DENKO

Aurora
2026-07-11 · rev 0.1

Precision VLF lightning & aurora receiver

PRELIMINARY — the instrument is in final development. Figures marked "(to be measured)" are design values pending bench characterisation; all other figures are measured or set by the design.

Denko Aurora is a lightning detector: it receives the natural radio signals (sferics) that every lightning strike broadcasts, records each strike's waveform, and time-stamps it precisely enough for networked strike location. It is built around a shielded, untuned ferrite-loop antenna and a 24-bit acquisition chain with flat in-band response — the received waveform's shape is preserved end to end, because the shape is the measurement. A DC-coupled signal path extends reception below the lightning band into the low-VLF region associated with geomagnetic and auroral activity. Every capture is time-stamped against a GNSS-disciplined pulse-per-second and cryptographically signed on the device. The receiver is powered and read out over a single Ethernet cable (PoE).

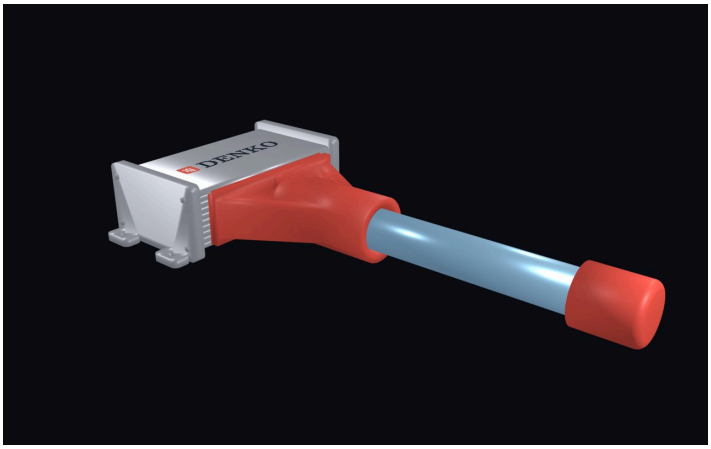

Figure 1: Denko Aurora — first production form (render from the production CAD).

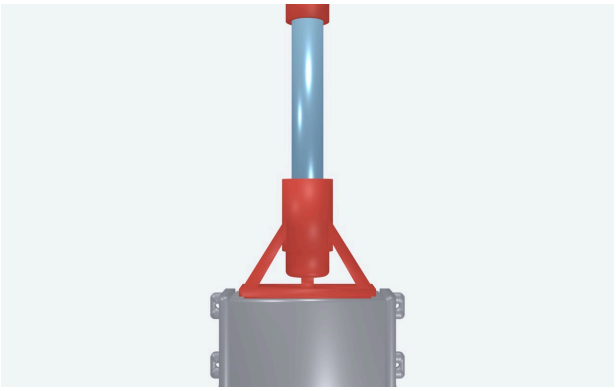

Figure 2: Top view: antenna perpendicular off the enclosure's ribbed side, centred; dielectric A-frame mount.

Features

- Shape-preserving signal path: flat in-band gain, no resonant peaking, no input transformer.
- Reception to the antenna's measured self-resonance; DC-coupled low-band reach for aurora-related activity.
- 24-bit ΔΣ acquisition, continuous stream — sferics and the low band from one conversion.
- Dual-band GNSS-disciplined timestamps, ready for networked time-difference lightning location.
- Waveforms signed on the device — no server or broker can alter a reading.
- Single-cable operation: power and data over Ethernet (PoE).
- Field-neutral mechanics: the antenna mount contains no metal (adhesive-bonded dielectric).
- Interchangeable antenna windows; each named for the phenomenon it has demonstrably recorded.

Applications

- Networked lightning location (TDOA)
- VLF / sferics observation and recording
- Aurora and geomagnetic-activity monitoring
- Institutional and citizen-science stations

Key parameters

Parameter	Value
Antenna (included)	FA-200 "Sferic": 200 mm shielded ferrite loop, untuned dB/dt
Usable band	flat region below antenna self-resonance ≈ 190 kHz (measured, this antenna)
Conversion	24-bit ΔΣ, 512 kSPS continuous
Dynamic range	design ≈ 111 dB single conversion *(to be measured)*
Timestamping	GNSS-disciplined (dual-band L1+L5), ≈ 11 ns resolution *(to be measured)*
Data	signed waveform stream over Ethernet
Power	PoE (IEEE 802.3af) *(to be specified)*
Enclosure	extruded aluminium, IP68, EMC-gasketed
Assembly envelope	≈ 342 × 140 × 51 mm incl. antenna
Mounting	table or mast — same build, rod horizontal in both
Operating temperature	enclosure −40 … +105 °C; assembly *(to be specified)*

Contents

1 System overview

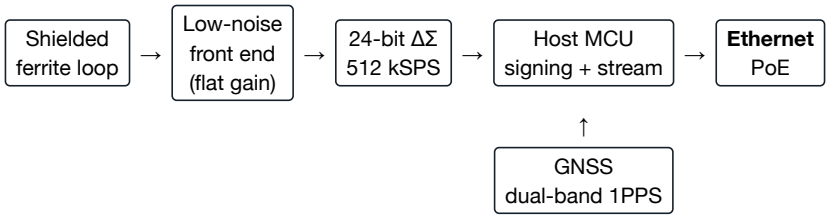

Figure 3: Signal chain. The path is DC-coupled and flat in-band from the antenna to the converter; event timestamps derive from the GNSS-disciplined pulse-per-second.

The receiver digitises the antenna's raw dB/dt output continuously at 24-bit resolution; lightning impulses (sferics) and the low-VLF band are taken from the same stream, so no mode switching or band selection is involved.

2 Antenna

The included FA-200 "Sferic" antenna is a 200 mm ferrite-rod loop wound on an indexed former (identical turn count on every unit) and operated untuned, as a broadband dB/dt sensor. Its response is used in the flat region below the measured self-resonance of ≈ 190 kHz; the resonance is a property of this antenna, not of the receiver, whose acquisition chain is kept wideband for future antenna windows.

An electrostatic (Faraday) shield of rolled aluminium surrounds the winding: the shield stops short of the rod ends so the magnetic field enters unimpeded, its longitudinal joint is an insulated lap (an electrically open seam — a closed conductive loop around the rod would short the signal), and it is grounded at a single point.

Antenna windows are interchangeable; variants with extended low-frequency reach are in development, and each is released under a phenomenon name only after that phenomenon has been recorded with that antenna (the recording is published with the product). Mounting geometry and the metal-free holder are covered in Section 5.

3 Timing

A dual-band (L1+L5) GNSS receiver disciplines the host clock; event timestamps resolve to ≈ 11 ns *(to be measured)*. Dual-band reception improves timing robustness in the presence of ionospheric variation and single-band interference. The timestamped, signed waveforms are suitable for multi-station time-difference-of-arrival lightning location networks.

4 Electrical characteristics

Design values, pending bench characterisation of production hardware.

Parameter	Min	Typ	Max	Unit
Supply — PoE input voltage [1]	37	48	57	V
Power consumption		*(to be measured)*		W
Conversion resolution		24		bit
Sample rate (continuous)		512		kSPS
System dynamic range		*(to be measured)*		dB
Timestamp resolution		≈ 11 *(to be measured)*		ns

Table 1: Preliminary electrical characteristics.

1. IEEE 802.3af (Class *(to be specified)*). A non-PoE DC input option is under evaluation and not part of this document.

5 Mechanical

The electronics enclosure is an extruded-aluminium industrial case (80.8 × 50.8 × 140 mm) with flanged end panels; its ingress and temperature ratings are listed under Section 6. The antenna assembly (Ø 26.2 mm envelope, ≈ 248 mm long including its dielectric end

holders) mounts perpendicular to the ribbed side wall, centred, with the rod's rear tip 40 mm from the wall and the nearest live winding turns 50 mm clear of it. Overall assembly envelope ≈ 342 × 140 × 51 mm; mass *(to be measured)*.

Two mounting poses use the same build (Figure 2): resting on a table, or mast-mounted through the end-panel flanges with the enclosure portrait; the antenna rod is horizontal in either pose.

The antenna's holder is bonded to the enclosure's cooling-fin profile with a flexible structural adhesive. The joint is metal-free by design — a conductive holder at the rod ends would short-circuit the field being measured. Cable entry is through a gland in one end panel; Ethernet exits the other.

6 Environmental

Parameter	Value
Enclosure ingress rating	IP68 (enclosure alone; assembly rating *(to be specified)*)
Enclosure temperature rating	−40 … +105 °C
Assembly operating range [1]	*(to be specified)*

Table 2: Environmental characteristics.

1. Bounded by the antenna-mount adhesive system (−40 … +90 °C class) and polymer parts; the published assembly rating follows environmental testing.

7 Ordering information

Order code	Description
DENKO-AURORA	Aurora receiver with FA-200 "Sferic" antenna, mast and table mounting
FA-200	Spare / replacement Sferic antenna window

Table 3: Ordering information. Reservations: denko.asia.

Extended-reach antenna windows (400 mm and 600 mm classes) are in development and will be listed when released (naming rule: Section 2).

8 Revision history

Version	Changes
0.1	Initial preliminary datasheet: system description, antenna and mechanical geometry from the released CAD, electrical values marked pending measurement.

Table 4: Document revision history.