Chelmsford Amateur Radio Society

Newsletter

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Next meeting: 4th April - 7.30pm, Oaklands Museum

Talk by RSGB President Nick Henwood, G3RWF

Inside this issue:

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

#2 - GB3DA	14th March
#3 - GB3ER	21st March
#4 - 80m 3.756MHz	28th March
#5 - 160m 1.947MHz	n/a

Essex Ham Net
Mondays 20:00h GB3DA

Mugs away! Our globe-trotting Secretary, exhibiting both his and CARS'. Brits have long had a reputation for taking their tea bags with them (you can't trust Johnny Foreigner with tea), but the mug as well?...

Contact details for the newsletter: editor@g0mwt.org.uk

Editorial

As I write this, I don't know what I will be doing when (if) this edition comes out, but the Newsletter has had a month or two's reprieve. As things stand, we have put a deposit on a new build house near Norwich City centre, having just walked away from another, recent, build that we came to realise may present problems in the future. Our choice this time was between that, or an absolute corker of a project about a couple of miles distant that would have been fabulous for radio.

Right at the top of a hill with enough roof space and garden to make an antenna system not only feasible, but desirable and trees that would have supported any number of wires, the latter was ripe for a complete make-over and an opportunity for a brilliant shack. Unfortunately, the approach was so steep and so far away from public transport, it would have made walking and cycling to any of the local amenities an unreasonable proposition in not so many years' time, so it had to go. As we get older we have to consider the practicalities of having to (and not wanting to) drive to medical, dental and city centre retail facilities with all the attendant traffic/parking problems, so we have had to compromise. The new house will be a challenge, but even if I have to resort to JT65 or similar data modes to get out, then so be it. I spend more time on the PC these days than I think I have ever done outside of work, so maybe it will be appropriate. - ***Ed***.

Dates for your diary

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

Tue. 4th April	Meeting - Talk by RSGB President Nick Henwood, G3RWF
Mon. 17th April	Skills Night - Danbury Village Hall
Sat. 22nd April	International Marconi Day - Operating from Sandford Mill using GX0MWT
Tue. 2nd May	Meeting - Tricks with Coax - John Regnault, G4WSX
Mon. 15th May	Skills Night - Danbury Village Hall
Tue. 6th June	Meeting - Table top sale
Mon. 19th June	Skills Night - Danbury Village Hall
Tue. 4th July	Meeting - Talks: Dr. Brian Styles, G3NSD, A Century Not Out; Tony, G4YTG - Antenna Tuners and more; Murray, G6JYB - Marconi Hidden Museum
Sun. 9th July	Sandford Mill - Science Discovery Day
Mon. 17th July	Skills Night - Danbury Village Hall
Tue. 1st August	Meeting - Constructor's competition
Mon. 21st August	Skills Night - Danbury Village Hall
Tue. 5th September	Meeting - Keith Maton from Martello Tower Group will talk about Radio Caroline
Mon. September 18th	Skills Night - Danbury Village Hall
Tue. 3rd October	Meeting - CARS Annual General Meeting
Mon. October 16th	Skills Night - Danbury Village Hall
Sun. October 22nd	Sandford Mill - Science Discovery Day
Tue. 7th November	Meeting - William Poel, G8CYK - Urban noise and SDR equipment
Mon. 20th December	Skills Night - Danbury Village Hall
5th December	Meeting CARS Christmas Social Night.

March Clubnight - Classic Computers

For our meeting at Oaklands Museum we had an excellent lecture by our own Andy Chapman, G7TKK on the early days of British home computing, or a meander through vintage home computers from 1970 to 1989.

The lecture started with a description of the early TTL chips and then a description of logic chips which led onto the development of the microprocessor designs. Using a white board Andy outlined the design of the early chips then went on to describe the internal architecture of a microprocessor in some detail, underlining his extensive knowledge of his subject.

A slide depicted the development timeline of silicon transistors from 1950 with 1 transistor, to 2010 with a 3072 core GPU and 8,000,000,000 transistors.

In the early seventies various British manufacturers started to produce motherboards incorporating the latest new microprocessors being manufactured in the United States these were picked up by keen computer enthusiasts interested in computing; for the first time it was possible to build a computer at home due to the low prices in comparison to the large commercial computer systems.

As more and more home computer enthusiasts built their own machines the first computer magazine was published called Personal Computer World and Andy displayed the first edition a 1978 copy which featured the Nascom 1. Andy started to build one of these machines and later, as we will see, added many different add on boards to expand the system.

Why is it that, seemingly, whenever I snap the Chapmen, one or the other always wants to show their better side? - *Ed*.

The Nascom home computer kits were a single board computer, made in the UK and based on the new Zilog Z80 micro processor chips. Unusual for the time, they included a keyboard, a video interface, a serial port used to store data on a cassette player and serial ports as well as a 2 x 8 bit parallel port. This would have cost you at the time; £199 for the basic kit.

The Nascom One computer system was supplied as a kit and required the enthusiast to solder all of the three thousand joints - no small undertaking. The motherboard used a Zilog Z80 CPU running at 2 MHz; it had 2 Kb of RAM and could be expanded to 64 Kb RAM, and had a 48 character X 16 line video interface outputting to a standard TV.

It had a simple operating system and later used CP/M. It was available from December 1977 to 1979.

From December 1979 to 1983 the Nascom Two became available, comprising a Zilog 4 MHz Z80A processor with 8Kb to 1Mb RAM.

Andy displayed both these models - one in its case with the keyboard and another with no case, but a series of boards in a caged back plane system with various boards.

Many expansion boards were available to expand the computer including memory, video, and even speech synthesiser boards. Andy had them all, which he displayed to the audience.

There is a website for these computers at www.nascomhomepage.com with a host of information and emulators. (*See also www.old-computers.com - Ed*)

Andy then displayed a rare British home computer - the Jupiter Ace, which was available from 1982 until 1984. Sales were not very high for this product due to the Forth interpreter and the fact that the 16K RAM pack doubled the base price of £90. The specification for this machine comprised a 3.2MHz Zilog Z80 processor,1 Kb of RAM expandable to 32Kb (with suitable add-ons) and an internal speaker. A Soundboard was made available by Essex Micro Electronics and a graphics card with four shades of grey.

After the break we moved on to the well known ZX81 by Sinclair Research and manufactured by Timex in Dundee. These were produced from 1981 to 1984 for £70 with a Zilog Z80 processor running at 3.25 MHz,1Kb to 16Kb memory, with a monochrome display. They sold over one and a half million units. Andy and his brother Chris, G0IPU had all the peripheral add-ons for this (Sinclair) range of home computers and they were also on show.

At the back of the hall were a selection of computers from Andy's extensive collection including the Commodore 3000 which sold worldwide and was the first computer for many small businesses, and an early portable Amstrad was also on display.

The evening rounded off with a look at a couple of Panasonic Tufbook portable laptops. These were older versions, but are still produced today; they are designed for harsh environmental use and can be dropped from a reasonable height and still work afterwards.

Oliver, M0WAG

Andy has added this note by email: **A story of Sinclair microcomputers**

The crappy single board computer is a PMOS National Semiconductor Single Chip Micro Computer SC/MP. This was manufactured to promote the SC/MP. Clive Sinclair's firm (Science of Cambridge) modified the National Semiconductors design to make the SoC MK14. A SC/MP II N mos Micro. This was designated as an 8060.

The SoC MK14 had a calculator display, 512 bytes of ROM, and 128 bytes of RAM (expandable to 256). The keyboard was a plastic membrane, and dreadful. Sinclair then produced the ZX80 (1k RAM), ZX81(1k RAM), ZX Spectrum(16k RAM), Sinclair Z88 Laptop, and the Sinclair QL.

Between the ZX80, and the ZX81, two of Sinclair's Engineers spun off a company called Jupiter Cantab. This new company designed and built the Jupiter Ace

Note: 8060 then followed by the 8080, Z80, 8086, 80286, 80386, 80486 and the Pentiums....

Predecessors: 4004, 8008, 8040

Motorola 6800 spun off the Fairchild 6502, which spun off Intel ("Fairchildren") and spun off XICOR ("eX Intel CORporation")

I also feel inclined to add to Oliver's report of the evening: Andy's collection of treasures (junk, to his XYL) was extensive and often duplicated, with several examples of add-on boards in various states of repair (or decay?) I wish I had taken note of the various names and numbers of the models and cards he had on display and was describing. A plethora of parts included a "Winchester" drive, a Digitalker speech synthesiser and a zillion Nascom add-on boards, all of which brought back some memories. Andy talked about the National Semiconductor Corporation (NSC) "Scamp" (SC/MP) microprocessor. The basic unit was originally made for use with a teletype but, as these were not generally available to the public, NSC made the Introkit which used one of their calculator cases as a display and keyboard. As Andy says above, this system was used as the basis of the Sinclair Mk 14 development kit - and look what that spawned.

One of Andy's rarities included an early version of Windows 1 on 5¼" floppies. I only ever knew Windows from version 3.1 onward and that was originally supplied on a series of 3.5" floppies. How big is it now?

He had a Raspberry Pi running on an old 9" green screen monitor and that reminded me of just how poor the old displays were. I remember my old Compukit UK101 running into a small B&W TV that, if memory serves correctly, I bought just for the job (but it must have been a cheap one.) I remember also, programming a game in Basic called "DF Hunt". The object of the game was to move around a simple (4:3, rectangular) "map" taking "bearings" on a hidden Tx and then, when you had moved around the screen, you could triangulate and calculate, either mentally or mathematically whereabouts on the grid the Tx was hidden. You could then hazard a guess as to the grid reference of the Tx.

The game was only a game inasmuch as, whilst you were leisurely rambling and plotting, your bearings were being subjected to some randomised errors that were supposed to simulate the effects of reflections and other propagation anomalies, so an element of luck was involved. Also whilst you were thinking and calculating, a competition element was also added: other competitors were also hunting the hidden Tx alongside you. LCM (little computer "men" and, no, YLs weren't included, this was the early 80's) starting in random locations were searching too, whilst having their bearings subject to the same random obfuscations. Additionally, their calculations were being randomly distorted so that you had a fighting chance of winning against them. You effectively took pot shots whilst they stumbled about slowly and continuously and if they happened upon the golden grid, accidentally or otherwise, they had won.

One last complication: once you had taken a stab at where you thought the hidden Tx was, this counted as a giveaway to the other competitors and your every guess served to reduce the bearing and calculation error of the little computer men. Whilst you could just guess and go for a grid reference, the LCM had to "walk" there one grid step at a time so, if you were quick, you could still win.

It was played a couple of times at Radio Club socials before being forgotten about. It had all the graphical sophistication of the original "Pong" tennis game (beep, boop, remember?), so no surprises there, then!

*Judging, by the questions, anecdotes and other responses, it was a nice trip down memory lane for the audience and a good reminder of just how fast technology has moved in recent years. Thanks Andy - **Ed**.*

Left: The Chapmen Sinclair cache (or is that cash on eBay?) with QL, Microdrives/Wafa drives/stringy floppies, thermal printers/RF hash generators and below, one of the original speech synthesisers (This is DigiTalker, This is Digitalker…)

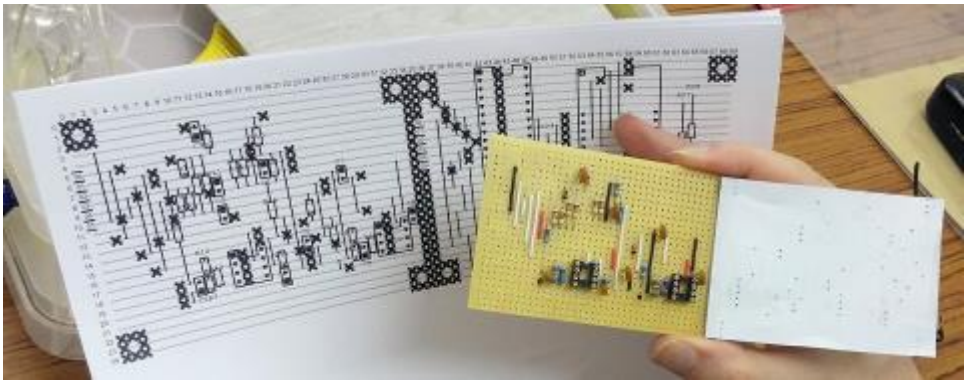
P.S. QL stood for Quantum Leap, which it was anything but...

March Skills Night

It never gets any less popular, does it? The formula remains the same, so does the venue, the people, the show 'n' tell, the quiz and, yes, even the cockups. It makes no difference. I reckon this is one event that will only go away if Pete, M0PSX becomes incapacitated.

Having said that nothing changes, Jim & Glynis had a new addition to their range of engraved goodies - a selection of pens that you could have personalised. A nice touch.

For some time now there has been a shadowy Cabal of geeks wishing to make their own Arduino based SWR/ impedance analyser and Alan, M0IWZ had brought along his latest efforts to continue building in the Hawkins room. Alan, Barry, G7BND and Keith, G3WGE have been comparing notes for a while and Alan had quite a following on this occasion, explaining his approach to those present. His layout, done in VeeCad is good, as you get a direct plot of what the Veroboard looks like after you have entered the data into a suitable schematic capture package. Alan prints a 1:1 layout and tapes it to the board so that you can more directly follow the tracking. Useful, indeed!



I have always been a bit wary of using Veroboard for RF, but if you restrain and/or isolate the critical areas suitably, then it can be quite effective. There are two main psychological barriers to me using it: parasitic inter-track capacitance and lack of ground plane. The inter-track capacitance can be solved by isolating them using the normal Vero spot facing tool (or drill bit) or just heating the tracks with a soldering iron and peeling them off with tweezers or long-nose pliers. The ground plane is a different matter though.

One thing I have done in the past, is tape bits of self-adhesive copper tape to the underside (or even top side) of the board to act as a vestigial ground plane. Punching through the tape is trivial and placing it underneath allows to connect all the tracks if so desired and placing it on top, you have the benefit of still having the isolated interconnections on the underside. By rubbing the foil with a suitable soft plastic handled tool, the indentations allow you to see the grid perfectly clearly through the foil so you don't lose the reference. You can still clear the copper foil with a spot facing tool to allow isolated connections to the underside tracks or just solder directly to the foil if you wish to ground a component. A small piece of tinned copper wire (e.g. a clipped component lead) punched through the foil would allow the foil and an underside track to be connected through by soldering top and bottom. I have just made a quick example here.

I'm sure this has been done, before but it might be news to someone.

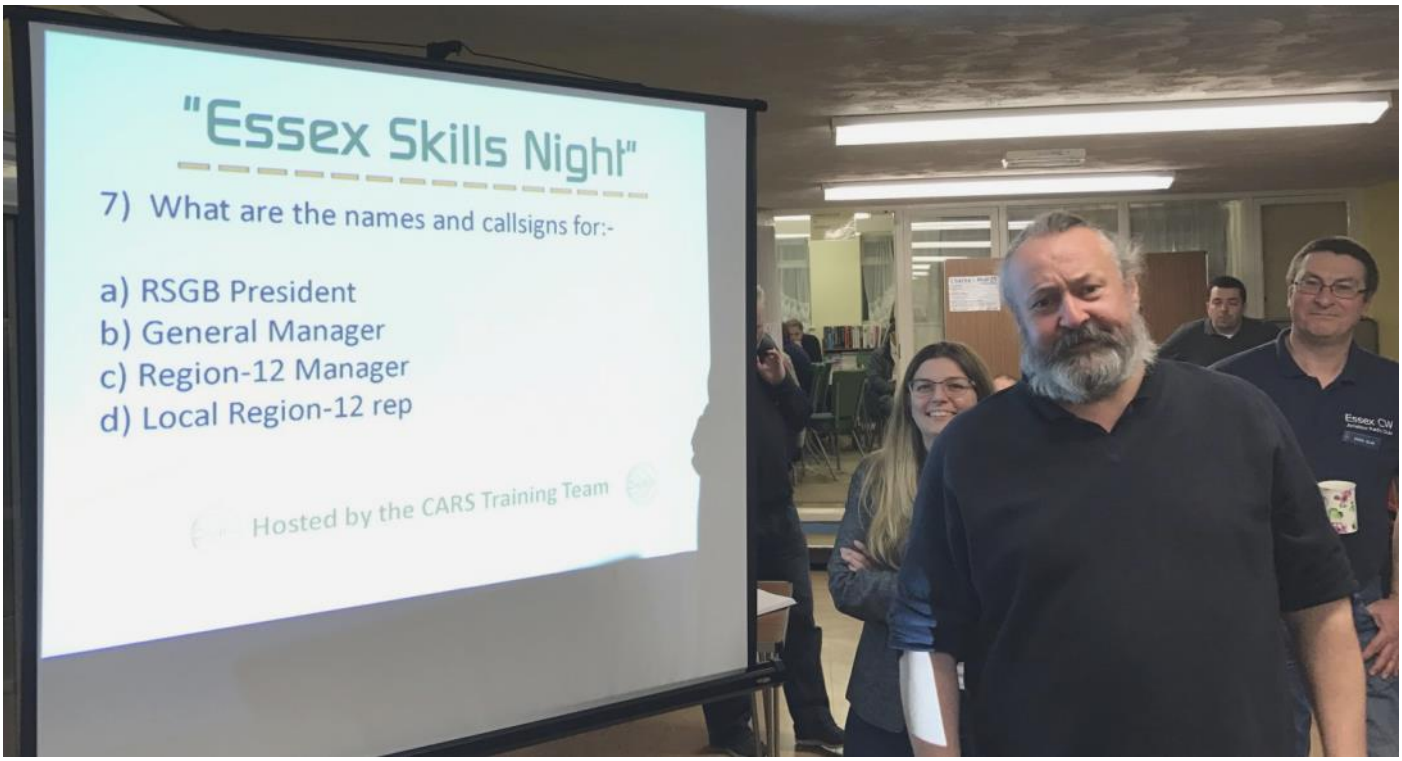
Andy, G7TKK brought a few examples of his old computers along. When asked if his tough book would survive a 1m drop, Andy obliged by just tipping it off the table onto the floor. “It’ll still work”, he said.

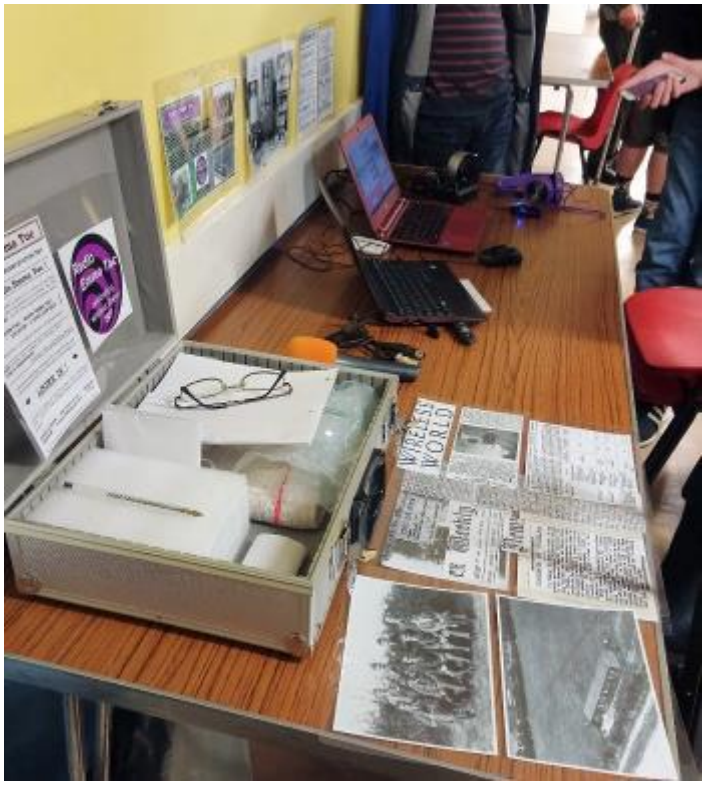
I had a look at his Amstrad NC100 notebook computer. “Press red to start a word processor” (or similar), so I did. To be presented with a few lines of text, along the lines of an electronic typewriter, makes one realise how restricting things were in those days, but we never noticed, did we? I remember using WordCraft on an old green screen computer and insisting I be allowed to write up my own reports rather than using the typing pool to do it for me. Entirely selfish, it allowed me to come to grips with the new tool and must have cost the company a fortune in my learning time. The desktop was a far cry from the PDP-11 that was also used in the lab, with its enormous disk stacks and (less imposing) 8” floppies. The floppy drives used 625W start-up power and weighed 34kg. Seems incredible now.

Paul, M0CNL came up from Clacton with his Hoxin dual band 2m/70cm antenna he wanted to use for satellite work. The Gamma matches for both bands seemed wrong according to the manufacturer’s instructions and he was trying to find out why. Chris, G0IPU verified Paul’s findings that you could get a match on 70cm, but not easily on 2m. The strange thing was that the good match for 70cm was obtainable with the fixing in the “wrong” position and the best match for 2m was in the correct position, but only gave 2:1 VSWR or thereabouts. It would have been nice to have had the chance to analyse it properly, but the MFJ analysers provide fairly limited information. It’s not possible to calibrate or gain phase information.

Rob, M0KCP representing Essex CW, was showing Mike, G4NVT all about the joys and modus operandi of iambic keyers.

The quiz was cobbled together at the last minute and Chris did a fine job of getting it ready in the nick of time. Another set of cryptic questions again had most people stumped, but it always informs.





Charlie, M0PZT was again selling his Ham Goodies, Jim, 2E0RMI had his “broadcast-station-in-a-box”, Nick. M0NFE attended to the Essex Ham stand and, with some encouragement, announced to the assembled company his recent engagement. The ‘T’ team did a fine job again with the refreshments and Anne’s famous cakes and pastries. Our thanks again go to all concerned—Anne Salmon, Myra, M0MYR and David, G3SVI. Steve, M0SHQ again had along his satellite antenna receiving equipment and was there to answer any questions and demonstrate radio HotSpots. So many things to do, so many willing helpers (and that includes Pete, M0PSX for pictures, as well). Thanks again for another entertaining event. - ***Ed***.

Morse classes

Learn Morse Code in eight weeks

Morse classes for the beginner will be starting again on Thursday 6th April.

Interested? Come along to Danbury Village Hall, starting at 7pm.

If you just want to improve your CW skills, come along any Thursday evening when you will be made very welcome.

Contact: CARS web page http://g0mwt.org.uk/training/index.htm#CW and morse@g0mwt.org.uk

or **Andy, G0IBN**, QTHr .

Feedback

I'm getting quite used to feedback from John, G6JPG. He sent me this:

"First: thanks for another packed newsletter; it seems far more than its 24 pages! I liked the article about (G)6YL; interesting that she got that call.

In "Diary", about turning your monitor (incidentally, I have long thought that the trend towards widescreen isn't sensible for computing: widescreen's OK for (some!) movies, but not (e.g.) word processing), you give the link to http://entechtaiwan.com/util/irotate.shtm . Well, as I usually do when someone recommends such a site, I left off the bit after the last /, to see what other utilities they have; one was/is a utility that's supposed to read out all the information available from your monitor (if I understood it rightly). I thought I'd try it with this netbook, to see what it said about the internal monitor (after virus scanning it of course, which didn't find anything); I thought if it was just reading, it would do no harm. It caused the screen to go all jagged - as if horizontal sync. had been lost; I eventually managed to shut the PC down, and fortunately it came back normal. Of course, I may have run the software incorrectly, or just been unlucky, but I'm not about to give it another try! [The irotate does indeed work well. Though moves your icons about - I use EzDesk to put them back (iconoid is an alternative for Windows 7 onwards, yes it really is from sillysot!).]

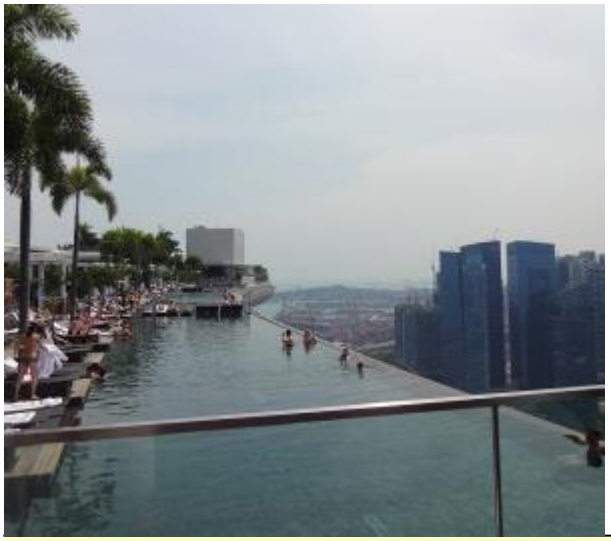
I'm sorry you're going; the newsletter has thriven (?) under you! On page 23, just below "Plus Size Sexy Wireless Lace Bra Gather Soft Thin Vest Bra For Women", you have a picture that at first I thought was connected to that - of what must be the biggest underwired cup in the world …"

I wish I'd spotted that one! Funny about iRotate moving John's icons. It doesn't do that to my PC - ***Ed***.

Why the holiday snaps?

Colin, G0TRM wrote: I don't know if you the watched the 'Hotel' in Singapore programme on BBC1 on 28th March but, looking through some pictures I took on our visit, there is one of the swimming pool on the boat and myself with a CARS mug, does it qualify for CARS mugs around the world slot?

Yes, Colin. It think it does! That pool is amazing. https://en.wikipedia.org/wiki/Marina_Bay_Sands) - ***Ed***.



Smudged Double Printing with Canon Pixma iP4850 Inkjet Printer

After 4 years of wonderful service my Canon Pixma iP4850 started to produce a blurred copy when using standard print setting. I tried using the Canon maintenance program and that did improve it a shade. My computer guru and I had a hour at improving it and in the end I settled for high quality and black only printing. The thought was - buy a new Canon printer - but looking at all of the reviews, all modern printers (up to £250) are now "3 in 1", e.g. scan, copy and print and "seem plastic rubbish" with all sorts of inherent faults like "cleans its teeth every time you switch on" and "every time you want to print-out a page", etc., etc.

I looked into HP Envy machines but was frightened off by the charges for the ink cartridges because the print heads are integral to each cartridge. Two new cartridges cost more than the whole new machine!

I wondered what a new print head would be for my Canon. The cheapest was about £53 including VAT with them usually costing about £67.

I stumbled on some You Tube videos of people washing theirs with water – I bit the bullet and had a go. I didn't actually unscrew the print-head from its body, but gently washed it using a slow dribble of warm, softened water from the tap – not from a hose pipe as I saw on one You Tube presentation. All the print heads I saw there were in a much worse state than mine.

I put it back together and did a couple of print runs. Poor quality colour and the black seems a bit blue, but I could print as black standard without the double print smudge I had before I went to greyscale and high quality – an improvement, at least.

Then I thought I would clean the newly washed print head using the Canon maintenance procedures. I had to put in a "big black ink". First try showed the black was poor, big black OK, but no magenta. A few hard cleans and the magenta and black came good, but I lost the big black.

After a frustrating half hour Canon popped a message up on the screen to "look at other things" – I thought "how stupid" but did check them anyhow to pacify it. I had not taken the yellow strip off the air Inlet of the new big black ink cartridge! Two more big cleans and the printer is running like new!

Who would have thought washing the print-head would save umpteen pounds? All it cost was a bit of ink which, in my case, is quite cheap and 2 hours of my time.

The two pictures show the Canon Pixma iP 4850 on my printer rack with a nice cup of tea and my Dymo LabelWriter 400 behind it and the other photo is with the top removed – hinges up showing the 5 cartridges – they sit above the print head so have to come out. A clip then hinges up and this releases the print head. I have noticed that this print head, Canon QY6-0080, is used on many Canon printers including quite recent ones – but they have different ink cartridges.

John Bowen, G8DET.

I must say I hadn't thought of doing that, but I have damp-wiped HP cartridges. I had an HP printer that started spraying ink around the inside of the compartment so I went for a Canon MG6350, a 3 in 1 wireless multi-role printer that has performed well in all aspects - even when using very cheap pattern cartridges. It uses six (it adds grey to the usual MCY, BK, PGBK) and they can be bought in bulk for less than the cost of single genuine product. If the head does ever clog, I'll know what to do! Thanks John - ***Ed****.*

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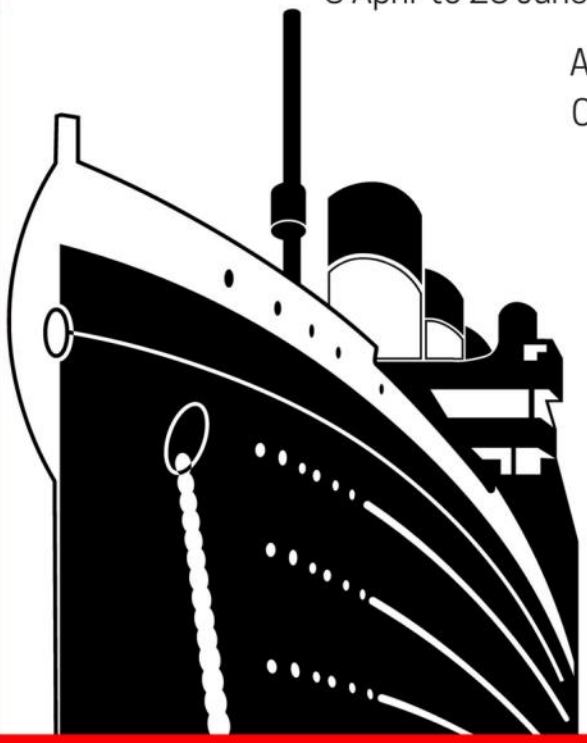

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Food for thought - SWR bridges

The circuit below is a simulator representation of the RF SWR bridge shown in this month's Arduino based SWR analyser article in RadCom on page.17.

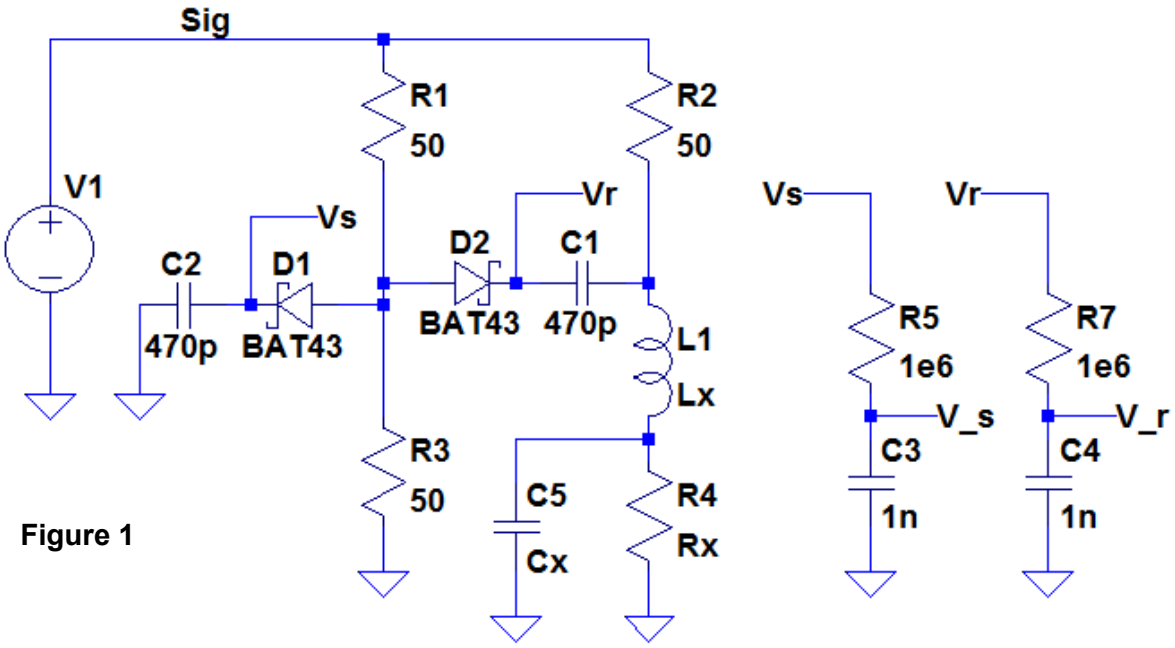


Figure 1

I wanted to simulate it because I couldn't understand how it was possible to do what the article purports to do: to measure the SWR of an impedance with the calculations shown. The equations look familiar, but putting numbers into them doesn't necessarily stack up.

The circuit shown in April 2017 RadCom page 17 (and my Figure 1) refers to two voltages, Vs and Vr, and the text body states that VSWR is (|Vs|+|Vr|)/(|Vs|-|Vr|). Er, no. it doesn't appear to be a general solution. It is stated that if Rx (R4) is open circuit, then Vs=Vr (true) so VSWR = ∞ and that if Rx =0, then Vs = Vr (also true) so again VSWR = ∞. Similarly, if Rx=50, then Vr =0 and VSWR=1. Those facts are true for every instance of applied voltage for the node Vsig in my circuit, but try the calculation for Rx at any value between those extremes and with anything other than Vsig = 2V rms and it all falls down. In the schematics, I have not given the generators (V1) a nominal 50Ω output impedance so that the bridge has a fixed voltage applied under all conditions. If the impedance at R4 is anything other than 50Ω, then the applied voltage to the bridge will obviously vary due to unequal loading and I didn't want this to upset any calculations. This is something to beware of and consider carefully in a practical implementation.

The more I puzzled over the circuit the more I couldn't see how it would work as described mathematically in general terms. Vs is a peak rectified value of the reference resistor junction, but is Vr really a peak representation of the voltage difference between the two junctions, or is it comparing apples with oranges?

First I simply calculated a few voltage divider scenarios with SWR = 2 and using resistive loads Rx = 25Ω and 100Ω and 2V rms applied to the bridge without any detectors involved. Using the method described above and ideal applied signal voltage, the two values of Rx results in answers of VSWR = 5 for Rx = 25Ω and VSWR = -7 for Rx = 100Ω. Changing the formula to VSWR = |(Vs+Vr)|/|(Vs-Vr)| gives 5 and 7, so at least the sign is reasonable. If the applied voltage at the node named Vsig on my diagram is 2V (1V at Vs) and you take Vs-Vr to be representative of reflection coefficient, Γ, then using the formula stated in the code [window] section of the article, VSWR = (1+|Γ|)/(1-|Γ|) does, in fact reveal correct answers, as you would expect. Any other applied voltage results in increasingly erroneous results as the 50:50 voltage division at Vs must imply a normalisation to something other than 1 (unity).

I then had to take into account complex loads and the phase relationship between them. The diode sensing Vr should do this, of course, but it was easy for me to put the following circuit into the simulator, eliminate or change Rx, XL or Xc for each scenario, and perform the simple (1+|Γ|)/(1-|Γ|) calculation on the quantities Vs-Vr for 100+j50 (SWR=2.62) and 100//-j50 (SWR=4.27:1).

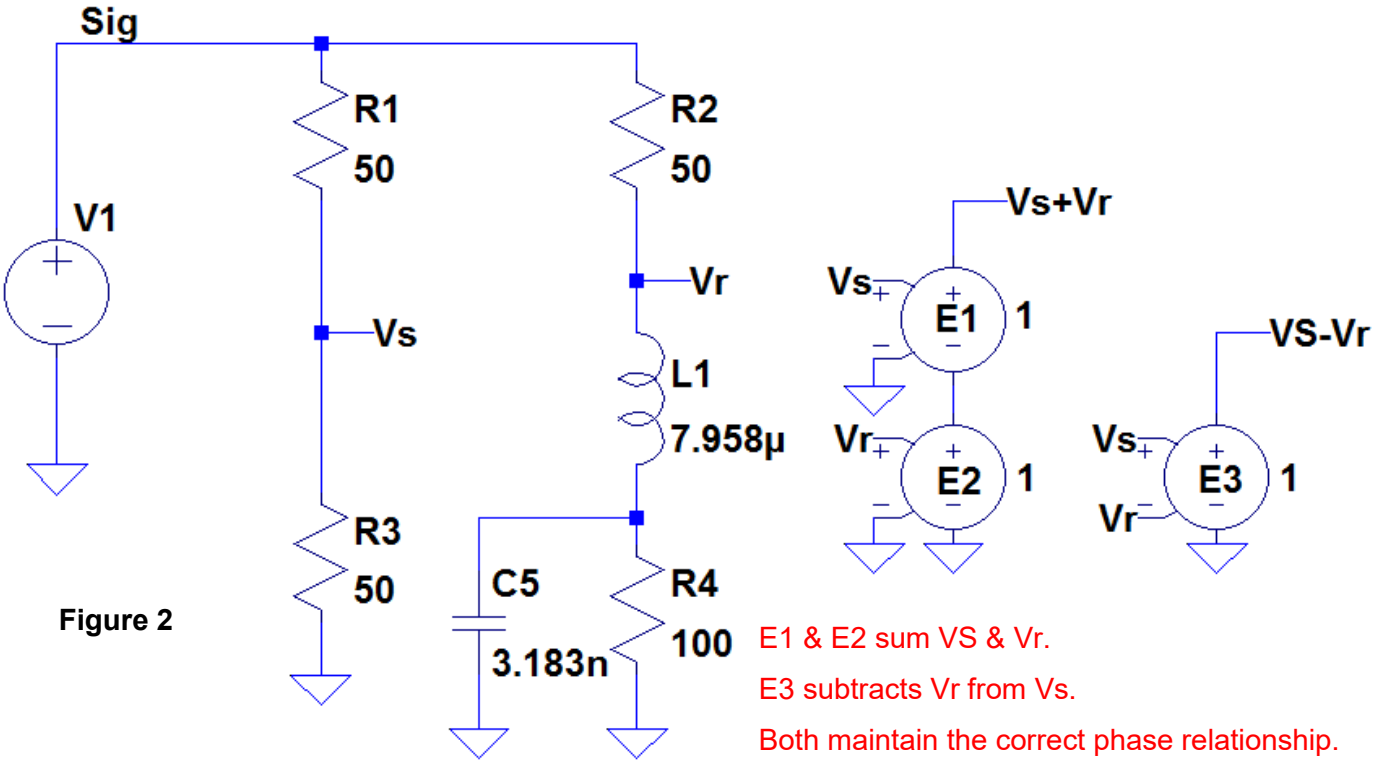


Figure 2

E1 & E2 sum VS & Vr.

E3 subtracts Vr from Vs.

Both maintain the correct phase relationship.

Again, this gave the correct VSWR for all resistive and complex impedances, but only if the applied voltage was 2V rms across the bridge, and only if the quantity SWR = (1+Γ)/(1-Γ) is used. Here are two examples, using 1V and 2V applied to the bridge (I'm ignoring poor results for the reactive loads) for two analyses using methods outlined above.

Vin =	Load	Vs	Vr	Vs+Vr	Vs-Vr	SWR	VSWR
1 volt	50R	0.500	0.500	1.000	0.000	224960	1.00
(+13dBm)	100R	0.500	0.667	1.167	0.167	7.00	1.40
	25R	0.500	0.333	0.833	0.167	5.00	1.40
	3.183nF	0.500	0.688	1.101	0.486	2.27	2.89
	7.958uH	0.507	1.014	1.521	0.507	3.00	3.06
	100//Xc	0.501	0.545	1.002	0.305	3.28	1.88
	100<->XL	0.501	0.710	1.208	0.226	5.36	1.58
2 volt	50R	1.000	1.000	2.000	0.000	224960	1.00
(+19dBm)	100R	1.000	1.333	2.333	0.333	7.00	2.00
	25R	1.000	0.667	1.667	0.333	5.00	2.00
	3.183nF	1.001	1.377	2.203	0.971	2.27	69.13
	7.958uH	1.000	2.028	3.041	1.014	3.00	-145
	100//Xc	1.002	1.091	2.004	0.610	3.28	4.13
	100<->XL	1.000	1.421	2.416	0.451	5.36	2.64

SWR = (Vs+Vr)/(Vs-Vr)

Γ = (Vs-Vr)

VSWR = (1+Γ)/(1-Γ)

On, now, to the "real" model: I found a ST Microelectronics Spice model for the BAT43 and used that for the simulated data shown here. It showed that at high voltage levels, the formulae just don't work and that to make any sense using the linearised VSWR, it had to be carried out lower voltage levels. Again, I did away with the ideal 50Ω generator series resistance and fixed the voltage across the bridge at exactly the correct level to represent two different drive levels: 0dBm and +10dBm. These were chosen as being readily available power levels from a small signal source. I used the diode "linearisation" mentioned in the article, which states correctly that a BAT43 diode can show logarithmic behaviour down to very low levels. At higher levels, it will start to linearise due to the resistance in the circuit and its own internal resistance.

The average voltages Vs & Vr were recorded as might be the case for a practical implementation (there is a fair bit of signal ripple on Vr and the filter at V_r is important). I carried out the full calculations according to the article and the results are given below. It is evident that the bridge does a reasonable job of indicating SWR, and it could be trusted at 1:1, but it is not very accurate if the model is to be believed. Mind you, who really cares if the SWR is infinity or 14:1 indicated, or 1.76:1, not 2:1 for a close match of a resistive load, but it is not very tolerant of reactive loads. The results are presented in the next table:

P(in) =	Load	Vs	Vr	SWR	Linear	Ideal
0dBm	50R	1.76E-02	4.96E-05	1.01	1.02	
	100R	1.81E-02	2.16E-03	1.27	2.04	
	25R	1.72E-02	1.49E-03	1.19	1.76	
	3.183nF	1.89E-02	1.39E-02	6.45	9.09	(Inf)
	7.958uH	1.89E-02	1.64E-02	14.10	12.49	(Inf)
	100//Xc	1.84E-02	5.09E-03	1.77	3.47	(4.27)
	100<->XL	1.67E-02	7.33E-03	2.56	5.08	(2.62)
	o/c	1.90E-02	1.65E-02	14.01	12.46	(Inf)
	s/c	1.65E-02	1.65E-02	32959.00	46.16	(Inf)
+10dBm	50R	1.82E-01	2.14E-04	1.00	1.01	
	100R	1.87E-01	2.17E-02	1.26	2.01	
	25R	1.79E-01	1.60E-02	1.20	1.78	
	3.183nF	1.91E-01	1.55E-01	9.56	10.80	(Inf)
	7.958uH	1.92E-01	1.74E-01	20.49	14.11	(Inf)
	100//Xc	1.89E-01	5.73E-02	1.87	3.72	(4.27)
	100<->XL	1.75E-01	7.47E-02	2.49	4.96	(2.62)
	o/c	1.92E-01	1.74E-01	20.60	14.13	(Inf)
	s/c	1.75E-01	1.75E-01	Inf	Inf	

I did build a very quick breadboard of the bridge alone, but without any amplification or extra filtering and the results were fairly similar, from the quick analysis I did. I haven't recorded those because the generator I was using was a very second-hand bit of kit in need to some TLC that has a random amplitude jitter. The output jumps erratically and unless you keep a constant eye on the output voltage from one measurement to another, you can be led up the garden path. It also has, of course, an output impedance that led to different voltage being applied to the bridge as I varied the unknown resistance. If I had a need for one of these analysers, then I would have made a better job of it and refined the layout, as well as the drive source impedance.

I may revisit it if I can find a stable signal source. I am well aware that there are many variations of this circuit out there and that it is used as the basis for many items of test equipment, but I still felt uncomfortable about it and wondered what a simulator would reveal for the rectified signal.

If you are thinking of making one of these, the note of caution I would use here is to check and double check with calibration, test loads and a simulation before putting all your faith in the measurements. Also, can anyone explain the relationship between the diode linearisation and bridge voltages to me please?

Whilst toying with this, I had been looking at the RF Wheatstone bridge that forms the basis of all these Arduino based SWR analysers. Looking up net references, I again came across G3YNH's website that I have mentioned before and has several useful downloads. There is a very good article on a precision RF bridge covering from 1.6-30MHz. It is a 40 page document detailing the build and theory of this design and is a very interesting read: http://www.g3ynh.info/zdocs/bridges/appendix/self_eval_refbrig.pdf.

Also, I saw a link there to an Italian site http://www.itermoionici.it/letteratura.html where I found Terman's Radio Engineering Hand book. It also has a less useful, albeit delightful download in the form of the RCA Radiotron Manual. Apart from describing in some detail the theory and manufacture of the valves, it has comprehensive data on their (then) range. What sets it apart for me, is the beautifully described and chatty nature of the application notes that seem half sales-pitch and half technical authority. Great stuff. - ***Ed***.

Smart meters and measurement accuracy

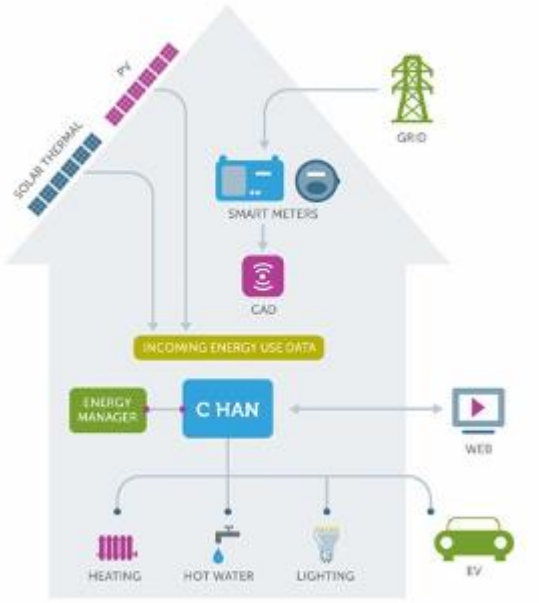
You may have noticed an item in the press recently about a study carried out by the Dutch University of Twente and HBO college, wherein they noticed that some smart meters were reading up to 580% higher than the real power consumption. This inaccuracy is related mainly to switching waveforms (e.g. dimmers) where there are many harmonics and fast edges and (inevitably) led to many scare stories. This was covered by the BBC's Money Box http://www.bbc.co.uk/programmes/b08hl261 (at about 17:10) where they interviewed Professor Leferink who did the study and Howard Porter, CEO of an organisation called BEAMA http://www.beama.org.uk/ who are the regulators for this industry.

The study was initiated after a farmer who had had solar panels installed and was complaining that some days he was getting less output than others (and, no, it wasn't just the sunshine). It transpired that the metering electronics were being affected by some power electronics elsewhere on the farm and the poor result was down to interference.

They noticed reports coming in from elsewhere in other countries, including some that showed lower than expected measurements, so the study was begun.

The meters tested in Professor Leferink's study, some bought in the UK, were industrial grade and using technologies applicable to the likes of sub-station and distribution metering (the words used were "non-fiscal") and not the types used in domestic metering. Mr. Porter stated quite categorically, that the meters used in the UK domestic metering market were subject to an EU wide regulation that mandates a maximum of 1-2% total accuracy and that they are typically more accurate than that. He also stated that the meters tested in the study were of a type that had not, and will not, be used in the Smart meter programme - of which about five million had been installed to date. If you look at BEAMA's website, you will find an updated article on there: http://www.beama.org.uk/news/do-emc-disturbances-affect-smart-meters-esmig-position-paper.html and a white paper on the subject: http://esmig.eu/news/do-emc-disturbances-affect-smart-meters.

Courtesy BEAMA website



The website carries the statement:

After weeks of careful deliberation ESMIG along with its members, have put together a paper explaing the unrealistic conditions in which the TU Twente study on the accuracy of smart meters was conducted and why the results are not relevant.

The main conclusions from this paper are :

- *The electromagnetic interference phenomena created in the tests of the University of Twente grossly exceed emissions limits allowable under EU regulation for equipment typically used in households.*
- *These conditions would not be found in any imaginable normal household scenario.*
- *There is no reason to question smart metering technology.*

You would think that Professor Leferink would have looked into that, wouldn't you? - ***Ed***.

Tailpiece

That's all for this month, folks. This is what we are going to. Not a lot of loft space and a small garden, but I'll make something of it. John, G3WSC used to use a convoluted length of annealed stainless steel wire strung between his shack, his thatched roof and a nearby tree. It was very small gauge and stainless steel is not a favourite for RF, but it worked and is all but invisible. It got snagged by a JCB digger bucket on a couple of occasions and to fix it, you just needed to twist the broken ends together. You *could* crimp it, although you could not solder it. The temporary repairs held up OK in all weathers!

Our move is currently re-scheduled for May 12th, so I may be in a position to do another issue. If I get busy, I don't know what it will turn out like, so fingers crossed! - ***Ed***.