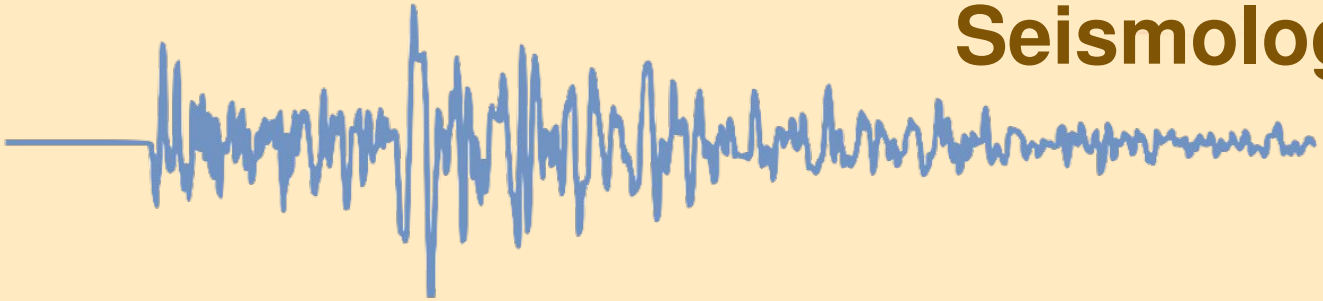
Newsletter of the Seismological Association of Australia Inc.

Mar-Apr 2019



Seismological Association of Australia Inc.

Newsletter of the
Seismological Association of Australia Inc.
PO Box 682, Mylor SA 5153

Your Committee

Chairperson - Blair Lade
m: 0407 189 061 e: blairl@bettanet.net.au

Chief Seismologist - David Love
p: 08 8336 8003 e: david@earthquake.net.au

Public Officer - Paul Hutchinson
m: 0419 829 216 e: windfarmer@bigpond.com

Secretary - Joe Grida
m: 0407 558 036 e: joe.grida@internode.on.net

Treasurer - Joe Grida
m: 0407 558 036 e: joe.grida@internode.on.net

Editor - Peter Gray
m: 0418 829 632 e: weaksignals@iinet.net.au

The SAA can be contacted by post to the address above, or by email to any member of Committee, as listed above

Membership of the SAA is open to all, with the only prerequisite being an interest in seismology. Membership applies for the calendar year (January through to December)

Membership fees are:
Full member $50

A Membership application form can be obtained from the Treasurer.

Member Submissions
Submissions for inclusion in the Newsletter are welcome from all members; please note that submissions may be held over for later editions. Wherever possible, text submissions should be sent via email in almost any word processing format. Your name may be withheld only if requested at the time of submitting. Images should be high resolution and uncompressed, although high resolution JPEGs are acceptable.

All enquiries and submissions should be addressed to the Editor and preferably sent by email to weaksignals@iinet.net.au

A word from the Editor
The association is currently quite active, as you will see on the SAA News page. Planning for this year's Science Alive event and the Bunnings BBQ fundraiser, upgrading some existing sites and consolidating it's assets in the hope of establishing some new sites in the near future. These activities all take time and effort, materials and of course, some cash. As a fairly new association, we don't have a great number of members to call upon, nor do we have buckets of money to draw from. We do have a lot of enthusiasim, resourceful members with some handy skills and a considerable knowledge base to work with. So we choose our tasks carefully and plan as best we can, to avoid wasting precious time and resources. Irrespective of whether the job is a small one or a large one, our aim is to do it right and only have to do it once. The outcome may be a new or improved capability, but enhancements in reliability or survivability are just as important, perhaps even more so in the case of remote sites.
It won't happen overnight but it will happen.
If you think you can help out and willing to do so, your input is more than welcome.

Peter Gray

SAA News and upcoming activities

Pacific Conference on Earthquake Engineering

A paper by Sinadinovski, McCue, Agus, Gibson and Love on the AEES Reconnaissance Mission to Papua New Guinea in March/April 2018 has been accepted for oral presentation at the Pacific Conference on Earthquake Engineering, to be held in Auckland, New Zealand between 4-6 April 2019.

Kevin McCue will be flying over to give the paper. Members will be able to read it in the next SAA Newsletter (#12).

Bunnings Fundraiser BBQ

It has been a long time coming but the SAA has been granted an opportunity to raise some much needed cash on (please take note)

Sunday, May 5th 2019 at Bunnings Mt. Barker (SA).

The times will be **9:00am thru 5:00pm** (normal opening hours).

If you are available to help out for a couple of hours or even the whole day, your time and effort will be appreciated.
Some of the items that will be required for the day include ice boxes/portable fridges for raw foods and drinks, camping sinks for hand and utensil washing, BBQ utencils etc. I have some but not enough for 40kg of sausages and associated consumables.
Proceeds from the fundraising will possibly go toward existing seismic station upgrades, new seismic site development or public liability insurance costs.

Science Alive 2019

An expression of interest to participate in this years Science Alive has been registered, following the feedback received from the 2018 event. (Newsletter #7)

Existing Seismic Station Upgrades

HKER

Since Newsletter #11 was published, the timing problem at Hawker has been rectified by John Teague, who replaced the faulty GPS unit. This was connected to the ageing drum recorder onsite. Although this is the only drum recorder active in Australia, it is a popular attraction in the area.

TPSO

The two long period Sprengnether Horizontals will soon be recommissioned to complement the Sprengnether 201 Vertical already in service. This will effectively reform the WWSSN LP seismometer which was removed from the Mt Bonython vault back in 2017 (Newsletter #4), with the added enhancement of an EchoPro recorder sending the 3 data streams to the Melbourne Uni EqServer. Following the recent Lippmann power incident (Newsletter #10) we are working on a DC Power wiring upgrade within the vault. This is primarily to increase reliability of the power system and hopefully, reduce the significant AC power costs currently being incurred by the association.

WKA & ROBE

David Love is planning a trip down to Willalooka and Robe sometime in April to do some much needed equipment upgrades. Both sites require new solar panels to keep them running reliably through the winter months, our southern coastal areas are often cloudy for days at a time. Another 100W will added to existing panels and harvest power more effectively.

New site development

PENW

As detailed on page 9 in this newsletter, Penwortham is up and running, currently sending data to the SAA EqServer.

MYP

A new site at Wattle Flat has been chosen. It will require some minor earthworks prior to installation of the seismometer, recorder, solar power system and communications equipment, most of which are being recycled from other, now decommissioned, sites.

Recent Seismic Activity

Article kindly submitted by David Love
SAA Chief Seismologist

The 2019-03-20 Mount Barker Earthquake, magnitude 2.2

This small earthquake occurred near the middle of the day (1:02pm, 0232UT). There are nearly 20 seismographs operated by SAA, private individuals, Geoscience Australia and schools within 100 km of the epicentre. When the data from all of these are combined it is possible to get an accurate location, reliable depth and an approximate focal mechanism. Figure 1 shows S-P circles from most of the nearer stations.

I was quite close to the epicentre at the time of the events, but walking outside I had no likelihood of feeling anything. The epicentre (-35.078,138.882) was on the eastern side of Mount Barker, and the hypocentral depth was 22 km. The nearest seismograph was in Mount Barker, and had a good P and S, so we can expect this depth to be reliable.

Unfortunately, there are always some stations that are not running for various reasons. At my own house, my backyard seismograph was overful. My garage (PSN) instrument was turned off because of an expected power outage during the day. Another PSN was off due to another power outage, and yet another site is waiting to be moved. Murphy's Law in action.

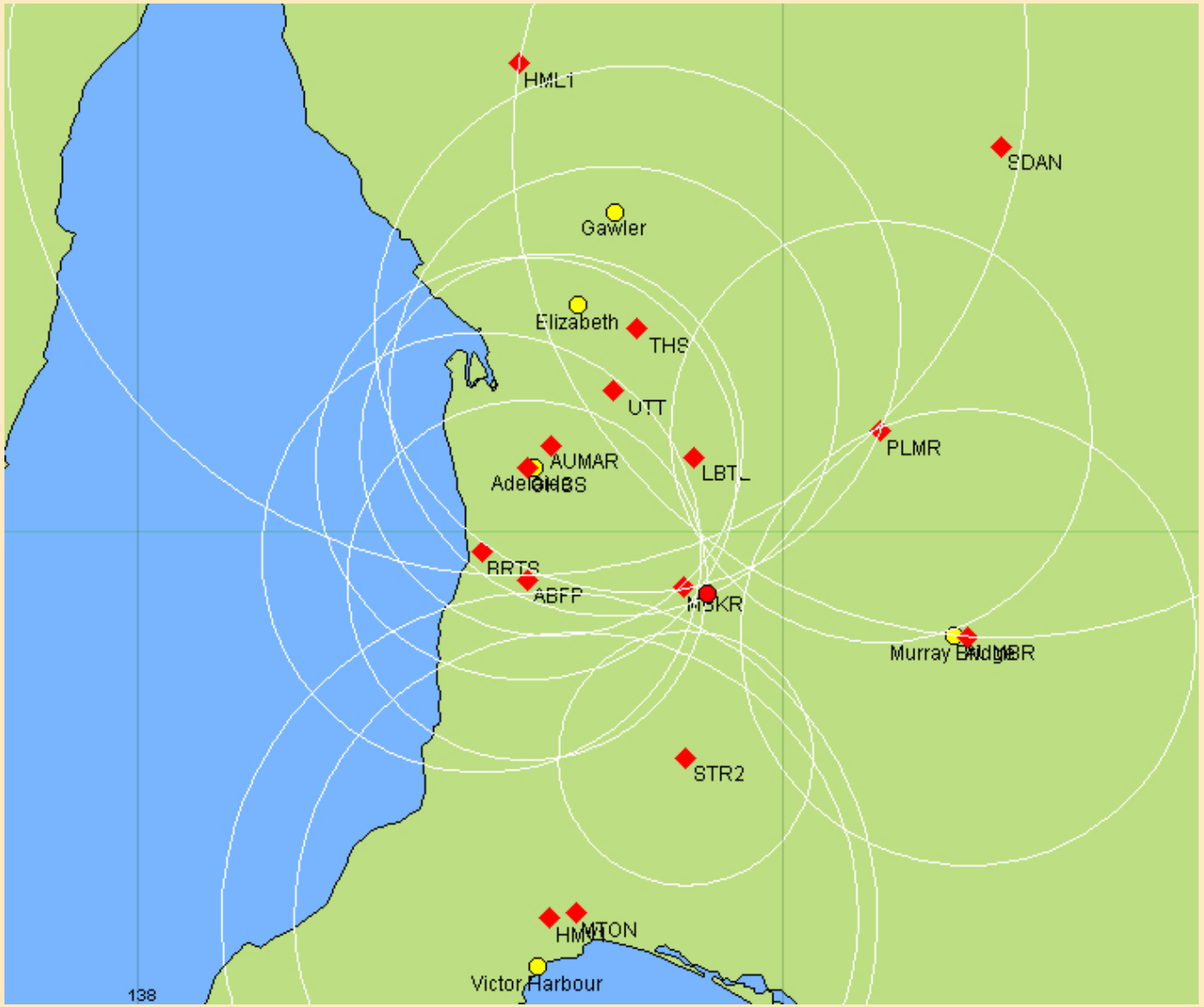


Figure 1: Showing S-P circles for most stations

Recent Seismic Activity

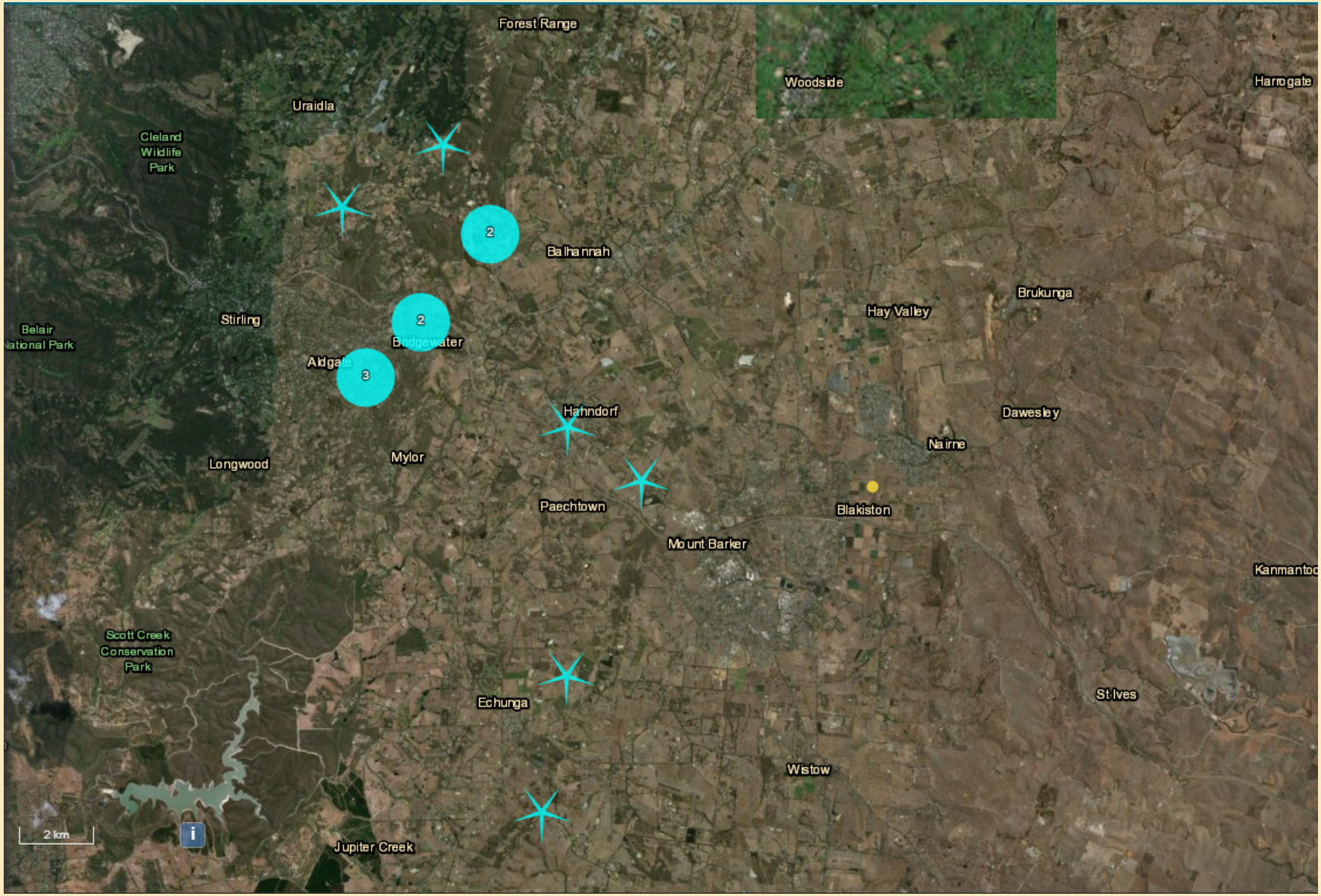


Figure 2:

Showing felt reports received by Geoscience Australia

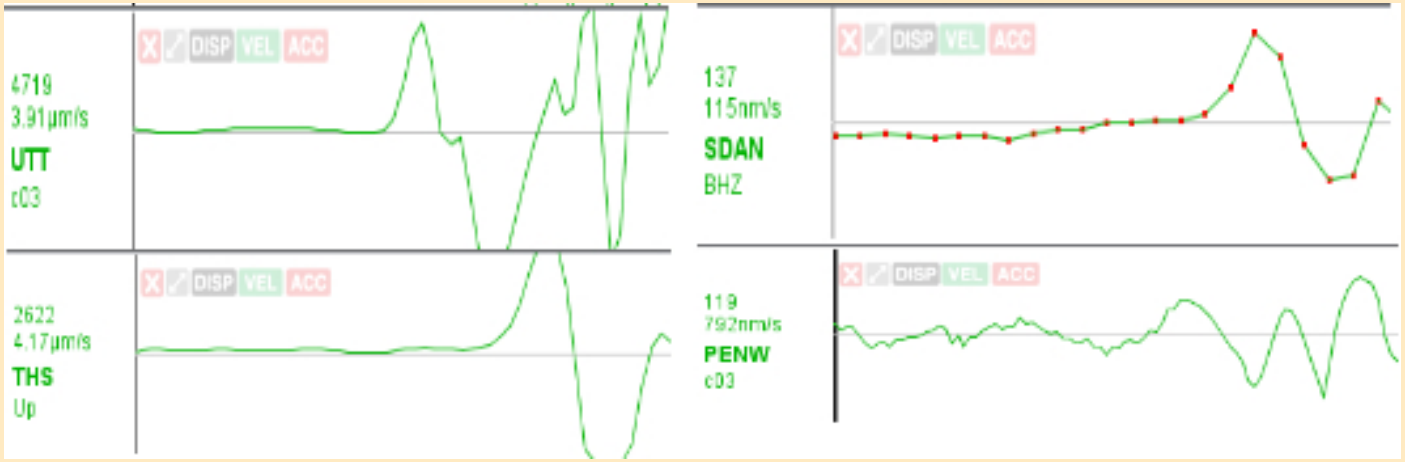
Recent Seismic Activity

Figure 3: First breaks for most stations. Some uncertain breaks were not used.

Recent Seismic Activity

Figure 3 continued:

First breaks for most stations.
Some uncertain breaks were not used.



GA received about 13 felt reports from the area (Figure 2). Their epicentre (yellow dot) was 4km NE of the SAA solution. This response about what would be expected from a small, deep earthquake in the middle of the day, even though the population in the area is quite significant.

This is one of the closest earthquake to the magnitude 3.8 event of 2010 which caused quite a stir across the hills and Adelaide.

With the extra seismic noise that occurs on working days, the clarity of the first breaks was a little down compared to other events, but the results were still useful. The first breaks of most stations are shown in Figure 3 on the preceeding page and continued above. The resulting focal mechanism is shown in Figure 4 on the next page. The poorly fitting stations (WALR and NAPP) are not very clear and could possibly be dropped. Likewise PENW is at a considerable distance and not very clear either. GHSS Govt House was noisy at that time of day, and not clear enough to use. The mechanism shows compression in a NW – SE direction. The nodal plane striking 60° and dipping 60° to the NW is the preferred nodal plane.

Both the depth of the earthquake and the focal mechanism are affected by the velocity model used. This is currently a very simple, single layer model. Now that a number of small earthquakes have been located in the hills region, it may be possible to calculate an improved model.

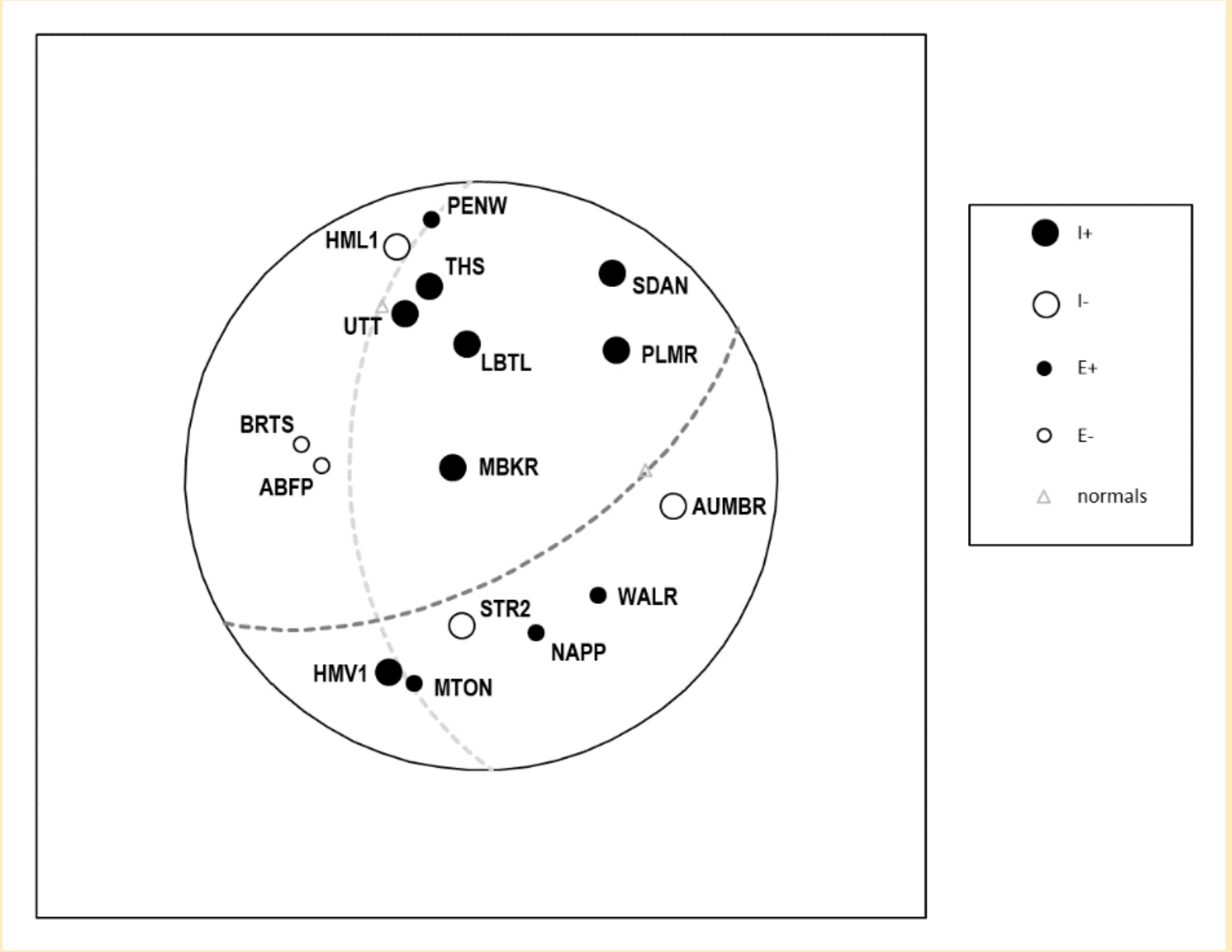
David Love
Chief Seismologist

Recent Seismic Activity

Figure 4:

2019-03-20
Mount Barker
M2.2 v2

Focal Mechanism
(upper hemisphere)
from first breaks



New Seismic Site (PENW)

Article kindly submitted by David Love

Penworthham, SA

In January Blair and David went north to investigate setting up a seismograph at the property of Jack Pappin. The site looked inviting, and in a few hours we were able to install a temporary site, under his house. Further up the hill, the cutting around his shed revealed a small rock outcrop. Just the spot for a permanent site. Jack arranged an ethernet connection to the shed in quick time.

On 15th February, Blair and David went north again, in a cool spell to build the permanent installation. Blair took a heavy duty electric jackhammer that David could hardly lift. We chose a spot a little further uphill from the outcrop expecting to strike rock about a foot down. In went the jackhammer. No rock, but plenty of sweat. Jack suggested a local who had a small digger. That saved the day. Not much later it turned up and progress was much faster. But at the chosen spot rock eluded us. We moved downslope, immediately beside the outcrop and installed the fibreglass pipe so that it was mostly below ground level.

Hand trenching for cables, snake through conduit, holes through the shed wall, GPS installation on the roof, soldering connectors, network niceties, and at the end of a hard day we had the station running. Jack added finishing touches the next day.

PENW now fills a gap between Hallett, Wallaroo and Hamley Bridge stations. The sensor is a Willmore, the recorder an EchoPro (ex. GA), and the data is currently sent to the SAA EqServer. It will move to the Melbourne Uni EqServer at a later date.

Blair and Jack watching the digger. A long way down, but no rock.

It shouldn't be that difficult, should it?

Article submitted by Peter Gray

Building a low noise, dual power supply from a single rail power supply, with battery backup

Upgrading equipment can be a frustrating experience at the best of times. There are so many new things to learn, some old assumptions to burn and of course, a considerable investment in time and resources to make it all happen. I like to think that I can roughly plan out a minor project pretty well, without resorting to gantt charts and too many spreadsheets. What the hell if it takes a week longer and I take another trip to Jaycar or Altronics for parts, as long I have another excuse to justify the two and a half hour round trip.

A little history: I have, until recently, used passive short period seismometers at MTON for the simple reason that I have been able to access a reliable supply of Willmore Mk IIs. This situation may extend into the future but I like to be able to second source hardware, particularly when using obsolete sensors and recorders, so alternate solutions needed to be explored. While I have used some triaxial accelerometers at MTON in the past, they didn't really work well with the Webtronics digitiser and being strong motion sensors, don't offer much return for the effort spent.

The challenge: Identify and obtain alternate equipment. The SAA has several Kinemetrics SS-1 Rangers currently in storage and a healthy supply of Kelunji EchoPro recorders, thanks to a recent donation by Geoscience Australia. Perhaps a temporary loan would be a good way for me to develop some familiarity with our workhorse equipment, while looking for suitable replacements for my own. This arrangement was explored and recently implemented, you can see the results on the SAA EqServer. Occasionally, opportunities present themselves on PayBay for seismic equipment. You have to be choosy and prepared for some disappoinments. Fortunately, the latter did not apply, and so the story continues...

The difference between a passive and an active sensor is usually DC power. A modern active sensor usually requires +12VDC, many of the older active sensors require ±12VDC. This is the case with the Kinemetrics WR-1 Ranger, an active version of this old but popular seismometer series. So how can we power this device adequately from a single, nominal +12VDC power source (battery power actually) from a recorder to a dual 12V supply with adequate power & low noise outputs.

Problem 1: SLA Batteries are a nominal 12V, which can be anywhere between 10V & 15V, depending upon their charge state & charger used. DC-DC Converters with wide input voltage ranges, fixed output voltages and power ratings are available, with or without some form of output regulation. The main consideration for this application is input voltage range and output voltage level, having opted to provide post conversion regulation by selecting suitable devices for the task.

Solution 1: For the DC-DC conversion device, I chose the Traco Power TEC 2-1223, a 2W model with ±15V outputs at 63mA max. per rail. The DC input range is +9V to +18VDC, ideal for 12V battery operation. Alternate models of 1W or 3W are also available, once the critical parameters are met. Cost generally increases with the amount of power they can handle and so does physical size.

Choices, choices... It shouldn't be that difficult, should it?
There are plenty of semiconductor devices available on the market, many of which have been around for a long time and you may be familiar with at least some of them. On the next page, I have collated a table of positive and negative "paired single" output regulators and a few dual output regulators, showing some their key "typical" specifications.
The WR-1 only requires 20mA of current at 12VDC per rail, so any of these would potentially do the job.

It shouldn't be that difficult, should it?

Regulator Device	Input Bias Current	Dropout Voltage	Line Regulation	Load Regulation	Ripple Rejection	Minimum Nominal	Maximum Nominal	Output Noise per volt	Output Noise above 10Hz
100mA Fixed Output									
MC78L12	4.2mA	1.7V	120mV	10mV	42dB	+11.4V	+12..6V	N/A	80µV
MC79L12	6.5mA	1.7V	250mV	50mV	42dB	-11.4V	-12.6V	N/A	80µV
100mA Adjustable Output									
LM317L	2.5mA	2.5V	2.4mV	60mV	80dB	+11.99V	+12.01V	30µV	360µV
LM337L	3.5mA	2.5V	1.2mV	12mV	80dB	-11.99V	-12.01V	0.003%	360µV
150mA Adjustable Dual Output									
TPS7A39	75µA	175mV	4.2mV	10.8mV	69dB	+11.99V	+12.01V	N/A	21µV
	60µA	145mV	15mV	85.8mV	69dB	-11.99V	-12.01V	N/A	22µV
150mA Fixed Dual Output									
LT3032-12	45µA	21mV	1.5mV	20mV	68dB	+11.82V	+12.18V	N/A	20µV
	45µA	21mV	1.5mV	20mV	54dB	-11.82V	-12.18V	N/A	30µV
500mA Fixed Output									
MC78M12	3.2mA	2.0V	8mV	10mV	80dB	+11.4V	+12.6V	N/A	75µV
MC79M12	4.4mA	1.1V	5mV	30mV	60dB	-11.4V	-12.6V	N/A	75µV
1A Fixed Output									
MC7812	3.4mA	2.0V	6mV	25mV	60dB	+11.4V	+12.6V	10µV/V	120µV
MC7912	4.4mA	1.3V	13mV	35mV	61dB	-11.5V	-12.5V	N/A	75µV
1.5A Adjustable Output									
LM317T	3.5mA	1.6V	1.2mV	12mV	80dB	+11.99V	+12.01V	0.003%/V	360µV
LM337T	3.5mA	1.6V	1.2mV	36mV	77dB	-11.99V	-12.01V	0.003%/V	360µV

A table of typical specifications for popular 12V Voltage Regulators

It shouldn't be that difficult, should it?

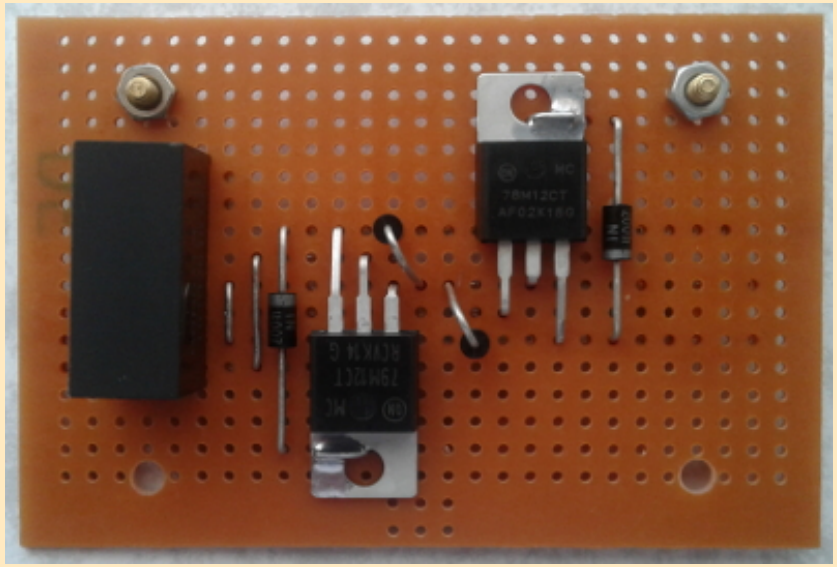
To help me sort through the myriad of device datasheets, what I needed to consider and what to ignore, I asked Chris Chapman in the UK for his assistance and experience with making these choices. My thanks to Chris for his help with this artice

Problem 2: Which voltage regulator(s) to use: If you refer to the table on the previous page, based upon the electrical data presented, the choice is a no brainer, the Texas Instruments TPS7A39 device wins hands down. The regulated DC output voltage figures have the tightest balance, the Output Noise figures are almost balanced and very low. Sadly, if you're prototyping a one-off power supply on Veroboard, hand soldering a 10 lead device with a footprint of 3mm x 3mm is beyond my skill level. The Linear Technologies LT3032-12 is a little larger (4mm x 3mm) but has 14 leads, two of which have heatsink planes underneath which also require soldering, both devices are definately wave machine soldering stuff.
Trade-off 1: A compromise, I'm going to have to avoid using either of the good devices and settle for the general purpose, three lead regulators.

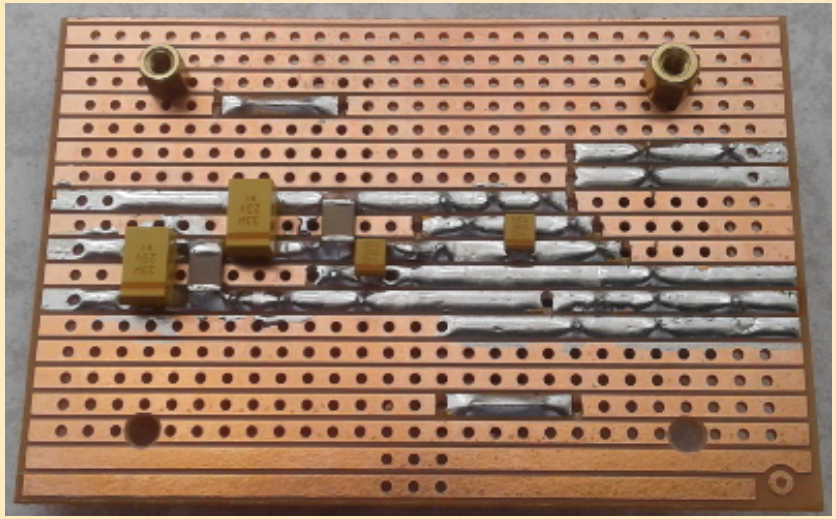
Problem 3: What happens below 10Hz? All the device specifications for output noise are for frequencies above 10Hz, the LM317/337s extend up to 10kHz and the remainder extend up to 100kHz. While that may suit many users, Chris thought that it leaves some questions for seismic applications where in many cases 10Hz is at the higher end of the frequency range of interest.

Solution to 2 & 3: Build it and they will come. Having now retired, I don't have access to the measurement equipment once available to me in one of my past lives. My initial thought was to build a number of different prototypes, run them on the intended equipment and see if there are any adverse effects.

MC78L12/MC79L12 Voltage Regulator pair: The first prototype to be finished was the board with the 100mA (TO-92 case) fixed voltage regulators. This was fitted into an in-line enclosure located between the EchoPro and the WR-1, then run for a week or so before being replaced with the next prototype to be built.



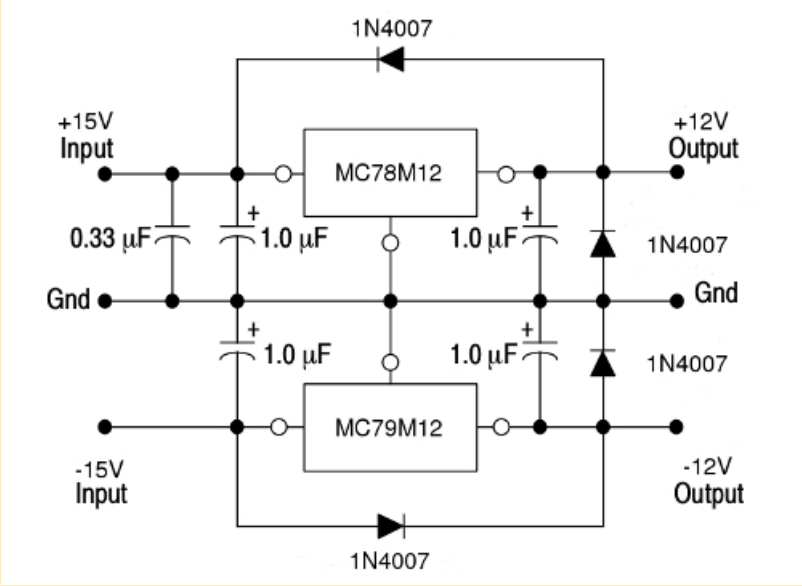
MC78/79M12 prototype using tantalum capacitors. The DC-DC Converter is on the left (above) and right (below)



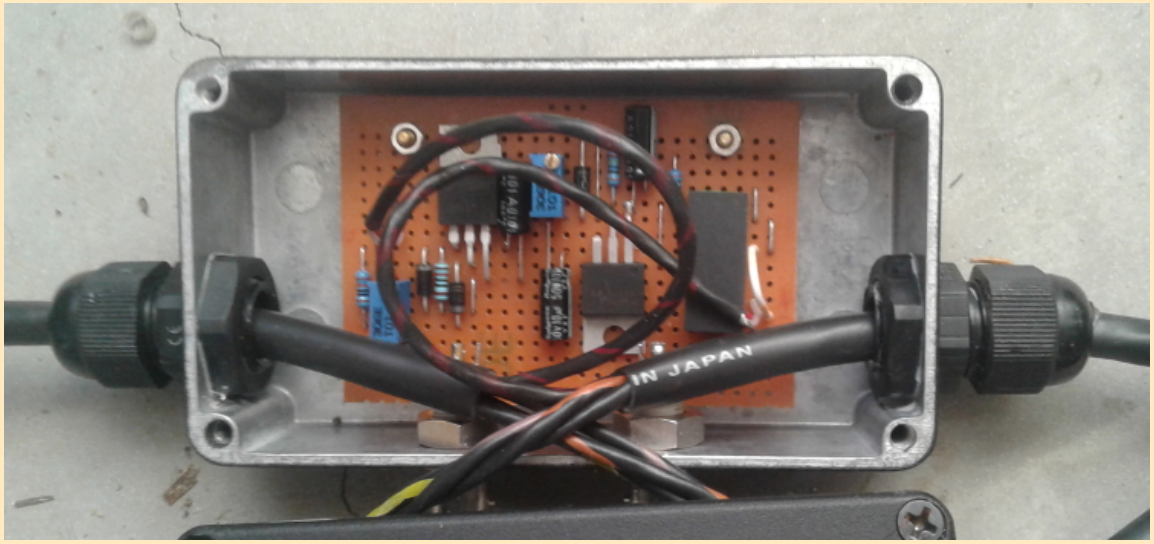
It shouldn't be that difficult, should it?

As this was the first time the WR-1 had been connected to an EchoPro, there were periods of experimentation with gain settings, filter settings and other teething issues. I think that this board could use another chance to prove itself. An opportunity to retest will be arranged in the near future.

LM317/LM337 Voltage Regulator Pair: This 1.5A (TO-220 case) prototype was connected for a couple of weeks with no apparent problems. This variant was selected to determine what effects varying the DC output levels would have on the seismic data, being the only prototype to have indepenently adjustable outputs. Of all the 3 lead regulators under consideration, this pair have the highest output noise figures (above 10Hz), 3 times that of it's nearest rival, the MC7812.



A typical fixed 3 terminal regulator schematic



LM317/337 prototype using electrolytic capacitors. The aluminiun case is the where the final prototype choice will be housed, close to the WR-1

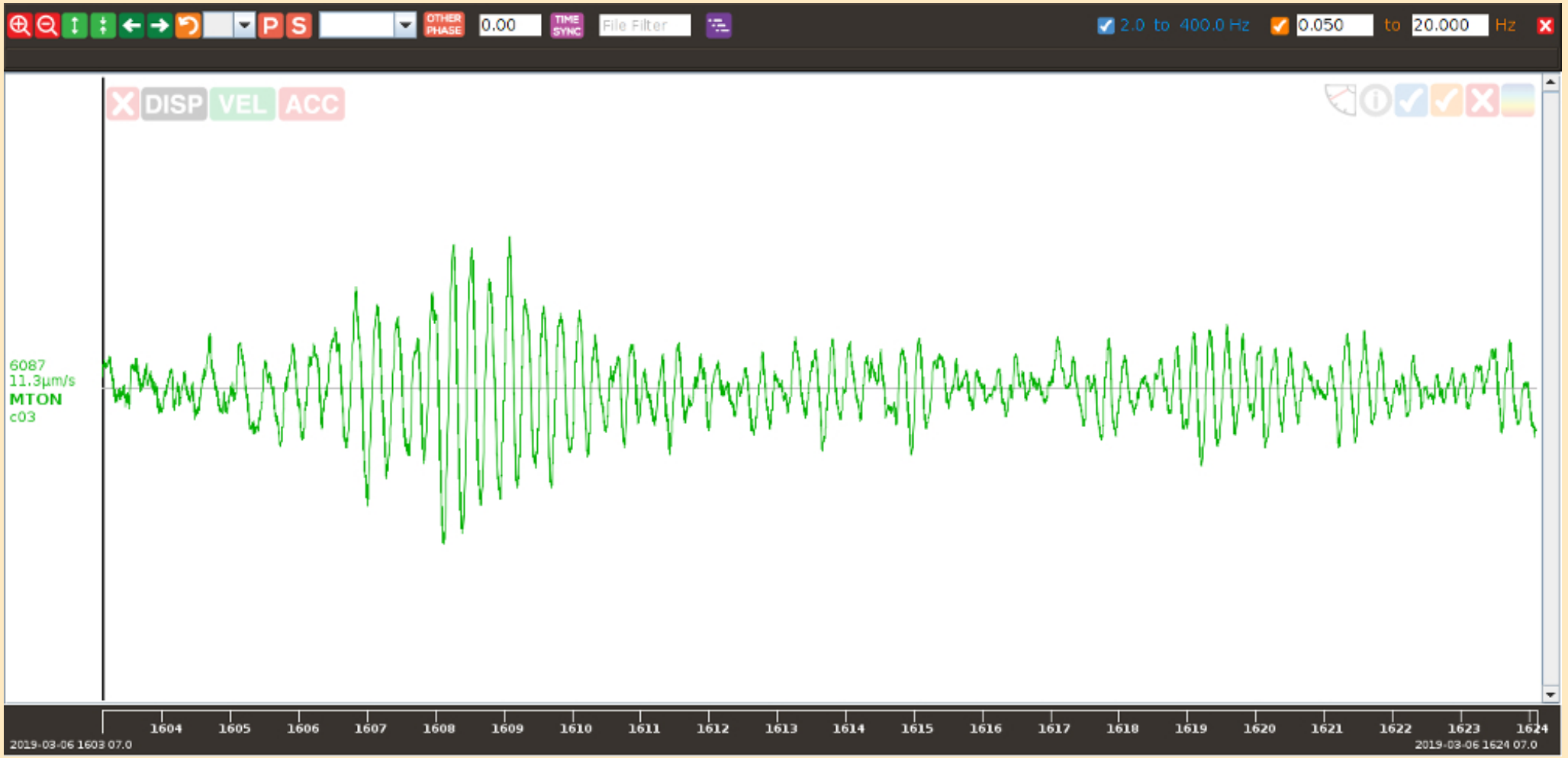
MC78M12/MC79M12 Voltage Regulator Pair: This pair of 500mA (TO-220 case) devices (images on the previous page) are currently connected to the WR-1 and have been for several weeks (at time of publication). During this period, MTON has picked up both teleseismic and local events, along with periods where little seismic activity has been discernable.

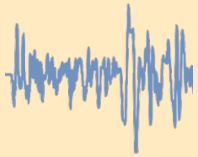
This schematic is typical for fixed voltage, 3 terminal regulators and was used for all the prototypes using such devices. The only differences were the capacitance values on the outputs which were generally larger (>10uF) than the 1.0uF shown.

A better test method will be needed to determine if any power supply noise is affecting the seismometer output. The 3 volt difference between input and output DC levels is uncomfortably close to the specified limits on some of these voltage regulators.

It shouldn't be that difficult, should it?

A practicle test for the LM317/LM337 Voltage Regulator Pair?
2019-03-06 15:46:14 A magnitude 6.4 quake in the region of the Kermadec Islands (north of New Zealand) depth approx. 29km.
A 20 minute trace of this event, the display filter has been set to the specified bandwidth (0.05Hz to 20Hz) of the seismometer. The Kinemetrics Ranger WR-1, located on the garage floor at MTON, appears to be working ok and shows some characteristics similar to those recorded at Geoscience Australia's Buckleboo station (BBOO) and the long period instruments at the Peters Seismological Observatory (TPSO).





Resources & useful links

Description	URL / Webpage	Notes
SAA Membership Application	https://www.assa.org.au/media/74629/saa-membership-	Join up with the SAA using this form
SAA Flier	https://www.assa.org.au/media/74629/saa-membership-	Our current brochure - flier, saying what we do
SAA Newsletters	https://www.assa.org.au/resources/technical-special-	Download any SAA Newsletter from this site
SAA EqServer	http://ade-eqserver.dyndns.org:8080/eqserver/	South Australian miniseed seismometers
Melbourne University EqServer	http://meiproc.earthsci.unimelb.edu.au/eqserver/	Australian miniseed seismometers
Regional Seismic Network	http://www.regional-seismic.net/	PSN seismometers - Aust. Centre for Geomechanics
Regional Seismic Users Website	http://www.rsuw.daleh.id.au/index.html	PSN seismometers - RSUW
Recent SA Earthquakes	http://earthquakes.mappage.net.au/q.htm	Data & summaries of recent SA quakes
Central QLD Seismology Research Group	http://www.cqsrg.org/	CQSRG - Kevin McCue
Astronomical Society of SA	https://www.assa.org.au/resources/technical-special-	ASSA - Seismology page
Geoscience Australia	http://www.ga.gov.au/earthquakes/initRecentQuakes.do	Our national authority on seismic events
QLD Uni Environmental & Earth Sciences	https://sees.uq.edu.au/	The University of Queensland - Col Lynham
Seismic Research Centre	https://www.src.com.au/	OEM of seismic instruments & software
symCDC	http://symcdc.com/	OEM of seismic instruments & software
IRIS Seismic Monitor	http://ds.iris.edu/seismon/	Global seismic events
Joint Australian Tsunami Warning Centre	http://www.bom.gov.au/tsunami/	Bureau of Meteorology site
Australian Earthquake Engineers Society	https://aees.org.au/	An organisation with similar interests
Atlas of the Underworld	http://www.atlas-of-the-underworld.org/	Mapping the Earth's mantle
Atlas of Living Australia	https://www.ala.org.au/	A Citizen Science initiative