LUMA 100

a fast, low-power, optical underwater communication system

Manual

Ver 1.4

HYDROMEA

1/2024

Contents

1 Introduction

The LUMA 100 is an optical modem for fast, reliable underwater communication. Each LUMA 100 is a full transceiver and thus capable of half-duplex communication (transmission and reception). A deep-sleep mode which the modem will enter after no data was received or transmitted for a set amount of time drastically reduces the power consumption. During deep-sleep the receiver is still active and the modem will wake up within 100 ms after receiving a beacon message from another modem.

2 Operation

2.1 Setup

Attach both modems to their respective host systems using matching female SubConn Micro 6 connectors such as MCIL6F, MCBH6F, MCOM6F, MCPBOF6F or MCDC6F. Please make sure to match the pinout provided in *Electrical and Software Characteristics*.

- Apply a suitable supply voltage (12 V – 36 V).
- When properly aligned and within communication range, the two modems now provide a **half-duplex** serial communication link.

> **WARNING:**
>
> - **bright LED light source, do not look directly at emitter**
> - **a few people may experience epileptic seizures when viewing flashing lights**

2.2 Operation

When in *active* mode the modem will broadcast all data received over the cable and send over the cable all data received from the optical receiver. When in *sleep* mode the modem ignores all data coming in from the optical receiver and the cable. Only a specific beacon message or power-cycling can wake up the modem.

Auto-sleep: When enabled, the modem will automatically enter sleep mode if no data has been sent or received for a set period which can be configured.

Beacon transmission: When the beacon interval time is set to a non-zero value the modem will regularly send a beacon message at the specified rate. Any modem in sleep mode which is within range will be woken up by the beacon.

Thermal fold-back: The emitter of the modem consists of 12 high-power LEDs composed of one bank of 6 LEDs and two banks of 3 LEDs each. During normal operation all 12 LEDs are transmitting in parallel to provide the highest possible transmission range. If the circuit board temperature rises above 60°C the modem will dynamically switch off emitter banks until the temperature returns to a safe level.

3 Modem configuration

The LUMA modems can be configured with the *LumaConf* software, available here (note: LumaConf for the LUMA 250LP also works with LUMA 100):

https://files.hydromea.com/luma/LumaConf_250LP.zip

The LUMA modems can be configured with the *LumaConf* software. *LumaConf* runs on Windows 7, Windows 8 and Windows 10, 64 bit version. Installation is not required; simply extract `lumaconf.exe` from the ZIP archive to a location of your preference (e.g. the Desktop) and run it. Windows may generate a warning about running software downloaded from the internet, which can be ignored.
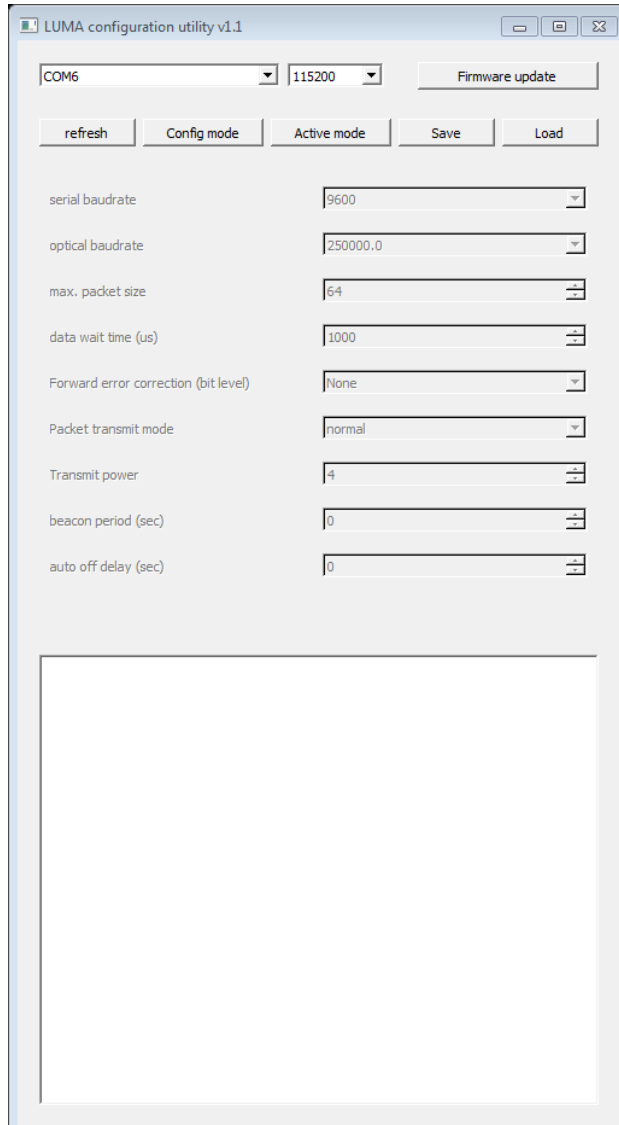
Figure 1: LumaConf modem configuration software

3.1 Connecting the modem

- Plug the LUMA modem with a serial adapter cable into a serial port, or via a USB-to-serial converter. Connect a power supply to the cable (12 V – 36 V)

- In the top left corner, set the correct COM port and baud-rate. The default setting is 115200 bps, but it may be different if the modems have been configured to another baud-rate.

- Click on "Config mode", and the parameters should become active (instead of greyed out) if all settings and connections are correct.

- The modem is now in configuration mode, which allows you to change the modem settings. Changed settings will be applied instantly but will revert to the previous settings after a power cycle. To save the new settings to the modem's internal flash

memory, click "Save". To leave configuration mode and return to regular operation, click "Active mode".

3.2 Communication settings

3.2.1 Serial baud-rate

This is the baud-rate setting for the communication to the modem over the attached cable. The baud-rate has to match the selected baud-rate of the host computer or connected device. Available baud-rates are:

9600, 19200, 38400, 57600, 115200 bits per second (default 115200 bps)

When changing the baud-rate of the modem, the baud-rate of the host PC also has to be changed to the same value.

Note that the changed baud-rate is not permanent until a "Save" command is sent, which is only possible if the new baud-rate settings work on the modem and the host PC.

3.2.2 Maximum packet size

The modem collects serial input data from the RS232/485 connection to combine it into a packet. This parameter specifies the maximum packet size. Packets can be smaller if there is no more input data after a specified time period. Large values reduce overhead, small values improve latency. The default value is 64, which is a good compromise.

3.2.3 Data wait time

This parameter specifies the maximum time in microseconds that the modem will wait for additional data before sending a packet before the maximum packet size is reached. Larger values reduce packet overhead but increase the maximum latency. Smaller values improve latency, but increase the packet overhead, which results in lower average throughput. The default value is 2000 microseconds.

3.2.4 Forward error correction

Forward error correction makes the communication link more robust and reliable, at the cost of maximum bandwidth. The following settings are available:

- **None**: No forward error correction is applied. This enables the highest throughput.

- **2x bit correction:** A codec that uses 2x redundancy to detect and fix bit errors

- **1.5x bit correction**: A codec that uses 1.5x redundancy to detect and fix bit errors

- **Burst (+30) correction:** A codec that can detect and fix burst errors. It adds 30 bytes to the packet size. Burst correction is supported for serial baud-rates of 9600 bps and 19200 bps. Higher baud-rates can be used only if the average speed of data transmission is below 19200 bps.

3.2.5   Packet transmit mode

The packet transmit mode specifies the packet-level redundancy used to increase robustness of the link.

- **Normal:** No packet-level redundancy is used (default).
- **4.1 redundant:** adds a 5th packet for every 4 packets for redundancy and error correction.
- **Dynamic retransmission:** The modem continues to send packets to use the full available optical bandwidth for the period of time specified in *3.2.3 Data wait time*.

3.2.6   Beacon period

The beacon period is the time between beacon messages, that are used to instruct the receiver not to go to sleep. Beacon messages are used to keep the receiving modems awake.

3.2.7   Auto off delay

If no beacon messages have been received for the time period specified in "Auto off delay", the modem enters a low-power sleep mode, with an average power consumption of less than 5 mW.

3.3   Sleep mode configuration example:

Using *LumaConf*, configure two modems as follows:

- on the modem A that should enter sleep (e.g. a modem installed on a sensor), change "auto off delay" to 30 seconds (see 3.2.7).
- on the modem B that wakes up the other modem (e.g. on an ROV), change "beacon period" to 2 seconds (see 3.2.6).

After changing settings, click "Refresh" to verify that the modem received the correct value. Click "Save" to store the new value permanently in the modem's internal flash. Then click "Active mode" to leave config mode and put the modem into normal operation.

If modem A doesn't receive any beacon messages for 30 seconds, it will go to sleep. Current consumption is then approximately 5 mW. When it receives the beacon messages from modem B, it will wake up. As long as it keeps receiving "beacon" messages, it will stay awake.

Note that strobing lights, or other sources of pulsed light interference, may also temporarily wake the modem up. It will keep listening for beacon messages to fully wake up and go back to sleep after 30 seconds. In rare circumstances, this could be an issue, e.g. if the modem is stored under a flickering light for extended periods, as it will be woken up continuously as soon as it goes to sleep. The current consumption in this case would be around 25-30 mA, until the interference source is removed.

3.4   Firmware update

- confirm that communication with the modem is established as described in *3.1 Connecting the modem*

- turn off the power supply to the modem (or unplug the SubConn connector, but leave the serial dongle in the USB port)

- set the serial port settings to 115200 bps (at the very top of *LumaConf*, the speed for your COM port, not the settings of the modem)

- click "Firmware update". A new dialog opens.

- switch on power to the modem (or plug it back in).

- Now, an entry should appear under "Devices". On the right-hand side are a few options, you can ignore most of them.

- make sure that under "Firmware", the entry "LUMA100 - RS232 <…>" is selected

- click "write Flash"

- wait until the progress bar reaches 100%. If it doesn't go through, click "Write Flash" again until it does complete.

- click "Start application". You should now be able to connect to the modem again as described above. Verify that the modem settings are still correct - they should carry across firmware updates in general, but bigger updates may invalidate the settings and revert to factory defaults.

4   Maintenance

Please wash the modem with warm water (only) to remove any built-up which could negatively affect its operation. Apply a thin film of silicone grease to the rubber part of the connector pins to protect the connector and to facilitate mating. For maintenance details regarding the connector follow SeaConn's instructions.
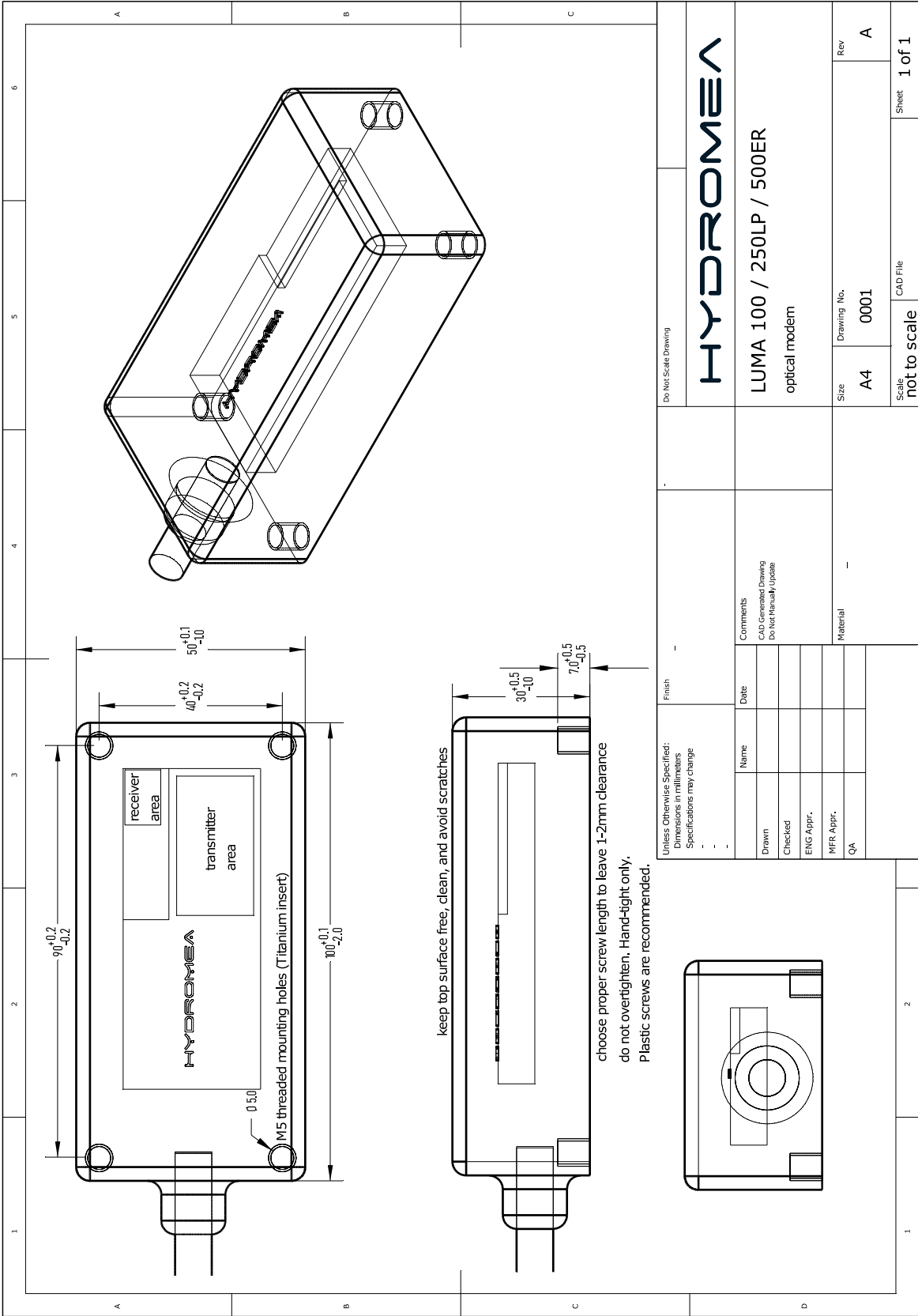
5   Electrical and Software Characteristics

Supply voltage (Vs)	12 V – 36 V
Power consumption	< 5 mW (sleep mode) 0.5 W (active mode, receiving) 1 – 3 W (active mode, transmitting)
Range	up to 2 m (6 ft 6")
Data rate (wire)	Software selectable: 9600, 19200, 38400, 57600, 115200
Transmission power	1 banks with 3 LEDs
Interface	Software selectable: RS232 RS485
Emission wavelength	475 nm
Beam pattern	120 degree cone
Connector pinout	1: Supply voltage (Vs) 2: GND 3: RS232 RX / RS485 D+ 4: RS232 TX / RS485 D- 5: n/c 6: n/c
Error correction	Software selectable: Forward error correction, overhead 2:1 Forward error correction, overhead 1,5:1 Burst error correction
Auto sleep	Software selectable: 0 (= off), 1 – 60000 seconds
Beacon signal interval	Software selectable: 0 (= off), 1 – 120 seconds

6 Mechanical Characteristics

Length x Width x Height	100 x 50 x 30 mm (3.9" x 2" x 1.2")
Weight in air	250 g (8.8 oz)
Weight in water	50 g (1.76 oz)
Connector	SubConn MCIL6M
Depth rating	6000 m (19000 ft)
Operating temperature	-5°C to +40°C (23°F to +104°F)
Storage temperature	-21°C to +50°C (-6°F to +122°F)

receiver area

transmitter area

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Ø 5.0

M5 threaded mounting holes (Titanium insert)

$50^{+0.1}_{-1.0}$

$40^{+0.2}_{-0.2}$

$90^{+0.2}_{-0.2}$

$100^{+0.1}_{-2.0}$

$30^{+0.5}_{-1.0}$

$7.0^{+0.5}_{-0.5}$

keep top surface free, clean, and avoid scratches

choose proper screw length to leave 1-2mm clearance

do not overtighten. Hand-tight only.

Plastic screws are recommended.

Do Not Scale Drawing

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LUMA 100 / 250LP / 500ER

optical modem

Size	Drawing No.		Rev
A4	0001		A

Scale	CAD File	Sheet
not to scale		1 of 1

Finish | Comments
CAD Generated Drawing
Do Not Manually Update

Unless Otherwise Specified:
Dimensions in millimeters
Specifications may change

	Name	Date
Drawn		
Checked		
ENG Appr.		
MFR Appr.		
QA		

Material

7 Errata

Version	Release date	Errata
1.0	1.4.2021	Original version
1.1	22.12.2021	• Updated logo • Added Errata • Updated links to LumaConf
1.2	7.4.2022	• Updated link to LumaConf
1.3	27.4.2023	• Updated drawing in 6, it now contains tolerances
1.4	23.1.2024	• Added operating and storage temperature ratings