MC-X1

Excavator Indicate System

Installation and Calibration Manual

MC-X1
Excavator Indicate System
Installation and Calibration Manual

Part Number 1022461-01
Rev B

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Manual Conventions

This manual uses the following conventions:

Convention	Description	Example
Bold	Menu, or drop-down menu selection	**File > Exit** (Click the **File** menu and click **Exit**)
	Name of a dialog box or screen	From the **Connection** screen...
	Button or key commands	Click **Finish**.
`Mono`	User supplied text or variable	Type `guest`, and click **Enter.**
Italic	Reference to another manual or help document	Refer to the *Topcon Reference Manual.*

NOTE Further information to note about system configuration, maintenance, or setup.

NOTICE Supplementary information that can have an adverse affect on system operation, system performance, data integrity, or measurements.

CAUTION	Notification that an action has the potential to result in minor personal injury, system damage, loss of data, or loss of warranty.
WARNING	Notification that an action has the potential to result in personal injury or property damage.
DANGER	Notification that an action has the potential to result in severe personal injury or death.

Introduction

This manual discusses how to install and calibrate Topcon's Indicate Excavator Systems utilizing the MC-X1 Controller.

The TS-i3 single and dual axis sensors used in the Topcon excavator systems measure the pitch and roll angle of various machine elements. Each sensor accurately measures a gravity-referenced angle of the body, boom, stick, and attachment, sending this angle data to a GX-55/GX-75 (GX Series) display to provide precise grade. Each sensor is configured and calibrated for its specific location on the excavator. The dual axis body sensor functionality is unique as it measures both pitch and roll (cross slope) of the machine.

Indicate System Components

Table 1 lists the hardware and software components of the indicate systems.

NOTICE The MC-X1 System Architecture requires all of the sensors to be running on a 500kbps Baud Rate. Legacy sensors used in MC-R3, MC-i3, and MC-i4 systems are not compatible with the MC-X1 excavator system. Ensure that the sensors to be used in the MC-X1 system have the correct part number and label denoting the 500kbps Baud Rate.

Table 1. 2D and 3D Excavator Indicate System Components

Hardware	Software/Firmware
MC-X1 Controller	3D-MC V12.2.307 or later
GX-55/GX-75 Display (GX Series)	MCXCONFIG (MC-X Machine Control Gateway)
TS-i3 Tilt Sensors (500kbps Baud Rate)	MC-MCX 6.01 or later
LS-B10W Laser Receiver (500kbps Baud Rate)	Topcon Receiver Utility (TRU) 3.2 or later
EASy-Proof Radio Module (3D Only)	
GR-i3 GNSS Antenna with Vibration Mount (3D Only)	
Optional	**Optional**
SL-100	SL-100 Firmware 1.15 or later
WiFi Antenna (OMNI 2.4-2.5 GHz)	
WiFi Antenna Magnet Mount (0-6 GHz)	

The TS-i3 Tilt Sensors, the MC-X1 Controller, the GX Series display, and the LS-B10W Laser Receiver make up the 2D indicate system. The LS-B10W adds a laser height reference, and is calibrated for its location on the stick of the excavator. The 3D system (Figure 1) utilizes two GR-i3 GNSS Antenna and a radio module for precise 3D control.

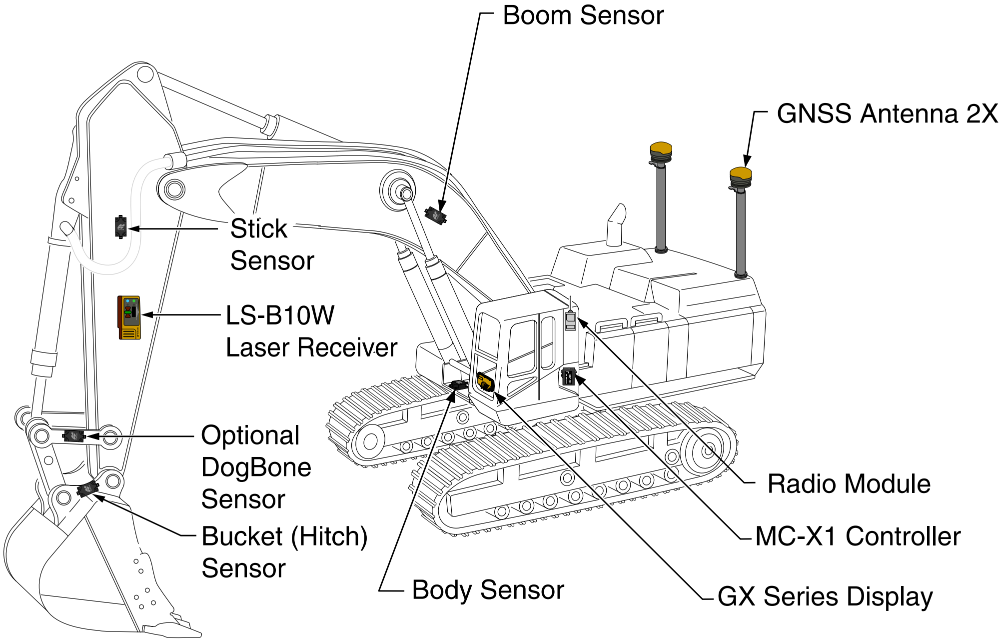


Figure 1: Machine Components

NOTICE When installing components, use the Topcon supplied fuse or fused power from the machine of the same rating.

NOTICE System ground must be connected to the frame side of the ground disconnect switch, not directly to the negative battery terminal.

Sitting in the cab facing forward, the sensor angles are 0° straight ahead (horizontal), +90° straight up, and -90° directly down (Figure 2).

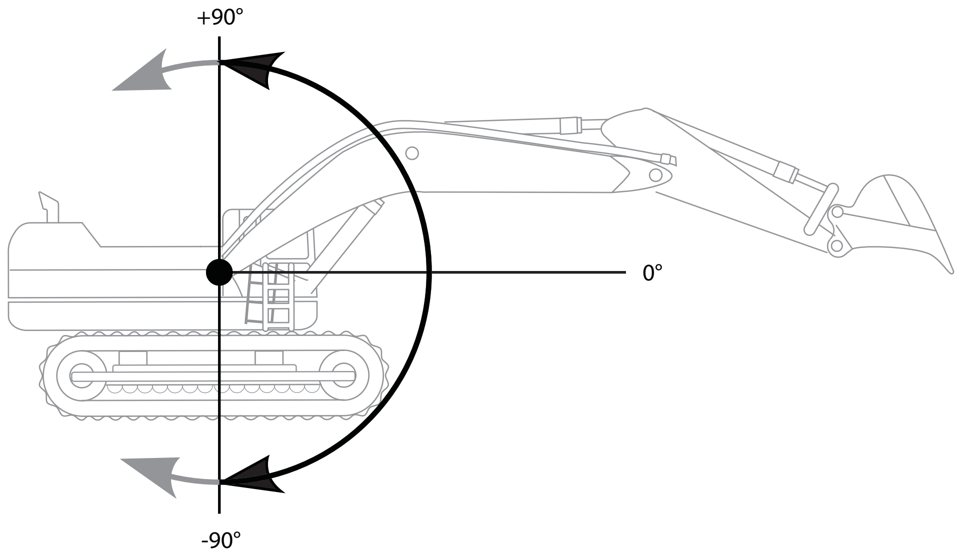


Figure 2: Angle Convention Used For Tilt Sensors

The Main and Auxiliary (Aux) antennas provide positional and heading information.

- Main antenna – determines 3D machine position.
- Aux antenna – determines heading using relative position.

Using TS-i3 sensors, the 3D position of the bucket is projected from the Main antenna.

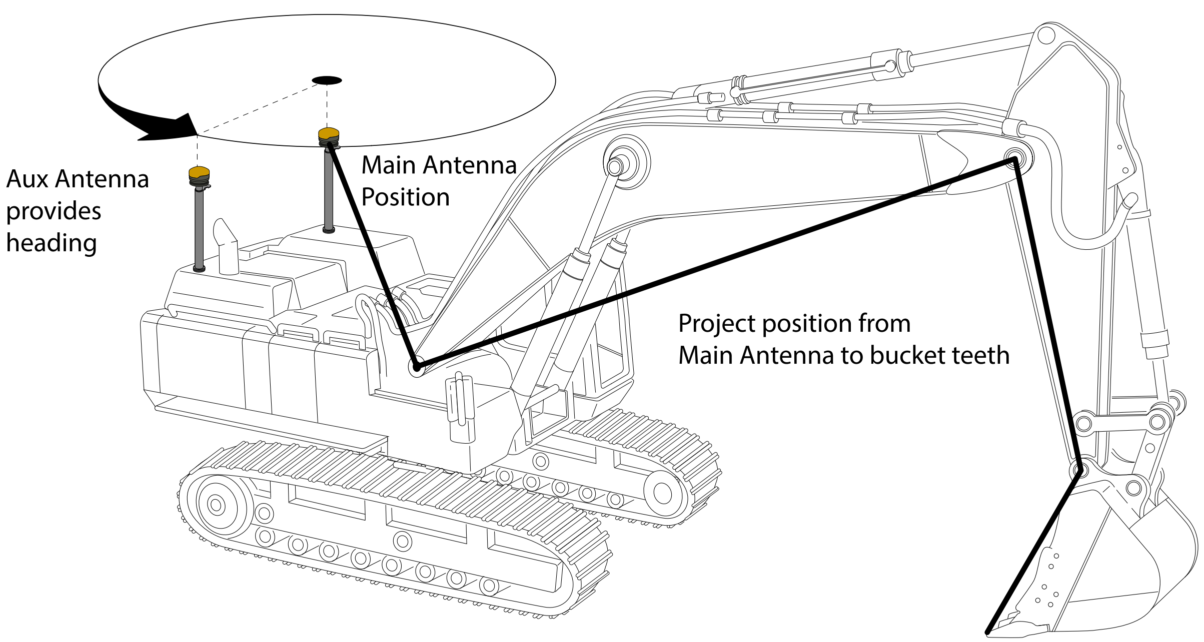


Figure 3: Tilt Sensor Positional and Heading References

2D System Configuration

Figure 4 shows the basic cabling connections for the 2D excavator indicate system.

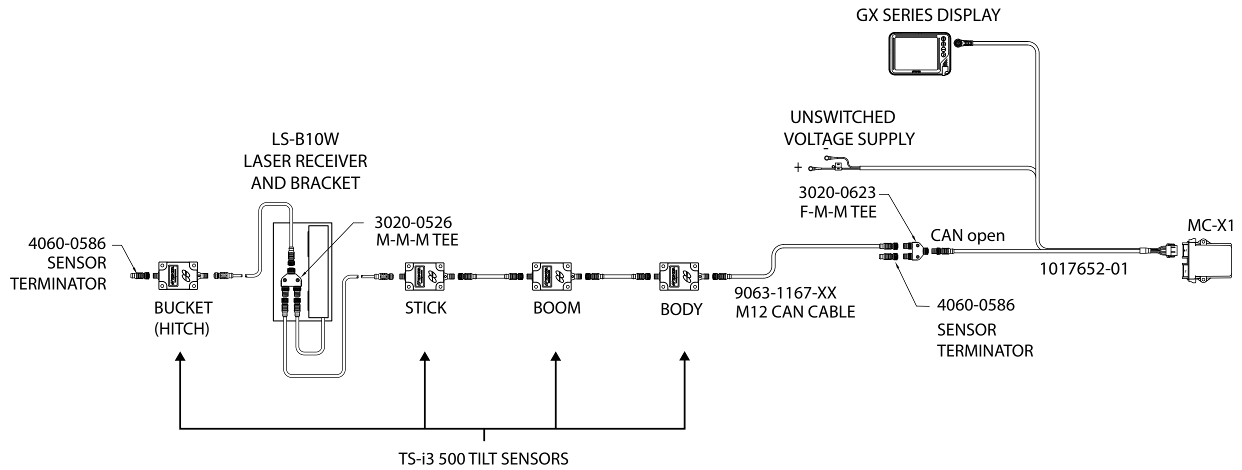


Figure 4: Basic Cable Connections - 2D Excavator Indicate System

3D System Configuration

Figure 5 shows the basic cabling connections for the 3D excavator indicate system with SL-100.

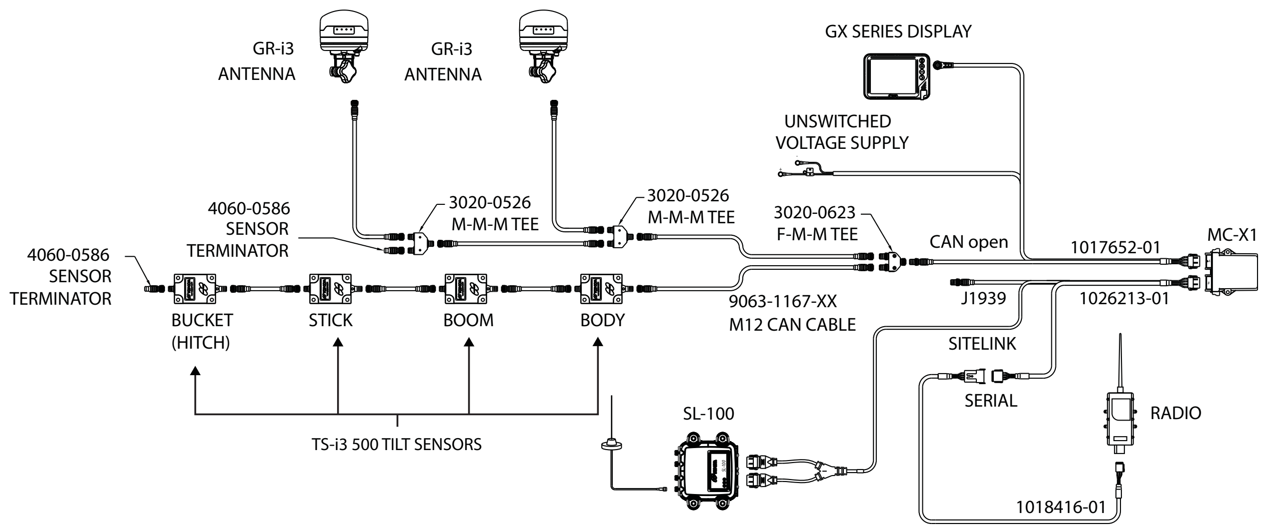


Figure 5: Basic Cable Connections - SL-100 3D Excavator Indicate System

NOTE 3D configurations may also include the LS-B10W laser receiver. See Figure 4 on page 4.

MC-X1 Connectivity and Configuration

Configuration of the unit can be done using a GX Series display while connected in the machine, or with a computer using the following programing cable:

- MC-X1 Program Cable

Connecting to the MC-X Web Interface from a PC

1. Open the web browser on the display or your computer.

2. Type `192.168.0.1` into the address bar to connect to the web interface of the MC-X1 (Figure 6).

Figure 6. Access Topcon Sitelink3D Gateway Web Interface

When prompted for the user name and password, enter `admin` for both (Figure 7).

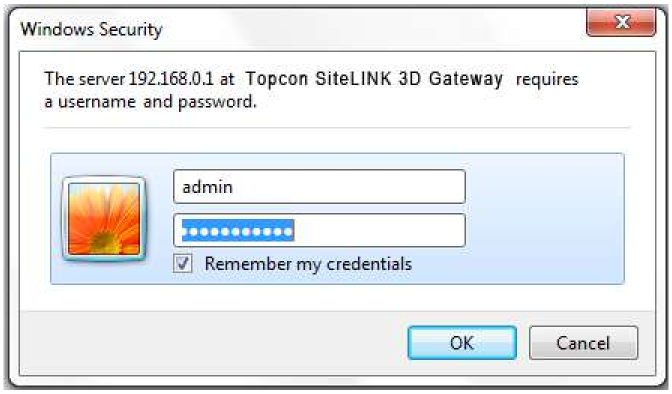


Figure 7. Enter Sitelink3D User Name and Password

Connecting to the MC-X Web Interface via MCXCONFIG

MCXCONFIG is also know as the MC-X Machine Control Gateway.

1. Download the MCXCONFIG installer file from myTopcon (https://www.topconpositioning.com/support).

2. Double-tap on the **MCXCONFIG** program icon on the desktop of the GX Series display to open the web interface.

3. When prompted for the user name and password, enter `admin` for both.

NOTICE A password is not required in MCXCONFIG 1.0.3.3 or later.

Viewing General Information and Firmware

From the left menu on the screen, click **Settings ▸ General.** The device information is listed in the **General Device Configuration** screen (Figure 8).

Figure 8. General Device Information

Upgrading MC-X1 Firmware

1. To upgrade MC-X1 firmware, click **Settings ▸ Firmware.**
2. Click the **Choose File** button. Windows® Explorer appears.
3. Locate and select the appropriate controller firmware for the MC-X1.
4. Click **Load Firmware** to begin.

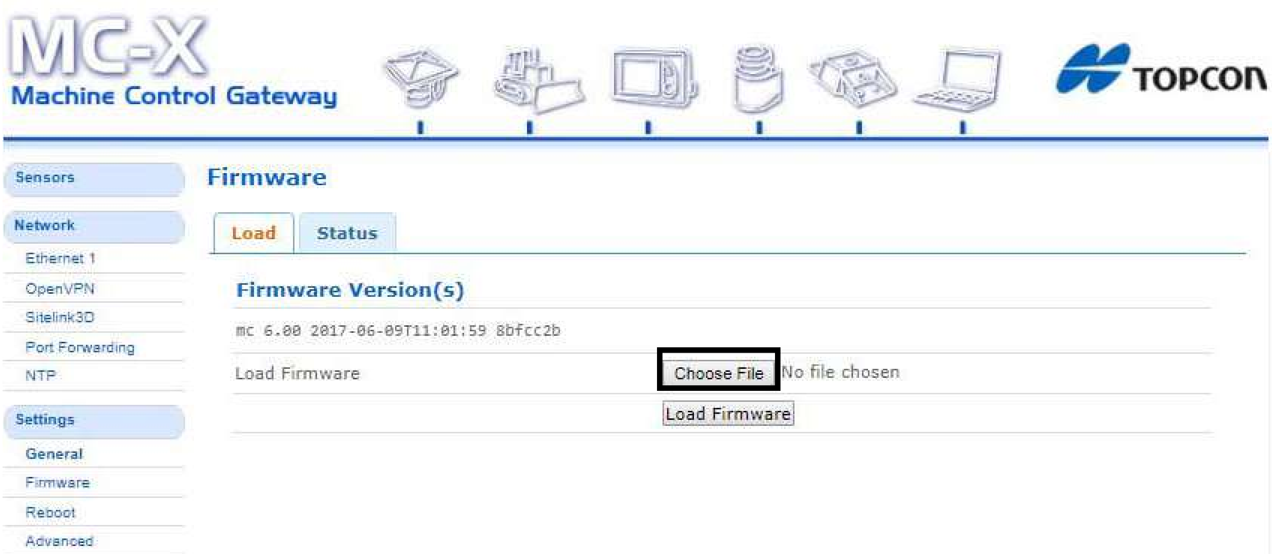


Figure 9. Load Firmware - Choose File

CAUTION Do not close the web browser or power off the system during the firmware upload process.

5. Once firmware loading is complete, a reboot prompt appears.

6. Click **Reboot**.

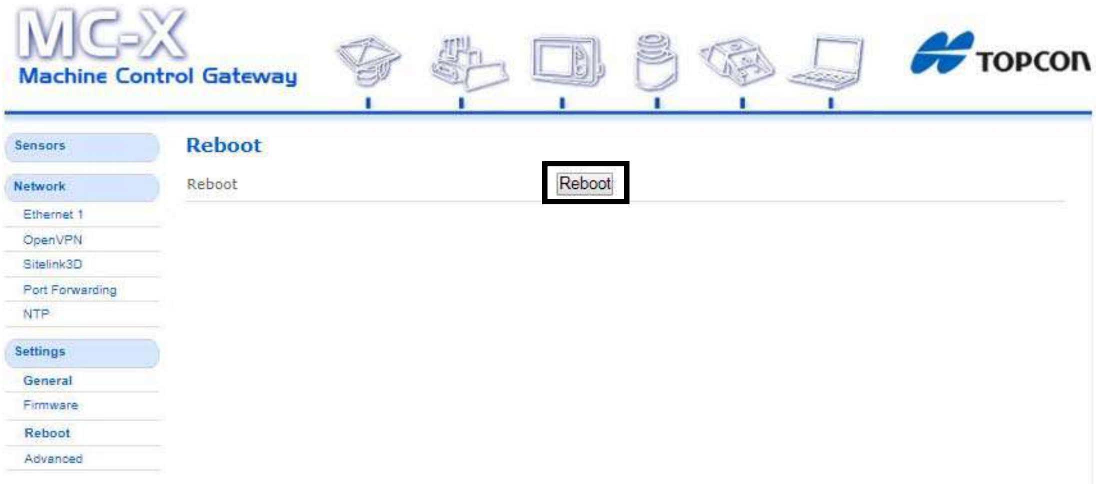


Figure 10. Reboot

Resetting the MC-X1

If the MC-X1 settings are in an unknown state, all the settings can be reset, which will remove most settings, including any user defined settings. This step is recommended if the history of the unit is unknown, or if it has been upgraded from any early beta version of the MC-X1 firmware.

1. From the menus on the left of the screen, click **Settings ▸ Advanced**, and then click the **Administration** tab.

2. In **Erase persistent data** row, select **Application** from the drop-down list.

3. Click **Erase**.

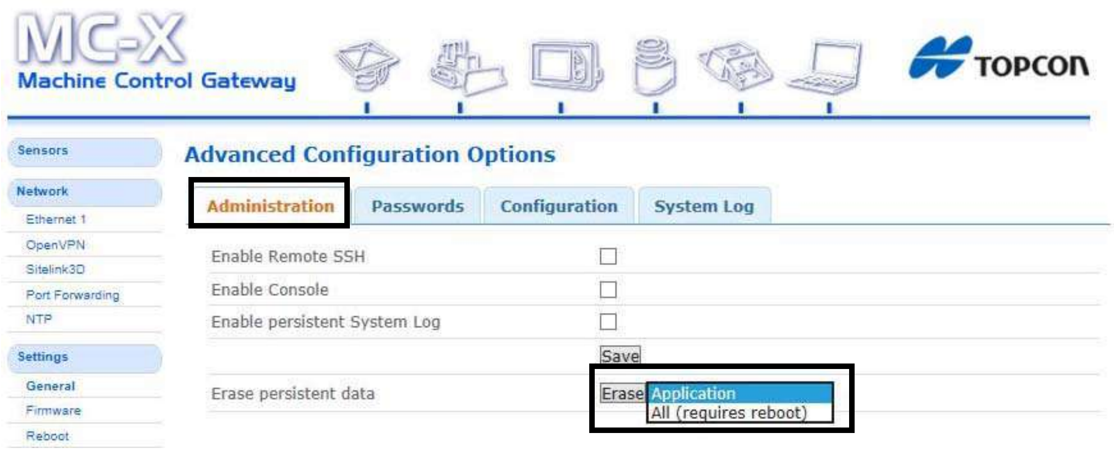


Figure 11. Firmware

4. Locate and click the **Reboot** shortcut link at the top of the screen, or click **Settings ▸ Reboot** on the left side of the screen.

Assigning GR-i3 Vibration Mount to Auxiliary

The Main GR-i3 Vibration Mount must be disconnected from the system in order to assign an Auxiliary (AUX) antenna.

NOTICE If **Left Pole**, **Right Pole**, **GRi3**, or **AuxGRi3** do not populate in the MC-X Machine Control Gateway **Sensors** menu, 3DMC must deploy a machine file with MC-X1 as Position input.

1. Open 3D-MC to create a machine builder file (if one has not already been created), and select **MC-X1** from the **Position input** drop-down menu. If a machine builder has already been configured, make sure MC-X1 is selected as the Position Input.

2. Navigate to the end of the machine builder, and tap **Finish**.

3. Ensure the correct machine file is selected on the **Machine files** page, and tap **OK**. Now, your .mx3 is deployed, and the necessary sensors will populate in the MC-X Machine Control Gateway **Sensors** menu.

NOTE An .mx3 file that is active in 3D-MC is considered the "deployment".

4. Open MCXCONFIG.

5. Disconnect the CAN cable from the bottom of the Main GR-i3 Vibration Mount on the Left side of the machine.

6. From the menus on the left of the screen, click **Sensors > Left_pole**, and then click the **Config** tab..

Figure 12. Settings - Left Pole - Config Tab

7. Select **Right** from the drop-down menu (Figure 13).

8. Tap **Save**. The GR-i3 Vibration Mount is set to AUX.

Figure 13. Right

9. Reconnect the CAN cable to the main GR-i3 Vibration Mount on the Left side of the machine.

NOTICE The GR-i3 units are not assigned Main or AUX. Only a Vibration Mount may be assigned to be AUX. The GR-i3s remain interchangeable.

Loading GR-i3 Firmware

1. Select the **GR-i3** menu under **Sensors**.

Figure 14. Sensors - GR-i3

2. Select the **Firmware Upgrade** tab.

Figure 15. Firmware Upgrade

3. Select **Choose File** (Figure 16) and navigate to the GR-i3 firmware file (.bin extension).

4. Choose **Upgrade** and the firmware upgrade process should begin (Figure 16).

Figure 16. Choose File

A notification appears once the upgrade process is complete (Figure 17).

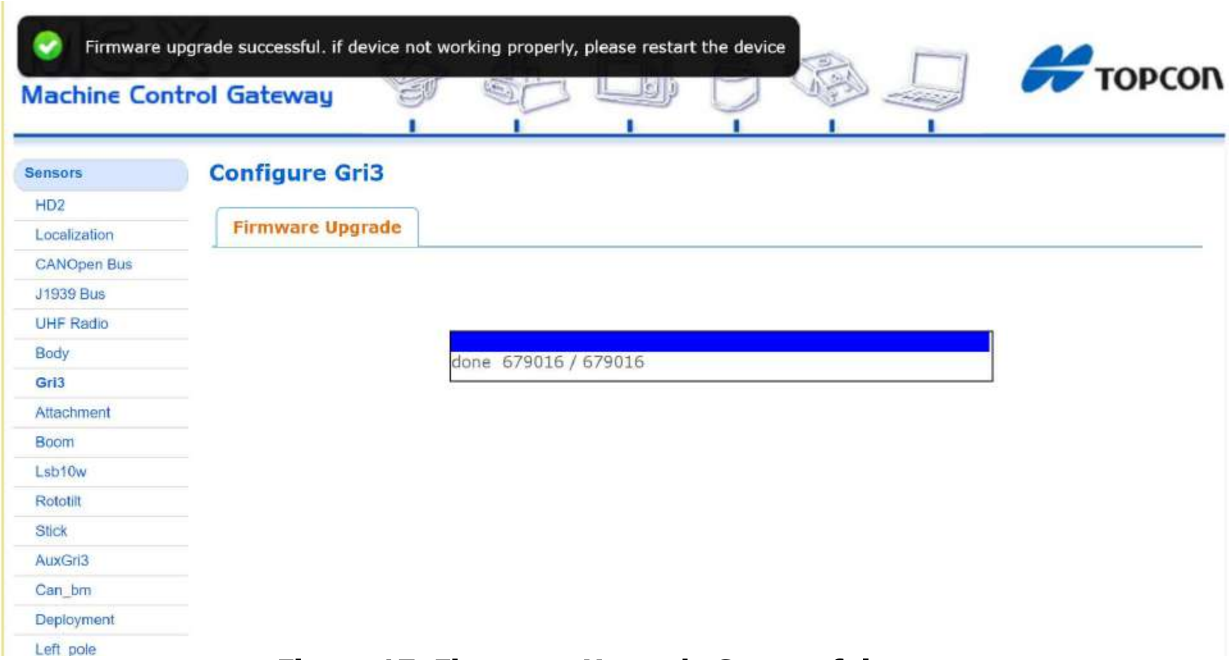


Figure 17. Firmware Upgrade Successful

5. Select **AuxGRi3** under the **Sensors** tab, and repeat steps 2 through 4 for the Auxiliary antenna.

Loading GNSS Firmware

1. Select the **GR-i3** menu under **Sensors.**

Figure 18. GNSS Firmware - GR-i3

2. Select the **GNSS Firmware Upgrade** tab.

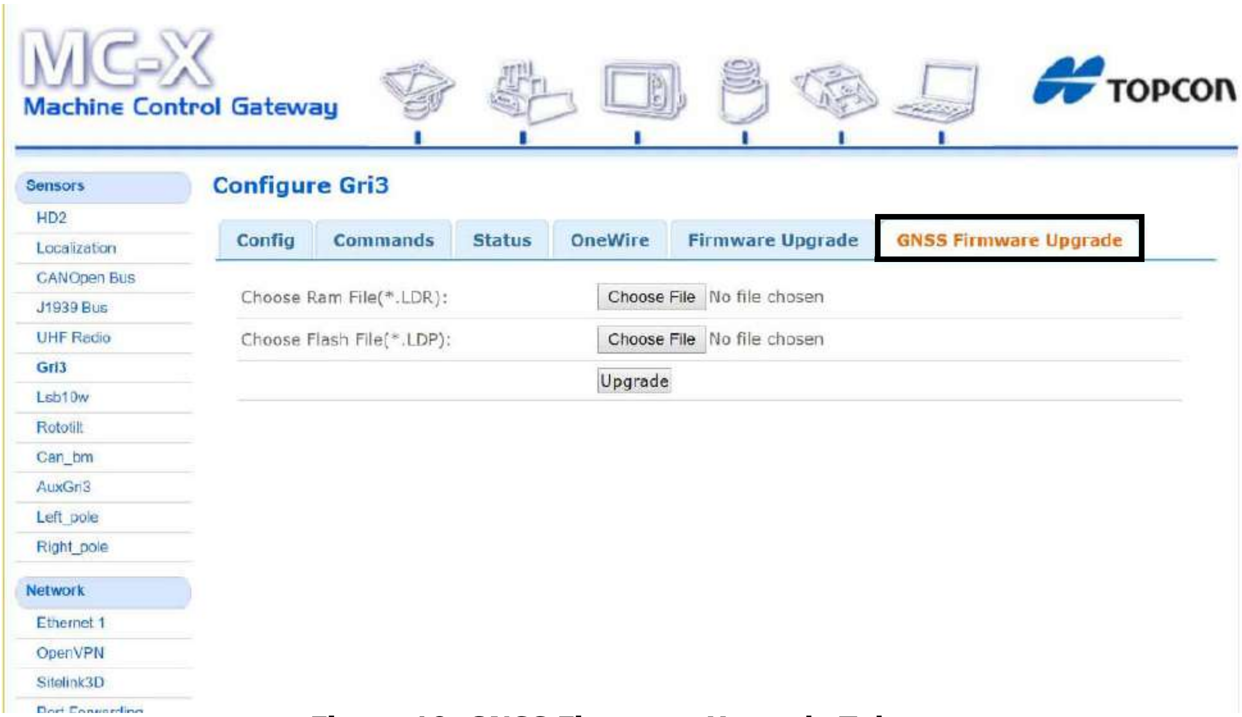


Figure 19. GNSS Firmware Upgrade Tab

3. To choose the RAM file, select **Choose File** and navigate to the GR-i3 firmware file (.ldr extension).

4. To choose the Flash file, select **Choose File** and navigate to the GR-i3 firmware file (.ldp extension).

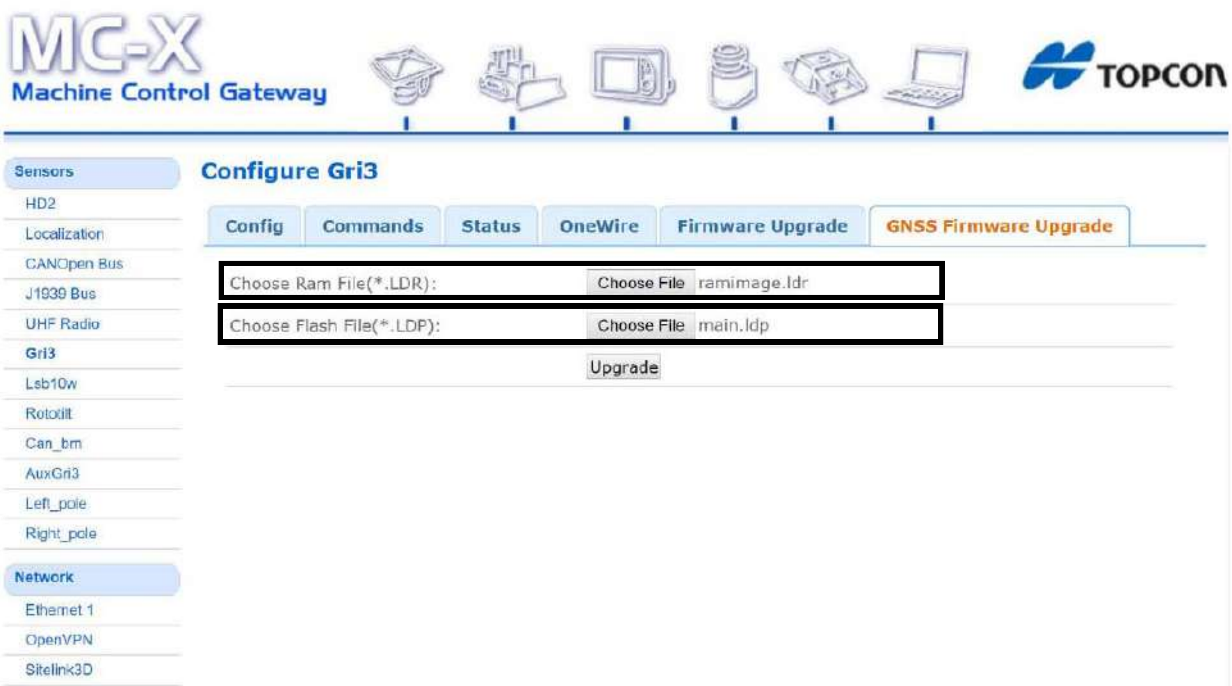


Figure 20. GNSS Firmware - Choose File

5. Choose **Upgrade** and the firmware upgrade process should begin. A notification appears once the upgrade process is complete.

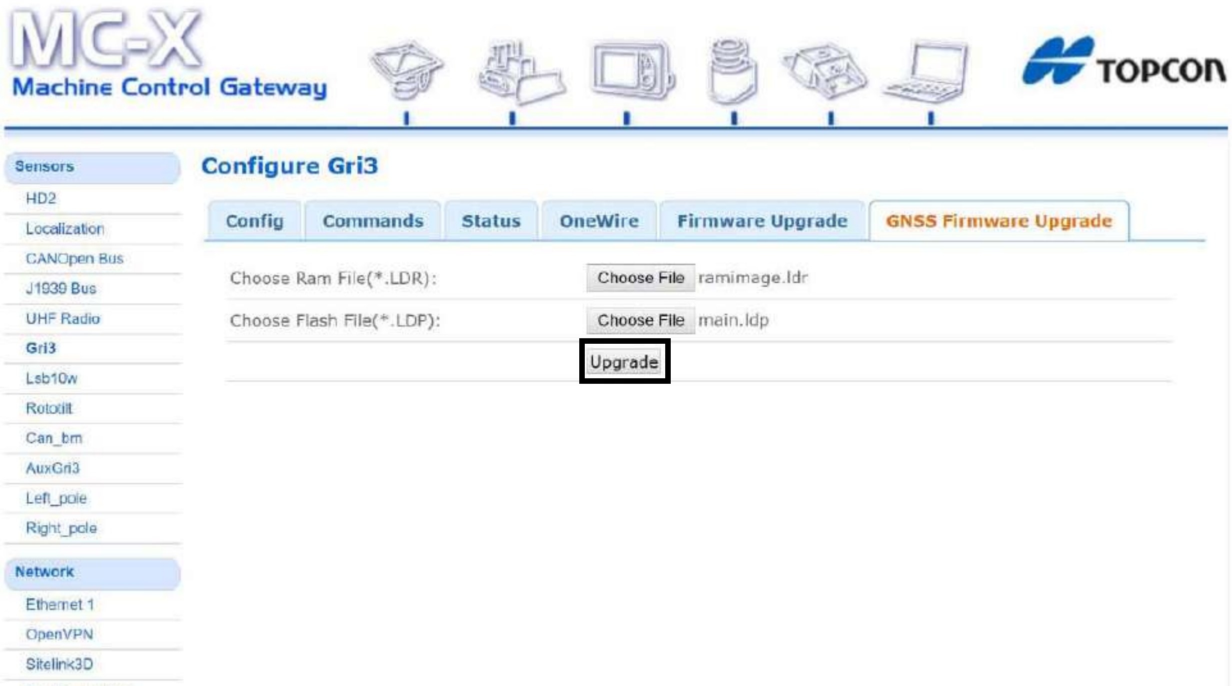


Figure 21. GNSS Firmware - Upgrade

6. Select A**uxGRi3** under the **Sensors** tab, and repeat steps 2 through 5 for the Auxiliary antenna.

System Verification

Now that all necessary firmware has been loaded onto the MC-X1, CAN communication can be verified.

1. Ensure all sensors and GR-i3s are connected, then tap on **CANOpen Bus**.

Figure 22. CANOpen Bus

2. All communicating devices will populate in the **Status** window (Figure 23).

CANOpen Bus

Status

Node ID	Type	Product	Revision	Serial #
54	tsi3	1413697358	66816	2630254
65	tsi3	1413697358	66816	2381965
73	tsi3	1413697358	66816	2381973
88	tsi3d	1413697358	66816	2093988
116	gri3	1735551283	65536	0
120	gri3	1735551283	65536	0

Figure 23. CANOpen Bus - Communicating Devices Status

Once a machine builder has been made active with the correct sensor designations (see "Calibration" on page 44), the Body, Boom, Stick, and Attachment will be selectable in the **Sensors** menu as shown in Figure 24 on page 14.

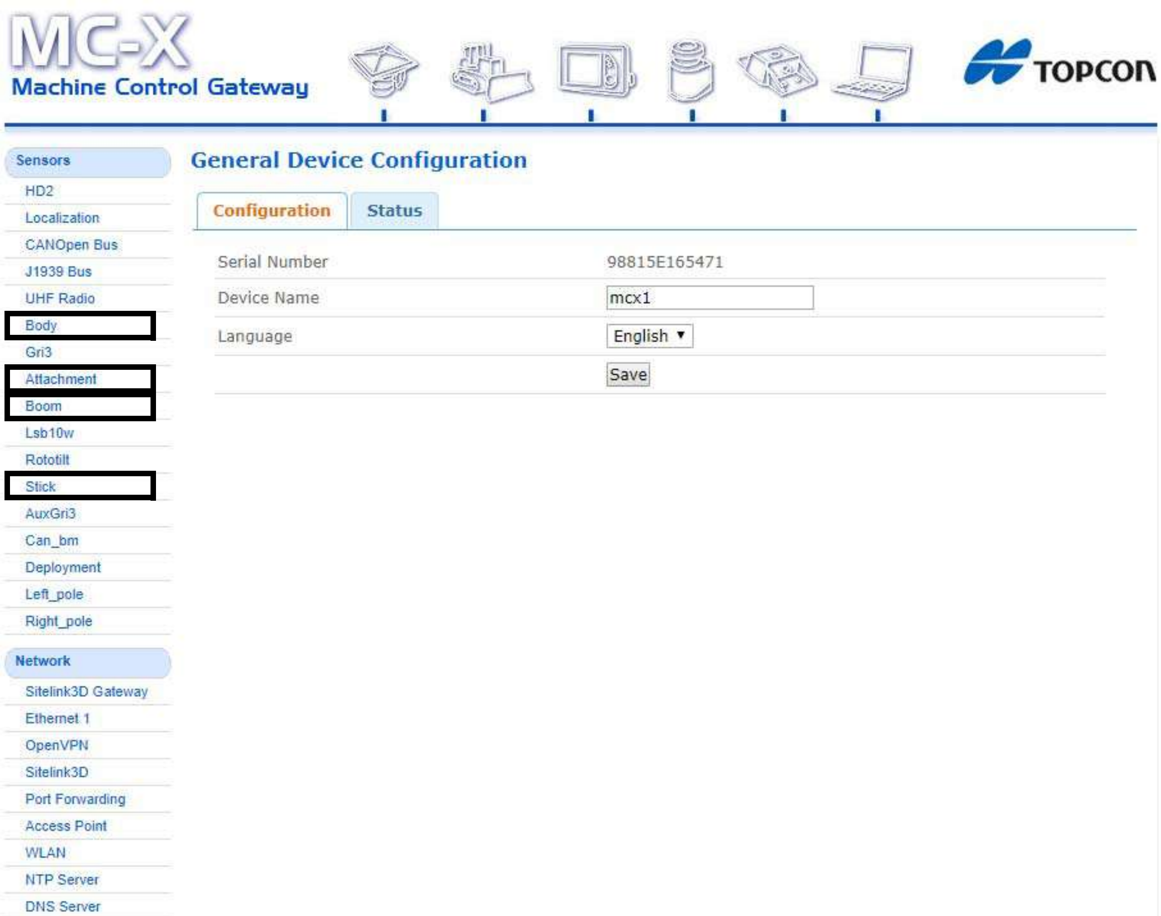


Figure 24. CANOpen Bus - Communicating Devices Status

Loading EASy-Proof Radio Channels

1. Open 3D-MC to create a machine builder file (if one has not already been created), and select **Satel EASy-Proof** from the radio drop-down menu. If a machine builder has already been configured, make sure **Satel EASy-Proof** is selected as the radio type.

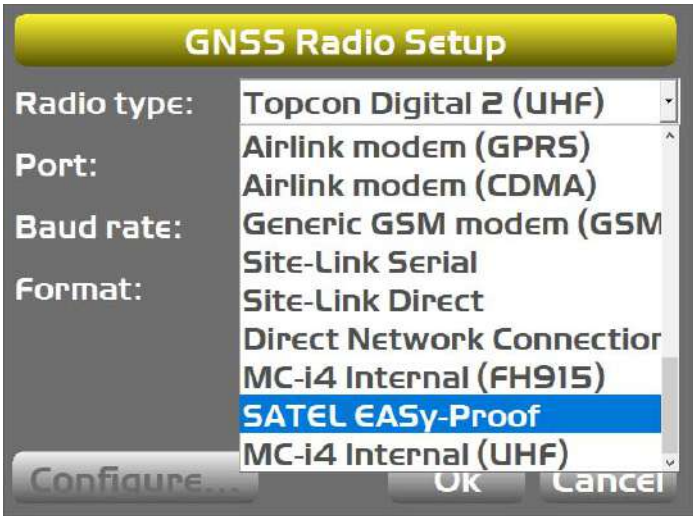


Figure 25. UHF Radio Setup

2. Navigate to the end of the machine builder, and tap **Finish**.

3. Ensure the correct machine file is selected on the **Machine files** page, and Tap **OK**.
   Now, your .mx3 is deployed, and the radio will populate in the MC-X Machine Control Gateway.

NOTE An .mx3 file that is active in 3D-MC is considered the "deployment".

---

4. UHF RADIO will not populate in the MC-X Web Interface unless an .mx3 file with the **Satel EASy-Proof** radio type is deployed from 3D-MC.

5. Open **MCXCONFIG**, and select **UHF Radio** under **Sensors**.

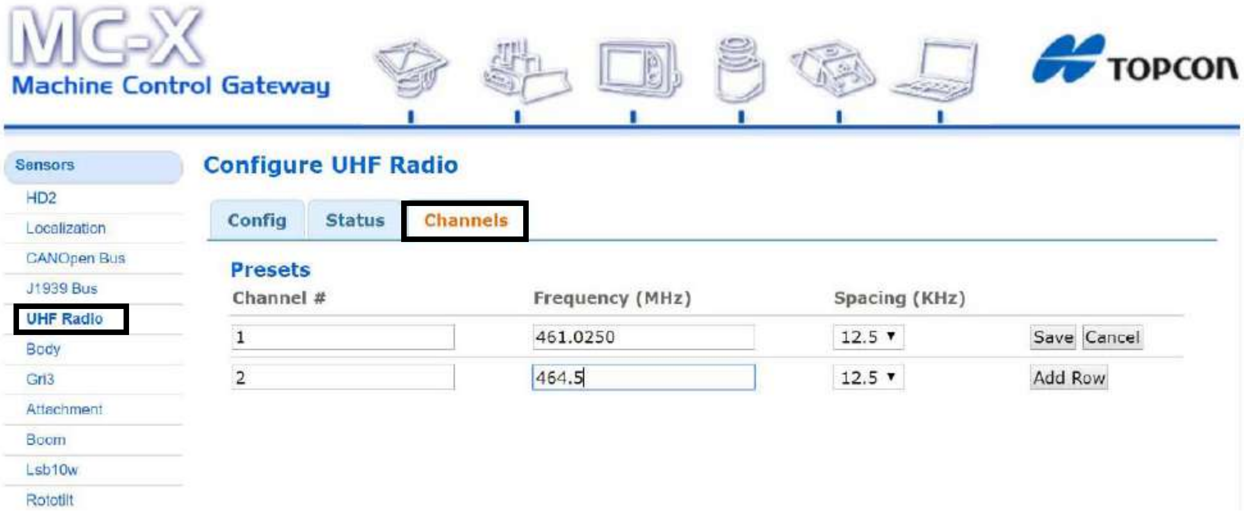


Figure 26. UHF Radio Setup

6. Tap the **Channels** tab, enter the appropriate values, and tap **Save**.

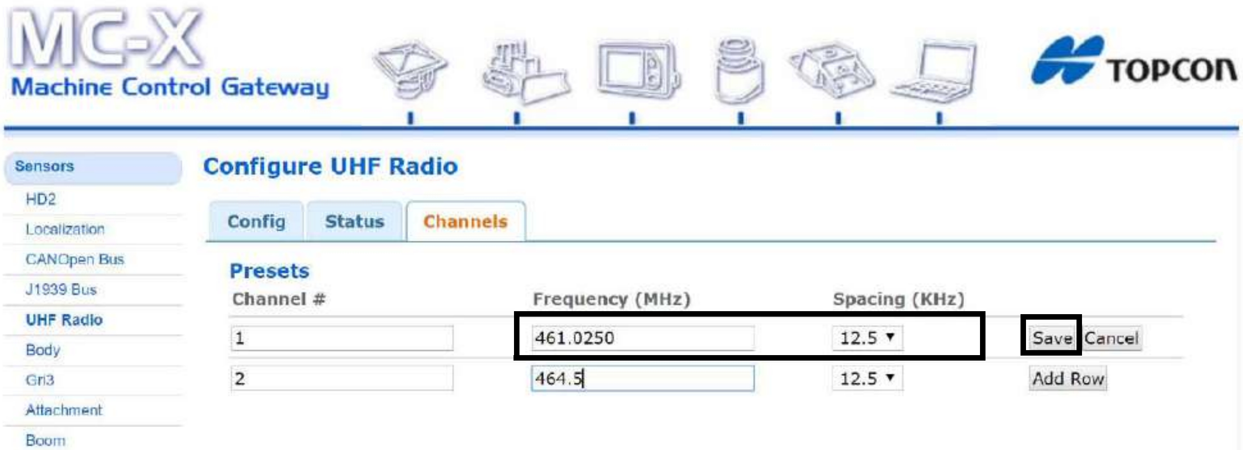


Figure 27. UHF Radio Setup

A notification appears when the values are saved (Figure 28).

Figure 28. UHF Radio Setup - Saved

7. Close **MCXCONFIG**.

8. Open **3D-MC**, and tap **Tools > Configure Radios > Configure**, and then select the appropriate channel from the drop-down menu.

9. Tap **Set**.

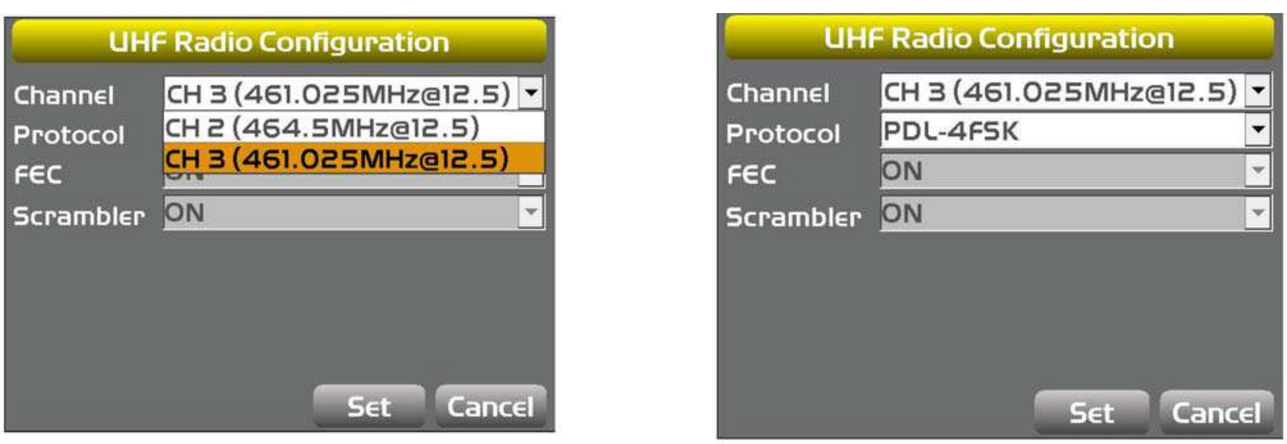


Figure 29. UHF Radio Configuration

Factory Reset for the GR-i3 via TRU

A Factory Reset resets all the receiver parameters to their default values and clears the receiver's Non-Volatile Random Access Memory (NVRAM). NVRAM holds data required for satellite tracking. Factory Reset does not delete any files from the receiver and does not reset modem parameters.

Perform a Factory Reset after loading a new GNSS firmware file and sometimes to eliminate communication or tracking problems. After performing the procedure, the receiver requires some time to collect new ephemerids and almanacs (up to 15 minutes)

To perform a Factory Reset using Topcon Receiver Utility (TRU):

1. Open **TRU** from the desktop of the GX Series display.

2. Tap **Device > Application Mode > Receiver Managing**.

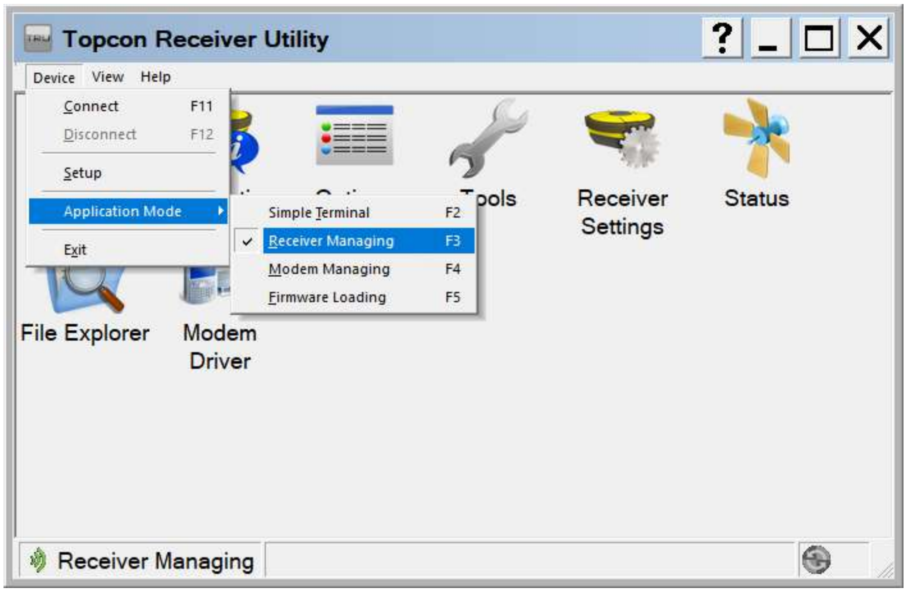


Figure 30. TRU - Receiver Managing

3. Tap **Device > Connect**.

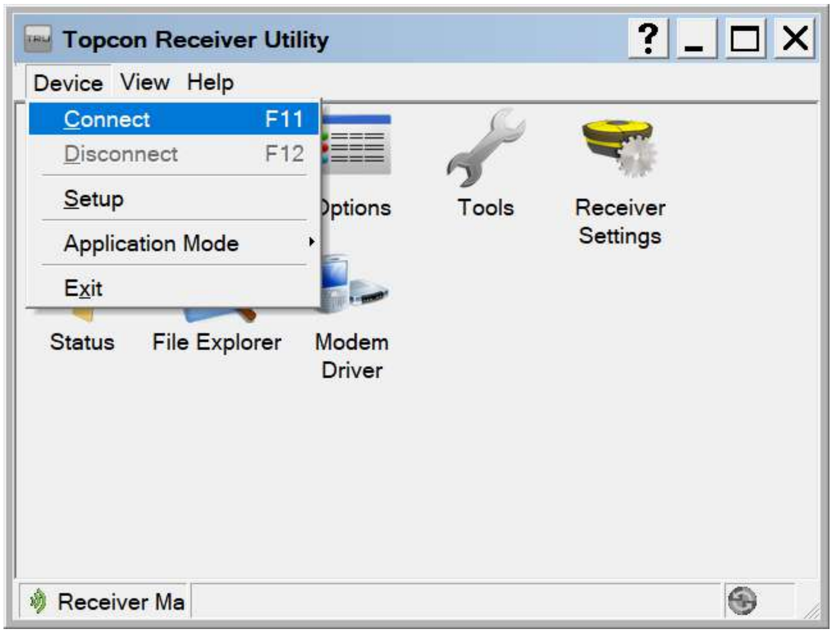


Figure 31. TRU - Connect

4. In the **Connection Parameters** screen, select **Network** from the **Connect Using** drop-down list.

5. In the **Device Name** field, tap … to select the device name to which the GPS receiver board is connected.

    a. If a Device name has not been configured, tap … . Then press and hold on the white area of the screen.

    b. Select **Add**. The **Network Connection** screen appears.

    c. Enter a **Name** to identify the Main GNSS board

NOTE MC-i3, MC-i4, and the GR-i3 utilize the same network parameters for Main and AUX GNSS boards.

    d. Enter the following network parameters for the GR-i3 Main GPS board:

    – IP Address or Host Name: `192.168.0.1`

    – TCP Port: `8012`

    – Password: `TPS`

    e. Tap **Ok**.

6. After resetting the Main GNSS board, repeat steps 3 to 5e for the Auxiliary GNSS board.

   The TCP Port for the Auxiliary GNSS board is `8013`.

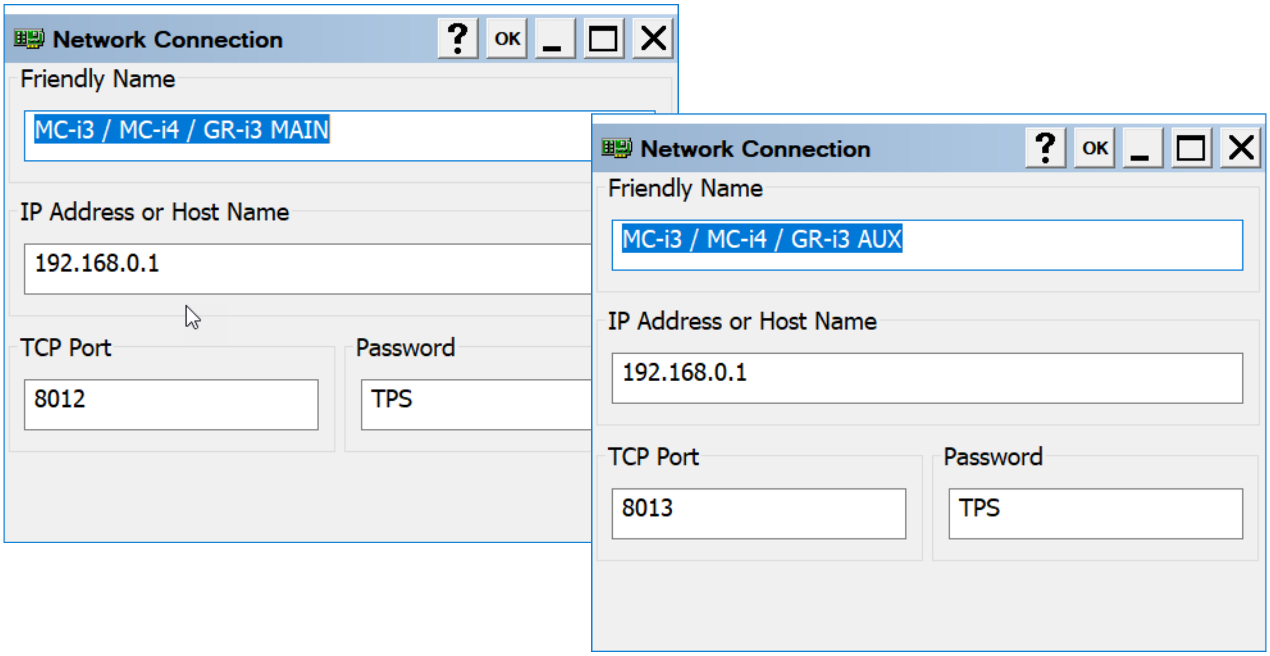


Figure 32. TRU - Network Parameters

7. Tap **Connect.**

8. Tap the **Tools** icon 

.

9. Select **Factory Reset**.

10. A popup message appears. Tap **OK**.

11. After both GNSS boards have been reset, close **TRU**.

Configuring SL-100 for MC-X1 Communication

The following section explains how to configure the optional SL-100 for communication with the MC-X1.

To communicate with the MC-X1, SL-100 Firmware 1.15 must be installed on the SL-100. Refer to the *SL-100 Configuration Manual* P/N: 1000226-01 to load the firmware.

NOTICE Firmware cannot be loaded while the SL-100 is connected to the MC-X1. SL-100 programming cables are necessary.

Once the SL-100 is connected, the **Sitelink3D Gateway** is accessible under **Network**.

Figure 33. Sitelink3D Gateway

To return to the MC-X Machine Control Gateway, click **Back**.

TS-i3 Sensors

NOTICE Before installation, note the following:

- Check the sensor's serial numbers before installing. The last two digits of the serial number determine the sensor CAN address, and must be unique to each machine.
- A sensor ending in 00 is considered a special CAN identifier, and will be identified as 01 in 3D-MC; therefore; if you have a sensor with 00 and a sensor with 01, there will be some confusion in 3D-MC.For example, sensor serial number 0302 and 0402 will have the same CAN address ("02"), causing communication errors.

CAUTION When mounting the tilt sensors, begin with the attachment to help simplify cable routing.

Each TS-i3 sensor contains a single or dual axis sensor element. The sensor's mounting location determines the sensor type; single axis or dual axis. Single axis sensors mount on the stick, boom, and attachment, in a left or right orientation. The body sensor is dual axis, and mounts only in a flat orientation with the label up.

NOTICE The dual axis TS-i3 sensor is labeled "TS-i3d".

When installing the sensors, ensure that they are mounted parallel to the axis being measured. Locate surfaces that protect the sensor from physical damage and are convenient for cable routing. When the position of the implement is at zero degrees (horizontal), make a note of the direction of the arrow marker on the serial label (located on the top of the sensor). This direction is needed during calibration. The calibration process uses 3D-MC to enter direction, orientation, and other sensor variables.

TS-i3 Sensor Orientation

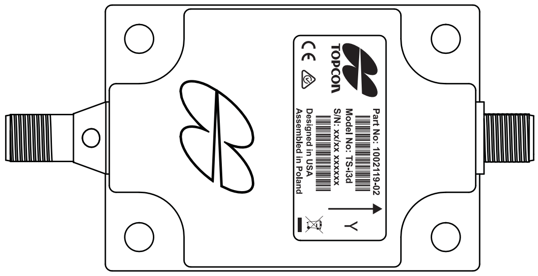


Figure 34: TS-i3 Sensor Location and Direction

CAUTION Mounting each tilt sensor within +/- 20° of the pivot centerline is a good practice. Though not necessary for system performance, squaring the sensors to each part of the machine makes for a cleaner looking installation.

CAUTION All tilt sensor orientation is determined when the implement is horizontal (zero degrees). The orientation of each tilt sensor is entered in 3D-MC.

CAUTION It is recommended that the sensors be installed on the boom, stick and attachment implements with serial numbers in ascending or descending order.

NOTICE When entering sensor information, make note of each sensor’s serial number and its orientation. TS-i3 sensor orientation for boom, stick, and hitch is only left or right.

CAN Termination

To ensure proper communication on the CAN bus, the last sensor physically connected must use the hard terminator provided with the excavator systems. Typically, the hard terminator connects to the hitch sensor or the tilt bucket sensor as shown in Figure 35.

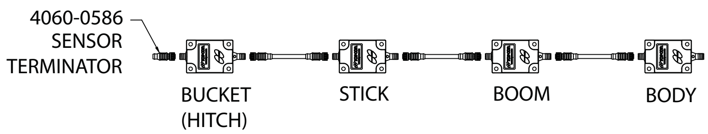


Figure 35: Hard Terminator on Last TS-i3 Sensor

On a 2D system, the hard terminator must also connect to the F-M-M Tee (Figure 36).

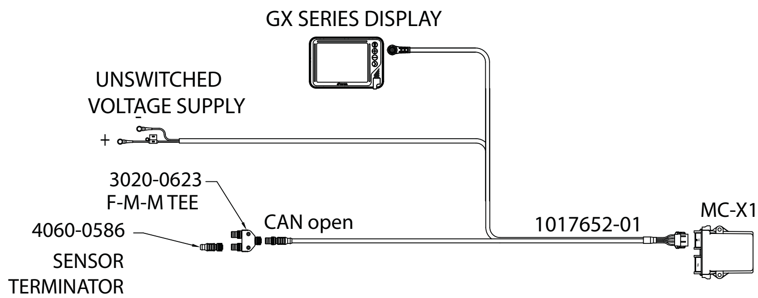


Figure 36: Hard Terminator on F-M-M Tee - 2D System

On a 3D system, the hard terminator must also connect to the M-M-M Tee at the last GR-i3 (usually the AUX), as shown in Figure 37,

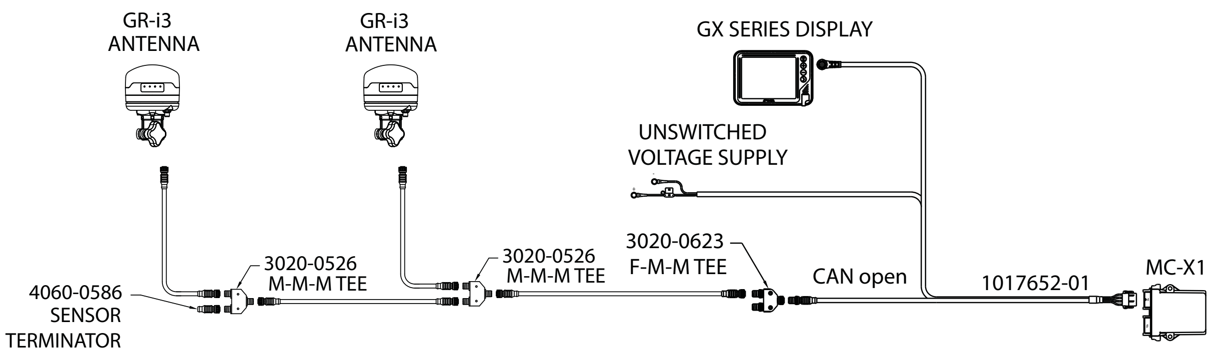


Figure 37: Hard Terminator M-M-M Tee - 3D System

Hitch Sensor

The hitch sensor is the most challenging sensor to mount to keep the sensor and cables protected.

If a quick release coupler is installed on the excavator, the most accurate and safe place to mount the sensor is on the inside of the coupler.

An alternative mounting location is on the left side of the DogBone, either on the inside or the outside of the DogBone itself; see “DogBone Sensor (Optional Mounting Location)” on page 25.

If no hitch sensor is used select **None (hanging attachment)**.

CAUTION TS-i3 sensors are only mounted on the left or right of the DogBone or quick-release.

When mounting the attachment sensor, keep the following in mind (Figure 38):

- Position the hitch on the ground (bucket flat on the ground) before mounting the sensor.
- Mount the sensor between the attachment pivot pin and the linkage pin as shown in Figure 38.
- Sensor is orientation Left/Right.

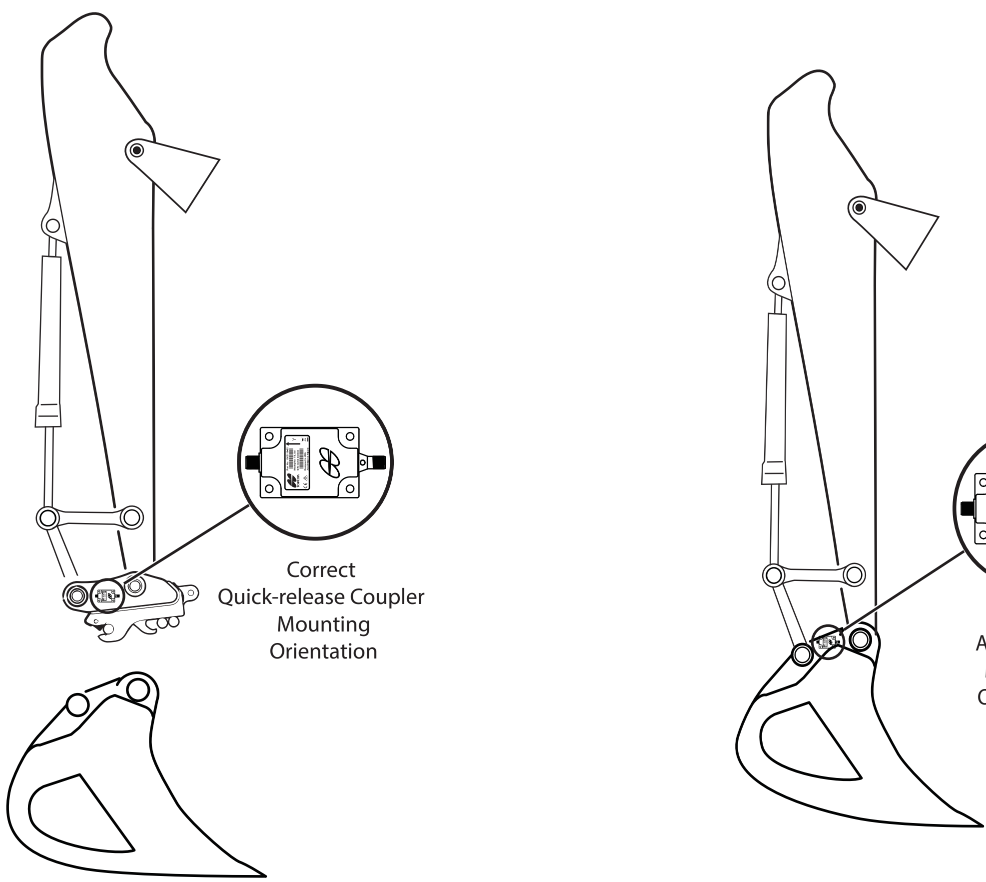


Figure 38: Quick-release and Attachment Sensor Mounting

DogBone Sensor (Optional Mounting Location)

An optional location for the hitch sensor is on the DogBone. This location offers additional protection of the sensor, but produces less accurate readings (especially if the joints are worn). If possible, placing the sensor on the inside of the DogBone will provide additional protection. Mounting the sensor on the DogBone requires additional calibration steps.

NOTICE	Installing the sensor on the inside of the DogBone may not be possible on smaller machines due to space constrictions.

CAUTION	If using the DogBone mounting option, worn joints in the DogBone linkage causes decreased accuracy.

CAUTION	TS-i3 sensors are only mounted on the left or right of the DogBone.

The recommended location of the sensor is on the left side of the DogBone.

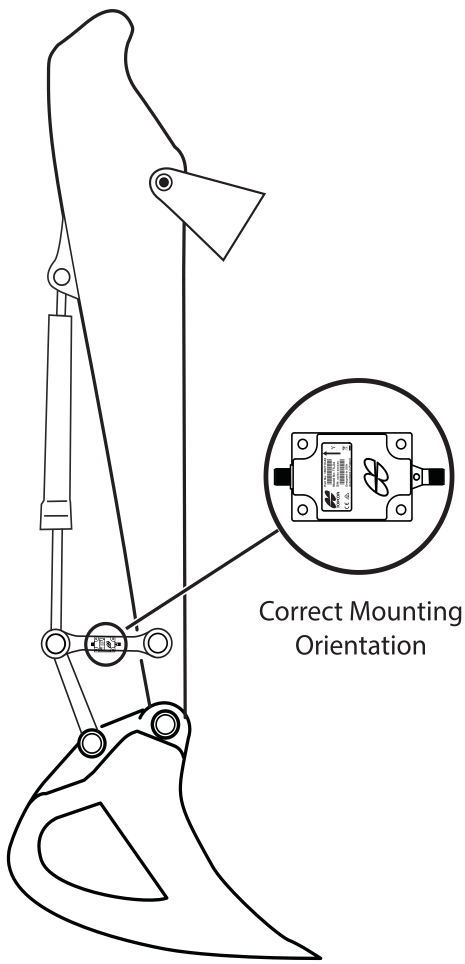


Figure 39: DogBone Sensor Mounting Example

Tilt Bucket Sensor

If using tilt bucket, an additional sensor may be mounted to the bucket (Figure 40). Tilt bucket sensor mounting differs from all other sensors. Determine the location and orientation of the sensor with the bucket sitting flat on the ground.

NOTICE	If using a single-axis TS-i3 sensor, mount the sensor vertically, with the label front/arrow right, or label back/arrow right from the cab perspective.

NOTICE	If using a dual-axis TS-i3d sensor, mount the sensor with a flat orientation, on a the top of the attachment with the label up. The arrow may point left, right, forward, or back.

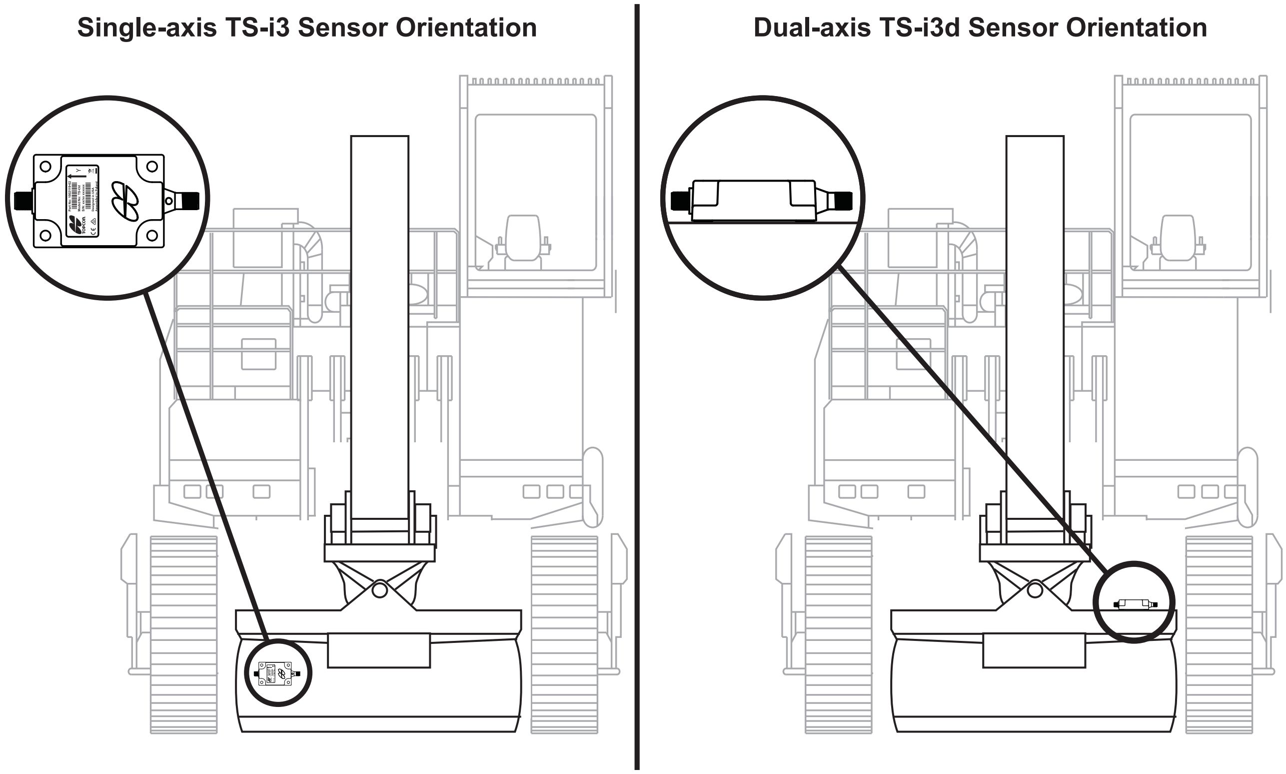


Figure 40: Tilt Bucket Sensor Mounting

Tilt Rotator

The following brands of supported Tilting/Rotating attachments include;

- Rototilt®
- Engcon®
- Steelwrist®

Each manufacturer has specific installation documentation which is required for setup and calibration.

Stick Sensor

Locate a convenient surface to mount the sensor. Mounting the sensor close to the top of the stick will help prevent damage during digging.

The mounting location shall be on the left or right side of the stick (from the cab point of view).

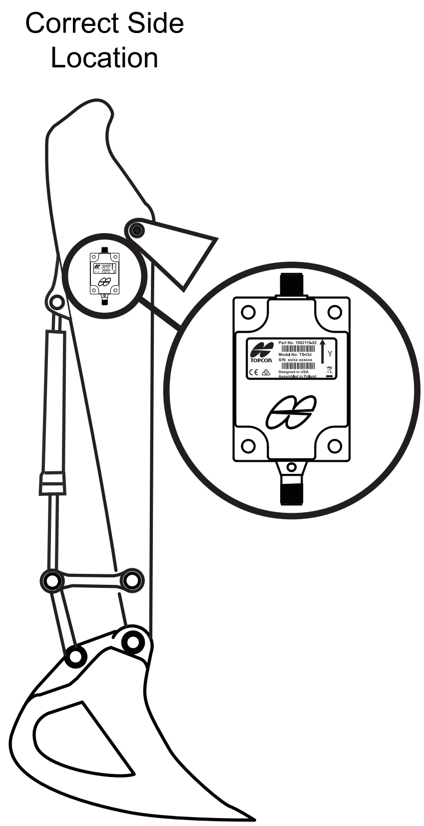


Figure 41: TS-i3 Stick Sensor Mounting

Boom Sensor

For the boom sensor, locate a convenient surface parallel to the boom center. The mounting location may be on the left or right side of the boom (from the cab point of view). Be sure to place the sensor at a location away from the boom pivot

CAUTION Placing the boom sensor on a tapered section will cause calculation errors.

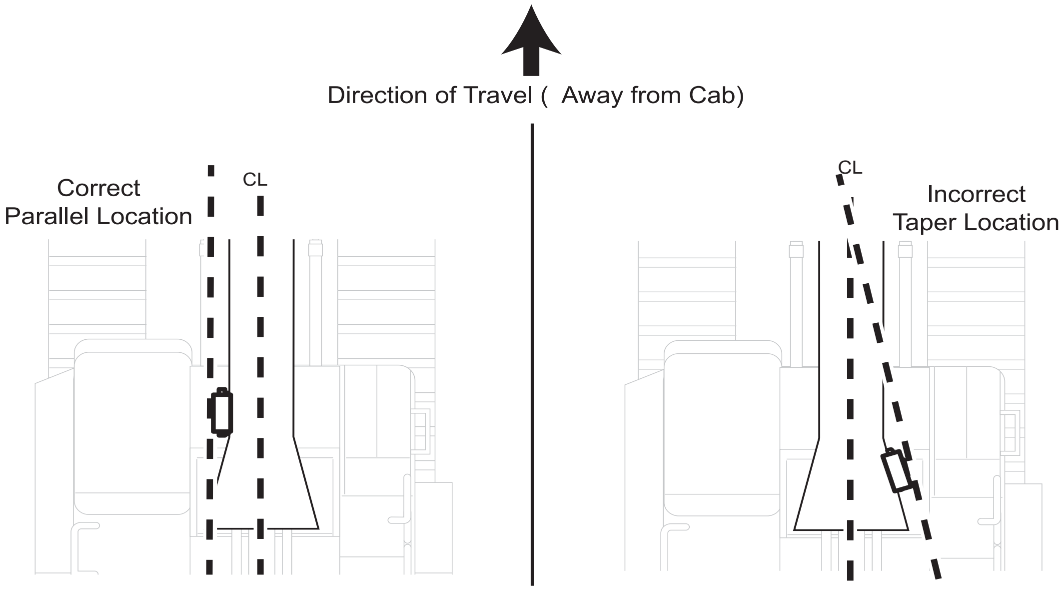


Figure 42: Boom Sensor Mounting

Secondary Boom Sensor

The secondary boom sensor mounting locations are identical to the primary boom sensor mounting locations. If a second boom is installed, see the previous section “Boom Sensor” on page 28.

Body Sensor

For the TS-i3d dual axis body sensor, locate a convenient surface where the sensor can be mounted with the label up.

The recommended mounting location is between the boom's elevation cylinders (Figure 43).

If a secure mounting surface cannot be between the boom's elevation cylinders, mount the body sensor to the alternative mounting location on top of the body, or under the boom pivot pin.

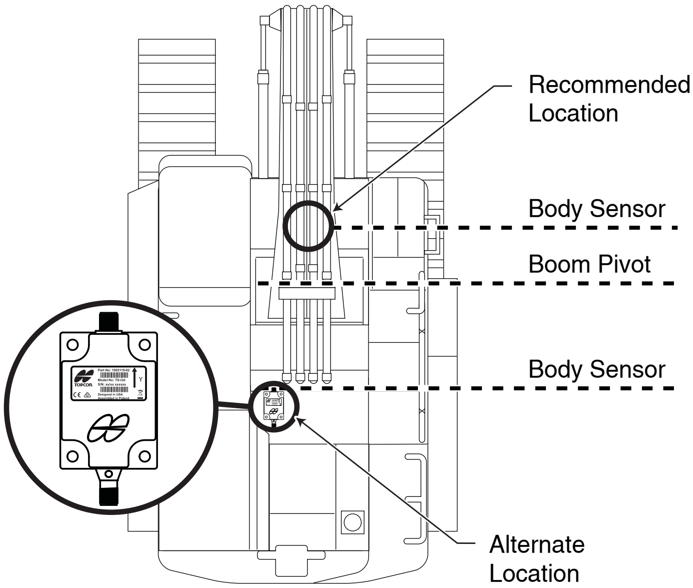


Figure 43: Body Sensor Mounting - Top View

LS-B10W

The LS-B10W Laser Receiver and bracket must be mounted on the left side of the stick. The following section describes bracket mounting, cable routing, and LS-B10W Laser Receiver mounting.

CAUTION	A mark on the laser receiver and the cross hairs on the mounting bracket are used to determine its position on the stick.

1. Before installing the LS-B10W bracket, you must assemble the bracket kit; see the *LS-B10W Indexing Bracket Assembly Instructions* (p/n: 7030-1370) for more information.

CAUTION	When determining mounting location, be cautious of limitations in cable lengths.

2. Install the LS-B10W onto the bracket.

3. Route the cables as shown in Figure 44.

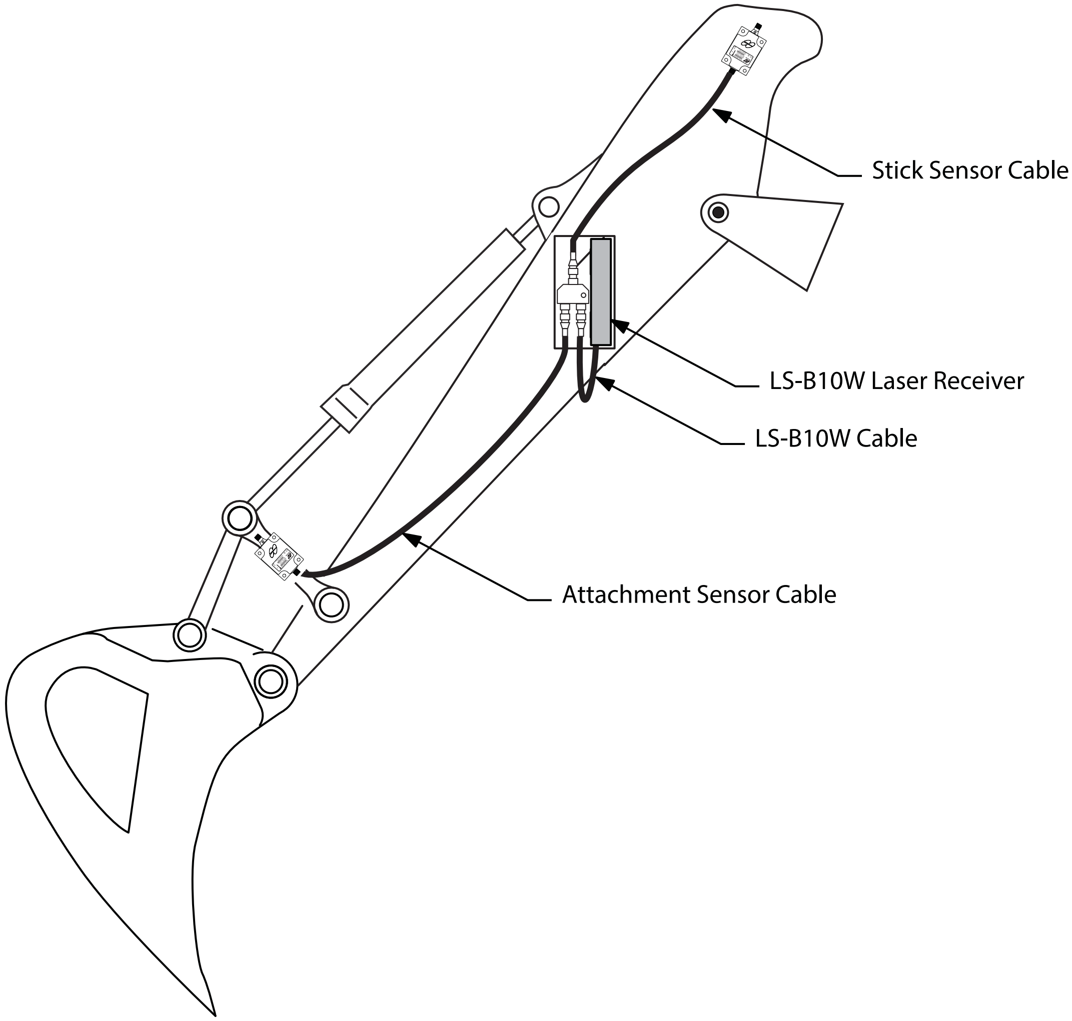


Figure 44: LS-B10W Cable Routing

MC-X1 Controller

Install the MC-X1 Controller onto the machine's body using the magnet mounts provided, and connect the cable to the GX Series Display.

GNSS Antenna, Mount and Pole

1. Weld the Antenna Pole Weld Mount to the top of the counterweight as shown in Figure 45.

CAUTION Various makes and models may require fabrication of mounting surface for the Antenna Pole Mount. Ensure that the top of the antenna is flush or slightly above the cab roof when mounted.

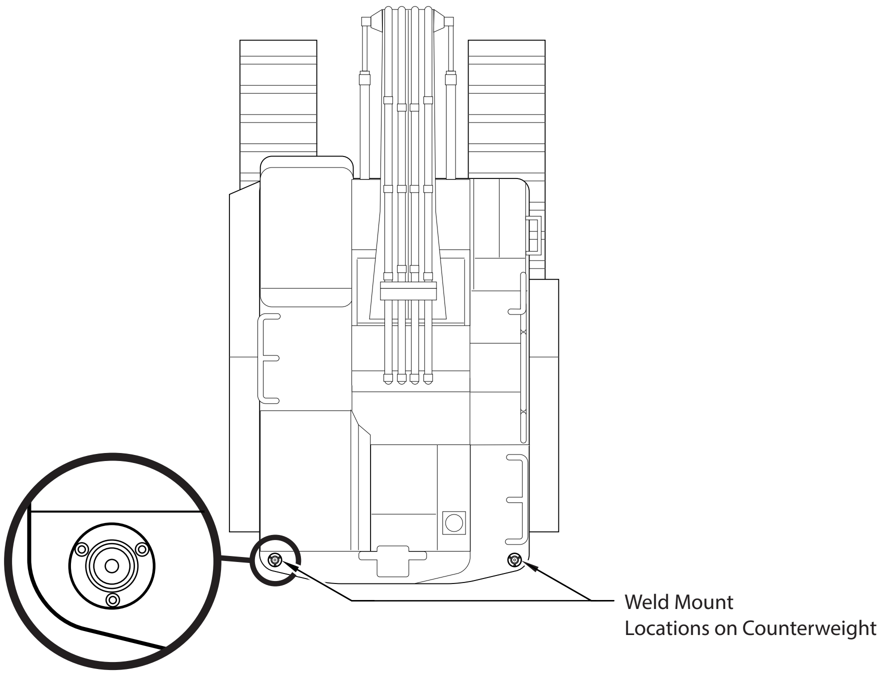


Figure 45: Antenna Pole Mount Weld Mount Locations

2. Repeat Step 1 on the opposite side of the excavator.

3. Install the two antenna poles onto the weld mount using the three (3) bolts as shown in Figure 46.

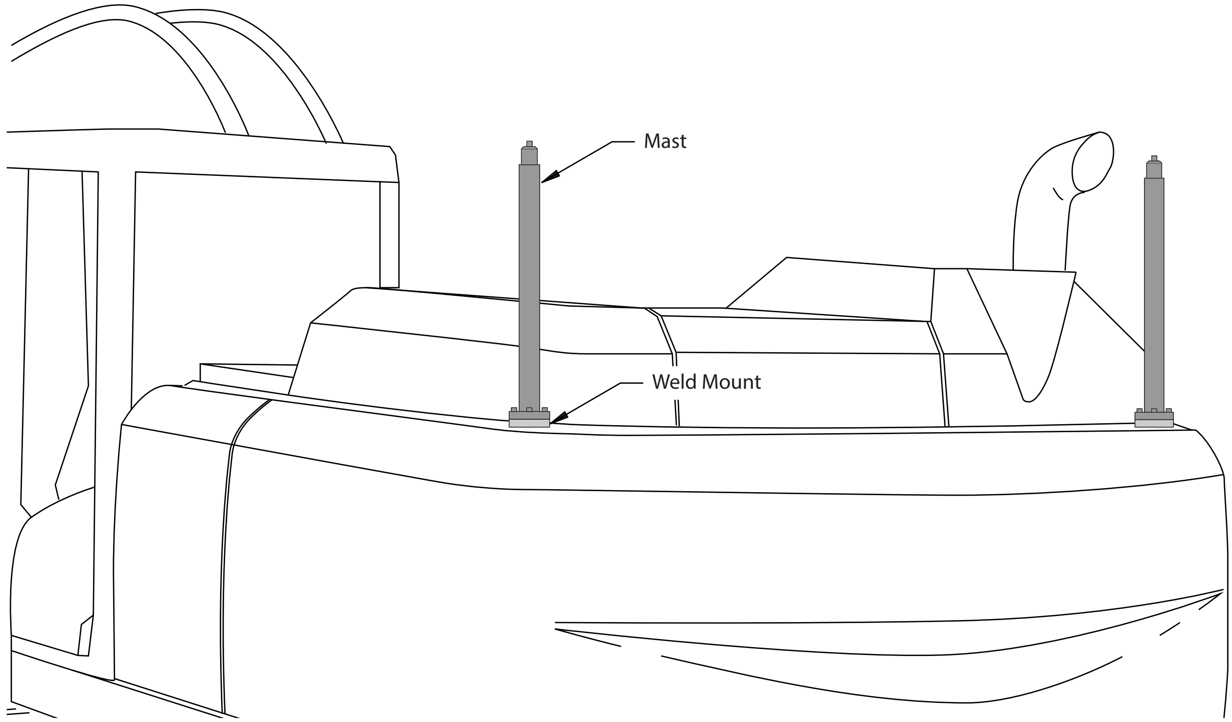


Figure 46: Antenna Pole Installed

4. Install the strain relief brackets. Remove the two (2) small bolts to route the TURK CAN cable through the bracket. Ensure enough cable is routed through, so that the cable can be threaded into the GR-i3 BASE (Figure 48 on page 33).

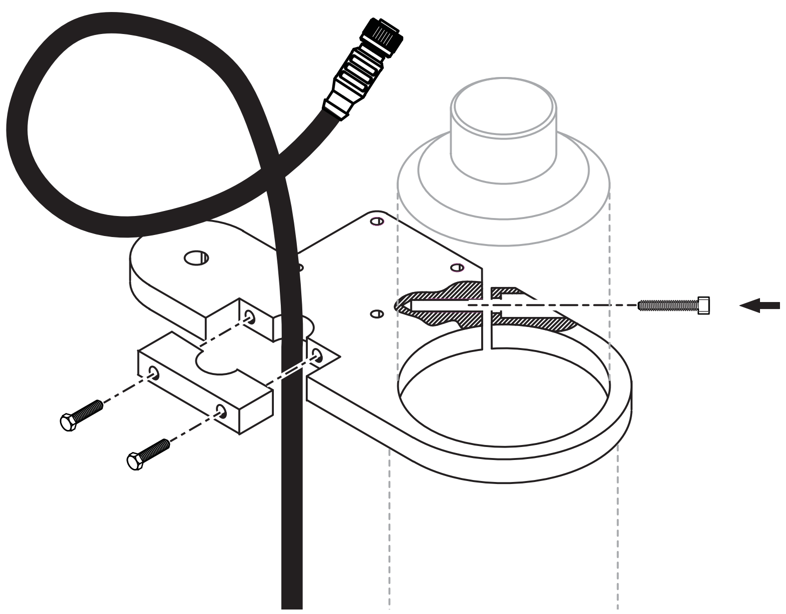


Figure 47: Strain Relief

5. Install the GNSS antenna, align the strain relief bracket, and connect the cable (Figure 48 on page 33).

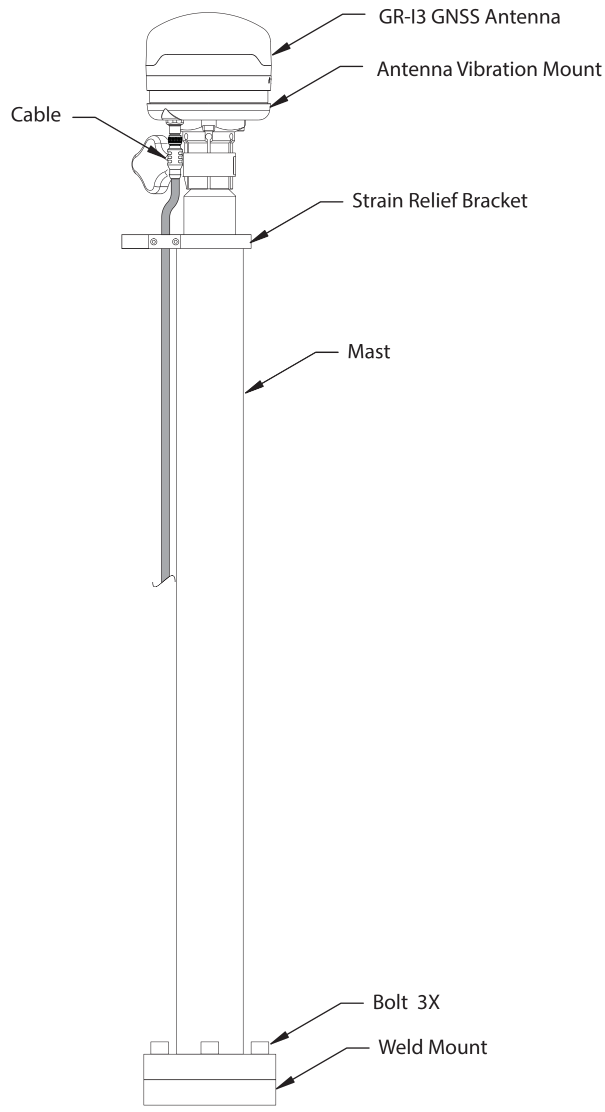


Figure 48: GNSS Antenna Installed on Pole

WiFi Antenna and Magnet Mount (If Purchased)

1. Install the WiFi Antenna Magnet Mount onto the machine's cab.
2. Install the WiFi Antenna onto the Magnet Mount.
3. Connect the WiFi Antenna cable to the MC-X1.

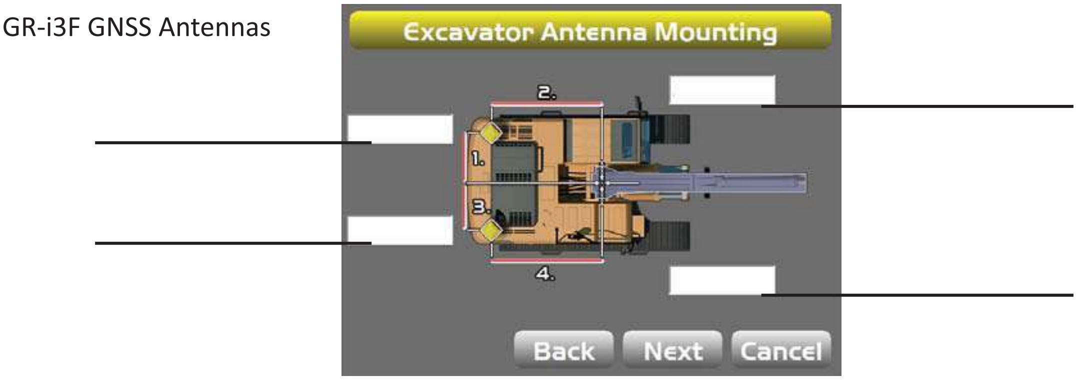
Taking Machine Measurements

Accurately measure and enter the machine dimensions into the 3D-MC machine builder, and write your measurements on the lines at the side of the following screen captures.

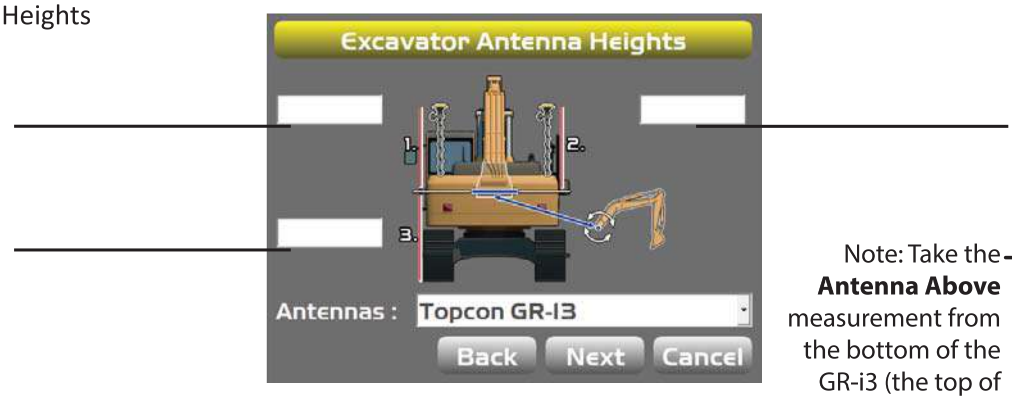
CAUTION Incorrect measurements or data entry errors have a direct affect on excavating accuracy. Take each measurement twice to ensure accuracy.

GR-i3

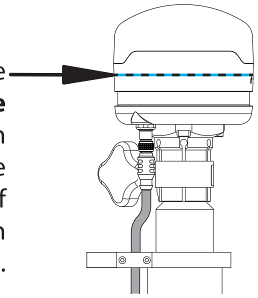
GR-i3F GNSS Antennas



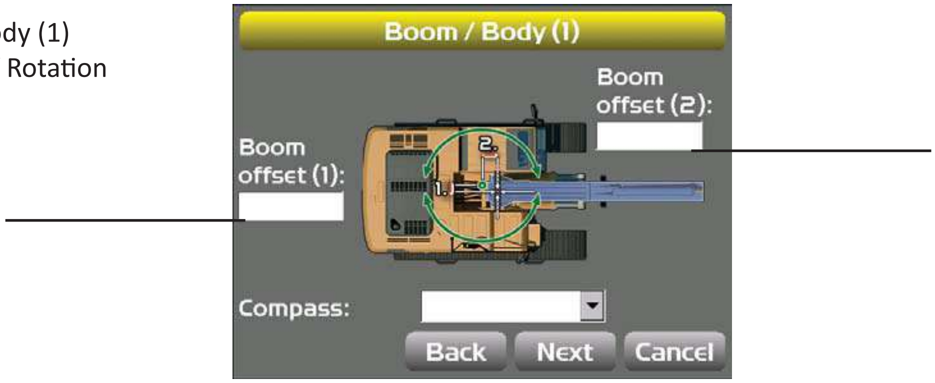
GR-i3F GNSS Antenna Heights



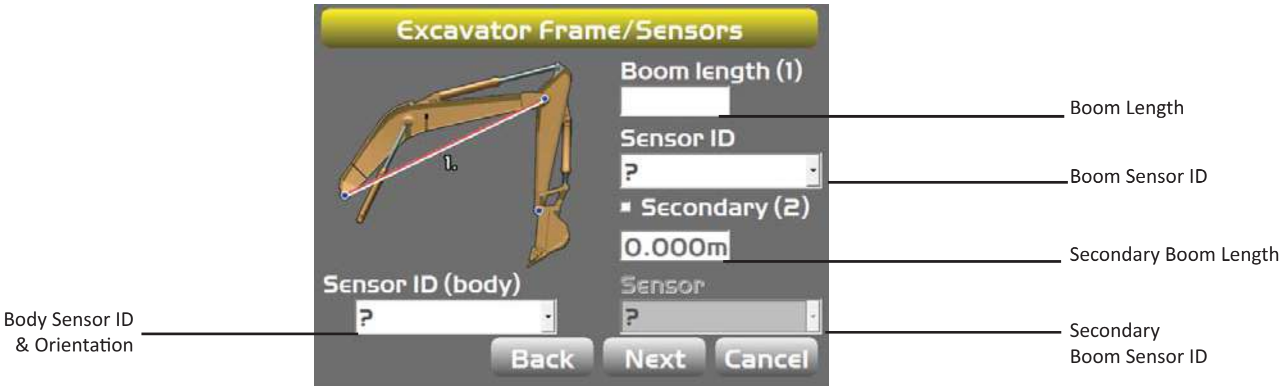
Note: Take the **Antenna Above** measurement from the bottom of the GR-i3 (the top of the Vibration Mount).



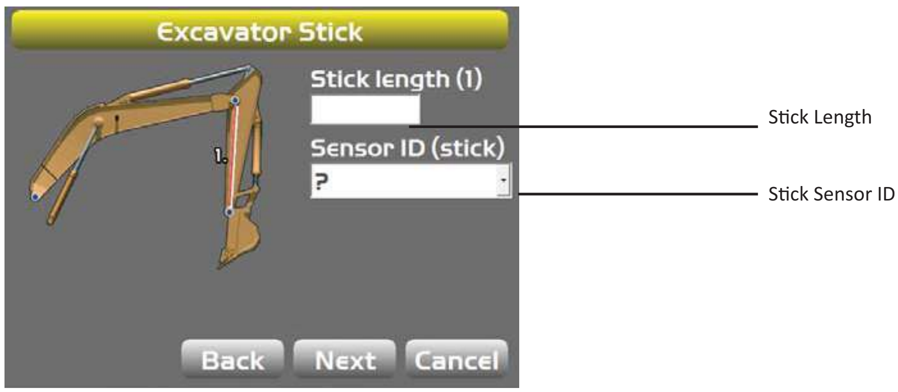
Boom/Body (1) Center of Rotation



Body and Boom



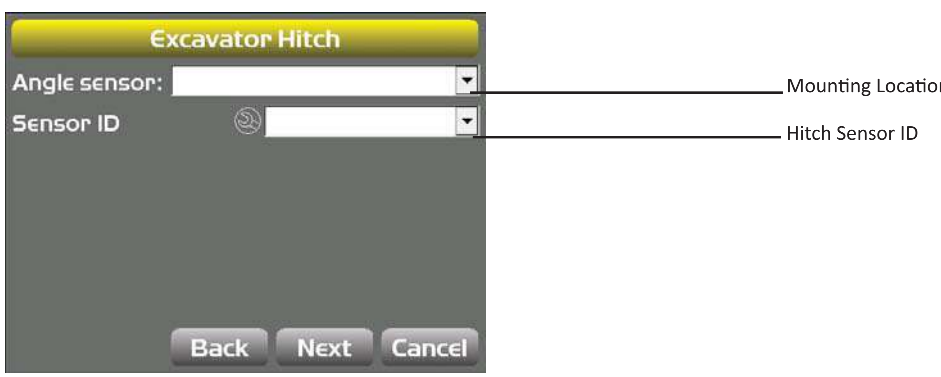
Stick



Hitch

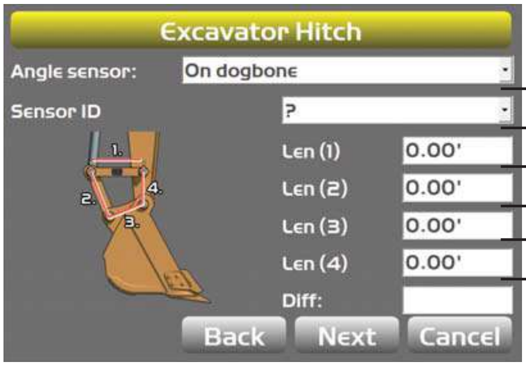
The Hitch Sensor may be mounted on the Dogbone or the Hitch/Coupling.

Hanging Attachment may be selected if there is no sensor.



DogBone

DogBone Lengths



Hitch Sensor ID

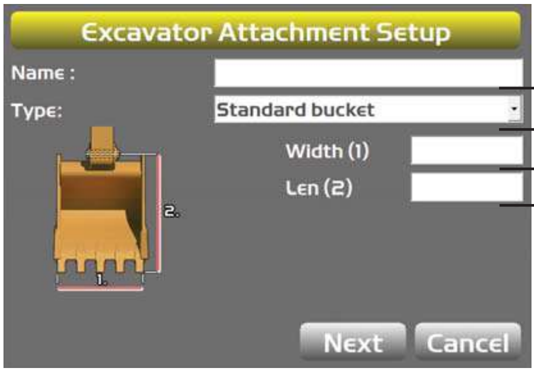
Note: Stick angle difference (Diff:) is determined during calibration of the machine.

Attachments

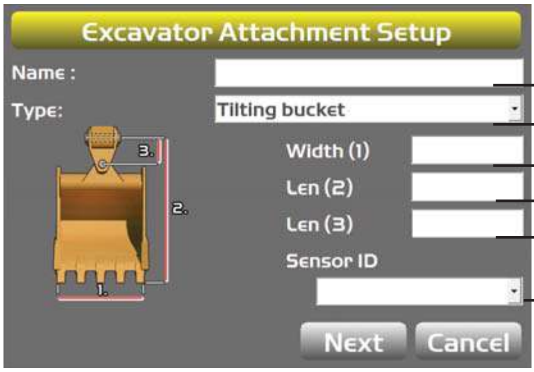
Attachment Width and Length (repeated for each bucket)

Note: Multiple attachments may be set up at any time. When ready for use, ensure that the desired attachment is calibrated (see pg. 35).

Record Sensor ID and orientation for all sensors.

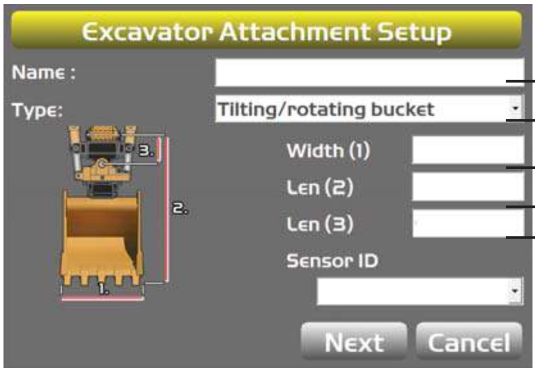


Note: **Length 3** is the length from the attachment pivot pin perpendicular to the tilt pivot pin. If this measurement is incorrect, the accuracy of the attachment will be degraded as it is tilted.



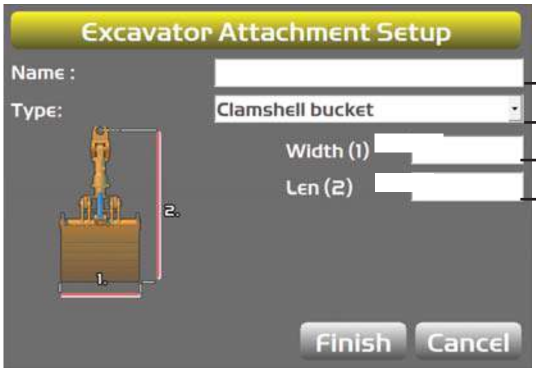
Sensor ID & Orientation

Attachment Setup Bucket Rotator

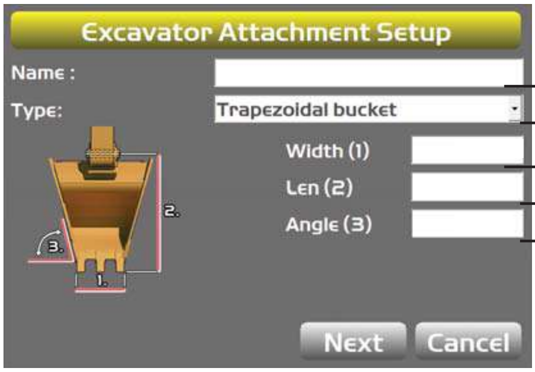


Sensor ID

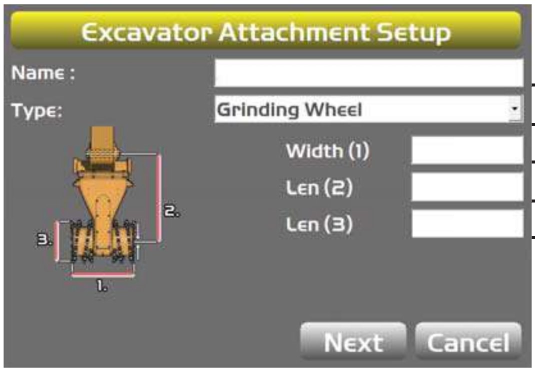
Attachment Setup
Clamshell Bucket



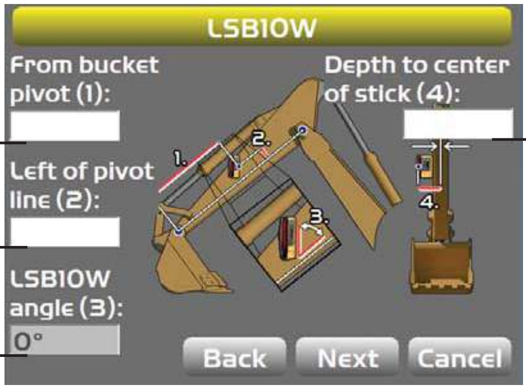
Attachment Setup
Trapezoidal Bucket



Attachment Setup
Grinding Wheel



LS-B10W



Distance from Bucket Pivot to LSB10W

Depth from Centerline of Stick

Distance from Left of Pivot

Angle to the Stick Centerline
Note: Only determinded during calibration of the machine.

Entering Sensor Information

Power up the system and allow several minutes for the 3D-MC software to detect the sensors.

Before calibrating the sensors on the excavator systems, set up each sensor in 3D-MC. You will need the following information:

- the last two digits of the sensor's serial number
- the physical orientation of the sensor mounting

Step 1: Configure the Machine File and the excavator options.

1. In the GX Series display, tap the **Power Button** ▸ **Control** ▸ **Machine setup**.
2. Select a current machine file and tap **Edit**, or tap **New** to create a new machine file.
3. On the **Configuration name/type** screen, enter or select the appropriate data as needed (Figure 49).

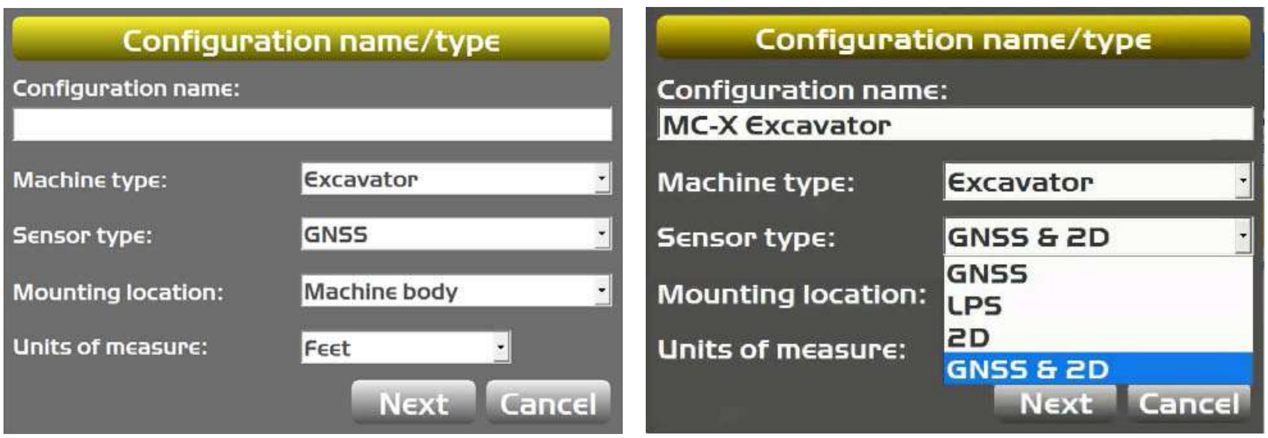


Figure 49: Configuration name/type

4. Tap **Next** to navigate to the **Excavator Options** screen and select **None** as the **Position Input** (Figure 50 on page 39).
5. Enter 3D/2D excavator options:
   a. For 3D systems, choose **MC-X1** for **Position Input** and **Sensor Input.**
   b. For 2D systems, select **MC-X1** for **Sensor Input**.

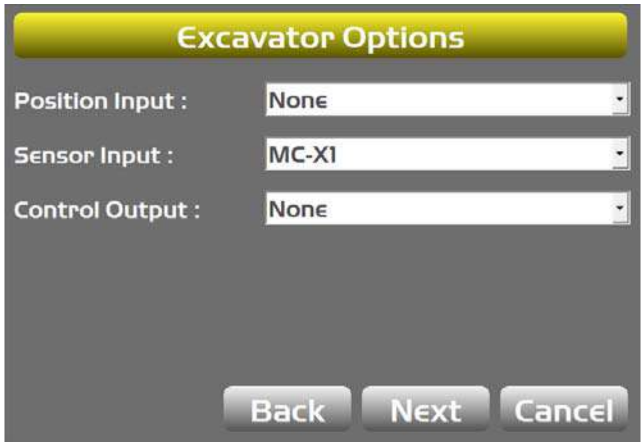


Figure 50: Select the Appropriate Position and Sensor Input

6. Enter 3D/2D sensor values:

   a. For 3D systems, tap **Next** to navigate to the **Excavator Antenna Mounting** screen, followed by the **Excavator Antenna Heights** screen. Enter the appropriate values as needed on both screens.

   b. For 2D systems tap **Next** to navigate to the **Excavator IMU Mounting** screen, and select the appropriate values as needed. Then tap **Next** to navigate to the **Boom / Body (1)** screen. Enter the appropriate values.

7. If using a TS-i4 as a compass, select **TS-i4** from the drop-down menu. Then tap the **Wrench** icon to calibrate the compass. Follow the on-screen instructions.

8. Tap **Next** to navigate to the **Boom / Body (2)** screen. Enter the appropriate value.

Step 2: Designate each sensor to its corresponding implement.

NOTICE	If using a TS-i4, **TS-i4-IMU** will be selected as the Sensor ID for the body.

NOTICE	For the Body, Boom, Stick, and Attachment sensors, Tap the appropriate **Sensor ID** box and select the serial number (last two digits) of the sensor corresponding to the machine element. Refer to your notes from installation to select the correct sensor ID from the drop-down menu.

1. Tap **Next** to navigate to the **Excavator Frame/Sensor** screen (Figure 51).

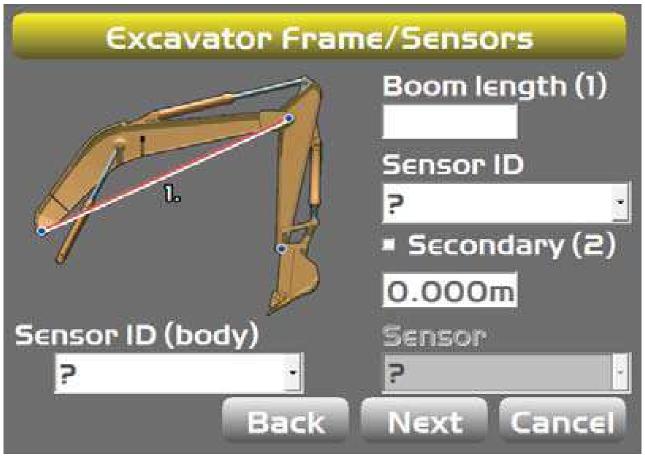


Figure 51: Select Body and Boom Sensor ID

2. Tap the appropriate **Sensor ID** box and select the serial number (last two digits) of the sensor corresponding to the machine element.

3. Enter the appropriate values.

4. Tap **Next** to access the **Excavator Stick** screen.

Figure 52: Select Stick Sensor ID

5. Enter the appropriate values, and select the corresponding sensor.

6. Tap **Next** to access the **Excavator Hitch** screen.

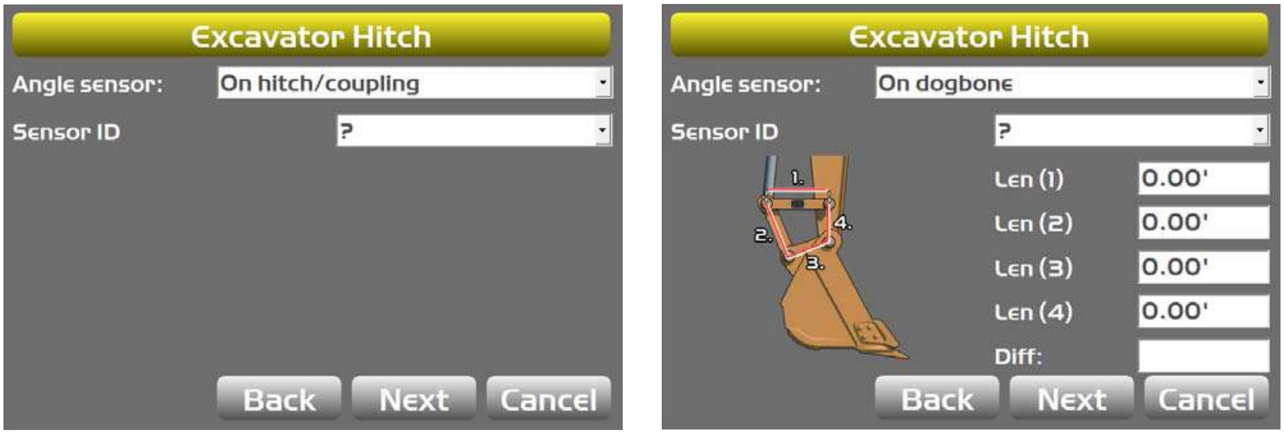


Figure 53: Select Bucket Sensor ID

7. Enter the appropriate values, and select corresponding sensor.

8. Tap **Next** to access the **Excavator Attachments** screen.

   a. Tap **New** to access the **Excavator Attachment Setup** screen.

   b. Enter or select the appropriate data as needed.

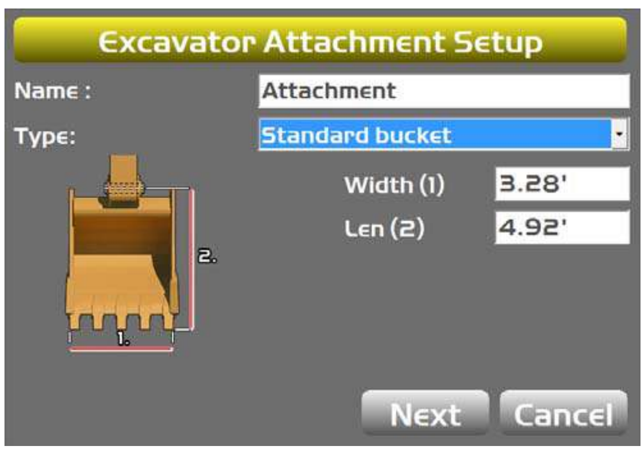


Figure 54: Excavator Attachments

   c. Press **Next** to access the **Calibrate Attachment Angle** screen (calibration performed in next chapter).

   d. Press **Next** to access the **Calibrate Bucket Base** screen (calibration performed in next chapter).

   e. Press **Finish** to access the **Excavator Attachments** screen.

   f. Repeat Steps a through e for each attachment.

Audible Guidance

1. Tap **Next** to access the **Audible Guidance** screen.
2. Enter the desired **Tone** and **Duration** settings.

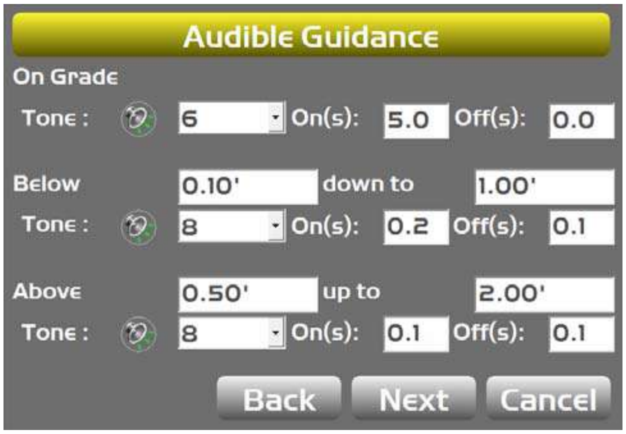


Figure 55: Audible Guidance

Lightbars

1. Tap **Next** to access the **Light Bars** screen.
2. Enter the desired settings.

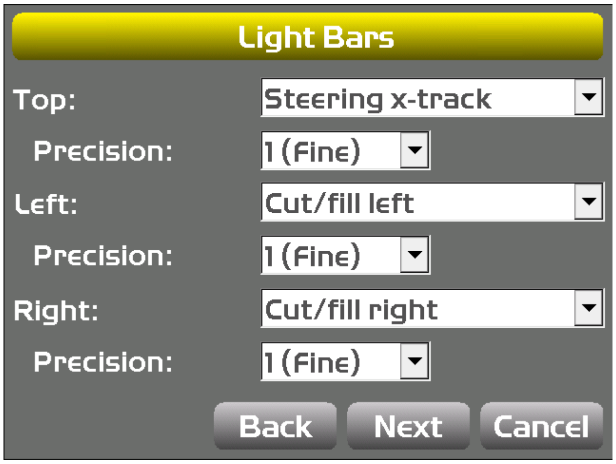


Figure 56: Lightbars

Configuration Complete

1. Tap **Next** to access the **Configuration Complete!** screen.

2. Press **Finish** to save configuration, or press **Cancel** to return to the **Machine Files** screen without saving.

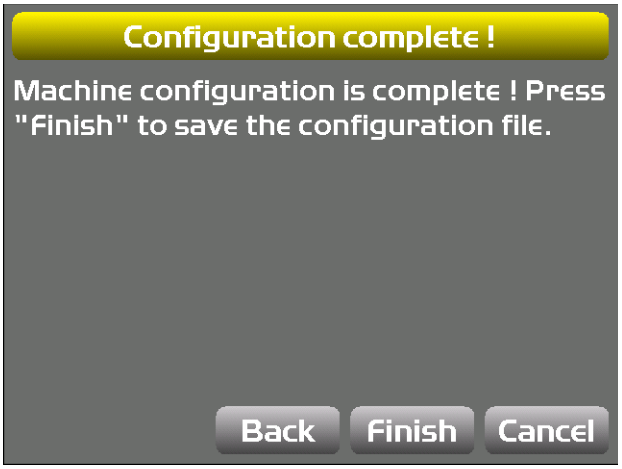


Figure 57: Configuration complete!

Calibration

Before calibrating the sensors, note the following:

CAUTION	If using the DogBone mounting option, worn joints in the DogBone linkage will cause decreased accuracy.

CAUTION	The best practice is to perform the machine calibrations as ordered in this manual. Performing the calibrations out of order will not affect system performance. There are two exceptions to this rule when using a DogBone sensor: a. You must calibrate the stick sensor before calibrating the DogBone sensor. b. When using a tilt bucket sensor you must calibrate the attachment/DogBone sensor before calibrating the tilt bucket sensor.

Sensor Filtering

The filter level for each sensor can be changed depending on the application and operator's choice. A value of 4 (heavy filtering) will dampen sensor reaction, while a value of 1 (light filtering) will cause faster sensor reaction.

1. On the GX Series display, tap the **Power Button** ▸ **Control** ▸ **Machine setup**. Select the applicable machine file and tap **Edit**. Tap **Next** to navigate to the **Excavator Frame/Sensors** screen, **Excavator Stick** screen, or the **Excavator Hitch** screen.

2. Tap the **Wrench** icon next to **Sensor ID** (Figure 58).

3. Select a filtering level and tap **OK** (Figure 58).

4. Navigate through the remaining steps of **Machine Setup**, then save the file and exit 3D-MC.

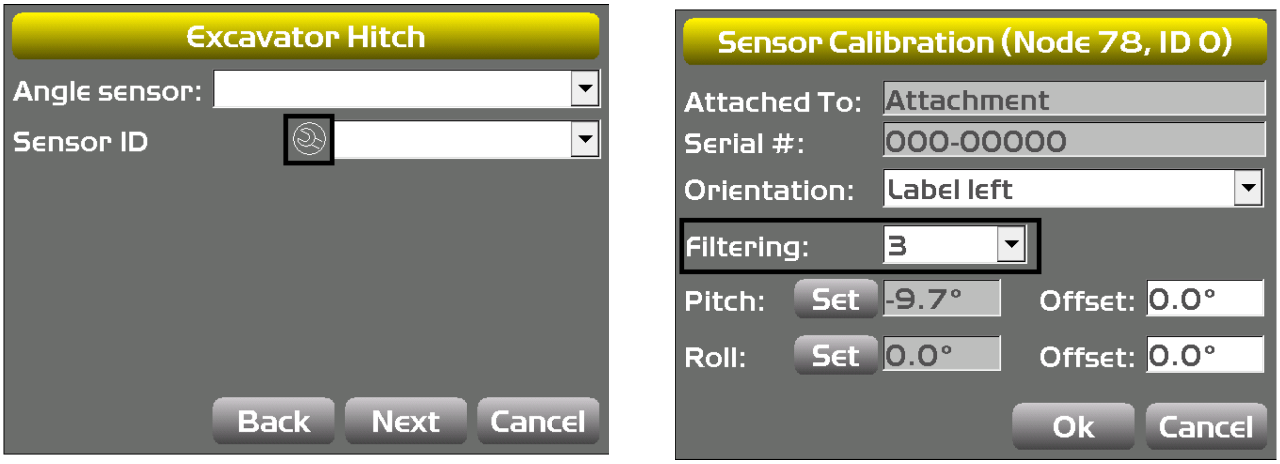


Figure 58: Set Filtering Level

Body Sensor

Once the sensors are named, assigned to a machine element, and the orientation is selected, calibrate each sensor using 3D-MC. A sensor calibration can be performed at any time.

1. On the GX Series display, tap the **Power Button** ▸ **Control** ▸ **Machine setup**.
2. Select the appropriate machine file, and tap **Edit**.
3. Continue to press **Next** to access the **Excavator Frame/Sensors** screen.
4. Tap the **Wrench** icon for the body sensor.
5. Tap the **Orientation** box, and select the physical orientation of the mounted sensor; tap **OK**.

NOTICE **Orientation** is **Label up** with the arrow pointing one of the four directions.

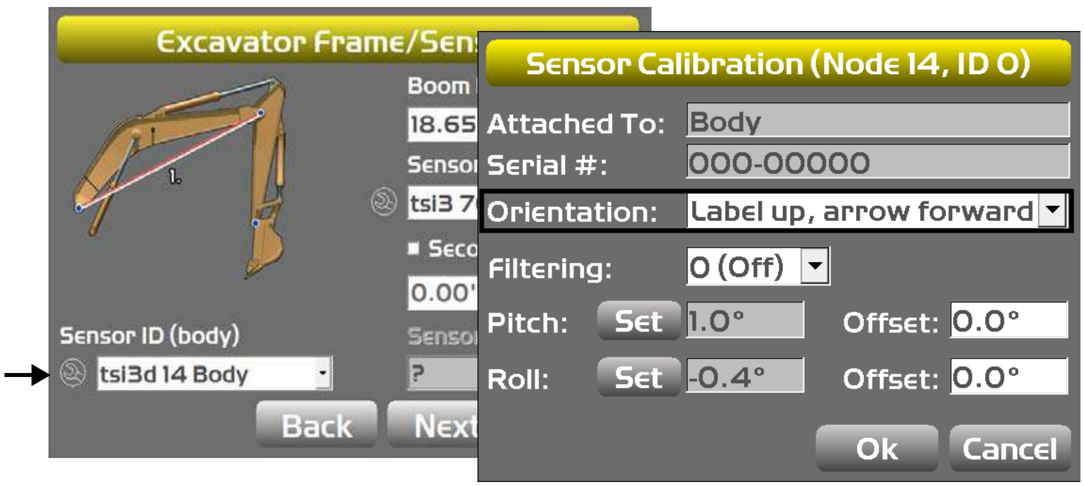
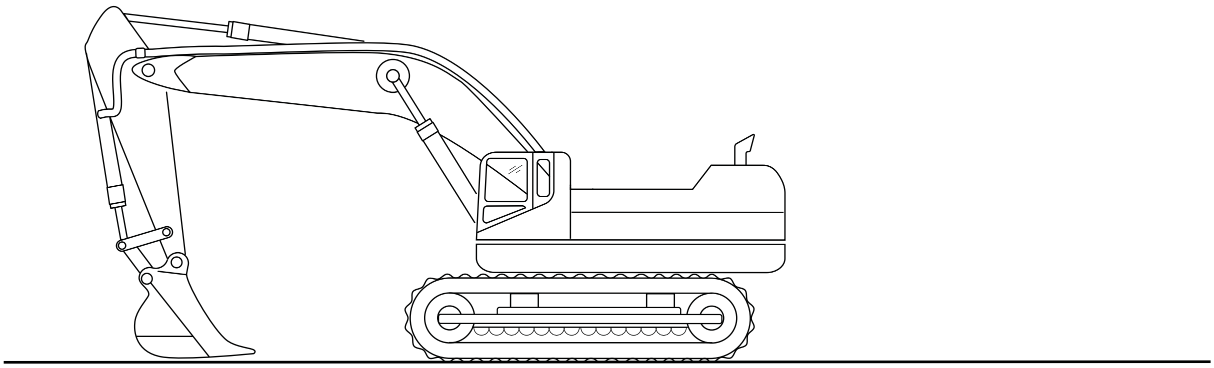
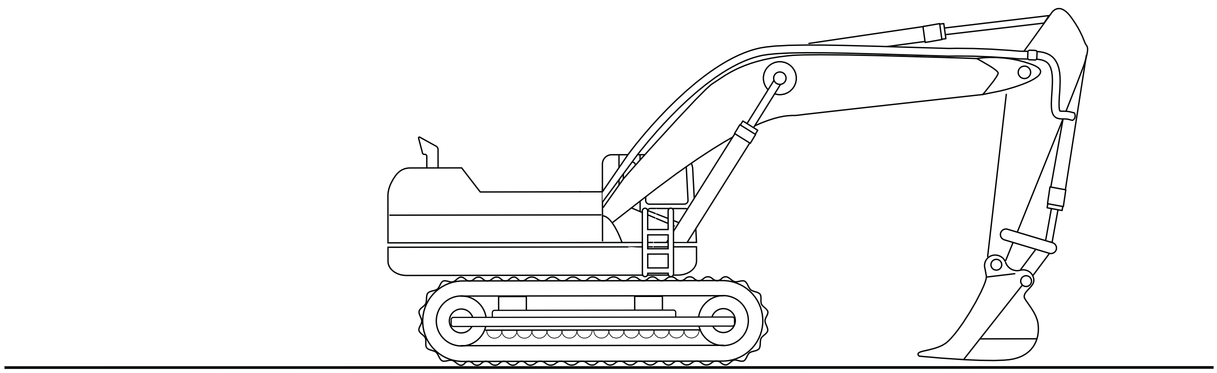


Figure 59: Select Sensor Orientation

CAUTION The body sensor calibration requires both the pitch and roll calibrations. Perform both calibrations at the same time to ensure accurate measurements.



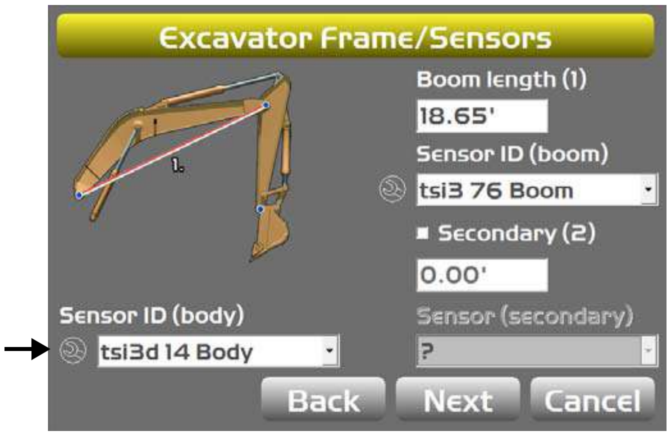
Starting Position - Position 1



Rotate 180° - Position 2

Figure 60: Body Calibrations for Latitudinal Slope

6. Position the machine on a flat and stable surface, free of obstructions.
7. Curl the stick and bucket in as close as possible to reduce tipping errors.
8. Rotate the body parallel to the tracks (Position 1) as shown in Figure 60.
9. Tap **Set** next to **Pitch,** enter the value as zero, and tap **Set** again (Figure 61); repeat for the **Roll** value.



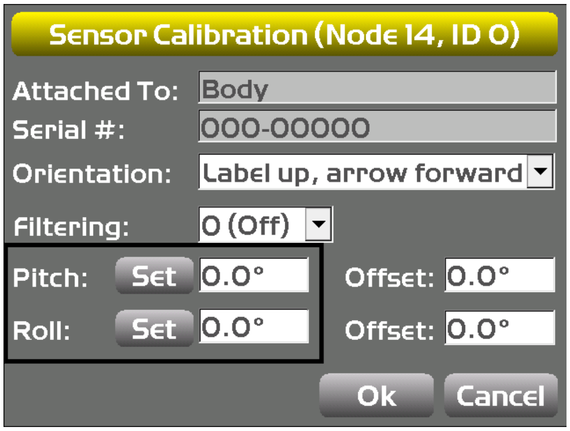


Figure 61: Set Pitch and Roll Values to Zero

10. Without moving the tracks, rotate the machine 180° (Position 2) as shown in Figure 60 on page 46.

11. Tap **Set** next to **Pitch**, set the value to half the displayed values, and tap **Set** again (i.e. -5.3/ 2 = -2.65 and -2.8/ 2 = -1.4) (Figure 62); repeat for the **Roll** value, and then tap **OK.**

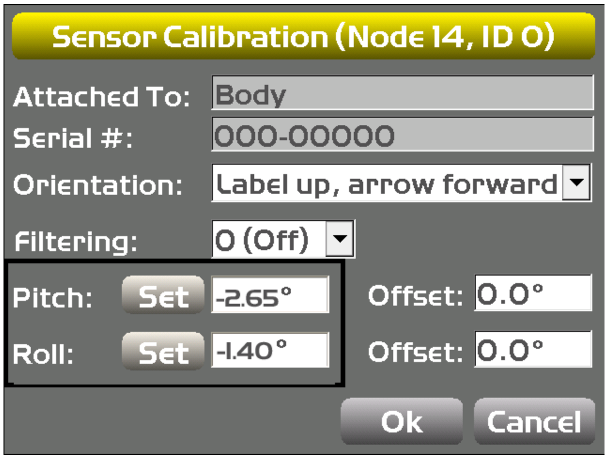


Figure 62: Set Pitch and Roll Value to Half of Displayed Values

CAUTION Once the body sensor roll value is calibrated, rotate the machine until the body Roll is 0.0. The remaining sensors require 0.0 Roll to be calibrated.

12. Tap **Ok** to return to the **Excavator Frame/Sensor** screen.

Boom Sensor

When performing the boom sensor calibration, a laser is recommended to correctly position the boom at zero degrees.

1. Tap the **Wrench** icon that corresponds to the boom sensor (Figure 64).

2. Select the correct orientation from the drop-down menu.

3. Ensure the machine is parked on a flat and stable surface, and that the Body Sensor reads a 0.0 degree roll.

4. Place a zero slope rotating laser along the side of the machine to shine on both the boom pivot and stick pivot.

5. Adjust the laser height to strike the center of the boom pivot (Figure 63).

6. Move the boom to align the stick pivot with the laser (Figure 63).

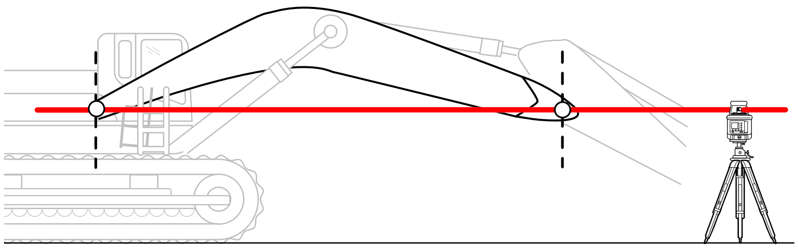


Figure 63: Place Laser to Strike Center of Boom Pivot

7. Tap the **Wrench**  icon that corresponds to the boom sensor (Figure 64).

8. Tap **Set** next to **Pitch**, enter the value as zero, and tap **Set** again (Figure 64).

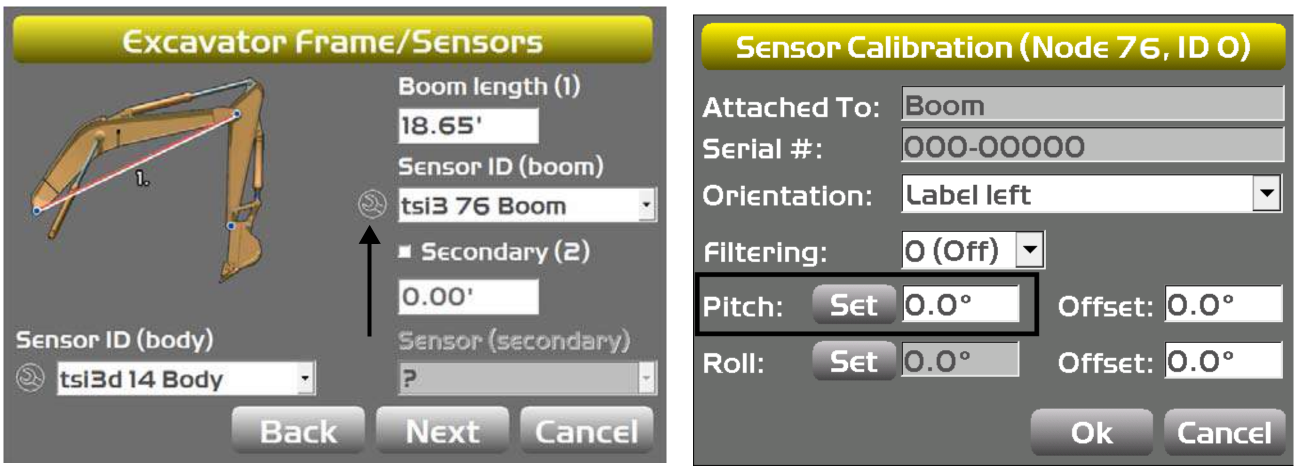


Figure 64: Set Pitch Value to Zero

9. Tap **OK** to return to the **Excavator Frame/Sensors** screen.

Secondary Boom Sensor (Optional)

The secondary boom sensor uses the same calibration method as the primary boom sensor.

1. Check the **Secondary Boom** check box (Figure 65), and see "Boom Sensor" on page 47 for instructions on calibrating the secondary boom sensor.

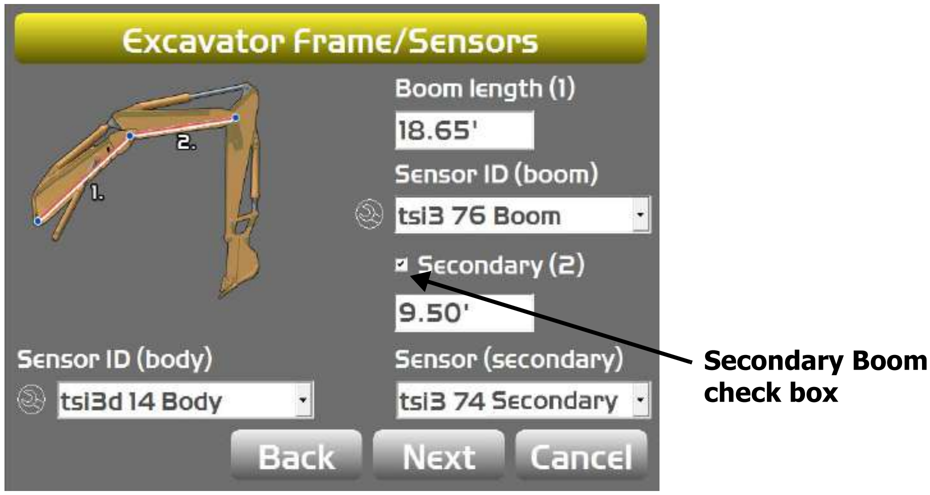


Figure 65: Secondary Boom Check Box

2. Tap **Next** to access the **Excavator Stick** screen.

Stick Sensor

1. Tap the **Wrench** icon that corresponds to the stick sensor (Figure 67 on page 50).
2. Select the correct orientation from the drop-down menu.
3. When performing the stick sensor calibration position the stick at -90 degrees. -90 degrees is accomplished when the Bucket Pivot Pin is directly under the Stick Pivot Pin. A magnet and plumb bob is recommended for this step.
4. Position the stick at -90° (Figure 66 on page 49).

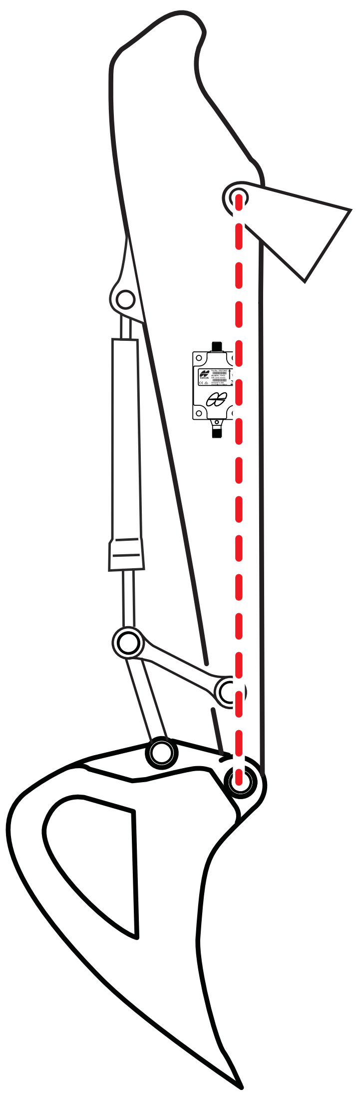


Figure 66: Stick at -90°

5. Tap **Set** next to **Pitch,** enter the **Pitch** value as -90.0°, and tap **Set** again (Figure 67).

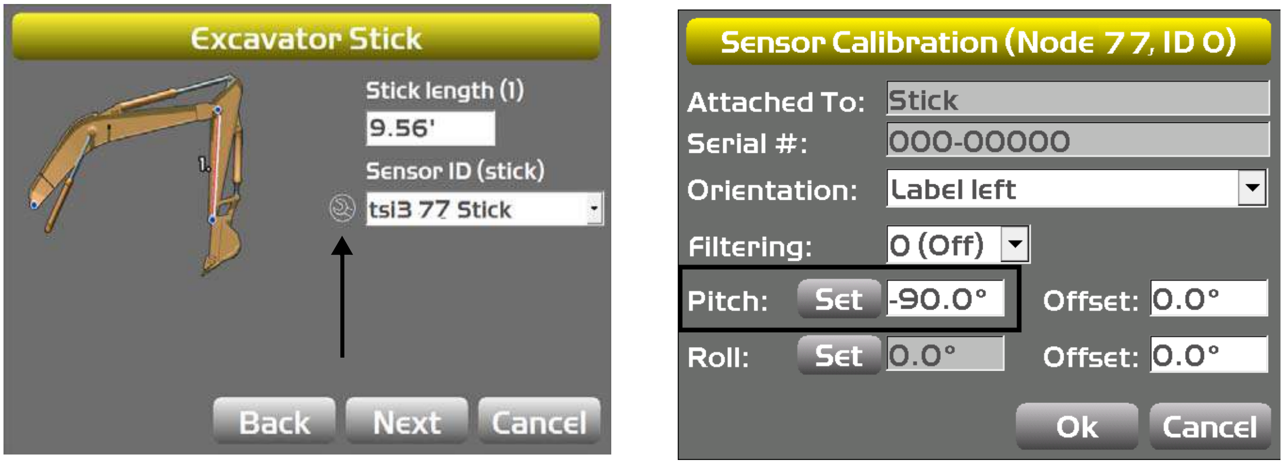


Figure 67: Set Pitch Value to -90.0

Excavator Hitch

There are two options to mount the hitch sensor:

- Mount the sensor directly on the attachment/bucket, or inside the quick release coupler.
- Mount the sensor on the DogBone.

Because the DogBone option requires extra steps before calibrating the bucket, this procedure will be discussed first.

NOTICE If mounting the hitch sensor directly on the attachment, or inside the quick-release coupler, skip to “On Hitch/Coupling” on page 52.

DogBone Sensor

When performing the DogBone sensor calibration, a builder’s level is required to correctly position the DogBone at zero degrees.

CAUTION The DogBone calibration compares the stick sensor to the DogBone sensor to determine bucket angle. The stick sensor must be properly calibrated before attempting the DogBone calibration.

1. Tap the **Wrench** icon that corresponds to the DogBone sensor (Figure 68).

2. Select the correct orientation from the drop-down menu (Figure 68).

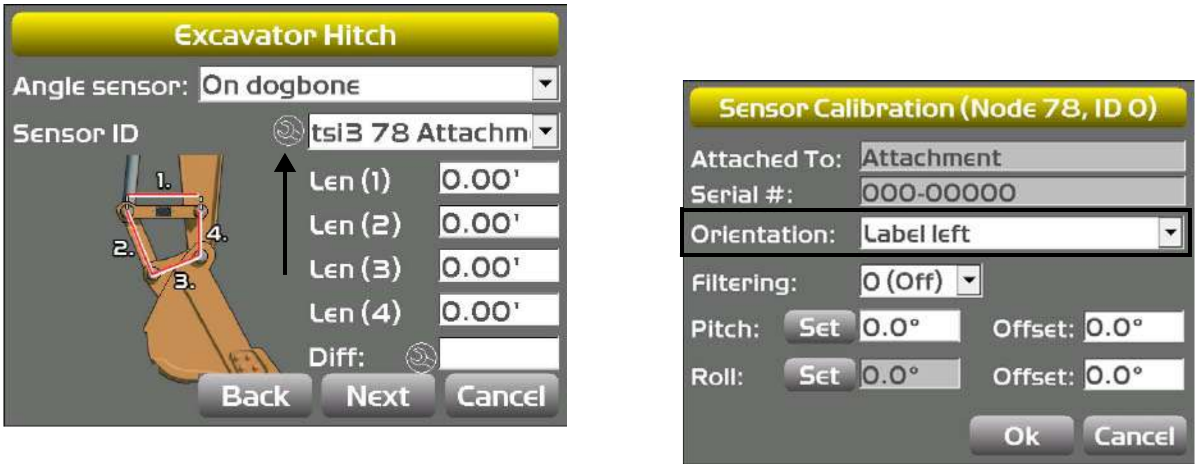


Figure 68: Check Sensor Mounted on DogBone.

3. Set the DogBone pivot pin and the bucket pivot pin vertical with either a plumb bob or a survey instrument. Then set the DogBone horizontal using a builder's level.

4. Once the DogBone is square and level, tap **Set** next to **Pitch**, enter `0.00`, and tap **Set**.

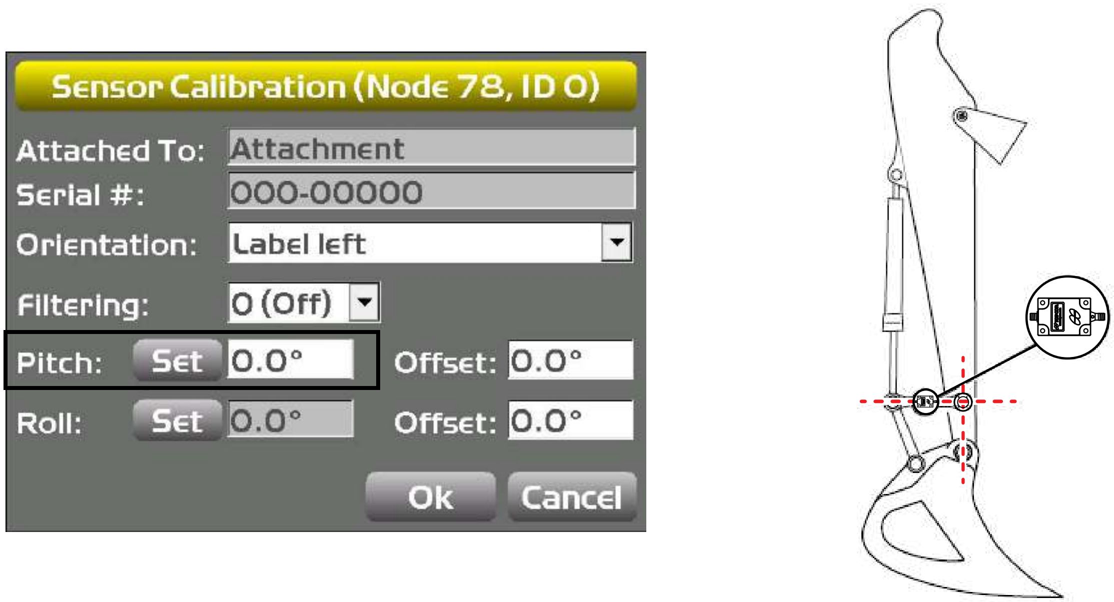


Figure 69: Set Pitch Value to Zero

5. Tap **OK**; the **Excavator DogBone** screen appears (Figure 70).

6. Tap the **Wrench** icon; the **DogBone Calibration** screen appears.

7. Ensure that the angle between the DogBone and line between the DogBone pivot pin and the attachment pivot pin is still 90 degrees, as was done in step 3.

8. Tap **OK**; the **Excavator DogBone** screen appears with a stick angle difference displayed.

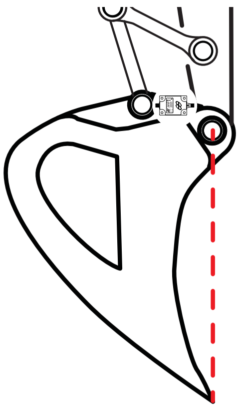
Figure 70: Determine Stick Angle Difference

9. If this is the last sensor physically connected to the machine, see "CAN Termination" on page 23.

On Hitch/Coupling

1. When performing the on hitch/coupling sensor calibration, position the bucket at -90° degrees.

Figure 71: On Hitch/Coupling



2. Align the bucket pivot, and the bucket teeth.

3. On the GX Series display, tap the **Power Button ▸ Control ▸ Machine setup**, select the applicable machine file for the job, and tap **Edit**.

4. Tap **Next** to navigate to the **Excavator Hitch** screen.

5. Tap the **Wrench** icon for the bucket sensor.

6. Tap **Set** next to **Pitch**, enter the **Pitch** value as -90.0 degrees, and tap **Set** again (Figure 72).

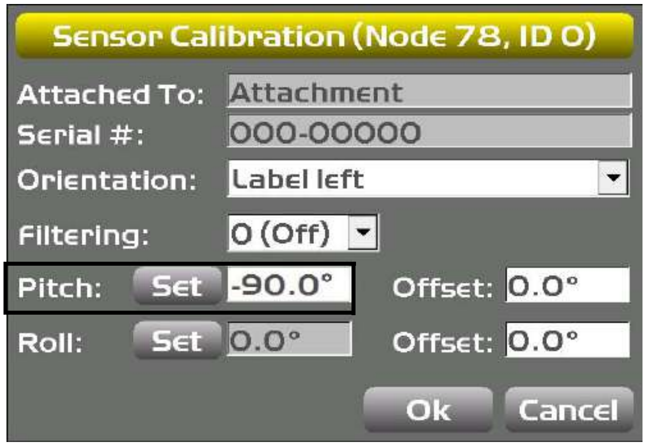


Figure 72: Set the Pitch Value to -90.0°

7. If this is the last sensor physically connected to the machine, see “CAN Termination” on page 23.

Attachment Edge

Perform the following attachment edge calibration procedures for all attachment types. These calibrations must also be performed for each individual attachment when using multiple attachments.

1. On the GX Series display, tap the **Power Button ▸ Control ▸ Machine setup**.

2. Tap **Next** until the **Excavator attachments** screen appears

3. Select the attachment that is on the machine.

4. Tap **Edit.** The **Excavator attachment setup** screen appears**.**

5. Tap **Next.**

6. With the attachment plumb, tap **Calibrate** from the **Calibrate Attachment Angle** screen (Figure 73); tap **Next** to go to the **Calibrate Bucket Base** screen.

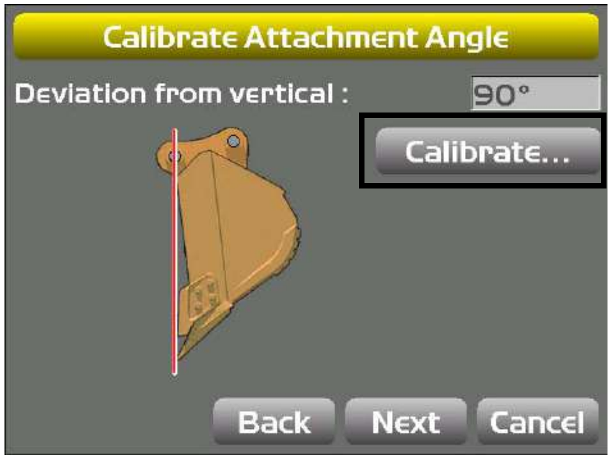


Figure 73: Calibrate Attachment Angle

7. Move the attachment so that the bottom of the attachment lays flat on the ground, and tap **Calibrate**; tap **Finish** to go to the **Excavator Attachments** screen (Figure 74).

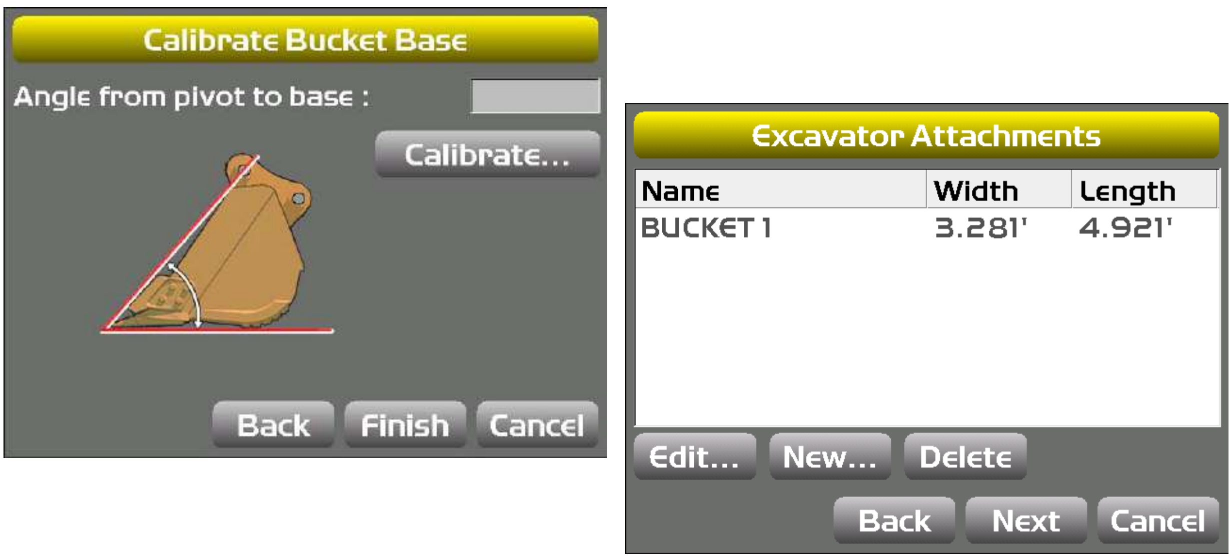


Figure 74: Calibrate Attachment Base

NOTICE If setting up multiple attachments of any kind, skip to "Multiple Attachments" .

Multiple Attachments

If a using a quick coupler to switch attachments, mount the sensor to the quick release mechanism, or the DogBone, not the attachment. When calibrating multiple attachments, you must perform the vertical and flat attachment calibrations for each applicable attachment; see "Attachment Edge" on page 53.

Tilt Bucket

1. On the GX Series display, tap the **Power Button ▸ Control ▸ Machine setup.** Select the applicable machine file for the job and tap **Edit**. The **Configuration name/type** screen appears.

2. Tap **Next** until you reach the **Excavator Attachments** screen, and then tap **New** to create a new Tilting bucket, or tap **Edit** to calibrate an existing Tilting bucket.

3. Select **Tilting Bucket** from the drop-down menu, and enter the bucket **Width** and **Length** (Figure 75).

4. Enter a value for the tilt bucket **Length (3)**, and select a **Sensor ID** for the tilt bucket sensor.

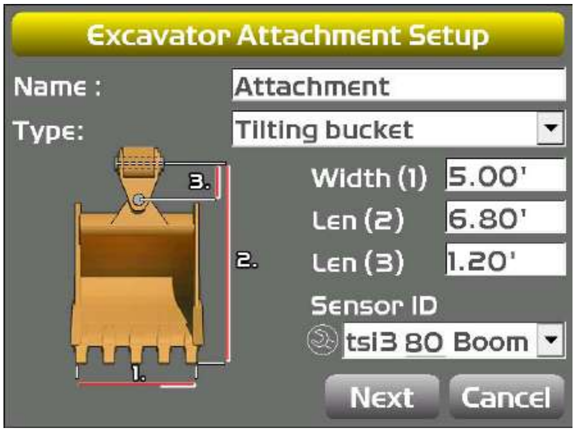


Figure 75: Enter Tilt Bucket Measurements

5. Using a carpenter's level adjust the bucket until the tilt pin is horizontal.

6. Using a carpenter's level, adjust the cross slope of the bucket until the bucket is level.

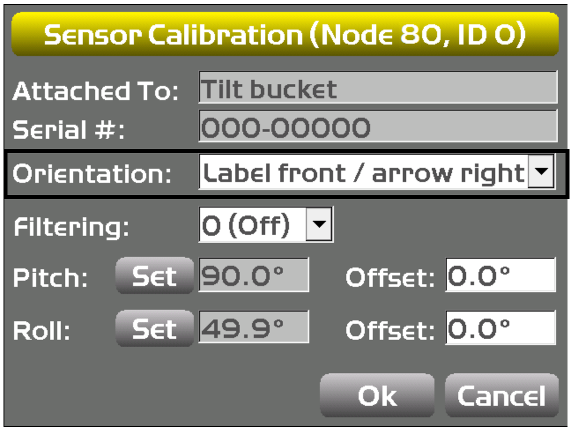
7. In 3D-MC, tap the **Wrench**  icon next to the **Sensor ID**.

8. Select the sensor's **Orientation** based on this position (Figure 76).

NOTICE

Note that the Single-axis TS-i3 sensor orientation is only
label front / arrow right or **label back / arrow right.**
If using the Dual-axis TS-i3d, the orientation is **label up / arrow front**, **label up / arrow back**, **label up / arrow left**, or
label up / arrow right.

Single-axis TS-i3



Dual-axis TS-i3d

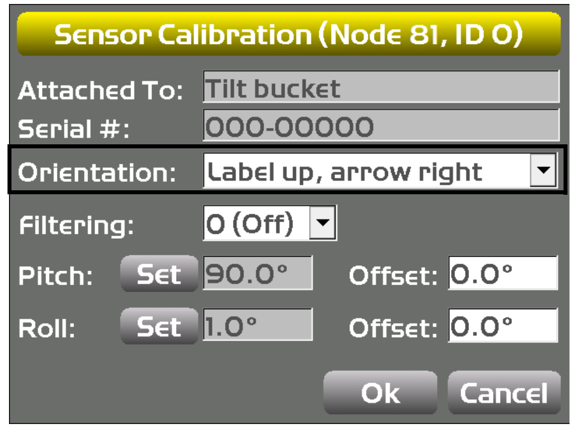


Figure 76: Select Tilt Sensor Orientation

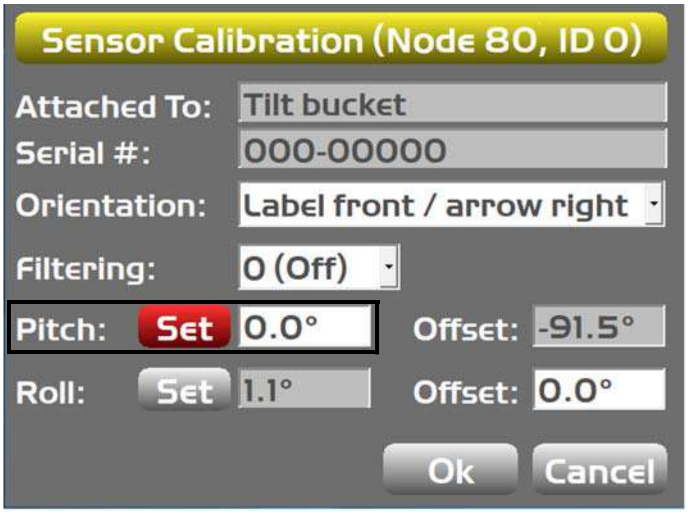
NOTICE

For both single-axis TS-i3 Sensor and dual-axis TS_i3d sensor follow steps 9 to 12

For tilt bucket always use the SET buttons to calibrate the tilt bucket. In calibration steps 9 to 12, 3D-MC calculates the relation (or position) between the hitch and tilt bucket sensor, and stores the value.

Even when dual axis TS-i3d sensor for tilt bucket is used, the pitch will be used from the hitch sensor.

9. Tap the **Set** button for **Pitch**. A popup screen will appear.



Single-axis TS-i3

Dual-axis TS-i3d

Figure 77: Set Pitch

10. To set the pitch:

    a. Single-axis: Ensure the tilt axis (or pin) is horizontal. Tap **Ok**.

    – The **Pitch** will be set to **0.0**, and the relationship between the Tilt Pivot and the Hitch sensor is recorded.

    b. Dual-axis: Ensure the tilt axis (or pin) is horizontal and the tilt is level. Tap **Ok**.

    – The **Pitch** will be set to **0.0**, and the relationship between the Tilt Pivot and the Hitch sensor is recorded.

11. Tap the **Set** button for **Roll** (Figure 78 on page 58). A popup screen will appear.

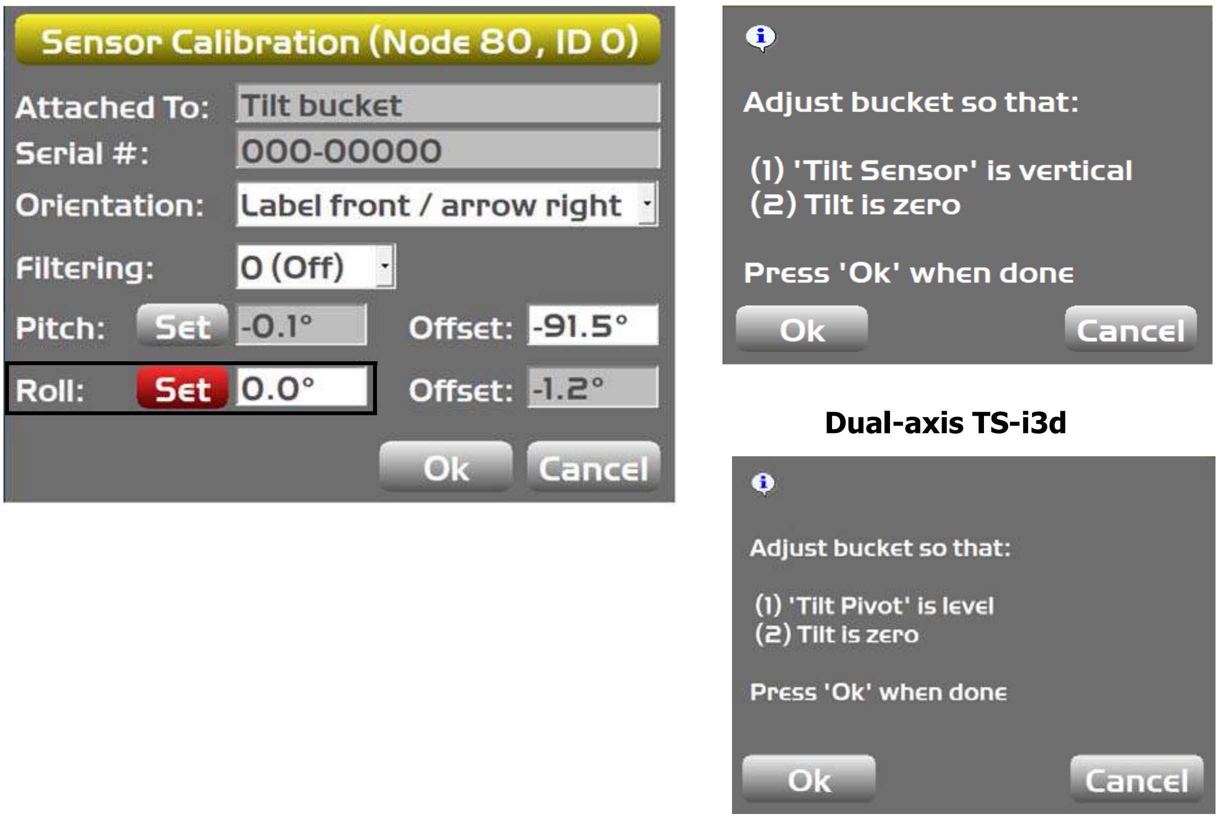


Figure 78: Set Roll

12. To set the roll:

    a. Single-axis TS-i3: Ensure **Tilt** is zero and the Tilt Sensor is vertical. For the Tilt sensor to be vertical, the label must be straight forward with arrow pointing to the right from the cab perspective or straight back with arrow pointing to the right from the cab perspective. Tap **Ok**.

    – The roll will be set to **0.0**, and the relationship between the verticality of the tilt sensor and Hitch sensor will be recorded

    b. Dual-axis TS-i3d: The Tilt Sensor should be horizontal (label facing up). Ensure the Tilt Pivot is level and the Tilt is zero. Tap **Ok**.

    – The roll will be set to **0.0**.

13. Tap **Ok** to finish this calibration.

NOTICE To calibrate the bucket edge, see "Attachment Edge" on page 53. If setting up multiple buckets of any kind, see "Multiple Attachments" on page 54.

Tilting Rotating Bucket

Refer to the Installation and Setup manual from the manufacturer of the tilting / rotating bucket.

Calibrating the LS-B10W

To calibrate the LS-B10W Laser Receiver, determine the position of the receiver on the stick. After calibrating the sensor, 3D-MC will determine the angle of the LS-B10W to the stick center line.

1. Position the machine on a stable surface free of obstructions, and rotate the body to 0.0° roll.

2. Orient the stick so that the LS-B10W is positioned vertically.

3. On the GX Series display, tap the **Power Button ▸ Control ▸ Machine setup**. Select the applicable machine file for the job, and tap **Edit**.

4. Tap **Next** to navigate to the **Laser Receiver (LSB10W)** screen.

5. Enter the following measurements for the LS-B10W (Figure 79).

   - **Depth to center of stick** – enter the measurement for the distance between the middle of the stick to the light cells on the LS-B10W.

   - **From bucket pivot** – enter the measurement for the distance from the along the projected line between the bucket pivot and stick pivot at the point where the LS-B10W is perpendicular to the projected line (Figure 79).

   - **Left of pivot line** – enter the measurement for the distance between the mark on the LS-B10W and the pivot line. If right of pivot line, use a negative value.

6. Make sure the LS-B10W Laser Receiver is vertical, and then tap **Calibrate** to determine the angle between the stick and the LS-B10W (Figure 79).

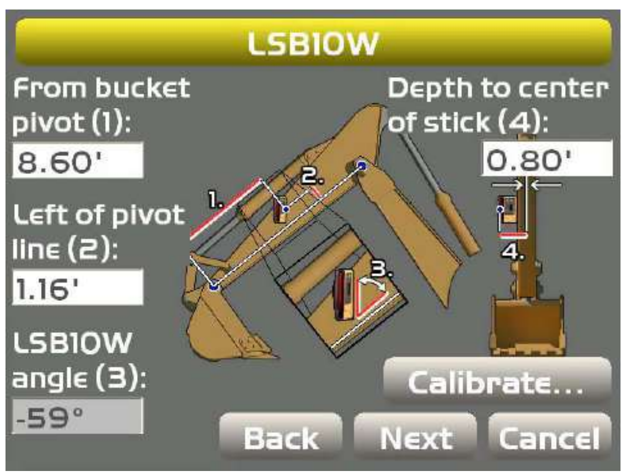


Figure 79: LS-B10W Laser Receiver Measurements

CAUTION	If the stick sensor is replaced with a new tilt sensor, you must recalibrate the LS-B10W Laser Receiver. To test the LS-B10W calibration, see "LS-B10W Test" on page 66.

Setup Verification

Performing a full system test verifies the accuracy of the excavator systems at various machine positions.

NOTE	It is your responsibility to be completely familiar with the cautions described in these installation instructions. These messages advise against the use of specific methods or procedures, which can result in personal injury, damage to the equipment, or unsafe operating conditions. Remember, most accidents are caused by failure to observe basic safety precautions.

Testing Machine Element Sensors for Accuracy

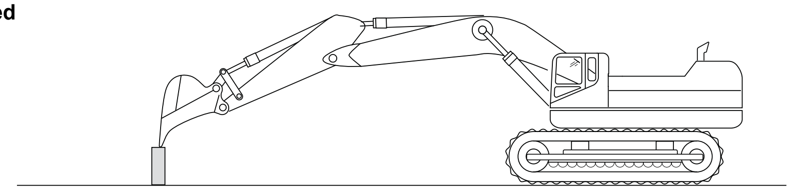
Testing the sensors on the boom, stick, and bucket requires three bucket measurements at three boom and stick extensions.

1. Using a hub, record the local coordinates with the following machine positions facing North.

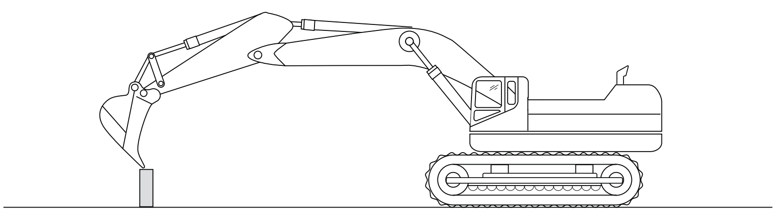
2. Then rotate 180° and record each position again facing South.

Record Bucket Positions with Boom and Stick Fully Extended

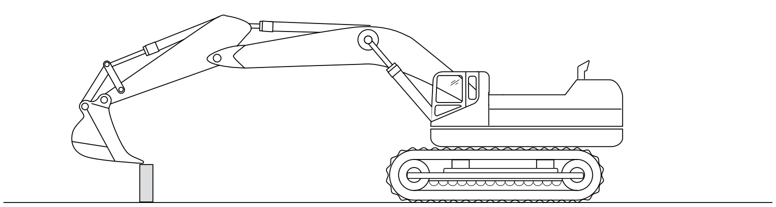
Bucket extended



Bucket mid-position

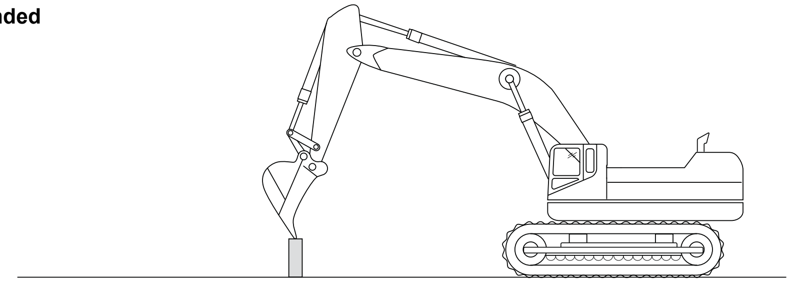


Bucket curled

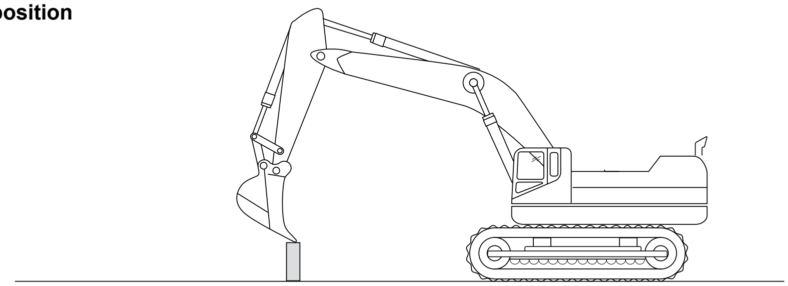


Record Bucket Positions with Boom and Stick in Mid-extension

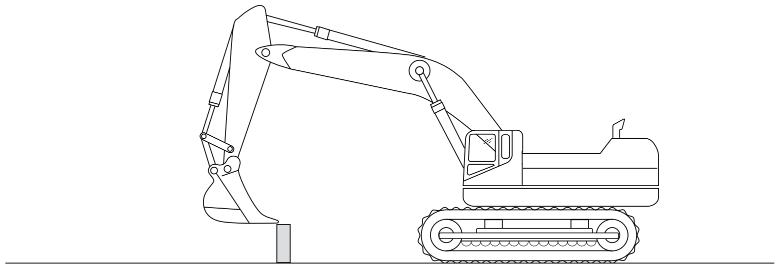
Bucket extended



Bucket mid-position

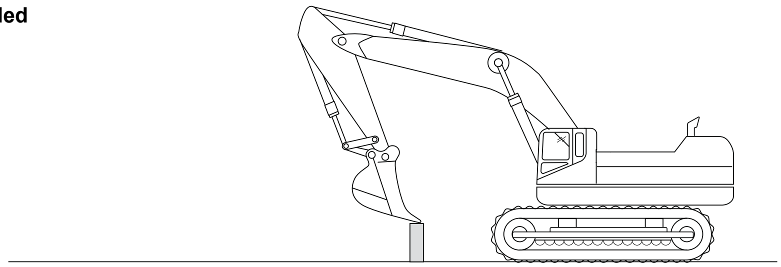


Bucket curled

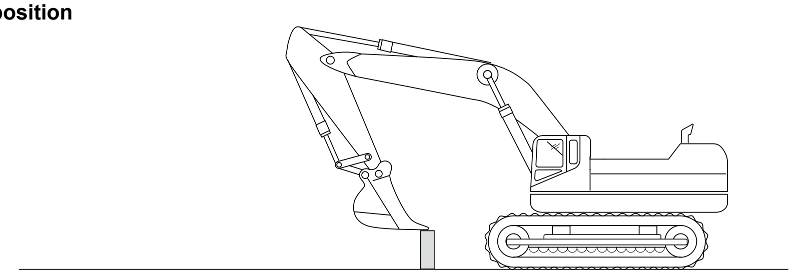


Record Bucket Positions with Boom and Stick Retracted

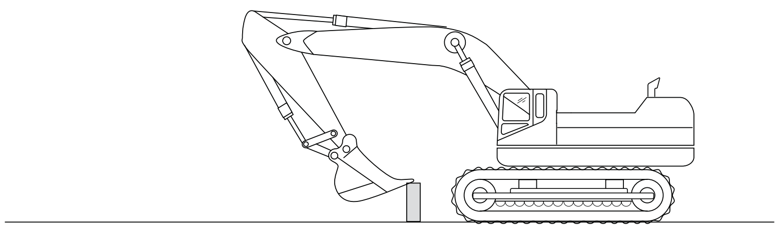
Bucket extended



Bucket mid-position



Bucket curled



If a hub with a known position is available, use those coordinates as the reference. Otherwise, use the first position as a reference. Compare each position to the reference. The difference should be within ± 0.2Ft.

String Line Verification

The following sections describe setting up a string line to test the sensor accuracy.

Setup

1. Set a zero slope using a laser.
2. Set up a string line the length of the machine’s reach, and then set up the string level.
3. Utilize the measure slope feature to perform the following test. For more information on the Measure Slope function, refer to the *3D-MC User's Manual P/N 1013510-01.*

Test

1. Extend the machine implements so that the bucket is at the far end of the string line.

2. Lower the bucket to the string, and tap OK on the **Measure first point** screen of the **Measure Slope** feature in 3D-MC.

3. Retract the machine implements so that the bucket is at the near end of the string.

4. Lower the bucket to the string and tap **OK** on the **Measure second point** screen of the **Measure Surface** feature. The sloping surface created by 3D-MC should match the slope of the string line as set by the laser.

5. Position the bucket on the string at several points, and compare the cut/fill readings shown in 3D-MC; cut/fill readings should be zero for each position (Figure 80).

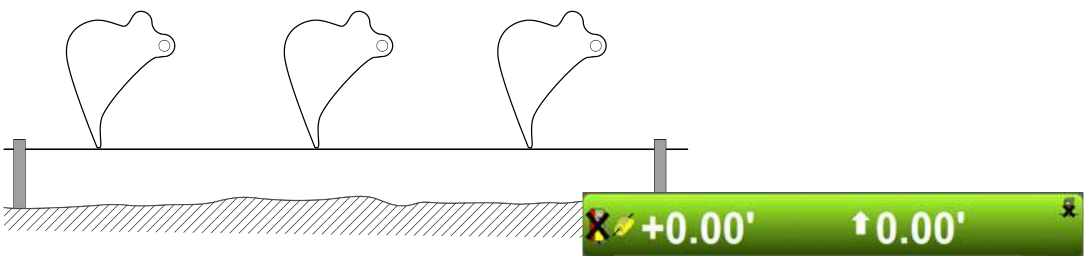


Figure 80: Move the Bucket and Compare 3D-MC Measurements

NOTE Reasonable accuracy is within 0.10´. If the machine is well maintained and the measurements made within this guide are precise, accuracy should be even better.

6. If the measurements read zero from point to point, the test is done. If they do not, see "Troubleshooting" on page 64.

Troubleshooting

When troubleshooting, begin with the hitch sensors. If you are unable to determine the problem, proceed with the stick sensor, and then the boom sensor. Note that for the hitch and boom sensors, there are optional secondary sensors that should be checked if they are used. If you are unable to determine the problem after following the procedures below, contact Topcon support.

Hitch Sensor

1. Position the hitch above the string line so that the bucket teeth or edge are at their closest point to the string.

2. Place the bucket teeth or edge on the string, and zero the bucket in 3D-MC.

3. Curl only the bucket in and out in various positions, and measure the distance from the string line to the bucket teeth a with measuring tape (Figure 81).

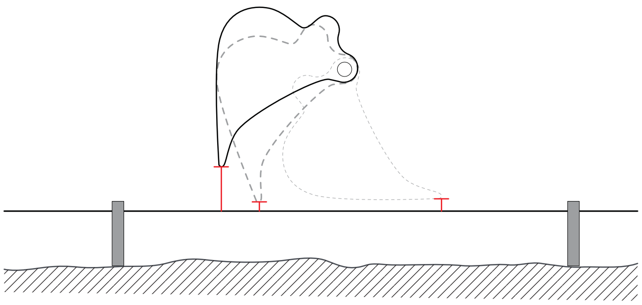


Figure 81: String Line Verification - Bucket

4. Compare the measuring tape values with those shown in 3D-MC.

5. If the measurements compared against 3D-MC match, there could be an issue with one of the other sensors; repeat steps 1-4 and reverify.

6. If the measurements compared against 3D-MC still match, check the tilt bucket sensor (if used), and then follow the steps in "Stick Sensor" below.

7. If the measurements compared against 3D-MC do not match, each sensor must be evaluated for machine measurement or calibration errors.

Stick Sensor

1. Position the bucket above the string line so that the bucket teeth or edge are at their closest point to the string.

2. Place the bucket teeth or edge on the string, and zero the bucket in 3D-MC.

3. Curl only the stick in and out at various positions, and measure the distance from the string line to the bucket teeth with a measuring tape (Figure 82).

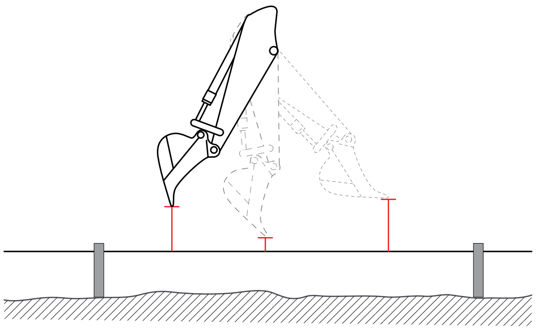


Figure 82: String Line Verification - Stick

4. Compare the measuring tape values with those shown in 3D-MC.

5. If the measurements compared against 3D-MC match, there could be an issue with one of the other sensors; repeat steps 1-4 and reverify.

6. If the measurements compared against 3D-MC still match, follow the steps in "Boom Sensor" below.

7. If the measurements compared against 3D-MC do not match, each sensor must be evaluated for machine measurement or calibration errors.

Boom Sensor

1. Position the bucket above the string line so that the bucket teeth or edge are at their closest point to the string.

2. Place the bucket teeth or edge on the string, and zero the bucket in 3D-MC.

3. Curl only the boom in and out at various positions, and measure the distance from the string line to the bucket teeth with a measuring tape (Figure 83).

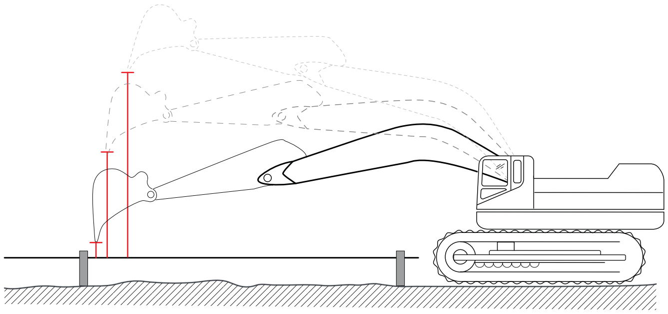


Figure 83: String Line Verification - Boom

4. Compare the measuring tape values with those shown in 3D-MC.

5. If the measurements compared against 3D-MC match, repeat steps 1-4 and reverify.

6. If the values still match, check the secondary boom sensor (if used), and then the body sensor.

7. If the measurements compared against 3D-MC do not match, each sensor must be evaluated for machine measurement or calibration errors.

LS-B10W Test

1. Set the Rotating Laser to transmit a flat plane beam.

2. Set flat string line, and measure the distance from the laser plane to the string line using a grade rod with laser receiver.

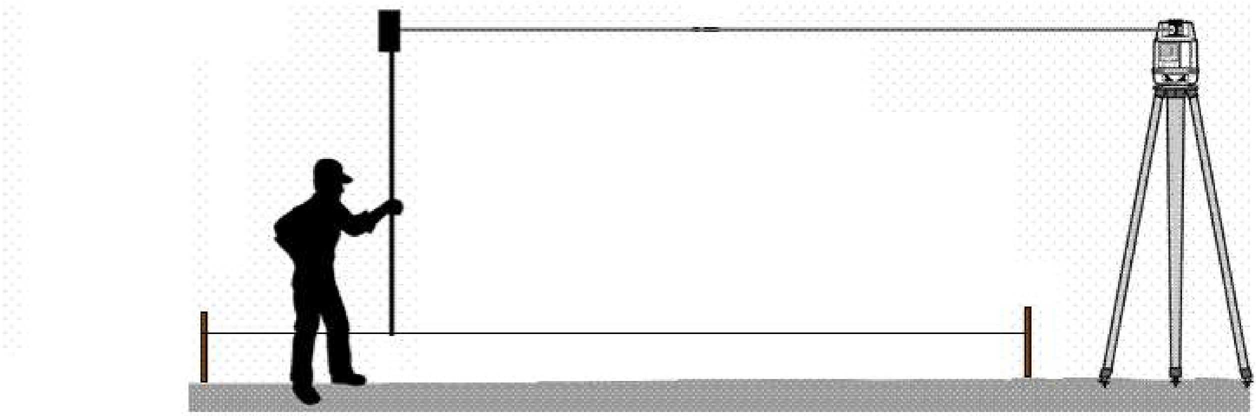


Figure 84: Laser Plane to String Line Measurement

Distance from laser plane to string line:_________________________

3. Create a 0% Known Slope Surface in 3D-MC by tapping the **Topcon Logo button ▸ Tools ▸ Known Slope,** ensure grade is 0.00%, and tap **OK**.

4. Place the LS-B10W in the laser plane, and press the **Zero to laser** button.

5. Set the **Elevation Set Point** equal to the distance from string to laser plane.

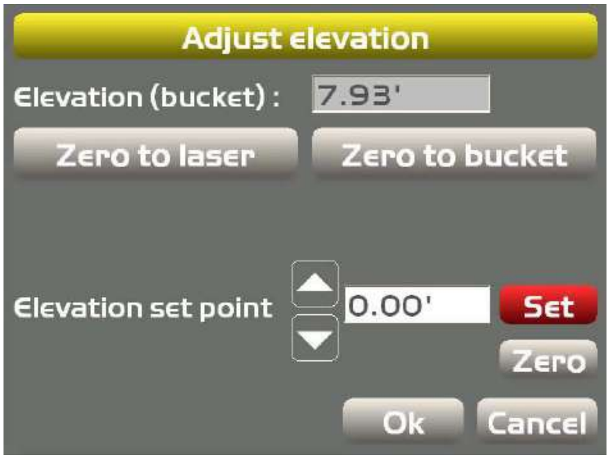


Figure 85: Zero to Laser

6. Touch the bucket tooth to the string and verify grade.

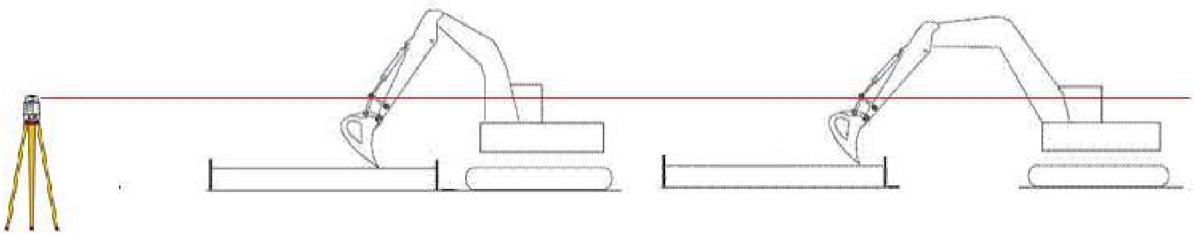


Figure 86: Laser Plane to String Line Measurement

7. Track the machine to a different location. Perform the **Zero to laser** function again.

8. Touch the bucket tooth to the string and verify grade.

Specifications

This chapter provides specifications for the MC-X1 Controller and GR-i3 Antenna.

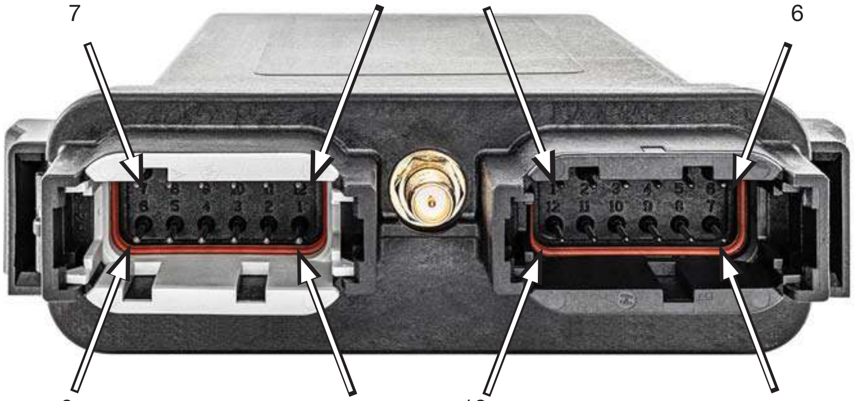
MC-X1

Table 2 lists the MC-X1 specifications.

Table 2. MC-X1 Specifications

General	
Supply Voltage	9-32VDC
Supply Current	0.2A typical operating current; max. at 24VDC input power, no peripheral equipment; 7.5A max. operating current
Electromagnetic Compatibility	Applicable Standards Emissions: Applicable regulation: EN 13309:2010; ISO13766:2006; EN 55032:2012 Immunity: Applicable regulation: EN 13309:2010; ISO 13766:2006; EN 301 489-1
Switched Output Power	5A sensor/conditioned output power
Ports	1 ea. port RS232/Digital IO 2 ea. Ethernet 2 ea. CAN
Wireless	WIFI 802.11abgn and BT 2.0/BLE 4.1
Environmental	
Operating Temperature	-40°C (-40°F) to +80°C (176°F)
Moisture Test	Per SR-012 level 2: 240 hours at 96%RH
Ingress Protection	IP67
Shock Test	25G 11 ms ½ sine wave 6X each axis
Salt Fog Test	ASTM B117-03
Vibration Test	10-2000Hz Random, 7.7 Grms.

Connector Pinouts



Conn A - DTM06 12-pin (A-coded, Gray)	
1	Power In
2	Ground
3	Ground
4	Conditioned Power Out
5	Ignition input (HW interlock and input to CPU)
6	Ground
7	Ethernet – RX+
8	Ethernet – RX-
9	Ethernet – TX+
10	Ethernet – TX-
11	CAN 1 – L
12	CAN 1 – H

Conn B - DTM06 12-pin (A-coded, Gray)	
1	Ethernet – RX+
2	Ethernet – RX-
3	Ethernet – TX+
4	Ethernet – TX-
5	CAN 2 – Low
6	CAN 2 – High
7	Conditioned power out
8	Ground
9	Ground
10	Digital In/Out, RS-232 RX, PPS/Event In/Out
11	Digital In/Out, RS-232 TX, PPS/Event In/Out
12	Conditioned Power Out

GR-i3

Table 2 lists the GR-i3 specifications.

Table 3. GR-i3 Specifications

General	
Supply Voltage	9-32VDC
Supply Current	0.2A typical operating current @ 24VDC 0.3A max. operating current @ 24VDC
Electromagnetic Compatibility	Applicable Standards Emissions: Applicable regulation: EN55022:1994 NA Immunity: Applicable regulation: EN55024:1998 A1:2001 and A2:2003 ESD: ±8KV RF: 27 to 500 MHz 3V/m Fast transient: ±0.5KV capacitively coupled
Ports	CANopen
Wireless	BT 2.0/BLE 4.0
Environmental	
Operating Temperature	Wired Operation via CAN: -40°C (-40°F) to +80°C (176°F) Wireless Operation: -30°C (-22°F) to +60°C (140°F)
Moisture Test	NA
Ingress Protection	IP67
Shock Test	25G 11 ms ½ sine wave each axis
Salt Fog Test	ASTM B117-03
Vibration Test	10-2000Hz Random, 7.7 GRMS, 8 hours each axis
Physical	
Housing	Magnesium alloy and PBT+PC Alloy
Housing Dimensions	135mm (5.31 in.) x 85mm (3.35 in.) x 36mm (1.42 in.)
Connectors	Custom 9-pin Pogo connector
Weight	0.68 Kg. (1.5 lbs)
Signal Tracking	
Channels	226 Universal Tracking Channels
Signals Tracked	GPS: L1, L2, L2C; GLONASS: L1, L2, L2C; BeiDou: B1, B2; Galileo: E1; SBAS; QZSS: L1, L2C

Table 3. GR-i3 Specifications

Accuracy	Standalone H: 1.2 m; V: 1.8 m DGPS H: 0.3 m; V: 0.5 m SBAS H: 0.8 m; V: 1.2 m RTK H: 5 mm + 0.5 ppm x baseline; V: 10 mm + 0.8 ppm x baseline RTK Initialization Time < 10 seconds RTK Initialization Reliability > 99%

Connector Pinouts

Conn A - 9-pin Pogo	
1	Power
2	CAN H
3	CAN L
4	—
5	—
6	—
7	—
8	Wire DN
9	Ground

WiFi Antenna

BLACK OMNI ANTENNA, 2.4-2.5 GHZ WI-F1

Topcon P/N: 1020001-01

Manufacturer: LAIRD TECHNOLOGIES
Manufacturer P/N: TRAB24003

Table 4. WiFi Antenna Specifications

General	
Specific Frequency	2400-2500 MHz
Gain dBi	3 dBi
Mobile Antenna Mounting Type	NMO
Antenna Material	Plastic
Maximum Power	100 W
Item Height	2.7 IN (69 MM)

WiFi Antenna Magnet Mount

HIGH FREQ NMO MAG MOUNT 0-6GHZ

Topcon p/n 1020002-01

Manufacturer: LAIRD TECHNOLOGIES
Manufacturer P/N: GB195RPSMAI

Table 5. WiFi Antenna Magnet Mount Specifications

General	
Frequency Range	0-6 GHz
Mounting Type	Magnetic base, NMO mount
Installation	Metallic/magnet mountable surface
Operating Temperature	-40°C (-40°F) to +85°C (+185°F)
Cable Type	Low loss, double-shielded ATX195
Cable Length	12 ft. (3.65 m)
Pull Strength	80 lbs

Safety Warnings and Regulatory Information

General Warnings

1. Read and become familiar with the machine manufacturer's operator's manual, including safety information, before installing or using Topcon components.
2. Use extreme caution on the job site. Working around heavy construction equipment can be dangerous.
3. DO NOT attach Topcon brackets, cables, or hose connections while the machine is running.
4. DO NOT allow any Topcon components to limit the visibility of the operator.
5. Use Ty-wraps to keep hoses and cables secured, and away from possible wear or pinch points.
6. Use eye protection when welding, cutting, or grinding on the machine.
7. Protect yourself at all times, and wear protective clothing when working on or near hydraulic lines. Hydraulic lines can be under extreme pressure, even when the machine is turned off.

DANGER Relieve all pressure in the hydraulic lines before disconnecting or removing any lines, fittings, or related components. If injury occurs, seek medical assistance immediately.

CAUTION When welding, use appropriate precautions and practices. After welding, all affected areas should be painted with a rust inhibitor.

DANGER Disconnect all Topcon system electrical cables prior to welding on the machine.

DANGER DO NOT weld near hydraulic lines or on any equipment when in operation.

CAUTION All mounting bracket welds must be secure and strong to prevent the sensor equipment from vibrating excessively, or from detaching at the weld during operation.

CAUTION This product should never be used:

- Without the operator thoroughly understanding the Operator's Manual and Quick Reference Guide.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Without proper safeguards at the job site.
- Contrary to applicable laws, rules, and regulations.

WARNING TPS products should never be used in dangerous environments. Use in rain or snow for a limited period is permitted.

WARNING Tampering with the unit by the operator or non-factory authorized technicians will void the unit's warranty:

- Do not attempt to open the unit and modify any of its internal components.
- Do not short circuit.

RF Radiation Hazard Warning

CAUTION To ensure compliance with FCC and Industry Canada RF exposure requirements, this device must be installed in a location where the antennas of the device will have a minimum distance of at least 20 cm from all persons. Using higher gain antennas and types of antennas not certified for use with this product is not allowed. The device shall not be located with another transmitter.

Installez l'appareil en veillant à conserver une distance d'au moins 20 cm entre les éléments rayonnants et les personnes. Cet avertissement de sécurité est conforme aux limites d'exposition définies par la norme CNR102 at relative aux fréquences radio.

Regulatory Information

The following sections describe the FCC and IC statements.

FCC Statements

FCC Rule15.19(a)(3)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

FCC Rule 15.21

Changes to the device not approved by the Topcon could void the user's ability to operate the device.

IC Statements

This Class A digital apparatus complies with Canadian ICE-S003.

The term "IC:" before the radio certification number only signifies that Industry Canada technical specifications were met.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum
(or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication. This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Déclaration de conformité IC

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Ce matériel respecte les standards RSS exempt de licence d’Industrie Canada. Son utilisation est soumise aux deux conditions suivantes: (1) l’appareil ne doit causer aucune interférence, et (2) l’appareil doit accepter toute interférence, quelle qu’elle soit, y compris les interférences susceptibles d’entraîner un fonctionnement non requis de l’appareil. Selon la réglementation d’Industrie Canada, ce radio transmetteur ne peut utiliser qu’un seul type d’antenne et ne doit pas dépasser la limite de gain autorisée par Industrie Canada pour les transmetteurs. Afin de réduire les interférences potentielles avec d’autres utilisateurs, le type d’antenne et son gain devront être définis de telle façon que la puissance isotrope rayonnante équivalente (PIRE) soit juste suffisante pour permettre une bonne communication.

Voltage

Input Voltage: 12 Vdc or 24 Vdc

Functional Range: 9-32 Vdc

Open Source Support

The Topcon TotalCare website contains the licenses and notices for open source software used in this product.

With respect to the free/open source software, if you have any questions or wish to receive a copy of the source code to which you are entitled under the applicable free/open source license(s), such as the GNU Lesser/General Public License, please visit http://topconcare.com/en/support/.

www.topconpositioning.com