R356 Driver/Controller

**Built-in 256x Microstepping Driver
and encoder feedback for position correction**

User Manual
Version 1.10

Thank you for purchasing the R356 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 connect or disconnect the DB-15 cable while power is still being applied to the controller.** This will damage the board. The minimum voltage for the controller is 12.0 volts.
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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This manual revision, is provided for distribution with R356 controllers sold through Lin Engineering

Special Symbols

 Indicates a <u>WARNING</u> and that this information could prevent injury, loss of property, or even death (in extreme cases).

R356 User Manual

Product: R356
Version: 1.10
Date: 3/16/2018

Version History		
Version	**Date**	**Description of Changes**
1.00	7/01/2008	New User Manual
1.01	4/3/2009	Added new RS485-232 converter card info and color code for opto sensor connection page 18.
1.02	8/11/09	Added max surface temperature. Updated encoder cable image.
1.03	9/16/09	Updated image for LED connection.
1.04	9/18/09	Updated pinouts and Appendix for step/dir mode.
1.05	10/29/2009	Added full step as a resolution option.
1.06	2/17/2010	Updated typo on page 6 for max step pulse rate.
1.07	11/03/2010	Updated step frequency to 16.7MHz
1.08	8/19/2014	Driver outputs updated Replaced Hyper Terminal with LinCommand
1.09	5/16/2016	Updated links and specs
1.10	3/16/2018	Update Name and Logo
1.11	1/27/2022	Update USB485 Connecting details

Table of Contents

1. FEATURES
- Operates from +12VDC to +40VDC
- Single 2 wire bus linking up to 16 R356 controllers (on RS485 bus)
- 3.0 Amp Peak Chopper (PWM) Driver (2.14 A/Ph)
- Full step, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256 step resolution
- Stand alone operation with no connection to a PC
- Execution Halt pending switch push button
- Pre-wired internally for Opto Switch inputs
- Homes to an Opto or Switch closure with a single command
- Fully programmable ramps and speeds
- Four digital I/O and two fixed output channels
- Switch selectable address
- Software selectable "Move" and "Hold" currents
- Two inputs can be used for left and right limit switches
- Option to use unit as a driver only and accept TTL step pulses
- Takes in single-ended optical encoder input for position correction
- Hold Current automatically selected upon move completion

Designer's Kit with USB communication

|	
Here is the list of components if you have purchased the optional Designer's Kit: • USB to RS485 converter card • A switch push button • Opto Sensor • A USB 6 foot long cable • 3-Pin cable (optional usage) Lin part number: USB Design Kit SAP#: 4696327000049	

Designer's Kit with RS232 communication

Here is the list of components if you have purchased the optional Designer's Kit: • RS485 to RS232 converter card • A switch push button • Opto Sensor • 3-Pin cable (optional usage) Lin part number: RS232KIT	
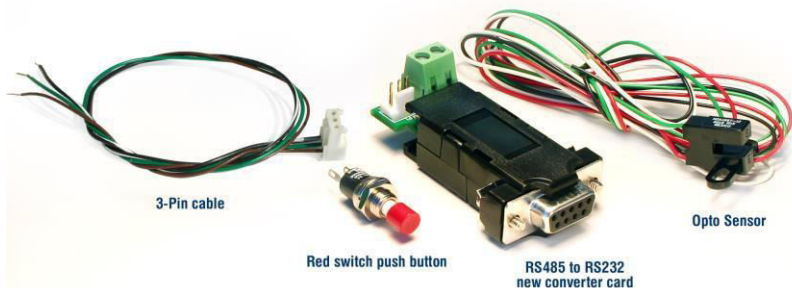
R356's Encoder Option

A single-ended optical encoder must be installed on your motor in order to have encoder feedback. Position correction mode can be turned on such that it will continually send step pulses until the true desired position and actual position equals each other. The option of simply sending an error report is also possible. The R356 must first be set up to work with the encoder by understanding the CPR and calculating an encoder ratio. See the Appendix B of this user manual.

Default Settings

Function (command)	Description
Running Current (m)	25% of 3.0 Amps (0.75 Amps)
Holding Current (h)	10% of the running current
Step Resolution (j)	256x
Top Velocity (V)	305175 pps (microsteps/sec)
Acceleration (L)	L=1000, 6103500 µsteps/sec^2
Position	0
Microstep smoothness (o)	1500
Outputs (J)	Both are turned off, J0, Outputs 1 & 2
Baud Rate	9600 bps

Table 1: Default Settings

2. ELECTRICAL SPECIFICATIONS

Supply Voltage: +12 to +40 VDC, 3 Amps
Peak Current: 0.3 to 3.0 Amps

Digital I/O Specifications
Number of I/O   4
Number of Outputs   2
Input Voltage   +0 VDC to +5 VDC (0 to 24V tolerant, but 5V recommended)
Input Current   700 mA
Pull-up Resistors   20k Ω
Protection   Static Protection to the microprocessor

For a 1.8° stepper:									
Steps per Revolution	200	400	800	1600	3200	6400	12800	25600	51200
Micro step size	1	2	4	8	16	32	64	128	256

3. OPERATING SPECIFICATIONS

Maximum Step Frequency 2^{24} (pps) or 16.7MHz
Operating Temperature Range   0° to 50° C
Storage Temperature Range   -20° to 70° C
Maximum surface temperature   70°C

Communication Specifications
Interface Type   RS485 (RS232 or USB with a converter card)
Baud Rate   9600*, 19200, or 38400 bps
Bits per character   8 Data
Parity   None
Stop Bit   1
Flow Control   None
*default/recommended

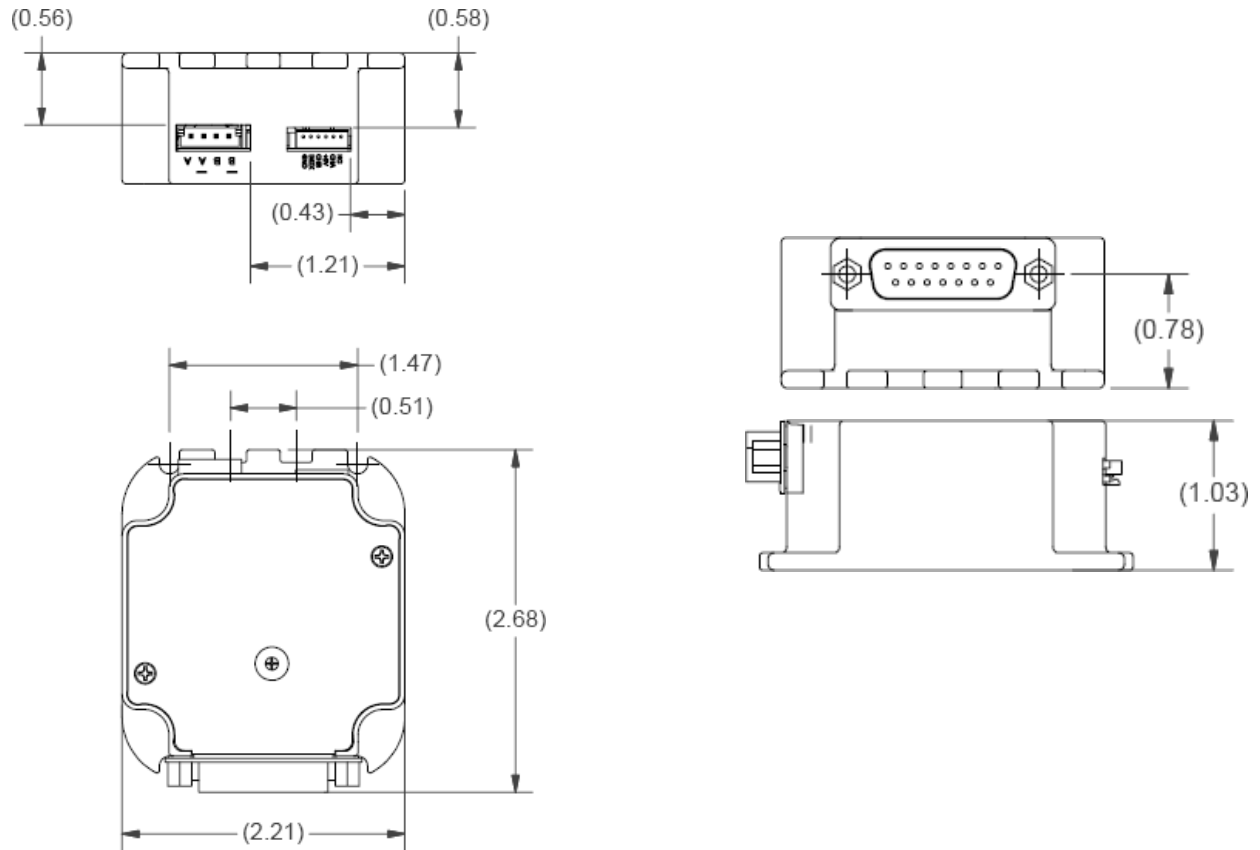## 4. MECHANICAL SPECIFICATIONS

Dimensions

Figure 1: Dimensions

5. PIN ASSIGNMENTS

A DB-15 female connector cable comes with every R356 unit. It receives power and provides the control connections for the R356 Unit. On the opposite end of the DB-15 female connector cable, there is a 3 pin connector provided for the converter card in order for the R356 to communicate with the PC. The four I/O wires are colored Orange, Orange/White, White and Red/White. This will allow for options such as solenoids, relays, opto isolators, LED's and many other input and output connections.

PIN #	COLOR	FUNCTION	I/O # or Function
1	Green	Power Ground	
2	Black	1A On/Off Output	Driver 2
3	White / Green	Direction Input (see Appendix D)	
4	Yellow	+5VDC Input for Opto Isolated STEP and DIR (see Appendix D)	
5	Orange	Input 2	Input 2 / Jog2
6	Yellow / White	Internal Power for Opto Sensor	
7	Orange / White	Input 3 (Opto Input)	Input 3 / Opto1
8	Black / White	RS485 A	
9	Red	+12V TO +40V POWER	
10	Blue	1A ON/OFF Output	Driver 1
11	Blue / White	Step Input (see Appendix D)	
12	Green / White	Signal Ground	
13	White	Input 1	Input 1 / Jog1
14	Red / White	Input 4	Input 4 / Opto2
15	Brown	RS485 B	

Table 2: Pin assignments

*Inputs are labeled 1, 2, 3 and 4 for programming the 'Halt', 'Skip', and special mode 'n' commands.
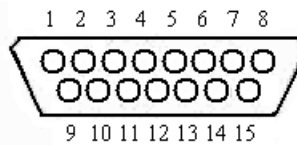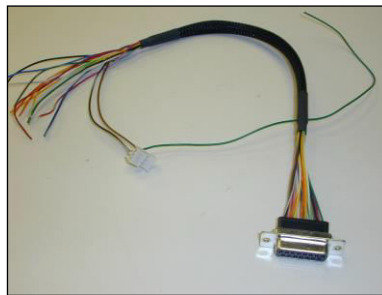

Figure 2: DB-15 Female Cable Connector (Rear View of R356 unit)

Cable 090-00096 (connects with either RS485-232 or USB485 Card)

Connecting to the USB485 card

R356 pin#	R356 color	*USB485 pin#
8	**Black**/**White**	3 (D+/A+, RS485A)
1	**Green**	1 (GND connect to Power Supply Ground)
15	**Brown**	2 (D-/B-, RS485B)

Table 3: Pinouts for using USB485

*Pin #1 is located here:

Figure 3: USB to RS485 converter card, p/n USB485

The USB485 converter card does not require power (it receives power from the PC). Power is still needed for the R356 controller/driver. Pin 8 and 15 from the DB-15 Wire harness may have a connector on it, to use with our updated USB485 converter card, simply cut the connector and directly mate Pin 8 and 15 to the USB485 converter card per the pinout above. Note: On the connector there is a loose green wire, please use this to connect GND on the USB485 to Power Supply GND, Pin 1, on the R356.

Connecting to RS232 card

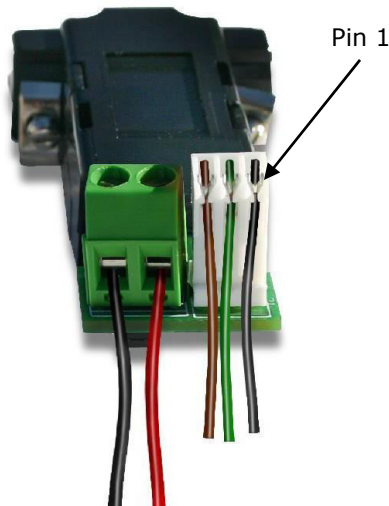| R356 pin#	R356 color	*RS232 card pin#
8	**Black**/**White**	1 (RS485A)
1	**Green**	2 (GND connect to Power Supply Ground)
15	**Brown**	3 (RS485B)

Table 4: Pinouts for using RS232

Figure 4: RS232 to RS485 converter card, p/n 083-00050

The RS232 card requires power (7-40VDC).

6. CONNECTION SPECIFICATIONS

⚠️ **DO NOT PLUG IN POWER SUPPLY UNTIL EVERYTHING IS CONNECTED.**

Quick Start
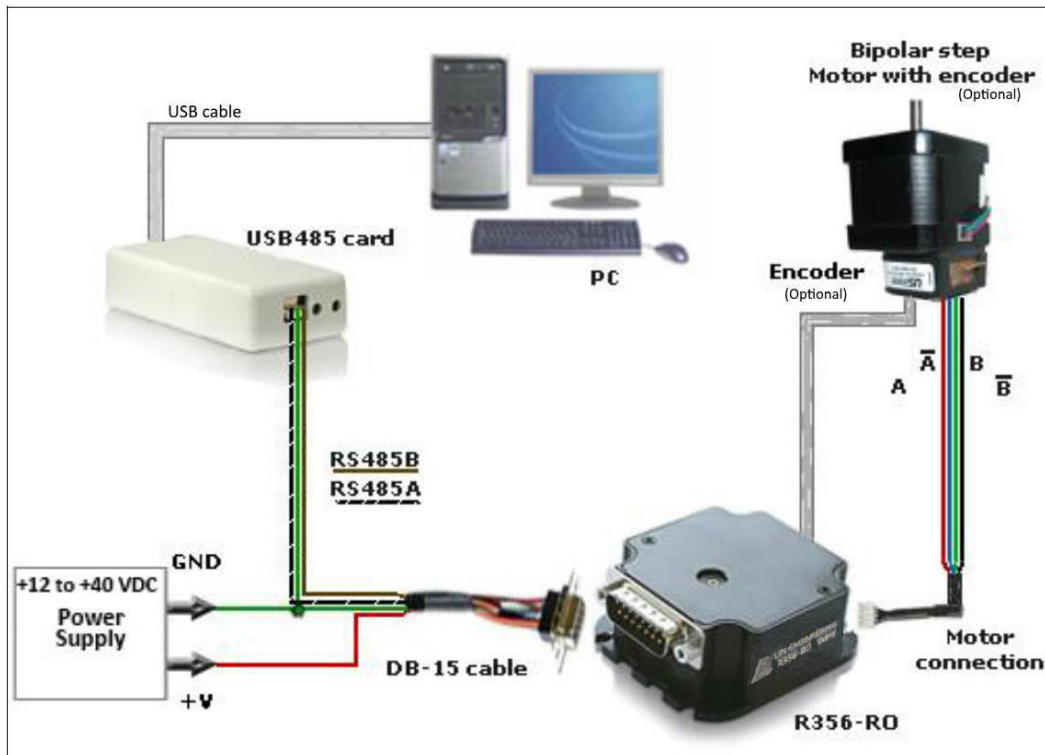**USB-485 converter card**

Figure 6: Connection using USB

1. The USB485 converter card connects to the R356 using the DB-15 cable that is provided to you. The 3-Pin connector is placed onto the converter card. If using our updated USB485, you can remove the connector and directly mate pin 8 and 15 to the USB485 card. Note: When removing the connector, there is a stray green wire, please use this wire to connect the GND on the USB485 to power supply GND, pin 1, on the R356.
2. You may refer to the pin assignments on pages 8 and 9.
3. Connect the motor and optional encoder to the R356.
4. Your power supply will be connected to the R356 directly. The USB485 card is powered via the PC. R356's **pin 9, Red wire is +12 to +40VDC**, **pin 1, Green wire is Ground**. The **USB485 converter card's Green wire needs to also connect to the power supply Ground**.
5. Connect the USB485 card to your PC using the USB cable provided to you. The driver should automatically installed into your computer via Windows. This should let you "Plug and Play".
6. Turn your power supply on and follow instructions for using Lin Command.

Quick Start
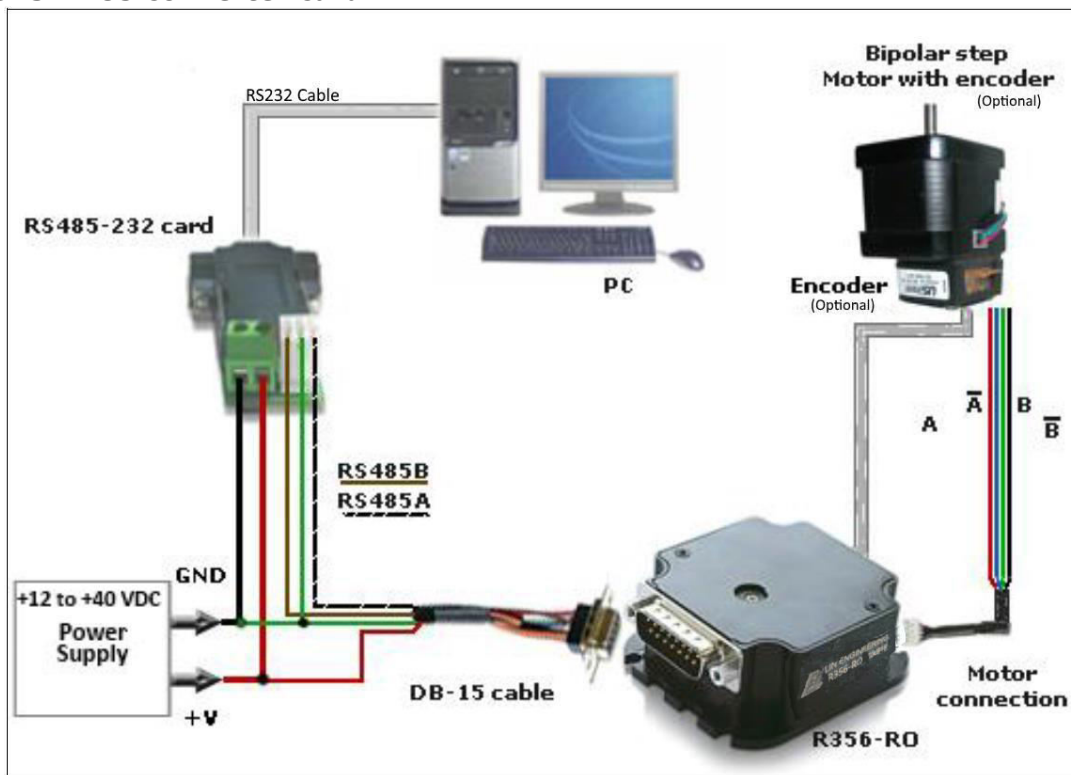**RS232-485 converter card**

Figure 5: Connection using RS232

1. The RS232 converter card connects to the R356 using the DB-15 cable that is provided to you. The 3-Pin connector is placed onto the converter card.
   R356's **pin 9, Red wire is +12 to +40VDC**, **pin 1, Green wire is Ground**. The converter card's **green wire needs to also connect to the power supply Ground**.
2. You may refer to the pin assignments on pages 8 and 9.
3. Your power supply will be connected to the RS232 card where the green header is located. **+ is for +12 to +40VDC, - is for the Power Supply Ground**.
4. Connect the motor and optional encoder to the R356.
5. Connect the RS232 card to your PC with a male to female DB-9 cable.
6. Turn your power supply on and follow instructions for using LinCommand.

Mating Connectors

The following cables are provided with the R356 unit (Part # 090-00096):

DB-15 cable:
See page 8 for pin assignments.

4-Pin cable for step motor:
One 4-pin cable is for the motor windings.

The table to the right depicts the function
Part # 090-00018

Color	Function
Red	A+ Phase
Blue	A- Phase
Green	B+ Phse
Black	B- Phase

Table 5: Pin description for Motor

Encoder cable:
This is ideally for a US Digital E2, E5, or E3 encoder. One side plugs into the R356. The opposite side has flying leads for connection to encoder.

Pin #	Color	Function
1	Green	Ground
2	White	Index
3	Yellow	Ch B
4	Red	+5VDC
5	Blue	Ch A
6	--	--

Table 6: Pinouts for encoder cable, Part #090-00153

7. <u>CONFIGURING AND CONTROLLING THE R356</u>

LinCommand Setup
For more detailed instructions, please refer to the LinCommand Manual.

Follow these steps to set up and use LinCommand:
> Note: If LinCommand has not been installed on your computer, you may download the program in 32 Bit or, 64 Bit, from one of the links below. After downloading, navigate to the 'Setup' file and double click 'Setup' to install.
> LinCommand 32 Bit
> LinCommand 64 Bit

1. After installation, double click on the LinCommand icon ![icon], to launch the LinCommand program.
2. Choose your model controller R256 or, R356 from the drop down box and then click [OK].
3. LinCommand opens in 'Normal' mode with a GUI interface for controlling the stepper motor. For Advance mode skip to step 8 below.
4. To continue in the 'Normanl' mode, choose your COM port, baud rate, and controller address (See Figure 9) and then click [Connect],
5. Choose the 'Motor Settings' tab. Set the Run Current*****, Hold Current, Step Resolution, Velocity, and Acceleration then click [Add Settings to Queue].
   ⚠ **CAUTION** Do Not Exceed Motors Peak Current or, Damage to the Motor and Controller Could Result! See "**Setting the Current**" on following page.
6. Double click on the "**Click Here to Add Command**" to bring up the motor control menu.
7. For a more instructions, please refer to the LinCommand Manual.

8. To operate in the 'Advanced mode', Choose 'Options' and select 'Advanced mode'.
9. Select your COM port and baud rated and then click [Connect].
10. Enter command strings on one of the 7 lines in the 'Send' window and click 'Send' to send command line to the controller.
11. For a complete list of commands and their definitions refer to the R356 Commands manual.

Example command: /1A10000R
- This will run unit #1 to the Absolute position 10000
- You can check the address of your driver by checking the dial at the top of the driver. (See Figure 9)
- A full list of commands is available in the Silverpak 23C / R356 Command List
- Most common commands to change are:
  - Step resolution (/1j2R sets R356 to half stepping)
  - Velocity in pulses/sec (/1V1000R sets the speed to 1000 pps)
  - Run current (/1m50R sets the run current to 50%)
  - Hold current (/1h20R sets the hold current to 20%)
  - Move the motor (/1P800R turns the motor 2 revs if half stepping 1.8°)

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
?/0`a Overflow

You may download, "Sample Programs for R256 and R356 controllers", for additional program examples.

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

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

Current is set based on the maximum amount of current the controller board can output, which is 3.0 Amps Peak. Below is a table of how much current will be applied to your motor for each setting.

Percent		Motor's Current Rating (Amps)	Driver's Equivalent Current (Amps)
10%	=	0.21	0.30
20%	=	0.43	0.60
30%	=	0.64	0.90
40%	=	0.86	1.20
50%	=	1.07	1.50
60%	=	1.29	1.80
70%	=	1.50	2.10
80%	=	1.71	2.40
90%	=	1.93	2.70
100%	=	2.14	3.00

Table 5: 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 Amps x 1.4 = ~1.2 Amps. Using *Table 5* we would see that 1.2 Amps is 40% of the driver's maximum output current.

Assuming the R356 is addressed to Number 1, this is what you'd program: **/1m40R**

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: **/1m46R**

This will set the controller to 1.4 Amps Peak. How did we get 1.4 Amps? → 1.0 Amps x 1.4 = 1.4 A Peak.

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 R356 Units

Connect multiple units by using the Converter card, shown below. If using the RS232-to-RS485 converter card, daisy chain all four wires: power, ground, RS485+ and RS485- prior to plugging into the converter card.
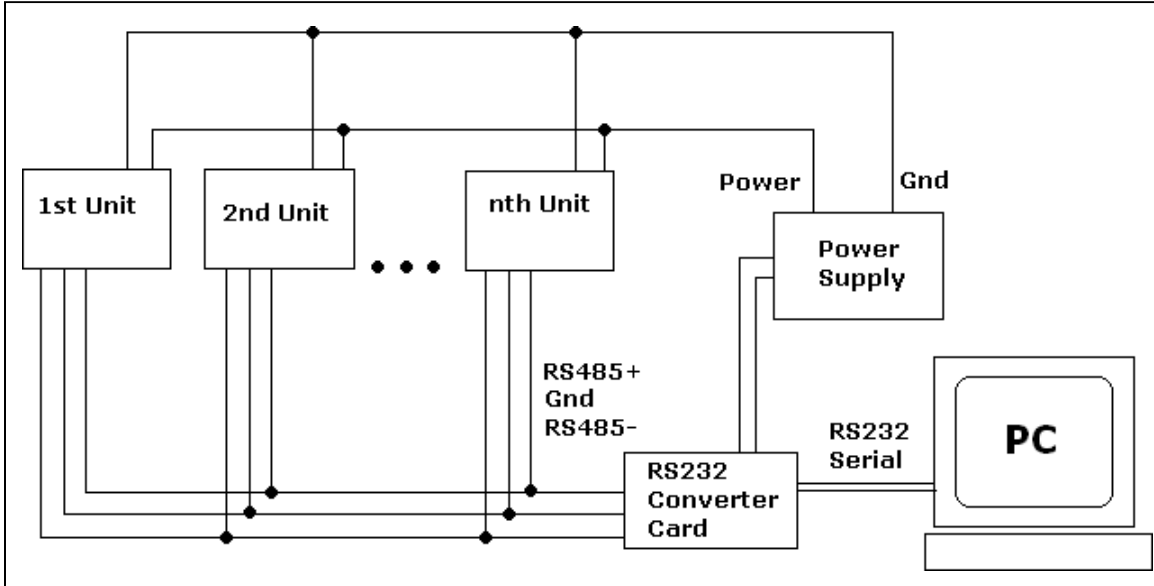

Figure 7: Connection using RS232 Converter Card

If using the USB485 converter card, connect all the power and ground lines on the units to the main power supply. Then daisy chain the RS485+ and RS485- lines prior to plugging into the USB485 card.
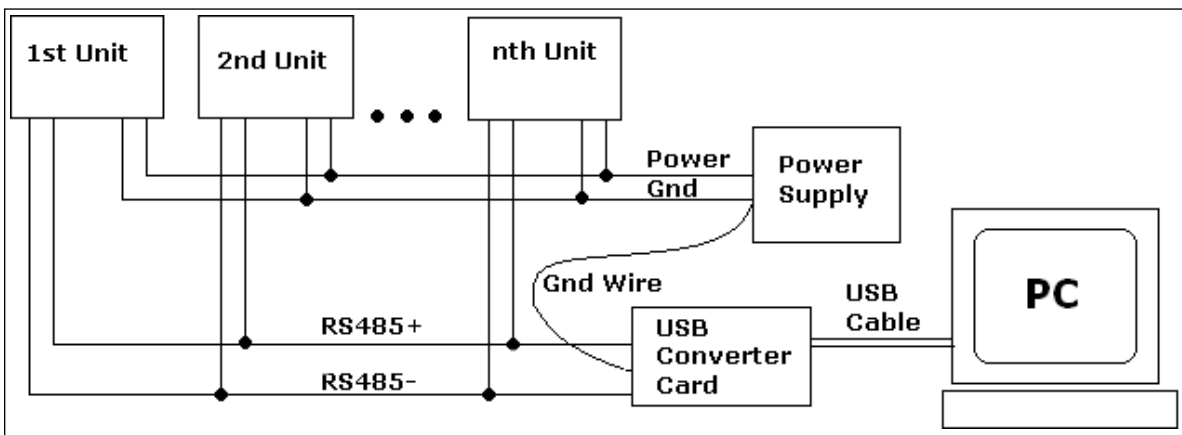
Be sure to also ground the USB485 card with Pin 2, ground.

Figure 8: Connection using USB485Converter Card

Changing the Address of the Controller

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

Figure 9: Address Dial

Connecting Accessories

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.
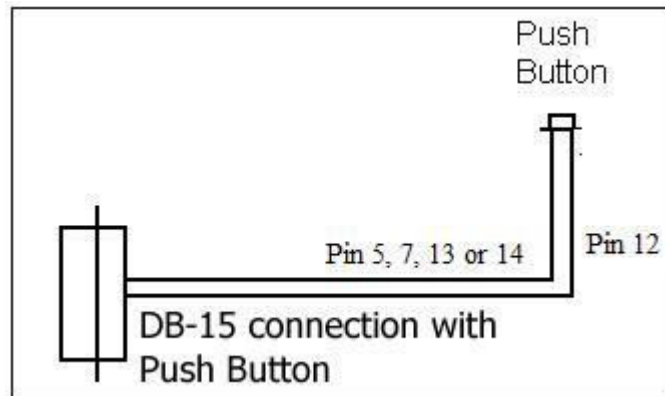
### Push Button

Figure 10: Push Button Schematic

Pins 5, 7, 13 and 14 can all be used with push buttons. Below shows the corresponding input numbers for these pins.

Input 1	Pin 13
Input 2	Pin 5
Input 3	Pin 7
Input 4	Pin 14

Table 7

LED or other output

The two driver outputs, pins 2 & 10, can drive an external device such as solenoids, LED's, or switches. These outputs are switches that ground internally, and therefore need to be connected to the +V of the power supply. Below is a recommended connection for lighting an LED with 20 mAmps:
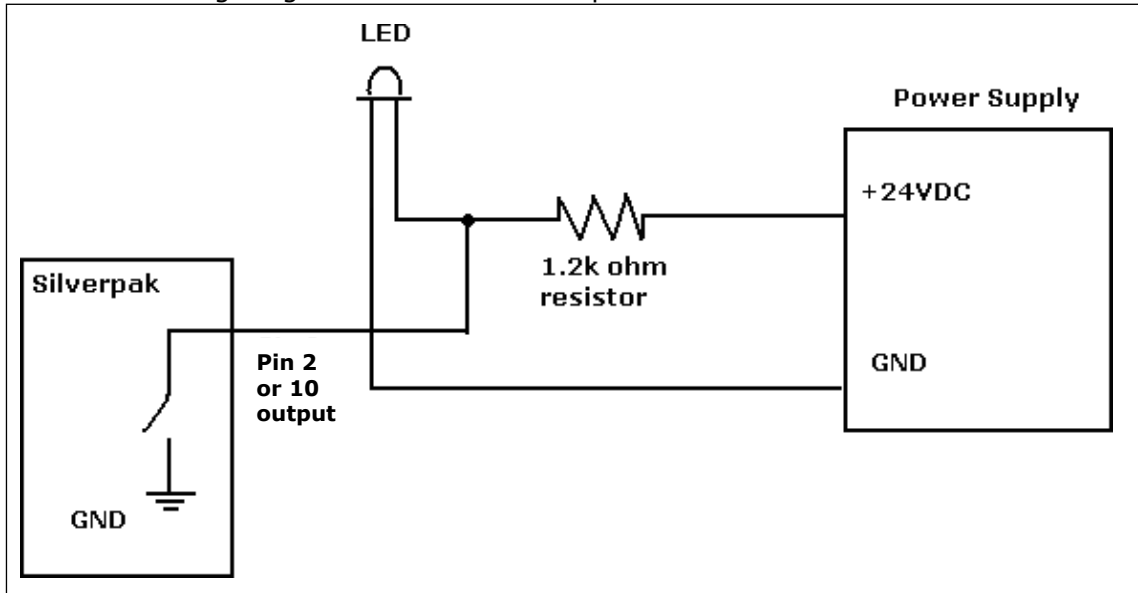
Upon entering command /1J3R, both pins 2 & 10 will output 1 Amps. The 1.2k ohm resistor will limit the current to 20 mAmps into the LED. Select any ohm value to limit your current based on the device that is connected to the output.
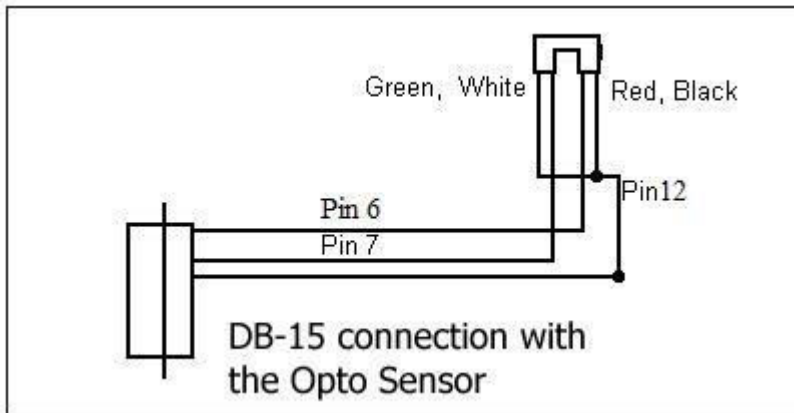
Optical Sensor

Figure 11: Opto Sensor Connection Schematic

Use the following table to connect the corresponding wires.

Optical Sensor	DB15 Cable	Pin #
Green →	Green/white	12
Black →	Green/white	12
Red →	Yellow/white	6
White →	Orange/white	7

Table 8

Appendix A
Encoder Usage

The R356 can do closed loop position correction. The encoder connects to the board internally.

Position Correction Mode

Position correction mode, when enabled will issue steps to the motor until the encoder reads the correct position. Once enabled, **positions are given in Quadrature encoder counts of the encoder – not in microsteps**. If the motor stalls during a move then this mode will reattempt the move until the encoder reads the correct number, or until it has tried a certain number of times and times out.

First: Set the Encoder Ratio:
Encoder ratio = [(Microstep * 200 steps/rev) / (CPR *4)]*1000
This must be a whole number after you multiply by 1000.
For example: a 1.8° motor set to 256x microstepping with a 1000 count encoder:
        Encoder ratio = ((200 * 256)/(1000*4))*1000 = 12800
        Set encoder ratio: /1aE12800R
If Encoder Ratio is Unknown:
Follow these steps:
1. Issue a /1n0R to clear any special modes
2. Issue a /1z0R to set position of encoder and controller to zero
3. Issue a /1A100000R and ensure the move completes at a velocity that does not stall.
4. Issue a /1?0 to read current position. This should be 100000.
5. Issue a /1?8 to read the encoder position
6. Issue a /1aE0R which auto divides these two numbers
7. Issue a /1?aE which read backs the encoder ratio computed
8. This value is a rough guide and may be a few counts off due to inaccuracies in the motor position and run-out of the encoder, but use the EXACT number that was returned and set it with a /1aEXXXXR. Or, please contact Lin Engineering and provide us with your motor part number and we can look up the encoder CPR for you.

Second: Set the Error in Quadrature Encoder Ticks allowed before correction begins:
/1aC50R (default is 50) Motor will move 50 encoder ticks away from desired position before position correction takes place. If aC is set to too small of a value, the motor may oscillate back and forth trying to locate the exact position. Use a larger aC value.
Third: Set the Overload Timeout Value:
This is the number of re-tries allowed under a stall condition: /1au10000R (default is 10)
Fourth: Enable the Feedback mode:
Zero the positions prior to enabling the feedback mode: /1z0R
Issue /1n8R to enable the feedback mode.

Overload Report Mode

Overload report mode when enabled, will compare the encoder value to the commanded position at the end of a move and report an error if the two values do not match within the range given by "aC". When this error occurs the drive will exit from any loops or strings it may be executing.

Overload report mode is enabled by /1n16R, and requires the encoder ratio to be entered correctly via the "aE" command. Issue a /1zR to zero both the encoder and position counter just prior to issuing /1n16R. Only the Position Correction mode or the Overload Report mode may be turned on at one time.

Notes:
1. When any command is received by the drive it will always respond with its status. The drive will only accept a command when it is not busy. This status byte received must be checked to ensure that the unit was not busy and that the command was accepted. This is especially important when position correction mode is enabled, because the drive may be attempting to correct position all by itself, and will reject an externally (via RS232) received command if it is busy in the middle of a correction move.
2. When position correction mode is enabled, /1n8R, then the drive will keep retrying any stalled moves, and will NOT halt any strings or loops upon detection of a stall.
3. During position correction mode /1T will halt any move, but there is a possibility that the drive may instantly reissue itself a position correction command, especially if it is fighting a constant disturbance. It may be necessary to issue a /1n0R to positively halt a move in progress.
4. Position correction mode is inhibited if the encoder underflows and goes negative (but will automatically resume if a move is made into the positive range). If position correction is required at the zero point, please redefine zero to be a slightly positive number with the "z" command. Eg /1z10000R
5. If the encoder ratio is changed from its default of 1000, the allowed max position will be decreased from $+2^{31}$ by the same ratio.

Appendix B
Peak current versus Amps/Phase

Where does the 1.4 times come from? Current is continuously changing when a motor steps. If the motor is rated for 1.0 A/Ph, it may receive 0 Amps, 1 Amp, 1.4 Amps, or anything in between if you are microstepping. For ease of explanation, we will look at the current waveform when we half step, or set the driver/controller to 2x microstepping.
If we take a look at both the A and B phases, and plot on an X-Y chart of when each phase receives current, and how much it receives, it will look like the chart below. Beginning at position 1, Phase A receives negative current, and Phase B receives positive current. Let's assume it is at coordinate (-1, 1).

HALF- STEPPING
Current Wave Form
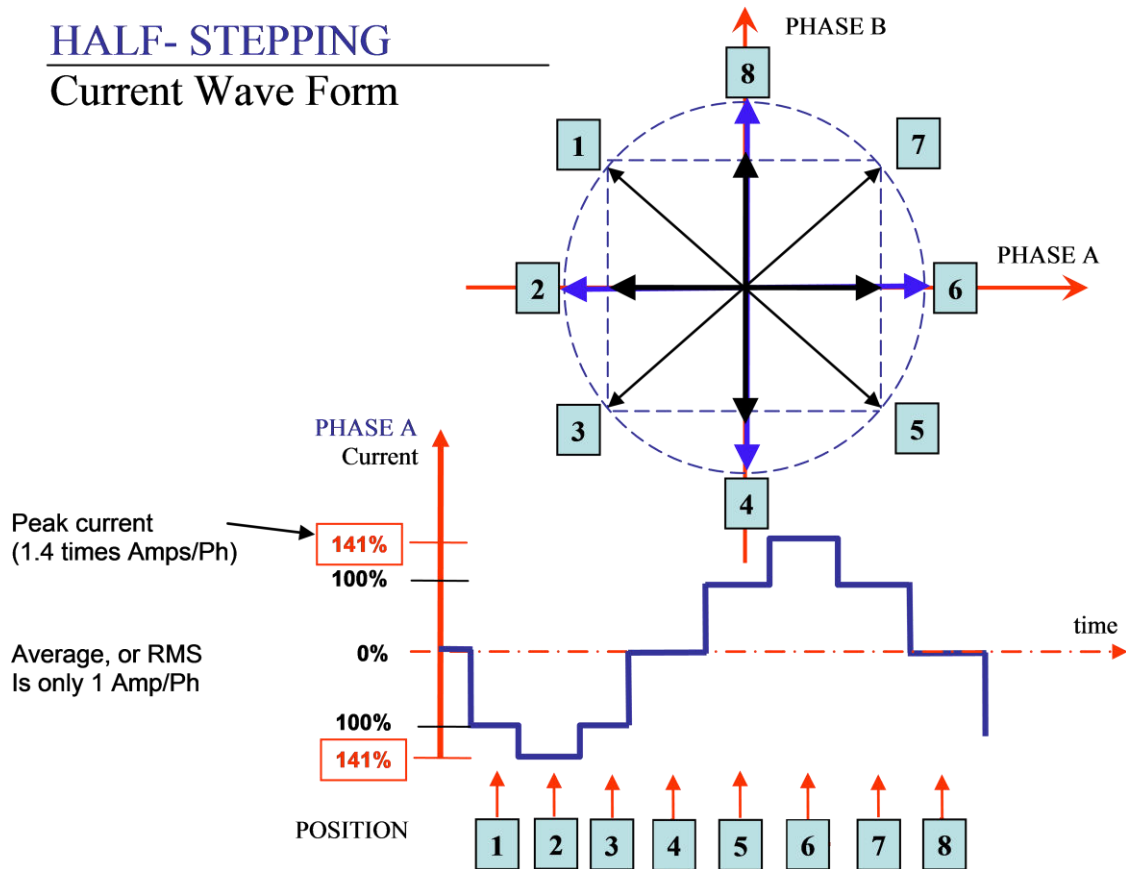
The position versus time graph just above, plots only the A Phase, following the eight different steps the motor will make. Current is changing with each position. Recall that a negative in electronics simply means reverse direction of current flow.

1.41 AMP (√2) 1 AMP 1 AMP	Take a look at position #7. If we were to draw the arrow at position 7 as the hypotenuse of a triangle, it would look like the triangle to our left. Recall from geometry a 90°-45°-45° triangle is a 1-1-√2 combination. The √2, or 1.4 value is also the radius of the dotted circle shown above. Therefore, during certain steps, Phases A or B will receive 1.4 Amps of current. But the average, or RMS current throughout these 8 steps is only 1.0 Amps. RMS and Amps/Phase is the same meaning.

The 1.4A along this hypotenuse is also known as the 2-Phase On position, since both A and B Phases are "On" and receive current. It is also known as the ***peak current.***

As we see the waveform that's plotted for the A Phase, the highest value on the curve is known as the peak value.

Motors have a rated current, or average RMS value since in operation, the current is continuously changing. The most logical way to describe a rating is to take an average, or RMS (root means squared) value. But drivers understand current in terms of peak current, therefore the conversion is: **Amps/Phase x 1.4 = Amps Peak**

Appendix C
Step and Direction Mode

The R356 unit can be configured as a driver only by first connecting it to your PC and saving the special mode "n96" in program memory storage zero.

1. First connect to your PC and save n96 in storage zero:
   /1s0n96R

2. Next, connect the positive side of a TTL squarewave for step pulses to Pin 11 (Blue/white wire).

3. Connect a +5VDC supply to Pin 4 (Yellow wire).

4. Tie together the negative pin of the step pulse to the negative 5VDC supply. This becomes your signal ground.

5. Change direction of rotation on the fly by connecting or disconnecting Pin 3 (White/green wire) to the signal ground that was just created in Step 4.

The unit can still accept commands via RS485 when in step & direction mode, but move commands via RS485 will override step pulses.

Appendix D
Motor Connections (Does not apply to SilverPak motors)

Step Motors have 4, 6, or 8 wires. To better understand how to connect your step motor with your R356 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.
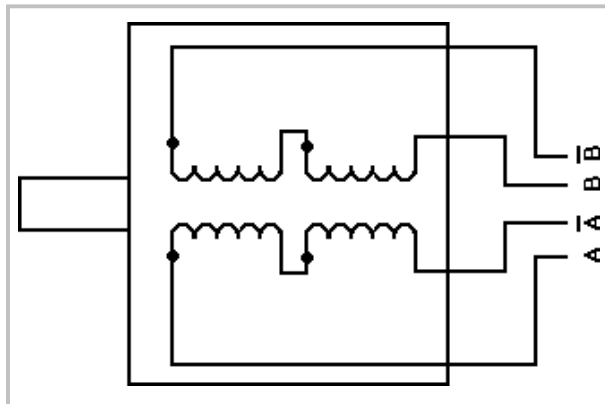

Figure 18: 4 Lead Wire Motor Connection

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.
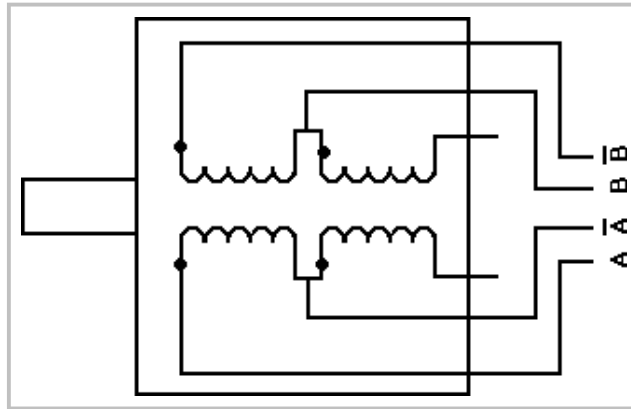

Figure 19: 6 Lead Wire Half Winding Connection

6 Lead Wire Motor Connection (Full-Winding)

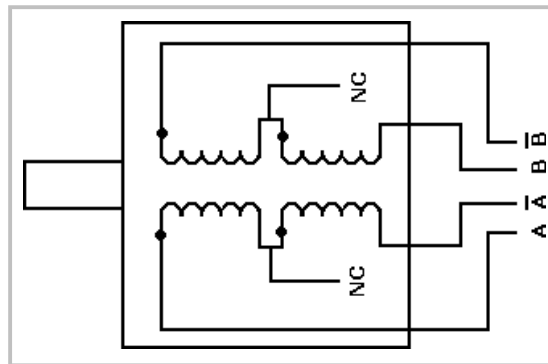For a full winding connection, use both end wires, the center tap is ignored. (NC: No Connection).

Figure 20: 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.
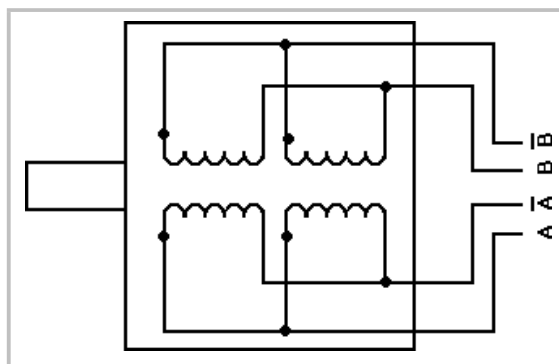

Figure 21: 8 Lead Wire Parallel Connection

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.
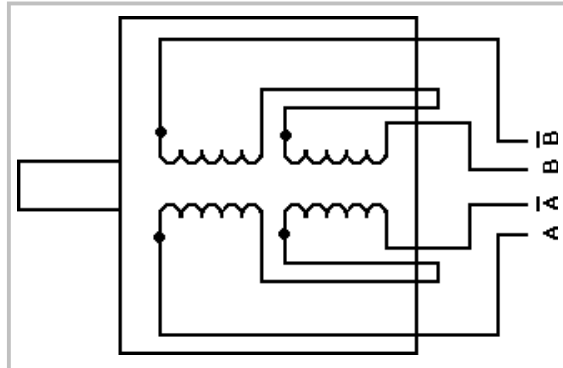

Figure 22: 8 Lead Wire Series Connection

Appendix E
Troubleshooting

USB485 interface card driver not communicating
Reinstall USB485 driver
1. Go to Windows Device Manager
2. Under the Ports Section, the USB485 should show as the
   "Prolific PL2303GL USB Serial COM Port (COM XX)"
3. If it does not show as this, it might show as the "USB Serial Controller".
4. If so, right click on this and "Update the driver". The name should change to the above as intended.
5. If it does not, please go this **link** to download and install the driver from the original Chip manufacturer.
6. Select the **PL23XX-M_LogoDriver_Setup.exe** and install. The name should now populate to **"Prolific PL2303GL USB Serial COM Port (COM XX)"**
7. When you send a command via Lin Command, a Yellow and Green light will blink to show that the command has been sent successfully.

Hardware Troubleshooting
   Carefully re-check all instructions for hardware and wiring diagrams.
   Many times problems are related to wiring and/or connector issues.

Technical Support

By Telephone: 408-919-0200 (Mon.-Fri., 8:00 a.m.-5:00 p.m. Pacific Time)
By Email: techsupport@linengineering.com
On the Web: www.linengineering.com

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance please contact us.