

R164 Controller
with built-in 64 Microstepping Driver



User Manual
Version 1.17

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Thank you for purchasing the R164 Controller with Microstepping Driver. This product is warranted to be free of manufacturing defects for one year from the date of purchase.

PLEASE READ BEFORE USING

Before you begin, ensure there is a suitable DC Power Supply. **Do not disconnect the DB-9 cable while power is still being applied to the controller.** This will damage the board. Under any circumstances, do not exceed +40 VDC.

DISCLAIMER

The information provided in this document is believed to be reliable. However, no responsibility is assumed for any possible inaccuracies or omissions. Specifications are subject to change without notice.

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There are known issues involving the Halt command (i.e., H01) when stored in memory location zero. Upon power up, the remaining command string after the Halt command might be executed if the user types in a new command. If memory location zero is not being used, the user is advised to always clear everything in memory by typing `/1?9`. Otherwise, the user may terminate the remaining command string in the buffer by issuing a `/1T`.

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1. FEATURES

- Controller with built in Microstepping Driver
- Operates from +12V to 40V
- Single 4 wire bus linking up to 16 stepper motors
- 1.50 Amp Chopper (PWM) Driver
- 1/2, 1/4, 1/8, 1/16, 1/32, 1/64 step resolution
- Stand alone operation with no connection to a PC
- Execution Halt pending switch push button
- Pre-wired for Opto Switch inputs
- Homes to an Opto or Switch closure with a single command
- Fully programmable ramps and speeds
- Two digital I/O and two fixed input channels
- Switch selectable address
- Software selectable "Move" and "Hold" currents
- Hold Current automatically selected upon move completion
- Simple DB9 connection

Designer's Kit

Here is the list of components if you have purchased the optional Designer's Kit:

- RS485 to RS232 converter card
- A DB-9 female connector cable, a switch push button, Opto Sensor, a 4 Pin connector for the converter card, and extra wiring for I/O
- CD-ROM with Manuals and Software

Default Settings

Running Current	30%
Holding Current	10%
Step Resolution	Half Step
Start Velocity	200 pps (pulses per second)
Top Running Velocity	3700 pps
Position	0

2. ELECTRICAL SPECIFICATIONS

Supply Voltage: +12 to +40 VDC
Peak Current: 0.1 to 1.5 Amps

Digital I/O Specifications

Number of I/O 2
Number of Inputs 2
Input Voltage +0 VDC to +24 VDC
Input Current 700 mA
Pull-up Resistors 10k Ω
Protection Static Protection to the microprocessor

3. OPERATING SPECIFICATIONS

Maximum Step Frequency	10,000 pulses per second (pps)
Operating Temperature Range	0° to 50° C
Storage Temperature Range	-20° to 70° C

Communication Specifications

Interface Type	RS485 or RS232
Baud Rate	9600 bits per second (bps)
# Bits per character	8 Data
Parity	None
Stop Bit	1
Flow Control	None

4. MECHANICAL SPECIFICATIONS

Size: 1.932" x 2.192" x 1.228" (49.07 mm x 55.68 mm x 31.19 mm)
Weight: 3.6 oz (100 gm)
Mounting: Four #6-32 screws, 1.622" x 1.992" (41.20 mm x 50.60 mm)
Cover: Aluminum, Anodized
Plate: Aluminum, Hard Anodized
Color: Black exterior

Dimensions

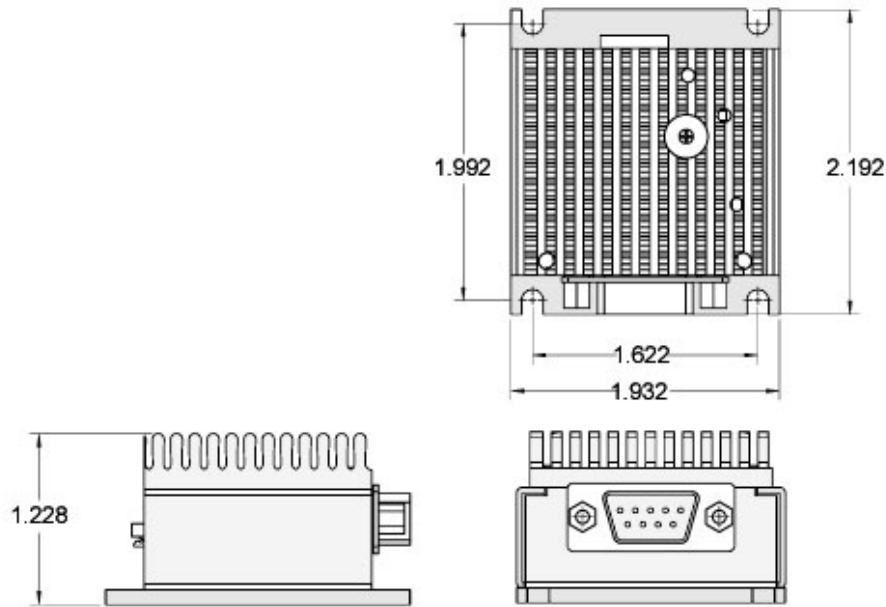


Figure 1: Dimensions Diagram

5. PIN ASSIGNMENTS

A DB-9 female connector cable receives power and provides the control connections for the R164 Controller. On the opposite end of the DB-9 female connector cable, there is a 4 pin connector provided for the converter card in order for the controller to communicate with the PC. This allows the user to solder and program the switch push button and the Opto Sensor, enabling several options. The two I/O wires are colored blue and black. This will allow for options such as solenoids, relays, opto isolators, LED's and many other input and output connections. See *Table 2* below for details.

Pin #	Color	Function	Input*
1	Red	+V (Main Power In)	
2	Black	I/O	1
3	Brown	RS485B (-)	
4	Black/White	RS485A (+)	
5	Orange	Switch Closure to GND (IN)	4
6	Green	GND (-V of main power in)	
7	White	Opto Sensor Phototransistor (IN)	3
8	Blue	I/O	2
9	Yellow	Opto Sensor LED (Power Out)	

Table 2: Pin Assignments

*Inputs are labeled 1, 2, 3 and 4 for programming the 'Halt' and 'Skip' Commands.

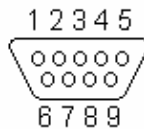


Figure 2: DB-9 Female Cable Connector (Rear View)

6. CONNECTION SPECIFICATIONS

Quick Start

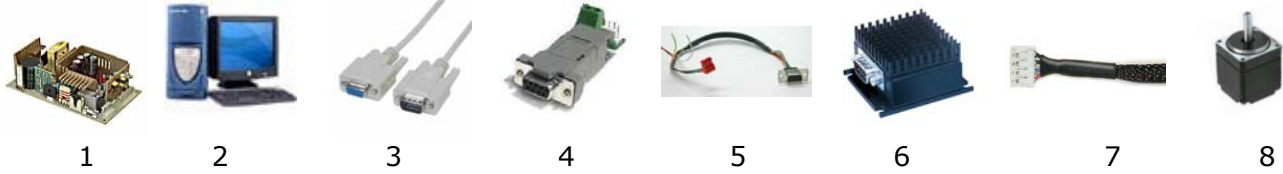
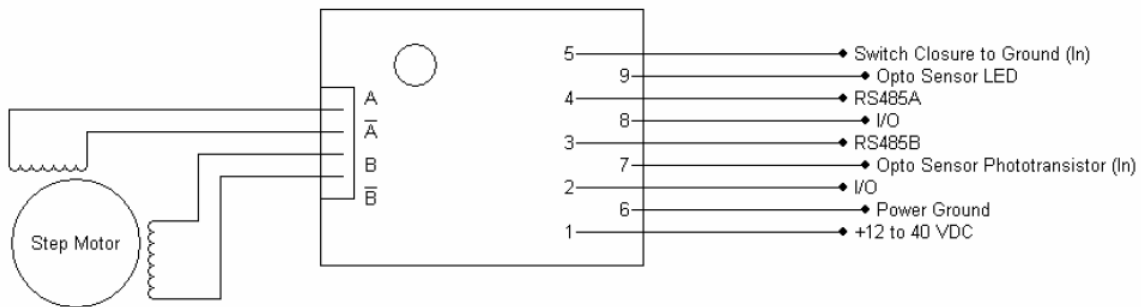


Figure 3: List of Parts

List of Parts:

1. Suitable DC Power Supply (+12 to 40 VDC)
2. PC with a Serial COM Port
3. DB9 Male-to-Female Serial Port Cable (Not Included)
4. RS485-to-RS232 Converter Card
5. 90-022 Cable to connect the Controller to Power and Controls
6. R164 Controller
7. 90-018 Cable to connect the motor to the R164
8. Appropriate Step Motor

R164 Connection Schematic



- Connect the Female end of the DB-9 Serial Cable₍₃₎ to your PC₍₂₎ and connect the Male end to the RS485-to-RS232 Converter Card₍₄₎
- Take the 90-022 cable₍₅₎ and connect the Red 4-Pin connector to the Converter Card₍₄₎
- Then take the other end of the 90-022 DB-9 cable₍₅₎ and connect it to your R164 Controller₍₆₎.
- Twist together the lead wires of the motor₍₈₎ with the lead wires end of the 90-018 cable₍₇₎. Red = A, Blue = A-, Green = B, Black = B-. See Wiring Diagrams at www.rmsmotion.com
- Next, connect the 4-Pin Connector end of 90-022 cable₍₇₎ with the R164 Controller₍₆₎
- Finally, connect your Power Supply₍₁₎ to the Green +/- pins on the Converter Card₍₄₎
- Now you are ready to use your R164 Controller, on your PC₍₂₎, open up HyperTerminal from Programs → Accessories → Communications

Mating Connectors

A mating D-Sub connector and crimp style connector are provided.



Part # 90-022



Part # 90-018

7. CONFIGURING AND CONTROLLING THE R164

HyperTerminal Setup

Please follow these steps in order to properly set up HyperTerminal:

1. Open a terminal from your PC by following these steps: Start Menu → Programs → Accessories → Communications → HyperTerminal
2. Assign a name for your New Connection
3. Under 'Connect using', select the COM connection that corresponds to your PC serial port (i.e. COM 1, COM 2, etc.) then click 'OK'
4. Set your Port Settings to default (i.e. 9600 baud, 8 data, no parity, 1 stop bit, no flow control)
5. Turn on local echo by going to: File → Properties → Settings tab → ASCII Setup: Click on the box for "Echo Typed Characters Locally" and click on the box for "Send Line ends with line feeds". These options will be useful when typing commands in HyperTerminal. Click 'OK'
6. Now you can type your commands
7. Example: /1A1000R
 - This will run Driver 1 to the Absolute position 10000
 - You can check the address of your driver by checking the dial at the top of the driver. (Changing the address of the Controller, page 10)
 - A full list of commands is available in the R164 Command List. Visit www.rmsmotion.com → Download → R164.

HyperTerminal Responses:

/0@□ indicates good command and that it was received correctly
/0b□ indicates bad command
/0C□ indicates that the command is out of range
/0'□ indicates that the command is terminated
/00□ Overflow

Setting the Current

CAUTION! DO NOT SET THE CURRENT ABOVE THE MOTOR'S RATED CURRENT.

In order to set the correct current for your motor, you must program the specified amount in HyperTerminal

Current is set based on the Maximum amount of current the controller board can output, which is 1.5 Amps Peak. Below is a table of how much current will be applied to your motor for each setting.

Percent	=	Desired Current (Amps)
10%	=	0.15
20%	=	0.30
30%	=	0.45
40%	=	0.60
50%	=	0.75
60%	=	0.90
70%	=	1.05
80%	=	1.20
90%	=	1.35
100%	=	1.50

Table 3: Desired Current

To achieve the equivalent Driver Current (Amps), multiply your motor's rated current by 1.4. Follow these examples:

Example One:

You have a motor that is rated at **0.85 Amps**, $0.85 \text{ Amps} \times 1.4 = \sim 1.2 \text{ Amps}$. Using *Table 3* we would see that 1.2 Amps is 80% of the driver's maximum output current.

Assuming the R164 Controller is addressed to Number 1, this is what you'd program: `/1180m80R`

Example Two:

You have a motor that is rated at **1.0 Amps**, and your Controller is addressed to Number 1, this is what you'd program: `/1195m95R`

This will set the controller to 1.4 Amps Peak. How did we get 1.4 Amps? $\rightarrow 1.0 \text{ Amps} \times 1.4 = 1.4 \text{ A}$

Example Three:

You have a motor that is rated at 1.0 Amps, but you would like to run it at 1.0 Amps Peak. Using *Table 3* we would see that 1.05 Amps is 70% is the correct setting.

This is what you'd program: `/1170m70R`

Example Four:

You have a motor that is rated at 0.35 Amps, here is the **MAXIMUM** current you are able to use: `/1133m33R`

Programming anything higher than this will damage the motor.

WARNING! Setting the Current to a value greater than the Motor's rated current will damage your motor, and may overheat the controller.

Connecting Multiple R164 Controllers

Connect multiple controllers by using the Converter card, shown below:

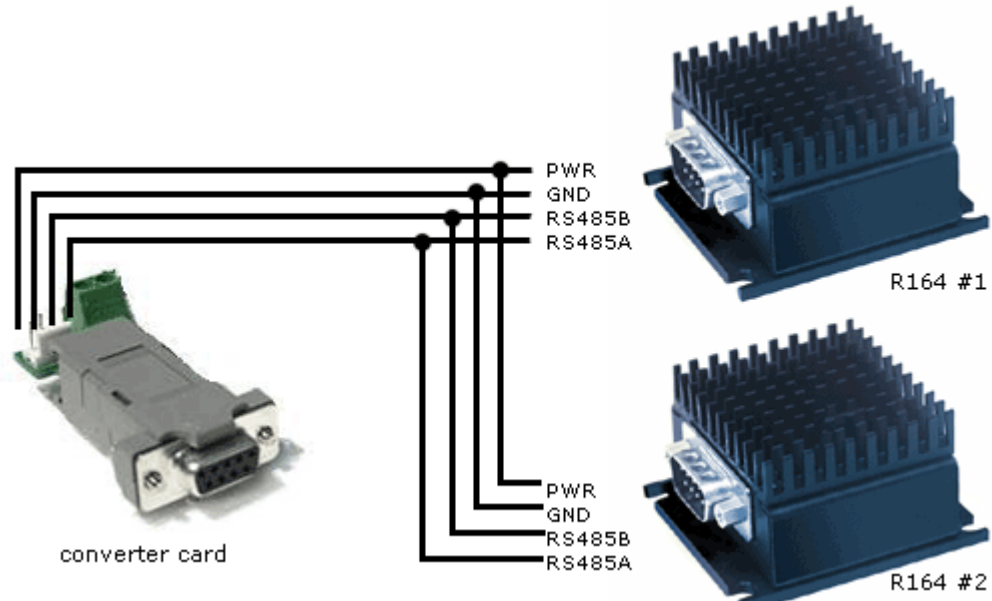


Figure 4: Connecting Multiple Controllers

Changing the Address of the Controller

Use a screwdriver to turn the dial so the arrow points to the desired Address. Use this number when programming commands. For example, /1P1000R



Figure 5: Address Dial

Connecting the Accessory Pieces

If you have purchased the Designer's Kit, there is a Red Push Button and an Optical Sensor included. Follow the schematics below in order to properly assemble accessory pieces.

Push Button

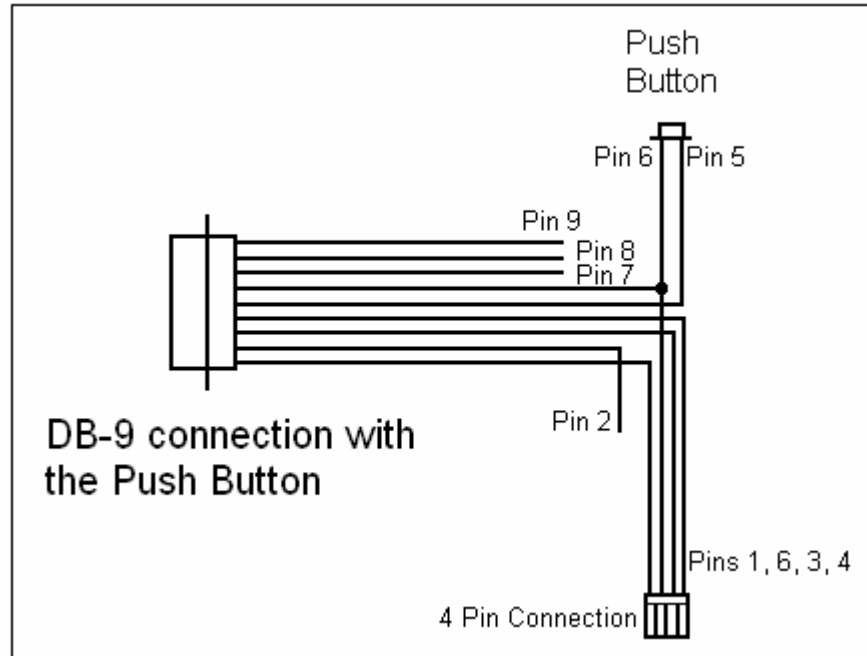


Figure 6: Push Button Schematic

It is best to solder the Push Button to Pin 5 which corresponds to Input 4, then solder Pin 6 (Power Ground) to the other side of the push button.

Input 1	Pin 2
Input 2	Pin 8
Input 3	Pin 7
Input 4	Pin 5

Table 4

Optical Sensor

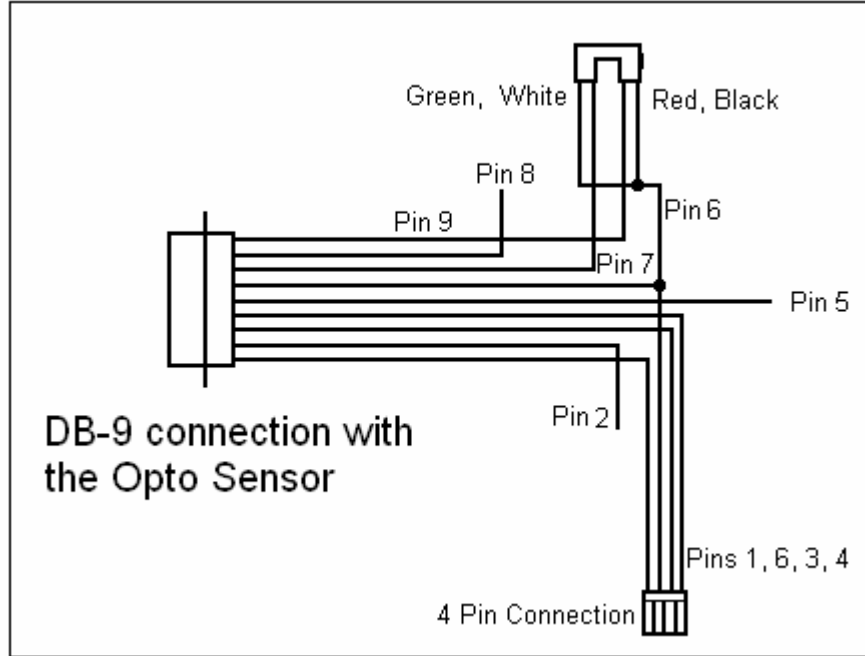


Figure 7: Opto Sensor Connection Schematic

The Opto Sensor uses Pins 6, 7, and 9. Use the following table to solder the corresponding wires.

Optical Sensor	DB9 Cable
Green →	Green
Black →	Green
Red →	Yellow
White →	White

Table 5

For a list of commands, please visit www.rmsmotion.com → Downloads → R164 Commands.

Encoder Usage

The R164 can also be used as reference to home by connecting to an US Digital E2 Encoder. The pinouts are as follows:

Pin Number	Function
1	Ground
2	Index
3	Channel A
4	+ 5 VDC
5	Channel B

The E2 encoder requires a separate +5 Volt power supply, as the R164 controller cannot provide a strong enough source of power.

In order to use the Indexer as a reference to home, connect Pin 2 from the encoder to one of the inputs on the controller. From the controller's side, for best results use Pin 5, the switch closure to ground.

In addition, use a pull-down resistor (10k Ω) to ensure that the controller will recognize the difference between high and low (4.85V and 0.5V).

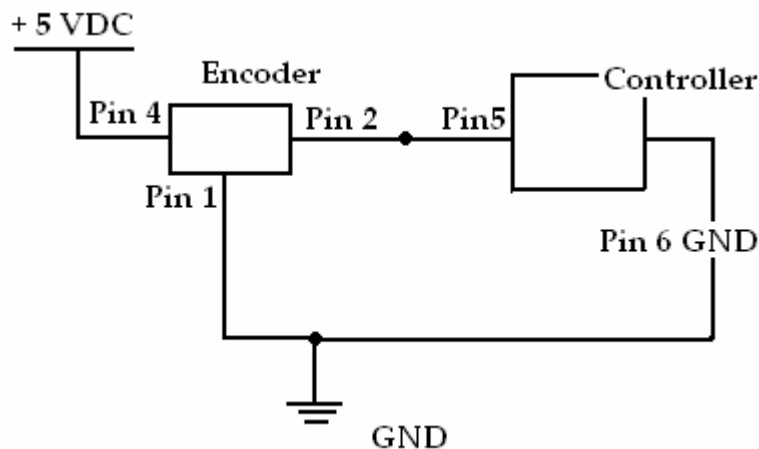


Figure 8: Encoder Pin Connection Schematic

After successfully connecting the encoder to the controller, now you can program the controller to run continuously. The motor will stop movement when the indexer goes high. This will send the high signal to Pin 5 on the controller.

If using channel 1, use this command to start the homing routine:

```
/1P0R
```

8. MOTOR CONNECTIONS

Step Motors have 4, 6, or 8 wires. To better understand how to connect your step motor with your R164 Controller, follow the Figures below for the corresponding motor. NOTE: The dots indicate the starting position of the wires when wound.

4 Lead Wire Motor Connection

Connect one set of windings to the A terminals. Connect the other set of windings to the B terminals. If the set of windings is unclear, take a pair of wires; use an ohmmeter to check for continuity. When you find the first two wires that have continuity, connect it to the A terminals. Connect the other two to the B terminals.

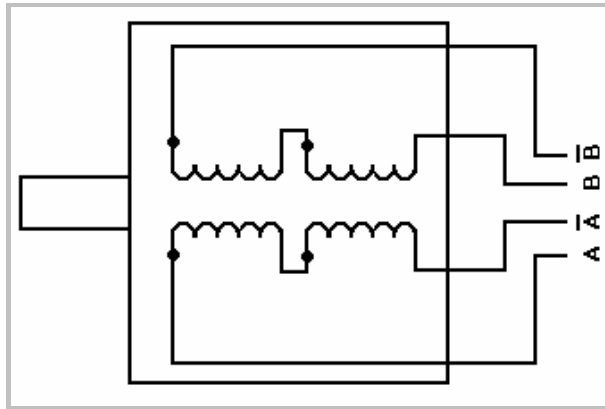


Figure 9.1: 4 Lead Wire Motor Connection

6 Lead Wire Motor Connection (Half Winding)

Six wire motors can be wound in two ways: Half Winding and Full Winding. Six wire motors contain a center tap on each of the two windings. For a half-winding connection, the center tap and one end of the wires are used.

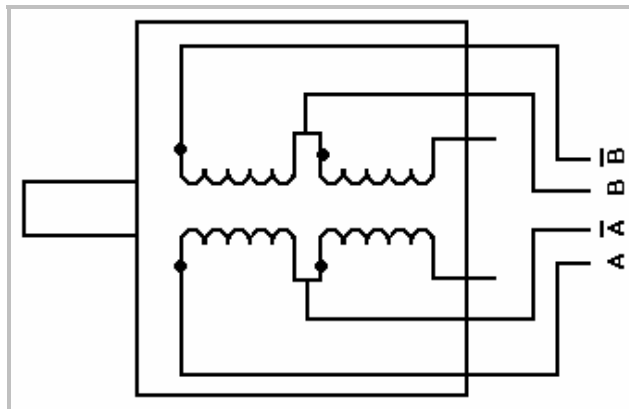


Figure 9.2: 6 Lead Wire Half Winding Connection

6 Lead Wire Motor Connection (Full-Winding)

For a full winding connection, use both end wires, the center tap is ignored. (NC: No Connection).

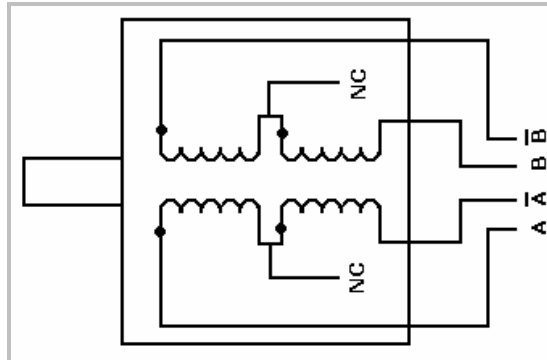


Figure 9.3: 6 Lead Wire Full Winding Connection

8 Lead Wire Motor Connection (Parallel Connection)

Eight wire motors can be connected in two ways: Parallel and Series. When in parallel, the wires are simply connected such that the beginning of each winding are connected together.

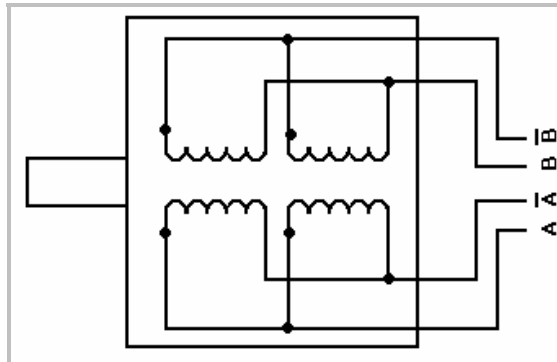


Figure 9.4: 8 Lead Wire Parallel Connection

8 Lead Wire Motor Connection (Series Connection)

Be sure to set the drive current to exactly half of the motor's rated parallel current rating when using the series connection.

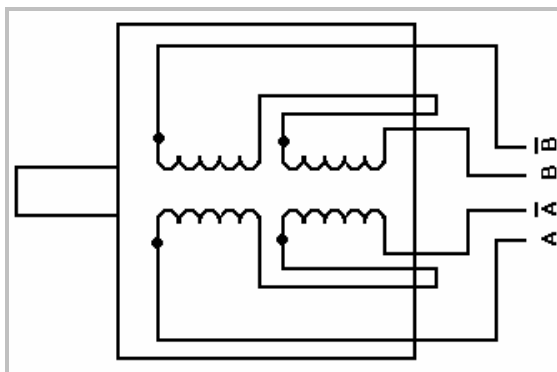


Figure 9.5: 8 Lead Wire Series Connection

9. Troubleshooting & FAQ

Cannot Type anything in HyperTerminal:

Is the correct COM Port selected? Are you using Windows 95? Windows 95 has had problems with its HyperTerminal. Use an operating system of Windows 98 or higher. Are you working on a Laptop? Sometimes there is a shift in Ground on Laptop Serial Ports. Pin 5 on the Serial Port is Ground. Make sure that this is connected to a true ground.

Did you check the Properties in HyperTerminal? Check the box in Properties → ASCII Settings → ASCII setup → 'Echo Typed Characters Locally'.

Is the LED flashing on the R164 Controller? A flashing light indicates it is waiting for Commands. The other steady LED indicates that Power is being supplied to it. If neither of these is on, then check your Power Supply.

Check the Converter Card. Use a voltmeter to measure if Power is coming into the card correctly and if power is being supplied to the Controller properly.

Can Type in HyperTerminal, but nothing is happening:

Check the LED's. If neither is on, the problem may be the Power Supply, check the connections. If one LED is steady, and the other is flashing, then the Power is OK.

Is the R164 Controller set to the correct Address? Check the Red Dial on the top of the controller. The white arrow should be pointing to the corresponding Address. Make sure that the arrow is not between 2 Addresses.

Check the Converter Card. Use a voltmeter to measure if Power is coming into the card correctly and if power is being supplied to the Controller.

Assuming the Properties of HyperTerminal are set as described in the Manual (HyperTerminal Setup), does HyperTerminal respond with a string of characters?
/0'□ indicates that the command is terminated
/0@□ indicates good command and that it was received correctly
/0C□ indicates that the command is out of range
/0b□ indicates bad command

Windows Application: When pressing 'Run' it gives the error - File Already Open:

Another program could also be running at the same time. Click End, and then try again. Sometimes if you are connected through a Network, there are problems with permissions in running programs. Check with your Administrator.

If HyperTerminal is open concurrently, you will receive an error. Only one program can be running at one time.

R164 Controller will accept commands, but the Motor will stall in the middle of a command:

This means there is not enough current being supplied to the Motor. Use the m and l (lower case L) commands to change the current, or run the Motor at a Lower Speed (V command).

Halt Command (H01) Issues

There are known issues involving the Halt command (i.e., H01) when stored in memory location zero. Upon power up, the remaining command string after the Halt command might be executed if the user types in a new command. If memory location zero is not being used, the user is advised to always clear everything in memory by typing /1?9. Otherwise, the user may terminate the remaining command string in the buffer by issuing a /1T.

I want to use one of the I/Os to turn on a LED to confirm that the motor has finished moving or moved to a certain position. How do I do it?

To turn on a LED to confirm that the motor finished moving you must use the "J" command in the command list section On/Off Drivers. We are assuming the unit executes the command sent. We cannot detect skipping because the set up is open loop. Example: /1P200J10R , is a position move 200 steps, then turn on driver 2.

What's the minimum and maximum voltage the RS485 to RS 232 Converter Card can handle?

Min and Max voltage levels: 7 to 40 VDC

Using a PLC to communicate with board

After the command, you need to issue a carriage return and linefeed.

Example: /1A1000R (absolute position move 1000). After the R, send a 0x0d in hex.