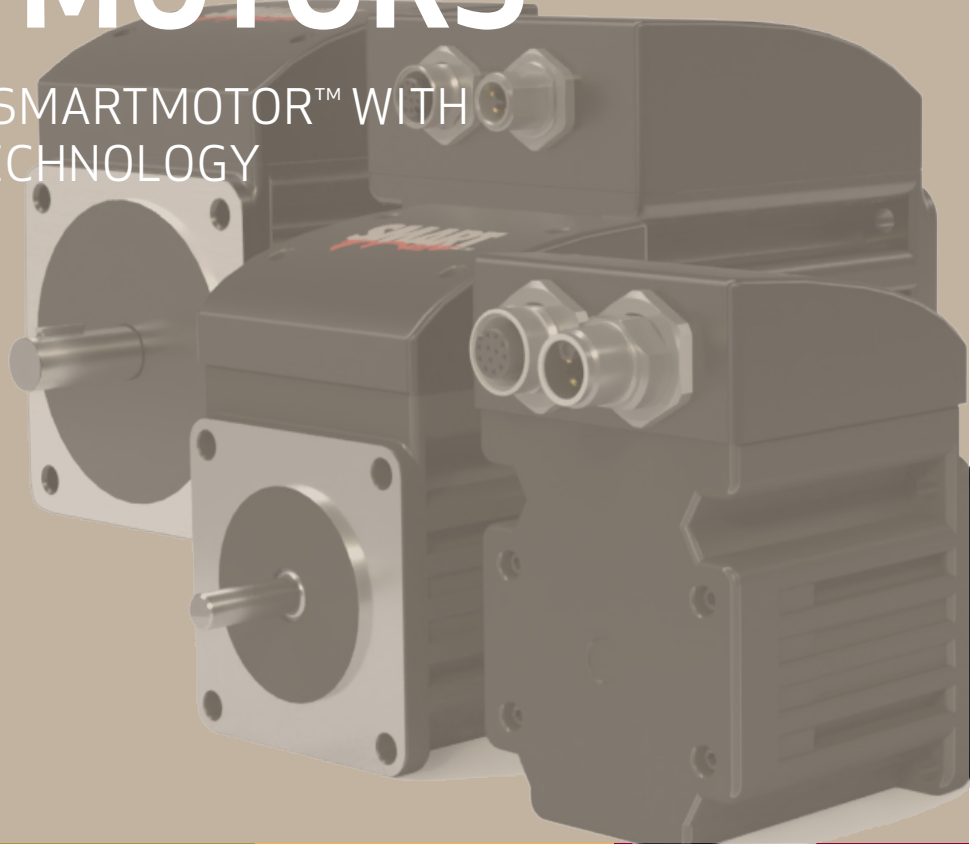


INSTALLATION AND STARTUP FOR

FULLY INTEGRATED SERVO MOTORS

CLASS 5 S-STYLE SMARTMOTOR™ WITH
COMBITRONIC™ TECHNOLOGY



Rev. D, March 2023

DESCRIBES THE INSTALLATION AND
STARTUP OF THE CLASS 5 S-STYLE
SMARTMOTOR™

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Moog Animatics Class 5 S-Style SmartMotor™ Installation and Startup Guide, Rev. D, PN: SC80100019-001.

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Please let us know if you find any errors or omissions in this manual so that we can improve it for future readers. Such notifications should contain the words " S-Style Installation and Startup Guide" in the subject line and be sent by e-mail to: animatics_marcom@moog.com. Thank you in advance for your contribution.

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Introduction

This chapter provides information on the purpose of the manual, safety information, and additional documents and resources.

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Purpose

The *S-Style SmartMotor™ Installation and Startup Guide* (the document you are currently reading) provides an overview of the S-style SmartMotor, along with information on unpacking, installation and start up. This guide is meant to be used in conjunction with the *SmartMotor™ Developer's Guide*, which describes the SmartMotor features, SMI software, programming, commands, and other topics related to SmartMotor application development.

NOTE: The features described in this guide apply to the S-style SmartMotor with firmware version 5.0.4.55 or later.

The information in this guide is meant to be used by properly trained technical personnel only. Moog Animatics conducts classroom-style SmartMotor training several times per year, as well as product seminars and other training opportunities. For more information, please see the Moog Animatics website or contact your Moog Animatics representative.

Combitronic Technology

NOTE: This feature requires an S-style SmartMotor with the CANopen option.

The most unique feature of the SmartMotor is its ability to communicate with other SmartMotors and share resources using Moog Animatics' Combitronic™ technology. Combitronic is a protocol that operates over a standard CAN interface. It may coexist with either the CANopen or DeviceNet protocols. It requires no single dedicated controller¹ to operate. Each SmartMotor connected to the same network communicates on an equal footing, sharing all information, and therefore, sharing all processing resources.

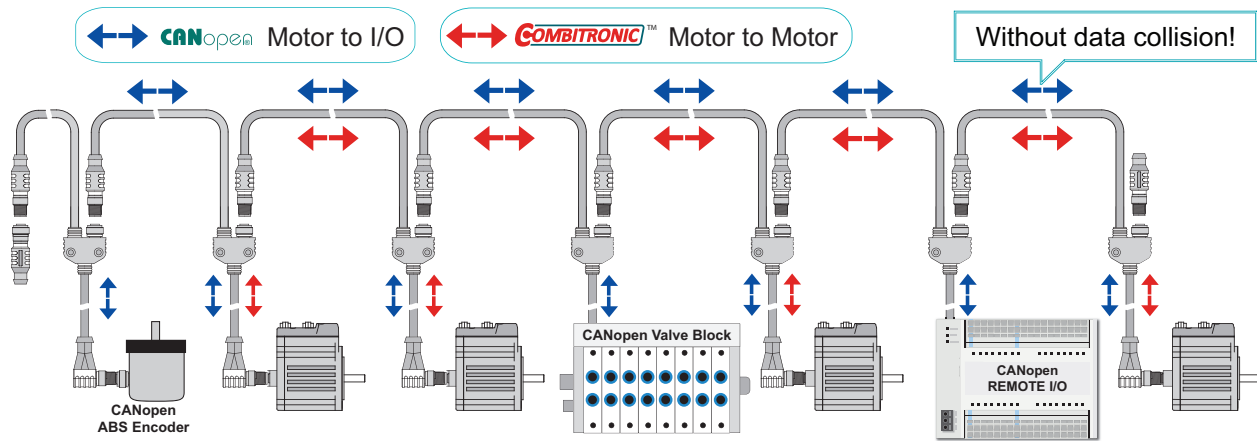
For additional details, see the *SmartMotor™ Developer's Guide*.

I/O Device CAN Bus Controller

NOTE: This feature requires an S-style SmartMotor with the CANopen option.

Expanded I/O capability allows the SmartMotor to interface with standard CiA 301 CANopen devices and function as the I/O device CAN bus controller (i.e., no external bus controller is needed). For more details, see the *SmartMotor™ Developer's Guide*. For CANopen object descriptions, see the *SmartMotor™ CANopen Guide*.

¹Moog Animatics has replaced the terms "master" and "slave" with "controller" and "follower", respectively.



Be sure to comply with the guidelines for CAN bus cabling and termination.

SmartMotor as I/O Device CAN Bus Controller

Safety Information

This section describes the safety symbols and other safety information.

Safety Symbols

The manual may use one or more of these safety symbols:



WARNING: This symbol indicates a potentially nonlethal mechanical hazard, where failure to comply with the instructions could result in serious injury to the operator or major damage to the equipment.



CAUTION: This symbol indicates a potentially minor hazard, where failure to comply with the instructions could result in slight injury to the operator or minor damage to the equipment.

NOTE: Notes are used to emphasize non-safety concepts or related information.

Other Safety Considerations

The Moog Animatics SmartMotors are supplied as components that are intended for use in an automated machine or system. As such, it is beyond the scope of this manual to attempt to cover all the safety standards and considerations that are part of the overall machine/system design and manufacturing safety. Therefore, this information is intended to be used only as a general guideline for the machine/system designer.

It is the responsibility of the machine/system designer to perform a thorough "Risk Assessment" and to ensure that the machine/system and its safeguards comply with the safety standards specified by the governing authority (for example, ISO, OSHA, UL, etc.) for the site where the machine is being installed and operated. For more details, see Machine Safety on page 9.

Motor Sizing

It is the responsibility of the machine/system designer to select SmartMotors that are properly sized for the specific application. Undersized motors may: perform poorly, cause excessive downtime or cause unsafe operating conditions by not being able to handle the loads placed on them. The *System Best Practices* document, which is available on the Moog Animatics website, contains information and equations that can be used for selecting the appropriate motor for the application.

Replacement motors must have the same specifications and firmware version used in the approved and validated system. Specification changes or firmware upgrades require the approval of the system designer and may require another Risk Assessment.

Environmental Considerations

It is the responsibility of the machine/system designer to evaluate the intended operating environment for dust, high-humidity or presence of water (for example, a food-processing environment that requires water or steam wash down of equipment), corrosives or chemicals that may come in contact with the machine, etc. Moog Animatics manufactures specialized IP-rated motors for operating in extreme conditions. For details, see the *Moog Animatics Product Catalog*.

Machine Safety

In order to protect personnel from any safety hazards in the machine or system, the machine/system builder must perform a "Risk Assessment", which is often based on the ISO 13849 standard. The design/implementation of barriers, emergency stop (E-stop) mechanisms and other safeguards will be driven by the Risk Assessment and the safety standards specified by the governing authority (for example, ISO, OSHA, UL, etc.) for the site where the machine is being installed and operated. The methodology and details of such an assessment are beyond the scope of this manual. However, there are various sources of Risk Assessment information available in print and on the internet.

NOTE: The next list is an example of items that would be evaluated when performing the Risk Assessment. Additional items may be required. The safeguards must ensure the safety of all personnel who may come in contact with or be in the vicinity of the machine.

In general, the machine/system safeguards must:

- Provide a barrier to prevent unauthorized entry or access to the machine or system. The barrier must be designed so that personnel cannot reach into any identified danger zones.
- Position the control panel so that it is outside the barrier area but located for an unrestricted view of the moving mechanism. The control panel must include an E-stop mechanism. Buttons that start the machine must be protected from accidental activation.
- Provide E-stop mechanisms located at the control panel and at other points around the perimeter of the barrier that will stop all machine movement when tripped.
- Provide appropriate sensors and interlocks on gates or other points of entry into the protected zone that will stop all machine movement when tripped.
- Ensure that if a portable control/programming device is supplied (for example, a hand-held operator/programmer pendant), the device is equipped with an E-stop mechanism.

NOTE: A portable operation/programming device requires *many* additional system design considerations and safeguards beyond those listed in this section. For details, see the safety standards specified by the governing authority (for example, ISO, OSHA, UL, etc.) for the site where the machine is being installed and operated.

- Prevent contact with moving mechanisms (for example, arms, gears, belts, pulleys, tooling, etc.).

- Prevent contact with a part that is thrown from the machine tooling or other part-handling equipment.
- Prevent contact with any electrical, hydraulic, pneumatic, thermal, chemical or other hazards that may be present at the machine.
- Prevent unauthorized access to wiring and power-supply cabinets, electrical boxes, etc.
- Provide a proper control system, program logic and error checking to ensure the safety of all personnel and equipment (for example, to prevent a run-away condition). The control system must be designed so that it does not automatically restart the machine/system after a power failure.
- Prevent unauthorized access or changes to the control system or software.

Documentation and Training

It is the responsibility of the machine/system designer to provide documentation on safety, operation, maintenance and programming, along with training for all machine operators, maintenance technicians, programmers, and other personnel who may have access to the machine. This documentation must include proper lockout/tagout procedures for maintenance and programming operations.

It is the responsibility of the operating company to ensure that:

- All operators, maintenance technicians, programmers and other personnel are tested and qualified before acquiring access to the machine or system.
- The above personnel perform their assigned functions in a responsible and safe manner to comply with the procedures in the supplied documentation and the company safety practices.
- The equipment is maintained as described in the documentation and training supplied by the machine/system designer.

Additional Equipment and Considerations

The Risk Assessment and the operating company's standard safety policies will dictate the need for additional equipment. In general, it is the responsibility of the operating company to ensure that:

- Unauthorized access to the machine is prevented at all times.
- The personnel are supplied with the proper equipment for the environment and their job functions, which may include: safety glasses, hearing protection, safety footwear, smocks or aprons, gloves, hard hats and other protective gear.
- The work area is equipped with proper safety equipment such as first aid equipment, fire suppression equipment, emergency eye wash and full-body wash stations, etc.
- There are no modifications made to the machine or system without proper engineering evaluation for design, safety, reliability, etc., and a Risk Assessment.

Safety Information Resources

Additional SmartMotor safety information can be found on the Moog Animatics website; open the topic "Controls - Notes and Cautions" located at:

<https://www.animatics.com/support/downloads/knowledgebase/controls---notes-and-cautions.html>

OSHA standards information can be found at:

<https://www.osha.gov/law-regs.html>

ANSI-RIA robotic safety information can be found at:

<http://www.robotics.org/robotic-content.cfm/Robotics/Safety-Compliance/id/23>

UL standards information can be found at:

<http://ulstandards.ul.com/standards-catalog/>

ISO standards information can be found at:

<http://www.iso.org/iso/home/standards.htm>

EU standards information can be found at:

http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/index_en.htm

Additional Documents

The Moog Animatics website contains additional documents that are related to the information in this manual. Please refer to these lists.

Related Guides

- Moog Animatics SmartMotor™ Installation and Startup Guides
<http://www.animatics.com/install-guides>
- *Class 6 D-Style SmartMotor™ Installation and Startup Guide*
<http://www.animatics.com/cl-6-d-style-install-startup-guide>
- *SmartMotor™ Developer's Guide*
<http://www.animatics.com/smartmotor-developers-guide>
- *SmartMotor™ Homing Procedures and Methods Application Note*
<http://www.animatics.com/homing-application-note>
- *SmartMotor™ System Best Practices Application Note*
<http://www.animatics.com/system-best-practices-application-note>

In addition to the documents listed above, guides for fieldbus protocols and more can be found on the website: <https://www.animatics.com/support/downloads/manuals.html>

Other Documents

- SmartMotor™ Certifications
<https://www.animatics.com/certifications.html>

- *SmartMotor Developer's Worksheet*
(interactive tools to assist developer: Scale Factor Calculator, Status Words, CAN Port Status, Serial Port Status, RMODE Decoder and Syntax Error Codes)
<https://www.animatics.com/support/downloads.knowledgebase.html>
- *Moog Animatics Product Catalog*
<http://www.animatics.com/support/moog-animatics-catalog.html>

Additional Resources

The Moog Animatics website contains useful resources such as product information, documentation, product support and more. Please refer to these addresses:

- General company information:
<http://www.animatics.com>
- Product information:
<http://www.animatics.com/products.html>
- Product support (Downloads, How-to Videos, Forums and more):
<http://www.animatics.com/support.html>
- Contact information, distributor locator tool, inquiries:
<https://www.animatics.com/contact-us.html>
- Applications (Application Notes and Case Studies):
<http://www.animatics.com/applications.html>

SmartMotor Overview

This chapter provides an overview of the design philosophy and functionality of the Moog Animatics SmartMotor. It also provides information on SmartMotor features and options, and where to find related documents and additional resources.

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SmartMotor Introduction

The Moog Animatics SmartMotor™ servo is an industrial servo motor with motion controller integrated into a compact package. Its design is based on these objectives:

1. Reduce development time
2. Lower machine-production cost
3. Simplify the machine (design, build and support)



Class 5 S-Style SmartMotor (34- and 23-frame)

The SmartMotor is powerful and unique because of its ability to control an entire machine. The combination of programmability, networking, I/O and servo performance is unmatched. The SmartMotor brings savings and value to the machine builder by removing complex and costly elements in the machine design, such as PLCs, sensors, I/O blocks, cabinets, etc.

SmartMotor Features and Options

NOTE: All specifications are subject to change without notice. Consult the factory for the latest information.

All SmartMotors offer these features:

- Full floating-point math and trigonometric functions with 32-bit precision results
- Dual trajectory generators enabling relative and absolute position moves or velocity moves on top of gearing or camming
- Advanced gearing allowing preset traverse and take-up winding parameters including dwells and wrap counts

- Advanced camming including cubic spline interpolation and dynamic frequency and amplitude changes. Add onto gearing for complex traverse and take-up winding patterns.
- Stand-alone, multi-axis linear interpolation with as many as 120 SmartMotors at a time
- Virtual-axis control into camming through gearing, which enables stand-alone, multi-axis coordinated motion
- Programmable and non-programmable protection features (both hardware and software)

A note about SmartMotor part numbers:

The SmartMotor uses a coded part number, which contains characters that describe the motor number, frame style and options. For details on decoding the SmartMotor part number, refer to the Understanding SmartMotor Part Numbers document at this address:

<https://www.animatics.com/support/downloads.knowledgebase.html>

S-Style Motors

NOTE: In addition to this information, see Other S-Style Motor Changes on page 56 for limitations of certain models.

S-style SmartMotors have:

- Depending on options selected, there can be a primary RS-232 communications port
- Depending on options selected, there can be a secondary RS-485 communications port
- Depending on options selected, there can be six channels of 5 VDC TTL non-isolated I/O
- Depending on options selected, there can be a dedicated, single-ended encoder output

These industrial (Fieldbus protocol) communications options are available on the S-style motors. (Availability varies by model number; contact the factory for details.)

- CANopen option

For more details, see Fieldbus Options on page 16.

For the S-style motors, these features require an option that provides RS-485 communication:

- Modbus Remote Terminal Unit (RTU) Follower (RS-485 COM 1)
- DMX Follower (RS-485 COM 1)

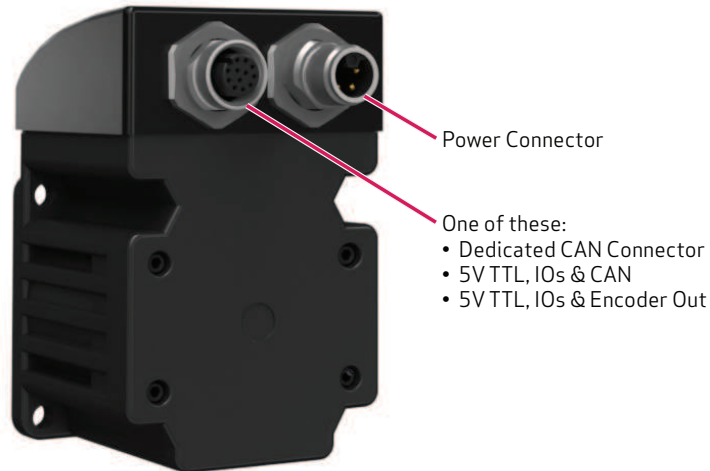
In addition, a hardware DE power option is standard, which allows the controller and drive amplifier to be powered from separate power sources. For more details, see Dual Power Configuration on page 17.

The S-Style motors are also IP65 sealed, except for the motor shaft, allowing them to be used in wet environments if mounted shaft-down or to a sealed surface (like an IP-sealed gearbox). For more details, see IP65 Motors on page 18.

The S-style motors are available in these NEMA frame sizes:

- NEMA 23
- NEMA 34

The next figure shows the connector locations for the S-style motors. For details on the S-style motor connectors, see Motors: Connectors and Pinouts on page 1.



S-Style Motor Connectors

Fieldbus Options

This section details the Fieldbus communications protocol options that are available on certain models of S-style SmartMotors.

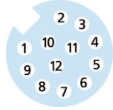
CANopen Fieldbus Protocol

NOTE: This protocol is available on certain S-style SmartMotors.

The CANopen fieldbus protocol provides these features:

- Basic motion commands available through the CiA V4.02 specification
- Ability to read/write SmartMotor variables
- Use of onboard I/O through CANopen, SmartMotor programs or serial commands
- Ability to run 1000 SmartMotor subroutines through CANopen
- Online diagnostics of the SmartMotor through SMI software and serial connection
- Logical addressing for 127 nodes
- User program status/interrupts can be triggered by receive PDOs
- Baud rates of 20 Kbps, 50 Kbps, 125 Kbps (default), 250 Kbps, 500 Kbps and 1 Mbps

Com/6xIO/CAN

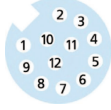


12-Pin, Com/6xIO/CAN Connector
(female is standard)

CANopen Pins:

- 7 CAN-L
- 8 CAN-H

Com/4xIO/CAN



12-Pin, Com/4xIO/CAN Connector
(female is standard)

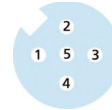
CANopen Pins:

- 5 CAN-L
- 6 CAN-H
- 7 CAN-L
- 8 CAN-H

NOTE: These 3 options apply to the connector below that is circled in red.



CAN Only



5-Pin, CANopen Connector
(female is standard)

CANopen Pins:

- 4 CAN-H
- 5 CAN-L

Dual Power Configuration

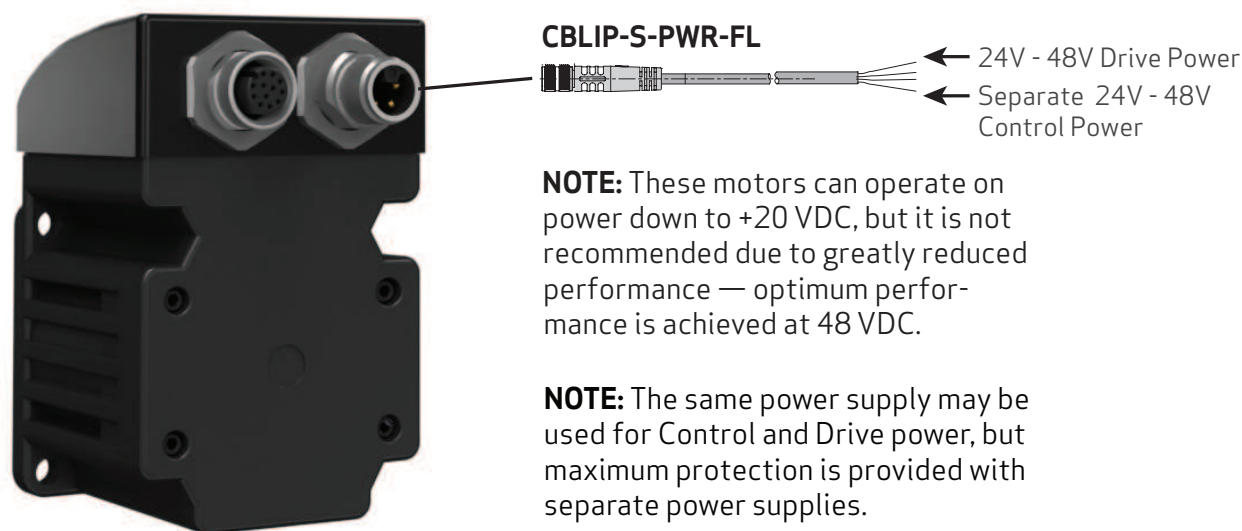
The S-style SmartMotor's hardware dual power configuration allows the controller and drive amplifier to be powered from separate DC power supplies (see the next figure).

This configuration provides these advantages:

- Controller can be powered from a standard 24-48 power supply
- Position will not be lost if drive power is lost
- No need to re-home
- Load surges will not cause a power surge on the controller

NOTE: All S-style SmartMotors are designed to allow the use of separate drive and control power supplies. No special ordering option is needed for those SmartMotors.

The next figure shows the connectors used for the power configuration.



S-Style SmartMotor Showing Dual Power Configuration

IP65 Motors

Certain models of SmartMotors, including the S-style, are available in IP-rated versions (see the *Moog Animatics Product Catalog* for details). The standard IP rating is IP65, which protects the motor from dust particles and splashing water. Contact Moog Animatics for details.



CAUTION: Although the S-style SmartMotor is IP65 rated, the motor's shaft is not sealed.

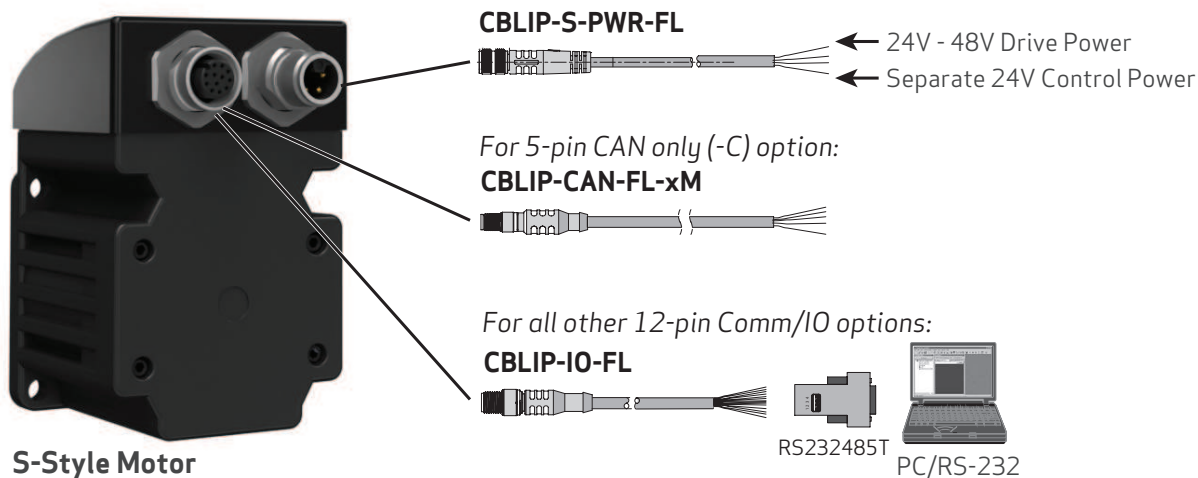
To be fully sealed for use in horizontal or shaft-up vertical applications, it must be mated, for example, to an IP-sealed gearhead with a sealed mounting surface or using a sealant (Loctite 574 or similar) between the mating surfaces.

Alternatively, it can be mounted in a shaft-down vertical orientation where the mounting surface itself may not necessarily be sealed.

IP ratings are in accordance with the code defined in international standard IEC 60529. Instead of the vague descriptions of "waterproof", "water-resistant" or "dustproof", the IP-rating system provides a uniform, quantifiable set of standards to which each product is rigorously tested. The IP code refers to the degree of protection for the electrical enclosures on a machine against liquid, solid objects and particulates. The first number after "IP" refers to the level of protection of the hazardous parts and electrical enclosures against solid objects and particulates, and the second digit indicates the level of water resistance. The higher the first digit rating in the IP system, the smaller the foreign object that it is protected against.

SmartMotors with the IP65 rating are both completely dust tight and protected from ingress of liquid that may occur from any angle (see CAUTION statement above), rendering no harmful effects on the electrical enclosure. The IP-rated models provide the perfect integrated servo for food and beverage manufacturing and packaging, rugged outdoor conditions, as well as any wet environment.

Note that there are special IP-rated cables, which are available from Moog Animatics, that are designed for use with the IP-rated SmartMotors. The next figure shows the cables, part numbers and corresponding connections.



IP-Rated Cables and Connections

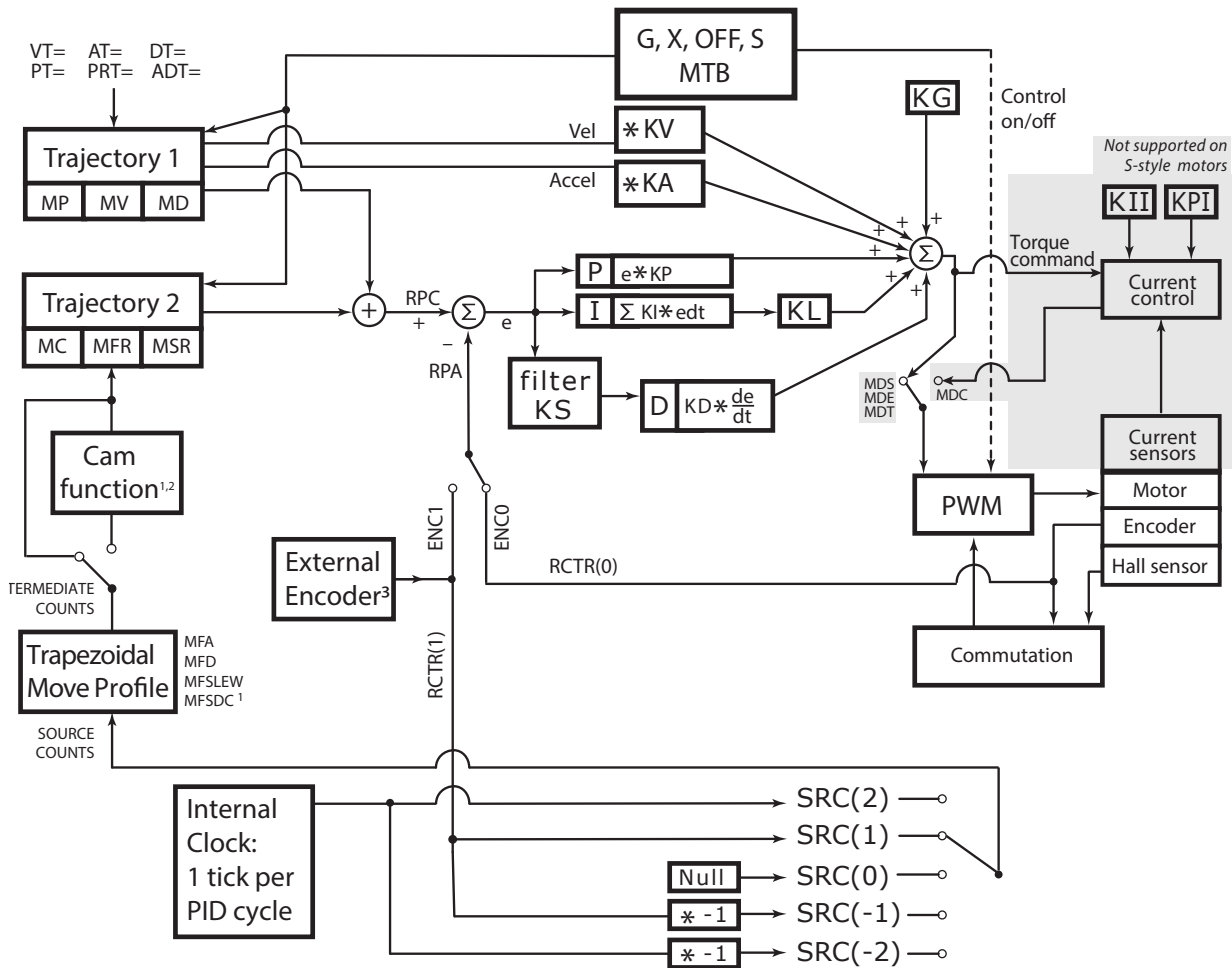
SmartMotor Theory of Operation

The Moog Animatics SmartMotor is an entire servo control system built inside of a servo motor. It includes a controller, an amplifier and an encoder. All that is required for it to operate is power and either an internal program or serial commands from outside (or both). To make the SmartMotor move, the program or serial host must set a mode of operation, state a target position with/or a maximum velocity at which to travel to that target, and a maximum acceleration. After these three parameters are set, a "Go" command starts the motion profile.

The core functional areas of the SmartMotor are:

- Motion Control Functions (see Motion Details in the *SmartMotor™ Developer's Guide*)
- System Control Functions (see Program Flow Details and see System Status in the *SmartMotor™ Developer's Guide*)
- Communication Functions (see Communication Details in the *SmartMotor™ Developer's Guide*)
- I/O Functions (see I/O Control in the *SmartMotor™ Developer's Guide*)

The next block diagram illustrates the relationship between the functional areas in the SmartMotor.



NOTES:

1. MFMUL and MFDIV commands do not have an effect on dwell time or distance. Dwell is strictly based on raw controller encoder counts selected by the SRC() command specifying internal virtual or external controller count source.
2. When feeding a Cam table with a gearing profile, changes to MFMUL and MFDIV will affect the time it takes to move through a Cam table but will not affect dwell time, as specified in the previous note.
3. External encoder is not available on the -C option models. See the Other S-Style Motor Changes topic for more information.

SmartMotor Theory of Operation Diagram

Getting Started

This chapter provides information on getting started with your SmartMotor.

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Unpacking and Verifying Your Shipment

Your Moog Animatics SmartMotor and accessories are carefully assembled, tested, inspected and packed at the factory.

When you receive your shipment, you should:

- Visually inspect all shipping containers for visible signs of shipping damage. If you see damage, please notify your carrier and then contact Moog Animatics to report the problem.
- Carefully unpack each component and verify the part number with your order. If there are any differences or missing items, please contact Moog Animatics so that the shipment can be corrected.
- Keep all boxes and packing materials. These may be needed for future storage or shipment of the equipment.

Installing the SMI Software

The SmartMotor Interface software (SMI software) provides a convenient user interface for programming the SmartMotor. Before you can use the SMI software, it must be installed on a Microsoft Windows PC.

The SMI software is distributed on CD-ROM or USB stick, and is also available as a download from the Moog Animatics website. To download the latest version of the SMI software, use this address:

<http://www.animatics.com/smi>

Then scroll to the bottom of the page and click the Free Download button.



SMI Download Button

The installation package is downloaded to your system.

NOTE: The SMI software requires Microsoft Windows XP or later.

Installation Procedure

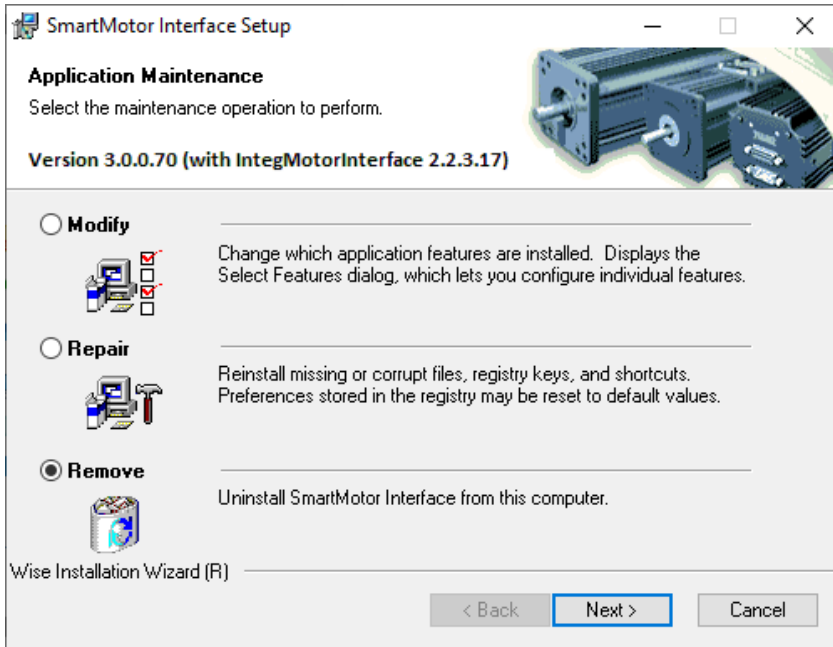
NOTE: Depending on the SMI software version and SmartMotor model being used, the software version and motor information may be different on your screens.

To install the SMI software:

1. Double-click the executable package (.MSI) file to begin the installation. In some versions of Microsoft Windows, you may receive a security warning message about running the file. You can ignore this message.

If this is a new installation, go to the next step.

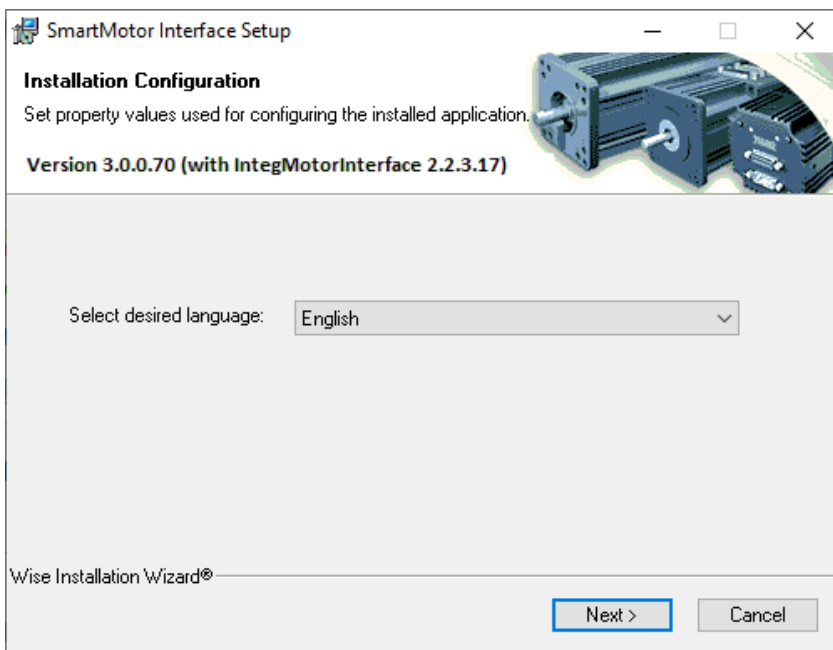
If this is an upgrade to a previous installation, you will see the window below. Select Remove, click Next and remove the existing software from your PC using the instructions.



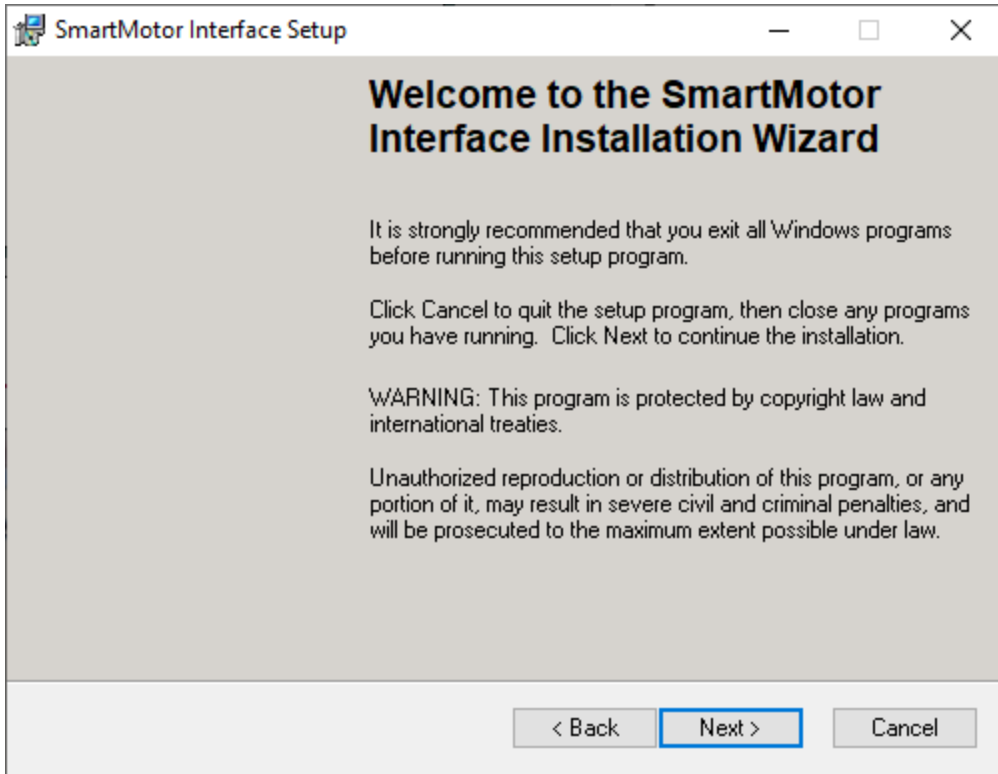
After removing the existing software, restart the installation process.

NOTE: All personal settings and user files will be retained.

2. Click Next to proceed. The Installation Configuration page opens.

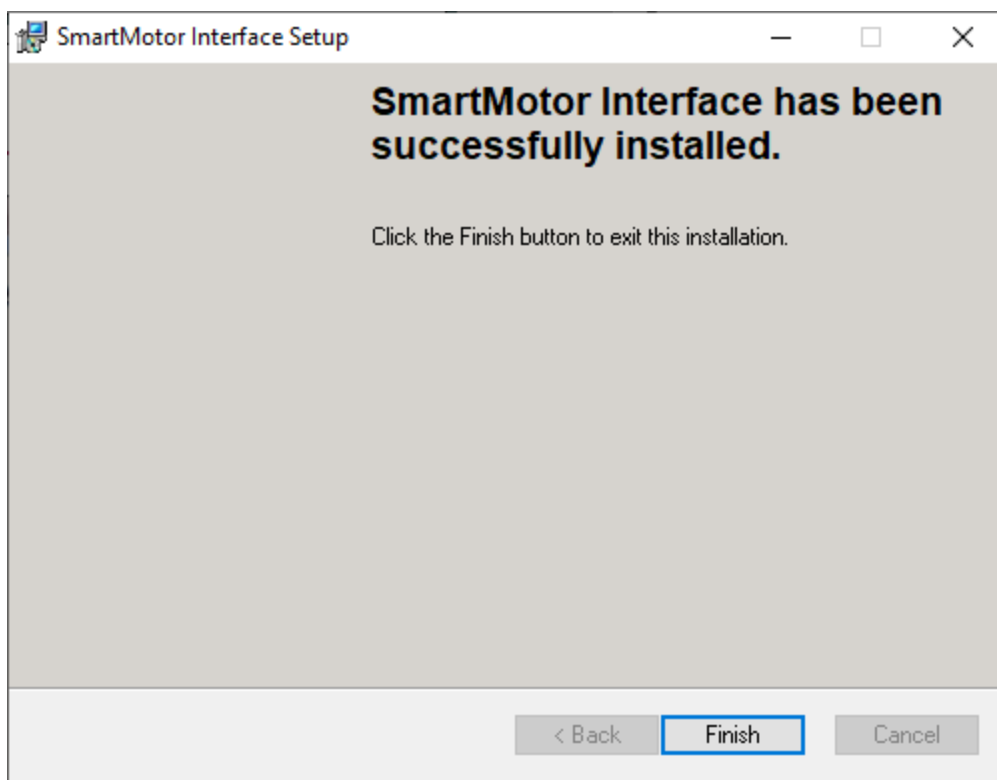


3. Click Next to proceed. The SMI software installation wizard starts and the Welcome page opens.



4. After you have finished reviewing the welcome information, click Next to proceed. Use the on-screen instructions to complete the SMI software installation.

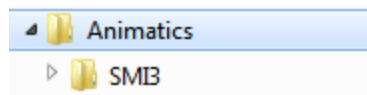
- When the installation has completed, the installation status message page opens, as shown in the next figure. Click Finish to complete the installation and close the installation wizard.



NOTE: After the software is installed, be sure to restart your computer before running the SMI software.

Installation Verification

To verify the installation, navigate to the C:\Program Files (or folder C:\Program Files x86) folder. You should see these folders:



Accessing the SMI Software Interface

The SmartMotor Interface software (SMI software) communicates with a single or series of SmartMotors from a Windows-based PC and gives you the capability to control and monitor the status of the motors. The SMI software also allows you to write programs and download them into the SmartMotor's long-term memory.

NOTE: Every SmartMotor has an ASCII interpreter built in. Therefore, it is not necessary to use the SMI software to operate a SmartMotor.

To open the SMI software, double-click the SmartMotor Interface shortcut on the Windows desktop.

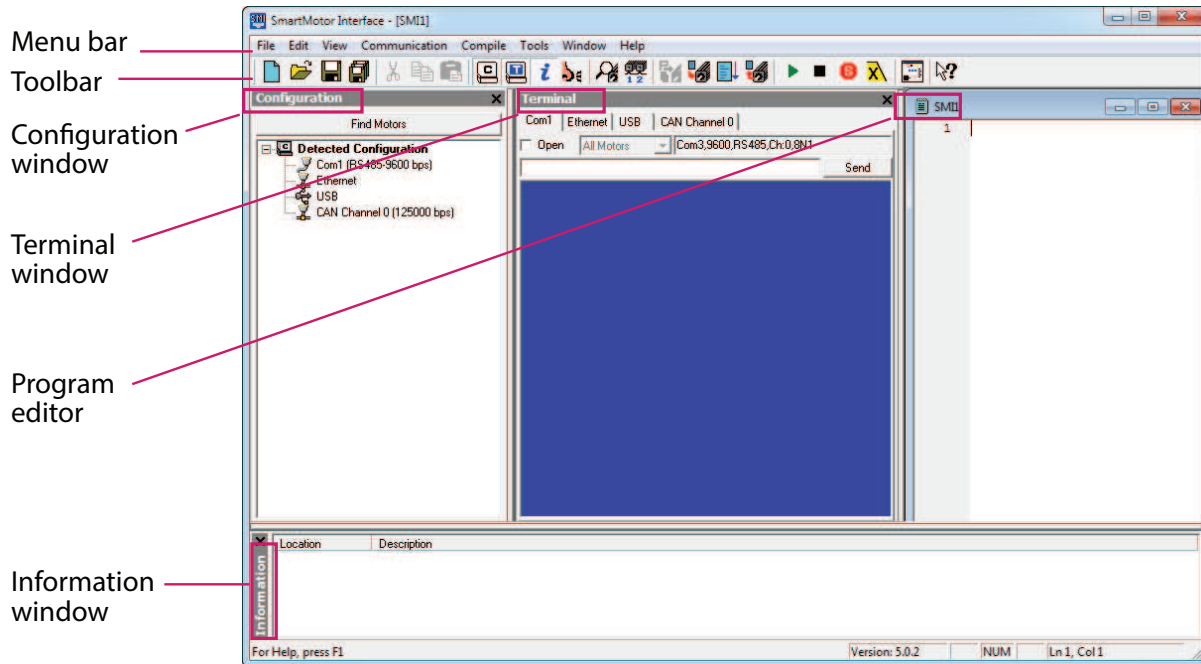


SmartMotor Interface Shortcut

Optionally, to open the SMI software from the Microsoft Windows Start menu, select:

Start > All Programs > Animatics > SMI3 > SmartMotor Interface

The SMI software interface opens, as shown in the next figure.



SMI Software Interface

NOTE: In addition to the software information in this section, there is context-sensitive help available within the SMI software interface, which is accessed by pressing the F1 key or selecting Help from the SMI software main menu.

These are the primary features in this interface:

- **Menu Bar:** All of the windows and functions of the SMI software can be accessed through the menu bar. Many of these are also accessible through the icons on the toolbar.
- **Toolbar:** The toolbar contains a collection of icons for accessing the primary features of the SMI software. Depending on the current state of the SMI software and the currently-active window, some toolbar buttons may be disabled.
- **Configuration Window (far-left window):** This window is used to display the current communication and detected motor configuration when no project is open, or the communication and motor configuration defined in an open project.
- **Terminal Window (middle window):** This window is used to communicate with SmartMotors (for example, issue single-line commands to one or all motors). The response (if any) is also shown in this window.
- **Information Window (lower window):** This window is used to display the results of user operations.
- **Program Editor (far-right window):** This window is used to manage, edit and print user programs. Most of the procedures for using the editor should seem familiar if you have used other Windows-based text editors.

For more details about these items, see the SMI software online help, which can be viewed in SMI by pressing F1 or selecting Help > Contents - SMI Software Help.

Understanding the Power Requirements

This section describes the power requirements for SmartMotor power, CPU power, I/O power and Communications power.

SmartMotor Power Requirements

Requirement: The power range for S-style SmartMotors is from 24 VDC to 48 VDC; do not exceed 48 VDC. Main power must be connected to a source capable of supplying the rated power of the motor.

NOTE: These motors can operate on power down to +20 VDC, but it is not recommended due to greatly reduced performance -- optimum performance is achieved at 48 VDC.

Details: Some of the larger SmartMotors can draw high current. Therefore, heavy gauge wire is required to connect the large motors. Control power consumes much less current. The exact amount depends on I/O, communication and brake usage, but it is generally under 300 mA. For more information, see the CPU, I/O and Communications Power section.

Voltages below 18 VDC could cause a brownout shutdown of the CPU, or what would appear as a power-off reset, under sudden load changes.



CAUTION: If power is reversed on any standard SmartMotor, immediate damage WILL occur and the SmartMotor will no longer operate.

When relying on torque/speed curves, pay close attention to the voltage on which they are based.

During hard, fast decelerations, a SmartMotor can pull up supply voltages to the point of damage if a shunt resistor pack is not used. Protective shunts are available from Moog Animatics.

Special care must be taken when near the upper voltage limit or in vertical applications that can back-drive the SmartMotor. Gravity-influenced applications can turn the SmartMotor into a generator and back-drive the power supply voltage above the safe limit for the SmartMotor. Many vertical applications require a shunt to protect the SmartMotor from damage. Protective shunts are available from Moog Animatics.



CAUTION: Many vertical applications and applications with hard, fast decelerations require shunts to protect the SmartMotor from damage. Note that shunts should always be placed between the motor input and any disconnect or E-stop relay to protect the motor when power is off or E-stop relay contacts are open.

S-style CPU, I/O and Communications Power

CPU Power Requirements

Requirement: Maximum of 5 VDC on any I/O pin or 5 VDC pin.

Details: S-style SmartMotors have an internal 5 VDC power supply to run the internal CPU. This supply can be easily damaged if an external voltage source of a higher voltage potential is applied. Therefore, do not exceed 5 VDC on any TTL-level I/O pin or 5 VDC pin.

I/O Power Requirements

Requirement: Maximum sink amperage = 25 mA; Maximum source amperage = 25 mA.

Details: Each on-board 5 V I/O pin has a minimum amount of protection consisting of a 100 ohm current-limit resistor and a 5.6 VDC Zener diode. Each I/O pin also has a 5 kohm pull-up resistor. When assigned as outputs, they act as a push-pull amplifier that drives hard to either the positive or negative 5 VDC rail. This means they are not open-collector I/O pins. Each I/O pin can sink up to 25 mA and source up to 25 mA. Exceeding this could result in damage to the I/O port.

Communications Power Requirements

Requirement: Proper serial ground signal referencing and shielding techniques are required; do not use the cable shield for the RS-232 ground reference.

Details: The S-style SmartMotor has a two-wire RS-232 port. This port meets IEEE standards with full +/-12 VDC potential on the transmit line. Proper serial ground signal referencing and shielding techniques must be used. Under no circumstances should the shield of a cable be used for the RS-232 ground reference. This could result in noise or corrupt data as well as ground loops that could damage the serial port chip set.

Understanding the Status LEDs

The S-style SmartMotor is not equipped with status LEDs. However, the status of the SmartMotor can be easily obtained by one of these methods:

- Viewing the status bits using the Motor View tool in SMI, see the online help file in the SMI software
- Reading the status bits, see the System Status chapter in the *SmartMotor™ Developer's Guide*

Connecting the System

This section describes system connections and cable diagrams for typical installations.

Minimum Requirements

At minimum, you will need:

1. An S-style 23- or 34-frame SmartMotor
2. A computer running Microsoft Windows and the SMI software
3. Power and data cables for the SmartMotor
4. Power supplies (for power requirements, see Understanding the Power Requirements on page 28)

S-Style Motor Connectors and Pinouts

The figures in this section provide an overview of the connectors and pinouts available on the S-style SmartMotors. These figures apply to both the 23- and 34-frame motors.



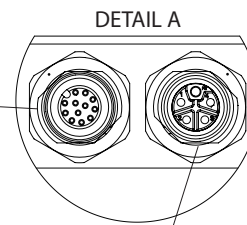
CAUTION: The S-style motor's M12 (M-style) connectors must be finger tightened only! DO NOT use a wrench or other tool. Doing so can cause overtightening of the connection, which may damage the connector and will void the warranty.

S-Style with Serial, 2xCAN and 4xI/O (SMxx165S, SMxx165S-BRK)

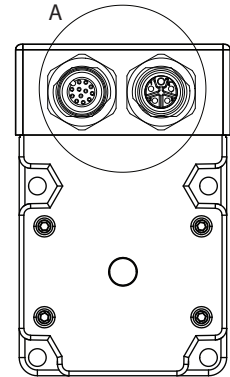


M12 12-PIN FEMALE
SERIAL, CAN AND I/O

Communication and I/O		
Pin	Function	Specification
1	I/O - 0	25mA Sink or Source 10Bit 0-5VDC A/D
2	I/O - 1	25mA Sink or Source 10Bit 0-5VDC A/D
3	I/O - 2	25mA Sink or Source 10Bit 0-5VDC A/D
4	I/O - 3	25mA Sink or Source 10Bit 0-5VDC A/D
5	CAN_L	non-isolated, 1MBaud Max
6	CAN_H	non-isolated, 1MBaud Max
7	CAN_L	non-isolated, 1MBaud Max
8	CAN_H	non-isolated, 1MBaud Max
9	RS-232 Tx	Com ch.0, 115.2 kBaud Max
10	RS-232 Rx	Com ch.0, 115.2 kBaud Max
11	+5VDC OUT	50mA Max (total)
12	SIG GND	Signal Ground



M12 4-PIN MALE
POWER



Power		
Pin	Function	Specification
1	MAIN POWER	+24-48VDC
2	CONTROL PWR	+24-48VDC (DE Option)
3	GND-MAIN	Ground Main Power
4	GND-CNTRL	Ground Control Power

Relevant Cables		
	PN	Description
Power	CBLIP-S-PWR-FL	S Power Cable, Flying Lead
	CBLIP-S-PWR-EXT	S Power Cable, M-F Extension
	CBLIP-S-T-FFM	S Power Cable, T Junction
CAN, RS-232, I/O	CBLIP-IO-FL	Comms and I/O Flying Lead Cable; also RA option

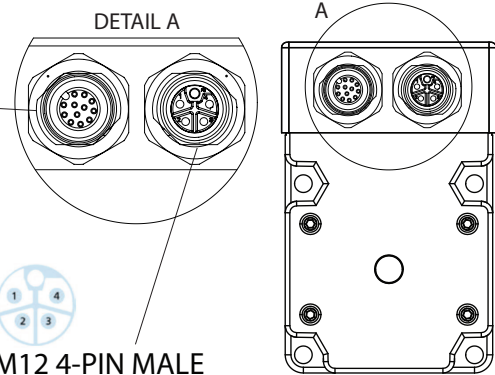
NOTE: COM1 is not available on this model. See the Other S-Style Motor Changes topic for more information.

S-Style with Serial, 1xCAN and 6xI/O (SMxx165S-I06, SMxx165S-BRK-I06)



M12 12-PIN FEMALE
SERIAL, CAN AND I/O

Communication and I/O		
Pin	Function	Specification
1	I/O - 0	25mA Sink or Source 10Bit 0-5VDC A/D
2	I/O - 1	25mA Sink or Source 10Bit 0-5VDC A/D
3	I/O - 2	25mA Sink or Source 10Bit 0-5VDC A/D
4	I/O - 3	25mA Sink or Source 10Bit 0-5VDC A/D
5	I/O - 4	25mA Sink or Source 10Bit 0-5VDC A/D
6	I/O - 5	25mA Sink or Source 10Bit 0-5VDC A/D
7	CAN_L	non-isolated, 1MBaud Max
8	CAN_H	non-isolated, 1MBaud Max
9	RS-232 Tx	Com ch.0, 115.2 kBaud Max
10	RS-232 Rx	Com ch.0, 115.2 kBaud Max
11	+5VDC OUT	50mA Max (total)
12	SIG GND	Signal Ground



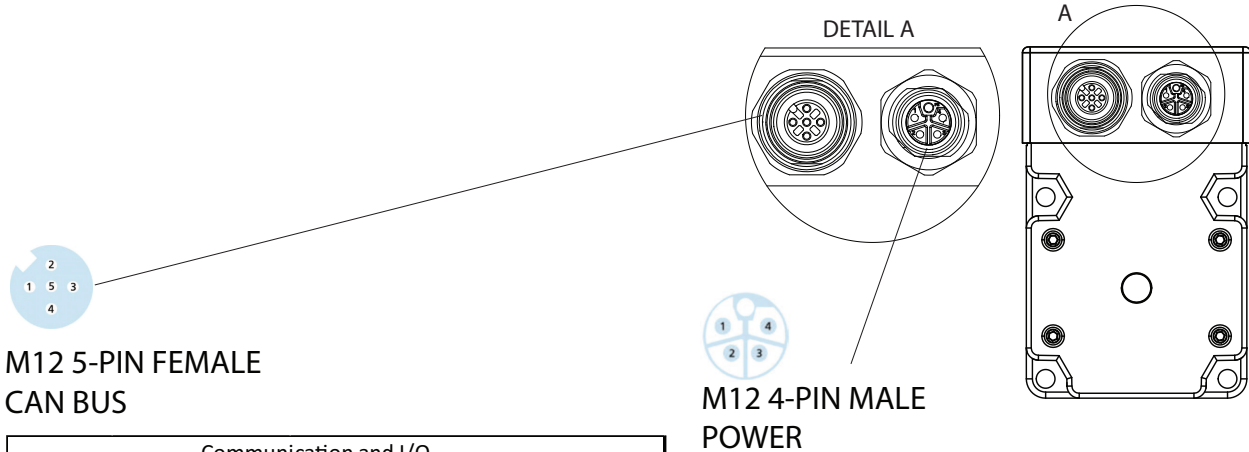
M12 4-PIN MALE
POWER

Power		
Pin	Function	Specification
1	MAIN POWER	+24-48VDC
2	CONTROL PWR	+24-48VDC (DE Option)
3	GND-MAIN	Ground Main Power
4	GND-CNTRL	Ground Control Power

Relevant Cables		
	PN	Description
Power	CBLIP-S-PWR-FL	S Power Cable, Flying Lead
	CBLIP-S-PWR-EXT	S Power Cable, M-F Extension
	CBLIP-S-T-FFM	S Power Cable, T Junction
CAN, RS-232, I/O	CBLIP-IO-FL	Comms and I/O Flying Lead Cable; also RA option

NOTE: COM1 is not available on this model. See the Other S-Style Motor Changes topic for more information.

S-Style with CAN Bus (SMxx165S-C, SMxx165S-BRK-C)



Communication and I/O		
Pin	Function	Specification
1	NC	No Connection
2	NC	No Connection
3	NC	No Connection
4	CAN_H	non-isolated, 1MBaud Max
5	CAN_L	non-isolated, 1MBaud Max

Power		
Pin	Function	Specification
1	MAIN POWER	+24-48VDC
2	CONTROL PWR	+24-48VDC (DE Option)
3	GND-MAIN	Ground Main Power
4	GND-CNTRL	Ground Control Power

Relevant Cables		
	PN	Description
Power	CBLIP-S-PWR-FL	S Power Cable, Flying Lead
	CBLIP-S-PWR-EXT	S Power Cable, M-F Extension
	CBLIP-S-T-FFM	S Power Cable, T Junction
CAN	CBLIP-CAN-EXT	IP CAN Extension Cable
	CBLIP-CAN-FL	IP CAN Flying Lead Cable; also RA option
	CBLIP-CAN-Y1	IP CAN Y Cable; also RA option
	CBLIP-TRM120	Terminating Resistor, Male
	CBLIP-TRF120	Terminating Resistor, Female

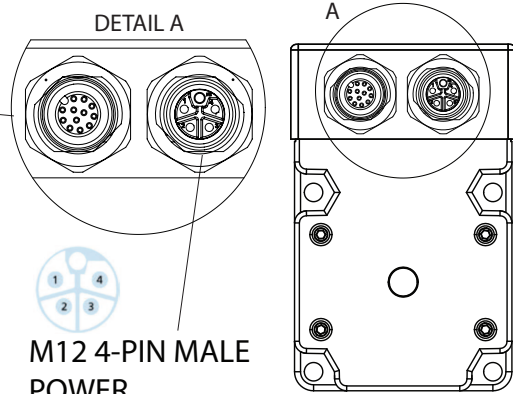
NOTE: COM0 and COM1 are not available on this model. See the Other S-Style Motor Changes topic for more information.

S-Style with Serial, Encoder Out and 6xI/O (SMxx165S-E0, SMxx165S-BRK-E0)



M12 12-PIN FEMALE SERIAL, ENCODER OUT AND I/O

Communication and I/O		
Pin	Function	Specification
1	I/O - 0	25mA Sink or Source 10Bit 0-5VDC A/D
2	I/O - 1	25mA Sink or Source 10Bit 0-5VDC A/D
3	I/O - 2	25mA Sink or Source 10Bit 0-5VDC A/D
4	I/O - 3	25mA Sink or Source 10Bit 0-5VDC A/D
5	I/O - 4	or configurable as: RS-485 A Channel 1
6	I/O - 5	or configurable as: RS-485 B Channel 1
7	ENCA OUT	Phase A Encoder Output
8	ENCB OUT	Phase B Encoder Output
9	RS-232 Tx	Com ch. 0, 115.2 kBaud Max
10	RS-232 Rx	Com ch. 0, 115.2 kBaud Max
11	+5VDC OUT	50mA Max (total)
12	SIG GND	Signal Ground



M12 4-PIN MALE POWER

Power		
Pin	Function	Specification
1	MAIN POWER	+24-48VDC
2	CONTROL PWR	+24-48VDC (DE Option)
3	GND-MAIN	Ground Main Power
4	GND-CNTRL	Ground Control Power

Relevant Cables		
	PN	Description
Power	CBLIP-S-PWR-FL	S Power Cable, Flying Lead
	CBLIP-S-PWR-EXT	S Power Cable, M-F Extension
	CBLIP-S-T-FFM	S Power Cable, T Junction
Encoder, RS-232, I/O	CBLIP-IO-FL	Comms and I/O Flying Lead Cable; also RA option

NOTE: CAN bus is not available on this model. See the Other S-Style Motor Changes topic for more information.

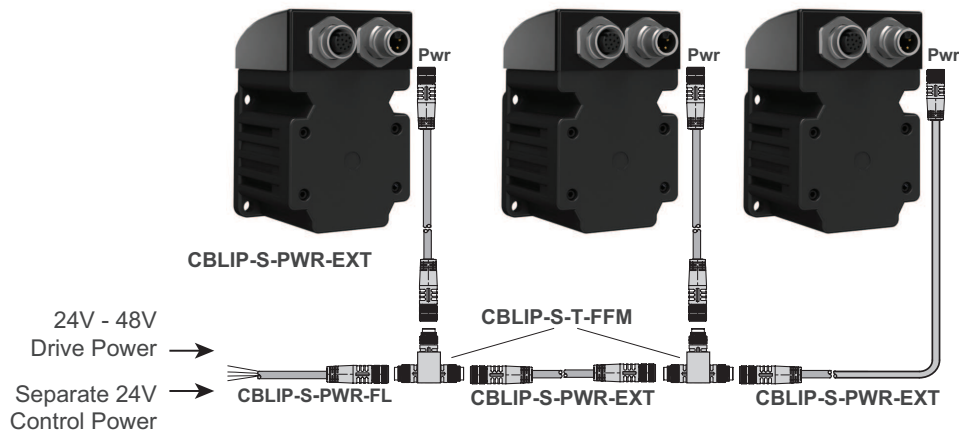
S-style Cable Diagrams



CAUTION: The S-style motor's M12 (M-style) connectors must be finger tightened only! DO NOT use a wrench or other tool. Doing so can cause overtightening of the connection, which may damage the connector and will void the warranty.

NOTE: In these cable diagram figures, power and communications cables are shown with straight connectors. Right-angle connectors are also available for most cables.

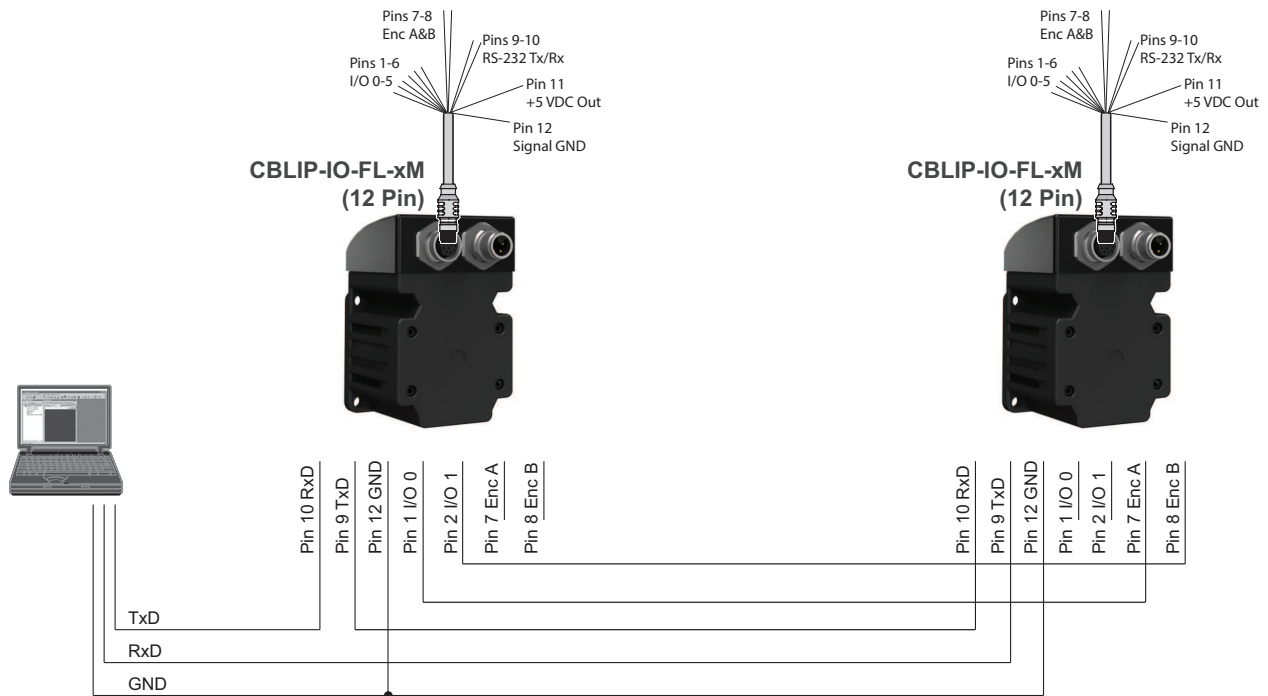
Power Multidrop



This power-connection method would be combined with a communications-connection method. For example, see the diagrams in the next two sections.

RS-232 Multidrop with ENC and I/O

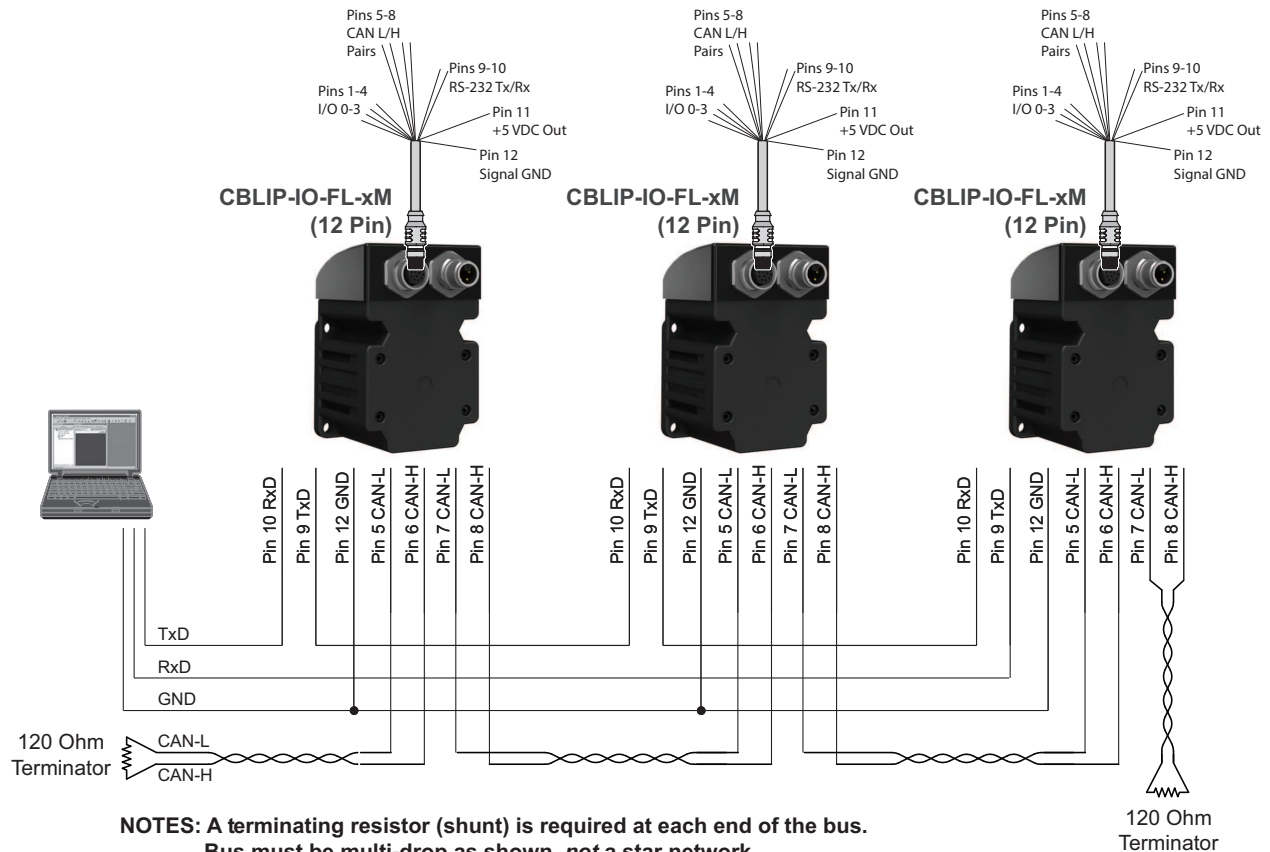
This communications-connection method requires S-style motors with RS-232, ENC and I/O option on the 12-pin connector. This example shows I/O on motor 1 communicating with the Enc A/B signals on motor 2.



This communications-connection method would be combined with a power-connection method. For example, see Power Multidrop on page 34.

RS-232, 2xCAN and 4xI/O Multidrop

This communications-connection method requires S-style motors with the RS-232, 2xCAN and 4xI/O communication option on the 12-pin connector.



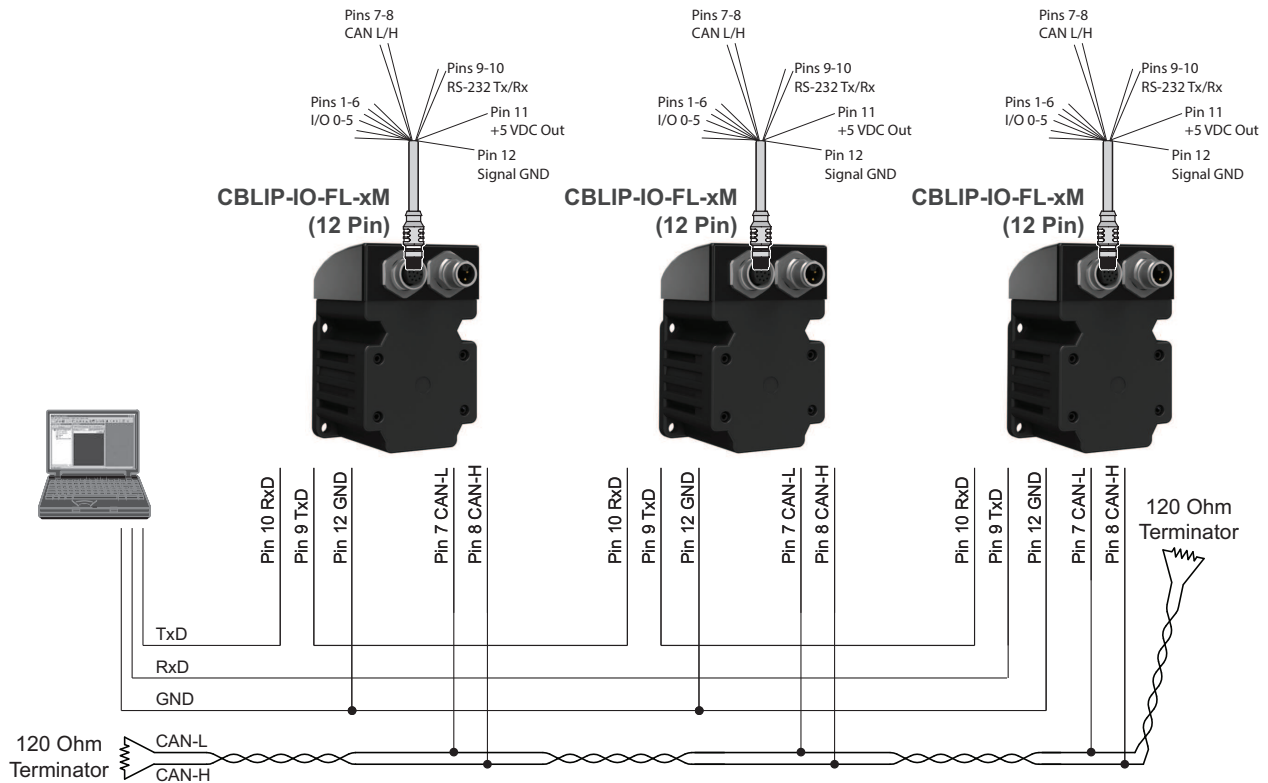
NOTES: A terminating resistor (shunt) is required at each end of the bus.
 Bus must be multi-drop as shown, *not* a star network.
 24V CAN bus power connection is *not* required at the motor.

NOTE: The CAN bus requires a termination resistor at each end. If the controller device (PC, PLC, etc.) does not include one, then an external termination resistor must be supplied.

This communications-connection method would be combined with a power-connection method. For example, see Power Multidrop on page 34.

RS-232, 1xCAN and 6xI/O Multidrop

This communications-connection method requires S-style motors with the RS-232, 1xCAN and 6xI/O communication option on the 12-pin connector.



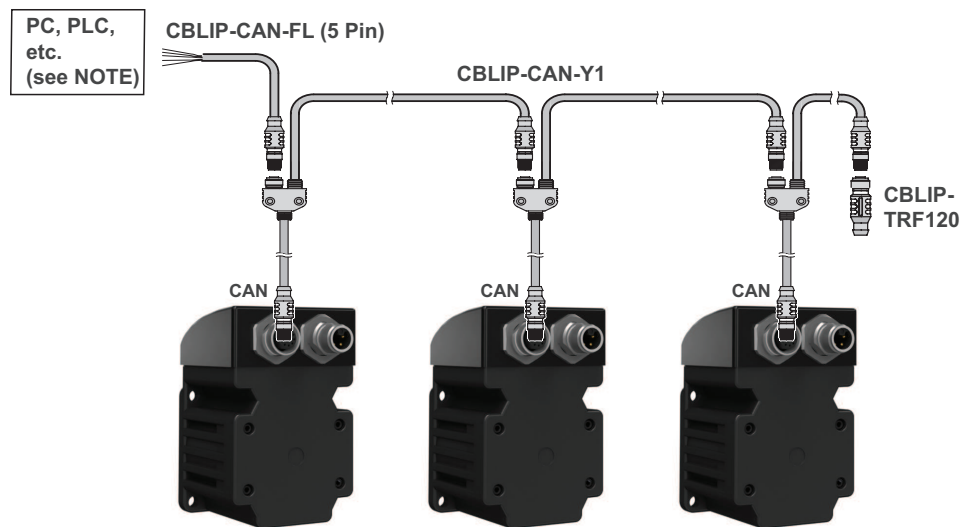
NOTES: A terminating resistor (shunt) is required at each end of the bus.
 Bus must be multi-drop as shown, *not* a star network.
 24V CAN bus power connection is *not* required at the motor.

NOTE: The CAN bus requires a termination resistor at each end. If the controller device (PC, PLC, etc.) does not include one, then an external termination resistor must be supplied.

This communications-connection method would be combined with a power-connection method. For example, see Power Multidrop on page 34.

CAN Multidrop

This communications-connection method requires S-style motors with the CAN only option on the 5-pin connector.



NOTE: The bus requires a termination resistor at each end. If the controller device (PC, PLC, etc.) does not include one, then an external termination resistor must be supplied.

This communications-connection method would be combined with a power-connection method. For example, see Power Multidrop on page 34.

CANopen Requirements

The CANopen specification has requirements for network topology, bus length, drop lengths, etc. For more details on this and the SmartMotor CANopen implementation, see the [SmartMotor™ CANopen Guide](#).

Detecting and Addressing the SmartMotors

This section describes how to detect and address the motors over the serial network. For details on other communications methods, see Communication Details in the *SmartMotor™ Developer's Guide*.

This procedure assumes that:

- The SmartMotor is connected to the computer. For details, see Connecting the System on page 29.
- The SmartMotor is connected to a power source. For details, see Understanding the Power Requirements on page 28 and Connecting the System on page 1.
- The SMI software has been installed and is running on the computer. For details, see Installing the SMI Software on page 23.

Understanding the Detection and Addressing Options

There are three different ways to use the SMI software to find and address the S-style SmartMotors that are connected to your PC:

- Use the Find Motors button—this method is recommended for first-time communications or when you don't know the port used to connect the motors. For details, see Using the Find Motors Button on page 39.
- Use the Detect Motors feature—this method can be used if you know the communications port used to connect your motors and if your motors may be pre-addressed. For details, see Using the Detect Motors Feature on page 42.
- Use the Address Motors feature—this method can be used if you know the communications port used to connect your motors. This method *always* re-addresses the motors; therefore, if you have pre-addressed motors connected, their addresses may be changed. For details, see Using the Address Motors Feature on page 44.

These methods are described in the next sections.

Some notes about motor addressing:

The SmartMotors power up in non-echo state (so no response is sent to the next motor), 9600 KB communications and a Base address of 0 (zero).

As the system addresses the motors in the RS-232 daisy chain, it starts with the first motor in the daisy chain, sets its address to 1, enables echo, and then puts that motor to sleep. It proceeds to the next motor in the daisy chain, sets its address to 2, enables echo and puts it to sleep. This process continues until all the motors in the daisy chain are addressed.

When the motor is addressed, it contains a unique identifier that allows it to respond to commands intended for that motor and ignore commands intended for other motors. For example, 1RPA reports the position from motor 1 only; all other motors in the daisy chain ignore the command. However, a global command, like ORPA, reports the positions from *all* motors. For more details on addressing and daisy chaining, see Daisy Chaining Multiple SmartMotors in the *SmartMotor™ Developer's Guide*.

Motor addresses are activated and stored using these methods:

- For serial addresses:
 - These are stored in the SmartMotor's volatile memory, which means they are lost when motor power is turned off.
 - After setting the address, it goes into effect immediately (do not reboot or perform a system reset with the Z command; either of these actions will delete the addresses).

- For CAN addresses:
 - These are stored in the SmartMotor nonvolatile memory (NVRAM), which means they are retained when motor power is turned off.
 - After setting the address, it doesn't go into effect until the system is restarted or reset.
 - The CAN address of a motor is different than the serial address (because they are communicating on different networks). However, for ease of use, you can "store" the serial address in the CAN address by entering the command:

CADDR=ADDR

Then, whenever you reset the system (either with the Z command or turning the power off and back on), you can recall the serial addresses of the motors from the stored CAN addresses, by entering the command:

OADDR=CADDR

Because the CAN address is permanently stored and doesn't change on power off or reset, this allows you to easily restore specific serial addresses.

When addressing the motors, you can address serial and CAN in the same command, which means you can use the serial network to communicate with the CAN bus. The leading number is the serial address; the number after the colon character is the CAN address. Consider this example:

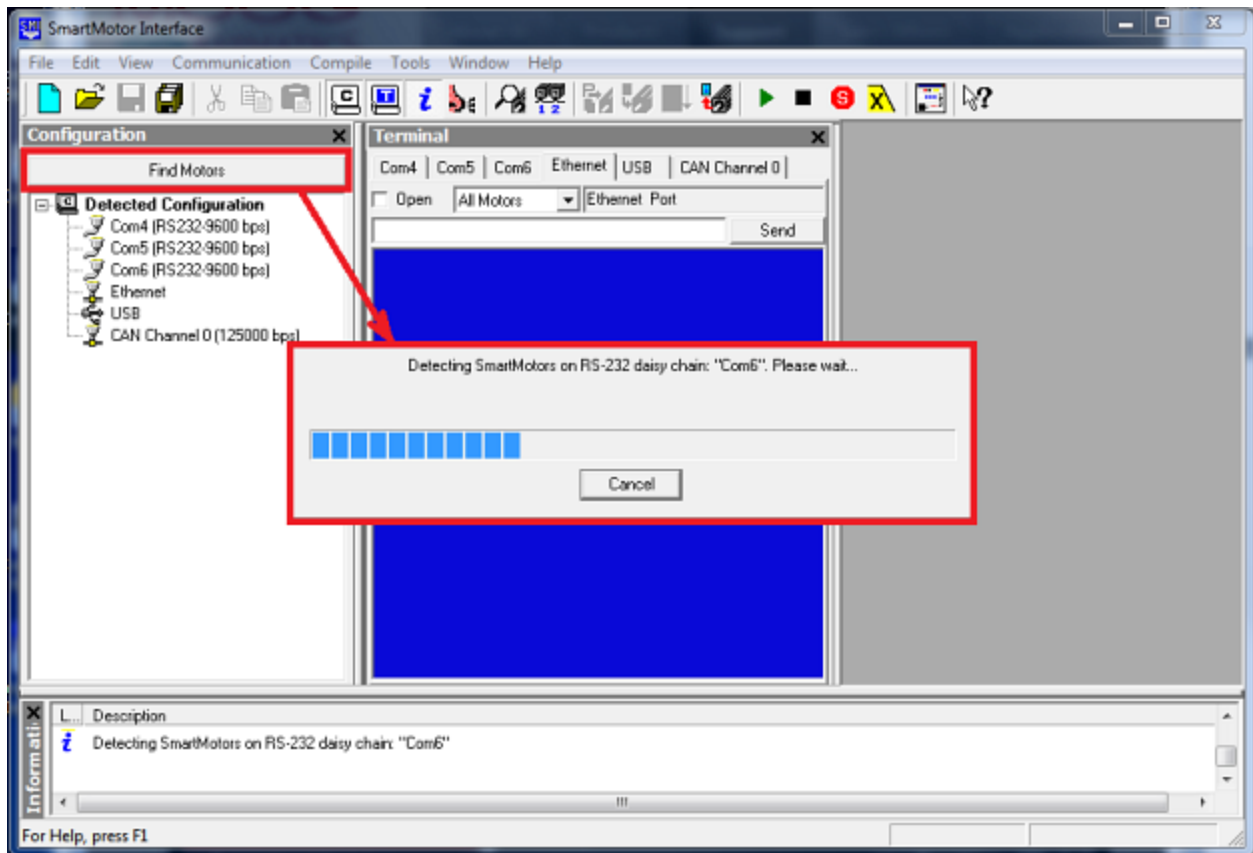
1RPA:2

The leading "1" is addressing the serial network motor 1; the ":2" is addressing the CAN network motor 2. In this example, the command is going out on the serial network to motor 1, then out the CAN port to motor 2, reading motor 2 position info, and then echoing it back to the host from CAN to motor 1 and then serial to host.

Using the Find Motors Button

The easiest way to locate any connected SmartMotor is to use the Find Motors button (see the next figure). This method searches every communications port (serial, USB, Ethernet, etc.) on the PC. If you don't know which port your motor is connected to, this method is the most thorough way to search. However, if you have many ports, this method can also take a long time.

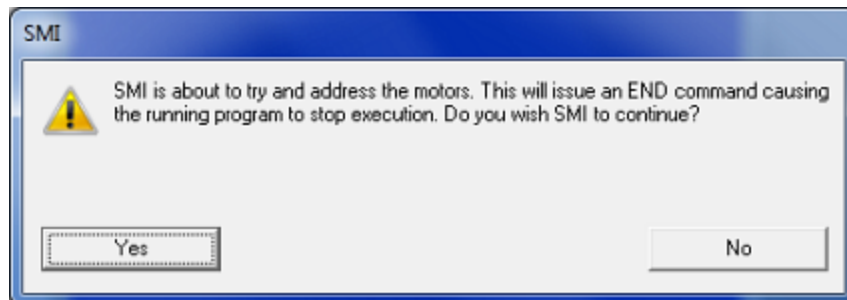
To begin searching for motors across all ports on the PC, in the Configuration window of the SMI software interface, click Find Motors. The SMI software begins searching for all SmartMotors connected to the PC.



Find Motors Detecting SmartMotors on the RS-232 Chain

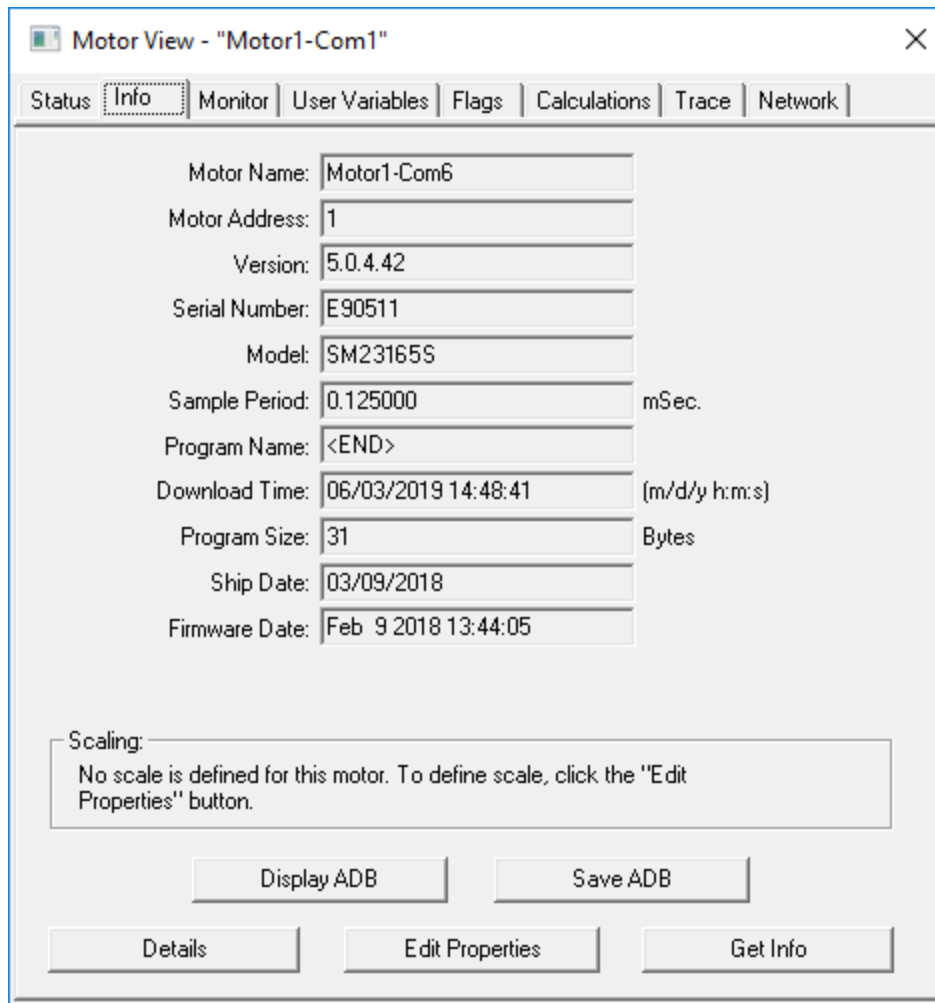
After the motors are detected, the SMI software will address them if needed. The next steps are only used when the SMI software finds motors that do not have addresses.

To address the motors, click Yes when you see this prompt:



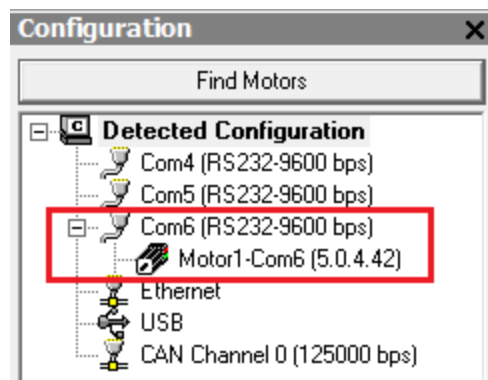
Address the Motors Prompt

A progress bar displays a "Getting motor information" message while the SMI software addresses the motors. During this process, the SMI software is collecting information on each motor. The information is the same as that shown in the Motor View window, which can be accessed by selecting the **Tools > Motor View > Info** tab:



Motor View Information

After the process has completed, the SMI software shows the found motors in the Configuration window under the corresponding communications port. Each motor is represented by a motor icon; the motor's address and firmware version are shown next to the motor icon.

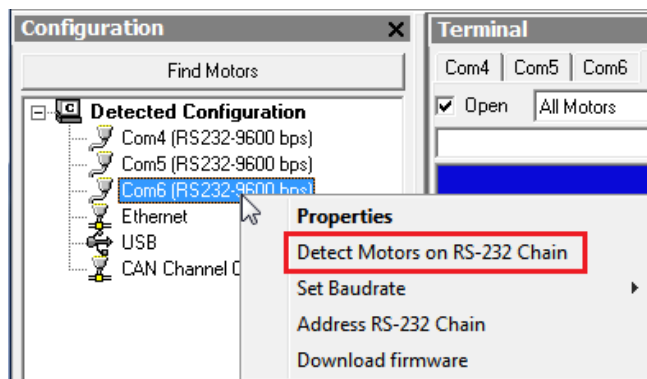


Configuration Window Showing Found/Addressed SmartMotor

Using the Detect Motors Feature

This method is similar to the Find Motors method, but it searches only the specified communications port for connected SmartMotors.

To use the Detect Motors feature, in the Configuration window of the SMI software, right-click the desired communications port and select Detect Motors from the menu.

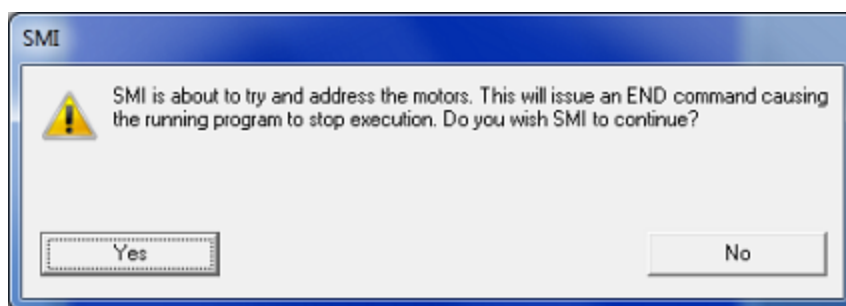


Selecting the Detect Motors Feature

The SMI software begins searching for all SmartMotors connected to the specified communications port. A progress bar is shown while the SMI software searches for the motors.

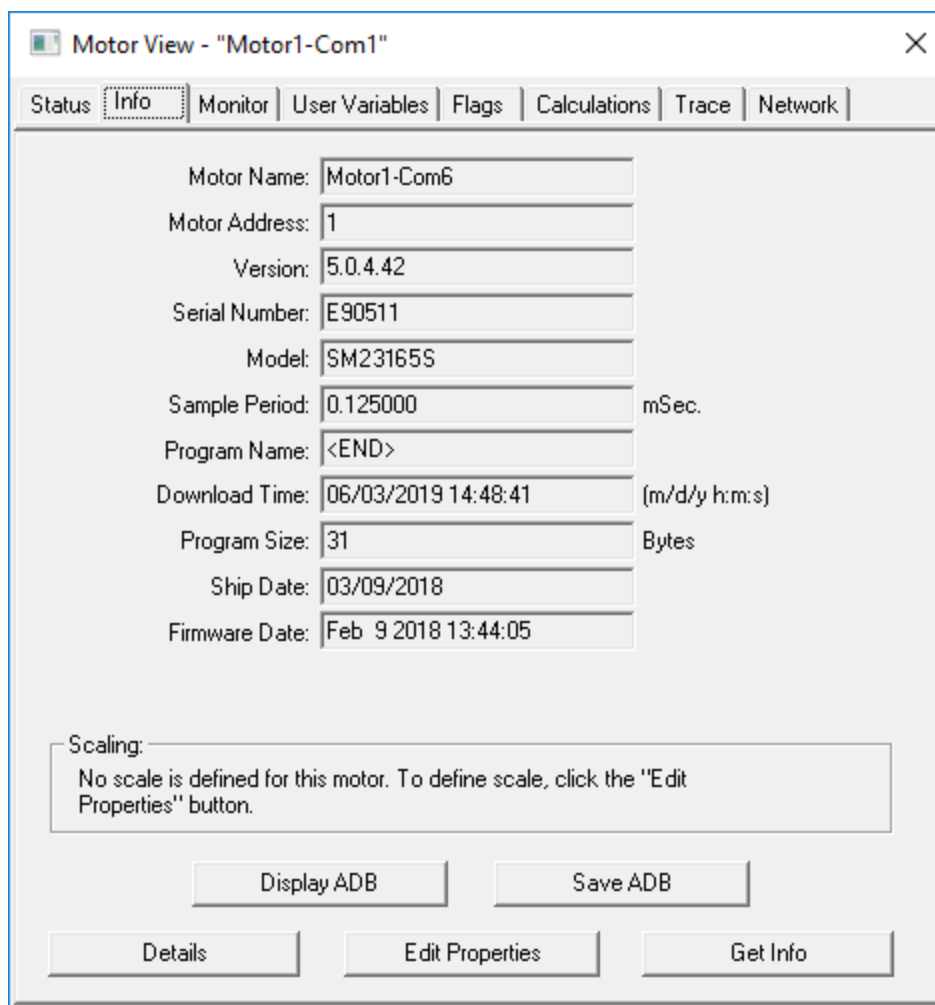
After the motors are detected, the SMI software will address them if needed. These steps are only used when the SMI software finds motors that do not have addresses.

To address the motors, click Yes when you see this prompt:



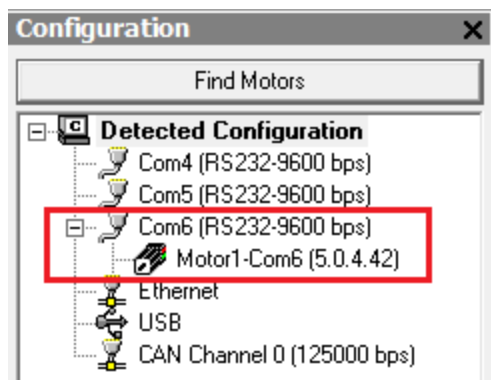
Address the Motors Prompt

A progress bar displays a "Getting motor information" message while the SMI software addresses the motors. During this process, the SMI software is collecting information on each motor. The information is the same as that shown in the Motor View window, which can be accessed by selecting the **Tools > Motor View > Info** tab:



Motor View Information

After the process has completed, the SMI software shows the found motors in the Configuration window under the corresponding communications port. Each motor is represented by a motor icon; the motor's address and firmware version are shown next to the motor icon.



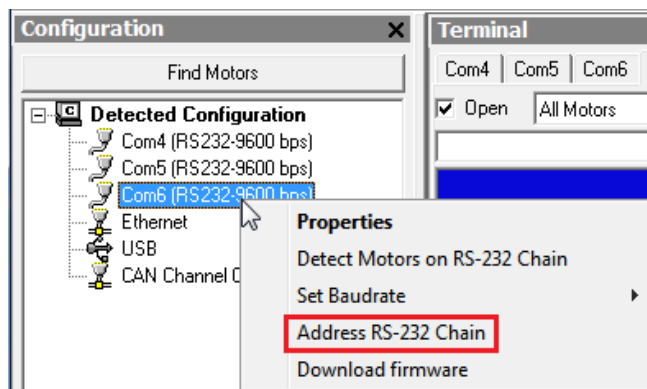
Configuration Window Showing Found/Addressed SmartMotor

Using the Address Motors Feature

This method assumes that there are motors connected to the specified port and will simply address each one that it finds.

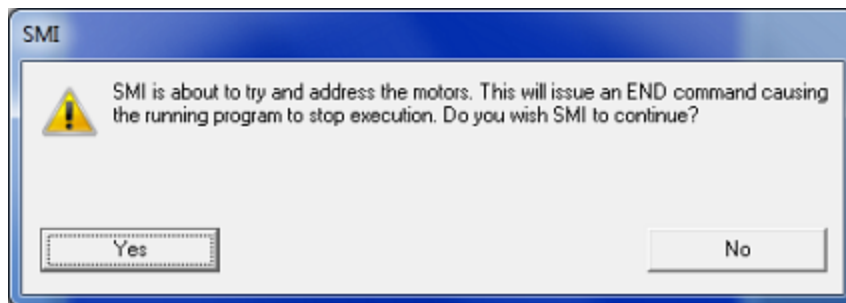
NOTE: This method will address (or re-address) every motor. If you pre-addressed your motors before connecting them, those motor addresses could be changed by this process.

To use the Address Motors feature, in the Configuration window of the SMI software, right-click the desired communications port and select Address RS-232 Chain from the menu.



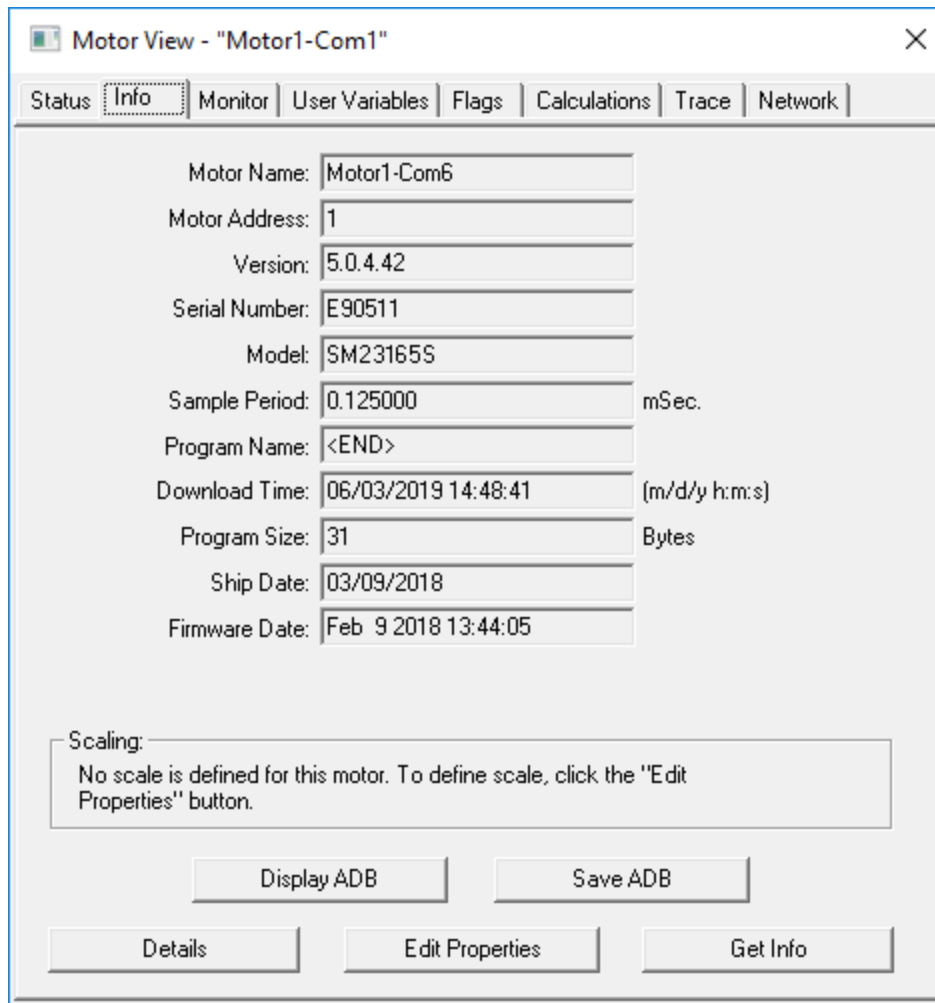
Selecting the Address Motors Feature

To address the motors, click Yes when you see this prompt:



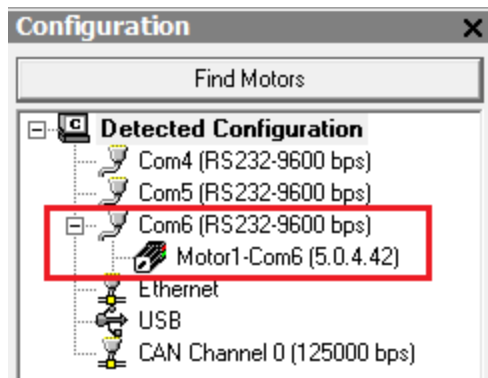
Address the Motors Prompt

A progress bar displays a "Getting motor information" message while the SMI software addresses the motors. During this process, the SMI software is collecting information on each motor. The information is the same as that shown in the Motor View window, which can be accessed by selecting the **Tools > Motor View > Info** tab:



Motor View Information

After the process has completed, the SMI software shows the found motors in the Configuration window under the corresponding communications port. Each motor is represented by a motor icon; the motor's address and firmware version are shown next to the motor icon.



Configuration Window Showing Found/Addressed SmartMotor

Checking and Clearing the Status Bits

NOTE: In addition to the software information in this section, there is context-sensitive help available within the SMI software interface, which is accessed by pressing the F1 key or selecting Help from the SMI software main menu.

The Motor View window is used to view and monitor various motor parameters. It is used in conjunction with the Terminal window to clear any active overtravel limits.

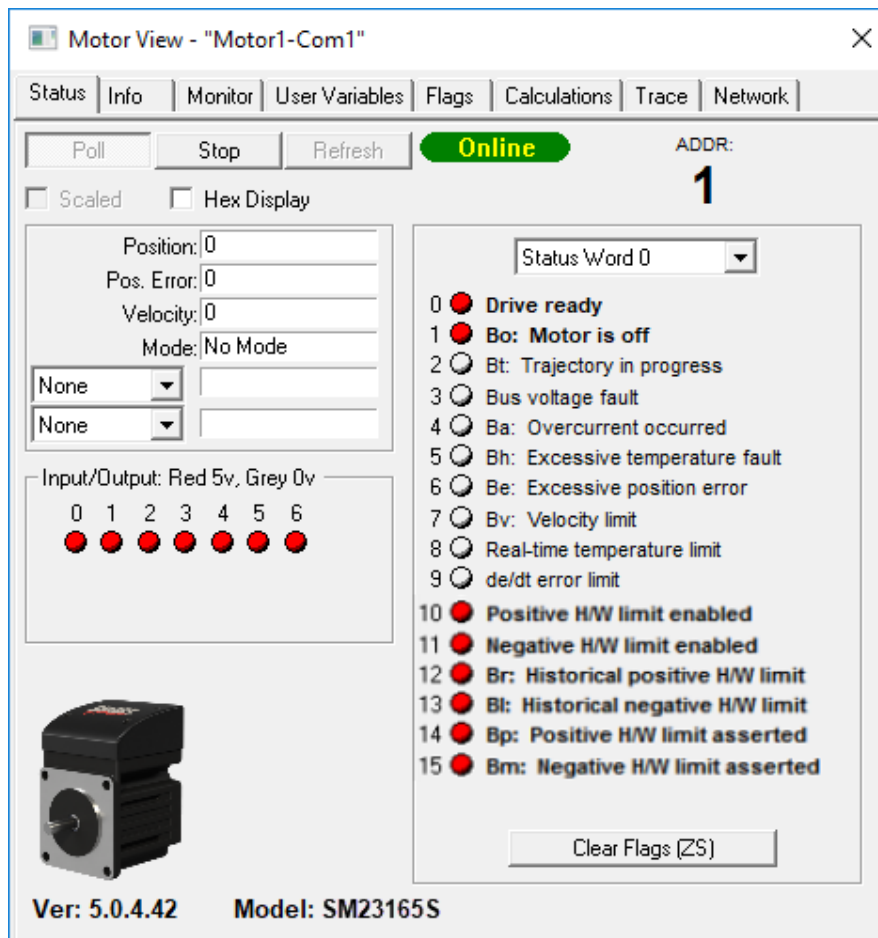
This procedure assumes that:

- The SmartMotor is connected to the computer. For details, see *Connecting the System* on page 29.
- The SmartMotor is connected to a power source. For details, see *Understanding the Power Requirements* on page 28 and *Connecting the System* on page 1.
- The SMI software has been installed and is running on the computer. For details, see *Installing the SMI Software* on page 23.
- The SmartMotor has been detected and addressed.

Polling the Motor

To view the current state of the status bits, you must poll the motor.

1. Double-click the motor icon to open the Motor View window (see the next figure).
2. Click the Poll button to begin polling data from the motor.

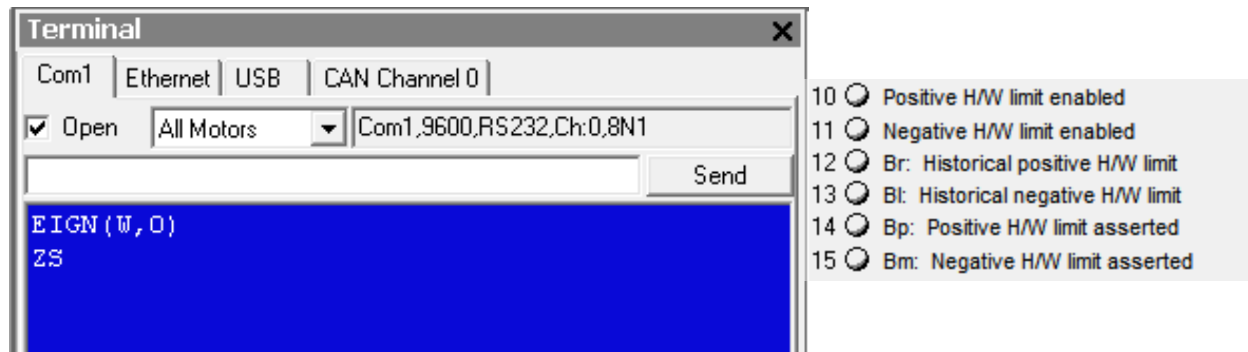


Motor View

A SmartMotor with no program and no I/O connections will boot up with active overtravel limits (see the red status bits numbered 10 through 15 in the previous figure).

Clearing the Fault Bits

To clear the historical fault bits, enter ZS. All remaining fault bits are cleared, as shown in the next figures.



ZS Command Entered

Remaining Bits Cleared

Moving the SmartMotor

NOTE: In addition to the software information in this section, there is context-sensitive help available within the SMI software interface, which is accessed by pressing the F1 key or selecting Help from the SMI software main menu.

The SMI software contains a Torque mode that is used to test the motor response and ensure the drive is operating properly.

This procedure assumes that:

- The SmartMotor is connected to the computer. For details, see Connecting the System on page 29.
- The SmartMotor is connected to a power source. For details, see Understanding the Power Requirements on page 28 and Connecting the System on page 1.
- The SMI software has been installed and is running on the computer. For details, see Installing the SMI Software on page 23.
- The SmartMotor has been detected and addressed.
- The fault bits have been cleared. For details, see Checking and Clearing the Status Bits on page 46.

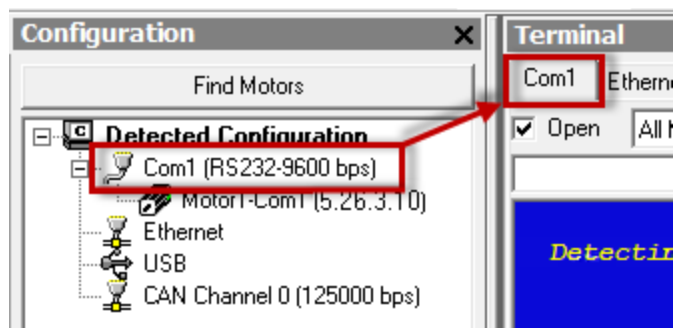
Making the Motor Move



WARNING: The larger SmartMotors can shake, move quickly and exert great force. Therefore, proper motor restraints must be used, and safety precautions must be considered in the workcell design (see Other Safety Considerations on page 8).

To make the SmartMotor move:

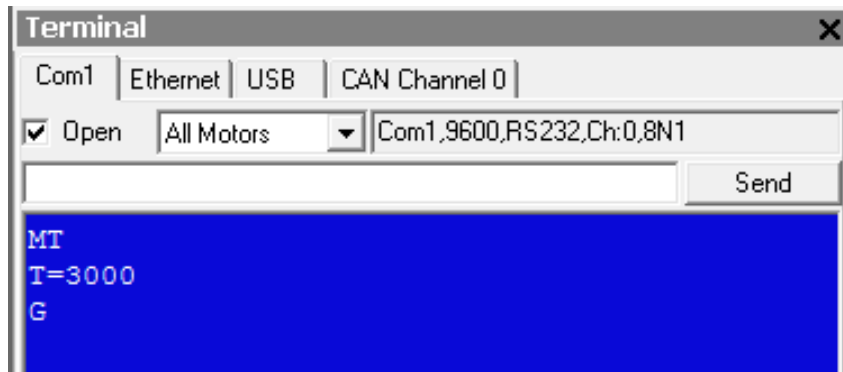
1. In the Terminal window, select the tab that matches the communications channel to which your motors are connected. To do this, look at the Configuration window, find the channel where the motors are listed and click that tab name in the Terminal window.



Tab Selected that Matches the Communications Channel

NOTE: If you do not have the correct tab selected, the commands you enter will not go to the motors and there will be no response.

2. Enter these commands in the Terminal window:



You should immediately see the motor shaft moving in the positive direction (clockwise, when looking at the end of the motor shaft). If the motor does not respond to the commands, see Troubleshooting on page 57 for troubleshooting tips.

NOTE: Macros (shortcut keys) can be used to simplify entry of frequently-used commands. For details, see Macros in the *SmartMotor™ Developer's Guide*.

3. After you have observed the motor shaft turning, enter the X command to decelerate the motor to a stop.

Setting and Reporting Torque

The commands in this section are related to the previous motion procedure. For more details on these commands, see the *SmartMotor™ Developer's Guide*.

MT (Mode Torque)

MT sets the mode of operation to torque mode. In this mode, the SmartMotor shaft applies a torque independent of position. For more details, see Torque Mode in the *SmartMotor™ Developer's Guide*.

T=formula (Set Target Torque)

T can be set to any value from -32767 to +32767, which represents -99.99% to +99.99% PWM (pulse-width modulation) commanded.

RTRQ (Report Actual Torque)

Enter RTRQ at the Terminal window to report the commanded torque from the trajectory generator.

Note that RTRQ typically reports a value that's one less than the T value. In the previous example, T=3000, but RTRQ reports 2999. The value returned by TRQ (and RTRQ) will typically be one less than the T (torque) value due to internal calculations. It may also be reduced in cases where the motor's output is in limitation. TRQ represents the output effort of the motor in both MT (torque mode) and servo modes (MV, MP, etc.). Therefore, it provides a seamless transfer across those modes without causing a ripple or bump in force to the load.

TS (Set Torque Slope)

The TS command defines how fast the processor applies a change in torque. For an example of the TS command, see the Chart View Example in the *SmartMotor™ Developer's Guide*.

Torque slope can range from -1 to 2147483647 (default). At a value of 65536, the processor changes torque by a value of 1 for each PID sample. The default sample rate is; you can view the current sample rate with the RSAMP command.

Checking the Motor Position

There are several ways to check the motor position:

- Report the position using commands from the Terminal window
- View the position in the Motor View tool

These two methods are described in the next sections. You can also view the position in the Monitor or Chart View software tools. For details, see SMI Software Features in the *SmartMotor™ Developer's Guide*.

This procedure assumes that:

- The SmartMotor is connected to the computer. For details, see Connecting the System on page 29.
- The SmartMotor is connected to a power source. For details, see Understanding the Power Requirements on page 28 and Connecting the System on page 1.
- The SMI software has been installed and is running on the computer. For details, see Installing the SMI Software on page 23.
- The SmartMotor has been detected and addressed.
- The fault bits have been cleared. For details, see Checking and Clearing the Status Bits on page 46.

Viewing the Motor Position with a Report Command

To report the motor position, in the Terminal window, issue the RPA (Report Position Actual) command:

```
RPA
```

The terminal responds with the current position of the motor:

```
RPA      3593657
```

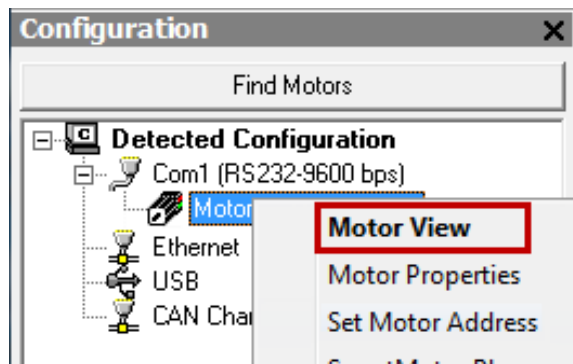
NOTE: The position is reported on the same line as the command; there is no line feed or carriage return for "report" commands.

The RPA command reports the actual motor position at the time the command was issued. Therefore, it is just a "snapshot"—if the motor is moving, the reported position is not dynamically updated.

Viewing the Motor Position with the Motor View Tool

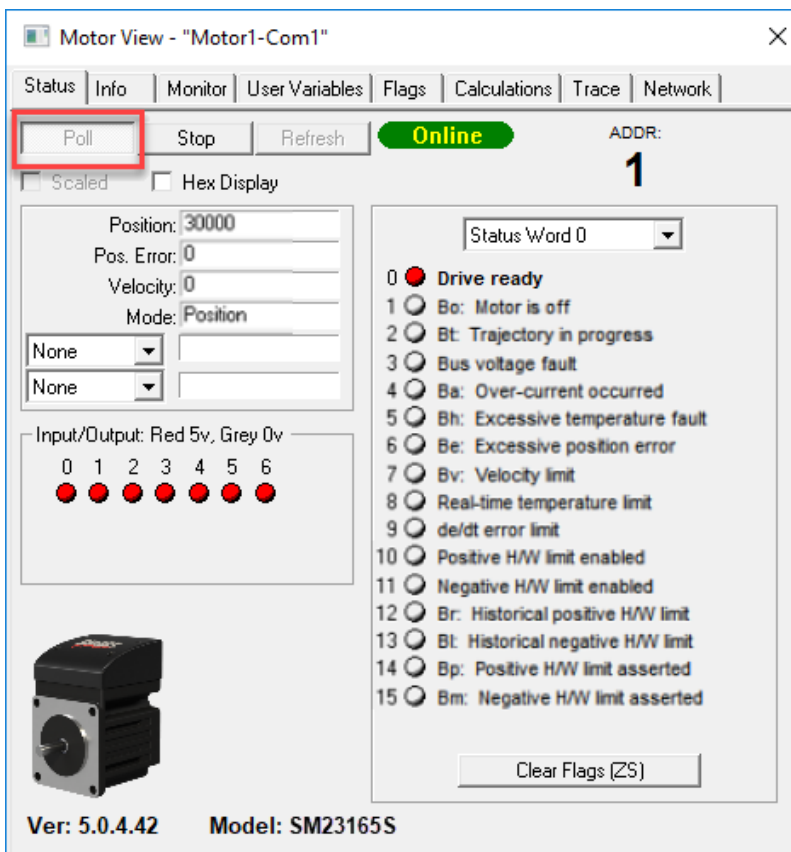
The Motor View tool provides another way to view the motor position. The advantage of using this tool is that the position is dynamically updated when the motor is moving.

To open the Motor View tool, from the SMI software Configuration window, right-click the motor you want to view and select Motor View from the menu.



Opening the Motor View Tool

After the Motor View window opens, click the Poll button to begin polling (getting information from) the motor. After polling begins, the motor position is shown in the Position box.



Motor View Tool Showing the Motor Position


Connectors, Pinouts and Examples

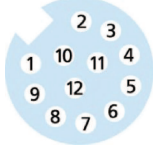
This chapter provides information on the SmartMotor connector pinouts and specifications. It also provides example I/O connection diagrams. For information on connecting the motors, see .

Class 5 S-Style Connector Pinouts	54
Class 5 S-Style I/O Connection Examples	55


Class 5 S-Style Connector Pinouts

This table shows the pinouts for the connectors on the Class 5 S-style SmartMotors.

PIN	MAIN POWER	Specifications:	Notes:	P1
1	Main Power	+24-48VDC	See NOTE	M12 4-Pin Male 
2	Control Power	+24-48VDC (DE Option)	See NOTE	
3	Common Ground		Ground	
4	NC			

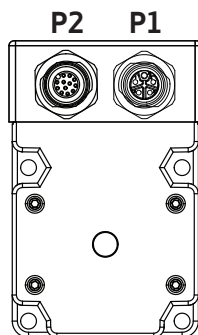
PIN	I/O CONNECTOR (5V TTL I/O)	Specifications:	Notes:	P2 Enc Out or CAN Option
1	I/O - 0 GP or Encoder A or Step Input	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D	1.5 MHz Max as Encoder or Step Input	M12 12-Pin Female 
2	I/O - 1 GP or Encoder B or Direction Input	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D	1.5 MHz Max as Encoder or Direction Input	
3	I/O - 2 Positive Over Travel or GP	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D		
4	I/O - 3 Negative Over Travel or GP	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D		
5	I/O - 4 GP, IIC (SDA) or RS-485 A (Ch. 1) or CAN-L based on motor option	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D	115.2 KBaud Max 1 MBaud Max, Non-isolated	
6	I/O - 5 GP, IIC (SCL) or RS-485 B (Ch.1) or CAN-H based on motor option	25 mAmp Sink or Source 10 Bit 0-5 VDC A/D	115.2 KBaud Max 1 MBaud Max, Non-isolated	
7	Encoder A OUT or CAN-L based on motor option	Phase A Encoder Output	1 MBaud Max, Non-isolated	
8	Encoder B OUT or CAN-H based on motor option	Phase B Encoder Output	1 MBaud Max, Non-isolated	
9	RS-232 Transmit	Com ch. 0	115.2 KBaud Max	
10	RS-232 Receive	Com ch. 0	115.2 KBaud Max	
11	+5 VDC Out	50 mAmp Max (total)		
12	Common Ground	Typ. SIG Ground		

NOTE: I/O ports input impedance = 5 kohm (5 kohm pull-up resistor)

PIN	CAN bus	Connection:	Notes:	P2 CAN Only Option
1	NC	NC		M12 5-Pin Female 
2	NC	NC		
3	NC	NC		
4	CAN-H	1 MBaud Max	Non-isolated	
5	CAN-L	1 MBaud Max	Non-isolated	

NOTE: These motors can operate on power down to +20 VDC, but it is not recommended due to greatly reduced performance — optimum performance is achieved at 48 VDC.

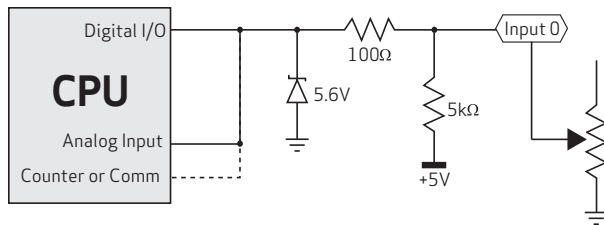
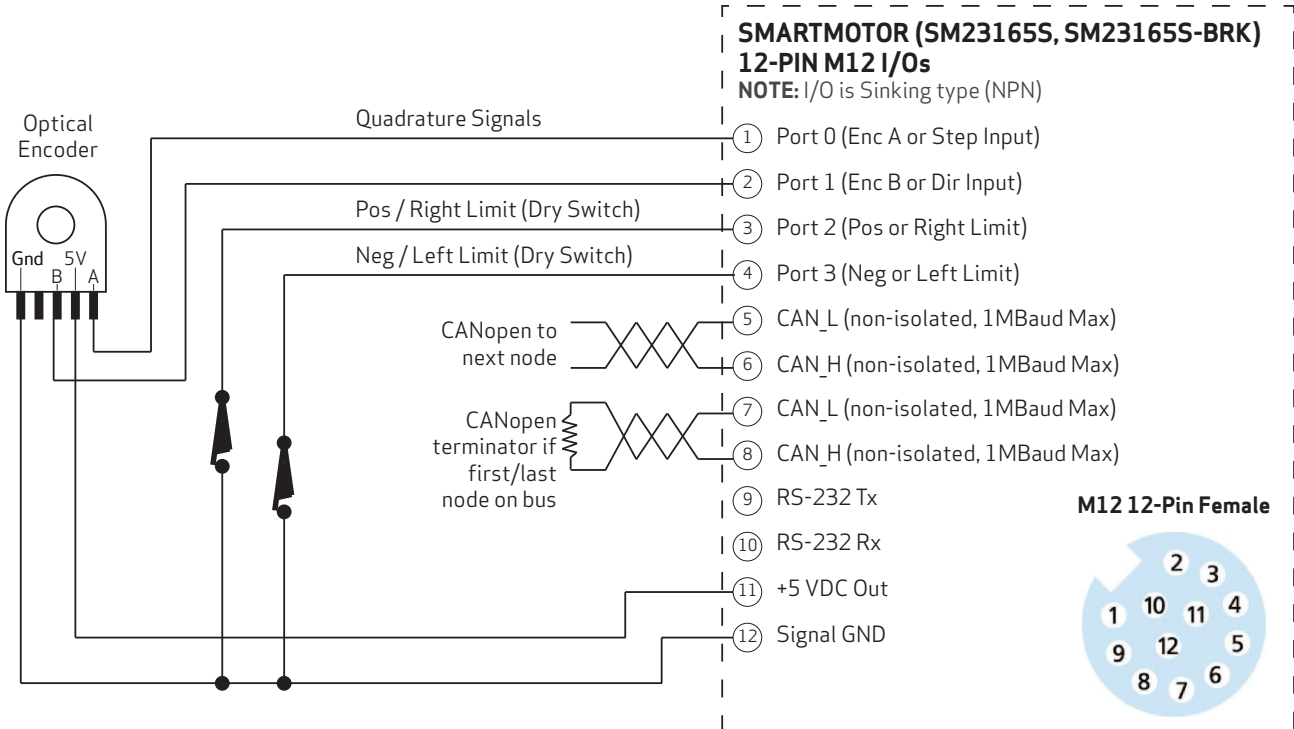
NOTE: All specifications are subject to change without notice. Consult the factory for the latest information.



CAUTION: Connectors P1 and P2 must be finger tightened only! DO NOT use a tool. Doing so can cause overtightening of the connection, which may damage the connector and will void the warranty.

Class 5 S-Style I/O Connection Examples

The next figure shows I/O connection examples for the Class 5 S-style motors that have the 12-pin communication and I/O connector. Also, refer to Connector Pinouts on page 1 for connector specifications.



Knowing the SmartMotor's internal schematic can be useful when designing external interfaces. SmartMotor I/O is logic 0 for voltages below 1.2V and logic 1 for voltages above 3.0V. Note that logic states for voltages between these are unpredictable.

NOTE: For improved linearity of analog potentiometers, select one that is less than or equal to the motor's internal pull-up resistor. For example, if the motor's pull-up resistor is 5 kohm, use a potentiometer that is no greater than 5 kohm.

Other S-Style Motor Changes

In addition, please note these items:

Features Not Available

These Class 5 SmartMotor features have *not* been implemented in the S-style SmartMotors:

- Some fieldbus communications (DeviceNet, PROFIBUS, etc.) are not available. However, CAN bus is available on several models. It is not available on the -EO option models.
- COM 0 port is not available on the -C option models. Therefore, those models do not support field upgrade of the motor firmware. Contact Moog Animatics applications engineering for more details.
- COM 1 port (second serial port) is not available on the base or -C option models; it is only available on the -EO option models.
- The -C option models do not support an external encoder.
- The SMI software CAN Lockup Wizard requires firmware version 5.0.4.55 or later; older versions will not support it.

Commands Not Currently Supported

These commands are *not* currently supported in the S-style SmartMotor:

Not applicable — all Class 5 commands are supported.

For Further Information...

For further information on SMI software features, SmartMotor programming details, communication details, motion details, a complete command reference and more, see the *SmartMotor™ Developer's Guide*.

Troubleshooting

This section provides troubleshooting information for common problems. For additional support resources, see: <http://www.animatics.com/support.html>.

Issue	Cause	Solution
Communication and Control Issues		
Motor does not communicate with SMI.	Transmit, receive or ground pins are not connected correctly.	Ensure that transmit, receive and ground are all connected properly to the host PC.
	Motor program is stuck in a continuous loop or is disabling communications.	To prevent the program from running on power up, use the Communications Lockup Wizard located on the SMI software Communications menu.
Motor disconnects from SMI sporadically.	COM port buffer settings are too high.	Adjust the COM port buffer settings to their lowest values. This is done In the Windows Device Manager> Advanced Settings dialog box for the associated COM port driver.
	Poor connection on cable from motor to PC.	Check the cable connections and/or replace it.
	Power supply unit (PSU) brownout.	PSU may be undersized for the application, which causes it to brown-out during motion. Make moves less aggressive, increase PSU size or change to a linear unregulated power supply.
Motor stops communicating after power reset, requires redetection.	Motor does not have its address set in the user program. NOTE: Serial addresses are lost when motor power is off or reset.	Use the SADDR or ADDR= command within the program to set the motor address.
Motor doesn't turn.	Faults not cleared.	Clear faults (see Checking and Clearing the Status Bits on page 46).).
Common Faults		
Bus voltage fault.	Bus voltage is too high for operation.	Check servo bus voltage. Check for excessive regenerative energy from motor due to no/insufficient shunt resistor.
	Bus voltage is too low for operation.	If motor uses the dual-power configuration (separate drive and control power supplies), ensure that both power supplies are connected and are sized correctly for the motor.
Overcurrent occurred.	Motor intermittently drew more than its rated level of current. Does not cease motion.	Consider making motion less abrupt with softer tuning parameters or lower acceleration profiles.
Excessive temperature fault.	Motor has exceeded internal PCB temperature limit of 85°C. Motor will remain unresponsive until it cools down below 80°C.	Motor may be undersized or ambient temperature is too high. Check motor sizing for the application in terms of continuous rating. Consider adding heat sinks or forced air cooling to the system.
Excessive position error.	The motor's commanded position and actual position differ by more than the user-supplied error limit.	Increase error limit, decrease load or make movement less aggressive. Also, ensure you are not voltage limited for the torque at speed required. If running from less than 48 VDC, check ratings for lower bus voltages and ensure the motor is within required torque capacity.
Motor faults on position error only after a certain amount of time.	Motor sized incorrectly.	Check motor sizing for the application in terms of continuous rating. Also, ensure you are not voltage limited for the torque at speed required. If running from less than 48 VDC, check ratings for lower bus voltages and ensure the motor is within required torque capacity.
Motor is not accurately corresponding to trajectory.		

Troubleshooting

Issue	Cause	Solution
Programming and SMI Issues		
Several commands not recognized during compiling.	Compiler default firmware version set incorrectly.	Use the Compiler default firmware version option in the SMI software Compile menu to select a default firmware version closest to the motor's firmware version. In the SMI software, view the motor's firmware version by right-clicking the motor and selecting Motor Properties.

TAKE A CLOSER LOOK

Moog Animatics, a sub-brand of Moog Inc. since 2011, is a global leader in integrated automation solutions. With over 30 years of experience in the motion control industry, the company has U.S. operations and international offices in Germany and Japan as well as a network of Automation Solution Providers worldwide.

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