GATEWAY

The Official Magazine of the Gippsland Gate Radio & Electronics Club Inc.

October 2016

LED Bar Graph Display

Arduino Interest Group

23cm Vertical Antenna

And More

President's report - page 3

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Event Queue

October:

21st	October General Meeting
23rd	Club Net 8.00 pm - on VK3RLP
29th-1st	Camping on the Avon River – Melbourne Cup Weekend
29th-30th	CQ WW DX / SSB CONTEST (Always Oct Last full weekend)
30th	Club Net 8.00 pm - on VK3RLP

November:

4th	Prac Night
6th	Club Net 8.00 pm - on VK3RLP
8st	Arduino night, Tuesday 7:30 – Guide hall
11th -14th	The Keith Roget Memorial National Parks Award Activation
13th	Club Net 8.00 pm - on VK3RLP
18th	November General Meeting
20th	Club Net 8.00 pm - on VK3RLP
22nd	Arduino night, Tuesday 7:30 – Guide hall – To be confirmed – possible Guides conflict
26th	Rosebud RadioFest 9:30 am till 2pm
26th-27th	WIA VHF/UHF Spring Field Day
27th	Club Net 8.00 pm - on VK3RLP
26th-27th	CQ WW DX / CW Contest (Always the last full weekend in November)

December:

2nd	Prac Night
10th	Christmas break up at Graeme brown's QTH

GGREC PRESIDENTS REPORT - MELTDOWN OR FISSION SURPLUS?

Twenty five years ago Mr Burns of Simpsons fame was interviewed about the impending failure of his nuclear power plant: ***"…Oh, Meltdown. Its one of those annoying buzzwords. We prefer to call it an unrequested fission surplus."***

Throughout 2016 we have been presented with different reports about the true state of the Amateur Radio representative body, the *Wireless Institute of Australia*. What we read in their magazine *Amateur Radio* is that there are some small management issues to be resolved. We are told that we should accept things the way they are and that any questions directed to the Board of Directors are attacks upon the integrity of the hobby.

The volunteer staff who had been holding the WIA together became exasperated from being repeatedly ignored by the management when they tried to communicate concerns and the need for action. In despair, many helpers have quit their posts, leaving unfulfilled voids. Reportedly, the Board's solution is to formalise even more isolation between themselves and office staff, rather than embracing and supporting the loyalty of volunteers who have kept the WIA alive for more than a century.

Two weeks ago, following frank discussions within our own club, I issued an open letter to other WIA affiliated clubs. This was to test the waters to see if we were unique in the conclusions we had drawn. In the brief time since then, I have been staggered at written and verbal feedback returned from the numerous clubs that feel the same way. A major lack of confidence in our Board seems universal and to date, no replies have been received that support their efforts.

Over the past year, two directors on the Board, Andrew Smith, VK6AS and Paul Simmons VK5PAS have attempted several times to introduce fiscal management and transparency. For this endeavour they have been isolated and verbally attacked by other Board members. When they attempted to use WIA news forums to inform members about the reasons for their proposals, they were censored and denied access. It's not about simple differences of opinion, it's about the deliberate shutting down of any conversation that exposes poor management.

This is an extraordinary turn of events. At their own expense, these two directors have taken the unprecedented step of having to communicate with their members from *outside* the institute. To that end, Andrew and Paul have embarked on a road trip to visit as many affiliated clubs that they can to tell the story behind their motivations and actions in person. An invitation to attend these sessions has been extended to all Amateurs in the region.

On Tuesday November 15, there are to be TWO information sessions in Melbourne:

At 2:00pm Andrew and Paul will visit the FAMPARC Clubrooms, located at the South side of the school grounds of Cornish College, Patterson Lakes/Bangholme. A free barbeque lunch (sponsored by GGREC) will be provided from 12:30pm. (Note, South heading traffic must take Wells Road, NOT the freeway.)

The second event will be hosted later that day by the EMDRC at 8:00pm their Clubrooms at 13a McCubbin St. Burwood. The EMDRC will also be providing a free barbecue at their location from 6:30pm

I thank both EMDRC and FAMPARC for the courage to host these events and recommend that those who are able, to make the trip to one of these two venues.

Readers may wonder why I have taken such a strong stand from what had been a neutral position. Mostly this is due to the actions of several long established Directors. They have dealt with concerns by branding them as a 'Witch hunt' and have focused on attacking the credibility of the messengers. This is not how representative officers of our WIA should behave.

The problems now facing the WIA are not going to be fixed with damage control language. A short course in corporate practises for the directors is not enough to change the mindset of those who dug the hole we are in. At best it will only replace big shovels with smaller shovels.
Ultimately, we must have a new board that will listen to their affiliated clubs and members, listen to the Amateur community and act accordingly.

And so onto other issues of interest…

At the upcoming GGREC General Meeting, Graeme Brown, VK3BXG will give a short talk on his methods for mobile 2 metre band antennas. It should be a good one.

Also Graeme has kindly volunteered his home location in Drouin, the site of our 70cm repeater, VK3RWD, as the venue for this years GGREC Christmas break-up Barbeque. This will happen on December 10, with more details appearing in November Gateway.

(Sadly, Dianne VK3JDI and myself will miss that event. We shall be heading for Germany, Switzerland, Italy and Austria spread over 22 days and 16 train rides, where the Australian summer will be but a dim memory perceived through cold feet and chattering teeth. Ho Ho Ho…)

I must seize this occasion to further compliment the efforts of Albert VK3BQO and Rob VK3BRS for the excellent training sessions on Arduino microcontrollers. These have been taking place in the Guide Hall at roughly 2 week intervals on Tuesday nights. Slowly but surely, the syntax and protocols of the Arduino language is drilling fresh paths into our collective brains.

The Uno microcontroller that we use are based upon Atmel microprocessors. They are inexpensive and are capable of driving a lot of devices, like relays, LEDs and motors. They have analogue inputs capable of measuring signals from a vast variety of sensors. In the middle they require a few lines of code to perform a huge range of tasks. We are fortunate that Albert's careful introduction to the technology is smoothing the way.

Last week I had a go at hooking up some servomotors to the Uno board. Using only the code that we had rehearsed so far, I was able to rotate my coffee mug to any position in a 180º radius. This, I am confident, will be useful one day…

Camping on the Avon River – Melbourne Cup Weekend

As promised, here are the details of the camp on the Avon River from Saturday October 29 until November 1 (Melbourne Cup Day). If you wish to join us for any or all of that period, here is what you need to know.

We are headed to a large, free camping area at a spot known as **Huggett's Crossing**. This will take maybe 2.5 to 3 hours of travel from say Dandenong. There is a basic toilet at the camp area. You must take everything you need and take all of your rubbish home with you afterwards. To get there you will need a 4wd, or all wheel drive, or a 2 wheel drive that has reasonable ground clearance. (The last kilometre to the site has some water runoff bumps in the track, but the track surface is good.) There are no creek or river crossings to get to the camp.

The Avon River at Huggetts Crossing (No you don't have to cross it)

Some extra

http://www.depi.vic.gov.au/__data/assets/pdf_file/0006/225699/Avon_Mount_Hedrick_Scenic_Reserve.pdf

How to get there:
(Note all km figures are quite exact, not rounded)

First drive to Hayfield.
To do that, take the Princes highway East out of Melbourne until you reach the far side of Traralgon. As you pass through the industrial area, you will see a turnoff on your left that says **Heyfield/Maffra (C105).** Take this road to Heyfield. (It will pass through Glengarry, Toongabbie and Cowwarr.)

When in Heyfield

- Drive to the top end of the town. There's a Mobil fuel station next to a big roundabout. (last chance to buy fuel etc. if you need it.)

- Reset your car trip meter to '0' here. From the roundabout, head East onto **Maffra Road** (also called Mary Street) for exactly 5km.

- Reset your trip meter. Then turn left onto the Heyfield/Upper Maffra Road and head North for quite a way. There are a couple of crossroads, but you stay on this one for 11 km where you come to a T junction. Turn **LEFT** here.

- Reset your trip meter. Stay on this road for 2km, then turn **RIGHT** onto **Kentucky Road**, just over a little bridge, then the road becomes a gravel road, but is in good condition.

- Reset your trip meter at the start of Kentucky Road. Follow Kentucky road for a while. (Later on it changes name to Green Hills Rd on some maps, but don't worry about that.) At the 7.0km mark there is a road on your Right called 'Springs road', but ignore that too. At the 7.5km mark you reach a T intersection with Green Hills Road on your Right. Don't take it either. Turn LEFT here and Reset your trip meter to zero again. Technically you will still be on Kentucky Road.

- From that T intersection, you just keep on following that Kentucky Road. (Ignore Huggetts Lookout, unless of course you want a look.) At the 2.6km mark from that 'Tee' junction there is another road on the left, but ignore that too. At the 3.6km mark from the Tee junction you reach our camp area at Huggetts Crossing.

- Look for the GGREC banner.

The Avon river near the campsite

Unless you get there really early, someone should be listening out on 145.450 from the camp.

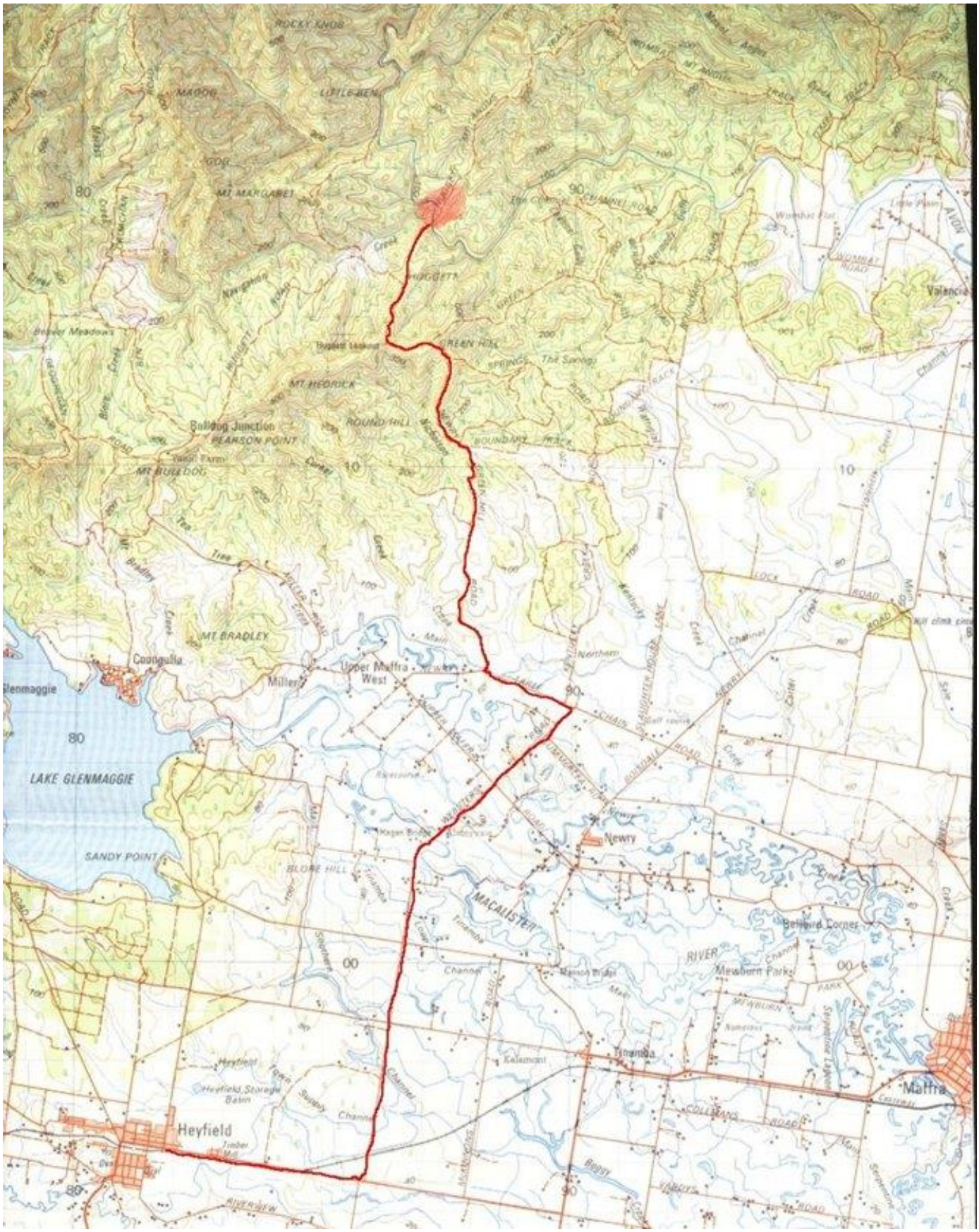
Not all participants will be able to join us for the whole duration, indeed some may wish to just stay one night, or come early on one day and just make a daytime trip of it.

There are a few things to do in the area, including walking trails, but its biggest attraction is that it is a nice place to chill out, connect a few wires to radio's and make a little pyramid of empty drinking vessels somewhere near the fireplace.

For those who may be interested, there will be speedboat races on Lake Glenmaggie all weekend, about a 30 minute drive from the campsite.

It is all pretty much up to the individual to be self-sufficient. If there are any other questions, you can send an email to ianjackson@dcsi.net.au

Phil VK3HPC at the campsite in 2010

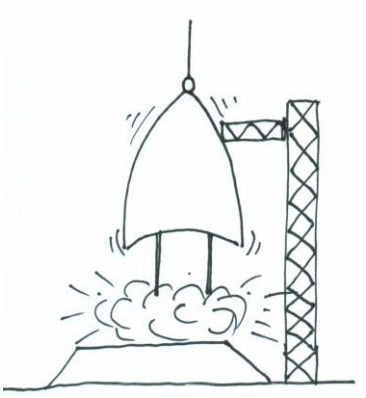


Here is a 1:100,000 scale contour map of the region, showing the path to the campsite from Heyfield

Notice Board

BLAST OFF WITH LOGIC GATES

At the November 4 Prac Night at the Club Shack Ian VK3BUF will be discussing some basics in how Logic gates are used in circuits. Not just an academic exercise, we want to de-mystify what these funny looking symbols mean when looking at a circuit diagram.



There will be more OR's than a Viking longship has, more AND's than the Blues brothers can put back together and more INVERTERS than an outback campsite. (sorry, its late)

There will be handouts and at least one quiz associated with this session. It should kick off at about 8:15 and last about one hour.

GGREC Sunday night Net

Want to know the latest GGREC Club news and details of upcoming events?
If you want to be kept up to date then you need to call into the **GGREC Sunday Night NET**.
The NET is held every **Sunday** at **8:00 PM** sharp on **VK3RLP 439.475 MHz, 91.5Hz** tone access.
Don't miss out!

Change of Arduino Venue and Day

After receiving an absolute majority of acceptance emails to change the Arduino session nights from Monday to Tuesday, we have made temporary arrangements to use the Guide hall for future sessions.

Regards
Albert VK3BQO

Corrections to the Magazine

If you find any general errors in the magazine, contact the editor, Paul VK3TGX
If however, you find errors in the **General Meeting Minutes**, contact the **club Secretary**.

Contact details are on the last page, or refer to the club membership list.

From The Editor

It's October already, too many chores and it's only going to get worse as we make our way to the silly season. A few weeks ago we visited Target in Mornington, and there it was, Christmas decorations. Already, 3 months out.

For the last few years I've being going to string a pile of 16 segment displays together so I could have "Merry Christmas" scrolling around my noggin at the annual GGREC Christmas party. However there is one big problem, all the work to build it for potentially half an hour of glory, probably a complete waste of time. Of this 'round' of construction projects, the 'Arduino' phase I've made another clock, started on a radio DDS module (currently stuck looking for RF bits) and the latest, an audio level meter. Many years ago I wrote a small amount of software for the desktop computer, this was before Windows, Yes it's been a while. The biggest problem for me has been information. Many years ago I bought an NEC APC3 computer, it came with a lovely set of manuals detailed all the function calls the machine supported, Well it didn't take long for me to write a weather fax receiving program, and some RTTY software etc. Then along came windows, with no information on how you talk to it. At the time I was writing in a language called "Turbo Pascal" however I never found out how to talk to windows using it, the authors quickly evolved it into an 'object oriented' model, about as quickly as it's price shot thru the roof. (It started life at $99) So I just moved over to micro's like the 6802 etc., the datasheets and manuals were readily available, all functions listed with nothing left out, unlike Windows where everything was left out. Now thankfully they have a few free packages, like "Microsoft visual design studio". Now after playing Arduino I've also had a quick dabble in a companion to Arduino called "Processing", the programs then run on your PC, rather than a Uno etc. Strange name but it looks promising. If nothing else, it and Arduino are nudging me down the path of learning the C language. Or am I on the wrong track, everyone these days seems to be talking web, don't write for a device, but put it on the web, then everything can run your code, they say, I'm not yet convinced.

However, on another front, the IoT has me somewhat interested, the "Internet of Things" as it is called. Fortunately Arduino marries in quite nicely, the only missing bit is how to connect your latest creation to the web, and how to do it safely. Unfortunately the preferred method, Wi-Fi and the protocol stack to use it are very complex and quite often very insecure. I just read all about how easy it is becoming to hack into a great stack of internet devices and use them to create havoc, like taking down the bureau of stats website. So when someone says the web is easy, just use this $7 wireless module from eBay, I tend to start panicking. If a largish manufacturer cannot make secure ADSL modems etc., what hope have we if we place our trust in a $7 no-name Chinese/Asian module. Shure, the chances of someone hacking your custom Arduino code is basically zero, However the chances of someone finding a hole in the code used for hundreds of thousands of 'generic' IoT web interface modules (remember, at this price point, most suppliers are just going to copy the opposition manufacturers code, bugs and all) and 'inject' some nefarious code is far too high. In the article I just read, they examined several internet devices, and found they used ancient Linux libraries of code to do their stuff, Any associated passwords were either default, or easily determined. All the device manufacturers had done was put their own custom code on top. The ancient buggy Linux code will, and can never be fixed, it is burned into ROM's inside the device, a ticking time bomb until you throw it away. Trouble is the replacement box you buy will probably be no better.

Paul VK3TGX

More Accuracy Required

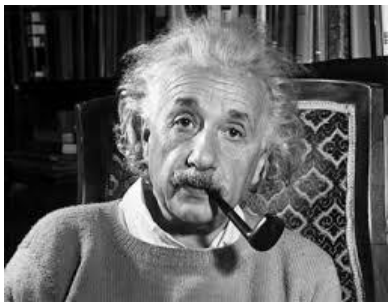
So at GGREC you have decided to make a battery box to power your field rig.
Have you considered the weight?

You go and purchase a nice kickass 120Ah 12V battery. The label claims it is 33kg - is that when it's empty or full?

Lets assume it is when its empty (best case), how much heavier will I be when charged.

Well lets see;
120Ah * 12V = 1440 volt amp hours
1400 VAh * 3600 = 5,184,000 Joules of Energy.

Now Energy has mass!
$E=mc^2$ (E= Energy, m= Mass, c = Speed of Light [299,792,458 meters/sec])
Therefore to solve for mass $m=E/c^2$



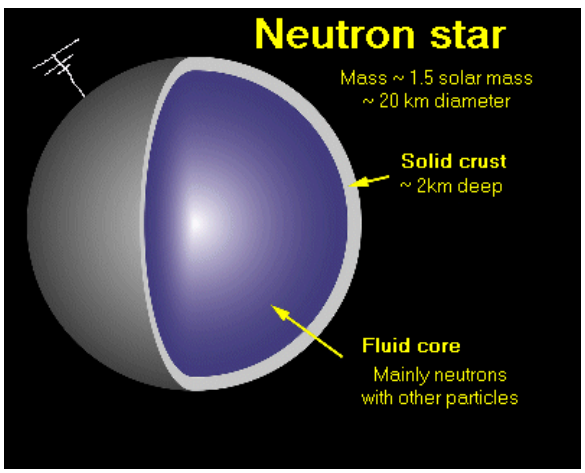
$m = 5,184,000J / 299,792,458^2$
$m = 0.00000000005768$ kg

Now we live on the surface of the earth that has an average gravitational force (g) of $9.807 m/s^2$ (well actually a bit more due to our lower latitude in Melbourne but that's for another day).

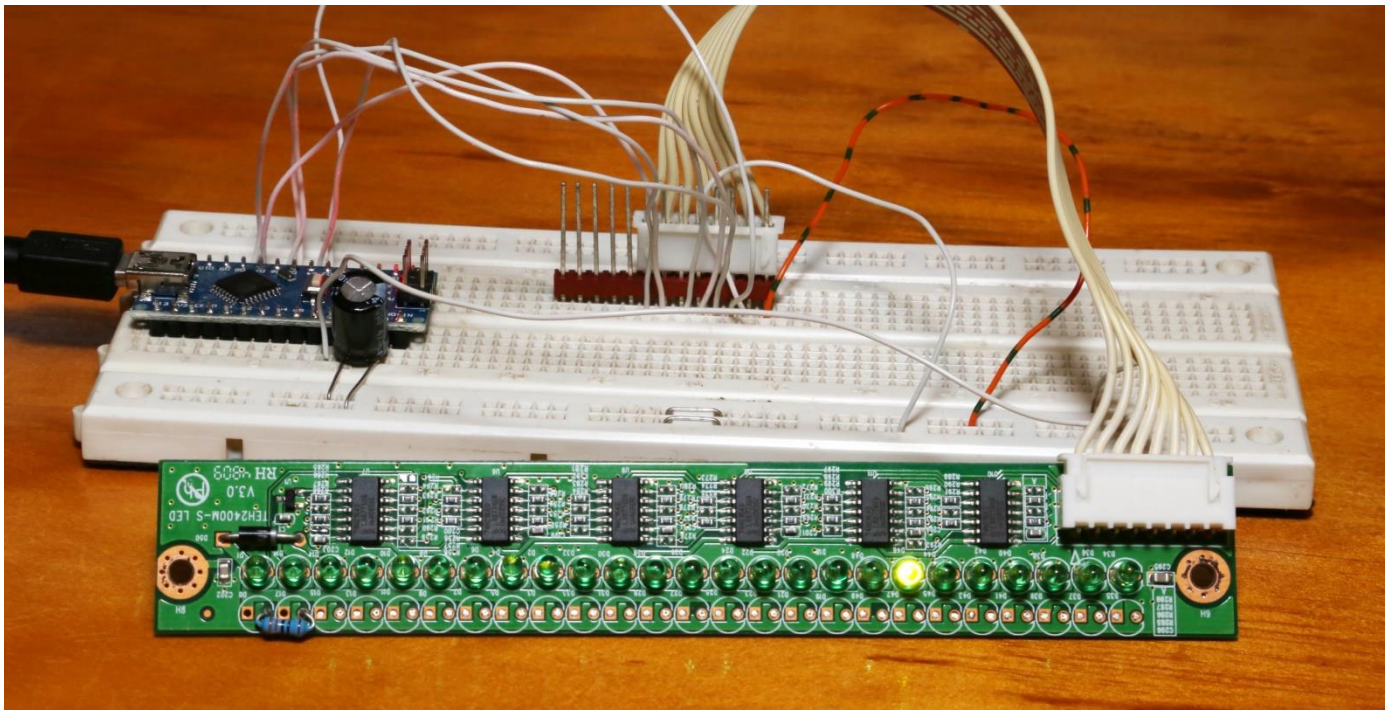
So the change of weight on Earth of the battery from empty to full is
$W = mg$
$W = 0.00000000005768kg * 9.807\ m/s^2$
$W = 0.000,000,000,56567$ kg

Now we can look at this in electronic terms
W = 565 *p*kg (pico-kilogram)
or
$W = 5.65 \times 10^{-10}$ kg

This might not seem like much, but what if we wanted to visit a neutron star say (only about 1.5 times the mass of our sun but only 15km in diameter) with our field kit for a rare entity DXpedition, that extra charge in the battery would weigh in excess of 110 Tonnes (110,000 kg).



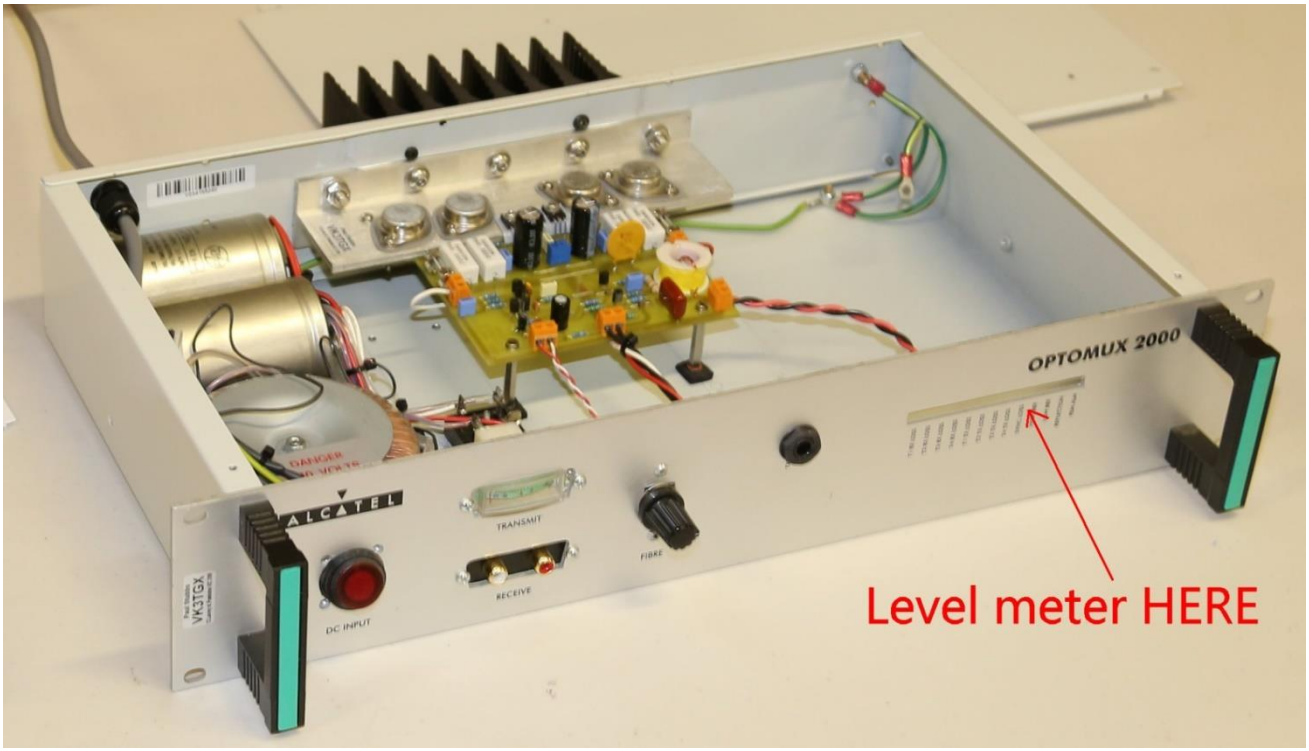
David Rolfe
VK3JL



Recently I re-started work on an amplifier project started ages ago.

It was originally intended as a whole house sound system, however I had had some doubts about its suitability, so it was put aside, and used temporarily for an alternative project.

One thing I wanted on the front panel was a decent level meter. As this amp could easily be turned on to play some backyard music etc., without me being able to hear the results. The last thing I wanted was to then head outside etc. and hear the amp was either set way too low, or conversely, severely clipping. I could have used a panel meter, however the box already had a nice slot in the front panel just asking to be used for a bar-graph display.



The ‘normal’ default for making bar-graph displays is an LM3914, or LM3915 bar graph driver IC, these work well, however they are limited to 10 LED’s. You can join 2 or more together for a bigger display, however if you are after a logarithmic ‘VU’ style display, it is a tad painful. I built a 20 LED unit years ago, and it ended up being a big compromise. I could not get a very smooth transition between the two IC’s. According to the data sheet, the first 3915 has to have its reference at 315mV, whereas the second IC has a much more respectable 10V, quite a contrast, and prone to trouble - have a read of the Texas Instruments data sheet, it is well covered.

Now we are all into Arduino’s these days, so why not use one. I mentioned the concept to Ian VK3BUF, he seemed to think it was a good idea; I was encouraged, so here we go.

The first thing I needed (apart from an Arduino Nano) was an actual display. Yes I could bung a pile of LED’s into a strip of Vero board, however I had a nice 25 LED display module in my junk box, courtesy of an old network switch. (Remember my articles on recycling)

Now for the code. The Arduino has a respectable 10 bit analogue to digital converter, bigger would be nice, but I’m glad I wasn’t lumbered with an 8 bit converter - that would have been the death of this project. The problem is that the A/D converter is linear, whereas the desired display is logarithmic. As you get towards the bottom of the display, the sample points get very close, the 10 bit converter just cut it.

Linear To Logarithmic

Linear to Log - 8 bit
- LED 1 - 255
- LED 2 - 128
- LED 3 - 64
- LED 4 - 32
- LED 5 - 16
- LED 6 – 8
- LED 7 - 4
- LED 8 - 2
- LED 9 - 1

This is my first look at what was required,

As you can see, each step is twice the previous (or half, going the other way). At first look you would think this is 3db steps, however as we are talking power, they are actually 6db steps. If you double the voltage into a resistive load, you also double the current meaning four times the power - 6db.

If you want 3 dB steps, you need to divide it up by root 2, or 1.414, rather than 2.00.

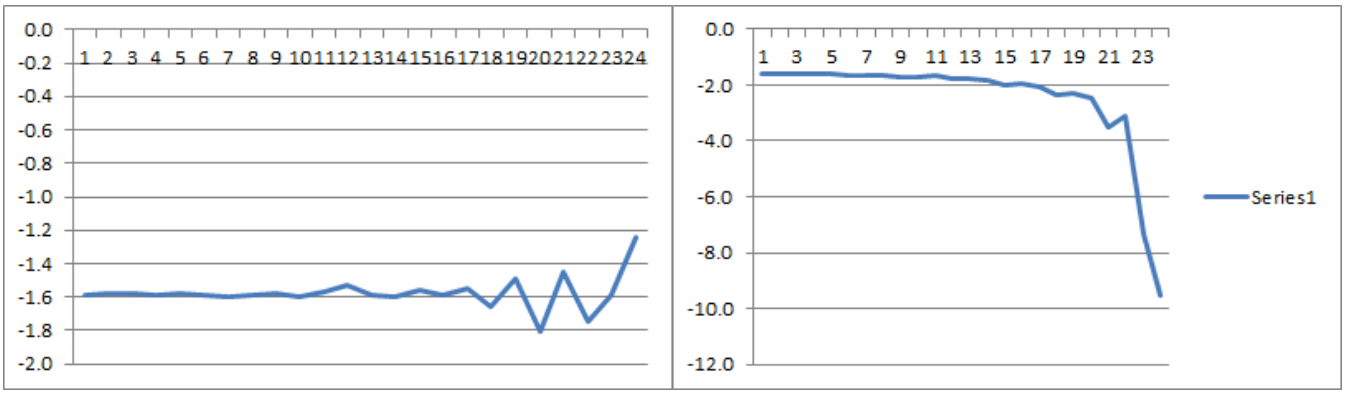
However this resulted in a 21 segment/LED display, not 25.

So it looks like I need to divide by something other.

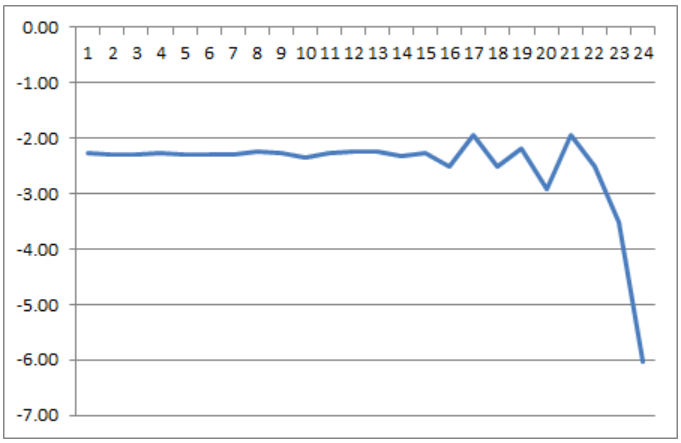
So I set up the whole table as a Microsoft excel spread sheet. Now small tweaks don’t involve heaps of calculator time. I soon came to the conclusion, for 25 LED’s, and using a 10 bit A/D converter as a source, a step of 1.3 was about as close as I could get it.

If I divide by greater than 1.3, I end up trying to measure numbers smaller that the converter can resolve, conversely lesser, and I wasn’t using the full span on the A/D converter. I wanted to try and see any noise (assuming it make it to ‘1’ on the A/D)

During my excel experiments, I thought I had found nirvana, 1.2 steps (13-1024 on the A/D) and then just take off 12 so I could see the bottom end, but when I calculated the dB difference of the steps, I’d created a Frankenstein, 1.6 dB steps slowly heading to 9.5 dB at the bottom!



The first graph is with no offset, yes there is jitter at the bottom, as we run out of A/D resolution, Now look at the next one, a logarithmic slope, from a log table – double log, is there such a thing – Maybe I'll try this slope, after all it only has to look good.



This is the response I am running with for now, fairly flat, then A/D jitter, the dive at the end is part lack of resolution and part fudge to get it to fit. To remove the dip I need an A/D reading of about 1.4, obviously that is impossible.

Maybe I should print this graph out and use is as part of the front panel, it should give it a technical/scientific look.

Pity I lost my job & access to that flash label printer – metalized polyester would look nice.

So how to convert from linear to log, well you could take the A/D readings and do a pile of maths, or you could do as I did and use a lookup table. As I had to fudge it a tad, a lookup table is the easiest solution. One advantage of the table over doing the math on board is that you can generate almost any curve you like. Mathematical imposibilites are no problem.

	A	B	C	D	E	F	G
1	Bar	/1.3	Rounded	Volts	Power (mW)	dbm	Round dbm
2	1	1024.0	1024	1.299492	1.688680	2.3	2
3	2	787.7	788	1.000000	1.000000	0.0	0
4	3	605.9	606	0.769036	0.591416	-2.3	-2
5	4	466.1	466	0.591371	0.349719	-4.6	-5
6	5	358.5	359	0.455584	0.207557	-6.8	-7
7	6	275.8	276	0.350254	0.122678	-9.1	-9
8	7	212.1	212	0.269036	0.072380	-11.4	-11
9	8	163.2	163	0.206853	0.042788	-13.7	-14
10	9	125.5	126	0.159898	0.025568	-15.9	-16
11	10	96.6	97	0.123096	0.015153	-18.2	-18
12	11	74.3	74	0.093909	0.008819	-20.5	-21
13	12	57.1	57	0.072335	0.005232	-22.8	-23
14	13	44.0	44	0.055838	0.003118	-25.1	-25
15	14	33.8	34	0.043147	0.001862	-27.3	-27
16	15	26.0	26	0.032995	0.001089	-29.6	-30
17	16	20.0	20	0.025381	6.441805E-04	-31.9	-32
18	17	15.4	15	0.019036	3.623515E-04	-34.4	-34
19	18	11.8	12	0.015228	2.319050E-04	-36.3	-36
20	19	9.1	9	0.011421	1.304465E-04	-38.8	-39
21	20	7.0	7	0.008883	7.891211E-05	-41.0	-41
22	21	5.4	5	0.006345	4.026128E-05	-44.0	-44
23	22	4.1	4	0.005076	2.576722E-05	-45.9	-46
24	23	3.2	3	0.003807	1.449406E-05	-48.4	-48
25	24	2.5	2	0.002538	6.441805E-06	-51.9	-52
26	25	1.5	1	0.001269	1.610451E-06	-57.9	-58

As this display is for a live audio display, not a scientific instrument, having the LED's correspond to an even dB number scale is not required. Sure each step (while fairly even) is a complicated number, but in this case, no problem at all. In fact I might not even end up putting any dB numbers on the display, they almost serve no purpose.

After creating the dB chart, I quickly realised I had a problem, Normally when coding this you would have a separate entry for each step of the input, however as the input is a 10 bit number, we would

need 1024 entries, a rather large table, so I did it backwards, my table has only 25 entries, one for each LED. the software scans down the table looking for a match to the incoming number, the number of steps it has to take through the table to get there becomes the result - i.e. the index into the table, normally the input, is now the output.

I saved memory on the table, at the expense of memory for the extra code, did I win out, not sure (one of my gripes with 'C', you type some exquisite text, almost oblivious to the resources burned) - it fits in the chip, so does it matter (this time) No.

Driving the LED's

The display module has 25 LED, connected to 6 74HC164 shift registers. A fairly common method of adding extra outputs to a micro - the Nano can only directly drive about 16 LED's, the Uno, even less. Yes I could have multiplexed them, but for all you Arduino fans out there I thought I'd show an alternative. (Plus that's what I had on my display board)

Now 6 74HC164's should be able to drive 48 LED's, however my board was only half populated. I could have added another row of 25 LED's - a stereo meter? Fitting the LED's was not a problem, fitting 24 SMD chip resistors is - My eyes are too old. Anyway this was for a mono amp, so I had no need for 2 banks of LED's (for now)

So I started tracing the tracks on the board to figure out how it was all connected, I was slightly shocked, it was configured as 3 separate arrays of 8 LED's, with only two 74HC164's in series, yes I could have linked them all together, but I don't have a decent microscope etc. (a Mantis stereo 'scope is over $1500)

The other surprise was LED 25 was a power LED, not connected to the shift registers. Having gone so far through the project assuming 25 LED, I reconnected #25 to a spare shift register output. The code I wrote to drive the display worked perfectly first time - I spent more time testing and verifying it, however the edit to support LED 25 was the straw that broke the camel's back, Marianna got up that night wondering where I was, she came into the study and said "what on earth are you doing, it's 4am!" (She was a touch more colourful!)

One of the disadvantages of the 74164, is they don't have any output latches, meaning as you shuffle the data into the register, your actions are there for all to see on the LED's, your only real option is to do it so fast that the effect is not overly visible. In my case there is a slight background glow. I will probably go back and try to optimise the code, although as I do so the code will probably not look as good, I will probably start removing function calls, placing all the code 'in line', the next step is to replace the Arduino digital writes with direct ATmega port writes, then as a last straw, assembly language!

The other parameter to fiddle with is how often the display is updated, basically you are trying to maximise the difference between clocking in new data, and leaving the registers static so the reading can be seen/read. Assuming you have optimised your code as far as possible for writing speed, then that only leaves the gap between updates. Making this gap too great and the remaining background glow will start to flicker (plus the display will look less lively). I put in a 20ms delay, that improved the contrast, however a 50ms delay and there was noticeable background flicker.

Another option would be to put a single transistor in series with the LED commons, then temporarily blank the display whilst updating the 74164 shift registers.

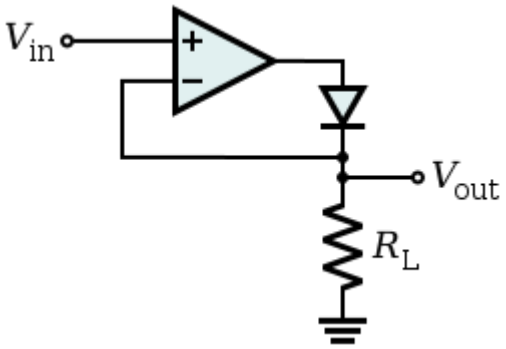
In my case as I am only lighting one LED at a time, I could directly use an Arduino port pin.

Audio Stages

So the micro section is done, now for the audio input stage. The incoming audio has to be converted into a voltage for the A/D to sample. If this was a more powerful chip with a 16 bit converter, I could just feed the audio straight in, but it isn't, Yes people have successfully made Arduino spectrum analysers, digitizing audio with the A/D and performing Fourier analysis etc., but when you do that you have to bias the A/D half way to allow for AC signals to be supported, meaning I'd lose half the resolution, plus I doubt I could get it to run fast enough to capture 20KHz audio (I'd like to see and measure signals way above this)

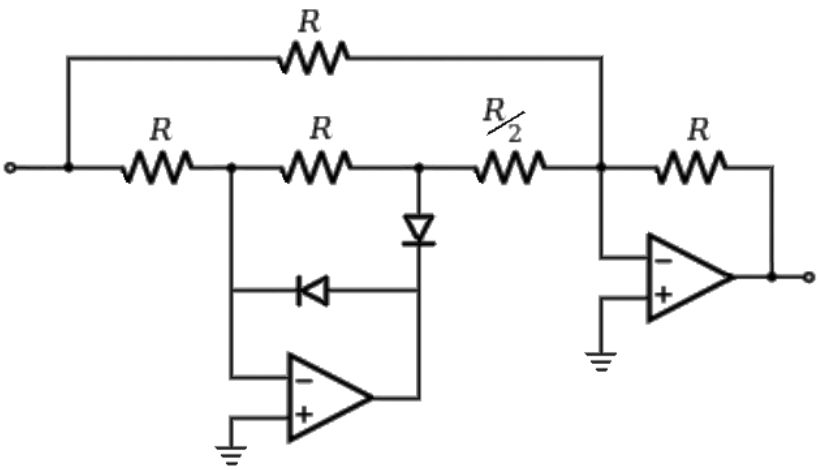
Come to think of it, that spectrum analyser project was doing everything in 8 bit, I wonder what restricting some rather flash mathematical transformations to 8 bit's with no floating point support would have on the resulting display?, Nah, use a pic32, or Raspberry Pi etc.

Anyway, back to the audio circuits, usually to convert AC to DC, you use a diode, however they introduce a voltage drop, this would severely impact on the bottom of the meter scale, the answer to this is to wrap an op-amp around the diode to remove its voltage drop and any other non-linearity's.

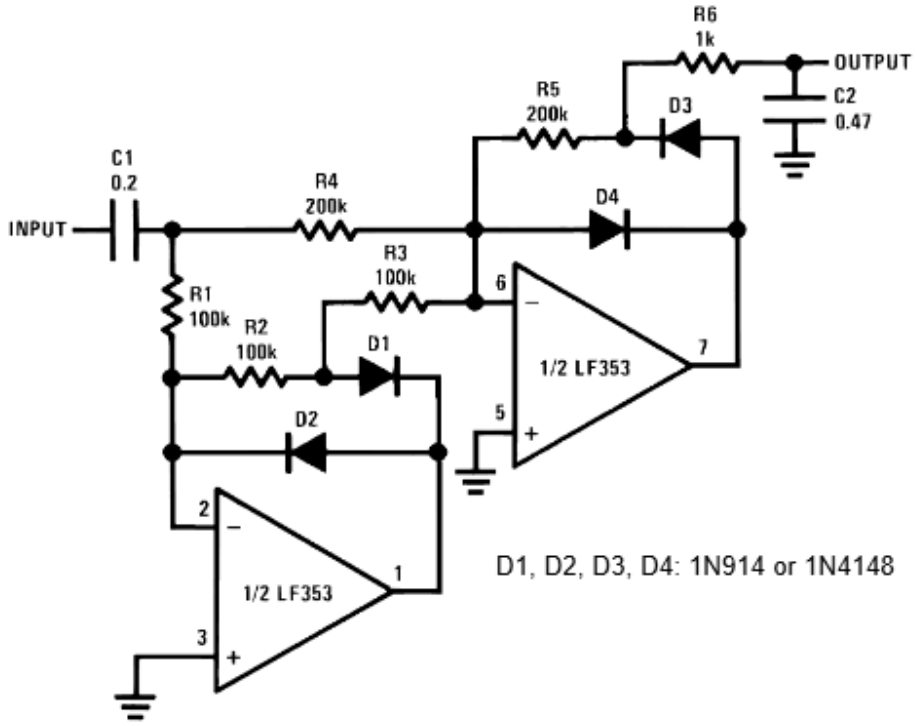


I was originally planning to use two of these, one inverting so I could captured both sides of the signal, and then apply a small amount of capacitance so the A/D converter would not miss any transients.

I then found a nice video https://www.youtube.com/watch?v=dCojRDwoFaI explaining the downfall of using an overly simple circuit.



He demonstrates the pitfalls and suggested this circuit.



Precision Full-Wave Peak Detector

However on perusing the LM3915 data sheets there was some nice designs in there also, and they were talking about measuring down to -90 Db, so maybe I should just use theirs. Even if I can't quite figure out how they work – after all these blokes have been playing op-amps longer than all of us combined. They know the practicalities and what can be gotten away with.

Even if you don’t intend touching the LM3914/3915, downloading the TI data sheets is well worth it for the notes on rectifiers circuits etc.

Paul VK3TGX

Recycling Transformers

When I was a young one, an electronics class was run at my school as an extra activity, I ended up stripping the odd old TV, then later on I and a few mates discovered the local tip, more TV's. I'm talking black and white valve sets here.
We used to strip them of anything useful, the odd valve & usually the power transformer.
Whilst the HT, often 300 odd volts was a bit scary and avoided, the filament windings were often very respectable and good for many a smoke releasing experiment. However there is only so much you can do with 6V, most toys (slot cars, trains etc.) need 12V, so I soon learned to strip them down and rewind them. They were the good old days, nice big cores, big bobbins with plenty of room. These days the iron cores are quite often soaked in some form of resin etc., the same goes for the bobbin, so pulling them apart, whilst not impossible is a big job, often not worth the effort. The supply source has also greatly dried up also, about the only place you'll get a half decent transformer is from is an old HiFi amplifier, TV's long ago moving to switch mode supplies - if you want a switch mode forget TV's, try an old computer supply.
Unfortunately these transformers are wimpy, compared to what was in a big old B/W TV.
There is some good news however, quite a lot of audio equipment has started using toroidal transformers. Toroidal transformers usually are a lot easier to deal with, no more long sessions removing the iron cores (and putting them back in the correct order) assuming the transformer has not being potted etc., all you have to do is remove the central bolt etc., then start winding on a new coil - you now have that extra rail in your HiFi system etc. (ready to run the Arduino level meter project etc.).
But how do you figure out how many turns?
Easy, wind on, say 5 turns of hook-up wire, turn on the power, then measure what is on that winding. It won't be much, maybe half a volt or so, but assuming your meter gives a reading with decent resolution, your set (if not, visit a mate and use his meter) If your meter doesn't have a good low volts AC range, and only reads on the last digit - oops, wrong meter.

Now divide the voltage you read buy the number of turns, you now have your volts per turn.
In the case of the transformer pictured, 5t gave 0.951 volts (0.1902 volts per turn)

So if you want to add a 12V winding, I would need 12 / 0.1902, or 63 turns.

In my case, I was going to use the transformer as a 100V audio line transformer.

Originally, on 240V it produced about 34-0-34V, obviously to power up an audio power amp.
I reconfigured the primary for 120V (it had 2 120V windings, wired in series)
Now If I scale that back to 100V, the secondary would be about 29-0-29 V
120, back to 100V is 120/100 = 1.2 – so 34

So the 0.951 (for 5 turns) divided by 1.2 = 0.7925 V
0.7925/5 turns = 0.1585 volts per turn.

If you're wondering why I'm using so many digits of resolution, it tends to pay off in the end if you have to run through a string of calculations, rounding errors can mount up and end up confusing you.

The original 34.74-0-34.75 winding, using the same 1.2 ratio is now 28.96-0-28.96
The difference from 28.96 to 20 is 8.96, 8.96/0.158=56.7 turns
After I removed the outer plastic wrapping I found the two 35V windings, were actually trifilar wound, i.e. side by side, meaning joining the two in parallel was easier than how they were configured out of the factory (i.e. the 35-0-35 configuration)
So I removed 57 turns and re wrapped the plastic bindings back on.
When I connected it up to the amp, feeding in 20V, the output was 100V - perfect!

Now I know a 100V audio transformer is a little unusual requirement, however say changing that same transformer to produce say 16V for a 13.8V supply has quite a few uses.
Now peeling off 18.75 volts, or 98 turns, your actually removing more than will be left behind.
To get the full output power from that transformer, you should really remove the entire secondary and wind on a new one with, say 4 strands of what you removed, or use some heavier wire. Actually going the four strand approach is easier, as it is easier to wrap thinner wire around the core than heavier wire. If you choose to do this you will soon learn all about the difficulties of hand winding a toroid, it's far from easy.

For these reasons I avoid doing total rewinds, but if you can make an otherwise surplus transformer serve a good use by peeling off 20 or so turns, then why not.
The same goes for adding an extra light duty secondary, it's only painful when you want to wind on a 20A 18V secondary, give yourself a lot of space and have a few soft jaw spring clamps handy, because if you have to let go in mid wind it will all unravel into an unwieldy mess. You need to keep a bit of tension on as you wind, the clamp allows you to put it down and take a break. (getting cramps in your hands is normal!)

Getting the phase correct.

One sure fire way of destroying a transformer is connecting two windings together, out of phase. If you put two secondaries in series, the wrong way, you will end up with no volts – no harm done. However if you do this on the primary of a transformer with two 120V windings, BANG and lots of smoke.
The same goes for connecting secondaries in parallel, getting it wrong can easily be the end of the transformer – DON'T rely on your power board to trip out.

So how do you make sure all is ok?

Well the easiest way is probably to use a 6V AC or less plug pack. and inject some volts into one of the windings. You could then monitor the plug-pack's current, if it shoots up as you connect the windings together, oops you've got it wrong.

However the better way for series connection, is connect them up and measure first, one winding, then both, on both you should get more volts. If you get near zero etc, reverse ONE of the windings and try again.

For parallel, just connect one side, then measure between the two remaining ends, you should see zero volts. Then as a final step, tap the ends together, no spark is good!

Don't be bothered by the fact the windings aren't producing their full output, this is an advantage, especially for 240V windings, less change of getting a boot, and doing a superman.

- Flying through the air with the greatest of ease!

Tools etc.

When playing with 240V transformers etc., there are a few things worth keeping handy.

1/ Isolation transformer, these can lessen, or prevent a boot from mains wiring.

2/ Insulated screwdriver & plyers etc., If you must play live, get yourself electricians style insulated handle tools.

3/ Mains current meter – handy to spot troubles before the smoke has a chance to exit. Those appliance power meters that you can buy are usually too slow for this role.

4/ Megger – to make sure the internal insulation is up to scratch.

5/ Variac – so you can slowly apply power, and hopefully spot the problem before you hit 240V. warning, a variac's outputs are LIVE to the mains, they offer NO isolation at all.

6/ 100W light globe – wired in series with a devices you are about to power up can also save your bacon when shorts and wiring mistakes are made.

7/ Safety switch – most household mains power boards SHOULD have one, check. Alternatively, you can buy an inline one for the workshop/toolbox.

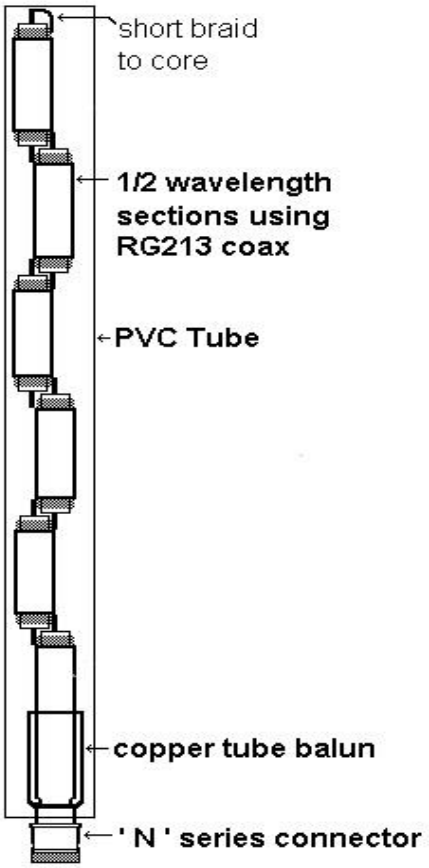
Paul VK3TGX

A recent addition to the stable

After recently acquiring a 23cm rig at a club auction I quickly realized that I didn't have an antenna for this band. Looking around in the usual places showed that there wasn't too much to choose from, and what was available would cost more than what I paid for the rig. Having helped a mate for many years building HF and UHF verticals and beams I decided that I should build the antenna so I chose the vertical Coaxial Collinear Antenna (or as our American neighbours call it the Co Co) for the exercise.

What is a Coaxial Collinear you ask ?

It is a vertical antenna that is made up of multiple ½ wavelength elements soldered together with an impedance matching balun at the bottom of the elements.



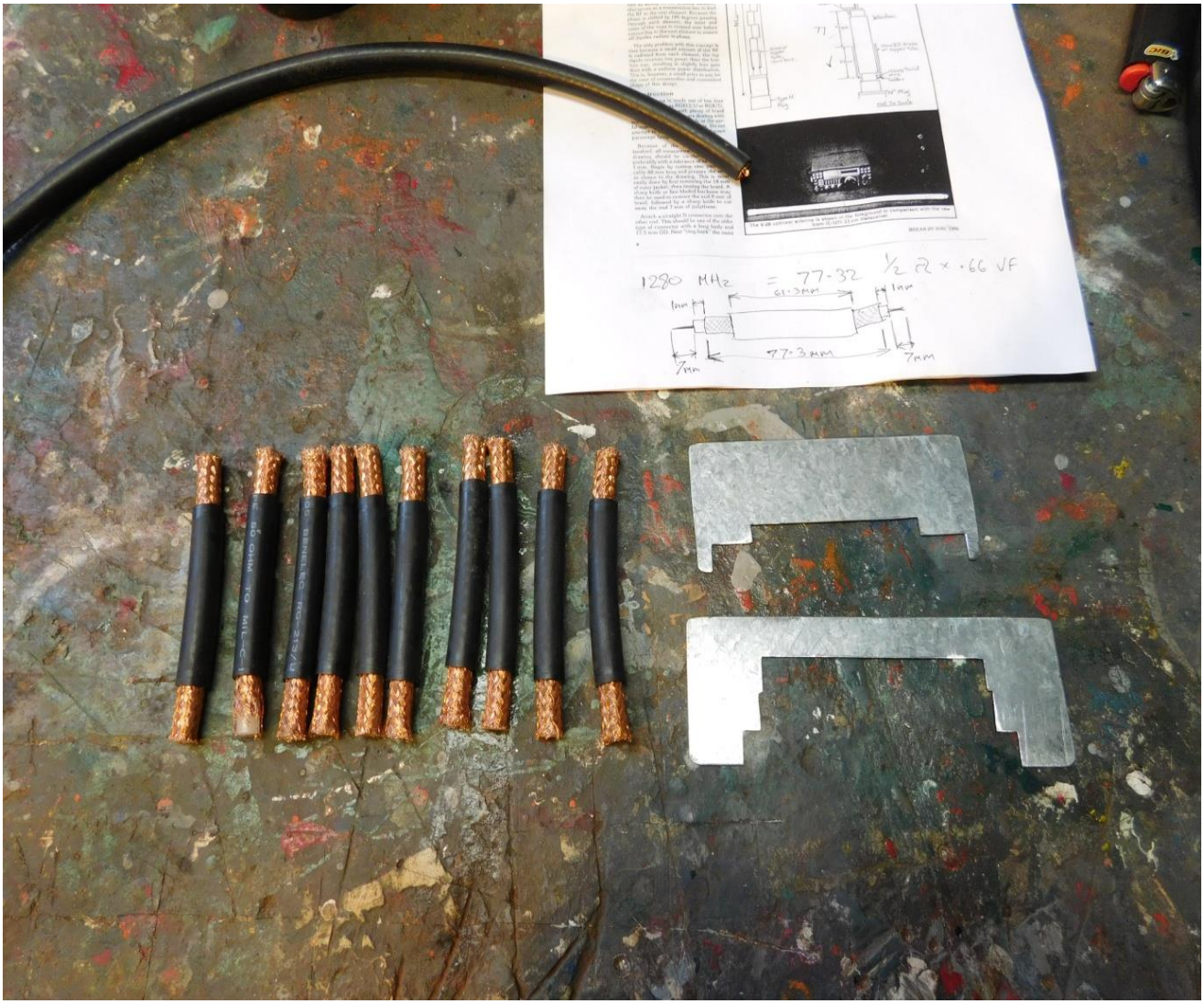
In this type of antenna each radiating element is one ½ wavelength piece of coax cable which as well as acting as the antenna element, also serves as a transmission line to feed RF to the next element. Because the phase is shifted by 180 degrees as it

passes through each element, the inner and the outer of the coaxial elements are crossed over as they connect to the next element to ensure all dipoles radiate in phase. The only issue with this design is that a small amount of RF is “lost” at each element because it is radiated. The top dipole receives less RF power than the bottom dipole which results in a slightly less gain than with a uniform power distribution, a small price to pay for the simplicity of the construction of the antenna.

One interesting feature of this design is that it is not primarily the amount of elements that dictate its gain but the physical length of the whole array.

Construction

The first step with the construction of the antenna is to cut up some lengths of coax, in this case I used some Benelec RG213.



Because of the very high frequency of this antenna the room for error in the measurements of the elements are increased so I made some sheet metal gauges to measure and adjust the element dimensions during the different stages of manufacture. You can see them in the bottom right in the photo above. As a guide the element dimensions were all made to within 0.5 mm (0.020”).

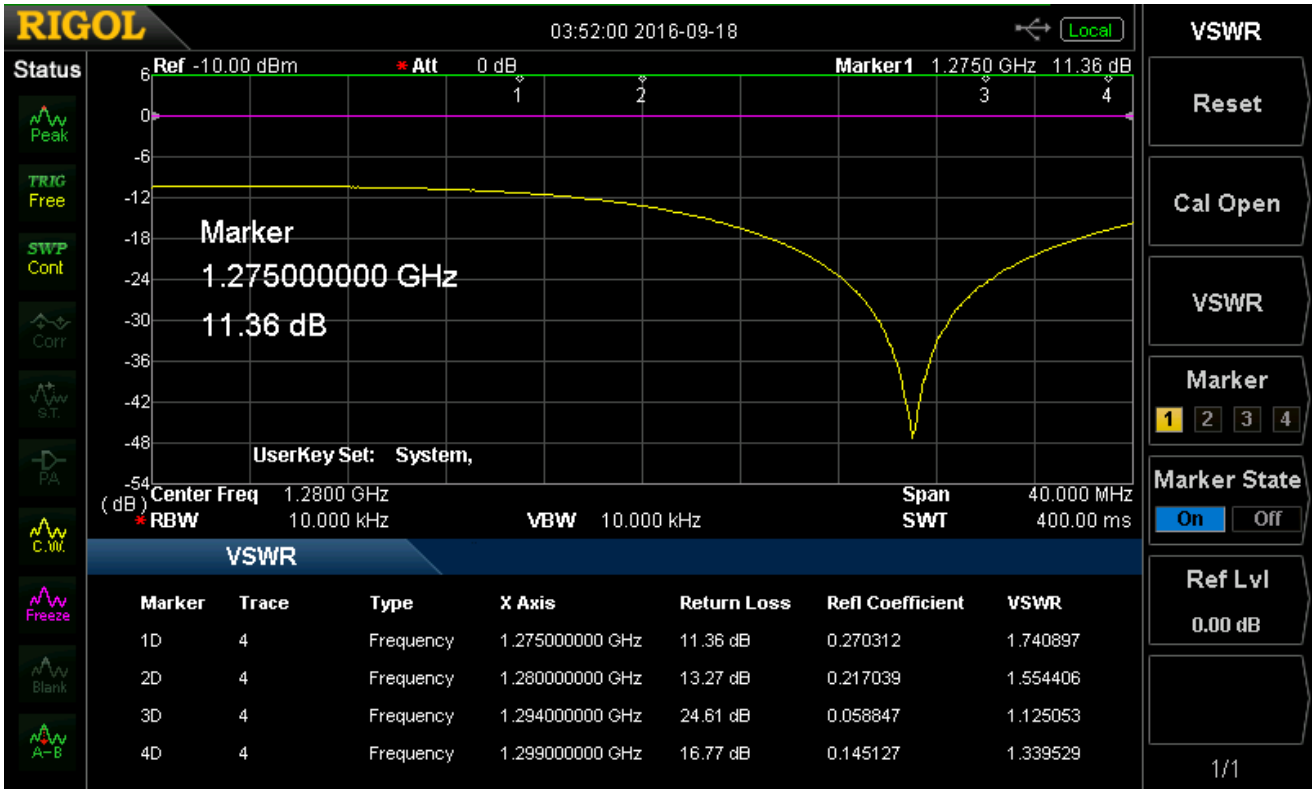
Some soldering flux and a large 80 watt soldering iron was used to tin the braided ends of the coax. Tinning the braid quickly stops the “inner” dielectric from melting and deforming the ends of the elements. Each element was then soldered to the next one to complete the assembly.

The final piece of the coaxial jigsaw was the balun at the bottom of the elements, a ¼ wave length of ½ “ copper tubing was measured, cut and then soldered to the coax “feedline” one ½ wavelength below the start of the first element.

I found some aluminium tube for the bottom mount of the antenna that was right for the job except it needed reducing down by 3 mm to fit inside the PVC radome. I set it in the lathe and turned it down to a slight interference fit for the inside the PVC tube, this way it would be a tight joint to keep any moisture out.

Testing

After assembly the completed antenna was tested for Return Loss (VSWR) and it came in where I had hoped it would. (1) The FM repeaters in the 23cm band have a 20 MHz split between RX and TX and to access the repeater, a 23cm radio receives around 1273 MHz and transmits around 1293 MHz so I was looking for a favourable SWR around 1283 MHz. This is what I found... (attention to detail in the measurements of the elements pays off here)



Pretty close to what I was aiming for. ☺

The antenna measured a bandwidth of about 25 MHz (SWR under 1.5:1) which is about right for this type of antenna and has a gain of approximately 6.5 dBd.

I’ll have to stop using the kitchen bench before I get yelled at by the XYL.... ;-)

Unfortunately I haven't got the antenna mounted yet due to bad weather and an injured shoulder but I will report back on its performance in a future edition of the magazine. I will also share some design details and theory if you want to have a go at making one of these yourself.

Also note that the design of this antenna can be scaled back to 70cm, 2M and 6M also. I have an eight element 70cm coaxial collinear that I built a few years ago that is still performing admirably.

Cheers and 73

Rob VK3BRS

1. Actually this was the second antenna that I built, the first one came in at 1310 MHz, a bit high from where I calculated. On the second antenna (this one described in the article) I added 1.5 mm to each element which lowered it approx. 20 MHz to where I wanted it to be. Note; at these frequencies a 1% error in the velocity factor of the coax (between stated and actual) can cause this amount of error at these frequencies (1.3 GHz), in this case around 20 MHz.

Arduino Interest Group

Here we go again,

Push buttons,

Digital.reads(..)
If (…) statements,
Loops.

And a few void's in a few heads here and there as we come to grips with it all.

One member brought in a bag of ice, to show how bad the weather had been down his neck of the woods.

That's real ice, none of that brew from the back of the local pub.

Study, study,

Pity I missed the last session, too busy typing up this edition of the mag.

You're all welcome to submit pictures etc.

How about some of your Arduino code?

Big Clock – an Arduino project, pt 3

Well my Arduino project, ‘Big Clock’ is all but finished.

It now lives on the wall in my kitchen, also being visible from the lounge room.

- I’m actually surprised how often I am referring to it, much much better than bending my head around trying to read the microwave or squinting trying to read a tiny 2x16 LCD clock set up as a temporary measure years ago. Due to its size a quick glance is all that’s required.

I was originally going to mount it above a doorway, and drill a hole in the wall for the power cable, but I ended up putting it above a window close-ish to the kitchen TV. As there are several leads there already, one more makes little difference, so I’ve skipped making a hole for now.

The box is made up from some pine wood I had handy, I borrowed a You-beaut Aldi frame clamp to hold it whilst the glue dried, but the clamp was all but useless.

Glued to the front of that is a piece of black card bought from Spotlight, then a sheet of red translucent Perspex it glued on top of that, sandwiching the black card between. The black card of course has the appropriate cut-outs for the displays; its main purpose is to stop the circuit board being visible through the translucent plastic front panel. The back panel is made from some scrap aluminium sheet.

I was planning to make the Arduino’s serial output available and perform some long term tests, however in my haste to get it up, that idea was soon forgotten about. I’m now thinking about making the simpler proto-board clock I also made, somewhat more permanent, I can then do some longer term testing in the workshop without having extra equipment cluttering up the kitchen. (Not that one would notice, given the current ‘clutter factor’ there now.)

I was now just reading the email from Albert about making a list of what is required for one’s Arduino project – oops, I think I’ve missed that step – too late now, Sorry Albert!

I've covered the hardware aspect of the clock, and how I connected the displays to the Arduino Nano, about the only hardware part left off was a power supply. I have a 12V system running around here, I just patched into that.

So that just leaves the software.

There are basically 3 parts to it, the main time keeping routines, the display drivers, and finally a small assortment of support routines. – The clock runs quite happily without the latter.

Due to my previous clocks, I knew early on that I had to get some interrupt routines happening; I've done this on basically every micro project I've ever made. Several years ago when Ian VK3BUF was running the Atmel microprocessor course, one of the first things he got going was an interrupt based timing system, he had 3 or so (it is a few years ago, I'm working from memory here, not notes) real time interrupts running. If you needed a particular bit of code to run once every second, then you just hooked it into the 1 second interrupt. All nice and swish, unfortunately the Arduino designers thought differently. This meant the necessary documentation was not to be had from them, Yes the ATmega micro is well equipped for it, and the 'C' language can do it, but what are the commands? Fortunately a good session on Google turned up a site where a bloke had written a simple interrupt demo, incredibly close to what Ian did by default years earlier. Have a look at http://www.instructables.com/id/Arduino-Timer-Interrupts/

```
//timer interrupts
//by Amanda Ghassaei
//June 2012
//http://www.instructables.com/id/Arduino-Timer-Interrupts/

//this code will enable all three arduino timer interrupts.
//timer0 will interrupt at 2kHz
//timer1 will interrupt at 1Hz
//timer2 will interrupt at 8kHz
```

This is a small extract of the comments near the start of the code, which tells you all about what it does.

I tried to paste the whole lot in here, but it's too long, so I will give you some extracts

```
//set timer1 interrupt at 1Hz
  TCCR1A = 0;// set entire TCCR1A register to 0
  TCCR1B = 0;// same for TCCR1B
  TCNT1  = 0;//initialize counter value to 0
  // set compare match register for 1hz increments
  OCR1A = 15624;// = (16*10^6) / (1*1024) - 1 (must be <65536)
  // turn on CTC mode
  TCCR1B |= (1 << WGM12);
  // Set CS12 and CS10 bits for 1024 prescaler
  TCCR1B |= (1 << CS12) | (1 << CS10);
  // enable timer compare interrupt
  TIMSK1 |= (1 << OCIE1A);
```

This is the setup code for the 1 second interrupt, most of it requires some deep reading of the appropriate Atmel data sheets for the micro, The main bit you will probably need to fiddle with is the centre bit where the timer compare register it set.

If you want to change the frequency of the interrupt, then you need to change the 15624 number. as defined by the simple formula (16*10^6) / (X*1024) – 1 for example, if you want to up that interrupt rate to 2Hz, the formula is (16*10^6) / (2*1024) – 1 or 7811.5 obviously we cannot have a '.5', so you'll have to settle for either 7811, or 7812, However as the main frequency determining source is quite often a ceramic resonator, the difference between the two is all bit lost in the accuracy of the low accuracy ceramic oscillator, In my clock I actually found 15635 closest to providing an accurate 1Hz. That just shows how far off my resonator is.

```
ISR(TIMER1_COMPA_vect){//timer1 interrupt 1Hz toggles pin 13 (LED)
//generates pulse wave of frequency 1Hz/2 = 0.5kHz (takes two cycles for full wave- toggle high then toggle low)
 if (toggle1){
  digitalWrite(13,HIGH);
  toggle1 = 0;
 }
 else{
  digitalWrite(13,LOW);
  toggle1 = 1;
 }
}
```

In the case of Timer one, this is the chunk of code that gets run every time that interrupt fires.

In the example code, it merely flashes the pin 13 LED, in my clock code, all the one second interrupts are counted in order to keep the time.

What is important to understand, is that it almost does not matter what the Arduino is doing, when this interrupt fires, it stop doing that and races off to here. After this code is done, then it returns to doing whatever was happening before the interrupt.

As an example, say you've told the Arduino to take a 10 second delay (now remember, while it is in the delay, nothing else happens) HOWEVER, it does not matter, the 1 second code above will get run – and the pin 13 LED will continue to flash right through that 10 second delay.

There are 3 hardware timers in the ATmega micro on your Arduino board, that was the 16 bit timer 1, almost identical code is present in the sample to look after the other two 8 bit timers. The 8 KHz and 2 KHz output signals will also continue unaffected by most of your code.

In my clock, the timer 1 is set to 1Hz, as per the example, for time keeping

Timer 2, running at 8KHz, is used for refreshing the 7 segment displays.

Timer 0, running at 2KHz in the example, is not used or implemented in my clock.

I am of the understanding that timer 0 is used by a lot of the internal Arduino commands, so there is a good chance that there will be some problems should you try both at the same time.
- one of the reasons (but not the main one) that I left timer zero alone.

The Arduino PWM function also make heavy use of the timers, so these will also interact in a not so good way.

However, for doing time keeping and doing display multiplexing, you cannot beat using the timers to generate real time interrupts.

As a side note, assuming you are unhappy with the accuracy of the 1Hz timer, an external 1Hz pulse (From a GPS etc.) can be easily connected to an Arduino pin, and used to drive the same interrupt handler shown above – Now the instructions for that ARE in the Arduino documentation.

Happy Arduino-ing.

Paul VK3TGX

General Meeting Minutes

Date : 16-9-2016
Start time : 20:12
Location : Club rooms.
Chairperson : Ian Jackson 3buf
Minute Taker : Michael Van den Acker 3ghm

Present : As per attendance sheet

Visitors: Len vk3fb

Apologies : As per attendance sheet.

Correspondence received : listed and tabled

Correspondence sent : listed and tabled

Treasurer's report : As tabled by Ian 3buf
Read & Moved : Graeme 3buf **Seconded :** 3facb **Carried :** Yes

New Callsigns : Robbie vk3famt

Previous Minutes : As per Gateway magazine
Moved : 3buf **Seconded :** 3kto **Carried :** Yes

Business arising from the previous minutes :
Correspondence relating to the management of the WIA. Discussion about various concerns including financial position.

New business :
Arduino nights have been going well and are well attended. Move to Tuesday night in the guide hall to give everyone more space. 19:30 start to setup tables etc.
No JOTA this year as the Guides will be down at Cerberus.
Camping weekend for the Melb. Cup weekend coming up soon.
Found the name badges that were ordered see Ian 3buf.
Christmas GGREC lunch on Sat 10th December. Leigh offered 3facb again.
Teletype machine as demonstrated at last meeting has been placed into the shack to do some more demos during the Tech night.
Thank you to Dianne & Ian for doing the minutes last meeting.

Meeting closed : 20:45

Next Committee Meeting : 1st Tuesday of the month
Next Prac Night : 1st Friday of the month
Next General Meeting : 3rd Friday of the month

Club Information

Meetings 2000hrs on third Friday of the month at the
Cranbourne Guide Grant Street Cranbourne
Prac nights first Friday in the Peter Pavey Clubrooms Cranbourne 1930hrs
Visitors are always welcome to attend

Office bearers

President	Ian Jackson	VK3BUF	Repeater Officer	Albert Hubbard	VK3BQO
Admin Sec	Michael Van DenAcker	VK3GHM	Web Master	Mark Clohesy	VK3PKT
Treasurer	Graeme Brown	VK3BXG	Magazine Editor	Paul Stubbs	VK3TGX
General 1	Rob Streater	VK3BRS	Property Officer	Bruno Tonizzo	VK3BFT
General 2	Max Hill	VK3TMK	Secretary	Ian Jackson	VK3BUF

Call in Frequencies, Beacons and Repeaters

The Club Station VK3BJA operates from the Cranbourne Clubrooms.
6m Repeater VK3RDD – Currently de-commissioned until further notice - *sorry*
70cm Repeater Cranbourne VK3RLP In 434.475MHz Out 439.475MHz CTCSS 91.5Hz
VK3RLP Repeater supports Remote Internet access (IRLP), Node 6794.
70cm Repeater Drouin VK3RWD In 433.575MHz Out 438.575Mhz CTCSS 91.5Hz
Simplex VHF - 145.450MHz FM • Simplex UHF - 438.850MHz FM
VK3RLP Beacons 1296.532MHz & 2403.532MHz

Membership Fee Schedule

Pension Member rate $25.00 Extra Family Member $20.00
Standard Member rate $40.00 Junior Member rate$25.00
Fees can be paid by EFT to BSB 633000 - Account 146016746.
• Always identify your EFT payments.
• Membership Fee's Are Due at each April Annual General Meeting.

Magazine Articles to editor@ggrec.org.au or vk3tgx@gmail.com
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