



Specialists
at depth

6D6.7 / 6D7 Seismic Data Logger

Manual v1.1

July 2023



Specialists
at depth

Data Logger 6D7
KM/T 4800-01
SerialNo.: 72301030



K.U.M. Umwelt- und Meerestechnik Kiel GmbH
Wischhofstr. 1-3, Geb. 15
24148 Kiel

Fon: +49 431 72092-20

Fax: +49 431 72092-44

www.kum-kiel.de

info@kum-kiel.de

CEO Thomas Kumbier
Amtsgericht Kiel, HRB 4773

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1 Overview Seismic Datalogger “6D7”



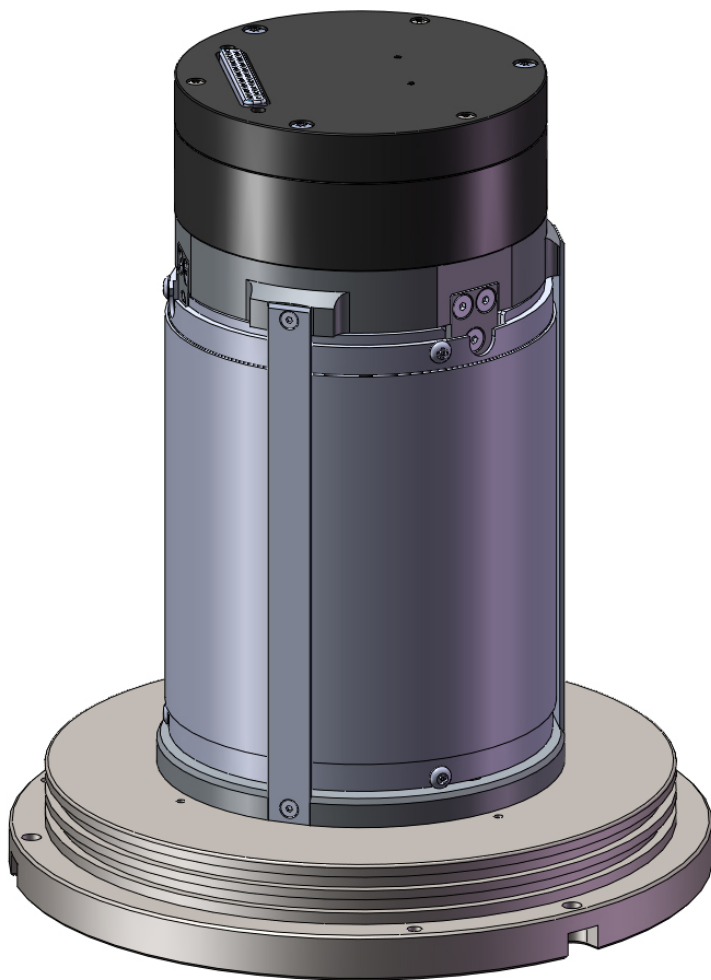
Datalogger, Power consumption 125 mW, 9-24 V

- Four synchronous channels, signal-to-noise-ratio better 142dB
- 32 bit input data recording
- FIR-filter, filter-delay already corrected in raw data
- SeaScan real time clock, non-linearity better than 0.02 ppm
- Data are stored on external StiK™
- StiK™ can be changed without opening the pressure vessel
- Ultra-Low-Power 125 mW
- AIS positioning after pop-up as an option
- Programming of the datalogger using any standard web browser
- Liveview of data when connected via DIRC II
- Easy firmware update via web browser possible

2 Connection and Use of the Datalogger

2.1 Connection

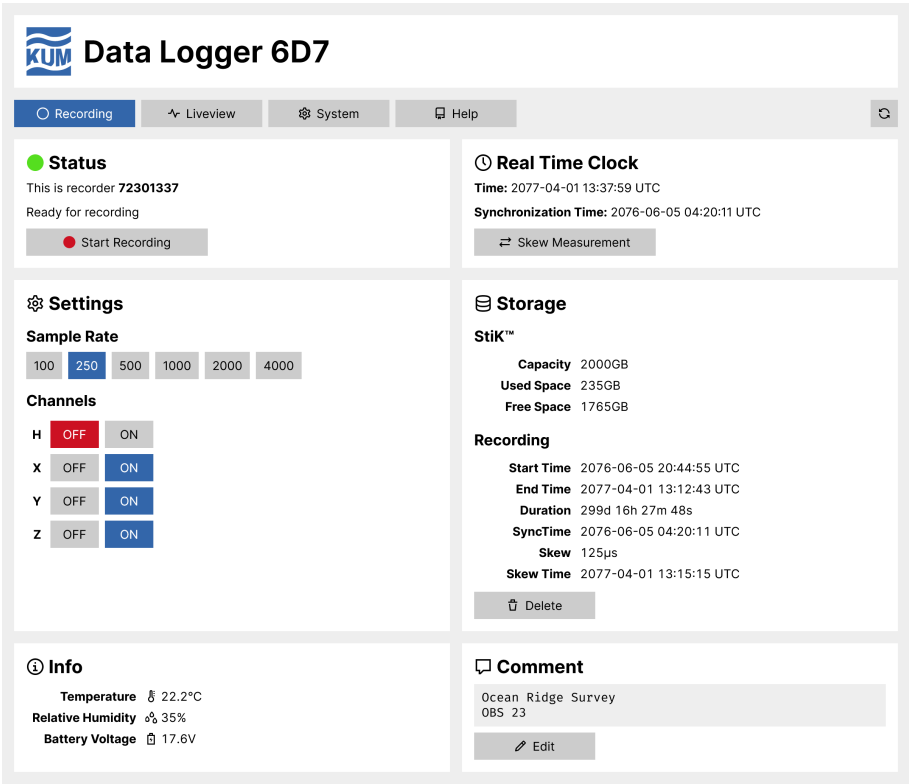
The power for the datalogger is supplied by a battery pack, usually included in the pressure vessel. After placing the datalogger on top of the seismometer fix it by carefully tightening the Torx screws and connect to the power cable. The recorder is ready for use now.



2.2 Web Interface

The communication device “DIRC II” is equipped with a web server and an access point. If connected to DIRC II a WiFi is established and you can use any modern web browser for communication. It takes about 45 seconds for the DIRC II to boot, as soon as the LED lights permanently the WiFi is ready for use. The default SSID of the network

always starts with “Dirc2-” followed by the serial number of the device. The default password is “seismics”. Connect your device (laptop, tablet or mobile) to the WiFi and type the IP-address (it is *always* “10.0.0.1”) into the address field of your web browser. The following website will appear:



2.2.1 Tabs

The tab bar allows access to the different areas of the interface.



The Recording tab is used to change the settings of the data logger, start and stop the recording, synchronize the time and get information about the data logger.

The Liveview tab displays the input signals of the data logger. This can be used as a quality check to make sure the instruments are working properly.

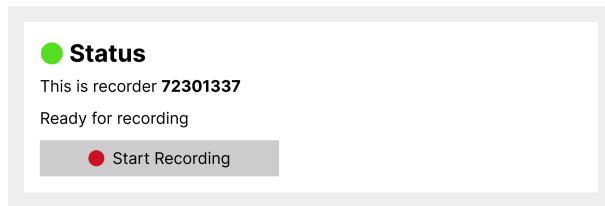
The System tab is used to change the WiFi settings and to update the firmware of DIRC II and 6D7.

The Help tab gives a short overview over the functionality of the data logger.

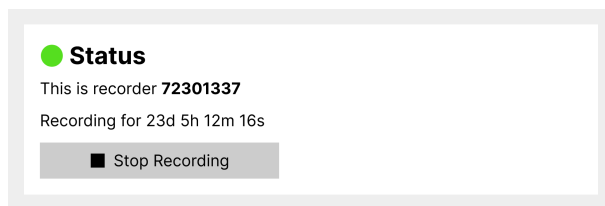
The Refresh button queries the current status from the data logger. This also reloads the attached storage.

2.2.2 Status

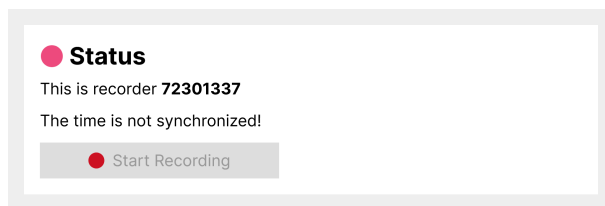
The status area shows the current recording status of the data logger. It also contains the button to start and stop a recording.



If a recording is running it looks like this:

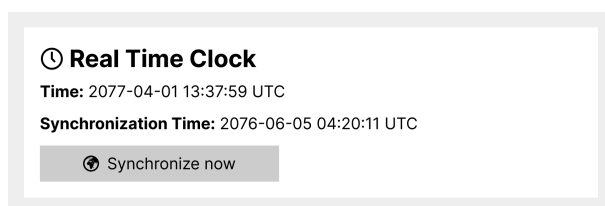


If the recording can not be started it will show the reason here.



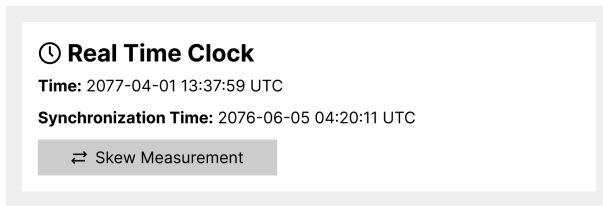
2.2.3 Real Time Clock

This area displays the status of the real time clock and gives the option to synchronize the time via GPS.



If the storage contains a recording you can instead measure the skew here.

The skew is the difference of the real time clock to the GPS time and is used to correct the timing error of the recording.



Important: It is mandatory to synchronize the clock *directly before* use and measure the skew *directly after* end of recording.

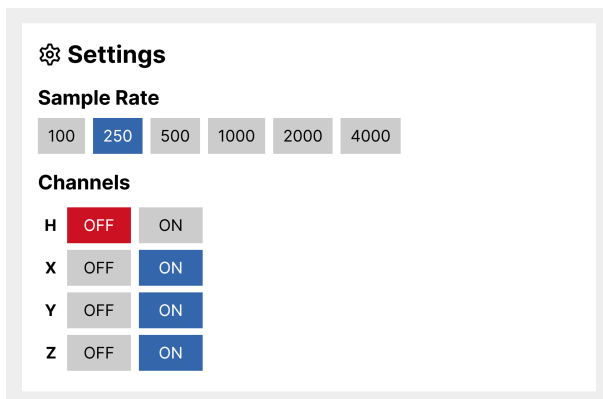
To synchronize the clock the GPS antenna “UHURA” is used (see page 20). Click “Synchronize now” to synchronize the datalogger with a valid GPS pulse. Once the synchronization is completed successfully, this is indicated in the web interface.

Remark: If there is no GPS connected, synchronization will fail and may only be possible once a stable GPS fix is acquired.

2.2.4 Settings

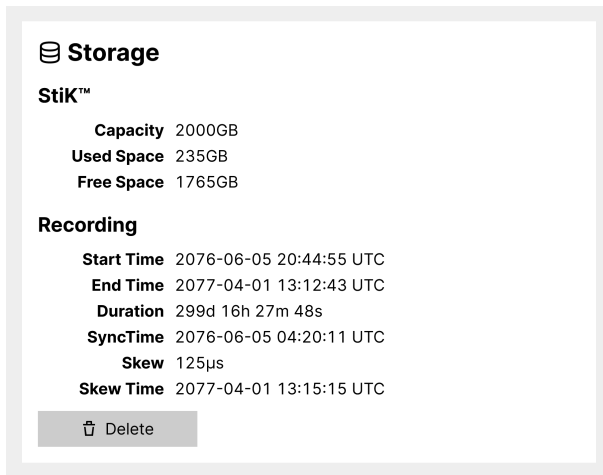
Here you can change the sample rate of the data logger between 100 and 4000 samples per second. The current sample rate is marked in blue.

You can also turn channels on and off here. If a channel is turned off, its data will not be recorded and the data logger will also use a little bit less power.

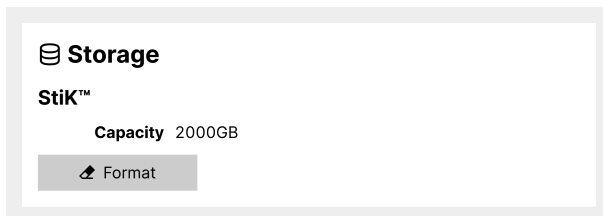


2.2.5 Storage

This area displays statistics about the storage medium in use and also details of the recording stored on it if any.



If the storage is not properly formatted for the 6D7 it will give you the option to format it here.

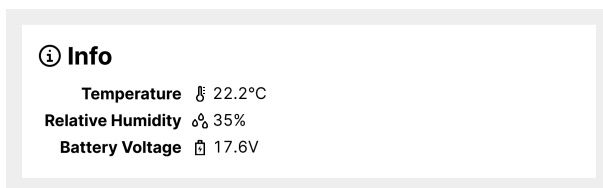


The required memory is dependant on both samplerate and recording time. The system records with 32 bit (= 4 byte) per sample, so the required memory is: $M = 4 \cdot 60 \cdot 60 \cdot 24 \cdot 30 = 10.5 \text{ MB}$ per channel per month per sps.

Example: At four channels and a samplerate of 250 sps you will need a monthly memory of $4 \cdot 250 \cdot 10.5 \text{ MB} = 10.5 \text{ GB}$.

2.2.6 Info


The info area displays the temperature and humidity as well as the battery voltage.




2.2.7 Comment

Here you can set a comment for your recording. The comment should usually include information like the experiment name and the station number.

The comment will be written to the storage at the start of the recording, so it can not be changed here afterwards.

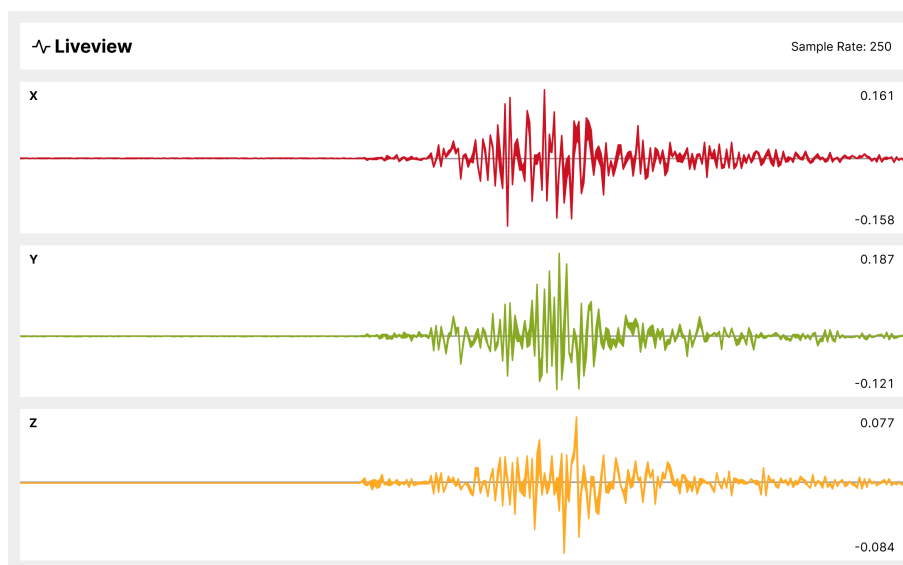
 **Comment**

Ocean Ridge Survey
OBS 23

 Edit

2.2.8 Liveview

The Liveview tab displays the input signals of the data logger. This can be used as a quality check to make sure the instruments are working properly.

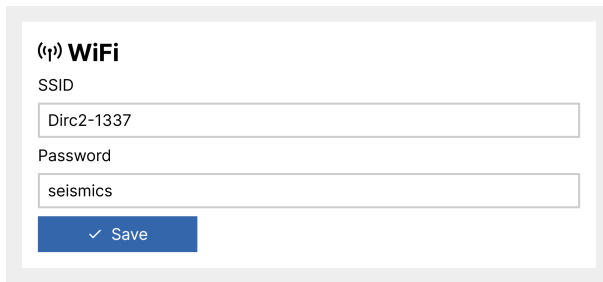


Please note that the signals shown are just a coarse representation of the data recorded. Even on a 4k screen it is not possible to show four channels of 32 bit data in full detail.

2.2.9 System

The System tab allows you to change the WiFi SSID and password.

In case you have lost your new password you can connect DIRC II to a PC directly with a USB cable, using the built in ethernet. Then navigate to this tab to see both SSID and password in plain text.



WiFi

SSID

Dirc2-1337

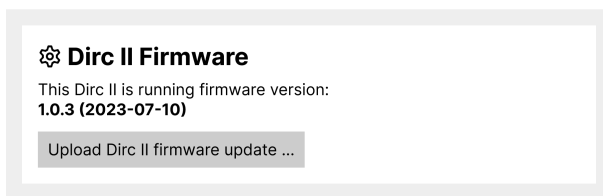
Password

seismics

✓ Save

You can also update the firmware for Dirc II. In case of a firmware update you will be supplied with a file by K.U.M. which you need to upload using the button.

When the update is complete Dirc II will reboot. You will need to connect to the WiFi network again if that does not happen automatically.



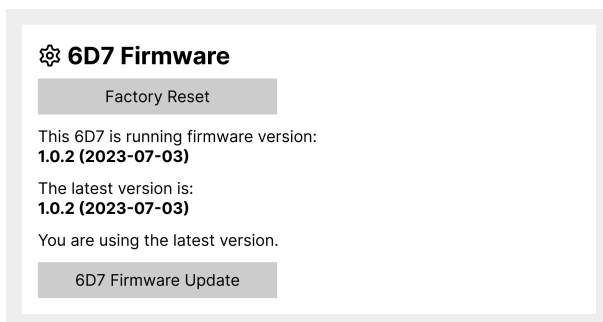
Dirc II Firmware

This Dirc II is running firmware version:
1.0.3 (2023-07-10)

Upload Dirc II firmware update ...

The firmware version of the currently connected 6D7 data logger is displayed here.

Each Dirc II version comes with a corresponding firmware for the 6D7 data logger. When the firmware version does not match you can update your data logger with the update button. This procedure has to be repeated for every 6D7 data logger.



6D7 Firmware

Factory Reset

This 6D7 is running firmware version:
1.0.2 (2023-07-03)

The latest version is:
1.0.2 (2023-07-03)

You are using the latest version.

6D7 Firmware Update

3 Downloading the Data and Conversion

3.1 Installing the Software

To download and convert the data you can use our open-source software “6d6-compat”. It runs on any standard Linux operating system. You can download it here:

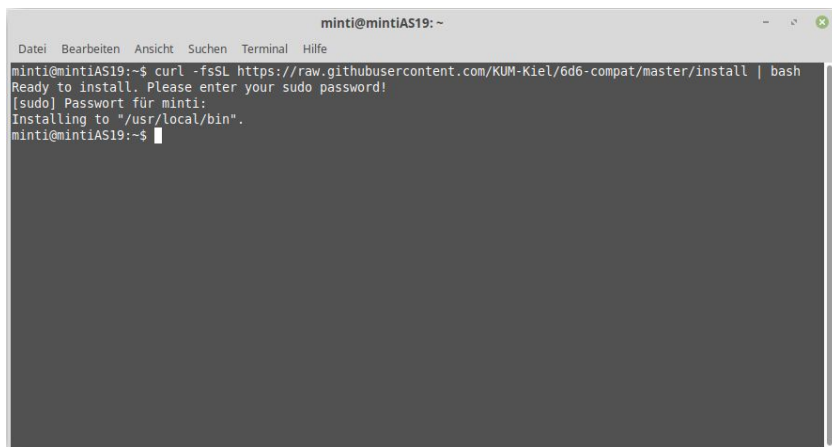
<https://github.com/KUM-Kiel/6d6-compat/releases>.

Please note: for programming the data logger any laptop or tablet with a web browser can be used¹, no matter if Linux, Windows or OS X is running. *For downloading and converting the data a Linux-computer (or macOS 13.1 or higher) is mandatory.*

To install the software enter following command in a terminal, as advised in the Readme-file:

```
curl -fsSL https://raw.githubusercontent.com/KUM-Kiel/6d6-compat/master/install | bash
```

Now the software is installed at `/usr/local/bin`:



3.2 Commands

After re-opening the terminal you can use commands as follows:

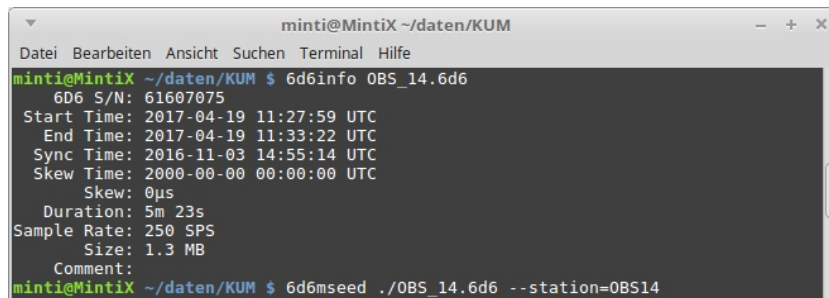
¹Tested with Firefox, Chrome, Safari, Opera and Edge 2023

3.2.1 6d6info

This will show some basic information like the start time, the duration or the serial number of the data logger.

Use it as follows: `6d6info /dev/sdX1`

This will show some basic information like the start time, the duration or the serial number of the data logger:

A screenshot of a terminal window titled 'minti@MintiX ~/daten/KUM'. The window shows the command '6d6info OBS_14.6d6' being executed. The output displays various metadata for the data file, including its serial number (61607075), start and end times, sync time, skew time, duration, sample rate, size, and a comment. The terminal prompt is 'minti@MintiX ~/daten/KUM \$'.

3.2.2 6d6copy

Copy a SD card to the file system.

Use it as follows: `6d6copy /dev/sdX1 file.6d6`

This will copy the contents of `/dev/sdX1` to `file.6d6`. Replace `sdX1` with the proper drive letter. On some systems this could also be `/dev/mmcbk0p1` or similar. Information about how the SD-card is named is logged in the file `syslog`. You will have permanent access to the file using `sudo tail -f /var/log/syslog`.

3.2.3 6d6mseed

Converts a .6d6 file to MiniSEED.

Use it as follows: `6d6mseed --station=CODE file.6d6`. This way day-files will be created that – beside the first and the last day – last from midnight to midnight. Using the option `--cut=3600` will create files of 3600 seconds length – and other lengths accordingly.

This will create a folder with the MiniSEED files. The program `6d6mseed` produces SEED from the recorded data as well as a logfile `events.txt` and a file `engineering.csv` with battery voltage, temperature and some more engineering data. Using the option `--help` shows a short hint how to use the software:

```
minti@MintiX ~/daten/KUM
Datei Bearbeiten Ansicht Suchen Terminal Hilfe
minti@MintiX ~/daten/KUM $ 6d6mseed --help
Version 1.2.2 (2017-04-24)
Usage: 6d6mseed [options] input.6d6

The program '6d6mseed' is used to convert raw data from the 6D6 datalogger
into the MiniSEED format.

Options
-----

--station=CODE

Set the MiniSEED station code to CODE. The station code is required for
MiniSEED generation. It can contain between one and five ASCII characters.

--location=CODE

Set the location to CODE. This should usually be a two character code.

--network=CODE

Set the network code to CODE. This is a two character code assigned by IRIS.

--output=FILENAME_TEMPLATE

Set a template for output files. The template string may contain the following
placeholders:

    %y - Year
    %m - Month
    %d - Day
    %h - Hour
    %i - Minute
    %s - Second
    %S - Station Code
    %L - Location
    %C - Channel
    %N - Network

The default value is 'out/%S/%y-%m-%d-%C.mseed'.

Examples
-----

Convert the file 'ST007.6d6' to MiniSEED using default values.

$ 6d6mseed --station=ST007 ST007.6d6

Convert the file 'ST007.6d6' specifying everything.

$ 6d6mseed ST007.6d6 \
  --station=ST007 \
  --location=DE \
  --network=XX \
  --output=%N/%S/%y-%m-%d-%C.mseed

minti@MintiX ~/daten/KUM $
```

During the conversion the progress is shown continuously:

```
minti@MintiX ~/daten/KUM
Datei Bearbeiten Ansicht Suchen Terminal Hilfe
minti@MintiX ~/daten/KUM $ 6d6mseed ./OBS_14.6d6 --station=OBS14
Processing './OBS_14.6d6'.
=====
6D6 ID: 61607075
RTC ID: 16089
Size: 1.3MB
Start Time: 2017-04-19 11:28:00 UTC
End Time: 2017-04-19 11:33:22 UTC
Duration: 5m 22s
Comment:
=====
Created file 'out/OBS14/2017-04-19-H.mseed'.
Created file 'out/OBS14/2017-04-19-X.mseed'.
Created file 'out/OBS14/2017-04-19-Y.mseed'.
Created file 'out/OBS14/2017-04-19-Z.mseed'.
100% 1.3MB
minti@MintiX ~/daten/KUM $
```

When data conversion is completed you can continue evaluating the data (for example

with PQL II, see next chapter).

3.2.4 6d6read

Converts a .6d6 file to a .s2x file.

Use it as follows: `6d6read < in.6d6 > out.s2x`

Note the angle brackets! They are important! This converts the input .6d6 file to .s2x. With the s2x-format you can use Send2X-tools. Attention: with this format you have to correct the skew manually with the Send2X tools!

3.2.5 6d6update

If necessary, you can install the most recent version of `6d6compat` and replace the old one by simply typing `6d6update`.

3.3 PQL II

The software PQL II is provided free of charge from the **IRIS PASSCAL Instrument Center** for different operating systems.

You can download it here www.passcal.nmt.edu/ftp/software/pql/. Only rpm packages exist for linux users, if your linux is based on ubuntu you can use `alien` to install PQL.

4 Details of the data logger 6D7

The data logger “6D7” is a development based on the predecessor “6D6”. More than 25 years experience in manufacturing seismic dataloggers helped us to design this unit, however, the hardware is all-out new and free of legacy. Our main focus was highest signal fidelity at lowest power consumption, closely followed by the intention to build a straightforward unit save to use both in the lab and on board.

The external storage “StiK™” and using a web browser for communication are just a few features that reflect this point of view.

4.1 Clock

- non-linearity better than 0.02 ppm (0.65 sec per year or 1.7 ms per day)
- -10 to $+80^{\circ}\text{C}$ linear

4.2 Pre-amplifier

The data logger is equipped with two different kinds of pre-amplifiers:

4.2.1 Hydrophone (passive) with active pre-amplifier

The hydrophone pre-amplifier is equipped with a hardware high-pass for frequencies down to 10 mHz (100 s). Hardware-default for amplification is a gain of four.

- Input range: $1250\text{ mV}_{\text{PP}} / \pm 625\text{ mV}$
- Signal-Noise-Ratio: better 120 dB

4.2.2 Seismometer (active) with passive attenuator

The seismometer pre-amplifier can be adjusted for any active seismometer. Currently, attenuators are available for the Trillium Compact 120 from Nanometrics and for the older CMG-40T from Guralp.

Pre-amplifier Broadband Seismometer:

- Input range: $20\text{ V}_{\text{RMS}} / \pm\sqrt{2} \cdot 20\text{ V}$
- Sensitivity: 75.925 counts per μV (13.171 nV per count, 2^{32} counts per $\sqrt{2} \cdot 40\text{ V}$)
- Signal-Noise-Ratio: better 142 dB

4.3 Storage



The 6D7 datalogger may be operated with two different data storage options: your first choice should be the K.U.M. StiK™. It is pressure resistant down to 12 000 m waterdepth and available in various capacities up to 1024 GB. StiK™ is attached from outside of the pressure vessel, there is no need to open the pressure vessel when exchanging and using it.

As an alternative, you can use internal memory.

Memory up to 2 TB is supported.

We strongly insist that you use internal memory provided from K.U.M. only. You can not rely on power calculations if you use alternative memory. Extensive testing has shown a range of five times the power consumption of different memory available on the market. Also, K.U.M. cards are guaranteed to be formatted according to the SD card standard.

You might attach both storage types at the same time to the datalogger, there exists a strict control hierarchy:

1. If in recording mode, any additional card will be ignored.
2. StiK™ is preferred. In case StiK™ is attached, the internal memory will be ignored.
 - a) In case a internal memory is installed, and you then attach StiK™, the datalogger will switch to StiK™.
 - b) If you remove StiK™, the datalogger will switch back to the internal memory.

5 Optional Upgrades

5.1 Internal GPS and AIS

Despite the high reliability and low spatial drift of our OBS-systems during deployment, the recovery of the instrument has been a time consuming job so far. To decrease the required time for recovery and increase the recovery success during bad weather and low visibility, the datalogger can be equipped with a combined GPS/AIS system: directly after ascending to the sea surface it looks for satellites. As soon as a GPS-fix is established both the clock drift is determined and the precise position is sent to nearby ships using AIS. The OBS appears on the digital sea map and can be picked up much faster. As the data are already time corrected when the system gets on board, one can immediately remove the external StiK and download the data.

6 Accessories

6.1 Storage StiK™



StiK™ is a thumb-sized external storage medium in its own pressure casing that is available with up to 1024 GB capacity. Operation and recovery of the instrument has never been so easy: after recovery rinse the pressure vessel with sweet water, remove the StiK™ and get it to the lab to download the data – that's it. There is no need to open the pressure tube.

StiK™ is designed to withstand 12 000 m water depth.

6.2 GPS UHURA



Our GPS receiver “UHURA” can be manufactured with 20m, 50m or 100m cable. The water proof housing has brackets to mount it on the railing for free sky sight.

In addition to GPS data “UHURA” is able to receive data from GLONASS and will receive data from GALILEO and BEIDOU as soon as available.

You should run “UHURA” at least 15 minutes before connecting it to a data logger: it is just every 15 minutes that the number of leap-seconds is transferred from the GPS-satellites. GPS-time runs continuously while UTC takes into account leap-seconds. In case the number of leap seconds is not yet transferred, the UTC time can be inaccurate by some complete seconds.

UHURA provides NMEA data with both 4800 and 9600 baud and a second pulse with integrated DCF77 encoding.

6.3 Junction Box DIRC II



6.3.1 How it works

To communicate with the data logger you will need “DIRC II” plus a suitable connection cable. If connected to “DIRC II”, the webserver inside “DIRC II” provides its webpages. You can communicate with the data logger as described in chapter 2.2.

“DIRC II” opens an access point. This way, you do not need a PC for communication with the data logger, a tablet or mobile will do as well.

For data download, however a Linux PC is mandatory. In case seismic data were recorded on a StiK™ it can be plugged in the appropriate slot in the “DIRC II” tool. “6d6copy” may then be started to download the data onto your Linux PC. In case your seismic

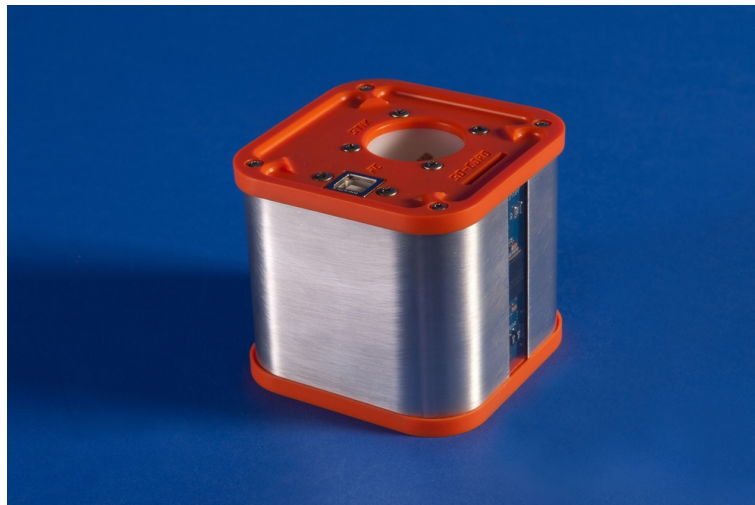
data was recorded on the data loggers internal memory, your data can be downloaded via the USB cable as well. In order to identify the right device for download, you may use the command `dmesg -w` in your unix shell. After downloading the raw data to your unix PC you may use 6d6-compat to convert the data into your preferred format.

6.3.2 Data and Connectors

DIRC II is equipped with four connectors and two switches:

- switch one: On and Off
- switch two: WiFi On and Off
- USB to be connected to a PC.
- a socket for StiK™ to download the data
- a socket for the GPS UHURA. Data will be transmitted with RS485 at both 4800 and 9600 baud, added by the second pulse. In addition the second pulse is DCF77 encoded
- a socket for data logger communication

6.4 Junction Box KIT



DIRC II's kid brother is called – KIT. It is just a USB to SD card adapter and it is only used to download data.

6.5 Transport case



We supply robust outdoor cases for “6D7” and all accessories individually. If you need a case for four 6D7, two DIRC II and 16 StiK™ – just ask.

7 Appendix

7.1 Technical Data

Modular Basic Datalogger, Power consumption 125 mW

The “6D7” incorporates both a digitiser, a high precision clock and data storage. The *complete* power consumption is as low as 125 mW.

A/D Converter

- Four channels, Signal-Noise-Ratio better than 142 dB
- 1 channel adapted for hydrophone 0.01 Hz to 1680 Hz
- 3 channels adapted for broadband-seismometer DC to 1680 Hz
- Sample rates 100, 250, 500, 1000, 2000, 4000 Hz
- 32bit data

Timing and Oscillator

- Non linearity better than 0.02 ppm
- Linearity between -10°C and 80 °C
- Timing module with Seascan oscillator

Data Storage

- Data are stored on external StiK™, currently up to 1024 GB
- StiK™ can be changed without opening the pressure housing
- Data can be stored on micro SDXC-Flash as an option, currently up to 1024 GB
- SDXC specification: max. 2 TB
- Continuous recording at 100 sps and 4 channels: more than 3 years

7.2 Coefficients of the FIR-Filter

FIR-filter coefficients are the same for any 6D7 datalogger. The FIR-filter steps 1 to 4 are used for all samplerates, step 5 is added for samplerate 100 only.

Coefficient	Step 1	Step 2	Step 3	Step 4	Step 5
Factor	1/512	1/8388608	1/134217728	1/134217728	1/65536
Decimation	2	2	4	2	5
h_0	3	-10944	0	-132	4
h_1	0	0	0	-432	-14
h_2	-25	103807	-73	-75	-46
h_3	0	0	-874	2481	-85
h_4	150	-507903	-4648	6692	-119
h_5	256	0	-16147	7419	-127
h_6	150	2512192	-41280	-266	-91
h_7	0	4194304	-80934	-10663	0
h_8	-25	2512192	-120064	-8280	141
h_9	0	0	-118690	10620	308
h_{10}	3	-507903	-18203	22008	455
h_{11}		0	224751	348	527
h_{12}		103807	580196	-34123	468
h_{13}		0	893263	-25549	243
h_{14}		-10944	891396	33460	-145
h_{15}			293598	61387	-644
h_{16}			-987253	-7546	-1150
h_{17}			-2635779	-94192	-1521
h_{18}			-3860322	-50629	-1601
h_{19}			-3572512	101135	-1255
h_{20}			-822573	134826	-400
h_{21}			4669054	-56626	961
h_{22}			12153698	-220104	2731
h_{23}			19911100	-56082	4722
h_{24}			25779390	263758	6681
h_{25}			27966862	231231	8335
h_{26}			25779390	-215231	9442

Coefficient	Step 1	Step 2	Step 3	Step 4	Step 5
h_{27}			19911100	-430178	9830
h_{28}			12153698	34715	9442
h_{29}			4669054	580424	8335
h_{30}			-822573	283878	6681
h_{31}			-3572512	-588382	4722
h_{32}			-3860322	-693209	2731
h_{33}			-2635779	366118	961
h_{34}			-987253	1084786	-400
h_{35}			293598	132893	-1255
h_{36}			891396	-1300087	-1601
h_{37}			893263	-878642	-1521
h_{38}			580196	1162189	-1150
h_{39}			224751	1741565	-644
h_{40}			-18203	-522533	-145
h_{41}			-118690	-2490395	243
h_{42}			-120064	-688945	468
h_{43}			-80934	2811738	527
h_{44}			-41280	2425494	455
h_{45}			-16147	-2338095	308
h_{46}			-4648	-4511116	141
h_{47}			-874	641555	0
h_{48}			-73	6661730	-91
h_{49}			0	2950811	-127
h_{50}			0	-8538057	-119
h_{51}			0	-10537298	-85
h_{52}				9818477	-46
h_{53}				41426374	-14
h_{54}				56835776	4
h_{55}				41426374	
h_{56}				9818477	
h_{57}				-10537298	
h_{58}				-8538057	

Coefficient	Step 1	Step 2	Step 3	Step 4	Step 5
h_{59}				2950811	
h_{60}				6661730	
h_{61}				641555	
h_{62}				-4511116	
h_{63}				-2338095	
h_{64}				2425494	
h_{65}				2811738	
h_{66}				-688945	
h_{67}				-2490395	
h_{68}				-522533	
h_{69}				1741565	
h_{70}				1162189	
h_{71}				-878642	
h_{72}				-1300087	
h_{73}				132893	
h_{74}				1084786	
h_{75}				366118	
h_{76}				-693209	
h_{77}				-588382	
h_{78}				283878	
h_{79}				580424	
h_{80}				34715	
h_{81}				-430178	
h_{82}				-215231	
h_{83}				231231	
h_{84}				263758	
h_{85}				-56082	
h_{86}				-220104	
h_{87}				-56626	
h_{88}				134826	
h_{89}				101135	
h_{90}				-50629	

Coefficient	Step 1	Step 2	Step 3	Step 4	Step 5
h_{91}				-94192	
h_{92}				-7546	
h_{93}				61387	
h_{94}				33460	
h_{95}				-25549	
h_{96}				-34123	
h_{97}				348	
h_{98}				22008	
h_{99}				10620	
h_{100}				-8280	
h_{101}				-10663	
h_{102}				-266	
h_{103}				7419	
h_{104}				6692	
h_{105}				2481	
h_{106}				-75	
h_{107}				-432	
h_{108}				-132	
h_{109}				0	

7.2.1 Impulse Response and Step Response

The (linear phase filtered) impulse response for higher samplerates is displayed below, followed by the graphic for 100 samples per second:

7.2.2 Convolution of two filters

Below you can see the Impulse-Response of the Linear Phase Filter (blue) and the Minimum Phase Filter (green). The datalogger "6D7" *always* uses the Linear Phase Filter.

In case you prefer a Minimum Phase Filter you can apply it to the data afterwards by convolution of both filter (grey in the picture). The result is not exactly the same but very close to the pure Minimum Phase filtered response.

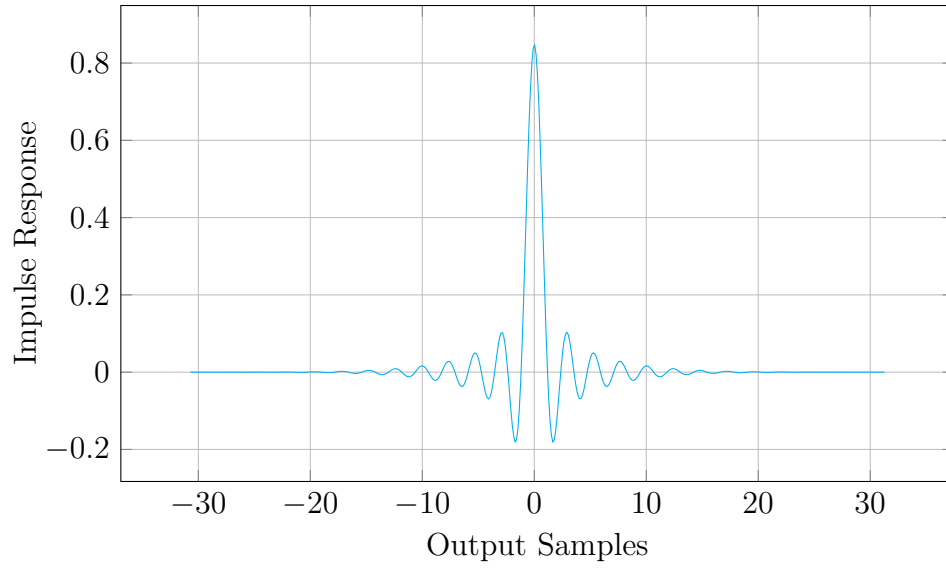


Figure 1: Impulse Response for samplerates ≥ 250 SPS

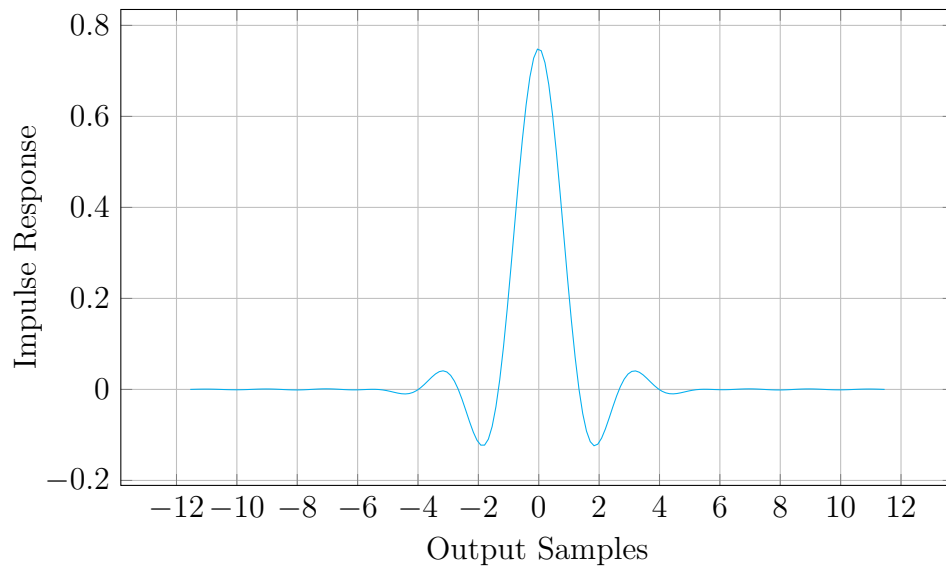


Figure 2: Impulse Response at samplerates < 250 SPS

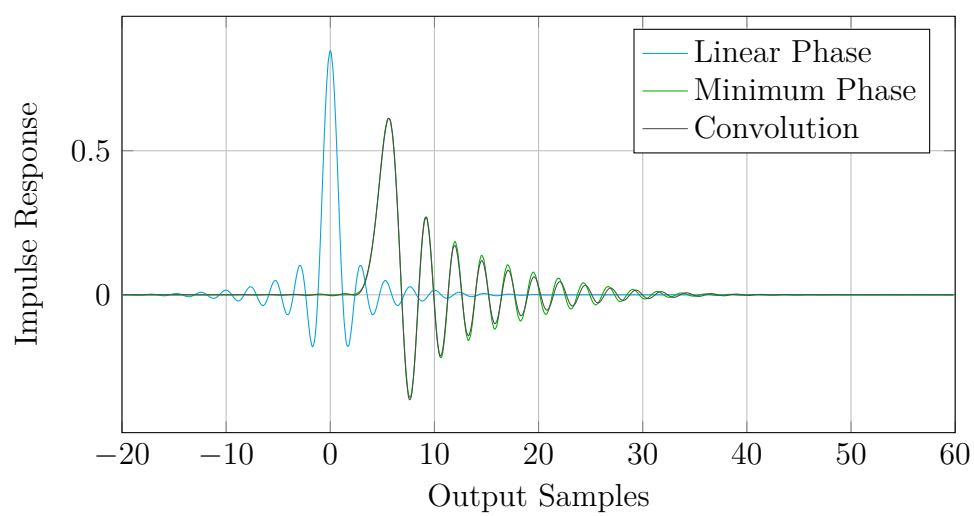


Figure 3: Convolution Impulse Response Linear and Minimum Phase

Here the Step Response of the Linear Phase (blue) and Minimum Phase Filter (green) as well as the Convolution (grey) is shown. Again, there is very good coincidence between the convolution and the original Minimum Phase filter.

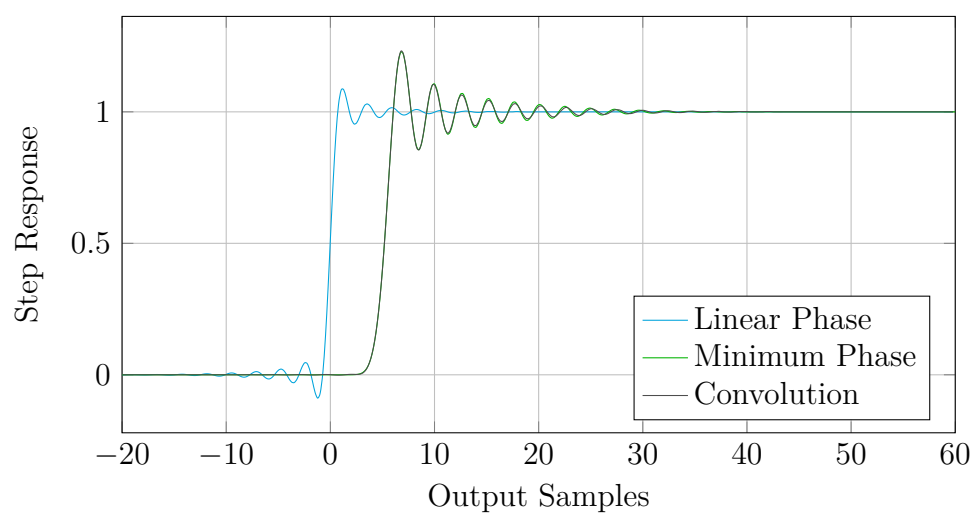


Figure 4: Convolution Step Response Linear and Minimum Phase

7.3 Frequently Asked Questions

- **What kind of software do I need?**

6d6-compatible is mandatory. You can download this package for free, please refer to page 13. It is used to download the data and convert it to your requested data format.

- **What data formats are supported?**

Currently mSEED and Send2X are supported, SEED, SEG-Y and further formats are in preparation. In case you need a special format please talk to us – we want to emphasize that any help for the open source software 6d6-compatible is welcome. Your help might speed up the implementation of your format...

- **My batteries have been empty at recovery. Is my data lost?**

Fortunately not. Data are time-stamped permanently. When batteries get drained, the 6D7 powers off the seismometer, stops recording and powers the clock only. If you are lucky, the clock is still synchronized - you can attach new batteries to the 6D7 (make sure not to finally cut the power!), attach the StiK™ and GPS and make your skew measurements.

- **I formatted my StiK™ accidentally. Is my data lost?**

Probably yes.

- **May I connect a geophone to a seismometer channel and vice versa?**

Definitely No! The output voltage of a seismometer is much higher than the range of a geophone input. On the contrary if you connect a geophone to the seismometer input you will get poor signals barely existing.

- **I would like to record Marine Mammals/Icebergs/Aliens – does it work?**

We don't know. But we can develop pre-amplifier modules in accordance to your needs.

- **My sensor supplies data using RS232/SPI/Ethernet – does it work?**

We will manage it.

- **I would prefer an atomic clock / CSAC – does it work?**

Yes, the datalogger is that modular that even a CSAC is supported. Please keep in mind that the CSAC alone consumes 125 mW – the power consumption of the datalogger will double in that case.

7.4 Meaning of LED colors

- **Green**
Ready for recording.
- **Blue flashing**
Communication running.
- **Green-Cyan flashing**
A recording is running. LED shuts off after 5 minutes.
- **Magenta**
Not ready for recording (Synchronised? Storage media? Battery voltage?).
- **Red flashing**
Should not happen – an error occurred. Check all connections, in case of need remove battery for 5 minutes and restart.

DATASHEET 6D7 – April 2023



POWER

Power system	Protected electronic re-settable fuse design with low voltage disconnect and restart, reverse battery and short circuit protection, 9 to 24 Volt
Ultra-low power	125mW @ 4-channel continuous recording @ 250sps
Communications	4-channel continuous recording @ 4000sps real-time Ethernet with data graphical displayed

SENSOR INPUTS

Channels	4, simultaneous sampling
Input Range	hydrophone/geophone: 1,25 Volt peak to peak seismometer: 20 V RMS
Sensitivity	75,925 counts per μV (2^{32} counts per $\sqrt{2} \cdot 40 V$)
Input Impedance	hydrophone: 200 M Ω seismometer: 114.3 k Ω

TIMING

Timing system	Internal MCXO clock
Timing non-linearity	less 0.02 ppm

DIGITIZER PERFORMANCE

Type	Proprietary sigma-delta
Filter type	Linear phase, shifted to Zero-Phase
FIR Filter delay	corrected in raw data
Dynamic Range	> 250 dB @ 250 sps
Shorted input noise	140 nanoVolts RMS typical at 100sps
Sample rates	100, 200, 250, 500, 1000, 2000, 4000 sps
High Pass Filter	hydrophone only: 0.01 Hz

DATA STORAGE

Standard	internal 128 GB
External	StiK™, pressure resistant to 12000 m waterdepth
File system	proprietary

STORAGE CAPACITY

internal	up to 1024 GB (available in 2023, specified to 2TB)
StiK™	up to 1024 GB (available in 2023, specified to 2TB)

DATA RETRIEVAL

Data Download	media exchange
Media exchange	hot-plugging

CONFIGURATION

Communication	remotely using any web browser over WiFi or Ethernet
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REAL-TIME DATA

Interfaces	Ethernet or WiFi
Data type	graphically displayed in web-browser

INTEGRATED USER INTERFACE

LED indicators	System status multi-colour LED
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CONNECTORS

Internal connector	25-pin for power and seismometer
External connector	37-pin for power, any type of sensors and communication

SENSOR SUPPORT

Sensor types	Broadband active and short period passive
Sensor power	Sensor power 9-24 V, switched on/off as required from recorder
Serial interface	Supports Nanometrics "Trillium compact"

ADDITIONAL LOGGING

Logged data	Power supply voltage Temperature Humidity GPS timing and channel parameters Configuration External Events
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SOFTWARE

Operating system	Linux
Applications software	6d6-compatible, open-source

ENVIRONMENTAL

Operating temp.	-10 °C to +80 °C
Storage temp.	-10 °C to +80 °C
Diameter	125 mm
Height	55 mm
Weight	555 g

Data Logger 6D7
KM/T 4800-01
SerialNo.: 72301030



Quick Reference Guide – Before Deployment

Please note: in case the system does not react as described here, please read the more detailed manual.

1. Connect UHURA with DIRC II.
2. Connect external power supply to DIRC II switch it on. Switch WiFi on.
3. Within 45 seconds, DIRC II will open an access point named **Dirc-nnn**.
4. Place data logger 6D7 on top of the seismometer and carefully fasten with 3 screws.
5. Connect 6D7 with the cable of the end cap and connect to power.
6. The LED of 6D7 lights magenta: 6D7 is ready to use.
7. Connect the end cap of the pressure tube with DIRC II using the socket “COM”.
8. Connect to the WiFi using the passphrase **seismics**.
9. Start a web browser and enter the IP-adress “10.0.0.1” at the adress field. You are now connected to the datalogger.
10. Connect a StiK™ to the datalogger. Both capacity and used data – if existing – is shown in the area “Storage”.
11. Where applicable erase the memory. Adjust channels and sample rate in the areas “Setting”.
12. Synchronize the datalogger – make sure UHURA has been running for at least 15 minutes.
13. “Status” button is colored green by now. In case it is not, stop here and carefully read the manual.
14. You can start a recording now.
15. Check if all sensors (hydrophone and seismometer) are connected and working .

Quick Reference Guide – After Recovery

Please note: in case the system does not react as described here, please read the more detailed manual.

1. Connect UHURA with DIRC II.
2. Connect external power supply to DIRC II switch it on. Switch WiFi on.
3. Within 45 seconds, DIRC II will open an access point named `Dirc-nnn`.
4. Connect the end cap of the pressure tube with DIRC II using the socket “COM”.
5. Connect to the WiFi using the passphrase `seismics`.
6. Start a web browser and enter the IP-adress “10.0.0.1” at the adress field. You are now connected to the datalogger.
7. Both capacity and used memory is shown in area “Storage” and the “Status” button is flashing.
8. Stop the recording.
9. Measure the skew – make sure UHURA has been running for at least 15 minutes.
10. Remove the storage medium. You now can disconnect the datalogger from DIRC II.
11. Connect the storage medium to DIRC II.
12. Connect Linux-PC with USB-cable to DIRC II.
13. Start a terminal and the software “`6d6info`” and “`6d6copy`” to download the data.

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 Data Logger 6D7. 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 Data Logger 6D7 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 Data Logger 6D7 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 Data Logger 6D7. Although this manual encompasses the latest operational features of the Data Logger 6D7, some features of the Data Logger 6D7 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 Data Logger 6D7 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 shipped 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 Data Logger 6D7 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:

E-mail: office@kum-kiel.de
Mail: K.U.M. GmbH
Wischhofstr. 1-3, Geb. 15
24148 Kiel
Germany

Fon +49 431 72092-20 Fax -44

For more information please go to www.kum-kiel.de.