

User guide Makin' Excavator 2D

Version 2.19



MAKIN' 3D
MACHINE CONTROL

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Contact the manufacturer:

Makin AS
Ingelsrudvegen 350
2324 Vang H.
NORWAY

www.Makin3D.com

E-mail: info@Makin3D.com

Org. no. 920 323 650

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1. Introduction

1.1. Congratulations on your new product

You are now ready to work more efficiently and keep the precision at an optimum level. Besides that, you will be more eco-friendly by doing the same amount of work in less time.

The system is designed to show you the information you need on the screen with the greatest accuracy.

At the construction site, you are the expert - Makin' 3D is the best work companion the excavator operator can get.

We at Team Makin wish you all the best with the use of your new system.

1.2. Maintenance

It is recommended to check the system's accuracy regularly. We recommend that the operator of the machine frequently checks the positioning against a known point on every job site. See chapter 7, *How to check calibration*.

1.3. Storage

Keep the equipment safe when it's not installed in the machine. Use of a protective case is recommended if the tablet and antennas are removed from the machine to secure the devices from external stresses such as knocks and bumps.

1.4. Cleaning

The equipment must be cleaned regularly to ensure full functionality over time.

Cleaning is done by blowing to remove dust, you can also choose to use a damp cloth to wipe the tablet.

Under no circumstances should the equipment be high-pressure washed - neither inside nor outside the engine compartment.

2. Responsibility

2.1. Installation

All installation and main calibration of the system must be carried out by Makin approved technical personnel. Failure caused by unauthorized installation or repair could cause a void of warranty.

It is important to follow the machine manufacturer's instructions for installing the Makin machine control system to avoid violating any machine supplier's warranty regulations.

The user is responsible for the product being used in accordance with the given instructions. The user is also responsible for ensuring that the reference models used are correct and that the bucket is properly calibrated and controlled.

Broken cables on the system may cause short circuits, system errors, and cause defective components. Ensure that no cables have external damage, damage must be repaired immediately before further use.

Errors in measurement results may occur if the equipment has been subject to impact, abuse, modification, or transport damage. Control of the system after such events is important to ensure an optimum result.

Warranty: For further details visit www.Makin3D.com for more information.

2.2. Limitations

The product is intended as a control tool for machine operators and any use beyond this is not permitted. The supplier or manufacturer cannot be held responsible for any use that goes beyond the given limits.

2.3. End-user license agreement

License: The system is preloaded with software, this can also be downloaded with permission from Makin. The software is protected by copyright and other laws. The use of the software is governed by the license agreement entered into the Makin' 3D system when purchasing the product.

For further legal terms and conditions, including but not limited to the applicable End User License Agreement between you and Makin, we refer you to visit Makin website, www.Makin3D.com.

2.4 Warranty disclaimer

Makin provides this documentation without warranty, term, or condition of any kind, either implied or expressed, including, but not limited to, the implied warranties, terms or conditions of merchantability, satisfactory quality, and fitness for a particular purpose.

Makin, its employees, and agents will not be responsible for any loss, however arising, from the use of, or reliance on this information.

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2.5. Software update

Software will automatically and frequently be updated and users will get a notification on the screen. Software updates require a valid Maintenance license. To start downloading an updated software version, users will be asked to agree before the download starts.

3. Compliance information

3.1. EU/Compliance

Makin hereby declares that the system and its components comply with the essential requirements and other relevant regulations of the Directives below.

3.2. 2014/30/EU

The EMC Directive limits electromagnetic emissions of equipment in order to ensure that, when used as intended, such equipment does not disturb radio and telecommunication as well as other equipment.

The directive also governs the immunity of such equipment to interference and seeks to ensure that this equipment is not disturbed by radio emissions when used as intended.

3.4. 2011/65/EU

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

3.5. 2006/42/EC

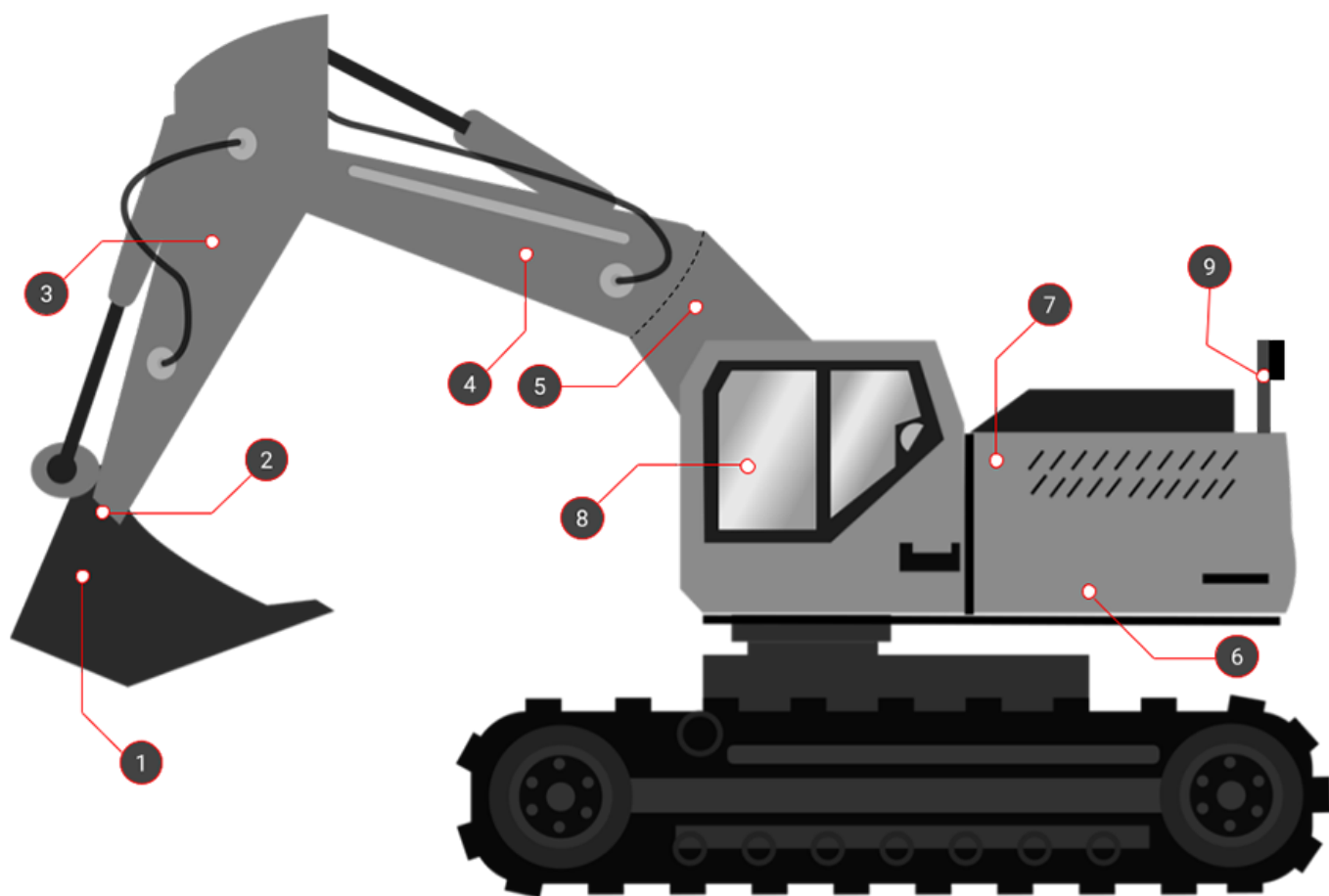
Machinery safety (MD)

3.6. ISO-13766-2006

The system has been tested and passed the EMC test. Earthmoving machinery.

4.1. Hardware Excavator 2D

Hardware overview



Bucket angle sensor

Machine sloping sensors

Tilt sensor for sideways
bucket angle. 360-degree
tilt-rotator (Optional)

Interface Box for system
power and data
communication

Stick angle sensor

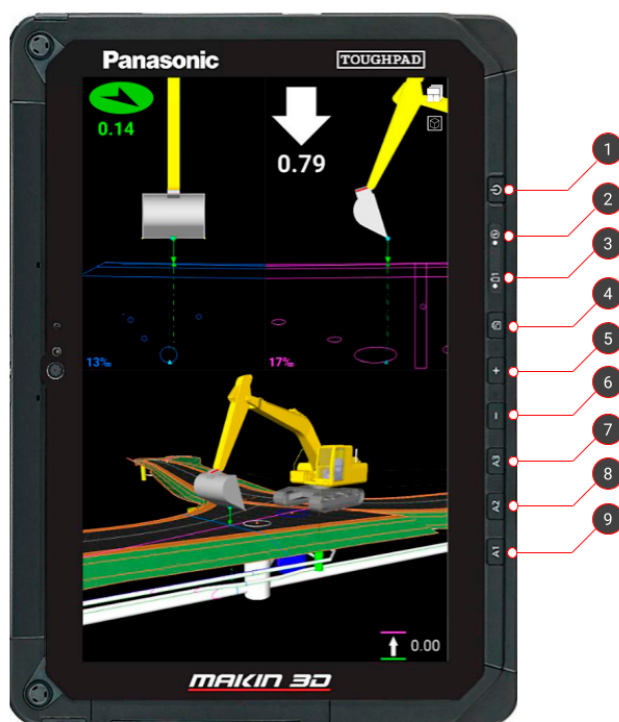
Tablet w. machine control
software

Boom height sensor

Compass

City boom sensor (Optional)

Tablet buttons and light indicators



On/Off button

Volume down

Power indicator

- No light: System is off
- Green light: System is on
- Blinking green light: Tablet in sleep mode

Not in use. Button can be programmed (more info below).

Charging indicator

- No light: External power source not connected
- Red light: Battery power is critically low. External power source not connected.

Not in use. Button can be programmed (more info below).

- Orange light: Tablet is currently charging
- Green light: Tablet fully charged

Auto-rotate screen. Button can be programmed (more info below).

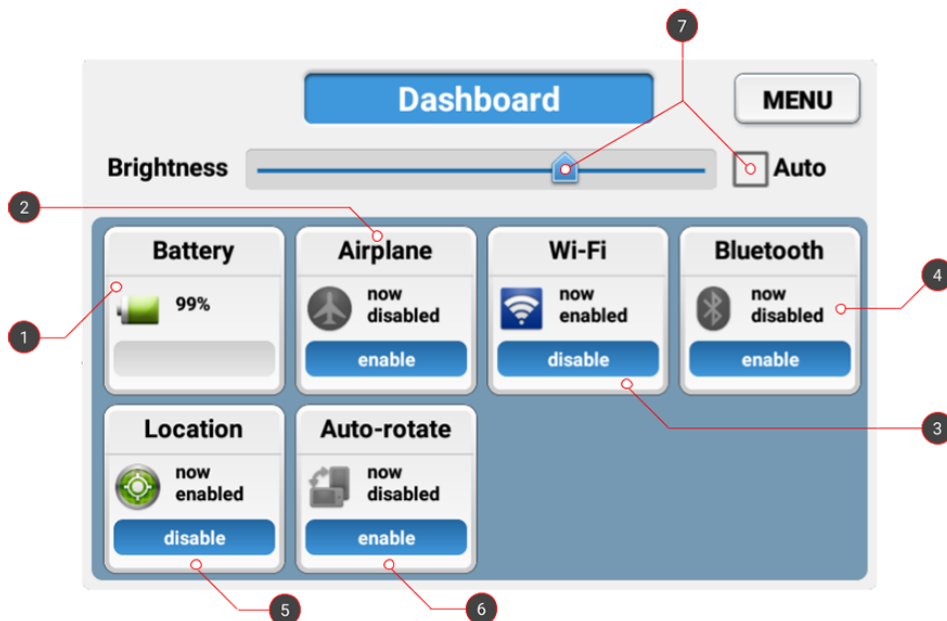
Basic tablet functionality via the 'Dashboard' app. Button can be programmed (more info below).

Volume up

Additionally, screenshots can be taken by pressing the 'On/Off button' and 'Volume down' (simultaneously holding down buttons 1 and 6 for about two seconds). This can be useful in the unfortunate case that assistance is required. Find the screenshots via the 'Foto' app.

Controlling basic tablet functionality

On the tablet, press the physical button labeled A1 to bring up the 'Dashboard' app, from which you can control the basic functionality of the tablet's hardware.



The battery indicator shows the remaining battery power of the tablet

Turn on/turn off the location service

Turn on/turn off Airplane mode

Turn on/turn off automatic screen rotation

Turn on/turn off WiFi radio

Screen brightness
adjustments

Turn on/turn off Bluetooth
radio

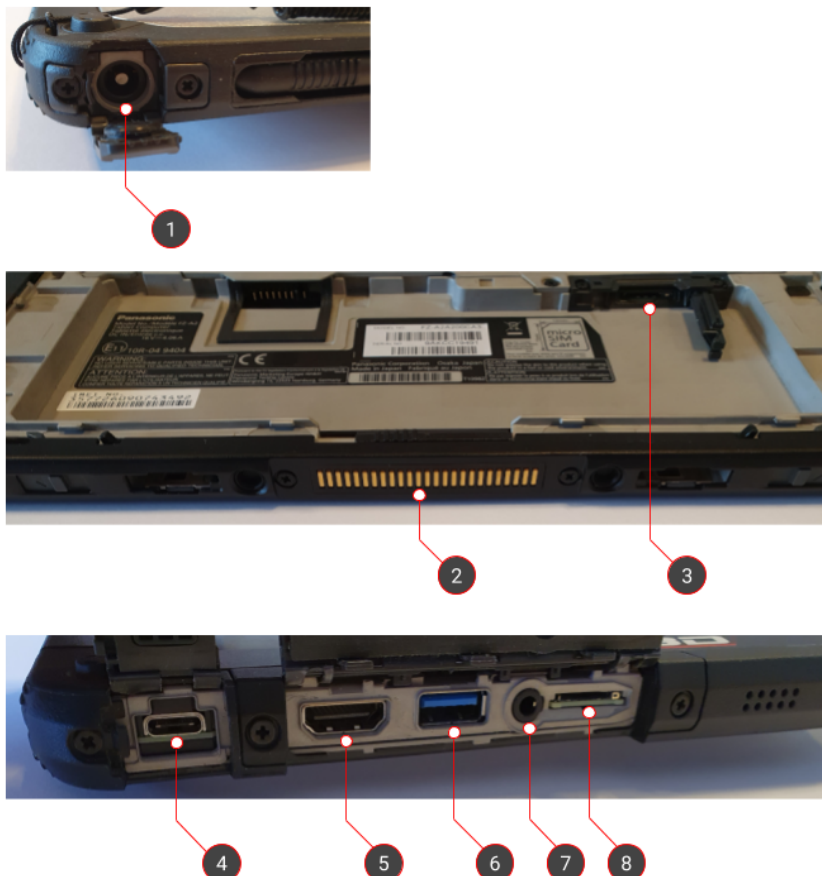
Programming the physical tablet buttons

Through an app called 'UserButtonManager', some of the physical buttons of the tablet can be easily programmed. These are called A1, A2, A3 and Rotate Lock in the app and correspond respectively to buttons 9, 8, 7, and 4 mentioned above.

By default, A1 launches the 'Dashboard' app and Rotate Lock toggles 'Auto-rotate'.

Tablet Panasonic FZ-A3 connections

The Panasonic FZ-A3 has connectors on the top, on the side, inside the battery compartment, and at the bottom.



16 V DC input power for
external charger

HDMI output to external
screen

Docking station connector
for data and power
transmission

SuperSpeed USB-A 3.0

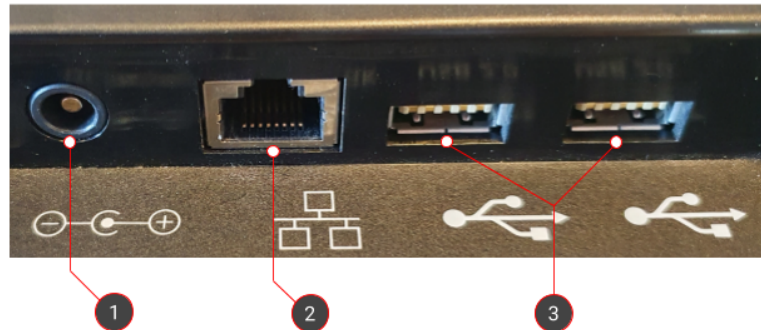
Micro SIM card for
broadband internet on both
tablet and GNSS receiver

Mini-jack audio output

USB-C

Micro SD for extended
storage

Docking station connections



16 V DC input power for
external charger

RJ-45 Ethernet

2x HighSpeed USB-A 2.0

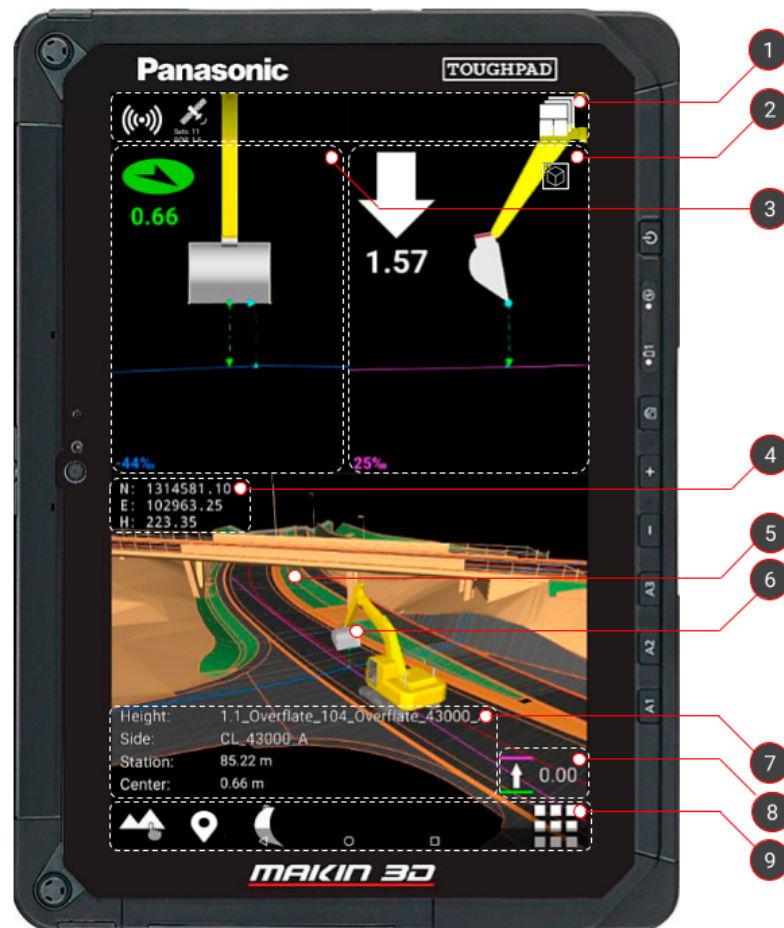
4.2. Software

How to turn the system on

- Turn on your Makin' 3D system by pressing the on/off button on the tablet. Android will start up and present the 'Lock screen'.
- Swipe upwards with one finger on the touchscreen to access Makin' 3D.
- If no project has been previously loaded, you will be prompted to do so. See 5.1. under 'Open or create a project'.

Elements of the runscreen

Makin' 3D has many different screens to choose between. Below is an explanation of one that contains most of the visual features available.



Top bar with status indicators for connectivity. It also contains features for resetting the pan and zoom level as well as changing between screens.

Tap the bucket/pole/tablet (also in the static views) to change or calibrate the machine's bucket or change pole/tablet height.

Indication of the slope in the main direction of the tool point. The arrow indicates the vertical distance to the selected height reference. The arrow will change color depending on the distance to the target. Tap the

indicator to change the height tolerances.

Indication of the slope in the cross direction of the tool point. The arrow indicates the horizontal distance to the selected side reference. The arrow will change color depending on the distance to the target. Tap the indicator to change the side distance tolerances.

Station: Indicate where on the centerline you are located. To the right of the Station, you can see the slope along the road

CL: Distance to centerline. To the right of the CL, you can see the slope across the road.

Height: Name of current Height Reference

Side: Name of the current Side Reference.

Info bar for Easting, Northing and Height coordinates.

Change the height offset according to the current reference - e.g. the specified plane or the loaded model file.

Tap any element in the loaded 3D model to bring up the References dialog.

Quick keys are shortcuts to features found in the menu.

Touch gestures



Use one finger to rotate a 3D View.



Use two fingers to pan a Top View or 3D View.



Spread or pinch two fingers to respectively zoom in or out a Top View or 3D View.



Tap to select.



Sometimes it is possible to long-hold for further options.

Symbols in the top bar



Indicating connection to the internet. The symbol appears white when connection is established and grey if no connection.



Indicates the number of visible satellites. The dilution of precision (DOP) as well as the coordinate quality (CQ) state how errors in measurements will affect the final estimation. Generally, DOP should be kept under 1.0 and CQ below 4 to maintain the highest possible confidence level. Tapping the icon will bring you to the GNSS settings.



Indication of synchronization of data between server and machine.



An indication that you have remote support from Makin.

This will usually be in connection to a remote support case where you will be notified.



Bring your machine back to the center of your screen after zooming and panning.



Placed in the upper right corner. Tap for change of screen, depending on the work you are doing, and what you want to have in focus.



Toggles between 2D (top view) and 3D view. This button is always placed in the runscreen that it toggles



Indicating project offset. The symbol appears when a project offset is applied to the active project

Shortcuts in the quick keys menu



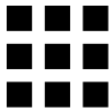
Tap to access the 'References' dialog. Another way to access this dialog is to select an element in the 3D model. Long hold to access the 'Project' menu.



The name of the current point code is shown on the icon's label. Tap to quickly log a point, which will be stored alongside general as-built data. Long hold to access 'Point codes'. You need to select a point code before logging a point.



Both the width and name of the bucket are shown on the icon's label. Tap to access the 'Bucket' dialog.



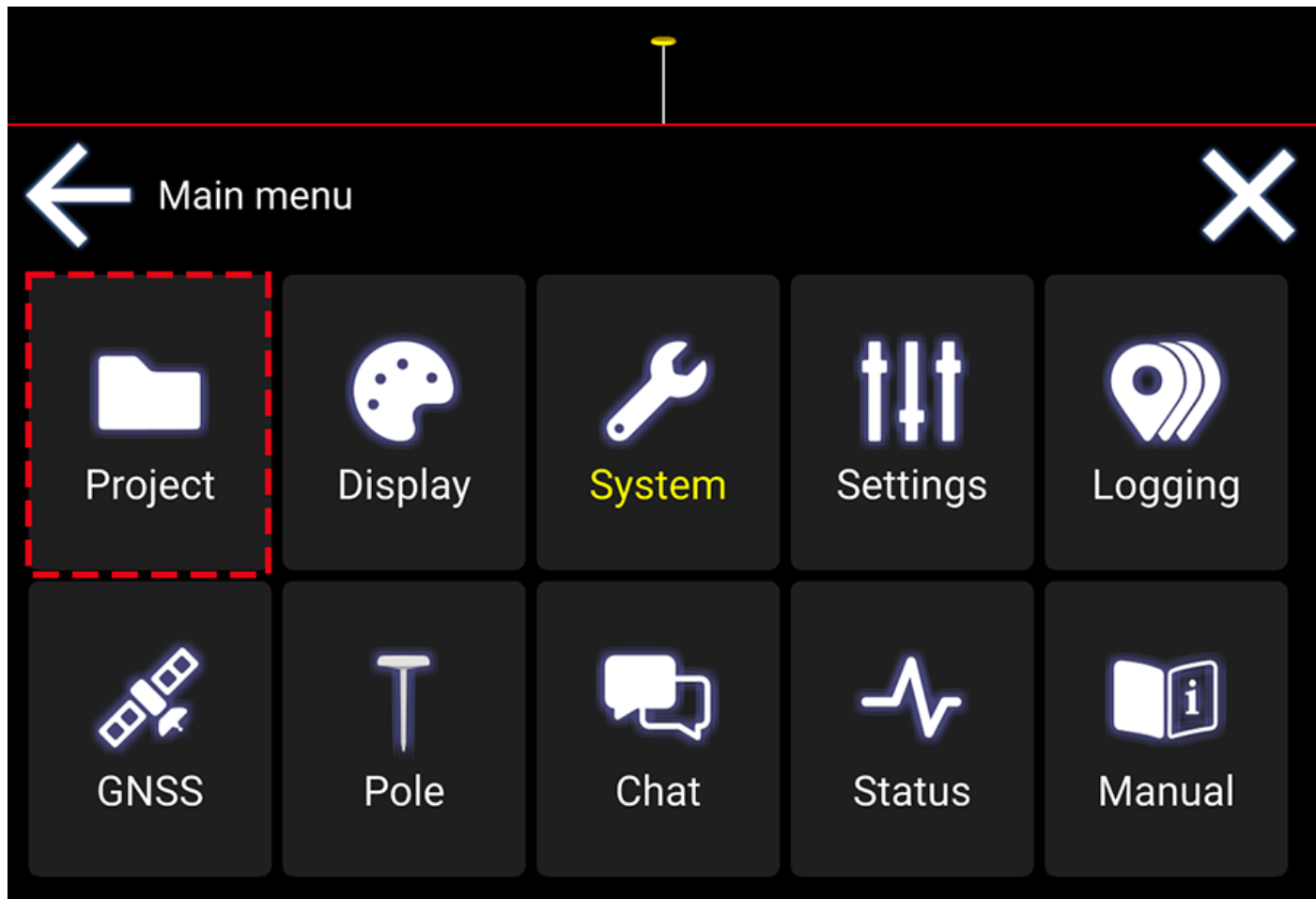
Menu, from where you can access all features of the system.

5. Menu

Project

Menu > Project

Working according to any kind of design is considered a project, whether it being a simple relative plane or referencing lines and surfaces in more complex 3D models.



Display

Show maps

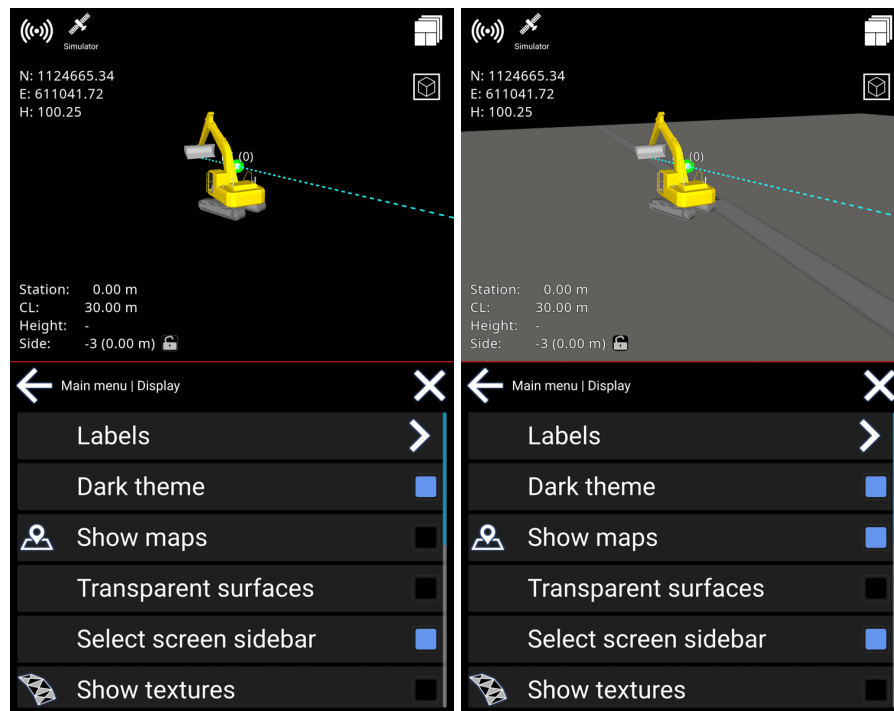
Menu > Display > Show maps

The user can hide or show maps together with the project to get a better overview. The map will be shown below the lowest active 3D reference in the project.

The tool cuts are shown on the map in Top View. Otherwise, tool cuts are only shown on elements of the 3D model marked as a height reference.

Note: In the 3D View, the map will be seen in a perspective view. If you want to see it straight from above, use the Top View instead.

- Tap to select/deselect visibility of map



Auto hide quick keys

Menu > Display > Auto hide quick keys

Auto Hide Quick Keys will hide the “quick keys” at the bottom of the screen after about 8 seconds of not touching the display.

When you touch the display they become visible again. It will give you a more clean view of what you are working on when icons are hidden.

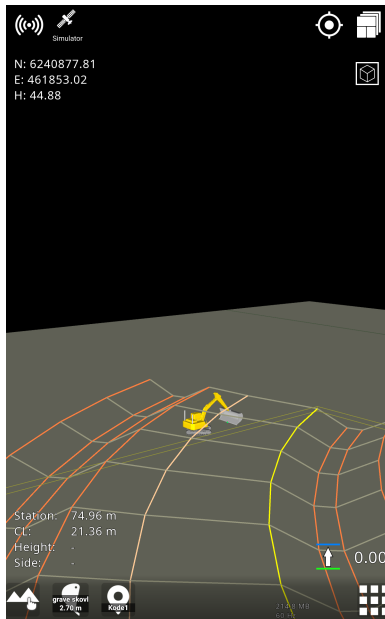
Transparent surfaces

Menu > Display > Transparent surfaces

Hide the surfaces to be able to see lines and points beneath them.

Note: Surfaces with textures will not be transparent.

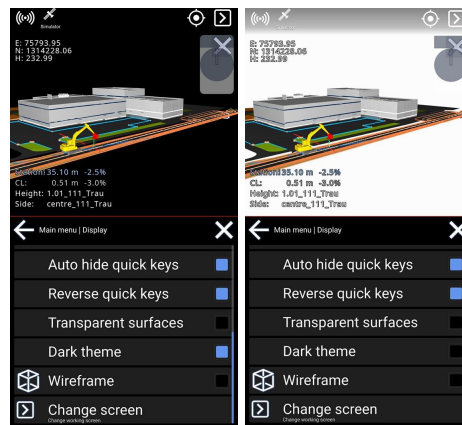
Warning: Reference selection is not visible when transparent surface is enabled.



Dark theme

Menu > Display > Dark theme

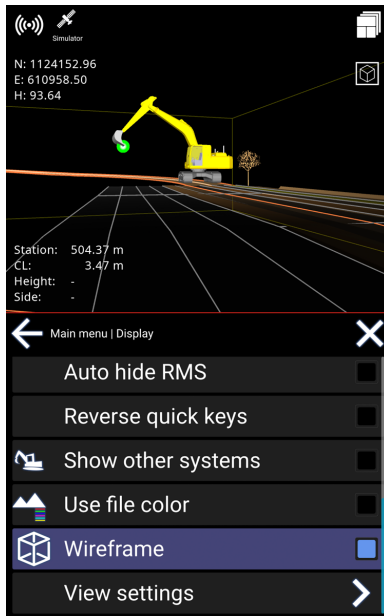
By default, the machine control system has the 'Dark theme' enabled, which is great at night time or when working in dimmed conditions. It's recommended to disable this feature when working in a bright environment, especially while working in direct sunlight, when staking out points outside the cabin, etc.



Wireframe

Menu > Display > Wireframe

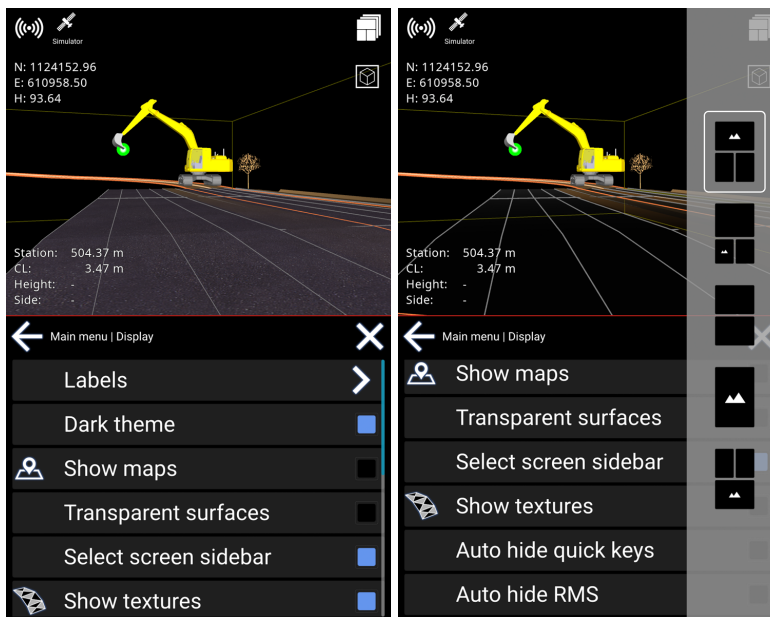
Tap Wireframe to enable the triangular design to be visible. This will show the edges of the triangles and might improve the visibility.



Change screen

Menu > Display > Select screen sidebar

This option is to change the working screen. 'Select screen' is also accessible by tapping the icon in the upper right corner.



View settings

Menu > Display > View settings

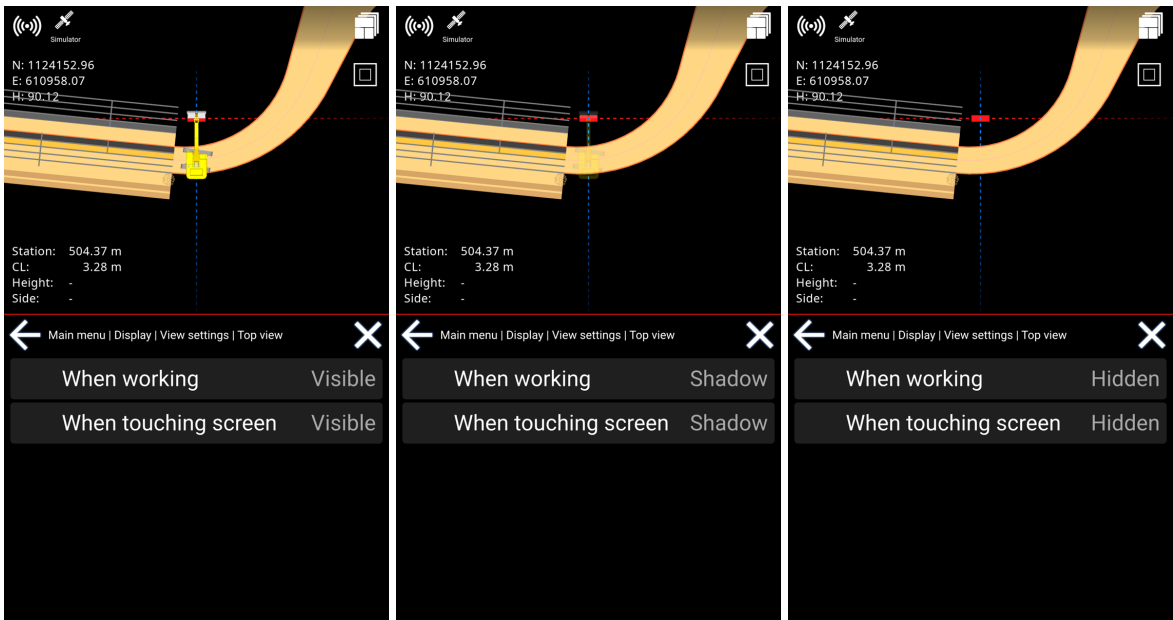
To obtain a better overview of your work, you now have the option of hiding the excavator or making it transparent.

Open the menu and select Display. Scroll down to View settings.

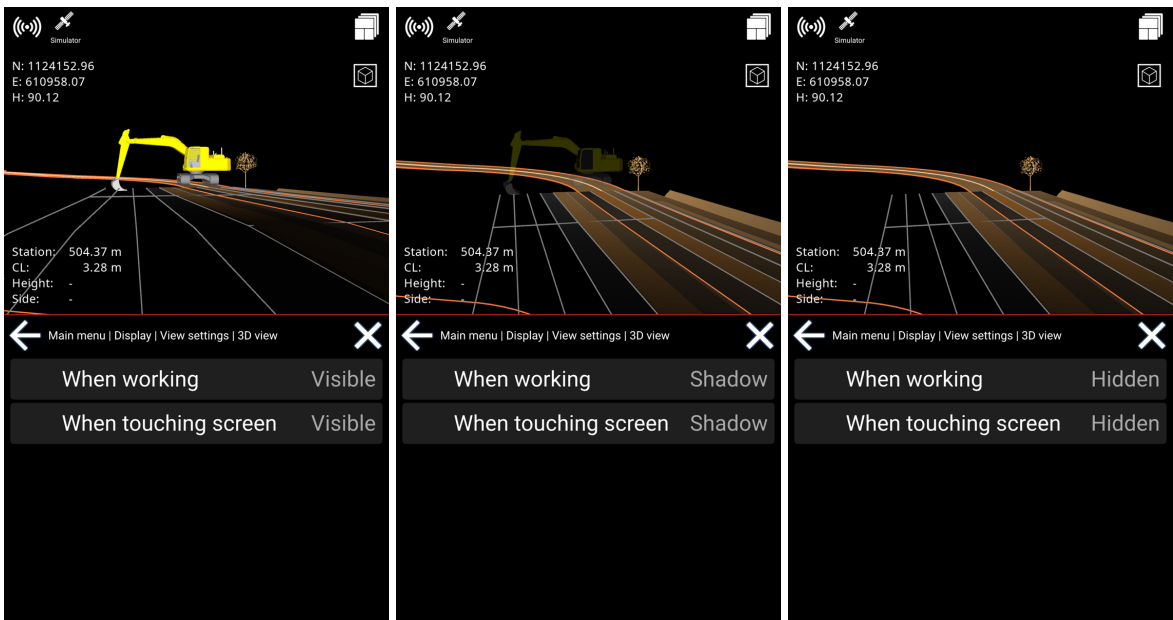
It is possible to set this individually for a work situation, or when you touch the screen. You can also choose individual settings for runscreens with 3D View or Top View.

You can now easily toggle between 3D View and Top View by pressing the icon in the upper right corner.

Menu > Display > View settings > Top view



Menu > Display > View settings > 3D view



Settings

Tolerances

Menu > Settings > Tolerances

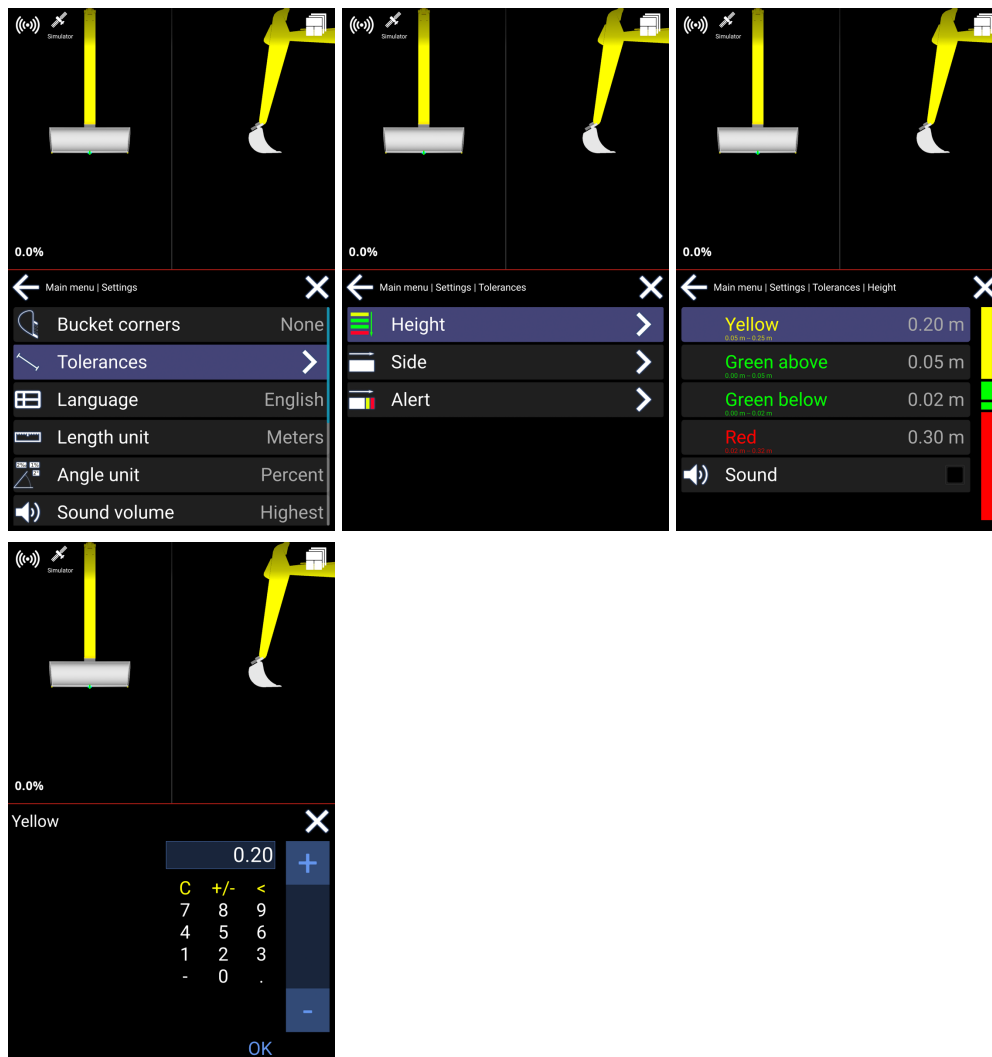
Tolerances are thresholds for calculations. They are used for different indications like colors and sound. You can change the tolerances for height, side, and alert.

When working outside the specified tolerances, the indicator in question is shown in white color.

Height tolerances

Menu > Settings > Tolerances > Height

The 'Yellow' band for the height tolerance indicates a distance for when to start showing that you are near a selected height reference.



'Green above' and 'Green below' is the limit for the accepted height deviation, respectively above and below the reference. It basically means that, as long as you are "this close" to the reference, the job is well done.

'Red' is an indication of excavating too deep into the ground. The tolerance is actually an expression for when to ignore the warning when you are far below the reference.

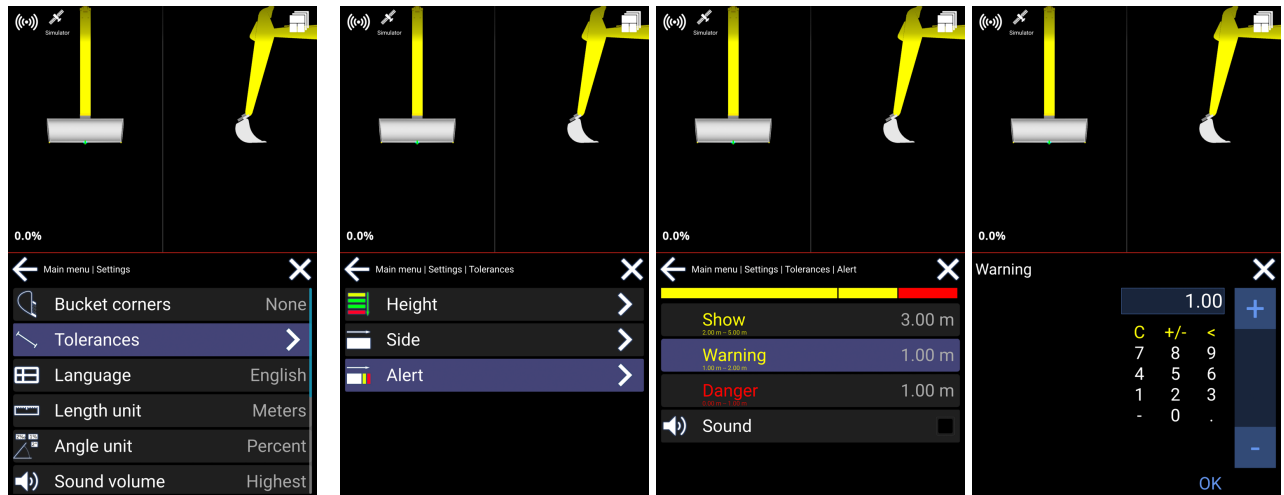
The sound option will enable different sounds depending on the band within which you are working. Check the blue box for sound or uncheck to mute. There will be no sounds when working above the yellow band and below the red band.

Alert tolerances

Menu > Settings > Tolerances > Alert

The tolerance for alert is divided into Show, Warning, and Danger.

- If you are in the “Show area” a red 3D line will be shown.
- If you are in the “Warning area” you will get a warning notification saying “Too close”.
- If you are in the “Danger area” you will get a Danger notification, also an alarm will sound if turned on.



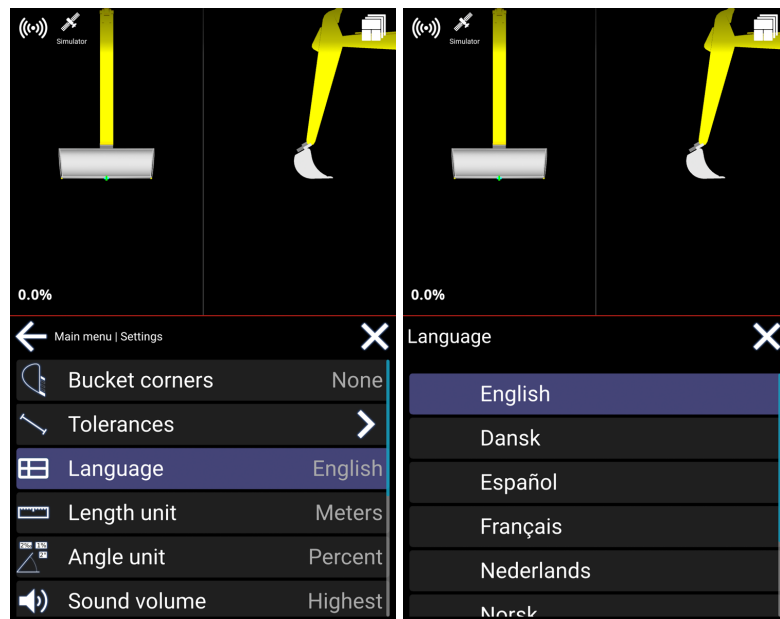
- Choose any of the 3 options (Show, Warning, Danger)
- Change the distance you want to the point of alert.

You will have a sound option as well. Check the blue box for sound or uncheck for mute.

Language

Menu > Settings > Language

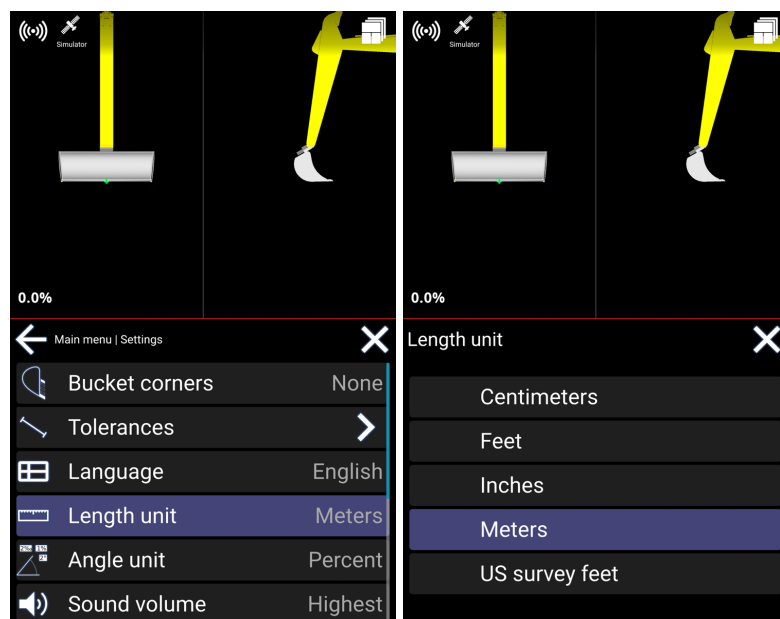
Simply select the language of your choice. The language is automatically changed and saved.



Length unit

Menu > Settings > Length unit

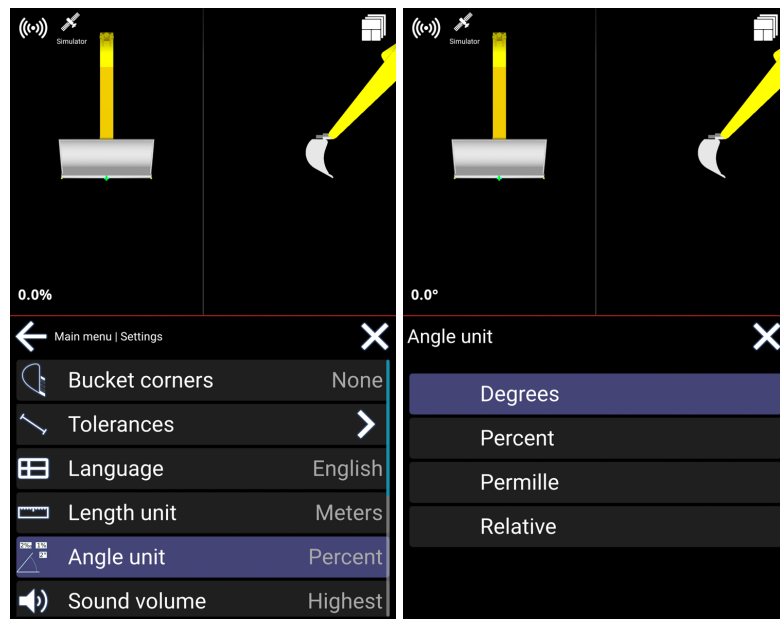
Tap to choose the length unit. It is automatically changed and saved.



Angle unit

Menu > Settings > Angle unit > Set angle unit

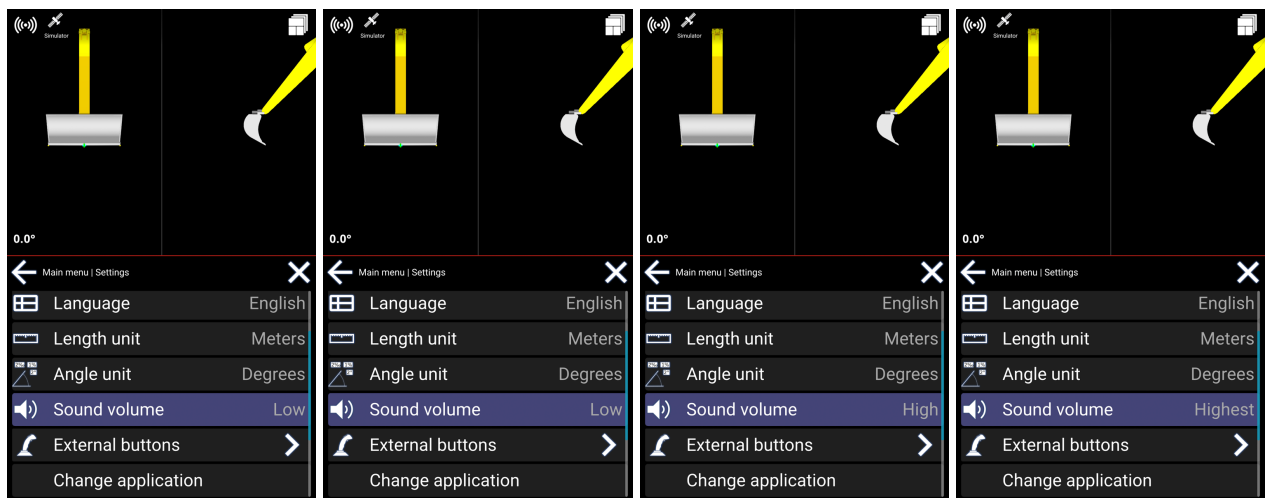
Tap to choose the angle unit. The angle unit is automatically changed and saved.



Sound Volume

Menu > Settings > Sound volume

Tap the sound volume again and again to change the sound level. Choices are given: Low, Medium, High, Highest.

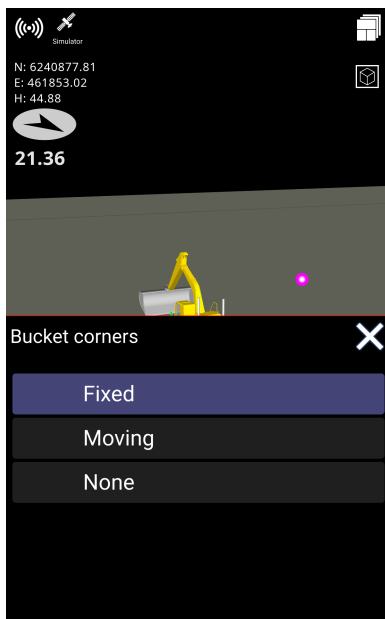


Bucket Corners

Menu > Settings > Bucket Corners

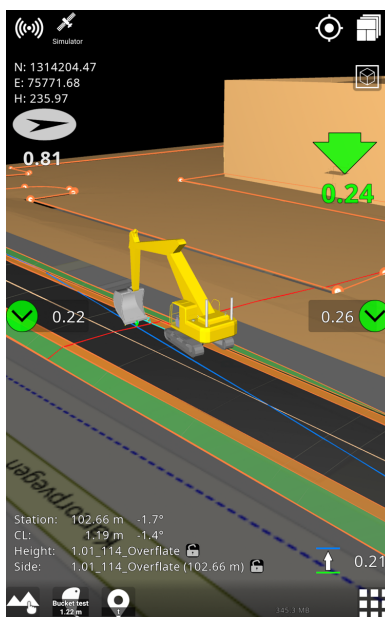
In the Bucket Corners menu, it is possible to turn On or Off bucket corner heights.

It is possible to select between Fixed or Moving Arrows.



The green bars in the red circles indicate the surface below the bucket

The arrows and numbers in the blue circles indicate how far and in what direction you should move the bucket to match the surface below.

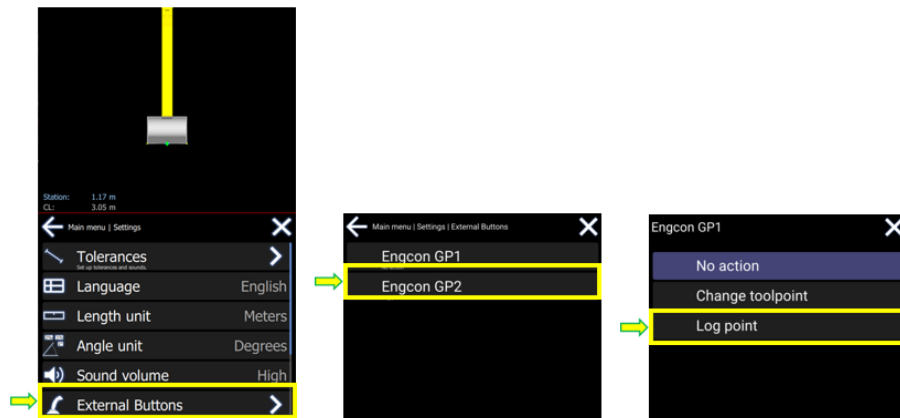


External buttons

Menu > Settings > External buttons

If you have a configurable joystick, you can set up the functionality here.

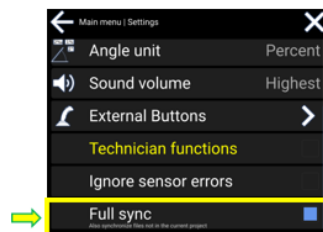
- Choose the button you want to configure.
- Choose between No action, Change of tool point, log point.



Full sync

Menu > Settings > Full sync

Full sync will not only synchronize the current project with the server but all projects on the server. Tap to enable or disable.



2D functionalities

Menu > 2D functionalities

This menu option is only available when GNSS is disabled. See chapter 5.6 *GNSS*.

Main direction

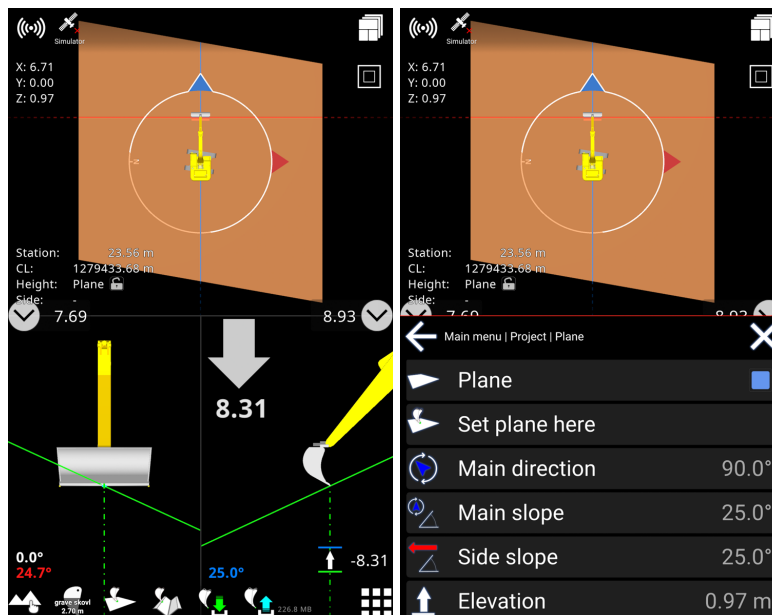
Menu > 2D > Main direction

Press the Main Direction button in the menu and you will set the direction that you will work.

- The Blue triangle will now indicate your **Main slope** - direction
- The Red triangle will indicate the **Side slope** - direction
- The clear triangle on the compass ring will show you the current direction of the machine.

When the direction of the machine is on top of the Blue triangle you will be on the **Main slope** - direction.

- **N** indicates the true North direction



Store position

Menu > 2D > Store position

This feature is also available directly from the quick keys when 'GNSS device' is disabled under GNSS. See chapter 5.6. *GNSS*.

Save the excavator's current position. The coordinates of the machine will be stored - not just the height, which will make it possible to move the machine to another location in a 2D environment, and later continue work from a new location.

An example of how to use this feature is described in the paragraph 'Pickup position' below.

Pickup position

Menu > 2D > Pickup position

This feature is also available directly from the quick keys when 'GNSS device' is disabled under GNSS. See chapter 5.6. *GNSS*.

This feature is used to position the machine at the desired coordinate determined by the tool of the machine. The default value given is the latest saved position by the 'Store position' feature described above, but you may specify any coordinate.

An example of use:

1. Select the tool point for one of the corners of the bucket that you wish to use to save the location with. You do this by tapping the bucket and afterward tap on the corresponding corner of the bucket.
2. Position the corner of your bucket on an identifiable point like fx. a control point - or similar marking.
3. Tap 'Store position' to save the position. The position will only be available in the system's memory and is not to be seen.
4. Now you can move the machine anywhere to do some temporary work.
5. When you want to continue work from your stored position, simply go back to your stored position by following steps 1 and 2 above, and this time choose 'Pickup position'.

Laser height

Menu > 2D > Laser height

Enter the height of a nearby construction laser. When the laser beam is hitting the laser stick sensor, the system can use its height as a reference for the machine.

Auto laser height

Menu > 2D > Auto laser height

Enabling 'Auto laser height' will automatically grab a laser beam from a nearby construction laser when hitting the machine's laser stick sensor. This will position the machine at the height given by the 'Laser height' value - described above.

Bucket

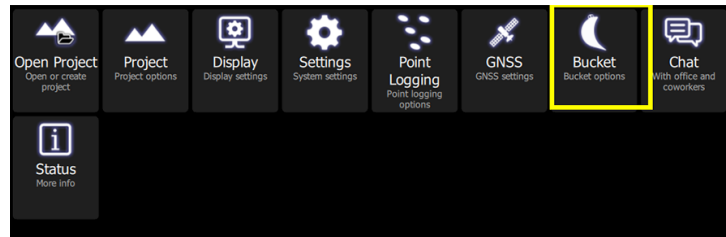
Menu > Bucket

There is a shortcut to this menu from the quick keys.

You will see all buckets saved on the tablet. Tap the bucket you want to use and always ensure that the calibration is correct before starting working.

For calibration: See chapter 6.1, *Bucket calibration*.

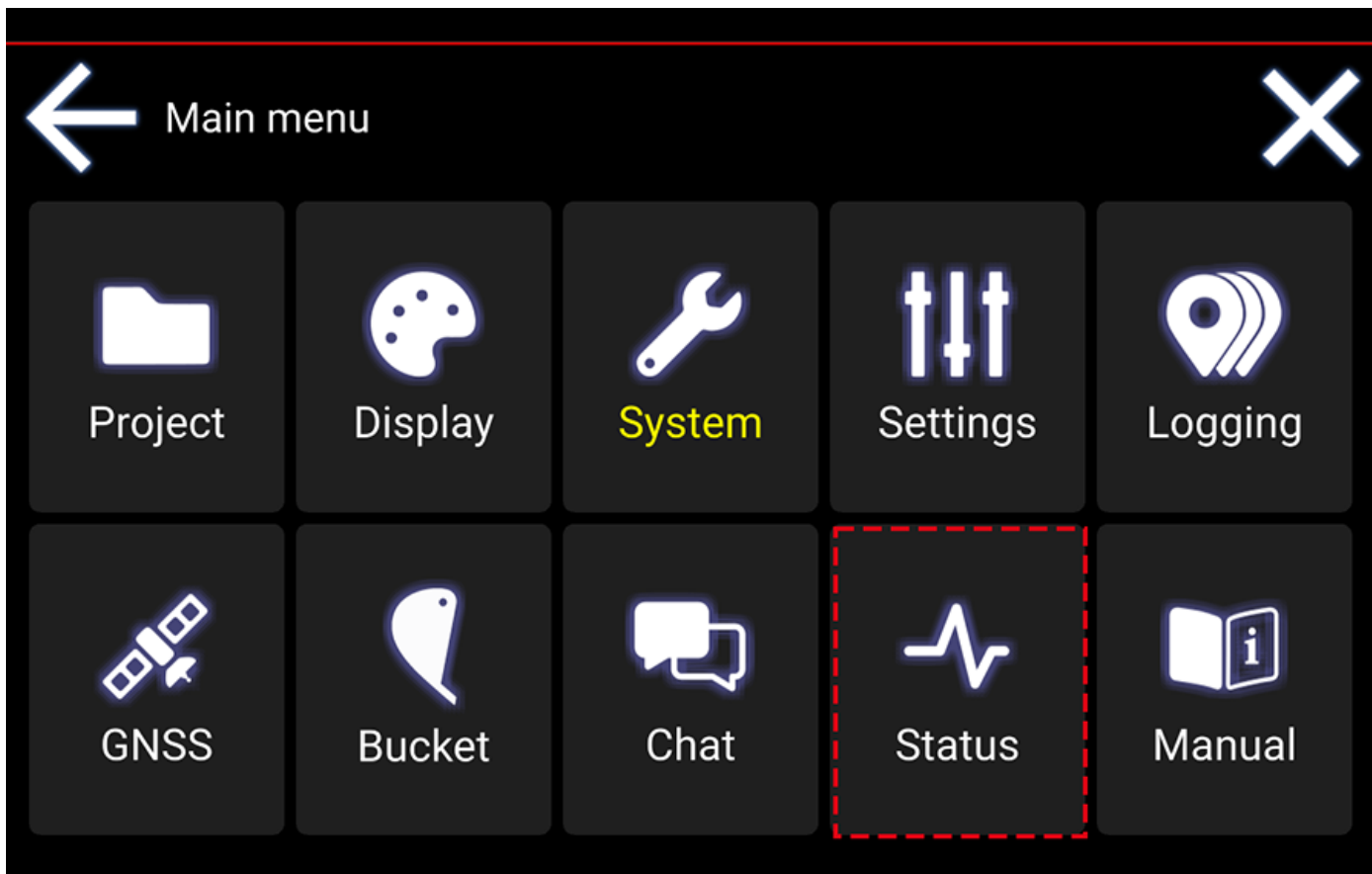
To check your calibration see chapter 6.2, *Check calibration of your excavator*.



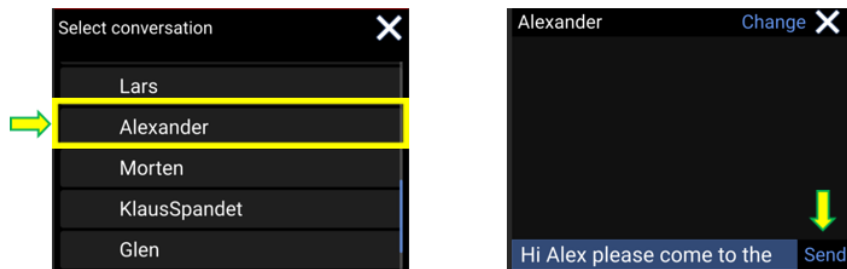
Chat

Menu > Chat

The chat feature helps you to communicate with your colleagues about the project you are working on.



- You will see all office personnel and coworkers from your company or project. This depends on the structure made by your management.
- Tap a contact from the list to begin messaging.

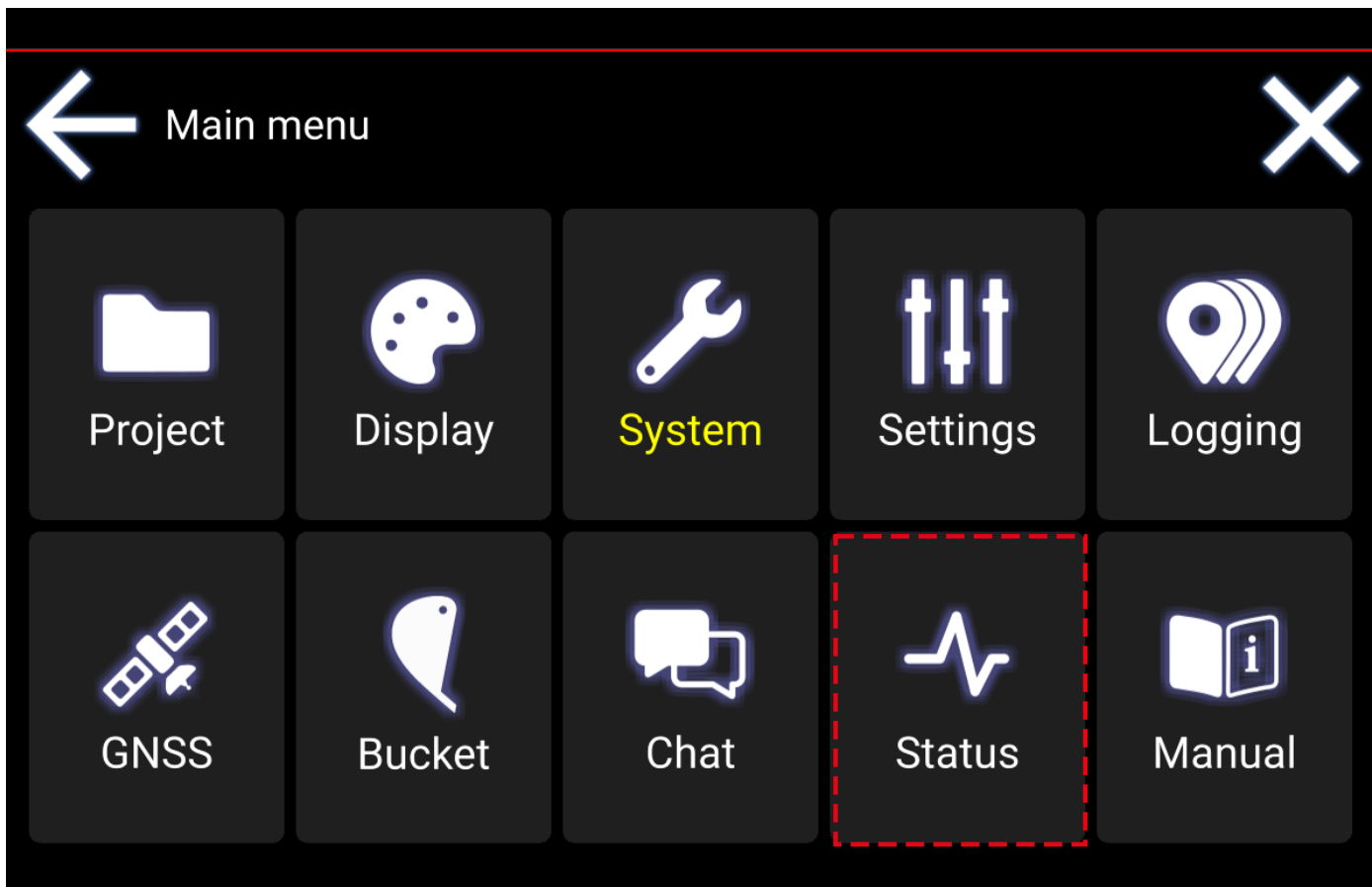


- Write a message and tap 'Send'.

Status

Menu > Status

This is where you will find various detailed system information.



- Tap 'GNSS' to see the connection status and your location.
- Tap 'Sensors' to see detailed sensor information.
- 'Version' is the current Makin' 3D software version of the Android app running on your tablet.
- 'IB-1 version' is the firmware version of the interface box connecting all the sensors to the system.



- System info. You can find all relevant information about your system by selecting 'System info'. Information such as System name, System number, System owner, and the associated licenses are shown here. When changes are made to the system, it will be shown under System info.

6. Calibration

Bucket calibration

Always place your machine on the most stable surface possible and read through the full chapter before starting.

Tools required

- Spirit level



- Tape measure

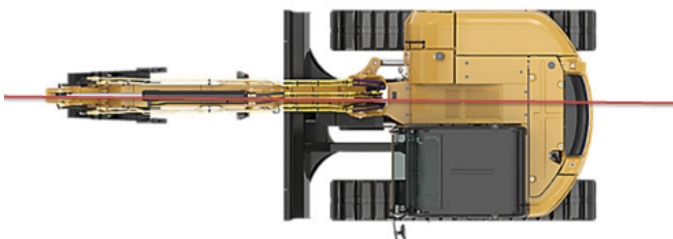


- Plumb bob or self-leveling point laser

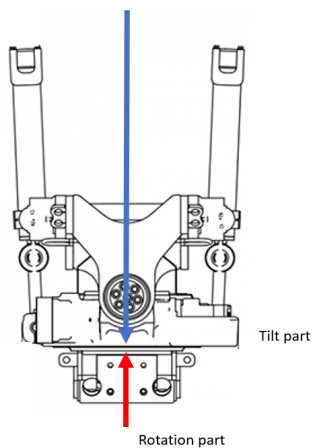


Before calibrating the bucket

- For excavators with a swing boom, please ensure that the boom is aligned to the machine's centerline before any calibrations are performed.



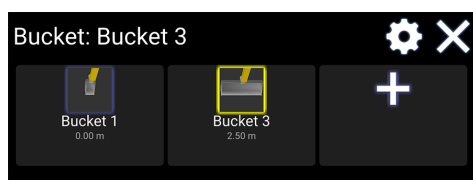
- For excavators with tilt rotators, please center the rotating device before bucket calibration.





Bucket calibration menu

Go to the bucket menu from the main screen. See chapter 5.7 *Bucket* for further details.

- If you want to add a new bucket, tap the plus symbol.
- Tap the bucket you want to calibrate.



- Tap the cogwheel symbol to begin calibrating.

Bucket 3  	
Name	Bucket 3
Coupler/Tilt	Tilt
Width	2.500 m
Length	2.000 m
Bucket angle	3.21°
Tilt offset	1.23°

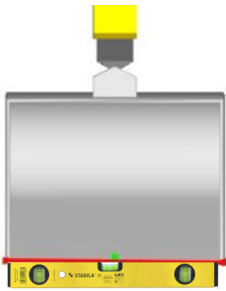
Bucket name

- In the bucket calibration, tap 'Name' to edit the name of the bucket. Type the name and press the checkmark to save.

Bucket tilt and quick coupler

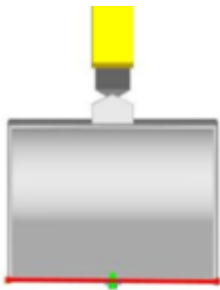
- This step is important to do before calibrating the bucket angle (see further below).
- Tap 'Coupler/Tilt' to state which application is present - i.e. None, Tilt, Rotortilt. If Rotortilt is present, the rotor must be in the center as stated above under *Before calibrating the bucket*.

- Tap 'Tilt offset' if you have tilt installed. Tilt the bucket until the cutting edge is horizontal using a spirit level. Then tap 'Reset' and 'OK' to save.



Bucket width

- In the bucket calibration, tap 'Width' to enter the width of the bucket. Tap 'OK' to save. The width is the total working width of the bucket, which you get by measuring the cutting edge.

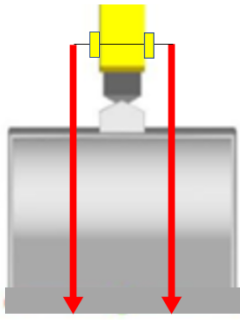


Bucket length

- Tap 'Length' to enter the length of the bucket. Tap 'OK' to save. The length is measured from the center pivot point at the end of the stick to the bucket's cutting edge.



- If you have a tilt rotor application then measure the length from both the left and right side of the stick pivot bolt to the cutting edge, as the tilt may not be dead center. Use the average of the two measurements and apply this as the bucket length.



Bucket angle

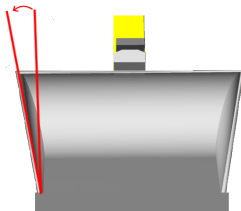
- Please make sure, you have followed the instructions under *Bucket tilt and Quick Coupler* above, before continuing to calibrate the bucket angle.
- Tap 'Bucket angle'. Place the machine with the boom and stick at a height that allows you to open and close the bucket freely. Below you find two ways of calibrating the bucket angle.

Tilt offset

See the description in *Bucket tilt and quick coupler* above.

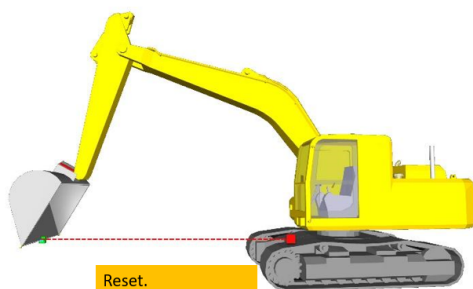
Profile angle

- The bucket's profile angle is optional, and for visualization purposes, only.
- Tap 'Profile angle' and type in the bucket's profile angle in the box. Press 'OK' to save.

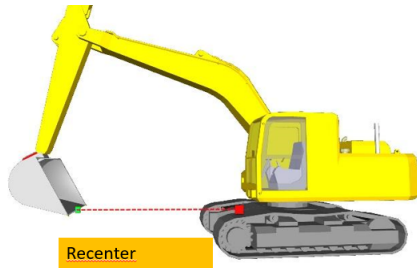


Laser option

- Place a self-leveling point laser on the machine frame pointing towards the bucket center point. The bucket must be horizontal.
- Open the bucket until the laser hits the center of the cutting edge. The more you can open and close the bucket the better the calibration result.



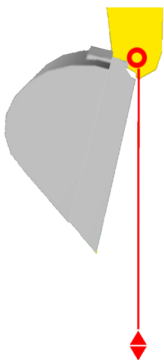
- Tap 'Reset'.
- Now close the bucket until the laser hits the center of the cutting edge again.



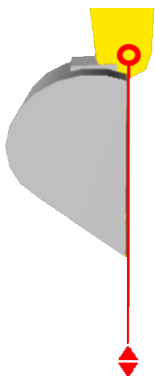
- Tap 'Recenter'.
- Tap 'OK' to save

Plumb bob option

- Place a magnet on the center of the stick's pivot bolt to hold the plumb bob line and let it hang.
- Then open the bucket if needed until the line is hanging free of the bucket.



- Close the bucket until the line just touches the cutting edge of the bucket.



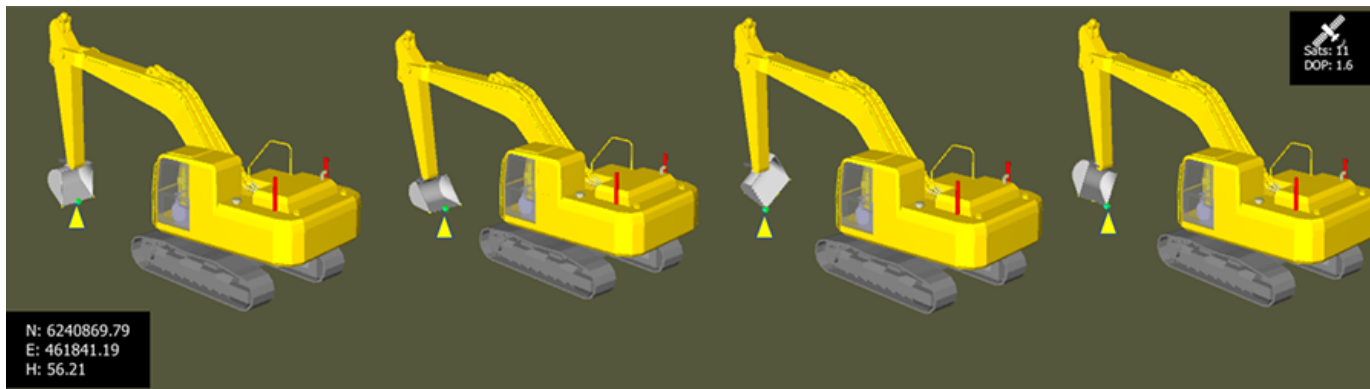
- Tap Reset and OK to save.

Check calibration of your excavator

Before you start your daily work we advise a calibration check should be performed.

Also, ensure that the machine you are going to operate is fully calibrated by a Makin' 3D specialist, and your current bucket is calibrated. Follow these steps:

1. You need a known point.
2. You need an operational GPS and correction signal with DOP so close to 1.0 or below as possible.
3. Place your open bucket with the cutting edge center horizontal on the point and check coordinates.
4. Then close the bucket and place the cutting edge center on the same known point.
5. If your reading is within a few centimeters from the target your calibration is ok otherwise recalibrate.
6. If you have tilt/rotor tilt check your calibration with full tilt and different rotation angles to both sides.



7. Troubleshooting

Error message	Possible cause	Possible Solution

If you cannot solve the problem using the advice found in the above table contact your reseller.

8. Appendix

Interface Box (IB-1)

Status information on the interface module can be read out by watching the LED Just next to the power connector.

Color	Indication
Green	ON - all ok
Flashing red	Firmware issue - contact reseller
White	System check of software
Cyan	Update of software ongoing

Demo mode

You can use your Makin' 3D system on Windows in demo mode to gain confidence in the user interface.

Please find below shortcuts for the functions.

Keyboard	Function
j	Jump to near the project
J	Jump to the roundabout in Odense S
n/N	Move forward/backward

b/B	Turn to the left/right
m/M	Turn to the right/left
space	Start/stop automatic driving
s/S	Move forward/backward on the centerline
+/-	Raise machine/lower machine
r	Screen and machine back to standard view
u	Jump to current side reference
1....8	Move the machine parts. Holding down ALT together reverses the movements.
1	Roll
2	Pitch
3	Rotate tracks
4	Boom
5	Stick
6	Bucket
7	Tilt

8	Rotor
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Network requirements

Due to various network security and firewall limitations when connecting to a network to run

- demo system
- Makin Win

you must verify with the local network administrator, that the following requirements are fulfilled to connect to Makin Cloud.

Outbound traffic on port

- 80
- 8008
- 10000-12000

Access to IP address of: cloud.makin3d.com