

SCS 4000/5000 Series™ Installation and Operation Manual

016-0159-925 Rev. F

05/15

E19667



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Calibration Reference Sheet

Record the settings and calibration values used when programming the SCS console and keep this sheet for future reference or when contacting a service technician.

Circle the setting selected on the console for the following options:

Units	US (Acres)	SI (Hectares)	Turf (1000 Square Feet)	
Speed Sensor	SP1 (Wheel Speed)	SP2 (Radar)	Speed Cal	

Write down the selected settings for each configured control channel in the spaces provided:

	Control Channel 1	Control Channel 2	Control Channel 3	Control Channel 4	Control Channel 5
Control Type					
Valve Type					

Write down the calculated calibration values in the spaces provided:

Boom Widths (Boom Cal)	Meter Cal	Rate Cal	Valve Cal	Volume in Tank/Bin
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.
4.	4.	4.	4.	4.
5.	5.	5.	5.	5.
6.				
7.				
8.				
9.				
10.				

Edit Mode

During normal operation of the SCS console, pressing the calibration keys will access a calibration screen. The operator must use the Edit mode to program numerical values into the SCS console. To enter Edit mode:

1. Press the ENTER key. The default or existing value will be cleared and the screen will display an “E” on the far right side of the screen.
2. Key in the value to replace the existing value. For example, press “2” “1” “2” “3” to enter a value of 2123.
3. Press the ENTER key to accept the keyed value and return to normal operation.

Note: During the initial console programming, pressing ENTER accepts the keyed value and advances to the next calibration screen.

Unit Definitions and Conversions

Unit of Measure Definitions

Abbreviation	Definition	Abbreviation	Definition
GPM	Gallons per Minute	PPK	Pounds per 1,000 square feet
L/min	Liters per Minute	mm	Millimeters
dL/min	Deciliters per Minute	cm	Centimeters
PSI	Pounds per Square Inch	dm	Decimeters
kPa	Kilopascal	m	Meter
GPA	Gallons per Acre	MPH	Miles per Hour
L/ha	Liters per Hectare	km	Kilometers
mL/ha	Milliliters per Hectare	km/h	Kilometers per Hour
GPK	Gallons per 1,000 Square Feet	US	Volume per Acre
PPM	Pounds per Minute	SI	Volume per Hectare
kg/min	Kilograms per Minute	TU	Turf Units (Volume per 1,000 Square Feet)
PPA	Pounds per Acre	[]	Metric Values
kg/ha	Kilograms per Hectare	{ }	Turf Unit Values

Unit of Measure Conversions

To convert the METER CAL value into the selected unit of measure, divide the original number printed on the Flow Meter label by the desired conversion value.

Fluid Ounces Conversion Formula	Liters Conversion Formula	Pounds Conversion Formula
$\frac{\text{Original METER CAL Number}}{128}$	$\frac{\text{Original METER CAL Number}}{3.785}$	$\frac{\text{Original METER CAL Number}}{\text{Weight of One Gallon of Product}}$

Liquid

- 1 U.S. gallon = 128 fluid ounces
- 1 U.S. gallon = 3.785 liters
- 1 U.S. gallon = 0.83267 imperial gallons
- 1 U.S. gallon = 8.34 pounds (water)

Length

- 1 millimeter (mm) = 0.039 inches
- 1 centimeter (cm) = 0.393 inches
- 1 meter (m) = 3.281 feet
- 1 kilometer (km) = 0.621 miles
- 1 inch = 25.4 mm or 2.54 cm
- 1 mile = 1.609 km

Area

- 1 square meter = 10.764 square feet
- 1 hectare = 2.471 acres or 10,000 square meters
- 1 acre = 0.405 hectares or 43,560 square feet
- 1 square mile = 640 acres or 258.9 hectares

Pressure

- 1 psi = 6.89 kPa
- 1 kPa = 0.145 psi

CHAPTER

1

Important Safety Information

Safety Information

NOTICE

Read this manual and the operation and safety instructions included with the implement and/or controller carefully before installing the SCS 4000/5000 Series console.

- Follow all safety information presented within this manual.
- If you require assistance with any portion of the installation or service of Raven equipment, contact a local Raven dealer for support.
- Follow all safety labels affixed to the system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. To obtain replacements for missing or damaged safety labels, contact a local Raven dealer.

When operating the machine after installing the SCS 4000/5000 Series console, observe the following safety measures:

- Be alert and aware of surroundings.
- Do not operate the console while under the influence of alcohol or an illegal substance.
- Remain in the operator's position in the machine at all times when the console is engaged in product control or feature operation. The machine operator is responsible for disabling or turning off automatic control features before leaving the operator's position.
- Determine and remain a safe working distance from other individuals. The operator is responsible for disabling or turning off automatic control features when the safe working distance has been diminished.
- Ensure the console is disabled prior to starting any maintenance work on the machine or parts of the application system.
- Follow all label instructions for proper chemical mixing, handling and container disposal methods.

 **DANGER**

Thoroughly bleed the nurse tank hose and all other system lines prior to disassembling the flow meter, fittings and hoses, especially in the case of anhydrous ammonia.

 **CAUTION**

Hydraulic Safety


- Raven Industries recommends that appropriate protective equipment be worn at all times when working on any hydraulic system.
- Never attempt to open or work on a hydraulic system with the equipment running. Care should always be taken when opening a system that has been previously pressurized.
- When disconnecting the hydraulic hoses or purging is required, be aware that the hydraulic fluid may be extremely hot and under high pressure. Caution must be exercised.
- Any work performed on a hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- When installing hydraulics or performing diagnostics, maintenance or routine service, ensure that precautions are taken to prevent any foreign material or contaminants from being introduced into the machine's hydraulic system. Objects or materials that are able to bypass the machine's hydraulic filtration system will reduce performance and possibly damage the hydraulic valves.

Electrical Safety

- Always verify that the power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the equipment.
- Ensure that the power cable is the last cable to be connected.
- Disconnect the SCS 4000/5000 Series console before jump-starting the vehicle.
- Disconnect the SCS 4000/5000 Series console and any other Raven systems before welding any component of the application equipment.

Sprayer & Spreader Control Systems

The Raven SCS 4000/5000 Series control systems are designed to simplify sprayer or spreader applications by providing speed compensated product application regardless of the vehicle speed while adjusting for the width and status of programmed boom sections and a target rate set by the operator. SCS control systems improve the uniformity of product coverage for up to five liquid (carrier or chemical injection) or granular products via product control nodes connected to a CAN, or Controller Area Network.

	<p>NOTICE</p> <p>Performance of the system relies on proper installation of the SCS system and preventive maintenance of the complete sprayer or spreader. Raven Industries recommends that the equipment operator review this manual thoroughly before operating the system. This manual provides procedures for installing and operating the SCS console and CAN product control system.</p>
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Once properly installed and calibrated for the machine and application type, the operator sets the target application rate for each product to be controlled by the SCS 4000/5000 Series console. Simply toggle the boom and master switches to the on positions and go. The console and product control nodes adjust the control valves to the target application rate regardless of vehicle speed or gear selection.

During product application, the SCS 4000/5000 Series consoles also function as an area monitor, speed monitor, and volume totalizer. The actual volume per area, or weight per area, is displayed for each product and a manual override switch allows the operator to manually adjust application of each product for system check-out and spot spraying.

System Components

The following sections offer a description of the system components for the various SCS consoles and control systems.

SCS 4000/5000 Control Systems

The SCS 4000/5000 system consists of a computer-based control console, a CAN boom sense/speed node, a speed sensor, a boom switch box or boom switches, up to five CAN product control nodes, control valve(s), flow meter(s) or encoder(s), injection modules (if applicable), and appropriate cabling.

Note: *Due to the harsh conditions and chemicals in the field of agriculture, appropriate cabling is required to ensure system integrity.*

The SCS 4000 and 5000 control systems are designed to be used with external boom switches. In order for the system to detect when and which booms are ON or OFF, the boom signal wires must be connected to the correct booms.

SCS 4070 Control Systems

The SCS 4070 system consists of a computer-based control console, a CAN boom sense/AccuBoom Combo node (if applicable), a speed sensor, up to five CAN product control nodes, control valve(s), flow meter(s) or encoder(s), injection modules (if applicable), and appropriate cabling.

Note: *The AccuBoom Combo node will not provide automatic section control during field operations using the SCS 4070. AccuBoom is only used to simplify cable and wiring for the built in boom section switches when using the SCS 4070 console.*

Due to the harsh conditions and chemicals in the field of agriculture, appropriate cabling is required to ensure system integrity.

SCS 4400/4600 Control Systems

The SCS 4400/4600 system consists of a computer-based control console, a speed sensor, up to four additional CAN product control nodes (the first product control node is hard-wired into the controller), control valve(s), flow meter(s) or encoder(s), injection modules (if applicable), and appropriate cabling.

Note: *Due to the harsh conditions and chemicals in the field of agriculture, appropriate cabling is required to ensure system integrity.*

The SCS 4600 controller is designed to be used with external boom switches. In order for the system to detect when and which booms are ON or OFF, the boom signal wires must be connected to the correct booms.

The SCS 4400/4600, in conjunction with a DGPS receiver, is also capable of recording valuable application data. This information is recorded in different formats to best fit the users needs and may be transferred via the compact flash card to a home or office computer.

Note: *The SCS 4400 with part number 063-0172-281 and SCS 4600 with part number 063-0172-343 both feature a compact flash card slot for application data transfer to a home or office computer. The data logging feature will only be used when connecting to an optional external console for logging or mapping applications.*

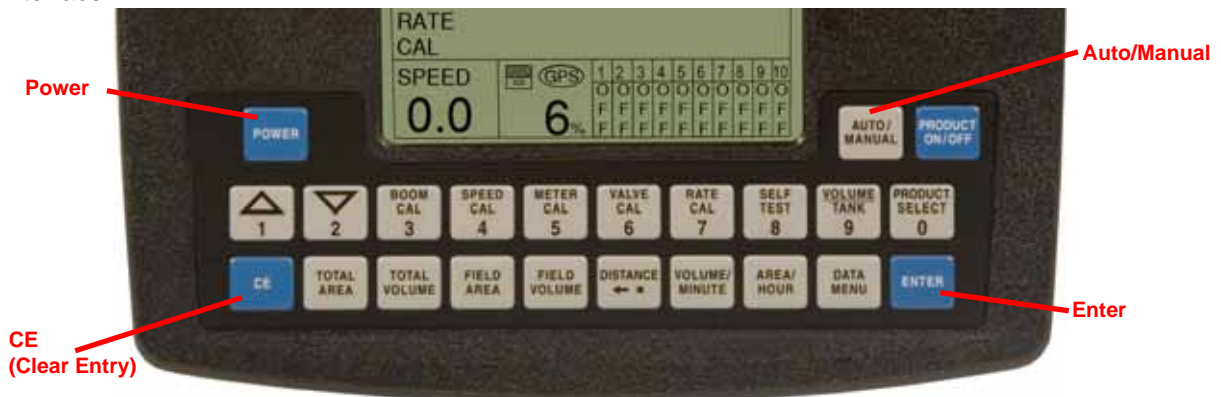
SCS 4000/5000 Series Console Feature Overview

Display Area

Each of the SCS 4000/5000 Series consoles feature an easy to read, backlit LCD display. This area displays application and user interface information such as speed, PSI, calibration and function data, rate of application, control mode (AUTO/MAN), percent of compact flash card used (only on SCS 4400/4600 consoles), and boom status.

Keypad

The SCS 4000/5000 Series consoles feature a push button keypad with large, clearly marked buttons for easy user interface.

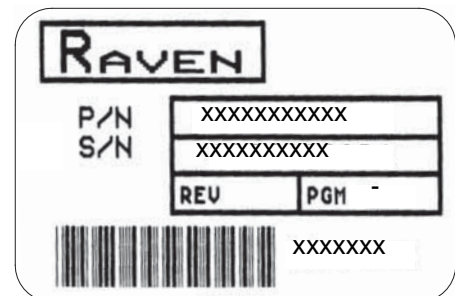


Note: The initial programming sequence must be completed before the SCS console can be operated normally. Calibration values must also be programmed on the calibration screens accessed through keys 3 through 7.

Serial Number

The part number, serial number, and hardware revision letter for each of the SCS 4000/5000 Series consoles may be found on the console label on the back of the SCS console.

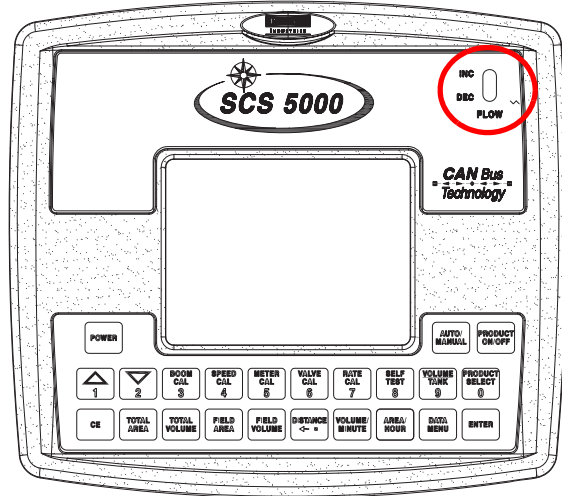
Please have this information available when contacting customer support.



SCS 4000/5000 Consoles

The manual flow control switch provides the capability for spot spraying.

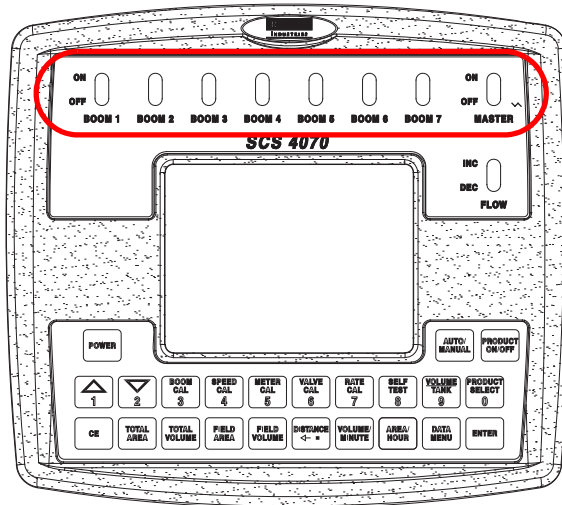
Note: The SCS 4000 and 5000 consoles require an external or vehicle switch box to sense boom status.



SCS 4070 Consoles

In addition to a manual flow switch, The SCS 4070 console offers seven boom and a master ON/OFF switch for boom section control.

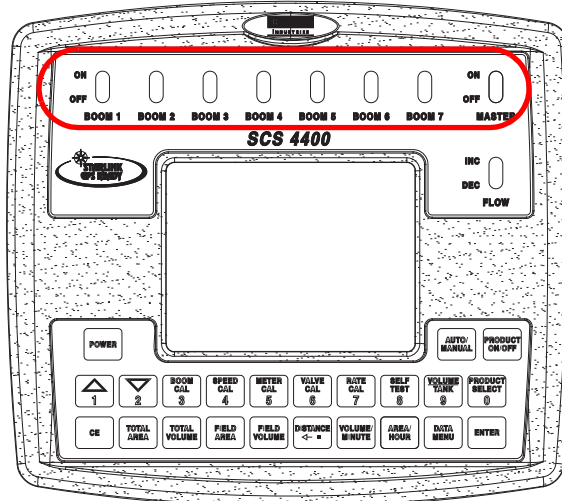
Note: The SCS 4070 console features boom sense and speed functionality built in.



SCS 4400/4600 Consoles

Both the SCS 4400 and 4600 consoles offer a manual flow control switch for spot spraying. The SCS 4400 features seven boom and one master switch for boom section control while the SCS 4600 console requires an external or vehicle switch box.

Note: The SCS 4400 with P/N 063-0172-281 and SCS 4600 with P/N 063-0172-343 feature a compact flash card slot on the left side of the console for application data transfer to a home or office computer. The data logging feature will only be used when connecting to an optional external console for logging or mapping applications.



Data logging consoles will only recognize compact flash cards up to 512 MB. Do not use cards with larger storage capacity with SCS consoles.

Care and Use

Refer to the following guidelines for proper care and use of the SCS console.

CAUTION

- Mount the console securely and route cables to prevent tripping hazards and to keep the wires from pinching or breaking.
- When temperatures are expected to be 10° F [-12° C] or lower, remove the console from the vehicle and store it in a climate controlled environment.
- Do not expose the console to precipitation, condensation or other liquids. Store the console in a dry environment when not in use.
- To prevent damaging the console, be sure to disconnect the console's power connection when jump starting or welding on the machine.

Technical Specifications

		U.S.	Metric
Dimensions	Height	8.007 in.	20.338 cm
	Width	8.991 in.	22.837 cm
	Depth	2.995 in. (Enclosure Only)	7.607 cm (Enclosure Only)
Weight		5.5 lbs. (max.)	2.5 kg (max.)
Environmental	Operating Temperature	-4° F to 158° F	-20° C to 70° C
	Storage Temperature	-40° F to 185° F	-40° C to 85° C
Power	Operating Voltage	9 VDC to 16 VDC Reverse Polarity Protected	
Ports	Amp	1 (Back)	
	Card Slot - Compact Flash	(SCS 4400/4600 Only) 1 (Side Cover)	
Mounting	Clamp ^a (Provided)	1.020 in. dia.	2.59 cm dia.
	Thumb Screws (Provided)	1/4"-20 x 1" Long	

a. Designed to secure the SCS 4000/5000 Series Console to a 1" dia. [2.54 cm] monitor bar or post.

Updates

Updates for Raven manuals as well as software updates for Raven consoles are available at the Raven Applied Technology Division web site:

www.ravenhelp.com

At Raven Industries, we strive to make your experience with our products as rewarding as possible. One way to improve this experience is to provide us with feedback on this manual.

Your feedback will help shape the future of our product documentation and the overall service we provide. We appreciate the opportunity to see ourselves as our customers see us and are eager to gather ideas on how we have been helping or how we can do better.

To serve you best, please send an email with the following information to

techwriting@ravenind.com

-SCS 4000/5000 Series™ Installation & Operation Manual

-Manual No. 016-0159-925 Rev. F

-Any comments or feedback (include chapter or page numbers if applicable).

-Let us know how long have you been using this or other Raven products.

We will not share your email or any information you provide with anyone else. Your feedback is valued and extremely important to us.

Thank you for your time.

A Controller Area Network, or CAN, is a high-integrity serial data communications bus that operates at a data rate of 250 kilobits per second for real-time control applications and uses special CAN cables and terminators for operation. The CAN protocol has excellent error detection and confinement capabilities, making it very suitable and reliable for agricultural applications.

CAN systems allow products to be added to a control system at any time. Up to five product control nodes may be connected to the SCS control system for any combination of liquid, granular, chemical injection, or spinner control applications.

The diagrams in this chapter show different hardware configurations for use with the SCS product control system. Some diagrams show optional features which may not apply to each system. These features and components are not required for CAN operation and optional features and cables may be ignored during a basic installation.

**NOTICE**

Be sure to read all safety instructions and follow all installation procedures to ensure proper installation of the CANbus system.

FIGURE 1. SCS 4000/5000 Single Product (Liquid) CAN Control System

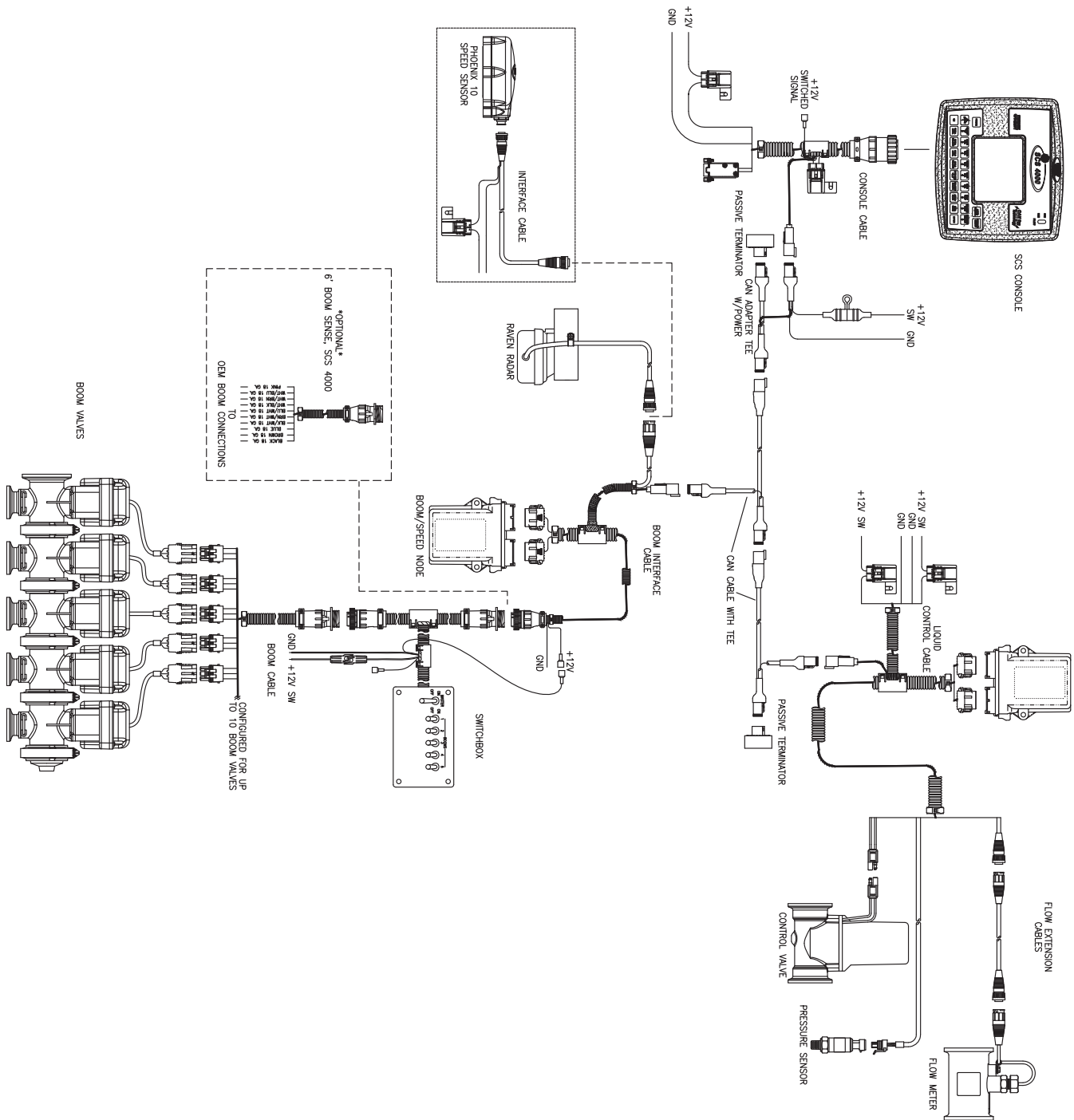


FIGURE 2. SCS 4070 Single Product (Liquid) CAN Control System

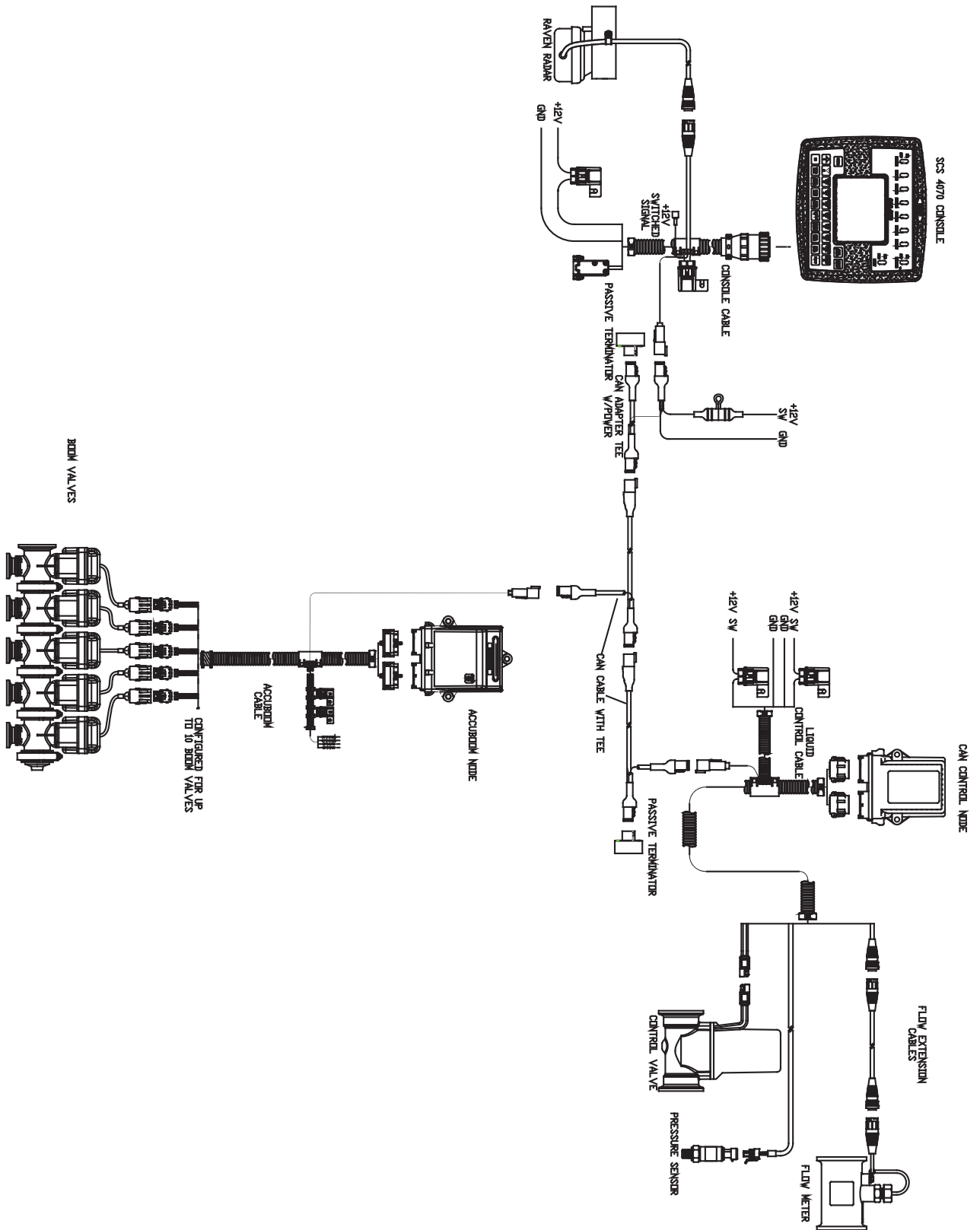


FIGURE 3. SCS 4000/5000 Multi-Product CAN Control System
One Granular Product plus Spinner Control

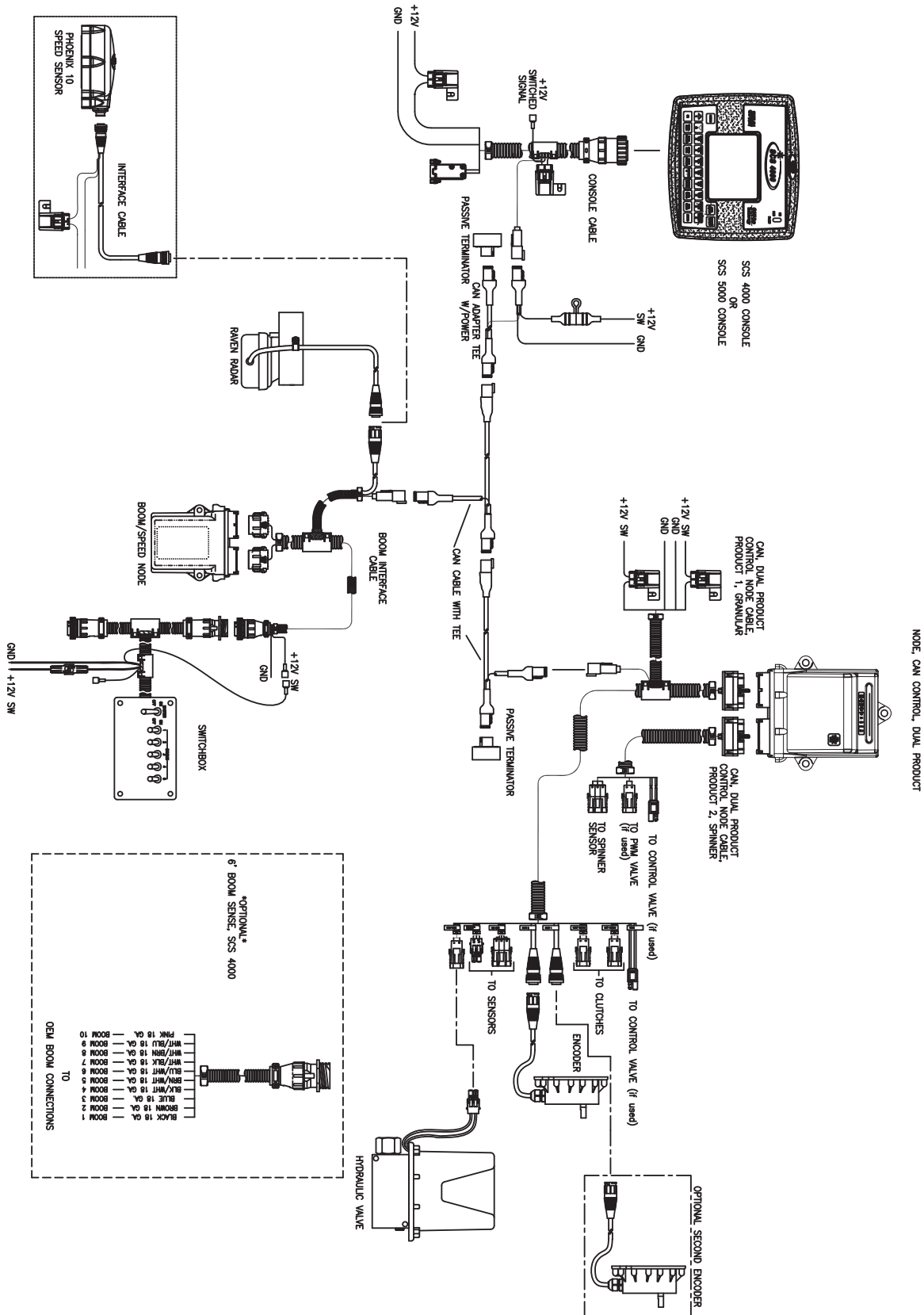
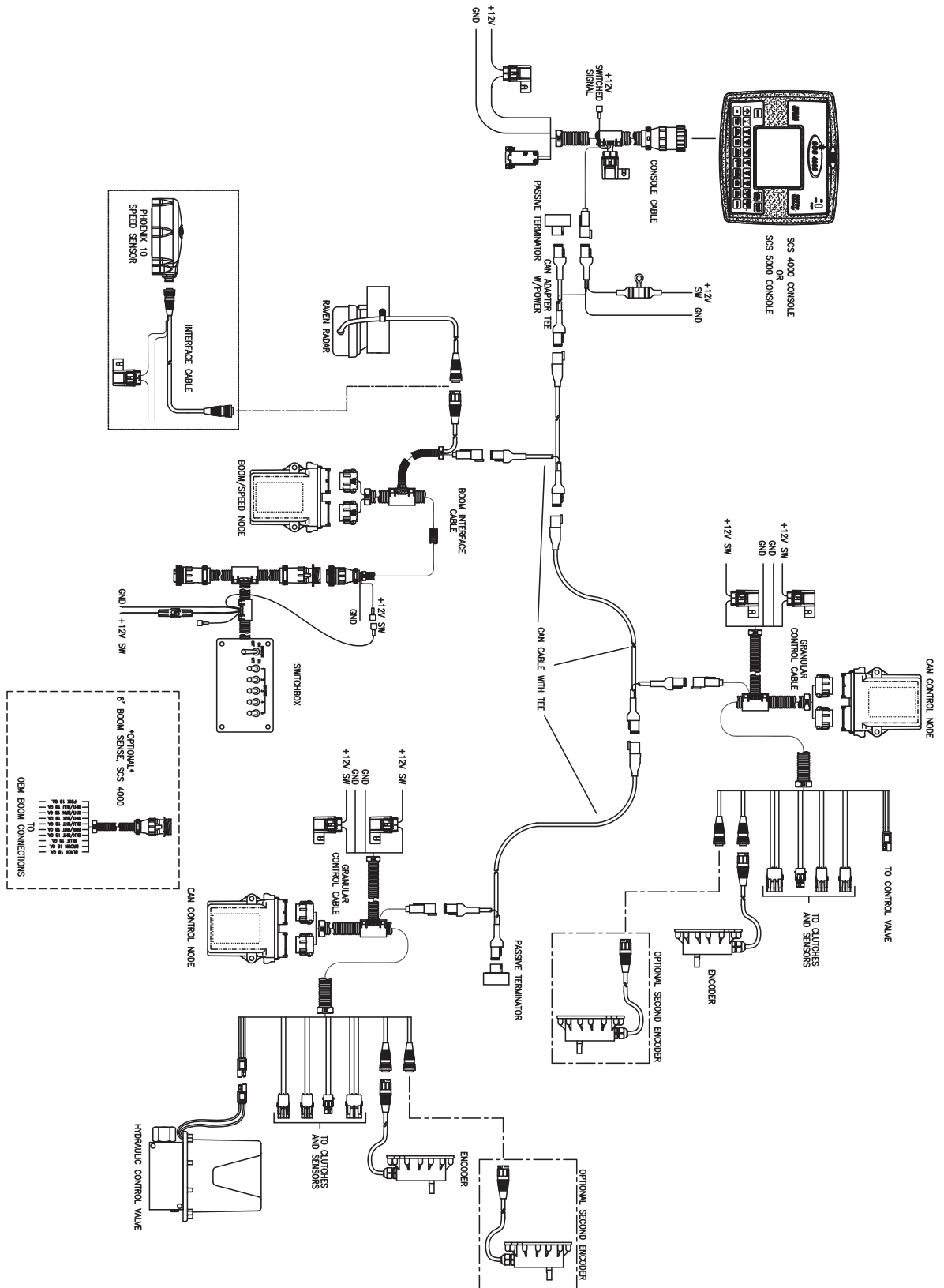


FIGURE 4. SCS 4000/5000 Multi-Product CAN Control System Two Granular Products



**FIGURE 5. SCS 4000/5000 Multi-Product CAN Control System
Two Granular Products plus Spinner Control**

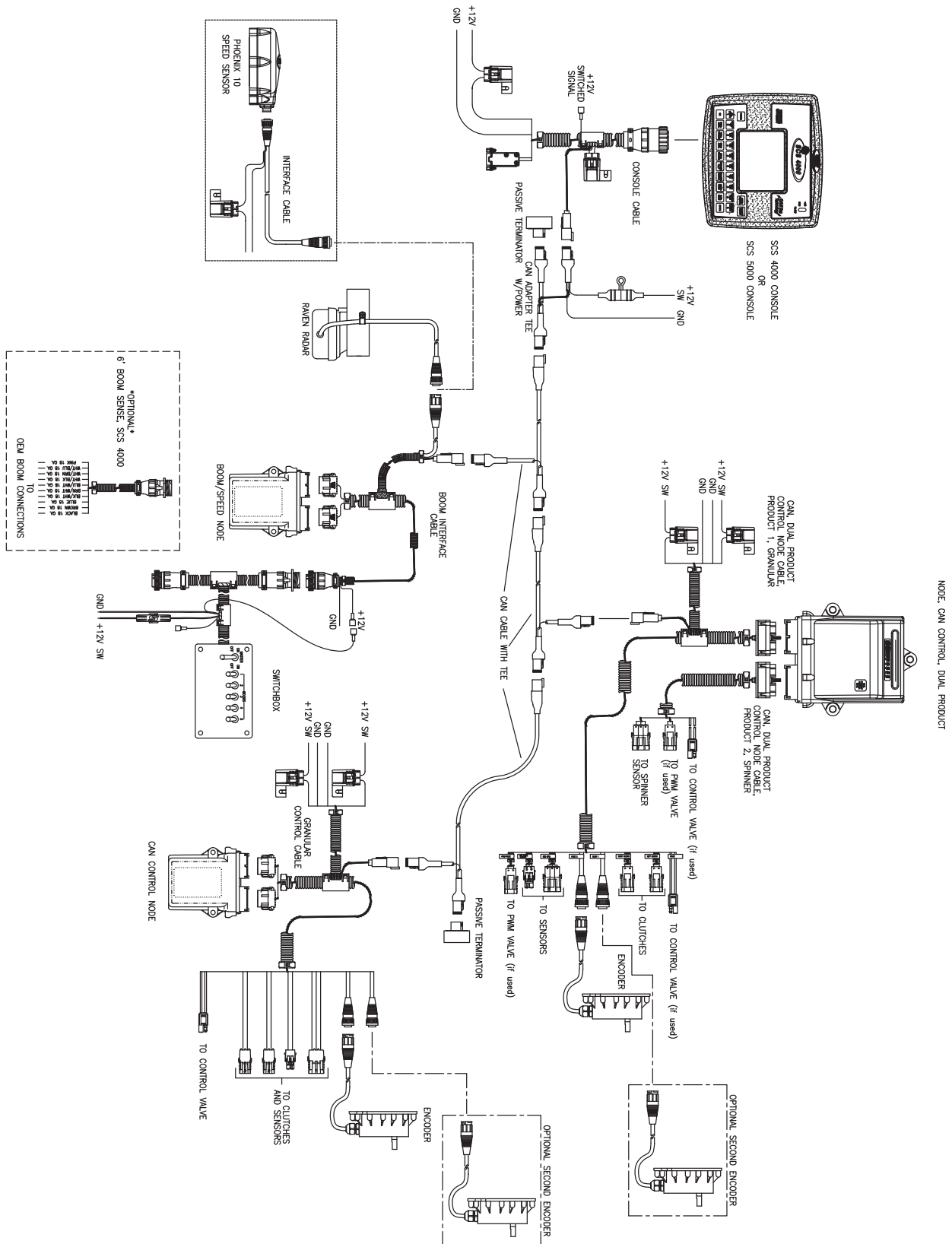


FIGURE 6. SCS 4400 Granular Control System

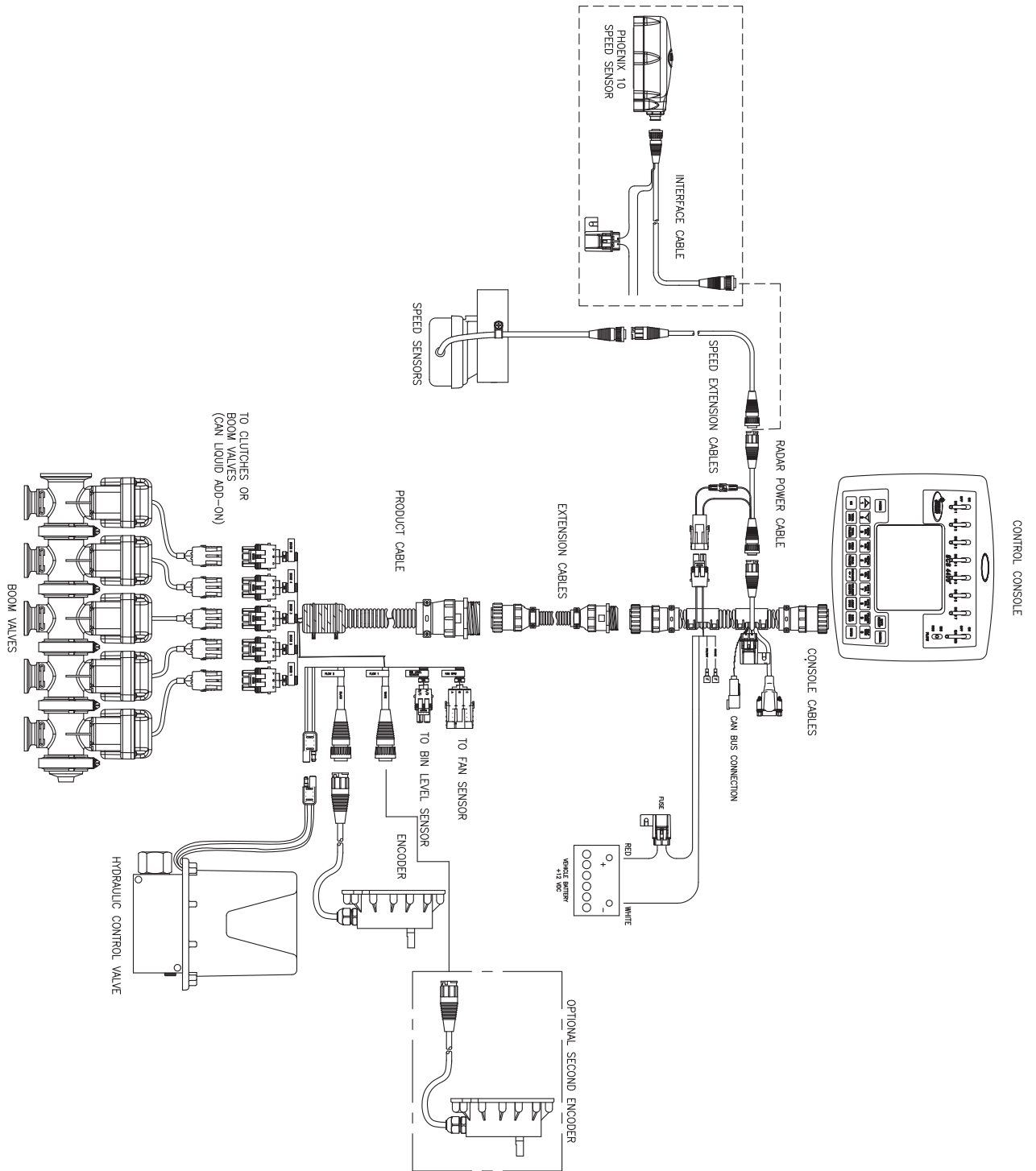
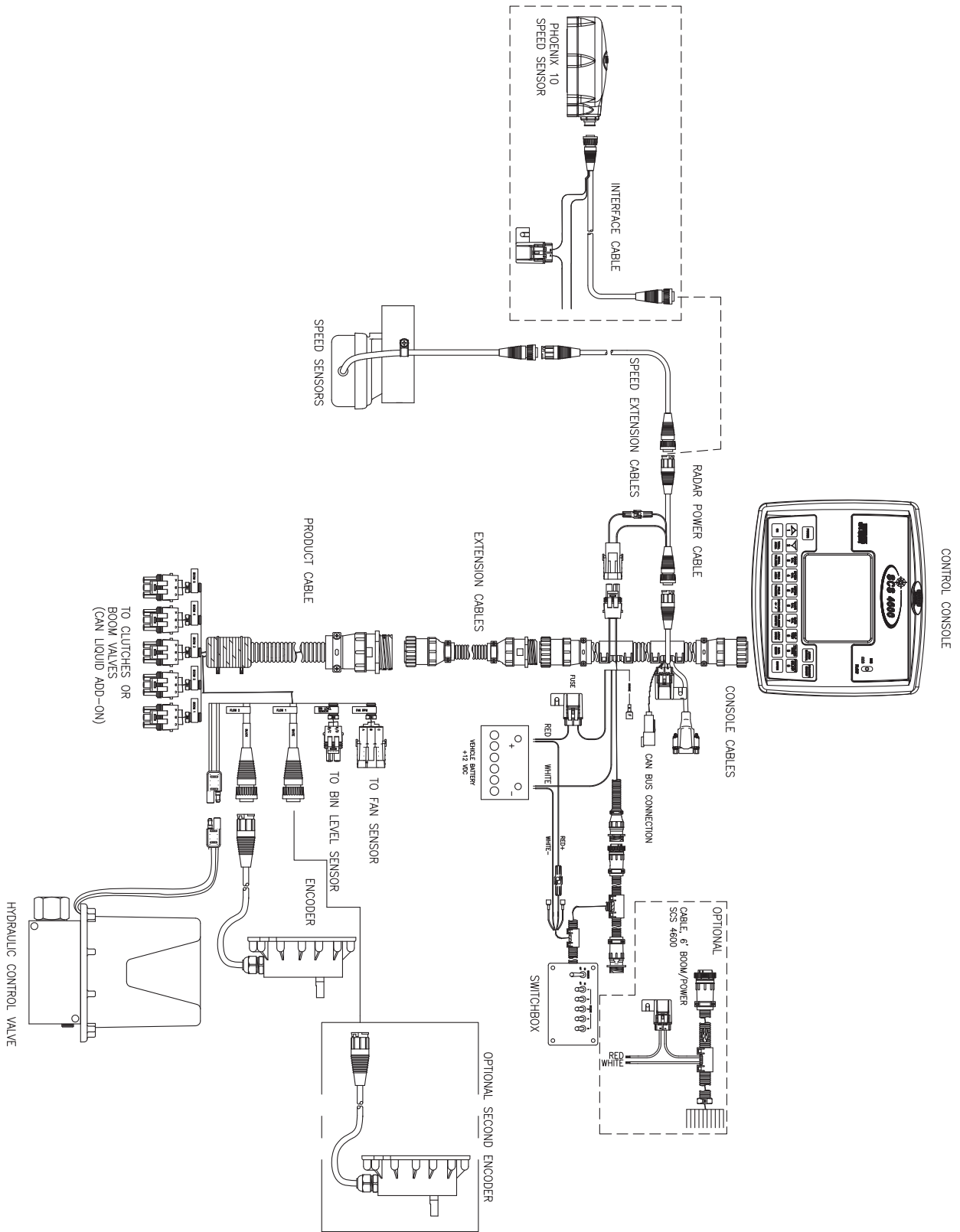


FIGURE 7. SCS 4600 Granular Control System



Detecting CAN Nodes

The SCS 4000/5000 Series console must be able to communicate with the CANbus system to ensure that the products are applied correctly. The SCS console should automatically establish communication with the boom/speed node, the AccuBoom™ and AutoBoom™ nodes (if installed), and up to five product control nodes via the CANbus.

When a node is detected, the node will the program and version of the connected node is displayed in the CAN Data Menu. To access the CAN Data Menu, press the DATA MENU button until CAN is highlighted at the bottom, left corner of the SCS display. Use the arrow up or down keys to scroll through the list of possible nodes

Note: *If a node is not found, troubleshoot the node to determine why SCS console cannot communicate with the node. See the Troubleshooting section later in this chapter for more information about CAN communication failures.*

Node Version Information

The CAN Data Menu displays program number and version of each node detected on the CANbus.

Retry CAN Initialization

If a node, or nodes, currently connected to the CANbus system are not displayed in the CAN Data Menu, press the POWER key to cycle power to the console. If nodes still do not display properly when the console is rebooted, the CANbus system may need to be readdressed. Proceed to the next section for instructions on readdressing the product nodes.

Readdressing the Nodes

If the SCS console is unable to detect a CANbus node on startup, troubleshoot the CANbus and the node (see the *CAN Troubleshooting* section on page 18), and then readdress the CANbus:

Note: *Only product nodes need to be addressed (single product, dual product, motor control, etc.).*

1. From the main screen, press the DATA MENU button until the CAN option is highlighted in the lower, left hand corner of the SCS display.
2. Use the up or down arrow keys to select the "Readdress Control Nodes" option on Page 2 of the CAN Data Menu.
3. Press the ENTER button to begin readdressing the product control nodes.
4. When prompted to reboot nodes, disconnect the logic power from the product node to be controlled as Product 1. After approximately 3 seconds, reconnect the node's logic power. The SCS console should have recognized the node as Product 1.

Note: *The SCS 4400/4600 consoles feature an integrated product control channel which will always appear as Product 1.*

5. If additional product nodes are installed in the CANbus, repeat step 4 to readdress additional product nodes.
6. Press the ENTER button to finish readdressing the product nodes and resume normal operation.

Programming CANbus Nodes

The CAN nodes are programmed using the SCS console in Edit mode.

See Chapter 5, *Initial Startup & Console Programming*, for information on programming CAN product nodes.

Refer to the AutoBoom™ Calibration & Operation manual for detailed operation of the optional AutoBoom™ system with your SCS 4000/5000 Series console.

CAN Troubleshooting

Although the control algorithm is located within the CAN node, all of the same troubleshooting techniques that are used in a traditional hard-wired system still apply to a CAN system and the behavior of the system remains the same. Flow and speed sensors, as well as the control valve and boom valves, are used in the same fashion.

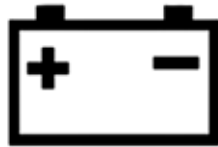
CAN Node Off-line Errors

The most likely causes for losing CAN communication between the console and any one of the nodes are:

1. Corroded and/or open connections in the circuit.
2. Console and/or CAN node logic power and grounds connected to a “dirty” power source (dirty power is defined as any circuit with a variable load that exceeds 1 ampere). This is especially true of circuits loaded by electrical coils.
3. Console and/or nodes connected to different power and/or ground sources. This can result in components operating at different voltage planes.

Below are some common causes for communication failures:

Issue	Possible Cause	Solution
CANbus cannot read the product node	<ul style="list-style-type: none"> The node is not connected to the CANbus 	<ul style="list-style-type: none"> Connect the node and reboot the SCS console to read the product node.
	<ul style="list-style-type: none"> Node is not properly powered 	<ul style="list-style-type: none"> Connect the clean power - 16 gauge red wire and high current power - 12 gauge red wire from the product node to a 12V DC power source that is capable of supplying power to all nodes connected to the CANbus system
	<ul style="list-style-type: none"> Node is not properly grounded 	<ul style="list-style-type: none"> Connect the clean ground - 16 gauge white wire and the high current ground - 12 gauge white wire to a good, quality ground source. Raven recommends grounding the wires to the negative terminal of the battery.
	<ul style="list-style-type: none"> CANbus ends not terminated 	<ul style="list-style-type: none"> Make sure that both ends of the CANbus system are properly terminated. Refer to the Raven CANbus Installation Manual for more information about installing terminators on the CANbus.
	<ul style="list-style-type: none"> Corroded pins in CANbus connections 	<ul style="list-style-type: none"> Check CANbus cable connectors for any highly corroded pins. Ensure dielectric grease has been applied to all cable connections exposed to weather and field conditions.
	<ul style="list-style-type: none"> Moisture in connection 	<ul style="list-style-type: none"> Check CANbus cable connectors for any corroded pins. Ensure dielectric grease has been applied to all cable connections exposed to weather and field conditions.
	<ul style="list-style-type: none"> Connectors not seated properly 	<ul style="list-style-type: none"> Check that all CANbus cable connectors are inserted fully (until the locking tab is engaged). Be sure to remove any moisture in connections which were not properly seated. Check for corroded pins and apply dielectric grease when reconnecting CANbus cables.

**CAUTION**

Be sure to follow instructions for connecting the power leads to the battery carefully. Reversing the power leads may cause damage to the SCS console. Be sure to connect the battery leads after all other components have been properly mounted and connected.

Install the SCS Console

Refer to the following requirements when selecting a mounting location for the SCS console:

- The console is not weatherproof. Mount the console inside the machine cabin or drivers compartment within easy reach of the driver or operator.
- Secure the console to an existing post or monitor bar using the provided clamps. Once mounted, the console should not impede normal machine operation.
- The console should be mounted in a location where it will not be jarred during normal equipment operation. Keep the console clear of moving elements within the machine cabin.
- Keep cable routing in mind when selecting a mounting location to avoid tripping hazards or damage to the cable during normal operation.

Mount the SCS Console

Note: If the CAN Switch Box will be installed with the console, use the mounting hardware provided with the CAN Switch Box. Refer to the CAN Switch Box Installation and Operation Guide for mounting instructions.

1. Select a mounting post or monitor bar within the vehicle cabin to secure the SCS console.
2. If necessary, remove the four bolts holding the mounting plate to the back of the console and rotate the plate 90° to mount the SCS console to a vertical post or monitor bar.

FIGURE 1. Standard Mounting Plate Configuration



Note: The mounting clamps are designed to secure the console to a 1" dia. [2.54 cm] monitor bar or post.

3. Use the provided clamp and thumb screws to secure the console to the selected mounting bar.

Cable and Power Connections

1. Connect the console cable to the large, round plug on the back of the SCS console.
2. Route the console cable out of the vehicle cabin and connect to the CANbus or product cabling on the sprayer or spreader. Refer to one of the following figures for a diagram of the console cable connections.
 - Figure 2, "SCS 4000/4070/5000 Series Console Connections," on page 23
 - Figure 3, "SCS 4400 Console Connections," on page 24
 - Figure 4, "SCS 4600 Console Connections," on page 25
 - Figure 5, "Chassis Cable Platform Example (SCS 4000/4070/5000 Consoles Only)," on page 26

Note: Flow meter and speed sensor extension cables are available from a local Raven dealer.

3. Use the supplied cable ties to secure the console cable to prevent the cable from pinching or breaking and to prevent tripping hazards.

- Connect the console cable to vehicle power as shown in the figures designated above. Refer to the *Raven CANbus Network Installation Manual* for details on connecting the console to vehicle power using the cabling platform installed on the vehicle.

Important: Do not connect the red and white leads to the vehicle starter. Make sure the vehicle accessory power (key) is off before routing the red and white battery leads to a 12-volt battery.

- Secure the power leads with plastic cable ties but do not tie the power wires close to existing battery cables or any other electrical wiring.

FIGURE 2. SCS 4000/4070/5000 Series Console Connections

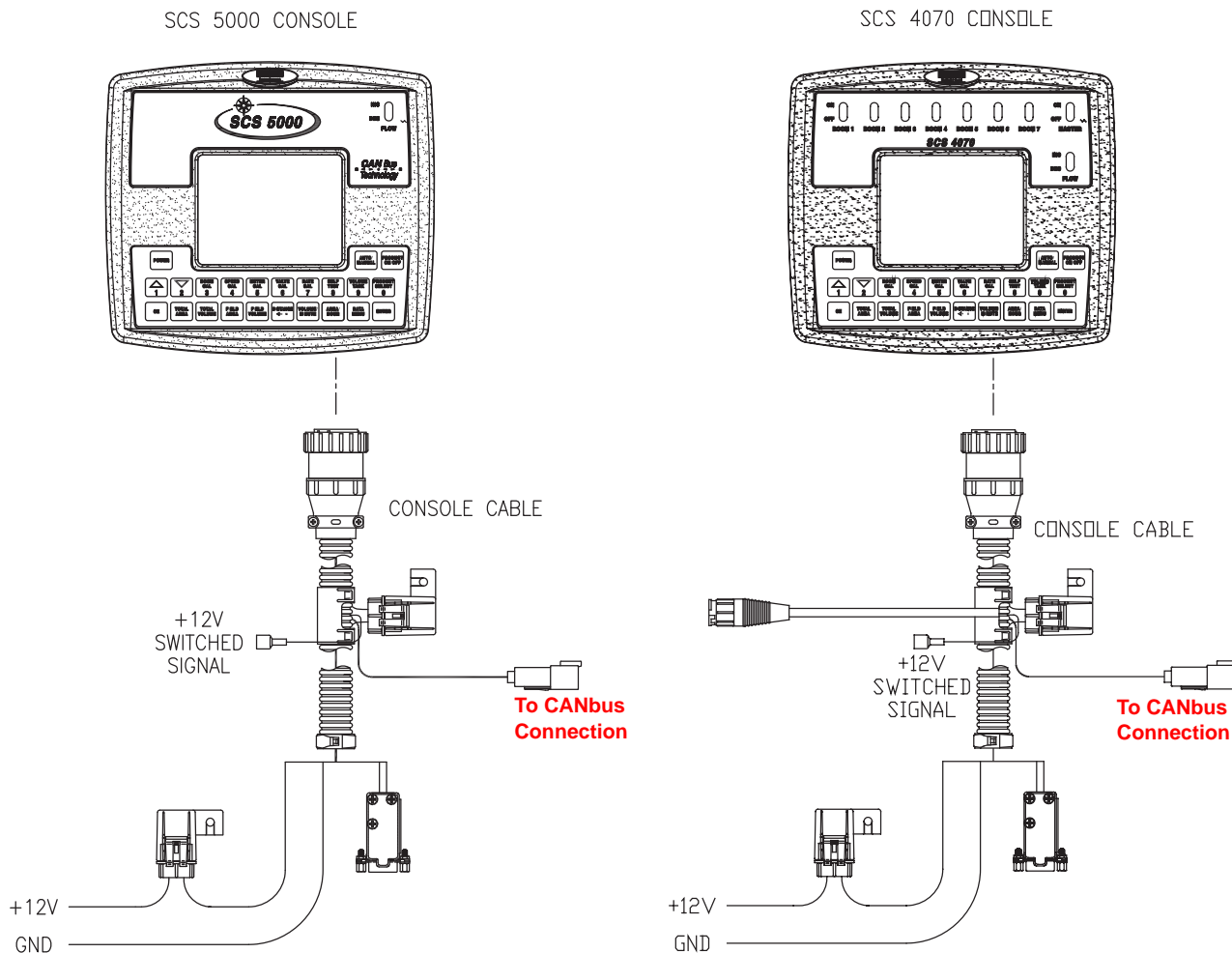
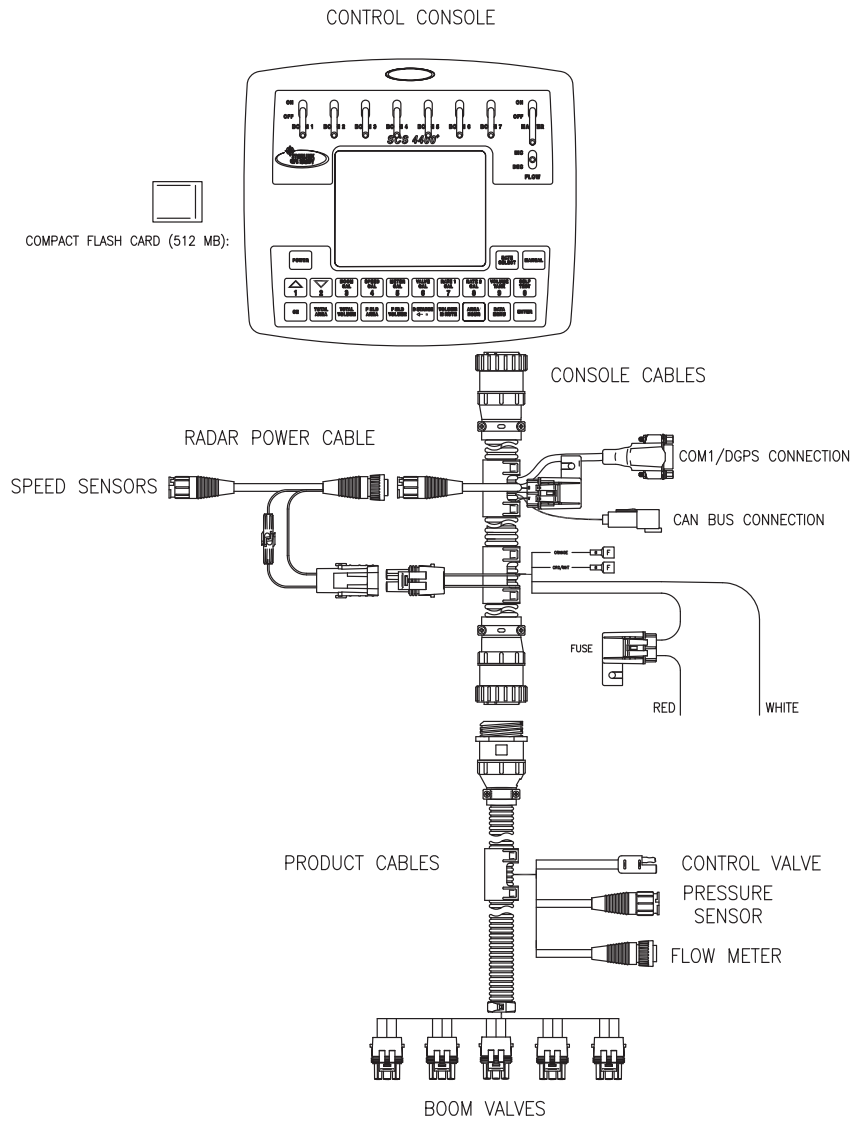
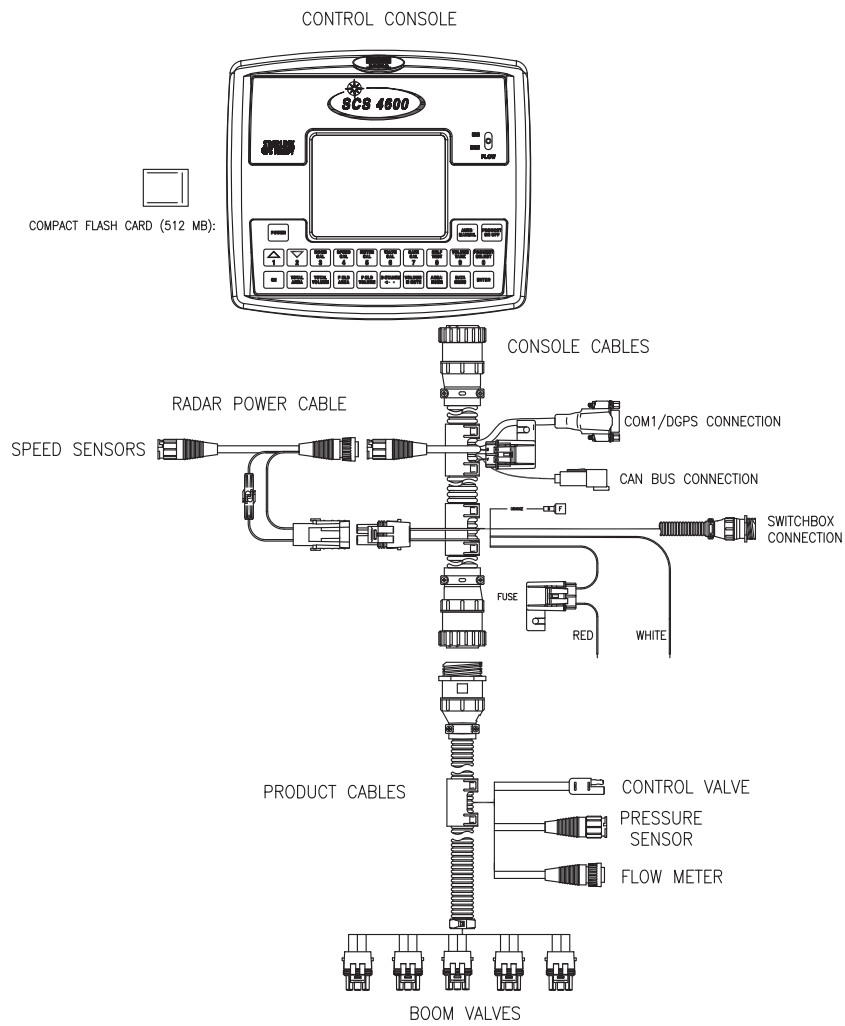


FIGURE 3. SCS 4400 Console Connections



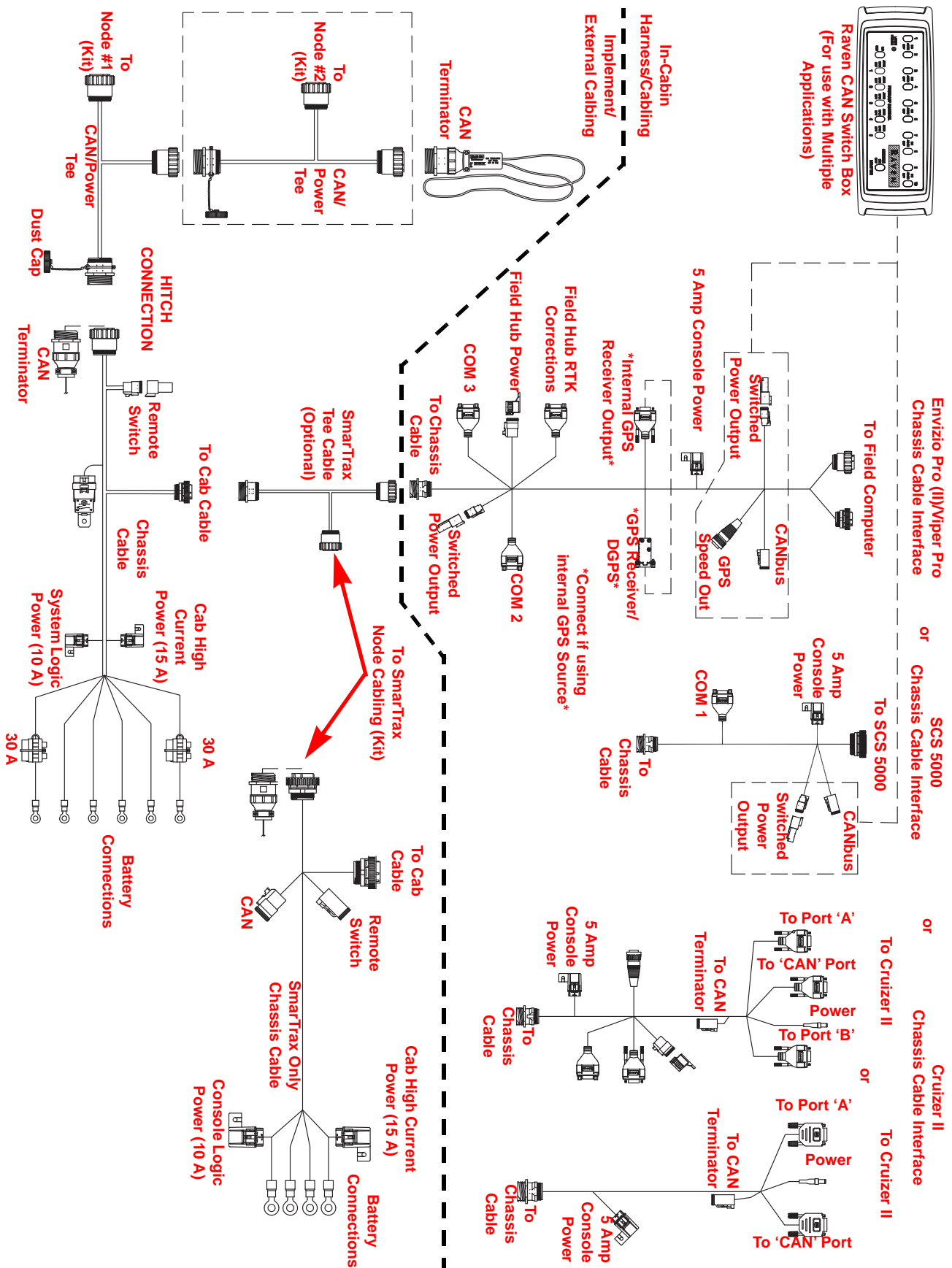
Note: The SCS 4400 with part number 063-0172-281 features a compact flash card slot for application data transfer to a home or office computer. The data logging feature will only be used when connecting to an optional external console for logging or mapping applications.

FIGURE 4. SCS 4600 Console Connections



Note: The SCS 4600 with part number 063-0172-343 features a compact flash card slot for application data transfer to a home or office computer. The data logging feature will only be used when connecting to an optional external console for logging or mapping applications.

FIGURE 5. Chassis Cable Platform Example (SCS 4000/4070/5000 Consoles Only)



The first time the SCS console is powered on, it will automatically enter a calibration mode. This initial programming sequence requires a selection for the units, product control type, speed sensor type, and control valve type before the flashing “CAL” (calibration) alert clears and the console is ready for normal operation.

Reset Console Memory

Occasionally, it may be necessary to reset the internal memory and return to the initial programming screens.

Note: *All configuration settings and data will be lost. Before performing a memory reset, be sure to write down all calibration data to simplify console programming after the memory has been cleared.*

To reset the internal memory:

1. Press the POWER button to turn the console OFF.
2. While holding the CE key, press POWER to turn the console ON.
3. Perform the *Initial Calibration Sequence* as described in the next section to restore the console to normal operation. Before beginning product application, verify all other settings on the console are reprogrammed to ensure proper operation of the control system.

Initial Calibration Sequence

Adjust Contrast

When the console is switched on for the first time, the Adjust Contrast screen will display.

1. Press and hold the UP ARROW key to increase the screen contrast or the DOWN ARROW to decrease the contrast.
2. Press ENTER to save this setting and proceed to the Units screen.

Note: *The screen contrast can be adjusted through the Data Menu after the initial programming. See Chapter 6, Data Menu, for more information.*

Language

Review the on-screen instructions and use the appropriate number keys to select the desired display language.

Units

The default setting for the Units screen is “US Acres.”

1. Press the CE key to cycle between SI Metric Hectares, Turf Square Feet, or US Acres.
2. Press ENTER to accept the displayed selection and advance to the Product Control Type screen.

Product Control Type

The default setting for the product control type is “Liquid” control.

1. Press the CE key to cycle between:

Note: *Some application types may require a specific node firmware version or an optional CANbus control hardware. If an application type selection is not available, contact a local Raven dealer for assistance.*

LIQUID. Application of a liquid product.

Note: *When using an optional Raven Sidekick Pro™ direct injection system with the SCS console, select liquid for the control type setting and refer to the Valve Type section on page 29 to configure the valve setting for the specific injection pump installed on the control system.*

GRANULAR 1. Dry or granular product application using a single encoder to meter application equipment with a single bed.

GRANULAR 2. Dry or granular product application using a single encoder to meter application from equipment with a dual bed.

GRANULAR 3. Dry or granular product application using a dual encoder configuration to meter application from equipment with a dual bed.

SPINNER. Select this option for RPM control of spinner speed during field operations.

NH3. An option for anhydrous ammonia rate control operations will be available if the product node is capable of specific rate control features. It is recommended to ensure this option is available and selected when controlling the application of anhydrous ammonia during field operations.

NH3 BOOST PUMP. The anhydrous pump control selection will be available if the product node is capable of specific control features for the AccuFlow HP boost pump. Select this option to allow the operator configure specific boost pump control features for field operations.

LIQUID 3-WAY. When using a 3-way, or flow back, type valve with a liquid control system, select the ‘LIQUID 3-WAY’ option. This control type setting allows the SCS console to properly meter the product flow applied through the boom sections.

2. Press ENTER to save this setting and advance to the Valve Type screen.

Valve Type

The default setting for the Valve Type screen is “Standard Valve.”

1. Press the CE key to cycle between:
 - STANDARD VALVE
 - FAST VALVE
 - FAST CLOSE VALVE
 - PWM VALVE
 - PWM CLOSE VALVE
 - HIGH VOLUME PUMP
 - LOW VOLUME PUMP

Note: *The high and low volume pump options are only available if a Sidekick Pro direct injection pump is detected on the CANbus.*

2. Press ENTER to accept the displayed selection and advance to either the Meter Cal or Spreader Constant screen.
3. If “Liquid” was selected as the product control type, skip to the *Meter Cal (Liquid Applications)* section on page 30. If “Spinner RPM Control” was selected as the product control type, skip to the *Fan Speed Cal (Spinner Applications)* section on page 30. If any of the granular control options were selected, a spreader constant and a product density or meter cal will have to be entered.

Note: *During the initial programming sequence, pressing ENTER in Edit mode will also advance to the next calibration screen.*

Spreader Constant (Granular Applications)

If you have selected any of the granular product control types, the next screen displayed after the valve type will be the Spreader Constant screen. A value greater than zero must be entered into this screen to advance to the next screen.

1. Use the Edit mode to input the initial spreader constant.
See the *Spreader Constant* section on page 58 for more information on calculating and adjusting the spreader constant for a specific machine set up.

Note: *Press the METER CAL button while on this screen to toggle between spreader constant and meter cal.*

2. The Product Density screen will display.

Product Density (Granular Applications)

After the spreader constant is entered, the SCS console will display the Product Density screen.

1. Use the Edit mode to input a density value for the granular product to be applied.

Note: *Press and hold the METER CAL button while on this screen to review the value for the spreader constant entered on the last calibration screen.*

2. The Valve Cal screen will display.

Meter Cal (Liquid Applications)

If “Liquid” was selected for the product control type, the Meter Cal screen will display after the Valve Type screen.

1. Use the Edit mode to input the meter cal value printed on the flow meter tag.
2. The Valve Cal screen will display.

Fan Speed Cal (Spinner Applications)

If “Spinner RPM Control” was entered as the product control type, the Fan Speed Cal screen will display after the Valve Type screen.

1. Use the Edit mode to input the Fan Speed Cal. The Fan Speed Cal value is the number of pulses detected per ten revolutions of the fan.
See the *Spinner RPM* section on page 60 for more information about calculating the fan speed cal.
2. The Valve Cal screen will display.

Valve Cal

The valve cal value is used to control the response time of control valve motors with respect to changes in vehicle speed. The valve cal can be adjusted after the initial programming to refine valve response. Raven recommends the following values for the initial control valve calibration number:

- Standard valves - 2123
- Fast and fast close valves - 743
- PWM and PWM close valves - 43

See the *Valve Cal* section on page 55 for details on refining this value for the various valve types.

1. Use the Edit mode to input the valve cal value for the control valves on your equipment.

Note: *More recent firmware releases automatically enter the recommended valve cal values based upon the type of control valve selected.*

2. The Rate Cal screen displays

Rate Cal

Enter the target application rate in gallons per acre (GPA), liters per hectare (L/ha) or gallons per 1000 square feet (GPK).

1. Use the Edit mode to input the rate cal value.
2. The Speed Sensor Type screen displays.

Speed Sensor Type

The default setting for the speed sensor type is “Radar SP2.”

1. Press the CE key to cycle between:
 - WHEEL SPEED SP1
 - RADAR SP2
2. Press ENTER to save the displayed selection and advance to the Speed Cal screen.

Speed Cal

Raven recommends the following speed calibration values for initial system setup.

Sensor Type Setting	Sensor Type	English	Metric
Radar/GPS (SP2)	External Raven GPS Receiver	785	199
	Internal GPS from Envizio Pro/Cruizer	812	206
	Raven Radar	598	152
Wheel (SP1)	Wheel Magnets	1000	254
	Speedometer Drive Speed Sensor	612	155

These values are good starting points and generally yield adequate results, however, the speed cal should be refined for each specific vehicle and speed sense system. See the *Speed Cal* section on page 51 for details on refining this value.

1. Use the Edit mode to input a speed cal value.
2. The Boom Cal screen displays.

Boom Cal

The boom cal value is the width of each boom section in inches [cm]. Up to ten boom cal values may be programmed into the SCS console.

1. Use the Edit mode to input the width of the boom section connected to the boom 1 connector or sense wire.
2. Once a boom cal value has been entered on the Boom 1 Cal screen, the flashing CAL alert will clear and the initial programming sequence is complete.

It is recommended to program the boom cal values for additional boom sections at this time. Press the UP or DOWN ARROW keys to access the Boom Cal screens for booms 2-10 and enter the boom widths for these boom sections.

Note: To return to the Boom Cal screens after the initial calibration is complete, press the BOOM CAL key.

Reprogramming Initial Settings

After the initial console programming sequence is complete, if there is a need to change initial console programming settings (working units, product control type, valve type, or speed sensor type):

1. Press and hold the SELF TEST key.
2. The display will flash the current settings. After 12 seconds, the display will stop on US ACRES.
3. Press CE to change the working units.
4. Press ENTER to accept the new setting and proceed to the next screen.
5. Repeat step 3 and step 4 as necessary for the speed sensor type, product control type and control valve type screens.

Console Programming

Edit Mode

During normal operation of the SCS console, pressing the calibration keys will access the selected calibration screen. In order to program numerical values into the SCS console, use the Edit mode. To enter Edit mode:

1. Press the ENTER key. The default or existing value will be cleared and the screen will display an “E” on the far right side of the screen.
2. Key in the desired value for the current setting. For example, press “2” “1” “2” “3” to enter a value of 2123.
3. Press the ENTER key to accept the keyed value and return to normal operation.

Note: *During the initial console programming, pressing ENTER accepts the keyed value and advances to the next calibration screen.*

Calibration Keys

The calibration keys allow the operator to program the SCS console and calibrate the system to the specific application equipment. See the *Edit Mode* section on page 32 for information on programming the SCS console using the Edit mode.

Boom Cal

Press the BOOM CAL button to display the boom calibration screen. This screen allows the operator to view and edit boom section widths for up to ten boom sections.

1. Press the BOOM CAL button. The Boom 1 Cal screen is displayed.
2. Press the UP or DOWN ARROW keys to view the boom section screens for additional sections.
3. Use the Edit mode to enter or edit boom section widths. If a boom section is not used or not needed, enter “0” as the value for that boom section’s boom cal.

Speed Cal

Press SPEED CAL to display the current speed calibration value used to determine vehicle speed. For more information, refer to the *Speed Cal* section on page 51.

Meter Cal

Press the METER CAL button to display the following settings for the selected node.

For Liquid Products: Press the METER CAL button to display the current programmed meter calibration value used to calculate the volume per minute, rate, and total gallons for each product being applied. The METER CAL value is printed on the tag on the flow meter.

Note: *For more information, refer to the Chapter 12, Flow Meter Maintenance & Adjustment Procedure.*

For Granular Products: Press the METER CAL button to display either the product density or spreader constant for the selected product node. Continue pressing the METER CAL button to toggle between the spreader constant and product density settings for the selected node.

Valve Cal

Press the VALVE CAL button to display the currently programmed calibration value used to adjust the control valve and keep product application on the target rate. This value sets control characteristics such as speed and reaction of the various control valves. For details on setting or adjusting this value for a specific control valve, refer to the *Valve Cal* section on page 55.

Note: *If the dual loop control feature is enabled, the valve cal value will be replaced with flow cal. Refer to the Dual Loop Control (PWM Valves Only) section on page 43 for information on the dual loop control feature or the Dual Loop Control Mode Settings section on page 57 for information on configuring or adjusting the dual loop control settings.*

Rate Cal

Press the RATE CAL button to display the currently programmed rate in gallons per acre (liters per hectare). This is the target rate for product application.

Self Test

Press the SELF TEST button to display a test speed for checking or troubleshooting the product control system.

Press and hold the SELF TEST button to view the SCS console initial programming values and settings. If the SELF TEST button is held for 12 seconds, the controller will stop scrolling and allow the operator to step through the various settings and enter new values if desired.

Function Keys

The function keys display current application information. This information may also be helpful in calibrating, fine tuning, or testing the controller or product control system. The totalizer buttons can be reset at any time.

Total Area

Pressing TOTAL AREA displays the total area covered.

Total Volume

Pressing TOTAL VOLUME displays the total volume applied.

Field Area

Pressing FIELD AREA displays the field area covered.

Field Volume

Pressing FIELD VOLUME displays the total volume applied to a field.

Distance

To display the SCS console odometer, displayed in feet or meters, press DISTANCE.

Note: *This reading is also useful when calibrating or fine tuning the speed cal.*

Volume/Minute

Pressing the VOLUME/MINUTE key displays the current volume per minute, or flow rate, in the units which the SCS console is programmed to apply.

Area/Hour

Pressing the AREA/HOUR key displays an estimate of the area that could be covered if both the current speed and boom operation were maintained over one hour.

Data Menu

Pressing the DATA MENU key accesses the SCS Data Menu. Refer to Chapter 6, *Data Menu* for more information on the Data Menu.

Product On/Off

The PRODUCT ON/OFF key toggles product control on or off. When a “close” type valve is selected, toggling product control off will result in the valve closing.

Tank Volume

Press the VOLUME/TANK button to display the current volume remaining in the tank or bin. Use the Edit mode to re-enter a volume of product in a tank or bin when the selected product is refilled.

Product Select

Pressing PRODUCT SELECT toggles the product selection on the controller. The product must be selected to view application data or change settings.

Self Test Mode

The Self Test mode can be used to simulate speed for testing the system while the vehicle is not moving. Press SELF TEST and use the Edit mode to enter a simulated operating speed. Verify the speed in the lower left corner of the display. The Self Test speed will clear when the speed sensor detects motion. If 6 MPH [10 km/h] is desired, enter 6.0 [10.0]. A speed cal value of 900 [230] or greater is recommended when operating in this mode.

Note: *To prevent the Self Test speed from disengaging while testing the system, disconnect speed connector on the console cable or boom sense/speed cable.*

Decimal Shift

The decimal shift feature is used to increase system accuracy at low application rates. Decimal shift is set during the setup of meter cal or product density.

Note: *The programmed rate cal value is also affected by the decimal shift feature. Be sure to verify the programmed rate cal when changing the decimal shift feature.*

To enable the decimal shift feature for the selected product:

1. Press the METER CAL button.
2. Press the ENTER key to enable Edit mode.
3. Press the DISTANCE key. The rate display for the selected product will change to reflect the decimal shift.
4. Enter the meter cal or product density for the selected product.
5. Press the ENTER key to accept the value and exit Edit mode.

To disable the decimal shift feature for the selected product:

1. Press the METER CAL button.
2. Press the ENTER key to enable Edit mode.
3. Enter the meter cal or product density for the selected product. The rate display for the selected product will change to reflect the changed decimal.
4. Press the ENTER key to accept the value and exit Edit mode.

The following tables illustrate how shifting the decimal point can increase system accuracy.

TABLE 1. Decimal Place Locations in Liquid Mode

	US		Metric		Turf	
	Unshifted	Shift	Unshifted	Shift	Unshifted	Shift
Rate Display	0000.0	000.00	00000	0000.0	000.00	000.00
Rate Cal	0000.0	000.00	00000	0000.0	000.00	000.00
Tank Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Total Area	000.0	000.0	000.0	000.0	0000	0000
Total Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Field Area	000.0	000.0	000.0	000.0	0000	0000
Field Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Vol/Minute	0000	000.0	0000	000.0	000.0	000.0
Area/Hour	000.0	000.0	000.0	000.0	0000	0000
Rate +/-	000.0	00.00	0000	000.0	00.00	00.00
Low Tank Level	0000	000.0	0000	000.0	000.0	000.0
Low Vol/Min	0000	000.0	0000	000.0	000.0	000.0

TABLE 2. Decimal Place Locations in Granular Mode

	US		Metric		Turf	
	Unshifted	Shift	Unshifted	Shift	Unshifted	Shift
Rate Display	00000	0000.0	00000	0000.0	0000.0	0000.0
Rate Cal	00000	0000.0	00000	0000.0	0000.0	0000.0
Tank Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Total Area	000.0	000.0	000.0	000.0	0000	0000
Total Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Field Area	000.0	000.0	000.0	000.0	0000	0000
Field Volume	000000	00000.0	000000	00000.0	00000.0	00000.0
Vol/Minute	0000	000.0	0000	000.0	000.0	000.0
Area/Hour	000.0	000.0	000.0	000.0	0000	0000
Rate +/-	0000	000.0	0000	000.0	000.0	000.0
Low Tank Level	0000	000.0	0000	000.0	000.0	000.0
Low Vol/Min	0000	000.0	0000	000.0	000.0	000.0

Note: When entering rate cal, remember that 200 PPA [kg/ha] is entered as 200 when unshifted and 200.0 when shifted.

Additional features of the SCS console can be modified using the Serial, Product, Console, and CAN submenus accessed by pressing the DATA MENU key on the SCS keypad. The Data Menu also contains the Product Summary screens for each product as well as the AutoBoom if the optional hardware is installed.

Each time DATA MENU is pressed, the display advances to the next submenu. Pressing the UP and DOWN arrow keys advances to the next option in the current display. Press the CE key to toggle an option setting or the ENTER key to use the Edit mode to input data.

Note: *The Data Menu contains calibrations and settings which are not required for SCS console operation.*

The following is a description of the features available within the Data Menu.

Serial Submenu

Data Logger

Enables or disables data logging. There must be a trigger value and trigger unit selected to enable this feature. When enabled and saving data to a flash card, the datalog file number will be shown.

Note: *The SCS 4400 with part number 063-0172-281 and SCS 4600 with part number 063-0172-343 both feature a compact flash card slot for application data transfer to a home or office computer. For consoles with other part numbers, the data logging feature will only be used when connecting to an optional external console for logging or mapping applications.*

Data logging consoles will only recognize compact flash cards up to 512 MB. Do not use cards with larger storage capacity with SCS consoles.

Field Reference

Allows user to enter up to a four-digit reference number to represent a job. The field reference is included in field begin and field end pages as well as the data logger time/date string.

GPS Baud Rate (SCS 4400/4600 Only)

Set the baud rate that the SCS console should use to communicate to a connected GPS receiver. Select between 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

Serial Baud Rate (SCS 4000/4070/5000 Only)

Select 1200 or 9600 baud for serial port communication.

Variable Rate Change Alarm

Enable or disable audible and visual alarm upon a variable rate change. When on, an alarm sounds 4 long beeps when a rate calibration number is changed via the serial port using a valid rate change request data string.

Trigger Value

The trigger value determines how often data is sent to the serial port (See Chapter 16, *Serial Interface & Data String Formats*). The trigger value is the number of trigger units between data strings. Data logger functions will not work until a non-zero trigger value is set.

Trigger Units

Used in data logging mode. The trigger unit is selectable between feet, meters, or seconds.

Additional Serial Options

SCS 4000/4070/5000

Print Field

Sends data to an optional printer connected to the console serial port to print field beginning and field ending pages. This option is not available when the data logger is set to on.

SCS 4400/4600

Data Direction

Select “Save Data to Card” or “Pass Data Through Comm Port” (used to communicate to an external device). When “Save Data to Card” is selected, the datalog software version will be shown for reference.

Note: Refer to the Data Logger section on page 37 for details on available consoles compatible with the data logging feature.

To send and receive data through the serial communication port, be sure to enable the data logging feature. Review Data Logger section on page 37 for more information. The default serial baud rate is configured at 9600 to work with most DGPS receivers or Raven consoles and field

computers. Refer to the Serial Baud Rate (SCS 4000/4070/5000 Only) section on page 38 to reconfigure the serial communication baud rate if necessary.

COM 1 Stop Bits

Select between one or two stop bits for communicating with a GPS receiver.

Datalog Mode

Select between logging "GPS and Console Data" or "GPS Data only." The master switch will pause the data log if GPS and console data are being recorded. GPS data only creates a continuous log.

VRC

Enable or disable variable rate control through the serial and CAN ports. When VRC is disabled, the SCS console will ignore variable rate information.

Product Submenu

Page 1

Boom Select

This feature allows the operator to assign products to individual boom sections. Products assigned to a boom section will only be applied when the assigned boom section is turned on.

Note: *The equipment plumbing and electrical systems must accommodate any selections made for this feature.*

Once entering boom select mode, use the CE key to toggle between products and use keys 1 through 0 to toggle the boom selection ON or OFF for booms 1-10 respectively. The boom status display indicator will show the selected booms for the active product. All booms are initially selected ON for each product.

Press ENTER to exit boom select mode.

Off Rate %

This is the acceptable percentage (+/-) of the actual rate in relation to the target rate. The off rate alarm will activate when the actual application rate (volume/area) is outside of this range for more than 5 seconds.

PWM High Offset

The PWM high offset is used to set the maximum desired RPM or hydraulic output of a PWM (Pulse Width Modulated) control valve.

To calibrate the high offset value:

1. Toggle the console to manual (MAN) mode and toggle any boom and master switches to the on position.
2. Hold the INC/DEC switch in the increase position.

3. If the motor exceeds the desired RPM, decrease the high offset by 10 and hold INC again.
4. Repeat step 3 until the motor runs at the desired RPM.
5. Add 10 to the current high offset value and use the Edit mode to program the new high offset value.

PWM Low Offset

The PWM low offset is used to set the minimum desired RPM or hydraulic output (zero point or shutoff point) of a PWM (Pulse Width Modulated) control valve.

To calibrate the low offset value:

1. Toggle the console to manual (MAN) mode and toggle any boom and master switches to the on position.
2. Hold the INC/DEC switch in the decrease position until motor stops.
3. Use the Edit mode to increase the low offset value until motor runs.
4. Subtract 10 from the current low offset value and use the Edit mode to program the new low offset value.
5. Verify the correct low offset value by holding the INC/DEC switch in the decrease position. If motor does not stop, reduce the offset value by 10 and repeat.

PWM Frequency

Used to set the coil frequency of PWM valve (default is 122 Hz). Refer to the PWM control valve manufacturer specifications for recommended PWM frequency.

Preset PWM Offset (PWM Valves Only)

When valve selection is programmed in PWM-Close mode, this can be set to provide an initial pulse width to the valve upon turning on booms or product. When programmed to zero, pulse width will return to previous state. When non-zero, initial pulse width can be selected between 1 (slow) and 255 (full scale). When programmed in PWM valve mode, PWM output will not exceed this value if non-zero when booms are off.

Standby Pressure (PWM Valves Only)

Note: *The standby pressure enable feature must be enabled to display the standby pressure value on the SCS console. Refer to the Standby (Pressure) Enable (PWM Valves Only) section on page 43 for details.*

Enter a non-zero value to set the target pressure for a liquid product system when in a standby condition in automatic control mode. When all of the boom valves or the master switch is in the off position, the system will maintain the target standby pressure in the product lines to keep the system charged and minimize the time required to re-establish a spray pattern when application is resumed. The standby pressure value is entered in PSI [kPa or BAR].

Note: *This feature is disabled when controlling product rate in manual control mode.*

Rate Bump Delta

Sets the increment at which rate cal is increased or decreased using INC/DEC switch while in automatic (AUTO) control mode.

Low Flow Limit

If actual volume/minute falls below the assigned limit, the control valve will be controlled to low flow limit and low limit alarm is activated. This value is automatically proportioned to the percentage of booms that are on (i.e. if the entered low limit is 4 and half the total boom length is shut off, the console automatically reduces the low limit to 2). Low limit value is entered in GPM [L/min] or PPM [kg/min].

Low Tank

When level in tank falls below the volume/tank value, the low level alarm is activated. The alarm will deactivate when the booms are turned OFF or a value equal to or greater than the low tank value is entered as the VOLUME/TANK. Entering "0" in low tank disables the alarm.

Valve Delay

This value is the delay between when the SCS console will control flow rate after the booms have been turned on. This setting can be set between 0-9 seconds.

This delay is active if the time between turning OFF and turning ON the booms is less than 30 seconds.

Spreader Constant

The spreader constant should be set at zero when applying liquid products.

See the *Spreader Constant* section on page 58 for details on calculating the spreader constant. The spreader constant may be entered during initial console programming or through the Data Menu.

Page 2

Valve Cal 2

This value can fine tune control valve response and help control application rate oscillations when the console is programmed in PWM mode.

When a fast close valve is selected, valve cal 2 is utilized to enable a high resolution rate control for lower application rates. Enter a non-zero value for the time, in milliseconds, which a closed valve will be driven open before switching into high resolution control. For example, a value of 200 will give the valve a 200 millisecond "burst" at a full 12 volts to open the fast valve from the closed position before resuming product rate control. A zero value will disable this feature.

Note: *If the dual loop control feature is enabled, the valve cal 2 value will be replaced with system gain. Refer to the Dual Loop Control (PWM Valves Only) section on page 43 for information on the dual loop control feature or the Dual Loop Control Mode Settings section on page 57 for information on configuring or adjusting the dual loop control settings.*

Pump Cal/Fan Cal

Set the number of pulses per revolution of the pump or fan for pump/fan RPM readout.

Dual Sensor Alarm %

For liquid chemical injection applications, sets tolerance between flow switch monitor and flow readings before “FLOW SW” alarm is enacted. For applications controlled in “Gran 3” mode, this value sets tolerance between dual encoder readings before “DUAL FLOW” alarm is enacted (boom select feature must be set up for only booms being used). Out of tolerance condition must be met for 5 seconds before alarm occurs.

Vacuum or Bin Level Alarm

When controlling chemical injection, the vacuum alarm can be enabled or disabled. For granular applications, a bin level sensor can be enabled or disabled. Disable this feature if a bin level sensor is not present or when the SCS console is not controlling injection.

Flow Switch Alarm (Chemical Injection Unit)

When controlling chemical injection, the flow switch alarm can be enabled or disabled. Disable when not controlling injection.

Note: *The flow switch alarm setting is only displayed for products controlled by a motor control node.*

Valve Advance (Standard or Fast Valve)

This feature allows the operator to set the amount of time (in seconds) in which the valve will be opened upon all boom sections being turned off and control in automatic (AUTO). A value of 1-9 means an advance of 1-9 seconds respectively. A value of 0 means no advance. This setting may be used in conjunction with the valve delay for low rate applications to build up pressure when the master switch is toggled on. For best results, approach the headlands at consistent speeds while turning all boom sections off.

Pressure

When equipped with pressure transducer(s), this area will display the current PSI [kPa/BAR]. Press CE to toggle between PSI, kPa, and BAR. If no pressure transducer is installed, “NOT INST” will be displayed.

Pressure 1 Cal

Used to calibrate pressure transducer #1. With pump turned off and 0 PSI [kPa] on the line, enter a pressure 1 of 0.

Pressure 2 Cal

Used to calibrate pressure transducer #2. With pump turned off and 0 PSI [kPa] on the line, enter a pressure 2 of 0.

Agitator

If equipped with an injection system featuring an agitator enabled output, this option enables or disables a chemical agitator.

PWM Output

Indicated position (output status) of PWM valve. Value will range from 0 (valve fully closed) to 255 (valve fully open). This can be used to fine tune the PWM low and high offsets.

VLV STATUS (when not programmed in PWM mode)

Displays the current status of the control valve (i.e. increasing, decreasing or idle) and gives further detail on the control status (Full on, in second breakpoint or in first breakpoint).

Page 3

Standby (Pressure) Enable (PWM Valves Only)

Note: *To enable the standby pressure setting, the product control system must have a PWM valve controlling a liquid application system and a pressure transducer connected to the control node. If these requirements are not met, the console will automatically disable the standby pressure enable feature.*

When enabled, the standby pressure setting will replace the preset PWM setting in the Product submenu. Review the Preset PWM Offset (PWM Valves Only) section on page 40.

The standby enable setting allows the operator to enable the standby pressure feature and enter a minimum pressure value. Refer to the *Standby Pressure (PWM Valves Only)* section on page 40 for information on the standby pressure value.

Low Pressure Limit

Enter a non-zero value to set a minimum pressure for the control system when applying liquid products. If the application or boom pressure falls to the set minimum value, the control valve will be controlled to maintain the low pressure limit value. The low pressure value is entered in PSI [kPa or BAR].

Dual Loop Control (PWM Valves Only)

The dual loop control feature is designed for use with low application rates and requires a pressure transducer with a liquid application system controlled with a PWM valve. The dual loop feature uses both the flow meter and pressure transducer to enhance the control response during operation at low application rates. The default setting for this feature is disabled.

Note: *If the dual loop control feature is enabled, the valve cal and valve cal 2 values will be replaced with flow cal and system gain settings. Refer to the Dual Loop Control Mode Settings section on page 57 details on setting and adjusting the flow cal and system gain values when using this control mode.*

Auto Calibration (PWM Valves Only)

The auto calibration feature may be used to automatically calibrate the high and low offset values for a PWM control valve in either a liquid or granular control system. The SCS console will display 'Not Calibrated' if the auto calibration process has not been performed for the selected control channel.

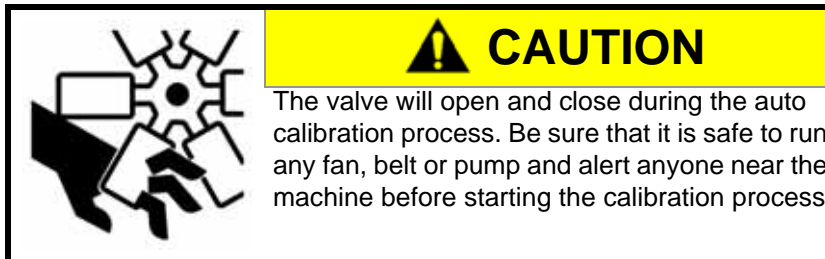
Note: *The auto calibration feature requires a PWM type control valve and a product node capable of performing the auto calibration feature. The SCS console will display 'Not Applicable' if the valve type or product node on the selected control channel is not capable of performing the auto calibration process.*

It is typically only necessary to run the auto calibration for each product node once. However, if significant modifications are made to the hydraulic system, or if the PWM control valve is replaced,

rerun the auto calibration to ensure the system is properly calibrated for the changes to the system.

To perform the auto calibration:

1. Empty any granular bins or fill liquid tanks with water only before performing the auto calibration process.
2. Press the PRODUCT ON/OFF key to turn the selected product off.
3. Toggle at least one section switch on.
4. Use the UP or DOWN ARROW keys within the Product submenu to select the 'Auto Cal' option on page 3.
5. Press the CE key to begin the auto calibration process.



The console will display 'Calibrating' and the system will begin operating the PWM valve to determine the high and low offset values. Allow the system a few minutes to perform the auto calibration process.

6. When the auto calibration process is completed, the console will display 'Calibrated.' Use the up and down arrows to verify the high offset and low offset values for the control channel.

Note: *If an error is detected during the auto calibration process, the console will display 'Calibration Error.' Review problem 26 in Chapter 9, Troubleshooting, to correct any issues with the PWM valve.*

Smart Control (PWM Valves Only)

Note: *The smart control feature cannot be enabled until the auto calibration process has been completed. Refer to the Auto Calibration (PWM Valves Only) earlier in this section for more information.*

The smart control feature may be enabled to provide quicker control responses to changes in vehicle speed, application rates or section status of a granular application system. With the feature enabled, the system will predict the PWM valve duty cycle required based upon the current application speed, rate or section status. From the predicted duty cycle, the system will adjust the valve to maintain the desired application rate.

Console Submenu

Contrast

Press ENTER to adjust the screen contrast. Press and hold the UP ARROW key to lighten or the DOWN ARROW to darken. Press ENTER when complete.

Audible Alarm

Press the CE key to toggle audible alarm On or Off.

Display Smoothing

Enable the display smoothing feature to allow the console to smooth the rate displayed during product applications. With this feature enabled, the actual rate in the rates area will display the target rate as long as the actual monitored application rate remains within $\pm 10\%$ of the target rate. The actual rate shown on the main screen will display the actual monitored rate if the application system does not reach the target rate dead band ($\pm 10\%$) within 10 seconds. Disable the display smoothing feature to monitor the actual application rate at all times.

Note: *The display smoothing feature is only active for products in Automatic control mode.*

Time, Month, Day, and Year

These selections are used to set the current date and time. Enter the last two digits of the current year.

Days Wait

Set the number of days after the console is powered off before the console goes into very low power consumption mode and time settings are lost.

Data Lock

Prohibits the entry of calibration values without first entering the data lock code. Enter a 4-digit security code or "0" to disable.

PGM REV Update

Displays the SCS console software program number and revision level.

The SCS console can be updated by pressing ENTER to initialize console update procedure via serial port.

Note: *Requires programming software, PC with null modem cable and replacement firmware (See Chapter 15, SCS 4000/5000 Series Firmware Update Procedure).*

Ratio Rate

Enable or disable ratio rate application mode. When enabled, products 2 and above will apply in ratio to product 1 flow (See Chapter 13, *Ratio Rate Feature*).

Zero Speed Shutoff

Enable or disable low speed shutoff feature. If enabled, product control will be shut off if speed drops below 0.7 mph [km/H] in automatic mode. The master switch must be cycled OFF and then ON to restart the system. If a constant speed greater than 0.7 mph [km/H] is not attained within 10 seconds, the low speed shutoff will be enacted again.

CAN Submenu

Boom Sense and Speed Node

Indicates status of boom sense/speed node. Installation required for use with SCS 4000 or SCS 5000 system. Installed on-board with SCS 4400 or SCS 4600.

-OR-

Speed Signal Source (SCS 4070 Only)

Press CE to toggle speed signal source between “Console” and “Speed/AccuBoom node” (if equipped).

AutoBoom Control Node

Indicates status of AutoBoom control node. This screen will only display if an AutoBoom node is installed. Refer to the *AutoBoom Calibration & Operation Manual* for detailed setup instructions.

Product Control Node 1

Installation required for use with SCS 4000, SCS 4070, or SCS 5000. Installed on-board with SCS 4400 or SCS 4600. The program and revision number of the product control node will be displayed if installed.

Product Control Node 2

Indicates status of CAN product control node #2. Program and revision of node will be displayed if installed.

Product Control Node 3

Indicates status of CAN product control node #3. Program and revision of node will be displayed if installed.

Product Control Node 4

Indicates status of CAN product control node #4. Program and revision of node will be displayed if installed.

Product Control Node 5

Indicates status of CAN product control node #5. Program and revision of node will be displayed if installed.

Row Sense Node

Indicates status of a row sense node.

Readdress Control Nodes

Reconfigure product control node order.

AccuBoom Control Node

Indicates status of AccuBoom control node. The program and revision number of the AccuBoom node will be displayed if this feature is installed.

Calibration Summary

These screens allow the operator to review the current values and settings for each configured product control channel. This screen is for review purposes only and the settings and values are not editable from these screens. Use the UP and DOWN ARROWS to scroll.

Data Logger (4400 and 4600 Only)

Note: *The SCS 4400 with part number 063-0172-281 and SCS 4600 with part number 063-0172-343 both feature a compact flash card slot for application data transfer to a home or office computer. For consoles with other part numbers, the data logging feature will only be used when connecting to an optional external console for logging or mapping applications.*

Data logging consoles will only recognize compact flash cards up to 512 MB. Do not use cards with larger storage capacity with SCS consoles.

The data logging system, connected to a DGPS receiver, saves on-the-go application information to a compact flash card for transfer to a personal computer. It combines GPS position with controller information to create a database of records that is recorded at an interval programmed by the user (see the *Trigger Value* and *Trigger Value* section on page 38). With appropriate software, a map can be created showing the path driven by the operator, along with controller information such as rate applied, boom status, time, area, and more.

Setup

1. Insert a compact flash card into the slot on the SCS 4400/4600 console prior to powering on console.
2. With console power on, press DATA MENU to bring up the Serial submenu.
3. Press the DOWN ARROW to advance to Trigger Value and use the Edit mode to enter the desired increment between recorded data.
4. Press the DOWN ARROW to advance to Trigger Units. Use the CE key to select the units for the Trigger Value. Select between feet or meters, and seconds (Meters only available if SI is selected as the console display units).
5. Press the DOWN ARROW key to advance to GPS Baud. Use the CE key to select the baud rate of the GPS receiver connected.
6. Press the DOWN ARROW key to advance to GPS Stop Bits. Use the CE key to select the number of stop bits to communicate with the connected GPS receiver.

- Press the DOWN ARROW key to advance to the Datalog mode. Use the CE key to select between logging “GPS and Console Data,” or “GPS Data Only.”

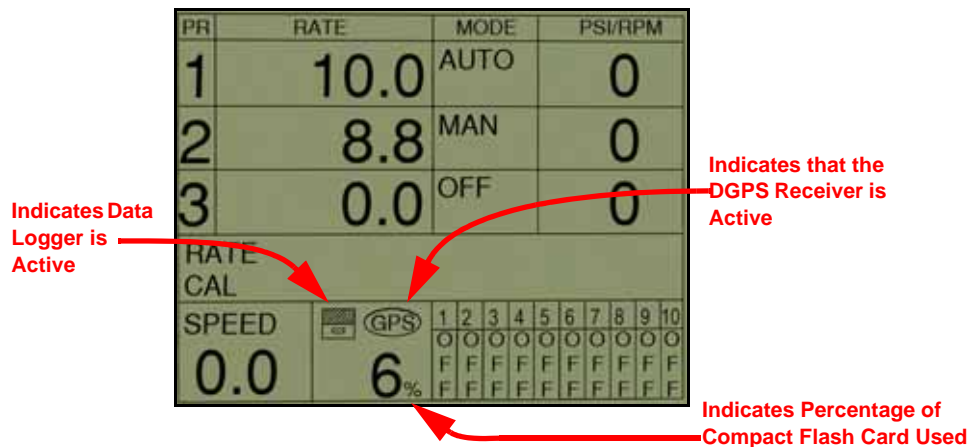
Note: If “GPS and Console Data” is selected, the master switch will pause the data logging feature. Each time the data logger is continued, a shapefile (.shp, .shx, .dbf) is created using the GPS GGA string from the receiver along with the console data. The file names will be numbered sequentially from: DATA001.shp, DATA001.shx, and DATA001.dbf to DATA999.shp, DATA999.shx, and DATA999.dbf.

If “GPS Data Only” is selected, the data log will be continuous. A shapefile (.shp, .shx, .dbf) is created using only the location points obtained from the GGA string from the GPS receiver.

- Data logging is now ready to begin. Press the DOWN ARROW key until ‘Data Logger OFF’ is displayed. Press the CE key to toggle to Data Logger ON.

The percentage of the compact flash card used is displayed in the lower section of the main screen. If no card is inserted, the display will read “Disk None.” If the card is full, the display will read “Disk Full.” A flashcard graphic appears above the disk percentage to indicate that data is being saved to the card. A GPS icon appears above the disk percentage to indicate the GPS signal is being received (See Figure 1 on page 48).

FIGURE 1. SCS Display



- Proceed with the application normally. When the job is complete, press DATA MENU to bring up Data Logger ON. Press the CE key to turn the Data Logger OFF.
- Switch the console power off and then remove the compact flash card. Data logging settings will be saved for future use. When starting a new operation, press the DATA MENU key and toggle the Data Logger ON.

Note: Do not remove or insert the compact flash card with the SCS power on. Data may become corrupted. Use only Sandisk or Transcend brand compact flash cards.

SCS Alarm Definitions

The following are brief descriptions of the visual and audible alarms for the SCS console. The audible alarm may be enabled or disabled from the Console submenu within the Data Menu.

Note: *The Audible Alarm:*

1. *Beeps for 1/2 second once per second.*
2. *Beeps for 1/4 second twice per second.*
3. *Continuous.*
4. *Beeps for 2 seconds every 16 seconds.*

Data Display	Audible Alarm (*)	Alarm Description
CHECK CAN NODES OR CAN COMMUNICATIONS	4	Console is not communicating with CAN nodes (See Chapter 9, <i>Troubleshooting</i>).
CHECK CONTROL NODE #	4	Console is not communicating with product control node # (See Chapter 9, <i>Troubleshooting</i>).
CHECK ACCUBOOM NODE	4	Console is not communicating with AccuBoom control node (See Chapter 9, <i>Troubleshooting</i>).
CHECK AUTOBOOM NODE	4	Console is not communicating with AutoBoom control node (See Chapter 9, <i>Troubleshooting</i>).
CHECK BOOM SENSE NODE	4	Console is not communicating with boom sense/speed node (See Chapter 9, <i>Troubleshooting</i>).
CHECK ROW SENSE NODE	4	Console is not communicating with row sense node (See Chapter 9, <i>Troubleshooting</i>).

Mode Display	Audible Alarm (*)	Alarm Description
VAR RATE	1	When Variable Rate Change alarm is enabled, visual and audible alarms will occur for 4 seconds to indicate that a valid rate change string has changed the target rate. Function acts independent of audible alarm setting.
BIN LEVEL	1	When Bin Level Alarm (Granular mode only) is enabled, alarm occurs to indicate low bin level (See <i>Vacuum or Bin Level Alarm</i> section on page 42).
VAC ERR	1	When Vacuum Alarm (liquid chemical injection mode only) is enabled, alarm occurs to indicate a vacuum error (See <i>Vacuum or Bin Level Alarm</i> section on page 42).
FLOW SW	1	When Flow Switch Monitor Alarm (liquid chemical injection mode only) is enabled, alarm occurs to indicate out of tolerance difference between flow switch monitor and flow reading (See <i>Dual Sensor Alarm %</i> section on page 42).
LOW LIM	2	When a Low Flow Rate Limit is entered, alarm occurs to indicate that volume/minute has dropped below low limit (automatic mode only). (See <i>Low Flow Limit</i> section on page 41).
DUAL FLOW	2	When programmed in Gran 3, Dual Flow Alarm will occur when difference between dual encoder readings becomes out of tolerance (See <i>Dual Sensor Alarm %</i> section on page 42).
OFF RATE	3	Alarm occurs when volume/area rate is out of tolerance from the target application rate for more than 5 seconds (See <i>Off Rate %</i> section on page 39).
LOW LEVEL	4	When a Low Tank value is entered, alarm will occur when volume/tank is less than Low Tank limit (See <i>Low Tank</i> section on page 41).

Mode Display	Audible Alarm (*)	Alarm Description
ZERO SPD	3	When Zero Speed Shutoff is enabled, an alarm will occur when speed drops below 0.7 MPH [km/H]. Product control will not be resumed until the master switch is cycled (See <i>Zero Speed Shutoff</i> section on page 46).
AUTO NOBM or MAN NOBM	n/a	"NOBM" indicates that no boom sections are turned ON for the given product. See <i>Boom Select</i> section on page 39 if boom sections are turned ON.

After the initial programming of the SCS console is complete, it may be necessary to refine the calibration values for the specific machine which will help the SCS console accurately control products during sprayer or spreader applications.

Note: Write down these Calibration Values for future reference or for calling technical support.

Speed Cal

Raven industries recommends the following values for the initial speed cal:

Sensor Type Setting	Sensor Type	English	Metric
Radar/GPS (SP2)	External Raven GPS Receiver	785	199
	Internal DGPS Receiver from an Envizio Pro (II) or Cruizer (II)	812	206
	Raven Radar	598	152
Wheel (SP1)	Wheel Magnets	1000	254
	Speedometer Drive Speed Sensor	612	155

These values are usually a good starting point and will generally yield adequate results; however, the speed cal should still be refined for each vehicle.

1. Make sure all of the boom section switches are turned OFF before powering the console ON.
2. Press the DISTANCE key and then reset the odometer display to "0" using the Edit mode.
3. Drive 1 mile [1 kilometer]. The SCS console will measure the distance driven using the original speed cal.

Note: *Accelerate and decelerate slowly.* To achieve the most accurate calibration, do **not** use the vehicle odometer or the SCS console distance display to measure the actual distance driven. Use section lines or highway markers to determine the actual distance.

4. At the end of the driven distance, press DISTANCE again and record the odometer reading.
 - a. The SCS odometer should read a value of approximately 5280 [1000]. If the display reads between 5260-5300 [990-1010], the default value of 598 [152] is accurate for the speed cal value.
 - b. If the distance displayed is not between 5260-5300 [990-1010], calculate the speed cal with the formula:

$$CSC = \frac{OSC \times 5280}{ODO}$$

where CSC = Corrected Speed Cal, OSC = Old Speed Cal, and ODO = the SCS odometer reading. Round to the nearest whole number.

For Example:

Assume that the SCS odometer reads 5000 [980] after a known 1 mile distance has been driven using an initial speed cal value of 598.

English (US) Units	Metric (SI) Units
$CSC = \frac{598 \times 5280}{5000} = 631.48$	$CSC = \frac{[152] \times [1000]}{[980]} = [155]$

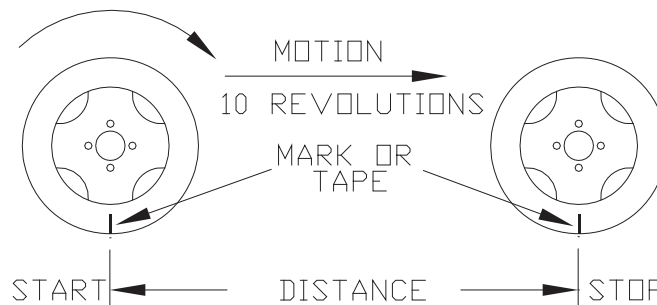
The Corrected Speed Cal value is 631 [155].

5. Press SPEED CAL and use the Edit mode to enter the new value.
6. Recheck the new speed cal derived in step 4 by repeating step 2 through step 5.

Wheel Drive Speed Sensor

1. Mark the tire on which the speed sensor is installed using chalk or a piece of tape as shown below.
2. Mark the initial spot on the ground.
3. Count 10 full revolutions of the wheel while traveling in a straight path. The mark must stop with the chalk or tape in the same position it was in at the starting point.

FIGURE 1. Wheel Magnet Speed Cal



4. Mark the stopping spot and measure the distance from the initial ground mark to the stopping mark in inches [dm]. Round to the nearest whole number.

Note: This measurement is critical to the performance of the console. **Measure Carefully.** Be sure tire is properly inflated before measuring. If possible, measurements should be made in the type of soil in which you will be spraying. The tire circumference will vary when measured in soft or hard packed soil. For best results, measure several times and average the results.

5. Press the SPEED CAL button and enter this measurement as the new speed cal.

Adjusting for Additional Magnets

Typically, four magnets are used with the wheel drive speed sensor. However, to ensure accurate speed readings for large tires and very low speed applications, additional wheel magnets may be necessary. Any even number of magnets may be used as long as they are of alternating color and equally spaced. After calculating the speed cal, this number must be adjusted according to the number of magnets used using the following formula:

$$\frac{4}{NMU} \times DM = ADJ$$

where ADJ = Adjusted Speed Cal, NMU = Number of Magnets Used, and DM = the Distance Measured above.

For Example:

The distance measured between starting and stopping marks is 1200 and six magnets are installed.

$$\frac{4}{6} \times 1200 = 800$$

The Adjusted Speed Cal is 800

Speedometer Drive Speed Sensor

1. Press the DISTANCE key and then reset the odometer display to “0” using the Edit mode.
2. Press the Speed Cal key and use the Edit mode to enter a speed cal value of 612 [155].
3. Drive 1 mile [1 km]. The SCS console will measure the distance driven using the original speed cal.

Note: *Accelerate and decelerate slowly. To achieve the most accurate calibration, do **not** use the vehicle odometer or the field computer distance display to measure the actual distance driven. Use section lines or highway markers to determine the actual distance.*

4. At the end of the driven distance, press DISTANCE again and record the odometer reading.
 - a. The SCS odometer should read a value of approximately 5280 [1000]. If the display reads between 5200-5350 [990-1010], the speed cal for the vehicle is 612 [155].
 - b. If the distance displayed is not between 5260-5300 [990-1010], calculate the speed cal with the formula:

$$CSC = \frac{OSC \times 5280}{ODO}$$

where CSC = Corrected Speed Cal, OSC = Old Speed Cal, and ODO = the SCS odometer reading. Round to the nearest whole number.

5. Press the Speed button and use the keypad to enter the Corrected Speed Cal. To verify the corrected speed cal:
 - a. Re-zero the distance display as in step 1.
 - b. Repeat step 3 and step 4. If the field computer odometer reading still does not match the distance driven, use the new values and redo the calculation and repeat step 5.

For Example:

Speed Cal = 612 [155]
 Actual Distance = 5280 [1000]
 Field computer odometer reading = 5000 [980]

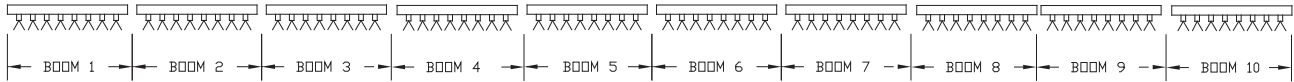
English (US) Units	Metric (SI) Units
$\frac{612 \times 5280}{5000} = 646.3$	$\frac{[155] \times [1000]}{[980]} = [158.1]$

The Corrected Speed Cal value is 646 [158].

Liquid Applications

Boom Cal

For liquid sprayers, the boom cal value is the width of the individual boom sections. Calculate the width of each boom section by measuring the spacing between spray tips in inches [cm] and then multiplying by the number of tips in each boom section.



Band Spraying Adjustment

Calculate the Adjusted Applied Rate with the following formula:

$$\frac{GPA \times BW}{TS} = AAR$$

where GPA = Gallons per Acre, BW = the Band Width in inches [cm] depending upon how the boom cal was calculated), and TS = tip spacing.

For Example:

Broadcast Rate = 20 Gallons per Acre [200 L/ha], Spacing = 40 inches [100 cm], and Band Width = 14 inches [40 cm]

English (US) Units	Metric (SI) Units
$\frac{20 \times 14}{40} = 7$	$\frac{[200] \times [40]}{[100]} = [80]$

the Adjusted Applied Rate is 7 Gallons per Acre or 80 liters per hectare.

Meter Cal

The flow meter calibration number can be found on the tag attached to each flow meter. Copy the information from the tag for future reference as the tags may fade or be lost during equipment operation.

Valve Cal

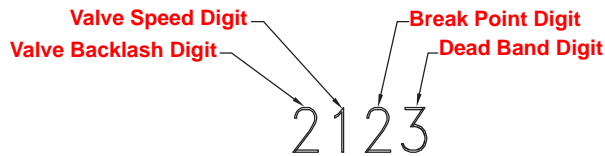
Note: If the dual loop control feature is enabled, the valve cal and valve cal 2 values will be replaced with flow cal and system gain settings. Refer to the Dual Loop Control Mode Settings section on page 57 details on setting and adjusting the flow cal and system gain values when using this control mode.

To ensure that the proper amount of product is being applied, the valve cal must be programmed for the type of control valve(s) connected to the control system. The field computer uses the valve calibration number to adjust the response time of the control valve motor to changes in the vehicle speed.

The following control valve calibration numbers are recommended for the valves listed:

Control Valve Type	Valve Cal
Standard (C-SD)	2123
Fast (C-F) or Fast Close (C-FC)	743
PWM (C-P) or PWM Close (C-PC)	43

Each digit in the calibration number corresponds to a specific function of the valve. The following functions apply to the digits in the valve calibration number:



Valve Backlash Digit

This value controls the time of the first correction pulse after detecting a change in correction direction. The values range from 1 to 9, where 1 is for a short pulse and 9 is for a long pulse.

Note: The backlash digit is not used with a fast, fast close, PWM, PWM close or standard motor control valve.

Valve Speed Digit

This value controls the response time of the control valve motor. If the valve speed setting is too fast, the valve will over correct and the system can start to oscillate. The following valves have specific values:

- Standard Control Valve: This valve has a range of values from 1 to 9, with 1 being slow and 9 being fast.
- Fast and Fast Close Control Valve: These valves have a range of values from 0 to 9, with 0 for fast and 9 for slow.

Note: The speed digit is not used with a PWM or PWM close valve.

Break Point Digit

The Brake Point digit sets the percent away from the target rate at which the control valve starts to turn at a slower rate so that it does not overshoot the target rate. The values range from 0 to 9, where 0 is a 5% rate, 1 is a 10% rate and 90 is a 90% rate.

Dead-Band Digit

The Dead Band digit is the allowable difference between the target rate and the actual application rate. The values range from 1 to 9, where 1 equals 1% difference and 9 equals 9% of the difference.

Rate Cal

The following information must be known in order to determine which spray nozzles to use with the sprayer.

- Nominal Application Pressure _____ PSI [kpa]
- Target Application Rate _____ GPA [L/ha]
- Target Speed _____ MPH [km/h]
- Nozzle Spacing _____ inches [cm]

From this information, calculate the volume per minute per nozzle as follows:

$$NVPM = \frac{Rate \times Speed \times NS}{5940[60000]}$$

where NVPM = Nozzle Volume per Minute (Gallons/Acre or [L/ha]), Rate = Target Application Rate, Speed = Target Speed of Application and NS = Nozzle Spacing.

For Example:

Application Pressure = 30 PSI, Target Application Rate = 20 GPA, Target Speed = 5.2 MPH and Nozzle Spacing = 20 inches

$$NVPM = \frac{20 \times 5.2 \times 20}{5940} = 0.35$$

Using the calculated Nozzle Volume per Minute of 0.35 at an Application Pressure of 30, select a tip that is capable of these application specifications. Contact a local sprayer supply dealer for available nozzles or spray tips.

Verifying Flow Rate Limits

The target rate for a field application also must be within the specified range of the flow meter measuring flow rate for the control channel.

Flow Meter Model	Flow Range
RFM 5	0.1 - 5 GPM [0.2 - 18.9 L/min]
RFM 15	0.3 - 15 GPM [1.1 - 56.8 L/min]
RFM 60P	1 - 60 GPM [3.8 - 210 L/min]
RFM 100	5 - 100 GPM [11.4 - 380 L/min]
RFM 200/ 200 Poly	15 - 200 GPM [56.8 - 760 L/min]
RFM 400	25 - 400 GPM [94.6 - 1515 L/min]

SCS Multi-Tier Features

For systems with multiple plumbing tiers (2 or 3 tier systems), additional features can be accessed by holding down the BOOM CAL key for 5 seconds. Use the arrow keys to toggle between the following features:

Tier 1 High Volume per Minute

Sets the maximum allowed volume per minute before the second tier is enabled.

- On a two tier system, both tiers will be enabled once this level is reached.
- On a three tier system, the first tier will shut off and second tier will turn on once this level is reached.

Tier 2 High Volume per Minute

On a 3 tier system, this selects the maximum allowed volume per minute before both tiers 1 and 2 are enabled. Set to zero for a 2 tier system.

Percent Tier Disable

Percentage factor at which the previously described volume per minute settings will cause the system to disable the higher tier.

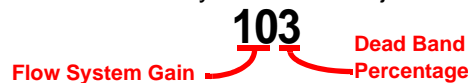
Dual Loop Control Mode Settings

The dual loop control feature is designed for use with low application rates and requires a pressure transducer with a liquid application system controlled with a PWM valve. The dual loop feature uses both the flow meter and pressure transducer to enhance the control response during operation at low application rates. The default setting for this feature is disabled.

Flow Cal

The flow cal value may be used when controlling a liquid application system using a PWM control valve. This value sets how the system responds to rate control inputs while product is flowing through the flow meter. A value between 11 and 999 may be entered for the flow cal value. The default value for the flow cal is 103.

The flow cal value has two components which may be used to adjust the response of the application system.



Note: *It is recommended to set the system gain value prior to making any adjustments to the flow cal value. When adjusting the flow cal value, it is not recommended to adjust the last digit (i.e. '3' in the default value).*

Flow System Gain. The first digit(s) of the flow cal correspond to a flow system gain between 1 and 99. The higher the flow system gain, the more aggressive the system will respond to changes in flow rate.

Note: *When entering a flow gain value from 1 to 9, it is not necessary to enter a zero in front of the value.*

If the system adjusts to rate control changes too slowly, increase the flow gain digit(s) to increase the system response rate. If the system overshoots or oscillates around the desired flow rate, decrease the flow gain digit(s) to help stabilize the system.

Dead Band Digit. The last, or right most, digit in the flow cal value is the dead band digit. The dead band digit is the allowable difference between the target rate and the actual application rate. The values range from 1 to 9, where 1 equals 1% difference and 9 equals 9% of the difference.

System (Pressure) Gain

The default setting for the system gain value is 100. To adjust the system aggressiveness, enter a value between 1 and 999 as necessary.

Note: *It is recommended to increase or decrease the current value in increments of 10 or less when making adjustments to the system gain setting. If the new value does not produce significant or notable changes in the system response, increments of 20 may be used.*

Increase the system gain value if the observed product pressure increases too slowly or if the system takes a long time to reach a set standby pressure or rate input change. If the system is consistently over shooting a set standby pressure or oscillating around a target rate, decrease the system gain value until the system stabilizes.

Granular Applications

Boom Cal

For Gran 1 (single belt) applications, enter the total width of the spread pattern in inches [cm] as boom 1 cal.

For Gran 2 (split belt) or Gran 3 (dual encoder) applications, enter the left side spread pattern as boom 1 cal and right side spread pattern as boom 2 cal.

Spreader Constant

Note: *The spreader constant should be verified by performing the procedure in the Verification of Spreader Constant section on page 59.*

For Gran 2 or Gran 3 applications, gate width is the total of both openings.

Standard Rate display

For Rates displayed in 1 pound increments, the formula to calculate the spreader constant is:

$$SC = \frac{311040}{L \times GH \times GW}$$

Where SC = the Spreader Constant, L = Length of belt travel in inches per 1 revolution of the encoder, GH = Gate Height in inches, GW = Gate Width in inches.

For Example:

Given a Length of belt travel of 13 inches, a Gate Height of 7 inches and a Gate Width of 15 inches:

$$\frac{311040}{13 \times 7 \times 15} = 228$$

Enter 228 as the Spreader Constant if the field computer is set to display English units.

Metric Rate Display

For Rates displayed in 1 kg increments, the formula to calculate the spreader constant is:

$$SC = \frac{18,000,000}{L \times GH \times GW}$$

Where SC = the Spreader Constant, L = Length of belt travel in centimeters per 1 revolution of the encoder, GH = Gate Height in centimeters and GW = Gate Width in centimeters.

For Example:

Given a Length of belt travel of 33 cm, a Gate Height of 18 cm and a Gate Width of 38 cm:

$$\frac{18,000,000}{33 \times 18 \times 38} = 797$$

Enter 797 as the Spreader Constant if the field computer is set to display Metric units.

Verification of Spreader Constant

To verify and refine the spreader constant, perform the following procedure:

1. Weigh loaded truck and note weight.
2. Enter the product density in lbs/ft³ [grams/liter] by pressing METER CAL and using the Edit mode.
3. Reset the total volume by pressing TOTAL VOLUME and using the Edit mode to program "0" as this volume.
4. With the rate switch in the MAN position, unload a portion of the load by positioning the boom switch to ON.
5. Determine the actual weight unloaded by re-weighing the truck.
6. Compare to the TOTAL VOLUME displayed by the console.
7. Perform the following calculation to correct the spreader constant if desired:

$$CSC = \frac{OSC \times TV}{AW}$$

where CSC = Corrected Spreader Constant, OSC = Old Spreader Constant, TV = TOTAL VOLUME, and AW = Actual Weight of product unloaded.

For Example:

Using an Old Spreader Constant of 228 [797], Total Volume = 2000 lbs [4400 kg], and the Actual Weight of product unloaded = 1950 lbs [4290 kg]

English (US) Units	Metric (SI) Units
$CSC = \frac{228 \times 2000}{1950} = 234$	$CSC = \frac{[797] \times [4400]}{[4290]} = [817]$

234 [817] is the new spreader constant. Repeat this procedure until the weight of the metered material equals the value displayed when you press TOTAL VOLUME.

Product Density

The product density in lbs/cu.ft. [grams/liter] is entered under the METER CAL key when a spreader constant is used. Press the METER CAL key again to toggle between meter cal and product density.

Note: To increase the system accuracy when applying at low rates, use the decimal shift feature as explained in Decimal Shift section on page 35.

Rate Cal

The target application rate in lbs/acre [kg/ha] is programmed by pressing RATE CAL. Consult the equipment manual to ensure that the selected gate opening is capable of applying at this application rate.

Note: *The spreader constant must be recalculated anytime the gate opening is changed.*

Spinner RPM

When using a CAN control node capable of controlling spinner speed, set up the product in SPINNER RPM CONTROL mode and use the following calibration values:

- METER CAL = the number of pulses (bolt heads) per revolution of the spinner multiplied by 10.
- SPREADER CONSTANT = 0
- RATE CAL = Target RPM

See the Boom Select feature in the *Boom Select* section on page 39 and configure boom selections accordingly.

Additional Calibration Data

Although it is not required for the SCS console operation, data may be programmed through the VOLUME/TANK key.

Entering Tank Volume

Press VOLUME/TANK and use the Edit mode to enter an estimated volume of product in the tank or bin. This setting must be reset each time the tank or bin is refilled.

Low Tank Alarm

The SCS console may be set to sound an alarm when the calculated volume of product remaining in the tank falls to a user defined level. To setup the Low Tank Alarm, refer to the *Low Tank* section on page 41.

“Zero Out” Display Information

The Total Area, Total Volume, Field Area, Field Volume, and Distance screens display current or as applied information that can be reset at any time. To “zero out” these values in the SCS console, use the Edit mode to enter a zero value into any one of these display values.

Before beginning an actual application, you will need to verify that the programming of the SCS console will produce the desired results. After the Initial Programming and Calibration procedures, the SCS console should be relatively accurate. However, the following procedures will help test the SCS console calibration and programming, refine the system for accurate product application for a specific machine, and help catch any calculation or programming errors.

Liquid Applications

Note: *When using suspensions, the system should be rinsed thoroughly after each days use.*

Initial Job Setup

1. Fill the sprayer tank with water only. If using a positive displacement pump, open the Pressure Relief Valve (PRV).
2. Place the master switch in the ON position and toggle all boom switches OFF.
3. Turn the SCS console power ON and verify that the console is in Automatic mode (Press AUTO/MANUAL to toggle).
4. Verify the boom widths, speed cal, meter cal, valve cal, and rate cal values have been programmed correctly.
5. Press SELF TEST to access the Self Test mode and enter a simulation speed. This value should represent the normal operating speed.
6. Run the pump at normal operating RPM.
7. If a positive displacement pump is used, set the pressure relief valve (PRV) to 65 PSI [450 kPa]. If a centrifugal pump is used, proceed with step 8.
8. Operate the boom switches to verify that the valves are functional and no nozzles are plugged.
9. Toggle the SCS console to Manual mode (Press AUTO/MANUAL).
10. Place all boom switches in the ON position.

11. Hold the Manual Override switch in the INC position until pressure reaches maximum. This ensures that the motorized Control Valve is fully open. Verify maximum pressure and RATE. (Pressure gauge is not supplied).

Note: *A pressure gauge must be installed to properly monitor the system.*

12. Adjust agitator line hand valve for desired agitation. Verify the maximum pressure is still present.
13. Hold the Manual Override switch in the DEC position until pressure is at its minimum. This ensures that the motorized Control Valve is fully closed. Verify minimum pressure and RATE. If minimum pressure and RATE cannot be obtained, consider using the by-pass plumbing system in Chapter 12, *By-Pass Line Plumbing System*.

Field Test

1. Drive at the target application speed with booms off to verify the SCS console speed display.
2. Turn the booms ON and place the console in AUTO mode. Increase or decrease vehicle speed by one MPH [2 km/h]. The system should automatically correct to the target application rate.
3. If for any reason, the system is unable to correct to the desired RATE, check for an empty tank, plugged line, malfunctioning pump, improper vehicle speed, or a defect in the system.
4. If the system still does not appear to be correcting properly, review the Initial System Set-up. For additional troubleshooting tips, refer to Chapter 9, *Troubleshooting*.
5. At the end of each row, toggle the master switch OFF to shut off flow. This will also shut off the area totalizer.
6. Verify the area covered and volume used.

Preventive Maintenance

Preventive maintenance is most important to assure long life of the system. The following maintenance procedures should be followed on a regular basis:

1. Flush entire system with water after use of suspension type chemicals. Failure to clean system can result in crystallization of chemicals which may plug the flow meter, lines, and/or tips.
2. Flush and drain tanks before storing the vehicle.

Note: *Freezing temperatures may damage the flow meter if the system is not properly drained.*

3. Disconnect the flow meter at the end of each spraying season and clean the turbine and inlet hub. Clean off all metal filings and wettable powders which have hardened on the plastic and metal parts. Check the inlet hub and turbine assembly for worn or damaged turbine blades and bearings. Flush with clean water and drain.
4. Remove the SCS console when not in use for extended periods and store the unit in a dry, temperature controlled environment. Keep the SCS console from freezing and away from moisture.

Granular Applications

Initial Job Setup

1. Verify that the product bin is empty.
2. Place all boom section switches in the OFF position.
3. Turn the SCS console power ON and verify that the console is in Automatic mode (Press AUTO/MANUAL to toggle).
4. Verify the boom widths, speed cal, spreader constant, product density, valve cal, and rate cal values have been programmed correctly.
5. Press SELF TEST to access the Self Test mode and enter a simulation speed. This value should represent the normal operating speed.
6. Operate the boom switches to verify that the booms are functional.
7. Toggle the SCS console to Manual mode (Press AUTO/MANUAL).
8. Place all boom switches in the ON position.
9. Hold the INC/DEC switch in the INC position for approximately 12 seconds. Note maximum rate displayed on the screen.
10. Hold the INC/DEC switch in the DEC position for approximately 12 seconds. Note minimum rate displayed on the screen.
11. The target application rate must be between the maximum and minimum rate displayed.

Field Test

1. Drive at the target application speed with booms off to verify the SCS console speed display.
2. Toggle the appropriate boom switches ON and press the AUTO/MAN button to toggle the console to Automatic. Increase or decrease speed by one MPH [2 km/h]. The system should automatically correct to the target application rate.
3. If for any reason, the system is unable to correct to the desired RATE, check for improper vehicle speed or a defect in the system.
4. If the system still does not appear to be correcting properly, review the *Initial Calibration Sequence* section on page 27. For additional troubleshooting tips, refer to Chapter 9, *Troubleshooting*.
5. At the end of each row, toggle the boom switches OFF to shut off the belt or chain. This will also shut off the area totalizer.
6. Verify area covered and volume used.

Preventive Maintenance

Remove the SCS console from the vehicle when not in use for extended periods and store in a dry, temperature controlled environment. Keep the SCS console from freezing and away from moisture.

Problem	Action
1. No display with power ON.	<ul style="list-style-type: none"> • Check fuses in console cabling. • Check battery connections. • Hold the DOWN ARROW key to darken the LCD contrast. • Return console to your dealer for service.
2. A digit cannot be entered via the keypad.	<ul style="list-style-type: none"> • Return console to dealer for service.
3. Console displays flashing "CAL" each time the vehicle engine is started.	<ul style="list-style-type: none"> • Check battery voltage and battery connections.
4. Console displays flashing "CAL" each time the master switch is toggled on or off.	<ul style="list-style-type: none"> • Check battery voltage and battery connections.
5. Console displays flashing "CAL" each time the speed changes.	<ul style="list-style-type: none"> • Check battery voltage and battery connections.
6. "Time" function is inaccurate or drifting.	<ul style="list-style-type: none"> • Verify console is connected to 12 V continuous power. • Return console to dealer for service.
7. One display digit has one or more missing segments	<ul style="list-style-type: none"> • Return console to dealer for service.
8. Speed display "0."	<ul style="list-style-type: none"> • Check speed sensor cable connector and plug on back of node for loose pins. • Clean pins and sockets on speed sensor cable connectors. • If no extension cable is used, replace speed sensor switch assembly. • If speed sensor extension cable is used, see Chapter 10, <i>Testing Extension Cables</i>. • If SCS 4000/5000, check speed signal source. • If SCS 4070, check speed signal source selection in the CAN submenu of the DATA MENU.

Problem	Action
9. Speed inaccurate or unstable (wheel drive speed sensor).	<ul style="list-style-type: none"> • Run speed check on hard surface road. If SPEED is accurate, investigate speed sensor on different wheel. • Remove one red magnet and one black magnet from the wheel (reposition remaining magnets directly across from each other). Enter a SPEED CAL number in the console twice as large as the correct SPEED CAL number. Run speed check on hard surface road. Remove these two magnets and replace with the other two. Run speed check. If SPEED is inaccurate with both sets, replace speed sensor assembly. Note: Re-enter original SPEED CAL number after testing is complete.
10. Rate reads "0."	<ul style="list-style-type: none"> • Verify SPEED is registering accurately. If SPEED is zero, refer to problem 8. • Verify TOTAL VOLUME is registering flow. If not, refer to problem 15.
11. Rate inaccurate or unstable.	<ul style="list-style-type: none"> • Verify that all calibration numbers and settings keyed into the console are correct. Verify SPEED is registering accurately. If SPEED is inaccurate, refer to problem 8 or problem 9. • In MAN (manual) operation, verify that RATE display holds constant. If not, refer to problem 12. • Confirm that boom section status shown on the display is not changing. • In MAN (manual) operation, check low end and high end pressure range. Pressure range must be per <i>Initial System Set-up</i> section on page 91. If pressure cannot be adjusted manually, refer to problem 15. • If problem persists, return console to dealer for service.
12. Cannot verify rate in manual operation or in auto.	<ul style="list-style-type: none"> • Check cabling to motorized control valve for breaks. • Check connections in cabling for cleanliness. • Verify that there is voltage at the valve connector by toggling master switch ON; AUTO/MAN switch to MAN; and POWER ON. Manually operate INC/DEC switch to verify voltage. • Verify that valve is turning, if not, replace control valve.
13. Sprayer pressure is correct but RATE is low.	<ul style="list-style-type: none"> • Verify that nozzle strainer screens or check valves are not plugged. • Verify that pressure at each boom is the same. • Verify all nozzles are of proper and same orifice size. <i>Rate Cal</i> section on page 56.
14. Total volume does not register.	<ul style="list-style-type: none"> • Check flow meter/encoder cable for breaks and shorts. See Chapter 10, <i>Testing Extension Cables</i>. • Check the internal components of the flow meter/encoder; clean and adjust. Chapter 12, <i>Flow Meter Maintenance & Adjustment Procedure</i> for flow meter cleaning and adjustments. • Replace flow meter transducer/encoder.
15. Total volume registers flow inaccurately.	<ul style="list-style-type: none"> • Verify that arrow on flow meter is pointing in direction of flow. See Chapter 12, <i>Flow Meter Maintenance & Adjustment Procedure</i>.
16. Motorized control valve rotates more than 1/4 turn.	<ul style="list-style-type: none"> • Replace motorized control valve.
17. Water inside cover of motorized control valve.	<ul style="list-style-type: none"> • Replace isolation flange assembly and coupler shaft. • Replace entire motorized control valve if PC board or motor is corroded and will not run.

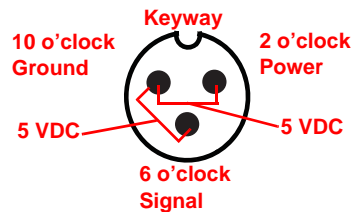
Problem	Action
18. Boom valve(s) will not operate.	<ul style="list-style-type: none"> • Check cable for wires with breaks. • Check connectors for cleanliness. • Check section switch(es) and master switch for operation. • Replace boom valves.
19. Can't obtain GPS signal	<ul style="list-style-type: none"> • Verify connections to GPS receiver. • Verify GPS baud rate and stop bits are properly configured. • Verify GPS receiver is powered and operating correctly.
20. Compact flash card not recognized.	<ul style="list-style-type: none"> • Reboot console. • Replace compact flash card; confirm card is Sandisk or Transcend brand 512 MB or smaller. • Return console to dealer for service.
21. Display reads "LOOKING FOR DATA TO FLASH IC WITH"	<ul style="list-style-type: none"> • Console was put into program update mode. Unhook cable from console, wait 30 seconds, and reboot console. Wait for program to be restored.
22. LCD contrast is too dark or too light	<ul style="list-style-type: none"> • To lighten LCD contrast, hold key 1, After one second, contrast will begin to lighten until key 1 is released. • To darken LCD contrast, hold key 2. After one second, contrast will begin to darken until key 2 is released. • LCD contrast can also be adjusted from the Console submenu within the Data Menu.
23. Console displays "check CAN nodes or CAN communication"	<ul style="list-style-type: none"> • If no CAN nodes are attached to the CANbus, press the DATA MENU key. CAN menu will appear and CAN node options will automatically be shut off. Operation can then be resumed as normal. • Verify that CAN nodes and console are connected to the CANbus and that the cabling between them is connected and in tact. • Verify that terminators are placed at both ends of the CANbus. • Verify that CAN nodes have logic power and ground are properly connected and energized and no fuses are blown on power leads. • Verify that CAN power adapter "T" cable is plugged in at the front of the CANbus and 12 V switched power is applied to the bus. • Reboot the console. • Contact Service Technician for CAN system repair.
24. Console displays "CHECK CONTROL NODE X" (where X refers to 1,2,3,4, or 5)	<ul style="list-style-type: none"> • If product control node X is not connected to the CANbus, press DATA MENU. CAN menu will appear and CAN node options can be toggled ON and OFF using the CE key. Operation can then be resumed as normal. • Verify that product control node X is connected to the CANbus. • Verify that product control node X has logic power and ground properly connected and energized and no fuses are blown on power leads. • Verify that CANbus cabling from the console to the node is connected and in tact. • Readdress CAN product control nodes. See <i>Readdressing the Nodes</i> section on page 17. • Move the product control node and product control node cable to a known good CAN connection closer to the console (take off another cable if necessary). If message for the product control node X goes away, replace CAN cabling going to the product control node x. Otherwise, replace product control node or product control node cable.

Problem	Action
<p>25. Console displays: "CHECK ACCUBOOM NODE," "CHECK AUTOBOOM NODE," "CHECK ROW SENSE NODE," or "CHECK BOOM SENSE NODE."</p>	<ul style="list-style-type: none"> • If node is not connected to the CANbus, press DATA MENU key. CAN menu will appear and CAN node options can be toggled ON or OFF using the CE key. Operation can then be resumed as normal. • Verify that node is connected to the CANbus. • Verify that node has logic power and ground properly connected and energized and no fuses are blown on power leads. • Verify that CANbus cabling from the console to the node is connected and in tact. • Move the node and node cable to a known good CAN outlet closer to the console (take off another node or cable if necessary). If message for the node goes away, replace CAN cabling going to the node. Otherwise, replace node or node cable.
<p>26. "Calibration Error" encountered during PWM auto calibration.</p>	<ul style="list-style-type: none"> • Verify that the selected product node(s) are set to off. Press the PRODUCT ON/OFF key to toggle the product off before running the auto calibration. • Toggle at least one section switch on before running the auto calibration. • Be sure that the speed cal, meter cal, valve cal, rate cal and boom cal values are entered properly for the selected product(s).

Speed Sensor Cables

Disconnect the extension cable from speed sensor assembly cable. Hold the extension cable connector so that the keyway is in the 12 o'clock position.

FIGURE 1. Speed Sensor Extension Cable Connector Pins



Note: *If a radar type speed sensor is used, the voltage between the 10 o'clock and 2 o'clock positions may read 12 VDC.*

If a +5V DC voltage reading is not present, disconnect the flow meter cable and re-test the speed sensor cable. If the voltage reads +5V DC when the flow meter cable is disconnected, test the flow meter cable per Testing the Flow Meter Cable section on page 70.

Testing the Speed Sensor Cable

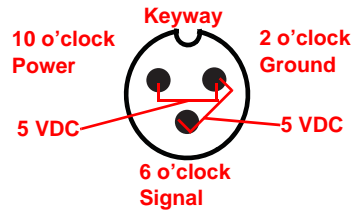
1. Press SPEED CAL and enter a value of 9999 as the speed cal.
2. Press DISTANCE to monitor the SCS console's odometer while testing this cable.
3. Use a small jumper wire or paper clip to short the 10 o'clock and 6 o'clock sockets with a "short-no short" motion. Each time the short is made, the distance reading should increase by increments of 1 or more.
4. If the distance does not increase, disconnect this section of cable and repeat this test at the next connector closest to console. Replace defective cable as required and test the speed sensor cable voltage as previously described.
5. If all cables test good, replace the speed sensor.

Note: *After testing is complete, re-enter correct speed cal number.*

Flow Meter/Encoder Cables

Disconnect the extension cable from the flow meter. Hold the flow meter cable so that the keyway is pointing in the 12 o'clock position.

FIGURE 2. Flow Meter Extension Cable Connector Pins



Note: If a +5 VDC voltage reading is not present, disconnect the speed sensor cable. If the voltage reading is restored, test the speed sensor cable per *Testing the Speed Sensor Cable* section on page 69.

Testing the Flow Meter Cable

1. Press METER CAL and enter a value of 1 as the meter cal.
2. Press TOTAL VOLUME to monitor the total volume applied screen while testing this cable.
3. Place boom and master switches to ON.
4. Use a small jumper wire or paper clip to short the 2 o'clock and 6 o'clock sockets with a "short-no short" motion. Each time the short is made, the total volume reading should increase by increments of 1 or more.
5. If the distance does not increase, disconnect this section of cable and repeat this test at the next connector closest to console. Replace defective cable as required and test the flow meter cable voltage as previously described.
6. If all cables test good, replace the flow meter.

Note: After testing is complete, re-enter correct meter cal numbers.

Connecting an SCS Console to a Raven Field Computer

Review the following sections before operating a multi-console CANbus (e.g. SCS 4400 with Envizio Pro).

Firmware Requirements

SCS 4000/5000 Series consoles with firmware v1.80 or higher will support the ability for an SCS 4070, SCS 4400 or SCS 4600 console to reside on a Raven CANbus and appear as CAN control node(s) to a Raven field computer. This firmware allows the field computer to be set up as the CAN controller and initiate VRA and/or AccuBoom jobs in conjunction with the SCS console via the CANbus.

When used with this configuration, product control node(s) should be updated to firmware version 1.40 or higher.

Operation Guidelines

The following guidelines are recommended when operating a multi-console CANbus:

1. Set up and programming of product control and boom section calibration values must be performed via the field computer.
2. Any boom section or master switches (if applicable) and the 'INC/DEC' switch on the SCS console may be used normally while the SCS display should only be used for monitoring application rate information and boom section status.
3. In order to properly initialize CAN nodes, be sure that the SCS console is powered up prior to the field computer.
4. Product(s) should only be turned ON/OFF via the field computer.

Failure to observe these guidelines may result in differences between calibration data on the field computer and SCS console, potentially causing a misapplication or errant as-applied map/report. In the event that these guidelines are not carried out, restart both the SCS console and the Raven field computer in the manner described.

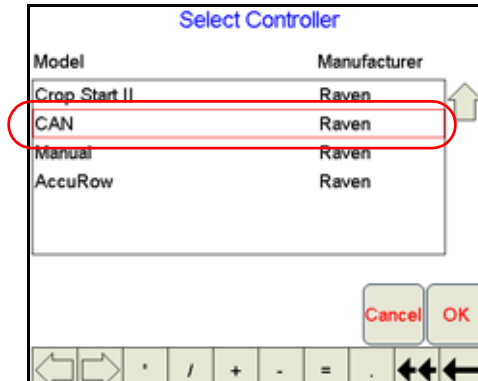
Note: *When utilizing Envizio Pro with an SCS 4000/5000 Series console and more than two products, the SCS controller may be utilized to program products 3 through 5, and initiate product control. However, boom section width calibration and boom select settings must be programmed via the Envizio Pro. Note that products 3-5 will not be mapped or recorded by the Envizio Pro.*

Field Computer Set Up

Viper Pro

To set up the Viper Pro console for CAN product control:

1. Touch the **Menu** button in the lower, right corner of the Viper Pro display.
2. Select **Setup** and then **Prod Control** within the menu.
3. On the Select Controller screen, select the CAN option from the list and touch the **OK** button to accept the selection and return to the main screen.



Envizio Pro or Envizio Pro II

To set up the Envizio Pro console for CAN product control:

1. Touch the **Tools Menu** icon on the Home screen.
2. Select the **Control Interface** icon within the System submenu.
3. Select the CAN Sprayer-Spreader Control from the list of product control options and touch the green check mark to accept the selection and return to the main Tools Menu screen.

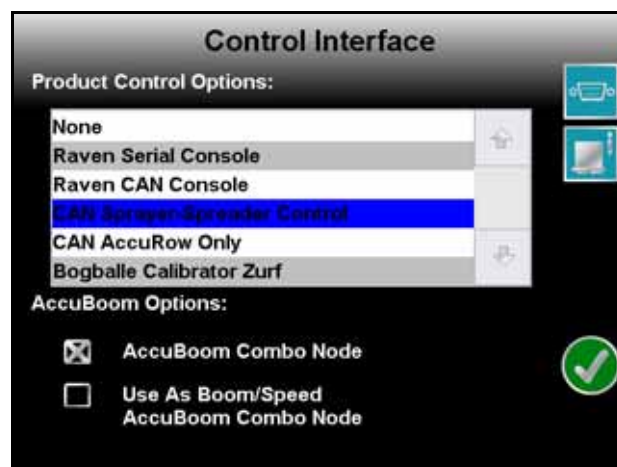
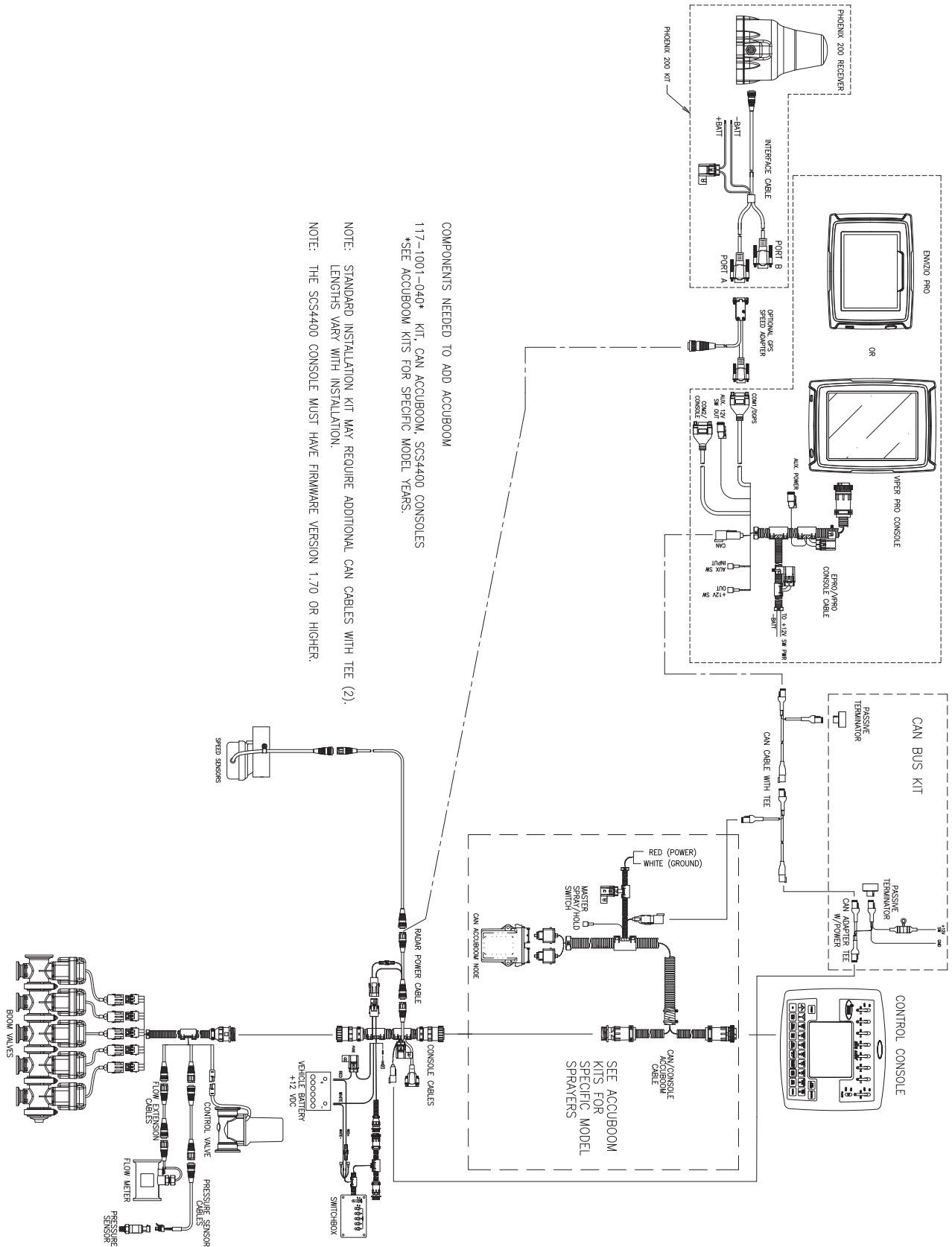


FIGURE 1. SCS 4000/5000 Series Console with a Raven Field Computer



COMPONENTS NEEDED TO ADD ACCUBOOM
 117-1001-040* KIT, CAN ACCUBOOM, SCS4400 CONSOLES
 *SEE ACCUBOOM KITS FOR SPECIFIC MODEL YEARS.

NOTE: STANDARD INSTALLATION KIT MAY REQUIRE ADDITIONAL CAN CABLES WITH TEE (2).
 LENGTHS VARY WITH INSTALLATION.
 NOTE: THE SCS4400 CONSOLE MUST HAVE FIRMWARE VERSION 1.70 OR HIGHER.

Cruizer or Cruizer II

FIGURE 2. SCS 4400 with Guidance System

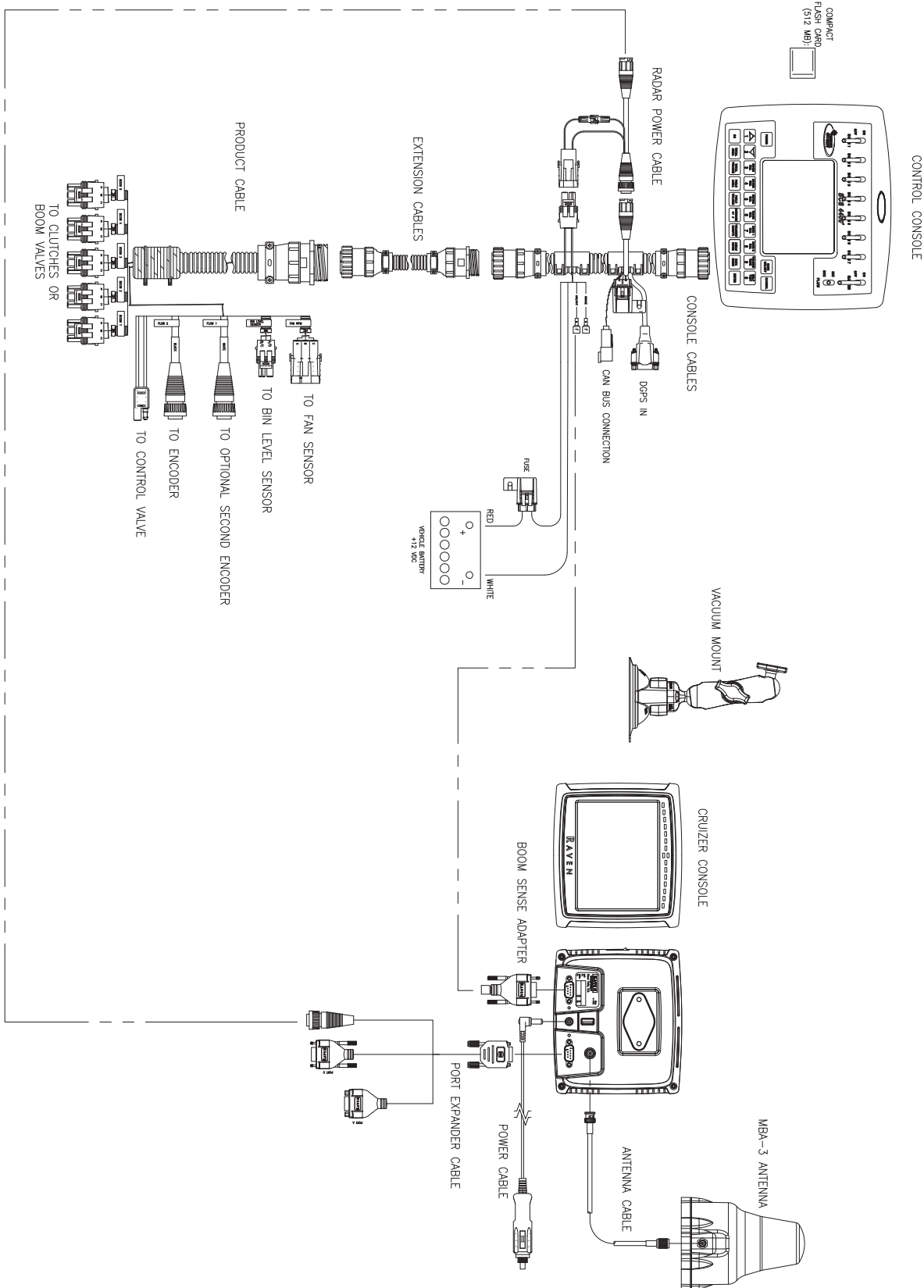


FIGURE 3. SCS 4600 with Guidance System

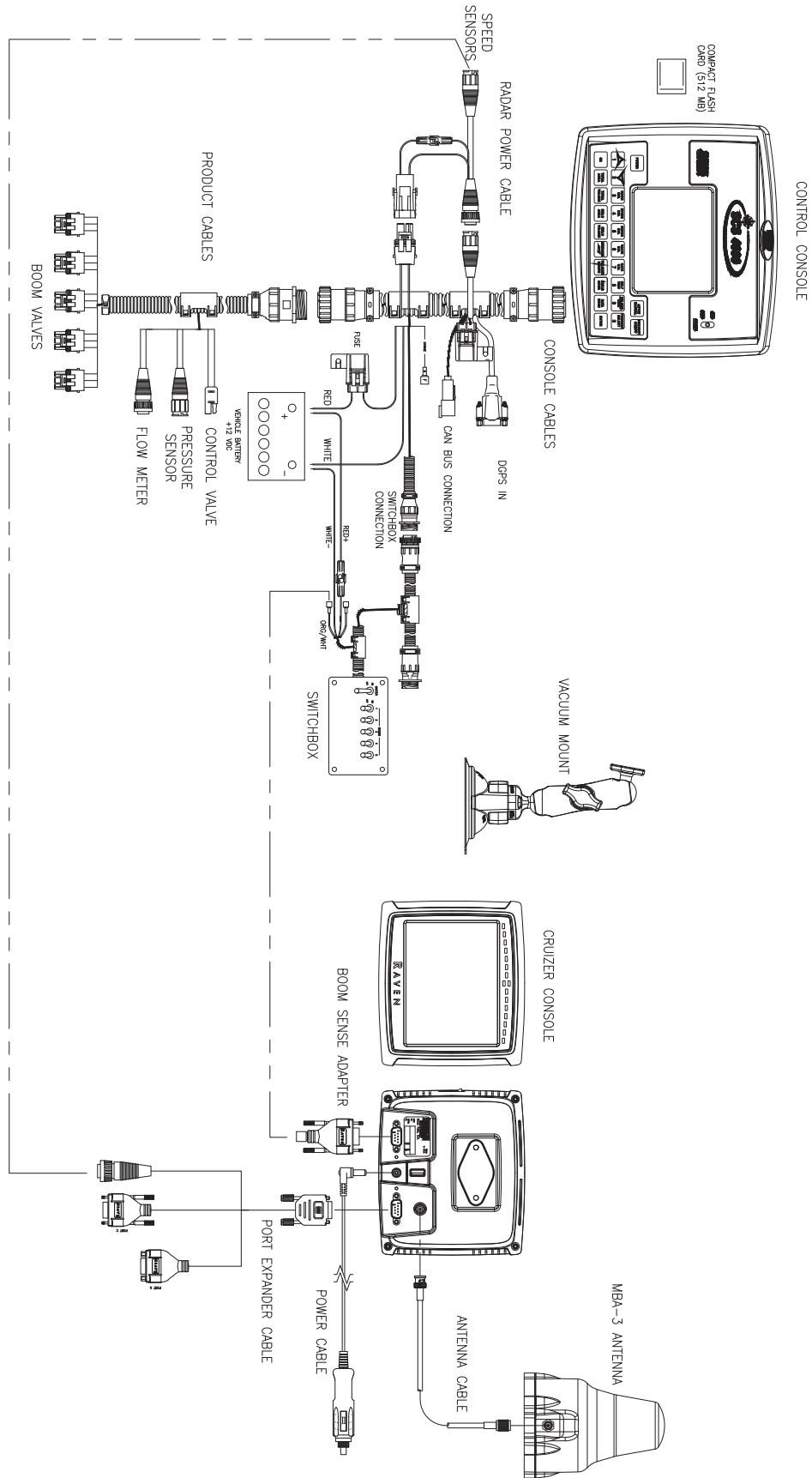
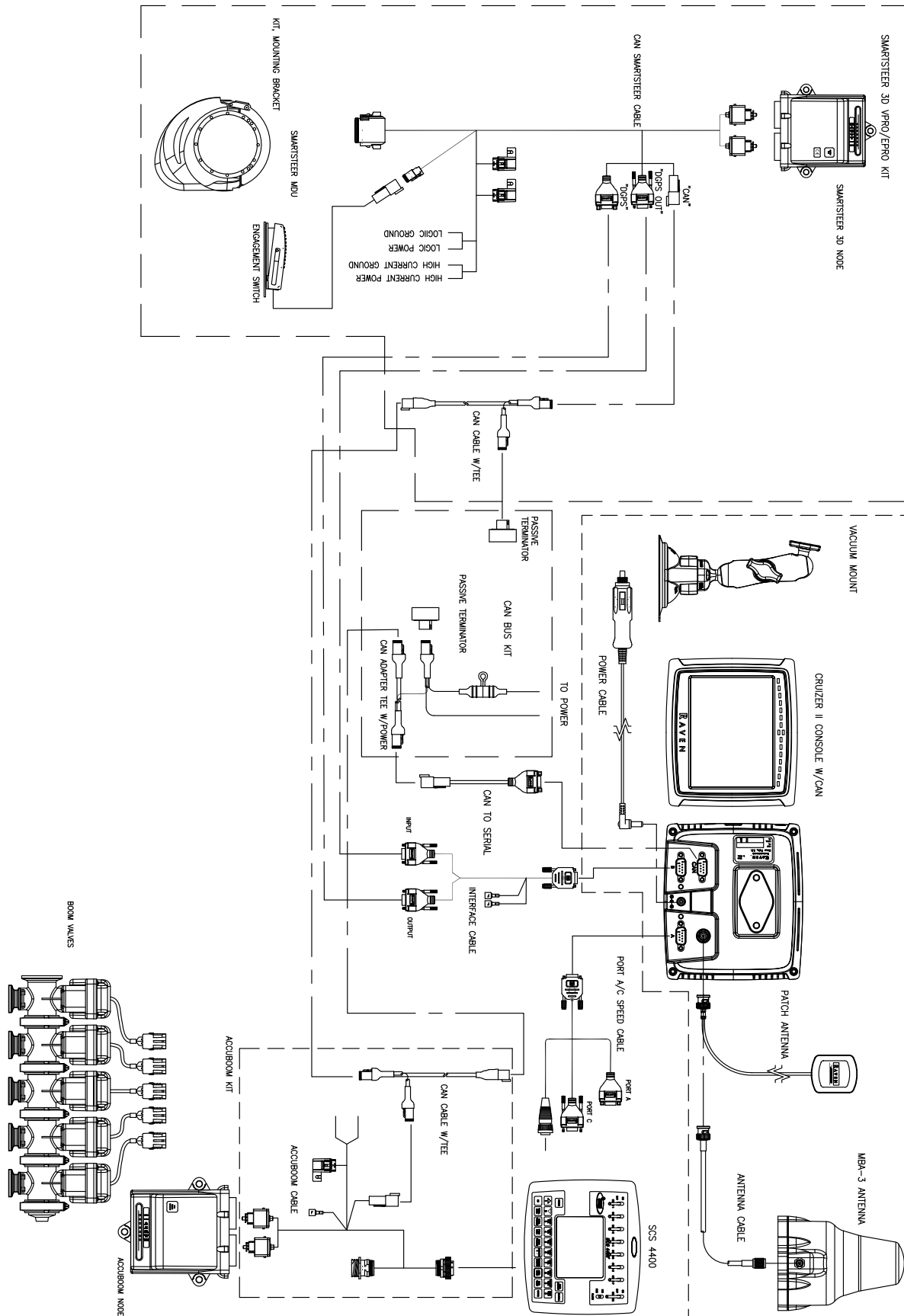


FIGURE 4. SCS 4400 Console with Cruiser II Console, SmartSteer and AccuBoom



Flow Meter Maintenance & Adjustment Procedure

Note: Thoroughly bleed nurse tank hose and all other system lines prior to disassembling the flow meter, fittings, or hoses.

1. Remove flow meter from the vehicle and flush with clean water to remove any chemicals.
2. Remove flange bolts or clamp from the flow meter.
3. Remove the turbine hub and turbine from inside flow meter.
4. Clean turbine and turbine hub of metal filings or any other foreign material, such as wettable powders. Confirm that the turbine blades are not worn. While holding the turbine hub in your hand, spin turbine. The turbine should spin freely with very little drag inside the hub.
5. If transducer assembly is replaced or if turbine stud is adjusted or replaced, verify the turbine fit before reassembling. Hold turbine hub with turbine on transducer. Spin turbine by blowing on it. Tighten turbine stud until turbine stalls. Loosen turbine stud 1/3 turn. The turbine should spin freely.
6. Re-assemble flow meter.
7. Using a low pressure (5 psi) [34.5 kPa] jet of air, verify the turbine spins freely. If there is drag, loosen hex stud on the bottom of turbine hub 1/16 turn until the turbine spins freely.
8. If the turbine spins freely and cables have been checked per *Testing the Flow Meter Cable* section on page 70, but flow meter still is not metering properly, replace flow meter transducer.

Procedure to Recalibrate Flow Meter:

1. Press METER CAL and enter a value of 10 [38].
2. Press TOTAL VOLUME and enter a value of 0.
3. Place the master switch and all boom sections in the OFF position.
4. Remove a boom hose and place it into a calibrated 5 gallon [19 liter] container.
5. Toggle the master switch and the boom switch corresponding to the hose that was placed in the container. Pump exactly 10 gallons or 38 liters.
6. Press TOTAL VOLUME. The reading displayed is the new meter cal value. This value should be within +/- 3% of the calibration number stamped on the tag of the flow meter.
7. Repeat this procedure several times to confirm accuracy (Always "zero out" the total volume display before retesting).

Note: For greatest precision, set meter cal to 100 [378] and pump 100 gallons (378 liters) of water.

8. To verify the flow meter calibration, the fill applicator tank with a predetermined amount of measured liquid (i.e. 250 gallons).

Note: Do not rely on graduation marks molded into the applicator tank.

9. Empty the applicator tank under normal operating conditions.
If the total volume displayed is different from the predetermined amount of measured liquid by more than +/- 3%, complete the following calculation:

$$CMC = \frac{MC \times V_M}{V_A}$$

Where CMC = the Corrected Meter Cal, MC = the Meter Cal used to apply the known volume, and VM = the Volume that your SCS console measured, and VA = the predetermined volume applied.

For Example:

The SCS console displays a Total Volume of 260 [984] when a Meter Cal of 720 [190] was used to apply a measured volume of 250 gallons [946 liters]. Therefore:

English (US) Units	Metric (SI) Units
$CMC = \frac{720 \times 260}{250} = 749$	$CMC = \frac{[190] \times [984]}{[946]} = [198]$

the Corrected Meter Cal is 749 [198]

10. Press METER CAL and enter the Corrected Meter Cal value before resuming application.

In Ratio Rate mode, the SCS console offers the ability to control up to four products in ratio to the first. The Ratio Rate feature is enabled through the console submenu within the Data Menu.

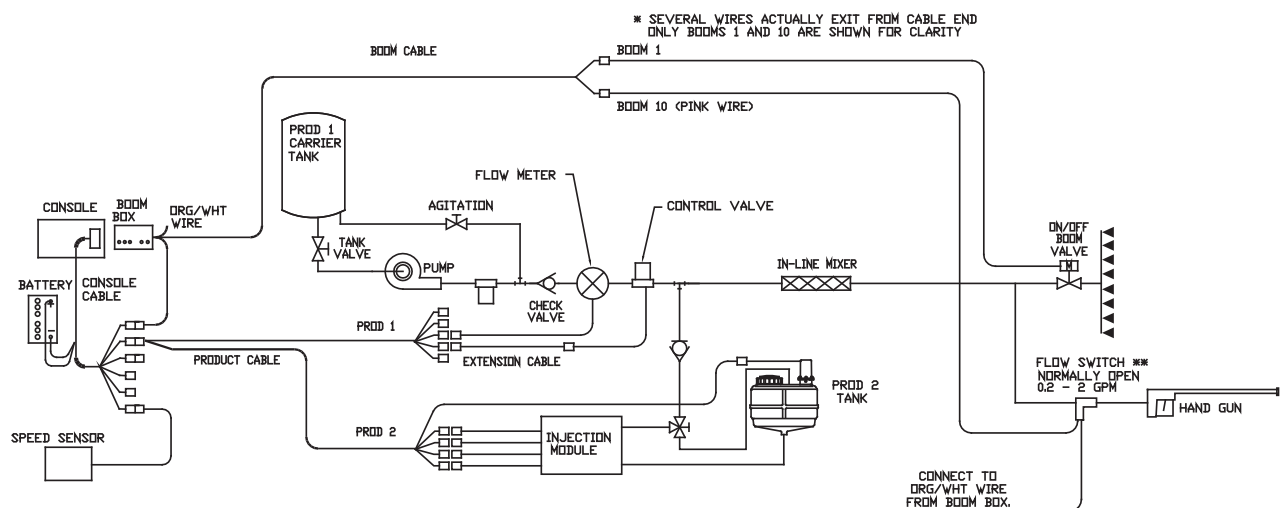
When the Ratio Rate mode is enabled, product 1 will control to a user defined volume/area when in Automatic (AUTO) mode, or display the Rate as volume/minute when in Manual (MAN) mode. Products 2 through 5 will be controlled in ratio to product 1.

When in Ratio Rate mode, pressing RATE CAL will display the RATIO RATE CAL and will be entered as follows:

- Product 1 gal/acre [liter/hectare] (if applicable)
- Products 2-5 oz/gal [dl/liter]

The ratio rate feature can also be utilized to operate a handgun (see Figure 1 on page 79).

FIGURE 1. Handgun Installation



Note that for handgun operation, a flow switch must be plumbed in-line as shown above. Connect one lead of the flow switch to the boom box orange/white wire. Connect the other flow switch lead to an unused boom wire. The associated boom must have a non-zero value programmed into the boom cal.

Handgun Operation:

1. Turn Ratio Rate mode ON through Data Menu.
2. Enter the desired ratio rate for products 2-5.
3. Place all boom switches to the OFF position.
4. Place the master switch to ON.
5. Put product 1 in manual mode. Adjust pressure using the INC/DEC switch.
6. Put products to be injected in automatic mode.
7. When handgun is operated, the injection pump(s) will run. When handgun is OFF, the injection pump(s) will shut off. The master switch overrides injection pump operation.

Note: *Determine pump setting for hand gun operation. Pump setting may be different than standard operation.*

$$V/M_{Pump} = RRC \times V/M_{P1}$$

Where V/MPump = the Pump Volume per Minute, RRC = Ratio Rate Cal, and V/MP1 = the Volume per Minute for Product 1.

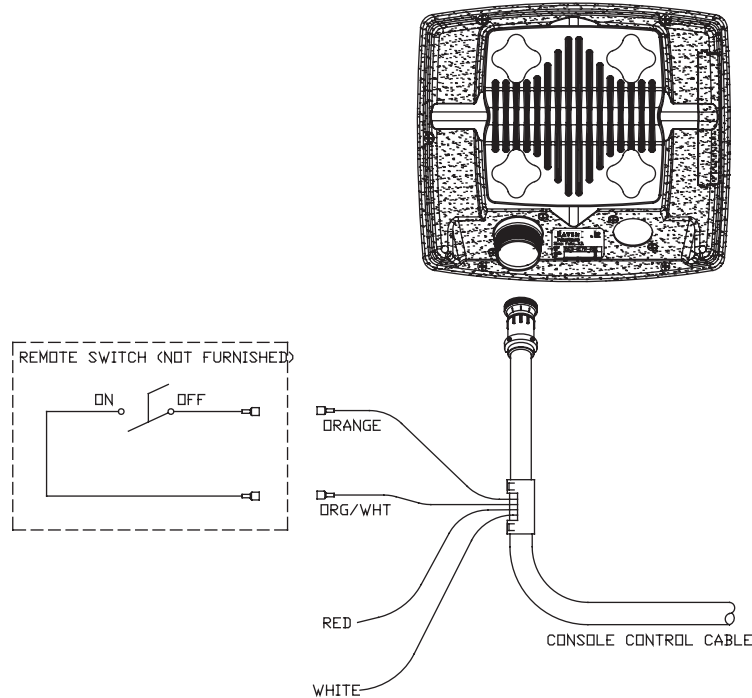
8. Proceed to pump output chart to determine correct pump setting.

Note: *After returning to standard operating mode, the ratio rate cal numbers are retained in the console memory.*

The flow switch used must match capacity of hand gun operation. Flow switch must be normally open.

The Remote Switch option is only available for the SCS 4400 console.

FIGURE 1. Remote Switch



Note: When properly installed, the remote switch is in parallel with the master switch; therefore switching the remote switch or the master switch ON will energize the boom valves.

SCS 4000/5000 Series Firmware Update Procedure

Using a USB to Serial Adapter

Computers without a serial port may still be used to update the Raven SCS 4000/5000 Series consoles using a USB to Serial Adapter (P/N 524-0002-063). Please read the following instructions for assistance setting up the USB to Serial Adapter before beginning the appropriate console update procedure later in this chapter.

Note: A computer running Microsoft® Windows™ is required to complete the update procedure for the Raven SCS 4000/5000 Series consoles.

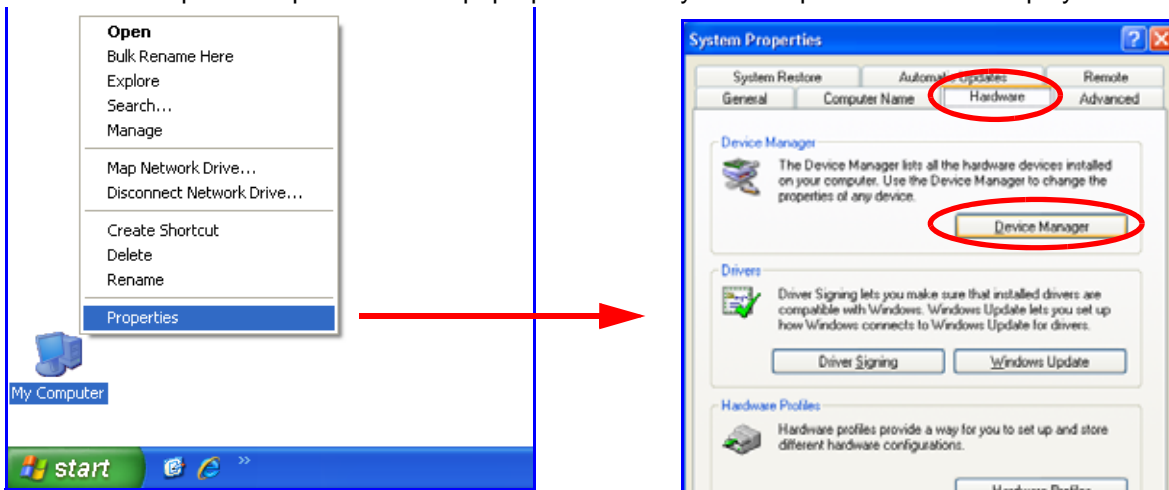
Do not connect the SCS console or null modem cable to the USB to Serial Adapter before completing the following procedure.

USB to Serial Adapter Preparation

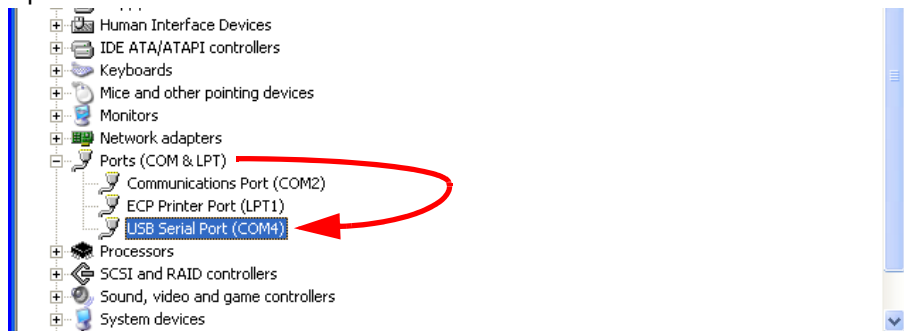
1. Insert the USB to Serial Adapter (P/N 524-0002-063) into a USB port on a home or office PC.

Note: The computer may detect and automatically set up the adapter. Allow the computer to complete the initial configuration before proceeding.

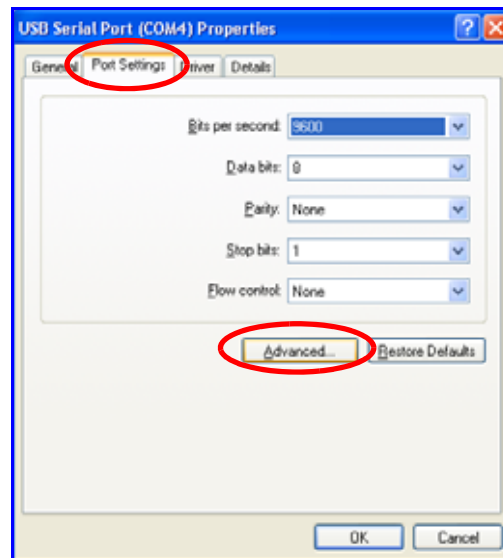
2. Insert the disk provided with the USB to Serial Adapter (P/N 524-0002-063) into the cd tray and follow the instructions provided with the adapter.
3. Right click on the “My Computer” icon on the desktop.
4. Select the “Properties” option from the pop-up list. The “System Properties” window displays.



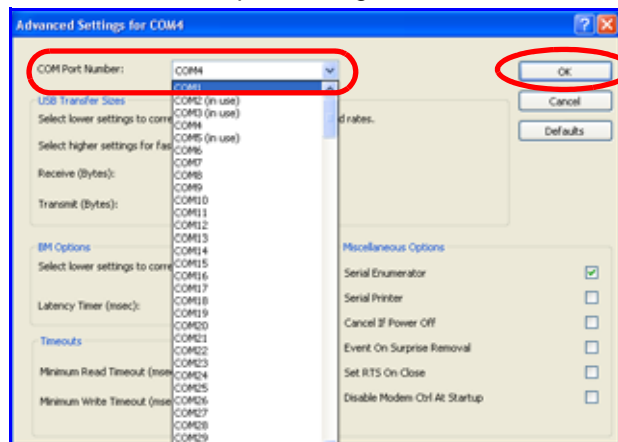
5. On the “System Properties” window, select the “Hardware” tab.
6. On the Hardware tab, click the “Device Manager” button. The “Device Manager” window is displayed.
7. Double click on the “Ports (COM & LPT)” item in the available devices list to access the “USB Serial Port” item within the port devices.



8. Double click on “USB Serial Port” to display the “USB Serial Port Properties” window.
9. Select the “Port Settings” tab.



10. Select the “Advanced...” button to view COM port settings for the USB to Serial Adapter.



11. From the “COM Port Number” drop down box, select the “COM1” option and click “OK.”

12. Close any open Device Manager and System Properties windows.
13. Refer to the firmware update procedure in the SCS 4000/5000 Series manual to complete the update.

Note: If Microsoft® ActiveSync™ is used on the PC, be sure to disable and completely shutdown ActiveSync before starting the firmware update procedure.

Be sure the console is powered off before proceeding with the firmware update procedure.

Serial Console Updater Utility

Note: The serial console updater utility is provided with the SCS Console firmware update file. The serial updater utility requires .NET Framework version 3.5 or newer to update the SCS console properly. With the proper framework, this utility is compatible with Microsoft® Windows XP™, Vista™ and Windows 7™ operating systems.

1. Using a 9-pin null modem cable (P/N 115-0171-395), connect the 9-pin serial connector from the SCS console to the 9-pin serial port on your PC.

Note: A standard serial cable will not work. A USB-serial adapter (P/N 524-0002-063) is required for computers without a serial port. This part is available through your local Raven dealer or most electronics suppliers.

2. On a home or office computer, go to the Raven web site:

www.ravenhelp.com

Download the latest firmware for your specific SCS console and save the file to your desktop.

3. Unzip or extract the compressed file saved to the desktop.

Note: A program to extract, or “unzip,” the firmware update (i.e. WinZip™) will be required to prepare the files for use with your SCS console. If your computer does not already have the ability to unzip a file, a trial version of the WinZip™ software tool is available at:

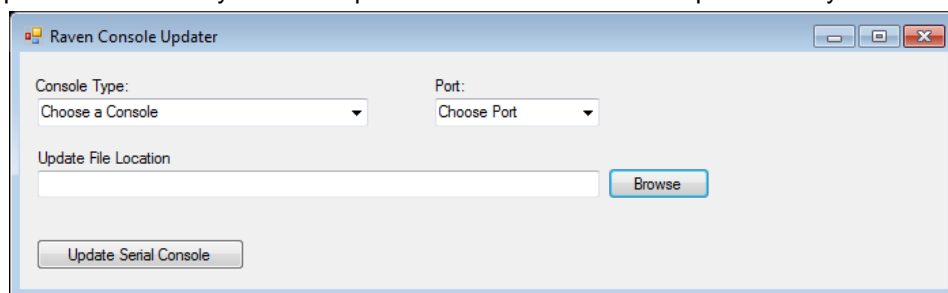
www.winzip.com

A free version of an unzip program is also available from the following web site:

www.freebyte.com/fbzip/

Before installing any unzip utility, verify that the software is compatible with your PC.

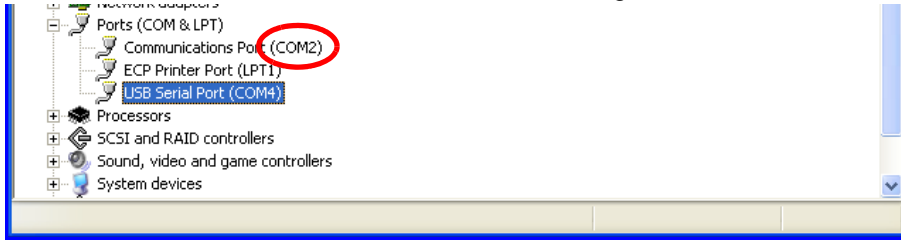
4. Locate the “SerialConsoleUpdater.exe” file from the extracted files and copy the utility to your desktop.
5. Open the updater located on your desktop to start the serial console updater utility.



6. Use the drop down list to select the console to be updated in the Console Type field.

7. Use the Port drop down to select the communication port to which the console is connected.

If you are unsure about the comm port assignment, refer to the procedure in *USB to Serial Adapter Preparation* section on page 83 starting with step 3. The assigned comm port should be displayed in parenthesis at the end of the available items on the Device Manager screen.



8. Click the “Browse” button to the right of the “Update File Location” field and locate the appropriate update file extracted to the desktop.

Update File Name	Connected SCS Console
“_SCS4000_4070_5000 Rev X_XX.txt”	SCS 4000
	SCS 4070
	SCS 4400 (Console P/N 063-0173-466)
	SCS 4600 (Console P/N 063-0173-477)
	SCS 5000
“_SCS4400_4600 Rev X_XX.txt”	SCS 4400 (Console P/N 063-0172-281)
	SCS 4600 (Console P/N 063-0172-343)

Note: DO NOT click the “Update Serial Console” button until the SCS console is properly configured as described in the following steps.

9. With the serial console updater utility open on your computer, power up the SCS console and prepare it to accept firmware updates:
 - a. Press DATA MENU until the ‘Console’ submenu is displayed.
 - b. Press the UP/DOWN arrow buttons to highlight PGM UPDATE and press ENTER. A warning will be displayed to verify that an RS 232 cable connected to the SCS console and the computer.
 - c. Press ENTER.
 - d. The SCS console should now display “LOOKING FOR DATA TO FLASH IC WITH.”
10. On the PC, click the “Update Serial Console” button on the updater screen.
11. Once the update starts, the console will display the current line number of the update file being sent to the console as well as the total number of lines to complete the update. The update may take anywhere from 5-20 minutes depending upon your computer.

Hyperterminal

Note: Hyperterminal is compatible with home or office PC's with Microsoft® Windows XP™ or earlier operating systems.

- Using a 9-pin null modem cable (P/N 115-0171-395), connect the 9-pin serial connector from the SCS console to the 9-pin serial port on your PC.

Note: A standard serial cable will not work. A USB-serial adapter (P/N 524-0002-063) is required for computers without a serial port. This part is available through your local Raven dealer or most electronics suppliers.

- On a home or office computer, go to the Raven web site:

www.ravenhelp.com

Download the latest firmware for your specific SCS console and save the file to your desktop.

- Unzip or extract the compressed file saved to the desktop.

Note: A program to extract, or “unzip,” the firmware update (i.e. WinZip™) will be required to prepare the files for use with your SCS console. If your computer does not already have the ability to unzip a file, a trial version of the WinZip™ software tool is available at:

www.winzip.com

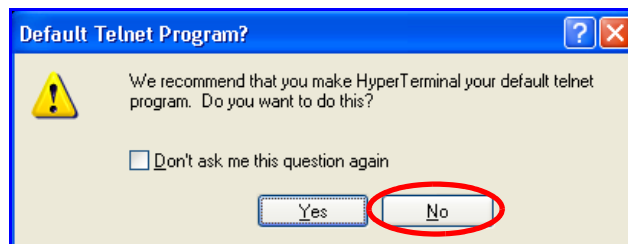
A free version of an unzip program is also available from the following web site:

www.freebyte.com/fbzip/

Before installing any unzip utility, verify that the software is compatible with your PC.

- Open the extracted file and locate the “SCS4000 Update.ht” (SCS 4000, 4070, and 5000) or “4400_4600 firmware.ht” (SCS 4400 or 4600).

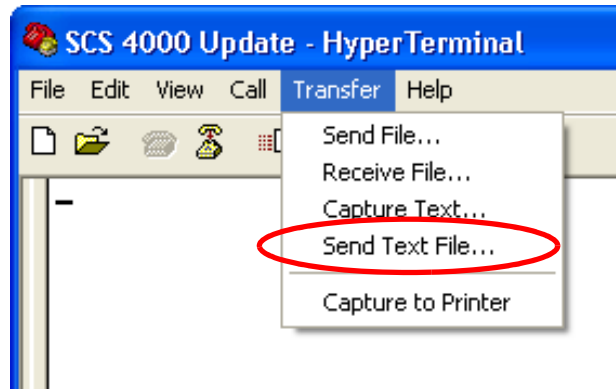
Your computer may ask you if you would like to use HyperTerminal as your default telnet program. Click “No.”



Note: For SCS 4400 consoles with part number 063-0173-466 or SCS 4600 consoles with part number 063-0173-477, use the “SCS4000 Update.ht” file to update the console.

- With the HyperTerminal program open on your computer, power up the SCS console and prepare it to accept firmware updates:
 - Press DATA MENU until the ‘Console’ submenu is displayed.
 - Press the UP/DOWN arrow buttons to highlight PGM UPDATE and press ENTER. A warning will be displayed to verify that an RS 232 cable connected to the SCS console and the computer.
 - Press ENTER.
 - The SCS console should now display “LOOKING FOR DATA TO FLASH IC WITH.”

- In the HyperTerminal program on your home or office PC, click “Transfer” in the menu bar and then choose “Send Text File.”



- Locate the appropriate text file to update the SCS console connected to the computer.

Update File Name	Connected SCS Console
"_SCS4000_4070_5000 Rev X_XX.txt"	SCS 4000
	SCS 4070
	SCS 4400 (Console P/N 063-0173-466)
	SCS 4600 (Console P/N 063-0173-477)
	SCS 5000
"_SCS4400_4600 Rev X_XX.txt"	SCS 4400 (Console P/N 063-0172-281)
	SCS 4600 (Console P/N 063-0172-343)

- Open the text file to begin the firmware update.
- Once the update starts, the console will display the current line number of the update file being sent to the console as well as the total number of lines to complete the update. The update may take anywhere from 5-20 minutes depending upon your computer.
- Once the update is finished, the SCS console will automatically power off.
- Close the HyperTerminal program and disconnect the null modem cable.

Note: SCS 4000/5000 Series communication strings are also compatible with the SCS 760.

1. Using a 9-pin null modem cable, connect the 9-pin serial connector from the SCS console to the 9-pin serial port on your PC. Optional 9-pin to 9-pin cable pinout (P/N 115-0171-395):
2. If you have an SCS 4400/4600, setup the console to pass data through comm port. See the Datalog options section in Chapter 7, Data Menu.
3. Configure the RS-232C serial port to the following settings:
 - 9600 Baud Rate
 - NO Parity
 - 8 Data Bits
 - 2 Stop Bits
4. Data stream to Raven console.

Note: All request and output strings begin with "\$R," to indicate a Raven communication string.

Remote Computer to SCS Console

Rate Change Request

To set Rate Cal values for all three products:

```
$R,RC,<rate_1_cal>,<rate_2_cal>,<rate_3_cal><CR><LF>
```

To set Rate Cal values for products 1 and 3 only:

```
$R,RC,<rate_1_cal>,<rate_3_cal><CR><LF>
```

Calibration String Values Request:

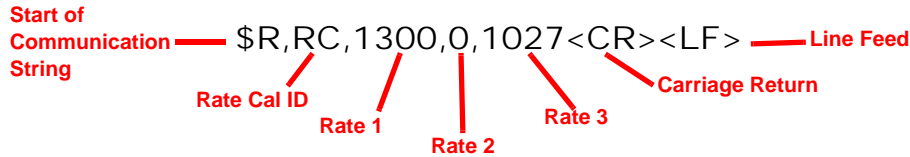
```
$R,CR<CR><LF>
```

Data String Request:

\$R,DR<CR><LF>

For Example:

Change product 1 rate to 130.0
 Change product 2 rate to 0.0
 Change product 3 rate to 102.7



Note: The decimal point will not be sent from the remote computer to the Raven console.

SCS 4000/4070/5000 Console to Remote Computer

All SCS 4000/4070/5000 output strings begin with \$R114-, the \$R indicates a Raven communication string, 114 are the last three digits of the program number and “-” denotes the software revision letter.

Calibration Strings:

- \$R114-,C1,<switch_byte_1>,<switch_byte_2>,<boom_1_cal>,<boom_2_cal>,<boom_3_cal>,<boom_4_cal>,<boom_5_cal>,<boom_6_cal>,<boom_7_cal>,<boom_8_cal>,<boom_9_cal>,<boom_10_cal>,<speed_cal> <CR><LF>
- \$R114-,C2,<meter_1_cal>,<meter_2_cal>,<meter_3_cal>,<meter_4_cal>,<meter_5_cal>,<spreader_constant_1>,<spreader_constant_2>,<spreader_constant_3>,<spreader_constant_4>,<spreader_constant_5><CR><LF>
- \$R114-,C3,<valve_cal>,<valve_2_cal>,<valve_3_cal>,<valve_4_cal>,<valve_5_cal>,<rate_1_cal>,<rate_2_cal>,<rate_3_cal>,<rate_4_cal>,<rate_5_cal><CR> <LF>

Bit	Switch Byte 1	Switch Byte 2	Switch Byte 3
0	boom 1	boom 8	prod 3 auto
1	boom 2	boom 9	prod 3 manual
2	boom 3	boom 10	prod 4 auto
3	boom 4	prod 1 auto	prod 4 manual
4	boom 5	prod 1 manual	prod 5 auto
5	boom 6	prod 2 auto	prod 5 manual
6	boom 7	prod 2 manual	0
7	1	1	1

Note: If prod auto and manual are both zero, the product is off. For switch Byte Bits: 0 = Off and 1 = On.

Data Strings:

- \$R114-,D1,<total_area_1>,<total_area_2>,<total_area_3>,<total_area_4>,<total_area_5>,<field_area_1>,<field_area_2>,<field_area_3>,<field_area_4>,<field_area_5><CR><LF>
- \$R114-,D2,<total_volume_1>,<total_volume_2>,<total_volume_3>,<total_volume_4>,<total_volume_5>,<field_volume_1>,<field_volume_2>,<field_volume_3>,<field_volume_4>,<field_volume_5><CR><LF>
- \$R114-,D3,<tank_1_volume>,<tank_2_volume>,<tank_3_volume>,<tank_4_volume>,<tank_5_volume>,<miles/km>,<feet/meters><CR><LF>

Actual Rate:

\$R114-,AR,<actual_rate_1>,<actual_rate_2>,<actual_rate_3>,<actual_rate_4>,<actual_rate_5><CR><LF>

Time/Date:

\$R114-,TD,<hr:min>,<month/day/year>,<field_reference><CR><LF>

SCS 4400/4600 Console to Remote Computer

All console output strings begin with \$R164-, the \$R indicates a Raven communication string, 164 are the last three digits of the SCS 4400/4600 program number and “-” denotes the software revision letter.

Calibration Strings:

- \$R164-,C1,<switch_byte_1>,<switch_byte_2>,<boom_1_cal>,<boom_2_cal>,<boom_3_cal>,<boom_4_cal>,<boom_5_cal>,<boom_6_cal>,<boom_7_cal>,<boom_8_cal>,<boom_9_cal>,<boom_10_cal>,<speed_cal> <CR><LF>
- \$R164-,C2,<meter_1_cal>,<meter_2_cal>,<meter_3_cal>,<meter_4_cal>,<meter_5_cal>,<spreader_constant_1>,<spreader_constant_2>,<spreader_constant_3>,<spreader_constant_4>,<spreader_constant_5><CR><LF>
- \$R164-,C3,<valve_cal>,<valve_2_cal>,<valve_3_cal>,<valve_4_cal>,<valve_5_cal>,<rate_1_cal>,<rate_2_cal>,<rate_3_cal>,<rate_4_cal>,<rate_5_cal><CR><LF>

Bit	Switch Byte 1	Switch Byte 2	Switch Byte 3
0	boom 1	boom 8	prod 3 auto
1	boom 2	boom 9	prod 3 manual
2	boom 3	boom 10	prod 4 auto
3	boom 4	prod 1 auto	prod 4 manual
4	boom 5	prod 1 manual	prod 5 auto
5	boom 6	prod 2 auto	prod 5 manual
6	boom 7	prod 2 manual	0
7	1	1	1

Note: If prod auto and manual are both zero, the product is off. For switch Byte Bits: 0 = Off and 1 = On.

Data Strings:

- \$R164-,D1,<total_area_1>,<total_area_2>,<total_area_3>,<total_area_4>,<total_area_5>,<field_area_1>,<field_area_2>,<field_area_3>,<field_area_4>,<field_area_5><CR><LF>
- \$R164-,D2,<total_volume_1>,<total_volume_2>,<total_volume_3>,<total_volume_4>,<total_volume_5>,<field_volume_1>,<field_volume_2>,<field_volume_3>,<field_volume_4>,<field_volume_5><CR><LF>
- \$R164-,D3,<tank_1_volume>,<tank_2_volume>,<tank_3_volume>,<tank_4_volume>,<tank_5_volume>,<miles/km>,<feet/meters><CR><LF>
- \$R164-,D4,<speed>,<pressure1_1>,<pressure1_2>,<pressure1_3>,<pressure1_4>,<pressure1_5>,<pressure2_1>,<pressure2_2>,<pressure2_3>,<pressure2_4>,<pressure2_5><CR><LF>

Actual Rate:

\$R164-,AR,<actual_rate_1>,<actual_rate_2>,<actual_rate_3>,<actual_rate_4>,<actual_rate_5><CR><LF>

Time/Date:

\$R164-,TD,<hr:min>,<month/day/year>,<field_reference><CR><LF>

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LIMITED WARRANTY

WHAT DOES THIS WARRANTY COVER?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

HOW LONG IS THE COVERAGE PERIOD?

Raven Applied Technology products are covered by this warranty for 12 months from the date of retail sale. In no case will the Limited Warranty period exceed 24 months from the date the product was issued by Raven Industries Applied Technology Division. This warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries.

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the warranty claim, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THIS WARRANTY?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

DO I NEED TO REGISTER MY PRODUCT TO QUALIFY FOR THE EXTENDED WARRANTY?

Yes. Products/systems must be registered within 30 days of retail sale to receive coverage under the Extended Warranty. If the component does not have a serial tag, the kit it came in must be registered instead.

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

To register, go online to www.ravenhelp.com and select Product Registration.

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

Raven Applied Technology products that have been registered online are covered for an additional 12 months beyond the Limited Warranty for a total coverage period of 24 months from the date of retail sale. In no case will the Extended Warranty period exceed 36 months from the date the product was issued by Raven Industries Applied Technology division. This Extended Warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries. In addition, the words "Extended Warranty" must appear on the box and all documentation if the failure is between 12 and 24 months from the retail sale.

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the product's registration for the Extended Warranty and the claim itself, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. Cables, hoses, software enhancements, and remanufactured items are not covered by this Extended Warranty. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.