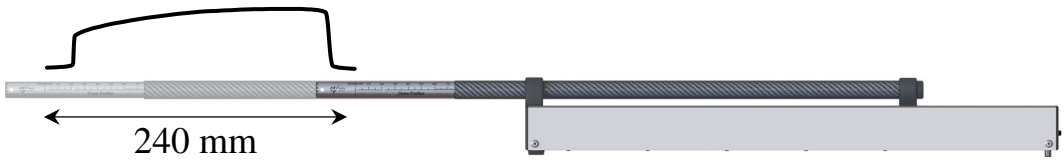
# *LoniMover*

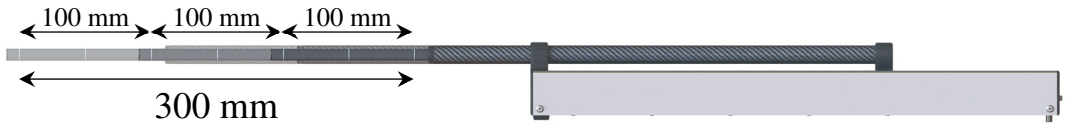
## *For Measurements Of:*

**Dose profiles/dose efficiency/$CTDI_{air}$**




**or**

**CTDI for broad collimations according to IEC 60601-2-44 Ed. 3:A1**



# NOTICE

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# INTENDED USE OF THE LONIMOVER

Together with your choice of sensor system it is to be used for quality control, service and maintanance of CT systems.

With the CT system in stand-by condition without patients present, the LoniMover is intended to be used:

- for assessing the performance of the CT scanner.
- for service and maintanance measurements.
- for quality control measurements.
- for educational purposes.

The product is intended to be used by hospital physicists, X-ray engineers, manufacturer's service teems, and other professionals with similar tasks and competencies.
The operator needs basic knowledge about the LoniMover system and any measuring system used before starting to use the LoniMover.
This can be achieved by studying the relevant documentation.

The product is NOT intended to be used:

- for direct control of any diagnostic X-ray system performance during irradiation of a patient.
- so that patients or other unquilified persons can change settings of operating parameters during and immediately before and after measurements.
- as the sole measurement system for the approval of an X-ray system for clinical operation.

# PREFACE

**Chapter 1** Gives an introduction to measurements of CTDI and dose profiles.

**Chapter 2** Explains the LoniMover system.

**Chapter 3** Explains the nessesary preparations of the system.

**Chapter 4** Explains how to measure with Sweep mode.

**Chapter 5** Explains how measure with Step mode.

**Chapter 6** General Information about maintenance, transportation and troubleshooting

**Chapter 7** Specifications for the LoniMover system and EC conformity

**Chapter 8** References used for this document

**Index** Contains an index register for this manual.

**It is advisable to read the manual at least once to gain familiarity with the terms used and the capabilities of the LoniMover system.**

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# Table of Contents

# 1. INTRODUCTION

⚠ This manual requires the user to have basic knowledge of CT measurements and metrics.

⚠ Before start of any movements, make sure the travel path is clear.

⚠ Before any exposure, ensure that no person is in the proximity of the CT.

⚠ If the LoniMover is left connected to power for a long time, it may get hot. Disconnect power when not in use.

Regular quality assurance measurements on CT scanners are necessary in order to monitor the dose levels patients are exposed to during medical examinations. In many countries, governments require regular quality compliance testing information from clinics and hospitals that perform CT examinations.

Important measurements on CT system include measurements of the Weighted CT dose index ($CTDI_w$) and dose efficiency.

## 1.1 $CTDI_w$ for wide collimations

Traditionally the $CTDI_w$ is measured with a 100 mm long integrating pencil ionization chamber (PIC) [1].

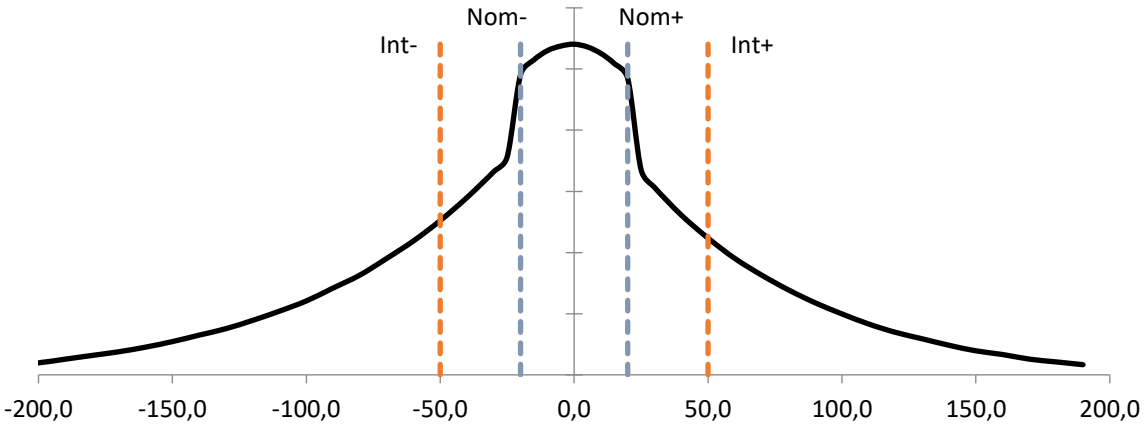



**Figure 1. Dose distribution for a 40 mm CT field inside a 300 mm phantom**

Figure 1 shows that the integration limits of ±50 mm (100 mm in total) is not enough. It gets even worse with collimations above 40 mm.

In the International Electrotechnical Commission (IEC) publication IEC 60601–2–44 Ed. 3:A1 (IEC 3.1) [2] the Weighted CT Dose Index ($CTDI_w$) has been extended for nominal total collimation widths (nT) greater than 40 mm and relies on measurements of $CTDI_{free\ air}$.

Each measuring position in traditional $CTDI_w$ calculations is calculated according to equation (1) below

$$CTDI_{100,nT>40mm} = CTDI_{100,ref}\, x \left(\frac{CTDI_{free\ air,nT}}{CTDI_{free\ air,ref}}\right), \quad (1)$$

or graphically:

$CTDI_{100,nT>40mm} =$

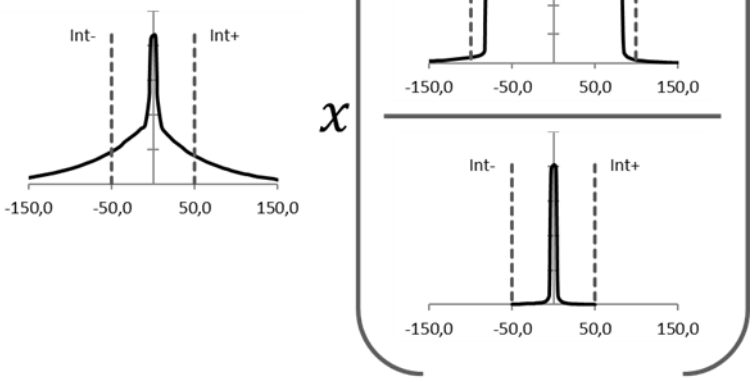



**Figure 2. Graphical presentation of equation (1). Note that the profiles represent CTDI not integrated dose (CTDI = integrated dose/nominal collimation).**

The reference collimation is below 40 mm, usually 5-20 mm, and measured both inside a standard CTDI phantom (all positions) and free in air (central axis).

In IAEA Human Health Reports No. 5 [3], a method is provided to measure the $CTDI_{free\_air,nT}$ for nominal total collimation widths exceeding 40 mm.

A 100 mm pencil ionization chamber (PIC) is suspended in the longitudinal (z) direction. Depending on the nominal total collimation width, the PIC is stepped into different contiguous locations between exposures to envelope the entire radiation field. The positions of the contiguous locations that are recommended by the IAEA to extend the integration length of the CTDIfree air,nT using a PIC is presented in Table 1 and graphically in Figure 3 and Figure 4 below.

| Collimation [mm] | Integration Length [mm] | IAEA Positions [3] [mm] |
|---|---|---|
| ≤40 | 100 | 0 |
| >40 to <160 | 200 | -50, 50 |
| 160 | 300 | -100, 0, 100 |

**Table 1. Recommended positions according to IAEA.**

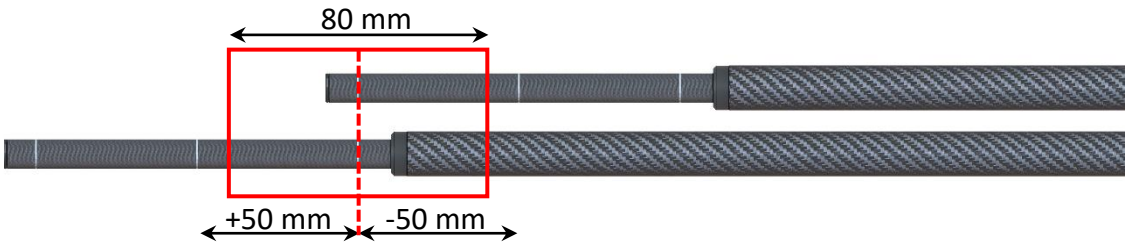



**Figure 3. Positions for collimations > 40 mm and < 160 mm (example at 80 mm).**

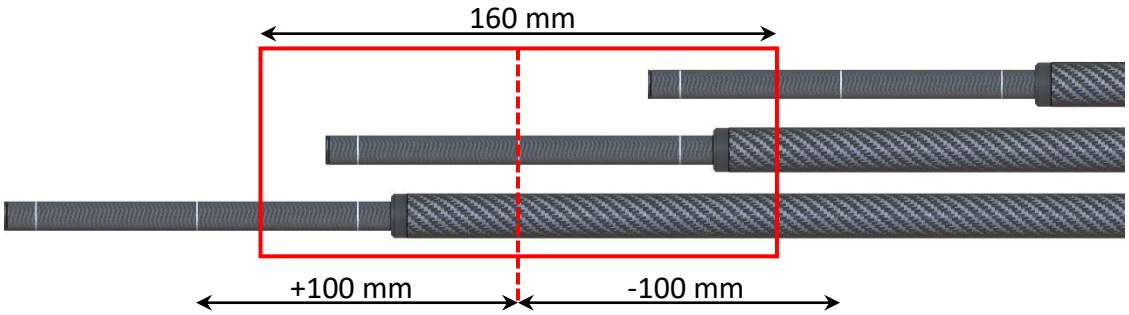



**Figure 4. Positions for collimations ≥160 mm (example at 160 mm).**

It is also possible to determine $CTDI_{free\ air,nT}$ from dose profiles (see chapter 1.2).
To learn more about different techniques for determine $CTDI_{free\ air,nT}$ it is recommended to read reference [4]. Please note that the RTI Mover used, is the precursor to the LoniMover.

## 1.2 Dose efficiency/profiles with a real time detector

By using a real time detector with a small detector volume and translate the detector through the CT field it is possible to generate dose distribution profiles.

The detector measures real time dose (kerma) continuously and report dose as a function of time.

If the translation speed is known the data can be converted to dose as a function of relative position.

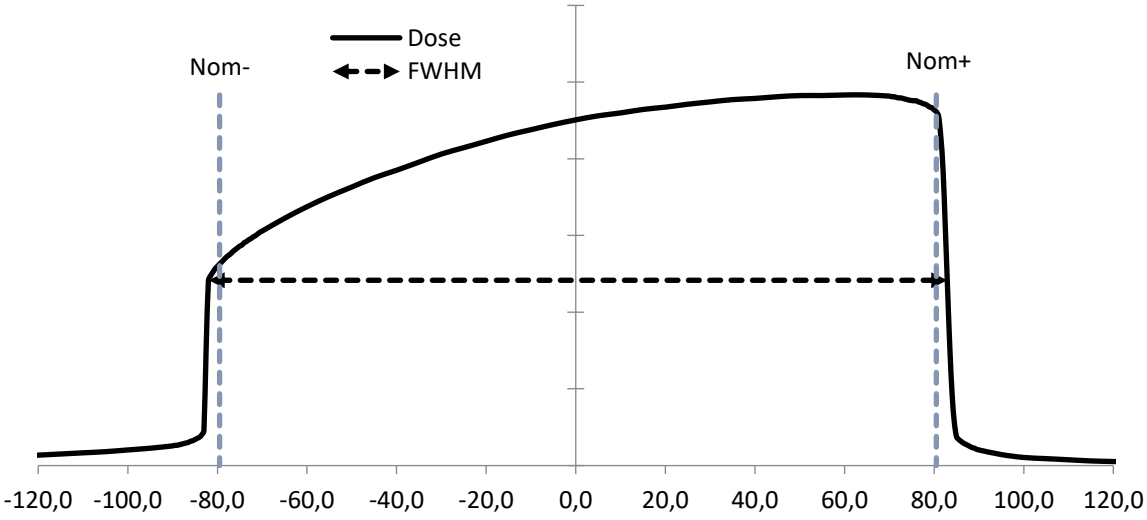



**Figure 5. Typical dose profile for a 160 mm nominal collimation on a GE Revolution CT.**

From the dose profile many useful metrics could be extracted, including but not limited to:

- Dose efficiency
- Full With Half Max (FWHM)
- Integrated dose
- $CTDI_{free\ air,nT}$ for use in IEC 3.1 calculations (see chapter 1.1)

If using the RTI CT Dose Profiler (CTDP) together with the RTI Piranha, RTI Ocean and The LoniMover, all these calculations are done automatically.

# 2. THE LONIMOVER SYSTEM

## 2.1 In the box

The LoniMover system consists of the following:

- Carrying case
- The LoniMover
- One detector holder probe for RTI CTDP and RTI PIC
- Power adapter for the LoniMover (24V, 2.71A, 5.5x2.1 mm center positive)
- The LoniButton
- USB cable for the LoniMover (5 m)
- USB cable for the LoniButton (1 m)
- USB extension cable (7 m)

## 2.2 The LoniMover

The purpose of the system is to move your measuring device either with constant velocity, *Sweep mode*, or to well defined positions, *Step mode*.

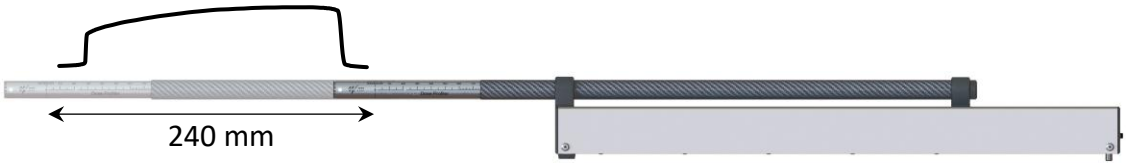



**Figure 6. The LoniMover in Sweep mode**

Sweep mode works great with small detectors that sample dose or dose rate over time, there by producing dose profiles.

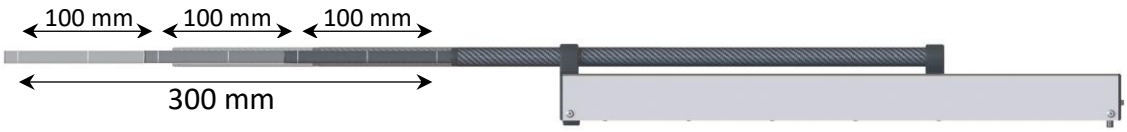



**Figure 7. The LoniMover in Step mode**

Step mode can be used for joining measurements with a 100 mm long pencil ionization chamber into a virtual 300 mm long chamber.

All mechanical parts are of highest quality and the chamber holder is made of carbon fiber to minimize scatter and are very rigid. There is no drop in the chamber path at the end of travel.

## 2.3 The LoniButton

The included LoniButton is the link between the software(s), the user and the mover system. To get perfect timing of all the components involved during Sweeps it even integrates the CT exposure button.

The LoniButton signals with different colors which function the button will trigger. See Table 2 for details.

| | LED color | | Function in Sweep mode | Function in Step mode |
|---|---|---|---|---|
|  |  | **Green** | **Starts sweep** | **N/A** |
| |  | **Blue** | **Return to start position** | **N/A** |
| |  | **Red** | **Emergency stop if in motion** | **Emergency stop if in motion** |

**Table 2. LoniButton signal system.**

The LoniButton is optional and all functions is available through buttons in the LoniCT software.

# 2.4 The LoniCT Software

## 2.4.1 General

The LoniCT software has three different regions (Figure 8):

1. Tabs for selecting mode
2. Mode specific settings and actions
3. Common connection settings, information and emergency stop button

How to use the different modes is described in section 4 and 5.

How to use the connection settings is described in section 3.1.

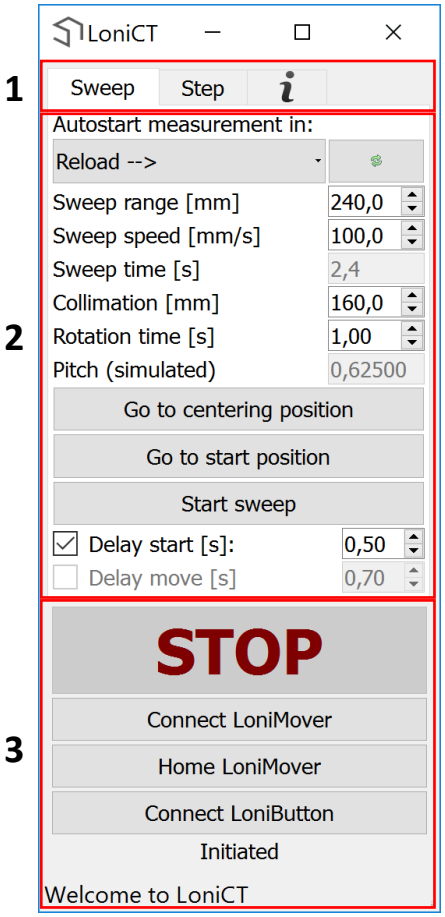



**Figure 8. LoniCT overview**

## 2.4.2 Info tab

The information tab shows software version and LoniMover hardware ID.

At this screen, buttons for this manual and link to Lonitech.se is available.

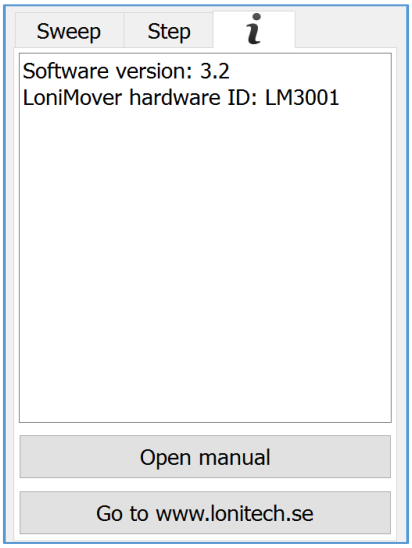



**Figure 9. LoniCT info tab**

### 2.4.3 Installation

To download the latest version of LoniCT visit:

https://lonitech.se/download

Open the downloaded “Install LoniCT 3.x.exe” file as an administrator and you will be presented with the window below.


**Figure 10. LoniCT installation welcome screen**

1. Read through the license agreement and check the “I accept the agreement” if you do agree

2. Click “Next” and you will be presented with the next screen below

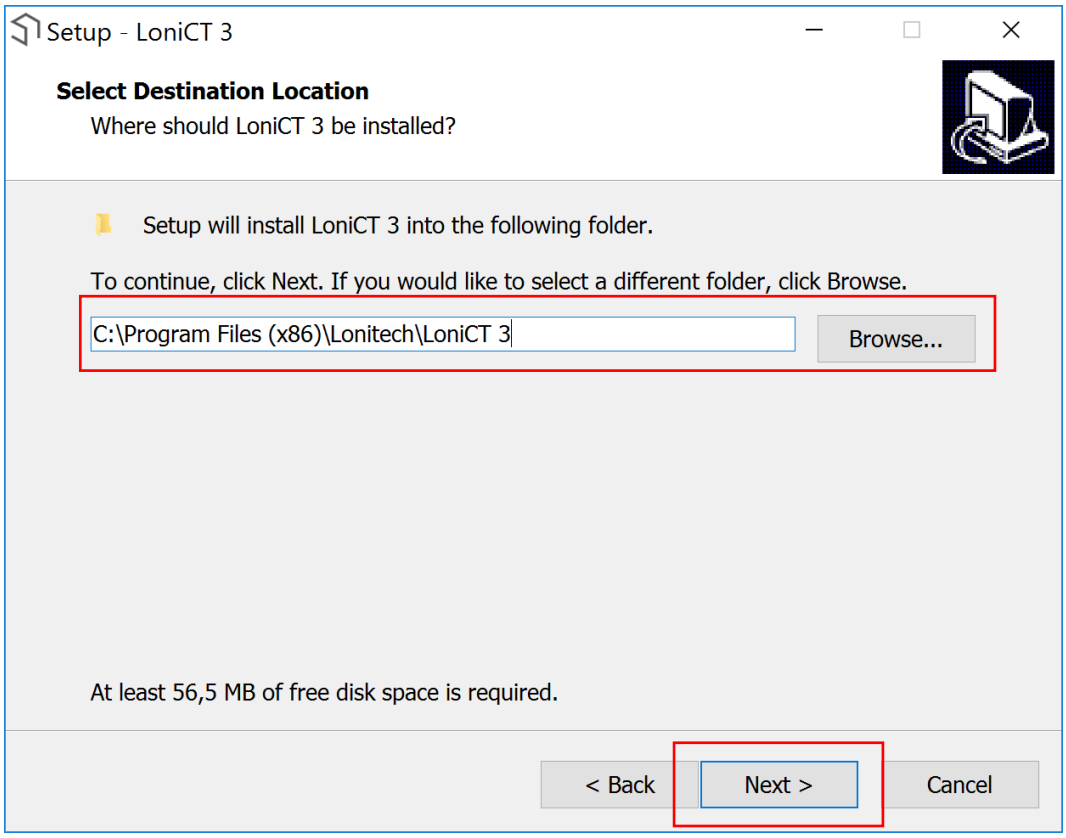



**Figure 11. LoniCT installation screen for selecting install location**

3. Select where you want to install LoniCT and click “Next”

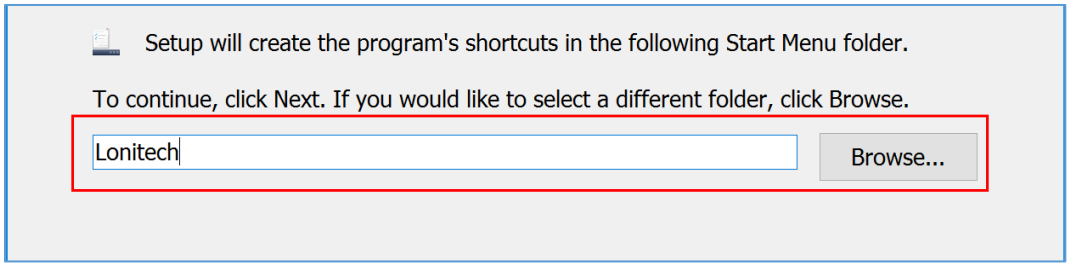



**Figure 12. LoniCT installation screen for selecting start menu folder**

4. Select a name of Start Menu folder and click “Next”

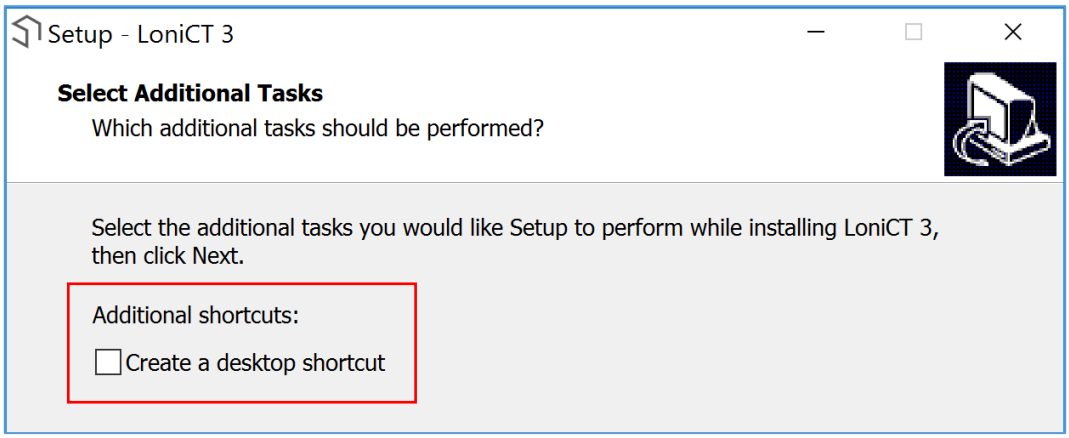



**Figure 13. LoniCT installation screen for selecting additional tasks**

5. Select if a shortcut to LoniCT should be created on the Desktop and click “Next”

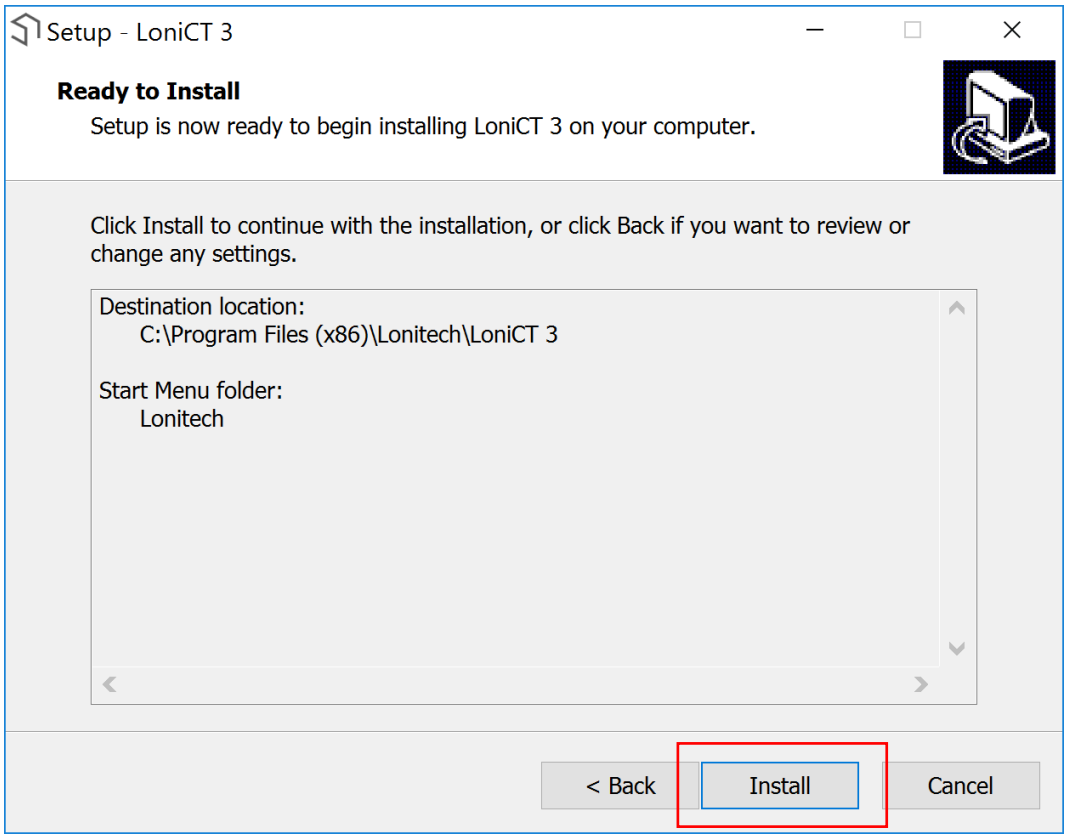



**Figure 14. LoniCT “ready to install” screen**

6. At the “Ready to Install” screen check that everything is in order and click “Install”

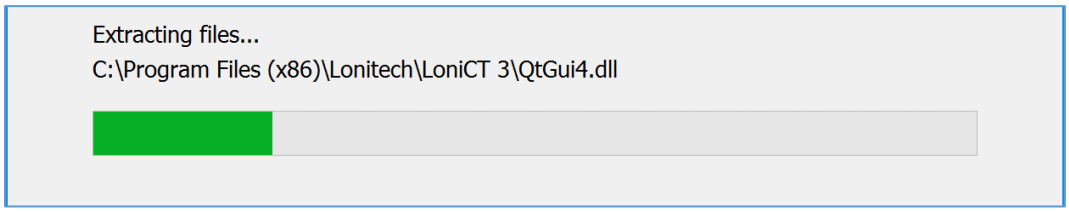



**Figure 15. LoniCT installer progress bar**

7. Wait for the installation to end

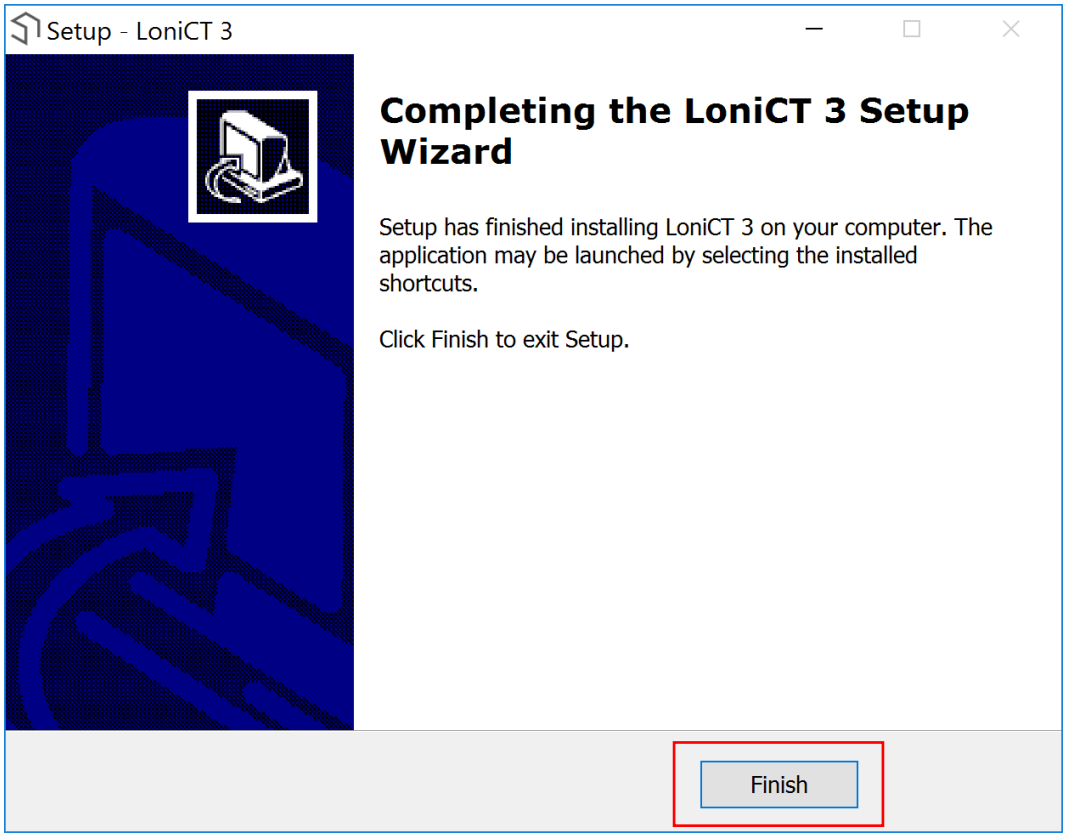
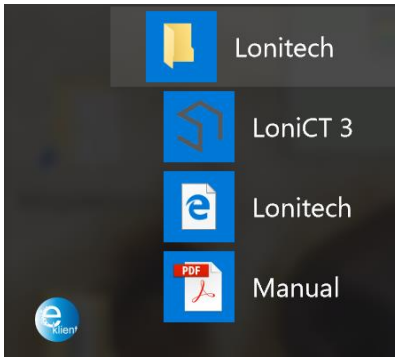



**Figure 16. LoniCT installation end window**

8. Click “Finish”

The installation of LoniCT, including drivers for the hardware, is now done and you can find shortcuts to LoniCT in the start menu and on the desktop if you chose to install one.
In the start menu you will also find a link to Lonitech.se and this manual.



### 2.4.4 Upgrading the LoniCT software

The upgrade procedure is identical to first time install as described in section 2.4.3 with exceptions for the steps involving selection of installation directory and Start Menu folder. The installer will check for previously installed versions and select the same location(s) when upgrading.

### 2.4.5 Uninstalling the LoniCT software

Use Windows “Add/Remove software” to uninstall LoniCT.

Please note that the drivers for LoniMover and LoniButton is not removed by this process, these drivers are often used for hardware from other vendors and it is not recommended to remove them.

# 3. PREPARATIONS

## 3.1 Connection

To connect the hardware to a Windows PC you need two (2) available USB sockets.

### 3.1.1 Connect the LoniMover

The LoniMover needs power and a USB-connection to work.

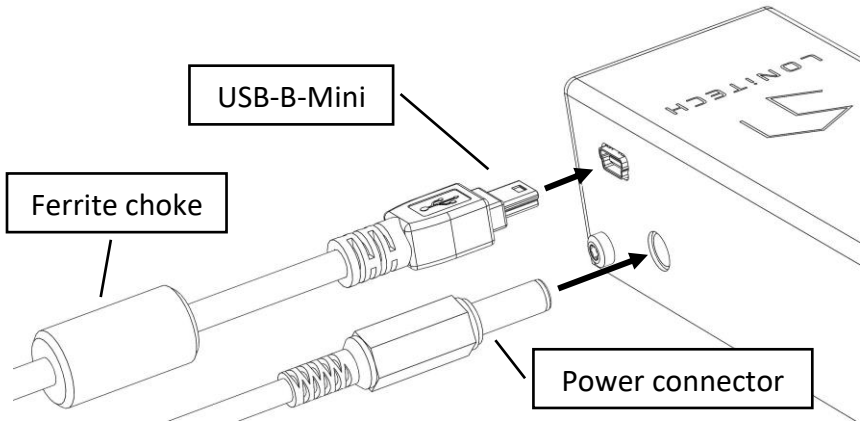



**Figure 17. Connection of the LoniMover**

LoniMover connection:

1. Connect power and USB cables to the LoniMover according to Figure 17. Make sure the cables are connected correctly before connecting the power adapter to the mains outlet
2. Connect the power adapter to the mains outlet
3. Connect the USB-cable to the Windows PC running the LoniCT software. Use supplied USB extension cable if necessary

⚠ Only use supplied power adapter and Mini USB cable with ferrite choke.

### 3.1.2 Connect the LoniButton

The LoniButton needs only a USB-connection to work.

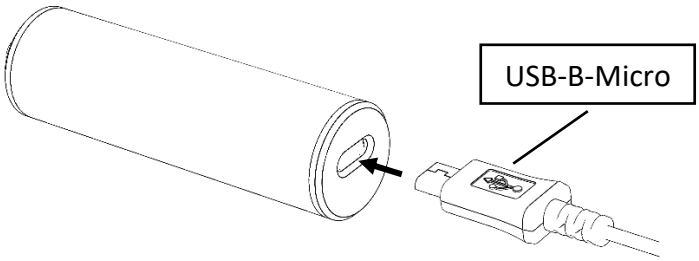



**Figure 18. Connection of the LoniButton**

LoniButton connection:

1. Connect the Micro USB cable according to Figure 18
2. Connect the USB-cable to the Windows PC running the LoniCT software

## 3.2 Mount measuring device

The LoniMover system includes a detector holder carbon fiber pipe that is adapted for the RTI CT Dose Profiler probe and RTI DCT10 Pencil Chamber.
Note the end configuration for the different probes in Figure 19.


**Figure 19. Detector holder for RTI CT Dose Profiler and RTI DCT10 Pencil Chamber**

### 3.2.1 Mount the RTI CT Dose Profiler (CTDP)

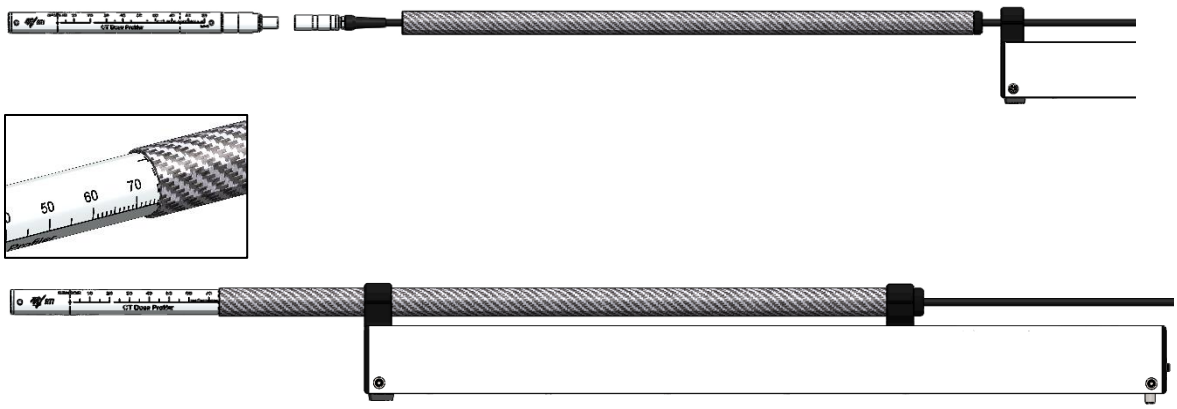



**Figure 20. Mounting the RTI CT Dose Profiler**

Mounting instructions for the RTI CTDP:

1. Insert CTDP cable with the LEMO connection first through the pipe, note direction of the pipe according to Figure 20
2. Connect the CTDP to the cable
3. Insert the CTDP in to the pipe
4. Insert the pipe through the front support of the LoniMover
5. Push the pipe through the moving part of the LoniMover, note the end position of the pipe
6. Make sure the cable is still connected to the CTDP and that the cable is free to move when the pipe is traversing without risk of disconnection from the CTDP

### 3.2.2 Mount the RTI DCT10 Pencil Chamber (PIC)

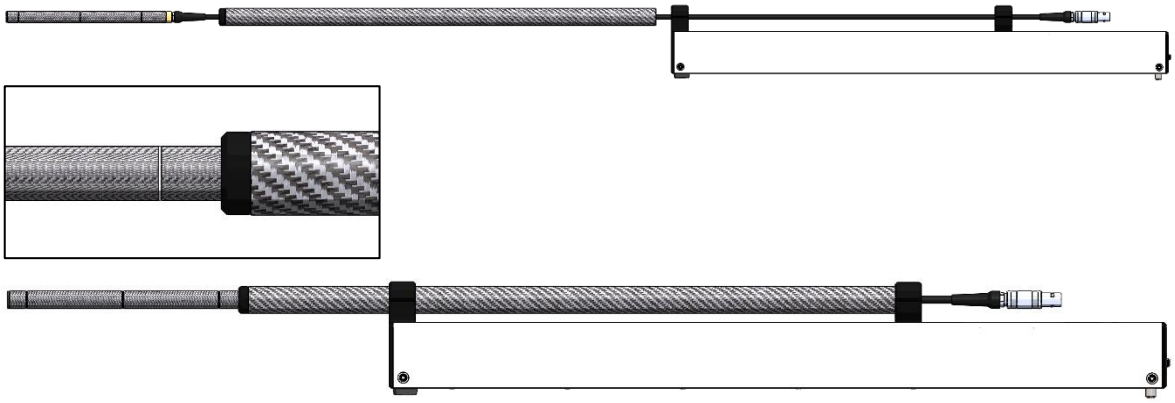


**Figure 21. Mounting the RTI DCT10 Pencil Chamber**

Mounting instructions for the RTI DCT10 Pencil Chamber (PIC):

1. Insert PIC cable with the LEMO connection through the pipe, note direction of the pipe according to Figure 21
2. Insert the PIC in to the pipe
3. Insert the pipe through the front support of the LoniMover
4. Push the pipe through the moving part of the LoniMover
5. Make sure the cable is free to move when the pipe is traversing

## 3.3 Connect hardware to software

If LoniMover and/or LoniButton is connected to the Windows PC before LoniCT software is opened, the software connects to them automatically.
If LoniCT is opened before connection of the USB cable(s) you need to connect the software manually by clicking the corresponding buttons at the bottom of the software GUI.
When the hardware is connected, the corresponding button text turns green and the text will show connection status.

# 3.4 Homing

Homing of the LoniMover is necessary for the system to know where the absolute position of the probe is. No other moves are possible before the system is homed.

Homing is only possible after the LoniMover is connected to the LoniCT software by the procedure described in chapter 3.3.

The homing sequence:

1. The probe moves backwards until homing switch is hit
2. The probe moves forward a short distance
3. Home position is set

If homing switch is already activated at start of sequence, step 1 is ignored.

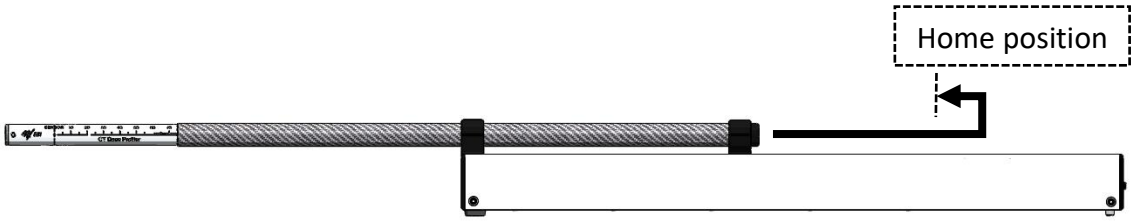
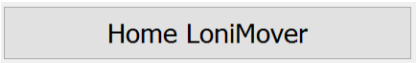



**Figure 22. Homing sequence of The LoniMover**

⚠ Before homing, make sure the travel path is clear!

To execute the homing sequence push the homing button




After completed homing sequence the homing button text turns green and the text reflects the homing status.


Homing status is preserved until power and/or USB are disconnected from the LoniMover, i.e. restarting the LoniCT software will not influence the homing status.

# 3.5 Alignment

Place the LoniMover on the CT table with the front in line with the table top edge. Do not use the table extension. Make sure the cables to the LoniMover has a secure route from the LoniMover to the PC even if the table top is moving.

## 3.5.1 Alignment using the lasers on the CT system

Put the LoniMover in Centring position.
Use the CT table and lasers to align the detector and pipe to be in the isocenter of the gantry according to Figure 23.

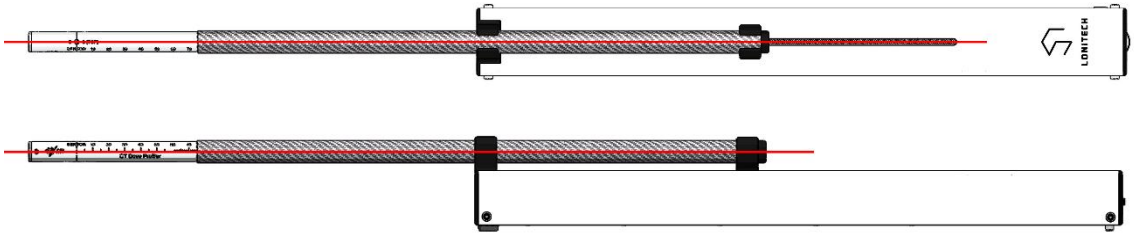


**Figure 23. Alignment of the LoniMover using the CT-lasers**

If needed, use the adjustment wheel at the back of the LoniMover to adjust angle, see chapter 3.5.2.

After alignment with the lasers it is always a good idea to take two perpendicular CT preview images of the setup and overlay a grid to verify position. Make adjustments if needed.

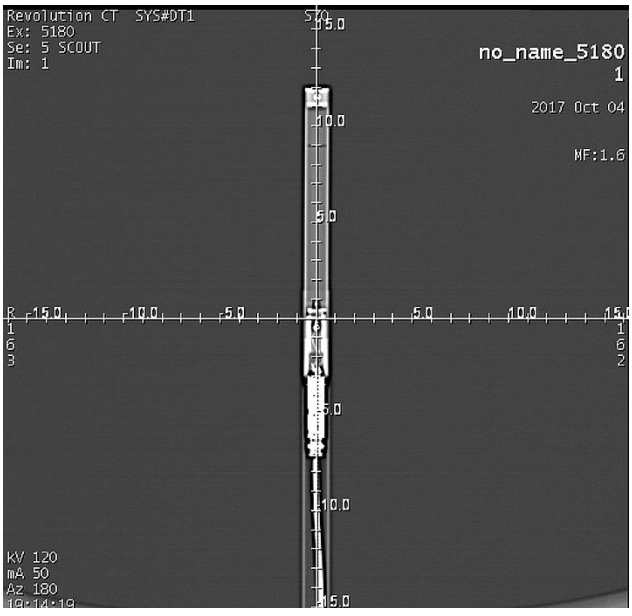



**Figure 24. CT PA-preview image with grid overlay**

## 3.5.2 Adjusting tilt angle of the LoniMover

By using the adjustment wheel at the back end of the LoniMover the angle can be adjusted.

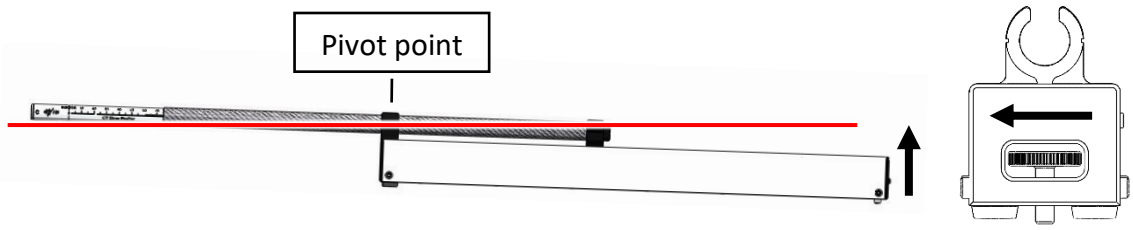



**Figure 25. Adjusting the angle of the LoniMover (example)**

# 4. MEASUREMENT WITH A POINT DETECTOR

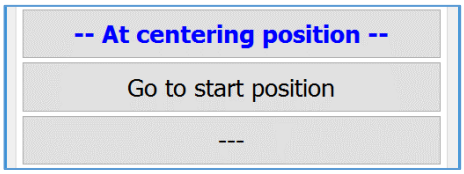
## 4.1 Preparing the system for Sweep mode

Make sure everything is connected, aligned and homed as described in chapter 3.

This chapter use the RTI Ocean, RTI CT Dose Profiler and RTI Piranha as an example off possible use of this mode (Sweep mode).

### 4.1.1 Alignment in z-direction, Sweep mode

If not active, select the “Sweep” tab in LoniCT and press the “Go to centering position” button.
When in place button text turns blue and text reflects status.




Using the table, align CTDP center of sensor with the z-laser according to Figure 26 below.

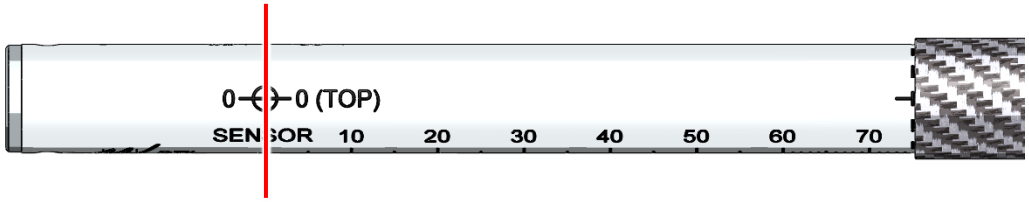


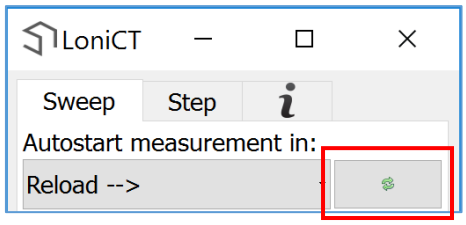

**Figure 26. CTDP alignment in z-direction**

### 4.1.2 Connect to RTI Ocean®

The LoniCT software integrates with RTI Ocean® by sending “Alt+s” to the Ocean window which will start a measurement.

Before this connection is possible you need to tell LoniCT which Ocean window to use (Ocean needs to be already open).

Click the “Reload” button to populate the dropdown.




Use the dropdown to select your Ocean window. Make sure you select the right window. Other windows with “Ocean” in their name will also be listed (i.e. explorer windows named something with Ocean).

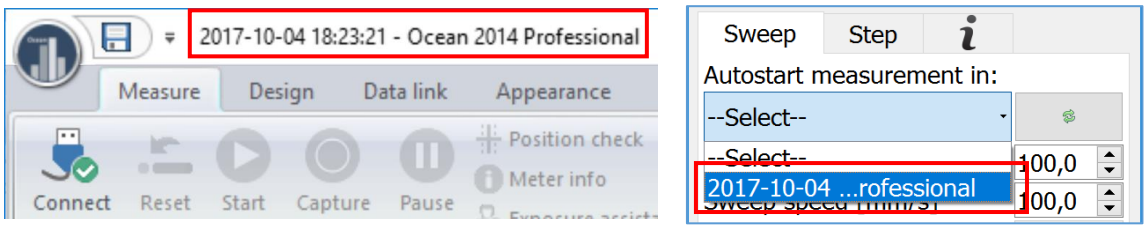



**Figure 27. Selection of Ocean window to connect LoniCT to.**

When selected, the RTI Ocean software will flash 3 times to verify that a connection is made.

Please note that if you after connection save the project in Ocean under another name the connection is lost and you have to reload and connect to the window with the newly saved file name.

### 4.1.3 Select parameters

Start by choosing a sweep range greater than the nominal collimation. For CTDI measurements don't use shorter range than 100 mm.

Depending on template used, RTI Ocean needs to know either travel speed or pitch in combination with rotation time (which in turn gives the travel speed).

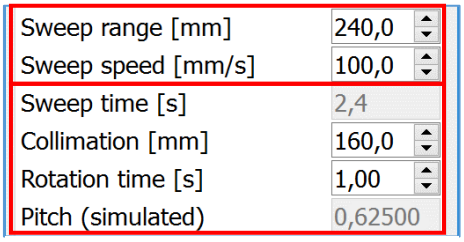



**Figure 28. Parameter selection for sweep mode**

A good starting point for Travel speed is 100 mm/s. At this speed even the maximum range of 240 mm is covered in less than 3 seconds which is the measurement time for RTI Oceans fastest sample rate. See the manual for RTI Ocean for more information about sample rates in Ocean.

By specifying the nominal collimation and a rotation time the LoniCT software calculates some useful parameters for us in RTI Ocean.

The rotation time does not have to be the true rotation time but the same value should be used in Ocean.

Summary | Gemotric Efficiency | Site

| View / Select | # | Set kV (kV) | Collimation (mm) | Pitch | Scan time (s) | Scan length (mm) | Tube rotation time (s) | Scan speed (mm/s) | Measuring time (s) | Exposure (mGy) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 14 | 120,0 | 160 | 0,625 | 10,0 | 100 | 1,00 | 100,00 | 3 | 27,44 |
| | 15 | 120,0 | 160 | 0,625 | 10,0 | 100 | 1,00 | 100,00 | 3 | 27,45 |

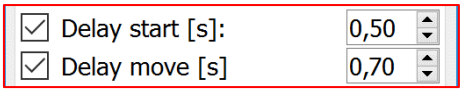
**Figure 29. Example parameter setup in RTI Ocean using the default "Geometric Efficiency" template**

The example RTI Ocean template in Figure 29 needs Collimation, Pitch and Tube rotation time to calculate the Scan speed. Transfer these values from LoniCT and make sure the calculated Scan speed is equal to selected Sweep speed in LoniCT.

Check that the Measuring time is longer than reported Sweep time in LoniCT. Scan time and Scan length is not used for calculations and can be left at default values.

### 4.1.4 Timing adjustments

Depending on margins on sweep range and delays in exposure there is a need for timing adjustments.




“Delay start” is used when there is a delay between activation of the exposure button on the CT system and actual exposure.

“Delay move” is only possible if RTI Ocean is connected (section 4.1.2) and this delay is added after Ocean is triggered to start a measurement.

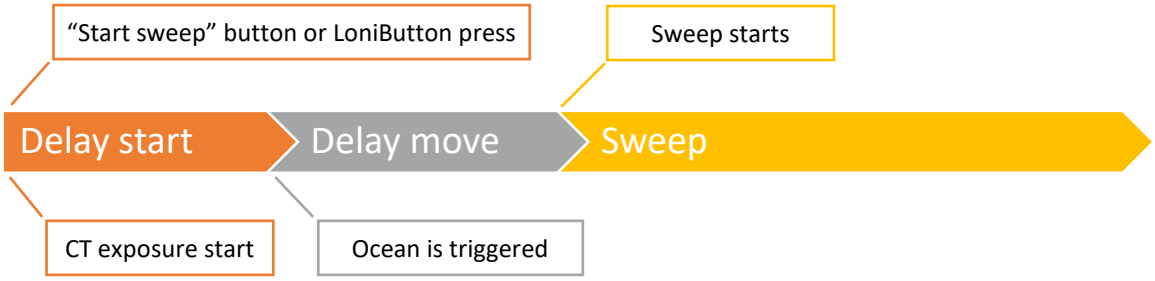



**Figure 30. Timing sequence**

If the dose profile generated by RTI Ocean during a Sweep is clipped at the left flank (i.e. a vertical left flank) there is a possibility that the CT exposure started after the Sweep and measurement. By adjusting the “Delay start” you give the CT time to actually start the exposure before Sweep.

When using manual start of CT exposure and LoniCT Sweep (section 4.2.4 below) this delay can be achieved by first pushing the CT exposure button, wait, and then click “Start sweep” button in LoniCT. The “Delay start” parameter can then be disabled.

If the dose profile generated by RTI Ocean during a Sweep is shifted far to the left the “Delay move” parameter will move it to the right at next measurement.
If using a Bluetooth link between RTI Ocean and the RTI Piranha the delay is greater than if using a USB link.

## 4.2 Measurement using Sweep mode

Consult the RTI Ocean manual for setting up a session for CTDP measurements using a spiral scan.

### 4.2.1 Set up the CT for Sweep mode

The LoniMover system is simulating the table movement during a spiral scan so the CT should be set up to only do axial scans without table movement.

Select scan parameters according to what you are about to measure/verify.

Make sure the exposure time is long enough to accommodate the whole sweep, with some margin (see Sweep time parameter in LoniCT). Use sine mode on CT to gain longer exposure times with stationary table. If sine mode is not possible use faster Sweep speed (not recommended due to lower resolution).

### 4.2.2 Prepare LoniMover for Sweep

If not in “Start position” (LoniButton is blue) push the LoniButton or the “Go to start position” button in the LoniCT software.

When in Start position the LoniButton is green and the LoniCT software buttons show that a Sweep is possible. See Figure 31.

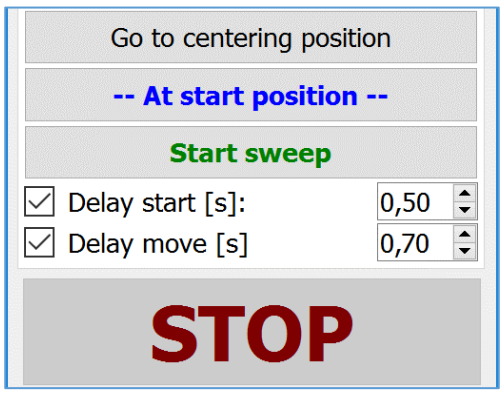



**Figure 31. LoniCT ready for Sweep**

### 4.2.3 Sweep measurement using the LoniButton

1. Prepare RTI Ocean for measurement and activate relevant row in template
2. Prepare the CT
3. Make sure the LoniMover is in start position (green light)
4. Use the LoniButton to press down the exposure button on the CT console

At stage 4 the CT starts the scan, LoniCT tells RTI Ocean to start a measurement (after a delay if active) and LoniCT then starts the Sweep (after another delay if active).

During Sweep the LoniButton signals red (E-stop if pressed) and at the end of Sweep it turns blue, signaling that a push will return the LoniMover to the start position ready for another measurement.

### 4.2.4 Sweep measurement using your mouse

1. Prepare RTI Ocean for measurement and activate relevant row in template
2. Prepare the CT
3. Make sure the LoniMover is in start position (Figure 32)
4. Press the exposure button on the CT
5. Klick the “Start sweep” button in the LoniCT software

At stage 4 the CT starts the scan and at stage 5, LoniCT tells RTI Ocean to start a measurement (after a delay if active) and LoniCT then starts the Sweep (after another delay if active).

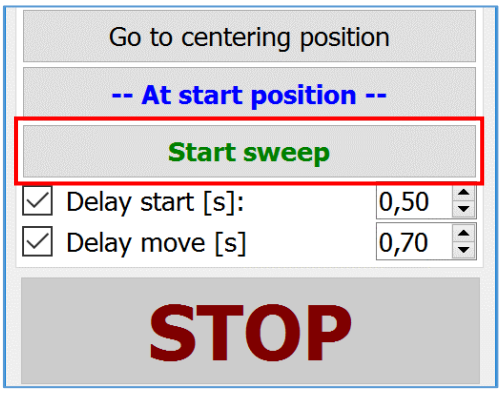



**Figure 32. LoniCT manual start**

During Sweep the STOP button can be used as E-stop.
At the end of Sweep push the “Go to start position” button and the LoniMover will return to the start position ready for another measurement.

# 5. MEASUREMENT WITH A PENCIL IONIZATION CHAMBER

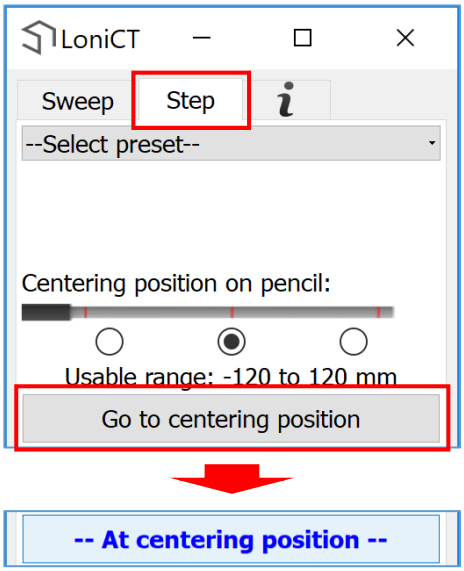
## 5.1 Preparing the system for Step mode

Make sure everything is connected, aligned and homed as described in chapter 3.

This chapter explain how to use the LoniMover system for step-and-shoot with a generic pencil ionization chamber (PIC).

### 5.1.1 Alignment in z-direction, Step mode

If not active, select the “Step” tab in LoniCT and press the “Go to centering position” button.
When in place button text turns blue and text reflects status.



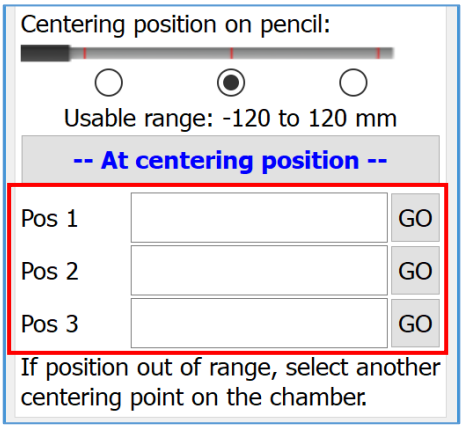

Using the table, align CTDP center of sensor with the z-laser according to Figure 33 below.

See section 5.1.3 for alternate ways to center for more stroke (in one direction).

**Figure 33. Alignment of PIC in z-direction**

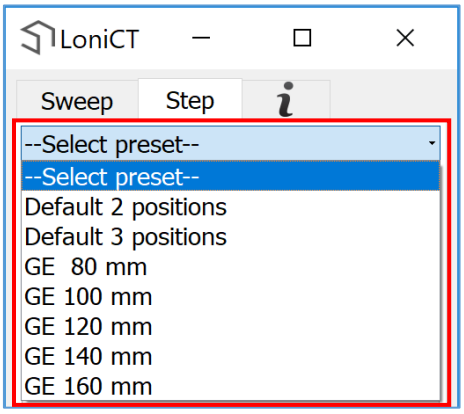
## 5.1.2 Define positions

Positions can be freely selected (within usable range) by entering positions (mm) in the fields “Pos 1” to “Pos 3”. You don’t need to use all the fields.



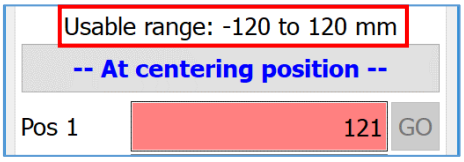

Please note that these positions are relative to the position where the PIC center is centered in the field. See section 5.1.3 for explanation.

Instead of entering positions manually you can use the dropdown to select preset positions based on IAEA [2] and GE Revolution CT recommended positions [5]




The “Default” positions are based on IAEA recommended positons, see Table 1.

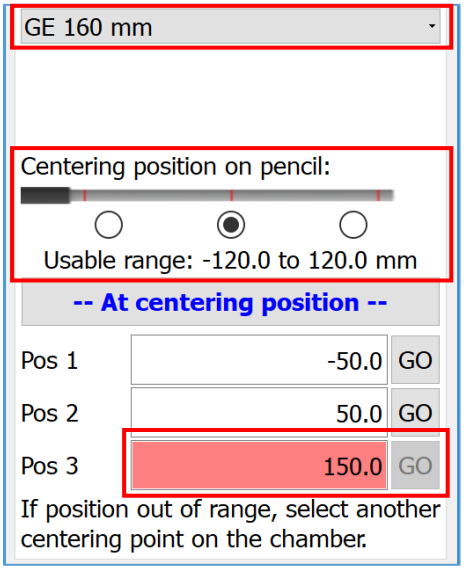
If you (or a preset) enters a position that is out of range the corresponding field turns red.




To center for longer range in one direction see section 5.1.3.

## 5.1.3 Using offset to gain range

In some situations you may need longer range/stroke than the LoniMover permits.




One example is the GE recommended positions for their 160 mm nominal collimation which is -50/50/**150** mm respectively [5].
The LoniMover maximum range is ±120 mm. To circumvent this you can select another centering point on your PIC and get more range in either direction according to Figure 34 below.

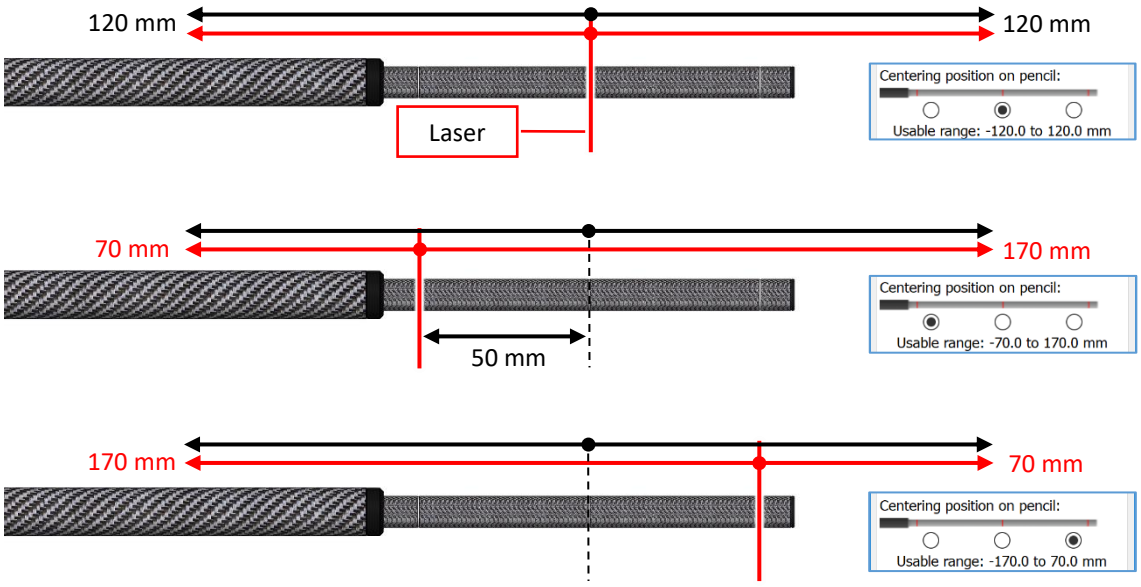



**Figure 34. Alternate centring positions and effect on range**

In Figure 34 the black arrows represent the physical range of the LoniMover from the absolute centering position, the possible range is always ±120 mm.
The red arrows/text are relative the laser (center of beam).

If you at alignment (section 5.1.1) choose to align the laser at the inner or outer marks of the PIC (±50 mm relative the center of the PIC) you gain range in either direction according to Figure 34 (and loose range in the other direction).

Please note that the software takes care of the offset calculations if you select the corresponding “Centering position on pencil” radio button and the positions are always relative the laser (center of beam).

Note that you have to realign the system physically according to section 5.1.1 and use a centering point on the PIC according to Figure 34 for this to work.

## 5.2 Measurement using Step mode

### 5.2.1 Set up the CT for Step mode

The LoniMover system advances the PIC through the CT beam in steps, the CT should be set up to do axial scans without table movement. At least as many exposures as positions used.

Select scan parameters according to what you are about to measure/verify.

### 5.2.2 Step mode measurement

1. Prepare the PIC measuring system for measurement
2. Prepare the CT (at least as many scans w/o table movement as positions)
3. Select positions to measure
4. Push the “Go” button to the right of the relevant position
5. Wait for the LoniMover to get into position, the “Go” text turns blue when ready
6. Make an exposure and collect the dose data from your PIC system
7. Repeat steps 4 through 6 for the other positions
8. Calculate $CTDI_{free\ air}$ according to praxis [2]

# 6. GENERAL INFORMATION

## 6.1 Maintenance

The LoniMover is a precision instrument and should be treated as such. Make sure that nothing falls into the mechanism and keep the product free of dust.
If necessary, clean with a slightly damp cloth.

The product does not contain any parts that can be serviced. Warranty is voided if product repair is attempted by the end user.

## 6.2 Storage and transport

The product should be stored in its carrying case when not used and during transport.

## 6.3 Troubleshooting

| Symptom | Cause | Actions to try in priority order |
|---|---|---|
| The LoniMover is connected but the LoniMover does not react to commands | USB connection lost | 1. Push LoniMover connection button<br>2. Disconnect and reconnect power and USB to the LoniMover and push the LoniMover connection button<br>3. Restart the LoniCT software |
| At move commands, the LoniMover is not moving and a loud noise is coming from the LoniMover. This is called “stalling”. | The resistance is too high for the system to move | 1. Make sure the travel path is clear<br>2. Only use supplied detector holders and recommended detectors<br>3. Dirt in the mechanism could cause the resistance to be too high. Please contact your supplier for cleaning/repair<br>Always perform homing after a stall. |
| The LoniButton does not trigger a move command | The LoniButton is not connected or the button is not pushed hard enough | Reconnect the LoniButton (USB and button in LoniCT)<br>Push the button harder and make sure the button is pushed straight |

**Table 3. Troubleshooting tips**

# 7. SPECIFICATIONS & CONFORMITY

| Performance | |
|---|---|
| Range | Up to 240 mm |
| Speed | 50 – 150 mm/s |
| Speed accuracy | ±1 % |
| Position accuracy | 0.05 mm |
| Acceleration time | 40 ms |
| **General** | |
| Communication | USB 2.0 (x2) |
| Software platform | Windows |
| Dimensions (L x W x H) | 404 x 41 x 58 mm |
| Weight | 0.8 kg |
| Force | <20 N |
| Power source | Power adapter, 24 VDC, 48 W |
| **Environmental** | |
| Storage temperature | -20°C – 50°C / 0°F – 120°F |
| Operating temperature | Normal indoor conditions |

**Table 4. Specifications**

### A note on acceleration/deceleration

The LoniMover uses acceleration and deceleration at the beginning and end of a movement. The acceleration/deceleration is linear and always 40 ms regardless of the target speed. This makes the first and last 40 ms of the sweep not suitable for precise measurements. This is usually no problem if a slightly longer range than needed is used.


**Figure 35. Speed profile during Sweep**

| Set speed [mm/s] | Acceleration distance |
|---|---|
| 50 | 1 mm |
| 150 | 3 mm |

**Table 5. Acceleration distances depending on set speed**

# 7.1 Declaration of Conformity

Herewith, Lonitech ensure that The LoniMover is designed and manufactured in accordance with good technical practice to comply with the basic health and safety requirements in the following Directive:

2006/42/EC Machinery Directive

CE

# 8. REFERENCES

This section contains references and other information suitable for reading if you are interested in CT measurements.

[1] Wikipedia, "Computed tomography dose index," [Online]. Available: https://en.wikipedia.org/wiki/Computed_tomography_dose_index.

[2] International Electrotechnical Commission (IEC), "Medical Electrical Equipment - Part 2-44 Edition 3 Amendment 1: Particular requirements for basic safety and essential performance of X-ray equipment for computed tomography, IEC 60601–2–44 Ed. 3:A1," IEC, Geneva, 2012.

[3] I. A. E. A. (IAEA), ”Human Health Reports No. 5: Status of computed tomography dosimetry for wide cone beam scanners,” IAEA, Vienna, 2011.

[4] R. Bujila, L. Kull, M. Danielsson och J. Andersson, ”Applying three different methods of measuring CTDI(free air) to the extended CTDI formalism for wide beam scanners (IEC 60601–2–44): A comparative study”.

[5] GE Healthcare, ”Revolution™ CT Technical Reference Manual Direction 5443887-1EN, Revision 3,” GE Healthcare, 2015.

# INDEX

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