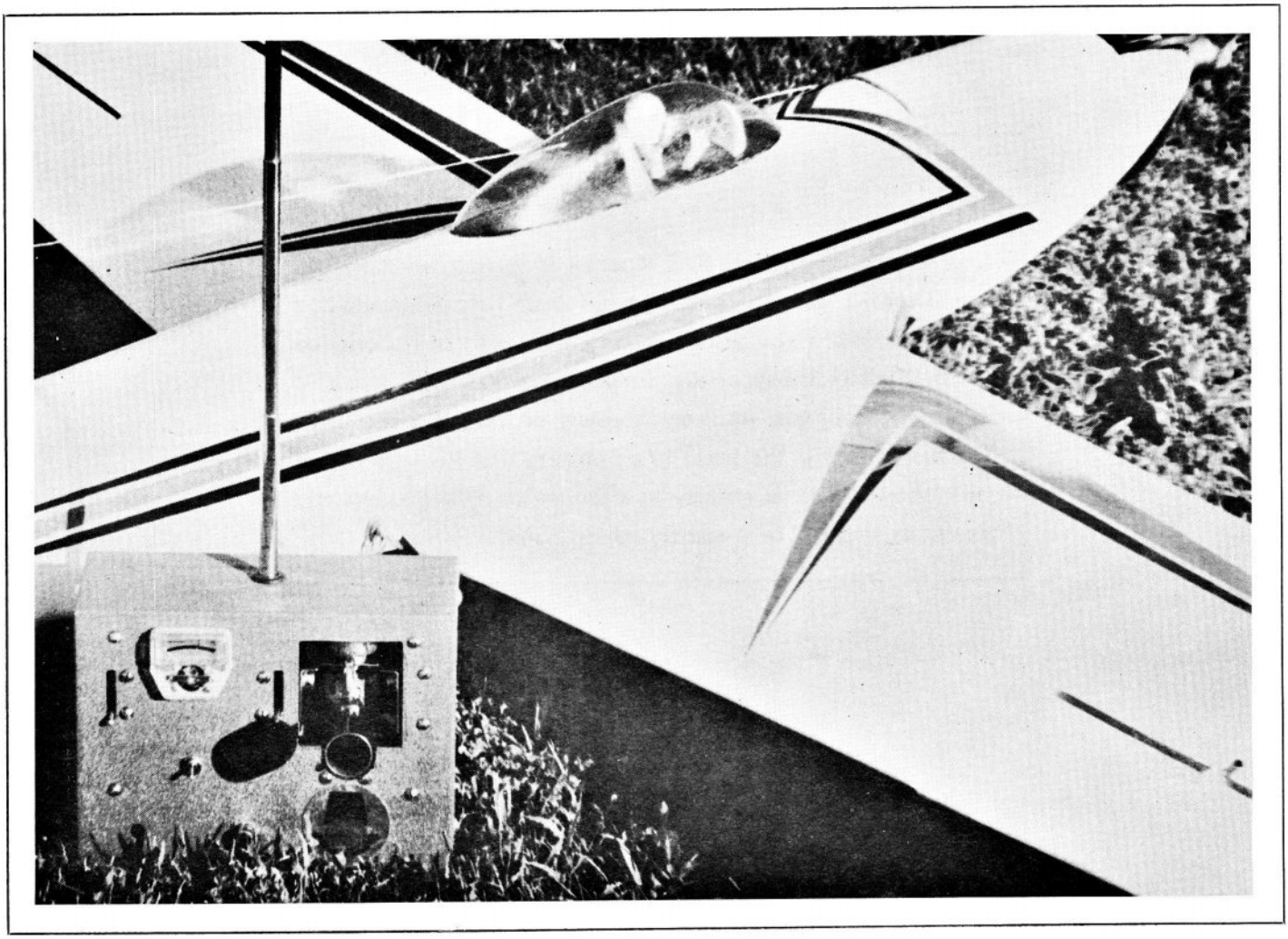
CONVERTING THE

RCM DIGITRIO

TO FOUR-CHANNEL OPERATION



Written By

Ed Thompson

Edited By

Don Dewey

RADIO CONTROL MODELER MAGAZINE

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*** NOTE**

Due to popular request R/C Modeler Magazine has reprinted the "Digitrio" exactly as it appeared when first published as a series in 1966. Because this is an exact reprint of the original RCM Digitrio, many prices, stock numbers, firm names and addresses, coupons, etc., are obsolete or have changed since the first printing. We want to emphasize that this reprint has been made available strictly as a service to RCM readers and not as an updated or currently edited book.

DIGITRIO DASH-FOUR

Modifying the

RCM DIGITRIO

To Four Channel Operation

By ED THOMPSON, RCM TECHNICAL EDITOR

R/C
MODELER

TECHNICAL FEATURE

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By ED THOMPSON, RCM TECHNICAL EDITOR

THIS month I have been able to do quite a bit of work on the four channel modification and will be able to complete the articles within about two or three weeks from the date of this writing. A brief discussion of the four channel version may help relieve some of the anxiety for those of you who are patiently waiting.

First of all, these modifications will allow present Digitrio owners to add another channel without performing "major surgery" on their units. The largest and most tedious task will be the mechanical changes to the transmitter in order to provide the additional control function. With this month's article we have included a three-control stick designed by Warren Thomas and Jim Holman of Jonesboro, Arkansas. This stick can be used with your existing Digitrio if it was built per the original article. Although this unit is not the easiest stick to duplicate, it does a good job. Warren and Jim built the prototype on the kitchen table with a minimum of assistance from the machine shop. I have logged well over a hundred flights with this stick, as presented here, and am convinced that a three control stick is the answer to improved flying over the more conventional two-stick arrangement. This is not to imply that you will be able to fly circles around Cliff Weirick simply because you have a three control stick, or that the three control stick is even superior to a two-stick transmitter. This, of course, depends on the individual. But — if you are an average flyer, like myself, you will note an immediate improvement in your flying abilities with the added confidence this type of contol unit affords.

On the other side of the ledger, the three-control stick has been played down by certain flyers with the implication that coordination of the various motions required are physically impossible to accomplish with any degree of proficiency. This is simply not true, and if you haven't tried it — do so! I think a better reason for the lack of popularity of this method of control are as follows:

1. Manufacturers have not come up with a good CLOSED FACE three control stick and the two stick arrangement is better for them from both a production and cost basis.

2. The average flier has not flown a digital system with a three control stick and has no basis of comparison. They are used to BOUNCING a stick from stop to stop and are prejudiced.

3. A lot of fliers are impressed more with the looks of a transmitter than how it operates. They simply can't live with a gaping hole in the front of their LITTLE JEWEL.

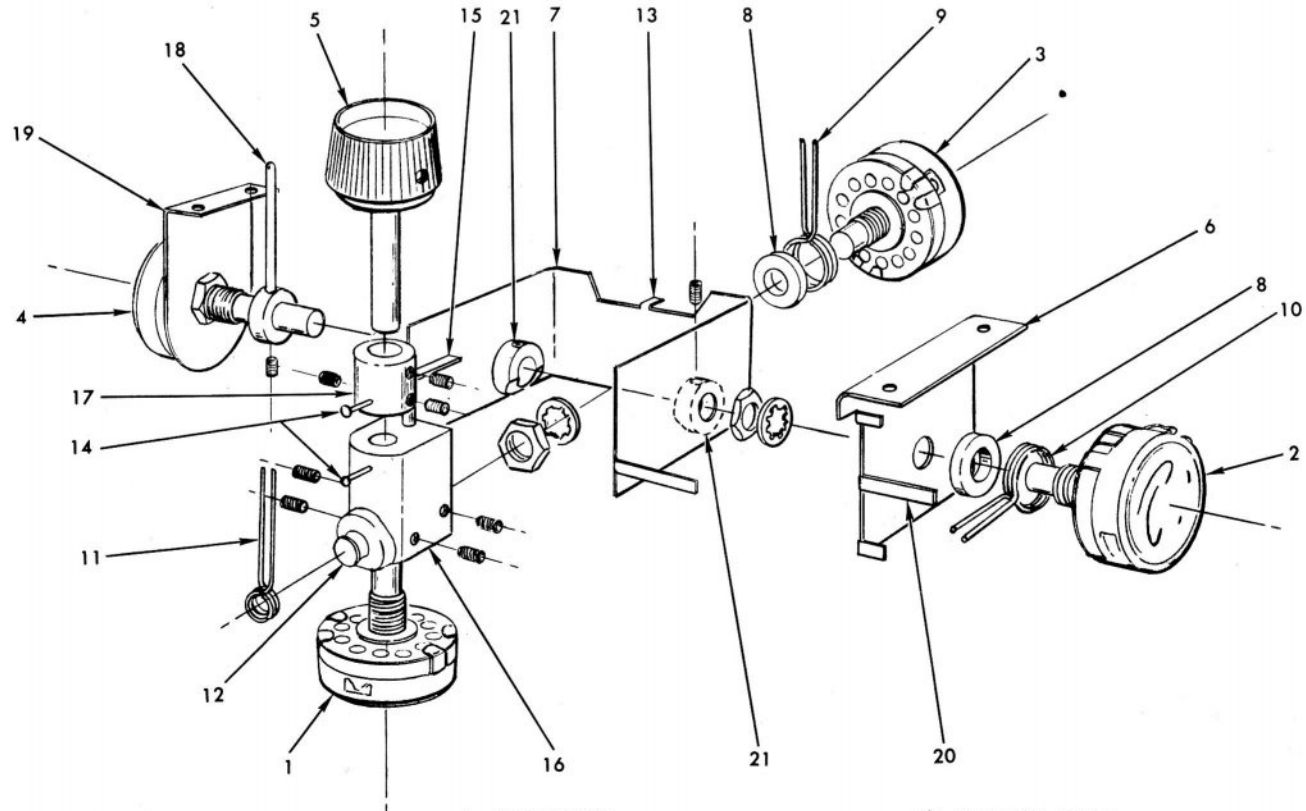
I will make the prediction that, if and when a good commercial, closed-face three-control stick is made available to the R/C modeling public, it will be

warmly accepted and gain widespread acceptance.

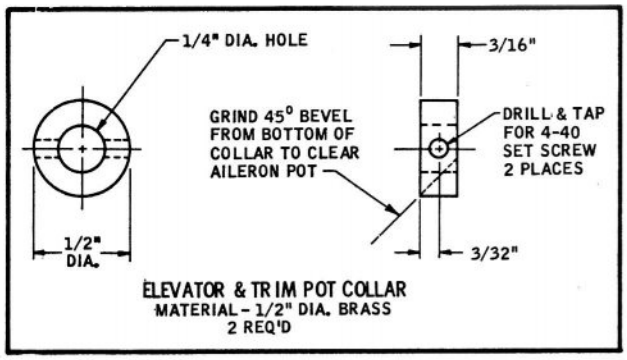
There are two Bonner stick versions of the RCM Digitrio-4. On one version, a single Bonner stick is used with the addition of a pot with a spring centering lever control for rudder added just below the meter. The two stick deluxe version, shown with this article, utilizes two Bonner sticks and conforms to the currently accepted transmitter layout.

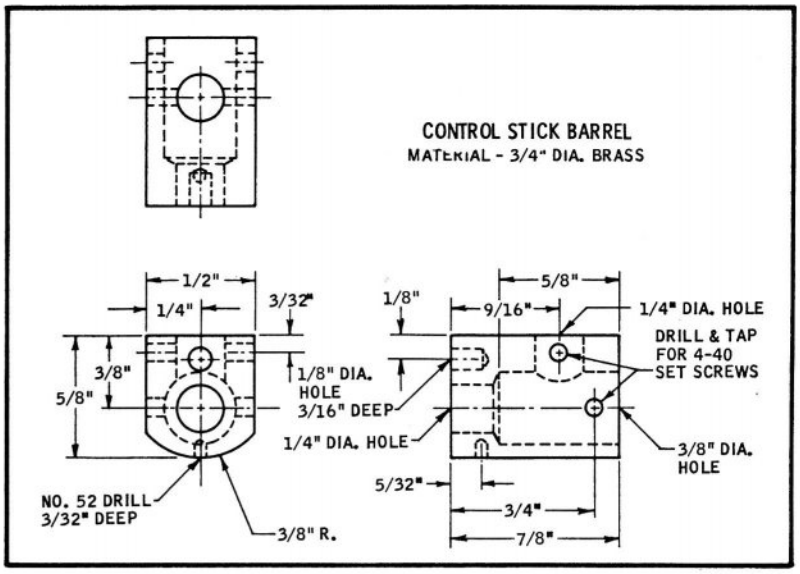
The electronic changes to the transmitter are simple, requiring an auxiliary board containing two more one-shots. After the modification you will use five pulses to obtain four channels. The reason for the **extra** pulse will be apparent after you read about the new decoder. There will be a minor change to the unijunction circuit, eliminating this stage as a control function. It will be retained only as a "clock." I don't particularly like that term — it tends to exaggerate its lowly function of providing a sync pause, and is one of several terms bantered about in advertisements to make products sound like a cross between a Gemini control system and an electronic brain that has been blessed with Holy Water.

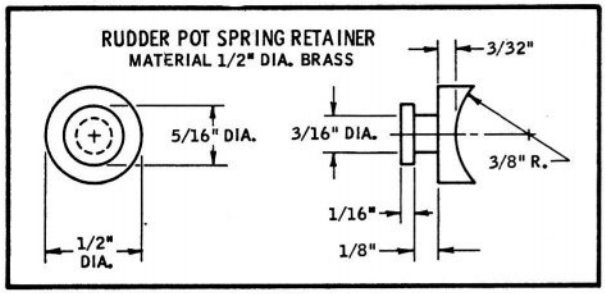
EXPLODED VIEW - COMPLETE DIGITRIO 4 STICK

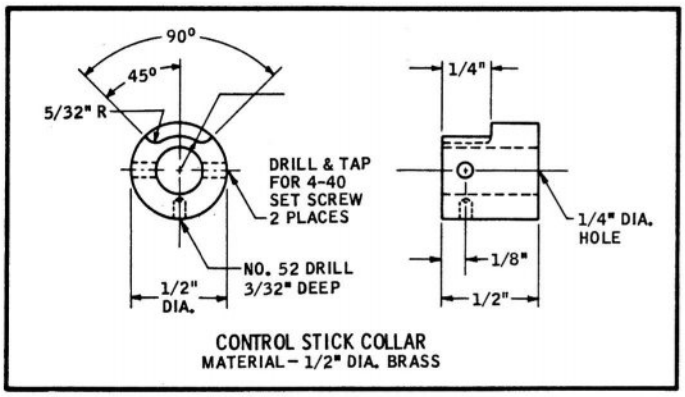


1. RUDDER POT
2. ELEVATOR POT
3. AILERON POT
4. ELEVATOR TRIM POT
5. CONTROL STICK
6. PART "A"
7. MAIN "U" FRAME
8. SPACER (2)
9. AILERON CENTERING SPRING
10. ELEVATOR CENTERING SPRING
11. RUDDER CENTERING SPRING
12. RUDDER SPRING RETAINER
13. AILERON CENTERING STOP
14. RUDDER POST (2)
15. AILERON POST
16. CONTROL STICK BARREL
17. CONTROL STICK COLLAR
18. TRIM POT LEVER
19. TRIM POT BRACKET
20. ELEVATOR CENTERING STOP
21. COLLAR (2) NOTE: COLLARS ARE SOLDERED TO MAIN "U" FRAME







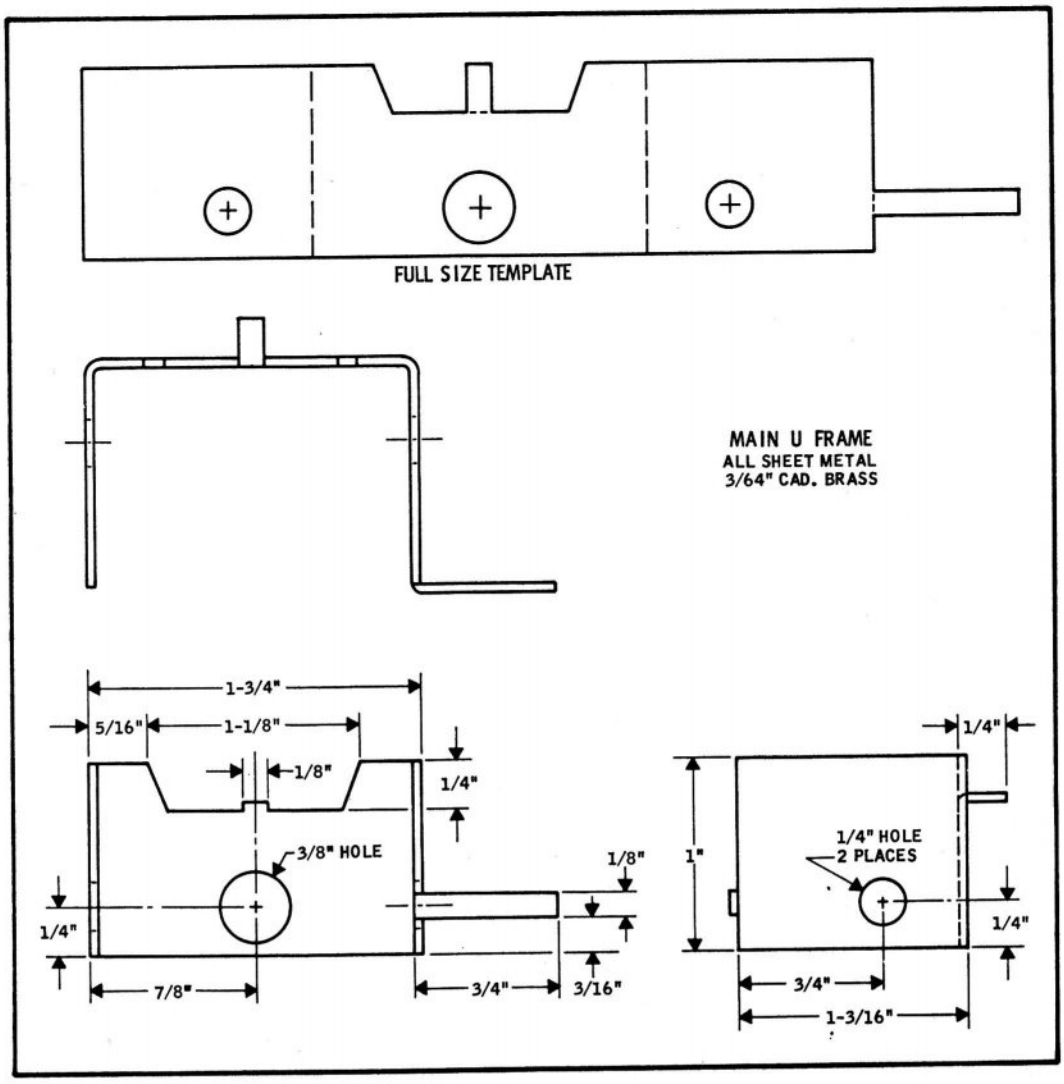


The decoder will be entirely new, and as stated before, will use silicon controlled switches. This will not be a "breakthrough" (another one of those terms I abhor), but what I consider to be a common sense usage of these so-called **new** devices. I say "so-called" new devices because they have been around for some time. This decoder is basically the same as I first used in 1960. At that time I used 3C30's (trigistor) which were anything but inexpensive! Recently, General Electric introduced a low-cost line of these devices, making their use practical. I am using the 3N84 in my decoder, and it might be a good idea to round up four of these before the supply dwindles. The only hobby distributor handling these units at the present time is World Engines. Allied Radio should have them, and any electronic parts distributor should be able to obtain them for you if they want your low-volume business.

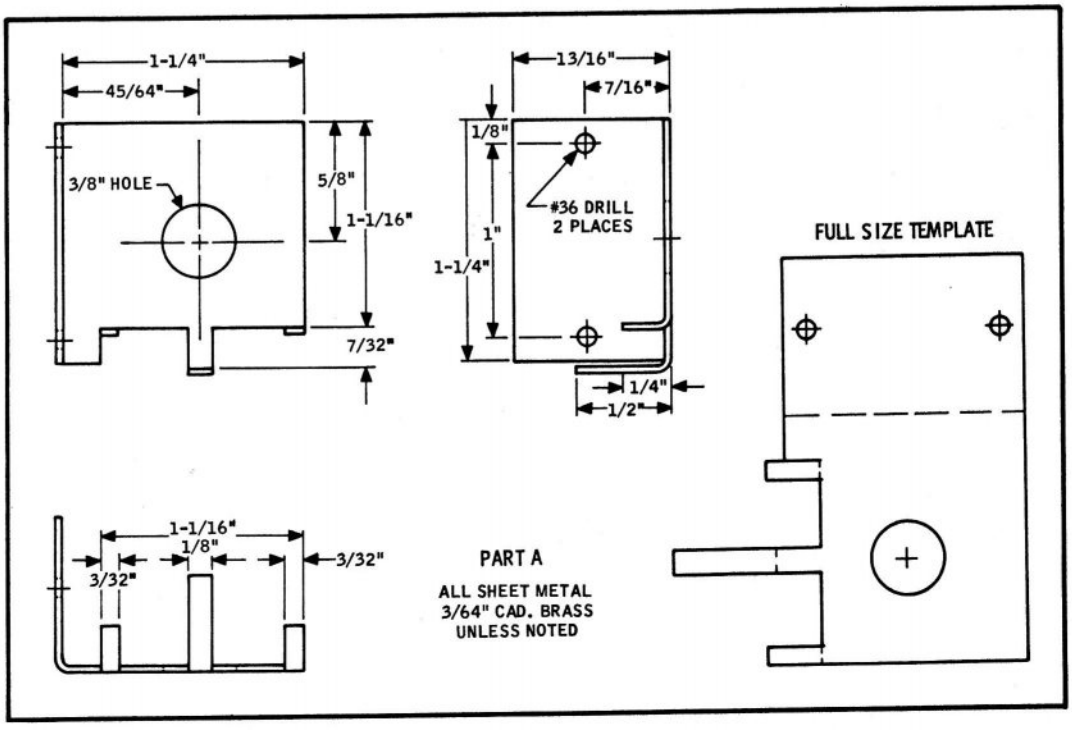
And — before the letters start rolling in about how I sold you out by not extending the present decoding method used on the original Digitrio, let me get **my** licks in. There are many reasons for going to the SCS's. As I said before, I have used this system before, and the only reason I didn't use it on the original Digitrio was because I wasn't aware of a low-cost SCS. The SCS decoder is superior to the original method and this should be enough reason for you not to fret. If you are harboring fears about wasted expense of the present decoder — forget them. Most of the parts on the present decoder can be used for the modification — it was planned this way. Let me say at this point, however, that I don't recomend that the unexperienced Einstein with a 250-watt instant heat soldering gun try it! Care should be taken when parts are transferred from one PC board to another unless you are proficient at salvaging parts or have a local technician handy.

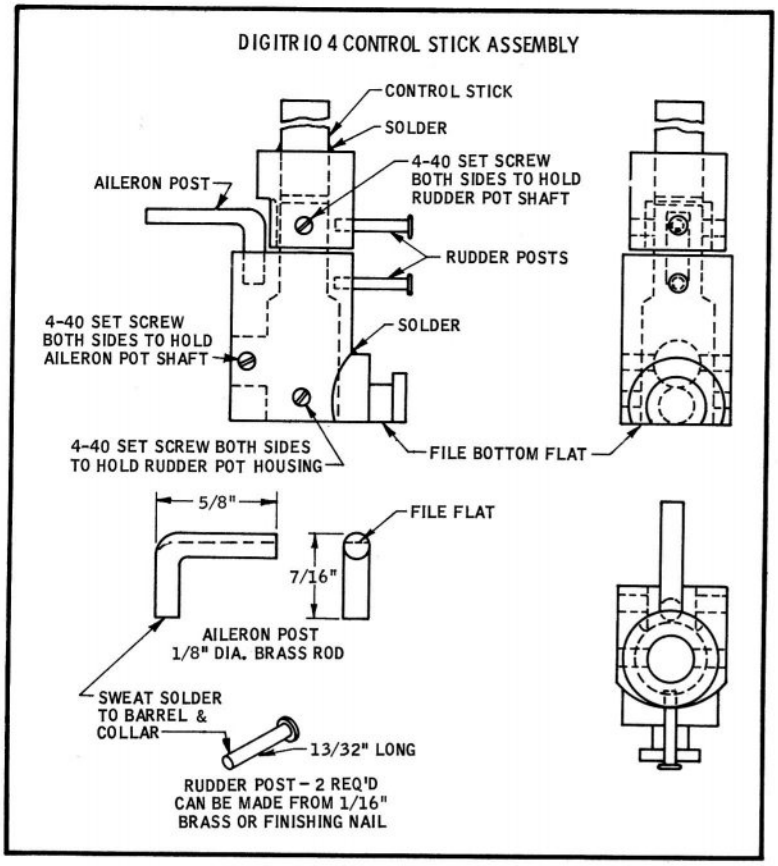
To start with, the new decoder is usable with as many channels as you wish to use with only minor considerations. In other words, it is easily expandable and can be used with one channel, or as many as you can find a use for. It will require one SCS per channel and all channels are operated in series. This eliminates complicated circuit inter-connections, timing circuits, gates, etc. So far, in addition to the four channel versions of this decoder that are currently flying, there are several five, six, and two eight-channel versions performing flawlessly. In order to obtain independence from timing problems, no one-shots are used in the new decoder, or any other type of circuit that is self-completing, except the method of sync, which is more of a passive type and completely non-critical, within reason. This is also why five pulses are used instead of four to obtain four channels. Instead of a one-shot sampling the sync pause for the additional channel, we will turn off the last stage with a pulse from the transmitter. Therefore, the decoder is commanded from the transmitter for all channels, rather than the decoder deciding the length of the additional channel pulse. This will come as a pleasant change to some of you who might be cussing the motor control on the original Digitrio. Also, since no requirements for timing are demanded of the decoder, there is no point where the servos will chatter to warn you of battery discharge. The new decoder will operate smoothly until the batteries are discharged down to their end point voltage and beyond! This increases the flying time per charge on the receiver pack considerably, and it seems as though they will never run down. So, "beware, lest these sintered-plate monsters do you in."

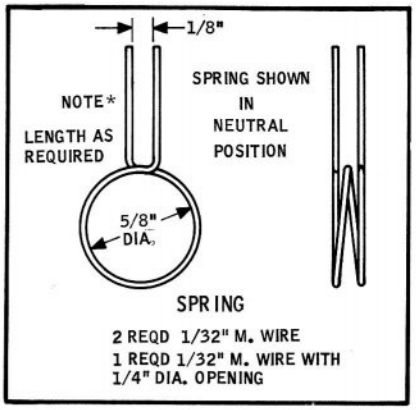
All-in-all, the new decoder is a superior design as compared to the original. It is also a better decoder when used for three channels. Before I am bombarded with letters from all the prophets possessing mystic powers of hindsight, let me say that I consider it as a normal improvement in circuitry that evolves from testing, evaluation, and plain ole' hard work! I don't care to hear all the, "I knew there was a better way" and associated cliches from the latter-day digital experts! If I sound bitter this month, it's because I am! I remember the time that I couldn't find anyone to discuss digital R/C circuits with, but since the Digitrio was introduced I find that some people have be-



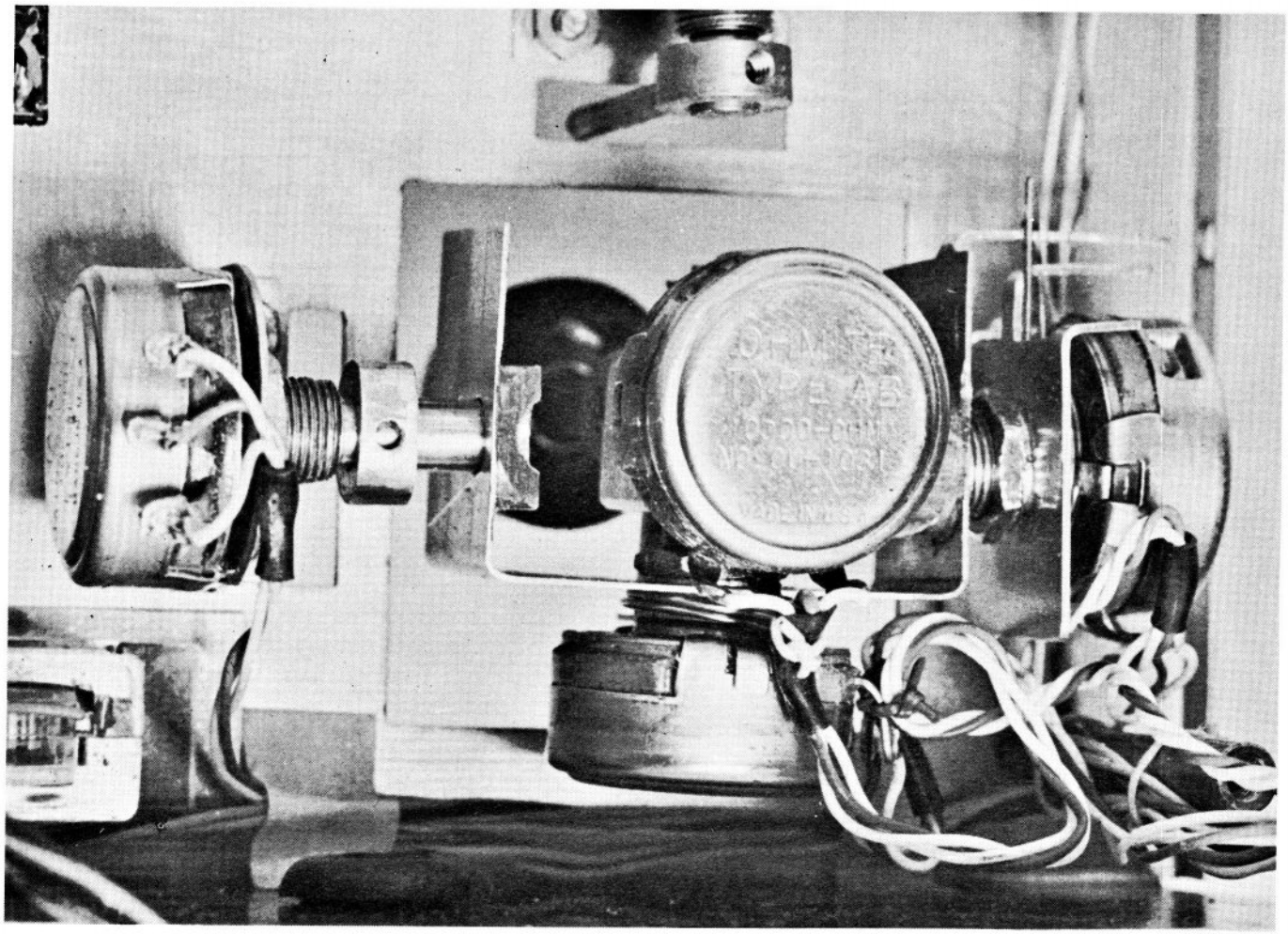
ALL STICK PARTS SHOWN FULL SIZE







come experts overnight and feel that they can modify my circuitry to their own liking and still hold me responsible for the results. As long as their modifications work the system takes on a new name and a magical air of detachment from the Digitrio. Of course when it doesn't work it is simply a lowly Digitrio. All I can say to this is (and I've said it before) if you want to modify, don't call it a Digitrio — give it a new name like the MICKEY MOUSE-ITRIO. This is not to imply that improvements cannot be made to the Digi-



trio — far from it! We encourage originality and hope that we have aroused the experimentors to come up with newer and better systems.

Digital systems are now at the point where they are becoming simpler, both in concept and parts count, than their predecessor ANALOG. They are, in fact, becoming simpler than the MICKEY MOUSE systems that wiggle and wag (except the servos). This, plus the fact that reliability has increased to what we had been accustomed to previously, is going to change a lot of design concepts and the R/C modeler as a whole is going to benefit. R/C radio equipment is starting to emerge from the hold that a certain few had on its advancement. This is due to several things. Number one — I think — is that the R/C modeler of today is not as easy to satisfy as he used to be. He demands higher quality and is fed up with being treated with disregard and having to make do with what is on hand. In the past this was the modelers own fault. Let's take a clear look at why digital came into being. It wasn't because the R/C modelers as a whole demanded a better system, it was simply because a handful of people worked like hell to come up with a better method of control. These same people sunk a lot of money into its development not knowing whether it would pay off or not. Fortunately it was a winner. As a result, a lot of manufacturers jumped on the band wagon. Then, and only then, did you, the modelers, start demanding better reliability of this new system. Right now you have the manufacturers trying to outdo each other for your dollar. Don't lose this advantage by becoming complacent again. Demand even better systems at reduced prices. Tell them what you want and I'll guarantee they will like it. When they can find out ways to please you and give you what you want it puts smiles on their faces and dollars in their pockets.

Now, for the first phase in converting the Digitrio to a Digitrio-4, Jim Holman and Warren Thomas describe their Digitrio experiences and three-control stick fabrication as follows:

"Hey! Did you hear that? Well, if you didn't, it was two fellows in Arkansas yelling shouts of joy at making two discoveries — one a long time ago when RCM magazine was first published, and the other when we were introduced to Ed Thompson and a thing called the Digitrio.

"Digitrio . . . this name was to be in our minds from September 1965 to March 1966, and you know, I don't think now it will ever be off our minds. Here is how it all started.

"Everyone around here was flying reeds — and there's a lot to be said for reeds — but if you haven't flown proportional . . . well, you ain't never flown! So one day my hand was lucky enough to get hold of the only proportional stick in Jonesboro, and a desire was nailed in my mind right then! I had to have a propo system somehow! Jim Holman was already nailed, so I sold my reeds, hocked my wife and kids, and sold the truck! Boy! They nearly sheared the sneeze pin right out of the mud valve! (Tech. Ed's Note: Boy, they sure talk funny 'down in the sticks!') But, before I had a chance to order the monster, the telephone rang. It was my close friend, Jim Holman, and he said — 'Warren, let's build a Digitrio!'

"I said, 'A Digit-what?' I was sure the kickapoo juice had him, but what **had** gotten to him was his copy of RCM.

"Well, you and several thousand other fellows know what ensued. I blasted out to the nearest mag stand, plunked down 50¢ and began looking for an article on a Digi-what! I found it. After several days of wondering whether Ed Thompson knew what he was talking about, and whether we had enough gray matter to build it, off went an order to World Engines.

"World Engines . . . there is another bunch of wonderful people who handle and make it possible for the American model hobbyist to secure just about everything from all four corners of the world. Well, to make a long story short, on a month-to-month basis we constructed the Digitrio while all the skeptics stood around and murmured soft remarks of skepticism every weekend. Every month when a new little pack of black-eyed peas with wires sticking out of them would arrive, we (Jim and I) energetically began the construction of one more digit. Finally, the systems were constructed, and I might add, with ease because of Ed's simple step-by-step method of construction.

"The only thing which gave me any trouble was those damn diodes. Finding anyone who knew how to determine polarity of a diode was murder — all local Einsteins gave us a different answer. Jim and I are not exactly electronic experts so you can see where this left us.

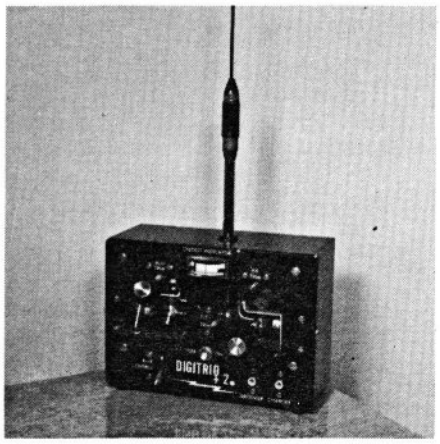
"We had never met Ed Thompson, but we decided now was the time to meet! So we picked up the phone and called him. We still have not formally **met** him, but we feel that we have made another good friend in the R/C world!

"Well, the systems were ready, nicads up, and naturally, rain, sleet, and snow. You name it, we had it! But with Jim Holman, a muddy runway and near gale winds don't mean a thing! So, naturally, a test flight was about to occur. With his engine firewalled, down the runway went the Falcon 56 with a completely new system! Jim flew it magnificently, topping it off with a beautiful landing even though his tiger stopped at 100 feet on a downwind turn. The next flight proved that proportional motor control was to keep Jim on the runway and out of the bean field — an experience that, up to now, we had not enjoyed.

"The weather finally let up on the following Tuesday and the phone rang. You guessed it — Jim, saying 'Let's go digit.' That was for me, so my test flight was to occur . . . and after nearly seven months without flying, I had some apprehensions as to whether I could even find the motor control! But my own system was 'go,' and in another few minutes, we were to see another Digitrio perform flawlessly. Well, Ed — you really did it, and as per your instructions concerning epoxying the components in the receiver and servos — well, came home and epoxied my transmitter! It, by far, took more shaking than the airborne components. We have now turned the skeptics into jello, and we are hearing from one, then another, this phrase — 'Boy, I have to build one of those!' Digitrios, that is!

"We hope you have enjoyed listening to our gab, which brings us to why we are gabbing in the first place. The Digitrio is going dash-four, and Ed threw a challenge at Jim and me concerning a stick assembly that would fit the present case opening. Ed didn't know what he had started, and neither did we when we said, 'Sure, Ed — we'll design one for you!'

5-channel by Don Graves, Pittsfield, Mass.



"Plenty of midnight oil was burned over one idea, then another. Finally Jim picked up a small piece of brass and said — 'What would you say if I said we had the whole thing right here?'

"We had been kicking the idea around, but I thought Jim had a diode in series with his horse and buggy! But as the night wore on, and the sun finally came up, we saw the idea jell until we could finally get the entire assembly in the Digitrio's $1\frac{15}{16}$" case opening.

"Before we begin, let's say a word or three about the construction of the stick. Nothing about it is very complicated. The prototype was constructed on a

kitchen table with drill, razor saw, hand tools, and minor machine shop help. One item of concern is the rudder barrel. Your rudder pot is housed in it, and to insure freedom of the rudder pot shaft, some minor polishing and adjustments are necessary, but it won't present any difficulty. (Tech. Editor Note: Here is where the local machine shop will come in handy.) Take care not to tighten the set screws on the rudder pot too tightly. Care must also be taken to insure that all holes for pots and bearings are in line with all their respective centering posts, or your stick will be slightly off center in the transmitter case. (Tech Editor Note: Actually the rudder control shaft will be slightly below center due to the barrel design.) If you have a Digitrio now, you are already on the road, for part "A" of original Digitrio stick (stationary pot mount and elevator centering post) is used in this stick with the exception of possibly slotting or relocating the mounting holes. Well, enough of the chatter. Brew up a pot of coffee, and let's get on with it. You fellows with Digitrios going now will have the necessary spacers and aileron and elevator springs.

INSTRUCTIONS

( ) First make two collars ½" OD, ¼" ID, 3/16" thick and drill and tap one of them for set screw as per drawing. Next make two 9/16" OD by ⅜" ID by 3/32" spacers. Now make centering springs for aileron and elevator and rudder as per drawings.

( ) Let's make the rudder barrel next. Take a piece of brass round stock ¾" diameter and ⅞" long. Care should be taken to square the ends in relation to the sides. Scribe a line exactly through the center of one end. Measure in ¼" and center-punch on the center line. Drill a pilot hole ⅛" diameter completely through the block. (NOTE: If you have a drill press or access to one, this operation is like shooting fish in a rain barrel. Otherwise, care should be taken to keep the holes straight.) Next, drill with ⅜" drill to within ⅜" of other end (Approx.). Next, continue this hole with ¼" drill. Using the scribed center line as a guide, flat the sides parallel to the line equally to a total width of 9/16". Flat the top side furthest from the center hole until it becomes square with the two sides. You should end up with a total of ½" flat surface on each side.

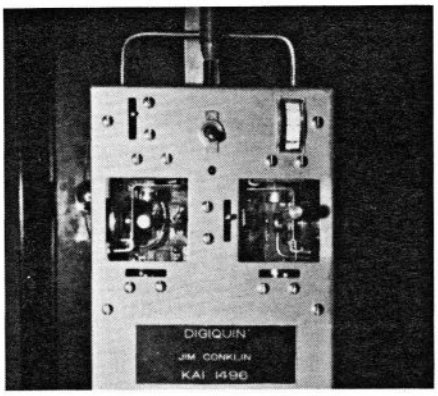
( ) Now let's locate the aileron pot shaft hole. Do this by scribing a center line full length down the top of the rudder barrel. (NOTE: See drawing defining top, bottom, sides, etc., of rudder barrel.) Starting at back of rudder barrel (end with ⅜" hole), come in 5/16" and center punch on this line. Drill a ¼" hole perpendicular to the ⅜" hole. (NOTE: This hole is only drilled through one side of the barrel — don't go all the way through.) Drill and tap for aileron shaft set screws now as per drawing. Set screws used were 4/40 by ⅛".

( ) Now let's go to the front of the rudder barrel, or the end with the ¼" hole. From the center of the ¼" hole towards top of the rudder barrel, measure ¼" and center punch. Drill a ⅛" hole approximately 3/16" deep. This hole is for the aileron centering post. Now let's scribe a line down the rounded portion of the rudder barrel, being careful to keep this line in center of ¼" hole at one end and ⅜" hole at the other. Down this center line from the front (¼" hole end) come down 5/32" and center punch, now drill a 1/16" diameter hole 3/32" deep. Don't drill into hole through center of barrel.

( ) This completes the basic rudder barrel, so lay it aside for now and let's make the other goodies. Construct the rudder spring retaining collar (this is best made on a lathe and the bottom filed flat), rudder centering post and the aileron centering post as directed in the drawing. The way we made the original aileron centering post was to take a piece of ⅛" brass welding rod, put it in the vise and heat it so we could get a good sharp bend (90 degrees). Then we filed a nice flat edge as noted so we could retain as much as possible inside the rudder centering collar. Silver braze the rudder spring retaining collar, the rudder centering post and aileron centering post on to the rudder barrel being careful to keep these in line. (Note drawings.)

( ) Next let's make the combination rudder centering collar and shaft extension as per drawing and silver braze the other rudder centering post into the collar as shown. (NOTE: Just a word of caution. The location of all the various components on the rudder barrel need to be centered for correct movement right and left.) Silver braze the ¼" diameter rudder shaft extension to the collar — its length is up to you — 1⅜" was used on prototype. Drill and tap the collar for the two 4-40 set screws.

5-channel Digitrio by Jim Conklin of Owensboro, Kentucky.



( ) Lay the rudder assembly aside and pour another cup of coffee. Now let's make the main U frame. Take a piece of 3/64" sheet brass, 1" x 4⅞", and lay out the main U frame as per drawing. (NOTE: All holes are centered ¼" up from bottom of sheet and center of aileron hole extends through center of elevator centering tab.) Now drill two ¼" holes and one ⅜" hole as noted on the drawing. These holes should be located and drilled as accurately as possible (this is important). Bevel the collars as shown in drawing. Next silver braze the collars (NOTE: Collars are ½" x 3/16" with ¼" hole) to U frame as noted in drawing. Now fold main U frame as per drawing.

If you are starting from scratch, and do not have a Digitrio already built, drill holes in part A as per drawing — do not drill any holes in transmitter case at this time — fit the completed stick in its relative position in the transmitter case and drill the holes to correspond with holes in part A.

If you do own a Digitrio — and intend to use the original part A — you can elongate the holes in part A to allow proper positioning of the stick assembly. (It will be necessary to move part A to the right approximately ⅛".)

( ) Assemble stick as per exploded view drawing. The rudder pot is Ohmite part #CU1031 (the same as recommended in the original article). After installing this pot, cut the shaft off 9/32" from the rudder barrel. (Tech Editor's Note: Solder joints on the prototype stick were "sweated" with ordinary solder and have adequate strength.)

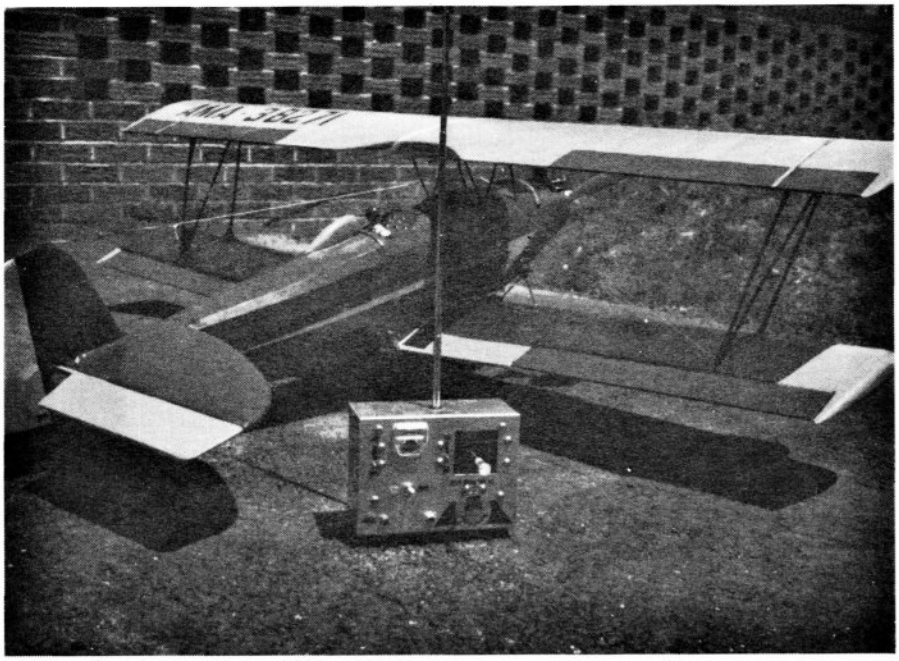
INSTALLING STICK ASSEMBLY

( ) Remove batteries completely to prevent damage and arrange transmitter for maximum accessibility. Remove old stick assembly completely and clip wires at pot terminals.

( ) Remove vertical (elevator), trim pot and clip wires at terminals.

( ) Install new 10K pot in elevator trim bracket with shaft cut to ¾". This shaft is used as pivot for stick assembly and "burrs," etc., should be removed. (Tech Editor Note: The bushing on main U frame can be soldered on side facing trim pot to prevent buying a new pot if your present shaft is too short.)

( ) Install stick assembly. This will be a cut and try job depending on the original stick configuration. If your original stick was as per Digitrio articles only minor adjustments will be necessary. If properly made and installed this new stick will give smooth trouble-free service. So take your time.



Warren Thomas, Jonesboro, Arkansas, claims his bipe is a real performer with Digitrio.

( ) Make necessary adjustments for smoothness, etc., if elevator trim pot moves while manipulating the stick. Center punch the threaded portion of the pot to stiffen it up.

( ) Rewire pots so that elevator wires go to vertical pot and rudder wires go to horizontal pot. If necessary, install new wires and tie off these wires to convenient places on the stick assembly to prevent strain and possible breakage.

You can continue to fly the Digitrio in this manner until you complete the modification to four channels. At which time you will wire the rudder pot.

Check your stick for proper throw by "eyeballing" the servos in operation. If you need more throw get out the file and remove excess material. This may require removal and reinstallation of the stick a couple of times until it is right. Take your time here and do a good job. You can also, at this time, temporarily wire the rudder pot for adjustment purposes

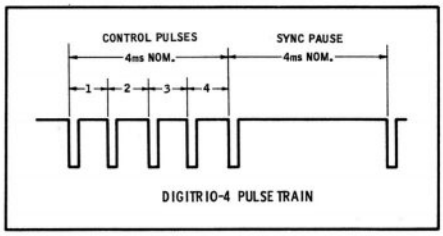
THEORY OF OPERATION (TRANSMITTER-4 MODIFICATION)

The transmitter modification for four channel operation is simply the addition of two more one-shots. The theory of operation of the one-shot circuit was covered previously so I'll just explain their use as applied to the modification.

To start with, two more one-shots are used to obtain five pulses for the four channels. This allows the unijunction to be used solely as a pulse train initiating circuit and sync pause generator. The unijunction has no direct control function. Rather than depend on a timing circuit in the decoder to compare with the timing of the unijunction, at relatively long timing periods, an additional one-shot is used to complete the pulse train action. This takes the demand for precise timing from the unijunction circuit and its operation becomes noncritical, within reason. It also relieves the decoder of precise timing and places it under the direct command of the transmitter for all channels. In other words, it becomes a passive receiver of pulses with noncritical timing circuits used throughout. During the sync pause the decoder resets itself without regard to precise timing.

The only electrical difference between the two additional one-shots is the use of 4.7K resistors as collector loads instead of 1K's used in the original Digitrio. These were used to keep current consumption down so the voltage regulator circuit would not have to be changed. The only significant component type change is the use of disc type .1's for the timing capacitors. These are discs with a good dielectric characteristic for this type circuit and should not be confused with inferior transistor general purpose discs. Also, you will note that no trim pot circuits are shown. Since these two one-shots are assigned duty as motor and rudder control circuits I didn't feel the extra expense and complication is warranted. However, if you wish trim on one or both of these controls, trim pots can be added the same as on the original Digitrio.

When the last one-shot of the original Digitrio (Q8 and Q9) completes its timing cycle, it triggers the first one-shot of the modification (Q1 and Q2). When this one shot completes its timing it triggers the remaining one shot of the modification (Q3 and Q4). This completes all control information. Approximately 4 MS later (during which the decoder resets) the unijunction circuit starts the chain reaction again. A transmitter pulse occurs when the unijunction initiates the action and one occurs for each of the one-shots. We now have five pulses controlling four variable channels. (See pulse train waveforms.)



DIGITRIO-4 PULSE TRAIN

The total unijunction recurrent timing period (frame rate) is approximately 8 MS — 4 MS nominal during the five control pulses plus 4 MS nominal for the sync pause. The sync pause is not critical and can vary from 4 MS upwards, but it's best to stay close to 4 or 5 MS unless you know the extent of the total action. Actually, the sync pause width varies constantly with control stick movement and its length is equal to the remainder of time left in the frame rate after the control pulses are sent.

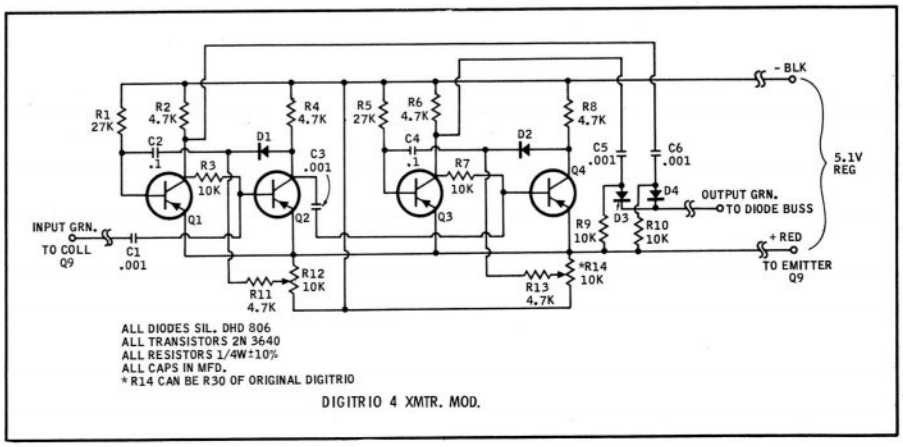
WIRING TRANSMITTER AUXILIARY P.C. BOARD

( ) Mount all 4.7K's. (6 ea)

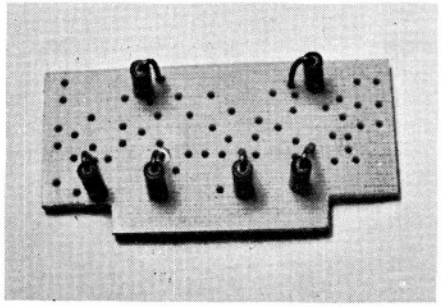
( ) Mount all 10K's. (4 ea)

( ) Mount all 27K's. (2 ea)

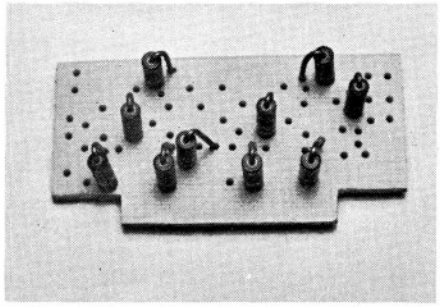
( ) Mount all diodes (4 ea.) Observe overlay for proper polarity. Bar is up on all diodes.



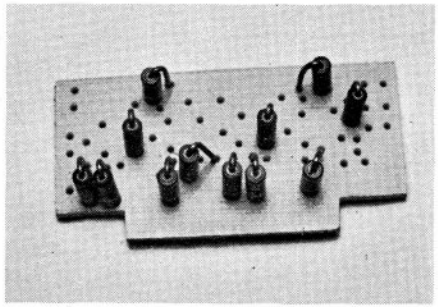
DIGITRIO 4 XMTR. MOD.



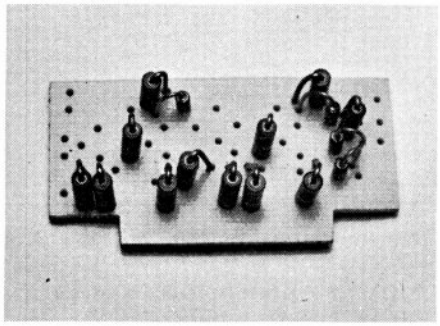
Six 4.7K resistors in place.



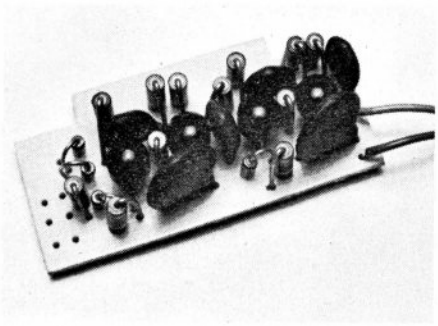
Four 10K resistors added.



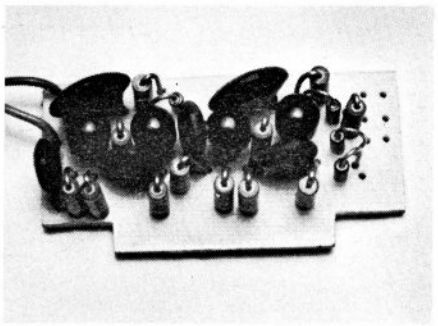
Two 27K's added to board.



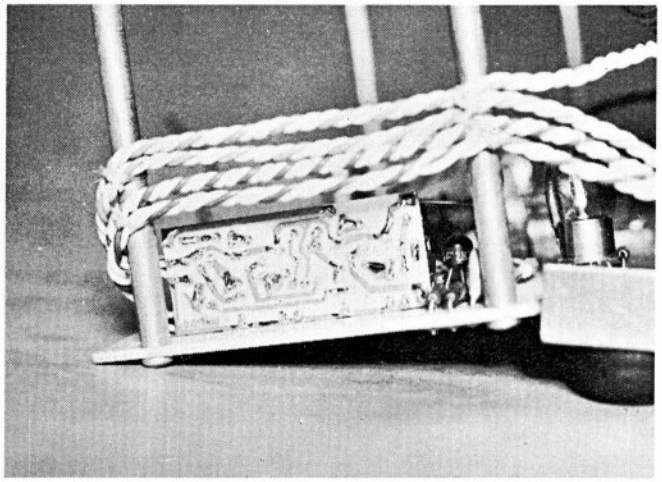
Diodes soldered in place.



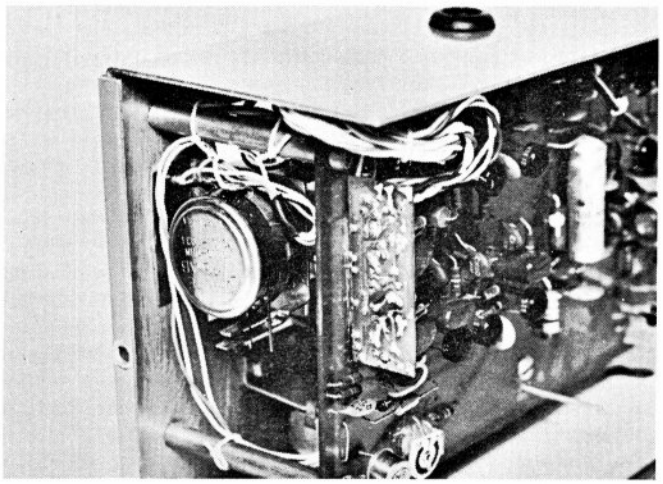
.1 and .001 mfd caps added.



Completed board, less control pot wires.

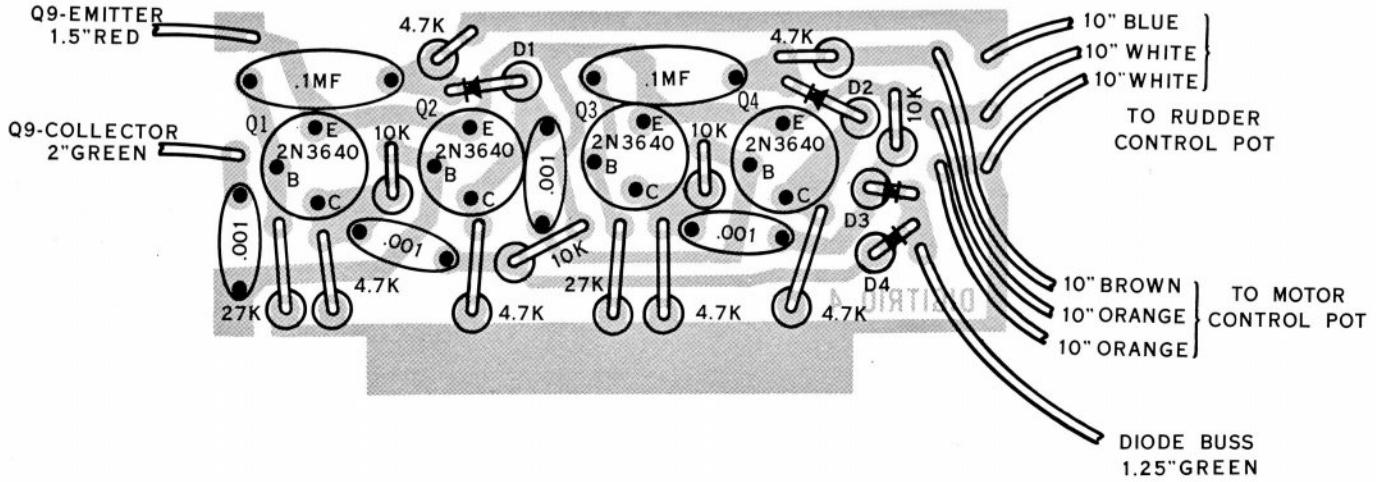


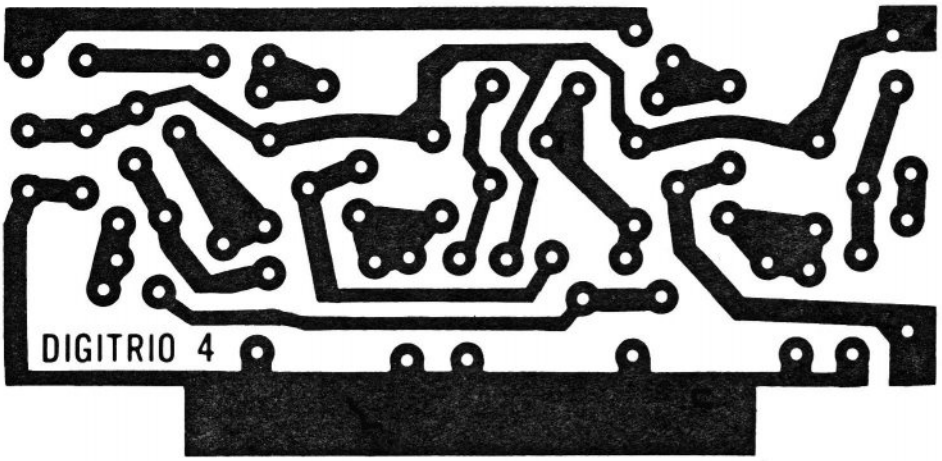
Auxiliary PC board installed on main transmitter board. Note neat. cabled control wire installation.



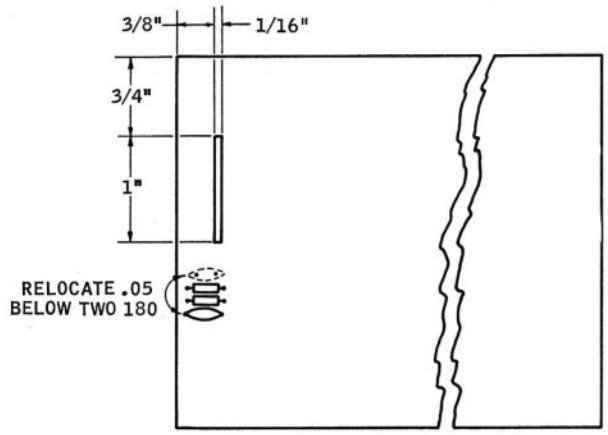
Main transmitter board in place and showing location of fourth channel auxiliary board.

DIGITRIO 4 COMPONENT LAYOUT





UPPER LEFT CORNER (COMPONENT SIDE UP)



1. SLOT IN MAIN P.C. BOARD TO ACCEPT AUX. P.C. BOARD
2. AUX. BOARD IS MOUNTED WITH COMPONENT SIDE FACING CENTER OF MAIN P.C. BOARD
3. NEG. BUSS OF AUX. BOARD IS SOLDERED TO NEG. 5.1V BUSS OF XMTR.
4. SLOT SHOULD BI-SECT 5.1V BUSS OF XMTR.

DIGITRIO-4 XMTR MOD.

PARTS LIST

REFERENCE NUMBER	DESCRIPTION	MANUFACTURER OR SOURCE	MANUFACTURER'S NUMBER
C1	.001	Erie	831-000-Z5U-102P
C2	.1	Erie	5655-000-Z5EO-1042
C3	.001	Erie	831-000-Z5U-102P
C4	.1	Erie	5655-000-Z5EO-1042
C5	.001	Erie	831-000-Z5U-102P
C6	.001	Erie	831-000-Z5U-102P
D1	Silicon Diode	G.E.	DHD 806
D2	Silicon Diode	G.E.	DHD 806
D3	Silicon Diode	G.E.	DHD 806
D4	Silicon Diode	G.E.	DHD 806
Q1	2N3640	Fairchild	2N3640
Q2	2N3640	Fairchild	2N3640
Q3	2N3640	Fairchild	2N3640
Q4	2N3640	Fairchild	2N3640
R1	27K ¼W 10% Res.	Ohmite	LIDSM
R2	4.7K ¼W 10% Res.	Ohmite	LIDSM
R3	10K " " "	"	"
R4	4.7K " " "	"	"
R5	27K " " "	"	"
R6	4.7K " " "	"	"
R7	10K " " "	"	"
R8	4.7K " " "	"	"
R9	10K " " "	"	"
R10	10K " " "	"	"
R11	4.7K " " "	"	"
R12	10K Pot	"	CU 1031
R13	4.7K ¼W 10% Res.	"	LIDSM
R14*	10K Pot	"	CU 1031

*R14 can be R30 of original Digitrio.

MISCELLANEOUS

P.C. Board		World Engines
Hookup Wire	(2 10" white) (1 10" blue) (3 ¼" green) (1 ½" red)	Controlaire, Bonner, etc.

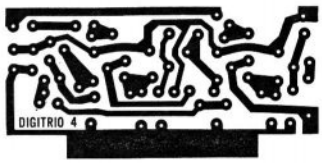
( ) Mount all .1 MFD caps. (2 ea)
( ) Mount all .001 MFD caps. (4 ea)
( ) Mount the 2N3640's. (4 ea)
( ) Add 10" white-blue-white control pot wires.
( ) Add 2" green input and 1¼" green output wires.
( ) Add 1½" length of red wire (positive).
( ) Clean and inspect board for "solder-bridged" lands.

PRELIMINARY CHECKOUT

( ) Check component installation for improperly installed parts.
( ) Check clearance between all component leads for "shorts."
( ) Flat the solder mounds with a fine file and clean with acetone or dope thinner.
( ) Measure the resistance between the positive (red) wire and the negative land (running across bottom of board). You should read approximately 2,000 ohms. Observe meter polarity.

PREPARING TRANSMITTER MAIN P.C. BOARD

( ) Cut slot in board as shown in drawing and photo (Don, take photo of slot). You should have split the land approximately in center and remove the inside half. This allows part of the land to be used to solder the two boards together. After you have made the measurements to cut this slot "eyeball" the task as you go to make up for slight differences between the two boards. This can be done by drilling a series of small holes and cutting them into a slot with an Xacto knife. If you accidently cut through this land, repair the break with a resistor lead.



Three times full size printed circuit board for auxiliary transmitter shown at left. Above: Actual size auxiliary board.

( ) Drill three #60 holes as follows for connecting wires:
(See original overlay)
1. Between top ends of D4 and D5 for the green output wire.
2. At the junction of Q9's emitter and the bar end of Z1 for red positive lead.
3. At the junction of the 1K, D2 and Q9's collector for the green input wire.

( ) Drill two new holes and relocate the .05 cap from above the two 180 ohm resistors to below it.

WIRING THE TWO BOARDS TOGETHER

( ) Insert the auxiliary board and solder it in place. Check for clearance between components of both boards.
( ) Solder the green output wire between the top ends of D4 and D5.
( ) Solder the red positive wire at the junction of Q9's emitter and bar end of Z1. The negative connection was made when you soldered the auxiliary board in place.
( ) Solder the green input wire in the hole you drilled at junction of 1K, D2 and Q9's collector.

FINAL TRANSMITTER WIRING

( ) Remove the orange-brown-orange wires at the P.C. board previously used for motor control.
( ) Remove and relocate R29 (10K) down to where the two orange wires used to be.
( ) Shorten orange-brown-orange wires by approximately 2½" and solder them to the auxiliary board as shown on the overlay.
( ) Wire the control pots as follows:
1. Select the left-hand set of stick and trim-pot wires from the main board and wire them to the elevator controls. White-blue-white to stick pot and yellow-green-yellow to the trim pot wire.
2. Wire the other set of stick and trim-pot wires from the main board to the aileron controls.
3. Wire the white-blue-white wires from the auxiliary board to the rudder control pot.
4. Wire the orange-brown-orange wires to the motor control pot (if not already wired).

NOTE: When connecting the wires to the two moveable control stick pots — it is important to provide some sort of strain relief to prevent wire breakage. Tie the wiring off and take as much time as necessary.

( ) Adjust R13 to midrange. Adjacent to Q5. (This sets frame rate to approximately 8 MS).
( ) Center all control pots electrically using the ohmmeter method.

DELUXE TRANSMITTER

For those of you who want a more professional look to your radio gear — here is a deluxe version of the Digitrio-4. The only difference between this version and the three control stick version is the mechanical differences to provide the "face lifting." Most of the construction details are shown in the pictures. A little more care should be taken during case preparation as minor "goofs" will appear exaggerated due to the overall effect of the commercial sticks.

My unit was built around the World Engine's kit using an unpunched transmitter case. The LMB #145 case can also be used. By inverting the P.C. board the standoffs delivered with the Bonner sticks can be used as is without shortening them. When you invert the P.C. board you will have to move the antenna mount support to the component side of the board. Also, it will be necessary to cut the top of the oscillator tuning coil form off slightly to clear one of the pot shaft locking screws on the Bonner stick beneath it. Drill a ⅛" hole beneath the coil form (L2) for tuning access. 4-40 blind nuts epoxied to the inside mounting holes of the Bonner sticks allow easy removal or installation of the P.C. board and stick assemblies as a unit. The P.C. board mounting posts are not "peened" at the stick assembly so that the sticks can be lifted off the posts for P.C. board access. This requires that the four outside mounting holes on the case front be large enough for the posts to be inserted into them. The meter was mounted with "Silastic," a silicon rubber adhesive. This was done strictly for appearance sake and mounting screws can be used. Silastic is a product of the Dow Corning Corp. and is one of the most useful adhesives I've found for the type of work I do. It has a myriad uses in RC modeling and must be used to be appreciated. A meter face print is shown for those of you who want the meter to read vertically. This can be exchanged for the present meter scale by removing the tape holding the two halves of the meter together.

I installed a "McKnight" charger, which appeared in an earlier issue of RCM, using a "TV" type AC connector and a chassis mount socket for the receiver. Two holes in the back of the transmitter allow you to monitor the charger in operation. The handle and battery pack came from World Engines.

As you can also see in the pictures I used 2N3640's in place of the 2N3638's and 2N3646's in place of the 2N706's. I recommended these changes a couple of issues back but no longer recommend the 2N3646's be used in the final amplifier due to a "burn out" believed to have been caused by base emitter junction failure due to transient voltage when the switch is turned on. I have also tested some Motorola transistors which I recommend as substitutes for the 2N3638's and 2N3640's — they are types MMPS3638 and MMPS3640.

For your convenience, the following is a listing of various sources of supply for Digitrio kits and accessories as previously advertised in the regular monthly issues of R/C Modeler Magazine. For additional information, please correspond directly with the manufacturers concerned:

Complete Digitrio Kits

World Engines, Inc., 8206 Blue Ash Road, Cincinnati, Ohio 45236.

These are the designer approved kits, each available separately, e.g., transmitter, receiver, decoder, and servos. Batteries, stick assembly, etc., not included. Tested and approved by RCM.

Compatible Servos

Spar Electronics, 15302 Oak Canyon Road, Poway, California 92064.

Designed for use with the Digitrio system, these servos have not been tested by RCM, but were used with a Digitrio system that recently set a world's hydroplane record.

Orbit Electronics, Inc., 11601 Anabel Avenue, Garden Grove, California.

Orbit has produced a digital servo that is compatible with the RCM Digitrio. These have not been tested by RCM, to date.

Hardware and Stick Assemblies

Justin Inc., 418 Agostino Road, San Gabriel, California.

A completely drilled and ready-to-use transmitter case with all stick assembly and pot mounting brackets for the Digitrio. Tested and approved by RCM.

Stanton R/C, Inc., 4734 North Milwaukee Ave., Chicago, Illinois 60630.

A Digitrio stick assembly kit and pot bracket hardware. Tested and approved by RCM.

Printed Circuit Boards

West Coast Slides, Box 788, San Pedro, California.

Printed circuit boards for the transmitter, receiver, decoder, and servos. These units have not been tested by RCM, to date.

Stanton R/C, Inc., 4734 North Milwaukee Ave., Chicago, Illinois 60630.

Printed circuit boards for the RCM Digitrio transmitter were tested and approved by RCM. It is assumed that the other printed circuit boards are also available.

Transmitter Stick Assemblies

World Engines, Inc., 8206 Blue Ash Road, Cincinnati, Ohio 45236.

The popular Bonner stick assembly, used on the Bonner Digimite, PCS, Kraft, Controlaire, and F&M proportional systems, is available from World Engines for use with the Digitrio. Tested and approved by RCM.

Micro-Avionics, Inc., 346 E. Foothill Blvd., Arcadia, California.

The Micro-Avionics stick assembly, used on the Micro-Avionics and Orbit proportional systems is available for Digitrio builders. Some transmitter case modification is necessary to fit this unit. Tested and approved by RCM.

Power Supplies

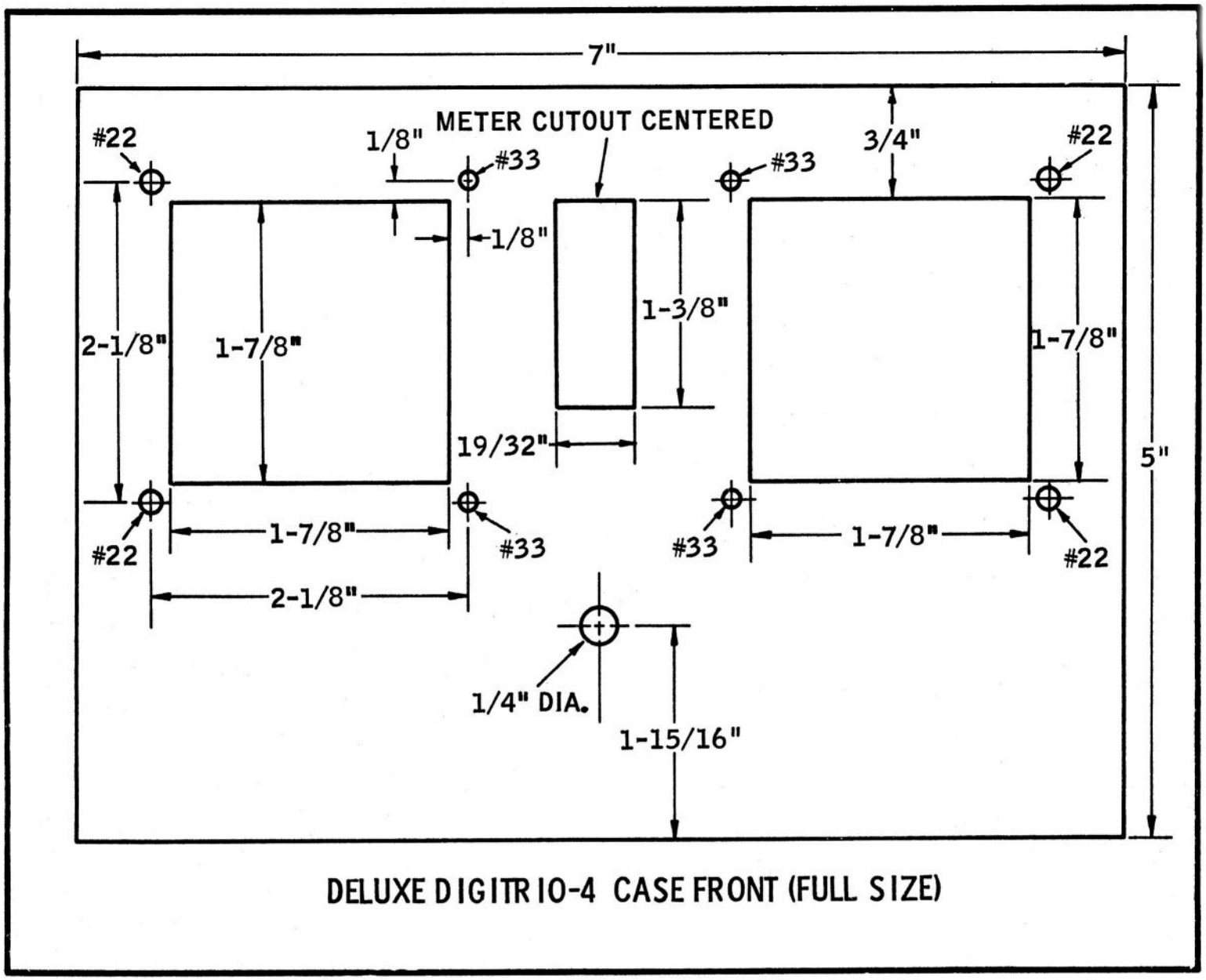
P & D Manufacturing Company, P. O. Box 34, Chino, California.

Complete power packs, or power pack kits, are available from this manufacturer. Designed exclusively for the Digitrio system, they have been tested and approved by RCM.

Mounting Boards

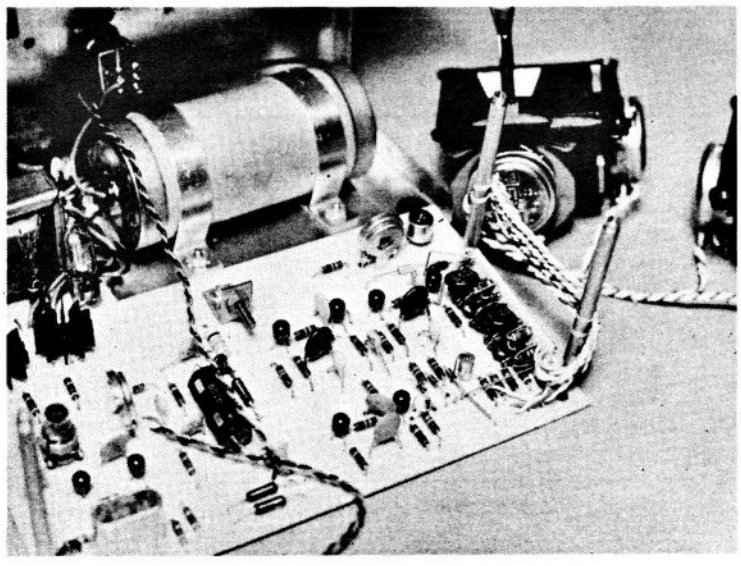
Fly-Tronics Engineering, 3010 Brook Drive, Muncie, Indiana 47304.

The Fly-Tronics Circuit Master is a printed circuit board on which the Digitrio servos mount, as well as a 15-pin Cannon plug for the receiver-decoder and power supply, thus eliminating many of the wires and most of the plugs in the system. Tested and approved by RCM.

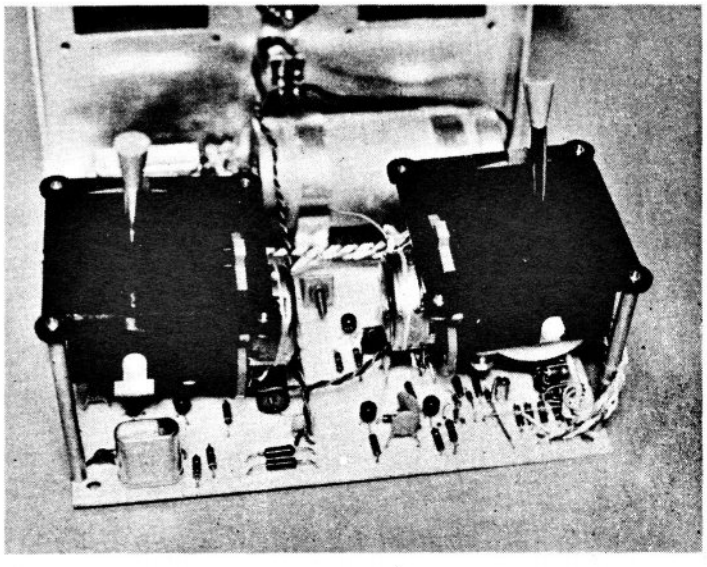


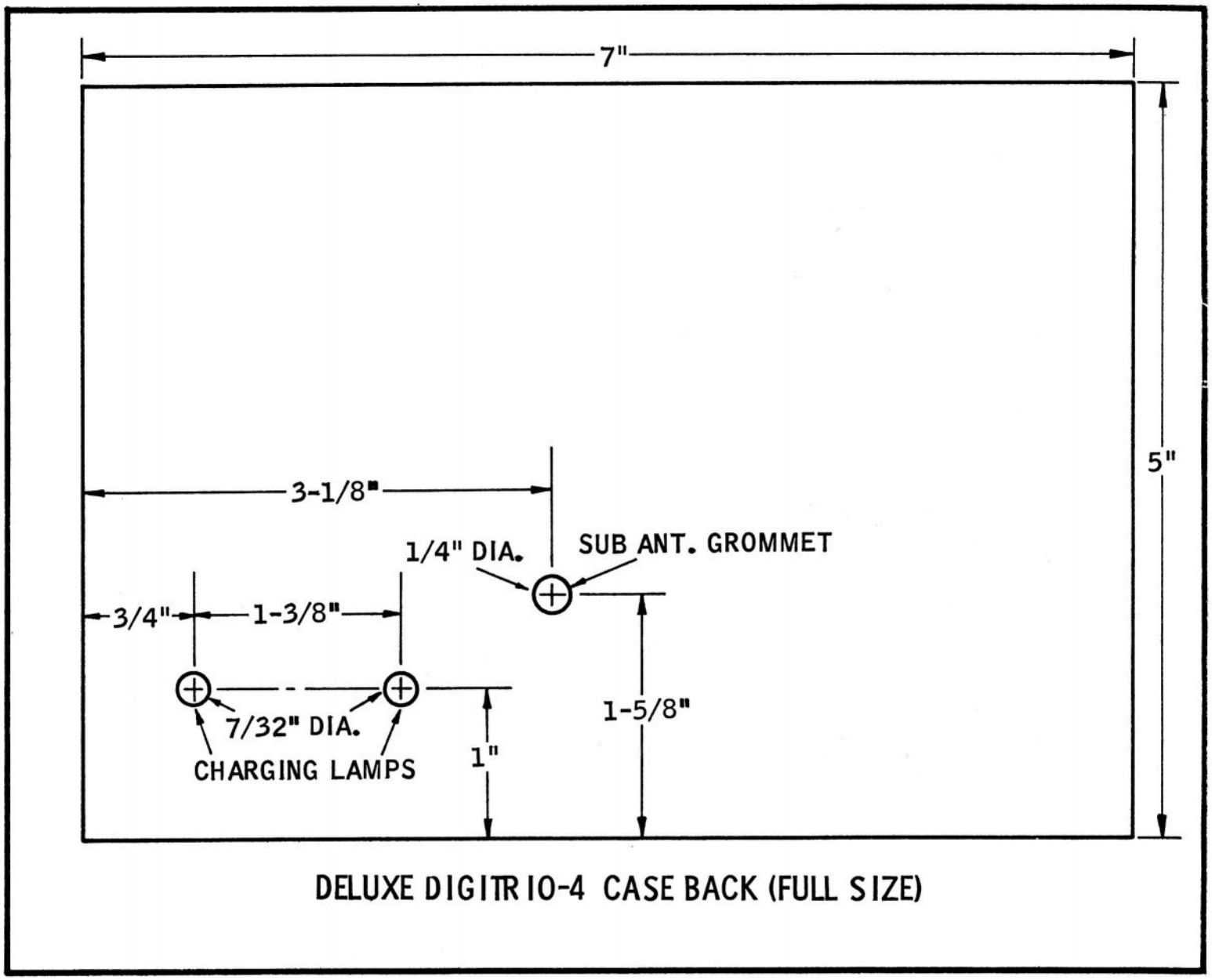
DELUXE DIGITRIO-4 CASE FRONT (FULL SIZE)

PC board removed from mounting posts shows McKnight dual charger in center left of photo and Controlaire nickel cadmium pack in upper center. Note neat cabling and tie-down of wires. Bonner sticks in background.



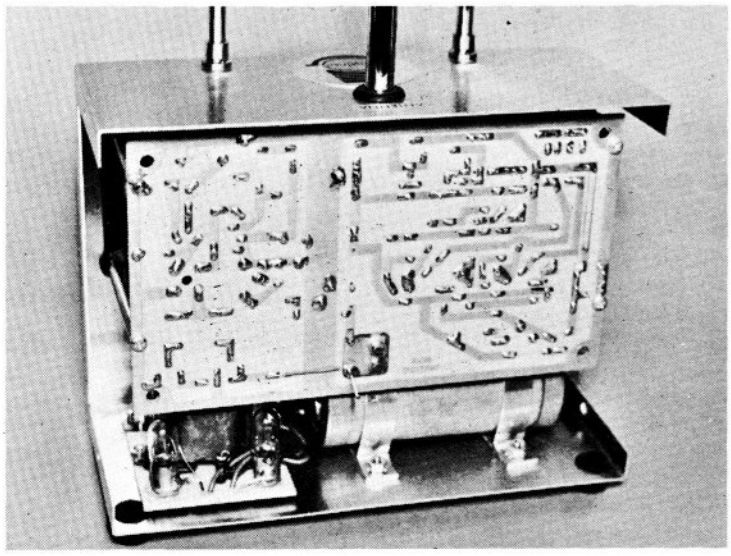
Bonner sticks mounted in place and entire assembly ready for mounting to case front. Note antenna mount support relocated on component side of board.

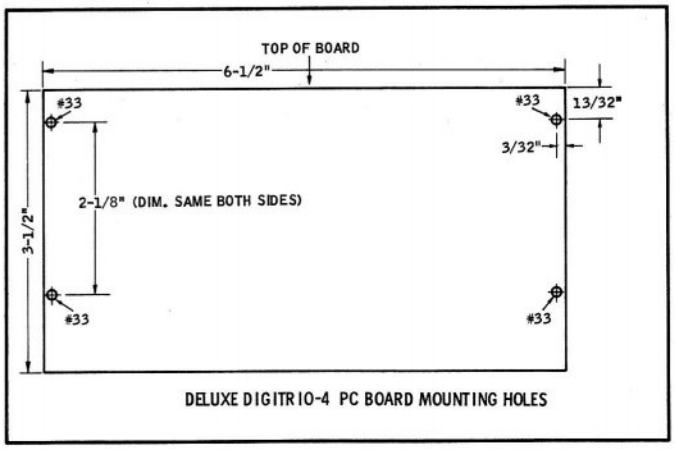




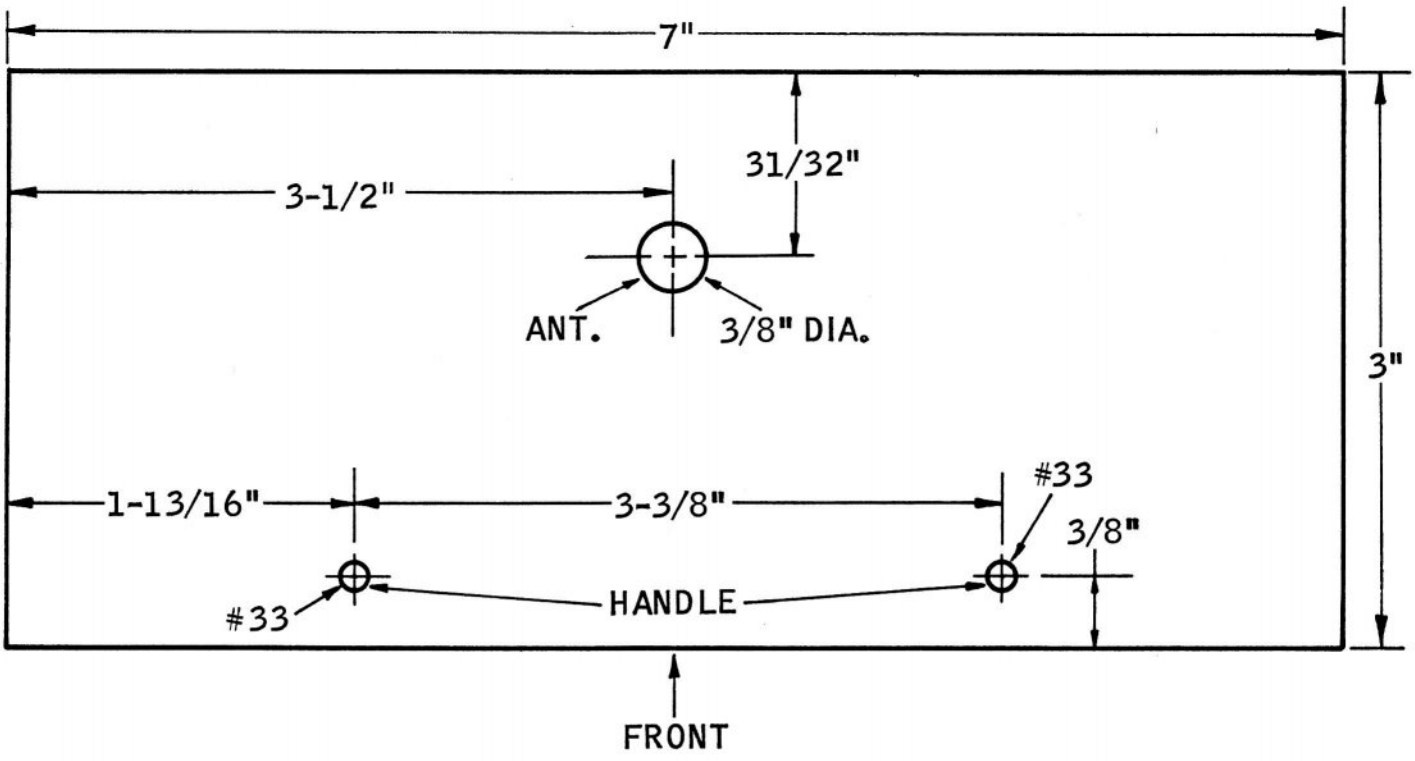
DELUXE DIGITRIO-4 CASE BACK (FULL SIZE)

Charger, power pack, Bonner stick assemblies, and printed circuit board mounted in place. Note antenna location. Chrome carrying handle shows partially on top front of case.



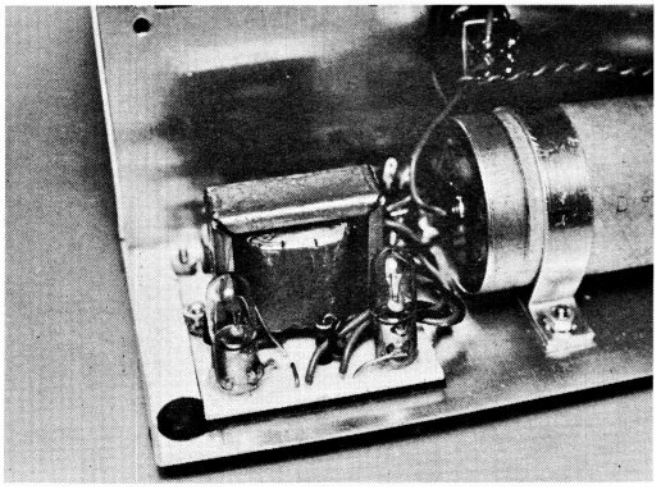


DELUXE DIGITRIO-4 PC BOARD MOUNTING HOLES

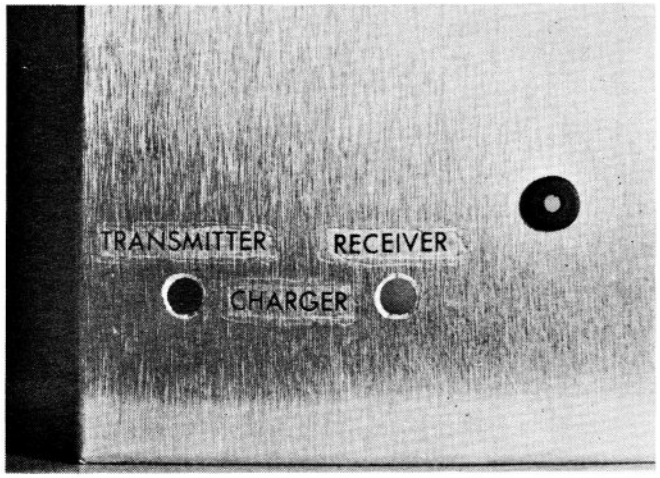


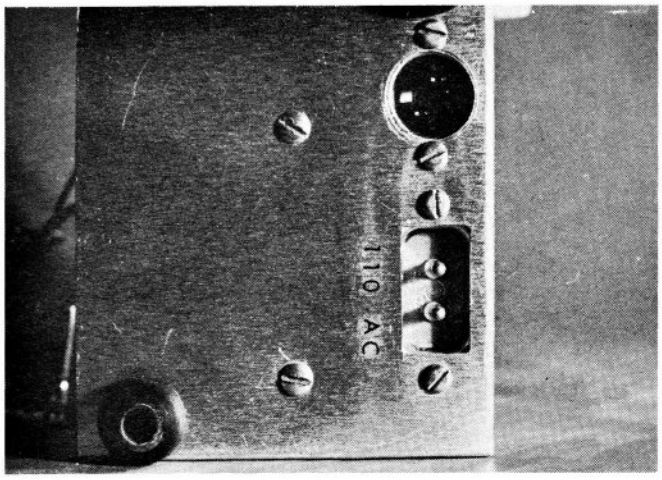
NOTE: CHECK ANT. ALIGNMENT BEFORE DRILLING HOLE.

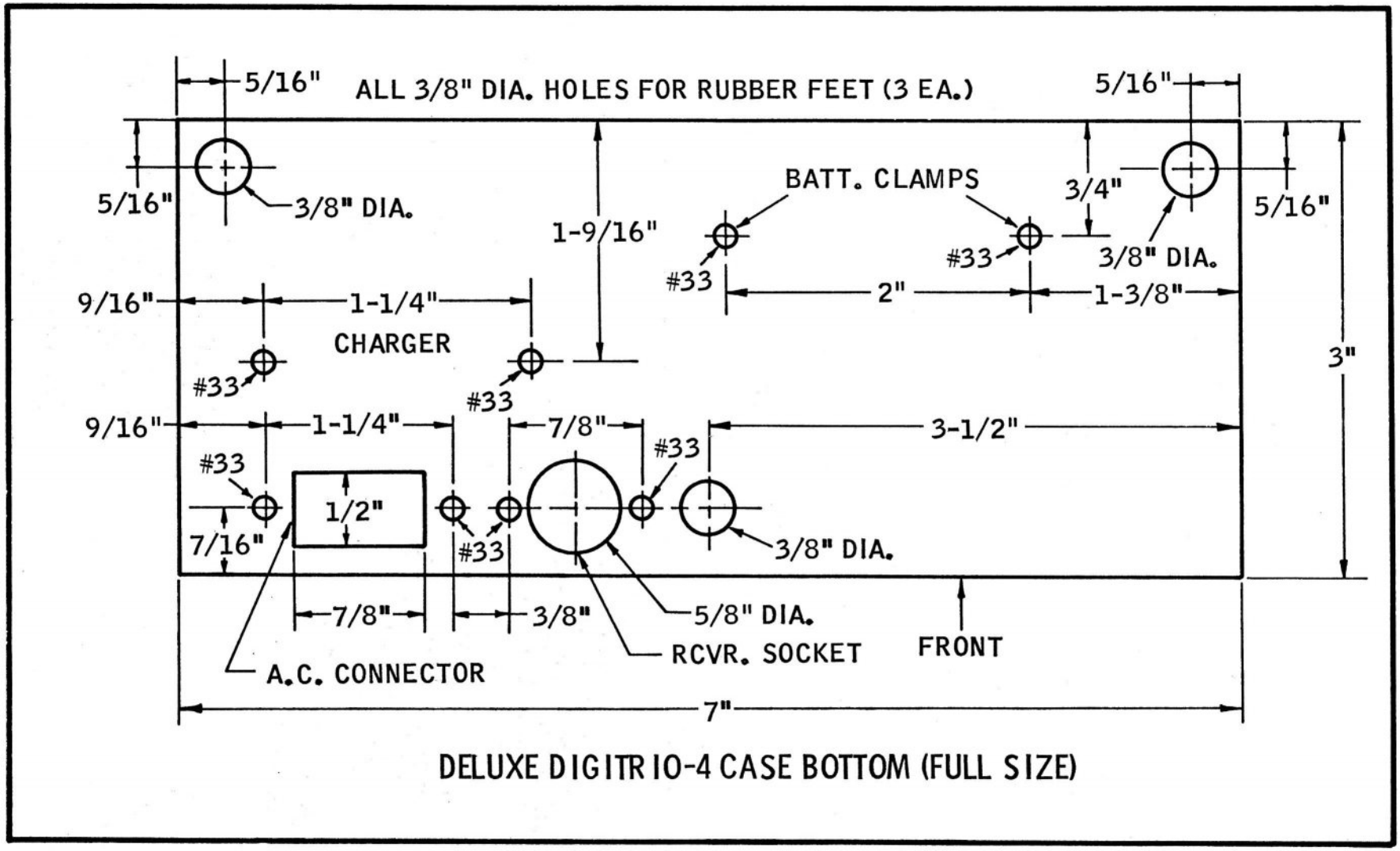
DELUXE DIGITRIO-4 CASE TOP (FULL SIZE)



YOU CAN GIVE YOUR DIGITRIO THAT 'CUSTOM COMMERCIAL' LOOK . . .







DELUXE DIGITRIO-4 CASE BOTTOM (FULL SIZE)