Volume I - ESOG Module 160 - Issue 1.1

VSATs' ODUs TYPE APPROVAL

30 July 2008

eutelsat
communications via satellite

EUTELSAT S.A.

SYSTEMS OPERATIONS GUIDE

ESOG Module 160

VSATs' ODUs TYPE APPROVAL

Issue 1.1 30-07-2008

1. INTRODUCTION 1

2. GENERAL 2
2.1. Step by Step Process 2
2.2. Data to be Submitted 2
2.3. Engineering Support 3
2.4. Design Review 3
2.5. Type Approval Tests 3
2.6. Financial Charges 3
2.7. Test Facilities 3

3. TYPE APPROVAL TESTS 4
3.1. Theory of Stability 4
3.2. Test Methods 4

4. EUTELSAT S.A. CERTIFICATION 6

5. FUTURE OPERATIONS 7

Annex A - Request for Type Approval 8

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' ODUs 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 type approval of earth station equipment depends on the ability to manufacture such equipment with repeated precision. If this cannot be guaranteed, then, in order to demonstrate minimum compliance with Eutelsat S.A specifications, the continual submission of test data is necessary.

The type approval of VSATs' Outdoor Units (ODUs) is focused uniquely on their RF stability issues.

This is particularly required given the high number of VSATs in operation where any instability problems caused by design or manufacturing shortfalls of ODU's may lead to epidemic interference situations causing unacceptable commercial/operational damage.

2. GENERAL

2.1. Step by Step Process

The basic steps to be followed by the applicant to obtain type approval are:

1. Obtain Eutelsat S.A. Documentation as appropriate.
2. Notify Eutelsat S.A. of the intention to qualify a VSAT ODU for "Type Approval".
3. Provide Eutelsat S.A. with the required technical information
4. Review Meeting with Eutelsat S.A.
5. Conduct, under coordination and control of Eutelsat S.A., type approval verification testing.
6. Evaluate, in coordination with Eutelsat S.A., test results.
7. Produce "Type Approval Verification Test Report" for submission to Eutelsat S.A.
8. Obtain "Eutelsat S.A. Type Approval Certification" for equipment in question.

2.2. Data to be Submitted

The data, that should be submitted to Eutelsat S.A., needs to include as a minimum the following details:

- DESIGN WALKTHROUGH

  - System Concept;
  - Functioning of the transmit unit during idle/active mode;
  - Output stages e.g. drivers and power amplifiers;
  - Temperature behaviour of amplifiers;
  - RF Shielding;
  - Absorber material/ - characteristics - /ageing;

- POWER AMPLIFIER

  - Product description;
  - Features;
  - Electrical Specification;
  - Operating Frequency [min/max];
  - Gain (S21) [min/max/typical];
  - Input/output VSWR [typical];
  - Output power at 1 dB Gain compression [min/typical];
  - Noise Figure [typical];
  - Gain variation over Operating Frequency ΔS21 [max/typical];
  - Gain Variation over Operating Frequency ΔS12 [max/typical];

- STABILITY CONSIDERATIONS

  - Scattering parameters (S11, S12, S21 and S22);
  - Design Objectives;
    . K-factor, det S
    . Difference in forward to reverse transmission (S21-S12)
  - Temperature behaviour;
  - Tolerance range;

- PRODUCTION ASPECTS

  - Quality control/assurance;
  - Screening tests (device & component level).

All information supplied to Eutelsat S.A. will be treated in the strictest confidence and not disclosed to any third party.

2.3. Engineering Support

Eutelsat S.A. will provide engineering support in order to witness the actual type approval tests as necessary together with arranging the necessary initial meetings relating to the test plan and design review.

2.4. Design Review

Eutelsat S.A. will arrange, after reviewing the submitted data from the applicant relating to the VSAT outdoor units (ODUs), for a meeting to discuss the technical aspects and confirm the schedule of tests.

2.5. Type Approval Tests

The tests relating to type approval are considered in the next section but the final programme of tests should be agreed at the design review meeting.

2.6. Financial Charges

There is a charge, fixed by Eutelsat S.A, which will be levied on the applicant for this "Type Approval Certification" and engineering support.

2.7. Test Facilities

The applicant seeking type approval of his ODUs shall normally provide all in plant (or other) testing facilities, any support materials and staff over the entire period of testing, according to Eutelsat S.A. requirements.
Alternatively the applicant may be requested by Eutelsat S.A to provide samples of his ODUs for the purpose of conducting tests in an independent laboratory to be agreed upon between Eutelsat S.A. and the applicant.

3. TYPE APPROVAL TESTS

3.1. Theory of Stability

The following formulas (also known as Stern or Rollet stability analysis method) are used to assess the stability conditions at the input / output of the ODU.

$$K = \frac{1 - |\underline{S}_{11}|^2 - |\underline{S}_{22}|^2 + |\det \underline{S}|^2}{2 \cdot |\underline{S}_{21} \cdot \underline{S}_{12}|} \quad (1)$$

$$\det \underline{S} = \underline{S}_{11} \cdot \underline{S}_{22} - \underline{S}_{12} \cdot \underline{S}_{21} \quad (2)$$

Unconditional stability conditions are guaranteed if following terms are fulfilled:

$K > 1$ and $|\det \underline{S}| < 1$

Alternative conditions are:

$K > 1$ and $B_1 = 1 + |\underline{S}_{11}|^2 - |\underline{S}_{22}|^2 - |\det \underline{S}|^2 > 0$ (3)

Unconditional stability can be graphically represented as impedance circle plots on the Smith Chart using following formulas:

	Input stability circles	Output stability circles
Center	$\underline{M}_{input} = \frac{(\underline{S}_{11} - \underline{S}^*_{22} \cdot \det \underline{S})^*}{\|\underline{S}_{11}\|^2 - \|\det \underline{S}\|^2}$ (4)	$\underline{M}_{output} = \frac{(\underline{S}_{22} - \underline{S}^*_{11} \cdot \det \underline{S})^*}{\|\underline{S}_{22}\|^2 - \|\det \underline{S}\|^2}$ (6)
Radius	$\underline{R}_{input} = \left\|\frac{\underline{S}_{12} \cdot \underline{S}_{21}}{\|\underline{S}_{11}\|^2 - \|\det \underline{S}\|^2}\right\|$ (5)	$\underline{R}_{output} = \left\|\frac{\underline{S}_{12} \cdot \underline{S}_{21}}{\|\underline{S}_{22}\|^2 - \|\det \underline{S}\|^2}\right\|$ (7)

3.2. Test Methods

It is recommended to investigate the unconditional stability at both system level and board level. Tests in a climatic chamber are recommended in particular at low temperatures (-40°C).

3.2.1. System Level

One recommended method to assess stability at system level is to measure the level of spurious emissions at the output of the ODU at various frequency ranges. This should be achieved by varying the following parameters:

- Ambient temperature (e.g.: measurements at +60°C, +25°C and -40°C are recommended);
- Load impedance (e.g. shifting load);
- Input signal (including idle mode);
- Frequency (it is recommended to measure up to at least 18 GHz for Ku-Band ODUs).

3.2.2. Board Level

The final power unit of the ODU plays a fundamental role to fulfil the stability conditions. In case this is feasible, it is recommended to isolate the final power unit and to mount it on a test fixture and then perform S-parameters analysis with a Network Analyser (e.g. HP 8510).
The following assessments are recommended at various temperatures and frequencies:

- K factor;
- $|\det \underline{S}|$;
- B1;
- $|S21| - |S12|$;
- Stability circles.

3.2.3. Additional Information

During the design review meeting, the manufacturer is expected to produce additional information i.e.:

- Block diagram of the ODU;
- Datasheet of the final power unit (including the gain, gain tolerance and gain variation versus temperature);
- Production and quality control procedures;
- Susceptibility aspects/measurements.

4. EUTELSAT S.A. CERTIFICATION

Based on the successful completion, demonstration, technical verification and certification of all mandatory electrical performance characteristics, Eutelsat S.A. will issue a type approval certificate to the applicant.

A unique type approval number will be assigned by Eutelsat S.A. to the certificate which will also contain a list of each piece of equipment (or equipment configuration) that was part of the testing.

The list of type approved VSATs' ODUs and their relevant configurations is published and regularly updated in the Eutelsat S.A. Web site.

5. FUTURE OPERATIONS

If following the type approval, the equipment undergoes a modification, that will affect either the configuration applied for or the repeatability of the tests, Eutelsat S.A. must be advised. Any further action will be agreed with the applicant but may require further testing.

If also during operations a problem occurs which raises concern about the repeatability of the measurements, Eutelsat S.A. reserves the right to require the tests to be repeated and to review the position regarding the continued certification.

Annex A - Request for Type Approval

To request Type Approval, complete the form as shown on the next page and forward to the Head of Ground Segment Operations at Eutelsat S.A. The mail address is indicated on the Operational Contacts Lists in the back of every ESOG Module.

APPLICATION FOR EARTH STATION EQUIPMENT TYPE APPROVAL

To: Head of Eutelsat S.A. Ground Segment Operations

Ref:..... Date: .....

From:.....

.....

This is to request type approval of the following VSAT ODU for operation in the Eutelsat S.A. space segment, based on the procedures as described in ESOG Volume I, Module 120:

(insert equipment details)

The anticipated number of production units will be ..... per year/total.

Technical details of a complete unit and the proposed type approval tests including test procedures are attached for your information.

It is suggested that all testing is to be undertaken at: .....
from: ..... to: .....

Full Company details:.....
Name:.....
Address: .....
.....
.....
Telephone: ..... Facsimile: .....
E-mail: .....

VSAT OUTDOOR UNIT (ODU) TRANSCEIVER

Manufacturer: .. .. Model: .....

Rating (Watt): .....

Weight: .....

Dimensions: .....

Manufacturer of the Power Module Device: .....

Output power Level Stability (RMS): + ... dB

- ..... dB

Transmit Frequency Stability: ± ..... KHz

The applicant certifies that the information provided to Eutelsat S.A. in this application and in the attached documents describes as close as possible the properties and performance of the VSAT ODU concerned. Any technical modifications introduced to this system in future will be reported to Eutelsat S.A. immediately.

Responsible Company Officer: ....

Place: ..... Date: .....

Signature/Company Stamp: .....

EUTELSAT S.A. OPERATIONS CONTACT POINTS

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