

- Overview -
Draft DO-260A, Appendix M
Enhanced Range Reception Techniques

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Scope of Appendix M

- Appendix M describes features not required by the current MOPS that may be useful to address potential optional capabilities
- Appendix M provides a description of techniques for extending the air-to-air reception range of 1090 MHz extended squitter
 - use of a directional antenna for 1090 MHz extended squitter reception
 - optimized 1090 MHz ADS-B reception employing a variable bandwidth receiver
 - increased receiver sensitivity with a low noise preamplifier
- These techniques may be applied independently or in combination where maximum air-to-air reception range desired

Background

- ADS-B airborne installations intended to support all of the applications defined by DO-242 must, in low density en route and oceanic airspace, support reception ranges of:
 - 90 NM forward (120 NM desired)
 - 45 NM toward the port and starboard
 - 40 NM to the aft.
- For high traffic density airspace the required reception range is 40 NM for any target bearing

Baseline Reception Capability

- The most capable ADS-B receiver class specified by draft DO-260A is for Receiver Class A3E (*Extended Capability with Enhanced Reception Techniques*)
 - A3E class receivers, with a MTL of -84 dBm, when used in conjunction with omni-directional diversity aircraft antennas are intended to satisfy the requirement of DO-242 for an air-to-air reception range of up to 90 NM in low fruit environments
 - assumes target aircraft of interest at the maximum range are equipped with Class A3 transmitters having a minimum transmit power (at the antenna port) of 250 watts

Enhanced Reception Range

- The focus of Appendix M is on describing techniques to provide for extended reception range (i.e., beyond 90 NM) in the forward direction, especially in low to moderate 1090 MHz fruit environments
 - may be applicable to future ADS-B enabled applications as suggested by Eurocontrol and others

Optimized Receive Antenna Configurations

- Aircraft antenna configuration is optimized specifically for the reception of extended squitters at the maximum range in the forward direction
 - supports reception at the ranges required by DO-242 in non-forward directions
- Baseline configuration's single element omni-directional top aircraft antenna is replaced with a multi-element directional receive antenna providing a nominal +2 to +3 dB of additional gain in the forward direction
 - omni-directional bottom receive antenna retained

Dynamic Bandwidth Control

- Baseline extended squitter receiver design employs intermediate frequency (IF) filtering with an effective bandwidth of typically 8 MHz
- A reduction in the IF bandwidth will allow for decreased receiver MTL values resulting in improved reception range when used in low-to-moderate 1090 MHz fruit environments
 - reducing the IF bandwidth to significantly less than 8 MHz (e.g., 4 MHz) may degrade the enhanced decoder performance in very high 1090 MHz Mode A/C fruit environments
- Dynamically varying the receiver bandwidth, and thus the receiver sensitivity and out-of-band rejection characteristics, as a function of the 1090 MHz fruit levels could extend the effective reception range
 - for the case where interference is not the limiting factor
 - while not degrading the reception performance in high fruit environments

Improved Receiver Sensitivity

- Baseline Class A3E receiver MTL is -84 dBm
- The use of a low-loss cables and a low noise preamplifier mounted near or integral with the receiving antenna could support a 3 dB improvement in receiver sensitivity (e.g., MTL = -87 dBm)

Conclusion

- It appears that a combination of the techniques described in Appendix M could provide air-to-air reliable reception ranges, in the forward direction, of perhaps >150 NM for the cases where the range is not interference limited
- Investigations are being conducted by the FAA to investigate these potential enhancements