

## Main product features

- Detects only 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
- Designed with a lifetime target of 30+ years



*The Jomitek Lightning Sensor & Analyzer, featuring internal analog sensors and an integrated custom real time operating system, with automatic postprocessing, analysis, and data transfer of lightning strike measurements.*

## Product family context

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

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

The LSA feature enhanced analysis, configuration, and reporting functionalities using e.g. the IEC 60870-5-104 protocol over Ethernet connection, a web based graphical user interface, InfluxDB or direct cloud server uploads.

Should blade specific strike detection be needed, correlation of the timing of LSA detection with information on the blade position, is supported. Guidelines on such options are available on request.

## Illustration



Simple mounting of sensor above wind turbine door

## General description

The Lightning Sensor & Analyzer 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, or remote SCADA, via Ethernet based protocols, when a lightning current surge is channelled through the structure the sensor 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 Power and Interface Box (PIB).

Mounting the sensor box is simple. Strong permanent magnets integrated in the box design, ensures attachment to magnetically adhesive surfaces. Note that additional caulking along the rim of the magnets is recommended.

A single Ethernet cable is the only interface to the box, in support of easy installation. The power is supplied via the Ethernet cable as Power over Ethernet (PoE) or DC.

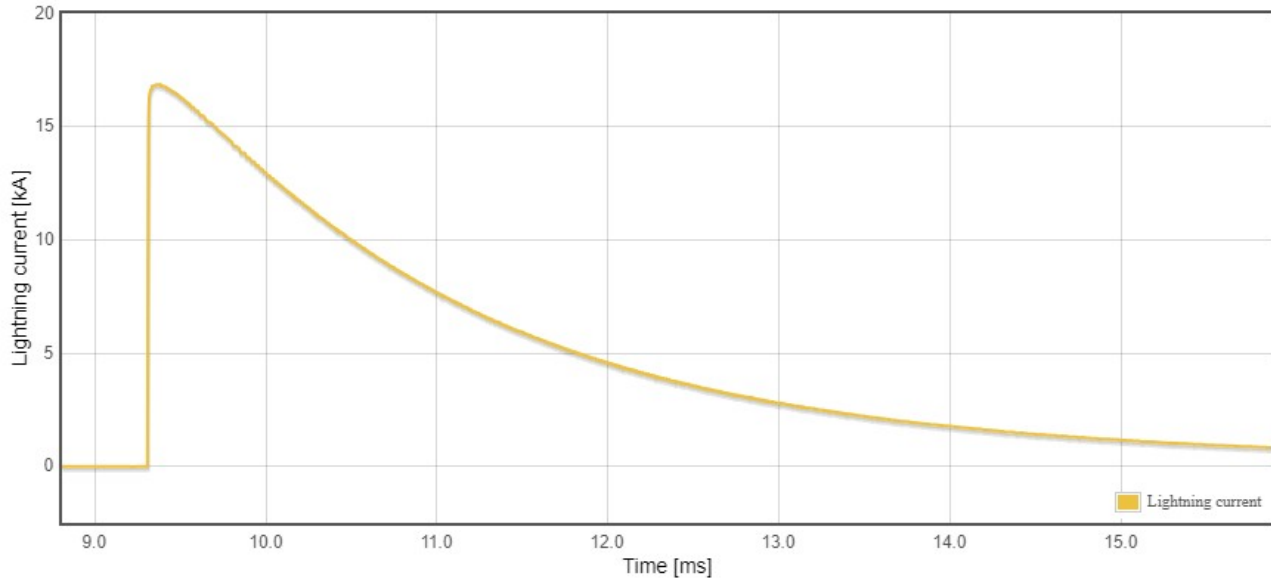
For installations requiring backwards compatibility with the Lightning Sensor Classic, a relay output is available, and most easily interfaced to via the PIB.

The internal memory will store all strikes for the lifetime of the turbine / sensor, however keeping only the full timeseries data for the last 1000 strikes.

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

To view the details of a strike, the web interface of the LSA can be used as illustrated below. All relevant lightning parameters are shown, including LPL I parameters.

Measured lightning discharge current - 2024-03-05T13:06:58.038+00:00 | Event ID: e00015



Reset zoom

Full recording

Save full recording

Save visible recording

LPL I parameters	Measurement	LPL I limit	Additional parameters	Measurement	Service limit
Peak current	16.86kA	±200kA	Polarity of main stroke	Positive	-
Specific energy	318.63kJ/Ω	10MJ/Ω	Total specific energy	322.37kJ/Ω	5000kJ/Ω
Maximum peak current	0.0kA	±50kA	Receptor mass loss	0.0g	-
Average steepness	2.33kA/μs	±200kA/μs	Inductive energy index	α0.41J	α5J
Charge, flash	42.61C	300 / 600C	Pulse count	1	-
Charge, long	32.5C	200C	Shortest rise time	7.23μs	-
Charge, short	0.0C	100C	LPL I severity	16.25	100.0

## 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 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 ( $\Sigma Idt$ )
Specific energy ( $\Sigma I^2dt$ )
Polarity (+/-)
Receptor mass loss (g)

### Sampling

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

### Memory

- Raw sample memory	2 x 1M samples
- Wav file memory	1000 strikes
- Event log memory	>1M strikes

### Interface

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

### Data transfer formats

Web interface
FTP
IEC 60870-5-104
Modbus TCP
InfluxDB
Cloud Server uploads
JSON

### 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	C5-M
ISO12944	

Installation guidelines are included in the manual.

## 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.

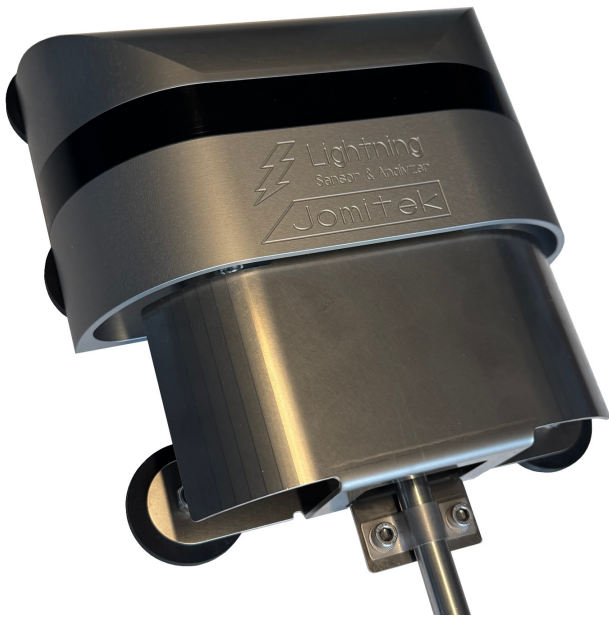


Laboratory test setup

## Mounting and testing

The sensor features a continuously running diagnostic to verify correct system functionality. Following installation, a test lightning pulse can be applied for an end-to-end test, using the Jomitek Lightning Generator.

For a sturdy and secure installation, it is recommended to order the LSA with the LSA bracket. Installation guidelines are provided in the LSA manual.



Sensor including bracket

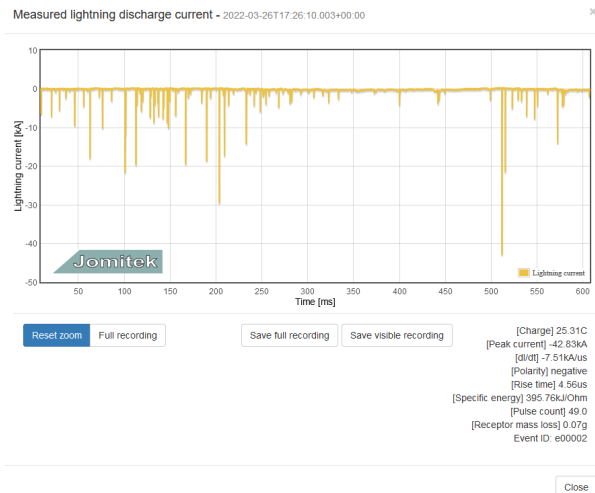
## Theory of operation

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.

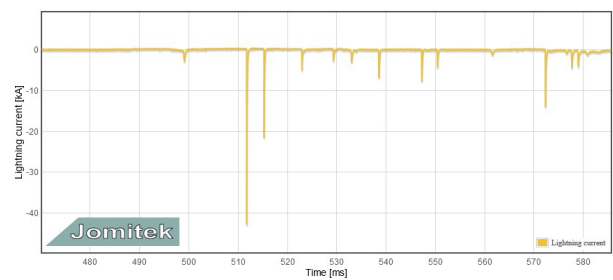
Whenever a trigger situation has been detected, a digital output relay is activated via the optional lightning sensor control box. The relay will automatically reset after a predefined period or by a specific reset command. After sensor internal data processing, the key measurement parameters and the 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.

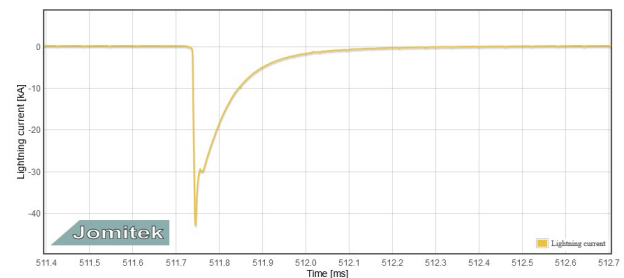
The wave files (time series recording) generated during a strike can be inspected in detail on the web interface or can be downloaded via FTP or the web interface as gzipped versions (.wav.gz-files).



Real world example of a lightning strike, presented via the LSA web interface



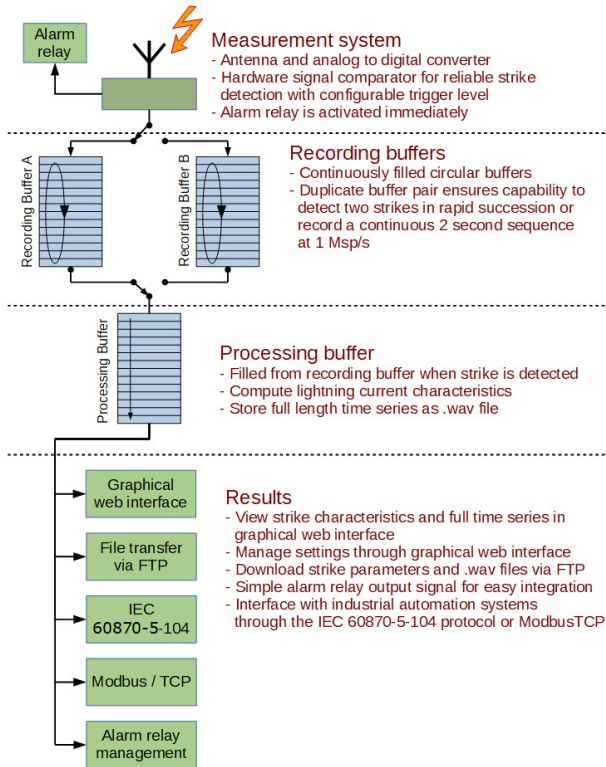
Zoom 1



Zoom 2

## Theory of operation, continued

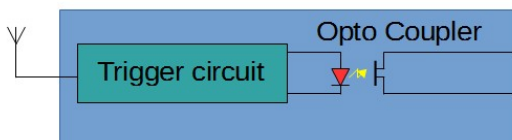
The processing flow, when a lightning strike is detected, is visualized in below figure:



## Relay output

Whenever a lightning strike is detected, 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 Power and Interface Box (PIB). The primary features provided with this are:

- 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 PIB 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 PIB 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:

The sensor is delivered in 4 versions. Configured with relay output, using the Mode B pins (implying only Mode A power supply is supported), or with no relay output, supporting both Mode A and B PoE. In addition the sensor interface may be supplied either supporting RJ45 (legacy) or an M12 X-coded connector.

### Part number Description

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