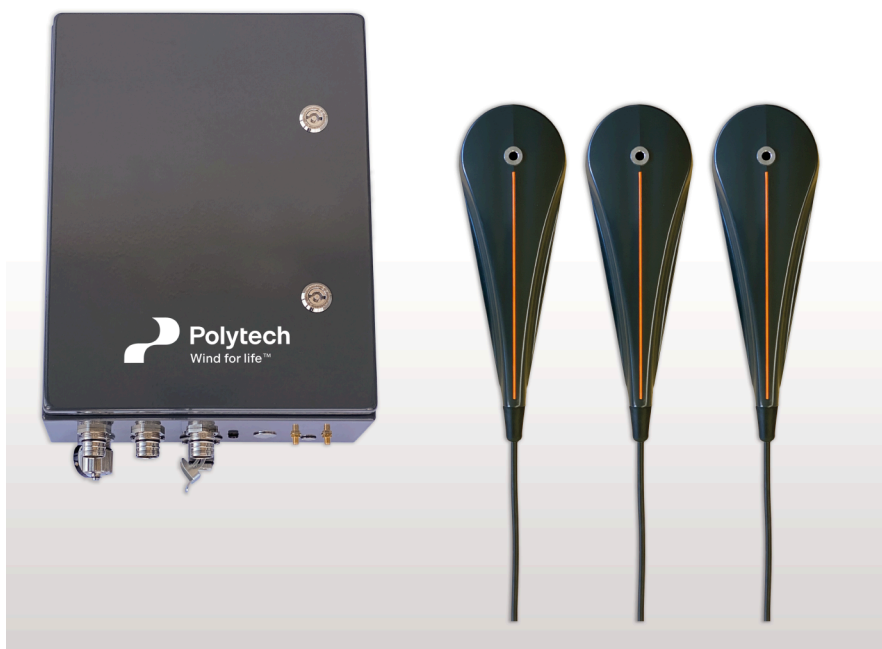


LKDS

Lightning Key Data System

The Lightning Key Data System (LKDS) is a state-of-the-art lightning condition monitoring system specially designed for wind turbines. Using input from Rogowski coil sensors the system can accurately measure and store the lightning waveforms when a strike occurs. From the recorded data, the system calculates the four key lightning parameters, that enables data driven evaluation of location and severity of a lightning strike in addition to improved intelligent service planning.

- Accurately measures:
 - Peak current [kA]
 - Maximum rise time di/dt [kA/ μ s]
 - Specific energy [kJ/ Ω]
 - Charge [C]
- Integrated or stand-alone solutions
- DNV Verified
- Conforms to IEC 61400-24 Ed2
- Easy to integrate into new and existing wind turbines
- Multiple data interfaces with high IT-security
- Designed for 25 years of operation in wind turbines
- Onboard battery and data backup



Product version:	3.1
Document ID:	LK-D001
Document Version	5.0
Language	EN

LKDS Hub Control Box

The LKDS Hub control box is the center of the LKDS system typically placed in the hub of the wind turbine. Using input from one or more sensors the powerful on-board digital signal processing unit logs and stores raw data and from these quickly calculate the key parameters of the occurred strike.

- Designed for the harsh environment in the hub
- Selectable trigger level
- Accurate measurement
- Fast processing of measured data
- Onboard web server
- Wired, fiber, and wireless connectivity
- Multiple data interfaces with high IT/OT-Security
- Time stamp via Internal, NTP or optional GPS



Measuring Properties

Property	Value	Unit
Measuring time	1400	ms
Pretrigger	100	ms
Trigger level (peak current intensity)	Adjustable 0.5 ... 200	kA
Sampling rate	10	Ms/s
Analog bandwidth (-3 dB)	3	MHz
Measuring range	±240	kA
Measuring tolerance current	± (2% + 0.2)	kA
Measurement tolerance specific energy	± (2% + 0.05)	MJ/Ω
Measurement tolerance charge transfer	± (8% + 10)	C
Digital resolution	16	bit
	7.3	A/bit
Enables the successive triggering of 4 events	✓	-
Records all three channels as soon as one channel is triggered	✓	-
Timestamp	GPS*, NTP	-

* Optional

Interfaces

Hardware Interfaces

Property	Value
WiFi connection / connector for external antenna	2.4 / 5 GHz
Acceleration sensor for rotor azimuth angle	✓
High precision sensor input	3

Optional

Property	Value
Optical trigger output	Event based Trigger threshold based on I_{peak}
Optical connector	LC, multi mode
GPS Puck Antenna	✓

Integrated software services

Property	Value
OPC-UA	✓
Polytech view data provider	✓
(S)NTP	✓
Admin page for setting parameters and communication	✓
User page for displaying records and accessing data	✓
SFTP	(✓)*
SSH	(✓)*

* Only accessible for root user

Internet connection is recommended for service and operation

IT Security

- Separate user access levels
- Support for RADIUS authentication
- Secure access protocols for SSH and FTP (Only accessible for root user)

Data Storage

Recording of the entire waveform in cyclic memory:

- Minimum 40 raw data sets on onboard storage
- Minimum 250 raw data sets on industrial SD card (32 GByte)

Optional:

- Minimum 500 raw data sets on industrial SD card (64 GByte)
- Minimum 1000 raw data sets on industrial SD card (128 GByte)

Processing of important parameters and storage in a cyclic event list (metadata):

- Peak current [kA]
- Charge [C]
- Specific energy [kJ/Ω]
- dI/dt [kA/μs]
- Minimum 2000 meta records on the onboard memory
- At least 2000 metadata records on industrial SD card (32 GByte)

Environmental Conditions

Property	Value	Unit
IP protection class	IP55	-
Corrosion resistance	C4-high (extended)	-
Permitted temperature (Transport and storage)	-25 ... 60	°C
Permitted temperature (Operation)	-25 ... 55	°C
Permitted relative humidity	0 ... 95	%rh
Permissible vibration *	2	g

* DIN EN 60068-2-6:2008, DIN EN 60068-2-27:2010

Certifications and conformity

Certification/Conformity

CE	✓*
DNV	pending
SGS	pending

* for further information on standards, Declaration of Conformity can be supplied upon request.

Electrical Data

Property	Value	Unit
Average Power consumption	15	W
Max. Power consumption	70	W
AC frequency	50/60	Hz
AC power supply	115-250	V
OR		
DC power supply	24	V
Battery backup time	Up to 3.5	h

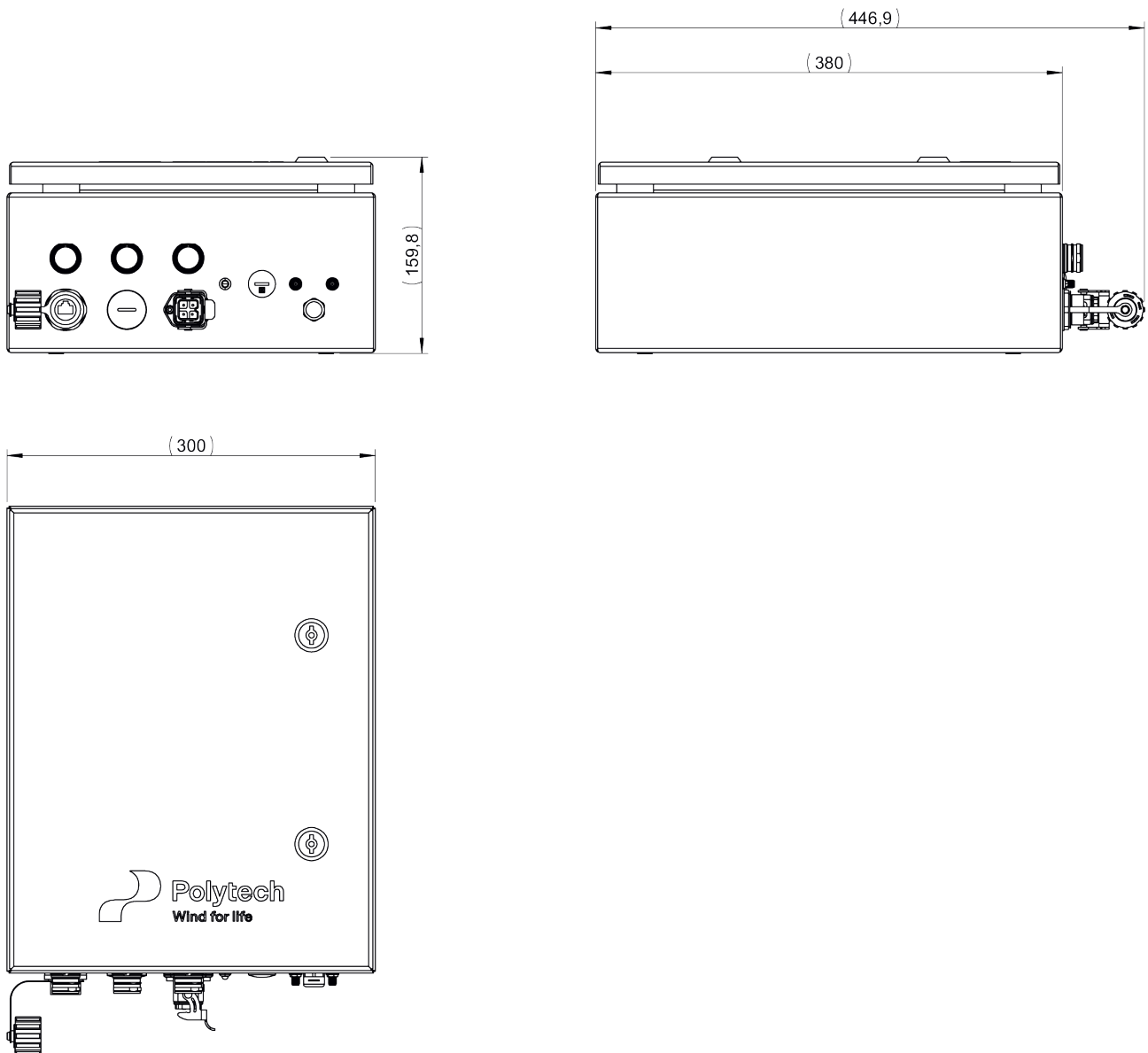
Mechanical Data

Property	Value	Unit
Depth	380.0	mm
Height	159.8	mm
Width	300.0	mm
Total weight*	9.5	kg

* LKDS without packaging

Overview

all units in mm



LKDS Sensors

The LKDS sensors are special designed Rogowski coil sensors suitable for Installation in the blade root down conductor.

- Designed for the harsh environment in the blade
- Outstanding durability
- Standard calibrated
- Various designs to fit most turbines



Measuring Properties

Sensor Type 1

Property	Value	Unit
Measuring principle	Rogowski coil	-
Current measuring range	-240 ... +240	kA
Maximum exposure current amplitude	-500 ... +500	kA
Frequency range (-3dB)	0.030 Hz ... 10 MHz	-
High voltage insulation	225*	kV

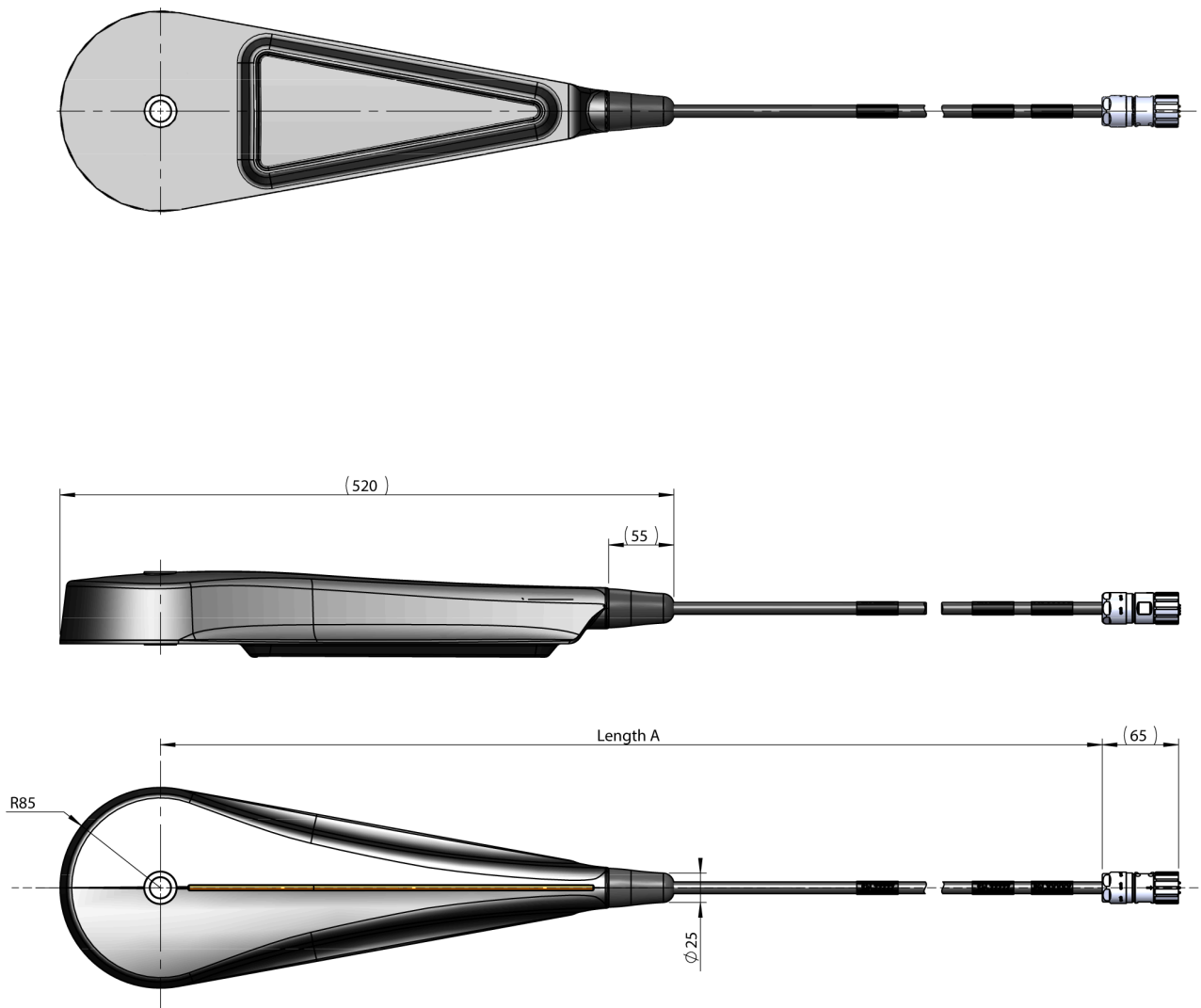
* 1.2 / 50 µs

Description	Length A in [mm]	Order no.
Sensor type 1 cable length 2.5 m	2500	608187
Sensor type 1 cable length 3 m	3000	608188
Sensor type 1 cable length 3.5 m	3500	608189
Sensor type 1 cable length 4 m	4000	608190
Sensor type 1 cable length 4.5 m	4500	608191
Sensor type 1 cable length 5 m	5000	608192
Sensor type 1 cable length 5.5 m	5500	608193
Sensor type 1 cable length 6 m	6000	608194
Sensor type 1 cable length 6.5 m	6500	608195
Sensor type 1 cable length 7 m	7000	608196
Sensor type 1 cable length 7.5 m	7500	608197
Sensor type 1 cable length 8 m	8000	608198
Sensor type 1 cable length 8.5 m	8500	608199
Sensor type 1 cable length 9 m	9000	608200
Sensor type 1 cable length 9.5 m	9500	608201
Sensor type 1 cable length 10 m	10000	608202

Overview

Sensor 1MKIII

all units in mm



Sensor Type 2

Property	Value	Unit
Measuring principle	Rogowski coil	-
Current measuring range	-240 ... +240	kA
Maximum exposure current amplitude	-500 ... +500	kA
Frequency range (-3dB)	0.030 Hz ... 10 MHz	-
High voltage insulation	135*	kV

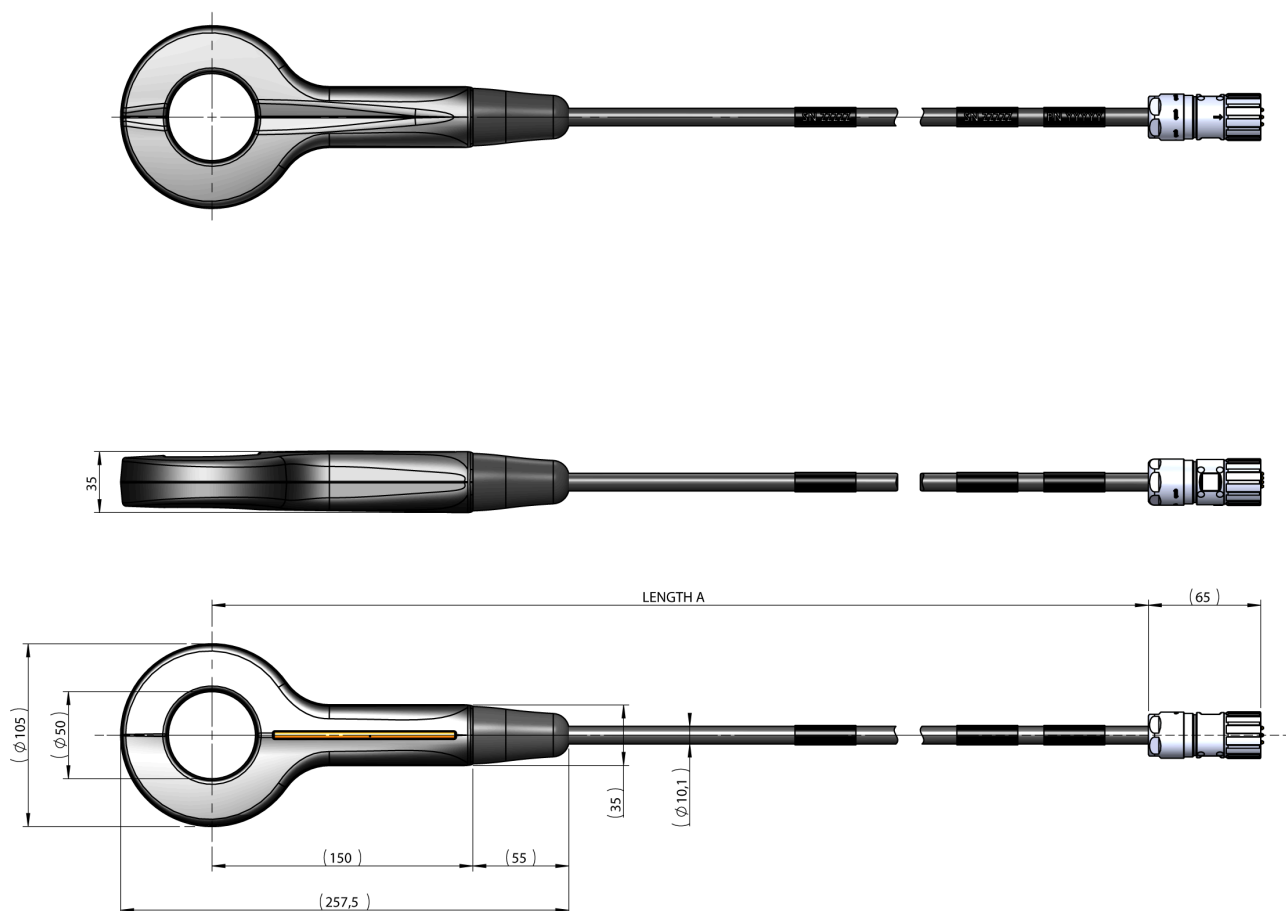
* 1.2 / 50 µs

Description	Length A in [mm]	Order no.
Sensor type 2 cable length 1 m	1000	608219
Sensor type 2 cable length 1.25 m	1250	608220
Sensor type 2 cable length 1.5 m	1500	608221
Sensor type 2 cable length 1.75 m	1750	608222
Sensor type 2 cable length 2 m	2000	608223
Sensor type 2 cable length 2.25 m	2250	608224
Sensor type 2 cable length 2.5 m	2500	608225
Sensor type 2 cable length 3 m	3000	608226
Sensor type 2 cable length 3.5 m	3500	608227
Sensor type 2 cable length 4 m	4000	608228
Sensor type 2 cable length 4.5 m	4500	608229
Sensor type 2 cable length 5 m	5000	608230
Sensor type 2 cable length 5.5 m	5500	608231
Sensor type 2 cable length 6 m	6000	608232
Sensor type 2 cable length 6.4 m	6400	608507
Sensor type 2 cable length 6.5 m	6500	608233
Sensor type 2 cable length 7 m	7000	608234
Sensor type 2 cable length 7.5 m	7500	608235
Sensor type 2 cable length 8 m	8000	608236
Sensor type 2 cable length 8.3 m	8300	608508
Sensor type 2 cable length 8.4 m	8400	608506
Sensor type 2 cable length 8.5 m	8500	608237
Sensor type 2 cable length 9 m	9000	608238
Sensor type 2 cable length 9.5 m	9500	608239
Sensor type 2 cable length 10 m	10000	608240

Overview

Sensor 2MKIII

all dimensions in mm



Accessories

Bushings for sensors

Sensor Bush M12/M16

Bushings to match the size of the down conductor bolts in the blade. Can only be used for sensor type 1

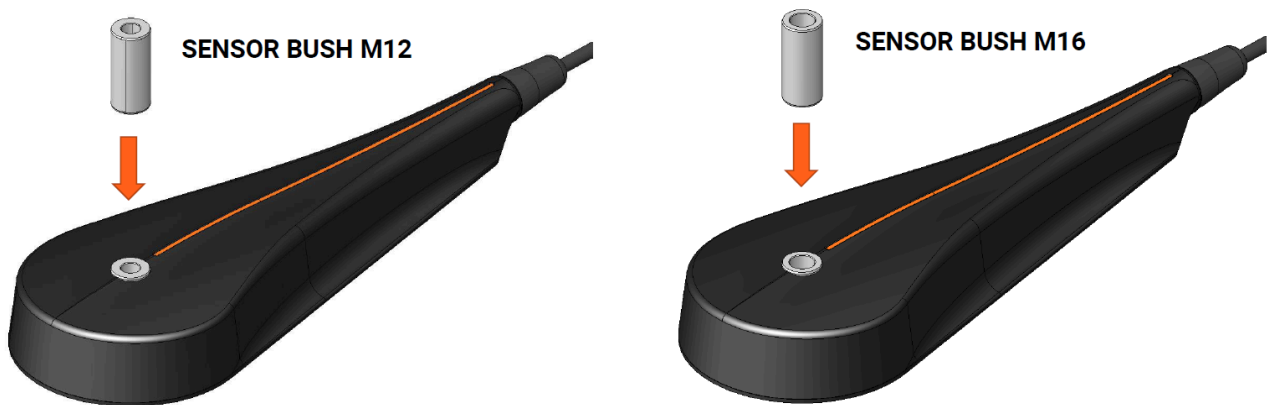


Figure 1: Sensor Bush M12/M16

Variants:

- Sensor Bush M12: 605056
- Sensor Bush M16: 605057

Sensor Extension Bush Kit

Kit with extension bush. Required if the down conductor bolt is too short.

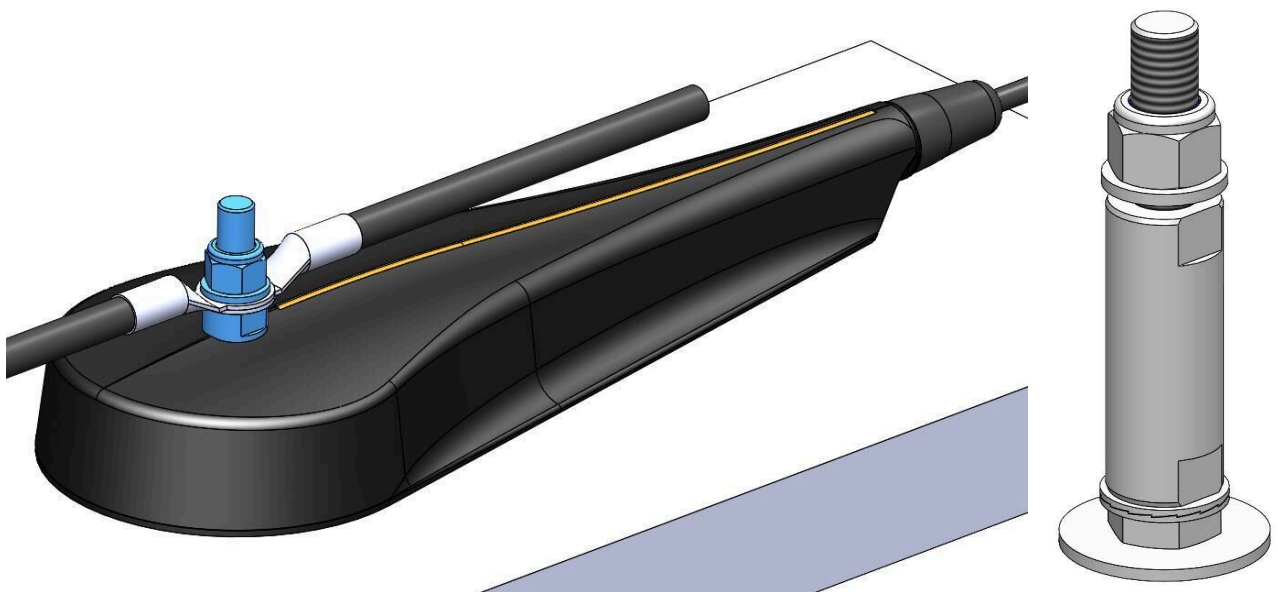


Figure 2: Sensor Extension Bush Kit

Variants:

- Sensor Extension Bush Kit M12: 701125
- Sensor Extension Bush Kit M16: 700847

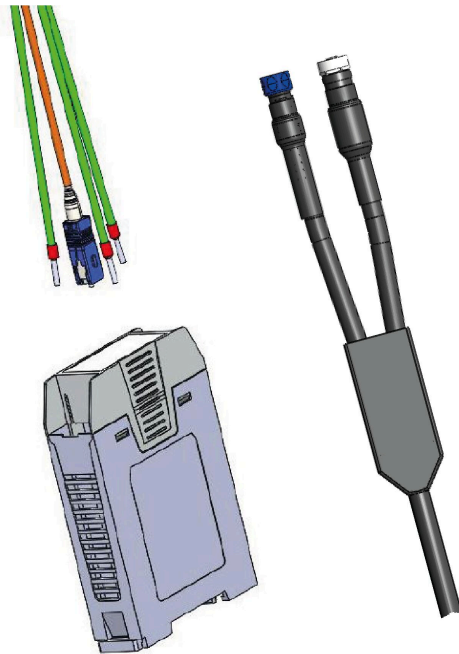
Power Cable Assembly



Some Power supply cables for the LKDS are part of the Power Com Cable Assembly.

Part number	Length
608323	3 m
608324	5 m
608325	8 m
608326	12 m
608327	15 m

Fiber-Optical Trigger Kit



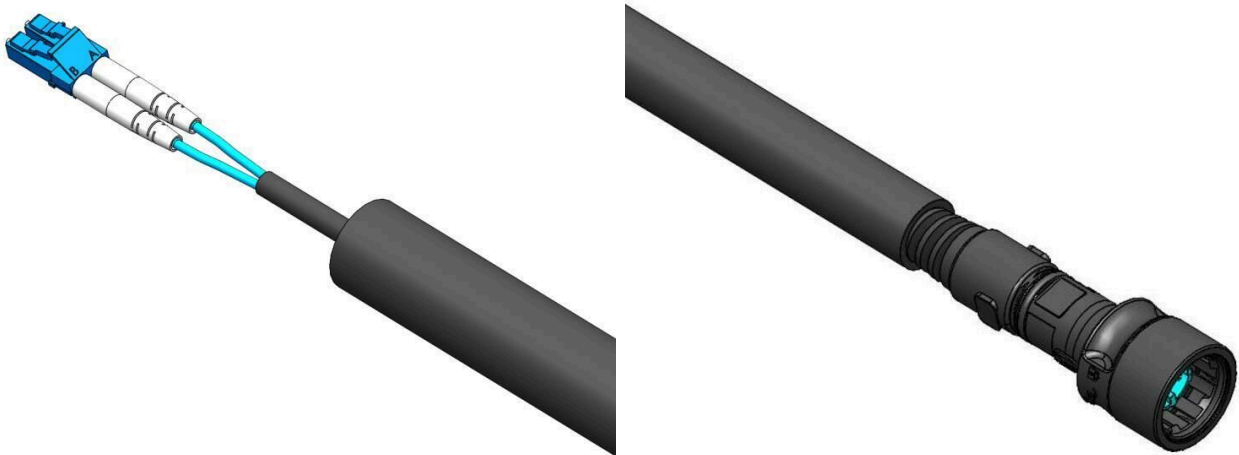
Kit for the fiber-optical trigger signal with LC-SC glass fiber cable and trigger box for installation in a turbine system.

Includes trigger box and Power Com cable.

Note: The Power Com cable contains a glass fiber cable and power cable in a cable duct.

Figure 3: Triggerbox and Power Com Cable

Multimode LC Fiber Cable



Multimode fiber-optical cable for connecting the LKDS control cabinet to another system.

LC dual connector, 5 m length.

5 m cable duct 4.8 m.

Bluetooth Ethernet Communication Kit

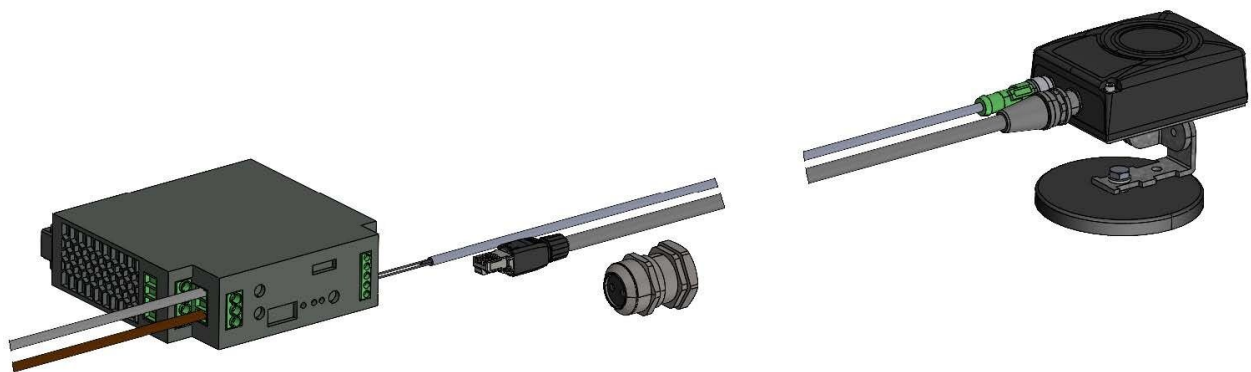


Figure 4: Bluetooth to Ethernet Communication Kit

- Bluetooth adapter
- Antenna
- M12 Ethernet cable 10 m
- M12 power cable
- Holder with magnet

Wi-Fi Kit and PoE Injector

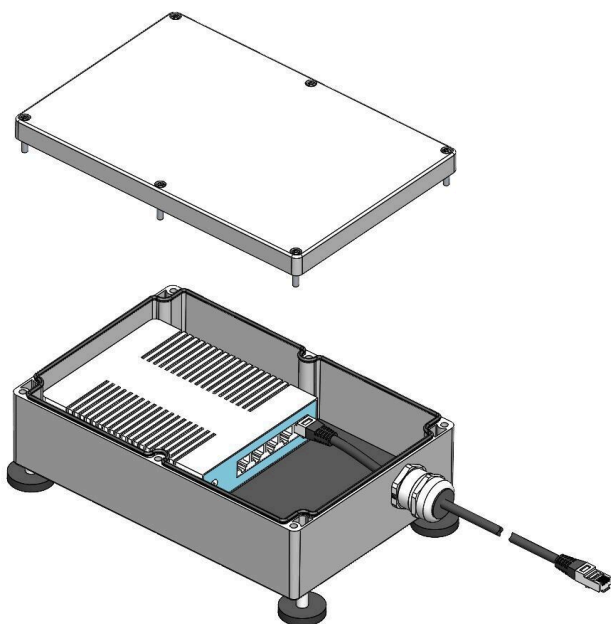


Figure 5: Wi-Fi Communication Kit

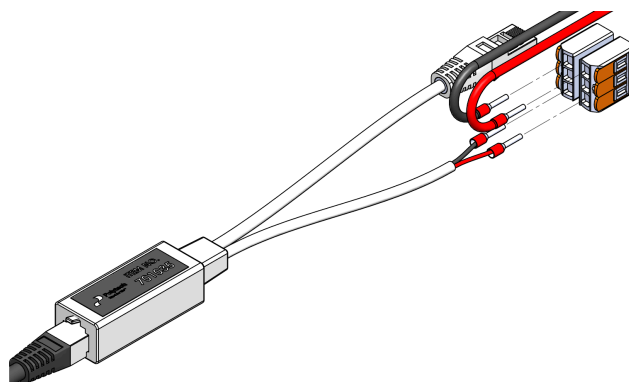


Figure 6: PoE Injector

Name	Part number	Description
Wi-Fi Kit	700854 (International) 701465-A (USA)	Wi-Fi access point powered by PoE in a box including bracket and magnet and RJ45 cable.
PoE Injector	701035	PoE injector as adapter for powering the Wi-Fi Kit.

For more information, see the following documents:

- *AC-D006 Wi-Fi Communication Kit technical datasheet*
- *AC-D007 PoE Injector technical datasheet*