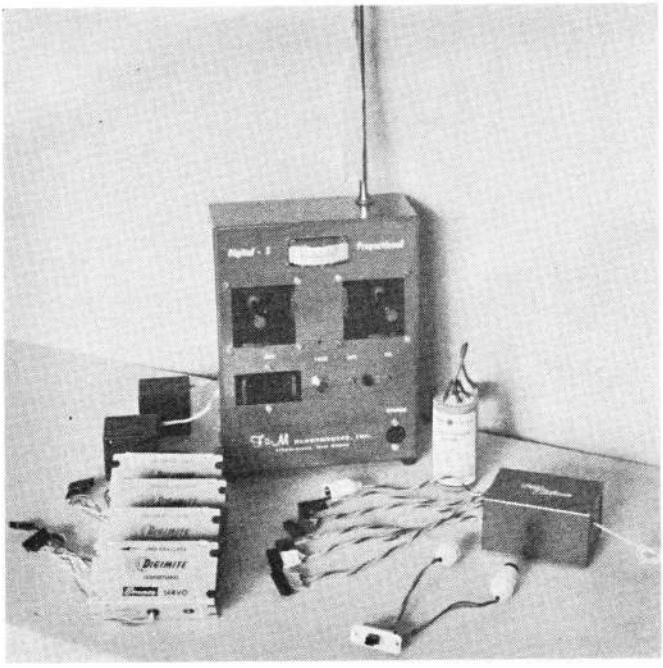


RCM PRODUCT REPORT:

F & M DIGITAL-5

PROPORTIONAL SYSTEM

By Bernie Murphy

THE F&M Digital 5 Proportional Control System is manufactured by F&M Electronics, Inc., 135 Vermont St., Albuquerque, New Mexico. F&M is a pioneer in the R/C field, with an enviable performance record. When it was announced that F&M was producing a digital proportional system, we waited patiently for the word that ultimately travels through the grapevine – good or bad. (Bad word travels much faster!) Gradually, the reports leaked through – mostly good, and to the effect that F&M had the first successful digital system on the market.

It wasn't until the 1964 Indiantown Gap Invitational that we had a chance to look at one of these rigs. Vern Krehbiel of VK Model Aircraft had one in his Cherokee prototype, and Leon Schulman had a new one in his Stormer. We watched closely the flights of both pilots, flying with at least five other frequencies operating simultaneously (these were the only digitals). No problems seemed to be encountered.

Late on Sunday afternoon, the inevitable happened – Schulman's throttle failed to operate. Lee asked if we would mind taking a look, as he was certain that the lock nut on the control stick had apparently loosened. Mind? This was the chance we had been waiting for. Sure enough, a loose nut was the only problem. (Ever have a loose nut on your field? We do!) It seemed somewhat ironical to have a mechanical failure when everyone was certain that this "digital stuff" was strictly "for the birds." Anyway, we had obtained a close look at the internal side of the transmitter and were impressed with the apparent quality of both materials and workmanship.

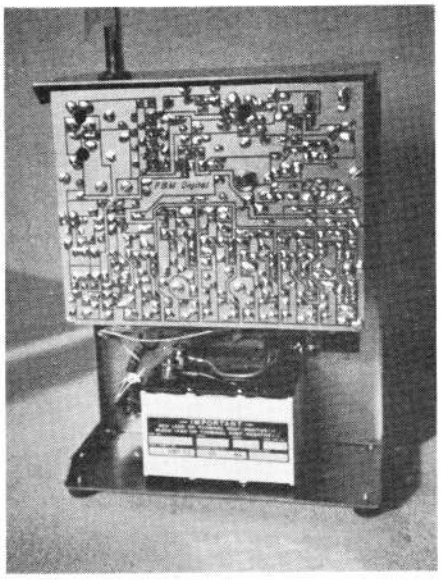
The good reports kept coming in, and in May we decided to do a product report on the Digital 5. The system was purchased through normal channels, arriving in about three weeks. The total system consisted of transmitter, receiver, four Digimite servos, nickel cadmium packs, chargers, and instructions, all well packed to withstand the rigors of shipment.

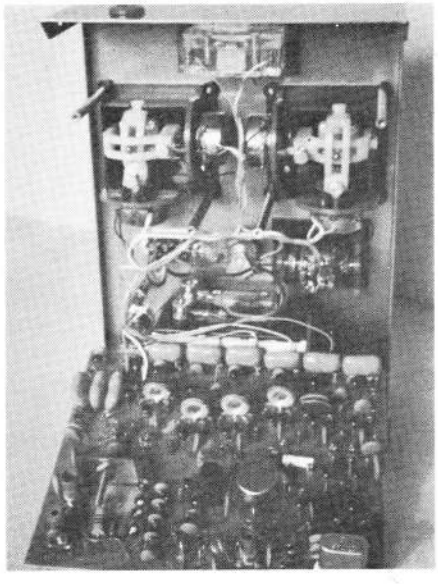
General Description

The F&M Digital 5 control system uses a digital technique known as Pulse Duration Modulation, commonly referred to as PDM. This technique is widely used in the transmission of information to and from missiles and satellites.

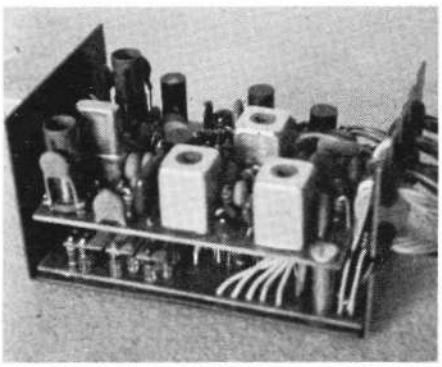
To understand how PDM actually works in the system, consider the control of one servo – say the aileron servo. Thirty times each second the transmitter sends out a pulse which is routed through the receiver to the aileron servo. When the aileron control stick is in the neutral position this pulse is 1.7 milliseconds long. Inside the servo, another pulse is generated whose length is dependent upon the position of the servo output arm. When the latter is centered, or neutral, the pulse generated in the servo is also 1.7 milliseconds long.

Assume now that both the transmitter stick and the servo are in the neutral position. When the pulse from the transmitter is received it is sent to the servo where it is compared to the length of the pulse generated in the servo. In this case, both pulses would be 1.7 milliseconds long and the servo would thus sense that it is in the correct position and would not move.





Two shots of F&M Digital-5 transmitter interior. PC board lowered to show Bonner stick assemblies.



Above: Digital-5 receiver-decoder. Right: F&M's new and larger plant facility.

Now the transmitter control stick is moved to the left position. The transmitter will now send an aileron pulse which is 1.1 milliseconds long. When the servo receives this pulse, it will compare it to its own 1.7 milliseconds pulse. Since the servo finds the incoming pulse to be shorter than its own, the servo will generate a signal, causing the motor to run in a direction which will move the servo arm to the left, shortening the servo pulse. Each pulse from the transmitter is compared, and the servo will continue to move until the pulse generated inside the servo matches the length of the pulse from the transmitter.

Eight sets of pulses are transmitted, followed by a brief "on time." Five of these pulses are used for control, the rest being used to assure proper cycling.

The Digital 5 is equipped with both "Lock-Out" and "Fail-Safe." Interference generally shows up as additional pulses, while loss of signal results in less than the normal eight pulses. Any time there are more than eight, or less than eight pulses, the receiver will automatically reject the erroneous carrier and go into "Lock-Out," in effect, locking all controls in their last position. If, after 1½ seconds of Lock-Out, the RF signal is still in error, the system will go into "Fail-Safe," returning all controls to neutral and running the engine to low throttle. Any time that the proper signal returns to the receiver, the pilot immediately regains control of the airplane.

Transmitter

The Digital 5 transmitter now employs the Bonner stick assemblies (no more loose nuts) in the most commonly used two-stick configuration. (Rudder and engine on left, aileron and elevator on the right.) An auxiliary control panel is located just under the left hand stick, allowing for easy control without releasing the primary control stick. One feature of the transmitter which could easily go unnoticed is the inclusion of engine trim. We have found this very useful, using low trim for engine cut-off, and high trim for idle. (The system is stable enough to allow this!)

A dual purpose meter is provided, reading either RF output or battery condition. The meter also indicates power supply charge rate while on charge. The transmitter has a relatively high output at .8 watts into a base loaded, 56", 6-section telescoping antenna. Selection and rating of electronic components is more than adequate. Silicon transistors are used throughout. The power supply is a 7.2V rechargeable nickel cadmium pack, with a 1.2 ampere hour rating. The current drain is 240 MaH. The overall level of workmanship is excellent, and typical of F&M's standards.

Receiver

The Digital 5 receiver is built on a two-deck configuration, the top deck containing the superhet receiver, while the lower deck contains the logic network or decoder. The physical size of the receiver is 2" x 1⅝" x 3" with a weight of 6 ounces. The receiver employs an all silicon superheterodyne with AGC, RF amplifier stage, and three IF stages. The digital circuitry is also all silicon, using fully saturating flip-flops with silicon diode decoding. Receiver sensitivity is better than 3 microvolts with an effective operating temperature range from 0 degrees F to 160 degrees F.

Servos

The system under evaluation was delivered with Digimite servos. These have been reviewed with other systems (RCM April 1965) and we shall not go into great detail concerning them. Two types of servos are supplied—Center Fail Safe for flying surfaces, and End Fail Safe for throttle. The servos feature a linear push-pull action, and are housed in a high-impact plastic case.

F&M recently announced that their Digital 5 was being shipped with a new servo manufactured by F&M. We have not as yet obtained one of these units, but feel certain that they will be found to be of comparable quality to that of the rest of the system.

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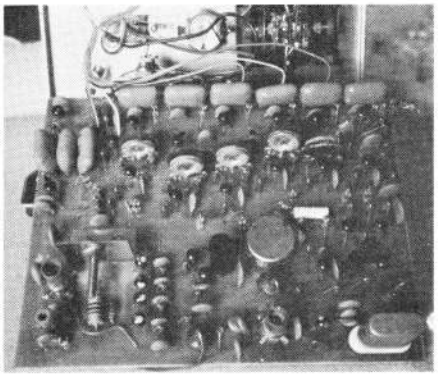

Installation and Tuning

Installation of the Digital 5 system is quite simple. The receiver is packed in foam, as is the power supply. The servos may be mounted in any convenient position, and are quite easily side mounted directly to the airframe side walls. DuBro Kwik Links have been used in all installations with no noise problems experienced. The antenna was run to the tip of the horizontal stabilizer, and in cases where excess length remained, up to the vertical fin. No tuning of the receiver or transmitter is necessary, or permitted. We did notice that on our initial setup, the servos did not fail-safe exactly in the center. This was caused by having the servos in positions other than those where the set was adjusted at the factory. Switching the servos around quickly cured this factor.

Price and availability

The F&M Digital 5 system sells complete with transmitter, receiver, four servos, power supplies, chargers, and switch harness for $539.50. It is readily available through your local hobby dealer.

RCM Findings

As we mentioned earlier, the Digital 5 was purchased last May. Since that time it has undergone the most extensive on-the-field checkout of any system tested by RCM. The initial flight tests were made in a Senior Falcon during a 45-minute lull between two thunderstorms. (We had heard that digital systems were susceptible to noise!) Three flights were logged without any evidence of Lock-Out or Fail-Safe. Control appeared to be precise and immediate. The only difficulty encountered was a lack of two-stick experience on the part of our left-handed pilot. He insisted on cradling the transmitter and flying it ala single stick, a habit which was soon overcome.

On subsequent flights every effort was made to cause the system to Fail-Safe, or at least Lock-Out. After an entire season of flying the Digital 5, Fail-Safe has occurred only twice, and then only briefly. On the first occasion, the ship was at an altitude of approximately 500 feet and about 2000 feet out with the transmitter antenna deliberately collapsed! On the second occurrance, the transmitter was inadvertently switched off while lighting a cigarette!

The Digital 5 has been flown in no less than seven ships, run in a sailboat, logging a total "on-time" in excess of one hundred hours and some fifteen gallons of fuel! It has spent over fifty flights in a Tauri with a pilot that had never before flown multi! The exacting control and ease of handling of the Digital 5 is evidenced by the fact that each ship in which it has been flown is in perfect condition, having suffered neither from equipment failure or from pilot error. The system is comfortable, in that it affords the flier a relaxed sense of security in his equipment, allowing him to concentrate on flying alone.

This is the F&M Digital 5 – a five

channel digital proportional system. A system that is well engineered, well built, and thoroughly reliable. It is recommended by RCM and rated as one of the best.

Addendum

The newest offering from F&M Electronics is their Digital-3, a three channel proportional system which employs a pulse duration modulation scheme similar to the Digital-5. The entire system uses all silicon components and the transmitter, again, radiates better than .8 watts output. The transmitter size is 5½" x 6" x 2¾", and is intended to be cradled in the left forearm while flying. The single stick is used for elevator and rudder/aileron while the engine throttle is on the right hand side of the case, permitting operation by the left index finger. A coupling plug is provided to permit coupled ailerons and rudder.

The receiver size of the Digital-3 is 1⅝" x 1¾" x 2½". Contained within is an RF amplifier, three IF stages, dual level AGC with three microvolt sensitivity.

The servos are compatible with those used in the Digital-5. The fail-safe feature is identical to the five channel system. Price of the complete system is $350, and includes transmitter, receiver, three servos, switch harness, both battery packs and chargers.