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For total off road performance nothing can match the new Mugen Bulldog.

The Bulldog turns quicker and sharper with A.W.D.S. All Wheel Drive AND Steering. That means that in addition to maximum traction 4 wheel drive, the Bulldog provides front and rear wheel steering to handle the tightest corners and trickiest tracks with ease.

High performance engineering throughout.

Mugen race engineering is tough, too. The heart of the Bulldog is a unique and extremely rigid "backbone" chassis which eliminates flex and reduces weight to a minimum. Inside, three separate differentials linked by cogged drive belts put the Bulldog's electric power to all four wheels with perfect balance.



Four wheel steering lets the Bulldog turn sharper and faster than conventional 4x4's.

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And the Bulldog is plenty fast. Off road racers love the quick response and tight cornering that most conventional 4WD cars lack. With unequal length, double wishbone independent suspension the ideal racing geometry for maximum traction is constantly main-

tained. Maximum travel and ground clearance let the Bulldog eat up bumpy surfaces at speed.

Another Mugen exclusive is the adjustable Air Shocks. With just a twist of a set screw wrench spring rate and damping can be quickly and easily track-tuned.

Race ready performance.

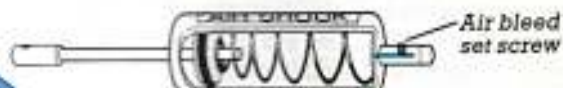
The 1:10 scale Mugen Bulldog is available as a complete kit including Mabuchi 840 motor and speed control system. All you need is a 2 channel radio system and 6 cell NiCd pack to go racing.

In fact, the Bulldog's potent combination of A.W.D.S. and light weight (as low as 3.5 lbs) make it ideal for off road competition.

When you're ready to start running circles around the competition build yourself a Bulldog. It's racing technology at its best... from Mugen.

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High traction, triple-spoke studded racing tires



Front and rear ball differentials



Center ball-type differential adds limited slip control (locked for slippery track, looser for high traction)

Composite "backbone" chassis houses triple diff/cogged belt drive system

(2 channel radio system and 6 cell NiCd battery required but not included in kit)

Powerful Mabuchi 840S motor

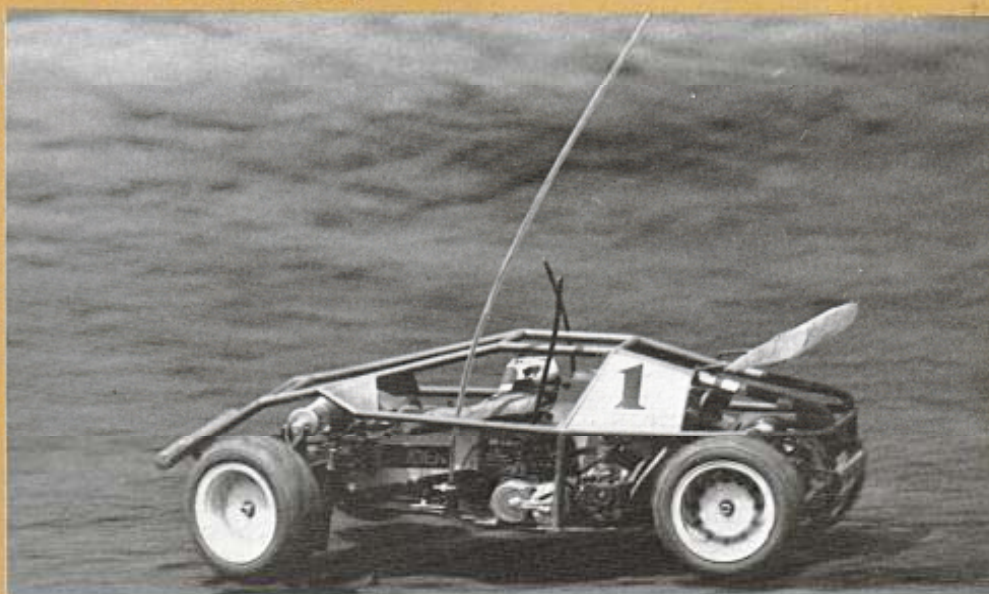
Dealers only contact Varicom Industries for distributor listing:
18480 Bandelier Circle, Fountain Valley CA 92728-8610

THE MUGEN BULLDOG

BY GARY HASKILL

Before the IFMAR 1/10 World Championships held at Del Mar, California in July 1985, almost nobody in the US had ever heard of the Mugen Bulldog. In this country, it seems that to go really fast in 4WD Open Class competition, you have had to own a Yokomo car and spend about five or six hundred dollars. The other alternative was to follow the trend of the 1985 ORRCA Open Class National Champion Chris Allec and completely *scratchbuild* your own trick car using parts from Hirobo, Yokomo, Associated, Kyosho or Tamiya, or whatever looked like it might fit the purpose and fill in any missing components with parts from your own machine shop. Chris proves it can be the fast way around a track, but it's usually far beyond most racers' budgets of time, and attention spans.

When the Mugen factory from Japan brought three cars over for the World Championships, most of us from the US gave the car no more than curious looks until we saw it on the track. Here was this ugly little "flexible flyer" with the weird four-wheel steering, and air shocks. But you know what? Once on the track the thing didn't look all that bad. When the dust of all the main events had cleared, Takashi Aizawa and one of the funny little Mugen cars had very nearly won the C Main in the Modified Class, finishing second to 1/12 Modified World Champion Tony Neisinger and ahead of last year's ORRCA Open National Champion Derek Schmitz. Now, 22nd place in the World out of over 100 drivers may not be what some people would consider sparkling results, but remember that this was very tough competition, and Aizawa was the highest placing Japanese driver, and had only had his car about two weeks! Obviously, at this point, a few more of us were giving the car the curious looks. Aizawa's car really had the barest of modifications as there are currently no after-market parts for the car; it's that new. The most notable modifications were a set of oil shocks (mono) mounted in the stock locations, locked rear steering, and a different speed control to handle the higher amps of an open motor and seven-cell pack.



First seen in the US at the IFMAR World Championships in Del Mar, California this summer, the Mugen offroad car has been gaining in popularity among American drivers.



The author won the Fifth Annual Western Off-road Championships with his Mugen racer.

I was fortunate enough to be introduced to Mr. Tada, the head of the Mugen factory on the Saturday of final qualifying, and at the Awards Banquet on Sunday night, we happened to be seated together for dinner. A little over a month later, after talking with Bruce McAviney of Varicom, the importer of the car, I walked out of his office with a new Mugen Bulldog AWDS and a lot of curiosity about what I would find when I got home and opened the box.

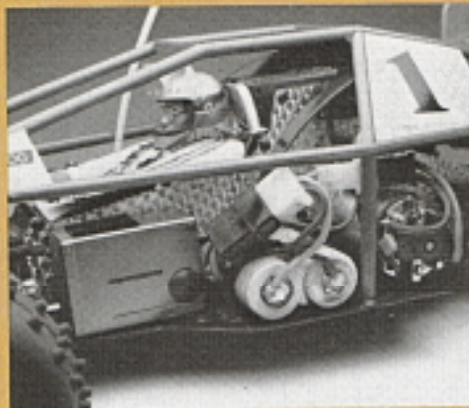
Upon opening the box at home, instead of just being curious, I was pleasantly surprised. The packaging is well done, with small parts in plastic bags. The major components such as chassis, shocks, motor and differential pulleys are neatly laid out in individual pockets of a plastic tray with a clear plastic cover to make it easy to find the parts needed for each step. All bags of small parts are numbered for the same reason.

When starting assembly of the Bulldog, I highly recommend laying a clean newspaper on your work table, and a paper towel or clean rag on top of it on which to build your differentials. This is to prevent the very tiny thrust balls from disappearing from your table during the assembly steps.

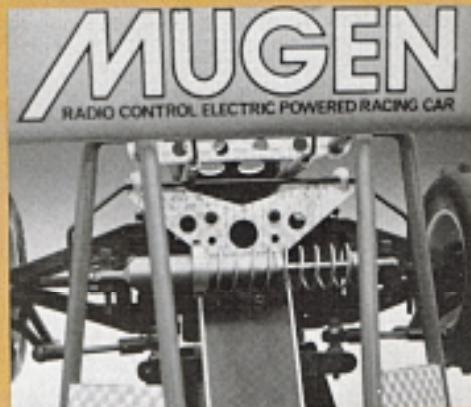
I use Associated's silicone differential



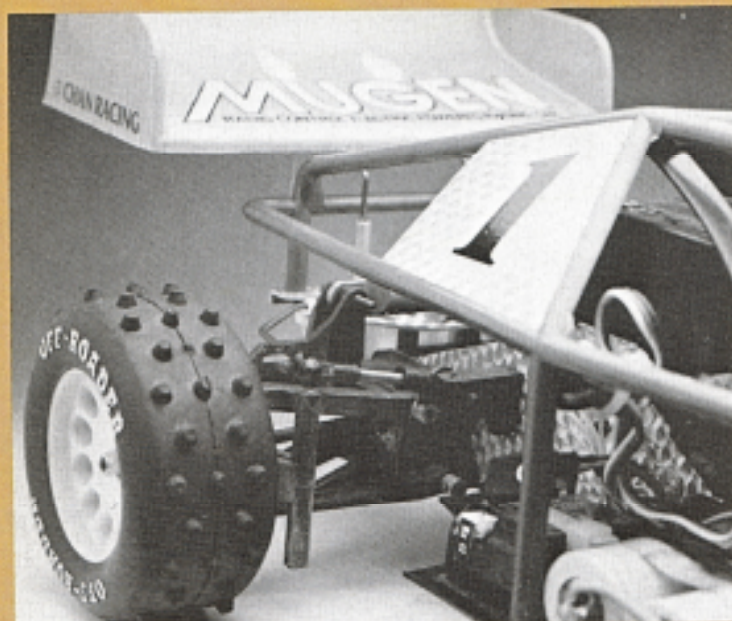
Overhead view showing washers on steering linkage and Delta shock in place.



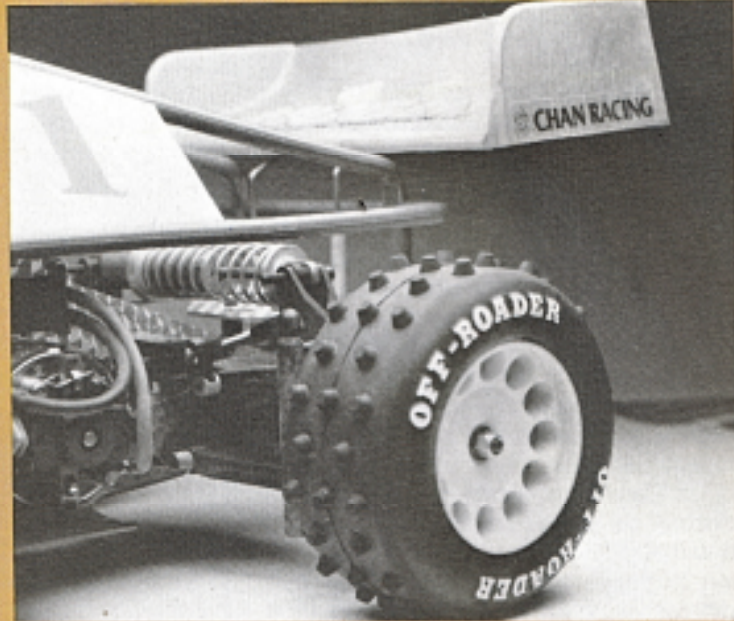
Motor and power amp for the Futaba speed control are visible from this left side view.



Top view of rear shows wing and mounting tubes, rear sway bracket and Delta shock.



Right rear view shows receiver installation and locking linkage for steering. Access to innards is easy with open body framework.



Left rear view shows rear steering locking method, Delta shock and motor installation, plus collars on suspension pins.

lube in the holes on the differential pulleys, but Bolink's or Trinity's silicone lubricants also work just fine. These are all a gel-type silicone, which stay where you put it. Carefully remove the larger steel differential balls from their plastic bag one at a time to install in the plastic differential pulleys. If they're a little hard to pick up, use needle pliers to carefully set the balls over each hole in the pulley, then gently press each ball into the hole with a finger. Add a little more silicone to each ball on both sides of the pulley before setting the shafts 'A' and 'B' from opposite sides. It may seem as though I am taking a lot of time on the differentials, but this is the most crucial part of the entire assembly process of the car.

Put a slight kink in the threaded end of the differential adjustment screw. This is to cause the screw to bind slightly as you put it in so that the differential can hold an adjustment setting better without changing during a race. After you screw in the adjustment screw to the recommended 2mm spacing under the head, add some of the silicone gel under the head of the screw all the way around. You can then gently install the very small thrust balls under the head of the screw and they will stay in place without tape to hold them. Use the toothpick you used to apply the gel to the differential screw to pick up the balls, and

when you have them all in place gently tighten the screw slightly and work the differential some as you tighten it to the point where it is somewhat free but you feel tension as you hold the pulley, and the opposite shaft should turn in the opposite direction.

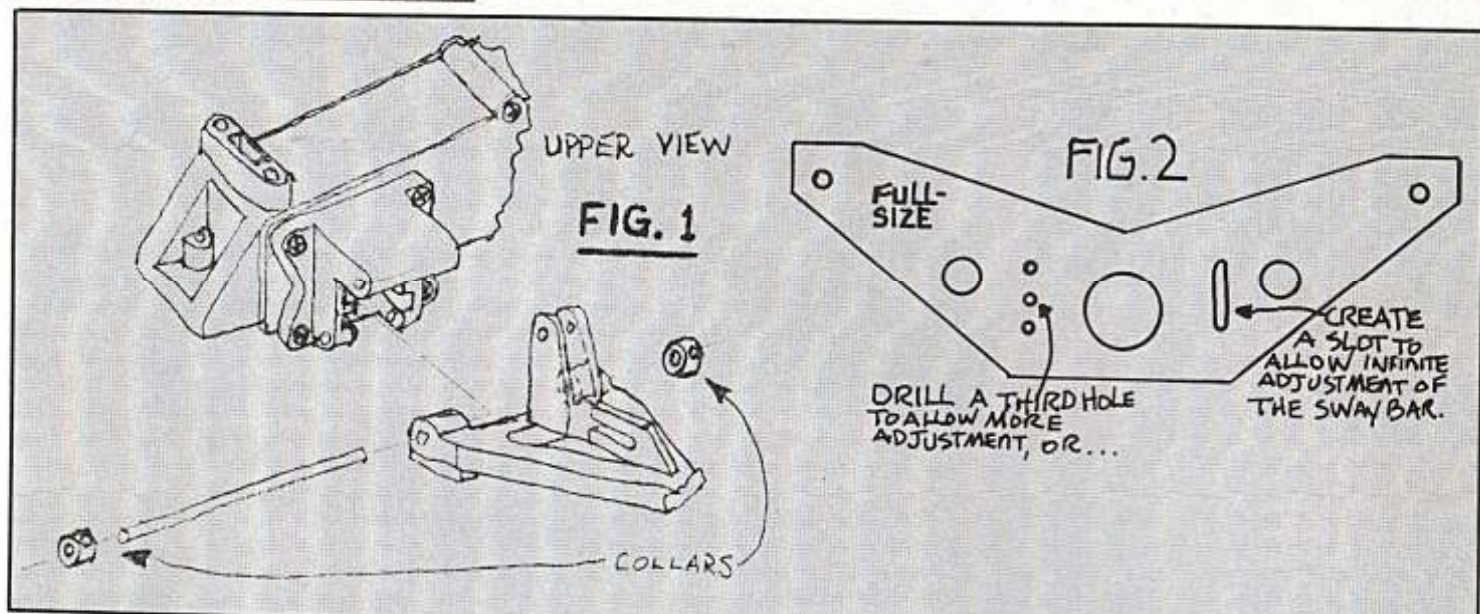
If adding the optional ball bearing set (recommended for racing), add the bearing now on each differential shaft and install the joint. Some Tamiya Thread Lock or

Zap Lock Medium are recommended here to keep the set screws from backing out of the joints with use.

The center differential is used more as a clutch or "slipper" but on my car I built it right and use just the front and rear differential of the car independently to adjust the handling of the car to each track. More front tightness than rear makes the car "push," more rear tightness will cause the car to "oversteer." Both about the same



The Mugen Bulldog comes off the stadium jump at the IFMAR World Championships recently. The Mugen caught the eye of the author in Del Mar, and he just HAD to have one of his own!



makes the car neutral.

If you want a true differential action out of your slipper differential, I recommend taking some sandpaper or emery cloth and "surfacing" the opposite sides of the center part of the gear, as it is slightly thick and a little distorted by the molding process (the factory is already fixing the problem). Next take a drill and ream each hole in the gear slightly oversize to the point where the differential balls will barely stay in their holes. Carefully clean the gear and add the silicone gel as you did earlier on the front and rear differentials and assemble according to the instructions. It is now a true differential. To be honest, I have not tried this on my car, but Chris Chan has done it to his car and claims it works better this way.

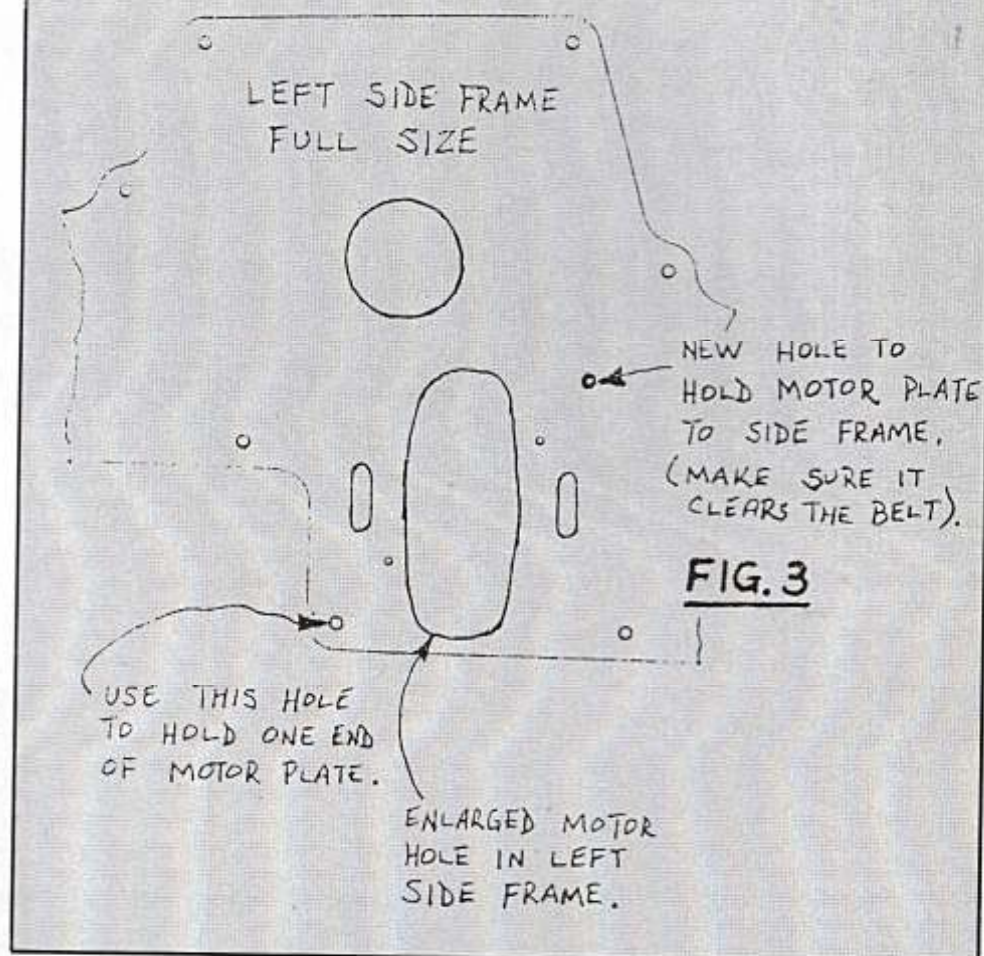
Belt drive has been used in 4WD cars before, most recently in the Hirobo 44B and of course Chris Allec's Hirobo-based, scratchbuilt 4WD car. The belt makes the car extremely quiet, and I've gotten very good battery life with no noticeable sacrifice in performance.

The rest of the car is very straightforward and simple, but there are several modifications which will help performance and ruggedness of the car.

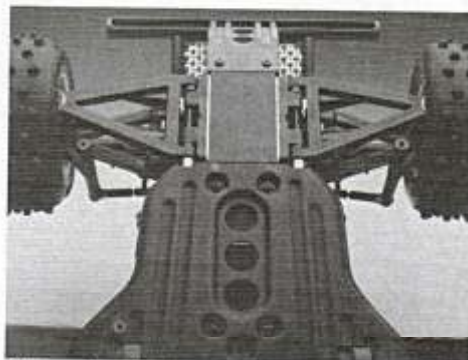
The first modification is very simple. Bolt on a pair of oil shocks. Either Associated 1.32 rear shocks or the new Delta pressurized shocks fit right in the stock mono shock locations. Kyosho rears will also fit, as will Parma. I plan to try a dual shock setup on the rear end soon, after I find time to make a new rear bracket.

The next thing I did on my car was to lock up the rear steering. Actually, on really tight tracks four-wheel steering could be an advantage, but the stock ratio is just too much. I plan to experiment some, but the final ratio will probably wind up about 5 or 10 percent rear-to-front steering, instead of the stock 25 to 30 percent.

I also made slots in the lower pan to accept reusable tie straps to hold in the batteries instead of the stock copper strap. I made notches at each end of the pan so

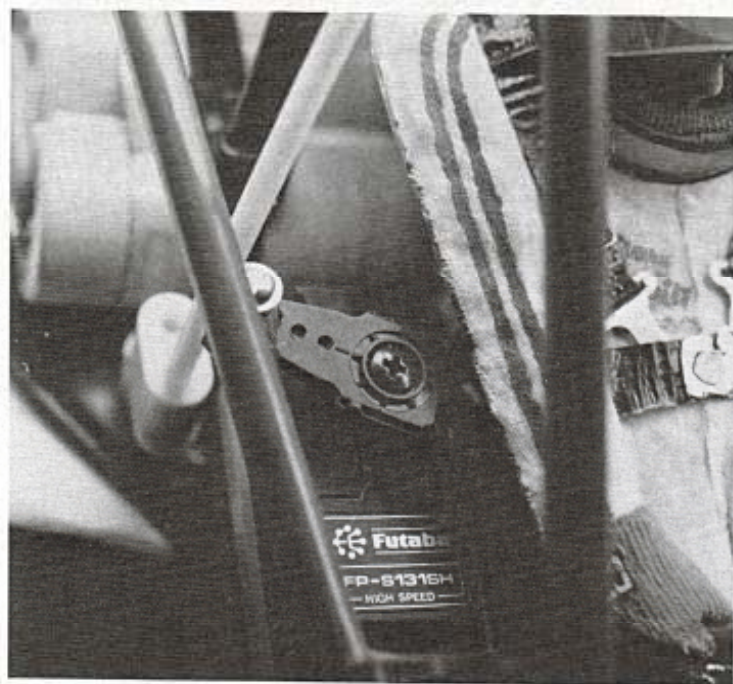


SOME SUGGESTED MODIFICATIONS TO THE BULLDOG BY THE AUTHOR.

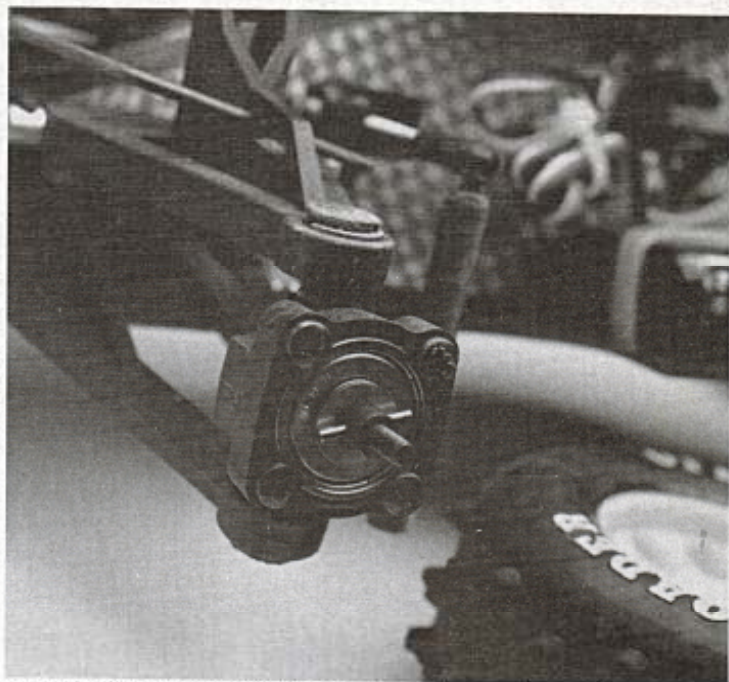


Note collars in place on lower pins, notches in pan to locate collars, and slots cut for tie wraps to hold batteries in place.

I could add drilled out Dubro 1/16 wheel collars to the inside end of each lower suspension pivot shaft to prevent the pins from sliding out of the suspension arms once they start to wear. The pan locks the collar so the shaft can't slide in toward the center of the car, and the collar keeps it from going the other way. I also added drilled out collars on each end of the upper shafts. Put washers over the balls on the rod ends of the steering linkage to prevent the balls from popping out of the rod ends upon a hard landing or a hit from another car.



Overhead view showing servo arm with washer on rod end, antenna tube and mount, and tie wrap on battery pack.



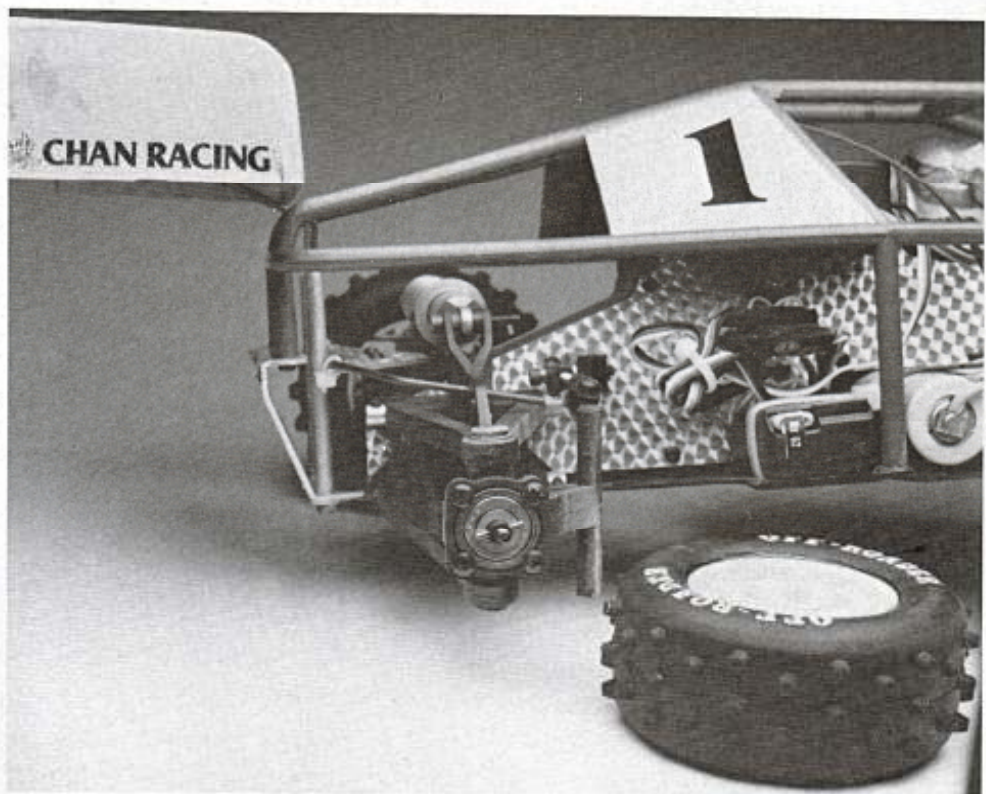
Close-up of right rear with wheel removed to show large diameter bearing and axle drive pin in place in steering arm.

I changed the speed control on my car to give more proportional movement and control. An Associated RC10 resistor bracket bolts in place like it was made for the car, or one of the now commonplace electronic units can also be used, if your budget can handle it.

Also, on my car I added wing tubes to the rear of the car and an Associated antenna mount from an RC10 in the stock location. Stock wheels will accept several different tires besides stock, most notably Proline #09-834's which fit Yokomos, or even Holiday Buggy tires if the center ridge is cut out. Lightly sand the circumference of the wheel first, then glue with an instant glue such as Zap CA+.

To counter my personal problem with seeing a dark car at night, I added Top Flite's reflective trim sheet to all exposed areas of aluminum on the side frames and sway bar brackets, and all the flat surfaces on the roll cage. I even added a piece of clear .030 butyrate sheet to the front of the cage and added reflective trim sheet there as well. This front piece is held on with "Shoe Goo" and acts as a front number plate and wing.

To complete the setup of my car, I used a Futaba 3PG Magnum system with an S131SH servo for steering, and Futaba's MC-106B speed control, and one of their new R102H micro two-channel receivers. This unit is tiny! It only weighs .77 ounces, a real bonus for keeping a car light. With a six-cell battery pack and ready to race, this car weighs in at a feather light 3-1/2 pounds, ROAR legal minimum for a 4WD car. That includes a wing and concurs driver in full cloth uniform. ORRCA rules don't even have a minimum weight, and this car, using lightweight equipment and regular driver, could probably come in at an astonishing 3-1/2 pounds without any major modifications.



Back side shows shock mount, wing tube installation, and receiver installation.

Now to the good part: performance on the track. By adjusting the front and rear differentials, the car's handling is adjustable to almost any track conditions and layout. Toe in and shock rates are other areas for experimentation. With its light weight, the car accelerates quickly with the stock motor and 14-tooth pinion supplied in the kit. Mugen offers a range of pinions from 11 through 16 teeth to handle any conditions imaginable, but with a stock motor 14 or 15 are fine, and a 12 or 13 work with really hot open motors on seven-cell packs.

The car slides easily into a turn and is very smooth in transition from low to high

speeds. The belts make this car very quiet and battery life with mild stock motors can be as much as six or seven minutes on six cells, without giving up performance.

The car took me approximately two weeks to sort out under racing conditions; as I finished everything at 2:30 a.m. the day before the 1985 ORRCA Nationals my qualifying left a lot to be desired because of numerous little problems and several cases of "brain fade" from being overly tired. Nevertheless, I happened to win and bump in two Open Class Main events after leading each by over a lap with a car that wasn't really ready. I was hooked!

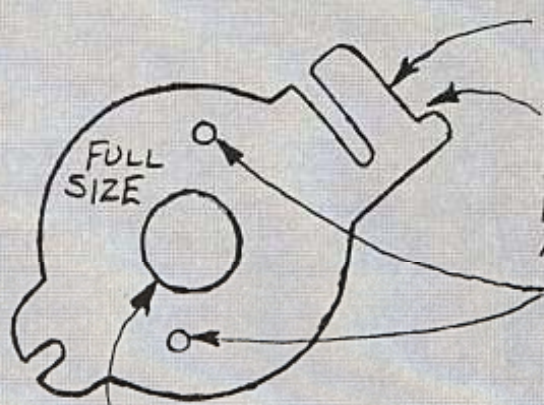


PLATE .062 -.080 THICK ALUMINUM.

NEW MOTOR MOUNTING PLATE MOUNTS TO LEFT SIDE FRAME IN THIS RELATIVE POSITION TO ALLOW GEAR MESH ADJUSTMENT.

THESE HOLES NEED TO BE SPACED TO CLEAR SCREWS TO HOLD YOKOMO AND MABUCHI MOTORS TO THE PLATE. INCLUDE THIN WASHERS WITH ALL NECESSARY SCREWS.

CENTER HOLE NEEDS TO CLEAR THE ARMATURE SHAFT BOSS ON BOTH YOKOMO AND MABUCHI STYLE MOTORS.

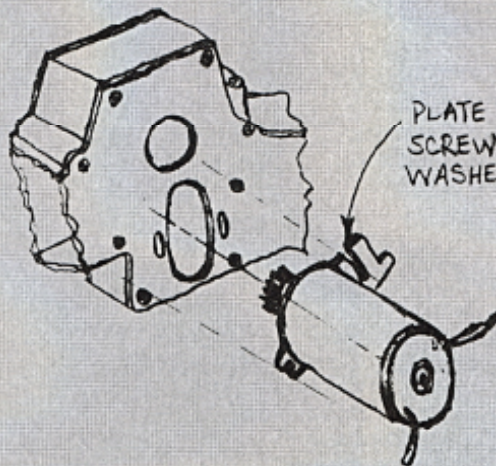
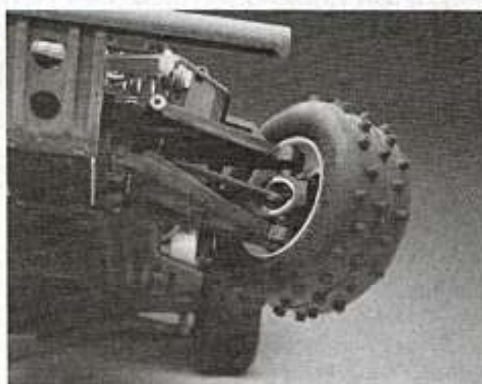


PLATE SLIDES UNDER SCREW HEADS AND WASHERS.

The following week at a local Friday night race I qualified the car second and finished second in Open 4WD behind 1985 ROAR 4WD National Champion Eustace Moore. One week later I was fortunate enough to win at the same track after being top qualifier. The car was finally working in Open Class with seven cells, but how would it work on six cells with a stock motor. I had heard the horror stories about how much drag belts caused and wondered if a stock motor could be fast enough.

The answer came the very next day in the new 4WD Stock Class as I was able to grab the TQ spot at the 5th Annual Western Offroad championships and on Sunday improved the time and also won the "A" Main. The car, with "Big Jim" Greenameyer's Checkpoint stock motor, never skipped a beat and it handled beautifully all weekend, as almost anyone in attendance can attest. Not only is the car good with seven cells, but also with six. Talk about impressed! Two TQ spots and two 'A' Main wins in two different classes at different tracks in only two days. This car really works, and it was only two weeks old at the time of the Western. Besides, I have never had any car that was quite as much fun to drive.

The funny little "flexible flyer" may still be ugly, but then so is a Volkswagen Beetle. Who cares? It works fine and is fun to drive, and that is what sold me on the car. I now have two of them, one for six-cell 4WD Stock Class, and the other for Open Class. The Stock 4WD car is pictured here.



Head-on shot showing upper collars in place, and John Cukras-modified front steering arm with aluminum insert.



Right front view shows washers on rod ends, servos and antenna mount. Holiday Buggy tires and collars on suspension shafts as well.



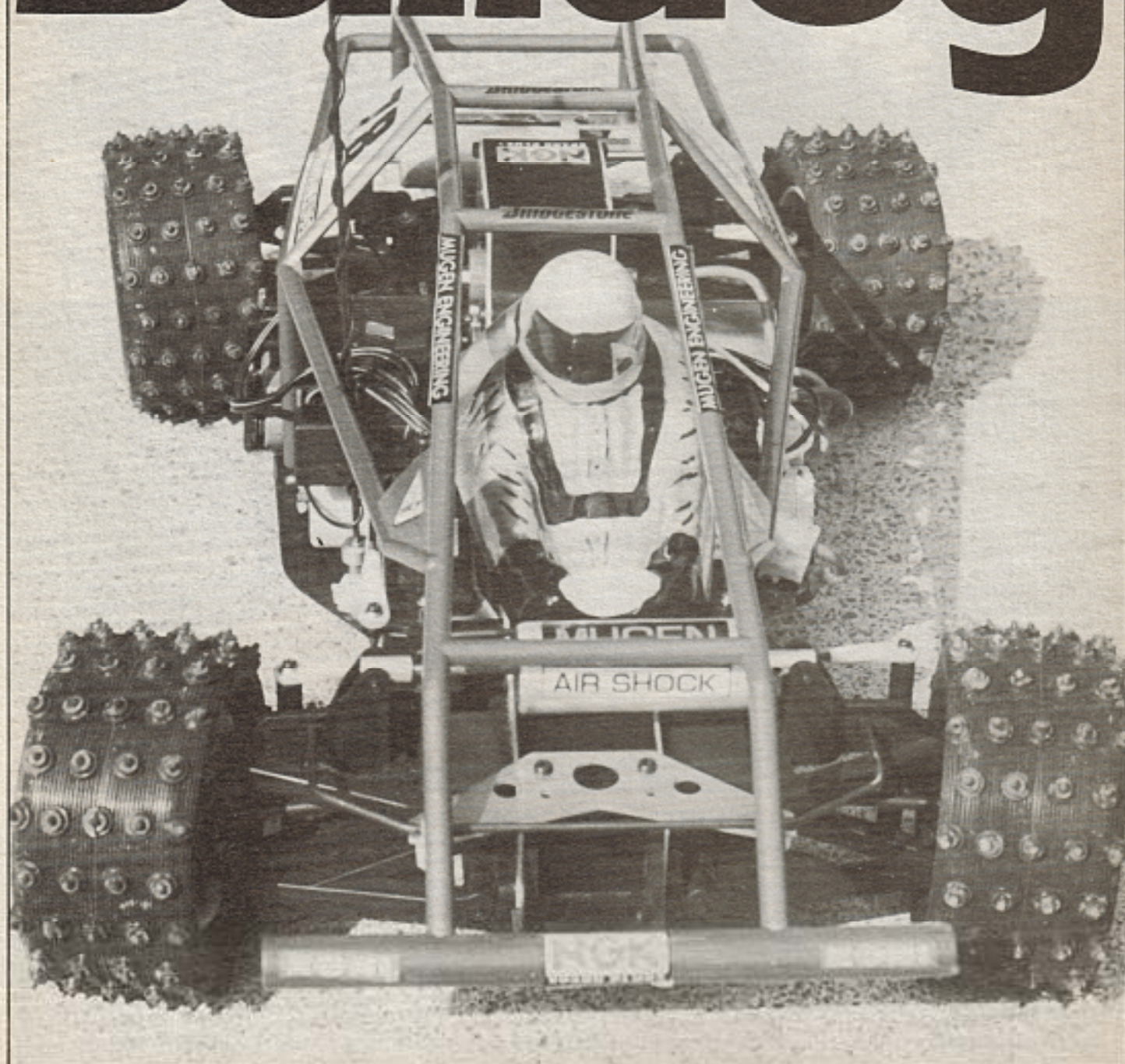
The Bulldog is a fierce competitor, responsive and rugged, right out of the box. Photo: Dowdy

What's really neat is the fact that now several manufacturers are working on trick parts for the car. Most notable at this point are M.I.P. who are working on custom differentials, J.G. Manufacturing, who are making skid bumpers and kydex belly pans, and Advance Turning and Mfg. are making some absolutely beautiful alloy wheels, and even Parma is working on some trick parts for the Bulldog. Other

manufacturers I'm sure are also planning on making aftermarket parts. Several of those products should be on the market by the time you read this article.

So if you're looking for something out of the ordinary, really fun to drive, and works well almost box stock, for about half or less that the price of a Yokomo, take more than a curious look at the Mugen Bulldog. I think you'll be pleasantly surprised. I was! ●

MUGEN Bulldog



IN THE 1/10th side of electric car racing new kits are released every month from the Land of the Rising Sun. *MUGEN* are a new name to this game. Their 'BULLDOG' follows tradition in being named after an animal, but from there on it is different. The main features of this kit are well thought out, and commend themselves to the beginner and expert alike.

The presentation is very good, a large colourful box houses all the parts in either vacuum-formed trays or labelled plastic bags. A ten page instruction book

is provided consisting mainly of diagrams and pigeon English instructions.

The first thing on the menu is the differentials. There are three in this kit, one for each axle, and one in the centre. Assembly is straightforward. In the plastic drive pulleys are eight large balls which act on two washers just as established practice for 1/12th cars. It is much easier to assemble the (very) small balls for the screw adjuster by smearing grease into the coned recess than trying to glue them to a piece of sticky

tape as suggested. Place the adjusting screw through the assembly, smear the recess with grease, and then put the balls in position. When all balls are in place, tighten the screw as described. I recommend that the large diff. balls also be greased prior to assembly, just a small blob on each ball. Adjusting the differentials is easier if they are set quite tight, bedded in by running the car, and then resetting them after the first run. All washers should be glued as directed using *Super Glue*. Be careful to remove all traces of grease

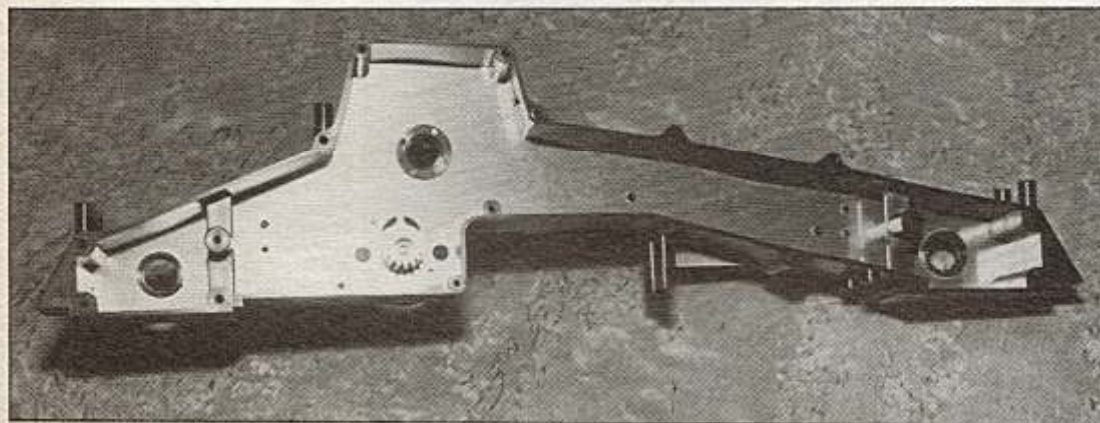
from the spindles and washers before doing this with *Lighter Fuel (Ronsonol)* or similar, otherwise the glue will not take. Once complete, put aside and start on the main assembly.

The centre spine of the car carries all the drive and suspension components. Select the exact sideplate and drive belt shown in the diagram, do not be tempted to start with the other side! Carefully tighten screws going into the Plastic, otherwise they will strip and not clamp. Using a large *Phillips No. 1* point screwdriver, insert all the self-tappers into the metal before locating the servo mounts and steering linkage carriers. A small screwdriver will not give the leverage required, and the head of the screw can be damaged.

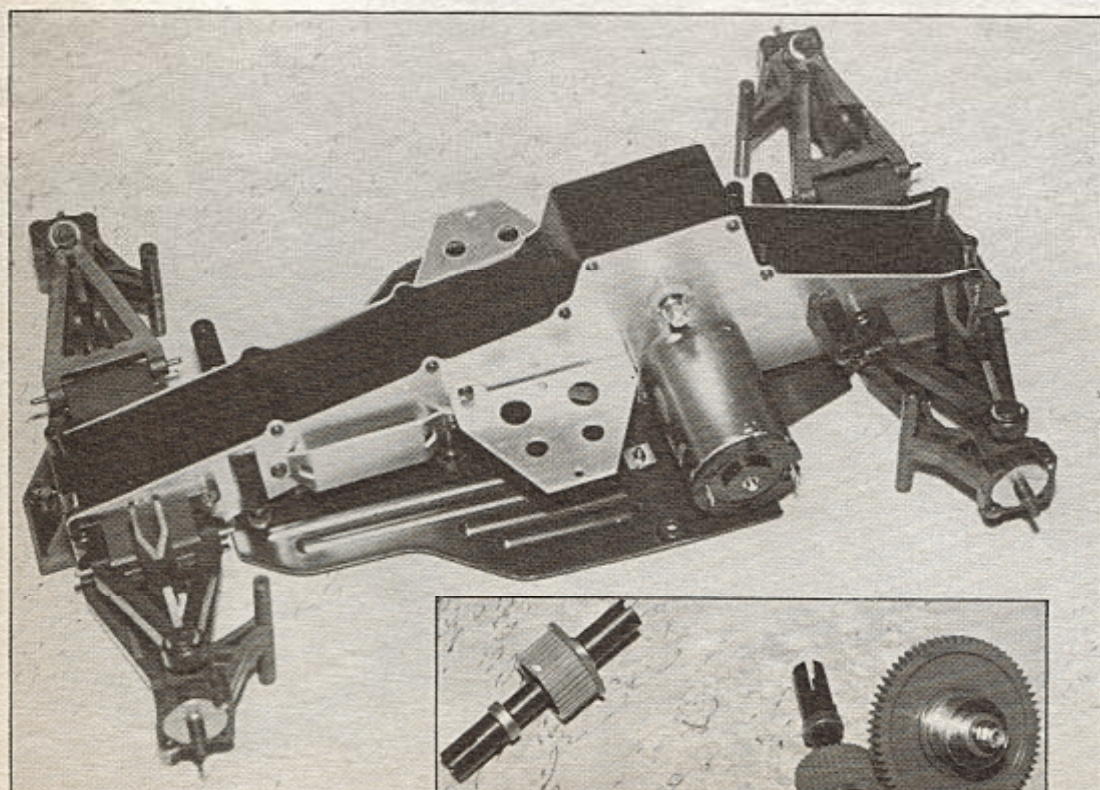
Once complete start on the other side. When all the diffs and belts are positioned, a small elastic band around each end helps to keep the side plate in position whilst the screws are inserted. Be especially careful of the screws which retain the suspension brackets, they can strip easily if not tightened gently but firmly to retain the bracket.

Suspension

The four corners of the car are identical, and once the suspension for one corner is mastered, the others are the same. There are no clips to retain the pivot rods, but the push fit in the brackets is seemingly alright. Place the spacers for the lower wishbones as shown in the instructions. Fit the underguard and anti-roll bars. Take care that the tie-wraps are positioned exactly as shown, otherwise there will be excess slack in the roll bar pivots. Before fitting the monoshocks, push the pins through the end holes and remove them to size the hole. This makes it easier to assemble through the yoke on the suspension arm. Install the steering linkages as directed, and use the supplied servo-saver only as this gives the required steering angle front to rear.



Opposite page: mean 'n' moody, the 'Bulldog' presents a no-nonsense ready-for-action image. Above: the centre drive spine with one side removed to show interior construction. Below: the completed drive column fitted to the chassis pan suspension bulkheads and wishbones are in place. Inset: the front, rear and centre differential units.



Track Test

Complete the kit by fitting your choice of speed controller and receiver, there is plenty of room for all the common makes. Fit the roll cage, install the driver figure (to make the car legal under BRCA rules) and set the toe-in/toe-out of front and rear wheels as shown in the instructions. Lastly, glue the tyres to the rims, I used *Super-Glue*, and bolt them to the axles making sure the drive pin is correctly located.

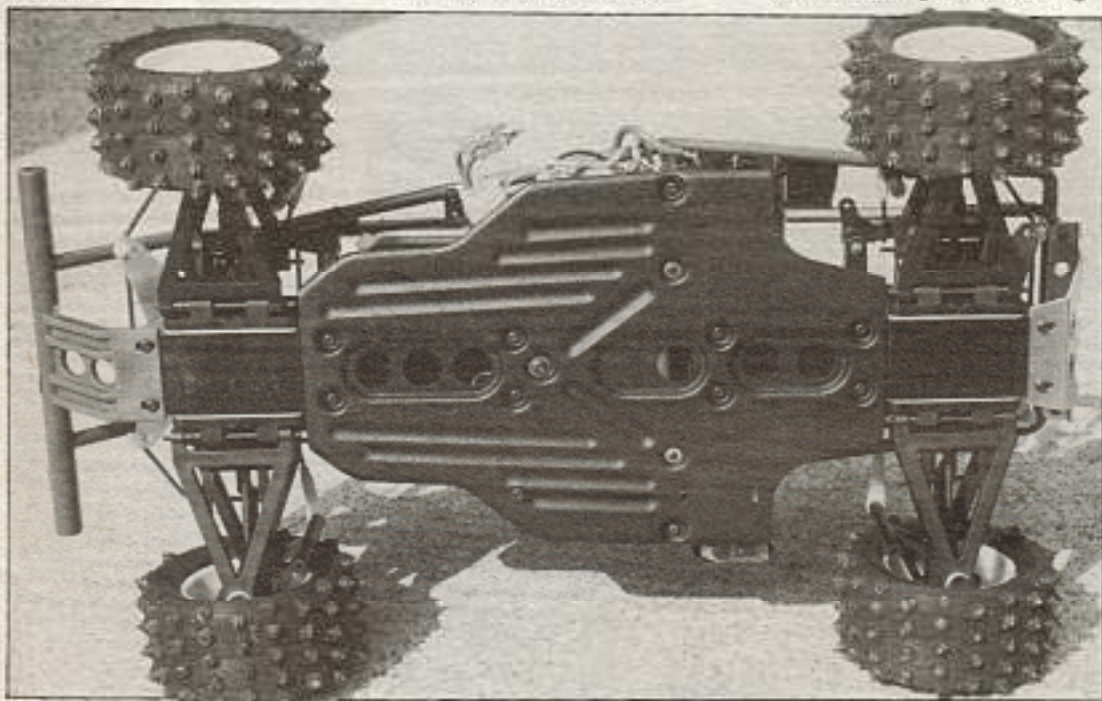
I found it impossible to set the air dampers as directed, the car always bounced when dropped from a height of 15cms. In the end I found a setting which minimised the bounce, this was with the air bleed screw just nipped tight.

Using the standard speed controller, a Sanwa 'Dash' radio set, and the supplied motor, I set forth to the local park. Acceleration is good, and the flat surface handling well damped.

Steering is very positive, tending to oversteer if the grip is low. Running on damp earth (plenty of that this year!) the grip from those large tyres was excellent, and the steering less sensitive. Acceleration remained high, pointing to good grip and working differentials. After the first run adjustments were made to the centre differential, and the rear axle differential to give freer movement. On the second run no change in handling

was detected! Although fitted with plain bearings, the car ran very freely, and is quite acceptable for beginners. A bearing kit is available.

This is an excellent kit from the engineering standpoint. The centre spine is strong, rigid, and maintenance free. Each corner of the car is identical, making for low cost and minimal spares holdings. The air dampers work well even on bumpy surfaces, and appear to



Left: the drive system when completed is extremely rigid giving a good base for the suspension to work from. The chassis pan is manufactured from a very thin and flexible plastic. Below: the 'Bulldog' roll-cage is moulded in polypropylene and can be easily removed. Opposite page: the 'Bulldog' on the race track.



need no maintenance at all. The front tyres project beyond the chassis making landings easy as the chassis does not touch the ground first and dig in. The only reservations are motor changing, which needs care not to lose the screws in the spine, and steering linkages which could wear unless totally replaced by ball joints.

Lastly I am not convinced that four-wheel steering is a good thing in general, and intend to try the car without. Four-wheel steering cars have not proved competitive at the highest levels, yet 4WD has.

All round a very good car which should find favour for its simple construction, maintenance and handling.

The price is £120.00 for the kit complete less Ni-Cad battery pack and radio gear, quite competitive by modern standards.

UK Importer: Irvine Engines Ltd. Available through good model shops.



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