Transponder Radio - Description of Equipment - Introduction

The Transponder LRU provides the receiver and transmitter functions of an Air Traffic Control Radio Beacon System (ATCRBS and ATCRBS/Mode-S), an Automatic Dependent Surveillance - Broadcast System (ADS-B) (In/Out), and a Universal Access Transceiver (UAT ADS-B) (receive only) when connected to external power, an antenna, and a display.

The Transponder LRU software will be developed to meet the Federal Aviation Administration (FAA) Radio Communications TSO-C74d, TSO-C112e, TSO-C154c, TSO-C166b, and TSO-C172b.

The Transponder LRU functions will be developed to meet the RTCA performance standards DO-144A, DO-181E, DO-260B, DO-282B, and DO-317B.

The radio tunes the requested frequency, provides received audio to external audio systems, accepts audio to be transmitted and transmitter keyline from the external systems, and reports the transmitter and receiver status and health.

Preliminary Specifications

Environmental:	Capability to highest of Helicopter and Jet DO-160.
Temperature:	-40 - +70 DegF Operating
Altitude	55,000 Feet
Primary Power	11 - 33 VDC
Antenna Connector	Type TNC

Inputs –

- Primary Power
- Holdup power input
- Arinc 429, to support TCAS processor per ARINC 735A

Outputs –

- Holdup power charging output

Input/Output –

- Transmit Suppression Bus, Open-Drain
- Databus, 3x CAN bus per Avilon Data-bus Protocol Specification (DPS)
- Transponder: with one antenna -

ATCRBS	1030/1090 MHz
ATCRBS - Mode S	1030/1090 MHz
ADS-B/TIS-B - In/Out Primary	1090/1090 MHz ES
ADS-B - In – Secondary	978 MHz - UAT (Receive Only)

- RF Output Power: 250W Peak Power minimum at rack antenna terminal, a Class 1 power level.

System Description

The Avilon Transponder will provide the following regulatory implementation:

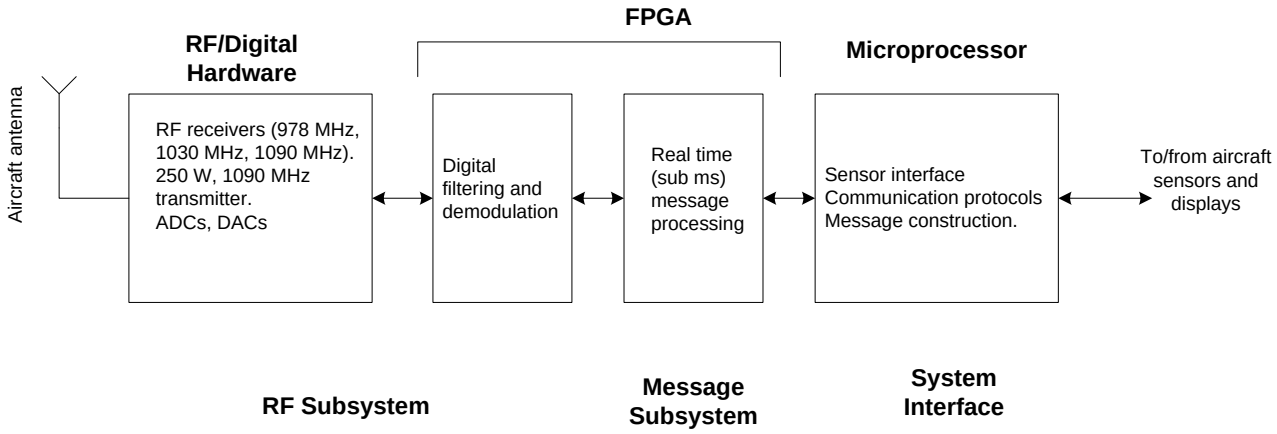
Function	Dox	Description	F in-MHz	F out-MHz
ATCRBS	TSO-C74D /RTCA DO-144A	Minimum Operational Performance Standards (MOPS) for ATCRBS Airborne Equipment	1030	1090
ATCRBS/ Mode S	TSO-C112E /RTCA DO-181E AC 20-151B	MOPS for ATCRBS ATCRBS/Mode S Airborne Equipment	1030	1090
MOPS ES ADS-B TIS-B	TSO-C166B /RTCA DO-260B AC 20-165A	MOPS for 1090 MHz ES ADS-B and TIS-B		1090
MOPS ASA ADS-B, R TIS-B	TSO-C195B /RTCA DO-317B AC 20-172B	MOPS for Aircraft Surveillance Applications (ASA) System	1090	
MOPS UAT ADS-B	TSO-C154C /RTCA DO-282B AC 20-165A	MOPS for UAT ADS-B	978	None

The Avilon Transponder card will provide the following functionality:

- A 978 MHz receiver that converts RF signals containing weather and traffic information to a modulation pattern to be sampled for digital signal processing and interpretation.
- A 1030 MHz receiver that converts ground or aircraft-generated interrogation signals to a modulation pattern to be sampled for digital signal processing and interpretation.
- A 1090 MHz receiver that converts location updates from other aircraft to a modulation pattern to be sampled for digital signal processing and interpretation.
- A 1090 MHz, 250 Watt transmitter for signal modulation representing transponder replies or ADS-B Out.

During 1090 MHz transmit the other three receivers will be inoperative.The RF Subsystem will use a single antenna that must be rated for 978 – 1090 MHz operation. The interfaces between the RF Subsystem receivers and the Message Subsystem will be parallel, multi-bit data streams. The interface between the RF Subsystem transmitter and the Message Subsystem will be a single digital connection that enables or disables the RF output.

The Transponder sub-systems are shown in the following figure.



Transponder LRU Block Diagram

Hardware Description

The Transponder LRU is a circuit card including several functions:

- 2 Receivers covering:
  978 MHz UAT Weather/traffic signals,
  1030 MHz ATCRBS & ATCRBS-S Ground or Aircraft Interrogation signals
- A Transponder covering:
  1090 MHz ABS-B Other Aircraft location update signals - In
  1090 MHz ADS-B Transmitter for Own Aircraft replies - Out
- Receiver controls to disable the receivers during reply transmissions
- DC Power conditioning and control

FPGA signal processes receive signal streams from A-to-D converters and provide down conversion and decimation and discrimination of modulation for subsequent digital signal processing in the microprocessor.

Software Description

Software digital signal processes cover message protocols, the interpretation of interrogations, the assembly of replies, reporting for display messages and data logs, and assembly of broadcast messages.

- Protocol Interpretation (ATC/ADS-B/TIS-B/UAT)
- ATCRBS PAM Interrogations for Identity and Surveillance (& reply)
- ATCRBS-S PAM Interrogations for Mode-S Transponder acquisition (& reply)
- ATCRBS-S Squitter Transmissions (short)(& message assembly)
- ADS-B/TIS-B Receiving Subsystem (& reporting)
- ADS-B Transmitting Subsystem (& message assembly)
- ADS-B Extended Squitter Transmissions (long)(& message assembly)
- UAT Receiving Subsystem (& reporting)
- Antenna/Transponder Diversity Management