CapstanAG™

Synchro™

Spray Application

Operator Manual

113100-596 Rev. B | Revised 01/2024 |

Thank you for your business!

At CapstanAG, our goal is to redefine the way people do their chemical application. Our PWM control systems have been setting the bar for maximum productivity for more than 20 years. Our focus on performance, support, and education have dramatically changed the landscape of agricultural chemical application.

CapstanAG specializes in creating proprietary systems for the agricultural industry, primarily focusing on chemical and fertilizer applications. Our inventive process involves research, engineering, design, and lab and field testing.

Service Contact Information

If a problem occurs with your system that cannot be corrected with the information in this manual, please contact your dealer for service and technical assistance. If further assistance is needed, contact CapstanAG.

System Purchased: _____

Dealer: _____

Contact: _____

Phone: _____

Address: _____

City,State/Province, Zip: _____

Factory Service/Repairs

CapstanAG

4225 S.W. Kirklawn Ave. | Topeka, KS 66609

Hours: 8:00 a.m. to 4:00 p.m. CST

Toll-free number: (855) 628-7722 | Fax: (785) 232-7799

CapstanAG.com | CapstanAG.ca

prodsupport@capstanag.com

Contents

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Chapter 1: Safety

Topics:

Signal Words

DANGER: Indicates an imminent hazard which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations, typically for aircraft components that, for functional purposes, cannot be guarded.

WARNING: Indicates a potential hazard which, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.

CAUTION: Indicates a potential hazard which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

IMPORTANT: This is used to draw attention to specific information that is necessary for the operation, setup, or service of the system.

Note: This is used for additional information that can help understand or operate the system.

Safety Signs

Figure 1: Safety Sign Example

The HCS aligned its provisions with the United Nations' Globally Harmonized System (GHS) Classification and Labeling of Chemicals in 2012. This is a GHS safety label example for a chemical hazard.

These labels and safety messages warn all personnel about hazardous chemicals or potentially unsafe chemical conditions that may exist while working around agricultural application equipment.

CapstanAG add-on application systems for OEM and retrofit agricultural application equipment (booms and toolbars) may contain HCS pictographs and GHS safety labels and safety signal word messages.

Pressurized Fluid Lines

Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when too much heat is present.

Personal Protective Equipment

Wear close-fitting clothing and the correct personal protective equipment (PPE) for the job. Refer to the specific chemical manufacturer documentation or other information for correct PPE.

Battery Safety

Use the procedure in the appropriate agricultural equipment manual for connecting, disconnecting, and jump-starting the machine's battery.

Keep sparks and flames away from the battery. Battery gas can explode and cause serious injury. Do not smoke in the battery charging area.

Remove jewelry, which might make electrical contact and create sparks.

Chemical Safety

Chemicals used in agricultural applications can be harmful to your health and/or the environment if not used correctly. Always follow all label directions for effective, safe, and legal use of agricultural chemicals.

Emergency Safety

Fire extinguishing systems must meet the applicable OSHA requirements, and all users of portable/ fixed fire suppression equipment must know the types, limitations, and proper uses of this equipment; including hazards involved with incipient stage firefighting.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Know the location of fire extinguishers and first aid kits and how to use them.

Examine the fire extinguisher and service the fire extinguisher regularly.

Follow the recommendations on the instructions plate.

Very small fires can be put out (extinguished) with a fire extinguisher. Use an appropriate method to extinguish a fire (water for paper fires, and chemical extinguishers for electrical or chemical fires).

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Chapter 2: Warranty

Topics:

Limited Warranty

What does the Limited Warranty cover?

The ultimate purchaser/user (“you”), by acceptance of seller Capstan Ag Systems, Inc.’s, (“our,” “we,” or “us”) product, assume all risk and liability of the consequences of any use or misuse by you, your employees, or others.

All replacement components furnished under this warranty, but shipped before the failed component is returned for evaluation, will be invoiced in the usual manner and warranty adjustments will be made after the component claimed to be defective has been returned to and inspected and deemed defective by us at our factory.

Upon determining that a component has failed under warranty, the repaired component or replacement component, furnished under this warranty, will be shipped at our expense, to your location. We will credit you an amount equal to the incoming freight you paid. We shall not be responsible for installation costs. (You shall be responsible for all customs and brokerage fees for all international transactions.)

If the component does not prove to be defective, you shall be liable for all freight, inspection, and handling costs. In no event will any claim for labor or incidental or consequential damages be allowed for removing or replacing a defective product. Warranty will be denied on any component which has been subject to misuse, abuse, accidents, or alterations, or to improper or negligent use, maintenance, storage, transportation, and handling.

Our liability under this warranty, or for any loss or damage to the components whether the claim is based on contract or negligence, shall not, in any case, exceed the purchase price of the components and upon the expiration of the warranty period all such liability shall terminate. The foregoing shall constitute your exclusive remedy and our exclusive liability.

The terms of this warranty do not in any way extend to any product which was not manufactured by us or one of our affiliates.

While necessary maintenance or repairs on your CapstanAG product can be performed by any company, we recommend that you use only authorized CapstanAG dealers. Improper or incorrectly performed maintenance or repair voids this warranty.

The foregoing warranty is exclusive and is in lieu of all other warranties expressed or implied. We shall not be liable for any incidental or consequential damages resulting from any breach of warranty.

Your exclusive remedy for breach of warranty shall be repair or replacement of defective component(s): Provided, if the component(s) are incapable of being repaired or replaced, your exclusive remedy shall be credit issued, but such credit shall not exceed the purchase price of the components.

On any claim of any kind, including negligence, our liability for any loss or damage arising out of, or from the design, manufacture, sale, delivery, resale, installation, technical direction of installation, inspection, repair, operation of use of any products shall in no case exceed the purchase price allocable to the components.

In no event, whether as a result of breach of contract or warranty or alleged negligence, shall we be liable for incidental or consequential damages, including, but not limited to: personal injury, loss of profits or revenue, loss of use of equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, environmental damage, crop losses, or claims of customers of you for such damages.

What is the period of coverage?

We warrant to you that our products are free from defects in material and workmanship in normal use and service for a period of one year from date of purchase.

How do you get service?

Our obligation under this warranty shall be limited to the repairing or replacing at our option, the component which our inspection discloses to be defective, free of charge, return freight paid by us, provided you: (i) Notify us of defect within thirty (30) days of failure; (ii) Return the defective component to us, freight prepaid; (iii) Complete the Owner Registration Form and returned it to us; and (iv) Establish that the product has been properly installed, maintained and operated in accordance with our instructions or instructions contained in our operations or maintenance manuals and within the limits of normal usage.

Any claim for breach of our warranty must be in writing addressed to us and must set forth the alleged defect in sufficient detail to permit its easy identification by us. All breach of warranty claims must be made within thirty (30) days after expiration of the warranty period, which is applicable to the defective product. Any breach of warranty claim not timely made will not be honored by us and will be of no force and effect. Any component that needs to be repaired or evaluated for warranty has to be authorized before return. Contact the factory (785-232-4477) to get a Return Materials Authorization (RMA #). This helps to track the part coming into the factory for repair or replacement.

Before returning any component to the factory, clean the component as well as possible to remove any dirt or chemical residue. Components received at the factory that are not clean will be returned and warranty denied.

After receiving your RMA #, package the part, making sure to include the RMA #, customer's name, your address and phone number and description of problems or failure. If the component(s) are not returned to the shipping address below within the thirty (30) day period, no credit will be issued for the part. Ship to:

Capstan Ag Systems, Inc.

Attn: Warranty/Repair

4225 SW Kirklawn Ave.

Topeka, KS 66609

Phone: (785) 232-4477 | Fax: (785) 232-7799

Hours: 8 am to 4:30 pm CST

Once the package is received by us, we have thirty (30) days to process the warranty claim. If the warranty claim is still open after thirty (30) days, the warranty will be accepted, and credit issued to.

How does state law relate to this Limited Warranty?

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.[1]

1 Rev. Date 11/02/2021

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Chapter 3: Introduction

Topics:

This Manual

This manual includes operation, maintenance, and installation information for the system you purchased.

Make sure that all personnel have read this manual and that they thoroughly understand the safe and correct operation and maintenance procedures. Failure to do so could result in personal injury or equipment damage.

This manual should be considered a permanent part of your system and should remain with the system at all times and when you sell it.

Right and left sides of the system are determined by facing the direction of forward travel of the machine on which the system is installed.

The information, screenshots, and other illustrations were correct at the time of publication. Changes can occur without notice.

This manual contains important information on how to safely and correctly install, operate, and maintain CapstanAG products. These instructions will help keep personnel safe, reduce downtime, and increase the reliability and life of the equipment, its components, and related systems.

Review the safety information in the manual(s) from the Original Equipment Manufacturer (OEM).

Follow the instructions (in this manual) and in the OEM manual(s) for each step, to make sure that work conditions in and around the OEM equipment are safe.

It is important for all individuals working with chemicals to understand the potential risks, necessary safety precautions, and proper response in the event of accidental contact.

Review the OEM manual(s) for chemical safety information.

Read, understand, and review the procedures in this manual and OEM manual(s). Use the Safety Data Sheets (SDS) and the required Personal Protective Equipment (PPE) for hazardous chemicals.

Please keep this manual and all enclosed documentation in an accessible location known to all operators, installation, and maintenance personnel.

If you do not understand the CapstanAG equipment after reading this manual, please obtain the proper training before working with equipment, to make sure that your own safety, as well as your coworkers' safety, is maintained.

Do not attempt to operate any equipment or system until you completely understand why, when, and how it operates. If you are uncertain after studying this manual, please contact CapstanAG.

System Identification

Write the system name, serial number, and other information down in the Service Contact Information on the inside cover of this manual. Your dealer will use these numbers when you order parts. File a copy of the identification numbers in a secure place off the machine.

If you are not the original owner of this machine, it is in your interest to contact your local CapstanAG dealer to inform them of this unit's serial number. Providing this information will help CapstanAG notify you of any issues or product improvements.

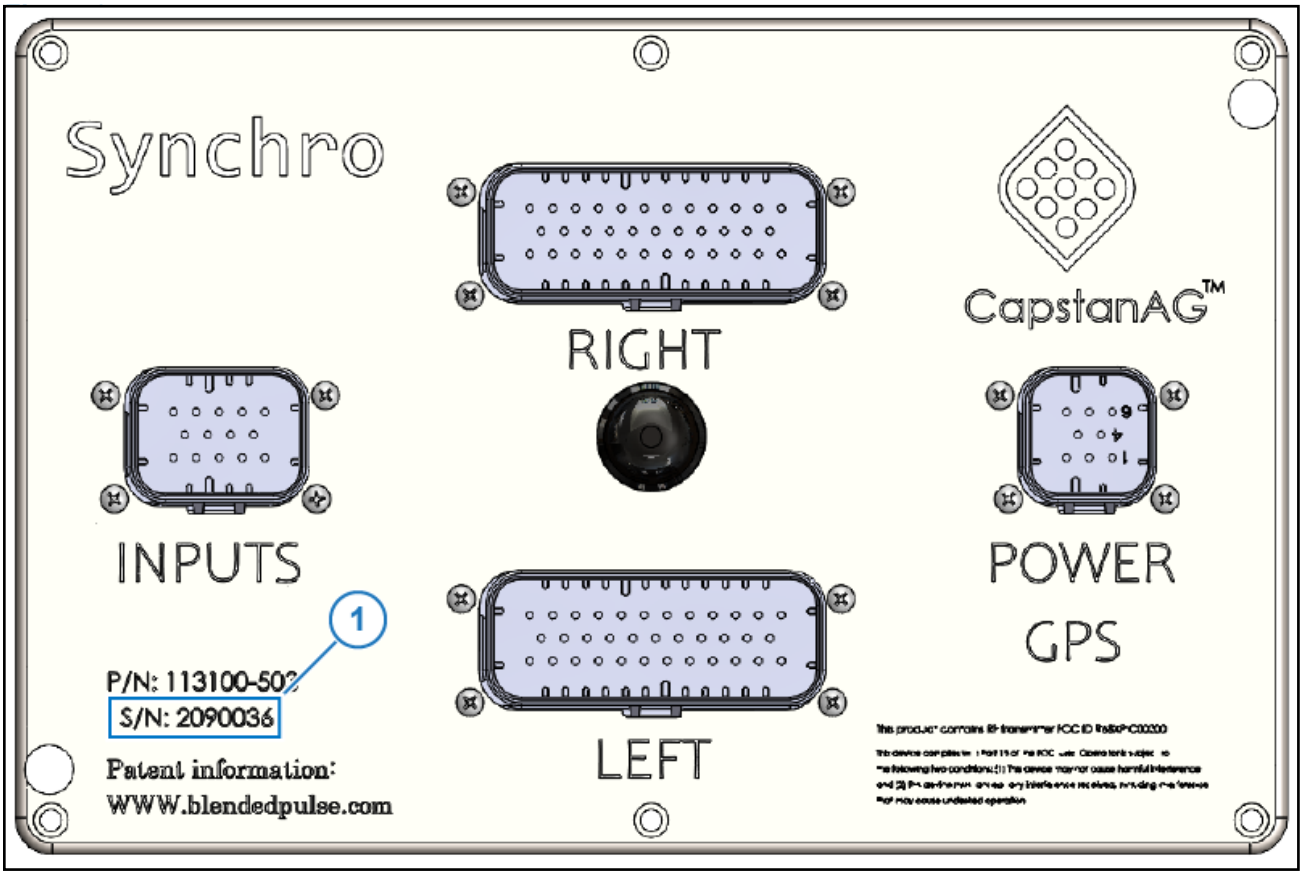

Figure 2: Serial Number

The Synchro™ system serial number is located on the controller (Figure 2, Item 1).

The serial number is used as the name of the controller Wi-Fi network.

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Chapter 4: Installation

Topics:

Clean the Existing System

Before installation of a new system, you must make sure that the existing system is clean of debris and the filtering system is functioning correctly. Flush all plumbing and any inline filters and tips.

For the new system to function correctly, the filter must be 80-mesh or finer.

Note: Debris can cause lodging of the nozzle valves, prevent the system from operating correctly, and damage internal components.

1. Release pressure from the system before servicing.
2. Thoroughly clean the system.

   Avoid high-pressure spray when cleaning the spray system components, valves, and wiring connectors.

Before Installation

CAUTION: Before installation, operation, or service to the system, read and understand the machine's operator manual and the system operator manual. Chemical residue may be present on/in the OEM equipment. Use the correct personal protective equipment.

WARNING: Chemical residues may be present in the agricultural equipment. Always use the proper personal equipment to avoid personal injury.

IMPORTANT: Before installation, make sure that all parts are included in the shipping boxes using the list of parts included in the order.

IMPORTANT: Do not connect the battery harness terminals to the battery until the installation of the system is complete.

IMPORTANT: Do not attach the harnesses with cable ties until the test of the system is complete.

Note: For correct operation, the sprayer must be equipped with a properly functioning Pressure/Flow bypass valve.

This provides the capability to relieve pressure (bypass flow back to tank) as the nozzle valve assemblies close when the operator toggles boom switches to **OFF** position at end of a row.

Nozzle Valve Assembly

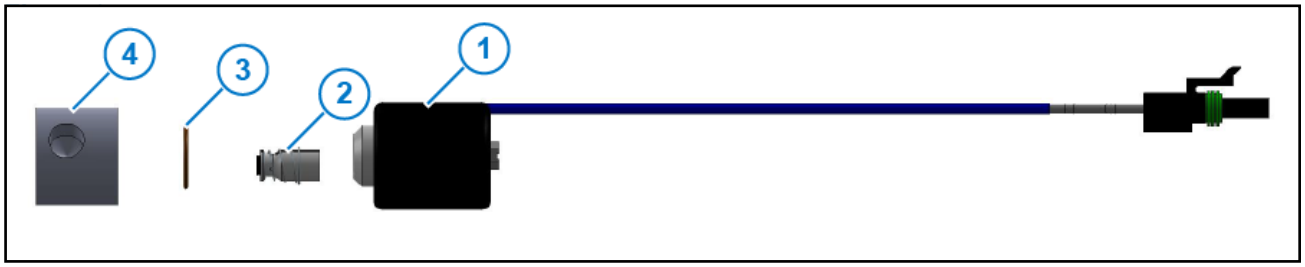

Figure 3: Nozzle Valve Assembly

Table 1: Nozzle Valve Assembly Components

Item	Description	Part Number		Item	Description	Part Number
1	Coil	625147-011		3	O-ring	715022-204
2	Plunger	716009-111		4	Valve Body	621083-001

System Layout

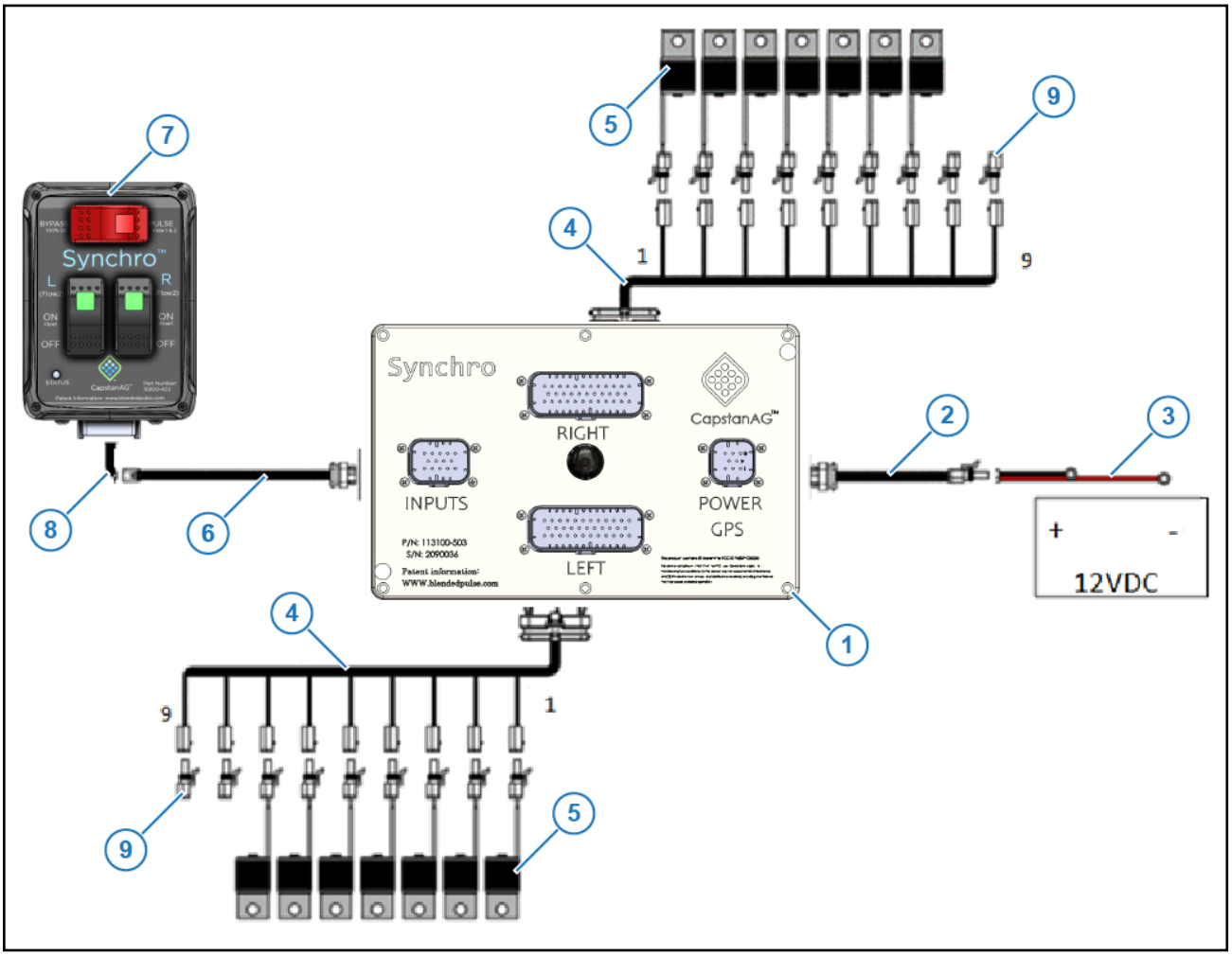

Figure 4: System Layout

Table 2: System Components

Item	Description		Item	Description
1	Control Module		6	Cab Box Harness
2	Power Harness		7	Cab Box
3	Battery Harness		8	Cab Box Extension Harness
4	Valve Harness		9	2-pin WP Tower Dust Plug
5	Valve Assembly			

Install the Valve Assemblies

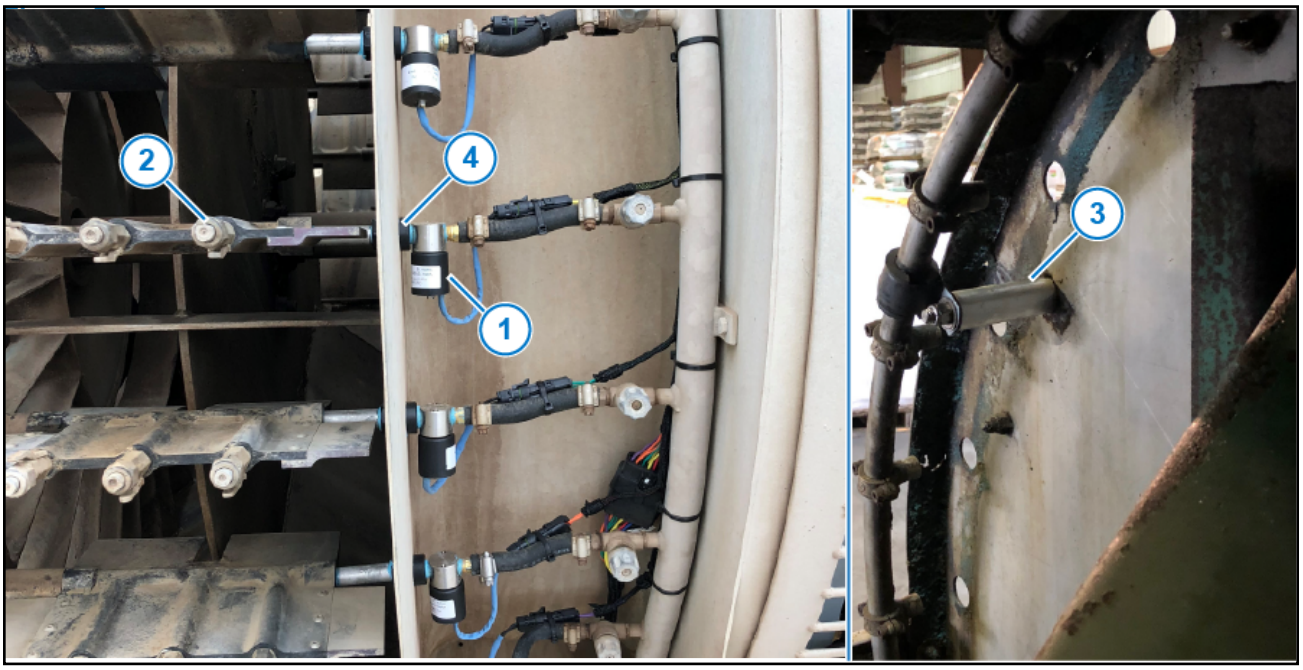

Figure 5: Vavle Assembly Installation

1. Identify the location for the valve assemblies (Figure 5, Item 1).

   The valve assembly location must be as close to the tip (Figure 5, Item 2) as possible without being in the airstream.

   Modifications may be needed to move mounting of manifold in order to insert CapstanAG valves out of the airstream.

   Standoffs (Figure 5, Item 3) may be needed in certain applications to move the boom away from the panel to allow for clearance for CapstanAG valves. This may vary for each make/model of sprayer.

   Note: Make sure that the new mounting location does not require flexible hose between the valve assemblies and the tips. Do not install a valve assembly upstream from a flexible hose.

   Only use rigid plumbing components between the valve assemblies and the tips

   Note: The AOF bushing (PN: 706530-145) shown (Figure 5, Item 4) is an optional purchase from CapstanAG that can be used when installing system on Air-O-Fan make sprayers. Contact your dealer or CapstanAG representative for more information.

   Note: Make sure that you route the harnesses where damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

   Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.

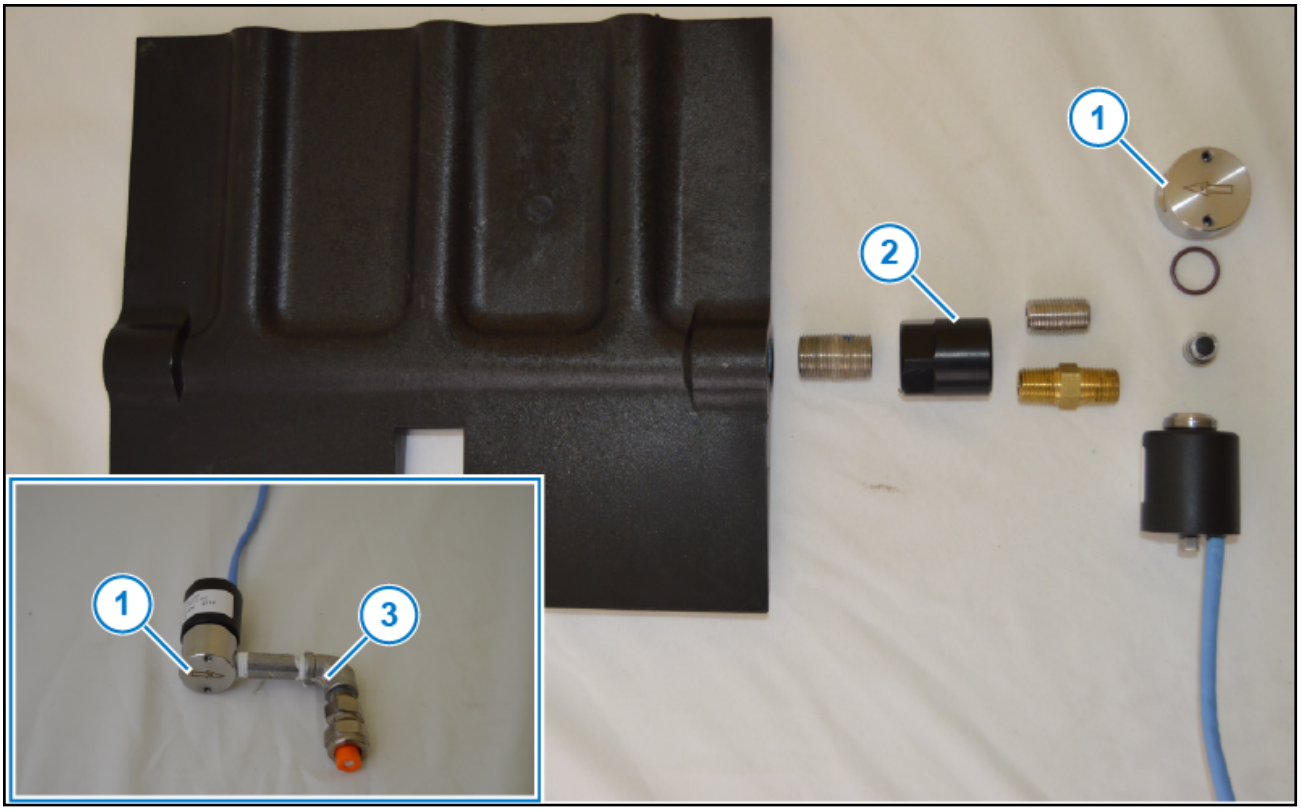

Figure 6: Valve Assembly Orientation

2. Install the valve assemblies between the existing system parts and inline of the fluid distribution system.

   Make sure that the valve assemblies are in the correct orientation—the arrow (Figure 6, Item 1) on the assembly is pointing with the direction of flow.

   Additional fittings may be necessary to connect the parts with the existing system parts.

   Note: Do not install plastic pipe fittings in between of stainless pipe fittings. Only use plastic pipe fittings if your existing system already has plastic pipe fittings.

   Note: Do not install a valve assembly upstream from a flexible hose. Only use rigid plumbing components between the valve assemblies and the tips

   Note: The AOF bushing (PN: 706530-145) shown (Figure 6, Item 2) is an optional purchase from CapstanAG that can be used when installing system on Air-O-Fan make sprayers. Contact your dealer or CapstanAG representative for more information.

   Another example of parts needed is shown (Figure 6, Item 3).

Install the Controller

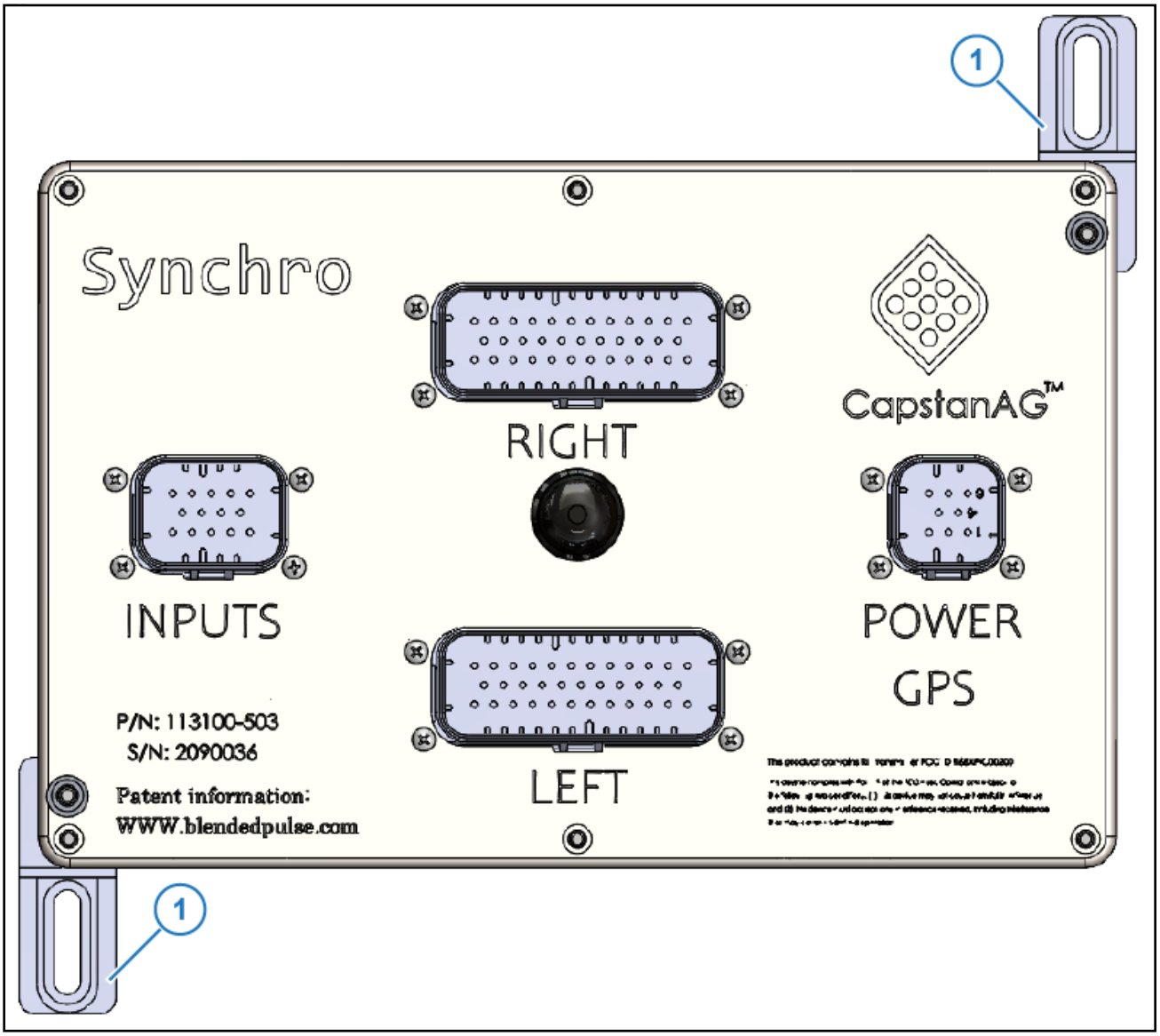

Figure 7: Controller

1. Find a central mounting location for the controller where all of the harnesses will reach. The front of the tank is preferred, if practical.

   The mounting locations must be on a solid surface with minimal vibrations, not in the airstream, and minimal exposure to any chemical spray.

   Make sure that the controller is not installed on an external surface where it can be damaged.

   Note: For improved Wi-Fi, do not install the controller in a contained area.
2. If only the case mounting tabs (Figure 7, Item 1) will be used to mount the controller, use the supplied hardware.
3. Install the controller using the most suitable method.

Install the Cab Box

Figure 8: Cab Box

1. Install the cab box in the cab of the machine, use hardware supplied.
   Make sure that the cab box is within reach of the operator.
2. Connect one end of the cab box harness to the 12-pin connector (Figure 8, Item 1) on the bottom of the cab box.
3. Route the harness to the back of the machine cab.

   Note: Make sure that you route the harnesses where the potential for damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

   Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
4. Find a location to route the harness outside of the cab.
5. Once the harness is outside the cab, continue routing the harness to the controller.

   Make sure to allow for movement at the hitch.

   Place connection point near hitch for ease of unhooking/decoupling sprayer from machine. If necessary, use the optional cab box extension harness.

Note: Make sure that you route the harnesses where the potential for damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.

6. Connect to the 14-pin connector on the controller labelled **INPUT**.

Install the GPS Puck

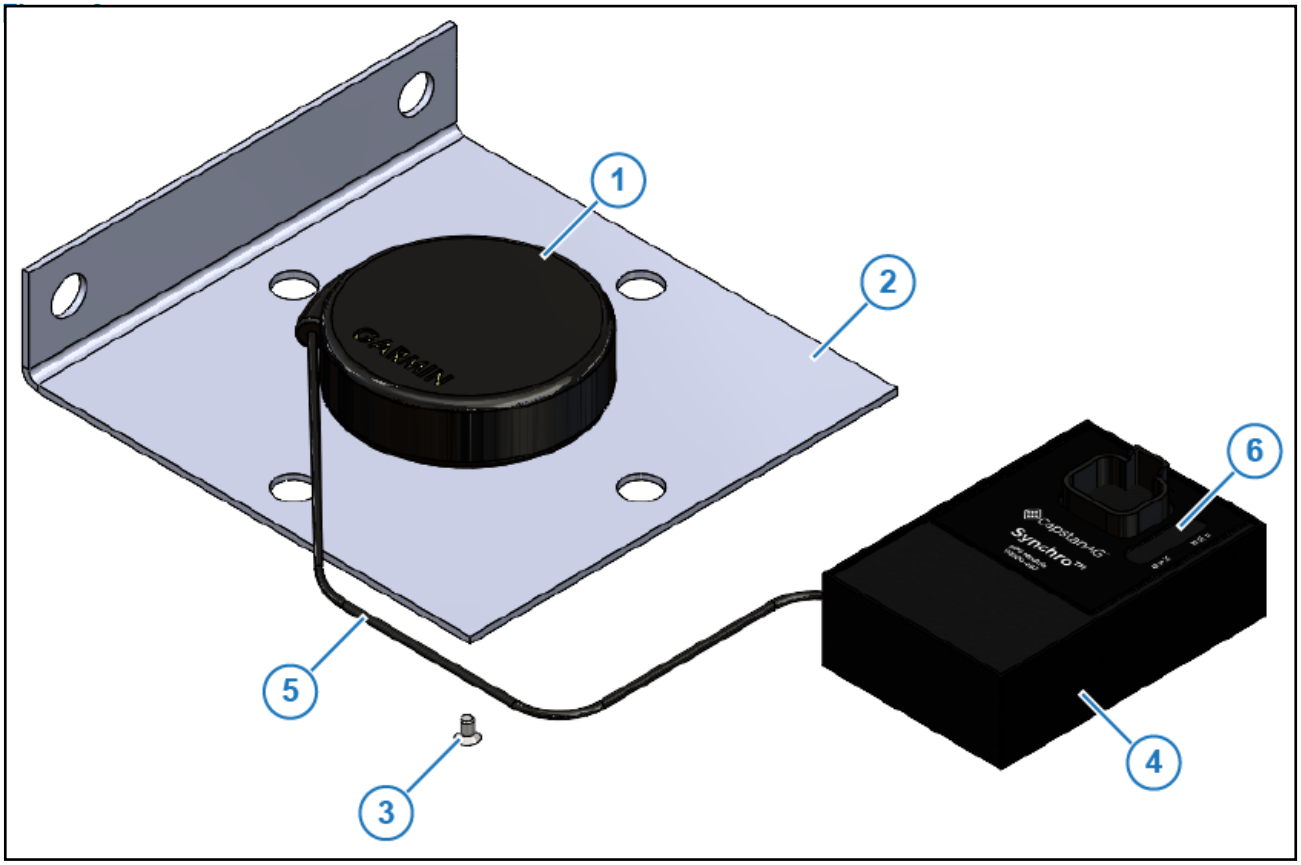

Figure 9: GPS Puck

1. Choose placement of GPS puck (Figure 9, Item 1) for an unobstructed view of sky.
2. Install GPS puck mount plate (PN 113100-419) (Figure 9, Item 2) using the hardware included (Figure 9, Item 3) with puck on top. Or place GPS with magnetic bottom on metal surface.
3. Choose placement of GPS module (Figure 9, Item 4) near controller. Route and secure harness (Figure 9, Item 5) appropriately. The GPS module harness will be connected to the 4-pin GPS drop on the Power harness, near the controller. Secure module with zip ties. Make sure LEDs on module (Figure 9, Item 6) are within view for reference.

Install the Valve Harnesses

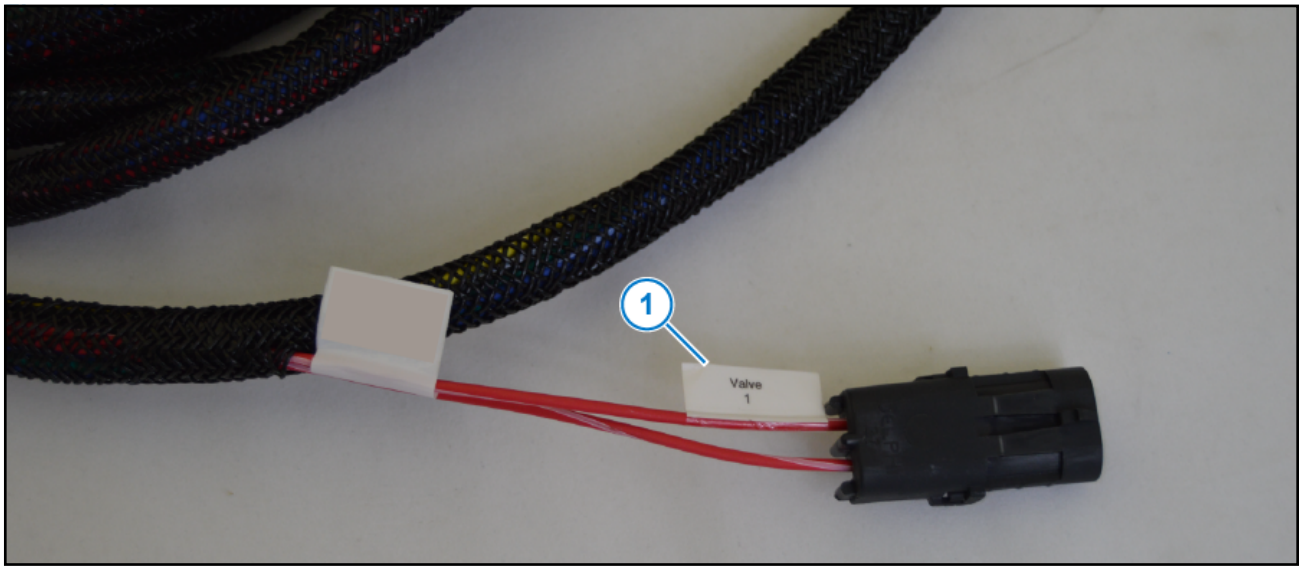

Figure 10: Valve Harness

There are two identical valve harnesses. The left and right side of the sprayer will be symmetrical.

Each harness has a label Valve #1 (Figure 10, Item 1) on the connector for the first valve. Valve #1 will also have a red/white tracer wire color, in case the label is missing.

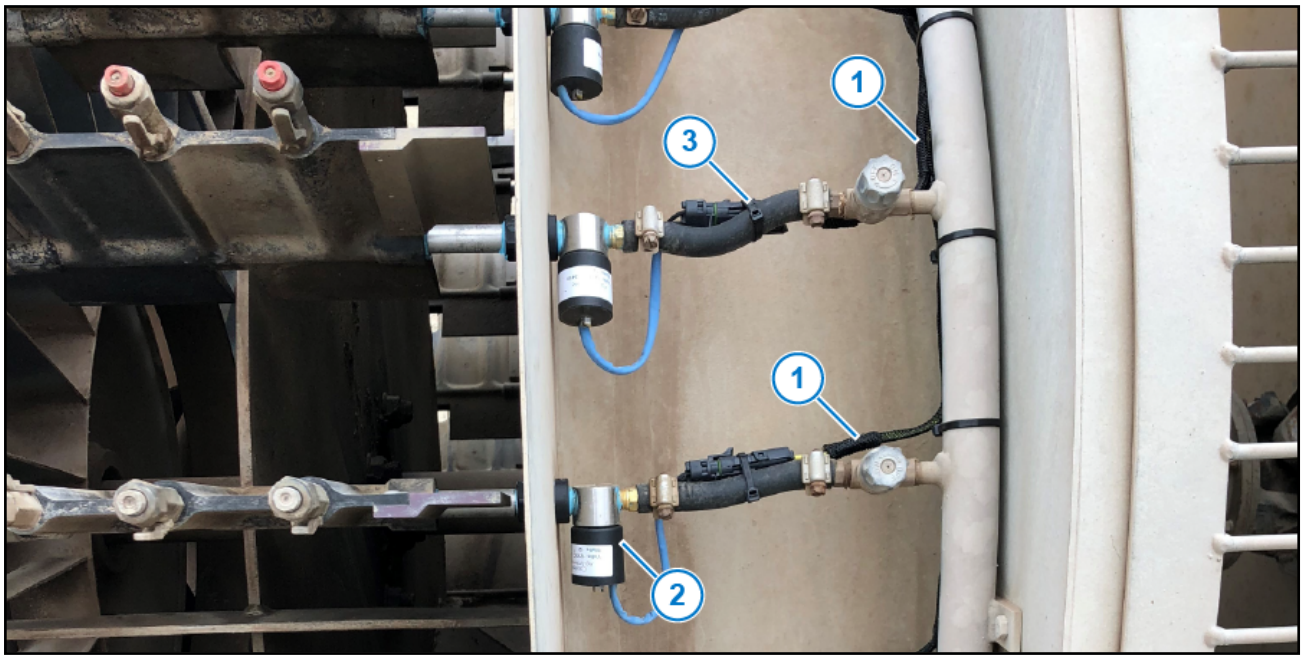

Figure 11: Valve Harness Connections

1. Begin connecting the valve harness (Figure 11, Item 1) to the valves on the sprayer. Connect the valves sequentially.
2. Route the valve harness from Valve 1 around half of the sprayer.

3. Connect each valve (Figure 11, Item 2) sequentially to the harness.
4. If there are unused connectors on the harness, install dust plugs (PN: 116200-045).
5. Continue routing the valve harness to the controller.
6. Repeat steps 1–5 for the opposite side.
7. Plug the 35-pin connector from each harness into the appropriate Left or Right plug on the controller.
8. Plug the 2-pin connector from ONE of the Valve harnesses into the 2-pin connector on the Inputs harness. It does not matter which is used. Install a dust plug in the unused connector.
9. Use the cable ties (Figure 11, Item 3) to attach the harnesses to the machine.

   Note: Make sure that you route the harnesses where the potential for damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

   Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.

Install the Power Harness

Note: This system can only operate on a 12 VDC power supply.

10. Start at the battery, but do not connect the terminals to the battery yet.
11. Route the battery harness toward the controller.

    Note: Make sure that you route the harnesses where the potential for damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

    Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
12. Connect the end of the battery harness with 4-pin connector to the power harness.

    If connecting to a tractor battery, try and place the 4-pin connector near the hitch to allow for easy disconnect.
13. Route the power harness to the controller.

    Important: Make sure that there is enough slack in the harness to avoid pinch points at the hitch.

    Note: Make sure that you route the harnesses where the potential for damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

    Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
14. At the controller, connect the power harness to the 8-pin connector on the controller labelled **POWER**.
15. At the battery, connect the positive (+) red cable to the red power terminal of a 12 VDC battery.
16. Connect the negative (-) black cable to the black ground terminal of a 12 VDC battery.
17. Connect the 4-pin plug on the Power harness to the GPS module.
18. Connect the 2-pin plug on the Power harness to the 2-pin drop on the Inputs harness.

Chapter 5: Setup

Topics:

System Dry Test

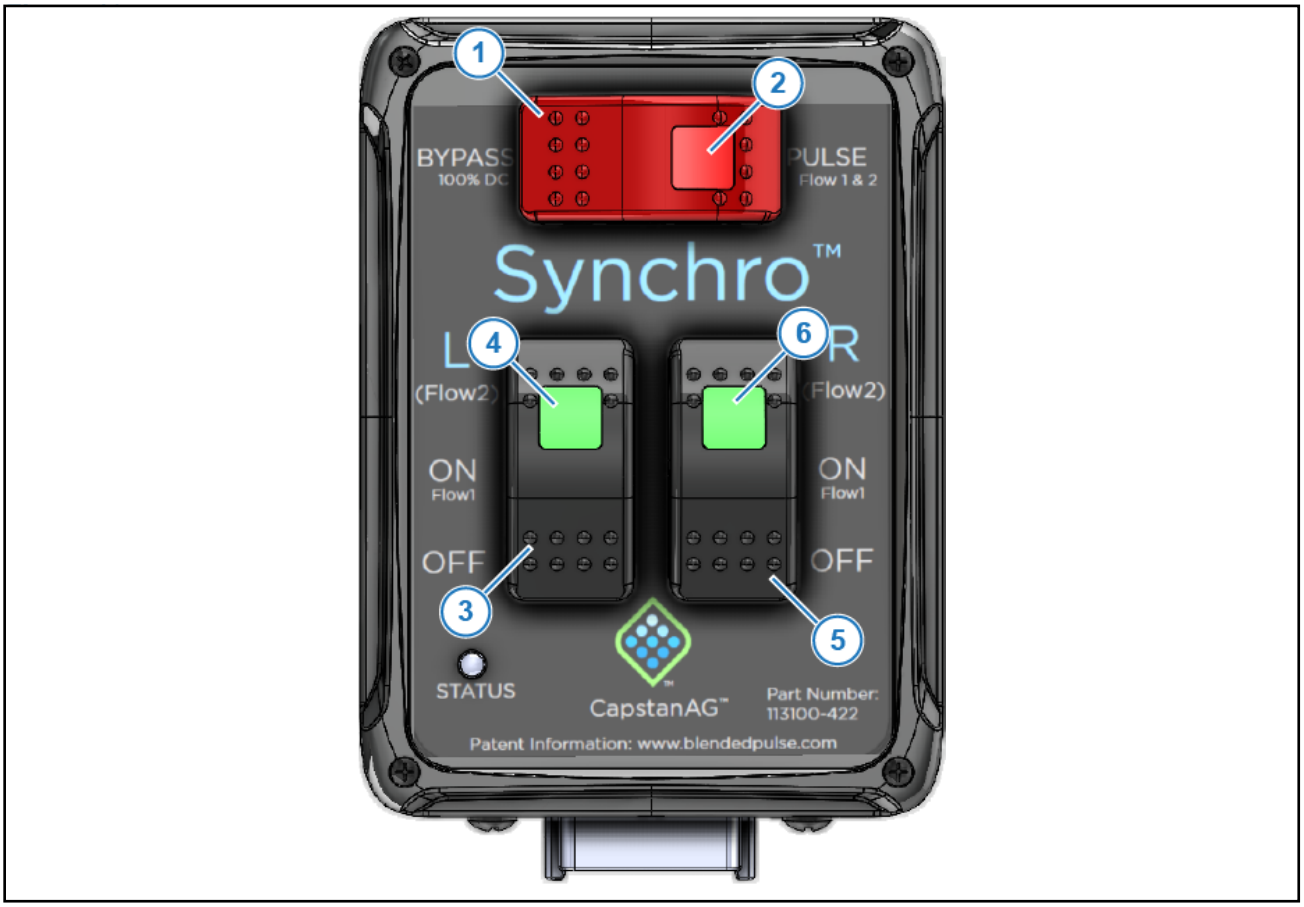

Figure 12: Cab Box Controls

1. Make sure that the sprayer is off.
2. On the cab box, toggle the red **Synchro** switch (Figure 12, Item 1) to **PULSE**.
   The LED (Figure 12, Item 2) in the switch will illuminate.
   The system should come with an active profile from the factory.
3. Toggle the L switch (Figure 12, Item 3) to **ON Flow 1**.
   The LED (Figure 12, Item 4) in the switch will illuminate.
4. Make sure that you can hear the nozzles click on the left side of the machine.
5. Toggle the L switch to **OFF**.
   The LED in the switch will not illuminate.
6. Toggle the R switch (Figure 12, Item 5) to **ON Flow 1**.
   The LED (Figure 12, Item 6) in the switch will illuminate.
7. Make sure that you can hear the nozzles click on the right side of the machine.
8. Toggle the R switch to **OFF**.
   The LED in the switch will not illuminate.
9. Start the system wet test.

System Wet Test

1. Use water to pressurize the system to aproximately 100 psi (Recommended maximum operating pressure is 125psi).
2. On the cab box, toggle the red **Synchro** switch (Figure 12, Item 1) to **PULSE**.

   The LED (Figure 12, Item 2) in the switch will illuminate.

   The system should come with an active profile from the factory.
3. Toggle the **L** switch (Figure 12, Item 3) to **ON Flow 1**.

   The LED (Figure 12, Item 4) in the switch will illuminate.
4. Make sure that all of the nozzles spray on the left side of the machine.
5. Check for leaks and repair as necessary.
6. Toggle the **L** switch to **OFF**.

   The LED in the switch will not illuminate.
7. Toggle the **R** switch (Figure 12, Item 5) to **ON Flow 1**.

   The LED (Figure 12, Item 6) in the switch will illuminate.
8. Make sure that all of the nozzles spray on the right side of the machine.
9. Check for leaks and repair as necessary.
10. Toggle the **R** switch to **OFF**.

    The LED in the switch will not illuminate.
11. If the system test fails, refer to Troubleshooting.
12. If the system test passes, secure the harnesses with cable ties.

    Note: Make sure that you route the harnesses where damage is minimized. Make sure that the harnesses are not exposed to impact or debris.

    Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
13. Installation is now complete and the system is ready for operation.

Rate Control Speed Range

Once the profile has been set up completely, the minimum and maximum speed values can be found by using the following procedure.

Note: The profile should be saved or downloaded before stating the following.

1. Increase the value in the speed input box (Figure 15, Item 3) until any of the values in the Duty Cycle % column (Figure 15, Item 18) reach 90.
2. Record this speed value.

   Above this speed the controller will stop active flow management and operate at the fixed default profile settings, which could result in underapplication of product.
3. Decrease the speed input box (Figure 15, Item 3) until any of the values in the Duty Cycle % column (Figure 15, Item 18) reach 10.
4. Record this speed value.

   Below this speed the controller will stop active flow management and operate at the fixed default profile settings, which could result in overapplication of product.

   Note: If using a secondary flow different than flow 1, the minimum and maximum speeds may be different than at flow 1. To check the duty cycle for flow 2, the user must select the value in the flow 2 input box.

GPS Status

GPS Module Status Lights

Figure 13: GPS Module LEDs

Under normal operating conditions, the PWR LED will be illuminated solid green.

When sending or receiving signals, the MSG LED will blink red.

Cab Box Status Light

Figure 14: Cab Box LED

When the red Synchro switch (Figure 14, Item 1) is toggled to PULSE, the status LED (Figure 14, Item 2) in the bottom left corner of the cab box should flash through a sequence of colors before settling on a solid color.

Table 3: LED Status Descriptions

LED Status		System Condition
Green	Solid	GPS is sending good data
Red	Solid	GPS is disconnected or not sending data
	Blinking	GPS is sending bad data
Blue	Blinking	Travel speed is too fast or too slow for the given flow target. (Only occurs during spraying with Flow 1 or Flow 2 profiles)

Capstan Synchro Website

The website, https://orchard.capstanag.com, is where you build or change profile information for your sprayer.

This website can be utilized to construct and save profiles. The profiles will need to be transmitted to the Synchro system when connected to controller, which is done in close proximity to controller.

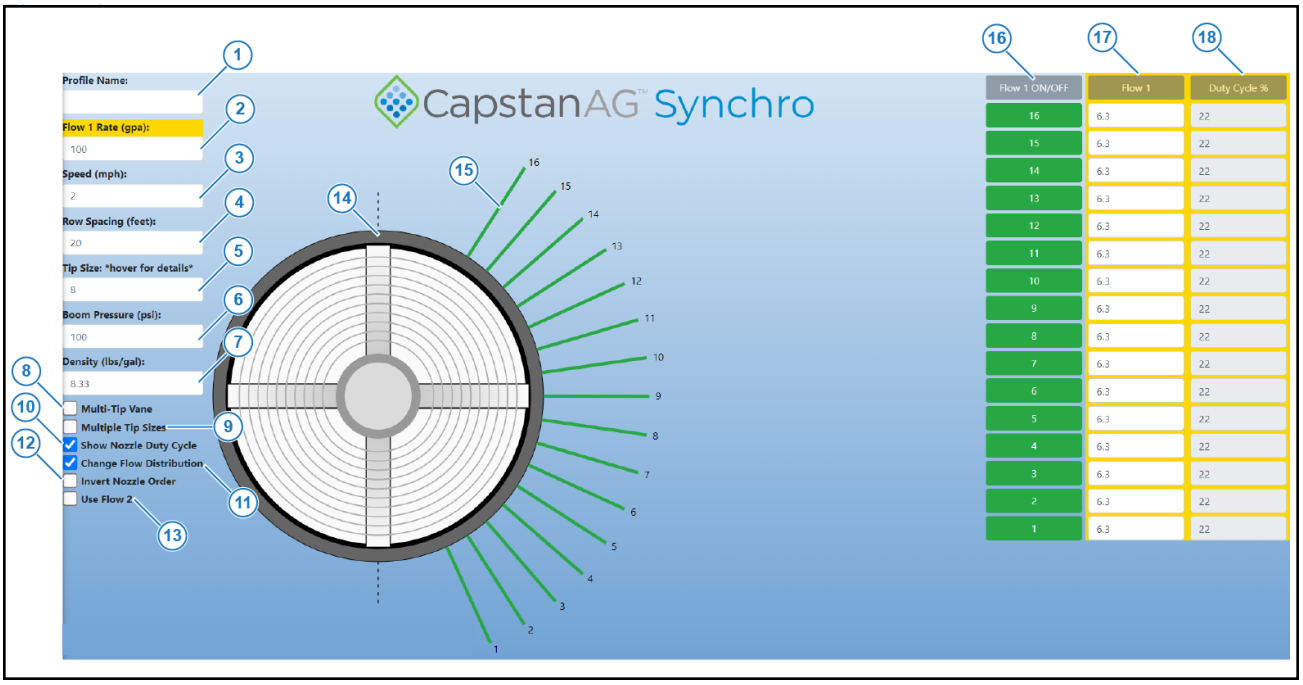

Figure 15: CapstanAG Synchro Website

Table 4: Home Page Components

Item	Name	Description
1	Profile Name	Name of the profile for the sprayer
2	Flow 1 Rate (gpa)	The rate of application of product in gallons per acre (Flow 1)
3	Speed (mph)	Enter the target speed the machine will be moving when product is applied (in miles per hour) **Note:** It is the responsibility of the operator to maintain this speed if using a Synchro system without GPS based rate control. Those with GPS rate control should choose a target speed in the middle of their spraying speeds.
4	Row Spacing (feet)	The distance between the rows (in feet)
5	Tip Size	Enter the tip size of the nozzles. Tip size is equivalent to the flow in gallons per minute at 40 pounds per square inch multiplied by 10, i.e. a #8 tip will flow 0.8 gpm at 40 psi. Refer to the correct tip chart to find these values. If a multi-tip vane is used then the tip size value should be set to the sum of tips at each nozzle. i.e. for a splitter with three tips, one #8 and two #3 then the tip size input will be #14. Tip Size equivalent for Disc-Core is GPM@40psi multiplied by 10.

Item	Name	Description
6	Boom Pressure (psi)	The force at the boom at which you want to spray (in pounds per square inch) **Note:** This pressure setting may differ from the pump pressure. It is the responsibility of the operator to maintain this pressure.
7	Density (lbs/gal)	Water is equal to 8.33 (in pounds per gallon)
8	Multi Tip Vane	Check this box if the machine uses multiple tip vanes
9	Multiple Tip Sizes	Check this box if multiple tip sizes are used on the boom. A Tip Size column will display on the right side of the screen.
10	Show Nozzle Duty Cycle	Check this box and a Duty Cycle column will show on the right side of the screen.
11	Change Flow Distribution	Check this box to change the flow nozzle by nozzle
12	Invert Nozzle Order	If the Invert Nozzle Order box is checked, Nozzle #1 will be the furthest drop from the controller.
13	Use Flow 2	Check this box to create a Flow 2 profile. A Flow 2 Rate box will display below Flow 1 Rate on the left side of the screen. Columns for Flow 2 will display on the right side of the screen. The column currently being adjusted will be highlighted.
14	Visual representation of flow distribution	As the information changes on this screen, the graphic will change to show a visual representation of the flow distribution as a result of the nozzle valves being controlled electronically. Nozzle color indicates: Gray — nozzle off Green — nozzle on and the settings are within the system parameters Red — not within system parameters (nozzle duty cycle must be between 10%–90%) and changes must be made for the system to function. **Note:** The nozzle line length is proportional to the flow. i.e. the longer the line the greater the flow.
15	Nozzle Order Numbers	Nozzle 16 will show at the top of the sprayer and Nozzle 1 will be at the bottom. Choose Invert Nozzle Order to make Nozzle 1 show at the top of the sprayer.
16	Master Switches	A Nozzle # icon that is green will spray. A Nozzle # icon that is gray is off and will not spray.
17	Flow Scalar(s)	Adjust these values to increase or decrease the amount of product each nozzle sprays as desired for the field and/or crop. A nozzle error message will display and the visual representation of the nozzle will change to red when the flow is outside of the system parameters (nozzle duty cycle 10%–90%). Adjust the nozzle flow, change the tip size, or change the pressure to remove the error.
18	Duty Cycle	This is informational only. You cannot change the duty cycle values in the location.

Make a Profile on a Web Device

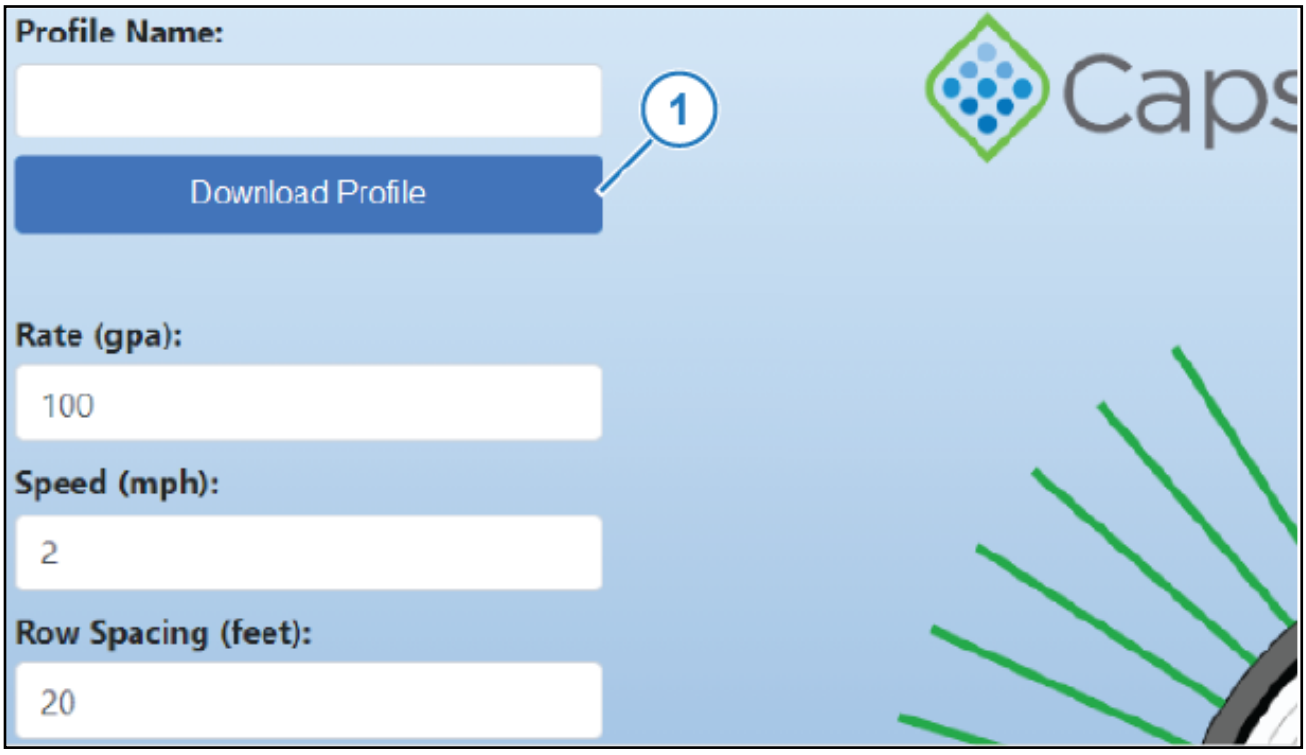

Figure 16: Online Profile Builder

A profile can be made on a computer or mobile device such as a tablet or phone that is connected to the internet. If you are using a device that is not portable, you will need to be able to transfer the profile to a portable device like a tablet, phone, or laptop computer.

1. Go to https://orchard.capstanag.com.
2. Enter the correct information for your sprayer.
   a. Give your profile a name.
   b. Fill in all values for your machine in the left hand column from top to bottom first.
   c. Select the drops in the Master Switches column that will be active for the profile.
   d. Edit the Flow Scalar values from top to bottom as needed.
   e. Edit the Tip Size values from top to bottom as needed.

   Refer to Capstan Synchro Website for more information on the website.
3. Click on **Download Profile** (Figure 16, Item 1).

   The profile is now downloaded to your device. If you are using a device that is not portable, you will need to move the profile to a portable device like a tablet, phone, or laptop computer or to virtual storage location (DropBox, Google Drive, email, etc.).

   You are now ready to transmit the profile. Refer to Transmit a Profile for more information.

   Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

Make a Profile on the Controller Wi-Fi

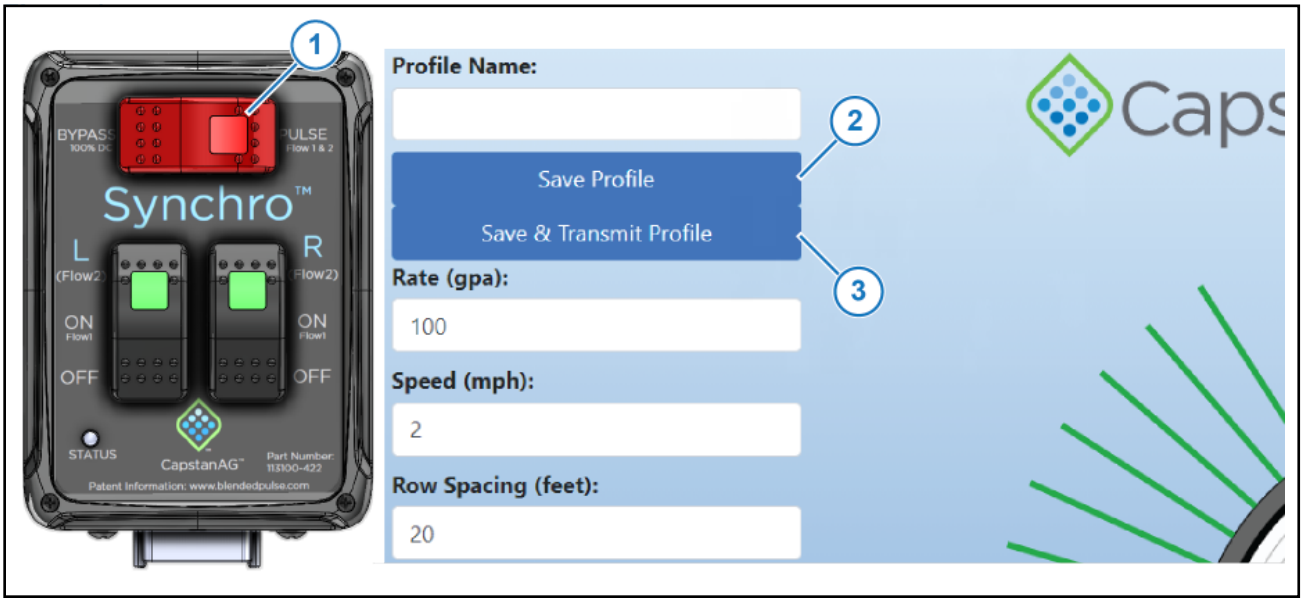

Figure 17: Controller Wi-Fi Profile Builder

1. On the cab box, toggle the red **Synchro** switch (Figure 17, Item 1) to **PULSE**.

   The light on the switch will illuminate.

2. On your device, connect to the **SYNCHRO 209XXXX WI-FI**.

   The **XXXX** shown above will be the last 4 digits of the controller serial number.

   There is no password for this Wi-Fi connection.

3. Go to 192.168.0.1/generate.html.

4. Enter the correct information for your sprayer.

   a. Give your profile a name.

   b. Fill in all values for your machine in the left hand column from top to bottom first.

   c. Select the drops in the Master Switches column that will be active for the profile.

   d. Edit the Flow Scalar values from top to bottom as needed.

   e. Edit the Tip Size values from top to bottom as needed.

   Refer to Capstan Synchro Website for more information on the website.

5. Click on **Save Profile** (Figure 17, Item 2) or **Save & Transmit Profile** (Figure 17, Item 3).

   - **Save Profile**—saves the profile to the controller
   - **Save & Transmit Profile**—saves the profile to the controller and automatically takes you to the transmit page.

   You are now ready to transmit the profile.

   Note: The profile must be transmitted before it can be set as the active controlling profile.

   Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

Transmit a Profile

Figure 18: Transmit a Profile

1. On the cab box, toggle the red **Synchro** switch (Figure 18, Item 1) to **PULSE**.

   The light on the switch will illuminate.

2. On your device, connect to the **SYNCHRO 209XXXX WI-FI**.

   The **XXXX** shown above will be the last 4 digits of the controller serial number.

   There is no password for this Wi-Fi connection.

3. Open a web browser and go to 192.168.0.1/transmit.html.

   The top line (Figure 18, Item 2) will always show the active profile. This is the profile that will spray when the system is turned on.

4. If a saved profle is being loaded, Proceed to Step 5. If you have created a profile using the internet rather than the controller wifi, click **Choose File** (Figure 18, Item 3) and browse to the location where the profile was saved.

   The selected file name will display on the screen. Proceed to Step 6.

5. To load a profile that was created using the controller wifi, or has already been saved to the controller, click on the drop down menu (Figure 18, Item 4) to select desired profile to transmit.

6. Click **Transmit Profile** (Figure 18, Item 5).

   As the profile is sent to the controller, **Profile transmission started**. will show on the screen.

   When the transmission is successful, **Profile transmitted successfully** will display in green (Figure 18, Item 6).

   This profile is now the active profile on the controller, and will stay active until another profile is transmitted to the controller.

Once transmitted, profile is stored on controller, and available to reload at a later date.

Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

7. If there is any red text on the screen (Figure 18, Item 7), an error in the transmission communication has occurred.

   Move closer to the controller and click **Transmit Profile** again.

8. You are now ready to spray.

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Chapter 6: Operation

Topics:

Spray with the Synchro System

Figure 19: Cab Box Controls

1. Get the sprayer ready for operation.
2. On the cab box, toggle the red **Synchro** switch (Figure 19, Item 1) to **PULSE**.

   The LED (Figure 19, Item 2) in the switch will illuminate.
3. To start the left side of the machine, toggle the L switch (Figure 19, Item 3) to **ON Flow 1**.

   The LED (Figure 19, Item 4) in the switch will illuminate.

   IMPORTANT: If the sprayer pump is on, toggling the boom switches may apply product. You can use the **L** (left) and **R** (right) side of the sprayer separately or together.
4. To start the right side of the machine, toggle the **R** switch (Figure 19, Item 5) to **ON Flow 1**.

   The LED (Figure 19, Item 6) in the switch will illuminate.
5. Operate the sprayer.

   IMPORTANT: Operating system above 125 psi may result in accelerated wear or plunger damage.

6. When you are done spraying, toggle the boom switch(es) and the **Synchro** switch off.

   When the switches are off the LEDs will not be illuminated

   IMPORTANT: If any switch is **ON**, the system will still pull a current that can drain the battery if the system responsible for charging the battery is not running, such as the tractor if using that battery, or the engine mounted on the sprayer if using that battery.

Spray in Bypass Mode

Spraying without the Synchro system activated can be used to flush the system out, or can be used to spray conventionally, if needed, during a failure.

Spray without using the Synchro system if necessary to complete a job if there is a failure in the system.

Diagnose and fix system failures as soon as possible.

1. On the cab box, toggle the red **Synchro** switch (Figure 19, Item 1) to **BYPASS**.

   The LED (Figure 19, Item 2) in the switch will not illuminate.
2. Toggle the **L** switch (Figure 19, Item 3) to **ON Flow 1**.

   The LED (Figure 19, Item 4) in the switch will illuminate.
3. Toggle the **R** switch (Figure 19, Item 5) to **ON Flow 1**.

   The LED (Figure 19, Item 6) in the switch will illuminate.
4. Operate the sprayer.

   The sprayer will function as it would without the Synchro system.

   The system will now operate with a constant equal flow of product through all nozzles and will not use the profile parameters.
5. When you are done spraying, toggle the boom switch(es) off.

   When the switches are off the LEDs will not be illuminated.

   IMPORTANT: If any switch is **ON**, the system will still pull a current that can drain the battery if the system responsible for charging the battery is not running, such as the tractor if using that battery, or the engine mounted on the sprayer if using that battery.

Secondary Flow Profile

The Capstan Synchro system is equipped with a second, momentary position for the L and R switches that activates a Secondary Flow profile. Some possible uses for this function include gaps between trees, or for spraying new growth trees which are shorter than the average height that the primary profile is set for.

To use the Secondary Flow function when spraying with the Synchro system:

1. Operate the sprayer with the red **Synchro** switch (Figure 19, Item 1) in the **PULSE** position.
2. When desired, press and hold either the **L** or **R** switches (Figure 19, Items 3 and 5) in the **(Flow 2)** position. This will momentarily switch the system to the Secondary Flow profile.
3. Release the **L** and/or **R** switches when Secondary Flow is no longer required. They switches will automatically return to the **Flow 1** position and the normal spray profile will resume.

   Note: the secondary flow settings must be set up in the profile using the generate webpage, otherwise there will be no difference between Flow 1 and Flow 2.

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Chapter 7: Maintenance

Topics:

Service the System

CAUTION: Before operation or service to the system, read and understand the machine's operator manual and the system operator manual. Chemical residue may be present on/in the OEM equipment. Use the correct personal protective equipment.

Before servicing the system or plumbing components, release the pressure and empty any product from the system and liquid delivery lines.

Jump Start, Weld On, or Charge the Machine

If jump starting the machine, make sure that your disconnect the system power harness or remove the fuses.

If charging the machine's batteries or welding on the machine, trip the circuit breaker.

Recommended Guidelines for Maintenance/Service

When servicing a system, the following are recommended:

- Perform the baseline service checks and verify the original setup values in this manual.
- Identify individual performance problems. Evaluate possible causes and corrections for performance issues.
- Troubleshoot individual components and replace, if needed.

IMPORTANT: The primary service tool will be a voltmeter that can measure voltage and resistance (ohms).

Maintenance Service Interval

Table 5: Recommended Service Intervals

Type of Service	Initial System Setup	Daily	Yearly/ Seasonally
Baseline Evaluation	X		X
Inspect the System		X	
Clean the System		X	
Clean the Strainers and Screens		X	
Clean the Nozzle Valves and Inspect the Plungers			X
Storage of the System			X

Details for each of these procedures are provided in this section.

Baseline Evaluation

1. Make sure that the voltage readings are correct.

   For more information, refer to:

   - System Load Capacity Test
   - Battery Voltage Test
2. Perform a visual check of all wire connections, harnesses, and connectors. Make sure that there are no loose, broken, or damaged parts.
3. Make sure that the liquid product plumbing and the strainer(s) are clean.
4. Check for damaged or missing decals. Replace if necessary.
5. Repair or replace any damaged components.
6. Perform the system tests.

   For more information, refer to:

   - System Dry Test
   - System Wet Test

Inspect the System

Before each use, visually inspect the Synchro system for issues.

- Visually examine the harnesses for cuts, nicks, or abrasions before each use. Replace any damaged parts immediately.
- Make sure that the strainers are clean.
- Make sure that all hoses and harnesses are secure.
- Check for loose mounting hardware and other components. Tighten if necessary.
- Check for damaged or missing decals. Replace if necessary.

Clean the System

- Thoroughly clean the system after each use.
- Flush the system with water. Do not store with chemical. Damage may occur to the internal valves.
- Avoid high-pressure spray when cleaning the system components.

Strainers and Screens

IMPORTANT: Clean the strainers on a regular basis.

Check the mesh size of the strainers and replace the screens if they are too coarse. Use 80-mesh or finer strainer screens. The filter manufacturer is specified only on the strainer housing. Only a color code identifies the strainer mesh size, which is not consistent between filter suppliers. An 80-mesh screen is required to prevent nozzles from plugging. When selecting a strainer, do not rely on the color coding. Check with the strainer manufacturer to be sure and select the 80-mesh strainer.

Plugged strainers will cause a reduction in system operating pressure.

When replacing the mesh screen on a Tee-jet Strainers:

1. Install and set the mesh screen in the strainer head.
2. Install the strainer cap.

   IMPORTANT: Failure to do this will likely result in a damaged mesh screen and overall strainer failure.

Clean the Nozzle Valve(s)

WARNING: Chemical residues may be present in the agricultural equipment. Always use proper personal equipment to avoid personal injury.

ease pressure from the system before servicing.

2. Clean the system before installation or service of the fittings, hoses, valves, or nozzles.
3. Wash the nozzle valve components to remove any debris.
4. Inspect the plunger for wear or damage.
5. If there is wear or damage to the plunger, replace the plunger.
6. Inspect the valve body.

   Make sure that the orifice is not plugged with debris, worn, or damaged.
7. If there is wear or damage to the orifice, replace the valve body.
8. Wash the nozzle body components to remove any debris.

   IMPORTANT: Do not use brake cleaner. Brake cleaner can damage the seal.

   IMPORTANT: During installation, apply 40 lbf in (4.52 Nm) of torque to the coil when it threads into the valve body to properly seat the O-ring.

Plunger Seal Inspection

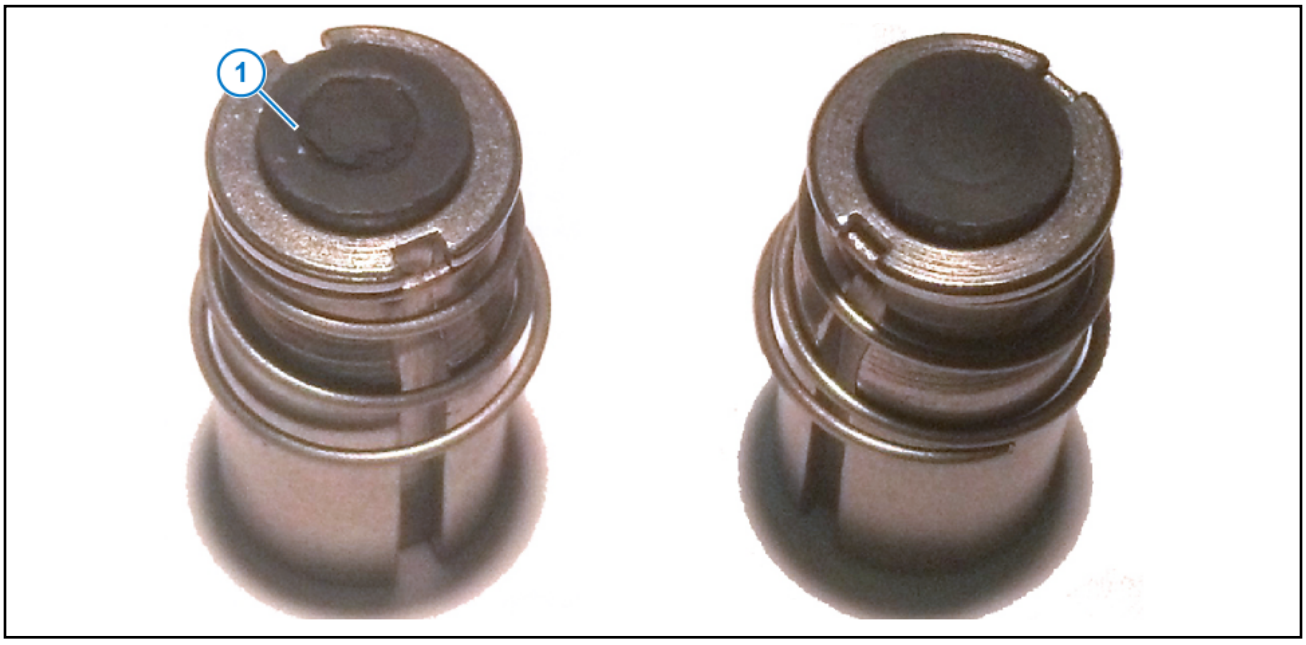

Figure 20: Plunger Assembly

After extended use, the plunger seal will wear a groove (Figure 20, Item 1) where the seal impacts the hard orifice seat. Replace the plunger if worn or damaged.

As the groove deepens, the pressure capacity of the valve will decrease until the pressure capacity interferes with the operating pressure of the system.

The result is erratic pulsing, often described as “flickering.” The system will operate normally at lower pressures until replacement parts can be installed. High operating pressures and abrasive chemicals will accelerate the wear of the plunger seal material.

Storage of the System

Thoroughly clean the implement and the system before any long storage.

Winterize for Storage

Do not use fertilizer to winterize! The use of fertilizer to winterize will cause internal damage to the nozzle valves.

Note: Improper winterizing will result in damage to the internal components of the nozzle valves. Review the manufacturer’s planter manuals for more information on proper winterizing.

Thoroughly clean the system before winter storage. Flush the system with clean water.

Winterize the system with RV antifreeze for winter storage. Proper winterizing of the machine with a CapstanAG system installed is essential. Make sure that the lines are completely full of antifreeze at 100% strength and that the nozzle valves are purged until 100% antifreeze is seen at all nozzle valves.

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Chapter 8: Troubleshooting

Topics:

Troubleshooting Charts

Note: Operate the machine to match the parameters set in the active profile:

- Speed
- Row Width
- Tip Size(s)
- Pressure

If the parameters are not met, the system will not operate correctly.

Table 6: Rate Instability Problems

Cause	Correction
Tips are too small	Install tips of the correct size
Tips are too large	Install tips of the correct size
Worn tips	Replace the tips
Plugged tips	Clean or replace the tips
Worn or sticky plunger(s)	Inspect the plunger(s) and replace as needed
Inlet plugged	Inspect the inlet and clean as necessary
Plugged filter(s)	Clean or replace the filter(s)
Filter(s) not correctly installed	Correctly install filter(s)
Plugged, kinked, or collapsed hoses	Inspect all hoses and replace as needed
Pump is not turned on	Refer to the sprayer manual for instructions to start the pump
Air in the spray boom	Bleed air from the system
Faulty pressure sensor	Replace the pressure sensor
Speed too slow	Increase speed
Speed too fast	Slow down
Pressure too low	Increase the pressure
Pressure too high	Decrease the pressure

Table 7: GPS Problems

Issue	Correction
Cab box status LED is flashing red	Cycle the Synchro switch OFF and ON
	Check the status LEDs on the GPS module, power should be solid on, and status should be blinking
Cab box status LED is solid red	Cycle the Synchro switch OFF and ON
	Check gps module connection
	Move machine/gps puck to an area with a clear view of the sky.

Table 8: Operation Problems

Issue	Cause	Correction
Single nozzle valve drips when shut off	Plunger is lodged with debris	Clean the nozzle valve
	Plunger is worn	Replace the plunger
	O-ring is pinched or broken	Replace the O-ring
Single nozzle valve sprays erratically	Plunger is worn	Replace the plunger
Single nozzle valve will not shut off	Plunger is lodged with debris	Clean the nozzle valve
	O-ring is pinched or broken	Replace the O-ring
Single nozzle valve will not turn on	Plugged tips	Clean or replace the tips
	Plunger is lodged with debris	Clean the nozzle valve
	Coil not receiving signal	Inspect harness(es), connect or replace as necessary
	Coil not operating	Inspect the coil and replace as necessary
Synchro Switch not illuminating when in the ON position.	No power to cab box or system	Make sure the system is connected to a 12 V power source
		Inspect the battery harness, power harness, and cab box harness. Replace as necessary
	Faulty cab box	Replace the cab box
Missing Wi-Fi signal	Synchro Switch not illuminating	Refer to Troubleshooting for Synchro switch not illuminating
	Out of range for the controller Wi-Fi	Move to be in range of the controller Wi-Fi. The range is usually within 50 feet of the controller. But the range varies with obstructions between the controller and connected device.
	Faulty controller	Replace the controller
One side not turning on	Faulty or disconnected harness	Inspect the harness and connect or replace as necessary
	Faulty cab box	Replace the cab box
	Faulty controller	Replace the controller
One side not turning off	Faulty cab box	Replace the cab box
Pressure substantially overshoots when nozzle valves are selected to close.	Pressure/flow bypass plugged	Check bypass valve for debris and clean as necessary

Table 9: Website Problems

Issue	Correction
I cannot find the profile I saved.	Check for a similar profile name. Only letters, numbers and the special characters ~ ( ) _ - { } [ ] . are allowed in profile names.
I get the error message **The web server is out of storage space**.	Contact your CapstanAG representative for instructions to delete profiles. You should be able to store over 8,000.
A profile was transmitted successfully but the spray pattern did not change.	Verify both the left and right boom switches are in the off position when transmitting a profile.
I get one or many **Error: Did not receive expected response** when trying to transmit a profile.	Move closer to the machine and try again. If that does not work turn the **Synchro** switch to off, wait five seconds, turn the switch on then try to transmit again.
When creating a profile I get a **Nozzle error**.	If the flow is too much, decrease the flow percentage or increase the tip size to adjust the flow to an acceptable value. If the flow is too little, decrease the tip size or increase the flow percentage to adjust the flow to an acceptable value.
The profile will not transmit when I press **Transmit**.	Verify none of the tip sizes are 0 for the profile trying to be transmitted.
I see a web page I'm not used to	Verify you visited either transmit.html or generate. html
The web page fails to load	Verify you are connected to the Synchro
The Synchro Wi-Fi is not listed on my device	Verify the red **Synchro** switch is turned on
	Make sure that you are within range of the controller Wi-Fi

Interchange Components

The system includes a number of usages of the same part in multiple locations:

- Nozzle Valves

When troubleshooting failed components, it can be helpful to replace the failed part with a working part at another location. If the problem follows the failed part to the new location, repair or replace the failed part.

If the problem does not follow the failed part, then the problem is likely elsewhere in the system, and other troubleshooting means may be followed.

Note: Use caution when failed parts are interchanged with a part that is operating correctly; in rare cases, the failed component may cause other components to fail at the new location.

Nozzle Valves

IMPORTANT: Operating system above 125 psi may result in accelerated wear or plunger damage.

Plugged nozzle valves can be classified into two categories:

- Plunger blockage
- Plunger stuck

Plunger blockage results when larger debris catches between the orifice and plunger seal. This is the smallest flow passage within the nozzle valve.

Stuck plungers result when smaller debris collects around the barrel of the plunger and binds the plunger in place. Symptoms of a blocked or stuck plunger are:

- Constant application
- Leaking when the nozzle is shut off
- No application

Note: Pinched or split O-rings will also cause nozzles to drip when shutoff.

Note: Operating a plugged nozzle valve for extended periods of time may result in a nozzle valve coil failure. Immediately clean any plugged nozzle valves.

CapstanAG recommends using an 80-mesh screen to prevent the nozzles from plugging.

Check the mesh size of the strainers and replace strainers if they are too coarse.

Refer to Clean the Nozzle Valve(s) and Plunger Seal Inspection for more information on resovling nozzle valve issues.

System Dry and Wet Tests

Performing the system dry and wet tests can further help diagnose problems with the system.

Refer to:

System Dry Test

System Wet Test

Coil Assembly Test

Use a voltmeter to measure the ohms of resistance across pins A and B on the coil connector.

Note: Correct resistance is:

- 12-watt coils resistance — 10 ohms to 11.5 ohms

If resistance value is incorrect:

- Clean the connector terminals and retest
- Replace the coil assembly

Coil assembly failures are often the result of two factors:

- Extended valve use with a plugged nozzle
- Extended use in corrosive environments

CapstanAG recommends cleaning any plugged valve assemblies immediately. Additionally, rinse the inside of the booms, and wash the outside of the coil assemblies with clean water as often as practical.

System Load Capacity Test

1. Start the machine engine.
2. Turn on all the boom sections.
3. Turn on all electrical loads, including the air conditioning, foam marker monitors, etc.
4. Observe the voltage readout on the correct settings screen in the display.

The nozzle valves operate best at 12 VDC or higher. Using less than 12 VDC will result in reduced pressure capacity. This will often result in erratic nozzle pulsing, sometimes described as flickering. Also, inspect the nozzle valves for worn plunger seals.

If low voltage is observed, inspect:

- Battery terminals, clean as necessary
- Battery condition
- Alternator condition
- Electrical connections

Battery Voltage Test

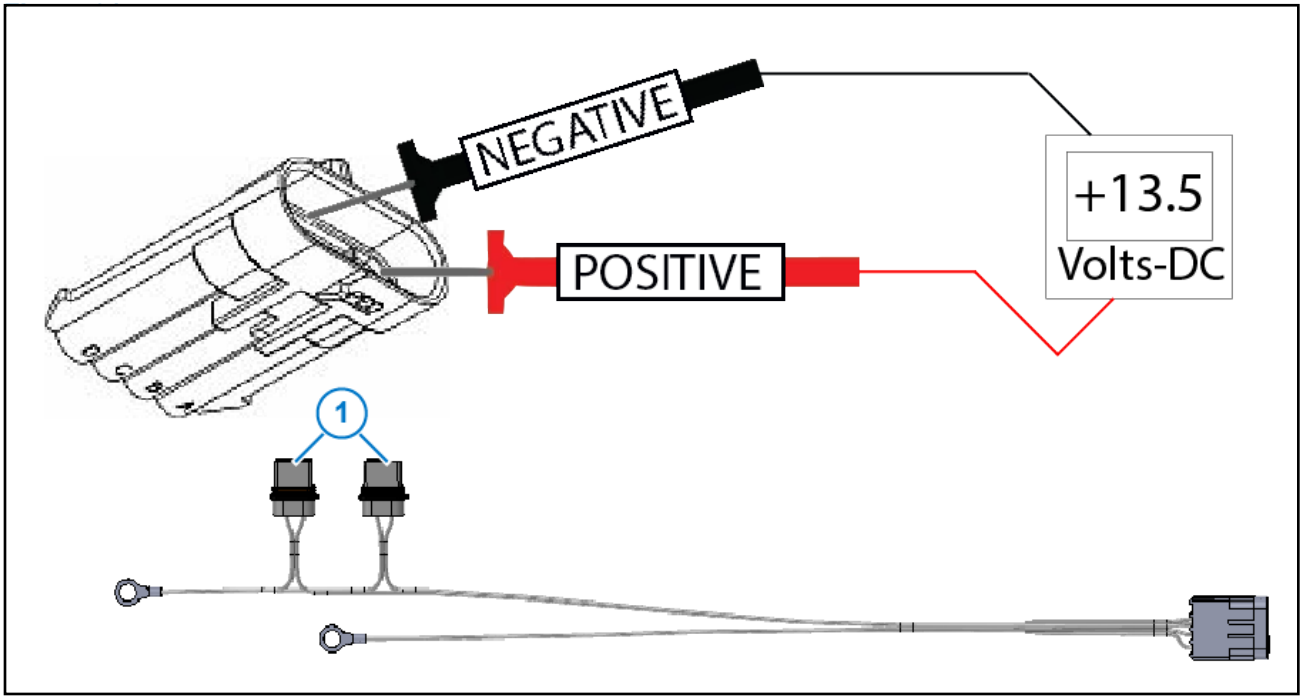

Figure 21: Battery Voltage Test

Disconnect the power harness (4-pin weather-pack connector) from the controller.

- With the engine of the machine running, use a voltmeter to observe that there is a 13.5 VDC between pin A and pin C or pin B and pin D.
- With the engine of the machine off, there is a 12.0 VDC between pin A and pin C or pin B and pin D.

Make sure that the polarity is accurate by looking at the positive voltage when the red (positive) probe is connected to pin 1, and the black (negative) probe is connected to pin 6.

If there is no voltage present between pin A (PWR +) and pin C (GND -) or pin B (PWR +) and pin D (GND -), check the following:

- The 20A fuses (Figure 21, Item 1) on the power harness
- The condition of the battery, battery harness, ring terminals, and alternator

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Chapter 9: Schematics

Topics:

System Layout

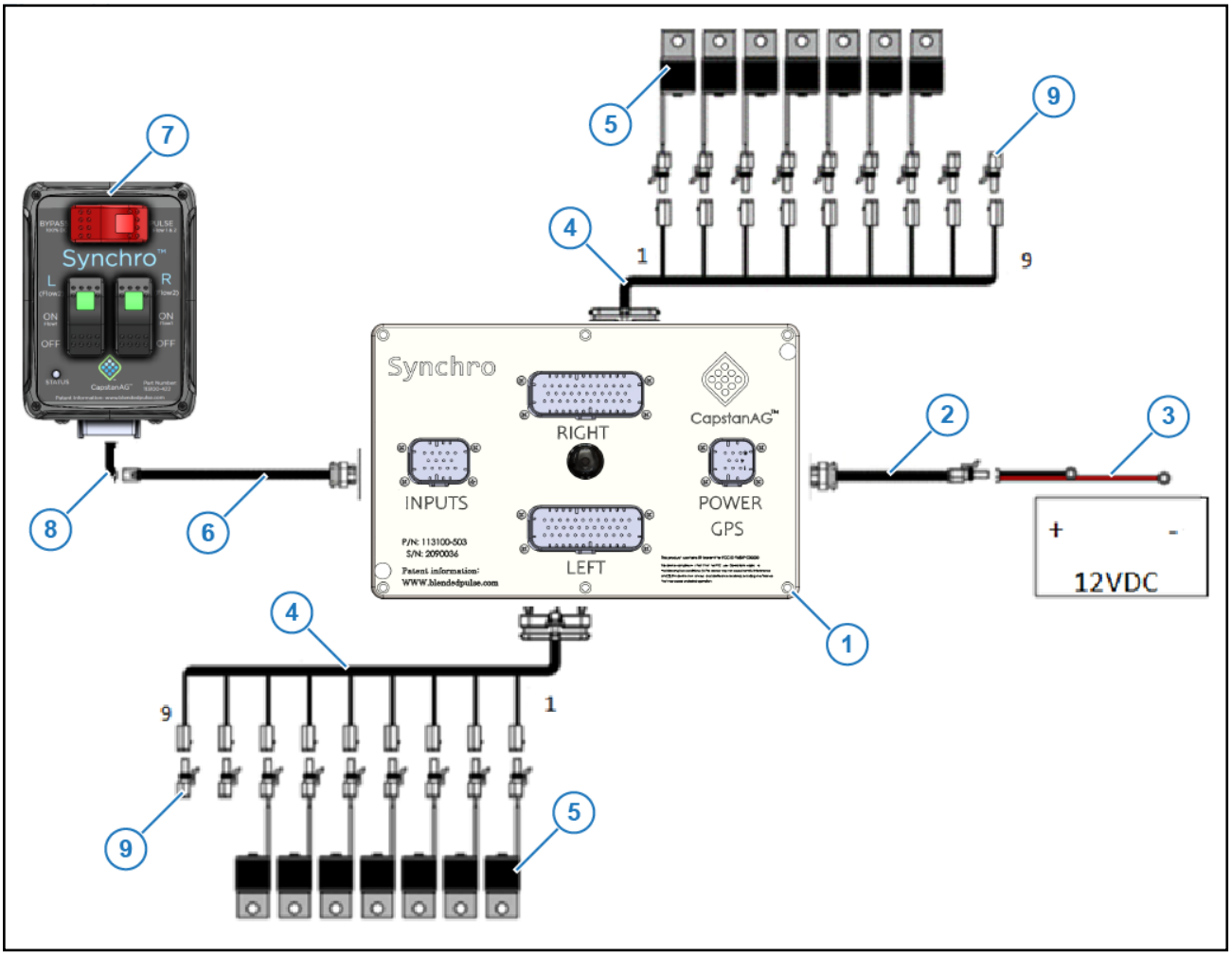

Figure 22: System Layout

Table 10: System Components

Item	Description		Item	Description
1	Control Module		6	Cab Box Harness
2	Power Harness		7	Cab Box
3	Battery Harness		8	Cab Box Extension Harness
4	Valve Harness		9	2-pin WP Tower Dust Plug
5	Valve Assembly			

Control Module Pinout

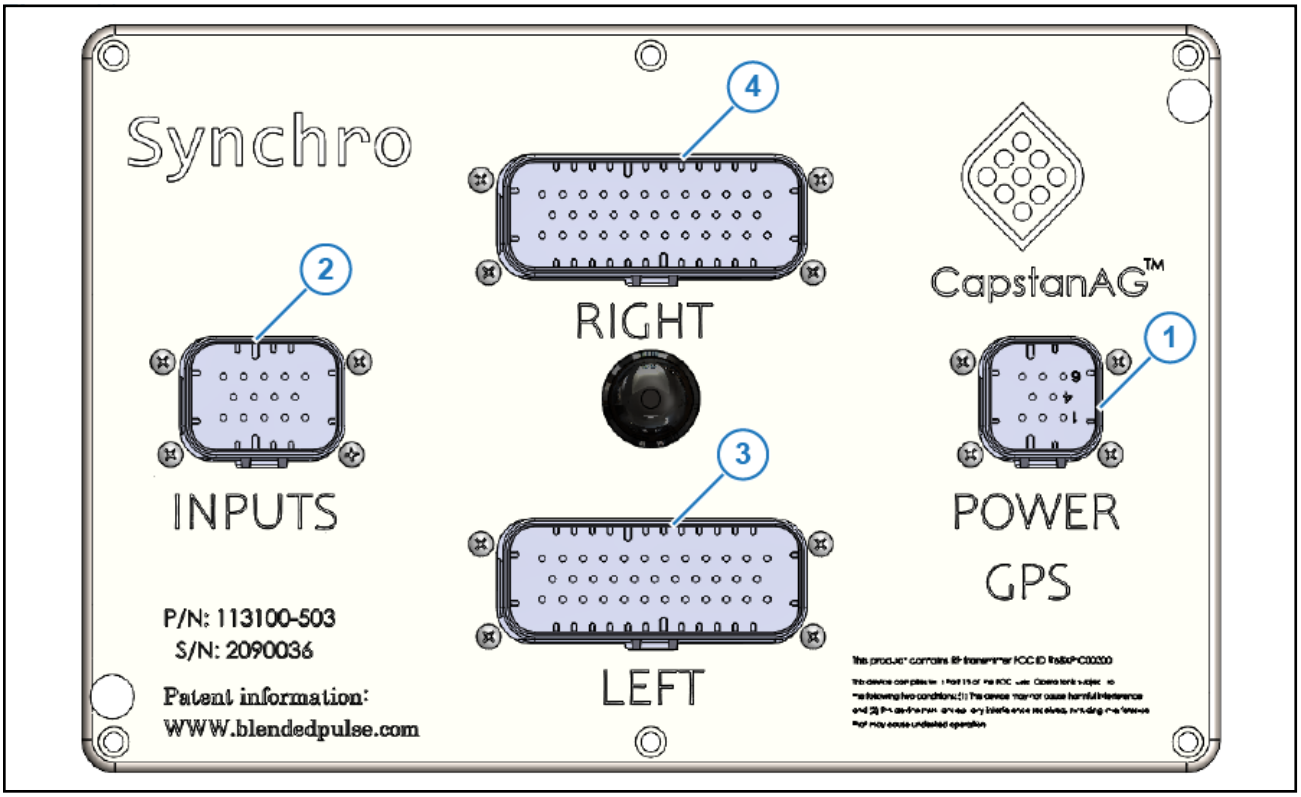

Figure 23: Controller Pinout

Table 11: Power Connector (Figure 23, Item 1) Pinout

Pin	Description		Pin	Description
1	Voltage Battery R		5	GPS Tx
2	Voltage Battery L		6	Ground
3	Unused		7	Ground
4	GPS Rx (UART Rx CAN H)		8	Ground

Table 12: Input Connector (Figure 23, Item 2) Pinout

Pin	Description		Pin	Description
1	12V Power		8	Unused
2	Bypass/Pulse Switch Input		9	GPS Ground
3	Left Boom Switch Input		10	Unused
4	Right Boom Switch Input		11	Unused
5	Status Line		12	Unused
6	Cab box Ground		13	Unused
7	GPS Switched Power		14	Unused

Table 13: Left Connector (Figure 23, Item 3) Pinout

Pin	Description		Pin	Description
1	Valve 1 Power		19	Valve 10 Power
2	Valve 1 Ground		20	Valve 10 Ground
3	Valve 2 Power		21	Valve 11 Power
4	Valve 2 Ground		22	Valve 11 Ground
5	Valve 3 Power		23	Unused
6	Valve 3 Ground		24	Valve 12 Power
7	Valve 4 Power		25	Valve 12 Ground
8	Valve 4 Ground		26	Valve 13 Power
9	Valve 5 Power		27	Valve 13 Ground
10	Valve 5 Ground		28	Valve 14 Power
11	Valve 6 Power		29	Valve 14 Ground
12	Valve 6 Ground		30	Valve 15 Power
13	Valve 7 Power		31	Valve 15 Ground
14	Valve 7 Ground		32	Valve 16 Power
15	Valve 8 Power		33	Valve 16 Ground
16	Valve 8 Ground		34	Left Flow 2
17	Valve 9 Power		35	Right Flow 2
18	Valve 9 Ground			

Table 14: Right Connector (Figure 23, Item 4) Pinout

Pin	Description		Pin	Description
1	Valve 1 Power		19	Valve 10 Power
2	Valve 1 Ground		20	Valve 10 Ground
3	Valve 2 Power		21	Valve 11 Power
4	Valve 2 Ground		22	Valve 11 Ground
5	Valve 3 Power		23	Unused
6	Valve 3 Ground		24	Valve 12 Power
7	Valve 4 Power		25	Valve 12 Ground
8	Valve 4 Ground		26	Valve 13 Power
9	Valve 5 Power		27	Valve 13 Ground
10	Valve 5 Ground		28	Valve 14 Power
11	Valve 6 Power		29	Valve 14 Ground
12	Valve 6 Ground		30	Valve 15 Power
13	Valve 7 Power		31	Valve 15 Ground
14	Valve 7 Ground		32	Valve 16 Power

Pin	Description		Pin	Description
15	Valve 8 Power		33	Valve 16 Ground
16	Valve 8 Ground		34	Left Flow 2
17	Valve 9 Power		35	Right Flow 2
18	Valve 9 Ground			

Table 15: GPS Module Connector Pinout

Pin	Description		Pin	Description
1	GPS Tx		3	12V Power
2	GPS Rx		4	Ground

Table 16: Cab Box Connector Pinout

Pin	Description		Pin	Description
1	Power		7	unused
2	Switched Power		8	unused
3	Flow 1 Left Boom		9	Flow 1 Right Boom
4	Flow 2 Left Boom		10	Flow 2 Right Boom
5	unused		11	Status Line
6	unused		12	Ground

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