The Jomitek Lightning Sensor & Analyzer

Jomitek

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Main product features

- Detects <u>only</u> direct lightning strikes

- Key measurement parameters:
  - Peak current
  - Rise time
  - Charge
  - Specific energy
  - Full waveform recording
  - Receptor mass loss / damage

- Robust and durable design for off-shore use

- PoE Power supply and Ethernet communication

- A single box connected with a single Ethernet cable

- Simple installation through magnetic adhesion

- Life time expectancy 20+ years

Lightning Sensor & Analyzer including the IP67 rated Ethernet cable connection.

Illustration

Sensor mounted above wind turbine door

Product family context

Jomitek offers two generations of lightning sensors. These are the Lightning Sensor Classic, and Advanced (LSA).

The Classic sensor features a simple relay functionality, which triggers when a lightning strike current exceeds a given threshold.

The Advanced model feature enhanced analysis, configuration, and reporting functionalities using the IEC 60870-5-104 protocol over Ethernet connection or a web based graphical user interface.

To determine the entry point of a lightning strike, Jomitek also offer simple sensors for turbine blades. However the most cost efficient way to enable blade strike detection, may be obtained by correlating the timing of LSA detection, with information on the blade position, assuming this is available to the turbine control system. Guideline on such correlation options are available on request.

General description

The 2nd generation Jomitek lightning sensor is designed with a focus on ease of installation and operation.

The system raises an alarm in the form of signalling to the turbine control via Ethernet based protocols, when a lightning current surge is channelled through the structure the system is mounted on.

There is no requirement for built-in battery backup for alarm retention, which eliminates the need for periodic maintenance of the sensor system. External power supply backup is assumed present at the site of installation. Power supply and additional battery backup systems are also offered as a separate Jomitek product; The lightning sensor control box.

Mounting the sensor box is simple. Strong permanent magnets integrated in the box design, ensures securing on magnetically adhesive surfaces. Additional caulking along the rim of the box is recommended.

A single Ethernet cable is the only interface to the box, which supports easy installation of the cabling.
The power is supplied via the Ethernet cable as Power over Ethernet (PoE).

For installations requiring backwards compatibility with the 1st generation lightning sensor, a relay output is available, when using the lightning sensor control box.

The internal memory keeps storage of more than 100 strike events.

> **Meets class I measurement requirements in IEC 61400-24 Annex L 2023**

To view the details of a strike event, the web interface may be used as illustrated below. All relevant lightning parameters are shown.

Measured lightning discharge current - 2022-03-26T17:26:10.003+00:00
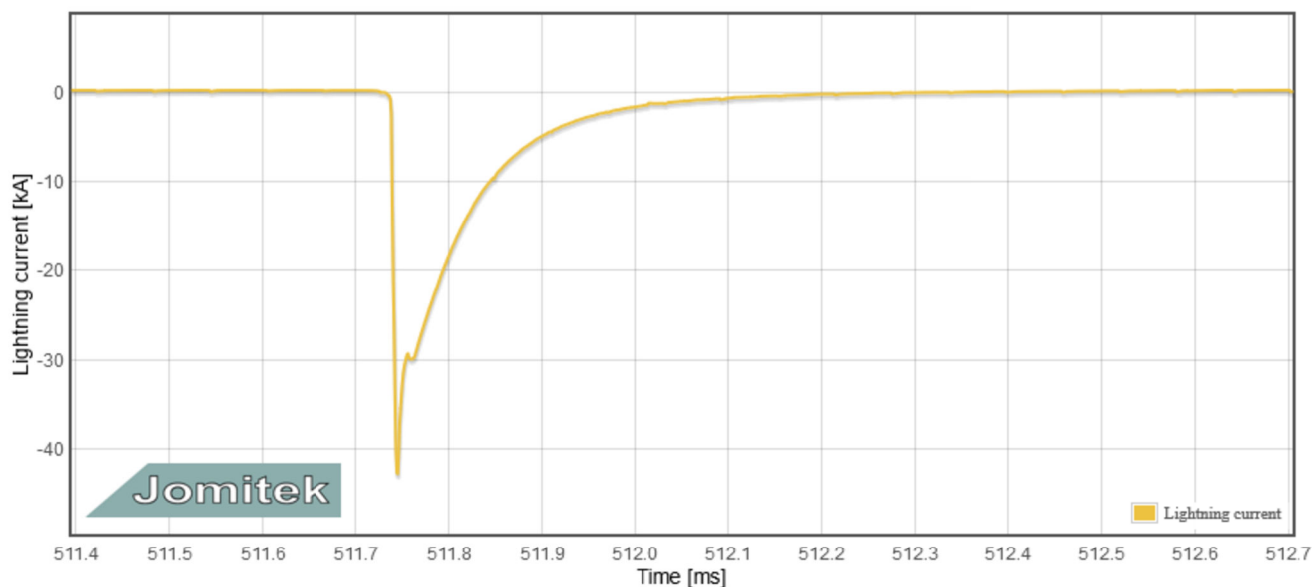
[Charge] 25.31C
[Peak current] -42.83kA
[dI/dt] -7.51kA/us
[Polarity] negative
[Rise time] 4.56us
[Specific energy] 395.76kJ/Ohm
[Pulse count] 49.0
[Receptor mass loss] 0.07g
Event ID: e00002

Technical specification

Power Supply

PoE according to IEEE-802.3af,	Mode A / Mode B
PoE input voltage range	24-48V
If relay output is used at Mode B pins:	Mode A
Power Level Class:	2 (17-20mA)

Measurement range

- Minimum peak current trigger level	1kA
- Current range	+/- 250kA
- Current accuracy	10%
- Charge range	0.01C - >100kC

Measurement Parameters

Strike timestamp (t)
Peak current (I)
Rise Time (dI/dt)
Charge (Σ Idt)
Specific energy (Σ I^{2}dt)
Polarity (+/-)
Receptor mass loss (g)

Sampling & Bandwidth

- Sample speed	2M samples/s
- Bandwidth	0.1 Hz -1 MHz
- Sample time per strike	1000 msec

Memory

- Raw sample memory	2 × 1M samples
- Wav file memory	1000+ strikes

Interface

- Ethernet cable	Screened CAT6
- Relay output via lightning sensor control box (use Mode B pins)	Isolated, AC/DC, max 24V
- Connector type	M12 X-coded or RJ45

Data transfer protocols

Web interface
FTP
IEC 60870-5-104
Modbus TCP

Mechanical properties

- Temperature range	-40 to +85°C
- Expected lifetime	20+ years
- Sensor box protection	IP66
- Humidity	5-95% rel.
- Size (l×w×h)	200 × 120 × 60 mm
- Mounting	Magnetically adhesive or using M6 bolts
- Weight	1280 g
- Environment class ISO12944	C5-M

Installation guidelines will be provided on request.

Standards and test reports

This device fulfils below standards:

EMC directive
- EN 61000-6-4:2019

Low Voltage directive
- EN 61010-1:2010

International Protection Rating (IP Code)
- IP66 (dust tight, powerful water jets)

Laboratory certification has been performed at the Shanghai University laboratory. Test reports are available on request.

Laboratory test setup

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Mounting and testing

Contact Jomitek for information on testing options for the Lightning Sensor & Analyzer equipment.

Example of sensor mounting solution below:



Sensor having extra strong magnets

Theory of operation

The sensor is continuously sampling the magnetic field near the turbine tower. If the signal raises above the trigger level, the active sample buffer is filled, and the alternate sample buffer is used afterwards. While the active buffer data is being processed and analysed, the alternate buffer is used to record potential new strikes, allowing for a combined 2 second continuous recording capability @ 1MHz.

Whenever a trigger situation has been detected, a digital output relay is activated via the optional lightning sensor control box. The relay will automatically reset after a predefined period or by a specific reset command. After sensor internal data processing, the key measurement parameters and the corresponding time series recording will be available for read out. This typically takes 40 seconds.

Readout of the data is possible using a number of protocols. A simple web interface might be used or the FTP protocol, the IEC 60870-5-104 protocol or Modbus TCP.

The wave files (time series recording) generated during a strike can be inspected in detail on the web interface or can be downloaded via FTP or the web interface as gzipped versions (.wav.gz-files).
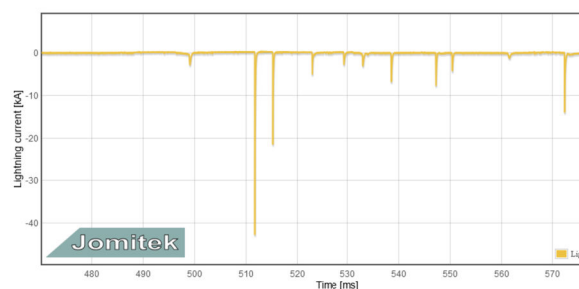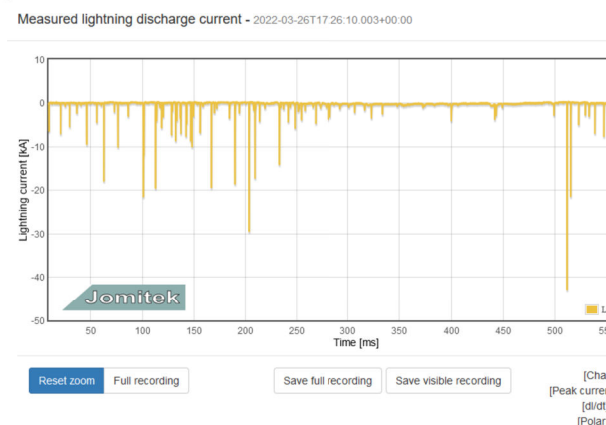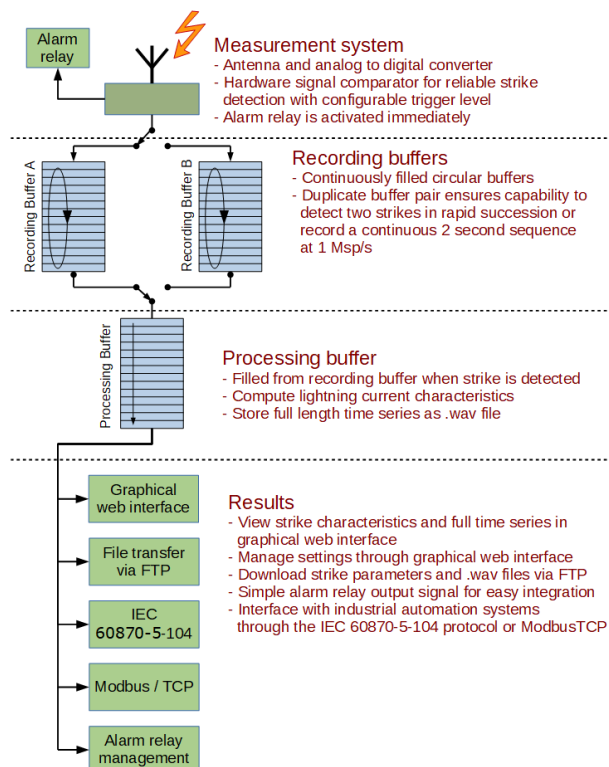

Example of a real lightning strike

Zoom 1
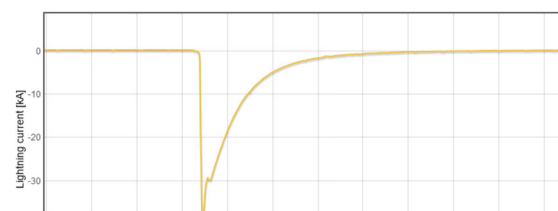
Zoom 2

Theory of operation, continued

The processing flow, when a lightning strike is detected, is visualized in below figure:

Measurement system
- Antenna and analog to digital converter
- Hardware signal comparator for reliable strike detection with configurable trigger level
- Alarm relay is activated immediately

Recording buffers
- Continuously filled circular buffers
- Duplicate buffer pair ensures capability to detect two strikes in rapid succession or record a continuous 2 second sequence at 1 Msp/s

Processing buffer
- Filled from recording buffer when strike is detected
- Compute lightning current characteristics
- Store full length time series as .wav file

Results
- View strike characteristics and full time series in graphical web interface
- Manage settings through graphical web interface
- Download strike parameters and .wav files via FTP
- Simple alarm relay output signal for easy integration
- Interface with industrial automation systems through the IEC 60870-5-104 protocol or ModbusTCP

- Interfacing of relay output signal
- Battery backup during power outage
- (Non-standard) PoE injection

Secondary features include

- Multiple power input redundancy
- Manual reset of lightning alarm
- Visual alarm indication via LEDs

Use case 1: Via the lightning sensor box relay interfacing, status LEDs and manual reset buttons, full backwards compatibility with the Jomitek Lightning Sensor Classic is provided.

Use case 2: If an industrial PoE switch/router with battery backup is not available for interfacing of the Lightning Sensor & Analyzer, the control box features an integrated, and easily accessible, Lithium Ion battery which can supply the lightning sensor with the power needed to ensure that a lightning causing a power outage is recorded and stored in non-volatile memory.

Use case 3: If an industrial PoE switch/router is not available the control box is able to inject a non-standard PoE signal, compatible with the lightning sensor, using one of the following sources

- 110/230VAC
- 12-48VDC
- Integrated battery

Ordering information:

Inside the box, 2 jumpers are configuring for relay output on 2 of the 8 Ethernet wires. See the Users manual for details. The box is delivered preconfigured in these 2 versions.

Part number	Description
J300 00001 001	Lightning Sensor & Analyzer, standard, RJ45
J300 00001 002	Lightning Sensor & Analyzer, Relay output, RJ45
J300 00061 003	Lightning Sensor & Analyzer, standard, M12
J300 00062 004	Lightning Sensor & Analyzer, Relay output, M12

Relay output

Whenever a lightning strike occurs, a digital electronic relay output is triggered. The Ethernet Mode B pins are used.

The output circuit is illustrated in below figure:
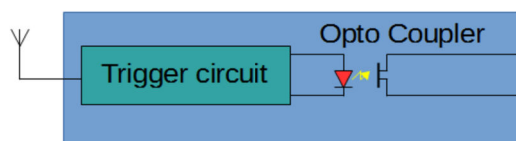
The maximum voltage to apply on the output pins is 24V.

The relay output ensures backwards compatibility with the Classic (1st generation) lightning sensor system.

Use of the lightning sensor control box

There are three use cases for the Lightning Sensor & Analyzer which requires adding a second box; the lightning sensor control box. The primary features provided of this box, are