INSTALLATION MANUAL

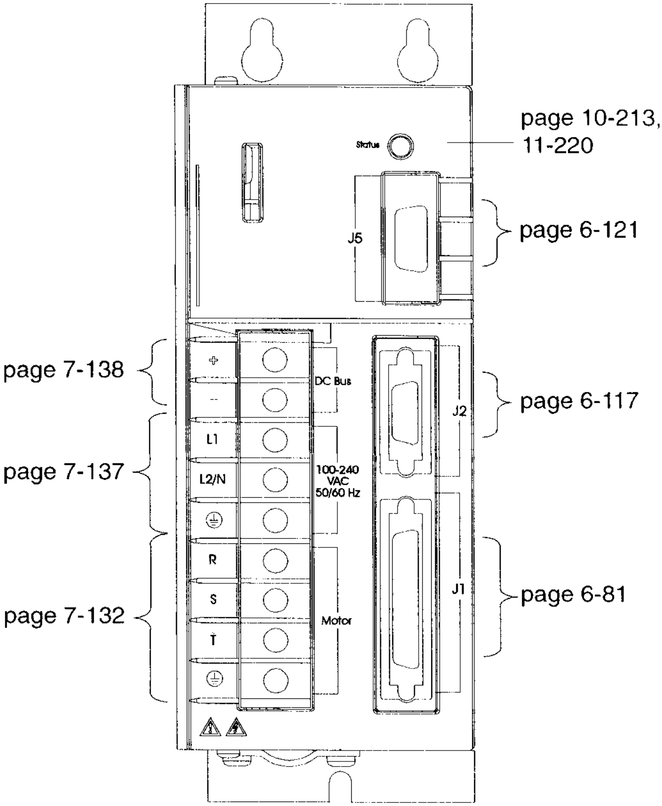
MICRO DSM

GIDDINGS & LEWIS, INC.

Pictorial Index

J5 - Serial Port		
1	RCV +	RS-485
2	RCV	RS-232
3	XMT	RS-232
4	XMT +	RS-485
5	Com	
6	Reserved	
7	RCV -	RS-485
8	XMT -	RS-485
9	Reserved	

J2 - Encoder	
1	Encoder +5V Pwr
2	Encoder 5V Com
3	Encoder +5V Pwr
4	Encoder 5V Com
5	Encoder +5V Pwr
6	Encoder 5V Com
7	Mtr Encdr Input Chnl A+
8	Mtr Encdr Input Chnl A-
9	Mtr Encdr Input Chnl B+
10	Mtr Encdr Input Chnl B-
11	Mtr Encdr Input Chnl I+
12	Mtr Encdr Input Chnl I-
13	Hall A
14	Hall B
15	Hall C
16	Absolute Position
17	Reserved
18	Reserved
19	Thermal Switch +
20	Thermal Switch -



J1 - Controller							
1	Encoder +5VDC	14	Auxiliary Chnl A+	27	I Limit	40	Reserved
2	Encoder 5V Com	15	Auxiliary Chnl A-	28	Analog Com	41	Reserved
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7	Mtr Output Chnl A+	20	Drive Enable	33	Selectable Input 2	46	Reserved
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11	Mtr Output Chnl I+	24	Drive Ready +	37	Reserved	50	Brake Enable -
12	Mtr Output Chnl I-	25	Drive Ready -	38	Reserved		
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INSTALLATION MANUAL

MICRO DSM

GIDDINGS & LEWIS

NOTE

Progress is an on going commitment at Giddings & Lewis. We continually strive to offer the most advanced products in the industry; therefore, information in this document is subject to change without notice. The illustrations and specifications are not binding in detail. Giddings & Lewis shall not be liable for any technical or editorial omissions occurring in this document, nor for any consequential or incidental damages resulting from the use of this document.

DO NOT ATTEMPT to use any Giddings & Lewis product until the use of such product is completely understood. It is the responsibility of the user to make certain proper operation practices are understood. Giddings & Lewis products should be used only by qualified personnel and for the express purpose for which said products were designed.

Should information not covered in this document be required, contact the Customer Care Team, Giddings & Lewis, 660 South Military Road, P.O. Box 1658, Fond du Lac, WI 54936-1658. Giddings & Lewis can be reached by telephone at (920) 921-7100.

108-31017-00

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Product Notice

Use of DSM Drive Lines

DSM Drive Line drives are intended for use as transistorized electronic amplifiers powering servo motors in machinery. As such, they must be part of a controlled system that includes a controlling device. They are not intended to independently control a motor. Instructions in the motor and control system manuals must be observed; this document does not replace those instructions.

Unless specified otherwise, DSM Drive Line drives are intended for use in a normal industrial environment, installed in a suitable electrical cabinet without exposure to excessive or corrosive moisture or abnormal ambient temperatures. The exact operating conditions may be established by referring to the data for the drive. The connection and control of drives in machinery is a skilled operation, disassembly or repair must not be attempted. In the event that a drive fails to operate correctly, contact the place of purchase for return instructions.

Safety Notes

There are some possible hazards associated with the use of drives. The following precautions should be observed. Specific Warnings and Cautions are listed in the Preface and Safety sections of the manual.

Installation and Maintenance: Installation and maintenance or replacement must be carried out by suitably qualified service personnel, paying particular attention to possible electrical and mechanical hazards.

Weight: Large drives are heavy, the center of gravity may be offset and removable covers shield internal components. When handling, take appropriate precautions and lift the equipment using permanent, fixed surfaces, such as the base; avoid lifting the device using protective cover shields that may be loose. Beware of sharp edges; use protective gloves when handling such assemblies.

Flying Leads and Loose Cables: Ensure that flying leads or loose cables are suitably restrained, to prevent snagging or entanglement, or are disconnected before carrying drives with such leads or cables.

Generation: If a motor is driven mechanically, it may generate hazardous voltages which are conducted from its power input terminals to the drive. The power connector must be suitably guarded to prevent a possible shock hazard.

Loose Drives: When running an unmounted drive, ensure that the cooling fan is adequately guarded and sufficient airflow is provided around the drive to ensure adequate cooling. The mounting surface of the drive is a heatsink and its surface temperature may increase when the drive is operating. If a motor is connected to the drive, remove the key which otherwise could fly out and restrain the motor before applying power to the drive.

Damaged Cables: Damage to cables or connectors may cause an electrical hazard. Ensure there is no damage before energizing the system.

Supply: Drives connect to a permanent main power source; not a portable power source. Suitable fusing and circuit protection devices are required. Consult the instructions and adhere to local and national regulations before connecting and energizing the drive.

Safety Logic Signals: Logic signals from the drive are interruptible signals; they are removed when power is removed from the drive. Consult the manual for information on auxiliary power connections that may be employed when these signals are used for safety purposes.

Safety Requirements: The safe incorporation of DSM Drive Line products into a machine system is the responsibility of the machine designer, who should comply with the local safety requirements at the place where the machine is to be used. In Europe this is likely to be the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is likely to be the National Electrical Code.

Mechanical Connection: Drives must be installed inside an electrical cabinet that provides environmental controls and protection. Installation information for the drive is provided in the manual and list the minimum installation requirements for the drive are provided in the manual. Motors and controlling devices that connect to the drive should have specifications that complement the capabilities of the drive.

Motors: Motors controlled by the drive should only connect to the drive; they should not connect directly to the AC line. Use of custom motors requires the entering of a valid thermal time constant, otherwise the motor overload protection will not function properly.

Disposal: DSM Drive Line drives do not contain hazardous substances. They may be disposed of as mechanical scrap. You may return the drive at your cost for disposal by us.

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Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- Who should use this manual
- The purpose and contents of this manual
- Storing the product
- Related documentation
- Conventions used in this manual
- Safety precautions
- Giddings & Lewis product support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting the Centurion DSM family of products

If you do not have a basic understanding of the Centurion DSM Line, contact your local Giddings & Lewis representative for information on available training courses before using this product.

Purpose and Contents of this Manual

This manual is a user guide for the Centurion DSM Line. It gives you an overview of the Centurion DSM family and describes the procedures you use to install, setup, use, and troubleshoot the Centurion DSM Line.

This manual provides instructions on how to setup and connect the Centurion DSM Line drive to a controlling device and a motor. A Centurion DSM Line drive can operate in one of several different functional modes. The hardware connections necessary to run the drive are detailed in this manual and basic software instructions are provided for common setup procedures. For detailed explanation of software instructions, refer to the comprehensive online instructions available in the DSMPro software.

The instructions in this manual detail how to install your DSM Line drive using DSMPro software with a personal computer. If you are using a TouchPad device, abbreviated command titles are displayed but the setup steps remain the same. If you are using the serial Host Command Language to control the drive, comprehensive instructions are accessible through the Host Command Reference icon displayed in the DSMPro window.

This manual is organized into numbered chapters and alphabetical appendices. The topics covered in each chapter and section are briefly described. Typographical conventions, warning and cautions specific to the drive, and complementary manuals are also described.

Title	Description
Safety	Lists general safety requirements that must be followed when installing or servicing the drive.
Selecting Other System Components	Identifies motors and signal types that are compatible with DSM Line drives.
DSMPro Installation	Provides snapshot instructions for installing, accessing and exiting DSMPro.
Unpacking, Inspecting and Storing	Lists what should be included with your DSM Line drive and instructs you on how to perform a basic functional test before installing or storing the drive.
Installation	Instructs you on how to physically install your DSM Line drive.
Interfaces	Each signal or set of signals is identified by: • Power requirements for driving the signal. • Functions performed by the signal. • Specifications, including ON and OFF states. • Schematic depictions of the circuit design for each signal type. The signals are grouped by the connector on which they are present.
• J1 - Controller	Diagrams depict the cable connections necessary for common controller interfaces.
• J2 - Encoder	Provides comprehensive information about the encoder signals, Hall Effect switches and thermostat connections available through this connector.

Title	Description
• J5 - Serial Port	Diagrams and instructions detail how to communicate with a drive using serial communications.
Power Connections	Provides information on making motor power, DC bus and AC Power connections.
Application and Configuration Examples	Describes the hardware and software set up necessary to install the drive as one of the following types operating in a specific mode:
• Analog Control	• Velocity or torque mode
• Preset Controller	• Velocity or torque mode
• Position Follower (Master Encoder)	• Velocity mode
• Position Follower (Step/Direction)	• Velocity mode
• Position Follower (Step Up/Down)	• Velocity mode
• Incremental Indexing	• Velocity mode
• Registration Indexing	• Velocity mode
• Absolute Indexing	• Velocity mode
Tuning	Provides instructions on how to tune a drive and motor combination using the autotuning or manual tuning features in DSMPro.
Status Display	Discusses the Status LED indicator on the front panel. Operating or Error Messages accessible through the TouchPad or a PC are explained.
Maintenance and Troubleshooting	Describes the minimal maintenance necessary with the DSM Line drives and provides a comprehensive troubleshooting chart of potential problems and their solutions.
Options and Accessories	Lists the optional equipment available for the DSM Line drives. Schematics and cabling examples are provided.
TouchPad Instructions	Describes how to program an DSM Line drive using the optional TouchPad device. Tables reference the various motor types that are programmed to work with the DSM Line drive. A copy of the *TouchPad Command Tree* card for the current firmware version is bound into the manual.

Title	Description
Electromagnetic Compatibility Guidelines for Machine Design	Describes common electrical noise problems and suggests methods to ensure ElectroMagnetic Compatibility.
Dynamic Braking Resistor Selection	Provides equations to assist in sizing resistors for dynamic braking.
Specifications	Details the design and operational specifications for the DSM Line drives in a tabular format.
Product Support	Describes the product assistance available, and lists telephone numbers for product assistance and additional on-line information.

Additional Instructions and Manuals

Host Commands and DSMPro

All Centurion DSM Line drives are setup through serial Host Commands. The drives can be configured directly through the Host Command language or indirectly through the DSMPro software. DSMPro is a graphical user interface that provides a visual method of accessing the Host Command language through the Microsoft Windows Operating System.

All documentation for both the Host Commands and DSMPro is online. Host Command information is available through a comprehensive online reference manual. DSMPro information is available through Help menus. The online information provides in-depth explanations of the Host Command language as well as the menus, windows and dialog boxes that make DSMPro a convenient method for programming Centurion DSM Line drives.

To access the Host Command Reference

- Click on the Host Command Reference icon in the DSMPro program group.

To access DSMPro Help

- Open DSMPro by clicking on the DSMPro icon in the DSMPro group, and
- Press the F1 key.

TouchPad

The optional TouchPad can be used to monitor and configure the Centurion DSM Line drive. The TouchPad command structure is similar to the structure of DSMPro, but operates through an abbreviated keypad interface. A *TouchPad Instruction* card is provided with the TouchPad. It describes the installation and operational instructions in a pocket-sized directory. The *TouchPad Command Tree* card and additional instructions for the TouchPad are included in the section titled "TouchPad Commands", which begins on page C-270. The *TouchPad Command Tree* card is a graphical presentation of both the operational instructions and the command structure for the Centurion DSM Line drives. You may find it convenient to refer to the *TouchPad Command Tree* card when using the TouchPad with a Centurion DSM Line drive.

Symbols and Conventions

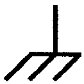
Typographical and Wording Conventions:

Example	Description
Drive Set Up	Text shown in this font and underlined indicates a Hot Key (keystroke combination) to quickly access a command. For example, Choose Drive Set Up, indicates typing ALT+D followed by ENTER accesses this command.
DSMPro	Text shown in this font is information to enter in a window or dialog box. For example, Choose the icon DSMPro.
win	Text in lower case bold is information to enter at a keyboard. For example, To start Windows from the DOS prompt, type **win** and then press ENTER.
ALT+F4[a]	Keys that should be pressed simultaneously are shown with a plus sign (+) between the key names. This example closes the active window.
ALT, F, N	Keys that should be pressed in sequence are shown with a comma (,) between the key names. This example opens the File menu and then opens a new file.
Choose	Indicates that an icon or a command is to be selected from a window or a command box. For example, the instruction for accessing the command icon Drive Set Up states: Choose Drive Set Up.
Select	Indicates that options are to be selected from a list. For example, the instruction for accessing or entering information states: Select Drive Type and Motor Model from the respective list box.
Type	Indicates that commands to enter in a command box. For example, the instruction for loading DSMPro states: Type **a:setup** and then press **ENTER**.
NOTE: or TIP:	Notes provide auxiliary information that is important to know. Tips provide hints or shortcuts that are useful. For example, NOTE — This step assumes DSMPro was installed in the DSMPro directory during setup. TIP — To disable the automatic Help display, choose the menu item Show Quick Start from the Help menu.

a. Microsoft® Windows™ reserves certain multiple keystroke combinations to activate Windows commands.

Graphical Symbols

This manuals uses the following graphic symbols.

Example	Description
	Protective conductor terminal (Earth ground)
	Chassis terminal (Not a protective ground)
	Risk of electrical shock symbol
	**DANGER**, **WARNING** or **CAUTION** require accompanying information notices to prevent potential personal injury and equipment damage.

Centurion DSM Line Product Receiving and Storage Responsibility

You, the customer, are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) you receive against your purchase order. If any items are obviously damaged, it is your responsibility to refuse delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. Leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Leave the drive in its shipping container prior to installation. If you are not going to use the equipment for a period of time, store it:

- in a clean, dry location
- within an ambient temperature range of -40 to 70° C (-40 to 158° F)
- within a relative humidity range of 5% to 95%, non-condensing
- in an area where it cannot be exposed to a corrosive atmosphere
- in a non-construction area

The "Drive Checkout Test" on page 2-47 is useful to verify that the unit is operating correctly after delivery.

General Safety Guidelines

This section covers general safety guidelines for electronic devices. Safety information specific to Centurion DSM Line drives appears in the chapter "Safety" on page 1-37.

Hazards which can be encountered in the use of this equipment are:

- Electric Shock
- Electric Fire
- Mechanical
- Stored Energy

There are no chemical or ionizing radiation hazards.

Electrical shock and fire hazards are avoided by using normal installation procedures for electrical power equipment in an industrial environment. Installation must be undertaken by suitably qualified personnel. Note that this amplifier must be installed in an industrial cabinet such that access is restricted to suitable qualified personnel.

Mechanical hazards are associated with potentially uncontrolled movement of the motor shaft. If this imposes a risk in the machine, then appropriate precautions must be made to electrically disconnect the motor from the drive when personnel have access to moving parts of the machine. Note also that the motor must be securely mounted at all times.

Stored energy hazards are both electrical and mechanical.

1. Electrical hazards can be avoided by disconnecting the drive from its power source and measuring the DC bus voltage to verify it has reached a safe level or by waiting for the time indicated in the warning on the front of the drive prior to removing the protective covers or touching any connections.
2. Mechanical hazards require a risk analysis on the effects of stored mechanical energy when the machine is running at speed, as well as the potential for the conversion of electrical energy stored in the drive being converted to mechanical energy. Electrical energy may be stored in drive for the time indicated in the warning on the front of the drive.

The following points should be observed for the safety of personnel:

- Only qualified personnel familiar with the equipment are permitted to install, operate and maintain the device.
- System documentation must be available and observed at all times.
- All non-qualified personnel should maintain a safe distance from the equipment.
- The system must be installed in accordance with local regulations.
- The equipment is intended for permanent connection to a main power input. It is *not* intended for use with a portable power input.
- Do *not* power up the unit without the covers in place and the protective conductor connected.
- Do *not* operate the unit without connecting the motor conductor to the appropriate terminal on the drive.
- Always remove power before making or removing *any* connection on the unit.
- Before removing the cover of the unit, shut off the main power and measure the DC bus voltage to verify it has reached a safe level or wait for the time as indicated on the front of the drive.
- Do *not* make any connections to the internal circuitry. Connections on the front panel are the only points where users should make connections.
- Be careful of the DC bus and shunt terminals. High voltage is present when power is applied to the drive.
- Never connect the DC- (negative) terminal to earth ground, the drive requires a floating DC bus.
- Do *not* use the ENABLE input as a safety shutdown. Always remove power to a drive before maintaining or repairing the unit.
- Motors without thermal protection devices require a valid thermal time constant. Otherwise the motor overload protection will not function properly.

Giddings & Lewis Support

Giddings & Lewis offers support services worldwide.

Local Product Support

Contact your local Giddings & Lewis distributor for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Giddings & Lewis for technical assistance, please review the information in the *Troubleshooting* chapter first. Then call your local Giddings & Lewis distributor. For the quickest possible response, we recommend that you have the part and model numbers and/or software revision level of your products available when you call. The Giddings & Lewis Product Support numbers are listed inside the back cover of this manual.

Safety 1

Installing and Using the Centurion DSM Drive

Read the complete manual before attempting to install or operate the drive. By reading the manual you will become familiar with practices and procedures that allow you to operate the drive safely and effectively.

You should always adhere to the safety guidelines listed in the "Product Notice" located on the back of the title page and the "General Safety Guidelines" on page 1-40. Specific Warnings and Cautions appear throughout the manual.

Safety Classifications

Safety notices describe the likelihood of exposure to hazardous situations and what could happen as a result of exposure to the hazard. Following are symbols and words used to introduce the information that is intended to prevent potential personal injury and equipment damage.

Symbols	Words
	**DANGER**: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations.
or	**WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	**CAUTION**: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may be used for situations that cause property damage only. It may also be used to alert against unsafe practices.

Potential Hazards

The equipment described in this manual is intended for use in industrial drive systems. This equipment can endanger life through rotating machinery and high voltages, therefore it is essential that guards for both electrical and mechanical parts are *not* removed.

Hazards which can be encountered in the use of this equipment are:

- Electric Shock
- Electric Fire
- Mechanical
- Stored Energy

These hazards must be controlled by safe machine design, using specific local regulations, normal safety guidelines and the specific notices that follow. There are no chemical or ionizing radiation hazards.

Voltage Potentials

DANGER

DC bus capacitors may retain hazardous voltages after input power has been removed, but will normally discharge in several seconds. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval listed on the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

Voltage potentials for the internal drive circuitry vary from 325 Volts above to 325 Volts below earth ground for a 240 Volt input. Voltages can reach 450 VDC within the drive. All circuits, including the connections on the front panel, should be considered “hot” when power is connected and for the time specified in the warning on the front of the drive after power is removed.

Your Responsibilities

As the user or person installing this drive, you are responsible for determining the suitability of the product for the intended application. Giddings & Lewis is neither responsible nor liable for indirect or consequential damage resulting from the inappropriate use of this product.

A qualified person is someone who is familiar with all safety notes and established safety practices, with the installation, operation and maintenance of this equipment and the hazards involved. For more detailed definitions, refer to IEC 364.

It is recommended that anyone who operates or maintains electrical or mechanical equipment should have a basic knowledge of First Aid. As a minimum, they should know where the First Aid equipment is kept and the identity of the trained First Responders in the facility.

Safety notes do not represent a complete list of the steps necessary to ensure safe operation of the equipment. If you wish further information, please contact the nearest distributor of Giddings & Lewis products.

General Safety Guidelines

This section covers general safety guidelines for electronic devices. Safety information specific to Centurion DSM Drives begins on page 1-37.

Hazards which can be encountered in the use of this equipment are:

- Electric Shock
- Electric Fire
- Mechanical
- Stored Energy

There are no chemical or ionizing radiation hazards.

Electrical shock and fire hazards are avoided by using normal installation procedures for electrical power equipment in an industrial environment. Installation must be undertaken by suitably qualified personnel. Note that this amplifier must be installed in an industrial cabinet such that access is restricted to suitable qualified personnel.

Mechanical hazards are associated with potentially uncontrolled movement of the motor shaft. If this imposes a risk in the machine, then appropriate precautions must be made to electrically disconnect the motor from the drive when personnel have access to moving parts of the machine. Note also that the motor must be securely mounted at all times.

Stored energy hazards are both electrical and mechanical.

1. Electrical hazards can be avoided by disconnecting the drive from its power source and measuring the DC bus voltage to verify it has reached a safe level or by waiting for the time indicated in the warning on the front of the drive prior to removing the protective covers or touching any connections.
2. Mechanical hazards require a risk analysis on the effects of stored mechanical energy when the machine is running at speed, as well as the potential for the conversion of electrical energy stored in the drive being converted to mechanical energy. Electrical energy may be stored in drive for the time indicated in the warning on the front of the drive.

The following points should be observed for the safety of personnel:

- Only qualified personnel familiar with the equipment are permitted to install, operate and maintain the device.
- System documentation must be available and observed at all times.
- All non-qualified personnel should maintain a safe distance from the equipment.
- The system must be installed in accordance with local regulations.
- The equipment is intended for permanent connection to a main power input. It is *not* intended for use with a portable power input.
- Do *not* power up the unit without the covers in place and the protective conductor connected.
- Do *not* operate the unit without connecting the motor conductor to the appropriate terminal on the drive.
- Always remove power before making or removing *any* connection on the unit.
- Before removing the cover of the unit, shut off the main power and measure the DC bus voltage to verify it has reached a safe level or wait for the time as indicated on the front of the drive.
- Do *not* make any connections to the internal circuitry. Connections on the front panel are the only points where users should make connections.
- Be careful of the DC bus and shunt terminals. High voltage is present when power is applied to the drive.
- Never connect the DC- (negative) terminal to earth ground, the drive requires a floating DC bus.
- Do *not* use the ENABLE input as a safety shutdown. Always remove power to a drive before maintaining or repairing the unit.
- Motors without thermal protection devices require a valid thermal time constant. Otherwise the motor overload protection will not function properly.

Unpacking, Inspecting and Storing 2

This chapter describes the steps which ensure that the drive will function as specified. The steps include:

- Unpacking the Centurion DSM Drive
- Inspecting the drive for shipping damage
- Testing the basic functionality of the drive
- Guidelines for storing the drive.

Unpacking the Drive

1. Remove the Centurion DSM Drive from the shipping carton and remove all packing materials from the unit. The materials and carton may be retained for storage or shipment of the drive.
2. Check all items against the packing list. A label located on the side of the unit identifies:
   - Model number
   - Serial number
   - Manufacturing date code.

Inspection Procedure

To protect your investment and ensure your rights under warranty, we recommend the following steps be performed upon receipt of the unit:

- Inspect the unit for any physical damage that may have been sustained during shipment.
- Perform the Inspections Test to verify the functionality of the unit.

If you find damage, either concealed or obvious, contact your buyer to make a claim with the shipper. If degraded performance is detected when testing the unit, contact your distributor or Giddings & Lewis to obtain a Return Material Authorization (RMA). Do this as soon as possible after receipt of the unit.

Testing the Unit

Drives are burned-in and individually tested before they leave the factory. However, damage may occur during shipping. Perform the procedures below to ensure the Centurion DSM Drive is operational and undamaged.

Abbreviated directions for connecting the drive to a motor and a PC are provided.

The test requires:

- Approximately 20 minutes to complete
- A motor with appropriate power and encoder cables
- A PC with the DSMPro software package installed
- An RS-232 communications cable
- An external I/O power supply
- A single phase 100-240 VAC, 50/60 Hz power source. Standard wall outlet power is suitable for verification testing of Centurion DSM Drives.
- A test cable constructed from two normally open switches, several pieces of 1.5 mm^2 (16 AWG) wire and a mating connector. Connectors are listed in "Mating Connectors" on page A-243. The Appendix "Options and Accessories" on page A-235 lists the cables.

During the test, power is removed several times. Always measure the DC Bus voltage to verify the bus capacitors are fully discharged, or wait for the time indicated in the warning on the front of the drive. The bus capacitors must be fully discharged for the subsequent steps to be valid.

If problems arise during this procedure, refer to "Troubleshooting" on page 11-220 and review other relevant sections in this manual, or call your local distributor.

WARNING

Perform the initial power-up with the motor shaft disconnected from a load and the shaft key removed. Improper wiring or undiscovered shipping damage could result in undesired motor motion. Be prepared to remove power if excessive motion occurs.

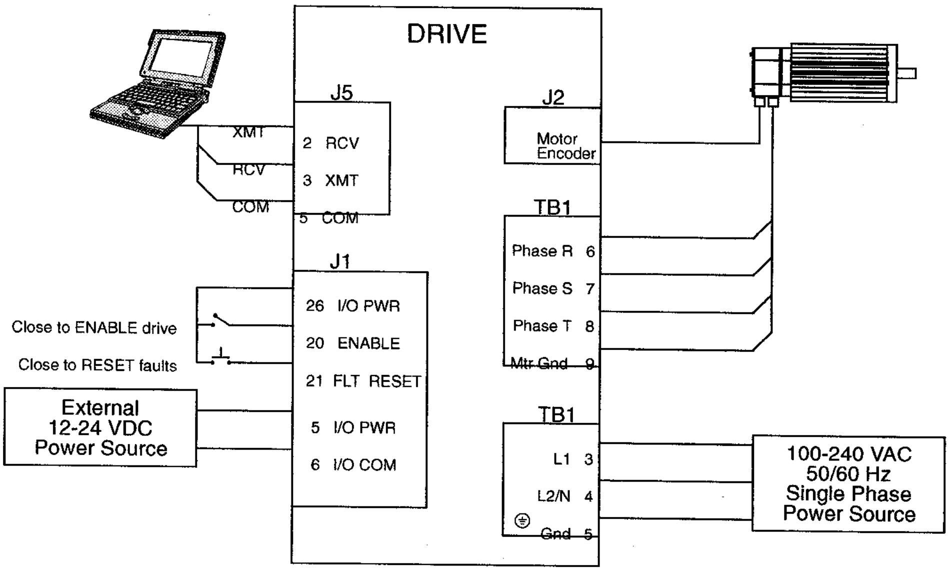
Hardware Set Up

Make the connections described below and shown in Figure 2.1. "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an external I/O power supply (12-24 VDC) to J1-5 and J1-6, or J1-26 and J1-13.
2. Connect an RS-232 cable between the serial port on the PC and the J5 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
3. Connect a Motor/Feedback cable from the motor to the J2 connector on the Centurion DSM Drive.
4. Connect a jumper wire with a toggle switch with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR).
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including its normally open toggle switches.
5. Connect a Power Cable between an external 100-240 VAC, 50/60 Hz power source and the L1, L2/N and ⏚ (Gnd) connections.

Figure 2.1 Host Mode Connection Diagram



WARNING

Be prepared to disable the drive or remove input power if excessive motor motion occurs while performing the following steps.

Drive Checkout Test

This test sequentially verifies that:

- Drive power wiring is correct and start-up logic is functioning.
- The drive and motor are correctly wired
- Drive serial communications are operational

Before beginning the "Initial Power-up", please check the following:

- All wiring and mounting to verify correct installation
- Input voltages to ensure they do *not* exceed specifications for the drive or motor.

Initial Power-up

1. Verify the AC power is within specifications at the terminal strip.
2. Switch the AC Power to ON and verify the Status LED is green
3. Switch the power OFF and wait until the DC Bus Voltage is below 30 Volts.
4. Connect the motor windings to:
    - R (TB1-6)for the Phase R winding
    - S (TB1-7) for the Phase S winding
    - T (TB1-8) for the Phase T winding
    - ⏚ (TB1-9) for the Ground connection.
5. If a brake motor is being used for the test, connect the brake relay:
    - BRAKE ENABLE + (J1-49) to the Motor Brake +
    - BRAKE ENABLE - (J1-50) to the Motor Brake -.
6. Switch AC Power ON again and verify the STATUS LED is green
7. Switch the power OFF and wait until the DC Bus Voltage is below 30 Volts.

Communications Verification

8. Start DSMPro on the PC.
9. Close any windows that are open in DSMPro.

10. Select PC Set Up from the Communications menu in DSMPro.

11. Verify the communication port settings match those of the drive, then select OK. Factory default drive settings are:

    - Baud Rate: 9600
    - Data Bits: 8
    - Parity: None
    - Stop Bits: 1
    - Serial Port: COM1

    Assignment of communications ports on PCs varies between manufacturers. The COM port setting for the drive and PC must match. Refer to "Troubleshooting" on page 11-220 if communication problems are encountered.

12. Switch AC power ON.

13. Select Read Drive Parameters from the Communications menu in DSMPro.

14. Select OK in the Drive Select dialog box. A dialog box indicating that the PC is reading drive parameters should appear.

    If this dialog box does *not* appear, a message appears that advises you to check the COM settings and the communication cable. If necessary, refer to "Troubleshooting" on page 11-220 for instructions on how to perform these checks.

Initial Drive Operation

1. When the message appears that a motor must be selected, choose OK. The Drive Set Up dialog box is selected with Motor Model active.
2. Select the appropriate motor from the drop-down Motor Model box.
3. Choose OK when the message appears advising that the drive must reset. A change in motor parameters requires reselection of the firmware based drive/motor tables. The software reset prevents improper sequencing of these table parameters.
4. Choose Close from the Drive Set Up window.
5. Select the Control Panel icon from the Drive Window.
6. Close the connection between J1-26 and J1-20 to enable the drive.

7. Holding torque should be sufficient so that the shaft is either immovable or very resistant to rotation.

8. Move the Slide Bar in the Control Panel window to the right and then to the left. Verify that the motor rotates:

   - CW as the Slide Bar is moved right of center, and
   - CCW as the Slide Bar is moved left of center.

   If the motor rotates in the wrong direction (CCW when the slide bar is set to the right of center) or jumps and locks-up, motor phasing and encoder feedback phasing may be incorrect. If necessary, refer to the Troubleshooting chapter for instructions on how to correct the motor power connections at TB1-1, 2, 3 and 4 or the encoder feedback connections at J2.

9. Choose Set to Zero. The motor will stop rotating.

10. Choose Drive Disable and verify the motor shaft can be rotated by hand.

11. Choose Drive Enable and verify the motor shaft has holding torque. (i.e., The shaft cannot be moved or moves with resistance.)

12. Open the connection between J1-26 and J1-20 to disable the drive.

13. Choose Close from the Control Panel window.

A drive completing these steps is functional. If the Centurion DSM Drive did *not* pass the steps above, refer to "Troubleshooting" on page 11-220.

▶ NOTE: For information on testing the digital and analog signals refer to "Testing Digital Outputs" on page 11-228, "Testing Digital Inputs" on page 11-230, "Testing Analog Output" on page 11-231 and "Testing Analog Input" on page 11-232.

Storing the Unit

Return the drive to its shipping carton using the original packing materials to enclose the unit.

Store the drive in a clean, dry place that will *not* exceed the following ranges:

- Humidity: 5% to 95%, non-condensing
- Storage temperature: -40° to 158° Fahrenheit (-40° to 70° Celsius).

Selecting Other System Components 3

This chapter reviews the Centurion Model DSM 007, 007P, 015, 015P, 030 and 030P drives, command sources and interfaces for the drives, and complementary motors and accessory equipment. Selection of complementary servo components allows you to efficiently connect other devices to your microdrive. Pertinent information about each is provided to assist you in planning your servo system.

Centurion DSM Drive Overview

The Centurion DSM Drives are part of a family of universal digital drives. Centurion DSM Drives use microcontrollers to digitally manage the current, velocity, and position. All system and application parameters are set in software, which ensures repeatability of all functions and prevents element drift.

A single unit fully encloses all electronics. An external transformer is *not* required on the power line. All connectors and indicators are accessible and clearly marked on the front panel.

Centurion DSM Drive Features

Drive Power Ratings

Several power levels of Centurion DSM Drives are available. All models have integral power supplies[1] and use a single phase power source. They differ only in physical size, indexing capability and output power:

- DSM 007 and 007P with continuous output power of 500 Watts.
- DSM 015 and 015P with continuous output power of 1000 Watts.
- DSM 030 and 030P with continuous output power of 2000 Watts.

The Centurion DSM Drives, when combined with brushless servo motors, provide continuous torque ranging from 0.17 Nm to 2.5 Nm (1.5 to 22.5 lb-in) and peak torque ranging from 0.48 Nm to 7.12 Nm (4.3 lb-in to 63 lb-in).

High Performance Microcontroller Technology

All digital current, velocity and position loop calculations as well as the motor commutation calculation are performed by a microcontroller.

IPM Technology

IPM (Intelligent Power Module) technology in the output stage provides a high frequency, digital PWM (Pulse Width Modulation) sine wave that controls the current loop, including overcurrent, short circuit and overtemperature protection.

1. DSM007, 007P, 015, 015P and 030 and 030P require an external 12-24VDC power source for I/O.

Analog and Digital Interfaces

All Centurion DSM Drives allow the user to select one of the following analog or digital command interfaces:

- ±10 Volt analog interface - velocity or torque control
- Presets (from one to eight binary inputs) - torque or velocity control
- Quadrature encoder digital interface - electronic gearing position follower
- Step/Direction digital interface - position control
- CW/CCW (step up/step down) interface - position control
- Indexing - position control from a single point in one of three ways
- Operating mode override - alternate movement interface

Encoder Control

A single, motor mounted encoder provides complete commutation information and velocity feedback. Low velocity regulation is enhanced by the use of a 5000 PPR (pulses per revolution) incremental encoder.

Encoder Output

A selectable output allows the encoder resolution to be specified for maximum performance without added circuitry. Outputs are differential line drivers capable of dividing the motor encoder signal by a factor of 1, 2, 4 or 8.

Digital I/O

Digital I/O channels allow the user to program the drive to fit the specific application. Power for the I/O must be supplied by an 12-24 VDC external I/O power source. Selections include:

- Four selectable (INPUT1, INPUT2, INPUT3 and FAULT RESET), optically isolated, active high inputs.
- One dedicated, control (ENABLE), optically isolated, active high input.
- Two selectable, optically isolated and short circuit protected, active high outputs.
- Two dedicated (BRAKE/DRIVE ENABLED and DRIVE READY), normally open relay outputs.

Analog I/O

A dedicated analog input provides current limiting capabilities, while the analog output can be customized to fit the application:

- One dedicated 0 - 10 Volt, analog input (EXTERNAL CURRENT LIMIT)
- One selectable, ±10 Volt analog output.

AC Input Power

Centurion DSM Drives covered by this manual are powered directly from a main 100-240 VAC single phase line.

Personality Module

EEPROM (electrically erasable programmable read only memory) stores both motor and application specific settings and parameters for the drive.

Multiple Protection Circuits

Device and circuit protection, and diagnostic information is provided by:

- Bi-color single point LED
- Overtemperature, short circuit and overcurrent protection for the power output
- I^2T (power-time) protection for the motor and the power drive
- Bus Overvoltage
- Bus Undervoltage
- Overspeed
- Fault diagnostics
- Watchdog timers provide fail-safe operation.

Command Sources

Serial Command Sources

Centurion DSM Drives are configured and controlled via a serial communication link. Commands may be issued from a variety of sources through a serial communications port. Possible command sources include:

- Personal computers
- Host computers
- Programmable Logic Controllers
- Motion controllers
- TouchPad.

The serial communication interface for the Centurion DSM Drive supports:

- RS-232 and the four wire RS-485 communications standards
- NRZ (non-return to zero) asynchronous serial format
- Baud rates: 1200, 2400, 4800, 9600 and 19200
- Parity generation and checking: Even, Odd or None

Connection of communication cables between the drive and user-supplied equipment is described in the following sections:

- One Centurion DSM Drive - “Single Axis RS-232 Set Up” on page 6-123
- Multiple Centurion DSM Drives - “Multiple Axes Four-Wire RS-485 Communications” on page 6-127.

Analog Command Sources

In the analog mode of operation, the Centurion DSM Drive requires a variable ±10 Volt DC external analog signal capable of driving the servo regulator’s command input at an input impedance of 13.3 kOhms. Choose a source such as a PLC (programmable logic controller), the DAC (digital-to-analog converter) of a computer, or a motion controller that meets this requirement.

Differential or single-ended line drivers may supply the signals for the auxiliary encoder inputs, step and direction inputs, and step up/down inputs. The differential signal must be capable of supplying at least 5 mA with 2.0 Volts across the + and - inputs. A differential signal source provides the best noise margin of all the interface circuit options. Single-ended signals from TTL drivers must be capable of sourcing or sinking 5 mA.

In the preset mode, the controlling device should be capable of sourcing 10 mA into the digital inputs.

I/O Interface

Analog Input

One analog input channel is accessible to the user. The analog input limits the peak current available from the drive.

- I LIMIT (current limit)

The analog signal must be within 0-10 Volt range and single-ended.

If this signal is not provided, the peak current of the drive may be set in software through the Drive Parameter window.

Analog Output

One analog output channel may be defined by the user through software:

- ANALOG is a ±10 Volt signal. The allowable current draw of the load is ±2 mA

This analog output is designed for monitoring purposes only. This signal should not be used for control purposes due to the relatively high ripple voltage (1%).

Digital Inputs

▶ NOTE: Power for the I/O must be supplied by an external 12-24 VDC power source.

Control Inputs

One optically isolated, single ended, active high, dedicated control input provides the controller ENABLE function. This input operates with switch closure or sourcing type transistor outputs.

The current rating is 10 mA maximum.

Selectable Inputs

Four optically isolated, single ended, active high inputs (INPUT1, INPUT2, INPUT3 and FAULT RESET) support logic type interfaces. The input circuits operate with switch closure or sourcing type transistor circuits.

The current rating of each input is 10 mA maximum.

Digital Outputs

Control Outputs

Two normally open relays are dedicated control outputs to the following signals:

- BRAKE/DRIVE ENABLED
- DRIVE READY.

The current ratings of each relay is 1 Amp at 30 VDC.

If using a motor with the 90VAC brake option, a user-provided relay may be driven by these outputs up to the specified levels. Refer to "BRAKE/DRIVE ENABLE Application Examples" on page 6-92 for information about the necessary hardware connections. Consult the I/O Configuration in the on-line DSMPro help for additional information about the software parameters.

Selectable Outputs

Two optically isolated, single ended, active high, current sourcing, discrete output channels provide logic outputs under software control.

Each selectable output channel is capable of sourcing 50 mA maximum and is optically isolated and short circuit protected.

Auxiliary Encoder Interface

The external encoder I/O port permits quadrature type encoder signals for applications, such as electronic gearing.

Encoder Inputs

Software automatically selects the appropriate input based on the command source:

- Master Encoder
- Step/Direction
- Step Up/Step Down.

Encoder Output

The resolution of the encoder output channel is under software control. The motor encoder signal is divided by 1, 2, 4 or 8 to provide an output from a differential line driver measured in PPR (pulses per revolution). The maximum encoder frequency output is 1 MHz (4 MHz quadrature).

> ▶ NOTE: If a controller requires synchronization to a specific output state, please refer to "IOUT Signal Generation" on page 6-103 for additional information.

DSMPro Software

A Windows-based software interface provides start-up selections. Tasks are organized for efficient set up, control and maintenance. Context sensitive, on-line help provides immediate assistance.

- Set up is simplified by a series of logically arranged set up screens.
- Files can be stored and printed for on-line or off-line modification, and on-site or off-site back-up.
- Diagnostic and set up tools make system integration easy.
- Critical information is available with complete Windows-based on-line help.
- Serial Host Language commands are explained through on-line help.
- User defined velocity, acceleration, position and torque parameters.
- Tuning and diagnosis is aided with an on-screen dual channel digital oscilloscope.
- On-screen meters and software tools provide rapid debugging and measurement.

Autotuning

Digital auto tuning allows easy setup. All adjustments are made in software, which immediately sets the servo system compensation parameters. This eliminates the time-consuming adjustments required by potentiometers.

Agency Approvals

- UL listed
- cUL listed
- CE marked.

Interface Cables

Standard motor power and encoder feedback cables, as well as communications cables, are available to complete your motion control system and provide reliable, trouble free start-up. Refer to "Options and Accessories" on page A-235 for optional equipment. Use of factory supplied cables is required for compliance to the European Electromagnetic Compatibility (EMC) Directive and to protect your warranty rights.

Motors

The Centurion DSM Drive is compatible with many motors, both Giddings & Lewis motors and motors from other manufacturers. Drive and motor parameters for all compatible motors are programmed into each Centurion DSM Drive at the factory. Giddings & Lewis motors that are compatible with the Centurion DSM Drives include:

- FSM Series motors
- HSM Series motors
- NSM Series motors
- SSM Series motors
- YSM Series motors.

DSMPro software speeds drive and motor set up by predefined parameters for each drive and motor combination.

Refer to the Torque/Speed curves in the Giddings & Lewis Product Guide or contact your local Giddings & Lewis distributor for motor sizing and compatibility assistance.

Options

- Power and feedback cables are potted and molded with 360 degree shielding.
- AC line filters.
- Breakout boards for I/O control and encoder interface.
- TouchPad - a compact and highly portable input and display device.

European Union Requirements

Centurion DSM Drives conform to the following European Union Directives:

- Low Voltage Directive (72/23/EEC, 93/68/EEC)
- Electromagnetic Compatibility Directive (89/336/EEC, 92/31/EEC, 93/68/EEC)

  Compliance with the EEC Directives is contingent on:

  A. Installation of AC line filters between the power source and the drive, and

  B. Use of factory authorized cables to connect motors.

  "European Union EMC Directives" on page 5-74 and "Options and Accessories" on page A-235 lists this equipment and associated part numbers.

Use of this product with other non-CE products or in a manner inconsistent with established testing requirements invalidates the CE registration declaration.

Giddings & Lewis motors currently available for use with Centurion DSM Drives in installations requiring CE marking include:

- FSM Series motors
- HSM Series motors
- SSM Series motors
- YSM Series motors.

DSMPro Installation 4

Installation of DSMPro on a PC is covered in this chapter, which:

- Lists the minimum PC hardware and software necessary to run DSMPro.
- Provides step-by-step instructions on how to load DSMPro.
- Shows you how to start and quit DSMPro and introduces the Drive Window, the main command window for DSMPro.
- Instructs you on how to access on-line help.

Instructions for using the features available in DSMPro are detailed in on-line help. To access the Help menu, depress the F1 key.

Hardware and Software Requirements

The minimum personal computer (PC) requirements to run the software are:

- A DOS computer with a 286 microprocessor
- A hard disk, with 2.0 MB of free disk space
- 3½ inch, 1.44MB floppy disk drive
- 2 MB of RAM
- A Video Graphics Array (VGA) monitor
- Microsoft Windows version 3.1
- A mouse is recommended.

Windows must be installed on your PC. If Windows is *not* already installed, refer to the appropriate Microsoft manual to install Windows on your computer.

Installing DSMPro

To install DSMPro software on a hard drive :

1. Make a backup copy of the DSMPro disk in one of the following ways:
   - Copy the DSMPro disk using the disk menu in the Windows File Manager or Windows Explorer.
   - If your computer has only one floppy disk drive, type from the DOS command line prompt **`diskcopy a: b:`** and then press **ENTER**. The software will prompt you when to insert the SOURCE (DSMPro) disk and when to insert the TARGET (blank) disk.
2. If Windows is *not* running, type **`win`** at the DOS prompt (**`C:>`**) for Windows 3.1 or type **exit** for Windows 95.
   If Windows is already running, close any open applications.
3. Insert the DSMPro disk into a 1.44MB floppy disk drive, typically drive A:, and close the drive door.
4. Choose Run, from the File menu in Windows Program Manager or choose Start/Run in Windows 95.
5. Type **`a:setup`** and then press **ENTER**. A message box will appear saying that the setup is initializing. The message box may be present for up to 40 seconds, depending on the speed of the PC.
6. Follow the instructions in the dialog boxes.
7. A status bar will keep you informed of the installation progress. When Setup is complete, choose OK or press **ENTER** to return to Windows.

Starting and Quitting DSMPro

Setup automatically creates the DSMPro program group and then returns you to Windows. The DSMPro program group provides access to the DSMPro application icon,

From the C:> Prompt

1. Type `win c:\dsmpro\dsmpro.exe`.

> ► **NOTE**: This step assumes DSMPro was loaded into the *c:\dsmpro* directory during setup.

The DSMPro start-up screen will open.

From Windows

1. Choose the DSMPro program group from the Program Manager or Windows Explorer in Windows.

> ► **TIP**: If the DSMPro window is *not* active, hold down ALT and press TAB (ALT+TAB) until the DSMPro title bar and icon are highlighted, or select DSMPro from the list in the Window menu.

2. Choose the DSMPro icon from the DSMPro program group.

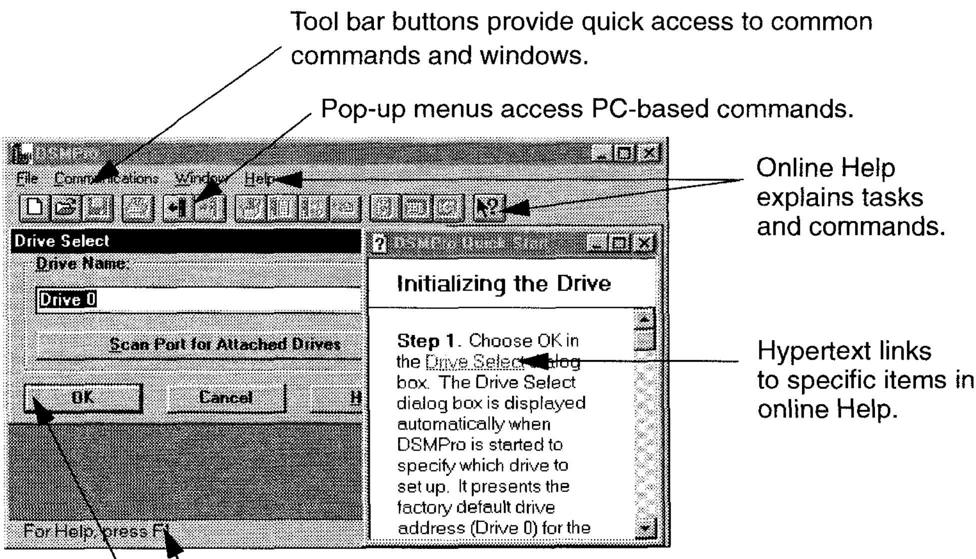
The DSMPro start-up screen will open.

The DSMPro Start-Up Screen

When DSMPro starts for the first time, its default instructions are:

- Display the Help menu - Quick Start.
- Present the Drive Select window. The Drive Select window offers Drive 0, which is the default drive address assigned at the factory.

The default DSMPro Start-up screen is shown below. The comments point out many of the Windows controls that are available in DSMPro.



Status bar reveals current menu selection and status information.

Buttons perform typical windows functions such as sizing, scrolling, and opening and closing windows.

▶ **TIP**: DSMPro displays the Help menu - Quick Start - when it is first accessed. To disable this automatic display, deselect the menu item Show Quick Start from the Help menu.

Version Level

The release level and date for DSMPro may be displayed by selecting About DSMPro from the Help menu. This information also appears in the initial DSMPro screen. The About DSMPro window includes additional data about system resources typically displayed in Windows Help.

The Readme File

A file, titled README, may be included in the DSMPro directory. This file contains installation instructions, change notes from previous revisions, and information that became available after this manual was printed. After you install DSMPro you can access this file by choosing the Read Me icon in the DSMPro window or by using Microsoft Write or an equivalent application program to view the file `readme.wri` in the directory path where DSMPro is installed.

Miscellaneous Files

Firmware Files

Firmware files are supplied in the Miscellaneous directory on the DSMPro diskette. The current revision level of drive firmware, excluding the TouchPad firmware, is displayed in the Drive Information window of DSMPro. The current revision level of TouchPad firmware is displayed as part of the TouchPad initialization when a TouchPad is connected to the drive.

The types of files and their functions are:

- Firmware - Main Operating firmware for the drive
- Boot Block - Drive Initialization firmware for the drive

Installation 5

Mechanical Installation Requirements

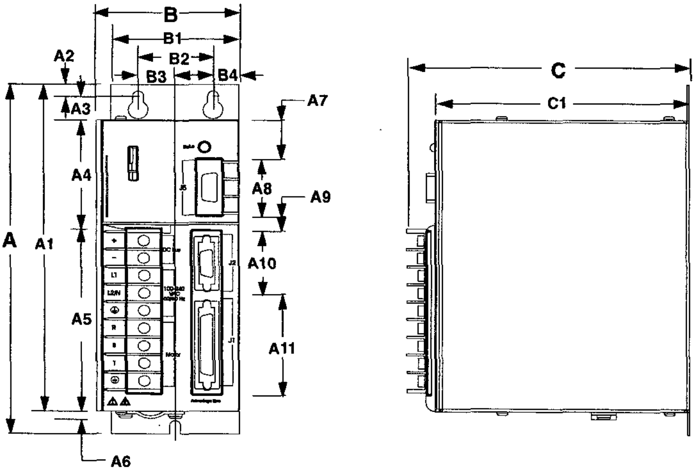
1. Mount the unit in an enclosure providing protection to IP54 (protected against dust and splashing water), or IP65 (dust free and protected against water jets) if the work environment is poor. Many NEMA (National Electrical Manufacturers Association) Type 4 cabinets provide this level of protection. Minimum cabinet requirements are:
   - Depth: 243.8 cm (9.6 inches).
   - Adequate sizing and/or ventilation to dissipate the heat generated by the Centurion DSM Drives. Refer to "Power Dissipation" on page F-307 for the amount of heat generated by Centurion DSM Drives and enclosure sizing equations.
2. Minimum unobstructed surrounding space for cooling air intake (and fan exhaust from the DSM 030 and 030P):
   - Above: 50.8 cm (2 inches)
   - Below: 50.8 cm (2 inches)
   - Sides: 1.25 cm (0.5 inches)
   - Front: 76.2 cm (3.0 inches) for cable clearance.

CAUTION If the cabinet is ventilated, use filtered or conditioned air to prevent the accumulation of dust and dirt on electronic components. The air should be free of oil, corrosives, or electrically conductive contaminates.

3. Position the drive in a vertical position on a flat, solid surface that meets the following weight, vibration and shock, altitude and humidity, airflow clearance, and temperature requirements.

   Unit weights are:
   - DSM 007 and DSM 007P: 1.7 Kg (3.7 Lbs)
   - DSM 015 and DSM 015P: 2.05 Kg (4.5 Lbs)
   - DSM 030 and DSM 030P: 2.0 Kg (4.4 Lbs)

Figure 5.1 DSM 007 and 007P Mounting Dimensions



Minimum Unobstructed Surrounding Space
for Cooling and Exhaust Air
Above 50.8 mm (2 inches)
Below 50.8 mm (2 inches)
Sides 12.5 mm (0.5 inches)
for Cable Bend Radius
Front 76.2 mm (3 inches)

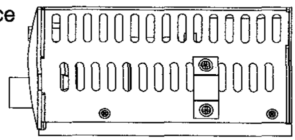


Table 5.1 DSM 007 and 007P Mounting Dimensions

	Dimension			*Dimension*	
	mm	*inches*		*mm*	*inches*
A	*198.12*	*7.80*	*B*	*72.60*	*2.86*
A1	*184.9*	*7.28*	*B1*	*65.02*	*2.56*
A2	*6.35*	*0.25*	*B2*	*38.10*	*1.50*
A3	*13.0*	*0.51*	*B3*	*18.54*	*0.73*
A4	*6.07*	*2.39*	*B4*	*13.21*	*0.52*
A5	*94.49*	*3.72*	*B5*	*5.58*	*0.22*
A6[a]	*5.0*	*0.20*			
A7	*22.10*	*0.87*	*C*	*146.05*	*5.75*
A8	*31.75*	*1.25*	*C1*	*129.03*	*5.08*
A9	*8.64*	*0.34*			
A10	*31.75*	*1.25*			
A11	*57.15*	*2.25*			

a. Power Cable bracket extends up to 20mm (0.80 inches)

Figure 5.2 DSM 015, 015P, 030 and 030P Mounting Dimensions

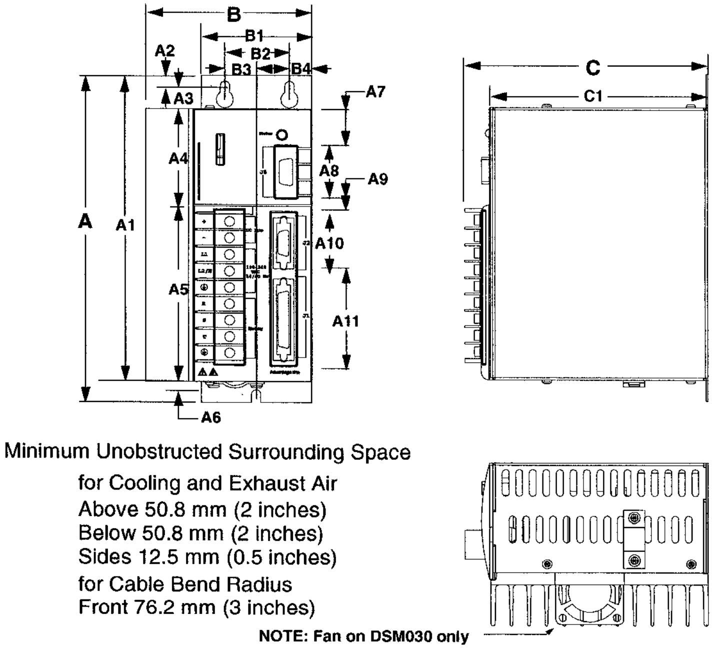


Table 5.2 DSM 015, 015P, 030 and 030P Mounting Dimensions

	Dimension				*Dimension*	
	mm	*inches*			*mm*	*inches*
A	*198.12*	*7.80*		*B*	*97.30*	*3.83*
A1	*184.9*	*7.28*		*B1*	*65.02*	*2.56*
A2	*6.35*	*0.25*		*B2*	*38.10*	*1.50*
A3	*13.0*	*0.51*		*B3*	*18.54*	*0.73*
A4	*6.07*	*2.39*		*B4*	*13.21*	*0.52*
A5	*94.49*	*3.72*		*B5*	*5.58*	*0.22*
A6[a]	*5.0*	*0.20*				
A7	*22.10*	*0.87*		*C*	*146.05*	*5.75*
A8	*31.75*	*1.25*		*C1*	*129.03*	*5.08*
A9	*8.64*	*0.34*				
A10	*31.75*	*1.25*				
A11	*57.15*	*2.25*				

a. Power Cable bracket extends up to 20mm (0.80 inches)

Vibration and shock, altitude and humidity limits are:

- Vibration: 2g at 10 to 2000 Hz
- Shock: 15g 11 msec half sine
- Altitude: 1500 meters (5000 feet),
  Derate power performance 3% for each 300 m above 1500 m (1000 ft above 5000 ft).
- Humidity: 5% to 95% non-condensing

Ambient operating temperature range and airflow clearances are:

- 0 ° to 55° Celsius (32° to 131° Fahrenheit).
- 50.8 mm (2 inches) above and below unit for airflow.

4. Bolt the unit to the cabinet using the mounting slots in the drive. Mounting dimensions are shown in Figure 5.2. The recommended size of mounting hardware is:

   - M5 Metric (1/4-20 equivalent), or
   - #10 MS bolts.

Interface Connections

Input/Output and power cables connect to the front panel of a Centurion DSM Drive, no internal connections are necessary.

DANGER

The user is responsible for conforming with all applicable local, national and international codes. Wiring practices, grounding, disconnects and overcurrent protection are of particular importance. Failure to observe this precaution could result in severe bodily injury or loss of life.

I/O Connections, including the external I/O power supply, are fully described in the following sections:

- "J1 - Controller" on page 6-81 defines the controller connections
- "J2 - Encoder" on page 6-117 defines the motor encoder connections
- "J5 - Serial Port" on page 6-121 defines the RS-232/RS-485 serial port connections

Power Connections are fully described in the following sections:

- "Power Connections" on page 7-131 defines the AC, DC Bus and Motor power connections.

Specific operational set ups are depicted in Figure 8.1 through Figure 8.11 (pages 8-143 through 8-191, respectively). These figures cover velocity and torque mode controls for:

- Analog Controllers in velocity or torque modes,
- Preset Controllers in velocity or torque modes,
- Position Followers using a Master Encoder,
- Position Followers using a Step/Direction signal,
- Position Followers using Step Up/Down signals,
- Incremental Indexing over a specific distance,
- Registration Indexing from a mark, or
- Absolute Indexing to a home position.

Wiring

Wiring sizes and practices, as well as grounding and shielding techniques are described in the sections listed below. Refer to "Power Connections" on page 7-131.

The descriptions represent common wiring practices and should prove satisfactory in the majority of applications.

▶ NOTE: Cables, listed in "Options and Accessories" on page A-235, are *not* rated for continuous flexing.

Minimum wire gages for power cables are listed in:

- "Motor Power Contact and Wire Size Recommendations" on page 7-134,
- "AC Input Power Sizing Requirements" on page 7-138.

Electromagnetic Compatibility

General Guidelines

Refer to the appendix "Electromagnetic Compatibility Guidelines for Machine Design" on page D-287 for an in-depth discussion of electromagnetic compatibility (EMC) and electromagnetic interference (EMI).

European Union EMC Directives

The Centurion DSM Drives are designed and tested to meet the European EMC Directive. Declarations of conformity, which enumerate the standards used, are included in the manual.

Installation requirements necessary to meet this directive are:

1. Use of factory supplied cables,
2. Use of an external AC line filter, and

WARNING Large leakage currents exist in AC line filters. They must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels prior to handling the equipment. Failure to observe this precaution could result in severe bodily injury.

3. If an external supply powers the I/O, grounding of this power supply is required.

Refer to the appendix "Options and Accessories" on page A-235 for part numbers. The following diagrams show the mounting dimensions for single phase AC Line Filters available from Giddings & Lewis.

Table 5.3 shows a typical filter selection matrix for Centurion DSM Drives. All the filters identified below are manufactured by Schaffner or Roxburgh and are widely available. There are many AC line filter manufacturers whose filters can be successfully integrated. Giddings & Lewis recommends Schaffner or Roxburgh filters based on our test results, but the machine builder is responsible for the suitability of the filter selection in a specific application. These filters can be used for distributing power to multiple drives, rather than using an individual filter for each drive. Further information is available from Schaffner (1-800-367-5566) or Roxburgh (01724.281770 [011.44.1724.281770 from the USA]).

AC line filters for use with Centurion DSM Drives are listed below:

Table 5.3 AC Line Filters for Centurion DSM Drives

	Part Number		
Drive	**Roxburgh**	**Schaffner**	**Giddings & Lewis**
DSM 007 and DSM 007P	MIF 06, MDF 06	FN 350-8	401-30222-00
DSM 015, DSM 015P and DSM110	MIF 10, MDF 16	FN 350-12	401-30216-00
DSM 030, DSM 030P and DSM120	MIF 23, MDF 18	FN 350-20	401-30217-00
DSM130	MIF 32, MDF 36	FN 350-30	401-34418-00
DSM175 (3- phase)	MIF 330, MIF 336	FN 351-36	401-34419-00

The Roxburgh filters differ in the number of stages. The MDF (Motor Drive Filters) filters are single stage filters; the MIF (Motor Inverter Filters) filters are three-stage filters. The three-stage filter will remove more of the noise, but the cost is more panel space in the higher current filters. In the lower current filters (<50 A), the panel space used is less for the MIF filters.

The Schaffner filters are single-stage filters. These differ from the Roxburgh filters in component types, values and placement. The leakage current is generally lower, but the amount of attenuation is lower too. These filters will work if the amount of noise in the environment is low, or if the design of the machine is such that only a nominal amount of attenuation is needed.

Basic guidelines for reducing electrical noise and increasing electromagnetic compatibility (EMC) are listed in "Electromagnetic Compatibility Guidelines for Machine Design" on page D-287.

AC Line Filters

Figure 5.3 MIF Single Phase AC Line Filter Mounting Diagram

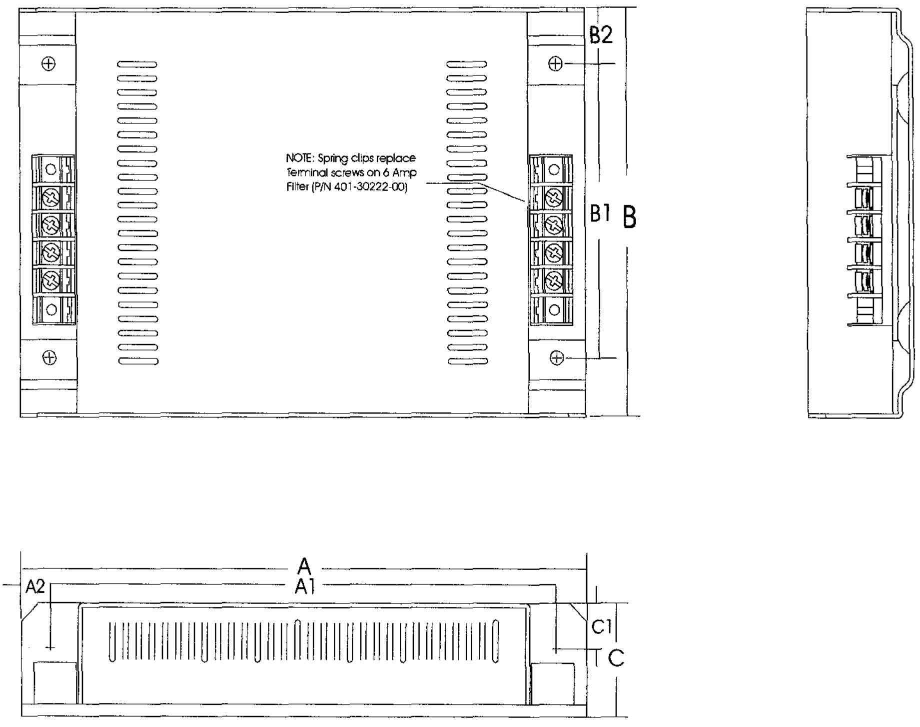


Table 5.4 MIF Single Phase AC Line Filter Engineering Specifications

	SINGLE PHASE 6A P/N401-30222-00		SINGLE PHASE 10A P/N401-30216-00		SINGLE PHASE 23A P/N 401-30217-00	
DIMENSIONAL DATA						
MEASUREMENT	mm	in	mm	in	mm	in
A	170	6.7	214	8.4	214	8.4
A1	152	6.0	192	7.6	192	7.6
A2	9	0.4	11	0.4	11	0.4
B	92	3.6	145	5.7	204	8.0
B1	55	2.2	104	4.1	164	6.6

	SINGLE PHASE 6A P/N401-30222-00		SINGLE PHASE 10A P/N401-30216-00		SINGLE PHASE 23A P/N 401-30217-00	
DIMENSIONAL DATA						
MEASUREMENT	**mm**	**in**	**mm**	**in**	**mm**	**in**
B2	18	0.7	20	0.8	20	0.8
C	25	1.0	40	1.6	47	1.8
C1	10	0.4	16	0.6	19	0.8
C2	15	0.6	24	1.0	28	1.0
ELECTRICAL and MECHANICAL SPECIFICATIONS						
Voltage/Freq.	250 VAC @ 50/50 Hz		250 VAC @ 50/50 Hz		250 VAC @ 50/50 Hz	
Current	6A @ 50°C		10A @ 50°C		23A @ 50°C	
Overload Current	150% 1 minute 200% 1 second		150% 1 minute 200% 1 second		150% 1 minute 200% 1 second	
Temperature	-25 to 95°C		-25 to 95°C		-25 to 95°C	
Leakage Current	5 mA @ 240V, 50 Hz		46 mA @ 240V, 50 Hz		200 mA @ 250V, 50 Hz	
Electric Strength	2500 VAC/1 minute		2500 VAC/1 minute		2500 VAC/1 minute	
Power Loss	3.5 Watts (Full Load)		2.7 Watts (Full Load)		10 Watts (Full Load)	
Terminals	2mm sq. spring clamp		M4 screw cross/ sq. 2x 2.5mm		M4 screw cross/ sq. 2x 2.5mm	
Weight	0.3 Kg (0.66 Lb.)		0.95 Kg (2.0 Lb)		1.6 Kg (2.5 Lb)	
Back Mounting	4 x M4		4 x M4		4 x M4	
Side Mounting	2 x M5		2 x M6		2 x M6	
Line filters are manufactured to millimeter dimensions (inches are approximate conversions).						

Power Wiring Diagram

MOTOR POWER WIRES R,S,T,GND

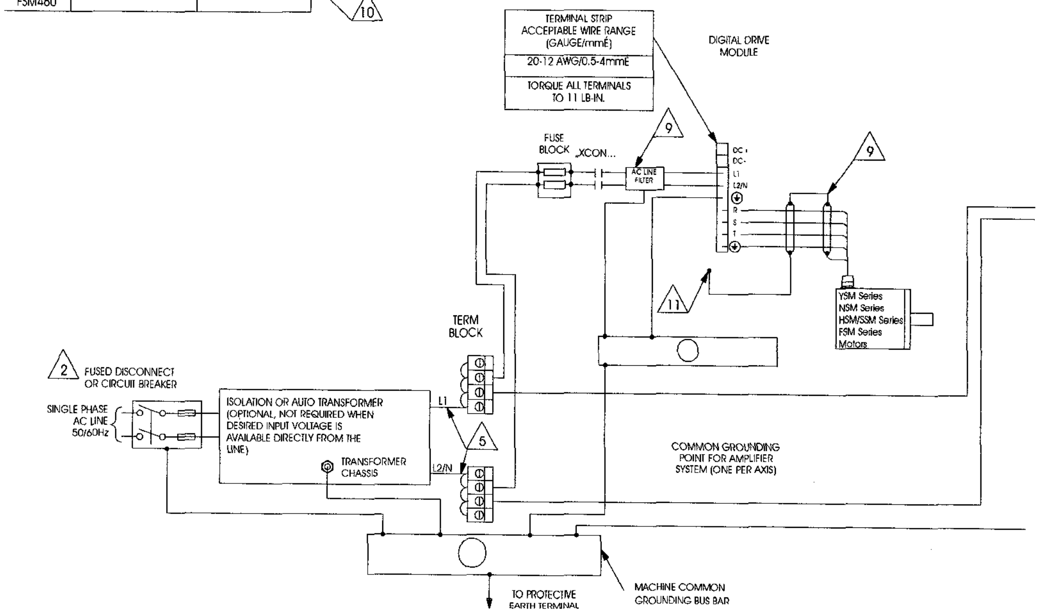
MOTOR	MOTOR POWER MATING CONNECTOR CONTACT SIZE (GAUGE/mmÉ)	MINIMUM RECOMMENDED POWER WIRE (GAUGE/mmÉ) (75°C COPPER MIN)
YSM	16 AWG/1.5mmÉ	16 AWG/1.5mmÉ
NSM		
HSM/SSM307		
HSM/SSM320		
HSM/SSM430	12 AWG/4.0mmÉ	
FSM430		
HSM/SSM460		14 AWG/2.5mmÉ
FSM460		

MOTOR POWER CONNECTOR

PIN	SIGNAL
A	R
B	S
C	T
D	MOTOR CASE

INPUT POWER WIRES

DRIVE	TERMINAL(S)	RECOMMENDED POWER WIRE (GAUGE/mmÉ) (75°C COPPER MIN)
DSM 007	L1,L2/N, ⏚	16 AWG/1.5mmÉ
DSM 015	L1,L2/N, ⏚	14 AWG/2.5mmÉ
DSM 030	L1,L2/N, ⏚	12 AWG/4mmÉ



NOTES

2 A SUPPLY DISCONNECTING DEVICE IS REQUIRED FOR MAINTAINANCE & SAFETY. LOCAL REGULATIONS SHOULD BE OBSERVED. IF A GROUNDED NEUTRAL IS USED INSTEAD OF L2, ONLY L1 MAY BE SWITCHED OR FUSED.

4 CURRENT RATINGS ARE INDEPENDENT OF THE INPUT VOLTAGE. REDUCED VOLTAGE WILL RESULT IN A REDUCTION IN SPEED, BUT NOT TORQUE.

5 DRIVE RATED 100-240 VAC RMS,SINGLE PHASE INPUT VOLTAGE (230 VAC STANDARD).

6. DO NOT DAISY CHAIN DRIVE MODULE POWER CONNECTIONS. MAKE SEPARATE CONNECTIONS DIRECTLY TO THE AC SUPPLY.

8. MULTIPLE DRIVE MODULES MAY BE POWERED FROM ONE TRANSFORMER OR OTHER AC SUPPLY SOURCE.

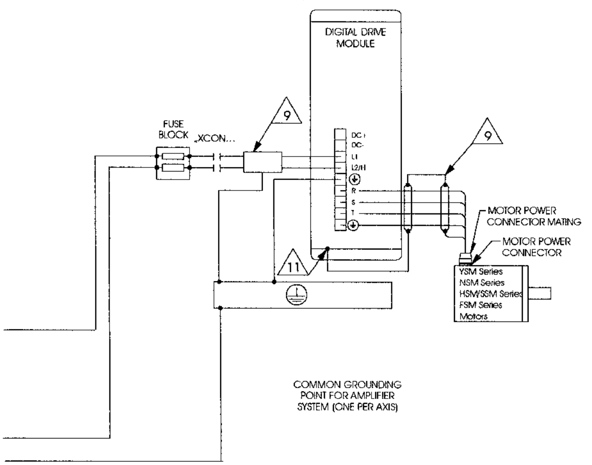
9 AC LINE FILTER AND SHIELDED MOTOR CABLE ARE TO BE USED FOR IMPROVING THE DRIVE MODULES ELECTROMAGNETIC COMPATABILITY, AND ARE REQUIRED TO MEET THE EUROPEAN ELECTROMAGNETIC COMPATABILITY DIRECTIVE. CAUTION: AC LINE FILTERS HAVE LARGE LEAKAGE CURRENTS AND REQUIRE DISCHARGE TIME UPON POWER REMOVAL. WIRING BETWEEN THE DRIVE MODULE AND FILTER SHOULD BE KEPT AS SHORT AS POSSIBLE. THE COMMON GROUND BUS BAR SHOULD BE AS CLOSE TO THE DRIVE AS POSSIBLE.

10 WIRE SIZES ARE MINIMUM RECOMMENDED VALUES. THE REQUIREMENTS OF LOCAL REGULATIONS SHOULD BE OBSERVED.

11 TERMINATE THE MOTOR POWER CABLE SHIELD BY CLAMPING IT TO THE DRIVE WITH THE BRACKET PROVIDED. THIS BRACKET CAN BE USED FOR STRAIN RELIEF IF NON-SHIELDED CABLES ARE USED. SNUG BRACKET SCREWS. DO NOT OVERTIGHTEN.
NEVER TORQUE OVER 10 LB-IN.

DIGITAL DRIVE MODULE INPUT CURRENT REQUIREMENTS		
ADVANTAGE TERMINALS		CURRENT REQUIREMENT, MAXIMUM (AMPS AC RMS)
L1,L2/N,	DSM 007	5.0 Amps AC at 100-240 Volts AC
	DSM 015	9.0 Amps AC at 100-240 Volts AC
	DSM 030	18.0 Amps AC at 100-240 Volts AC

NOTE: POWER INITIALIZATION REQUIRES A SHORT PERIOD OF INRUSH CURRENT OF 100A FOR THE INPUT. DUAL ELEMENT TIME DELAY (SLOW BLOW) FUSES ARE RECOMMENDED. FUSE SIZES MUST BE SELECTED ACCORDING TO LOCAL REGULATIONS.



REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
A	22019	JM	RELEASED	—	—

UNLESS OTHERWISE SPECIFIED

DRAWN BY: JM 7-19-96

DESIGN ENGR: —

DIAG, POWER WIRING CONNECTIONS, DSM 007, 015, 030

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PART NO.

SCALE	DWG SIZE	SHEET
N/A	C	1 of 1

This chapter provides information about:

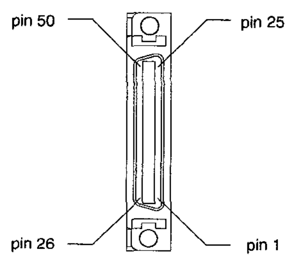
- Interface signals available on the Centurion DSM Drive
  - J1 - The Controller interface for commanding and reporting motion
  - J2 - The Encoder interface for reporting movement by the motor
  - J5 - The Serial interface for communicating with the drive.
- Commonly encountered interface cabling methods
- Optional signal extension kits and standard cables.

J1 - Controller

J1 is a 50 pin female mini-D connector (AMP 2-178238-7) for connecting a host computer or controller to the drive. Contact between the connector's shell and the grounded chassis provides shield termination. This section lists the connector pin-outs and provides signal specifications.

Table 6.1 J1 Controller Pin-Outs

Pin & Signal		Description	Pin & Signal		Description	Pin & Signal		Description
1	+5VDC	Encoder +5V DC	20	ENABLE	Drive Enable	39		Reserved
2	ECOM	Encoder Common	21	RESET	Fault Reset	40		Reserved
3	+5VDC	Encoder +5V DC	22	CMND+	Analog Command+	41		Reserved
4	ECOM	Encoder Common	23	CMND-	Analog Command-	42	OUTPUT 1	Selectable Output 1
5	I/O PWR	External I/O Power (12-24 VDC)	24	READY+	Drive Ready+	43	OUTPUT 2	Selectable Output 2
6	I/O COM	External I/O Common	25	READY-	Drive Ready-	44		Reserved
7	AOUT+	Motor Encoder Output Channel A+	26	I/O PWR	External I/O Power (12-24 VDC)	45		Reserved
8	AOUT-	Motor Encoder Output Channel A-	27	I LIMIT	Current Limit	46		Reserved
9	BOUT+	Motor Encoder Output Channel B+	28	ACOM	Analog Common	47		Reserved
10	BOUT-	Motor Encoder Output Channel B-	29		Reserved	48		Reserved
11	IOUT+	Motor Encoder Output Channel I+	30		Reserved	49	BRAKE+	Brake Enable+ (Drive Enabled+)
12	IOUT-	Motor Encoder Output Channel I-	31	ANALOG1	Analog Output 1	50	BRAKE-	Brake Enable (Drive Enabled-)
13	I/O COM	External I/O Common	32	INPUT1	Selectable Input 1			
14	AX+/CW+/ STEP+	Auxiliary Encoder Channel A+	33	INPUT2	Selectable Input 2			
15	AX-/CW-/ STEP-	Auxiliary Encoder Channel A-	34	INPUT3	Selectable Input 3			
16	BX+/ CCW+/ DIR+	Auxiliary Encoder Channel B+	35		Reserved			
17	BX-/ CCW-/ DIR-	Auxiliary Encoder Channel B-	36		Reserved			
18	IX+	Auxiliary Encoder Channel I+	37		Reserved			
19	IX-	Auxiliary Encoder Channel I-	38		Reserved			



Cables are available in various lengths for connecting between J1 and a suitable controller. The appendix "Options and Accessories" on page A-235 lists the cables. "J1 Terminal Strip/Breakout Board" on page 6-116 details the optional signal extension kit that is available. "Interface Cable Examples" beginning on page 6-108 depict various interface cable types commonly encountered in applications.

Digital I/O Power

The drive requires an external 12 to 24VDC power source for the inputs and outputs.

External I/O Power

The external I/O power supply must be capable of supplying at least 250 mA.

The pin-outs are:

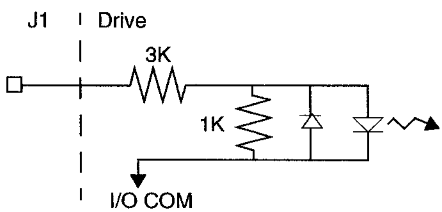
I/O PWR (12 to 24 Volts)	J1-5	J1-26
I/O COM	J1-6	J1-13

The external I/O COM must be grounded to meet the European Low Voltage Directive (LVD).

Digital Inputs

Centurion DSM Drives have active high inputs, which prevent disconnects and ground faults from activating a drive. The typical ON time for an input to be recognized is 2.0 msec.

Figure 6.1 Digital Input Circuit



Two discrete input circuits types are available on the J1 connector. Both circuits support logic type interfaces with optically isolated, single ended and active high characteristics.

Dedicated Control Circuits

The ENABLE input interface with switch closures or sourcing type outputs.

Selectable Circuits

INPUT 1, INPUT 2, INPUT 3 and FAULT RESET operate with switch closures or sourcing type circuitry. Selectable inputs are:

Not Assigned (default)	Reverse Enable	Start Index
Drive Mode Select	Operation Mode Override	Define Home
Integrator Inhibit	Preset Select A	Sensor (available only on INPUT 2)
Follower Enable	Preset Select B	Remove COMMAND Offset
Forward Enable	Preset Select C	
Fault Reset	Start Homing	

Refer to the I/O Configuration section of the on-line DSMPro Help for information on choosing the input type for each channel.

Table 6.2 General and Dedicated Inputs

Digital Input	Pin Number	Function/Description
ENABLE	J1-20	Enables and disables the drive. Motor torque cannot be applied unless the ENABLE input is active.
FAULT RESET	J1-21	General purpose input selectable to one of several drive functions. Refer to DSMPro on-line Help and the table below for I/O configuration.
INPUT 1	J1-32	
INPUT 2	J1-33	
INPUT 3	J1-34	

Table 6.3 INPUT1, INPUT2 and INPUT3 Functions

Function	Description
Drive Mode Select	Active[1] state configures the drive for Torque Mode. Inactive[2] state selects the personality EEPROM setting as the command source.
Integrator Inhibit	Active[1] state zeros the Velocity Loop Error Integrator.
Follower Enable	Active[1] state allows the position loop to track the AUXILIARY POSITION LOOP signal when in the Follower mode.

<table>
<tr><td>Forward Enable</td><td colspan="5">Active[1] state allows forward commands in velocity mode only. If this input is inactive or not connected, no velocity command will be allowed in the forward direction. If motion is in progress when the input is pulled low or disconnected, the drive halts immediately without deceleration control. The COMMAND signal is clamped internally to 0 Volts.</td></tr>
<tr><td>Reverse Enable</td><td colspan="5">Active[1] state allows reverse commands in velocity mode only. If this input is inactive or not connected, no velocity command will be allowed in the reverse direction. If motion is in progress when the input is pulled low or disconnected, the drive halts immediately without deceleration control. The COMMAND signal is clamped internally to 0 Volts.</td></tr>
<tr><td>Operation Mode Override</td><td colspan="5">Active[1] state selects the Operation Mode Override setting as the command source.
Inactive[2] state selects the Operation Mode setting as the command source. Table 6.4 on page 6-86 lists the valid Operation Mode and Operation Mode Override combinations.</td></tr>
<tr><td rowspan="11">Preset Select A
Preset Select B
Preset Select C</td><td colspan="5">Active[1] or Inactive[2] states select one of the eight presets shown in the following binary table:</td></tr>
<tr><td rowspan="2"></td><td colspan="3">BINARY CODE</td><td></td></tr>
<tr><td>C</td><td>B</td><td>A</td><td>Description</td></tr>
<tr><td>Preset 0</td><td>0</td><td>0</td><td>0</td><td>Preset 0 or Index 0 is selected.</td></tr>
<tr><td>Preset 1</td><td>0</td><td>0</td><td>1</td><td>Preset 1 or Index 1 is selected.</td></tr>
<tr><td>Preset 2</td><td>0</td><td>1</td><td>0</td><td>Preset 2 or Index 2 is selected.</td></tr>
<tr><td>Preset 3</td><td>0</td><td>1</td><td>1</td><td>Preset 3 or Index 3 is selected.</td></tr>
<tr><td>Preset 4</td><td>1</td><td>0</td><td>0</td><td>Preset 4 or Index 4 is selected.</td></tr>
<tr><td>Preset 5</td><td>1</td><td>0</td><td>1</td><td>Preset 5 or Index 5 is selected.</td></tr>
<tr><td>Preset 6</td><td>1</td><td>1</td><td>0</td><td>Preset 6 or Index 6 is selected.</td></tr>
<tr><td>Preset 7</td><td>1</td><td>1</td><td>1</td><td>Preset 7 or Index 7 is selected.</td></tr>
<tr><td>Start Index</td><td colspan="5">A change from inactive to active starts an indexing move.</td></tr>
<tr><td>Define Home</td><td colspan="5">A change from inactive to active defines the home position for absolute indexing.</td></tr>
<tr><td>Sensor</td><td colspan="5">A change from inactive to active is sensed as a registration or home sensor.
NOTE: This selection is available only on INPUT 2.</td></tr>
<tr><td>Remove COMMAND Offset</td><td colspan="5">A change from inactive to active sets the offset of the analog COMMAND input to achieve a zero command.</td></tr>
</table>

Fault Reset	A change from inactive to active will clear any faults and re-enable the drive, if any faults were pending.
Start Homing	A change from inactive to active will start the homing procedure.
1 - Active state indicates current flow through the input optocoupler. 2 - Inactive state indicates no current flow.	

The specifications for these inputs are listed in Table 6.5 on page 6-87.

Table 6.4 Operation and Override Mode Combinations

	Operation Override Modes							
Operation Modes	Analog Velocity	Analog Torque	Preset Velocity	Preset Torque	Follower Master Encoder	Follower Step/Dir	Follower Step Up/ Down	Indexing
Analog Velocity	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Analog Torque	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Preset Velocity	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Preset Torque	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Follower Master Encoder	Yes	Yes	Yes	Yes	No	No	No	Yes
Follower Step/Dir	Yes	Yes	Yes	Yes	No	No	No	Yes
Follower Step Up/ Down	Yes	Yes	Yes	Yes	No	No	No	Yes
Indexing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 6.5 Digital Input Specifications

Parameter	Description	Minimum	Maximum
ON state Voltage	Voltage applied to the input to guarantee an ON state	10.8 VDC	28 VDC
ON state Current	Current flow into the input to guarantee an ON state.	3.0 mA	10.0 mA
OFF state Voltage	Voltage applied to the input to guarantee an OFF state.	-1 VDC	2 VDC
OFF state Current	External leakage current into the input to guarantee an OFF state.	-0.5 mA	0.5 mA

Input Interface Circuit Examples

Figure 6.2 Drive Input Connected to a Switch/Relay Contact

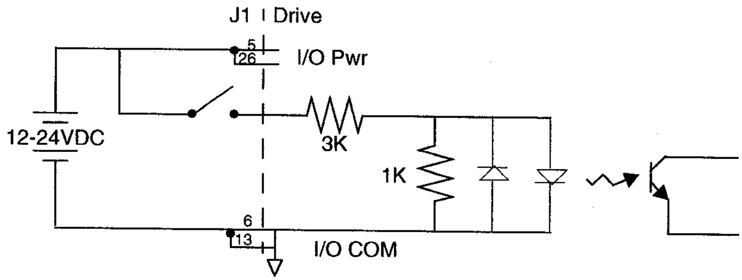


Figure 6.3 Drive Input Connected to an Opto-Isolator

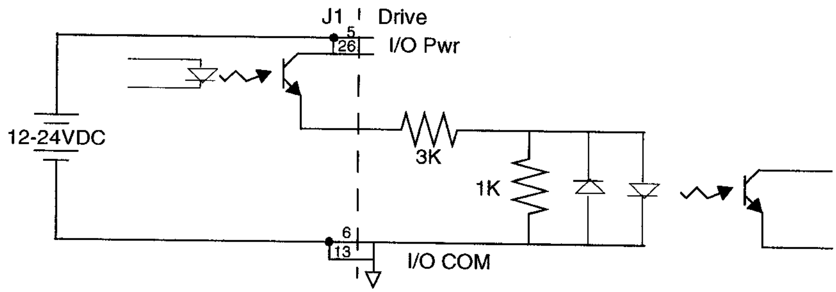


Figure 6.4 Drive Input Connected to an Active High Sourcing Transistor

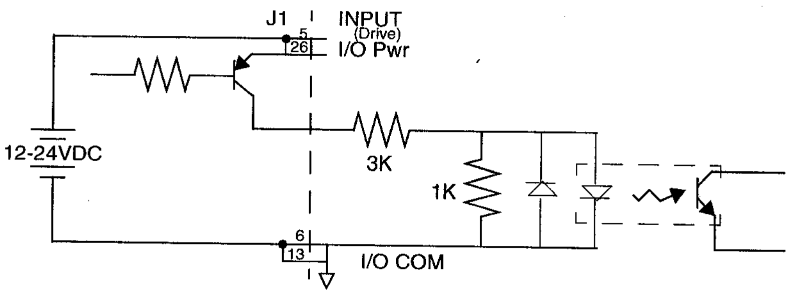


Figure 6.5 Drive Input Connected to Active Low Output using a Switch/Relay

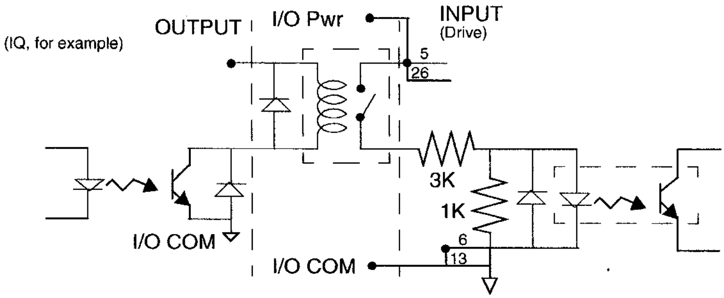


Figure 6.6 Drive Input Connected to Active Low Output using an Opto-Isolator

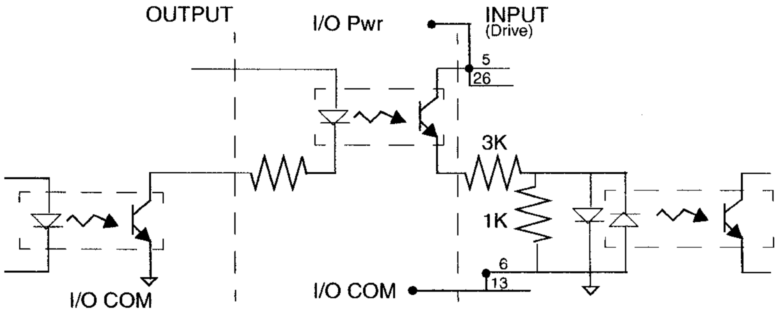
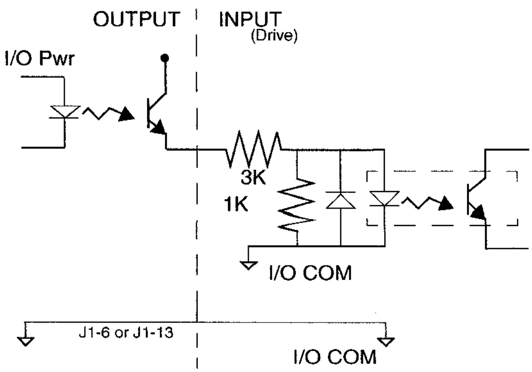


Figure 6.7 Drive Input Connected to Sourcing Output



Digital Outputs

Two types of discrete output circuits are available on the J1 connector:

- Dedicated relay outputs
- Selectable transistor based outputs

Both types support 12-24 VDC logic interfaces:

Dedicated Relay Outputs

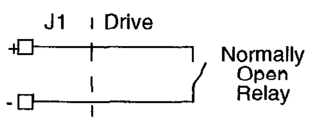
BRAKE/DRIVE ENABLED and DRIVE READY. Each output is a normally open relay. The relays are rated for 1 Amp at 30 VDC.

► NOTE: The Brake contacts may be used to control 24VDC brakes on Giddings & Lewis motors with a 4" frame or smaller. A user provided relay may be driven by these outputs if higher power levels are required. Refer to Figure 6.10 for examples.

Selectable Transistor Outputs

OUTPUT 1 and OUTPUT 2 are optically isolated and short circuit protected, active high, single ended transistor output channels. Each channel sources a maximum of 50 mA.

Figure 6.8 READY and BRAKE/DRIVE ENABLED Circuits



READY and BRAKE/DRIVE ENABLED Circuits

The specifications for these outputs are listed in Table 6.6 on page 6-91.

Table 6.6 READY and BRAKE/DRIVE ENABLED Output Specifications

Parameter	Description	Maximum
ON state resistance	Internal resistance between J1-24 (+) and J1-25 (-) or J1-49 (+) and J1-50 (-) when the contacts are closed.	1 Ohm
ON state current	Current flow through the relay when contacts are closed.	1 Amp
OFF state current	Leakage current from either output when the relay contacts are open.	0.01 mA
OFF state Voltage	Voltage difference between the outputs with open relay contacts.	30 Volts

Figure 6.9 Digital Output Circuit.

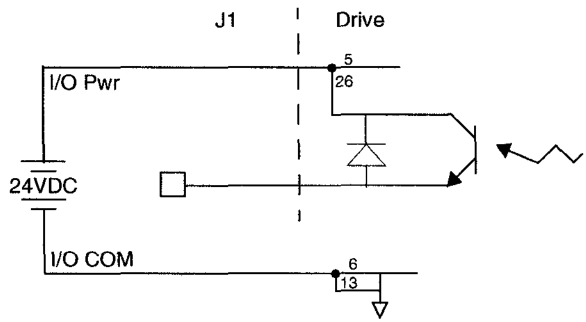
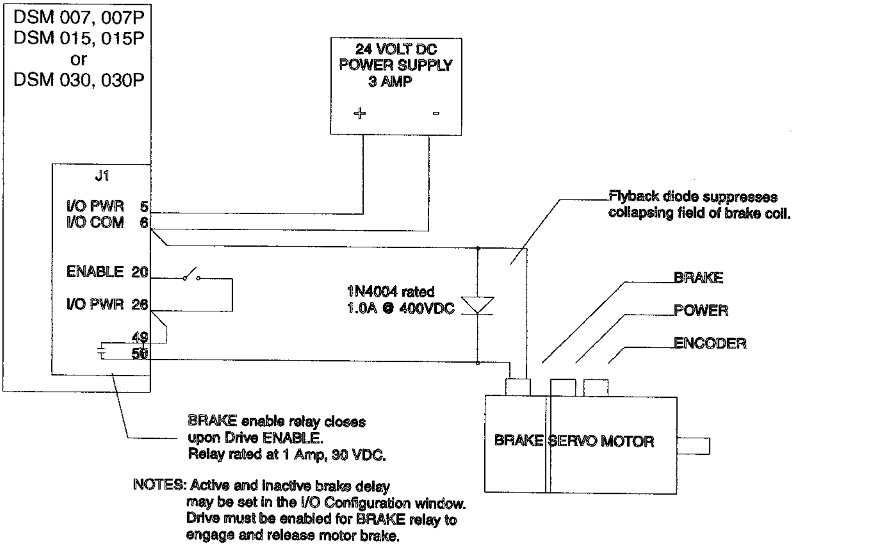


Figure 6.10 depicts a typical applications for the BRAKE/DRIVE ENABLE outputs. Table 6.7 lists the current draw for 24VDC and 90VDC brake coils on Giddings & Lewis motors suitable for use with a DSM 007, 007P, 015, 015P, 030, or 030P.

Figure 6.10 BRAKE/DRIVE ENABLE Application Examples



Suggested brake wiring when 24VDC brake current exceeds 500mA or for 90VDC brakes:

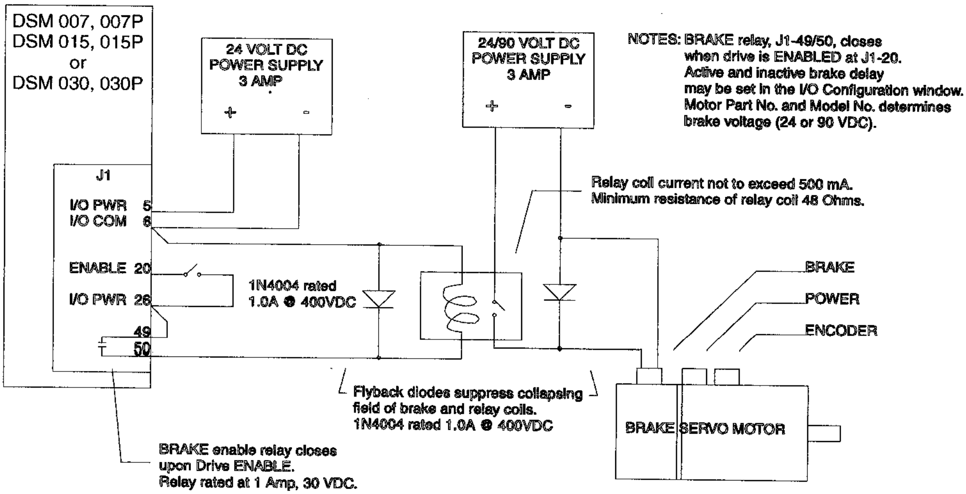


Table 6.7 Current Draw for Brake Motor Coils

MOTOR	24VDC	90VDC	MOTOR	24VDC	90VDC
HSM3XXX	0.60A	0.098A	YSM102	0.26A	NA
HSM4XXX	0.69A	0.17A	YSM103	0.26A	NA
SSM3XXX (old)	0.60A	0.21A	YSM206	0.31A	NA
SSM4XXX (old)	0.88A	0.26A	YSM212	0.31A	NA
SSM3XXX (new)	0.60A	0.098A	YSM323	0.37A	NA
SSM4XXX (new)	0.69A	0.17A			

Table 6.8 Selectable Output Circuits

Digital Output	Pin Number	Function/Description
READY	J1-24 (+) J1-25 (-)	Relay closure indicates the drive is operational and does *not* have a fault. Refer to "READY and BRAKE/DRIVE ENABLED Output Specifications" on page 6-91
BRAKE	J1-49 (+) J1-50 (-)	Relay closure releases the brake. Delay time is selectable (Refer to DSMPro - I/O configuration) and may be used as a drive enabled output. This signal is the inverse of the ENABLE output, although a time delay may be selected. Refer to "READY and BRAKE/DRIVE ENABLED Output Specifications" on page 6-91
OUTPUT 1	J1-42	General purpose output. Selectable from one of several drive functions. (Refer to DSMPro - I/O configuration on-line Help and Table 6.9.)
OUTPUT 2	J1-43	General purpose output. Selectable from one of several drive functions. (Refer to DSMPro - I/O configuration on-line Help and Table 6.9.)

Table 6.9 OUTPUT1 and OUTPUT2 Functions

Function	Description
In Position	An active state indicates the position window condition is satisfied, and the zero speed condition is satisfied. The position window and zero speed range are selectable settings.
Within Window	An active state indicates the position window condition is satisfied. The position window range is a selectable setting.

Zero Speed	An active state indicates the velocity loop zero speed signal is active. The zero speed limit is a selectable setting.
Speed Window	An active state indicates the velocity loop speed window is active. The speed window range is a selectable setting.
Current Limit	An active state indicates the torque current is limited.
Up To Speed	An active state indicates the velocity loop AT SPEED signal is active. The at speed level is a selectable setting.
Drive Enabled	An active state indicates the ENABLE signal is active and no fault is detected.
Bus Charged	An active state indicates the DC bus is energized.
Disabling Fault	An active state indicates a fault disabled the drive.
In Motion	An active state indicates the indexing sequence is in the motion portion.
In Dwell	An active state indicates the indexing sequence is in the dwell portion.
Sequence Complete	An active state indicates all batches of the indexing sequence are finished.
Registered	An active state indicates the indexing move has been adjusted after sensing the registration sensor.
At Home	An active state indicates the drive is at the home position.
Axis Homed	An active state indicates the drive has been homed.
NOTE: Refer to the I/O Configuration section of the DSMPro on-line Help for further explanation of these output signals.	

Table 6.10 Transistor Output Specifications

Parameter	Description	Minimum	Maximum
ON state Voltage	Voltage difference between the external I/O power supply and the output when the transistor is ON.	0 VDC	1.5 VDC
ON state current	Current flow when the transistor is ON.	0 mA	50 mA
OFF state Voltage	Voltage difference between the external I/O power supply and the output when the transistor is OFF.	0 Volts	50 Volts
OFF state current	Leakage current from the output when the transistor is OFF.	-0.1 mA	0.1 mA

Output Interface Circuit Examples

Figure 6.11 Drive Output Connected to an Opto-Isolator

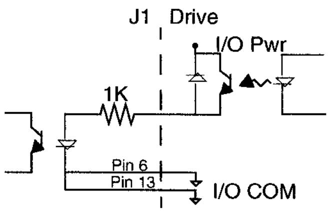


Figure 6.12 Drive Output Connected to an LED Indicator

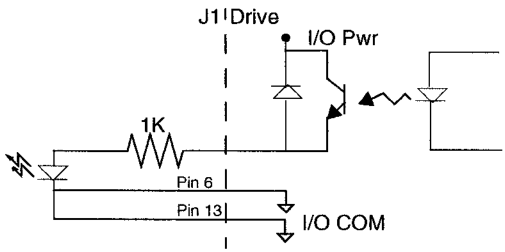


Figure 6.13 Drive Output Connected to a Resistive Load

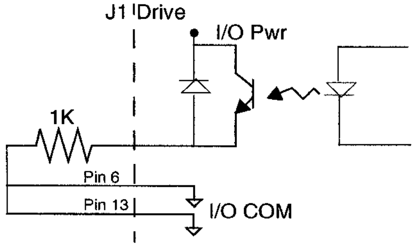


Figure 6.14 Drive Output Connected to a Switch/Relay

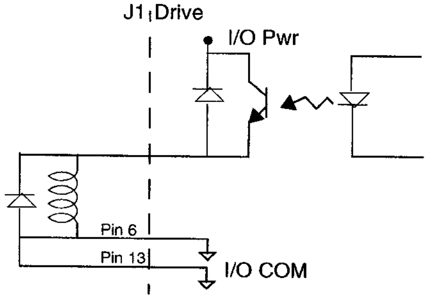


Figure 6.15 Drive Output Connected to Active Low Input using a Switch/Relay

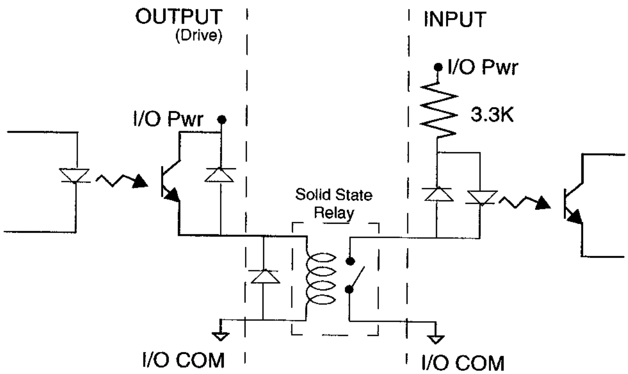


Figure 6.16 Drive Output Connected to Active Low Input using an Opto-Isolator

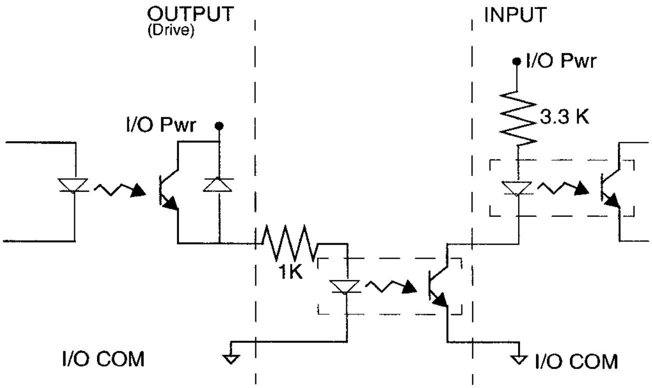
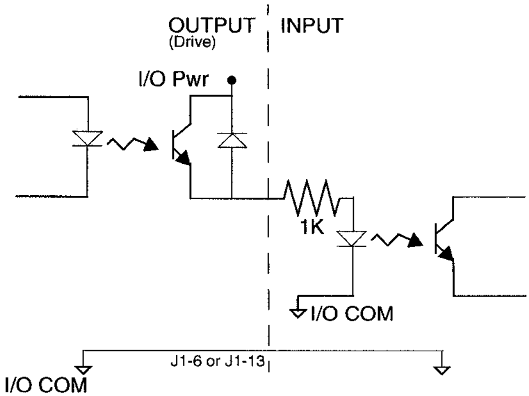


Figure 6.17 Drive Output Connected to Active High (Sinking) Input



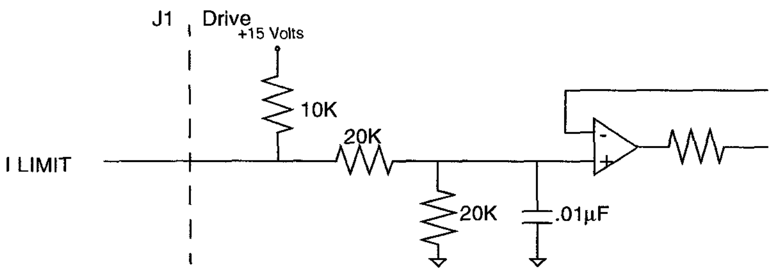
Analog Inputs

Two types of analog input circuits are available on the J1 connector:

- The current limiting input supports 0 to +10 Volt signals
- The command input supports 0 to ±10 Volt signals.

External Current Limit (I LIMIT)

Figure 6.18 External Current Limit Circuit



ILIMIT limits the current, which provides torque, to the motor. The range is 0 to +10 Volts (where 10 Volts corresponds to maximum drive current).The analog I LIMIT signal is converted into a digital word by a 10-bit ADC (analog to digital converter). If the I LIMIT input is *not* connected, current is not limited.

Table 6.11 Analog Inputs (I LIMIT)

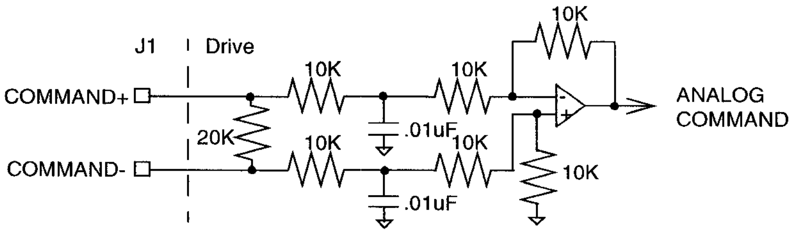
Analog Input	Pin Number	Function/Description
Current Limit (I LIMIT)	J1-27	Limits the peak current command, which produces torque.

Table 6.12 External Current Limit Input Specification

Parameter	Description	Minimum	Maximum
Maximum Current	Short circuit between the input and ground.		-1.5 mA
Input Signal Range	Allowable voltage applied to the input.	0 Volts	+10 Volts

Command Input

Figure 6.19 Analog COMMAND Input Circuit



The analog command signal to the drive has a range of ±10 Volts. The signal is either a torque or a velocity command, depending on the software configuration of the drive. The differential input is processed by a 14 bit analog to digital converter (ADC) to produce a digital value.

Table 6.13 Analog Command Input

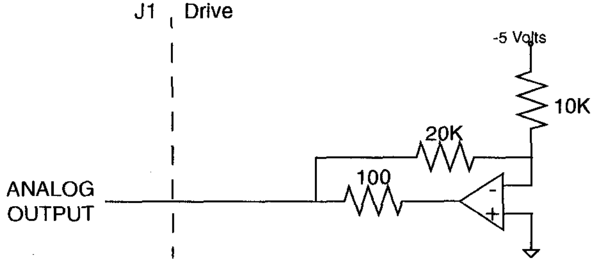
Analog Input	Pin Number	Description
COMMAND	J1-22 (+) J1-23 (-)	Analog command signal is a differential type signal to drive the servo controller. If the drive is in Velocity Mode configuration, the differential COMMAND signal is the velocity command. If the drive is in Torque Mode configuration, the differential COMMAND signal is the torque or current command. Separate scale and offset parameters are used for the input, depending on whether the signal is a velocity command or a torque current command.

Table 6.14 Analog Command Input Specifications

Parameter	Description	Minimum	Maximum
Input Impedance	Open circuit impedance measured between (+) and (-).	13.3 kOhms	
Input Signal Range	Allowable voltage applied between (+) and (-) inputs.	0 Volts	±10 Volts

Analog Output

Figure 6.20 ANALOG 1 Output Circuit



A selectable output is available for monitoring by the user: ANALOG 1 (J1-31).

WARNING

The user must provide an external circuit to ignore the analog output signal for two seconds after power-up. After reset the analog output may be in an indeterminate state for a short period before it stabilizes at the software controlled setting. Failure to observe this precaution could result in severe bodily injury.

Table 6.15 Analog Outputs: ANALOG 1

Analog Output	Pin Number	Description
ANALOG 1	J1-31	Selectable analog output. Displays the selected firmware variable along with selectable scale and offset. The scale or offset are calculated as shown below.
ACOM	J1-28	Analog Common (return).

Table 6.16 Analog Output Specifications

Parameter	Description	Minimum	Maximum
Output Current	Allowable current draw of the load	-2 mA	+2 mA
Output Signal Range	Voltage range of the signal	-10 Volts	+10 Volts

The following signals can be mapped to the analog output.

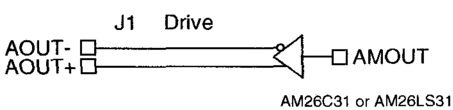
- Current – Command
- Current – Average
- Current – Peak +
- Current – Peak -
- Current – Input Limit +
- Current – Input Limit -
- Velocity – Motor Feedback
- Velocity – Command
- Velocity – Error
- Position – Motor Feedback
- Position – Command
- Position – Error
- Position – Error Peak +
- Position – Error Peak -

The following signals can also be monitored when DSMPro is configured for Advanced Mode.

- Position – Master
- Position – Loop Output
- Velocity – Loop Output
- Filter Output
- R-Phase Current
- T-Phase Current
- Torque Current
- Field Current
- Torque Voltage Command
- Field Voltage Command
- Analog COMMAND Input
- Bus Voltage

Motor Encoder Output Signal

Figure 6.21 Output Encoder Interface Circuits



The motor quadrature encoder signals are supplied to an external position controller. The signals are differential, quadrature, and TTL level. The output resolution is selectable and can be divided by 1, 2, 4 or 8.

The signal frequency (f_{out}) of the motor encoder output in Hertz (Hz) can be calculated with the equation:

$$f_{out} = \frac{Vm \cdot linecount}{60 \cdot N}$$

where:

Vm is the motor encoder velocity in rpm
Line count is the number of encoder lines/revolution of the motor mounted encoder, and
N is the output divider from the software selected parameter (1, 2, 4 or 8).

If the device connected to the motor encoder output counts all edges, the count frequency is four times f_{out}.

For example, a motor with a 2000 line encoder is rotating at 3000 rpm, and the Motor Encoder Output signal is set to Divide by 1, the encoder signal frequency is:

$$f_{out} = \frac{3000 \cdot 2000}{60 \cdot 1} = 100kHz$$

A counter counting all edges registers 400 kHz for this example.

Table 6.17 Motor Encoder Output Signal

Analog Output	Pin Number	Description
AOUT (+) AOUT (-)	J1-7 (+) J1-8 (-)	Motor Output Channels A(+) and A(-). Differential TTL levels from line driver. Signal resolution is selectable.
BOUT (+) BOUT (-)	J1-9 (+) J1-10 (-)	Motor Output Channels B(+) and B(-). Differential TTL levels from line driver. Signal resolution is selectable.
IOUT (+) IOUT (-)	J1-11 (+) J1-12 (-)	Motor Output Channels I(+) and I(-). Differential TTL levels from line driver. Output pulse occurs once per motor shaft revolution.

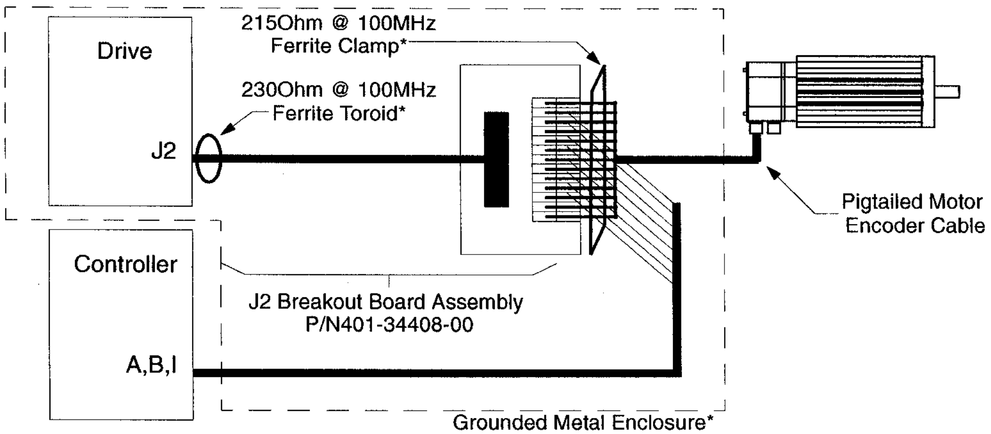
Table 6.18 Motor Encoder Output Specifications

Parameter	Description	Minimum	Maximum
Differential Output Voltage	Voltage measured between the (+) and (-) pins with R_L = 100 Ohm.	2.0 Volts	
Output Current	Current flowing out of the (+) or (-) pin.	-20 mA	+20 mA

IOUT Signal Generation

The Index output signal (IOUT) is *not synchronized* to a particular state of the A and B output signals (AOUT and BOUT). Some controllers, such as those used in the CNC industry, use the condition I=1, A=1, B=1 to indicate a home position. In such applications the encoder outputs from the drive *cannot be used*, since it cannot be guaranteed that the IOUT signal will be active during the state AOUT=1, BOUT=1. Instead, the unbuffered motor encoder signals can be used as shown below. The J2 Breakout Board assembly connects the motor encoder signals directly to the position feedback of the controller.

Figure 6.22 J2 Breakout Board Assembly - European Union EMC Compliance



NOTE: An asterik (*) indicates an installation option to comply with EU EMC Directives. Either a grounded metal enclosure or ferrite cores provide the requisite EMC protection.

▶ NOTE: If a controller connected to the drive requires the Index Output (IOUT) signal to be synchronized to a particular state of the A and B Outputs (AOUT and BOUT) the unbuffered encoder outputs from the motor must be used.

J2 Breakout Board Assembly - European Union EMC Compliance

Two options are available to achieve EMC compliance when a Centurion DSM Drive uses the J2 Breakout Board Assembly to transfer an unbuffered encoder signal to a control device. Either method of installation reduces the radiated emissions to an acceptable level. Be aware that either installation option is in addition to the EMC requirements specified elsewhere in this manual.

- Install the drive and J2 breakout board assembly (terminal block and cable), and the pigtailed cable inside a grounded metal enclosure.

  - or -
- Install ferrites of an appropriate rating at the specific locations:

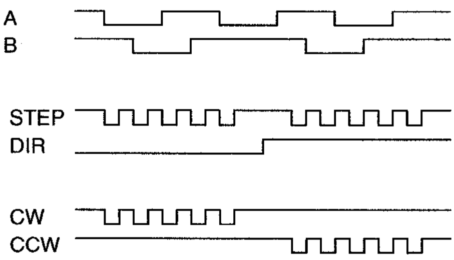
  A. J2 Cable - 230 Ohm @ 100 MHz toroid (FerriShield P/N SS28B2032) immediately adjacent to the J2 connector on the drive.

  B. Pigtailed Motor Encoder Cable - 215 Ohm @ 100 MHz ribbon cable clamp (Fair-Rite P/N 2643164051 and two clips Fair-Rite P/N 0199001401) over the unshielded conductors.

▶ NOTE: Drives are tested using specific installation methods, and the information above is based on successful tests. If the drives are installed in this manner, then compliance with European EMC requirements may be expected, although it is impossible to guarantee that a specific installation will meet EMC requirements without testing it.

Auxiliary Encoder Input Types

Figure 6.23 Auxiliary Encoder Inputs



The drive may be electronically geared by a remote signal. Electronic gearing may be driven by any of the following three signals:

A master incremental encoder that generates quadrature encoder signals

Step and direction signals, such as those created by indexers for step motors

CW (Step Up)/CCW (Step Down) signals, typically used with stepper indexers.

▶ NOTE: The use of differential signals is strongly recommended. Single-ended signals are susceptible to noise, which may cause intermittent or continuous errors.

▶ NOTE: To improve noise immunity, terminate cable shields at both ends of the cable. Connect shields to the backshell of the connector with a complete circumferential (360°) termination. The cable connector should then connect to chassis ground (*not* signal ground.

Figure 6.24 Auxiliary Encoder Input Circuit

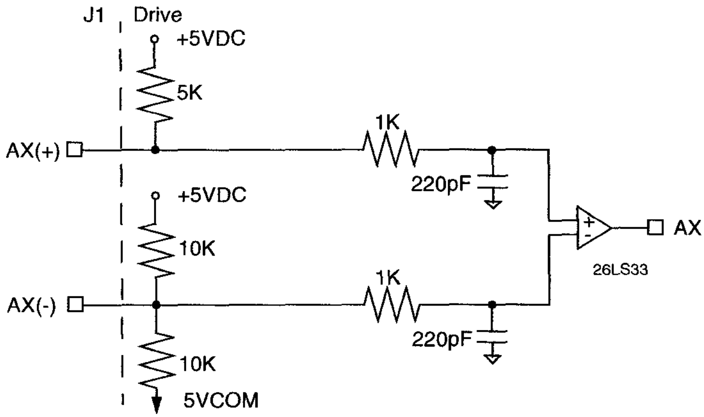


Table 6.19 Motor Encoder Output Signal

Auxiliary Encoder Input	Pin Number	Description
AX + and AX-, or Step + and Step-, or CW+ (Step Up+) and CW- (Step Up-)	J1-14 (+) J1-15 (-)	Auxiliary Channels A(+) and A(-). Differential, quadrature, or TTL level encoder input. The signal input and resolution are selectable.
BX (+) and BX(-), or DIR (+) and DIR(-), or CCW+ (Step Down+) and CCW- (Step Down-)	J1-16 (+) J1-17 (-)	Auxiliary Channels B(+) and B(-). Differential, quadrature, or TTL level encoder inputs. The signal input and resolution are selectable.
IX (+) and IX (-)	J1-18 (+) J1-19 (-)	Auxiliary Input Channels I(+) and I(-). Differential, quadrature, or TTL level encoder inputs.

The input circuits shown in the following diagrams support connections to differential TTL line drivers, single-ended TTL line drivers and open collector devices. These inputs are under software control.

Table 6.20 Quadrature Interface Specifications

Specification	Description	Minimum	Maximum
ON State Voltage	Voltage difference between the + and - inputs that indicate an ON state.	1.0 Volts	+15 Volts
OFF State Voltage	Voltage difference between the + and - inputs that indicates an OFF state.	-1.0 Volts	-15 Volts
Common Mode Voltage	Voltage difference between an encoder signal input and the reference ground of the drive.	-15 Volts	+15 Volts
Current Draw	Current draw into the + input or - input	-5 mA	+5 mA
A or B Signal Frequency	Frequency of the A or B line inputs. Count frequency is 4 times this frequency, since the circuitry counts each of the four transitions in a single line.		1 MHz
Index Pulse Width	Pulse width of the index signal. The index signal is active for a percentage of the revolution, therefore the speed of the encoder dictates the pulse width.	500 nsec	

Interface Cable Examples

The use of differential signals is highly recommended. This is due to the immunity of differential signals to common mode interference. Single-ended encoder interface circuits are *not recommended*, and may result in system malfunction.

To improve noise immunity, a cable shield should terminate at both ends of the cable. Shields should connect to the backshell of the connectors with termination around the full circumference (360°). The connectors should attach to chassis ground (not signal common).

Figure 6.25 External Encoder Interface via TTL Differential Line Drivers

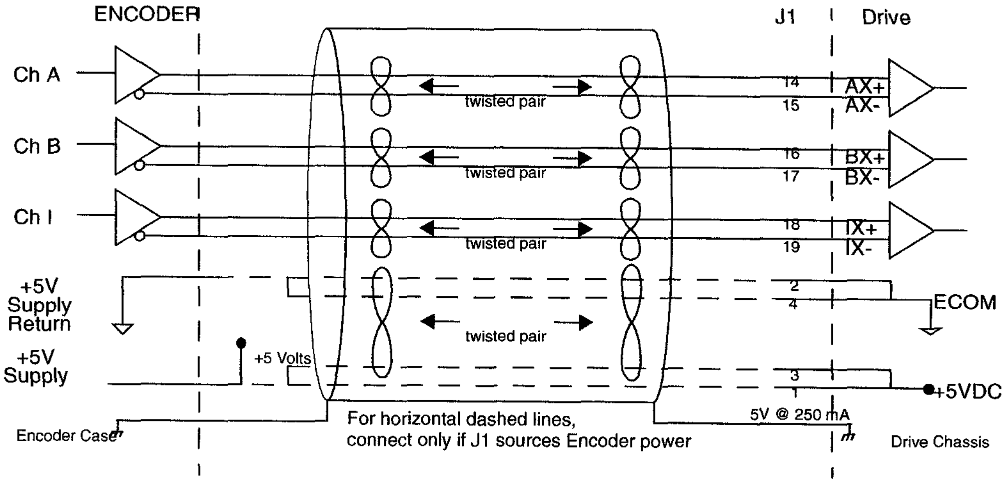


Figure 6.26 Complementary Encoder Interface via 7406 Line Drivers with Pull-up Resistors

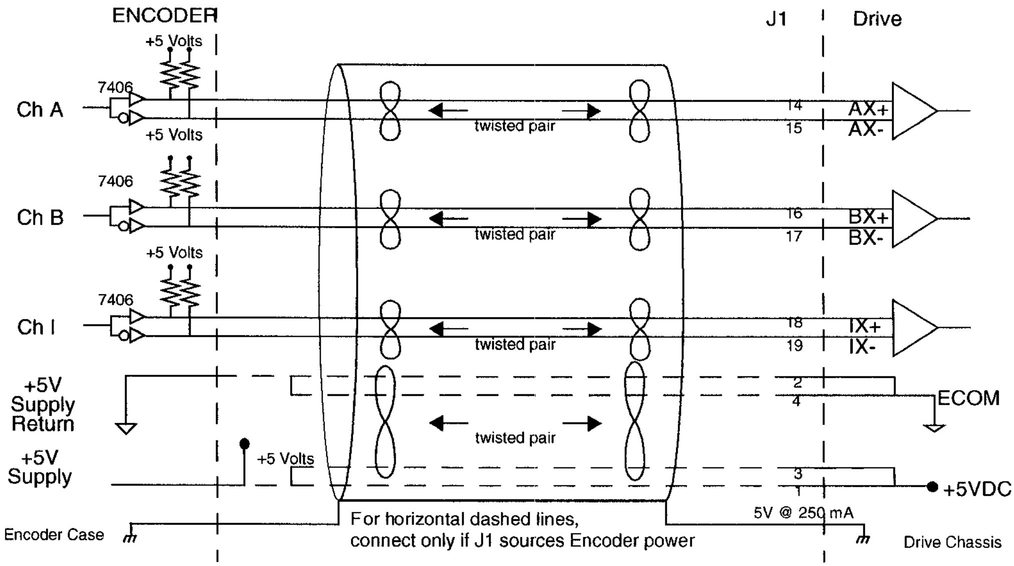


Figure 6.27 Complementary Encoder Interface via Standard TTL Logic

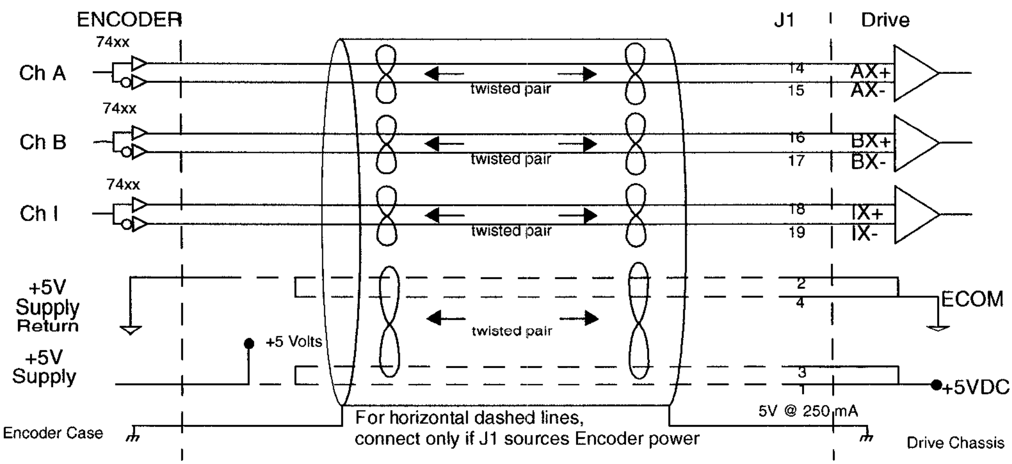


Figure 6.28 Single-Ended Encoder Interface via Open Collector Transistor without Pull-up (not recommended)

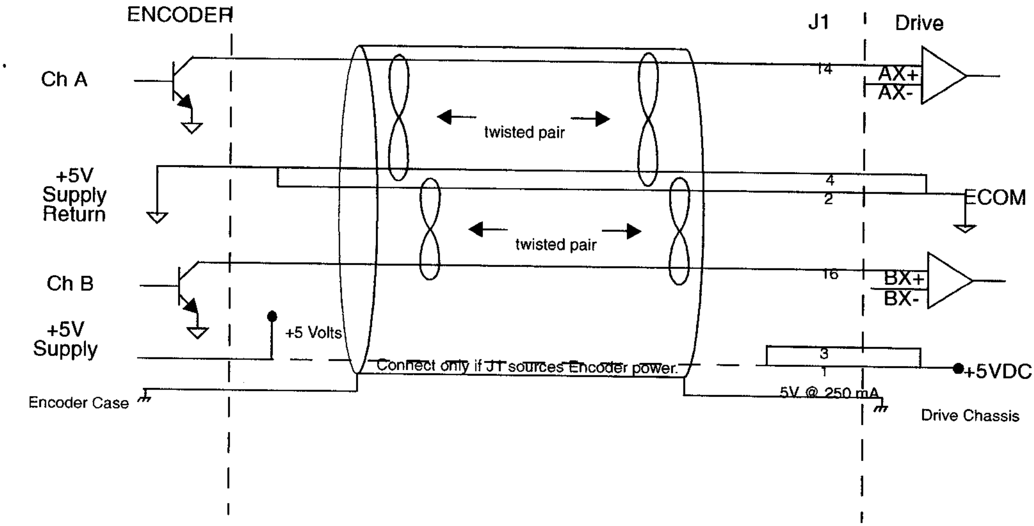


Figure 6.29 Single-Ended Encoder Interface via Standard TTL Signals (not recommended)

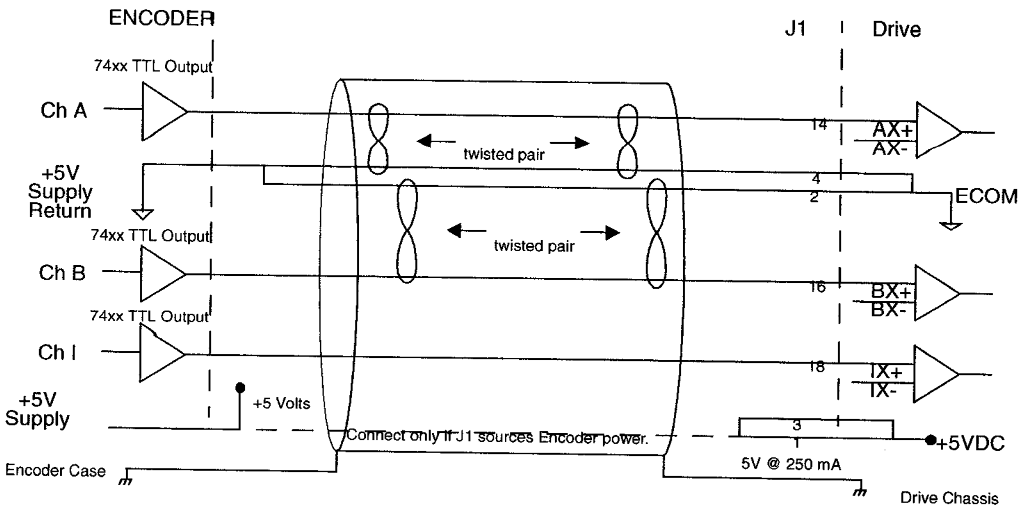


Figure 6.30 Single-Ended Encoder Interface via Open Collector Transistor
with 5 VDC to 12 VDC Pull-up (not recommended)

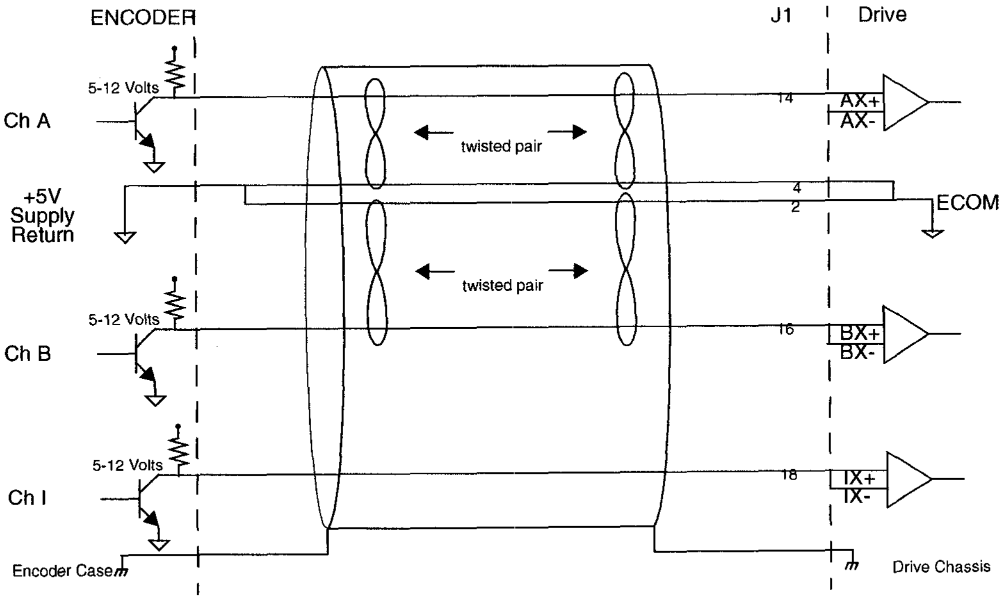


Figure 6.31 Single-Ended Encoder Interface via Open Collector Transistor with 24 VDC Pull-up (not recommended)

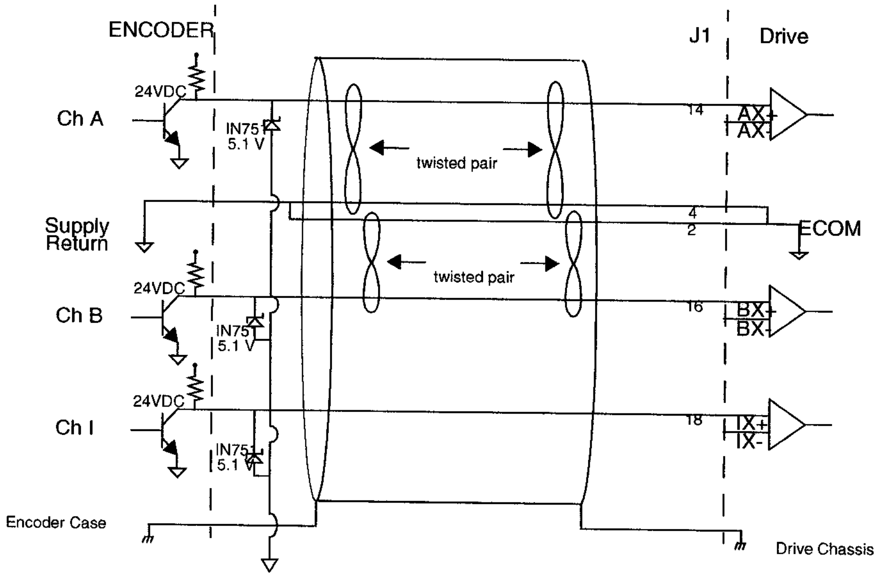


Table 6.21 Step/Direction and CW/CCW (Step Up/Step Down) Interface Specifications

Specification	Description	Minimum	Maximum
Signal frequency	Frequency of the input signal.		1 MHz
Pulse Width	Time interval the step (CW/CCW) signal must remain in a single state for detection.	500 nsec	
Setup Time	Time interval the direction (CW/CCW) signal must be stable before the corresponding step (CCW/CW) signal changes state.	500 nsec.	

The following diagram shows the relationship between STEP and DIRECTION inputs.

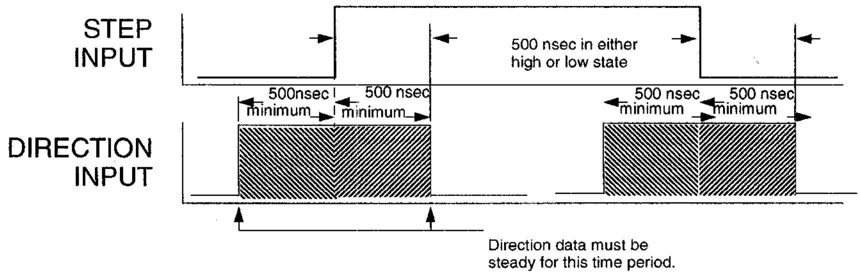


Figure 6.32 External Step/Direction Interface via TTL Differential Line Drivers

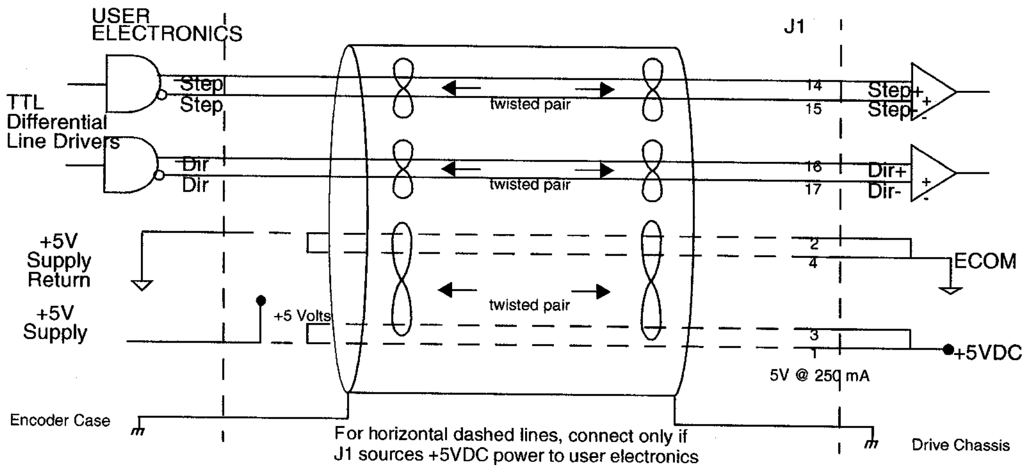


Figure 6.33 External Step/Direction Interface via Single-Ended TTL Line Drivers (not recommended)

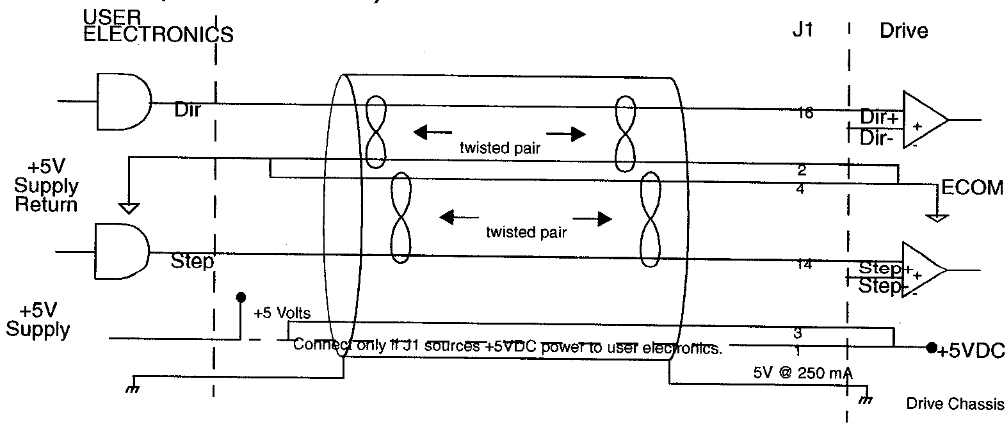


Figure 6.34 External CW/CCW (Step Up/Step Down) Interface via TTL Differential Line Drivers

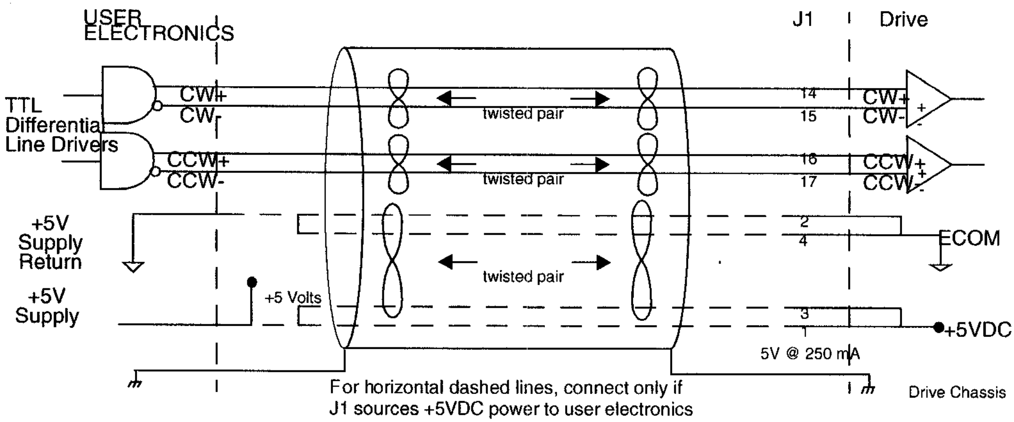
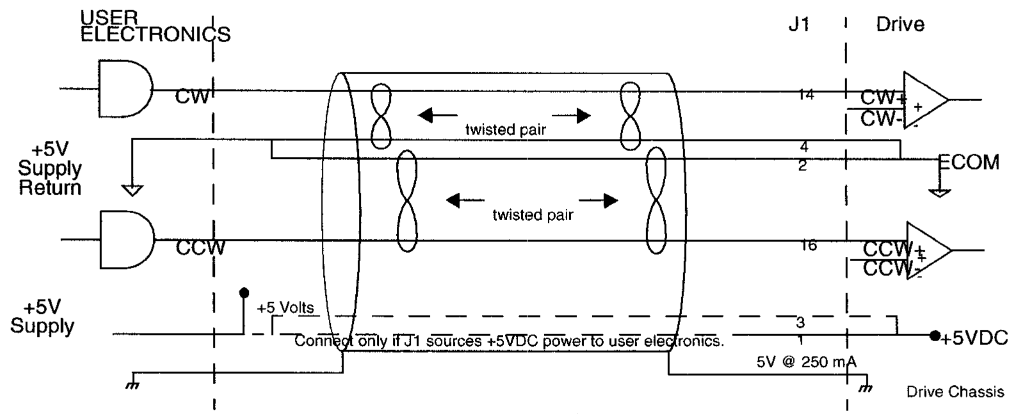


Figure 6.35 External CW/CCW (Step Up/Step Down) Interface via Single-Ended Line Drivers (not recommended)



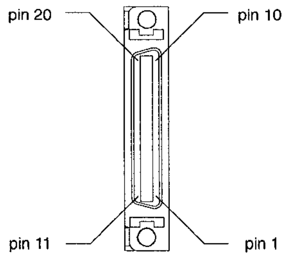
J1 Terminal Strip/Breakout Board

A 50-pin terminal strip kit is available for extending the signals from the J1 connector. The kit includes a 1 meter (3-foot) interface cable, a 50-pin terminal strip and mounting hardware. Refer to "Options and Accessories" on page A-235.

"Cabling Examples" on page B-265 depicts the use of this kit to pass a cable through a bulkhead.

J2 - Encoder

Pin & Signal		Description	Pin & Signal		Description
1	*EPWR*	*Encoder Power*	*11*	*I (+)*	*Motor Encoder Input Channel I(+)*
2	*ECOM*	*Encoder Common*	*12*	*I (-)*	*Motor Encoder Input Channel I(-)*
3	*EPWR*	*Encoder Power*	*13*	*A*	*Hall Effect A*
4	*ECOM*	*Encoder Common*	*14*	*B*	*Hall Effect B*
5	*EPWR*	*Encoder Power*	*15*	*C*	*Hall Effect C*
6	*ECOM*	*Encoder Common*	*16*	*ABS*	*Absolute Position*
7	*A (+)*	*Motor Encoder Input Channel A(+)*	*17*		*Reserved*
8	*A (-)*	*Motor Encoder Input Channel A(-)*	*18*		*Reserved*
9	*B (+)*	*Motor Encoder Input Channel B(+)*	*19*	*TS(+)*	*Thermal Switch (+)*
10	*B (-)*	*Motor Encoder Input Channel B(-)*	*20*	*TS(-)*	*Thermal Switch (-)*



Cables are available in various lengths for connecting between J1 and a suitable controller. The appendix "Options and Accessories" on page A-235 lists the cables. "J2 Terminal Strip/Breakout Board" on page 6-120 details the optional signal extension kit.

CAUTION

Ensure that encoder signals are connected properly. Incorrect connection of encoder signals will result in improper rotor position and/or incorrect commutation.

Figure 6.36 Motor Encoder Interface Circuit

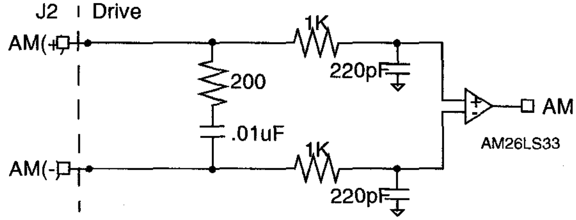


Figure 6.37 Hall Effect Sensor Circuit

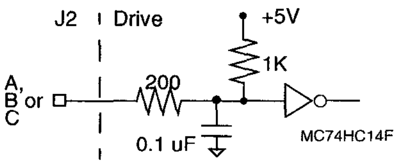


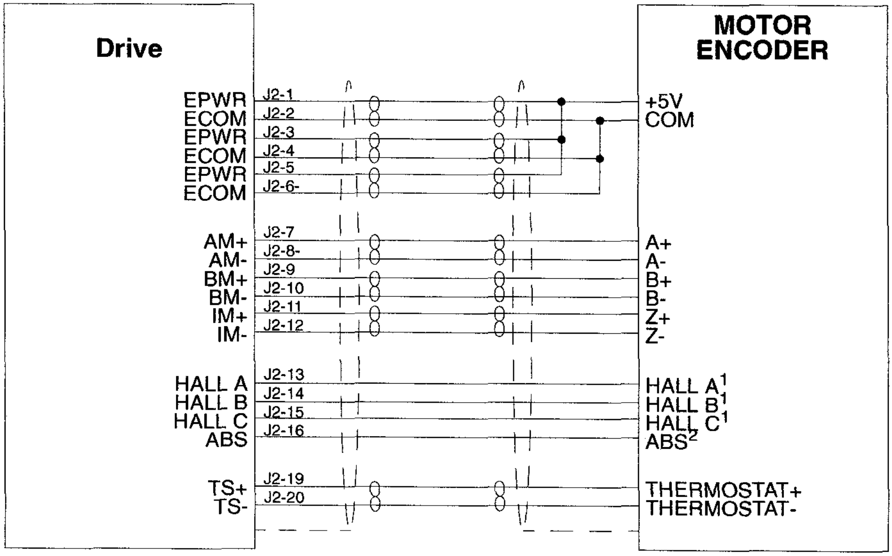
Table 6.22 J2- Motor Encoder Connector Pin-Outs

Motor Encoder	Pin Number	Function/Description
EPWR	J2-1 J2-3 J2-5	Encoder power.
ECOM	J2-2 J2-4 J2-6	Encoder common
A+ A–	J2-7 (+) J2-8 (–)	Motor Encoder Input Channel A+ and Channel A–. Accepts TTL level signals from a line driver.
B+ B–	J2-9 (+) J2-10 (–)	Motor Encoder Input Channel B+ and Channel B–. Accepts TTL level signals from a line driver.
I+ I–	J2-11 (+) J2-12 (–)	Motor Encoder Input Channel I+ and Channel I–. Accepts TTL level signals from a line driver. Output pulse occurs once per motor shaft revolution. [a]
HALL A	J2-13	Hall Effect A sensor logic level input. Internally pulled up to +5VDC through a 1 kOhm resistor.

Motor Encoder	Pin Number	Function/Description
HALL B	J2-14	Hall Effect B sensor logic level input. Internally pulled up to +5VDC through a 1 kOhm resistor.
HALL C	J2-15	Hall Effect C sensor logic level input. Internally pulled up to +5VDC through a 1 kOhm resistor.
ABS	J2-16	Absolute Position used on Giddings & Lewis motors for commutation.
	J2-17 J2-18	Reserved.
TS+ TS–	J2-19 J2-20	Thermal Switch + and Thermal Switch – are a motor overtemperature signal.[a]

a. DSMPro software automatically determines the presence or absence of a motor thermal switch signal based on the motor selected in the Drive Select window. Giddings & Lewis FSM-, HSM-, NSM- and SSM-Series motors typically have thermal switches and signal continuity is provided on these motors. YSM-Series motors do not have thermal switches and signal continuity is *not* required.

Figure 6.38 Centurion DSM Drive Motor Encoder Connections



NOTES:
1. For encoders with differential Hall ouputs (A+, A-, B+, B-, C+ and C-) connect only the + outputs to the drive.
2. The ABS signal is only available on selected Giddings & Lewis encoders.

J2 Terminal Strip/Breakout Board

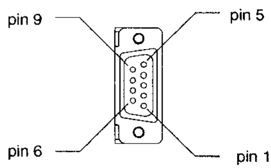
A 25-pin terminal strip kit is available for extending the encoder signals from the J2 connector. The kit includes a 3-foot (1 meter) interface cable a 25-pin terminal strip, and mounting hardware. Refer to “Options and Accessories” on page A-235.

“Cabling Examples” on page B-265 depicts the use of this kit to pass a cable through a bulkhead.

J5 - Serial Port

Table 6.23 J5 Controller Pin-Outs

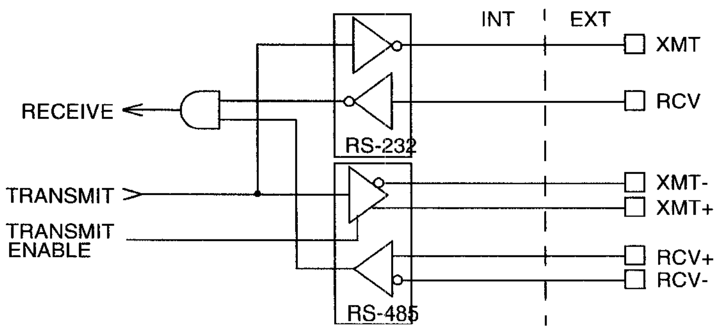
Pin & Signal		Description	Description
1	*RCV(+)*	*Receive (+)*	*RS-485 (four wire)*
2	*RCV*	*Receive*	*RS-232*
3	*XMT*	*Transmit*	*RS-232*
4	*XMT(+)*	*Transmit (+)*	*RS-485 (four wire)*
5	*COM*	*+5 VDC Common*	
6		*Reserved*[a]	
7	*RCV(-)*	*Receive (-)*	*RS-485 (four wire)*
8	*XMT(-)*	*Transmit (-)*	*RS-485 (four wire)*
9		*Reserved*[a]	



a. Do *not* connect any device to J5-6 or J5-9 except a TouchPad.

J5 is a 9 pin female D-shell connector. This connector is a serial interface that allows communication with another Centurion DSM Drive, a PC, a terminal, a host computer, a controller or an optional TouchPad. The shell of the connector is grounded to the chassis for shield termination.

Figure 6.39 RS-232/485 Interface Circuit



The serial interface of the drive uses the standard NRZ asynchronous serial format, and supports both the RS-232 and the four wire RS-485 communications standards.

- Standard baud rates include 1200, 2400, 4800, 9600 and 19200 baud. 9600 is the factory default setting.
- Even, odd, and no parity generation/checking are supported. No parity is the factory default setting.
- The maximum number of Centurion DSM Drives allowable on a four-wire RS-485 bus is 32.
- The maximum length of an RS-232 cable is 15 meters (50 feet).
- The maximum length of an RS-485 cable is 1220 meters (4000 feet) with 0.20 mm^2 (24 AWG) wire.

Cables are available in various lengths for connecting between the serial port of a drive and a control unit, such as a PC. "Options and Accessories" on page A-235 lists the cables, and the male and female connectors for the cables.

▶ NOTE: The shell of the connector is grounded to the chassis for shield termination.

The following table lists the pin-outs for J5.

Table 6.24 J5 - Serial Port Connector Pin-Outs

Auxiliary Encoder Input	Pin Number	Description
RCV (+) RCV (-)	J5 - 1 (+) J5 - 7 (-)	RS-485 differential receiver input (to drive)
XMT (+) XMT (-)	J5 - 4 (+) J5 - 8 (-)	RS-485 differential transmitter output (from drive)
COM	J5 - 5	Common serial port interface
	J5 - 6	Reserved[a]
RCV	J5 - 2	RS-232 receiver input (to drive)
XMT	J5 - 3	RS-232 transmitter output (from drive)
	J5 - 9	Reserved[a]

a. Do *not* connect any device to J5-6, or J5-9, except a TouchPad.

Serial Communications Overview

Centurion DSM Drives communicate via a standard NRZ (non-return to zero) asynchronous serial format, which supports either RS-232 or four wire RS-485. The pin-out arrangement on the drive serial ports provides self-sensing of the communication standard. To change from RS-232 to four wire RS-485 requires a simple change of the cable.

In multiple drive installations, a unique address must be assigned to each drive through software. The factory default drive address is setting is Address 0. All addresses changes are made through DSMPro software selection. Up to 32 (1 through 32) are supported.

▶ NOTE: Address and communications settings) changes are not immediate; they are logged but do not become active until *after* the drive is RESET.

Each drive may be assigned a unique name of up to 32 characters in length; a name is often easier to remember than the address of a drive. DSMPro software automatically associates a drive name with the correct drive address.

RS-232 Connections

The address of each drive is set using DSMPro software. Refer to the DSMPro on-line Help.

▶ NOTE: Do *not* connect any device to J5-6 or J5-9 except a TouchPad.

Single Axis RS-232 Set Up

A single Centurion DSM Drive may be selected using RS-232 communications. After cabling is attached to the unit and the drive address is assigned, configuration of (i.e., communications with) the unit may proceed.

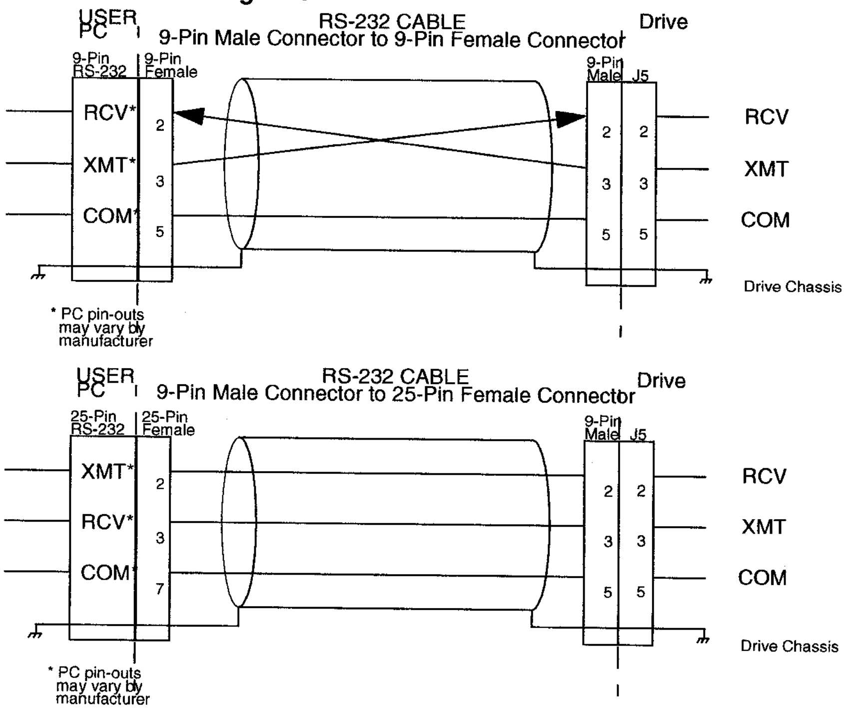
Factory default settings for a Centurion DSM Drive are:

- Address 0
- 9600 Baud
- 8 Data, No Parity, 1 Stop bit

The following steps outline how to select the communications options:

1. Connect an RS-232 cable between the computer and a serial connector on the drive (J5).

Figure 6.40 RS-232 Connection Diagrams



2. Verify the computer can communicate with the drive by performing the following:

A. Switch drive power to ON

B. Start DSMPro on the attached PC

C. Choose CANCEL from the Drive Select window

D. Select Communications from the menu

E. Select PC Set Up from the pull down menu

F. Verify the port settings, and if necessary, change them, then choose OK.

G. Select Communications from the menu

H. Select Read Drive Parameters from the pull down menu

I. Choose OK in the Drive Select window.

3. Verify that DSMPro reads the drive parameters. If not, refer to "Troubleshooting" on page 11-220.

> NOTE: The Scan Port for Attached Drives option in the Drive Select window of DSMPro will identify any attached drives. If a drive is identified, but cannot be communicated with, the Baud Rate selection must be modified.

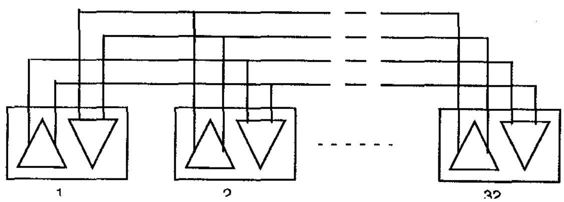
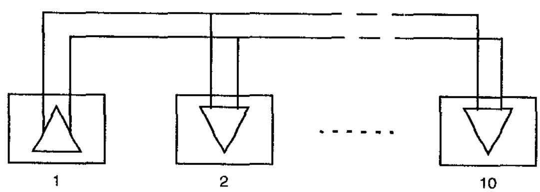
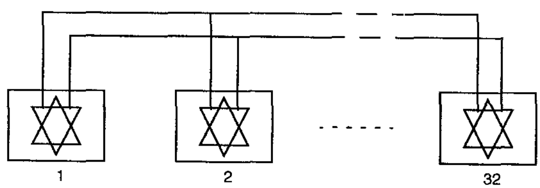
The cable diagrams provide wiring examples for both 9 pin and 25 pin serial ports from an IBM compatible personal computer to the drive. RS-232 pin-outs vary between computer manufacturers. Check the hardware reference manual of your machine to ensure correct signal connections between the computer and the drive.

Four Wire RS-485 Connections

The Centurion DSM Drives use a variation of the RS-485 standard, known as four wire RS-485. Four wire RS-485 uses one differential signal for host to drive transmissions, and another differential signal for drive to host transmissions. (The RS-485 standard specifies a single differential signal for transmissions in both directions.)

The four wire RS-485 configuration also allows the host to use a RS-422 type interface. Because the host is driving multiple receivers and receiving from multiple transmitters, RS-422 is limited to multiple axes connections with 10 or less drives. The figure below summarizes the four wire RS-485, RS-422, and RS-485 standards.

Figure 6.41 RS-485/RS-422 Communication Comparison

Four Wire RS-485 Differential 4 Wires 2 Signal Pairs 1 to 32 Transmitters 1 to 32 Receivers	
RS-422 Differential 4 Wires 2 Signal Pairs 1 Transmitter 1 to 10 Receivers	
RS-485 Standard Differential 2 Wires 1 Signal Pair 1 to 32 Transmitters 1 to 32 Receivers NOTE: Not applicable to Centurion DSM Drive drives	

Multiple Axes Four-Wire RS-485 Communications

> NOTE: Do *not* connect any device to J5-6 or J5-9 except a TouchPad.

1. Select a previously unused address (1 - 32) from DSMPro - Drive Set Up.
2. Connect cables between:
   - **A.** The host computer and the serial port on the initial drive (J5) in the multiple drive configuration.
   - **B.** The other serial port on the initial drive (J5) and the serial port on the next drive (J5) in the multiple drive configuration

> NOTE: Flat ribbon cabling is *not* recommended for RS-485 connections.

3. Verify the communication settings on the computer are correct:
   - **A.** Start DSMPro on the attached PC
   - **B.** Choose CANCEL from the Drive Select window
   - **C.** Select Communications from the menu
   - **D.** Select PC Set Up from the pull down menu.
   - **E.** Verify the port settings, and if necessary, change them, then choose OK.

> NOTE: Address 0 is the preferred address for the initial configuration of a drive. It forces the drive to the default communications parameters.

4. Verify the ability to communicate between the computer and the connected drives by:

- **A.** Switch drive power to ON
- **B.** Select Communications from the menu
- **C.** Select Read Drive Parameters from the pull down menu
- **D.** Select the drive to communicate with from Drive Select window (the drive must have an address that matches one of the drive addresses in the chain)
- **E.** Choose OK in the Drive Select window.

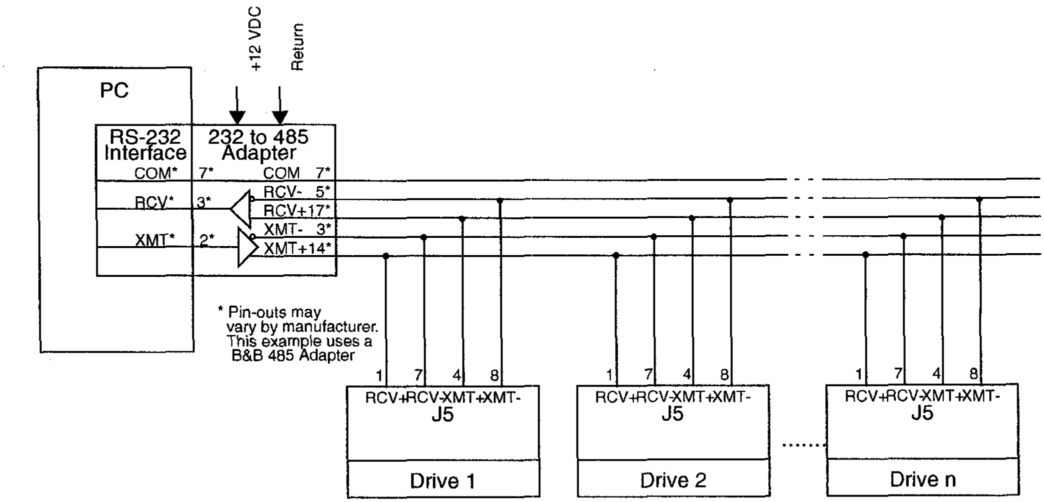
5. Verify that DSMPro loads the drive parameters. If not, refer to the troubleshooting section.
6. Repeat the preceding two steps for each additional drive.

   Four wire RS-485 connections are shown below. The cable diagram provides a wiring example of a daisy chain connection in a typical installation A multi-drop cable, as shown in Figure 6.42 may also be used.

Multiple Axes RS-232 Communications

Multiple axes systems may be controlled by a computer with an RS-232 serial port. An RS-232 serial communication port may be converted to four wire RS-485 communication by attaching an RS-232 to four wire RS-485 converter. The figure below depicts the use of such a device.

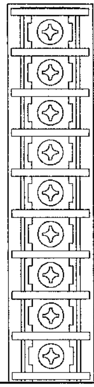
Figure 6.42 RS-232 to RS-485 Connection Diagram



Power Connections 7

DC bus, single phase AC power and motor connections are provided on the Terminal Block (TB-1).

Table 7.1 TB1 - DC Bus and AC Power Terminal Block Connections

Description	Identifier	Terminal	DSM 007 and 007P DSM 015 and 015P DSM 030 and 030P
DC Bus + voltage	DC BUS +	1	
DC Bus - voltage	DC BUS -	2	
100-240 VAC input power	L1 (Line 1)	3	
100-240 VAC input power	L2 (Line 2)/ N (Neutral)	4	
Safety (earth) ground	⏚	5	
R phase power to motor	R	6	
S phase power to motor	S	7	
T phase power to motor	T	8	
Motor case ground	⏚	9	

Power Wiring Connection Diagrams for the DSM 007, 007P, 015, 015P, 030 and 030P are provided on page 5-78. Wiring for the external I/O power is described and depicted in the chapter "Application and Configuration Examples" on page 8-141.

DANGER

DC bus capacitors may retain hazardous voltages after input power has been removed, but will normally discharge in several seconds. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval listed on the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

WARNING

Motor power connectors are for assembly purposes only. They should not be connected or disconnected while the drive is powered.

Motor Power Cabling

TB1-6, TB1-7, TB1-8 and TB1-9 are the terminals for connecting the drive to the windings of a motor.

► NOTE: Proper phasing of these outputs relative to the motor terminals is critical. Double check the connections after wiring the motor

Table 7.3 lists the drive terminals and typical motor connections. Table 7.4 on page 7-138 lists the minimum wire size for making power wiring connections.

Motor Phase Signal	Description	Terminal
R	R phase from drive	TB1-6
S	S phase from drive	TB1-7
T	T phase from drive	TB1-8
⏚	Ground for the motor case	TB1-9
NOTE: Torque all terminal connections to 1.25 Nm (11.0 lb-in).		

Refer to "Options and Accessories" on page A-235 for a list of available Giddings & Lewis cables.

Shield Termination of Power Cables

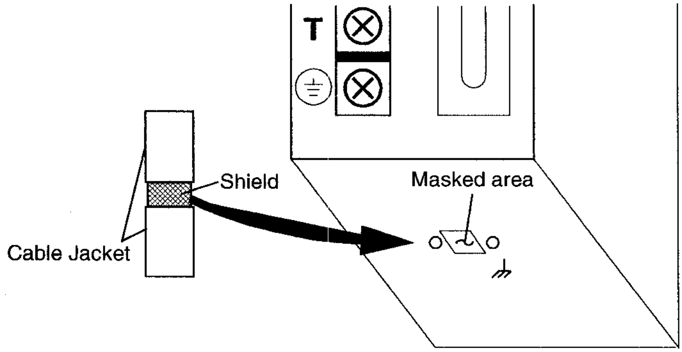
DANGER

Shielded power cables must be grounded at a minimum of one point for safety. Failure to ground a shielded power cable will result in potentially lethal voltages on the shield and anything connected to it.

FSM Series, HSM Series, NSM Series, SSM Series Motor Power Cable

Factory supplied motor power cables are shielded. The power cable is designed to be terminated at the drive during installation. A small portion of the cable jacket is stripped, which exposes the shield wires. The exposed area must be clamped to the bottom of the drive chassis using the clamp provided. It is critical for EMC performance that the shield wires be clamped against the area of the chassis which is not painted.

Figure 7.1 Motor Power EMC Shield Connection

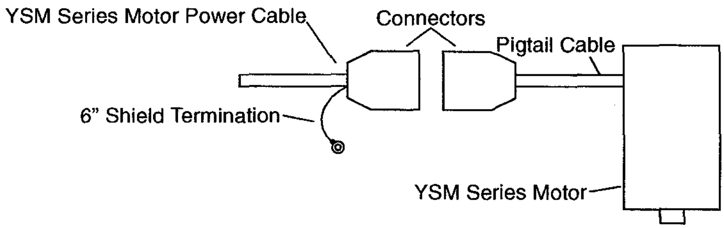


Power cable shield termination clamp on bottom of DSM 007, DSM 015 and DSM 030

YSM Series Motor Cables

YSM Series motors have a short "pigtail" cable which connects to the motor but is not shielded. These motor power cables have a 6 inch shield termination wire with a ring lug which should be connected to the closest earth ground. The shield termination wire may be extended to the full length of the motor pigtail if necessary, but it is best to connect the supplied wire directly to ground without lengthening.

Figure 7.2 YSM Series Motor Cable Termination



WARNING

High voltage may be present on the terminals of the drive. Remove power and disconnect the power cable before making or removing any connection.

CAUTION

Do not tin (solder) the exposed leads on cables. Solder contracts over time and may loosen the connection.

Table 7.2 Motor Power Contact and Wire Size Recommendations

Motor Size	Motor Power Mating Maximum Contact Size mm^2 (AWG)	Minimum Recommended 90°C Power Wire mm^2 (AWG)
2005 through 3016	1.5 (16)	1.5 (16)
4030	4 (12)	1.5 (16)
4050	4 (12)	2.5 (14)

Motor Overload Protection

The drive utilizes solid state motor overload protection which operates:

- Within 8 minutes at 200% overload
- Within 20 seconds at 600% overload.

Power Supply Protection

The feedback encoder, auxiliary encoder and optional TouchPad are powered by a single internal power supply. The power supply has a “resettable” fuse that opens at 3 amps and automatically resets itself when the current falls below 3 amps.There are no internal fuses requiring replacement.

Emergency Stop Wiring

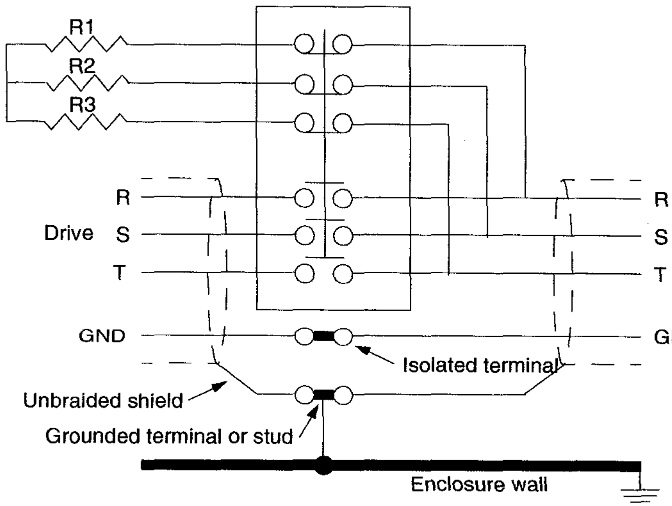
An overlapping contactor may be inserted between the motor and the drive for emergency stop purposes. The contactor must not simply break the motor current, it also must switch a three phase resistive load in parallel with the motor windings.

The three resistors provide dynamic braking. In addition, they prevent continuous arcing at the main contacts when breaking DC currents, such as when the motor stalls. Simply breaking the motor current can result in high voltages due to motor inductance, which will cause prolonged arcing in the contactor. In extreme cases, the prolonged arcing could result in the contactor catching fire. An overlapping contactor provides the required timing by engaging the braking contactors before the drive contactors disengage.

Figure 7.3 depicts a contactor installation with resistive loads. Guidelines for the installation include:

- Resistor values should be one to four times the winding resistance for good braking performance. Refer to the appendix "Dynamic Braking Resistor Selection" on page E-297 for resistor sizing equations.
- Screen and ground cables should be connected as shown.
- Shields should be unbraided (not a drain wire soldered to the shield).
- Connection lengths should be minimized.
- Safety ground (GND) and shield connections are permanently connected. This is essential for electrical safety.
- EMC guidelines require connection of the shield at the point where the contactor is inserted.

Figure 7.3 Emergency Stop Contactor Wiring



AC Power Cabling

The DSM 007, 007P, 015, 015P 030 and 030P drives require single phase, 100 to 240 VAC rms power with an input frequency of 47 - 63 Hz. "Power" on page F-306 lists the output power characteristics of the drives. The AC input supplies power to the motor. Alternatively, the drive may be powered by an external DC power source. In either case, an external power source must provide input power to the I/O.

TB1-3, TB1-4 and TB1-5 are the single phase AC input power terminals for the DSM 007, 007P, 015, 015P, 030 and DSM 030P.

DANGER

The user is responsible for conforming with all applicable local, national and international codes. Wiring practices, grounding, disconnects and overcurrent protection are of particular importance. Failure to observe this precaution could result in severe bodily injury or loss of life.

WARNING

High voltage may be present on the terminals of the drive. Remove power and disconnect the power cable before making or removing any connection.

CAUTION

Do not tin (solder) the exposed leads on cables. Solder contracts over time and may loosen the connection.

Table 7.3 TB1 - AC Power Terminals

Signal	Description	Terminal
L1	100 to 240 Volts AC Line 1 input power.	TB1-3
L2/N	100 to 240 Volts AC Neutral.	TB1-4
⏚	Safety (earth) ground	TB1-5
NOTE: Torque all terminal connections to 1.25 Nm (11.0 lb-in).		

Table 7.4 AC Input Power Sizing Requirements

Drive Model	Input Current	Inrush Current	Fuse Size[1]	Wire Size mm (AWG)	Transformer Size[a]	
DSM 007 or DSM 007P	5 A AC_{rms}	75 A peak	5 A	1.5 (16)	1 kVA min	100 kVA max
DSM 015 or DSM 015P	9 A. AC_{rms}	100 A peak	10 A	2.5 (14)	2 kVA min	100 kVA max
DSM 030 or DSM030P	18 A. AC_{rms}	100 A peak	20 A	4.0 (12)	4 kVA min	100 kVA max

1. In the United States, the National Electrical Code (NEC), specifies that fuses must be selected based on the motor full load amperage (FLA), which is not to be confused with the drive input current. The largest fuse allowed under any circumstances is four times the motor FLA. Therefore the largest fuse permissible for use with the Centurion DSM Drive is four times the motor rated continuous current (converted to an RMS value). The Digital Servo Drive has been evaluated and listed by Underwriters Laboratories Inc. with fuses sized as four times the continuous output current of the drives (FLA), according to UL 508C.
In almost all cases fuses selected to match the drive input current rating will meet the NEC requirements and provide the full drive capabilities. Dual element, time delay (slow acting) fuses should be used to avoid nuisance trips during the inrush current of power initialization. The fuse sizes listed are recommended values, but local regulations must be determined and adhered to.
The Centurion DSM Drive utilizes solid state motor short circuit protection rated as follows:

Short Circuit Current Rating with No Fuse Restrictions:

Suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical Amperes, 240 Volts maximum.

Short Circuit Current Rating with Fuse Restrictions:

Suitable for use on a circuit capable of delivering not more than 200,000 RMS symmetrical Amperes, 240 Volts maximum, when protected by high interrupting capacity, current limiting fuses (Class CC, G, J, L, R, T).

a. Application Note Number 17 details Transformer Sizing requirements for a variety of applications.

DC Bus

TB1-1 and TB1-2 are the DC Bus connections for an external shunt.

WARNING

External shunt resistors connect directly to the power bus. For safety reasons, external shunt resistors must be enclosed.

DANGER

DC bus capacitors may retain hazardous voltages after input power has been removed, but will normally discharge in several seconds. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval listed on the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

CAUTION

Do *not* connect an external I/O power supply to the DC Bus. The DC+ and DC- terminals connect directly to the power bus of the drive.

Application and Configuration Examples 8

This section explains how to install and verify the Centurion DSM Drive for various modes of operation. The procedures verify the installation by:

- Showing how the power and logic wiring is connected.
- Selecting the Operation Mode setup for the drive.
- Tuning the drive for a particular motor type and size.
- Verifying the basic functionality of the drive and motor combination.

How to modify the units of measurement for DSMPro displays is explained on page 8-197.

Analog Control

The Centurion DSM Drive can be set up as an analog drive in either the Velocity or Torque mode by making the hardware connections and performing the software setup and tuning described below. The connection diagram depicts the minimum hardware necessary. Interfacing the drive to an external controller requires similar circuitry from the controller to J1. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

Hardware Set Up

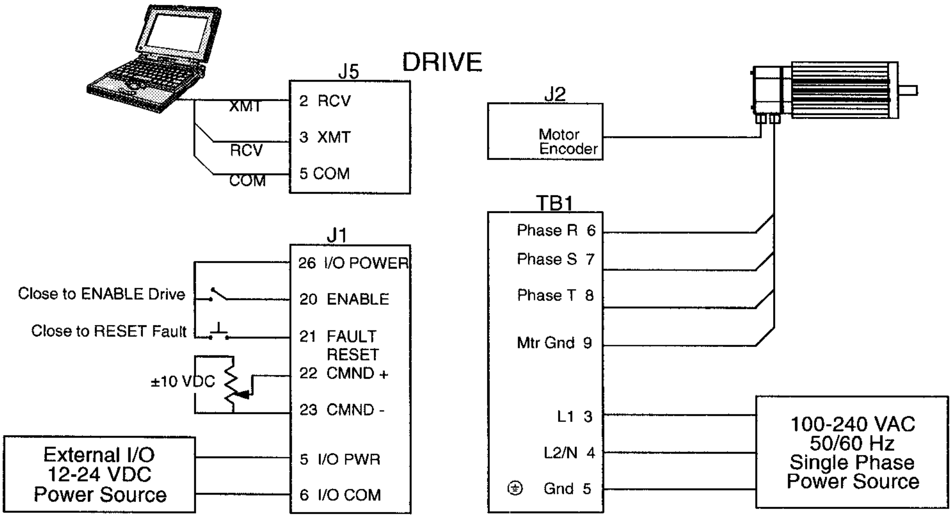
Make the connections described below and shown in the figure.

1. Connect a ±10VDC power source between J1-22 and J1-23 (ANALOG CMND +/-) to provide the analog speed or torque command.
2. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the drive. A simple 3 wire cable is depicted in the figure below.
3. Connect a Motor/Feedback cable from the motor to the J2 connector on the drive.
4. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
5. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
6. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
7. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.1 Analog Controller Connection Diagram



Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to "Status Indicator" on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer's communication settings.
5. Verify the communications port settings of the PC match those of the drive.

- If the settings are correct, select OK in the Port - Settings dialog box.
- If the settings are different, correct the Port - Settings to allow communications with the drive.

  Factory default communications Port - Settings for the drive are:
  - Baud Rate: 9600
  - Data Bits: 8
  - Parity: None
  - Stop Bits: 1
  - Serial Port: COM1

Refer to "RS-232 Communication Test" on page 11-226 for troubleshooting instructions.

6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

   ▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select OK. The Drive Set Up window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.
10. Select or verify the correct motor model number from the drop down Motor Model list.
11. If a message advises that the drive must be reset, choose Yes.
12. Select the Operation Mode parameters for the drive:

Velocity Mode Settings	Torque Mode Settings
Analog Velocity Input as the Operation Mode	Analog Torque Input as the Operation Mode

13. Choose Close to exit the Drive Set Up window.
14. Choose the Drive Parameters icon from the Drive window and then select the Analog tab.
15. Enter appropriate Scale and Offset values for the input.

16. Verify the Status indicator is green.

Tuning

NOTE: Do *not* attempt to Tune a drive with the Command mode set for Analog Torque Input. If the drive is set to torque mode, continue with the Operation section below.

NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window. The drive must be configured in Velocity mode for tuning to be effective.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING

Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Open the switch between J1-26 and J1-20 to disable the drive.

8. Choose Normal Drive Operation from the Tuning window.
9. Choose Close to exit the Tuning windows.
10. Verify the Status indicator is green.
11. Close any open windows or dialogs.

Operation

The drive is now configured as an Analog Controller in either the velocity or torque mode.

- The current loop is compensated properly for the selected motor.
- The servo parameters have been setup with an unloaded motor.
- The motor speed or current is commanded through the analog input.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.

Preset Controller

The Centurion DSM Drive can be set up as a preset controller in the Velocity or Torque mode by making the connections described below. Three discrete digital inputs provide the programmable speed or torque control. Up to eight different preset speed or torque settings can be selected by using the three digital inputs in various binary combinations, as shown in the table below. The connection diagram depicts the minimum hardware necessary. Interfacing the drive to a controller requires similar circuitry from the controller to J1. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

Table 8.1 Preset Binary Inputs.

	Inputs			
	C	**B**	**A**	**Description**
Preset 0	0	0	0	Preset 0 is a preprogrammed speed or current. All inputs are OFF[1].
Preset 1	0	0	1	Preset 1 is a preprogrammed speed or current. Only Preset Select A input is ON[2].
Preset 2	0	1	0	Preset 2 is a preprogrammed speed or current. Only Preset Select B input is ON[2].
Preset 3	0	1	1	Preset 3 is a preprogrammed speed or current. Preset Select A and Preset Select B are ON[2].
Preset 4	1	0	0	Preset 4 is a preprogrammed speed or current. Only Preset Select C input is ON[2].
Preset 5	1	0	1	Preset 5 is a preprogrammed speed or current. Preset Select A and Preset Select C are ON[2].
Preset 6	1	1	0	Preset 6 is a preprogrammed speed or current. Preset Select B and Preset Select C are ON[2].
Preset 7	1	1	1	Preset 7 is a preprogrammed speed or current. All Preset Select inputs are ON[2].

1. A preset input signal that is OFF is inactive, which means no current flows through the optocoupler.
2. A preset input signal that is ON is active, which means current flows through the optocoupler.

Hardware Set Up

Make the connections described below and shown in the Figure 8.2. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

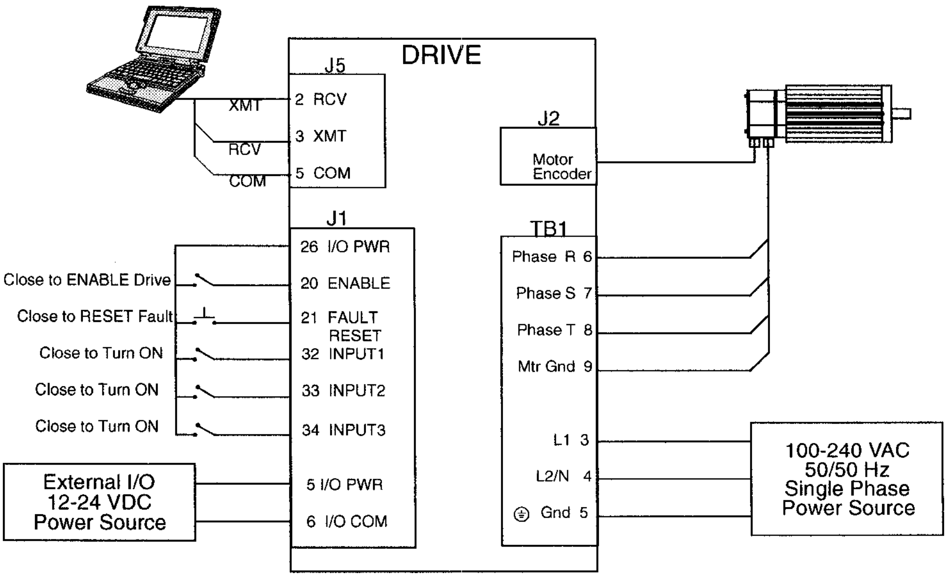
1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-33 (INPUT2) and J1-26 (I/O PWR)
   - J1-34 (INPUT3) and J1-26 (I/O PWR)
   - Connect a switch between J1-21 (FAULT RESET) and J1-26 (I/O PWR).

These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.

1. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
2. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.2 Preset Controller Connection Diagram



Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer’s communication settings
5. Verify the communications port settings of the PC match those of the drive.

- If the settings are correct, select OK in the Port - Settings dialog box.
- If the settings are different, correct the Port - Settings to allow communications with the drive.

  Factory default communications Port - Settings for the drive are:
  - Baud Rate: 9600
  - Data Bits: 8
  - Parity: None
  - Stop Bits: 1
  - Serial Port: COM1

Refer to the section "RS-232 Communication Test" on page 11-226 for troubleshooting instructions.

6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.
10. Select or verify the correct motor model number from the drop down Motor Model list.
11. If a message advises that the drive must be reset, choose Yes,
12. Select the Operation Mode parameter for the drive:

Velocity Mode Settings	**Torque Mode Settings**
Preset Velocities as the Operation Mode	Preset Torques as the Operation Mode

13. Choose Close from the Drive Setup window.
14. Choose the Drive Parameters command icon from the Drive window and then select the Preset tab.

15. Enter the appropriate parameters for the Command mode in which the drive will operate:

Velocity Mode Settings	**Torque Mode Settings**
Enter the appropriate velocity value for each speed required	Enter the appropriate current value for each torque required

Up to eight presets (0-7) may be programmed.

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive window.

19. Assign one of the three Preset Selects (A, B and C) to each of the Digital Input Assignments. For example, the following selects three presets:

- Input 1 to Preset Select A
- Input 2 to Preset Select B
- Input 3 to Preset Select C

The presets provide up to eight binary combinations of speed or current. Unassigned preset inputs should be set to Not Assigned, which forces an OFF state.

20. Verify all Digital Output Assignments are Not Assigned.

21. Choose Close to exit the I/O Configuration window.

Tuning

NOTE: Do *not* attempt to Tune a drive with the Command mode set for Preset Torques. If the drive is set to Torque mode, continue with the Operation section below.

NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window. The drive must be configured in Velocity mode for tuning to be effective.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.

9. Choose Close to exit the Tuning window.

10. Verify the Status indicator is green.

11. Close any open windows or dialog boxes.

Operation

The drive is now configured as a Preset Controller in Velocity or Torque mode.

- The servo parameters have been setup with the unloaded motor.
- The motor speed or current is controlled through the digital inputs.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close any of the switches for INPUT1, INPUT2 or INPUT3 to run the drive at the programmed preset speed or torque.

Position Follower (Master Encoder)

The Centurion DSM Drive can be electronically geared to a master incremental encoder generating quadrature encoder signals by making the hardware connections and performing the software setup and tuning described below. The connection diagram depicts the minimum hardware necessary. Interfacing the drive to an external controller requires similar circuitry from the controller to J1. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

Hardware Set Up

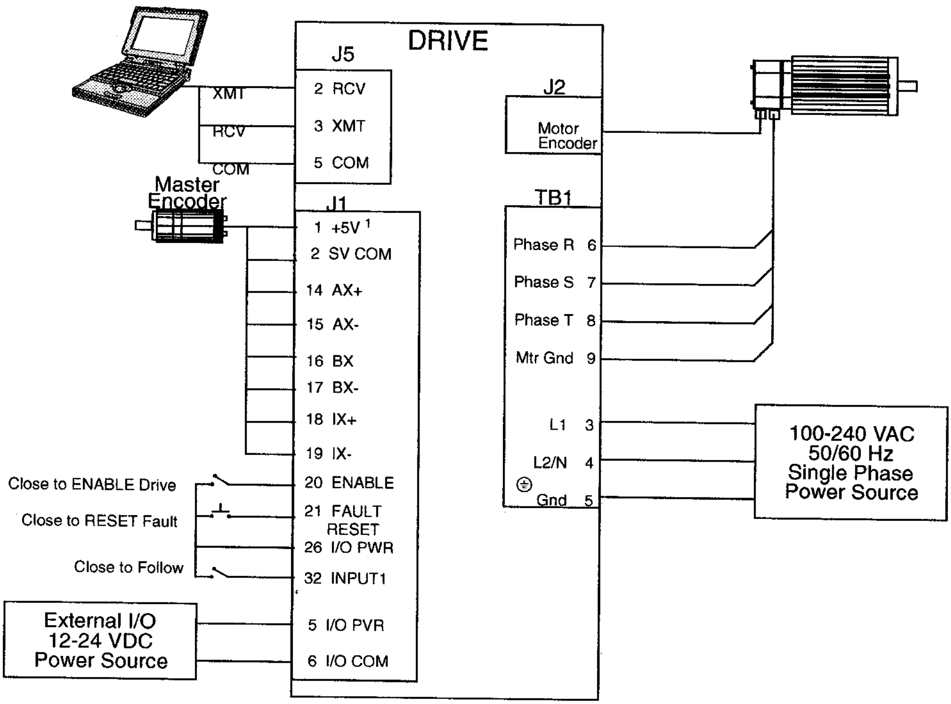
Make the connections described below and shown in the Figure 8.3. The appendix “Options and Accessories” on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect the Master Encoder to the drive as shown in the diagram.
5. Connect a jumper wire with a switches between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
6. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
7. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.3 Position Follower (Master Encoder) Connection Diagram



Note 1. Refer to Figure 6.25, 6.26, 6.27, 6.28, 6.29, 6.30 and 6.31 for additional details on the Control Interface Cable.

Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to "Status Indicator" on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer's communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     - Baud Rate: 9600
     - Data Bits: 8
     - Parity: None
     - Stop Bits: 1
     - Serial Port: COM1

   Refer to the section "RS-232 Communication Test" on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.

10. Select or verify the correct motor model number from the drop down Motor Model list.

11. If a message advises that the drive must be reset, choose Yes,

12. Select Follower: Master Encoder as the Operation Mode for the drive.

13. Choose Close from the Drive Setup window.

14. Choose the Drive Parameter command icon from the Drive window, and then select the Follower tab.

15. Enter an appropriate Gear Ratio as the Follower Input. The default Gear Ratio is 1:1 (motor encoder pulses:master pulses). If a Gear Ratio of 3:1 is entered, the motor is moved 3 encoder pulses for every incoming master pulse.

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
For example:

- Follower Enable as Input 1
- Not Assigned as Inputs 2 through 3.
- Not Assigned as Inputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

21. Verify the Status indicator is green.

Tuning

▶ NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as a Position Follower (Master Encoder).

- The current loop is compensated properly for the selected motor.
- The servo parameters have been setup with the unloaded motor.
- The motor position is controlled by the master encoder input.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close the switch between J1-26 and J1-32 to enable following.

Position Follower (Step/Direction)

The Centurion DSM Drive can be set up as a Position Follower using Step/Direction commands by making the hardware connections and performing the software setup and tuning described below. This configuration allows the Centurion DSM Drive to electronically gear or drive a servo motor using step and direction signals that typically control a stepper drive. The connection diagram depicts the minimum hardware necessary. Interfacing the drive to a stepper indexer requires similar circuitry from the stepper indexer to J1. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad may also may be used.

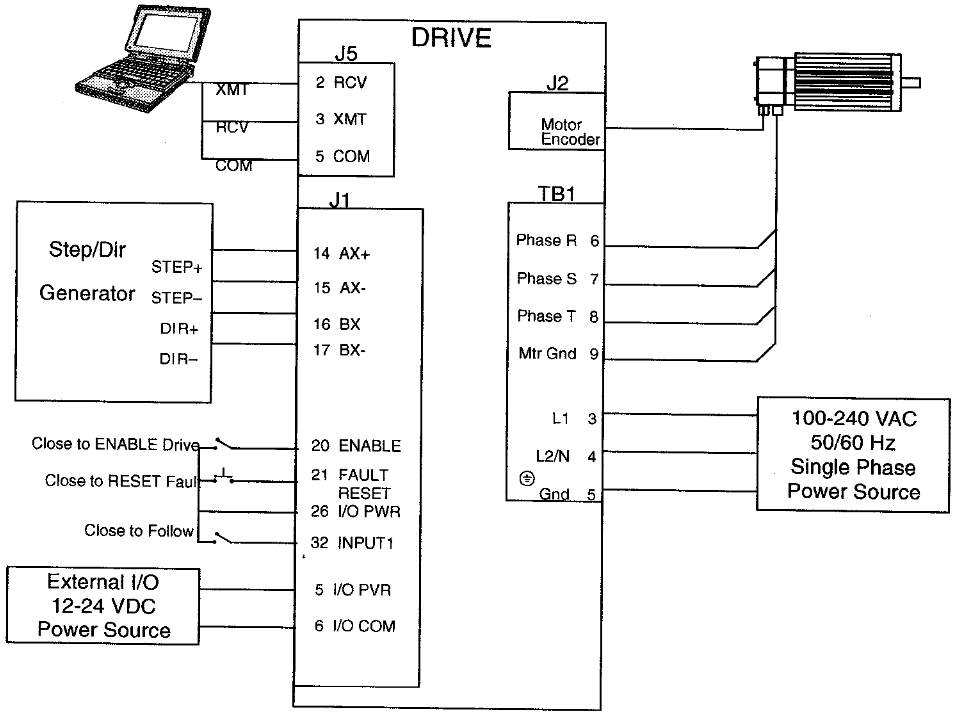
Hardware Set Up

Make the connections described below and shown in the Figure 8.4. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect the Step/Direction signals to the drive as shown in the diagram.
5. Connect a jumper wire with a switches between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).
6. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
7. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.4 Position Follower (Step/Direction) Connection Diagram



Note 1. Refer to Figure 6.25, 6.26, 6.27, 6.28, 6.29, 6.30 and 6.31 for additional details on the Control Interface Cable.

Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer’s communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     - Baud Rate: 9600
     - Data Bits: 8
     - Parity: None
     - Stop Bits: 1
     - Serial Port: COM1

   Refer to the section “RS-232 Communication Test” on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

► NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.

10. Select or verify the correct motor model number from the drop down Motor Model list.

11. If a message advises that the drive must be reset, choose Yes,

12. Select Follower: Step/Direction as the Operation Mode for the drive.

13. Choose Close to exit the Drive Set Up window.

14. Choose the Drive Parameters command icon from the Drive window and then select the Follower tab.

15. Enter an appropriate Gear Ratio as the Follower Input. The default Gear Ratio is 1:1 (motor encoder pulses:master pulses). If a Gear Ratio of 3:1 is entered, the motor is moved 3 encoder pulses for every incoming step pulse.

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
    For example:
    - Follower Enable as Input 1
    - Not Assigned as Inputs 2 through 3.
    - Not Assigned as Outputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

Tuning

NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING

Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as a Position Follower (Step/Direction).

- The servo parameters have been setup with the unloaded motor.
- The motor position is controlled by the step/direction inputs.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close the toggle switch between J1-26 and J1-32 to enable following.

Position Follower (Step Up/Down)

The Centurion DSM Drive can be set up as a Position Following using Step Up and Step Down signals typically used to control stepper drives. The connection diagram depicts the minimum hardware necessary. Interfacing the drive to a controller requires similar circuitry from the indexer to J1. Instructions are provided to configure the drive with DSMPro software.

Hardware Set Up

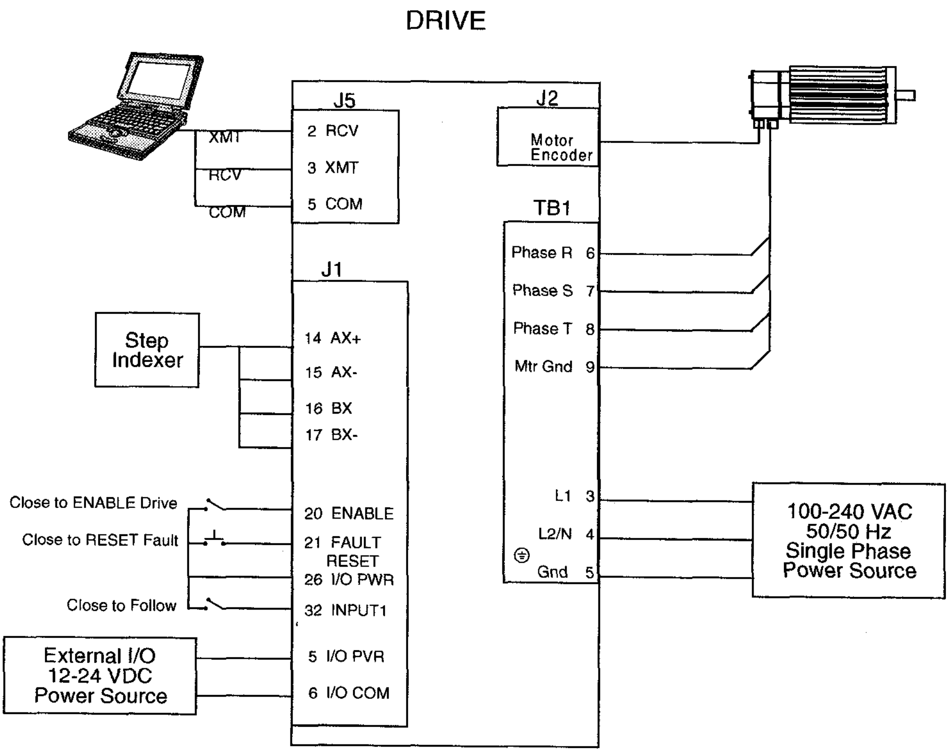
Make the connections described below and shown in the Figure 8.5. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the Centurion DSM Drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect the Stepper Indexer to the drive as shown in the diagram.
5. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
6. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
7. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.5 Position Follower (Step Up/Down Controller) Connection Diagram



Note 1. Refer to Figure 6.34 and 6.35 for additional details on the Control Interface Cable.

Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer’s communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     - Baud Rate: 9600
     - Data Bits: 8
     - Parity: None
     - Stop Bits: 1
     - Serial Port: COM1

   Refer to the section “RS-232 Communication Test” on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

   ▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.

10. Select or verify the correct motor model number from the drop down Motor Model list.

11. If a message advises that the drive must be reset, choose Yes,

12. Select Follower: Step Up/Step Down as the Operation Mode for the drive.

13. Choose Close to exit the Drive Set Up window.

14. Choose the Drive Parameters command icon from the Drive window and then select the Follower tab.

15. Enter an appropriate Gear Ratio as the Follower Input. The default Gear Ratio is 1:1 (motor encoder pulses:master pulses). If a Gear Ratio of 3:1 is entered, the motor is moved 3 encoder pulses for every incoming step pulse.

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
    For example:
    - Follower Enable as Input 1
    - Not Assigned as Inputs 2 through 3.
    - Not Assigned as Outputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

Tuning

NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING

Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as either a Position Follower (Step Up/Step Down).

- The servo parameters have been setup with the unloaded motor.
- The motor position is controlled by the step indexer.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close the toggle switch between J1-26 and J1-32 to enable following.

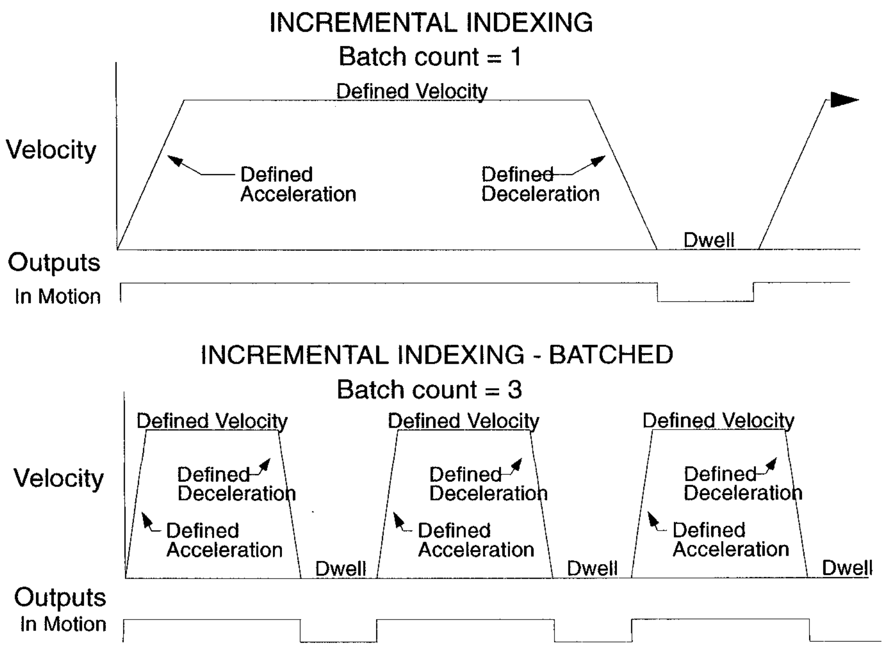
Incremental Indexing

NOTE: This feature is available only on drives capable of indexing: DSM 007P, DSM 015P and DSM 030P.

The Centurion DSM Drive can be set up as a incremental indexer by making the hardware connections and performing the software setup and tuning described below. A connection diagram depicts the minimum hardware necessary. Interfacing the drive to an external controller requires similar circuitry from the controller to J1, refer to "J1 - Controller" on page 6-81. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

The following examples depict a simple incremental index move and a batched (multiple) move using incremental indexing.

Figure 8.6 Incremental Indexing Examples



Hardware Set Up

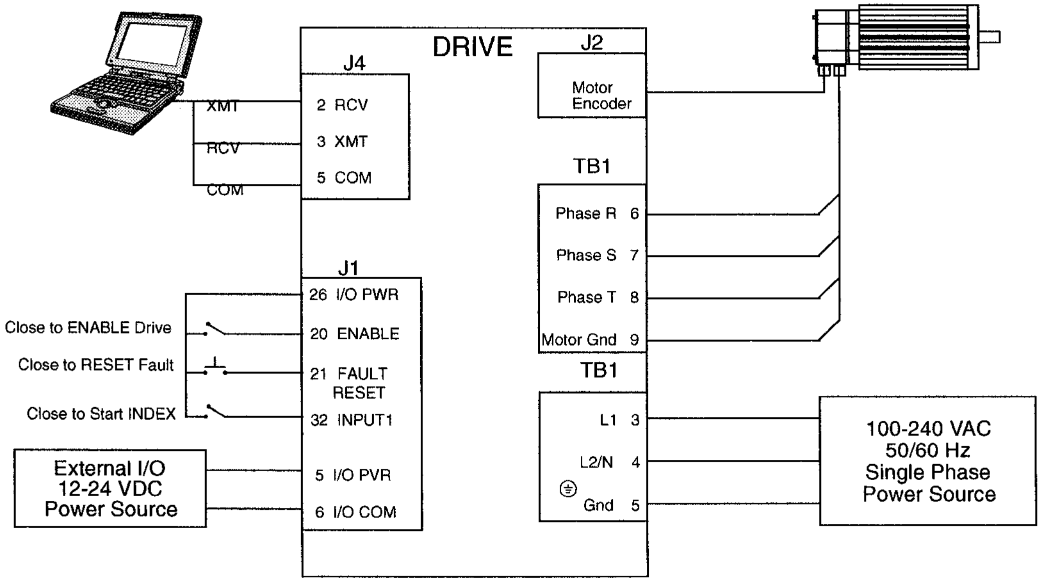
Make the connections described below and shown in the Figure 8.7. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the Centurion DSM Drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
5. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
6. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.7 Incremental Indexing Connection Diagram



Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer’s communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     – Baud Rate: 9600
     – Data Bits: 8
     – Parity: None
     – Stop Bits: 1
     – Serial Port: COM1

   Refer to the section “RS-232 Communication Test” on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

   ▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.

10. Select or verify the correct motor model number from the drop down Motor Model list.

11. If a message advises that the drive must be reset, choose Yes.

12. Select Indexing as the Operation Mode for the drive.

13. Choose Close to exit the Drive Set Up window.

14. Choose the Drive Parameters command icon from the Drive window and then select the Indexing tab.

15. Enter the following values for Index 0. Refer to "Incremental Indexing Examples" on page 8-173 for examples of Single and Batched Incremental Indexing profiles.

Single Move Settings	**Batched Move Settings**
Incremental as Mode	Incremental as Mode
8000 as Distance	8000 as Distance
1 as the Batch Count	3 as the Batch Count
0 as Dwell	1000 as Dwell
Appropriate values for Acceleration and Deceleration	Appropriate values for Acceleration and Deceleration

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
For example:
    - Start Index as Input 1
    - Not Assigned as Inputs 2 through 3.
    - Not Assigned as Outputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

Tuning

► NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING ⚠ Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as an Incremental Indexing controller.

- The servo parameters have been setup with the unloaded motor.
- Motion is commanded through the inputs.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close the toggle switch between J1-26 and J1-32 to start Index 0.

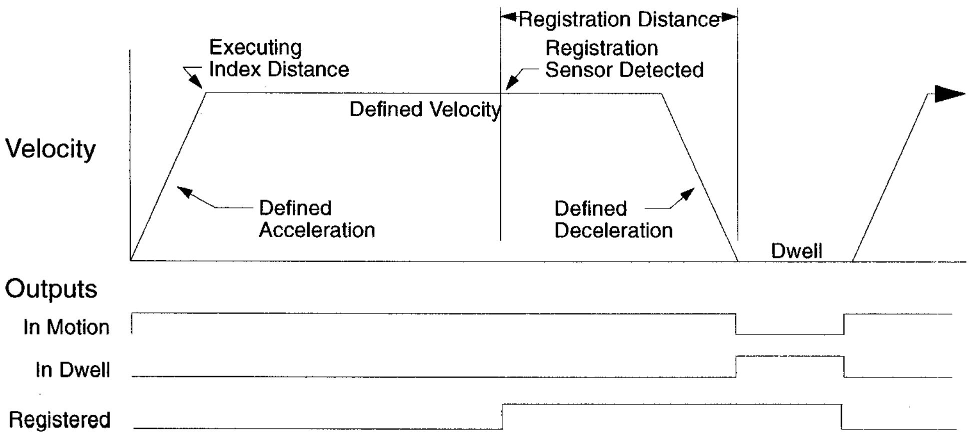
Registration Indexing

▶ NOTE: This feature is available only on drives capable of indexing: DSM 007P, DSM 015P and DSM 030P.

The Centurion DSM Drive can be set up as a registration indexer by making the hardware connections and performing the software setup and tuning described below. A connection diagram depicts the minimum hardware necessary. Interfacing the drive to an external controller requires similar circuitry from the controller to J1, refer to "J1 - Controller" on page 6-81. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

The following example depicts a batched (multiple) move using registration indexing.

Figure 8.8 Registration Indexing Examples



Hardware Set Up

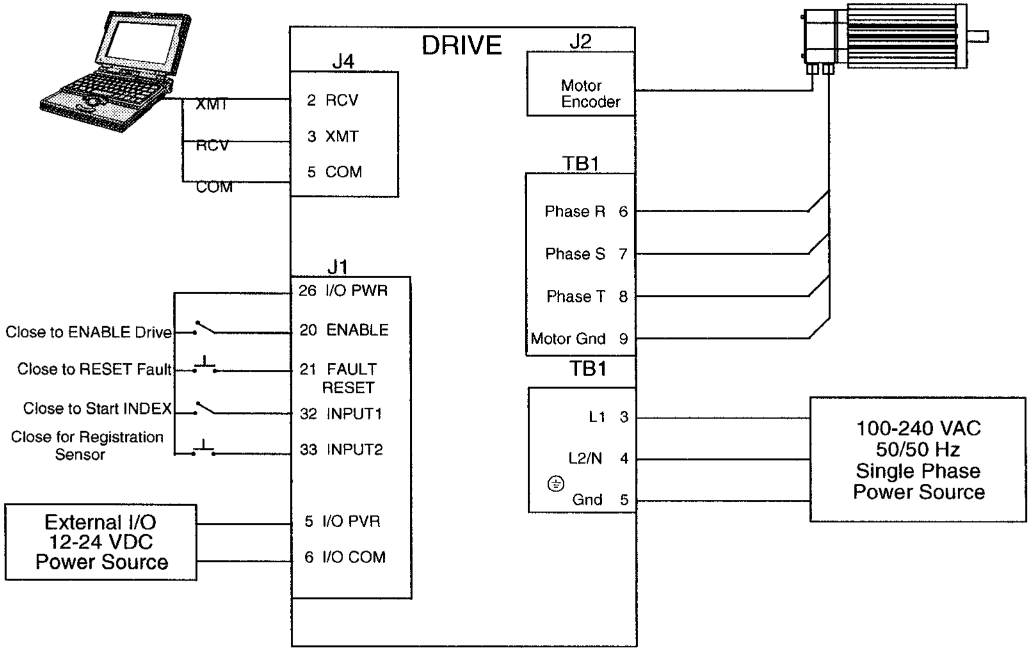
Make the connections described below and shown in the Figure 8.9. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the Centurion DSM Drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect the Index Sensor to the drive as shown in the diagram.
5. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-33 (INPUT2) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
6. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
7. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.9 Registration Indexing Connection Diagram



Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.

4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer's communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     - Baud Rate: 9600
     - Data Bits: 8
     - Parity: None
     - Stop Bits: 1
     - Serial Port: COM1

   Refer to the section "RS-232 Communication Test" on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

   ▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.
10. Select or verify the correct motor model number from the drop down Motor Model list.
11. If a message advises that the drive must be reset, choose Yes.
12. Select Indexing as the Operation Mode for the drive.
13. Choose Close to exit the Drive Set Up window.
14. Choose the Drive Parameters command icon from the Drive window and then select the Indexing tab.

15. Enter the following values for Index 0.

Single Move Settings	Batched Move Settings
Registration as Mode	Registration as Mode
8000 as Distance	8000 as Distance
1 as the Batch Count	8000 as Registration Distance
0 as Dwell	3 as the Batch Count
Appropriate values for Acceleration and Deceleration	1000 as Dwell
	Appropriate values for Acceleration and Deceleration

NOTE: The Registration Distance must be longer than the Deceleration Distance or the move will not be registered.

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
For example:

- Start Index as Input 1
- Registration Sensor as Input 2.
- Not Assigned as Input 3.
- Not Assigned as Outputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

Tuning

▶ NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING

Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as a Registration Indexing controller.

- The servo parameters have been setup with the unloaded motor.
- Motion is commanded through the inputs.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

When motion is required:

1. Close the switch between J1-26 and J1-20 to enable the drive.
2. Close the toggle switch between J1-26 and J1-32 to start Index 0.
3. Close the toggle switch between J1-26 and J1-33 to simulate registration.

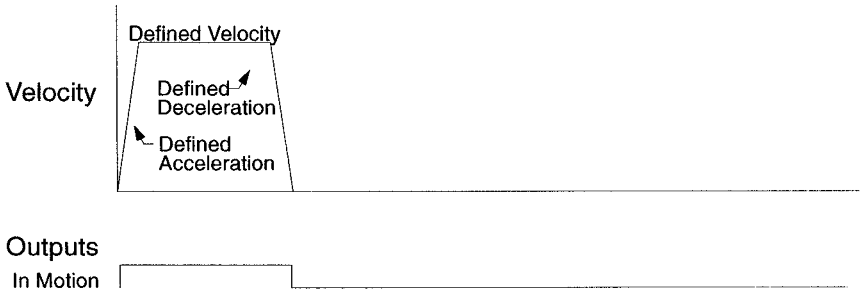
Absolute Indexing

NOTE: This feature is available only on drives capable of indexing: DSM 007P, DSM 015P and DSM 030P.

The Centurion DSM Drive can be set up as a absolute indexer by making the hardware connections and performing the software setup and tuning described below. A connection diagram depicts the minimum hardware necessary. Interfacing the drive to an external controller requires similar circuitry from the controller to J1, refer to “J1 - Controller” on page 6-81. Instructions are provided to configure the drive using a PC with DSMPro software, but the optional TouchPad also may be used.

The following example depicts a simple move from a home position.

Figure 8.10 Absolute Indexing Examples



Hardware Set Up

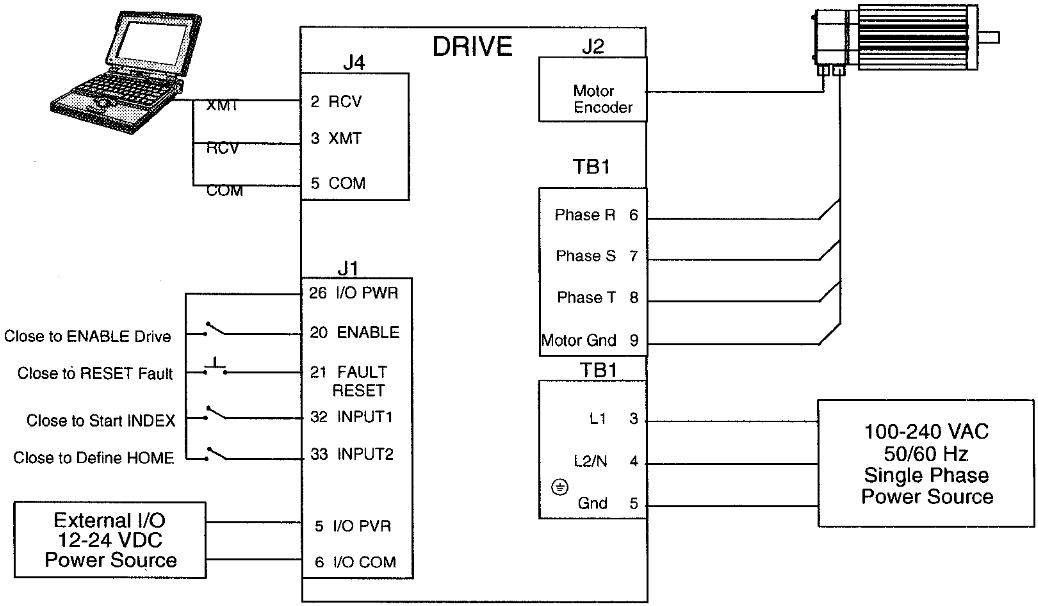
Make the connections described below and shown in the Figure 8.11. The appendix "Options and Accessories" on page A-235 lists the interconnect cables available from the factory.

1. Connect an RS-232 cable between the serial port on the PC and the J4 connector on the Centurion DSM Drive. A simple 3 wire cable is depicted in the figure below.
2. Connect a Motor/Feedback cable from the motor to the J2 connector on the Centurion DSM Drive.
3. Connect a Power cable from the motor to TB1 (terminals R, S, T and ⏚) on the drive.
4. Connect a jumper wire with a toggle switch between the following pins:
   - J1-20 (ENABLE) and J1-26 (I/O PWR)
   - J1-32 (INPUT1) and J1-26 (I/O PWR)
   - J1-33 (INPUT2) and J1-26 (I/O PWR)
   - J1-21 (FAULT RESET) and J1-26 (I/O PWR).

   These connections provide manual control for enabling or disabling the drive and resetting faults. The figure below shows the jumper, including normally open toggle switches.
5. Connect an external 12 to 24 VDC power source for powering I/O to J1-5 (I/O PWR) and J1-6 (I/O COM).
6. Connect the drive to a single phase 100-240 VAC, 50/60 Hz power source.

Connection Diagram

Figure 8.11 Absolute Indexing Connection Diagram



Configuration

Carefully check all connections before entering these parameters.

1. Switch the AC Power to ON and verify:
   - Status LED is green. Refer to “Status Indicator” on page 10-213 for an explanation of the display codes.
2. Start DSMPro on the PC.
3. Choose Cancel from the Drive Select dialog box.
4. Select PC Set Up from the Communications menu in DSMPro to display the personal computer’s communication settings.
5. Verify the communications port settings of the PC match those of the drive.
   - If the settings are correct, select OK in the Port - Settings dialog box.
   - If the settings are different, correct the Port - Settings to allow communications with the drive.

     Factory default communications Port - Settings for the drive are:
     - Baud Rate: 9600
     - Data Bits: 8
     - Parity: None
     - Stop Bits: 1
     - Serial Port: COM1

   Refer to the section “RS-232 Communication Test” on page 11-226 for troubleshooting instructions.
6. Select Read Drive Parameters from the Communications menu.
7. Verify the Drive Name and Address are correct for the drive that is being addressed.
8. Choose OK to load the drive parameters.

   ▶ NOTE: A motor must be selected for the parameters to load.

9. If the message box appears that a motor must be selected, select **OK**. The Drive Setup window is displayed with Motor Model selection parameter active. The motor may be selected from the drop down box. If this message box does not appear, the motor displayed in the Motor Model box was previously selected.

10. Select or verify the correct motor model number from the drop down Motor Model list.

11. If a message advises that the drive must be reset, choose Yes.

12. Select Indexing as the Operation Mode for the drive.

13. Choose Close to exit the Drive Set Up window.

14. Choose the Drive Parameters command icon from the Drive window and then select the Indexing tab.

15. Select the following values for Index 0:

Absolute as Mode
8000 as Position
1 as Batch Count
0 as Dwell
Appropriate values for Velocity, Acceleration and Deceleration

16. Choose Close to exit the Drive Parameters window.

17. Verify the Status indicator is green.

18. Select the I/O Configuration command icon from the Drive Window.

19. Select an appropriate digital input from the pull-down lists available as Digital Input Assignments in the I/O Configuration window.
For example:

- Start Index as Input 1.
- Define Home as Input 2.
- Not Assigned as Input 3.
- Not Assigned as Outputs 1 and 2.

20. Choose Close to exit the I/O Configuration window.

Tuning

NOTE: Do *not* attempt to Auto Tune systems that have gravitational effects. The Centurion DSM Drive will *not* hold initial position.

1. Choose the Tuning command icon from the Drive window.
2. Select AutoTune from the Tuning mode group.
3. Select the appropriate values for the following Auto Tune commands:
   - Distance and
   - Step Current.
4. Select the appropriate entry for the Motor Direction:
   - BiDirectional,
   - Forward Only or
   - Reverse Only.
5. Close the toggle switch between J1-26 and J1-20 to enable the drive.

WARNING

Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

6. Choose Start from the Tuning window. The drive powers the motor shaft for a short period and then motion will cease. Then DSMPro displays the calculated gains and disables the drive.
7. Choose Normal Drive Operation from the Tuning window.
8. Open the switch between J1-26 and J1-20 to disable the drive.
9. Choose Close to exit the Tuning window.
10. Verify the Status indicator is green.
11. Close any open windows or dialog boxes.

Operation

The drive is now configured as a Absolute Indexing controller.

- The servo parameters have been setup with the unloaded motor.
- Motion is commanded through the inputs.

The firmware saves the parameters in EEPROM memory. Thus the drive can be power cycled and, after power-up, will use the parameters selected in the steps above.

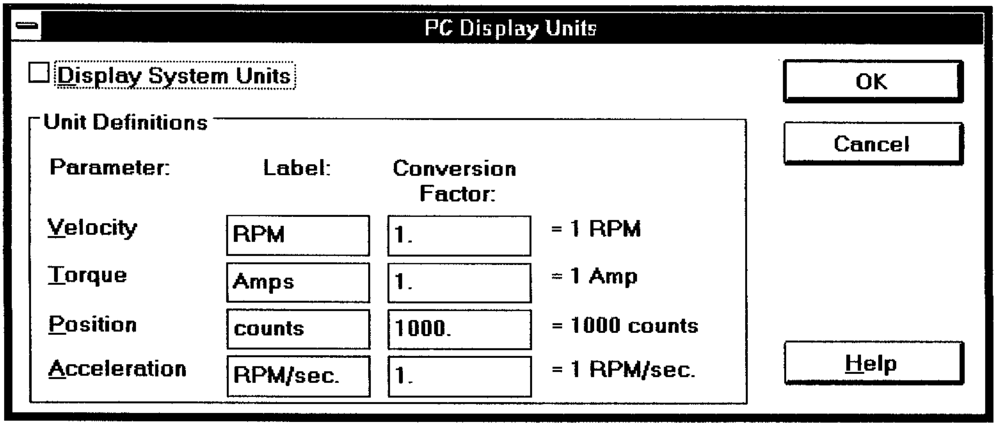
When motion is required:

1. Close the switch between J1-20 and J1-26 to enable the drive.
2. Close the toggle switch between J1-32 and J1-26 to start Index 0.
3. Close the switch between J1-33 and J1-26 to define the Home position.

Modifying User Units

The units displayed for any Centurion DSM Drive may be modified using a PC with DSMPro software. The PC Display Units help menu defines the various parameters displayed by DSMPro. Default settings for Units are shown in Figure 8.12.

Figure 8.12 PC Display Units - Default Dialog



Changing the Display Units Settings

The following example changes the Label and Conversion Factor for the Position and Acceleration parameters. This example assumes a 2000 line encoder (8000 pulses/revolution).

- Position - from Counts to Motor Revolutions
- Acceleration - from RPM/sec^2 to Revs/sec^2

1. Choose the Drive Parameters command icon from the Drive window and then select the Units button. The PC Display Units dialog appears with default settings as shown.

2. Select the Position Label cell, and change counts to Mtr Revs.

   NOTE: Labels are limited to 8 characters.

3. Select the Position Conversion Factor cell, and change 1000 to 0.125. Mathematically 1/8 (0.125) of a motor revolution is 1000 counts, given that the motor has a 2000 line (8000 count) encoder.
4. Select the Acceleration Label cell, and change RPM/sec to Revs/sec.
5. Select the Acceleration Conversion Factor cell, and change 1. to .016. Mathematically 1.6×10^{-2} revs/sec^2 is 1 RPM/sec, given the motor has a 2000 line (8000 count) encoder.
6. Choose OK to exit the PC Display Units dialog.

The modified units will be displayed where appropriate within the DSMPro windows. For example, these changes cause the Indexing tab in the Drive Parameters window to display:

- Distance in Mtr Revs
- Acceleration in Revs/sec^2
- Deceleration in Revs/sec^2

The following units were not effected by the changes:

- Dwell in msec
- Velocity in RPM

Tuning 9

Centurion DSM Drives are tuned quickly and easily for a wide variety of applications. Two tuning modes are available through the software:

- Auto Tune
- Manual Tune

Tuning Guidelines

The following tuning guidelines briefly describe the tuning adjustments. These guidelines provide you with a basic reference point should the application require additional adjustments.

General Tuning Rules

- Tune the velocity loop first and then, if the drive uses following or step/direction commands, tune the position loop.
- To widen the velocity loop bandwidth, increase the P-gain setting, decrease the I-gain setting or increase the low-pass filter bandwidth. This provides a faster rise time and increases drive response.
- To increase stiffness, increase the I-gain setting. It rejects load disturbance and compensates for system friction.
- To reduce velocity loop overshoot, increase P-gain or decrease I-gain.
- To reduce mechanical resonance, use a stiffer mechanical coupling or decrease the low-pass filter value and the velocity loop update rate.
- If the motor oscillates, decrease either individually or together the:
  - P-gain
  - I-gain
  - low-pass filter bandwidth.

High Inertia Loads

Proper compensation of load inertia may not be simply a matter of increasing the P-gain and I-gain settings. Problems are often encountered when tuning systems with a high load to motor inertia ratio.

Mechanical Resonance

Mechanical resonance between the motor and the load occurs when the motor and load are oscillating with the same frequency but opposite phase: when the motor is moving clockwise the load is moving counter clockwise. The amplitude of the motor and load oscillations is such that the total momentum of the oscillating system is zero. In the case of a high load to motor inertia ratio this means that the motor may be moving quite a lot while the load is not moving nearly as much. Mechanical resonance occurs as a result of compliance (springiness) between the motor inertia and load inertia. It may result from belts, flexible couplings or the finite torsional stiffness of shafts. In general, the stiffer the couplings, the higher the resonant frequency and lower the amplitude. If the motor shaft is directly coupled to the load, a mechanically resonating system usually emits a buzz or squeal at the motor.

There are several ways of dealing with this problem but they fall into two groups: change the mechanical system or change the servo-motor response. Changing the mechanical system might involve reducing the inertia ratio via gearboxes or pulleys, or by increasing the stiffness of the couplings. For very high performance systems and systems with low resonance frequencies the mechanics may require changing to effectively deal with the resonance.

The second way of dealing with mechanical resonance is by changing the servo-motor response. This may be done by reducing the P-gain, I-gain, velocity loop update rate or low-pass filter value.

Figure 9.1 Velocity Loop Structure

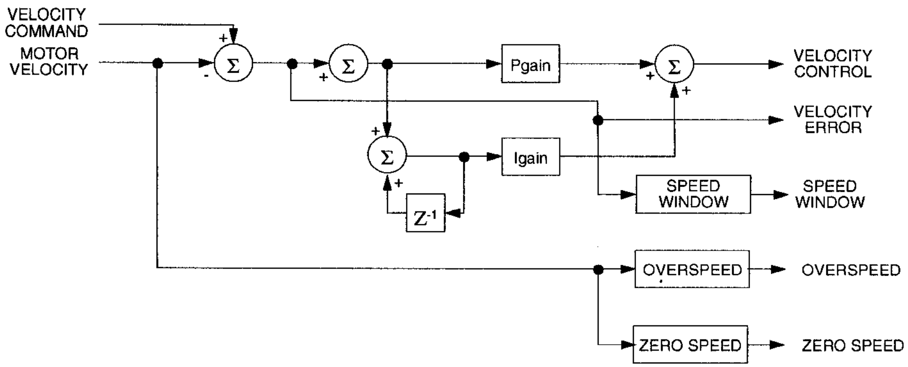
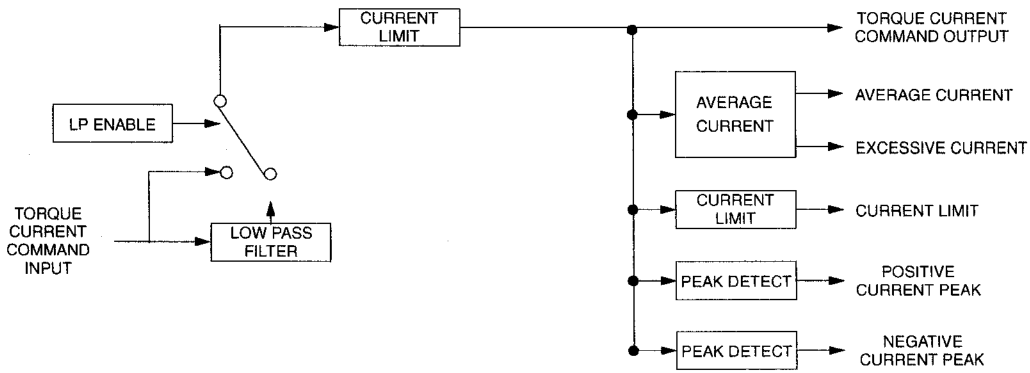


Figure 9.2 Torque Current Conditioning Structure



Reducing the value of the P-gain, low-pass filter frequency and the update frequency all have the effect of reducing the servo-motor bandwidth. As long as the resonating frequency is fairly high this will likely be acceptable, but if the resonating frequency is low it may be necessary to modify the mechanics of the system.

Backlash

Backlash between the motor and load effectively unloads the motor over a small angle. Within this small angle, the increased gain can result in oscillations. Some backlash may be unavoidable, especially with gear reduction. If backlash is present, the inertia match between the load and motor must be properly sized for good servo performance (load inertia should roughly equal motor inertia). Gearing reduces the inertia reflected to the motor by the square of the gear reduction from motor to load. Therefore, the gear ratio must provide the required match.

Auto Tune Mode

The Auto Tune mode uses a "self-tuning" algorithm that automatically adjusts the drive's position and velocity loop gain parameters. Adjustments do not require special equipment. This mode will tune a drive for constant response across different applications. The results often provide acceptable response, but in general should be considered a starting point.

Tuning parameters adjustments are set to achieve a reasonable bandwidth and servo response based on the system inertia and friction. Auto tune may be used when a significant amount of compliance or backlash exists (for example, belt systems) in the mechanical load, but precise tuning requires the load be fully coupled to the motor. Instability problems occur when the load is not fully coupled to the motor.

▶ NOTE: The autotune algorithm will not provide satisfactory results in systems with significant gravitational effects.

Auto Tuning

A PC running DSMPro or the TouchPad is required to perform tuning on the drive.

Before auto tuning is invoked, three autotuning parameters must be set:

- Distance sets the rotation limit of the motor. This is the maximum distance the motor is allowed to move during any one test.

  ▶ NOTE: Autotuning in the bi-directional mode includes two different tests.

- Step Current sets the amount of current given to the motor during the test. If this is set too low, a system may not move enough to gather sufficient data, if it is set too high the test will be too short and very jerky.
- Motor Direction (Forward Only/Reverse Only/Bi-directional) sets the rotational direction for the test. The bi-directional test does the same test in both directions, with the forward rotation first.

Auto tune procedures are explained for each drive configuration in "Application and Configuration Examples" starting on page 8-141. The following steps generalize the DSMPro tuning procedures. Similar procedures apply for the TouchPad.

When autotuning is selected, the drive rotates the motor shaft for a short time interval, typically a few seconds. Motor movement should *not* exceed 30 seconds.

WARNING ⚠ Rotating motor shafts can cause extensive damage and injury. Motors must be properly guarded during testing and installation.

1. Choose the Tuning command icon from the Drive window.

2. Choose Auto Tune from the Tuning window. This activates the Auto Tune Command and Motor Direction boxes within the Tuning window. Then enter or select:
   - appropriate values for Distance in the Auto Tune Command box,
   - appropriate values for Step Current in the Auto Tune Command box, and
   - an appropriate motor rotation in the Motor Direction box on a PC, either:
     - BiDirectional, if the motor will be powered in both the forward and reverse directions.
     - Forward Only, if the machinery is designed to operate only in the forward direction.
     - Reverse Only, if the motor will be powered only in the reverse direction.

   Use the default settings if you are uncertain about what values to enter. The default settings are set to values appropriate to the drive and motor combination selected during drive initialization.
3. Enable the drive.
4. Choose Start from the Tuning window. The drive rotates the motor shaft and then motion will cease. The calculated gains are displayed and the drive is disabled.
5. Disable the drive manually.
6. Choose Normal Drive Operation from the Tuning window.
7. Enable the drive.
8. Choose Close to exit the Tuning window.

► NOTE: Auto tuning does not have a velocity limit, but it does adhere to the motor Overspeed setting in the Drive Parameters window.

Manual Tune Mode

Manual tuning may be used to adjust the gain settings and filter frequency of the velocity and position regulator. The following sections briefly explain these settings. An understanding of the function for each type of gain and filtering will allow you to effectively tune the system.

Two types of manual tuning are available:

- Velocity tuning
- Position tuning.

Before manual tuning is invoked, the Velocity, Distance and Motor Direction parameters must be set. Refer to "Auto Tune Mode" on page 9-202 for information on setting these parameters.

The velocity loop should always be tuned *before* the position loop, as velocity loop tuning affects the position loop response.

Gain settings and signal filtering are the primary methods to electrically tune a system. An understanding of the types of gain and their purposes, as well as a general understanding of filtering, are essential background knowledge to properly tune a servo system.

Gains

Table 9.1 Velocity Loop Gains

Parameter	Description
P-gain	Proportional gain of the velocity regulator. P-gain controls the bandwidth of the velocity regulator by adjusting the control response proportional to the error. The P term of the velocity regulator commands an acceleration current that is proportional to the velocity error.
I-gain	Integral gain of the velocity regulator. Integration in the velocity regulator forces the motor velocity to precisely follow the commanded velocity. This assumes operation under steady state conditions (velocity command or load does <u>not</u> change). I-gain controls: • The stiffness or the ability to reject load torque disturbance. • The amount of velocity overshoot, which may cause the system to become unstable or oscillate. The I term of the velocity regulator commands an acceleration current proportional to the integral of the velocity error.

Table 9.2 Position Loop Gains

Parameter	Description
Kp-gain	Proportional gain of the position loop. Kp-gain changes: • The position loop bandwidth. • The settling time of the position loop. In general, the higher the value of Kp-gain the faster the settling time. However, a high value of Kp-gain with inadequate velocity loop bandwidth results in overshoot and ringing.
Kd-gain	Differential gain of the position loop. Provides position loop damping and reduces overshoot caused by Kp or Ki gain.

Kff-gain	Feedforward gain of the position loop. Kff-gain reduces following error. However, a high value of Kff-gain can result in position overshoot. A reduction in following error allows the system to more closely approximate gear driven systems.
Ki-gain	Integral gain of the position loop. Ki-gain decreases the time period for the error to decay. A non-zero value of Ki allows integration in the position loop which eliminates the steady state following error. However, a non-zero value for Ki may introduce overshoot and ringing, which cause system instability (oscillation). NOTE: Ki-gain is used in conjunction with the Ki Zone value. Ki Zone is the area around the commanded position where Ki-gain is active.
NOTE: Position Loop Gains are used in the Position Following mode only.	

Filters

The velocity regulator has one low pass filter. The filter bandwidth range is from 1 Hz to 992 Hz. The filter serves two purposes:

- Adjusts the frequency range to remove or filter the noise produced by encoder resolution.
- Reduces the amount of the mechanical resonance in the mechanical system (e.g., belt systems).

Similar results may often be achieved by reducing the update rate of the velocity loop.

Manual Tuning

Manual tuning may be used to adjust the gain control parameters P and I, and the filters. A square wave is generated by the drive to assist in the adjustment. Manual velocity tuning requires the following:

- Step Period value to be specified
- Step Velocity value to be specified.

> NOTE: Always tune the velocity loop *before* the position loop, as Velocity loop tuning affects the position loop response.

Tuning the Velocity Loop

The Auto Tune procedure provides a starting point for velocity loop tuning. Manual tuning is desirable when very precise adjustments are required.

The following steps describe how to manually tune the velocity loop. These steps precede the manual position loop tuning procedure, which should follow velocity loop tuning.

1. Disable the drive.
2. Choose Manual Tune (Velocity Step) from the Tuning window.
3. Enter the desired step Velocity (rpm) of the internal square wave generator.
4. Enter the desired Time to complete one cycle of the square wave of the internal step velocity.
5. Select the desired Motor Direction (Forward Only, Reverse Only, or Bi-Directional).
6. Select the Oscilloscope.
7. Enable the drive.
8. Choose Start. The motor should start moving and the oscilloscope will display the commanded velocity and the motor velocity.
9. While monitoring the motor velocity waveform, increase P-gain until the desired rise time is achieved.
10. While monitoring the motor velocity waveform, increase I-gain until an acceptable amount of overshoot is reached.

11. Apply filtering by selecting Filters, and then select Filter Enable.

12. While monitoring the motor velocity waveform, decrease the filter Bandwidth until the overshoot begins to increase (in many applications the filter is not necessary).

13. Choose Stop.

14. Disable the drive.

15. Choose Normal Drive Operation.

16. Choose Close.

17. Enable the drive.

The drive's velocity loop is tuned.

Tuning the Position Loop

Specify the step period and step position values, and then input a square wave to the position loop. Adjust the gain parameters Kp, Kd, Kff, Ki, and Ki Zone to tune the system.

> ▶ NOTE: Tune the velocity loop before attempting to tune the position loop. The bandwidth of the velocity loop must be set before position loop tuning is attempted.

1. Disable the drive.
2. Choose Manual Tune (Position Step) from the tuning window.
3. Enter an appropriate Distance count (step position) for the internal square wave.
4. Enter an appropriate time to complete one cycle of the square wave for the internal step position.
5. Select the desired Motor Direction (BiDirectional, Forward Only or Reverse Only).
6. Select the Oscilloscope.
7. Enable the drive.
8. Choose Start. The motor will move and the oscilloscope will display the commanded position and motor position.

9. Increase the Kp gain while monitoring the signal on the scope. The Kp gain should be adjusted until the desired rise time is achieved, with no overshoot. Refer to Figure 9.3.
10. Increase Ki very slowly until the signal begins to overshoot.
11. Increase Kd very slowly to remove the overshoot caused by Ki.
12. In general you may leave the Kff gain set to 100.
13. Choose Stop.
14. Disable the drive.
15. Choose Normal Drive Operation.
16. Choose Close.
17. Enable the drive.

The position loop has been tuned. The drive may be operated as a master encoder, step/direction or step up/down configuration.

Velocity Loop Tuning Examples

Figure 9.3 Signal Nomenclature

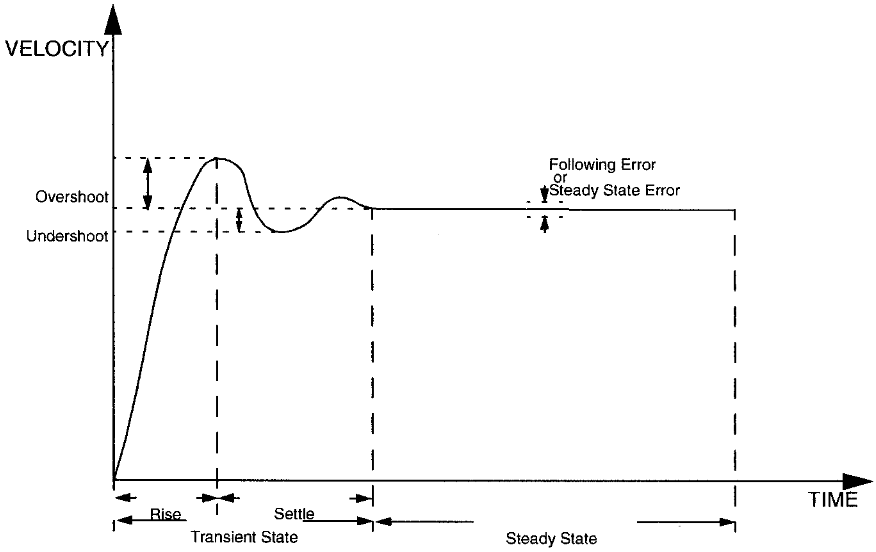


Figure 9.4 Underdamped Signal

UNDERDAMPED
Motor Velocity consistently overshoots the Velocity Command. To correct:
- Decrease P-gain
- Decrease I-gain

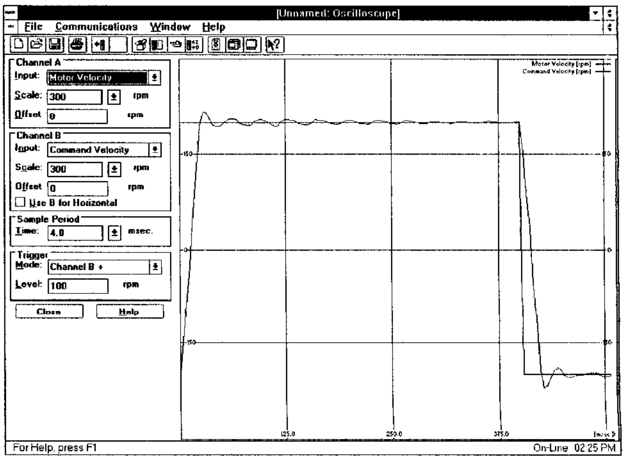


Figure 9.5 Overdamped Signal

OVERDAMPED
Motor Velocity consistently undershoots the Velocity Command. To correct:
- Increase I-gain
- Increase P-gain

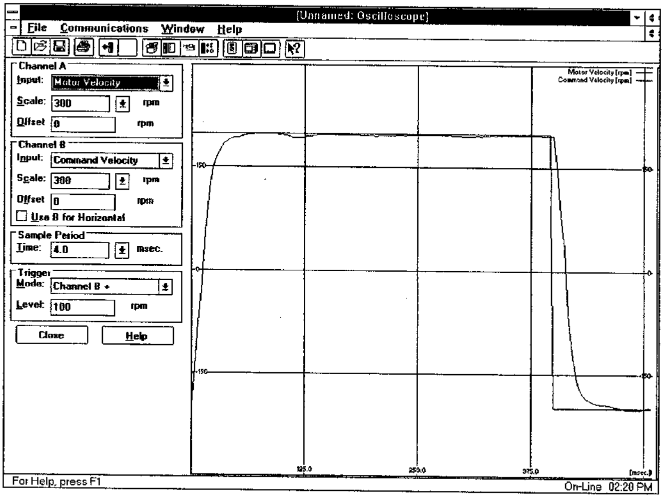
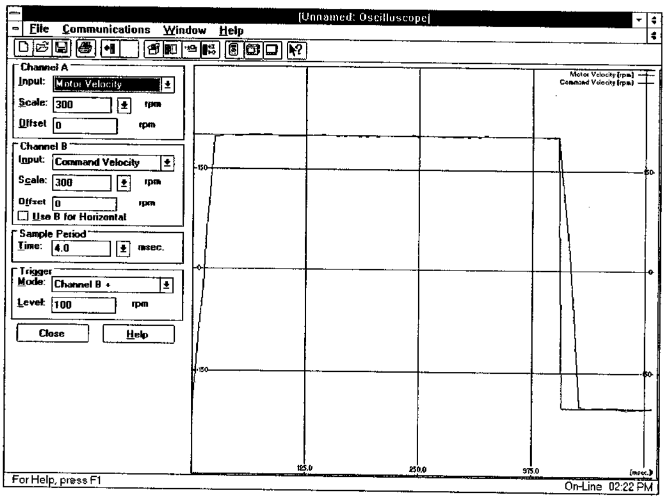


Figure 9.6 Critically Damped Signal (Ideal Tuning)

CRITICALLY DAMPED
Motor Velocity quickly settles to the Velocity Command.



A single front panel indicator displays the status of the drive on a continuous basis:

- The Status LED lights whenever the bus is energized.

Status Indicator

The Status indicator is a three level LED, which indicates the current operational state of the drive. The status level is indicated by the color of the LED.

- Green = Normal operation
- Blinking Green/Orange = Drive Fault
- Orange = Hardware malfunction
- Blank = Power not supplied or hardware malfunction

Refer to "Troubleshooting" beginning on page 11-220 for troubleshooting tables.

Error Messages

If there is a fault, the specific error messages may be accessed by attaching a PC or TouchPad to the Centurion DSM Drive. Faults are detected by the drive in two ways: power-up hardware and run-time faults. A power-up fault usually requires servicing of the hardware, while a run-time fault can be cleared by resetting the drive.

"Maintenance and Troubleshooting" lists error codes and possible actions or solutions to take when resolving the error condition.

Run Time Error Codes

Table 10.1 Run Time Error Codes

Error Code	Fault Description
01 - 03	Reserved
04	Motor Overtemperature, Thermostat
05	IPM Fault (Overtemperature / Overcurrent / Short Circuit)
06 - 08	Reserved
09	Bus Undervoltage

Error Code	Fault Description
10	Bus Overvoltage
11	Illegal Hall State
12 - 16	Reserved
17	Excessive Average Current
18	Motor Overspeed
19	Excessive Following Error
20	Motor Encoder State Error
21	Auxiliary Encoder State Error
22	Motor Thermal Protection
23	IPM Thermal Protection
24	Excess Velocity Error
25	Commutation Angle Error
26	Reserved
27	Axis not Homed
28	No Motor Selected
29	Motor Selection not in Table
30	EEPROM Write Error
31 - 50	Reserved

Power-Up Error Codes

A power-up error indicates in almost all cases that the drive should be returned to the factory for service. In general, any occurrence of a Power-up error should be treated with extreme caution. It may indicate the hardware is marginal.

Situations that may cause drive hardware errors, and which can be remedied outside the factory include:

A watchdog time-out error may result from electrical "noise" (electromagnetic interference - EMI), a firmware error, or a hardware malfunction. The context of the watchdog error needs to be investigated to determine the source of the problem.

The following table lists the Power-Up Error Codes

Table 10.2 Power-Up Error Codes.

Error Code	Fault Description
51	Program Memory Boot Block Error
52	Program Memory Main Block Error
53	Uninitialized Personality EEPROM Error
54	Personality EEPROM Read Error
55	Personality EEPROM Data Corruption
56	Processor Watchdog Error
57	Reserved
58	Processor RAM Error
59	Reserved
60	Uninitialized Service EEPROM Error
61	Service EEPROM Read Error
62	Service EEPROM Data Corruption Error
63 - 73	Reserved
74	Personality EEPROM Write Error
75 - 78	Reserved

Error Code	Fault Description
79-n	Data Out of Range where n = suberror parameter 1 - Serial baud rate selection 2 - Serial stop bits/parity selection 3 - Position Loop Kp 4 - Position Loop Ki 5 - Position Loop Kff 6 - Position Loop Kd 7 - Gear ratio 8 - Encoder Output Divider 9 - Velocity Loop Update Period 10 - Velocity Loop P Gain 11 - Velocity Loop I Gain 12 - Velocity Loop D Gain 13 - Reserved 14 - Analog Command Velocity Offset 15 - Analog Command Torque Offset 16 - User D/A Variable Selection 17 - Command Source 18 - Drive Mode (Torque/Velocity) 19 - Tuning Direction 20 - Motor/Encoder User Alignment Offset 21 - Encoder Size 22 - Motor Torque Constant 23 - Motor Inertia 24 - Motor Back EMF 25 - Motor Resistance per Phase 26 - Motor Inductance per Phase 27 - Motor Commutation Type 28 - Motor Encoder Hall Offset 29 - Motor Encoder Index Offset 30 - Motor Pole Count
80-1	Service Data Out of Range (Drive Type)
81	Reserved
82	Mask ROM Block Checksum Error
83 - 99	Reserved

Maintenance and Troubleshooting 11

This section provides a description of suggested maintenance activities and an in-depth troubleshooting chart.

Maintenance

The Centurion DSM Drive is designed to function with minimum maintenance.

DANGER

DC bus capacitors may retain hazardous voltages after input power has been removed, but will normally discharge in several seconds. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval listed on the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

Periodic Maintenance

Normally the only maintenance required is removal of superficial dust and dirt from the drive and a quick check of cabling insulation and connections.

Cleaning

To clean the drive, use an OSHA approved nozzle that provides compressed air under low pressure ≤20 kPa (30 psi) to blow the exterior surface and the vents clean.

Cable Inspection

Inspect the cables, particularly the power connections, to verify the connection.

- All power connections should be torqued to 1.2 Nm (11 lb-in).
- D-shell connectors can be inspected for proper seating and signal continuity.
- Visually inspect all cables for abrasion.

Data Transfer

After you have configured the drive and tuned the drive, the data stored in the EEPROM personality module should be saved off-line. Saving the parameters off line will allow you to clone several machines with the same mechanics and provides an emergency backup of the drive data.

To transfer the data from the drive to a PC:

1. While on-line with a drive, click on **File** in the toolbar menu.
2. Select Save As..., the Save As window will appear.
3. Enter the file name and press ENTER or choose OK to save.

To transfer the data from a PC to a drive:

1. Close all windows in DSMPro.
2. Choose File in the toolbar menu.
3. Choose Open.
4. Select the desired file name or enter the file name to be loaded and press ENTER or choose OK.

   If you do not know the name of the file to be loaded, select the correct directory from the **Directories** box and select the file name from the displayed list of file names. The DSMPro Off-Line Drive window will appear along with the selected file name.
5. Select Communications from the toolbar menu.
6. Select Overwrite Drive Parameters.
   The Drive Select window will appear.
7. Select the drive to be configured, and then press ENTER or choose OK to load the parameters into the personality module.

Firmware Upgrading

Centurion DSM Drives may be upgraded in the field to the latest version of firmware. Firmware versions are available from the Giddings & Lewis Product Support group. The procedure describes how to reload the firmware installed in your drive using the Upgrade Firmware command available in DSMPro software.

DSMPro provides checks and controls through message boxes which ensure that the loading of firmware is performed properly.

Firmware Upgrade Procedure using DSMPro

1. Copy the new firmware into the Firmware subdirectory of the DSMPro application directory.
2. Start DSMPro.
3. When the Drive Select window appears, select Cancel. The Drive Select window closes without connecting to the drive.
4. Choose Upgrade Firmware from the File menu. The Drive Select window will appear.
5. Select the drive to upgrade, and then select OK. The Select Firmware File window will appear.
6. The Select Firmware File window contains a list of firmware files identified by version information. Only the files that can be applied to the connected drive are displayed, which minimizes the danger of transferring an incorrect file. To select the firmware files:
   - Select the appropriate file to upgrade the drive firmware.
   - Select OK when the file is highlighted.

   A visual indicator traces the progress of the firmware upgrade.

   NOTE: Do *not* remove power or reset either the drive or the PC during the upgrade. Any interruption of the firmware upgrade could cause the drive to become *inoperable*.

7. When the upgrade is complete a dialog box confirms completion of the upgrade and reminds you that the drive must be reset at this time.
   - Select Yes if you want to perform a software reset of the drive.
   - Select No if you wish to reset the drive by removing power.

Troubleshooting

A single LED on the front panel indicates the status of the drive on a continuous basis:

- Green = Normal operation
- Blinking Green/Orange = Drive Fault
- Orange = Hardware malfunction
- Blank = Power not supplied or hardware malfunction

A table of problems, potential causes, and appropriate actions to take to resolve the problem is included below.

If problems persist after attempting to carefully troubleshoot the system, please contact your local distributor for further assistance.

Error Codes

Error codes may be accessed by attaching either a PC with DSMPro software or a TouchPad to the serial port (J5):

- DSMPro displays errors in two windows: Fault History and Display Fault Status,
- The TouchPad display errors in the DrvStat parameter under the STATUS branch title.

Table 11.1 Troubleshooting Guide

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
STATUS LED not lit		No AC power	Verify power (115/230VAC single phase) is applied to the drive.
		Internal power supply malfunction.	Call factory

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
Motor jumps when first enabled		Motor encoder wiring error	Check motor encoder wiring. See Figure 6.38 on page 120
		No Absolute signal at J2-16	Monitor Absolute signal at J2-16.
		Incorrect motor chosen in personality module	Select the proper motor in DSMPro.
Digital I/O not working correctly		I/O power supply disconnected	Verify connections and I/O power source
Motor Overtemperature	04	Motor TS+ (J2-19) and TS- (J2-20) pins open	Verify TS+ (J2-19) and TS- (J2-20) connections for continuity.
		Motor thermostat trips due to: High motor ambient temperature, and/or Excessive RMS torque	Operate within (not above) the continuous torque rating for the ambient temperature (40°C maximum). Lower ambient temperature.
IPM Fault	05	Motor cables shorted	Verify continuity of motor power cable and connector.
		Motor winding shorted internally	Check for short on R,S,T and Gnd windings of the motor.
		Drive temperature too high	Check for clogged or defective fan. Ensure cooling is not restricted by insufficient space around the unit.
		Operation above continuous power rating	Verify ambient temperature is not too high (above 60° C). Operate within the continuous power rating.
		Output short circuit or overcurrent	Drive has a bad IPM, replace drive.

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
Bus Undervoltage	09	Low AC line/AC power input (100 V AC minimum for safe drive operation)	Verify voltage level of the incoming VAC power. Check AC power source for glitches or line drop (below 90 VAC). Install an uninterruptible power supply (UPS) on your VAC input.
Bus Overvoltage	10	Excessive regeneration of power When the drive is driven by an external mechanical power source, it may regenerate too much peak energy through the drive's power supply. The system faults to save itself from an overload.	Change the deceleration or motion profile and/or reduce the reflected inertia of your mechanical system. Use a larger system (motor and drive).
		Excessive AC input voltage	Verify input is below 264 VAC.
		Output short circuit	Check for shorts.
		Motor cabling wires shorted together	Check for shorts.
		Internal motor winding short circuit	Check for shorts.
Illegal Hall State	11	Incorrect phasing Bad connections	Check the Hall phasing. Verify the Hall wiring.
RESERVED	12		
RESERVED	13		
RESERVED	14		
RESERVED	15		
RESERVED	16		

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
Excessive Average Current	17	Excessive time at peak current	Reduce acceleration rates Reduce duty cycle (ON/OFF) of commanded motion. Increase time permitted for motion. Mechanical jam or excessive frictional load. User larger drive and motor.
		Software parameter set too low	Increase Average Current parameter to a less restrictive setting.
		Insufficient bus voltage	Correct the under voltage condition or intermittent AC power or install a larger size transformer.
		Motor Phasing is incorrect	Check motor phasing.
Motor Overspeed	18	OVERSPEED parameter in the drive set to low for the application	Using DSMPro (refer to Drive Parameters section) set Overspeed parameter to an acceptable range for the application.
		Motor commanded to run above Overspeed setting	Reduce command from position controller or change velocity parameter in the position controller.
		Motor encoder phasing is incorrect	Check encoder phasing.
Excess Following Error	19	The software position error limit was exceeded	Increase the feed forward gain to 100%. Increase the following error window (refer to DSMPro Drive Parameters section). Retune the drive to reduce the following error. Increase the slew limit window (refer to DSMPro Drive Parameters).

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
Motor Encoder State Error	20	The motor encoder encountered an illegal transition	Replace the motor/encoder Use shielded cables with twisted pair wires. Route the feedback away from potential noise sources. Check the system grounds.
		Bad encoder	Replace motor/encoder.
Auxiliary Encoder state error	21	The auxiliary encoder encountered an illegal transition	Use shielded cables with twisted pair wires. Route the encoder cable away from potential noise sources. Bad encoder - replace encoder Check the ground connections
Motor Thermal Protection Fault	22	The internal filter protecting the motor from overheating has tripped.	Reduce acceleration rates Reduce duty cycle (ON/OFF) of commanded motion. Increase time permitted for motion. Use larger drive and motor.
IPM Thermal Protection Fault	23	The internal filter protecting the IPM at slow speed has tripped.	Reduce acceleration rates Reduce duty cycle (ON/OFF) of commanded motion. Increase time permitted for motion. Use larger drive and motor.
Excess Velocity Error	24	Velocity exceeded allowable range.	Increase time or size of allowable error. Reduce acceleration.
Commutation Angle Error	25	Bad encoder	Replace encoder or motor/ encoder. Check wiring of motor encoder index signal.
RESERVED	26		
RESERVED	27		
No Motor Selected	28	No motor was selected when the drive was enabled.	Select a motor before enabling the drive.

Problem or Symptom	Error Code	Possible Cause(s)	Action/Solution
Motor Information Missing	29	The motor number is referencing a motor that is not currently in the drive.	Select a motor that is in the drive. Update the motor tables in the drive (contact the factory).
RESERVED	30-99		Call the factory.

RS-232 Communication Test

This test verifies communications between an Centurion DSM Drive and a personal computer by connecting the XMT pin to the RCV pin. The jumper bypasses the potentially defective cable and remote unit.

Test equipment requirements are:

- A PC running DSMPro
- The Terminal mode available in Microsoft® Windows™.

1. Close all DSMPro windows.
2. Select Communication from DSMPro and verify your communication settings.
3. Verify the communication cable pin out and check cable continuity. Refer to "RS-232 Connection Diagrams" on page 6-124.
4. If the communication cable is OK, do the following:
   - **A.** Disconnect the communication cable from the drive (but leave the cable connected to the PC).
   - **B.** Jumper pins 2 and 3 on the D connector of the communication cable.
   - **C.** Close and exit from DSMPro.
   - **D.** Select the Terminal from the Program Manager (Terminal is usually in the Accessories group).
   - **E.** Select Settings from the Main menu:
     - Select Terminal Emulation from the drop down menu,
     - Choose DEC VT-100,
     - Choose OK to close the dialog box.

F. Select Settings from the Main menu

- Select Communications from the drop down menu
- Choose COM1 (or the number of the communication port the drive is connected to) from the Connections sliding list.
- Set Baud Rate to 9600
- Set Data Bits to 8
- Set Stop Bits to 1
- Set Parity to NONE
- Set Flow Control to XON/XOFF
- Choose OK to close the dialog box.

5. Type any character on the keyboard. The character should echo back on the screen.

If you see the character on the screen remove the jumper between pins 2 and 3, close the Windows Terminal and restart DSMPro.

If the character does *not* echo back on the screen, do the following:

- Disconnect the cable from your PC.
- Jumper Pins 2 and 3 on the communication port of the PC.
- Type any character on the keyboard.
  - If the character echoes back, the communication port is OK and the cable or the connectors are defective. Replace the communication cable assembly.
  - If the character did *not* echo back, the communication port is defective. Replace the communication port.

Testing Digital Outputs

This test verifies the functionality of the selectable outputs.

Test equipment requirements are:

- A PC running DSMPro
- A multimeter.

This test assumes there are no error codes displayed, and the I/O power supply (internal for DSM110, 120, 130 or 175 and external for DSM 007, 007P, 015, 015P, 030 or 030P) for the drive is connected correctly.

▶ NOTE: Disconnect the outputs from any external hardware while performing this test.

1. Disable the drive by opening the switch connecting J1-26 and J1-20.
2. From the Drive Window select the Output Diagnostics command icon.
3. Verify each of the Digital Outputs in the Output Diagnostics window registers the appropriate readings on a multimeter when the following values are set:

▶ NOTE: This test assumes that I/O power is 24 VDC.

A. Drive Ready box, then measure the resistance between J1-24 and J1-25.

- If the box is checked, the resistance should read approximately 1 Ohm.
- If the box is not checked, the resistance should read very high (> 1 MOhm).

B. Brake Enable box, then measure the resistance between J1-49 and J1-50.

- If the box is checked, the resistance should read approximately 1Ohm.
- If the box is not checked, the resistance should be very high (> 1 MOhm).

A load is necessary to test the transistor outputs listed below. A 1 kOhm resistor may be connected from the transistor output (J1-42, J1-43, J1-44 or J1-45) to the I/O COM (J1-6).

C. Digital Output 1, then measure the voltage between J1-42 and J1-13.

- If the box is checked, the voltmeter should read approximately +24 VDC.
- If the box is not checked, the voltmeter should read approximately 0 VDC.

D. Digital Output 2, then measure the voltage between J1-43 and J1-13.

- If the box is checked, the voltmeter should read approximately +24 VDC.
- If the box is not checked, the voltmeter should read approximately 0 VDC.

4. After the test has been completed you may select Close to exit Output Diagnostics window.

Testing Digital Inputs

This test verifies the functionality of the selectable inputs.

▶ NOTE: This test assumes that I/O power is 24 VDC.

Test equipment requirements are:

- A PC running DSMPro
- A jumper wire.

It assumes there are no error codes displayed, and the 24V power supply is connected correctly.

1. Disable the drive by opening the switch connecting J1-26 and J1-20.
2. Choose the I/O Display command icon from the Drive Window.
   - **A.** Connect J1-20 to J1-26. The Enable indicator activates.
   - **B.** Connect J1-21 to J1- 26. The Reset Faults indicator activates.
   - **C.** Connect J1-31 to J1-26. The Input 1 indicator activates.
   - **D.** Connect J1-32 to J1-26. The Input 2 indicator activates.
   - **E.** Connect J1-33 to J1-26. The Input 3 indicator activates.
3. Choose Close to exit the I/O Display window.

Testing Analog Output

The following tests verify the functionality of the analog outputs.

> ▶ NOTE: This test assumes that I/O power is 24 VDC.

Test equipment requirements are:

- A PC running DSMPro
- A voltmeter.

Testing Analog Output 1

1. Disable the drive, by opening the connections between the ENABLE input and the I/O Power (I/O PWR).
2. Disconnect the connections to J1-31.
3. Select Output Diagnostics icon from the Drive Window.
4. From the Output Diagnostics window select Analog Output 1.
5. Enter 1000 in the D/A level box.
6. Connect a DC voltmeter across analog test points J1-31 and J1-28. The meter should read approximately 1 Vdc.
7. Repeat step using different positive or negative values for the D/A Level. Verify the meter reads the values you enter.

Testing Analog Input

The following test verifies the functionality of the analog input.

▶ NOTE: This test assumes that I/O power is 24 VDC.

The tests require:

- a PC running DSMPro, and
- a 10 kOhm potentiometer.

Testing the Current Limit Input

1. Verify the accuracy of the potentiometer with an ohmmeter before installing.
2. Disable the drive by opening the connections between the ENABLE input and the I/O Power (I/O PWR).
3. Disconnect the connections to J1-27 and J1-28.
4. Connect the 10K potentiometer between J1-27 and J1-28.
   Refer to “J1 - Controller” on page 6-81 for a diagram showing the location of the pins.
5. Choose the Drive Signals command icon from DSMPro.
6. Choose Set Up, if the Drive Signals Set Up window is not already active.
7. Choose Current - Input Limit + as the analog signal.
8. Choose OK to close the Set Up window and activate the Drive Signals window.
9. Slowly adjust the potentiometer while viewing the Drive Signals window. The Current - Input Limit + value should update as the potentiometer is adjusted.

Testing Encoder Inputs

The following test verifies both reception and transmission of the line count from an encoder by the drive.

> NOTE: This test assumes that I/O power is 24 VDC.

The tests require:

- A PC running DSMPro, and
- A motor encoder.

Testing Encoder Inputs

1. Disable the drive by opening the connections between the ENABLE input and I/O Power (I/O PWR).
2. Choose the Drive Set Up command icon from DSMPro.
3. Choose Divide by 1 as the Motor Encoder Output Signal.
4. Make the following hardware connections:
   - Connect the motor encoder to J2.
   - Jumper the Auxiliary Encoder Inputs to the Motor Encoder Outputs by connecting the following pins:

J1-7 to J1-14	J1-10 to J1-17
J1-8 to J1-15	J1-11 to J1-18
J1-9 to J1-16	J1-12 to J1-19

5. Choose the Encoder Diagnostics command icon from DSMPro.
6. Choose Zero Count for both the Motor Encoder and Master Position Input.
7. Slowly rotate the encoder shaft by hand while observing the counts for both the Motor Encoder and Master Position Input. The Motor Encoder and Master Position Input line counts should be equal.

Options and Accessories

A

Centurion DSM Drives conformance to the European Union Directives is contingent on:

1. Installation of AC line filters between the power source and the drive, and
2. Use of factory supplied cables to connect FSM, HSM, NSM, SSM, or YSM Series motors to a drive. Diagrams and schematics for all Giddings & Lewis cables are shown in Cable Diagrams, Schematics and Examples, beginning on page B-245.

Centurion DSM Drives

	Description
DSM 007	500 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM 007P	500 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
DSM 015	1000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM 015P	1000 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
DSM 030	2000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM 030P	2000 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
DSM110	1000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM120	2000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM130	3000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
DSM175	7500 Watt Universal Drive, single or three phase 100-240 VAC @ 50/60 Hz
DSM1150	15000 Watt Universal Drive, three phase 100-240 VAC @ 50/60 Hz

Fuses

Description	Part Number
1 Ampere, fast acting, inline for DSM110, 120, 130, 175, or 1150 (Littelfuse R451001, or equivalent)	0006-9071-001
Fuse for DSM110, 120, 130 or 175 External Shunt Resistor (Littelfuse CCMR-4.5 or equivalent)	0006-9070-001

Options and Accessories

Description	Part Number
TouchPad	401-34405-00
AC Line Filter for DSM 007 or 007P (6 A_{rms} Continuous, Single Phase)	401-30222-00
AC Line Filter for DSM 015, 015P or -110 (10 A_{rms} Continuous, Single Phase)	401-30216-00
AC Line Filter for DSM 030, 030 or -120 (23 A_{rms} Continuous, Single Phase)	401-30217-00
AC Line Filter for DSM130 (30 A_{rms} Continuous, Single Phase)	401-34418-00
AC Line Filter for DSM175 (55 A_{rms} Continuous, Single Phase)	401-34420-00
AC Line Filter for DSM175 (36 A_{rms} Continuous, Three Phase)	401-34419-00
J1 to 50-pin Terminal Strip (Breakout Board), includes 1m (3ft) cable and mounting hardware	401-34409-00
J2 to 25-pin Terminal Strip (Breakout Board), includes 1m (3ft) cable and mounting hardware	401-34408-00
DSM110/120/130 External Shunt Resistor	401-34308-00
Manuals	
TouchPad Instructions	108-31019-00
Centurion DSM Drive Installation Manual for DSM110, 120, 130 or 175	108-30083-00
Centurion DSM Drive Installation Manual for DSM 007, 007P, 015, 015P, 030 or 030P	108-31017-00

Interface Cables

Diagrams and schematics for these cables are shown beginning on page B-246.

Description		Part Number
J1 to customer supplied connector (no connector)	3 m (10 ft)	401-34411-10
	7.6 m (25 ft)	401-34411-25
	15 m (50 ft)	401-34411-50
	23 m (75 ft)	401-34411-75
J3 to customer supplied connector (no connector) *(DSM-010, -020, -030 and -075 only)*	3 m (10 ft)	401-34410-10
	7.6 m (25 ft)	401-34410-25
	15 m (50 ft)	401-34410-50
	23 m (75 ft)	401-34410-75

Serial Interface Cables

Diagrams and schematics for these cables are shown beginning on page B-249.

Description		Part Number
J4/J5 to PC [RS-232] (9 pin D-shell connector)	3 m (10 ft)	502-04020-10
	7.6 m (25 ft)	502-04020-25
	15 m (50 ft)	502-04020-50
J4/J5 to customer supplied connector (no connector)	3 m (10 ft)	401-34423-10
	7.6 m (25 ft)	401-34423-25
	15 m (50 ft)	401-34423-50
J4/J5 to J4/J5 four wire RS-485 communications	1m (3ft)	502-04021-01

Encoder Feedback Cables

Diagrams and schematics for these cables are shown beginning on page -253.

Description		Part Number
FSM, HSM or SSM Series Motors to customer supplied connector (i.e., no connector)	3 m (10 ft)	401-34425-10
	7.6 m (25 ft)	401-34425-25
	15 m (50 ft)	401-34425-50
(DSM 007, 015 and 030 require Rev C or higher cable)	23 m (75 ft)	401-34425-75
(DSM 007, 015 and 030 require Rev C or higher cable)	30 m (100 ft)	401-34425-00
FSM, HSM or SSM Series Motors to J2	3 m (10 ft)	401-34407-10
	7.6 m (25 ft)	401-34407-10
	15 m (50 ft)	401-34407-10
(DSM 007, 015 and 030 require Rev C or higher cable)	23 m (75 ft)	401-34407-10
(DSM 007, 015 and 030 require Rev C or higher cable)	30 m (100 ft)	401-34407-10
NSM Series Motors to customer supplied connector (no connector)	3 m (10 ft)	401-30252-10
	7.6 m (25 ft)	401-30252-25
	15 m (50 ft)	401-30252-50
	23 m (75 ft)	401-30252-75
	30 m (100 ft)	401-30252-00
NSM Series Motors to J2	3 m (10 ft)	401-30231-10
	7.6 m (25 ft)	401-30231-25
	15 m (50 ft)	401-30231-50
	23 m (75 ft)	401-30231-75
	30 m (100 ft)	401-30231-00
YSM Series Motors to customer supplied connector (no connector)	3 m (10 ft)	401-30253-10
	7.6 m (25 ft)	401-30253-25
	15 m (50 ft)	401-30253-50
(DSM 007, 015 and 030 require Rev C or higher cable)	23 m (75 ft)	401-30253-75
((DSM 007, 015 and 030 require Rev C or higher cable)	30 m (100 ft)	401-30253-00
YSM Series Motors to J2	0.6 m (2 ft)	401-30233-02

Description		Part Number
	3 m (10 ft)	401-30233-10
	7.6 m (25 ft)	401-30233-25
	15 m (50 ft)	401-30233-50
(DSM-005, -009 and -019 require Rev D or higher cable)	23 m (75 ft)	401-30233-75
J2 to customer supplied connector (no connector)	3 m (10 ft)	401-34424-10
	7.6 m (25 ft)	401-34424-25
	15 m (50 ft)	401-34424-50
(DSM 007, 015 and 030 require Rev C or higher cable)	23 m (75 ft)	401-34424-75
(DSM 007, 015 and 030 require Rev C or higher cable)	30 m (100 ft)	401-34424-00

Motor Power Cables

Diagrams and schematics for these cables are shown beginning on page -259.

Description		Part Number
Drive to 2000 or 3000 Motors (HSM or SSM Series)	3 m (10 ft)	401-34413-10
	7.6 m (25 ft)	401-34413-25
	15 m (50 ft)	401-34413-50
	23 m (75 ft)	401-34413-75
	30 m (100 ft)	401-34413-00
Drive to 4000 Motors (FSM, HSM or SSM Series)	3 m (10 ft)	401-34414-10
	7.6 m (25 ft)	401-34414-25
	15 m (50 ft)	401-34414-50
	23 m (75 ft)	401-34414-75
	30 m (100 ft)	401-34414-00
DSM130 or DSM175 to 6000 Motors (FSM, HSM or SSM Series)	3 m (10 ft)	401-34415-10
	7.6 m (25 ft)	401-34415-25
	15 m (50 ft)	401-34415-50
	23 m (75 ft)	401-34415-75
	30 m (100 ft)	401-34415-00
DSM 1150 to 6000 Motors (FSM, HSM or SSM Series)	3 m (10 ft)	401-34416-10
	7.6 m (25 ft)	401-34416-25
	15 m (50 ft)	401-34416-50
	23 m (75 ft)	401-34416-75
	30 m (100 ft)	401-34416-00
DSM 1150 to 8000 Motors (FSM, HSM or SSM Series)	3 m (10 ft)	401-34417-10
	7.6 m (25 ft)	401-34417-25
	15 m (50 ft)	401-34417-50
	23 m (75 ft)	401-34417-75
	30 m (100 ft)	401-34417-00
Drive to NSM Series Motors	3 m (10 ft)	401-30230-10
	7.6 m (25 ft)	401-30230-25

Description		Part Number
	15 m (50 ft)	401-30230-50
	23 m (75 ft)	401-30230-75
	30 m (100 ft)	401-30230-00
Drive to YSM Series Motors	3 m (10 ft)	401-30232-10
	7.6 m (25 ft)	401-30232-25
	15 m (50 ft)	401-30232-50
	23 m (75 ft)	401-30232-75
	30 m (100 ft)	401-30232-00

Connector Kits

Connector kits provide the ability to construct custom length cables. Kits are available for all Centurion DSM Drive connectors. Each kit consists of the appropriate 3M connector with the corresponding plastic backshell, and instructions.

Connector	Type	Part Number
J1	50 pin mini D-shell, 24-30 AWG cable solder cup, squeeze latch	401-56489-00
J2	20 pin mini D-shell, 24-30 AWG cable solder cup, squeeze latch	401-56490-00
J3	26 pin mini D-shell, 24-30 AWG cable solder cup, squeeze latch	401-56491-00
J4 or J5	9 pin D-shell for RS-232 or RS-485	401-56492-00

Mating Connectors

The following connectors are listed solely to provide a cross-reference of mating connectors for the J1, J2 or J3 connectors on the Centurion DSM Drives. Centurion DSM Drive conformance to the European EMC Directive is contingent on the use of Giddings & Lewis cables.

These connectors are *not* available from Giddings & Lewis. Please contact the manufacturer or a distributor for additional information. Manufacturer phone numbers are: 3M 1-800-225-5373 and AMP 1-800-522-6752

DDM	Mating Connector	Mating Backshell	Description
J1	AMP 2-175677-7	AMP 176793-7	50-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Plastic Backshell, Squeeze Latch
	3M 10150-6000EC[1]	3M 10350-A200-00	50-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Metal Backshell, Squeeze Latch
	3M 10150-3000VE	3M 10350-52F0-008	50-pin Mini D Ribbon, 24-30 AWG, Solder Cup, Plastic Backshell, Squeeze Latch
J2	AMP 2-175677-2	AMP 176793-2	20-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Plastic Backshell, Squeeze Latch
	3M 10120-6000EC[1]	3M 10320-A200-00	20-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Metal Backshell, Squeeze Latch
	3M 10120-3000VE	3M 10320-52F0-008	20-pin Mini D Ribbon, 24-30 AWG, Solder Cup, Plastic Backshell, Squeeze Latch
J3	AMP 2-175677-4	AMP 176793-4	26-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Plastic Backshell, Squeeze Latch
	3M 10126-6000EC[1]	3M 10326-A200-00	26-pin Mini D Ribbon, 28-30 AWG, Insulation Displacement, Metal Backshell, Squeeze Latch
	3M 10126-3000VE	3M 10326-52F0-008	26-pin Mini D Ribbon, 24-30 AWG, Solder Cup, Plastic Backshell, Squeeze Latch

1. For use with MDR Hand Press Tool Kit, 3M part number 3829

Cable Diagrams, Schematics and Examples B

Factory supplied cables allow Centurion DSM Drives to conform to the European Union Directives when connecting the drive to motors, controllers or computers. The following diagrams provide information on the cables available from the factory.

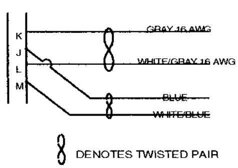
Refer to the Appendix, "Options and Accessories" on page A-235 for ordering information.

The information below applies to all factory supplied cables.

- Wire Insulation Type: Polyvinyl Chloride
- Conductor size: 0.08 mm^2 (28 AWG) tinned copper, except as noted below.
  [0.25 mm^2 (24 AWG) on 502-04020-XX, 502-0402-XX and 401-34423-XX]
  [1.5 mm^2 (16 AWG) on 401-34413-XX and 401-30232-XX]
  [2.5 mm^2 (14 AWG) on 401-34414-XX]
  [6 mm^2 (10 AWG) on 401-34415-XX]
- Braid Shield Coverage: 85% minimum
- Jacket Material: Thermoplastic elastomer
- Moldings: 105°C (221°F) Black PVC
- Flex Rating: 1,000,000 cycles
- Minimum Bend Radius

Control Cables		Motor Power Cables	
Connector	millimeters (inches)	Cable	millimeters (inches)
Controller (J1)	171.45 (6.75)	401-34413-XX	50.80 (2.0)
Encoder (J2)	129.54 (5.10)	401-34414-XX	57.15 (2.25)
		401-34415-XX	76.20 (3.0)

- Cables are manufactured to inch dimensions. Millimeter dimensions are approximate conversions from inches.
- Alternate field wiring diagram for FSM, HSM, or NSM Series encoder cables is shown below



Interface Cables

Figure B.1 J1 to J3 Interface Cable (P/N 401-34422)

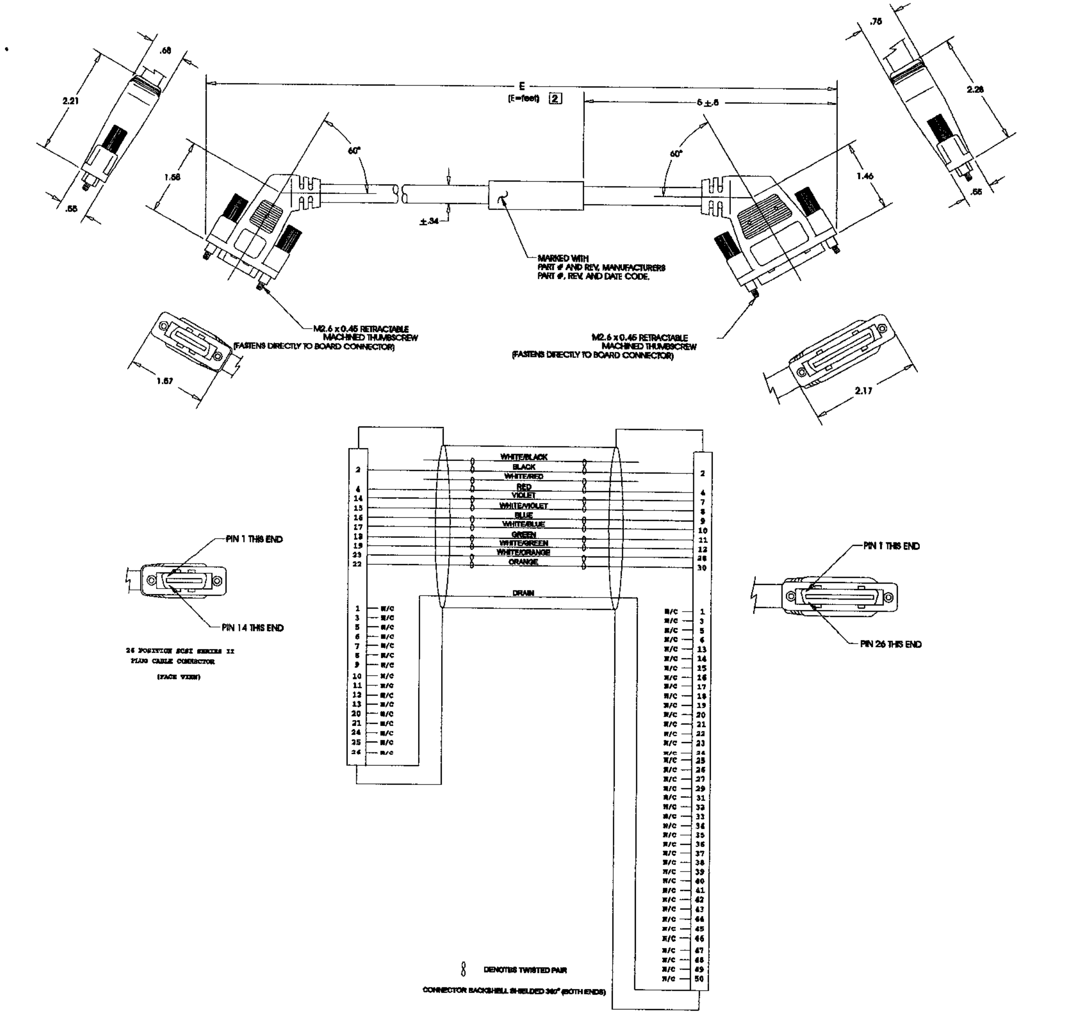
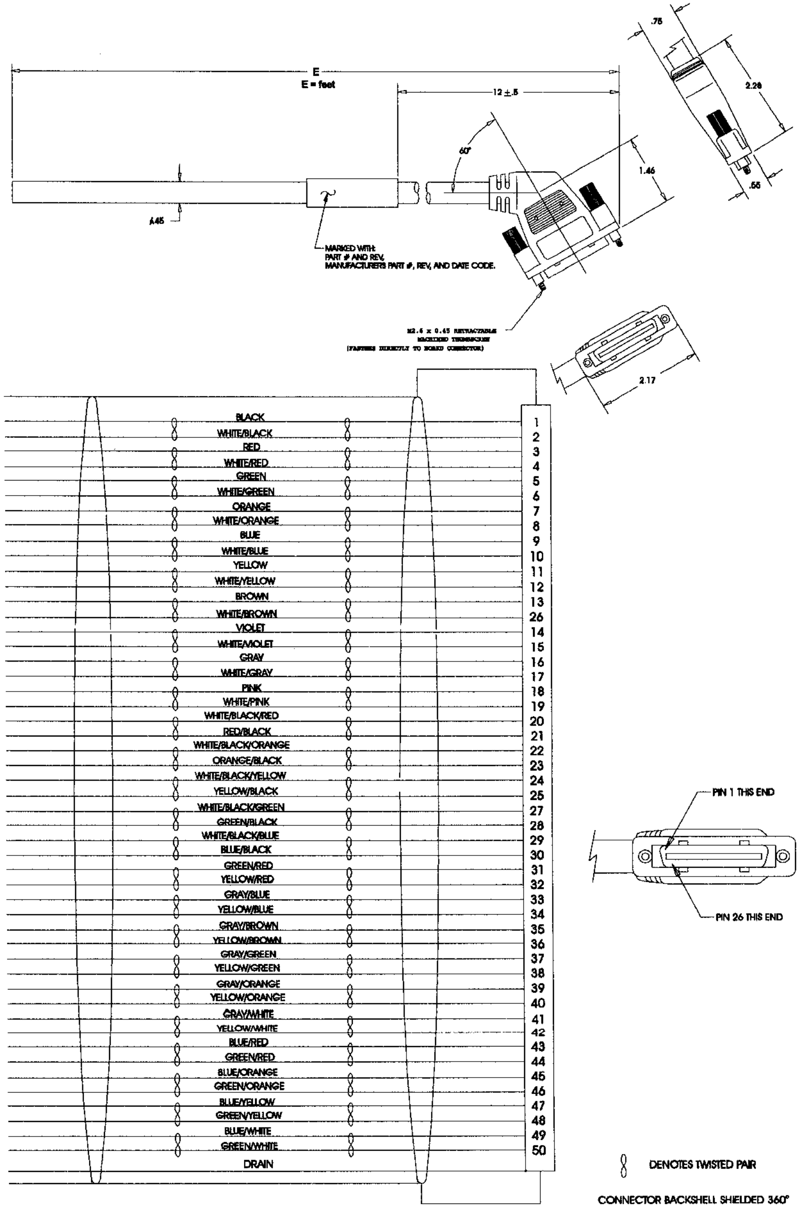


Figure B.2 J1 to No Connector Interface Cable (P/N 401-34411)



Serial Interface Cables

Figure B.3 J5 to 9-pin D-Shell Interface Diagram (P/N 502-04020)

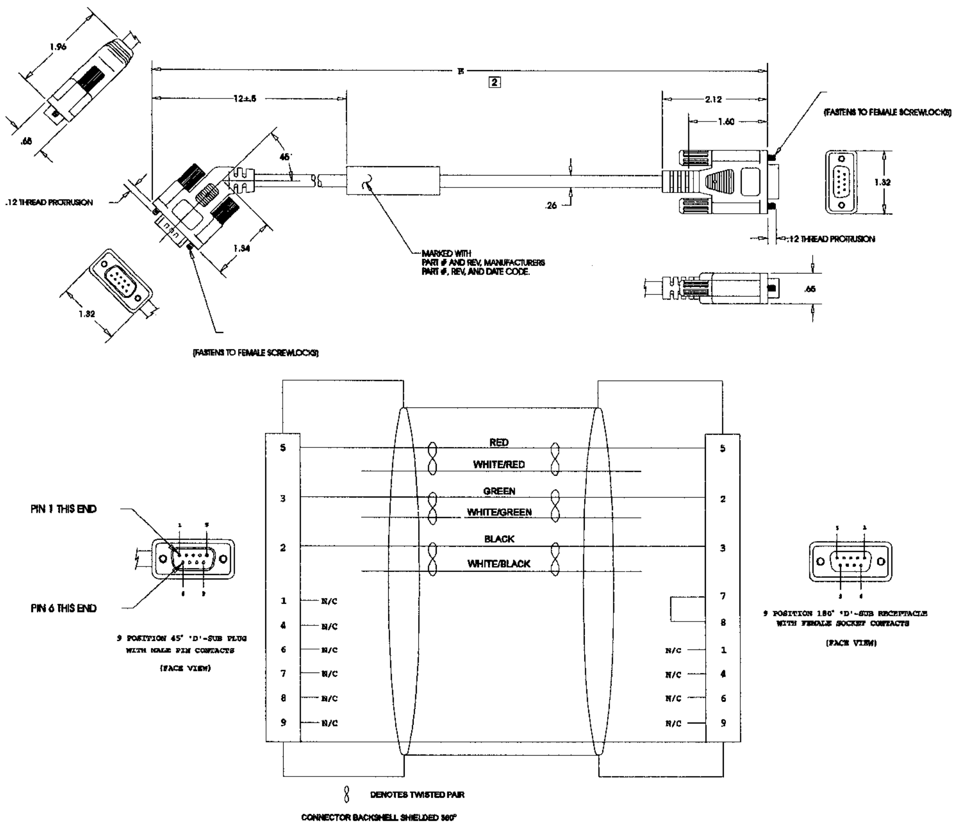


Figure B.4 J5 to J5 Serial Interface Cable (P/N 502-04021)

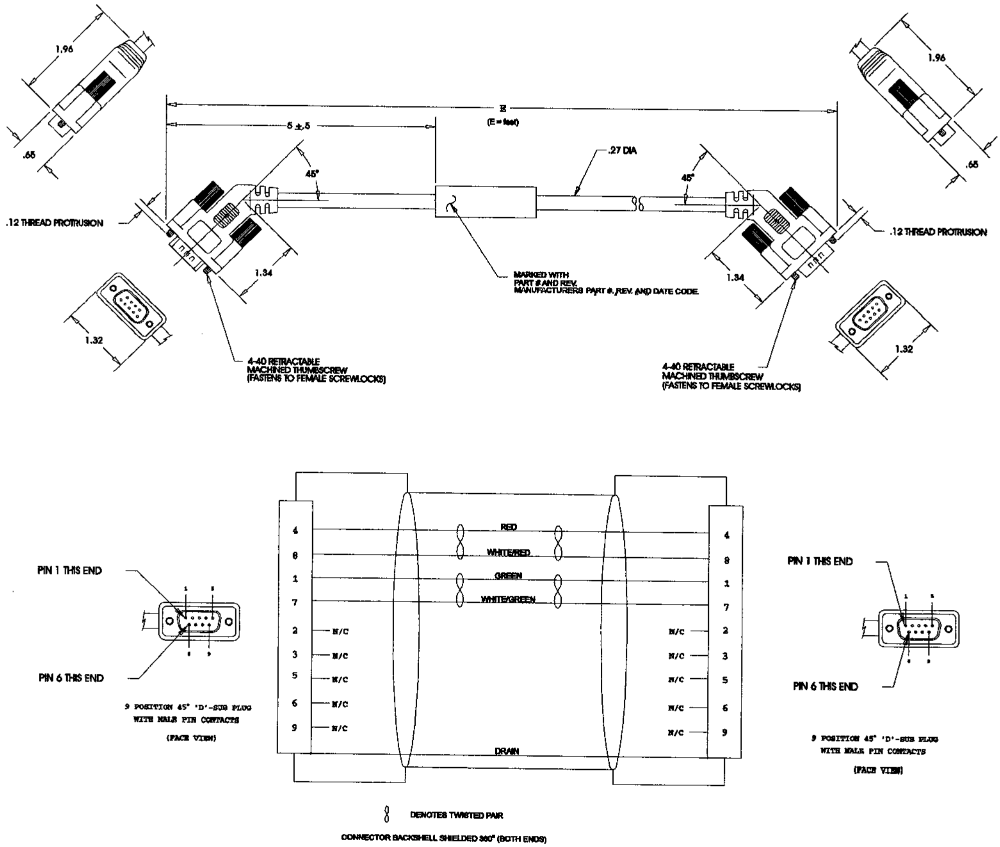
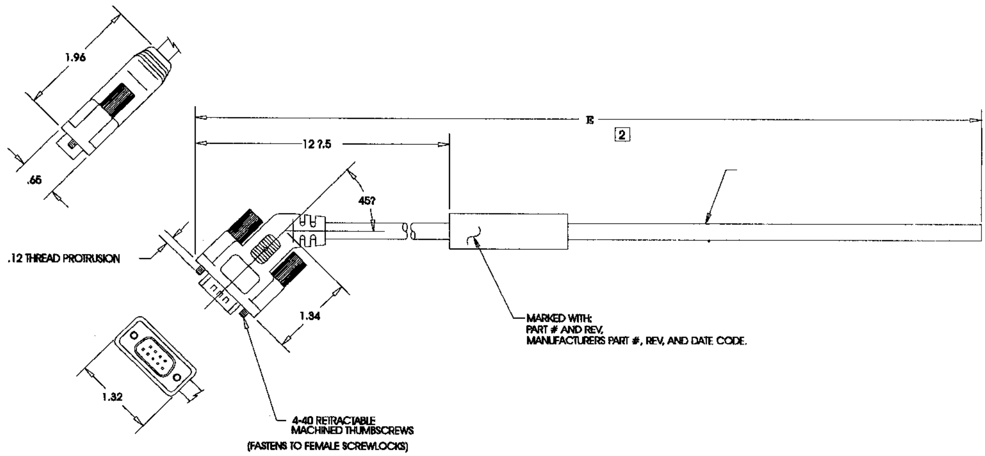
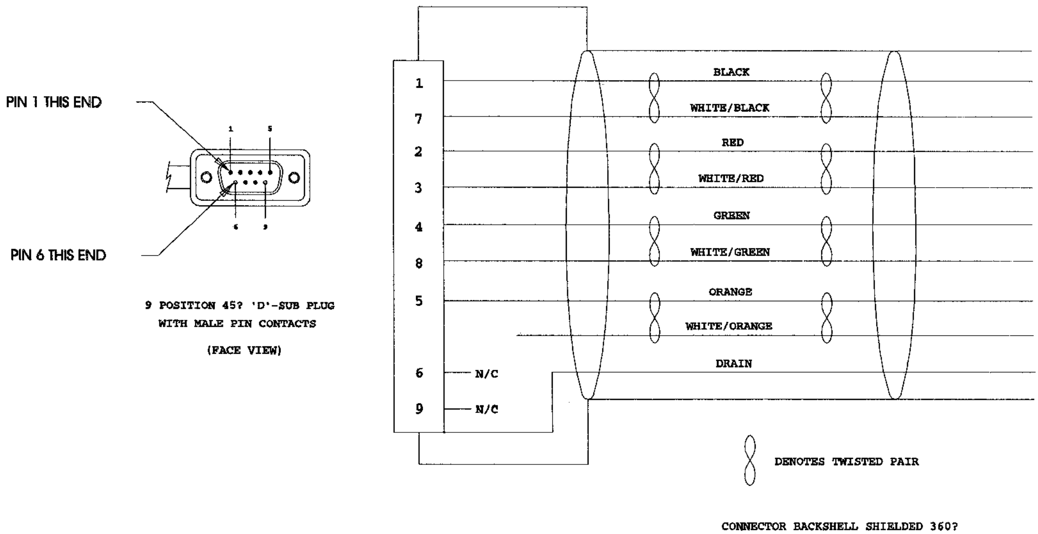


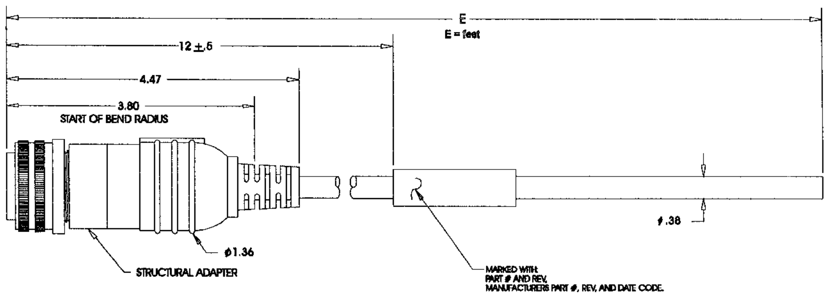
Figure B.5 J5 to No Connector Serial Interface Cable (P/N 401-34423)





Encoder Feedback Cables

Figure B.6 FSM, HSM or SSM Series Motors to No Connector Encoder Cable (P/N 401-34425)



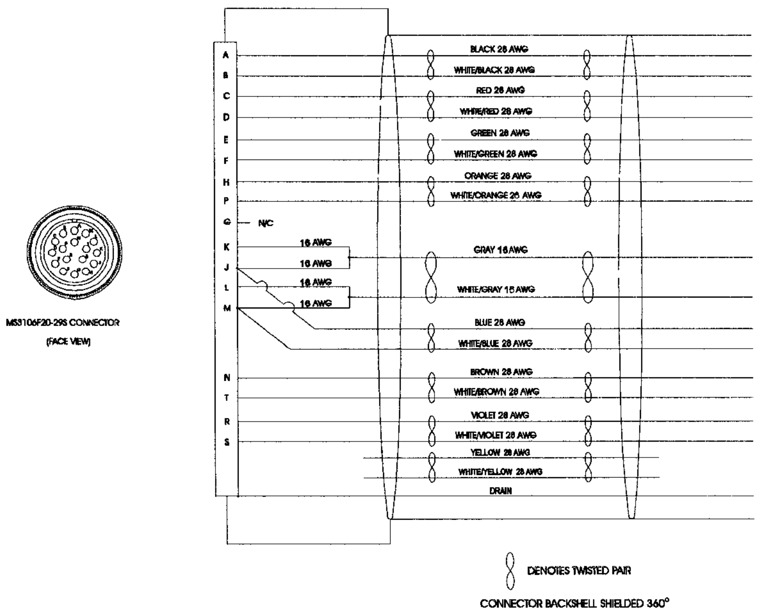
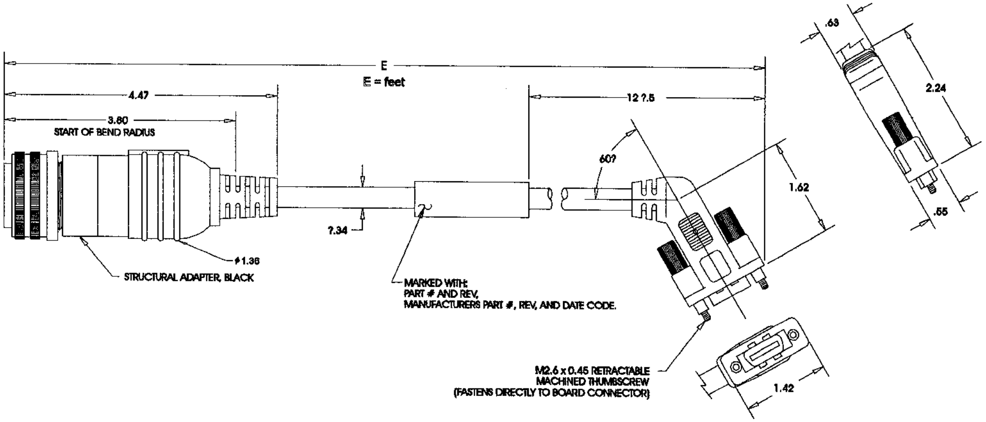


Figure B.7 J2 to FSM, HSM or SSM Series Encoder Cable (P/N 401-4407)



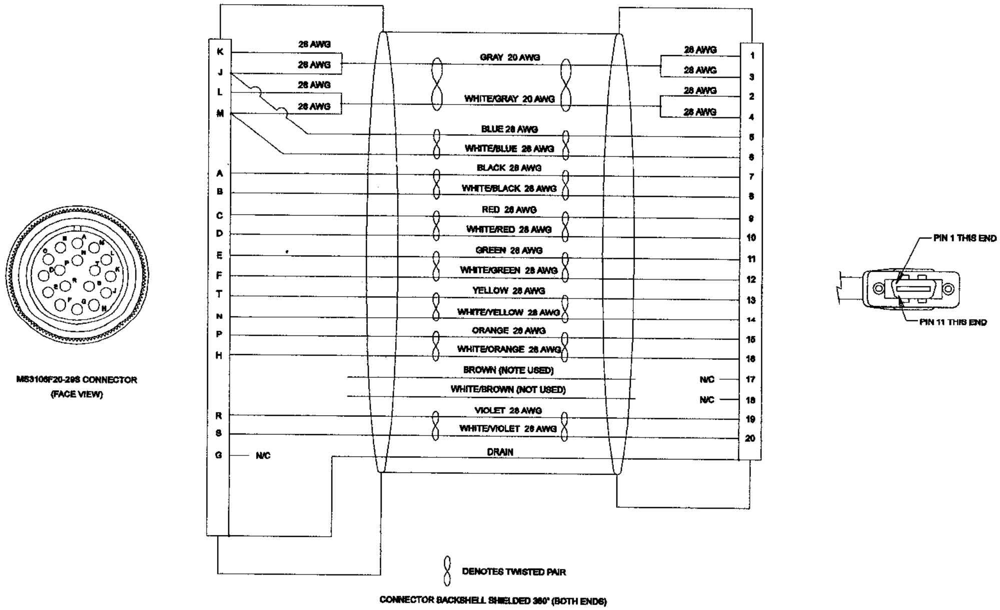
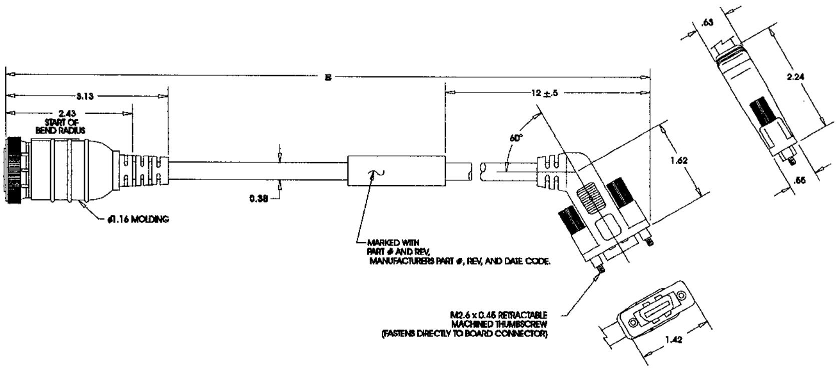


Figure B.8 J2 to YSM Series Encoder Cable (P/N 401-30233)



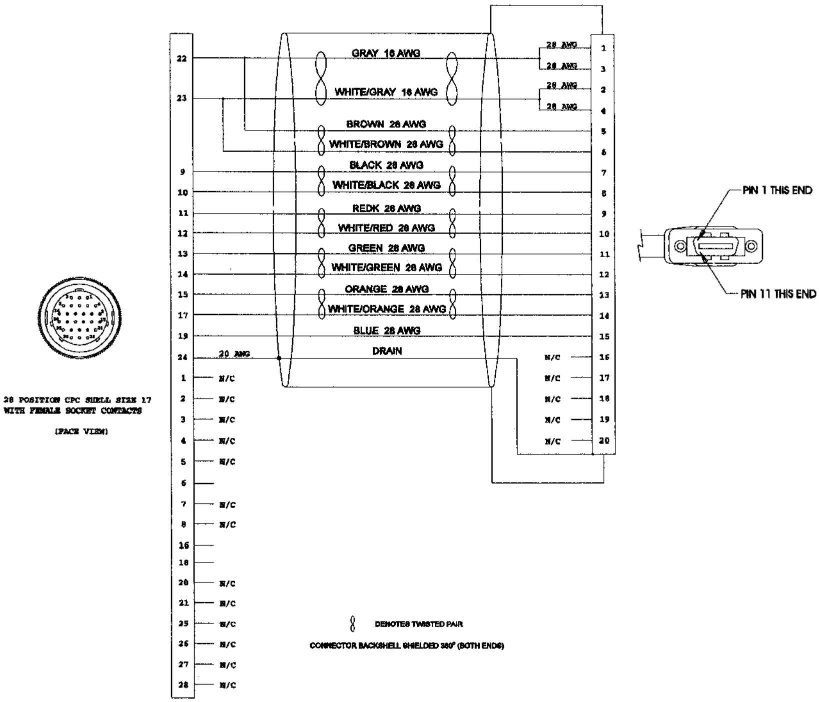


Figure B.9 No Connector to YSM Series Encoder Cable (P/N 401-30253)

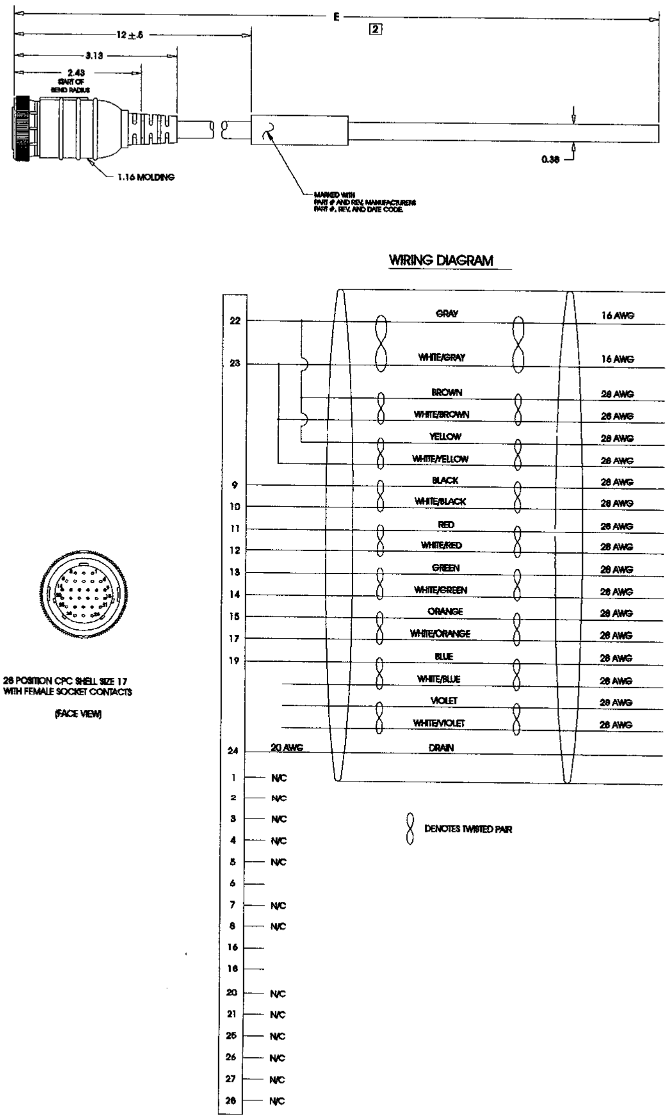
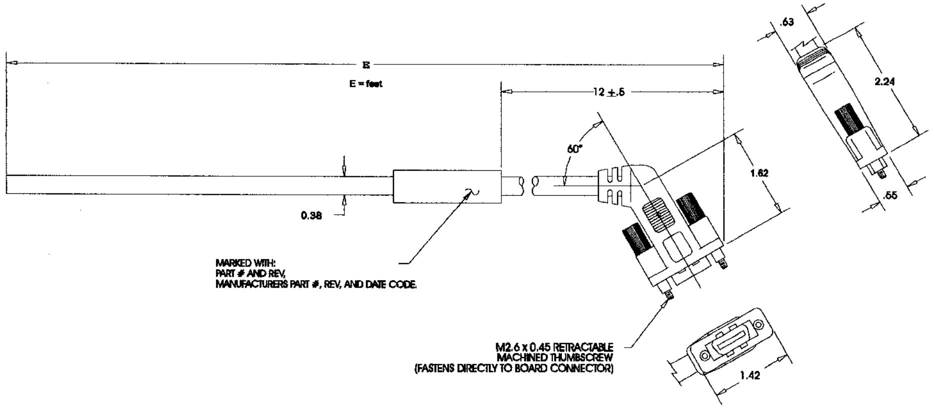
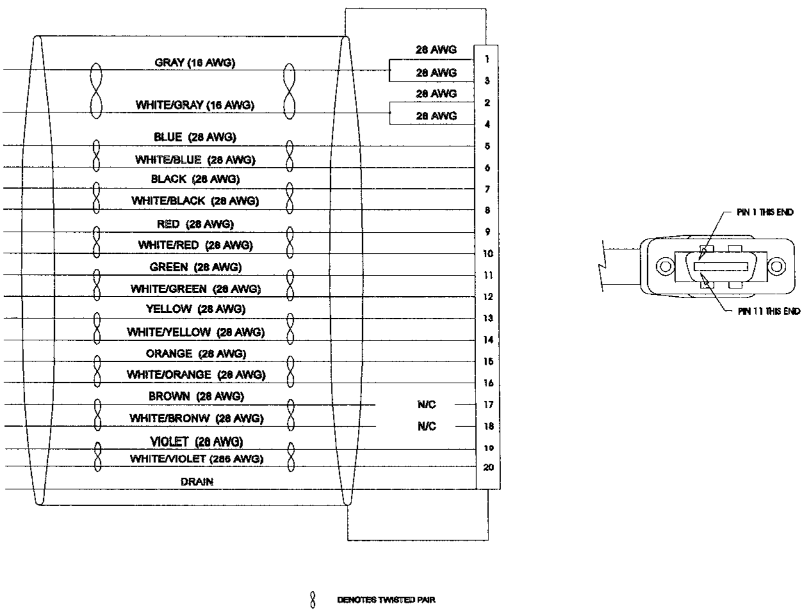


Figure B.10 J2 to No Connector Encoder Cable (P/N 401-34424)





DENOTES TWISTED PAIR

CONNECTOR BACKSHELL SHIELDED 360°

Motor Power Cables

DANGER

Shielded power cables must be grounded at a minimum of one point for safety. Failure to ground a shielded power cable will result in potentially lethal voltages on the shield and anything connected to it.

Figure B.11 200 or 300 FSM, HSM or SSM Series Power Cable (P/N 401-34413)

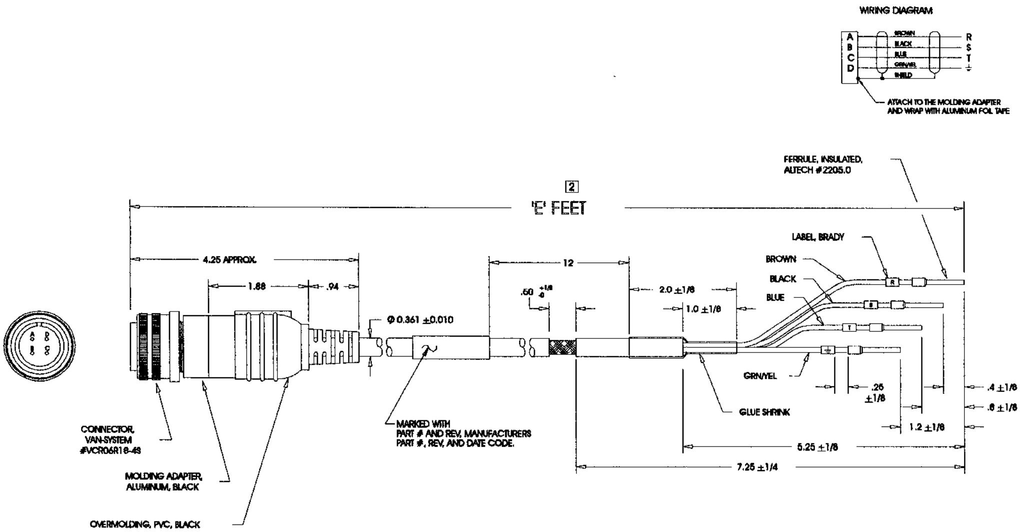


Figure B.12 400 FSM, HSM or SSM Series Power Cable (P/N 401-34414 or 401-30273)

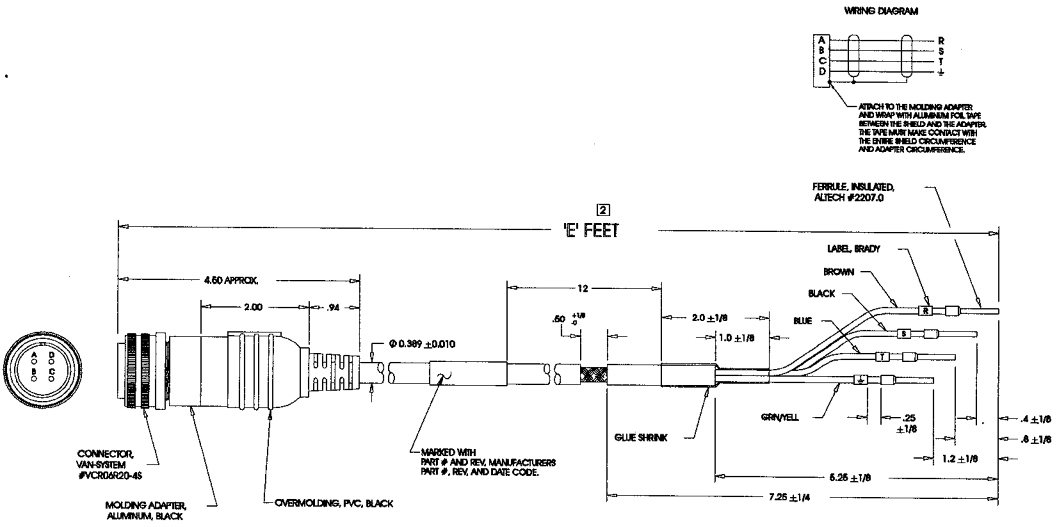


Figure B.13 6000 FSM, HSM or SSM Series Power Cable (P/N 401-34415)

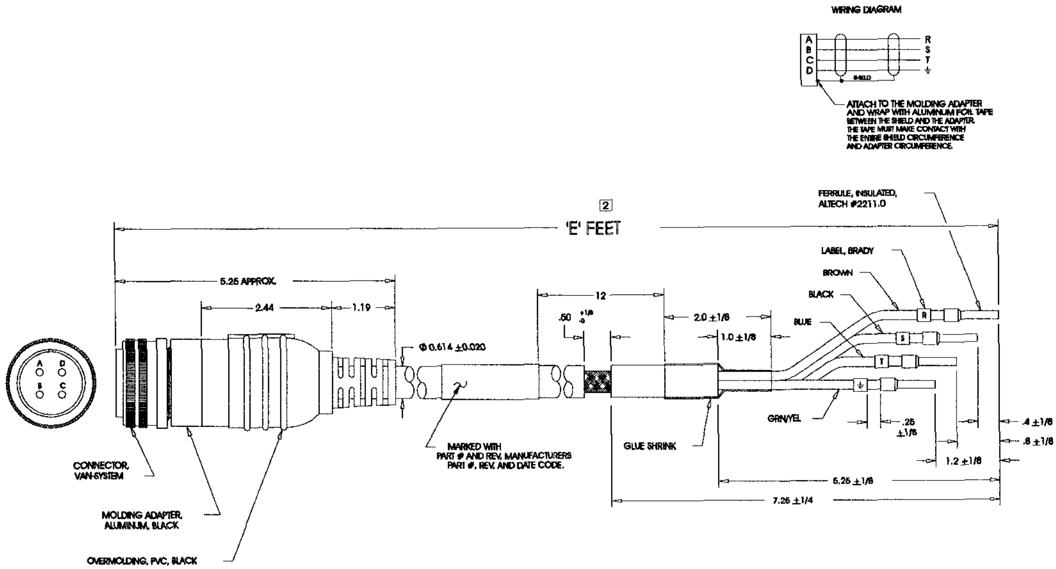
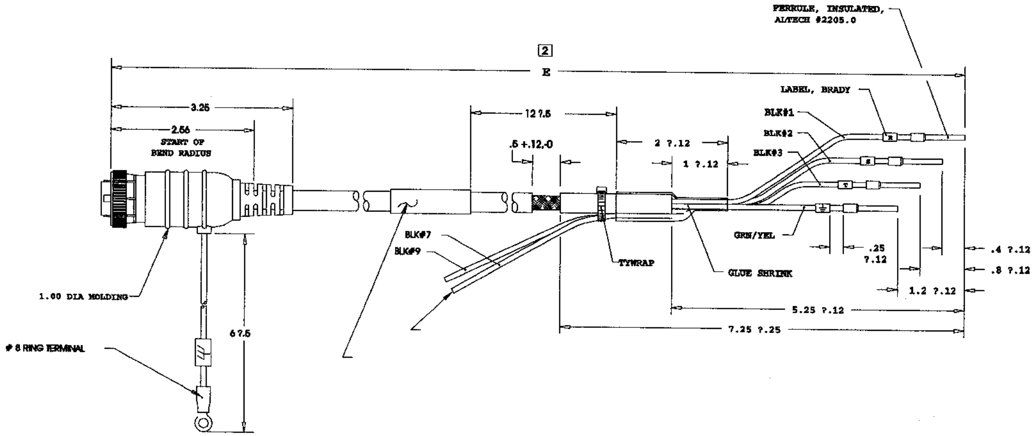
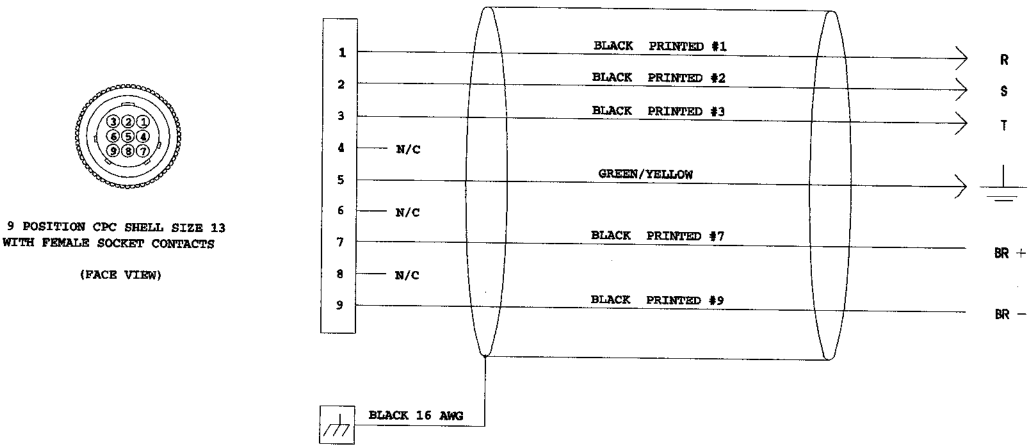


Figure B.14 YSM Series Power Cable (P/N 401-30232)

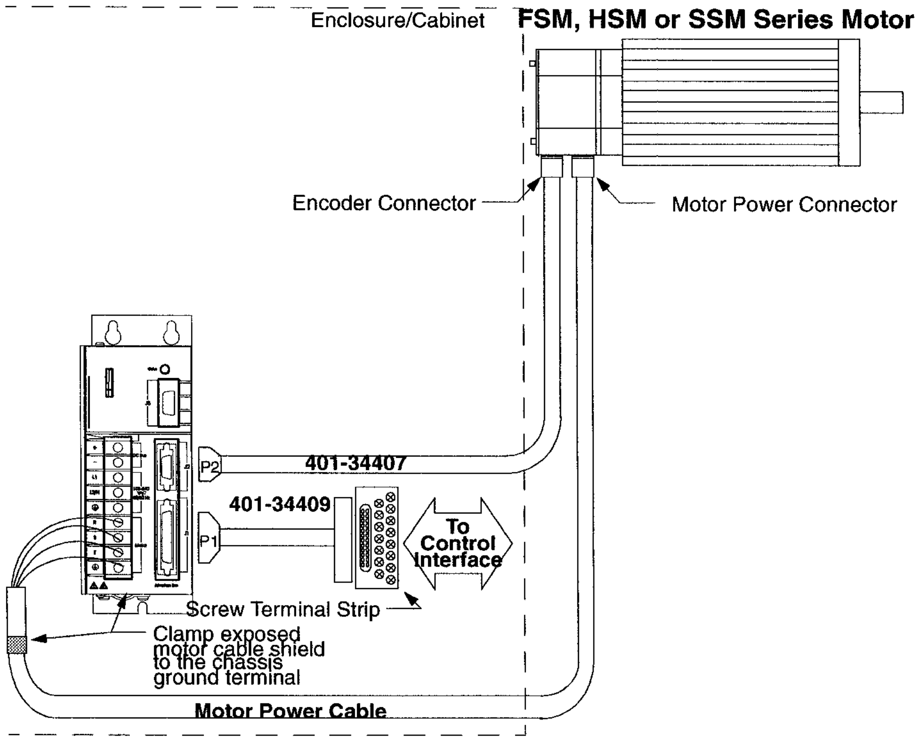


WIRING DIAGRAM



Cabling Examples

Figure B.15 FSM, HSM or SSM Series Motors to Centurion DSM Drive



NOTES:

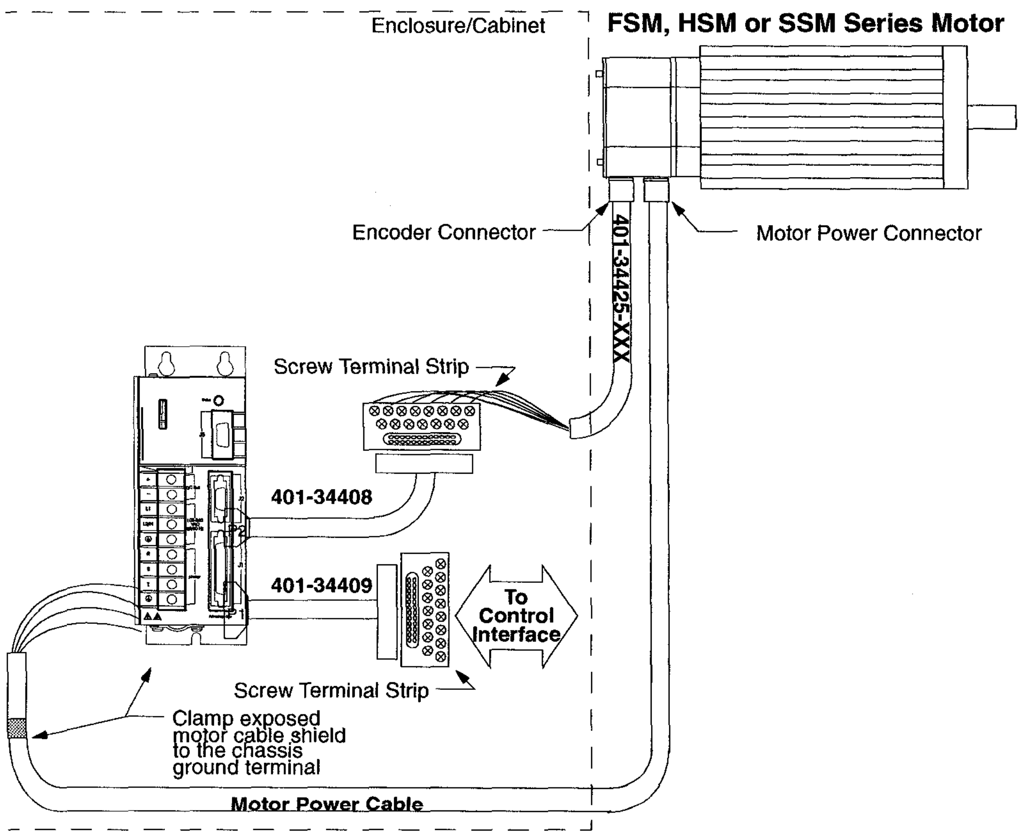
This wiring method should be used to run cables through a bulkhead or enclosure without removing the connectors.

Cable 401-34407-XXX has connectors on both ends. The connectors are molded and potted to the cable and may not be disassembled.

Adaptor Kit 401-34409 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 50-pin Mini D ribbon connector at the drive end and a 50-pin D connector at the terminal strip end.

Motor Power Cables - Use Centurion DSM Drive cables if the CE Mark is required. DS100/200 cables may be used if the CE Mark is not an issue. In either case, the shield on the motor power cable must be properly grounded at both ends; the shield is grounded at the motor end when the MS connector is mated.

Figure B.16 FSM, HSM or SSM Series Motors to Centurion DSM Drive using P2 Terminal Strip



NOTES:

This wiring method provides the option to run cables through a restrictive bulkhead or enclosure.

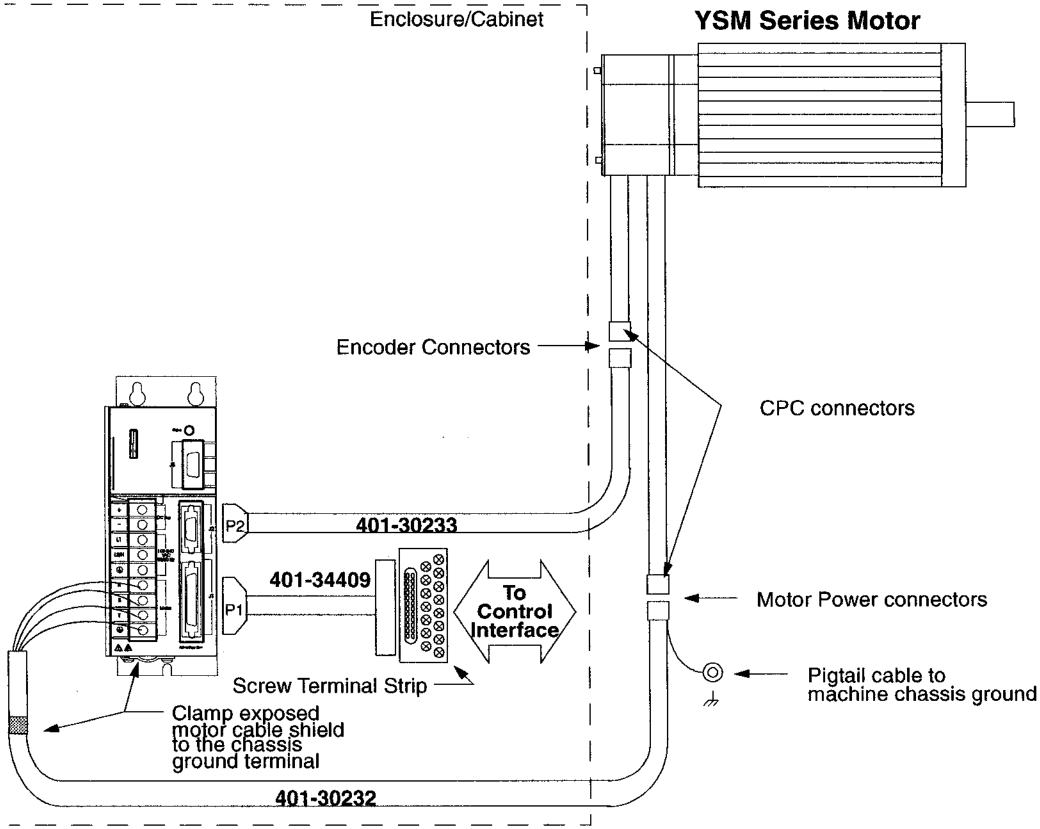
Cable 4001-34425-XXX has a connectors on the motor end only. The cable connector is molded and potted to the cable and may not be disassembled. Refer to the schematic for cable 401-34407-XXX for information on wiring this cable to the J2 Terminal Strip.

Adaptor Kit 401-34409 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 50-pin Mini D ribbon connector at the drive end and a 50-pin D connector at the terminal strip end.

Adaptor Kit 401-34408 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 20-pin Mini D Ribbon connector at the drive end and a 20-pin D connector at the terminal strip end.

Motor Power Cables - Use Centurion DSM Drive cables if the CE Mark is required. Digital Servo Drive-200/500 Series cables may be used if the CE Mark is not an issue. In either case, the shield on the motor power cable must be properly grounded at both ends; the shield is grounded at the motor end when the MS connector is mated.

Figure B.17 YSM Series Motors to Centurion DSM Drive Drive



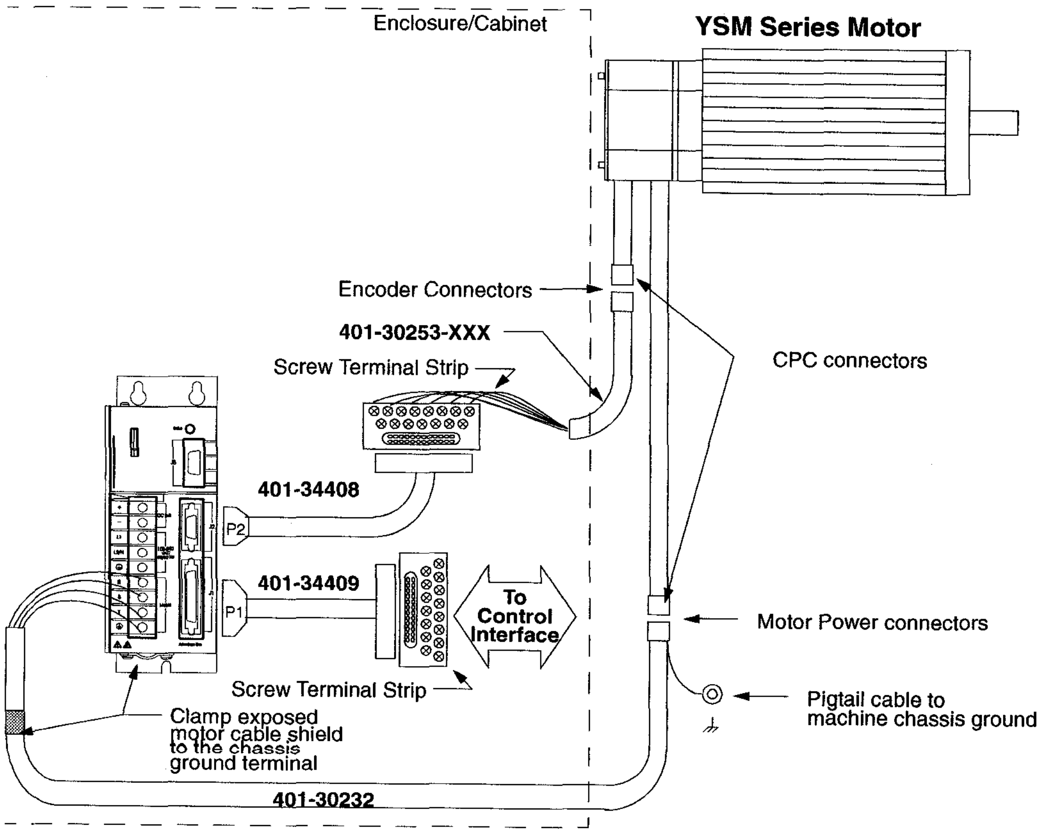
NOTES:

This wiring method should be used to run cables through a bulkhead or enclosure without removing the connectors.

Cable 401-30233-XXX has connectors on both ends. The connectors are molded and potted to the cable and may not be disassembled.

Adaptor Kit 401-34409 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 50-pin Mini D ribbon connector at the drive end and a 50-pin D connector at the terminal strip end.

Figure B.18 YSM Series Motors to Centurion DSM Drive using P2 Terminal Strip



NOTES:

This wiring method provides the option to run cables through a restrictive bulkhead or enclosure.

Cable 401-30253-XXX has a connector on the motor end only. The cable connector is molded and potted to the cable and may not be disassembled. Refer to the schematic for cable 401-30233-XXX for information on wiring this cable to the J2 Terminal Strip.

Adaptor Kit 401-34409 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 50-pin Mini D ribbon connector at the drive end and a 50-pin D connector at the terminal strip end.

Adaptor Kit 401-34408 includes the 3 foot cable, screw terminal strip and mounting bracket. The cable has a 20-pin Mini D Ribbon connector at the drive end and a 20-pin D connector at the terminal strip end.

TouchPad Instructions C

Introduction

The optional TouchPad is a compact and rugged device for interfacing with Centurion DSM Drives. It provides the operator with a convenient device for accessing status information, program variables, and control functions, plus message display capabilities on any Centurion DSM Drive.

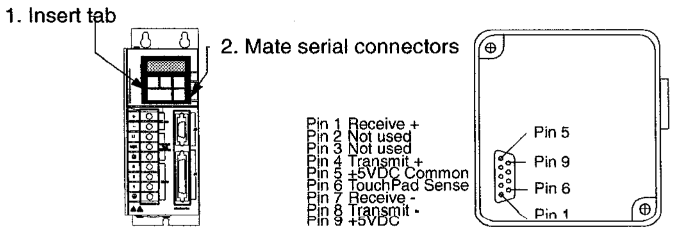
An 8-character dot matrix display and a sealed-membrane type keyboard are housed in a compact case. A locking tab and a single 9-pin D shell serial connector on the backpanel connects the TouchPad to any Centurion DSM Drive via four-wire RS-485 communications.

Four cursor keys and a Mode/Enter key provide access to the TouchPad menus and enable the user to select and change parameters, activate commands, and monitor drive variables. The TouchPad also allows the user to display drive status and diagnostic information, and to control functions, such as distances, speeds, and other alphanumeric data.

Installation and Operation

1. Power down the drive.
2. Plug the TouchPad into the serial port on the Centurion DSM Drive by latching the tab into the drive and then mating the connector as shown.

Figure C.1 TouchPad Connection and Pinouts



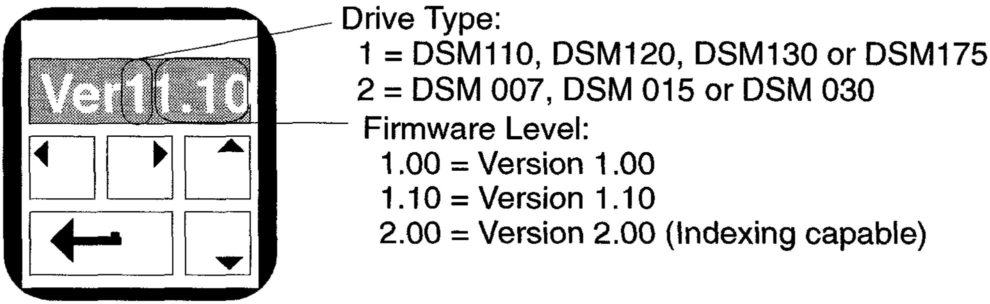
3. Power-up the drive. Installing the TouchPad defaults the drive to the following settings:

- Address 0
- 19200 Baud
- 8 Data bits
- 1 Stop bit
- No Parity bit
-

The personality module settings stored in the drive are not affected by the installation or removal of the TouchPad.

4. Verify the Ver##.## displayed is correct at power-up. The version number designates the type of drive and its firmware level. Figure C.2explains this display.

Figure C.2 TouchPad Version Number Display



If you are referring to the TouchPad Command Tree card, verify the version number display and the Drive Type and Firmware Version of the card are the same.

5. After self-test is completed, the TouchPad display defaults to the branch title DRVSETUP.

6. Horizontal and vertical movement through the TouchPad Command Tree and parameter modification is explained below. The "TouchPad Command Tree" on page C-274 depicts the structure of the TouchPad Command Tree.

TouchPad Commands

Commands are entered by pressing a single key or combination of keys. Two modes of operation are available. Parameter mode allows you to move through the TouchPad Command Tree to each parameter. Modify mode allows you to monitor and change each parameter, often while the drive is operational.

The Parameter mode displays for the TouchPad Command Tree are depicted on the "Supplemental Instructions" on page C-272.

Key	Function	
Mode/Enter	Toggles the parameter display between the two operating modes. **Parameter** mode shows the abbreviated command name of the selected parameter. Refer to the TouchPad Command Tree Chart for a full text definition. **Modify** mode shows the setting, often a number, for the selected parameter. Key functions in each mode are explained below.	
	Mode of Operation	
Key	**Parameter**	**Modify**
Left Arrow	**Previous Branch/Decrement #** Selects the previous branch in the command tree, or Decreases the Preset number when in Preset Drive Parameter mode.	**Move Left** Moves the flashing character selection to the left, advancing the level of the cursor setting. For example: **00052**00 ◄ **0005**200
Right Arrow	**Next Branch/Increment #** Selects the next branch in the command tree, or Increases the Preset number when in Preset Drive Parameter mode.	**Move Right** Moves the flashing character selection to the right, lowering the level of the cursor setting. For example: **0005**200 ► **00052**00
Down Arrow	**Next Parameter** Selects the next parameter down the branch of the command tree.	**Decrement Character** Decreases the selected character(s). For example: 2 ▼ 1, or B ▼ A
Up Arrow	**Previous Parameter** Selects the next parameter up the branch of the command tree.	**Increment Character** Increases the selected character(s). For example: 1 ▲ 2, or A ▲ B
Up & Down Arrows *Press both keys at the same time*	Not functional in this mode.	**Undo Change/Escape** Restores a changed parameter to its original setting. NOTE: This command must be performed before moving to another parameter or branch.
Mode/Enter	**Next Mode/Last Parameter** When displaying a parameter, enters the **Modify** mode of operation. When displaying a branch title, selects the last parameter modified in branch.	**Next Mode** Returns the display to the **Parameter** mode of operation.

Supplemental Instructions

Motor Selection

Enter a Motor Identification number to load the correct motor parameters into the drive. Table C.3 on page C-279 and Table C.3 on page C-279 list the motors available in the motor table directory. Selection of a motor defines default operating parameters for the drive and motor combination.

Analog Output Scaling

Selection of Analog Output Scaling through the TouchPad requires manual input of the scaling parameters. To calculate the necessary scaling parameters, first determine the Command Source (Analog or Preset/Follower). If Analog is the Command source, then determine the Drive Mode (Velocity or Torque).

Depending on the Command Source/Drive Mode, calculate the scaling information to be input at the Analog Output Scaling display as follows:

Analog in Velocity Mode

1. Divide the desired velocity scale (rpm) by the maximum motor speed (rpm) and multiply that value by 16383.

Analog in Torque Mode

1. Divide the desired current scale by the lesser of the following:
   - Motor Continuous Current (Amps) times 3, or
   - Drive Rated Current (Amps)
2. Multiply that value by 8191.

Preset/Follower

1. Enter the desired position (in counts).

Displays

Text

A drive name longer than eight characters may require scrolling with the Left, [◄], and Right, [►], arrow keys. Drive names may be up to 32 characters in length.

Flashing characters in the Modify mode display are the characters that are active.

- Change the cursor position and resolution using the [►] and [◄] keys. For example: If the Drv Name in the Modify mode displays InFeed with the F flashing, pressing the [►] key causes the first e to flash.
- Press the [▲] or [▼] keys to increment or decrement a character by scrolling through the list of valid ASCII characters. For example, If the Drv Name in the Modify mode displays InFfed with the lowercase f is flashing, pressing the [▼] key causes the flashing character to decrement to e.

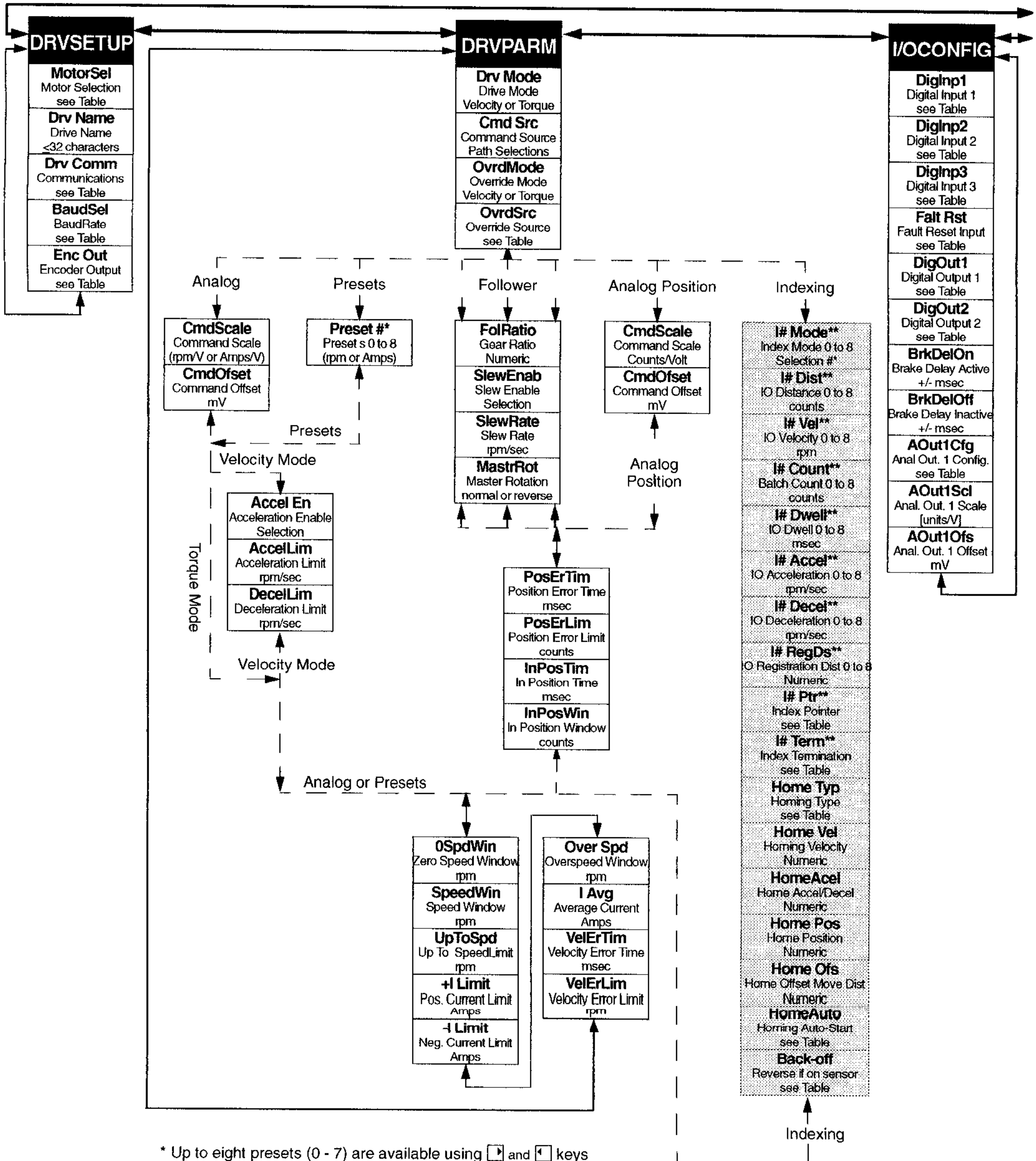
Numeric

Flashing characters in the Modify mode display are the numbers that are active.

- Change the cursor position and resolution using the [►] or [◄] key. For example: If the Over Spd in the Modify mode displays 5200 and 52 is flashing, pressing the [►] key causes 520 to flash.
- Press the [▲] or [▼] key to increment or decrement these numbers.
  For example: If the Over Spd value is 5200 and 52 is flashing, pressing the [▲] key causes the setting to increment by 100 rpm each time the key is pressed.
- Parameter values may not exceed the maximum or minimum limits, regardless of the cursor position.
  For example: If the SpeedWin setting is 5000 rpm and the Maximum Speed in the motor table is 5200, pressing the [▲] key increases the parameter to 5200 (the upper limit), but pressing the [▼] key decrements the parameter to 4000.

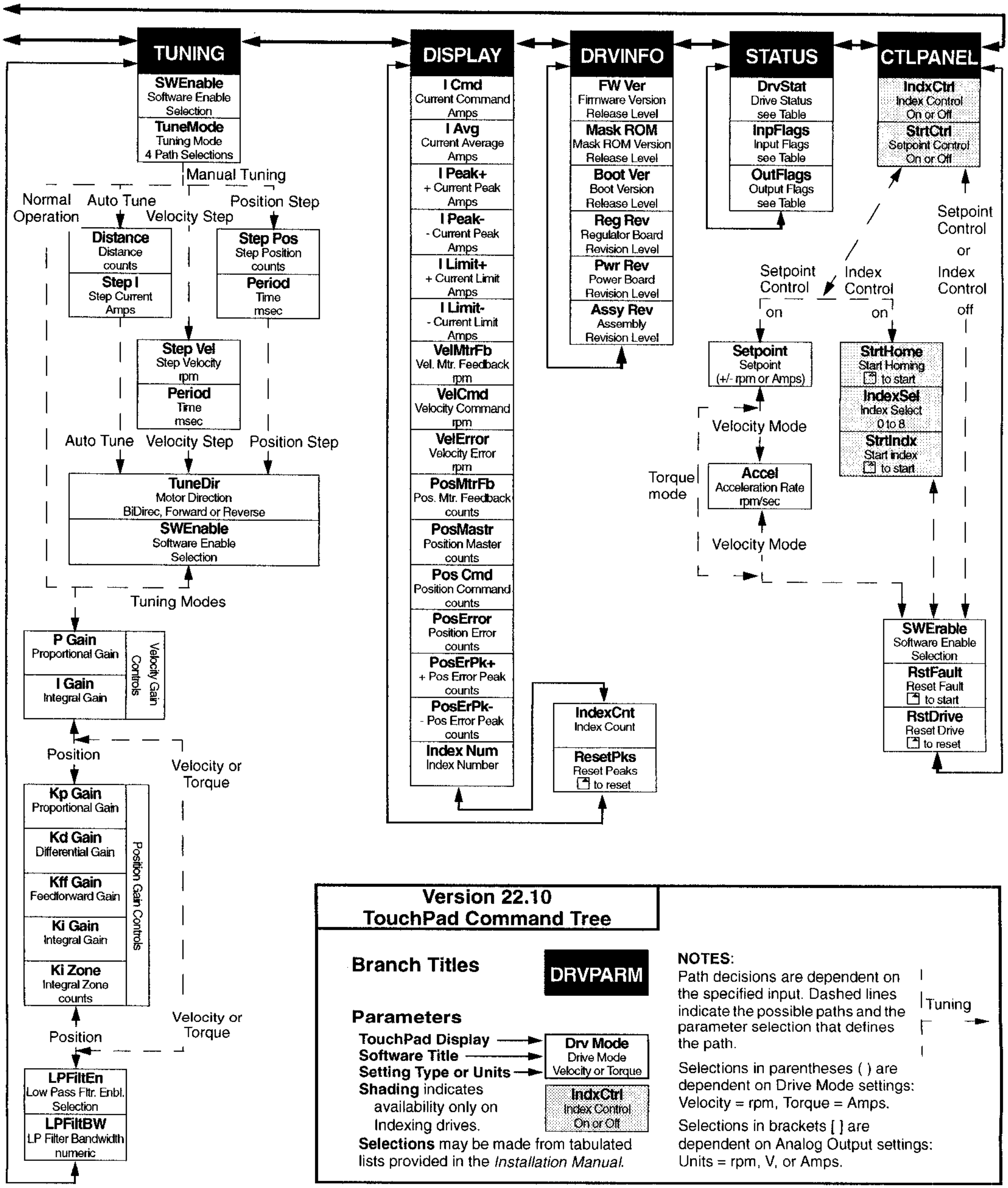
The most significant digit is reserved when a parameter allows a negative (-) setting or the parameter provides a list of possible selections. The [▲] or [▼] key toggles the minus sign.

Figure C.3 TouchPad Command Tree



* Up to eight presets (0 - 7) are available using [▶] and [◀] keys

** Up to nine index selections (0 - 9) are available using [▶] and [◀] keys


TUNING
SWEnable
Software Enable Selection
TuneMode
Tuning Mode
4 Path Selections
Manual Tuning
Normal Operation
Auto Tune
Velocity Step
Position Step
Distance
Distance
counts
Step I
Step Current
Amps
Step Pos
Step Position
counts
Period
Time
msec
Step Vel
Step Velocity
rpm
Period
Time
msec
Auto Tune
Velocity Step
Position Step
TuneDir
Motor Direction
BiDirec, Forward or Reverse
SWEnable
Software Enable
Selection
Tuning Modes
P Gain
Proportional Gain
I Gain
Integral Gain
Velocity Gain Controls
Position
Velocity or Torque
Kp Gain
Proportional Gain
Kd Gain
Differential Gain
Kff Gain
Feedforward Gain
Ki Gain
Integral Gain
Ki Zone
Integral Zone
counts
Position Gain Controls
Position
Velocity or Torque
LPFiltEn
Low Pass Fltr. Enbl.
Selection
LPFiltBW
LP Filter Bandwidth
numeric
DISPLAY
I Cmd
Current Command
Amps
I Avg
Current Average
Amps
I Peak+
+ Current Peak
Amps
I Peak-
- Current Peak
Amps
I Limit+
+ Current Limit
Amps
I Limit-
- Current Limit
Amps
VelMtrFb
Vel. Mtr. Feedback
rpm
VelCmd
Velocity Command
rpm
VelError
Velocity Error
rpm
PosMtrFb
Pos. Mtr. Feedback
counts
PosMastr
Position Master
counts
Pos Cmd
Position Command
counts
PosError
Position Error
counts
PosErPk+
+ Pos Error Peak
counts
PosErPk-
- Pos Error Peak
counts
Index Num
Index Number
IndexCnt
Index Count
ResetPks
Reset Peaks
to reset
DRVINFO
FW Ver
Firmware Version
Release Level
Mask ROM
Mask ROM Version
Release Level
Boot Ver
Boot Version
Release Level
Reg Rev
Regulator Board
Revision Level
Pwr Rev
Power Board
Revision Level
Assy Rev
Assembly
Revision Level
STATUS
DrvStat
Drive Status
see Table
InpFlags
Input Flags
see Table
OutFlags
Output Flags
see Table
CTLPANEL
IndxCtrl
Index Control
On or Off
StrtCtrl
Setpoint Control
On or Off
Setpoint Control
on
Index Control
on
Setpoint Control
or
Index Control
off
Setpoint
Setpoint
(+/- rpm or Amps)
Velocity Mode
Torque mode
Accel
Acceleration Rate
rpm/sec
Velocity Mode
StrtHome
Start Homing
to start
IndexSel
Index Select
0 to 8
StrtIndx
Start index
to start
SWErable
Software Enable
Selection
RstFault
Reset Fault
to start
RstDrive
Reset Drive
to reset
Version 22.10
TouchPad Command Tree
Branch Titles
DRVPARM
Parameters
TouchPad Display
Software Title
Setting Type or Units
Shading indicates
availability only on
Indexing drives.
Drv Mode
Drive Mode
Velocity or Torque
IndxCtrl
Index Control
On or Off
Selections may be made from tabulated lists provided in the Installation Manual.
NOTES:
Path decisions are dependent on the specified input. Dashed lines indicate the possible paths and the parameter selection that defines the path.
Tuning
Selections in parentheses ( ) are dependent on Drive Mode settings: Velocity = rpm, Torque = Amps.
Selections in brackets [ ] are dependent on Analog Output settings: Units = rpm, V, or Amps.

List

The most significant digit is reserved for an active/inactive selection marker when a parameter provides a list of possible selections.

- A filled arrow, ➧, in the most significant digit indicates the active setting from a list of possible settings. Inactive settings are indicated by a unfilled arrow, ⇨.
  For example: If the drive is functioning as Preset Controller in the Velocity mode, pressing the ⇩ key from DRVPARAM scrolls through the CmdSrc list which includes ➧Presets, ⇨AuxEnc, ⇨StepDir, ⇨StepU/D, and ⇨Analog.
- The Mode/Enter, ⇦, key selects a parameter from the list.
- List selections that are undefined are indicated by ➧ Unknown. This display indicates the TouchPad data table is incompatible with the drive.

Lists are associated with all parameters, except DISPLAY and DRVINFO. Refer to the tables beginning on page C-280 for the items in each list. Table C.17, "Drive Status List for TouchPad" on page C-285 is a read-only list, all other lists contain possible parameter selections. After an option is selected, the display reverts to the parameter from which the option was selected. For example: Selection of the EncAlign parameter under STATUS provides the options ➧ Normal and ⇨ Align. Selection of either option returns you to the EncAlign display.

Ratio

A FolRatio (gear ratio) longer than eight characters may require scrolling with the ▶ and ◀ keys. The ratios are numeric values that increment or decrement by 1 each time the ▲, or ▼, key is pressed.

The method of display is dependent on the length of the ratios:

- If the ratio is eight characters or less, the complete ratio is displayed.
  For example, a Master to Follower ratio of one-thousand to nine-hundred is displayed as 1000:900.
- If the ratio requires more than eight characters the ratio is displayed in two parts: a Master Ratio and a Follower Ratio. The position of the colon (:) after or before each numeric value indicates Master or Follower for these larger ratios.
  The ▶ and ◀ keys toggle between the Master Ratio and the Follower Ratio.
  For example: A Master to Follower ratio on 1001:1000 is displayed in two separate displays. The Master Ratio is displayed as 1001: and pressing ▶ displays the Follower Ratio :1000.

Fault/Error/Warning

C.1lists the possible fault, error and warning messages that may appear on the TouchPad. The items below describe the different types of messages.

- The TouchPad displays Fault and a description. A Fault message requires additional troubleshooting of the drive.
  Clear the fault display by depressing the ▲ and ▼ keys simultaneously.
  Fault codes are stored in the TouchPad parameter DrvStat and are explained with troubleshooting guidelines in Table 11.1 on page 11-220.
- The TouchPad alternately displays Error and the error name. Clear an error by pressing the ← key.
- The TouchPad momentarily displays and then clears a warning when an invalid entry is made.

Table C.1 TouchPad Fault/Error/Warning Displays

Display	Level	Description
BufOvFlo	Error	Communications buffer overflowed.
Can'tDo	Error	An invalid function type encountered in the TouchPad data table. The TouchPad data table is incorrect for the drive.
Checksum	Error	The checksum of the command is in error. Information is corrupted.
CmdNoEnb	Error	The command is not enabled.
DataDisp	Warning	The parameter is a live data display and cannot be modified.
DrvEnabl	Warning	The parameter cannot be changed while the drive is enabled.
Fault	Fault	Drive fault detected.
InvlData	Warning	Invalid data was entered for the parameter.
InvldFn	Error	Illegal function code received by drive. The TouchPad data table is incorrect for the drive.
InvldRsp	Error	Invalid Response received from drive. Received code did not match transmitted code.
Lower Lim	Warning	The lower limit of the parameter has been reached.
NoMemory	Error	TouchPad memory has been exhausted.
NoRetSel	Warning	Mode/Enter key incorrectly pressed.
OverRng	Error	Value from drive is too large to display.
RAMWrite	Error	An error was detected while writing the drive's parameter memory.
ReadOnly	Warning	The parameter is Read Only and cannot be modified.
Timeout	Error	The communications port timed out.
UnxpChar	Error	The communications port received an unexpected character.
UpperLim	Warning	The upper limit of the parameter has been reached.

Motor Table

Table C.2 TouchPad Motor Table Identification by Motor Series

Motor	ID	Motor	ID	Motor	ID	Motor	ID
FSM430 B24	15	HSM610	27	NSM4220 E5000	852	SSM620	12
FSM460 B24	3	HSM620	28	NSM5630	85	SSM630	6
FSM490 B24	16	HSM630	29	NSM5630 E5000	853	SSM835	13
FSM610 B24	17	HSM835	30	NSM5637	86	SSM845	14
FSM620 B24	18	HSM845	31	NSM5637 E5000	854	YSM102 115V	69
FSM620 E5000	786	NSM2302	335	NSM5647	87	YSM102 230V	68
FSM630	19	NSM2304	336	NSM5647 E5000	855	YSM103 115V	71
HSM205	20	NSM3406	81	SSM205	8	YSM103 230V	70
HSM307	21	NSM3406 E5000	849	SSM307	4	YSM206 115V	73
HSM320	22	NSM3412	82	SSM320	5	YSM206 230V	72
HSM430	23	NSM3412 E5000	850	SSM430	9	YSM212 B24 115V	75
HSM460	25	NSM4214	83	SSM460	1	YSM212B24 230V	74
HSM490	26	NSM4214 E5000	851	SSM490	2	YSM323 230V	77
HSM490 E5000	794	NSM4220	84	SSM610	11		

Table C.3 TouchPad Motor Table Identification by Motor ID

ID	Motor	ID	Motor	ID	Motor	ID	Motor
1	SSM460	17	FSM610 B24	68	YSM102 230V	86	NSM5637
2	SSM490	18	FSM620 B24	69	YSM102 115V	87	NSM5647
3	FSM460 B24	19	FSM630	70	YSM103 230V	335	NSM2302
4	SSM307	20	HSM205	71	YSM103 115V	336	NSM2304
5	SSM320	21	HSM307	72	YSM206 230V	786	FSM620 E5000
6	SSM630	22	HSM320	73	YSM206 115V	794	HSM490 E5000
8	SSM205	23	HSM430	74	YSM212B24 230V	849	NSM3406 E5000
9	SSM430	25	HSM460	75	YSM212 B24 115V	850	NSM3412 E5000
11	SSM610	26	HSM490	77	YSM323 230V	851	NSM4214 E5000
12	SSM620	27	HSM610	81	NSM3406	852	NSM4220 E5000
13	SSM835	28	HSM620	82	NSM3412	853	NSM5630 E5000
14	SSM845	29	HSM630	83	NSM4214	854	NSM5637 E5000
15	FSM430 B24	30	HSM835	84	NSM4220	855	NSM5647 E5000
16	FSM490 B24	31	HSM845	85	NSM5630		

TouchPad Options and Lists

Table C.4 Option Selections for the TouchPad

DRVPARM		TUNING	
Parameter	**Options**	**Parameter**	**Options**
AccelEn	Enable/Disable	SWEnable	Enable/Disable
SlewEnab	Enable/Disable		
I OverRd	Enable/Disable		

STATUS		CTLPANEL	
Parameter	**Options**	**Parameter**	**Options**
SWEnable	Enable/Disable	SWEnable	Enable/Disable
EncAlign	Normal/Align	Start	Normal/CtlPanel
RmvOfst	$\boxed{\blacktriangle}$ to Rmv		

TouchPad Lists

Table C.5 Drive Communications Parameter List for the TouchPad

Display	Parameter
00	7 Data Bits, 1 Stop Bit, Even Parity
01	7 Data Bits, 1 Stop Bit, Odd Parity
02	8 Data Bits, 1 Stop Bit, No Parity
03	8 Data Bits, 1 Stop Bit, Even Parity
04	8 Data Bits, 1 Stop Bit, Odd Parity

Table C.6 Baud Rate Parameter List for TouchPad

Display	Parameter
00	1200 Baud
01	2400 Baud
02	4800 Baud
03	9600 Baud
04	19200 Baud

Table C.7 Encoder Output Parameter List for TouchPad

Display	Parameter
÷ by 1	Divide Encoder counts by 1
÷ by 2	Divide Encoder counts by 2
÷ by 4	Divide Encoder counts by 4
÷ by 8	Divide Encoder counts by 8

Table C.8 IO Mode Parameter List for TouchPad

Display	Parameter[a]
Inc	Incremental Indexing
Abs	Absolute Indexing
Reg	Registration Indexing

a. Parameters available only if the drive supports Indexing.

Table C.9 Index Pointer Parameter List for TouchPad

Display	Parameter[a]
00	Index 0
01	Index 1
02	Index 2
03	Index 3
04	Index 4
05	Index 5
06	Index 6
07	Index 7
08	RAM Index

a. Parameters available only if the drive supports Indexing.

Table C.10 Index Termination Parameter List for TouchPad

Display	Parameter[a]
Stop	Stop
NxtINow	Start another Index immmediately
NxtIWt	Start another Index at next Start Index transition

a. Parameters available only if the drive supports Indexing.

Table C.11 Home Type Parameter List for TouchPad

Display	Parameter[a]
Sns/Mrk	Home to Sensor, then to Marker
Marker	Home to Marker
Sensor	Home to Sensor

a. Parameters available only if the drive supports Indexing.

Table C.12 Homing Auto-Start Parameter List for TouchPad

Display	Parameter[a]
Disable	Auto-Start Homing inactive
Enb/Rst	Auto-Start Homing if not already Homed
Enable	Auto-Start on every Enable

a. Parameters available only if the drive supports Indexing.

Table C.13 Reverse Enable for Homing

Display	Parameter[a]
Inactive	No reversing if started on Sensor
Active	Reverse if started on Sensor

a. Parameters available only if the drive supports Indexing.

Table C.14 Digital Input Parameter List for TouchPad

Display	Parameter
Not Asgn	Not Assigned (not used)
DrvMode	Drive Mode
IntInh	Integrator Inhibit
FolEnab	Follower Enable
FwdEnab	Forward Enable
RevEnab	Reverse Enable
CMD Ovrd	Analog COMMAND Input Override
PreSelA	Preset Select Line A
PreSelB	Preset Select Line B
PreSelC	Preset Select Line C
StrtInd	Start Index
DefHome	Define Home
Registr	Registration/Sensor
-CmdOfs	Remove Command Offset
Home	Start Homing
FaltRst	Fault Reset

Table C.15 Digital Output Parameter List for TouchPad

Display	Parameter
Not Asgn	Not Assigned (not used)
InPos	In Position
PosWin	Within Position
0 Speed	Zero Speed
SpdWin	Speed Window
+ILimit	Positive Current Limit
-ILimit	Negative Current Limit
UpToSpd	Up to Speed
DrvEnab	Drive Enable

Display	Parameter
BusChg	Bus Charged
Fault	Disabling Fault
AtHome	At Home
SeqEnd	Sequence Complete
Moving	In Motion
InDwell	In Dwell
Homed	Axis Homed

Table C.16 Analog Output Parameter List for TouchPad

Display	Parameter
I Cmd	Current Command
I Avg	Average Current Command
IPeak+	Positive Current Peak
IPeak-	Negative Current Peak
ILimit+	Positive Current Limit
ILimit-	Negative Current Limit
VelMtr	Motor Velocity
VelCmd	Velocity Command
VelErr	Velocity Error
PosMtr	Motor Position
PosCmd	Position Command Slewed
PosErr	Position Error
PosEPk+	Positive Position Peak Error
PosEPk-	Negative Position Peak Error
PosMstr	Master Position

Table C.17 Drive Status List for TouchPad

Display	Parameter
DrvEnab	Drive Enabled
DrvRdy	Drive Ready
+24 Fuse	+24 VDC Fuse blown *not applicable to DSM 007, DSM 007P, DSM 015, DSM 015P, DSM 030 or DSM 030P*
5v Fuse	+5 VDC Fuse blown *not applicable to DSM 007, DSM 007P, DSM 015, DSM 015P, DSM 030 or DSM 030P*
EncFuse	Encoder Power Fuse blown *not applicable to DSM 007, DSM 007P, DSM 015, DSM 015P, DSM 030 or DSM 030P*
MtrOvT	Motor Thermostat Overtemperature
IPMFalt	IPM Fault (Overtemperature/Overcurrent/Short Circuit)
IMLinBk	Channel IM Line Break
BMLinBk	Channel BM Line Break
AMLinBk	Channel AM Line Break
BusOvV	Bus Undervoltage
BusUndV	Bus Overvoltage
IlglHal	Illegal Hall State
SubIntr	Unused Interrupt - sub processor
MainInt	Unused Interrupt - main processor
ExsAvgI	Excessive Average Current
OvSpeed	Motor Overspeed
ExsFErr	Excessive Following Error
MtrEnc	Motor Encoder State Error
MstrEnc	Auxiliary Encoder State Error
MtrThrm	Motor Thermal Protection
IPMThrm	IPM Thermal Protection
EnNoMtr	No Motor Selected while enabling drive
MtrType	Motor Selection not in Table
PersWrt	Personality Write Error
ServWrt	Service Write Error

Display	Parameter
CPUComm	CPU Communications Error
MtrOvt	Motor Overtemperature
IPMFalt	IPM Fault
ExsVErr	Excess Velocity Error
Comutat	Commutation Angle Error
Not Homd	Axis Not Homed

NOTE: The Drive Status display is read-only. DrvEnab and DrvRdy indicate the drive is functional. The other displays indicate an error condition.

Table C.18 Input Flags Parameter List for TouchPad

Display	Parameter
FltRst	Fault Reset Input Flag
ENABLE	Drive Enable Input Flag
Input1	Input 1 Input Flag
Input2	Input 2 Input Flag
Input3	Input 3 Input Flag

Table C.19 Output Flags Parameter List for TouchPad

Display	Parameter
READY	Ready Output Flag
BRAKE	Brake Output Flag
Outpt1	Output 1 Flag
Outpt2	Output 2 Flag

Electromagnetic Compatibility Guidelines for Machine Design D

This appendix provides background information about Electromagnetic Interference (EMI) and machine design guidelines for Electromagnetic Compatibility (EMC). Installation requirements for compliance to the European Electromagnetic Compatibility Directive are specified in "European Union Requirements" on page 3-62. AC Line Filters necessary for European EMC compliance are listed in "AC Line Filters" on page 5-76.

Introduction

Perhaps no other subject related to the installation of industrial electronic equipment is so misunderstood as electrical noise. The subject is complex and the theory easily fills a book. This section provides guidelines that can minimize noise problems.

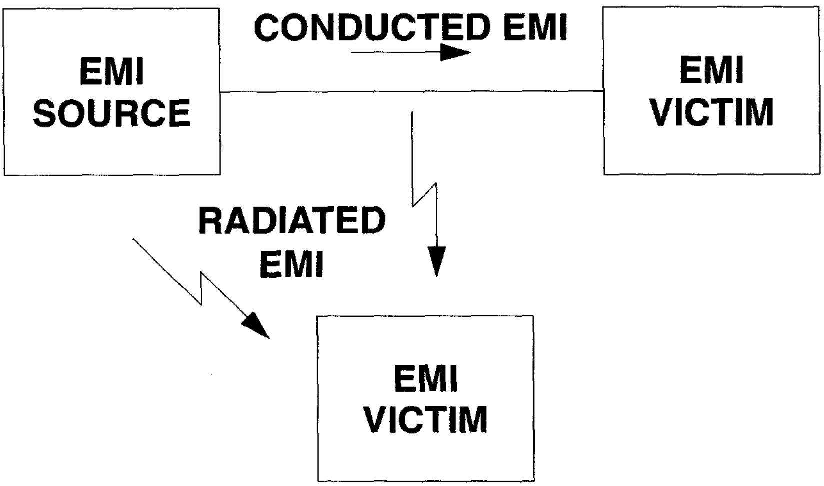
The majority of installations do not exhibit noise problems. However, the filtering and shielding guidelines are provided as counter measures. The grounding guidelines provided below are simply good grounding practices. They should be followed in all installations.

Electrical noise has two characteristics: the generation or emission of electromagnetic interference (EMI), and response or immunity to EMI. The degree to which a device does not emit EMI, and is immune to EMI is called the device's Electromagnetic Compatibility (EMC).

Equipment which is to be brought into the European Union legally requires a specific level of EMC. Since this applies when the equipment is brought into use, it is of considerable importance that a drive system, as a component of a machine, be correctly installed.

"EMI Source-Victim Model" shows the commonly used EMI model. The model consists of an EMI source, a coupling mechanism and an EMI victim. Devices such as servo drives and computers, which contain switching power supplies and microprocessors, are EMI sources. The mechanisms for the coupling of energy between the source and victim are conduction and radiation. Victim equipment can be any electromagnetic device that is adversely affected by the EMI coupled to it.

Figure D.1 EMI Source-Victim Model



Immunity to EMI is primarily determined by equipment design, but how you wire and ground the device is also critical to achieving EMI immunity. Therefore, it is important to select equipment that has been designed and tested for industrial environments. The EMI standards for industrial equipment include the EN61000-4-X series (IEC 1000-4-X and IEC801-X), EN55011 (CISPR11), ANSI C62 and C63 and MIL-STD-461. Also, in industrial environments, you should use encoders with differential driver outputs rather than single ended outputs, and digital inputs/outputs with electrical isolation, such as those provided with optocouplers.

The EMI model provides only three options for eliminating the EMC problem:

- reduce the EMI at the source,
- increase the victim's immunity to EMI (harden the victim), or
- reduce or eliminate the coupling mechanism.

In the case of servo drives, reducing the EMI source requires slowing power semiconductor switching speeds. However, this adversely affects drive performance with respect to heat dissipation and speed/torque regulation. Hardening the victim equipment may not be possible, or practical. The final, and often the most realistic solution is to reduce the coupling mechanism between the source and victim. This can be achieved by filtering, shielding and grounding.

Filtering

As mentioned above, high frequency energy can be coupled between circuits via radiation or conduction. The AC power wiring is one of the most important paths for both types of coupling mechanisms. The AC line can conduct noise into the drive from other devices, or it can conduct noise directly from the drive into other devices. It can also act as an antenna and transmit or receive radiated noise between the drive and other devices.

One method to improve the EMC characteristics of a drive is to use an isolation AC power transformer to feed the amplifier its input power. This minimizes inrush currents on power-up and provides electrical isolation. In addition, it provides common mode filtering, although the effect is limited in frequency by the interwinding capacitance. Use of a Faraday shield between the windings can increase the common mode rejection bandwidth, (shield terminated to ground) or provide differential mode shielding (shield terminated to the winding).

▶ NOTE: "Common mode" noise is present on all conductors referenced to ground. "Differential mode" noise is present on one conductor referenced to another conductor.

One alternative to AC line filters to reduce the conducted EMI emitting from the drive. This allows nearby equipment to operate undisturbed. In many cases an AC line filter will not be required unless other sensitive circuits are powered off the same AC branch circuit. The basic operating principle is to minimize the high frequency power transfer through the filter. An effective filter achieves this by using capacitors and inductors to mismatch the source impedance (AC line) and the load impedance (drive) at high frequencies.

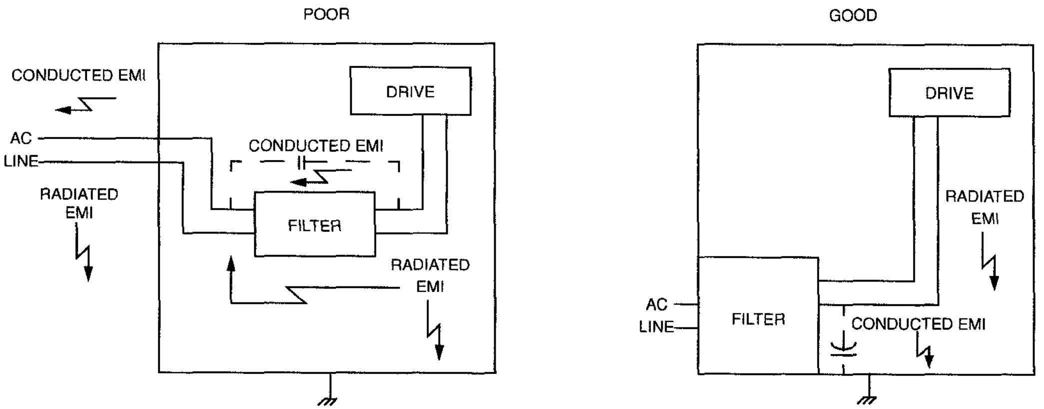
For drives brought into use in Europe, use of the correct filter is essential to meet emission requirements. Detailed information on filters is included in the manual and transformers should be used where specified in the manual.

AC Line Filter Selection

Selection of the proper filter is only the first step in reducing conducted emissions. Correct filter installation is crucial to achieving both EMI attenuation and to ensure safety. All of the following guidelines should be met for effective filter use.

1. The filter should be mounted to a grounded conductive surface.
2. The filter must be mounted close to the drive input terminals, particularly with higher frequency emissions (5-30 MHz). If the distance exceeds 600mm (2 feet), a strap should be used to connect the drive and filter, rather than a wire.
3. The wires connecting the AC source to the filter should be shielded from, or at least separated from the wires (or strap) connecting the drive to the filter. If the connections are not segregated from each other, then the EMI on the drive side of the filter can couple over to the source side of the filter, thereby reducing, or eliminating the filter effectiveness. The coupling mechanism can be radiation, or stray capacitance between the wires. The best method of achieving this is to mount the filter where the AC power enters the enclosure. "AC Line Filter Installation" shows a good installation and a poor installation.

Figure D.2 AC Line Filter Installation



When multiple power cables enter an enclosure, an unfiltered line can contaminate a filtered line external to the enclosure. Therefore, all lines must be filtered to be effective. The situation is similar to a leaky boat. All the holes must be plugged to prevent sinking.

WARNING

Large leakage currents exist in AC line filters. They must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels prior to handling the equipment. Failure to observe this precaution could result in severe bodily injury.

If the filter is mounted excessively far from the drive, it may be necessary to mount it to a grounded conductive surface, such as the enclosure, to establish a high frequency (HF) connection to that surface. To achieve the HF ground, direct contact between the mounting surface and the filter must be achieved. This may require removal of paint or other insulating material from the cabinet or panel.

The only reasonable filtering at the drive output terminals is the use of inductance. Capacitors would slow the output switching and deteriorate the drive performance. A common mode choke can be used to reduce the HF voltage at the drive output. This will reduce emission coupling through the drive back to the AC line. However, the motor cable still carries a large HF voltage and current. Therefore, it is very important to segregate the motor cable from the AC power cable. More information on cable shielding and segregation is contained in the section on shielding.

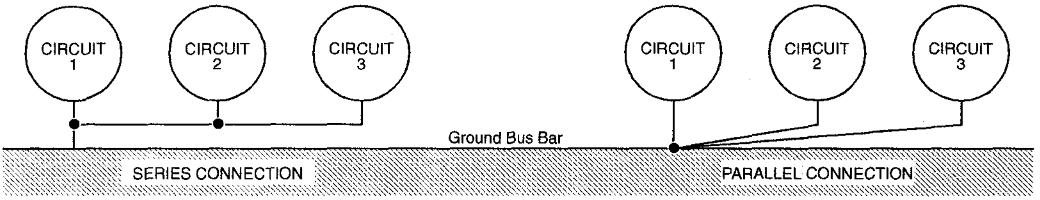
Grounding

High frequency (HF) grounding is different from safety grounding. A long wire is sufficient for a safety ground, but is completely ineffective as an HF ground due to the wire inductance. As a rule of thumb, a wire has an inductance of 8 nH/in regardless of diameter. At low frequencies it acts as a constant impedance, at intermediate frequencies as an inductor, and at high frequencies as an antenna. The use of ground straps is a better alternative to wires. However the length to width ratio must be 5:1, or better yet 3:1, to remain a good high frequency connection.

The ground system's primary purpose is to function as a return current path. It is commonly thought of as an equipotential circuit reference point, but different locations in a ground system may be at different potentials. This is due to the return current flowing through the ground systems finite impedance. In a sense, ground systems are the sewer systems of electronics and as such are sometimes neglected.

The primary objective of a high frequency ground system is to provide a well defined path for HF currents and to minimize the loop area of the HF current paths. It is also important to separate HF grounds from sensitive circuit grounds. "Single Point Ground Types" shows single point grounds for both series (daisy chain) and parallel (separate) connections. A single point, parallel connected ground system is recommended.

Figure D.3 Single Point Ground Types



A ground bus bar or plane should be used as the "single point" where circuits are grounded. This will minimize common (ground) impedance noise coupling. The ground bus bar (GBB) should be connected to the AC ground, and if necessary, to the enclosure. All circuits or subsystems should be connected to the GBB by separate connections. These connections should be as short as possible, and straps should be used when possible. The motor ground conductor must return to the ground terminal on the drive, not the GBB.

Shielding and Segregation

The EMI radiating from the drive enclosure drops off very quickly over distance. Mounting the drive in an enclosure, such as an industrial cabinet, further reduces the radiated emissions. The cabinet should have a high frequency ground and the size of the openings should be minimized. In addition, the drive is considered an "open" device which does not provide the proper IP rating for the environment in which it is installed. For this reason the enclosure must provide the necessary degree of protection. An IP rating or Nema rating (which is similar to IP) specifies the degree of protection that an enclosure provides.

The primary propagation route for EMI emissions from a drive is through cabling. The cables conduct the EMI to other devices, and can also radiate the EMI. For this reason, cable segregation and shielding are important factors in reducing emissions. Cable shielding can also increase the level of immunity for a drive. For example:

- Shield termination at both ends is extremely important. The common misconception that shields should be terminated at only one end originates from audio applications with frequencies $\leq$20 kHz. RF applications must be terminate the shield at both ends, and possibly at intermediate points for exceptionally long cables.
- When shielded cables are not terminated at the cable connection and pass through the wall of a cabinet, the shield must be bonded to the cabinet wall to prevent noise acquired inside the cabinet from radiating outside the cabinet, and vice versa.

- When shielded cables are terminated to connectors, the shield must be provide complete 360° coverage and terminate through the connector backshell. The shield must *not* be grounded inside the connector through a drain wire. Grounding the shield inside the connector couples the noise on the shield to the signal conductors sharing the connector and virtually guarantees failure to meet European EMC requirements.
- The shield must be continuous. Each intermediate connector must continue the shield connection through the backshell.
- All cables, both power and signal, should use twisted wire pairing.

The shield termination described above provides a coaxial type of configuration which provides magnetic shielding, and the shield provides a return path for HF currents that are capacitively coupled from the motor windings to the frame. If power frequency circulating currents are an issue, a 250 VAC capacitor should be used at one of the connections to block 50/60 Hz current while passing HF currents. Use of a properly shielded motor cable is essential to meet European EMC requirements.

The following suggestions are recommended for all installations.

1. Motor cables must have a continuous shield and be terminated at both ends. The shield must connect to the ground bus bar or drive chassis at the drive end, and the motor frame at the motor end. Use of a properly shielded motor cable is essential to meet European EMC requirements.

2. Signal cables (encoder, serial, analog) should be routed away from the motor cable and power wiring. Separate steel conduit can be used to provide shielding between the signal and power wiring. Do not route signal and power wiring through common junctions or raceways.

3. Signal cables from other circuits should not pass within 300 mm (1 ft.) of the drive.

4. The length or parallel runs between other circuit cables and the motor or power cable should be minimized. A rule of thumb is 300 mm (1 ft.) of separation for each 10 m (30 ft.) of parallel run. The 30 mm (1 ft.) separation can be reduced if the parallel run is less than 1 m (3 ft.).

5. Cable intersections should always occur at right angles to minimize magnetic coupling.

6. The encoder mounted on the brushless servo motor should be connected to the amplifier with a cable using multiple twisted wire pairs and an overall cable shield. Encoder cables are offered in various lengths that have correct terminations.

Persistent EMI problems may require additional countermeasures. The following suggestions for system modification may be attempted.

1. A ferrite toroid or "doughnut" around a signal cable may attenuate common mode noise, particularly RS-232 communication problems. However, a ferrite toroid will not help differential mode noise. Differential mode noise requires twisted wire pairs.
2. Suppress each switched inductive device near the servo amplifier. Switch inductive devices include solenoids, relay coils, starter coils and AC motors (such as motor driven mechanical timers).
3. DC coils should be suppressed with a "free-wheeling" diode connected across the coil.
4. AC coils should be suppressed with RC filters (a 200 Ohm ½ Watt resistor in series with a 0.5 uF, 600 Volt capacitor is common).

Following these guidelines can minimize noise problems. However, equipment EMC performance must meet regulatory requirements in various parts of the world, specifically the European Union. Ultimately, it is the responsibility of the machine builder to ensure that the machine meets the appropriate requirements as installed.

EMC
DECLARATION OF CONFORMITY

Application of Council Directive(s) 89/336/EEC, 92/31/EEC, 93/68/EEC

Manufacturer's Name: Giddings & Lewis
Manufacturer's Address: 666 South Military Road
Fond du Lac, Wisconsin 54936-1658

European Representative Name: Giddings & Lewis
European Representative Address: Randles Road, Knowsley Industrial Park
Prescot, Merseyside L34 9EZ England

Herewith declares that all servo drives listed below,

Model Name	Part Number	Model Name	Part Number
DSM110	401-34400-00	DSM130	401-34402-00
DSM120	401-34401-00	DSM175	401-34403-00

when operating any of the following motor families,

SSM, HSM, and FSM

when operating with or without the optional Touch Pad,

P/N 401-34405-00

and when installed in accordance with the installation instructions contained in the "Centurion DSM100 Drive Hardware and Installation Manual,"

P/N 108-30083-00

conform to the following generic and basic standards.

EN 55011:1993	(CISPR 1) Group 1 class A
EN 50082-2:1995	EN 61000-4-2, ENV 50140, ENV 50204, EN 61000-4-4, ENV 50141, EN 61000-4-8

We, the undersigned, hereby declare that the equipment specified above conforms to the above directive(s).

Manufacturer	**Legal Representative in Europe**
Signature Dylan B. Vanderhaar	Signature
Full Name Douglas B. Vonderhaar	Full Name ROGER MICHAEL COLLINS
Position Vice President and General Manager	Position FINANCE DIRECTOR
Place Giddings & Lewis Automation Control	Place Giddings & Lewis Knowsley
Date 29 MAR 96	Date APRIL 4.96.

Dynamic Braking Resistor Selection E

This appendix provides equations to assist in sizing resistors for dynamic braking.

Introduction

A properly sized resistive load may be required to dynamically brake the system by dissipating the energy stored in a motor. The section "Emergency Stop Wiring" on page 7-135 depicts the necessary circuitry.

Winding inductance is ignored in this analysis, which allows the load on the motor winding to be considered as purely resistive when dynamic braking occurs. This simplifies the evaluation to a scalar analysis, instead of a vector analysis. For simplicity, friction, damping and load torque also are ignored in the equations.

Dynamic Braking Equations

Equations for the magnitude of instantiates velocity, and per phase current, energy and power are derived by solving the differential equation governing the motor velocity. The equations are shown below.

Table E.1 Dynamic Braking Resistor Parameters

Parameter	Description	Parameter	Description
i(t)	Phase Current	R_L	Line-Neutral Dynamic Braking Resistance
E(t)	Per Phase Energy	K_E	Peak Line-to-Line Back EMF
J_m	Motor Inertia	K_T	Peak Line-to-Line Torque Constant
J_L	Load Inertia	ω_o	Initial Angular Velocity
P(t)	Per Phase Power	w	Angular Velocity
R	Motor Line-to-Line Resistance	t	Time

Figure E.1 Dynamic Braking Equations

$$\omega(t) = \omega_o e^{-t/\tau}$$

where

$$\tau = 0.866\left[\frac{(R + 2R_L)(J_M + J_L)}{K_E K_T}\right] \tag{1}$$

$$i(t) = \frac{K_E \omega_o e^{-t/\tau}}{0.866(R + 2R_L)}$$

$$E(t) = \frac{1}{2}(J_L + J_M)\omega_o^2 e^{-2t/\tau}$$

$$P(t) = \left[\frac{(J_L + J_M)\omega_o^2}{2\tau}\right]e^{-2t/\tau} = 1.154\left[\frac{K_E K_T \omega_o^2}{(R + 2R_L)}\right]e^{-2t/\tau} \tag{2}$$

For this type of response, 98% of the energy will be dissipated in 4 time constants. Therefore the average power for each dynamic braking event can be calculated as:

$$P_{AVE} = \frac{1}{2}(J_M + J_L)\omega_o^2\left(\frac{1}{4\tau}\right) = 0.144\frac{K_E K_T \omega_o^2}{(R + 2R_L)} \tag{3}$$

Equation 1 is used in equations 2 and 3 to put the power in terms of the motor parameters and the dynamic braking resistance (i.e., independent of the load inertia).

Sample Calculations

The following example uses an HSM490 motor with a 10 times inertia mismatch and dynamic braking resistors sized at four times the motor winding resistance. The average power of the motor is 1116 Watts for the selected parameters, but it is unlikely that a resistor with this Wattage is required. Pulse type currents, such as this example, require sufficient thermal mass to absorb the energy and to dissipate or accommodate the peak Voltage. Adequate information for intermittent duty cycle and surge current applications is seldom provided by resistor manufacturers. However, often they will assist in resistor selection when supplied with the current profile.

▶ NOTE: The equations using the symbol ":=" are "assigned" in Mathcad®.

Figure E.2 HSM490 Motor Parameters in MKS Units

$K_T := 0.74 \qquad R := 0.9 \qquad J_m := 0.00068$

$$K_E := 90 \qquad K_E := \frac{K_E \cdot 60}{2 \cdot \pi \cdot 1000} \qquad K_E = 0.859$$

Figure E.3 Load Inertia, Dynamic Braking Resistance and Velocity in MKS Units

$$R_L := 4 \cdot R \qquad J_L := 10 \cdot J_m \qquad \omega_o := \frac{3000 \cdot 2 \cdot \pi}{60} \qquad \omega_o = 314.159$$

Figure E.4 Time Vector

$t := 0, 0.01, \ldots 0.5$

Figure E.5 Time Constant (seconds)

$$\tau = \frac{0.866(R + 2 \cdot R_L) \cdot (J_m + J_L)}{K_E \cdot K_T} \qquad \tau = 0.083$$

Figure E.6 Current Calculation (Amps)

$$i(t) := \frac{K_E \cdot \omega_o \cdot e^{\frac{-t}{\tau}}}{0.866(R + 2 \cdot R_L)}$$

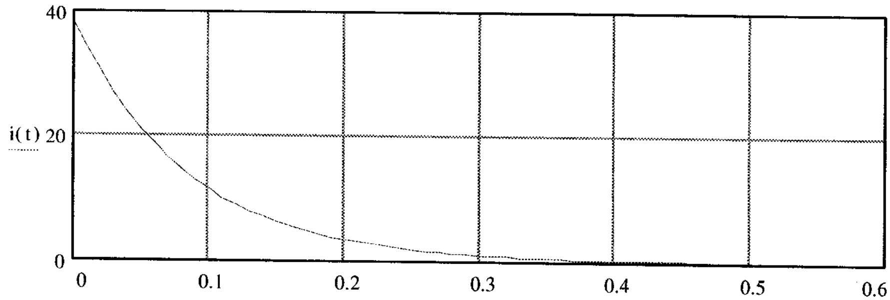


Figure E.7 Instantaneous Power Calculation (Watts)

$$P(t) := \left[\frac{1.154 \cdot K_E \cdot K_T \cdot \omega_o^2}{(R + 2 \cdot R_L)}\right] \cdot e^{\frac{-2 \cdot t}{\tau}}$$

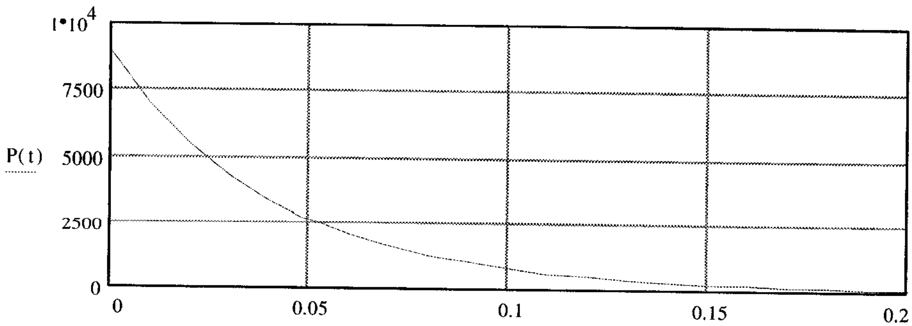


Figure E.8 Average Power (Watts)

$$P_{ave} := 0.144\left[\frac{K_E \cdot K_T \cdot \omega_o^2}{R + 2 \cdot R_L}\right]$$

$$P_{ave} = 1116$$

Agency Approvals	
UL and cUL	UL 508C File E15483
CE mark	Low Voltage Directive and Electromagnetic Compatibility Directive Certificate of Conformity from TUV Product Service
Environmental	
Operating Temperature	0°C to 55°C (32°F to 131°F)
Storage Temperature	-40°C to 70°C (-40°F to 158°F)
Humidity	5% to 95% non-condensing
Altitude	1500 meters (5000 feet) Derate 3% for each 300 m above 1500 m (1000 ft. above 5000 ft.)
Vibration	10 to 2000 Hz @ 2g
Shock	15g 11 millisecond half sine
Dielectric Withstanding (Hi-Pot)	
Main AC	1414 (1500) VDC for 1 minute, <5mA leakage current
NOTE: Metal Oxide Varistors (MOVs) between line and earth ground must be removed when testing. Internal EMI filter capacitors require testing with DC Voltage.	
Weight	
DSM 007, 007P	1.7 Kg (3.7 Lbs)
DSM 015, 015P	2.05 Kg (4.5 Lbs)
DSM 030, 030P	2.0 Kg (4.4 Lbs)
Motor Encoder Interface	
Signal Output Power	5 Volts DC
Encoder Inputs	A/B, Differential, 26LS33 input, 1 MHz (4 MHz Quadrature) Maximum Signal Frequency, 1/T Low Speed Measurement
Thermostat Inputs	Normally closed
Hall Inputs	Single-ended, 5 Volt Logic
ABS Input	0 to 5 Volt, 10-bit

User Interface	
Serial Port	RS-232 or four wire RS-485, 1200 to 19200 baud
Status Display	3 Level LED
Addressing	Software selected
Digital Inputs	
Selectable (4)	12-24 Volt, Optically Isolated, Single ended, Active High, 4.5 mA nominal
ENABLE	12-24 Volt, Optically Isolated, Single ended, Active High, 4.5 mA nominal. Minimum ON time = 1.5 msec.
Digital Outputs	
Selectable (2)	12-24 Volt, Short Circuit Protected, Optically Isolated, Single-ended, Active High, 50 mA maximum
BRAKE	Normally Open Relay, 1 A
READY	Normally Open Relay, 100 mA
Digital I/O Power Supply	User supplied 12 to 24 VDC
Analog Inputs	
Current Limit (I LIMIT)	0 to 10 Volt, single-ended, 5 kOhm input Impedance
COMMAND	±10 Volt, Differential, 13 kOhm input Impedance, offset software adjustable
Analog Outputs	
ANALOG1	0 to 10 Volt, 8 bits, 2 mA maximum
Auxiliary Encoder Input	
Auxiliary Encoder Signal Input	26LS33 Input, 4 MHz Count Frequency Differential/Single-ended A/B Step/Direction CW/CCW
Motor Encoder Output	
Motor Encoder Output	AM26C31 or AM26LS31 Differential Driver, Divide by 1, 2, 4, or 8 Differential output is 2.0 Vdc across a 100 Ohm load

Memory	
Parameter Data Retention	20 years
Motor Protection	
Motor Overload Protection	The drive utilizes solid state motor overload protection which operates: within 8 minutes at 200% overload within 20 seconds at 600% overload
Speed Regulation	
Type	Digital, PI
-3dB Bandwidth	300 Hz
-45° Bandwidth	50 Hz
Ripple	±0.44 rpm with 5000 line encoder
Speed Range	1:8000 rpm
Position Regulation	
Type	Digital, PI with Feedforward
Filters	
Low Pass	Digital, 0 - 1000 Hz, -3 dB Bandwidth, Selectable
Software Controls	
Data Collection (2)	128 samples @ 5 kHz Sample Rate
Firmware	Factory installed EEPROM
Operating Modes	Torque, Velocity or Position
Command Sources	Analog Auxiliary Encoder Presets Step/Direction CW/CCW Indexing: Incremental, Registration, Absolute (Indexing on DSM 007P, 015P and 030P only)
Autotuning	Position and Velocity Loop
Manual Tuning	Position or Velocity Loop
User Set-up	DSMPro or TouchPad

Software Controls (cont.)	
Diagnostics	Motor or Auxiliary Encoder Checks Digital Output Override Analog Output Override
Serial Protocol	7-bit ASCII, Checksum, Active Response
Power-Up Faults	EPROM Checksum EEPROM Checksum SRAM Write/Read Watchdog Reset A/D Conversion D/A Conversion
Run-Time Faults	Motor Overtemperature Bus Overvoltage IPM Fault Overspeed Excess Error Encoder State Change Illegal Hall State
Selectable Digital Inputs	Drive Mode Select Integrator Inhibit Follower Enable Forward Enable Reverse Enable Operation Mode Override Preset Selects Start Index Define Home Remove Command Offset Start Homing Sensor

Software Controls (cont.)	
Selectable Digital Outputs	In-Position Within Window Zero Speed Speed Window ± Current Limit Up To Speed Drive Enabled Bus Charged Disabling Motion In Motion In Dwell Sequence Complete Registered At Home Axis Homed
Speed Control Command	
Range	0 to ±32,767 RPM (actual maximum speed depends on the motor/drive combination)

Power

	DSM 007 & DSM 007P	DSM 015 & DSM 015P	DSM 030 & DSM 030P
AC Input Voltage and Frequency	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz
AC Input Current	5 A_{rms}	9 A_{rms}	18 A_{rms}
Bus Voltage	141-339 Vdc	141-339 Vdc	141-339 Vdc
Output Peak Current	7.5 Amps	15 Amps	30 Amps
Continuous Output Current (peak)	2.5 Amps	5 Amps	10 Amps
Bus Capacitance Energy Absorption (from 325-400 Vdc Bus)[a]	38 Joules C=1410uF	51 Joules C=1880uF	51 Joules C=1880uF
Peak Power Output[b]	120 Vac 0.9 kWatts 240 Vac1.8 kWatts	120 Vac 1.3 kWatts 240 Vac 2.7 kWatts	120 Vac 2.7 kWatts 240 Vac 5.5 kWatts
Continuous Power Output[b]	120 Vac 0.3 kWatts 240 Vac 0.6 kWatts	120 Vac 0.6 kWatts 240 Vac 1.2 kWatts	120 Vac 1.2 kWatts 240 Vac 2.5 kWatts

a. Bus capacitance energy absorption is based on the following equations:

$$\varepsilon = \frac{1}{2}C(V^2{}_f) - \frac{1}{2}C(V^2{}_i)$$

$$\varepsilon = \frac{1}{2}C(420)^2 - \frac{1}{2}C(325)^2$$

$$\frac{1}{2}C \cdot (420^2 - 325^2) = C(35387)$$

$$ifC = 17 \times 470uF, E = 282$$

b. Power outputs are based on the following equation:

$$kWatts = \left(VAC \times \frac{I_{Rmax}}{\sqrt{2}} \times \sqrt{3}\right) \times 0.85$$

Power Dissipation

Centurion DSM Drives dissipate power that results in cabinet heating. The following table lists power dissipation values. Calculate the cabinet cooling requirements using the power dissipation information and formulas below.

Current as % of Rated Continuous Current	DSM 007 & DSM 007P	DSM 015 & DSM 015P	DSM 030 & DSM 030P
100	48 W	48 W	50 W
NOTE: These values do *not* include external shunt regulator power (regenerated power).			

Maximum power losses are shown to help size a NEMA 12 or equivalent enclosure and to ensure the required ventilation. Typical power losses are about one-half maximum power losses.

When sizing an enclosure with no active method of heat dissipation, the following equation approximates the size of enclosure necessary:

$$T = 4.08 * (Q/A) + 1.1$$

where:
T = Temperature difference between inside air and outside ambient (°F)
Q = Heat generated in enclosure (watts)
A = Enclosure surface area in $ft.^2 = (2dw + 2dh + 2wh) / 144$
d = Depth in inches
h = Height in inches
w = Width in inches

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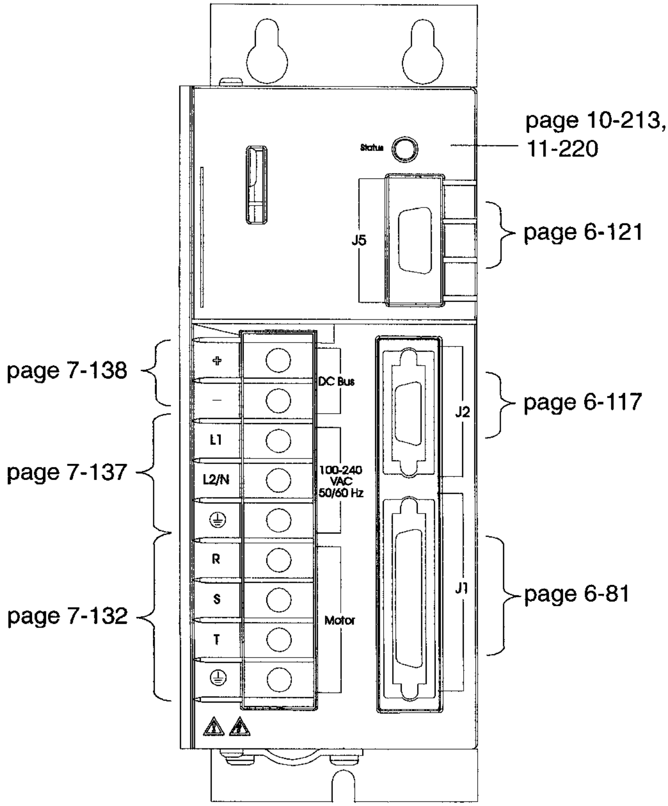
1	RCV +	RS-485
2	RCV	RS-232
3	XMT	RS-232
4	XMT +	RS-485
5	Com	
6	Reserved	
7	RCV -	RS-485
8	XMT -	RS-485
9	Reserved	

J2 - Encoder	
1	Encoder +5V Pwr
2	Encoder 5V Com
3	Encoder +5V Pwr
4	Encoder 5V Com
5	Encoder +5V Pwr
6	Encoder 5V Com
7	Mtr Encdr Input Chnl A+
8	Mtr Encdr Input Chnl A-
9	Mtr Encdr Input Chnl B+
10	Mtr Encdr Input Chnl B-
11	Mtr Encdr Input Chnl I+
12	Mtr Encdr Input Chnl I-
13	Hall A
14	Hall B
15	Hall C
16	Absolute Position
17	Reserved
18	Reserved
19	Thermal Switch +
20	Thermal Switch -



J1 - Controller							
1	Encoder +5VDC	14	Auxiliary Chnl A+	27	I Limit	40	Reserved
2	Encoder 5V Com	15	Auxiliary Chnl A-	28	Analog Com	41	Reserved
3	Encoder +5VDC	16	Auxiliary Chnl B+	29	Reserved	42	Selectable Output 1
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7	Mtr Output Chnl A+	20	Drive Enable	33	Selectable Input 2	46	Reserved
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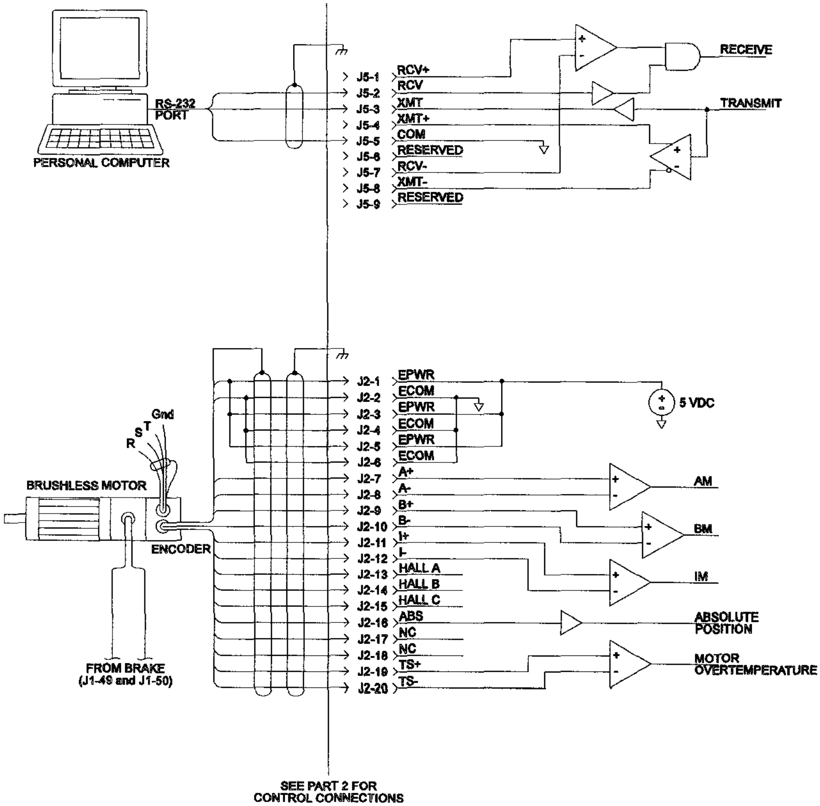
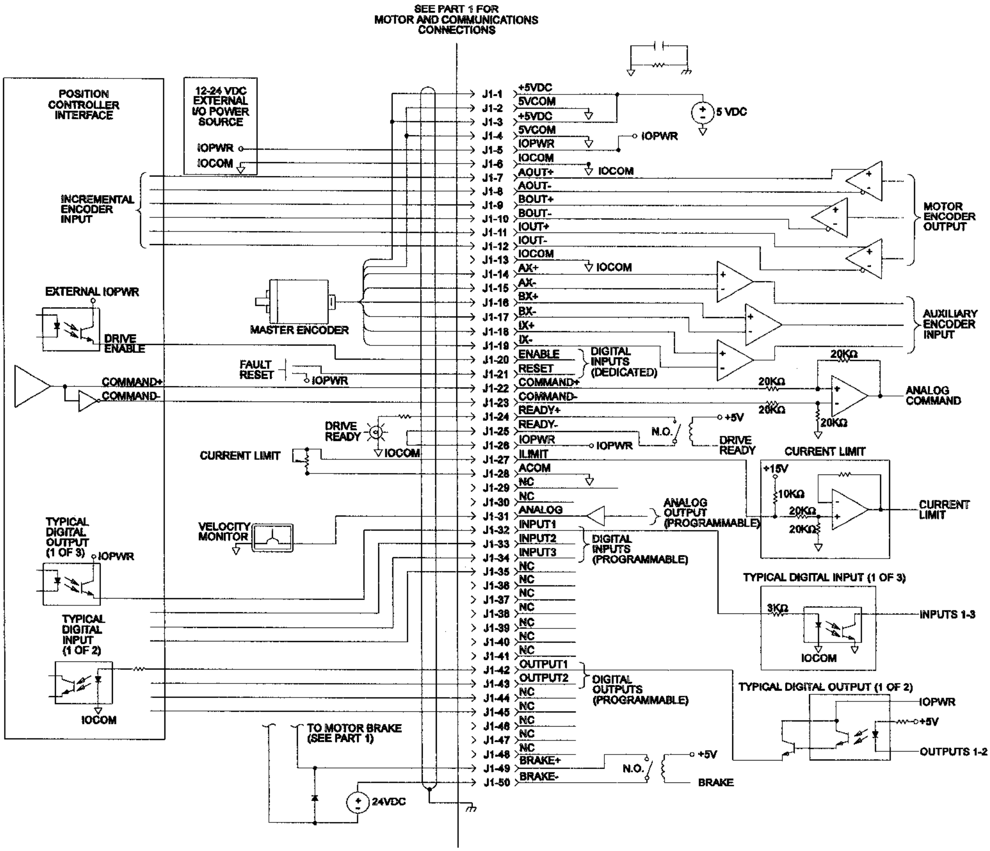
Interface Connections

This section illustrates the components and connections typical for a Centurion DSM100 Drive DSM 007, 007P, 015, 015P, 030 and 030P drive.



DSM Interface Connection Diagram - J2 and J5



DSM Interface Connection Diagram - J1

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Giddings & Lewis product support is available over the phone. When you call, you should be at your computer and have the hardware and software manuals at hand. Be prepared to give the following information:

- The version numbers of the hardware and software products.
- The type of hardware that you are using.
- The fault indicators and the exact wording of any messages that appears on your screen.
- How you have tried to solve the problem.

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The applications engineers can also be reached via fax at 1-920-929-4669. The fax machine is open 24 hours 7 days a week. Faxes will be answered during regular business hours only.

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