RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #12

Output Power Requirements for 1090ES Transmissions

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Summary

The Mode S transponder MOPS, DO-181C specifies the peak output power for a Mode S transponder. This working paper proposes that WG3 consider reducing the range of allowed output power level for class A3 extended squitter airborne installations.

References:
1. DO-181C, Transponder MOPS
2. DO-242A, ADS-B MASPS
3. SC186/WG3 WP12-05, 1090 MHz Extended Squitter Assessment Report, June 2002, FAA/EUROCONTROL

1. Background

The Mode S transponder MOPS, DO-181C specifies the peak output power for a Mode S transponder. Section 2.2.3.2 of DO-181C requires that the minimum RF peak power for equipment intended for installation in aircraft that operate at altitudes above 15,000 feet and/or have a normal cruising speed in excess of 175 knots is 21.0 dBW (125 W) measured at the antenna terminals. This section also requires that the maximum RF peak power is 27 dBW (500 W) measured at the antenna terminals. The ADS-B MASPS, DO-242A, includes a requirement that Class A3 ADS-B systems have an air-to-air range of 90 NM in the forward direction. While flight tests and link simulation suggest that it may be possible for the 1090 MHz ADS-B to satisfy this requirement in a low interference RF environment, such a in oceanic or low density en route airspace, such a requirement could not be readily satisfied is applied to overflights of certain high density terminal airspace. One revision introduced in DO-242A was Note 10 to Table 3-4(a) which states:

> *Air-to-air ranges extending to 90 NM are intended to support the application of Flight Path Deconfliction Planning, Cooperative Separation in Oceanic/Low Density En Route Airspace, as described in §**Error! Reference source not found.**. It is noted in Section 2.2.2.6, in connection with Table 2-8, that the operational concept and constraints associated with using ADS-B for separation assurance and sequencing have not been fully validated. It is possible that longer ranges may be necessary. Also, the minimum range required may apply even in high interference environments, such as over-flight of high traffic density terminal areas.*

Although the specific requirements of DO-242A do not explicitly apply the 90 NM air-to-air range requirement in other than low density airspace (as per Section 2.2.6 and Table 2-8 of DO-242A) the above note makes it clear that operation in an over-flight of a high traffic density terminal is at least desirable and might in the future become a requirement.

2. Proposal

Since only Class A3 airborne installations are intended to support applications requiring more than 40 NM air-to-air ranges, it may be appropriate to require that all Class A3 equipment and installations provide a higher RF peak power output than the minimum value allowed by DO-181C. Specifically it is proposed in DO-260A to add a requirement that the RF peak output power, measured at the antenna terminal, must be within the range of 200 W to 500 W for any Class A3 installation. The 2 dB increase in the minimum allowed transmission power level should offer an improvement in the overall link budget for the pair-wise case of Class A3 equipped aircraft. The simulations performed by Applied Physics Lab and Lincoln Lab (reference 3) have assumed the peak RF power output levels were statistically distributed over the range of 125 W to 500 W. Increasing the lower end of this range to 200 W would result in approximately a 1 dB increase in the mean power level received from a fleet of A3 equipped users. Further simulations will be required to assess to what extent this will increase the 1090 Extended

Squitter reception range between high altitude Class A3 users in both the low interference environment that is specifically required by DO-242A and also in the LA2020 scenario (i.e., the high traffic density/high interference case that SC-186 agreed would be used for assessing the performance of the ADS-B links). It is believed that existing air transport class Mode S transponders would be compatible with the proposed minimum peak RF output power requirement for Class A3 systems. However, existing Mode S transponders intended for commuter/air taxi/corporate class aircraft would probably only be compatible with Class A2 systems under this proposal.