9. Driver IC

Check the voltage on pin 1. The voltage should be high (~5V) at low speed. As speed increases, this should decrease. An oscilloscope, will show the PWM. If problems check circuit around Q1.

Check the voltages around the FET driver. The replacement trimpot resistors should ensure its correct.

The voltage on pin 2 (the shut-down) should be high (~5V). If pin 2 voltage is wrong, suspect the circuit around the Comparator.

If all this checks out, the voltage on the motor terminal that is surrounded by the current sensor should have PWM on it when the accelerator is increased. With Zero throttle, it should be 24V and at full speed it should decrease to near zero. If it does not go to zero, ensure 5V on the output of the Picaxe (it should be in full conduction at full speed).

10. Final steps

If all this checks out, link the 100 Ohm resistor in series with the battery and connect a 12V or 24V toy motor to the motor terminals. The throttle should alter the speed from zero to fast. If you don't have a motor, try a 24V bulb or two 12V bulbs (of equal wattage) in series .

Regenerative braking

Decreasing the throttle very quickly should brake the motor quickly. If it doesn't, suspect the charge pump circuit (D3, C9). The top-side FET needs to turn on. (This FET only turns on when the motor is running. In neutral it is off). FETs should stay cold.

Real motor

Now it is time to try it on the real motor under no load. Attach the FETs to the heat-sinks with the screws and nuts. Solder the heatsink and FET pins in place. Connect the motor. The speed should alter smoothly from zero to full. The motor should brake when the throttle is released quickly.

If all tests are past, the system is ready to put on the bike or cart. Ensure smooth speed control. Check that releasing the throttle creates braking. (if you don't have a free-wheel).

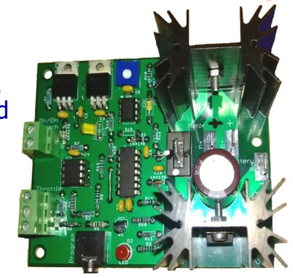
Parts:

Part	*Description*	*#*	*Received*
ICs	IR21844 (Half-bridge FET driver)	1	
	LM393 (Comparator)	1	
	LM7805 (5V regulator)	1	
	LM7815 (15V regulator)	1	
	RAZU-2 (Current sensor)	1	
Transistors	IRF3205 (Power FET)	2	
	BC547 (NPN transistor)	1	
Diodes	1N4148 (signal diode)	3	
	33V (Zener)	1	
	LED	1	
Capacitors	1200uF 35V (electro capacitor)	1	
	0.047UF (mono capacitor)	9	
	2n2 (ceramic capacitor)	1	
PCB		1	
Trimpot	*(Replaced with resistors below)* 560 Green,Blue,Black,Black 3k3 Orange,Orange,Black, Brown	1 1	

Part	*Descriptor*	*#*	*Received*
Resistors	22k (Red Red Black Red	2	
	10k (Brown Black Black Red)	8	
	2k2 (Red Red Black Brown)	2	
	1k (Brown Black Black Brown)	4	
	100 (Brown Black Black Black)	1	
	10 (Brown Black Black Gold)	2	
Heatsinks		2	
Picaxe	08M2	1	
	8 Pin DIL socket	1	
Connectors	3 pole screw terminal block	1	
	2 pole screw terminal block	1	
	6.3mm QC terminal Tabs	4	
	Connector for programming cable	1	

EVOLOCITY

Dynamic Motor Controller *(2017)*



This is a good controller capable of optimising the performance of your motor. The Picaxe IC takes the signal from the throttle position, sends a signal to FETs to turn on and off at a particular frequency which dictates the output power and therefore speed of the motor.

All parts for the kitset are listed on the back page of this booklet. Please check that you have all the listed components.

Assembly:

The underlined parts MUST go around the correct way

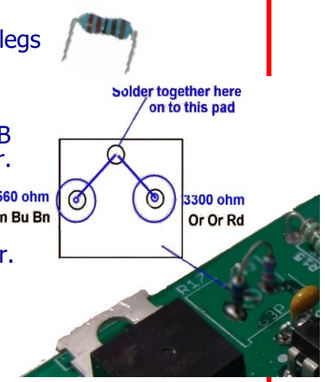
- **Resistors:** These can be mounted **either way around.**
  Ensure correct value is in each position as shown on the PCB.
  The resistor sizes and colour codes are:

#	*Size*	*Colour code*	*#*	*Size*	*Colour code*	*#*	*Size*	*Colour code*
R_1	100	Brown, Black, Black Black	R_8	1k	Brown, Black, Black Brown	R_{15}	1k	Brown, Black, Black Brown
R_2	1k	Brown, Black, Black Brown	R_9	2k2	Red, Red, Black, Brown	R_{16}	10k	Brown, Black, Black Red
R_3	10k	Brown, Black, Black Red	R_{10}	2k2	Red, Red, Black Brown	R_{17}	10k	Trimpot replaced (SEE BELOW)
R_4	22k	Red, Red, Brown Red	R_{11}	10k	Brown, Black Black Red	R_{18}	Nil	Not needed
R_5	10k	Brown, Black, Black Red	R_{12}	22k	Red, Red, Black, Red	R_{19}	10K	Brown, Black, Black Red
R_6	1k	Replace with a link wire if using a standard throttle.	R_{13}	10	Brown, Black, Black, Gold	R_{20}	10K	Brown, Black, Black Red
R_7	10K	Brown, Black, Black, Red	R_{14}	10	Brown, Black, Black, Gold	R_{17}	560 3k3	Green, Blue, Black, Black Orange, Orange, Black, Brown
Note: In all colour codes the last (separated) band is the 'Tolerance or quality' band								

Identify each resistor by its colour code. Bend it as shown. Push its legs through the paper in the above table against the correct label.
Ensure you have ALL resistors and each one is correctly identified.

When you have them all bent and identified insert them into the PCB
In the correct places and as close to the PCB as possible then solder.

Find R17 on the PCB.
In the past atrimpot was used here. We have replaced it with two resistors to give best protection for the motor without limiting power.
Inset the two legs of the 560 Ohm resistor as shown
Twist one leg of the 3k3 resistor around the top leg of the 560 resistor and the other through the remaining hole. Solder all into place including the twisted joint.

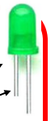


- **Diodes** These **MUST** go the correct way around with the bands at the end shown on the PCB.

  D1,D3,D5 are all the same type 1N4148,
  D4 is a 33Volt Zener diode and looks different.

*Note: the **black band** at the end of each diode MUST match the way they are shown on the PCB.*

- **LED** - insert with the flat on the ridge around the base matching the diagram on the PCB.



- **Capacitors** Mount the big capacitor with the negative strip matching the negative side of the PCB symbol.

Mount the other capacitors **either way around.**

- **ICs** These are the black devices with lots of legs. The notch on the chip MUST match the notch marked on the PCB. Mount all ICs in this way.
Note: The Picaxe is mounted in a socket. Solder this into PCB and gently push Picaxe into it.

- **Transistor** Mount the 3 legged transistor BC547 with the flat face in the same orientation as on the PCB.

- **Terminals (battery & motor)** Push them into the board and solder in place. Use the long terminal through the current sensor M-

- **Voltage Regulators LM7815 and LM 7805** insert in the appropriate holes and lie them back with the metal tag against the PCB. Solder into place.

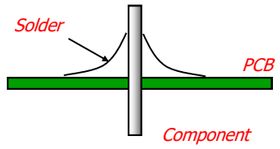
- **Current sensor** Around the M– terminal there is a current sensor with three legs. Remove the paper backing, insert the middle leg to the middle hole, top to hole nearest R16 and bottom nearest C10. Push idown into the rectangle and stick it to the board. Solder.

- **Screw terminals and stereo socket** can now be soldered into place.

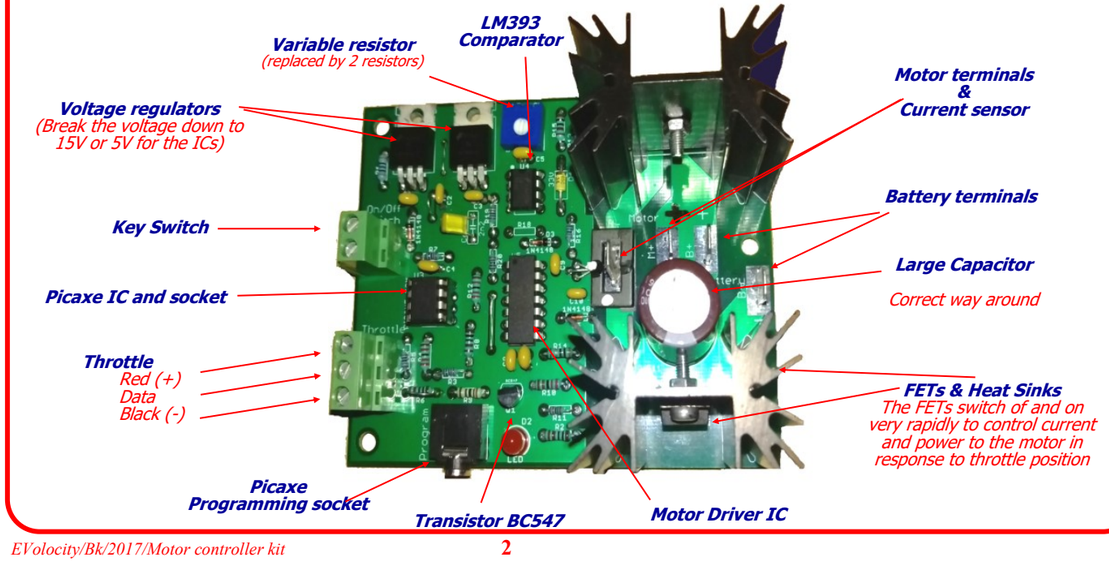
- **Motor FETs (IRF3205)** **Mount after the testing—see next page.**
Screw the FETs to each of the heat sinks ensuring the metal surfaces are firmly in contact. (thermal conducting paste may be used between the metal surfaces).
Insert the heatsinks and attached FETs into the PCB and solder into place.

Check your soldering joints are well formed and look like mini "volcanoes"

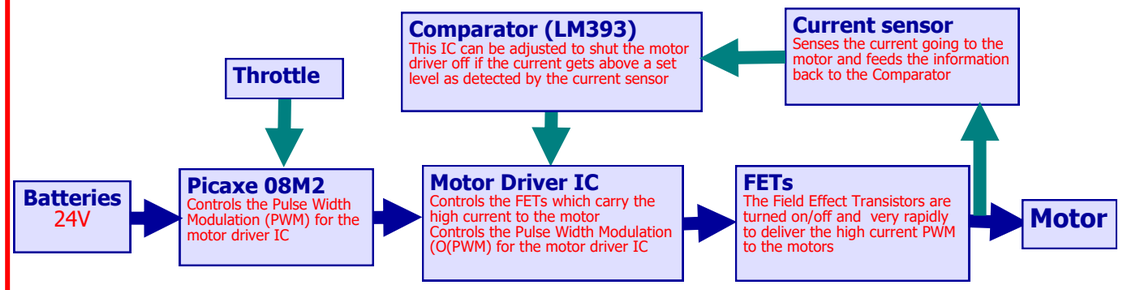
Check your soldering hasn't flowed between joints to 'bridge' them.



Completed PCB - *should look like this:*



Overview of Operation:



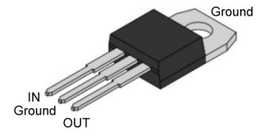
Testing:

The following allows the controller to be set up for best operation. If you have a fully adjustable power supply, it is better to do the first tests with the voltage set to 24V and the current set to approx 0.2 amps.
If you don't have a suitable power supply **use two 12V batteries in series with a ~100 ohm resistor at the positive terminal**.

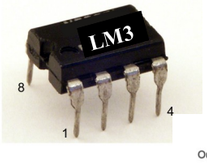
1. Connect the supply/battery to the B+ and B- terminals in the correct polarity.
Don't connect anything else. If the resistor smokes, something is wrong with the power section. Both FETs may be turned on. Use a 1000 ohm resistor and check the gate voltage. It should be zero on both FETs. If all is well, there should be very little voltage drop across the 100/1000 ohm resistor. Fit the 100 ohm resistor again.

2. Link the B+ switch terminals. If the 100 ohm resistor smokes, check for short circuits. Voltage across the 100 ohm resistor should be < 2V

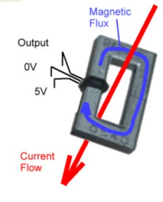
3. Regulator pin-out
The input of the 15V regulator (U1) should be about 21V.
The Ground (tab) should be 0V. The output 15V
The input of the 5V regulator should be 15V, ground 0V, output 5V.
Fix any errors in these voltage before proceeding.



4. ICs:
Check that the supply is getting to each IC.
Pin 8 of the **LM2393** Comparator should be 15V, and Pin 4 at 0V.
Pin 1 of the **Picaxe** should be 5V, Pin 8 at 0V.
Pin 7 of the **Driver IC** should be 15V, Pins 3, 5 should be 0V.

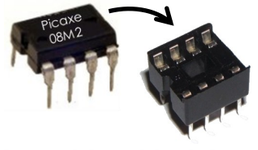


5. Current sensor:
Check the 5V & 0V on the current sensor around the motor output terminal.



6. Throttle
The throttle supply should = 5V. Ground (without the throttle connected) = 0V.

Put right any voltages before proceeding.



7. Picaxe
Fit the Picaxe to its socket the correct way around. The notch must match the shape on the PCB. It may be programmed beforehand or in the board.

8. Throttle
Fit the twist-grip accelerator to the 3 green screw terminals making sure **red is positive, black is negative** (or ground) as marked on the PCB.
Twisting the throttle should make the input (centre) terminal go from a low voltage up to 5V.
Use a voltmeter to check the voltage on Pin 5 (programming Pin 2) the output pin of the Picaxe.
A low throttle setting should show a low voltage and go higher as the throttle is increased.
If you have an oscilloscope, you will be able to observe the change in PWM.