PACIFIC SCIENTIFIC

HIGH PERFORMANCE MOTORS & DRIVES

110 Fordham Road
Wilmington, MA 01887
(978) 988-9800
Fax (978) 988-9940

Part# MA6430
List Price $30 U.S.
January, 1999
Rev 2

M A 6 4 3 0

6 4 3 0 D r i v e

Installation & Hardware Reference Manual

WARRANTY AND LIMITATION OF LIABILITY

Includes software provided by Pacific Scientific

Pacific Scientific warrants its motors and controllers (“Product(s)”) to the original purchaser (the “Customer”), and in the case of original equipment manufacturers or distributors, to their original consumer (the “Customer”) to be free from defects in material and workmanship and to be made in accordance with Customer’s specifications which have been accepted in writing by Pacific Scientific. In no event, however, shall Pacific Scientific be liable or have any responsibility under such warranty if the Products have been improperly stored, installed, used or maintained, or if customer has permitted any unauthorized modifications, adjustments, and/or repairs to such Products. Pacific Scientific’s obligation hereunder is limited solely to repairing or replacing (at its option), at its factory any Products, or parts thereof, which prove to Pacific Scientific’s satisfaction to be defective as a result of defective materials or workmanship, in accordance with Pacific Scientific’s stated warranty, provided, however, that written notice of claimed defects shall have been given to Pacific Scientific within two (2) years after the date of the product date code that is affixed to the product, and within thirty (30) days from the date any such defect is first discovered. The products or parts claimed to be defective must be returned to Pacific Scientific, transportation prepaid by Customer, with written specifications of the claimed defect. Evidence acceptable to Pacific Scientific must be furnished that the claimed defects were not caused by misuse, abuse, or neglect by anyone other than Pacific Scientific.

Pacific Scientific also warrants that each of the Pacific Scientific Motion Control Software Programs (“Program(s)”) will, when delivered, conform to the specifications therefore set forth in Pacific Scientific’s specifications manual. Customer, however, acknowledges that these Programs are of such complexity and that the Programs are used in such diverse equipment and operating environments that defects unknown to Pacific Scientific may be discovered only after the Programs have been used by Customer. Customer agrees that as Pacific Scientific’s sole liability, and as Customer’s sole remedy, Pacific Scientific will correct documented failures of the Programs to conform to Pacific Scientific’s specifications manual. PACIFIC SCIENTIFIC DOES NOT SEPARATELY WARRANT THE RESULTS OF ANY SUCH CORRECTION OR WARRANT THAT ANY OR ALL FAILURES OR ERRORS WILL BE CORRECTED OR WARRANT THAT THE FUNCTIONS CONTAINED IN PACIFIC SCIENTIFIC’S PROGRAMS WILL MEET CUSTOMER’S REQUIREMENTS OR WILL OPERATE IN THE COMBINATIONS SELECTED BY CUSTOMER. This warranty for Programs is contingent upon proper use of the Programs and shall not apply to defects or failure due to: (i) accident, neglect, or misuse; (ii) failure of Customer’s equipment; (iii) the use of software or hardware not provided by Pacific Scientific; (iv) unusual stress caused by Customer’s equipment; or (v) any party other than Pacific Scientific who modifies, adjusts, repairs, adds to, deletes from or services the Programs. This warranty for Programs is valid for a period of ninety (90) days from the date Pacific Scientific first delivers the Programs to Customer.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES (EXCEPT AS TO TITLE), WHETHER EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE, AND ARE IN LIEU OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF PACIFIC SCIENTIFIC. PACIFIC SCIENTIFIC'S MAXIMUM LIABILITY WITH RESPECT TO THESE WARRANTIES, ARISING FROM ANY CAUSE WHATSOEVER, INCLUDING WITHOUT LIMITATION, BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, WARRANTY, PATENT OR COPYRIGHT INFRINGEMENT, SHALL NOT EXCEED THE PRICE SPECIFIED OF THE PRODUCTS OR PROGRAMS GIVING RISE TO THE CLAIM, AND IN NO EVENT SHALL PACIFIC SCIENTIFIC BE LIABLE UNDER THESE WARRANTIES OR OTHERWISE, EVEN IF PACIFIC SCIENTIFIC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, DAMAGE OR LOSS RESULTING FROM INABILITY TO USE THE PRODUCTS OR PROGRAMS, INCREASED OPERATING COSTS RESULTING FROM A LOSS OF THE PRODUCTS OR PROGRAMS, LOSS OF ANTICIPATED PROFITS, OR OTHER SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER SIMILAR OR DISSIMILAR, OF ANY NATURE ARISING OR RESULTING FROM THE PURCHASE, INSTALLATION, REMOVAL, REPAIR, OPERATION, USE OR BREAKDOWN OF THE PRODUCTS OR PROGRAMS, OR ANY OTHER CAUSE WHATSOEVER, INCLUDING NEGLIGENCE.

The foregoing shall also apply to Products, Programs, or parts for the same which have been repaired or replaced pursuant to such warranty, and within the period of time, in accordance with Pacific Scientific's date of warranty.

No person, including any agent, distributor, or representative of Pacific Scientific, is authorized to make any representation or warranty on behalf of Pacific Scientific concerning any Products or Programs manufactured by Pacific Scientific, except to refer purchasers to this warranty.

Table of Contents

1 Overview of the 6430

In this chapter This chapter introduces the 6430 stepper drive. Topics covered are:

- 6430 definition
- Other system components
- System diagram
- How to use this manual
- Warranty information

1.1 6430 Definition

Overview The Pacific Scientific 6430 converts step and direction inputs into motor winding currents to control a two-phase stepper motor. Principal features include microstepping and digital electronic damping for high resolution and smooth operation through both the low speed and mid-band resonance regions.

The output current of the 6430 is dip switch selectable from 0.625A rms (0.88A peak in microstep mode) to 5A rms (7.1 A peak in microstep mode).

The Pacific Scientific 6430 can be powered from 120 or 240 Vac (60/50 Hz). This input is switch selectable for either 120 or 240 Vac. An internal PWM switching power supply provides up to 300 W ± 10% of power to the stepper drive.

Drive features

Bipolar chopper drive - patented 4-phase PWM (pulse width modulation) chopping electronically controls the motor winding currents at 20 KHz frequency. This combines the best of recirculating and non-recirculating current regulation producing high back EMF rejection with low chopping ripple current. Benefits include: reduced heat dissipation, low electric noise and improved current control during motor braking.

Microstepping - switch selectable: full, 1/2, 1/5, 1/10, 1/25, 1/50, 1/125, and 1/250 step capability with decimal jumper installed and 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, and 1/256 with decimal jumper removed.

Digital Electronic Damping - patented circuit eliminates torque and/or motor stalling through mid-speed region that is inherent in all open loop stepper applications.

Short circuit protection circuitry - disables the drive if a short circuit occurs on the motor outputs. The drive must be power cycled to clear fault.

MOSFET power devices - allows chopper frequency of approximately 20 KHz, eliminating acoustical noise often associated with choppers.

Optically isolated signal interface connection - optical isolation is provided on the step, direction and enable inputs in addition to the enabled output. The use of optical isolation increases the options available for system grounding. The source commanding the step and direction lines is not tied directly to the motor power supply ground, allowing the system ground point for these signals to be made external to the unit.

UL Recognition - 508C (Type R) PENDING - File Number E-137798. This will also comply with CSA Standard for Process Control Equipment, C22.2 No. 142-M1987.

Power supply features

66 Vdc Output - three pin pluggable connector (J6) designed to supply 66 Vdc to power an additional drive. The total power available for both the internal and external drives is 66 Vdc
@ 4.6 A or 300 W ± 10%.

User adjustments

Motor current - sets the motor phase current to 5.0, 4.375, 3.75, 3.125, 2.5, 1.875, 1.25, or 0.625 A rms.

using DIP switch S1

Step size - sets the amount of shaft rotation per step (with the decimal jumper installed). The settings are full, half, 1/5, 1/10, 1/25, 1/50, 1/125, and 1/250 steps per (micro)step. This corresponds to 200, 400, 1000, 2000, 5000, 10,000, 25,000, and 50,000 (micro) steps per revolution with a standard 1.8° motor. With the decimal jumper removed, the settings are 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, and 1/256 steps per (micro) step. This corresponds to 400, 800, 1600, 3200, 6400, 12,800, 25,600, and 51,200 (micro) steps per revolution.

Digital Electronic Damping control - enables this patented feature which eliminates loss of torque and possible motor stalling conditions when operating at mid-range speeds. This instability is a phenomenon of the electronic, magnetic and mechanical characteristics of a stepping motor system. The compensation circuit damps mid-range oscillations by advancing or delaying switching of the output current relative to the incoming pulse train.

Idle current reduction (ICR) - enables or disables idle current reduction which reduces motor winding current by 50% of its rated value during motor dwell periods. ICR begins 0.1 second after the last input step pulse occurs. This delay can also be set to 0.05 seconds or 1 second using a plug-on jumper.

Note: *The current will return to 100% at the next step pulse.*

using plug-on jumpers

Step filter - when enabled (jumper installed) rejects noise pulses on step input less than 500ηs wide. Useful if maximum step rate is 500 KHz.

Enable sense - allows the polarity of the enable input to be reversed. With the jumper installed, the enable input opto-isolator must be driven to enable drive. With the jumper removed, enable input opto-isolator must be driven to disable.

using AC Switch SW1

Off line 120/240 Vac - switch selects AC input. **DO NOT apply 240 Vac with AC Switch in 120 Vac position.**

Typical applications

Typical applications for 6430 include:

- X-Y tables and slides
- Packaging machinery
- Robotics
- Specialty machinery
- Index feed of material
- Labeling machines

1.2 Other System Components

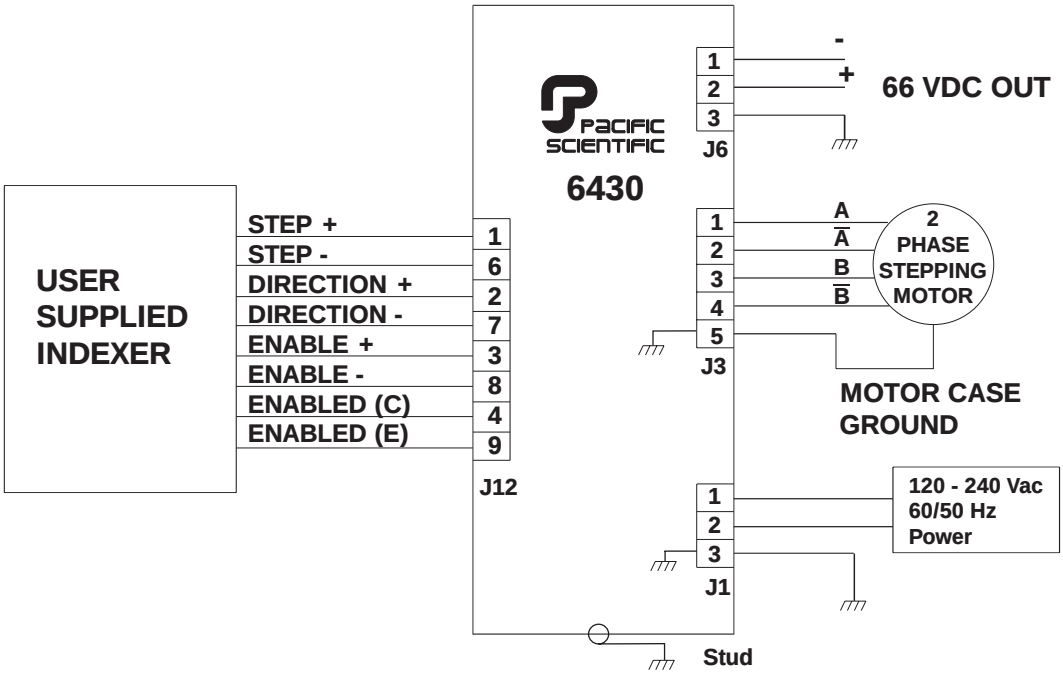
Overview

The other components that, along with the drive, comprise a complete motor control system are:

- Indexer or step source
- Motor

Installation guidelines for these components are described in Chapter 2, “Installing the 6430 Stepper Motor Drive.”

System diagram The following diagram shows an installation of the drive in a typical system.



Note: *Your installation may vary from this configuration.*

1.3 How to Use this Manual

This manual contains information and procedures to install, setup, and troubleshoot the 6430 stepper motor drive.

The most effective way to use this manual is to follow the installation and power up instructions contained in Chapter 2 and Chapter 3.

1.4 Warranty

The Pacific Scientific 6430 drives have a **two year warranty** against defects in material and assembly. Products that have been modified by the customer, physically mishandled, or otherwise abused through miswiring, incorrect switch settings, and so on, are exempt from the warranty plan.

2 Installing the 6430

In this chapter

This chapter explains how to install the 6430 stepper motor drive. Topics covered are:

- Unpacking and inspecting the 6430
- Installing and using the 6430 unit safely
- Selecting other system components
- Mounting the 6430 in your installation
- Connecting input/output cables

2.1 Unpacking and Inspecting

Unpacking procedure

1. Remove the 6430 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 inside the chassis of the unit identifies the unit by model number, serial number, and date code.

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 -40 degrees C and 70 degrees C. To prevent damage during storage, replace the unit in the original shipping carton.

2.2 Installing and Using the 6430 Unit Safely

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 misuse of this product.

Note: *Read this manual completely to effectively and safely operate the 6430 unit.*

Warning

The circuits in the 6430 drive 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 6430 unit:

- Do not operate the drive without the motor case tied to earth ground.

  Note: *This is normally done by connecting the motor's case to J3-5 of the 6430 and connecting J1-3 of the 6430 to earth ground. These pins are marked by a* ⏚ *symbol on the silkscreen and are shown on the diagram on page 2-4.*

- Do not make any connections to the internal circuitry. The input and output signals are the only safe connection points.
- Always remove power before making or removing connections from the unit.
- Be careful of the J3 motor terminals when disconnected from the motor. With the motor disconnected and power applied to the drive, these terminals have high voltage present, even with the motor disconnected.
- Do not use the ENABLE input as a safety shutdown. Always remove power to the drive for a safety shutdown.

2.3 Selecting Other System Components

Selecting an indexer

The 6430 drive requires STEP and DIRECTION inputs. Select an indexer that provides, as a minimum, these commands. A compatible indexer will provide the capability to drive the input circuits shown in Section 2.5.4. For most applications that operate at speeds above 300 RPM, an indexer that can ramp the step frequency is required.

Selecting a motor

The 6430 is designed for use with Pacific Scientific's line of hybrid stepper motors or most other 2 phase stepper motors. The drive works with either the standard line or the enhanced high performance line of stepper motors. The motor winding current rating must be compatible with the output current of the drive package.

Refer to the Torque/Speed Curves in the Pacific Scientific "Motion Control Solutions Catalog" or contact your local Pacific Scientific distributor for sizing and motor compatibility assistance.

2.4 Mounting the 6430 Unit

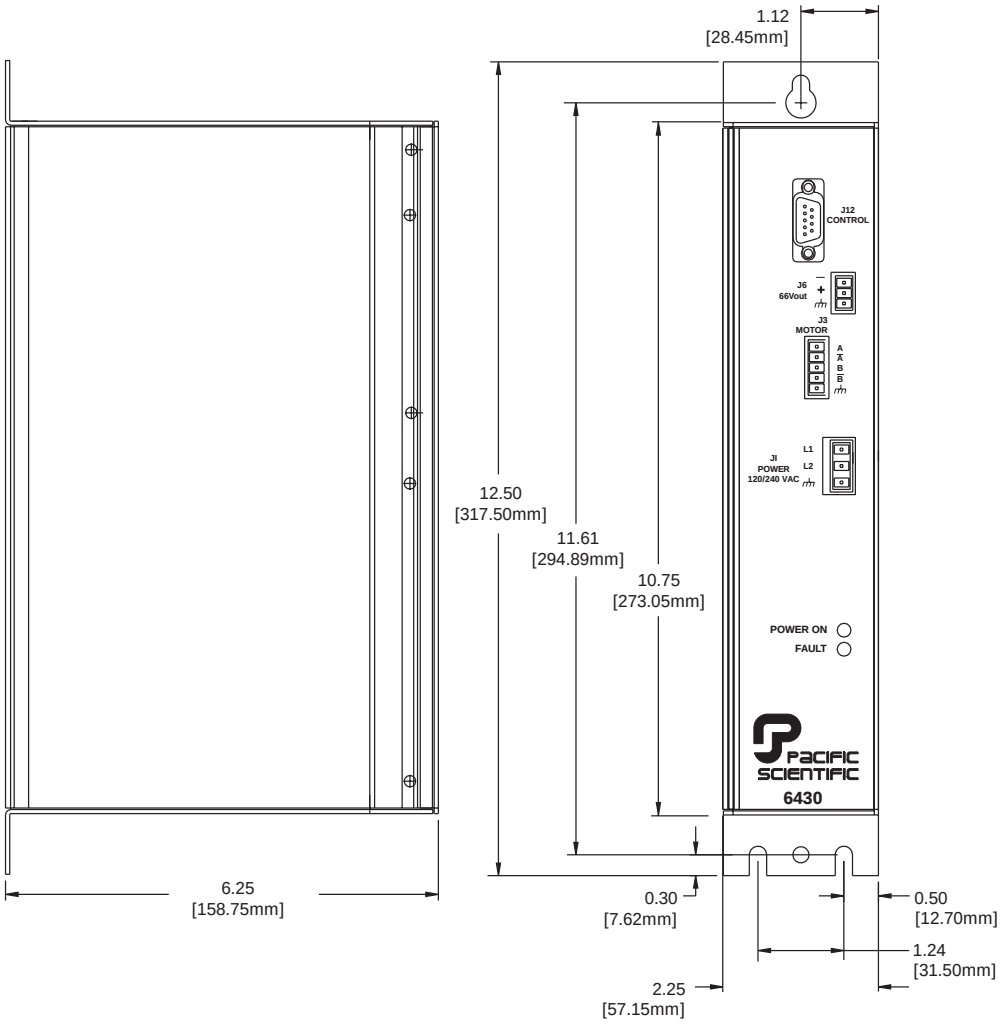
Mounting guidelines

Your installation should meet the following guidelines:

- Vertical orientation for the unit.
- Flat, solid surface capable of supporting the approximate 6.0 lbs. weight (2.7 kg. mass) of the unit.
- Free of excessive vibration or shock.
- Minimum unobstructed space of 4 inches (10 cm) above and below the unit.
- Maximum ambient temperature of 50°C

Mounting dimensions

When mounting the 6430, please refer to the dimensions below:



2.5 Connecting to the 6430

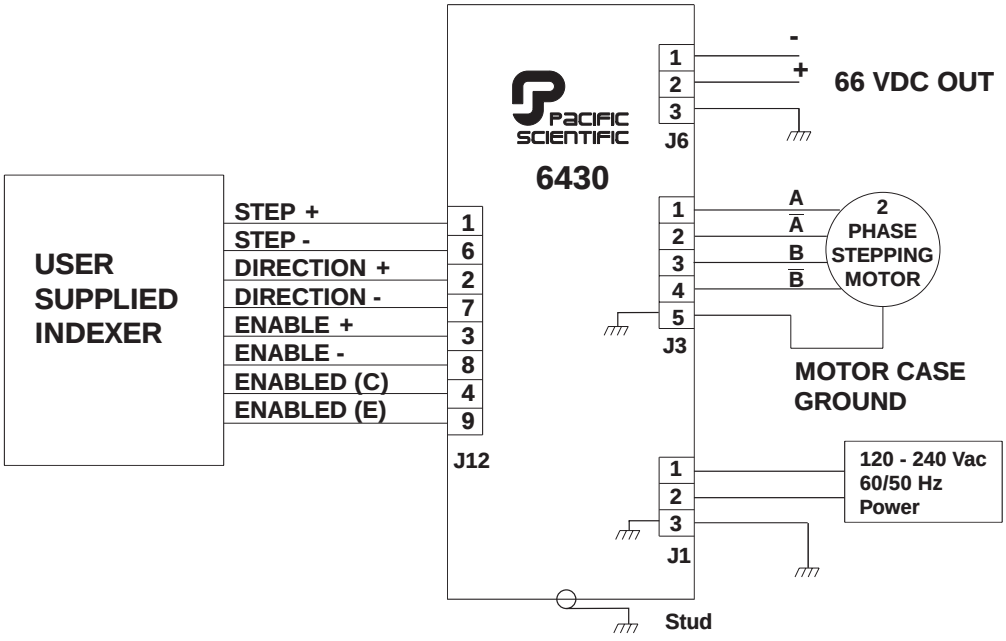
Introduction

The four input/output (I/O) connectors are:

- J1 - Power connector
- J3 - Motor connector
- J6 - External 66 Vdc Output connector
- J12 - Signal connector

These inputs and outputs are shown in the diagram below.

Connection diagram



Wiring is application specific

Wiring sizes, wiring practices and grounding/shielding techniques described in the following section represent common wiring practices and should prove satisfactory in the majority of applications.

Caution

Non-standard applications, local electrical codes, special operating conditions, and system configuration wiring needs take precedence over the information included here. Therefore, you may need to wire the drive differently then described here.

Noise pickup reduction

Use shielded and twisted cabling for the signal and power cables as described below. This precaution reduces electrical noise.

Shock hazard reduction

Refer to section 2.2 for safety information that must be followed to reduce shock hazard.

2.5.2 J1 120/240 Vac Power Connector

Introduction

The J1 power connector should be used to power the 6430 from 120/240 Vac (60/50 Hz).

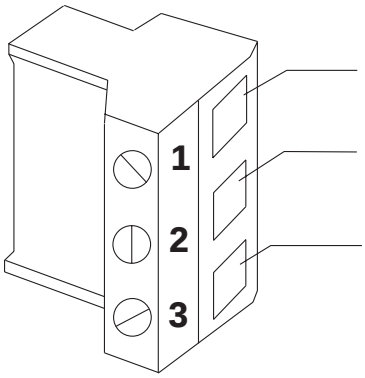
Mating connector

The J1 120/240 Vac power connector mates to a PCD 3-pin screw cable connector. The mating connector, supplied with the unit, is type ELFP03210.

Cable requirements

Use 16- to 14-gauge shielded wire for the cabling.

Cable diagram - J1 power cable



White - AC L1

Black - AC L2

Green - Earth Ground

Procedure

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

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

Caution

Do not solder the tips of the cables going into the PCD connector. This can result in a loose connection.

2.5.2 J3 Motor Connections

Introduction

The J3 motor cable connects the drive to the motor windings and motor case. J3 utilizes a plug-in screw terminal/type connector to simplify assembly and allow quick connect and disconnect.

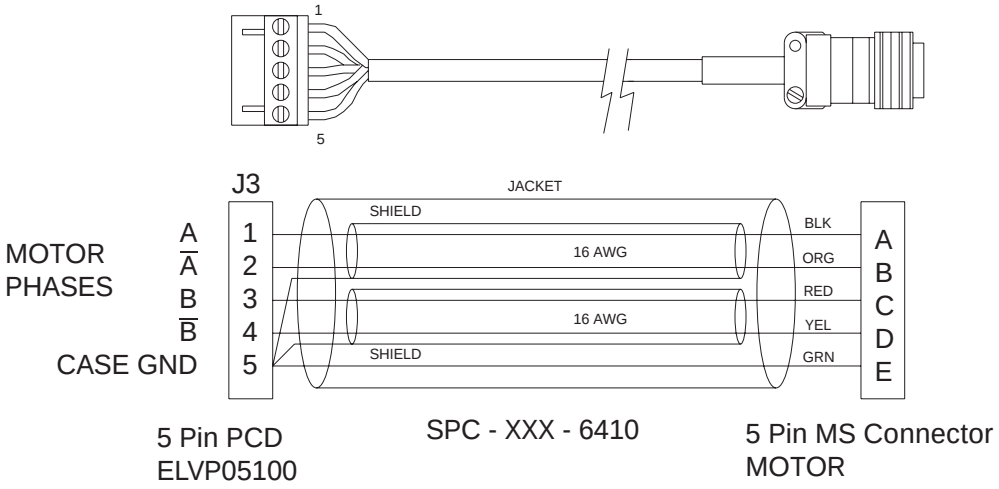
Pacific Scientific cable

Pacific Scientific makes cables that connect directly from J3 to our system motors. To order the cable from Pacific Scientific, use the order number SPC-xxx-6410, where "xxx" is the length, in feet (one-foot increments) up to 50 feet. For example, SPC-050 is a 50 feet long cable.

Pacific Scientific makes cables for both **E** and **H** series stepper motors (SPC-xxx-6410) and **K** and **N** series stepper motors (SPC-xxx-6410-KN). Please refer to the correct diagram on the following page.

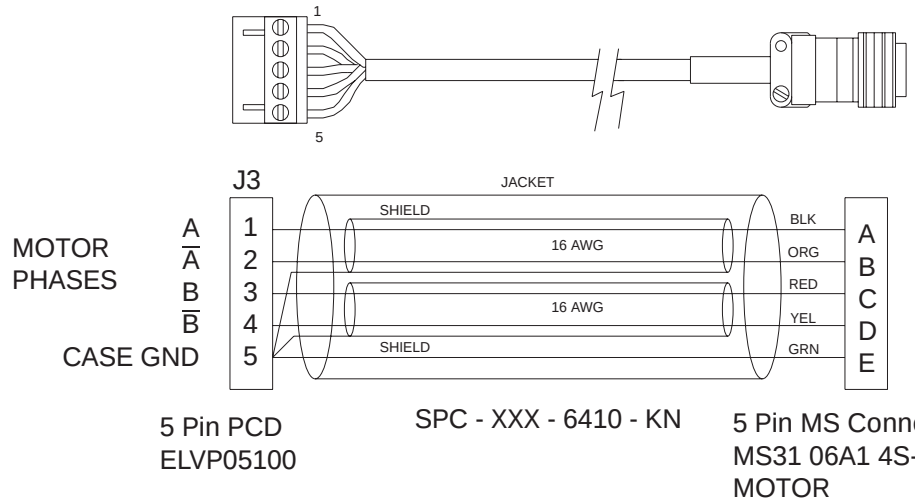
Pacific Scientific cabling diagram

If you are using Pacific Scientific **E** and **H** series motor cable, with the mating connectors already attached, install as follows:



Pacific Scientific cabling diagram

If you are using Pacific Scientific's **K** or **N** series stepper motors, install as follows:



5 Pin PCD
ELVP05100

SPC - XXX - 6410 - KN

5 Pin MS Connector
MS31 06A1 4S-5S
MOTOR

Making your own cable

To make your own motor cable, follow the guidelines given below for wiring to the J3 mating connector. Depending on your motor configuration, refer to the appropriate diagram at the end of this section to determine the motor connections required.

J3 connection table

Output	Pin	Explanation
Motor Phase A	J3-1	Motor Phase A excitation. Twisted Pair.
Motor Phase $\overline{A}$	J3-2	
Motor Phase B	J3-3	Motor Phase B excitation. Twisted Pair.
Motor Phase $\overline{B}$	J3-4	
Drive Case (Earth) Ground	J3-5	Connected to the motor case ground.

Mating connector

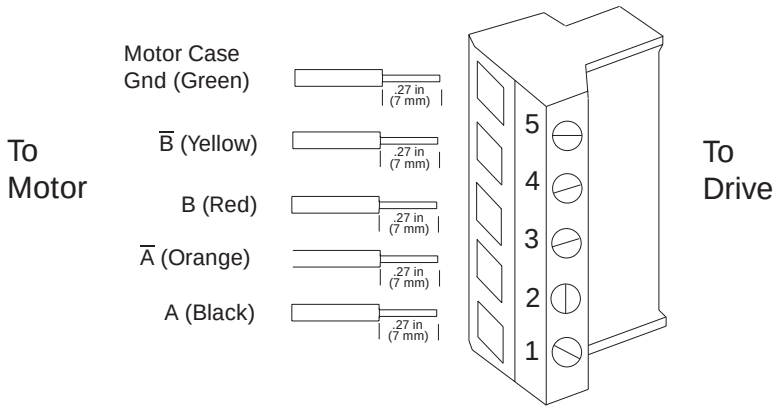
The J3 motor connector on the 6430 mates to a 5-pin PCD screw cable connector. The mating cable connector is type ELVP05100.

Cable requirements

The mating connector terminals will accept #16 to #18 AWG wire. Pacific Scientific recommends using #16 AWG.

For the motor cable, use cable with two twisted pairs twisted at about 3 to 4 turns per inch (1 to 1.5 turns per centimeter) for the motor phase excitations and a fifth wire for the case ground. As an option, the cable may be shielded to reduce radiated noise. A single shield can be used around both phase excitations and the ground wire or each phase excitation (twisted pair) can be individually shielded as in the Pacific Scientific cables. Connect shields to pin 5 of the mating connector.

Cabling diagram - J3 motor



Note: *The colors in the diagram follow the Pacific Scientific stepper motor cable color code.*

Procedure

1. Strip the wires to 0.27 in (7mm).
2. Attach wires to connector as indicated in the diagram.

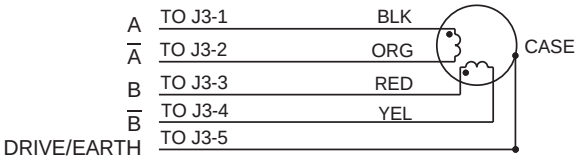
Note: *Make sure the screws on the PCD connector are tightened down firmly on the wiring.*

Caution

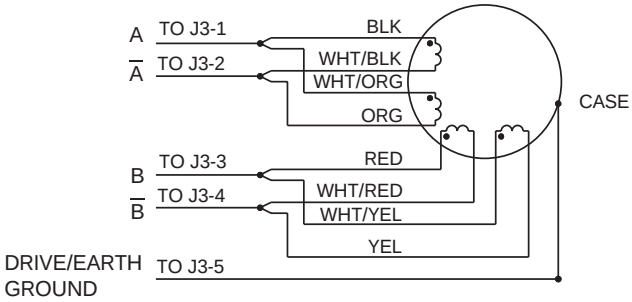
Do not solder the tips of the cables before insertion into the connector. Solder can contract and cause a loose connection over time.

Flying Lead Connection

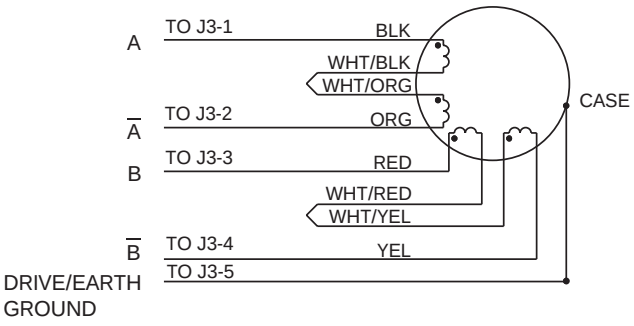
The figure below shows the connections required between the 6430 connector J3 and Pacific Scientific motors having flying leads. Connections are shown for 4 lead motors, 8 lead motors with paralleled windings, and 8 lead motors with series windings. Wire nuts may be used for the winding connections at the motor end.



FOUR LEAD MOTOR



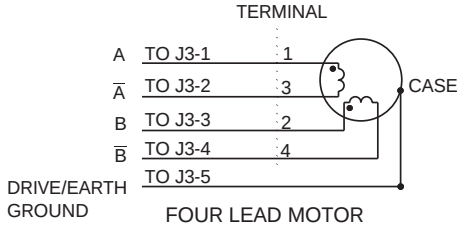
EIGHT LEAD MOTOR CONNECTED IN PARALLEL



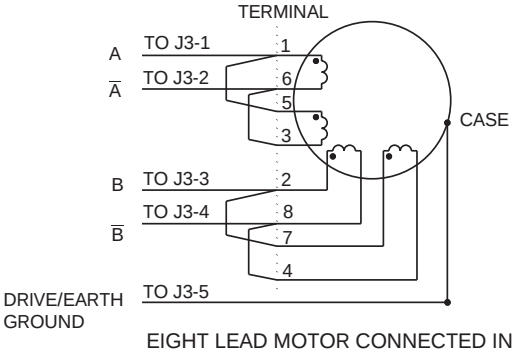
EIGHT LEAD MOTOR CONNECTED IN SERIES

Terminal board connections

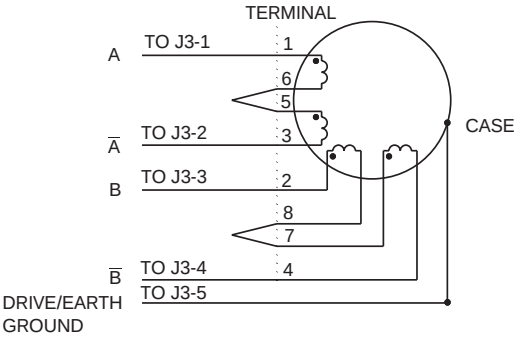
The figure below shows the connections required between the 6430 connector J3 and Pacific Scientific stepper motors having a terminal board in the rear end bell. Connections are shown for 4 lead motors, 8 lead motors with paralleled windings, and 8 lead motors with series windings.



FOUR LEAD MOTOR



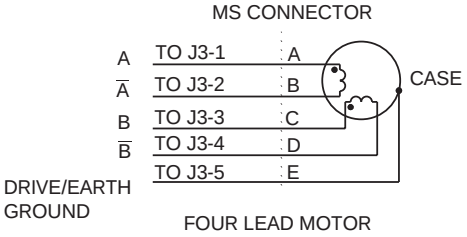
EIGHT LEAD MOTOR CONNECTED IN PARALLEL



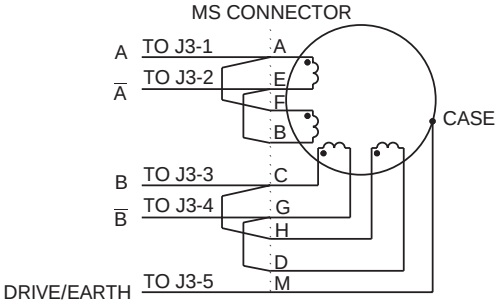
EIGHT LEAD MOTOR CONNECTED IN SERIES

MS connectors connection

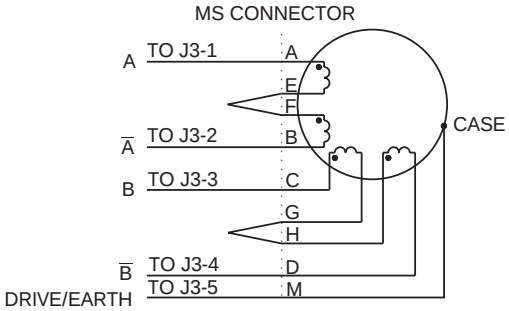
The figure below shows the connections required between the 6430 J3 connector and Pacific Scientific stepper motors having MS connectors. Connections are shown for 4 lead motors, 8 lead motors with paralleled windings, and 8 lead motors with series windings.



FOUR LEAD MOTOR



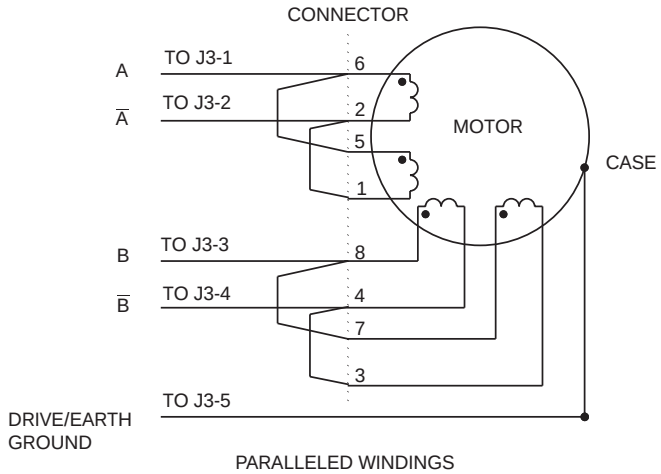
EIGHT LEAD MOTOR CONNECTED IN PARALLEL



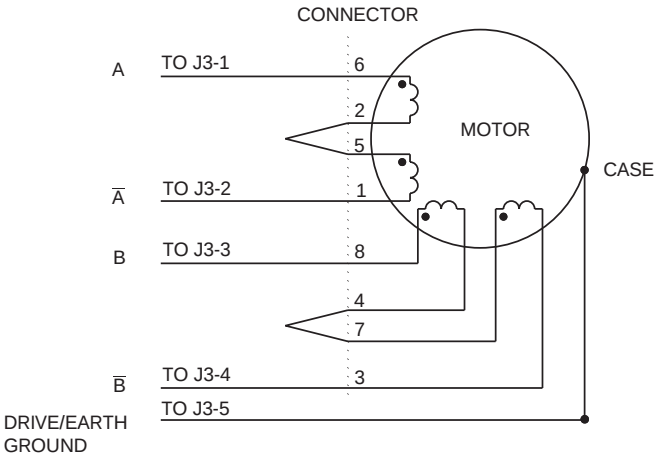
EIGHT LEAD MOTOR CONNECTED IN SERIES

Power Max motor connections

The figure below shows the connections required between the 6430 and Pacific Scientific Power Max Motors. Power Max motors have an eight pin connector and can be configured with either parallel or series windings.



PARALLELED WINDINGS



SERIES WINDINGS

2.5.3 J6 - External 66 Vdc Output Connection

Introduction

The J6 external 66 Vdc output allows the 6430 to power additional drives.

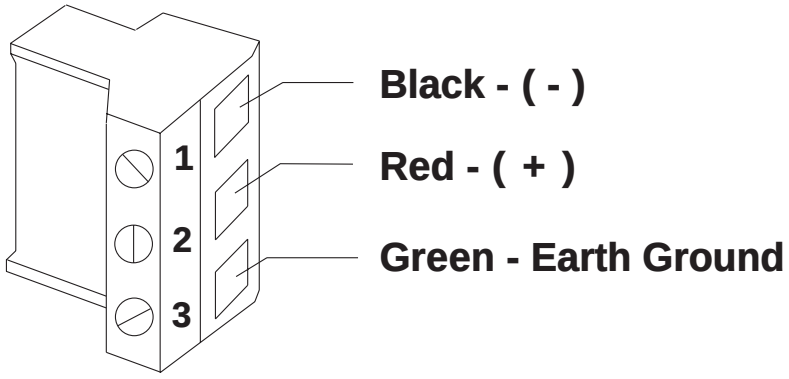
Mating connector

The J6 output connector mates to a PCD 3-pin screw cable connector. The mating connector, supplied with the unit, is type ELVP03100.

Cable requirements

Use 18- to 16-gauge shielded wire for the cabling.

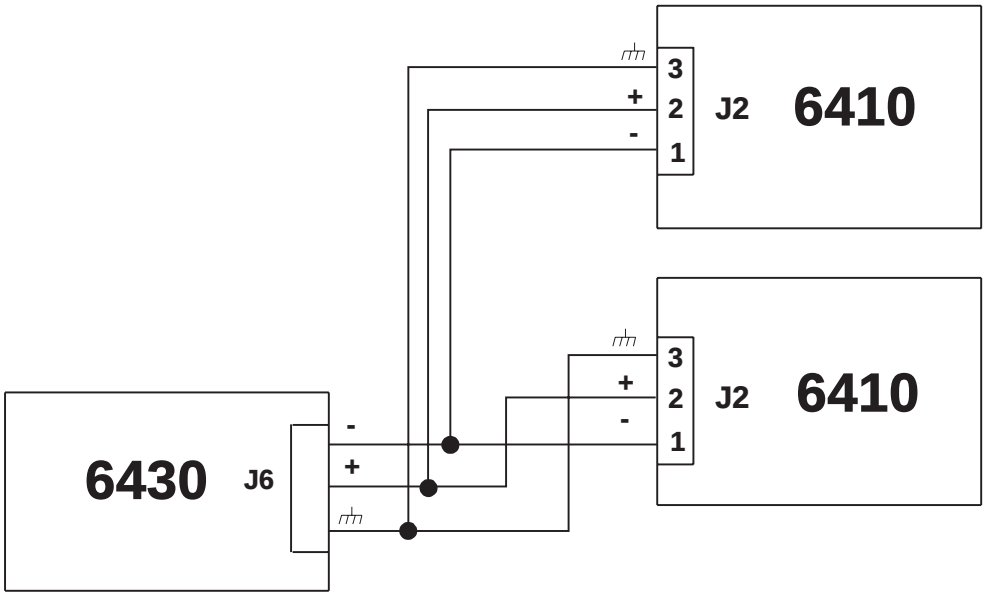
Cable diagram - 66 Vdc Output



Connection diagram

In multi-axis applications, if additional 6410s are added, it is preferable to run each power connection from the J6 DC output to the 6430 as shown below. **DO NOT** daisy-chain the power connections.

Note: *The total power available for both the internal and external drives is 66 Vdc @ 4.6 A or approximately 300 W ±10%. If the two drives are running simultaneously and require more than 4.6 A, the voltage will drop. The power supply has a low voltage protection circuit that will fault the drive if the voltage is < 55 Vdc.*



Note: *If the 6430 is powering additional 6410s with J6, a total of 1000 μf (maximum) 100 Vdc aluminum electrolytic capacitor, rated for 2A ripple current or greater @ 10 KHz and 105°C, must be installed at the 6410 (as close to the 6410 as possible) if the cable length is over 3 feet. DO NOT exceed 1000 μf total on J6 external connector.*

2.5.4 J12 Signal Interface Connection

Introduction

The J12 signal interface accepts step, direction and enable signals from an indexer or other source and outputs an enabled signal which indicates the 6430 is applying current to the motor windings.

J12 signal table

Note: *All inputs and outputs are optically isolated.*

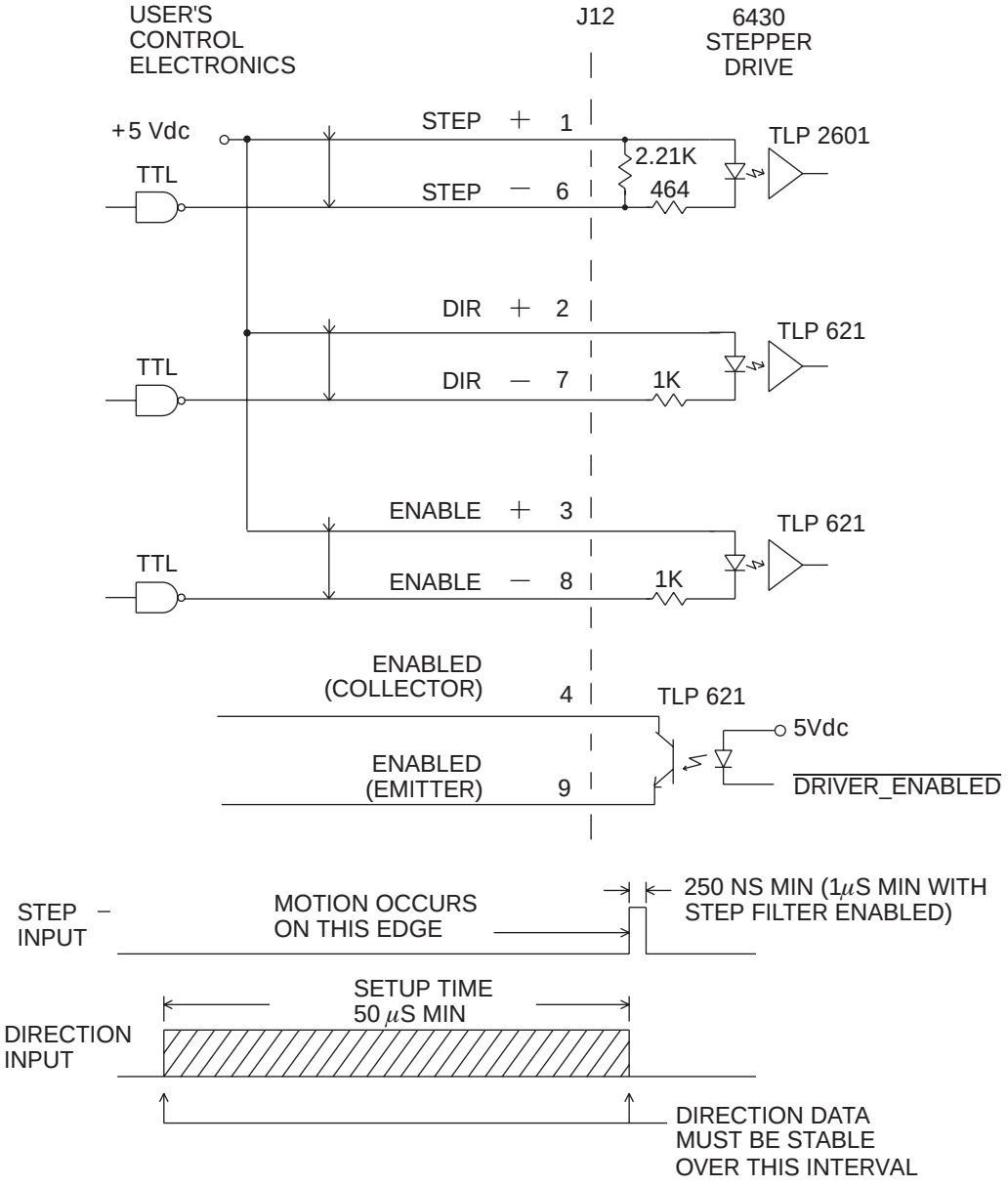
Input/Output	Pin	Explanation
STEP +	J12-1	Input used to command motor rotation. See figure at the end of the table for circuit and timing information.
DIR +	J12-2	Input that determines the direction of motor rotation. If standard motor wiring is followed, the motor will turn clockwise if the opto current is zero. The sense of the DIR + input can be reversed by reversing the connection of either (but not both) motor phase connectors (i.e. switching A & $\overline{A}$ **OR** B & $\overline{B}$). Refer to the figure at the end of the table for timing and circuit information.
ENABLE +	J12-3	Input used to enable or disable the 6430's power stage. With the J6 5-6 jumper out (factory default) the power stage is enabled if the opto current is zero and disabled if the opto is driven. Inserting the jumper reverses this functionality. See figure at the end of the table for circuit information. There is a delay of approximately 500 μs after enabling the drive and the power stage becoming active.
Enabled Collector	J12-4	Output. Collector of transistor that is on when the 6430's power stage is active. See figure at the end of the table for circuit information.
	J12-5	Not used.
STEP -	J12-6	Input used to command motor rotation. See figure at the end of the table for circuit and timing information.

Table cont'd

Input/Output	Pin	Explanation
DIR -	J12-7	Input that determines the direction of motor rotation. If standard motor wiring is followed, the motor will turn clockwise if the opto current is zero. The sense of the DIR + input can be reversed by reversing the connection of either (but not both) motor phase connectors (i.e. switching A & $\overline{A}$ **OR** B & $\overline{B}$). Refer to the figure at the end of the table for timing and circuit information.
ENABLE -	J12-8	Input used to enable or disable the 6430's power stage. With the J6 5-6 jumper out (factory default) the power stage is enabled if the opto current is zero and disabled if the opto is driven. Inserting the jumper reverses this functionality. See figure at the end of the table for circuit information. There is a delay of approximately 500 μs after enabling the drive and the power stage becoming active.
Enabled Emitter	J12-9	Output. Emitter of transistor that is on when the 6430's power stage is active. See figure at the end of the table for timing and circuit information.

Typical interface The figure on the following page shows a typical interface between the user's electronics and the 6430. The TTL gates should have totem pole outputs and be capable of sinking at least 10.0 mA at 0.4 volts.

Interface diagram

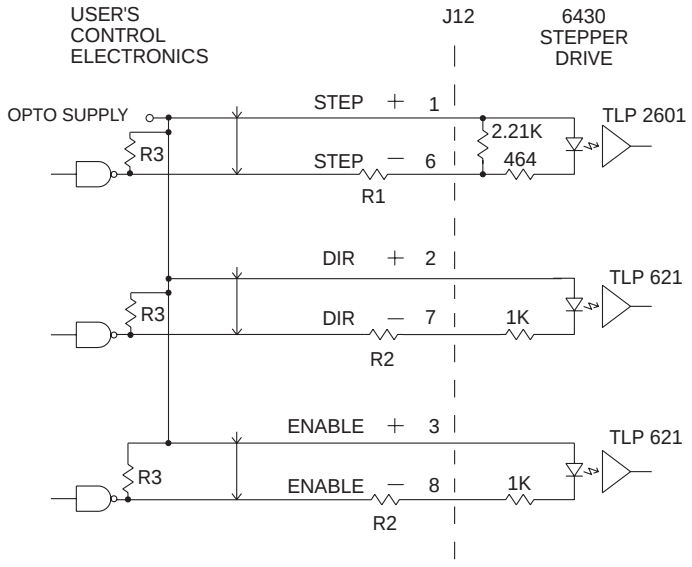


Higher voltage interface

Voltages up to 30 volts can be used for the opto power input to the 6430 drive. However, a resistor must be put in series with the command inputs as shown below. Values for several common supply voltages are given in the following table.

If the drives have open collector outputs, pull up resistors (R3) should be added as shown. A typical value of R3 is 2.7K.

Opto Supply to 6430	R1	R2
+12 Vdc	1 Kohm	1.5 K
+15 Vdc	1.5 Kohm	2.2 K
+30 Vdc	3.3 Kohms	6.8 K



Mating connector

The J12 signal interface connector is 9 contact female D connector. The mating cable connector is an ITT Cannon DE-9P with ITT Cannon DE110963 Hood and D20419 Clamp Kit.

3 Powering Up the 6430 Drive

In this chapter

This chapter explains how to power up the 6430 drive after installation. Topics covered are:

- Setting up functions using switch S1 and Jumper J6
- AC Switch (SW1) Settings
- Testing the installation

This section is intended to familiarize the 6430 user with the hardware adjustments and settings required to power up and operate the 6430 drive.

Introduction

The 6430 drive is a two board assembly incorporating a Drive and a Power Board set.

Drive

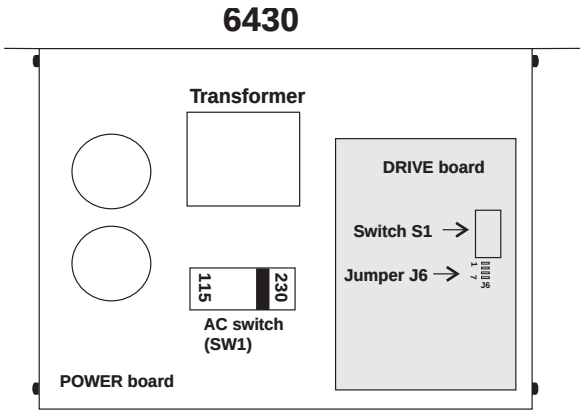
The drive board has an eight position DIP switch (S1) and a group of four jumpers (J6) controlling drive current, digital electronic damping, idle current reduction and binary or decimal step size.

Power

The power board has an AC switch (SW1) to select 120 or 240 Vac operation.

Warning

Connecting 240 (230) Vac with switch in 120 (115) Vac position will permanently damage the drive.



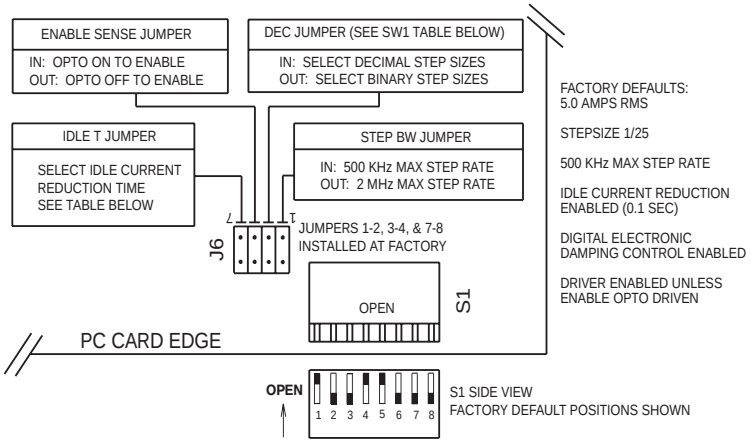
3.1 Setting Switch S1 & Jumper J6 on Drive Board

Introduction

DIP switch S1 and Jumper J6 set the following:

- Step size
- Motor current level
- Digital electronic damping ON/OFF
- Idle current reduction
- Enable sense
- Step filter response time

Location of S1



SW1 POSITION 1	2	3	STEP SIZE DEC JMPR IN	DEC JMPR OUT
CLOSED	CLOSED	CLOSED	FULL	HALF
CLOSED	CLOSED	OPEN	HALF	1/4
CLOSED	OPEN	CLOSED	1/5	1/8
CLOSED	OPEN	OPEN	1/10	1/16
OPEN	CLOSED	CLOSED	1/25	1/32
OPEN	CLOSED	OPEN	1/50	1/64
OPEN	OPEN	CLOSED	1/125	1/128
OPEN	OPEN	OPEN	1/250	1/256

SW1 POSITION 6	7	8	MOTOR CURRENT AMPS RMS
CLOSED	CLOSED	CLOSED	5.0
CLOSED	CLOSED	OPEN	4.375
CLOSED	OPEN	CLOSED	3.750
CLOSED	OPEN	OPEN	3.125
OPEN	CLOSED	CLOSED	2.5
OPEN	CLOSED	OPEN	1.875
OPEN	OPEN	CLOSED	1.25
OPEN	OPEN	OPEN	0.625

SWI POSITION 4	DIGITAL ELECTRONIC DAMPING
CLOSED	DISABLED
OPEN	ENABLED

IDLE-T JUMPER	SW1 POSITION 5	IDLE CURRENT REDUCTION
IN	CLOSED	DISABLED
IN	OPEN	0.1 SEC DELAY
OUT	CLOSED	0.05 SEC DELAY
OUT	OPEN	1.0 SEC DELAY

3.1.1 Step Size

Definition

The step size sets the amount of rotation per input step. Fifteen step sizes are available using Jumper J6 position 3-4 and DIP switch S1 positions 1-3 as shown. For all Pacific Scientific stepper motors and all 1.8° step motors, step size can be converted to steps per rotation using the following table:

Decimal		**Binary**	
Full	200	Half	400
Half	400	1/4	800
1/5	1,000	1/8	1,600
1/10	2,000	1/16	3,200
1/25	5,000	1/32	6,400
1/50	10,000	1/64	12,800
1/125	25,000	1/128	25,600
1/250	50,000	1/256	51,200

Benefits

Selecting a microstep size of 1/5 or smaller results in:

- higher resolution
- smoother low speed operation
- ability to operate in low-speed resonance regions

3.1.2 Digital Electronic Damping Control

Definition

Mid-speed instability and the resulting loss of torque occurs in any step motor/drive system due to the motor back EMF modulating the motor winding currents at certain speeds. Mid-speed instability can be explained as a region of potential instability that occurs as a result of the electronic, magnetic, and mechanical characteristics of any stepping motor system. The circuitry used to control this phenomenon does so by advancing or delaying the switching of the output current with respect to the incoming pulse train. This should be taken into account if the user is attempting to employ pulse placement techniques.

Enable the digital electronic damping function by placing DIP switch S1 position 4 in the open position as shown. This is the default position and should be used for most applications if your application is affected by loss of torque at mid-range speeds. If pulse placement techniques are being used, disable the digital electronic damping function by placing DIP switch S1 position 4 in the open position.

Benefit

This feature controls torque loss at mid-range speeds. When enabled, the motor maintains torque at mid-range operation, provided the torque load does not exceed motor torque ratings.

3.1.3 Idle Current Reduction

Definition

The Idle Current Reduction (ICR) function reduces the phase current at times when no motion is commanded. Motor current is reduced when no step commands are received for a given time. This time can be set to 0.05 seconds, 0.1 seconds or 1.0 second. Current to both motor windings is reduced by one-half.

The ICR function can be enabled/disabled and the time delay between the last step command and current reduction can be set to 50 ms, 0.1 seconds, or 1.0 second using DIP switch S1 position 5 and Jumper J6 position 7-8. With the jumper installed (factory default), ICR is disabled when DIP Switch S1 position 5 is in the closed position and enabled with a delay of 0.1 second (current is reduced by 50% when no step command is received for 0.1 second when the switch is open. With the jumper removed, ICR is enabled and the delay can be set to 0.05 second or 1.0 second by placing DIP Switch S1 position 5 in the closed or open position respectively.

Note: *When ICR is active, both the holding torque generated by the motor and the motor stiffness around the holding position are reduced by approximately 50%.*

Benefits

The ICR function:

- Reduces motor and drive heating during stand-by operation

3.1.4 Setting Motor Current

Motor current can be set using DIP Switch S1 positions 6, 7, and 8 as shown. Current should be compatible with motor current ratings.

3.1.5 Enable Sense Control

The polarity of the enable input can be changed using Jumper J6 position 5-6. With the jumper removed (factory default), the drive is enabled when the enable input is not driven and disabled when driven (current flows in enable opto). This allows the 6430 to be used with no connection to the enable input. With the J6 5-6 jumper installed, the enable input must be driven (current in opto) for the 6430 power stage to be enabled.

3.1.6 Step Bandwidth Adjustment

A digital filter can be enabled which reduces susceptibility to noise on the step input at the expense of a lower limit on maximum step frequency. With Jumper J6 positions 1-2 installed (factory default) the filter is enabled and step pulses must have a minimum width of one microsecond. Pulses less than 0.5 microseconds in width will be rejected. With the filter disabled, Jumper J6 position 1-2 removed, step pulses must be a minimum of 0.25 microseconds wide. Therefore, the maximum step frequency is 500 KHz with the filter enabled and 2 MHz with the filter disabled.

3.2 Setting AC Switch on Power Board

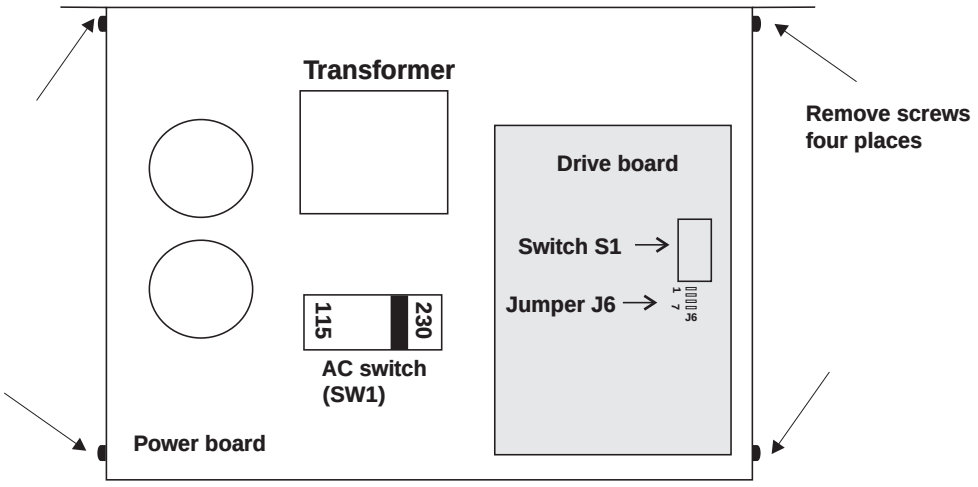
Introduction

The AC Switch (SW1) on the 6430 power board allows the user to select 120 **OR** 240 Vac.

Warning!

Connecting 240 (230) Vac with switch in 120 (115) Vac position will permanently damage the drive.

Location of AC Switch



Note: *The AC Switch is preset at the factory in the 230 Vac position.*

3.3 Testing the Installation

Background

The following procedure verifies that the 6430 is installed properly and that it was not damaged during shipment.

Procedure

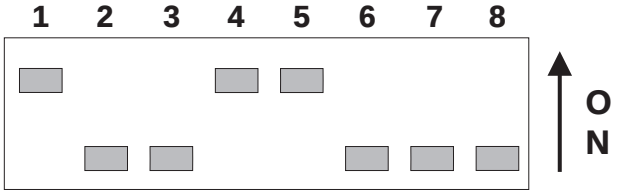
After installing the 6430 as described in Chapter 2, test your installation as follows.

Warning

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

Connections test

1. Check all wiring and mounting to verify correct installation.
2. With the power Off, check that S1 is set as follows (factory default settings):



These settings reflect the following:

- Step size of 1/25
- Digital electronic damping enabled
- Idle current reduction enabled
- 5 A rms motor current

Warning

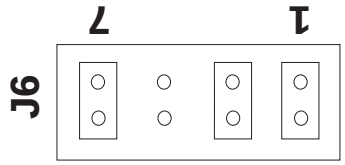
If the motor is rated at less than 5 A rms winding current, set positions 6, 7, & 8 accordingly.

Procedure cont'd

Warning

Make sure power is removed before proceeding.

3. Check that Jumper J6 is set as follows:



These settings reflect the following:

- Idle Current Reduction Enabled (0.1 second delay)
- 6430 enabled without enable input driven
- Decimal step size selected
- Step input filter enabled

4. Switch On 120 **OR** 240 Vac power, as selected by position of AC Switch.

Warning!

Connecting 240 (230) Vac with switch in 120 (115) Vac position will permanently damage the drive.

Signals test

1. Verify that the motor has holding torque by attempting to rotate the motor shaft. The energized motor shaft is either immovable or is resistant to rotation.
2. Input a step command and verify that the motor moves.
3. Reverse the polarity of the DIRECTION signal and step the motor. The direction of rotation should change.

Getting help

If you need further assistance with your installation, please contact your local distributor.

4 Maintaining/Troubleshooting

In this chapter This chapter covers maintenance and troubleshooting of the 6430 unit.

4.1 Maintaining the 6430 Drive

Introduction The 6430 drives are designed for minimum maintenance. The following cleaning procedure, performed as needed, will minimize problems due to dust and dirt build-up.

Procedure Remove superficial dust and dirt from the unit using clean, dry, low-pressure air.

4.2 Troubleshooting the 6430 Drive

Introduction The 6430 has an "enabled" output which is on when the drive is enabled and off when the drive is disabled or faulted due to any of the following:

- Output overcurrent (line-to-line or line-to-neutral short)
- Bus overvoltage
- Low voltage supply out of tolerance.

Procedure Use the troubleshooting tables and the simple circuit shown on the following pages to diagnose and correct most problems. If you are unable to achieve satisfactory operation, contact your local Pacific Scientific Distributor or the Applications Engineering Department.

4.2.1 Troubleshooting 6430 Power Board

Corrective action table Use the following table to troubleshoot the 6430's power supply.

SYMPTOM	POSSIBLE CAUSE	ACTION
Motor does not turn LEDs ON (green and/or red)	120/240 Vac switch in 240 position, input from 120 Vac	Turn power off, correct switch position.
	AC Input line low	Increase Input AC to spec.
	Dead short or overload across external 66 Vdc output connector (J6).	Remove short or reduce load.
	Over temperature	Check ambient temperature or internal fan malfunction/blockage.
	Bad load connection	Check load connection. Check J6 Vdc output with a voltmeter and ensure output voltage is 66V ±3%. 1. If output voltage > 70 Vdc and < 78 Vdc add a load and ensure Vdc is ≈ 66Vdc. 2. If output voltage > 78 Vdc, return 6430 to factory for service.
	Drive board fault	See Section 4.2.2

Table (cont'd)

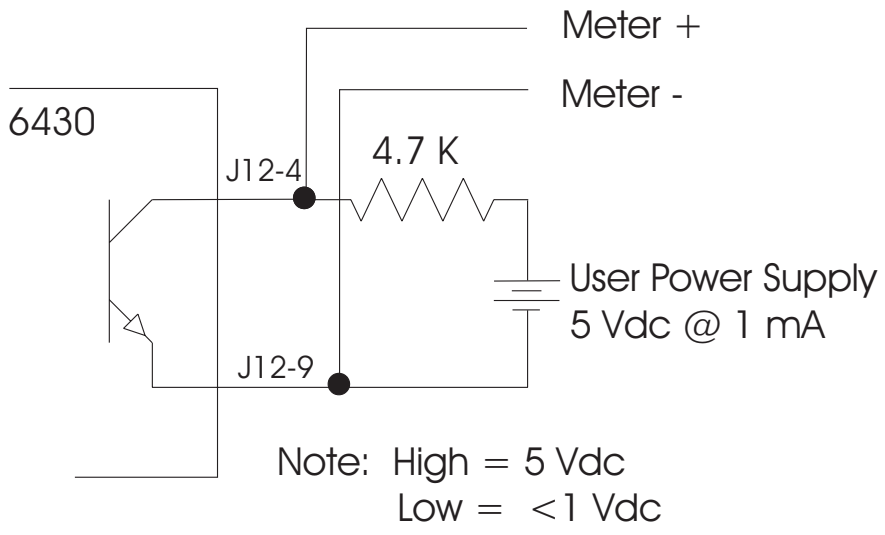
SYMPTOM	POSSIBLE CAUSE	ACTION
Motor does not turn, LEDs OFF	Check AC input	Use proper input.
	240 Vac applied and switch in 120 Vac position.	Return to factory for service.
Motor runs for a while and stops, both LEDs come on	Over temperature.	Reduce load. Check for excessive ambient temperature. Check for internal fan malfunction/blockage.
Motor turns on and off on its own and red LED keeps flashing **OR** Motor stops after running once.	120 Vac applied and switch in 240 Vac position	Correct switch position.
	Over load.	Reduce load.
	AC input line low.	Check input AC line voltage for low line.
	Drive Board Fault.	See Section 4.2.2
	Internal failure.	Return to factory for service.

4.2.2 Troubleshooting the drive board

Corrective action table Use the following table to troubleshoot the drive board:

SYMPTOM	CORRECTIVE ACTION
Motor produces no torque, Meter reads high. *Note: See figure on next page*.	Ensure that the J6 5-6 jumper is out, or if in, that the enable input opto is driven with at least 3 mA. Disconnect the AC power. Disconnect motor cable and cycle the J1 power supply Off and On. If the meter reads low, check motor cable and motor for shorts across the windings or between the windings and the motor case.
Motor produces no torque, meter reads low. *Note: See figure on next page*.	Verify that DIP Switch S1 position 6, 7, and 8 (current select) are set correctly. Re-check that the motor cable is wired correctly and properly plugged into the drive.
Motor produces torque but does not turn.	Make sure that the STEP input is switching and meets specified electrical and timing requirements.
Motor rotates in the wrong direction	Check polarity of the DIRECTION input. Also, check that the DIRECTION input satisfies the specified electrical and timing requirements. Reverse the A and $\overline{A}$ motor phases.
Motor does not reach expected position	Check that the step size setting of the drive is the same as the step size setting of the indexer. Verify that the motor does not stall. If it does: 1. Use a finer step size to avoid low-speed resonance problems. 2. Enable Digital Electronic Damping control. (S1 position 4 OFF). Check that the STEP and DIRECTION Inputs satisfy all electrical and timing requirements.

Simple circuit diagram



IMPORTANT NOTE!

If you suspect that the 6430 drive has been damaged, DO NOT simply replace it with another and apply power.

If the drive is defective

If you cannot correct the drive problem, or if it is defective, return it to Pacific Scientific for repair or replacement.

Return procedure

1. Call Pacific Scientific at (815) 226-3100 from 8am to 6pm Eastern Standard Time to get a Returned Materials Authorization Number (RMA#).

Note: *Do not attempt to return the 6430 or any other equipment without a valid RMA#. Returns received without a valid RMA# will not be accepted and will be returned to the sender.*

2. Pack the drive in its original shipping carton. Pacific Scientific is not responsible or liable for damage resulting from improper packaging or shipment.

3. Ship the drive to:

   Pacific Scientific

   110 Fordham Road

   Wilmington, MA 01887

   Attn: Repair Department, RMA# _____

Note: *Do not ship Pacific Scientific motors to the above address. The correct address for motors is:*

Pacific Scientific

4301 Kishwaukee Street

Rockford, IL 61105

Attn: Stepper Repair Department, RMA# _____

Shipment of your drive or motor to Pacific Scientific constitutes authorization to repair the unit. Refer to Pacific Scientific's repair policy for standard repair charges. Your repaired unit will be shipped via UPS Ground delivery. If another means of shipping is desired, please specify this at the time of receiving an RMA#.

Appendix A Specifications

Electrical

Input voltage 120/240 Vac (+10%, -15%) 60/50 Hz

Rated drive current (motor phase current)

Setting	
5 A	5A ± 0.25A
4.375	4.375 ± 0.2A
3.75	3.75 ± 0.2 A
3.125	3.125 ± 0.15 A
2.5	2.5 ± 0.15 A
1.875	1.875 ± 0.125
1.25	1.25 ± 0.125
0.625	0.625 ± 0.1 A

Fuse 5 A Slo-Blo 250 Vac

Drive circuit Two-phase bipolar, chopper current regulated

Chopper frequency 20 KHz, nominal

Step size

Switch settable	Steps/motor revolution (1.8° stepper motor)
Full **(1/2)**	200 **(400)**
1/2 **(1/4)**	400 **(800)**
1/5 **(1/8)**	1000 **(1600)**
1/10 **(1/16)**	2000 **(3200)**
1/25 **(1/32)**	5000 **(6400)**
1/50 **(1/64)**	10000 **(12800)**
1/125 **(1/128)**	25000 **(25600)**
1/250 **(1/256)**	50000 **(51200)**

Signal input requirements

(See circuit diagram, Section 2.5.4)

Optically Isolated Inputs:

Input	Min Input Current - Opto ON	Max Input Current	Max Reverse Voltage (Input to J12-9)
J12-1, J12-6 - Step	5.5 mA	10 mA	5 volts
J12-2, J12-7 - Direction	3.0 mA	4.5 mA	5 volts
J12-3, J12-7 - Enable	3.0 mA	4.5 mA	5 volts

Signal output characteristics

(See circuit diagram, Section 2.5.4)

J12-4, J12-9 Enabled

(Optically isolated NPN transistor with open collector and open emitter)

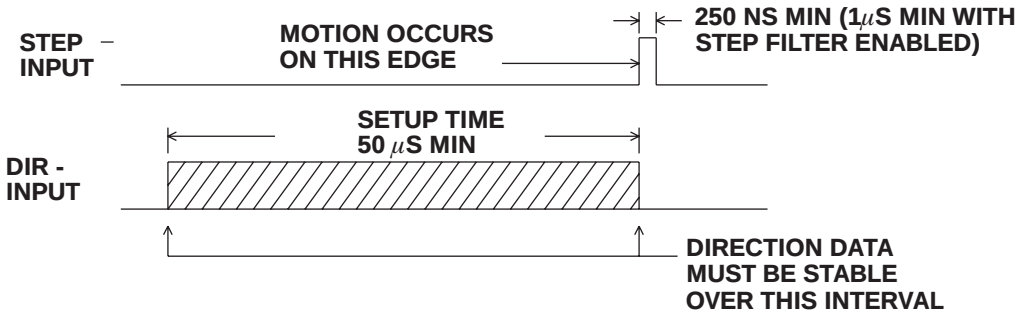
Maximum low level voltage while sinking 2 mA: 0.5 volts

Maximum step rate

2 MHz with step filter disabled
500 KHz with step filter enabled

Step/Direction timing requirements

The figure below show the required timing relationship between the STEP and DIRECTION inputs:



Minimum ramp time for step rate (Accel/Decel)

50 milliseconds (This restriction only applies with digital electronic damping control enabled.

Drive state generator transition delay relative to input step

1. With digital electronic damping control enabled, at pulse frequencies less than 500 full steps/sec, delay is less than 500 μsec. At frequencies greater than 500 full steps/sec, delay is less than 270° of the input pulse period.

2. With digital electronic damping control disabled, delay is less than 10 μsec at all step frequencies.

Environmental

Operating Temperature	Full rated current 0 to 50°C ambient air
Storage temperature	-40°C to +70°C
Humidity Range	10 to 90%, non-condensing

Mechanical

Dimensions	Refer to Section 2.4
Weight	6.0 lb nominal

Connectors

AC Input	Phoenix MSTBA 2,5/3-G connector. Mating connector: Phoenix MCI, 5/5-ST-3,81.
Signal	9 contact female D connector, Mating connector: ITT Cannon DE-9P with ITT Cannon DE110963 Hood and D20419 Clamp Kit.
Motor	PCD ELVH0510 connector. Mating connector: PCD ELVP05100.
66 Vdc output	PCD ELVH0310 connector. Mating connector: PCD ELVP03100.

Appendix B Ordering Information

Background

This appendix lists 6430 part numbers and gives information on ordering.

6430 part number table

Part	Pacific Scientific Order #	Comment
Stepper Drive	6430	
Connector Kit	CK6430	9-pin D connector
		5-pin PCD
		3-pin PCD
		3-pin PCD
Installation and Hardware Manual	MA6430	
Motor Cable	SPC-xxx-6410 SPC-xxx-6410-KN*	xxx represents length in feet; for example, SPC-005 is a cable 5 feet long. For lengths over 50 feet contact Pacific Scientific. The connectors are MS on the motor end and PCD on the drive end to connect to Pacific Scientific motors.

***Note:** *Cables for* **K** *and* **N** *series stepper motors.*

How to order	Contact Pacific Scientific to order these parts.
Call	815-226-3100 from 8am to 6pm Eastern Standard Time.
Write	Pacific Scientific 4301 Kishwaukee Street Rockford, IL 61105
Fax	(815) 226-3048

Index

N

O

P

R

S

T

U

V

W