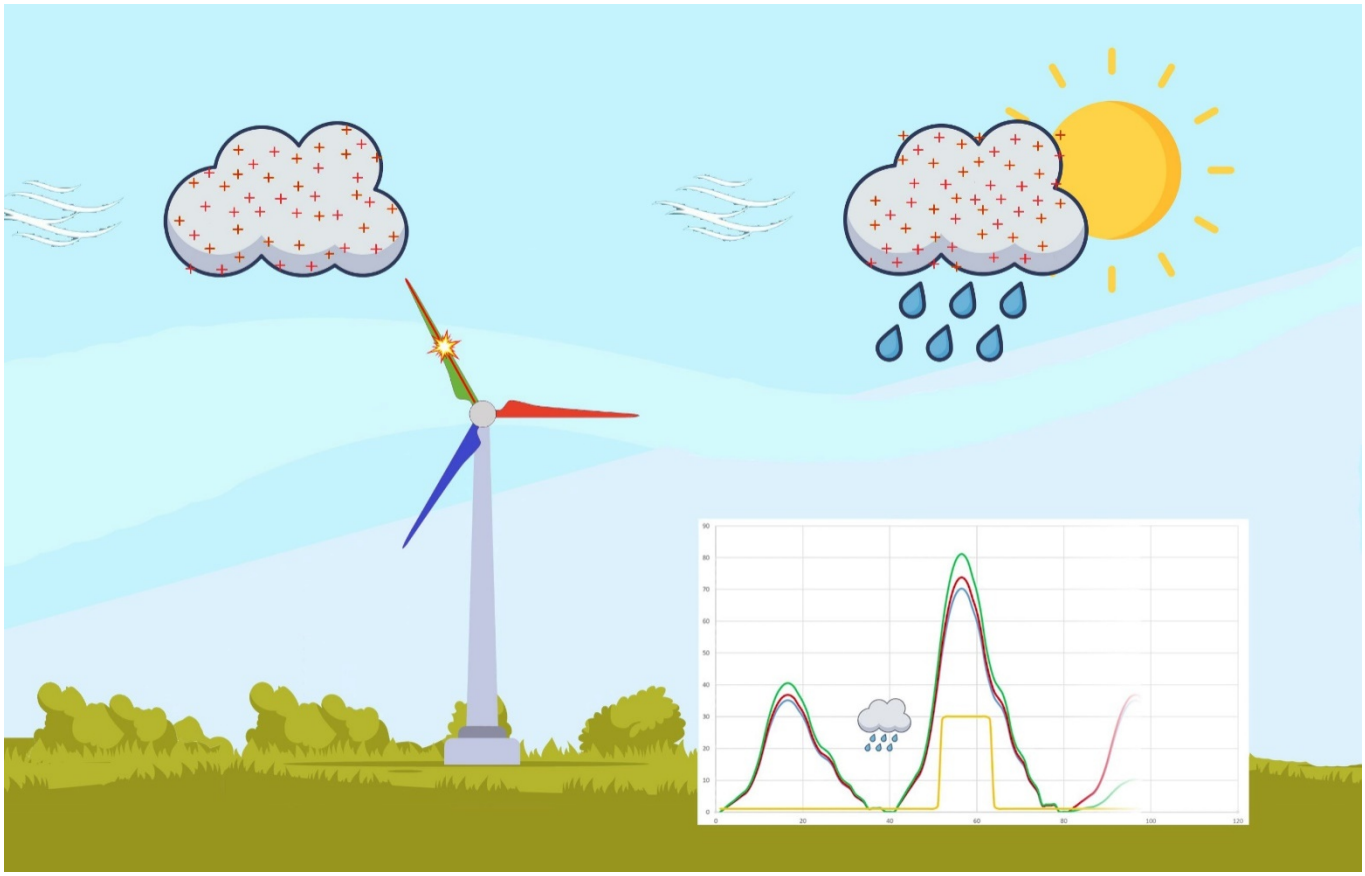


Detect faulty lightning down conductors in turbine blades

- Avoid need for regular inspections
- Detect faulty down conductors within a few days, rather than months
- Focus on site repair work where it is needed

Instantaneous detection of precipitation on the blades

- Lower the rotational speed to reduce leading edge wear, hereby extending the blade life time
- Ensure production capacity is limited only during active downpour on the specific turbine
- Limit the turbine blade speed relative to the severity of the precipitation

The Jomitek Lightning Down Conductor Sensor (LDCS)

Datasheet as of 21 August 2023

www.jomitek.dk Powerful solutions

General description

The Jomitek Lightning Down Conductor Sensor provides an alarm when a down conductor inside a blade is faulty. It will also generate an alarm including a severity rating, when precipitation falls on the blades.

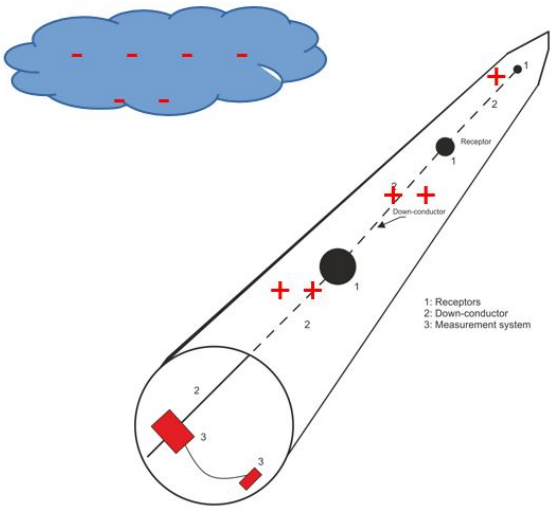
Using a novel patented detection method, continuous detection of the operational state of the blade down conductors in a wind turbine is enabled. The method make use of the atmospheric charge that is naturally present in the air surrounding the wind turbine, to compare the relative length of the down conductors.

The system consists of a sensor installed internally at the root of each blade, where the down conductor interface between blade and hub is located, as well as a data analysis and control unit placed in the hub. Each sensor transmit measurements to the control unit through an optical cable.

The sensors are self powered by the charge collected by the blade down conductors, and acts as a spark gap inserted in series with the down conductor. The control unit will continuously analyse the sensor input to determine if there is a need to signal an alarm for a faulty down conductor.

Product input/output features

- Alarm relay interface
- Alarm LED's and alarm test option
- Ethernet interface (web / FTP / Modbus / IEC-104)
- Reset option on front panel



The Jomitek Lightning Down Conductor Sensor (LDCS)

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The sensor

The sensor consists of a spark gap fully rated to comply with IEC 61400-24 Lightning Protection Level I requirements, which include 200kA 10/350us withstand capability. The sensor also include a sensing circuit generating light pulses via the optical fiber. The pulse frequency scale with the flow of charge through the lightning down conductor. The sensing circuit will during normal operation provide a voltage clamping capability limiting the voltage potential across the spark gap to less than 50V.

The logic unit

The logic unit collect optical signals from the sensors, and analysethis input todetermine if a down conductor is faulty or precipitation is hitting the blades.

The picture illustrate the logic unit with 1 out of 3 optical interfaces connected. A complete installation require all 3 sensor interfaces attached.

Alarm and power status is indicated by LEDs on the logic unit. The push buttons are for local alarm reset and for generation of alarms for installation and maintenance test.

System components

For a turbine, one logic unit and 3 sensors are needed.

The logic unit has 2 options for power supply:

1. 230VAC
2. 24VDC

The 24VDC is supplied through the M12 alarm relay connector.

The Ethernet connector is for interfacing to turbine control or a PC via an Ethernet switch. The alarm information is also available via the Ethernet interface.

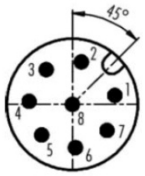
The logic unit can be mounted using a DIN rail.

One sensor connected to the control unit

M12 connector configuration

M12 Standard - with DC-in:

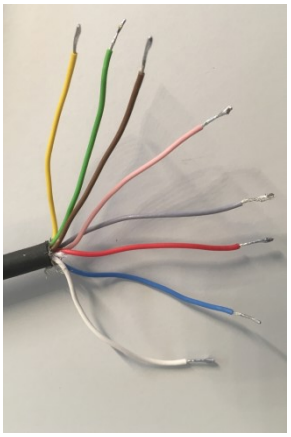
Pin	Description
1	Power Failure
2*	Blade Alarm 1 / Common Blade Alarm
3	Common (-)
4	Alarm Reset
5	Blade Alarm 2
6	Blade Alarm 3
7	DC supply in +/-
8	DC supply in -/+
Shield	Earth



	X	Y
1	2,69	0,57
2	0,57	2,69
3	-1,66	2,20
4	-2,75	0,19
5	-1,94	-1,94
6	0,19	-2,74
7	2,20	-1,65
8	0,00	0,00

1 weiß/*white*
2 braun/*brown*
3 grün/*green*
4 gelb/*yellow*
5 grau/*grey*
6 rosa/*pink*
7 blau/*blue*
8 rot/*red*

Geschirmte Versionen: Schirm auf Gehäuse oder Pin 8
Shielded versions: shield on housing or pin 8



* pin 2 functionality is configurable via software. Default setup is 'Blade Alarm 1', unless otherwise requested by customer before or during ordering.

The Jomitek Lightning Down Conductor Sensor (LDCS)

Technical specification

Power supply input	
1.	230/115 VAC*
2.	24-48VDC
Power consumption,	
typical, DC-in	1.3 VA
typical, AC-in	3 VA
Maximum	10 VA
Ethernet Interface	RJ45
Protection	IP67
Control signal connector	M12, 8 wire
Protection class	IP55
Mounting	DIN rail
Operating temperature	-30 to +65 degree C
Storage temperature	-45 to +65 degree C
Dimensions of logic unit (lxdxh)(connectors not included)	185x65x90 mm
Dimensions of sensor (lxdxh)(connectors not included)	200x92x100mm
Weight	
Logic unit	700g
1x sensor	900g
1x optical fibre (10m)	150g
1x Interface cable (2m)	300g
1x Ethernet cable (5m)	300g

The device fulfils below standards:

EMC directive
- Emission: EN 50081-2:1993
- Immunity: EN 61000-6-2:2005

Low Voltage directive
- EN 61010-1:2010

International Protection Rating (IP Code)
- IP55 (dust protected, water jets)

Wind Energy Generation Systems – Part 24: Lightning protection,
- IEC 61400-24

where the sensor is equivalent to a spark gap in the conduction path to ground.

* 115VAC supply voltage to be specified when ordering. 230VAC is standard.

Fulfillment of standard IEC 61400-24

The sensor is mounted in series with the down conductor from the blade to the hub.

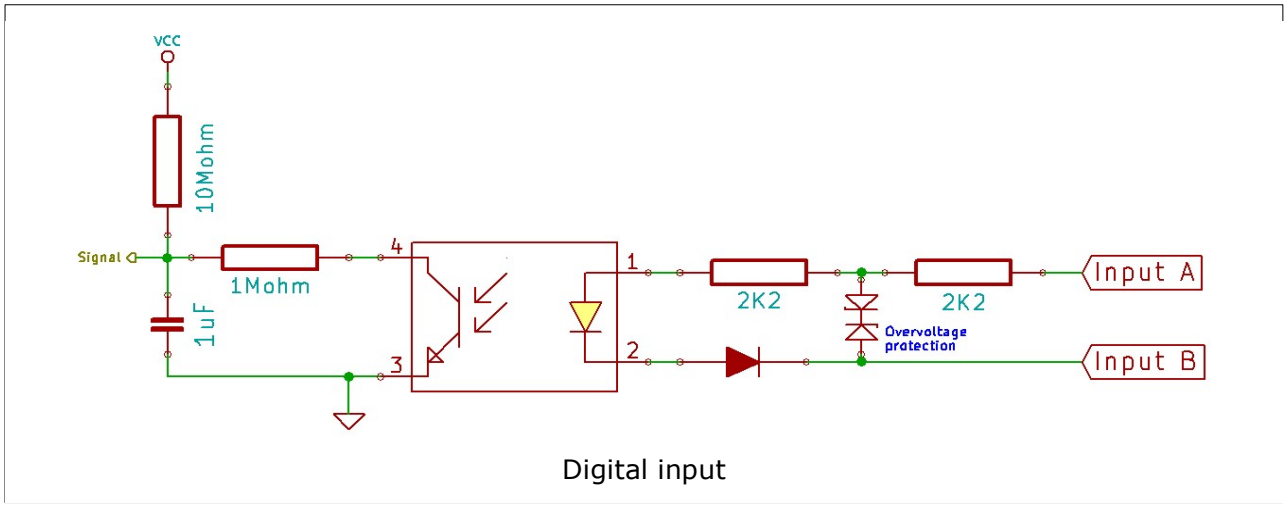
As this is the intended path for the lightning current to pass down, it is important to be able to measure the continuity of the overall Lightning Protection System (LPS). The sensor is seen as a spark gap in this context, and should be treated as such as detailed in chapter 12.2.4 of the standard.

Extract of IEC 61400-24 chapter 12.2.4

> Continuity measurements shall be made in accordance with IEC 62305-3 and shall be made with an appropriate instrument, such as a four-wire micro ohm meter.
>
> NOTE Connections via brushes or spark gaps or equivalent can be short circuited if necessary, to make a continuity measurement of other parts of the LPS.

Electrical interface

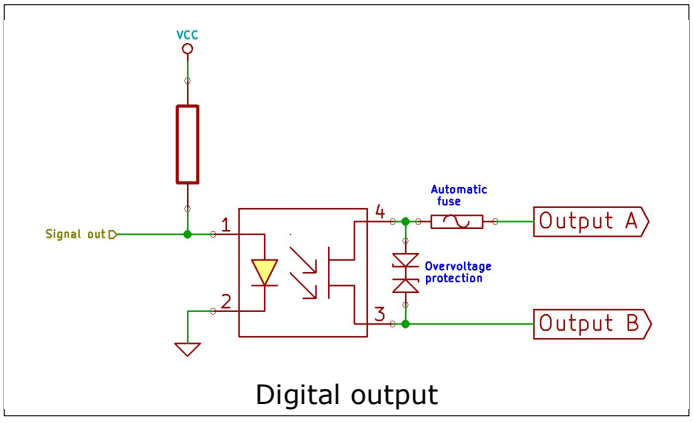
All inputs and outputs are isolated by optocouplers.



Digital input

Digital inputs are:
- Reset alarm
- Test alarm

Digital outputs are:
- Lightning alarm(s)
- Power failure alarm



Digital output

Installation guide

1. Carefully follow the safety procedures at the actual site in general, and in order to halt the turbine.
2. Make sure that the down conductor is the only conductive path between the blade and the hub area. Use a simple ohmic measurement to verify a resistance higher than 100kohm when the down conductor cable between the hub and blade is disconnected during installation.
3. Mount a sensor at the root of each blade in series with the blade down conductor.
4. From each of the 3 sensors, place the optical fibre by cable strips so that they will not be damaged by the pitch regulation mechanism. Coil the fibers at the assembly point for the Logic box.
5. Carefully note the blade number, such that it matches the sensor input number.
6. Apply the power supply to the logic unit.
7. If relay output is used, attach the M12 connector cable to the nacelle interface.
8. If Ethernet WiFi is used, install a WiFi router.
9. When power is applied, test the fiber connection by sending light (e.g. from a mobile phone) into the fiber at the sensor end and check that the 'activity' LED lights up accordingly on the logic unit.
10. Start the turbine again.
11. To detect a damaged lightning down conductor within a blade, the sensor will need a few days in operation before an alarm is triggered.

Please refer to the Jomitek Lightning Down Conductor Sensor manual for additional detailing of the installation, setup and verification process for the sensor system. See http://jomitek.dk/en/downloads/product-information/

Ordering information

Description	Partnumber
Lightning Down Conductor Sensor	J350 00051 002
Lightning Down Conductor Logic Unit	J350 00021 001
M12 interface cable 2.1 meters (last 3 digits=length in dm)	J710 00004 021
Optical fiber 10 meters (last 3 digits=length in dm)	J720 00008 100
Ethernet cable with IP67 connector termination at one end, 2m	J700 00054 020
Ethernet cable with IP67 connector termination at one end, 5m	J700 00012 050
Ethernet cable with IP67 connector termination at one end, 10m	J700 00010 100
Schuko terminated IEC 60320 C13 connector for 230/115VAC	J740 00055 010

Note that the AC power cable, if used, is most cost efficiently sourced by the customer. A standard IEC 60320 C13 connector must be applied.