GRADEMETRIX™ DOZER
INSTALLATION GUIDE
Revision: A2

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6549091	7292186	7808428	8140223
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Table of Contents

Device Compliance, License and Patents 2
Chapter 1: Getting Started 6
Overview 6
Getting Started 7
Tools List 8
Preparing for Installation 9
Safety Information and Warnings 10
What's Included in Your Kit 11
Machine Inspection Checklist 15
Chapter 2: GMS-1 Sensor Installation 16
Overview 16
GMS-1 Sensor Installation 17
Chapter 3: Installing the Sensor Junction Box 22
Overview 22
Install the Sensor Junction Box 23
Chapter 4: Installing the VR500 Antenna 25
Overview 25
Install the VR500 Antenna 26
Chapter 5: Installing the IronTwo Control Box 29
Overview 29
Install IronTwo Control Box 30
Install the Power Cable 32
Install Cable Routing 33
Chapter 6: GradeMetrix System 34
Overview 34
Measure and Set Up Equipment 35
Configure Machine Measure 37
Set Up Sensor 40
Calibrate System 43
Quick Calibrate 45

3D Calibration 47
Verify Machine Accuracy 62
Save Machine Settings 65
Appendix A: Troubleshooting 67
Overview 67
Troubleshooting 68
Appendix B: Technical Specifications 70
Overview 70
VR500 GNSS Receiver 71
IronTwo 76
GMS-1 Sensor 78
Appendix C: Cable Pin-Outs 80
Overview 80
Part Number 051-0426-10 81
Part Number 051-0406-10 83
Part Number 051-0407-10 84
VR500 Installation Schematic 85
Index 86
End User License Agreement 87

Chapter 1: Getting Started

Overview

Introduction

Chapter 1 provides you with the information and proper tooling needed to begin a GradeMetrix Dozer installation.

It is recommended for only an experienced service technician perform the installation and configuration of the Hemisphere GradeMetrix system.

Contents

Topic	See Page
Getting Started	7
Tools List	8
Preparing for Installation	9
Safety Information and Warnings	10
What's Included in Your Kit	11
Machine Inspection Checklist	15

Getting Started

Introduction

This section lists the tools required, preparation, and power setup necessary to prepare your machine for the GradeMetrix dozer system installation.

Tools List

Tools list

A variety of tools are needed to properly set up and install your GradeMetrix dozer system.

Review the following list and locate these required tools prior to beginning installation:

- ☐ Slotted screwdriver
- ☐ Phillips screwdriver
- ☐ Adjustable wrench
- ☐ ½” & 3/8” ratchet set
- ☐ Inch sockets
- ☐ Metric sockets
- ☐ Cable tie cutters
- ☐ Allen wrench set (inch)
- ☐ Allen wrench set (metric)
- ☐ Torx wrench
- ☐ Wire stripper / Crimp tool
- ☐ GNSS base/rover
- ☐ Open wheel measuring tape
- ☐ Cable ties
- ☐ Split tube or other cable protection
- ☐ Electrical Tape
- ☐ Heat Shrink
- ☐ Electrical terminals i.e., spade, ring etc.
- ☐ Thread locker i.e., Loctite or similar
- ☐ Nickel anti-seize grease or similar
- ☐ Cold Gal and Machine-color paint if welding

Preparing for Installation

Prepare for installation

To prepare for a dozer installation, place the dozer on a flat surface.

Locate a clean source of power and a safe mounting location for the IronTwo control box. Check to ensure the control box and the GMS-1 sensors have power.

Important: The IronTwo must receive 7 – 36 VDC of input power from the machine (most machines should provide 24 V directly from the battery).

Note: The IronTwo must be installed so the operator can see the screen. Use care not to place the IronTwo in a location that might compromise visibility or block an exit from the cab.

Safety Information and Warnings

Safety information and warnings

Refer to the safety manual of each machine for proper operation and safety precautions. Store this guide and all related safety information with related machine manuals for future reference.

Prior to installing and operating GradeMetrix, read and follow all safety precautions as outlined in this manual.

Review and adhere to the follow safety warnings:

- Before you begin working on the machine, use the machine's master switch to disconnect power to the machine.
- A human operator is required to manually maintain a safe operating speed.
- GradeMetrix is a grade reference tool and is not designed to replace the machine's operator. **Do NOT allow a driver to operate without safety instructions. Avoid obstacles to prevent human, machine, and property injury.**

Important: The safety warnings contained in this manual are intended as guidelines and are not meant to be a complete list of potential hazards.

What's Included in Your Kit

Kit contents

Your GradeMetrix kit contains the parts listed in Table 1-1, Installation Kit Contents.

Table 1-1: Installation Kit Contents

Level	Part Number	Description	Quantity
1	051-0406-10	CBL, IO, VR500, 22-PIN to 5-PIN, 3.5M	1
1	051-0407-10	CBL,IO,IronOne Bulkhead, 4m	1
1	051-0426-10	HGNSS IronTwo Bulkhead Cable	1
1	051-0425-20	Cable, M12 CAN M/F Sensor, 3m	1
1	050-0022-01	CBL,ADO,POWER	1
1	050-0046-01	CBL,ADO,PWR ADAPT	1
1	150-0053-10	IronOne BT_Wifi Antenna	1
1	150-0054-10	IronOne Cellular Antenna	1
1	150-0056-10	Antenna, BT_WiFi, ANT-GXH918-TNC_M	1
1	676-0036-0	ADAPTER,MINI-C,N2K,BULKHEAD	1
1	710-0148-10	IronOne Flush Mount Kit	1
2	604-0054-000	RAM MNT, 2.43 INCH BASE, 1.5 INCH BALL	1
2	675-1211-000#	SCR,SEMS-INT.TOOTH,10-32,1/2",PHIL,SS	4
1	710-0149-10	IronOne U-Mount Kit	1
2	604-0015-000#	ASSY,ARM.W/U-BOLT.BASE.AND.ROUND.BASE	1
2	675-1211-000#	SCR,SEMS-INT.TOOTH,10-32,1/2",PHIL,SS	4
1	710-0157-10	KIT, VR500 MACH. CTRL MOUNT, PERMANENT	1
2	602-1185-10	PLATE, WELDED, VR500 MC MOUNT	1
3	676-1102-10	M8X1.25, HEX WELD NUT, STEEL	4

Continued on next page

What's Included in Your Kit, Continued

Kit contents, continued

Table 1-1: Installation Kit Contents (continued)

Level	Part Number	Description	Quantity
2	602-1186-10	BRACKET, VR500 MC MOUNT	2
2	675-1342-10	SCR, BUTTON HEAD, HEX, M8X1.25, 20MM, SS	8
2	678-1129-000#	WSHR,LCK.HEL,M8,2MM-THK,SS-A4	8
2	678-1146-10	WSHR, FLT, 0.344" ID, 0.75" OD, SS 18-8	4
2	681-1076-10	PLUG, LDPE, FOR 23.4mm DIA HOLE	4
1	710-0159-10	KIT, VR500 MACH. CTRL MAGNETS	1
2	478-0020-10	MAGNET,BASE,NEODYMIUM,1.75" OD, .375"THK	4
2	675-1343-10	SCR, 1/4-20X1.25", TORX, FLAT HEAD, SS	4
2	676-1105-10	NUT, HEX, NYLOC, 1/4-20,SS.18-8	4
2	678-1147-10	WSHR, FLT, 0.265" ID, 0.875" OD, SS 18-8	4
1	710-0160-10	KIT, M12 JUNCTION BOX / BULKHEAD ADAPTER ASSY	1
2	051-0409-10	CBL,M12 CAN,R/A(M)-STR(F),5-WAY,5M	1
2	400-0351-10	CONN,RCPT,M12(M)-(F),5-WAY	1
2	601-1291-10	END PLATE, BULKHEAD ADAPTER, M12 SERIES	2
2	602-1184-10	BRACKET, M12-5PIN ADAPTER	1
2	675-1349-10	SCR,M6x1.0mm,25mm,SHC,SS.18-8	2
2	676-1086-000	Nut, Nylock, M6, SS	2
2	678-1136-0	WSHR.FLT,M6,12mmOD,SS.18-8	4

Continued on next page

What's Included in Your Kit, Continued

Kit contents, continued

Table 1-1: Installation Kit Contents (continued)

Level	Part Number	Description	Quantity
2	678-1151-10	WSHR,INTERN-TOOTH,M16,26mmOD,SS.18-8	1
2	681-0021-10	GROMMET, 5/8"ID, 1-1/8"OD, EPDM,BLACK	1
1	710-0209-10	KIT, DOZER COIL CABLE, 10 FT	1
2	051-0413-10	CBL, CAN, 5-pin M12,(F)-(F), 10 Ft. COIL	1
2	675-1349-10	SCR,M6x1.0mm,25mm,SHC,SS.18-8	2
2	676-1086-000	Nut, Nylock, M6, SS	2
2	678-1136-0	WSHR.FLT,M6,12mmOD,SS.18-8	4
2	699-0041-10	CARABINER, 5/16" THK , SS	2
2	699-0042-10	P-CLAMP, 3/8" ID, EPDM CUSHION, SS	2
1	710-0215-11	KIT, SENSORS, GMS-1, DOZER	1
2	710-0217-10	KIT, GMS-1 SENSOR MOUNT, WITH COVER	1
2	710-0218-10	KIT, GMS-1 SENSOR MOUNT, BASIC	1
2	750-5019-10	SENSOR,GMS-1,DUAL AXIS,VER,M12-5PIN,M-F	1
2	750-5020-10	SENSOR,GMS-1,DUAL AXIS,HOR,M12-5PIN,M-F	1
1	710-0230-10	GradeMetrix Consumables Kit, VR500	1
2	675-1346-10	Scr,M5x0.8mm,20mm,BHC,SS.18-8	2
2	675-1359-10	SCR,MACH,M6X1mm,20mm,SHC,SS. NYL.PEL	2
2	675-1360-10	SCR,M6x1.0-16L,HEX HEAD,SERRATED FLANGE	2
2	675-1363-10	SCR,MACH,M6X1mm,12mm,SHC,SS. NYL.PEL	2
2	675-1367-10	Scr,M5x0.8mm,10mm,PPHC,SS.18-8,BL-OX	2

Continued on next page

What's Included in Your Kit, Continued

Kit contents, continued

Table 1-1: Installation Kit Contents (continued)

Level	Part Number	Description	Quantity
2	676-1103-10	Nut,HEX,M5x0.8mm,SS.18-8	2
2	677-2019-000#	TIE.WRAP,5.5",30LBS,0.18"TH,NYL.BLK	2
2	678-1136-0	WSHR.FLT,M6,12mmOD,SS.18-8	2
2	678-1149-10	Wshr,Flat,M5,10mmOD,SS.18-8	2
2	678-1150-10	Wshr,Lock.Split,M5,9.2mmOD,SS.18-8	2
1	750-0245-10	CAN TERMINATION RESISTOR, M12(F)	1
1	752-0028-10	VR500 RECEIVER, HGNSS	1
1	752-0040-10	HGNSS IronTwo Display	1

NOTE: Due to manufacturing processes outside of HGNSS purview, the installer may be required to adapt the GradeMetrix kit to your individual system.

Machine Inspection Checklist

Machine Inspection Checklist

To ensure peak performance, GradeMetrix should be installed only after a thorough machine inspection has been conducted.

To avoid bodily and machine injury, follow the machine inspection checklist below:

- Park the machine on a clean and level surface.
- Turn off the machine and remove +power from the batteries.
- Lower all implements to the ground.
- Apply the parking brake and chock wheels if necessary.
- Inspect any drilling and/or cutting sites to ensure no electrical wiring damage will be incurred.
- Periodically re-measure the blade width at the tips to adjust accuracy due to blade wear.

Chapter 2: GMS-1 Sensor Installation

Overview

Introduction

The dozer uses a GMS-1 sensor on the chassis and a GMS-1 sensor on the blade for pitch and roll. This chapter details the steps required for installing these sensors.

Contents

Topic	See Page
GMS-1 Sensor Installation	17

GMS-1 Sensor Installation

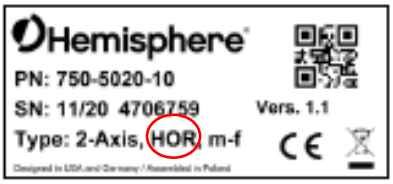
Sensors

There are two types of GMS-1 sensors. There is a horizontal sensor (P/N: 750-5020-10) used on the chassis and a vertical sensor (P/N: 750-5019-10) used on the blade.

It is extremely important to ensure the horizontal and vertical sensors are mounted in the correct location.

The labels on the GMS-1 sensors clearly indicate each sensor.

Below is a horizontal sensor label.



Below is a vertical sensor label.

The mounting bracket must be welded to the appropriate locations:

- **Body sensor** – The horizontal slope sensor used to measure the pitch and roll of machine.
- **Blade sensor** - The vertical tilt sensor used to measure the blade lift.

Important: It is important to choose safe welding locations for each sensor. The blade sensor should be welded as close to the center of rotation of the blade as possible. The coil cable should be run to avoid all pinch points and not placed in front of the dozer's radiator, as heat from the radiator will reduce the cable's lifespan.

Continued on next page

GMS-1 Sensor Installation, Continued

Brackets

The GMS-1 sensors include a base bracket (P/N: 602-1194-10) that can be welded to the machine. This bracket has two welding holes, so the bracket can be welded to the machine and hide the weld. Refer to Figure 2-1 bracket dimensions.

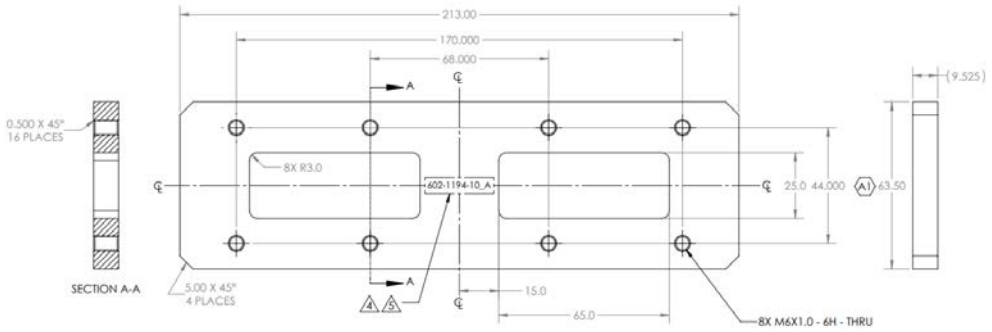


Figure 2-1: Bracket dimensions

Strain relief wings are also included. Screw the strain relief wing onto the bracket with the provided 14mm M6x1mm screws. The CAN cable can be zip-tied to the strain relief wing.

Figure 2-2 shows the drawing of P/N: 602-1196-10 strain relief wing.

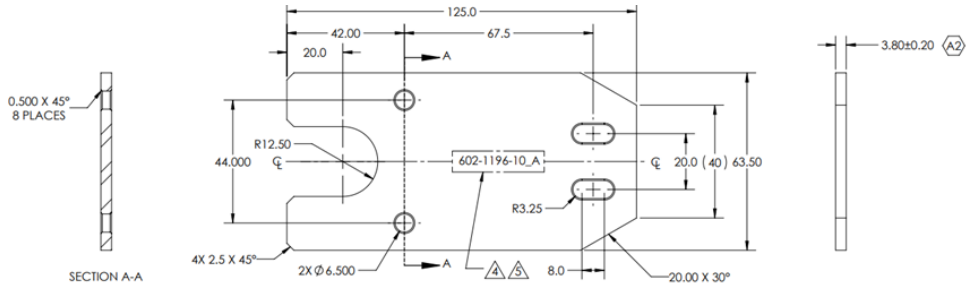


Figure 2-2: P/N 602-1196-10 strain relief wing

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GMS-1 Sensor Installation, Continued

Brackets, continued

After the base bracket has been welded onto the machine, the GMS-1 sensor can be bolted onto the bracket with the provided 20mm M6x1mm screws.

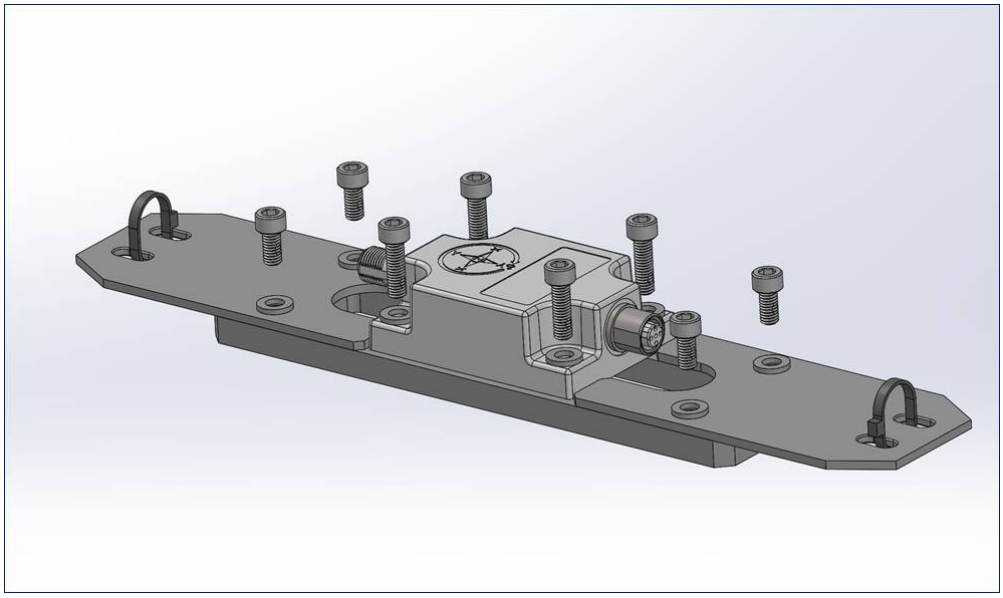

Figure 2-3: Base Bracket Screws

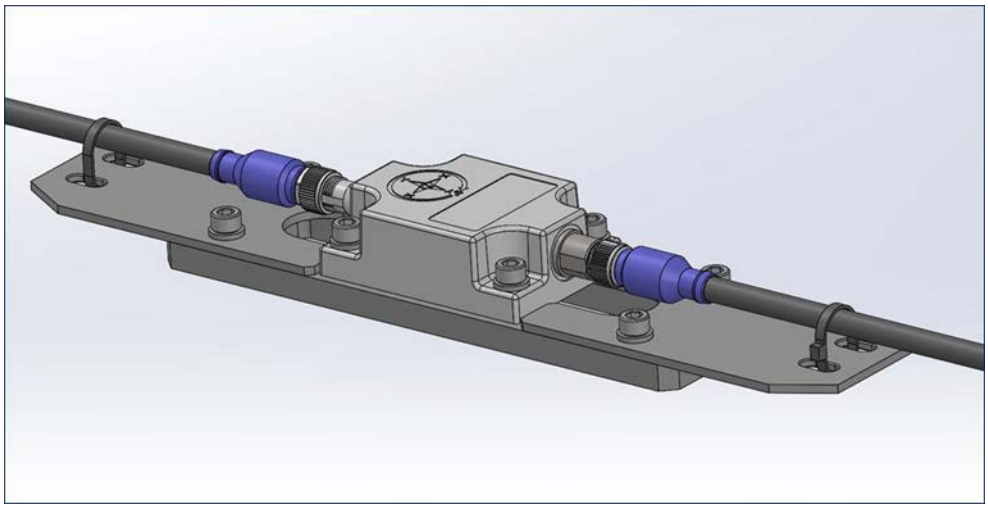

Figure:2-4: Bracket

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GMS-1 Sensor Installation, Continued

Brackets, continued

One strain relief plate and one spacer (P/N: 602-1197-10) is included for the blade. The spacer can be attached to the base bracket on the opposite side of the strain relief wing using the provided 14mm M6x1mm screws. See the following example.

A cover is added to the sensor bracket for protection.

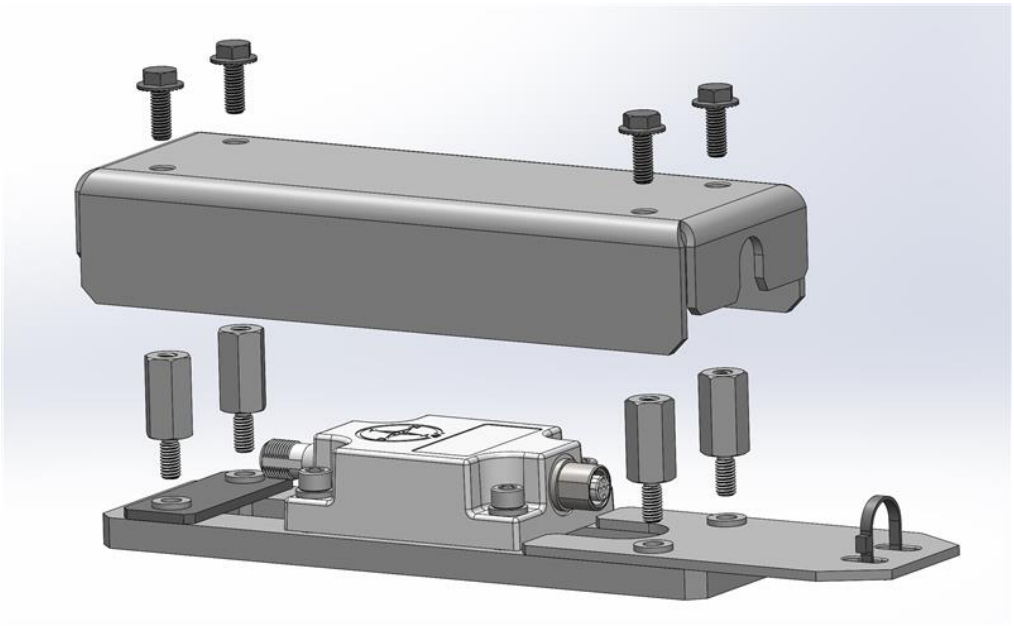

Figure 2-5: Strain Relief Plate and Spacer

Note: The standoffs in the blade installation are used only because a cover is placed (not bolted) over the installation.

For the chassis, use the M6 screws instead of the standoffs, and bolt (P/N: 602-1195-10) the cover onto the installation.

Continued on next page

GMS-1 Sensor Installation, Continued

Sensor Placement

Place the horizontal sensor on the chassis and level to the dozer body. Place the label of the GMS-1 sensor either facing up or facing down.

The LED light can be placed facing left, right, up, or down. Take care to square the sensor so the LED faces one of these locations.

The vertical sensor must be placed on the blade. Place the label facing forward (toward the front of the machine) or backward (toward the cab).

The LED light can be placed to face up, down, left, or right. The base bracket should be welded onto the blade and the cover placed over the sensor. The coil cable is connected to this sensor.

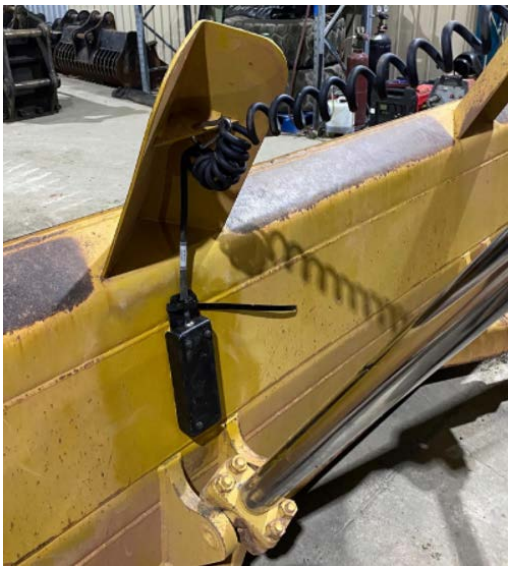

Figure 2-6: Horizontal Sensor and Chassis

Chapter 3: Installing the Sensor Junction Box

Overview

Introduction

This chapter provides the information to install the sensor junction box in your dozer.

Contents

Topic	See Page
Install the Sensor Junction Box	23

Install the Sensor Junction Box

Steps to install the sensor junction box

A CAN cable runs from the IronTwo (inside of the cab) to the sensor junction box. A second CAN cable runs from the sensor junction box to the sensor on the blade.

The sensor junction box protects the cable running from the IronTwo to junction box, so if the CAN cable connected to the dozer blade sensor becomes damaged, the cable running to the IronTwo does not need to be replaced.

To install the sensor junction box, follow the steps as detailed in Table 3-1: Install Sensor Junction Box.

Table 3-1: Install Sensor Junction Box

Step	Action
1	Install the blade sensor junction box at the front area of the machine in a location suitable for cable wiring. Figure 3-1 shows the sensor junction box mag-mounted to the front of the dozer. The sensor junction box can also be welded or bolted onto the machine. **Figure 3-1: Sensor junction box mag-mounting**
2	Install the blade sensor cable in a location that will not interfere with the blade movement.

Continued on next page

Install the Sensor Junction Box, Continued

Steps to install the sensor junction box, continued

Table 3-1: Install Sensor Junction Box (continued)

Step	Action
3	Install a cable strain relief connection. Tie the wrap cable to either of the existing locations or install the P-Clamps. **Figure 3-2: Sensor Junction Box**
4	Route the cable through the engine compartment toward the cab. Ensure the cable is clear of any moving engine parts and hot areas (i.e., the exhaust and turbo).
5	Route the cable in to connect to the IronTwo control box cable. We recommend installing cable wrap on any part of cable that may come in contact with wear locations or excessive heat.
6	Connect the blade sensor coil cable (P/N: 051-0413-10) from the blade sensor to sensor junction box, and ensure the cable is secured to avoid any machine pinch points.

Chapter 4: Installing the VR500 Antenna

Overview

Introduction

Chapter 4 provides all the information you need to install the VR500 antenna to your dozer.

Contents

Topic	See Page
Install the VR500 Antenna	26

Install the VR500 Antenna

Overview

The VR500 antenna may be installed parallel or perpendicular to the centerline of the machine.

If installing the VR500 perpendicular to the centerline of the machine, place the primary antenna on the left-hand side of the machine and secondary on the right-hand side.

If installing the VR500 parallel to the centerline, install the primary antenna in the back and install the secondary antenna in front.

Steps to install the VR500 antenna

To install the VR500 antenna, follow the steps as detailed in Table 4-1.

Table 4-1: Install VR500 antenna

Step	Action
1	Install the VR500 antenna onto the mounting bracket.
2	If welding to a surface plate, (Weld Plate Kit P/N: 710-0158-10), square it center and close to the centerline of cab.
3	If using magnetic mounting (Mag Mount Kit P/N: 710-0157-10), remove the bottom plate and install the magnets directly on the cross bars. **IMPORTANT: If the antenna mount moves or the antenna location is changed, the calibration and measure-up must be repeated, or the machine accuracy will be inaccurate. We recommend permanently marking the exact location for future reference.**

Continued on next page

Install the VR500 Antenna, Continued

Steps to install the VR500 antenna, continued

Table 4-1: Install VR500 antenna (continued)

Step	Action
4	Figure 4-1 shows the VR500 mounting brackets. If you are using a weld-on mount, use the bottom plate. Do not use the bottom plate if you are using the magnetic mount. **Table 4-1: Permanent mount (P/N: 710-0157-10)**

Part Number	Description
602-1186-10	BRACKET, VR500 MC MOUNT
602-1185-10	PLATE, WELDED, VR500 MC MOUNT
681-1076-10	PLUG, LDPE, FOR 23.4mm DIA HOLE
675-1342-10	SCR, BUTTON HEAD, HEX, M8X1.25, 20MM, SS
678-1146-10	WSHR, FLT, 0.344" ID, 0.75" OD, SS 18-8
678-1145-10	WSHR, LCK, 8.5mm ID, 14.8mm OD, SS.18-8

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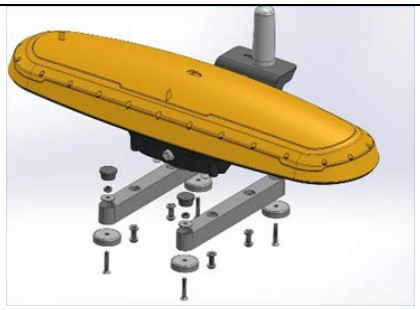
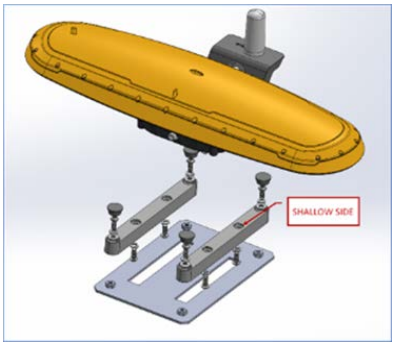
Install the VR500 Antenna, Continued

Steps to install the VR500 antenna, continued

Table 4-1: Install VR500 antenna (continued)

Step	Action
4 (cont.)	  **Figure 4-1: VR500 mounting brackets** **Table 4-3: Magnet Mount: (P/N: 710-0158-10)** Part Number / Description: 602-1186-10 — BRACKET, VR500 MC MOUNT 681-1076-10 — PLUG, LDPE, FOR 23.4mm DIA HOLE 675-1342-10 — SCR, BUTTON HEAD, HEX, M8X1.25, 20MM, SS 678-1145-10 — WSHR, LCK, 8.5mm ID, 14.8mm OD, SS.18-8 478-0020-10 — MAGNET, BASE, ENCASED, NEODYMIUM, 1.75"OD, .375"THK
5	Apply cable wrap on the cable (cable P/N: 051-0406-10) where the cable may be exposed to chaffing, rubbing, or high heat to extend the cable life.

Chapter 5: Installing the IronTwo Control Box

Overview

Introduction

This chapter provides information necessary to install the IronTwo to your GradeMetrix dozer.

Contents

Topic	See Page
Install IronTwo Control Box	30
Install the Power Cable	32
Install Cable Routing	33

Install IronTwo Control Box

Steps to install IronTwo Control Box

To install the IronTwo Control Box, follow the steps as detailed in Table 5-1: Install IronTwo Control Box.

Table 5-1: Install IronTwo Control Box

Step	Action
1	Determine an operator-acceptable location to mount the IronTwo control box. **Figure 5-1: IronTwo Control Box**
2	Use either the U-Mount RAM mount, or the flush-mount RAM ball, to mount the IronTwo where the operator can operate the blade and see the guidance on the IronTwo console.

Continued on next page

Install IronTwo Control Box, Continued

Steps to install IronTwo Control Box, continued

Table 5-1: Install IronTwo Control Box (continued)

Step	Action
3	When installing the flush mount, determine how to install the RAM ball on the machine and use your own hardware. Hardware is provided to mount the RAM ball onto the back of the IronTwo. **Part Number** / **Description** 604-0054-000 — RAM MNT, 2.43 INCH BASE, 1.5 INCH BALL 675-1211-000# — SCR,SEMS-INT.TOOTH,10-32,1/2",PHIL,SS **Table 5-2: U-Mount Kit: P/N: 710-0149-10** **Part Number** / **Description** 604-0015-000# — ASSY,ARM.W/U-BOLT. BASE. AND. ROUND.BASE 675-1211-000# — SCR,SEMS-INT.TOOTH,10-32,1/2",PHIL,SS
4	Make sure the operator can safely exit the machine. The IronTwo control box must not block or hinder access to any door of the cab.

Install the Power Cable

Steps to install the power cable

To install the power cable, follow the steps as detailed in Table 5-3: Install Power Cable.

Table 5-3: Install Power Cable

Step	Action
1	The IronTwo power cable comes in two sections. P/N: 050-0022-01 has a right-angle connector that connects to the power on the back of the IronTwo and connects to P/N: 050-0046-01.
2	Attach the positive (red) wire to a clean power source and the negative (black) to machine ground. The orange wire is ignition. Ground the ignition if it is not used. Else, connect the ignition to an ignition source.
3	Route the cable into the cab. Use cable wrap where the cable may wear through the insulation.

Install Cable Routing

Steps to install cable routing

To install the cable routing, follow the steps as detailed in Table 5-4: Install Cable Routing.

Table 5-4: Install Cable Routing

Step	Action
1	Install Comm IronTwo Bulkhead cable (P/N: 051-0426-10) onto the back of IronTwo control box into the “COMM” connector. **Figure 5-2: IronTwo cable to VR500 Bulkhead**
2	From inside the cab, route the VR500 data cable, (P/N: 051-0407-10) from the previously installed 5-pin bulkhead connector up to the IronTwo Control Box Bulkhead cable 6-pin Deutsch connector.

Power System

1. Power up the IronTwo control box.
2. Check the LEDs and the sensor to verify power and operation of components. The LEDs are located on the bottom side of VR500 for Power, GNSS, Heading, and Radio power.

Chapter 6: GradeMetrix System

Overview

Introduction

This chapter provides information necessary to use the GradeMetrix System to measure and setup your equipment.

Contents

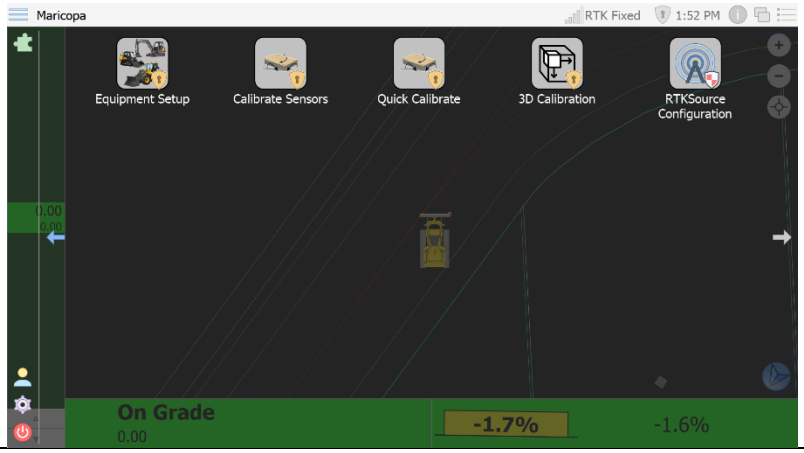
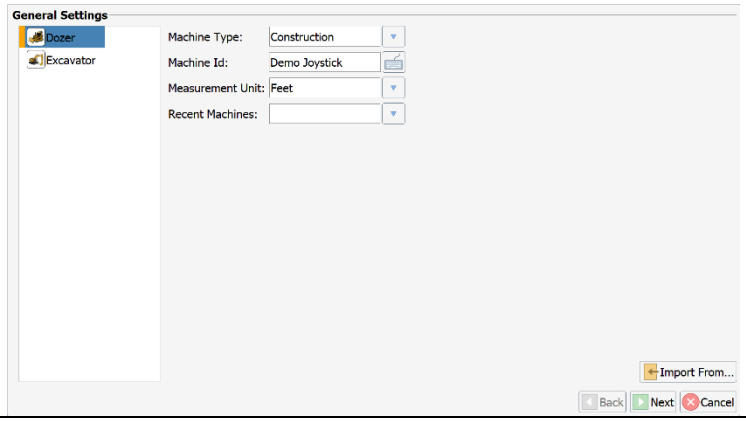
Topic	See Page
Measure and Set Up Equipment	35
Configure Machine Measure	37
Set Up Sensor	40
Calibrate System	43
Quick Calibrate	45
3D Calibration	47
Verify Machine Accuracy	62
Save Machine Settings	65

Measure and Set Up Equipment

Steps to measure and set up equipment

To measure and setup your equipment, follow the steps as detailed in Table 6-1: Measure and Set Up Equipment.

Table 6-1: Measure and Set Up Equipment

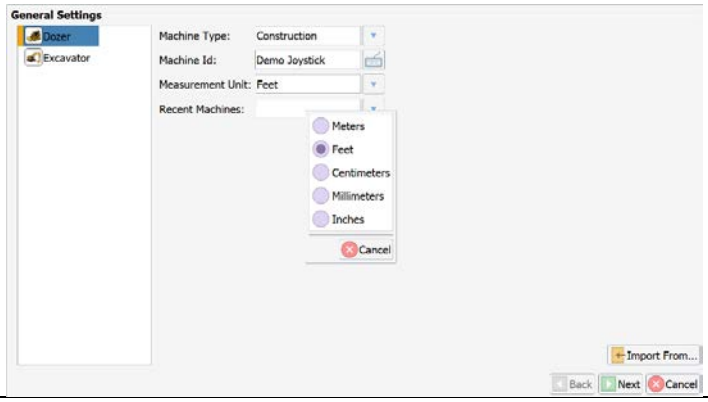
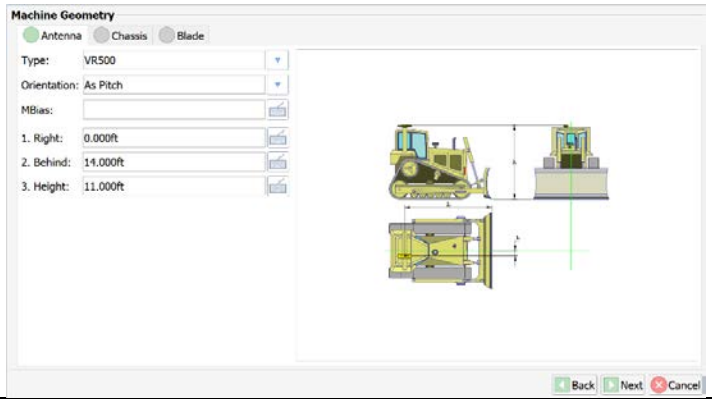
Step	Action
1	Select **Equipment Setup**. 
2	Select **Dozer** in the **General Settings** screen. 
3	Select **Machine Type**.

Continued on next page

Measure and Set Up Equipment, Continued

Steps to measure and set up equipment, continued

Table 6-1: Measure and Set Up Equipment (continued)

Step	Action
4	Assign a **Machine ID**. **Note:** Your Machine ID should be a unique identifier that will identify this specific machine to your company.
5	Select the unit of measure. Click **NEXT**. 
6	Follow the screen directions for measuring the machine. Locate the three tabs across the top below **Machine Geometry** for machine measure configuration. • Antenna location • Body size • Blade size 

Configure Machine Measure

Configure Machine Measure

To configure your machine measure, follow the steps as detailed in Table 6-2.

Table 6-2: Configure machine measure

Step	Action
1	On the **Antenna** tab, select the type of antenna and receiver you are using. For dozer installations, select the VR500 receiver.

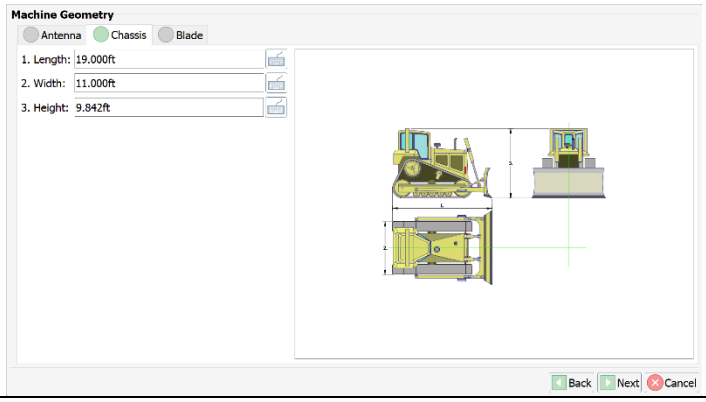
Field	Description
Pitch orientation	The VR500 orientation is parallel with the machine's tracks and the arrow points in the direction of forward travel.
Roll orientation	Roll orientation is perpendicular to the machine's tracks with the arrow pointing to the right side of machine.
MBias	This value will automatically be calculated during the 3D calibration and does not need to be manually typed in. MBias is the angular offset between the VR500's heading and the machine's heading. If the machine is facing due north (0 degrees) and the VR500 reads 5 degrees, the MBias is 5 degrees.
Right	This value is the distance of the primary antenna from the centerline of the machine. If the primary antenna is to the left of the centerline, this value is negative. **Note: You do not need to enter this value. It will be calculated automatically during the 3D calibration.**

Continued on next page

Configure Machine Measure, Continued

Configure Machine Measure, continued

Table 6-2: Configure machine measure (continued)

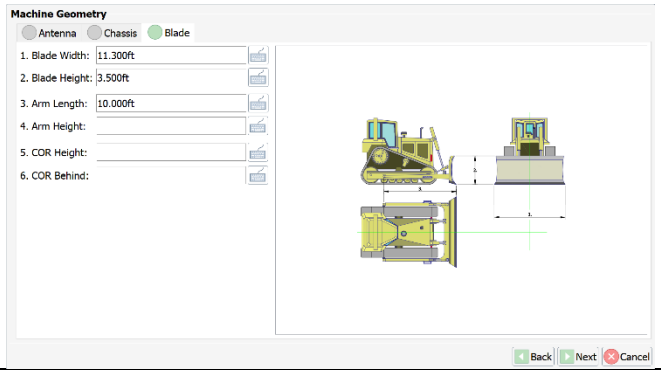
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1 (cont.)</td><td>
<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>Behind</td><td>This value is the distance from the primary antenna to the blade. Note: You do not need to enter this value. It will be calculated automatically during the 3D calibration.</td></tr>
<tr><td>Height</td><td>This value is the height of the antenna above the tracks (measured to the lip of the VR500). Note: You do not need to enter this value. It will be calculated automatically during the 3D calibration.</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Click the Chassis tab. Type the body length, width, and height per the diagram below. These values can be approximate, as they are only used for graphics.
 
</td></tr>
</table>

Continued on next page

Configure Machine Measure, Continued

Configure Machine Measure, continued

Table 6-2: Configure machine measure (continued)

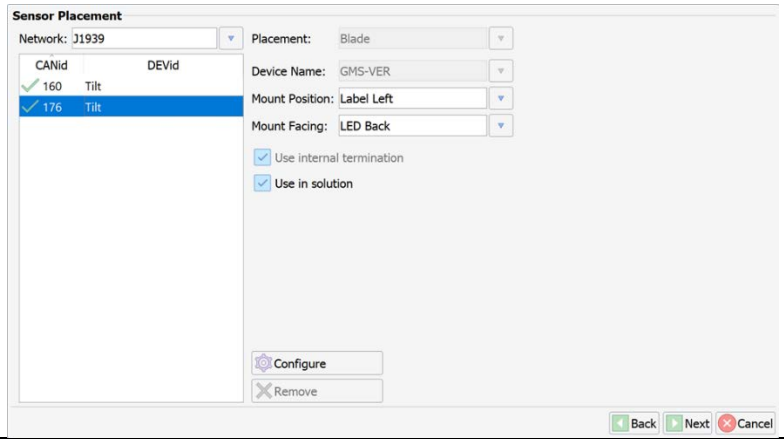
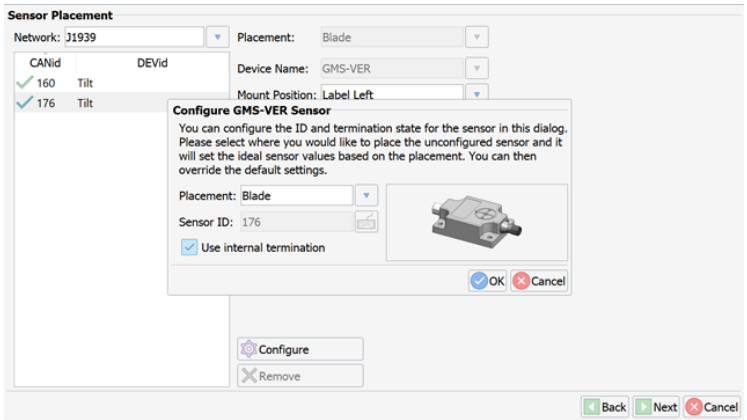
Step	Action
3	Click the **Blade** tab. Type the blade width and height and the arm length. These values must be as accurate as possible. 
4	You must enter the Center of Rotation (COR) height and behind offsets. To do this, the Operator should roll the blade left and right to find the center of rotation of the blade. Find the point the blade rotates around. After locating the center of rotation, measure the height above the cutting edge and the distance behind the tip of the cutting edge.

Set Up Sensor

Set up sensor

Ta After clicking **Next** in the screen above, you will see the **Sensor Placement** screen.

Table 6-3: Set up sensor

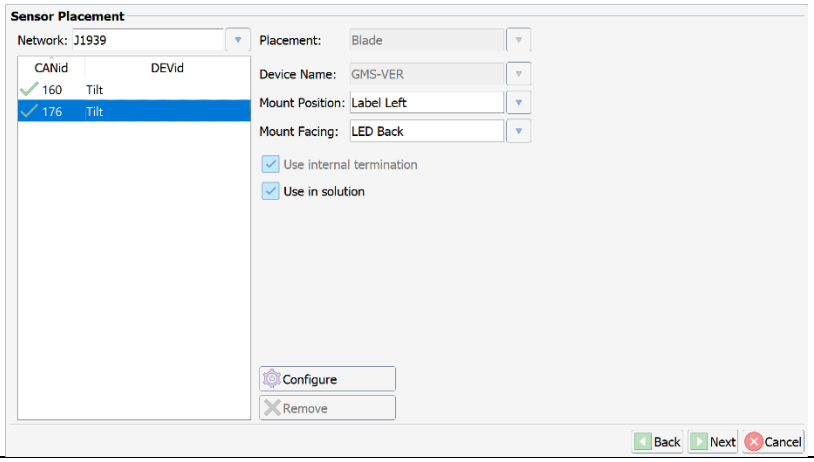
Step	Action
1	Click **Sensor Network**. Set **Network** to **J1939**. 
2	Each sensor is unconfigured. Click the sensor name and click **Configure**. A dialogue window displays. Click the dropdown box next to **Placement**. If the sensor is on the blade, select **Blade**. If the sensor is on the chassis, select **Chassis**. For the blade sensor, check **Use internal termination**. Click **OK**. 

Continued on next page

Set Up Sensor, Continued

Set up sensor, continued

Table 6-3: Set up sensor (continued)

Step	Action
3	Set up the orientation of the sensor. **Mount Position** refers to the direction of the label. For the chassis sensor: **If ...** / **Then ...** the label is facing up — Set to **Label Up** the label is facing down — Set to **Label Down** For the blade sensor: **If ...** / **Then ...** the label is facing forward — Set to **Label Forward** The label is facing toward the cab — Set to **Label Back** 

Continued on next page

Set Up Sensor, Continued

Set up sensor, continued

Table 6-3: Set up sensor (continued)

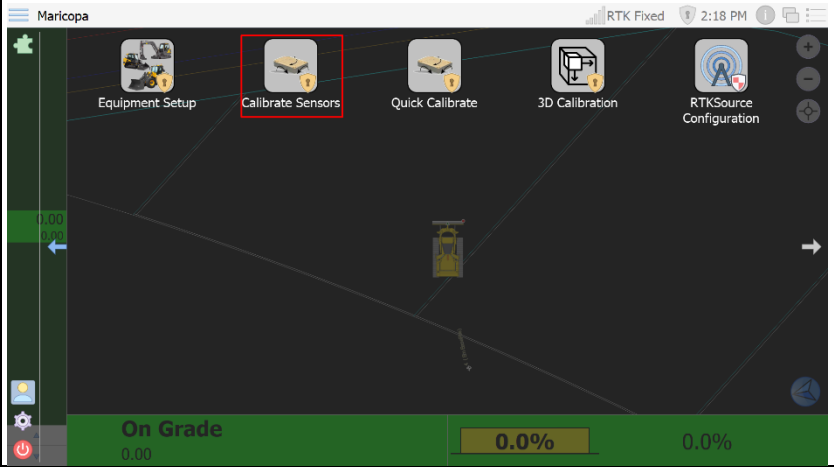
Step	Action
4	If **Mount Facing** is selected, a pull-down screen displays. You can select from the listed options for the blade sensor's arrow orientation.
5	Click **FINISH**.

Calibrate System

Calibrate system

To calibrate the system, follow the steps as detailed in Table 6-4: Calibrate System. The dozer should be outside with a clear view of the sky and no obstructions. Use this method to calibrate all the sensors using GradeMetrix.

Table 6-4: Calibrate System

Step	Action
1	Click **Calibrate Sensors** and follow instructions. It is recommended to use a firm, flat surface during the calibration process. 

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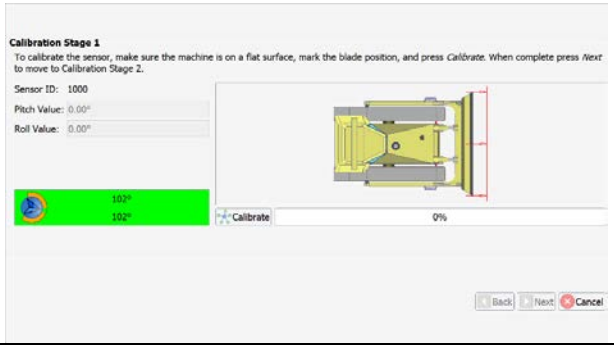
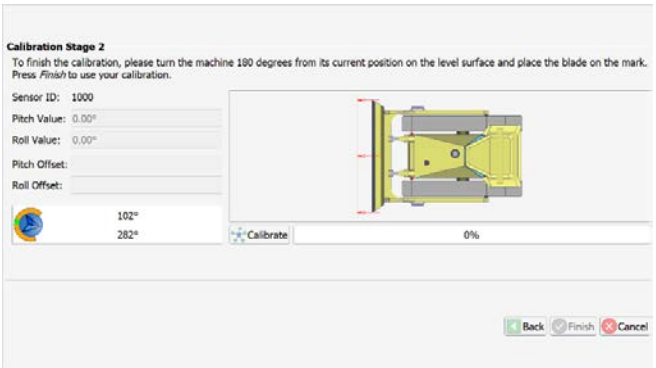
Calibrate System, Continued

Calibrate system, continued

Table 6-4: Calibrate System (continued)

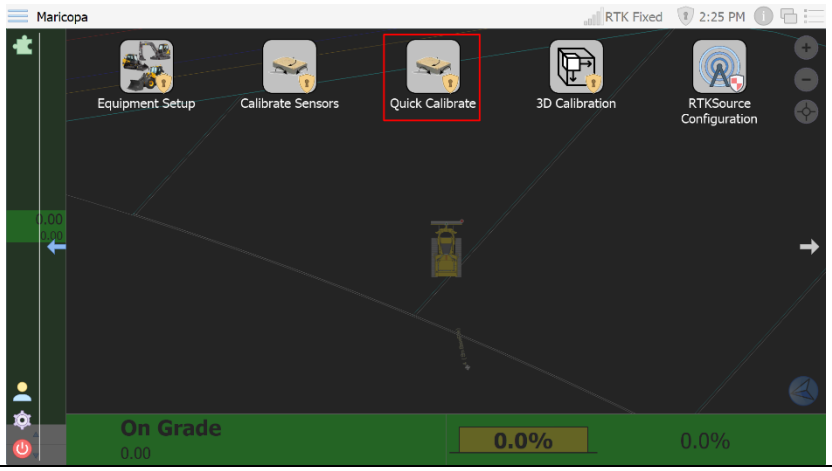
Step	Action
2	Follow the instructions on the screen. Locate a firm, flat level surface twice the length of the machine. Place the machine so the blade sits in the middle as shown below. Mark the blade position on ground. Mark both the cutting edges. Select **Calibrate**. Click **Next**. 
3	Follow the instructions on the screen. Carefully lift the blade so as to not damage the marks and track the machine to rotate 180 degrees and carefully place the blade to align with the mark made at the last step Select **Calibrate**. Select **Finish**. 

Quick Calibrate

Steps to quick calibrate

To quick calibrate the system, follow the steps as detailed in Table 6-5: Quick Calibrate.

Table 6-5: Quick Calibrate

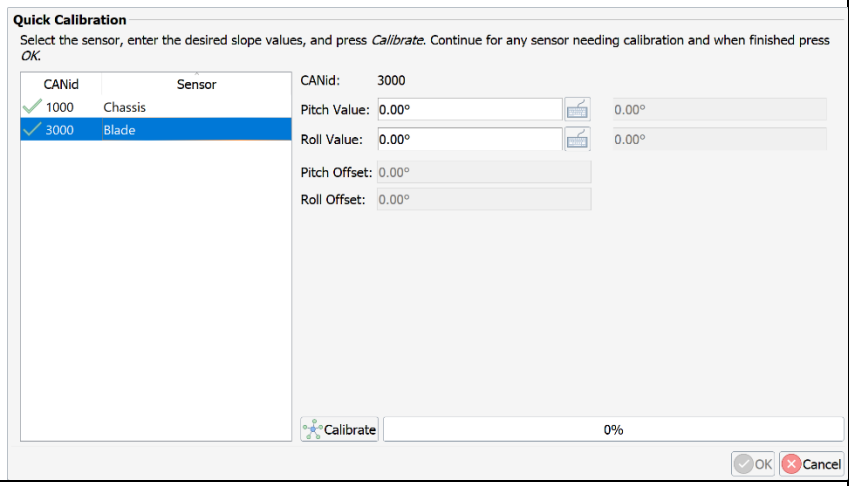
Step	Action
1	Click **Quick Calibrate**. This method is a direct setting of a single sensor and works well with a calibrated 'Smart Level' tool. 

Continued on next page

Quick Calibrate, Continued

Steps to quick calibrate, continued

Table 6-5: Quick Calibrate (continued)

Step	Action
2	Select the sensor to be calibrated. Enter the 'Smart Level' readings of the pitch and roll values for each sensor. Select **Calibrate**. 
3	Click **OK** when you are finished calibrating all the sensors.

3D Calibration

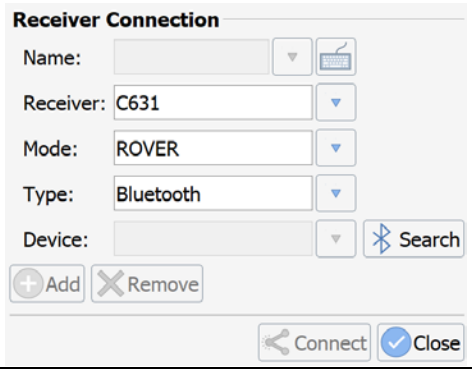
3D Calibration

Before proceeding with the 3D calibration, ensure the chassis and blade sensors are calibrated. If you have a six-way blade, make sure the blade is square. Face the machine **North**.

The VR500 on the dozer and the C631 rover must be RTK Fixed. Make sure the C631, connected to SiteMetrix™ Grade, is running the same projection as GradeMetrix. To check if the C631 is in the same datum, set it next to the primary antenna of the VR500 enclosure. Verify the readings are close between the two. If the projection is incorrect, the northing and easting will show obvious errors.

To calibrate a GradeMetrix Dozer, use SiteMetrix Grade.

Table 6-6: SiteMetrix Grade Points

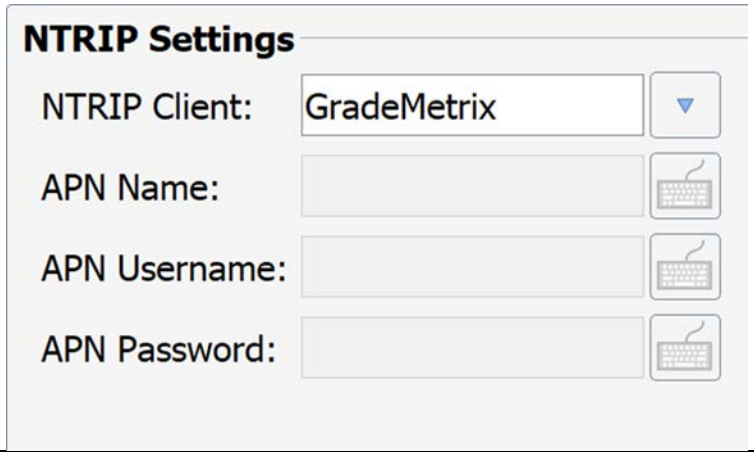
Step	Action
1	Click the **Bluetooth** icon on the top-right of the screen. A dialogue window displays. Click **Search** to search for Bluetooth devices. 

Continued on next page

3D Calibration, Continued

3D Calibration, continued

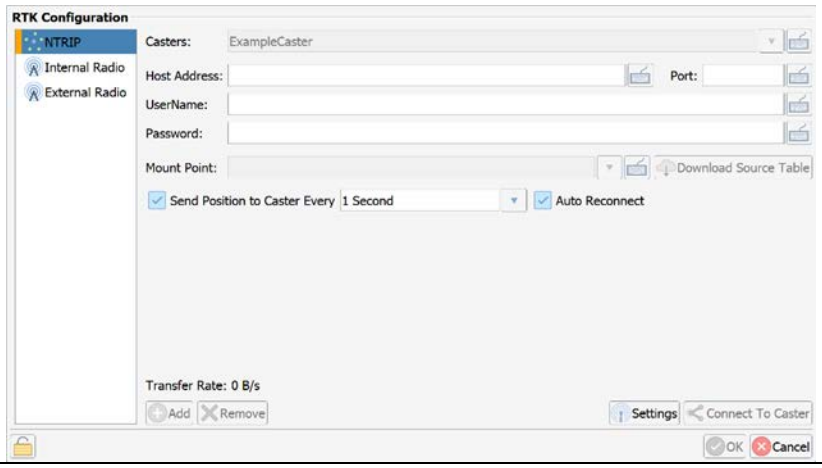
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
2	Click **Search** to search for the receiver. The Bluetooth ID is the serial number. There is no Bluetooth pin. Set **Mode** to either **Rover**, **Base**, or **Static**. Under **Name**, use the option to name the C631 as “base” or “rover”, rather than using the serial number. Click **Connect**. After connecting to the rover, configure the RTK. Go to the menu, scroll to the right, and click **RTKSource**. SiteMetrix Grade can receive RTK over NTRIP and use the internal UHF radio or an external UHF radio.
3	If using NTRIP, you can use the data collector’s internet (if internal cellular modem or WiFi) or the C631’s internal GSM modem. To setup click **Settings**. 

Continued on next page

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
4	If the NTRIP Client is set to **GradeMetrix**, the data collector's internet will be used to access the NTRIP caster and the RTK messages will transfer back to the C631 via Bluetooth. If the NTRIP Client is set to **Receiver**, the C631's internal modem will be used. Type the **APN Name**, **Username**, and **Password**. Type a **Caster** name. You can add multiple NTRIP casters to SiteMetrix Grade (all saved in a database). Type the **IP address/DNS**, **Port**, **Username**, and **Password**. Click **Download Source Table**. 

Continued on next page

3D Calibration, Continued

3D Calibration, continued

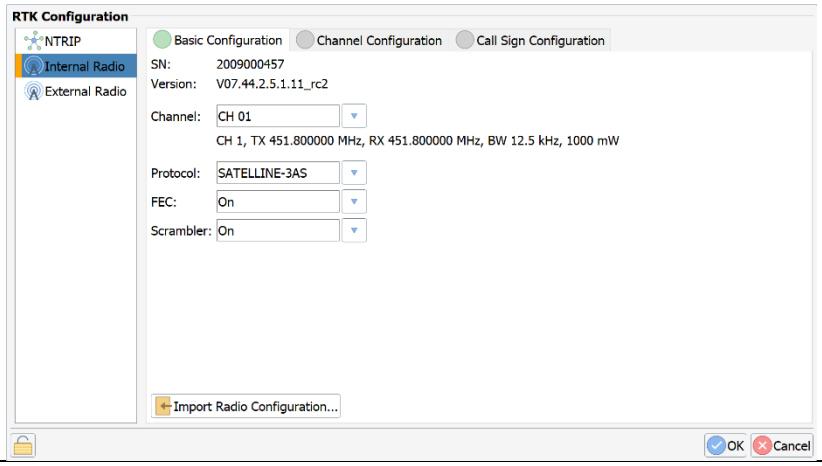
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
5	Select the correct mount point. If using a VRS network (or the nearest base station), click **Send Position To Caster Every** and select an interval for your position to send to the caster. Click **Auto Reconnect** to ensure that the software reconnects to the NTRIP caster every time it opens or if internet is lost and re-gained. Click **OK**. **Note**: After clicking **OK**, the NTRIP client is the only source of RTK (even if the internal UHF radio is configured). If you wish to switch to a configured internal UHF radio, go to **RTKSource Configure**, click **Internal Radio**, and click **OK**.

Continued on next page

3D Calibration, continued

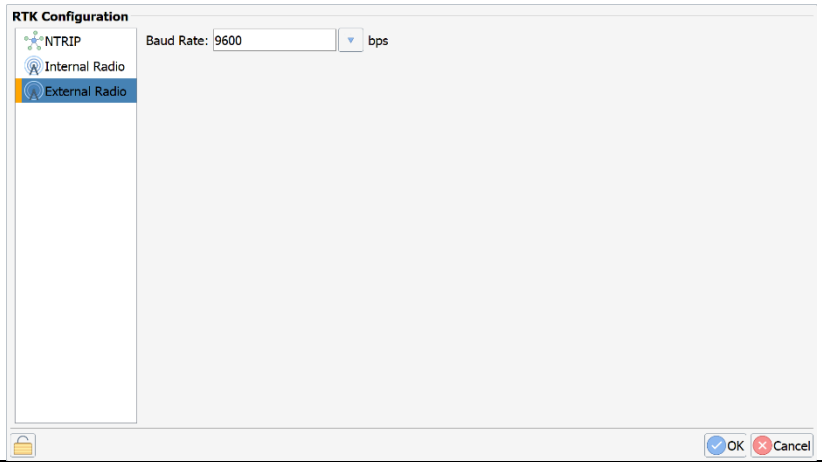
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
6	Alternatively, you can use the **Internal Radio**. Click the **Internal Radio** tab. If you have the correct administrative settings, you can enter channels using **Channel Configuration**. **Warning: You are responsible for verifying which frequencies and bandwidths can be set up for your region.** Select the **channel**, **protocol**, **FEC** (if applicable), and scrambling (if applicable). Click **OK**. **Note:** After you click **OK**, the internal UHF radio is the primary source of RTK (even if the NTRIP client is configured) the receiver will use the radio. If you wish to switch to a configured the NTRIP client, go to **RTKSource Configure**, click **NTRIP**, and click **OK**. 

Continued on next page

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
7	Finally, you can select an **External Radio**. Click **External Radio**. SiteMetrix Grade does not support the configuration of an external radio, but you can set the baud rate of the serial port of the C631. On the bottom of the C631 are two Lemo connectors. One connector has 5 pins for an external radio, and the other has 7 pins. 
8	Verify the antenna height is correct.

Continued on next page

3D Calibration, Continued

3D Calibration, continued

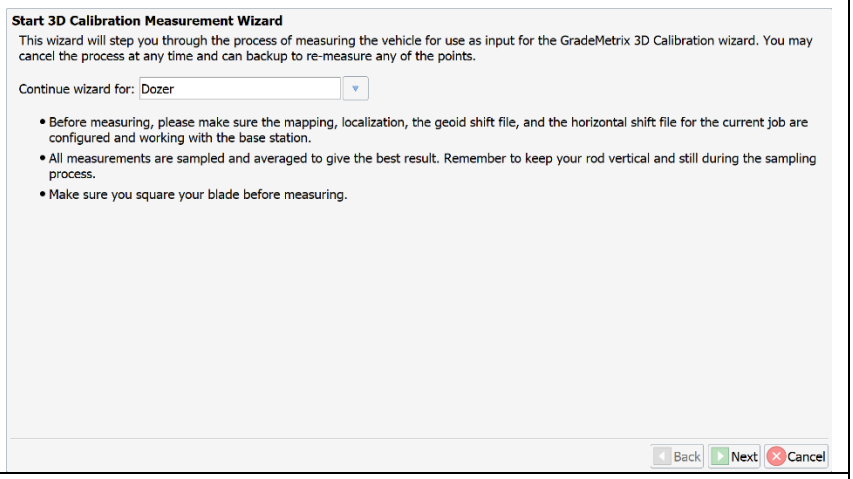
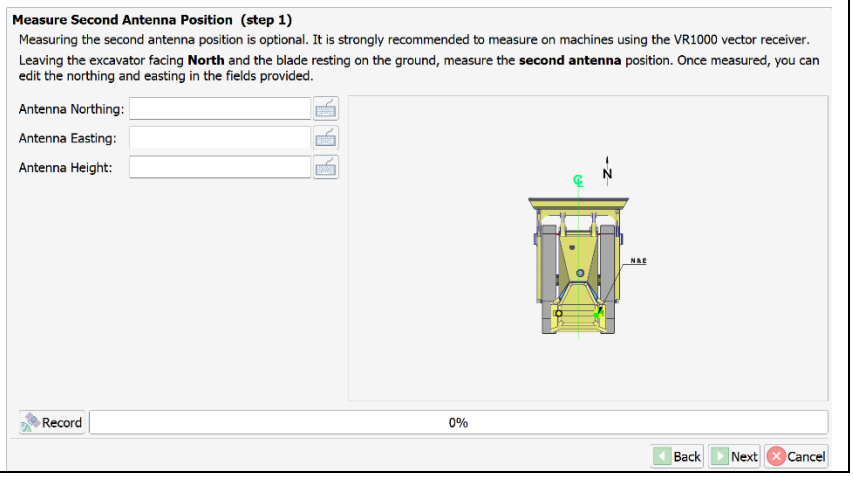
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
9	Go to the main menu. Click **Calculations**.
10	Click **Vehicle Calibration Wizard**.

Continued on next page

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

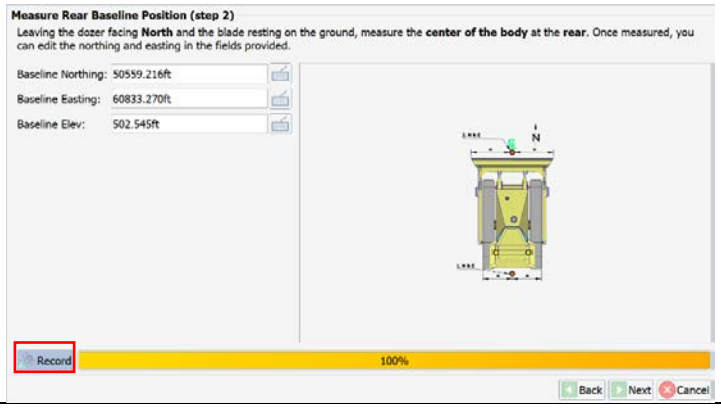
Step	Action
11	Select **Dozer**. 
12	It is not necessary to measure the secondary antenna position when using a VR500. Click **Next**. 

Continued on next page

3D Calibration, Continued

3D Calibration, continued

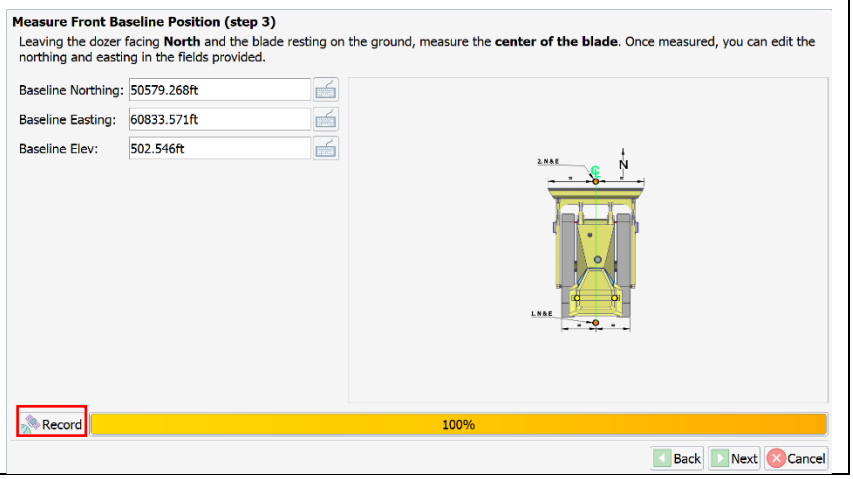
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
13	Measure the GNSS position at the rear of the machine in the center. Click **Record** to measure the point. 

Continued on next page

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
14	To measure the center of the blade, pull a tape to find the correct center of the blade. Click **Record** to measure the point. 

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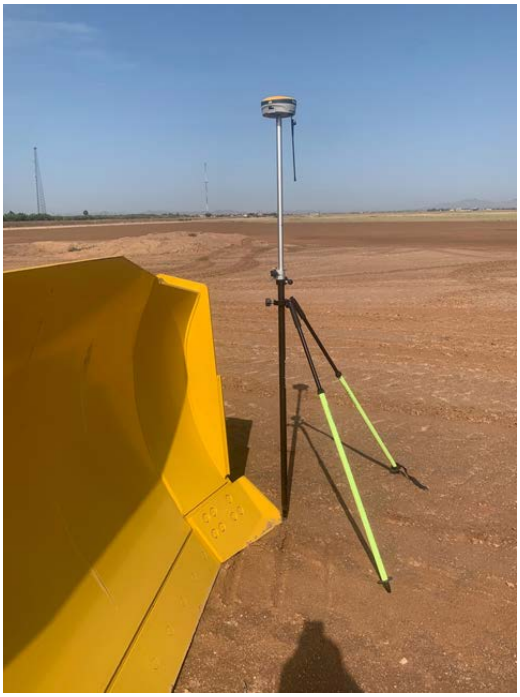
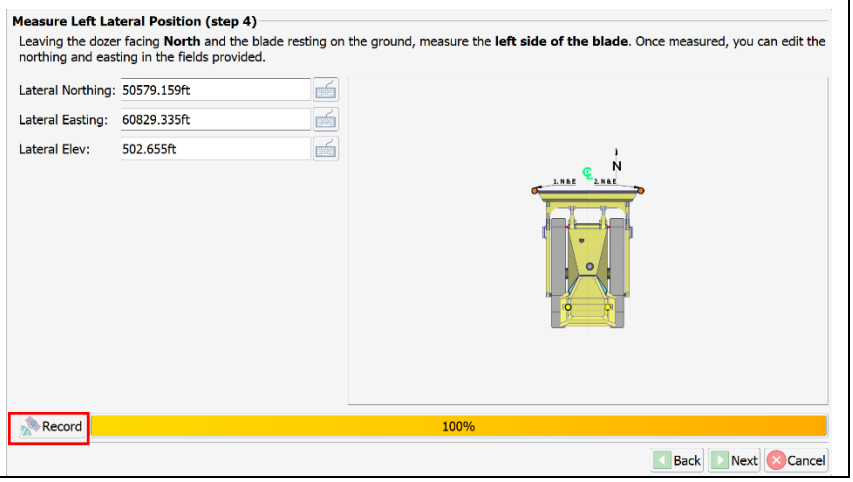
3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
15	Measure the left blade tip.  Click **Record** to measure the point. 

Continued on next page

3D Calibration, continued

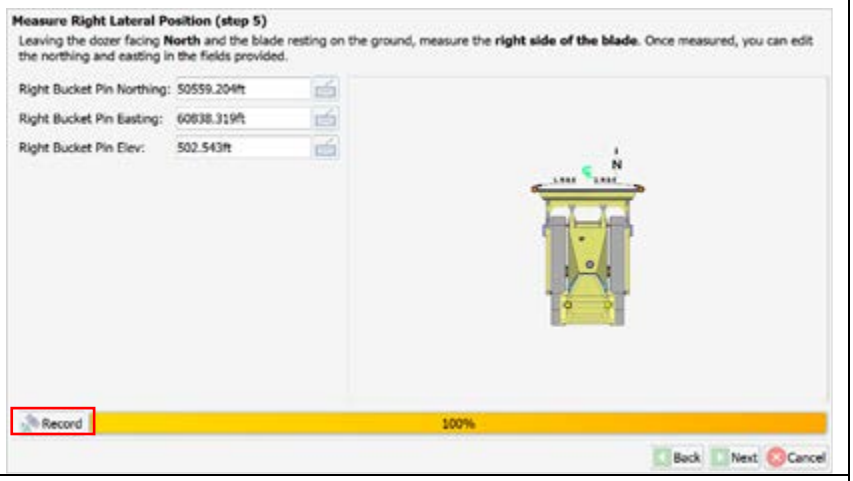
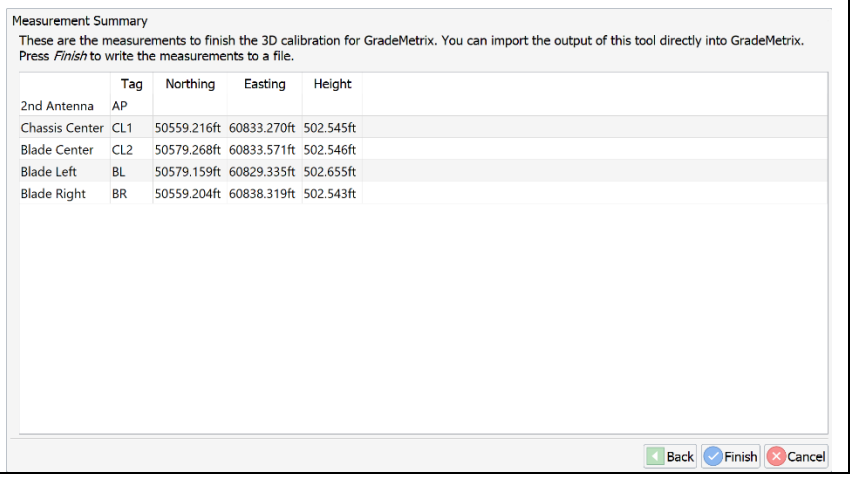
Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
16	Measure the right blade tip.

Continued on next page

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

Step	Action
17	Click **Record** to measure the point. 
18	A summary of all points recorded is provided. Click **Finish**. To save the file, insert a USB thumb drive to your HT20 tablet and save the file. 

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3D Calibration, Continued

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

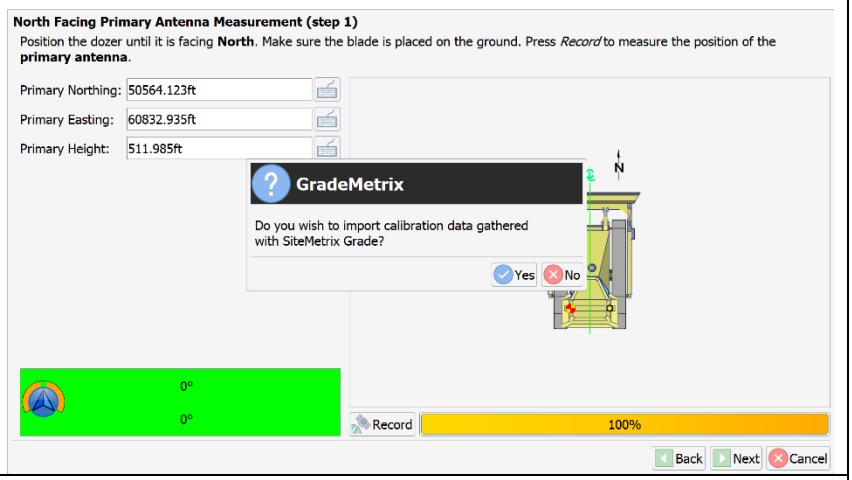
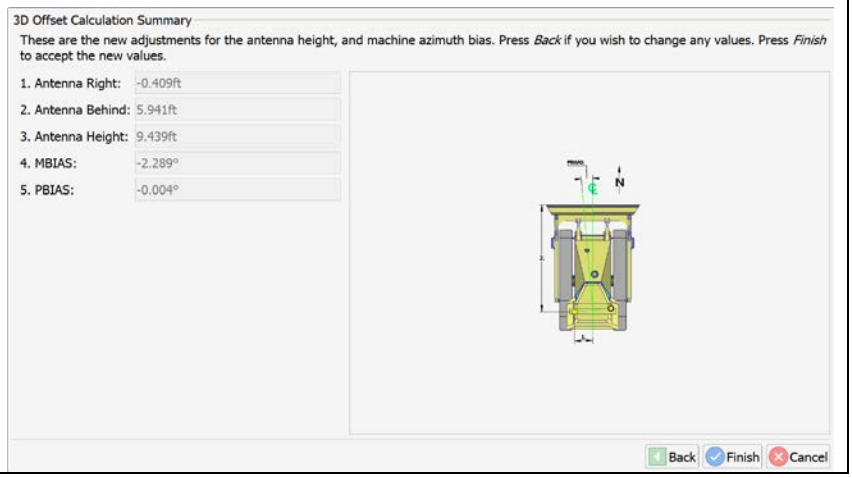
Step	Action
19	Return to the GradeMetrix dozer. Click the **3D Calibration** icon in GradeMetrix dozer.
20	Position the machine facing North and click **Record**.

Continued on next page

3D Calibration, Continued

3D Calibration, continued

Table 6-6: SiteMetrix Grade Points (continued)

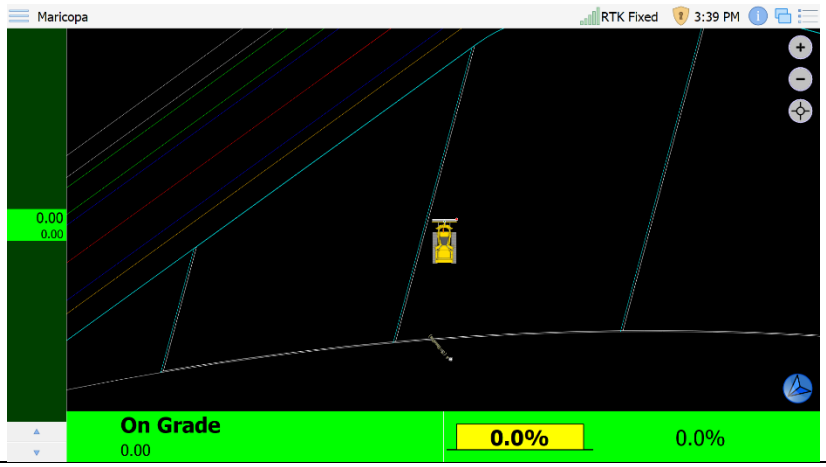
Step	Action
21	A prompt displays to load your file from SiteMetrix Grade. Click **Yes**. 
22	The 3D Calibration Summary displays all of your primary antenna offsets. Click **Finish**. 

Verify Machine Accuracy

Verify machine accuracy

To verify the accuracy of the machine, follow the steps as detailed in Table 6-7: Verify Machine Accuracy.

Table 6-7: Verify Machine Accuracy

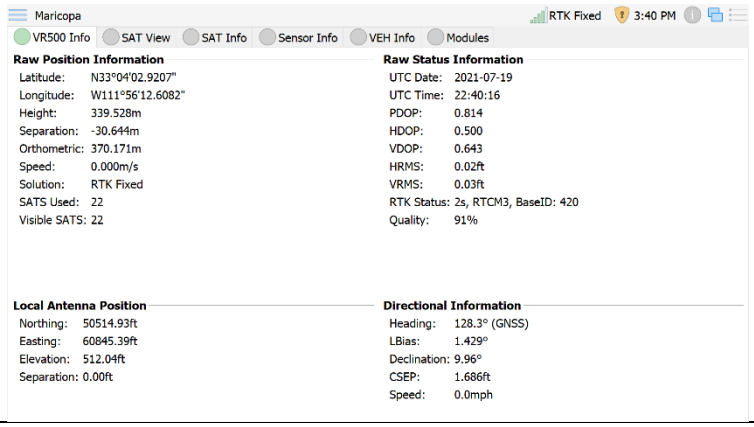
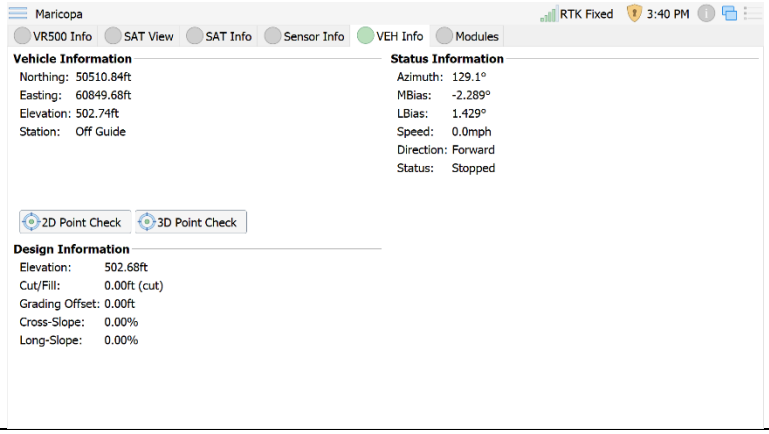
Step	Action
1	From the main operational screen, select the “folder” icon in the upper-right corner of the screen. 

Continued on next page

Verify Machine Accuracy, Continued

Verify machine accuracy, continued

Table 6-7: Verify Machine Accuracy (continued)

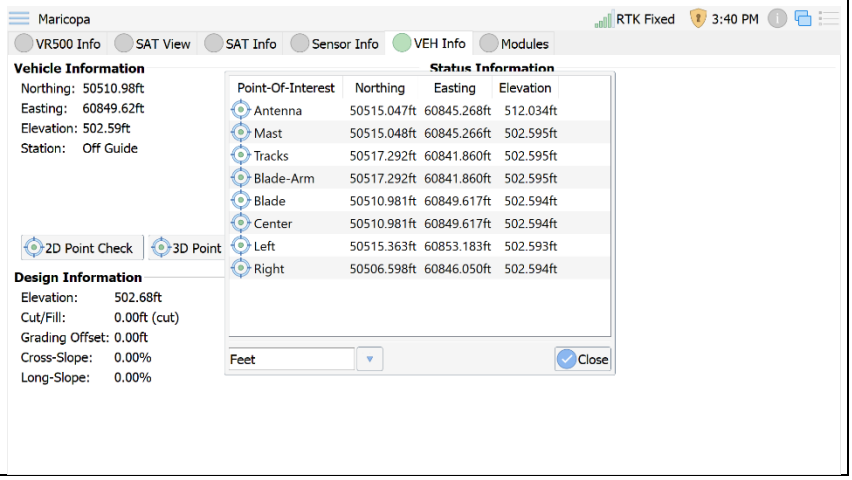
Step	Action
2	Verify you have an RTK Fixed solution before proceeding. 
3	Select the VEH (Vehicle) tab to verify the blade accuracy. 

Continued on next page

Verify Machine Accuracy, Continued

Verify machine accuracy, continued

Table 6-7: Verify Machine Accuracy (continued)

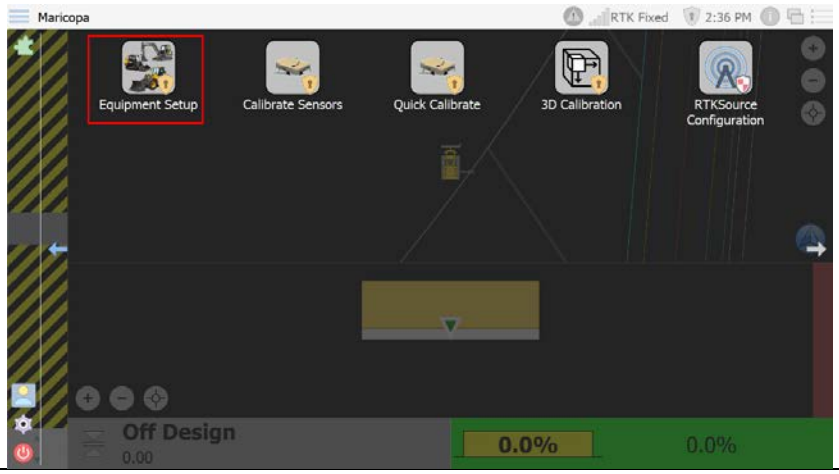
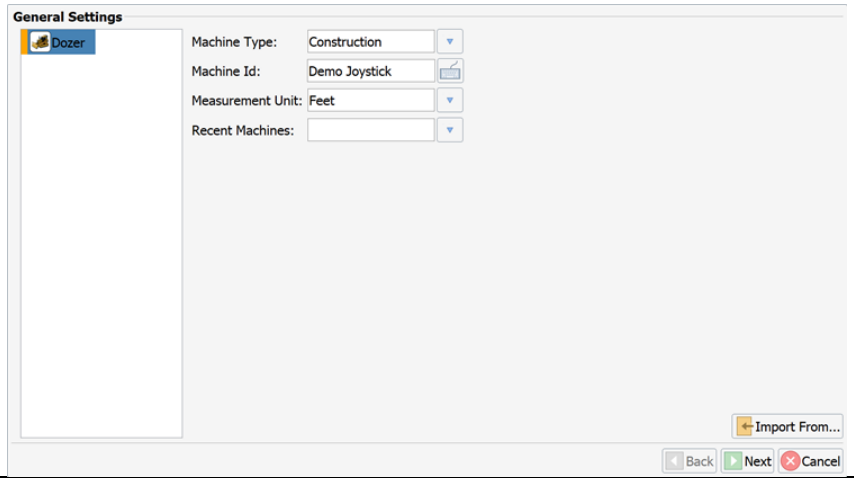
Step	Action
4	Select **3D Point Check** to check the accuracy at multiple locations. Use a rover to verify accuracy at left blade tip, right blade tip, and center blade. 

Save Machine Settings

Save Machine Settings

To save the settings for your machine, use the following steps.

Table 6-8: Save Machine Settings

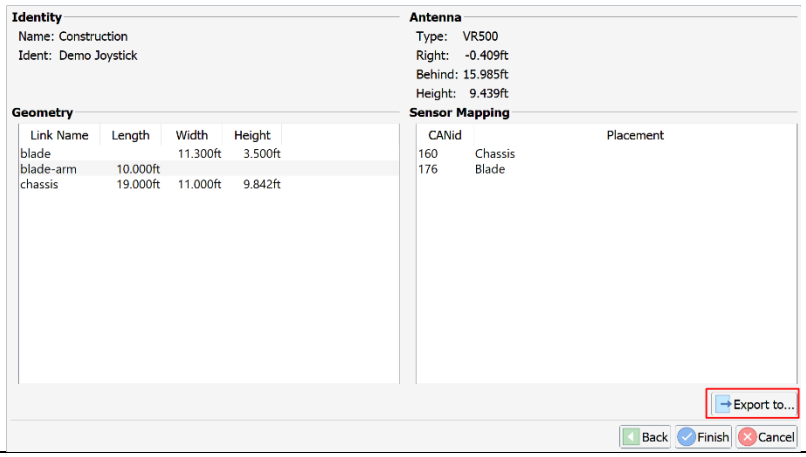
Step	Action
1	To save your machine settings, go to **Equipment Setup**: 
2	Click **Next**. 

Continued on next page

Save Machine Settings, Continued

Save Machine Settings, continued

Table 6-8: Save Machine Settings (continued)

Step	Action
3	Click **Next** until the final screen displays. Click **Export to…** and save the machine settings to a USB thumb drive. 

Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for the dozer installation.

Note: It is important to review each category in detail to eliminate it as a problem.

Contents

Topic	See Page
Troubleshooting	68

Troubleshooting

Troubleshooting

Table A-1: Troubleshooting

Issue	Possible Solution
Incorrect Position	First, check a control point with the machine and the survey rover. If the horizontal or vertical position is off, first consider if it is off by a consistent amount throughout the jobsite, or if the position bust varies throughout the job. If it is consistent, consider the following: • Check your machine measurements/offsets. If any of these are incorrect, your projected position will be off. • Bad localization. Make sure that all points in your localization file have low residuals and/or that the correct coordinate system is selected (this can make a significant difference). If there is an inconsistent position bust, check: • Sensor mounting was incorrectly selected and/or the sensor was not calibrated. This is evident if your position is correct when flat, but not if you are on a slope. • If the position at the GPS antenna is correct, but the position bust worsens as you approach the cutting edge, it may be a heading offset error.
No GPS Position	First, check to see if the VR500 is powered on. There are LED lights underneath the receiver. If the receiver is not powered, disconnect the cable and use a multimeter to verify it is receiving power and ground. Check the monitor screen and sky plots to see if there is any data from the receiver. If there is no data, but the receiver is powered, there could be a bad serial connection / mismatched baud rate.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Issue	Possible Solution
No RTK	1. If using a base station onsite (versus an NTRIP service), first check to verify the base station is turned on. 2. If the base station is turned on and sending RTK out over UHF, check to see if the Tx (or TD on some radios) light is flashing once per second. 3. Verify that the other rovers on the job site are receiving RTK corrections, if available. 4. If it is flashing once per second, check to verify the settings (frequency, bandwidth, forward error corrections, modulation, and protocol) at the base match that of the rover. 5. Check to see if the UHF light at the rover is blinking once per second. If it is, refer to #3. 6. The receiver may be out of UHF range. Consider installing the external UHF antenna (if using a VR500). You may need to install repeaters. See if the RTK corrections work when the machine is closer to the base station. 7. If using NTRIP, check cellular connectivity. One option is to exit GradeMetrix and verify you can go to a website via the browser.
IronTwo Will Not Power On	1. Check to verify the power cable is connected to machine power. The positive should go to a reliable, clean power source and ground to the chassis of the machine. 2. Disconnect the cable and refer to the pinout to see if 12V or 24V (depending on machine) is going into the IronTwo by using a multi-meter. If the multimeter reads 12V or 24V, then power is confirmed, and the IronTwo may need to be serviced. If you do not have any power, then check your power source, ground, and all fuses.

Appendix B: Technical Specifications

Overview

Introduction

Appendix B contains the technical specifications for the VR500 GNSS receiver, the IronTwo control box, and the GMS-1 sensor.

Contents

Topic	See Page
VR500 GNSS Receiver	71
IronTwo	76
GMS-1 Sensor	78

VR500 GNSS Receiver

VR500 Receiver

Table B-1: VR500 Receiver

Item	Specification
Receiver type	GPS, GLONASS, BeiDou, Galileo and RTK with carrier phase and L-band dual antenna
Channels	744
Satellites	12 L1CA GPS 12 L1P GPS 12 L2P GPS 12 L2C GPS 15 L5 GPS 12 G1 GLONASS 12 G2 GLONASS 12 G3 GLONASS 22 B1 BeiDou 22 B2 BeiDou 14 B3 BeiDou 12 Galileo E1 12 Galileo E5a 12 Galileo E5b 3 SBAS or 3 additional L1CA GPS 2 L-band
Primary antenna	GPS L1,L1P,L2C,L2P,L5 GLONASS G1,G2,Pcode BeiDou B1,B2,B3 Galileo E1,E5a,E5b L-band

Continued on next page

VR500 GNSS Receiver, Continued

VR500 Receiver (continued)

Table B-1: VR500 Receiver (continued)

Item	Specification
Secondary antenna	GPS L1,L1P,L2C,L2P GLONASS G1,G2 BeiDou B1,B2 Galileo E1,E5b, L-band
GPS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, and 20 Hz available
Horizontal accuracy	<table><tr><th></th><th>RMS (67%)</th><th>2DMRS (95%)</th></tr><tr><td>RTK[1,2]</td><td>8 mm + 1 ppm</td><td>15 mm +2 ppm</td></tr><tr><td>Atlas®</td><td>0.04 m</td><td>0.08 m</td></tr><tr><td>SBAS (WAAS)[1]</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA[1]</td><td>1.2 m</td><td>2.4 m</td></tr></table>
Heading accuracy	0.27° RMS
Pitch/roll accuracy	< 1° RMS
ROT	145°/s maximum
Timing (PPS) accuracy	20 ns
Cold start time	< 60 s typical (no almanac or RTC)
Warm start time	< 30 s typical (almanac and RTC)
Hot start time	< 10 s (almanac, RTC, and position)
Maximum speed	1,850 km/h (999 kts)
Maximum altitude	18,288 m (60,000 ft)
Differential options	SBAS, Autonomous, External RTCM v2.3,RTK v3, L-band (Atlas), and DGPS
Antenna LNA gain input	10 to 40 dB

Continued on next page

VR500 GNSS Receiver, Continued

VR500 Communi-cation

Table B2: Communication

Item	Specification
Serial ports	3x full-duplex UART's 2x 3.3V CMOS 1x RS-232
CAN	2 CAN ports NMEA2000, ISO-11783
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, CAN, Hemisphere GNSS binary
Correction I/O protocol	Hemisphere GNSS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+3, and Atlas
Timing output	PPS CMOS, active high, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ 10 pF load
Ethernet	1x 10/100 base-T

VR500 Power

Table B-3: Power

Item	Specification
Input voltage	9-32 VDC
Power consumption	10.8W Maximum (All signals and L-band)
Current consumption	1.2A Maximum

Continued on next page

VR500 GNSS Receiver, Continued

VR500 Environmental

Table B-4: VR500 Environmental

Item	Specification
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration	50Gs, 11ms half sine pulse, 10 shocks in each direction and axis, total 60 shocks Operational IEC 60068-2-29 MIL-STD-810G **Vibration Sine:** 30.6 Grms MIL-STD-810G SAE J1211 ISO 16750-3:2007 **Vibration Random:**5.96Grms IEC 60068-2-64 MIL-STD-202F
EMC[4]	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

VR500 Mechanical

Table B-5: Mechanical

Item	Specification
Dimensions	68.6 L x 22 W x 12.3 H cm
Weight	3.9 kg
Status indication	Power, GNSS, Heading, Radio
Power/Data connector	22-pin environmentally sealed

Continued on next page

VR500 GNSS Receiver, Continued

VR500 L-band sensor

Table B-6: VR500 L-band sensor

Item	Specification
Receiver type	Single Channel
Channels	1525 to 1560 MHz
Sensitivity	140 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and Automatic
Reacquisition time	15 seconds (typical)

VR500 aiding device

Table B-7: VR aiding device

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 3° heading for periods up to 3 minutes when loss of GPS has occurred.[3]
Tilt sensor	Provide pitch and roll data and assist in fast startup and reacquisition of heading solution.

VR500 footnote references

[1]Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity.
[2]Depends also on baseline length.
[3]Under static conditions.

IronTwo

IronTwo system

Table B-8: System

Item	Specification
Processor	Intel® Celeron N3350
Storage	SSD 64GB, RAM 4GB
Operating System	Windows 10

IronTwo mechanical

Table B-9: Mechanical

Item	Specification
Dimensions	263.28 W x 171 H x 35.7 D (mm) 10.4 W x 6.7 H x 1.4 D (in)
Weight	1.38 kg (3.04 lbs)
Mount	Adjustable 1.5” RAM ball mount

IronTwo environmental

Table B-10: Environmental

Item	Specification
Operating Temperature	-20°C to +60°C (-4°F to 140°F)
Operating Humidity	30% ~ 90% (non-condensing)
Enclosure	IP65

Continued on next page

IronTwo, Continued

IronTwo power

Table B-11: Power

Item	Specification
Input Voltage	9 - 36 VDC

IronTwo screen

Table B-12: Screen

Item	Specification
Display Type	10.1” TFT edge-to-edge projective capacitive multi-touch screen
Size	192.8 mm × 116.9 mm (7.59” × 4.6”)
Resolution	1920 × 1200, 800:1
Luminance	700 cd/m

IronTwo communication

Table B-13: Communication

Item	Specification
Serial Port	2 x RS232
CANBUS	2 × CANBUS
USB	2 × USB 2.0
Ethernet	2x 10/100 LAN
Wi-Fi	IEEE 802.11a/b/g/n/ac
Cellular	4G LTE
Bluetooth	Bluetooth 4.1

GMS-1 Sensor

GMS-1 sensor measurement range

Table B-14: Measurement range

Item	Specification
Pitch	± 180°
Roll	± 85°

GMS-1 sensor accuracy

Table B-15: Sensor accuracy

Item	Specification
Absolute Accuracy	±0.30°
Resolution	±0.01°
Repeatability	±0.05°
Refresh Rate	20 Hz
Base Sensor Cycle	5ms
Hysteresis	±0.05°

GMS-1 sensor electrical

Table B-16: Electrical

Item	Specification
Supply Voltage	9 – 30 VDC
Current	≤ 65mA @ 10 VDC
EMC Emittance	DIN EN 61000-6-4
EMC Immunity	DIN EN 61000-6-2

Continued on next page

GMS-1 Sensor, Continued

GMS-1 sensor pin-outs

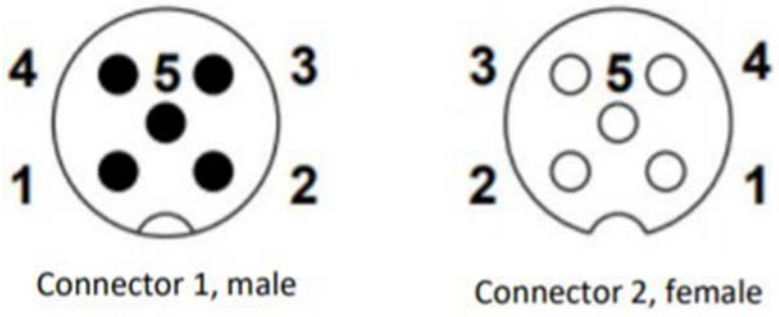


Figure B-1: GMS-1 Sensor pin-out

Table B-17: GMS-1 Sensor pin-out

Signal	Connector	Pin Number
Power Supply	Connector 1	2
GND	Connector 1	3
CAN High	Connector 1	4
CAN Low	Connector 1	5
CAN GND	Connector 1	1
Power Supply	Connector 2	2
GND	Connector 2	3
CAN High	Connector 2	4
CAN Low	Connector 2	5
CAN GND	Connector 2	1

Appendix C: Cable Pin-Outs

Overview

Introduction

Appendix C contains the cable pin-outs used for installation of the VR500 and IronTwo.

Contents

Topic	See Page
Part Number 051-0426-10	81
Part Number 051-0406-10	83
Part Number 051-0407-10	84
VR500 Installation Schematic	85
Index	87

Part Number 051-0426-10

P/N: 051-0426-10

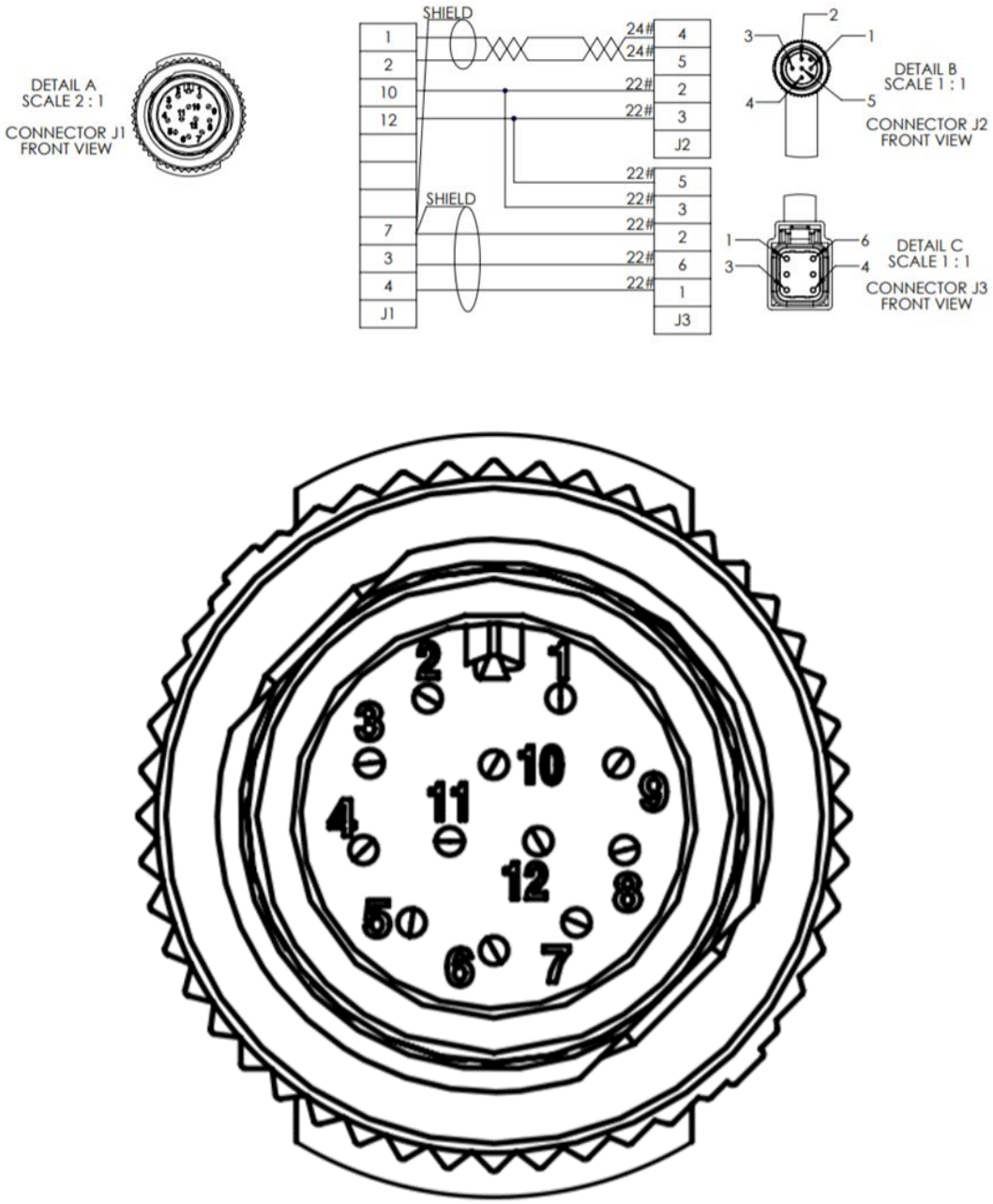


Figure C-1: Part Number: 051-0426-10

Continued on next page

Part Number 051-0426-10, Continued

P/N: 051-0426-10, continued

Table C-1: Part Number 051-0426-10 Pin-Outs

J1	J2	J3	Signal
1	4		CAN High
2	5		CAN Low
3		6	IronTwo RS232 Rx
4		1	IronTwo RS232 Tx
5		2	
6			
7		2	Signal Ground
8			
9			
10	2	3	12V+ Out
11			
12	3	5	Power Ground

Part Number 051-0406-10

P/N: 051-0406-10

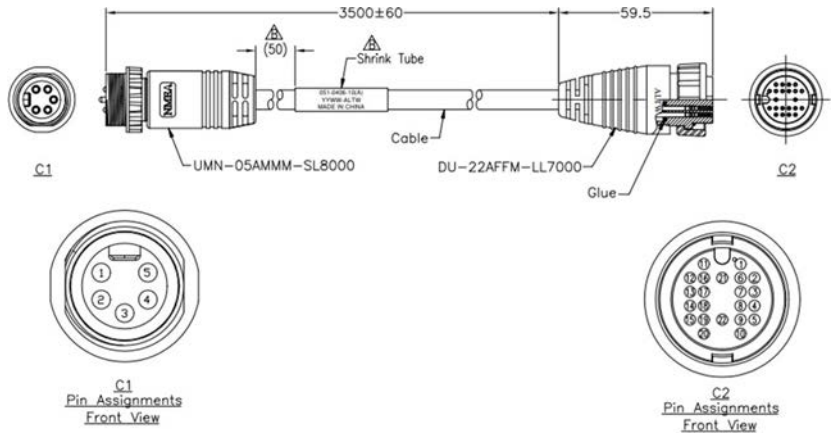


Figure C-2: Part Number: 051-0406-10

Table C-2: Part Number: 051-0406-10 Pin-Outs

C1	C2	Signal
1	21	Power+
2	12	VR500 Port A RS232 Tx
3	11	VR500 Port A RS232 Rx
4	22	Power-
5	13	Signal Ground

Part Number 051-0407-10

P/N: 051-0407-10

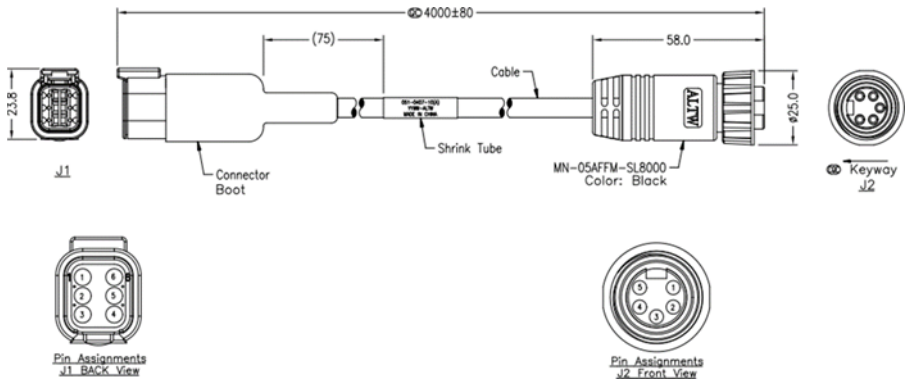


Figure C-3: Part Number: 051-0407-10

Table C-3: Part Number: 051-0407-10 Pin-Outs

J1	J2	Signal
1	3	VR500 Port A RS232 Rx
2	5	Signal Ground
3	1	Power-
4		
5	4	Power+
6	2	VR500 Port A RS232 Tx

VR500 Installation Schematic

VR500 Installation Schematic

Table C-4: Excavator Schematic-R232 and Power, IronTwo -VR500

051-0426-10 J1	051-0426-10 J3	051-0407-10 J1	051-0407-10 J2	051-0406-10 J2	Signal
1					CAN High
2					CAN Low
3	6	6	2	12	IronTwo RS232 Rx/VR500 Tx
4	1	1	3	11	IronTwo RS232 Tx/V500 Rx
5					
6					
7	2	2	5	13	Signal Ground
8					
9					
10	3	3	1	21	12V+ Out
11					
12	3	5	4	22	Power Ground

Index

Body sensor 17
Boom sensor 17
Firmware 15
GradeMetrix 6, 8
installation 6, 8, 9
IronTwo 9
Message interface 17
RAM 76
VR1000 ..... 70, 71

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End User license agreement, continued

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End User License Agreement, Continued

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21. **EXPORT RESTRICTIONS**. Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.
22. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.
23. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.
24. **FORUM FOR DISPUTES**. The parties agree that the courts located in Calgary, Alberta, Canada and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Hemisphere concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.
25. **APPLICABLE LAW**. This Agreement shall be governed by the laws of the Province of Alberta, Canada, exclusive of any of its choice of law and conflicts of law jurisprudence.
26. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.

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