

MacGregor Radio Control



DIGIMAC II & III

DIGITAL PROPORTIONAL EQUIPMENT

HANDBOOK
& INSTRUCTIONS

Sole U.K. Distribution by RIPMAX LTD.

10

N.P.

AN INTRODUCTION TO MACGREGOR RADIO CONTROL AND YOUR NEW DIGIMAC OUTFIT

To the discerning modeller our name is already synonymous with precision electronics and impeccable performance. An enviable reputation gained only through years of experience and leadership in the radio control field, coupled with continued first-class workmanship and reliability, second to none. You may be confident that when you purchase MacGregor equipment, you are receiving the end product of months of intensive research, development and punishing field trials which will ensure you trouble-free performance for years to come.

All equipment is presented in the distinctive MacGregor style, with cases in brushed, blue aluminium and moulded parts in unbreakable black nylon. To prolong the attractive appearance and prevent undesirable deterioration from corrosive fluids and general wear and tear, all metal parts are heavily plated and the cases are now protected by a special clear vinyl coating.

Controls and moving parts, including the famous MacGregor MR10 and MR12 servos, have all been precision engineered to provide accurate and positive control, whilst being sufficiently rugged to withstand the inevitable hard wear to which they will be subjected. The circuits all employ the most up-to-date top quality components and various unique and revolutionary design techniques are incorporated to achieve the ultimate in stability and reliability.

The transmitter and receiver combinations have been designed from the outset to provide more than adequate interference-free range for even the keenest-sighted modeller, even in the vicinity of several other radio control operators. If you clash frequencies, the facility of plug-in crystals allows you to use any one of 12 channels suitably spread over the entire band allotted by the authorities.

Power for the equipment as supplied is, in the case of the Digimac II, derived from readily replaceable pen cell batteries. The Digimac III comes complete with nickel/cadmium rechargeable batteries and in addition sports a special RF/battery output meter. These batteries can be easily charged overnight using our AP05 Charger. Both power sources provide adequate operation time but if it is desired, rechargeable batteries can be used for the Digimac II also and a special conversion service is available. An additional advantage of rechargeable outfits is that two similar transmitters on the same frequency, can be linked via their charging sockets in a Teacher/Pupil arrangement with our AP06 'Buddy Box' Harness.

All these factors, together with the backing of our famous, unequalled after sales service, provide the degree of reliability which has become the MacGregor Hallmark.

REMEMBER, when you invest in radio control equipment, you want it to work smoothly and reliably for a long time. So do we. Our reputation depends on it! Therefore we ask you to read the following instructions carefully and follow any recommendations for installation and use so that faultless operation may be achieved with the minimum of effort.

THE MACGREGOR DIGIMAC II AND DIGIMAC III DIGITAL PROPORTIONAL RADIO CONTROL EQUIPMENT

HANDBOOK AND INSTRUCTIONS

INDEX

GENERAL INFORMATION:

List of Digimac Equipment	...	...	...	...	2
List of Digimac Accessories	...	...	...	...	3
Digimac Conversions	...	...	...	...	4
Digimac II and Digimac III Specifications	...	...	...	...	5
What is Digital Proportional Control?	...	...	...	...	6
A simple introduction to the workings of these systems for the non-technical modeller.					
List of Crystal Frequencies and Colour Coding	...	...	...	...	8
License Information	...	...	...	...	8
INSTRUCTIONS FOR DIGIMACS II AND III	...	...	...	...	9
General:—	The transmitter—Controls and Functions	...	...	...	10
	Interchanging Control Ratchets/Springs	...	...	...	12
	The Receiver and Servos—Hook-up and Channel Identification	...	...	...	13
	Crystals and fitting them	...	...	...	14
	Dry Battery Supplies for Digimac II	...	...	...	15
	Charging Instructions for Digimac III	...	...	...	15
Operating Instructions:—	General Test and Operational procedure	...	...	...	17
	Pre-Operational Check and Range Tests	...	...	...	18
	Teacher/Pupil Operation	...	...	...	18
Installation:—	Servos and Linkages	...	...	...	19
	Receiver and Power Packs	...	...	...	21
	General Installation Tips including Suppression of Electric Drive Motors	...	...	...	22
Final Re-Cap and Fault Check List	...	...	...	...	23
GUARANTEE AND REPAIR SERVICE	...	...	...	...	24
LIST OF REPLACEMENT SPARES AND CONVERSION CHARGES	...	...	...	...	25

LIST OF DIGIMAC EQUIPMENT

Items shown under the combo headings below are normally supplied together in a special presentation box.

Please check the contents carefully and make sure everything is there.

Servos and crystals are supplied separately to the above, but spaces are provided in the presentation box for containing these.

MR1222 Digimac II Combo

- 1 MR1200 2 channel Transmitter complete with 6 pen-cell, clip-in battery box.
- 1 MR22 2 channel Receiver/Decoder.
- 1 AP09P Receiver/Servo 4 pen cell Battery Pack with switch and harness.
- 1 Packet containing one control centring spring and one control ratchet bar with two fixing screws.

MR1323 Digimac III Combo

- 1 MR1300 3 channel Transmitter including integral 280mAh re-chargeable power pack.
- 1 MR23 3 channel Receiver/Decoder.
- 1 AP04P 280mAh Receiver/Servo Rechargeable Power Pack with switch and harness.
- 1 AP05 Dual Purpose Charger for 280 Power Packs.
- 1 AP08P Digimac Charging Harness.
- 1 Packet containing two control ratchet bars with four screws.

Plus:

- 1 Pair MR0-6 Matched Crystals to your own choice of frequency (twelve available).
- 1-3 MR10P Standard Digimac Servos, or MR12P Miniature Digimac Servos.

All servos are supplied complete with 4 mounting grommets and 2 different output devices (Disc and Arm).

DIGIMAC ACCESSORIES

In addition to the standard range of Digimac units, i.e. Transmitter, Receiver and Servos, the following accessories are available to allow complete versatility of the equipment in any application. The items are available at any Ripmax stockist or in case of difficulty please write to MacGregor Radio Control.

- *MR14 Proportional Sail Winch Unit.
This unit is designed to fit any of the Ripmax Pile Motors so that any degree of torque can be obtained.
- *MR15 Proportional Speed Control Unit.
A completely self contained electronic unit which gives proportional speed control both in forward and reverse. For motors up to 12 volt 10 amps.
- AP06 'Buddy Box' Harness—See page 18 of Manual.
- AP07 Servo Tray.
Moulded in nylon and designed to take 3 MR10P servos plus receiver switch—See page 19.
- AP10 Adjusto Links.
Moulded in unbreakable polypropylene, these links connect directly from push rod to control surface via a one piece hinge. Fully adjustable with thumbscrew. Sold in pairs.
- AP12 One Piece Hinges.
The perfect answer for slop-free control surfaces. Moulded in unbreakable polypropylene. Sold in packs of one dozen.
- AP14 Electric Motor Switcher Unit.
Designed to fit both MR9 and MR10 Servos. This unit will provide forward/stop/reverse control of electric motors up to 12 volts 10 amps.
- AP17 Servo Mounting brackets.
Sold in pairs, these brackets are for individual mounting of MR10 Servos.

*These items will become available sometime during the first half of 1973.

DIGIMAC CONVERSIONS

In order to cater for the individual requirements of modellers and provide the greatest value for money, the following conversions can be carried out at our factory.

Conversion of Digimac II to Rechargeable Operation:

The Digimac II outfit, as supplied, is designed to work from readily replaceable pen cell batteries and full compensation for reductions and fluctuations in battery voltages is incorporated.

However, if desired, rechargeable nickel/cadmium batteries, as used in the Digimac III outfit, may be used instead of the dry batteries. Voltages required for the Ni/Cads are 8.4 volts for the transmitter and 4.8 volts centre-tapped for the receiver and servos, and a minimum capacity of 280mAh is recommended for both.

The MacGregor AP04P Rechargeable Power Pack is recommended for use with the receiver and servos and this comes complete with integral switch and moulded battery box.

To convert the transmitter a special factory conversion service is offered. This consists of the fitting of appropriate 280mAh cells into the transmitter together with a charging socket. A special Charging Harness is also supplied for charging both batteries simultaneously with our AP05 Charger or similar.

The converted transmitter can also be used for teacher/pupil operation using our AP06 'Buddy Box' Harness and this is described on Page 18.

Only the Digimac II transmitter is required by us for this service and the scale of charges is indicated on the back page of this manual.

Conversion of Digimac II to Digimac III:

The Digimac II has been designed to enable conversion to three channel operation to be carried out easily and at reasonable cost. When converted, the Digimac II is identical in every respect to the standard shop bought Digimac III including a 280mAh rechargeable ni/Cad battery, charging socket and output meter in the transmitter, and the appropriate case fronts. The AP09P Dry Battery Pack can still be used for the receiver and servos, or alternatively we recommend the use of our AP04P Rechargeable Power Pack which can be supplied with the above conversion. A charging harness will be supplied with the converted outfit for charging the batteries simultaneously with our AP05 Charger or similar.

For this service we require the transmitter and receiver to be sent to us, and charges for this conversion are included on the back page of this manual.

Further Conversions:

Although no further extensions can be made beyond three channel operation in the above transmitters, it should be noted that the MR22 and MR23 receivers can be converted right up to six channel operation. Details can also be found on page 25.

If you require any of these conversions, the appropriate units should be carefully packed and sent, together with your cheque or Postal Order for the correct amount (including return postage) to:— MacGregor Industries Limited.

DIGIMAC II AND III SPECIFICATIONS

MR1200 and MR1300 Transmitters:

Size	: 151mm x 142mm x 38mm (6" x 5.6" x 1.5") Long control levers extend 27mm (1.1") beyond case front.
Weight	: Digimac II with dry batteries—1 lb. 1 oz. (482 gms) Digimac II with 280 Ni/Cads—1 lb. 2 oz. (510 gms) Digimac III with 280 Ni/Cads—1 lb. 3¾ oz. (550 gms)
Aerial	: Bottom loaded, telescopic 1.26m (48") fully extended. 61mm (2.4") retracted.
Supply	: Digimac II—9 volts from 6 x 1½ volt pen cells. Digimac III—9.6 volts from internal 8 cell 280mAh rechargeable Nickel/Cadmium power pack.
Charging Digimac III	: 28 mA maximum for 14-16 hours via D.I.N. socket in side of case.

MR22 and MR23 Receiver/Decoders:

Size	: 70mm x 38mm x 22mm (2.75" x 1.5" x 0.875")
Weight	: MR22—1.9 oz. (53.9 gms) MR23—2.0 oz. (56.7 gms)
Supply	: 4.8 volts Ni/Cads or 6 volt Dry cells.
I.F. Frequ.	: 470 KHz

MR10P Standard Digimac Servo:

Size	: 48mm x 36mm x 21.5mm (1.875" x 1.4" x 0.85") O/P devices extend 6.5mm (0.25") above case. Lugs with grommets protrude 8mm (0.3") either end.
Weight	: 1.8 ounces (51 gms)
Output	: Rotary via alternative disc or arm.
Thrust	: Up to 5 lb over 90 deg. transit (Inner hole)
Transit Time	: 1 sec for complete transit.
Supply	: 2.4 + 2.4 volts Ni/Cads or 3 + 3 volts Dry Batteries.

AP09P Dry Battery Receiver/Servo Pack:

Size	: 60mm x 30mm x 30mm (2.375" x 1.16" x 1.16")
Weight	: 2.8 ounces (79.5 gms) with switch, harness and 4 x 1½ volt pen cells.

AP04P 280mAh Rechargeable Receiver/Servo Pack:

Size	: 39mm x 39mm x 32mm (1.55" x 1.55" x 1.25")
Weight	: 3.5 ounces (99 gms) with switch and harness.
Cells	: 4 x 280mAh Nickel/Cadmium cells, 4.8 volt C.T.

Installation Weights

Digimac II	: MR22 Receiver and 2 MR10P Servos With AP09P Power Pack—8.3 oz. (235 gms) With AP04P Power Pack—9.0 oz. (255 gms)
Digimac III	: MR23 Receiver and 3 MR10P Servos with AP04P Power Pack—10.90 ounces (309 gms).

WHAT IS DIGITAL PROPORTIONAL CONTROL?

Whilst it is not necessary to know how your new radio outfit achieves its control in order to operate it successfully, it is felt that the following simple explanation of the system may be of interest to some modellers. Sometimes even a elementary knowledge of the workings of technical equipment can help one to avoid simple mistakes which otherwise may be made quite unwittingly.

The systems that are used in everyday life are usually proportional. For example, when the wheel of a ship is turned, or similarly the steering wheel of a car, the appropriate control, i.e. rudder and front wheels respectively, turn by a proportional amount. However, in the case of radio control equipment this precise operation is achieved by sending information in the form of electrical energy through the air to control a remote mechanism instead of via physical connecting links.

How is this done? In a 'digital' radio system things can be made a little simpler to comprehend by likening the process to a movie film. In the latter, a series of still pictures or 'frames' are projected in rapid succession, each one depicting the position or size of moving objects at one particular moment during this movement. The resulting effect on the screen is a continuous moving picture, the staccato effect of the pictures being 'smoothed out' by the eye. Similarly, in a 'digital' system the transmitter is a 'projector', sending out information in a continuous stream of 'frames' of equal duration but this time it is radio energy and not light that is transmitted. The complete frame consists of a series of periods or pulses of energy, formed by switching the radio signal on and off rapidly at determined intervals. The duration of transmission between each break and the next is controlled by one of the sticks on the transmitter, hence if there are four breaks there will be three independantly variable periods of transmission or 'pulses' between them. If a stick is moved, the corresponding pulse will increase or decrease proportionally in each successive frame that is transmitted. To complete the frames, after all the pulses have been transmitted, a pause, or fixed period of uninterrupted signal, is added to separate successive frames and enable the decoding electronics in the receiver to reset, in order to be able to accept the next frame. In practise, tens of frames are produced each second.

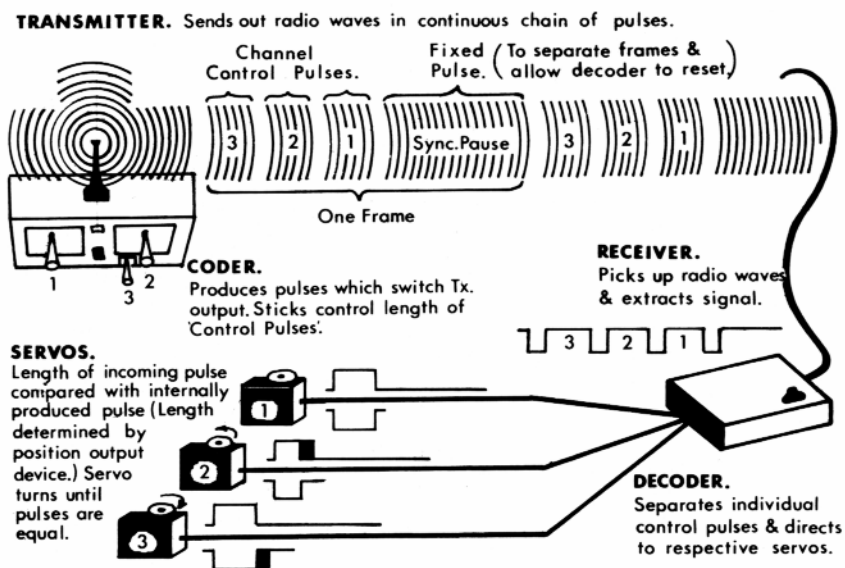
O.K. so far? Lets move on now to the receiving end. It would be a little difficult in such a simple discussion to explain how the complex superhet receiver picks up the radio signal and processes it. Therefore it will suffice to say that the receiver simply acts like a switch—so that it is 'on' when it receives a pulse and goes off in between each pulse. Hence the result is a chain of 'ons' and 'offs', still in frames and still exactly following the orders as given out by the transmitter. This information is then passed to the decoder which, by a process used in computers termed 'logic', separates the individual control pulses in each frame. In the case we considered, i.e. 3 channel, we would have three quite separate chains of pulses from three independent outputs. Each chain consisting of one of the three pulses in the original frames, separated

by a fixed 'off' period. The final link in the system is the servo. Here the pulses, which don't forget are still variable from the transmitter, are compared with a similar pulse internally produced by the servo. This internal pulse starts at the same time as the incoming pulse and its duration is controlled by the position of the output arm. The servo is driven in one direction or the other, if the input pulses are longer or shorter than the internal comparison pulse, until the servo corrects the discrepancy and hence comes to rest. As with the film, the frames are produced so fast that the resultant action is continuous and extremely sensitive.

Now you know all about it. Not too difficult is it?

Remember though, the electronic circuits involved in these processes, although appearing reasonably simple in terms of action, are extremely complex and should at all times be treated with the highest respect.

Fig. 1.



LIST OF CRYSTAL FREQUENCIES FOR MACGREGOR DIGIMAC

This list includes all the channel frequencies commonly used in the U.K. and most other countries, for model radio control. It utilizes the entire "27 KHz Band" allotted by the G.P.O. for this purpose, whilst allowing sufficient channel separation to allow acceptable rejection of 'foreign' frequencies by the superhet receiver.

MACGREGOR MATCHED CRYSTALS are accurately ground and selected to a rigid specification to conform with the conditions given above. They are supplied in pairs and are colour coded as per the table. Transmitter and receiver crystals are marked T and R respectively, so they cannot be confused.

Appropriately coloured MACGREGOR FREQUENCY PENNANTS which clip directly onto the transmitter aerial are also available.

All the frequencies shown are available in MacGregor Matched Crystals with the exception of the last, which is omitted for technical reasons, and the list includes respective receiver crystal frequencies for MacGregor receivers. Colour codes for identification of channels are indicated, together with the MacGregor part number.

Channel	Colour	TX.Frequency (MHz)	RX.Frequency (MHz)	Part No.
1	Brown/Grey	26.970	26.500	MR0
2	Brown	26.995	26.525	MR1
3	Red/ Brown	27.020	26.550	MR1/2
4	Red	27.045	26.575	MR2
5	Orange/Red	27.070	26.600	MR2/3
6	Orange	27.095	26.625	MR3
7	Yellow/Orange	27.120	26.650	MR3/4
8	Yellow	27.145	26.675	MR4
9	Green/ Yellow	27.170	26.700	MR4/5
10	Green	27.195	26.725	MR5
11	Blue/Green	27.220	26.750	MR5/6
12	Blue	27.255	26.785	MR6
13	White	27.270	26.800	Not available

LICENCES

You need a licence to operate model control equipment. No tests, etc., are involved, and the cost is a modest £1.50 for five years.

Apart from the obvious possibility of restrictions if licence dodging is indulged in, the more licences are issued, the greater the voice of radio control enthusiasts in official circles. Licence forms should be obtained from G.P.O. Radio and Broadcasting Department, Waterloo Bridge House, Waterloo Road, London, S.E.1.

INSTRUCTIONS

PLEASE READ CAREFULLY AND TAKE MENTAL NOTE OF ANY PRECAUTIONS AND TIPS MADE AS TO THE OPERATION AND INSTALLATION OF THIS EQUIPMENT. MORE OPERATIONAL FAILURES ARE DUE TO POOR INSTALLATION AND MISUNDERSTANDING OF INSTRUCTIONS THAN ANY OTHER SINGLE CAUSE.

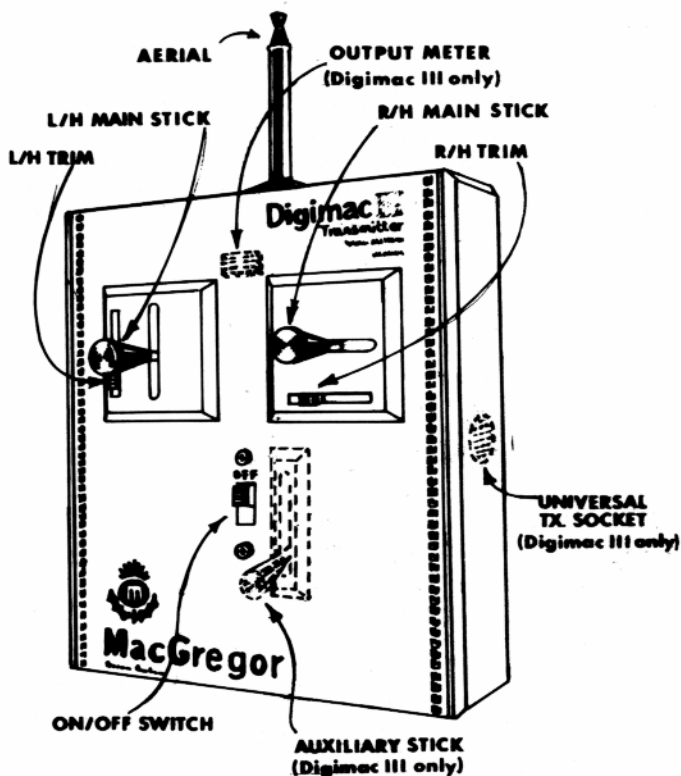
THIS EQUIPMENT IS FULLY PRETUNED AND ALIGNED IN EVERY RESPECT, AND DOES NOT REQUIRE ANY ADJUSTMENT WHATSOEVER.

DO NOT TAMPER WITH IT AND UNDER NO CIRCUMSTANCES ALLOW ANY PERSONS QUALIFIED OR UNQUALIFIED TO ATTEMPT ANY REPAIRS OR ADJUSTMENT TO THE SYSTEM—THIS VOIDS THE GUARANTEE.

(See page 24)

THE DIGIMAC II AND III TRANSMITTERS

Fig. 2.



THE TRANSMITTER CONTROLS

Operation:

The Digimac II and III transmitters are both provided with two primary, single axis, joy stick controls, each of which operates one independent simultaneous function. The right hand stick moves from side to side, horizontally and the left hand stick moves vertically, up and down. The joy sticks are so designed and positioned so as to facilitate simple and convenient simultaneous operation with the thumbs of each hand.

Both the primary controls have their own separate electro-mechanical trim control, which allows minute adjustments to be made without altering the physical position or movement of the joy stick. In this way the models attitude, once in motion, may be corrected to 'straight and level' whilst the control sticks remain at neutral. Trim levers move in the same direction as their associated main controls and are located as shown in the diagram opposite.

The Digimac III transmitter, in addition to the above, has an extra non-trimmable auxiliary control and this is located immediately below the right hand main stick. The control moves up and down, vertically and provides a third simultaneous, fully proportional function.

Function:

As supplied, the right hand horizontal function of the Digimac II is self centring and is thus intended for directional control of a model boat, car or 'rudder only' aircraft. The left hand control on the other hand, is ratchet controlled and can be preset to any desired position for controlling engine speed.

On the Digimac III, both left and right primary functions are supplied with self centring action, whilst the third auxiliary function is ratchet controlled. In this mode the unit is intended for use with model aircraft with two directional controls (such as elevator and rudder, or elevator and ailerons) plus engine throttle control.

Should you find the particular arrangement of your transmitter alien to your tastes, or simply unsuitable for your particular model, the controls can be rearranged. For instance slope soaring fans often require all controls on a Digimac II or III to be self centring or the boating enthusiast with a Digimac III will find it easier with throttle (i.e. ratchet control) on the left main control rather than using the auxiliary.

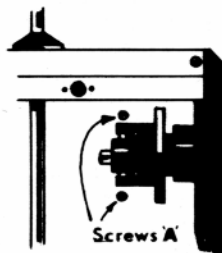
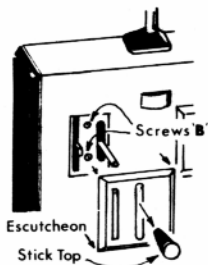
Full instructions for interchanging ratchets, etc., on the two primary functions, can be found on the next page. The Digimac III auxiliary function cannot be modified to self centring simply, as it involves dismantling of the assembly. We therefore request in this case that the transmitter be returned to us together with a suitable note and a cheque or postal order for £1-25 to cover handling costs and return postage, and we will endeavour to return it to you within 48 hours.

Incidentally, a useful tip when using the left hand primary control for throttle is to utilise the trim as a 'motor cut' facility. To do this, adjust 'tickover' of your engine whilst main stick is at 'slow' and trim is at 'fast'. When the trim is then moved to 'slow', further closing of the throttle will cause the engine to stop.

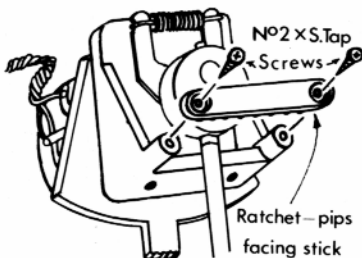
INSTRUCTIONS FOR INTERCHANGING MAIN CONTROL MODES

A. Self Centring to Ratchet Action:

- 1 Make sure transmitter switch is OFF before attempting any alterations.
- 2 Remove the control stick end knob, by turning clockwise and pulling simultaneously.
- 3 Remove the transmitter back. Then remove front escutcheon retaining screws 'A' using a 'Pozidrive' screwdriver and lift off escutcheon.



- 4 Unscrew and remove screws 'B' and carefully lift stick assembly away from p.c. board. Take care not to pull or damage attached wires.
- 5 Screw ratchet bar in place with screws provided, as shown. Tighten until you have desired ratchet action.
- 6 Replace stick assembly carefully and fit screws 'B'. Make sure lever is 'free' to move before finally tightening screws.
- 7 Refit front escutcheon over main stick and trim lever and locate in case cut out. Hold the escutcheon in place and refit retaining screws 'A'.
- 8 Push on the control stick end knob and finally, remove the centring spring from the metal gimbals. Keep the spring somewhere safe as it may be required again.



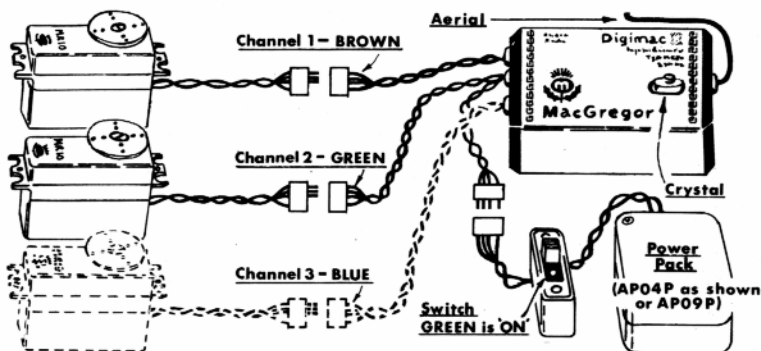
MAKE NO ATTEMPT TO REMOVE GIMBALS OF CENTRING MECHANISM AS THIS WILL RESULT IN LOSS OF CRITICAL CONTROL SETTING. It is quite safe to leave these loose as they cannot interfere with operation in any way.

B. Ratchet to Self-Centring Action:

- 1 Repeat steps A1 to A4 above and then unscrew or remove completely the ratchet bar.
- 2 Fit centring spring provided over the gimbal ends so that the loops at each end sit in the nicks in the gimbals.
- 3 Refit assembly following steps A6-A7 above.

THE DIGIMAC II AND III RECEIVERS AND SERVOS

Fig. 3.



The Digimac II and III Receivers have connected, at one end, a piece of white insulated wire 33" long. This is the aerial and no electrical connection is made to this wire at all. Details for positioning etc., of this aerial are discussed later in the section dealing with Installation, but it will suffice for now to say that it should always be fully extended when operating the outfit, and its end should not be allowed to touch any metal objects.

At the other end of the receivers are several wire looms. Three in the case of the Digimac II and four on the Digimac III. One of these looms in each case is terminated in a 4-pin plug and the others in 4-pin sockets. The plug is for connection of the receiver to the AP04P RECEIVER/SERVO POWER PACK via a mating 4-pin socket on the connecting harness.

All MacGregor plugs and sockets are polarized, i.e. one pin/socket connection is reversed, and they cannot be connected the wrong way.

PLEASE NOTE: WHEN CONNECTING A RECEIVER TO A POWER PACK, SWITCH THE SLIDE SWITCH IN THE HARNESS OFF UNTIL REQUIRED. UNNECESSARY DRAIN ON THE BATTERY WILL RESULT OTHERWISE. 'ON' IS INDICATED BY A GREEN DOT ON THE SWITCH SLIDER.

All the remaining looms from each receiver are for connection to the servos (or alternative control devices) and each is made up of four wires. The red, black and white wires are common to all these looms. The fourth, the output lead, bears the colour which correlates the respective output of the decoder with its corresponding control on the transmitter as follows:

CHANNEL COLOUR TRANSMITTER CONTROL

Digimac II and	1	Brown	R.H. STICK	VERTICAL
Digimac III	2	Green	R.H. STICK	HORIZONTAL
Digimac III only	3	Blue	AUXILIARY STICK	

The MR10P and MR12P Servos are all fitted with approximately 6 inches of cable to allow for a wide choice of positioning, and each has a 4-pin polarized plug which is connected directly to one of the receiver outputs. All servos are identical and can be connected in any order.

CRYSTALS:

One pair of MacGregor Matched Crystals is supplied with your outfit and their frequencies are identified by their colour, as per the table on Page 8. A MACGREGOR FREQUENCY PENNANT or alternatively a 9" length of ribbon, coloured accordingly, should be clipped to the transmitter aerial at all times to indicate your frequency to other modellers.

DON'T FORGET TO CHANGE THE PENNANT IF YOU CHANGE CRYSTALS!

The Transmitter crystal determines the actual Radio Frequency transmitted and this is the frequency normally referred to. The matching Receiver crystal is 470 KHz below that of the Transmitter and this is essential for the correct operation of the Superhet receiver. So, **ALWAYS USE MACGREGOR MATCHED CRYSTALS** and always ensure that you put the Transmitter crystal in the Transmitter and the Receiver crystal in the Receiver.

TRANSMITTER CRYSTALS are marked with a 'T'.

RECEIVER CRYSTALS are marked with an 'R'.

Fitting:

To fit the Transmitter crystal, remove the case back by turning the fasteners through 90° and lift off. Viewing from the back, the crystal socket is located to the right of the aerial, adjacent to the on/off switch. Simply plug the crystal into this socket and refasten the back by lining up the stud slots with the top of the case and press firmly home.

To fit the Receiver crystal simply insert it through the hole in the case and push home.

TAKE GREAT CARE NOT TO DROP OR HEAT CRYSTALS, as they are delicate components which can easily be damaged by both impact and heat.

POWER SUPPLIES:

Digimac II With Dry Battery Packs:

As supplied the Digimac II is provided with special moulded battery boxes for both the transmitter and for the receiver and servos. These are designed to take standard high power, 1½ volt pen cell batteries—six for the transmitter and four for the receiver and servos.

To gain access to the transmitter battery pack remove the case back plate. The battery box is in the left hand side and should be removed in order to fit the pen cells.

WHEN INSERTING CELLS INTO A BATTERY BOX, OBSERVE THE POLARITY CAREFULLY. THIS IS CLEARLY PRINTED IN EACH RECEPTACLE OF THE BOX. ALSO, MAKE SURE THE CELLS ARE PROPERLY IN PLACE BEFORE REPLACING THE PACK IN THE TRANSMITTER.—A good tip is to wrap tape around the full battery pack to ensure the cells stay in place.

A press stud connector is provided for connection of the transmitter pack, and this should be pressed firmly into place before replacing the pack in the transmitter case. This connector also ensures correct polarization of the supply.

After fitting the batteries and the crystal (see previous page) replace the transmitter back plate.

The receiver/servo power pack is dealt with in the same manner as the transmitter pack but in this case only four pen cells are required and connection to the receiver is made via a four-pin polarized socket which mates with the four pin plug on the receiver.

Replacement: Provided high power type pen cells are used, the battery packs will provide continuous operation for up to 3 hours. Wherever possible, however, it is recommended that a voltmeter be used to test both power packs on load.

THE BATTERIES SHOULD BE CHANGED WHEN THEY REACH 7.5 VOLTS AND 4.8 VOLTS FOR THE TRANSMITTER AND RECEIVER RESPECTIVELY. Below these voltages the set may continue to operate but servo action will be erratic and range will be seriously reduced, so that operation under these circumstances should not be attempted. Never replace single cells at a time, as this, although not detrimental to the equipment will considerably reduce the life of the new cells.

The Digimac III with Rechargeable Power Packs:

In these outfits, as supplied, the power packs are partially charged and may be operated for a short time in order to check the correct operation of the outfit. However, **BEFORE ATTEMPTING TO OPERATE THE OUTFIT IN A MODEL, BOTH TX. AND RX. POWER PACKS MUST BE CHARGED OVERNIGHT, i.e. 14-16 HOURS.**

Chargers: The AP05 280 mAh CHARGER is specifically designed for use with the DIGIMAC and provides the correct constant current output for charging both receiver and transmitter power packs simultaneously. The charger is complete with its own 3 core mains flex and all that is required

for correct operation is the addition of a 3-pin mains plug. A 2-amp fused plug is recommended here if possible.

IT IS IMPORTANT TO FIT A MAINS PLUG PROPERLY, SO IF YOU ARE IN ANY DOUBT WHATSOEVER, CONSULT YOUR LOCAL ELECTRICAL SHOP OR A QUALIFIED ELECTRICIAN.

Unless an alternative charger is ordered specially, the mains supply requirements are 220-440 volts A.C. ONLY. ON NO ACCOUNT SHOULD THE CHARGERS BE CONNECTED TO A DIRECT CURRENT, (D.C.) SUPPLY.

Alternative chargers may be used with the Digimac if desired, but the correct charge rate for both power packs must be adhered to, i.e. 28mA MAXIMUM for 14-16 hours. A CONSTANT CURRENT charger, specifically designed for this type of cell must be used however. A car battery charger is NOT suitable.

Charging:

- 1 Plug the RED and BLACK banana plugs of the AP08P Charging Harness into the respective coloured sockets on the charger. **MAKE SURE NEVER TO PLUG THESE CHARGER PLUGS IN THE WRONG WAY ROUND. SERIOUS, IRREPARABLE DAMAGE CAN BE CAUSED TO THE SPECIAL NICKEL CADMIUM CELLS BY REVERSE CHARGING.**
- 2 Plug the Transmitter Charging Plug into the Universal socket in the right hand side of the Transmitter. For charging, the Transmitter must be switched 'OFF', or no charge will flow to the power packs.
- 3 Connect the polarized 4-pin Receiver Charging Plug to the mating socket on the Receiver/Servo Power Pack harness and switch the slide switch 'ON'.
- 4 Plug the Charger into the mains. The charging indicator light will glow red when charging is in progress and this will gradually become dimmer as charging proceeds. During charging the Charger will get warm. This is quite normal and there is no cause for alarm.
- 5 After a period of 14 to 16 hours switch 'OFF' and disconnect the charger from the mains.
- 6 To check the charge of the batteries, unplug the charging harness, plug in the Transmitter crystal and replace the back, fully extend the aerial and Switch on. The output meter should read well up in the GREEN sector if the batteries are fully charged.

As the equipment is used, the meter reading will slowly drop until after approximately 2-2½ hours (3½-4 hours in the case of 550 Power Packs) it will reach the white dividing line between the red and green sectors. **WHEN THE NEEDLE IS ON THE WHITE LINE THE BATTERIES ARE DISCHARGED AND MUST BE RECHARGED BEFORE FURTHER USE.** If you are operating when this occurs, however, don't panic. The batteries will have sufficient residual charge to keep the set operating for a period long enough to bring your model back. Do not abuse the safety factor however as after a period of several minutes the batteries will flatten completely and the set will cease to function. (Meter drops into RED sector).

continued over..

ALWAYS recharge before use. If the batteries are not fully discharged however (i.e. Meter still in GREEN) it is not necessary to charge for the full 14-16 hours every time. In such a case, a charge period equal to seven times the time for which the batteries have been used is sufficient. Note, however, it is recommended that after about fifteen successive charges in this manner, the batteries be discharged (until the meter is on the white line) and recharged for the full 16 hours.

OPERATING INSTRUCTIONS

Hook up and general test procedure:

- 1 With reference to the diagram on page 13, connect the receiver to Receiver/Servo Power pack with switch in the 'OFF' position, and connect the Servos in any order. Refer to the table of receiver output codings on Page 14 to select controls desired.
- 2 Insert the Crystal marked 'R' into the Receiver and extend the Receiver Aerial.
- 3 Insert the Transmitter Crystal, marked 'T' and also, in the case of the Digimac II, the Dry Battery Pack if not already fitted. Replace the transmitter back plate.
- 4 Digimac II: Switch the Transmitter 'ON' and, for the purposes of checking the system only, fully retract the aerial.

Digimac III: Fully extend the Transmitter Aerial and then switch the Transmitter 'ON'. The Output Meter should read in the green sector. If not, switch off and check as follows:—

Needle well down in RED Sector	a) No Crystal in Transmitter or Crystal is faulty. Fit or replace Crystal and proceed.
	b) Battery completely discharged. Recharge fully before proceeding.
Needle on WHITE dividing line	c) Battery just discharged. Recharge fully before proceeding.

If Meter is reading correctly, proceed as follows:

Retract Transmitter Aerial for checking the system. The Output Meter reading will drop but this can be ignored.

- 5 Switch on the Receiver. If not already in their centred positions, the Servos should immediately centralize with the exception of those which are on ratchet controlled channels. These will take up their positions relative to the positions of the controls on the Transmitter.
- 6 The Servos should now follow any movement of the respective Transmitter controls or trims and a check should be made to ensure fully free movements on all channels.
- 7 Finally, SWITCH OFF THE RECEIVER THEN SWITCH OFF TRANSMITTER IN THAT ORDER. This is simply to ensure that all the servos remain centred (or at a prefixed position dependant upon the Transmitter controls) and ready for installation. For the same reasons, always switch the Transmitter on first, then the Receiver.

Pre-operational Check:

When your installation is completed and you are completely satisfied with its operation (See pages 19-22 on Installation), **ALWAYS CHECK THE SYSTEM FOR CORRECT OPERATION AND RANGE ON EVERY OCCASION BEFORE RELEASING YOUR MODEL.**

Initially the Maximum range* with the Transmitter Aerial full extended should be verified and the results noted. This should be carried out by two people ideally, one holding the Transmitter normally and the other walking with the model held at shoulder height and the extended Receiver Aerial at right angles to the direction he is going. The range with the Aerial fully retracted* should also be assessed and noted. This latter measurement is sufficient to verify the complete range of the equipment and should be checked before each days operation and also after any crash or particularly heavy landing.

* Please Note: Figures are deliberately not given concerning range. When checking these radio systems at ground level, atmospheric and ground conditions, as well as immediate environmental surroundings, can affect the figure obtained. Therefore, as stated above, the ground range should be assessed for yourself individually. Ground to air range will be more than adequate for any model.

BEFORE LAUNCHING REMEMBER TO FULLY EXTEND THE TRANSMITTER AERIAL.

Teacher/Pupil operation:

The MACGREGOR AP06 "BUDDY BOX" HARNESS is available as an extra and enables two rechargeable transmitters fitted with the Universal Charging Socket and on the same frequency, to be linked as a Teacher/Pupil system. This arrangement is particularly recommended for 'novice' operators, especially when flying model aircraft, as it allows the pupil to control with the ability of the teacher, an experienced operator, to take over at any time he chooses to demonstrate manoeuvres or avoid an accident. In this way, training can be completed without loss or damage of models which is bound to occur when learning alone.

To connect the 'Buddy Box' Harness, plug the BLACK plug into the socket of the PUPILS transmitter and the GREY plug into the TEACHERS transmitter. The Pupils' transmitter must be switched 'OFF' and remain 'OFF'. Then with the Teachers' transmitter 'OFF', the pupils transmitter is automatically on via the harness. The Teacher can "over-rule" at any time by simply switching 'ON'.

For model aircraft, it is recommended that the Teacher first takes the plane up using the Pupils transmitter and trims it for correct flying attitude. Then on the second flight, when the Transmitters are linked, he can trim his own Transmitter to suit and be confident that when he hands over control the novice can take over where he left off.

INSTALLATION

The Digimacs II and III are precision control systems capable of a high degree of resolution and accuracy. Therefore, in order to reap the benefits from these intrinsic values, installation and mechanical connections must be of a similarly high standard. It is not worth risking a valuable radio outfit and model for the sake of a few hours work to ensure a neat, reliable system!

Servos and Linkages

The most important thing to remember when installing servos into a model is that they are miniature, precision machines and should be treated accordingly and with respect.

Therefore:

1 Always mount servos securely, yet resiliently so as to absorb any undue vibration which would otherwise be transmitted to the servos, and hence could be detrimental.

By far the best way of mounting servos in model boats and model aeroplanes (except that which is used for ailerons) is to use a servo tray which itself is resiliently mounted on hardwood bearers glued into the model. The MACGREGOR AP07 SERVO TRAY is recommended here and is specially made from unbreakable nylon to take three MR10 servos, two side by side longitudinally and one laterally. Provision is also made for mounting the receiver switch on the tray. Each servo is individually mounted on its own grommets and the entire unit is additionally supported on four corner grommets. An alternative home made servo tray may be used if desired, made from either plywood or Tufnol and cut out to suit your particular installation.

Some installations demand individually mounted servos and therefore the above method cannot be used. In such cases the servos can be mounted, once again with their own individual grommets, onto hardwood bearers as with the servo tray or onto MACGREGOR AP17 SERVO MOUNTING BRACKETS as shown on Page 20.

To mount servos, a washer should be placed on each of the four mounting screws before passing through the grommets. The screws should be tightened until the washer rests on the grommet and then given one extra turn. **DO NOT OVERTIGHTEN MOUNTING SCREWS**, or essential resilience of grommets will be lost.

A double sided adhesive, resilient tape is also commercially available for mounting servos. Use of this should be avoided, however, except where alternative mounting methods, as above, are completely impractical.

2 Make sure connecting harnesses and plug/socket connections are not trapped or strained in any way.

These should be run along paths such that they cannot be crimped or pulled by moving linkages or removable hatches and wings, (e.g. One piece wings with integral aileron servo). Where possible, tape the harnesses

SERVO MOUNTING AND LINKAGES

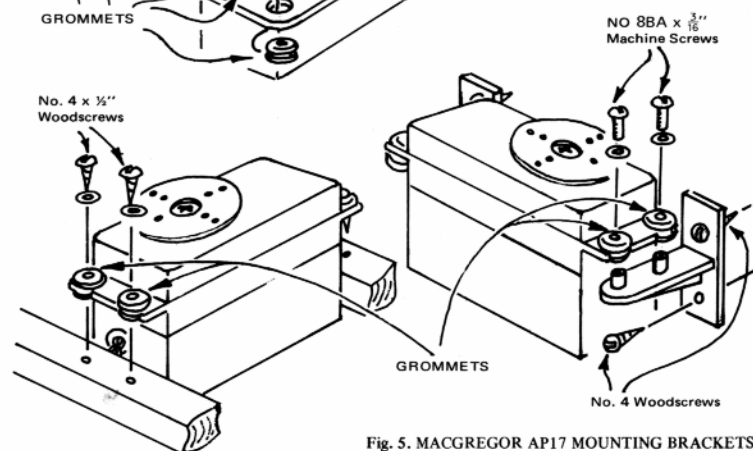
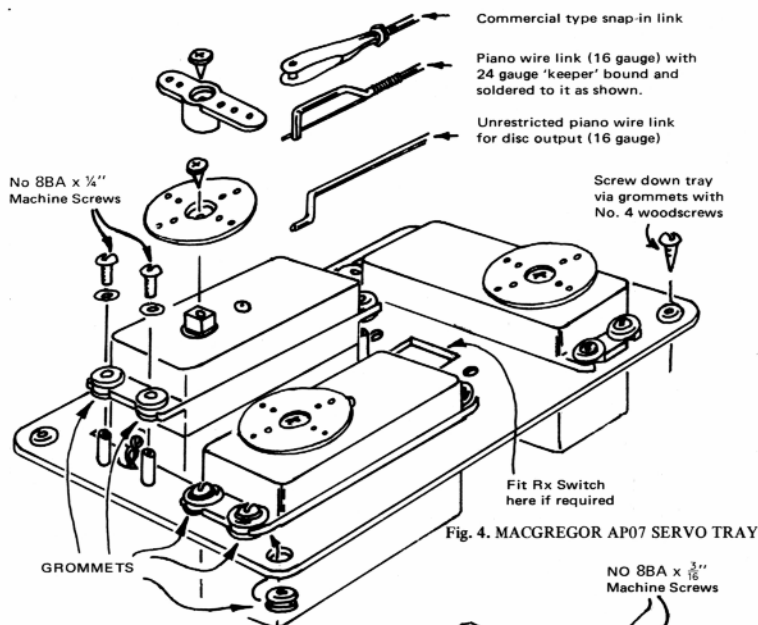


Fig. 6 HARDWOOD BEARERS

to the sides of the model. Plugs and sockets can also be taped together to avoid them pulling apart accidentally.

3 Before installing linkages, check for correct direction of movement of the control surfaces with movement of servo.

This can be selected by changing the position of the servo output devices. The arm and disc supplied with each servo will fit in four positions and can be easily interchanged or altered by removal of the retaining screw in the centre. For intermediate trimming of output arm position a 50 thou' Allen Key can be inserted down the centre hole, under the retaining

screw and turned until the desired position is obtained. Don't forget to replace the screw after any change!

4 Linkages must be installed so they move freely yet without backlash, with the model in any position. Hinges and other bearing joints should be as frictionless as possible.

For connection to servos and control horns, etc., the commercial snap-in type of connector (CLEVIS) is recommended for push rod ends. Alternatively, home made piano wire connectors can be used but these should be fitted with 'keepers' to stop them accidentally becoming disconnected during operation. For rudders ('planes or boats'), ailerons and elevators, MACGREGOR AP10 ADJUSTO LINKS can be used. These attach directly to the control surface and have a one piece unbreakable hinge and integral adjuster, thus eliminating any slop which can occur with other types of connector. AP12 ONE PIECE POLYPROPYLENE HINGES are also available.

Bowden cables should be used only in difficult installations where solid links are impractical. They should also be securely fastened along their length so that no transverse movement can occur.

5 Where controls terminate against a mechanical stop, e.g. Engine throttle, car steering; ensure the servo is not stalled at the limits of travel.

Any drag or stalling of a servo will impose unnecessary drain of the Power Pack and hence a cut in useful operation time. It can also damage the servo! Therefore, fit some sort of override device in the linkage (there are several commercially available) or extend the control arm so that movement required for full control coincides with the full servo travel. When using disc output devices, make sure connector links cannot foul as the disc turns. To avoid this use unrestricted piano wire link as shown opposite, or cut away a portion of the disc to clear the link at the limit of travel.

6 Always provide for some mechanical adjustment, whichever linkages are used, so that final trimming up can be achieved after installation.

Before adjusting linkages always ensure the servos are neutralised.

Receiver and Power Pack

These should be loosely wrapped in $\frac{1}{4}$ " - $\frac{3}{4}$ " foam rubber, or similar material and packed in the model such that they cannot move about. The power pack should be sufficiently separated from the receiver and servos so that, in the event of a crash or hard landing, it will not cause serious damage to these units. The actual position of the power pack will need to be arranged to suit the CG of the model.

The full receiver aerial (33"), where possible, should be knotted and then led out to the tail fin or similar attachment point so that no strain is put on its connection in the receiver. The aerial can be further protected against breakage by using an elastic band at its remote end to tension it.

Avoid shortening the aerial as this will result in loss of range. For model boats and cars, however, where not so much range is required the aerial can be cut to say 18", and then securely soldered to a vertical whip aerial 15" long mounted on the model. The overall length of 33" is thus

maintained. Whip aerials should be well insulated from any metal parts and a bead should be glued on the end to safeguard against accidental damage to eyes, etc.

The switch can be mounted either on the servo tray or alternatively in any convenient position in the top or side of the model. To fit the switch, remove the two retaining screws from the moulded cover. Fit the dolly into a suitable cutout to ALLOW FOR ITS UNIMPAIRED OPERATION, and screw in place with 8BA or No. 2 Self Tapping screws, through the mounting surface. CHECK FOR THE CORRECT OPERATION OF THE SWITCH AFTER MOUNTING.

General

Avoid trailing leads where possible and make sure nothing can move except the control linkages and surfaces.

Always ensure that your installation is fuel proof and water proof. Considerable deterioration and damage can result where equipment has been allowed to get wet. In aircraft and cars, the receiver and power pack can be protected by placing them in plastic bags. For boats the use of a polythene "sandwich" box is recommended and this can contain the entire installation. Push rods and wires can be brought out via suitably greased tubing glued in the sides of the box. Where installations are completely enclosed with no vents, a small sachet of Silica-Gel crystals should be enclosed to absorb any condensation which may form. This should be changed periodically.

The equipment has been designed from the outset to be insensitive to interference and metal to metal noise. However, as a general rule for absolute safety the following points should be observed:

- 1 In models where electric motors are used for propulsion the radio equipment, in particular the receiver, should be kept as far as possible from the motor and its associated batteries and wiring. The receiver aerial should be led out along such a path that it does not pass close to these sources of interference.
- 2 Suppression of electric drive motors is also strongly recommended. In many cases this may not be necessary, but the types and conditions of motors are so numerous and varied that it is safer to be sure. To do this, a radio capacitor of value between 0.1 and 0.5 mF should be soldered directly between the connections of the motor. Then solder a T.V. suppression choke to each of the motor terminals and connect the battery supply to the other ends of these chokes, so that they are in series with the motor. The chokes should be of suitable current carrying capacity to handle the current drawn by the motor, and this is usually indicated in the motor specifications or on a plate attached to the motor. (Note: R.S. Components Ltd., manufacture suitable chokes. These are available in several current ratings, and should be obtainable at any good radio component shop.
- 3 Joints and couplings where two metal parts can rub together should be avoided and only plastic to metal or all plastic types used. Where this is impractical, the two parts should be linked by a short flexible piece of wire.

.... A FINAL RECAP

The following is a list of GOLDEN RULES for the successful operation of your DIGIMAC controlled model.

- 1 Range check your equipment with the Tx aerial fully extended before the first operation in a model, and verify this periodically in the same spot. (See Page 18)
- 2 Then, carry out a few short range checks with the aerial retracted, to use as your standard, quick check before each days operation.
- 3 Always ensure your transmitter aerial is fully extended before releasing the model.
- 4 Always ensure that you are not interfering with another modeller who is on your frequency. If so, change frequency or switch off and wait!
- 5 The output of the transmitter is a minimum along the axis of its aerial. Therefore, avoid pointing the aerial at the model.
- 6 If there are several modellers around you should always form a group (20-30 yards apart will do) and never let your model pass very close to another transmitter.
- 7 If you are new to proportional model control, it is advisable to enlist the help of an experienced radio control modeller, particularly in model aircraft flying when initially testing and learning to fly. Our "Buddy Box" facility will considerably help you through this period.
- 8 "Novice" model aircraft pilots should always use small control surfaces and small movements. Overcontrol is the cause of the majority of aircraft crashes.
- 9 Always check your installation for any damage or displacement before each days operation and also after any crash or particularly heavy landing.
Particularly check:
 - (a) That all functions operate normally over their full range of travel even when the engine is running.
 - (b) All servos for any damage or wear due to vibration, particularly the mounting flanges, output arms and retaining screws.
 - (c) Either i) That both batteries are charged and the Tx output meter reads in the green sector.
Or ii) That all pen cells, if used, are still in place and power packs are firmly clipped in.
 - (d) All plugs and sockets for good fit. Bending the pins slightly can often restore good contact.
 - (e) Periodically check all cables for signs of strain. Slight flexing or tugging of cables may disclose an intermittent fault before it has time to do any damage.
- 10 ALWAYS investigate any apparent failure, however brief. Faults can be very intermittent and difficult to find but IF IN DOUBT—DON'T RISK IT! YOU MAY DO IRREPARABLE DAMAGE WHICH COULD HAVE BEEN AVOIDED.

GUARANTEE AND REPAIR SERVICE

MacGregor Radio Control Equipment is guaranteed against faulty manufacture for a period of six months from date of purchase.

A Guarantee Card is included with your outfit, and **THIS MUST BE COMPLETED AND RETURNED TO US WITHIN FOURTEEN DAYS**, in order that, in case of difficulty, your equipment can be inspected under the conditions here stated.

The Guarantee covers faulty equipment caused by defective components or manufacturing error only and provided the equipment has not been tampered with, we will repair and service it free of charge.

Damage incurred from crashing of models or mishandling of the equipment is not covered by the Guarantee and a service charge will be made accordingly for any repairs carried out.

REMEMBER: In 90% of crashes due to equipment failure there was a prior warning. Very few faults occur due to component failure, even less are due to manufacturing defects. Nearly all failures are due to damage resulting from previous crashes and mishandling, so always investigate **BEFORE** operating and avoid these unhappy occurrences.

To ensure prompt service when returning equipment, please follow the instructions listed below, carefully.

- 1 Make sure rechargeable batteries are charged prior to the despatch, or in the case of dry battery packs, remove all pen cells. It is illegal to send these through the post.
- 2 If you are sure of the failure return only the items which need attention. If any uncertainty exists at all, however, the complete outfit should be returned. A minimum handling charge of 50p is made for each item returned where repair is not covered by our Guarantee.
- 3 Remove servos from mounts and any padding from receiver.
- 4 Different plugs or other modifications which interfere with factory testing procedures will be returned to original standards at your expense.
- 5 Include a brief, but thorough explanation of all problems and service required. Label all servos as to their function.

Our Guarantee does not cover loss or damage of equipment whilst in transit from you to us. Therefore:

- 6 Carefully pack each individual item with sufficient packing material to prevent shipping damage. Include a list of all items being returned and double check that all items listed have been packed!
- 7 Include your **NAME AND FULL ADDRESS** inside the parcel as well as outside. Also for your own protection, register or insure all parcels.
- 8 Label your parcel clearly in at least two places and send to:
MacGregor Industries Limited, (Radio Control Division)
Canal Estate, Langley, Bucks, SL3 6EQ.

In the event of repair under Guarantee your equipment will be returned to you post free. In all other cases an estimate will be sent to you covering the cost of repairs and postage and no action will be taken until approved by you and payment made.

FACTORY CONVERSION SERVICE

To convert:

DIGIMAC II TO RECHARGEABLE OPERATION

MR1200 Transmitter conversion only, including 280mAh Ni/Cads, charging socket and separate charging harness £6.00

As above but including Output Meter Extra £3.50

AP04P Receiver/Servo Rechargeable Power Pack £4.00

AP05 280 Charger £3.75

DIGIMAC II TRANSMITTER TO DIGIMAC III TRANSMITTER

(This conversion includes full conversion to MR1300 with Ni/Cads, output meter, and third channel)

Standard MR1200 with dry battery packs £11.00

Converted rechargeable MR1200 without O/P meter £6.00

Converted rechargeable MR1200 with O/P meter £5.00

FOR ALL FURTHER CONVERSION TO FOUR OR SIX CHANNEL OPERATION THE TRANSMITTER MUST BE REPLACED BY AN APPROPRIATE NEW MR1400 or MR1600 TRANSMITTER

DIGIMAC II RECEIVER TO DIGIMAC III RECEIVER £3.00

DIGIMAC II RECEIVER TO DIGIMAC IV RECEIVER £4.25

DIGIMAC II RECEIVER TO DIGIMAC VI RECEIVER £5.50

DIGIMAC III RECEIVER TO DIGIMAC IV RECEIVER £3.00

DIGIMAC III RECEIVER TO DIGIMAC VI RECEIVER £4.25

SPARES

Replacement spares available from your Stockist or direct from MACGREGOR INDUSTRIES LIMITED.

The following spares may be within the range of home repair. *If any doubt exists, however, return the affected unit for full Service.* We cannot be responsible for any repairs other than those carried out at our factory.

Description	Part No.	Price
MR10P Servo		
Set Output Devices	MR10/1	40p
Set gears	MR10/2	40p
Cermet Pot. and Wiper	MR10/3	70p
Intermediate Shaft	MR10/4	7p
Case Top	MR10/5	50p
Case Middle	MR10/6	50p
Case Bottom	MR10/7	60p
Set Case Screws (4)	MR10/8	19p
Motor	MR10/9	£2.00
Rubber Grommets (Pk. of 12)	MR10/10	8p
4-pin Plug and Socket	PS4	25p
Servo Tray	AP07	50p
Servo Mounting Brackets (Pair)	AP17	12p
MR1200 and MR1300		
Control Knob (large)	MRT1	10p
Control Knob (small)	MRT2	10p
Ratchet Bar	MRT4	5p
Centring Spring	MRT5	5p
Aerial	MRT6	75p

MR22 and MR26 Receivers:

NONE—Please return for service in all cases of damage.

NOTE: If spares are ordered from MacGregor Industries Limited, please include an additional 5p to cover cost of postage.



MacGregor Industries Limited

Canal Estate Langley Bucks Telephone Slough 42251/2/3