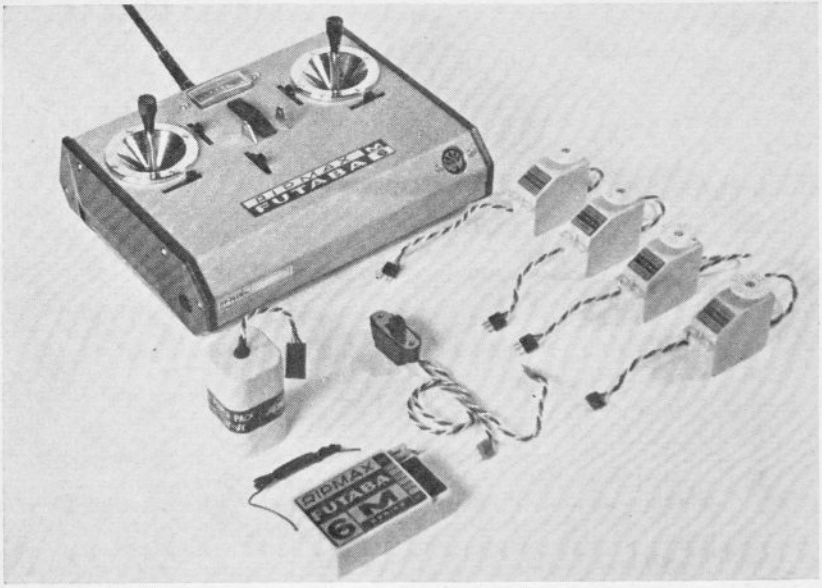


R. C. M. E. Test Report

FUTABA SERIES M

By Rex Boyer

ALTHOUGH Futuba R/C systems have sold in U.K. for some years, their Series M is the first of their digital proportional we have tested.

Even the most cursory glance makes it obvious that the Futaba, whilst not necessarily revolutionary in new design, is certainly individual in style. The very professional styling of the Tx case, right down to the details suggest that a great deal of thought and tooling expense has gone into the system. Quite a change from the usual folded metal cases of the majority of current systems. It seems quite sad that it is necessary to import good looking systems with customer appeal when most of the basic R/C development was done in the U.K. or U.S.A. The system comes complete with six sets of crystals.

Transmitter

The encoder follows what has become normal practice i.e. multi-vibrator clock generator followed by a string of half shots. Pre-set pots are fitted to all channels to facilitate setting-up and also applied for the frame rate. A further pre-set pot controls the deflection of the meter on the front case. This meter is, we were surprised to see, not an R.F. meter but a battery state indicator, a feature long since discarded by most in favour of R.F. output monitoring. Needless to say, you can leave the XTAL out and still get a good reading!

The output of the encoder modulates a buffer stage inserted between the conventional XTAL oscillator and the parallel transistor P.A. stage. Large heat sinks are fitted to the ouput transistors and we did notice they run quite warm to the touch. In the Futaba we find a double π output stage (to really get rid of the harmonics) followed by a base loaded aerial. All five coils in the R.F. section are turnable and all capacitors are fixed. This is only the second system we have seen with a double π output stage, a feature no doubt fitted to comply with some of the more stringent continental licensing laws – a commendable feature.

Futaba M Series transmitter follows their established and distinctive style, now improved with moulded side caps and vinyl clad centre. Futaba stick assemblies offer extremely pleasant action and feature ratchet trims. There are hooks for a neck strap, a retract switch top left of case and a micro action buddy box switch – top right. The rear cover removes without extracting self-tap screws and reveals a tidy internal arrangement. Power pack plugs into circuit via a line connector. A neck strap is provided with the system, together with short and long stick assembly tops.

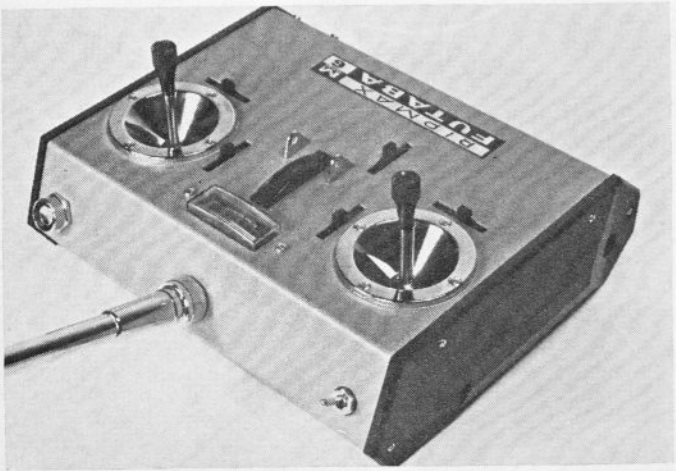
One point that did stand out was the use of a paper based p.c. board, obviously less costly in manufacture than a glass fibre board. We also noted use of sprayed carbon control pots instead of the usual moulded type – a weak point in the system we feel.

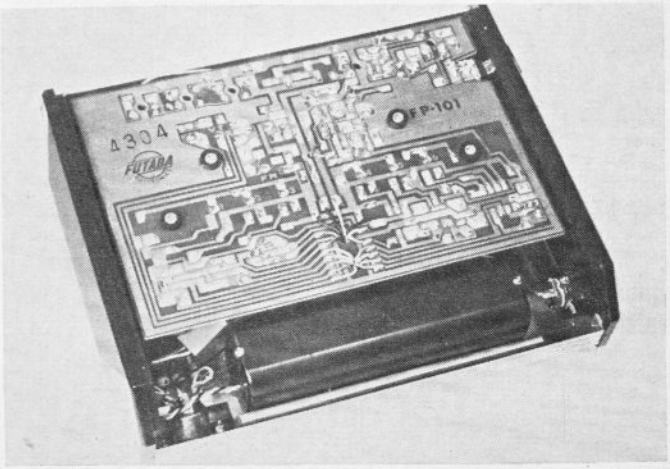
The pupil-pilot button on the top of the Tx case is one of the best we have yet found, very positive and light and also effectively surrounded to prevent inadvertent operation. Power supply is 9.6 volts of nicad cadmium pen cells made up in two groups of four and fitted into a plastic container in the bottom of the Tx case. All very neat and tidy.

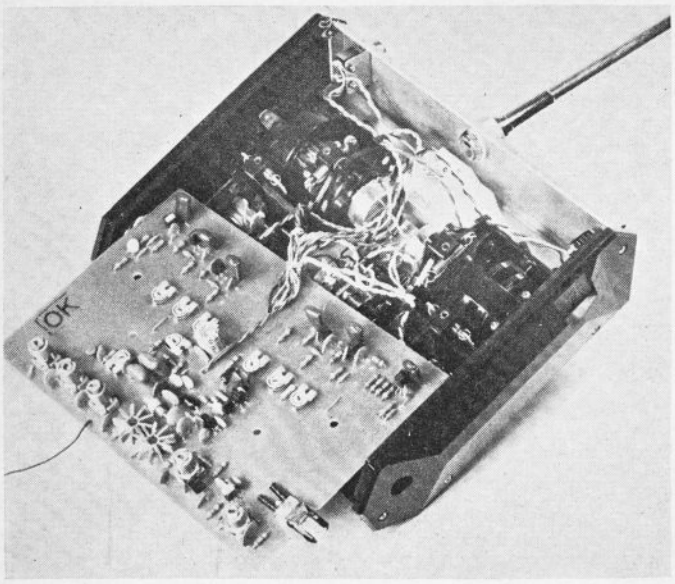
The P.C. board is flow soldered and the quality of the joints is above average.

Receiver

This is housed in an intricate moulded plastic box which is screwed together. The Rx at first sight seems to contain two I.F. strips, but closer examination reveals that of the 7 metal cans, four contain R.F. coils. The input circuitry is more than usually complex and would appear to contain a loading coil for the aerial, the bottom of this coil being fed into a conventional double tuned R.F. section. The fourth can in the line-up serves the XTAL oscillator tuned circuit. This is turnable and it is a long time since we have seen a turnable local oscillator in a receiver let alone a screened one. Needless to say the XTAL is plug in. The output of the local oscillator is fed into the centre of the mixer stage which is followed by a two stage conventional I.F. strip. The rectified I.F. output is further amplified and passes through a noise clipping filter network before being applied to a 740L04 hex inverter I.C. chip. This chip is so connected so as to provide all the necessary signals for correct functioning of the eight bit shift register used as the decoder. In the Futaba, a 74L164 I.C. is used. Both I.C. are by National semi-conductors. One thing which did come to light during our examination is that the 'data clear' pin of the shift register was connected, this is unusual, but in the case







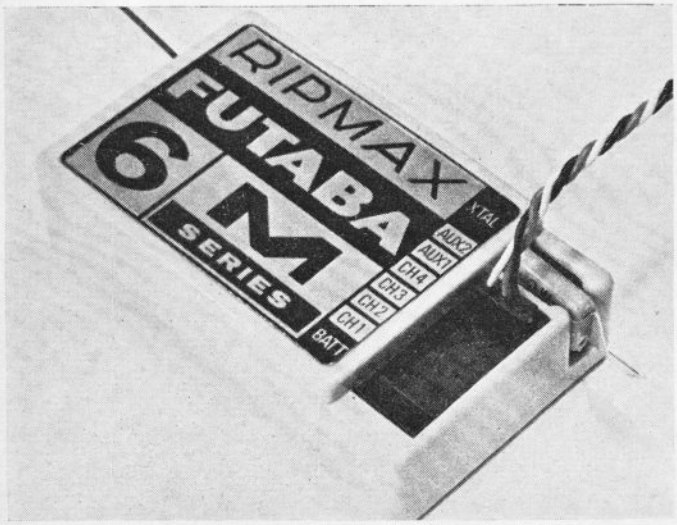
of the Futaba, necessary due to the fact that the servo amplifiers or D.C. coupled to the decoder.

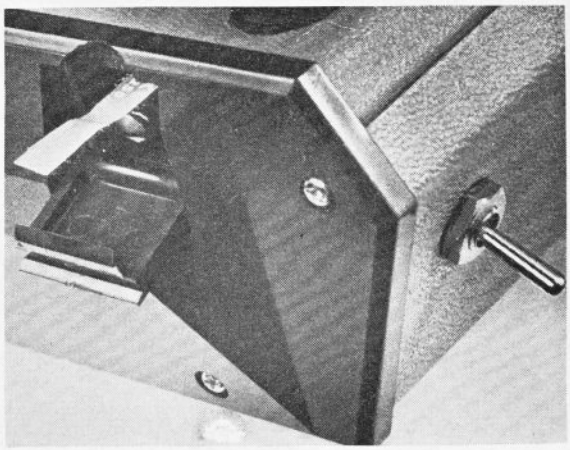
To explain a little further, when power is applied to a shift register chip in the absence of a transmitter signal as in the case if you switch on the Rx before the Tx then the outputs can come up in any form, say outputs 1, 2 and 7 are logic 0 and the rest are logic 1. In this set of circumstances, the servos connected to the output with logic 1 present would rotate continually. Obviously this is not a desirable set of circumstances, so the chip is fitted with a 'clear' pin to enable the decoder chip to be cleared of all logic '1s' and so prevent the servos cycling. This pin requires a logic '1' to enable this function in the Futaba. A simple R/C circuit performs this function rather like the hold of the sync stage in a discrete component decoder. The last two outputs of the chip are not used, making the system a six function.

The chip is directly connected to a built in output socket assembly which is probably custom made for Futaba.

Before leaving the Rx circuitry it is worth noting the power supply arrangements to the Rx. The battery is connected to the p.c. board where it is decoupled – the output voltage level of the regulator transistor is set by a zener diode. In all we counted four large value components on the supply rails. Truly great attention to detail as the I.C.s do not really like more than 5 volts and a fully charged Ni Cad can offer 5.6-5.8 volts.

Futaba M Series receiver is a compact, 'flat pack' single deck unit in a specially designed moulded case. Note the connector block with control functions conveniently identified – no 'poke-and-hope' experimentation here! Plug-in crystal is accessible, yet is well protected and firmly held in position by grippers. Like most, the circuit is a tight fit on the p.c. board. R.F. coils are 'canned', like the I.F.s. Case snaps together and retained with screws.





Transmitter P.C. board is quite sparse. Control stick mode is easily altered by simply transposing a ratchet brake from one stick assembly to the other – not necessary to remove centring springs, but to achieve this, the case sides have to be removed. Plug-in crystal is accessible through small hatch in case side – a neat feature. Six sets of crystals are provided, plus frequency penants.

Servo

Here again we see a custom built unit, small, neat and in some features owing credit to the U.K. made servos. The motor is 16 mm. unit not as would be expected by one of the usual makes but by a new (to us) concern with the trademark COPAL, TOKYO, JAPAN. Suppression for the motor is in the form of a 5 mfd. electrolytic capacitor straight across the amature connection and one of which is connected to the motor case.

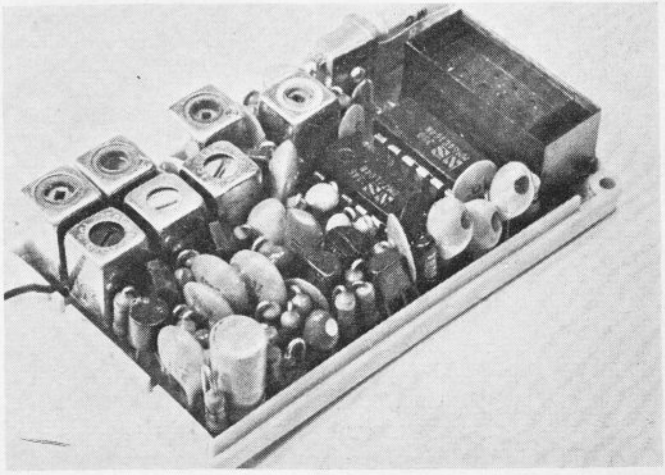
The servo amplifier is in the form of two special I.C. chips manufactured it would appear, by R. OHM with only nine external components. This must surely be the smallest count servo amplifier we have seen. The feedback pot is a ceramic type connected as a potential divider. Soldering on the p.c. board is by hand, it possibly being just a trifle small to fit into a machine solderer.

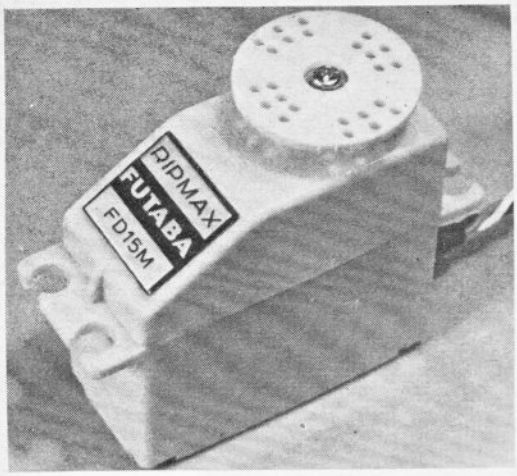
Gears in the servo are plastic throughout, even the motor pinion, and the gear teeth are, by current standards, a little on the coarse side. The output gear and its respective pinion are twice as deep as the rest of the train. End pegs are moulded onto the output gear to prevent the servo output rotating outside a given travel. The output disc is retained by a screw into a brass sleeve which passes through the output gear. This sleeve is slotted to permit servo centring adjustment without dismantling the servo. Input to the servo is by a three-way plug with flat spade-type pins.

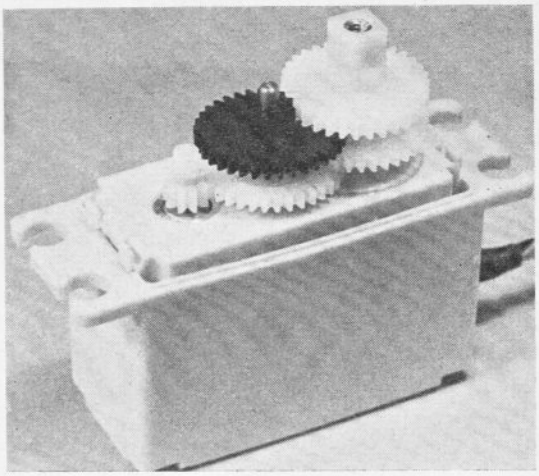
TEST RESULTS

Transmitter timings (in milliseconds)

Channel	Function	Min.	Neutral	Max.	Trim Range
1	Aileron	·92	1·36	1·75	± ·1 ms.
2	Elevator	·9	1·36	1·76	± ·1 ms.
3	Throttle	·9	–	1·76	± ·1 ms.
4	Rudder	·91	1·35	1·75	± ·1 ms.
Aux 1	Proportional	·77	–	1·8	– –
Aux 2	Switch	·75	–	1·9	– –







Futaba FD15M is one of the smallest in production. Features rotary output. Unusual sloping end of case permits the end of a wooden push rod to come nearer to the rotary output disc, thus shortening the wire push-rod end and achieving a more whip-free linkage to the control surface. Gear train features deep output gear to withstand shock loads. Servo are provided with unit.

Frame time 18.1 ms 55 frames/sec.

From the foregoing, the system is seen to be very accurately set up. The auxiliary function gives more travel than the four primary functions.

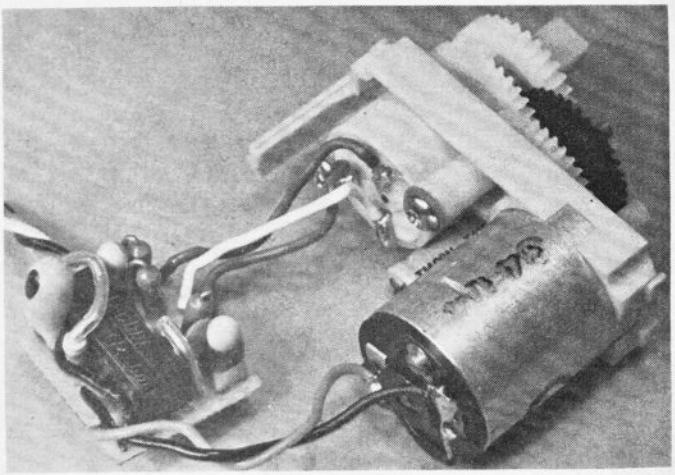
Servo response

	Clockwise		Anticlockwise	
Travel	34°		35°	Trim: +7·5° −7°
Just stalled:	26 oz/in	=	4·33 lb. at $\frac{3}{8}$ rad.	

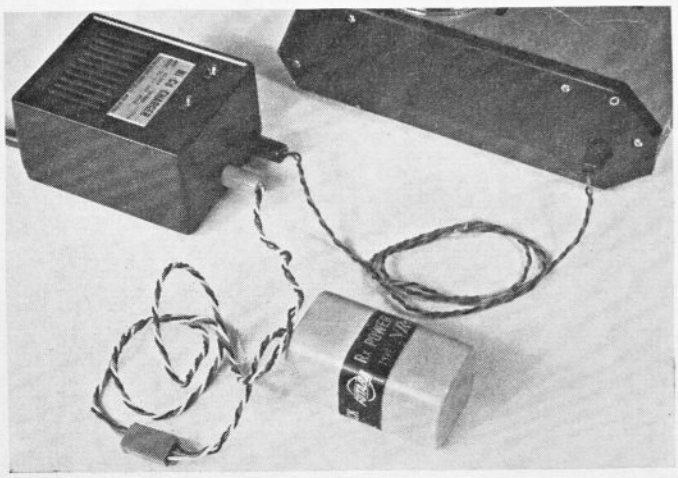
Load	$\frac{3}{8}$ rad.	Against load (CW)	With load (CCW)	Remarks
No load		·32 sec.	·29 sec.	
2 oz. load	5·3	·33 sec.	·28 sec.	
4 oz. load	10·6	·36 sec.	·3 sec.	
8 oz. load	20·8	·39 sec.	·28 sec.	Slight undershoot
10 oz. load	31·2			,, ,,
12 oz. load	42·6	·44	·26 + ·2 for 1·8%	,, ,,
16 oz.		·52	·25 + ·32 for 2%	,, ,,

Time taken is for 70° rotation.

As can be seen from the above results, the Futaba M series is the fastest and most powerful of all systems we have yet tested. Only on the very high loads did the servos show any signs of undershoot so that the linearity of servo response is excellent. In the no load condition the servos showed slight overshoot characteristics in the CCW direction and slight undershoot in the CW direction. This tendency of over and under damping increased with load so that in the heaviest of loads the overshoot was 1% of total travel. There is just a perceptible dead band in the response of the servo. This servo's response is definitely the best with an I.C. amplifier we have yet seen. We can make no other comment.



'M' Series system features external, transformer isolated charger with bulb indicators to show when charging is in progress. Charger is light and small and employs individual jack plug connectors to feed into transmitter and receiver power packs.



Other test figures

Transmitter

Power: 9.6v nominal 10.1v measured.
Current: 185 mA Aerial down
110 mA Aerial up
Aerial length 44 in.

Receiver

4.8v nominal, 5.25v measured

Rx currents:

		Tx on
Rx only. 8mA		
Rx + 1 servo	15.5mA	,,
,, ,, 2 ,,	22	,,
,, ,, 3 ,,	28 mA	,,
,, ,, 4 ,,	36 mA	,,

Test results here show the I.C. amplifier to have a current drain of approx 7-8 mA per servo quiescent state. It reminds us of the distant days of all discrete component Rx and servo amplifiers. We must add, however, that very little load is needed to put the standing current up to around 100mA so keep those linkages free.

Charger

This is a separate unit and allows changing of Tx and Rx packs both simultaneously and separately. Indication of change being by a small L.E.D. (light emitting diode).

Conclusions

In conclusion we must say that the Futaba Series M offers a servo response performance second to none. This is slightly spoiled by one or two features which would not make an astronomical increase in price to correct.

Distributor: RipMax Ltd., Ripmax Corner, Green lane, Enfield, Middx. Prices: including transmitter, receiver, external charger with charging leads, long and short control stick tops, receiver switch harness, aileron servo extension lead, neckstrap, servo trays and mounting hardware, six crystal sets and frequency pennants and four servos. Four function (four servos) £145. Six function (four servos) £155. Extra servos £14.