



# Chelmsford Amateur Radio Society Newsletter

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**Next meeting: 1st November - 7.30pm, Oaklands Museum**

**25 minute chats—various contributors**

## Inside this issue:

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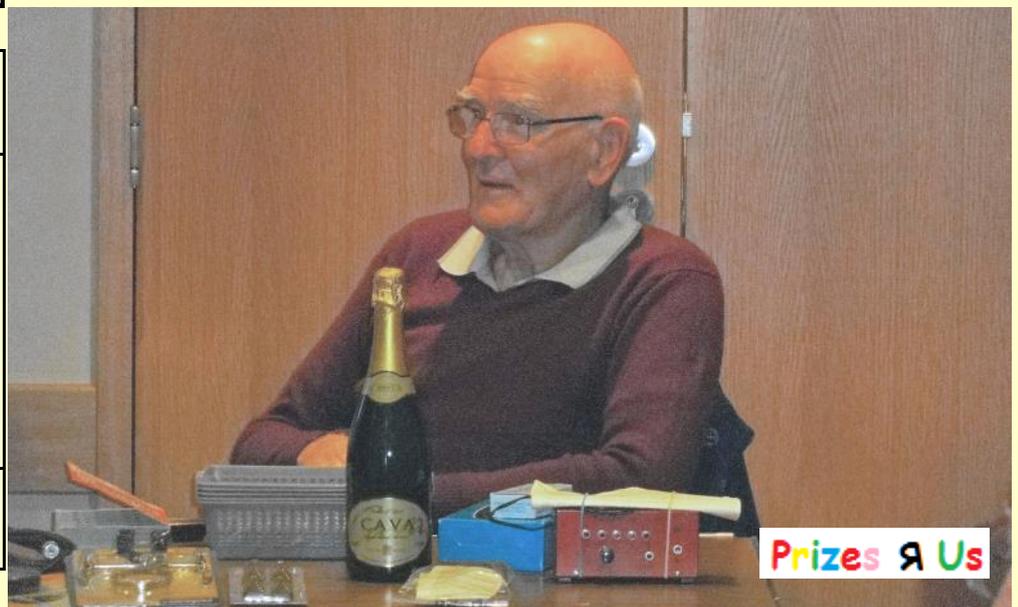


Awards & prizes at the AGM: figurehead, recipients and administrator.

**Club Nets - Tuesdays 20:00h**  
**Net Controller: TBD**

- #2 - GB3DA 11th October
- #3 - GB3ER 18th October
- #4 - 80m 25th October  
3.756MHz
- #5 - 160m n/a  
1.947MHz

**Essex Ham Net**  
**Mondays 20:00h GB3DA**



Contact details for the newsletter: [editor@g0mwt.org.uk](mailto:editor@g0mwt.org.uk)

## Editorial

Hello again, and welcome to the latest edition of this newsletter. It has been a pleasure to produce this one. I have had timely contributions from several people and it has been relatively easy to put together. Had it not been for Skills, it would have been out within very short order! Thanks to those involved and I hope you enjoy reading the articles. Alan Hanna, M0IWZ has written up his work on the weather station that won him his prize and Tim Wander, G6GUX has given us an insight into Sandford Mill's workings.

The New Committee has now been chosen and installed and we look forward to seeing some changes taking place. Discussions at the AGM again echoed the oft-held view that the Society is heading for oblivion if nothing can be done to attract if not young, then at least new members. The largest growing demographic of new licensees is in the 40+ age group but this is not being reflected in the membership. It is a fair bet that younger people would not necessarily be attracted to a Society with an aging membership that sets so much store by the past, and it is also very likely that older people are likely to be rooted, geographically, so we are just as unlikely to see membership changes due to house or job moves in that age group.

What, then, can be done to change the situation? Answers on a postcard please...

Autumn is setting in now and I expect the bands will start to change. I only know that by reading articles in the likes of RadCom, as I find I am still not operating as much as I should, but I do know that on those occasions during the summer when I have listened round, there doesn't seem to have been much of interest. This is partly due to me being unwilling to idle my time away in front of a radio when there is fine weather to be had outside and partly because when I am in the shack, I'm either using the wrong bands or there always seems to be something else more pressing that needs fixing, building, measuring or studying (not to mention writing up this Newsletter.) On a final note, I recently caught up again with Peter, M0PSD and visited his excellent and much re-vamped shack. Last time I saw it I was impressed, but this time it was like visiting Santa's grotto early. Digitally interconnected doesn't seem to be an adequate phrase to describe his systems. The other thing I noticed was the almost total lack of background noise on the bands. Signals seemed to just leap out of an S1-S2 background on the lower bands. I have to go up to over 20m to get that sort of quietness. Some people are so lucky! - **Ed.**

### Dates for your diary

*Please note: the dates may be subject to change...*

Tue. 1st November	Meeting - 25 minute chats (not 25 @ 1min each...)
Mon. 21st November	Skills Night - Danbury Village Hall
Tue. 6th December	Meeting - Christmas Social Evening
Mon. 19th December	<b>No Skills Night!</b> - everyone will be taking it easy...
Tue. 3rd January	Meeting - Riding the radio waves - Jane Humphreys
Mon. 16th January	Skills Night - Danbury Village Hall
Sun. 5th February	Canvey Rally - Paddocks Community Centre, Long Road, SS8 0JA
Tue. 7th February	Meeting - Talk on Diplomatic Wireless - by Peter Grimshaw, M0HSG
Tue. 7th March	Meeting - Classic Computers - Andy Chapman, G7TKK
Tue. 4th April	Meeting - RF Kits Design & Manufacture - David Powis, G4HUP (hupRF.com)
Tue. 2nd May	Meeting - Tricks with Coax - John Regnault, G4WSX
Tue. 6th June	Meeting - table top sale
Tue. 1st August	Meeting - Constructor's competition

## AGM 4<sup>th</sup> October 2016 Report

The meeting started a little late this year, due mainly to technical issues with the PC and projector. I welcomed the 30 members that came to the AGM and re-iterated my desire to stand down as chairman. The next thing was to give an outline to the evening's events as there was no PowerPoint presentation to display the agenda, which was the original plan.

**President's Report:** I then passed the floor to our President, Tony, G4YTG who gave us a quick appraisal of the club from his point of view. Next came the presentation of the Constructors Competition 1<sup>st</sup> place award to Alan, M0IZW for his weather station, and certificates for the runners up Steve, G0GHO for his S-parameter test set, Dave, M0HBV for his wobblator and Frank, M1GFE for 1st time entrant. He then passed it back to me for the Chairman's report.

**Chairman's Report:** At this point I had intended to run a short PowerPoint presentation outlining the society's activities over the 12 months since the 2015 AGM, but was unable to... so I just carried on ad lib from a prompt sheet, as you do when the "tech" goes west (it took ages to do the PowerPoint presentation). An outline :-

### Danbury Village Hall:

11 Skills Night Danbury Village Hall with Pete M0PSX, Society .  
45 Radio Course Nights.

### Meetings at Oakland Museum:

5MHz NVIS Propagation - Dr.Marcus Walden, G0IJZ  
Christmas Social Event & Quiz by CARS & G8DET  
Meteor Detection using 2m Amateur Radio - Peter, M0ZBU  
Satellites - Steve Hedgecock M0SHQ  
Novel Antennas - Andrew Chapman, G7TKK  
2MT Writtle The Birth of British Broadcasting - Tim Wander  
Introducing Moon Bounce - John Regnault, G4SWX  
Tabletop Sale - Colin, G0TRM  
Talk on Innovantennas - Justin Johnson  
'Milli-metric Microwaves' - Chris Whitmarsh, G0FDZ  
Annual General Meeting.

### Outside Events:

9 Days Sandford Mill.  
2 Days Hall Street.  
2 Days Marconi Sailing Club.

**Treasurer's Report:** Next up was the Treasurer's report. A balance sheet was available showing income over expenditure. Queries were received in light of the income to expenditure for the Intermediate Course from Oliver, M0WAG. Our Treasurer Myra, M0MYR explained that the previous Treasurer had placed some of the income in a broader heading on the balance sheet. Comment was made regarding the assets of the club being included and that the list is far from complete; this is an ongoing issue that needs a dedicated volunteer to head up, as your Chairman has run out of free time at present. Please contact me if you wish to take on this task.

**Training Manager's Report:** Next up was the Training Manager's report (me again; would you like the role of Training Manager? Please contact me). In the past year we have had 48+ candidates on 10 courses at all licence levels over 45 weeks (on Thursdays). Pass rate is good, and this is down to the dedication on the CARS Training Team.

**Skills Report:** Peter M0PSX next gave an appraisal of the Skills Nights.



<b>Committee Members Summary</b>	<b>Proposer</b>	<b>Seconder</b>
<b>Chairman</b>		
Chris Chapman, G0IPU	Tony, G4YTG	Myra, M0MYR
<b>Vice Chairman (new post)</b>		
Paul Gledhill, G7BHE	Note misplaced	Note misplaced
<b>Treasurer</b>		
Myra Davis, M0MYR	Steve, G4GHO	Chris, G0IPU
<b>Secretary</b>		
Colin Page, G0TRM	Chris, G0IPU	Tony, G4YTG
<b>Membership Secretary</b>		
Ray Shaves, 2E0GVE	Chris, G0IPU	Myra, M0MYR
<b>President (Ex-Officio)</b>		
Tony Gilbey, G4YTG		
<b>Vice President (Ex-Officio)</b>		
Murray Niman, G6GYB		
<b>Other members</b>		
Andy Chapman, G7TKK David Davis, G3SVI Oliver Prin, M0WAG Clive King, M0GHH	Co-opted Co-opted Chris, G0IPU Tony, G4YTG	David, G3SVI Chris, G0IPU
<b>CARS Duties</b>		
<b>Programme Secretary/Club Callsign</b>		
Colin, G0TRM		
<b>Facebook</b>		
Chris, G0IPU Paul, G7BHE		
<b>Twitter</b>		
Murray, G6JYB Chris, G0IPU		
<b>PayPal</b>		
M0MYR, G6JYB, G0IPU, 2E0GVE		
<b>Training Manager/Raffle</b>		
Chris, G0IPU		
<b>QSL Manager</b>		
Oliver, M0WAG		
<b>Essex Chronicle &amp; Weekly News Liaison</b>		
Colin, G0TRM		
<b>Publicity &amp; RadCom Liaison</b>		
Trevor Hawkins, M5AKA		
<b>Members of the Public Contacts</b>		
David, G3SVI Myra, M0MYR		
<b>Website/email lists</b>		
Murray, G6JYB		
<b>Newsletter Editor (ex Committee)</b>		
Steve Webb, G4GHO		

**Committee Elections:** The CARS Committee all stood down and the floor was passed to President Tony, G4YTG, who ran the re-election of the new Committee. I reiterated my desire to stand down as Chairman due to time constraints and asked if anyone in the room would like to take on the role, to no avail.... Not wishing to leave the committee without a Chairman, in itself a bad situation, I have decided to continue, whilst looking for a volunteer for the position of Chairman.

**Retiring Committee members:**

Steve Webb, G4GHO

Steve is our Newsletter editor, and I'm sure you will agree with me that Steve does a brilliant job. I'd like to take this opportunity to thank Steve for his time on the Committee and long may he do the newsletter for the Society.

**Amateur Of the Year:** After the well deserved tea break, Amateur of the Year was awarded to a CARS Member who, in the opinion of CARS Members has, in the past year, promoted and contributed significantly to CARS and Amateur Radio in general. Nominations were taken in the previous months, and forms were handed out on the night, and to my surprise – I was the winner of it. (I did not expect that; in my opinion Steve Webb was by far the winner for his dedication to the Newsletter).

**Raffle & Prizes:** Along with our usual raffle we also had our extra Prize draw for a Baofeng UV-5R dual band handheld radio. This was won by Myra, M0MYR.

**What Do You Want From Your Club?:** There then followed a discussion on “what do you want from your club?” that was mostly dominated with “where are all the newly licensed Amateurs from the training courses?” This was an interesting debate with no ultimate conclusion. The demographic of our Society is that we are an older club, with older members...

We ran out of time for the last item on the AGM - Events & Talks, but we are always open to suggestions. If you have any ideas, requests or feedback on the content you are offered or would like to see, then please do not hesitate to contact any Committee member and it will be gratefully considered.

Chris, G0IPU



Alan, M0IWZ collects his well-deserved prize



and David, M0HBV also collects his.



Chris, G0IPU and Paul, G7BHE; both concerned that Paul will get mugged for his valuable raffle prize of car door protectors!



Tony, G4YTG is only too happy to give Chris, G0IPU his Amateur of the Year award for the work he has done during his stand-in time as Chairman.

*What Chris hasn't said in his report, is that he only intends to stand for three months (i.e. until the New Year), after which he says he will stand down.*

*It is important that he be allowed to exercise that choice before his personal life suffers. - Ed.*

## News from Sandford Mill

from **Tim Wander**

A busy summer! Having stepped into the breach (so to speak) at the Mill to help Nick and the team after Nick Sturgess's departure earlier this year - this summer has been both fascinating, interesting and all times a little frustrating - but a lot of progress has been made.

Firstly, thank you to all the volunteers from all the different groups whose efforts continue to make Sandford Mill a truly unique and inspiring building - part museum, part store, part repository, part classroom, outward bound centre, school and many other things - hence the new signs I put up for open day that just say... Sandford Mill.

You have to be there for a while to even work out the many different things that go on. On the building side I have been able to lend my support to push on with a series of building and site checks - all have gone well and the electrical fault in the classroom pump room has now been resolved.

On the museum front, in the short time available, I have managed to reorganise parts of the collection and document, reclassify and move around other parts into logical groups. This, along with several clearouts has made some limited space (which seems to be filling rapidly even now).

Some fascinating museum finds have been identified - the YB1 radio from 1918 (but with a 'needs more research' provenance associated with the first BBC broadcasts through early 1923) and the HS55A amplifier (1917) are very rare items and both are planned to be gently restored. We have managed to restore the original 2MT piano stool and Peter Bridgeman has done a fantastic job with the T1154 and R1155 re-furbs - now on display at Oaklands. Colin Page is also working on one of the Marconi Morse code inkers which is in an very poor condition.

Other projects now ongoing include the 1971 LOCUS 16 Computer – the world's first 16 bit minicomputer donated last year by BAE Systems - which has been installed and is now being rebuilt at the Mill. This is the only surviving complete example in the world. The television volunteer engineering team has grown and sound and vision seem to have been restored... there is even a rumour that one of the new volunteers has just fixed a design fault on a circuit board on a Camera that was shipped in 1966 – 50 years on. Now *that* is proper after sales service.

We have also started an internal revamp and reorganisation of the famous 2MT Writtle hut, working toward the rapidly approaching centenaries; January 2020 through to November 2020 for the Chelmsford broadcasts, (June 2020 for Dame Nellie's Concert) and of course February 2022 starts the 100th anniversary year of 2MT. A lot of planning is already underway including a planned 95<sup>th</sup> trial celebration/ broadcast from '2MT' in February 2017 – we hope to produce actual concerts and broadcasts at the correct time and place – 100 (and 95) years on. Watch this space for future updates.

As part of all this I am attempting to find time to rework the 2012 New Street Works book into a 2020 Centenary celebration for the New Street works and Melba's broadcast – so if you have any memories, anecdotes or photographs of the factory that didn't make it the first time, please send them in. I have received many since it first came out and many found new photographs, including a large section, sadly, on the site's recent demolition and "rebuild" - photographed and recorded over several years by Susan and Richard Wilson.

I also hope to rewrite the 2MT Writtle Book in some form for the centenary (yes, again). Since the 2010 edition much more research has come in (especially re the RFC origins of the 2MT team) and many more photographs have turned up. If you have anything to add to the 2MT story please email me – indeed if you would like to help, email me!

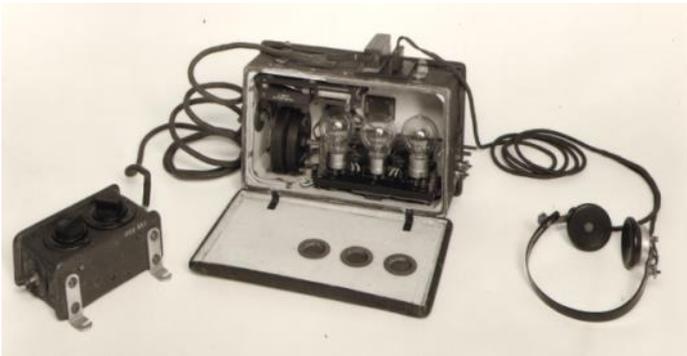
As per Hall Street this spring, any proceeds from these hopefully 'fascinating reads' will go toward the Centenary project funding. There will also be a dedicated website to the centenary plans and we are hoping to produce a short video or two to promote the events. Watch this space!

And now some appeals for the Museum:-

- 1) Does anyone know of – or can you guess from your career history - where we might find a Marconi Myriad Computer? Today we (i.e. the National Computer Museum, Leeds University, Sandford Mill et. al.) cannot find any surviving example: I have vague memories about AFTN Switching in Cyprus (FLIGHT report confirms installation in 1967) and South Africa military switches – can you help?



- 2) We are trying to get the important Great Baddow Chain Home Radar Mast listed – you may be surprised to know that due to several 'technical' reasons this unique and only complete surviving CH radar mast has effectively no statutory protection. I have to assemble a report about its use from 1954 until today. This history, when coupled with its important wartime history, will allow us to have another go – so any information please email me – I need to cover all its uses - for radar, TV, microwave projects etc. Thanks.



- 3) As the Centenary fast approaches we are urgently seeking the loan of any early wireless equipment from WW1 and RFC use designed by the Brooklyn/Joyce Green RFC and later Writtle engineering teams. So can anyone loan us a Sterling W/T set or one of the early AD series of equipment designed, built and tested by Eckersley and his team between 1919 and 1922? (*Pics left - Ed.*)



- 4) The Hut now has an original 1916 tortoise stove in place and a correct Clifophone gramophone on its way. We are looking for a 78 r.p.m. record of Robert Howe singing the 'Floral Dance' – the first record to be played on 2MT.
- 5) We are still looking for an elusive picture of the Hall Streets Works wireless station - the one across the road from the main factory site...anyone seen one?

- 6) We are looking for more information on the Broomfield Wireless Station - formed in 1903 and badly damaged in WW2 - does anyone have any pictures or can point me to a source?

The 2MT transmitter rebuild is also gathering pace – through a generous donation to the museum we have now been able to provide all the original Marconi valves and new displays are being planned including a history the valve from 'Fleming to Acorn' - and a new display dedicated to the career of Peter Eckersley. Indeed a huge amount of volunteer effort has gone into sorting out the Mill's huge valve collection and there have been some very early and possibly unique finds that we hope to display soon.

So while working on the future centenaries of British Broadcasting at the Mill - we were also pleased to accept on long term loan the amazing recreation of the Titanic Radio Room built by Ted Sinclair and first seen at the successful Hall Street exhibition earlier this year. I have also managed to have a first pass re-vamp of just some of the displays at Oaklands Museum – more planned in January.

The Sandford Mill Museum area has also had its own 'revamp' of some of the displays – much more work needs to be done – interestingly the Museum holds potentially the largest collection of original MIMCO equipment in the world – now being documented in a separate project.

The two Mill 'open days' were very well attended with numerous museum tours and hut tours telling the story of Marconi, Crompton's, Safety at Sea, the Titanic and, of course, the birth of British Broadcasting. Thanks to all who those who came and those who helped.

A new line of research has been the Mill's Filter House – with each tour attracting 60 plus people. The story of Chelmsford's turbulent and, at times, difficult water supply from 1815-1984 has met with a lot of interest and several new projects are being based around this unique building and indeed the history of Sandford Mill itself. The Filter House is probably the last of its type in the world that went from "black" river water to chlorinated/softened/Ph controlled drinkable water in one building - producing some 3 million gallons everyday.

On a slightly smaller scale Jim and the team have nearly rebuilt the water wheel and the volunteers continue to support the education team with their many "hands on" working displays and demonstrators. Even some horse harnesses from an earlier century are being restored - proving it's not all science and engineering based here at the Mill!

**Tim Wander, G6GUX** (yes, OfCom just gave it back) timwander@compuserve.com

*I have to say that, since Tim has been at the Mill, I have been both impressed by and pleased with what has happened and the publicity material that has been produced for the various events. Let's hope that Tim's enthusiasm, his willingness to allow and encourage CARS members to go along to the Mill and prepare for events and his guided tours give the place a new lease of life and our club, a raised profile - Ed.*

## Zurich DPS-2512 13.8V 20A PSU problem

At least, I think that's what it is. I've been trying to find out what is the matter with a PSU I acquired. It has no manufacturer's part or model number, but it is a Zurich, it has both voltage and current meters and is very similar to ones I've seen for sale second hand with the above part number.

It essentially works, but trips out at the slightest provocation and, although the output voltage runs down to zero, trying to put a light bulb across the output is almost impossible—even trying to ramp it up from nothing (yes, I know the filament is low resistance when it is cold, but the PSU doesn't even start *trying* to draw current). I've been trying to draw out the circuit and, apart from the generally shoddy build and "made in China" quality, it might as well have been designed in Chinese for all I can make of it—even a simulator is not making sense of what I think the circuit is. I do understand these things generally, but this circuit has me beaten at the moment. I guess it might have a fault but, until I decide I know what it *should* be doing, I'm going to be chasing my tail by just poking about at random. Can anyone help with this?

If I can trace the circuit accurately, I'll write it up, as it doesn't seem to be "out there" anywhere. Either that or I'll redesign it with something I can understand - **Ed**.

## Low Cost Wind Speed and Direction Indicator

By Alan Hanna, M0IWZ

### Introduction

I had been looking for a wind speed and direction indicator for a while and although you can buy them off the shelf I couldn't find one that was either affordable, or had the features that I was looking for. It needed to have a device hard wired to the sensors as I wouldn't be able to easily change the batteries in the sensors and one that would show average speed and direction as opposed to only instantaneous values. I decided that if I couldn't find one, then the only other choice was to build one myself. This is the result of that decision.



### Design Brief

When deciding to build this device I set out a few goals to help keep the project within scope and budget. It had to:

- be low cost and use easily obtainable parts
- work
- show average wind speed
- show average wind direction
- use hard wired sensors (wireless was not an option)

### Design

The first part of the project was to find the sensors. After a few nights on the web I found that Maplin sell spares for their units and using eBay I was able to purchase the direction and speed indicators for just over £12.00

The next part of the project was how to display the results. I wanted to have dials to show the output but they are very expensive, so I decided to design my own. After a bit of thought I came up with using a stepper motor to move a pointer and a dial could be easily printed on a label and stuck to an old CD.

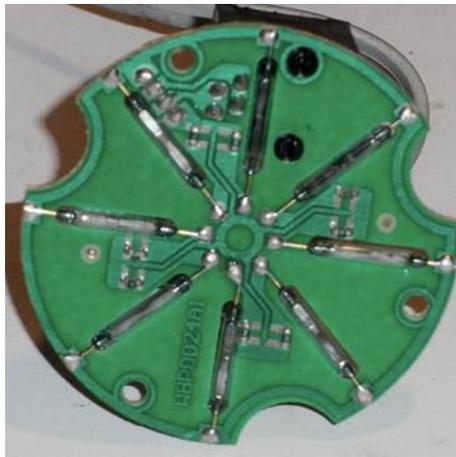
Cost?£1.26 for the stepper motors and the motor driver was another £1.

Next was how to connect the dials with the sensors. This was easy using an Arduino Uno costing £2.99. All I needed now was a box to put it all in and a bit of code to make it work.

### Technical Detail

#### Wind Direction Sensor

This is a simple device. A set of eight reed switches are connected in series with eight resistors. This gives a unique resistance value when each of the eight cardinal wind direction points are shown. There is a side effect of this design in that if the magnet is put halfway between two reeds then both will operate and give a new resistance value. These values are shown in black in the table.



Pos'n °	Ohms	A/D Value
0	64k7	890
22.5	21k7	705
45	132k8	785
67.5	6k5	410
90	8k2	465
112.5	800R	80
135	900R	90
157.5	600R	65
180	2k1	185
202.5	1k3	125
225	3k8	285
247.5	3k	245
270	16k	635
292.5	?	1024
315	120k	945
337.5	?	1024

**Wind Speed Sensor**

Another simple device, a reed switch contact is made on each revolution of the unit.

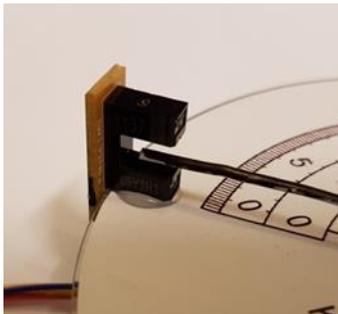


**Dials**

The dials are made from a CD with a label printed and stuck on the front and the stepper motor fastened to the CD with 2 bolts. There is also a small slot sensor (from an old printer) that is used to zero the dial. The pointers are made from a twist wrap held in place with a blob of hot melt glue.



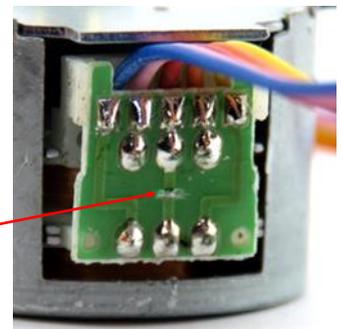
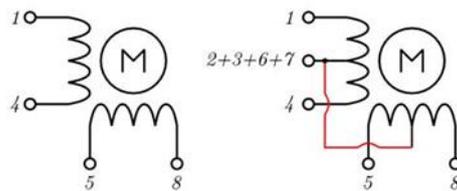
Stepper motor fitted to the CD



Slot sensor fitted to the dial

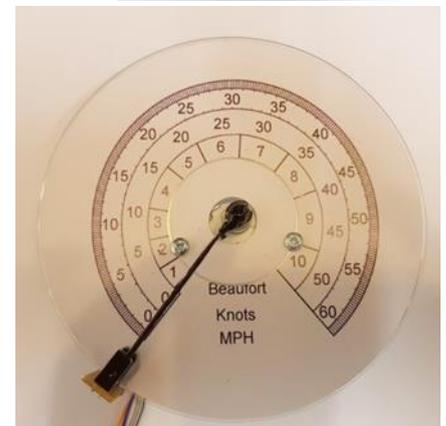
The stepper motors require a bit of modification to convert them from unipolar to bipolar operation. This is an easy modification that requires the cutting of a track on the PCB on the side of the motor.

*Bipolar 4 wires      Unipolar 5 wires*



Cut track here

Finished Dial



**Stepper motor drivers**

I decided to use H Bridge stepper motor drivers and Easydriver seem to be the PCB of choice when scanning the internet. I purchased a couple of PCBs and interfaced this to the Arduino using the Accelstep library. This means I only need two pins to drive each stepper, one pin controls the direction of the stepper and the other pin is pulsed each time a step is required.

**Zero position sensors**

I need to know where the pointers are when the unit is first switched on. To achieve this I use a slot sensor from an old printer I had lying about. The slot sensor is an opto sensor and gives a Hi when the slot is interrupted. This is interfaced to the Arduino with a couple of resistors, one to limit the current to the LED source and one to act as a pullup on the open collector output of the sensor.

**Function Switches**

I require inputs to allow me to select the different operating modes. I have five inputs and this is achieved using four input pins. Sw1 controls the 30 Sec average, Inst, and 15 Min average. Sw2 controls the Gust and Gust Reset function. Each input is pulled Hi via a 10k resistor.

## Sensor Inputs

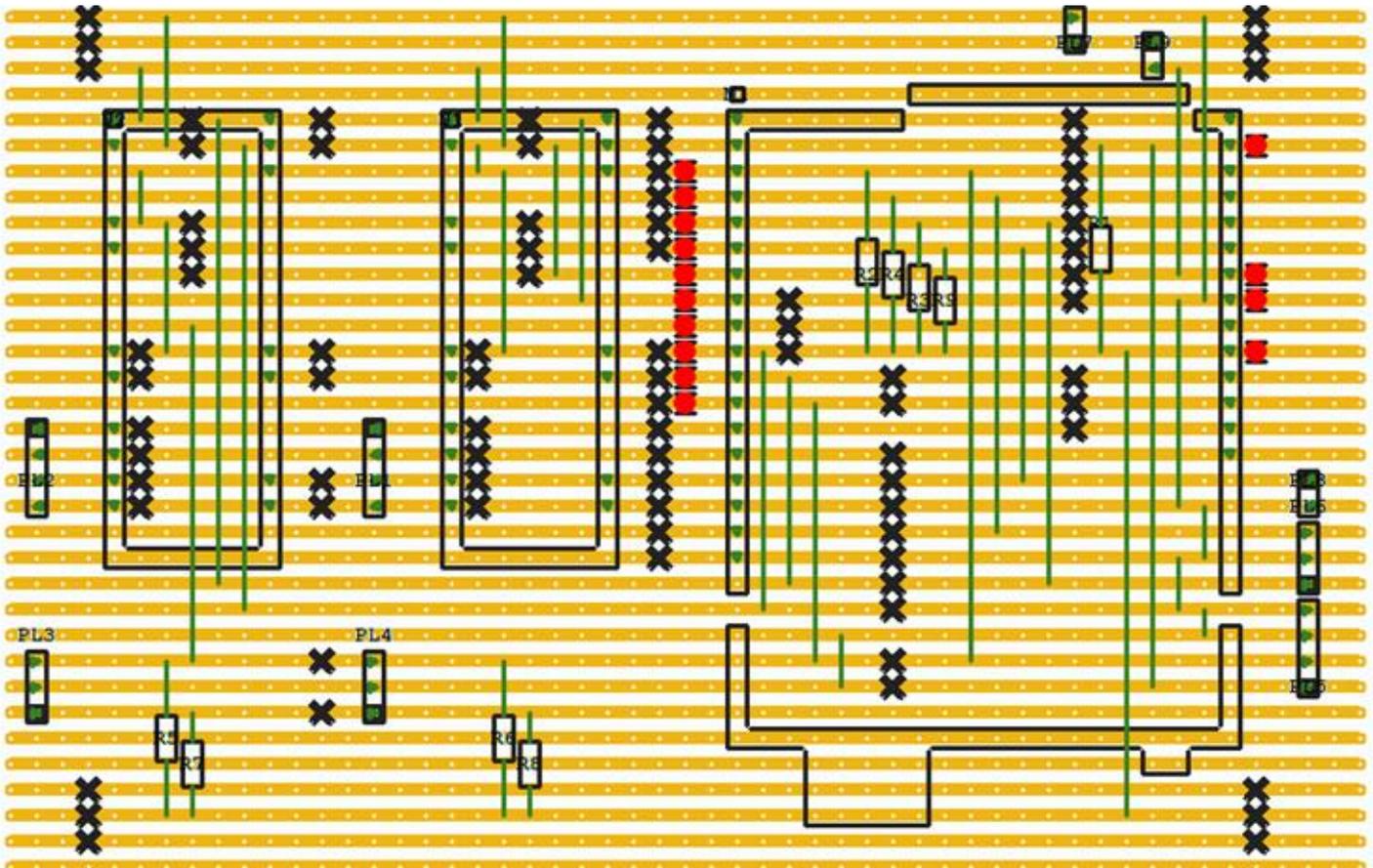
The Speed sensor is connected via a 10k pullup. Each time the sensor completes one revolution it causes a low input pulse to the Arduino.

The Direction input is attached to one of the analogue to digital pins via a voltage divider circuit. A lookup table is then used to map the A/D value to a direction.

The schematic was then drawn up in a CAD package and I exported the netlist to my Veroboard prototyping software.

## PCB Layout

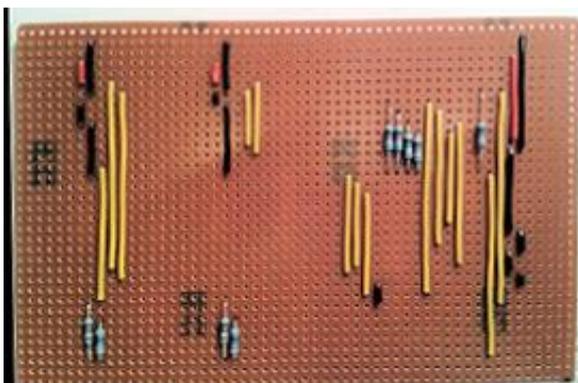
Using VCAD, I laid out the stripboard and then proceeded to solder and wire up the circuit.

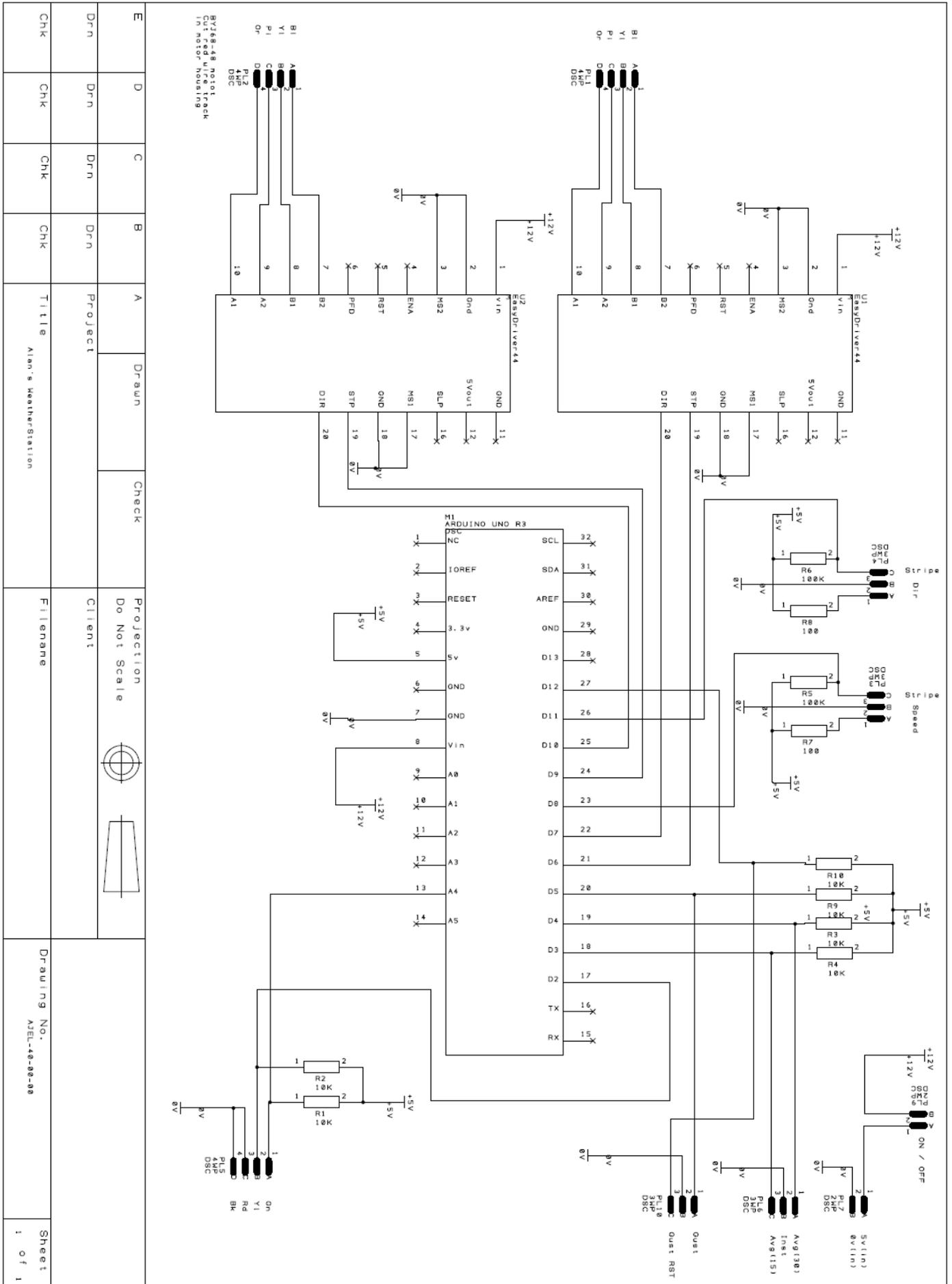


## Board construction

Stripboard showing wire links and resistors fitted

Rear of Stripboard showing joints and cuts

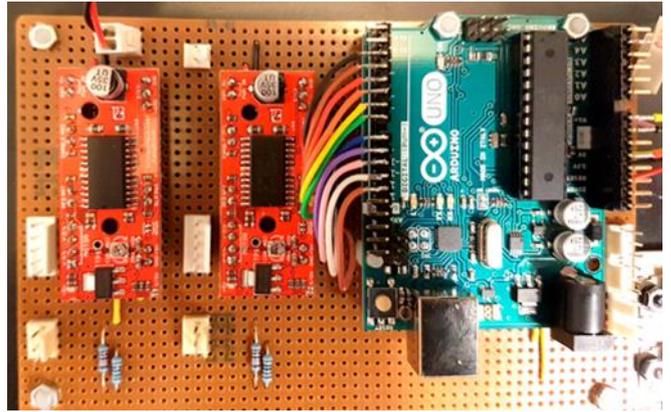




E	D	C	B	A	Drawn	Check	Projection Do Not Scale	Client	Drawing No. AZEL-16-00-00	Sheet 1 of 1
Drn	Drn	Drn	Drn	Project						
Chk	Chk	Chk	Chk	Title Alan's WeatherStation						

Finished PCB with Stepper Motor Drivers and Arduino fitted (right)

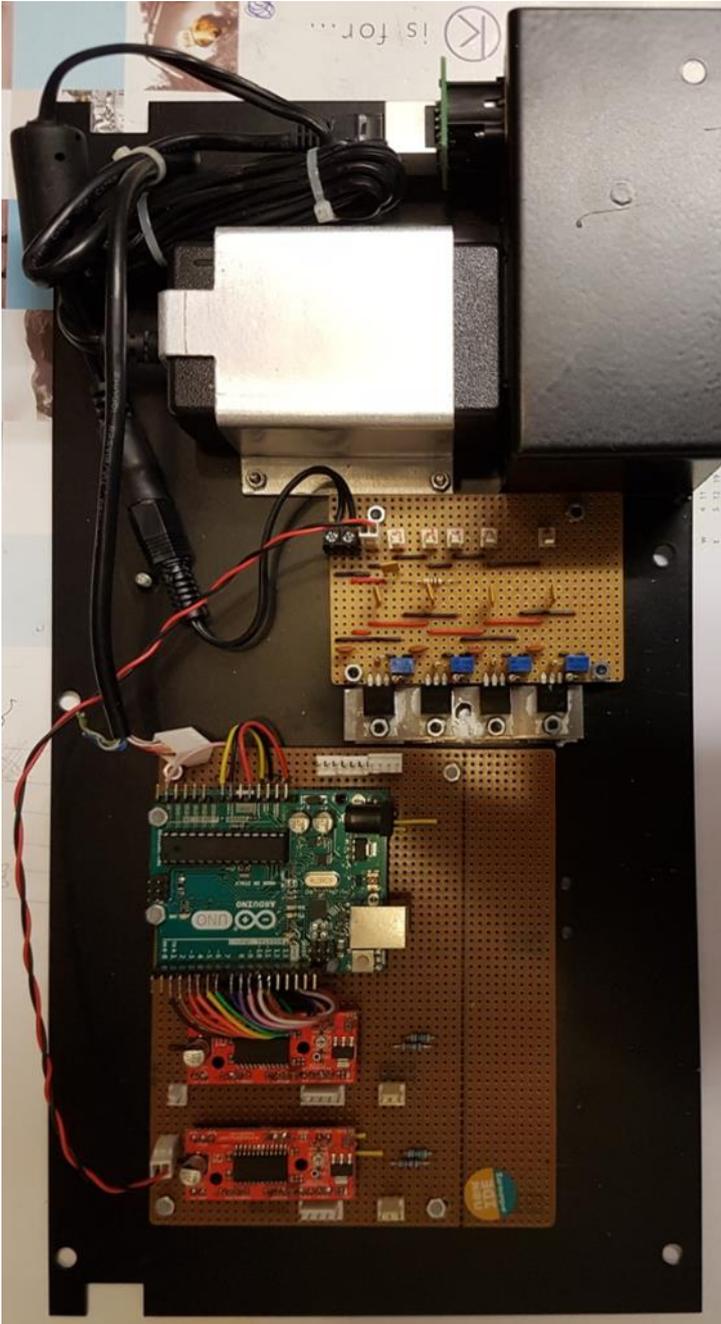
PCB installed inside the case (below)



### Software

Without going into too much boring detail the software is straightforward:

- 1) Zero the dials
- 2) Start 2.5 second timer
- 3) While timer is active, count pulses from speed indicator
- 4) End of 2.5 second timer
- 5) Count the number of pulses received in 2.5 seconds
- 6) Calculate the speed using the formula:  
 $V \text{ m/s} = \text{PulseCnt}(2.25/2.5)$
- 7) Calculate new 30 second and 15 minute average speed
- 8) Calculate new 30 second and 15 minute average direction
- 9) Calculate the wind direction using a lookup table for reed display switches
- 10) Move speed dial to new position
- 11) Move direction dial to new position
- 12) Go to 2



### Conclusion

I set out at the beginning of this project with the aim of building something useful and to learn about the Arduino and stepper motors; in that respect I have achieved my goals. The finished unit does not look the best, but then it was a design goal to make this as cheap as possible and I don't think I could have built it for much less.

Total build cost was slightly over £20.00. The most expensive item was the direction indicator at £9.99. All of the items were purchased through eBay (mostly from China) and the case was donated from the scrap bin at my place of work.

The unit works well and is in regular use. The average direction and speed functions perform well and I have also added a gust and direction of gust function as well.

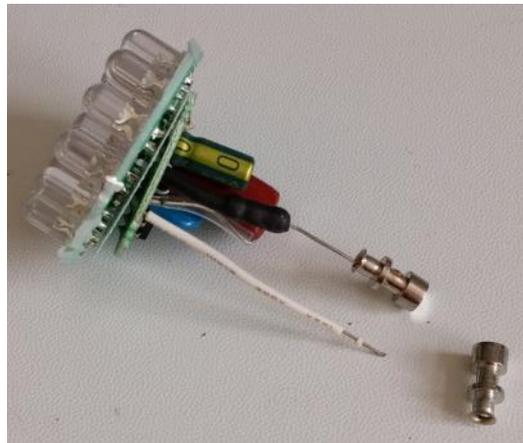
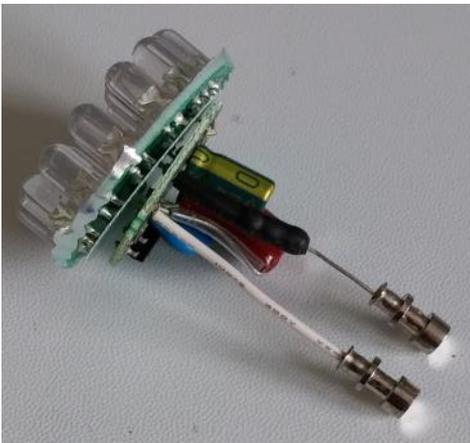
The hardest part of the project was getting the direction dial to move to the new position using the shortest distance. The difficulty came about as the dial transitions through zero. A chat with the C.A.R.S training team soon solved the problem. Thanks guys.

Alan, M0IWZ

## LEDs, reliability & EMI

I use GU10 Led lamps for the bedside reading lights and two different makes have failed by becoming intermittent, well before the allotted umpteen thousand hours they are supposed to run for. The first failure occurred a year or so ago and I kept the lamp for a while with the intention of breaking it apart to see what was inside it, but eventually, I just threw it away. When this last one went, however, I decided to smash it carefully (it is glass and ceramic) and investigate it.

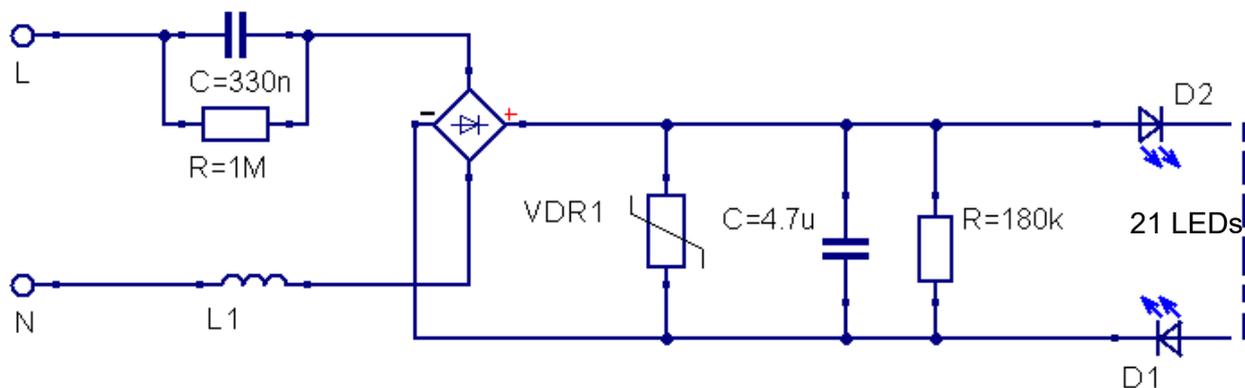
The problem seems to be that there are two crimp terminals that form the main lamp contact and these crimp down onto the wires forming the circuit. One of the leads looks like a standard RFC and is very small diameter. The crimp is loose and hasn't completely closed on it, but it is still retained; perhaps by a kink in the lead. The other lead is a larger diameter but, paradoxically, the crimp is completely loose on this wire - hence the intermittency, I guess.



While I was at it, I traced out the circuit and in common with other LED lamps, it has a series capacitor to drop the volts (using the reactance), a bridge rectifier, a 75V ac transorb varistor, a token

reservoir capacitor, bleed resistor and a choke. When I was doing the mains pickup experiments referred to elsewhere, I brought the loop near the LED light in my shack and it didn't respond in any meaningful way. It would appear it doesn't emit harmful switching frequencies and harmonics like the CFL lamps do.

That's a relief! - **Ed**.



## Line frequency interference II

In last month's issue, I wrote that I was going to try to see what sort of field strength was around the shack at the 50Hz line frequency and harmonics thereof, in order to help sort a hum pickup problem. I have had some success. To recap, I wanted to see how much current was induced by local 50Hz fields in a shorted loop, both in and out of the shack.

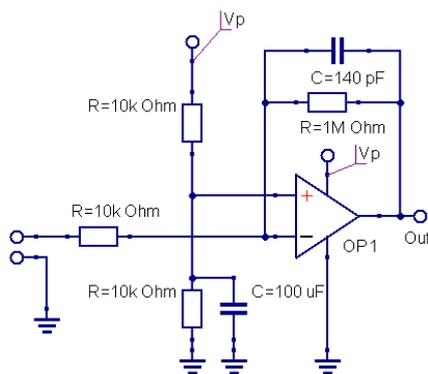
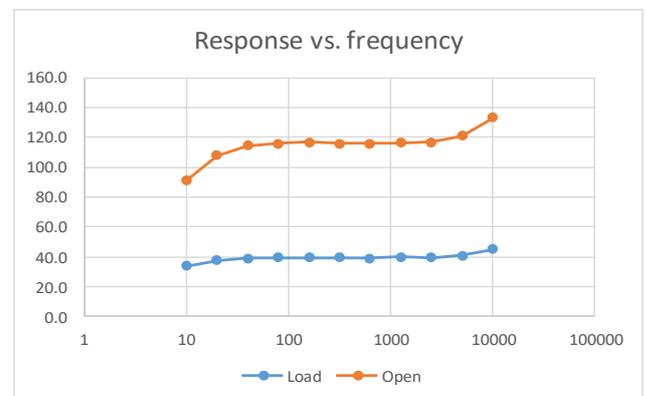
I reported that I started with a loop of 10g wire about 1m diameter. In fact, the piece of wire was about 2.6m long (circumference) so the average diameter would have been about 0.825m and the enclosed area about 0.53m<sup>2</sup>. I then found that by approximately doubling the length, I could get effectively double the induced current in the current probe. Stands to reason, really. Actually, the combined lengths of wire and resultant area was about 0.55m<sup>2</sup>. The area is important as the induced voltage is dependent upon that, the number of turns, N, and the magnetic field strength according to Faraday's law:  $V = -N * \frac{\Delta(BA)}{\Delta t}$  where B is magnetic flux density (T), A is loop area and t is time.

Using this, we can say that the term NA for the double loop would be equivalent to  $2 * 0.55\text{m}^2 = 1.1\text{m}^2$ .

As the loop is closed, the induced voltage owing to the 50Hz magnetic field will cause current to flow in the loop; the magnitude of which is determined by the loop resistance. It is that current I want to detect by using a commercial **e-on** current sensor such as those used in domestic energy meters.

The current sensor is important, because the actual voltage developed in the loop wire will be very low indeed. In an attempt to get the flattest frequency response I could, I used a 1Ω series resistor in place of the sensor, but then I got no perceptible current flow in the sensor and no sensible voltage on the 'scope across either the resistor or the open loop.

In order to calibrate the sensor, I clipped it round the output lead of an audio amplifier that was loaded with a 4Ω resistor. In its original equipment, the sensor was terminated with 180R. This gives a sensitivity of ~40mV/A and a flatter curve than leaving it unterminated, but I wanted as much sensitivity as I could get, so I settled for the open circuit figure of 116mV/A. This is pretty flat anyway between 50Hz and 2.5kHz (up to the 50th harmonic).



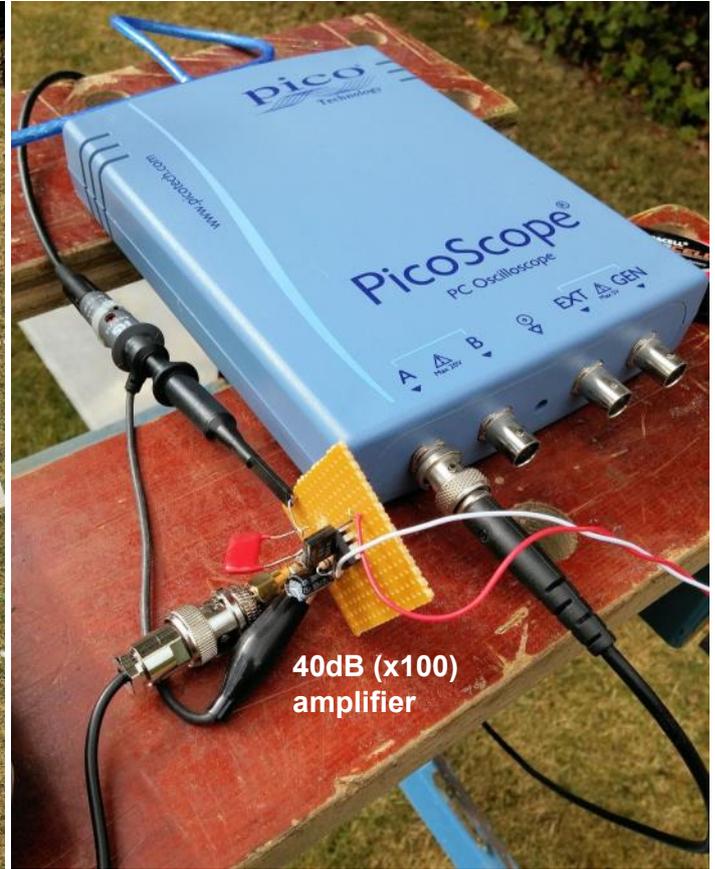
I built a 40dB amplifier and ran this off a 9V battery so that I could use it outside for convenience and eliminate any PSU derived ripple. If I'd had a rail-rail op-amp available, I probably would have used the USB output as a source of supply, as I was using my USB PicoScope's built in signal generator for calibration and the 'scope to resolve the final signals.

After initially testing the double loop I remembered I had a 4m length of aluminium strip left over from an abortive loop antenna experiment, so I pressed that into service. This gave an area of 1.27m<sup>2</sup>, which is not a great step up on the effective 1.1m<sup>2</sup> of the smaller double loop, but seemed to give greater output by a factor of about 2:1, so if I assume the voltage is broadly similar for the two loops, I can also assume the resistance of the aluminium loop is probably about half that of the double loop.

Consequently, for any given induced voltage, the current will be higher. I tested this with a 4-terminal measurement: by passing a high current and measuring the voltage, but only used the double loop in the shack 'cos it was easier to handle. I measured a resistance of about 25mΩ in that.

So; what does all this tell us? One thing that came to light is that when the loop is in the horizontal plane the pickup is at its greatest. Conversely, it is possible to almost null out the pickup by orienting the loop toward the vertical. Why this should be, is uncertain at present. The size of the large loop made it a bit difficult to orient in my shack which is essentially a cube, measuring 2m x 2.2m x 2.4m but...

It was still possible to get the loop situated around the worst offenders. These were soldering iron power base, 90W and 300W linear PSUs (i.e. with large transformers). See pix, later for results. After making measurements in the shack, I went outside and made some more in the garden, about as far from any houses (and wiring) as I could get. There are no mains carrying cables anywhere near and the laptop was on batteries, so it was surprising to see the pickup that was realised out there.



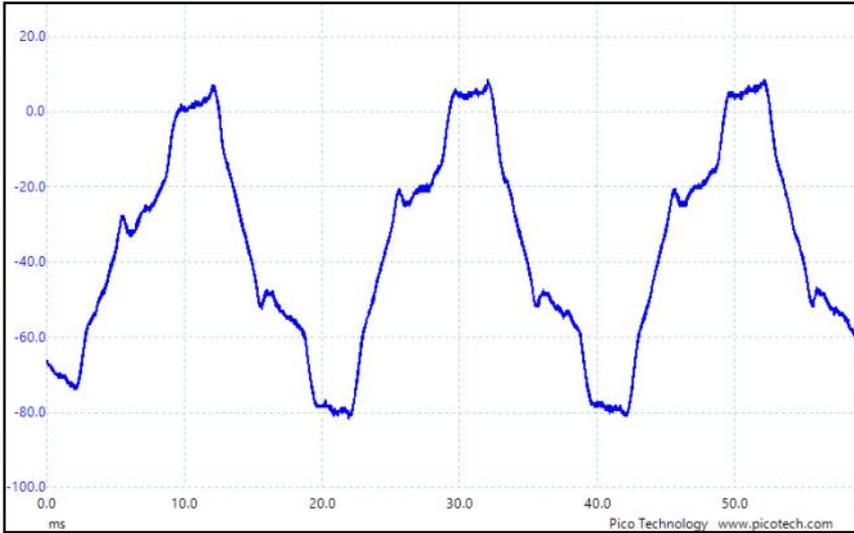
Above: test station in garden and detail of 'scope and x100 amplifier

Left: Large loop with heavy bolt to reduce resistance, support the loop in the best approximation to a circle and allow the sensor to be clipped on.

The grass is in poor nick after the lack of rain and the ground is dry as a bone.

My tuner's antenna ground is probably suffering, too.

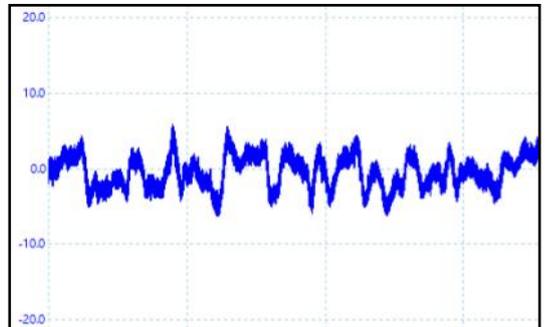
The voltages shown on the following graphs must be divided by 11.6V (or 11600mV) to obtain the loop current in amps. Only snippets are shown to give an indication of the magnitude of the current.



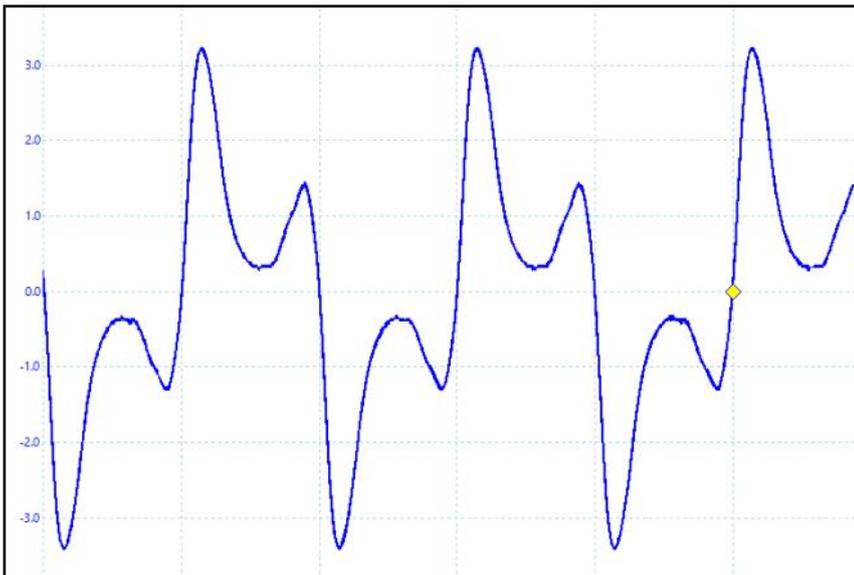
Above: Large loop horizontal outside in garden. Waveform shows totally different harmonic content.  $I_{pk-pk} = 6.9mA$



Dual loop horizontal in shack. Only the PC is switched on.  $I_{pk-pk} = 2.59mA$

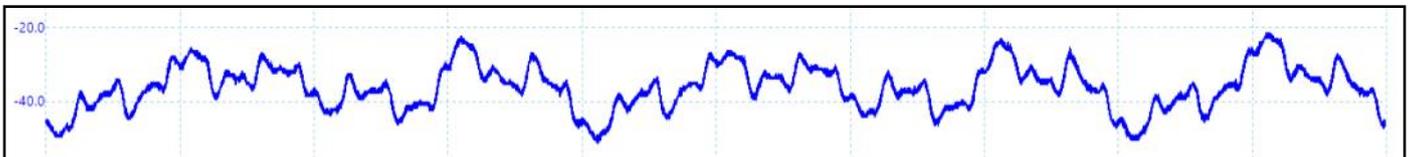


Loop oriented for min in shack. Only the PC is switched on.  $I_{pk-pk} = 1.2mA$



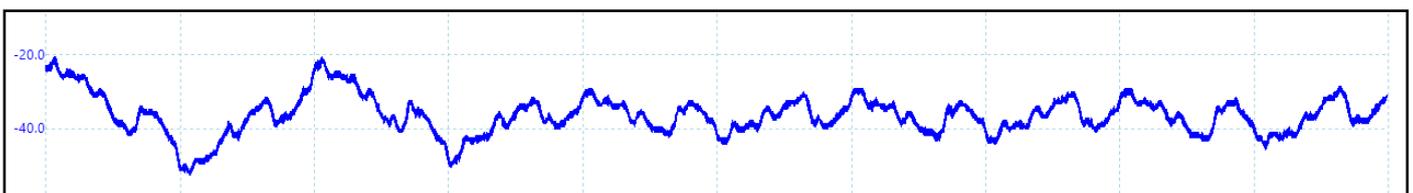
Left: loop horizontal in shack. PC and 300W PSU are both on.  $I_{pk-pk} = 574mA$

That is a lot of current! It doesn't seem to matter where in the shack the loop is placed; pickup is still large, but it is at a max with the PSU in the centre of the loop. I don't know why the waveform is that shape.



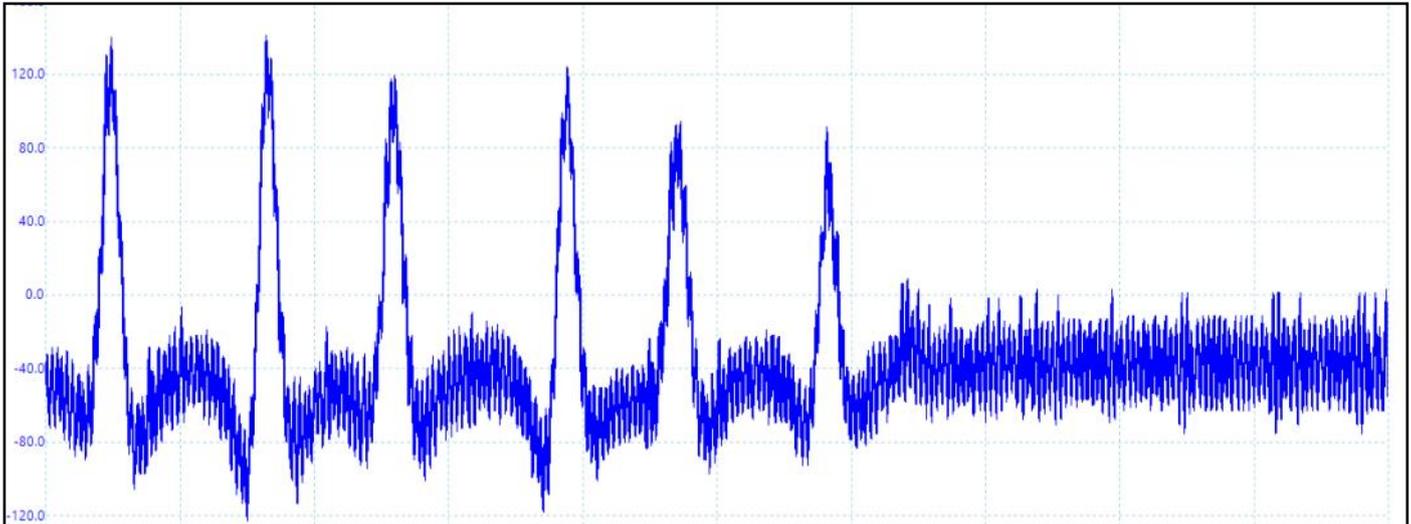
Above: Large loop oriented E-W in the garden.  $I_{pk-pk} \sim = 2.6mA$

Below: Large loop oriented N-S in the garden.  $I_{pk-pk} \sim = 2.6mA$



## Conclusion?

Who knows? All I can say is that there is the opportunity for current to be induced in any metal close to a magnetic field (no chance of getting the Nobel prize for that statement!) but, as for determining the local field strength, it can really only be done on fundamental frequencies. In the garden, with no obvious local field and the wavelength at 50Hz being 6 million meters, what, exactly, constitutes near field? If there is a local field, will that distort the results? Below is a graph of the voltage induced when I waved a very strong neodymium magnet near one edge of the large loop whilst it was laying on the ground with the timebase set to 500mS/div to show the brief and random fluctuations in pickup over time.



The equivalent current is just over 200mA<sub>pk-pk</sub>. With the PSU in the shack, I was getting 574mA<sub>pk-pk</sub> as shown on the previous page. I would never have thought that the PSU's external field was anything like as strong as it appears to be with this experiment and, believe me, those neodymium magnets are *strong*!

I thought the induced waveform was down to PSU rectifier current, so I removed the secondary feed and, with the lid off the PSU, the pick up was increased by about 50% but the waveform remained the same. This says that the PSU screening is partially effective and, as I was expecting more of a sine wave, it led me to wonder if it was the sensor core saturating at these levels. OK, at those levels, I thought, I really must be able to see that voltage on the output of the loop and so it proved to be. I opened the loop connected the x100 amplifier directly to the ends and there was an almost identical waveform. So; not core saturation, then. What is it, I wonder.

The measured sensor voltage in the 300W PSU example is 6.654V<sub>pk-pk</sub> which equates to 0.574A<sub>pk-pk</sub> and, multiplying this by the resistance of 25mΩ gives 14.35mV<sub>pk-pk</sub>. This is still a very small voltage and only the low loop resistance causes

$$V = -N * \frac{\Delta(BA)}{\Delta t}$$

So; from the previous formula and knowing V, N & A, can we work out B as a product of T/s?

14.35e-3 = -2 \* 0.55m2 \* B/t so B/t = 0.052T/s<sub>pk-pk</sub>. Wait, though. Can I say that? Dunno. If this was a fundamental frequency (say, 50Hz) then t would be 0.02 and B would be 0.652T.

Have I learned anything? Yes, I have had a graphic demonstration of what I already 'knew', that a metal loop will have current induced in a magnetic field, but the extent or magnitude of which, I had absolutely no idea. Is it any wonder that we get problems with line frequency pickup on our equipment? It has been worth it for that alone. Screening on the PSU is all but useless, even with a steel case and it's likely to be the just the same in keeping magnetic fields out in similar equipment and aluminium is even worse at 50Hz. It also shows why operating on a battery is no guarantee of success. If there is ever a need to keep line frequencies and harmonics out of my equipment, then I would be better off making sure that best wiring practise is followed and no loops are introduced.

Now, where is that TM-733 and what is allowing the pickup I am experiencing? - **Ed**.

## Repairs **A** us

Why is it that I always finish up fixing other peoples' kit and I never seem to be able to solve my own problems? Some months ago, Brian, G3CVI made it known on the CRS 2m net that he had a problem with his SLB-300 linear and that he was no longer able to lift the (very) heavy thing down from the shelf himself. I volunteered to give him a hand and for various reasons, only recently got around to going over to see him.

There was no life in it at all, no obvious panel fuse, the mains lead fuse was intact and the lead was sound but no 'thump' from the mains transformer when it was switched on. What had happened to the volts? It turned out that there was a fuse in the IEC socket itself. That was a new one on me and took me a while to realise it. Luckily, it also incorporated a spare fuse but it would have been folly to install it without determining the cause of the rupture. There was nothing more sophisticated than a heavy transformer and KBPC3510 35A, 1kV bridge rectifier in the PSU. A quick diode check showed at least one of the diodes was short, so I carted the whole thing off to find some replacements. Farnell were offering these at £4.35 each and RS had them at 54p each for 10 off. It was a no-brainer, really, so it was soon replaced, with a bag of spares to boot. Let's hope they prove unnecessary.



The linear was returned, powered up, checked out and approved in short order and all then seemed well, except for one small thing. The SWR on Brian's MFJ ATU seemed reluctantly difficult to tune Brian knows his antenna well, as does he the settings for the ATU for each band so it seemed a little strange. Also, the meter stayed reading after keying off.

At one point, I touched the SWR meter's plastic window and, although he wasn't transmitting, the crossed needles leapt toward my finger. Then it dawned on me. The meter cover must have built up a static charge that was attracting the needles and giving a false reading. I held my finger in place on the plastic and simultaneously touched the metal case to ground it and you could see the charge draining away as the needles slowly receded toward their respective zero positions. I have seen static on meter windows before to a slight extent, but nothing like as pronounced as on this occasion.

What was causing that I wonder? - **Ed**.

## Repairs **A** them

I may not be able to solve my problems, but others sometimes can for me. I bought a wood burner and got it installed last September. We have a perfectly sound central heating system, so the stove only gets used for occasional weekend evenings for 'mood'; it doesn't, therefore, get a bashing.

I dismantled it recently to have the chimney swept and found to my dismay that the cast iron log retainer had already cracked, that it wasn't a warranty item and that I would have to shell out for a new one.

Chris, G0IPU offered to help initially, but welding cast iron is fraught with difficulty and then Tony, G4YTG came to the rescue after I asked him at Committee if he could braze it - I know he has such equipment.

Not only did he do the job (perfectly) he delivered it back to me as well! Job done. Thanks, Tony!

What would that have cost at a blacksmith, I wonder? - **Ed**.

## First iPod?

A while back I caught up with a lady I once worked with and we were talking about her children. She was shopping for a birthday present and she was saying how they now have all sorts of things at a ridiculously early age that we could never have dreamed of when we were children. She recounted how one of her children had asked her: "mummy, how old were you when you got your first iPod?" Catherine said "Ooh - about 37". "No, mummy", said her daughter, "your *first* one"



## October Skills night

This was an interesting evening. I don't have attendance figures, but it seemed a good turnout. I didn't get around as much as I would have liked, but there will be other occasions on which I can put that right, I'm sure. The 2m Slim Jim antenna workshop was again gainfully employed with Chris, G0IPU and Alan, M0IWZ in charge.

Dave, G4HUP was on hand with his HupRF kits and advice and Paul, M0CNL brought along some of his modified Easy Digi kits. That was good, as he was able to demonstrate PCB making techniques and talk about the digimode interface. He also had some for sale to benefit Essex Repeater Group funds. The kit was inexpensive, comprehensive and well documented. I bought one to see if I could persuade my TS570D to cooperate with my PC.



I had brought along a selection of test gear on the off-chance that some visitors would express an interest. In the past, when I have done this, it has been received in a lukewarm manner, but this time it seems a different mix of people must have been on hand. I spent quite a while talking about the various aspects of digital signal function generation, two tone signals, spurious, harmonics and Fourier transforms. My VNWA was employed to look at the club's MFJ-949(?) ATU for want of something to study and it was found to be curiously reluctant to tune into 50Ω on 80m! Strange.



Paul donated one of his kits to CARS for the next raffle.

That was very generous of you Paul.

Thanks very much!





Selim, M0XTA brought along his IC7300 and was able to talk about 4m operation and his new weekly 4m net—subjects which he is keen to expand on. I really must look around at the other bands. Basically, I just have HF, 2m and 70cm Tx capability, although I have a 6/2/70 triband antenna so that must be excuse enough to buy a rig to cover that band as well, right?

Paul, G7BHE was on hand to talk about DMR, Yaesu Fusion & D-Star and was able to pass on his knowledge by programming someone else's rig during the evening. The demonstrations encompassed that happy mix of the desirability of commercial kit with the fascination of the Raspberry Pi and the satisfaction of some additional homebrew.

What more would you want?



Sample D-Star kit to get you going.

Steve, M0SHQ was there to chase the satellites (with what looks like a fire stick in the poor light) and people gathered to appreciate his efforts. It's fortunate the rain seemed to have passed over for this activity.

The next event in November will be the last one this year, as the organisers take a break in December and start to think about the things that they can get lined up for next year.

Many thanks to Pete, M0PSX for the pictures and for the help with this issue. - Ed.

