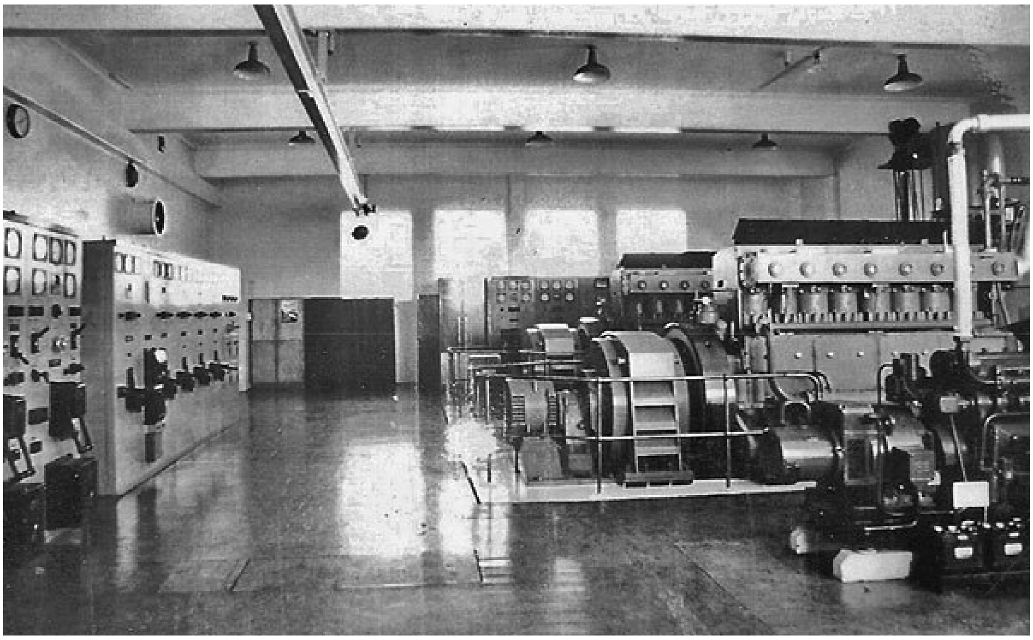
Ham Hum

September 2017

The official newsletter of
The Hamilton Amateur Radio Club (Inc.)
Branch 12 of NZART - ZL1UX
Active in Hamilton since 1923

Hamilton Amateur Radio Club Inc. Serving the Hamilton Community for over 90 Years ZL1UX



Next Meeting

20th September : 7:30pm

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From the Editor

Spring is in the air. Or at least, some trees at my place are showing new green growth and flowers, so I guess things are warming up.

I haven't done much on HF all winter so I'm planning on checking out my aerial setup just in case one of the winter storms damaged more than just tree branches.

SB PROP ARL ARLP035
ARLP035 Propagation de K7RA

A new video from Dr. Skov:

https://youtu.be/qvjfFpRMQpY

Average daily sunspot numbers and solar flux declined this week (August 24 to 30). Average daily sunspot number went from 39.9 to 33.3, while average daily solar flux declined to 81.2 from 84.6.

Average planetary A index declined from 23.1 to 7.1, and average mid-latitude A index went from 18.6 to 7.4.

The latest forecast shows planetary A index at 24, 16, 12 and 8 on September 1 to 4, 5 on September 5 and 6 then 8, 10 and 8 on September 7 to 9, 5 on September 10 to 12, 25 on September 13, 30 on September 14 and 15, then 25 and 12 on September 16 and 17, 8 on September 18 and 19, 5 on September 20 to 22, 10 on September 23 and 24, then 8, 15, 25, 18, 15 and 8 on September 25 to 30, then 5 on October 1 to 4, 10 and 8 on October 5 and 6, 5 on October 7 to 9, 25 on October 10, 30 on October 11 and 12, then 25, 12 and 8 on October 13 to 15.

Predicted solar flux is 92 on September 1 and 2, 91 on September 3, 90 on September 4 to 7, 80 on September 8, 85 on September 9 to 14, 88 on September 15 to 18, 85 on September 19 and 20, then 82 and 80 on September 21 and 22, and 78 on September 23 to 25, 77 and 75 on September 26 and 27, 74 on September 28 and 29, 72 on September 30 through October 3, 75 and 80 on October 4 and 5, 85 on October 6 to 11 and 88 on October 12 and 15.

Geomagnetic activity forecast for the period September 1 to 27, 2017 from OK1HH.

"Geomagnetic field will be:

Quiet on September 10 and 11, 20 and 21

Mostly quiet on September 4 to 6, 23, 26

Quiet to unsettled September 3, 8 and 9, 19, 22, 27

Quiet to active on September 2, 7, 12, 16 and 17, 24

Active to disturbed on September 1, 13 to 15, 18, 25

Remark: Parenthesis means lower probability of activity enhancement and/or lower reliability of prediction."

For more information concerning radio propagation, see the ARRL Technical Information Service at http://arrl.org/propagation-of-rf-signals. For an explanation of numbers used in this bulletin, see http://arrl.org/the-sun-the-earth-the-ionosphere.

An archive of past propagation bulletins is at http://arrl.org/w1aw-bulletins-archive-propagation. More good information and tutorials on propagation are at http://k9la.us/.

Monthly propagation charts between four USA regions and twelve overseas locations are at http://arrl.org/propagation.

Instructions for starting or ending email distribution of ARRL bulletins are at http://arrl.org/bulletins.

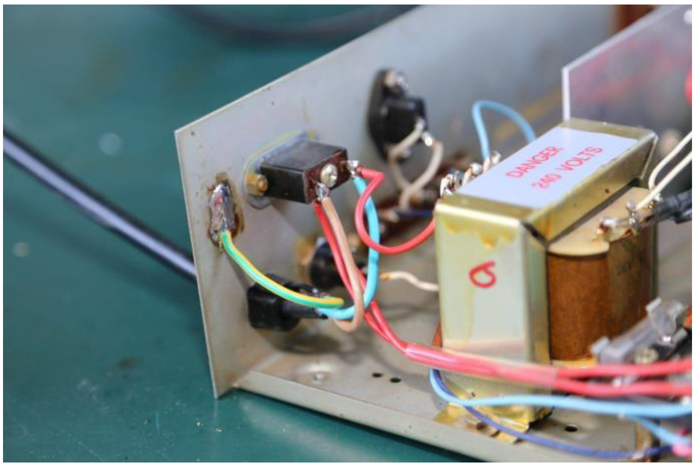
Sunspot numbers for August 24 to 30, 2017 were 43, 39, 35, 22, 17, 35, and 42, with a mean of 33.3. 10.7 cm flux was 78.8, 80.8, 77.5, 78.2, 81.6, 84.3, and 86.9, with a mean of 81.2. Estimated planetary A indices were 11, 5, 5, 10, 4, 10, and 5, with a mean of 7.1. Estimated mid-latitude A indices were 16, 7, 5, 6, 3, 10, and 5, with a mean of 7.4.

Transistor Sound

Years ago I heard all about "Transistor sound", or was that Transistor noise, and how terrible these new solid state amplifiers were, stick with valves was the cry by the golden ear brigade.

I was born at the end of the valve era, and frankly anything that wanted to kill me, was to be avoided, so I was happy to skip the 200+ volt HT supplies of the era, and stick with transistors.

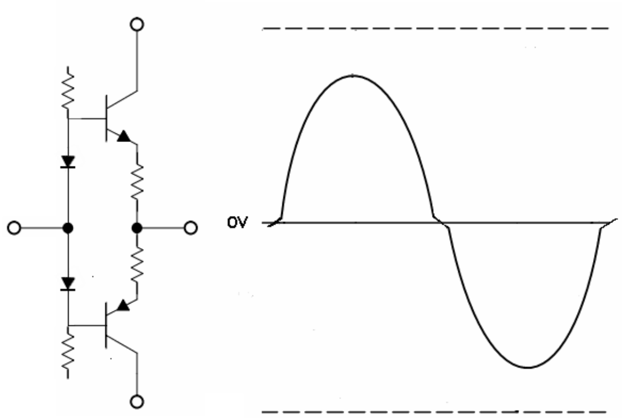
By the time I had grown up and could afford a HiFi system, the art had advanced enough that I never really knew what transistor sound was – that is apart from nasty miniature tranny radio's.



Recently, a colleague from church dropped off this ancient Diamond brand amplifier that he picked up at the tip shop? All it needed was a new power cord. I'm not sure how the original cord was anchored, as all that was left was half a rubber grommet, no clamp etc.

So after doing some panel bashing to fit a plastic cable clip, and soldering the earth wire to the sheet metal chassis (Boy was the original joint dodgy) it was time to give it a run. – Yuk

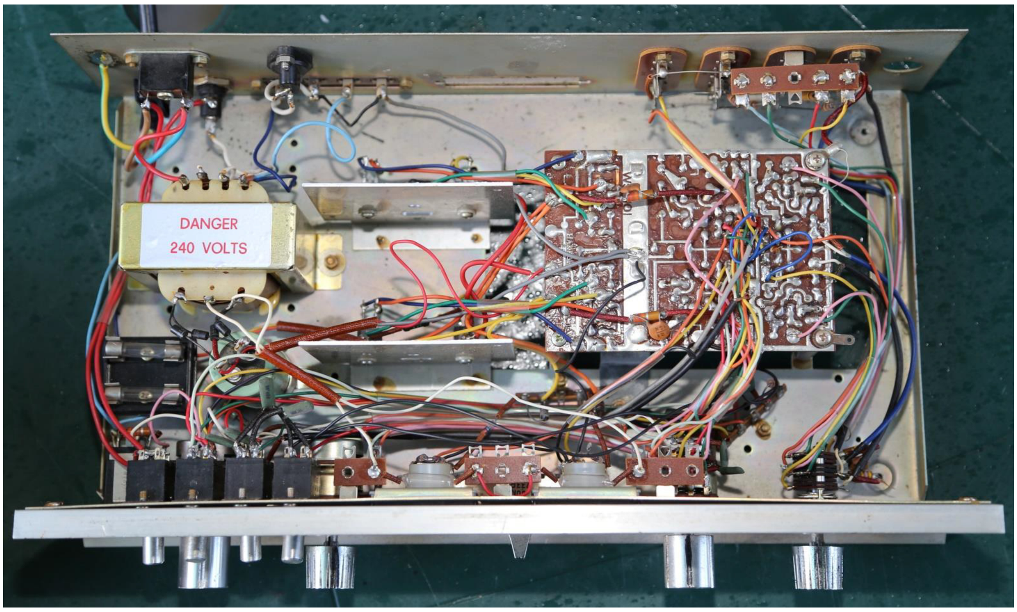
Apart from several other faults, the basic sound out was terrible, I then remem-



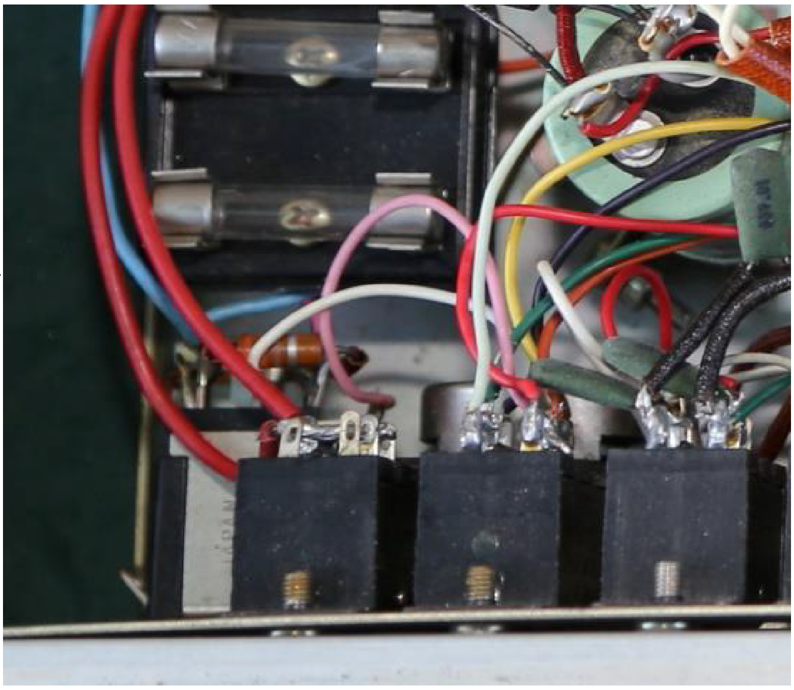
bered all those tales about transistor sound.

So for comparison purposes with something of a similar vintage, I dug out an old Linmark valve stereo amplifier. This amp uses a single ended configuration using ‘modern’ miniature valves; I think you’d be lucky to get 5W a channel, about the same as the Diamond with a single 20V DC supply. The first thing I noted (surprise surprise) was the Linmark was so much quieter.

One of the first suspects in transistor amps is crossover distortion. As the signal passes from one polarity to the other, one output transistor cuts out and its mate takes over. On a valve amp, this process is quite smooth, and you kind of have to



go out of your way to get it wrong, however with a transistor, the cut-off is a lot more abrupt. You have to make a lot of effort in controlling those output devices so you don’t end up with a crossover ‘bump’ in your signal. Another problem, alluded to often in 'Silicon Chip' magazines is the earthing and routing of signal lines. Everything is low impedance, with high currents, so voltage drops and high current lines inducing signals into other lines abound. Quite a while ago they did a re-design of the old ETI 480 amplifier, and they achieved quite marked improvements in distortion figures just by getting the track layout right. In the article they also specify how the wiring is to approach & leave the board, for fear of inducing a non-symmetrical signal into a sensitive part.



Graeme VK3XTA had a job fixing an old church PA amp; he simply gutted it and fitted one of these Silicon Chip SC480 amps, and was rewarded by comments that the sound system sounded so much better! http://archive.siliconchip.com.au/cms/A_30285/article.html

Back to the Diamond, if you look how it was put together, it looks like the designers expected it to fail regularly (or was that a hangover from endless work to make it work acceptably) as the main board is mounted upside down, over a large hole, making changing parts a breeze.

Now look at all that wiring, what a mess, and where is the shielding etc.

One surprise is the input selector, two selections for a turntable; normally such a selector would be on the back panel, as one doesn't generally change your turntable cartridge that often.

I was expecting a great rise in the noise when I selected the magnetic pre-amp, but it wasn't so, there was almost no change at all. I didn't actually connect a turntable, so who knows if it actually works. Or maybe it has really low gain, hence the lack of noise – what was there was all but drowned out by heaps of noise in the main amplifier.

I was also no fan of the all but dodgy mains wiring around the power switch, with basically no isolation between it and the surrounding audio wiring, live solder tags etc. And then there was the soldering …… Real 'A grade' (not) stuff.

So did I repair it – No. After fitting the power lead, I figured I'd already spent more time on it than it was worth.

-VK3TGX

High-frequency chip brings researchers closer to next generation technology

A novel, high-frequency electronic chip potentially capable of transmitting tens of gigabits of data per second—a rate that is orders of magnitude above the fastest internet speeds available today—has been developed by engineers at the University of California, Davis.

Omeed Momeni, an assistant professor of electrical and computer engineering at UC Davis, and doctoral student **Hossein Jalili** designed the chip using a phased array antenna system. Phased array systems funnel the energy from multiple sources into a single beam that can be narrowly steered and directed to a specific location.

"Phased arrays are pretty difficult to create, especially at higher frequencies," Momeni said. "We are the first to achieve this much bandwidth at this frequency."

The chip prototyped by Momeni and Jalili successfully operates at 370 GHz with 52 GHz of bandwidth. For comparison, FM radio waves broadcast between 87.5 and 108 MHz; 4G and LTE cellular networks generally function between 800 MHz and 2.6 GHz with up to 20 MHz of bandwidth.

Most modern electronics are designed to operate at lower frequencies. However, the growing demand for faster communication, and new and emerging applications of sensing and imaging are driving the creation of technologies that function at higher frequencies.

Reaching speed limit of 4G networks

"Theoretically, 4G cellular networks have reached their data rate limit," Momeni said. "As we continue to migrate to systems like cloud computing and next generation cellular networks, the need for speed is growing. Higher frequencies mean more bandwidth and more bandwidth means higher data rate."

The tiny piece of hardware designed by Momeni and Jalili is evidence that it is possible to harness the large available bandwidth at millimeter-wave and terahertz bands on a single, compact chip. This is an important step toward the development of scalable systems that can be used to sharpen technologies like spectroscopy, sensing, radar, medical imaging and high-speed communication.

In future work, Momeni plans to integrate the chip into imaging and communication systems.

The research was supported by a five-year National Science Foundation CAREER grant awarded to Momeni. The ongoing project is titled "Scalable Traveling and Standing Wave Structures for High-Power and High-Efficiency Terahertz and mm-Wave Radiator and Phased Array Systems."

Read more at:
https://phys.org/news/2017-08-high-frequency-chip-closer-technology.html#jCp

The challenges of developing a linear CubeSat transponder

AMSAT SA recently tested the third generation of a linear transponder to become the main pay-load on their CubeSat, Kletskous. The first two generations both worked very well but accord-ing to Leon Lessing, ZS6LMG, who earlier this year took over the development of the transponder, “you don’t want to launch an oven into space”, inferring that it uses too much power of which there is little available on a satellite that measures only 1 dm^3.

In a CubeSat, there is no luxury of thick metal shields. This means that one has to be mindful of de-signing a transponder that does not suffer interference between various elements on the transponder board and neighbouring boards in the stack. To minimise the requirement for physical screens, one way to overcome the possible interference problem is by using rigid shielded, properly terminated cables to transport mixer signals on the board.

“Working on the Kletskous transponder I found out the hard way that small self-contained RF designs can be a major challenge. On a previous balloon flight, I ran two RDA1846 devices as a FM only transponder, with very good success, except that the higher in near space the devices went, the more they became desensitised”, Leon said.

Designing a single signal transponder is trivial, but designing a linear transponder capable of handling multiple signals presents a major RF engineering challenge. One of the challenges is the automatic gain control (AGC) of the transponder, for example signal A comes in at a 10 dB lower level than signal B. Once this has passed through the linear transponder the effect is that the difference between signal A and sig-nal B will still be 10 dB. With the constraints on the weight and power of the CubeSat it is impossible to try and improve this situation. The only workaround is for every person on the ground wishing to communicate through the transponder to use the minimum uplink power to ensure successful communications.

Filtering is extremely important, but there is a fine line between signal quality and selectivity: the more filters the higher the loss. The higher the loss the more the signal has to be amplified, and with more amplification noise is introduced, reducing the quality of the signal.

The current design operates on the classic regenerative principle where the incoming signal is filtered, amplified, translated to a different frequency, filtered, and again amplified before being transmitted.

When conceiving Kletskous, AMSAT SA considered various options. It was decided that to give as many radio amateurs access to satellites communication, a linear transponder was decided on. The ad-vantage is that it will be able to handle CW, SSB, digital modes (obviously weak signal modes are excluded), and FM.

The concept is to set the filters such that the transponder will not do spectrum inversion. In other words, it will not translate an upper side band (USB UHF) input to lower side band (LSB VHF) output but receive USB (UHF) and transmit USB (VHF).

The first design used fractional-N phase lock loop (PLL) / direct digital synthesis (DDS) devices which worked very well but had the drawback that these devices consume huge amounts of power which is in short supply on a CubeSat.

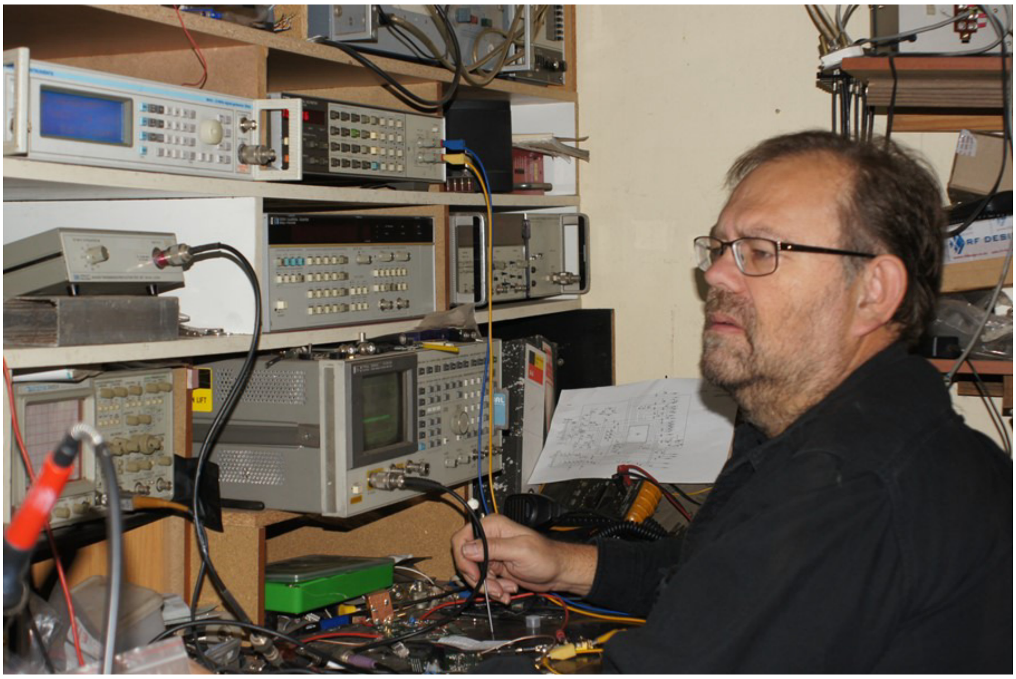
Current design

A SiLabs Si5351 clock generator device is used as a local oscillator. However, there was a challenge in that this device can maximally generate 200 MHz, which does pose a problem as 390 MHz is required for the first mixer. The problem was addressed by adding a tripler circuit that takes the 130 MHz output of the Si5351 and produces 390 MHz.

The transponder is controlled via a single I2C interface, the devices on the bus being the Si5351 clock generator, MCP23008 I/O expander and the MCP4725 digital-to-analogue converter. The MCP23008 is used to switch the power domains, and the MCP4725 is used to control the average output power of the transponder.

The input stage utilises two surface acoustic wave ceramic filters to ensure that the minimum of un-wanted signals reach the IF amplifier. This implies that the lower level harmonics of the tripler will not cause any unwanted signals in the operating range of the IF.

The mixers are UPC2758 double balanced mixers with integrated gain stages. The specifications of these devices are 19 dB gain, ±9 dB noise figure and an IP3 specification of +5 dBm.



An IF frequency of 45 MHz with a bandwidth of 15 kHz was selected. (Any IF frequency can be select-ed as long as the second and third harmonics do not fall close to the receive or transmit bands.) The RF2637 AGC amplifier can be programmed for gains ranging from -55 dB to +51 dB. It has an IP3 specifica-tion of -2 dBm (at a gain setting of -55 dB) and a maximum noise figure of 7,2 dB.

Various topologies are possible for up-converting the 45 MHz IF signal to the required 145 MHz output frequency. A possibility is to mix the 45 MHz IF with a 190 MHz signal. A low pass filter must then be used to filter out the unwanted 190 MHz and 235 MHz components. Another other option is to mix the 45 MHz IF with a 100 MHz signal and filter out the unwanted 100 MHz and 55 MHz components. Currently the first option has been implemented.

A BFR93 transistor configured as a linear amplifier is used to boost the level of the wanted 145 MHz signal. The final amplifier follows this, a 2SK3475 RF MOS-FET capable of 500 mW output at 7,2 V. The out-put power level control loop is closed via an AD8307 logarithmic amplifier and an operational amplifier.

The 145 MHz signal is filtered once again before being radiated by the dipole antenna. One of the original ideas was to make use of a class AB amplifier for the final stage. This was abandoned due to the bulky ferrites/transmission lines that would have been required. Another option is a readymade, 10 W power module. This is currently plan B, but it does add a lot of weight to the transponder. It also has the capability of destroying the power budget.

The next step is to finalise the transponder PCB for the “flat-sat” integration with the other modules of the CubeSat. This is an exciting time where all the various sub-systems are connected to test the full functionality of the CubeSat before it is built into the spaceframe.

- Hans van de Groenendaal, features editor, EnineerIT

Upcoming Happenings & Events

Date	*Happenings & Events*
1st September	**NZART HQ Infoline**
4th September	HF Net, 3.575 MHz, 19:30
5th September	VHF Net, 146.525 MHz, 20:00
11th September	HF Net, 3.575 MHz, 19:30
12th September	VHF Net, 146.525 MHz, 20:00
15th September	**NZART HQ Infoline**
18th September	HF Net, 3.575 MHz, 19:30
19th September	VHF Net, 146.525 MHz, 20:00
20th September	**Club meeting**
24th September	**NZART Official Broadcast**
25th September	HF Net, 3.575 MHz, 19:30
26th September	VHF Net, 146.525 MHz, 20:00

6th October—NZART HQ Infoline

7-8 October—NZART Microwave Contest

18th October—Club Meeting

29th October—NZART HQ Infoline

29th October—NZART Official Broadcast

3rd November—NZART HQ Infoline

5th November—NZART Straight Key Night

17th November—NZART HQ Infoline

26th November—NZART Official Broadcast

2-3 December—NZART Field Day Contest

For more information on any of the above please contact myself or any committee member.

Club Information

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Business Meeting:	1930 First Wednesday of each month except January 88 Seddon Road, Hamilton
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eMail:	branch.12@nzart.org.nz
HF Net:	3.575MHz LSB 1930 Mondays
VHF Net:	146.525MHz simplex 2000 Tuesdays
2m Repeater:	145.325MHz -600kHz split
STSP Repeaters:	146.675MHz -600kHz split 438.725MHz -5 MHz split
ATV Repeater:	Off air pending channel changes

Cover Photo: Backup power at Himatangi.
http://maritimeradio.org/himatangi-makara/himatangi-radio/1960-1969/life-of-a-himatangi-technician/

http://maritimeradio.org/himatangi-makara/himatangi-radio/technical/emergency-power/

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