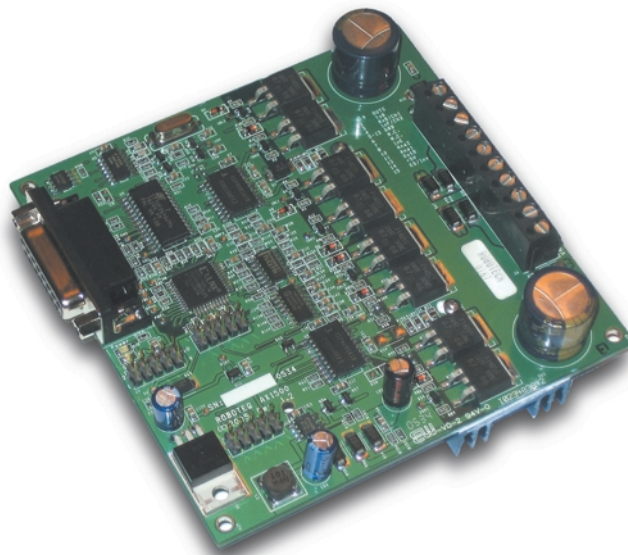


# **AX1500**

## **Dual Channel Digital Motor Controller**

### **Quick Start Manual**



v1.9b, June 1, 2007

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# Important Safety Warnings

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## **Read this Section First**

The AX1500 is a high power electronics device. Serious damage, including fire, may occur to the unit, motors, wiring and batteries as a result of its misuse. Transistors may explode and require the use of safety glasses when operated in direct view. Please review the User's Manual for added precautions prior to applying full battery or full load power.

### **This product is intended for use with rechargeable batteries**

Unless special precautions are taken, damage to the controller and/or power supply may occur if operated with a power supply alone. See "Power Regeneration Considerations" on page 35 of the Users Manual. **Always keep the controller connected to the Battery.** Use the Power Control input to turn On/Off.

### **Avoid Shorts when Mounting Board against Chassis**

Use precautions to avoid short circuits when mounting the board against a metallic chassis with the heat sink on or removed. See "Attaching the Controller Directly to a Chassis" on page 183.

### **Do not Connect to a RC Radio with a Battery Attached**

Without proper protection, a battery attached to an RC Radio may inject its voltage directly inside the controller's sensitive electronics. See

### **Beware of Motor Runaway in Improperly Closed Loop**

Wiring or polarity errors between the feedback device and motor in position or closed loop position mode may cause the controller to runaway with no possibility to stop it until power is turned off.

# **AX1500**

## **Quick Start**

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This section will give you the basic information needed to quickly install, setup and run your AX1500 controller in a minimal configuration.

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### **What you will need**

For a minimal installation, gather the following components:

- One AX1500 Controller and its provided cables
- 12V to 40V high capacity, high current battery
- One or two brushed DC motors
- One R/C to DB15 connector (provided)
- Miscellaneous wires, connectors, fuses and switch

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### **Locating the Connectors**

Take a moment to familiarize yourself with the controller's connectors.

The front side (shown in Figure 1) contains the Power/Status LED and the 15-pin connector to the R/C radio, joystick or microcomputer, as well as connections to optional switches and sensors.

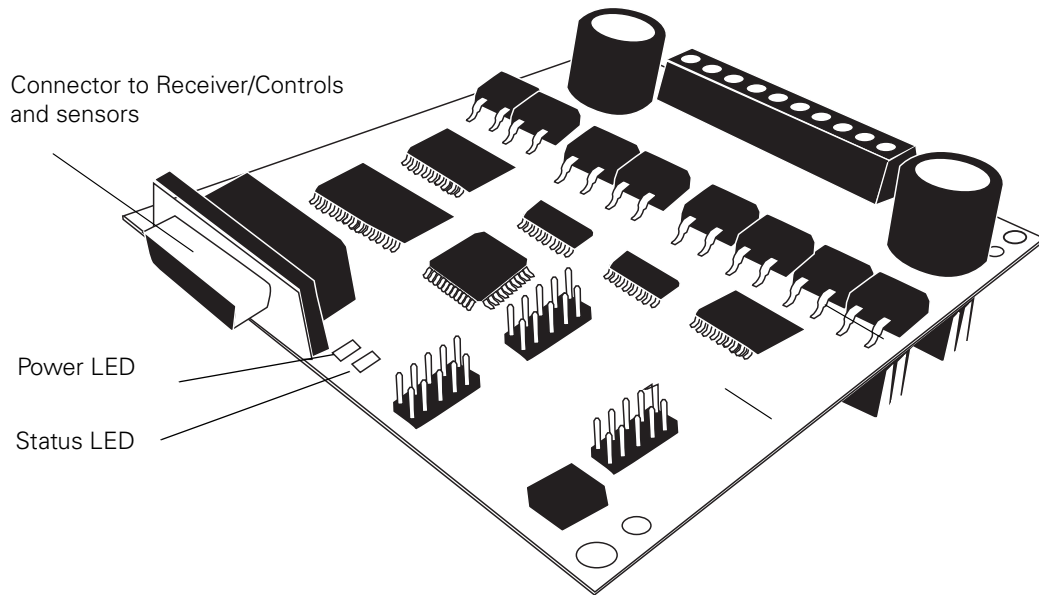


FIGURE 1. AX1500 Controller Front View

At the back of the controller (shown in the figure below) are located all the terminals that must be connected to the batteries and the motors.

**Note:**

Both VMot terminals are connected to each other in the board and must be wired to the same voltage.

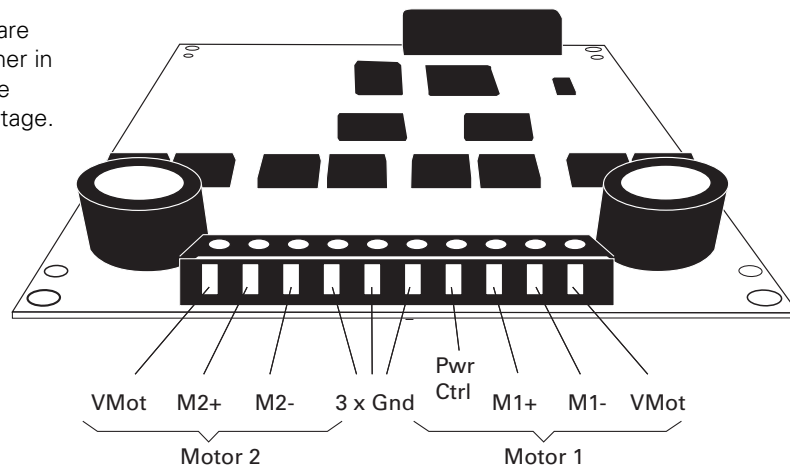
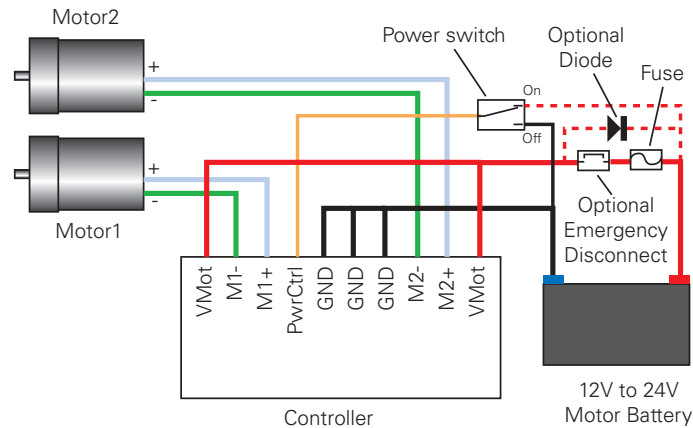


FIGURE 2. AX1500 Controller Rear View

## Connecting to the Batteries and Motors

Connection to the batteries and motors is shown in the figure below and is done by connecting wires to the controller's terminal strip.



### Notes:

- The Battery Power connection are doubled in order to provide the maximum current to the controller. If only one motor is used, only one set of motor power cables needs to be connected.
- Typically, 1, 2 or 3 x 12V batteries are connected in series to reach 12, 24 or 36V respectively.
- The Power Control wire **MUST** be used to turn On and Off the controller.

FIGURE 3. AX1500 Electrical Power Wiring Diagram

1- Connect each motor to one of the two M+ and M- terminal pairs. Make sure to respect the polarity, otherwise the motor(s) may spin in the opposite direction than expected

2- Connect two of the three Ground terminals to the minus (-) terminal of the battery that will be used to power the motors. Connect the two VMot terminals to the plus (+) terminal of the battery. The motor battery may be of 12 to 40 Volts. There is no need to insert a separate switch on Power cables, although one is suggested for Emergency disconnect. See "Controller Power" on page 28 for a detailed discussion and more wiring options.

Avoid extending the length of wires from the battery to the controller as the added inductance may cause damage to the controller when operating at high currents. Try extending the motor wires instead since the added inductance on the motor side of the controller is not harmful.

**The two VMot terminals are connected to each other inside the controller. The same is true for the Ground Terminals. You should wire each pair together as shown in the diagram above.**

3- The Power control terminal **MUST** be connected to Ground to turn the Controller Off. For turning the controller On, even though the Power Control may be left floating, whenever possible pull it to an unfused 12V or higher voltage to keep the controller logic solidly On. You may use a separate battery to keep the controller alive as the main Motor battery discharges. Refer to the chapter "Connecting Power and Motors to the Controller" on page 27 for more information about batteries and other connection options.

## Important Warning

Do not rely on cutting power to the controller for it to turn off if the Power Control is left floating. If motors are spinning because the robot is pushed or because of inertia, they will act as generators and will turn the controller, possibly in an unsafe state. ALWAYS ground the Power Control wire to turn the controller Off and keep it Off.

## Important Warning

The controller includes large capacitors. When connecting the Motor Power Cables, a spark will be generated at the connection point. This is a normal occurrence and should be expected.

## Connecting to the 15-pin Connector

The controller's I/O are located on its standard 15-pin D-Sub Connector. The functions of some pins varies depending on controller model and operating mode. Pin assignment is found in the table below.

Pin	Signal		
	RC Mode	RS232 Mode	Analog Mode
1	2A Digital Output C (same as pin 9)		
2	TxData		
3	RC Ch1	RxData	Unused
4	RC Ch 2	Digital Input F	
5	Ground Out		
6	Unused		
7	Unused		
8	Digital Input E (Not available when Encoder module is present) and Analog Input 4		
9	2A Digital Output C (same as pin 1)		
10	Analog Input 2		
11	Analog Input 1		
12	Analog Input 3		
13	Ground Out		
14	+5V Out (100mA max.)		
15	Emergency Stop or Invert Switch input		

### Connecting the R/C Radio

Connect the R/C adapter cables to the controller on one side and to two or three channels on the R/C receiver on the other side. If present, the third channel is for activating the accessory outputs and is optional.

When operating the controller in “Separate” mode, the wire labelled Ch1 controls Motor1, and the wire labelled Ch2 controls Motor2.

When operating the controller in “Mixed” mode, Ch1 is used to set the robot’s speed and direction, while Ch2 is used for steering.

See “R/C Operation” on page 101 of the User’s Manual for a more complete discussion on R/C commands, calibration and other options.

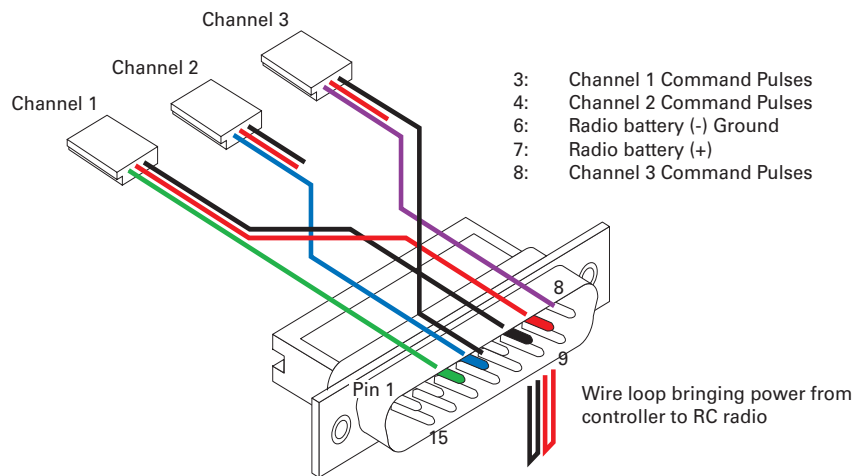


FIGURE 4. R/C connector wiring for 3 channels and battery elimination (BEC)

This wiring - with the wire loop uncut - assumes that the R/C radio will be powered by the AX1500 controller. Other wiring options are described in “R/C Operation” on page 101 of the User’s Manual.

### Important Warning

**Do not connect a battery to the radio when the wire loop is uncut. The RC battery voltage will flow directly into the controller and cause permanent damage if its voltage is higher than 5.5V.**

Connecting the optional channel 3 will enable you to turn on and off the accessory output. See “Connecting Sensors and Actuators to Input/Outputs” on page 51 and “Activating the Accessory Outputs” on page 110 of the User’s Manual.

## Powering On the Controller

**Important reminder:** There is no On-Off switch on the controller. You must insert a switch on the controller's power terminal as described in section "Connecting to the Batteries and Motors" on page 17.

To power the controller, center the joystick and trims on the R/C transmitter. In Analog mode, center the command potentiometer or joystick. Then turn on the switch that you have placed on the on the Power Control input.

A Power LED located next to the 15-pin connector will lit to indicate that the controller is ON.

The status LED will start flashing a pattern to indicate the mode in which the controller is in:

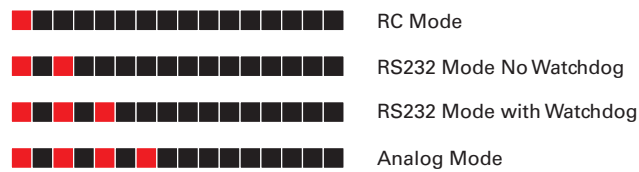


FIGURE 5. Status LED Flashing pattern during normal operation

## Default Controller Configuration

Version 1.9b of the AX1500 software is configured with the factory defaults shown in the table below. Although Roboteq strives to keep the same parameters and values from one version to the next, changes may occur from one revision to the next. Make sure that you have the matching manual and software versions. These may be retrieved from the Roboteq web site.

TABLE 1. AX1500 Default Settings

Parameter	Default Values	Letter
Input Command mode:	(0) = R/C Radio mode	I
Motor Control mode	(0) = Separate A, B, speed control, open loop	C
Amp limit	(5) = 26.25A	A
Acceleration	(2) = medium-slow	S
Input switch function	(3) = no action	U
Joystick Deadband	(2) = 16%	d
Exponentiation on channel 1	(0) = Linear (no exponentiation)	E
Exponentiation on channel 2	(0) = Linear (no exponentiation)	F
Left / Right Adjust	(7) = no adjustment	L

Any one of the parameters listed in Table 1, and others not listed, can easily be changed either using the PC with the Roboteq Configuration Utility. See "Using the Roborun Configuration Utility" on page 161.



## Connecting the controller to your PC using Roborun

Connecting the controller to your PC is not necessary for basic R/C operation. However, it is a very simple procedure that is useful for the following purposes:

- to Read and Set the programmable parameters with a user-friendly graphical interface
- to obtain the controller's software revision and date
- to send precise commands to the motors
- to read and plot real-time current consumption value
- Save captured parameters onto disk for later analysis
- to update the controller's software

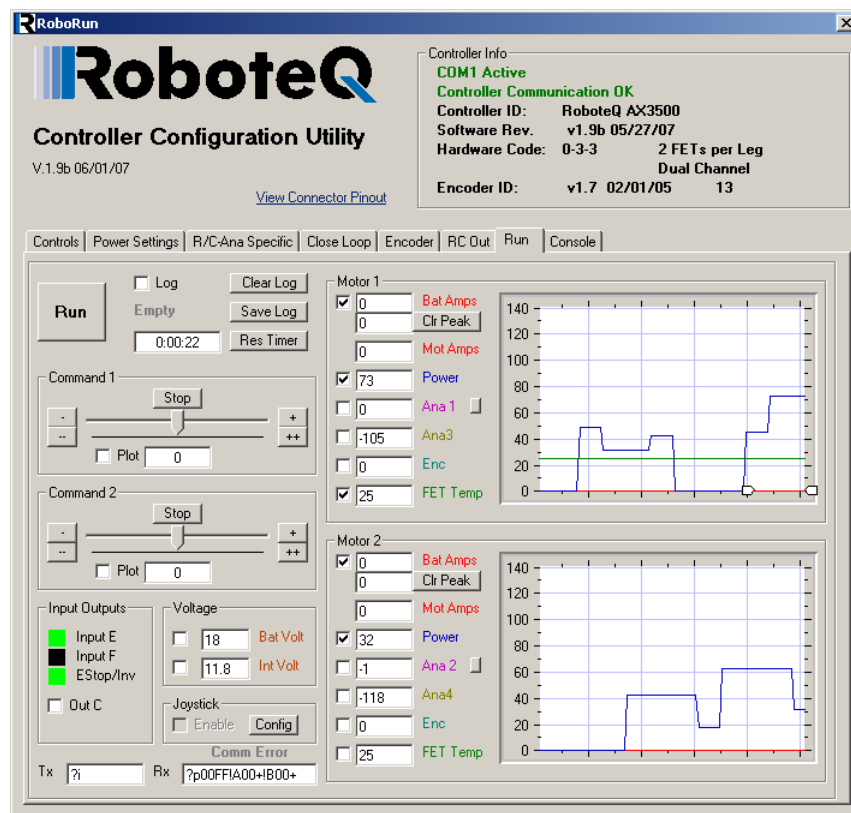


FIGURE 6. Roborun Utility screen layout

To connect the controller to your PC, use the provided cable. Connect the 15-pin connector to the controller. Connect the 9-pin connector to your PC's available port (typically COM1) - use a USB to serial adapter if needed. Apply power to the controller to turn it on.

Load your CD or download the latest revision of Roborun software from [www.Roboteq.com](http://www.Roboteq.com), install it on your PC and launch the program. The software will automatically establish communication with the controller, retrieve the software revision number and present a series of buttons and tabs to enable its various possibilities.

The intuitive Graphical User Interface will let you view and change any of the controller's parameters. The "Run" tab will present a number of buttons, dials and charts that are used for operating and monitoring the motors.

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## **Obtaining the Controller's Software Revision Number**

One of the unique features of the AX1500 is the ability to easily update the controller's operating software with new revisions downloaded from Roboteq's web site at [www.roboteq.com](http://www.roboteq.com). This is useful for adding features and/or improving existing ones.

Each software version is identified with a unique number. Obtaining this number can be done using the PC connection discussed previously.

Now that you know your controller's software version number, you will be able to see if a new version is available for download and installation from Roboteq's web site and which features have been added or improved.

Installing new software is a simple and secure procedure, fully described in "Updating the Controller's Software" on page 178 of the User's Manual.

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## **Exploring further**

By following this quick-start section, you should have managed to get your controller to operate in its basic modes within minutes of unpacking.

Each of the features mentioned thus far has numerous options which are discussed further in the complete User's Manual, including:

- Self test mode
- Emergency stop condition
- Using Inputs/Outputs
- Current limiting
- Closed Loop Operation
- Software updating
- and much more