
2 Installing the SC720 Series

In this Chapter

This chapter explains how to install the SC720 series unit. Topics covered are:

- Installing and using the SC720 series unit safely
- Selecting other system components
- Unpacking and inspecting the SC720 series controller
- Mounting the SC720 series controller in your installation
- Connecting input signals
- Selecting switch functions

2.1 Installing and Using the SC720 Series

Your responsibility

As the user or person applying this unit, you are responsible for determining the suitability of this product for any application you intend. In no event will Pacific Scientific Company be responsible or liable for indirect or consequential damage resulting from the use of this product.

Note: *Read this manual completely to effectively and safely operate the SC720 series unit.*

Safety background



Voltage levels within this controller can exceed 400 Vdc and/or 230 Vac.

Warning

The circuits in the SC720 series controller are a potential source of severe electrical shock. Follow the safety guidelines to avoid shock.

Safety guidelines

To avoid possible personal injury whenever you are working with the SC720 series controller:

- Do not power up the controller without the cover on and the chassis tied to earth ground.
- Do not operate the controller without the motor case tied to earth ground.
- Do not make any connections to internal circuitry.
- Do not connect or disconnect the motor with power applied to the unit. Always remove power before making any connections to the unit.
- Before removing the cover of the unit, shut off power and allow the unit to sit for 5 minutes to discharge the internal voltages.
- Be careful of the motor terminals of the drive when disconnected from the motor. With the motor disconnected and power applied to the controller, the motor terminals of the drive have high voltage present.
- Do not use the enable input as a safety shutdown. Always remove power to the controller for a safety shutdown.

2.2 Selecting Other System Components

Introduction

Match your SC720 series unit to your other components:

Selecting a command source

The SC720 series unit requires a variable ± 5 to ± 12 Vdc external analog signal capable of driving the servocontroller 50 k Ω input impedance for velocity command control. Choose a source such as a PLC, the DAC of a computer, or a motion controller.

Selecting a motor

The SC720 series unit is designed for use with Pacific Scientific's line of brushless servo motors including the R (rare earth) and F (ferrite) series motors. Refer to the Pacific Scientific Motion Control catalog for system torque-speed curve information.

2.3 Unpacking and Inspecting

Unpacking procedure

1. Remove the SC720 series controller from the shipping carton. Make sure all packing materials are removed from the unit.
 2. Check the items against the packing list. A label located on the side of the unit identifies the unit by model number, serial number, and date code.
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Inspection procedure

Inspect the unit for any physical damage that may have been sustained during shipment.

If you find damage, either concealed or obvious, contact your buyer to make a claim with the shipper. Do this within 10 days of receipt of the unit.

Storing the unit

After inspection, store the controller in a clean, dry, place. The storage temperature must be between -25 degrees C and 85 degrees C. To prevent damage during storage, replace the unit in the original shipping carton.

2.4 Mounting the SC720 Series

Cabinet selection

Select a standard deep NEMA (National Electrical Manufacturer's Association) cabinet appropriate for industrial applications.

The SC722 and SC723 require a 10 inch (25.4 cm) deep cabinet. The SC724, SC725, and SC726 require a 12 inch (30.5 cm) deep cabinet.

Note: A SC720 with SERCOS Personality Module requires an additional 2 inches in depth when selecting a cabinet.

Caution

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



SC723 mounting
dimensions
(in inches)

Figure 1: Dimensions of the 1000 Series Single-Drop Mounting Bracket. The diagram shows a side view of the bracket with various dimensions labeled. Key dimensions include: top width 5.00, top right offset .38, total top width 8.75, total height 16.75, mounting hole spacing 14.50, mounting hole diameter 15.75 MTG., ground stud offset 0.28, and bottom width 2.50. A note specifies a 0.75 clearance space for connectors and lead dress.

31.75

127.0

9.65

218.44

425.45

368.3

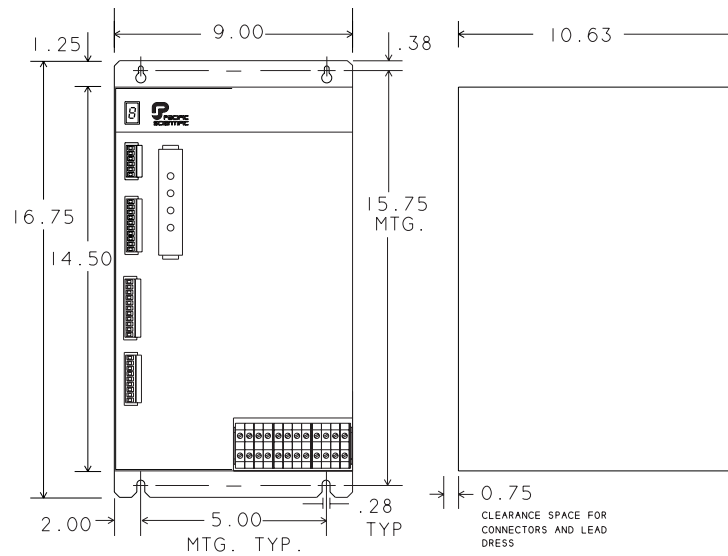
400.05 MTG.

19.05
CLEARANCE SPACE FOR CONNECTORS AND LEAD DRESS

7.11

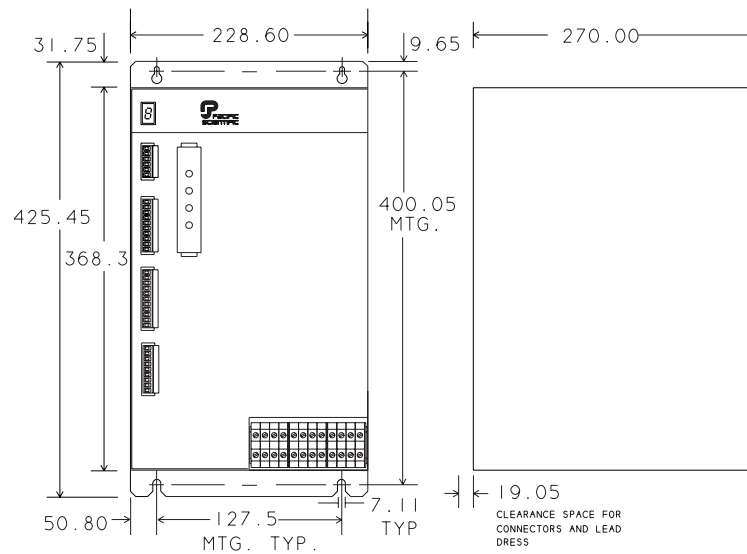
63.5
MTG. TYP.

SC724/725
mounting
dimensions
(in inches)

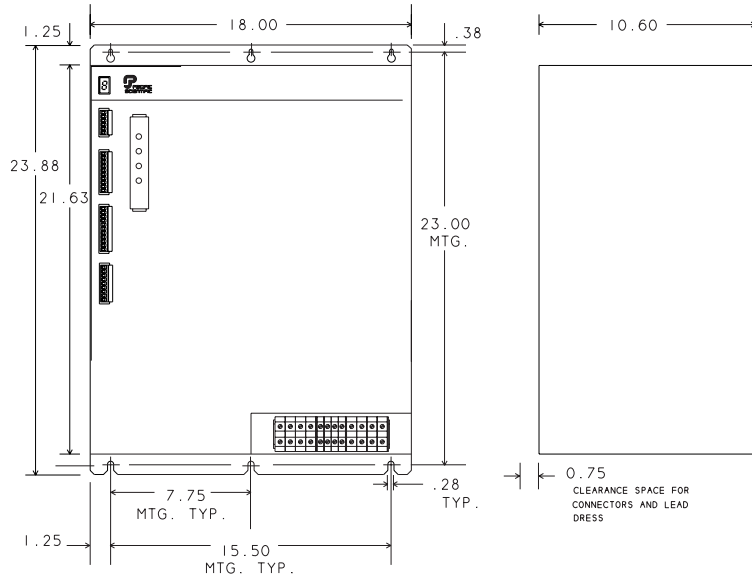


Installation

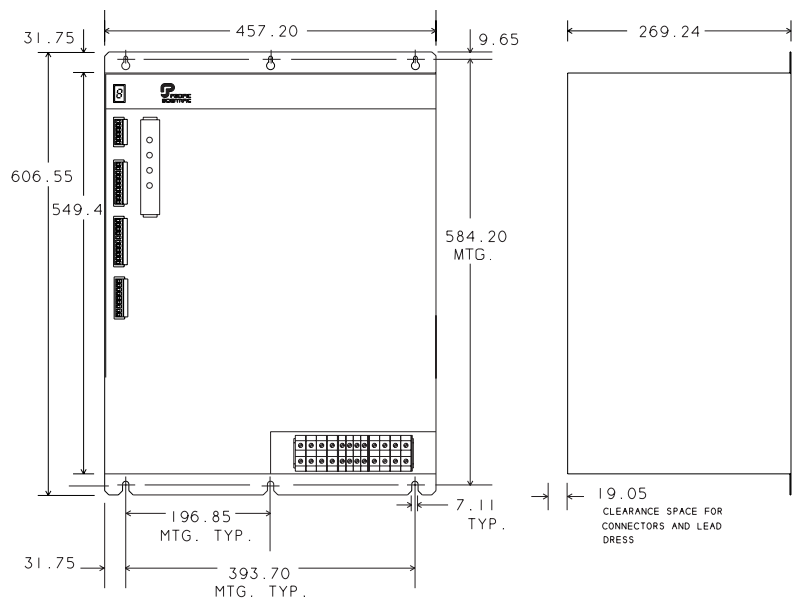
SC724/725
mounting
dimensions (in
millimeters)



SC726 mounting
dimensions
(in inches)



SC726 mounting
dimensions (in
millimeters)



Mounting guidelines

The SC720 series controller is designed for installation in a cabinet. Your installation should meet the following guidelines:

- Vertical orientation for the controller
- Flat, solid surface capable of supporting the approximate weight of the units as follows:
 - SC722 - 13 lbs (5.9 kg)
 - SC723 - 16 lbs (7.26 kg)
 - SC724 - 40 lbs (18.16 kg)
 - SC725 - 40 lbs (18.16 kg)
 - SC726 - 90 lbs (40.86 kg)
- Free of excessive vibration or shock.
- Minimum unobstructed space of 4 inches (10 cm) above and below the controller. The controller is cooled by built-in fans.
- Operating temperature of:
 - 0 to 50 degrees C at full rated output current.
 - 0 to 60 degrees C at 70% full rated output current. Derate linearly from 100% to 70% of full rating at 60 degrees C.

Mounting procedure

Bolt the unit to the cabinet using the mounting slots (refer to dimensions figure) with 1/4-20 (M6 metric equivalent) or # 10 bolts.

Power dissipation

The SC720 series controller dissipates power that results in cabinet heating.

To estimate the power dissipation for use in calculating cabinet cooling requirements, use the values shown in the table. These numbers are approximate and do not include shunt regulator power (that is, regenerated power).

Output current % of rated continuous current	Power dissipation (watts)				
	SC722	SC723	SC724	SC725	SC726
0	10	10	15	15	15
25	15	20	39	69	130
50	23	35	68	135	270
75	32	54	109	218	435
100	45	77	150	300	600

2.5 Connecting the Input/Output Cables

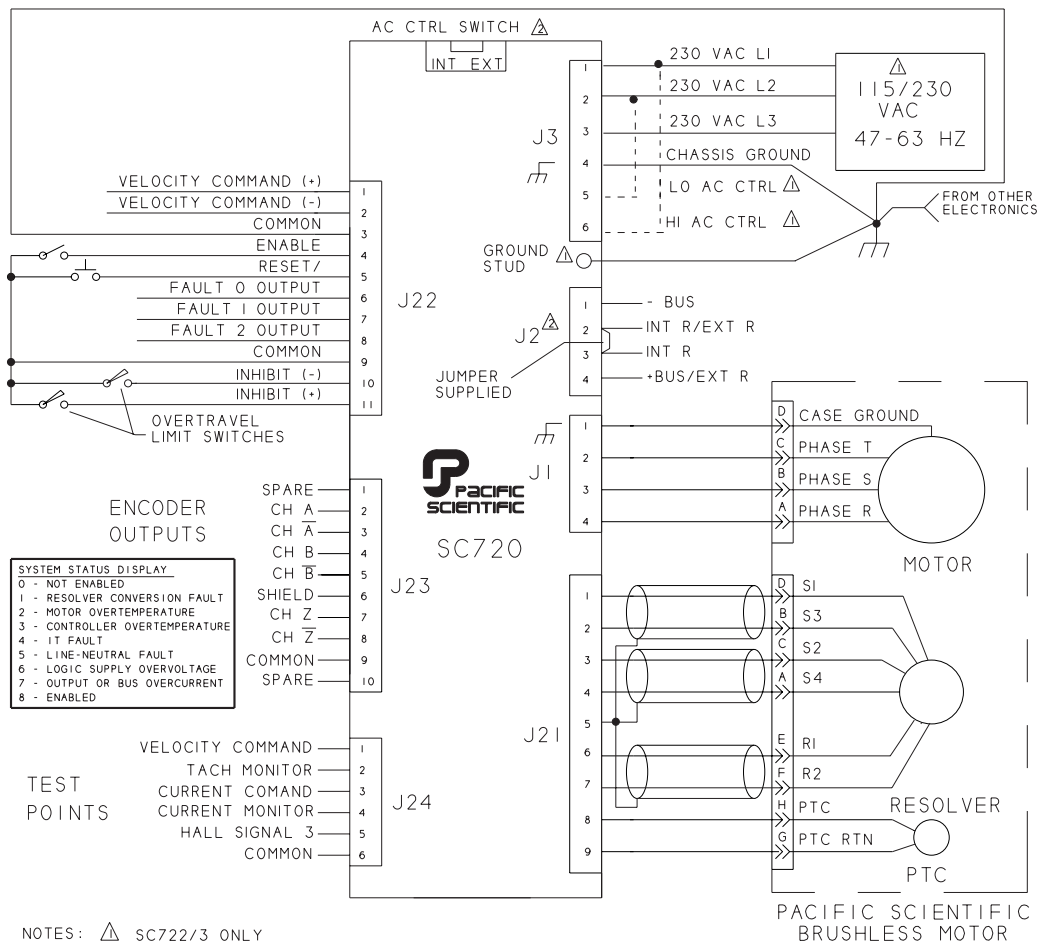
Introduction

The six input/output cables are:

- J1 - Motor windings
- J2 - Shunt regulator/bus
- J3 - 230 Vac power
- J21 - Resolver and overtemperature sensor
- J22 - Command inputs and fault outputs
- J23 - Encoder outputs
- J24 - Test outputs

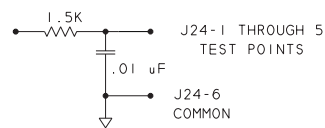
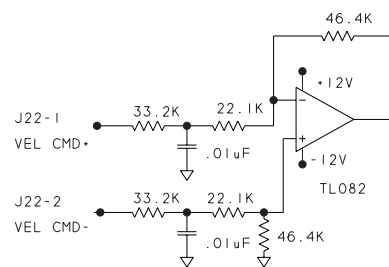
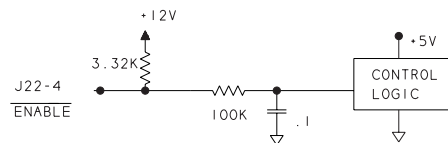
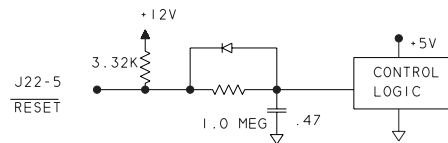
These inputs and outputs and a circuit diagram are shown on the following pages:

Input/Outputs

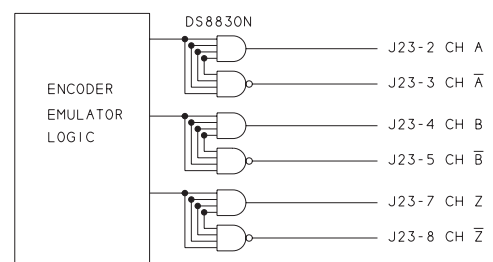
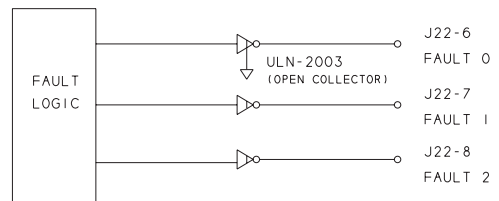
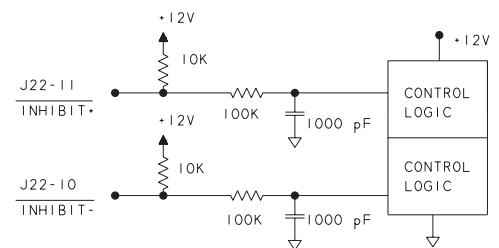


Installation

I/O Circuits



PIN	EXPLANATION
1	VEL CMD
2	VEL FB
3	I-CMD
4	I-FB
5	HALL 3



2.5.1 J3 230 Volt AC Power and J1 Motor Cabling

Introduction

The J3 230 V ac power cable connects voltage to the logic supply and the motor power supplies.

The J1 motor cable connects the controller to the motor windings.

J3 - 230 V ac
power input table

Input	Pin	Explanation
230 V ac - line 1	J3-1	<div>Fan</div> 230 V ac power for motor supply.
230 V ac - line 2	J3-2	
230 V ac - line 3	J3-3	
Chassis ground	J3-4	Safety ground for controller.
Control voltage - 115/230 V ac	J3-5	Power for control circuits and fault logic (see AC switch).
Control voltage - 115/230 V ac	J3-6	

J1 - motor output
table

Output	Pin	Explanation
Motor ground	J1-1	Ground for the terminal case. Necessary for correct operation of the controller and motor.
Motor phase T	J1-2	T output phase from controller.
Motor phase S	J1-3	S output phase from controller.
Motor phase R	J1-4	R output phase from controller.

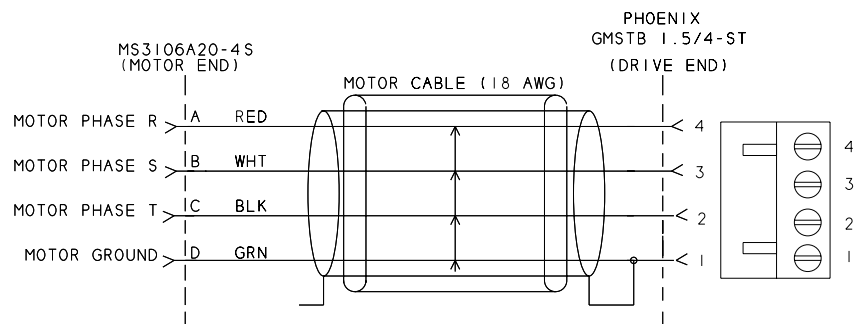
AC switch

The AC switch applies to the SC724, SC725, and SC726 drivers only.

Note: *The switch is mounted on the right side of the drive.*

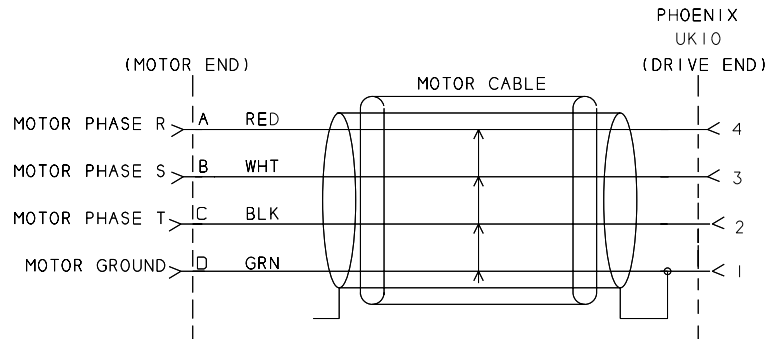
Input	Explanation
Ext	Control power from J3-5, J3-6
Int	Control power from J3-1, J3-2

Wiring diagram - SC722/SC723



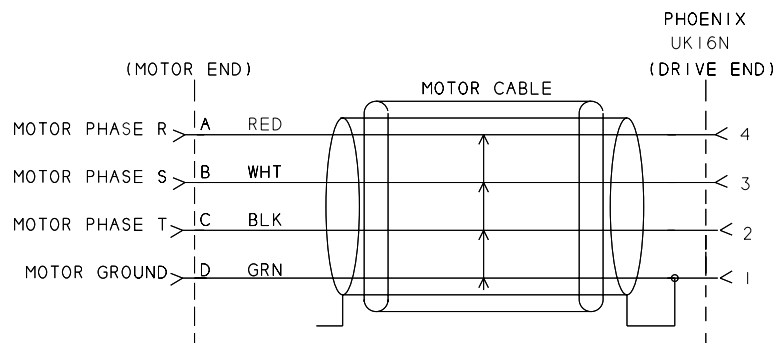
Note: *Insulate shield drain wire at motor end.*

**Wiring
diagram -
SC724/SC725**



Note: Insulate shield drain wire at motor end. If shield is not used, then twist ends.

**Wiring
diagram -
SC726**



Note: Insulate shield drain wire at motor end. If not used, then twist.

Installation

Mating connectors - SC722/723

J3 120 V ac power - this input is for a Phoenix 6-pin screw terminal mating connector. The connector is type GMSTB 1.5/6 ST 7.5 mm. The Phoenix order number is 17-66-92-9.

J1 motor - this output is for a Phoenix 4-pin screw mating connector. The connector is type GMSTB 1.5/4 ST 7.5 mm. The Phoenix order number is 17-66-90-3.

Note: *Mating connectors are used only on SC722 and SC723 model controllers. J1 and J2 are screw terminal for the SC724, SC725 and SC726 model controllers.*

Cable requirements

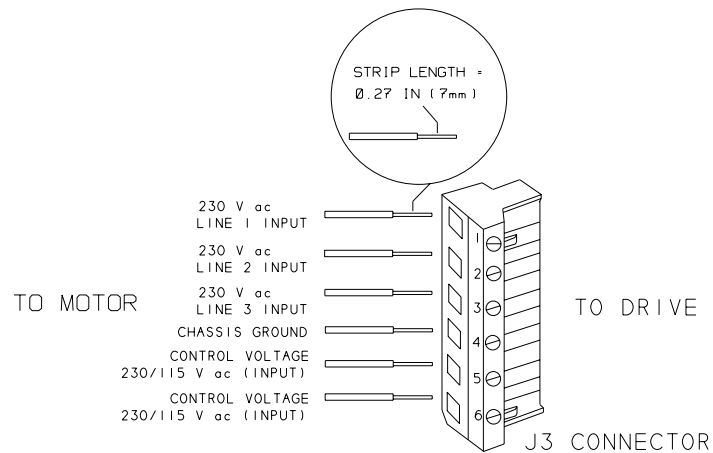
The recommended wire size shown in the table below is sufficient to handle the rated current of the drive. Wire sizes are in AWG.

Model #	Range	Recommended	
		Motor	Line
SC722	#18 to #14	#18	#18
SC723	#18 to #14	#18	#18
SC724	#18 to #8	#16	#16
SC725	#18 to #8	#10	#12
SC726	#16 to #6	#8 *	#10

* Use wire size #6 above 50A Continuous.

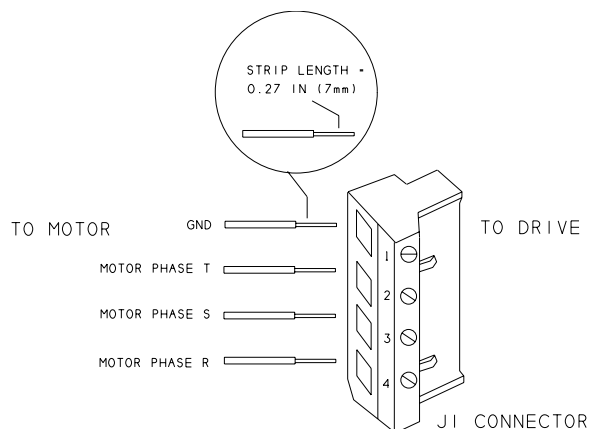
For **motor** cable, obtain cable with the four connectors twisted at about 3 to 4 turns per inch (1 to 1.5 turns per centimeter). As an option, the cable may be shielded to reduce radiated noise.

**Cable
diagram - J3
V ac power
(SC722/723)**



Note: Mating connectors are used only on SC722 and SC723 model controllers. J1 and J2 are screw terminal for the SC724, SC725 and SC726 model controllers.

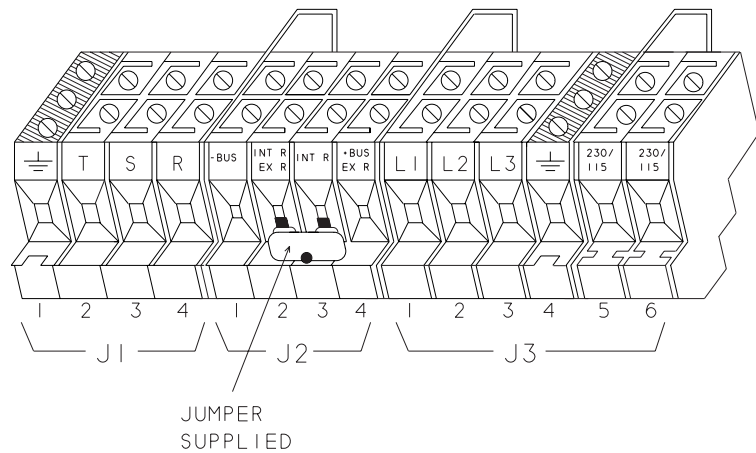
**Cabling
diagram - J1
motor
(SC722/723)**



Note: Mating connectors are used only on SC722 and SC723 model controllers. J1 and J2 are screw terminal for the SC724, SC725 and SC726 model controllers.

Installation

**Cabling
diagram -
J1 motor
(SC724/725/
726)**



J1 CONNECTIONS	J2 CONNECTIONS	J3 CONNECTIONS
1 GROUND	1 BUS	1 L1 (230 V _{ac})
2 PHASE T	2 INT R/EXT R	2 L2 (230 V _{ac})
3 PHASE S	3 INT R	3 L3 (230 V _{ac})
4 PHASE R	4 +BUS/EXT R	4 GROUND
		5 LO AC CTRL
		6 HI AC CTRL

Procedure

1. Attach the wires to the desired connector as indicated in the diagram.

Note: Make sure the screws on the Phoenix connector are tightened down firmly on the wiring.

Caution

Do not solder the tips of the cables before insertion into the connector. Solder can contract and cause a loose connection over time.

2. If connecting the motor cable, remove power from the SC720 series unit.





Warning

For motor terminal connection, disconnect the power cable before making or removing connections to the unit. The motor terminals have high voltage present when the SC720 series unit is On.

3. Plug the mating connector firmly into the SC720 series unit.
4. Connect the motor cable, if used, to J2-1.

Warning



For the V ac power cable, the chassis ground must be tied to earth ground. Failure to do this leaves the potential for severe shock hazard. Make sure the ground is connected via J1-4 or that the ground connects to the ground stud on the lower mounting tab of the SC720 series unit.

2.5.2 J21 to J24 - Input/Output Cabling

Introduction

The four input/output cables are:

- J21 - Resolver and overtemperature sensor
- J22 - Command inputs and fault outputs
- J23 - Encoder outputs
- J24 - Test outputs

The cables and connectors are described in the following sections. Build the cables per the following procedure.

Procedure

1. Refer to the following sections for connection information for the appropriate mating connector.
2. Use 22- to 14-gauge wire for the cabling.

For the **resolver cable**, obtain individually twisted-shielded cable for output pairs (refer to diagram, page 2-9) twisted at about 3 to 4 turns per inch (1 to 1.5 turns per centimeter).

The cable must be shielded as shown in the diagram for proper operation and to reduce noise pickup.

Procedure (cont'd)

3. Strip the wires to 0.27 inch (7 mm).
4. Attach the wires to the connector as indicated in the connector diagram.

Note: *Make sure the screws on the Phoenix connector are tightened down firmly on the wiring.*



Caution

Do not solder the tips of the cables before insertion into the connector. Solder can contract and cause a loose connection over time.



Warning

The chassis ground must be tied to earth ground. Failure to do this leaves the potential for severe hazard. Make sure the ground is connected via the ground stud on the front of the SC720 controller.

5. Plug the connector firmly into the SC720 controller.

J21 Resolver and Over Temperature Inputs and Outputs

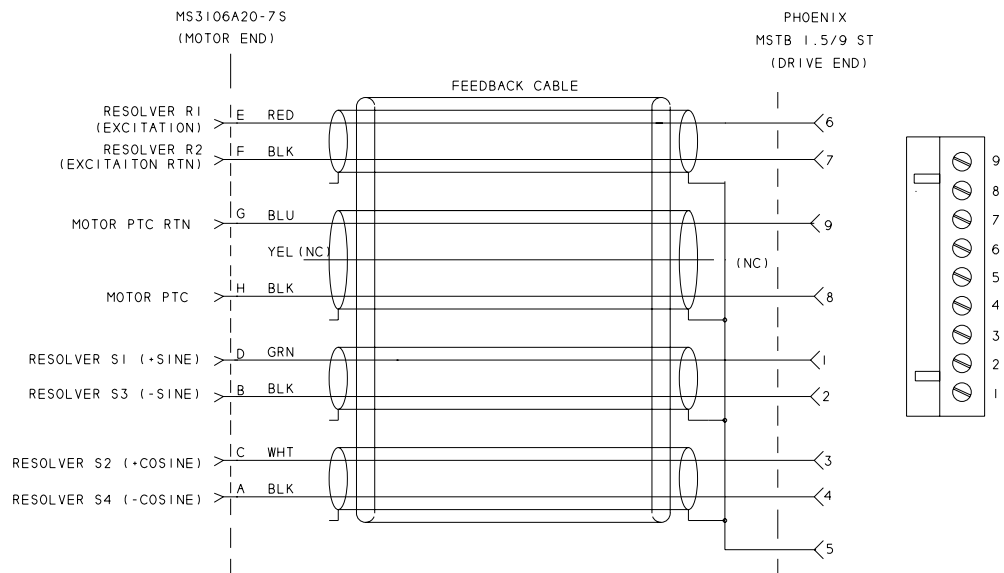
Introduction

Resolver sine and cosine signals are processed to produce commutation, velocity, and position information. The PTC (positive temperature coefficient) thermistor input is also located here to provide thermal overload protection for the motor.

Input/output table

Input/Output	Pin	Explanation
Resolver S1+ sine (input) Resolver S3- sine (input)	J21-1 J21-2	Sine inputs (plus and minus) from resolver. These are differential inputs.
Resolver S2+ cosine (input) Resolver S4- cosine (input)	J21-3 J21-4	Cosine inputs (plus and minus) from resolver. These are differential inputs.
Shield ground	J21-5	Ground for resolver cable shield.
Resolver excitation and excitation return (output and ground)	J21-6 J21-7	Output drive for resolver excitation winding.
Motor PTC and PTC return (input and ground)	J21-8 J21-9	PTC temperature overload sensor.

Wiring diagram



Notes:

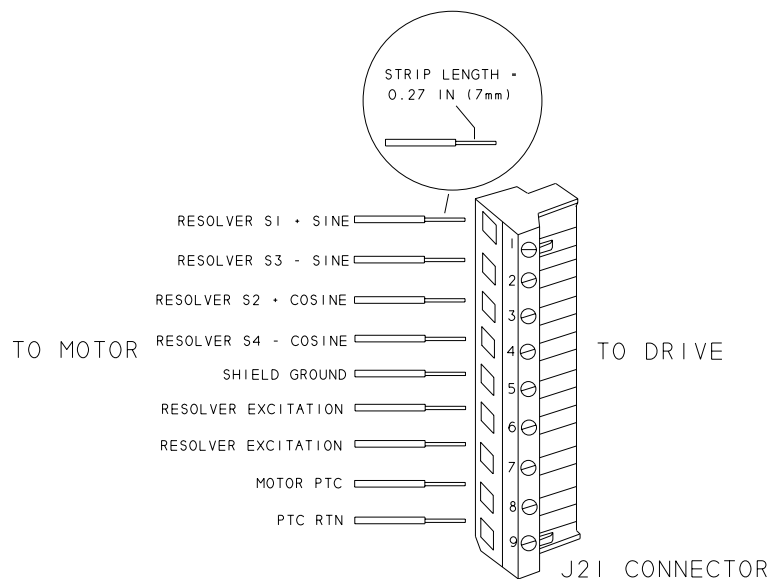
1. Individually insulate shield drain wires at motor end.
2. Individually insulate unused wires at motor end.
3. Individually insulate unused wires at drive end.

Mating connector

The J21 resolver cables are for a Phoenix 9-pin screw mating connector. The connector is type MSTB 1.5/9-ST 5 mm. The Phoenix order number is 17-54-58-8.

This connector is supplied with the drive.

Cabling Diagram - J21 Resolver



Installation

Procedure notes



When building the resolver and PTC cable, make sure to follow these additional guidelines:

Caution

Ensure that the resolver signals are correctly oriented as shown. Incorrect orientation will lead to incorrect rotor position and/or incorrect commutation.

- Connect the resolver shield cable to J21-5. **Do not connect the resolver shields at the motor end.**
- Connect the PTC and PTC return.

Note: Tie the PTC and PTC return pins together if not using a PTC. The controller will not operate if these pins do not have inputs.

J22 Command Input/Output Connection

Introduction

The command interface accepts velocity, enable, reset, and inhibit inputs. It outputs fault 0, 1, and 2 signals.

Input/output table

Input/Output	Pin	Explanation
Velocity command +, - (inputs)	J22-1 (+) J22-2 (-)	Velocity inputs ± 5 to ± 12 V analog input. Input impedance is 50 K Ω minimum.
Shield (ground)	J22-3	Servocontroller is power and connection to single point ground.
Enable (input)	J22-4	Enable required for operation. Input load is a 3.32 K Ω pull up to 12 Vdc. An open collector transistor can be used by connecting the collector to this pin and the emitter to J22-9. A relay contact or transistor should have a rating exceeding 12 V with $V_{ce}(\text{sat}) < 1$ Vdc at 5 mA.

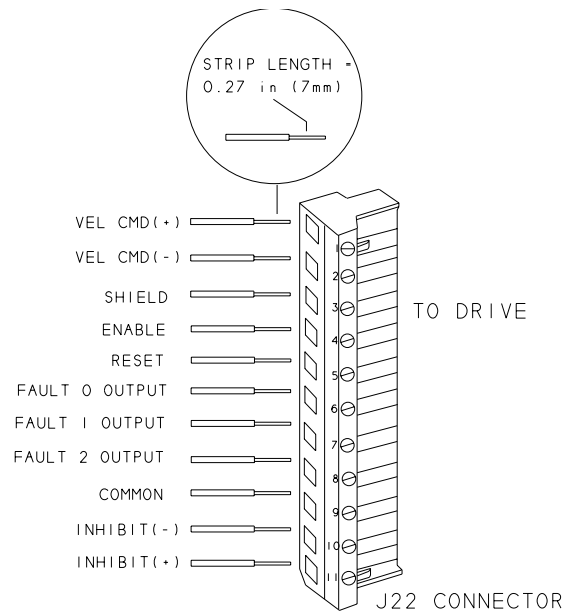


Input/Output	Pin	Explanation
Reset (input)	J22-5	Resets the controller after a fault; controller is held disabled while reset is applied. An open collector transistor can also be used by connecting the collector to this pin and the emitter to J22-9. The contact or transistor should have a rating exceeding 12 V with $V_{ce(sat)} < 1 \text{ Vdc}$ at 5 mA.
Fault 0, 1, 2 (outputs)	J22-6, J22-7, J22-8	<p>Indicates the fault code when controller is faulted. Outputs are open collector with a rating of 30 Vdc, 100 mA maximum sinking current, and $V_{sat} < 0.5 \text{ V}$ for 25 mA or less sinking current. Wire OR to create single active low indicator of fault.</p> <p>Caution</p> <p><i>Do not connect these outputs directly to a supply. Damage may occur if this is done.</i></p> <p>Note: <i>Fault outputs will <u>not</u> properly indicate a faulted controller when control power is removed.</i></p> <p>Fault Outputs signify:</p> <p>0 = Outputs On (sinking current)</p> <p>1 = Output Off</p>



Input/Output	Pin	Explanation
Fault 0, 1, 2 (outputs) (cont.)	J22-6, J22-7, J22-8	<p>0 1 2</p> <p>1 1 1 No faults</p> <p>0 0 0 Bus overvoltage or overcurrent</p> <p>0 0 1 Control power fault</p> <p>0 1 0 Line-neutral fault</p> <p>0 1 1 IT fault or no personality module</p> <p>1 0 0 Controller overtemp</p> <p>1 0 1 Motor overtemp</p> <p>1 1 0 Resolver conversion</p>
Common (ground)	J22-9	Controller common point at same potential as 12 Vdc RTN. This pin is ground for the enable and reset inputs and the fault outputs.
Inhibit -, + (input)	J22-10, J22-11	Selects directional dynamic braking mode via digital inputs. Inputs are active low pulled up to + 12 Vdc with 10 K Ω resistors, requiring a minimum sink drive of 2 mA.

Cabling diagram - J22 Command



Installation

Mating connector

The J22 command cables are for a Phoenix 11-pin screw mating connector. The connector is type MSTB 1.5/11-ST 5 mm. The Phoenix order number is 17-54-62-7.

This connector is supplied with the drive.

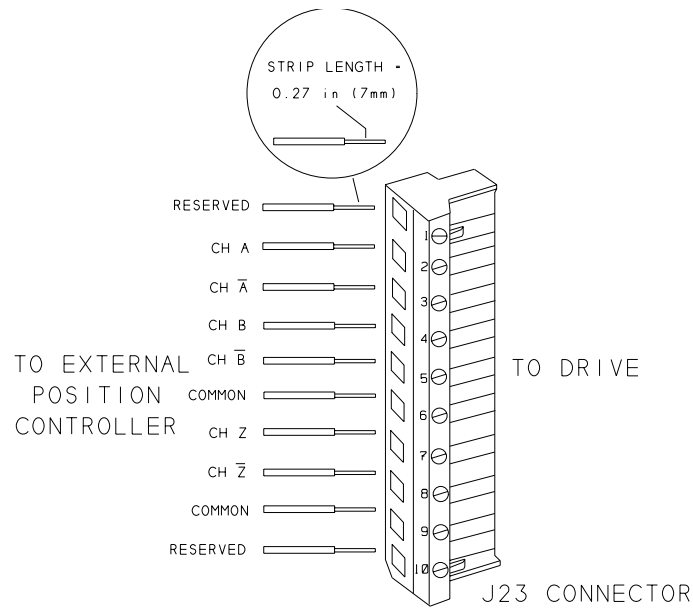
J23 Encoder Emulator Output

Introduction Connector J23 outputs encoder quadrature signals for A, \overline{A} , B, \overline{B} , Z and \overline{Z} for use by an external position controller.

Output table The following table lists the outputs on connector J23:

Output	Pin	Explanation
Reserved	J23-1, J23-10	Reserved. Do not connect to these pins.
Channel A and \overline{A} , Channel B and \overline{B}	J23-2, J23-3 and J23-4, J23-5	Differential, quadrature, TTL encoder emulation signals from the resolver. Signals are from line drivers that are indefinitely short circuit to ground proof. Signal resolution is set by the personality module.
Channel Z and \overline{Z}	J23-7, J23-8	Differential, TTL marker pulse output. Output pulse occurs once per motor shaft revolution and lasts for one quadrature encoder width. Signals are from line drivers that are indefinitely short circuit to ground proof.
Common	J23-6, J23-9	Termination point for the cable shield. Tied internally to the servocontroller's power supply common.

Cabling diagram - J23 Encoder



Mating connector

The J23 encoder cables are for a Phoenix 10-pin screw mating connector. The connector is type MSTB 1.5/10-ST 5 mm. The Phoenix order number is 17-54-60-1.

This connector is supplied with the drive.

J24 Test Output

Introduction

The J24 Test Outputs allow you to monitor controller performance.

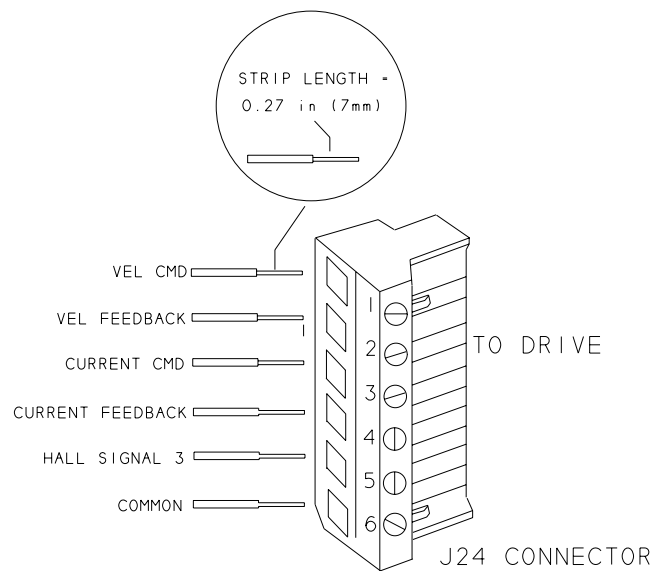
Output table

The following table lists the outputs on connector J24.

Output	Pin	Explanation
Velocity command	J24-1	Output of the velocity command +, - differential amplifier used to buffer the velocity command. This signal and the Tach Monitor signal should have the same magnitude with a properly operating non-saturated velocity loop.
Tach Monitor	J24-2	Resolver-measured motor speed. Scale factor is determined by tachometer select switch on personality module. ± 10 V full-scale output.
Current command	J24-3	Output voltage of the velocity loop compensation block which is the commanded current. ± 4.5 volts corresponds to \pm peak output current. This signal and the current monitor signal output should have the same magnitude with a properly operating non-saturated Current Loop.

Output	Pin	Explanation										
Current monitor	J24-4	<p>Output voltage proportional to the measured motor peak current amplitude, which in turn is proportional to shaft torque. ± 4.5 volts corresponds to peak servocontroller current.</p> <p>Monitor Scale Factor</p> <table><tr><td>SC722</td><td>0.63 V/A</td></tr><tr><td>SC723</td><td>0.32 V/A</td></tr><tr><td>SC724</td><td>0.16 V/A</td></tr><tr><td>SC725</td><td>0.08 V/A</td></tr><tr><td>SC726</td><td>0.04 V/A</td></tr></table>	SC722	0.63 V/A	SC723	0.32 V/A	SC724	0.16 V/A	SC725	0.08 V/A	SC726	0.04 V/A
SC722	0.63 V/A											
SC723	0.32 V/A											
SC724	0.16 V/A											
SC725	0.08 V/A											
SC726	0.04 V/A											
Hall Signal 3	J24-5	0 to 5 volt digital motor commutation signal with 1.5 K Ω source impedance. At constant shaft speed, this signal is a square wave at the motor electrical frequency (60 Hz at 1800 RPM for 4 pole R series motor. 120 Hz at 1800 RPM for 8 pole F series motor.)										
Common	J24-6	Reference and return ground.										

Cabling diagram - J24 test



Mating connector

The J24 test cables are for a Phoenix 6-pin screw mating connector. The connector is type MSTB 1.5/6-ST 5 mm. The Phoenix order number is 17-54-62-0.

This connector is supplied with the drive.