BlueJay 400-C User Guide

WARNING

- **Modifying the Motor Controller parameters can damage equipment, property and cause INJURY/DEATH to yourself/others.**
- **Modifications may VOID your WARRANTY**
- **Factory/Dealer settings should only be performed by trained technicians**

Questions? Feedback? Send email to: **support@bluejaytuning.com**

Table of Contents

What BlueJay Does

BlueJay is a DIY performance tuning application for the motor controllers used in electric golf carts and utility vehicles.

BlueJay automatically detects your controller, saves and restores settings, and makes motor tuning simple - even for beginners.

Get the latest version: https://bluejaytuning.com

- **Automatic controller detection**: BlueJay queries your connected controller to detect the brand/model/type

- **One application for many controllers**. No manual guesswork of which Chinese OEM tuning application to use

- **Highlights the most important and commonly adjusted tuning parameters**, making them quick and intuitive to edit.

- **Save and Restore**: Snapshot your current configuration or roll back to a known-good one

- **Supports tuning profiles**, including:

    ○ Sporty and Fast

    ○ Casual About Town

    ○ Hill Climber

    ○ Many other community supported

- Fully **English interface** with simple and clear parameter descriptions

BlueJay works with a wide range of vehicles using compatible AC motor controllers, including Advanced EV, Bintelli, Coleman, Denago, Evolution / HDK, ExCar, EZKruiser, Gotraxx, Gorilla, Moto Electric, Icon, PDG, Racka, Royal, Spartan, Star, Tao, Many others with FJ, EV48-400-C and Tercel/LVTong/JHL controllers!

Getting Started

Look at the BlueJay Quick Start Guide PDF to get up and running fast.

Settings

By default, BlueJay is configured to probe for all supported controllers.

To save time, you may want it look for just your controller brand.

Click the Setting selection on the left side and then check/uncheck the controllers that you want.

Be sure to click Save if you make changes to the settings.
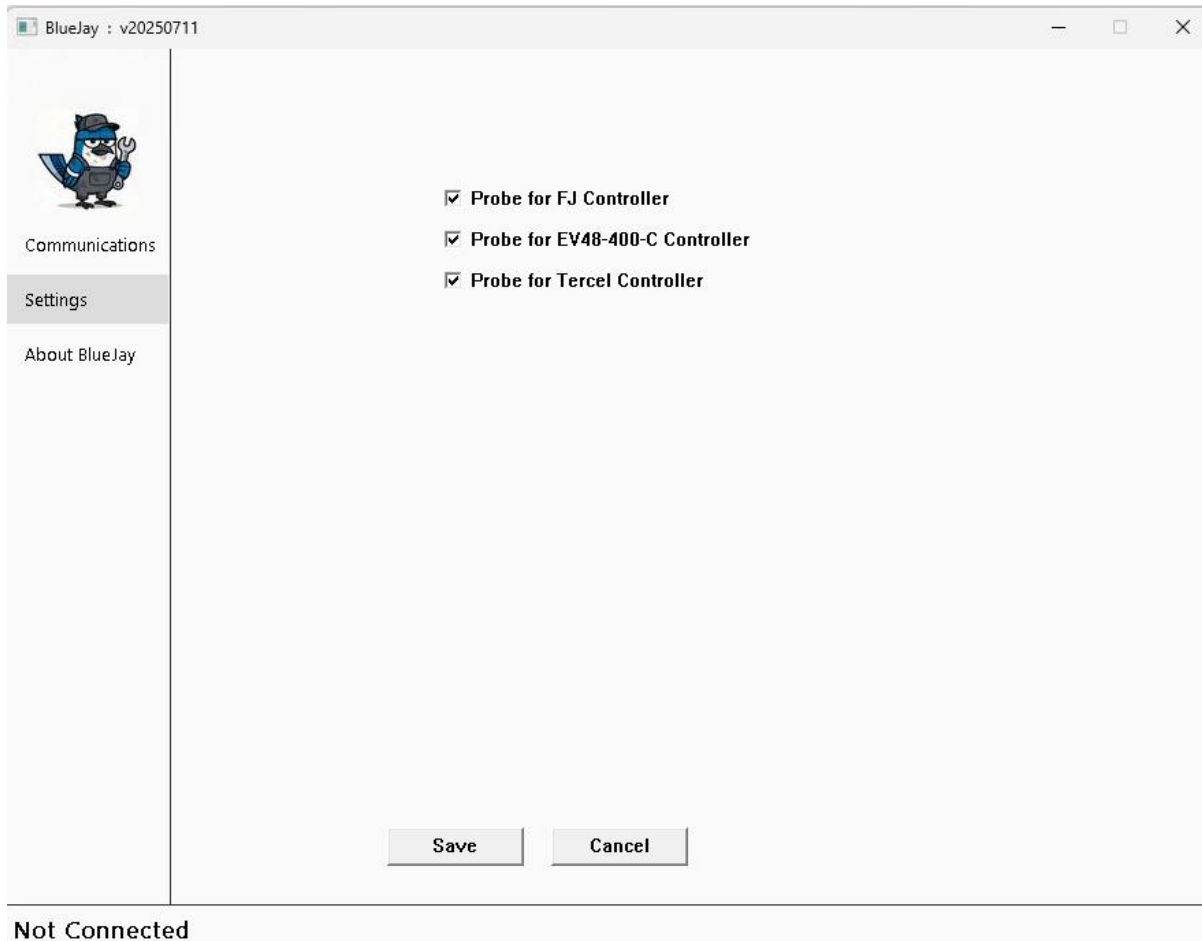
Trouble Shooting

BlueJay can't identify controller

- Make sure your cart is powered on. The controller must have power in order to communicate

- Make sure that you installed your cable's device driver

  - Most cables require a Windows Device Driver to be installed. If you purchased from Cart Cables, go here to find the appropriate driver:

    - https://www.cartcables.com/pages/drivers

- Make sure your controller is supported by BlueJay.

  - Identify your controller brand/model/type here:
    - https://www.cartcables.com/pages/controller-id-guides

Can't edit a parameter

- Make sure you are double-clicking the "set" cell of the parameter row.

- Grey Parameter rows are read-only and can not be edited.

Won't load backup

- Make sure you are loading the correct controller brand/model/type

- Make sure you haven't hand edited the backup file

Won't load profile

- Make sure you are loading the correct controller brand/model/type

- Make sure you have the parameter named spelled correctly

- Make sure the parameter value is within min/max range

Something Else

- Send email describing issue to: **support@bluejaytuning.com**

FAQs

An updated list of FAQs can be found at: https://bluejaytuning.com/faqs.html

Why isn't BlueJay free?

Since the OEM controller programs like GEF12Host or Fj Programming tool are free, why isn't BlueJay also free?

- Actually those OEMs programs are NOT free. They are licensed applications that have been pirated and copied onto various download sites.

- BlueJay is supported multi-controller application that provides many features that the OEMs applications do not, such as:

  ○ Save/Restore

  ○ Profiles

  ○ User Guide

  ○ Every common tuning parameter defined and described in the User Guide

  ○ Email application support, bug fixes, new versions

Where can I find the latest BlueJay version?

- Go to: **https://bluejaytuning.com**

Where can I find a list of reported bugs?

- Go to: **https://bluejaytuning.com/downloads.html#issues**

- Report bugs to: **support@bluejaytuning.com**

Will you give me personal support to tune my controller?

- No, we offer application support via email and bug fix support but we cannot tell you what parameter values to use for tuning your controller.

- Read the user manual for general guidance

  ○ There is NOT a one size fits all. Use caution and intelligence

- Get community support by posting tuning questions for the various Golf / Utility Cart forums and sites.

EV48-400-C Tuning

BlueJay auto-detects Evolution EV48-400-C controllers. The EV48-400-C is an AC motor controller used in some Evolution Electric Vehicles, specifically designed for models like the Classic 2/4 Plus, Forester 4/6 Plus, D5 carts and others.

A 4-pin square programming port located beneath the fuse block in the battery bay allows for customization and tuning of vehicle settings.

To connect and program the EV48-400-C controller, you'll need:
- A programming cable such as the CartCables CC-CBL-EVO2SE

Tuning is not complicated but it does come with risks that MUST be understood and accepted:

- **Modifying the Motor Controller parameters can damage equipment, property and cause INJURY/DEATH to yourself/others.**
- **Modifications may VOID your WARRANTY**
- **Factory/Dealer settings should only be performed by trained technicians**

This section discusses an approach to performance tuning. What values do you use to tune your cart? It depends on what you want. There is not a one size fits all.

- Don't just enter numbers that someone told you about

- Look at your existing values

- Determine your goals

- Make small changes

- Test with caution

Before you make any changes, you should make a backup of the current parameters by clicking the Save button.

To change a parameter, double-click on the the "set" cell of the parameter row. Make sure your change is between the valid min and max for that parameter. After editing, the "set" cell will highlight in yellow to show that it has changed.

Changes are not written to the connected controller until you click the Write button.

If you want to discard changes before writing, click the Reset button.

You can return to a previous saved state by clicking the Load button and choosing a previously saved file for the connected controller. After loading, differences from the current state and the loaded files will be highlighted in yellow. Be sure to review both the Tuning and Sink tables to see changes. Changes are not actually written to the controller until you click the Write button.

Common tuning areas are:

- Speed

- Acceleration

- Regen/Deceleration

<u>**Note:**</u>

•   BlueJay's 400-C parameter names might be slightly different than the OEM name in an attempt to simply/clarify the parameter's purpose.

Speed

Speed tuning controls how fast the golf cart can travel under various conditions. This involves adjusting the maximum motor RPM, and then forward/reverse RPMs in High and Low gears.

Start by setting your motor maximum speed:

- Motor Maximum Speed

  - Maximum RPM in any direction in any gear

  - Range: 0-8000 RPM

    - The OEM allowed max is 6000 RPM.

      - Use caution if exceeding OEM range.

      - Excessive use High RPM can lead to faults and premature motor/controller failures

Next adjust your "Forward High/Slow Gear Max Speed" - These set how fast the cart can go in High (H) and Slow (S) modes. Both values are capped by whatever you put into Motor Maximum Speed.

- Forward High Gear Max Speed

- Forward Slow Gear Max Speed

Why set Forward High Gear Max Speed LESS than Motor Maximum Speed?
- If you set Motor Maximum Speed to 6000 RPM and Forward High Gear Max Speed to 5700 rpm, you'll leave a ~5% "emergency headroom".

- Some controllers (including EV48-400-C) don't handle hitting their max rpm very gracefully - it can trigger "Over-speed Protection" faults or cause sudden motor braking.

- Motor Maximum Speed is the absolute hardware/software ceiling. You are never allowed to spin faster than this - no matter what.

- Forward High Gear Max Speed is a targeted performance setting. This is the normal 'full throttle' behavior for everyday use.

- If going downhill, heavy load, strong tailwind, slight overrun, **the motor can momentarily spin up crashing into the Motor Maximum Speed limit and fault out**.

Why set Forward High Gear Max Speed to MATCH the Motor Maximum Speed?
- If you want every possible RPM out of the motor (racing, timed event, crazy top speed cart).

- If you are certain you will never coast or over-speed downhill into a fault.

- If you are maximizing efficiency and minimizing motor margin for maximum range.

Next set your cart's Reverse Max Speed.

- This should be a conservative value, around 1000 RPM

Acceleration/Deceleration

Now that you've set your max forward and reverse RPM, you'll want to make a plan on how to get to those speeds. The 400-C divides forward acceleration/deceleration into 7 "partitions" each.

These acceleration parameters tell the controller how quickly in RPMs per second that you want to get from one partition to the next.

While the range for these are 0-100 and your existing numbers may look low, **Do NOT change immediately to large numbers!**

Take your existing values and add 5-10 to a partition slowly and test.

- Too large will make your cart dangerous and out of control.

- **Don't be stupid. Go slow, test**.

The deceleration partitions will use your motor to slow your cart down when your foot is off the accelerator pedal and you transition from one partition to the next.

Take your existing values and add/subtract 1-2 to a partition slowly and test.

- Too large of number here will slow your cart aggressively and you'll eat your windshield.

- **Don't be stupid. Go slow, test**.

Torque

The torque is the "muscle" behind the acceleration plan. Each torque partition value limits or defines the force the motor can use to achieve the acceleration plan.

Torque is the rotational force that the motor produces to turn the shaft. Think of it like how hard you twist a wrench - torque is that "twisting" force. Torque tuning affects how well the cart can climb hills, carry loads, or launch from a stop. Adjusting torque levels can help balance power, hill climbing, efficiency, and battery life.

There's two types of torque to discuss:

- Driving Torque

  ○ This refers to the motor operating as a motor, i.e., driving the vehicle forward or backward using electrical energy drawn from the battery.

  ○ The Driving Torque Factor in this mode limits how much driving torque the motor can produce at specific RPMs.

- Regenerative Torque

  ○ This is when the motor operates as a generator, i.e., converting kinetic energy back into electrical energy to recharge the battery (regenerative braking).

  ○ The Regenerative Torque Factor in this mode limits how much braking torque can be applied by regenerative braking at specific RPMs.

The 400-C divides forward driving torque into 7 partitions and regenerative torque into 6 partitions, where each toque partition is a value from 0-100 which is the % of max available torque

- If you set a high acceleration but a low torque, you might notice the vehicle feels sluggish or lags when climbing or starting under load.

- If you set high torque but low acceleration, you'll have more pulling power, but the controller will deliberately slow down how fast you ramp up.

- Be conservative at low speed to avoid jerky starts, higher torque at higher speeds when needed for hills or carrying load.

Like acceleration, do NOT start with large torque numbers!

Take your existing values and add 5-10 to a partition slowly and test.

- Too large will make your cart dangerous and out of control.

- **Don't be stupid. Go slow, test**.

EV48-400-C Parameters

This section describes all EV48-400-C parameters that BlueJay supports. Refer to the above section for discussion on how they relate and an approach to performance tuning.

If you feel that there are needed parameters that are missing, send us an email.

BlueJay presents tuning parameters into 4 tuning tabs.

- Just because a parameter is in these tabs does NOT mean you need to adjust.

- Only change what you need to.

- Change in small increments and test. Go slow, be careful, be smart.

The most common tuning parameters are in the Speed, Accel or Regen tabs. The Sink tab (aka 'the 'kitchen sink') are other important tuning parameters that may be useful to advanced/experienced tuners.

<u>Note:</u>

- BlueJay's 400-C parameter names might be slightly different than the OEM name in an attempt to simply/clarify the parameter's purpose.

These are listed in alphabetical order.

Accelerator Max Value

- The max of accelerator pedal. When pedal sensor reads this voltage, the motor is at Maximum Motor Speed RPM

- Range: 2.0-5.0V

Accelerator Min Value

- The dead zone of accelerator pedal. When pedal sensor reads this voltage, the motor is at 0 RPM

- Range: 0-2.0V

Accelerator Pedal Sensor Type

- The sensor type used in accelerator box

- Range: External communication, Analog+Switch, Analog, Switch

CAN Baudrate

- Controller Area Network (CAN) bus communication baud rate

- Range: 200KBits/s-1000KBits/s

Controller Over Temperature Cutback Power

- The controller temperature in °C when **exceeded** will cause power to the motor to be reduced

- Range: 0-95°C

- Use caution when modifying this parameter as too high of a temperature setting can burn out or motor/controller

Controller Over Temperature Zero Power

- The controller temperature in °C when **exceeded** will cause power to the motor to be cut off.

- Range: 0-95°C

- Use caution when modifying this parameter as too high of a temperature setting can burn out motor/controller

Controller Under Temperature Cutback Power

- The controller temperature in °C when **under** will cause power to the motor to be reduced
- Range: -40-0°C
- Use caution when modifying this parameter as too high of a temperature setting can burn out or motor/controller

Controller Under Temperature Zero Power

- The controller temperature in °C when **under** will cause power to the motor to be cut off.
- Range: -40-0°C
- Use caution when modifying this parameter as too high of a temperature setting can burn out motor/controller

Driving Torque Factor 0 → 500 RPM

- Motor Driving Torque when RPM is between 0 and 500 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 500 → 1000 RPM

- Motor Driving Torque when RPM is between 500 and 1000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 1000 → 1500 RPM

- Motor Driving Torque when RPM is between 1000 and 1500 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 1500 → 2000 RPM

- Motor Driving Torque when RPM is between 1500 and 2000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 2000 → 2500 RPM

- Motor Driving Torque when RPM is between 2000 and 2500 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 2500 → 3000 RPM

- ◦ Motor Driving Torque when RPM is between 2500 and 3000 RPM

- ◦ Range: 0-100 % of max available torque, Motor Maximum Torque

Driving Torque Factor 3000 → MAX RPM

- ◦ Motor Driving Torque when RPM is between 3000 and Motor Maximum Speed

- ◦ Range: 0-100 % of max available torque, Motor Maximum Torque

Forward Acceleration 0 → 500 RPM

- ◦ Acceleration when RPM is in between 0 and 500 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 500 → 100 RPM

- ◦ Acceleration when RPM is between 500 and 1000 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 1000 → 2000 RPM

- ◦ Acceleration when RPM is between 1000 and 2000 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 2000 → 3000 RPM

- ◦ Acceleration when RPM is between 2000 and 3000 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 3000 → 4000 RPM

- ◦ Acceleration when RPM is between 3000 and 4000 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 4000 → 5000 RPM

- ◦ Acceleration when RPM is between 4000 and 5000 RPM

- ◦ Range: 0-100 RPMs per second

Forward Acceleration 5000 → MAX RPM

- ◦ Acceleration when RPM is in between 5000 and Motor Maximum Speed RPM

- Range: 0-100 RPMs per second

Forward Deceleration MAX → 5000 RPM

- Acceleration when RPM is between Motor Maximum Speed and 5000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 5000 → 4000 RPM

- Acceleration when RPM is in between 5000 and 4000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 4000 → 3000 RPM

- Acceleration when RPM is between 4000 and 3000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 4000 → 3000 RPM

- Acceleration when RPM is between 4000 and 3000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 3000 → 2000 RPM

- Acceleration when RPM is between 3000 and 2000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 2000 → 1000 RPM

- Acceleration when RPM is between 2000 and 1000 RPM

- Range: 0-100 RPMs per second

Forward Deceleration 1000 → 0 RPM

- Acceleration when RPM is between 1000 and 0 RPM

- Range: 0-100 RPMs per second

Forward High Gear Max Speed

- Maximum Forward RPM in High gear.

  - See above discussion for what you want to set here.

- The range for this are 0-Motor Maximum Speed RPM

- The OEM allowed max is 6000 RPM. Use caution if exceeding OEM range.

Forward Slow Gear Max Speed

- Maximum Forward RPM in Slow gear.

- Range: 0-Motor Maximum Speed RPM

  - The OEM allowed max is 6000 RPM. Use caution if exceeding OEM range.

Hill Hold Mode

- Sets how motor behaves when it detects you're on a hill/slope.

- The 400-C infers in you're on a slope by motor speed, accelerator position, brake signal, direction (forward/reverse) and probably more than anything whether the motor is accelerating or decelerating without torque request.

  - For example:

    - If motor RPM is increasing while accelerator = 0, assume vehicle is rolling downhill

    - If accelerator = 0, brake = off, speed = 0, and a rollback is detected → engage hill hold

- Range:

  - Holding on the slope

    - When you stop on a hill, the motor actively resists rollback.

    - Think of it like an automatic hill hold.

    - Set Slide Max Motor Speed low (50–100 RPM) so you barely creep, if at all.

  - Running down on the slope

    - When you're driving downhill, the motor gently applies regenerative braking.

    - Set Slide Max Motor Speed high (200–400 RPM) so you can roll downhill in a controlled way without freewheeling.

    - Good for mountain courses, long downhill stretches where you'd otherwise have to ride the brake pedal a lot.

Motor Maximum Power

- Max electrical power allowed (W)

- Range: 0-14000W

Motor Maximum Speed

- Maximum RPM in any direction in any gear

- Range: 0-8000 RPM

  - The OEM allowed max is 6000 RPM. Use caution if exceeding OEM range.

- Setting Motor Maximum Speed changes the max range for Forward High Gear Max Speed, Forward Slow Gear Max Speed, Reverse Max Speed

Motor Maximum Torque

- Max mechanical torque output (Nm)

- Range: 0-70Nm

Motor Over Temperature Cutback Power

- The motor temperature in °C at when **exceeded** will cause power to the motor to be reduced

- Range: 0-160°C

- Use caution when modifying this parameter as too high of a temperature setting can burn out or motor/controller

Motor Over Temperature Zero Power

- The motor temperature in °C at when **exceeded** will cause power to the motor to be cut off.

- Range: 0-160°C

- Use caution when modifying this parameter as too high of a temperature setting can burn out or motor/controller

Motor Temperature Sensor Type

- The type of temperature sensor used in the motor

- Range: Uncheck, PT100, PT1000, KTY84

Reduction Ratio

- The gear ratio between the motor and the drive wheels, through a reduction gearbox or differential. It's sometimes also called the final drive ratio or gear ratio.

- Range: 0.0-1000.0

Regenerative Torque Factor MAX→5000 RPM

- Motor Driving Torque when RPM is between Motor Maximum Speed and 5000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Regenerative Torque Factor 5000→4000 RPM

- Motor Driving Torque when RPM is between 5000 and 4000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Regenerative Torque Factor 4000→3000 RPM

- Motor Driving Torque when RPM is between 4000 and 3000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Regenerative Torque Factor 3000→2000 RPM

- Motor Driving Torque when RPM is between 3000 and 2000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Regenerative Torque Factor 2000→1000 RPM

- Motor Driving Torque when RPM is between 2000 and 1000 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Regenerative Torque Factor 1000→0 RPM

- Motor Driving Torque when RPM is between 1000 and 0 RPM
- Range: 0-100 % of max available torque, Motor Maximum Torque

Reverse Acceleration

- Acceleration when in Reverse direction
- Range: 0-100 RPMs per second

Reverse Deceleration

- Deceleration when in Reverse direction
- Range: 0-100 RPMs per second

Reverse Max Speed

- Maximum Reverse RPM in ANY gear.
- Range: 0-Motor Maximum Speed RPM
  - The OEM allowed max is 6000 RPM. Use caution if exceeding OEM range.

Slide Ki on the Slope

- Sets how aggressive or soft the motor correction is while holding
- Ki is integral correction (adds up small errors over time to fix drifting).
- Range: 0.0-1.0

Slide Kp on the Slope

- Sets how aggressive or soft the motor correction is while holding.
- Kp is proportional correction
  - Bigger Kp = harder fight against slope immediately).
- Range: 0.0-10.0

Slide Max Motor Speed

- Sets how fast the motor is allowed to spin while holding the vehicle on a slope.
- For example, if set to 300 RPM even if gravity tries to pull you, motor resists enough to stay below 300 RPM.
- Range: 0-600 RPM

Speed Loop Ki

- Integral Gain - Looks at the accumulated error over time and adds more torque until the speed error is gone. If the cart slowly drops speed on a long climb, Ki keeps adding torque until RPM comes back up to target.
- Start low and increase by 0.01 at a time. Too high can cause surging.
  - You may want to increase this in combination with decreasing "Forward Acceleration $0 \rightarrow 500$ RPM" so starting off doesn't jump/buck.
- Eliminates steady-state speed error (e.g. cruising up a hill).
- Range: 0.0-1.0

Speed Loop Kp

- Proportional gain - determines how fast the motor reacts to throttle input or changes in load. As as your speed drops below the target (throttle setting), the controller increases torque proportional to that drop.

- A higher Kp makes the controller push harder immediately when it senses RPM loss. S

- Start with a moderate increase, only 1 pt at a time. Too high will cause throttle to feel jerky or cause oscillation at steady speed.

- Range: 0.0-10.0

Tire Diameter

- The tire size in millimeters

- Range: 0-1000

Comments, questions, corrections? Send email to: **support@bluejaytuning.com**