power Amplifier*

INTRODUCTION

To ensure ABS delivers and maintains the high quality service to every customer, ABS requires customer to fully meet the test requirements that are provided in this User Guide. Customer's Earth Stations that meets the requirements will be authorized to operate on the ABS satellite, in cooperation with the ABS Technical Assistance Center (TAC) and ABS TT&C, Dubna.

This User Guide provides the procedures, requirements and details that are applicable to satellite communications Earth Stations, which should be met when accessing the ABS satellite.

The details of the User Guide are divided into three sections:

- **Satellite Access Procedures**:
  Procedures that customers are required to follow to register or to modify their links with ABS.

- **Customer Support Procedures**:
  Procedures that outline the Interruption and Maintenance notifications

- **Earth Station Verification Test Procedures:**
  Test procedures that customer are required to conduct in order to register an Earth Station with ABS (Earth Station Verification Tests).

If there is any question regarding the procedures, please contact TAC and/or TT&C Dubna.

ABS Technical Assistance Center (TAC)

HOTLINE: +603 2145 8282
Alternative No: +852 3591 8782
E-mail: tac@absatellite.net

ABS TT&C, Dubna

Phone No. : +7 495 956 3426
E-mail: ttu@rscc.ru

Section A:

Satellite Access Procedures

1. Overview

This section provides the procedures that customers are required to follow in order to properly initiate transmission from an uplink ES to ABS satellite or to modify the link parameters.

Customer should complete and send the Satellite Access Form (Refer to Section D - Appendices) via email to TAC and TT&C Dubna within one (1) working day of the proposal date of the activation or modification of the link. ABS will confirm with the customer on the actual date and time.

The customer should ensure that their ES is registered with ABS before proceeding to link activation procedure. The ES registration procedures are described in Section C – Earth Station Verification Test Procedures of this User Guide.

Contact TAC and/or TT&C Dubna immediately if problems occurred during the transmission for problem confirmation or resolution. They can confirm whether there is an actual satellite transmission problem, or isolate what may well be a specific downlink problem due to equipment performance, weather-related conditions, third-party interference, etc. Any changes to service parameters must be authorized and confirmed by them.

Note: ABS reserves the right to investigate the facts, demand a written explanation from the customer pertaining to the suspected violation, and enact immediate measures to rectify the situation.

2. Link Activation Procedures

Step 1: Ensure the ES is properly aligned to the intended satellite in AZ, EL and Polarizer using the ABS satellite's beacon signals (C-band beacon signals 3,999.5 MHz / 3,400.5 MHz or Ku-Band beacon signal 12,500.5 MHz/12,749.5 MHz).

Step 2: Prior to transmission, ensure all uplink equipment is warmed up and stable and ready for transmission by setting the proper frequency and encoders and/or modulator calibrate to assigned bandwidth and carrier parameters, etc.

Step 3: Call TAC and/or TT&C Dubna at the allocated time to confirm transmission parameter.

Step 4: During the transmission confirmation, you will be asked for (or will confirm) the following information:

- Your name and the return phone number(s) at the transmitter site.
- Station ID.
- Transponder assignment.
- Exact operating frequency and polarization assignments.

Step 5: When advised to transmit an unmodulated carrier at the lowest possible level (the low power is typically 20 dB below the projected full power level). They will confirm your uplink frequency and antenna alignment (pointing and polarization) are correctly set.

Step 6: If instructed, change or offset uplink frequency so that they can verify the carrier on the satellite to ensure proper cross-pole isolation. As necessary, rotate ES antenna polarizer to optimize the cross-polarization of ES carrier. They will attempt to achieve the highest polarization isolation possible (minimum at 30 dB).

Step 7: Increase the power level slowly to the nominal operating power for ES service. If carrier power is satisfactory, modulate the carrier as instructed.

Step 8: Verify the performance (C/N, Eb/No or BER) at the receiving site and fine tune power level as instructed.

Note: Any changes made during testing of carrier may well cause interference or a reduction in performance to adjacent carriers, especially on shared or multi-carrier transponders, resulting in a loss of service to other customers. Failure to contact the TAC and/or TT&C Dubna on any changes in carrier operation may result in: a) the immediate termination of testing or service; b) the denied access to the satellite for subsequent transmissions; and c) Significant liability for any damage it may cause to the health of the satellite. A timely reporting of problems to them is much more likely to result in identification and correction of problems; reports or complaints received after the end of the transmission will almost certainly be difficult if not impossible to confirm.

3. Link Modification Procedures

Step 1: Call TAC and/or TT&C Dubna at the allocated time and verify permission to adjust transmission parameters. Change the transmission of the ES to the new parameters after being authorized and confirmed by them.

Step 2: Verify the performance (C/N, Eb/No or BER) at the receiving site and fine tune power level as instructed.

4. Link Shutdown Procedures

Step 1: Inform TAC and TT&C Dubna via email at least one (1) working day prior to the intended time to shutdown.

Step 2: After the carrier is shutdown, switch the output of the SSPA/HPA to the dummy load, or put the unit on STANDBY mode, to avoid noise or other unwanted signal from being transmitted. There should be no RF transmission from the ES to ABS Satellite.

Section B:

Customer Support Procedures

1. Service Interruption Notifications

In the event of any service interruptions, the customer is required to email a completed Service Interruption Form (Refer to Section D - Appendices) to TAC and TT&C Dubna and immediately contact the TAC and/or TT&C Dubna:

ABS Technical Assistance Center (TAC)

HOTLINE: +603 2145 8282
Alternative No: +852 3591 8782
E-mail: tac@absatellite.net

ABS TT&C, Dubna

Phone No. : +7 495 956 3426
E-mail: ttu@rscc.ru

During the trouble shooting process, the customer is required to assist TAC and/or TT&C Dubna and provide detailed information of the problem and the impact on services.

They will verify the problem and perform the trouble shooting once they received any complaints or Service Interruption Report Form from the customer. They will update the customer on trouble shooting development as and when it is available until the given problem is resolved.

2. Maintenance Notifications

For any maintenance notifications, TAC shall give the customer at least one (1) day notice prior to any tests which may affect service to the customer, and shall consult and mutually agree with the customer (such agreement not to be unreasonably withheld or delayed) as to the time and duration of such tests.

In emergency cases, TAC shall notify the customer of the tests as soon as reasonably practicable under the circumstances and use reasonable efforts to minimise the period of any disruption so caused

Section C:

Earth Station Verification Test Procedures

1. Overview

The purpose of conducting Earth Station Verification Test (ESVT) is to ensure the Earth Station (ES) has fully met the mandatory performance characteristics and requirements before the ES is able to access the ABS Satellite.

Customers are required to fill-up and submit the Earth Station Verification Test Form (refer to Section D - Appendices) to TAC and TT&C Dubna, to request for verification tests via email within one (1) working day of the proposed test date.

The tests that may be needed to be performed are:

- Antenna Pointing Verification Test
- Cross-Polarization Isolation Tests
- Antenna Sidelobe Pattern Tests
- Earth Station E.I.R.P Power and Frequency Stability
- Earth Station Figure of Merit (G/T)

Every ES that has passed the tests will be registered with ABS and a Station ID will be assigned to the ES.

2. Antenna Pointing Verification Test

2.1 Azimuth (AZ) and Elevation (EL) Angle Adjustment Procedure

Test Procedures

Step 1: Check the C-band beacon signals (3,999.5 MHz / 3,400.5 MHz) or Ku-Band beacon signal (12,500.5 MHz/12,749.5 MHz) visibility.

Step 2: Adjust the ES antenna AZ and EL angles to maximize the signal level; record the corresponding AZ and EL angles.

Step 3: Rotate the ES antenna polarization to maximize the signal level and record the polarizer angle.

Step 4: Adjust the ES antenna AZ in the CW direction starting from the position determined in Step 2 above until the peak of the first side lobe is reached. This is indicated by the beacon level decreasing as the antenna pattern passes through the first pattern null, increasing again until it peaks at the first side lobe, and then begins to decrease again. Record the antenna pointing angle for this side lobe peak**.**

Step 5: Normalize the antenna pointing back to the peak of the main lobe.

Step 6: Repeat Step 4 for the CCW direction AZ. Lock the AZ axis at the highest peak of the main lobe as determined in Step 1 if no other higher peak is observed.

Step 7: Adjust the ES antenna EL in the upward direction starting from the position determined in Step 2, until the peak of the first side lobe is reached. Record the antenna pointing angle for this side lobe peak.

Step 8: Normalize the antenna pointing back to the peak of the main lobe.

Step 9: Repeat Step 7 for the downward direction EL. Lock the AZ axis at the highest peak of the main lobe as determined in Step 1 if no other higher peak is observed.

2.2 Polarizer Adjustment Procedure

Test Procedures

Step 1: Check the C-Band beacon signals (3,999.5 MHz / 3,400.5 MHz) or the Ku-Band beacon signal (12,500.5 MHz/12,749.5 MHz) visibility.

Step 2: Receive the beacon signal with co-polarization receive antenna feed and record the received signal level.

Step3a: If the ES is equipped to receive a cross-polarized downlink signal (antenna with two receiving ports, one for each polarization), measure the signal level at the output of the cross-polarization feed port. Adjust the polarizer angle so that a signal null is achieved at the output of the cross-polarization feed port; then record the received level and the polarizer angle.

Step3b: If the ES is not equipped to receive the cross-polarized downlink signal (antenna with only one receiving port), adjust the polarizer so that a signal null is achieved at the output of the co-polarization feed port; record the signal level and the polarizer angle. Rotate the polarizer by 90º from the recorded Null angle and lock it there. Verify the received signal is the same or better than that of Step 2.

3. Cross-Polarization Isolation Tests

The antenna system of the earth station including the waveguide must be capable of transmitting and receiving signals with linear polarization corresponding to the polarization of the signal received and transmitted by the satellite. It is recommended to equip the antenna to enable both transmit and receive polarization to be changed or tuned if this becomes necessary.

3.1 Transmit Cross-Polarization Isolation Test

Test objective

To adjust ES polarization in relation to satellite polarization and test the cross-polarization attenuation of the signal radiated by the ES in C and Ku bands. The ES cross polarization isolation must be 30dB or more.

Test Procedures

Step 1: ES polarization adjustment:

Step 2: The ES will radiate a carrier towards the satellite and monitor its level on the spectrum analyzer

Step 3: The TAC or TT&C Dubna will measure the level of the signal received from the ES in co-polarization and cross-polarization channels

Step 4: The optimum ratio between the polarization of the signal transmitted by the ES and the polarization on the satellite is achieved by adjusting the position of the ES polarizer by 90 degrees. This adjustment is performed by slowly turning the polarizer in relation to its initial position within 5° CCW and then CW to choose its optimal position

Step 5: They will monitor the carrier level in the cross-polarization channel and record on the analyzer signal changes depending on the turning angle of the polarizer and will record the minimum signal at the point of the optimum matching of the ES and satellite polarization planes

Step 6: The cross-polarization signal attenuation is calculated as follows:

$$A = C_{cop.} - C_{cross\text{-}pol.} \quad (dB)$$

3.2 Receive Cross-Polarization Isolation Test

Test Objective

To adjust ES polarization in relation to satellite polarization and test the cross-polarization attenuation of the signal radiated by the ES in C and Ku bands. The ES cross polarization isolation must be at least 30dB or more.

Test Procedures

Step 1: Adjust the ES antenna by the satellite beacon signal and enable manual antenna control.

Step 2: According to the test program, the TAC or TT&C Dubna will radiate an unmodulated carrier.

Step 3: Using the spectrum analyzer, the ES will adjust the polarization by the maximum of the signal received.

Step 4: The ES will turn the polarizer approximately by 90 degrees and perform adjustment by the minimum of the received signal. Record the level of the cross-polarization signal, Ccross-pol.

Step 5: The ES will turn the polarizer back by exactly 90 degrees and record the level of the co-polarization signal, Ccop.

Step 6: The cross-polarization signal attenuation is calculated as follows:

$$A = Ccop. - Ccross\text{-}pol. \quad (dB)$$

4. Antenna Side Lobe Pattern Tests

4.1 Transmit Antenna Test

Test objective

The purpose of this test is to determine the ES sidelobe levels and antenna pattern shape for transmission.

The ES meets the ABS requirement if the gain of an antenna with $D/\lambda \geq 50$ of 90% of co-polarization peaks of sidelobe does not exceed the following values:

$G = 29\text{-}25 \log \theta$ dBi	$\theta^{\circ}_{MIN} \leq \theta \leq 20^{\circ}$
$G = -3.5$ dBi	$20^{\circ} < \theta \leq 26.3^{\circ}$
$G = 32 - 25 \log \theta$ dBi	$26.3^{\circ} < \theta \leq 48^{\circ}$
$G = -10$ dBi	$\theta > 48^{\circ}$

$\theta^{\circ}_{MIN} = 1^{\circ}$ or $(100\lambda/D)$ if $100 \lambda / D > 1$

λ: wavelength;
D: antenna diameter;
G: sidelobe gain in relation to isotropic antenna, dBi;
θ: angle in degrees between the main lobe axis and the direction in question.

This requirement should be met at any frequency inside the assigned band for any direction within 3° of the geostationary arc.

This section is also applicable to non-axis-symmetrical antenna:

- Transmit Antenna : $D/\lambda \geq 35$ (operating in the 10 -14 GHz band)
- Receive Antenna : $D/\lambda \geq 22$ (operating in the 10.7 - 11.7 GHz band)

Test Procedures

Step 1: Set up the equipment as shown in Fig. 1.

Step 2: Set a transmit frequency on ES transmitter.

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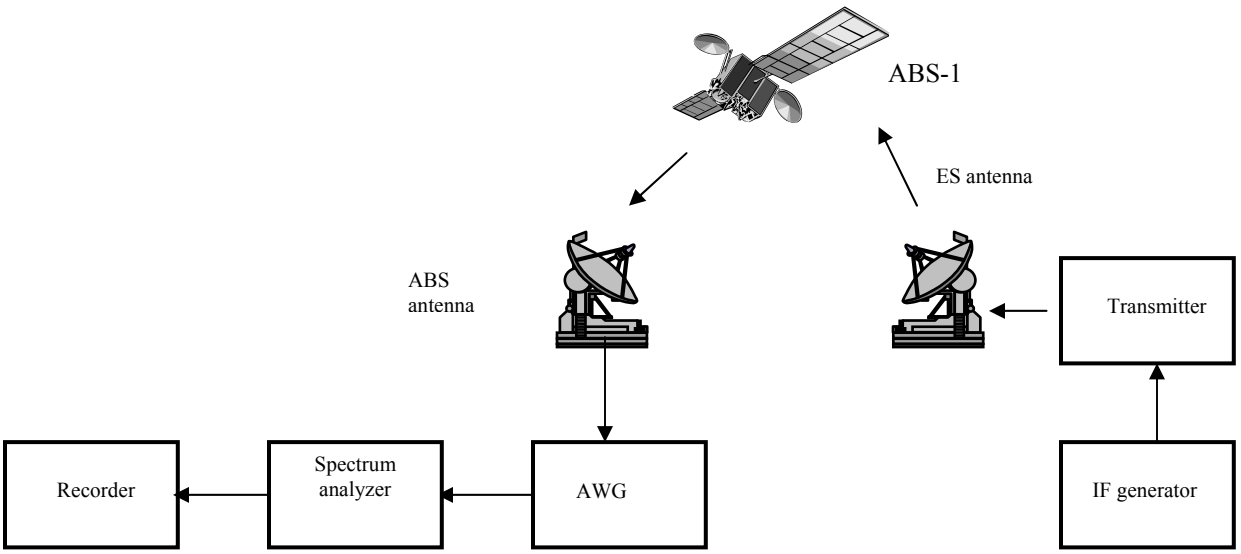


Fig.1. Block diagram for the ES transmit antenna pattern test

Step 3: The ES need to change its transmitter power until the analyzer reached the required signal/noise ratio as instructed by the TAC or TT&C Dubna.

Step 4: When instructed, slew the ES antenna in CCW direction from the position (where the received signal is peaked) off the satellite by 6^o in θtr., at a constant rate (e.g. 0.02^o/sec), while timing the movement. Record the time taken and provide the information to them.

Step 5: At the same slew rate, move the main lobe of the ES antenna through the satellite in CW direction over a 12^0 (corrected θtr) range from its previous position.

Step 6: Repeat Step 4 and Step 5 for the elevation axis over a range ± 6^o from the main lobe centre. TAC or TT&C Dubna will record the ES antenna pattern by elevation and azimuth.

Step 7: The corrected azimuth plane angles, θtr. is calculated as follows:

$$\theta tr. = 2\arcsin\left[\left(\sin\frac{\theta}{2}\right)\cos\beta\right]$$

θ: indicated Azimuth angle from boresight

β: indicated elevation angle above true horizon

4.2 Receive Antenna Pattern Test

The receive sidelobe levels should be limited to protect received signals from outside interference. The requirements on the receive antenna pattern (AP) sidelobe levels are recommended to be met like transmit antenna pattern test (Refer to Section 4.1).

Test Procedures

Step 1: The TAC or TT&C Dubna will radiate an unmodulated signal with constant power required to saturate the power amplifier of the satellite transponder.

Step 2: The ES shall point and fine tune its antenna to the satellite.

Step 3: Record the maximum level of the received signal on the analyzer.

Step 4: When instructed, slew the ES antenna in CCW direction from the position (where the received signal is peaked) off the satellite by 6^o in θtr., at a constant rate (e.g. 0.02^o/sec), while timing the movement. Record the time taken.

Step 5: At the same slew rate, move the main lobe of the ES antenna through the satellite in CW direction over a 12^0 (corrected θtr) range from its previous position

Step 6: Repeat Step 4 and Step 5 for the elevation axis over a range ± 6^o from the main lobe centre.

Step 7: Record the ES antenna pattern by elevation and azimuth. Draw the 29-25 log θ [dB] curve on the plot for $1^0 \geq |\theta| \geq 6^o$

Step 8: The corrected azimuth plane angles, θtr. is calculated as follows:

$$\theta tr. = 2\arcsin\left[\left(\sin\frac{\theta}{2}\right)\cos\beta\right]$$

θ: indicated Azimuth angle from boresight

β: indicated elevation angle above true horizon

5. Earth Station E.I.R.P Power and Frequency Stability Test

It is recommended to make sure that the level of each transmitted carrier can be adjusted within ±7 dB relative to the nominal level in order to make changes according to the eventually modified transmission plan, optimize transponder utilization and comply with frequency coordination conditions.

Test objective

The purpose of this test is to check E.I.R.P. power and frequency stability of the ES carrier during 12 hours period. The variation in power shall be less than ± 0.50 dB and the variation in frequency shall be less than ± 1 KHz.

Test procedures

Step 1: As instructed, ES will radiate towards the satellite an unmodulated carrier with a level, which initially is 10 dB lower than the rated value set for the test.

Step 2: The receiving TAC or TT&C Dubna will use its spectrum analyzer to monitor the ES carrier and the beacon level or the level of its own test carrier.

Step 3: **T**he ES will set the carrier E.I.R.P. value according to the test plan. The set carrier level is monitored by the ES using a spectrum analyzer connected at RF to the satellite signal receive chain.

Step 4: They will automatically record changes in ES carrier parameters in relation to the E.I.R.P values in terms of level and frequency.

Step 5: After the tests are completed, the ES will switch the transmitter off. Similar tests are performed for redundant ES equipment as well.

Section D:

Appendices

1. Satellite Access Form

SATELLITE ACCESS FORM

Date Initiated: _____

Customer Information			
Company Name		Requested by	
Contact No.		E-mail Address	
Fax No.			

Earth Station Location Information			
Station ID		City	
Location		Country	
Contact Person		Latitude (N˚)	
Contact No.		Longitude (E˚)	
Fax No.		Schedule Start Date	
E-mail Address		Schedule Start Time	Local GMT

Satellite Information			
Satellite		Transponder No.	
Uplink Polarization		Uplink Center Freq	MHz
Downlink Polarization		Downlink Center Freq	MHz

Carrier Information			
Carrier ID		U/L Freq. Range	MHz
Carrier Type	☐ Analog ☐ Digital ☐ Video ☐ Data	D/L Freq. Range	MHz
Modulation Type		Allocated BW	MHz
Data Rate	kbps	Uplink EIRP	dBW
FEC/Turbo		Nominal Tx Power	Watts
Add. Coding (RS)		Satellite EIRP/Carrier	dBW
Min Eb/No Required			

*****To be filled by TAC / TT&C Dubna***			
Activation Date:	(dd/mm/yyyy)		
Activation Time:	(hh:mm)	C/N	dB
Serviced by		Verified by	
Signature		Signature	
Date		Date	
Remarks			

Contact Information	
ABS TAC Hotline: +603 2145 8282 Alternative No: +852 3591 8782 Email: tac@absatellite.net mark@absatellite.net	ABS TT&C. Dubna Tel: +7495 956 34 26 Fax: +7495 237 89 19 Email: ttu@rscc.ru ISmolkov@rscc.ru

2. Service Interruption Report Form

SERVICE INTERRUPTION REPORT FORM

Date Initiated:

Earth Station Information			
E/S Location		ABS Station ID	
Contact Person		Contact No.	
E-mail Address		Fax No.	

Interference Information			
Date of Detection		Location	☐ Within Tx ☐ At the guard
Time of Detection	Local GMT	Nature of Interference	☐ Continuous ☐ Intermittent
Transponder No.			☐ Sweeping ☐ Fixed
Affected BW	MHz		☐ Others:
Start Freq.	MHz	Spectral Shape	
Stop Freq.	MHz	Impact on Operation	☐ Severe ☐ Minimum
C/N	dB		☐ None
Suspected Source		No. of Affected Stations	
Other Information		Affected Carriers (CF)	MHz

Action Progress Logs **to be filled by TAC / TT&C Dubna

Date/Time	Ref	Event	Initial

Closure Approval **To be filled by TAC / TT&C Dubna

Serviced by: _____ Verified _____ Approved by: _____

Date: _____ Date: _____ Date: _____

Signature: _____ Signature: _____ Signature: _____

Remarks: _____

3. Earth Station Verification Test Form

EARTH STATION VERIFICATION TEST FORM

ESVT ID: _____ Date Initiated: _____

Customer Information*			
Company Name		Requested by	
Contact No.		E-mail Address	
Fax No.			

Earth Station Location Information*			
Location		City	
Contact Person		Country	
Contact No.		Latitude (N˚)	
Fax No.		Longitude (E˚)	
Email Address		Scheduled Start Date	
		Scheduled Start Time	GMT

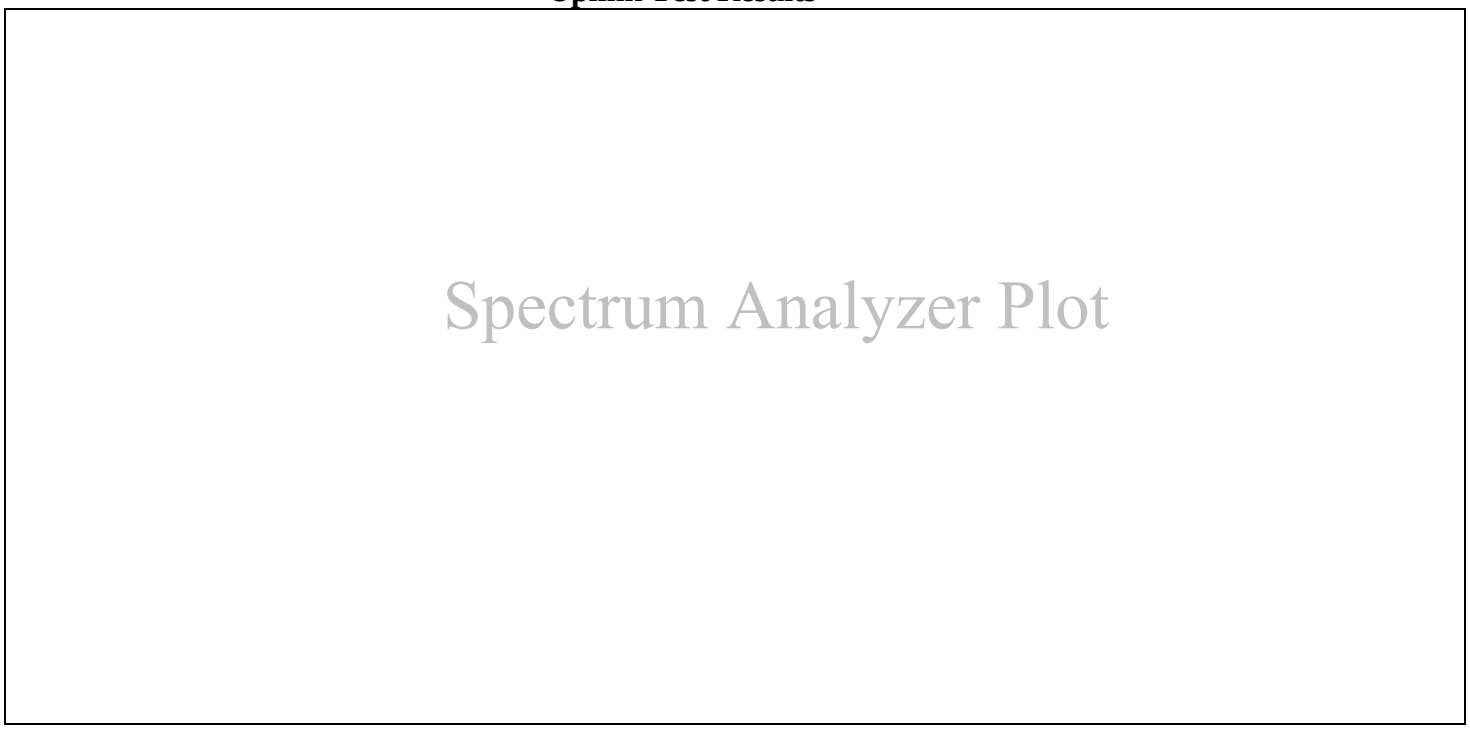
Earth Station Information*			
Antenna Make		LNA/LNB Noise Temp.	K
Model	☐ Fixed ☐ Transportable	LNA/LNB Gain	dB
Antenna Diameter	m	HPA Type	☐ SSPA ☐ TWTA ☐ Klystron
Antenna Tx Gain	dB		
No. of Tx Port		Max HPA Power	Watts
No. of Rx Port			
Baseband Equipment Model (Modem, encoder, modulator)			

Satellite Information**			
Satellite	ABS-1 ☐ C-band ☐ Ku-band	Transponder***	
Satellite Beam	☐ A ☐ B ☐ N ☐ S	Uplink Center Freq***	MHz
Uplink Polarization	☐ Horizontal ☐ Vertical	Downlink Center Freq***	MHz
Downlink Polarization	☐ Horizontal ☐ Vertical		
Beacon Frequencies			

Test to be Performed**			
Tests	☐ Antenna Pointing ☐ Cross-Polarization Isolation (CPI) ☐ Frequency Stability, kHz ☐ Power Stability, dB ☐ Antenna Pattern Verification ☐ Other Test	Remarks	

*** To be filled by customer**
**** To be filled by TAC / TT&C Dubna**
***** To be filled by TT&C Dubna**

EARTH STATION VERIFICATION TEST FORM
Uplink Test Results



Spectrum Analyzer Plot

Test Results*			
Station ID		Actual Test Date Actual Test Time	 GMT

Test	Comments	Results	
☐ Antenna Pointing		Acceptable	Yes☐ No☐
☐ Cross-Polarization Isolation (CPI)	> 30 dB	Acceptable	Yes☐ No☐
☐ Frequency Stability, kHz		Acceptable	Yes☐ No☐
☐ Power Stability, dB		Acceptable	Yes☐ No☐
☐ Antenna Pattern Verification		Acceptable	Yes☐ No☐
☐ Other Test		Acceptable	Yes☐ No☐
Conclusion			
Serviced by			

Contact Information

ABS TAC
Hotline: +603 2145 8282
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Email: tac@absatellite.net
mark@absatellite.net

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