WARNING - DANGEROUS VOLTAGES

VOLTAGE LEVELS WITHIN THIS PRODUCT CAN EXCEED 120 VAC AND 100 VDC. THESE VOLTAGE LEVELS CAN CAUSE SERIOUS INJURY OR BE FATAL, THEREFORE FOLLOW GOOD ELECTRICAL PRACTICES, APPLICABLE ELECTRICAL CODES AND THE CONTENTS OF THIS MANUAL.

Due to the wide variety of uses for the 5440, it is the responsibility of the user or those applying the unit to determine the suitability of this product for any intended application. In no event will Pacific Scientific Company be responsible or liable for indirect or consequential damage resulting from the use of this product.

The figures, tables, and examples shown in this manual are intended solely to supplement the text. Because of the varied requirements of any particular application, Pacific Scientific Company cannot assume responsibility or liability for actual use based upon the illustrative uses and applications included in this manual.

MODEL 5430 INSTRUCTION MANUAL

TABLE OF CONTENTS

LIST OF FIGURES

SECTION 1

INTRODUCTION

The 5430 is a driver package which operates from 120 volts AC and provides the necessary functions to convert step and direction inputs into motor winding currents, driving a two phase bipolar stepping motor. The standard output is 5.0 amps/phase with a 65 volt DC bus. The 5430 is designed for use with Pacific Scientific's SIGMA line of hybrid stepping motors and will work with either the standard SIGMA line or the SIGMAX enhanced high performance line of stepping motors. The motor winding must be compatible with the output rating of the driver package.

1.1 Overview of Operation

Figure 1.1 is a functional block diagram of the 5430. There are two major blocks the driver and the power supplies.

The microstepping motor driver is a high efficiency bipolar chopper utilizing Pulse Width Modulation to electronically control the motor winding currents, (20 KHZ chopping frequency). The drive accepts step pulse, direction, and a current control input, and supplies the correct outputs for driving two-phase stepping motors. The three signal inputs are optically isolated.

The power supply includes a line operated step down transformer. The outputs of the transformer are rectified and in the case of the logic supply regulated to provide power to the drive. Incorporated into the supply is a power dump circuit which will remove energy from the supply if the supply voltage rises above 80 volts, this can occur under certain deceleration conditions.

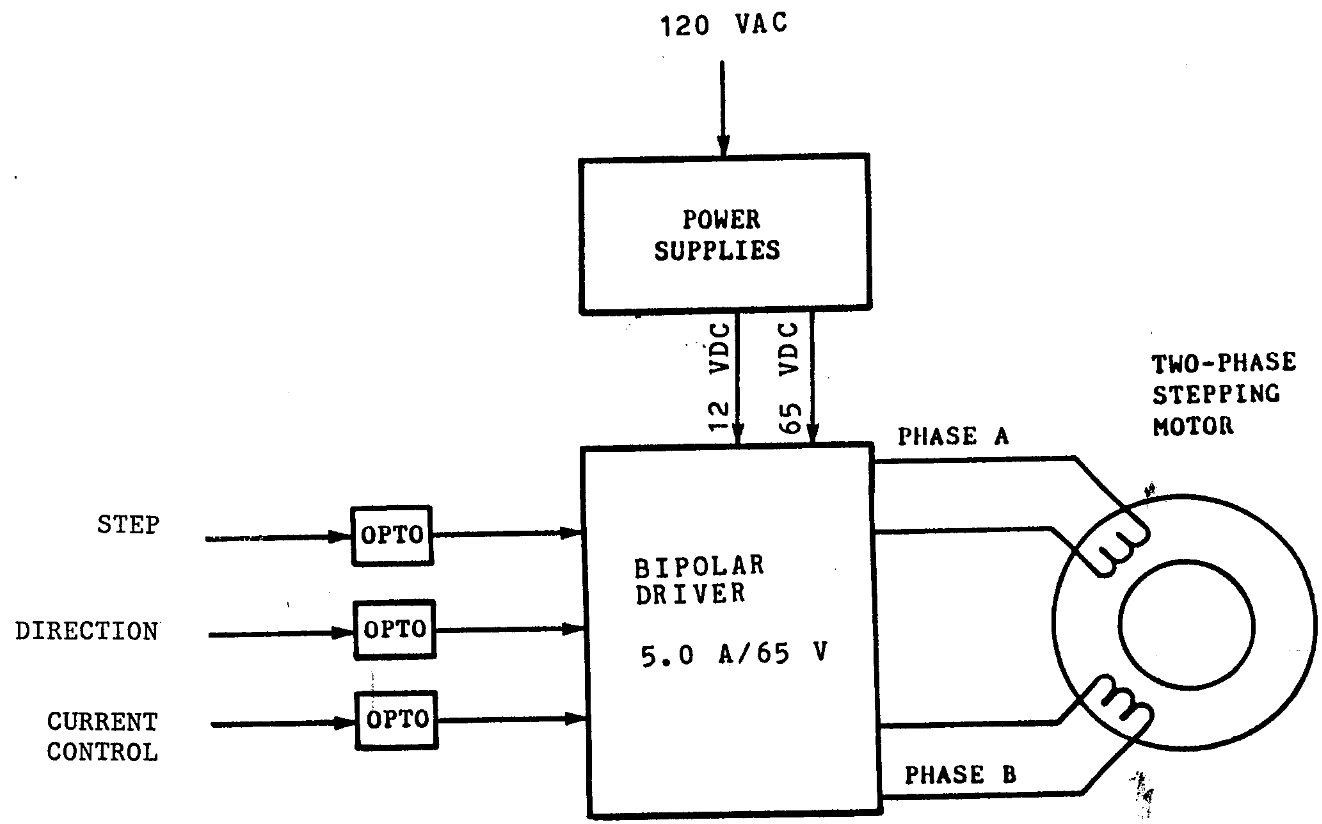
1.2 Features

The drive power stages are protected against overheating and phase-to-phase and phase to ground short circuits. The presence of a short circuit is indicated by the Disable LED and an output logic signal. The short circuit detector clears automatically when the fault is cleared.

An Idle Current Reduction (ICR) feature allows motor winding currents to be automatically reduced by 50% during motor standstill periods. ICR begins one second after the last input step pulse occurs, and may be enabled or disabled by the user by a circuit board jumper. One logic input has been provided to allow the user to program output current levels to the motor. The programmable current levels available are 0 and rated. Due to sine/cosine current excitation in the microstepping mode, the actual RMS current level while microstepping (1/2, 1/5, 1/25, and 1/125 step) is 70% of the full step rated current. The microstep current boost feature allows the motor microstep current to be boosted 1.4 times at step rates above 500 full steps per second. Boosting the 70% rated current by a factor of 1.4 brings winding current back to rated levels. The current boost feature is switch selectable.

The 5430 drive package has additional circuitry to eliminate midrange frequency instability. Midrange 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 transistors with respect to the incoming pulse train. This should be taken into account if the user is attempting to employ pulse placement techniques. The midrange stability feature can be enabled or disabled by the user with a circuit board jumper.

Optical isolation is provided on the step, direction and the current control lines. 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 in the 5430 allowing the system ground point for these signals to be made external to the unit.



FUNCTIONAL BLOCK DIAGRAM

FIGURE 1.1

SECTION 2

SPECIFICATIONS

2.1 Electrical

Input Voltage	:	120 VAC (+/- 15%) Single Phase, 60 HZ
Input Current	:	5 Amp RMS maximum
Fuse	:	MDA 6 on both 120 VAC lines
Drive Circuit	:	Two-phase bipolar, chopper current regulated.
Bus Voltage	:	65 Volt nominal at 120 Volt AC Input.
Rated Current		
Full Step	:	5.0 +/- .1 Amp
Microstep	:	3.5 +/- .1 Amp
Micro step with current boost on above 500 full steps/sec.	:	5.0 +/- .1 Amp
Step Size	:	Full, 1/2, 1/5, 1/25, 1/125 selected via Dip Switches
ICR Feature	:	Idle Current Reduction circuit reduces motor current 50% during motor idle periods. ICR starts one second after last step input pulse prior to motor standstill. The current is automatically returned to rated value at the next step pulse.
Microstep Current Boost	:	With current boost enabled, driver microstep current is boosted 1.4 times rated microstepping current at step rates above 500 full steps per second. With current boost disabled, driver supplies rated microstep current at all step rates.

Driver State Generator Transition Delay Relative To Input Step :	(1) With stability control circuit enabled, at pulse frequencies less than 500 full steps per second, delay is less than 500 usec. At frequencies greater than 500 full steps per second, delay is less than 270 Degrees of the input pulse period. (2) With stability control circuit disabled, delay is less than 10 usec at all step frequencies.
Stability Control Selection :	With stability control enabled the drive will electronically compensate for mid-range instability which results in loss of torque at higher speeds. Stability control can be disabled via circuit board solderless jumper.
Disable LED Indication :	DS1 LED illuminates for internal driver disable conditions (overcurrent, overtemperature, invalid DIP switch setting on the drive).
External Current Control :	One optically isolated logic signal input allows external motor current selections of 0 and rated current. Optically isolated TTL or open collector with external pull-up resistor required,10 mA minimum sink current. Ref. Fig. 9, Note 7.
Chopper Frequency :	20 kHz, nominal
STEP Pulse Input :	Optically isolated TTL, or open collector with external pull-up resistor required, 10 mA minimum sink current. Ref. Fig. 9, Note 7. 2.25 usec minimum pulse duration. Motor will step on the low-to-high transition of the input pulse.
DIRECTION Input :	Optically isolated TTL, or open collector with external pull-up resistor required, 10 mA minimum sink current. Ref. Fig. 9, Note 7. For standard Sigma wiring (see Appendix).
Maximum Pulse Rate :	40,000 pulses/second - full-step 80,000 pulses/second - half-step

	200,000 pulses/second - 1/5, 1/25 and 1/125 step
Minimum Ramp Time :	50 milliseconds.
Optoisolator Power Input :	5 to 30 Vdc, 40 mA, max. (Requires external resistor, see Note 2, Figure 9.)

2.2 Environmental

This unit is of an "open frame" design and is intended to be placed within a cabinet. The cabinet should be ventilated by filtered or conditioned air to prevent the accumulation of dust and dirt on the units electronic components. The air should also be free of corrosive or electrically conductive containments.

The unit is cooled by natural convection. To ensure proper cooling maintain the spacing recommendations outlined in section 2.7. Also sufficient airflow must be maintained to keep the cabinets internal ambient temperature within the units ratings given the power dissipation estimates in section 2.6.

Operating Temperature :	0 to 50 degrees C at full rated current 0 to 60 degrees C at 70% full rated current (Microstep mode) with Idle Current Reduction enabled. When mounted as specified in section 2.7.
Storage Temperature :	-25 to 85 degrees C
Humidity :	0 to 95%, non-condensing
Altitude :	1500 Meters (5000 feet)

2.3 Mechanical

Figure 2.1 shows the mechanical outline of the 5430. Three slots are provided for mounting the unit on a vertical surface. The unit must be mounted vertically to ensure proper cooling. The unit weight is approximately 18 pounds and should be mounted accordingly. Recommended mounting hardware are 1/4-20 bolts.

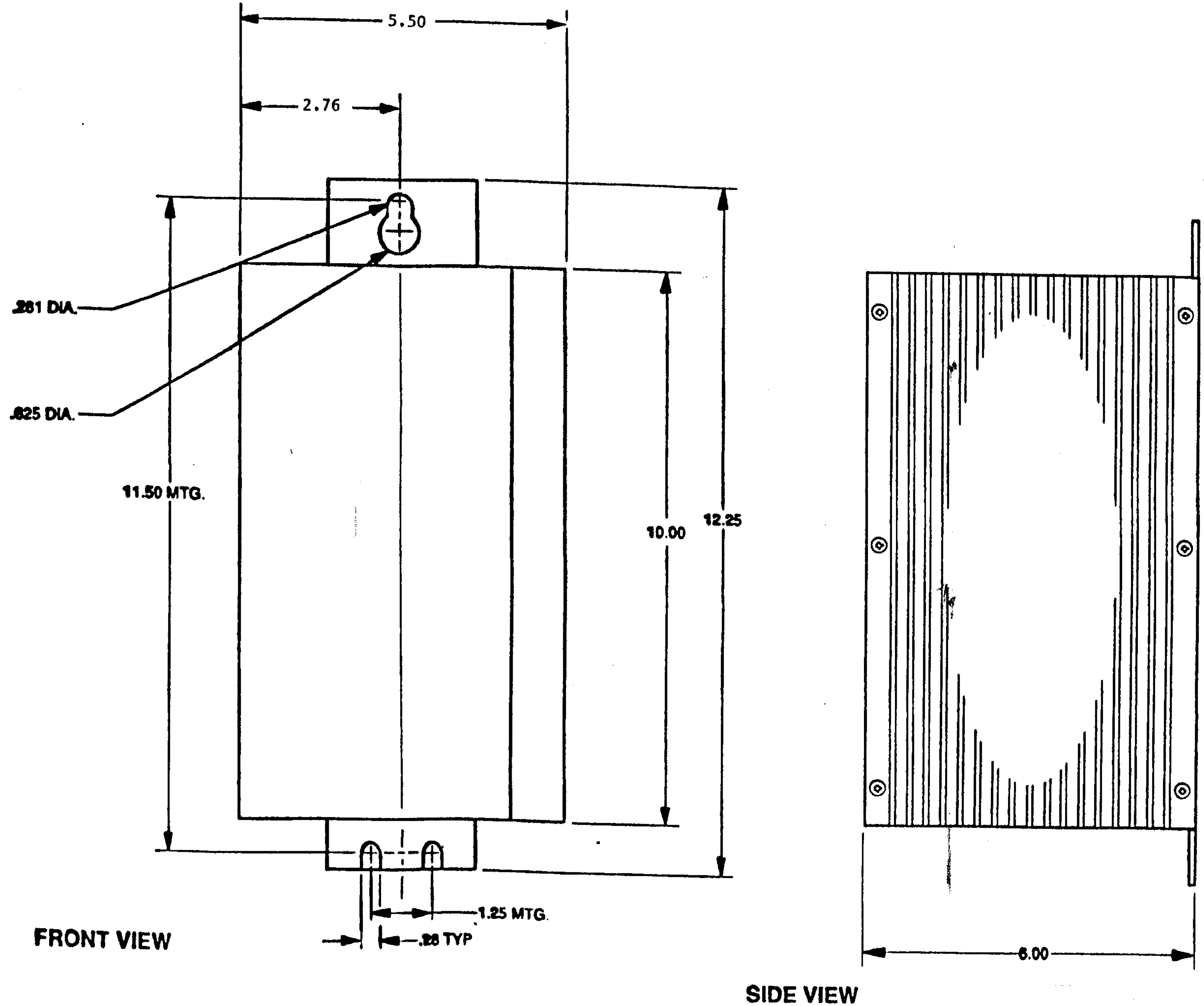


Figure 2.1

Mechanical Outline

2.4 Connector Data

J1 : Motor Connector

5 pin plug-in screw terminal connector mating connector is supplied

J2 : 120 VAC Power Connector

3 pin plug-in screw terminal connector mating connector is supplied

J3 : Signal Connector

ITT Cannon DAP-15SAA. Mating connector: ITT Cannon DA-15P with ITT Cannon shell DA110963-2 or equivalents.

2.5 Power Dissipation

The power dissipation of the 5430 is determined by a number of factors such as motor winding impedance, input step rates, idle current reduction usage , line voltage, ect. For estimating the power dissipation for determining cabinet cooling requirements a number of 40 watts should be used.

2.6 Mounting

Figure 2.1 shows the mechanical outline of the 5430. Mounting is accomplished by three slots located on the unit. The unit must be mounted vertically on a flat, solid surface taking into account its weight of approximately 18 pounds. Recommended mounting hardware are 1/4-20 bolts.

The unit should not be subjected to excessive vibration or shock. The environment should be free of corrosives, moisture, and dust. Refer to Section 2.2 for the environmental specifications of the 5430. To insure proper cooling, there must be a minimum unobstructed space of 4 inches above and below the unit and 1 inch on each side.

Since this unit is of an "open frame" construction, it should be located within an enclosure to protect it from physical or environmental damage. The unit will fit in a standard 8 inch deep NEMA enclosure for industrial applications.

SECTION 3

INPUT SIGNAL CONNECTIONS

There are three connectors located on the front panel of the unit through which all connections are made to the 5430.

J1	:	Motor Connector
J2	:	120 VAC Power Connector
J3	:	Drive Signal Interface Connector

3.1 J1 Motor Connector

J1 is a five position plug-in screw terminal connector, mating connector is supplied.

J1 - 1	:	Motor phase A connection.
J1 - 2	:	Motor phase A connection.
J1 - 3	:	Motor phase B connection.
J1 - 4	:	Motor phase B connection.
J1 - 5	:	Motor power return. The motor case can be connected to this point to reduce system electrical noise.

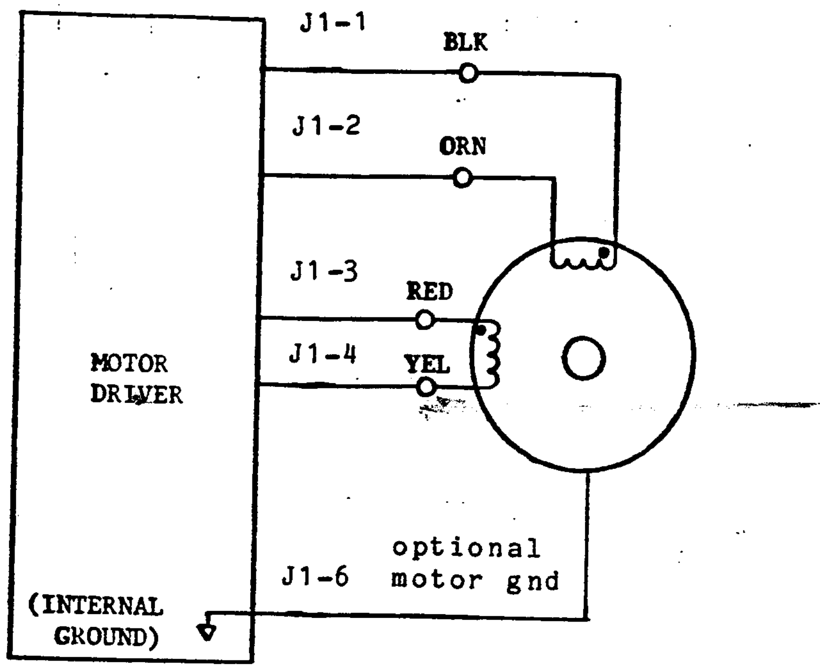
Refer to figures 3.1 and 3.2 for typical motor connections for Pacific Scientific bipolar stepping motors.

3.2 J2 120 VAC Power Connector

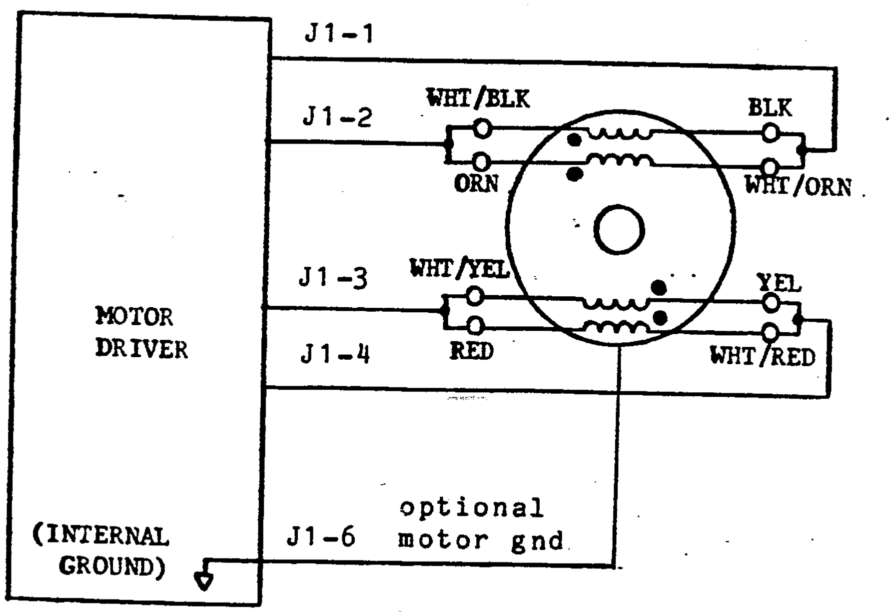
J2 is a 3 position plug-in screw terminal connector, mating connector is supplied.

J2 - 1	:	Chassis ground point. This terminal is the safety ground point for the unit and must be tied to earth ground to prevent shock hazard.
J2 - 2	:	120 VAC input.
J2 - 3	:	120 VAC input.

No special phasing of the 120 VAC inputs is required.



4 LEAD MOTOR



8 LEAD MOTOR

Figure 3.1

Standard Motor Connections For Sigma Line Motors

5410 DRIVER	SIGMA MOTOR TERMINAL BLOCK		
	4-INCH DIAMETER SPLASHPROOF		3-INCH DIA. SPLASHPROOF
	4 Lead	8 Lead	4 Lead
J1-1	1	1	2
J1-1		5	
J1-2	3	3	3
J1-2		6	
J1-3	2	2	1
J1-3		7	
J1-4	4	4	4
J1-4		8	

Figure 3.2

Motor Connections For Sigma Splashproof Motors

3.3 J3 Signal Connector

J3 - 1 : STEP Signal Input. The input pulse train that causes the motor to step is applied at this pin. The step will occur on the low-to-high transition of the STEP pulse; the STEP pulse must have a minimum duration of 2.25 usec. Figure 3.3 illustrates the STEP input circuit and Figure 3.4 the step input timing.

J3 - 2 : DIRECTION Signal Input. For a given connection of motor phase windings, this input determines the direction of rotation of the stepping motor. If standard Sigma wiring is followed, and the desired motor direction is incorrect, reversing the connections of one of the stepping motor phase windings will cause a reversal of the effect of the DIRECTION input. Figure 3.3 illustrates the DIRECTION input circuit.

J3 - 3 : Not Used

J3 - 4 : Internal Connection, not to be used.

J3 - 5 : 5 Vdc Output . This output will supply up to 30 mA for optically isolating the output status signals.

J3 - 6 : Signal Ground. This pin is connected to the drive module's ground bus.

J3 - 7 : Signal Ground. Connected to drive module's ground bus.

J3 - 8 : ~~Not Used~~ Disable Driver when pulled low

J3 - 9 : Optical Coupler Power Input. This input requires a separate 5 to 30 Vdc at 40 mA maximum to power the optoisolators within the drive module. Voltages higher than 5 Vdc require an additional resistance in the input logic lines (refer to Figure 6).

J3 - 10 : Current Control Input. This input is used to control the phase currents to the motor. The input is normally a logic high ("1"). A logic high will configure the driver for rated current levels, while a logic low ("0") will disable the driver producing zero current through the motor windings.

J3 - 11 : Not Used

J3 - 12	:	Internal connection, not to be used.
J3 - 13	:	Not Used
J3 - 14	:	Not Used
J3 - 15	:	Internal connection, not to be used.

Sigma Line Indexer Connections

The 5430 drive module accepts step and direction input to control the stepping motor. These inputs can be provided by Sigma line indexers 3020 and 3076. Figures 3.5 and 3.6 show the signal connections to the 5430 for these products.

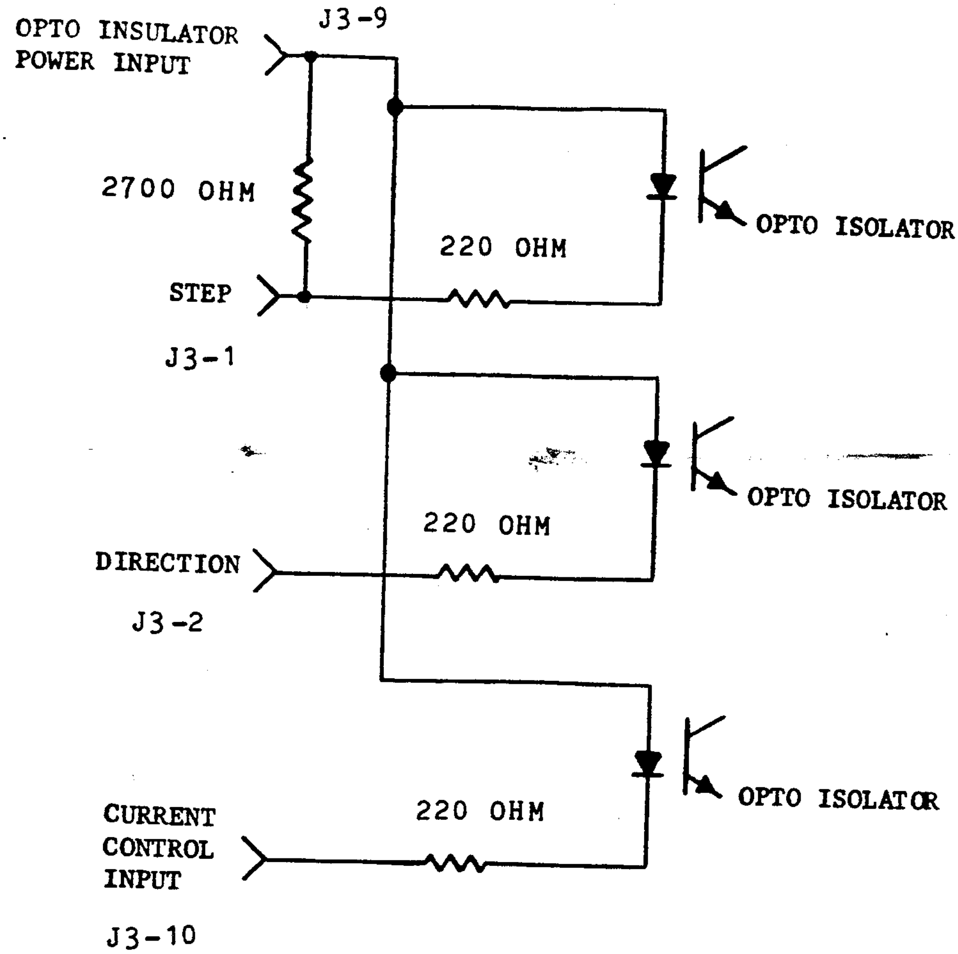


Figure 3.3

Step, Direction And Current Control Input Circuits

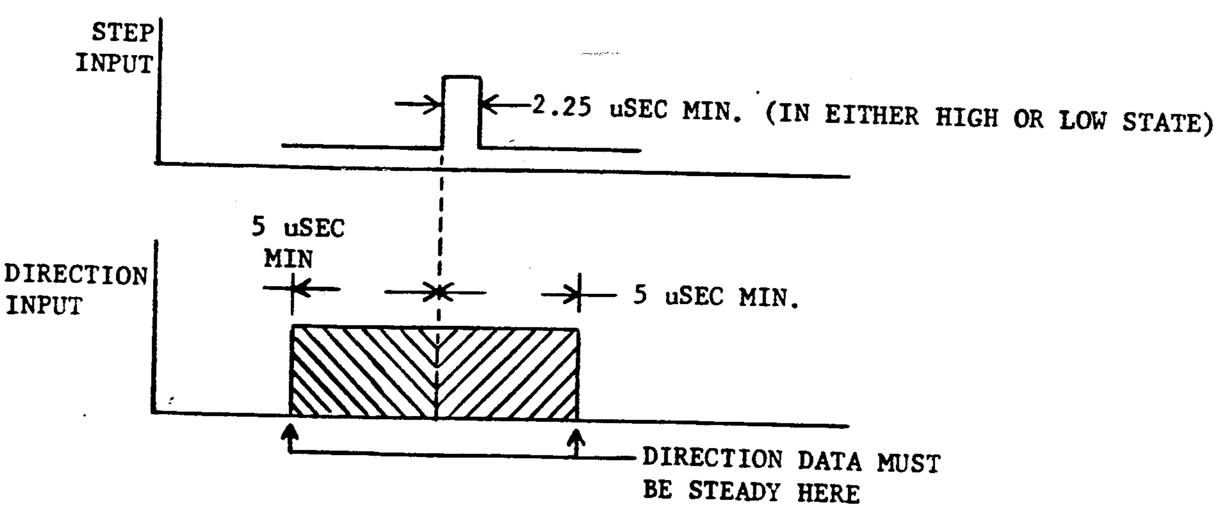
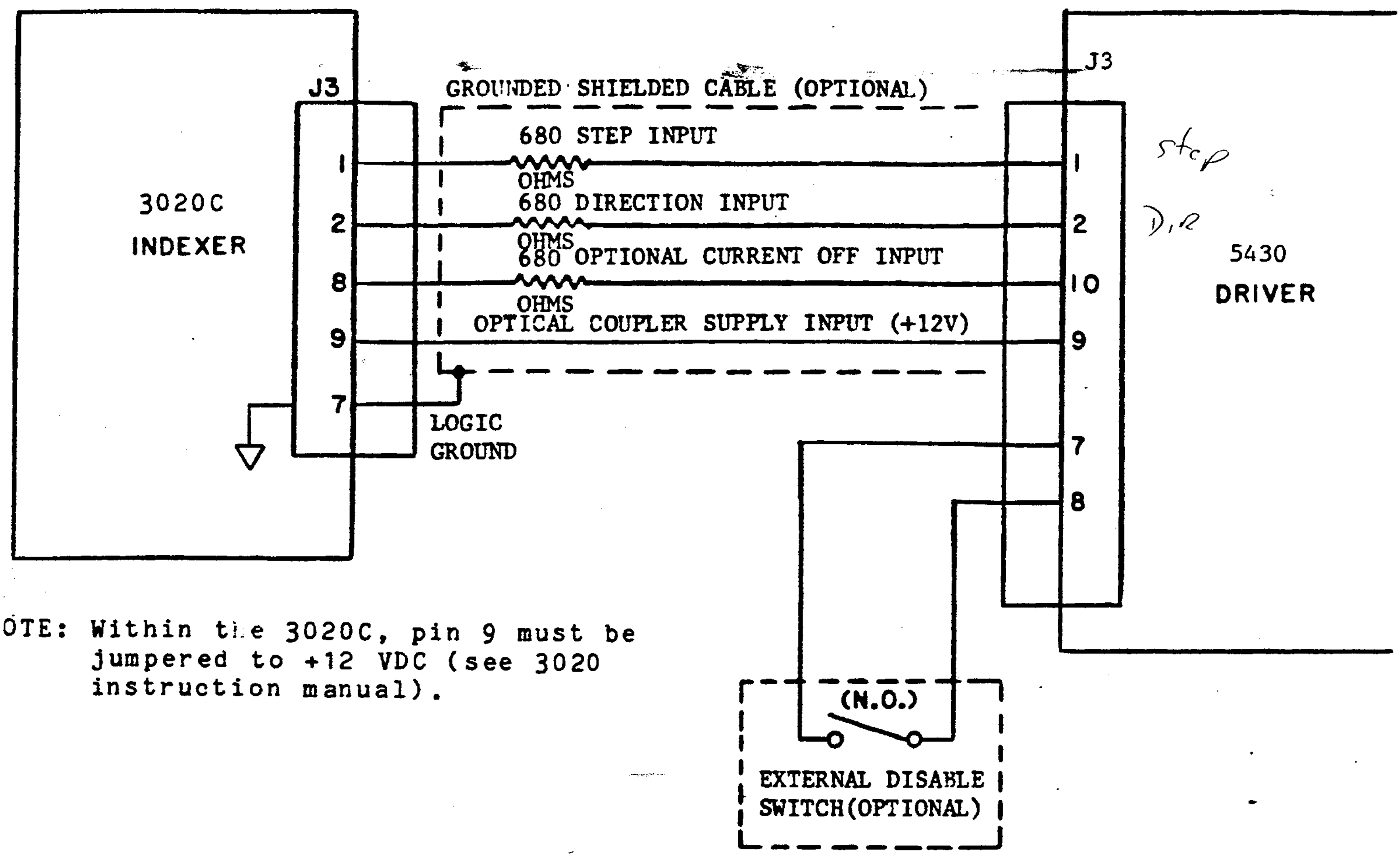


Figure 3.4

Step And Direction Signal Timing



NOTE: Within the 3020C, pin 9 must be jumpered to +12 VDC (see 3020 instruction manual).

Figure 3.5

Signal Connections for 3020C Indexer

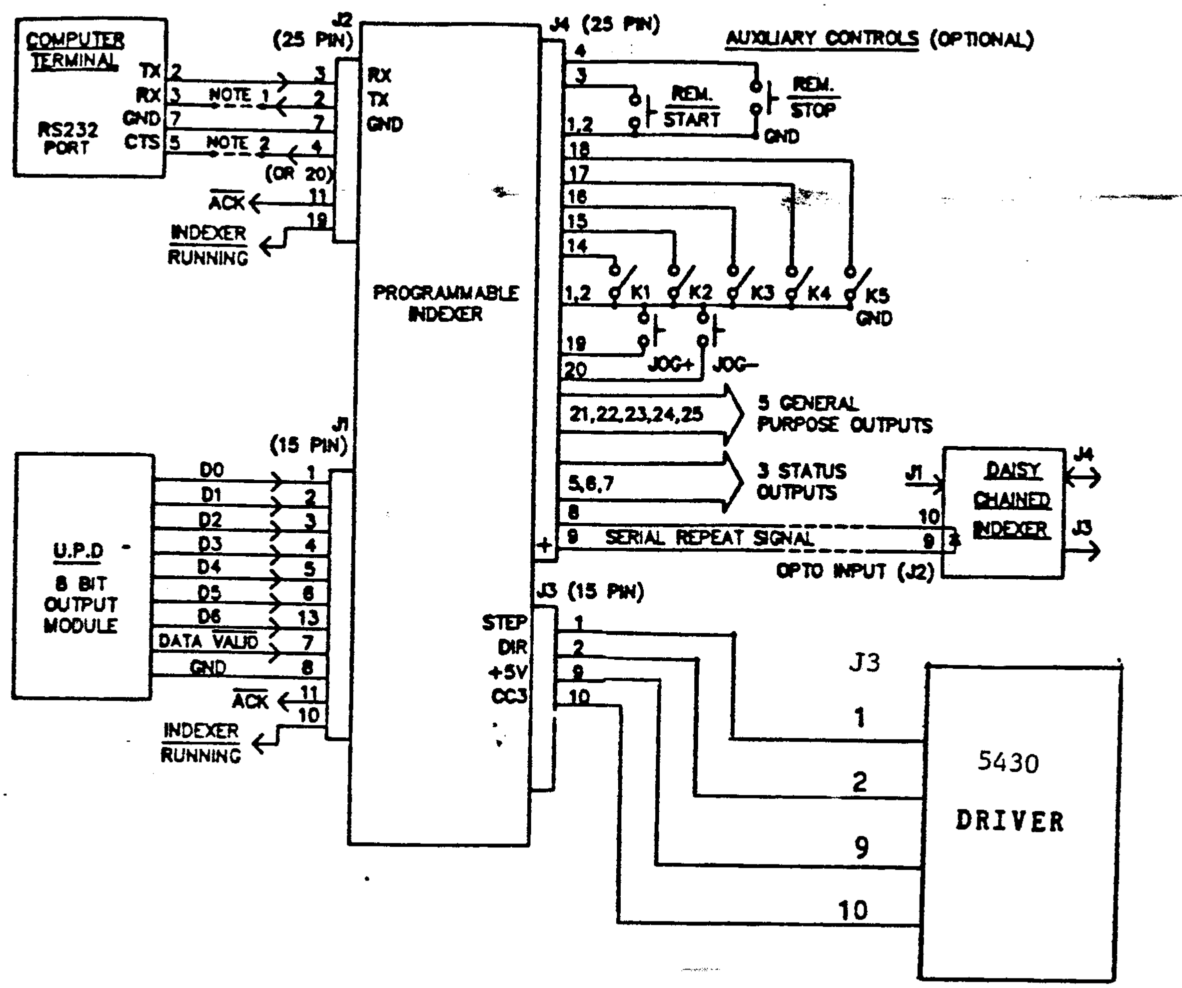


Figure 3.6

Signal Connections for 3076 Indexer

SECTION 4

JUMPER AND SWITCH SELECTABLE FUNCTIONS

The function selection jumpers and dip switches are located on the drive module and are accessed through the bottom opening of the package. Refer to figure 4.1.

1. Stepping Mode/Current Boost DIP Switch. Selection of the full, 1/2, 1/5, 1/25 or 1/125 step mode is accomplished via a 4 circuit DIP switch S1. Three of the switch positions are used for stepping mode selection. The fourth is used for selecting microstep current boost. Figure 5 below shows the switch selection options. Note that open = "1", closed = "0".

STEP MODE	DIP SWITCH SETTINGS 1	2	3	4
1	0	0	0	Open = Rated Current
1/2	1	0	1	
1/5	1	0	0	
1/25	0	1	0	Closed = Mid Frequency Current Boost
1/125	0	0	1	

Table of DIP Switch Settings

2. Stability Control Enable/Disable Jumper. Enabling or disabling the stability control circuit is accomplished by means of the lift-off jumper located as shown in Figure 7. The positions of the jumper are printed on the p.c. board.

   When this jumper is in position 1 (stability control circuit enabled), the step input timing is modified to control and maintain synchronous motor speed in the midrange instability region of the stepping motor system's torque vs speed curve. When disabled, the stability control circuit has no effect on input pulse timing.

MID-RANGE JUMPER	FUNCTION
POSITION 1	STABILITY CONTROL ENABLED
POSITION 2	STABILITY CONTROL DISABLED

3. Idle Current Reduction Enable/Disable Jumper. Enabling or disabling the ICR circuit is accomplished by means of the lift-off jumper located as shown in Figure 7. When this jumper is in position 4, it will reduce phase current flowing to both motor windings to one-half the nominal value after not receiving a step input pulse for approximately one second. Current will remain at this reduced level until a step pulse is received by the drive. At this time phase current(s) will return to their previously set values and stepping will occur.

Current reduction is useful to conserve energy at standstill or to allow the motor to cool in high duty cycle applications. It should be noted that the holding torque generated by the motor will also be reduced by approximately 50% when ICR is enabled.

IDLE CURRENT JUMPER	FUNCTION
POSITION 4	ICR ENABLED
POSITION 3	ICR DISABLED

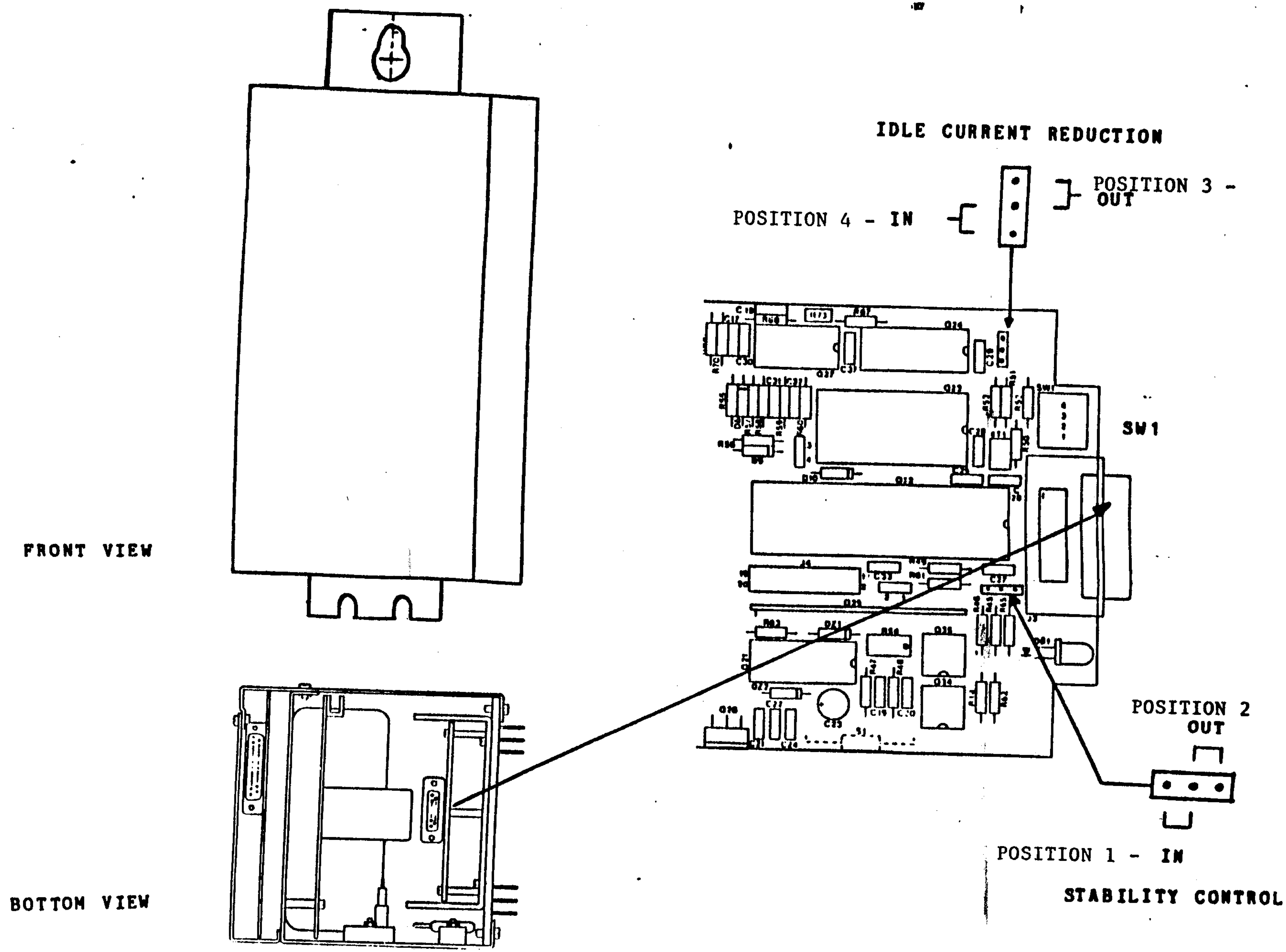


Figure 4.1

Jumper and Switch Locations on Driver

SECTION 5

INSTALLATION/SET-UP

Due to the wide variety of uses for the 5430, it is the responsibility of the user or those applying the unit to determine the suitability of this product for any intended application. In no event will Pacific Scientific Company be responsible or liable for indirect or consequential damage resulting from the use of this product.

The figures, tables, and examples shown in this manual are intended solely to supplement the text. Because of the varied requirements of any particular application, Pacific Scientific Company cannot assume responsibility or liability for actual use based upon the illustrative uses and applications included in this manual.

WARNING

DANGEROUS VOLTAGES, CURRENTS, TEMPERATURES, TORQUES, FORCES, AND ENERGY LEVELS CAN EXIST IN THE PRODUCT AND ITS ASSOCIATED STEPPING MOTOR. EXTREME CAUTION AND CARE SHOULD BE EXERCISED IN THE APPLICATION OF THIS EQUIPMENT. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT AND ITS APPLICATION.

5.1 Unpacking and Inspection

Remove the 5430 from its shipping carton and check the items against the packing list. A nameplate located on the side of the unit identifies the unit by model number, serial number, and date code.

Inspect the unit for any physical damage that may have been sustained during shipment. All claims for damage whether concealed or obvious must be made to the shipper by the buyer as soon as possible after receipt of the unit.

Remove all packing materials from the unit. If the unit is to be stored, it should be stored in a clean, dry place. The storage temperature must be between -55 degrees C and 85 degrees C. To prevent damage during storage, it is recommended that the unit be stored in its original shipping carton after completing inspection for damage.

5.2 Mounting

Figure 2.1 shows the mechanical outline of the 5430. Mounting is accomplished by three slots located on the unit. The unit must be mounted vertically on a flat, solid surface taking into account its weight of approximately 18 pounds. Recommended mounting hardware are 1/4-20 bolts.

The unit should not be subjected to excessive vibration or shock. The environment should be free of corrosives, moisture, and dust. Refer to Section 2.3 for the environmental specifications of the 5430. To insure proper cooling, there must be a minimum unobstructed space of 4 inches above and below the unit and 1 inch on each side.

Since this unit is of "open frame" construction, it should be located within an enclosure to protect it from physical or environmental damage. The unit will fit in a standard 8 inch deep NEMA enclosure for industrial applications.

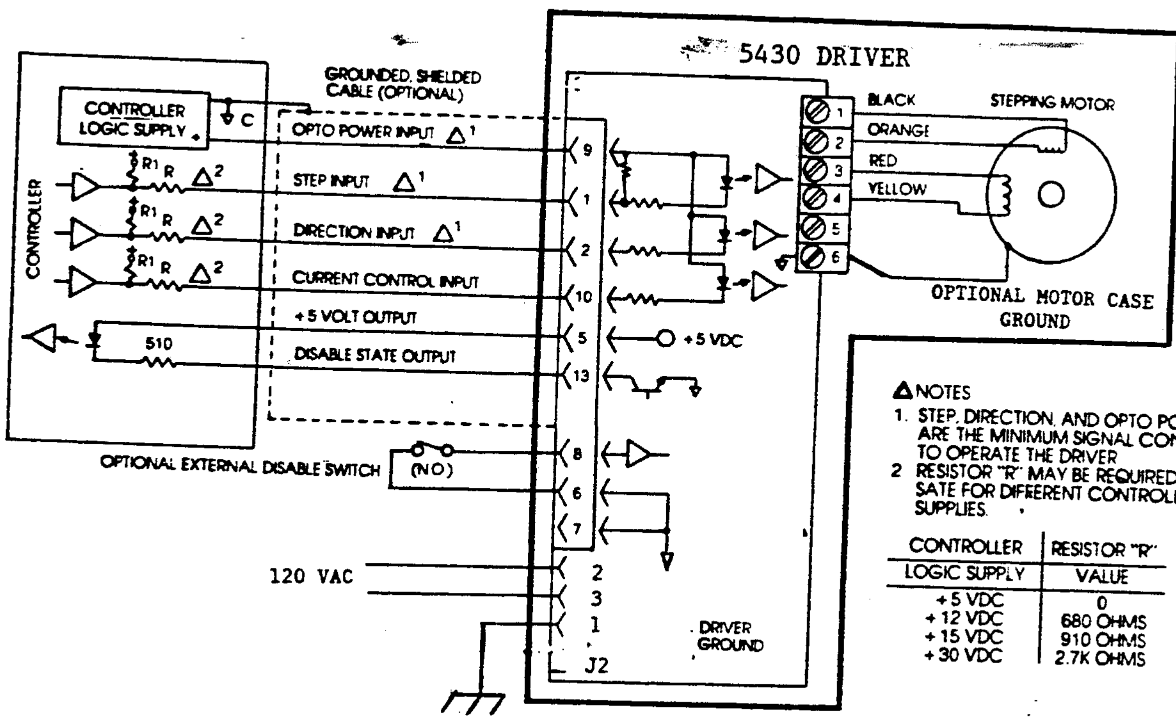
5.3 Interconnection Wiring

Figure 5.1 illustrates the interconnection wiring of the 5430 to a stepping motor and step and direction source.

Wiring sizes, wiring practices, and grounding/shielding techniques described in this manual are intended as a guideline only. Due to the variety of applications served by this product, no single method of interconnection is universally applicable. The information included in this manual represents common industrial wiring practices and should prove satisfactory in the majority of applications. However, local electrical codes, special operating conditions, or system configurations should take precedence over the information provided herein.

To reduce the possibility of noise pickup, power and signal wiring should be routed separately. Signal wiring should be shielded. Motor phase wiring should be twisted to reduce radiated noise.

To minimize shock hazard, all components should connected to a common earth ground point.



NOTES

1. STEP, DIRECTION, AND OPTO POWER INPUTS ARE THE MINIMUM SIGNAL CONNECTIONS NEED TO OPERATE THE DRIVER
2. RESISTOR "R" MAY BE REQUIRED TO COMPENSATE FOR DIFFERENT CONTROLLER LOGIC SUPPLIES.

CONTROLLER LOGIC SUPPLY	RESISTOR "R" VALUE
+5 VDC	0
+12 VDC	680 OHMS
+15 VDC	910 OHMS
+30 VDC	2.7K OHMS

Figure 5.1

Interconnection Wiring Diagram

5.4 Initial Power Up

Every 5430 is burned-in and fully tested before leaving the factory. However, it is possible that damage has been sustained by the unit during shipment. This procedure should be followed to insure that the unit has not sustained shipping damage and has been installed properly. The initial power up sequence makes use of a motor and a step and direction source, such as the Sigma Line 3076 indexer, to test the functionality of the 5430.

WARNING

THIS INITIAL POWER UP PROCEDURE SHOULD BE PERFORMED 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.

(1) Verify that the unit is wired and mounted per instructions in this manual. Be especially careful in checking the 120 VAC input connections and the motor connections.

(2) Verify that the jumper settings are per the following:

Idle Current Reduction	-	POSITION 4
Stability Control	-	POSITION 1
Step Size Setting	-	FULL STEP

(3) Unplug the J1 motor connector. Make sure 120 VAC power is OFF when you do this.

(4) Apply 120 VAC power. Verify that the green power LED is on and the red disable LED is off.

(5) Remove 120 VAC power from the unit.

(6) Plug the J1 motor connector into the unit.

(7) Apply 120 VAC power to the unit.

(8) Verify that the power on LED is on and the disable LED is off.

(9) Verify that the motor has holding torque.

(10) Input a step command to J3-1 (refer section 3.3 for input requirements) the motor should move. A power connection to J3-9 (optocoupler power input) is required for the step input to be functional. The power can be obtained from an external source referenced to the Step and Direction source, in which

the optical isolation is used or from the internal +5 Volt DC power J3-5 in which case the step and direction source ground has to be tied to the drive ground J3-6,7.

(11) Change the state of the direction signal (J3-2), the direction of motion should change.

If the unit successfully passed the above procedure, you may now try exercising the unit on your own. If the unit does not pass the above tests contact the Pacific Scientific Company or its representatives for assistance.

SECTION 6

THEORY OF OPERATION

The Model 5430 driver module contains a translator circuit that translates STEP and DIRECTION signal inputs into switching signals sent to the phase A and phase B power amplifiers, a stability control circuit, a logic power supply that feeds regulated +5 Vdc to various logic circuits within the drive module, and phase A and phase B power amplifiers that supply correctly sequenced current pulses to the phase A and phase B step motor windings. In addition, the module contains phase A and phase B overcurrent sense circuits that protect against short circuit conditions.

The translator accepts STEP input pulses of a minimum 2.25 usec duration from an indexer or other pulse source, and outputs current control signals that switch the power circuits in the phase A and phase B power amplifiers. The step motor will advance one full step or one microstep for each STEP pulse received. Selection of either the full step or microstep mode is done by means of a DIP switch in the translator circuit. Setting the switches in the proper positions selects either full, 1/2, 1/5, 1/25, or 1/125 step mode. The motor will step on the low-to-high transition of the STEP input pulse.

For a given set of motor phase winding connections, the DIRECTION input to the translator determines the direction of rotation of the stepping motor. Reversing the connections to one phase winding reverses the direction of shaft rotation and therefore reverses the effect of the DIRECTION input. The DIRECTION input must be present a minimum of 5 usec both before and after the low-to-high transition of the STEP pulse. Figure 5 shows the required timing relationship between the STEP and DIRECTION inputs.

Microstepping is achieved by controlling the currents of the phase A winding and the phase B winding in a sine/cosine analog relationship. This drive technique results in increased positional resolution and velocity smoothness over that of conventional full or half-step driver designs using constant square wave current control.

The microstepping driver receives step pulses and direction signals from an external controller. Each step pulse causes the driver to increment or decrement the motor phase currents in order to move the motor shaft one microstep. The motor will rotate at a rate equal to the input step pulse frequency multiplied by the microstep scale factor. A DIP switch located on the driver provides five selectable microstep pulse increments from one to 1/125 of full step.

The sine/cosine current commands for each microstep position are digitally stored in a prom look-up table, and are processed through a digital-to-analog converter (DAC) to provide the continuous analog current command for each phase. Each current command is summed into a current feedback control circuit that regulates motor phase currents independent of voltage, temperature, or winding impedance variations.

The advantages of microstepping are low speed motor resonance problems can be substantially reduced, torque ripple is reduced, and finer positional resolution is achieved. The disadvantages are increased pulse rate required for the same velocity and reduction of low speed and holding torque.

Each power amplifier contains a chopper circuit whose function is to sense the magnitude of current in its associated phase winding and to momentarily cut off power to this winding when this current exceeds a predetermined value. Timing circuits within the chopper produce a stable chopper frequency of approximately 20 kHz that is substantially independent of phase winding inductance. The midrange stability control circuit, when enabled, controls the timing of the STEP output with respect to the input pulse command in order to maintain synchronous motor speed.

SECTION 7

APPLICATION CONSIDERATIONS

Disable Indicator

The drive package is equipped with a disable LED which illuminates for any internal driver disable condition such as overcurrent, overtemperature, or invalid switch setting. The following is a table of possible fault conditions:

	COMMENTS
1. Driver module overtemperature.	Allow the module to cool to where it will again begin to operate (85oC) and do one of the following: 1) Reduce ambient air temperature. 2) Force cool the module with a fan and avoid restricting air flow around the unit. 3) Reduce the on time of the module (duty cycle) by: a) Automatic current reduction (ICR jumper) b) Program current DISABLE using the current control feature. Note: In this state, depends on motor detent torque to hold motor position.
Low input voltage on the 120 VAC input. 90 VAC minimum.	Check the input AC voltage.
2. Incorrect motor connector wiring.	Check for the following: 1) Incorrect phase-to-phase motor wiring. 2) Incorrect phase-to-power-ground wiring. 3) Internal cable short circuit from phase-to-phase. 4) Internal motor phase-to-phase short circuit.
3. Power output device failure.	Return drive module to factory for repair.

SECTION 8

CONNECTIONS SUMMARY

8.1 J1 - MOTOR CONNECTOR

J1 - 1	:	Motor Phase A
J1 - 2	:	Motor Phase A
J1 - 3	:	Motor Phase B
J1 - 4	:	Motor Phase B
J1 - 5	:	Common

8.2 J2 - 120 VAC POWER INPUT

J2 - 1	:	Chassis Ground
J2 - 2	:	120 VAC Input
J2 - 3	:	120 VAC Input

8.3 J3 - Signal Connector

J3 - 1	:	Step Input
J3 - 2	:	Direction Input
J3 - 3	:	Not Used
J3 - 4	:	Internal Connection
J3 - 5	:	5 Volt DC Output
J3 - 6	:	Drive Ground
J3 - 7	:	Drive Ground
J3 - 8	:	Not Used
J3 - 9	:	Optocoupler Power Input
J3 - 10	:	Current Control Input
J3 - 11	:	Not Used
J3 - 12	:	Internal Connection
J3 - 13	:	Not Used
J3 - 14	:	Not Used
J3 - 15	:	Internal Connection

SECTION 9

JUMPER AND SWITCH FUNCTION SUMMARY

9.1 DRIVE SELECTABLE FUNCTIONS (refer to Fig 4.1)

S1 - 1	:	Microstep Setting (refer to Section 4.3)
S1 - 2	:	Microstep Setting
S1 - 3	:	Microstep Setting
S1 - 4	:	Microstep Current Boost Above 500 SPS Closed = Enable Current Boost Open = Disable Current Boost
W1	:	Idle Current Reduction POSITION 4 = Enable ICR POSITION 3 = Disable ICR
W2	:	Mid-Range Stability Control POSITION 1 = Enable POSITION 2 = Disable