



# Machine Control Buyers Guide



## Why?

Why invest in machine control and site positioning technology? These technologies will improve machine productivity, reduce rework and maintain better quantity variance. These benefits are wholly dependent on the quality of the information and setup that is provided. This guide outlines the consideration that need to be made prior to embarking on the journey that is Machine Control.

## Precision

What accuracy can I expect? The rule of thumb is as follows:

**Most Accurate:** Universal Total Station (UTS) = 1/8"

**Very Accurate:** Rotation Laser = 1/4"

**Accurate:** GPS/GNSS = .1'

All of these accuracies are relative to the setup conditions and calibrations associated with the equipment.

## Satellites

GNSS receivers work from the ability to receive information from satellites orbiting the earth. There are many different satellite constellations that are essential to achieving high-performance GNSS solutions.

The newest GNSS receivers are capable of receiving all signals on all bands from the available constellations. The benefit of this is it allows for receivers to maintain high accuracy in locations (tree canopy, next to buildings, etc.) that previously wasn't possible.

GNSS USA/Glonass Russia/QZSS Japan/Galileo EU/BeiDou China

Make sure you understand what satellites your receivers are activated to use, and are capable of utilizing.

## Data Prep

You'll hear it referred to as a file, or a model, or a design. Really what it is an electronic representation of the project plan set that is properly formatted to work efficiently with the machine control system.

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Understanding Data files and choosing the right person to do your data prep is probably the most critical part of creating a successful technology program

There are a lot of very reputable companies who can perform data prep services, interview and look for recommendations or as for references before beginning to work with someone.

Communication will need to be made with the engineer or designer of the project. They can provide CAD files and a full PDF plan set for the file builder to reference.

### **Common File Types:**

.dxf/.dwg/.xml

Each Machine Control Manufacturer uses specific file types, but every machine control model consists of these components:

- Design Surface + Linework + Calibration = Project File
- Design Surface – this is the grading surface file and is typically built to finish grade
- Linework – contains 2D and 3D linework for all project features (curb, sanitary, buildings, etc.)
- Calibration – Site Calibration or Localization is a process that aligns the engineer design with the real-world, we'll cover more in the Site Setup section

## **Site Setup**

Every project that utilizes GPS technology will need so degree of site setup and preparation.

To build engineered designs you will need to localize your project that that it can be properly scaled and aligned with the engineered plans.

To do this you will need to a licensed surveyor to set project control points. Ideally you would have a minimum of 5, 3D control points that surround the project and are outside of construction limits.

3D Control Points have a horizontal position (Northing, Easting) and a vertical position (Elevation). Once project control is established you can setup a semi-permeant base location and localize the project for use with machine control.

This process is essential to the accuracy and alignment of your work.



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## Base and Rover

To perform the functions of machine control, site setup and grade verification you will need to utilize a GNSS base and rover.

The primary function of a GNSS base is to receive correction information from satellites and broadcast that information, from a known point, via a radio signal, to the rover and machines.

The primary function of the rover is to serve as a layout and checking tool. The rover receives radio signal from the base and provides a high accuracy position that allows it to set grade stakes and verify grades.

## Correction Sources

**Radio** - Most common sources. There are primarily two types of radios; 900mhz (Spread Spectrum) and 450mhz (UHF). Both 450mhz and 900mhz are forms of ultra high frequency bands, but 450mhz is often referred to as just UHF. UHF radios provide longer range signals, but are more susceptible to interference. Also, certain settings can require an FCC license to operate. UHF radio settings are universal and make working across different manufacturers possible.

900mhz is much less complicated to use, but is manufacturer specific. Each brand will not communicate with another brands radio. These radios also typically have less range, but are not susceptible to interference.

**3rd-Party** there are several options of 3rd-Party radios that allow interoperability between manufacturers, but with additional setup and cost

**Cellular/IBSS** - This is gaining popularity as state and private networks are developed. VRS (Virtual Reference Stations) use a series of base stations to create a large area of coverage over a given area that broadcast the corrections via cellular signal. This allows you to run multiple jobs without the need of a local base station for each job. IBSS is using a base station to broadcast corrections over the internet. This is especially useful on linear jobs that have obstructions to radio signals. The VRS networks are growing quickly and are usually a subscription based service per each GPS unit.

**L-Band** - these signals was satellite-based signals and do not require to use of a reference station. They have been very common in agricultural for a long time, but are starting to gain acceptance in construction as the accuracy of the services increase. These are typically subscription-based services depending on the level of desired accuracy.

*Examples:* Hemisphere Atlas and Trimble Centerpoint RTX

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# Machines

Once all the above criteria is understood and met you can then focus on the machine technology.

## 2D Vs. 3D

What type of machine control or guidance do I need? Typically you hear it referred to as 2D or 3D.

2D is going to consist of a depth and slope style system that gets an elevation reference from a bench location or a rotating laser. These systems do not know where you are at relative to a project, but can provide indicate or automatic controls for building pads, slopes or digging to a desired depth.

*Examples:*

- IDig 2D Touch
- Trimble GCSFlex
- Futturra EconGrade

3D is more commonly called GPS or GNSS (Global Navigation Satellite Systems). GPS systems are typically built upon the components of a 2D system but also require the use of high precision GNSS receivers that utilize RTK (Real-Time Kinematic) corrections via a Base Station or Cellular VRS (Virtual Reference Station). Most of these systems are also capable of getting corrections from Robotic Total Stations for work in high precision or poor-quality GPS areas.

*Examples:*

- Hemisphere GradeMetrix
- Trimble GCS900

# Aftermarket Vs. Integrated

Most every OEM is developing integrated technology or partnering with Aftermarket providers to deliver factory fit options with integrated components and manufacturers warranties and support. There are many factors to consider when considering an aftermarket system vs. An integrated system. The guide serves as a good starting point but be sure to ask lots of questions when considering a machine control purchase.

**Aftermarket** – systems provided by manufacturers other than the machine's OEM. These systems are more versatile and can usually fit a large variety of machine sizes and configurations.

*Examples:* Trimble, Topcon, Leica, Hemipshere, Carlson, iDig

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**Integrated** – systems usually consist of a combination of components from the OEM and some After-market suppliers. These systems are purpose built per machine size and model and cannot move easily, or at all, from machine to machine.

*Examples:* CAT Grade Control, Komatsu iMC, John Deere SmartGrade

Many of the factory fitments vary in function and ability and are very commonly misunderstood by both the customer and the dealer who supports it.

If there is a large disparity between systems and machine pricing it critical to make sure you are properly comparing the systems functions and abilities.

## GPS “Ready” Machines

Many of the Tier IV interim and newer machines have a sort of GPS “Ready” fitment. Usually this is available on machines that have electric-over-hydraulic control valve. Different manufacturers have different fitments that are designed to work with specific aftermarket systems. These fitments can be worth thousands of dollars of saved parts and labor on an aftermarket GPS installation. Below are a few of the most common.

**CAT ARO** – ARO is Attachment Ready Option. This means the machine has the ability to, and many necessary components to easily install a Trimble GCS or Earthworks system.

**Komatsu Plug and Play** – Topcon Plug and Play kits were installed on Komatsu D65-17 and D61-23 dozers. This contained all the wiring and brackets necessary to install a Topcon 3DMC system. Only a small finishing kit was needed to complete the installation.

**John Deere IGC** – IGC machines have necessary CAN connections to allow for aftermarket installation of Trimble and Topcon.

There are so many different combinations and options when it comes to integrated vs. Aftermarket. If you ever have questions or need a second opinion please reach out and contact us we will be glad to give you our assement.



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# Training

The most important part of any GPS machine control purchase, setup and operation is the process. If there is no proper process established prior to beginning utilizing GPS machine control you will not be able to achieve the full potential of your investment.

So, when you are negotiating on a base & rover, integrated machine, aftermarket, or even file work makes sure you are asking your sales or support rep to include all necessary start-up training and that there is a full agreement of what products, services and follow up support is included in your purchase.

All of the products in the market today produce very good results when they are properly setup and utilized, make sure you are selecting a Construction Technology Partner that will support your company's needs as they grow and change.



## YouTube

<https://www.youtube.com/channel/UCB7gt4LVI3NbskLeUsI8SDQ>



## Podcast

<https://marketscale.com/industries/engineering-and-construction/how-technology-drives-roi-for-construction-companies/>



## Tech Talks

<https://www.conexpoconagg.com/techtalks>



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