



>> INTERACTING WITH YOUR WORLD

Volume II - ESOG Module 240 - Issue 1.2
SKYPLEX HANDBOOK
30 July 2008

EUTELSAT_{S.A.}

SYSTEMS OPERATIONS GUIDE

ESOG Module 240

SKYPLEX HANDBOOK

Issue 1.2

30-07-2008



1. INTRODUCTION	1
1.1. Initial Access	1
1.2. Operational Phase	1
2. MANDATORY PRE-TRANSMISSION LINE UP TESTS (PTLU)	2
3. SKYPLEX STATION SYSTEM TESTING: SCPC BASELINE MODE	3
3.1. Channel Analysis: Demodulation, Check of Nominal Uplink EIRP and Frequency, Buffer Status for SUT	3
3.2. Verification Skyplex Protocol between SUT - SIMS	4
3.3. System Analysis: DVB Compliance Tests at Transport Stream Level at CSC	4
3.4. Picture Assessment at Elementary Stream Level (PES) at CSC (when applicable)	4
3.5. Reports	5
4. SKYPLEX STATION SYSTEM TESTING: TDMA BASELINE AND TURBO MODE FOR STATIONS INTERACTING WITH SIMS.	6
4.1. Channel Analysis: Demodulation, Check of Short-Burst Initial Ranging, Station_id, Nominal Uplink EIRP and Transmit Time Jitter for SUT	6
4.2. Verification of Skyplex Protocol between SUT - SIMS	7
4.3. System Analysis: DVB Compliance Tests at Transport Stream Level at SIMS	7
4.4. Picture Assessment at Elementary Stream Level (PES) at SIMS	7
4.5. Reports	7
5 SKYPLEX STATION OPERATIONS.	8
5.1. Eutelsat's System Discipline	8
5.2. Eutelsat's Interference Management.....	8
ANNEX A - Pointing Alignment.....	9
ANNEX B - Polarisation Alignment.....	10

FOREWORD

The Eutelsat S.A. Systems Operations Guide (ESOG) is published to provide all Eutelsat S.A. space segment users with information that is necessary for successful operation of earth stations within the Eutelsat S.A. satellite system.

The ESOG consists of 2 Volumes. They contain, in modularised form, all the necessary details, which are considered important for the operations of earth stations.

Volume I concentrates on Earth Station and Antenna Approvals, System Management and Policy aspects.

Volume II describes the initial line-up of satellite links between earth stations and the commissioning of earth stations for Eutelsat S.A. services. The modules which are contained in this Volume relate to the services provided via Eutelsat S.A. satellites.

The ESOG can be obtained either by requesting a printed version to Eutelsat S.A. or in Acrobat format from the Eutelsat S.A. Web:

<http://www.eutelsat.com>

Paris, 30-07-2008

OVERVIEW ESOG MODULES

VOLUME I

EUTELSAT S.A. SYSTEM MANAGEMENT AND POLICIES

Earth Station Standards	Module 100
Earth Station Access and Approval Procedures	Module 110
Earth Station Type Approval	Module 120
Earth Station Verification Assistance (ESVA)	Module 130
Operational Management, Control, Monitoring & Coordination	Module 140
VSATs' ODU Type Approval	Module 160

VOLUME II

EUTELSAT S.A. SYSTEMS OPERATIONS AND PROCEDURES

Digital Services Handbook	Module 210
VSAT Handbook	Module 230
SKYPLEX Handbook	Module 240
DVB Television Handbook (being prepared)	Module 250

1. INTRODUCTION

The purpose of this Skyplex Handbook is to provide pointing, alignment and Skyplex access and operations guidelines to assist in the installation and commissioning of Skyplex terminals as well as daily operations to ensure that performance objectives are being met.

1.1. Initial Access Phase

Prior to accessing the satellite, any Skyplex earth station must have obtained Eutelsat S.A. Approval to Access the Space Segment in accordance with ESOG Module 110.

Some important preparatory issues for conducting successful testing are presented below:

- a) Test Plan, Test Schedule and Instructions: prior to the commencement of any satellite transmissions, the Skyplex station Operator shall have received the detailed line-up test schedule containing all necessary technical/operational parameters and other special instructions.
- b) CSC Coordination: prior to the first satellite access of the Skyplex station, the station operator must establish communications with the Eutelsat S.A. CSC in Paris, as detailed in the ESOG Module 140. Facsimile and telephone numbers are as indicated in the table of contact numbers attached to each ESOG module.

1.2. Operational Phase

Important operational issues for conducting successful operations are presented below:

- a) E/S daily operations: Operators are responsible for maintaining their transmission parameters according to a valid transmission plan and initial line-up test results.
- b) All anomalies observed in operations should be reported to Eutelsat CSC.
- c) Eutelsat CSC is the 24-hours central contact point for management of Skyplex system discipline and interferences procedures. All instructions from CSC needs to be executed immediately by all operators.

2. MANDATORY PRE-TRANSMISSION LINE-UP TESTS (PTLU)

The pre-transmission line-up (PTLU)¹ is mandatory and applies to all Skyplex modes (SCPC and TDMA) and upon its successful completion the earth station will be granted Authorisation to Operate in the Eutelsat S.A. Space Segment as described in the ESOG Module 110, Paragraph 3.2.

The Eutelsat S.A. CSC in Paris (or the SIMS operator) will be responsible for conducting the mandatory PTLU tests.

- Step 1: SUT (Station Under Test) will optimise Satellite Pointing towards correct satellite. See Annex A for detailed procedure.
- Step 2: SUT will optimise Polarisation Alignment. See Annex B for detailed procedure.
- Step 3: SUT will verify that carrier frequency, EIRP level and all other transmission parameters are in accordance with the Eutelsat S.A. approved transmission plan.
- Step 4: A telephone contact is established between the SUT and the CSC/SIMS operator. This contact must be maintained at all times.
- Step 5: SUT shall confirm to the CSC/SIMS operator that antenna pointing and feed alignment has been optimised and will communicate:
 - a) Eutelsat S.A. Earth Station code.
 - b) Satellite + transponder + channel_id to be accessed.
 - c) Transmit frequency of carrier_id.
- Step 6: Under the Control of the CSC/SIMS operator, SUT transmits the carrier at the nominal EIRP in the allocated transponder at the assigned frequency.
- Step 7: CSC will verify SUT cross-polar alignment.

For that purpose one test slot which is cross-polar carrier free is allocated by Eutelsat S.A.².

- a) On the CSC request, SUT will radiate a CW (continuous carrier) at nominal level and at the allocated frequency.
- b) CSC will verify the cross-polar component of SUT.
- c) Under instruction of CSC, SUT will adjust the polariser in clockwise and counter-clockwise direction until minimum cross-polar signal level has been reached.
- d) SUT ceases transmission of the CW.
- e) SUT changes carrier frequency to the frequency included in the approved transmission plan.

¹ PTLU is normally performed in coordination with the Eutelsat CSC. In certain operational cases, PTLU coordination will be performed directly by the SIMS operators (with exception of Step 7).

² This test is omitted in case when Eutelsat S.A. cannot assign a frequency slot accessible by the Skyplex E/S operator.

3. SKYPLEX STATION SYSTEM TESTING: SCPC BASELINE MODE

3.1. Channel Analysis: Demodulation, Check of Nominal Uplink EIRP and Frequency, Buffer Status for SUT

- Step 1: The CSC will record CBER and VBER of the Skyplex transponder and of the services carried over the cross-polar transponders.
- Step 2: The CSC will verify that the SCPC slot allocated to the SUT is free (the corresponding dummy packet PID is present and its bit rate is different from zero).
- Step 3: The CSC will verify that the SUT is programmed for the correct SCPC mode and the correct SCPC slot.
- Step 4: SUT will start transmission at nominal EIRP level and nominal uplink frequency. SUT activates interrogation packet of the telemetry and verifies that it is receiving the telemetry correctly.
- Step 5: The CSC verifies the telemetry packet presence, if the onboard demodulator synchronises the carrier (the corresponding dummy packet PID has bit rate equal to zero) and if Skyplex CBER and VBER remain at the previously measured levels.

If any of the conditions above is not fulfilled, the CSC will ask SUT to: immediately STOP transmission and go back to step 1.

- Step 6: The CSC will verify correct synchronisation and demodulation of the downlink MCPC signal with a DVB reference receiver and correct interpretation of the telemetry packet of the channel under test. SUT will verify correct reception of telemetry packet.
- Step 7: The CSC will verify that the SUT transmits at the assigned nominal uplink frequency within a maximum deviation of ± 50 kHz. Should this not be the case, SUT will adjust the frequency in 10 kHz steps under instruction from CSC.
- Step 8: The CSC will verify that the SUT transmits at the assigned nominal uplink EIRP. Should this not be the case, under instruction from CSC, SUT will adjust the EIRP in 1 dB steps, until nominal level is achieved.
- Step 9: The CSC verifies that the buffer status remains stable. Should this not be the case, under instruction from the CSC, the SUT will verify the configuration of the station to make sure that the "slaved to buffer status" and "False Lock Detect" option are properly chosen.
- Step 10: The CSC will verify that the performance of the two cross-polar transponders remain unchanged (i.e. CBER, VBER) to ensure that no cross-polar interference is caused by the SUT.

3.2. Verification Skyplex Protocol between SUT - SIMS

- Step 1: If all the above conditions are fulfilled, the CSC authorises SUT to request with a Skygate command the connection to the SIMS (Service Information Management Server).
- Step 2: CSC will verify in the PAT (Program Association Table) that the new service has been integrated into the SI tables (presence of the corresponding new PMT).
- Step 3: For the monodirectional mode (“Automatic acknowledgement” option chosen), CSC will verify the protocol of service connection/disconnection from the SIMS as follows:
- Under instruction from CSC, the SUT will send the disconnect command from the Skygate. CSC will verify in the PAT that the service disappears. After that, SUT will send again the connection command and the CSC will verify that the service reappears in the PAT.
- If PID ghosts were present in step 2, CSC will verify that they disappear after disconnection. If not, SIMS should be verified.
- Step 4: For the bidirectional mode (“Automatic acknowledgement” option disactivated), CSC will verify this mode of operations as follows:
- In coordination with CSC, a CRN (Complete Re-synchronisation Notification) re-synchronisation of PSI/SI tables command is sent from the SIMS to the SUT. CSC will then verify that SIMS receives updates of PSI/SI tables from SUT and that SUT receives the corresponding Acknowledgement from SIMS.

3.3. System Analysis: DVB Compliance Tests at Transport Stream Level at CSC

- Step 1: The CSC will verify compliance of the service_ids and the PIDs used by the new SCPC channel with the values authorised in the corresponding transmission plan.
- Step 2: The CSC will analyse all PSI/SI tables (PAT, PMT, NIT, SDT...) on contents and syntax according to the DVB standard of the downlink MCPC carrier and DVB numbering scheme assigned to the transmission in the relevant transmission plan.
- Step 3: The CSC will analyse MPEG-2/DVB parameters relevant to the SUT, including PCR (Program Clock Reference), correct implementation of PTS/DTS (Presentation and Decoding Time Stamps) and all parameters of the DVB measurement guidelines ETR 290 (ETSI Document).

3.4. Picture Assessment at Elementary Stream Level (PES) at CSC (when applicable)

- Step 1: The CSC will verify the picture quality of the new SCPC channel by demodulating and demultiplexing the signal at Elementary Stream Level (PES) by an MPEG-2/DVB commercial grade reference IRD. At the CSC carefully observe during about five minutes that no pixelisation occurs.
- Step 2: The CSC will reduce EIRP in 1dB steps to the level when transponder VBER increases its value or until pixelisation occurs (whatever occurs first), recording the EIRP readouts from the telemetry packet.
- Step 3: On request from the CSC, SUT re-establishes nominal EIRP transmission.

3.5. Reports

- Step 1: Short report from the test will be recorded at the CSC. In case of line-ups performed by SIMS Operator, a short report from the test will be provided to Eutelsat S.A., Ground Segment Operations.

4. SKYPLEX STATION SYSTEM TESTING: TDMA BASELINE AND TURBO MODE FOR STATIONS INTERACTING WITH SIMS

4.1. Channel Analysis: Demodulation, Check of Short-Burst Initial Ranging, Station_id, Nominal Uplink EIRP and Transmit Time Jitter for SUT

- Step 1: The SIMS Operator will make a CBER and VBER recording of the Skyplex transponder and of the services carried over the cross-polar transponders.
- Step 2: The SIMS Operator will ask SUT which channel_id and station_id have been programmed and will verify that they correspond to the allocated ones. Should this not be the case, SUT will correct either channel_id and/or station_id under instruction from SIMS Operator.
- Step 3: SUT will verify that the equipment delay and the propagation delay is correctly configured; the SIMS Operator will ask the SUT to transmit 10 times the short-burst. The short burst should appear on the downlink at least 7 times. The SIMS Operator will check coherency in the guard time field in the telemetry packet.
- Step 4: The SIMS Operator will verify that the SUT transmits at the assigned nominal uplink EIRP. Should this not be the case SUT will adjust the EIRP level in 1 dB steps, under instruction from SIMS Operator.
- Step 5: Alternative method for SIMS Operator to establish the nominal EIRP for SUT is as follows:
- SUT will transmit only short-bursts in Manual mode.
 - SUT reduces its EIRP until VBER of 1E-4 for the transponder is observed by CSC.
 - SUT will increase the EIRP by 4 dB and this level is then recorded as the nominal EIRP for SUT.
- Step 6: The SIMS Operator will verify the transmit time jitter of the SUT. The check will be done by observing the guard time field in the telemetry packet.
- SIMS Operator will verify that the burst position is at the assigned Nominal Position in the TDMA frame, within \pm one byte. Should this not be the case, under instruction from SIMS Operator, SUT will correct the burst position.
 - SUT will program telemetry for 1 request per second and will verify that the transmit window is programmed with the value of 30 bytes.
 - SUT will remain in Manual mode for 2 hours.
 - SIMS Operator will verify that the recorded telemetry guard time field varies smoothly.
 - If the test is successful, SUT will program the transmit window to 20 bytes.
- Step 7: The SIMS Operator will verify that the performance of the two cross-polar transponders remain unchanged (i.e. CBER, VBER).

4.2. Verification of Skyplex Protocol between SUT - SIMS

Repeat step 1 to 4 of Chapter 3.2

4.3. System Analysis: DVB Compliance Tests at Transport Stream Level at SIMS

Repeat step 1 to 4 of Chapter 3.3

4.4. Picture Assessment at Elementary Stream Level (PES) at SIMS

Repeat step 1 to 3 of Chapter 3.4

4.5. Reports

SIMS Operator will provide a short report from the test to Eutelsat S.A., Ground Segment Operations.

5. SKYPLEX STATION OPERATIONS

5.1. Eutelsat's System Discipline

- a) All Skyplex Earth Station operators should be able to communicate and follow instructions given to them by CSC.
- b) Each RF Carrier Activation and De-Activation must only be done under the CSC control.
- c) Pre-Transmission Line-up (PTLU) is mandatory for stations accessing the satellite for the first time or making any change to transmission parameters or equipment settings.
- d) In case of deviations from Nominal Operational Status any instruction given by the CSC (e.g. to increase/reduce EIRP or eliminate crosspolar interference) to restore parameters to nominal must be implemented immediately. Any formal requests (e.g. SOPN – System Operating Notice) must be given appropriate attention.
- e) For in station maintenance or tests, antenna should be depointed from the satellite (if possible) and HPA output or antenna feed input should be monitored to ensure no spurious transmissions occurs.

5.2. Eutelsat's Interference Management

- a) All uplink Earth Station operators should be able to communicate and follow instructions given to them by Eutelsat CSC.
- b) If interference is detected, the Eutelsat CSC will immediately take steps to eliminate it by its localisation and request for ceasing the transmission from the station creating interference.
- c) For the station creating interference problems a support in the identification of the source of the problem by SIMS staff, Eutelsat CSC and other Eutelsat Skyplex staff to the operator could be provided.

Annex A - Pointing Alignment

Operators are requested to begin the installation and initial pointing and alignment of their Skyplex station according to their supplier instructions. A suggested procedure to assist Skyplex stations operators is as follows

- Step 1: Check azimuth, elevation and polarisation angle calculations.
- Step 2: Accurately set antenna pointing and feed polarisation offset.
- Step 3: Verify the frequency of the on-board satellite beacon or another appropriate RF carrier. If a spectrum analyser is available, accurately calculate the downlink frequency that you will be viewing on it. Remember that some LNBS (Low Noise Block) down-converters may have fairly unstable local oscillators and this must be taken into account when setting the spectrum analyser span/division and resolution bandwidth.
- NOTE:** The on-board beacon is visible from any point within Eutelsat S.A. satellite beam coverage.
- Step 4: Once all these values are determined and the antenna is pre-pointed, begin a slow antenna sweep in azimuth each side of the calculated azimuth and repeat in small (0.5°) elevation increments. Carefully peak antenna pointing once the beacon/RF carrier is detected in order to obtain the maximum receive level.

Operators should then begin the final alignment of the subject station, before proceeding to polarisation alignment and then system tests with the CSC.

Annex B - Polarisation Alignment

Test Description

This method requires a spectrum analyser (which must be of good quality, e.g. -140 dBm/Hz noise floor) to be available at the SUT (Station Under Test).

The following is the procedure to be employed:

- Step 1: Connect the spectrum analyser to the output port of the antenna feed system of the SUT. RF access should be available at the outdoor unit. Adjust the spectrum analyser and feed to receive a predetermined satellite carrier in the polarisation where the Skyplex station will operate. The corresponding slot in the opposite polarisation should be signal-free, in order to enable the cross-polar nulling detailed below. (As an example of spectrum analyser settings, choose a resolution bandwidth in the order of 10 kHz, a video bandwidth in the order of 1 kHz and a frequency span in the order of 1 MHz)
- Step 2: Adjust carefully the antenna in azimuth and elevation to maximise the satellite carrier received on the spectrum analyser.
- Step 3: Adjust carefully the polariser (or feed) in clockwise and counter-clockwise direction until the received signal is maximised. Mark the antenna and polariser (or feed) positions.
- Step 4: Rotate the feed system by 90° clockwise or counter-clockwise without changing the previous frequency, sweep bandwidth and resolution bandwidth settings.
- Step 5: Re-adjust if necessary the input sensitivity of the spectrum analyser until the received satellite carrier can be detected (a line amplifier may be required for spectrum analysers with a noise floor above -140 dBm/Hz).
- Step 6: Adjust carefully the polariser (or feed) in clockwise and counter-clockwise direction until minimising the satellite carrier (crosspol nulling). Mark the feed position and note this signal level value. Also note the maximum signal levels obtained clockwise and counter-clockwise to this setting.
- NOTE:** If the received signal is still too high with respect to the expected cross-polar performance of the antenna being aligned, then adjust carefully the antenna in azimuth and elevation if necessary to minimise the carrier received at the spectrum analyser and then repeat steps 5 and 6.
- Step 7: Rotate the feed by exactly 90° counter-clockwise or clockwise i.e. in the opposite sense of Step 4.
- Step 8: The feed position should now correspond to that obtained in maximising the co-polar (Steps 2 and 3). In the case of a small difference the SUT should be maintained at the setting obtained in Step 7. Important differences in the two settings may indicate problems in the antenna assembly (e.g. de-focusing of the feed) and support from the Eutelsat CSC is required to re-optimize the polarisation alignment.

NOTE: For offset front feed antennas the cross-pol null exists only in azimuth, so there is no requirement to adjust the polariser (or feed) in elevation

EUTELSAT S.A. OPERATIONS CONTACT POINTS

<p>Eutelsat S.A. CSC e-mail: csc@eutelsat.fr</p>	<p>Voice: +33-1-45.57.06.66 Fax: +33-1-45.75.07.07</p>
<p>Ground Segment Operations</p> <p>Earth Station Approval and Line-up Office e-mail: esapproval@eutelsat.fr</p> <p>Type Approval e-mail: typeapproval@eutelsat.fr</p>	<p>Voice: +33-1-53.98.48.11 Fax: +33-1-53.98.37.41</p> <p>Voice: +33-1-53.98.39.25 +33-1-53.98.46.13</p> <p>Voice: +33-1-53.98.48.16</p>
<p>Resource Engineering Group</p> <p>e-mails : dsvplan@eutelsat.fr</p> <p>ltplan@eutelsat.fr</p>	<p>Voice: +33-1-53.98.42.50 Fax: +33-1-53.98.30.00</p>
<p>Eutelsat S.A. Booking Office e-mail: booking@eutelsat.fr</p>	<p>Voice: +33-1-53.98.47.07 Fax: +33-1-53.98.37.37</p>
<p>Mailing Address</p>	<p>Eutelsat S.A. 70, rue Balard F-75502 PARIS Cedex 15 FRANCE</p>
<p>Eutelsat S.A. Corporate Web</p>	<p>http://www.eutelsat.com</p>
<p>Eutelsat Extranet (password protected)</p>	<p>http://services.eutelsat.fr</p>