

# XRS™

## Auto Rate Controller

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## System Manual



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### System Manual

The XRS™ Auto Rate Controller is an electronic control system optimized for orchard and vineyard spraying. It can help you achieve maximum yields and operate more cost-effectively by providing the information you need to maintain proper application rates of liquid chemicals and fertilizer. The system has been designed for easy installation and operation. However, since each installation will vary depending on your equipment, please take time to familiarize yourself with this manual and the actual components before beginning installation. Following the procedures described in this manual will help ensure proper performance and avoid problems or questions once you are in the field.

The XRS™ can be configured for English or Metric units.  
Please read the manual carefully and follow the instructions that apply to your application.

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# Kit Component Parts and Hardware

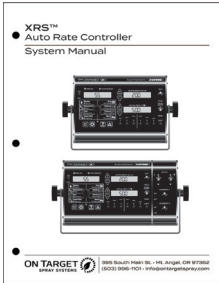
Note: photos include parts from both PN02024 - Standard Version and PN02025 - Sidecar Version kits



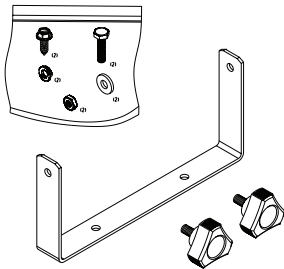
**XRS Console**  
P/N 19920



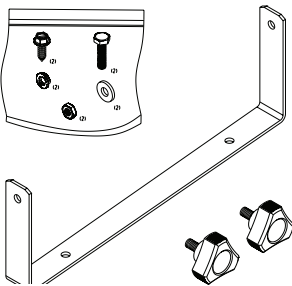
**XRS Console w/Sidecar**  
P/N 19909



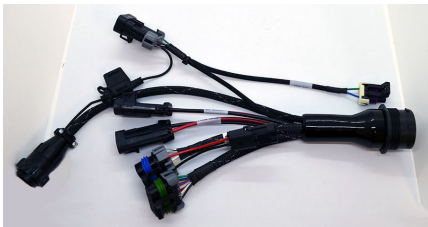
**Reference Manual**  
P/N 19910



**Console Mount Kit**  
P/N 13774



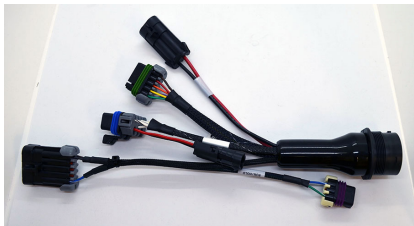
**Console Mount Kit**  
P/N 19935



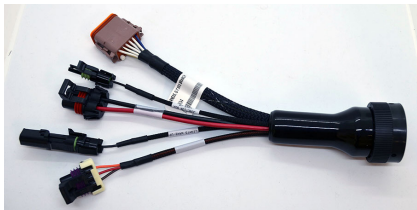
**Wiring Harness SC, Console/Junc.**  
P/N 19912



**Wiring Harness SC, Branch**  
P/N 19913



**Wiring Harness, Console/Junc.**  
P/N 19933



**Wiring Harness, Branch**  
P/N 19934



**Power Cable, w/10A fuse**  
P/N 14315-C



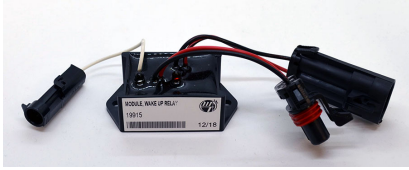
**Power Cable, w/30A fuse**  
P/N 19914



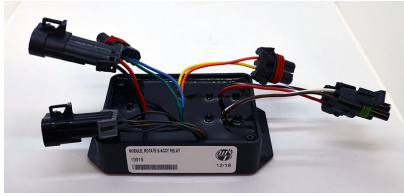
**Power Cable, Junction Box**  
P/N 19916

# Kit Component Parts and Hardware

Note: photos include parts from both PN02024 - Standard Version and PN02025 - Sidecar Version kits



**Wake Up Relay Module**  
P/N 19915



**Rotate & Accy. Relay Module**  
P/N 19919



**Extension Cable, 25' 3-pin M/P150**  
P/N 13209



**Extension Cable, 25' 2-pin M/P480**  
P/N 18829



**Extension Cable, 25' 6-pin M/P**  
P/N 18826



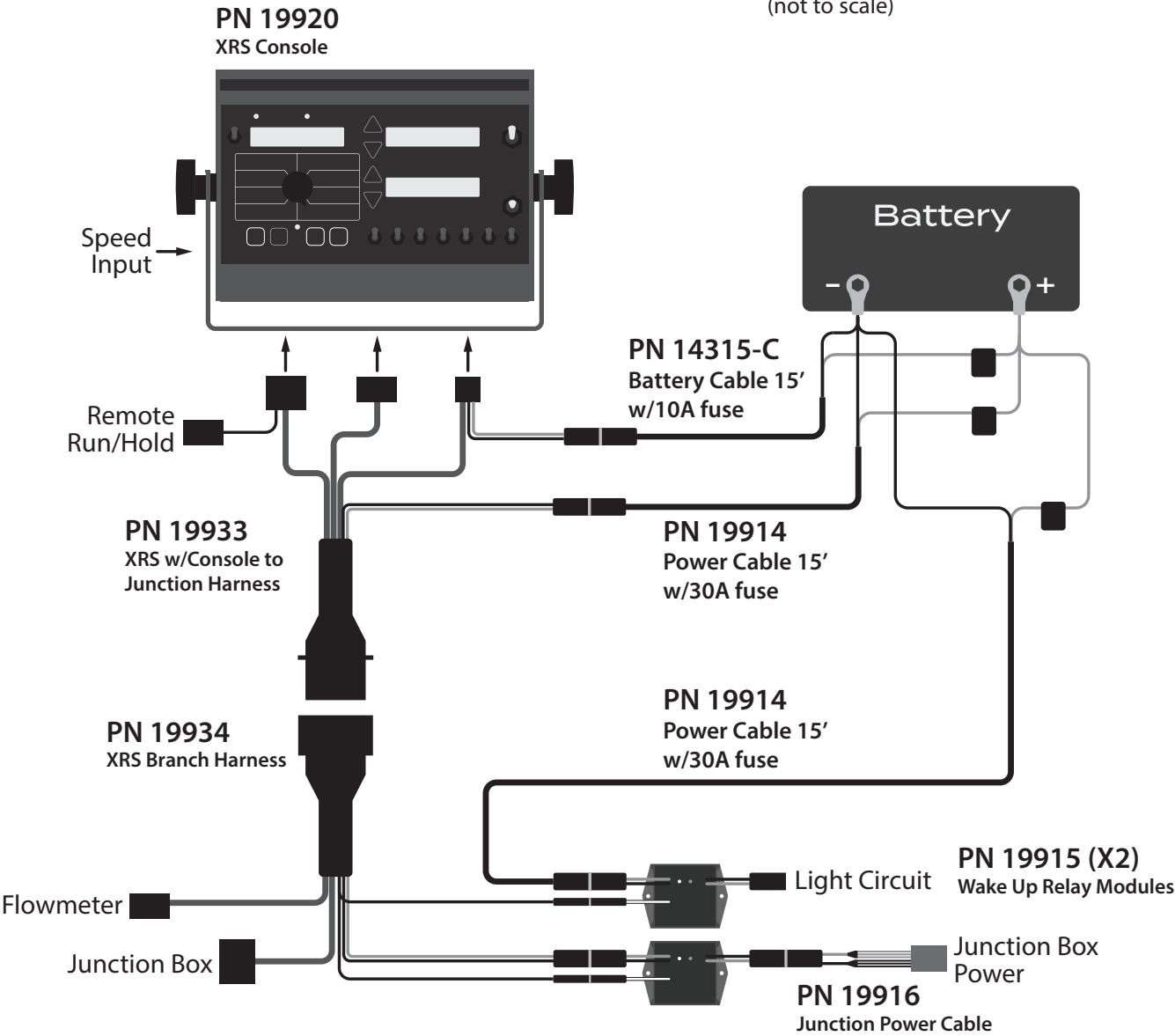
**Extension Cable, 5' 2-pin M/P480**  
P/N 18827



**Extension Cable, 10' 2-pin M/P480**  
P/N 18828

# System Overview

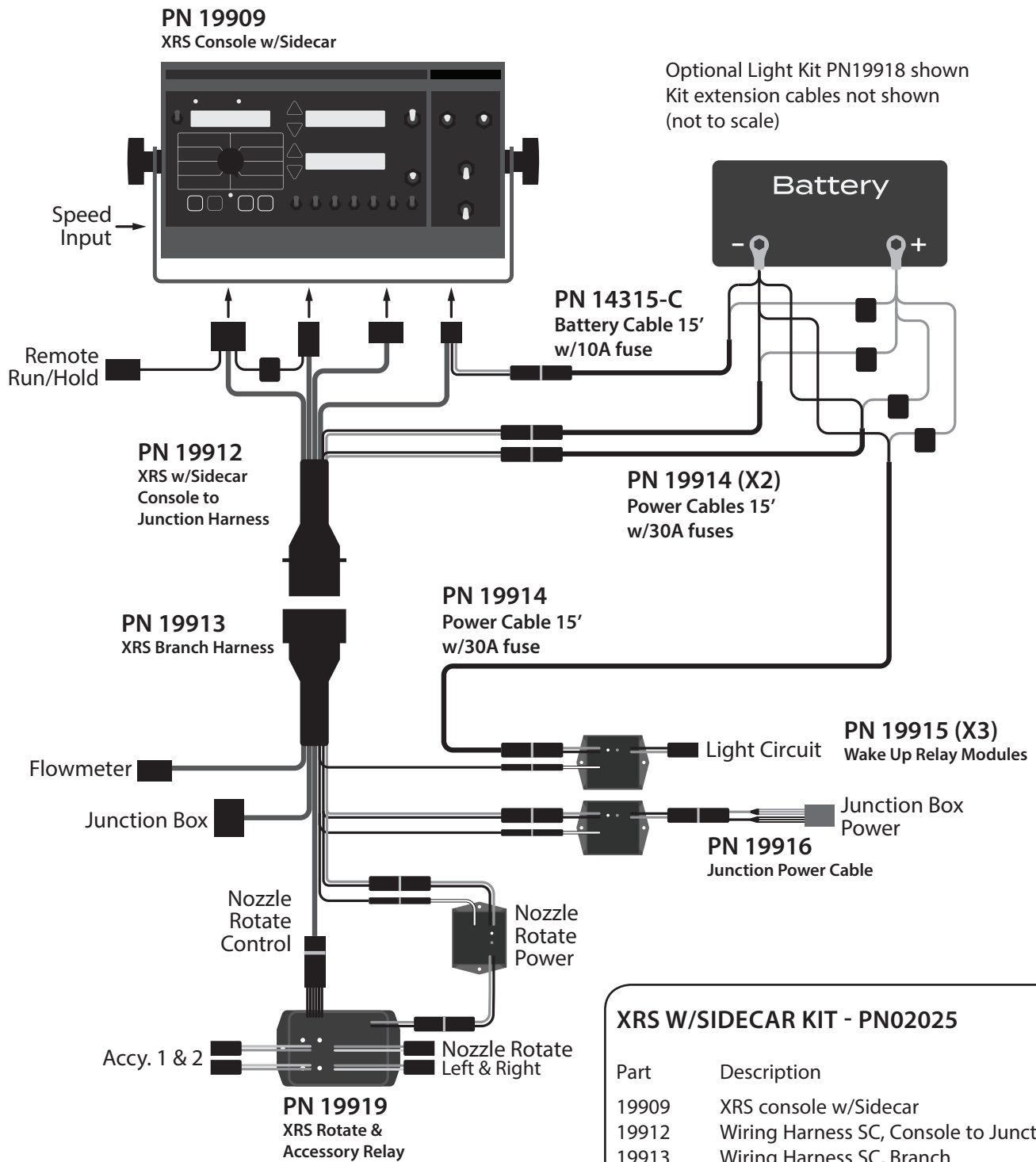
Optional Light Kit PN19918 shown  
Kit extension cables not shown  
(not to scale)



## XRS KIT - PN02024

Part	Description	Qty.
19920	XRS Console	1
19933	Wiring Harness, Console to Junction	1
19934	Wiring Harness, Branch	1
14315-C	Power Cable w/10A fuse, 15'	1
19914	Power Cable w/30A fuse, 15'	1
19916	Power Cable, Junction Box	1
13209	Extension Cable, 25' 3-pin M/P150	1
19915	Wake Up Relay Module	1
13774	Console Mount Kit	1
19910	XRS Manual	1

# System Overview



## XRS W/SIDECAR KIT - PN02025

Part	Description	Qty.
19909	XRS console w/Sidecar	1
19912	Wiring Harness SC, Console to Junct.	1
19913	Wiring Harness SC, Branch	1
14315-C	Power Cable w/10A fuse, 15'	1
19914	Power Cable w/30A fuse, 15'	2
19916	Power Cable, Junction Box	1
18827	Extension Cable, 5' 2-pin M/P480	1
18828	Extension Cable, 10' 2-pin M/P480	1
18829	Extension Cable, 25' 2-pin M/P480	1
13209	Extension Cable, 25' 3-pin M/P150	1
18826	Extension Cable, 25' 6-pin M/P	1
19915	Wake Up Relay Module	1
19919	Rotate & Accy. Relay Module	1
19935	Console w/Sidecar Mount Kit	1
19910	XRS Manual	1

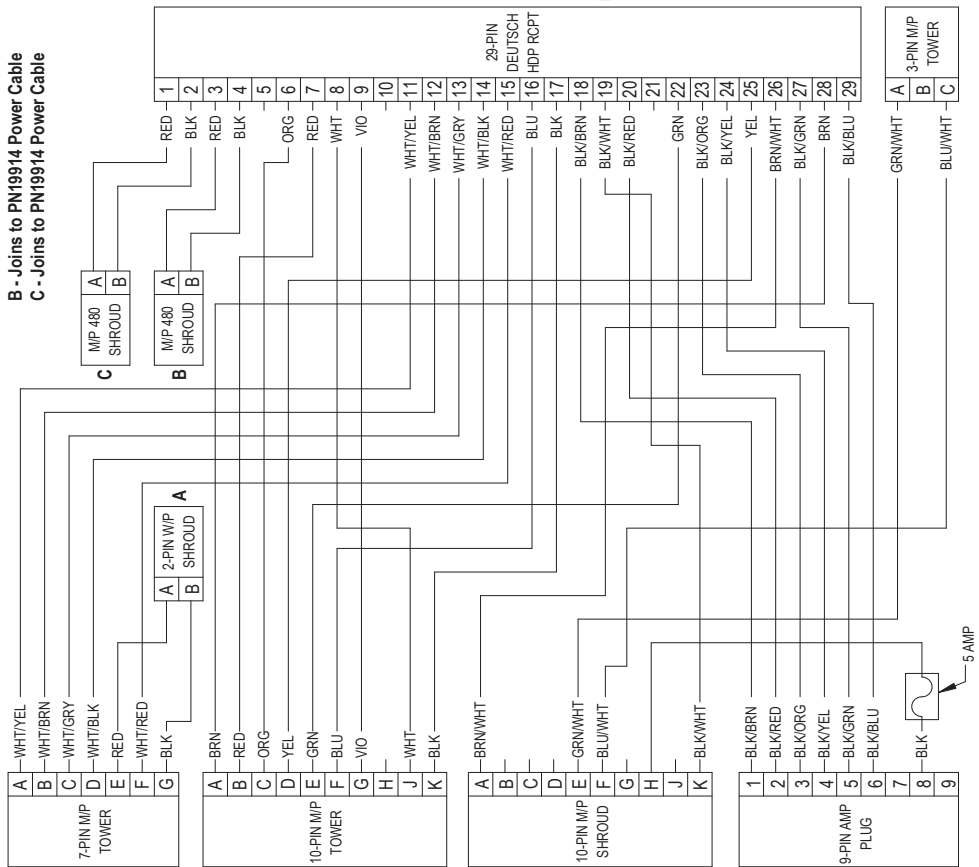
8  
XRS ELECTROSTATIC CONSOLE





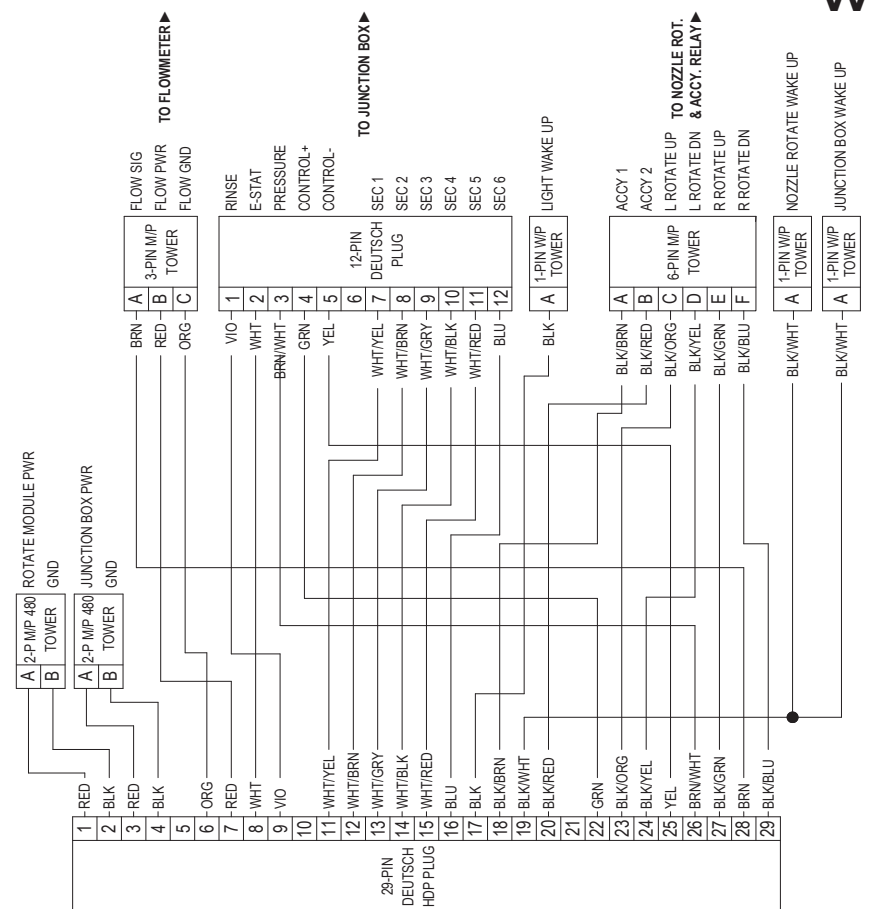
### PN 19912

Console (w/ Sidecar) to Junction Branch Harness Cable



### PN 19913

Console (w/ Sidecar) to Junction Branch Harness Cable



XRS ELECTROSTATIC CONSOLE

SIDECAR

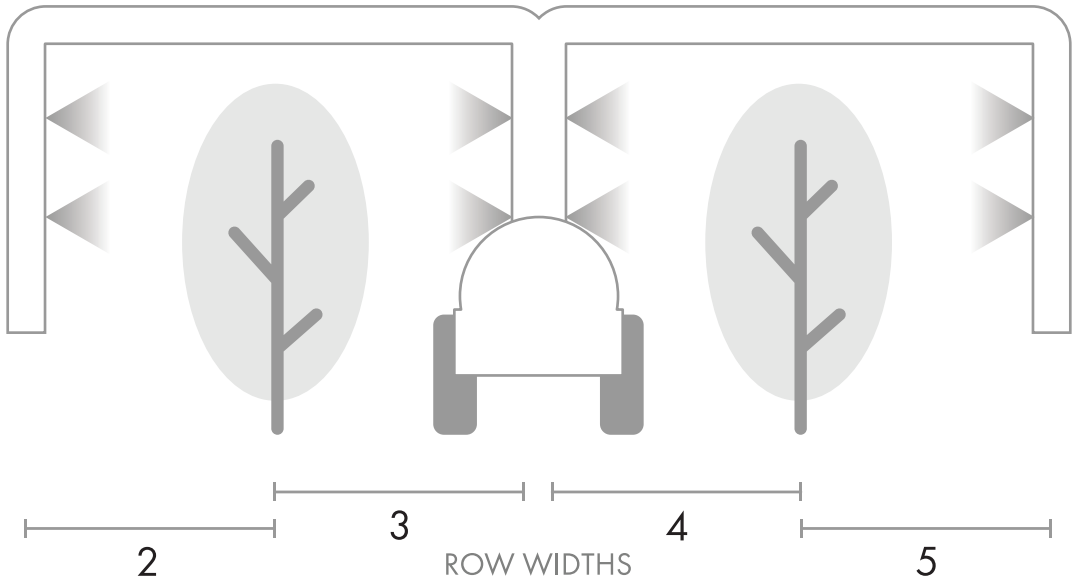
# Operating Modes

## Vineyard Mode:

**Sections:**

Sections are assigned consecutively left to right, as shown. Each section has individually assignable row width.

**Note:** in the shown configuration, Sections 1 & 6 would not be used.



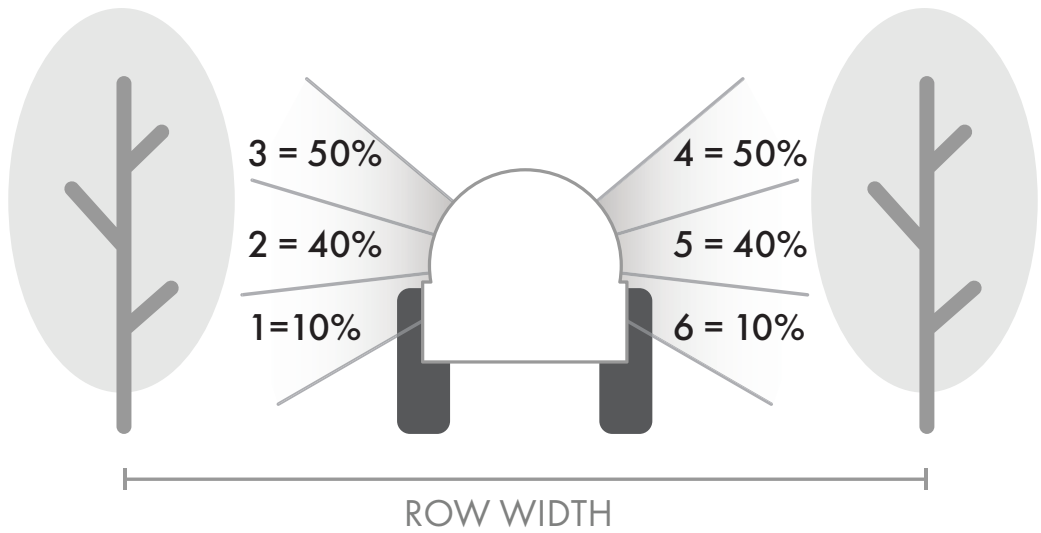
## Orchard Mode:

**Sections:**

Row Width is defined as the working distance illustrated below. If all sections are on, the full Active Width is used to accumulate Area sprayed. If one section is shut off, the full width is still used to calculate area. However, if all sections on the same side are turned off, the Active Width is reduced by half. The Active Width is always displayed in the top right side display.

**Section Rate Percentage:**

Section rate percentage is assignable per side to accommodate a variety of spraying situations. As a default, sections 1 & 6 each apply 10% of rate, sections 2 & 5 each apply 40%, and sections 3 & 4 each apply 50%, as shown. These percentage settings are accessed in Calibration Mode in the **%Rate/Sect.** parameter (**Distance** position on rotary dial).



# Function Summary

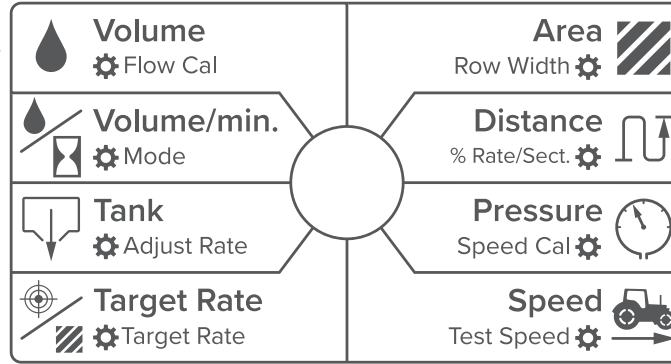
## Rotary Dial Positions

**Volume:** Displays the total volume of product applied in gallons (liters). May be reset. **See note below.**

**Volume/min.:** Total gallons (liters) of liquid applied per minute.

**Tank:** Gallons (liters) of liquid remaining in Tank.

**Target Rate:** Current Target Rate



**Area:** Keeps a running count of the total area worked in acres (hectares). May be reset. **See note.**

**Distance:** Distance traveled in either Feet or Meters. May be reset.

**Pressure:** System pressure (if pressure sensor is connected to system).

**Speed:** Ground speed in miles per hour (kilometers per hour).

**Indicator LED:** On when in Calibration and Special Calibration modes, and to indicate Rate Alarm Errors.

**Note:** VOLUME and AREA counters function in pairs. If the VOLUME counter 1 is reset, it also resets AREA counter 1. There are 3 independent data sets. The number icon indicates which counter set is shown. Counters do not accumulate data when console is in HOLD or sections are turned off.

## Button Functions



### AUTOMATIC/MANUAL

Changes operation from automatic control to manual. (If Manual Control is enabled).



### CALIBRATION

- Enters & exits calibration modes.
- Selects the Section # in 'Width Cal' position.
- Select the page # in "Special" Calibration.



### INCREASE/DECREASE



- In Volume or Area, the "+" button selects the counter set.
- RESET: When in Hold and not in CAL, clears the selected counter set when held for one second.
- When in CAL, the "+" button increases and the "-" button decreases the calibration value displayed.



### ADJUST

ACTIVE WIDTH

Adjusts the total working width. Increment of change is specified in Special Cal. settings.

ACTUAL RATE

Adjusts the application rate in real time. The new rate is stored in memory and is recalled if changing rate with Rate Select switch. Increment of change is specified in Calibration - Adjust Rate setting.

## Switch Functions

Console Power Switch



Switches system between active and standby



### Section switches

Up=On  
Down=Off



1



**E-Stat On/Off:** By default, E-Stat circuitry is enabled and indicated by LED above main window. To disable E-Stat circuit, hold switch up for 2 seconds (same to re-enable).

**Rinse:** To initiate Rinse routine, hold switch down for 2 seconds. Rinse routine can be cancelled by again holding the switch down for 2 seconds. Rinse duration and flow rate parameters are located in **Special Calibration** menu.

## Display Windows

- Main Display Window** - shows data from current choice on rotary dial. Also displays Hold status, calibration page number, auto/manual status, and counter number.
- Active Width** - shows total active width in feet during application. Shows "HOLD" when system is in hold.
- Actual Rate** - Displays Actual Rate of application.

1

ACTIVE WIDTH

2

ACTUAL RATE

3

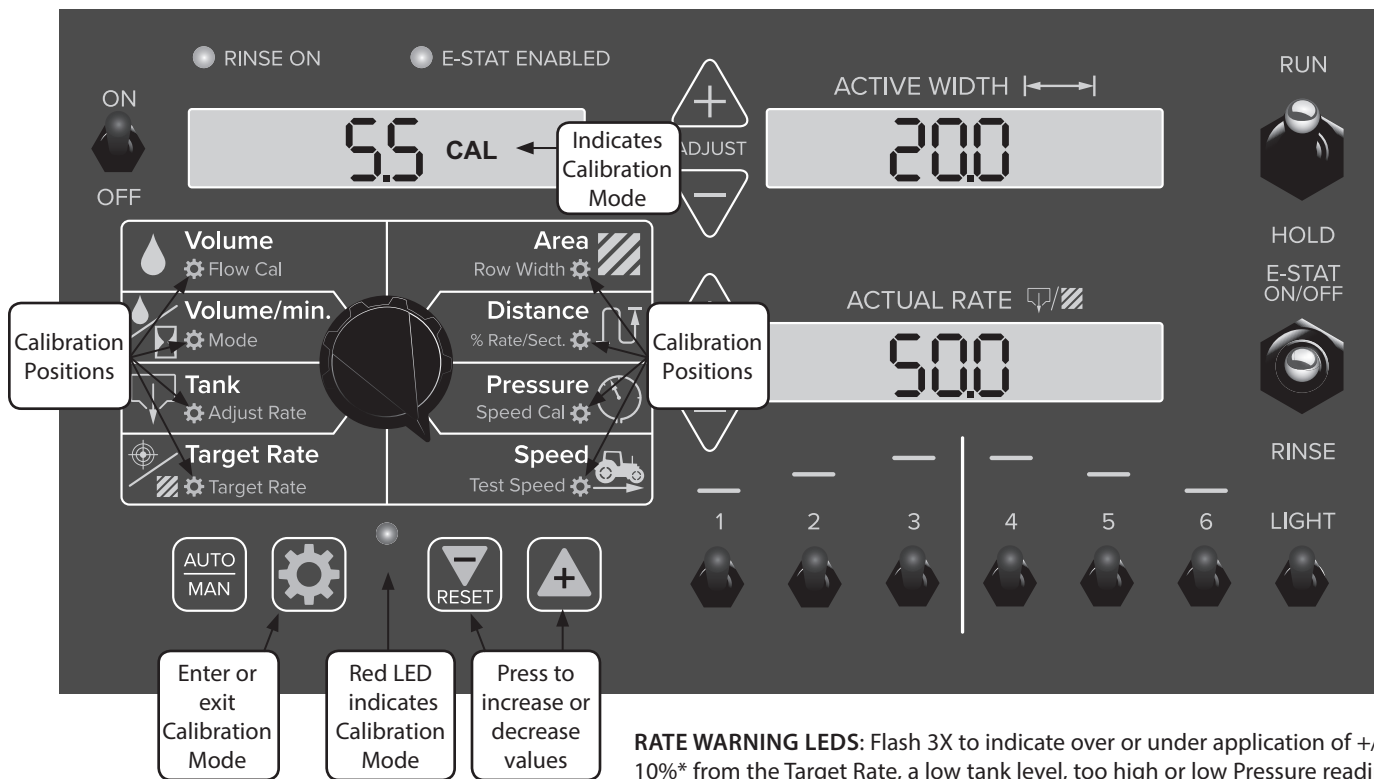
# Calibration

Before operating the XRS, it is necessary to calibrate it for the intended work and components. The first step is choosing intended UNITS - English or Metric, in Special Calibration, page 15.

## CALIBRATION STEPS:

1. Stop the vehicle, if moving.
2. Switch console to HOLD.
3. Press and hold the CAL button about 1 second until the 'CAL' icon appears on screen and Red LED light is on.
4. Select calibration position on rotary selector (see explanations of each position starting on page 13).
5. Adjust values using Increase/Decrease buttons.
6. To exit Calibration without saving changes - turn console OFF.
7. To save changes and exit Calibration - press and hold the CAL button for 1 second - 'CAL' icon on screen will turn off and red LED light will turn off.

The example shown here would turn on Test Speed, and adjust the Test Speed value.












**RATE WARNING LEDS:** Flash 3X to indicate over or under application of +/- 10%\* from the Target Rate, a low tank level, too high or low Pressure readings, or Minimum Flow feature is active. \*NOTE: % adjustable via 'Rate Alarm Threshold'.

## Calibration (cont.)

### Calibration Positions

<b>Flow Cal</b>	<p>This position calibrates the system to the flowmeter factory setting. The XRS system is designed to read flowmeter input as <b>Pulses per Unit x2</b>. Input the calibration number found in your flowmeter documentation. Default is 145. Setting this number to 0 enables Pressure Based Control - see Appendix D.</p> <p><b>Default: 145</b></p>	<b>Row Width</b>	<p>Adjust the effective working width for each section. Unit increment is .1'. To adjust Row Width, quickly press and release the CAL key until the desired Section Number is displayed in the Width window. Use +/- buttons to adjust each value.</p> <p>Enter a value of "0" (.000) for any unused sections.</p> <p><b>Defaults:</b> Vineyard - each section 10' Orchard - 20'</p>
<b>Mode</b>	<p>See Operating Modes - pg. 11. Choose between Vineyard and Orchard mode:</p> <p><b>Vineyard Mode:</b> Sections are configured from left to right. Each section has a separate width.</p> <p><b>Orchard Mode:</b> Sections are functionally grouped - sections 1 2 3 on the left, and sections 4 5 6 on the right. Application rate is divided on each side into 10% of rate in sections 1 &amp; 6, 40% of rate in sections 2 &amp; 5, and 50% from sections 3 &amp; 6. (Default rates listed - see %Rate/Sect. parameter at right.)</p> <p><b>Default: Vineyard</b></p>	<b>%Rate/Sect.</b>	<p><b>Orchard mode only.</b> This setting modifies the assignment of rate percentage between grouped sections. (See <b>Mode</b> at left.) Upper right window shows which section is being adjusted. Press Cal button to advance through sections.</p> <p><b>Defaults: 1&amp;6=10%, 2&amp;5=40%, 3&amp;6=50%</b></p>
<b>Adjust Rate</b>	<p>Adjust the value for the desired amount of change to be used for making on-the-go rate adjustments. When operating in AUTO control, pressing +/- buttons will change the TARGET RATE by the amount entered for ADJUST RATE. This allows the operator to make incremental changes to the TARGET RATE. To disable this feature, simply enter a value of zero.</p> <p><b>Default: 1</b></p>	<b>Speed Cal</b>	<p>This position calibrates the system to the speed sensor. The XRS system is designed to read distance input as <b>Distance per Unit</b>. Default value is .189 for Micro-Trak Astro GPS sensor. NOTE: A fine-tuning procedure for calibration factors is explained in Appendix C.</p> <p><b>Default: .189</b></p>
<b>Target Rate</b>	<p>Adjust the value for the selected target application rate in gallons per acre (liters per hectare). This is the application rate that the console will lock onto when operating in AUTO.</p> <p><b>Default: 50</b></p>	<b>Test Speed</b>	<p><b>(OPTIONAL) TEST SPEED</b> is <u>not</u> a CALIBRATION setting. It internally simulates a speed signal to test the system without the vehicle moving. It allows you to test a spraying application with water to make certain that all of the equipment is operating properly while remaining stationary. Test speed is cancelled by exiting CAL. Test speed will not accumulate Distance/Area measurements.</p> <p><b>Default: 0</b></p>

## Calibration Default Settings & Change Notes

Your Setting	Default					Default	Your Setting									
	145	 <b>Volume</b> ⚙️ Flow Cal			<b>Area</b>  Row Width ⚙️		Vin.: All sections 10' Orch.: 20'									
	Vineyard	 <b>Volume/min.</b> ⚙️ Mode			<b>Distance</b>  % Rate/Sect. ⚙️		<table><tr><th>Left</th><th>Right</th></tr><tr><td>3 = 50%</td><td>4 = 50%</td></tr><tr><td>2 = 40%</td><td>5 = 40%</td></tr><tr><td>1 = 10%</td><td>6 = 10%</td></tr></table>	Left	Right	3 = 50%	4 = 50%	2 = 40%	5 = 40%	1 = 10%	6 = 10%	
Left	Right															
3 = 50%	4 = 50%															
2 = 40%	5 = 40%															
1 = 10%	6 = 10%															
	1	 <b>Tank</b> ⚙️ Adjust Rate		<b>Pressure</b>  Speed Cal ⚙️		.189										
	50	 <b>Target Rate</b> ⚙️ Target Rate		<b>Speed</b>  Test Speed ⚙️		0										

# Special Calibration

Special Calibration mode accesses important system parameters and settings.

## SPECIAL CALIBRATION STEPS:





1. Turn ON console while pressing the CAL button - screen will display "SPEC", then 'CAL' and number 1 (Page 1).
2. Select a Special Calibration position using rotary knob. (See explanations of settings on page 15)
3. Adjust Page 1 value or press the CAL button to access Pages 2-4.
4. Adjust value using Increase/Decrease buttons.
5. To exit Special Calibration without saving changes - turn console OFF.
6. To save changes and exit Special Calibration - press and hold the CAL button for 1 second - 'CAL' icon on screen will turn off and red LED light will turn off.





**NOTE: Supervisor Lockout** - Press and hold Auto/Man button 3 seconds to enter Supervisor Lockout control - use Increase/Decrease buttons to enable/disable this feature. Once locked, Special Calibration values can be viewed but not adjusted. Press CAL button to exit.

## Restoring Default Calibration Values

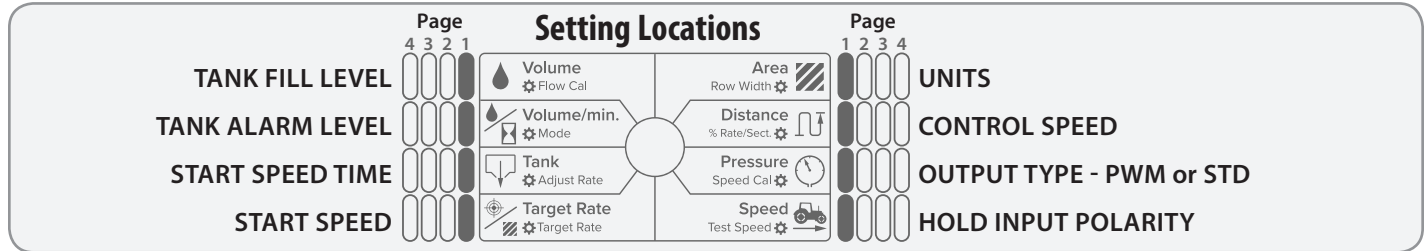
To restore default calibration values and clear all counters (Tank, Volume, Area and Distance):

1. Change the UNITS value. (Area position - page 1)
2. Turn the rotary knob to a different calibration page.
3. Turn the rotary knob back to UNITS.
4. Reset UNITS value to original choice.

Page 4	Page 3	Page 2	Page 1		Left Side of Rotary Dial
Minimum Alarm Speed	Minimum Pressure	Manual Enable	Tank Fill Level	←	 <b>Volume</b> ⚙️ Flow Cal
Audible Alarm Enable	Fixed Minimum Flow	Three-way Valve Enable	Tank Alarm Level	←	 <b>Volume/min.</b> ⚙️ Mode
Section Input Polarity	Proportional Minimum Flow	Auto Shutoff	Start Speed Time	←	 <b>Tank</b> ⚙️ Adjust Rate
Custom Data Select	Rate Alarm Threshold	Agitation % PWM / STD Valve Polarity	Start Speed	←	 <b>Target Rate</b> ⚙️ Target Rate

Right Side of Rotary Dial	Page 1	Page 2	Page 3	Page 4
<b>Area</b> Row Width ⚙️ 	Units	Pressure Offset	PWM PWM Frequency	Rinse Time
<b>Distance</b> % Rate/Sect. ⚙️ 	Control Speed	Pressure Alarm Low	PWM Maximum Pulse Width	Rinse Flow Rate
<b>Pressure</b> Speed Cal ⚙️ 	Output Type PWM or STD	Pressure Alarm High	PWM Minimum Pulse Width	—
<b>Speed</b> Test Speed ⚙️ 	Hold Input Polarity	Pressure Full Scale	Row Width Adjust	—

## Special Calibration Settings - Page 1



### TANK FILL LEVEL

**Location:** PAGE 1 - VOLUME

**Description:** Adjust this setting to the known capacity of the tank. This value will be automatically entered when in Tank position by pressing the Increase (+) button. This can be set to OFF (0) up to 65535 max.

Parameter units:

English - gallons

Metric - liters

**Default:** Off

### TANK ALARM LEVEL

**Location:** PAGE 1 - VOLUME/MINUTE

**Description:** Enables and adjusts value for Tank Alarm - set value to notify operator when level is reached. This can be set to OFF (0) or between 1 - 65535.

Parameter units: English = gallons, Metric = liters.

**Default:** Off

### START SPEED TIME

**Location:** PAGE 1 - TANK

**Description:** Enables "Quick Start - Speed" function and defines the duration of the simulated speed - up to 6 seconds. See Appendix C for details. Setting to 0 (Off) will disable the function.

**Default:** Off

### START SPEED

**Location:** PAGE 1 - TARGET RATE

**Description:** Enables "Quick Start - Speed" function and defines the intended simulated speed in MPH (km/H). See Appendix C for details. Setting to 0 (Off) will disable the function.

**Default:** Off

### UNITS

**Location:** PAGE 1 - AREA

**Description:** Defines unit of measurement - English, Metric - and loads system defaults. Changing UNITS setting also clears all counters.

**Default:** English

### CONTROL SPEED

**Location:** PAGE 1 - DISTANCE

**Description:** (OPTIONAL) This position adjusts valve response time to fine-tune the system. Example: increase Control Speed if the system is responding slowly to rate changes because of slow-moving valves. The range of settings is -12 to 3.

**NOTE:** Exercise caution when increasing the valve response speed - the system may become unstable with higher control speed numbers entered.

**Default:** -1

### OUTPUT TYPE - PWM OR STD

**Location:** PAGE 1 - PRESSURE

**Description:** Choose PULSE (PWM) OR STD (reversing polarity DC) electronic drive signal for the control valve. The display will show PULSE or STD (also shown when console is powered up.)

**Default:** Standard DC

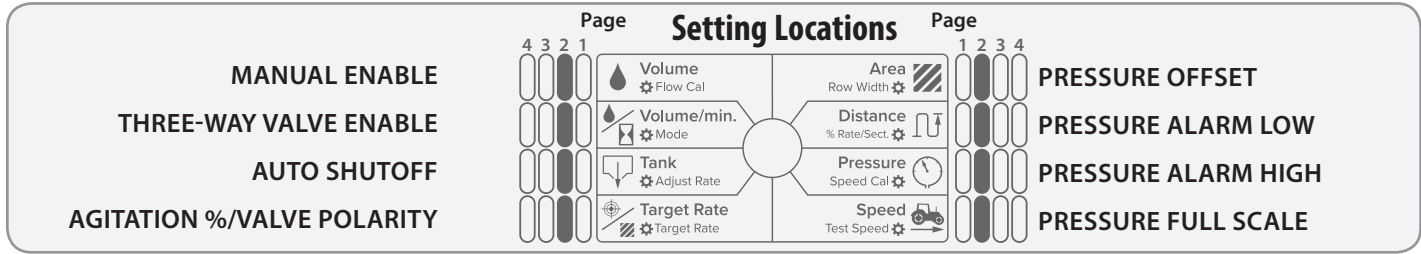
### HOLD INPUT POLARITY

**Location:** PAGE 1 - SPEED

**Description:** On Remote Run/Hold connection - allows user to reverse the circuit function. The default setting is CLOSED - meaning that XRS will be in HOLD when the circuit is closed.

**Default:** Closed





## MANUAL ENABLE

**Location:** PAGE 2 - VOLUME

**Description:** Enables (ON) or disables (OFF) Manual Control mode. Disabling this function means the console will only run in AUTO mode and the AUTO/MAN switch will be inactive.

**Default:** On

## THREE-WAY VALVE ENABLE

**Location:** PAGE 2 - VOLUME/MIN.

**Description:** Enables the use of three-way Valves with the XRS system. This setting changes the internal calculations for section totals so that flow in return lines to the tank (or to hydraulic system) is not included when sections are turned off.

**Default:** Off

## AUTO SHUTOFF - STD ONLY

**Location:** PAGE 2 - TANK

**Description:** Enables Auto Shutoff feature - it runs the control valve towards minimum flow each time HOLD is selected, or when all (non-zero width) sections are turned off, or when in AUTO and ground speed goes to zero. Duration of Auto Shutoff feature is 18 seconds.

**Default:** Off

## AGITATION PERCENTAGE - PWM ONLY

**Location:** PAGE 2 - TARGET RATE

**Description:** In PWM Output, this enables Tank Agitation when system is in Hold, and adjusts the desired duty cycle for the agitation. This can be set to OFF (0) or from 1 to 100%. Agitation is disabled during any calibration mode.

**Default:** Off

## VALVE POLARITY - STD ONLY

**Location:** PAGE 2 - TARGET RATE

**Description:** In STD Output, this defines operation of the flow control valve - choose Bypass or Inline plumbing configuration.

**Default:** Inline

## PRESSURE OFFSET

**Location:** PAGE 2 - AREA

**Description:** Adjusts system to calculate pressure readings when using an "Absolute" style pressure sensor. Input Absolute Atmospheric Pressure in PSI (bar) for your location.

Note: Leave at 0 when using optional Micro-Trak pressure sensor(s) P/N 18757-18758, they are "gauge" type sensors and self-adjust for ambient atmospheric pressure.

**Default:** 0

## PRESSURE ALARM LOW

**Location:** PAGE 2 - DISTANCE

**Description:** Enables and adjusts value for Pressure Alarm - set value to notify operator when low level is reached. This can be set to OFF (0) or up to 50% of FULL SCALE setting. Parameter units: English = PSI, Metric = bar.

**Default:** Off

## PRESSURE ALARM HIGH

**Location:** PAGE 2 - PRESSURE

**Description:** Enables and adjusts value for Pressure Alarm - set value to notify operator when high level is reached. This can be set to OFF (0) or up to 100% of FULL SCALE setting. Parameter units: English = PSI, Metric = bar.

**Default:** Off

## PRESSURE FULL SCALE

**Location:** PAGE 2 - SPEED

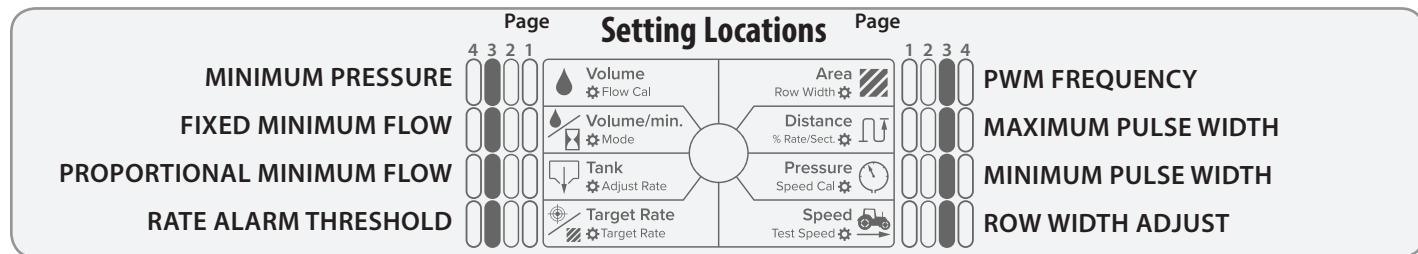
**Description:** Displays and adjusts FULL SCALE (maximum) value for Pressure Sensor. Default setting is 150 PSI for Micro-Trak Pressure Sensor P/N 18757. Adjust it to 300 PSI for Micro-Trak P/N 18758.

NOTE: This measurement is always rated in PSI - even if Metric units were specified in the UNITS Special Calibration setting.

**Default:** 300



## Special Calibration Settings - Page 3



### MINIMUM PRESSURE

**Location:** PAGE 3 - VOLUME

**Description:** When using Pressure Control, this sets an absolute minimum flow for the system.

**Default:** Off

### FIXED MINIMUM FLOW

**Location:** PAGE 3 - VOLUME/MIN.

**Description:** Sets a fixed absolute minimum flow (gpm) for the system. This ensures that the flow rate is never less than the lowest range of the flowmeter - preventing the flowmeter from stalling.

**Default:** Off

### PROPORTIONAL MINIMUM FLOW

**Location:** PAGE 3 - TANK

**Description:** Sets minimum flow value in Gallons/minute for the system - proportional to the number of active sections.

**Default:** Off

### RATE ALARM THRESHOLD

**Location:** PAGE 3 - TARGET RATE

**Description:** Adjusts threshold value for the Rate Alarm - can be set from 10-30%. This value is the percentage of difference between the actual rate of application and the intended (target) rate.

**Default:** 10%

### PWM FREQUENCY - PWM ONLY

**Location:** PAGE 3 - AREA

**Description:** In PWM Output, this adjusts value for PWM Frequency. This can be set from 50 to 500Hz. Consult your PWM device information for optimal frequency.

**Default:** 200Hz.

### MAXIMUM PULSE WIDTH PWM ONLY

**Location:** PAGE 3 - DISTANCE

**Description:** In PWM Output, this adjusts value for Maximum Pulse Width. This can be set from 0 to 100% (This value must be larger than the Minimum Pulse Width.)

**Default:** 90%

### MINIMUM PULSE WIDTH PWM ONLY

**Location:** PAGE 3 - PRESSURE

**Description:** In PWM Output, this adjusts value for Minimum Pulse Width. This can be set from 0 to 100% (This value must be smaller than the Maximum Pulse Width.)

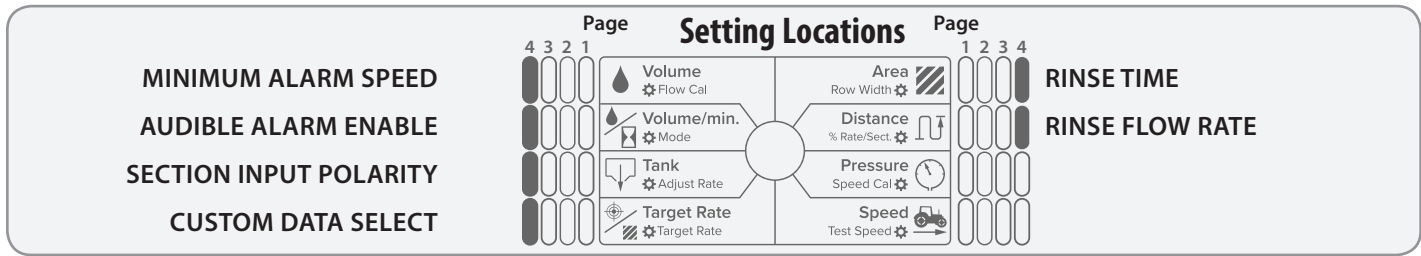
**Default:** 10%

### ROW WIDTH ADJUST

**Location:** PAGE 3 - SPEED

**Description:** This setting defines the increment step of change per key press of Increase/Decrease buttons for adjusting total width. Unit increment is .1'.

**Default:** 0.5'



## MINIMUM ALARM SPEED

**Location:** PAGE 4 - VOLUME

**Description:** Enables and adjusts a minimum speed threshold for the audible alarm - this prevents unneeded warnings while stopping and starting. This can be set to OFF (0) or from 0.1 to 99.9 mph (km/h). Affected alarms are Application Rate Error and Minimum Flow.

**Default:** Off

## AUDIBLE ALARM ENABLE

**Location:** PAGE 4 - VOLUME/MIN.

**Description:** Enables (ON) or disables (OFF) Audible Alarm function - allows user to operate system without hearing any system warnings.

**Default:** On

## SECTION INPUT POLARITY

**Location:** PAGE 4 - TANK

**Description:** This setting allows the user to reverse the polarity of section inputs. This may be useful when connecting a separate device to the XRS system for automatic section control.

**Default:** 12v

## CUSTOM DATA SELECT

**Location:** PAGE 4 - TARGET RATE

**Description:** Choose the information displayed in the data window.

Choose from:

**Rate** - Calibrated Target Rate

**Pulse** - Shows PWM output Duty Cycle

**Default:** Rate

## RINSE TIME

**Location:** PAGE 4 - AREA

**Description:** This setting defines the total duration of the Rinse routine in minutes. This can be set from .10 to 10 minutes.

**Default:** 2 minutes

## RINSE FLOW RATE

**Location:** PAGE 4 - DISTANCE

**Description:** This setting defines the intended flow rate during the Rinse routine. This can be set from .1 to 255 gallons/minute.

**Default:** 5 gallons/minute

## Special Calibration Default Settings & Change Notes

### Special Calibration - Page 1

Your Setting	Default			Default	Your Setting
	Off	TANK FILL LEVEL	UNITS	English	
	Off	TANK ALARM LEVEL	CONTROL SPEED	-1	
	Off	START SPEED TIME	OUTPUT TYPE: PWM or STD	Std DC	
	Off	START SPEED	HOLD INPUT POLARITY	Closed	

### Special Calibration - Page 2

	On	MANUAL ENABLE	PRESSURE OFFSET	0	
	Off	3-WAY VALVE ENABLE	PRESSURE ALARM LOW	Off	
	Off	AUTO SHUTOFF	PRESSURE ALARM HIGH	Off	
	Off/Inline	AGITATION or VALVE POLARITY	PRESSURE FULL SCALE	300 psi	

### Special Calibration - Page 3

	Off	MINIMUM PRESSURE	PWM FREQUENCY	200 Hz	
	Off	FIXED MINIMUM FLOW	MAXIMUM PULSE WIDTH	90%	
	Off	PROPORTIONAL MINIMUM FLOW	MINIMUM PULSE WIDTH	10%	
	10%	RATE ALARM THRESHOLD	ROW WIDTH ADJUST	0.5'	

### Special Calibration - Page 4

	Off	MINIMUM ALARM SPEED	RINSE TIME	2 minutes	
	On	AUDIBLE ALARM ENABLE	RINSE FLOW RATE	5 GPM	
	12v	SECTION INPUT POLARITY		Not Used	
	Rate	CUSTOM DATA SELECT		Not Used	

# Operation

Make sure your system is properly calibrated before beginning to apply product. *We also recommend completion of the Pre Application System Checkout described on page 21 prior to beginning any operations.*

## Manual Operation

This mode sets and maintains a steady flow rate (GPM) **not** affected by changes in vehicle speed. The overall application rate (GPA) will vary depending on speed (slow vehicle speed = increased application rate, fast speed = lower application rate.)

Manual mode is most useful for system set up, spot applications, etc.

1. Press the AUTO/MAN button to select Manual mode ("MAN" icon will be displayed).
2. Adjust the flow rate by using the Rate Adjust buttons to adjust the servo valve. The longer the buttons are held, the faster the valve will move to allow both rapid movement and fine adjustments.

Note: Manual control can be disabled by changing the MANUAL ENABLE setting in Special Calibration.

### ADJUSTING IN HOLD:

If the console is in HOLD, or if all section valves are OFF, the servo valve can be adjusted using the Rate Adjust buttons. Monitoring the flow rate (GPM or LPM) can be useful for system pressure tests, etc. The above applies only when using a Standard (Std) control valve. A PWM (PULSE) control valve is always Off when in HOLD.

## Automatic Operation

This mode sets and maintains a steady application rate (GPA) - unaffected by changes in speed or section switching.

1. Press the AUTO/MAN button to select Automatic mode ("AUTO" icon will be displayed).
2. Switch on the desired number of sections.
3. Switch the RUN/HOLD switch to RUN.
4. Drive vehicle. (Speed signal will activate system.)

Use the Section switches, the RUN/HOLD switch or remote RUN/HOLD sensor to Start or Stop application at any time.

### ON-THE-GO RATE ADJUSTMENTS

To adjust the application rate, press the Rate Adjust buttons. The increment of this change is set in the ADJUST RATE position in Calibration. For example, if the calibrated TARGET RATE = 20.0 GPA and ADJUST RATE = 1.0 GPA, pressing ADJUST RATE once will increase the target rate from 20.0 to 21.0. The display will momentarily show the new TARGET (21.0) for two seconds before it resumes showing the ACTUAL application rate. The "adjusted" target rate is maintained until console power is turned off or Calibration mode is entered. NOTE: The target rate may also be adjusted while in HOLD.

# Pre-Application System Checkout

Before beginning actual operation, perform the following “**Pre-Application**” procedure to ensure that your valve settings, nozzle selection and desired speed range will allow the XRS to provide the required application control. This procedure should be repeated for each new nozzle selection and/or application rate. (Most nozzles will maintain an adequate spray pattern over a maximum speed range of two to one - for example, 12 mph max./6 mph min.)

## OPTIMIZING LIQUID FLOW RATE

For best performance, the flow rate should be adjusted so the control valve is operating mid-position. If the valve is forced to operate almost fully open or fully closed, erratic flow control will result. This procedure will balance the liquid flow to provide smooth, accurate flow control.

1. Fill your sprayer tank with clean water - **DO NOT** use chemicals until the entire system is completely checked out and operating properly.
2. Start pump; bring up to normal operating RPM. Do NOT exceed safe system pressure.
3. Power up XRS and switch system to **HOLD**.
4. Enter Calibration mode by pressing and holding **CAL** button.
5. Turn rotary knob to TEST SPEED position.
6. Enter the fastest speed you'll be driving while applying product - use Increase/Decrease buttons to adjust number.
7. Select **Manual** control using **Auto/Man** switch.
8. Turn all section switches on.
9. The CAL icon will flash to indicate simulated ground speed mode.
10. Turn console to **RUN**.
11. Press and hold **Increase** button until maximum flow is reached. (May take 10+ seconds depending on valve.)
12. If installed, adjust agitation valve for desired agitation amount.
13. If the rate displayed is more than 15% over your desired application rate, reduce liquid flow by one or more of the following:
  - a. Slow down pump RPM
  - b. Open a return or agitation valve to reduce flow through the flowmeter.
  - c. Close a throttling valve (controls output to the sections) to choke down pump output.
14. If the rate displayed is less than your desired application rate, increase liquid flow by one or more of the following:
  - a. Increase pump RPM
  - b. Close a return or agitation valve to increase flow through flowmeter.
  - c. Open a throttling valve (controls output to sections) to increase pump output.

# Troubleshooting

## General

All our products are tested prior to packaging so, unless there has been damage in shipment, you can be confident that everything will be operational when you receive it.

However, if you do encounter a problem that appears to be equipment failure, **PLEASE DO NOT OPEN THE CONSOLE**. Your system is protected by a warranty and we will gladly correct any defect.

Many problems are the result of mistakes in installation or operation. Before returning any parts for service, carefully check your installation and review the operating instructions. *For easy-to-follow guidelines, refer to the troubleshooting section which follows.*

### CONSOLE APPEARS DEAD

Using a test light or meter, check for 12 volts at the power source. Also check for damaged power cable or reversed terminals. *(Console requires 12 volts for proper operation).* Check connections of ignition or power switch.

### SPEED IS ALWAYS ZERO OR ERRATIC

Check for properly calibrated Speed Cal. number. Review speed sensor installation and check cables for breaks or incomplete connections. For magnetic sensors, check for proper mounting, alignment, and the air gap of the speed sensor relative to the magnet assembly. Also, make sure magnet polarities are alternated.

### DISTANCE COUNT IS INACCURATE

Speed Cal was incorrectly measured or entered. Review calibration, re-adjust and test.

### AREA COUNT IS INACCURATE

Implement width or Speed Cal was measured or programmed incorrectly. Go back through the original procedures, make changes, and test for acre (hectare) count again. **(Make sure no width is entered for unused boom sections.)** Verify accuracy with formula:

Acres = Distance x Width in feet/43560

Hectares = Distance x Width in meters/10,000

### NO READOUT OF GALLONS (LITERS), OR GALLONS (LITERS) PER MINUTE

Check to see that the sprayer pump and equipment are operating properly. If liquid is moving through the line, check the flow sensor to be sure it is screwed all the way into the flowmeter.

Check to see that a FLOW CAL number has been entered. Also check cable for breaks or incomplete connection.

If the flowmeter is new or has not been used for a long period of time, the turbine may be sticky. Flushing the system out with water should make the turbine spin freely.

Flow rate may be too low to register a reading, or foreign material may be lodged in the flowmeter.

### BOOM SECTION SHUT-OFF

If you are in AUTO with no speed, all the boom sections will be automatically shut-off.

### TOTAL LIQUID USED IS INACCURATE

This may result from an incorrectly-entered "FLOW CAL" value. Check the number stamped on the flowmeter tag, and be sure this is entered in the console's "FLOW CAL" position. If the meter has been used for some time, wear may have changed the Flow Cal value. *See Fine-Tuning Flowmeter Calibration in Appendix B.*

Check the mounting position of the flowmeter. With lower flow rates, the meter should be mounted vertically. Also check to see that the flow sensor is screwed all the way into the flowmeter.

Other causes may be inaccurate sprayer tank markings, a flow rate too low to register, or foreign material lodged in the flowmeter.

### CONSOLE IS ERRATIC IN OPERATION

If you have a two-way radio, it may be mounted too close to the console. Keep all XRS cables away from the radio, its antenna and power cable.

Ignition wires may be causing the console to malfunction. Keep XRS cables away from ignition wires, or install ignition suppressor.

Reroute all cable away from electric solenoids, air conditioning clutches and similar equipment.

Check the CONTROL SPEED calibration number in Calibration. If the RATE tends to overshoot or oscillate, the CONTROL SPEED setting may be too high for the control valve being used; reduce the CONTROL SPEED setting by 1 (range is -12 to +3).

### DISPLAYED MEASUREMENTS DO NOT MAKE SENSE

The console may be in the incorrect measurement mode (English or metric).

### DISPLAY READS "99999"

DISTANCE, AREA, and VOLUME counters read 99999 when they have exceeded their maximum count. Reset to zero to resume counting.

### SYSTEM OPERATION (CONTROL) IS SLUGGISH IN AUTOMATIC MODE

Check the CONTROL SPEED setting in Calibration. If using a slow valve (4 seconds or more, close to open) increase the CONTROL SPEED setting.

# Troubleshooting (cont.)

## Checking Individual Components

### CONSOLE

The best way to field test a console is to connect it to a harness on a vehicle with a functioning console.

### HARNESS

The harness can be checked using an ohmmeter or continuity tester. The wiring diagrams show the pin out of all connectors. *See pages 8 & 9.*

### ELECTRICAL INTERFERENCE

Erratic operation of the system may be the result of electrical interference from ignition wires or inductive loads (electrical clutch, fan, solenoid, etc.). Always try to route wires as far away from suspect areas as possible. If problems occur, you may need to relocate the console and/or wiring harness, or install a noise suppressor.

### POWER

Check power source with an electrical meter or test light. If there is no power, trace cable toward battery looking for breaks. Also check any fuses or circuit breakers that supply power to the console.

### ACCESSORY POWER

The speed, flow and run/hold cables all have an accessory power wire. Check for 12 volts between B and C of these connectors. If power is not present, make sure the accessory power wire is not open or shorted to ground or to another wire. If this wire has a problem, the console may exhibit erratic behavior or not function at all.

### RUN/HOLD HALL-EFFECT SENSOR

Caution: Improper connection or voltage could damage the Hall-Effect sensor. The Hall-effect sensor works similar to a reed switch, but requires power in order to function. This particular type of Hall-effect sensor "closes" when near the south pole of a magnet and is otherwise "open".

Ground pin C (black) and connect clean 12 volts to pin B (white) of the Hall-effect sensor cable. Connect the positive lead (red) of an ohmmeter or continuity tester to pin A (red) and the negative lead (black) of the ohmmeter or continuity tester to pin C (black) of the Hall-effect sensor cable.

Holding the tip of the sensor up to the south pole of a magnet should result in a very low resistance (around 300 ohms). Taking the sensor away from the magnet should result in a very high resistance (infinite).

### MAGNETIC HALL-EFFECT SPEED AND FLOW SENSORS

*Caution: Improper connection or voltage could damage the Hall-effect sensor.* The Hall-effect sensor functions much like a reed switch, but requires 12VDC to operate. Also, the Hall-effect sensor requires alternating magnetic polarities in order to switch. This means that the north pole of a magnet will "open" the circuit and the south pole will "close" it.

Ground pin C (black) and connect clean 12 volts to pin B (white) of the Hall-effect sensor cable. Connect the positive lead (red) of an ohmmeter or continuity tester to pin A (red) and the negative lead (black) of the ohmmeter or continuity tester to pin C of the Hall-effect sensor cable.

Holding the tip of the sensor up to the north pole of a magnet should result in a very high resistance (infinite), while holding the tip of the sensor up to the south pole of a magnet should result in a very low resistance (around 300 ohms).



# Troubleshooting (cont.)

## Checking Console Inputs

### CONSOLE INPUTS

If there is no response from any of the following tests, refer to the main wiring diagram to locate the next connector in line toward the console and repeat the test at that connector. If there is a response at that connector, the problem may be in the cable between the two connectors (or the connectors themselves).

#### SPEED INPUT

Turn rotary switch to the SPEED position and disconnect the speed sensor cable from the speed connection. Use a meter to check for voltage. It should read 12V between pins B and C and 9V between pins A and C.

*See Figure.*

#### FLOW INPUT

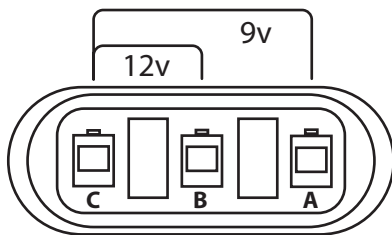
Turn rotary switch to VOLUME/MINUTE and disconnect the flow sensor cable from the main harness flow connection. Use a meter to check for voltage. It should read 12V between pins B and C and 9V between pins A and C.

*See Figure.*

#### REMOTE RUN/HOLD INPUT

Disconnect the remote run/hold sensor from the main harness Remote Run/Hold connection. Use a meter to check for voltage. It should read 12V between pins B and C and 9V between pins A and C.

*See Figure.*



**Three-Pin Connector Testing**

Note: If a multi-meter is not available, find a small piece of wire to use as a jumper. Short across pins A and C several times quickly to send a signal to the console. If the cable is functional, the console should respond with a reading.

### FLOWMETER

Shaking the Flowmeter end to end should produce a “rattling” sound (shaft end play). Blowing in the meter from either end should spin the turbine freely. If the turbine spins freely but the meter will not register flow with a known working sensor, the turbine may be defective.

### SERVO VALVE CONTROL SIGNAL

With the console turned ON, put the console in MANUAL mode and place the remote Run/Hold switch in the RUN position. Using a voltmeter or simple test light, check from a good frame ground to each of the servo wires on the main harness connector. You should get 0 volts on each wire. Holding the **Rate Adjust +** button should cause the RED wire to pulse toward 12 volts (light will pulse). Holding the **Rate Adjust -** button should cause the BLACK wire to pulse toward 12 volts (light will pulse).

### SERVO VALVE

The best way to test the servo valve is with a known working console. Turn console ON, put the console in MANUAL mode, place the remote Run/Hold in the RUN position, and turn the rotary switch to RATE. With the servo valve connected to the servo valve lead on the main harness, holding the **Rate Adjust +** button should close the servo valve and holding the **Rate Adjust -** button should open the servo valve ( if plumbing is configured for Bypass operation). The servo valve should operate smoothly in both directions, from fully open to fully closed.

You may also test a servo valve with a 9V battery. Connecting the battery to each terminal on the servo valve should cause the servo valve to run in one direction. Reversing the battery connections should cause the servo valve to run the other direction. The servo valve should operate smoothly in both directions, from fully open to fully closed.



## Appendix A - Fine Tuning Speed/Distance Calibration Value

This procedure is used to verify the Speed/Distance calibration. In order to achieve accurate measurements, each step in this fine tuning procedure should be performed as precisely as possible.

### PREPARATION

- Once the system is fully installed and calibrated, select a straight tract of ground that is similar to your actual application conditions and as level as possible.

**NOTE: Using a course with a different ground surface, such as a hard-surface road, will result in different readings than exact application conditions.**

- Accurately measure a distance of 1000 feet (300 meters). Clearly mark the beginning and end points with flags or something highly visible to the operator.

### PROCEDURE

- With the console turned ON, place the Run/Hold switch in the HOLD position. (The HOLD icon will be displayed). Turn the rotary dial to the DISTANCE position. Reset the distance counter by pressing and holding "RESET" until the display returns to 0. (CLEAR will be displayed when reset is pressed). Make sure pump is off. Turn on the section switches.
- You are now ready to drive the measured course. Pick a location on the vehicle to use as a marker for starting and stopping the distance counting function (door handle, mirror, step, etc.). You should begin driving the course well ahead of the starting flag and drive past the ending flag, using the Run/Hold switch to start and stop the counting function. It is not recommended to start from a dead stop at the starting flag and stop at the ending flag.
- Place the Run/Hold switch in RUN when the marker on the vehicle passes the starting flag to activate the distance counting function. The console display numbers will increase, adding to the distance total as you drive. Drive the pre-measured course and place the Run/Hold switch in HOLD, when the marker on the vehicle passes the ending flag, to stop the distance counting function. The console display should display "HOLD". Stop the vehicle in a level and safe area and continue with this procedure.

- With the rotary dial still at DISTANCE (SPEED CAL), press and hold the CAL button for one second. Once the console is in "CAL," the speed calibration value will be displayed. Momentarily press the CAL button and the word "CAL" will begin to flash and the distance travelled will be displayed. *See below.*



- When the display shows distance ("CAL" is flashing), verify whether the number displayed is the exact distance you drove (+/- 1 - 2 %). If not, press the **Increase** or **Decrease** button to adjust the figure to match the distance driven.
- When the number shown on the display matches (as closely as possible) the actual distance driven, you have arrived at the correct calibration value. If you cannot adjust the displayed distance to exactly match the actual distance driven, adjust the figure as close as possible to the actual distance. You may check the calibration number by momentarily pressing the CAL button. The word "CAL" will stop flashing and the SPEED CAL number will appear. Exit "CAL" by pressing the CAL button for one second.

The speed sensor is now calibrated. To verify proper calibration, repeat the procedure a second time. Write down the new speed calibration number and keep it in a safe place. If the calibration values are ever accidentally changed, you can simply re-enter this number.

## Appendix B – Fine Tuning Flowmeter Calibration Value

This procedure is used to verify and fine-tune the flowmeter calibration. Every flowmeter is calibrated with water at the factory and stamped with a calibration value. Enter that value as a starting point and use this procedure to fine-tune that value for your specific installation and spraying application. This procedure should be repeated each time a new solution is being applied or when the flowmeter installation has been altered. *(Differing solutions have different specific gravities and flow characteristics.)*

### PROCEDURE

1. Fill sprayer tank with water - preferably 100 gallons or more. The larger the volume of water used, the more accurate the calibration.)
2. Start sprayer pump and turn on sections until air is purged from lines. Turn off sections but leave pump running.
3. Turn on MANUAL mode. Then switch to RUN.
4. Turn rotary knob to VOLUME/MINUTE. Adjust rate to amount needed for target rate using **Increase/Decrease** buttons.  
**Gallons per Acre X MPH X Width in feet / 495=Gallons per Minute**
5. Switch to HOLD.
6. Turn console rotary knob to the VOLUME position. Select the counter (1-3) that you want to use. Press and hold the RESET button until the display reads 0 (1 second).
7. Turn on all sections, turn Run/Hold switch to RUN, and run a known amount a water (preferably 100 gallons or more). \*
8. Put Run/Hold switch in HOLD position. Compare the console's VOLUME reading with the known amount of water run. If the two amounts are within two percent, no fine tuning is required. If the two amounts are more than three percent different, continue with the next step.
9. With the console still in the VOLUME position, enter calibration, hold the CAL button until the red warning light comes on (about one second). The display will show the flowmeter calibration value and the CAL icon.
10. Momentarily press the CAL button, The CAL icon will begin the flash and the total volume will be displayed. *See figure below.*
11. When the TOTAL FLOW value is displayed, use the **Increase or Decrease** button to adjust the value to match the amount of water run.
12. Momentarily press the CAL button. The CAL icon and the flowmeter calibration number will be displayed. You will notice that the flowmeter calibration value has changed. Write down the new flowmeter calibration value. This is your "fine tuned" calibration number, keep it for future reference.
13. Exit calibration by holding the "CAL" button until the red warning light goes out (about one second).

**\* The most accurate method to measure the volume of water run is to place a container under EVERY nozzle and add together the amount from each nozzle. This assures that 100 percent of the water is collected and that all nozzles are spraying equally. It is important to perform this procedure at a flow rate similar to that which will be used in the field. It is also possible to disconnect the main boom line and run it to a large measuring container but a valve must be installed and properly adjusted to simulate actual field conditions.**



101.7 CAL

## Appendix C – “Quick Start” Function

Quick Start can be enabled for use in Automatic operating mode. Each method uses a separate set of Special Calibration parameters. See Special Calibration section to enable/adjust the parameters.

### Quick Start - SPEED

Provides an instant Speed (simulated) whenever the system goes from HOLD to RUN.

#### USAGE:

This is useful for applications where the delay associated with acquiring enough Speed signal pulses to provide the console with a valid operating speed is unacceptable. This is intended for situations where the application equipment is quickly going from a stopped condition (Speed=0) to an operating speed.

#### SETUP:

Two Special Cal factors, **START SPEED** and **START SPEED TIME**, must be set (values > 0) to enable this feature.

\* **Important:** Verify that “Quick Start –VALVE” is disabled: (START TIME = ‘OFF’).

\* **Important:** Make sure AUTO DELAY TIME = 0, so it does not add any delay to the Quick Start feature.






#### HOW IT WORKS:

When switching from HOLD to RUN, the console will use the **START SPEED** value as the simulated Speed (example: 5 mph) for **START SPEED TIME** (example: 2 seconds).

## Appendix D – Pressure Based Control

### Enabling

XRS can be configured for Pressure Based Control by entering Calibration and adjusting the **Flow Cal** number to 0. Then, adjust **Minimum Pressure** and **Proportional Minimum Flow** parameters in Special Calibration settings (see page 14). Both parameter values must be adjusted to enable Pressure Based Control. The **Minimum Pressure** parameter is only visible and accessible when Pressure Based Control has been enabled; **Proportional Minimum Flow** can also be used in flowmeter based control.

1. With console powered on and in **Hold**, enter Calibration Mode by pressing  button.
2. Turn rotary dial to **Flow Cal** setting.
3. Adjust **Flow Cal** value to 0 to enable Pressure Based Control. LCD screen will display **Pr-ESS**.
4. Press  to save changes and exit Calibration Mode.
5. Turn off console.
6. Enter Special Calibration Mode by holding  button and turning on power.
7. Turn rotary dial to Volume position.
8. Press  button twice to access **Minimum Pressure** setting. LCD screen will display CAL and number 3.
9. Adjust value to the recommended minimum pressure rating for your nozzles.
10. Turn rotary dial to Tank position to access **Proportional Minimum Flow** setting. LCD screen will display CAL and number 3.
11. Calculate value by taking nozzle flow rate at the minimum pressure for your system, then multiply by the number of nozzles.
12. Adjust to that calculated value using increase button.
13. Press and hold  button to save settings and exit Special Calibration. System is now prepared for Pressure Based Control.

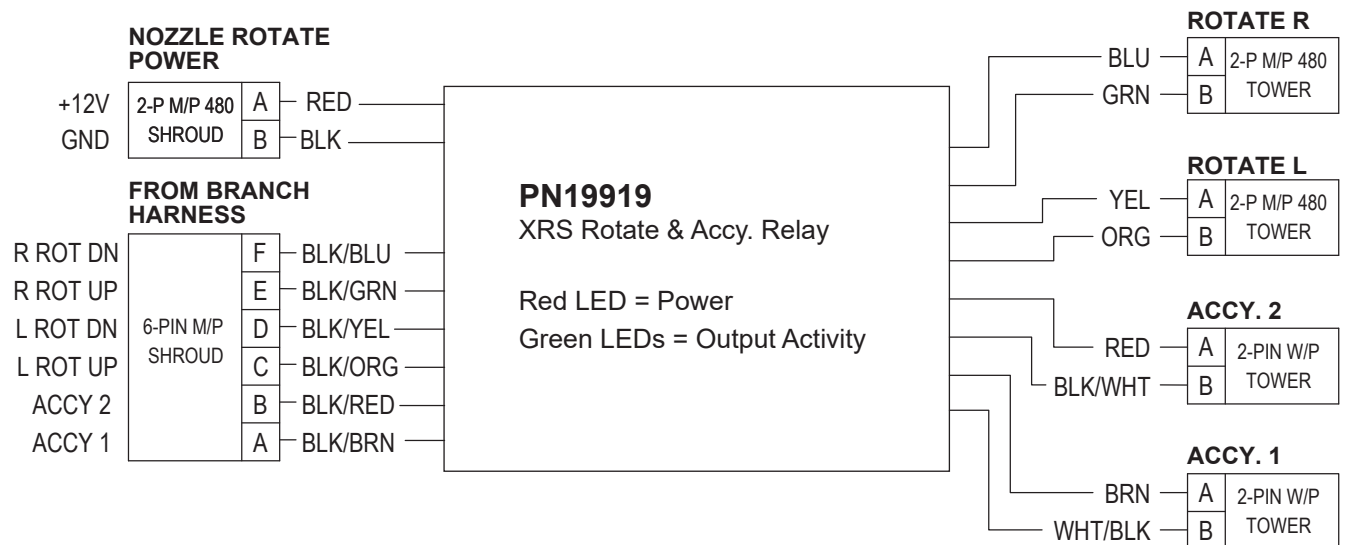
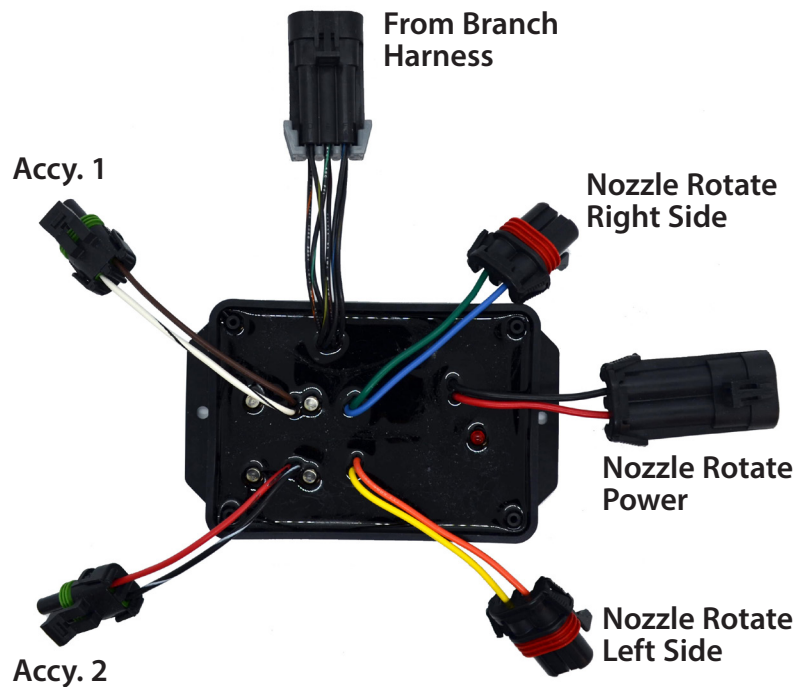
### Operation

When operating in Pressure Based Control, the system will calculate flow and totals based only on readings from the pressure sensor.

## PN19919 Rotate & Accy. Relay Module

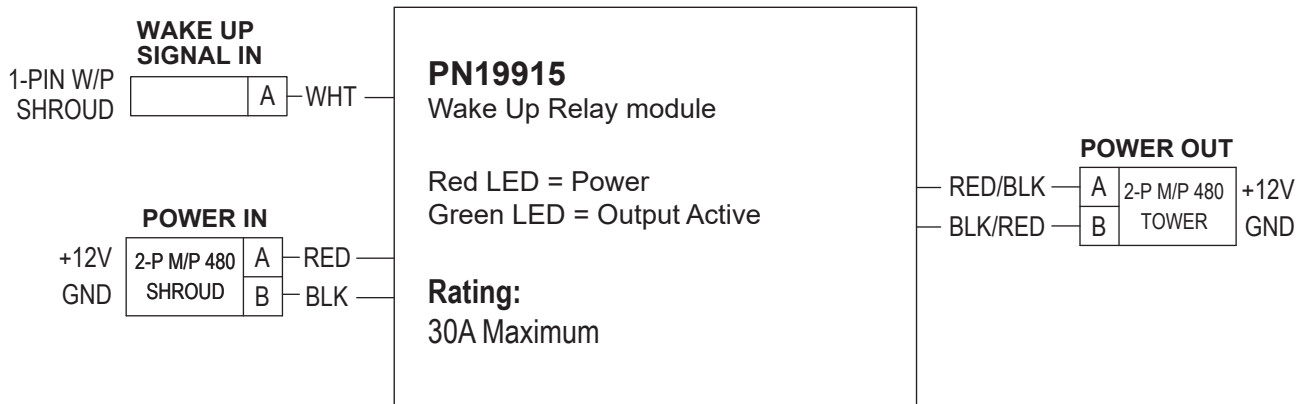
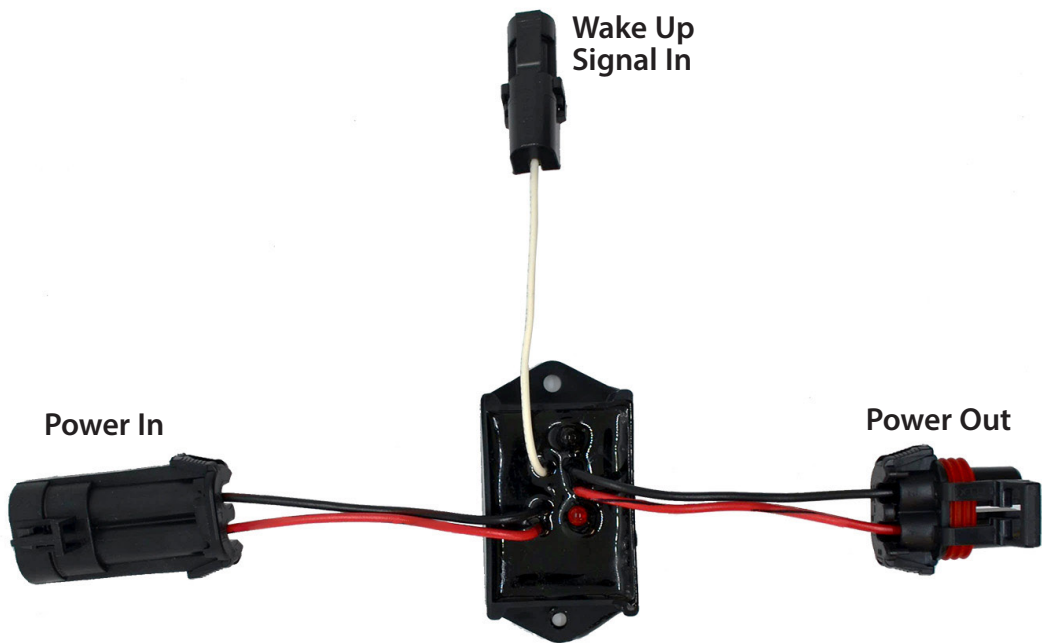
PN19919 Rotate & Accessory Relay module is an optional item - included in the On Target XRS w/Sidecar kit, PN 02025. The 19919 module controls 12v outputs to both Right and Left side nozzle rotate actuators, and 2 Accessory outputs. The red LED indicates power, the 4 green LEDs indicate output activity for each connection.

### Sidecar Controls



# PN19915 Wake Up Relay Module

PN19915 Wake Up Relay module is used in the On Target XRS wiring system to control 12v power. The 19915 module controls 12v output for **Junction Box Power**, **Light Circuit Power**, and **Nozzle Rotate Power**.



The On Target XRS controller system is manufactured by Micro-Trak Systems Inc. exclusively for On Target Spray Systems.

## Warranty

Micro-Trak Systems, Inc. (herein "Seller") warrants to the original purchaser (herein "Buyer") that, if any product or part of the product (herein "Parts") proves to be defective in material or workmanship, upon inspection and examination by Seller, within three (3) years from the original date-of-purchase, and is returned to Seller with dated proof-of-purchase, transportation prepaid, within sixty (60) days after such defect is discovered, Seller will, at their option and sole discretion, either repair or replace said part, except that the warranty for expendable Parts, including but not limited to, light bulbs and batteries shall be thirty (30) days from the original date-of-purchase; and except that the warranty for Parts manufactured by someone other than the Seller, including but not limited to, shut-off valves, control (servo) valves, flowmeters, pressure sensors, pumps, compressors, tanks and tank accessories, DGPS receivers and related repeater and base stations shall be one (1) year from the original date-of-purchase; and except that the warranty for Parts manufactured by someone other than the Seller, including but not limited to, memory cards and drives, mapping software, terminals, PC's, laptops, tablets and other computer devices shall be thirty (30) days from the original date-of-purchase. Any damage or failure to said part resulting from abuse, misuse, neglect, accidental or improper installation or maintenance, unauthorized modification, use with other parts and/or products, or attributable to acts of God, as determined solely by the Seller, will invalidate the warranty. Said part will not be considered defective if it substantially fulfills the performance specification. Buyer shall be responsible for all maintenance services, if any, all in strict accordance with the procedures outlined in the manual. The warranty does not include labor, installation, replacement parts or repairs, delivery of replacement parts or repairs or time and travel. Said warranty is non-transferable.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY, FITNESS FOR PURPOSE AND OF ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED. THE SELLER'S LIABILITY, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, IN NEGLIGENCE OR OTHERWISE, SHALL NOT EXCEED THE RETURN OF THE AMOUNT OF THE PURCHASE PRICE PAID, AND UNDER NO CIRCUMSTANCES SHALL THE SELLER BE LIABLE FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES. SELLER NEITHER ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION OR LIABILITY IN CONNECTION WITH SAID PART. NO ACTION, REGARDLESS OF FORM, ARISING OUT OF THE TRANSACTIONS UNDER THIS AGREEMENT MAY BE BROUGHT MORE THAN ONE (1) YEAR AFTER THE CAUSE OF ACTION HAS OCCURRED.

Buyer accepts these warranty terms and limitations unless the part is returned to Seller, via proper distribution channels and approved return authorization, with dated proof-of-purchase, transportation prepaid, within sixty (60) days from the date-of-purchase for refund of the purchase price.

Doc: MTS Warranty Statement\_010119a Rev 2\_01012019

