



SpraySync Hardware Guide

February 2024

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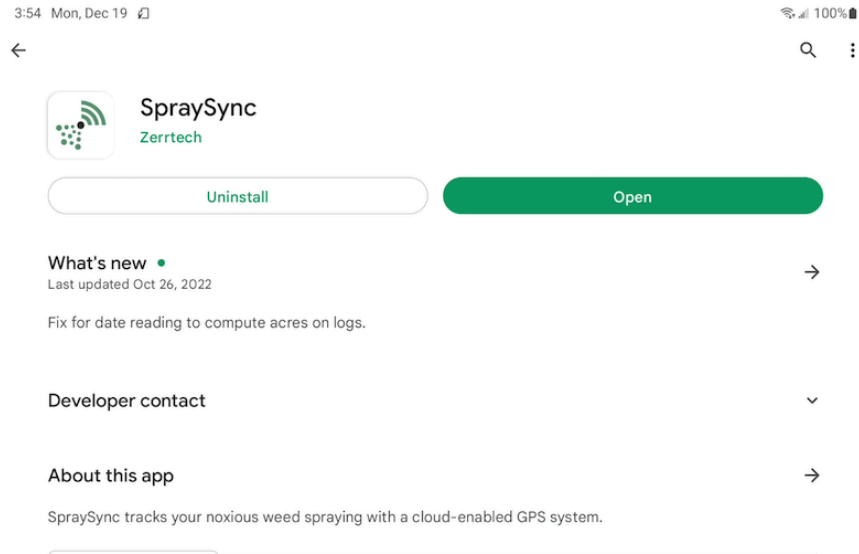
1. Introduction

The SpraySync system consists of:

- Android mobile app designed to run on a tablet (suggested tablets are rugged Samsung tablets specifically Samsung Galaxy Tab Active 3)
- A single SpraySync monitor box, currently two models. Both monitor boxes are a hardware device that interfaces with the sprayer to monitor status of nozzles/switches or hoses through electrical switches or flow switches. This device plugs in via USB to the tablet running the Android mobile app. Power for the device is from the tablet via USB, and USB also handles data flow from the monitor box to the mobile app.
 - WT1 box - for trucks, ATV/UTVs with multiple nozzles, tracks up to 15 total inputs - up to 11 voltage signals and up to 4 flow switch or electrical non-voltage toggle on/off switches
 - BP1 box - for only backpacks, tracks a single flow switch or electrical non-voltage toggle on/off switch input
- Android tablet - Samsung Galaxy Tab Active3 64GB with unlocked LTE Verizon cellular data capability (optional upgrade to a larger tablet the Active4 Pro)
- Tablet mount - custom fit to the Samsung Galaxy Tab Active3 to provide constant power using a cigarette adapter or direct battery connection (or mount for the Active4 Pro if tablet is upgraded)
- Web application that is used for reporting and administration of the system
- Cloud servers that store all of the data tracked by each tablet and provide data synchronization of all the different tablets

The mobile app is available only for Android in the Google Play Store:

https://play.google.com/store/apps/details?id=com.zerrtech.spraysync&hl=en_US&gl=US



The web site to use for reporting and administration is available at: <https://app.spraysync.com>

Our marketing web site is a valuable resource for training and many other resources:
<https://spraysync.com>

2. Hardware

The SpraySync WT1 box (Fig. 2.1) has the capability to track up to 15 total inputs, up to 11 valve/nozzle signals (electrical 12V signals) and additionally up to 4 flow switches (on/off monitoring a hose reel) or electrical toggle on/off switches.



Figure 2.1 SpraySync WT1 Monitor Box

The SpraySync BP1 box (Fig 2.2) is designed specifically for backpack sprayers, it has the capability to track only a single non-powered switch. This can be either a flow switch or an electrical no-voltage toggle on/off switch. It is lighter weight than the WT1 box, due to being smaller and made out of plastic instead of aluminum.



Figure 2.2 SpraySync BP1 Monitor Box

2a. Sprayer Controllers

We have developed custom wiring harnesses that greatly simplify the installation for specific sprayer controllers:

- TeeJet 744A-3 (both solenoid and ball valve)
- Norstar RS6000
- Raven SCS 450
- Raven SCS 4400

As customers come to us with a sprayer controller we have seen for the first time, we may elect to work on developing a harness or may develop a custom one-off solution.

If a sprayer has a sprayer controller but we have not developed a wiring harness yet, the installation instructions are the same as in the section 2b that follows.

TeeJet 744A-3

The TeeJet 744A-3 has two configurations that involve a different end cable. One cable for solenoid valves, another cable for ball valves. See our standalone TeeJet 744A-3 Installation guide for more information.

Norstar RS6000

The Norstar RS6000 has a standalone installation guide you can see for more information.

Raven SCS 450

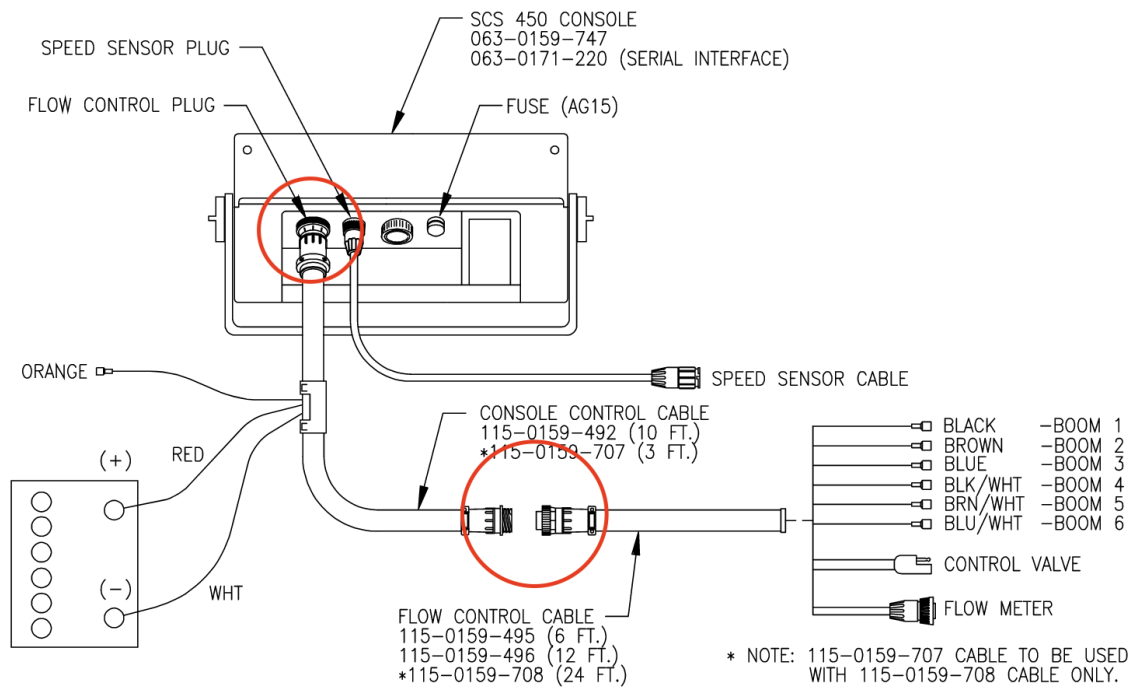
The Raven SCS 450 has 6 boom switches. Our wiring harness allows us to track all 6 boom switches.



Here is a picture of the wiring harness, it taps into the 16 pin console cable connector.



Below is a diagram of the Raven SCS 450 and the places that our wiring harness attaches are circled in red. The preferred option is to connect up directly into the sprayer console.



We have recorded an installation video for the Raven SCS 450:

<https://youtu.be/B8rC-nhSKSc>

Below is the wiring table for the wires inside the Raven 450 16 pin cable to our SpraySync WT1-12 cable. We have a single wiring harness that can be used for the Raven SCS 450 and SCS 4400.

WT1-12 Cable Pins	SpraySync Wire Color	Raven SCS 450 Wire Color	Raven SCS 450 Boom Section	SpraySync Switch Config Input #
1	Brown	Black	1	1
2	Red	Brown	2	2
3	Orange	Blue	3	3
4	Yellow	Black/White	4	4
5	Green	Brown/White	5	5
6	Blue	Blue/White	6	6

7	Purple	White/Black (not needed for 450 but part of 4400)	N/A	N/A
12 - Ground	Gray - Ground	White (Ground pin 1)		

Raven SCS 4400

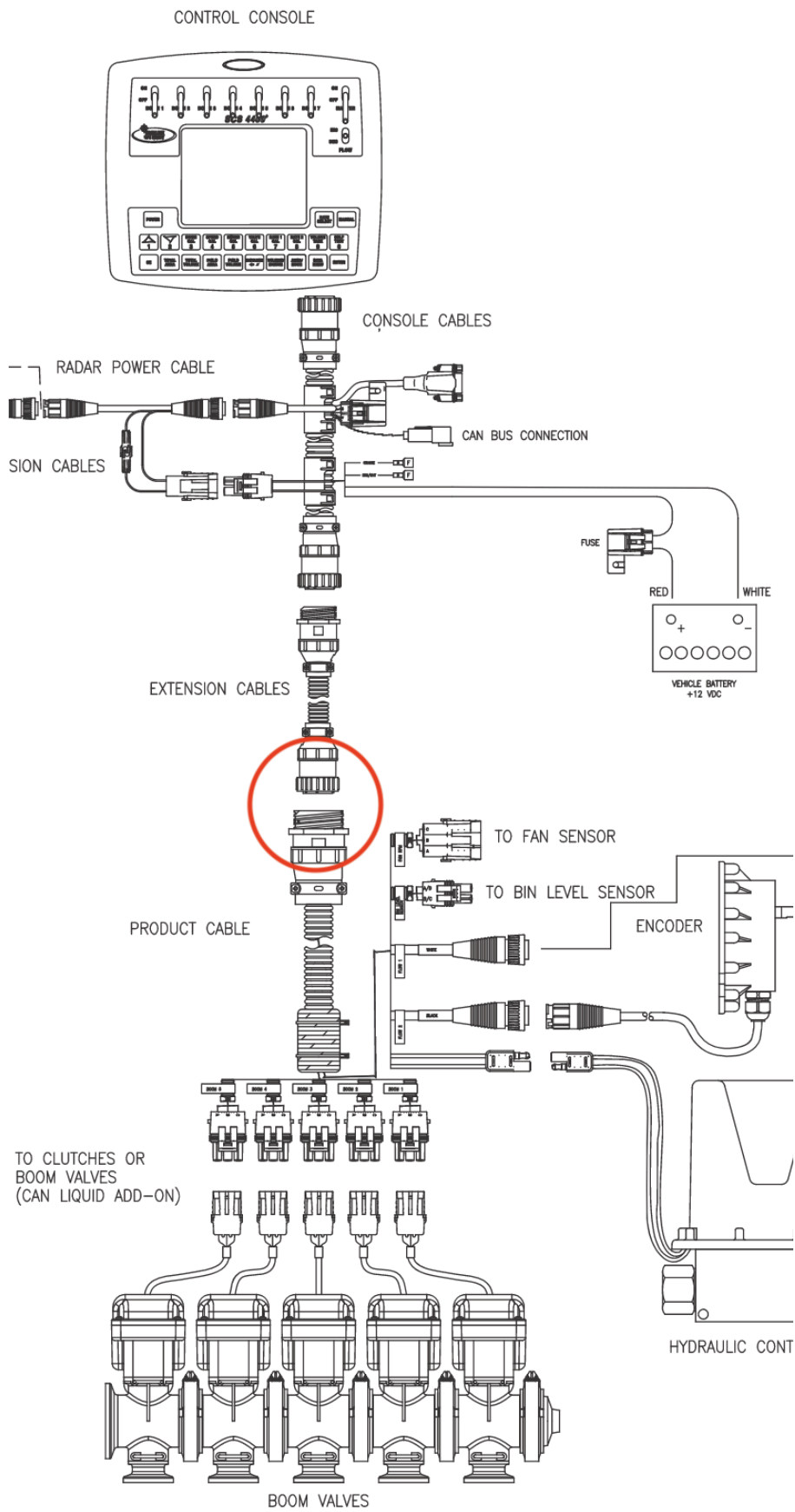
The Raven SCS 4400 has 7 boom switches. Our wiring harness allows us to track all 7 boom switches.



Below is a picture of the wiring harness, it taps into the 16 pin console cable connector. This wiring harness is the same as the one used for the Raven SCS 450.



Below is a diagram of the Raven SCS 4400 and the location where our wiring harness is circled in red, should be a 16 pin product cable.



We have recorded an installation video for the Raven SCS 4400:

<https://www.youtube.com/watch?v=5rvx9vgdT9U>

Below is the wiring table for the wires inside the Raven 4400 16 pin cable to our SpraySync WT1-12 cable.

WT1-12 Cable Pins	SpraySync Wire Color	Raven SCS 450 Wire Color	Raven SCS 450 Boom Section	SpraySync Switch Config Input #
1	Brown	Black	1	1
2	Red	Brown	2	2
3	Orange	Blue	3	3
4	Yellow	Black/White	4	4
5	Green	Brown/White	5	5
6	Blue	Blue/White	6	6
7	Purple	White/Black	7	7
12 - Ground	Gray - Ground	White (Ground pin 1)		

2b. Electrical Switches - Generic Sprayer Integration

We also can integrate into the electrical system when you don't have a sprayer controller. If you have your own custom controller with switches that turn on valves, we can integrate with those too. The design of our box allows for us to monitor and track any 12v switch signal from your vehicle. In the case of a sprayer controller or any switches mounted on a panel, we either connect onto the switches directly if they are accessible, the individual wires that go from the switches to the valves, or a multi-wire cable that goes from the switches out to the valves.

Here is an example wiring schematic (Figure 2.3) of how to connect to the WT1 monitor box for a system where you have switches that control either a solenoid valve or a ball valve.

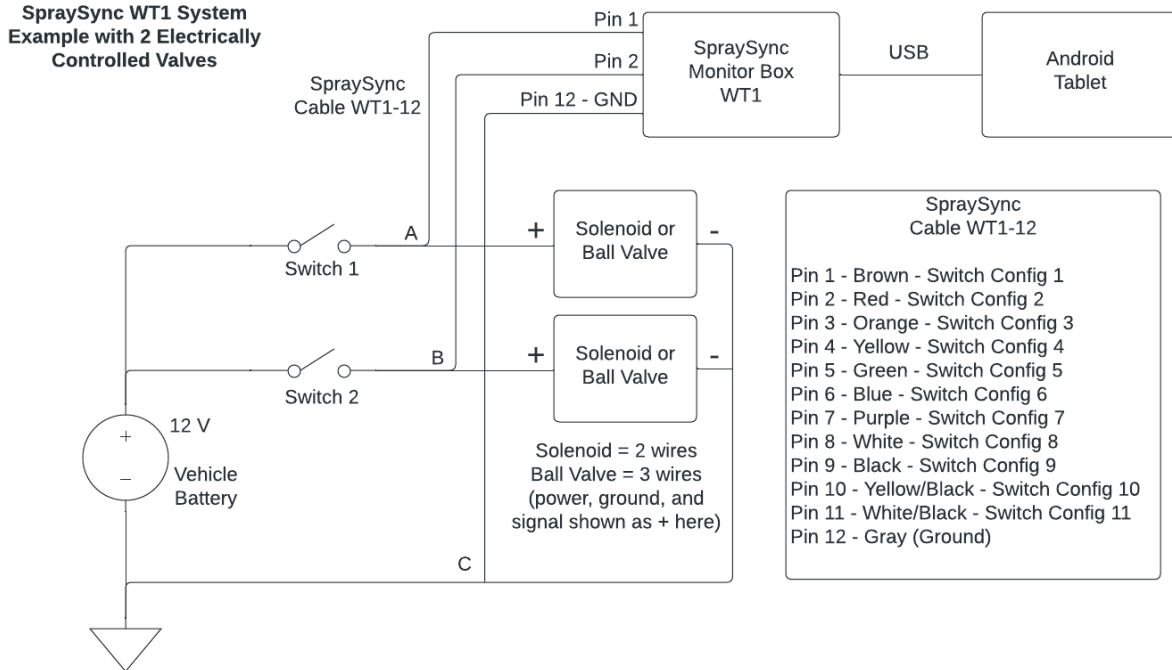


Figure 2.3 SpraySync WT1 Wiring Diagram

At point A, B, and C in Figure 2.3 is where you splice into the existing wiring. We need the signals and also the ground wire. Different sprayers can have different ways to access this wiring. You may have to cut the insulation around a cable to access the wires.

Note: if it is a solenoid valve, you will have 2 wires. We are looking to tap into the signal wire that is bringing a switched 12V to the solenoid. If it is a ball valve, you will have 3 wires, positive, negative, and the signal. The signal wire is the one you tap into for a ball valve, it is 12V when on and disconnected when off.

Prior to splicing in, it is suggested to turn the vehicle on but have all the switches off, take a multimeter, put it in DC voltage reading configuration, and put a probe on points A or B and the ground probe on a connection to ground on the vehicle. We want to ensure that there is no 12-14V signal going to the solenoid valve or to the signal input on the ball valve when the switch is off. Then when you turn on the sprayer boom switch, the point A or B that corresponds to the switch, it should be 12V. This ensures that you have the correct configuration and your system is capable of integrating with our SpraySync monitor box with no modifications.

Some sprayers with solenoid valves that we have seen in the field are wired in reverse of the diagram above. In this reverse wired situation, there is a permanent positive 12V signal going all the way out to one terminal on the solenoid valve (represented by the negative terminal in the wiring diagram). The reverse configuration would have the negative terminal going to the left side of switch 1 and 2 in the diagram above. We cannot track your sprayer in this configuration. This configuration also would not be safe as you have a 12V hot wire all the way out at the back of the vehicle that is on the whole time that the vehicle is on. If you connect the SpraySync monitor box while in this reverse configuration, you may damage the SpraySync box. To allow your sprayer to be tracked, please change the wiring to match the diagram above. It is usually as simple as turning the vehicle off, disconnecting the battery while doing work, then swapping the wires at the switch terminal, then repeating the testing process above.

Now that we have ensured our sprayer is wired up correctly, we can proceed with tapping into the valve signals from the switch.

Three main techniques to tap in are using T tap connectors, Quick Splice connectors, or Butt connectors.

T Tap connectors

T Tap connectors can also be known as quick splice connectors. There are a few variations.

Here is an example of a T Tap connector in Figure 2.4



Figure 2.4 - T Tap Connectors

A benefit of a T Tap connector is that it is removable. Also it allows you to splice together different size wires, the different colors correspond to the size of wire you are tapping. This will be dependent on the wiring in your system. The wire in the WT1-12 pin cable is 22 AWG. You will need to use a crimper to crimp the WT1-12 pin cable to the spade terminal. You may choose to wrap the entire connector assembly in electrical tape to ensure a better more permanent connection that holds up to vibration better.

Quick Splice Connectors

Quick splice connectors allow you to avoid needing a crimper, but they only work well if both wires are around the same size. Since we use a 22 AWG wire in our WT1-12 cable, and a typical wire in a sprayer that is powering a solenoid will be a bit bigger to take some current, these types of connectors may not work well. See example below in figure 2.5

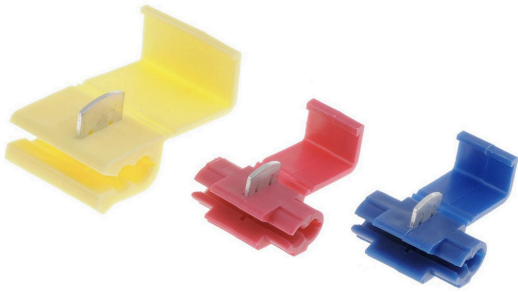


Figure 2.5 - Quick splice connectors

Butt connectors

These also may be called butt splice connectors. They can come insulated or non-insulated. If you use the non-insulated ones, always wrap them in electrical tape or heat shrink. If you have different sized wires on either side, you can always strip more wire and then double it over onto itself. With us always using stranded wire in these situations, it's a valuable technique.

Insulated butt connector example in Figure 2.6 that also happens to have heat shrink around it so you can install and then heat shrink for a tight fit.

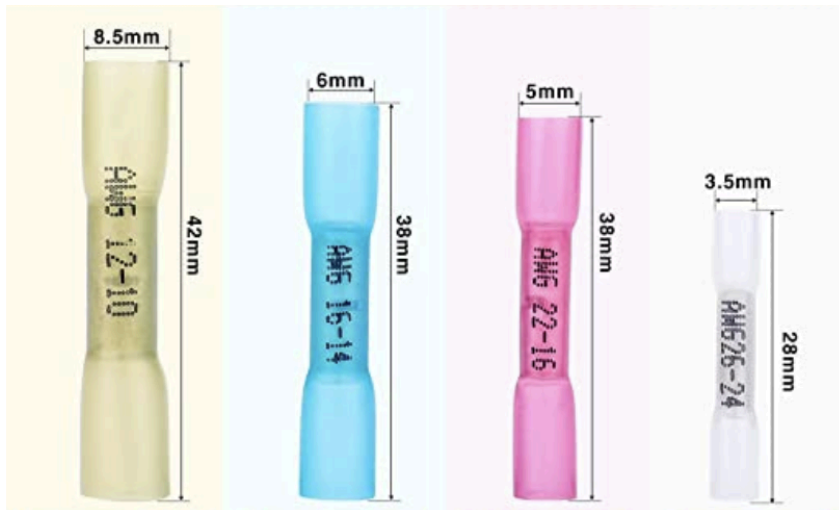


Figure 2.6 - Insulated butt connectors

Non-insulated butt connector example below in figure 2.7. Always wrap these in heat shrink or electrical tape after crimping. I prefer these because they are easier to crimp without worrying about ruining any insulation or heat shrink while crimping as in the insulated version in figure 2.6.



Figure 2.7 - Non-insulated butt connectors

Here is an example of what a finished non-insulated butt connector splice looks like in figure 2.8.

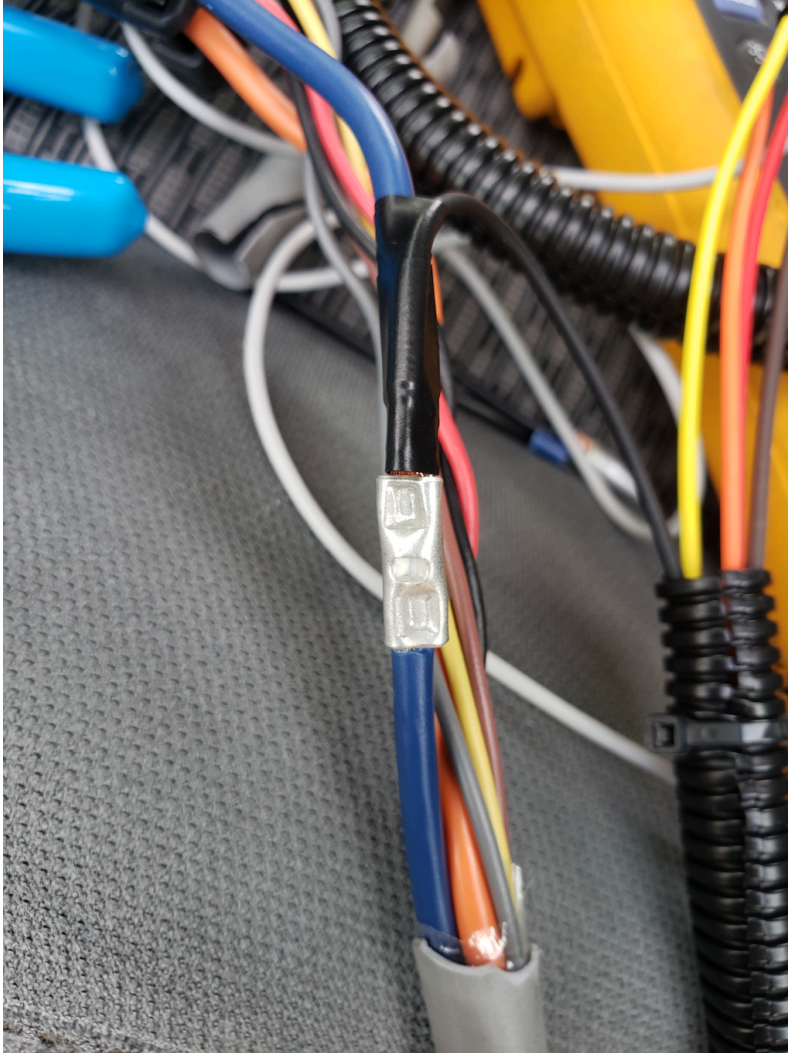


Figure 2.8 - Non-insulated butt connector splice

This shows a blue wire that happens to be a ground wire in the cable.

First step is that we cut the wire in two, strip both ends. Then we put our blue wire in with a wire from our SpraySync WT1 cable and crimp it. Insert only wire in butt connector, do not let any insulation from the wire go in the butt connector, it will prevent a reliable connection. On one side, you put in the appropriate color wire from our SpraySync cable which is 22 AWG and should be able to slip in most any butt connector end along with the original wire.

Please ignore the specific colors in this example, they will be different with your sprayer. See the table of our SpraySync cable colors in Figure 2.3.

Example of this first step of putting one wire from the sprayer and one wire from the SpraySync cable in Figure 2.9.

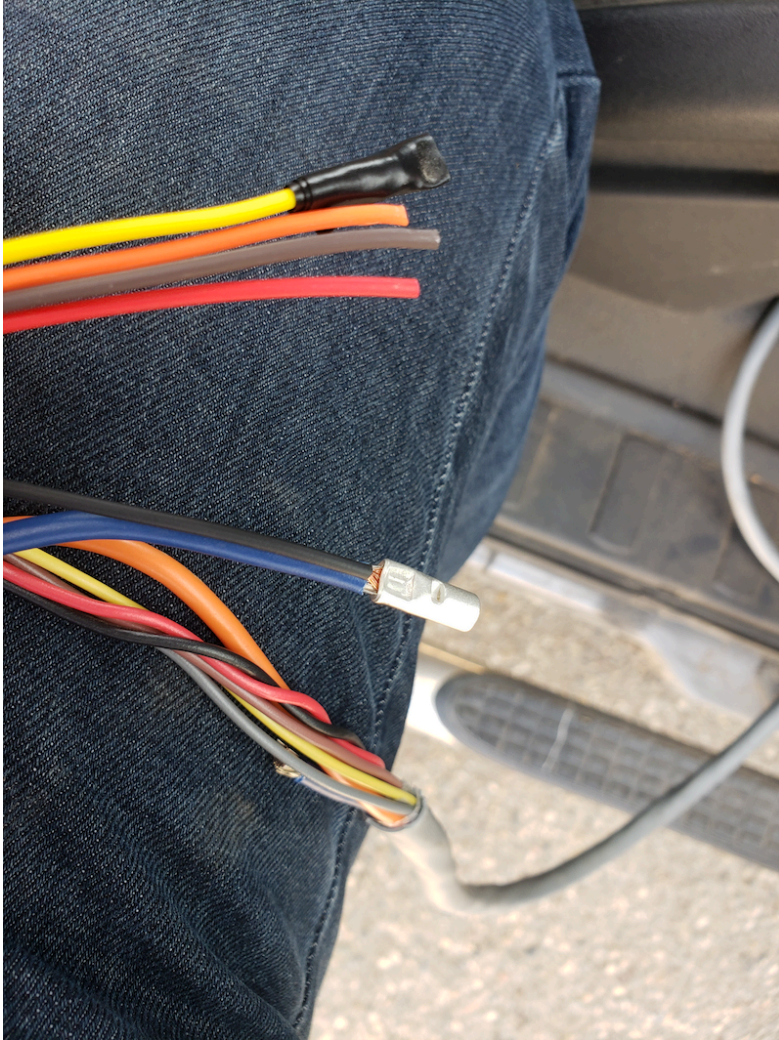


Figure 2.9 - Wires cut to prep for splicing, non-insulated butt connector with 2 wires into one side of butt connector

Here is a closeup in Figure 2.10.

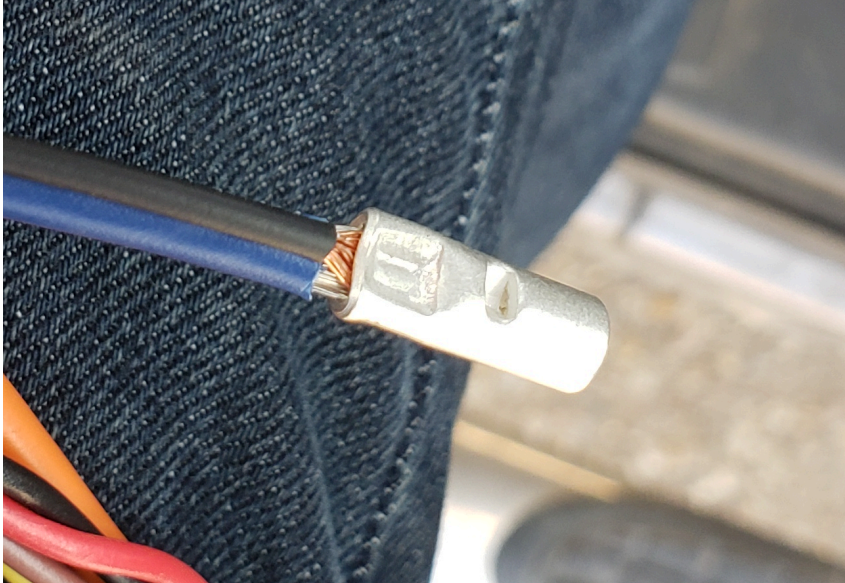


Figure 2.10 - Non-insulated butt connector splice closeup

To finish out, place the other end of the blue wire into the other end of the butt connector and crimp. For each individual butt connector that you add, use electrical tape to wrap it so no wire or connector is showing and go down the wire about an inch. In a similar way you can use some heat shrink, make sure you cut to length to overlap down the wire to provide some strain relief.

Make sure if you use heat shrink that you will need to slide the heat shrink over the butt connector and down the already crimped wire before you put the other wire in the one remaining open side, then after you crimp the second wire you can slide the heat shrink back over the butt connector making sure you have the butt connector in the middle and overlap either side of the butt connector.

2c. Trucks

Larger trucks typically have a sprayer controller, we have created our own wiring harnesses to make the integration easier with the sprayer controllers listed above in section 2a. Other controllers, or trucks with no sprayer controller and just have switches mounted to a panel, we look to splice into the cable or connections in the back at the valves. Examples of this generic sprayer integration are shown and explained in great detail in the previous section 2b.

Trucks can also have a hose reel, we use a flow switch with a backflow/check valve to track on/off. For connecting a flow switch, see an explanation in the backpack section 2e.

2d. ATV/UTV

ATV/UTVs can have some of the same controllers that bigger trucks have. More commonly they may have a smaller sprayer controller like a TeeJet 744A-3 or Texas Industrial Remcor TXRC1B. They of course may have no off the shelf sprayer controller and just have switches mounted on a panel. Even when there are just switches, we use the same technique as trucks, we are always primarily looking to tap into the electrical signal that is going out to the valves. Please see section 2a if you have a supported sprayer controller mentioned in that section. See section 2b if you do not have a supporter sprayer controller or you have switches on a panel.



For cases where there are no valves, we can also monitor the flow using flow switches, which give us an on or off signal when there is flow or no flow. ATVs/UTVs can be a combination of valves and a hose reel where we would use a flow switch on the hose. Same for a backpack which usually will only have a hose. As long as you can add in a flow switch inline, we can track it. For information on how to integrate a flow switch, you can see the backpack section 2e.



2e. Backpack

For integrating with a backpack, we use a special backpack-only box, the SpraySync BP1 Monitor Box. This box only has the capability of tracking a single flow switch or electrical toggle on/off switch.

The SpraySync BP1 Monitor Box has two panel mount input connectors, one is a 2 pin connector where the flow switches go in. The other is a USB connector, the same as the SpraySync WT1.

The BP1 monitor box also differs from the WT1 box in a few ways. It is smaller and made of plastic to save weight which is important when using a backpack. The BP1 supports only a single flow switch or electrical toggle on/off switch, where the WT1 supports up to 11 electrical powered switches and up to 4 flow switches or electrical toggle on/off switches.

We still use a tablet to track the backpack, the GPS comes from the tablet. The tablet is still directly wired to the BP1 monitor box just like with the WT1 monitor box.

We have two strategies to integrate with a backpack sprayer that are based on customer preference and some may work better depending on the specific backpack sprayer being used. There's no one size fits all solution so we work with you to find the best solution.

We'll present two different strategies.

- Using a toggle switch
- Using a flow switch

But first here is how we mount the SpraySync BP1 monitor box to the backpack sprayer.

Backpack BP1 Monitor Box Mounting

You can mount the box onto the backpack sprayer via velcro sheet or glue it directly onto the sprayer tank. We recommend velcro so that it is removable if you end up wanting to clean the tank.



For velcro mounting, we flip the monitor box over and put a velcro sheet cut to size onto the back of the box, and apply the sticky side to the box.



Then we take the opposing velcro sheet, place it on without taking the backing off to expose the sticky side.



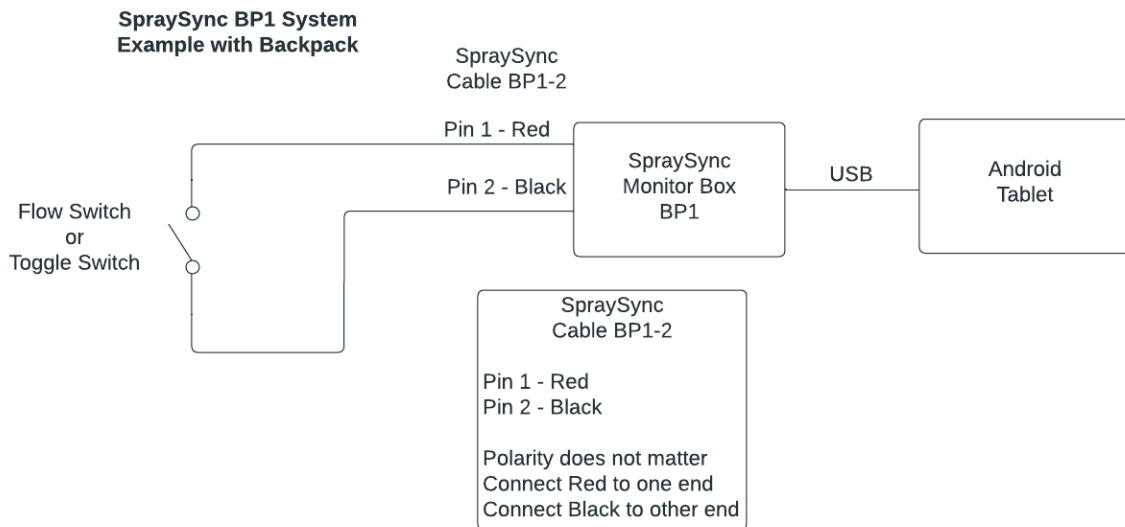
Remove the backing off to expose the sticky side and press onto the backpack sprayer tank and hold for a minute. Orient the box so the panel mount inputs are facing down.



Now we will look at the different strategies for tracking a backpack.

Wiring Diagram

For each strategy, either using a toggle switch or a flow switch, the wiring diagram is the same:



Backpack Toggle Switch

The general concept is that you will have a switch on your wand that you toggle at the same time that you pull the trigger on the wand. You may want to choose this option if you do not want to add a flow switch or any modifications into the liquid path through the hose.

We will show the setup of a rocker style switch being used. The toggle switch will have two wires coming out of it, those wires go straight into the BP1 2-pin cable.

Here are a couple pictures of the rocker switch mounted to the wand.





We use zip ties to make sure everything stays in place on the wand and all the way down the hose.

Any extra cable we want to be sure to zip tie. In backpack sprayers, if they have a bottom frame as a base, it is a great point to zip tie onto, as long as you keep the bottom stable for when you are filling the backpack.

The opposite end of the cable plugs into the 2-pin input in the box. Need to ensure there is enough strain relief on the cable going into the box so that nothing causes it to be pulled out. Leave some slack in the cable and zip tie as close as you can right to the frame.



Backpack Flow Switch

We can use a flow switch along with a check valve to help us only track when the chemical mix flows in a single direction. The check valve helps the flow switch not give false readings by chemical mix sloshing around in the tank as you walk. The check valve may not be necessary, we recommend going without the check valve first and then if you have issues with false triggering the flow switch while bouncing around or walking, that the check valve may help with that.

Here is the flow switch setup we will use. If there is an arrow on the flow switch, it needs to match the direction of the chemical flow. There certainly will be an arrow on the check valve, it should also be pointing in the direction the chemical will flow. I suggest putting the check valve before the flow switch so the check valve is closer to the tank than the flow switch.

It is important to look at the pressure that your sprayer is rated for and make sure that your connections are all rated for the amount of pressure.

The flow switch will be rated for a flow rate range. Please ensure that your sprayer typical flow rate is within that range.

If you are using barbs on the ends, make sure that the barb size matches the inner diameter of your hose and use a hose clamp for a tight fit.



Always use water tape or paste to help seal all the connections. Below is the flow switch connected up to the output of the backpack sprayer tank and zip tied to the frame.



The flow switch has two wires. Those two wires can be connected to the monitor box 2 wire inputs via the cable. There is no polarity with the flow switch wires, or the wires in the cables.



Finishing up the install with USB cable

The last piece of the install is the USB cable that goes from the BP1 monitor box to the tablet. The tablet has the GPS so needs to be carried with. One cost-effective way is using a shoulder strap with a tablet case to keep the tablet handy.

First step for connecting the USB cable is to connect it to the BP1 monitor box.



Then also zip tie it to the frame at the bottom. Zip tie the USB cable to the other 2 pin cable.



Then run the USB cable up so that it comes over the top of the backpack so that you can zip tie it onto a shoulder strap when you connect it to the tablet. Be careful to stay clear of the manual pump mechanism if that is the type of backpack sprayer you have. The USB cable will have a USB A connection, but the tablet will have a USB C connection. We'll need an adapter to finish the tablet connection.

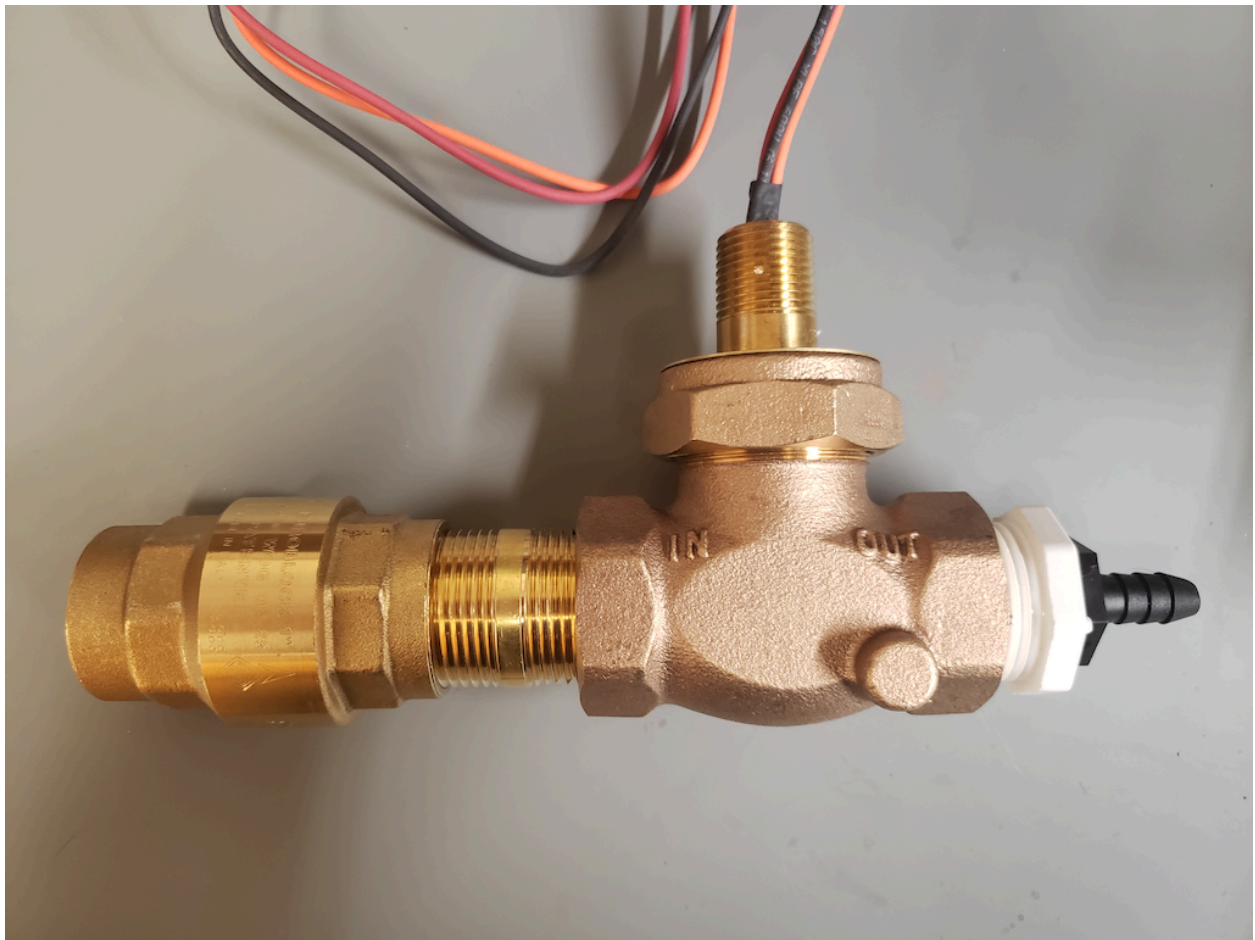


2f. Flow Switch

For tracking electrical non-powered valves or hand wands/hose reels, you can add a flow switch. When fluid flows, the flow switch connects the two wires which the WT1 monitor box can read through the 8 pin interface.

One possible flow switch we use is a Gems Sensor FS-200. It is optional to use a check valve with the flow switch, we recommend going with the flow switch only, then only bring the check valve in if you are in a situation where you see issues due to driving around between spray jobs and fluid sloshing around in the lines causes the flow switch to mistakenly trigger. The flow switch also works best if you have filtration of > 150 micron particles, without filtering your performance may vary. This flow switch can be unscrewed at the top to clean it out without removing the entire flow switch from the hoses, so if it does get dirty you just flush your system out with water, then you can safely remove the top and inspect, clean what is needed. It has 3 wires, red, orange, black. We only need the orange and black ones for our purposes.

Here is a picture of a Gems Sensors FS-200 adjustable 1-6 gpm flow switch and a check valve.



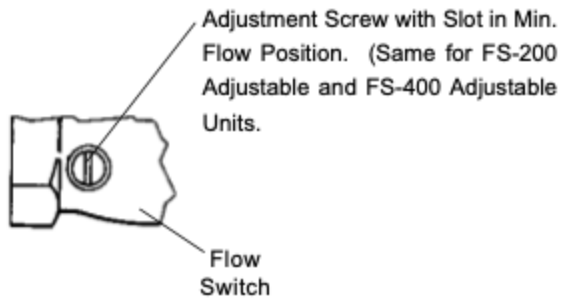
Mount with the wires coming out of the top oriented in the vertical direction, as recommended by the manufacturer.

Direction of check valve arrow points with the flow, and into the IN of the flow switch, OUT goes to the hand wand.

To adjust the flow rate setting, there is a screw:

Flow Setting Adjustment . . .
(FS-200/400 Adjustable and FS-400 Units.)

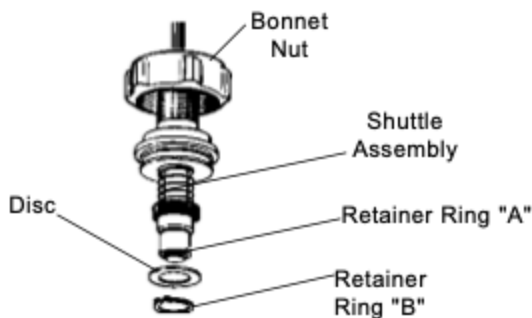
Standard units are normally supplied with adjustment set at "minimum flow" - adjustment screw slot (and vane within unit) in vertical position, as shown below. Adjustment may be made with unit on test stand or installed in system. With liquid flowing at desired rate, adjust screw in side of housing until unit just actuates. (Switch closes or opens, as desired.)



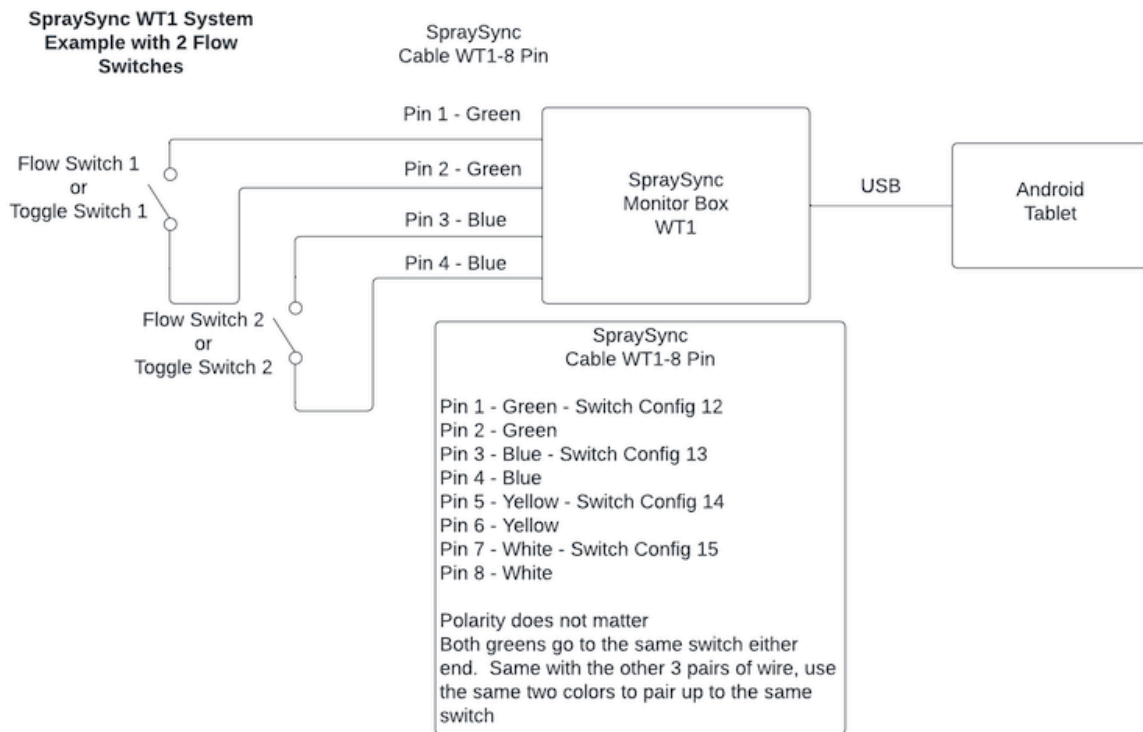
To maintain, here are instructions to remove the flow switch housing.

Maintenance . . .

Occasional cleaning when excessive contamination is present in the liquid is the only maintenance normally required. With system shut-down and no liquid in piping, remove bonnet nut to disassemble unit for cleaning. **It is not necessary to remove unit body from the system.** Remove retainer ring "A" for complete shuttle disassembly. Remove ring "B" to disassemble disc only.



In our circuit diagram for flow switches:



For the Gems Sensors FS-200 take the orange and black wires, and connect them to a pair of same colored wires in our WT1-8 pin cable. For instance, the flow switch orange wire goes to green pin 1 and the flow switch black wire goes to green pin 2. Polarity does not matter. Just make sure that the two identically colored wires from the WT1-8 pin cable go to the orange and black wires on the flow switch. For other flow switches, the wire colors may not be the same. We are looking for the wires that indicate that when there is no flow, the wires are normally open (NO). That means that when there is flow, the wires will close/connect. That connection is what the monitor box picks up as a trigger indicating spraying is happening.

2g. Tablet

We complete the hardware system by using a tablet and tablet mount. We recommend the rugged line of tablets from Samsung, the Galaxy Tab Active3 64GB of storage with unlocked LTE cellular data capability through a Verizon plan. Activating an unlimited cellular data plan enables the table to sync live while spraying, however the application and system still works when it is offline with no access or poor quality. In addition to your spray maps and log/form entries, most configuration changes you make using the SpraySync mobile app on the tablet will sync to the cloud using the tablet's cellular data plan.

Our SpraySync monitor box uses a hardware USB to transfer data about the switches/valves to the mobile app, and this particular tablet allows us to power the tablet and also plug our Monitor box in via USB. This is possible, but not as easily done with other tablets. The Active line of tablets from Samsung have a docking station interface at the bottom of the tablet that allows the tablet mount to power and keep a USB port open to plug our box in.



Optionally, you may use the larger, newer version of the Active3, which is the Active4 Pro. The Active4 Pro is available at a higher price point than the Active3.

Cables

WT1 Box Cables

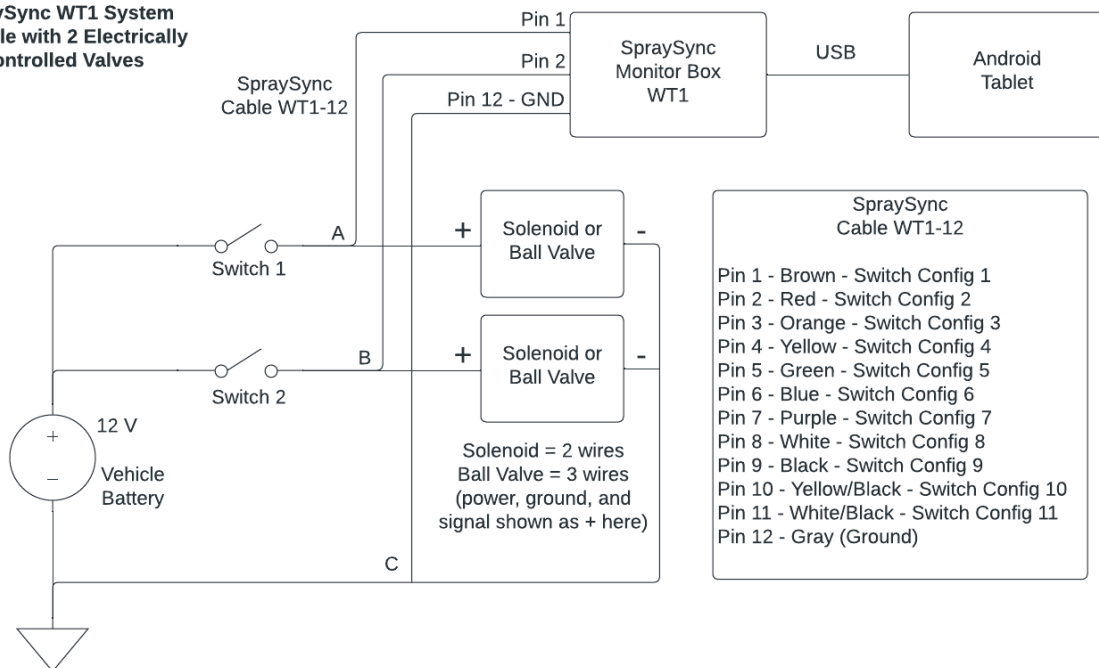
There are 3 cables that may ship with the SpraySync WT1 box. Either of the cables may not be included depending on what your sprayer requires.

- 12 pin voltage signal cable - Cable WT1-12
- 8 pin flow switch no-voltage signal cable for tracking up to 4 flow switches/toggle switches - Cable WT1-8
- Screw in USB cable

12 pin WT1-12 Cable

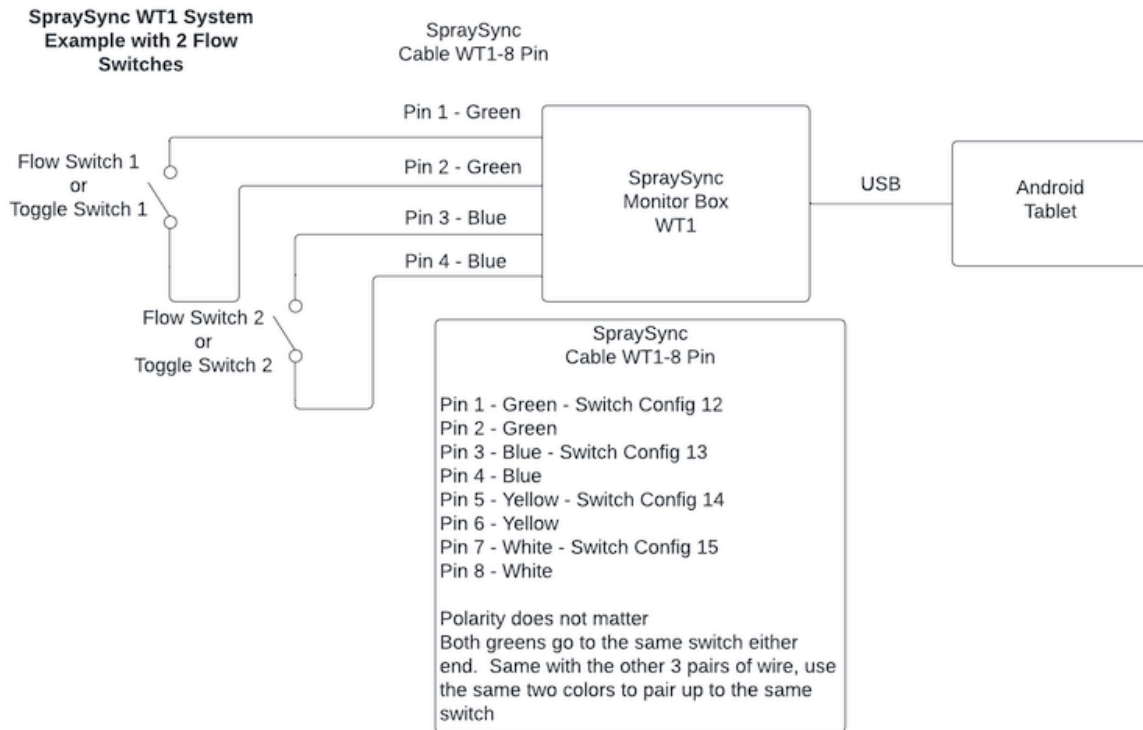
The 12 pin voltage signal cable WT1-12 is capable of tracking 11 voltage signals and has 1 ground connection. Pins 1-11 represent switches 1-11 in the app. Pin 12 is ground. The connector is a snap in connector, no twist, that has a locking tab. The connector and cable are also waterproof rated.

**SpraySync WT1 System
Example with 2 Electrically
Controlled Valves**



8 pin Flow Switch Cable

The 8 pin flow switch no-voltage signal cable should never have a live voltage 12v signal put on it. It is only for flow switches or for electrical non-voltage switches that you have as a passive monitor of an actual switch (as in a DPST switch where a powered pole goes to the valve and the non-powered pole goes to one of these). The 8 wires will be 2 green, 2 blue, 2 yellow, 2 white designed as pairs. If you want to monitor a flow switch, you send both green wires out and connect them up to the two flow switch wires that close when flow is detected. Since they are a passive/non-voltage switch, the polarity does not matter. The green wires will be input 12, the blue wires will be input 13, yellow will be input 14, white will be input 15, in the SpraySync vehicle switch config. The SpraySync WT1-8 cable connector is a snap-in connector, no twist, that has a locking tab. The connector and cable are also waterproof rated.



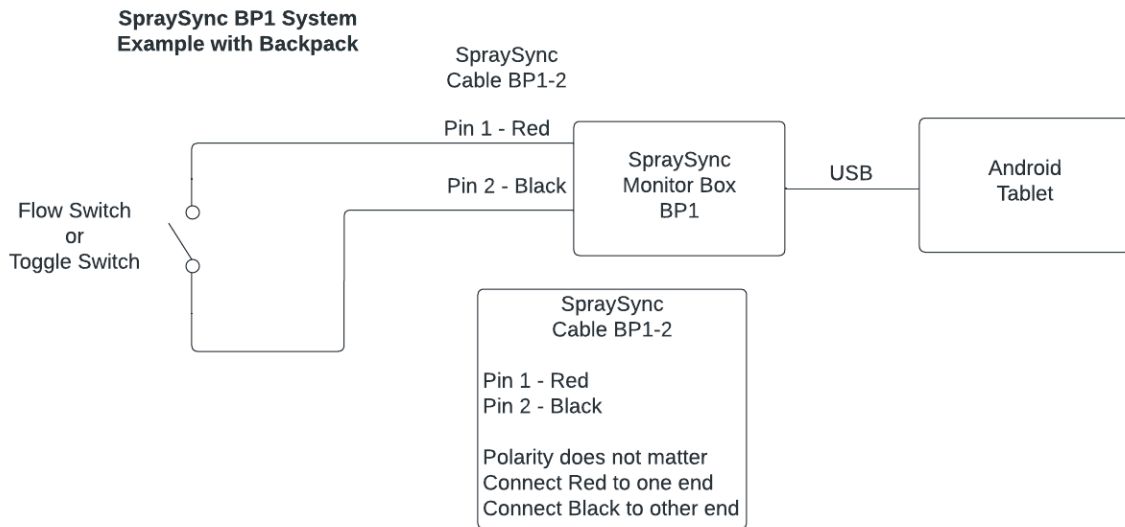
USB Cable

The screw in USB cable is a custom cable that is screwed in to prevent any vibration from causing the cable to fall out. The opposite end that goes into the tablet mount does not have a screw end, but it is recommended to zip tie the USB to the tablet mount if you have issues with it falling out.

BP1 Box Cables

There are 2 cables that ship with the SpraySync BP1 box

- 2 pin flow switch no-voltage signal cable for tracking a single flow switch/toggle switch - Cable BP1-2
- Screw in USB cable



3. Versioning

- [1] - Initial User Guide
- [2] - Updating features and supported sprayer units
- [3] - Updating for 2022 latest screenshots
- [4] - Hardware updates and details, wiring diagrams, and new tank level log feature
- [5] - Split Hardware/Software guides into two separate documents
- [6] - More flow switch info
- [February 2024] - More details on the flow switch, breaking out BP1 and WT1 flow switch sections to make more clear.