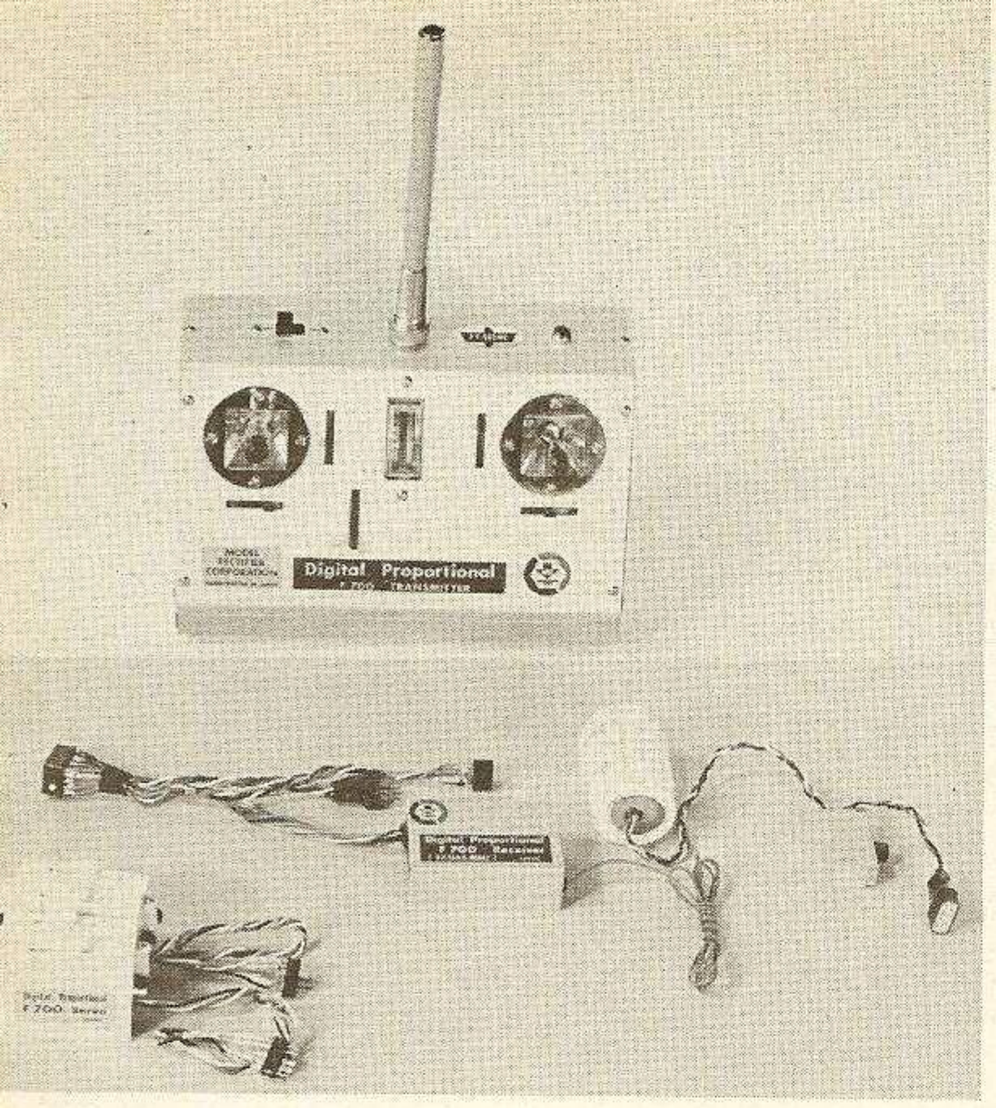
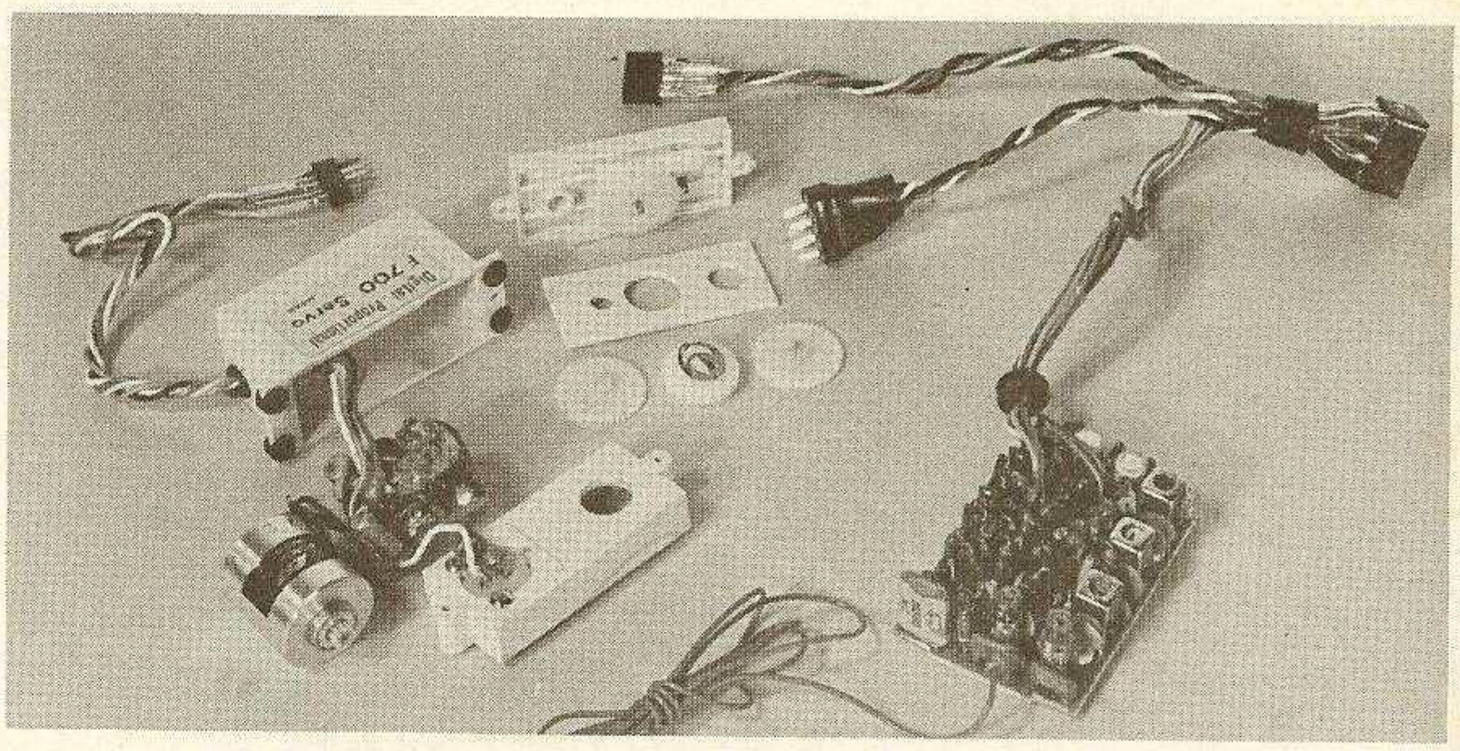


Note unusual but comfortable transmitter shape, upward antenna. Receiver plugs are convenient.



Look close, you can see the tiny wafer transistors. Conventional circuits are used throughout. MRC servo is not copy of U. S. designs. It is small and fast and light.

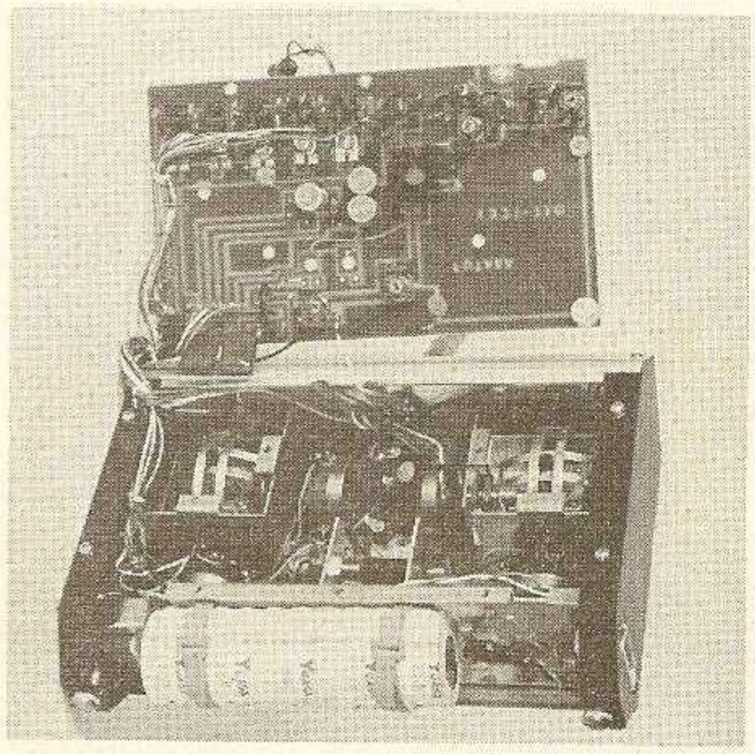
MRC F-700 Digital System

A Blue Ribbon Review

FRED M. MARKS

THERE are a number of ways to come up with a full-house digital proportional set here in the U. S. There are at least eight major manufacturers of complete commercial systems. For about half the retail price of these commercial sets, one can procure the kit systems popularized by Heath and now available from Cannon, Royal Products, and Controlaire. The third source is from the foreign manufacturers, primarily Japanese, German, and Canadian through American distributors. The obvious question is "just how do the foreign-made sets compare?" Those made in Japan particularly, since (a) they generally retail for less than American-made sets and (b) there is always the old question of quality in Japanese-made electronics.

The MRC F-700 digital set is representative, and can be compared with other equipments I have reviewed. The F-700 is made by Futaba for MRC. Its features are an airborne unit about the same weight (16 ozs. total) and size of most American-made sets of the current model; servos which are small, powerful, very fast, with a rack output; and a transmitter much more classy in layout than most sets seen.



This transmitter is constructed very neatly and all the parts are quite accessible. The sticks are smooth and light.

This is a five-channel digital system operating in the 27 MHz band. The frame length is 16 ms and control pulse width is 1.5 milliseconds (ms) at neutral ± 0.5 ms for control. The control pulse is positive going. This is a complete system, ready to operate after charging the batteries. It consists of the transmitter, receiver, with switch harness and battery pack, four servos (the fifth servo is available separately) and charging harness. The charger is built into the transmitter.

The transmitter is a two-stick configuration, available with the sticks set up for Mode I or Mode II. The sticks are fully enclosed with electronic trim on all four functions. Two sets of stick knobs are provided to permit selection of the desired stick length.

The auxiliary channel is the lever located just below and to the left of the meter. The meter gives indication of RF output. Transmitter case size is 7½" x 6" x 2¾". However, this is not the usual rectangular case. The 7½" dimension is horizontal. The top and bottom of the case are sloped. The antenna protrudes from the top of the case at a 45-degree angle so that the antenna automatically assumes the correct attitude for most efficient radiation, i.e., near vertical.

The design of the transmitter in conjunction with the antenna location makes for a comfortable, well balanced arrangement. A 12-volt battery pack is made up of 450-mah capacity nickel cadmium cells. The charger for both the transmitter pack and the airborne battery pack is built into the transmitter. In a unique departure from most American-made units, an isolation transformer is used in the charger. Furthermore, it is fuse protected! The total weight is 3 lbs.

In addition to the general configuration of the transmitter, there were three specific features which I found especially convenient. The antenna connector was well made and could be tightened quite firmly with no tendency to unscrew the fitting on the transmitter when removing the antenna. Also, a charge indication light is provided which is easily visible since it protrudes slightly from the top of the case. The third is that by removing the transmitter back and bottom, and upon removal of the circuit board mounting screws, the entire circuit board can be positioned on the work bench for examination or repairs and ready access is had to the entire transmitter interior.

The transmitter circuitry is relatively straightforward. The encoder is timed by a free running multi, followed by a series of half shots. No attempt is made to adjust frame length with charging pulse widths. The RF section consists of the oscillator, modulator, and a single RF amplifier. You are warned in the instruction sheets that "The MRC-F-700 is a very high output transmitter. Operating with a collapsed antenna for extended periods may seriously affect its output." A quick check on the power output transistor and its heat-sink revealed that it was indeed; the heat-sink becomes quite warm when operating with the antenna extended, thus operation for extended periods with the antenna collapsed would put an undue heat load on the output transistor. The current into the final amplifier (transistor) was checked and found to be 62 milliamps at 12 volts for 0.844 watts into the final. Radiated power would be slightly less, but overall, a very powerful transmitter designed to cut through interference. (Please refer to the 1969 *American Aircraft Modeler Annual* for a tabulation of current transmitter outputs.) The total drain of the transmitter was 120 milliamperes.

The receiver is $2^5/_{16} \times 1^9/_{16} \times {}^{13}/_{16}$". It weighs under 2 ozs. All plugs are external to the receiver with a plug block used as a power junction and for signal output to four of the five available servo functions. Power is supplied by a separate plug and, in the usual

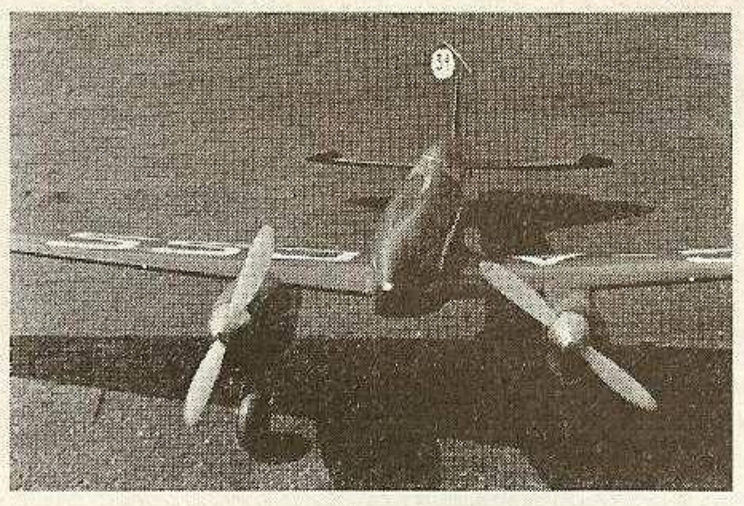
Continued on page 87

de Havilland Comet

Continued from page 23

first response always is to cut back the throttle to get the plane into a straight glide headed for the field, and then to jog the throttle to see which engine is giving the trouble. When you have figured this out, trim your rudder accordingly and add throttle little by little until you see that you can stay airborne. Please don't horse around, trying to fly on one engine. Land and fix the problem!

The plane may handle well on one engine



in straight flight but make all turns gradual and flat. If you bank too sharply or slow down too much in a turn, you may drop off in a spin. This is not a bad feature of the model. It is true of any twin-engine craft. It is good practice to fly when no other planes are up so you can listen to your engines. When you don't have to worry about an engine failure, fly with the crowd — and good luck!

Remember when landing this monster, "Hightail it!"

MRC F-700 Digital System

Continued from page 52

manner, a separate aileron plug is provided. Wiring to the aileron plug is unique in that only one bundle of wires comes from the receiver to the plug block. The aileron signal lead is contained in this bundle and the aileron power leads are taken from the plug block. The signal lead is simply routed on to the aileron plug. The power plug is handled in like manner. All plugs are female at the receiver end except for the power plug, thus there are no bare plug pins to short.

Charging of the receiver pack is performed via the power plug and switch harness, so be sure to leave access to this plug in model installations. The receiver mechanical design is quite compact. A metal case is used and the 1/16" glass-epoxy board is held very tightly by inserting "tangs" on each end of the board into a mating slot in the case bottom. When the cover is forced

into place, the receiver board is locked in place. No sheet metal screws, machine screws or tape mounting here!

When I removed the receiver board for examination, it appeared to me that there were only two transistors! There were only two of a familiar configuration; the rest are little white wafers about ⅛" in diameter and 1/16" thick mounted right down against the board. Circuitry again is conventional: a double tuned front end, a crystal controlled oscillator, a mixer followed by the usual 455 KHz IF. Detection and AGC feedback take place at the third IF with AGC applied to all stages. This is almost a necessity in view of the powerful transmitter. The only two larger transistors are used for amplification of turn-on, turn-off pulses to the decoder. The decoder appears to be made up of two of the small transistors per stage, arranged in the SCR configuration.

There is a unique noise suppression circuit incorporated in the airborne unit which involves a fifth wire to each servo. This wire connects to the servo feedback circuit via a resistor. This lead for all servos is made common at the plug block and capacitively coupled to +4.8 volts in the receiver. Thus there is a fifth wire (OV, +2.4V, +4.8V, signal, and the extra wire) throughout the system. The function of this system is to provide for better cancellation of servo noise. Judging from observation with a scope, this circuit does absorb some of the normal stepping of power supply voltage during servo movement.

The airborne battery pack is a set of four 450 mah button cells in a pack 1⅜" in diameter by 2" long. This pack is attractively sealed with end caps and white heat-shrink tubing. As always, the airborne pack is the limiting factor on system duration. The 450 mah pack provides about three hours of safe, continuous operation. One of the pleasant features found in the receiver system was the use of a slight tang at the back edge of all plugs. This permits a good grip with greasy hands and remedies that old "no-no" of disengaging plugs by tugging on the wires. In addition, these plugs have an extremely fool-proof coding. If anyone gets them plugged in wrong, he's too drunk to fly anyway!

The servos are constructed quite similarly to most current American-made servos. The same good old Mitsumi motor is used. The servos are 2¼ x 1½ x 27/32" and weight is 1.8 ozs. per servo. Case construction is high impact plastic, the gear train is nylon and push-pull output is available via the dual rack output. No wheel output is provided. Mounting is by means of end mount lugs and grommets. Circuitry for the servo is again straightforward. One unique item is the use of the tiniest trim pot I have seen to set the center position.

The servo is quite fast with a transit time of 0.6 sec., end-to-end. Accompanying this high transit rate is, as would be expected, a damping rate somewhat lower than normal. One full cycle of overshoot usually occurs with slight variation from servo to servo. There is however, no dither or oscillation. The noise cancellation circuitry apparently is partially responsible, that there is absolutely no cross-talk or unwanted chatter between servos. Rather amazing, in view of the extremely short transit time. Thrust of the servos was measured to be approximately 2.5 lbs.

The manufacturer made no specific claim regarding temperature stability. However, in keeping with my normal practice, I tested the system from 0-degree F to around 150-degree F. Satisfactory operation was obtained from approximately 20-degree F to 150-degree F.

The system was test-flown rather extensively in a Senior Falcon, powered by a Merco 61. These tests were performed during cold weather ranging from 35 to 50 de-

grees. A total of around two hours actual flight time was accrued with no problems or failures. During one session, the field was plagued by interference on the frequency of the test set to the extent that two systems of other makes could not be flown. Yet the F-700 seemed unaffected on the ground. We did not feel that it was wise to risk possible loss of a good airplane by flying in the face of interference.

The system performed well during flight tests. The trim levers yield a rather useful broad range which was particularly needed on the Falcon elevator because of the power of the 61 used. One problem: a metal transmitter case is very cold to the bare hand in cold weather. A pair of old gloves with the thumbs split was found a great help.

Evaluation: The MRC-700 tested compares quite favorably with American-made equipment. There were a number of innovations, such as the use of the fifth wire for noise cancellation in the airborne unit; well-designed, very fast servos; a transmitter designed for balance and easy handling; a transformer for isolation of the charger from 110 VAC; an extremely rugged receiver design; and others mentioned in the preceding text. Unusual measures were found such as the use of sleeving on all exposed component leads and application of some form of compound (appearance similar to Plio-Bond) to the assembled receiver and servo components to prevent damage due to vibration. However, this material would also appear to make repairs more difficult. Despite all these innovations, the manufacturer could make one slight effort which would improve the professional appearance of the set: simply clean the soldering flux off the boards. They are hand-soldered with rosin core solder and this rosin remains.

As always, every set has some things of which I am critical. These are minor in this case. The servos are packed rather tightly and any removal for repairs or motor replacement must be done very carefully. The pinion on the servo motor is nylon and could cause a problem if you fail to mesh it very carefully with the next gear. Finally, the location of the transmitter switch is such that it could inadvertently be bumped to the "Off" position while operating.

There is one question which can be answered only with time: that of equipment servicing. The set is guaranteed by MRC for 90 days from purchase, and they service the equipment. MRC is one of our oldest hobby distributors and has a firm reputation. No matter where I go and no matter whose equipment is discussed, someone is always unhappy over service. It seems that modelers put an awful lot of stock in hearsay. I'm not sure what the ultimate solution is, but I feel that the distributors of Japanese-made digital equipment stand behind their equipment quite well.

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