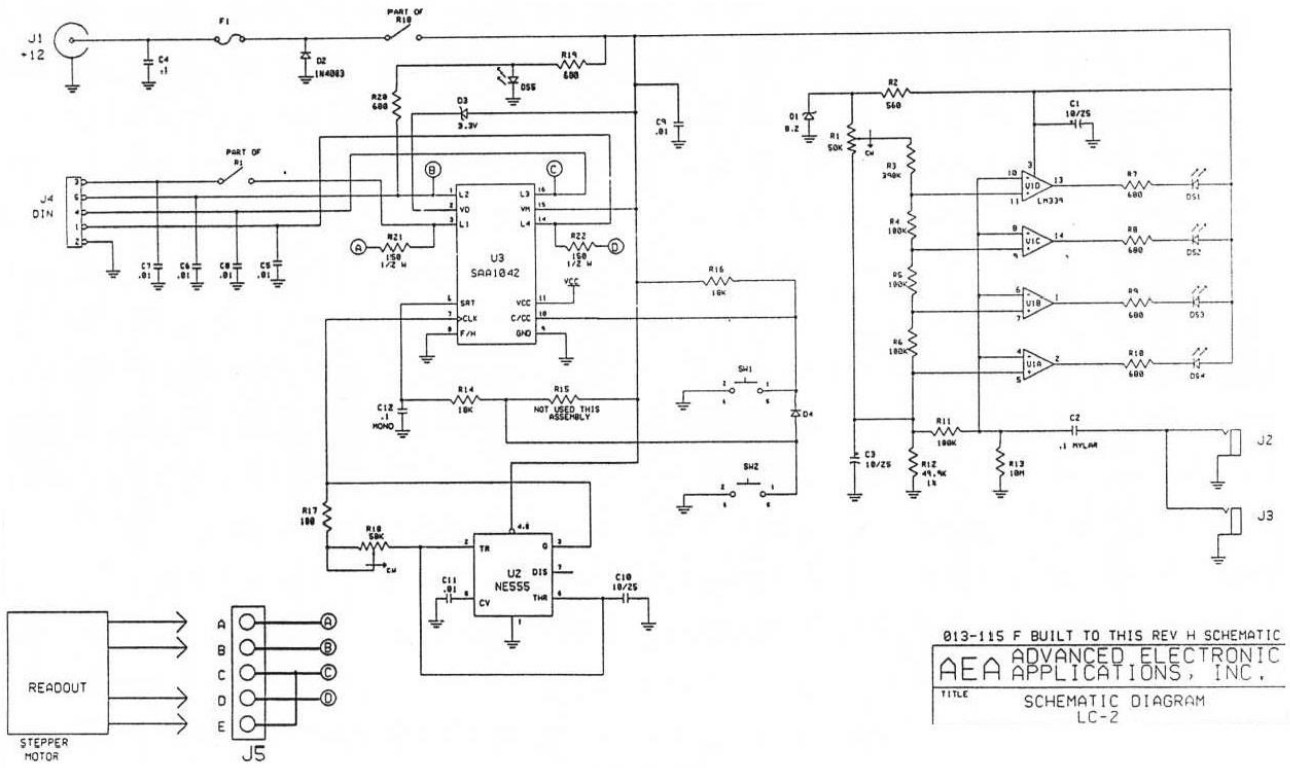
Replacement magnetic loop control unit by G4CNH

Having been given an ISOLOOP magnetic loop antenna, without a control box, I started a search on the internet for some ideas, well at least a circuit diagram of the missing LC-2 control unit for a start. My practical skills of stepper motors being virtually zero and AEA who made the ISOLOOP went out of business long ago!

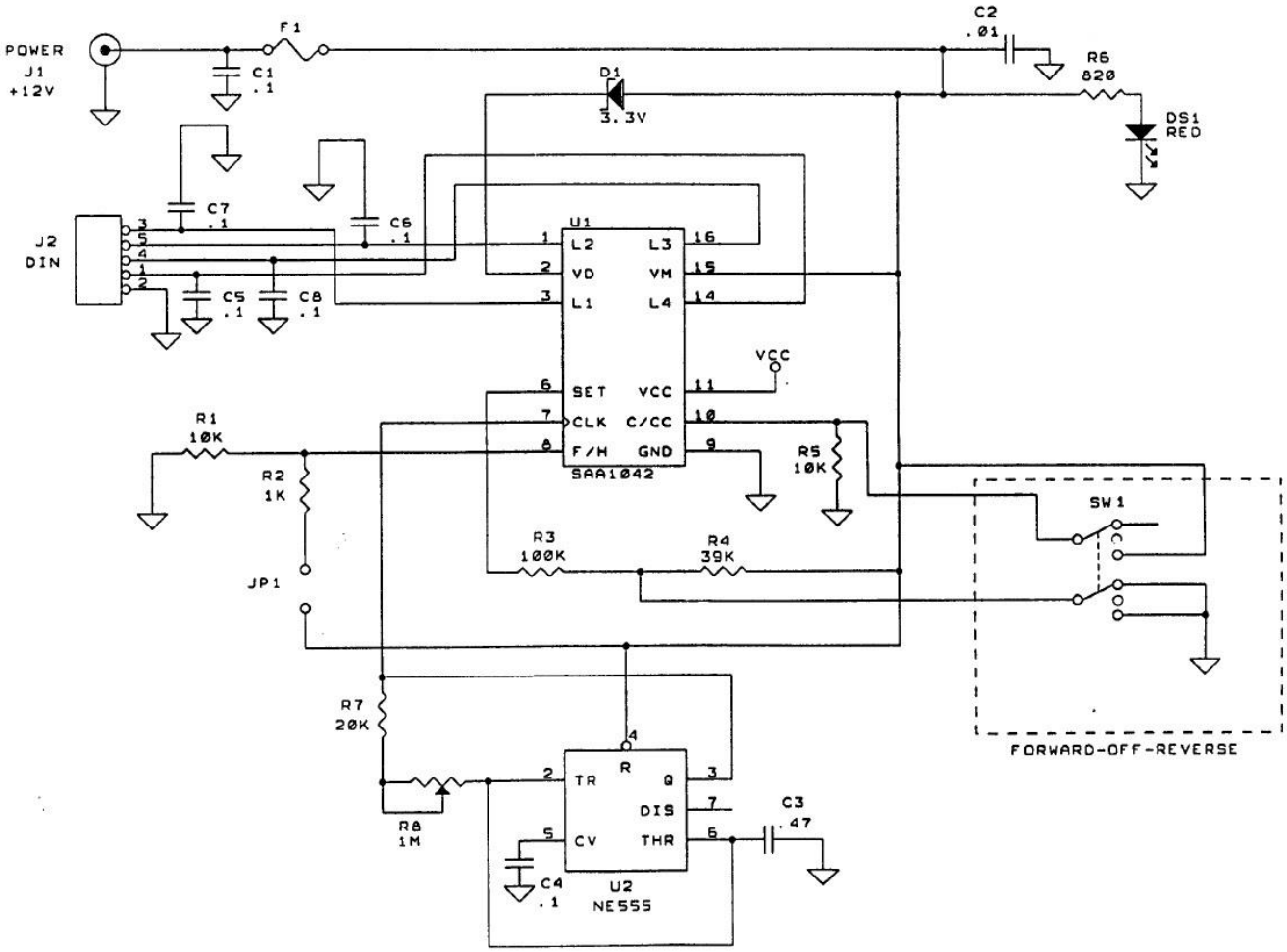
Here is the circuit:-



The problem for me was trying to work out what display it uses, LED's perhaps?
No! I discovered by searching the internet that the display is indeed another stepper motor, as shown, thus it was easy then to understand what the need for calibration was all about.
The routine is to peak the antenna on the connected receiver at 21MHz then S1 is made open circuit to stop any further movement of the antennas stepping motor. The display stepper is now moved using the UP/DOWN buttons until 21 is indicated on its rotating display. Then S1 is reconnected and a check is made that the receiver peaks at 14 MHz and 28MHz. If the display is found incorrect then it is indicative of the antenna capacitor being out by 180 degrees so the routine has to be done again.
So S1 is only used for so-called calibration and the switch associated with the speed control S10 is POWER ON/OFF.
The antenna motor is therefore not stopped by S1 in normal use, it is stopped by the SET input of the SAA1042 being held 'high'. It is taken 'low' by either of the UP/DOWN push buttons, SW2 (DOWN) acting direct and SW1 (UP) via the diode D4.
So SW1 takes pin 10 of the SAA1024 'low' to command a clockwise rotation whilst at the same time starting the motor by taking pin 6 'low' also via D4.
SW2 cannot take pin 10 of the SAA1024 'low' because of diode D4 but takes pin 6 'low' so an anti-clockwise rotation is commanded.

I had no intention of buying another stepper motor just as a frequency display and the non-linearity of the antenna capacitor would make fitting a simple LED display difficult.
Did the earlier LC-1 employ an indicating stepper motor too?

No! This earlier unit was a lot simpler but did all that was required AND appears to use a biased toggle switch for UP/DOWN, which I had in mind to use on my copy of the control unit.
Here is the circuit for this controller:-

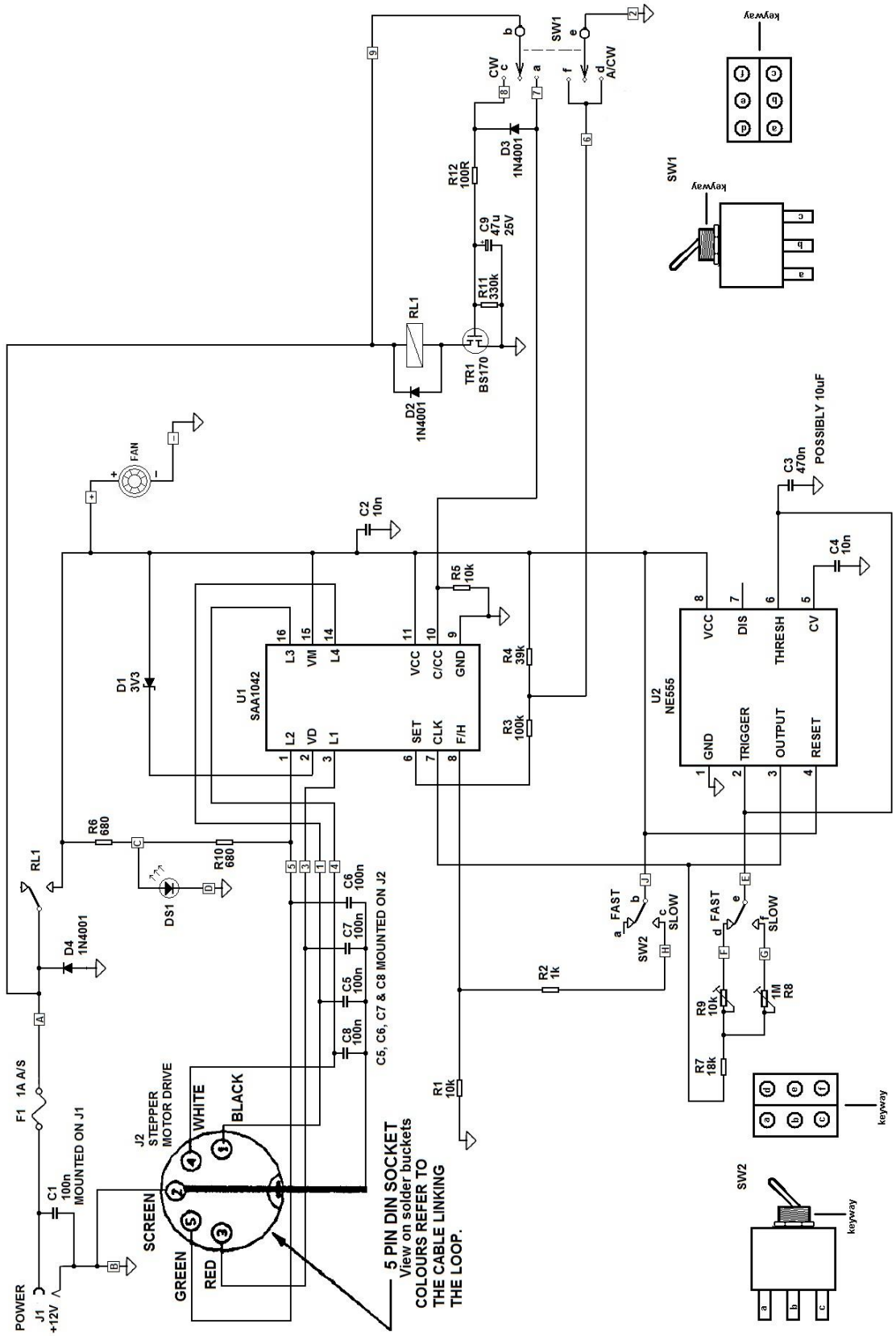


This is the circuit I shall use, probably placing the LED DS1 into the location shown on the LC2 circuit.
It should flicker when the antenna motor is turning and I shall also fit the polarity protection diode D2 after the fuse F1.
I am also tempted to fit a SPEED HIGH/LOW switch fed by two pre-set controls so that the best speeds can be set.
Notice the jumper link JP1 which I suspect can be used to set the antenna stepper motor to give a smaller angular movement and thus making tuning a little easier. Maybe this was found to be not worthwhile else surely a switch would have been fitted as an option. I can invoke this via a diode when the speed switch is set to SLOW.

There just remains the power switch on the LC-2 which is not used here on the LC-1.
Was this a later modification to reduce over heating of the stepper motor?

I have a crazy plan in my mind about this, it may be useful, perhaps not, but I may try it. ☺

My proposed circuit:-



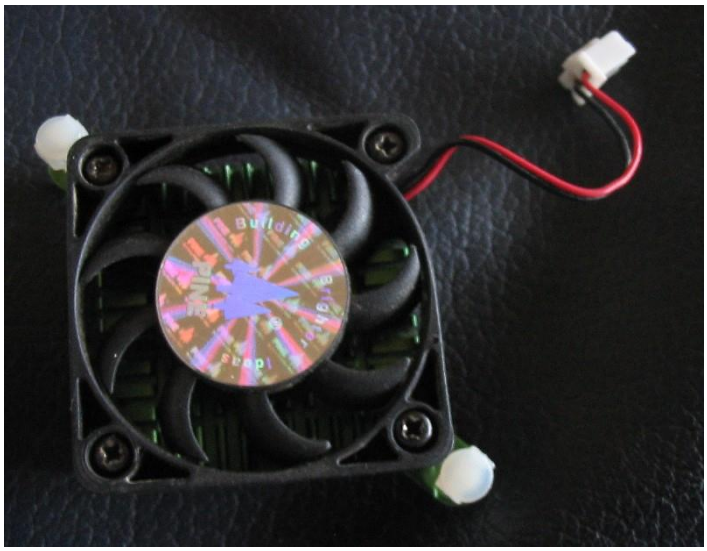
I have changed a couple of things.

1) A relay is now engaged whenever the UP/DOWN switch is operated. This remains energised for approximately 15 seconds after which power is removed from the controller chip and fan. This should ensure that there is no motor winding current when in standby.
   D3 prevents the C/CC input being incorrectly set in the switch UP position.
2) The FAST/SLOW switch now gets its supply from separate pre-set controls. In the SLOW position it also sets the controller chip to half angular movement.

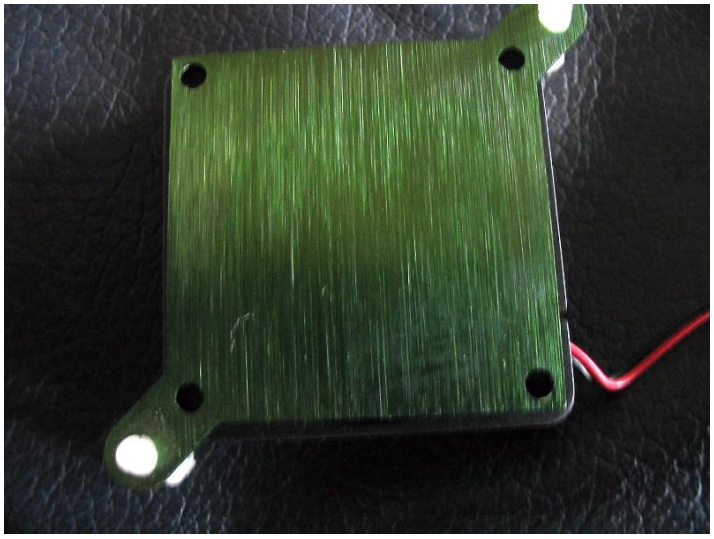
Circuit Board

The original control boards relied on large copper areas to keep the control chip cool.
As my replacement board will be strip board and thus lack large copper areas for cooling, I searched around the proverbial junk box for an alternative. I was lucky enough to find an old PC card which had a fan and heatsink on it. The heatsink has a plain back which originally interfaced with a large chip and it also sports a 12V Fan – perfect!

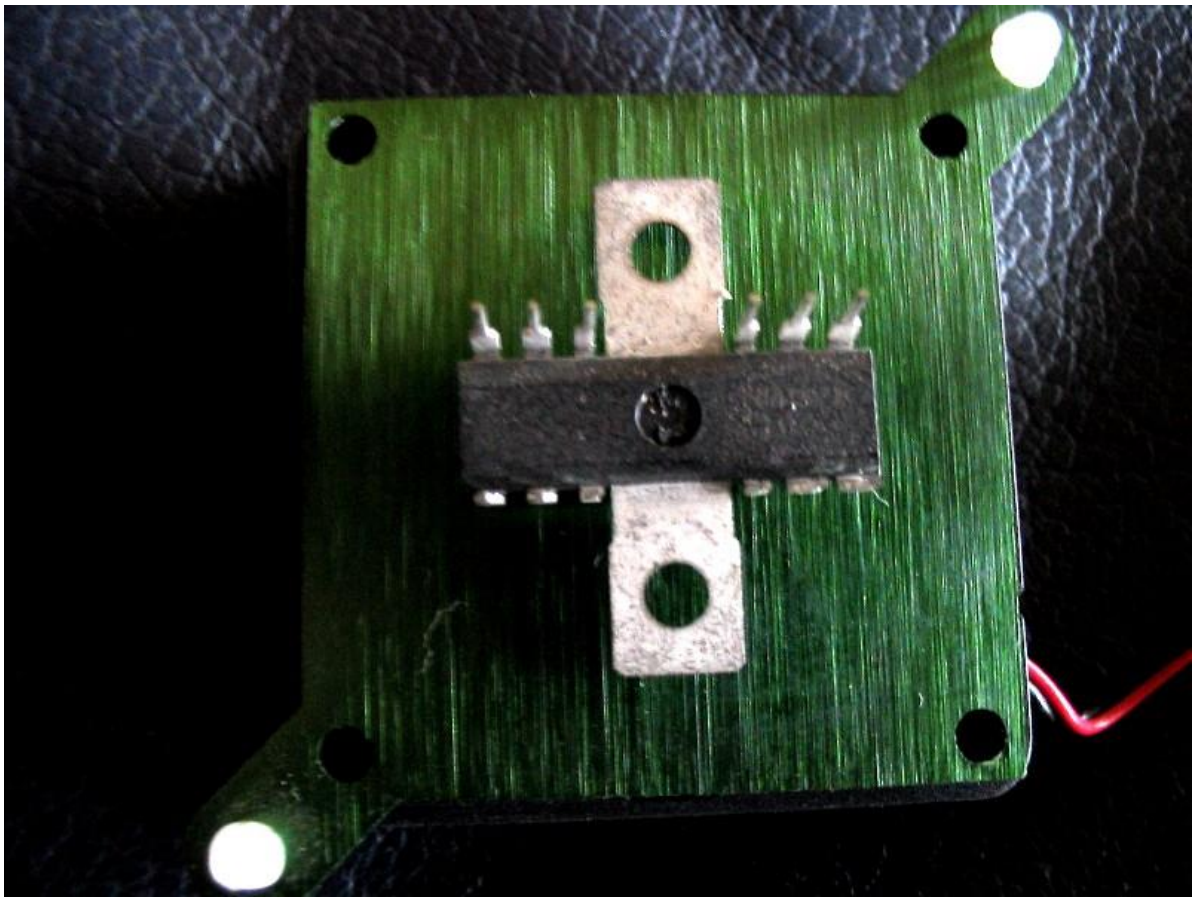
Here is one side of the fan/heatsink combination:-



Here is the flat side:-



And here is the planned fitting of the control chip, the original plastic fixings were too short so were replaced with M3 hardware with spacing achieved by an M4 nut at each point.
It is important to use these fixing points in order to remove the strain from the legs of the control chip. The sink was drilled to take two small self-tap fixings for the tabs on the chip.



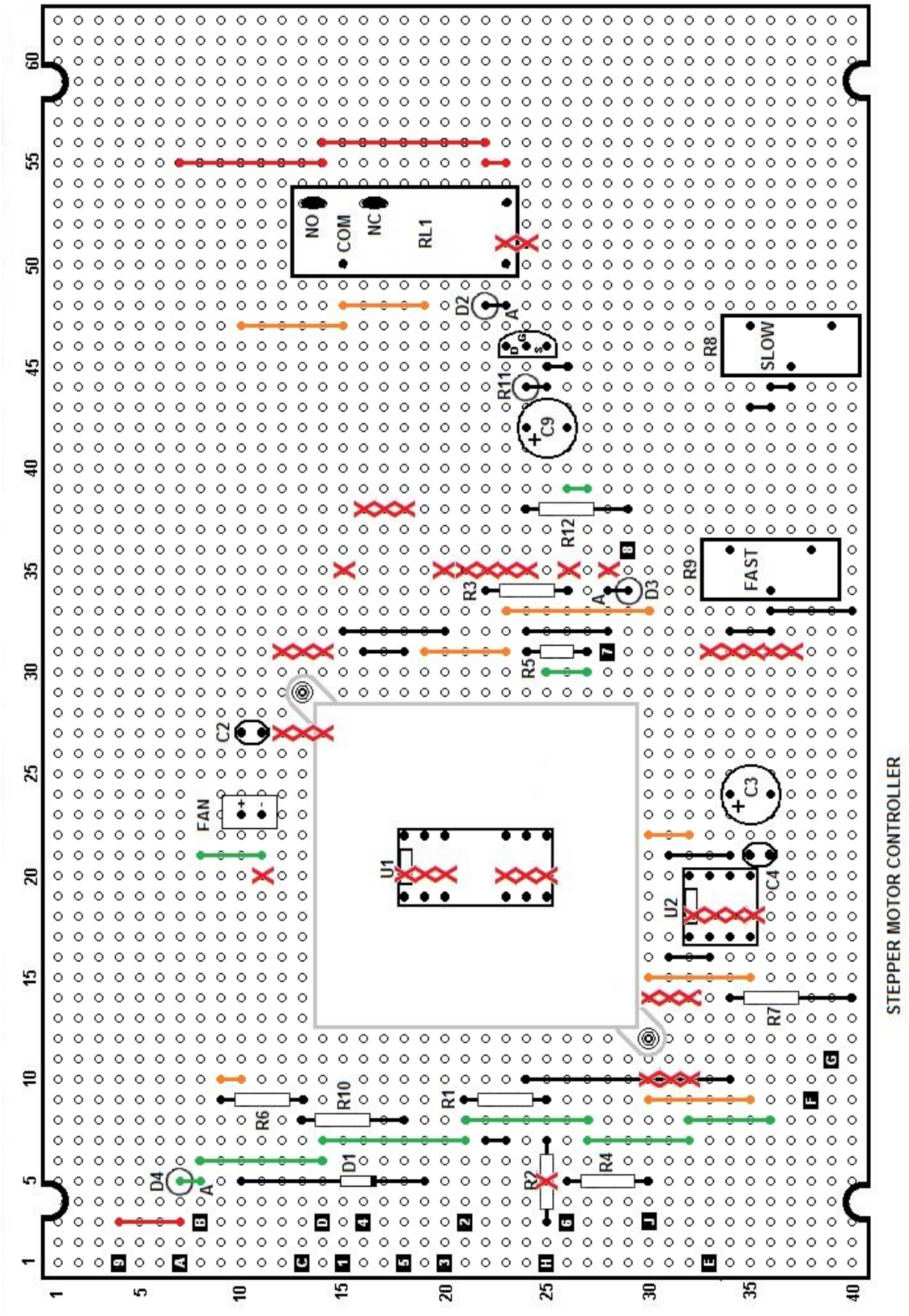
Now of course you do not have to go this way, if you are making a control box yourself then you are free to adopt any method you like to provide a heatsink for the SAA 1042.

Parts Used

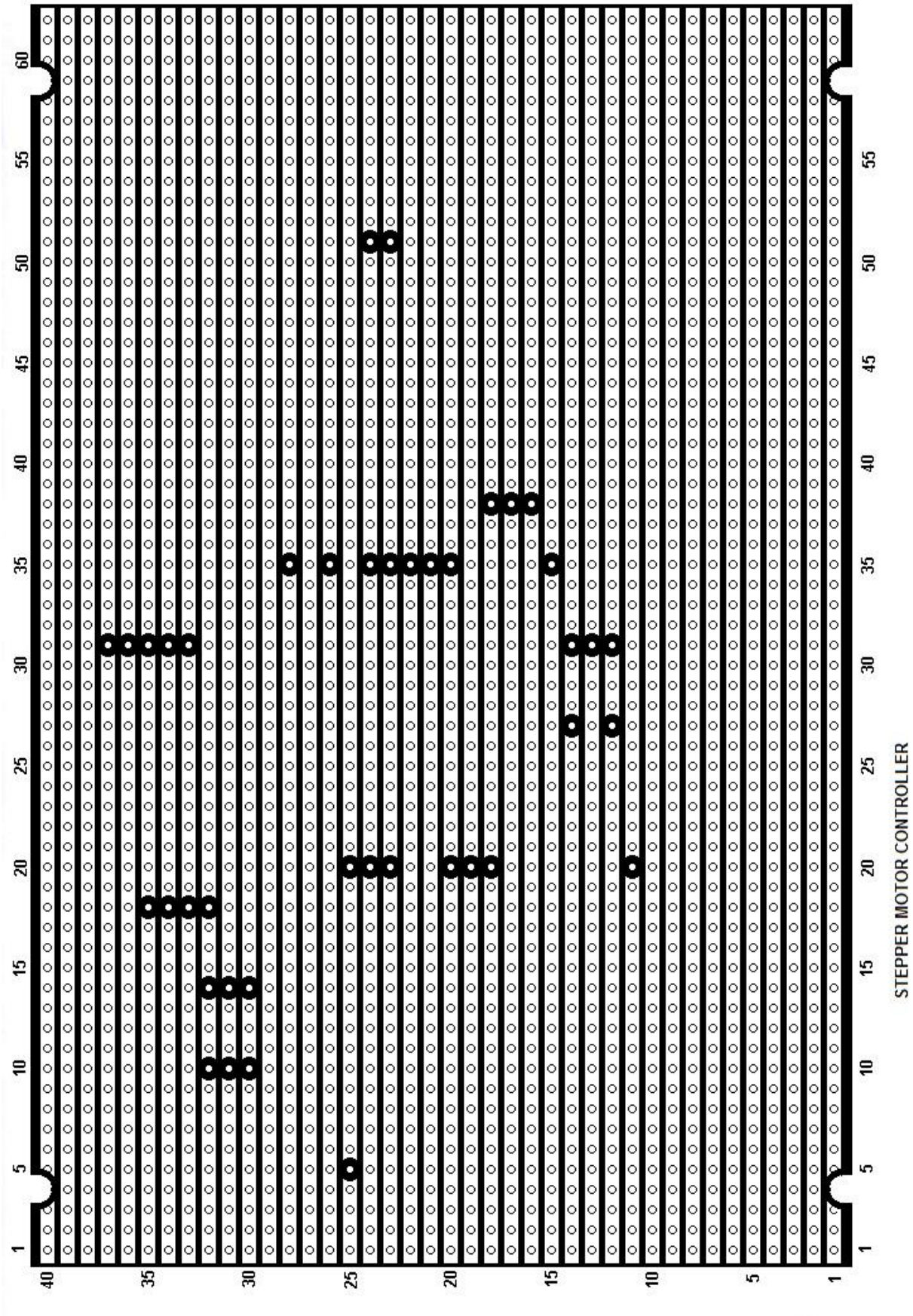
REF	DESCRIPTION	SUPPLIER	PART No.
1	Case, 50 x 19 x 40mm	Farnell	152-0401
2	Strip Board 100 x 160mm	RS	292-6875
3	20mm Panel Fuse Holder	Cricklewood	FU20P
4	Nickel plated bezel for DS1	RS	237-0569
5	1mm Vero pins (18 off)	Cricklewood	CQP1
C1	100nF, 50V Disc Ceramic	Cricklewood	CZF100N
C2	10nF, 50V Disc Ceramic	Cricklewood	CZF10N
C3	470nF, 63V Polyester	Cricklewood	CPB470N
C4	10nF, 50V Disc Ceramic	Cricklewood	CZF10N
C5	100nF, 50V Disc Ceramic	Cricklewood	CZF100N
C6	100nF, 50V Disc Ceramic	Cricklewood	CZF100N
C7	100nF, 50V Disc Ceramic	Cricklewood	CZF100N
C8	100nF, 50V Disc Ceramic	Cricklewood	CZF100N
C9	47uF, 25V	Cricklewood	47H25
D1	3V3 Zener Diode	Cricklewood	1Z3V3
D2	1N4001	Cricklewood	1N4001
D3	1N4001	Cricklewood	1N4001
D4	1N4001	Cricklewood	1N4001
DS1	Orange 5mm LED	RS	228-5994
F1	1A Slow Blow, 20mm		
	Mating Plug if required	Cricklewood	ROCA
J1	DC Panel Socket, 2.1mm centre pin	Cricklewood	ROCN
J2	5 pin 180 degree DIN Socket, Panel Mount	Cricklewood	DC518
	Mating Plug if required	Cricklewood	DP518
R1	10k, 0.5W	Cricklewood	H10K
R2	1k, 0.5W	Cricklewood	H10K
R3	100k, 0.5W	Cricklewood	H100K
R4	39k, 0.5W	Cricklewood	H39K
R5	10k, 0.5W	Cricklewood	H10K
R6	680 Ohms, 0.5W	Cricklewood	H680R
R7	18k, 0.5W	Cricklewood	H18K
R8	1M, preset	Cricklewood	PT15A1M0
R9	10k, preset	Cricklewood	PT15A10K
R10	680 Ohms, 0.5W	Cricklewood	H680R
R11	330k, 0.5W	Cricklewood	H330K
R12	100 Ohms, 0.5W	Cricklewood	H100R
RL1	12V PCB SPDT power Relay	Cricklewood	RXS12
SW1	DPDT centre off – biased toggle	Cricklewood	TM22B2
SW2	DPDT toggle	Cricklewood	TM22N1

REF	DESCRIPTION	SUPPLIER	PART No.
TR1	BS170 FET, 500mA	Cricklewood	BS170
U1	SAA1042 Stepper Motor Controller		
U2	NE555 Timer		

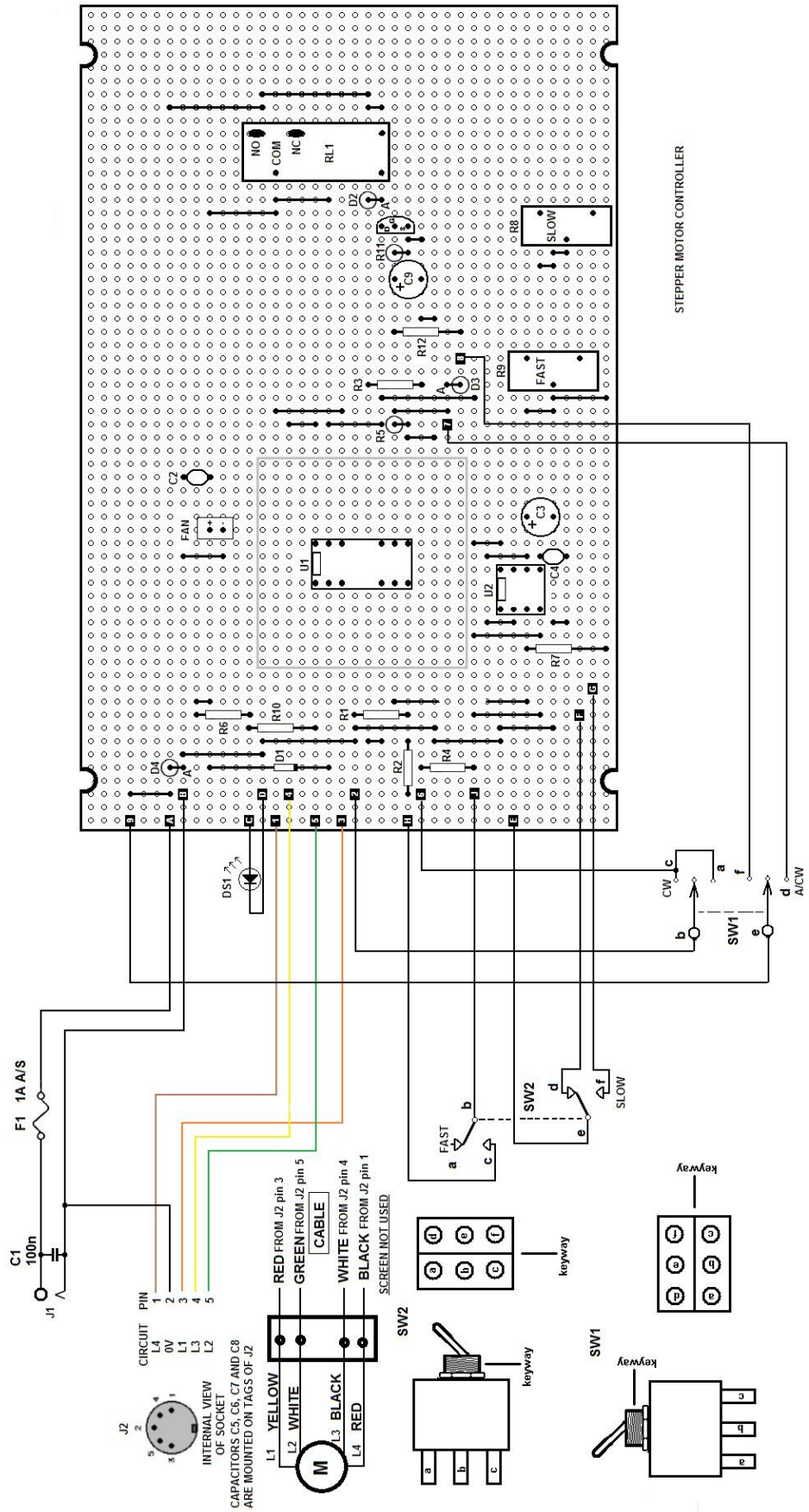
Board Plan showing X ray Track cuts



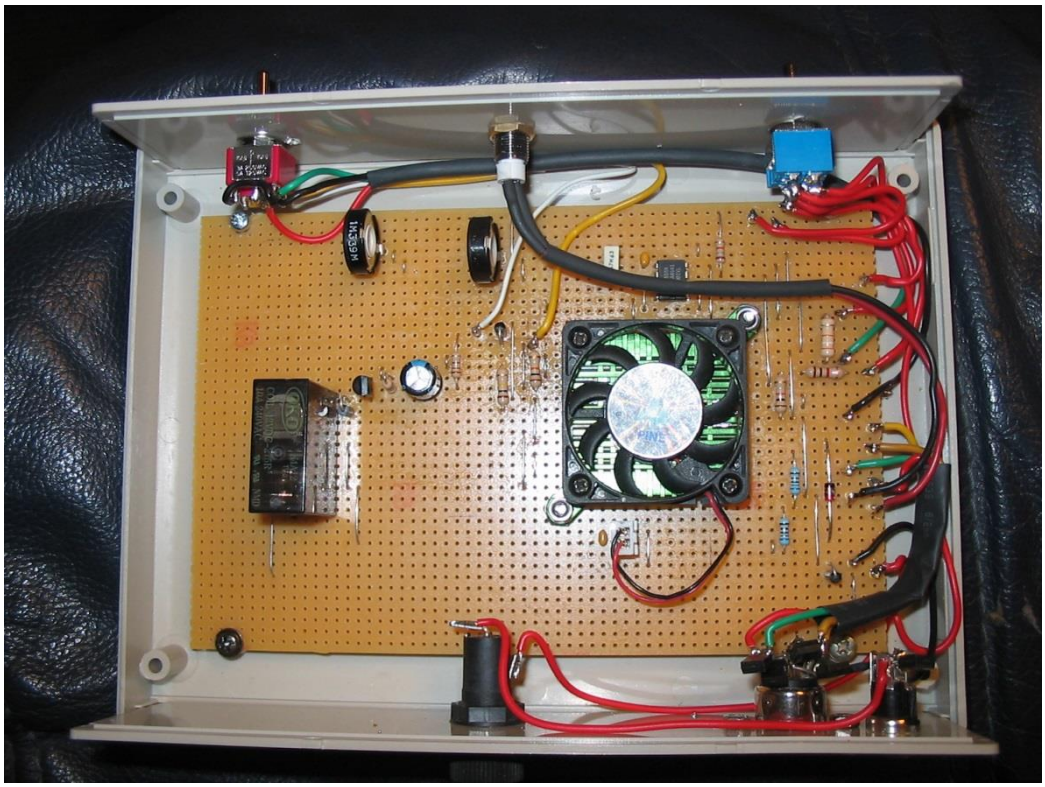
Track cuts on underside



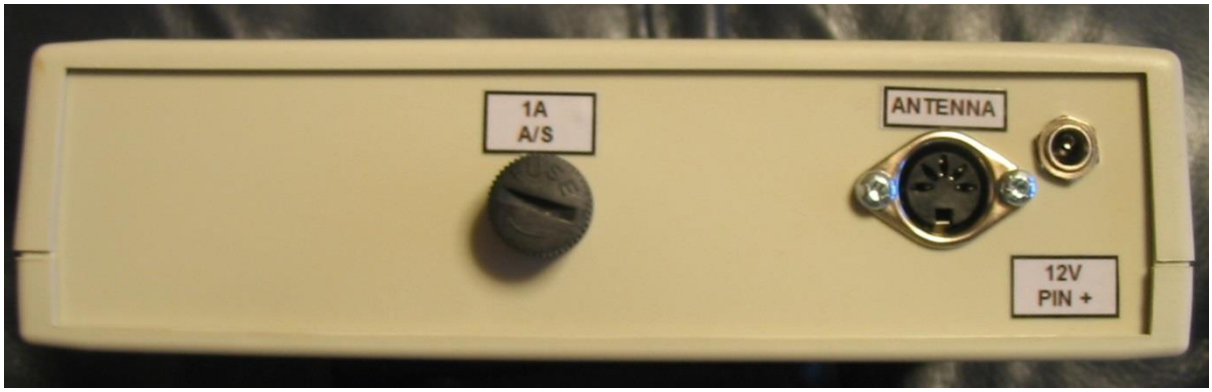
Board and external wiring



Final views of the completed unit.



Rear Panel



Front Panel

Getting the thing to work is another story, not the control box as that works fine, but the loop motor itself refused to even buzz!

The motor was found to be solid from rust, it took a whole days effort to eventually spit it apart and get the moving parts working again. Now it was buzzing but not turning though it did appear to be trying hard. I found the Red wire in the control cable to be open circuit at the connector close to the motor, part of the L1/L2 circuit. But putting this right still only gave a buzz with no movement so I decided to try slacking off the bolts that held the motor together to see if the motor would self-centre. This was the answer and I was rewarded with rotation in both directions, even at the slow speed. The pre-set controls were adjusted for best response and the motor put back into the Loop casing.

So now the happy owner of a magnetic loop antenna and next was a test of it on the bands.

It seems to be OK, it tunes well and the SLOW speed I have is excellent for getting the loop spot-on. I can hear all the stations on a pile up on 20 metres even though the noise level is incredibly high from my block of flats, I had hoped the loop might help against this but it does not appear to.

SWR is good on 20 metres, not so good on 15 or 10 though acceptable. I suspect the close proximity of the building and also the wire cable that holds a pigeon net in position around the open part of the balcony. I intend to take the antenna out into the local park when the weather is better and away from the 100 family tower block I live in.