

# Deviation Request #106 for an ETSO approval for CS-ETSO applicable to Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment (ETSO-C112d)

## Consultation Paper

### 1 Introductory Note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board [Decision No 12-2007](#) products certification procedure dated 11th September 2007, Article 3 (2.) of which states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.”

This update of the deviation document reflects that for some of the requirements, which are subject of this deviation consultation paper, there is no legal basis foreseen to grant exemptions from regulation (EU) No 1207/2011.

### 2 Deviation Requests

#### 2.1 ETSO-C112d#3 Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

##### 2.1.1 Summary of Deviation

Deviate from EUROCAE ED-73E section 4.2 (RTCA/DO-181E Section 2.3.1) for the Environmental Conditions to perform testing between 980 MHz to 1080 MHz at 50 mV/m instead of at the Category S levels of 1 V/m as specified in EUROCAE ED-14E RTCA/DO-160D Section 20.3(d) for transponder that had been previously authorised for ETSO-2C112b or ETSO-C112c, if only a software update to provide ADS-B out functionality relative to the previous authorisation is performed and compliance to regulation (EU) No 1207/2011 is not claimed.

##### 2.1.2 Original Requirement

EUROCAE ED-14E Section 20.3(d) Test Frequency Exclusions

RF receiving equipment may show sensitivity to in-band receive frequencies during susceptibility testing. This sensitivity is normal for devices that are required to be sensitive according to the receiver MOPS. This sensitivity is therefore normal and such frequencies may need to be excluded or levels at these frequencies reduced during testing.

Unless otherwise specified by the applicable receiver minimum performance standard, the following exclusion band shall apply for radio receivers. The band of frequencies from ten percent below the lowest operating frequency in the band to ten percent above the highest operating frequency shall be tested to Category S levels. Required receiver performance shall be stated in the test procedure and report, or in the specific receiver performance standard. The frequencies from one percent below the radio receiver tuned frequency through one percent above the tuned frequency shall be tested to Category S for damage assessment only.

This test is not intended to evaluate the normal MOPS RF performance characteristics of the receivers, nor is the test intended to evaluate receiver performance in the presence of any interfering signal induced or coupled into the receiver's RF input port(s). Other responses due to power line and/or control/signal line coupling, or direct coupling through the receiver's enclosure shall be evaluated and pass/fail criteria determined based on the specific receiver specifications or performance requirements.

RTCA/DO-160D Change 1, 2, 3 Section 20.3.d

RF receiving equipment may show sensitivity to in-band receive frequencies during susceptibility testing. This sensitivity is normal for devices that are required to be sensitive according to the receiver MOPS. This sensitivity is therefore normal and such frequencies may need to be excluded or levels at these frequencies reduced during testing.

This test is not intended to evaluate the normal MOPS RF performance characteristics of the receivers, nor is the test intended to evaluate receiver performance in the presence of any interfering signal induced or coupled into the receiver's RF input port(s). Other responses due to power line and/or control/signal line coupling, or direct coupling through the receiver's enclosure shall be evaluated and pass/fail criteria determined based on the specific receiver specifications or performance requirements.

Tests shall be performed to full levels, or for frequencies within 5% of the tuned frequency, to Category S levels. Required receiver performance shall be stated in the test procedure and report, or in the specific receiver performance standard.

### 2.1.3 Industry

Industry understands and summarizes the last paragraph of DO-160D Change 1, 2, 3 Section 20.3.d to be:

Tests shall be performed at Cat. S levels for frequencies within 5% of the tuned frequency, and the receiver must meet the performance requirements stated in the MOPS.

In this instance, "MOPS" corresponds to RTCA/DO-181E Section 2.3.1, which specifically requires testing of multiple receiver requirements (present in Test Group 1 of Table 2-12) during RTCA/DO-160D Section 20 environmental testing.

RTCA/DO-181E does not otherwise specify reduced test levels or alternative test methods. This requirement conflicts with the second paragraph of DO-160D Change 1,2,3 Section 20.3.d which states that "This test is not intended to evaluate the normal MOPS RF performance characteristics of the receivers,

nor... receiver performance in the presence of any interfering signal induced or coupled into the receiver's RF input port(s)." MOPS of other avionics equipment sensitive to in-band signals, such as VHF Comm's and GPS receivers, specify further reduced test levels for in-band receiver performance testing.

Industry wishes to reconcile the conflict between RTCA/DO-181E Section 2.3.1 and RTCA/DO-160D Change 1, 2, 3 by testing at 50 mV/m at the receiver centre frequency +/- 4.85% (corresponding to the frequency range from 980 MHz to 1080 MHz).

ELOS is provided by the fact that in a real-world installation, an interfering signal with field strength of 1 V/m present at the transponder would produce signal levels at its receiver input exceeding the sensitivity of the receiver. This is due to the proximity of the transponder to the antenna as well as leakage in the shielding of the coaxial cable connecting the transponder to the antenna. Interfering signals at these levels in the receiver's passband would interfere with receiver operation regardless of whether or not the transponder itself is immune to a 1 V/m interfering signal. MOPS of other avionics equipment acknowledge that such immunity within the receiver's passband is unnecessary and include provision for testing at a reduced level within the receiver's passband.

Industry agrees to identify in the Declaration of Design and Performance as well as in the installation and / or operation manual that the transponder does not meet regulation (EU) No 1207/2011. ~~Industry also agrees to identify in the aforementioned documents that the applicant must seek approval of an exemption from the appropriate authority for the affected aircraft model before flying into European airspace once the mandate becomes effective.~~

#### 2.1.4 Equivalent Level of Safety

The equipment was deemed suitable during initial approval, and the software update just allows that the units to support ADS-B out.

#### 2.1.5 EASA position

The deviation is granted.

### 2.2 ETSO-C112d#4 Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

#### 2.2.1 Summary of Deviation

Make the requirement EUROCAE ED-73E Section 3.12.7 (RTCA/DO-181E Section 2.2.8.6) Response in the Presence of CW Interference not applicable for transponder that had been previously authorised for ETSO-2C112b or ETSO-C112c, if only a software update to provide ADS-B out functionality relative to the previous authorisation is performed and compliance to regulation (EU) No 1207/2011 is not claimed.

#### 2.2.2 Original Requirement

EUROCAE ED-73E Section 3.12.7 Response in the Presence of CW Interference

In the presence of non-coherent CW interference at a frequency of  $1030 \pm 0.2$  MHz, at signal levels of 20 dB or more below the desired Mode A/C or Mode S interrogation signal level, the transponder shall reply correctly to at least 90 percent of the interrogations.

### 2.2.3 Industry

This requirement was added in EUROCAE ED-73C / RTCA DO-181D in 2008 to address potential reply probability reductions in the presence of CW interference. Legacy transponders intended for re-use through software-only ADS-B updates are consequently unable to meet this requirement due to the existing hardware being designed prior to this requirement's introduction.

ELOS is provided by the fact that existing and installed transponders comply with the standards that were current at the time of the article development. This deviation improves safety by facilitating field loadable SW updates for thousands of existing installations to enable ADS-B output capabilities. Industry agrees to identify in the Declaration of Design and Performance as well as in the installation and / or operation manual that the transponder does not meet regulation (EU) No 1207/2011. ~~Industry also agrees to identify in the aforementioned documents that the applicant must seek approval of an exemption from the appropriate authority for the affected aircraft model before flying into European airspace once the mandate becomes effective.~~ Field loadable SW updates allow operators to immediately utilize previously certified transponders for ADS-B output equipage, which would provide a better safety impact than delaying ADS-B equipage until recertification of new, retrofitted transponders.

### 2.2.4 Equivalent Level of Safety

The equipment was deemed suitable during initial approval, and the software update just allows that the units to support ADS-B out.

### 2.2.5 EASA position

The deviation is granted.

## 2.3 ETSO-C112d#5 Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

### 2.3.1 Summary of Deviation

Deviate from EUROCAE ED-73E Section 3.15.1 (RTCA/DO-181E Section 2.2.11) Response to Mutual Suppression Pulses Paragraph B to allow the suppression output signal to return to the inactive state in less than 15 microseconds instead of 10 microseconds after transponder RF transmission provided that the suppression output signal total time does not exceed transponder RF transmission by more than 20 microseconds for transponder that had been previously authorised for ETSO-2C112b or ETSO-C112c, if only a software update to provide ADS-B out functionality relative to the previous authorisation is performed and compliance to regulation (EU) No 1207/2011 is not claimed.

### 2.3.2 Original Requirement

ED-73E Section 3.15.1.b / DO-181E Section 2.2.11.b specify that “The suppression output signal shall precede the transponder RF transmission by no more than 10 microseconds and return to the inactive state in less than 10 microseconds.”

### 2.3.3 Industry

Industry understands the intent of this requirement is to minimize the total time other mutually suppressed L-band equipment are suppressed when the transponder is not actually transmitting. The alternative requirement requested in this deviation shifts the allocation of the suppression window allotted from 10 microseconds before the transponder transmission and 10 microseconds after the transponder transmission to 5 microseconds before and 15 microseconds after the transponder transmission. The intent of the original requirement is preserved as the time that other mutually suppressed L-band equipment are suppressed while the transponder is not transmitting will still remain the same.

ELOS is provided by the fact that the total time which other connected L-band equipment are mutually suppressed when the transponder is not actually transmitting is within the total time allowed by the MOPS. Additionally, existing and installed transponders comply with the standards that were current at the time of the article development. This deviation improves safety by facilitating field loadable SW updates for thousands of existing installations to enable ADS-B output capabilities. Industry agrees to identify in the Declaration of Design and Performance as well as in the installation and / or operation manual that the transponder does not meet regulation (EU) No 1207/2011. ~~Industry also agrees to identify in the aforementioned documents that the applicant must seek approval of an exemption from the appropriate authority for the affected aircraft model before flying into European airspace once the mandate becomes effective.~~

### 2.3.4 Equivalent Level of Safety

The equipment was deemed suitable during initial approval, and the software update just allows that the units to support ADS-B out.

### 2.3.5 EASA position

The deviation is granted.

## 2.4 ETSO-C112d#6 Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

### 2.4.1 Summary of Deviation

Deviate from EUROCAE ED-73E paragraph 3.2.4 g (RTCA DO-181D, / DO-181E paragraph 2.2.2.4.g.) Sensitivity and Dynamic Range requirements.

## 2.4.2 Original Requirement

ED-73C / ED-73E paragraph 3.2.4.g. (DO-181D / DO-181E paragraph 2.2.2.4.g.) states:

The spurious ATCRBS (Air Traffic control Radar Beacon System) reply ratio resulting from low level Mode-S interrogations shall be no more than:

1. An average of 1% in the input interrogation signal range between -81 dBm and the Mode-S MTL (Minimum Triggering Level), and;
2. A maximum of 3% at any given amplitude in the input interrogation signal range between -81 dBm and the Mode-S MTL.

## 2.4.3 Industry

This requirement was added in ED-73C/DO-181D in 2008 to address potential spurious interference when interrogation signal levels are just below Minimum Triggering Level (MTL). The existing transponder hardware was designed before the requirement was introduced and is not able to meet the requirement with the current hardware design. This transponder is a legacy design which is being re-used with a software only change to provide ADS-B operation.

The current performance for spurious ATCRBS reply ratio from low level Mode-S interrogations is an average of 7.2% with a maximum of 31.8% in the input interrogation signal range between -81 dBm and the Mode-S MTL. These numbers are derived from a conservative theoretical worst case analysis demonstrating that the non-compliant performance of these transponders does not adversely impact the level of safety at the aircraft or airspace level.

ELOS is provided by the fact that the worst case scenario of additional replies caused by this deviation will result in a worst case of 3690 additional replies per second or 7.0% of total frequency spectrum load. Mitigations built into TCAS, ground ATC radar processing, and ADS-B applications ensure that an Equivalent Level of Safety will be maintained.

Refer to ETSO.DevP.81b, where this deviation was previously granted by EASA under ETSO-C112c#5.

(Note that existing installed transponders comply with the standards that were current at the time of the article development. This deviation improves safety by facilitating field loadable SW updates for thousands of existing installations to enable ADS-B output capabilities. Industry agrees to identify in the Declaration of Design and Performance as well as in the installation and / or operation manual that the transponder does not meet regulation (EU) No 1207/2011. ~~Industry also agrees to identify in the aforementioned documents that the applicant must seek approval of an exemption from the appropriate authority for the affected aircraft model before flying into European airspace once the mandate becomes effective.~~ Field loadable SW updates allow operators to immediately utilize previously certified transponders for ADS-B output equipage, which would provide a better safety impact than delaying ADS-B equipage until recertification of new, retrofitted transponders.)

## 2.4.4 Equivalent Level of Safety

See justification for ETSO-C112c#5.

## 2.4.5 EASA position

The current ETSO-C112d refers to EUROCAE ED-73E. The requirement is not new in ED-73E but existed already in E D-73C and is endorsed by ETSO-C112c applicable since 21.12.2010.

ICAO Annex 10 Volume IV amendment 85 has a corresponding requirement in paragraph 3.1.2.10.1.1.5.2. That requirement is applicable to equipment certified after 1 January 2011.

The ICAO requirement per se is not aiming for retrofit action of the existing fleet but wants to ensure that new designs are respecting the requirement to solve observed issues and to reduce channel load to allow further traffic growth.

As the ICAO is talking about equipment certification and not aircraft certification we consider that even existing transponder designs may be selected for new installation and certification on board aircraft. This would allow even for upgrades of old designs with new software under the provision of the aircraft certification process.

The ETSO certification is the only equipment certification process in the EASA system. When doing a major change to an existing equipment under the provisions of 21A.611 this leads automatically to a new application and a new authorisation. The date of application is setting the applicable certification basis. Equipment certification is considered a voluntary process as parts and appliances could always be certified as part of the aircraft.

Considering the need for an upgrade path for existing transponder design, based on the industry presentation, and the nonexistence of a mandate to update existing installations we accept the deviation as an Equivalent Level of Safety has been demonstrated under the following condition:

As regulation (EU) No 1207/2011 Requirements for the Performance and the Interoperability of Surveillance for the Single European Sky makes ICAO Annex 10 Volume IV amendment 85 paragraph 3.1.2.10 are binding requirements the applicant needs to identify in the Declaration of Design and Performance as well as in the installation and or operation manual that the transponder does not meet regulation (EU) No 1207/2011 ~~and that an exemption must be asked for the affected aircraft model when flying into European airspace after 7 December 2017.~~

~~Note: EASA is not competent to grant exemptions to regulation (EU) No 1207/2011.~~