



# NERG NEWS

North East Radio Group Inc  
PO Box 270, Greensborough, VIC 3088  
www.nerg.asn.au ABN - 19 340 249 865  
Incorporated 1985 Victoria Reg No A0006776V  
Affiliated with the WIA

## WHAT'S ON THIS MONTH *Monthly meeting*

**Thursday 9<sup>th</sup> February 2017 Regular club meeting** 8:00 pm till late at the club rooms.

### ***Coffee Club***

**Thursday 23<sup>rd</sup> February 2017 7:30 pm** till around 10:00 at the club rooms.

### **Gainfully Unemployed Lunch Group**

**Tuesday 28<sup>th</sup> February 2017 11:00 am** for coffee, lunch around 12:15 in the Bistro. At the Greensborough RSL. Please let Jim VK3KE know if you are attending.

### ***Radio Café***

#### ***Every Thursday afternoon***

Radio Cafe is back for 2017 commencing Thursday 9<sup>th</sup> Feb. Come along and have a chat, operate the club station or show off your latest construction project.

# February 2017

## A Masthead Diplexer and LNA for 2M and 70cM

*Paul McMahon VK3DIP*



*Figure 1 The Diplexer/LNA*

### ***Note from the editor***

***Paul has sent an update to this article indicating that this should not be used for FM operating as it is and that this is Part 1 of a two part article. Part 2 will describe a simple sequencer and why you need it!!.***

### **Overall**

The need for this device, the internals of which are seen in Figure 1, came out of my usual practice of setting up for contesting at the last moment, wanting to minimise the time and effort required to get going, being stingy about multiple expensive coax runs, and finally having

a transceiver with a single connector for both 2M and 70cM.

The idea was to make something that could handle both a 70cM and 2M Yagi on the same mast/rotator using a single run of good coax back to the base FT897D. There is nothing particularly new here, basically I took a diplexer design that I had used before, mated it with a PGA103 low noise amplifier and relay, added a bias tee to feed power up the coax, and stuck it all in one weather proof box. In my case I have been using LMR400 coax since the NERG had a group buy of it some time back. It is not as flexible as the similar diameter RG213 but has much lower losses, it is however even at the NERG bulk price, not cheap. So, if I wanted to use it for the run to the 70cM antenna, then using the same length for both 2M and for power feed makes the pain a bit less.

The complete schematic for this is shown in Figure 2.

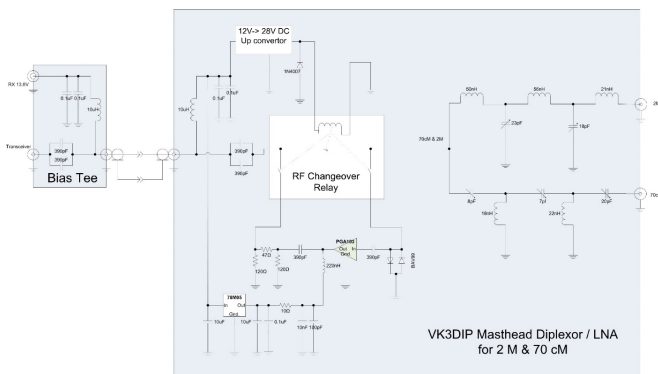


Figure 2 LNA/Diplexer Overall Schematic

In my case the relays etc. are arranged so that the power over the coax is only needed to be present while in receive. i.e. no DC volts and the LNA is out of circuit and the antennas are switched straight through. With DC volts present the relay switches in the now powered up LNA.

The parts list ( Table 1 ) shows the bits I used but in most cases these are not particularly critical, substitutes will probably work just as well.

Table 1 Parts List

Parts List
Weatherproof 6x6x3 inch Junction Box
N Panel mount sockets x 4
1x Coaxial Changeover Relay
1x12V to 28V Step-up DC-DC converter
1xPGA103 Amp built on MiniKits EME162 board
2M/70cM Diplexor
DC Bias Tee x 2 (10uH/800pF)
Various hook-up cables and hardware.

This detail all in together is a bit hard to see, so a look at the various sub-sections is in order.

### The PGA103 LNA

The LNA layout on the EME162 PCB is shown in Figure 3. With the matching schematic segment given in Figure 4



Figure 3 LNA showing output Attenuator

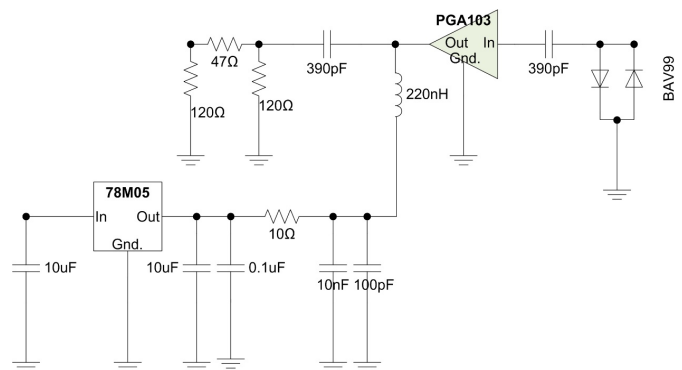


Figure 4 PGA103 LNA Schematic

Both the PGA103 and the EME162 board were obtained from minikits.com.au.

The design is basically an amalgam of a number found on the web, primarily from F4EMY and F1JKY. You can see I used back to back diodes on the input to try and restrict any overloading. The BAV99 is perfect for this use as it has the two high speed/low capacitance

back to back diodes in one small three-legged package. I also put an approximately 8dB (7.7dB actually) attenuator in the output side, as I have plenty of gain to play with, and it also provides some protection if the relay is a bit slow and the 100W TX tries to go the wrong way. Resistors are easier and cheaper to replace than the PGA103. This also helps to provide a good termination impedance for the PGA103 keeping it well behaved. I picked this value simply because the SM resistors were to hand, other values of attenuation could be used. As guidance the idea of the masthead amplifier is to basically set the system noise figure, as well as to provide enough gain to compensate for the losses in the coax run. You could probably get by with 0dB attenuation, but there is room for it on the board so better safe than sorry.

The swept frequency response of my prototype is shown in Figure 5.

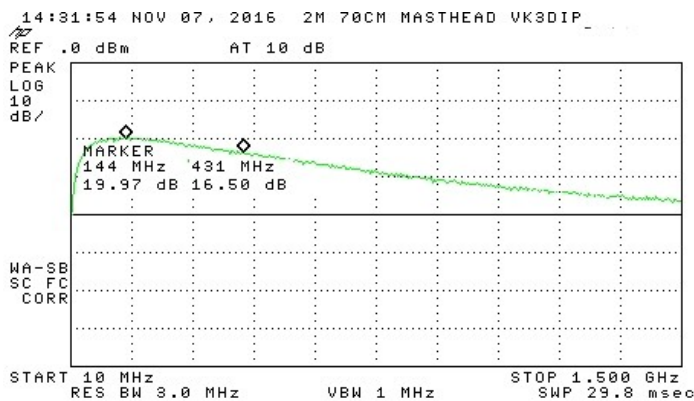


Figure 5. LNA frequency response.

As you can see I ended up, even with the attenuator in place, with about 20dB gain at 2M and 16.5dB at 70cM. While I have no calibrated noise figure meter, from reports of similar setups on the web I would be expecting values well sub 1dB, which while not quite being at EME levels, it is not that far off, and it should have very good intermod performance which is what you want for contests where there are other nearby strong stations.

## The Diplexer.

The Diplexer layout is shown in Figure 6 with the schematic in Figure 7.



Figure 6 Diplexer layout.

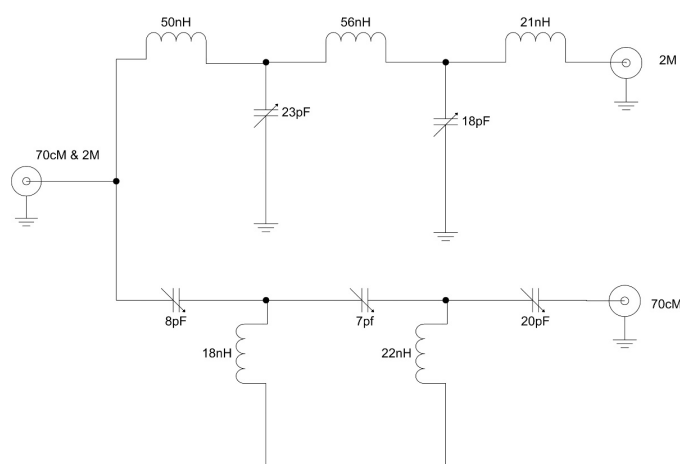


Figure 7 - Diplexer Schematic.

The design is a fairly classic one. Basically it consists of a high pass filter section for the 70cM leg and a low pass section for the 2M one. I chose five element filters in each case, with also in both cases a 3dB frequency (i.e. crossover point) roughly in the middle of the two bands at 250-300MHz.

Anyway, the design was realized using the Tonne Software diplexer software that comes with the ARRL handbook these days, to save having to use filter tables etc. While the net frequency response of my prototype has somewhat higher ripple than the ideal design (see Figure 8), this is in part because I tuned it for minimum losses at the two bands of interest. This is desirable for several reasons, not least of which is that being in front of the LNA any losses here would directly add to the noise figure.

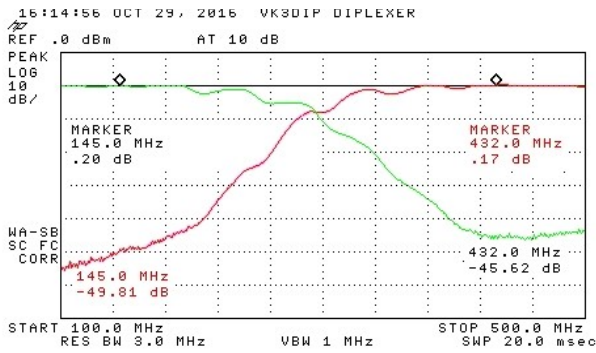


Figure 8 - Diplexer Frequency Response.

I used air variable trimmer capacitors for all capacitors to again minimize losses, as well as to handle the potentially high voltages that come with TX levels of 100 watts or so. Coil turns and diameters were calculated using a spreadsheet I put together some time back shown in Table 2

16AWG	Close Wound (spacing out decreases inductance)								
Approx Inductance in nH	Turns								
	1	2	3	4	5	6	7	8	
Diam (inner) (mm)	2.5	4.7	13.0	22.4	32.2	42.3	52.5	62.9	73.2
	3	5.6	15.9	27.6	40.0	52.8	65.8	79.0	92.2
	3.2	6.0	17.0	29.8	43.3	57.3	71.5	85.8	100.3
	3.5	6.6	18.9	33.2	48.4	64.2	80.3	96.6	113.0
	4	7.6	22.0	39.1	57.4	76.4	95.8	115.6	135.5
	4.5	8.6	25.3	45.3	66.8	89.3	112.4	135.9	159.6
	5	9.6	28.7	51.7	76.8	103.0	130.0	157.5	185.3
	5.5	10.7	32.2	58.4	87.1	117.3	148.5	180.2	212.5
	6	11.7	35.8	65.3	97.9	132.2	167.8	204.1	241.1
	8	16.2	50.8	94.8	144.3	197.4	252.8	309.9	368.2
Length(mm)	1.3	2.6	3.9	5.2	6.5	7.7	9.0	10.3	

Table 2 Inductance values for small inductors, (small/zero length leads).

The main aim of the Diplexer is to have as low as possible attenuation at the nominal port frequency, between that port and the common port, while providing as much attenuation as possible at the frequency of the other port. As can be seen from Figure 8, I achieved in this case less than 0.2 dB through attenuation at the individual port frequency (, or wanted frequency), with better than 45dB attenuation at the other port (not wanted) frequency. The net effect is that effectively only 2M energy goes out(in) the 2M port, and 70cm energy goes out(in) the 70cm port, but they are mixed together at the common port. The diplexer is basically a no moving parts frequency selective antenna switch.

## The Bias Tee.

The bias tee is basically just another diplexer, in this case the two bands/frequencies being separated are DC and RF (2m&70cm), The power and RF share the coax but at each end are separated out into the two bands DC and RF. In this case, we get away with only a single element filter of a single series capacitor for the high pass (RF) and a two-element series Inductor, shunt capacitor for the low pass (DC). As I only wanted this to work for 2M and 70cm (i.e. not HF also) I could get away with reasonably small values in both series cases (10nH and 780pF, the later formed by two 390pF's in parallel). This makes things much simpler as the larger values you need for HF can introduce self-resonances at VHF/UHF with all sorts of undesirable effects. The values are not particularly critical, you can pretty much use whatever you have that is within cooee. I used two high power 390pF surface mount types in parallel simply because that is what I happened to have to hand with a high enough voltage rating (, similarly for the inductor but in this case, it is the current rating that is important). The voltage and current ratings are determined by how much RF power you are going to run up the stick, along with the DC current required by the LNA/relays, respectively.

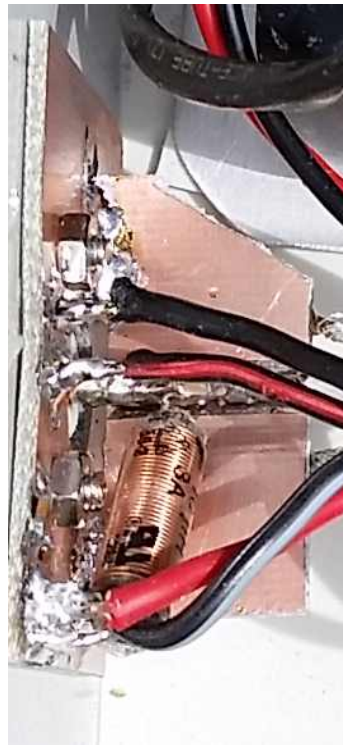


Figure 9 Masthead Bias Tee Layout.

## Coax Relay.

The Masthead end of the bias tee is fashioned using some scraps of PCB mounted directly on the back of a panel N socket connector. (Figure 9) The short section of strip-line with the capacitors in series was made using two hacksaw cuts roughly 3mm apart, and the small land on the base for the volts out was likewise just one corner of the otherwise earth connection PCB again separated by a hacksaw cut. All cuts are of course just through the copper layer not the fiberglass.



Figure 10- Reworked Commercial Bias Tee

You will see that, being lazy, the base end Bias Tee (Figure 10) was actually a modified commercial one bought at a hamfest for a couple of dollars. To make it suitable for the use here I had to remove the Zener regulator, swap over the capacitor and inductor, and replace a TNC with an N connector. I obviously left the static arrester and LED in place but don't show them on the schematic.

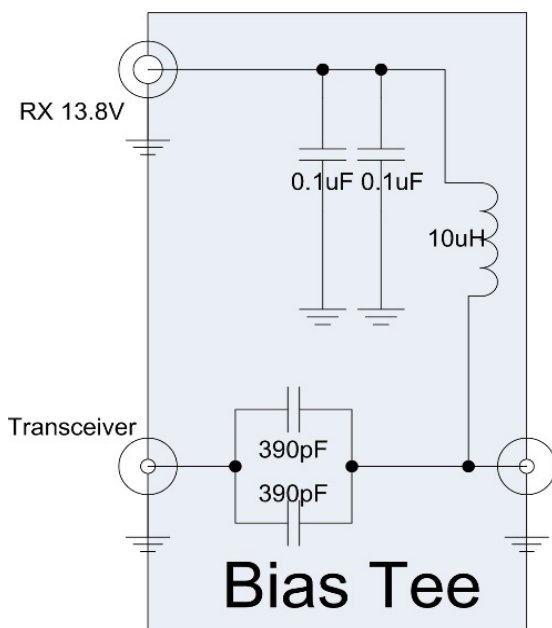


Figure 11- Bias Tee Schematic.

The final bits needed are the coaxial relay and associated cables and power supply. The power supply (stepping the approx. 12VDC in to 28VDC out) is required because the relay used needed the 28V to pull in. I did originally try a pair of 12V single pole double throw relays but had to pension them off because they had reasonably poor isolation performance at 2M/70cM. Even 40db isolation (the loss/isolation from the common to the "off" port) means with 100Watts in 100mW hitting the reverse of the LNA. I lost a few PGA103s in early versions either due to this or front end overload. I have had no problems since changing over to the current special changeover relay (and adding the input protection diodes). The type of relay I used is shown in Figure 12. I originally go on to this type of relay from the notes handed out at a NERG talk of microwave equipment some time back. In the picture, you will see one relay with four N female connectors. The top two connectors are normally connected together (ie. with relay power off) so nominally one is in and the other out, and so when energised in is connected to out. With volts on the left top connector connects to the bottom left connector and the right top to the right bottom. So the bottom two connectors go to the masthead amp. Obviously this would work for either a RX pre-amp or TX power-amp ( assuming you got things the correct way around) but not both. These relays have well in excess of 50dB isolation even at the highest frequency, and very low on losses. As advised in that NERG talk the relays were obtained from Chinese sellers on EBAY, they look to be salvaged from commercial telecom equipment. There are several "brands" that have been on offer but they all seem identical under the skin. Unfortunately, they have been very popular with Hams etc. when I got mine they were available for less than \$40 each, but a quick search now showed them going for over \$100, well over in some cases To find them on eBay Search for "N type RF coaxial relay switch DC-2.2Ghz" .



Figure 12- Coax changeover relay

As stated these relays have very good performance specs. but they do need 28V to operate. Fortunately eBay and China can supply small DC/DC step up modules for under \$2 each (Search for " **DC-DC Boost adjustable step Up Converter XL6009**" ) These modules (plus a reverse arrestor diode across the relay terminals) effectively provide a very convenient 12V drive for the relays.

## The NERG NEEDS YOU!!



For the

## John Moyle Memorial Field Day

18<sup>th</sup> - 19<sup>th</sup> March 2017

We would like to encourage members to come and have a great time with the club at the 2017 Field Day. We have permission to operate on Mount Macedon but are still on the look out for a better location. The 2017 field day will commence on Saturday 18<sup>th</sup> March at 0100UTC (Noon local time) through till 0059UTC (one minute to noon) Sunday 19<sup>th</sup> March. The aim of field day is to encourage and provide familiarisation with portable and field operation, and provide training for emergency situations.

In Past years the NERG has participated with great success and lots of fun for those who came along and operated or assisted in station setup and pull down. We are planning now and need to know who is coming along.

If you are planning to participate please let David VK3UQ know at [vk3uq@nerg.asn.au](mailto:vk3uq@nerg.asn.au)

### ARDF NEWS

*Amateur Radio Direction Finding is a part of our hobby which is flourishing around Melbourne. This is probably due to the Victorian ARDF Group and their tireless workers.*

*There are no ARDF events planned for February*

### FOXHUNT NEWS

*For those NERGs that are interested in getting into foxhunting we are planning a training day or evening. This is where an experienced foxhunter will help you set up your car and give you some hints on equipment selection and operation and also run a few practice hunts. Please contact Greg VK3VT or Grant VK3GWS.*

*There are monthly hunts held on 2 metres on the third Friday of the month and new hounds*

are always welcome. So if you enjoy the experience there will be plenty of opportunities to hone your skills and have some fun!!

## Still FOR SALE

Bags of cable ties for sale. Black UV resistant 140mm x 3.6mm. There are 100 cables ties per bag. Price \$2 per bag or \$10 for 6 bags or \$20 for 12 bags.

**Contact Chris VK3AWG**

### Discounts from Suppliers

Club members can get discounts from two suppliers:

**Altronics. (Australia Wide)**, Mention you are from the North East Radio Group or give our customer no - 64429. Discount will be minus 10% up to 45% off depending on the item. (Actual discounts depend on the product type and quantity purchased). There is No Minimum Spend in store to receive the discount. For on-line or phone Sales there **IS** a Minimum spend of \$25.00 inc GST but **NOT** including Freight. In the comments section put "64429" to receive the discount. <http://www.altronics.com.au>

**Jaycar Electronics stores** by mentioning you are from the "North East Radio Group" You need to spend a min \$25.00 to receive a 10% discount. <http://www.jaycar.com.au/>

### December 2016 PLANNED DXPEDITIONS

If you missed the Central African Republic they are back on for a fortnight so get busy!!

Start	End	Entity	Callsign
Feb 01	Feb 14	Central African Rep	TL8TT
Feb 01	Feb 14	Mauritius	3B8HE
Feb 01	Mar 03	Senegal	6W2SC
Feb 02	Feb 08	Cyprus SBA	ZC4A
Feb 02	Feb 08	Guadeloupe	FG
Feb 03	Feb 08	Fernando de Noronha	PY0F
Feb 03	Mar 11	Rwanda	9X2AW
Feb 04	Feb 11	Costa Rica	TI7
Feb 05	Feb 26	Guinea	3X
Feb 06	Feb 18	Namibia	V5
Feb 07	Feb 07	Bahrain	A91SD
Feb 08	Feb 10	Iran	EP2C
Feb 08	Feb 18	South Cook Is	E51AMF
Feb 09	Feb 11	Malta	9H3HN
Feb 09	Feb 14	Belize	V31VP
Feb 10	Feb 15	Bhutan	A5A
Feb 10	Feb 17	Easter I	CE0Y
Feb 10	Feb 22	Panama	HP
Feb 10	Feb 24	Guantanamo	KG4
Feb 10	Feb 26	Lesotho	7P8
Feb 12	Feb 15	Panama	HP
Feb 13	Feb 26	Macao	XX9D
Feb 13	Feb 27	San Andres & Providencia	5J0NA
Feb 13	Mar 03	Austral Is	TX5T
Feb 13	Mar 07	San Andres & Providencia	HK0
Feb 14	Feb 20	St Kitts & Nevis	V4
Feb 15	Feb 21	Belize	V3
Feb 15	Feb 21	Fernando de Noronha	PY0F
Feb 16	Mar 05	Pitcairn I	VP6EU
Feb 17	Feb 21	Palau	T88DT
Feb 17	Feb 25	Sint Maarten	PJ7
Feb 21	Feb 24	Juan Fernandez	CE0Z
Feb 22	Mar 07	Barbados	8P9AL
Feb 24	Feb 26	Dodecanese	SX5R

Thanks to <http://www.ng3k.com/misc/adxo.html>

## CONTESTS

***This month sees the big RTTY contest – the CQWPX RTTY on the 11<sup>th</sup> and 12<sup>th</sup> – great fun if you have RTTY working well on your station, N1MM Logger is the preferred logging software.***

<b>February 2017</b>	
CQ WW RTTY WPX Contest	0000Z, Feb 11 to 2359Z, Feb 12
SARL Field Day Contest	1000Z, Feb 11 to 1000Z, Feb 12
Asia-Pacific Spring Sprint, CW	1100Z-1300Z, Feb 11
Dutch PACC Contest	1200Z, Feb 11 to 1200Z, Feb 12
ARRL Inter. DX Contest, CW	0000Z, Feb 18 to 2400Z, Feb 19
Russian PSK WW Contest	1200Z, Feb 18 to 1159Z, Feb 19
CQ 160-Meter Contest, SSB	2200Z, Feb 24 to 2200Z, Feb 26
SARL Digital Contest	1300Z-1600Z, Feb 26

Many thanks to

<http://www.hornucopia.com/contestcal/contestcal.html>

## Remote Station



***This is now available to members, you will need:***

- *An Advanced or Standard Licence. (Foundation Licensees can receive only.)*
- *A windows computer with sound card connected to a speaker and a microphone. A PC headset is ideal.*
- *OR an android tablet or phone and are prepared to pay for the app (less than \$20)*
- *Download the client from RemoteHams.com install it on your machine and register with RemoteHams.com using your callsign. The android app is called RCForb and is available on google play.*
- *The NERG station is currently known as “VK3GG test” Connect to it and request “club” membership and TX capability. Then wait until your membership is approved and away you go!*
- *Transmit Usage privileges will only be available to financial NERG members with VK callsigns.*

## EDITORIAL

*Welcome to 2017, looks like there has been an increase in solar activity in the last few weeks so get on the air and work a few before the sunspot number plummet again!! Of course you can always start building antennas for 30, 40,80 and 160M as they will be the go to bands over the next few years.*

*I hope to have some articles ready on constructing antennas for these frequencies in the next few months. Recently I decided to build a 2m and 70cm antenna to put up on the tower. I remember Paul VK3DIP had an article in NERG News of May 2015 on a antenna that looked suitable. I put it together and the SWR was perfect on both bands so I should soon be back on the NERG Net with a reasonable signal. Thanks Paul for a great article.*

*Paul has provided another great article for this issue on adding a diplexer, preamp and switching to use separate antennas for 2 & 70 but just a single co-ax.*

**73 Greg VK3VT**





**Margherita  
Pizza & Pasta**  
9434 4980

**Margherita Pizza ph 9434 4980**  
**89 Main Road, Lower Plenty, Vic 3093**  
web [www.margherita.com.au](http://www.margherita.com.au)

*Margherita's Still Sponsor the NERG and provide the excellent suppers that we have come to enjoy. Order your next Pizza dinner from them and tell them you appreciate their support of the club.*

### NERG NEWS ARTICLES

*The NERG is always happy to receive news, articles, and member's wanted or for sale advertisements for inclusion in the newsletter. Please contact the editor at [news@nerg.asn.au](mailto:news@nerg.asn.au)*

### THE NERG

*The NERG Inc. Reg No A0006776V <http://nerg.asn.au> The North East Radio Group, Inc. is an amateur radio club devoted to encouraging members and others to enjoy the hobby of amateur radio. It tries not to hang on ceremony and endless reporting but rather participate in the fun aspects of this fascinating hobby.*

### WEB SITES

*The NERG is on Facebook – A group has been established and can be found at <https://www.facebook.com/groups/nergamateurl/> Members are encouraged to join this group*

*WEB Sites: <http://www.nerg.asn.au> and <http://www.qsl.net/vk3rmh>*

### MEMBERSHIP FEES

*(Due in August): Full: \$30 Family: \$40  
Concession: \$20 Send to: NERG Treasurer,  
PO box 270, Greensborough, Vic., 3088*

### COMMITTEE

President David VK3UQ  
Vice President Greg VK3VT  
Secretary John VK3XD  
Treasurer Margie VK3VOJ

#### Committee Members

Colin VK3VGB	Chris VK3AWG
Matthew VK3BKT	Grant VK3GWS
Ethan VK3ETC	Mark VK3BYY
Don VK3KDT	

### MEETINGS

*Main Meeting: 2nd Thursday of each month at 7.45 PM (not Dec & Jan) Coffee Shop nights: 4th Thursday each month. Briar Hill Community Hall, 126 Mountain View Road, Briar Hill (Near Sherbourne Road intersection) Melway map ref 21-C3*

### NETS

*NERG NETS run on 146.575 MHz FM Simplex (8.30 – 9.30 pm Thursdays). Please join the discussions. Also used as a general Net frequency.*