UHURA &
DIRC in the box
Version 2

Manual
April 2019

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Contents

1 Overview GPS-system "DIRC in the box / UHURA"

Figure 1: GPS-Antenna "UHURA"

Exact timing is a vital part of most fields of research. The most commonly used method of synchronization today is GPS. But many cheaper GPS receivers lack a pulse-per-second (PPS) signal and their time usually has high latency and jitter. The GNSS antenna "UHURA" is designed to receive GPS, GLONASS and GALILEO. It's BEIDOU-ready.

"UHURA" provides NMEA-data using RS485 with both 4800 baud and 9600 baud. Inside DIRc the signal is converted to RS232. An extra line provides a latency-free, DCF77 encoded PPS signal. On top of the second pulse the DCF77-Signal is encoded. This way you can synchronize systems that would otherwise need an extra radio receiver.

"UHURA" is delivered in a watertight housing and can be equipped with cables up to 100m length.

Figure 2: DIRC in the box

The central control center in the lab is called "DIRC in the box". "DIRC" provides power to "UHURA" and collects the GPS data. To communicate with the data logger, connect a PC and the seismic data logger "6D6" to "DIRC". You can also download the data with "DIRC". Finally, the data logger "6D6" can establish a WiFi access-point to communicate with the data logger using any WiFi device .

Size

	Size	Cable length	Weight	IP code
DIRC	220 x 180 x 95 mm	1m	1700g	IP54
UHURA	D 140 x 90 mm	30m, 50m, 100m	800g	IP67

2 Internal Structure DIRC
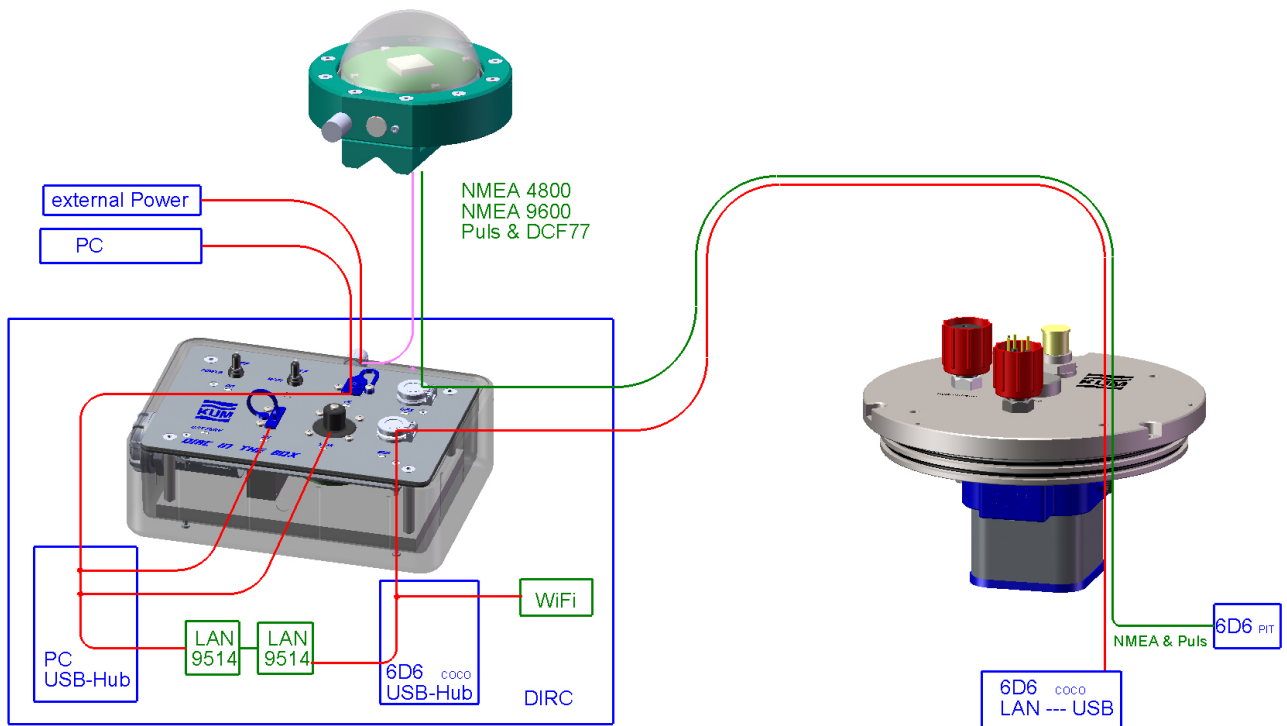
Figure 3: How DIRC works

In figure 3, you can see all functional components and wires from "DIRC in the box". All internal parts of "DIRC" are powered by USB from a PC while "UHURA" is powered either by the external power supply or by the internal battery. If the external power supply is used, the internal battery is charged simultaneously.

"DIRC" is equipped with a lithium-ion rechargeable battery (3.7V Li-Mn 3000mAh). For safe transport the battery can be removed. The picture above shows the endcap of the battery.

3 Pinout

3.1 Description of the connections

Number	Connection	No. of Pins	Description
1	Power	5	External Power Supply
2	Battery	–	Lithium rechargable, can be removed for transport
3	ON/OFF	–	Switches power on[1]
4	WiFi	–	Switches WiFi on
5	PC	4	Connects internal USB hub to PC
6	GPS	8	Socket for GPS antenna "UHURA"
7	SD	9	Socket for SD card to download the data
8	StiK	12	Socket for StiK$^{\text{TM}}$ to download the data
9	6D6	16	Communication with the datalogger
10	Battery	–	Charge control

[1] This switches on the power supply for "UHURA" and boots the data logger "6D6". The sockets for StiK$^{\text{TM}}$, SD card and USB are connected to the USB hub. In addition, an USB-ethernet-device for data logger communication is attached to the hub. For charging the internal battery, the external power supply needs to be attached.

3.2 8-pin Socket "GPS" for communication with"UHURA"

Pin	Purpose	Source	Description
1	Vcc	DIRC	12 Volt
2	PPS -	UHURA	Second pulse minus [2]
3	PPS +	UHURA	Second pulse plus
4	NMEA - 9600	UHURA	NMEA 9600 baud minus
5	NMEA + 9600	UHURA	NMEA 9600 baud plus
6	NMEA - 4800	UHURA	NMEA 4800 baud minus
7	NMEA + 4800	UHURA	NMEA 4800 baud plus
8	GND	DIRC	Signal Ground

[2] RS485 is used for communication with the antenna, therefore a pair of cables is used for each signal line.

3.3 16-pin Socket "6D6" for datalogger communication

Pin	Purpose	Source	Description
1	NMEA 9600	DIRC	NMEA with 9600 baud [1]
2	1 PPS	DIRC	Pulse-per-second from GPS [2]
3	AGND	DIRC	Signal Ground GPS
4	Vcc USB	6D6	5V USB
5	USB-DN	6D6	USB Data line
6	USB-DP	6D6	USB Data line
7	USB-GND	6D6	Signal Ground USB
8	VBAT2	6D6	Vdd from the battery pack inside the pressure tube [3]
9	VCNC	DIRC	Vdd back to web server [3]
10	NMEA 4800	DIRC	NMEA with 4800 baud [4]
11	–	–	–
12	–	–	–
13	–	–	–
14	–	–	–
15	–	–	–
16	–	–	–

[1] 3.3V UART

[2] There is a DCF77-signal coded on top of the – latency free – second pulse to synchronize

systems that require a radio signal instead.

[3] The data logger's webserver is only powered when connected to the communication socket. There is a bridge between VBAT2 and VCNC inside the socket. This way the web server is definitely shut off when the cable is unplugged.

[4] You can use "DIRC in the box" to synchronize dataloggers manufactured by the company SEND (and other instruments that require 4800 baud) as well.

4 Meaning of the LED's: DIRC

LED	Status	Description
Power	green	System is switched on
	off	System is switched off but battery can be charged
WiFi	green	WiFi is switched on
	off	WiFi is switched off
PC	green	USB Hub is powered by PC or power supply
	off	USB hub not powered
GPS	green	GPS connected, but no GPS Fix yet
	flashing	GPS signal is valid[1]
	off	GPS not connected
BATTERY	green	External power, battery is charged / trickle charged
	red	Battery powers "DIRC"
	off	Not in use
SD	green	SD card is attached
	flashing	Data download from SD card
	off	No SD card attached
StiK	green	StiK™is attached
	flashing	Data download from StiK™
	off	No StiK™is attached
6D6	green	Connection between web server and PC
	flashing	Communication between web server and PC
	off	Web server not connected or connection using WiFi

[1] The GPS-antenna is configured to only hand over validated signals. If there are less than 4 satellites or weak signal, the signals are set to zero. When the LED is flashing you can be sure that a GPS signal exists *and that it is reliable*. However, we recommend to wait at least
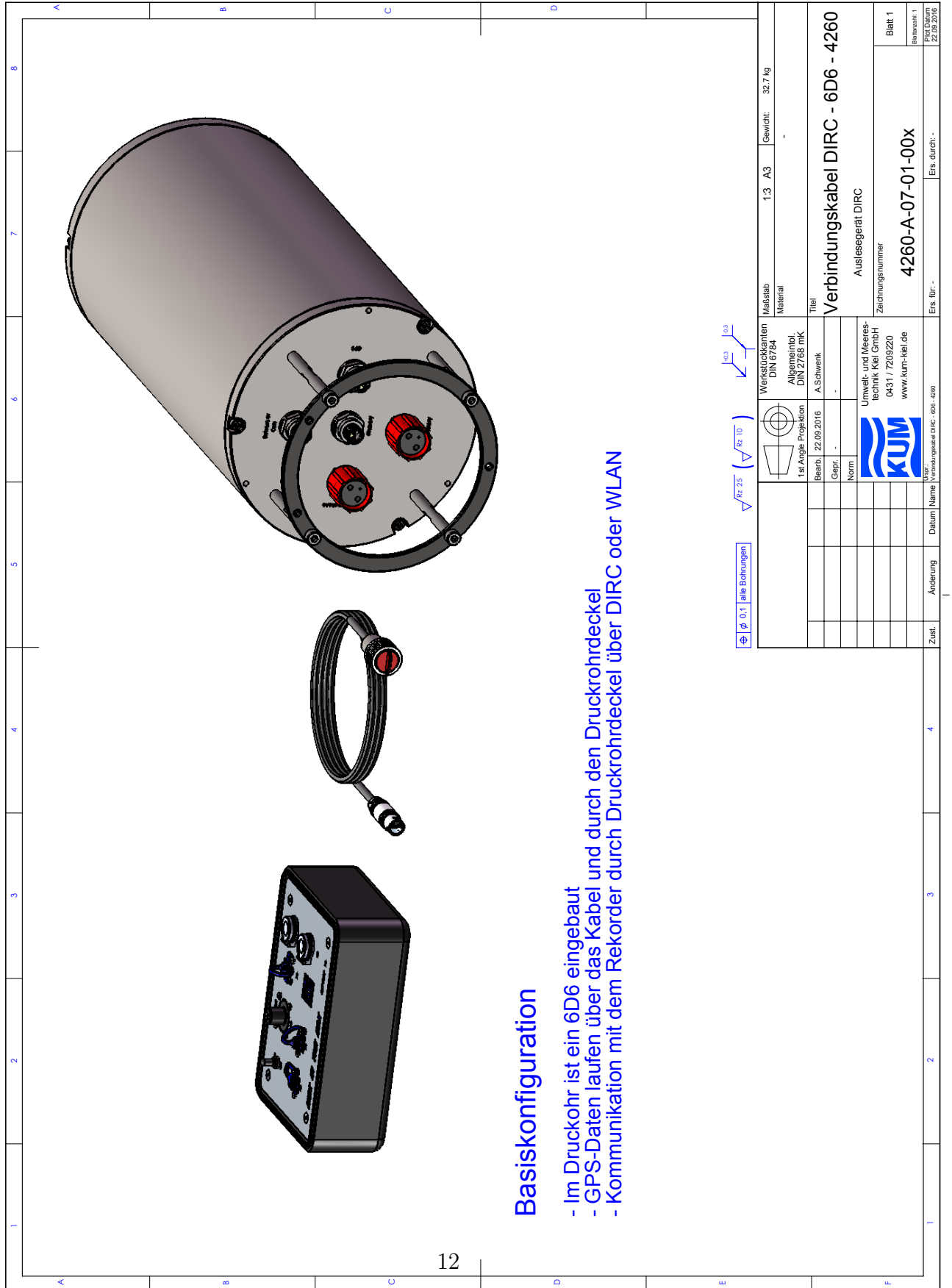
15 minutes after the first GPS fix. The reason for that is the information policy of the GPS system: information about leap seconds is transmitted every 15 minutes only. If another leap second occurred while "UHURA" has been shut off there would be a one second difference until this information is sent.

5 Meaning of the LED: UHURA

Status	Description
red	System is booting. In case it keeps permanently, contact K.U.M
orange	System has no fix yet
green flash	System working. Second pulse represents a binary "0" [2]
blue flash	System working. Second pulse represents a binary "1" [2]

[2] On top of the GPS-NMEA the second pulse is DCF77 encoded. This is to supply outdated data logger that require this feature.

6 Available Cables

Basiskonfiguration

- Im Druckrohr ist ein 6D6 eingebaut
- GPS-Daten laufen über das Kabel und durch den Druckrohrdeckel
- Kommunikation mit dem Rekorder durch Druckrohrdeckel über DIRC oder WLAN

Verbindungskabel DIRC - 6D6 - 4260

Auslesegerät DIRC

4260-A-07-01-00x

Maßstab 1:3 A3   Gewicht: 32.7 kg

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Werkstückkanten
DIN 6784

Allgemeintol.
DIN 2768 mK

A.Schwenk

1st Angle Projektion
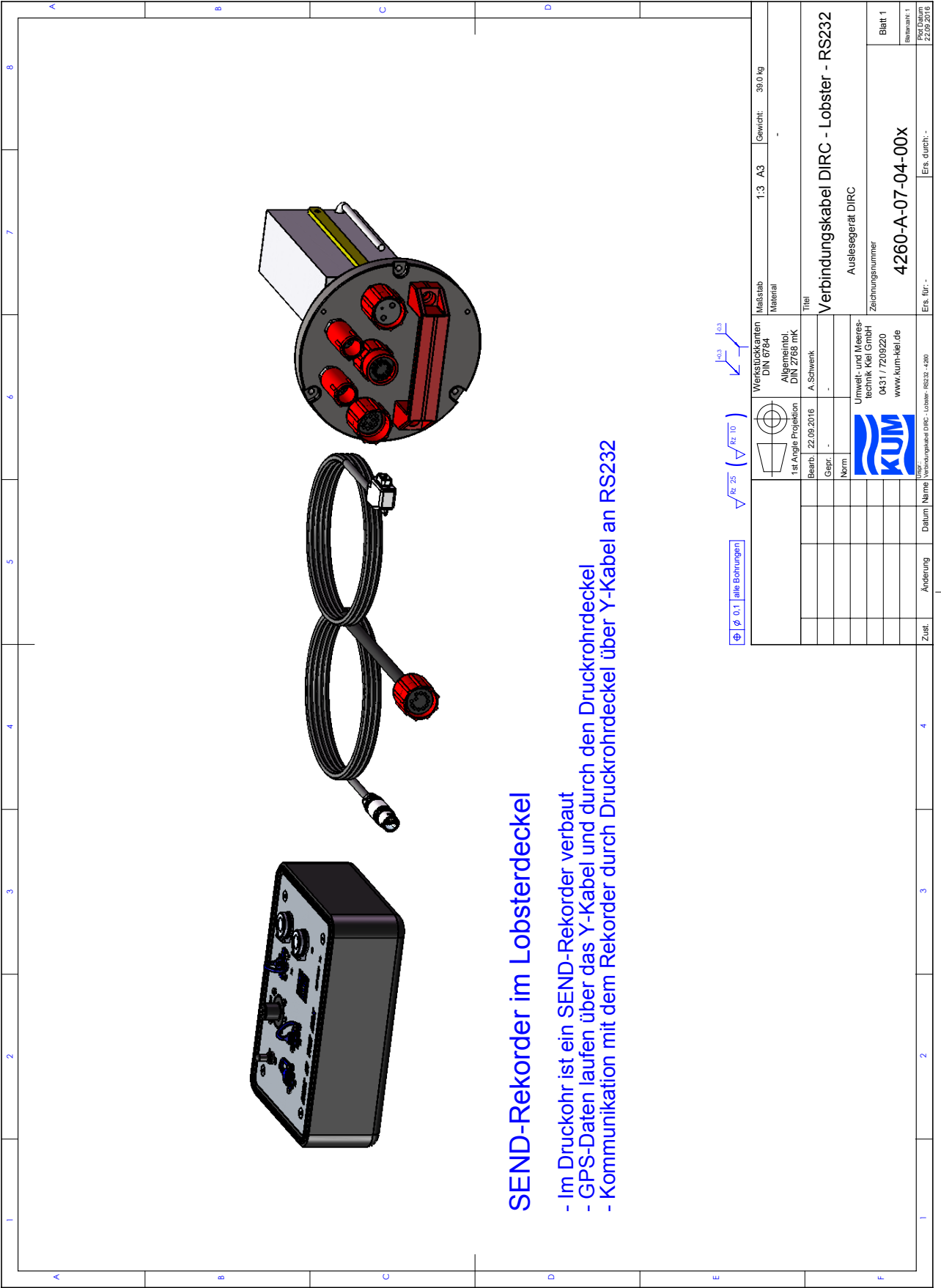
Bearb. 22.09.2016
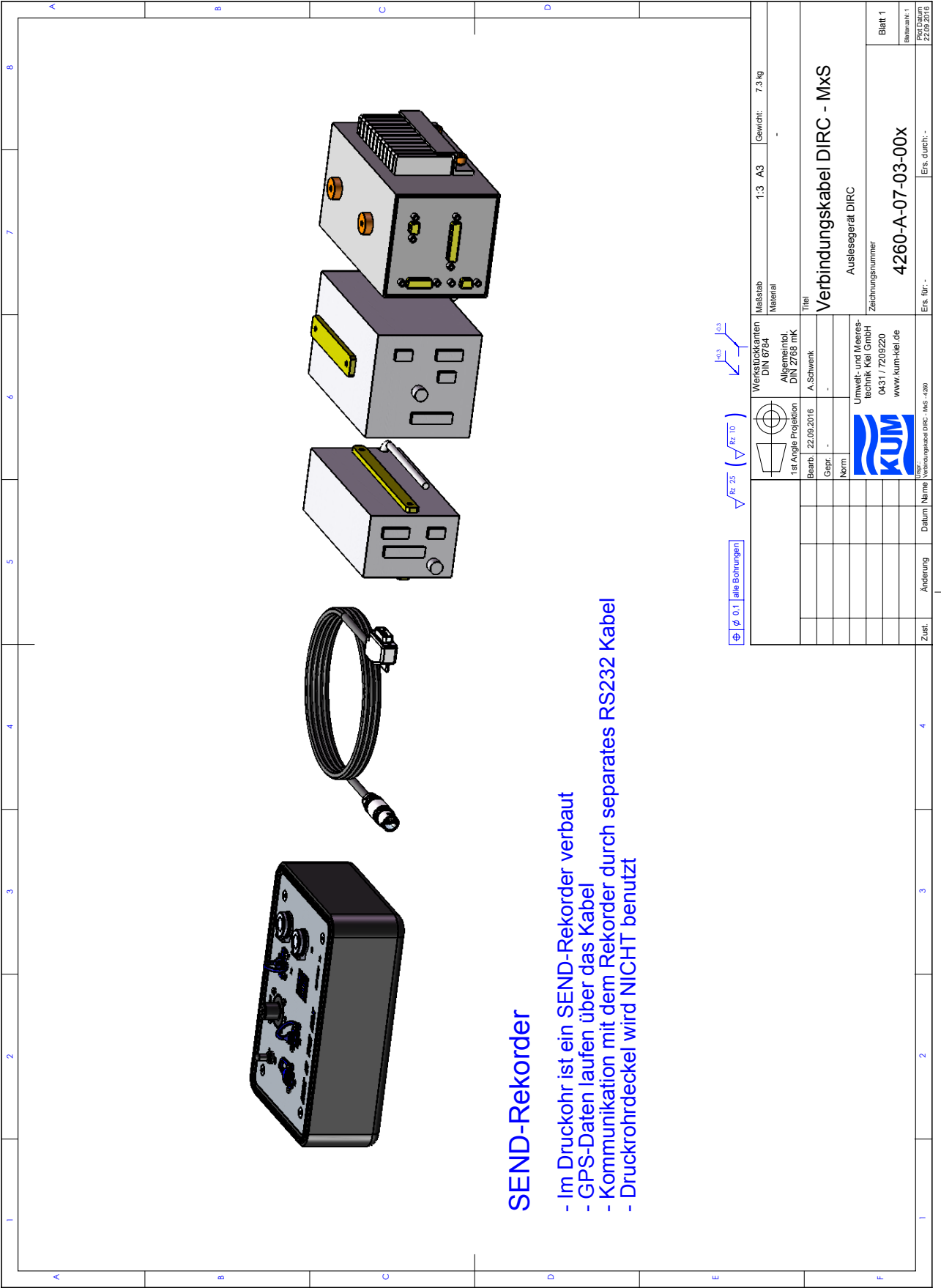
Blatt 1

12

6D6 im Lobsterdeckel mit Adapter

- Im Druckohr ist über einen Adapter ein 6D6 Rekorder verbaut
- GPS-Daten laufen über das Kabel und durch den Druckrohrdeckel
- Kommunikation mit dem Rekorder durch Druckrohrdeckel über DIRC oder WLAN

⊕ ⌀ 0,1 | alle Bohrungen

√ Rz 25 (√ Rz 10) √ Rz 10

Werkstückkanten DIN 6784		
1st Angle Projektion	Allgemeintol. DIN 2768 mK	
Bearb.	22.09.2016	A.Schwenk
Gepr.	-	-
Norm		

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Urbild: Verbindungskabel DIRC - Lobster-4260

Maßstab	1:3	A3	Gewicht:	37.9 kg
Material	-			

Titel
Verbindungskabel DIRC - Lobster

Auslesegerät DIRC

Zeichnungsnummer
4260-A-07-05-00x

Ers. für: -   Ers. durch: -

Blatt 1
Blattanzahl: 1
Prot Datum
22.09.2016

Zust.	Änderung	Datum	Name

SEND-Rekorder im Lobsterdeckel

- Im Druckohr ist ein SEND-Rekorder verbaut
- GPS-Daten laufen über das Y-Kabel und durch den Druckrohrdeckel
- Kommunikation mit dem Rekorder durch Druckrohrdeckel über Y-Kabel an RS232

Maßstab	1:3 A3	Gewicht:	39.0 kg
Material	-		

Titel

Verbindungskabel DIRC - Lobster - RS232

Auslesegerät DIRC

Zeichnungsnummer		
4260-A-07-04-00x		Blatt 1
		Blattanzahl: 1
Ers. für: -	Ers. durch: -	Prd.Datum 22.09.2016

Werkstückkanten DIN 6784
Allgemeintol. DIN 2768 mK
1st Angle Projektion

	Datum	Name
Bearb.	22.09.2016	A.Schwenk
Gepr.	-	-
Norm		

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Verbindungskabel DIRC - Lobster- RS232 - 4260

⌖ ⌀ 0,1 alle Bohrungen

Zust.	Änderung	Datum	Name

SEND-Rekorder

- Im Druckohr ist ein SEND-Rekorder verbaut
- GPS-Daten laufen über das Kabel
- Kommunikation mit dem Rekorder durch separates RS232 Kabel
- Druckrohrdeckel wird NICHT benutzt

Maßstab		1:3	A3	Gewicht:	7.3 kg
Material				-	

Titel

Verbindungskabel DIRC - MxS

Auslesegerät DIRC

Zeichnungsnummer

4260-A-07-03-00x

Ers. für: - | Ers. durch: -

	Werkstückkanten DIN 6784		
1st Angle Projektion	Allgemeintol. DIN 2768 mK		
Bearb.	22.09.2016	A.Schwenk	
Gepr.	-	-	
Norm			

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Urspr.
Verbindungskabel DIRC - MxS - 4260

Blatt 1

Blattanzahl: 1

Plot Datum
22.09.2016

$\sqrt{Rz\ 25}$ ($\sqrt{Rz\ 10}$)

$\oplus$ ϕ 0,1 | alle Bohrungen

Zust. | Änderung | Datum | Name

Zust. | Änderung

7 Performance

Receiver type: 72-channel UHURA engine; GPS L1C/A, SBAS L1C/A, QZSS L1C/A, QZSS L1 SAIF, GLONASS L1OF, BeiDou B1I, Galileo E1B/C

Parameter	Specification					
Accuracy of time pulse sig	RMS 99%	30 ns 60 ns				
Frequency of time pulse sig		0.25 Hz to 10 MHz				
Operat. limits[1]	Dynamics Altitude Velocity	≤ 4 g 50.000m 500 m/s				
Velo. acc.[2] Head. acc.[2]		0.05m/s 0.3 degrees				
GNSS		GPS	GLONASS & GPS	GLONASS	BeiDou	Galileo
Horizontal pos. acc.[3]		2.5m	2.5m	4m	3m	TBC[4]
Max navigation update rate		5 Hz	10 Hz	10 Hz	10 Hz	10 Hz
Time-To-First-Fix[5]	Cold start	26 s	29 s	30 s	34 s	45 s
	Hot start	1 s	1 s	1 s	1 s	1 s
	Aided starts[5]	2 s	2 s	2 s	3 s	7 s
Sensitivity[7]	Track & Nav	-164 dBm	-164 dBm	-163 dBm	-160 dBm	-154 dBm
	Reacquis.	-160 dBm	-159 dBm	-156 dBm	-155 dBm	-152 dBm
	Cold start	-148 dBm	-147 dBm	-145 dBm	-143 dBm	-133 dBm
	Hot start	-157 dBm	-156 dBm	-155 dBm	-155 dBm	-151 dBm

[1] Assuming Airborne < 4 g platform

[2] 50% @30m/s

[3] CEP, 50%, 24 hours static, -130 dBm, > 6 SVs

[4] To be confirmed when Galileo reaches full operational capability

[5] All satellites at -130 dBm, except Galileo at -127 dBm

[6] Dependent on aiding data connection speed and latency

[7] Demonstrated with a good external LNA

8 WARNING – READ THIS FIRST!

All personnel involved with the installation, operation, or maintenance of the equipment described in this manual should read and understand the warnings and recommendations provided below.

WARNING

> **This manual is a reference book only. It does not claim completeness and refers to other literature in certain chapters. This manual cannot and shall not substitute an instrument introduction through an expert. Programming and deployment of an autonomous deep-sea instrument is an utmost complex affair and require the detailed know-how of all components and their composition in order to guarantee successful operation. That's why we expressly recommend that solely trained personnel shall operate and maintain the instruments.**

Static Sensitive Devices

This equipment contains devices that are extremely sensitive to static electrical charges. Therefore extreme care should be taken when handling them, as static electricity may be present on the body and clothing. Normal handling precautions involve the use of anti-static protection materials and grounding straps for personnel.

High Voltages

High Voltage may be present in all parts of the GPS UHURA & DIRC . Use caution when the electronics are removed from their containers for servicing.

Improper Line Voltage

Operation with improper line voltage may cause serious damage to the equipment. Always ensure that the proper line voltage is used.

Hardware Variations and Compability

The GPS UHURA & DIRC contains both standard and proprietary hardware. At times K.U.M. may change the standard components due to their availability or performance improvements. Although the component manufacturers, along with their models and styles may change from unit to unit, replacement components will generally be interchangeable. K.U.M. will make every effort to see that replacement components are interchangeable. K.U.M. may also change certain hardware per customer requirements. Therefore, portions of this manual, such as parts lists and test features, are subject to change. These sections should be used for reference only. When changes are made that affect GPS UHURA & DIRC operation, they will be explicitly noted.

Purpose of this Manual

The purpose of this manual is to provide the user with information on the setup, operation, care, and features of the GPS UHURA & DIRC . Although this manual encompasses the latest operational features of the GPS UHURA & DIRC , some features of the GPS UHURA & DIRC may be periodically upgraded. Therefore the information in this manual is subject to change and should be used for reference only.

Warnings, Cautions, and Notes

Where applicable, warnings, cautions, and notes are provided in this manual as follows:
WARNING!
Identifies a potential hazard that could cause personal injury or death to yourself or to others.
CAUTION!
Identifies a potential hazard that could be damaging to equipment or could result in the loss of data.
NOTE:
Recommendations or general information that is particular to the material being presented. It may also refer to another part of this manual or to another manual.

Liability

K.U.M. has made every effort to document the GPS UHURA & DIRC in this manual accurately and completely. However, K.U.M. assumes no liability for errors or for any damages that result from the use of this manual or the equipment it documents. K.U.M. reserves the right to

upgrade features of this software and to make changes to this manual without notice at any time.

Warranty statement

All equipment manufactured by K.U.M. is warranted against defective components and workmanship for a period of one year after shipment. Warranty repair will be done by K.U.M. free of charge. Shipping costs are to be borne by the customer. Malfunction due to improper use is not covered in the warranty, and K.U.M. disclaims any liability for consequential damage resulting from defects in the performance of the equipment. No product is warranted as being fit for a particular purpose, and there is no warranty of merchantability. This warranty applies only if:

- The items are used solely under the operating conditions and in the manner recommended in Seller's instruction manual, specifications, or other literature.

- The items have not been misused or abused in any manner, nor have repairs been attempted thereon without the approval of K.U.M. Customer Service.

- Written notice of the failure within the warranty period is forwarded to Seller and the directions received for properly identifying items returned under warranty are followed.

- The return notice authorizes Seller to examine and disassemble returned products to the extent Seller deems necessary to ascertain the cause for failure.

The warranties expressed herein are exclusive. There are no other warranties, either expressed or implied, beyond those set forth herein, and Seller does not assume any other obligation or liability in connection with the sale or use of said products. Any product or service repaired under this warranty shall be warranted for the remaining portion of the original warranty period only.

Equipment not manufactured by K.U.M. is supported only to the extent of the original manufacturer's warranties.

Returned Material Authorization

Prior to returning any equipment to K.U.M., a Returned Material Authorization (RMA) number must be obtained. The RMA will help us identify your equipment when it arrives at our receiving dock and track the equipment while it is at our facility. The material should be shipped to the address provided in the K.U.M. Customer Service section. Please refer to the

RMA number on all documents and correspondences as well. All returned material must be shipped prepaid. Freight collect shipments will not be accepted.

CAUTION! Never attempt to ship portable topside units in their outdoor case alone. Although rugged, these cases are not intended to be used as shipping containers, and the delicate internal components could be damaged if used in this manner.

All shipments must be accompanied by a copy of your proforma invoice, showing the value of the material and the reason for its return. When shippend from outside the European Union: If the reason is for repair, it must be clearly stated in order to move through customs quickly and without duties being charged. Whenever possible, please send copies of original export shipping documents with the consignment.

Final Disposal

The GPS UHURA & DIRC contains materials (especially batteries) that need proper disposal. Please contact customer service if your local disposal contractor is in doubt.

Customer Service

Customer service personnel at K.U.M. are always eager to hear from users of our products. Your feedback is welcome, and is a valuable source of information which we use to continually improve these products. Therefore we encourage you to contact K.U.M. Customer Service to offer any suggestions or to request technical support:

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