

Deviation Request ETSO-2C197#4 for an ETSO approval for CS-ETSO applicable to Information Collection and Monitoring Systems (ETSO-2C197)

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.”

2 ETSO-2C197#4 Information Collection and Monitoring Systems

2.1 Summary of Deviation

Deviates from EUROCAE ED-155 I-3.2.4 by permitting a lower signal to noise ratio consistent with aircraft audio system performance and using the same pass/fail criteria as the standard crash recorders.

2.2 Original Requirement

EUROCAE ED-155

I-3.2.4 Audio Noise Level – Signal to Noise

With no signal applied to any input channel, the reproduced signal shall be below the output level produced by an input Reference Signal by the value defined in Table I-3.1.

This requirement shall be met across the frequency band as defined in Table I-3.1 with the input both open and short circuited. The above Signal to Noise performance shall be met in the presence of out-of-band input signals at the Reference level when tested in accordance with paragraph I-5.2.3.

NOTE: *If audio channels are specified with the audio frequency response of the area channel, the area channel out-of-band signal definition shall apply.*

Table I-3.1 excerpt:

Characteristic	Cockpit Area Microphone	Cockpit Area Microphone Preamplifier	Recorder Cockpit Area Microphone Channel	Recorder Pilot Audio Channel
Signal to Noise (minimum)	67 dB referenced at 94 dB SPL	80 dB referenced to signal equivalent to 120 dB SPL at microphone	80 dB referenced to signal equivalent to 120 dB SPL at microphone	80 dB referenced to 1 Vrms input level with 0dB selectable input attenuation.

(...)

I-5.2.3 Audio Noise Level – Signal to Noise (paragraph I-3.2.4)

a Equipment Required:

*Audio Signal Generator,
 A-weighted Filter IEC 651(1979),
 3rd Octave Filters IEC 225 (1966),
 Audio Power Meter,
 Replay equipment as specified by the manufacturer.*

b Measurement Procedure:

Operate the CARS with all flight functions and aircraft interfaces active, i.e. image, data-link, etc., and apply the reference signal to each recording channel for 30 seconds. Replay the recordings and measure the output levels using the audio power meter.

Operate the CARS with all flight functions and aircraft interfaces active, i.e. image, data-link, etc., for 30 seconds for each of the following five different input conditions – open, shorted and with three separate out-of-band signals applied. For the out-of-band tests, connect the signal generator to each channel of the recorder under test and set the input signal to the Reference Signal Level. Select, in turn, frequencies of 31.5 kHz, 40.0 kHz and 50.0 kHz for the area microphone channel, and 8 kHz, 10 kHz and 12.5 kHz for the other audio channels. Replay the recordings measuring the un-weighted 22 kHz bandwidth noise level in 3rd octave bands for the area microphone channel, and A weighted noise level in 3rd octave bands for the pilots audio channel(s). Table I-5.1 and Table I-5.2 are examples for entering this data for the area microphone and audio channels respectively. Enter the calculated ratio in dB of the output for the reference signal input relative to the output for zero input. Record the lowest value in the last row of the table. This value should be greater than the specification given in Table I-3.1.

2.3 Industry

There are two distinct areas where the ED-155 pass/fail criteria for signal to noise measurements are difficult to achieve in practice. These are described in the following sections.

2.3.1 Open/Shorted Requirement

For the "open/shorted" requirement, the test set-up in terms of cable length and shielding has a significant impact on Signal to Noise (S/N) measurement, yet the objective is to test the performance of the recorder.

Due to the high impact of cabling effects, which is the weakest part of the signal to noise chain, meeting the 80dB requirement for the stand-alone recorder is not practical. In practice, the cabling on an actual aircraft installation will have a significant impact on the signal to noise ratio.

Also described in RTCA DO-214A section 1.2.1.2 Circuit Noise *"Through the use of current aircraft wiring design practices, communication system produced noise may be maintained at least 40 dB below the desired speech signals"* describes the maximum noise inserted in the Recorder Pilot Audio Channel.

In addition, the $1 V_{RMS}$ reference signal specified in ED-155 is closer to the noise floor than the CVR specification of $3 V_{RMS}$ as specified in ARINC-757A-1 Cockpit Voice Recorder. This equates to a -9.5 dB difference which is not representative to a real aircraft environment as has been proven on CVR installations over many years.

Empirical testing has demonstrated that it is possible to achieve signal to noise ratios ranging from 55 dB to 74 dB by using different cable set-ups (all performed with Shielded Twisted Pair (STP)). The value of 80 dB is considered excessive as this has not been achieved using different cabling.

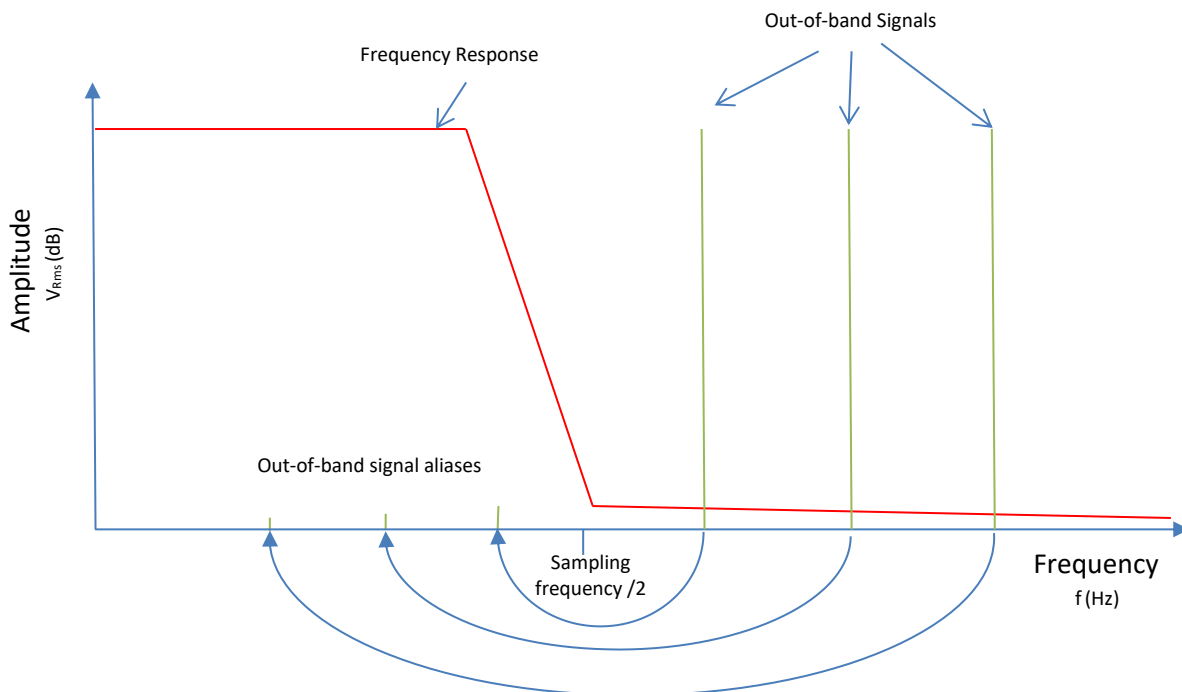
As an alternative means of compliance, it is suggested that a threshold of 70 dB would be more realistic, even for installations where a combined recorder is used with all interfaces active.

2.3.2 Out of Band Requirement

The test procedure for out-of-band signal to noise ratios at the frequencies specified in ED-155 section I-5.2.3 is not viable for two reasons:

Firstly, to meet this requirement would require an anti-aliasing filter sufficient to attenuate the out-of-band signals. This would be necessary to avoid signal aliases within the required frequency band (see graph below). However, such a filter design would also impart a recording delay and adversely affect pass-band ripple to marginal levels.

Secondly, the signal levels at the specified out-of-band frequencies would be beyond the cut-off frequency points of the pilot audio and cockpit area microphone channels. Due to the roll-off in frequency response, the signal levels appearing at the recorder input would therefore be significantly attenuated below those specified in ED-155 and would not occur in a real aircraft environment.



As an alternative means of compliance, the following criteria are set:

- (1) The signal to noise ratio for out-of-band frequencies is reduced to 48 dB. This is consistent with ED-112A (section I-3.2.5 & table I-3.1) and the audio performance & aircraft wiring design standards as described in DO-214A (section 1.2.1.2).
- (2) An improved method of assessing recorded audio quality is introduced, such as Speech Transmission Index (STI) as specified in ED-112A, extending the test to include out-of-band signals.
- (3) The same STI quality indices as published in ED-112A section I-3.2.4 and table I-3.1 are used for ED-155 compliance.

2.3.3 Conclusion

This deviation proposes to replace the ED-155 requirements of Table I-3.1 as follows:

Characteristic	ED-155 requirement		Deviation ETSO-2C197#4	
	Recorder Cockpit Area Microphone Channel	Recorder Pilot Audio Channel	Recorder Cockpit Area Microphone Channel	Recorder Pilot Audio Channel
Signal to Noise (minimum)	80 dB referenced to signal equivalent to 120 dB SPL at microphone	80 dB referenced to 1 Vrms input level with 0dB selectable input attenuation.	70 dB for open and shorted circuit, 48 dB for out-of-band signals referenced to signal equivalent to 120 dB SPL at microphone and achieving an STI Quality Index with out-of-band signals ≥ 0.85	70 dB for open and shorted circuit, 48 dB for out-of-band signals referenced to 1 Vrms input level with 0dB selectable input attenuation and achieving an STI Quality Index with out-of-band signals ≥ 0.75

2.4 Equivalent Level of Safety

This deviation provides an equivalent level of safety because alternate performance is consistent with the overall aircraft audio system performance and wiring design as recognized by RTCA DO-214A for aircraft audio systems and with the cockpit voice recorders for large aircraft as specified in ED-112A.

2.5 EASA position

We accept the deviation.