RCM DIGITRIO

CONVERSION TO SIX METERS

By ED THOMPSON

RCM TECHNICAL EDITOR

Members of the Monmouth (New Jersey) M.A.C. pose with their RCM Digitrios. Group has monthly "Digitrio Builders Meetings" in addition to regular club dates. Photo by Dick Sarpolus.

THIS last month we've been busy working the four channel conversion into shape for publication. There are several prototypes being flown around the states and all reports to date have been gratifying. I've been flying the heck out of mine — so far about 250 flights. By the time the conversion appears, there should be at least 2,000 flights on the prototypes. Although the conversion will be to only four channels, the basic decoder can be expanded very simply. There are currently several five and one eight channel versions flying.

I am presently working at top speed on the Digitrio 4 and will try to kick it off next month. The modification is designed to be as painless as possible. It consists of the addition of a small P.C. board in the transmitter, a three-control stick assembly (or if you wish, your own arrangement) and a new decoder board to replace the existing one. Most of the parts on the old decoder board can be reused in the transmitter modification, keeping the necessary additional parts to a minimum. If some of you want to get a head start, you can build a new transmitter case with provisions for four channels around the existing Digitrio transmitter P.C. board. The small transmitter modification board will not interfere with your mechanical layout. Those of you who have wanted to build a Digitrio but desired to wait until the four channel version was presented can build the Digitrio, less the decoder board (save the parts) for a head start. It will not be necessary to modify the motor servo on the four channel system.

I have built a transmitter using 2N3640's in place of the 2N3638's and 2N3646's in place of the 2N706's. I recommend the 2N3640's as substitutes for the 2N3638's and the 2N3646's for the 2N706's in the untuned power amplifier circuit. I haven't found any heat sinks that fit the 2N3646's but they can be made by cutting down the TO-5 type. I have also found a good substitute for the timing capacitors used in the one shots. These are made by Erie and are type Z5E.

We received a letter from Buddy Tomlinson of Groves, Texas about his four channel Digitrio and was surprised to see that Buddy's circuit was almost identical to the one I had been flying, except for his method of sync. Buddy was kind enough to incorporate my sync circuit and forward his P.C. board layout, overlay, and a brief writeup. This circuit is recommended only for those technicians who like to experiment. I have abandoned this particular circuit in favor of SCS's and recommend that only technicians use it. At the time of this writing Buddy has a dozen or so flights on it and says the only problem he encountered so far is one of sync when the equipment is first turned on. According to Buddy, if you turn the receiver on before the transmitter, or swamp the receiver, one of the servos may run to an extreme position. Turning the switch off and then on again will restore it to its proper sync condition and Buddy claims he has never had it lose sync while flying. I didn't have this problem when I was flying this circuit and don't know what might be causing it. In any case, it should be thoroughly checked out before use. Buddy gave us permission to print his address and stated he would like to correspond with any technicians interested in the circuit, or for that matter just to swap ideas on any electronics circuitry. His address is:

B. G. Tomlinson
2310 Owen Ave.
Groves, Texas

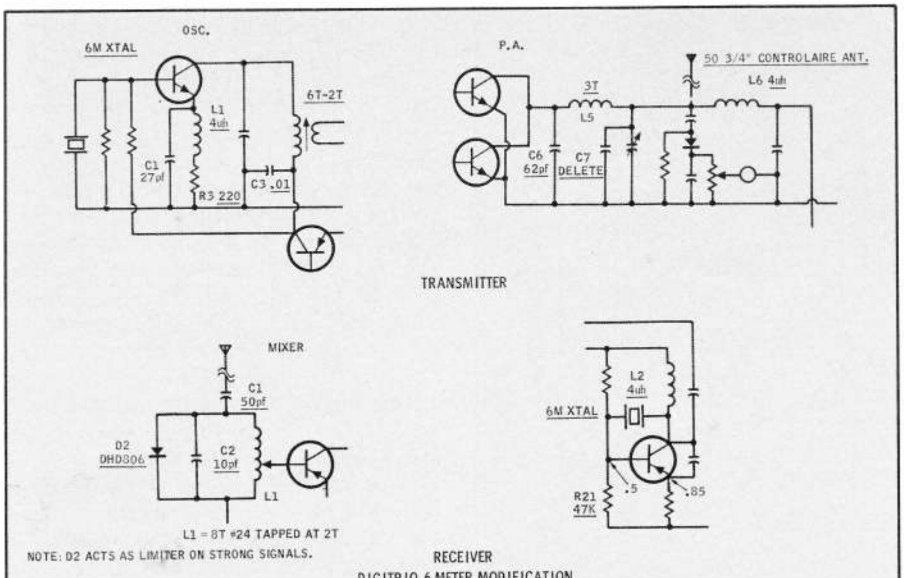
Here is a note on the servos passed on to me by Tomlinson. A couple of fellows he knows have bent the finger assembly on the output arm to prevent it hitting the .001 capacitor. This may cause the fingers to run off the end of the resistance element when the output arm is at the extreme position. To prevent this, the .001 should be moved to the left to obtain clearance rather than bending the wiper assembly.

I have been flying the retractable gear that I mentioned last month with excellent results. Cletus Brow put a lot of thought and ingenuity into these devices. The installation is simple since each gear has its own actuator, eliminating cables, etc. Operation is practically foolproof and they require almost no maintenance.

Each unit has an air actuating cylinder and motor crankcase pressure is used for power. A unique and practically foolproof pressure switch using surgical tubing is actuated by the motor or extra channel servo for operation.

A reed valve, from a Cox .020 is used between the motor and the actuators. Once the gear is retracted no further pressure is needed. This also allows the gear to stay retracted if the motor stops. Ted White uses this feature to best advantage by dropping his gear at the last moment on dead stick landings. At the Southwest Regionals this year he had

Buddy Tomlinson shown with his 4-channel Digitrio. Tomlinson's modifications detailed in this issue.



DIGITRIO 6 METER MODIFICATION
ALL CHANGES UNDERLINED

everyone, even the spectators, yelling "drop the gear" thinking he had forgotten them. With a smile on his face, and hardly able to contain himself, he waited until the last minute, dropped the gear and dead sticked his El Gringo almost dead center on the spot. This ended one of the best flights I have seen and one that had the spectators and even some of the contestants applauding each maneuver. Ted sure knows how to milk the points out of the judges!

Here are some features of this gear:

1. Easy installation.
2. Positive down lock.
3. Nose wheel steering has built in yoke assembly allowing push/pull operation.
4. Light weight, approximately 14 ozs. total.
5. Maintenance free.
6. No electrical noise.
7. Foolproof operation when properly installed.
8. All units shock absorbing (coil springs).
9. Machined wheel mounting hardware supplied allows adjustment of gear height.
10. Thoroughly flight tested and proven reliable.

RCM approves and recommends this gear.

In the May 1966 issue of RCM, I presented a home crafted stick, designed by Mr. Gerald Dale. The construction writeup for this unit on page 88 appears to have been written by myself. Actually, Mr. Dale wrote the assembly instructions and should receive full credit.

Apparently those who have built the Digitrio are not having many problems. I base this on the fact that I have received very few letters of complaint, and those that I have received concern minor difficulties or problems that could easily be cured with the modifications I have printed. I am very interested in knowing how the Digitrio is performing throughout this country as well as overseas and have made up a form which I hope you readers will fill out and mail to me. I will compile the information I receive and publish it. Please take a few minutes of your time to do this for me as it will give the readers a chance to evaluate the Digitrio and provide me with valuable information for future projects.

I am currently editing several other articles for publication and as soon as they are ready, they will be printed in an effort to expand the technical coverage of the magazine. You readers can help here by letting me know what you want to see in print, and also by submitting technical material for evaluation. Unlike dealing with the "big time" editors, you don't have to knock yourselves out for nothing — just drop me a line if you think you have a "goodie" and describe it. I'll let you know if I feel it is worth general publication and assist you in the preparation of an article. You will receive full credit for the article and a check for your contribution. Remember that I am a technician who flies R/C every chance I get and I have the facilities to evaluate almost anything you can come up with, so I am not going to reject any articles because I am twenty years behind the "times" and afraid of laying an egg. Also I am not a "know-it-all" who thinks that only a chosen few are worthy contributors. If you have a "goodie," your project will receive a fair evaluation and I may learn a few things in the process. Don't expect overnight acceptance however, because anything printed in RCM must be evaluated completely and be of top quality. I'll work with a prospective author until we are both satisfied that it is "top quality."

Here are some guidelines for prospective authors that will help speed up acceptance and save both of us time:

1. Jot down a description of your device or circuit and send it to me along with a photo.
2. Be prepared to send me a sample, if requested, for evaluation.
3. Insure that the item can be duplicated with the same performance as the original.
4. Be prepared to work as hard and as long as necessary to see the "project" through.

SIX METER CONVERSION FOR DIGITRIO

The changes necessary for six meter operation of the Digitrio are shown in the attached drawings. All schematic changes are underlined. Since any person operating equipment on six meters must be a licensed amateur operator, I won't go into a lengthy discussion of the changes. I used a 50¾" antenna from World Engines which is, theoretically, a little short of resonance. To provide for true resonance, I installed a four-turn slug-tuned coil, the form being the same as used at L2. Due to ground loss resistance a significant improvement in output power, but if you are a purist you can install one. Use the shield and one shot modifications described earlier.

Range of the six meter version is as good, and may exceed, the eleven meter version. I have more than two hundred flights on mine and have experienced no system problems. We don't have many six meter problems where I fly, but in some of the more congested areas "RF wise" it would be a good idea to spend a little time finding a "clear spot" to operate the system.

The equipment is tuned just like the 27 MC version and operates just as well. Dave Holmes of Grafton, Va., replaced the oscillator transistor with a 2N3646

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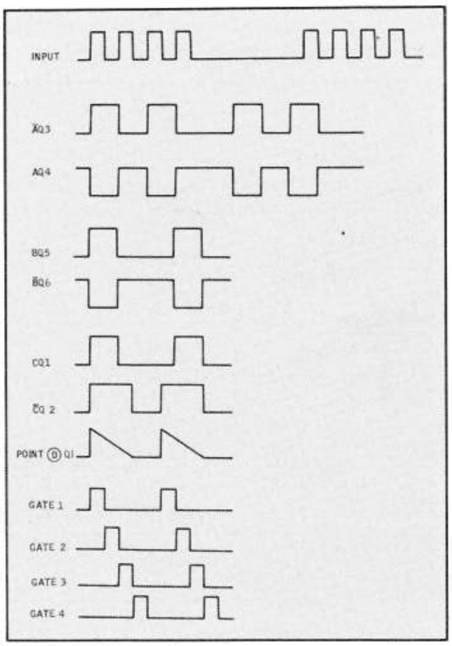
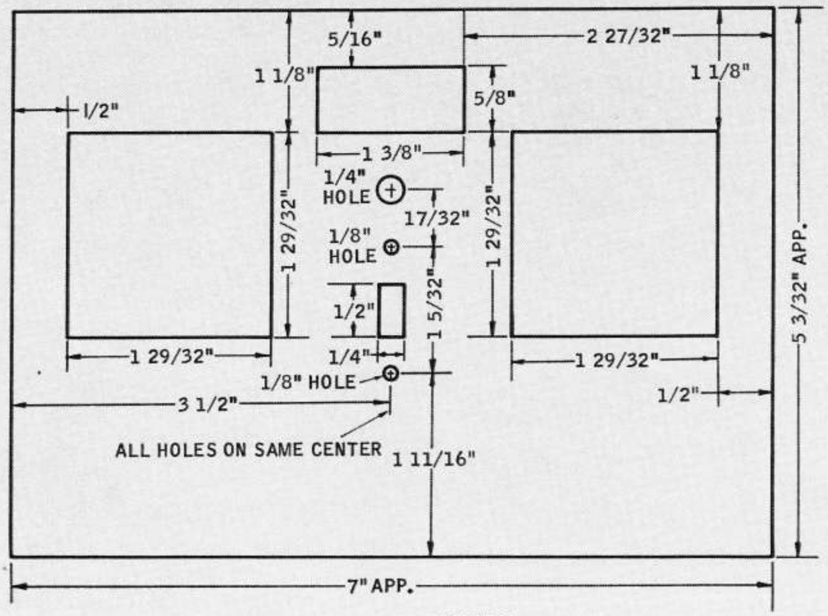
Waveforms from B. G. Tomlinson's 4-channel Digitrio conversion. See text for theory and construction.





CASE SAME SIZE DIGITRIO
(FROM WORLD ENGINES)

when he found that slow pulse recovery time was causing wide output pulses. I haven't experienced this problem, but am passing it on in case it may help someone. Dave has been flying his six meter version for about seven months and says he has never had a range problem or glitches due to insufficient signal strength.

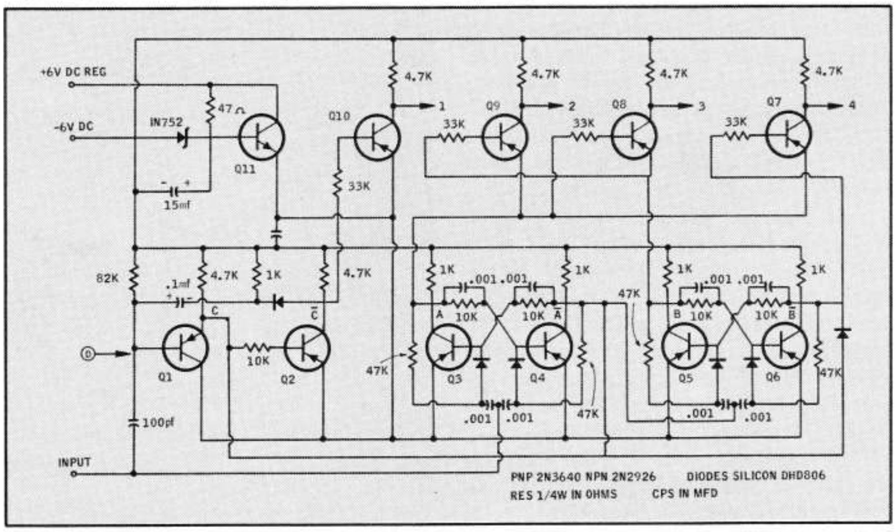
FOUR CHANNEL DIGITRIO BY B. G. TOMLINSON
THEORY OF DECODER

Most of the circuits in the decoder were covered briefly in the first article and in the Trio decoder. Two flip-flops, one one-shot, and three gates (Q10 is merely an amplifier) are used to count/sort the pulse trains into separate channels. Constant reference to the decoder waveforms will be necessary to grasp its operation.

The input to the decoder is a replica of the transmitted signal. Q3 and Q4 (flip flop) are triggered by the leading edge of each pulse. This produces square waves at both collectors (Point A and A). The width of these pulses are determined by the width between the leading edges of the pulses in the incoming pulse train. Since Q3 and Q4 cannot be in the same state at the same time, A and A will be inverted replicas of each other.

Q5 and Q6 (B and B) form another flip-flop which is triggered by Q4. This flip-flop changes state each time Q4 produces a pulse, which will be every other time Q3 and Q4 receive a pulse from the incoming pulse train. They are inverted replicas of each other.

Q1 and Q2 (C and C) form the one shot that is used to measure the time between the #1 pulse in the pulse train. The time between #1 pulse is compared with the timing of this one shot to produce the motor control pulse. It is also used to reset the two flip flops during the sync pause.



Q7, Q8, and Q9 are the output gates for pulses 2, 3, and 4 respectively. Q10 is the motor control output transistor. Q11 in conjunction with Z1 provide regulated voltage for all timing circuits including the reference generators in the servo. It also provides regulated voltage for the receiver.

Let's start with the action of the one shot Q1 and Q2 and the two flip-flops Q3 and Q4, Q5 and Q6. During the sync pause, Q1 and Q2 will return to the quiescent state, Q1 conducting and Q2 cut off. Q1 will produce a positive pulse at this time and cause the two flip-flops to sync Q3 off, Q4 on, Q5 off, and Q6 on. Q2 being off will place a negative voltage on the base of Q10, forward-biasing it on. Gates Q7, Q8, and Q9 are cut off at this time. There will be a positive voltage on the base and negative voltage on the emitter of Q7, this will not allow it to conduct. Q8 has a negative voltage on its emitter and base and cannot conduct. Q9 has a negative voltage on its emitter and base and it cannot conduct. As can be seen these gates must have positive emitter and negative base in order to conduct.

When the first pulse arrives it changes the state of the one-shot and the flip-flops. When Q1 cuts off and Q2 goes on, the base of Q10 goes to ground potential, cutting it off. At the same time Q3 goes to ground and Q4 goes negative, Q5 and Q6 remain as they were, Q5 negative and Q6 ground Q3 and Q5 forward-biases Q9 causing it to conduct. Under this condition neither Q7, Q8, or Q10 is forward-biased so they are not conducting.

The second pulse will change both flip-flops. Q3 goes to negative, Q4 to ground and Q4 at this time triggers the second flip flop causing Q5 to go to ground and Q6 to go negative. Q8 at this time will be forward-biased by Q3 and Q5 turning on giving us another control pulse. At the same time Q9 is turned off Q7 and Q10 still have the wrong potential and cannot conduct.

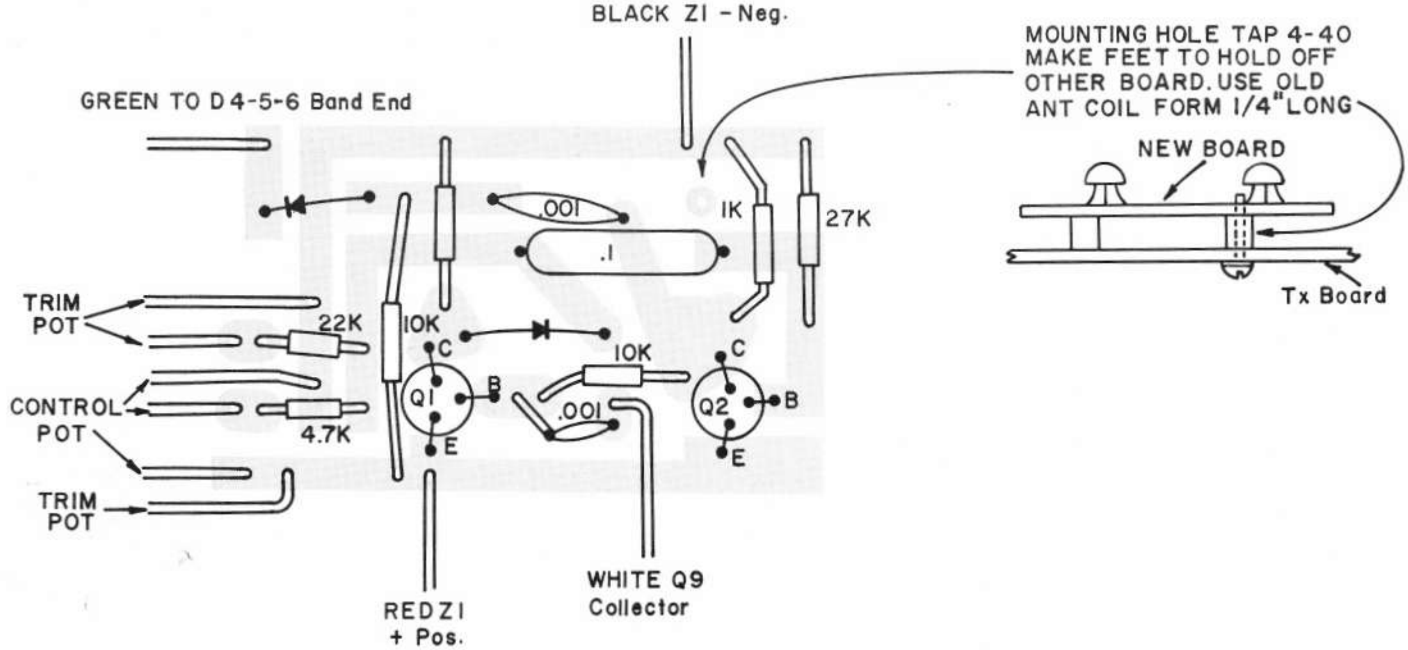
The third pulse will change the first flip-flop again causing Q3 to go to ground and Q4 to go negative, Q5 and Q6 remain the same. This turns off Q8. Q7 will be forward-biased by Q3 and Q6 giving us our last control pulse.

The fourth pulse changes both flip-flops. Again Q3 goes negative, Q4 to ground, but Q5 goes to negative and Q6 goes to ground. This turns Q7 off; at this point all gates have the wrong potential and cannot conduct. The sync pause starts over again and after approximately 6.5 MS the one shot will return to its quiescent state. This brings us back to where we started.

SYSTEM IN GENERAL

In building the decoder, care should be taken when installing the diode that lays down.

I have made all the latest changes to



MOUNT IN TOP LEFT HAND CORNER OF DIGITRIO Tx BOARD

the system (servos and Tx). They all help to some degree.

The system is rock solid; no servo chatter or buzzes with or without signal. I find that it is as reliable both on the ground and in the air as the Digitrio. I have noted that you can cause it to go out of sync (servo or servos will run to one end or the other) by swamping the receiver. Back off turns Tx off then on and it will sync again.