

PALACE PULSE



The newsletter of the

Crystal Palace Radio & Electronics Club

Affiliated to the Radio Society of Great Britain
Established January 1956

Meetings are held on the first Friday of each month.
The room opens at 7:30pm for an 8pm start at:
All Saints Parish Church,
Beulah Hill, London, SE19 3LG
(opposite the junction with Grange Road).
Visitors are always welcome.

*A Merry Christmas and Happy New
Year to all of our readers*

Web sites: Club Admin: <http://cprec.btck.co.uk/>
Club Technical: <http://cprec.btck.co.uk/OurTechnicalSite>
Email: cprec.g2lw@gmail.com
Club Net: Each Wednesday at 20:00 on FM on 145.525MHz (S21) ± QRM
Experimental net each Saturday at 20:00 on FM on 51.55MHz
Twitter @BobFBurns or www.twitter.com/bobfburns

Next meeting: Friday 3rd January 2020

Video Evening

In this issue: *Future Meetings & Events, Recent Event News, Factor 7 by 'Theorist', Technical Snippets, Members News, Miscellaneous, Noticeboard, Diary of External Events, News from other Clubs, Local Training Courses and Club Contact Information.*

See the last page for local training courses and club contact information

Dear Reader

This newsletter is being published a week early to allow for Christmas postal delays.

Future 2020 Club Meetings and Events

03 Jan 20	M	Video Evening
07 Feb 20	M	Annual General Meeting
06 Mar 20	M	Practical Fault Finding by Martin Butler M1MRB
03 Apr 20	M	DMR Hotspots by Damien 2E0EUI
01 May 20	M	S Parameters, SmithCharts and a cheap Vector Network Analyser by Alan G8NKM

C = Contest, CM = Committee meeting, E = External event, M = club meeting, R = Rally, T = Training course, V = Visit.

03 Jan 2020 - Video Evening

The next club meeting will be a Video Evening. Alan writes:

'At next January's club night we will be viewing a video and discussing why we use AC instead of DC at home with an introduction to the commercial battle that took place between Edison and Tesla over power distribution around 1885 in New York. This will be followed by a video on why we use 3 phase AC instead of single phase for power distribution, electric generators and electric motors.'

Recent Event News

06 Dec - Christmas Social

This was a well attended event with lots of eating and talking - thankyou to all those who contributed to the buffet, including Jim's XYL Doris who contributed a very tasty 'bucket of trifle' (Jim's words!). Interestingly last year we had an excess of mince pies and fruit cake - this year we had none!

We had one visitor and Geoff Godfrey sent his apologies for being unable to attend.

Factor 7 by 'Theorist'

Back in the March 2015 newsletter (you can find it on the website) I wrote a piece about the Wow! Event, which was and is the only credible radio signal that could conceivably be from an extra-terrestrial intelligence/civilisation, although I doubt if anybody actually believes that it did come from aliens. The signal was at 1420.4556 MHz, which happens to be about 50Hz above the frequency at which neutral hydrogen has a spectral line, the '21cm' or 'Hydrogen line'. There is a huge amount of neutral hydrogen in the universe so the

1400 to 1427 MHz band is protected internationally as it is of importance to astronomers in this regard.

Looking at 'space' frequencies in general the band between 1420 and 1670 MHz (21 and 18 cm approx) is of astronomical interest as the hydroxyl radical (OH⁻ ion) has a strong line at 18 cm and Hydrogen has the strong 21cm line, and of course the two could combine to make water. The gap between the two is therefore called the 'water hole' not just because of this, but because it happens to be unusually quiet electromagnetically; therefore it is thought to be a region which aliens could use to communicate with one another or us. The term is also a pun on the word 'waterhole' as a meeting place. That the Wow! Signal fell in this region was one reason for its importance, although its closeness to the H line can easily be explained as a blue shift from a source of Hydrogen moving towards us at about 10 km/s. Anyway, this region is where astronomers interested in the search for extra-terrestrial intelligence (SETI) concentrate their efforts. Amazingly the existence of the 21 cm line was predicted in 1944 by Hendrik van der Hulst. Fortuitously it is not affected by interstellar dust through which it can easily pass.

Surprisingly perhaps, the first attempts to detect ETs were in 1899 (Tesla) and 1900 (Marconi), and were unsurprisingly focused on Mars. Both claimed to have detected signals that could potentially have come from Martians. Perhaps they had both just read 'The War of the Worlds' by HG Wells which began serialisation in 1897. There was even a 'radio silence' day in America in 1924 when Mars came particularly close to the Earth, so that communication attempts by scientists could be carried out.

Moving forward, the Nobel laureate Enrico Fermi famously posed the question in the 1950s 'where in everybody?' His reasoning was that if an alien civilisation existed and could reach and inhabit another planet, then they could at an exponentially increasing rate fill the galaxy within a period of at most about 400 million years, and probably considerably less time than this. The Earth should therefore have been colonised or at least visited, presumably with some kind of communications going on between the stars, but there is no evidence of this; indeed the universe seems to be deafeningly quiet. This problem is known as the Fermi Paradox.

Most articles or broadcasts which address the issue of the likelihood of alien civilisations start with the Drake equation. This was put forward by

Frank Drake in 1960 and basically says that 'the number of civilisations in our galaxy with which communication is possible' depends on seven factors which must be multiplied together. These are 'the average rate of galactic star formation', 'the fraction of those stars with planets', 'the average number of those planets that develop an ecosystem', 'the fraction of those that develop life', 'the fraction of those that develop intelligent life', 'the fraction of those planets with intelligent life that develop interstellar communication', and a seventh factor. Unfortunately the factors must be estimated as their values are not known precisely, but at the time Drake estimated that there should be between 1,000 and 100 million other 'communicable civilisations' in our galaxy somewhere. Drake himself conducted the first modern SETI listening experiment in 1960 but found nothing.

NASA had its own SETI programme for a while, but today if the term SETI is used it is likely to refer to the SETI institute which is under contract to NASA and also funded by the NSF (National Science Foundation) and has associations with Silicon Valley. They are involved in research in astrobiology, climate, the search for ex-planets and also for SETI as well as other things. They have an especially designed telescope called the Allen Telescope Array, which is easily misread as Alien, but is named after one of the founders of Microsoft Paul Allen. Note that it is not just used to detect signals from other intelligent species.

There were a lot of factors that had to be considered in the design of this instrument, but the key ideas were worked out around 1998. The strategy that emerged was to have an array of



smaller dishes with a random placement over about a square kilometre. I am not a radio expert but apparently this enables a concentrated beam shape that provides maximum sensitivity at the

spot being examined, while minimising sensitivity outside of this spot. Making a large number of smaller dishes is also more economic than making one large dish, and the array can then always be extended by adding more dishes. The signals do have to be combined however, but thanks to the advances in electronics/computing, and the declining cost, this is not the problem it once was. In addition the array can be divided so that more than one star can be examined at once. It covers 0.5 to 11.2 GHz. So far no signals have been detected that could be construed as alien communications.



I have already indicated all but one of the seven Drake factors. The seventh factor is the average length of time civilisations that develop interstellar communication survive and continue to send communications. Drake was almost certainly primarily concerned here with the possibility that civilisations would destroy themselves with nuclear weapons. I doubt very much that he considered global warming or death by plastic. Perhaps that seventh factor is the answer to Fermi's question.

Member News

a) Our Secretary Alan G8NKM is continuing with the development of a remote HF aerial tuning unit. The manual control software is basically complete and work proceeds with the automatic control software and some form of enclosure.

b) Giorgio IV3 - 57306, our member in Italy, sends his best wishes to all club members for Christmas and the New Year.

c) Club subscriptions for 2020 become due on 1st January and the treasurer will be pleased to receive your payment of £12.00 as soon as is convenient. If you would like to pay by bank transfer please contact our Treasurer.

Club News

a) This is a formal notice that the club AGM will take place at 8pm on 07 February 2020 at our regular meeting venue. This is an important event in the club calendar and is your opportunity to:

- Receive the officers reports for 2019
- Elect a new committee
- Have your say on past activities
- Make suggestions for the future club programme

Please make a note in your diary to keep the date free.

Officer's reports will be included in the February 2020 newsletter which is due out in late January.

We have included a construction contest in past AGM evenings but this was discontinued due to insufficient entries. The committee would reconsider this decision if sufficient members indicated an interest.

b) Club Cupboard: The new secure storage system agreed with the church is now working fairly well although we are still waiting for a key to the outer cupboard door. Some fifteen chairs are also stored in the space next to our metal cupboard and we have been asked to return them to that space after our meeting is over and put the tables back next to the piano in the church.

c) Club Web Site: has been updated so that all club items for sale are now held in one location which will make it easier to update as changes take place.

Technical Snippetts

a) Quartz Crystal Plating: Readers of Sprat from the G-QRP Club will have seen that Phil Miller Tate M1GWZ, a recent speaker to our club, has developed a copper plating method for reducing the resonant frequency of a crystal. A video of the process can be viewed on Youtube at the following URL:

https://www.youtube.com/results?search_query=ctkp40v4oc4

b) Polypropolene Rope: This material has a typical life of about five years in British sunlight and when it is approaching its end of life the outside surface become very 'hairy' as the fibres degrade. As soon as the external appearance changes it should be replaced.

I have just had the tree surgeons in to trim some overgrown trees in my garden and had asked

them to move the polypropolene halyard holding up my HF aerial as it had worn through the soft bark and jammed. It transpired that the rope had degraded to near breaking point so a new halyard was installed on another branch and my HF aerial is now back to its full height.

If any club member would like to conduct some HF band tests please let me know. For stations located in the club catchment area these tests should be carried out early in the day when it is quiet and the skip is very short.

c) Temperature Sensors: It is possible to make a fairly simple sensor head to control one or more cooling fans by mounting a negative coefficient thermistor inside a copper or brass tube which has one end flattened down and drilled to provide a mounting surface.

Since the thermistors are oval in shape the hosting tube can be compressed slightly to increase its width to accomodate the shape. The mounting end is flattened in a vice with the shanks of two small drills inserted in the other end to keep the space open for the thermistor. As the flattened end is not usually level with the outside surface of the tube a washer or metal spacer will be required together with some heat transfer compound.

The photo below shows an example using a wire ended 5000 ohm (at room temperature) NTC thermistor mounted inside a copper tube that offers a snug but not a tight fit with the thermistor body. The thermistor is first connected to flexible insulated wire leads with the solder joints sleeved to reduce the risk of the wires breaking and then retained in place using a two pack epoxy resin.



The completed sensor is bolted down onto the heatsink on the opposite side to the fan.

The thermistor is attached to a simple circuit that drives a comparator that in turn drives a current amplifier to control a relay or the fans directly

depending on the currents and voltages involved. The circuit includes a preset potentiometer to allow the temperature threshold to be adjusted. If you plan to use multiple sensor heads because you have more than one heatsink to monitor then some form of sensor equalisation will be required to cater for the thermistor resistance tolerance.

The comparator may be a 710 or based on an op-amp like the 741 or CA3140 with some positive feedback to provide a little hysteresis to prevent the circuit oscillating each side of the switching threshold due to noise. Most op-amps have an open loop gain of about 100dB so there will be a lot of noise at the output which can cause problems in comparators.

In my new linear power supply I have four heatsinks on the rear panel, each with a temperature sensor. The sensors are diode OR'd together to a single control system so the first sensor reaching a threshold causes all four fans to operate. There are four temperature ranges to be detected:

- Cool - no fan operation
- Warm - low fan operation (almost silent)
- Hot - full fan operation (a bit noisier)
- Too Hot - over-temperature warning light illuminates

Each of the three comparators has about 5% hysteresis so the operate point has a slightly higher temperature than the respective off point.

d) Adjustable Regulator ICs: Although fairly old, the L200 is a useful and relatively low cost device. It can supply up to 2amps output current subject to sufficient heat sinking and has a minimum output voltage of 2.85V. There is built in thermal protection, maximum current limiting and with a few external components the current limit may be made variable.

The maximum current may be increased with the use of an external current amplifier. The data sheet is available on the Internet and contains many application examples. Typical price is about £3.

I have included an example L200 circuit on the last page of this newsletter which was developed to replace the regulator assembly in my Daiwa PS-12M bench PSU which failed while testing an RF amplifier. The output is variable from around 3v - 15v and the maximum current is 8A, limited by the mains transformer and rectifier.

To be on the safe side I replaced all of the electrolytic capacitors used for smoothing as the power supply was more than a few years old. The L200 is mounted on a small black anodised

heatsink which is attached to the printed circuit board. At 8A output current the L200 has to provide a maximum of 400mA and typically much less to the TIP3055 current amplifiers.

The current limit 1K preset PC potentiometer is adjusted to set the onset of limiting to 8A load current. The 1N5401 diode is there to protect the power supply in the event of a large electrolytic capacitor or rechargeable battery being left connected to the output terminals when the PSU is switched off.

Miscellaneous

a) Last month a date gremlin found its way into the newsletter - the Rainham Rally was incorrectly shown as being on 20th February 2020 whereas it should have been 23rd February as is now shown.

b) Project Silica: Nick sent me an email with a short article referring to a new storage technology being developed by Microsoft. To quote from the website:

'Project Silica is developing the first-ever storage technology designed and built from the media up, for the cloud. We are leveraging recent discoveries in ultrafast laser optics to store data in quartz glass by using femtosecond lasers, and building a completely new storage system designed from scratch around this technology. This opens up an incredibly exciting opportunity to challenge and completely re-think traditional storage system design, and to co-design the future hardware and software infrastructure for the cloud.'

See: <https://www.microsoft.com/en-us/research/project/project-silica/> for more information.

c) WRC-19 Changes: Those readers interested in the 50MHz amateur radio band changes can find details on the IARU web site at:

<https://www.iaru-r1.org/index.php/174-news/latest-news/1919-wrc19-more-details-on-the-50mhz-changes>

Notice Board – Wanted and For Sale

The Notice Board is for all club members to use so if you have one or more items that you wish to buy or sell then please send in the details. Some of the current list of items may be viewed at: <http://cprec.btck.co.uk/SaleofClubEquipment>
All excl P&P.

For Sale

a) Fujitsu-Siemens Amilo Pro Laptop running Windows XP Pro, Intel dual core 1.7GHz CPU,

1GB RAM, 80GB hard drive, 15inch LCD, USB, CD/DVD, VGA, WiFi, battery charger, carrying bag, AVG, Office97, Libre Office and assorted utilities, no diskette drive, £35 ono.

Contact Bob on 01737 552170 or G3OOU(at)aol.com.

b) CPREC has a large bank of fundamental and overtone quartz crystals, from 1.0 – 99.91MHz and the list is on the club website as a downloadable PDF file. Prices are £1 each to club members and £2 each to non members, excluding P&P. Contact Bob on 01737 552170 or G3OOU(at)aol.com.

All items are offered on a first come first served basis.

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G3OOU

Diary of External Events

02 Feb 2020 - South Essex ARS 36th Canvey Radio & Electronics Rally

Cornelius Vermuyden School, Dinant Avenue, Canvey Island, Essex SS8 9QS. Talk in 145.550MHz. Free car parking, two large halls. Opens 10am, disabled visitors 9.45am. Entry £3, children under 10 free. Tea, coffee, soft drinks and bacon butties will be available. Radio, computing and electronics traders. Details from Tony, G0JYI via tony@tonystreet.net.

09 Feb 2020 - Harwell Radio and Electronics Rally

Didcot Leisure Centre, Mereland Road, Didcot, Oxon, OX11 8AY (3 miles from A34 Milton Interchange). Open 10am to 3pm, entry £3 (under 12s free). Free car parking, disabled parking and facilities. Talk in 145.550MHz (G3PIA). Traders, SIGs and RSGB Bookstand. Home-made refreshments. Details from rally@g3pia.net or 01235 816379 [www.g3pia.net].

23 Feb 2020 - Rainham Radio Rally

The Victory Academy, Magpie Hall Road, Chatham, Kent, ME4 5JB. Open 10am to 3pm, local and national Traders, BRATS Kitchen, Interactive Zone for Kids and Junk, Talk in on 145.550MHz using GB4RRR. Contact 07825 838 877 or rally-coordinator@brats-qth.org

29 Mar 2020 - Hamzilla Radio Fest 2020

Discovery Science Park, Gateway House, Ramsgate Road, Sandwich, Kent CT13 9FF.

Open 9.30am for early bird admission £5, 10am for general and disabled access £3, under 16 and disabled carer free. There will be trade stands, exams available on the day and hot and cold refreshments. www.hamzilla.uk

14 APRIL 2020 - West London Radio & Electronics Show (Kempton Rally)

Kempton Park Racecourse, Staines Road East, Sunbury on Thames, TW16 5AQ. Talk-in station, free car parking, opens at 10am with disabled visitors gaining access 10 minutes earlier. Trade stands, Bring & Buy, special interest groups and lectures. Catering is available on site. More details from Paul, M0CJX on 08451 650 351, info@radiofairs.co.uk or www.radiofairs.co.uk.

News from Other Clubs

Club Secretaries – please ensure that your future meeting details are present in your newsletters, on your websites or sent to our newsletter editor Bob G3OOU. Palace Pulse is published about ten days before our club meeting which is on the first Friday of each month and closes for editorial contributions a few days before publication. Due to differing publication dates and short lead times it is getting increasingly difficult to include other clubs' events although we will endeavor to do so if advised in time. **If we are regularly unable to obtain the information then that club entry will be removed from this newsletter.**

Readers - If you plan to visit one of these club meetings please check with the club concerned in case of any last minute changes.

Bredhurst Receiving and Transmitting Society

Meet on Thursday night from 8:30pm at the Parkwood Community Centre, Long Catlis Road, Rainham, Kent, ME8 9PN. Contact

secretary@brats-qth.org or <http://www.brats-qth.org/brats/>

19 Dec Club night at the shack

02 Jan 20 RTTY Interface Building

Bromley & District Amateur Radio Society

Meets at 19:30 on the third Tuesday of each month at the Victory Social Club, Kechill Gardens, Hayes, Bromley, BR2 7NH. Contact Andy G4WGW on 01689 878089 or [enquiries\(at\)bdars.co.uk](mailto:enquiries(at)bdars.co.uk). Web: www.bdars.co.uk

17 Dec Quiz & Mince Pies

21 Jan 20 AGM and 2020 Programme Planning

Chelmsford Amateur Radio Society (CARS)

Meets at 19:30 on the first Tuesday of each month at Oaklands Museum, Moulsham Street, Chelmsford, Essex, CM2 9AQ. Contact:

[secretary\(at\)g0mwt.org.uk](mailto:secretary(at)g0mwt.org.uk) Web: www.g0mwt.org.uk

Coulsdon Amateur Transmitting Society (CATS)

8:15pm on 2nd Monday each month. Contact: Andy Briers G0KZT on 07729 866600 or secretary(at)catsradio.org. Web site:

<http://www.catsradio.org/>

05 Jan 20 CATS Annual Dinner

10 Feb 20 Practical Evening, Fix-its, Electronics Play, Social

09 Mar 20 Surplus Sale/Auction

Crawley Amateur Radio Club (CARC)

Every Wednesday 20:00 – 22:00, every Sunday 11:00 – 13:00. Formal events are on the fourth Wednesday of the month, 7-30pm for 8pm. Phil M0TZZ on 07557 735265 or secretary(at)carc.org.uk or Web:

<http://www.carc.org.uk/>

22 Jan 20 Club AGM

Cray Valley Radio Society (CVRS)

Meets at 8pm on the 1st and 3rd Thursday of each month at 1st Royal Eltham Scouts HQ, Rear of 61 - 71 Southend Crescent, Eltham, London, SE9 2SD. Contact: Richard on secretary[at]cvrs.org. Web

www.cvrs.org

19 Dec Christmas buffet: Bob M0MCV

16 Jan 20 2020 meeting/event planning meeting: Dave G8ZZK

Dorking & District Radio Society

Meetings at 7.45pm. Contact: David Browning (M6DJB) at [djb.abraxas\(at\)btinternet.com](mailto:djb.abraxas@btinternet.com). Web site: <http://www.ddrs.org.uk>

28 Jan 20 Practical Fault Finding by Martin Butler M1MRB

25 Feb 20 Visit to Vintage Radio Museum, East Dulwich

24 Mar 20 Count Basie And His Discovery Via Ionospheric Propagation by Colin Richards G3YCR

28 Apr 20 Propagation Prediction Using the Chilbolton Ionosonde by Philip Miller Tate M1GWZ

26 May 20 6m Operation by Chris Deacon G4IFX

Echelford Amateur Radio Society

Meetings on 2nd and 4th Wednesdays of each month at new venue: St. Hilda's Church Hall, Stanwell Road, Ashford, TW15 3QL. Enquiries to Phil at M1GWZ(at)icloud(dot)com. Web site:

<http://www.qsl.net/g3ues/index.htm>

08 Jan 20 Bring & Buy

22 Jan 20 Using an Oscilloscope - Pete Worrell G4GJV / Phil Miller Tate M1GWZ

12 Feb 20 Loop Antennas - Colin Berry, M0GXV

26 Feb 20 Annual Construction Contest - what have you been making recently? Bring it along!

Hastings Electronics & Radio Club

Meetings held at the Taplin Centre, Upper Maze Hill, St Leonards on sea, TN38 0LQ, 7pm for 7:30 on the fourth

Wednesday of each month. Information from Gordon Sweet M3YXH on 01424 431909, email: sionet3344(at)hotmail.co.uk

Web: <http://herc-hastings.org.uk/>

December No meeting

Horsham Amateur Radio Club

meets on the first Thursday of each month at the Guide Hall, 20 Denne Road, Horsham, West Sussex, RH12 1JF. NRQ TQ172304 at 20.00hrs local time. Contact Alister Watt G3ZBU at [g3zbu\(at\)hotmail.com](mailto:g3zbu@hotmail.com) or <http://www.harc.org.uk/>

19 Dec Social

Mid-Sussex Amateur Radio Society (MSARS)

Meet most Fridays in the Millfield Suite, Cyprus Hall, Burgess Hill, RH15 8DX from 7.30pm till 10.00.

Contact Stella on 01273 844511,

M6ZRJ(at)msars.org.uk or www.msars.org.uk

20 Dec Christmas Quiz - Sue G6YPY

03 Jan 20 Radio Night

17 Jan 20 Radio Night & Table Top Sale

24 Jan 20 Update on Future Training

North Kent Radio Society

Meets at the Hurst Community Centre, Room 15, Hurst Place, Bexley, Kent, DA5 3LH. Doors open at 8PM. More information from Stephen G8JZT on secretary@nkrs.info or 07985 753370 evenings or weekends.

Web: <http://www.nkrs.org.uk/>

14 Jan 20 Curry Night (not a regular club night)

21 Jan 20 Frank G3WMR on Jersey

18 Feb 20 Bring a Thing Night

South East Essex Amateur Radio Society (SEARS)

Contact Mark Callow 2E0RMT on 07842 336444 or secretary(at)southessex-ars.co.uk or

<http://www.southessex-ars.co.uk/>

Meetings: 7pm 2nd Tuesday each month at The White House, Kiln Road, Benfleet, Essex, SS7 1BU.

14 Jan 20 Canvey Rally Preparations

11 Feb 20 Rally summary and recap

10 Mar 20 Nigel Newman M0ICH a talk about his time in the Royal Signals

Surrey Radio Contact Club (SRCC)

7.30 for 7.45pm on 1st. and 3rd. Mondays every Month. Contact John Kennedy G3MCX on 020 8688 3322 or secretary(at)g3src.org.uk. Web:

<http://g3src.org.uk/>

06 Jan 20 Club IC9700 demo and familiarisation session

20 Jan 20 Skills and Fixit

03 Feb 20 Digital Voice Communications by G6PTY

17 Feb 20 Skills and Fixit

02 Mar 20 Spring Surplus Equipment Sale

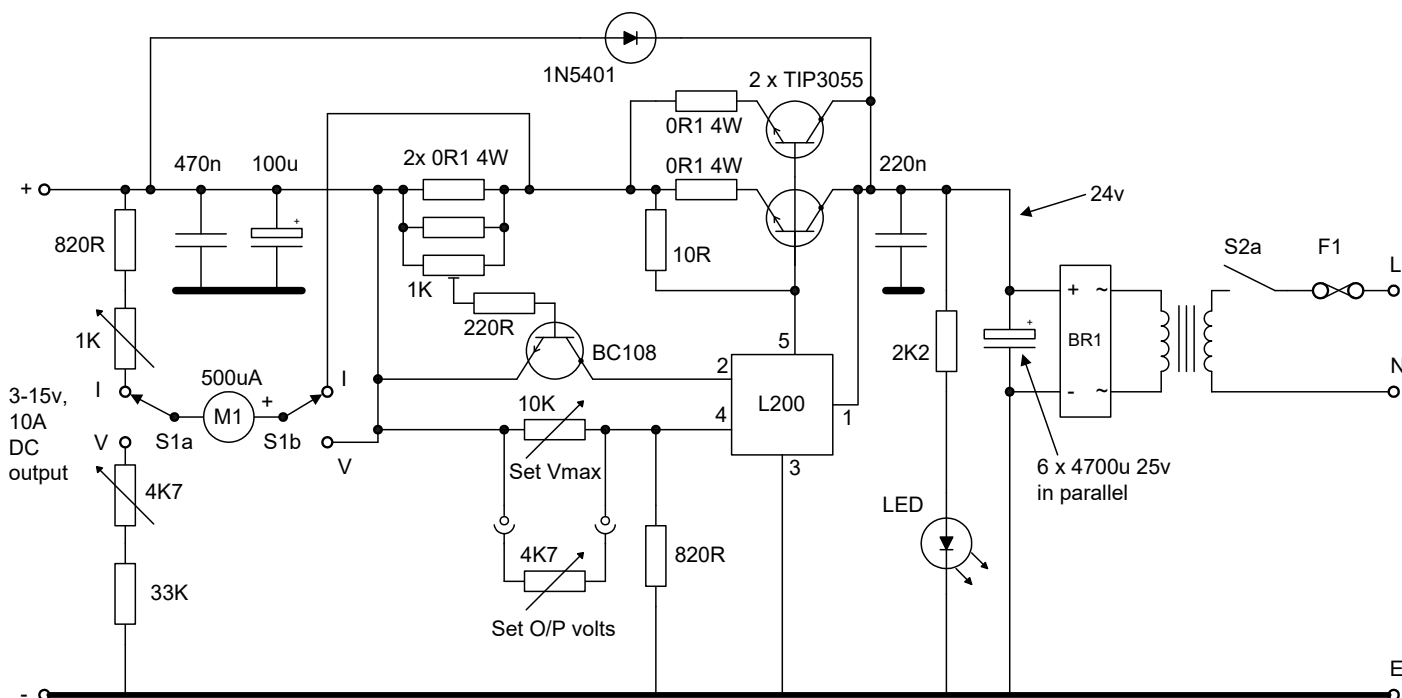
Sutton & Cheam Radio Society

8pm on 3rd Thursday every month. Contact Chris Howard at info(at)scrs.org.uk Web:

<http://scrs.org.uk/>. SCRS run a practical group most Monday evenings at the Bandstead Scout Hut.
 16 Jan 20 New training syllabus by Alan Betts, G0HIQ
 20 Feb 20 Sutton and Cheam, the early years. Neil Horton, M0ZEY
 19 Mar 20 Building the QRP labs QCX kit, Matthew

Nassau, M0NJX
 16 Apr 20 From Top Band to 198 Long Wave by Jim Lee, G4AEH
 21 May 20 AGM and Construction competition

Please replace the (at) with @ when using any email addresses shown in this newsletter.



Notes:

1. Bridge rectifier BR1 and TIP3055 devices mounted on a separate heatsink
2. L200 has a small PCB mounted heatsink

Local Training Courses - Please note that the new syllabus is now in operation.

Crystal Palace Radio & Electronics Club is a member of the South East Tutors training group.

Licence Level	Dates	Location	Club Provider	Format	Further details
Foundation	1 & 8 Feb 2020	Eltham, SE9 2SD	Cray Valley	Two Saturdays	www.cvr.org
Intermediate	05 Apr - 07 May 2020	Bromley BR2 7NH	Bromley & District ARS	Three Sundays	www.bdars.co.uk
Foundation	04 Oct - 18 Oct 2020	Bromley BR2 7NH	Bromley & District ARS	Two Sundays	www.bdars.co.uk
Intermediate	14, 21, 28 November 2020	Eltham, SE9 2SD	Cray Valley	Three Saturdays	www.cvr.org
	= course commenced				

Palace Pulse is published ten days before each meeting and closes for contributions five days before the publication date. Please send contributions to the newsletter editor shown below.

CPREC Committee Information

Officers:		
Chairman:	Secretary:	Treasurer:
Damien Nolan 2E0EUI	Alan O'Donovan G8NKM	Ian Skeggs M6FZC
E: cprec.g2lw(at)gmail.com	E: cprec.g2lw(at)gmail.com	E: cprec.g2lw(at)gmail.com
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Bob Burns G3OOU	Newsletter Editor	T: 01737 552170 E: g3oou(at)aol.com
Nick Stapley	Web Manager	