



# Operators Manual Toolkit Software



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# TABLE OF CONTENTS

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<b>WARNINGS</b>	<b>4</b>
<b>TERMS AND DEFINITIONS</b>	<b>5</b>
<b>PROGRAMMING THE CONTROLLER</b>	<b>7</b>
<i>PREFERENCES</i>	<b>8</b>
<i>CONTROLLER INFO</i>	<b>11</b>
<i>CONTROLLER SETTINGS</i>	<b>12</b>
<i>APPLICATION</i>	<b>17</b>
<i>THROTTLE SETTINGS</i>	<b>21</b>
<i>SIN/COS CAL</i>	<b>22</b>
<i>MONITOR</i>	<b>23</b>
<b>LED BLINK CODES</b>	<b>24</b>
<i>THROTTLE AND BRAKE CODES</i>	<b>24</b>
<i>ALARM CODES</i>	<b>25</b>
<i>CODE DEFINITIONS</i>	<b>26</b>
<b>WARRANTY STATEMENT</b>	<b>28</b>

# WARNINGS

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## GENERAL WARNINGS

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### Safety Notes:

When working on electric vehicles, sudden unexpected events can occur, it's recommended to:

- Place the drive axle on jack stands—wheels off the floor.
- When working on wiring or batteries, always remove rings, watches and secure dangling clothing/hair/jewelry.
- Use the proper safety equipment, eye protection, and insulated tools.
- Never connect a computer while the vehicle is being charged.
- Disconnect batteries before installing or working on the Alltrax controller.
- Wear safety glasses.
- Because hydrogen can build up due to gassing from the batteries, work in a well ventilated area.
- Make sure the battery pack is fused.
- Do not clean the controller with a high PSI pressure washer.
- When cleaning batteries, take precautions to keep the battery acid from splashing on the controller.

### CAUTION:

It is the installer's responsibility to ensure the correct equipment (i.e. wire, motor, solenoid, fuse etc) is installed in the vehicle. Equipment should be sized correctly for planned usage. Failure to do so could pose a significant risk of explosion, fire, property damage and serious injury or death.

## READ AND SAVE THESE INSTRUCTIONS

## **Terms and Definitions**

**IPM:** *Internal Permanent Magnet*

**SMPM:** *Surface Mount Permanent Magnet*

**KI:** *Integral Gain for PI/PID controllers*

**KP:** *Proportional Gain for PI/PID controllers*

**KD:** *Derivative Gain for PI/PID controllers*

**Quadrature:** *Most common type of Speed Sensor Signal used in AC Induction motor applications*

**Sine/Cosine:** *Commonly used for speed sensors in IPM and SMPM motor applications.*

**ITS:** *Inductive Throttle System, used in DC EZGOs*

**KSI:** *Key switch input, refers to signal voltage from the KEY*

**Roll Detect:** *Is a feature that uses the speed sensor to determine whether or not the cart is moving with no active throttle.*

## **Special Features**

### **Low Voltage Protection -**

If battery voltage falls below your set Under Voltage limit the controller will shut off the power supply completely to prevent the batteries from getting drained to the point of damaging themselves. If you plug the controller into the toolkit software you will get a large SHUTDOWN warning to notify you of what happened. You can bring power back by cycling the TOW/RUN or plugging your charger back into the cart.

#### ***Trigger Limits -***

*5v under shutdown triggered in 5 minutes*

*10v under shutdown triggered in 1 minute*

### **Encoder Pulses/Revolution Constraint (Quadrature Encoder)**

The maximum encoder frequency the controller will accept is 10 kHz. To determine how fast this constraint will allow the motor to spin, use the equation:

$$\text{Max Speed Encoder Limit} = 600000 / \text{Encoder Size}$$

*(e.g., a motor with 128-pulse encoder can run up to 4587 rpm).*

### **Firmware Max Speed Constraint**

The maximum motor speed the controller will allow is 13,000 rpm.

$$\text{Max Sped RPM Limit} = 13,000$$

# PROGRAMMING THE CONTROLLER

Controllers ordered for stock configuration come pre-programmed and do not need to be programmed before use. If the user would like to customize their performance or has upgraded their motor and needs a matching motor map the controller can be connected to a computer with a USB A to B, commonly referred to as a “printer cable”.



The USB A to B cable is used to connect your motor controller to your personal computer. Using the free Alltrax Toolkit you can customize your performance to match your needs.

The Alltrax Toolkit software can be  
downloaded from:  
<https://alltraxinc.com/alltrax-tool-kit/>  
No purchase necessary

## Software used for programming the AC Controllers.

NOTE: Toolkit software will NOT work on Windows® 8-RT (Tablet version). We are compatible with Win 10 & Win 11

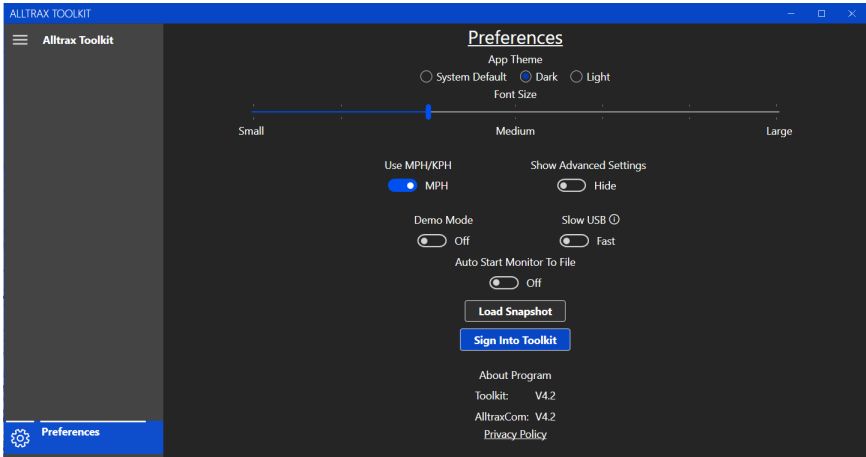
[DOWNLOAD SOFTWARE](#)

## AC Toolkit Software Manual

[AC Toolkit Software Manual](#)

# PROGRAMMING THE CONTROLLER

When opening the Toolkit software the program is looking for a controller, without one connected you will get a mostly blank screen. Unlike previous versions of the software you can now demo a controller if you'd like to play with the software while waiting on your new controller.



Clicking on **Preferences** will now give you some options even before a controller is connected.

**App Theme:** Lets you switch between ‘Default’, ‘Light’ and ‘Dark modes’ to make viewing easier.

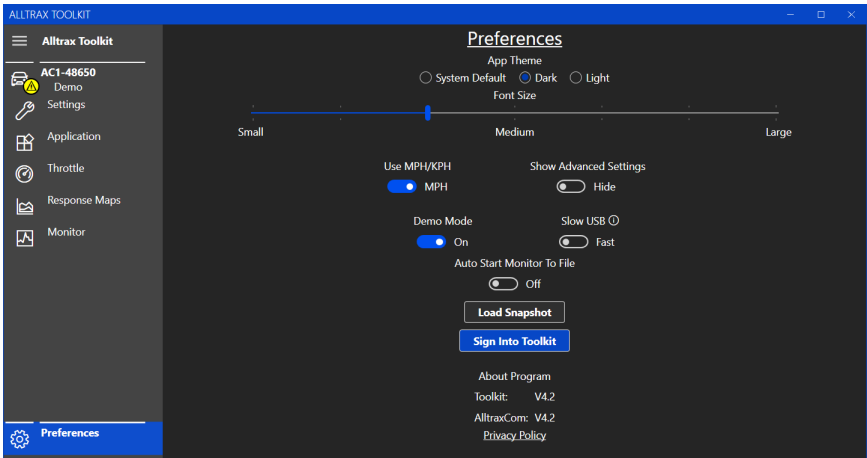
**Font Size:** Allows you to customize the size of font from small to large, default position shown.

**Use KPH/MPH:** The new toolkit can now show MPH in the monitor tab, this option allows you to choose between MPH/KPH for speed displayed in the monitor tab

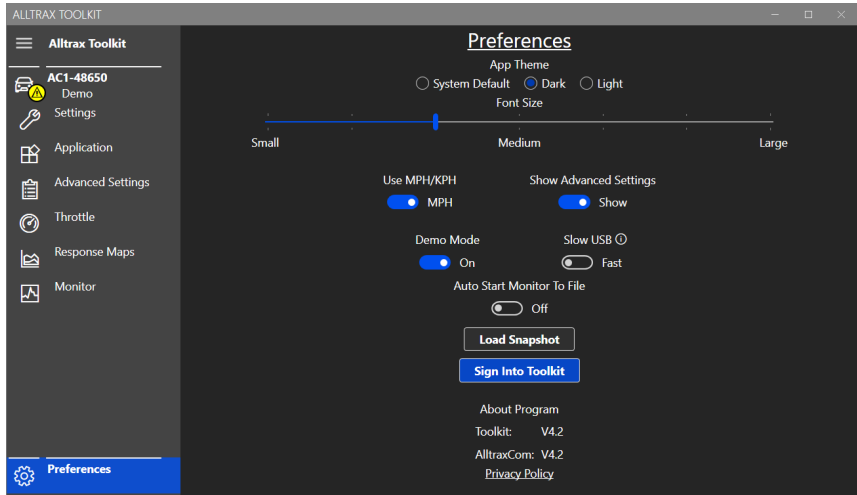
**Slow USB:** Slows the USB signal down, use if you have problems with crashes when changing settings.

# PROGRAMMING THE CONTROLLER

**Demo Mode:** Selecting this makes the toolkit create a fake controller so you can try playing with the settings before getting connected to a controller. These settings will not carry over when you plug into an actual controller and are purely for demonstration purposes

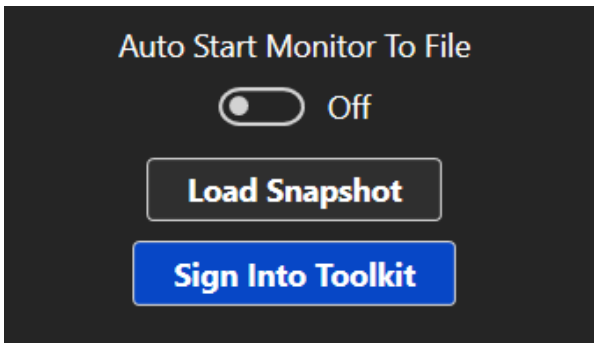


**Show Advanced Settings:** This is for advanced users only and we do not recommend touching it unless the car is on jack stands and you know what you're doing.



# PROGRAMMING THE CONTROLLER

**Sign Into Toolkit:** To save changes to some features in the toolkit program you need to create an account and log in. Once logged in if you try to change any settings that were previously locked you will be prompted with an end user agreement that essentially says you take responsibility for your own actions. Once you agree the new settings will save to the controller and you can freely change anything you like so long as you're logged in. You don't need an internet connection to use the software in general, but to save certain changes you will.

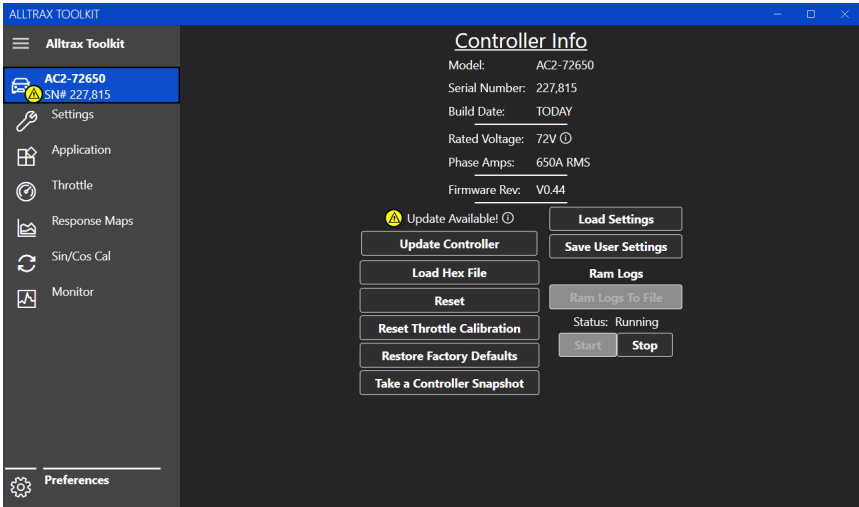


**Load Snapshot:** In the controller info tab you can create a “snapshot” which saves all of your settings to a file and can then be uploaded into the software through this button. It allows us to see exactly how your controller is programmed - do not use this for copying settings to new controllers it's for troubleshooting only.

**AutoStart Monitor to File:** When set to ‘ON’ the computer will immediately begin recording everything it sees as soon as you open it up. The new toolkit takes 12 readings per second, we don't recommend having this option set to on unless you're fully aware of what you're doing.

# PROGRAMMING THE CONTROLLER

## Controller Info



**Controller Info:** Displays information about the controller such as rated voltage, RMS current rating, serial number, build date and which firmware revision it is using.

**Load Hex File:** Use only when directed by an Alltrax rep.

**Reset:** Digitally kills power to the controller restarting it.

**Reset Throttle Calibration:** Restores factory throttle and brake calibration settings.

**Save User Settings:** Backup your settings to an external file.

**Load Settings:** Load previously saved user settings and motor maps.

**Take a Controller Snapshot:** Creates a file that can be sent to Alltrax Tech Support which displays all of your settings.

**Restore Factory Defaults:** Returns all settings to default values.

**Update Controller:** If your toolkit software is newer than your controller it will ask to update your controller. We recommend keeping it up to date.

# PROGRAMMING THE CONTROLLER

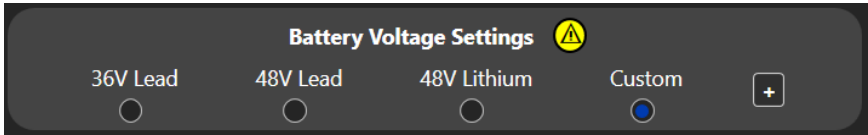
## Settings



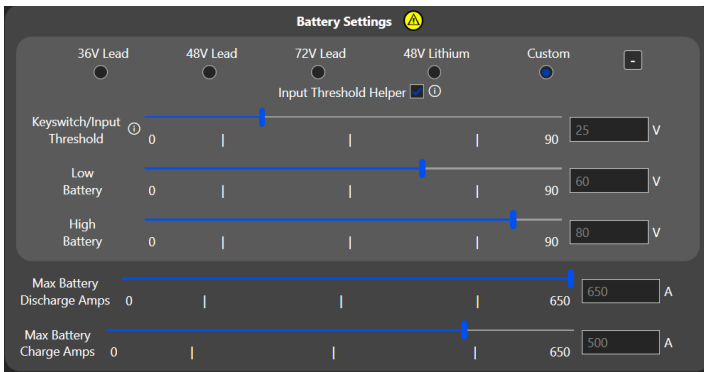
Potential warning symbol. We recommend hovering your cursor over it when seen.



Hovering your mouse over this symbol will give you a description of the setting/option.



General voltage settings for stock applications. Clicking the plus symbol allows you to fully customize these settings.



**Keyswitch/Input Threshold:** Minimum voltage the controller will respond to on low current connections like the key.

**Low Battery:** Minimum voltage the controller will operate for, if running lithiums set this based on your manufacturers specifications.

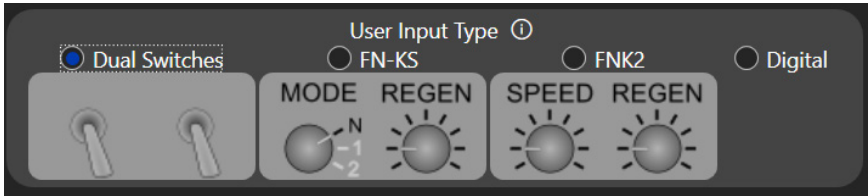
**High Battery:** Max voltage the controller operate for, if running lithiums set to battery manufacturers specifications.

**Max Battery Discharge:** Maximum amperage the controller is allowed to draw from the battery pack. If running lithium set this based on your batteries listed PEAK DISCHARGE.

**Max Battery Charge Amps:** Maximum amperage allowed to be pushed back into the battery for Regen. If running lithium this also needs to be set based on your batteries specifications.

# PROGRAMMING THE CONTROLLER

## Settings



User Input Type allows you to select which Alltrax FN control you're using with the controller. All controllers come with an FN-KS and should be set there as a default. If you're not using a function box run Dual Switch and only program the Normal setting.

While using the function boxes you will have two numbers for:

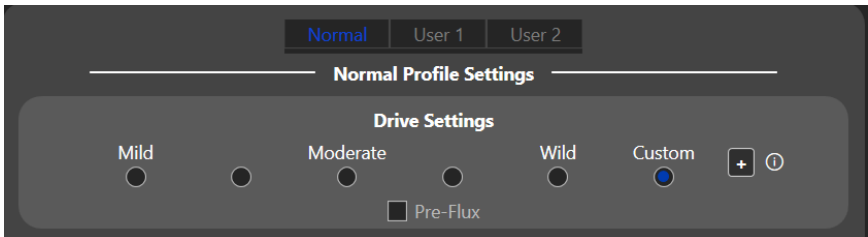
**Forward Speed** - *Maximum forward speed*

**Positive Speed Rate** - *Acceleration rate*

**Regen Phase Amps** - *Motor current used for regen*

The top number is minimum (knob turned all the way left)

The bottom number is maximum (knob all the way right)



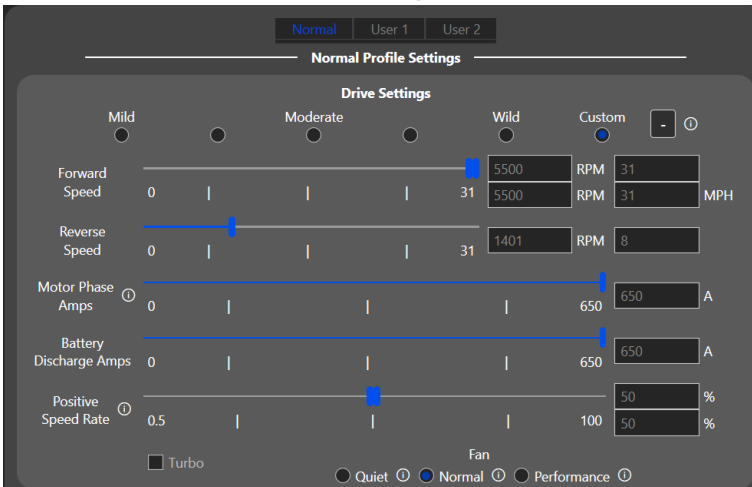
If you're using an FNKS you can set up three performance profiles, otherwise NORMAL is the only profile that will affect you.

**Drive Settings:** Allows you to choose your level of performance using Alltrax's pre defined settings. Custom auto selects when you click the plus sign and start manually fine tuning the advanced sliders.

**Mild - Wild:** Performance presets for people, good starting points then you can fine tune any setting you don't like from there.

# PROGRAMMING THE CONTROLLER

## Settings



**Forward Speed:** Sets the top speed for forward direction, can be set as RPM or if you have your gear ratio and tire size set it can also be adjusted by MPH or KMH.

**Reverse Speed:** Sets the top speed for reverse. With PMAC and 3 phase motors you can achieve identical performance in both directions.

**Motor Phase Amps:** Torque potential of the motor, or how many amps the controller will allow it to produce in response to the systems load.

**Battery Discharge Amps:** Max current draw from the battery, this will be limited by your battery settings at the top of the page so you can't accidentally set it too high.

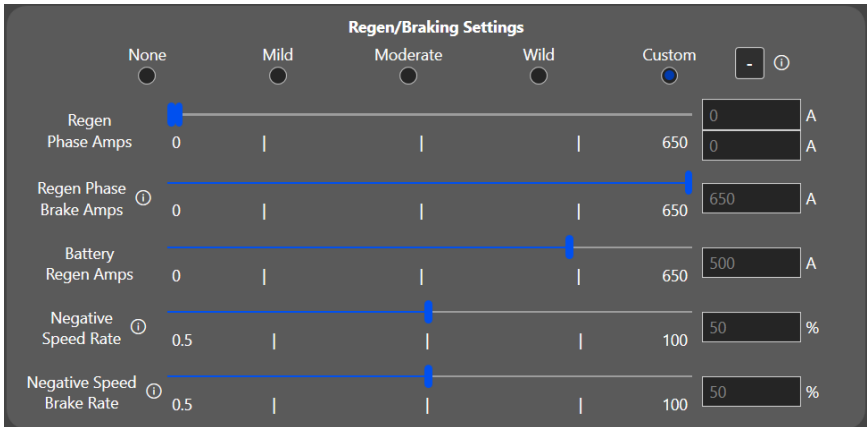
**Positive Speed Rate:** Felt acceleration rate, it won't affect top speed just how quickly you get there. Turning this up too high can make the throttle very, very responsive.

**Turbo:** Tries to exchange torque for RPM at higher speeds. Will increase top speed on flat ground.

**Fan:** Allows you to choose how the fan operates. Quiet has a delayed response so it only comes on when needed. Normal comes on anytime the temperature hits a certain point and ramps up with temperature. Performance is full on all the time.

# PROGRAMMING THE CONTROLLER

## Settings



Regen Braking Settings allow you to pick from pre defined braking ratios. You can customize them to fit your personal preference by clicking on the plus sign and adjusting the sliders.

**Regen Phase Amps:** Braking current used to slow the motor.

**Regen Phase Brake Amps:** If the vehicle is equipped with a brake sensor, the controller will apply extra braking force in relation to the brake pedal signal.

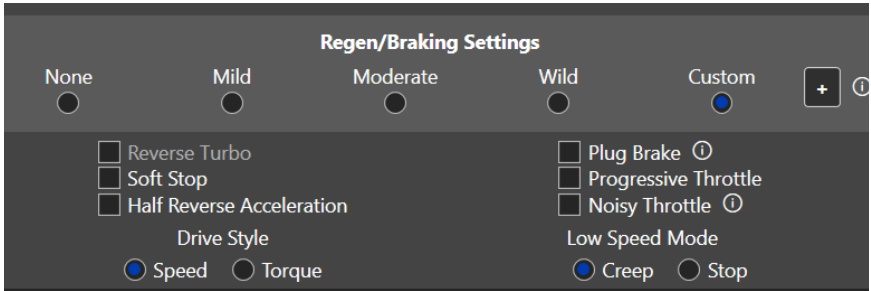
**Battery Regen Amps:** Current being pushed back into the battery when regen braking occurs. Will be limited based on your battery settings at the top of the toolkit. If you're running lithium this needs to stay within the batteries specifications.

**Negative Speed Rate:** How quickly the cart slows down from regen braking. The higher the number the faster it will slow to a stop.

**Negative Speed Brake Rate:** How quickly the controller will stop you based on the brake pedal, when using a brake sensor.

# PROGRAMMING THE CONTROLLER

## Settings



**Reverse Turbo:** Allows turbo to activate in reverse

**Soft Stop:** When regen braking, it prevents a sudden hard jerk as you come to a complete stop.

**Progressive Throttle:** Can help smooth out rough throttles and tone down initial take off speed.

**Half reverse Acceleration:** Lower acceleration speeds in reverse only

**Plug Brake:** Extra braking force when changing directions while driving.

**Noisy Throttle:** Can smooth out jumpy/jittery throttle signals.

**Drive Style:** Determines how throttle is applied.

*Speed:* Speed is directly related to pedal press

*Torque:* Pedal press determines applied torque, speed is determined by user settings. So 50% pedal is 50% applied torque rather than 50% applied speed.

**Low Speed Mode:** Determines how zero throttle is handled.

*Creep:* Allows the cart to creep to halt when at 0 throttle

*Stop:* Keeps the cart locked in place when at 0 throttle.  
Requires motor brake to function.

# PROGRAMMING THE CONTROLLER

## Application

The screenshot shows a dark grey interface with two sections. The top section is titled 'Enabled Features' with a yellow warning triangle icon. It contains two columns of checkboxes. The first column has: Brake Resistor (unchecked), PreCharge (checked), Charger Interlock (unchecked), Fan (checked), Horn (unchecked), Footswitch Input (checked), Brakeswitch Input (unchecked), Tow Run Input (unchecked), Forward Input (checked), Reverse Input (checked), User 1 Input (checked), and User 2 Input (checked). The second column has: Stall Detect (checked), Roll Detect (checked), Stock Replacement (unchecked), Input Bias (unchecked), Motor Brake (unchecked), Motor Temperature Sensor (checked), Reverse Speed Sensor (unchecked), and Swap Phase Wiring (checked). The bottom section is titled 'Speed Conversion' with a yellow warning triangle icon. It has two rows: 'Gear Down Ratio: 12 :1' and 'Tire Diameter: 22 Inches' with a small circle icon next to it.

**Brake Resistor:** Currently only used with EZGO RXVs

**Pre Charge:** Determines if the controller is looking for Pre Charge

**Charge Interlock:** Can look for an interlock signal from charger

**Fan:** Turn the fans off/on

**Horn:** Some AC cars won't work with a disconnected horn, this disables it through the controller.

**Footswitch Input:** Enable/Disable footswitch signal

**Brakeswitch Input:** Enable/Disable required brakeswitch signal

**Tow/Run Input:** Whether or not you have a Tow/Run switch

**Forward Input:** Default forward if you have no 'Forward' pin

**Reverse Input:** Allows controller to respond to reverse input

# PROGRAMMING THE CONTROLLER

## Application

**User 1 Input:** Controller will respond to voltage input from User 1 connection of the harness

**User 2 Input:** Controller will respond to voltage input from User 2 connection of the harness

**Stall Detect:** Can be disabled for testing purposes

**Roll Detect:** Enable/Disable Roll Detect

**Input Bias:** Determines Hi/Lo ground bias

**Motor Brake:** Used in applications with a motor brake (RXV, ICON)

**Motor Temp Sensor:** Checked when using a temp sensor

**Reverse Speed Sensor:** Reverse the direction the motor thinks it is spinning as it can be installed in either orientation.

*\*\*\*Never do this unless the Key is OFF and the vehicle is NOT moving\*\*\**

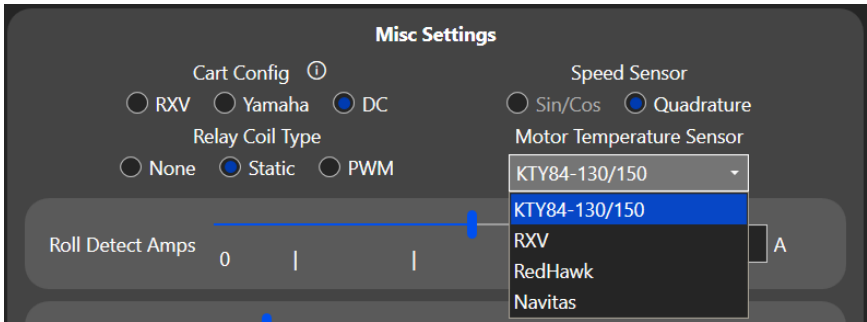
**Swap Phase Wiring:** Allows controller to swap phase wiring internally.

*\*\*\*Never do this unless the Key is OFF and the vehicle is NOT moving\*\*\**

**Speed Conversion:** Uses tire height and gear ratio to determine MPH

# PROGRAMMING THE CONTROLLER

## Application

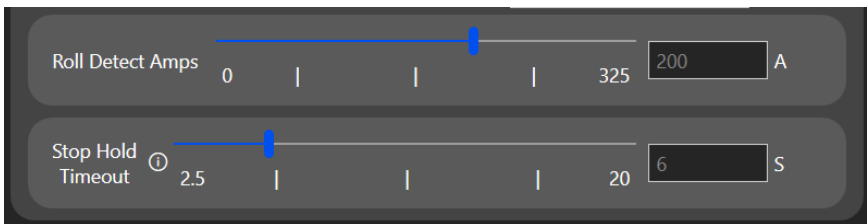


**Cart Config:** Defines the controller's response changes and start up sequence. Not all carts are the same and this setting should match your application.

**Relay Coil Type:** Tells the controller what style of Relay/Main Contactor you're using or if you're using one at all. A relay is required for most applications.

**Speed Sensor:** Selects between Sine/CoSine and Quadrature speed sensor types. PMAC motors make use of Sine/CoSine, 3 phase use quadrature.

**Motor Temperature Sensor:** Tells the controller which style of speed sensor you are using.



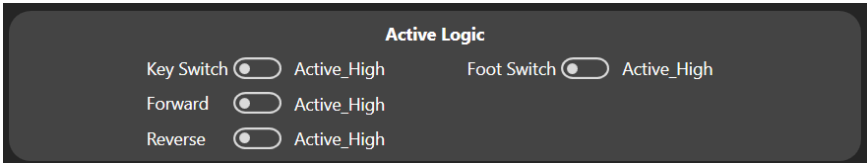
**Roll Detect Amps:** The amperage used to stop the cart when the controller senses wheel speed with no pedal activated.

**Stop Hold Timeout:** The way this affects you depends on if you have a motor brake and if you have regen set for 'stop mode'. It is the amount of time roll detect will hold you stopped before engaging the motor brake or allowing you to creep forward again.

# PROGRAMMING THE CONTROLLER

## Misc Settings

### Active Logic



### Active Logic

refers to the controllers ability to respond to either Hi or Lo voltage signal inputs from the cart.

**Key Switch:** Determines if the controller responds to positive (Hi) or ground (Lo) control voltage from the Key.

**Forward:** Determines if the controller responds to positive (Hi) or ground (Lo) control voltage from the Forward Reverse switch - forward side.

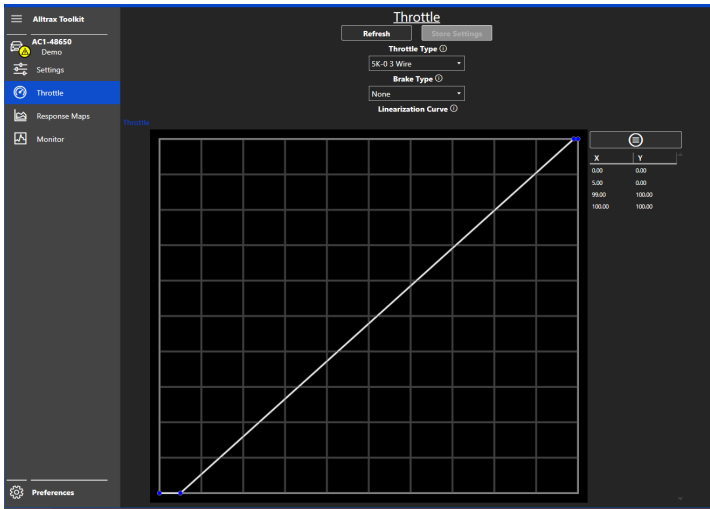
**Reverse:** Determines if the controller responds to positive (Hi) or ground (Lo) control voltage from the Forward Reverse switch - reverse side.

**Foot Switch:** Determines if the controller responds to positive (Hi) or ground (Lo) control voltage from the “foot switch” in your throttle.

**Tow/Run:** Determines if the controller responds to a positive (Hi) or ground (Lo) control voltage from the Tow/Run switch on your system.

# PROGRAMMING THE CONTROLLER

## Throttle Settings



**Store Settings:** Allows you to save any changes you made to the throttle curve graph. Can be loaded again later or into separate controllers.

**Throttle Type:** Drop down menu which allows you to select from various stock and aftermarket throttle types.

**USB Throttle:** This allows you to control the system using your computer as a throttle rather than the one in the car. Good for testing purposes

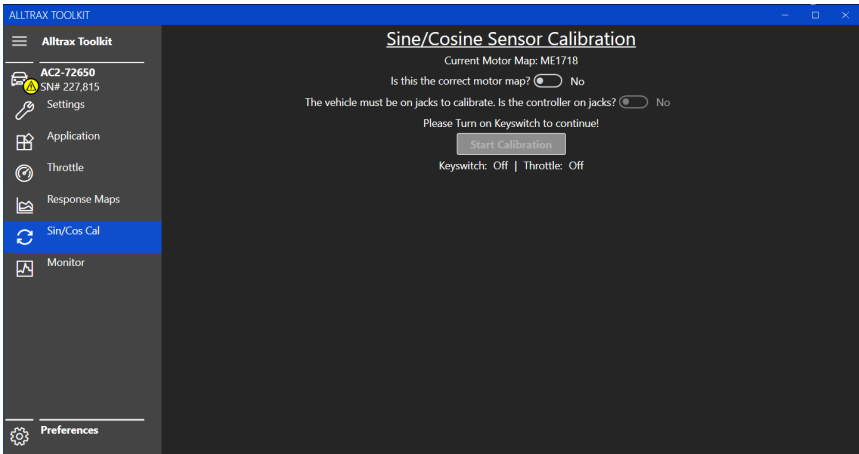
**Absolute Throttle:** Used for custom throttle applications.

**Brake Type:** Allows you to select from all the available brake styles, mainly used for the RXV and custom applications with an electric motor brake.

**Throttle Graph:** You can use this graph to linearize your throttle input. To add a point to the graph simply double click on any spot of the curve, you can then move the points around and reshape the curve to your needs. The X/Y axis can be displayed on the right or hidden from view.

# PROGRAMMING THE CONTROLLER

## SINE COSINE CALIBRATION



This setting is specific to the AC2 controllers running PMAC motors. With a PMAC motor you need to make sure the mechanical position matches the electrical position so we calibrate that using this tab of the software.

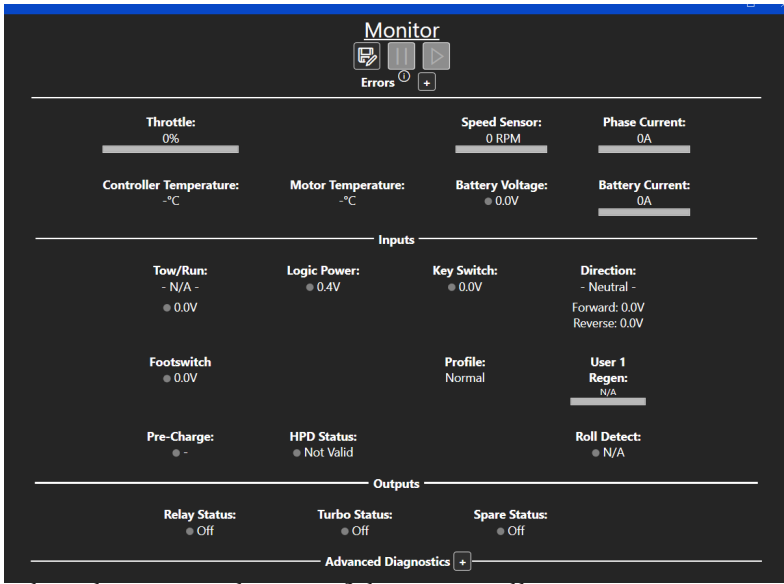
Your current motor mapping will be listed at the top, if it's different than your motor contact Alltrax to get the correct mapping.

Make sure the vehicle is in the air, the motor is installed and then follow the directions on the screen to begin calibrating the system.

The same motor map can be used on multiple applications but anytime you install the PMAC motor onto the vehicle you will want to run this calibration to make sure everything is matched up correctly.

# PROGRAMMING THE CONTROLLER

## Monitor Functions



The three buttons at the top of the screen allow you to save your monitor log to a file, Pause recording and Start recording.

**Errors:** Error flags will only appear when the problem occurs now. If you'd like to see them all the time you can click the plus sign beside ERRORS to reveal them.

Displayed below errors and above inputs is your voltage/amperage information for the high current circuit as well as RPM, MPH and temperature.

**Inputs:** For the inputs section the new toolkit software can not only tell you if something is on or off but tell you the actual voltage being used.

**Outputs:** Displays relay status and whether or not turbo is active

# BLINK CODES

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On power up, the controller will blink out a throttle code and then a Status or Error Code (see below)

## Throttle Type Codes:

1 Green LED Flash	=	2-wire 0-5k throttle
2 Green LED Flash	=	2-wire 5K-0 throttle
3 Green LED Flash	=	0-5V throttle
4 Green LED Flash	=	EZGO ITS throttle
5 Green LED Flash	=	3-wire 0-5k
6 Green LED Flash	=	6 to 10.5 Taylor Dunn throttle
7 Green LED Flash	=	MCOR
8 Green LED Flash	=	Reserved
9 Green LED Flash	=	Pump
10 Green LED Flash	=	USB Throttle
11 Green LED Flash	=	Absolute Throttle
12 Green LED Flash	=	PWM_Throttle

## Brake Type Codes:

1 Green LED Flash	=	2-wire 0-5k throttle
2 Green LED Flash	=	2-wire 5K-0 throttle
3 Green LED Flash	=	0-5V throttle
4 Green LED Flash	=	Reserved
5 Green LED Flash	=	3-wire 0-5k
6 Green LED Flash	=	6 to 10.5 Taylor Dunn throttle
7 Green LED Flash	=	MCOR
8 Green LED Flash	=	Reserved
9 Green LED Flash	=	Reserved
10 Green LED Flash	=	USB Throttle
11 Green LED Flash	=	Absolute Throttle

# BLINK CODES

## Normal Display Status:

Solid Green Light	=	Controller Ready to Run
Solid Red Light	=	Controller in programming mode
Solid Yellow Light	=	Throttle is wide open and the controller is <u>NOT</u> in Current Limit
Blinking Yellow Light	=	Throttle is wide open, but the controller is in Current Limit

## Error Codes:

AC alarm codes flash a sequence of green then red. All alarms are self clearing and will repeat until the error condition has been corrected.

1 Green and 1 Red LED Flash	=	Short Circuit/Output Fault
1 Green and 2 Red LED Flash	=	Battery Under Voltage
1 Green and 3 Red LED Flash	=	Battery Over Voltage
1 Green and 4 Red LED Flash	=	Over temperature
1 Green and 5 Red LED Flash	=	Throttle Power Fault
1 Green and 6 Red LED Flash	=	Pre-Charge Failure
2 Green and 1 Red LED Flash	=	Throttle/Brake Range
2 Green and 2 Red LED Flash	=	Motor Temperature
2 Green and 3 Red LED Flash	=	High Throttle Over range
2 Green and 4 Red LED Flash	=	High Throttle Under range
2 Green and 5 Red LED Flash	=	Low Throttle Over range
2 Green and 6 Red LED Flash	=	Low Throttle Under range
3 Green and 1 Red LED Flash	=	Throttle/Brake Range
3 Green and 2 Red LED Flash	=	Bad Variable Set Loaded
3 Green and 3 Red LED Flash	=	Relay Coil Overcurrent
3 Green and 4 Red LED Flash	=	Brake Coil Overcurrent
3 Green and 5 Red LED Flash	=	Reserved Overcurrent*
3 Green and 6 Red LED Flash	=	Horn Overcurrent
4 Green and 1 Red LED Flash	=	Reserved
4 Green and 2 Red LED Flash	=	Reserved
4 Green and 3 Red LED Flash	=	Hardware Failure
4 Green and 4 Red LED Flash	=	Startup Failure
4 Green and 5 Red LED Flash	=	Reserved
4 Green and 6 Red LED Flash	=	Reserved
5 Green and 1 Red LED Flash	=	General Error

# CODE DEFINITIONS

## Error Code Definitions:

- Short Circuit/Output Fault:  
Controller detected a short circuit or other fault on the output circuit. Check wiring.
- Battery Under Voltage:  
B+ Voltage lower than Low Voltage Battery Setting. Check pack voltage or program settings.
- Battery Over Voltage:  
B+ Voltage Higher than Over Voltage Battery Setting. Check pack voltage or program settings
- Over temperature:  
Busbar temperature exceeds 90°C. Let controller cool and/or add fan.
- Throttle power Fault:  
This is a 5V fault, if the speed sensor gets damaged this alarm will be one of the alarms triggered. Can also be caused by a fault in voltage based throttles
- Pre-charge Failure:  
B+ voltage and KSI voltage differ by more than 5v. Stuck solenoid.
- Under Temp:  
Busbar Temperature reads less than -20°C
- High Throttle Over range & High Throttle Under range:  
High Side of throttle signal is outside of acceptable window for that throttle type. Check and/or replace throttle. Change throttle type to correct throttle installed on car.
- Low Throttle Over range & Low Throttle Under range:  
Low Side of throttle signal is outside of acceptable window for that throttle type. Check and/or replace throttle. Change throttle type to correct throttle installed on car.
- Bad Variable Set Loaded:  
Alltrax loaded variable data is missing or corrupted. Contact Alltrax
- Throttle/Brake Range:  
The RXV has a “throttle” built into the brake pedal to communicate with the motor brake. This alarm indicates an error in that signal.

# CODE DEFINITIONS

## **Error Code Definitions:**

- Relay coil overcurrent:  
Relay coil has shorted, the wires were attached incorrectly or the suppression control diode is backwards.
- Brake coil overcurrent:  
Short in the brake pedals resistor coil. Presently this can only trigger on EZGO RXV applications
- Horn Overcurrent:  
There is a short in the horn circuit, could be wiring or horn related

# WARRANTY STATEMENT

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Alltrax, Inc., (hereafter Alltrax) warrants that the product purchased is free from defects in materials or workmanship for a period of 2 years from the date of manufacture. This warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence, accidents, repairs, improper installation, submersion, alterations or use contrary to any instructions provided by Alltrax in verbal or written form.

In the event you should need warranty repair, contact Alltrax at (541) 476-3565 to receive warranty service authorization instructions for returning the defective product to Alltrax for evaluation. Products or parts shipped by customer to Alltrax must be sent postage paid and packaged appropriately for safe shipment. Alltrax is not responsible for customer products received without warranty service authorization and may be rejected.

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***“Thank you Nikola Tesla, for a better motor”***