SERIES 5B/C
VALVE STATUS MONITOR DEVICENET™

Installation, Operation and Maintenance Manual
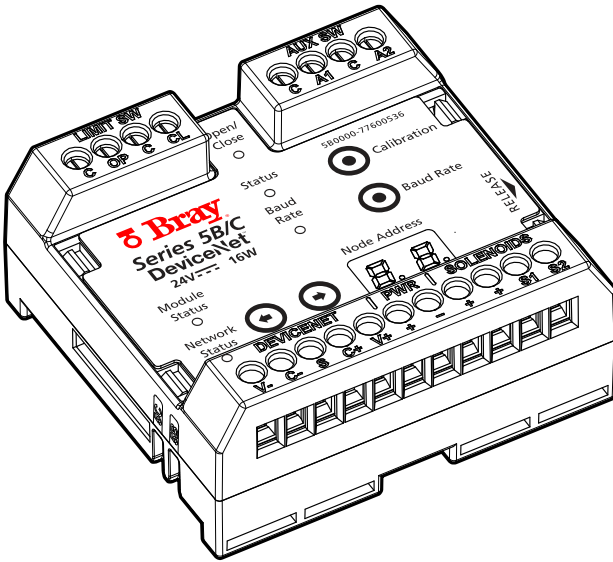

ठ **Bray**

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1.0 INTRODUCTION

The Bray Series 5B/C (S5B/C) Valve Status Monitor (VSM) with Communication Protocol electronics (CommPro) is an intelligent switchbox device that provides both position feedback and diagnostic information for discrete valves. It accomplishes this by interfacing with a bus network, over which commands can be sent and feedback can be returned. Once connected to the network, the Bray S5B/C VSM with CommPro becomes part of a larger system, which is required to ensure proper operation of the device. To refer to the elements of the system, a common terminology is used throughout this document, as defined below.

Definition of Terms

- CommPro – Bray S5B/C Valve Status Monitor with DeviceNet™ Communication Protocol module

  - Valve – Discrete valve being monitored by the CommPro module

  - Process Controller – Device acting as the network master that communicates with the S5B/C via the CommPro module.

2.0 DESCRIPTION OF OPERATION

The function of the CommPro is to monitor the state of mechanical switches operated by a rotating cam shaft internal to the VSM. This cam shaft is set to trip the switches when the valve travel limits have been reached. Operation of the valve position can be controlled by the process, or the CommPro can operate the valve to the travel limits using solenoid valves. This operational capability, coupled with the position monitoring, gives the CommPro the ability to report degraded or erroneous operation to the Process Controller based on calibration procedures performed at the factory or on-site.

Every CommPro has been designed to communicate using a specific communication protocol, designated by the part number.

- DeviceNet™: 5B-0000-77600-536

⚠ **WARNING**

If CommPro is installed in S5C VSM, refer to S5C IOM for additional requirements.

NOTICE

Operating the CommPro outside the operational constraints defined in this manual may impair the protection provided by the equipment.

3.0 HARDWARE DESCRIPTION

- One terminal strip (11 terminals) for field connections

- Two terminal strips (4 terminals each) for factory wiring of position switches

- LED User Interface

  - Bi-color Red/Green DeviceNet™ Module & Network Status LEDs

  - Tri-color RGB DeviceNet™ Baud Rate LED

  - Seven segment Red Node Address LED indication

  - Bi-color Red/Blue Product Status LED

  - Bi-color Red/Green Open/Close Position LED

- Parameter switches

  - Calibration switch

  - Baud Rate switch

  - Node Address adjustment switches

3.1 Field Connection Terminals

Each CommPro has 11 terminals dedicated to field connections. These terminals are where the bus connections are made, where external power is provided (if needed), and the load connections are terminated.
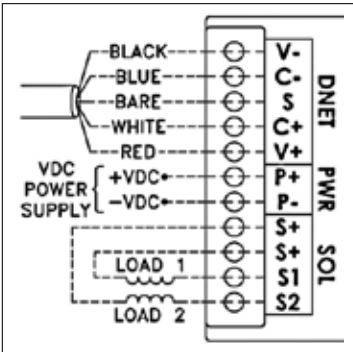

Figure 1: Field wiring of the CommPro

3.1.1 DeviceNet™ connections

The CommPro can be provided with a 5-pin DeviceNet™ connector. This connector is factory terminated at the field terminals, so additional wiring is not required.
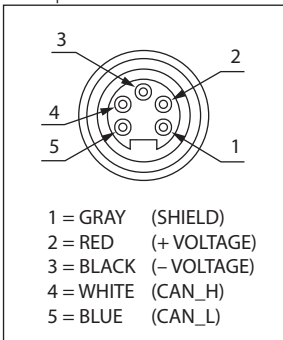

1 = GRAY   (SHIELD)
2 = RED   (+ VOLTAGE)
3 = BLACK   (– VOLTAGE)
4 = WHITE   (CAN_H)
5 = BLUE   (CAN_L)

Figure 2: DeviceNet™ Male Connector

3.1.2 Power Supply

For DeviceNet™, power is provided to the CommPro via the communication bus connections. However, the CommPro can operate a load as large as 13.8W, which may be too great a load for some networks to sustain. Therefore, an external power connection is provided to reduce loading on the bus power supply. In addition, this external power connection can be used as a backup power supply if bus power is lost.

If used, the power supply must provide 24VDC ± 10%, and must power the CommPro module along with any load connections. If the maximum output load is needed (13.8W), then the power supply

should be able to supply at least 750mA. Since this is a DC connection, it is important that proper polarity is maintained when making this connection.

3.1.3 Load Connections

The CommPro is designed to operate up to two inductive loads at 24VDC. The product was specifically designed and tested to operate two 6.9W solenoid valves; however, any resistive or inductive load of equal or lesser wattage could be operated from this connection.

Each load connection has a wattage limit of 6.9W, and the CommPro has a total wattage limit of 13.8W. Exceeding these limits will result in a fault state. All loads are operated discretely (on/off) using 24VDC. Since these are DC connections, it is important that proper polarity is maintained when making these connections.

3.2 Factory Connection Terminals

Two terminal strips, located on the opposite side of the CommPro from the field connection terminals, are provided for making factory installed terminations. It is at these terminals that the position monitoring switches are connected.
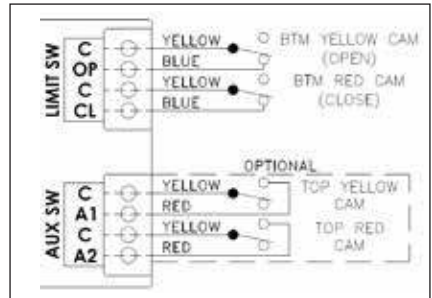
Figure 3: Factory wiring of the CommPro module

3.2.1 Limit Switches

The switches attached to this terminal strip have been set at the factory to be engaged when the travel limits have been reached, fully open and fully closed. The CommPro relies on this position feedback to report position to the Process Controller. If the switches are not being engaged at the fully open and close positions, the cams on the cam shaft should be adjusted to ensure proper operation. If both switches are engaged at the same time, a fault state will occur.

3.2.2 Optional Auxiliary Switches

Auxiliary switches allow for custom indication to be provided to the Process Controller. The cams that engage the auxiliary switches can be positioned to any position desired in the field, as these switches do not affect standard operation of the CommPro.

3.3 LED Description

3.3.1 Module Status

The bi–color (Green/Red) LED provides device status as required in the DeviceNet™ standard. It indicates whether the device has power and is operating properly.

For this state:	LED is:	To indicate:
No Power	Off	There is no power applied to the device.
Device Operational	Green	The device is operating in a normal condition.
Device in Standby (The Device Needs Commissioning)	Flashing Green[1]	The device needs commissioning due to configuration missing, incomplete or incorrect. The device may be in the Standby state. Reference the Identity Object in Volume 1, Chapter 5: Object Library.
Recoverable Fault	Flashing Red[1]	The device has a recoverable fault.
Unrecoverable Fault	Red	The device has an unrecoverable fault; may need replacing.
Device Self Testing	Flashing Red-Green[1]	The device is in Self Test. Reference the Identity Object in Volume II for device states.
[1]For information on LED flash rates, refer to section 9.2.8		

Figure 3: Module Status States (from Page 9-2.1 of The CIP Networks Library, Volume 3, DeviceNet™ Adaptation of CIP, Ed. 1.14, Nov 2013)

3.3.2 Network Status

The bi–color (Green/Red) LED indicates the status of the communication link as required in the DeviceNet™ standard.

For this state:	LED is:	To indicate:
Not Powered/Not On-line	Off	Device is not on-line. – The device has not completed the Dup_MAC_ID test yet. – The device may not be powered, look at Module Status LED. – No network power present.
On-line. Not Connected	Flashing Green[1]	Device is on-line but has no connections in the established state. – The device has passed the Dup_MAC_ID test, is on-line, but has no established connections to other nodes. – For a Group 2 Only device it means that this device is not allocated to a master. – For a UCMM capable device it means that the device has no established connections.
Link OK On-line, Connected	Green	The device is on-line and has connections in the established state. – For a Group 2 Only device it means that the device is allocated to a Master. – For a UCMM capable device is means that the device has one or more established connections.
Connection Time-Out	Flashing Red[1]	One or more I/O Connections are in the Timed-Out state.
Critical Link Failure	Red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network. (Duplicate MAC ID, or Bus-off).
Communication Faulted and Received an Identify Comm Fault Request - Long Protocol	Flashing Red & Green[2]	A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request - Long Protocol message.
[1]For information on LED flash rates, refer to section 9-2.8		
[2]For information on LED flash rates, refer to Chapter 2, section 2-11.4.3		

Figure 4: Network Status States (from Table 9-2.2 of The CIP Networks Library, Volume 3, DeviceNet™ Adaptation of CIP, Ed. 1.14, Nov 2013)

3.3.3 Node Address

The Node Address displays the current address of the CommPro module. For DeviceNet™, a valid address must be assigned to the CommPro by the user before bus communication can begin.

Default Address
DeviceNet™: 63

3.3.4 Baud Rate

The tri-color (Red/Green/Blue) LED displays the data rate of messages originating from the CommPro. The CommPro must use the same data rate as the DeviceNet™ network to be successfully commissioned. The CommPro ships with a default baud rate of 125K.

• 125K baud – Blue LED on

• 250K baud – Green LED on

• 500K baud – Red LED on

3.3.5 Product Status

The bi-color (Red/Blue) LED indicates normal operation by cycling the blue LED on and off every second. In the event of a fault state, the indicator will alternate between red and blue every second. To clear the fault state, the Calibration Switch must be pressed to retest any load connections.

The possible faults that can occur are:

• Limit Switch Fault – Both limit switches engaged at the same time

• Solenoid Overload – One of the load connections is drawing too much current

• VSM Overload – The total output load is too large for the CommPro

3.3.6 Open/Close

The bi-color (Red/Green) LED indicates the current position of the VSM, based on the limit switch state. When in the open position, the green LED is on; when in the close position, the red LED is on.

3.4 User Switches

3.4.1 Calibration Switch

Switch that enters the CommPro into an automated test of its output connections. Both outputs are individually and quickly cycled (< 0.1s on time), which allows for the power draw of each load to be measured. In the event of excessive power draw at one or both load connections, a fault state will be entered.

If a fault state is active, then the Calibration Switch should be pressed for the load(s) to be retested. This ensures that the fault condition has been corrected by the user.

3.4.2 Baud Rate Switch

Switch that allows for the operating baud rate of the CommPro to be adjusted. When this switch is pressed, the baud rate indicator will begin flashing, indicating that it is adjustable. Every subsequent press of the switch will increment the baud rate to the next highest value. Once the highest baud rate is reached, pressing the switch again will return to the lowest baud rate value. Once the desired baud rate has been selected, the baud rate switch should not be pressed for at least 3 seconds. In that time, the CommPro will set the baud rate to the new value.

Valid Baud Rates
125K, 250K, 500K

3.4.3 Node Address Switches

Switches that allow the address of the CommPro to be adjusted. When either of these buttons are pressed, the node address display will begin flashings, indicating that it is adjustable. Pressing one of the switches while the node address display flashes will cause the address to increment or decrement, dependent on which switch is pressed. Holding one of the switches while the node address display flashes will automatically increment the node address every 0.25 seconds. Once the desired address has been selected, the node address switches should not be pressed for at least 3 seconds. In that time, the CommPro will set the address to the new value.

Valid Address Range
DeviceNet™: 0-63

4.0 DEVICENET™ INTERFACE

4.1 Configuration

When adding the CommPro to a DeviceNet™ network, it must have a unique node address. The CommPro ships with a node address of 63 and baud rate of 125K, which are the default values for a new device. If the CommPro is added to a network with either a conflicting MAC ID or incorrect Baud rate, the network will not be affected, but the CommPro will be taken offline as indicated by a solid red color on the Network LED. The unit must then be removed from the network and returned after the conflicts have been resolved.

4.2 Commissioning

Commissioning is the process of taking the CommPro from the on-line state to establishing a dedicated connection with a master on the network. The controller supports a Polled network connection and an Explicit message connection. These connections are supported simultaneously but only one connection of each type is supported at a time.

When the controller transitions from the On-line state to the Commissioned state, the Network LED will change from flashing green to a solid green. When the Master / Slave relationship is released, the Network Led will return to a flashing green.

The Process Controller needs to have the information contained in the EDS file of the CommPro referenced before commissioning will occur.

4.2.1 EDS File

An EDS (Electronic Data Sheet) is an external file that contains information about configurable attributes for a device, including object addresses of each parameter. The EDS provides the user with a simple to use interface for configuring and monitoring a device.

The EDS file is included with the CommPro to aide in commissioning. Products such as the Process Controller will use the EDS to automatically obtain the data that is required for configuration. When the CommPro EDS file is accessed through an application, all the parameters available for monitoring and configuration are displayed. EDS parameters which are settable can be modified and saved to the CommPro.

Depending upon the EDS enabled application that is used, features such as monitoring are available which provide the user with a continuously updated display of the selected parameter group.

4.3 Communication

All communication with the CommPro takes place over the DeviceNet™ network. The DeviceNet™ interface gives the user the ability to control and monitor the CommPro. The CommPro supports standard DeviceNet™ Polled and Explicit messaging connections.

4.3.1 Polled Message Connection

A polled message connection provides a Master with the ability to rapidly send and receive short messages to all devices on a network in a cyclic fashion. This is typically the main communication mode of a process controller.

The Polled message sent by the master must be 1 byte in size, which the CommPro responds to with 2 bytes. All bytes received by the CommPro are referred to as consumed bytes and all bytes transmitted by the CommPro are referred to as produced bytes.

Produced Message	
Connection Path	Class 4 (Assembly), Instance 101, Attribute 3
Size	2 bytes
Description	Provides position & status information. Message composition shown below.

9988443322222222

99 – 2 bits – Same format as parameter 9

88 – 2 bits – Same format as parameter 8

44 – 2 bits – Same format as parameter 4

33 – 2 bits – Same format as parameter 3

22222222 – 8 bits – Same format as parameter 2

Consumed Message	
Connection Path	Class 4 (Assembly), Instance 100, Attribute 3
Size	1 byte
Description	Accepts a position command. Uses the same format as Parameter 1 in the Supported Attributes.

4.3.2 Explicit Message Connection

An explicit message connection provides the Master with the ability to directly access a parameter that is supported by the CommPro. These parameters are accessed by using the "GET" or "SET" DeviceNet™ attribute service.

4.4 Supported Attributes

The CommPro supports attributes in Application Class 100, Instance 1, which provide access to the features that are also accessible in the EDS (Electronic Data Sheet). These attributes are provided in the event the user wishes to monitor or control aspects of the controller beyond a polled message connection.

A Process Controller will typically access the CommPro through a polled message connection. To monitor or control additional features of the CommPro, an explicit message must be sent to the appropriate attribute. All attributes can be read (GET service) and written (SET Service) unless otherwise noted.

The EDS (Electronic Data Sheet) file, which is provided with the CommPro, contains the most current information pertaining to attribute data. Use the EDS as a reference for data types, data formats, and data conversion. Also check the Bray website to obtain the latest EDS file for the CommPro (www.bray.com).

Param	Attribute Description	Attribute (Hex)	Attribute (Decimal)
1	Command Position	0x64	100
2	Valve Position[1]	0x65	101
3	Limit Switches[1]	0x66	102
4	Auxiliary Switches[1]	0x67	103
5	Enable Failure Detect	0x68	104
6	Failure Command State	0x69	105
7	Product Status[1]	0x6A	106
8	Load 1 Status[1]	0x6B	107
9	Load 2 Status[1]	0x6C	108
12	Serial Number[1]	0xC0	192

[1] Attributes which are not settable.

Table 1: S5B/C DeviceNet™ supported attributes

4.4.1 Attribute Definitions

4.4.1.1 Parameter 1 – Command Position

Attribute	100
Size	1 byte
Read/Write	R/W
Description	Allows for position control through the operation of the output loads. 0 – All loads off (default) 1 – Load 1 on 2 – Load 2 on 3 – All loads on 4 – Load test

4.4.1.2 Parameter 2 – Valve Position

Attribute	101
Size	1 byte
Read/Write	R
Range	0-100% (0-255)
Description	Reports the current position of the valve. 0% – Fully closed 100% – Fully open

4.4.1.3 Parameter 3 – Limit Switches

Attribute	102
Size	1 byte
Read/Write	R
Description	Reports the state of the limit switches. 0 – Limit Switches off 1 – Open Limit Switch engaged 2 – Close Limit Switch engaged 3 – Both Limit Switches engaged

4.4.1.4 Parameter 4 – Auxiliary Switches

Attribute	103
Size	1 byte
Read/Write	R
Description	Reports the state of the auxiliary switches. 0 – Auxiliary Switches off 1 – Auxiliary Switch 1 engaged 2 – Auxiliary Switch 2 engaged 3 – Both Auxiliary Switches engaged

4.4.1.5 Parameter 5 – Enable Failure Detect

Attribute	104
Size	1 byte
Read/Write	RW
Description	Determines if the S5B/C DeviceNet™ will operate to a set position in the event of DeviceNet™ communication failure. 0 – Disabled (default) 1 – Enabled

4.4.1.6 Parameter 6 – Failure Command State

Attribute	105
Size	1 byte
Read/Write	RW
Description	Determines the position the S5B/C DeviceNet™ operates to in the event of a DeviceNet™ communication failure. 0 – All loads off (default) 1 – Load 1 on 2 – Load 2 on 3 – All loads on

4.4.1.7 Parameter 7 – Product Status

Attribute	106
Size	1 byte
Read/Write	R

Description	Indicates the presence of any faults that may be preventing operation.
	0 – Normal
	1 – Load Testing
	2 – Limit Switch Fault
	   (Both switches engaged)
	3 – Channel Overload
	   (Too much current – single load)
	4 – VSM Overload
	   (Too much current – total load)

4.4.1.8 Parameter 8 – Load 1 Status

Attribute	107
Size	1 byte
Read/Write	R
Description	Displays the status of the load at the Solenoid 1 connection. 0 – No load detected (Open circuit) 1 – Normal 2 – Overloaded 3 – Short circuit

4.4.1.9 Parameter 9 – Load 2 Status

Attribute	108
Size	1 byte
Read/Write	R
Description	Displays the status of the load at the Solenoid 2 connection. 0 – No load detected (Open circuit) 1 – Normal 2 – Overloaded 3 – Short circuit

4.4.1.10 Parameter 12 – Serial Number

Attribute	192
Size	4 bytes
Read/Write	R
Description	Provides the factory assigned serial number for the unit.

5.0 QUICK START GUIDE

1. If installation of the CommPro is required, follow the Installation Instructions.

2. If necessary, load the EDS file into the Process Controller.

3. Apply power to the DeviceNet™ network. The CommPro will individually light all LEDs as part of the initialization procedure. Initialization is complete once the Module Status light is solid green.

4. Adjust the CommPro Node Address to the next available address on the bus, or to the address that has been programmed into the Process Controller.

5. The Network LED should begin to flash green at 0.5 second intervals. This indicates that the CommPro has recognized the DeviceNet™ network and is ready to be commissioned by the Process Controller.

6. Once commissioned, press the Calibration switch to detect the state of the connected output loads.

7. Product is ready for service.

6.0 INSTALLATION INSTRUCTIONS

1. Before beginning installation of the electronics package, install all external cabling at the conduit entries for the Bray VSM enclosure. Unused conduit entries should retain the supplied plugs.

2. Install all ground wires to the Bray VSM enclosure supplied ground screw(s).

3. Install the supplied electronics package mounting bracket using the supplied mounting hardware, e.g. flathead screws.

4. Orient the electronics package such that the 11 terminals are orientated towards the front of the Bray VSM.
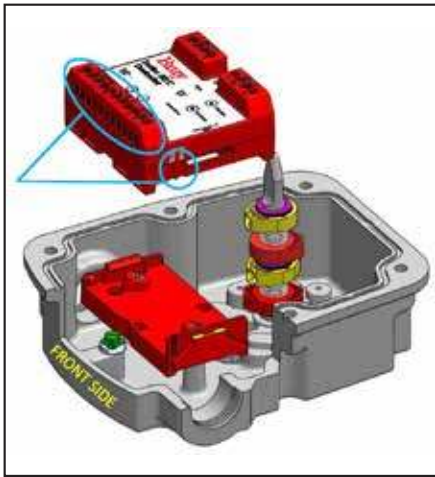

Figure 6: Correct orientation of the electronics package relative to Bray VSM & mounting bracket

5. Align the side slot on the electronics package with the notch on the mounting bracket, based on the Bray VSM (5B or 5C) that it is being installed in.
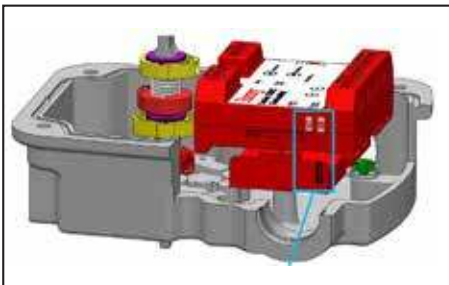

Figure 7: Alignment of appropriate slot

6. Pitch the electronics unit during installation to engage the horizontal slot on the electronics package with the non-adjustable hook of the mounting bracket.
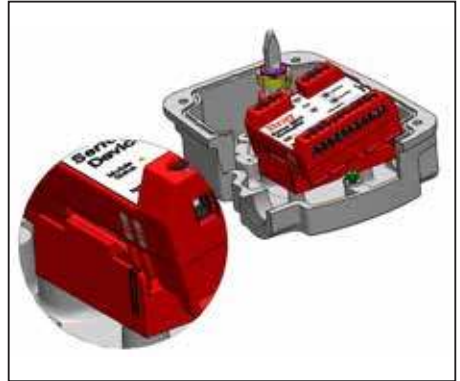

Figure 8: Pitching of the electronics package to begin installation

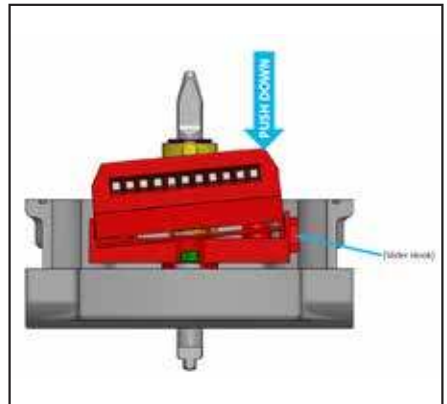7. Push down on the electronics package to snap it into place on the mounting bracket.

Figure 9: Push down on electronics package until the slider hook snaps in place

8. Mate all required wire terminations based on the provided wiring diagram.

7.0 EXPLODED VIEW DRAWINGS

7.1 Exploded View - 5B

ITEM	PART NUMBER	DESCRIPTION	QTY
1	5B0000-77600536	CommPro Assembly, DeviceNet	1
2	075303-72105534	Screw, Flat Head, X-Drive	2
3	5B0000-23500536	Commpro Adapter Assembly	1
4	5B0000-73306533	Commpro Certification Label, Mylar	1
5	5B0000-73304533	Commpro Serial Tag, Mylar	1
ALTERNATIVE COMPONENTS			
1	5B0000-77601536	CommPro Assembly, AS-i	1
1	5B0000-77602536	CommPro Assembly, Profibus-DP	1
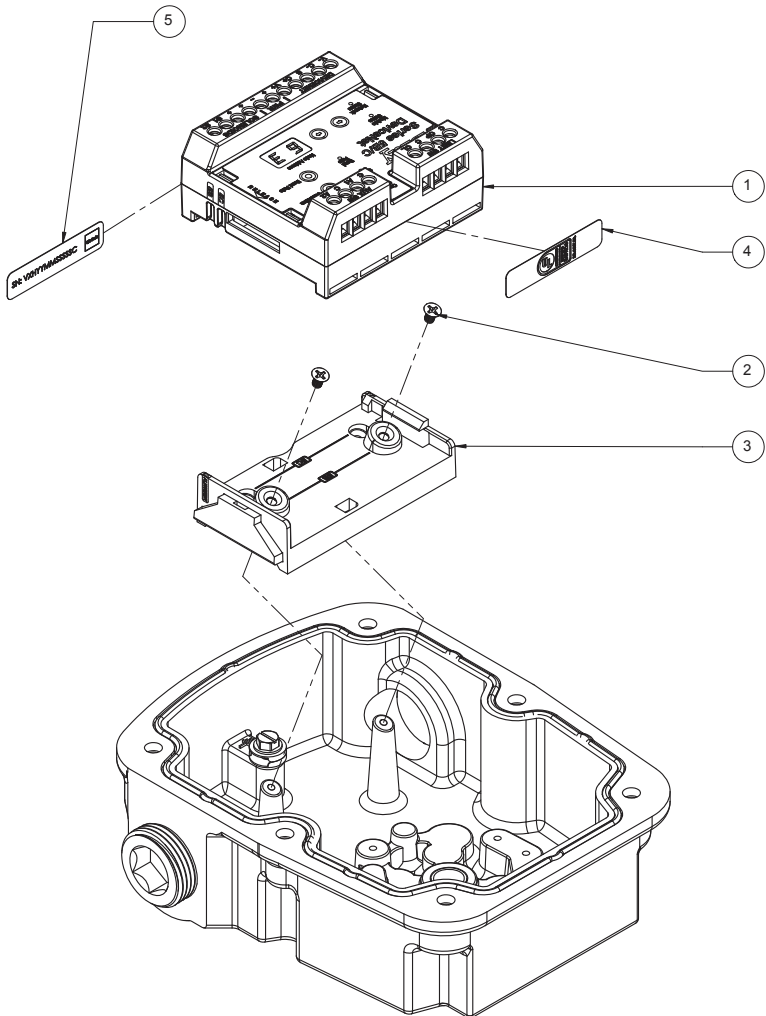
7.1 Exploded View - 5C

ITEM	PART NUMBER	DESCRIPTION	QTY
1	5B0000-77600536	CommPro Assembly, DeviceNet	1
2	5B0000-73306533	CommPro Certification Label, Mylar	1
3	075303-72105534	Screw, Flat Head, X-Drive, M3x0.5x5mm	2
4	5B0000-23500536	CommPro Adapter Assembly	1
5	5B0000-73304533	CommPro Serial Tag, Mylar	1
ALTERNATIVE COMPONENTS			
1	5B0000-77601536	CommPro Assembly, AS-i	1
1	5B0000-77602536	CommPro Assembly, Profibus-DP	1
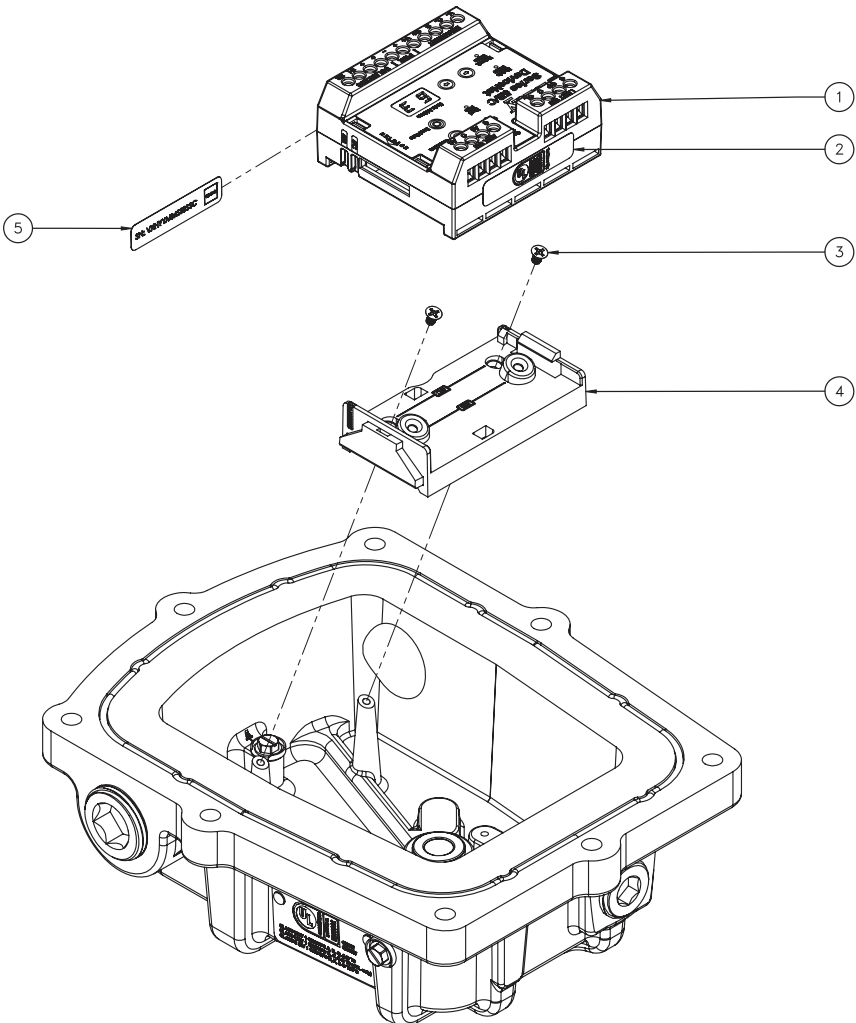
8.0 TECHNICAL SPECIFICATIONS

Mechanical	
Electronics Enclosure Material	PC/ABS Blend
Mounting Bracket Material	Glass-filled Nylon
Dimensions with bracket	3.05" x 2.53" x 1.43" [77.5 x 64.3 x 36.3mm]
Dimensions w/o bracket	2.73" x 2.53" x 1.21" [69.3 x 64.3 x 30.7mm]
Weight	Max 3.5 oz [100g]
Terminals	
Wire Gauge	26-16 AWG [0.13-1.31 mm2]
Torque Limit	3.5 in-lbs [15.6 N]
Temperature Rating	-13 to 149°F [-25 to 65°C]
Installation	Designed for use within Bray VSMs
Switch connections	Only switches approved for use within Bray VSMs should be used with the product

Electrical	
Input Voltage	24 VDC ± 10%
Power Consumption	16 W Max
Load(s)	24 VDC Solenoids
# of Load Connections	2 Max
Load Switch	Solid-State (NMOS Open-Drain)
Load Limit	6.9 W per load 13.8 W max
LED Wavelengths	
Red	630 nm
Green	550 nm
Blue	470 nm
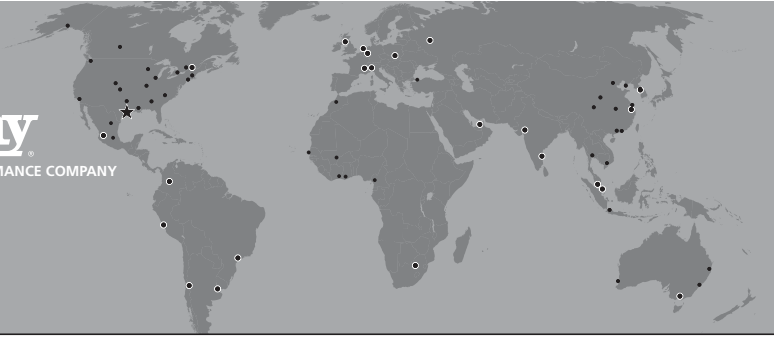
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