



IN CONTROL

There are three basic operating systems employed in achieving radio control of model cars. The most common by far is AM or to give it its full title Amplitude Modulation. With this system the signal is transmitted to the receiver by varying the amplitude of the carrier wave. It is employed by most of the cheaper sets and it is generally held that such sets are less accurate and have a lower resistance to interference than the alternative systems. Oddly enough no one seems to have told Futaba this and some of their most sophisticated sets are AM. They do not noticeably appear to have any particular problems with interference. One advantage of AM sets is that the crystals are very much cheaper. It's surprising how the cost of these can add up.

Until recently the only alternative system was FM, Frequency Modulation. Here as the name implies the signal is transmitted by the modulation of the carrier wave frequency. It's generally held to be more resistant to interference and is certainly more accurate in terms of frequency spacings. For this reason all the sets currently available on 40MHz, where the frequency spacing is very much closer than that employed with 27MHz, are FM sets.

The very latest operating system is PCM which stands for Pulse Code Modulation. The technique and theory behind PCM has been available for some time now, but it's only

recently that the hardware technology has reached a stage advanced enough to take full advantage of it.

Basically the information is sent from the transmitter to the receiver as a series of coded digital pulses. The information is sent in binary form. Therefore the transmitter only has to transmit 0's and 1's and the receiver can 'correct' any interference as the signal will be nearer one value than the other. Using this system a vast

Many 2ch Radios are available—Colin Leake takes a look at them.

stream of information can be sent.

So great is the ability to handle information that the system actually has time to transmit a coded recognition signal preceeding each new positional instruction. It is this coded signal that enables PCM sets to have a fail-safe mode.

The receivers are in effect on-board computers that look for this coded signal to be constantly repeated between commands. If a good signal is not received for a predetermined time, in the region of half to one second, it deduces that transmission has ceased or the interference is occurring and goes into the fail-safe mode.

Having covered the three different operating systems let me dispel some of the most popular myths. AM sets do not interfere with FM sets. PCM sets can neither cause nor be affected by interference. NOT TRUE I'm afraid, EACH OPERATING SYSTEM IS CAPABLE OF INTERFERING WITH THE OTHERS AND NONE, NOT EVEN PCM, IS IMMUNE FROM INTERFERENCE.

Now we come to the subject of operating frequencies. Basically there are three presently on offer in this country. 27MHz, 40MHz, and the so called unique ones.

Let's deal with the latter first. It is very unlikely that you will be offered a truly unique frequency, they do exist but the sets have to have been specially modified and the crystals cut to suit. If you are offered such a set, what you are most likely being offered is one on an illegal frequency that was intended for sale in some other country. My advice is not to touch them. When only twelve legal 27MHz channels were available and less of the illegal sets were around I could see the temptation, but now with thirty additional channels on 40MHz there is simply no need. The problem is that there are more of these sets about than one might think, and without the protection of the peg board interference is always a possibility. If you are offered a 40MHz set either new or more likely secondhand make sure it is a legal one. Race Directors might turn a blind eye to some frequencies but they are sure to

Left: JR beat 2 radio in hand.
Below: Top drivers use many different forms of R/C this scene is at Romsey at the Reedy International Race.



be very hot on 40MHz sets that do not conform to the regulations.

There are twelve 27MHz channels and they are invariably referred to by colour. To confuse matters the manufacturers all too often mark the crystals with their frequency rather than the colour. For the benefit of mankind and posterity the correlation between the two is as follows. Grey/Brown = 26.975MHz. Brown = 26.996MHz. Brown/Red = 27.025MHz. Red = 27.045MHz. Red/Orange = 27.075MHz. Orange = 27.095MHz. Orange/Yellow = 27.125MHz. Yellow = 27.145MHz. Yellow/Green = 27.175MHz. Green = 27.195MHz. Green/Blue = 27.225MHz. Blue = 27.255MHz.

The 40MHz channels are referred to by numbers. They start at 665 and go up in tens to number 955. The transmitter crystal frequencies start at 40.665MHz and raise 0.010 at a time up to 40.955MHz in line with the channel numbers.

Transmitters come in two forms. By far the most numerous in this country are the so called twin stick designs. With these one stick moves forwards and backwards to control the throttle and brake. The other moves from side to side to control the steering. The second type have the steering controlled by a steering wheel. Most of these have a pistol type handgrip with the throttle and brake operated by a trigger built into it. These are rapidly becoming the norm in many countries and are beginning to find favour here in the UK as new drivers begin to realise that they do not have to copy everything the star drivers use. Whilst virtually none of the Top Drivers in this country use steering wheel sets, many of the Top Drivers in the rest of the world do.

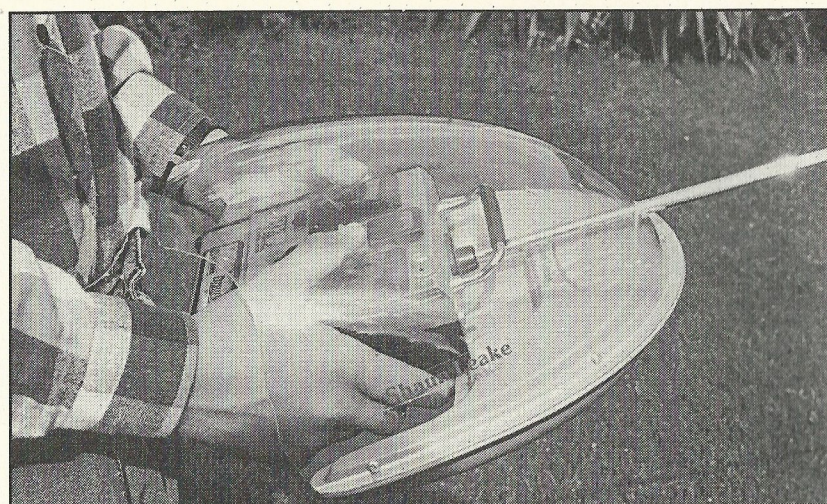
Features . . .

All sets come with trim adjusters on both channels, these are used to adjust the neutral centre point of the servos.

The next most common feature found is servo reversing switches. As the name implies they are used to reverse the direction in which the servos move.

Now we come to the features found on the more advanced and expensive sets. Servo end point adjustment enables the servo travel in either direction to be limited. Very useful this, as it saves having to keep making mechanical adjustments on the linkages. On the steering side not only can it be used to limit the amount of travel but it can also be used to take out any bias to ensure equal steering in each direction. On I.C. powered cars, look for this feature on the throttle servo as well as on the steering servo. It is necessary to make sure that the servo is never in a stalled condition which might cause it to burn out.

A rate switch is normally only to be found on the steering side. It is used to reduce the total amount of steering available. In most sets on which this is found the degree to which the servo throw is reduced is adjusted by turn-



Radio Controls do not like water: This is an available transmitter cover which stops the majority getting to contact with the transmitter.

ing a knob and the effect can be switched in or out with a separate switch.

The effect of exponential rate adjustment is less obvious. Basically it means that the servo movement can be made less sensitive in a small band either side of the neutral position. It is normally used to make the cars more stable on the straight without losing any steering lock on tight corners. It used to be found only on the steering control, but some sets are now appearing with it on the throttle, where it can be used to provide more sensitive throttle and brake control.

One set on the market has a warm up button. This is for use on I.C. powered cars only. It can be used to blip the throttle by a preset amount and frequency to keep the engine warm before the start of a race. We have a set that has this feature. Makes it very difficult to set an Electronic Speed Controller if this has been inadvertently switched on!

Some sets have the ability to use a so-called Direct Servo Control Lead. This lead enables the transmitter to be directly connected to the receiver in such a way that both may be operated in the pits, to carry out any necessary adjustments without causing any interference to others. We have sets that have this feature and I must say that at busy race meetings I have often found it invaluable, when, say, a last minute servo change has been found necessary.

On now to the receivers. Here only one term will be found that may need some explanation. BEC receivers are becoming increasingly common. These are receivers that have a Battery Eliminator Circuit built into them. This simply means that when used with electric cars they may receive their electricity supply directly from the main battery power pack thus eliminating the need to use a separate receiver power pack. The saving thus made in weight and space is obvious.

If you are intending to use an electronic speed controller you may well find that this has a BEC capability of its own so your choice of set need not be limited to those with BEC

receivers.

Before I move away from the subject of receivers one of the questions that is always put to me by beginners is—"How do we protect the radio gear from the effects of water?" Well, obviously as far as receivers go they should be well wrapped up in thick rubber balloons and covered with a layer or two of self amalgamating or electrical insulating tape. This provides some protection but more needs to be done to cover the possibility of water still getting in and or the effects of condensation. To achieve this I used to spray the PCB (printed circuit board) with pure silicon grease. This is effective and does not harm the components but it does make repairs difficult. After a few terse notes from repair workshop managers I am now a reformed character and use only materials designed for the job. I shudder to think what they used to say to Ted Longshaw, he used to pack his receiver solid with silicon grease! I now use RS Components Tropicalised Varnish, but any specialised spray designed to protect PCBs will do. Loctite PCB Protect is another that comes to mind. The same material can be used to protect the PCBs found in the servos and in electronic speed controllers. Before I leave this subject, once correctly protected it's surprising how resistant the equipment can be made to the immediate effects of water. Not so though the long-term effects. Corrosion is the big enemy and is the direct cause of a great deal of equipment failure. If you have raced in the rain unwrap the gear as soon as possible and dry it out before any damage can occur. When we are faced with this problem in a three day meeting I use the car's heater to dry out the equipment between days.

Servos . . .

On now to servos. The only term that needs any explanation here is Coreless Motors. These are a very expensive form of motor with a very low rotating mass. As a result the inertia that needs to be overcome to

get the servo moving is very much reduced and servos equipped with this type of motor are very fast to react. They are only found in servos at the top of the price range. It is worth bearing in mind that it is all too easy to burn this style of motor out. If you do they are so costly that the servo will most likely be beyond economic repair. In the old days before coreless motors it was common practice to speed up the then relatively slow servos by using five rather than four cells in the receiver packs. Some drivers still do, but with the speed of the modern servo it is no longer either necessary or desirable. Despite the fact that the servos are nominally rated at 6 volts, doing so will only shorten their life. It is also important to ensure that such servos are never allowed to be held in a stalled condition. To allow this to happen is a certain way to burn the motors out.

. . . and types

Firstly we have the basic cheap servo with a conventional motor and plain bearings. This is the type of servo that is sold with most radio sets. Despite the fact that they are cheap they should in no way be thought of as rubbish. If you are racing Tenth Scale on or off road, or Twelfth Scale Stock Cars at club level they are more than adequate and will give long and reliable service.

Next we have the miniature servos. These are very small and expensive high speed servos that were originally developed for the very specialised field of twelfth scale racing. They may be used to advantage wherever the steering loads are not too great and weight saving is an important consideration. They normally have coreless motors and are fully ball raced.

Thirdly we have the top of the range servos designed for eight scale I.C. racing. These are inevitably fully ball raced and feature coreless motors. They are fast and extremely accurate. Often the mistake is made of thinking of these as being Water Proof. It is more correct to think in terms of them as being water resistant. It is still desirable to treat the PCB. In addition to this I make a practice of spraying the outside of the servo case with a water repellent spray every time one of the cars is put on the track in the wet. Most manufacturers offer these servos with various operating speeds and torques. In effect they all have the same motor with a different gear ratio to output spline. The faster the servo the lower the torque. For circuit racing it is safe to go for the middle to higher speeds all round. They will have adequate torque and there is little danger of burning out the motor as long as the dreaded stall condition is avoided. With heavy Rally Cross cars this type of servo is only used for the throttle/brake control. Here it is better to go for the slower speed variants with their higher torque ratings.

Lastly, but by no means least, we have what is often referred to as

'brick' servos, so called because of their physical size. These are very powerful affairs capable of producing the awesome torque that is necessary to steer the modern four wheel drive eight scale rally cross car, and of withstanding the considerable loads that are fed back into them from these cars.

Before we finally move on to the subject of what the various manufacturers have to offer, there are two more questions that often crop up. The first is, "What's a Combo?" Well, I have no idea where the term originated from but it has come to be used

plastic tags that can be carefully moved to allow the contact to be drawn out of the plastic. In the case of those using metal tags it may be necessary to lever the tag back up before reinsertion so that the contact locks correctly in the plastic.

Naturally one needs to know the colour coding that each manufacturer uses before the leads can be matched up. As this is intended to be the definitive book on Model Car Racing, as far as I can establish they are as follows: Futaba is Red +ve, Black -ve, White Signal. R is Red +ve, Brown -ve, Orange Signal. Multiplex



The 2ch Dash from Sanwa is a popular choice.

for a Radio Control sold complete with transmitter, receiver and batteries etc. but no servos. I suspect that manufacturers often price their sets like this to make them look affordable, but it does have a very real advantage in that this way one can specify the servos separately.

Compatibility

The second question, or rather two questions, are: "Can I use one make of servo with another make of transmitter and receiver?" and "How do I go about it?". The answer to the first question is normally yes, though it is possible that there may be some loss of total servo travel. The answer to the second question is that most manufacturers' plugs can be persuaded to fit in other makes of equipment with the careful use of a sharp modelling knife. The snag is that they all seem to put the various wires in a different order in the plug. In order to overcome this it is necessary to remove the relevant contacts from the plug and reinsert them in the desired hole. A careful examination of the plug will reveal that these contacts are held in place by small metal or

is Red +ve, Black -ve, Yellow Signal. Sanwa is Grey or Red Tracer +ve, Centre -ve, Third Signal. KO is Red +ve, Black -ve, Blue Signal. Digifleet is Red +ve, Black -ve, Yellow Signal. Acorns is Red +ve, Black -ve, White Signal.

On now, and in no particular order, to what the various manufacturers have to offer. Sanwa sets are imported into the UK by Irvine Engines who have, as one might expect, full workshop facilities available to back the product up. Sanwa in fact make a full range of sets up to and including some very sophisticated devices. There are those of us still clinging to our old Sanwa 'Excellence' sets who wish it were otherwise but importers Irvine have chosen to concentrate on the volume end of the market. In this area they have their simple 'Dash' range of sets available both with and without servo reverse. It's difficult to ascertain the going rate for these in the shops as they are often sold as package deals complete with the cars etc. . . . As far as I can make out they can normally be found for somewhere in the region of £55.00, which is not bad for what is basically a well made and reliable set.

Whilst I find myself unable to drum up any great enthusiasm for the 'Dash', that is most definitely not the case with their second offering the 'Turbo', or as it has been previously known the 'Machine-1'. In line with the direction that the rest of The World has taken this set is in the now rapidly becoming accepted steering wheel configuration. The design itself is unusual. Instead of mounting the main body of the radio perched up on top of the pistol grip the Sanwa designers have sensibly mounted it on the front face of the grip in such a way that the pistol grip is in effect located on the back of the set. The result is a mean and purposeful looking device that is very well balanced and comfortable to hold. What really excites me about this set though is the features it packs for such a remarkable price. Dual rates with kick down, exponential, total throw adjust, servo reverse and direct servo control exactly the features I would recommend anyone who wished to take their racing seriously to look for. To find all this available in a set that can be purchased for in the region of £65.00, with two reasonable servos is indeed exceptional.

Sanwa have a range of servos available to suit all the model car racer's needs. At the bottom of the range they offer their SM 631 which should prove more than adequate for most tenth scale club racers.

Moving up!

Moving up the range they have two servos aimed at eighth scale racers. The SM 357 is a High Speed Servo (0.15sec/60deg-3.5Kg/cm) and the SM 354 is a High Torque Servo (0.25sec/60deg-5.0Kg/cm).

In the mini field they also offer two alternatives. The SM 401 (0.25sec/60deg-2.2Kg/cm) and the high speed version of the same servo the SM 410HS (0.15sec/60deg-1.5Kg/cm).

They do not have a servo to offer that is suitable for use on the steering of eighth scale rally cross cars.

Next we come to the JR range of sets imported by MacGregor Industries Ltd. Their range starts with the very basic 'Beat 2' with BEC capabilities.

Moving up market from that JR have broken away from the main stream, where PCM sets are normally only found at the top of a manufacturer's range, and produced two very competitively priced PCM sets. The 'Beat 2 CX' (PCM) is a basic twin stick set with BEC capabilities, Servo Reverse and a Fail Safe System in the event of interference occurring. It also incorporates some clever circuitry to set any electronic speed controller with which it is being used to neutral in the event that the voltage from the common power pack becomes dangerously low. The 'Alpina' is a steering wheel type set that has basically the same features as the 'Beat 2' set with the addition of steering rate adjustment.

At the top of their range comes the

Apex Racing. This is full specification twin stick set intended for the serious racer, particularly those racing IC Powered Cars. It has every conceivable feature one could possibly need and is one of only two such sets available that can meet the UK requirements of 40MHz. Even before the advent of 40MHz it was rapidly growing in popularity. Now with the expected rush towards 40MHz we can expect to see it being used in ever increasing numbers.

For those wishing to avail themselves of 40MHz sets in a lower price bracket, MacGregor do a simple conversion of their own on the Max FM range or sets, that makes this stylish twin stick range suitable for use with model cars.

All JR sets that are not PCM sets feature the clever ABC & W system in their receivers. I have yet to find out just what the initials stand for but in essence if the receiver is receiving background interference it reduces its own sensitivity to the point where



A slightly upmarket set the EX11-32S from Sanwa incorporates steering rate.

this is illuminated but it is still capable of receiving the strong command signal.

JR are cagey about their future plans, but when one looks at what they have achieved with the range that carries the suffix computer one can't help but wonder what exciting developments they may have in the pipeline for us.

As far as servos go the JR range starts with the basic NES 507 that is supplied by them with most radios. With its P.T.F.E. bearings this is a respected economically priced servo.

The JR range of coreless motor ballraced servos suitable for use with I.C. powered cars is becoming increasingly popular. They have no less than four servos on offer, the NES 4005 (0.17sec/60deg-3Kg/cm), the NES 4051 (0.19sec/60deg-3.4Kg/cm), the NES L4001 (0.23sec/60deg-4Kg/cm), and the new NES 4031 (0.25sec/60deg-4.4Kg/cm). For what it's worth we have been using the NES 4051 on the steering and the NES 4031 on the

throttle/brake.

For twelfth scale electric racing they offer the NES 205 (0.27sec/60deg-1.8Kg/cm).

K.O. sets are imported into the UK by Elite Models. They are one of the smaller Japanese manufacturers but none the less for that their products have come to be held in very high regard by the racing fraternity. The fact that their equipment is used by the Dutch Serpent Team and was also used to win the Tenth Scale World Championships last year speaks for itself. All their transmitters are presently pistol grip steering wheel types, though there are persistent rumours that they are eventually going to launch a twin stick design.

The basic set is the 'EX7', an AM set with dual neutral throttle trim and servo reverse. This set sells for £79.95.

Next up the range we have an unusual set that is built especially for electric racing. It has a tiny receiver and incorporates all the features one could possibly want, including full BEC capability. As far as I know the provision of a separate button to provide instant reverse is a feature unique to this set. I have just recently been informed that this set is now available on a legal 40MHz frequency. Bearing in mind that it is supplied with top quality servos the price of £125.00 is very reasonable.

Right at the top of the range comes the 'EX' that quite simply incorporates every feature one could possibly want and then some more. As an example it has a feature that enables the set to be used on cars that have four wheel steering, operated by two servos, in such a way that the ratio of steering between the front and rear can be varied. Like I said all the features one could possibly want and more!! The price of £199.00 represents good value with two top quality servos.

For some odd reason all K.O. sets, even those at the top of the range, have always been supplied as dry cell sets, though they do have provision for Ni-Cads by way of a charging socket. When looking at the prices it is therefore necessary to take into account that it will be desirable to purchase separate Ni-Cads and a suitable charger. Mind you, this is something that should be looked into with all sets. Many are dry cell to keep the price down, some do not even have charging jack sockets! I regard the use of Ni-Cads as highly desirable. They work out more economic in the long run, and using them one can ensure that each race is started with fully charged batteries.

Long lasting

K.O. servos have a reputation for being extremely rugged and long lasting. I can personally attest to this. I have a pair that started out life some years ago in a stock car, then did time in an I.C. powered boat, before being used briefly in a eighth scale circuit car. They are currently installed in one of our tenth scale circuit

cars and are still going strong. Apart from what comes with the kits Elite stock only two types of servo. The 301 BS is the high speed version and the 301 BZ is the high torque version. I have no performance figures for these servos to hand other than the fact that the 301 BZ delivers a massive 5.5Kg/cm of torque.

Futaba radios are imported by Ripmax and in terms of range and volumes sold must be considered the market leaders. Apart from the quality of the sets themselves, and the service back-up available, one of the features that makes the Futaba sets so popular is the availability of a very small, light and neat micro receiver. This receiver with its built in fly leads is absolutely ideal for model car racing, being very easy to fit into any car and easily made waterproof.

Attack, attack!

The basic twin stick Futaba set is the 'Attack-R'. This is a simple competitively priced set with BEC capability.

Next in the range comes the 2LGX, another twin stick set this time with additional features that make it an economically priced favourite with electric car drivers.

Up until recently the top of the range twin stick set has been the immensely popular 'FP3 EXG', or as it is more commonly known the Futaba 'Gold'. A look round the pits at any eighth scale meeting will reveal at least half the drivers using this set. Listing its features would take more space than is available here. The face and top of the transmitter is covered with knobs and switches and just about every feature imaginable is built in. This is the set that even has the famous, and I believe unique, 'Warm up Button'. In common with the top range sets of a number of other manufacturers the transmitter is modular. That is to say a section of the transmitter can be unplugged from the back so that a new one on a different frequency can be fitted. A useful feature if you intend to compete abroad.

Recently Futaba have added a PCM set to their range, the 3 EGP PCM. This set has a very comprehensive specification and appears to have been designed as a replacement for the 'FP3 EXG'.

Futaba have not neglected the steering wheel configuration. Here they have two sets on offer. The most basic of these is the 'Magnum Junior'. This set follows the classic steering wheel set design. It features steering rate adjustment, throttle low and high side trimmers and servo reversing switches. The second steering wheel set is the 'Delux Magnum'. This may be thought of as a steering wheel version of 'FP3 EXG'.

The one weakness in the Futaba range at the moment is that they are unable to offer any 40MHz sets. I can't believe that this is a situation that can be allowed to go on for long. The official line is that Futaba will not release any such sets until they are certain that they can manufacture one

that will conform to the very strict requirements of the new regulations. They are especially concerned at the very tight frequency spacings.

The basic Futaba economy servo has now become the FP-S148 (0.22sec/60deg-3Kg/cm). This rugged low profile servo has a surprisingly advanced specification for such a competitively priced servo.

Next we have the legendary FP-S132H (0.13sec/60deg-1.8Kg/cm). A glance down the equipment chart of any twelfth scale meeting will reveal that this servo is almost universally used by all the drivers. The FP-S132 is the high torque version of the same servo (0.16sec/60deg-2.4Kg/cm).

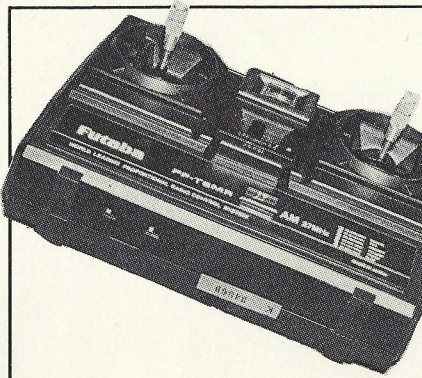
The FP-S135S (0.17sec/60deg-2.6Kg/cm) is a new servo in the mini class. Physically it is even smaller than the S132. It is slightly slower but more powerful.

The FP-S134 is the one we all rather unkindly refer to as 'The Brick', and is used in nearly all Eighth Scale Rally Cross Cars. Big it is but with an operating speed of 0.19sec/60deg and an impressive torque delivery of 8Kg/cm this is indeed a mighty servo.

Up until recently the 131SH and the high torque version the 131S were the Futaba servos that were used for eighth scale circuit racing. This servo is still available but Futaba now have a new double ballraced servo, the FP-S132 (0.24sec/60deg-4Kg/cm) available at a very reasonable price. The FP-S130S and SH is basically the same servo but uses a Coreless Motor. It looks very much as if this may well be intended to become a replacement for the 131 range.

Hundreds of drivers the length and breadth of The Land will be familiar with Acoms Radios. These are imported into the UK by RIKO who just happen to be the importers of Tamiya kits as well. Their latest offering is the 'Technidrive', which is aimed at the mass tenth scale market. A simple twin stick set with servo reverse, all I can find to say is that it appears to fulfil this task with admirable efficiency.

The home electronics supply giant Maplin (well known for the futuristic cover of their catalogue) have entered the market with two economically priced sets.

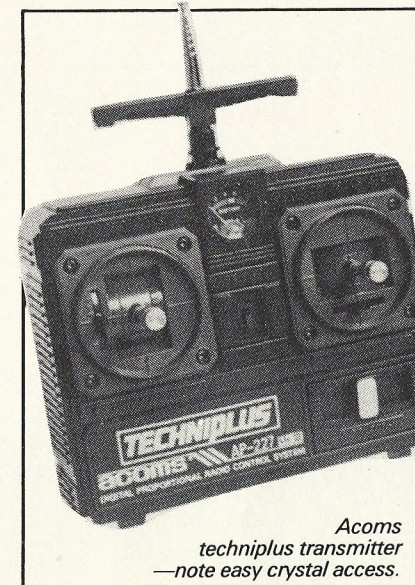


The excellent 2ch from Futaba complete with servo reversing switches.

The cheapest of these is a simple twin stick set with BEC capabilities and Servo Reversing Switches. At an advertised price of only £49.95 this set, which is also capable of being run on Ni-Cads looks very good value. The Ni-Cads, are not however included in the price.

The second set they have on offer is steering wheel type, which is slightly more sophisticated in that it has steering and throttle range control as well as servo reverse switches. This set has no BEC capabilities, but it should be born in mind that such a device is easy and simple to build, indeed only a few years ago most drivers used to do just that. No prizes for guessing where many of us got the components from, Maplin!!

Multiplex are a range of quality sets made in West Germany, import-



Acoms technidrive transmitter —note easy crystal access.

ed by Harry Brooks, with all the features any racer could want. I've left them until last, in the hope that details of their new set would be with me in time. Unfortunately they have not arrived in time so I'm left short of information. The last time I reviewed a set made by Multiplex was some two years ago when they produced one for Yankee. I remember being very impressed by the standard of construction and the comprehensive nature of its features, especially the ability to alter the braking power from the rostrum. In that review I was a little concerned at the price. Given this I now find the fact that Harry Brooks can import such a high quality set and sell it for just £150.00 as a Combo remarkable. Needless to say the Multiplex Servos are of equally high quality.

Finally, no such review would be complete without a mention of the Novak equipment imported into this country by Central Models. Not manufacturers of complete radio control systems Novak are content to manufacture very high quality specialist equipment for electric car racing. To this end they offer an extremely small and lightweight servo the NES-1A and an equally specialised receiver the NER-2S.