Raven CANbus System Installation Guide

P/N 016-0171-504 Rev. B 04/15 E19451

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APPENDICES

CHAPTER 1

Important Safety Information

Safety Information

NOTICE

Read this manual and the operation and safety instructions included with the implement and/or other equipment carefully before installing the a Raven product control console or field computer.

- 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 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 field computer.
- 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 hydraulic system. Objects or materials that are able to bypass the machine 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 console or field computer before jump-starting the vehicle.
- Disconnect the console or field computer and any other Raven systems before welding any component of the machine.

CHAPTER 2

Introduction to the Raven CANbus System

CANbus Overview

A Controller Area Network, or CAN, system is a high-integrity serial data communications bus that operates at a data rate of 250 kilobits per second for real-time control applications. The CAN protocol has excellent error detection and confinement capabilities, making it highly suitable and reliable for agricultural applications. Due to the harsh field and environmental conditions experienced in agricultural applications, CAN networks require specialized cables and CAN terminators to protect the integrity of the CAN system and, when properly installed and maintained, may help to ensure trouble free control system operation.

By design, Raven CANbus systems are highly flexible to fit a variety of needs in the field of precision agriculture. CANbus systems allow for modularization of the control system and allow nodes to be added to expand the number of control channels or to add optional features to a control system at any time.Raven CAN control consoles or field computers are capable of interfacing with several channels to control any combination of liquid, granular, chemical injection or spinner control applications.

Note: *Refer to the operation manual for the specific control console or field computer for additional information on control channel capabilities and available features.*

This guide has been prepared to assist with the installation of basic components used with liquid, granular or spinner control CANbus control modules.

Note: *Any diagrams in the following sections may be used as a basic connection illustration for Raven CANbus product control systems. Some diagrams may show optional features which may not apply to every control system. These features and components are not required for CAN operation and optional components and cables may be ignored during a basic installation.*

Contact a local Raven dealer for additional information and assistance with connecting the CANbus components.

Although the control algorithm is located within the CAN node, all of the same troubleshooting techniques used in a hard-wired system still apply to a CANbus control system and network. When used in CANbus systems, the flow and speed sensors, as well as the control valve and boom valves, are used in the same fashion as traditional control systems. This guide also contains information for diagnostics and troubleshooting of many Raven CANbus control nodes. Refer to Appendix C, *Node Diagnostic Indicators*, for information on diagnostic indicator lights available on some Raven CANbus control nodes or Appendix A, *Raven CANbus Troubleshooting* for node troubleshooting procedures. Review Appendix E, *CAN Diagnostic Tool*, for information on using the Raven CAN diagnostic tool.

Raven Cable Platforms

Raven control systems are compatible with either the generation 1 or generation 2 cable platforms. Each platform offers a range of optional features which can be added to the control system at any time. Contact a local Raven dealer for assistance with selecting the appropriate cable platform for a specific application or to interface with existing equipment already installed on the machine.

NOTICE

Please read the installation instructions for the specific cable platform being installed with the control console or field computer prior to beginning installation. Contact a local Raven dealer for assistance or to purchase additional components necessary to set up the CANbus system.

Note: *The maximum length of the CANbus communication lines for either of the following cable platforms is 273 yards [250 meters]. To avoid communication issues when expanding or adding to a CANbus system, it is recommended to use the shortest tee cable length necessary to reach nodes or system components.*

Generation 1 Cabling Platform

The generation 1 cabling platform consists of separate cable lines for connecting the CANbus, power and other components to the control system. This system utilizes CAN tee and product cabling widely available through any Raven dealer and is capable of handling any combination of liquid, granular, spinner or chemical injection applications in the control system.

Note: *Refer to Chapter 5, Generation 1 Cable Connections, for installation procedures with the generation 1 cabling platform. Generation 1 cabling may also be used to connect a field computer to a Raven serial control console. When used in this configuration, the field computer will be used primarily for mapping and guidance. Since the serial control console is performing product rate control, the field computer will not require a boom sense, speed or a product control node. An AccuBoom, AutoBoom or SmarTrax node still may be connected to the field computer.*

Generation 1 cabling features a separate CANbus communication line that utilizes square, 4-pin Deutsch connectors and square, 4-pin terminators.

CAN Terminators

Passive CAN terminators must be installed at each end of the 4-pin CAN communication trunk line to signal the end of the CANbus. Terminators help to condition CAN communication signals and reduce signal reflection which can cause communication errors.

Refer to the *CAN Communication Lines* section on page 28 for details on connecting the generation 1 CAN communication cables and terminators. Be sure to review the *Best Installation Practices* section on page 20 when building or modifying a CANbus system.

Generation 2 Cabling Platform

The generation 2 cabling platform is designed and well suited for installing a Raven control system on a tractor and interfacing with a towed implement such as a sprayer, spreader or planter. This cable platform offers reduced cab clutter and streamlined installation with improved CANbus and power cabling for any full featured system.

Note: *Generation 2 cabling may not be suitable for all SCS 4000/5000 Series consoles. Contact a local Raven dealer for more information regarding this platform and a specific SCS control console. Refer to Chapter 6, Generation 2 Cable Connections, for installation procedures with the generation 2 cabling platform.*

Generation 2 cabling features integrated the CANbus communication and power lines in the same cables and utilizes a round, 16-pin terminator.

CAN Terminators

Passive CAN terminators must be installed at each end of the CANbus system or at the hitch connection to signal the end of the CANbus. Terminators help to condition CAN communication signals and reduce signal reflection which can cause communication errors.

Important: *When unhitching from towed implements, replace the dust caps over open connections to protect connectors from dirt and moisture. Replace the passive terminator at the tractor hitch connection to protect the hitch connector or avoid communication errors when operating the tractor CAN system independently.*

Refer to the *CAN Communication Lines* section on page 45 for details on connecting the generation 2 CAN/ power tee cables and terminators.

Installation Overview

A basic CANbus control system may include the following components for liquid or granular application systems:

Liquid Components	Granular Components
Speed Sensor or GPS Receiver[a]	Speed Sensor or GPS Receiver[a]
Flow Meter	Encoder
Control Valve	Hydraulic Control Valve
Pressure Transducer (Optional)	Fan RPM Sensor (Optional)
Boom Valve(s) or Manifold	Bin Level Sensor (Optional)
Node(s) and Node Harness	Node(s) and Node Harness
Control Console or Field Computer	Control Console or Field Computer

a. The GPS receiver must be capable of outputting a radar type speed signal for use with most existing Raven CANbus systems. Newer Raven CANbus systems may be capable of outputting a GPS speed signal over the CANbus network. Contact a local Raven dealer for more information or assistance with updating CANbus components to utilize this feature.

Note: *The optional components listed above are not required for application rate control. These components are available to provide additional feedback for the equipment operator during field applications. Contact a local Raven dealer for more information.*

Additional features or components which combine functions of the hardware listed above may be installed in CAN systems and may drastically affect the design and connection of the product control system. For this reason, it is recommended to work with a local Raven dealer to design a CANbus network to create an application system best suited for the applicator or needs of a specific operation.

Powering a CANbus System

Power for a CANbus system is separated into high current and logic power supply lines.

- High current power is used to provide working power to valves and other components of the application control system.
- Logic power is used to provide power for computing and processing the various commands sent via the CANbus from the control console to the nodes.

Installation Overview

The following items will be required to complete the installation of a basic CAN product control system.

NOTICE

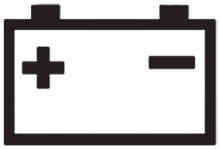
Be sure to read all safety instructions and follow all installation procedures for each component to ensure proper installation of the CANbus system.

1. Mount the control console or field computer.
2. Connect the console cable.
3. Build the CANbus network and connect CAN modules.

4. Mount the speed sensor. To ensure proper installation of the speed sensor, refer to the installation instructions provided with the specific speed sensor or GPS receiver.

Note: *The GPS receiver must be capable of outputting a radar type speed signal for use with most existing Raven CANbus systems. Newer Raven CANbus systems may be capable of outputting a GPS speed signal over the CANbus network. Contact a local Raven dealer for more information or assistance with updating CANbus components to utilize this feature.*

5. Mount the product control hardware for liquid or granular applications as appropriate. Refer to Chapter 3, *Install Components for Liquid Applications*, or Chapter 4, *Install Components for Granular Applications*, an overview of the basic installation of required components for these system types.
6. Mount and connect the product control nodes to the installed control hardware (e.g. control valve, boom valves and product nodes).
7. Mount the console and connect the console or chassis cabling. Refer to the specific controller manual for detailed mounting and cable connection information.
8. Connect the console or chassis cable power leads to the vehicle battery.



CAUTION

Be sure to follow instructions for connecting the power leads to the battery carefully. Reversing the power leads may cause damage to the console. Do not connect the battery leads until all other components have been properly mounted and connected.

Updates

Updates for Raven manuals as well as several CANbus system components are available at the Applied Technology Division web site:

www.ravenhelp.com

Sign up for e-mail alerts to receive notice when updates for your Raven products are available on the Raven web site.

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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

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-Raven CANbus System Installation Guide
-P/N 016-0171-504 Rev. B
-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.

CHAPTER 3

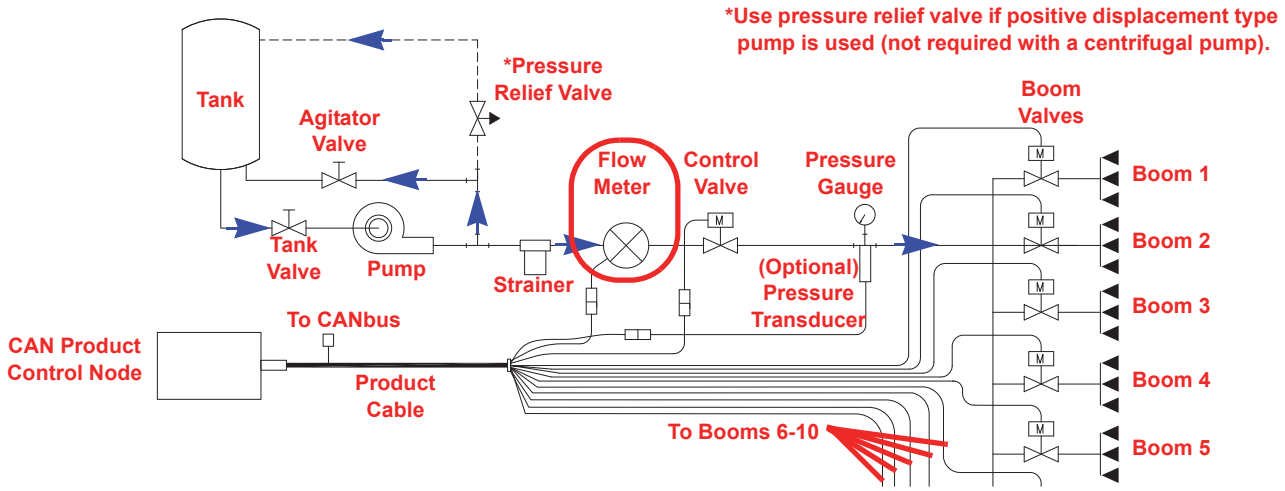
Install Components for Liquid Applications

The following sections illustrate basic installation of the flow meter, control valve, boom valves and an optional pressure transducer for liquid application systems.

Mount the Flow Meter

Important: *All flow through flow meter must go to the boom valves only. To measure application rates accurately, ensure that no return, agitation or sparge lines feed back to the product tank or pump after the flow meter.*

FIGURE 1. **Flow Meter Installation Example**



1. Install the flow meter upstream of the control valve in the area of the boom valves (horizontal to the ground) using the supplied bracket.
   a. Allow a minimum of 7-1/2” [20 cm] of straight hose on the inlet side of the flow meter.
   b. Any hose bend radius on outlet of the flow meter should be gradual.
   c. Flow must be in the direction of the arrow on the flow meter.
2. The flow meter will be connected to the ‘Flow’ connector on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the flow meter to the control system using these cable platforms.

Optional Pressure Transducer Installation

An optional pressure transducer may be used to monitor pressure of liquid products controlled by the SCS control console.

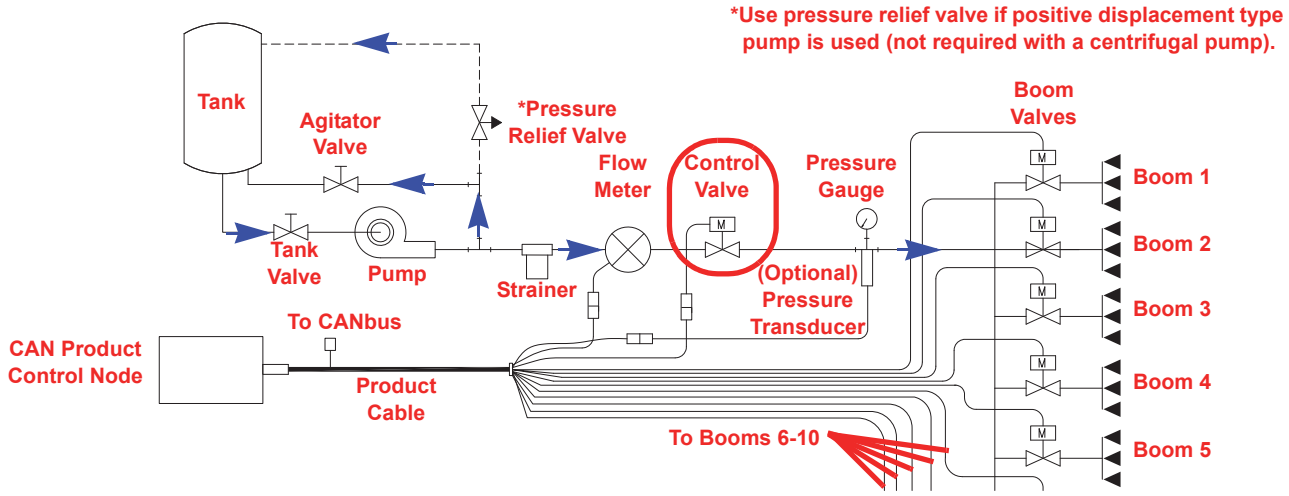
Note: *The pressure in the product lines may be monitored by the equipment operator to ensure a proper spray pattern is maintained or that the product lines are appropriately charged during field application. A Raven product control system does not require a pressure transducer for control functions.*

1. Install the pressure transducer (P/N 422-0000-090) into the product carrier line. The transducer body features a 1/4” NPT thread to secure the transducer into the carrier line.
2. The pressure transducer will be connected to the ‘Pressure’ connector on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the pressure transducer to the control system using these cable platforms.

Note: *Contact a local sprayer supply dealer for fittings or adapters to install the transducer. Contact a local Raven dealer for extension cables if necessary. When using a pressure transducer with the SCS 4400 or 4600, a pressure sensor cable will be required to connect the pressure transducer to the flow cable.*

Mount the Control Valve

FIGURE 2. Standard Control Valve Installation Example



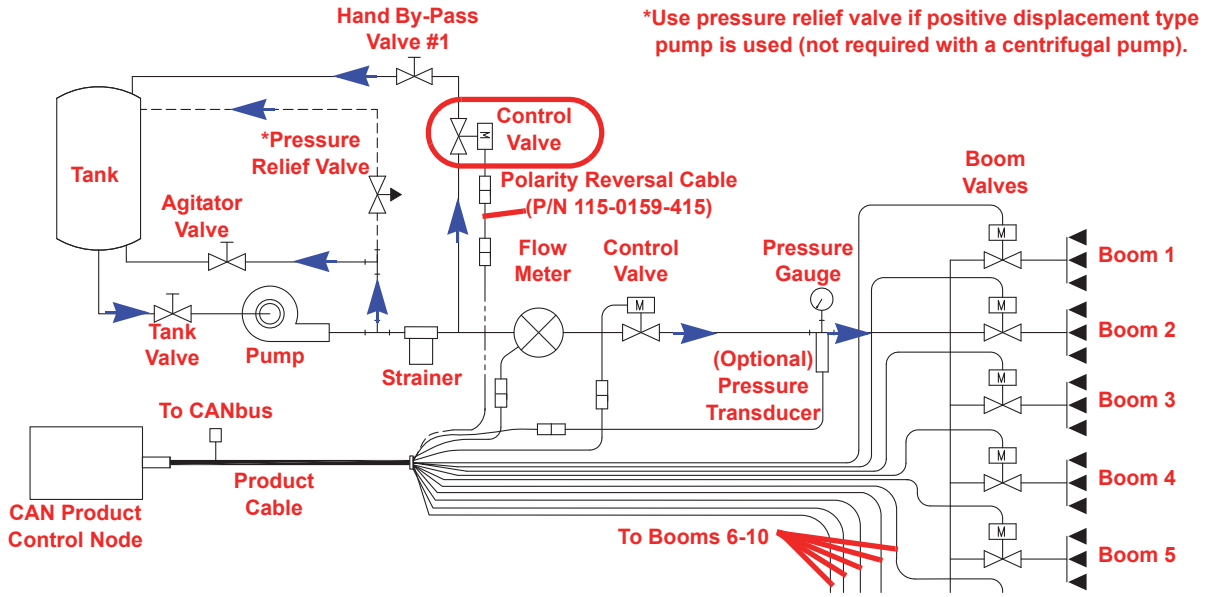
Note: *This diagram applies only to applications at 3 GPM [11 lit/min] or greater. For flow rates less than 3 GPM [11 lit/min], the motorized control valve is mounted in a by-pass line. Refer to the Alternate By-Pass Line Plumbing Systems section on page 11 for alternate plumbing system installation.*

1. Mount the motorized control valve in the main hose line between the flow meter and boom section valves and with the motor in the upright position.
2. The control valve will connect to the 2-pin connector (green/yellow wires) on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the control valve to the control system using these cable platforms.

Alternate By-Pass Line Plumbing Systems

The by-pass line plumbing system is an alternate plumbing method used in ultra-low volume liquid spraying applications. In the by-pass line method, the control valve is mounted in a tank return line and the product application rate is controlled by adjusting the amount of product returning to tank.

FIGURE 3. Alternate By-Pass Control Valve Installation Example



Note: *This diagram applies only to applications of less than 3 GPM [11 lit/min]. For flow rates of 3 GPM [11 lit/min] or greater, the motorized control valve is installed in the main product line. Refer to Figure 2 on page 10 for a diagram of a standard control valve installation.*

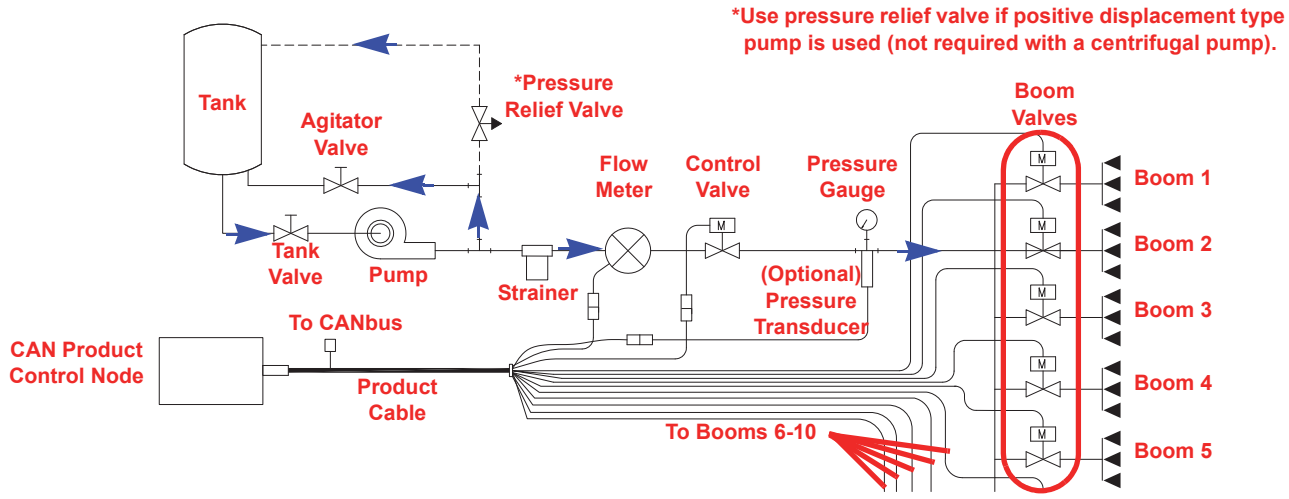
To operate the control valve in this configuration, a polarity reversal cable (P/N 115-0159-415) will be required.

1. Mount the motorized control valve in the by-pass line with the motor in the upright position.
2. Connect the polarity reversal cable (P/N 115-0159-415) to the 2-pin connector (green/yellow wires) on the control valve.
3. The open connector will connect to the 2-pin connector (green/yellow wires) on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the control valve to the control system using these cable platforms.

Mount the Boom Section Valve(s)

Note: *A boom sense cable may be installed to obtain section status information using existing boom control hardware already installed on a machine. Contact a local Raven dealer for more information before removing any existing section valves from the machine.*

FIGURE 4. Boom Valve Manifold Installation Example



1. The boom section valves or a boom valve manifold is installed on the center rack of the machine or implement.
2. Plumb the section valves into the applicator lines to allow the system to control boom sections as desired. Up to ten individual sections may be controlled with a Raven product control system.

   The Raven product control system may be configured for several application types and can be integrated on many types of application equipment. Contact a local Raven dealer for information and assistance with configuring the Raven control system for a specific application.
3. The boom section valves will be connected to the boom sense wires on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the section valves to the control system using these cable platforms.

CHAPTER 4

Install Components for Granular Applications

The following sections illustrate basic installation of the encoder(s), hydraulic control valve, an optional fan speed or bin level sensor for dry or granular application systems.

Mount the Hydraulic Control Valve

NOTICE

Review the equipment manual and the *Hydraulic Safety* section on page 2 and follow all safety procedures when working with the hydraulic system.

1. Mount the hydraulic valve with the motor in the upright position.
2. Connect the hydraulic control valve to the machine hydraulic system. Refer to Figure 1, “Spinner System Control Valve Installation Diagram,” or Figure 2, “Pneumatic System Control Valve Installation Diagram,” for the typical hydraulic connections.
3. The hydraulic control valve will connect to the 2-pin connector (green/yellow wires) on the flow or product control cable. Refer to Chapter 5, *CANbus and Control Cable Connections*, for more information on connecting the control valve to the control system.

Note: *Contact a local Raven dealer for more information and for assistance with selecting the appropriate product cable(s) for a specific application or application equipment.*

FIGURE 1. **Spinner System Control Valve Installation Diagram**

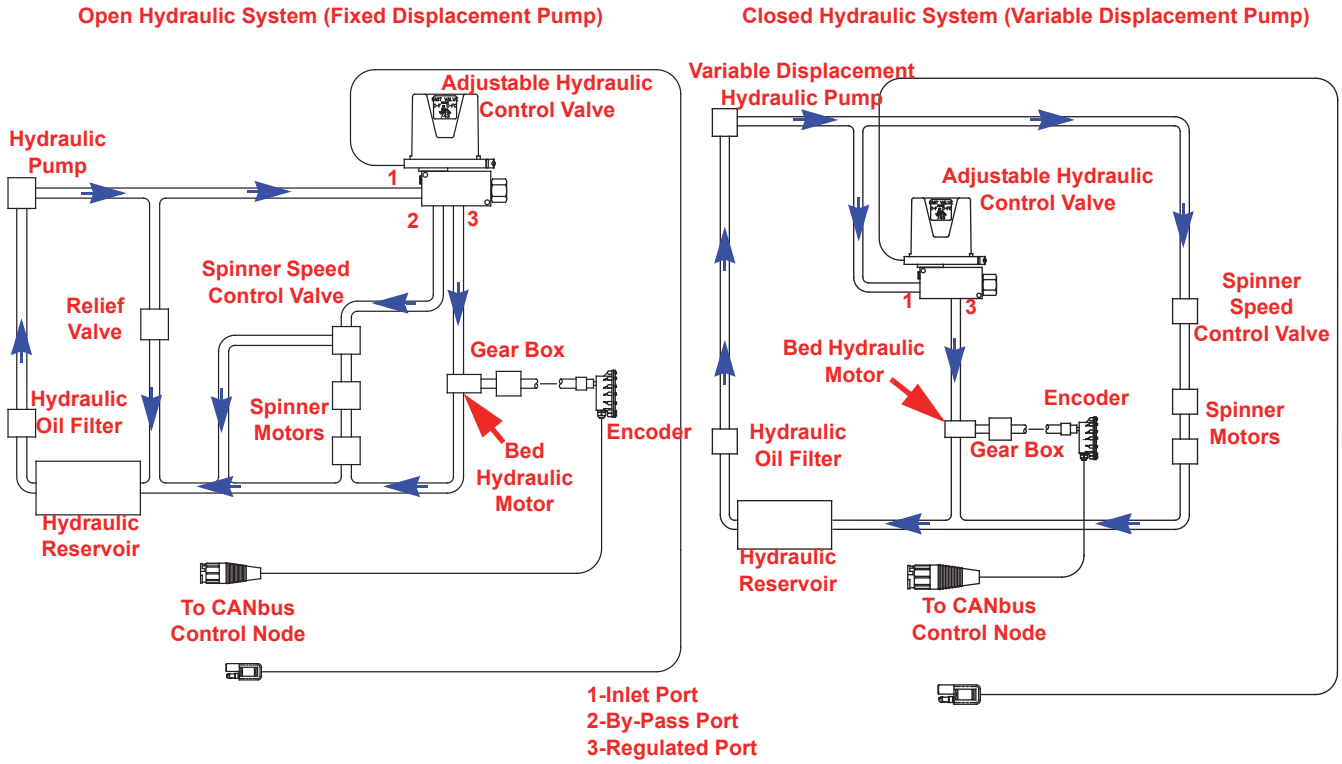
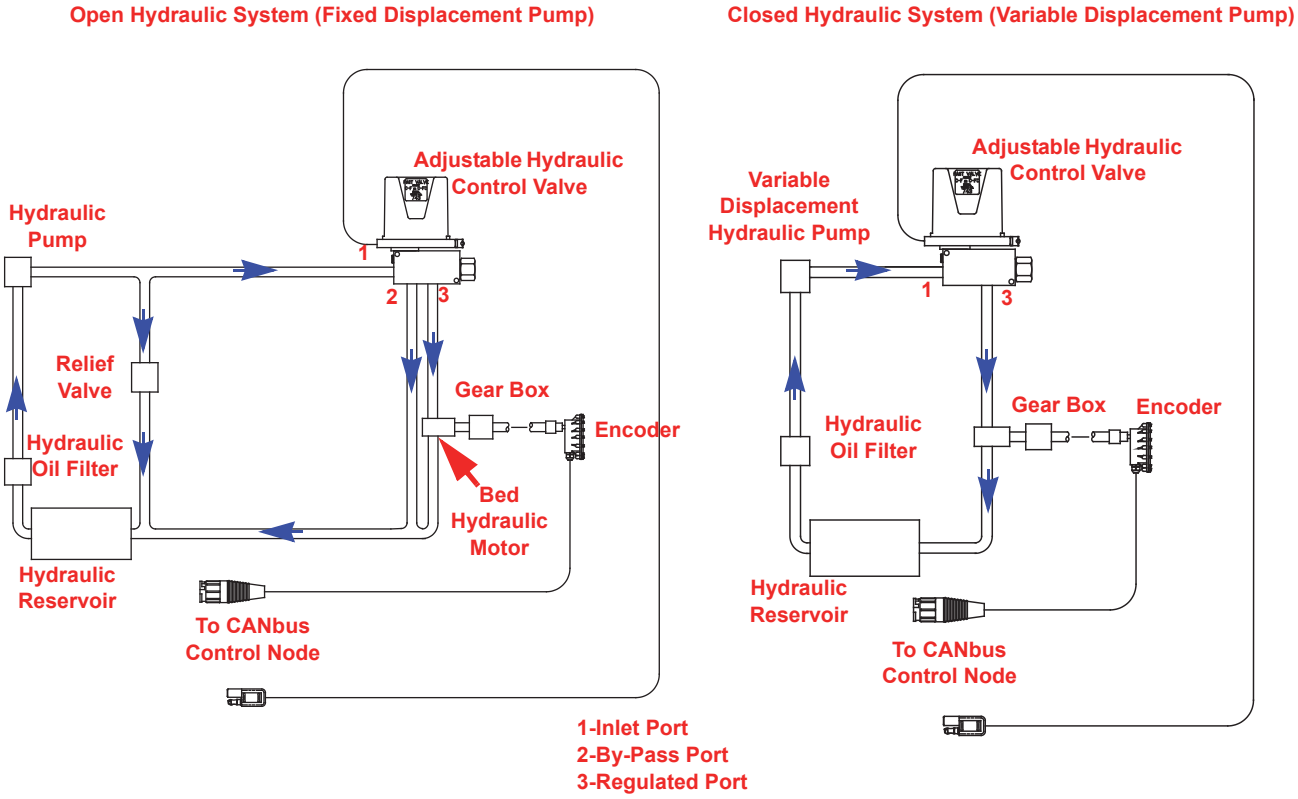


FIGURE 2. **Pneumatic System Control Valve Installation Diagram**



Mount the Encoder

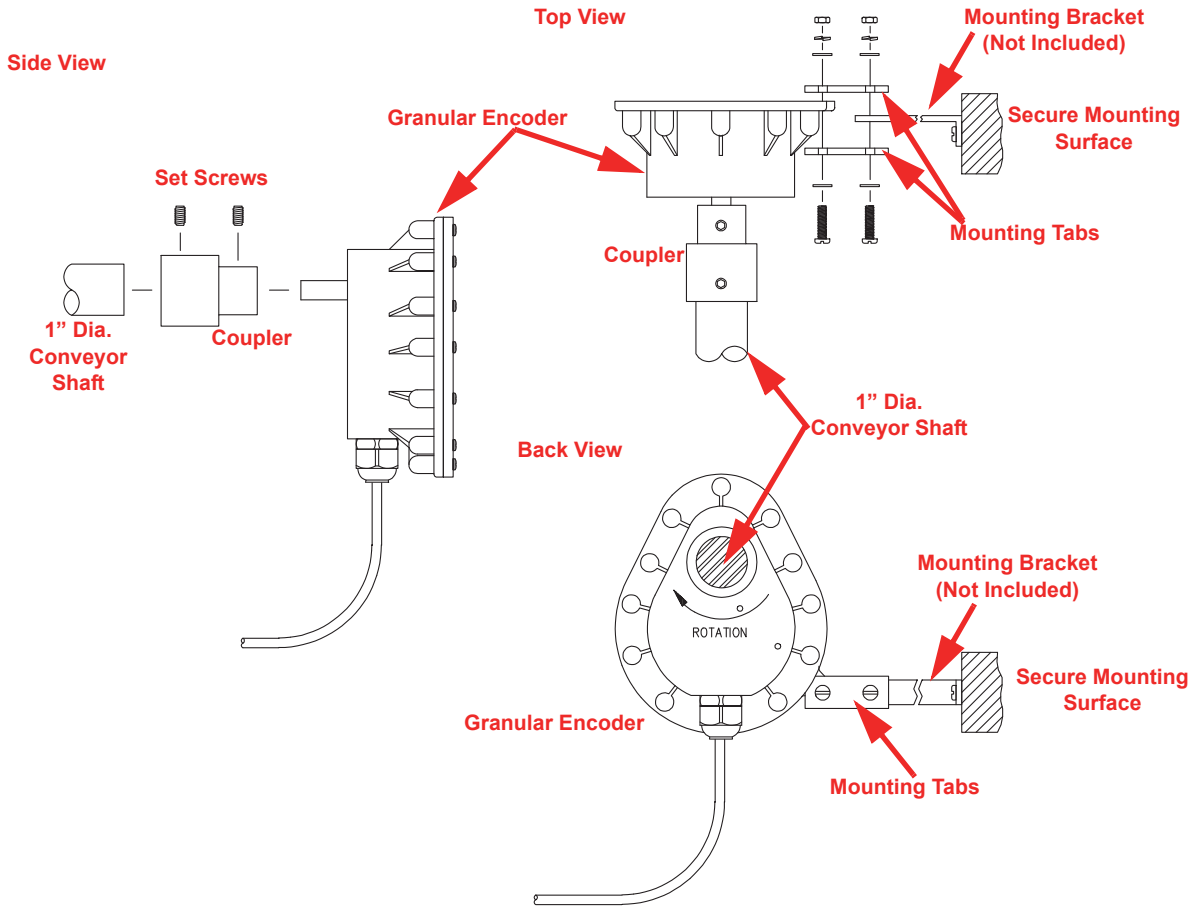
Note: *The encoder coupler fits a 1" [2.54 cm] diameter conveyor shaft. The encoder assembly should be connected to the conveyor shaft or another shaft which rotates at a known ratio to the conveyor.*

1. Apply grease to the encoder shaft, conveyor shaft and encoder coupler.
2. Install the coupler on the end of the encoder shaft.
3. Mount the encoder and coupler on the output shaft of the conveyor.
4. Secure the coupler to the encoder and conveyor shafts using the supplied set screws.
5. Install a mounting bracket (not supplied) and mounting tabs to hold the encoder body stationary during operation.

Note: *Do not rigidly mount the encoder body to the mounting bracket. The encoder should be supported by the coupler only. The mounting bracket and tabs are used only to prevent the encoder from rotating while the shaft is spinning (refer to Figure 3 on page 15).*

6. The encoder will connect to the 'Flow' connector on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the encoder to the product control system using these cabling platforms.

FIGURE 3. **Encoder Installation**

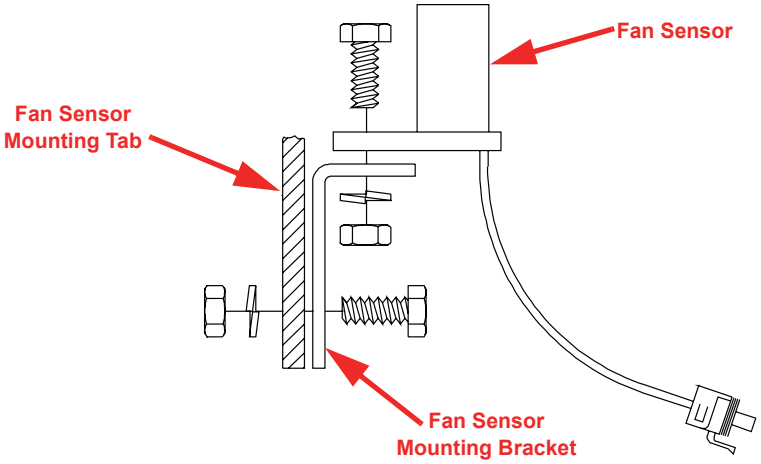


Optional Fan RPM Sensor Installation

Refer to the following procedure to install the optional fan RPM sensor kit (P/N 117-0159-575).

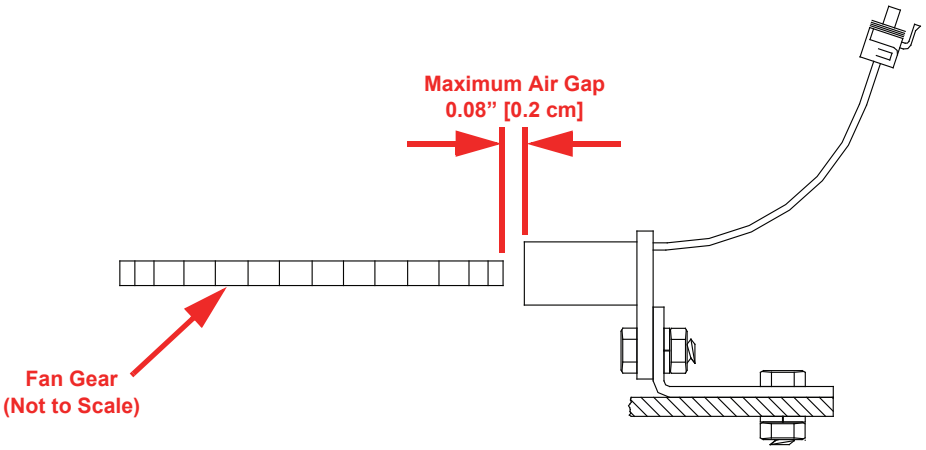
1. Attach the fan RPM sensor to the fan sensor bracket using the supplied bolt, lock washer and nut.
2. Mount the fan sensor assembly on the fan sensor mounting tab using a stainless steel bolt, lock washer and nut.

FIGURE 4. Fan RPM Sensor Assembly



3. Adjust the gap between the fan gear and fan sensor to between 0.040” and 0.080” [1.016 mm to 2.032 mm].

FIGURE 5. Fan Sensor Gap Adjustment



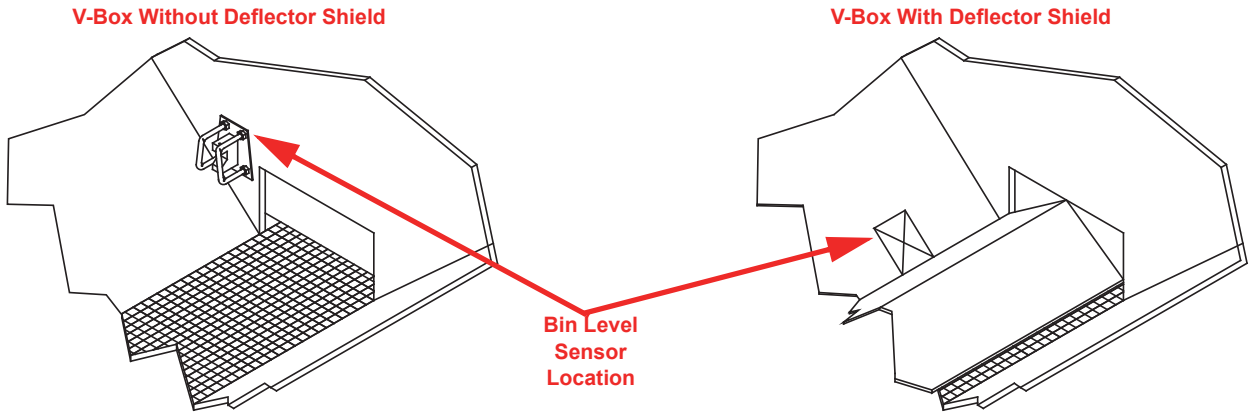
4. The fan speed sensor will connect to the ‘Fan Speed’ connector on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the fan speed sensor to the product control system using these cabling platforms.

Optional Bin Level Sensor Installation

Refer to the following procedure to install the optional bin level sensor kit (P/N 117-0159-640).

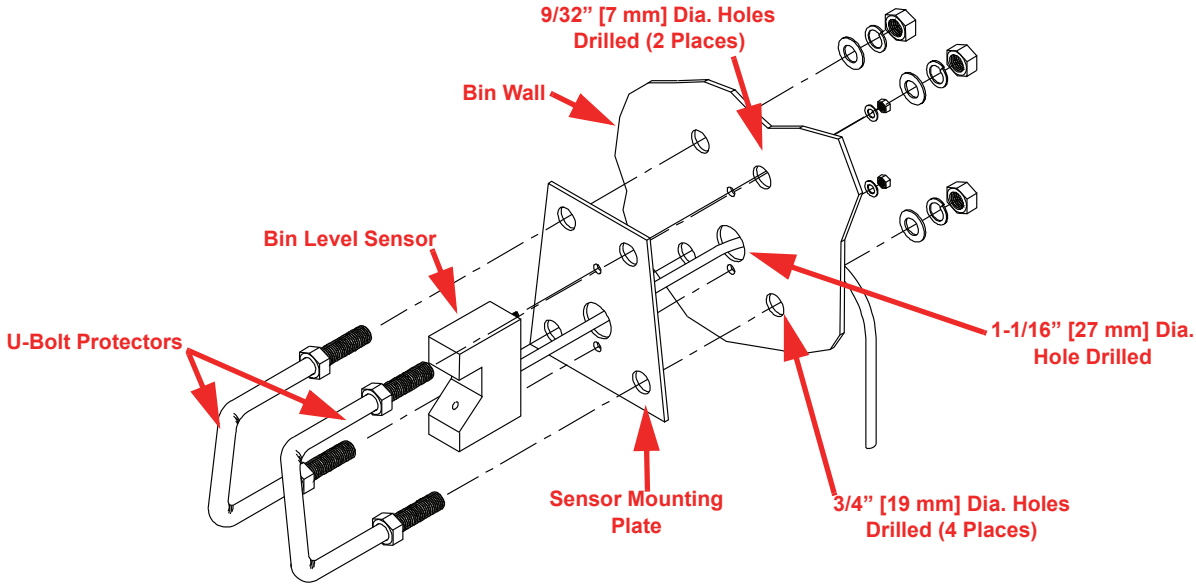
1. Determine the appropriate bin level sensor mounting location for the type of bin on the machine.

FIGURE 6. Bin Level Sensor Mounting Location



2. Use the sensor mounting plate as a template to mark the bin for drilling holes.

FIGURE 7. Bin Level Sensor Assembly



3. Drill the mounting holes according to the figure above. De-burr holes in the bin wall before mounting the sensor.
4. Route the sensor cable through the mounting plate and bin wall as shown.

5. Secure the mounting plate to the bin wall using the u-bolt protectors, flat and lock washers and nuts.
6. Secure the bin level sensor to the mounting plate and bin using lock washers and nuts.
7. Route and connect the sensor cable connector to the flow cable connector.
8. Secure all cables with plastic cable ties.
9. The bin level sensor will connect to the ‘Bin Level’ connector on the flow or product control cable. Refer to Chapter 5, *Generation 1 Cable Connections*, or Chapter 6, *Generation 2 Cable Connections*, for more information on connecting the fan speed sensor to the product control system using these cabling platforms.

CHAPTER 5

Generation 1 Cable Connections

The following sections illustrate connecting a product control system using the or generation 1 cabling platform. This platform utilizes CANbus communication cables with a 4-pin Deutsch connector and requires a CAN power tee to be installed to provide shielding for the CAN network. Each node will connect to power and ground using separate leads.

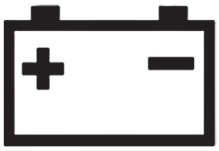
Note: *Generation 1 cabling may utilize optional cables designed to incorporate some of the CAN and power cable connections. These cables may be purchased through a local Raven dealer to reduce cab clutter, customize the installation for specific applications or to connect optional system components to the CAN network. Contact a local Raven dealer for more information or assistance with specialized cables available for the generation 1 platform.*

Refer to the following sections for details on:

- Connecting product control hardware to CAN nodes to create modules.
- Connecting modules to the CANbus to create a network.
- Connecting the Raven display to the network.
- Connecting the network to a source of clean, controlled logic power.

Best Installation Practices

Wiring power to the control console and CANbus nodes is especially important for proper operation of the product control system. Many issues related to CAN systems can be traced to improper wiring of power and ground leads. Review the following items and refer to Figure 1 on page 21 to properly connect the CAN system.



CAUTION

Reversing the power leads may cause damage to the display. Review the *Electrical Safety* section on page 2 and read all instructions for connecting the power leads prior to connecting the display to power.

Raven recommends connecting the control console to power only after all components have been properly mounted and installed.

The information below illustrates proper methods for wiring a CANbus system using either the generation 1 or generation 2 cable platforms.

1. Always use sealed connectors with dielectric grease. Unsealed, crimped connections (i.e. butt connectors) should be avoided.
2. In addition to using dielectric grease, mount all CAN terminators and nodes with the connector(s) pointing down to avoid collecting water and/or chemicals. Liquids collecting within the terminator can corrode pins and may cause CAN issues.
3. Use dedicated bus bars to connect the control console and all nodes to the same source for both power and ground.

Note: *Connecting the GPS receiver (logic power) to the CANbus bars allow engine shutdown without losing GPS.*

4. Connect the power directly to a clean, controlled logic power source. Do not connect to any source of power that will receive distortion or noise from other equipment, such as pumps, valves or radios, installed on the vehicle or machine.
5. Connect the ground leads directly to the vehicle battery or negative power bus. **Do not** use chassis ground connections.
6. Provide relays to switch power to the CAN logic power on and off to avoid draining the battery. Raven recommends connecting the orange wire from the console cable to switch a relay to provide logic power to the CAN nodes (see Figure 1 on page 21). This makes the display or console the master power switch for the CANbus network and will allow engine shutdown without removing power from the console.

CAUTION

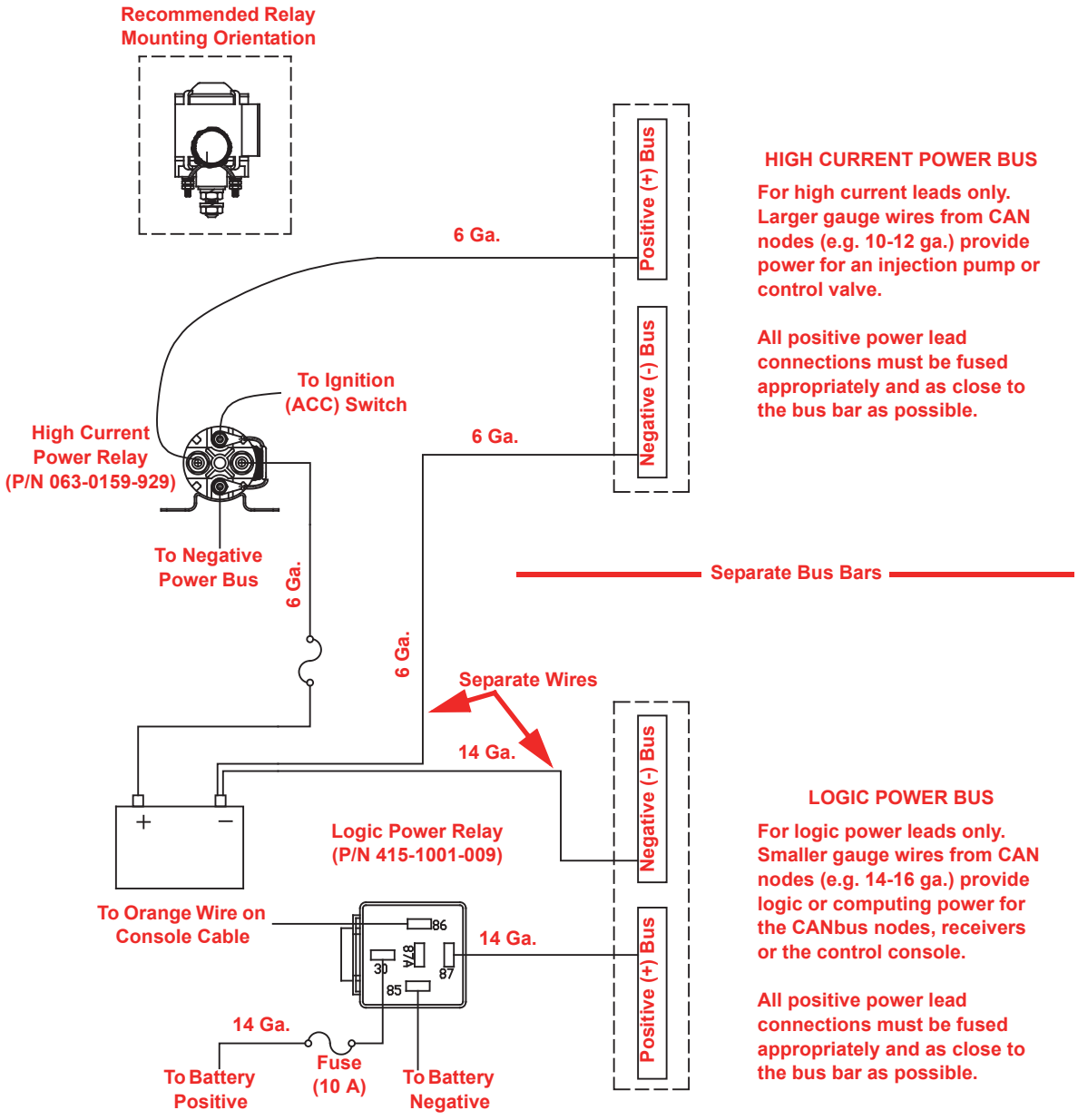
Do not start the vehicle engine while the display console is powered on. Shut down the console before starting the vehicle to avoid damage to the display.

7. Provide two CAN terminators for optimal signal integrity through the CANbus. Terminators should be installed at each end of the CANbus. CAN power, obtained from a switched power source, runs throughout the bus to act as a shield.

Note: *Generation 1 cabling will require a CAN power adapter tee cable. This cable should be placed toward the front of the bus with one end terminated.*

Following these recommendations will result in the most robust system possible while greatly reducing CAN communication problems.

FIGURE 1. CANbus System Wiring Diagram



Note: *The high current power relay is capable of handling up to 80 amps while the logic power relay is limited to 10 amps.*

Boom Sense and Speed Node Module

The boom sense and speed node provides boom status and speed information to the Raven CANbus for product control operations. Refer to the following procedure to connect the boom sense and speed node to the speed sensor and section switch box or joystick functions.

Note: *Refer to Figure 2 on page 23 for a diagram of a standard boom sense speed node module. The boom sense and speed node is not required if a Raven controller or optional system component features boom and/or speed sense node functionality. Review product documentation or contact a local Raven dealer to determine if a boom sense and speed node is necessary for a specific installation.*

1. Connect the section valves or section switches to the boom sense or boom control cable.

   To control section valves using an existing switch box or joystick functions:

   a. Use the boom sense cable to tie into the existing machine switch functions. Contact the machine manufacturer to connect the sense lead wires to the following sections:
      - Black wire to section switch #1
      - Brown wire to section switch #2
      - Blue wire to section switch #3
      - Black wire with white stripe to section switch #4
      - Brown wire with white stripe to section switch #5
      - Blue wire with white stripe to section switch #6
      - White wire with black stripe to section switch #7
      - White wire with brown stripe to section switch #8
      - White wire with blue stripe to section switch #9
      - Pink wire to section switch #10

   b. Connect the large round connector on the boom sense cable to the boom interface cable.

   To control section valves with an aftermarket Raven switch box:

   a. Connect the section valves to the 3-pin connectors on the appropriate boom control cable. Contact a local Raven dealer for assistance with selecting and purchasing the boom control cable.

   b. Connect the boom control cable to the Raven switch box cable.

   c. Route the red and white power leads to the high current and logic power bus bars.

Important: ***Do not*** *connect the power leads until all components are installed and properly connected to the Raven CAN network.*

   d. Connect the switch box cable to the boom interface cable.

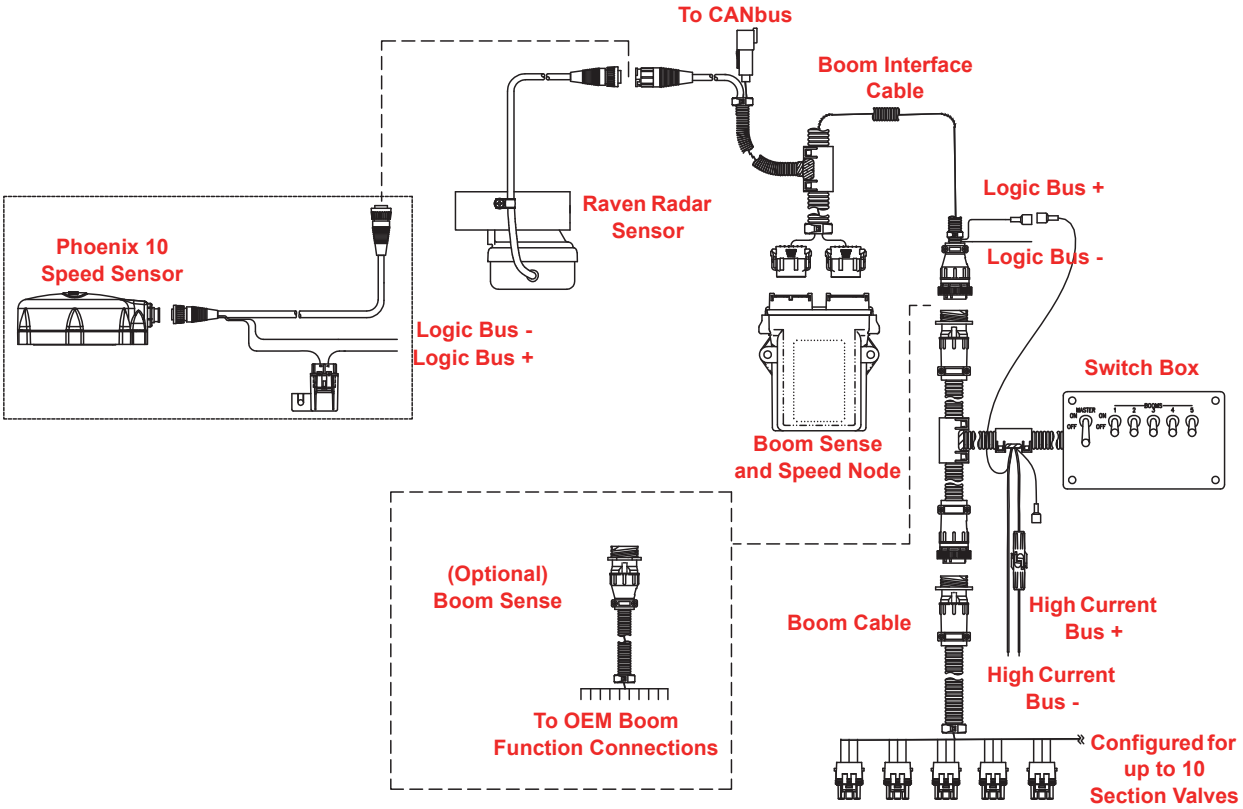
2. Connect the large, rectangular connectors to the boom sense and speed node. Insert the gray connector on the interface cable to the gray port on the node and the black connector to the black port.
3. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections.
4. Connect the round, 3-pin connector on the boom interface cable to the speed sensor. If necessary, a speed sensor extension cable may be used to connect the speed sensor to the boom interface cable.
5. The 4-pin Deutsch connector will connect to the CANbus communication line. Refer to the *CAN Communication Lines* section on page 28 for instructions on building a CAN ‘trunk’ line using the generation 1 cabling platform.

6. Route the red and white battery leads to a source of clean 12 VDC logic power.

Important: ***Do not*** *connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

Note: *The orange wire from the switch box cable may be connected to the red wire on the boom interface cable to provide power to the boom sense and speed node.*

FIGURE 2. **CAN Boom/Speed Node Example**



Product Node Modules

Raven product control nodes provide control channels for the field computer or controller to monitor and control application rates for a product. Refer to the following sections to connect the product node to control components.

Note: *Refer to Chapter 3, Install Components for Liquid Applications, or Chapter 4, Install Components for Granular Applications, for information on installing the necessary control hardware.*

Liquid Product Control Module

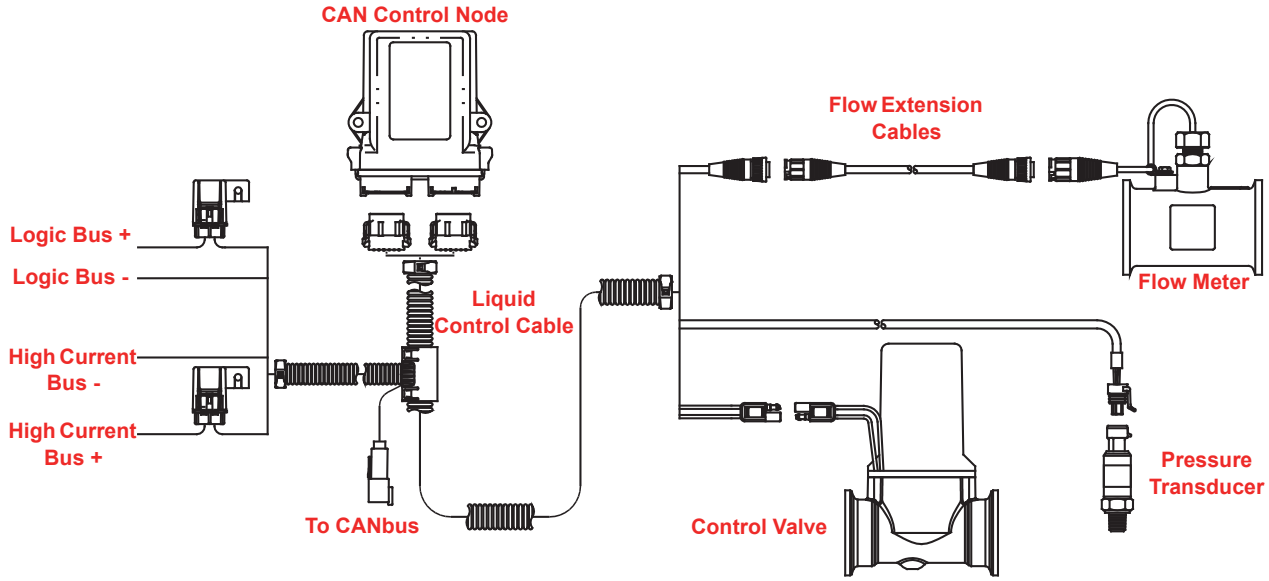
1. Connect the control valve to the 2-pin (yellow/green wires) connector on the control cable.

Note: *To properly operate the control valve in a by-pass system, a polarity reversal cable (P/N 115-0159-415) must be connected between the control cable and control valve.*

2. Connect the flow meter to the round 3-pin connector on the control cable. If necessary, a flow meter extension cable may be used to connect the flow meter to the control cable.
3. An optional pressure transducer may be connected to the remaining 3-pin connector to monitor pressure of a liquid product during application.
4. Connect the large, rectangular connectors to the product node. Insert the gray connector on the interface cable to the gray port on the node and the black connector to the black port.
5. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections.
6. The 4-pin Deutsch connector will connect to the CANbus communication line. Refer to the *CAN Communication Lines* section on page 28 for instructions on building a CAN 'trunk' line using the generation 1 cabling platform.
7. Route the red and white power leads to the high current and logic power bus bars.

Important: ***Do not*** *connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

FIGURE 3. **CAN Liquid Node Example**

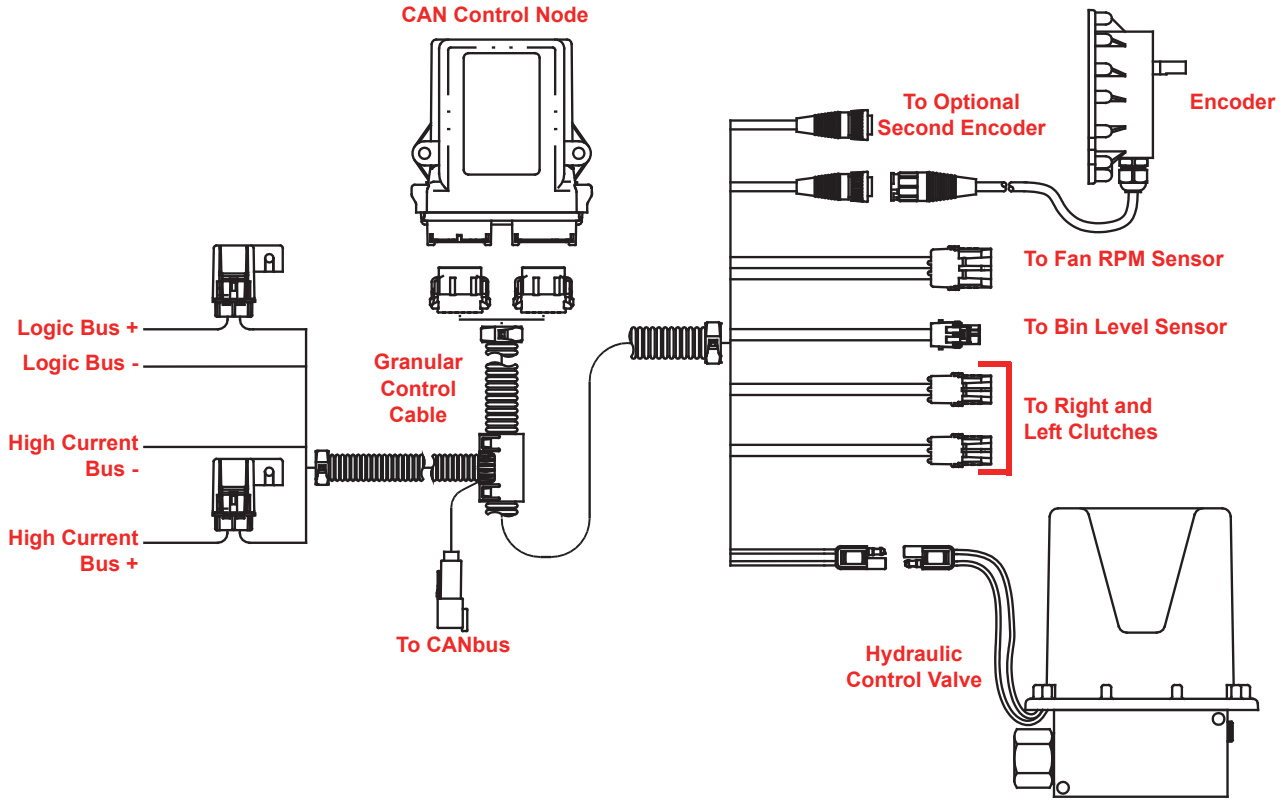


Granular Product Control Module

1. Connect the control valve to the 2-pin (yellow/green wires) connector on the control cable.
2. Connect the encoder(s) to the round, 3-pin connectors on the control cable. For single encoder systems, be sure to connect the encoder to the ‘Flow 1’ connector.
3. An optional fan RPM sensor may be connected to the 3-pin connector labeled ‘Fan RPM’ to monitor fan speed during a granular product application.
4. An optional bin level sensor my be connected to the 4-pin connector labeled ‘Bin Level Sensor’ to monitor for a low bin condition during a granular product application.
5. Connect the left and right clutches to the 2-pin clutch connectors.
6. Connect the large, rectangular connectors to the product node. Insert the gray connector on the interface cable to the gray port on the node and the black connector to the black port.
7. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections.
8. The 4-pin Deutsch connector will connect to the CANbus communication line. Refer to *CAN Communication Lines* section on page 28 for instructions on building a CAN ‘trunk’ line.
9. Route the red and white power leads to the high current and logic power bus bars.

Important: ***Do not*** *connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

FIGURE 4. CAN Granular Node Example



Granular Dual Channel Node with Spinner Speed Control Module

The dual product node provides two control channels to monitor and control both an application rate and the speed of a spinner or fan. Refer to the following procedures to connect a dual product node to control spinner speed and product application.

Product Channel 1 (Granular) Control Cable

To connect the product 1 or granular product control cable to the dual product node:

1. Connect the control valve to either the 'Valve' or the 'PWM Valve' connector on the control cable. For standard or fast type control valves, connect the valve to the 2-pin (yellow/green wires) connector labeled 'Valve.' For PWM hydraulic type valves, connect the valve to the 2-pin 'PWM Valve' connector.

Note: *Only one control valve should be connected to the product 1 or granular control cable. Connecting more than one control valve to this control cable may cause inaccurate system operation.*

2. Connect the encoder(s) to the round, 3-pin connectors on the control cable. For single encoder systems, be sure to connect the encoder to the 'Flow 1' connector.
3. An optional encoder or RPM sensor may be connected to the 3-pin connector labeled 'Fan RPM' to monitor fan speed during a granular product application. When controlling spinner speed via the control system, this connection should only be used to monitor a second or optional encoder or RPM sensor. Do not connect the spinner RPM sensor to this connector.
4. An optional bin level sensor my be connected to the 4-pin connector labeled 'Bin Level Sensor' to monitor for a low bin condition during a granular product application.
5. Connect the left and right clutches to the 2-pin clutch connectors.
6. Insert the large, rectangular connector to the product node. Connect the product 1 control cable to the left node port (refer to Figure 5 on page 27).

Note: *Do not force the connector into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

7. Tighten the 1/4" bolt to secure the node connector to the node.
8. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections.
9. The 4-pin Deutsch connector will connect to the CANbus communication line. Refer to the *CAN Communication Lines* section on page 28 for instructions on building a CAN 'trunk' line.
10. Route the red and white power leads to the high current and logic power bus bars.

Important: ***Do not*** *connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

Product Channel 2 (Spinner) Control Cable

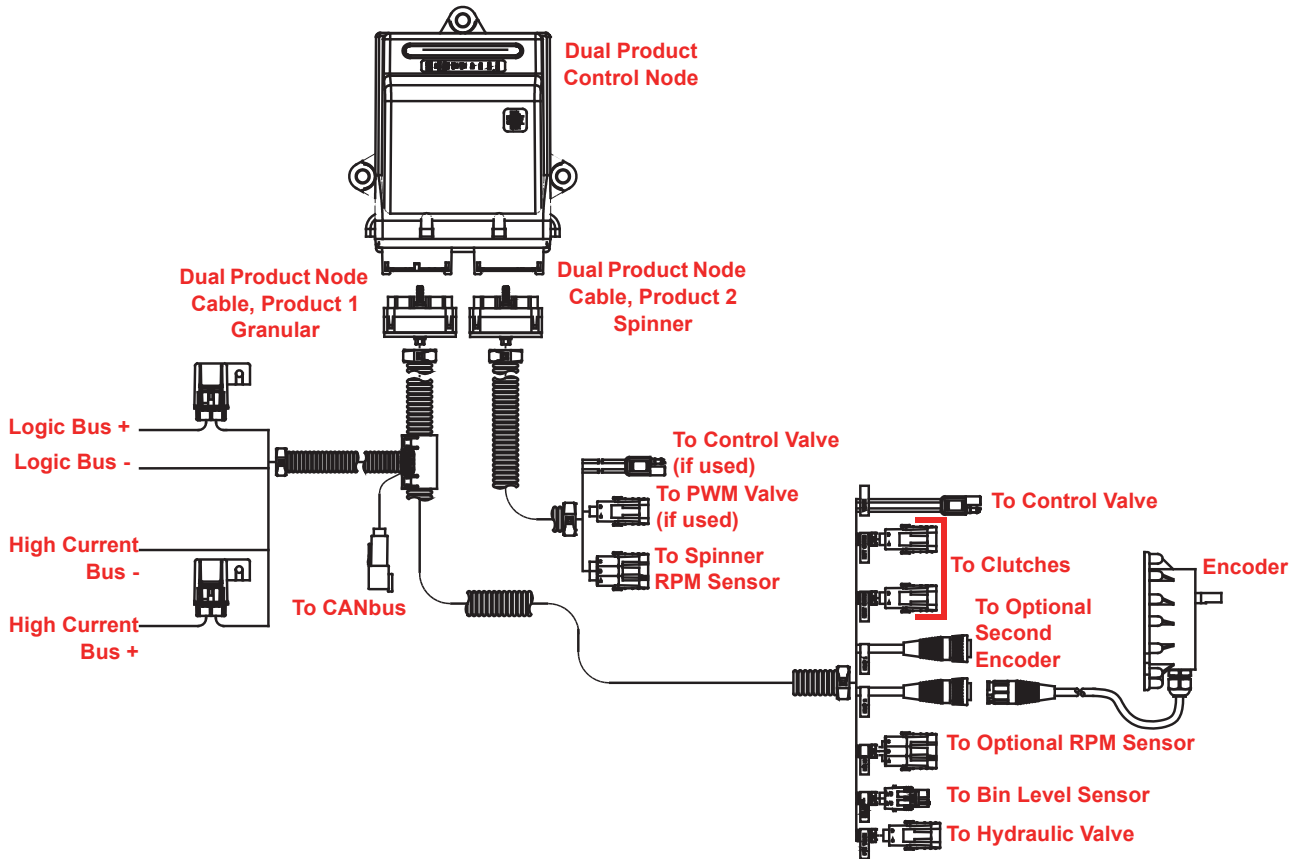
To connect the product 2 or spinner speed control cable to the dual product node:

1. Connect the control valve used to control the fan or spinner speed to the appropriate valve connector on the spinner speed control cable. Connect standard or fast type control valves to the 2-pin (yellow/green wires) “trailer” type connector. Connect hydraulic or PWM type valves to the 2-pin Weather Pack “shroud” type connector.
2. Connect the fan speed sensor to the 3-pin Weather Pack “shroud” type connector. The spinner RPM sensor **must** be connected to this cable connector to control the spinner RPM during field operations.
3. Insert the large, rectangular connector to the product node. Connect the product 2 spinner speed control cable to the right node port (refer to Figure 5 on page 27).

Note: *Do not force the connector into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

4. Tighten the 1/4” bolt to secure the node connector to the node.

FIGURE 5. **CAN Granular Dual Product Node with Spinner Speed Example**



CAN Communication Lines

The CAN communication trunk line connects the various CAN node modules to the CANbus network and provides information to the control console or field computer. Refer to the following procedures to build a Raven CANbus network on a machine.

CAN Power Adapter and Tee Cables

A CAN power adapter tee cable (P/N 115-0171-368) must be installed with generation 1 cabling to provide a shield for CAN communication signals.

Note: *The CAN power tee kit (P/N 117-0159-923) is available and includes a CAN adapter tee with power cable and two CAN passive terminators. Refer to Figure 6, "CANbus Communication Trunk Line," below.*
Some optional console or control cabling may feature a CAN power adapter tee with power cable built into the optional harness. A separate CAN adapter tee with power cable should not be installed with these optional cables. Contact a local Raven dealer for assistance with optional cabling configurations and requirements.

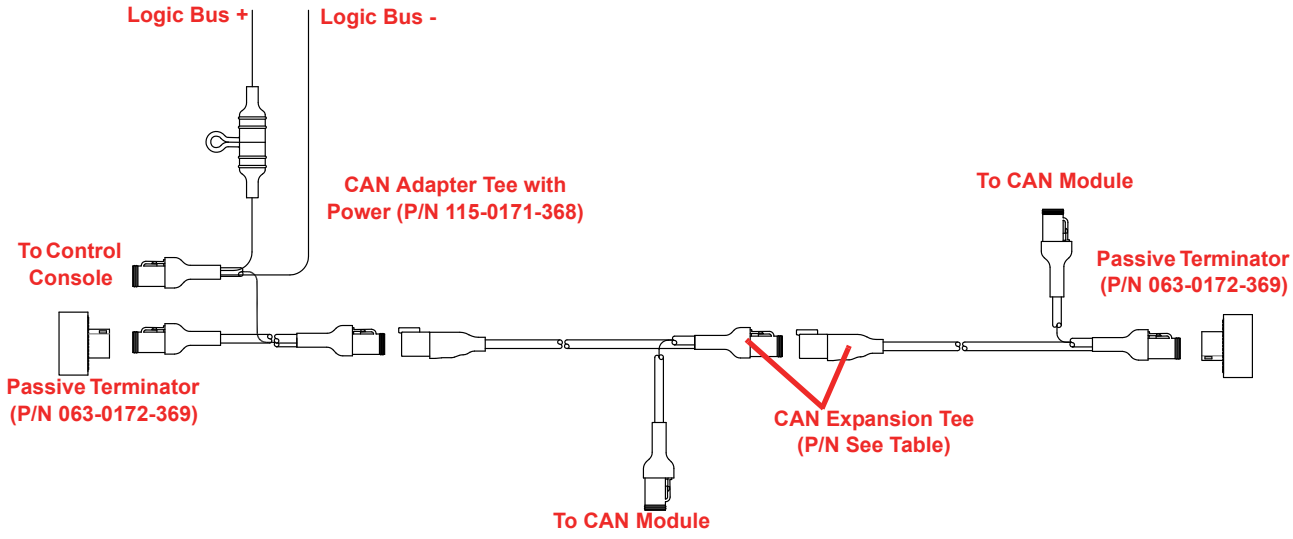
1. Connect the power adapter tee cable to the 4-pin Deutsch connector on the console or interface cable.
2. Connect a CAN passive terminator (P/N 063-0172-369) to the power adapter tee cable.
3. Route the red and white power leads to the high current and logic power bus bars.

Important: ***Do not*** *connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

4. Connect one of the following tee expansion cables to the remaining 4-pin connector.

Part Description	Part Number
Tee Extension Cable - 6 in. [15 cm]	115-0171-364
Tee Extension Cable - 6 ft. [1.8 m]	115-0171-326
Tee Extension Cable - 12 ft. [3.6 m]	115-0171-362
Tee Extension Cable - 18 ft. [5.4 m]	115-0171-690
Tee Extension Cable - 24 ft. [7.3 m]	115-0171-363

FIGURE 6. **CANbus Communication Trunk Line**



5. Connect the expansion tee cable to one of the CAN modules (e.g. the boom sense and speed module) installed on the machine.
6. Install the passive terminator on the remaining connector to terminate the CAN communication line.

Adding CAN Modules to the Generation 1 Cable Platform

To provide application rate control via a Raven CANbus network, a boom/speed and product module must be detected on the CANbus network. If the display console is capable of controlling the rate of multiple products during field applications, additional product modules may be added to the CANbus network to add application rate control channels. Refer to the specific display manual or contact a local Raven dealer for information on the number of control channels compatible with the console.

The display console may also be capable of interfacing with optional systems via the CANbus network. For example, a Raven AutoBoom™ system may be used to automatically adjust boom height in the field or a Raven SmarTrax™ system may be used to automate swath steering during field applications. Contact a local Raven dealer for more information about these and other Raven systems available to enhance field application or data management on various Raven control consoles or field computers.

Note: *Some consoles offer functionality for the boom sense, speed or product control node hard wired into the console. Review the control console manual or contact a local Raven dealer to determine the components required for a specific control console.*

Raven field computers may be connected to a serial control console (e.g. SCS 440 or 460) without requiring a boom/speed or product node. An AccuBoom, AutoBoom and/or SmarTrax node may still be connected to the field computer. In this configuration, the field computer will monitor rate information from the serial control console.

To add modules to the CANbus network:

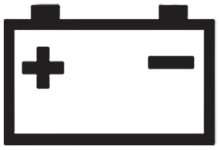
1. Remove the CAN passive terminator (P/N 063-0172-369) from the end of the CANbus.
2. Install one of the following tee expansion cables to the connector from which the passive terminator was removed:

Part Description	Part Number
Tee Extension Cable - 6 in. [15 cm]	115-0171-364
Tee Extension Cable - 6 ft. [1.8 m]	115-0171-326
Tee Extension Cable - 12 ft. [3.6 m]	115-0171-362
Tee Extension Cable - 18 ft. [5.4 m]	115-0171-690
Tee Extension Cable - 24 ft. [7.3 m]	115-0171-363

3. Connect the tee expansion cable to the CAN module to add to the CAN network.
4. Replace the passive terminator to the remaining Deutsch connector at the end of the CAN communication line.

Power Connections

After all components are properly mounted and all cabling and connections are complete, the CANbus network and control console may be connected to power.



CAUTION

Review the *Best Installation Practices* section on page 20 before connecting the power leads to vehicle power.

1. Make sure the vehicle accessory power (key) is off before routing the red and white power wires to a 12-volt power source.
2. Attach the white power lead wire to the negative (-) power bus terminal.

Important: ***Do not*** *use chassis ground connections.*

3. Connect the red battery wire directly to the positive (+) power bus terminal.

Important: ***Do not*** *connect the red and white leads to the vehicle starter.*

4. Secure the power leads with plastic cable ties but do not tie the lead wires close to any existing electrical wiring or power cabling.
5. Power up the control console and review the control console or field computer manual for information on completing any initial calibration procedures. Verify that all connected nodes or modules are detected by the console.

CHAPTER 6

Generation 2 Cable Connections

The following sections illustrate connecting a product control system using the generation 2 cabling platform. This platform is well suited for use on tractors and interfacing with a towed implement such as a sprayer, spreader or planter. This cabling platform offers reduced cabin clutter and streamlined installation procedures and robust CANbus and power connections for any full featured system.

Note: *Raven recommends utilizing the generation 2 cable platform with any OmniRow planter population and section control system to simplify connection of the control system with row control hardware mounted on a planter implement. Contact a local Raven dealer for more information on the OmniRow system.*

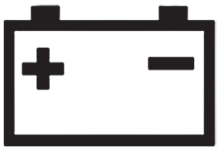
The same flow cables used with many existing Raven SCS control systems may be used with the generation 2 cabling platform. This cross functionality means that many existing control systems with a Raven SCS control console (e.g. SCS 440, 660 or 4400) may be upgraded to the latest CANbus controller while reusing the existing flow cables. Contact a local Raven dealer for more information or assistance with upgrading an existing serial control system.

Refer to the following sections for details on:

- Connecting product control hardware to CAN nodes to create modules.
- Connecting modules to the CANbus to create a network.
- Connecting the Raven display to the network.
- Connecting the network to a source of clean, controlled logic power.

Best Installation Practices

Wiring power to the control console and CANbus nodes is especially important for proper operation of the product control system. Many issues related to CAN systems can be traced to improper wiring of power and ground leads. Review the following items and refer to the *Power Connections* section on page 47 to properly connect the CAN system.



CAUTION

Reversing the power leads may cause damage to the display. Review the *Electrical Safety* section on page 2 and read all instructions for connecting the power leads prior to connecting the display to power.

Raven recommends connecting the control console to power only after all components have been properly mounted and installed.

The information below illustrates proper methods for wiring a CANbus system using either the generation 1 or generation 2 cable platforms.

1. Always use sealed connectors with dielectric grease. Unsealed, crimped connections (i.e. butt connectors) should be avoided.
2. In addition to using dielectric grease, mount all CAN terminators and nodes with the connector(s) pointing down to avoid collecting water and/or chemicals. Liquids collecting within the terminator can corrode pins and may cause CAN issues.
3. Use dedicated bus bars to connect the control console and all nodes to the same source for both power and ground.

Note: *Connecting the GPS receiver (logic power) to the CANbus bars allow engine shutdown without losing GPS.*

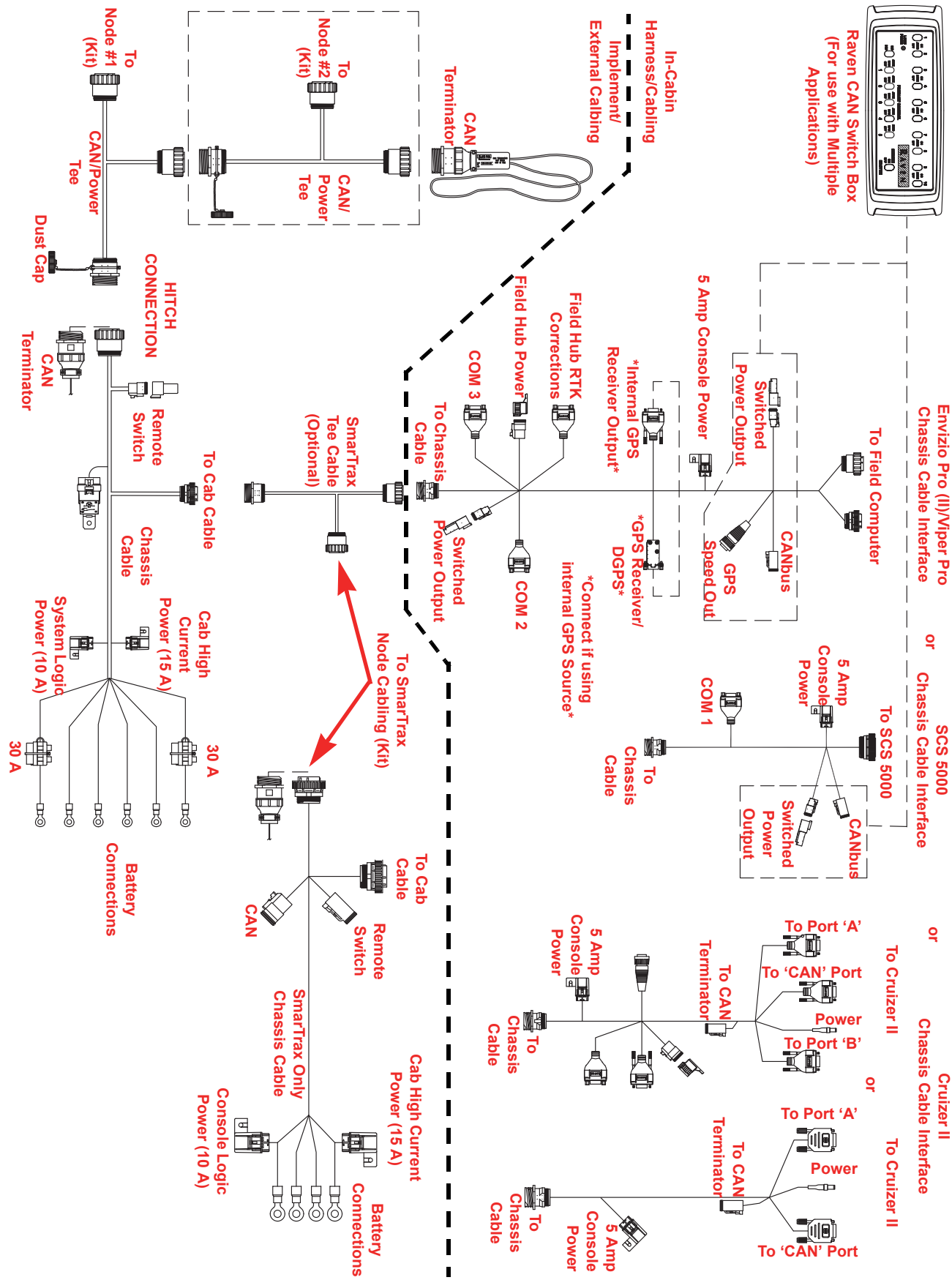
4. Connect the power directly to a clean, controlled logic power source. Do not connect to any source of power that will receive distortion or noise from other equipment, such as pumps, valves or radios, installed on the vehicle or machine.
5. Connect the ground leads directly to the vehicle battery or negative power bus. **Do not** use chassis ground connections.

Note: *A logic power relay is not required for installations using generation 2 cabling. This cable platform provides a logic power relay to avoid draining the vehicle battery.*

6. Provide two CAN terminators for optimal signal integrity through the CANbus. Terminators should be installed at each end of the CANbus. CAN power, obtained from a switched power source, runs throughout the bus to act as a shield.

Following these recommendations will result in the most robust system possible while greatly reducing CAN communication problems.

FIGURE 1. **Generation 2 Cable Connection Diagram**



Install the Chassis Cable

Note: *Chassis cables are designed to fit a specific machine make and/or model. Contact a local Raven dealer for purchasing or more information on the generation 2 cable platform.*

1. Mount the large, 16-pin round hitch connector at the back of the vehicle or tractor hitch and secure using cable ties as necessary.

   Ensure that the hitch connector is clear of any moving components and will not be damaged during normal equipment operation. The hitch connector should not drag on the ground at any time whether connected to an implement cable or terminated.

Note: *Insert a CAN terminator (P/N 063-0173-224) into the hitch connector when an implement or CAN cabling is not connected to the hitch.*

2. Route the red and white battery leads to a source of clean 12 VDC logic power.

Important: ***Do not** connect the battery leads until all components are installed and properly connected to the Raven CAN network.*

3. Route the round connector labeled 'To Cab Cable' toward the vehicle cabin and secure using cable ties as necessary. This connector will connect to the chassis interface cable in the vehicle cabin. Contact a local Raven dealer for available console or field computer cable options.

Display Cable, Raven CAN Switch Box and Speed Sensor

Note: *Disregard this procedure for Cruizer II installations.*
The CAN Switch Box and switch box mounting bracket should be mounted to the Raven display prior to beginning the following procedure. Refer to the CAN Switch Box Installation and Operation Guide for detailed instructions.

1. Refer to the Raven display installation instructions for mounting and cabin cabling information for the specific Raven control console or field computer.
2. Connect the display cable to the Raven display.
3. Connect the 2-pin Deutsch connector labeled 'Switched Power Output' to the back of the CAN Switch Box.
4. Connect the 4-pin Deutsch connector labeled 'CANbus' to the back of the CAN Switch Box.
5. To use a built-in GPS receiver to provide a simulated radar speed signal, connect the 3-pin round connector labeled 'GPS Speed Out' to the back of the CAN Switch Box.

   If an external speed sensor (e.g. Raven Phoenix 200/300 receiver, Raven Radar, a third party speed sensor, etc.) will provide speed signal, use the appropriate speed adapter cable to connect the speed sensor to the 3-pin round connector on the back of the CAN Switch Box. Contact a local Raven dealer for available adapter cables and more information.
6. Route the connector labeled 'To Chassis or SmarTrax Tee Cable' out of the vehicle cabin.
7. Connect the display cable to the connector labeled 'To Cab Cable' on the chassis cable and secure using the coupling ring. See Figure 1 on page 33 for available display cables.

Note: *A SmarTrax tee cable must be installed between the chassis and display cable to connect the Raven SmarTrax automated steering system to the CANbus network. An optional cabin extension cable may be installed between the cabin cable and chassis cable if necessary to provide additional length for cabin connections.*

Boom Sense and Speed Node Module

The boom sense and speed node provides boom status and speed information to the Raven CANbus for product control operations. The CAN Switch Box features an internal boom sense and speed node and eliminates the need for a separate boom sense or speed module. Review the *Display Cable, Raven CAN Switch Box and Speed Sensor* section on page 34 to connect the CAN Switch Box to the CANbus network.

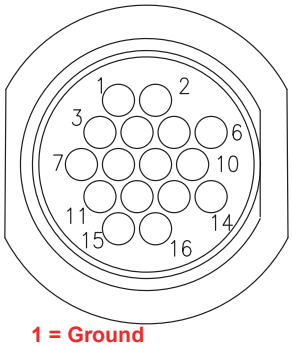
Product Node Modules

Raven product control nodes provide control channels for the field computer or controller to monitor and control application rates for a product. Refer to the following sections to connect the product node to control components.

Note: *Refer to Chapter 3, Install Components for Liquid Applications, or Chapter 4, Install Components for Granular Applications, for information on installing the necessary control hardware.*

The following procedures are provided as an example of building a CANbus network with the generation 2 cable platform. Contact a local Raven dealer for additional assistance or information on optional components used with the generation 2 cable platform.

SCS 440/450 Cabling (16-Pin) Liquid Product Control Modules



Note: *Contact a local Raven dealer for assistance with available cables and cable lengths or for purchasing information. 16-pin flow cables may be identified by looking at the large, round connector on the product controller cable (see the figure to the right).*

1. Connect the control valve to the 2-pin (yellow/green wires) connector on the flow cable.

Note: *To properly operate the control valve in a by-pass system, a polarity reversal cable (P/N 115-0159-415) must be connected between the control cable and control valve.*

2. Connect the flow meter to the round 3-pin connector (female pins) on the flow cable. If necessary, a flow meter extension cable may be used to connect the flow meter to the control cable.
3. Connect the ‘Boom’ connectors on the flow cable to the section valves. Sections valves are typically numbered from left to right, however some equipment configurations may require the section valves to be connected in a different order.
4. Connect the flow cable to the product controller cable. If necessary, a flow extension cable may be installed between the flow cable and product controller cable.
5. Route the large, rectangular connectors to the product controller node and insert into the node ports.

Note: *Do not force the connectors into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

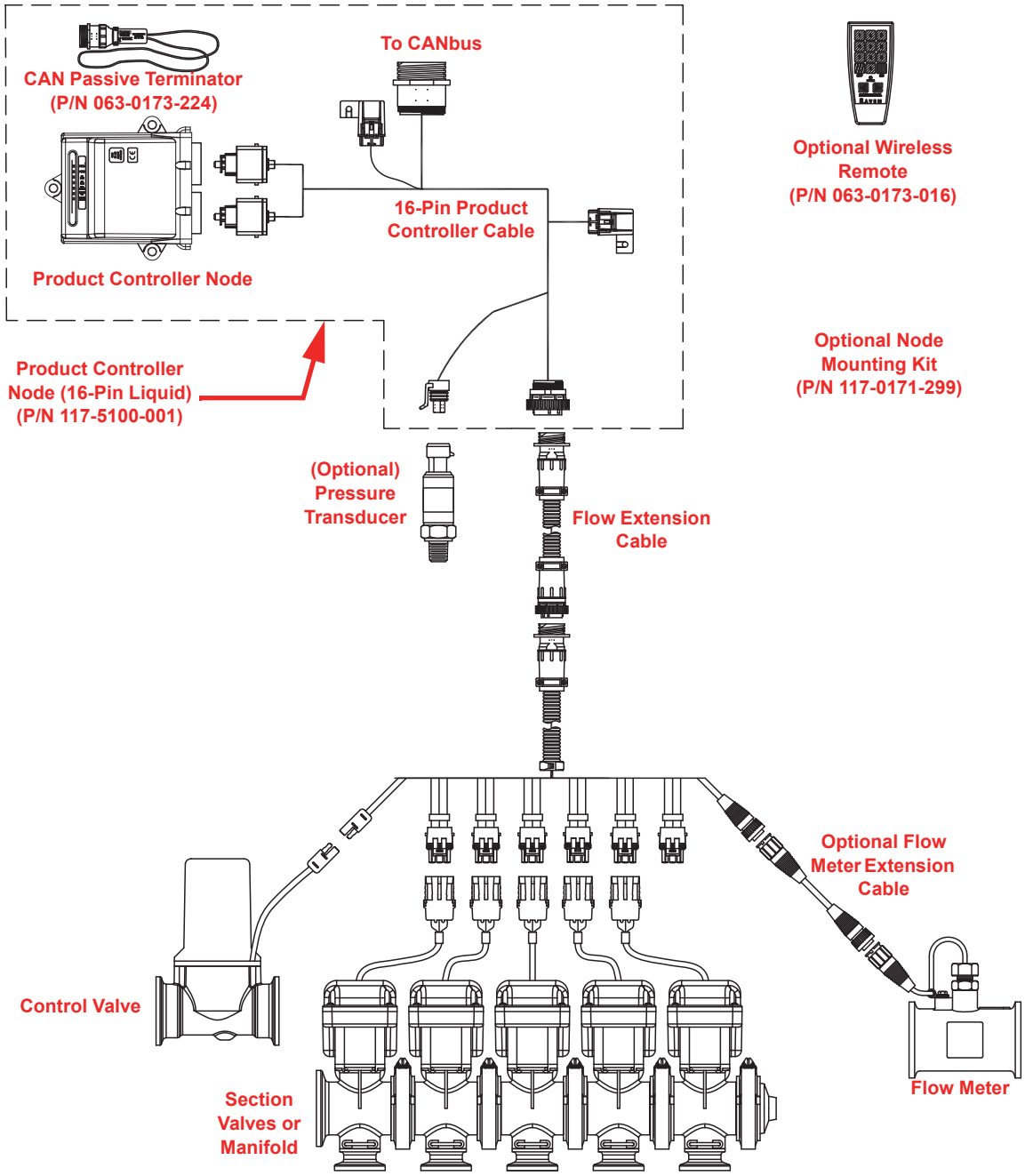
6. Tighten the 1/4” bolt to secure the node connectors to the node.

7. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections. The node should be held in place securely and should not move excessively during normal equipment operation.

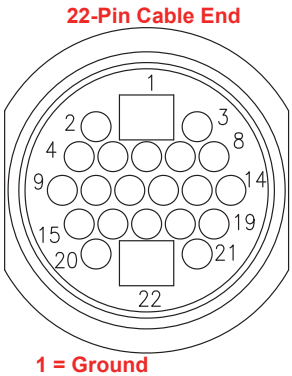
Note: *An optional node mounting kit (P/N 117-0171-299) may be used to create a secure mounting position for the product controller node.*

8. An optional pressure transducer may be connected to the 3-pin connector on the product controller cable to monitor pressure of a liquid product during application.
9. The remaining 16-pin connector will be connected to the CAN tee cables to connect the product controller module to the CANbus network. Refer to the *CAN Communication Lines* section on page 45 for more information on connecting CAN modules to the CANbus network.

FIGURE 2. **16-Pin Liquid Product Control Module Example**



SCS 460/660 Cabling (22-Pin) Liquid Product Control Modules



Note: *Contact a local Raven dealer for assistance with available cables and cable lengths or for purchasing information. 22-pin flow cables may be identified by looking at the large, round connector (see the figure to the right).*

1. Connect the control valve to the 2-pin (yellow/green wires) connector on the flow cable.

Note: *To properly operate the control valve in a by-pass system, a polarity reversal cable (P/N 115-0159-415) must be connected between the control cable and control valve.*

2. Connect the flow meter to the round, 3-pin connector (female pins) on the flow cable. If necessary, a flow meter extension cable may be used to connect the flow meter to the control cable.
3. Connect the ‘Boom’ connectors on the flow cable to the section valves. Sections valves are typically numbered from left to right, however some equipment configurations may require the section valves to be connected in a different order.
4. Connect the flow cable to the 37-pin to 22-pin adapter cable. If necessary, a flow extension cable may be installed between the flow cable and adapter cable.

Note: *A 37-pin extension cable may be used between the adapter cable and the product controller cable if preferred for cable routing.*

5. An optional pressure transducer may be connected to the 3-pin round connector on the adapter cable to monitor pressure of a liquid product during application.
6. Connect the adapter cable to the product controller cable.
7. Route the large, rectangular connectors to the product controller node and insert into the node ports.

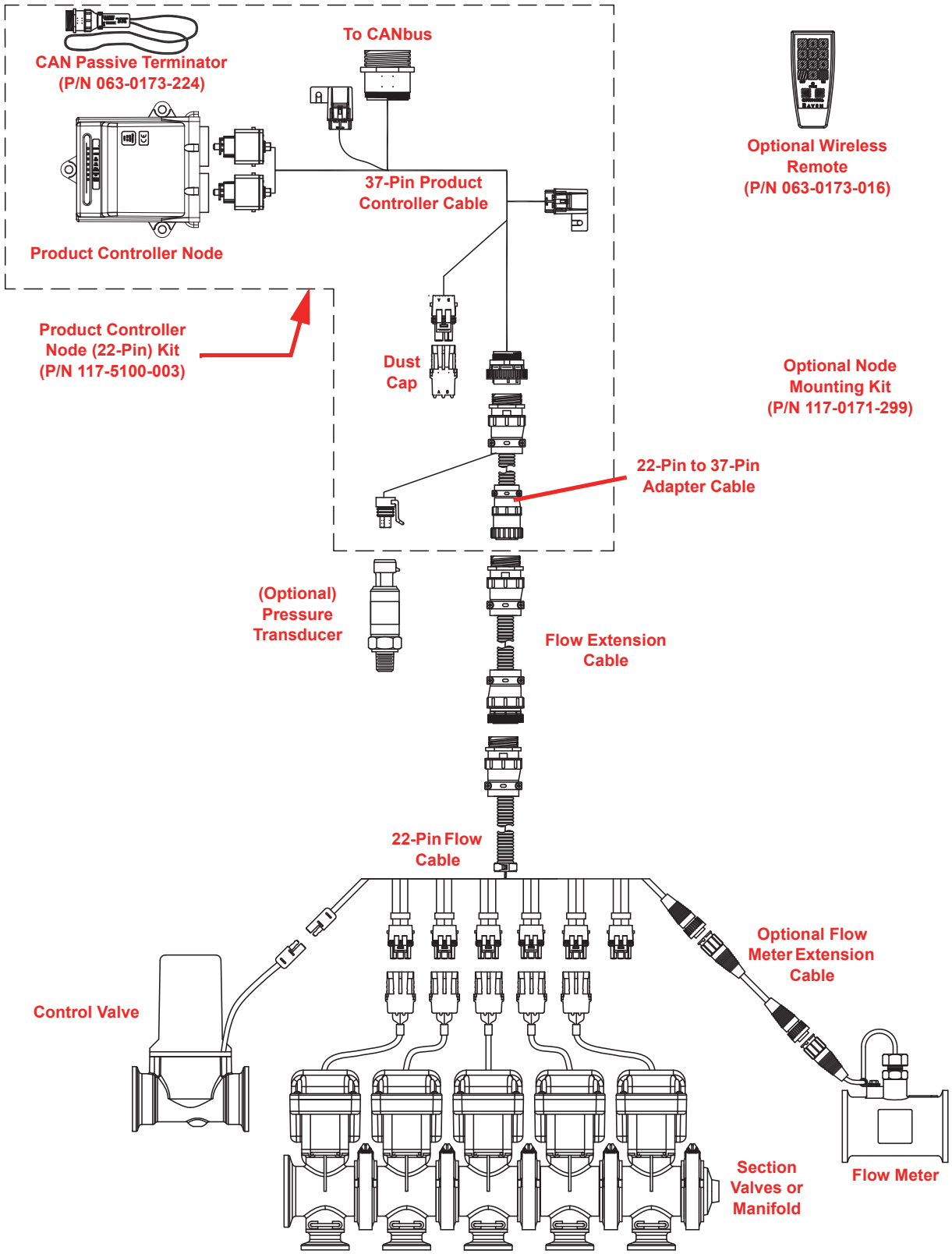
Note: *Do not force the connectors into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

8. Tighten the 1/4” bolt to secure the node connectors to the node.
9. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections. The node should be held in place securely and should not move excessively during normal equipment operation.

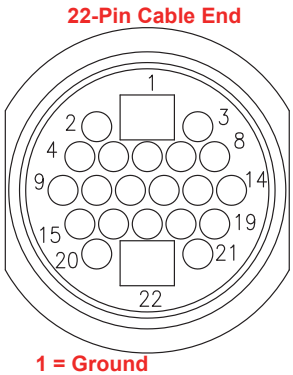
Note: *An optional node mounting kit (P/N 117-0171-299) may be used to create a secure mounting position for the product controller node.*

10. An optional pressure transducer may be connected to the 3-pin connector on the product controller cable.
11. The remaining 16-pin connector will be connected to the CAN tee cables to connect the product controller module to the CANbus network. Refer to the *CAN Communication Lines* section on page 45 for more information on connecting CAN modules to the CANbus network.

FIGURE 3. **22-Pin Liquid Product Control Module Example**



SCS 460/660 Cabling (22 -Pin) Granular Product Control Modules with Optional Spinner Speed Control



Note: *Contact a local Raven dealer for assistance with available cables and cable lengths or for purchasing information. 22-pin flow cables may be identified by looking at the large, round connector (see the figure to the right).*

1. Connect the hydraulic control valve to the 2-pin (yellow/green wires) connector on the flow cable.
2. Connect the encoder(s) to the round, 3-pin connector on the flow cable. If necessary, a flow extension cable may be used to connect the encoder(s) to the control cable. For single encoder systems, be sure to connect the encoder to the ‘Flow 1’ connector.

Note: *22-pin flow cables only support a single encoder.*

3. An optional fan RPM sensor may be connected to the 3-pin connector labeled ‘Fan RPM’ to monitor fan speed during a granular product application.
4. An optional bin level sensor my be connected to the 4-pin connector labeled ‘Bin Level Sensor’ to monitor for a low bin condition during a granular product application.
5. Connect the left and right clutches to the 2-pin ‘Clutch’ connectors.
6. Connect the left and right shaft sensors to the 2-pin ‘Shaft Sensor’ connectors.
7. Connect the flow cable to the 37-pin to 22-pin adapter cable. If necessary, a flow extension cable may be installed between the flow cable and adapter cable.

Note: *A 37-pin extension cable may be used between the adapter cable and the product controller cable if preferred for cable routing.*

8. Connect the adapter cable to the product controller cable.
9. Route the large, rectangular connectors to the product controller node and insert into the node ports.

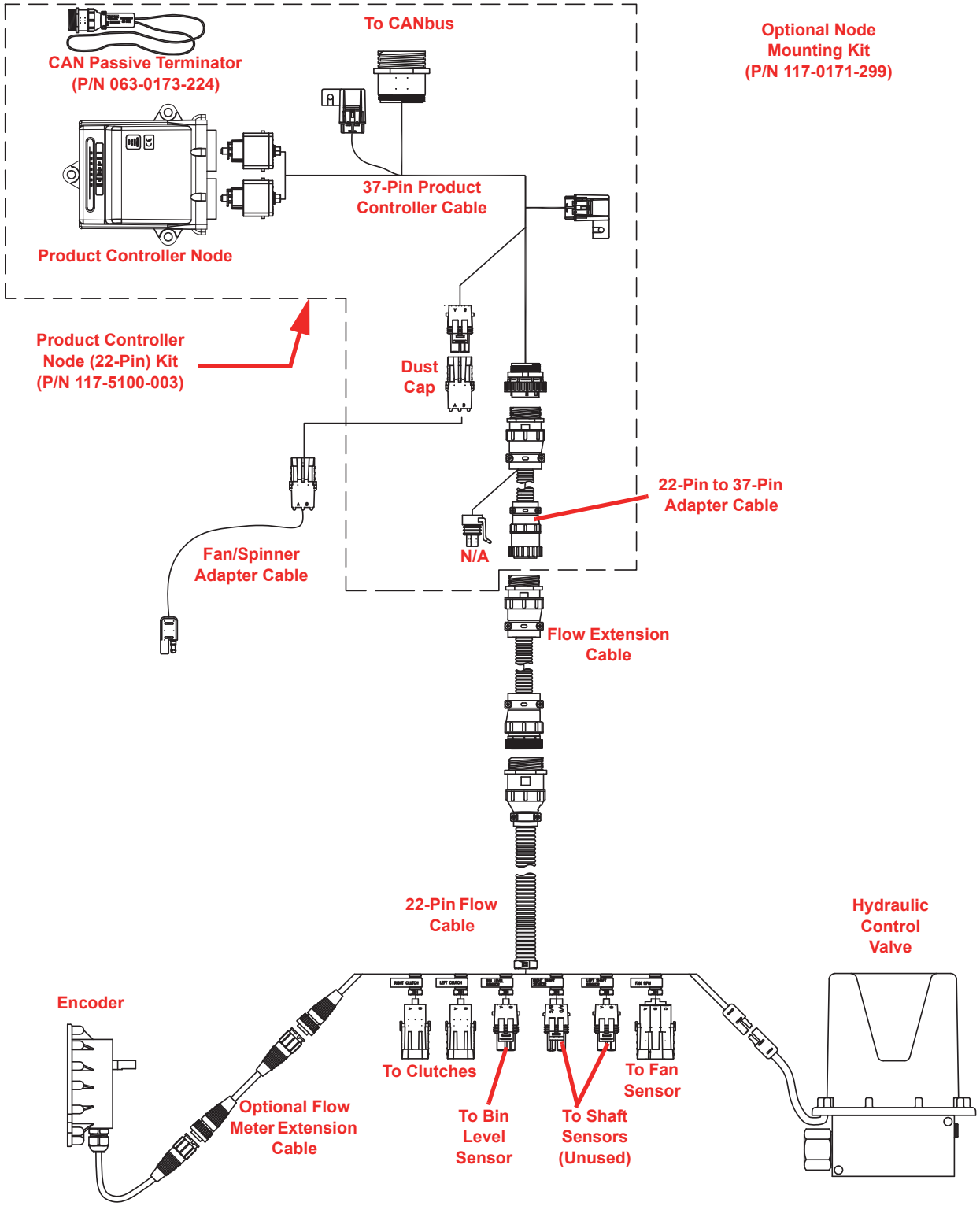
Note: *Do not force the connectors into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

10. Tighten the 1/4” bolt to secure the node connectors to the node.
11. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections. The node should be held in place securely and should not move excessively during normal equipment operation.

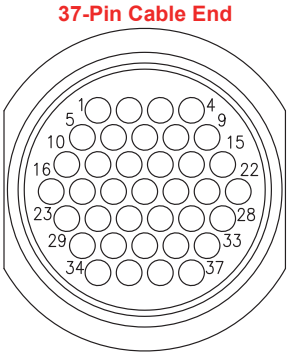
Note: *An optional node mounting kit (P/N 117-0171-299) may be used to create a secure mounting position for the product controller node.*

12. To control the speed of a spinner or fan during granular applications, locate the 2-pin connector with the dust cap on the product controller cable.
13. Remove the dust cap and connect the optional adapter cable (P/N 115-0171-880).
14. Route the adapter cable to the valve controlling the fan or spinner speed and connect the adapter cable.
15. The remaining round 16-pin connector will be connected to the CAN tee cables to connect the product controller module to the CANbus network. Refer to the *CAN Communication Lines* section on page 45 for more information on connecting CAN modules to the CANbus network.

FIGURE 4. **22-Pin Granular Product Control Module with Optional Spinner Speed Control Example**



SCS 4400/4600 Cabling (37-Pin) Liquid Product Control Modules



1 & 2 = Ground
3 = Switched Power
36 & 37 = Live Power

Note: *Contact a local Raven dealer for assistance with available cables and cable lengths or for purchasing information. 37-pin flow cables may be identified by looking at the large, round connector (see the figure to the right).*

1. Connect the control valve to the 2-pin (yellow/green wires) connector on the flow cable.

Note: *To properly operate the control valve in a by-pass system, a polarity reversal cable (P/N 115-0159-415) must be connected between the control cable and control valve.*

2. Connect the flow meter to the round, 3-pin connector (female pins) on the flow cable. If necessary, a flow meter extension cable may be used to connect the flow meter to the control cable.
3. An optional pressure transducer may be connected to the remaining 3-pin round connector (male pins) on the product controller cable to monitor pressure of a liquid product during application. Contact a local Raven dealer for available cables and lengths or purchasing information.
4. Connect the ‘Boom’ connectors on the flow cable to the section valves. Sections valves are typically numbered from left to right, however some equipment configurations may require the section valves to be connected in a different order.
5. Connect the flow cable to the product controller cable. If necessary, a flow extension cable may be installed between the flow cable and product controller cable.
6. Route the large, rectangular connectors to the product controller node and insert into the node ports.

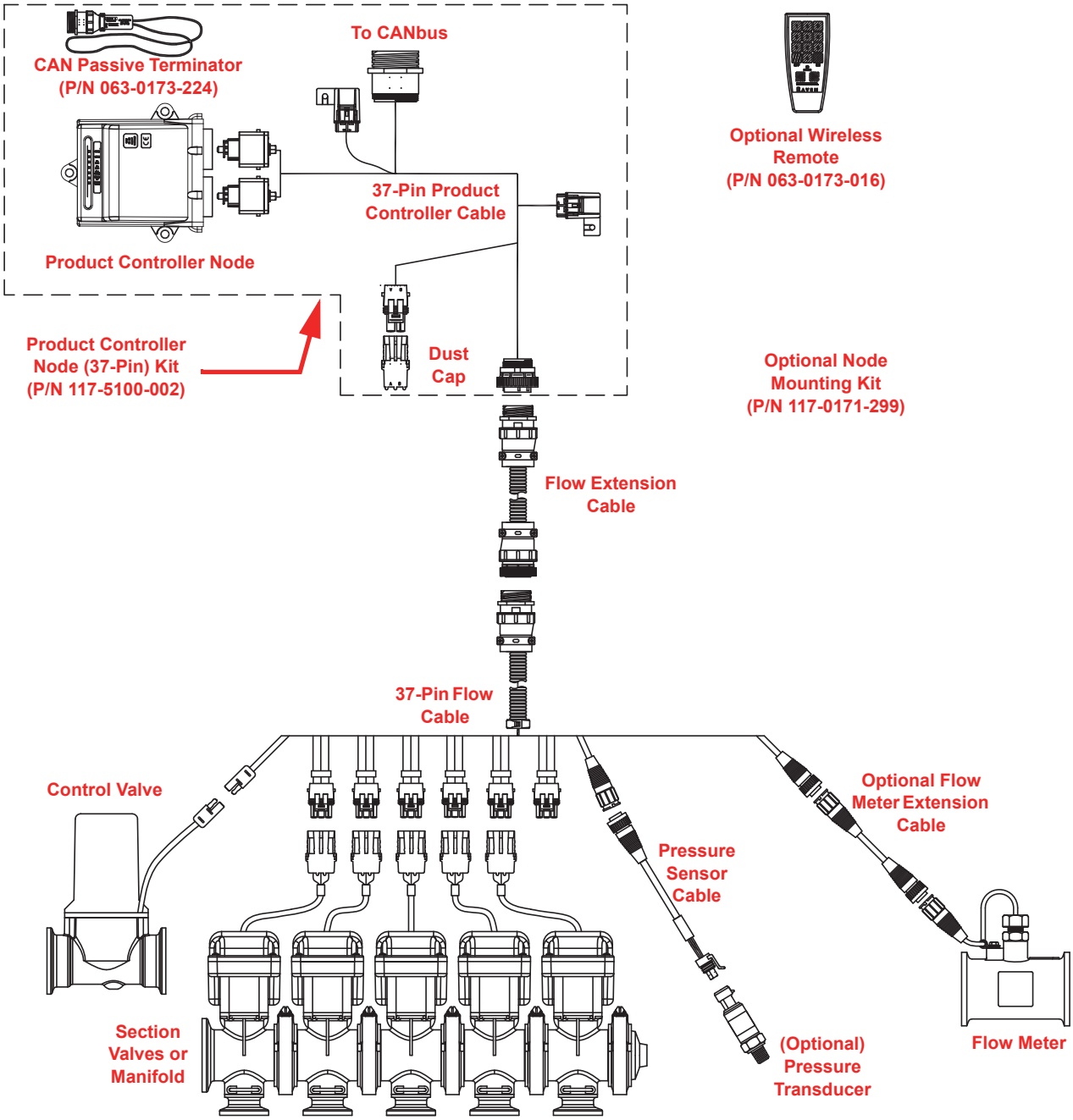
Note: *Do not force the connectors into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

7. Tighten the 1/4” bolt to secure the node connectors to the node.
8. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections. The node should be held in place securely and should not move excessively during normal equipment operation.

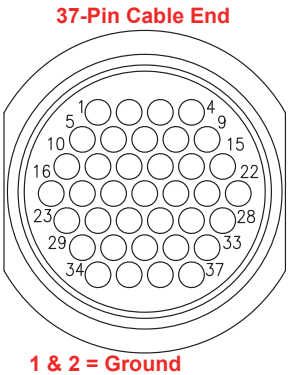
Note: *An optional node mounting kit (P/N 117-0171-299) may be used to create a secure mounting position for the product controller node.*

9. An optional pressure transducer may be connected to the 3-pin connector on the product controller cable.
10. The remaining 16-pin connector will be connected to the CAN tee cables to connect the product controller module to the CANbus network. Refer to the for more information on connecting CAN modules to the CANbus network.

FIGURE 5. **37-Pin Liquid Product Control Module Example**



SCS 4400/4600 Cabling (37-Pin) Granular Product Control Modules with Optional Spinner Speed Control



Note: *Contact a local Raven dealer for assistance with available cables and cable lengths or for purchasing information. 37-pin flow cables may be identified by looking at the large, round connector (see the figure to the right).*

1. Connect the hydraulic control valve to the 2-pin (yellow/green wires) connector on the flow cable.
2. Connect the encoder(s) to the round, 3-pin connector on the flow cable. If necessary, a flow extension cable may be used to connect the encoder(s) to the control cable.

Note: *For single encoder systems, be sure to connect the encoder to the 'Flow 1' connector.*

3. An optional fan RPM sensor may be connected to the 3-pin connector labeled 'Fan RPM' to monitor fan speed during a granular product application.
4. An optional bin level sensor my be connected to the 4-pin connector labeled 'Bin Level Sensor' to monitor for a low bin condition during a granular product application.
5. Connect the clutches or section valves to the 2-pin 'Boom' connectors.

   Systems with the 37-pin flow cables may control up to 5 clutches or boom valves. Typically, sections or clutches will be controlled in a left to right configuration with the 'Boom 1' connector controlling the furthest left section. Contact a local Raven dealer for more information or additional assistance with these configurations.
6. Connect the flow cable to the product controller cable. If necessary, a flow extension cable may be installed between the flow cable and product controller cable.
7. Route the large, rectangular connectors to the product controller node and insert into the node ports.

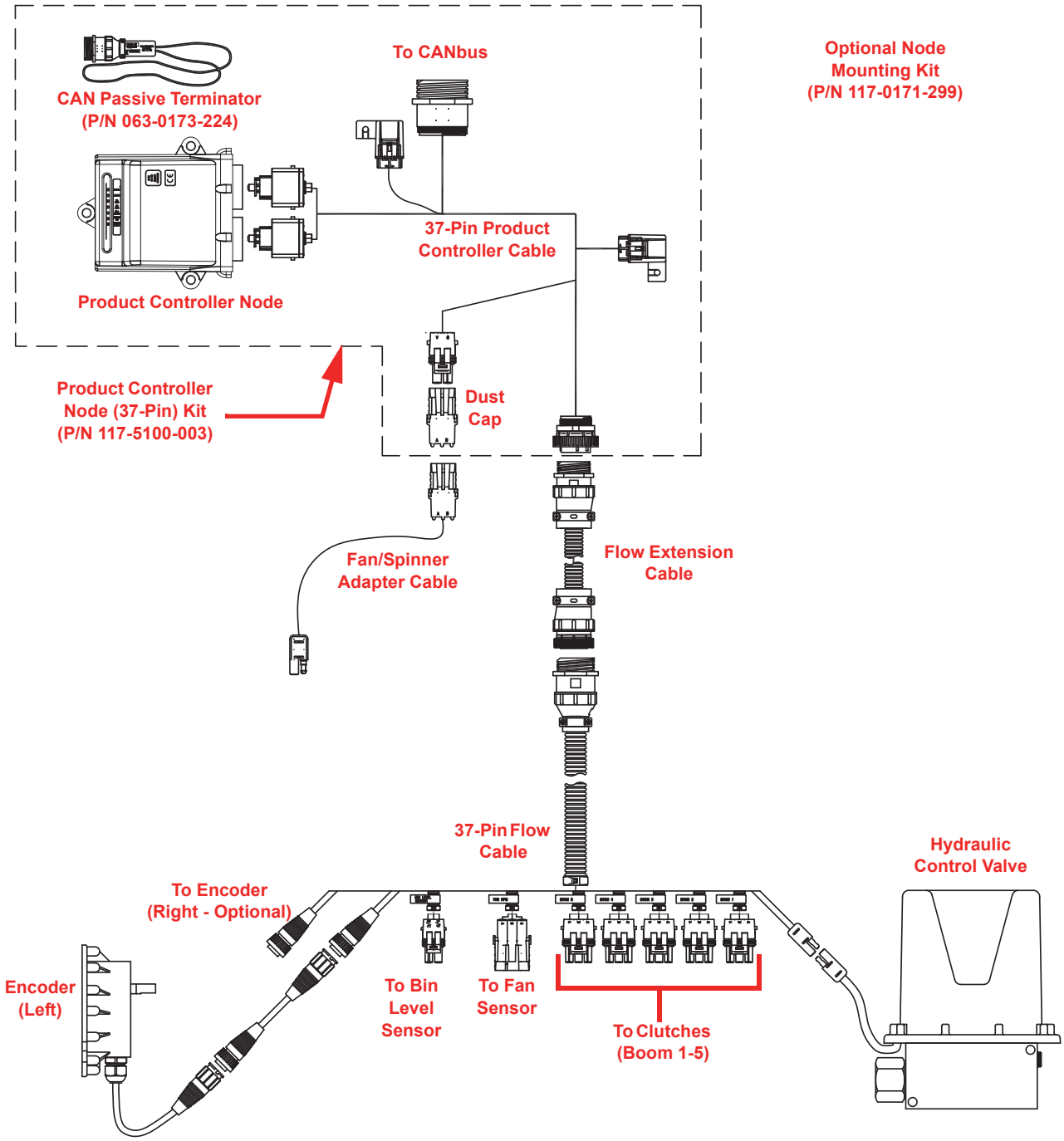
Note: *Do not force the connectors into the node. The connectors are keyed to ensure the connectors are installed properly and should insert with very little force required.*

8. Tighten the 1/4" bolt to secure the node connectors to the node.
9. Mount the node with the ports facing down to avoid collecting water or chemical in the node connections. The node should be held in place securely and should not move excessively during normal equipment operation.

Note: *An optional node mounting kit (P/N 117-0171-299) may be used to create a secure mounting position for the product controller node.*

10. To control the speed of a spinner or fan during granular applications, locate the 2-pin connector with the dust cap on the product controller cable.
11. Remove the dust cap and connect the optional adapter cable (P/N 115-0171-880).
12. Route the adapter cable to the valve controlling the fan or spinner speed and connect the adapter cable.
13. The remaining round 16-pin connector will be connected to the CAN tee cables to connect the product controller module to the CANbus network. Refer to the *CAN Communication Lines* section on page 45 for more information on connecting CAN modules to the CANbus network.

FIGURE 6. **37-Pin Granular Product Control Module with Optional Spinner Speed Control Example**



CAN Communication Lines

The CAN communication trunk line connects the various CAN node modules to the CANbus network and provides information to the control console or field computer. When using the generation 2 cabling platform, CAN communication and node power are integrated into the same cabling to simplify installation and interfacing with a towed implement. Refer to the following procedures to build a Raven CANbus network on a machine.

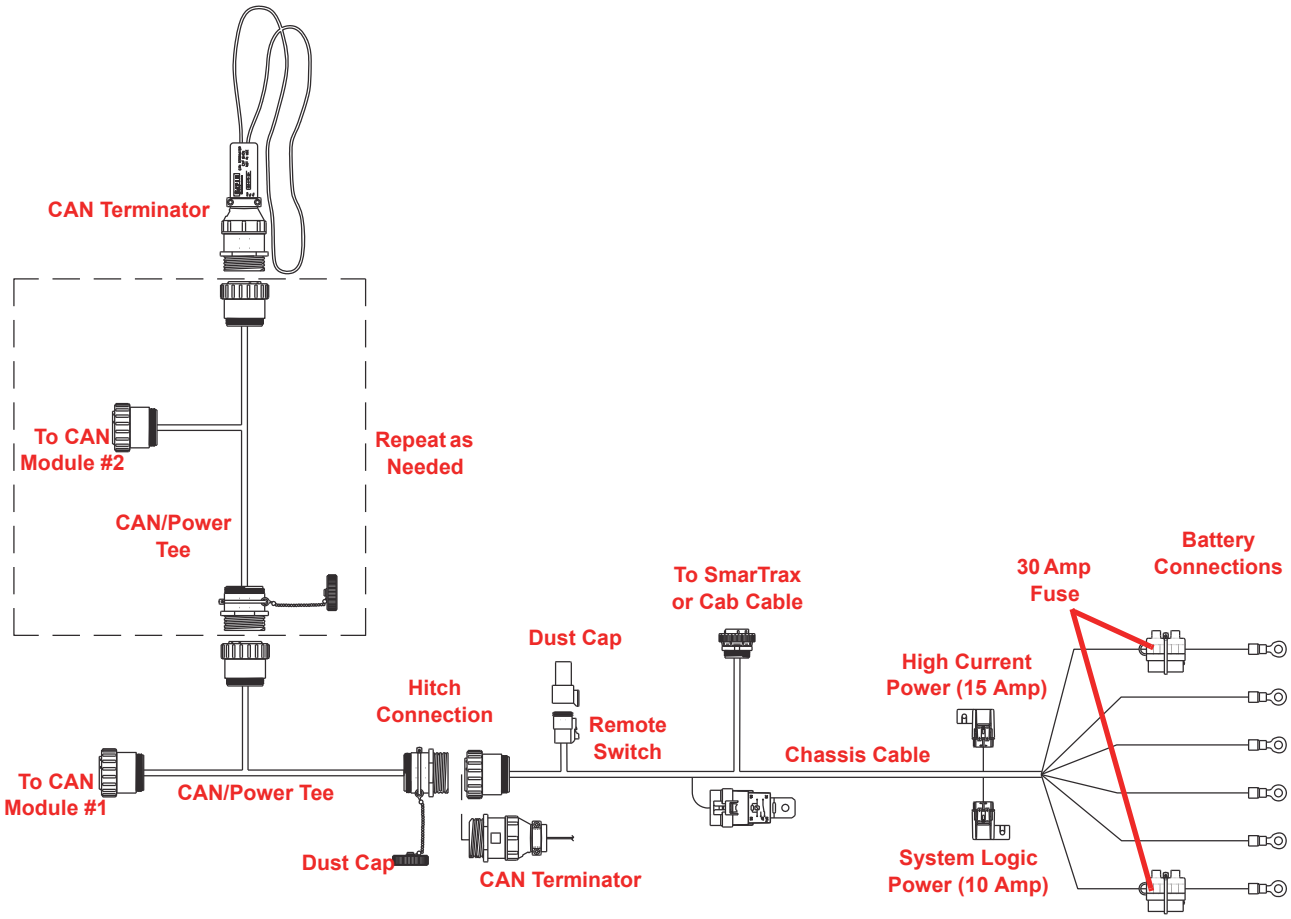
CAN/Power Tee Cables

1. Mount a CAN tee extension cable on the implement hitch so that the male connector will be able to reach the chassis cable hitch connector. Extension cables are available as listed below.

Part Description	Part Number
Tee Extension Cable - 12 in. [30 cm]	115-0171-928
Tee Extension Cable - 6 ft. [1.8 m]	115-0171-951
Tee Extension Cable - 12 ft. [3.6 m]	115-0171-916
Tee Extension Cable - 24 ft. [7.3 m]	115-0171-917
Tee Extension Cable - 36 ft. [10.9 m]	115-0171-934

2. Install a CAN passive terminator (P/N 063-0173-224) on one of the female connectors.
3. Connect the remaining female connector to the product controller module.

FIGURE 7. **CANbus Communication Trunk Line**



Adding CAN Nodes

To provide application rate control via a Raven CANbus network, a boom/speed and product module must be detected on the CANbus network. If the display console is capable of controlling the rate of multiple products during field applications, additional product modules may be added to the CANbus network to add application rate control channels. Refer to the specific display manual or contact a local Raven dealer for information on the number of control channels compatible with the console.

The display console may also be capable of interfacing with optional systems via the CANbus network. For example, a Raven AutoBoom™ system may be used to automatically adjust boom height in the field or a Raven SmarTrax™ system may be used to automate swath steering during field applications. Contact a local Raven dealer for more information about these and other Raven systems available to enhance field application or data management on various Raven control consoles or field computers.

Note: *Some consoles offer functionality for the boom sense, speed or product control node hard wired into the console. Review the control console manual or contact a local Raven dealer to determine the components required for a specific control console.*

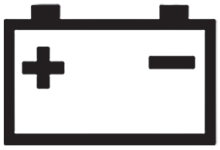
Raven field computers may be connected to a serial control console (e.g. SCS 440 or 460) without requiring a boom/speed or product node. An AccuBoom, AutoBoom and/or SmarTrax node may still be connected to the field computer. In this configuration, the field computer will monitor rate information from the serial control console.

To add modules to the CANbus network:

1. Remove the terminator (P/N 063-0173-224) from the tee extension cable at the end of the trunk line.
2. Connect another tee extension cable to the 16-pin connector from which the terminator was disconnected (see above table or contact a local Raven dealer for available cables).
3. Connect the CAN module to add to the CANbus network to one of the female expansion connectors.
4. Replace the terminator on the remaining 16-pin connector.

Power Connections

After all components are properly mounted and all cabling and connections are complete, the CANbus network and control console may be connected to power.



CAUTION

Review the *Best Installation Practices* section on page 32 before connecting the power leads to vehicle power.

1. Make sure the vehicle accessory power (key) is off before routing the red and white battery wires on the chassis cable to a 12-volt battery.
2. Attach the white power lead wires to the negative (-) battery terminal.

Important: ***Do not*** *use chassis ground connections.*

3. Connect the red battery wires directly to the positive (+) battery terminal.

Important: ***Do not*** *connect the red and white leads to the vehicle starter.*

4. Secure the power leads with plastic cable ties but do not tie the lead wires close to any existing battery leads or any other electrical wiring.
5. Power up the control console and review the control console or field computer manual for information on completing any initial calibration procedures. Verify that all connected nodes or modules are detected by the console.

APPENDIX

A

Raven CANbus Troubleshooting

Although the algorithm is located within each specific control node, all of the same troubleshooting techniques used with traditional hard wired control systems still applies to a CANbus system. While CANbus technology allows modular control system design, the behavior of the system remains the same. Flow and speed sensors, as well as the master and section control valves, are used in the same fashion.

The following table provides solutions for many common issues encountered with CANbus control systems. Please review the following table for information on possible causes for CANbus networks or individual control nodes going offline, intermittent communication errors and issues, or unexpected or “flaky” system response to control inputs.

Note: *For more information, or additional assistance with a specific issue, contact a local Raven dealer. The Raven technical support center is also available to support you or your dealer when necessary.*

Problem	Solution
1. Raven control console speed display shows a zero value.	A speed source and signal is required for application control systems. • Check speed source selection in Raven CAN control console. • Check node and node harness for loose pins. • Clean pins and sockets on speed sensor cable connectors. • If no extension cable is installed, replace the speed sensor assembly. • If an extension cable is installed, test the speed sensor extension cable as outlined in Appendix D, *Testing Extension Cables*.
2. Raven control console speed inaccurate or unstable (wheel drive speed sensor).	• Run a speed check on hard surface road. If the speed display is accurate, investigate moving the speed sensor to a 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 value twice the correct speed cal value and then run the speed test on a hard surface road. Swap the magnet set removed previously with the set used during the speed test and rerun the speed test. If the speed test is inaccurate with both magnet sets, replace the speed sensor assembly. **Note:** *Re-enter the correct speed cal value after testing is complete.*

Problem	Solution
3. Raven control console rate display shows a zero value.	• Verify that the speed sensor is registering accurately. If speed is zero, troubleshoot the speed sensor. Refer to problem 1 or problem 2 for speed sensor troubleshooting procedures. • Check that the boom cal values have been entered correctly for implement or each section. Verify that the sections display as on or active on the Raven control console when the section switches are operated. • Verify that the volume tally registers flow. Refer to Appendix D, *Testing Extension Cables* for more information on testing the flow meter/encoder cables. • If the volume tally does not accurately measure liquid product flow, check that the flow meter is installed properly. Refer to the *Mount the Flow Meter* section on page 9.
4. Raven control console rate display is inaccurate or unstable.	• Verify that the console speed value is accurate. If speed is not accurate, troubleshoot the speed sensor. Refer to problem 1 or problem 2 for speed sensor troubleshooting procedures. • Verify that all required calibration values and settings programmed into the Raven control console are correct. • Set the rate control mode to manual and verify that the actual rate display holds constant. If the rate display still fluctuates in manual mode, troubleshoot the control valve. Refer to problem 5 for control valve troubleshooting procedures. • Confirm that the section status shown on the display is not changing. • In manual control mode, check the low and high end pressure range. Pressure ranges must allow for normal spray conditions. If pressure cannot be adjusted manually, check that the flow meter is installed properly. Refer to the *Mount the Flow Meter* section on page 9. • If the problem persists, contact a local Raven dealer for additional assistance.
5. Control valve not holding rate in manual or automatic control modes.	• Check motorized control valve cabling for breaks or fraying. • Check and clean cable connections. • Verify that 12 volt DC power is provided at the control valve cable connector. To verify voltage, power on the control console, toggle the master switch on, toggle the control console to manual control mode and manually operate the increase/decrease rate switch. • While operating the increase/decrease rate switch, verify that the valve is operating. If the valve is stuck, flush and clean out the valve plumbing. If the motor does not run, contact a local Raven dealer to repair or replace the control valve.
6. Pressure is correct but system does not reach target rate	• Check spray nozzle strainer screens or check valves are not plugged. • Verify that the pressure to each boom section is the same. • Verify that all nozzles are the proper and same orifice size. • Review the Raven control console operation documentation for more information on setting the application rate.

Problem	Solution
7. Control console does not register volume correctly.	• Check the flow meter/encoder cable for breaks or shorts. See Appendix D, *Testing Extension Cables*. • Check the internal components of the flow meter/encoder. Clean and adjust as necessary. Refer to Appendix B, *Flow Meter Maintenance and Adjustment Procedure*. • Replace the flow meter transducer or encoder.
8. Motorized control valve rotates more than a quarter (1/4) turn.	• Contact a local Raven dealer to repair or replace motorized control valve.
9. Water inside motorized control valve cover.	• Replace isolation flange assembly and coupler shaft. • Contact a local Raven dealer to repair or replace control valve if the PC board is damaged or motor is corroded and will not run.
10. Boom valve(s) will not operate	• Check node harness cabling for broken or frayed wires. • Check and clean boom cabling connections. • Check section switch(es) and master switch operation. • Verify high current power to the node controlling the boom valves (e.g. AccuBoom control node or product controller node). • Contact a local Raven dealer to repair or replace boom valve(s).
11. Product control node(s) not programmed or addressed properly.	New product control nodes are configured to control channel 1 by default. New product control nodes installed with existing application systems must be re-addressed before the control console will detect additional control channels. • Refer to the console operation documentation for details on re-addressing a product control node. • Verify that each product control channel is properly configured and that the implement settings in the control console are correct and complete.
12. Master or section switches in the incorrect position.	Section displays on the Raven control console depend upon the status of in cabin or vehicle switch boxes to display or enable sections. • Check that the master switch is toggled on. • Check that any section switches are toggled on. When operating with an optional automatic section control feature (e.g. AccuBoom, OmniRow, etc), any section switches on the equipment must be set according to the specific control console or application equipment. • Review the control console manual or machine installation manual to verify switch position required for AccuBoom operation.
13. Broken fuse or breaker.	The control console or nodes may not power up if the fuse or breaker protection has been engaged. • **(Gen 1 Cabling)** Check and replace console cable and node harness fuses. If fuses break repeatedly or continuously, contact a local Raven dealer for more assistance. • **(Gen 2 Cabling)** Check chassis cable fuses and circuit breakers. If breakers trip or fuses break repeatedly or continuously, contact a local Raven dealer for more assistance.

Problem	Solution
14. CAN node(s) or control console wired directly to battery without controlled power supply.	Control nodes and some Raven control consoles will continue to draw current unless the power supply is switched off. To avoid draining the vehicle battery, be sure to connect node logic and console power to a controlled power source. **Note:** *Refer to the documentation provided with the CAN control console for specific power connection information. In general, Raven recommends the following:* • Connect the control console power and ground leads as instructed in the installation documentation provided with the CANbus control console. • Connect the node logic power and ground leads to a controlled source of clean logic power. The power source may be controlled using the vehicle ignition switch to toggle a relay.
15. Weak battery or bad power source.	A weak or bad power source may keep the CANbus from initializing properly or may cause the CANbus system to go offline. • Verify that the battery is providing at least 10 volts DC at the node(s). Replace vehicle or implement power system components as necessary. **Important:** *Do not jump-start the vehicle with Raven components connected to the vehicle power system. Jump-starting the vehicle may damage Raven system components. Always remove the Raven console and CANbus components from power before jump-starting the vehicle.*
16. Control console not connected to the CANbus.	CAN communication cables, especially for nodes on towed implements, must be connected to provide CAN messages to the control console. • **(Gen 1 Cabling)** Ensure that the CAN connector on the control console cable is properly connected to the CAN trunk line. • **(Gen 2 Cabling)** Verify that the chassis cable hitch connector is connected to the implement CAN/power tee connector.
17. Node(s) not connected to CANbus.	Loose node harness connections may cause individual nodes to encounter intermittent communication errors. In some cases, a poor node connection may cause issues with other control nodes on the CANbus or unexpected system response during control operations. • Locate control node(s) on the implement and verify that the harness cinch connector, locking tabs or rings are secure. • Trace CAN trunk line or chassis cable connections and verify that all connections are secure and the locking tab or ring is fully engaged. Check any loose connections for moisture or corroded pins. Refer to the procedures for troubleshooting moisture or corroded pins later in this section to continue troubleshooting the CANbus system.

Problem	Solution
18. CANbus not properly terminated.	A Raven CANbus network requires two CAN terminators for proper operation. A CANbus system with too many or too few terminators may experience communication errors or drop offline. ***Note:*** *Some Raven components provide "built-in" terminator functionality and will be used in place of a separate CAN terminator. Use a volt meter or multimeter to test the trunk or chassis communication cables as outlined in Appendix D, Testing Extension Cables to test for the proper resistance (ohms) in the communication line.* • **(Gen 1 Cabling)** Trace the CANbus trunk line and check for empty CAN tee cable connectors or extra CAN terminators. Remove any extra tee cables or terminators if found in the system. Review to the *CAN Power Adapter and Tee Cables* section on page 28 for trunk line connection information and the *Generation 1 CAN Tee Cables* section on page 63 to test CAN tee cabling as necessary. • **(Gen 2 Cabling)** Trace the chassis cable and CAN/power tee cables and check for empty connectors or extra CAN terminators. Remove any extra CAN/power tee cables or terminators if found in the system. Review to the *CAN/Power Tee Cables* section on page 45 for chassis cable connection information and the *Generation 2 CAN/Power Tee Cables* section on page 63 to test CAN/power tee cables as necessary. • Refer to the specific Raven control console operation manual for more information about retrying CANbus initialization or restart the control console.
19. Poor or improper power and ground connections	Improper power and ground connections are a common cause of several CANbus issues. Check the following items carefully and use a volt meter or multimeter to test the CANbus system. Loose power and ground connections may cause intermittent communication interruptions, lost calibration settings, or the CANbus to drop offline. • Check that the power and ground leads are secure and clean any corrosion from the terminals or posts. Noisy or "dirty" power and ground connections (any circuit with a variable load exceeding 1 ampere) may cause interference on the CANbus network. • Avoid chassis ground connections. Chassis grounds can create inconsistent voltage across the CANbus and cause communication errors or introduce noise into the CANbus network. • Avoid splicing or tapping into existing machine circuits to avoid introducing noise into the CANbus. Route control console, CAN and node logic leads directly to a source of clean logic power and ground. Route node high current leads to separate power and ground connections to avoid introducing noise into the CANbus. • Be sure to isolate CAN power, node logic power and control console power from node high current power using separate power and ground leads. Do not use a common lead or power source connection to power these components to avoid introducing noise into the CANbus. ***Note:*** *Refer to the documentation provided with the CAN control console for specific power connection information.*

Problem	Solution
20. Moisture in CANbus cable connections, node harness or node enclosure.	Moisture within the trunk or chassis cable connections can cause communication errors and will eventually corrode cable or node pins. Moisture building up within the node will damage the node and cause the node to drop off the CANbus system. • Always apply dielectric grease to any connectors exposed to weather, harsh chemicals or other sources of moisture. • Mount nodes with the node connectors facing toward the ground to help prevent moisture from accumulating in and around the ports or penetrating the node enclosure. • Avoid directing pressure washers or hoses at the CANbus cable connections or node enclosures while washing the implement or equipment. When possible, select mounting locations which protect the node from direct exposure to weather or spray. • If moisture accumulates within the node, disconnect the node and drain liquids from the enclosure. Allow the node to dry thoroughly. Reconnect and test the control node. If the diagnostic indicators do not illuminate, the node fails to initialize with the CANbus or does not function properly, replace the control node. Moisture allowed to accumulate in cable or node connectors will eventually corrode pins and will cause communication errors or failure. Refer to the troubleshooting procedure for corroded, broken or missing pins to continue troubleshooting the CANbus.

Problem	Solution
21. Corroded, broken or missing pins in CANbus cable connections, node harness or node enclosure.	Moisture within cable connections will eventually corrode or damage pins and cause communication errors. • Check trunk or chassis cable lines for moisture and debris. If any moisture has penetrated a connector, check for damaged or missing pins and replace cables as necessary. To help keep moisture from penetrating the cable connections, apply dielectric grease to any connectors exposed to the weather or harsh chemicals. • Check node connectors and node enclosures for moisture. If moisture has penetrated the enclosure, drain the node and allow the enclosure to dry thoroughly. Check the node functionality. If the node indicators do not illuminate or the node is not detected during CAN initialization, replace the node. • When operating in exceptionally harsh conditions, it may be necessary to reapply dielectric grease to connectors or node ports periodically to help prevent moisture from penetrating the node or cable connection. Forcing connectors together can damage or break pins or may force pins out of the cable connectors. • Inserting the node or cable connections should not require any use of force. If force is necessary to align the cable connections, or if significant force is necessary to engage the locking tab or secure the locking ring, disconnect the connectors and recheck for proper alignment or debris in the connector. • The cinch connectors used on several Raven control nodes are not labeled or color matched with the node connector. These connectors should not require the application of force to insert or seat the connector into the node. If force is required, remove the connector, verify that the keyways are properly aligned and retry the connection. To ensure proper connector alignment, locate the letters “A” through “K” and “L” through “Y” on the node connectors. Align the connectors so that the letters “A” through “Y” are in alphabetical order along the same side of the node as diagnostic indicator lights. • Use a volt meter or multimeter to test the trunk or chassis communication cables as outlined in Appendix D, *Testing Extension Cables*. If voltage does not test correctly, there may be a bad cable or poor cable connection somewhere in the CANbus. • Trace trunk or chassis cable lines for loose or empty cable connections or for frayed or damaged cables. Replace any cabling as necessary or remove extra cables as found.

APPENDIX

B

Flow Meter Maintenance and 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 58, 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:

$$CMC = \frac{720 \times 260}{250} = 749$$

or

$$CMC = \frac{[190] \times [984]}{[946]} = [198]$$

the Corrected Meter Cal is 749 [198]

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

APPENDIX

C

Node Diagnostic Indicators

Raven CAN Node Diagnostic Indicators

Several Raven CAN control nodes feature green light-emitting diodes (LEDs) which may be used to diagnose issues within the system.

Note: *If the LEDs are not displayed as outlined in the figure below or are all on continuously, check the CAN connections and the control cable connections on the node. If the issue persists, contact a local Raven dealer for additional technical support.*

FIGURE 1. **CAN Control Node LEDs**

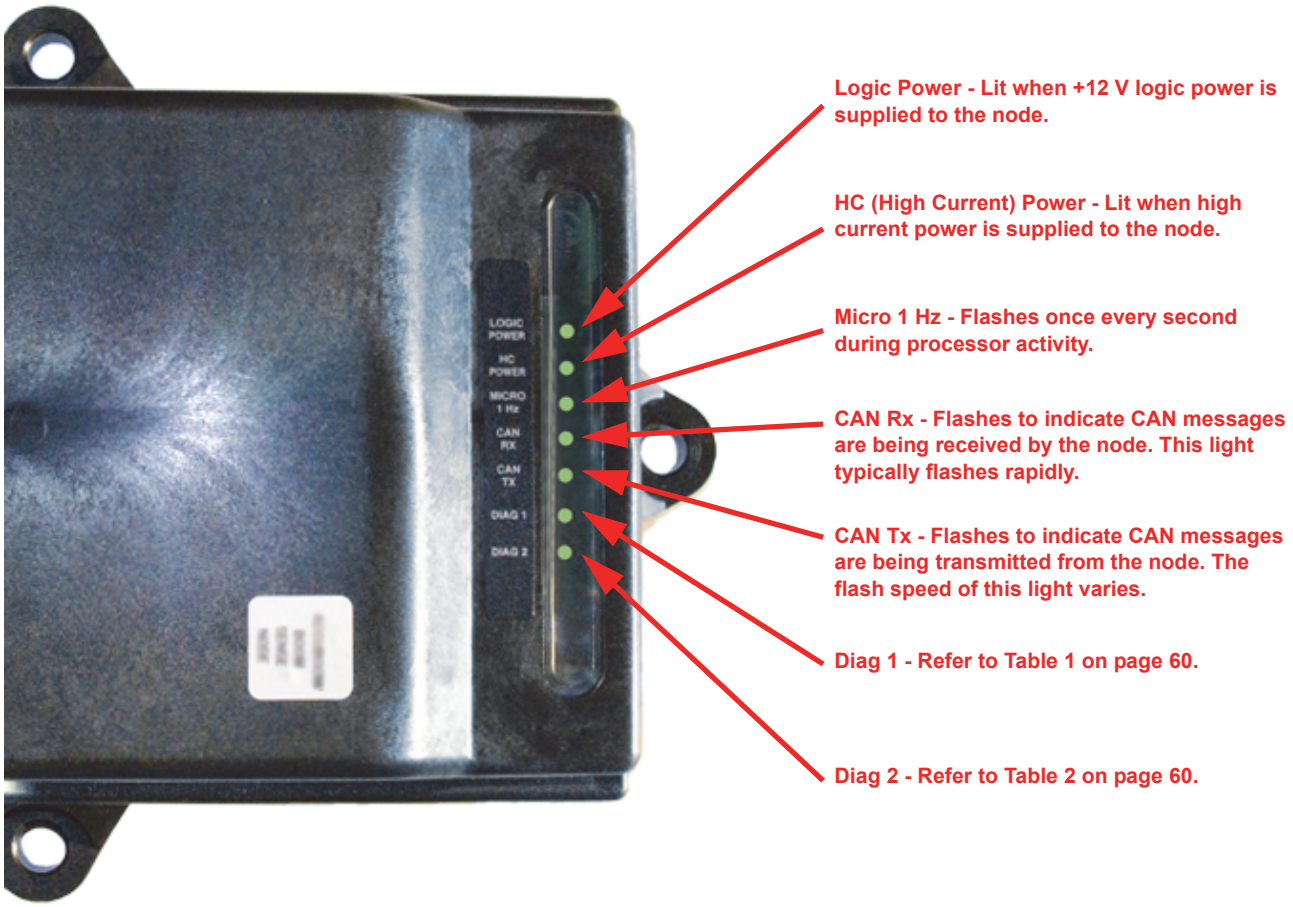


TABLE 1. Diagnostic 1 Indicator Light Definition

Control Node	Indicator Definition
AccuBoom	Lit when the master switch or any boom section switch is in the on position. Indicator should not be illuminated if the master and all boom section switches are toggled to the off position.
AutoBoom	Lit if a second Ultrasonic sensor is detected on one of the booms.
SmarTrax and SmartSteer	Lit when the node is receiving GPS messages from a DGPS receiver.
Product Controller, Air Cart and Planter/ Seeder Auxiliary Nodes	• Solid - Calibration is not complete for at least one of the active products (e.g. missing rate cal, meter cal, valve cal, etc.). • Flashing - Node is receiving meter or encoder transitions from one of the active products; or • Flashes for one second when the remote section controller is used for every received key press.
Planter Control Node	• Solid - Calibration is not complete for at least one of the active products (e.g. missing target population, meter cal, valve cal, speed cal or section setup). • Flashing with meter cal set at 1 - Node is receiving encoder transitions from one of the odd-numbered active controls. • Flashing with meter cal set at value other than 1 - Indicates that the node is receiving seed singulation transitions from one of the odd-numbered rows. • Flashes for one second when the remote section controller is used for every received key press.

TABLE 2. Diagnostic 2 Indicator Light Definition

Control Node	Indicator Definition
AccuBoom	Lit if the wireless remote section controller is being used.
AutoBoom	Lit if a second Ultrasonic sensor is detected on one of the booms.
SmarTrax and SmartSteer	Lit if the 3D unlock code has been entered and accepted.
Product Controller, Air Cart and Planter/ Seeder Auxiliary Nodes	• Flashes to indicate that the node is receiving encoder transitions for the right side (gran 3 systems only) or fan, spinner, or pump RPM transitions; or • Flashes once for every key press when the remote section controller is used.
Planter Control Node	• Flashing with meter cal set at 1 - Node is receiving encoder transitions from one of the even-numbered active controls. • Flashing with meter cal set at value other than 1 - Indicates that the node is receiving seed singulation transitions from one of the even-numbered rows. • Flashes once for every key press when the remote section controller is used.

APPENDIX

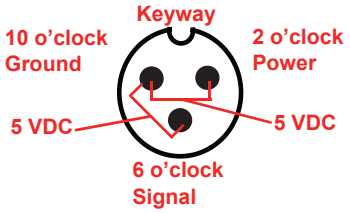
D

Testing Extension Cables

Speed Sensor Extension 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/Encoder Cable section on page 62.

Testing the Speed Sensor Cable

Note: *Refer to the console specific instructions provided with the control console for details on entering cal values or navigating the user interface.*

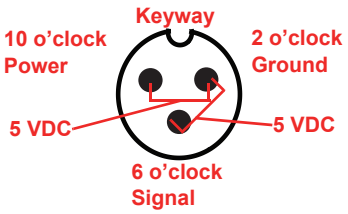
1. Enter a value of 9999 as the speed cal.
2. Observe the Raven CAN control console odometer reading while testing the speed sensor extension cable.
3. Use a small jumper wire or paper clip to short the 10 o'clock and 6 o'clock sockets with a "short-no short" motion. Each time the short is made, the odometer 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 value.*

Flow Meter/Encoder Extension Cables

Disconnect the extension cable from the flow meter or encoder. Hold the extension 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 61.*

Testing the Flow Meter/Encoder Cable

1. Enter a value of 1 as the meter cal.
2. Observe the Raven control console total volume value while testing the extension cable.
3. Place boom and master switches to the ON positions.
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 10 or more if the meter cal has been set to 1.

Note: *For testing purposes, be sure to set the meter cal to a value of 1 for the specific product channel being tested. Higher meter cal values will require more "short-no short" motions to register volume changes.*

5. If the volume 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 or encoder cable voltage as previously described.
6. If all cables test good, replace the flow meter or encoder.

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

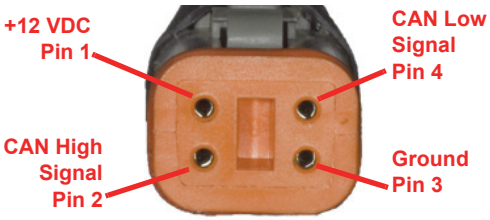
CAN Communication Tee Cables

If the diagnostic indicator lights on the control node do not illuminate or CANbus communication messages become sporadic during operation, it may be necessary to test voltage on the CAN trunk line or CAN/power tee cables. Refer to the following sections for information on testing voltage with the cable platform used on the vehicle or machine.

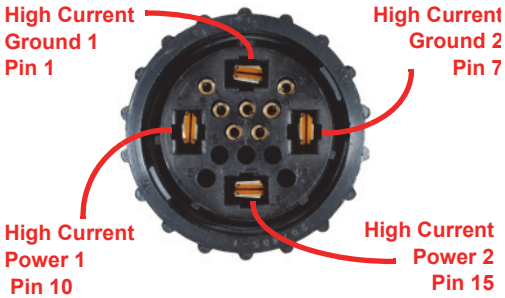
Test the voltage at each CAN junction as shown in the tables below to determine if the tee cable is faulty and should be replaced.

Generation 1 CAN Tee Cables

Pin Connection	Multimeter Test
1 to 3	+12 Volts DC
2 to 3	2.5 Volts (±1 Volts)
3 to 4	2.5 Volts (±1 Volts)
2 to 4	75 Ohms (2 terminators) 150 Ohms (1 terminator)



Generation 2 CAN/Power Tee Cables



Pin	Description
1	High Current Ground 1
2	(Not Used)
3	Switched Logic Power
4	Logic Ground
5	CAN Power
6	CAN High Signal
7	High Current Ground 2
8	CAN Ground
9	CAN Low Signal
10	High Current Power 1
11	(Not Used)
12	(Not Used)
13	(Not Used)
14	Remote Master Signal
15	High Current Power 2
16	(Not Used)

Pin Connection	Multimeter Test
1 to 10 or 7 to 15	+12 Volts DC
3 to 4	+12 Volts DC
6 to 8	2.5 Volts (±1 Volts)
8 to 9	2.5 Volts (±1 Volts)
6 to 9	75 Ohms (2 terminators) 150 Ohms (1 terminator)

APPENDIX

E

CAN Diagnostic Tool

Introduction

The Raven CAN Diagnostic Tool is designed to monitor communication signals over a Raven CANbus network using the generation 1 cabling platform. This tool may be used to help diagnose errors with communication signals such as:

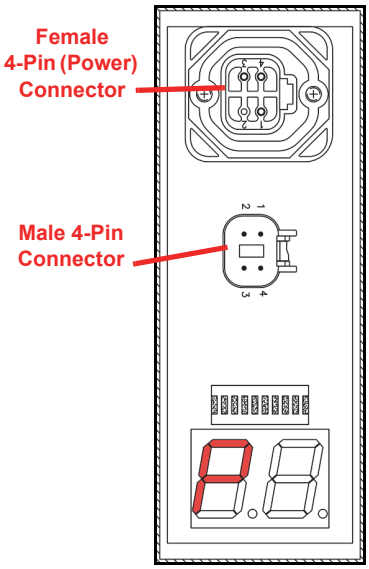
- CAN control console not recognizing one or more nodes
- Section status on the CAN control console not matching actual section status on equipment
- Intermittent CAN communication

Note: *Do not use the Raven CAN Diagnostic Tool in place of a CAN terminator. Two CAN terminators must be installed at the ends of the CAN communication lines while using the Diagnostics Tool. Removing a terminator from the communication line may cause additional communication errors.*

Some optional Raven components feature a built-in CAN terminator to simplify installation and cabling. Review the documentation provided with each Raven component or contact a local Raven dealer for additional assistance with these components.

Connection and Power

The Raven CAN Diagnostic Tool is powered through the CAN tee cables with power supplied from the CAN adapter tee with power cable. The Diagnostic Tool will be powered at any junction in the CANbus network as long as the tee with power cable remains connected to the network. Refer to the numbered locations shown in Figure 1 on page 67.



If properly connected, the Diagnostic Tool should automatically power on and display a “P” followed by the program revision currently installed on the Diagnostic Tool. The program revision will be displayed for 2 seconds before the tool begins to monitor CAN communication data.

Note: *If the Raven CAN Diagnostic Tool does not power up when connected to the CAN communication line, verify that the CAN adapter tee with power cable is properly connected to a source of +12 VDC power and that the battery is sufficiently charged.*

In-Line Connection

Connecting the Diagnostic Tool in the CAN communication line will monitor CAN signals as transmitted during normal operations and is a good place to start troubleshooting a system.

To connect the Diagnostic Tool in-line, disconnect a CAN tee cable junction and connect the tee cables to the Diagnostic Tool connectors. All CAN signals transmitted over the CAN network will be monitored by the tool. For example, the Diagnostic Tool may be connected in-line at any of the numbered locations in Figure 1 on page 67 and should display the same CAN communication data at each point. If the monitored data at these locations varies significantly, this may indicate that the source of the issue is between the junctions. Troubleshoot the cables and connections between these points to locate the faulty cable or connection.

Eliminating Components from the CANbus Network

A CAN terminator may be connected to the male connector on the Diagnostic Tool while moving the tool to different locations to eliminate nodes or system components from the CANbus network. This may help to help diagnose which part of the system is causing issues.

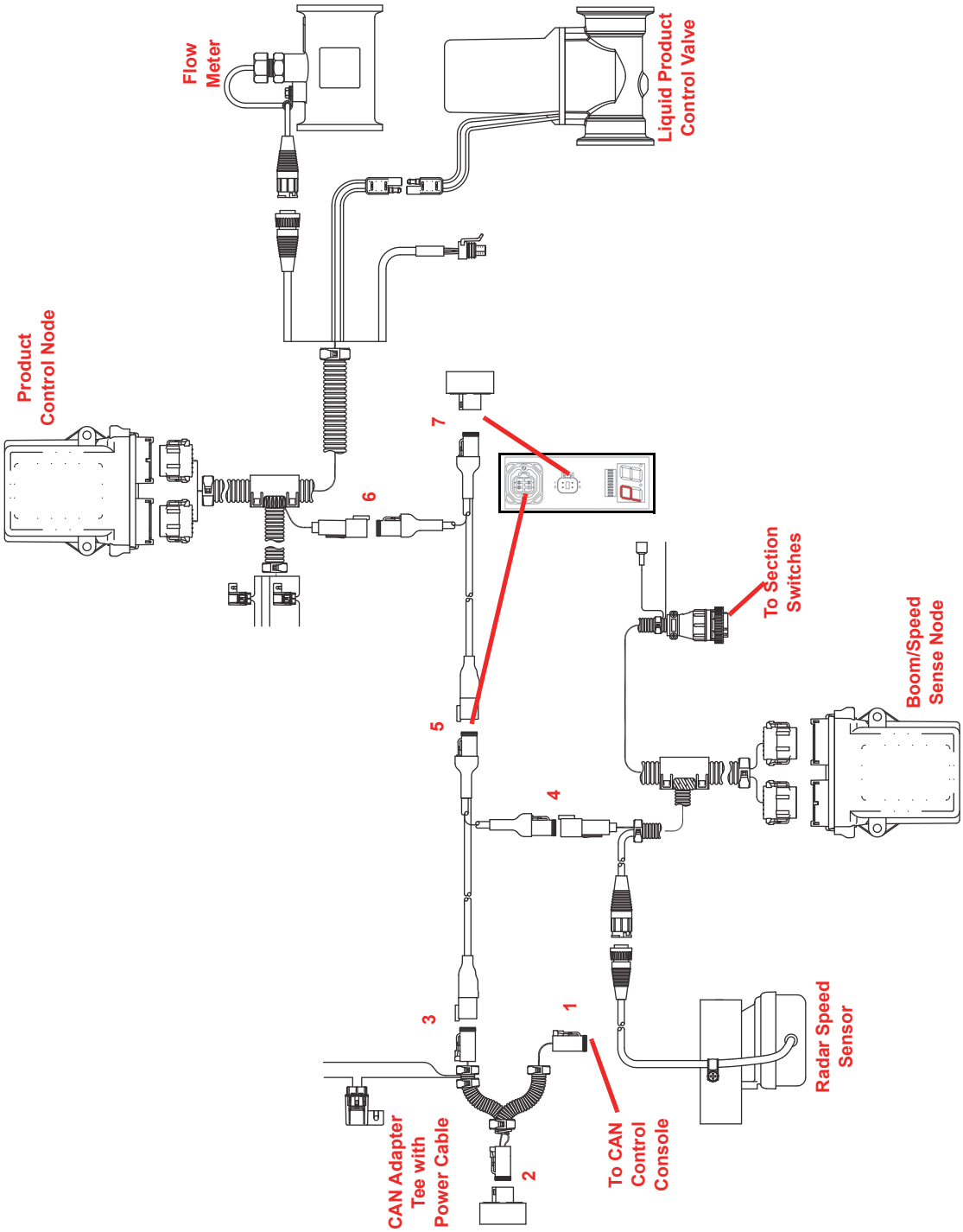
Note: *When moving a CAN terminator with the Diagnostic Tool, be sure that the CAN adapter tee with power cable remains connected to the CAN communication line. The Diagnostic Tool will not operate without the adapter tee and power from the CAN lines.*

For example, if the Diagnostic Tool is connected at location 7 as shown in Figure 1 on page 67 and then moved to location 5 with the terminator still connected to the Diagnostic Tool, the product control node and all cabling after location 5 will be eliminated from the CAN communication network.

If CAN communication errors are not detected in this configuration, the source of communication issues is most likely to be found with the product control node or cables after location 5. If errors are still detected in this configuration, the issue may be located in the boom/speed node or cabling before location 5.

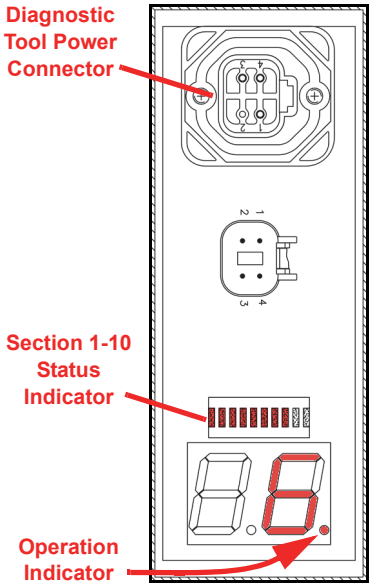
Note: *If using a terminator connected to the Diagnostic Tool to eliminate node modules from the CAN network, it is recommended to start from the back of the CAN communication line and work toward the CAN adapter tee with power cable.*

FIGURE 1. **Example CAN System Diagram**



Diagnostic Operation

After the Raven CAN Diagnostic Tool has initialized, the tool begins monitoring CAN communication signals automatically. While monitoring CAN communications, the far right point or indicator in the display should be flashing to indicate that the tool is functioning properly.



Note: *If the indicator is not flashing, check the 4-pin connectors on the Diagnostic Tool. If the indicator is still not flashing, there may be a problem with the tool and the tool may need to be replaced.*

Display

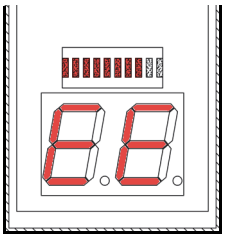
During operation, the display will cycle through the following items as available.

- Detected CANbus node values
- Error codes and tally of each error type

The display will automatically cycle through the detected nodes followed by the error codes and error tallies.

"EE" - End of Errors

When the last error code has been displayed, the tool will flash 'EE' twice before repeating the cycle again.



Note: *If no CAN nodes are detected on the CAN network, the Diagnostic Tool will show "--" before repeating any detected errors. Refer to the Error Codes section on page 70 for additional information on displayed error codes.*

Section Status Indicator

The Raven CAN Diagnostic Tool continuously monitors the status of up to 10 sections controlled via a CAN network. The section 1 through 10 LED's are displayed from left to right above the digital display (section 1 far left and section 10 far right). When the section is toggled on, the corresponding LED on the tool should be lit.

Note: *The indicator will not display section status without a Raven CAN Switch Box or boom sense/ speed node (diagnostic tool display value "20") detected on the CANbus network.*
Refer to the CANbus Node Display Values section on page 69 for more node display values and be sure a CAN Switch Box or boom sense/speed node is properly powered and connected to the CANbus network

For example, the section status indicator above displays sections 1 through 8 should be active while sections 9 and 10 should be off or disabled. If toggling corresponding section switches or functions on or off does not change the status shown on the Diagnostic Tool, check the boom sense node and section valve wiring and connections or contact the Raven technical support center for additional assistance.

CANbus Node Display Values

The following values may be displayed if the corresponding node is detected and recognized while monitoring the CANbus communication signal.

Diagnostic Tool Display Value[a]	Raven CAN Node
1 to 9	Product Control/Controller Nodes (1-9)
a to f	Product Control/Controller Nodes (10-15)
10	Consoles
20	Raven CAN Switch Box or Boom Sense/Speed Node
21	AccuBoom Combo Node
22	Hydraulic Switch Sense (used with AutoFold systems)
23	Planter Controller Nodes with Speed Sense in Integrated
30	AccuBoom, AccuRow or Seed Hawk® SCT™
31	Real Time Injection or Seed Hawk SCT
35	Air Seeder Drill Cart Node
39 to 3f	AccuRow Planter Section Control Node
40 to 45	AutoFarm
40	Potato Row Planter Node
50	GreenSeeker
51	Jacto Light Bar
52 to 56	Jacto Nodes
57 to 5f	Other Jacto Nodes
60	AutoFold Control Node
69 to 6f	Planter Controller Node
70	AutoBoom
72	Steerable Hitch
90	SmarTrax/SmartSteer Control Nodes

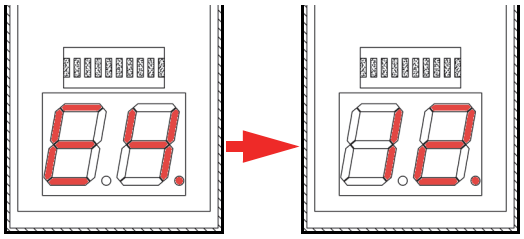
a. All values displayed by the Raven CAN Diagnostic Tool correspond to the hexadecimal CAN communication codes transmitted via the CAN communication signals.

Note: *The Diagnostic Tool updates the list of nodes each time the tool cycles through the list of nodes found on the CANbus network.*

If a node value displays intermittently while monitoring the CAN system, check the node and related cabling for common causes of communication issues such as poor power or ground connections, loose cable connections or corroded pins.

Error Codes

If the CAN Diagnostic Tool detects errors while monitoring CAN communication signals, the display will cycle through the type of errors detected followed by a tally of each error type.



For example, if the tool displays ‘E4’ followed by the value ‘12,’ the tool has encountered 12 instances of the ‘stuff’ error within the CAN communication signal.

If errors are detected, the Diagnostic Tool will display the one or more of the following error codes and the cumulative tally for the displayed error type:

Error Code	Error Type	Description
E1	Acknowledgement Error	No dominant bit detected in the acknowledgement slot.
E2	Form Error	A form error results from one or more violation of the fixed form of the CRC delimiter, Acknowledgement Delimiter or end of frame bit fields.
E3	CRC Error	Received checksum does not match transmitted checksum.
E4	Stuff Error	More than five consecutive bits of the same parity have been detected.
EE	End of Errors	All errors detected on the system have been displayed. Diagnostic Tool will restart diagnostic cycle.
--	Node Error	No nodes detected or recognized on the CANbus network.

Note: *In general, the type of error is not as significant as the overall number of errors encountered in CAN communication signal. The CAN Diagnostic Tool will display a cumulative number of errors (up to 99) each time the cycle repeats. If the tool is connected for a long period of time, disconnect the cable connected to the power (top) connector for 2 seconds and reconnect to reset the tool.*

While some errors are normal on a CANbus system, a large number of errors may cause performance issues or stop the system from operating at all. Refer to *Troubleshooting* section on page 71, for information on troubleshooting a system in which CAN communication errors are causing issues.

Troubleshooting

If a large number of errors are detected while monitoring CAN communications with the Raven CAN Diagnostic Tool:

1. Make sure both ends of the CANbus are terminated. A Raven CANbus system requires a terminator, or a component providing the functionality of a terminator, on each end of the CANbus communication line. Too many or too few terminators may cause more errors in the CAN communication signals.
2. Check the power and ground connections for the CAN adapter tee cable and each CANbus node. Poor power and ground connections are common causes of communication issues within a CANbus network.
3. Check the CANbus communication line for open or corroded connectors. Be sure to use dielectric grease in all connections which could be exposed to moisture or chemicals.
4. Connect a CANbus terminator directly to the CAN Diagnostic Tool and connect the tool in various locations in the CAN communication line to exclude CAN nodes or components from the CANbus signal. Refer to the *Eliminating Components from the CANbus Network* section on page 66.
5. Use the Diagnostic Tool to check for errors in the system with the vehicle engine both shut off and running. If additional errors occur in the CAN communication signal with the engine running, check that the CAN power and ground leads are routed away from other power cables, the vehicle alternator or other electrical equipment.
6. With the vehicle running, power on other electrical equipment on the vehicle (e.g. air conditioners, 2-way radios, DGPS receivers, injection or product pumps, agitators, etc.). One or more of these components may be causing additional noise in the CAN communication line.

   Try moving the power and ground connectors for any suspected components and/or the Raven product power and ground leads or the CAN communication line to reduce the noise introduced into the CANbus system.

If a large number of errors are still occurring in the CAN communication signal after checking and/or correcting the above issues:

1. Connect the Diagnostic Tool at a junction near the console (e.g. location 1, 2 or 3 as shown in Figure 1 on page 67).
2. Power up the console or field computer.
3. Verify that the Diagnostic Tool detects the console or field computer (a value of “10” is displayed while cycling through the detected CAN nodes).
   - If the Diagnostic Tool does not detect the console, the console may be defective. Contact the Raven technical support center for additional assistance or to receive a return materials authorization number.
   - If the Diagnostic Tool detects the console, but one or more nodes on the CAN network are not shown, retest the system at the next CANbus junction.
4. Repeat step 1 through step 3.
5. If different nodes are detected from one location to another, the CAN tee cable in between the junctions may need to be replaced. If one or more nodes are never detected, check the CAN connectors at the particular node(s) and check voltage supplied at the node connectors.

Readdressing Nodes

If the Diagnostic Tool does not detect one or more product control node(s), the CANbus system may need to be readdressed. Refer to the console or field computer manual for instructions on readdressing the CAN network.

Note: *Disconnect the CAN Diagnostic Tool from the CAN network before readdressing the CAN nodes. Only product control nodes may be readdressed.*

After readdressing the CANbus, reconnect the Diagnostic Tool and start operation again.

Updating the Diagnostic Tool

Updates will be made available periodically for Diagnostic Tools with program revision 2.0 or later. A Raven CANbus system with a Raven field computer will be required to transfer the update to the tool. Contact the Raven technical support center for more information and to obtain the latest program revision update.

Note: *Any Diagnostic Tool with a program revision prior to 2.0 are not capable of being updated and will not be able to monitor CAN communication from nodes not listed on the back of the Diagnostic Tool.*

To update the CAN Diagnostic Tool:

1. Insert a USB flash drive into a home or office computer. The flash drive should be one previously used with a Raven field computer (e.g. Viper Pro, Envizio Pro II, etc.) to ensure that the drive is compatible with the field computer.
2. Create a folder labeled “CanUpload” on the root directory of the flash drive (i.e. “G:\CanUpload” where G is the drive letter assigned by the computer).
3. Copy the .hex update file for the Diagnostic Tool to the “CanUpload” folder created on the USB flash drive.
4. Connect the Diagnostic Tool to a Raven CANbus network with a Raven field computer.
5. Refer to the field computer manual to access the CAN Node or CANbus update program.
6. When prompted to select a node to update, select the CAN Diagnostic Tool update file and proceed with the update procedure.

RAVEN

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.

016-0171-537 Rev. A, E19889

RAVEN

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.

016-0171-536 Rev. A, E19889