

Terabee LoRa Level Monitoring XL

Installation Guide

v1.0

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Introduction

The purpose of this document is to give guidelines for mechanical information, and installation of the Terabee LoRa Level Monitoring XL device in silos, tanks and other structures.

Symbols explanation

The following symbols are used within the document:





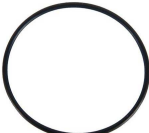


This symbol indicates important messages or specific recommendations in order to operate the product in the intended manner

Inside the package

The following items and components are included in the standard LoRa Level Monitoring XL product offering :

Table 1 - LoRa Level Monitoring XL components

Components	Visuals	Comment
LoRa Level Monitoring XL device		
LoRa Antenna (868MHz or 915KHz)		Available in two versions : <ol style="list-style-type: none"> 1. 868 MHz 2. 915 MHz <i>Note : Terabee does not provide the antenna as a separate accessory</i>
Standard Type D battery, 19 AH (inside the level device)		Shipped inside the level device
USB 2.0 Micro-B cable (50cm)		Allows device connection to PC and access to Terabee Configuration Software
O-Ring		Ensures IP65 sealing between the level device and installation point (e.g Terabee flange accessory)

Accessories

The following accessories are available for better support of the final application installation.

Table 2 - Mounting accessories for LoRa Level Monitoring XL

Components	Visuals	Comment
Flat Mounting Flange (includes self-tapping screws)		Supports installations on top of silos (external part), flat surfaces only

Adjustable Bracket (includes a lock nut)		Supports installations inside silos, on ceiling or with an extension arm attached to a wall
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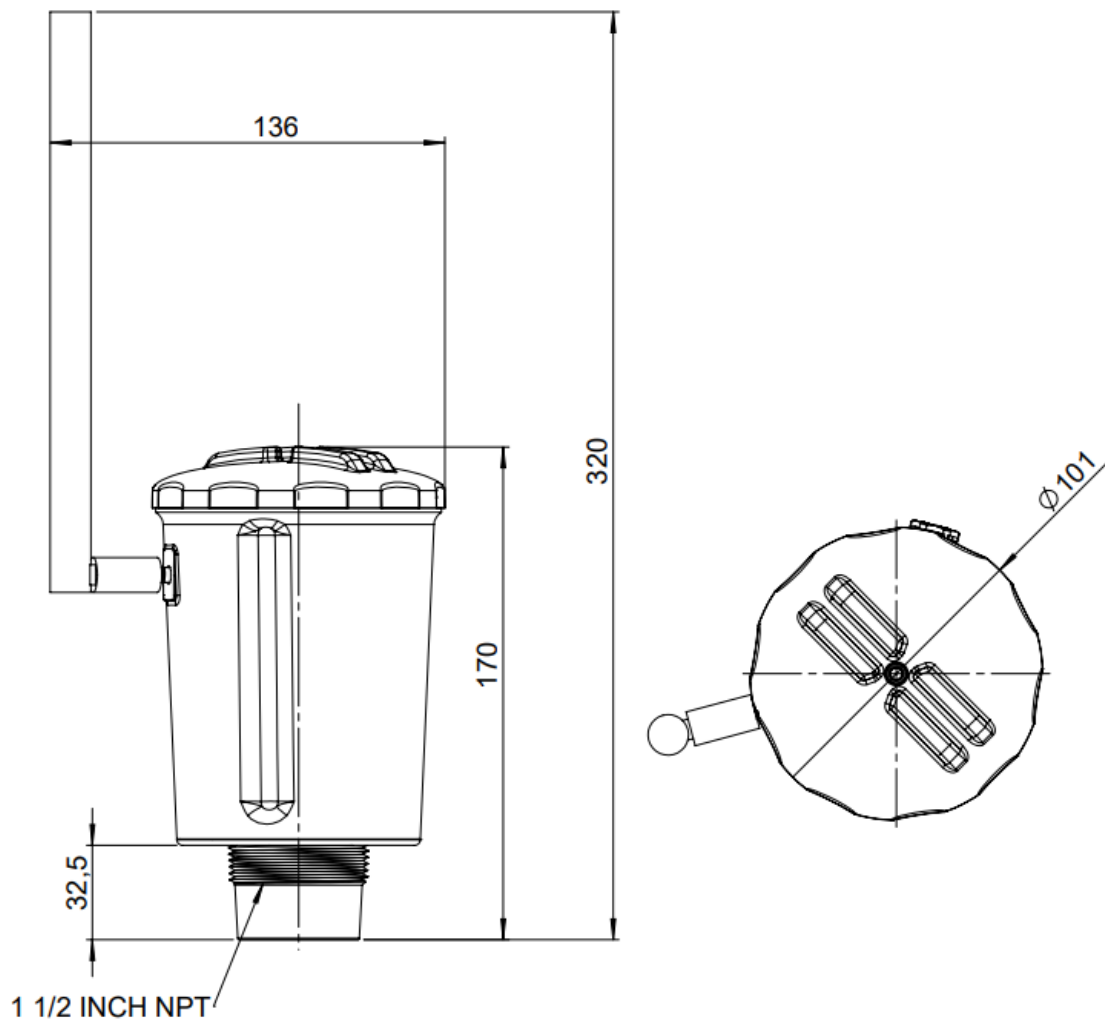


Please note that accessories are not included in the basic Terabee LoRa Level Monitoring XL offering, and need to be acquired separately.

Mechanical design and dimensions

Housing material : Polycarbonate, ABS
Housing color : Grey RAL7004
Protection level : IP65

External dimensions :



Prerequisites, best practices for installation

Selecting an appropriate location for device installation is an important step as it ensures optimal accuracy of the distance measurements, communication reliability via LoRaWAN and overall device protection. Exact installation point will depend on a number of factors, including but not restricted to :

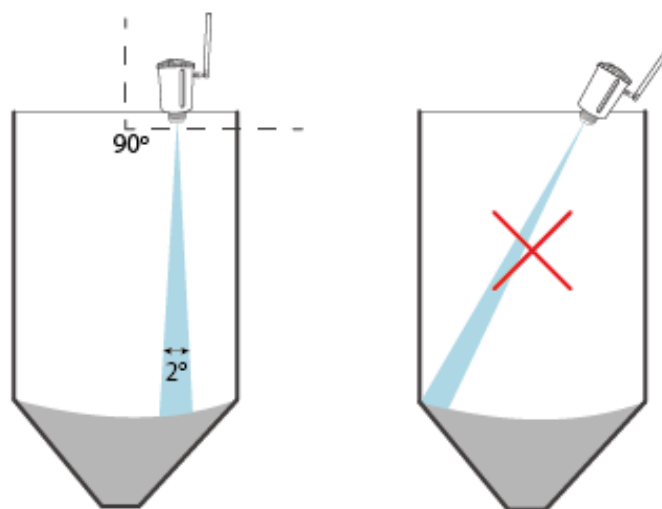
- overall silo dimensions and architecture,
- material inlet and outlet points,
- monitored material type (liquid vs solid),
- available physical space for device installation,
- equipment inside the silo (e.g inlet pipes, air evacuation, etc),
- overall accessibility,
- and other potential application-specific factors.



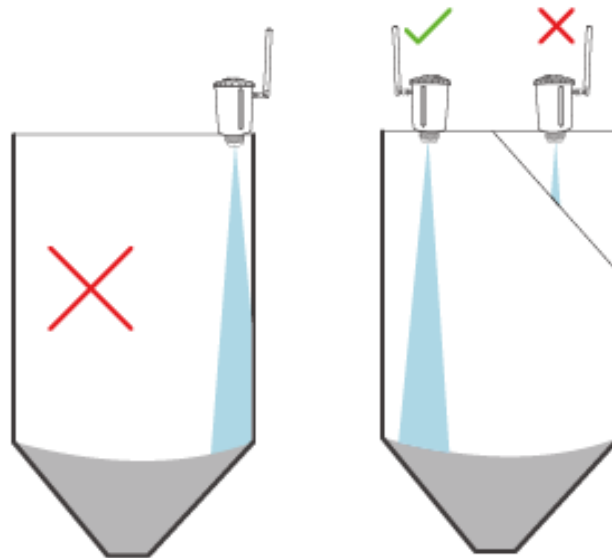
Given the variety of silo and tank models available in the field, the installation point & method may strongly vary from one silo manufacturer to another. Based on the above factors & below recommendations the user is responsible for accessing and choosing a suitable sensor installation point.

Please respect the following recommendations and factors when choosing an installation point for the Terabee device on top or inside a silo :

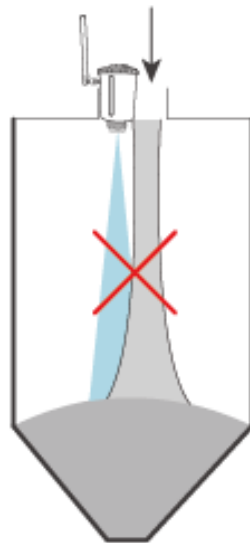
1. *Ensure that the device is installed vertically, positioned perpendicular (90 degrees) to the ground level. Attachments with angled device position may lead to inaccurate measurements and reduced system performance*



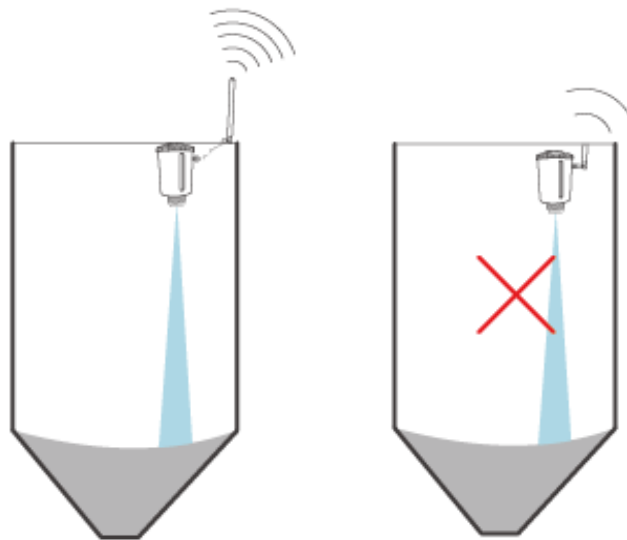
2. Consider the overall container dimensions. Terabee recommends to use existing technical drawings (blueprints) of the silo, or assess most suitable attachment points by visually inspecting the silo.
3. Do not install the sensor near the container walls or any other equipment / obstructions inside the tank that might block the sensors Field of View (Fov). Internal structure and equipment can potentially abstract the light beam of the sensor resulting into false data.



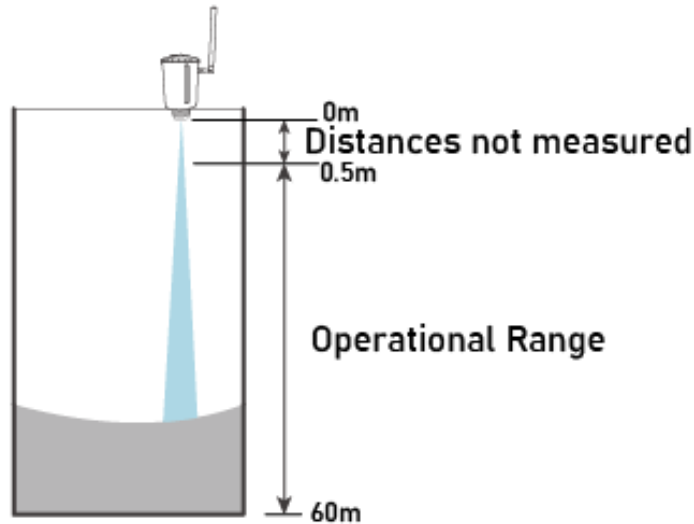
4. Consider material inlet and outlet points in the silo. Avoid mounting the sensor inside or close to the filling point as the material re-filling process can damage the sensor or affect its measurements by attracting too much dust particles / dirt.



5. *The sensor must be installed with a clear line of sight from the sensor lens to the monitored material surface. The Terabee device uses invisible infrared light to perform distance measurements, therefore if not sure whether the sensor FoV is reaching the material surface, please select a more suitable installation point (with no obstructions).*
6. *Mounting close to sources of heat or strong electromagnetic fields can decrease performance. It is also recommended to avoid having other sources of continuous wave or modulated IR light close to the sensor.*
7. *Within the first meter from the sensor avoid objects with high surface reflectivity in a cone of approximately $\pm 45^\circ$ around the central optical axis of the sensor.*
8. *Do not mount anything directly in front or next to the distance sensor, that might interfere with the light emitting and receiving light beams. There must be no interfering objects in the measuring range of the optical ToF sensor.*
9. *Do not mount the level device close to anything with lots of movement and vibration (electrical motors, etc).*
10. *Device installations (including antenna) inside a metal or other conductive component silo or tank, may lead to reduced capabilities and range of data communication via LoRaWAN.*



11. *Please note that material measured closer than 50cm range will be reported as an error message (object too close), as it breaches the minimum range of the sensor specifications. Once the material level decreases and passes the 50cm distance mark from the sensor lens, the system will continue outputting valid distance values.*



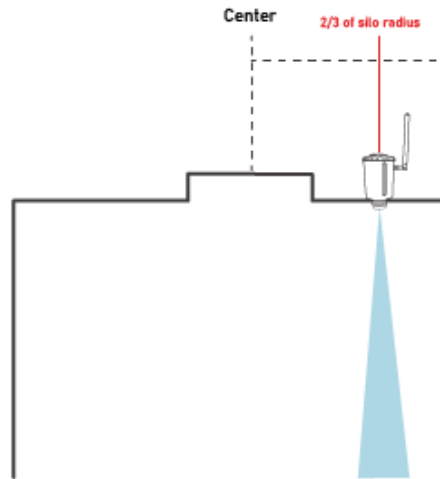
12. Please note that large amounts of dust in the silo may affect measurement quality due to dust particles accumulating on the sensor lens. In such cases, the sensor may output an invalid reading (error message) as the dust layer may be (partially) blocking light emission, and thus the sensor lens must be physically cleaned.

Installation in tanks with liquid materials

Device exact installation point is less important for accurate estimation of material fill level, due to the flat (even) distribution of the material. Make sure the sensor is positioned perpendicular to the monitored contents, and its FoV is not obstructed by the container walls or any other equipment inside the container.

Installation in silos with solid materials

In cases when contents are stored in a silo with a conical bottom part, and where inlet / outlet points are centrally located - Terabee recommends to install the level device on the top of the silo, at a position that is 2/3 of the silo radius .







As the material goes through a full emptying cycle in the silo - often resulting in uneven distribution at different heights due to arching and coning effects - this installation setup will allow for optimal average estimation of remaining material fill level over a complete emptying cycle.



Please note that due to uneven material distribution inside the silo and the 2 degree Field-of-View used for distance measurements - the Terabee device may not always measure the highest point of the material stored in the silo.

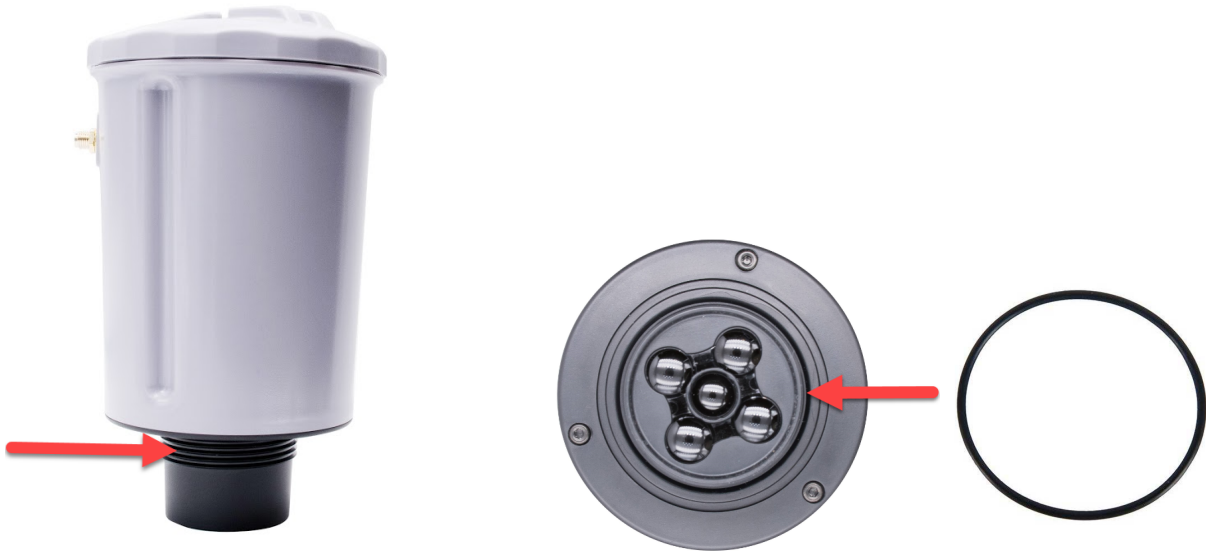
Device installation options

Table 3. Mounting methods : Stock Level Supervisor

Option	Description	Visualization
1	<p>Using onboard NPT 1.5 inch thread (National Pipe Thread).</p> <p>Suitable for installations directly inside silos with openings (e.g female NPT), or integration with custom flanges.</p>	
2	<p>Using Terabee Flat Mounting Flange.</p> <p>For installations on top of silos (external), flat roof surfaces.</p>	
3	<p>Using Terabee Adjustable Bracket.</p> <p>For installations inside containers (e.g interior part of the hatch), or on ceilings for open containers.</p> <p>This method can also be used for mounting devices on a vertical wall surface attached to an extension arm (e.g river level monitoring).</p>	
4	<p>Using the slot for hook insert (located on top lid). Hook insert not provided by Terabee.</p>	

Using onboard NPT 1.5 inch thread

Terabee device features a 1.5 inch NPT (male) thread connection, making the device compatible with female NPT threads directly located on silos or allowing users to integrate with custom selected flanges.



The Terabee device comes with an O-ring (see in image above) to allow water tight sealing once the device is installed.

Users can also use adapter rings for changing thread standards (e.g BSP), or adapting to smaller / larger thread connections. Please note that adapter rings are not provided by Terabee.

Using Flat Flange (accessory)

Ensures Terabee device installation on top of silos / tanks (external part), and on flat surfaces. Requires drilling on the selected installation point.



Table 4. Necessary equipment for Flat Flange installation

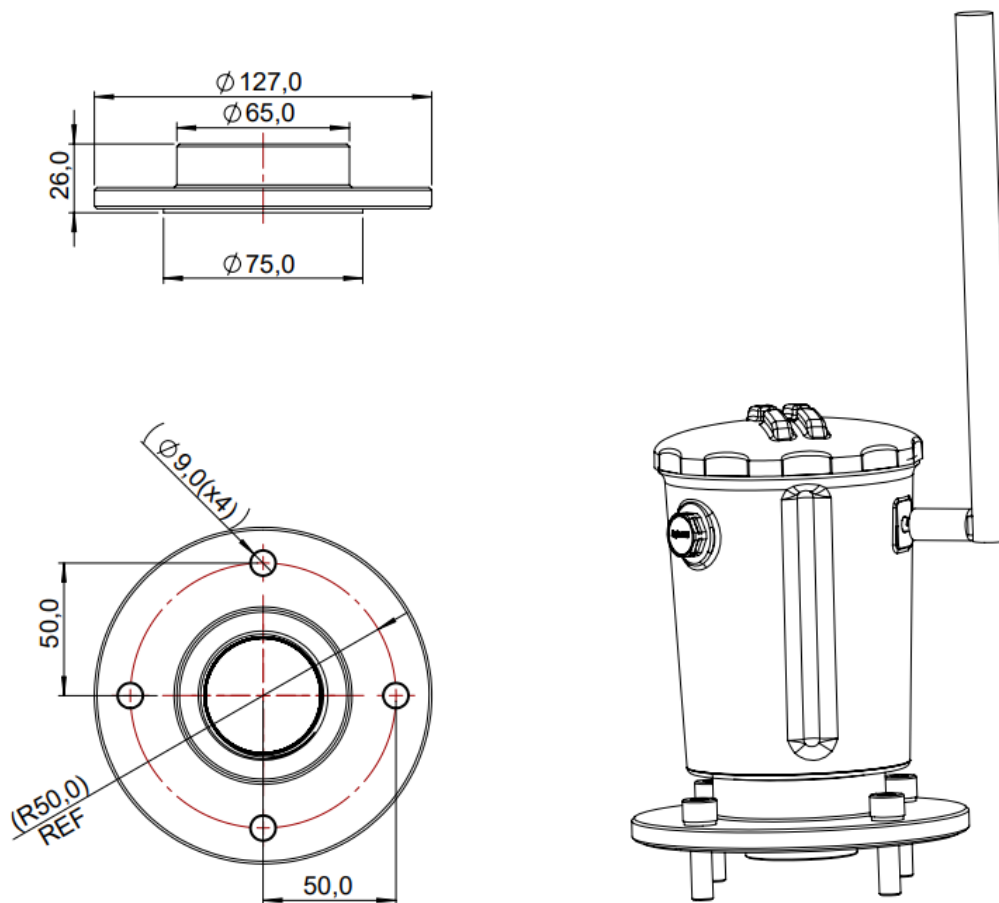
Components included	Necessary Equipment <i>(not provided)</i>
<ul style="list-style-type: none">● LoRa Level Monitoring XL (1 unit)● O-ring (1-unit)● Flat Mounting Flange (1 unit)● M8 self-tapping screws (4 units)● Rubber washers (8 units)● Silicone padding (1 unit)	<ul style="list-style-type: none">● Hole saw with drilling machine● Drilling machine with 7mm drill bit● 13mm nut driver socket with machine

Installation steps

1. For marking hole positions - place the Terabee flange over the preferred installation point. Mark the center (NPT threaded) hole position along the 4 screw hole positions on the silo surface.
2. Make a Ø50.0mm hole on the flat surface of silo (marked in center position), using the hole saw. This opening will be used for putting through the ToF sensor part of the Terabee device.

3. Next, drill 4 x pilot holes of $\varnothing 7.0\text{mm}$. These openings will be used for self tapping screws.
4. Insert the provided silicon pad on the bottom side of the flat flange, aligning it with the screw holes and the NPT thread hole. Place and align the flat flange over the machined holes on the silo surface.
5. Before attaching the flange, make sure about the presence of the provided O-ring between flange and level device.
6. Screw the 4 self tapping screws through the 4 holes of the flange along with the provided rubber washers.
7. Insert the Terabee level device in the NPT thread opening on the flange, and screw the device until it is locked - ensuring sealing against liquids and gases.
8. Installation is successfully completed.

Flat flange dimensions



Using Adjustable Bracket (accessory)

Ensures Terabee device installation inside the silo with attachment to internal silo / tank surface (e.g hatch). Accessory also allows attachments on ceilings in open containers or on vertical walls using an extension arm (not provided by Terabee).



Please be aware that device installation inside silos can limit the LoRa communication range.



Table 5. Necessary equipment for Mounting Bracket installation

Components included	Necessary Equipment <i>(not provided)</i>
<ul style="list-style-type: none">• LoRa Level Monitoring XL (1 unit)• Adjustable Mounting Bracket (1 unit)• Nut (1 unit)	<ul style="list-style-type: none">• Screwdriver for M5 screws.• M5 screws (5 units)

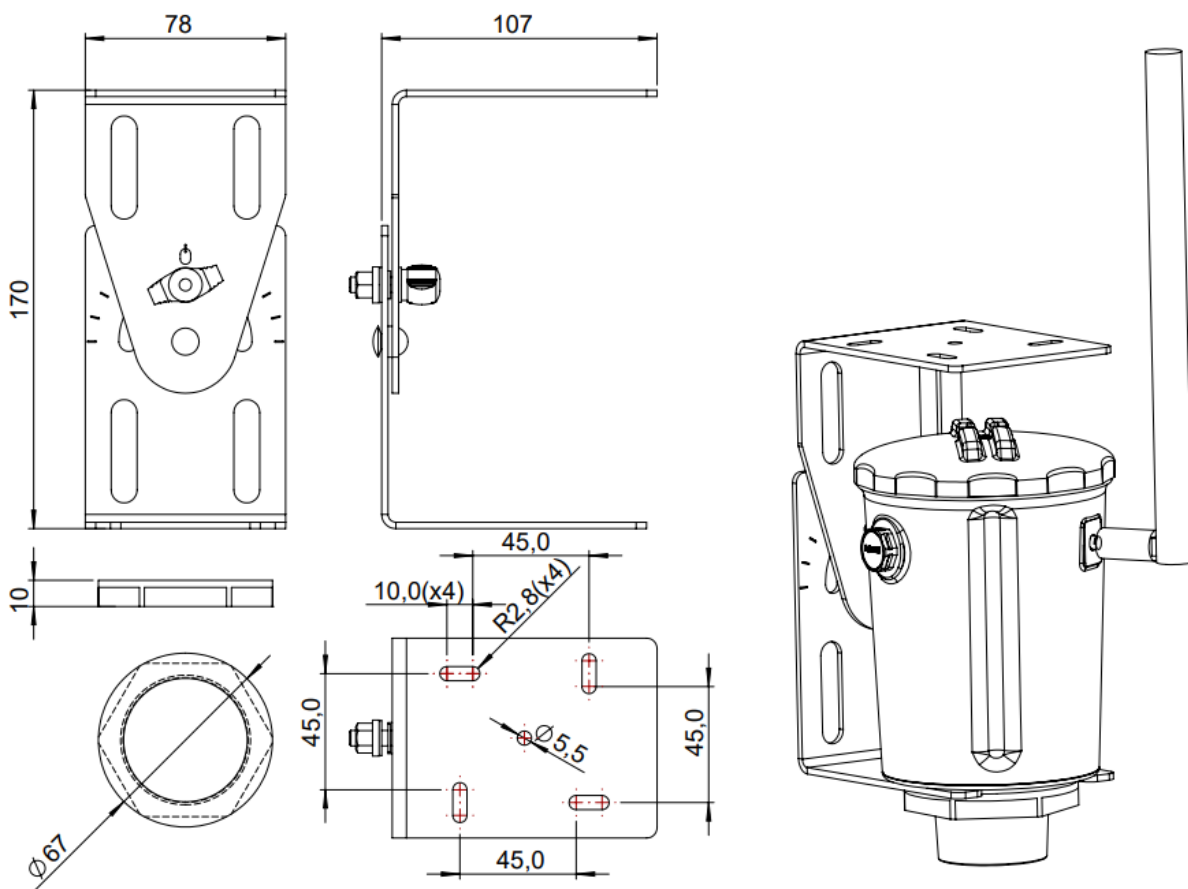
Installation steps

1. Set the preferred angle of the 2-part mounting bracket by adjusting the knob and locking it under the required angle. Use the engraved markings (1 mark per 15 degrees) for more accurate angle setting.
2. Insert the Terabee device inside the mounting bracket, positioning the NPT thread of the device in the bracket opening. Screw the nut on the NPT thread connection, to lock the level

device with the bracket.

3. Optional : extra slots on the bracket are provisioned in case zip ties are to be applied around the level device.
4. Install the mounting bracket (with the level device mounted) in a preferred location. Use the available M5 slots (and provided M screws) to attach the system to the silo selected surface.
5. Installation is successfully completed.

Adjustable Bracket Dimensions



Optical ToF sensor characteristics

Measured detection area

The Terabee LoRa Level Monitoring XL is an optical distance measurement sensor that uses near infrared Time-of-Flight principle. The sensor features a 2 degree Field of View beam. The following table demonstrates the measured detection area (spot diameter in reception) at different ranges.

Table 5. Measured detection area at different ranges

Distance (m)	Measured detection area (cm)
5	20 x 20
10	40 x 40
15	60 x 60
20	80 x 80
30	120 x 120
45	180 x 180
60	240 x 240

Field of View characteristics

Due to the open Field of View nature of the LED optics, the Teabee optical sensor measures an average distance within the projected area. At larger distances and in cases when the material surface has formed under a steeper angle (e.g due to coning or arching effects) - the ToF sensor will average and output a "middle point" from the projected area.

More information about LED-based Time-of-Flight technology and how the detected target material affects distance measurements can be found in the sources below :

[A Brief Introduction to Time-of-Flight Sensing Part 1 – The Basics](#)

[A Brief Introduction to Time-of-Flight Sensing Part 2 – Indirect ToF Sensors](#)

