

System Overview and Description

openAir duo is a fully featured ADS-B Ground Station offering advanced frequency monitoring functions. Based on a dual channel high-sensitive SDR receiver and decoder the reception is optimized for the 1090 MHz frequency.

openAir duo features:

- Facilitates easy data exchange with other systems (ASTERIX, JSON, RAW formats)
- Advanced decoding techniques, decoding of overlapping signal frames, CRC correction
- Option for recording of raw RF signals on embedded hard disk
- Detection and decoding of ADS-B and Mode 3A/C/S messages and DME pulses on 1090 MHz frequencies
- High dynamic receiver allows monitoring of en-route, terminal area and surface movement at the same time
- Decoding according to DO260/A/B, ICAO Annex 10
- ED-129B compliant ASTERIX CAT021, CAT023, CAT247 output
- Narrow cavity bandpass filters allowing for installation in difficult RF environment
- High precision timestamping with ± 25 ns accuracy. Works well as node in a multilateration network.
- Optionally low-power ADS-B transmitter for site-monitoring
- BITE functionality
- ESD protection on all antenna inputs
- Compact and high reliability
- Low cost of ownership, designed for maintenance-free 24x7 operation
- Web-based CMS application
- May be used as stratum-1 NTP time server in the network
- Second channel may be used for providing antenna diversity on 1090MHz or for receiving data on another frequency like 1030, 868, 978 MHz
- Option to combine both channels to single input for a multi-frequency antenna
- Option for fully redundant station set-up to further increase MTBF

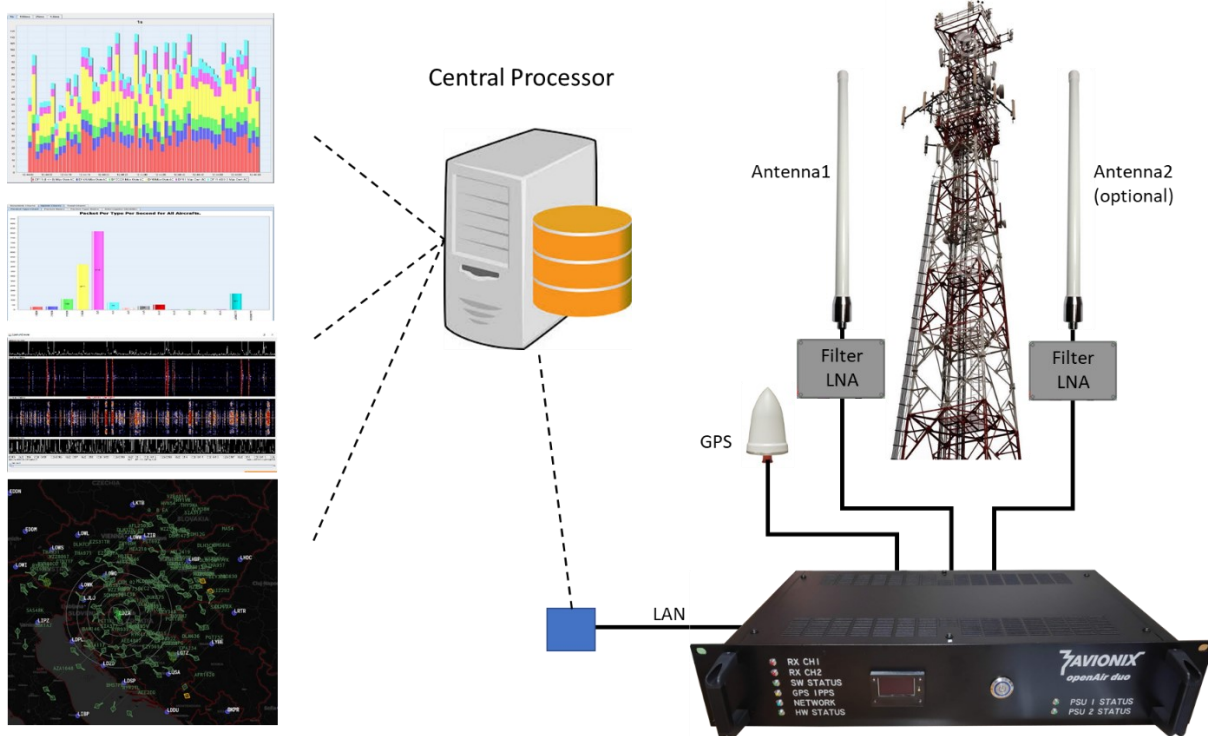


Figure 1 - Single Receiver System

In a standard setup the frequency monitoring station is connected to the 1090MHz antenna and an active GPS antenna. It is advised to use the provided low loss 50Ω antenna cable. **The location of the 1090 antenna is crucial for the performance of the system.** Obstructions in the line-of-sight in the direction of targets attenuate the signal significantly and will reduce the reception range. In difficult environment, eg. installation at the side of a mast it is advised to install the second antenna to cover the full 360-degree range. The signals from both antennas are processed individually and merged to an overall traffic view.

The GPS antenna needs to be installed under clear sky, but line-of-sight requirements are less stringent than for the 1090 antenna.

The received ADS-B messages are converted to ASTERIX CAT021 (v0.23, v0.26, v1.4, v2.1, v2.4) for either local visualisation or transmitted to a central server for data fusion with data from other ADS-B stations or radar systems.

The station is designed for zero-maintenance and does not contain serviceable parts. After power-on the station boots into operational mode. A display on the front informs about the hardware and software status, network address and reception performance.

Receiver Architecture

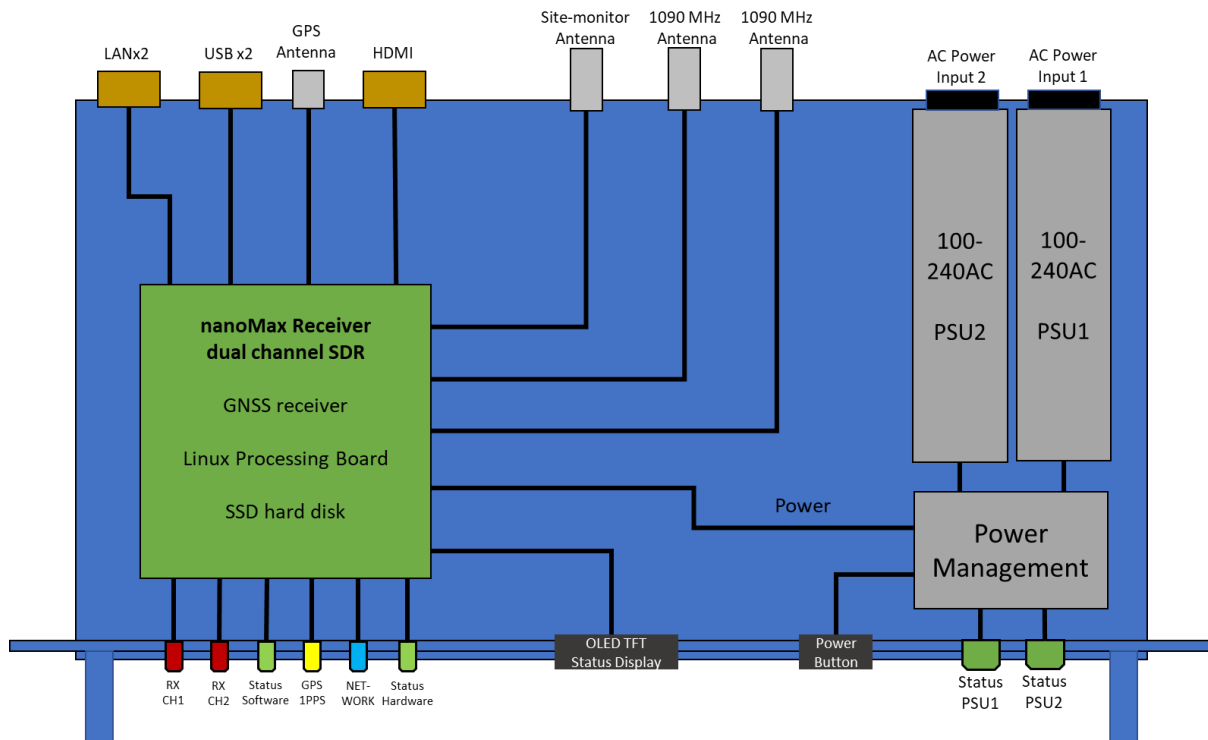


Figure 2 – Block diagram

Dual channel SDR receiver

The receiver station includes a high-performance dual channel SDR radio configured for reception on the 1090 MHz frequency. The onboard GNSS receiver is used to provide precise timing and location information to the system.

Linux Processing Board

A single board computer with quad core processor running Linux is performing the data decoding, processing and distribution over the network interface. Additionally, it runs the web-based CMS application to monitor the station and the ASTERIX output processor.

Internal Storage Disk

The internal storage solid state disk has is used to store log files, ADS-B and ASTERIX messages for a 30-day period. Oldest data is removed automatically to prevent the disk from running full.

OLED Status Display

The front side display gives constantly information about reception performance and the status of all system components.

Site Monitor

The site monitor module periodically transmits ADS-B messages at low power (-20dBm) as BITE test for the RX path.

Receiver Description

Front panel



Figure 3 - Receiver unit (front view)

Item	Description
RX CH1	Red LED, Pulse for message on 1090 MHz
RX CH2	Red LED, Pulse for message on 1090 MHz (optional)
SW STATUS	Green LED Steady ON: all OK, Flashing: problem with software module
GPS 1PPS	Yellow LED, GPS pulse-per-second
NETWORK	Blue LED, network connection established
HW STATUS	Green LED Steady ON: all OK, Flashing: BITE detected problem
OLED TFT display	Display with detailed status information
Power Button	Blue LED, OFF: power off, ON: power on, Flashing: power down in progress
PSU 1 STATUS	Green LED, indicates connection to mains power input 1
PSU 2 STATUS	Green LED, indicates connection to mains power input 2

Table 1 – Front panel description

Rear panel



Figure 4 – Receiver unit (back view)

Item	Description
PSU1	Mains connector for PSU 1
PSU2	Mains connector for PSU 2
RX CH1	1090 MHz antenna connector (N-type female)
RX CH2	1090 MHz antenna connector (N-type female) (optional)
GPS	GPS antenna connector (BNC female)
TX	Antenna connector for ADS-B site-monitor
HDMI	HDMI output, only for maintenance purposes
ETH1	Ethernet LAN connection 2 (RJ-45 jack)
ETH2	Ethernet LAN connection 1 (RJ-45 jack)
USB 1	USB port 1, eg. for mouse
USB 2	USB port 2, eg. for keyboard
⏏	Earthing point

Table 2 – Rear panel description

Receiver Unit



Figure 5 – Receiver Unit

Compliance	
EUROCAE	ED-129B, ED-102/A
ICAO	Annex 10, Doc 9871, RTCA DO-260/A/B
CE certification	EN 62311; EN 62368-1; ETSI EN 301 489-1 V2.2.3; ETSI EN 301 489-19 V2.1.1; ETSI EN 300 440 V2.2.; ETSI EN 303 413 V1.1.1
Decoding	DF0, DF4, DF5, DF11, DF17, DF18, DF19, DF20, DF21, MODE A/C
RF characteristics	
Input Sensitivity	-93 dBm
Maximum power input	10 dBm
Frequency	1090MHz, option for other frequency on CH2
Performance	
Processing	up to 2500 MODE-S/sec
Targets	up to 300 tracked targets
Processing delay	10ms
Electrical characteristics	
Input voltage	Dual 110-240VAC Option for 9-35VDC input
Power consumption	up to 24W
Mechanical characteristics	
Connector type	N male (RF input), BNC (GPS input)
Weight	6 kg
Height	2HU
Dimensions	Width 43cm, depth 25cm
Working temperature	0 – 60 °C
Ingress Protection	IP52
Reliability	
MTBF of redundant station	>50.000h
Availability	>99,9%

Table 3 – Receiver unit specification