FIVE AND NINE PLUS

THE OFFICIAL NEWSLETTER OF THE APPLEDORE AND DISTRICT AMATEUR RADIO CLUB

Club Callsigns: G2FKO and GX2FKO
Web Site : www.adarc.co.uk

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August, 2015

EDITORIAL

Welcome to another Club 5&9 Newsletter.
Brace yourselves folks - this month is another **Back to Basics talk by yours truly** - yes me!
I hope to see many of you despite August being a busy month for many with family and friends visiting our lovely part of the world.
Not a great deal to report this month except that preparing for my talk caused me to venture into the garden shed and replace the batteries in the remote Auto ATU which means I am at last back on the air! So all the hair tugging etc for the talk has had a silver lining.
Perhaps this is a suitable time to give an advance warning of our **September Meeting which is a Bring & Buy** - so time to dig out any gear now surplus to requirements for it to find a new home.
Also, please don't forget that our **October Meeting is open to family and friends and promises to be a cracker** with **Peter Christie** talking about the **'History of Bideford'** - not one to miss - several of my friends together with the xyl are already interested.
A date to put in your diary is the expedition by **John (G3JKL)** to Lundy as part of the **Lundy DX Group** (callsign MX0LDG) between **October 6th to 13th**.
Further detail can be found on QRZ at :-

https://www.qrz.com/lookup/MX0LDG

So, enjoy the Newsletter

Terry (G4CHD)

CLUB MEETINGS

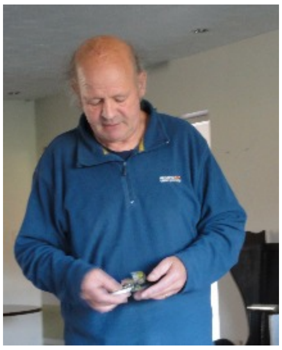
Meetings are held at the Appledore Football Social Club starting at 7.30pm for 8.00pm. Visitors always welcome. For further information, contact Alan (M6CCH) - details in the top panel.

August 17th	Back to Basics - "Coax Losses - Measurement & Effects" by Terry (G4CHD)
September 21st	"Bring & Buy"
October 19th	**Open Meeting** - "History of Bideford" by Peter Christie
November 16th	"MX0LDG Operations from Lundy" by John (G3JKL)
December 14th	"Club Christmas Party" (open meeting)
January 18th	"Radio Quiz" by John (G3JKL)
February 15th	"Whistles to Radios - Police Communications" by Alan (M6CCH)
March 21st	"Club AGM"
April 18th	"QSLing - Traditional to the latest methods of confirming a QSO" by John (G3JKL)

EDDYSTONE EC10 - Anyone remember this beauty ?

REPORT ON THE JUNE MEETING

"Practical Applications for the new Raspberry Pi 2"
by Steve (G6SQX)



Steve's talk once again showed how an in depth knowledge of the Raspberry Pi - now version 2 - can enable this diminutive product to achieve fantastic results. Steve enumerated the improvements to this product and showed how they could be utilised to advantage.
The array of equipment which Steve brought to the Meeting was very impressive as can be hopefully seen from the photos and provided a first hand demonstration of the system described in Steve's talk.

Such talks take an enormous amount of preparation and the Club is extremely grateful to Steve for giving us another fascinating insight into the possibilities provided by the Raspberry Pi.

Many thanks Steve for all your hard work and giving those present a most entertaining and informative talk.

Terry (G4CHD)

LOCAL SKEDS

Zepp Net: **Mon, Tues, Thurs : 145.450 MHz 4pm**
Wed via GB3DN - 4pm

6m Net: **Wednesday, 8pm, 51.480 MHz FM**

HF Net: **Friday at 3pm 7.145 MHz ± qrm**

Slow Morse: Run by **Dave (G3YGJ)** every **Tuesday and Thursday, 7pm clock time on 145.250 mode FM.**

70cm Net: **Sunday, via GB3ND, 11am - noon local time.**
Available on Echolink node 221334

LOCAL REPEATERS

70cm Handy Cross Repeater/Echolink (#221334) Gateway (GB3ND)
User: Listen 433.35MHz– Transmit 434.95MHz
Access 1750Hz Tone (Timeout 4.25 mins)/ 77Hz CTCSS
Repeater keeper is Jeff (G4SOF)

2m Stibb Cross Repeater (GB3DN)
http://www.g0rql.co.uk/gb3dn.htm
User: Listen 145.6375MHz - Transmit 145.0375 MHz.
Access 1750 Hz Tone or 77 Hz CTCSS Repeater keeper is Tony (G1BHM).
Yahoo users group for general chat and banter at :-
http://groups.yahoo.com/group/GB3DN/

SUDOKU PUZZLE

The aim is to enter a number into each cell so that **any column, or any row, or any block of cells contains all numbers from 1 to 9**.

3	7	8		5				
5	6		9			3		
			1					
	2				7		6	
		6					8	
		4			1			2
				9				
2				8		6		5
			7			8	9	3

Terry (G4CHD)

CROSSWORD

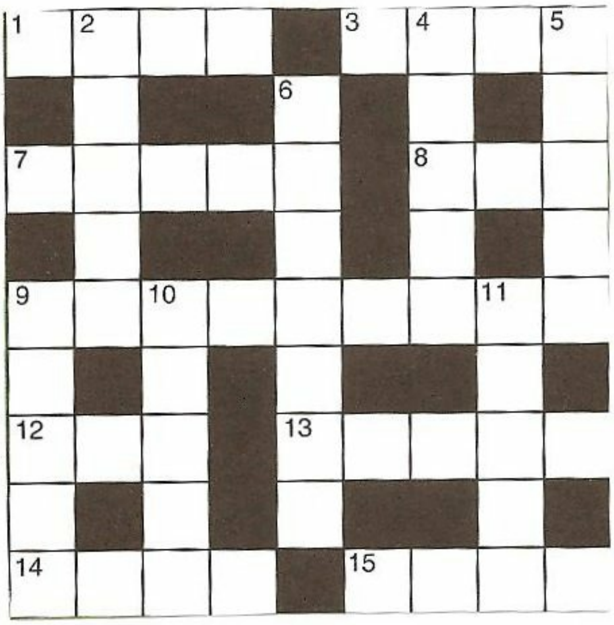
This month's Crossword is by Stuart (M1FWD).
The answers will be published in next month's Newsletter. Good luck !

Clues Across

1) The repetition of a sound by the reflection of sound waves (4)
3) TV station currently on Sky channel 532 (4)
7) ? Coast, Tango Uniform land (5)
8) Male swan (3)
9) In computing, apparatus for connecting two pieces of equipment so that they can be operated jointly (9)
12) A small flatfish of the genus Limanda (3)
13) Woodwind double-reed musical instruments of treble pitch (5)
14) Large recess usually found at the eastern end of a church (4)
15) A sleeve providing electrical insulation (4)

Clues Down

2) A group of witches (5)
4) Yankee Oscar land car manufacturer (5)
5) A former English gold coin first issued in 1351 (5)
6) A native of Five Bravo island (7)
9) Victor Uniform land (5)
10) In Victor Kilo land, colloquial name for cans of beer (5)
11) A game for two, with 16 pieces (5)



Last month's answers :-

<u>Across</u> 1) cod 3) scud 5) resin 6) pen 8) Utah 9) Kiev 11) tit 13) setts 14) tempo 15) DNA

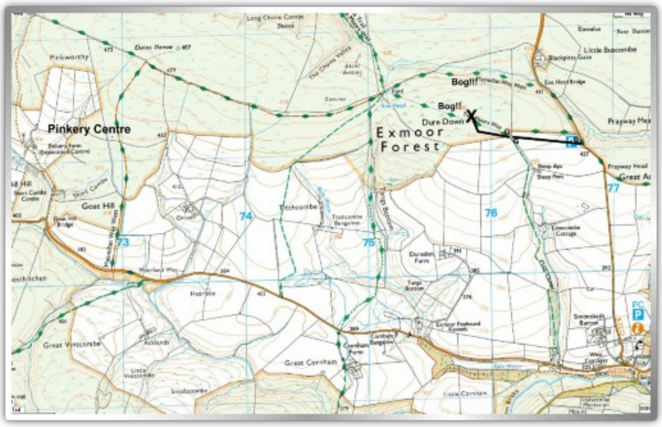
<u>Down</u> 1) circuit 2) distant 3) sine 4) dye 6) printed 7) Navassa 10) Oslo 12) ice

Stuart (M1FWD)

PICNIC AT DURE DOWN

The purpose of the "Picnic" held on Sunday, August 2nd (members were advised by email) was an opportunity to set up the lightweight station being developed to assess the location as a future repeater site for the Exmoor perambulation. The following is a report from Steve (G6SQX) :-

With views of Dartmoor to the south, Wales to the north and Dunkery beacon to the east, Dure Down was found to be an ideal location for a picnic on a sunny August Sunday.



The location we had chosen was about 500m from the layby at Prayway head and as we hadn't visited the site we had set out anticipating having to carry the kit along the Tarka trial. With that in mind we had reduced the weight of the mast and antenna to a minimum and used Yaesu Vx8 hand held radios combining aprs on 2m with the voice comms on 70cms with a transmitting power of 5 watts
In the event we found that we could easily access the site with basic 4x4 vehicles and had a straight forward access across fields via 3 gates, disturbing a couple of young stags and skylarks on the way to a dry grassy site in a good location. The rushy area beyond we found was a sphagnum bog full of cotton grass which was best avoided!!

We erected a short mast about 4m high with a Diamond X300 6/8db co-linear antenna and soon made contact with Dave G3YDJ in Bideford and Dave G4XWQ in Barnstaple who over the period of operation were able to carry out various antenna experiments. Further contacts were made with a couple of GWs who were located in the Rhonda area north of Cardiff. Unfortunately we couldn't copy Bill G3SGW in Bishops Tawton who was trying to contact us. We set up the chairs using the vehicles as a windbreak whilst we enjoyed our lunch and afterwards with Peter 2E0DYM in control, Fred G0EOB and myself drove around the area (1/4 w magmount Yaesu Vx8). We checked Brendon 2 gates, and the road through from Simonsbath to the Pinkery centre. We had full S9 in all the locations apart from the approach to the Pinkery centre which was a bit scratchy. We had a S6-S7 signal at the Pinkery centre but with a 10 metre mast at Dure Down along with a more efficient antenna at the centre we should be assured of a S9+.

In practice we have found that the radio mobile coverage maps we use are useful to give a general idea but lack the accurate terrain information
needed to to give absolute results.

It will be interesting to see how the coverage is improved particularly in the area north of the chains ridge as the site has a good take off in that direction.

Aprs packets from both the vehicle and main antenna had 100% copy from Dure Down being received by GW8VFQ on the Gower peninsular and my home station near Kings Nympton.

We logged a sample of 50 packets which included stations from around the Southwest, Wales and Ireland. We had received the Guernsey repeater earlier in the day so expected a good catch.

Mel 2E0MEL joined us after lunch having made contact with us from near Tiverton and had been talked in by Peter. Mel provided some welcome luxury transport off the moor after the event.

It was a successful exercise and proved that the proposed site at Dure Down should give a good overall coverage of the course taken on the Exmoor perambulation and is easy to access with vehicles.

Special thanks to
Peter 2E0DYM, Helen G0EOA, Fred G0EOB, Mel 2E0DYM, Dave G4XWQ, Dave G3YGJ, Bill G3SGW
Derry, Annie, Jane
and to the the amateurs who called in to the station.

73s Steve G6SQX

BASIC PRINCIPLES OF ELECTRICALLY SMALL ANTENNAS

The following pages contain an interesting article I found on the internet which I hope members will enjoy reading. It can be found at

http://www.highfreqelec.summittechmedia.com/Feb07/HFE0207_tutorial.pdf

and is from the February 2007 issue of High Frequency Electronics and written by Gary Breed.

So that's it for this month - I hope everyone enjoys the read

Best 73s de Terry (G4CHD)

Principles of Electrically Small Antennas
by Gary Breed

Electrically small antennas have been an important part of communications engineering since the beginning. Whether they are small compared to the extremely long wave-lengths used at the lowest radio frequencies, or intended to save space in GHz - range wireless devices, the basic principles are the same. This tutorial will review those principles, with primary attention to describing the performance tradeoffs of small size.

Definition of " Electrically Small"

There are various rules of thumb for considering an antenna to be electrically small. The most common definition is that the largest dimension of the antenna is no more than one-tenth of a wavelength. Thus, a dipole with a length of λ/10, a loop with a diameter of λ/10, or a patch with a diagonal dimension of λ/10 would be considered electrically small [1].

This definition makes no distinction among the various methods used to construct electrically small antennas. In fact, most work on these antennas involves selecting topologies suitable for specific applications, and the development of integral or external matching networks.

Common Applications

Most readers will be familiar with several common uses of small antennas. Loop antennas and short monopoles (whip) for medium-wave (AM broadcast) reception are common in home and vehicle entertainment systems.

With wavelengths in the 200 to 600 meter range, these antennas far exceed the λ/10 criterion. Antennas for FM and television broadcast reception are sometimes reduced in size for convenience and portability.

The ubiquitous 315 or 433 MHz wireless remote control and telemetry systems for keyless entry, garage door openers, wireless door-bells and remote-reading thermometers rarely have "full-size" resonant antennas, since a wavelength is around 1 meter. A λ/4 monopole would be 17 cm long, and requires a similarly-sized counterpoise.

The developing RFID market demands low cost and small size. A 3 cm square RFID tag will have an antenna that is considered electrically small at any frequency below about 1 GHz. Handheld RFID readers will allow somewhat larger antennas, but will still fit the λ/10 criterion at many of the commonly used frequencies.

Finally, of course, are wireless phones, which now have integrated GPS, Bluetooth™ and other radio systems. Only the largest form factors can support antennas that are large enough to be outside the electrically small definition.

Small Antenna Types

The most common structures used in electrically small antennas are the short dipole (or equivalent monopole and ground place), the small loop, and the dielectrically-loaded patch.

Each of these has many variations to fit the mechanical constraints of specific applications, but these three are an appropriate basis for understanding the issues involved in efficiency, impedance matching and radiation patterns. We will examine the topic using the classic dipole and loop as examples.

For more information on electrically small patch antennas, readers are directed to Reference [2].

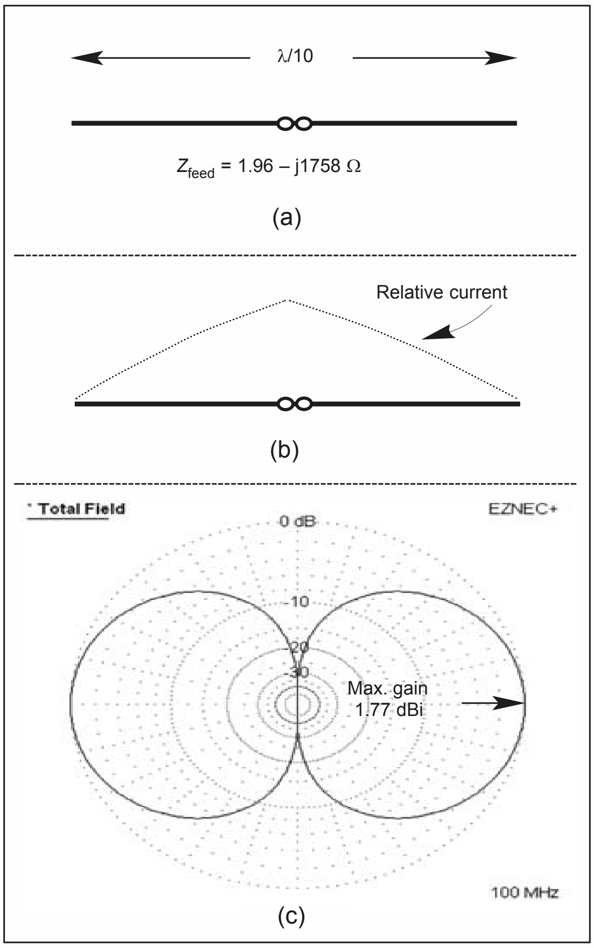


Figure 1 · Short dipole example: (a) dimensions and impedance; (b) current distribution, and © radiation pattern and gain.

The Short Dipole

Figure 1(a) shows a short dipole antenna. At 100MHz, a λ/10 dipole with a 1 mm conductor diameter has an impedance at the centre feedpoint of 1.96 $-j1758$ ohms, as determined by NEC2 numerical modelling [3].

This low resistance and high capacitive reactance illustrates that a large impedance transformation will be required to match this antenna to a typical 50 ohm system.

The current distribution on a short dipole is a portion of the cosine current distribution seen on a half-wave resonant dipole. In this case, the current distribution is nearly tri-angular (Figure 1(b)). This current distribution results in the free-space radiation pattern of Figure 1(c), in a plane containing the antenna wire.

Note that the small size of this antenna does not greatly reduce the efficiency. The maximum gain of 1.77 dBi is only 0.37 dB less than a half-wave dipole's 2.14 dBi gain. However, this is only part of the efficiency story. As will be shown later, the matching system is the primary contributor to reduced efficiency in electrically small antennas.

The Small Loop

Figure 2 shows a small circular loop, with a diameter of λ/10. The radiation resistance of a small loop can be calculated from [4]:

$$R_r = 31{,}171\ (A/\lambda^2)^2$$

where R_r is radiation resistance, the number 31,171 is $320\pi^4$, with A (loop area) and λ (wavelength) in the same units.

Solving for a λ/10 diameter loop, where $A = \pi\ (\lambda/20)^2$, the radiation resistance is found to be 1.92 ohms.

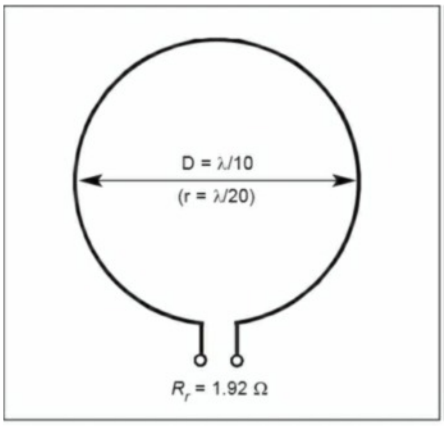


Figure 2 · A small loop also has a low radiation resistance.

The actual feedpoint impedance will include the resistive loss of the conductor (with skin effect), plus the inductance of the loop, which will have a result in the region of 3.0 +*j*800 ohms. The radiation pattern and gain are similar to the λ/10 short dipole.

Current distribution is nearly uniform on a small loop and does not reveal much about its behaviour.

Impedance Matching Issues

The input impedance of both the short dipole and small loop has a small resistive component and a large reactive component.

Of concern is the loss within the matching circuitry. Even with relatively a high Q, large-value reactive components will have significant resistance that contributes to system loss.

For example, Figure 3(a) shows an ideal, lossless matching network to transform the 1.96 –*j*1758 ohms of the short dipole to 50 ohms system impedance. Mathematically, this provides a proper match, albeit narrow-band.

However, ideal inductors do not exist. A practical Q for an inductor is between 50 and 200, depending on construction and effects of coupling to the surrounding environment. For a Q of 100, each inductor will have a resistive loss of X_L/Q, or 879/100 = 8.79 ohms. Since there are two inductors, the total additional resistance in series with the antenna input is 17.58 ohms. Ignoring the smaller loss from the capacitor, the finite Q of the inductors results in a loss of :-

$$20\log[1.96/(17.58+1.96)] = 21 \text{ dB}$$

Figure 3(b) shows a modified matching network that accommodates the additional loss. The different values demonstrate how an empirically-derived matching network (e.g. determined by trial-and-error experimentation) can get results that are far from calculated network values that do not account for losses.

The matching process is similar for the small loop, except that the matching involves a large value of X_C instead of X_L. Since capacitors have much higher Q than inductors, it would seem that small loop matching would have lower losses than an equivalent dipole match. This is generally true, but note that the loop example occupies an area much larger than the example dipole. A loop that is more comparable to the dipole in its physical dimensions will be smaller and have a lower value of R_r, which will increase matching network losses.

Mitigating the Loss Problem

Many technical papers and patents describe alterations in the structure of small antennas in ways that increase the radiation resistance and/or implement lower loss matching techniques. Loading— the addition of capacitive or inductive elements, both lumped and integral to the antenna, is the most common group. Top hats, folded elements, 3-dimensional structures, dielectric foreshortening and other methods are commonly used to add electrical length to a small antenna, raising the radiation resistance.

Often— perhaps too often— the inefficiency of a small antenna is just included in the link budget calculations and overcome by increased system gain, transmit power or simply accepting reduced communication range. This may work for some applications, but all these consequences are detrimental to system performance, decreasing performance and shortening battery life. A useful reduction of losses in the antenna and matching network can be easy and cheap, but requires the designer to be aware that such an improvement can be obtained.

Hopefully, this tutorial raises the awareness of loss and efficiency issues with small antennas. The next step is to learn some of the options for getting better performance for future product designs.

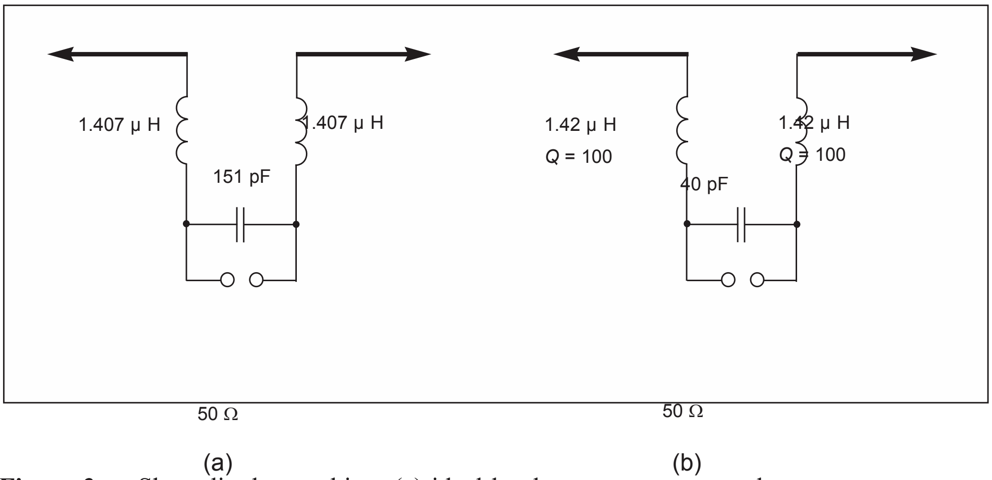


Figure 3 · Short dipole matching: (a) ideal lossless components, and (b) values required for practical inductors with a Q of 100.

References

1. D. Miron, *Small Antenna Design*, Newnes 2006.

2. R. Garg, P. Bhartia, Inder Bahl and A. Ittipiboon, *Microstrip Antenna Design Handbook*, Artech House 2001.

3. As implemented in EZNEC+ by Roy Lewallen, www.eznec.com.

4. J. Kraus, *Antennas*, McGraw-Hill 1950, Ch. 6, section 6-8.