1/8 Brushless: A beginner's guide.

There are a series of parts that you'll need to convert a 1/8 scale truggy or buggy from Nitro to Electric. I'm writing this to help you choose those parts, and help you make an informed decision. Be aware that it is quite difficult to go brushless without getting some stuff in from abroad, so be ready for that.

The LIST: (make sure you've ticked off everything from here, or your conversion won't be going anywhere fast)

- Motor mount
- Battery tray/box/mount
- LiPo battery
- Brushless motor
- Brushless ESC
- Pinion
- Connectors
- Accessories that may be useful

I'll cover these one step at a time, with options and links.

The Physical Conversion Bits:

There are a few ways of doing the modifications required to make your chassis ready for brushless power. The first, and most simple way, is to get a 'conversion kit.' The likes of RC-Monster and Tekno-RC make 'bolt-on' conversion kits for models such as the RC8 and RC8T, the Hot Bodies D8, the Losi 8ight and T (in both V1 and V2 versions), the Hong Nor X2-CRT and the Mugen MBX5T and MBX6. RC-Monster will soon bring out a conversion for the '09 spec XT8 as well.

These conversion kits include a new chassis, motor mount, battery tray, servo mounts, and, in the case of the Tekno-RC kits, an Electri-Clutch and mechanical braking kit for those who don't like the 'feel' of ESC brakes or prefer a clutch, for some reason unknown to me. Note the Tekno kits require you to buy a pinion or clutch bell and clutch separately, though the flywheel is included. The RC-Monster kits aren't compatible with a clutch, though mechanical brakes can be used, if you want to make up some custom mounts for the brake servo, they do include a pinion though.

RC-Monster also make a 'Slipperential'. This little device replaces the standard centre differential with a slipper clutch and a differential in one. This helps prevent shocks from being passed from the drivetrain (which has no give in it) to the motor – which can cause rotor failure.

If your car wasn't included in the above list then RC-Monster can cater for your needs. They make motor mounts for almost all the popular 1/8 buggies and truggies. These include:

- Xray XB808
- Xray XT8/XB8
- Mugen MBX5/T and MBX6/T
- Kyosho MP9
- Kyosho MP7.5/777
- Hobao Hyper 7/8
- Hong Nor X1-CRT
- Hong Nor X1-CR, X2-CR, X2-CRT
- Losi 8B/T V1 and V2
- Associated RC8/T

- O'Donnell Z01B
- Hot Bodies Lightning Stadium
- Hot Bodies D8
- Thunder Tiger ST-1
- LRP SX8-BX

They also make a battery box, and you can specify its dimensions to fit a battery of your choice perfectly. You will probably need to drill a couple of holes on top of the stock chassis holes to secure the battery box. Note you will need to countersink those holes to do it properly. At least 4 M4 screws would be needed to attach the battery box securely.

I'll cover pinions later on, as this is one of the more complex parts of choosing components.

Electronics

First: Choose your battery.

There are many excellent batteries available on the market today. Anything from a budget Zippy, to the most expensive Flightpower, you'll find them being used in a conversion. The goal here is to devote the largest proportion of your budget (something like 1/3 to ½ of your overall budget to batteries). Rather than list all the different LiPo manufacturers, I'll list a few who are good, and a few to avoid:

GOOD

- Hyperion, excellent quality cells at a very reasonable price; they have a wide range of capacities and voltages to choose from. A stand out feature is the ability to charge at up to 5C (basically, take the capacity of the Lipo in mAh, divide it by 1000, and you have 1C, this is what the old generation Lipos could be charged at safely, so they take an hour to charge from fully-discharged. With 5C charge times are as low as 12 minutes from fully-flat). They are available in the UK in limited numbers from Robot Birds, but expect to pay a bit more than you would from abroad.
- Flightpower, again excellent quality cells, but they are more expensive than the Hyperions, for in essence, the same properties. Available in the UK, which is a bonus for some. 5C charging.
- Zippy/Turnigy, the real budget brand. For the money, they have reasonable quality, and a wide range of capacities and voltages. They are available with many discharge ratings, and I advise to stick with the 25C and 30C ranges, as they may be a little economical with those numbers. Abroad only, if you want to make use of the budget factor.
- Thunderpower, one of the 'old greats' along with Flightpower. They are now producing 40C hard case packs up to 4S and from 3200mAh to 5000mAh. They have also released a more traditional soft-case range, with a continuous discharge of 45C and 6C charge rates. They are more expensive than Hyperion, though less so than Flightpower. Their ratings are accurate.
- Polyquest/PolyRC, again, like Flightpower, Thunderpower and Hyperion, this company have been around a long time. They are the only manufacturer that still uses Enerland cells, which are meant to be the best cells out there (though I think the new generation Hyperions and Thunderpowers give them a good run for their money). They have recently released a new 43C range of Lipos, and their ratings will be spot on. They are priced a little above Flightpower.

BAD

- Maxamps, I know these are always being advertised in the magazines as fantastic batteries, and the reviewers always back this up, but then again, they are being supplied with free LiPos, and advertising is how the magazines make their money, so take these 'opinions' with a massive pinch of salt. Maxamps have improved over the last few years, but are overpriced for their properties, and in many cases have badly overstated capacity and discharge ratings. Their cell matching is also known to be shoddy. One example of a Maxamps pack that shows this is when someone bought a Maxamps pack, charged it up and gave it a run. During this run, one of the cells puffed, even though the pack wasn't being overstressed. He took the heatshrink off the pack and inspected the cells (as they have the original manufacturer's ratings on them). The battery was sold as a 4S 4500mAh 25C pack. 2 cells were indeed of this rating, one cell was a 4200mAh 25C cell, and the other was a 4500mAh cell of a 15C rating – which was the cell that puffed.
- Losi, plus point: they're hard-cased. Unfortunately, the minus points list is far longer. The packs have no 'C' rating, but appear of poor quality (puffing is common), and the cells don't appear to be properly padded out inside the case. They are also expensive for what you get, so I wouldn't bother.
- Anyone who tries to sell a Zippy pack (on eBay or similar) for over 100% profit. You'll soon spot them when someone is selling packs that have identical specifications and heatshrink as the Zippy/Turnigy packs, but for a largely increased price, from either the US or the UK. They are most likely Zippy packs. Buy direct from HobbyKing and buy two for the same price.
- Any pack where the brand/manufacturer is not stated, or where the brand or manufacturer is not a reputable one in your eyes. Yeah Racing is one of these 'brands to avoid'. There's probably nothing wrong with their packs in a 1/10 buggy, but add the extra stress and amp draw of a 1/8 and they will puff under the pressure. Basically, go for a premium LiPo, and you'll never look back.

Decide what voltage you'll run, as it will determine the ESC required, what motor you'll use, and the overall gearing.

With voltage, a higher voltage is generally more efficient, when combined with a low kV motor, than an equivalent speed lower voltage higher kV motor. However, before you say, 'oh I'll run 10S then' hold up. Higher voltage = more expensive packs for the same power capacity (multiply the voltage by the pack's capacity in Ah, and you'll have Wh, which is an effective way of comparing pack's effective power. E.G: a 6S 3000mAh pack has 66.6Wh, and a 4S pack needs 4500mAh to achieve 66.6Wh, so the packs have the same effective power), and also means more weight, in effect, voltage is heavier than capacity. Also, if you pick a high voltage, it means a more expensive ESC will be required to deal with that extra voltage. Conversely, a high current will also require a more expensive ESC, so a balance needs to be found.

Many racers feel that an ideal compromise is 5S, as it is more efficient than 3S or 4S setups, is lighter than 6S setups, has a large range of capacity choices, and can run a very large range of motors, though more on that later.

Unfortunately, it is quite hard to 'guess' what capacity and voltage will be required to run your car for the required time. Most people will still be running in the nitro class, and, while some tracks run 10 minute finals, many will run 15 or 20 minute finals, and here comes the dilemma: do you run one big pack, that lasts the whole 20 minutes, but at the cost of handling, or, do you have two

packs, running one at a time, giving shaper handling and a faster car, but at the expense of time wasted in a pit stop, which for electrics, is a long process, taking 30 seconds or more for a battery change.

After having run the latter set-up, I changed to the former, and bought the biggest battery I could afford, a 6S 6100mAh pack. This was purely for experimental purposes. Anyway, it has 135.42Wh on offer (though, as it is only 18C, it effectively has less useable capacity than that), and, with my ESC punch control turned to 80%, and sensible gearing (more on these later), I was able to achieve 26 minutes on the track. I'm not a fantastic driver either, and still suffer from the 'nitro blip' which is something it is best to 'unlearn.' This means that, I can now pick a lighter, lower capacity, higher quality pack, and should still achieve that magical 20 minutes. I've now picked a 5S 5500mAh pack which is over 100g lighter than the other one, and should still give me a little headroom over the 20 minutes in case I'm driving like a loon.

Unfortunately, too many factors influence run-time, so it is unlikely that you'll be able to draw any hard and fast rules from what's written above. It'll require a little experimentation. The only gems of information I can give you are:

- Pick the highest 'C' battery you can afford, you'll get more useable capacity
- In general, 4S 5000mAh will get you between 11 and 15 minutes, provided you are geared sensibly (more on that later), have an appropriate motor, and drive on an 'average' track, i.e. not a 5th scale track with ridiculously long straights. This also depends on ESC settings, overall weight, and track conditions
- Go lighter overall, and you'll get longer run-time, a larger battery isn't always the answer!

Picking a Motor

Now you've chosen (or at least have some idea of) the voltage you wish to run with, you can pick a motor. The kV rating and overall size are what you need to watch out for here; pick a motor that is too small for the application and it will overheat and cause problems, pick a motor with the wrong kV and you'll be outside the efficiency range for motors within 1/8 scale.

I'll go over a few brands that are worth looking into:

- Tekin: a quick note first about 'the rotor issue'; these motors had some problems with the V1 production rotors, I certainly did, but these appear to have been solved and units are shipping with the V2 rotors. If you are unfortunate enough to have a V1 rotor, and it fails, get in contact with Tekin's customer service. They are very helpful, and will send you a new V2 rotor to replace your broken V1. They don't even ask for your V1 back, as this would add extra time to your wait.
  Their motor's stand out feature, is that they are true '8th scale-sized' motors, but are also sensored. As with all sensored motors however, they can also be run in sensorless mode if you don't have a sensored ESC. They come with a variety of kV ratings, in two different sizes, billed as 'truggy and buggy' sized motors. The kV ranges between 1400 and 2650 kV for buggies and 1350 and 2250kV for truggies. These motors are well made, and of good quality.

  New Info: I have run these motors for around 2 months now, and I'm afraid to say I cannot recommend them yet. I had a V1 rotor failure, and got a V2 from Tekin. Since then, I have had the V2 rotor fail. There are many cases of V2 rotor failure in Europe and the UK, but not in the US. It is probably

down to the fact that European tracks are rougher, and have far faster corners, but the rotors aren't surviving.

Run a slipperential or a clutch! This is advice passed to me by Tekin. My rotor seemed to survive its last meeting with a slipperential, so much so, that I came 4th in the A-Final.

- Neu: The original motor for use in 1/8 electrics, available in many different sizes and kV ratings. A rule of thumb is to use a 1509 for light buggies, a 1512 for all buggies, and a 1515 for heavy buggies and truggies. The '15' part refers to the diameter, whilst the second two digits refers to the length. These motors aren't cheap, but are very good quality and develop excellent power.
- Hacker, as with the Neus, they are even better quality, though are more suited to buggies due to their nature – they are more of a 'revvy' motor than a torquey motor. Even more 'not cheap' than the Neu motors. Available in the UK from Flighttech Distribution.
- Lehner/LMT, probably the best quality around, though do make sure you have a grip on yourself before you look at the price.
- Castle Creations: they make a couple of licensed copies of the Neu 15xx range, a 2650kV, which is suitable for buggies running 3S or 4S at a push, and a 2200kV which is suitable for buggies and truggies running 4S. A 1800kV motor is on the cards for those users of 5S. These motors may not be *quite* as good as the Neus, but are a damn sight cheaper, and provide excellent 'bang for your buck'. These are available in the UK from Flighttech Distribution, or Horizon UK.
  Up and coming motors:
  1. A 1800kV 1512 (see Neu section), which will be good on 5S, or a conservative 4S set-up
  2. A 1518 1850kV (see Neu section), which is going to be for very large/heavy truggies on 4 or 5S.
- Losi: if you want to buy all your stuff from Ol' Blighty, you'll probably take a good look at the Losi motors. I have now run a Losi 1700kV motor, and will say that it's very good. The only gripe I have with it are that the motor end bells both came apart from the motor, meaning I didn't finish my final. This is due to some really weedy screws used to hold the end bells to the can. If you have a set-up where the motor is supported around its midsection, then you'll probably be fine, although if not, take the stock screws out and drill the holes to about 2mm, then tap for M2.6. Put some nice M2.6 x 5mm screws in there and it'll be far more reliable. Available from Horizon UK.
- Speed Passion: I wouldn't bother with these at all. They are not of that high quality, and you'll find better deals elsewhere. Available in the UK from Schumacher Racing.
- Medusa: if you can still get your hands on one, go for it! They are extremely high quality for very little money. Go for a 36-60-xxxx for buggies, a 36-70-xxxx for heavy buggies and truggies, and a 36-80-xxxx for heavy truggies. They recently announced that they were to leave the RC industry, so bear in mind the lack of any warranty.
- Feigao: the original budget motor, in essence, they are the same quality and such as the Speed Passion motors, as they are both manufactured by Hobbywing. They are far cheaper than the Speed Passion motors, which is why I mentioned them. If you are on an extremely tight budget, or are just testing things out – then this is where you want to go. They tend to run very hot, and won't be as powerful as those more expensive brands.
- Novak: In my opinion, they are not really suitable for 1/8 buggy and truggy applications, due to their low diameter (less torque) and unusable (for the

track at least) kVs (at least 3000kV, which is just too high). The Novak system is pretty much ancient now in comparison to the newer, more reliable, more suited systems like the MMM and RX8.

- Mtroniks: I don't have any experience of the Mtroniks motor, but it looks like a Feigao-based motor. Like the Novak, the kV is unsuitable for anything but 3S on a track.
- LRP: These are very new, so there isn't much info out there at the moment, however, initial reports indicate that it is just a normal 10th brushless motor, but a bit longer, so it overheats, as it doesn't really have enough torque for its intended application. It is sensored.

Picking a kV:

You've decided on a voltage, a motor brand, and I'm assuming you know what vehicle you'll be running. It's now time to pick a kV. This number is essentially how many revolutions the (unloaded) motor will make, per volt applied. EG: a 2500kV motor is running with a 14.8V battery pack. Peak revolutions should be: 2500 x 14.8 = 37000rpm. Now, what to do with that number?

Optimum sensorless motor efficiency occurs between 28000 and 35000rpm, so compare the peak revs with this range. If it is outside this range, it's time to change the motor. The efficient kV range for different voltages is as below; note the kV values are approximate:

Voltage/rpm	28,000rpm	31,500rpm	35,000rpm
11.1V (3S)	2500kV	2850kV	3150kV
14.8V (4S)	1900kV	2150kV	2350kV
18.5V (5S)	1500kV	1700kV	1900kV
22.2V (6S)	1250kV	1400kV	1600kV

If you are running sensored, then the table will look more like this:

Voltage/rpm	20,000rpm	27,500rpm	35,000rpm
18.5V (5S)	1100kV	1500kV	1900kV
22.2V (6S)	900kV	1250kV	1600kV

You can get away with running far lower kVs with sensored set-ups, as the sensors mean the pull away will be smooth, whilst this idea is not used with sensorless, as the motor will tend to cog (stutter) upon start up with very low rpm. This only really works with a higher voltage, and tends to limit gearing options a bit.

Choosing an ESC:

Again, there are many different ESCs on the market with varying current and voltage capabilities, as well as varying tune ability. I will cover the most well known, and those that are highly recommended:

- MGM: The 'original' 1/8 scale ESC manufacturer. They make a series of very expensive, high capability controllers. If you wish to run very high voltages, look no further! Many of MGM's ESCs were designed with car use in mind, so have effective brakes – something plane and helicopter ESCs lack. They can run up to 10S and also can be programmed via USB. Sensorless only.
- Castle Creations: The first 'well known' R/C manufacturer to make a 1/8 worthy ESC. The Mamba Monster Max has been through three phases, and now is pretty much bulletproof. Castle are famed for their excellent warranty (1 year), customer service and attitude. For instance; if your MMM explodes because you've wired it in backwards or something, the most you'll be charged by Castle is $70 for a brand new ESC. The MMM is

capable of 6S, but will only run motors in sensorless mode. It includes a USB programming kit in the box, allowing the user to adjust and tune the ESC. It is however large (especially so if you're used to 1/10 ESCs), so you'll need to plan out where it will be mounted in the car. These are also available in 'combos' with one of the Castle motors as I covered above.

- Tekin: The RX8 ESC is also 6S capable, though can run sensored motors, in what Tekin call 'D2 – Dual Drive Mode Technology', which essentially means that whilst pulling off, or accelerating from slow corners, the ESC runs in sensored mode, for smooth acceleration, but then changes to sensorless operation, as it allows the motor to rev higher. It is also smaller than most other 1/8 ESCs, which makes it easier to place on the chassis. The main two things that hurt the RX8's advantage are that the warranty is only 120 days, and that it does not include USB programming adapters, though it is compatible with Tekin's Hotwire. It is also far pricier than its main competitor, the MMM. It is also available in 'combo' format, though has a far larger range of motors available than any of its competitors.
- Speed Passion/Hobbywing: Hobbywing make two ESCs, an 80A 4S ESC, suitable for lighter buggies, and a 150A 6S ESC for buggies and truggies. These come with programming cards, but can also be programmed via USB. Like the Tekin, they are also sensored, but unlike the Tekin, they are simply massive. The 150A ESC makes the MMM look small. On the plus side though, they are very cheap in comparison to the brand names. The Speed Passion Silver Arrow ESC is the 80A version with a fancy bent piece of aluminium stuck on the side. What isn't very good about this is the price – it is well over twice the price of the Hobbywing version, for no difference in performance.
- Losi: Their ESC is capable of 5S, and is on the same price point as the MMM. However, many feel that it has less driveability than the MMM, considering they are both sensorless. It is also programmable via USB (the adapter is included), though they also include a program card for trackside adjustment. It is also huge, like the 150A Hobbywing. There have been many failures of the ESC, so I would steer clear of it to be honest.
- Novak: Outdated and limited to 4S, it is not programmable via USB, and wasn't really intended for this purpose. Unfortunately, until Novak come out with a decent 1/8 ESC, I'll have to say 'avoid'.
- Mtroniks: I really don't know about it. Knowing some other Mtroniks stuff, I would say avoid to be on the safe side.
- LRP: This should belong in the bullet point below really. This ESC is IDENTICAL to the normal 1/10 SPX, with another cap stuck on the side. If you want to run anything more than 2S, you must buy an external BEC to replace the in-built one. Exactly like the 'Modified ECSs section'. It is sensored though...
- Modified ESCs: in the early days of 1/8 brushless, if you didn't have enough money for an MGM, you'd mod a capable 1/10 ESC. Speedo's like Castle Creation's Mamba Max and Tekin's R1 Pro were prime candidates. To use these, you'll require an external BEC and some capacitors – it's best to look around on forums such as RC-Monster to find out which ones are best for what. You need to disconnect the red wire from the ESC's receiver plug to disable the BEC, which helps to make the ESC 4-5S capable. The capacitors help increase the ESC's capability further, though you won't have a reliable ESC at anything past 5S. You only need the external BEC if you plan on running the servo and Rx off the main drive battery.
- Castle Creations Mamba Max Pro: This looks like it could be a really good alternative to the RX8 in lightweight buggy set-ups. It's sensored, 6S capable, and quite small and light (for an 8th ESC!), It is also far cheaper at about $130, compared with the RX8's $200. I always found the Castle Link more intuitive than the Hotwire, and seems 'more compatible,' in that it'll work on a wider variety of computers, whilst the Hotwire seems a bit picky.

Gearing

I know that users of 1/10 electric cars would say ‘just experiment with different pinions until you find the right one.’ In theory that’s great, but with 1/8 Mod 1 pinions they need to be made from hardened steel, which pushes the price up to around £10 per pinion, you probably don’t want to buy 5 different pinions to find out ‘which is right.’ So here’s my guide to gearing your ride properly:

1. Find out the differential ratios of your vehicle. This is the ratio of the number of teeth of the ring gear to the pinion gear. Most of the latest buggies and truggies are 4.3:1 (43 teeth on the ring gear, 10 teeth on the pinion); though this may not be true for your car so check it out!
2. Find out what size the spur gear is. These vary between 40T and 62T so again, do your research properly.
3. Measure the diameter of the tyres in inches, for off road buggy tyres, this is about 4.5”, whilst for truggies, it’s around 5.8”, though this could vary depending on whether you’re using LPR tyres or not.
4. Make sure you know what voltage and motor you’re using.
5. Visit this web page, and plug in your values. When it comes to the added radius of tyre ballooning, for buggies, use 0.5”, and for LPR truggy tyres, use an inch. Then try a pinion size – something like a 14T to start with – and click ‘Calculate Speed’. A series of values come up, but you’re most interested in the ‘Theoretical Maximum Vehicle Speed’ and the ‘Total Motor Speed.’ You want to be geared for just over 40mph for most tracks. If yours is particularly tight and technical, gear for around 35-40mph, whilst if you have a very high speed track, gear for around 40-45mph. Make sure you have entered the added radius for ballooning.

Make sure the pinion you choose is hardened steel, and even better if it is hard coated as well. If the pinion is soft, don’t expect it to last long against that steel spur gear.

Connectors and other electrical

Connectors

The amount of current that 1/8 conversions can pull is ridiculously high, so having good quality connectors is a must. Poor quality, or not up to the task = high resistance, which can damage your electrical components, or at least prevent your system from reaching its full potential. It is paramount that you pick connectors that are up to the job. We’ll start with motor connectors:
Firstly, if you have an ESC and motor with solder tabs, direct solder the motor to the ESC, then there are no connectors at all, so you’ve got nothing to worry about.

However, not all of the ESCs and motors on the market have solder tabs, so you’ll need something to bridge that gap. For example, the MMM uses Castle’s 6mm gold tubes, whilst Losi’s ESC uses 4mm gold tubes, and many of the motors I mentioned just have three wires sticking out of the back. The best connectors to use for motors are gold tubes, due to the high current capacity, and that you can switch the motor wires if the direction of rotation of the motor is wrong. 4mm connectors will usually suffice, though if you’re feeling over the top, you could use 5.5 or 6mm connectors, they will have less resistance but they are more expensive and are less readily available.

For the battery to ESC connection, it really depends on which route you took earlier; did you go for the ‘one big battery, no stop’ strategy, or the ‘two or three battery, with pit stop’ strategy.

With the former, the best connectors to use would be something like 6mm gold tubes again. However, if you feel you may accidentally plug them in the wrong way around, or if you chose the latter, use polarity-protected plugs, so then you can’t, and neither can your pitman in the heat of the moment.

Deans are *just* good enough for 1/8 scale, though I’d only use them in lighter buggies to be on the safe side, there have been cases of them melting. A better choice, and a personal favourite, would be the Losi/E-Flite EC5 connectors. These are 5mm gold tubes inside a housing that can only be plugged in one way around, though they can be very tight to pull apart. Another option would be the Traxxas connectors, which, like Deans, use flat contacts, though there is a larger surface area per connection than Deans. They are also polarity protected.

Wire

Make sure you use at least 12 AWG wire for the battery and motor connections. 10 AWG is better, but depending on which ESC and connectors you use, may be impractical. Larger wire is better (performance wise) as it has lower resistance than smaller wire.

USB Programming Kits

These can be very useful if you plan on adjusting many features of your ESC. For instance, with the RX8 ESC, timing is only adjustable through Hotwire – Tekin’s ESC programming kit. They also provide an easier interface to use than watching for lights and beeps from the ESC and motor, as with traditional ESC programming.

Useful websites list:

For general information	For LiPos	For other electronics	For conversion parts
RC-Monster Forums	RC-LiPos	RC-Monster	RC-Monster
oOple (UK)	RC-Monster	Tekno-RC/Impakt-RC	Tekno-RC/Impakt-RC
	Flighttech Distribution (UK)	Flighttech Distribution (UK)	
	Robot Birds (UK)	Much-More UK	