SF30/D microLiDAR® sensor

High speed LiDAR sensor for accurate mapping and obstacle detection



Disclaimer

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Welcome to LightWare

Thank you for selecting LightWare as your **partner** in distance sensing technology.

LightWare is a pioneer in microLiDAR® distance sensors, drawing upon **four decades** of expertise in LiDAR technology to develop application-specific products renowned for their **accuracy, reliability, and durability**. LightWare's assembly process involves meticulous handling of sensors and optics, creating microLiDAR® sensors of world class quality. Our production methods benchmark the **ISO 9001:2015** standards at scale, with manufacturing capabilities reaching up to **45,000 units annually**, with each microLiDAR® unit crafted to the same exacting standards. Unsurprisingly, leading companies worldwide trust LightWare as their **preferred LiDAR partner**.

We are dedicated to ensuring **your success** when using LightWare microLiDAR® sensors to address your unique distance measuring and geospatial challenges.

Beyond this comprehensive product guide, our website's **resource center** (https://lightwarelidar.com/) offers a wealth of supplementary information, **including APIs, CAD drawings, and FAQs**.

Our dedicated technical support desk is at your service if you require assistance with integration or technical queries. Reach out to them at support@lightwarelidar.com.

LightWare products come with a **24-month limited warranty**, covering any defects in material or workmanship under normal use. For detailed warranty information, please refer to our website at https://lightwarelidar.com/terms-and-conditions/. We're here to support you on your journey — sensing your world with LightWare LiDAR.

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1 Overview

This product guide is a comprehensive companion to your LightWare SF30/D microLiDAR® - the long-range LiDAR sensor when you cannot afford to miss anything.

With its 200 meter / 656 ft distance and/or height measurement and 20,000 updates per second, the LightWare SF30/D stands out as a clear leader in it's size and weight category. This compact, yet robust and easy-to-use sensor delivers class-leading performance, plug-and-play ease of integration, and reliable results. At only **31.53 grams / 1.11 oz** and a power draw of 0.475W, it unlocks new opportunities in high-speed distance measurement on extended missions.

The supreme update rate of the SF30/D allows the sensor to be used in applications where **detection speed is paramount**. Coupled with the alarm output, the high-speed capability of the SF30/D has the ability to **trigger actions** in the system with minimal processing delay. The SF30/D's first and last pulse feature provides depth and distance insights from more than one target in its field of view, helping to penetrate foliage or dust.

The SF30/D uses the time-of-flight principle to measure distance, emitting a rapid succession of laser pulses that are reflected by target objects and then received back and processed immediately. It uses 905-nanometer laser technology, ensuring optimal performance at an affordable price, while meeting **class 1M eye safety** standards. Its accuracy is not affected by the color or texture of the target surface or the laser beam's angle of incidence, and it is virtually immune to background light, wind, and noise.

The **excellent optics** in the SF30/D allows it to be integrated into systems that need to perform reliably – even in difficult conditions like bright sunshine on dark surfaces. The **lenses are IP67 rated** while the rugged electronic enclosure allows for convenient access to the communications terminals. There are robust **mounting brackets** available for the SF30/D to allow steady and precise mounting of the sensor to achieve the best results.

With the SF30/D is the workhorse microLiDAR® that powers your application with unmatched speed and reliability.

2 Safety

Always adhere to these product safety precautions and operate the sensor strictly in accordance with the guidelines outlined in this product guide. LightWare bears no responsibility or liability for any damage or injury, whether direct or indirect, arising from a failure to comply with these stipulations. Non-compliance with the precautions or warnings provided in this product guide constitutes a breach of safety standards intended for the proper use of the sensor.

2.1 Laser eye safety

LightWare LiDAR sensors comply with the United States Food and Drug Administration (FDA) laser eye safety regulations for safe use around humans and animals, based on the international standard IEC 60825-1 and utilizing LaserSafe PC Professional for the computations.

Caution: The sensor contains a laser and should never be aimed at a person or animal. Do not view the laser with magnifying optics such as microscopes or telescopes.

This laser product emits non-ionizing laser radiation. It is classified as Class 1M, indicating that the laser beam is safe to look at with the naked eye during normal use. However, avoid viewing it through magnifying optics such as binoculars, microscopes, telescopes, etc. Despite the safety rating, refrain from looking into the beam, switch off the device when in the vicinity, and never stare directly into the lens from less than half a meter.

Caution: Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Warning: Risk of permanent eye damage

- Class 1M lasers are **not safe** if viewed through **magnifying optics such as microscopes, binoculars, or telescopes from a distance less than the NOHD**.
- The laser eye safety rating of the sensor depends on the mechanical integrity of the optics and electronics. It must **not be disassembled or modified in any way**.
- **If the sensor is damaged, do not continue using it**.
- The sensor should be mounted using the mounting holes or product-specific brackets. **Do not attach to or clamp the lens tubes** as this may cause damage and adversely affect the laser safety rating.
- There are **no user-serviceable parts**, and maintenance or repair must only be done by the manufacturer or a qualified service agent.
- No regular maintenance is required, but if the lenses start collecting dust, they may be wiped with suitable lens-cleaning materials. Ensure that the device is switched off before looking into the lenses.

2.2 Labeling

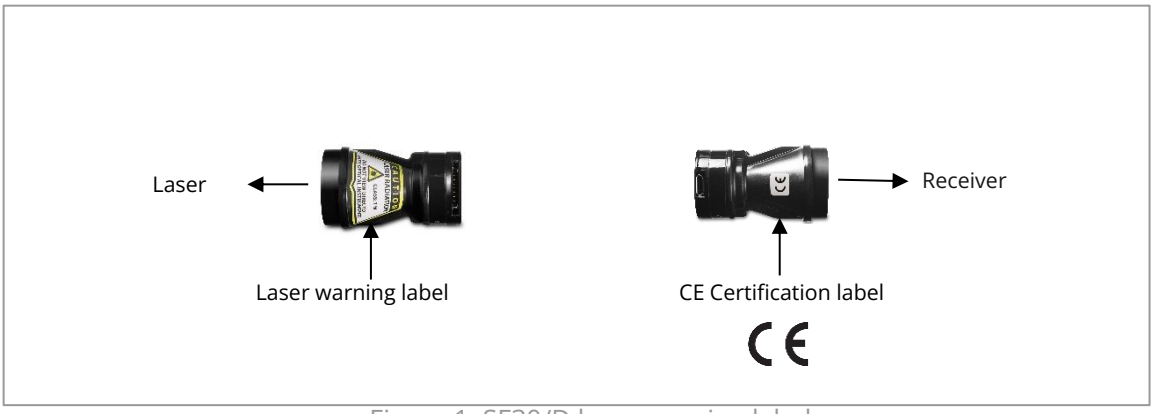


Figure 1: SF30/D laser warning label

Important note: It is a legal requirement to display the laser warning label on your final product or system. To assist with this, LightWare has included an extra laser warning label in the packaging.

2.3 Laser radiation information

Table 1: Laser radiation information

Specification	Value
LightWare product	SF30/D microLiDAR®
LiDAR type	Static single beam
Eye safety classification	Class 1M
Laser wavelength	905 nm
Pulse width	16 ns
Pulse frequency	20 kHz
Average laser power	1.8 mW
Maximum energy per pulse	90 nJ
Extended Nominal ocular hazard distance (Extended NOHD)*	22.1 m / 72.5ft

* Distance beyond which binoculars may be safely used.

Approximate values only. Please contact LightWare LiDAR if further information is required.

3 Key technical specifications

Table 2: SF30/D microLiDAR® key technical specifications

SF30/D microLiDAR® key technical specifications	
Performance	
Range	0.2 to 200m / 0.6 to 656ft (70% albedo in sunlight conditions, 0.9 x 0.9 m target size)
Update rate	39 to 20,000 readings per second (customizable to suit application)
Resolution	1 cm / 0.4 in
Accuracy	± 5 cm / ± 2 in for update rates lower than 500 readings/s ± 10 cm / ± 4 in for update rates higher than 500 readings/s
Connections	
Power supply voltage	4.5 to 5.5 V
Power supply current	96mA typical, <220mA on startup
Outputs and interfaces	Serial UART and I²C (3.3 V TTL, 5 V tolerant)
Form factor	
Dimensions	30 mm x 56 mm x 50 mm / 1.2 in x 2.2 in x 2 in
Weight	29.96 g / 1.06 oz (excluding cables)
Optical	
Approvals	FDA: 1410968-000 CE certified ROHS3 Compliant REACH unaffected NDAA compliant (Section 848) Blue UAS ready
Laser safety	Class 1M (Please refer to the eye safety section of this user guide, above)
Optical aperture	25.0 mm / 1.02 in
Beam divergence	< 0.2°
Environmental	
Operating temperature	-20 to 60°C / -4 to 140°F
Storage temperature	–40 to 80 °C / -40 to 176 °F
Enclosure rating	Full unit is IP40 & front face is IP67
Accessories	
Communication cable	LW 000_135
USB cable for SF11/ SF30 / SF20	AE10418-ND
DroneCAN Adaptor	ACC_DroneCAN
Default settings	
Serial port settings	Baud rate 115200, 8 data bits, 1 stop bit, no parity, no handshaking
I²C address	0x66 (Hex), 102 (Dec)
Update rate	39 readings per second

4 Accessories

To support configuration and integration, the following accessories are available for purchase from the LightWare website:

4.1 Communication cable

Each SF30/D is supplied with a communication and power cable. Additional cables are available for purchase from our online store.

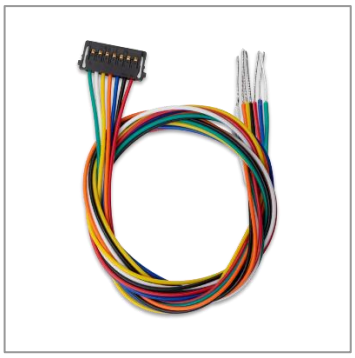


Figure 2: LA 000_135 - Communication cable for SF11/SF30

4.2 USB cable

An optional USB Type A to USB Type B Micro cable is available to connect the SF30/D to your computer using the micro-USB interface on the SF30/D.



Figure 3: AE10418-ND - USB cable for SF30/D

4.3 DroneCAN adapter

A DroneCAN adapter is available to seamlessly integrate the LightWare LiDAR rangefinder with DroneCAN enabled flight controllers.

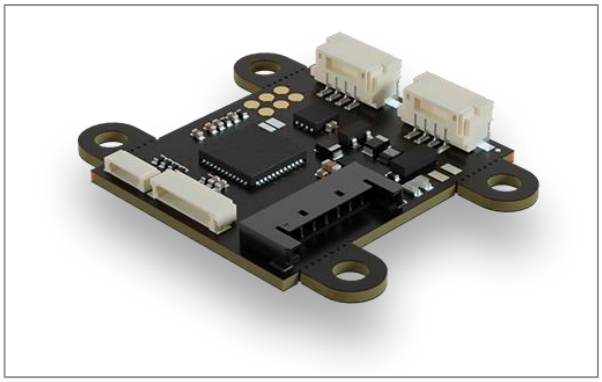


Figure 4: ACC_DroneCAN – DroneCAN adapter

5 Getting started

LightWare Studio is a free application (available for Windows, macOS, and Linux) and is the gateway to configuring your microLiDAR® sensor and visualizing your data. This software empowers you to customize settings, fine-tune sensor parameters, and easily analyze data. It also facilitates firmware upgrades and in-field diagnostics and support.

Detailed step-by-step videos are available on LightWare's YouTube channel: https://www.youtube.com/@LightWareLiDAR/videos

Follow these easy steps to get going with your LightWare microLiDAR®:

1. Download and install the version of LightWare Studio compatible with your operating system from the Resource section of LightWare's website at https://lightwarelidar.com/. You can safely install over an existing version of LightWare Studio if you are upgrading.

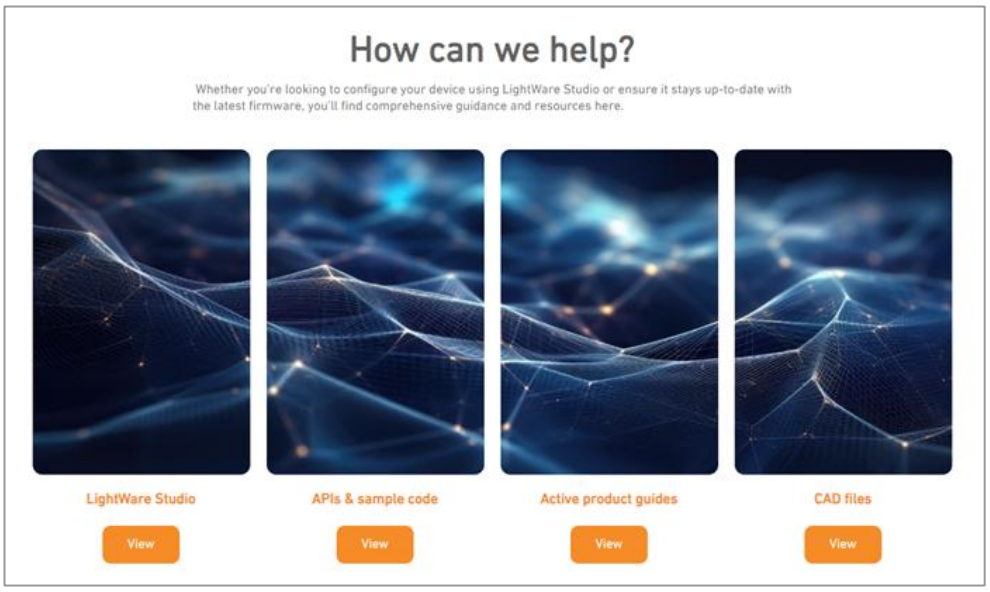


Figure 5: LightWare Studio website download page

2. Once the installation is complete, the *Welcome to LightWare Studio* page will open, prompting you to attach a device to your computer.

3. Carefully connect your SF30/D to your PC via a standard MicroUSB cable.



Figure 6: SF30/D connection to a PC via microUSB cable

Caution: To avoid the risk of shorting the high voltage lines on the sensor circuit board, connect the USB cable to the sensor first before connecting it to the computer.

4. When connecting the sensor for the first time, Windows users may experience a brief delay as the operating system installs the necessary generic communication driver. Please allow the installation process to complete.

5. LightWare Studio will automatically detect the device and present it for selection on the Welcome page. The Welcome page may show other communications ports on your computer. Select the LightWare SF30/D sensor.

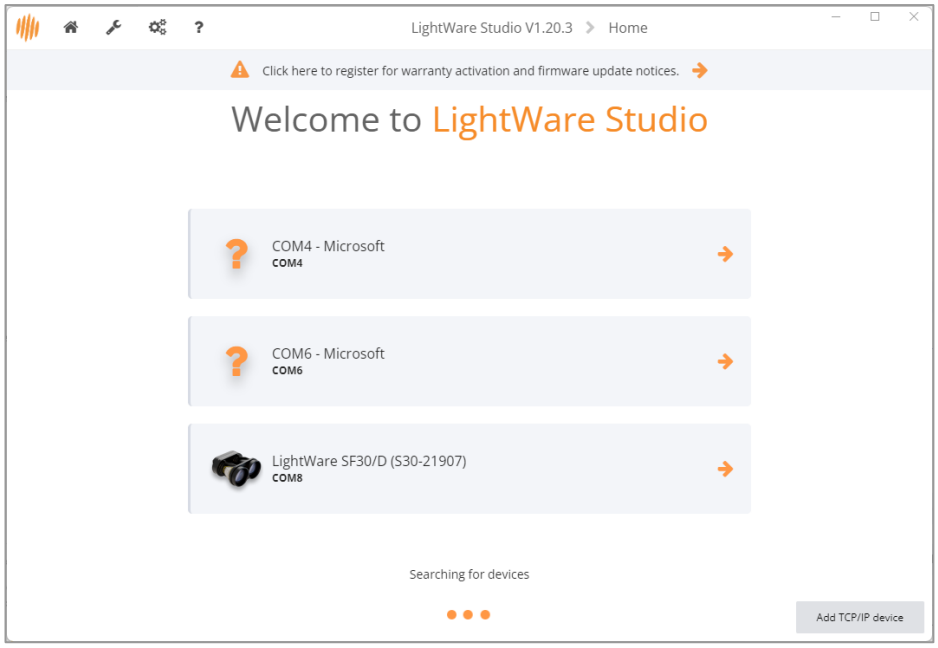


Figure 7: Connection established with the SF30/D

6. LightWare Studio will start on the device's Info page, indicating the serial number, hardware version and firmware version of your device.

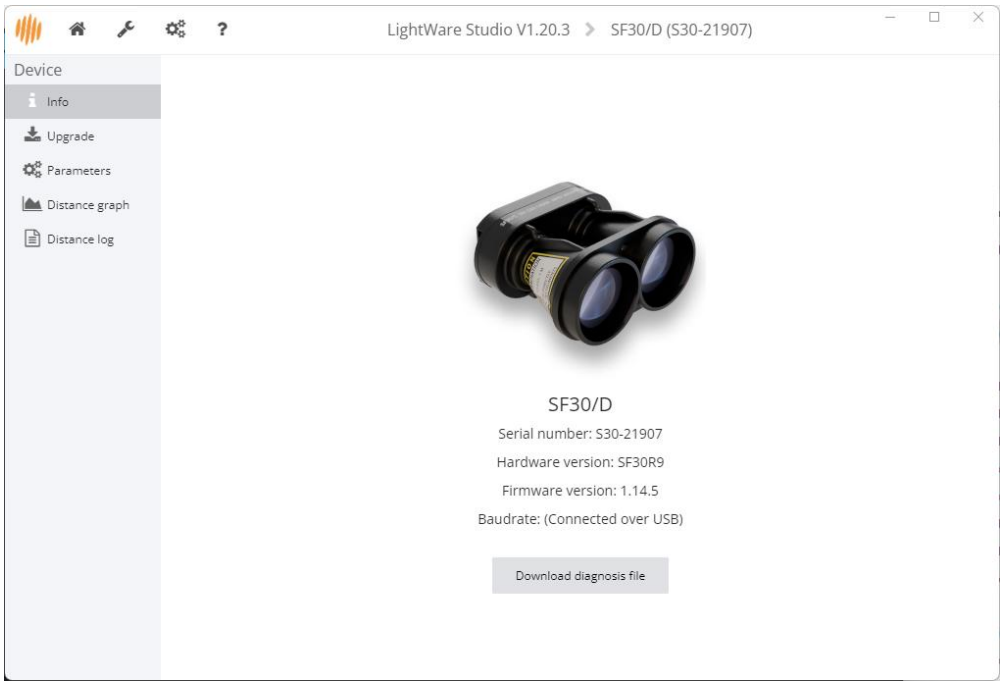


Figure 8: LightWare Studio device information page

7. Navigate to the *Distance mode* tool from the left panel. This streams live distance data in meters as it is scanned by the sensor as a graph.

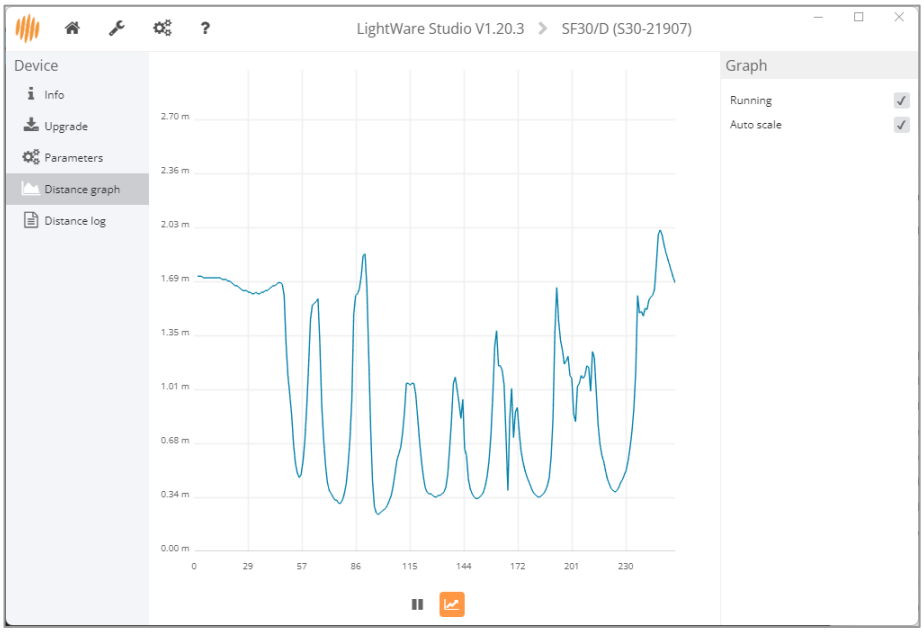


Figure 9: LightWare Studio SF30/D distance graph page

8. Navigate to the *Distance log* tool from the left panel. This tool streams live distance data in meters as it is scanned by the sensor. Toggle the parameters on the right to stop or start the streaming, add line numbers or time stamps, or switch on different data types.

9. Data can be downloaded and saved using the *save* icon above the data.

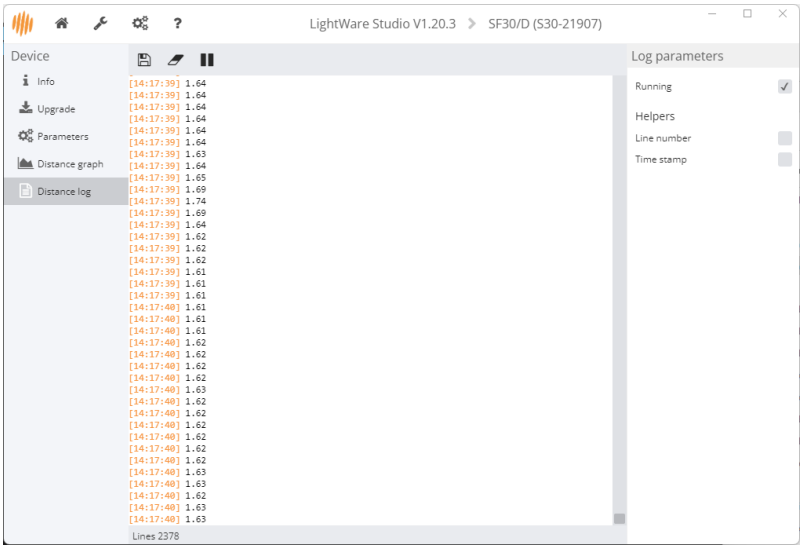


Figure 10: LightWare Studio SF30/D distance log page showing measurements

6 Parameters, settings, and tools

6.1 Setting the device parameters

Your LightWare SF30/D microLiDAR® sensor can be configured via LightWare Studio or from a host controller using the product commands through the serial UART or I²C communication interfaces.

To set the device parameters using LightWare Studio:

1. In the left panel, click on *Parameters* to open the detailed parameters page.

2. The scroll-down list of adjustable parameters will be displayed, with explanatory notes and dropdown options.

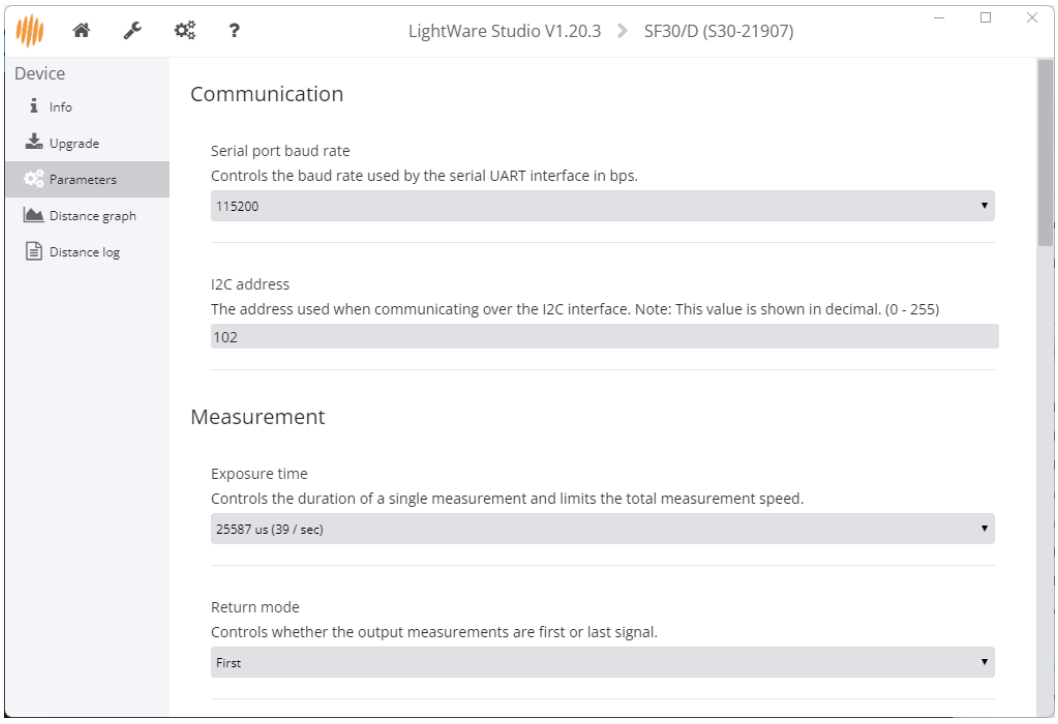


Figure 11: LightWare Studio SF30/D detailed parameters page

3. Set your device parameters according to your requirements. Refer to the table below for more information.

Table 3: SF30/D adjustable parameters

Parameter	Explanation	Options/range
Communication		
Serial UART baud rate	Select the serial UART interface baud rate, (in bps).	9 600 to 921600
I2C address	The address used when communicating over the I²C interface. A whole number in decimal.	0 to 127
Measurement:		
Exposure time	Controls the duration of a single measurement and limits the total measurement speed.	50µs – 25587µs (20010 to 39 readings per second)
Return mode	Controls whether the output measurements are first or last pulse.	First / Last
Lost signal confirmations	The number of failed readings required before a loss of signal is reported, (whole number).	1 to 250
Analog:		
Analog port output rate	Controls the output rate of the analog port.	39 to 20010 readings per second
Analog range	The value in meters that 0V to 2.048V represent	1 - 256
Alarms		
Alarm activation distance	Warn when an object is detected closer than this user-set alarm distance. (In meters, up to two decimal places.)	0.5 to 254
Alarm hysteresis	The amount by which distance reading must decrease below the alarm distance before the alarm is cleared. Used to prevent alarm chatter. (In meters, up to two decimal places.)	0.06 to 50 meters
Alarm latch	If latching is enabled and the alarm is triggered, the alarm output will remain active until manually released.	Select/Deselect
Legacy data output		
Output type (legacy)	Controls the data output type. Primarily used for legacy compatibility.	Distance over USB, Distance and strength over USB, Distance over Serial, Analog voltage over USB, Full communication mode
USB port output rate (legacy)	Controls the output rate of the USB port. Limited by exposure time.	39 to 625 readings per second
Serial port output rate (legacy)	Controls the output rate of the serial port. Limited by exposure time.	39 to 20010 readings per second
Extra		
Synchronization output	Output on the Sync output (2, white) will be high while the ranging function is in operation when not in I2C mode.	Select/Deselect
Sensitivity offset	Adjust the receiver sensitivity to ensure consistent reliability in excessive levels of direct sunlight.	-30000 to 0

6.2 Settings and tools

Additional application **settings** are available by clicking on the *gears* icon in the top menu:

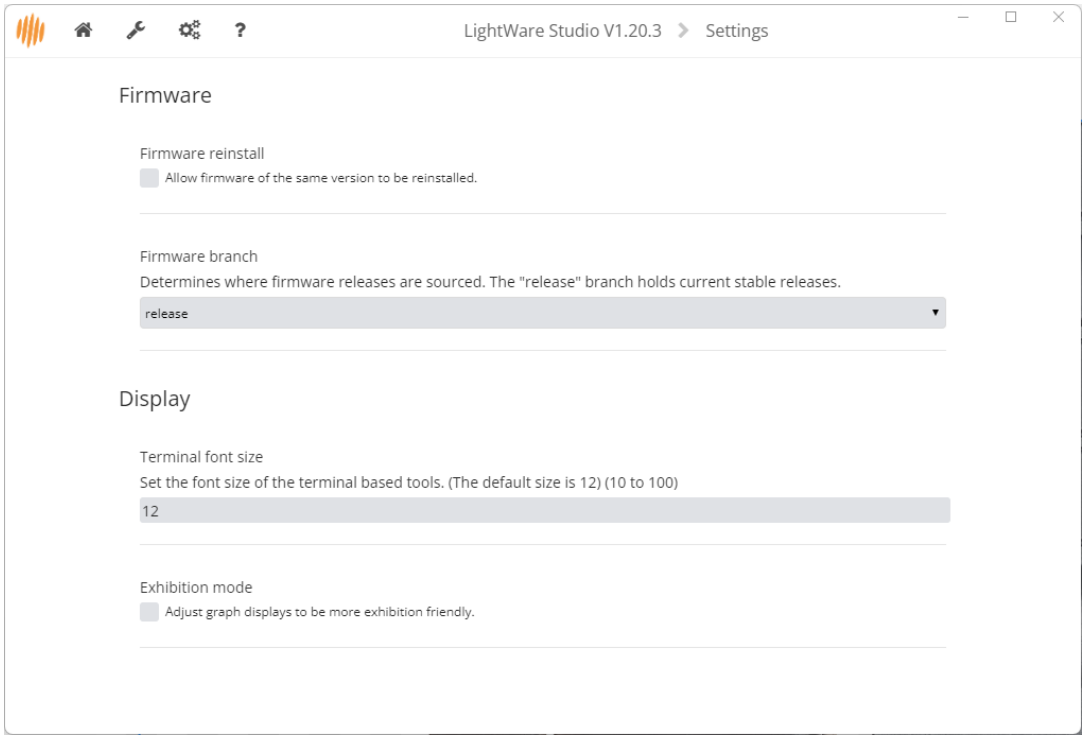


Figure 12: LightWare Studio application settings page

You can access the **specialized device tools page** by clicking on the *wrench* icon in the top menu, including a traditional terminal if needed:

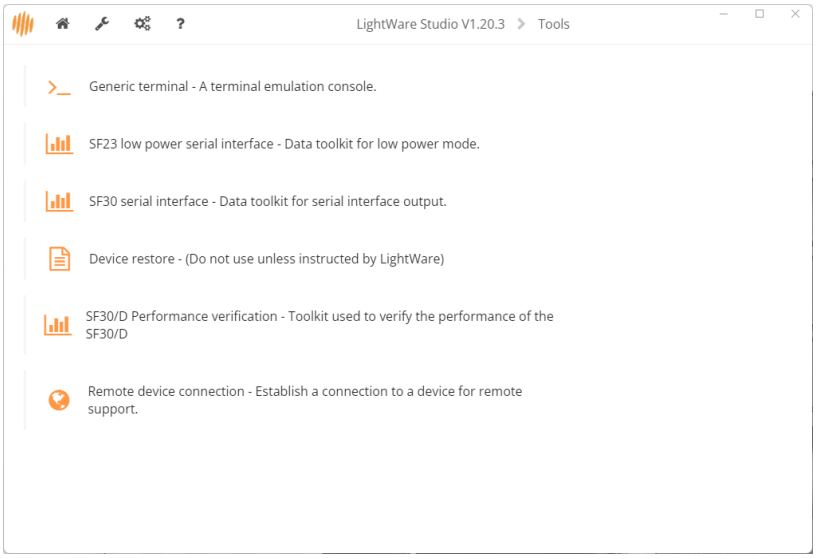


Figure 13: LightWare Studio specialized tools page

7 Installation, mounting, and cabling

7.1 Mechanical interface

For detailed CAD files, please refer to the LightWare resource center at https://lightwarelidar.com/.

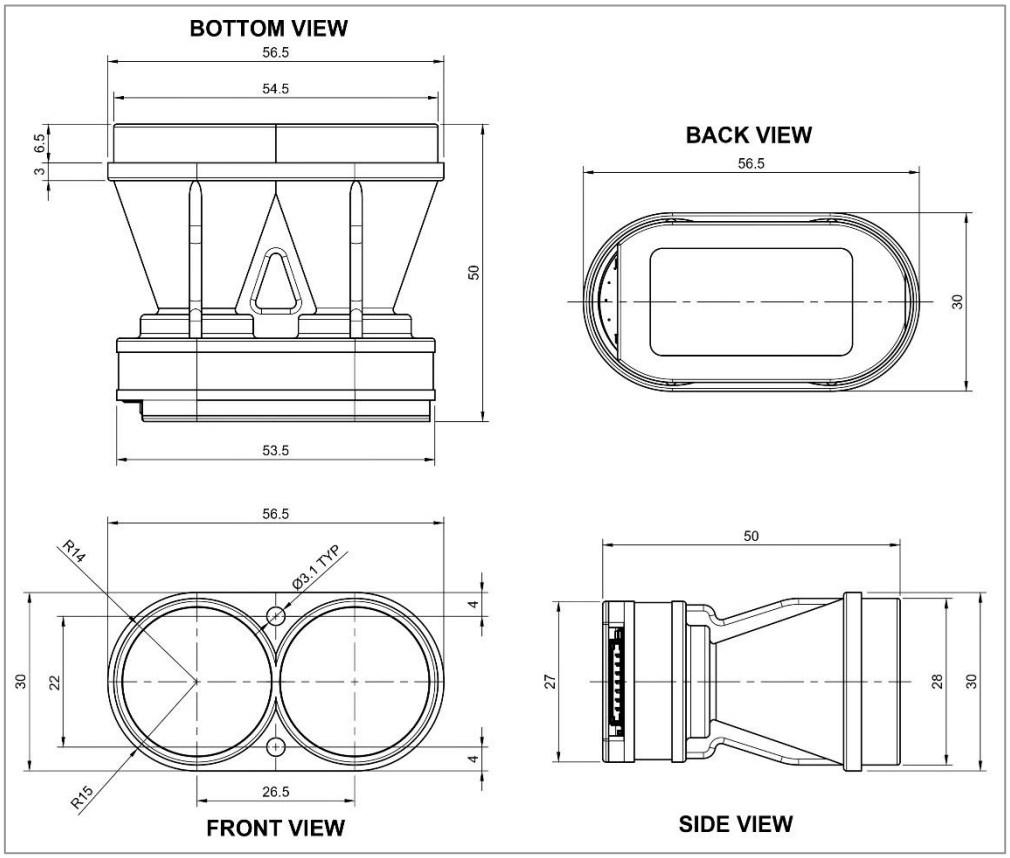


Figure 14: SF30/D dimensions

Caution: This sensor is an OEM module that requires the customer to provide appropriate heat sinking and EMI shielding.

7.3 Mounting and alignment instructions

Take careful note of the following points when mounting the sensor:

- When choosing a position, ensure that there is **nothing in the path** of the laser beam and that there are **no shiny or highly reflective surfaces near the beam path** that could result in false signals.
- Do not mount the sensor recessed within a cavity of the airframe. This can cause false readings in short-range distances (side lobes) or out-of-range conditions. Mount the sensor **flush with the exterior** or keep the recess conical and shallow.
- The back end of the sensor has a semi-exposed PC board with IP40 ingress protection and is designed to be integrated into an airframe or enclosure, while the lens assembly is IP67 rated. For protection against water and dust, install the sensor with only the lenses exposed, and with a **watertight seal** around the lens flange. (Refer to the image below)



Figure 22: An example of good integration

- Make sure the sensor is securely mounted to prevent false readings or damage.
- The LightWare microLiDAR® sensor is designed for installation with exposed lenses. If it is to be mounted behind glass, ensure use of non-reflective glass and mount the sensor flush with the glass to prevent false readings. The glass must have good transmission at 905 nm wavelength, with an anti-reflective coating optimized for this wavelength.
- Ensure adequate heat dissipation and EMI shielding is provided to the sensor.
- Secure the communication cable to prevent it from pulling on the connection port.

7.4 Orientation

The sensor requires a clear line-of-sight to measure distance to a target surface. It can be mounted with a vertical or horizontal lens orientation.



Figure 24: Sensor mounting orientations

It can be mounted in a downward facing, angled, or forward-facing orientation, depending on your application:

- Mount with a downward-facing orientation for altimetry, terrain following, or precision landing applications.
- Mount at an angle to reduce reaction lag time for terrain following. The ideal angle depends on the speed traveled and the overall system lag but should be between 20° and 45°.
- Mount in a forward-facing orientation for sense-and-avoid or position-hold applications.



Figure 25: Sensor mounting angle

7.5 Communication and power cable

The SF30/D is supplied with an LW 000_135 communication cable. This cable carries the power supply, communications signals, and servo driver signals, and connects to the SF30/D through an eight-position receptacle connector. The cable is shielded and must be earthed to reduce electromagnetic interference (EMI). Spare cables are available from the LightWare online store: https://lightwarelidar.com/.



Figure 26: SF30/D communication cable connection

Table 4: SF30/D pinout table

Connector Pin	Wire	Serial Function	I²C Function
1	Green	Alarm output	SCL
2	White	Sync output	SDA
3	Yellow	TXD, transmit data for serial connections	
4	Orange	RXD, receive data for serial connections	
5	Blue	ANALOG	
6	Black	GND, power supply negative, power or logic	
7	Red	VIN, +5 V power supply positive	

Note: The serial UART, I²C, and servo interfaces use 3.3 V TTL logic, (5 V tolerant). The 5-volt power supply should be sized appropriately for startup power.

8 Advanced features

8.1 First and last pulse detection

This LightWare microLiDAR® sensor features *first and last pulse* processing, capturing both initial and final laser return signals in scenarios where multiple objects are within the sensor's line of sight. It is important to note that objects must be separated by approximately five meters or more for separate return signals to be recognized.

First and last pulse capability allows the microLiDAR® sensor to measure its altitude above the ground while simultaneously monitoring its height above treetops or structures for collision avoidance, and enhances performance in challenging environmental conditions like dust, rain, fog, and snow. By discerning both pulses, the sensor can effectively penetrate these elements and accurately report the furthest distance as the actual target. This feature also allows the sensor to measure the distance to objects through foliage.

A glass window in the sensor's line of sight will reflect some laser energy back toward the receiver, potentially resulting in false readings. The sensor's *first and last pulse* detection feature can usually mitigate this issue, depending on the type of glass used.

Although *first and last pulse* detection is helpful when the sensor needs to be positioned behind a protective window, this type of mounting is not recommended, as LightWare sensors are designed to be integrated with exposed lens elements.

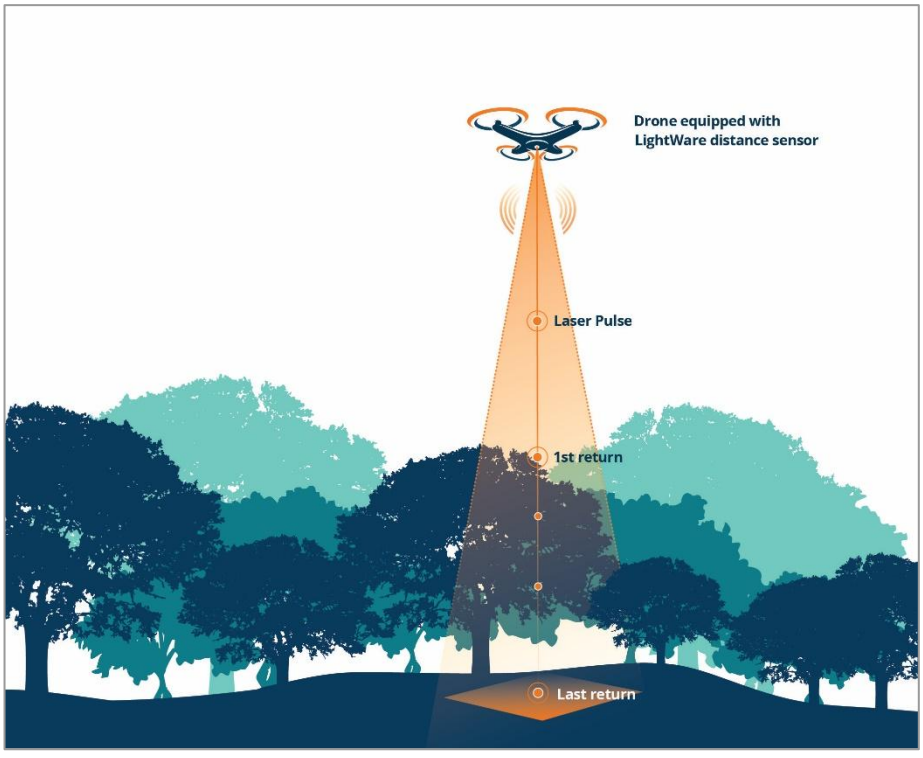


Figure 15: First and last pulse detection

8.2 Alarms

Your LightWare SF30/D microLiDAR® measures and reports distances and has a dedicated alarm channel providing live alarm status outputs, warning of potentially hazardous conditions.

The Alarm trigger provides warnings when the ground (or another object) is detected closer than their user-set alarm distance. Each time a distance measurement is taken, the data is analyzed internally by the sensor and the alarm status is updated in real time.

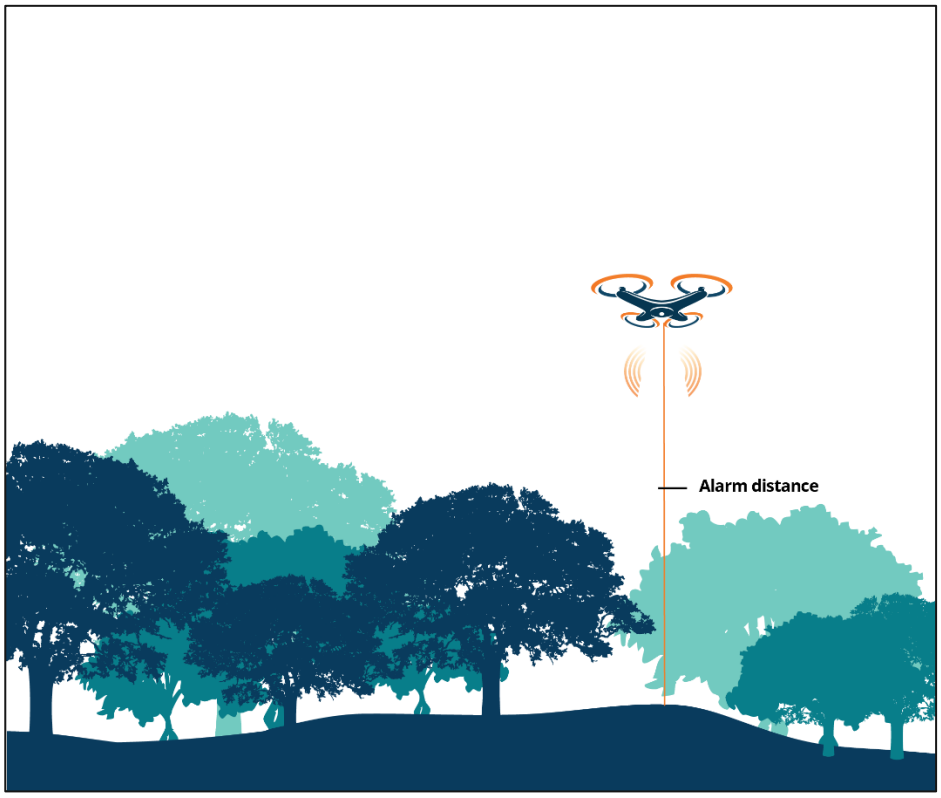


Figure 16: Alarm A and B

These alarm parameters (including hysteresis) can be set using the LightWare Studio parameters page or by using commands through your host controller.

9 Communication interfaces

The LightWare microLiDAR® sensor can be connected to a host controller, transmitting results and receiving commands with a serial UART or an I²C communication interface.

- The one-to-one serial UART interface allows one sensor to communicate with a single host controller.
- The configurable address of the I²C communication interface allows multiple sensors to be connected to one host controller on a common bus.

Once a sensor is connected to a host controller, the first command from the host controller will inform it which of the two communication interfaces is being used. Subsequent commands sent from the host controller to the sensor will request values, change settings, or alter the sensor's performance. The sensor will reply to a single command with a single reply, although the streaming command allows the sensor to continuously update the reply without the host resending the command. Note that streaming data is only available through the serial UART interface. The complete command list is contained in this product guide.

We suggest using LightWare's pre-built APIs wherever possible, which are available via the LightWare website resource center. If you require more control or do not find a suitable pre-built API, you can use the information below to build a compatible system. The packet-based binary protocol is compatible with higher-level APIs like C, Python, and JavaScript. Please contact LightWare for assistance with APIs or programming if required.

9.1 Serial UART interface

For serial UART communication, the sensor uses encapsulated packets to send and receive data. A packet sent **to** the sensor is a request. A correctly formatted request will always be **replied** to with a response. Streaming is available through the serial UART interface. In this case, the sensor sends request streaming packets without a direct request from the host, and they do not require a response from the host.

Requests are made using one of the sensor commands. The complete command list is contained in this product guide. Commands are flagged as either read or write. When a read request is issued, the response will contain the requested data. When a write request is issued, the contents of the response will vary depending on the command.

Default serial UART interface properties:

- Baud rate: 115200 (configurable)
- Data: 8 bit
- Parity: none
- Stop: 1 bit
- Flow control: none

9.2 I²C interface

For I²C communication, the sensor will always be the slave on the I²C interface and only transmit data when requested by the master.

Multiple sensors can be connected to an I²C bus. The I²C serial bus configurable address allows connecting multiple devices on a common bus. Default I²C interface Address: 0x66 or 102. The sensor's I²C interface SDA and SCL pins use 3.3 V logic levels with a 3.3kΩ pull-up resistors, but are also 5 V tolerant.

Requests are made using one of the sensor commands. The complete command list is contained below in this product guide. When a read request is issued the response will contain the requested data. When a write request is issued there is no response generated.

10 Commands

Your LightWare microLiDAR® use the packet-based binary communication protocols for both serial UART and I²C communications. The packet-based binary protocol is a register-based protocol that is compatible with higher-level APIs like C, Python, and JavaScript. This is LightWare's recommended protocol as it allows for various data streaming from a single request.

The first command sent by the host to the sensor after powerup will be used to detect whether serial UART or I²C mode is in use. The sensor will not return a response to the first command. Subsequently, for each command sent by the host controller, a single reply will be returned by the sensor.

To initialize the communication with the sensor, send the command to request the Product name. It is advisable to send the command to query the Product name twice in succession shortly after powerup. As described above the first request will not return a response, however the second request will return the product name, indicating that the sensor has indeed initialized successfully, and a handshake has been successfully established with the sensor.

The streaming ($) command can be used to command the sensor to continuously update the reply without waiting for the host controller to resend the command

10.1 Binary protocol

10.1.1 Binary protocol - Command structure

Both request and response **packets** are composed of the following bytes:

Table 5: Packet composition

	Header			Payload		Checksum	
Byte	start	flags low	flags high	ID	data	CRC low	CRC high

Table 6: Header Flag byte explanation

Byte	**Flags high**								**Flags low**							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Payload length (0 to 1023)								Reserved							Write

- The **start** byte is always 0xAA and indicates the beginning of a packet.
- The **flags** bytes form a 16-bit integer representing the packet's payload length and read/write status.
- The **payload** includes the ID byte, the data bytes, and the write bit. Its length is between 1 and 1023 bytes, inclusive depending on the command type.
- The **ID** byte indicates which command the request/response relates to.
- The **command list** is contained later in this product guide.
- The **write** bit is 1 to indicate write mode, or 0 to indicate read mode.
- The **CRC** bytes form a 16-bit/2-byte checksum value used to validate the integrity of the packet data. The sensor will not accept and process a packet if the CRC is not correctly formed. Every byte in the packet except for the CRC itself is included in the checksum calculation.

10.1.2 Binary protocol - Checksum algorithm

The **checksum** algorithm is CRC-16-CCITT 0x1021. Below are two CRC calculation examples:

Table 7: Checksum algorithm

C/C++	JavaScript

uint16_t createCRC(uint8_t* Data, uint16_t Size)
{
  uint16_t crc = 0;
 	
  for (uint32_t i = 0; i < Size; ++i)
  {
  uint16_t code = crc >> 8;
  code ^= Data[i];
  code ^= code >> 4;
  crc = crc << 8;
  crc ^= code;
  code = code << 5;
  crc ^= code;
  code = code << 7;
  crc ^= code;
  }
 	
  return crc;
}
	function createCRC(data, size) {
	  let crc = 0;
	
	  for (let i = 0; i < size; ++i) {
	  let code = crc >>> 8 & 0xFF;
	  code ^= data[i] & 0xFF;
	  code ^= code >>> 4;
	  crc = crc << 8 & 0xFFFF;
	  crc ^= code;
	  code = code << 5 & 0xFFFF;
	  crc ^= code;
	  code = code << 7 & 0xFFFF;
	  crc ^= code;
	  }
	
	  return crc;
	}

10.1.3 Binary protocol – Reading bytes

Once a packet is successfully read it can be processed based on its command ID. It is vital to **verify the payload length and checksum** before processing.

If either of the following errors are received, “invalid packet length” or “checksum is invalid”, please roll the incoming stream back to one byte after where the start byte was detected.

Below is the process for reading the raw serial byte stream and identifying packets:

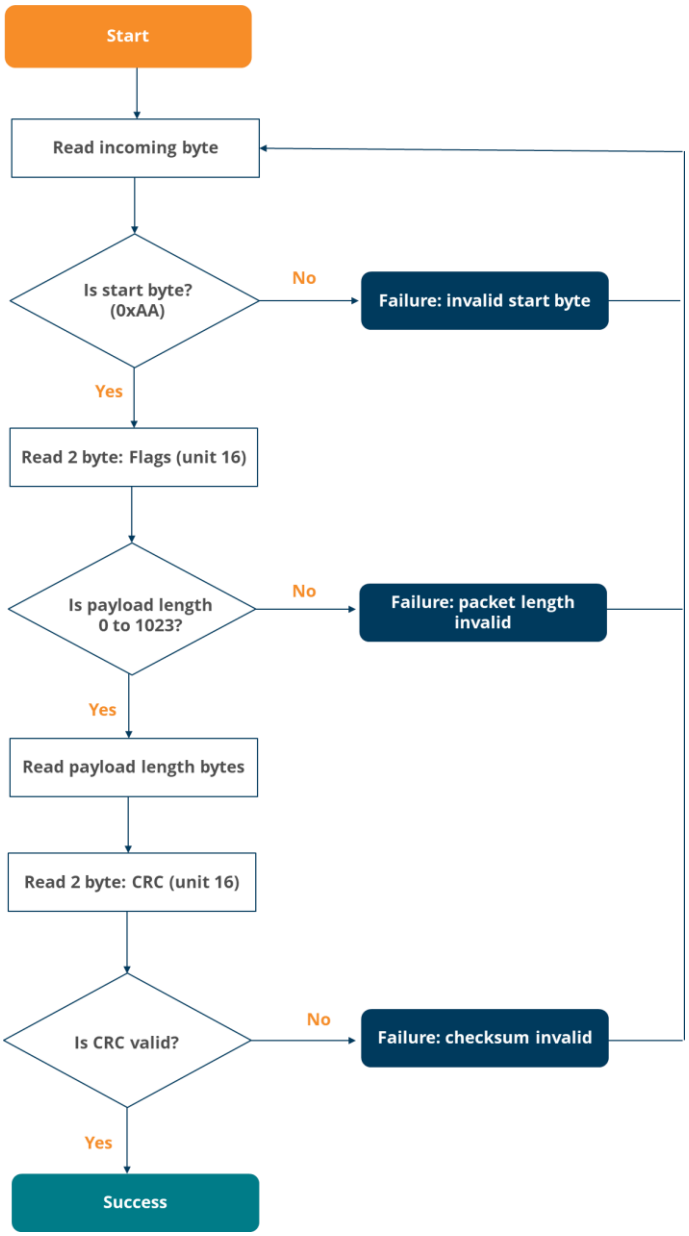


Figure 17: Process flow for reading bytes

10.1.4 Binary protocol - Sending commands

Every request sent to the sensor will receive a response. The response also confirms that the request was received and processed. The timeout value and number of retries should be optimized for the specific application.

Below is the process for sending a command request and reading the response:

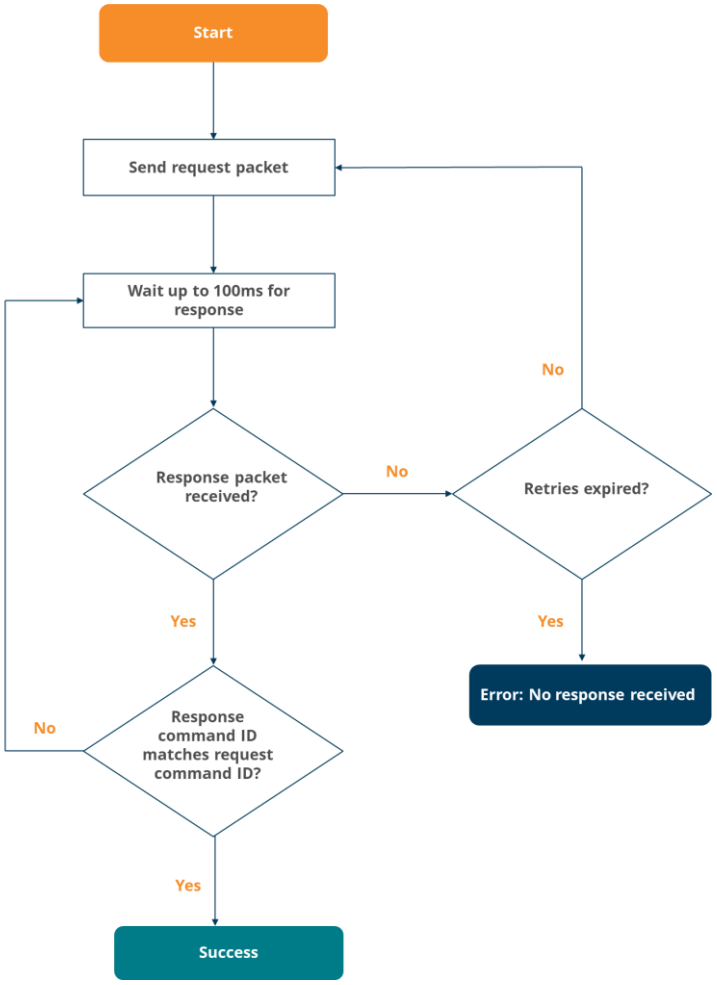


Figure 18: Process flow for sending commands

10.1.5 Binary protocol - Saving

Parameters listed in the command list below, and indicated to persists across power cycles, must be saved to onboard flash once changed.

To save the parameters, the Token (ID 10) must be read from the unit by sending a read command. The value received must then be sent as the data in the Save Parameters command (ID 12) to the unit.

The Token expires every time after use and consecutive save commands will require the request of a new token prior to the save commands sent.

10.1.6 Binary protocol – Command list

Table 8: Binary protocol command list

<table>
<tr><th>ID</th><th>Name</th><th>RW</th><th>Read bytes</th><th>Write bytes</th><th>Persists</th><th>Description</th></tr>
<tr><td>0</td><td>Product name</td><td>R</td><td>16</td><td>-</td><td>-</td><td>A 16-byte string indicating product model name.
Always SF30 followed by a null terminator.
Use to verify the SF30 is connected and operational over the selected interface.</td></tr>
<tr><td>1</td><td>Hardware version</td><td>R</td><td>4/ uint32</td><td>-</td><td>-</td><td>The hardware revision number as a uint32.</td></tr>
<tr><td>2</td><td>Firmware version</td><td>R</td><td>4</td><td>-</td><td>-</td><td>The currently installed firmware version as 4 bytes.
Used to identify the product for API compatibility.
<table>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Patch</td><td>Minor</td><td>Major</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>3</td><td>Serial number</td><td>R</td><td>16</td><td>-</td><td>-</td><td>A 16-byte string (null-terminated) of the serial identifier assigned during production.</td></tr>
<tr><td>9</td><td>User data</td><td>RW</td><td>16</td><td>16</td><td>Yes</td><td>16 bytes of user data stored and read for any purpose.</td></tr>
<tr><td>10</td><td>Token</td><td>R</td><td>2 / unit16</td><td>-</td><td>-</td><td>Next usable safety token / Current safety token.
Once used, it will expire, and a new token will be created.</td></tr>
<tr><td>12</td><td>Save parameters</td><td>W</td><td>-</td><td>2/ uint16</td><td>-</td><td>Commands written to, that must be stored and persist across power cycles will be saved to flash memory on the receipt of the latest Token (ID 10) value sent to this command.
The safety token prevents unintentional writes.
The token expires once a successful save has completed.</td></tr>
<tr><td>14</td><td>Reset</td><td>W</td><td>-</td><td>2/ uint16</td><td>-</td><td>Writing the safety token to this command will restart the sensor.</td></tr>
<tr><td>28</td><td>Synchronization output</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>The Sync output line will be pulled high while the laser is active and ranging
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Enabled</td></tr>
</table></td></tr>
<tr><td>29</td><td>Distance output</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>No</td><td>Configures the (44) distance data command data output. Each bit toggles the output of specified data.
<table>
<tr><th>Bit</th><th>Output</th></tr>
<tr><td>0</td><td>First return raw</td></tr>
<tr><td>1</td><td>First return filter</td></tr>
<tr><td>2</td><td>First return strength</td></tr>
<tr><td>3</td><td>Last return raw</td></tr>
<tr><td>4</td><td>Last return filter</td></tr>
<tr><td>5</td><td>Last return strength</td></tr>
<tr><td>6</td><td>Background noise</td></tr>
<tr><td>7</td><td>Temperature</td></tr>
</table></td></tr>
<tr><td>30</td><td>Stream</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>No</td><td>Serial and USB interface only.
(If used on I²C, the data will not be retrievable.)
Reading from the stream command will indicate what type of data is currently being streamed.
Writing to the stream command will set the type of data to be streamed.
<table>
<tr><th>Value</th><th>Streamed data</th></tr>
<tr><td>0</td><td>disabled</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>ID</th><th>Name</th><th>RW</th><th>Read bytes</th><th>Write bytes</th><th>Persists</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>5</td><td>(44) Distance data cm</td></tr>
<tr><td>11</td><td>(40) Full speed distance in cm</td></tr>
</table>
</td></tr>
<tr><td>40</td><td>Full speed distance in cm</td><td>R</td><td>varies</td><td>-</td><td>-</td><td>
This command contains distance data as measured by the SF30/D combined in packets to allow the full speed data output. The first or last return data selection must be made by selecting (77) Return Mode.

This data can be streamed at any time when (30) Stream is set to 11 and this command will then automatically output at the measurement update rate.

The number of distance data points included in the packet is dictated by the update rate and can vary from 1 up to 128. This number is included in the data packet as data byte 0.
<table>
<tr><th>Data output bytes</th><th>Description</th><th>Size</th></tr>
<tr><td>0</td><td>Number of data points [n]</td><td>Int8</td></tr>
<tr><td>1-2</td><td>Distance 1 of n (cm)</td><td>int16</td></tr>
<tr><td>3-4</td><td>Distance 2 of n (cm)</td><td>int16</td></tr>
<tr><td>5-6</td><td>... (cm)</td><td>int16</td></tr>
</table>
</td></tr>
<tr><td>44</td><td>Distance data in cm</td><td>R</td><td>varies</td><td>-</td><td>-</td><td>
Distance data in cm as measured by the SF30.
This command can be read any time, but if (30) Stream is set to 5, this command will automatically output at the measurement update rate.
The data included will vary and be packed in order based on the configuration of the (29) Distance output command.
<table>
<tr><th>Data output bit</th><th>Description</th><th>Size</th></tr>
<tr><td>0</td><td>First return raw (cm)</td><td>Int16</td></tr>
<tr><td>1</td><td>First return filtered (cm)</td><td>Int16</td></tr>
<tr><td>2</td><td>First return strength (%)</td><td>Int16</td></tr>
<tr><td>3</td><td>Last return raw (cm)</td><td>Int16</td></tr>
<tr><td>4</td><td>Last return filtered (cm)</td><td>Int16</td></tr>
<tr><td>5</td><td>Last return strength (%)</td><td>Int16</td></tr>
<tr><td>6</td><td>Background noise</td><td>Int16</td></tr>
<tr><td>7</td><td>Temperature</td><td>Int16</td></tr>
</table>
</td></tr>
<tr><td>50</td><td>Laser firing</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>No</td><td>
Reading this command will indicate the current laser firing state.
Writing to this command will enable or disable laser firing.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Enabled</td></tr>
</table>
</td></tr>
<tr><td>55</td><td>Temperature</td><td>R</td><td>4/ uint32</td><td>-</td><td>-</td><td>Reading this command will return the measured temperature in 0.01 of a degree.</td></tr>
<tr><td>70</td><td>Output data type</td><td>RW</td><td>1/ unit8</td><td>1/ uint8</td><td>Yes</td><td>
Controls the data output type. Primarily used for legacy compatibility
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Distance over USB</td></tr>
<tr><td>1</td><td>Distance and strength over USB</td></tr>
<tr><td>2</td><td>Distance over serial</td></tr>
<tr><td>3</td><td>Analog voltage over USB</td></tr>
<tr><td>4</td><td>Full communications mode</td></tr>
</table>
</td></tr>
<tr><td>76</td><td>Update rate</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>
Controls the SF30's sampling update rate.
Reading this command will return the current update rate.
Writing this command will set the update rate.
<table>
<tr><th>Command value</th><th>Update rate samples/second</th></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Name</th><th>RW</th><th>Read bytes</th><th>Write bytes</th><th>Persists</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>0</td><td>20010</td></tr>
<tr><td>1</td><td>10005</td></tr>
<tr><td>2</td><td>5002</td></tr>
<tr><td>3</td><td>2501</td></tr>
<tr><td>4</td><td>1250</td></tr>
<tr><td>5</td><td>625</td></tr>
<tr><td>6</td><td>312</td></tr>
<tr><td>7</td><td>156</td></tr>
<tr><td>8</td><td>78</td></tr>
<tr><td>9</td><td>39</td></tr>
</table>
</td></tr>
<tr><td>77</td><td>Return mode</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>This select the output signal between the first and the last return.

Reading this command will return the current Return Mode. The command will change the distance output between First return and Last Return.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>First Return</td></tr>
<tr><td>1</td><td>Last return</td></tr>
</table>
</td></tr>
<tr><td>78</td><td>USB port output rate</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>Controls the output rate of the USB port. Limited by exposure time.
<table>
<tr><th>Command value</th><th>Update rate samples/second</th></tr>
<tr><td>5</td><td>625</td></tr>
<tr><td>6</td><td>312</td></tr>
<tr><td>7</td><td>156</td></tr>
<tr><td>8</td><td>78</td></tr>
<tr><td>9</td><td>39</td></tr>
</table>
</td></tr>
<tr><td>79</td><td>Serial port output rate</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>This control the update rate of the data output through the Analog output of the SF30/D.
Reading this command will return the current update rate. Writing this command will set the update rate.
The update rate is selected from the following table:
<table>
<tr><th>Command value</th><th>Update rate samples/second</th></tr>
<tr><td>0</td><td>20010</td></tr>
<tr><td>1</td><td>10005</td></tr>
<tr><td>2</td><td>5002</td></tr>
<tr><td>3</td><td>2501</td></tr>
<tr><td>4</td><td>1250</td></tr>
<tr><td>5</td><td>625</td></tr>
<tr><td>6</td><td>312</td></tr>
<tr><td>7</td><td>156</td></tr>
<tr><td>8</td><td>78</td></tr>
<tr><td>9</td><td>39</td></tr>
</table>
</td></tr>
<tr><td>80</td><td>Analog Data Update Rate</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>This control the update rate of the data output through the Analog output of the SF30/D.
Reading this command will return the current update rate. Writing this command will set the update rate.
The update rate is selected from the following table:</td></tr>
</table>

<table>
<tr><th>ID</th><th>Name</th><th>RW</th><th>Read bytes</th><th>Write bytes</th><th>Persists</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td><table><tr><th>Command value</th><th>Update rate samples/sec</th></tr><tr><td>0</td><td>20010</td></tr><tr><td>1</td><td>10005</td></tr><tr><td>2</td><td>5002</td></tr><tr><td>3</td><td>2501</td></tr><tr><td>4</td><td>1250</td></tr><tr><td>5</td><td>625</td></tr><tr><td>6</td><td>312</td></tr><tr><td>7</td><td>156</td></tr><tr><td>8</td><td>78</td></tr><tr><td>9</td><td>39</td></tr></table></td></tr>
<tr><td>85</td><td>Noise</td><td>R</td><td>4/ uint32</td><td>-</td><td>-</td><td>Reading this command will return the level of measured background noise.</td></tr>
<tr><td>86</td><td>Median filter enable</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>Reading this command will return the status of the median filter.
Writing this command will set the status of the median filter.<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Disabled</td></tr><tr><td>1</td><td>Enabled</td></tr></table></td></tr>
<tr><td>87</td><td>Median filter size</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>Yes</td><td>Reading this command will return the size of the median filter.
Writing this command will set the size of the median filter.
The valid range is 3 to 32.</td></tr>
<tr><td>88</td><td>Smoothing filter enable</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>Reading this command will return the status of the smoothing filter.
Writing this command will set the status of the smoothing filter.<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Disabled</td></tr><tr><td>1</td><td>Enabled</td></tr></table></td></tr>
<tr><td>89</td><td>Smoothing factor</td><td>RW</td><td>1/ uint32</td><td>1/ uint32</td><td>Yes</td><td>Reading this command will return the strength of the smoothing filter.
Writing this command will set the strength of the smoothing filter.
The valid range is 1 to 99.</td></tr>
<tr><td>91</td><td>Baud rate</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>The serial baud rate used by the serial interface.
This parameter only takes effect when the serial interface is first enabled after power-up or restart.
Reading this command will return the baud rate.
Writing to this command will set the baud rate.<table><tr><th>Value</th><th>Baud rate (bps)</th></tr><tr><td>0</td><td>9600</td></tr><tr><td>1</td><td>19200</td></tr><tr><td>2</td><td>38400</td></tr><tr><td>3</td><td>57600</td></tr><tr><td>4</td><td>115200</td></tr><tr><td>5</td><td>230400</td></tr><tr><td>6</td><td>460800</td></tr><tr><td>7</td><td>921600</td></tr></table></td></tr>
<tr><td>92</td><td>I2C address</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>The I²C address value is in decimal.
Reading this command will return the I²C address.
Writing this command will set the I²C address.</td></tr>
<tr><td>98</td><td>Sensitivity offset</td><td>RW</td><td>4/ int32</td><td>4/ int32</td><td>Yes</td><td>Adjust the receiver sensitivity in cases where there is high incident sunlight.</td></tr>
</table>

<table>
<tr><th>ID</th><th>Name</th><th>RW</th><th>Read bytes</th><th>Write bytes</th><th>Persists</th><th>Description</th></tr>
<tr><td>105</td><td>Alarm distance</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>Yes</td><td>The distance in centimeter at which the alarm is activated</td></tr>
<tr><td>106</td><td>Alarm hysteresis</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>Yes</td><td>The dead band around the alarm activation distance in centimeters</td></tr>
<tr><td>107</td><td>Alarm latch</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>Yes</td><td>If latching is enabled and the alarm is triggered, the alarm output will remain active until manually released.
To release the alarm, write a zero to Alarm latch</td></tr>
<tr><td>108</td><td>Alarm state</td><td>R</td><td>1/ uint8</td><td>-</td><td>No</td><td>Reading this state will provide the answer whether the Alarm is in a triggered state or not</td></tr>
<tr><td>110</td><td>Analog range</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>Yes</td><td>The value in meters that 0V to 2.048V represents (1-256). Indicate the maximum distance that should report a voltage of 2.048V</td></tr>
<tr><td>111</td><td>LED</td><td>RW</td><td>1/ uint8</td><td>1/ uint8</td><td>No</td><td>Switches the LED on the sensor on or off
<table><tr><th>Value</th><th>Description</th></tr><tr><td>0</td><td>Disabled</td></tr><tr><td>1</td><td>Enabled</td></tr></table></td></tr>
<tr><td>115</td><td>Lost signal confirmations</td><td>RW</td><td>4/ uint32</td><td>4/ uint32</td><td>Yes</td><td>The number of failed measurements before a loss of signal is reported</td></tr>
<tr><td>116</td><td>Zero offset</td><td>RW</td><td>4/ int32</td><td>4/ int32</td><td>Yes</td><td>Amount in millimeters to offset readings by</td></tr>
</table>

11 Firmware updates

Occasionally, LightWare will release new firmware for your sensor, to address bug fixes or introduce additional features. All registered customers will receive an email notification when new firmware is released for their LightWare sensor.

Caution: LightWare strongly advises that all LightWare sensors are kept up to date with their latest firmware revision.

You can check whether your sensor is equipped with the latest firmware and access updates directly through LightWare Studio as follows:

1. Select *Upgrade* from the left panel.

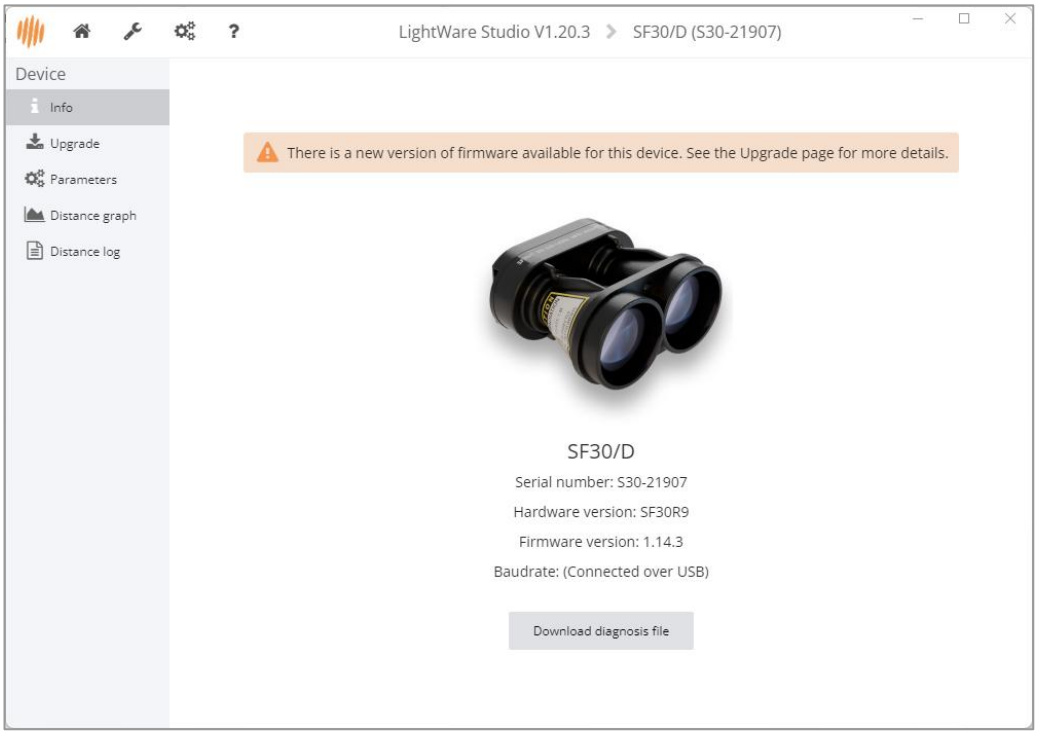


Figure 19: LightWare Studio device information page

2. The page will display the firmware version currently installed on the sensor and indicate whether any recent upgrades are available for download.

3. If you need to upgrade, click the *Install* button, and follow the instructions.

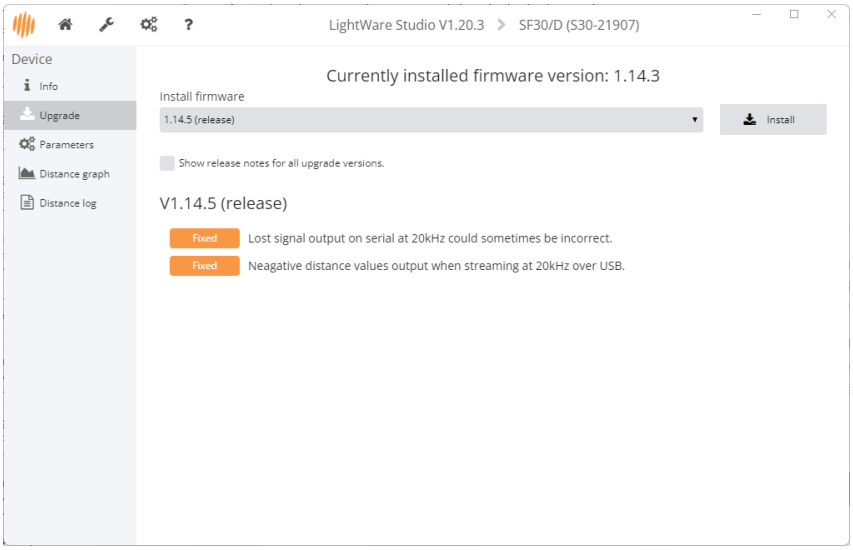


Figure 20: LightWare Studio firmware upgrade page

4. The page will display the currently installed firmware version on the sensor, and it will indicate whether any recent upgrades are available for download.

5. After selecting Install, a prompt will request permission to proceed

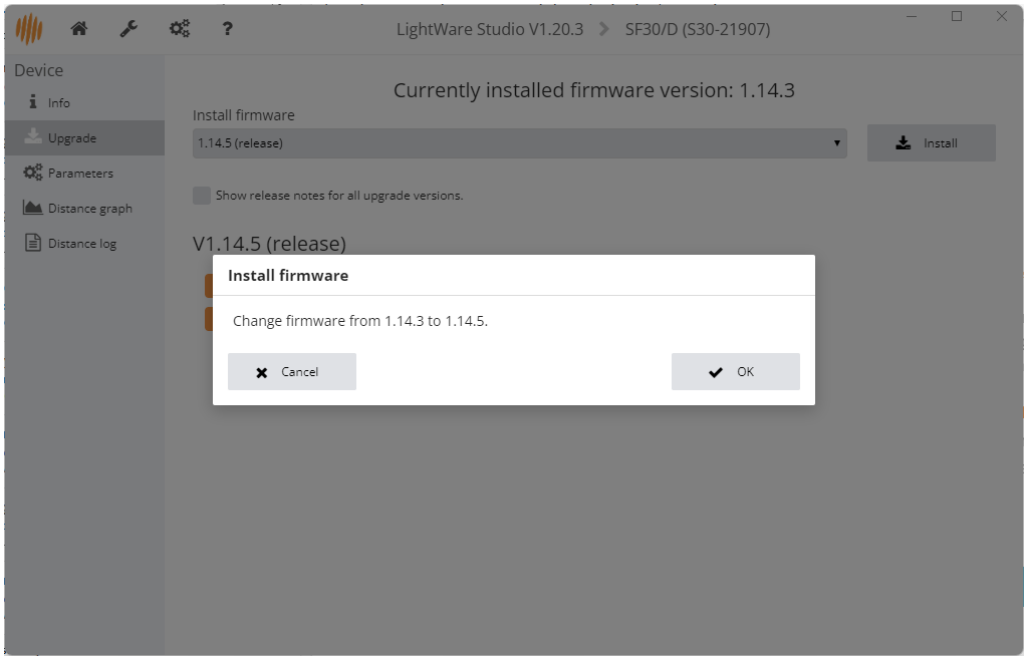


Figure 21: Confirmation of firmware upgrade

6. The firmware will be installed to your device, and the device will automatically reboot.

12 Troubleshooting

Table 13: SF30/D troubleshooting

Problem	Solution
1. Sensor outputs a short distance reading or distorted distance reading	• The sensor is receiving a signal caused by scattered light from a close-by object in the vicinity of the beam, such as a desk surface, landing gear, pole, or highly reflective object. Relocate your sensor or the object and test again.
2. Sensor outputs -1 / 230	• This is an out-of-range condition. There is no measurable object within the sensor's range.
3. Sensor is not communicating with the serial UART controller at all.	• Ensure that the sensor's baud rate is compatible with the controller. • Ensure that the sensor's TXD and RXD lines are connected to the controller's RXD and TXD lines, respectively. • If using ArduPilot or PX4, ensure that the correct parameters for sensor integration have been set. • Ensure that the sensor supply voltage is within the specified range and is not dropping below the specified minimum level. If using a separate power supply, ensure a common ground.
4. Sensor is not communicating with the I²C controller at all.	• Ensure that the sensor SDA and SCL lines are connected to the controller SDA and SCL lines, respectively. • If using ArduPilot or PX4, ensure that the correct parameters for sensor integration have been set. • Ensure that the sensor supply voltage is within the specified range and is not dropping below the specified minimum level. • If using a separate power supply, ensure a common ground.
5. Alarms not visible	• Check alarm zone distances are set correctly • Alarm takes time to reset, check "GPIO alarm confirmation count"
6. Sensor stops communicating during flight	• Check the power supply to the sensor. • Ensure all cable connections are properly seated and secured.
7. Readings are erratic or changing too fast	• Check the update rate and ensure it is suitable for the application. (Slower update rates are advised for altimetry.) • Consider using the built-in filters to remove background noise. • Check the grounding via the shielded cable. • Investigate possible sources of electromagnetic interference (EMI).
8. The sensor is running hot	• Ensure adequate ventilation and heat sinking to prevent heat build-up.
9. Filtered output appears slow/irregular	• Ensure that the filter selected, and filter size selected matches your application. • Ensure only one filter is selected at a time, unless bench tested

10. Sensor not working via Serial adapter	• If the sensor was set to startup in I²C mode, please contact our technical support team for assistance. • The maximum baud rate supported by the LightWare USB adaptor is 921600. If the baud rate was set to a value higher than 921600, please contact our technical support team for assistance.

For issues not covered above, refer to the FAQs in the LightWare website resource center or contact LightWare's dedicated technical support team for assistance with remote testing of your LightWare sensor.

13 Repair and maintenance

13.1 Maintenance and calibration

The LightWare microLiDAR® sensor contains no moving parts, and **no regular maintenance** is required. The sensor **does not need regular calibration** and will remain true to specification throughout its lifespan if used as directed.

13.2 Cleaning

The lenses of the LightWare microLiDAR® are coated with an anti-reflective, non-scratch coating. If lenses collect dust, use a clean, soft cloth or air compressor to remove it. Should that not be sufficient to clean the lenses, only isopropyl alcohol should be used to avoid scratching the sensor's lens or damaging the coating. Keep the device free from moisture in accordance with its IP rating.

13.3 Electrical safety

- Check all electrical connections are isolated and that there are no exposed wires.
- Ensure the power supplied to the device does not exceed the maximum rated voltages specified in the technical specifications section.
- Keep the device free from moisture in accordance with the IP rating.

13.4 Service and repairs

If you experience any problems with your sensor, please contact the LightWare technical support desk for in-field diagnostics before sending the unit to LightWare. During in-field

support, you may be requested to supply the device's diagnostics file, which can be downloaded from LightWare Studio from the device *Info* page.

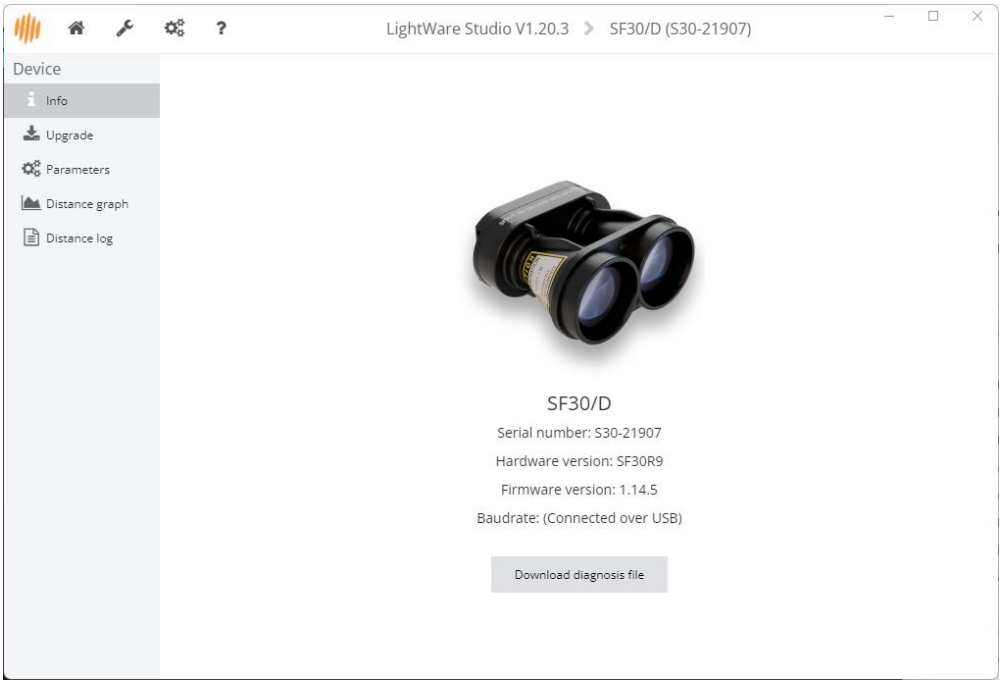


Figure 22: LightWare Studio device information page

If the unit needs to be returned to LightWare for repairs, LightWare support will assist you with the Return Merchandise Authorization (RMA) procedure.

14 End-of-life safe disposal

At LightWare, we are committed to protecting the environment and ensuring that our products have minimal impact on the planet at the end of their lifecycle. As your device reaches the end of its operational life, we encourage you to dispose of it in a responsible and environmentally friendly manner.

Please do not dispose of LightWare sensors with general household or commercial waste.

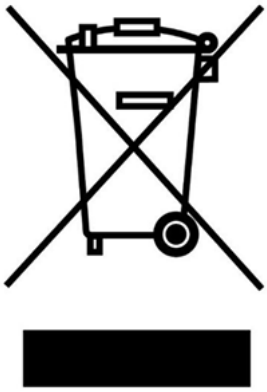


Figure 23: End-of-life disposal

LightWare sensors consist of ABS and other plastics, acrylic, and glass components, which are widely recyclable. The electronic PC board assembly should be disposed of through a reputable electronic waste recycler in your area. Alternatively, return your device to LightWare for safe disposal.

15 Document revision history

Table 14: Revision history

Revision	Date	Comments
Rev 3	2025/06/11	Major rework of the Product Guide
Rev 2	2021/07/02	Add "40. Full Speed Distance in cm" stream data
Rev 1	2020/04/14	Fix "44. Distance data in cm" links
Rev 0	2020/02/06	First edition