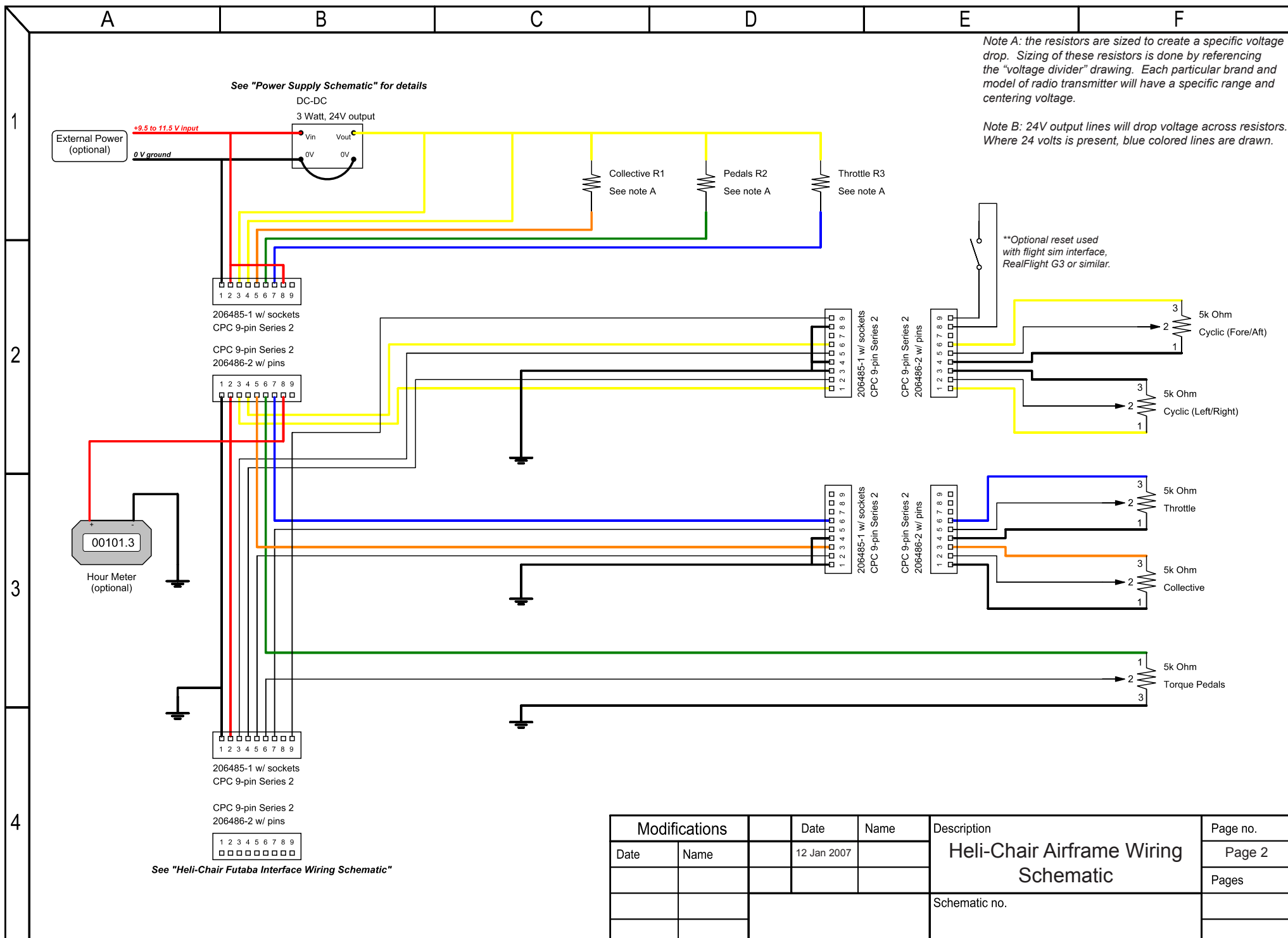
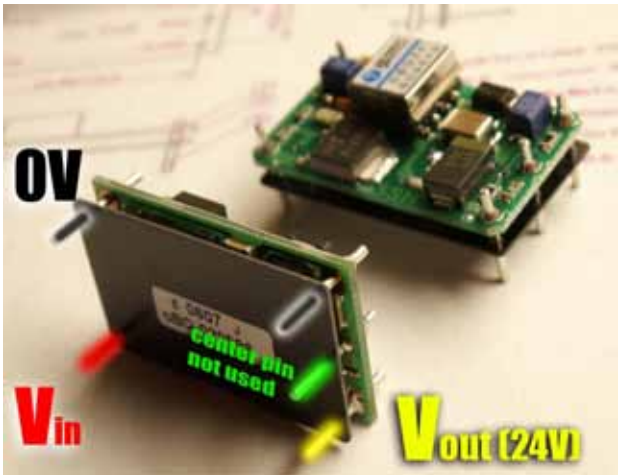
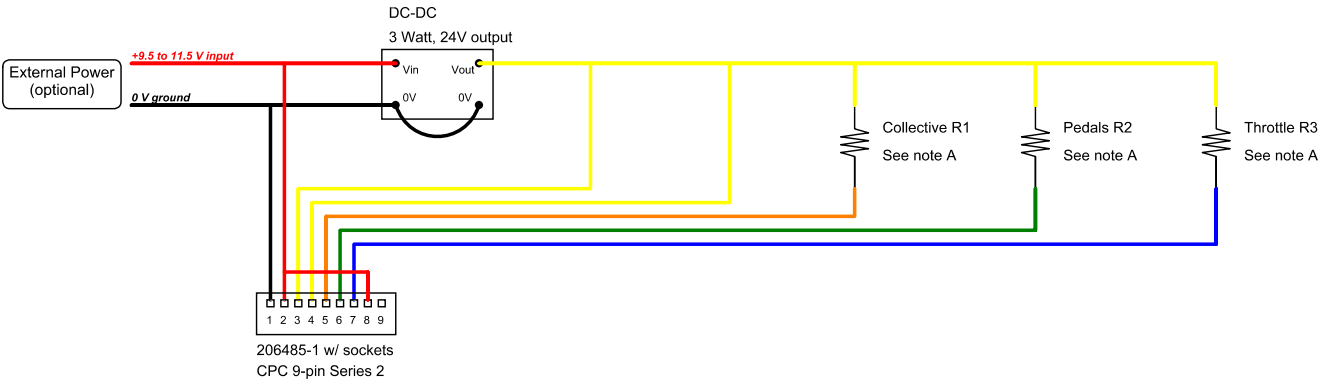


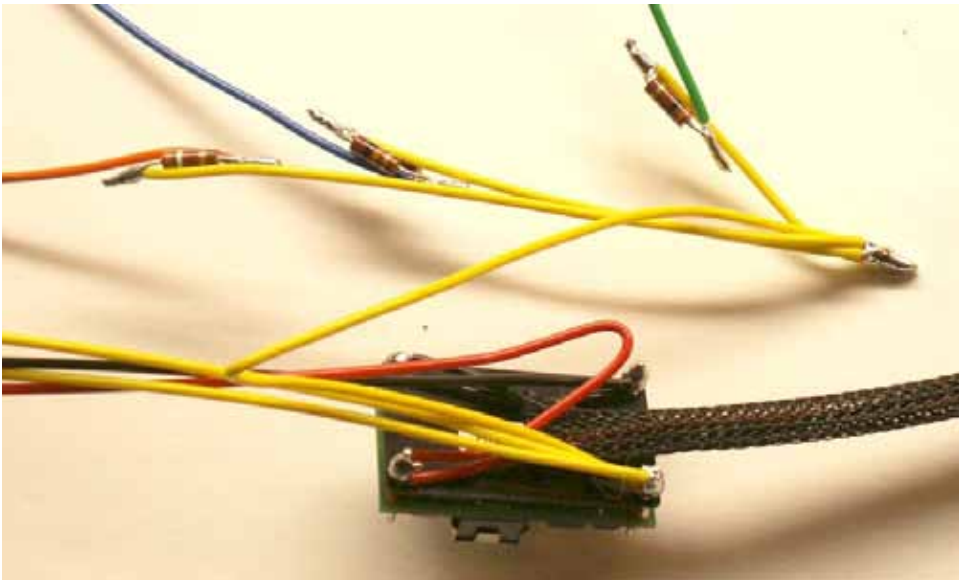
Heli-Chair Schematic Drawings



1



2



ETA 24V DC-DC unit
(see spec sheet for more details)

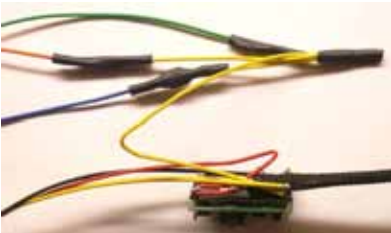
Take note of some of the techniques seen in these photos. When soldering to the posts on the power supply, be cautious to avoid excess heat for prolonged periods. Solder quickly and efficiently.

Notice the method used to solder the resistors in-line. This is a highly recommended trick to reduce strain on the delicate leads after heatshrink is applied.

Where possible, every wire is looped backwards and routed such that it will not directly place strain on the component. The photos show only one end result, you may find other tricks that work even better.



4



Modifications		Date	Name	Description	Page no.
Date	Name	12 Jan 2007		Power Supply Wiring Schematic and Wiring Tips	Page 3
					Pages
				Schematic no.	

The Voltage Divider Concept

When we built the prototype Heli-Chair, we did so with no additional circuitry or components other than what we took from inside the transmitter. The problem with this approach is that the gimbals on the transmitter move about 80 degrees of rotation and the cyclic on the Heli-Chair sweeps through about 20 degrees of rotation. Without changing anything, this means you would have about 1/4th of the total range of motion for that axis.

In production versions, we have overcome this simple problem. Because the transmitter is simply looking for a voltage change from full left to full right (or full up/down), if we measure that change precisely, we can reproduce it precisely, regardless of the amount of control movement. We take advantage of a popular electrical circuit theory called voltage division.

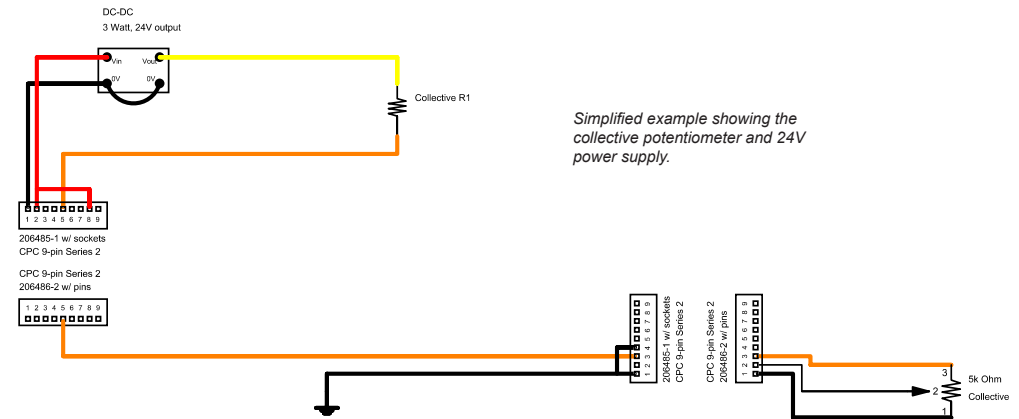
A potentiometer is merely a resistor with a center “tap”. At each end of the resistor is 0V and, say for example, 5V. Depending on the location of the tap relative to each end, we can vary the “tap” voltage from 0 to 5. If we are capable of moving it full range, we get the full 5V movement. If we rotate a potentiometer 20 degrees (1/18th of a circle), we get 1/18th of the applied voltage. In the example stated, about 0.28 volts.

See drawing “Voltage Centering and Swing” for more info about the actual voltage outputs of a particular model of radio.

Now, lets say for example that we know we need a 2.5 volt swing from full left to full right, and that our control we have built moves about 35 degrees from full left to full right. If we use a single turn potentiometer, 35 degrees is about 1/10 of the full turn (360=1 turn). And in that 1/10th turn, we need to get 2.5 volts of “swing” or change. This means we would need ideally 25 volts applied to the potentiometer.

So by knowing the movement of the potentiometer by measuring the degrees or actually measuring the resistance change, we can set the input voltage to an exact number, creating the ideal voltage signals for our transmitter. Using a 24 Volt power supply is the best way to do this. The potentiometers inside the radio operate on either a 3V or 5V input, but they move 70 degrees or so. Some of the potentiometers on the chair will move 180 degrees (throttle), and some just 20 degrees (cyclic). This means we need to have different voltages to each one. We do this by using an in-line resistor.

If we are using 5000 Ohm potentiometers and a 24V source, lets say we are setting up the collective and it's range of motion is 90 degrees. The collective input on the radio needs 3.5 volts of variation. 90 degrees=1/4th of 360 and 3.5 volts must also equal 1/4th of the total voltage, so we need 14 volts to the potentiometer. With 24 volts input to the potentiometer, we would get actually $24 \times (1/4)$ or 6 volts change...too much. If we put a resistor “R” in series with the potentiometer, we can drop the voltage to an ideal level. The diagrams on this page illustrate this example and show you how to calculate the resistance needed to exactly match the voltage change.



V.input = input voltage to the series circuit, from the DC-DC converter

V.swing = desired voltage change over full deflection of control

V.pot = ideal potentiometer supply voltage to obtain V.output

R1 = in-line resistor sized for the particular application

R.pot = resistance rating of potentiometer, usually 5000 Ohm

R.pot.meas = measured resistance change over full control deflection range

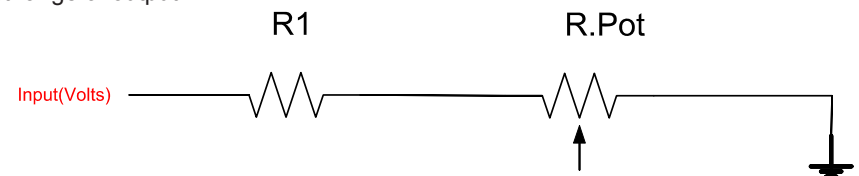
EQUATIONS

$$\text{Eq(1) } V_{\text{pot}} = (V_{\text{swing}} \times R_{\text{pot}}) / (R_{\text{pot.meas}})$$

$$\text{Eq (2) } R1 = (R_{\text{pot}} \times V_{\text{input}} \times V_{\text{pot}}) - R_{\text{pot}}$$

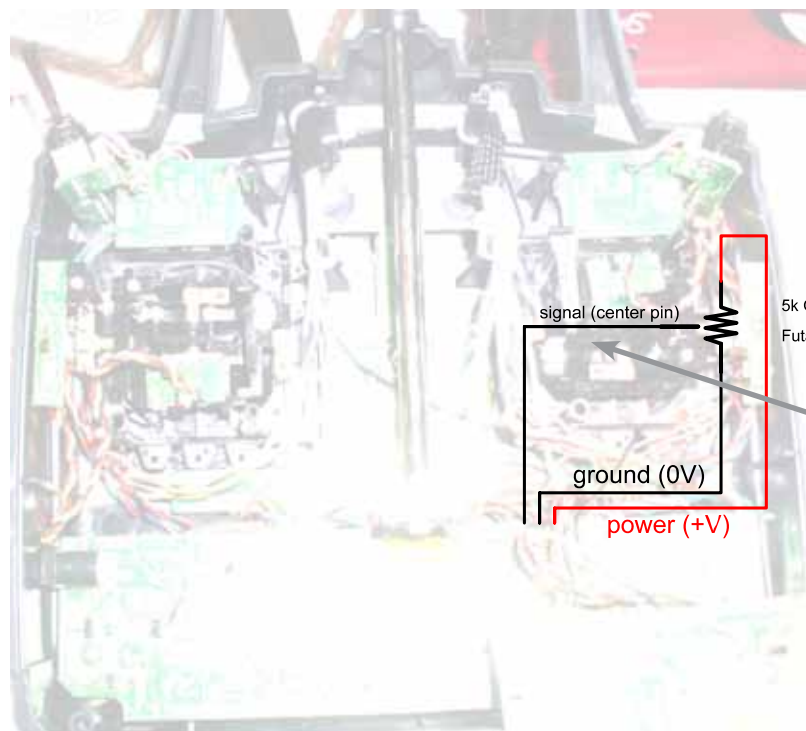
Use Equation 1 first, input the voltage swing desired and the resistance rating of the potentiometer as well as the measured range of resistance at the potentiometer when the controls are deflected fully from stop to stop. This is a reflection of the degrees of movement of the control compared to a full 360 turn.

Having calculated now the value of V.pot, put the value into Equation 2 along with the other variables shown and find the ideal value of the in-line resistor to “tune” your potentiometer for the perfect range of output!



Modifications		Date	Name	Description	Page no.
Date	Name	12 Jan 2007			Page 4
				Voltage Divider Theory	Pages
				Schematic no.	

Wiring Schematic Before Modification



signal (center pin)

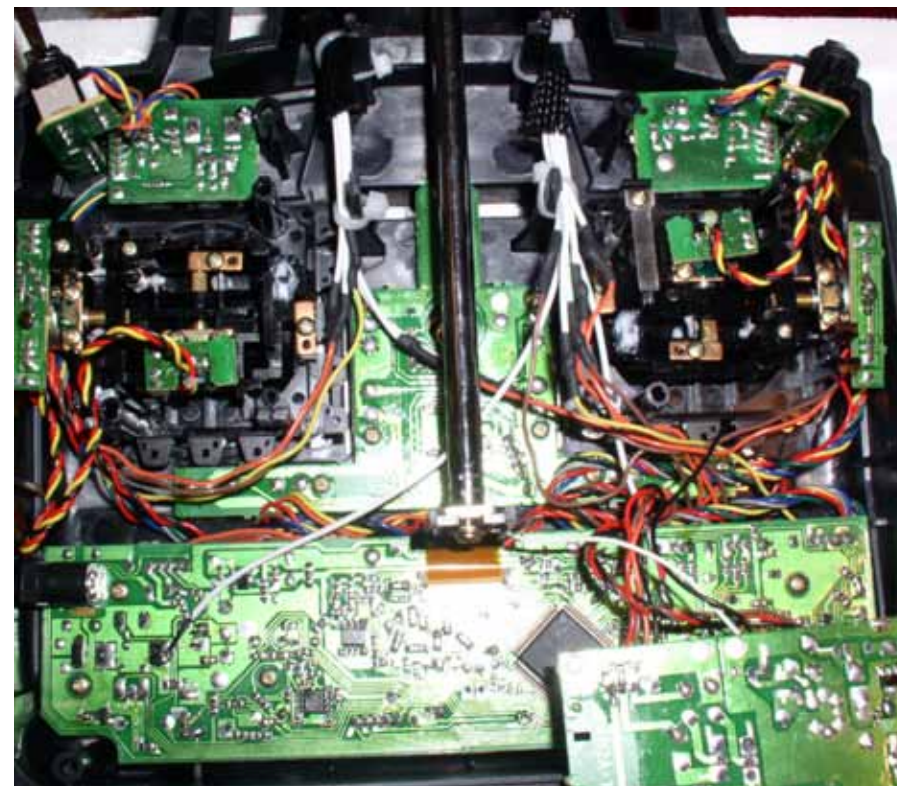
5k Ohm
Futaba

ground (0V)

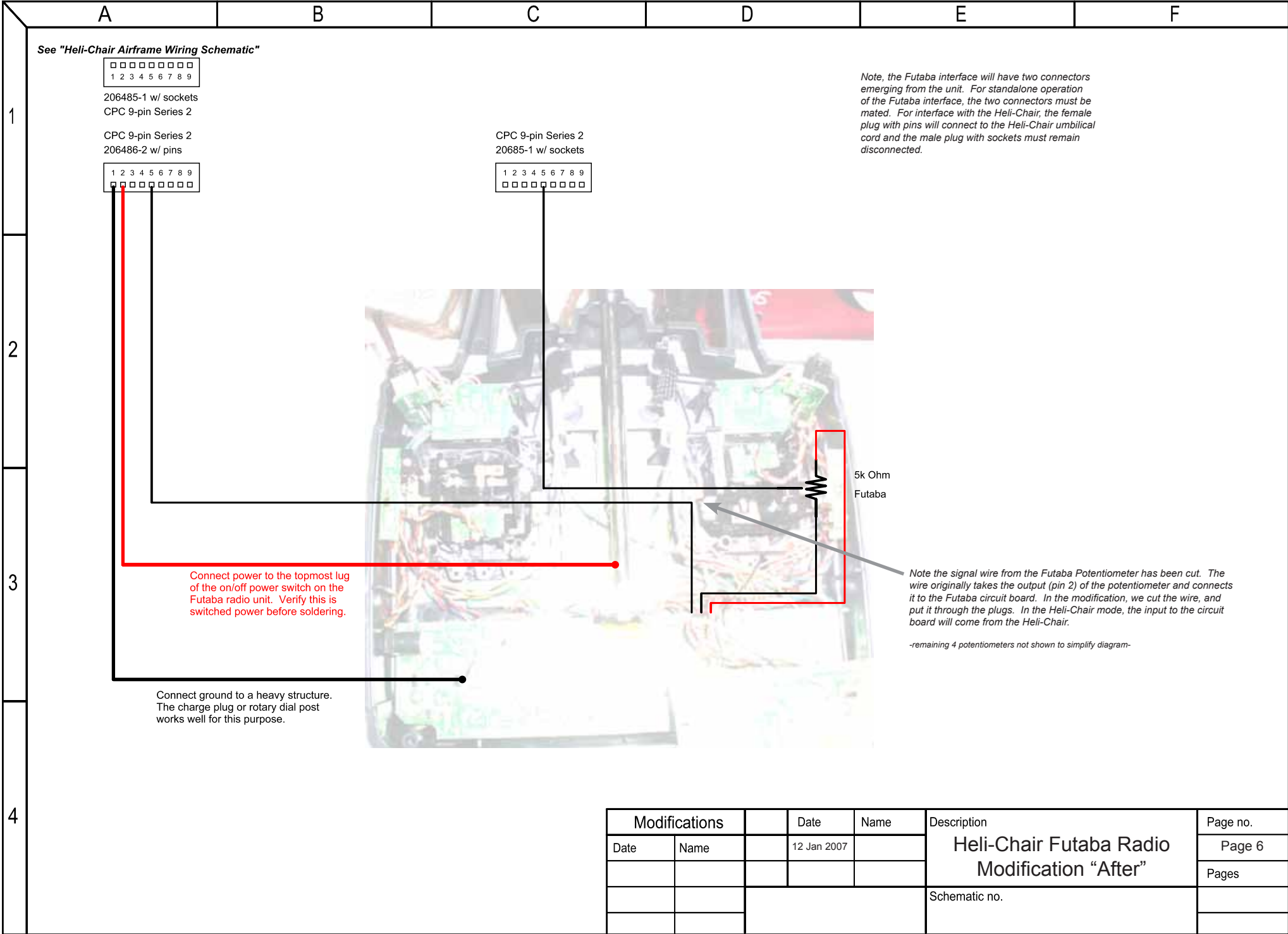
power (+V)

Note the signal wire from the Futaba Potentiometer will be cut. The wire originally takes the output (pin 2) of the potentiometer and connects it to the Futaba circuit board. In the modification, we cut the wire, and put it through the plugs. In the Heli-Chair mode, the input to the circuit board will come from the Heli-Chair.

-remaining 4 potentiometers not shown to simplify diagram-



Modifications		Date	Name	Description	Page no.
Date	Name	12 Jan 2007		Heli-Chair Futaba Radio Modification "Before"	Page 5
					Pages
				Schematic no.	



1

CONFIDENTIAL: HELI-CHAIR DESIGN SPECIFICATIONS

7C Radio Wiring

(tx inputs=green, tx outputs=blue)

GROUP	COLOR	USAGE	L	R	XMT ONLY MODE	Signal from Sticks			voltage swing
						center	left/dow	right/up	
common ground	black	ground	1			7CHP			
tx battery output	red	switched power	2			7CHP			
channel 1	brown	cyclic left/right	3	3	3	7CHP	1.65	2.58	0.676 1.904
channel 2	orange	cyclic fore/aft	4	4	4	7CHP	1.663	0.58	2.808 -2.228
channel 3	brown	collective	5	5	5	7CHP		2.593	0.734 1.859
channel 4	orange	torque pedals	6	6	6	7CHP	1.656	0.515	2.714 -2.199
channel 6	yellow	throttle	7	7	7	7CHP		0	3.32 -3.32
		spare	8	8					
		spare	9	9					

2

9C Radio Wiring

(tx inputs=green, tx outputs=blue)

GROUP	COLOR	USAGE	L	R	XMT ONLY MODE	Signal from Sticks			voltage swing
						center	left/dow	right/up	
common ground	black	ground	1			9CHP			
tx battery output	red	switched power	2			9CHP			
channel 2	yellow	cyclic fore/aft	3	3	3	9CHP	2.485	3.938	1.04 2.898
channel 1	blue	cyclic left/right	4	4	4	9CHP	2.505	0.836	4.12 3.284
channel 3	white	collective	5	5	5	9CHP	2.485	3.896	1.112 2.784
channel 4	yellow	torque pedals	6	6	6	9CHP	2.487	0.833	4.15 3.317
channel 6	brown	throttle	7	7	7	9CHP		4.44	0.822 3.618
		spare	8	8					
		spare	9	9					

3

JR 9303 wiring

(tx inputs=green, tx outputs=blue)

TX MOVEMENT	COLOR	USAGE	L	R	Signal from Sticks			voltage swing
					center	left/down	right/up	
common ground	black	ground	1					
tx battery output	red/white	10V power	2					
logic voltage output	blue	logic voltage 5.0V	3					
aileron	red/white	cyclic left/right	4	4	2.53	4.72	0.33	4.39
elevator	brown	cyclic fore/aft	5	5	2.52	0.25	4.67	4.42
throttle	orange	collective	6	6		0.91	4.11	3.20
rudder	yellow	torque pedals	7	7	2.51	4.72	0.31	4.41
VR left	yellow	throttle	8	8	2.52	0.72	4.64	3.92
elevator D/R	green		9	9		0.00	(float)	-NA-
gear	blue/white		10	10		0.00	(float)	-NA-
AUX 4	black/white		11	11	(float)	5.00	0.00	5.00
VR right	yellow		12	12	2.53	0.74	4.68	3.94
aileron D/R	green		13	13		0.00	(float)	-NA-
rudder D/R	blue/white		14	14		0.00	(float)	-NA-
AUX 2	black/white		15	15	(float)	5.00	0.00	5.00
cyclic trim	white	UP	25					
cyclic trim	white	DN	26					
cyclic trim	white	LEFT	27					
cyclic trim	white	RIGHT	28					

4

cyclic trim	white	UP	25					
cyclic trim	white	DN	26					
cyclic trim	white	LEFT	27					
cyclic trim	white	RIGHT	28					

Typical Centering Voltage and Total Swing

These tables present the measured values we typically see in the three most popular radios we work on. You may certainly find that your particular radio has slightly different numbers. The charts you see on this page should be something you attempt to duplicate right at the beginning of your project.

Your goal is to measure each axis you are going to wire “outside” of the radio to the Heli-Chair. If you can measure the voltage output of the in-radio potentiometer at the limits of movement as well as at center, you have all the information you need. The “voltage divider” drawing page contains the theory and equations necessary to tune your ‘Chair to exactly replicate the voltages of your transmitter.

Keep close track of everything you do, as meticulous documentation will be very helpful in eventually troubleshooting, maintaining or repairing your wire harness.

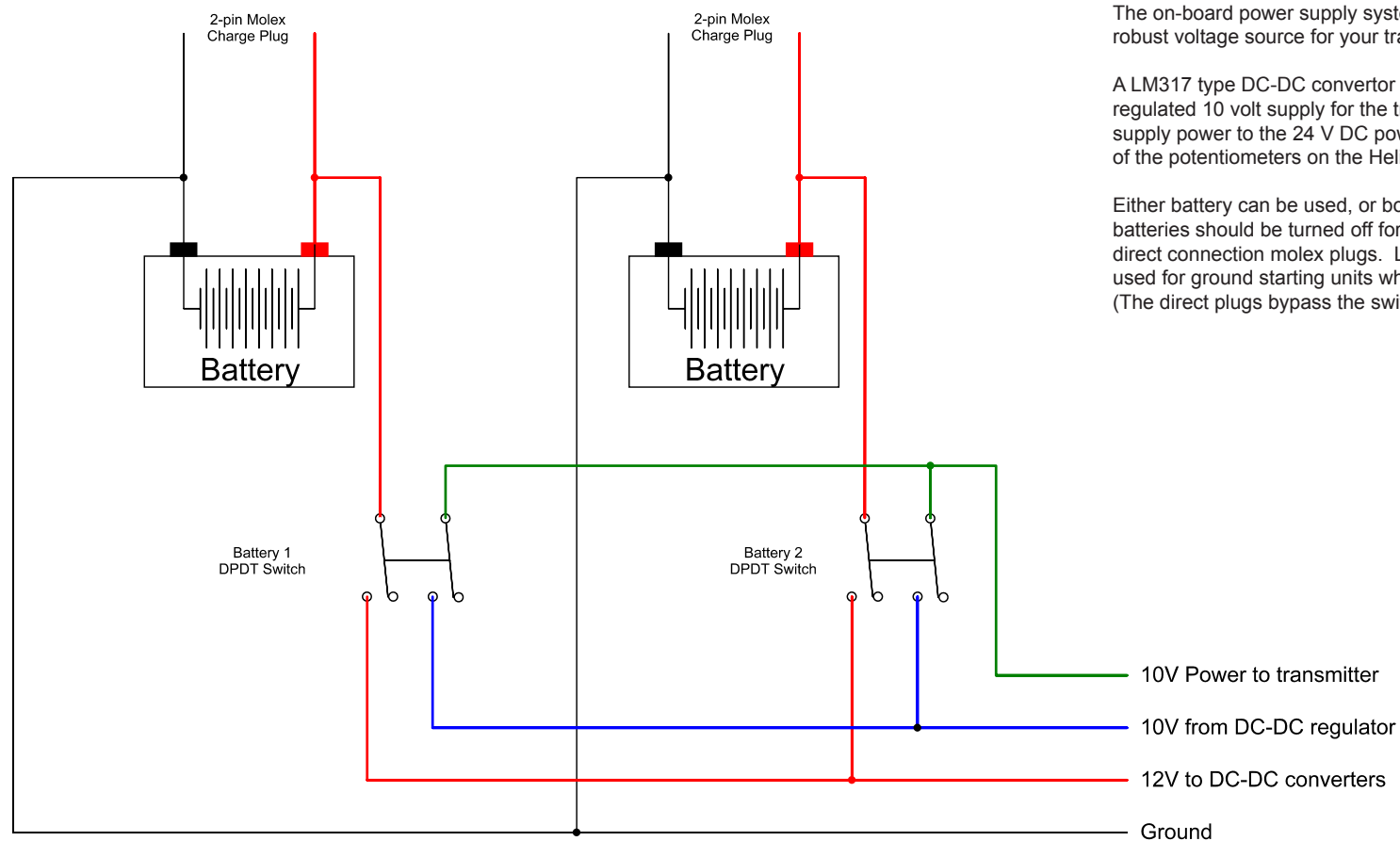
Notice that the JR9303 chart has been developed to the extent that it displays voltage swings for even the D/R switches and VR sliders. There is no reason that ANY transmitter can be outfitted with each of these channels, we simply chose to display the 9303 numbers as an example.

As one final note, you may find that currently manufactured Futaba radios use a single color of wire (blue) in their construction. This is unfortunate and makes our job harder when retrofitting a wire harness, but it does not change functionality in any manner. JR radios are still currently using colored wire in their construction but are a bit harder to work on because the wire bundles are a bit tighter and shorter. There is less volume inside the JR radios for added wiring as well.

Modifications		Date	Name	Description	Page no.
Date	Name	12 Jan 2007		Selected Futaba and JR Voltage Measurements	Page 7
					Pages
				Schematic no.	

	A	B	C	D	E	F																																	
1	To setup the new Heli-Chair			Note Regarding Potentiometer Polarity for a 7C type Heli-Chair																																			
	DO NOT connect the radio until all voltages are setup and tested. Damage to the radio unit will occur if limits are exceeded.			Pin 2 of each potentiometer is the signal wire and goes directly from the Heli-Chair to the Futaba Radio Transmitter. The “polarity” of the potentiometer is determined by pins 1 and 3. Voltage and ground have to be applied to these pins. Which pin is positive and which is ground will determine the direction that the potentiometer rotates for the desired control movement.																																			
2	The base philosophy of the system is to increase the voltage supplied to the potentiometers such that their diminished rotational range of motion still creates the equivalent voltage swing of the Futaba radio. Typically, the 7C radio will center at 1.65 volts and swing plus and minus about 1.2 volts for a range of around 0.4 to 2.9 volts.			A) CCW rotation of the fore/aft cyclic potentiometer shaft (viewing from the shaft) corresponds to forward cyclic.																																			
	Power the 24V DC-DC converter with the external power supply leads. The supply voltage needs to be between 8 and 18 volts (a typical car battery will work perfectly). A small 9V battery will work as well.			B) CCW rotation of the left/right cyclic potentiometer shaft corresponds to left cyclic input.																																			
3	Measure the voltage between pins 1 and 2 of the umbilical connector. Pin 1 MUST be 0V and pin 2 will measure the voltage of the battery you are using. If you have the black lead of the voltmeter on pin 1 and red lead on pin 2, and the measured voltage is negative, you have pins 1 and 2 reversed.			C) CCW rotation of the throttle potentiometer shaft corresponds to moving the throttle towards idle.																																			
	Measure the voltage between pin 1 and each pin 3,4,5,6,7 for each of the control axii. Adjust the potentiometer of each control so that when centered, the voltage is equivalent to the center voltage for the: cyclic roll and pitch and for the pedals. For the collective and throttle, set the voltages at the collective down and throttle-idle position rather than at center.			D) CCW rotation of the collective potentiometer shaft corresponds to up collective input.																																			
4	Continue setup by programming your radio appropriately for the helicopter. When programming is complete, connect the Heli-Chair to the radio and verify that the servos move appropriately. If they are reversed, you can reverse them in the radio, but the better way is to reverse the wires on pins 1 and 3 of the potentiometer for that channel. BE SURE to re-adjust the potentiometer before continuing, as the reversal of the wires will give you a very high voltage output prior to re-adjustment.			E) CCW rotation of the torque pedal potentiometer shaft corresponds to right pedal input.																																			
				Other radio systems and variations on design of your Heli-Chair may give a completely different result. The easiest way to set the polarity, if you don't know beforehand, is to simply connect the wires and try it. If they work in reverse, then swap power and ground at pins 1 and 3.																																			
<table><tr><td colspan="2">Modifications</td><td></td><td>Date</td><td>Name</td><td rowspan="4">Description</td><td>Page no.</td></tr><tr><td>Date</td><td>Name</td><td></td><td>12 Jan 2007</td><td></td><td rowspan="3">Setup and Adjustment Notes, Tips and Tricks</td><td>Page 8</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>Pages</td></tr><tr><td></td><td></td><td colspan="3"></td><td>Schematic no.</td></tr><tr><td></td><td></td><td colspan="3"></td><td></td><td></td></tr></table>							Modifications			Date	Name	Description	Page no.	Date	Name		12 Jan 2007		Setup and Adjustment Notes, Tips and Tricks	Page 8						Pages						Schematic no.							
Modifications			Date	Name	Description	Page no.																																	
Date	Name		12 Jan 2007			Setup and Adjustment Notes, Tips and Tricks	Page 8																																
							Pages																																
							Schematic no.																																

	A	B	C	D	E	F																																
1	General Notes:			Part numbers and sources:																																		
	The potentiometers should be 5000 ohm single turn precision potentiometers. They come in many forms, the ones we use are the Bournes 6639 series. They're high quality, have a good solder lug and seem to work well. Make sure to get LINEAR potentiometers, as another type, logarithmic, would not do the job.			These part numbers can be used to spec components on www.mouser.com and from there, you can branch out and perhaps find a better local source. Go to http://www.heli-chair.com/wiring_101.html for even more information on general wiring techniques, sources for tools, parts and other materials.																																		
	We recommend the AMP CPC Series II connector system. This is a positive locking connector which has very high quality pins. You will have to spend some money on tools to crimp these connector pins, but it is well worth it.			potentiometer: 652-6639s-1-502 24V DC-DC convertor: 618-OBQ24SC0512 1/4 watt carbon resistor kit: 370-BJ250-2 and 370-BJ250-1 external battery (optional): 547-PS1250F2 heatshrink: use 3:1shrink ratio polyolefin, adhesive lined tiewraps: 514-08432 (example part number)																																		
2	You can cut corners and use something like the Molex .093 series connector bodies and pins. This is about 1/4th the cost of AMP Series II, but at a much lower quality. In fact, you don't necessarily need to have connectors at all, it simply makes things easier to work with.			For the AMP Series II CPC connector assembly: AMP plugs: 571-2064851 AMP receptacle: 571-2064862 AMP backshell: 571-2060621 AMP pins/sockets: 571-2050891 and 571-2050901 extraction tool: 571-910672 crimp tool: contact heli-chair for assistance																																		
	A good on-line vendor is www.mouser.com or digikey.com , either one has everything you need. There are many local vendors and a variety of sales places in countries throughout the world. Half of the battle is knowing where to get your parts.			For MOLEX type connector assemblies: .093" pins and sockets: 571-7701471 and 571-7701461 12pin receptacle: 571-7701001 12pin plug: 571-7701021 crimp tool: 538-63811-1000 extraction tool: 571-3188371																																		
3	The DC-DC convertor is an inexpensive device which in some cases is really just a luxury. We HIGHLY recommend a stabilized powersource like this but in fact you can sacrifice resolution and even use the 3V or 5V output from your transmitter. You will want something that takes 8 to 15 volts input and outputs a constant voltage of at least 12V...24V output is recommended as you can tune down the voltage for each axis and still retain FULL resolution of the gimbal movement.																																					
4																																						
				<table><tr><th colspan="2">Modifications</th><th></th><th>Date</th><th>Name</th><th rowspan="4">Description</th><th>Page no.</th></tr><tr><td>Date</td><td>Name</td><td></td><td>12 Jan 2007</td><td></td><th>Page 9</th></tr><tr><td></td><td></td><td></td><td></td><td></td><th>Pages</th></tr><tr><td></td><td></td><td colspan="3"></td><td>Schematic no.</td></tr><tr><td></td><td></td><td colspan="3"></td><td></td><td></td></tr></table>			Modifications			Date	Name	Description	Page no.	Date	Name		12 Jan 2007		Page 9						Pages						Schematic no.							
Modifications			Date	Name	Description	Page no.																																
Date	Name		12 Jan 2007			Page 9																																
						Pages																																
						Schematic no.																																



The on-board power supply system is designed to provide a redundant and robust voltage source for your transmitter and other 12 volt systems.

A LM317 type DC-DC converter is used to convert the 12 Volt battery to a regulated 10 volt supply for the transmitter. Likewise, the 12 volt batteries supply power to the 24 V DC power supply used to increase the resolution of the potentiometers on the Heli-Chair.

Either battery can be used, or both can be used at the same time. Both batteries should be turned off for charging. Charging is done through the direct connection molex plugs. Likewise, these direct connect plugs can be used for ground starting units where high amperage draw is necessary. (The direct plugs bypass the switches and will carry high current loads).



Modifications			Date	Name	Description On-Board Power Supply	Page no.
Date	Name		12 Jan 2007			Page 10
						Pages
						Schematic no.

A

B

C

D

E

F

Wiring a coolie ("hat") switch for trim functions:

Depending on your radio transmitter, the digital trim function either provides a momentary ground or a momentary 5V (or 3V) signal. The trim switch connects the appropriate wire to either the ground or power bus. The digital trim assembly for each channel is typically a pair of momentary SPST switches. They are actually 2 individual board mounted buttons, but a single plastic slide that you actuate with your fingers from the front of the radio will simply depress one switch for UP and one for DN (or L and R).

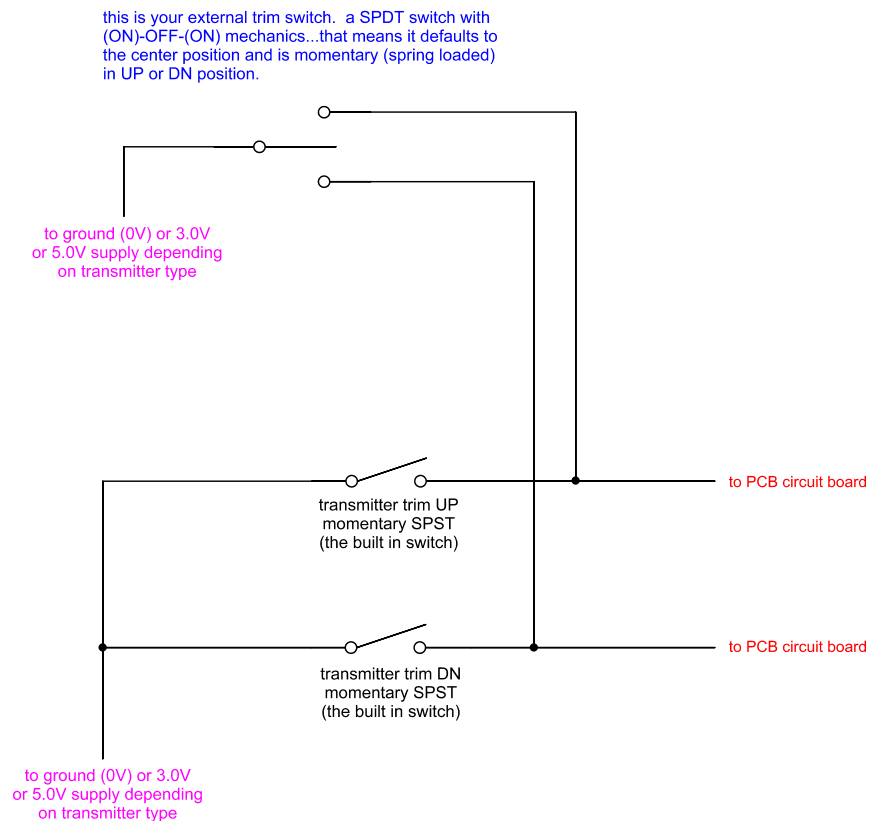
You can measure the resistance to ground to verify if this is a ground-type trim and if not, you'll have to power the unit to confirm that it is on the 3V or 5V buss.

The external trim buttons can be in parallel with the in-transmitter buttons. That is, the wires can be soldered DIRECTLY to the printed circuit board without disabling the switches at the board. In this way, either the transmitter or the "heli-chair" switch sets are capable of trimming at any time.



The trim wires may be susceptible to radio interference from your transmitter antenna. If you get random inputs of trim while operating the radio, you will have to try shielding the trim wires with metal foil (or re-wire using shielded cable), or live with the minor interference. If the problem is severe, you must disconnect the trim wires from the bundle.



This diagram represents the interface of one stick's UP/DN trim function. It is necessary to repeat this wiring process for each axis you wish to trim.



Modifications		Date	Name	Description	Page no.
Date	Name	12 Jan 2007		Wiring Coolie-Hat Style Trim Function	Page 11
					Pages
				Schematic no.	

	A	B	C	D	E	F																																		
	cyclic button ID	wire color at airframe cyclic plug		possible voltage		function at JR9303 radio																																		
1	trigger	brown		-, float		"gear"																																		
	right of coolie hat	red/white		+, -, float		"aux 4"																																		
	pinkie	blue/white		-, float		"rudder D/R"																																		
	thumb	yellow		+, -		right side VR slider																																		
	left of coolie hat	black/white		+, -, float		"aux 2"																																		
2			<p>The table above shows recommended switch assignments when using the Inifnity stick grip with a JR9303 radio. ANY transmitter can be configured in a similar manner to that shown here. The main goal of your wiring approach is to mimic the voltages generated by the radio itself. You will find with the 2 or 3 way switches that they go either to ground, power or remain "floating" when acuated.</p> <p>The Inifnity stick grip shown can be purchased at AircraftSpruce.com, the part number is 11-00031 and can also be purchased directly from Inifnity Aerospace at: http://www.inifnityaerospace.com</p>																																					
3																																								
4	<table><tr><th colspan="2">Modifications</th><th></th><th>Date</th><th>Name</th><th>Description</th><th>Page no.</th></tr><tr><td>Date</td><td>Name</td><td></td><td>12 Jan 2007</td><td></td><td rowspan="2">Infinity Cyclic Grip Upgrade with JR9303 Specifics</td><td>Page 12</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>Pages</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>Schematic no.</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>						Modifications			Date	Name	Description	Page no.	Date	Name		12 Jan 2007		Infinity Cyclic Grip Upgrade with JR9303 Specifics	Page 12						Pages						Schematic no.								
Modifications			Date	Name	Description	Page no.																																		
Date	Name		12 Jan 2007		Infinity Cyclic Grip Upgrade with JR9303 Specifics	Page 12																																		
						Pages																																		
					Schematic no.																																			

Manufacturer Component Spec Sheets and Drawings



Features

- Essentially infinite resolution
- Excellent rotational life
- High quality, rugged construction
- General purpose applications
- Non-standard features available
- Cost and space saving

BOURNS®

6539/6639 - Precision Potentiometer

Electrical Characteristics¹

	6539 Servo Mount	6639 Bushing Mount
Standard Resistance Range	1 K to 100 K ohms	1 K to 100 K ohms
Total Resistance Tolerance	±15 %	±15 %
Independent Linearity	±2.0 %	±2.0 %
Effective Electrical Angle	340 ° +3 °	340 ° +3 °
End Voltage	0.5 % maximum	0.5 % maximum
Output Smoothness	0.1 %	0.1 %
Dielectric Withstanding Voltage (MIL-STD-202, Method 301)		
Sea Level	750 VAC minimum	750 VAC minimum
Power Rating (Voltage Limited By Power Dissipation or 300 VAC, Whichever is Less)		
+70 °C	1.0 watt	1.0 watt
+125 °C	0 watt	0 watt
Insulation Resistance (500 VDC)	500 megohms minimum	500 megohms minimum
Resolution	Essentially infinite	Essentially infinite

Environmental Characteristics¹

Operating Temperature Range	+1 °C to +125 °C	-40 °C to +125 °C
Storage Temperature Range	-65 °C to +125 °C	-65 °C to +125 °C
Temperature Coefficient		
Over Storage Temperature Range	±500 ppm/°C maximum	±500 ppm/°C maximum
Vibration	15 G	15 G
Wiper Bounce	0.1 millisecond maximum	0.1 millisecond maximum
Total Resistance Shift	±10 %	±10 %
Voltage Ratio Shift	±0.5 %	±0.5 %
Shock	50 G	50 G
Wiper Bounce	0.1 millisecond maximum	0.1 millisecond maximum
Total Resistance Shift	±5 %	±5 %
Voltage Ratio Shift	±0.5 %	±0.5 %
Load Life	1,000 hours, 1 watt	1,000 hours, 1 watt
Total Resistance Shift	±10 %	±10 %
Rotational Life (No Load)	10,000,000 shaft revolutions	10,000,000 shaft revolutions
Total Resistance Shift	±10 % maximum	±10 % maximum
Moisture Resistance (MIL-STD-202, Method 106)		
Total Resistance Shift	±15 %	±15 %
IP Rating	IP 40	IP 40

Mechanical Characteristics¹

Mechanical Angle	Continuous, Stops (340 ° +8 °, -0 °) available
Torque (Starting & Running) ²	0.40 N-cm (0.5 oz.-in.) max.
Mounting	170-200 N-cm (15-18 lb.-in.) maximum
Shaft Runout	0.13 mm (0.005 in.) T.I.R.
Lateral Runout	0.08 mm (0.003 in.) T.I.R.
Shaft End Play	0.13 mm (0.005 in.) T.I.R.
Shaft Radial Play	0.13 mm (0.005 in.) T.I.R.
Pilot Diameter Runout	0.06 mm (0.0025 in.) T.I.R.
Backlash	0.1 ° maximum
Weight	18 gm (6539 Servo Mount), 24 gm (6639 Bushing Mount)
Terminals	Rear Turret Type
Soldering Condition	Recommended hand soldering using Sn95/Ag5 no clean solder, 0.025 " wire diameter. Maximum temperature 399°C (750 °F) for 3 seconds. No wash process to be used with no clean flux.
Marking	Manufacturer's name and part number, resistance value and tolerance, linearity tolerance, wiring diagram, and date code.
Ganging (Multiple Section Pots)	1 cup maximum
Hardware (6639 only)	One lockwasher (H-37-2) and one mounting nut (H-38-2) is shipped with potentiometer.

¹ At room ambient: +25 °C nominal and 50 % relative humidity, except as noted.

² 2.82 N-cm (4.0 oz.-in.) max. at -40 °C.

Recommended Part Numbers

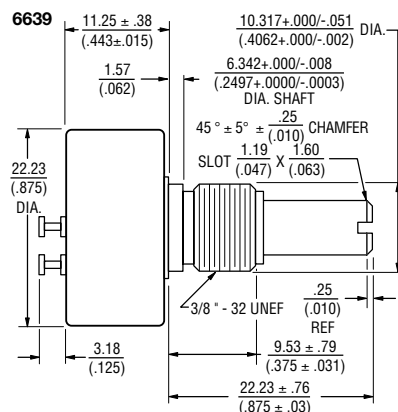
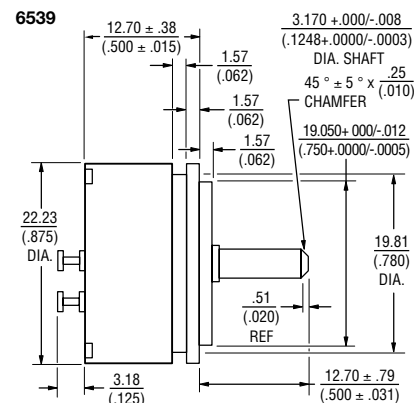
Part Number	Resistance (Ω)
6539S-1-102	1,000
6539S-1-502	5,000
6539S-1-103	10,000

BOLD FACE LISTINGS ARE IN STOCK AND READILY AVAILABLE THROUGH DISTRIBUTION.

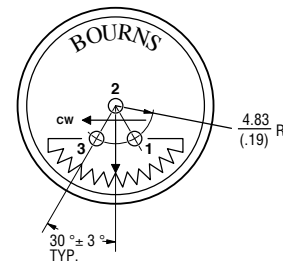
FOR OTHER OPTIONS CONSULT FACTORY.

Part Numbers		Resistance (Ω)
Continuous Turn	Mechanical Stops	
6639S-1-102	6639S-301-102	1,000
6639S-1-202	6639S-301-202	2,000
6639S-1-502	6639S-301-502	5,000
6639S-1-103	6639S-301-103	10,000
6639S-1-203	6639S-301-203	20,000

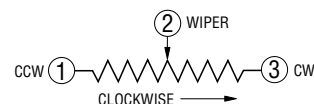
Product Dimensions



65/6639



TOLERANCES: EXCEPT WHERE NOTED
 DECIMALS: XX ± .51 XXX ± .13
 FRACTIONS: ±1/64
 DIMENSIONS: MM (IN.)



3 WATT DC-DC CONVERTER

OBQ- SC / WC 0512
SINGLE/ DUAL CHANNEL

Specifications	Model												
OBQ**SC/WC0512 3WATTS/SINGLE/2 OUTPUT	OBQ05SC0512			OBQ12SC0512		OBQ15SC0512		OBQ24SC0512		OBQ22WC0512		OBQ23WC0512	
Input Characteristic													
Input Voltage DC[V]	5	12	5	12	5	12	5	12	5	12	5	12	
Input Range DC[V]	4.5-16												
Inrush Current [A]	Not specified												
Input Range													
at no load [mA](typical)	41	44	51	54	51	53	57	59	66	64	64	64	
at full load[mA](typical)	676	297	789	342	779	337	800	346	843	356	800	342	
Line Back Noise [mVp-p](typical)	200	100	100	80	200	100	200	100	200	100	200	100	
Efficiency [%] (typical) *1	74	70	76	73	77	74	78	75	74	73	75	73	

[illegible]

Conditions:

*1 at 25°C and rated input/output

*2 OBQ**WC0512 satisfies the above-mentioned specifications at the same load conditions on both outputs

*3 measured by a bayonet probe at the output connector at a 0 to 100MHz bandwidth

*4 when input voltage changed from 4.5V to 16V rapidly at rated output

*5 when output current changed from 0mA to rated current keeping the current of other output below minimum rated current at rated input

*6 when output current changed from minimum rated current to rated current keeping the current of other output above minimum rated current at rated input

*7 when output current of both outputs changed from 0mA to rated current identically at rated input

*8 at -20 to +71°C

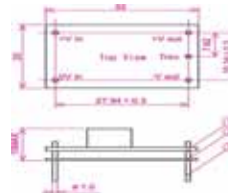
*9 for 7hour period after 1hour warm-up at 25°C and rated input/output

*10 when output current changed rapidly between 25% and 75% of rated current at rated input

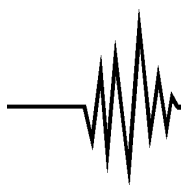
*11 to increase output voltage, put a resistor between pin"0" and trimming pin

*12 to reduce output voltage, put a resistor between pin "+" and trimming pin

DIMENSION DIAGRAM



- ☐ Double-sided PCB Form 1.0
☐ 400: Insulated No
☒ 1.0016 PCB Material: RoHS 2100 1.2H
 Copper Plating 1-2um
 Silver Plating 3-4um
 www.seimoon.com



POWER  SONIC

Rechargeable Sealed Lead-Acid Battery



PS-1250

12 Volt 5.0 Amp. Hrs.

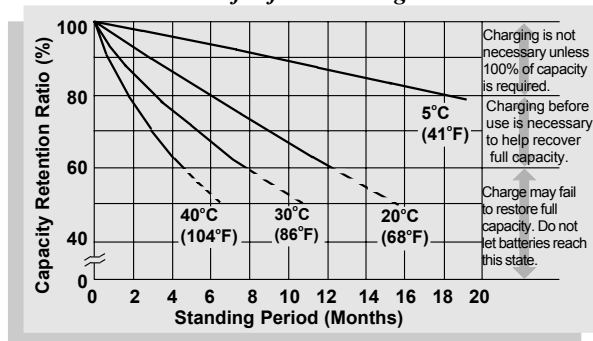
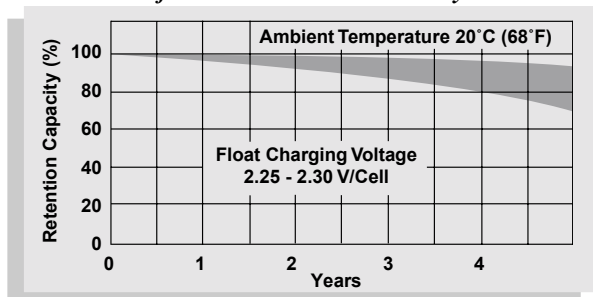
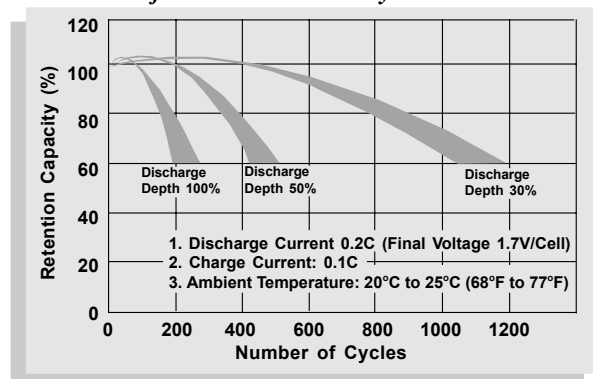
Features:

- Absorbent Glass Mat (AGM) technology for superior performance.
- Valve regulated, spill proof construction allows safe operation in any position.
- Power/volume ratio yielding unrivaled energy density.
- Rugged ABS plastic case and cover
- Approved for transport by air. D.O.T., I.A.T.A., F.A.A. and C.A.B. certified.
- U.L. recognized under file number MH 20845.



PERFORMANCE SPECIFICATIONS

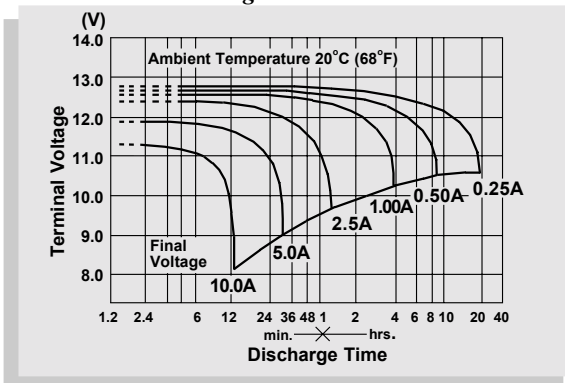
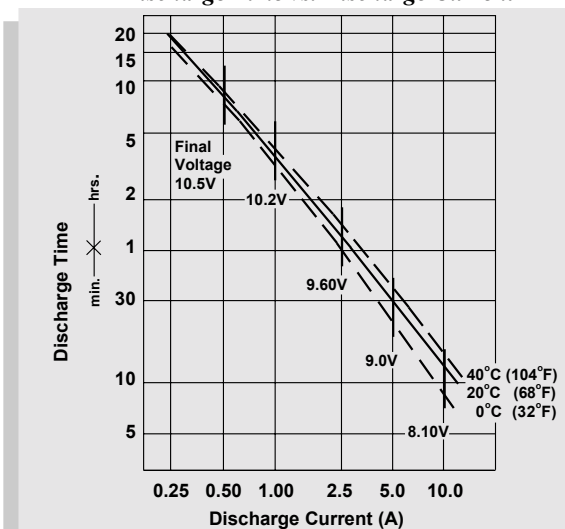
Nominal Voltage.....	12 volts (6 cells in series)
Nominal Capacity	
20 hour rate (250mA to 10.50 volts)	5.0 A.H.
10 hour rate (450mA to 10.50 volts)	4.5 A.H.
5 hour rate (800mA to 10.20 volts)	4.0 A.H.
1 hour rate (3200mA to 9.00 volts)	3.2 A.H.
Approximate Weight.....	3.75 pounds (1.7 kg)
Energy Density (20 hour rate).....	1.53 Watt-hours/cubic inch (93.4 Watt-hours/l)
Specific Energy (20 hour rate).....	14.5 Watt-hours/pound (32.0 Watt-hours/kg)
Internal Resistance (Fully Charged Battery).....	30 milliohms (approximately)
Maximum Discharge Current (\leq 7 Min.).....	15 amperes
Maximum Short-Duration Discharge Current (\leq 10 Sec.).....	50 amperes
Terminals.....	F1": Quick disconnect tabs, 0.187" x 0.032", mate with AMP. INC. FASTON "187" F2": Quick disconnect tabs, 0.250" x 0.032", mate with AMP. INC. FASTON "250"
Shelf Life — % of nominal capacity at 68° F (20° C)	
1 Month.....	97%
3 Months.....	91%
6 Months.....	83%
Operating Temperature Range	
Charge.....	-4°F (-20°C) to 122°F (50°C)
Discharge.....	-4°F (-20°C) to 140°F (60°C)
Case.....	ABS Plastic

Shelf Life and Storage*Life Characteristics in Stand-By Use**Life Characteristics in Cyclic Use***CHARGING**

Cycle Applications: Limit initial current to 1250mA. Charge until battery voltage (under charge) reaches 14.40 to 14.70 volts at 68°F (20°C). Hold at 14.40 to 14.70 volts until current drops to approximately 50mA. Battery is fully charged under these conditions, and charger should either be disconnected or switched to "float" voltage.

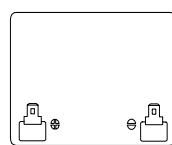
"Float" or "Stand-By" Service: Hold battery across constant voltage source of 13.50 to 13.80 volts continuously. When held at this voltage, the battery will seek its own current level and maintain itself in a fully charged condition.

NOTE: Due to the self-discharge characteristics of this type of battery, it is imperative that they be charged after 6-9 months of storage, otherwise permanent loss of capacity might occur as a result of sulfation.

Discharge Characteristics*Discharge Time vs. Discharge Current*

Physical Dimensions: in. (mm)

Terminals

**"F1"** FASTON

0.187" x 0.032"

quick disconnect

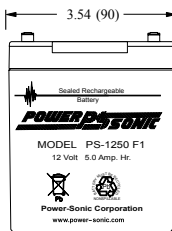
tabs.

"F2" FASTON

0.250" x 0.032"

quick disconnect

tabs.



Tolerances are +/- 0.04 in. (+/- 1mm) and +/- 0.08 in. (+/- 2mm) for height dimensions.
All data subject to change without notice.

POWER-SONIC

SALES & MARKETING
3106 Spring Street
Redwood City, CA 94063 USA
Tel: 650-364-5001 Fax: 650-366-3662
national-sales@power-sonic.com



ISO9001-2000
FM39170

www.power-sonic.com

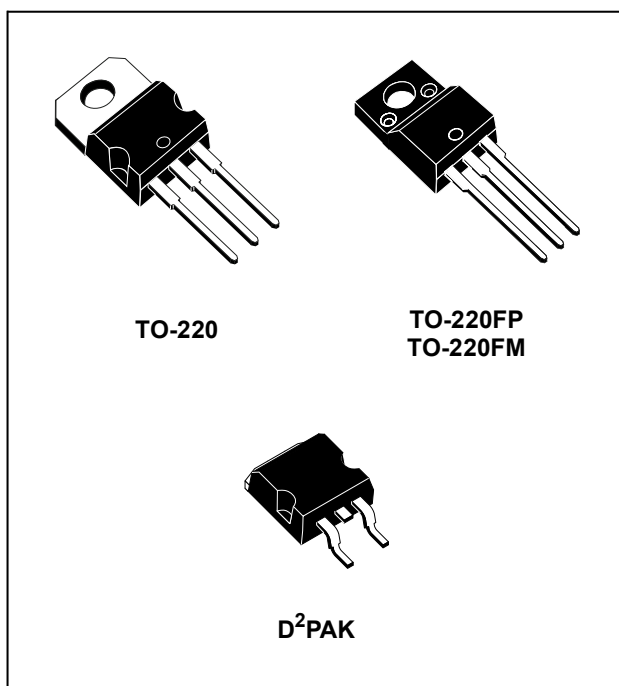
CUSTOMER SERVICE
9163 Siempre Viva Road
San Diego, CA 92154 USA
Tel: 619-661-2030 Fax: 619-661-3648
customer-service@power-sonic.com

PRECISION 1A REGULATORS

- OUTPUT CURRENT IN EXCESS OF 1A
- OUTPUT VOLTAGES OF 5; 6; 8; 9; 12; 15; 18; 20; 24V
- THERMAL OVERLOAD PROTECTION
- OUTPUT TRANSITION SOA PROTECTION
- 2% OUTPUT VOLTAGE TOLERANCE
- GUARANTEED IN EXTENDED TEMPERATURE RANGE

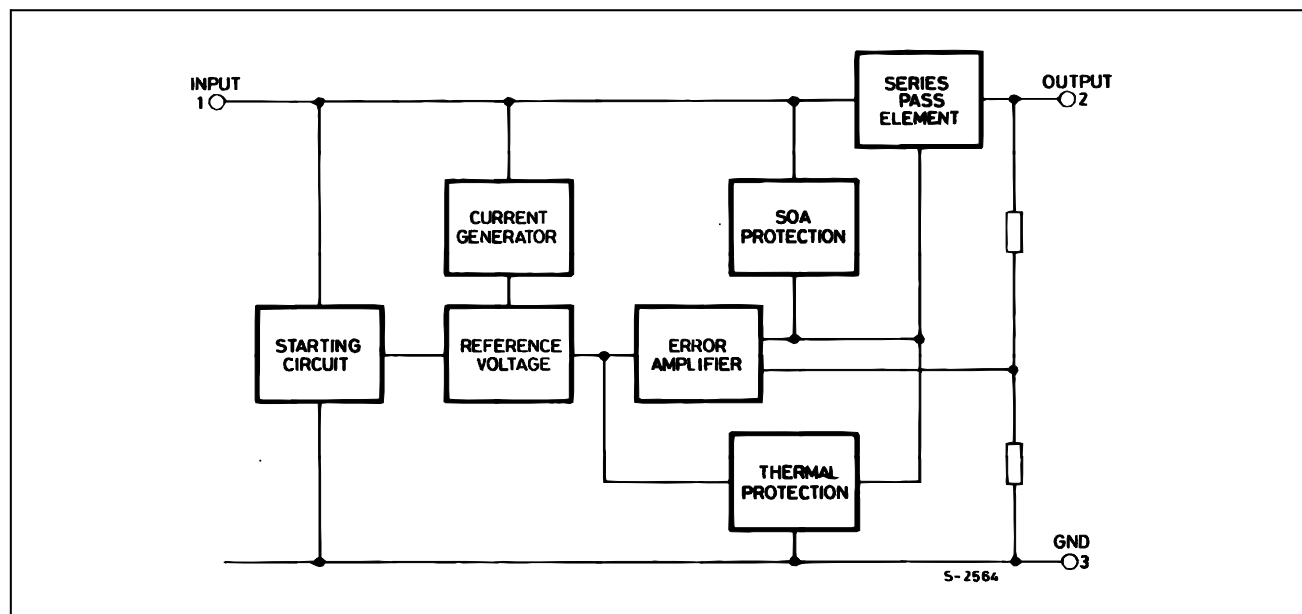
DESCRIPTION

The L7800A series of three terminal positive regulators is available in TO-220, TO-220FP, TO-220FM and D²PAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problem associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these



devices can be used with external components to obtain adjustable voltage and currents.

SCHEMATIC DIAGRAM



Procedural Notes and Task Techniques in Text Format

Modify 7C radio, 2 hours

cut 10x 1/2" lengths of 1/8" diameter shrink tubing
cut 10x 11" and 2x 15" pieces of 22ga milspec wire
strip and tin one end of all wires
2x 7.25" pieces of clean cut 3/8" mesh sleeving
7 series II pins, 5 sockets
2x 1" lengths of silicone wrap

Procedure:

Drill 2x 5/16" diameter holes at top of radio
remove dial on front of radio
remove antenna
remove crystal, battery door and battery
remove back cover, 4 screws
using phillips screwdriver, remove computer board at bottom of radio, 5 screws
cut orange and brown wire from right stick bundle 3" from board (4-wire bundle on LEFT viewing from back)
cut yellow wire from right switch board (5-wire bundle on LEFT viewing from back), this is the VR knob
unravel brown, orange and yellow wires
reinstall computer board and knob on front of radio
cut orange and brown wire from left stick (on RIGHT viewing from back of radio)
tin all exposed wire leads with solder
bend a 'U' shape hook in all wires, including 11" lengths of 22ga but EXCLUDING 15" lengths of wire
solder a 11" length of wire to each exposed wire in the radio
heat shrink all 10 solder joints
solder power lead to topmost powerswitch junction
 build up a bead, then dip wire in (two steps with cooling between)
solder ground lead to ground post for dial-key (either post)
 build up a bead, then dip wire in (two steps with cooling between)
color these wires red and black for identification (with a marker)
 thread through left side hole (RIGHT viewing from rear)
tiewrap wire bundles to lower post (nearest power switch)
cut all wires to 4.75" extending from radio
strip wires and crimp pins to left bundle (RIGHT viewing from rear) and sockets to right bundle (LEFT)
cut tie wraps
slide mesh sleeving on each bundle, unheated end through hole
slid on backshell on each bundle
insert pins to appropriate location
silicone wrap at location of clamp for protection
re-tiewrap to posts, tiewrap to second posts nearest top of radio (orient wraps to hold bundles down)
 mesh sleeving will just extend below bottom post
replace antenna
replace circuit board
reassemble radio cover, crystal and battery
connect connectors and secure cable grips
powerup radio and check channel assignment using endpoint set screen (to see each channel has correct motion)
PICS: have pic of radio with orientation arrows, detail pics of radio with modifications in progress

Modify 9C radio, 2.5 hours

cut 10x 1/2" lengths of 1/8" diameter shrink tubing
cut 11x 11" and 1x 15" piece of 22ga milspec wire
strip and tin one end of all wires, strip 15" wire kinda short
2x 7.25" pieces of clean cut 3/8" mesh sleeving, flame the ends
7 series II pins, 5 sockets
2x 1" lengths of silicone wrap

Procedure:

Drill 2x 5/16" diameter holes at top of radio
remove antenna
remove crystal, battery door and battery
remove back cover
cut yellow and blue wire from right stick bundle (on LEFT viewing from back) 3" from board
cut brown wire from right switch board (on LEFT viewing from back of radio), this is the VRD signal wire
cut white and yellow wire from left stick (on RIGHT viewing from back of radio)
tin all exposed wire leads with solder
bend a 'U' shape hook in all wires, including 11" lengths of 22ga but EXCLUDING 15" length of wire
solder a 11" length of wire to each exposed wire in the radio
heat shrink all 10 solder joints
solder power lead to topmost powerswitch junction
 build up a bead, then dip wire in (two steps with cooling between)
solder ground lead to ground post of charge jack
 build up a bead, then dip wire in (two steps with cooling between)
color these wires red and black for identification (with a marker)
 thread through left side hole (RIGHT viewing from rear)
tiewrap wire bundles to lower post (nearest power switch)
cut all wires to 4.75" extending from radio
strip wires and crimp pins to left bundle (RIGHT viewing from rear) and sockets to right bundle (LEFT)
cut tie wraps
slide mesh sleeving on each bundle, unheated end through hole
slid on backshell on each bundle
insert pins to appropriate location
silicone wrap at location of clamp for protection
re-tiewrap to posts, tiewrap to second posts nearest top of radio (orient wraps to hold bundles down)
 mesh sleeving will just extend below bottom post
replace antenna
replace circuit board
reassemble radio cover, crystal and battery
connect connectors and secure cable grips
powerup radio, check channel assignment using endpoint set screen (to see each channel connected properly)

Wire Cyclic sub-assembly, 1.5 hours

all wires each potentiometer are 15" long (yellow x2, black x2, white x2)

solder wires to potentiometers

use 6" of 1/8" diam spiral wrap on each potentiometer

terminate fore/aft potentiometer wires with CPC pins, slide on shell and insert into connector

terminate and load L/R potentiometer wires into connector

use 10 to 11" of 1/4" diam spiral wrap on both together

*put a few inches adjacent connector body, then put body over the spiral wrap, then finish wrapping

hint: if in doubt, don't solder yellow and black wires, just put hooks and the test in final assembly

Wire Cyclic bundle on airframe side, 0.5 hours

7' white wire x2 4' black wire x2 4' yellow wire x2

8" spiral wrap, 1/4" diameter

[ADD 18" to yellow and black wires for under-seat box option]

loop forward into frame a few inches for a service loop

Wire Collective sub-assembly, 1.5 hours

*throttle potentiometer, all leads 60", braid first 30" of leads

take the first 10 inches adjacent potentiometer and tripple back

there should be about 33" remaining out the back of collective

use 14" of 1/8" diam spiral wrap at exit, thread into collective post and braid after fully threading

*collective potentiometer, all leads 29"

use 8" of 1/8" diam spiral wrap on leads into post

braid leads after threading past boss in collective riser

*cut all leads to ~9" extended beyond bottom exit of collective post

terminate with male pins

Wire Collective bundle on airframe side, 0.5 hours

6'3" white wire x2 3' black wire x2 3' blue wire 3' orange wire

6" of 1/4" spiral wrap

loop forward into frame a few inches for service loop

Wire and install Hobbs meter, 1 hour

ground and positive lead 8' long [ADD 18" for under-seat box option]

terminate into 2 pin .062 molex

braid wires full length

use 12" of 1/8" spiral wrap and 1" heat shrink for strain and abrasion resistance

install using 2 WDG clamps, cut down clamp to fit better

Wire Pedal potentiometer, 0.75 hours

signal wire 10', green/black are 8' long [ADD 18" to the 8' wires for the under-seat box option]

2' of 1/8" spiral wrap

braid remaining length of wires

loop into frame for a service loop

- *all wires exit rear of frame for bundling, bundle into: futaba umbilical, ground, brain box
- *leave 5 signal wires until last, check voltage, centering and put into connector body during final adjustments.
- *USE COLORED wire mesh on brain bug
- *in addition to itemized procedures, it takes another 1.5 hours to group, solder and finalize, ready to tune pots

Wire Power Supply, 1.5 hours

solder ground jumper wire between both grounds
 solder 2 ground wires, 12" long
 solder 2 red +12V wires, 12" long
 solder 3 yellow +24V wires, two are 12" long, one is 6" long
 solder 3 yellow wires, 4" long to the short yellow (branching power)
 cut green blue orange wires to 12" long, solder with respective resistors
 stagger yellow wire buss for length, solder on resistor/output wire subassemblies
 cut 12" mesh sleeving for external power input
 braid external power wires, insert into mesh sleeving, terminate with molex .093" 2-circuit with PINS
 include blank female body to protect pins in use

Caliber 30 radio setup for Futaba 7CHP, 1.5 hrs

radio setup and program notes
 -center tailrotor servo without gyro connected. connect gyro and adjust gain AND center in conjunction to achieve a center with appropriate gain. if the center is out of whack you will loose range. always physically center the servo arm with servo in true neutral and with gyro connected you will never know true center (HELI-MAX), all servo arms mounted 90 degrees to pushrod with servo centered

Chair 2 program (revo mixing, collective/throttle mixing)

start with new H-1, PCM type, set model name CHAIR2
 disable hover throttle trim, hover throttle VR, pitch trim, hover pitch VR,
 connect servos roll-1, pitch-2, collective-3, pedals-4 (NO GYRO YET), throttle-6
 provide neutral signal to all servos and rig arms 90deg to pushrods
 reverse 1,3,6
 adjust subtrims all 1,2,3,4,6
 must have collective at neutral (use endpoint screen to see neutral point)
 set neutral position with endpoint screen, then adjust subtrim
 now install gyro - adjust gain and center at same time keeping arm at 90degrees
 set endpoints: pedal 100%, cyclic 80%
 rig collective down limit with bar tangent at upper surface to index mark (1/2 dia below center)
 grab the bar and wiggle to relieve sticktion
 rig collective up so collars on mast meet
 collective is approximately 45 down and 100 up with 3151 servo
 rig throttle full each way (collective at limits puts throttle at limits) with a little extra
 adjust down limit to 15% shorter than full idle
 THIS IS THE IDLE speed setting to be adjusted on first flight
 program throttle TH curve 100, 80, 60, 30, 0
 THIS IS ROTOR RPM setting to be adjusted on first flight
 program PMIX1, this is the ENGINE CUT
 master=offset, slave=channel6, switch is H.down, rate +20%
 switch H down is engine cutoff

program REVO

hi=-10, lo=-10

switch A.up

switch A up is revo mixing on

program exponentials (see radio worksheet)

set all failsafes to NORMAL except 6, program this to go to idle, test failsafe

these numbers are for 3004 throttle servos and pedal servos, 3151 for cyclic servos

Box 1 program is exact copy of chair 2

Chair 1 program (no revo mixing, collective/throttle mixing)

start with new ACRO, PCM, ch5 and ch7 OFF

reverse 1 and 3

subtrim 1,2,3,4,6

endpoints set the same way as for chair 2 program

program exponentials (see radio worksheet)

program offset throttle cut

set failsafe same as chair 2, test failsafe

Heli-Chair production flight test procedure, 1 hr

initial flight test box1 mode without chair

set idle travel and cutoff mix

set subtrims for hover

re-rig tail rotor and others if necessary

finalize subtrims for hover

copy subtrims to chair1 mode

test revo mix and adjust (pull collective from hover)

could maybe do a little more on revo mixing, am setting lo to 0, should I use -?

copy box1 to chair2

test chair1 mode with heli-chair

do not adjust subtrims

adjust pots to center chair with the radio

note that almost perfect centering should be accomplished prior to this stage with an empty model

memory

VERIFY that idle travel doesn't go past the zero point of the potentiometer!!!!!!!

Finalize, trim and adjust, 2.5 hours

Recommended Channel Assignments

Throttle
Collective
Pedals
Cyclic L/R
Cyclic F/A

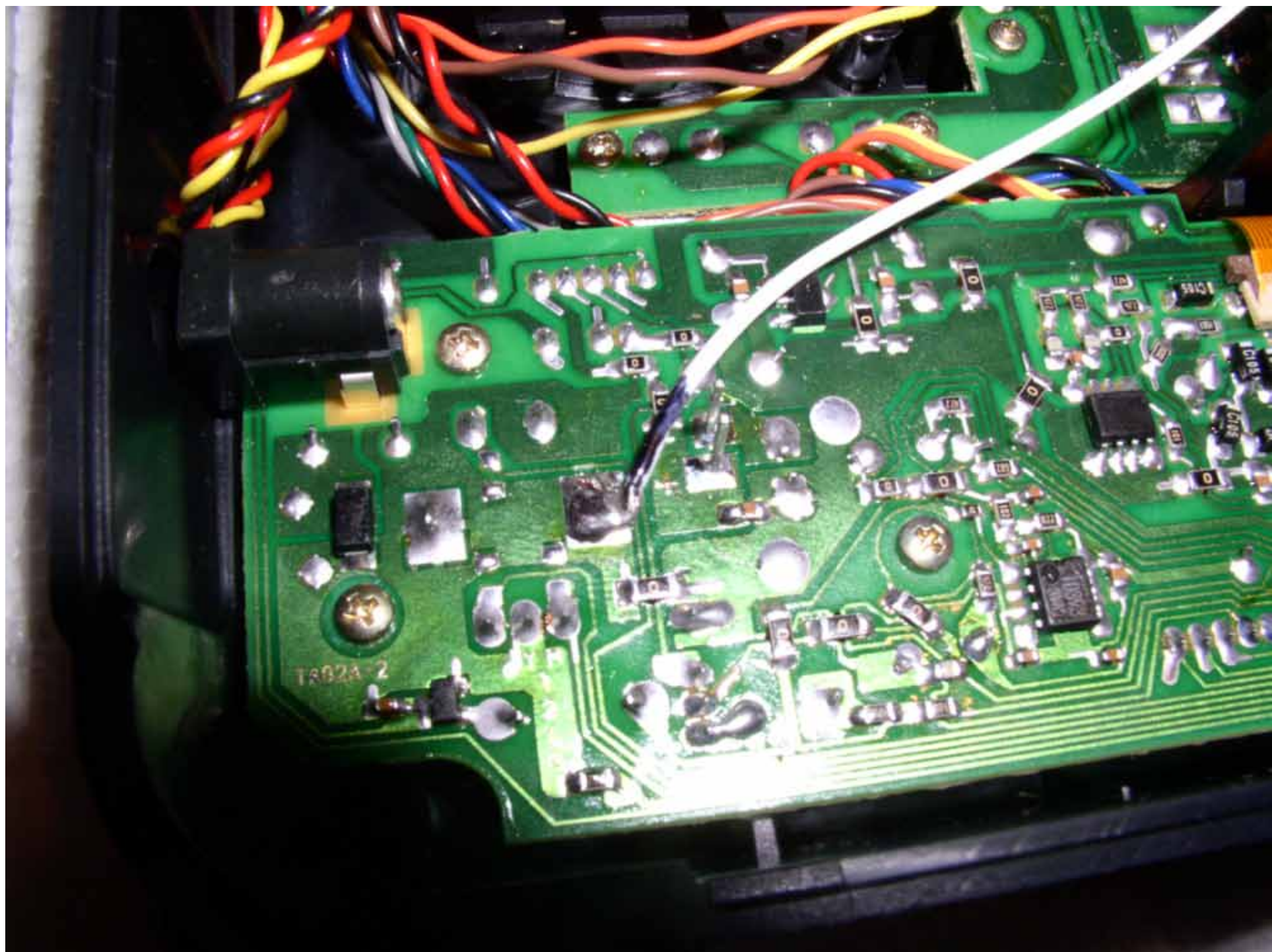


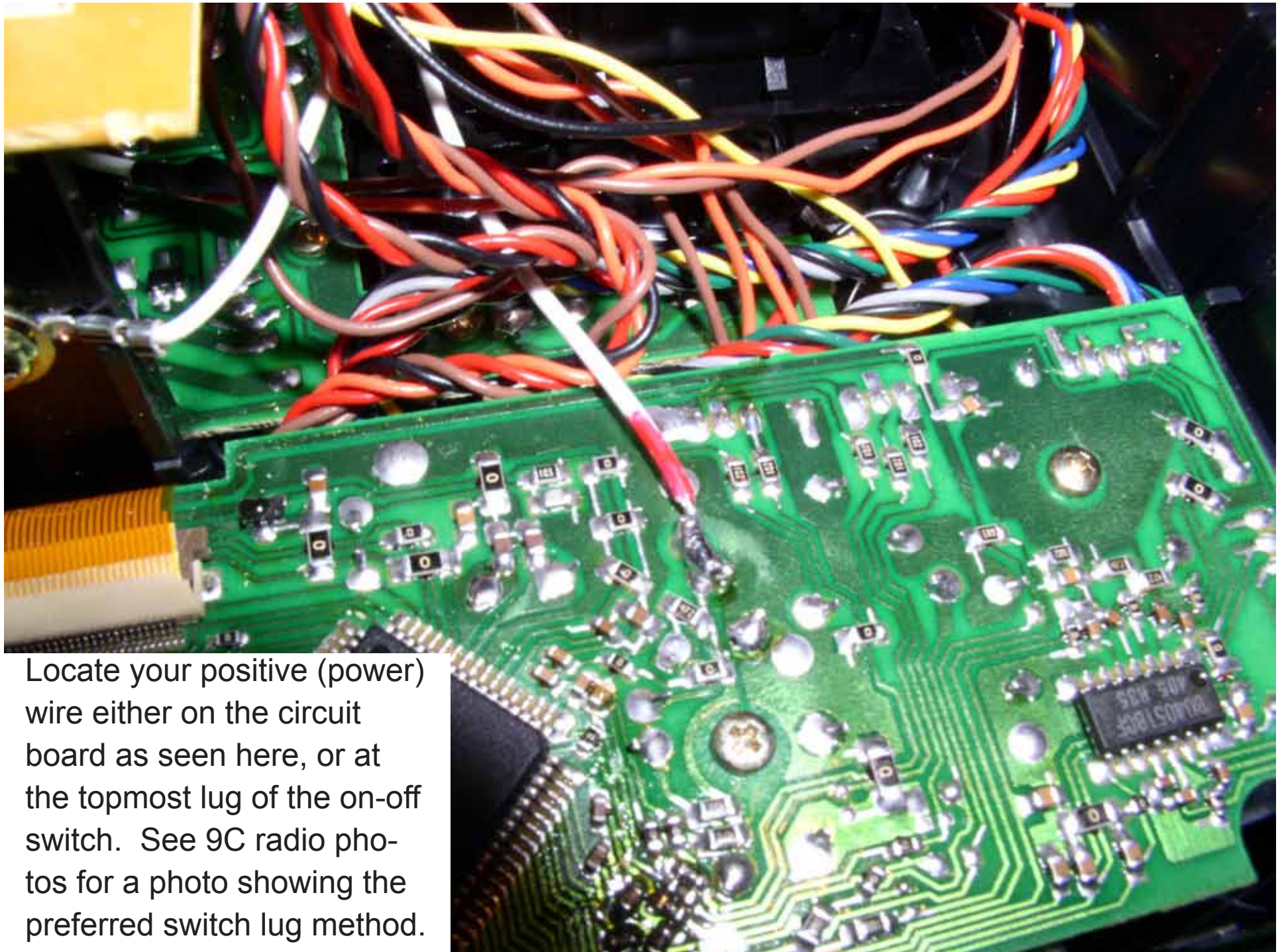
Throttle
Collective
Pedals
Cyclic L/R
Cyclic F/A



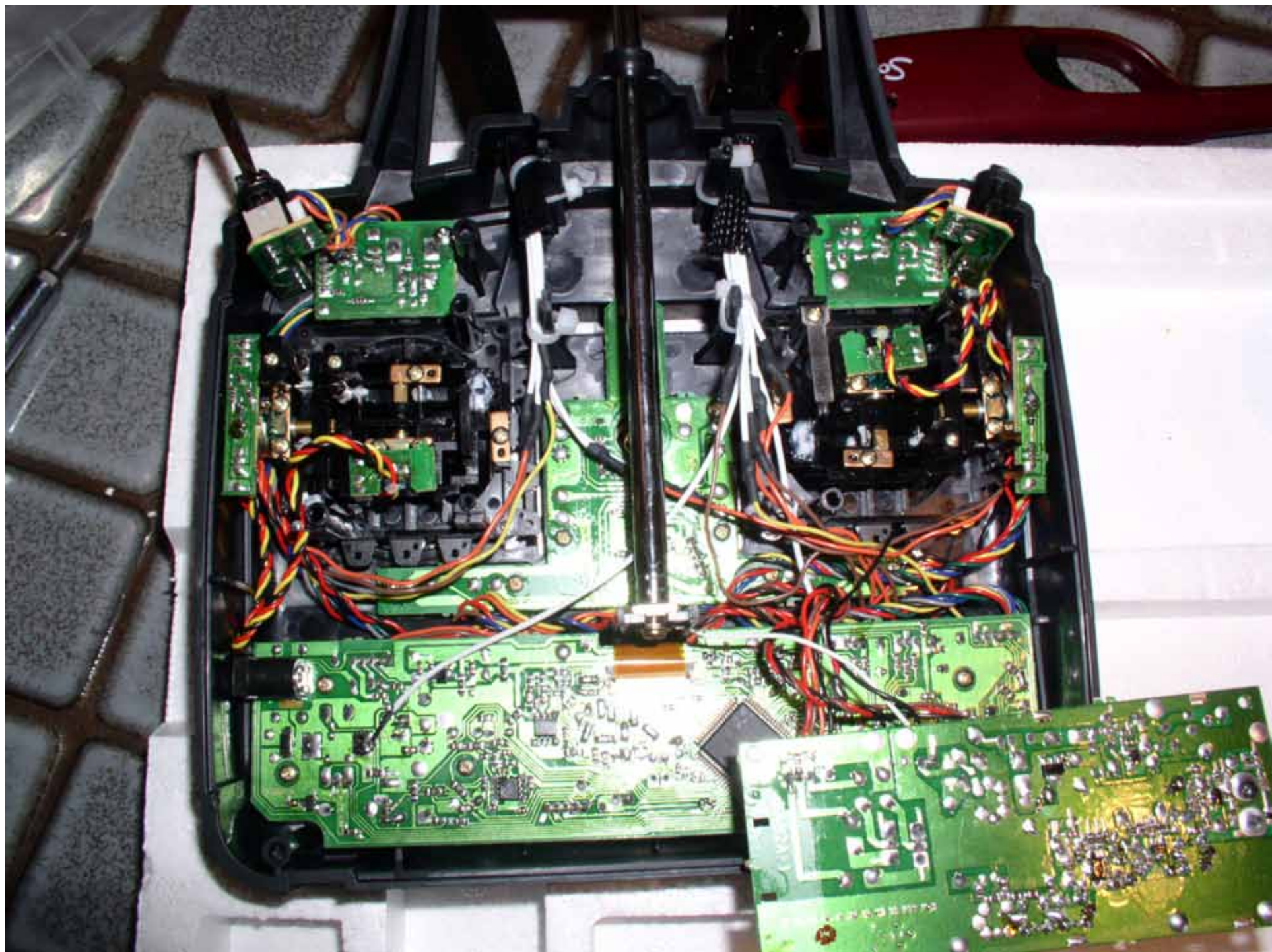
Futaba 7C Radio Modification Pictures, Basic 5-Channel







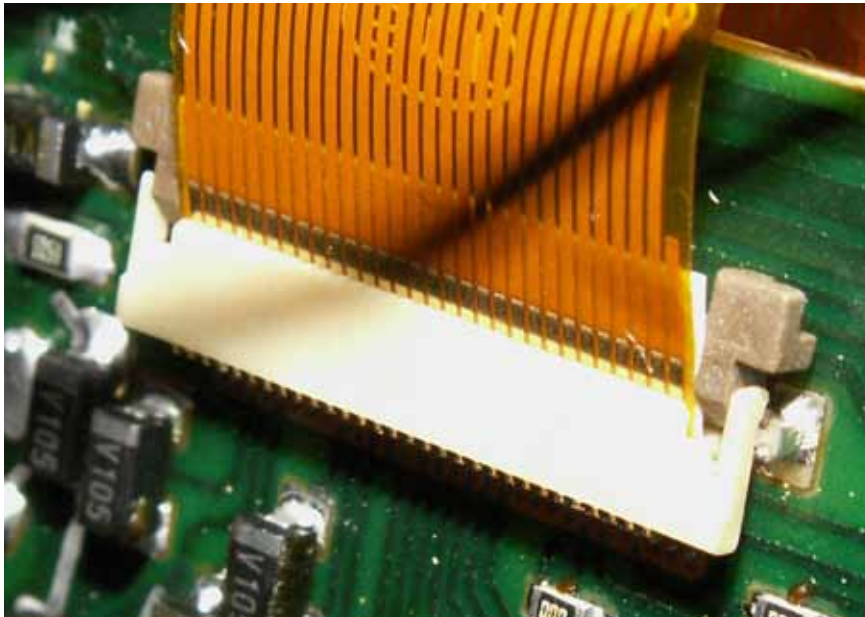
Locate your positive (power) wire either on the circuit board as seen here, or at the topmost lug of the on-off switch. See 9C radio photos for a photo showing the preferred switch lug method.







If you are brave, you can disconnect the lower circuit board assembly by raising the tabs and extracting the edge connector. This is not a recommended technique, it is difficult to get the connector re-assembled.



Futaba 9C Radio Modification
Pictures, Basic 5-Channel (not
much difference from the basic
7C modification)

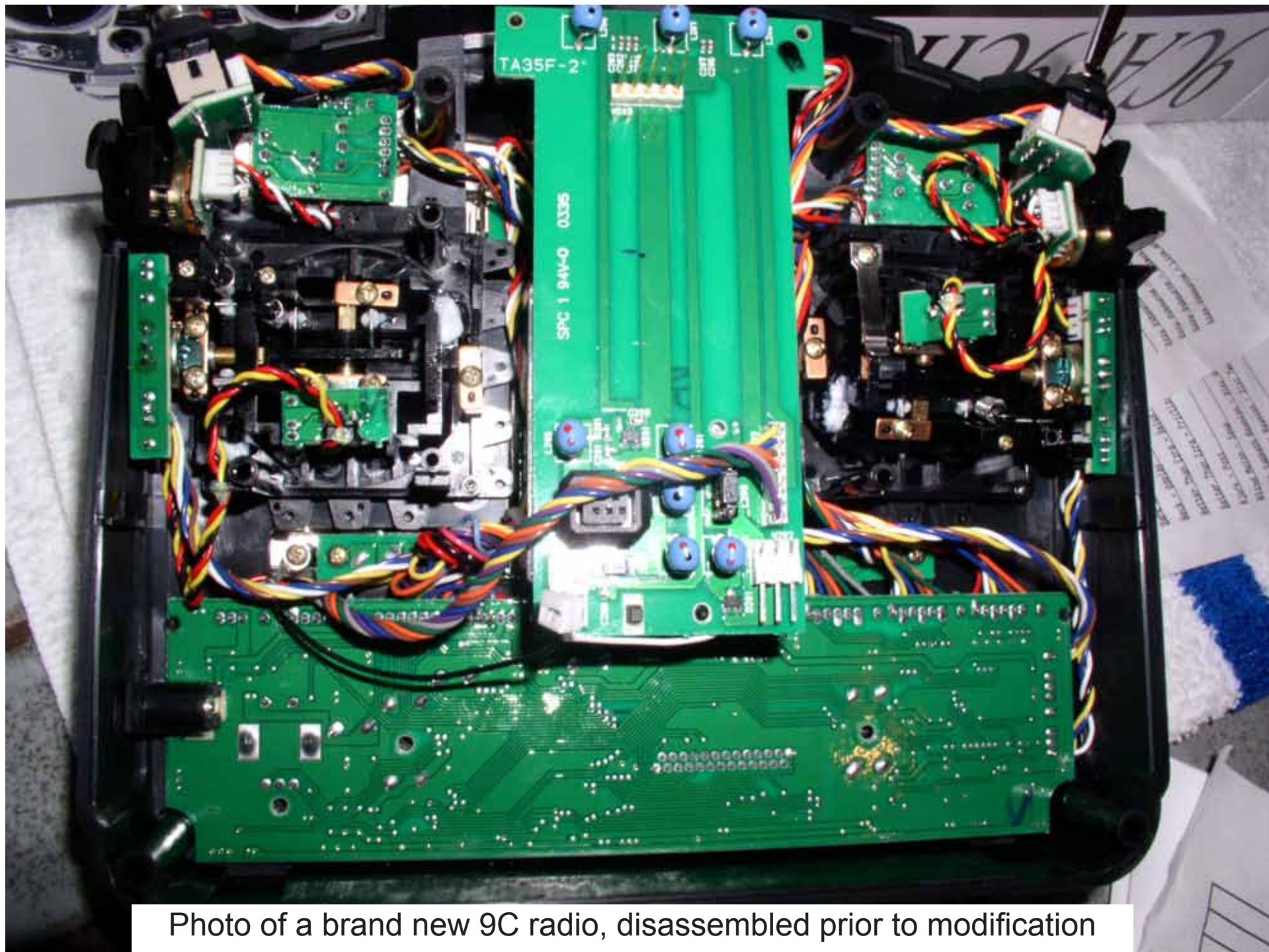


Photo of a brand new 9C radio, disassembled prior to modification

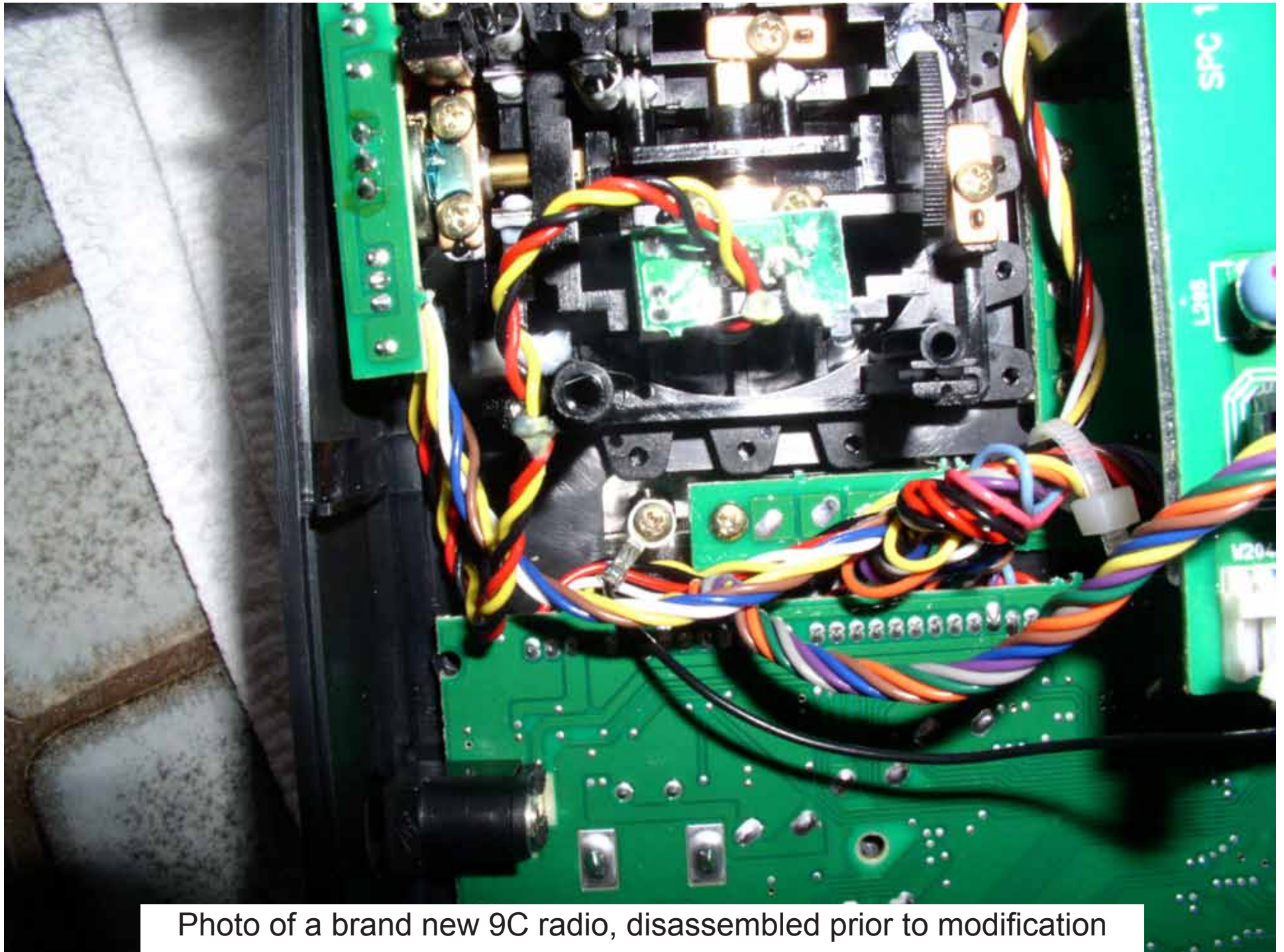


Photo of a brand new 9C radio, disassembled prior to modification

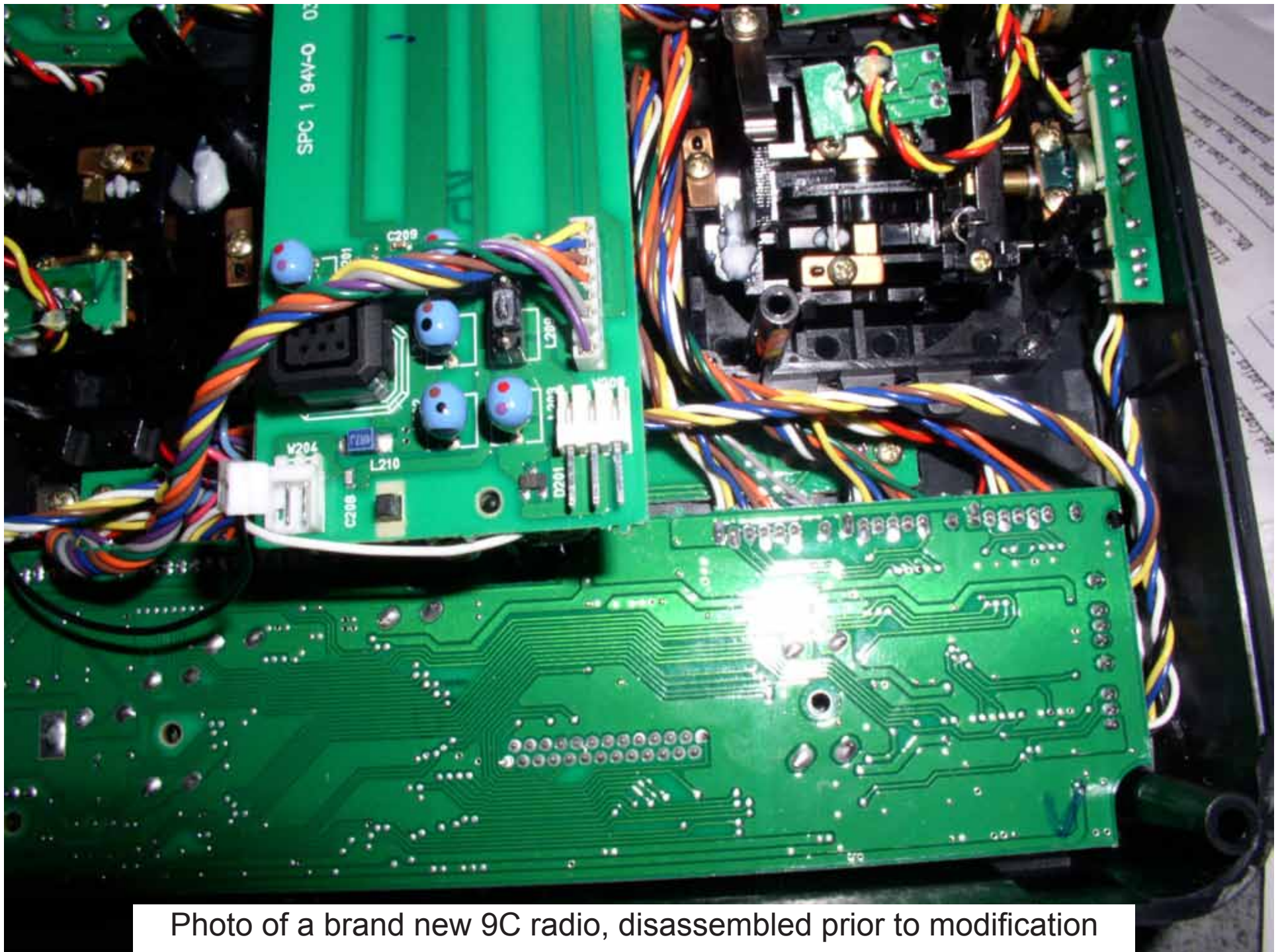
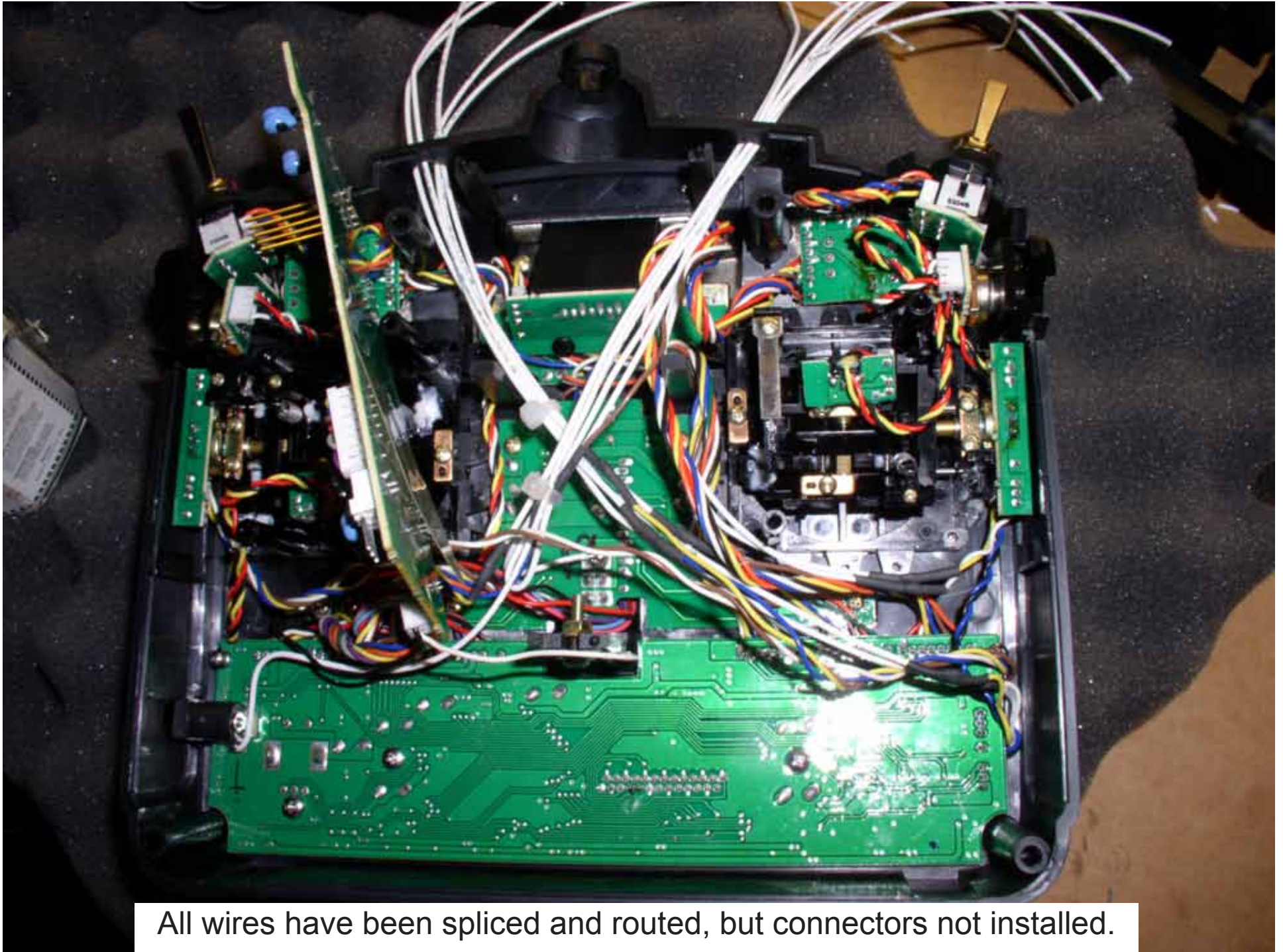
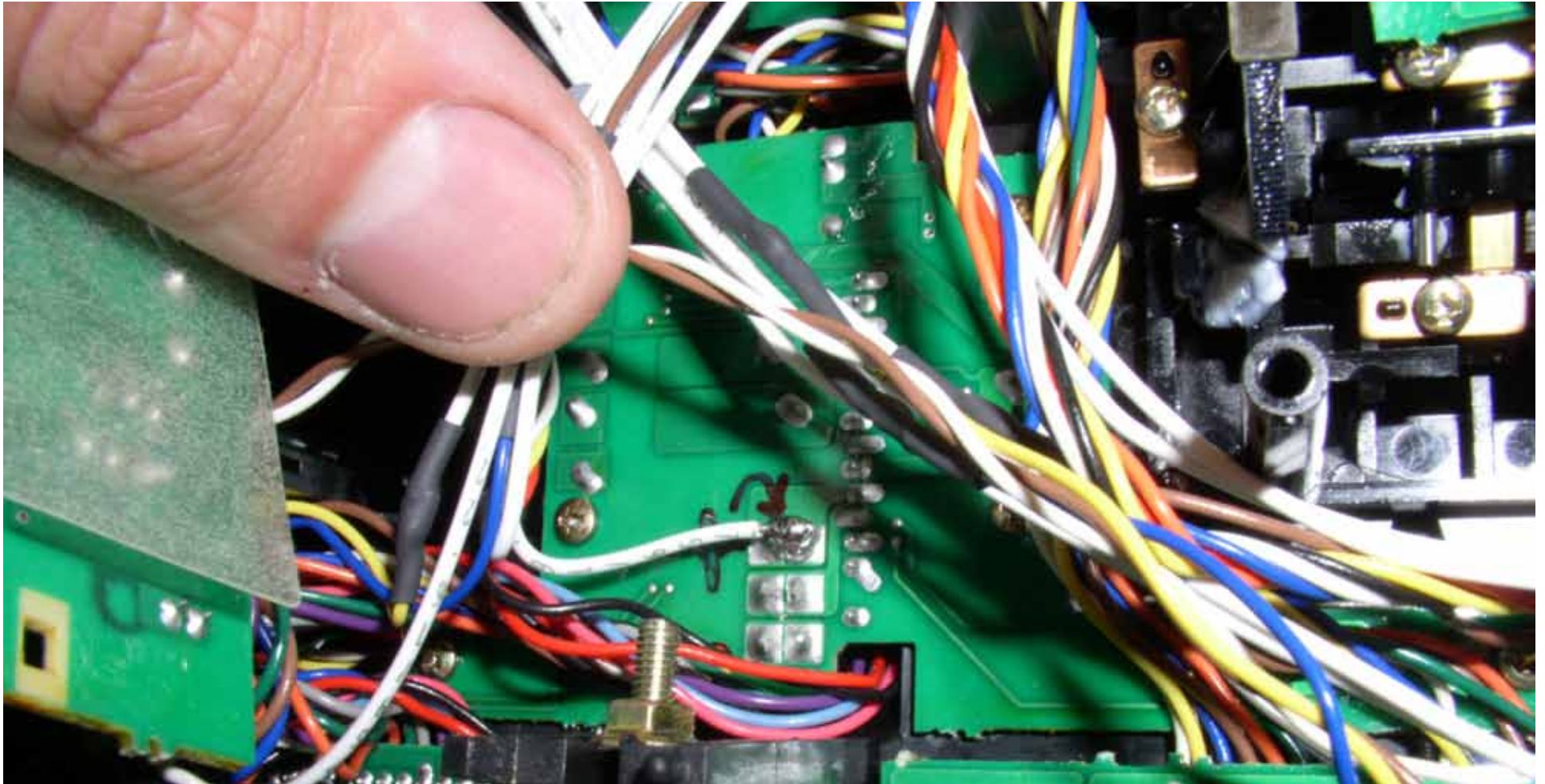


Photo of a brand new 9C radio, disassembled prior to modification

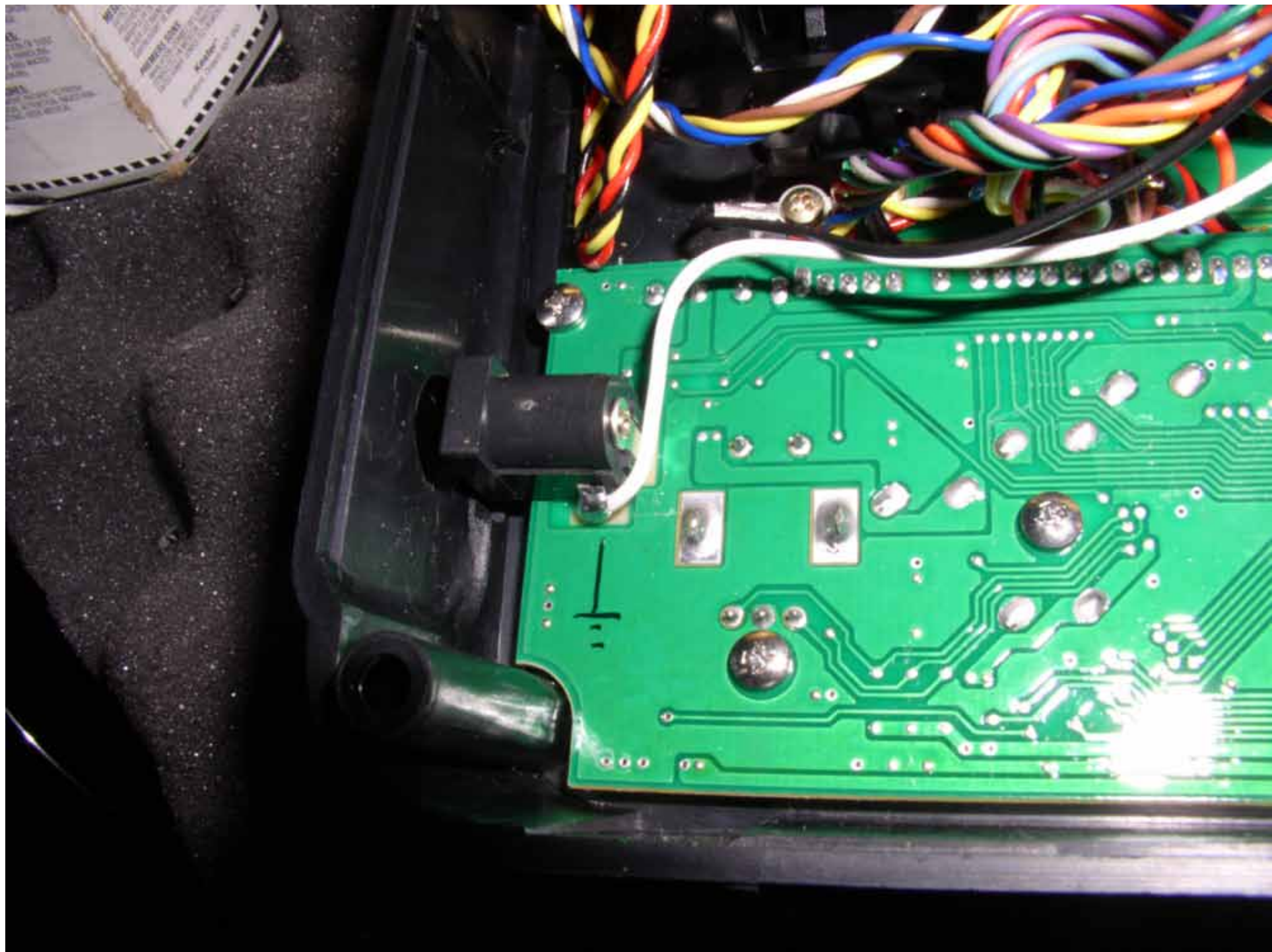


All wires have been spliced and routed, but connectors not installed.

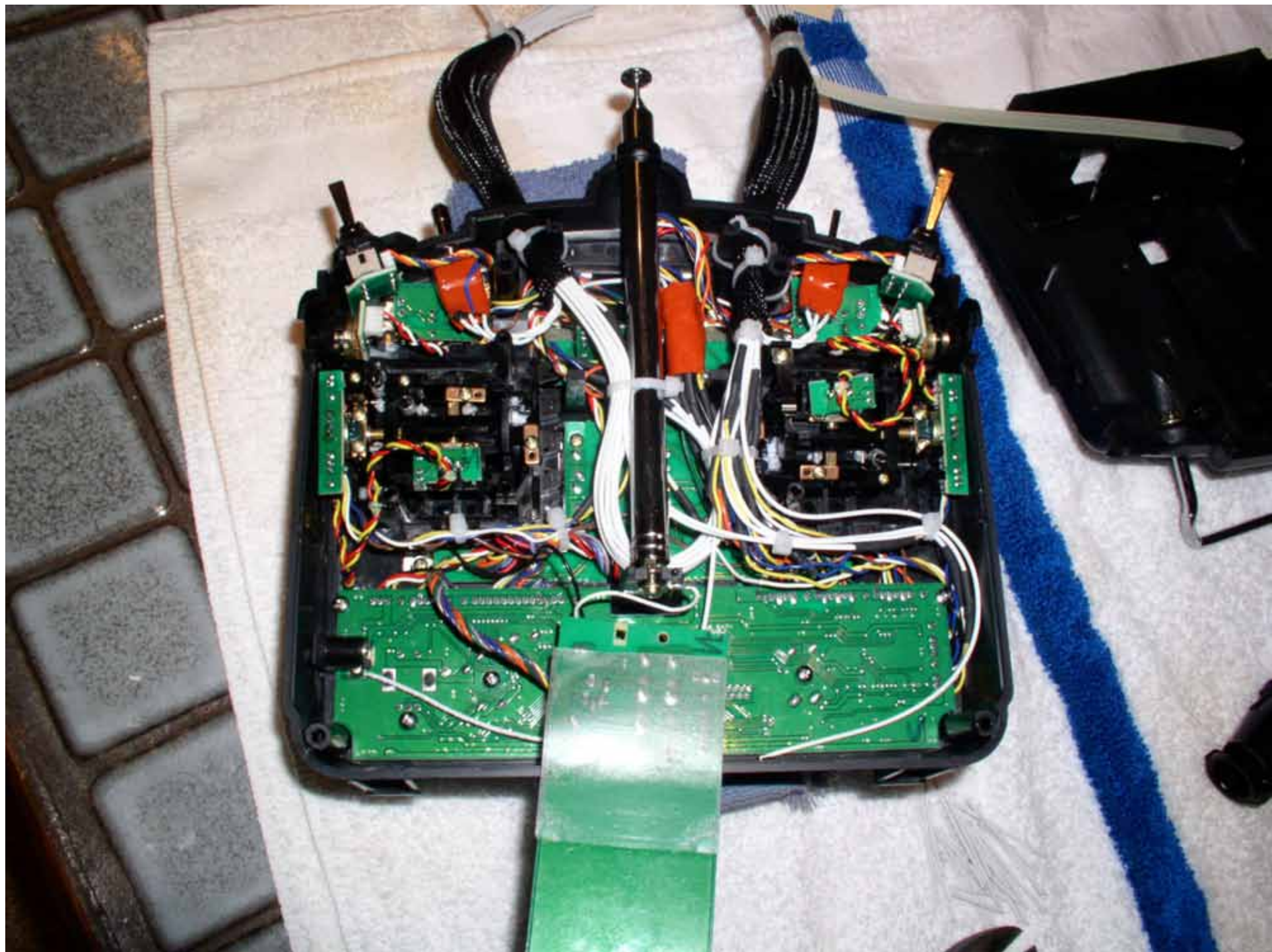


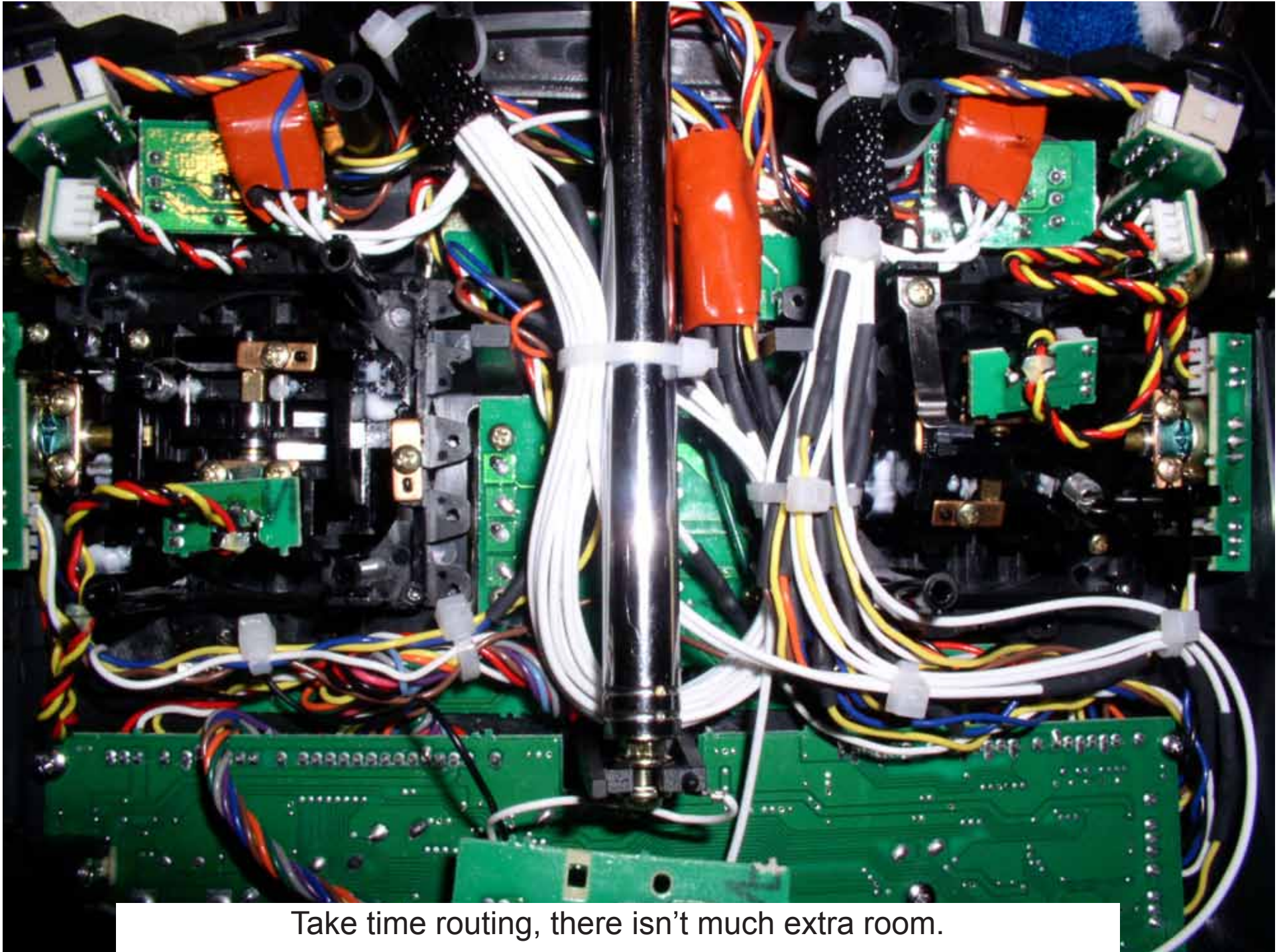
This is a great place for the power wire on almost any radio transmitter. Usually the battery will come into the switch at the center lug and when switched on, will connect to the top lug. A continuity test is the best way to ensure this is the case.



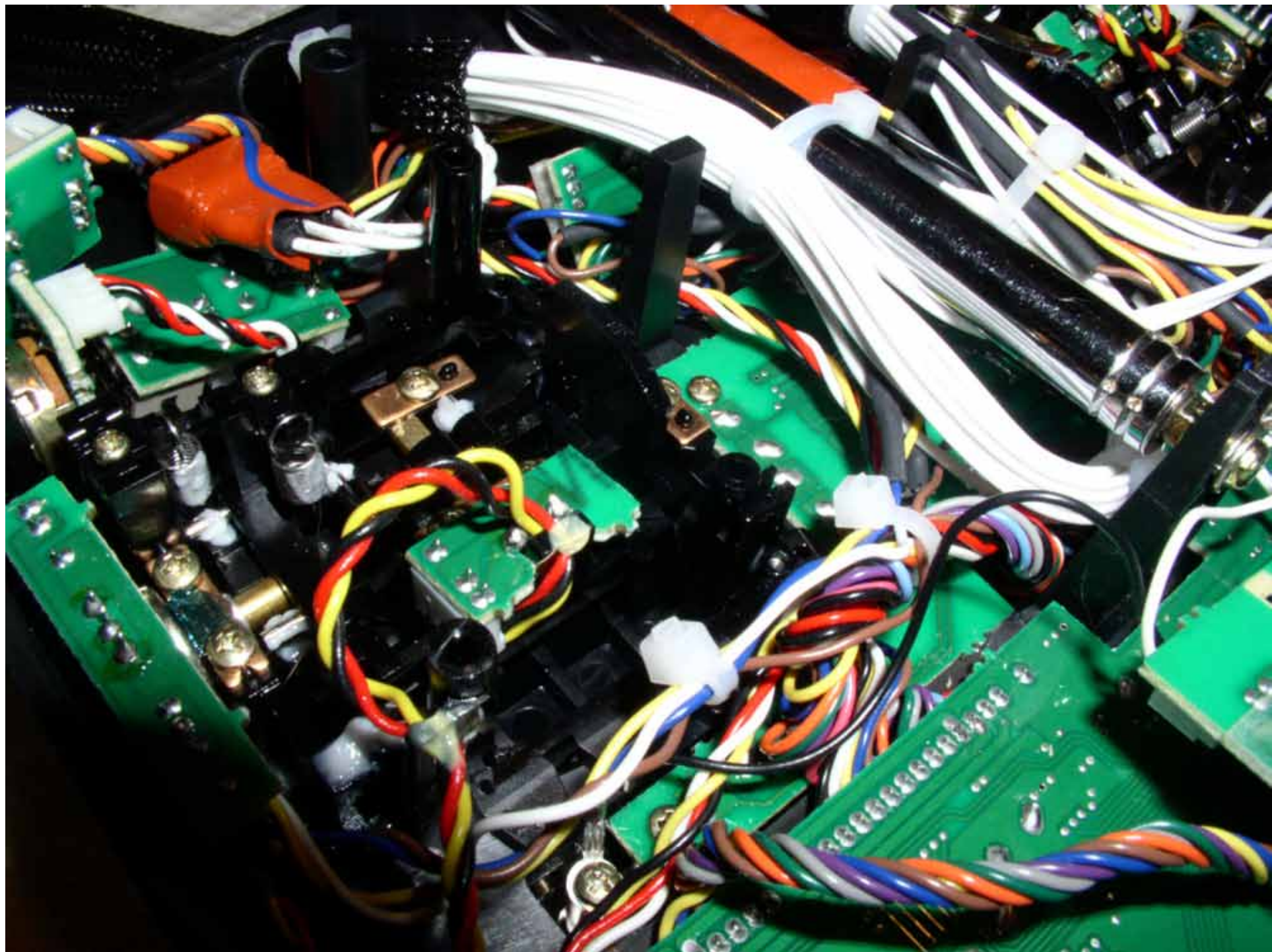


Futaba 9C Radio Modification,
added trims and other channels
(This is the prototype radio for our
first Heli-Chair)





Take time routing, there isn't much extra room.







An added toggle switch on each side of this radio.



JR9303 Radio Modification With
Cyclic Grip Upgrade (All channels
and trims are wired)

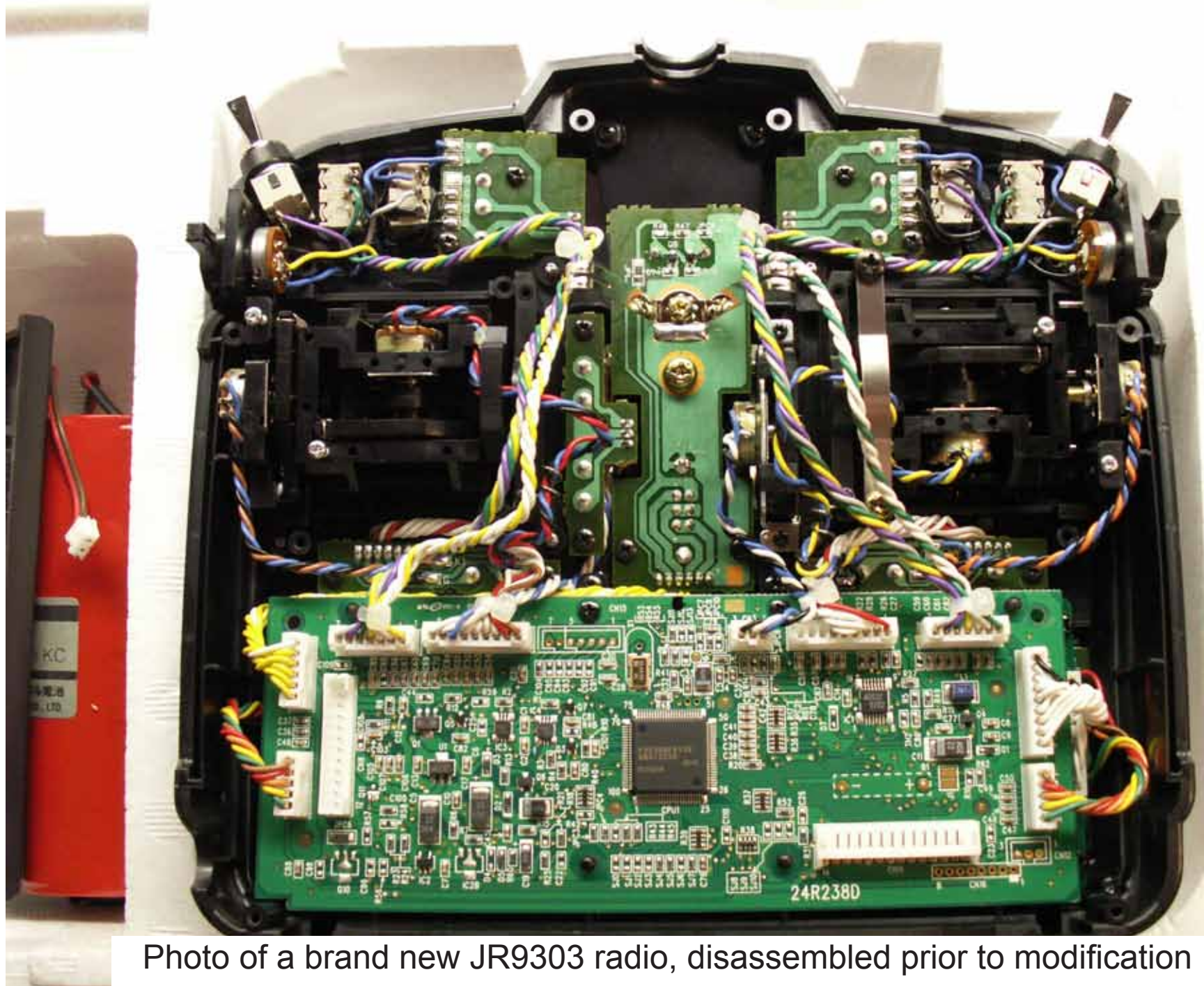


Photo of a brand new JR9303 radio, disassembled prior to modification

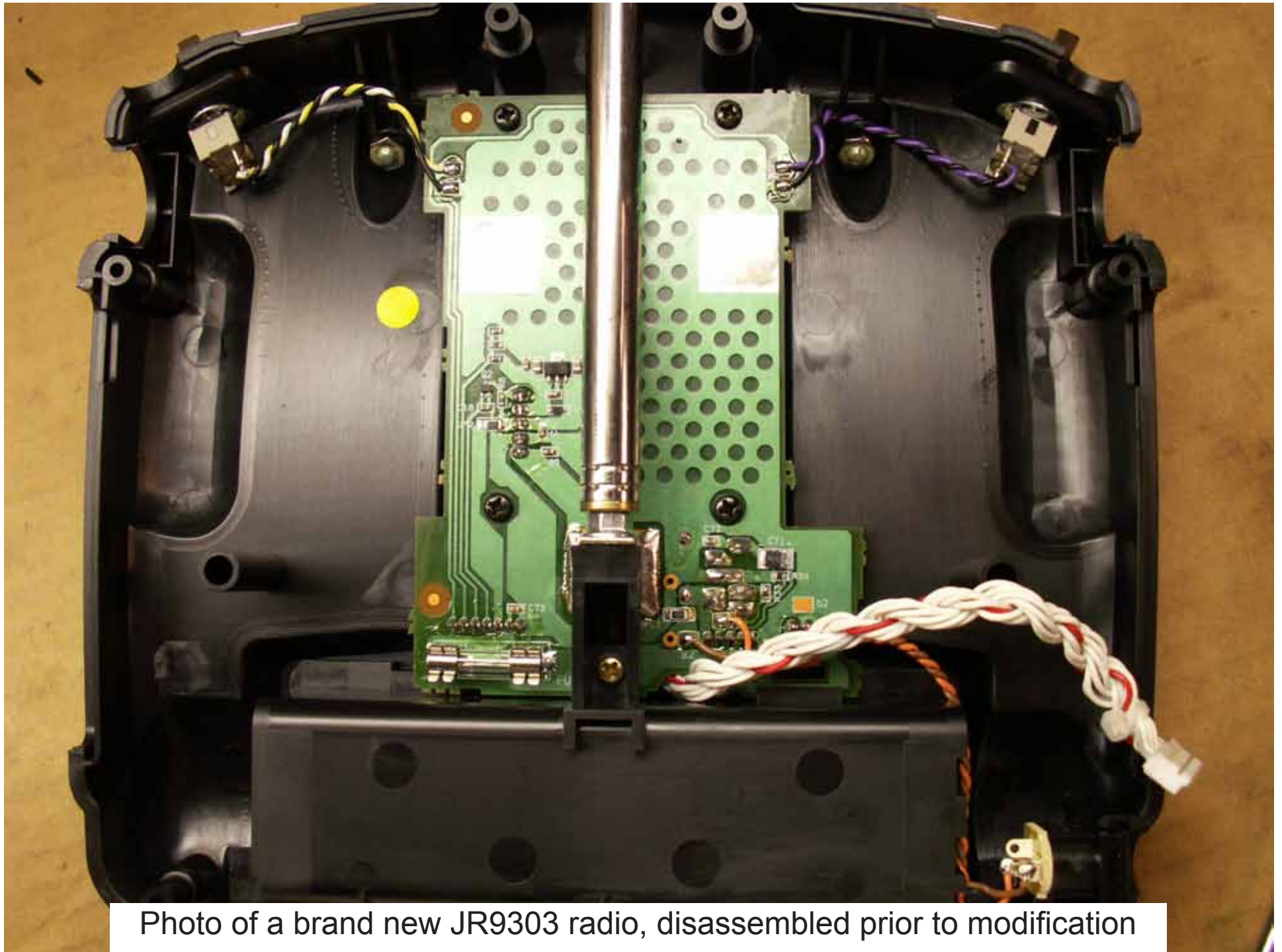


Photo of a brand new JR9303 radio, disassembled prior to modification

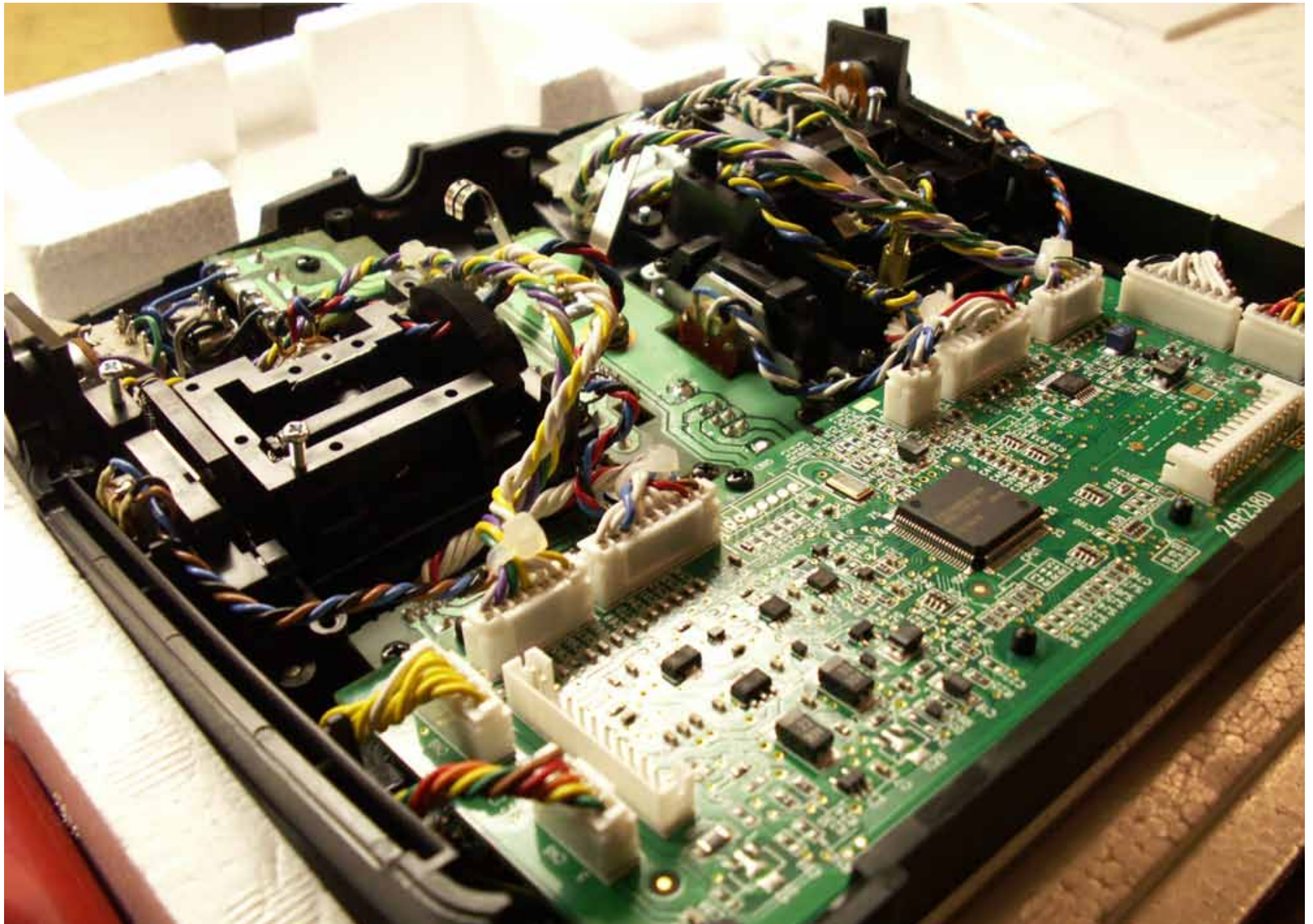


Photo of a brand new JR9303 radio, disassembled prior to modification

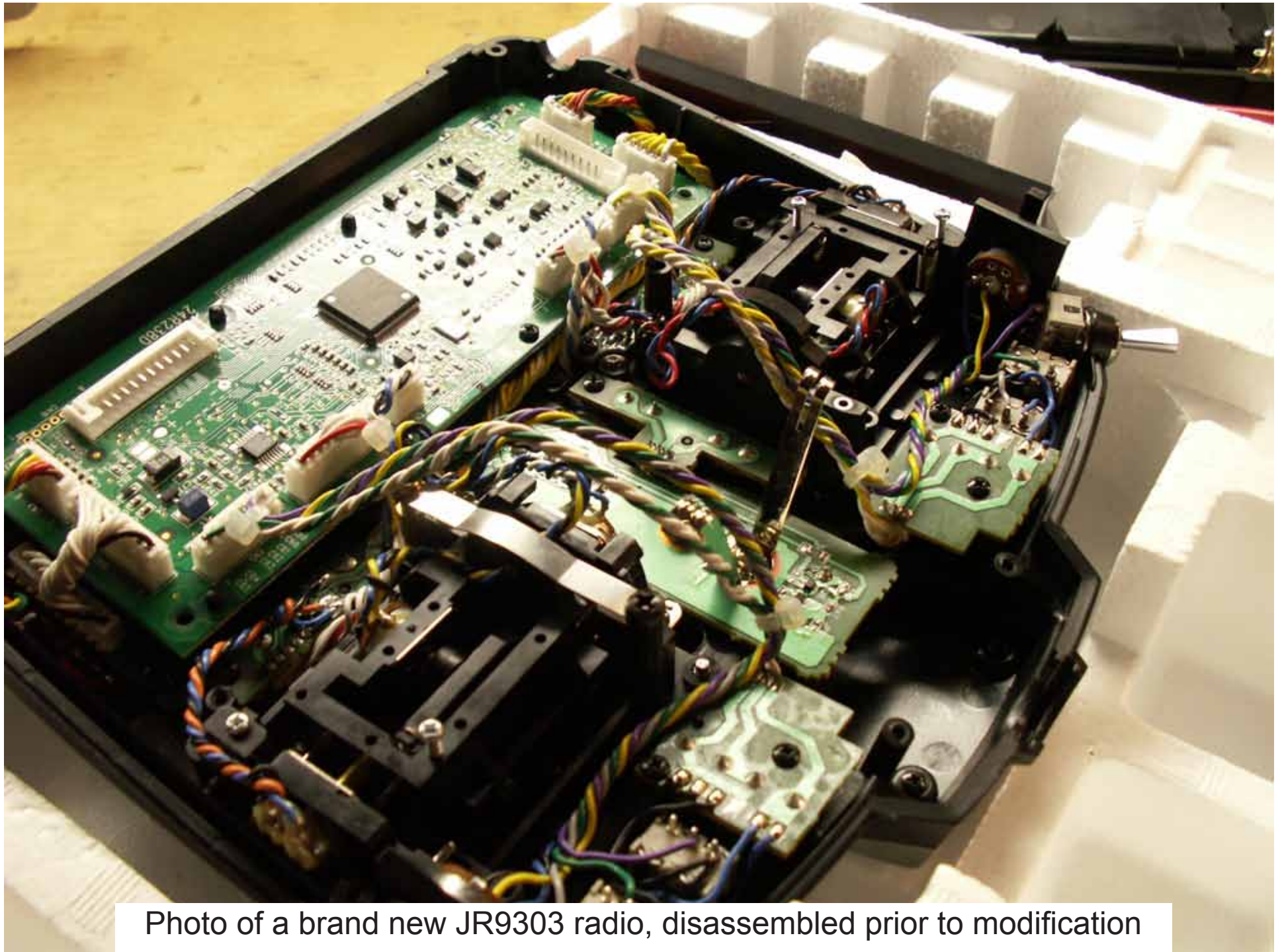
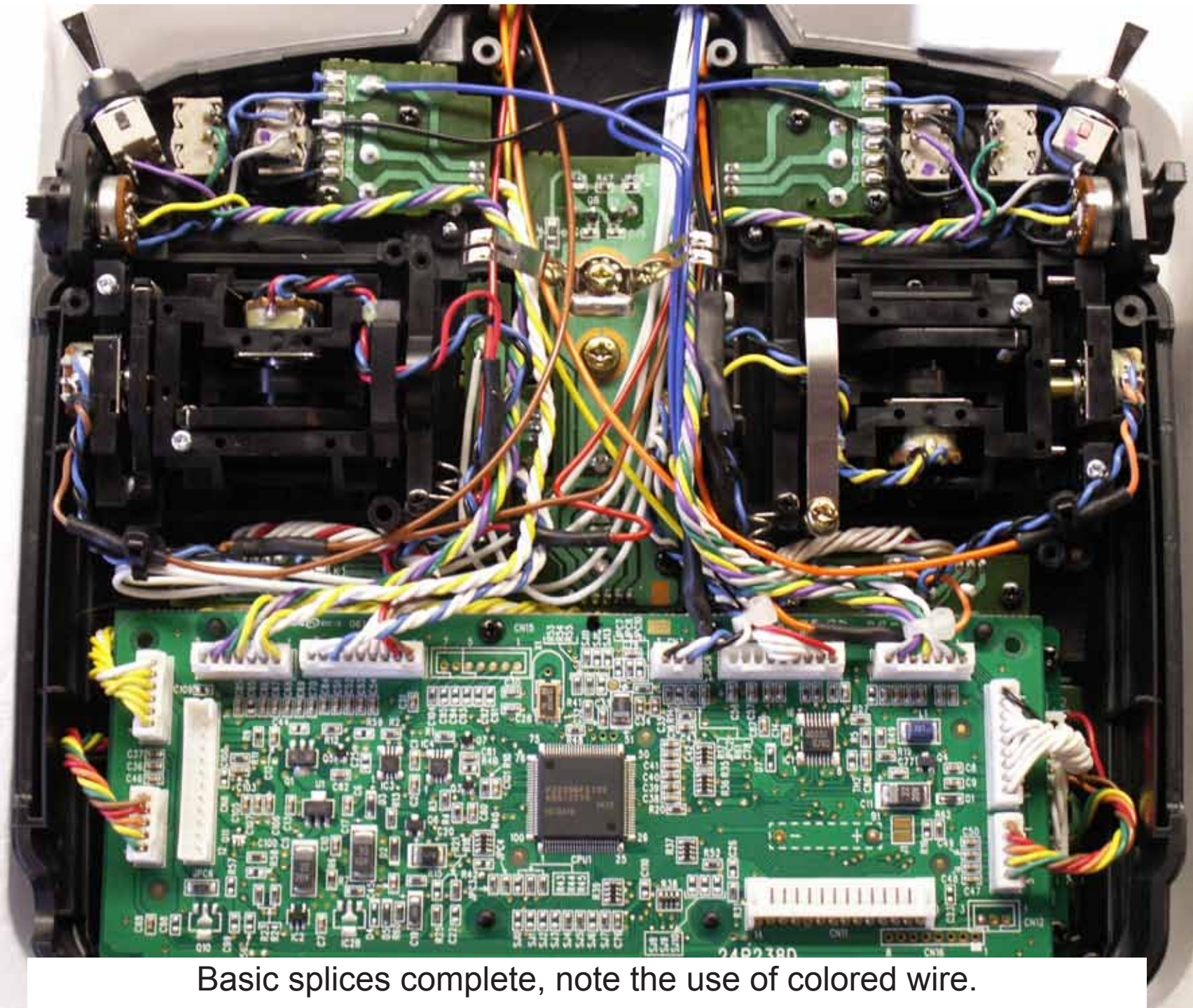
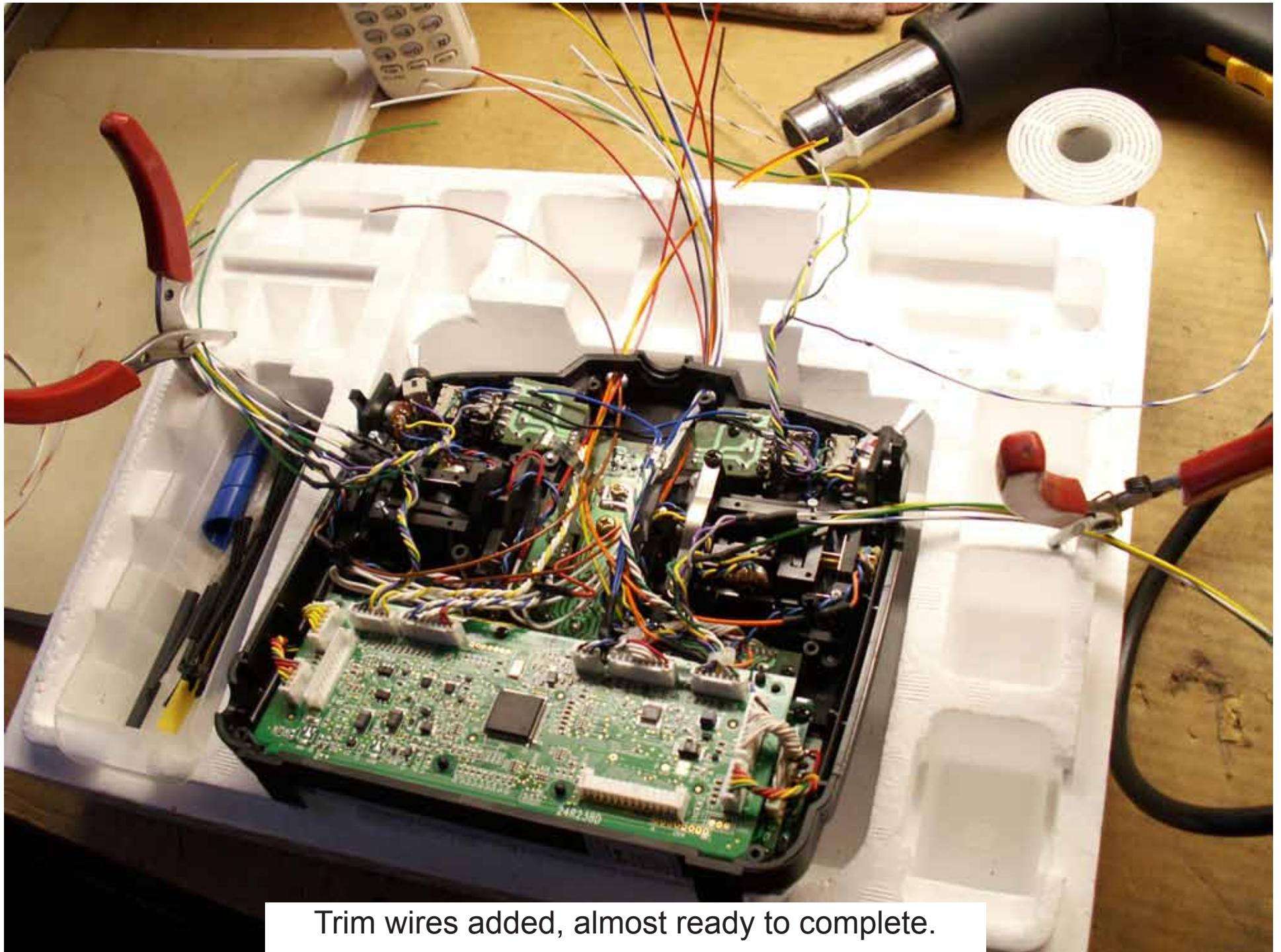


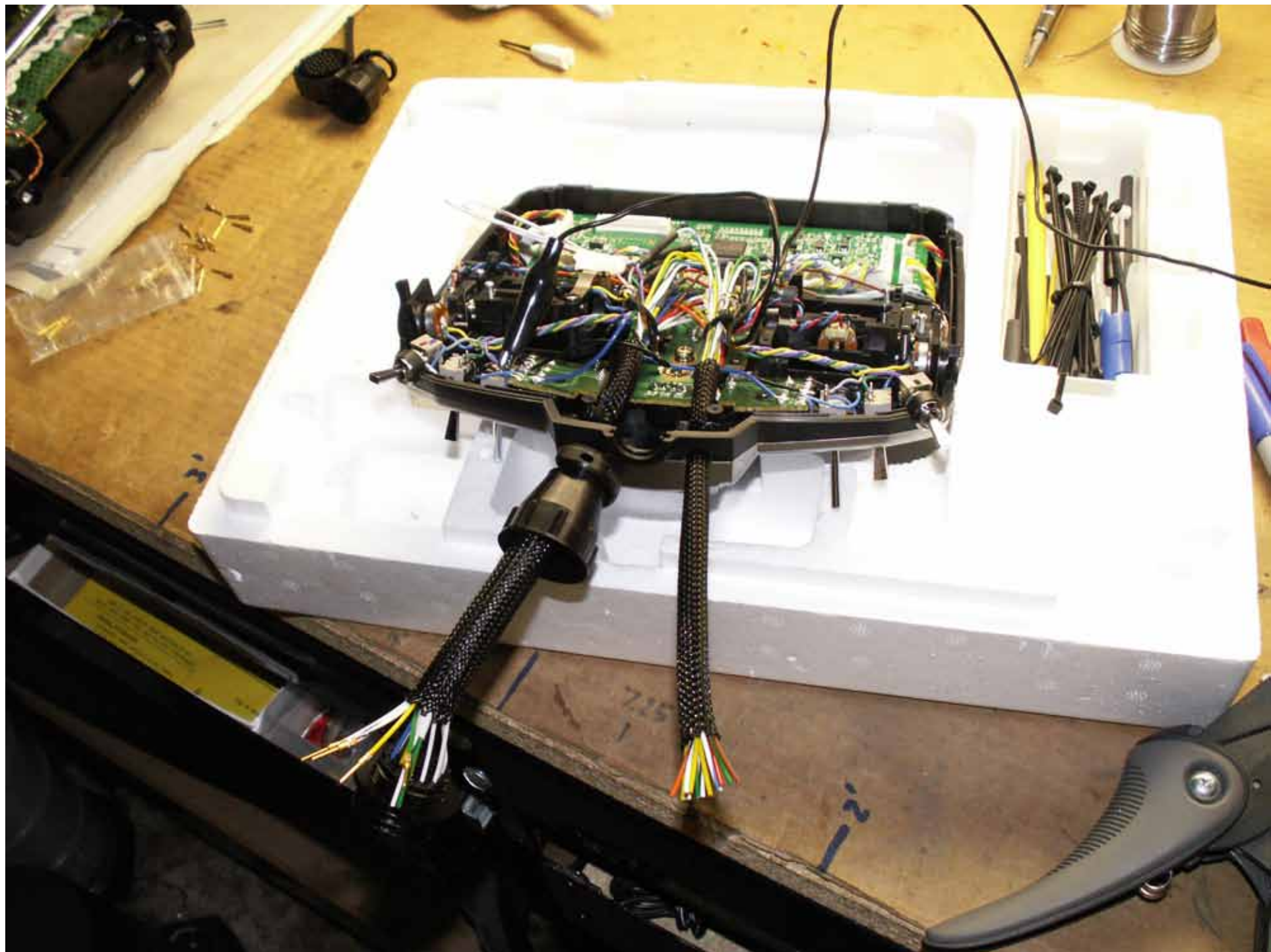
Photo of a brand new JR9303 radio, disassembled prior to modification



Basic splices complete, note the use of colored wire.



Trim wires added, almost ready to complete.





Modification of a RealFlight G3 Transmitter Interface for Direct Connection to Heli-Chair

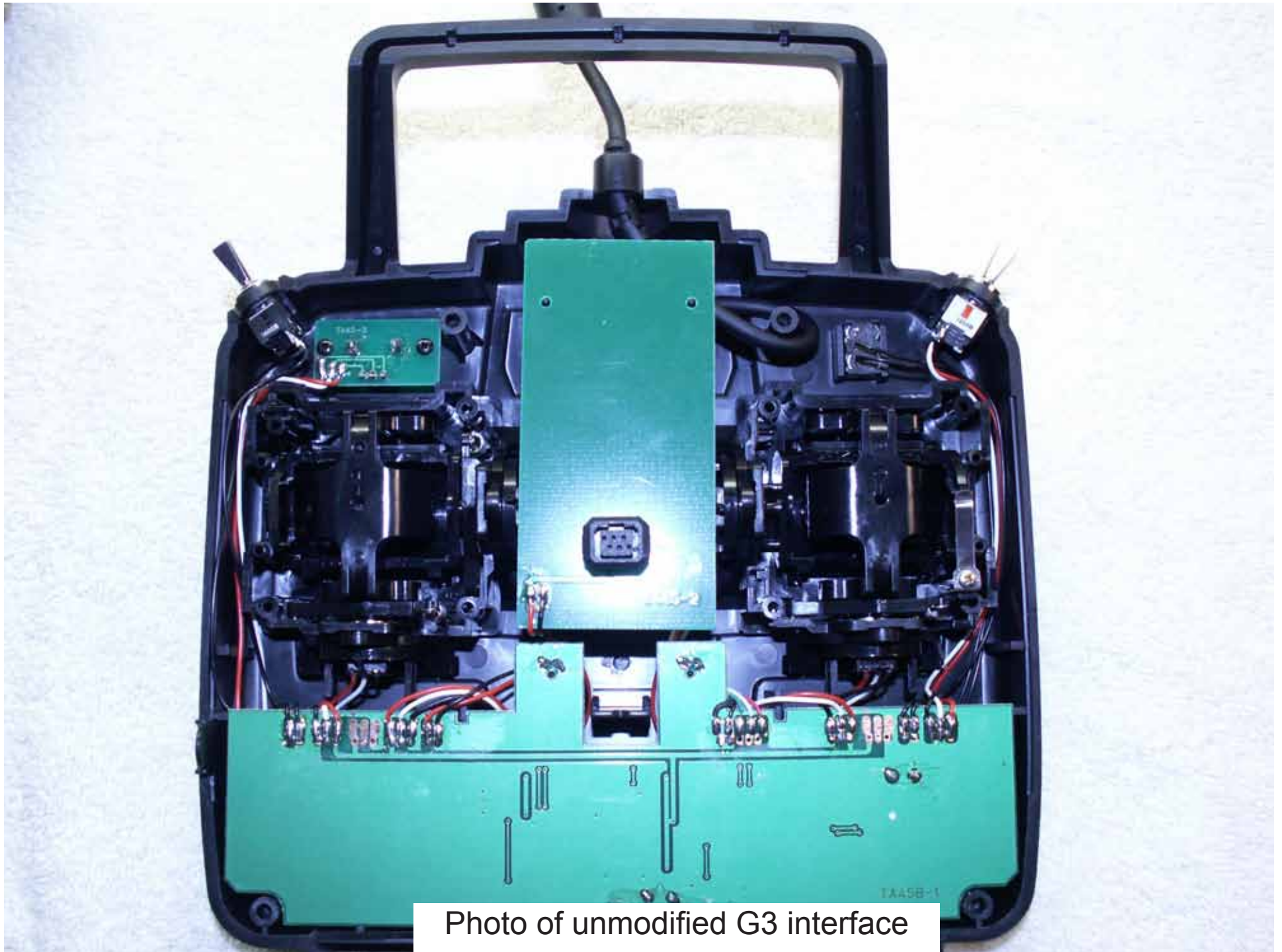


Photo of unmodified G3 interface

