FIRST ANNUAL ARRL WEST CENTRAL FLORIDA SECTION TECHNICAL CONFERNCE

SATURDAY APRIL 4, 2015
Bert J. Harris Jr. Agri-Civic Center - Sebring, FL

CONFERENCE PROCEEDINGS

INTRODUCTION

Welcome to the First Annual West Central Florida Section Technical Conference Proceedings publication. The inspiration of this document came from the Conference Proceedings that the ARRL publishes every year for the ARRL/TAPR Digital Communications Conference. The purpose of this documents is to compile all the presentation material (Power Point presentations and any handouts) that were given by our presenters at the Conference into one document for convenient reference now and in the future. Their works have been placed in this document without editing except for fitting onto print form. None of the contents have been changed. I would like to thank all of our presenters who gave presentations this year at our very first West Central Florida Section Technical Conference.

The West Central Florida Section Technical Conference 2015 Presenters:

John Chaput KK4LI
Larry Lazar KS4NB
Geoff Haines N1GY
Ben Henley KI4IGX
Bob Allison WB1GCM
Darrell Davis KT4WX

A special thanks to Bob Allison WB1GCM for coming down from ARRL Headquarters (on a holiday weekend nonetheless) to help make our first conference a great success.

This conference will be an annual conference and we look forward to our next West Central Florida Section Technical Conference in 2016.

73
Darrell Davis KT4WX
Section Manager – ARRL West Central Florida Section

PRACTICAL GROUNDING

BY

JOHN CHAPUT, KK4LI

You cannot predict where lightning will strike, but you can definitely see where it has been.

1. A ground rod here and a ground rod there invites trouble.

2. It is better to use the power company ground as a starting point.

3. A closed loop ground system is better than an open ended one. The closed loop helps to lower static noise on the HF bands

4. All equipment should be connected to the same ground point. Do not connect your equipment in a “Daisy Chain” fashion. The potential voltages in the ground system should go up and down the same way for all your equipment.

5. The better the soil conductivity, the better the lightning dissipation. Here in florida, our sandy soil has poor conductivity unless you are very near the coast where the water table is close to the surface.

6. Lightning will travel to dissipate and if it does not have an easy path to ground it will go looking in your house wiring, gas lines, plumbing, telephone and TV cables

7. If the ground wire is not buried too deeply, it can add to the RF ground radials of your antenna and thus lower static noise.

8. If a lightning storm is forecast, disconnecting your antennas from the radios is highly recommended. This disconnect should take place outside the house, where the entry panel is grounded, not inside. If lightning can travel from the earth to the cloud or vice-versa, it will have no trouble at all jumping the few feet from the end of your coax to expensive gear inside the house.

9. A simple ground for most 30 to 40 foot towers would be to run a heavy gauge wire (#4 or larger) from the tower leg to the power company ground wire. Use a split bolt and ground clamp to make this connection. Solder will vaporize instantly and remove any protection you thought you had.

10. Sand or scrape the meter ground wire apply an anti-oxidation material and make the connection mechanically tight.

11. You can supplement this ground rod with another rod right at the tower leg. These ground rods should all be 8 feet long at a minimum.

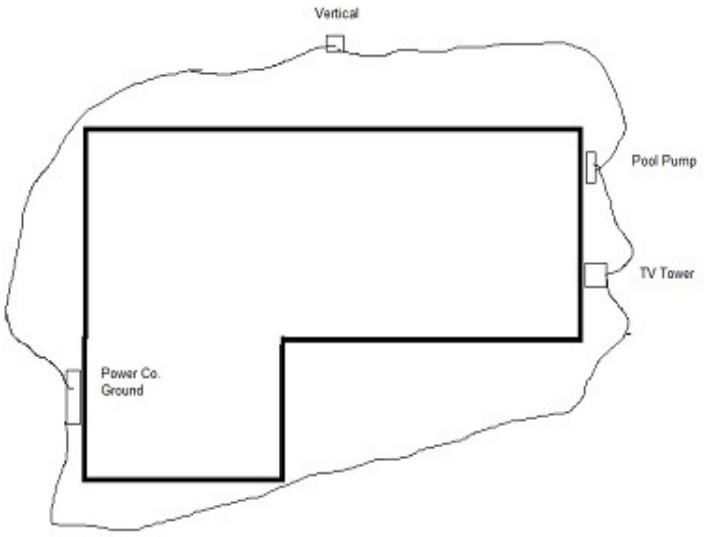
12. If you can find them, porcupine dissipators work well on the top of the tower and on any projecting antenna mounting structures.

13. If you have multiple towers and or satellite dishes on your property and they are individually grounded, you have a major problem. A lightning strike or even a near miss will cause a current surge that will create a huge imbalance in the grounds and cause major damage trying to equalize the imbalance buy going through your gear.

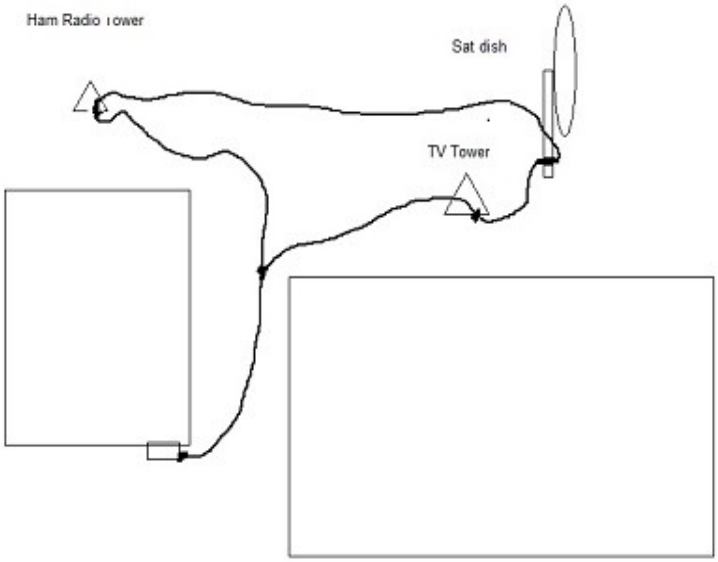
14. A solution to this problem is to run a heavy gauge loop from the power company ground to all of the towers and /or dishes so that they are all connected to the loop. This keeps the surge from entering your home

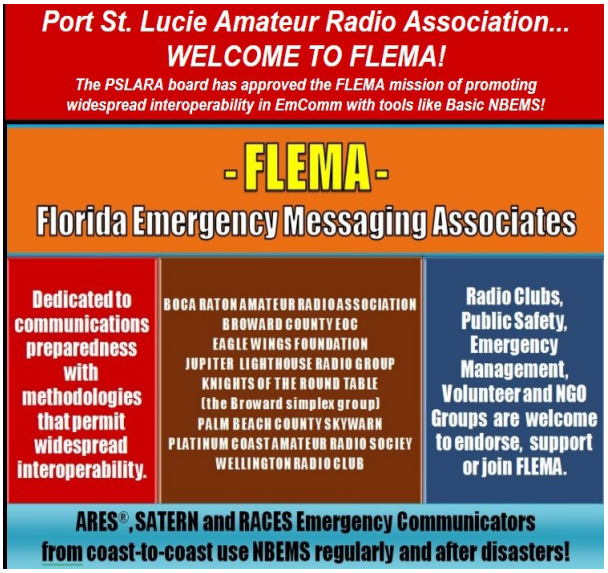
DIAGRAMS

For Point 3

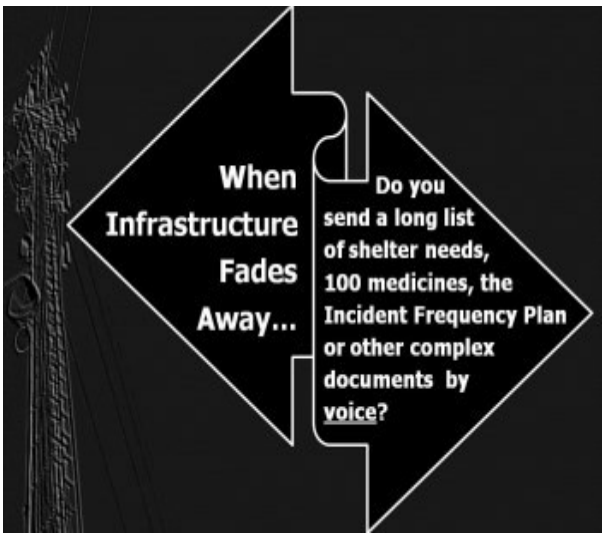


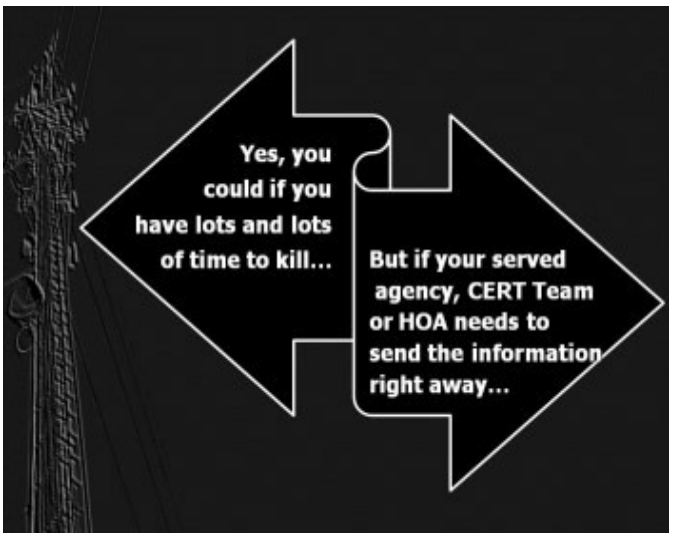
For Point 13 and 14

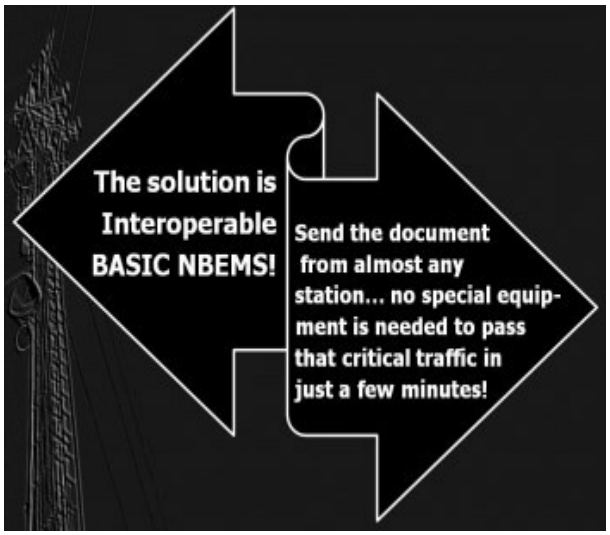


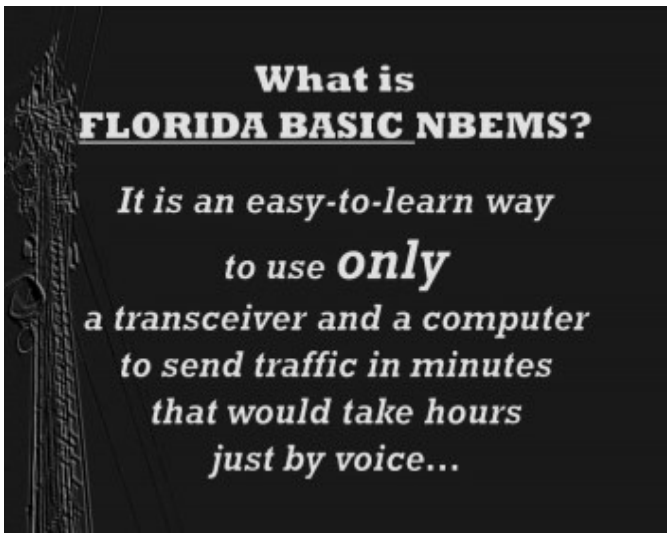

Port St. Lucie Amateur Radio Association...
WELCOME TO FLEMA!
The PSLARA board has approved the FLEMA mission of promoting widespread interoperability in EmComm with tools like Basic NBEMS!
- FLEMA -
Florida Emergency Messaging Associates
Dedicated to communications preparedness with methodologies that permit widespread interoperability.
BOCA RATON AMATEUR RADIO ASSOCIATION
BROWARD COUNTY EOC
EAGLE WINGS FOUNDATION
JUPITER LIGHTHOUSE RADIO GROUP
KNIGHTS OF THE ROUND TABLE
(the Broward simplex group)
PALM BEACH COUNTY SKYWARN
PLATINUM COAST AMATEUR RADIO SOCIEY
WELLINGTON RADIO CLUB
Radio Clubs, Public Safety, Emergency Management, Volunteer and NGO Groups are welcome to endorse, support or join FLEMA.
ARES®, SATERN and RACES Emergency Communicators from coast-to-coast use NBEMS regularly and after disasters!


FLORIDA BASIC NBEMS...
Empowering the emergency communicator with a simple, no cost and interoperable method of handling complex documents.
1ST Presented at the Southeast Florida Regional Communications Symposium by the Wellington Radio Club, NBEMS Elmer Team-5/12/14
Palm Beach County citizen corps
Updated Jan. 2015
Copyright 2014/15 L. Lazar, KS4NB


When Infrastructure Fades Away...
Do you send a long list of shelter needs, 100 medicines, the Incident Frequency Plan or other complex documents by voice?


Yes, you could if you have lots and lots of time to kill...
But if your served agency, CERT Team or HOA needs to send the information right away...


The solution is Interoperable BASIC NBEMS!
Send the document from almost any station... no special equip-ment is needed to pass that critical traffic in just a few minutes!


What is
FLORIDA BASIC NBEMS?
It is an easy-to-learn way to use only a transceiver and a computer to send traffic in minutes that would take hours just by voice...

Traffic such as
FEMA, CAP, Red Cross, Skywarn,
ARRL Radiograms, and other
disaster related forms
including spreadsheets,
long lists, and lengthy text.
<>
It complements voice operation
and doesn't replace it.

Is FLORIDA BASIC NBEMS different from regular NBEMS?

YES... Regular NBEMS is a powerful software suite of eight tremendously flexible programs with many applications...

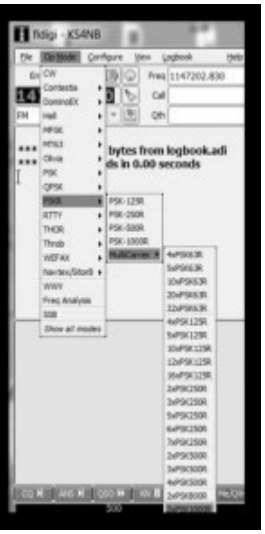
- fldigi / flarq - digital modem / ARQ file transfer - version 3.21.83
  flamp - Amateur Multicast Protocol - file transfer program - version 2.1.02 Update release
  AMP specification - version 3.0 documentation updated
- flwrap - file encapsulation / compression - version 1.3.4
- flmsg - Forms manager - version 2.0.4 - maintenance update
- flrig - rig control program, cooperates with fldigi - version 1.3.16
- flwkey - modem program for the K1EL Winkeyer series - version 1.1.6
- fllog - version 1.1.8
- flnet - version 7.2.1 - New release for Linux, Windows and OS X

BASIC NBEMS is:

- *Simplified... uses only 2 of the 8 programs*
- *Specially configured version*
- *Geared specifically for complex documents and interoperability*
- *Used on HF as well FM VHF/UHF mixed voice and digital mode traffic and emergency nets.*

FOR EXAMPLE:

Regular NBEMS handles over a 100 digital modes... currently 24 in PSK alone!
<>
Keeping it *ultra simple* means using only one or two digital modes known to be almost bullet-proof!



NBEMS Stations - VHF/UHF FM

◄ BASIC NBEMS... Very simple and ultra-portable. Just a radio and com-mon computer are needed... that's all! The radio is held up to the computer for "acoustical coupling" of the data tones. Even at low volume levels, the complex documents are sent reliably. The key is the amazing, free software... FLDIGI+FLMSG. Shown is an optional speaker/mic.

TYPICAL HF NBEMS ►
Multi-digital mode stations often have special cables & interfaces. They can still be used for Basic NBEMS and complex documents.
Obviously they are not nearly as portable and require much more training and experience to operate. This equipment is NOT required for PBC Basic NBEMS on FM.

NBEMS Summary: PBC Basic vs. Regular

	BASIC NBEMS	REGULAR NBEMS	COMMENTS ABOUT REGULAR NBEMS
Operator Training	Minimal	Much More	Much to learn about modes, interfaces, cabling, setup, etc. + added configurations
Station Complexity	Minimal	Complex	Almost always requires a digital interface
Operations Uniformity	Universal	Non-uniform	Many types of interfaces, and many digital modes
Cost	None	Typically ~$100.	Regular NBEMS encourages the use of digital interfaces

Which is likely to gain widespread acceptance here?

Florida Basic NBEMS Has Just THREE Major Objectives

- **Ultra simplicity**
- **Uniformity**
- **Inexpensiveness**

Simple, Uniform & Cheap

Make it possible to

Train & empower as many people as possible in the SAME system... that's real interoperability!

Simplicity, Interoperability Plus Many Trained People Make Possible:

Rapid deployment anywhere...

EOCs, Command Posts, Clubhouses, Shelters & similar EMCOMM Sites.

How does Florida Basic NBEMS achieve those objectives?

With its many realistic and great features...

Rich Features of Florida Basic NBEMS

Doesn't depend upon infrastructure... uses simplex or repeater

Easy to setup and move a Basic NBEMS Station

It's fun to use between drills and disasters.

Auto Send & Auto Receive with FLDIGI & FLMSG Freeware!

Interest in Basic NBEMS Has Exploded...

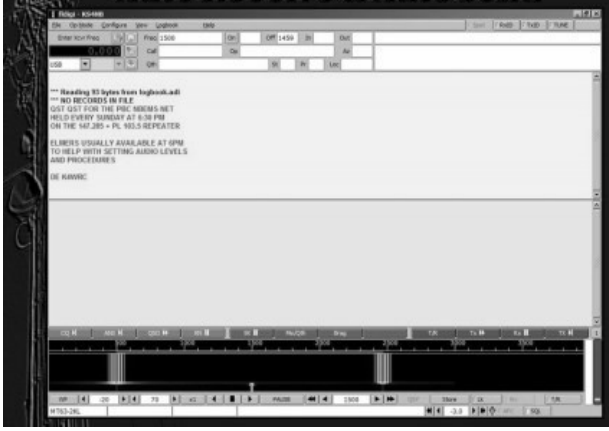
Over ~~125~~ 175 people trained since Dec '13 from Monroe through Brevard Counties!

During hurricane season Wellington Net Check-ins have grew from zero to 20 each Tuesday!

As of 8/23/14

- Frequent presentations
- Workshop training
- 1:1 Elmering
- On-the-air training
- Word of mouth

FLDIGI+FLMSG Great software with Auto Receive & Auto Send



The free, easy-to-use FLDIGI plus FLMSG software do the work!

All work is done by your computer, no digital interface or TNC controller needed.

Older computers work just fine.

Software does the work!

FLDIGI encodes and decodes the information with tones and controls TX and RX. FLMSG formats and saves/opens messages.

TO TRANSMIT:
Tones from your computer speakers go into your radio's mic for transmission.

TO RECEIVE:
Tones from your radio's speaker go to your computer's mic for decoding the transmission.

$64,000

If the software does the work, what does the Operator do ????

To receive a document, He or she:

- Holds the radio, or speaker, or earphone to the computer microphone.
- Acknowledges the receipt of the message.
- Prints and delivers the document. BTW, it is AUTOMATICALLY saved!

How foolproof or easier can the process get?

What does the Operator do to Transmit a document?

- In FLMSG, select the document or form format needed.
- Drag-N-Drop it, or type it, on the form screen.
- Save the completed document/message
- Hold the radio mic to the computer speaker... press the PTT button. Click Autosend.

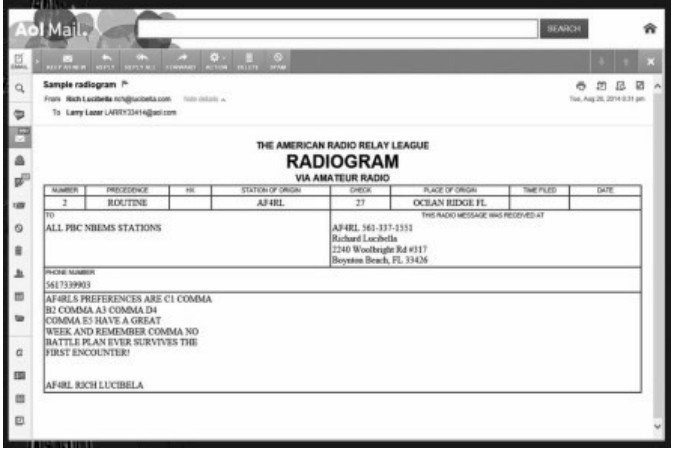
Almost as easy as receiving!

But wait... there's a BONUS!

Assume you are outside the disaster area and the sender asks you to relay the message elsewhere.

With a just few keystrokes, you can send the document by Email!

Abracadabra!



Sample documents sent by Florida Basic NBEMS with transmit time listed.

RADIOGRAM ready to print. Transmit time=22 seconds.

PLUS IT DOES AN *AUTOMATIC* WORD CHECK!

THE AMERICAN RADIO RELAY LEAGUE

RADIOGRAM

VIA AMATEUR RADIO

NUMBER	PRECEDENCE	HX	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE
1	ROUTINE	HXA	K4WRC	14	WELLINGTON EOC	1048L	FEB 04

TO

DAVID LAZAR

THIS RADIO MESSAGE WAS RECEIVED AT

K5ANB 561-385-2986
LARRY LAZAR
1213 WHITEPINE DR.
WELLINGTON, FL 33414

PHONE NUMBER
7812590951

DO NOT WORRY X AM WELL X HUGS TO JOSEPHINE
AND HEATHER X GRAMPS

GRAMPS

ICS-205 ready to print. Transmit time=1 min 41 sec.

Incident Radio Communications Plan-SAMPLE		1. Incident Name: Amateur Radio and Other Volunteer Activation		2. Date / Time Prepared: 6/01/2012		3. Operational Period:
4. BASIC RADIO CHANNEL / TALK-GROUP or MODE UTILIZATION						
Group	System / Cache	Channel / Talkgroup	Additional Settings	Function	Assignment	Remarks
RACES	RACES - Wellington	147.285/147.885 147.285 Simplex	PL 103.5 Hz	Primary	Communications per EOC & Public Safety needs. WellingtonEmergency Net	Village of Wellington Operations...
		442.050/447.050 442.050 Simplex	PL 103.5 Hz	Secondary		Cache of 40+ HT1000s
	RACES - EOA 4					
(Lake Worth - Lantana - Wellington)"	146.940/146.340	PL 88.5 Hz	Primary	Admin communications between RACES operations		
		145.390/144.790	PL 110.9 Hz	Secondary		

Remember that list of 100 meds? Transmit time = 2 minutes 8 secs

Medicines available at the County Special Needs Shelter.
Call for available doses & inventory.

GENERIC NAME	BRAND NAME
Acarbose	Precose
Adalimumab	Humira®
Albuterol oral tablet	Albuterol
Alskiren	Tekturna
Alprazolam	Xanax
Armodafinil	Nuvigil
Benzodiazepines	N/A
Botulinum toxin	Botox®
Bupropion	Wellbutrin®
Butalbital	Fioricet®
Capsaicin, topical	Qutenza
Carisoprodol	Soma®
Chlordiazepoxide	Librium
Citalopram	Celexa
Clonazepam	Klonopin
Clonidine	Catapres
Clorazepate	Tranxene
Colchicine	Colchicine
Cromolyn	Cromolyn
Cyclobenzaprine ER	Amrix®
Dantrolene	Dantrium®
Dexlansoprazole	Dexlant®
Diazepam	Valium
Diclofenac	Voltaren®
Dimethylsulfoxide	DMSO
Diphenhydramine	Benadryl
Doxazosin	Cardura
Escitalopram	Lexapro®
Esomeprazole	Nexium®
Estazolam	ProSom
Etanercept	Enbrel®
Exenatide	Byetta
Famotidine	Duexis®
Fentanyl buccal	Fentora®
Fluoxetine	Prozac®
Flurazepam	Dalmane
Fluvoxamine	Luvox
Formoterol	Foradil®
Glimepiride	Amaryl
Glipizide	Glucotrol
Glyburide	Glynase
Hydralazine	Apresoline
Hydrocodone	Vicoprofen®
Indacaterol	Arcapta®
Indomethacin	Indocin®
Infliximab	Remicade®
Insulin	Humulin
Insulin	Novolin
Ipratropium	Atrovent®
Ketamine, topical	Ketamine
Ketorolac	Toradol®
Lacosamide	Vimpat®
Lamotrigine	Lamictal®
Levetiracetam	Keppra®
Lidocaine patch	Lidoderm®
Linezolid	Zyvox
Lorazepam	Ativan
Marijuana	Marinol®
Meperidine	Demerol®
Meprobamate	Miltown
Methadone	Methadose®
Midazolam	Versed
Miglitol	Glyset
Milnacipran	Savella/Ixel®
Minoxidil	Loniten
Modafinil	Provigil®
Montelukast	Singulair®
Morphine ER	Avinza®
Morphine ER	Kadian®
Nabilone	Cesamet®
Naproxen ER	Naprelan®
Nateglinide	Starlix
Omalizumab	Xolair®
Orphenadrine	Norflex®
Oxazepam	Serax
Oxycodone/aspirin	Percodan®
Oxymorphone	Opana®
Pantoprazole	Protonix®
Paroxetine	Paxil
Pentazocine lactate	Talwin
Pentazocine/Naloxone	Talwin NX
Phenytoin	Dilantin®
Pioglitazone	Actos
Piroxicam	Feldene®
Pramipexole	Mirapex®
Prazosin	Minipress
Promethazine	Phenergan
Propoxyphene hcl	Darvon®
Propoxyphene napsylate	Darvon-N®
Quazepam	Doral
Quetiapine	Seroquel
Rabeprazole	Aciphex®
Repaglinide	Prandin
Risperidone	Risperdal
Ropinirole	Requip®
Rosiglitazone	Avandia
Salmeterol	Serevent®
Saxagliptin	Onglyza
Sertraline	Zoloft®
Sitagliptin	Januvia
Spironolactone	Aldactone

What makes Florida Basic NBEMS so reliable?

- The mode of choice for FM: MT-63 2000 LONG
- Forward error correction with data redundancy in time and in frequency.
- Very resistant to noise – It can lose more than 25% of signal and still copy.
- Punches thru interference.
- Works very well with acoustical coupling... even at low speaker levels!
- Used by MARS, Red Cross and ARES in national and regional nets and exercises

The coalition that was formed to promote interoperability In Palm Beach County has grown so quickly and so widely that its name has changed to the FLORIDA Emergency Messaging Associates, FLEMA...

It was

-PBEMA-

Palm Beach Emergency Messaging Associates

Dedicated to communications preparedness with methodologies that permit widespread interoperability.

BOCA RATON AMATEUR RADIO ASSOCIATION
BROWARD COUNTY EOC
CENTRAL PBC ARES
EAGLE WINGS FOUNDATION
JUPITER LIGHTHOUSE RADIO GROUP
KNIGHTS OF THE ROUND TABLE
(the Broward simplex group)
PALM BEACH COUNTY SKYWARN
PALM COAST AMATEUR RADIO SOCIEY
SOUTH PBC ARES
WELLINGTON RADIO CLUB

Radio Clubs, Public Safety, Emergency Management, Volunteer and NGO Groups are welcome to endorse, support or join PBEMA.

ARES®, SATERN and RACES Emergency Communicators from coast-to-coast use NBEMS regularly and after disasters!

If you are convinced, you'd want to know:

How do I get started?

- ✓ If you haven't had Hands-On Basic NBEMS training, download the Basic NBEMS Guide.
- ✓ Follow its Step-by-Step instructions on where to get the free software, install and configure it.
- ✓ Test & troubleshoot your installation with the separate guide.
- ✓ Contact a Basic NBEMS Elmer.

- ✓ Elmers* are listed on the cover of the Guide. They can help you get started and especially to set computer sound card levels. It can even be done by telephone!

**Hamspeak for experienced people who volunteer to assist beginners.*

- ✓ If you are near Palm Beach County, check into the Tuesday night PBC NBEMS Net… 7:30pm
- ✓ From May thru the end of hurricane season, from 7pm to 7:30pm, an NBEMS Elmer is usually available to help you set your audio levels and tutor on procedures.
- ✓ In south Palm Beach County, the BRARA NBEMS Net is Monday at 8pm.

- ✓ In Broward County, the Knights of the Round Table, simplex group has nets the 1st & 3rd Saturday.
- ✓ South Brevard Emergency Net uses Basic NBEMS every Thursday at 7PM and offers Elmering on and off the air.

✓ To download the Basic NBEMS Guides, Google:

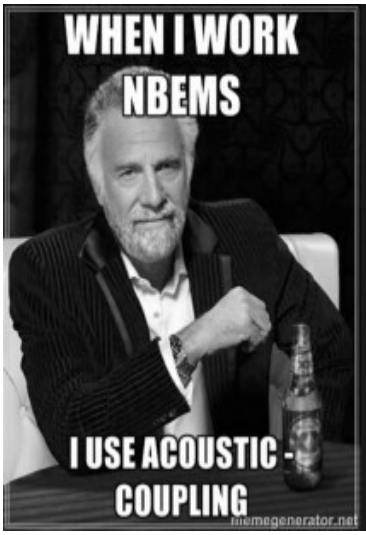
FLEMA NBEMS

click on the first listing.
Look for the list of "resources" and select the Guide you need.
(when the name changes, there will be a new page)

Not convinced...
Here's another demo

Not convinced?

Here's a testimonial from Dave, K4WAG...



Any Questions?

Thanks for being such a great audience...

NOW GET ON-THE-AIR AND ACOUSTICALLY COUPLE!

Homebrewing for the Amateur Radio Operator

or:

"Don't Throw That Out, I Can Put a Radio In That"

How It Used To Be

- Back in the day, almost everything Ham Operators used was built at home. There was no Icom, no Yaesu, no Kenwood. Beyond the CW key and the occasional tube, everything was homebrewed. As the hobby grew, manufacturers began to supply kits, then whole transmitters and receivers, but even after WWII it was common for operators to build much of the stuff they needed.

How It Is Now

- Today, the scene has changed so much even Marconi would think it was Magic!
- Radios today are all solid state, surface mounted wonders of miniaturization. It has become almost impossible for the average ham to attempt construction or repair of the rigs they use to communicate. Indeed, even finding someone to repair a rig has become difficult.

So What To Do?

- The rigs themselves may be too complex to work on at home, but that does not mean homebrewing is dead. Far from it, the art of "rolling your own" is alive and well in Amateur Radio today! There are many aspects of the hobby that lend themselves to making your own gear.

Why?

- There is a powerful sense of accomplishment that comes from doing it yourself. There is also the satisfaction of saving a significant amount of money. In many cases you can build **IT** yourself for much, much less than **IT** would cost to buy. Now, I have not said what **IT** is yet.

What **IT** Is.

- **IT** could be a new microphone, or a different antenna. Maybe a tuner or a better grounding system for the radio room. **IT** might even be a QRP rig or some kind of Transverter. Or **IT** could be just a ON AIR sign for the operating position. **IT** will all depend on what YOU need **IT** to be. The sky is the limit.

Getting Started

- To begin homebrewing in Amateur Radio it is NOT necessary to be a PHD in Electronics. Most “homebrewers” are just like you and I. If I can build projects for my “shack”, I am dead certain you can too, and probably better too. A little practice with an ordinary soldering iron and you can be on your way to success.

Making Choices

- There is one major caveat to point out about “Homebrewing”. You must decide which projects are easier and cheaper to buy, and which ones can be DIY. I have built devices which did not work the way I thought they would and spent almost as much as if I had purchased it ready made. I have also built devices that work as well or better than the commercial gear for 10% of what the dealer charges.

An Example

- There is a well known manufacturer who sells a DF antenna for about $80. It is a very nice Yagi antenna. There is a plan for a similar antenna on the Internet which performs equally well, and can be built for about $15 even if you have to buy all of the components, an old tape measure and some PVC pipe. I loaned it to a friend for a DF contest and he won First Place.

Another Example

- Another area that hams love to experiment with is the microphone. We all seem to want a desk mic or a headset in addition to the hand mic that came with our rig. To switch between them you need a Mic Selector Switch. You can pay the dealer as much as $200 for a fairly good one, or you can build your own out of an old data switch for less than $20, including the connectors.

What Components?

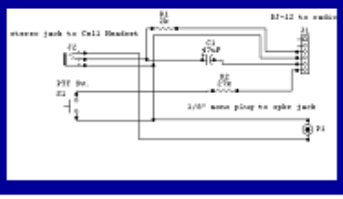
- I can hear you now, “but I don’t know anything about resistors or capacitors or any of that stuff”. So far we have not used even ONE electronic device! Just wire A to pin A and wire B to pin B. It really is that easy. A mic selector switch has no components other than connectors and wire.

Now We Add The Parts

- The next step up, is to add a few (2 or 3) electronic parts like resistors and capacitors. You can modify an inexpensive PC desk mic to work with your ham rig for less than the shipping for the “Amateur Radio Desk Mic”. The same circuit converts a cell phone “earset” to the lightest and best “headset” you could ever put on a transceiver.

The Circuit

- As you can see this circuit has very few parts, 2 resistors, 1 capacitor, 1 push button switch, and a few connectors. The earset itself will cost as little as $3.



Availability of Wired Headsets

- Since the cellular industry has gone to Bluetooth almost exclusively, the wired headsets (or earsets) for this project are becoming less common. You can still find them online for less than $5. You can also build this circuit with two 3.5mm Stereo Jacks for use with a PC style headset. Any PC headset that uses two 3.5mm stereo plugs will work with the circuit.

Antennas, Antennas, Antennas

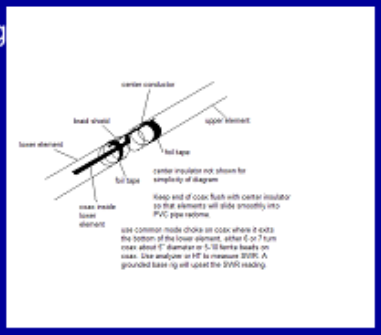
- Antennas are where we as “homebrewers” can really shine. You can build an antenna for the frequency of interest that will equal or better any commercial unit available. It may not be as stylish, but the money saved can go towards that new wonder radio you have your eye on. There are several examples here tonight.

The OCF Sleeve Dipole Vertical

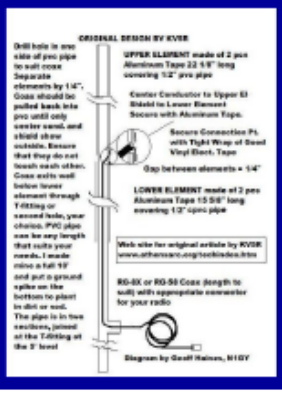
- This antenna was designed by Harold Melton, KV5R to increase the range of his handheld. Just some ½” PVC pipe and a few strips of aluminum duct tape combined with some coax and a connector. It covers all of 2 meters and 70 centimeters and a good deal of the PSBs as well. Total cost: Less than $10.

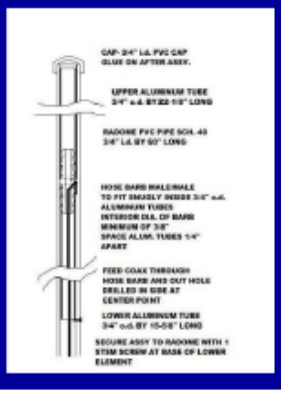
The OCF Sleeve Dipole

A detail showing how the coax is attached to the elements of the antenna.



More Pictures





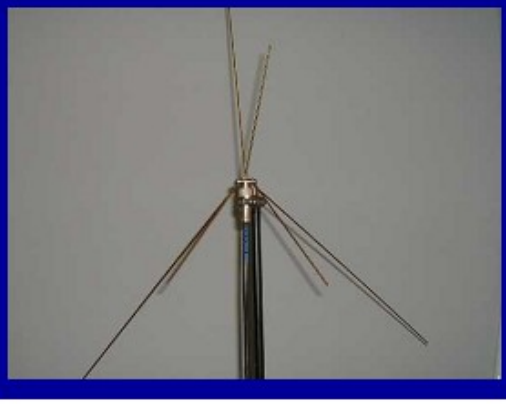
And Yet More Pictures

- These guys built 20 of the OCF Sleeve Antenna to rig out their ARES group.

A Different Approach

- Another neat and simple dual band antenna can be made from a few lengths of brazing rod and an SO-239.
- This antenna combines a 2 meter ¼ wave with a 70 cm ¼ wave on the same mount.
- This design is by Scott Duckworth, NA4IT

Dual Band Antenna



The Details

- A simple "V" of brazing rod with one leg cut to 6" and the other cut to 19" is soldered to the previously prepared center pin of the SO-239. Two pairs of radials are attached to the 4 mounting holes of the connector, 1 pair cut for VHF and the other cut for 70 cm. Attach coax and mount on a mast of some sort and the job is done.

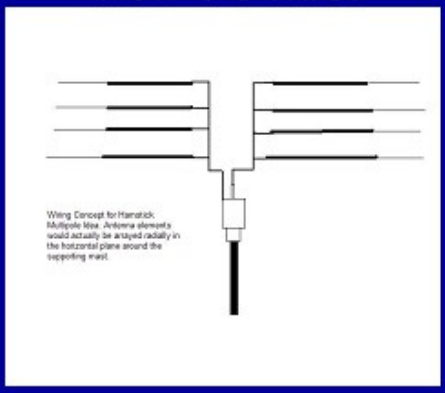
Another Antenna Tale

- I needed an antenna system that would give me both DX and NVIS capability in a portable package. Since the available commercial options were very expensive I came up with the "Octopus". The following slides show how it was done.

The Octopus

The Hub

How It Is Wired



NVIS vs DX?

- Changing from DX to NVIS is simplicity itself. Just lower the antenna array to about 10 feet for NVIS and raise it to the full height of the mast for DX. The mast can be a commercial unit like the ones from MFJ or you can roll your own. You can use 1 pair of “Hamsticks” to start and add up to 3 more pairs as the budget permits. I have 75, 40, 20 and 15 meters.

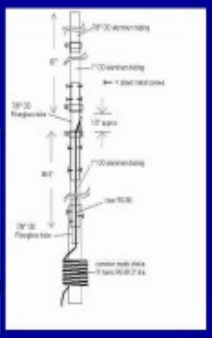
The Base

The Base In Place

Some other Projects

More Projects

And More Projects



Will He Ever Stop?

Don't Throw It Away!

The Point

- The point of all this is that with a tiny bit of effort and even less cash, you CAN fit your station out with quality antennas and other accessories. You will learn some about the electronics involved and much about yourself in the bargain. The feeling of accomplishment when you say "yep, and I built it myself" is unbelievable and the fun meter just goes off the scale.

Questions?

- Some of the projects we have talked about are on display here tonight. If anyone would like information on how to build any of these projects, there are handouts available for some of them. For the others please see me. If anyone has any questions please feel free to ask them now. Thank you and 73

Don’t throw that out! I can make a radio out of that!
Homebrewing in the 21st Century

Geoff Haines, N1GY

. You are here probably because you are interested in getting the maximum enjoyment out of amateur radio. In this day and age, when the complexity and miniaturization of our radios has made “rolling your own” a phrase that seems to apply only to smoking strange kinds of plant material, it is important to realize that you can still build many of the various gadgets that go along with that wondrous device you paid several hundred dollars for at the ham radio store not so long ago.

The average ham looks at the inside of his or her latest acquisition with eyes that get wider and wider as they see components so small and so numerous that a microscope seems as important a tool as a soldering iron. Those same hams perhaps do not realize that the accessories they attach to that radio, like computer interfaces, desk mics and the like have just a fraction of the components that the radio itself has.

By the way, all of the projects I will talk about today, are freely available on the internet. Either on my web site: www.n1gy.com, or other sites around the web. I have a handout here tonight with a list of sites to get anyone started. Alternatively, if you already know what you want to build, just enter it in a Google search and see what comes back.

A perfect example is an adapter that lets you substitute a microphone made for a computer for the stock hand mic that came with your rig. The fancy desk mic that the manufacturer of your radio offers may cost over 200 dollars. Even the aftermarket manufacturer charges close to 100 dollars for their version of a desk mic. Go into any store like Staples or Office Depot and you can pick up a desk mic for less than 20. So what's the difference?

Well, for starters there are probably 700,000 active hams in the US. Compare that to the 100,000,000 computer users. The market is simply much bigger. Economies of scale do have a major effect on the price of goods. Now, how difficult is it going to be to convert that PC desk mic into one for your favorite IC-706?

The component count is 4. One resistor, one polar capacitor, one push button and one half of a CAT-5 cable. That’s all. Most radios come with a circuit diagram and a pin-out diagram of the mic connector. Figure out which wire is ground and which wire is PTT and put the pushbutton switch between them. Find the wire that has 8 0r 9 volts DC on it and connect the resistor between it and the mic element of the PC mic. Find the wire that goes back to the radio from the mic, usually called mic+ and solder the capacitor between the resistor and the mic + wire. The other wire from the mic element goes to mic ground or to the same ground that you used for the PTT switch. You have now built your own desk mic. Total cost, maybe 30 dollars.

Some hams like to use headsets when they are operating. Several vendors, some of them at any hamfest, will happily sell you a headset costing from 70 to over 200 dollars. These headsets are very good. I prefer to go to Big Lots or Radio Shack and buy

a computer universal headset. They cost anywhere from 2 dollars to 10 dollars, are communications grade quality and other than the parts mentioned for the desk mic, the only extra component you need to convert them to ham radio is a couple of 3.5 mm stereo jacks and an enclosure, both available from Radio Shack. I use one of these little honeys for every net I operate or check in on. The audio quality of my signal with the computer headset is every bit as good as when I was using my Heil Traveler 706 headset. Now I have no way to quantify that with instrumentation. Like most of you, I rely on the response of other hams to my request for an audio check. The hams who have responded, comment favorably on the audio from the little $4.90 headset from Big Lots. I rest my case. The one limitation I have noticed is that some of them seem to have a finite lifespan. When any crackle surfaces and becomes noticeable, I just toss the earset and open a new one. The other factor is that the quality of the headsets can vary widely. Some designs work great, others not so much. Once you find a design that works, stick with it. At less than $10 each, one would have to go through a lot of headsets to equal the cost of the units made by the big boys.

Now maybe you would like to have the option of using a headset or a desk mic for a net or other purpose, and just use the hand mic for rag chewing. Rather than plug and unplug each mic, wouldn't it be easier to just throw a switch to go from one to the other? Now that the computer world has gone all USB and Bluetooth, the A-B data switches we used to use to share a printer between two PCs are obsolete (for Computers!) These come in various flavors, but the commonality is that they all have a 2,3, or 4 position switch that has anywhere from 8 to 25 poles. They usually have some kind of DB connector in and 2 to 4 DB connectors out. All one needs to do is convert those connectors to ones suitable for your mic and external speaker ports. The connectors are available at your local home improvement store or electronics shop.

Another area that is still wide open for homebrewing is the area of antennas. Just as in the previous example, you can pay lots of money for an antenna, whether it be VHF or HF, multi-band or single band. There are all kinds of antennas out there commercially and the prices vary from less than 20 bucks to well over a thousand. Now I am not anti commercial antenna. I have several at my QTH, I have several more on my SUV. But, if you want to “roll your own”, there are dual band antennas out there being made by hams just like you from materials that never saw the inside of a ham shop. A perfect example is the silver and white unit on my web site . The foil tape came from Home Depot, The PVC ditto. The spike that is used to plant the antenna in the ground came from Best Hardware. The coax could have come from Radio Shack, but actually I got it from Frank, AC4MK at a hamfest several years ago. Total cost was somewhere in the neighborhood of 7 bucks. Some of you may have seen an article in QST about the design. I built two more using aluminum tubing instead of foil. They work just fine on both 2 meters and 440. I use one at my house, along with a commercial unit for the two radios in the radio room.

Another type of antenna is the Yagi. More properly the Yagi-Uda after its inventors, two Japanese hams. This type of antenna seems to send amateurs searching

for the check book, but it need not be so. There is a web site called “Cheap Yagis” where you will find antenna designs made from welding rod, heavy gauge house wire, electric fence wire, and cheap wood or PVC booms. For VHF and UHF these antennas work excellently.They may not look like much, but it works just fine. If you live in a deed restricted development, you will have to hide it in the attic anyway.

Another web site has a design for a Yagi on 2 meters specifically designed for DF work. It not only works great but the design, using measuring tape for elements is almost immune to damage from getting in and out of the car or walking through the woods. The elements flex if they hit something and bounce right back. Joe Leggio, WB2HOL designed it and the cost of construction will probably set you back less than 15 bucks. Bill, W1WAB, borrowed mine and won the DF contest his club ran a few years ago.

Living here in Florida, we have to be ready much of the year for severe weather. If a hurricane hits, the likelihood is great that there will be a period of time after the storm when the normal infrastructure just isn’t there. I felt that I needed an HF antenna for such an eventuality, but I didn’t want to have to lower and modify the antenna every time I needed to change bands. The “Octopus” is the result.

Consider the lowly “Hamstick Dipole”. Now multiply it by 4. Now connect them all together to one coax run to the tuner or the radio direct. Place it on top of a masting system that collapses to fit inside your trunk, but extends up to 25 feet when needed. Make it all erectable by one person. Now you have got something. The December 2007 issue of QST has all the particulars. I homebrewed the mast, but MFJ now sells a similar unit that will go even higher. Of course it costs more too.

Even when severe weather is not in the offing, the “Octopus makes a great antenna to take to the beach for a little DX tanning session. Just park one of the cars wheels on top of the base and away you go. Guy ropes are recommended for heights above 15 feet and once they are in place, the car can be moved elsewhere if needed. If you need an NVIS antenna, just lower the mast so that the antenna is about 10 to 12 feet high and you are all set.

Of course, the skills you hone by homebrewing gear do not have to be restricted to ham radio. The need was seen for a test rig to check out the wiring of a mic switcher. My son loaned me a CAT-5 cable tester which solved the problem for the moment. I thought, "that would be a nice piece of gear to have around” until I saw the price. A little puzzling around gave me a super simple circuit that has almost no electronics in it at all. Two AA cells gives me 3 volts, a multi-position switch and 8 LEDs gives me a way to check the continuity of each wire in the cable separately. Total cost about 15 bucks. Notice the enclosure, it is courtesy of Home Depot, not the electronics store. The tester can be used to check the wiring in your LAN at home too.

There are many other devices you can think of that will increase your enjoyment of amateur radio without appreciably decreasing the size of your wallet. Just a few examples:

Baby food containers, those plastic rectangular ones, make great parts holders. If there is no toddler in your family, don't be afraid to ask your neighbors who do, to save

the empty containers for you.

Fishing lure boxes are also great. The small units that have lids on both the top and the bottom are great for storing resistors, caps, inductors, or batteries.

If you find that the local Radio Shack has gone or is in bankruptcy court, look for enclosures in the electrical aisle at the local home improvement store. They are cheap and easily workable.

CAT-5 or CAT-3 cable for computer or phone networks is perfectly good for any radio that uses modular connectors. If you find that RF is getting into the cable, eliminate the leaky RF, don't blame it on the cable.

The cables and connectors are available for a fair bit less at the home improvement store than they are at the computer store.

Another area that I call homebrewing is the use of computer programs like Publisher from Microsoft Office and others to design and print all kinds of things for the hobby. QSL cards, business cards, labels for controls, enclosure labels, log book pages, net logs, statistics sheets for nets, the list goes on and on. Why pay somebody for QSL cards that are a compromise from what you really want, when you can print them out with your own design. And you don't have to buy 500 of them at once. Just print out what you need, when you need it. Open Office is compatible with MS Office and is FREE to boot.

That neat little interface you built to connect the radio to your computer will look much more professional if the control labels are done with your printer rather than a Sharpie.

The possibilities are virtually endless. The skills you develop building simple little gadgets for ham radio may with time have you tackling much bigger projects. Everybody has to start somewhere. Once upon a time, I did not know which end of the soldering iron was hot. I found out the hard way too. I am no electronics maven. I have trouble to this day with IxE/R or however that formula goes. If I can construct these things, then I know YOU can too, probably better. One of the wonders of our hobby is that the FCC license permits us to do all kinds of things that the commercial radio user doesn't dare try. They buy all of their equipment as virtually plug and play, and the prices they pay for gear reflect that. Amateur Radio Operators are permitted and even encouraged to "roll your own". Let's keep that spirit alive and well, and build something to increase your enjoyment of ham radio. Your project might wind up in the pages of QST!

Some Websites of Interest

www.arrl.org	ARRL web site for almost anything
www.arrl.org/tis/tismenu.html	Technical Info and tons of projects
www.arrlwcf.org	The WCF Website with lots of info
nist.time.gov	The most accurate time check anywhere
http://time.is/	Another very accurate time display. This is the one I use for nets.
www.portforward.com	Go here to get Echolink and others to work with your Router and firewall
ad5x.com	Web site of Phil Salas, AD5X, QST author and all round ham radio guru.
www.animatedknots.com	Good knots will keep that FD tower in the air
www.n1gy.com	The web site of Geoff Haines, N1GY, Technical Coordinator, and QST Author
www.qrz.com	Huge Ham Radio Site. Most hams are listed here, you have to sign up to get all the data available but it is free so no worries.
www.eham.net	See Above. Note that the reviews of radio gear can be somewhat skewed by reviewers with an axe to grind.
www.hamuniverse.com	Lots of Projects and Info
n5xu.ece.utexas.edu/rfsafety/	Don't bake yourself, use this RF evaluator.
www.srh.noaa.gov/tbw/	The Ruskin Office of the Nat. Weather Service
www.nhc.noaa.gov/	The National Hurricane Center. You know why!
www.ni4ce.org/	The web site for info on "Big Stick"
www.ac6v.com/	A huge links site for Ham Radio. AC6V is a SK but the site is maintained by his son
service.gm.com/techlineinfo/radio.html	If you only want to download one file on mobile installations, make it this one.

SOURCES FOR PARTS
FOR YOUR NEXT PROJECT

Sources:

http://www.mpja.com/ - MPJA Online. A Florida based supplier of surplus parts, tools, etc.

http://www.radioshack.com/home/index.jsp - The store we all love to hate. However, they do still have plenty of components, enclosures, tools and supplies and they are everywhere.

http://www.packetradio.com/index.html - The URL for BuxxComm. Lots of parts and assembled devices for ham radio.

http://www.allelectronics.com/ - This California based company has thousands of surplus parts and devices, tools, supplies etc.

http://www.qsradio.com The site of **Quicksilver Radio** top site for Powerpole Connectors and other bits and pieces for ham radio.

http://www.pl-259.com/index.html - This is the URL for Tower Electronics. This Wisconsin based vendor is familiar to many hams here in Florida since they come to many of the local hamfests in our area.

http://www.mouser.com/ - One of the larger companies supplying parts and tools to both the hobbyist and the industry.

http://www.alliedelec.com - Another large electronics company

http://www.harborfreight.com/ - Harbor Freight has cheap tools, lots of outlets in our area.. For hobby purposes, the less expensive tools will do just fine in most situations.

http://www.sarasota-electronics.com/ - A local retail outlet with many hard to find parts and tools. Not much on the web site, but the site will give you the address and phone number. Great store to browse a bit.

I am quite sure you can add plenty of sources to this list. I am not familiar with local parts suppliers outside of the Bradenton - Sarasota area. There may be lots of others in the Greater Tampa Bay Area.

73,

Geoff Haines, N1GY

Introduction to the PICAXE Microcontroller

By Darrell Davis KT4WX
ARRL Technical Specialist
ARRL West Central Florida Section

Introduction to the PICAXE Microcontroller

KEY TO THIS PROGRAM

If you like this program:
Fall asleep with your head forward

If you dislike this program:
Fall asleep with your head backward.

All the heads should be forward
when I am finished :-)

Introduction to the PICAXE Microcontroller

PROGRAM OUTLINE

- History of the PICAXE
- PICAXE Processor Line
- PICAXE Commands
- PICAXE Programming
- PICAXE Sample Program and Cautions
- Sample PICAXE Project – Timer

Introduction to the PICAXE Microcontroller

I. History of the PICAXE

- Based upon the Microchip PIC Series of Microcontrollers.
- PICAXE is a pre-loaded "Basic Interpreter" or "bootstrap firmware code".

Introduction to the PICAXE Microcontroller

I. History of the PICAXE

- Produced by a UK (British) company called Revolution Education Ltd. (Rev-Ed)
- The first PICAXE interpreter was produced in 1999 but has been vastly improved and expanded since that time.

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

- Currently there is a wide selection of processors available in the PICAXE line.
- Available in 8 Pin to 40 Pin DIP packages.
- Available also in Surface Mount: (SOIC, and TQFP Packages).

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE M2 SERIES
Standard Series of Controllers

Processor	Program Memory	I/O Pins	RAM	Clock
PICAXE 08M2	2048 Bytes (2K)	6	128 Bytes	4-32 MHz
PICAXE 14M2	2048 Bytes (2K)	12	512 Bytes	4-32 MHz
PICAXE 18M2	2048 Bytes (2K)	16	256 Bytes	4-32 MHz
PICAXE 20M2	2048 Bytes (2K)	18	512 Bytes	4-32 MHz

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE X2 SERIES
Advance Series of Controllers
More Features, Ports, and Speed

Processor	Program Memory	I/O Pins	RAM	Clock
PICAXE 20X2	4096 Bytes (4K)	18	256	4-64 MHz
PICAXE 28X2	4096 Bytes (4K)	22	1280	4-64 MHz
PICAXE 40X2	4096 Bytes (4K)	33	1280	4-64 MHz

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE 08M2

PICAXE 14M2

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE 18M2

PICAXE 20M2

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE 20X2

PICAXE 28X2

Introduction to the PICAXE Microcontroller

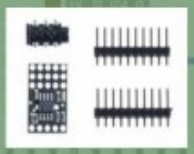
II. PICAXE Processor Line

PICAXE 40X2 – TOP OF THE LINE
600 mm DIP Package – All others 300mm DIP Package

Introduction to the PICAXE Microcontroller

II. PICAXE Processor Line

PICAXE 08M2 MODULE



PICAXE 28X2 MODULE

Introduction to the PICAXE Microcontroller

III. PICAXE Commands

- Originally, microcontrollers were programmed in assembler
- More recently, nearly all microcontroller programming is done in C++
- The PICAXE is programmed in BASIC!!

Introduction to the PICAXE Microcontroller

III. PICAXE Commands

Digital Input/Output Commands

COMMAND	DETAILS	COMMAND	DETAILS
High	Switch an output pin on	Pwmout	Generate a continuous pulse width modulation
Low	Switch an output pin off	Pwmduty	Set duty cycle of a pulse width modulation output
Toggle	Switch an output between on and off	Input	Set a pin as an input
Sound	Generate simple sounds	Output	Set a pin as an output
Button	Detect and debounce a pushbutton switch	If Pin	Respond to the state of an input pin

Introduction to the PICAXE Microcontroller

III. PICAXE Commands

Time Delays and Variables

COMMAND	DETAILS	COMMAND	DETAILS
Pause	Pause for a defined number of milliseconds	For/Next	Repeat a loop for number of time. Return from loop
Pauseus	Pause for a defined number of microseconds	If / Else	Conditionally execute program code. Alternative
Wait	Delay for a number of seconds	Endif	End of If / Else statement
Sleep	Sleep for a period of time	Gosub / Return	Call a routine Come back from routine
Doze	Reduce pwr consumed for a short period of time	Goto	Continue program execution from label

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

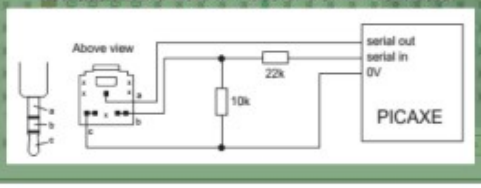
- PICAXE is programmed with a serial connection
- Programming Pins: SERIN, SEROUT, GND.
- Programming can be done with a Windows Based PC with a RS232 Serial or USB Port.

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Serial Port Programming

Can use a DB-9 Male in Place of 3.5 mm Connector



Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

USB Port Programming
Uses a USB to Serial Adapter.

USB Serial Cable
#AXE027

USB Serial Adapter
#AXE029

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Programming Software:
PICAXE Programming Editor – Version 5

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Programming Software:
PICAXE Editor 6
(Replaces PICAXE Programming Editor V5)

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Programming Software:
AXEPAD: Available in Windows, Linux, and Mac

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Items needed to start with
PICAXE Programming and Experimenting:

- Computer with Windows, Linux, or Mac OS.
  More programming applications available with Windows.
- Serial Cable or USB to Serial Converter:
  If computer has USB Ports only or if desired Port.

Introduction to the PICAXE Microcontroller

IV. PICAXE Programming

Items needed to start with
PICAXE Programming and Experimenting:

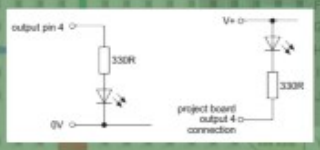
- 3VDC TO 5VDC Power Supply or Battery.
  DO NOT EXCEED 5VDC.
- PICAXE Controller of choice.
- Solderless Breadboard with parts needed to breadboard desired circuit..

Introduction to the PICAXE Microcontroller

V. PICAXE SAMPLE PROGRAMS AND CAUTIONS

Quick Program: BLINKNG LED
Turns Port 4 (PIN 3) On and off in a continuous loop.

```
main:   high 4
        pause 1000
        low 4
        pause 1000
        goto main
```



Introduction to the PICAXE Microcontroller

V. PICAXE SAMPLE PROGRAMS AND CAUTIONS

Do not apply more than 5VDC to your PICAXE!!

Introduction to the PICAXE Microcontroller

VI. Sample PICAXE Project

DEMONSTRATION TIME:

A 3 minute or 10 minute timer with a PICAXE 08M2 Processor with less parts count than a comparable 555 Timer and the 555 Timer cannot do 2 time modes without more parts count.

Introduction to the PICAXE Microcontroller

CONTACT INFORMATION

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INTRODUCTION TO THE ARDUINO

By Darrell Davis KT4WX
ARRL Technical Specialist

INTRODUCTION TO THE ARDUINO

KEY TO THIS PROGRAM

If you like this program:
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INTRODUCTION TO THE ARDUINO

PROGRAM OUTLINE

I. HISTORY OF THE ARDUINO
II. WHAT IS THE ARDUINO
III. CURRENT ARDUINO LINE
IV. ARDUINO SHIELDS
V. ARDUINO IDE
VI. SAMPLE PROJECT
VII. ARDUINO RESOURCES

INTRODUCTION TO THE ARDUINO

I. HISTORY OF THE ARDUINO

- The Arduino was created in 2005 by a team of professors at an Italian college led by a professor named Massimo Banzi.
- Massimo had taught his students previously using the BASIC STAMP but it was more expensive ($100 price range).

http://spectrum.ieee.org/geek-life/hands-on/the-making-of-arduino

INTRODUCTION TO THE ARDUINO

I. HISTORY OF THE ARDUINO

- Massimo wanted the board to cost, "equivalent of going out to dinner at a pizza place."
- The name Arduino has an unusual origin: "Ria de Arduino" - The name of a pub in Ivrea, Italy that Massimo and his associates frequented.

http://spectrum.ieee.org/geek-life/hands-on/the-making-of-arduino

INTRODUCTION TO THE ARDUINO

I. HISTORY OF THE ARDUINO

- Arduino has had phenomenal success with over 700,000 "official" boards as of 2013.
- Extensively used by those in the Makers (DIY) movement and embraced by amateur radio operators, the original "makers".

http://spectrum.ieee.org/geek-life/hands-on/the-making-of-arduino

INTRODUCTION TO THE ARDUINO

II. WHAT IS THE ARDUINO

- The Arduino is a microcontroller with a preloaded bootloader that loads the programmers code upon power up.
- Bootloader (Bootstrap Firmware): Software that runs on power up to set up the necessary environment for user code to execute.

INTRODUCTION TO THE ARDUINO

II. WHAT IS THE ARDUINO

- The Arduino IDE, for writing software is based upon the Processing Programming Language and uses a C and C++ syntax.
- The Arduino hardware interface is based upon the Wiring language.

INTRODUCTION TO THE ARDUINO

II. WHAT IS THE ARDUINO

- The software and hardware is licensed under the open source *Creative Commons Attribution Share-Alike 2.5 license*.
- Commons license information: http://creativecommons.org/licenses/

INTRODUCTION TO THE ARDUINO

II. WHAT IS THE ARDUINO

- Arduino originally used the ATMEL AVR Microcontroller Architecture (ATMega)
- Newest Arduino implementation using an Atmel ARM Controller (Arduino Due)
- There are numerous Arduino clones on the market.

INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

OFFICIAL ARDUINO LINE

- The following are the most popular Arduino products.
- Full Arduino product line: http://arduino.cc/en/Main/Products

INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

ARDUINO UNO R3

http://arduino.cc/en/Main/ArduinoBoardUno

8 bit Processor, 16 Mhz Clock, 32K Program Memory.

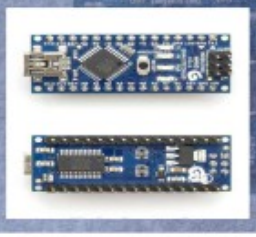
- Based upon AVR ATMega328U Processor.

INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

ARDUINO NANO:

http://arduino.cc/en/Main/ArduinoBoardNano



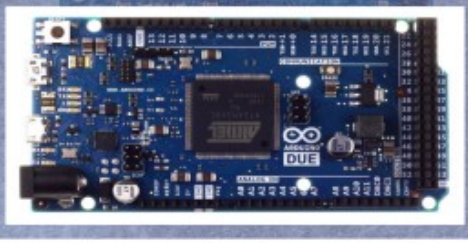
- Arduino that is the size of a 40 pin DIP IC.
- Great for integration into another project.

INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

ARDUINO DUE

http://arduino.cc/en/Main/ArduinoBoardDue



INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

ARDUINO DUE

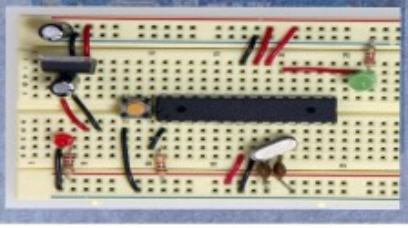
- **Based upon an ARM Cortex M3 Processor by ATMEL instead of an AVR processor.**
- **32 Bit Processor, Clock speed 84 MHz, 512K Program Memory, 96K RAM, and 54 I/O pins for larger projects.**

INTRODUCTION TO THE ARDUINO

III. CURRENT ARDUINO LINE

UNOFFICIAL ARDUINO

Arduino without the board



INTRODUCTION TO THE ARDUINO

IV. ARDUINO SHIELDS

WHAT ARE "ARDUINO SHIELDS"?

- Arduino boards have headers that allow other boards to be plugged into an Arduino.
- These plug in boards are called "Shields".
- Arduino shields are standardized and can be used with any version of the Arduino.

INTRODUCTION TO THE ARDUINO

IV. ARDUINO SHIELDS

- Arduino Shields use 0.100" spaced headers and must match the Arduino spacing to be Shield compatible.
- The original Arduino specification had (2) 1 X 6, and (2) 1 X 8 Header rows.
- The newer Arduino shield specification (R3) adds two pins to one of the 1 X 8 headers.

INTRODUCTION TO THE ARDUINO

IV. ARDUINO SHIELDS

ARDUINO SHIELD PINOUT – R3 VERSION

INTRODUCTION TO THE ARDUINO

IV. ARDUINO SHIELDS

SHIELD PLUGGED INTO ARDUINO

INTRODUCTION TO THE ARDUINO

V. ARDUINO IDE

- Arduino has a standard Integrated Development Environment to write programs, test, debug and load programs onto an Arduino.
- Available for the Windows, Linux, and Mac Operating Systems.
- Free of charge from the Arduino website.

INTRODUCTION TO THE ARDUINO

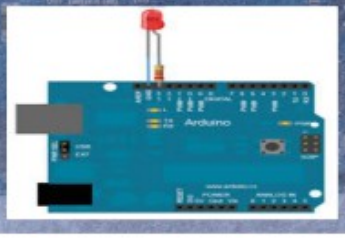
V. ARDUINO IDE

Screenshot of the Arduino 1.0 development software running a program to make an LED blink.

INTRODUCTION TO THE ARDUINO

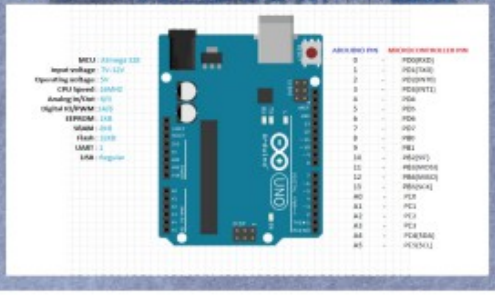
VI. SAMPLE ARDUINO PROJECT

Blinking an LED On and Off



INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT



INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

Blinking an LED On and Off

```
const int LED = 13;  // LED connected to digital pin 13
void setup()
{
    pinMode(LED, OUTPUT); // sets the digital
    // pin as output
}
void loop()
{
    digitalWrite(LED, HIGH); // turns the LED on
    delay(1000); // waits for a second
    digitalWrite(LED, LOW); // turns the LED off
    delay(1000); // waits for a second
}
```

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

1. Arduino Ports must be defined first, before any other program code.

This is done by declaring each port with a Global Constant with the *const* command. Constants cannot be changed by any program code.

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

2. All Arduino programs must have a minimum of two functions.

- Setup () - This is for code that will run once at the beginning of your program.
- Void() - Contains the core of your program. This is the main loop that runs over and over again.

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

- Each module of a program is called a function. Most programs will have numerous functions. The "void ()" function will call upon other functions in its execution.
- The void() will continous loop until you shut the Arduino power source off or push the reset button.

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

const int LED = 13; // LED connected to digital pin 13

- *The variable "LED" has been assigned a value of 13.*
- *The "const int" defines LED as a constant variable.*
- *Double slashes are used for comments. Comments are ignored by the compiler. They are a programmers aid. Good programmers use them generously.*

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

```
void setup()
{
    pinMode(LED, OUTPUT); // sets the digital pin 13 as
    output
}
```

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

- *The variable "LED" has been assigned a value of 13.*
- *The command "pinMode" is the command used to assign the pin number and whether it is an output or input.*
- *Double slashes are used for comments. Comments are ignored by the compiler. They are a programmers aid.*

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

```
void loop()
{
    digitalWrite(LED, HIGH); // turns the LED on
    delay(1000); // waits for a second
    digitalWrite(LED, LOW); // turns the LED off
    delay(1000); // waits for a second
}
```

INTRODUCTION TO THE ARDUINO

VI. SAMPLE ARDUINO PROJECT

- *The command "digitalWrite" (variable "LED" still has a value of 13) makes that port go High.*
- *The command "delay" is a time pause and the value is in milliseconds.*
- *This routine will turn the LED on and off in 1 second intervals.*
- *This program will run until you turn the power off or push the reset button.*

INTRODUCTION TO THE ARDUINO

VII. ARDUINO RESOURCES

BOOKS:

Getting Started with the Arduino
by Massimo Banzi: ISBN 978-1-449-309879

Arduino for Ham Radio (ARRL)
Gwen Popiel KW5GP: ISBN 978-1-62595-016-1

Beginning Arduino Programming
by Brian Evansl: ISBN-13: 9781430237778

INTRODUCTION TO THE ARDUINO

VII. ARDUINO RESOURCES

BOOKS:

Arduino Notebook V1.1
by Brian Evans (found on Arduino website)
http://playground.arduino.cc/uploads/Main/arduino_notebook_v1-1.pdf

Introduction to Arduino
by Alan Smith (Free Ebook and website)
http://introtoarduino.com/downloads/IntroArduinoBook.pdf

INTRODUCTION TO THE ARDUINO

VII. ARDUINO RESOURCES

WEBSITES – Just to get started with:

Arduino Website: http://www.arduino.cc

Arduino Playground: http://playground.arduino.cc/

Arduino Wikipedia page:
http://en.wikipedia.org/wiki/Arduino/

INTRODUCTION TO THE ARDUINO

VII. ARDUINO RESOURCES

WEBSITES – Just to get started with:

Arduino UNO Wiki:
http://www.seeedstudio.com/wiki/Arduino_UNO

Arduino Video Tutorials:
Search for Jeremy Blum Arduino Tutorial
Link to first video:
https://www.youtube.com/watch?v=fCxzA9_kg6s

INTRODUCTION TO THE ARDUINO

QUESTIONS OR TIME FOR ANOTHER DEMO PROGRAM PERHAPS?

THANK YOUR FOR YOUR TIME AND ATTENTION!!

INTRODUCTION TO THE ARDUINO

CONTACT INFO

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Fort Meade, FL 33841-9584

Phone: (863) 245-9923
Email: kt4wx@arrl.net
Web: http://www.kt4wx.org

HAMS HELPING HAMS

ARRL MENTOR PROGRAM

The Ham's Guide to Repeaters

ARRL MENTOR PROGRAM

What Is A Repeater?

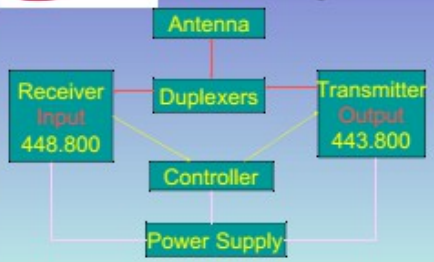
ARRL MENTOR PROGRAM

What Is A Repeater?

A repeater is a device which will receive a signal on one frequency and simultaneously transmit it on another frequency.

ARRL MENTOR PROGRAM

Block Diagram



ARRL MENTOR PROGRAM

Fundamentals

Power Supply

RX

Antenna

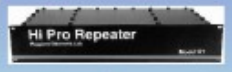
TX

Site Coordination

CAT 300 DX

ARRL MENTOR PROGRAM

Types



Makes and Models

All Repeaters Are not Voice Repeaters

Types of Repeaters

- FM Voice – Very common.
- ATV – Amateur Television.
- AM and SSB - Not very common.
- Digipeaters – Primarily used for packet communications.
- Multi-channel (wideband) – Amateur satellites.

Discussion Points

- Simplex Operations
- Input Frequency
- Duplexer
- Controller
- Hang - Time
- Courtesy Beep or Msg
- Offsets

.

Discussion Points

- Duplex Operations
- Output Frequency
- CTCSS / PL / CG
- Ancillary Functions
- Time-Out Timer
- Autopatch
- Operating Practices

.

- Most hams are familiar with FM voice repeaters.
- They are the most popular repeater used in Amateur Radio.
- These repeaters are commonly found on 29, 144, 222 or 440 MHz bands.
- Though not as popular, there are FM repeaters on the 6m amateur band.

When we use the term *repeater* we are almost always talking about transmitters and receivers on VHF or higher bands, where radio-wave propagation is normally line of sight.

Why Do We Use Repeaters?

Greater Range

A repeater's expanded coverage greatly enhances the ability to communicate with mobile stations and hams using hand held transceivers.

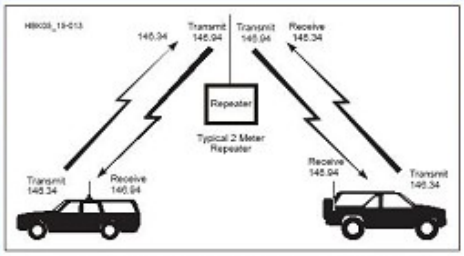


Fig 15.13 — Typical 2-m repeater, showing mobile-to-mobile communication through a repeater station. Usually located on a hill or tall building, the repeater amplifies and retransmits the received signal on a different frequency.

Location, Location, Location

Repeaters are often located on high ground or tall towers that offer greater coverage than that offered by *simplex* operation.

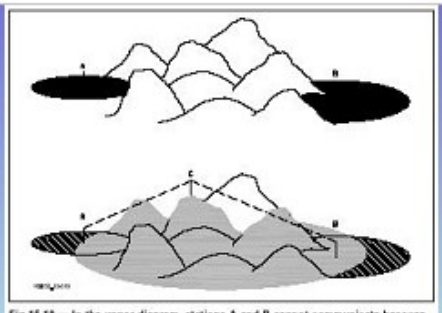


Fig 15.19 — In the upper diagram, stations A and B cannot communicate because their mutual coverage is limited by the mountains between them. In the lower diagram, stations A and B can communicate because the coverage of each station falls within the coverage of repeater C, which is on a mountaintop.

Using A Repeater

Using a repeater is not much different than making any other two way contact.

Simplex and Duplex

When two stations contact each other using the same frequency for both transmit and receive, they are said to be operating *simplex*.

Simplex and Duplex

Duplex operation is where one station transmits on frequency A and receives on frequency B and the other station transmits on frequency B and receives on frequency A.

Simplex and Duplex

- Full duplex is when both stations can transmit and receive signals simultaneously.
- A repeater operates in full duplex mode.

Simplex and Duplex

- Because users of a repeater cannot transmit and receive simultaneously, the stations are actually operating in *half duplex* mode.

When making a contact through a repeater it is important to make sure that you are on the correct pair of frequencies.

Input and Output

- The frequency that a repeater receives is the *input* frequency.
- This is the frequency that your station will be transmitting on.

Input and Output

- The frequency that a repeater transmits on is the *output* frequency.
- This is the frequency that your station will be receiving.

Input and Output

- Repeaters are commonly referred to by their transmit frequency. This is the receive frequency displayed on your radio.

Input and Output

- Your radio should display *your receive frequency* (the repeater's transmit frequency) when monitoring the repeater.

Offset

The difference between the repeater's output frequency and input frequency is known as the *offset*.

Offset

Most repeaters use a standard offset.

Standard Frequency Offsets for Repeaters

Band	Offset
29 MHz	100 kHz
52 MHz	1 MHz
144 MHz	600 kHz
222 MHz	1.6 MHz
440 MHz	5 MHz
902 MHz	12 MHz
1240 MHz	12 MHz

Plus or Minus

- The offset frequency can either be above or below the repeater's transmit frequency.
- The band plan has taken the guess work out of +/-.

More Topics

- Duplexer
- Controller
- Hang - Time
- Courtesy Beep or Msg
- . Ancillary Functions
- Time-Out Timer
- Autopatch
- Operating Practices

Duplexers

- Allows Repeater to Transmit & Receive at the same time on ONE Antenna

Duplexers

- One side pass the high frequency while notching the low
- Other side passing the low frequency while notching the low

Antennas

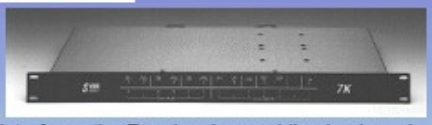
- Commercial Grade Repeater Antennas.
- Folded Dipole Style.
  - Can be configured for Omni or Directivity.
- StationMaster, Fiberglass Style

Feedlines

- Most Repeaters use Commercial Grade antenna feedlines.
- Higher Frequencies and long runs for high towers mean huge signal losses with cheap cable.
- Larger cable, lower losses

Andrews or Cablewave 7/8" Foam

Controller



- Interfaces the Receiver by providing Logic and Audio to the Transmitter.
- Provides Automatic ID of Repeater
- Provides Timers, Messages and other Functions

Timers

- Hang / Tail Timer
  - Amount of Time the Repeater Transmitter stays on-the-air after User Stops Transmitting.
- Courtesy Timer
  - Time between User end of transmission and Courtesy "Reset" beep.
- Time-Out-Timer
  - Amount of time before Repeater Transmitter shuts off. Usually about 3 minutes.

Courtesy Message

- Tells the User when the Time-Out-Timer has reset.
  - Usually after a slight delay to allow for other stations to break in.
- If a User begins Transmitting Prior to the Courtesy Message, Previous Users Time is added to your Time.
  - After 3 minutes, Repeater will "Time-Out".

Autopatch

- Additional Function of the Controller that interfaces the Repeater to the Telephone System.
- No business calls allowed.
  - Although because of deregulation, some "commercial" type calls are allowed now.
  - Ultimately, it's up to each Repeater Owner/Trustee. Ask first.

CTCSS / PL / CG

- CTCSS = Continuous Tone Coded Squelch System
  - PL = Private Line "Motorola's Trade Name
  - CG = Channel Guard "General Electric's Trade Name
- Sub-Audible Tone, superimposed on a Transmitted Signal to open a Receivers Squelch.
- If a Receiver hears a Signal With the Correct Frequency CTCSS Tone, Squelch Opens, otherwise it ignores the signal.

CTCSS / PL / CG

- In Repeater Early days, "PL" was used to keep stations out - ie, "Closed" Repeater. Available to members only.
- Now, because there are so many repeaters, and frequency pairs are becoming scarce, "PL" allows a user to "Select" which Repeater one brings up in overlapping areas.
- Also Used to keep Interference out of Repeater.

Ancillary Functions

- Other Functions provided by a Repeater might be Linking to other Repeaters for "Wide Area" Coverage.
- Severe Weather Alerting.

x

x

x

x

Have Fun

- **Repeaters are a great way to stay in touch with local hams and club members.**

The Serious Side

- **Repeaters play a big role during emergencies.**
- **When used for emergencies keep the repeater open for priority communications.**

The Serious Side

- Repeaters are also used for public service events that you may wish to volunteer to help with.

The Serious Side

- Make sure that you have registered with the event coordinator before joining in any type of net or organized communications for an event.

Support

- Repeaters are built and maintained at the expense of a club, an individual or a small group of hams.

Support

- While not required, it is a nice gesture to support the sponsor of a repeater that you frequently use by joining the club or making a donation.

DMR

MOTOROLA simoco JVCKENWOOD

Vertex Standard Hytera KIRISUN tait

OVERVIEW OF TWO-WAY DIGITAL RADIO

Digital Mobile Radio

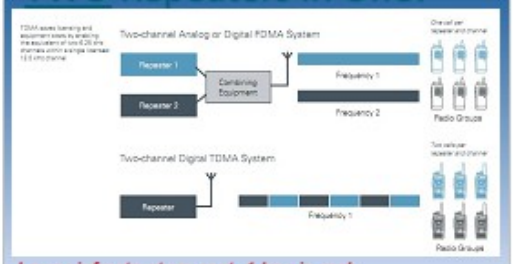
- An ESTI published worldwide standard
- Over a HALF DOZEN manufacturers of DMR radios
- Superior voice quality over older digital modes
- Longer battery life
- Supports multiple talk groups on one channel
- Supports data applications
- Commercial ETSI/TIA specs mean rugged performance over temperature and congested urban RF environments

Motorola Solutions

MOTOTRBO

OVERVIEW OF TWO-WAY DIGITAL RADIO

TWO Repeaters in One!



Lower infrastructure cost, 1 box in rack
TWO voice channels from one repeater

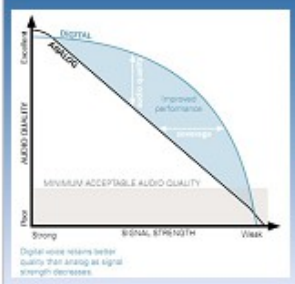
Half the Channel Bandwidth

Traditional Analog	DMR
25 kHz Channel Bandwidth	**12.5 kHz** Channel Bandwidth
1 Channel 1 Repeater	**2 Channels** 1 Repeater

More Spectrum Efficient than Older Digital Modes

Guard Band	No Guard Band
as large as 10 kHz between channels	between 2 channels
Total BW= 22.5 kHz	**Total BW= 12.5 kHz**

Better Signal Quality



Digital voice retains better quality than analog as signal strength decreases.

- No hiss, popping, or static
- Better RF range than older digital technologies
- Forward Error Correction and Cyclic Redundancy Check coders

Better Audio Quality

- Listen for yourself. DMR does sound better than older digital technologies.

Longer Battery Life

Older Digital Modes (FDMA)

DMR (TDMA)

"For each hour of usage the TDMA radios show between 19% and 34% less battery capacity is required than for the FDMA models."

"40 percent improvement in talk time in comparison with analogue radios "

http://dmrassociation.org

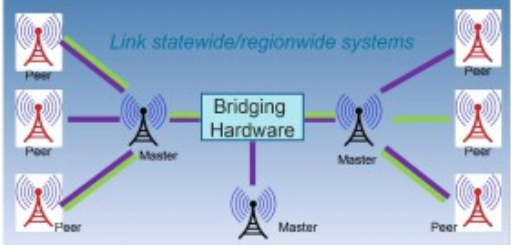
Data and Voice at the Same Time

Slot 1 Voice

Slot 2 GPS Location
(or second channel voice when not sending GPS data)

Give your location WHILE talking!

MotoTrbo IP Site Connect 1 or 2 slots (channels)



Dynamic Mixed Mode: First in – First Out

Repeater dynamically detects the type of input
IP site connect currently not supported in DMM

This is a stand-alone repeater option only.

Free Text Messaging

Send to one person, or a group of people.

- Weather Alerts
- Club Meetings
- Announcements

APCO

P25

OVERVIEW OF TWO-WAY DIGITAL RADIO

Project 25 Definition

Project 25 (P25) is the standard for interoperable digital two-way wireless communications products and systems"

Project 25 Definition

Developed under state, local and federal government guidance and in conjunction with the Telecommunications Industry Association (TIA) governance, P25 is gaining worldwide acceptance for public safety, security, public service, and commercial applications. The published P25 standards suite is administered by the TIA in their Mobile and Personal Private Radio Standards Committee (TR-8)."

Project 25 Definition

Equipment that demonstrates compliance with P25 is able to meet a set of minimum requirements to fit the needs of public safety. These include the ability to interoperate with other P25 equipment, for example, so that users on different systems can talk via direct radio contact."

Project 25 History

- From 1976 to 1979, a **functional specification** was developed for Public Safety trunked systems
- This specification is **APCO Project 16 (P16),** established by the Association of Public Safety Communications Officials International, Inc. ("APCO")
- The P16 specification included definitions for Public Safety radio communication systems with analog voice, and radio channel trunking using the **newly-allocated 800 MHz frequency band**

Project 25 History

- The P16 functional specifications permitted development of **proprietary systems**
- Three proprietary P16 systems evolved:
  - EF Johnson's Multi-Net®,
  - Motorola's SMARTNET®,
  - and General Electric's EDACS®
- The subsequent deployment of proprietary systems **minimized interoperable solutions** once an initial system decision was made

Project 25 History

- In an attempt to achieve interoperability, five 800 MHz mutual aid channels were designated for interoperability – these are known as the **NPSPAC channels**. NPSPAC is the abbreviation for "National Public Safety Planning Advisory Committee"
- While some federal, state and local agencies implemented systems that complied with **P16 specifications**, the varying proprietary protocols and different Public Safety frequency bands **deterred improved interoperability**

Project 25 History

- In 1988, the FCC, at the direction of Congress, published a **"Notice of Inquiry"** on radio technologies for Public Safety
- Comments and Reply Comments were received and published in 1989
- Responding to the Commission's initiative, a **large group of users**, **vendors** and other interested parties (many of whom commented on the FCC NOI noted above) met in Washington DC in December 1989, to discuss **"Public Safety Digital Radio"**

Project 25 History

- The result was the formation of the **APCO P25 coalition**
- This user coalition included:
  - APCO,
  - The Association for Telecommunications and Technology Professionals Serving State Government (formally NASTD, the National Association of State Telecommunications Directors),
  - and Federal Government users

Project 25 History

- A **steering committee** was formed to manage the process
- The P25 Steering Committee has **eleven members** and is co-chaired by APCO and NASTD
- The members include:
  - Four APCO Representatives,
  - Four NASTD Representatives,
  - and Three Federal Government representatives

Project 25 History

- Technology development began in 1990, when the Federal government participants, who had hired a consultant **(GTE)** to develop Digital Radio Technology recommendations (before APCO P25 began), offered the results of this study to the coalition as a **benchmark** or starting point for their process
- In response, technology recommendations from users, academia, and manufacturers caused significant **deviation from the baseline parameters** proposed by the

Project 25 History

- In January 1992, a **first draft** was completed describing user requirements
- As part of the standards development process, **P25 requested assistance from TIA** (Telecommunications Industry Association) to provide technical advice to P25 for its standard(s)
- A Memorandum of Understanding (**MOU**) was signed between Project 25 and TIA to this effect
- A **2nd MOU was prepared for industry** to assure the proper agreements regarding Intellectual Properties (IPR)
- These agreements continue in effect today

Project 25 History

- TIA in concert with P25 created an **ad hoc committee** to facilitate action on items and issues raised in the process
- This committee called **APIC** (APCO Project 25 Interface Committee) is patterned after the TIA processes
- Each participating User and Manufacturer has **one vote** in the APIC deliberations
- Lengthy deliberations on **voice coding** and **digital radio modulation techniques** resulted in extensive efforts to address alternatives

Project 25 History

- An **evaluation program** derived from the CTIA (Cellular Telecommunications Industry Association) **vocoder** evaluation processes was used to test proposed vocoders
- After a discussion of the **modulation alternatives** the coalition demanded a practical demonstration of the techniques eventually adopted

Project 25 History

- In **1995**, APCO completed the new recommended standard now known as **P25**
- P25 specifies **features and signaling for narrow band digital voice and data** with conventional and trunking modes of operation
- TIA provided the development of this suite of standards, following an industry-sanctioned and American National Standards Institute **(ANSI) accredited process**

Project 25 History

- With TIA's assistance, P25 was structured to specify details of fundamental digital Public Safety communications to allow **multi-source procurement** and **interoperability** for the life of P25 systems"

P25 Viability and Sustainability

- The **P25 standard** has been adopted by the National Telecommunications and Information Administration (**NTIA**), which manages spectrum for the federal government
- In addition, **NTIA** also specified use of **P25 narrow band by the year 2005** for the VHF Hi bands (162-174 MHz), and by 2008 for all other bands
- Many **US government agencies** (e.g. Treasury, Interior, Departments of Defense (DoD) and Justice) have **specified P25** for procurements of new radio communications systems and equipment – **DHS is "recommending" P25** for monies sent to state and local government for interoperability solutions

P25 Viability and Sustainability

- **P25 Phase 1** published standards define Public Safety radio communications in **12.5 kHz channels**
- **FCC rulings in the VHF and UHF** frequency bands require more spectral efficiency through the use of narrower radio channels, i.e. **12.5 kHz**
- While a **stay has been granted** to users regarding the decision by the FCC to ban new licenses for 25 kHz channel equipment after January 2004, **FCC rules requiring narrow band type accepted equipment still remain**

P25 Viability and Sustainability

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P25 Viability and Sustainability

- **Additionally FCC rules as presently interpreted give Public safety users until January 1, 2018** to convert their systems to meet the spectral efficiencies of 12.5 kHz or better
- These rulings present **requirements** for users to upgrade their systems to meet the FCC mandated efficiencies

P25 Viability and Sustainability

- Both the **FCC and NTIA narrow band rules** increase public safety and federal agency **interest** in P25 systems and equipment
- **P25 compliant radio systems** and equipment offer the opportunity to implement Public Safety radio **interoperability**
- Today, many **Public Safety wireless communications planning efforts** are based on using P25 compliant systems and equipment for **interoperability** and to meet **narrowband** spectral efficiency required by NTIA and the FCC

P25 Phase 1

- Phase 1 radio systems operate in 12.5 kHz analog, digital or mixed mode using FDMA access method.
- Continuous 4 level FM (C4FM) modulation—a special type of 4FSK modulation—for digital transmissions at 4800 baud and 2 bits per symbol, yielding 9600 bits per second total channel throughput. Of this 9600, 4400 is voice data generated by the IMBE codec, 2800 is forward error correction, and 2400 is signalling and other control functions.

P25 Phase 1

- Receivers designed for the C4FM standard can also demodulate the "Compatible quadrature phase shift keying" (CQPSK) standard, as the parameters of the CQPSK signal were chosen to yield the same signal deviation at symbol time as C4FM while using only 6.25 kHz of bandwidth. Phase 1 uses the IMBE voice codec.

P25 Phase 2

- To improve spectrum utilization, P25 Phase 2 has been developed for trunking systems using a 2-slot TDMA scheme.
- Uses the AMBE+2 voice codec to reduce the needed bitrate so that one voice channel will only require 6000 bits per second (including error correction and signalling).
- Is not backwards compatible with Phase 1 (due to the TDMA vs FDMA operation), although TDMA radios and systems are capable of operating in Phase 1 FDMA when required. This could make analog narrow-band FM the de facto "interoperability" mode for some time.

System Fusion by Yaesu

Overview

- Digital communications in amateur radio and the case for C4FM
- Yaesu's implementation of C4FM: System Fusion

C4FM Modulation

- At same bandwidth, C4FM circuit can be simplified and the Bit Error Rate approved
- Main modulation method in LMR these days
- Yaesu using this as the basis for SystemFusion in the amateur market

FDMA vs TDMA

- FDMA circuitry is simpler than TDMA
- TDMA reduces transmission time by one-half or more, reducing power consumption

Is C4FM compatible with D-STAR?

- No, it's not; different modulation techniques (GMSK vs C4FM)
- Is this a problem in the amateur radio world?
- Not really; an example of the experimentation that amateur radio is known for

Is C4FM Digital always the superior mode?

- No, it isn't; there will be instances when analog is superior
- We amateurs know that different modes have different advantages and that some are preferred in certain circumstances
- C4FM is another mode available to amateurs, increasing our capabilities; it's another tool in our toolbox

Yaesu's : System Fusion

- Three C4FM modes, using 12.5 kHz bandwidth:
- V/D Mode – Voice/Data simultaneous communication, half for voice, half for data and error correction
- Voice FR (full rate) Mode – all bandwidth used for voice, top audio quality
- Data FR Mode – all bandwidth used for data
- Analog FM – 25 kHz; used when signals too weak for digital

AMS (Automatic Mode Select)

- Transceiver recognizes the incoming mode (C4FM digital or analog FM) and switches over to match that mode
- No need to remember to manually switch the mode on the transceiver
- Enables mixed-mode communication on compatible repeaters
- If a SystemFusion repeater is installed, you're not locked out if you don't have a SystemFusion transceiver

New Functions Gained with C4FM

- Digital GM (Group Monitor) Function – see where group members are located
- Snapshot Function – transmit images taken with camera microphone
- Smart Navigation Functions
- Simultaneous Voice and Data transmissions allows APRS-type position data to be sent while transmitting
- Backtrack navigation – allows one to return to a preset point (useful for hiking)

AMS (Automatic Mode Select)

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- No need to remember to manually switch the mode on the transceiver
- Enables mixed-mode communication on compatible repeaters
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ICOM

D-STAR

Digital Smart Technology for Amateur Radio

D-STAR?

- Digital Radio capability—
- Voice and Data at low speed on any VHF/UHF band
- Currently implemented on 2M and 70cm
- High speed data on 1.2 GHz only
- Supports voice as well
- Capabilities resident in compliant radios and repeaters without need of additional equipment

D-STAR?

- Open protocol published in 2001
- Research funded by Japanese government and administered (and owned?) by the Japanese Amateur Radio League
- Open to anyone to implement

D-STAR?

- Digital Voice (DV) data stream
- supports both voice (3600 bps including error correction) and data (1200 bps) on any band
- RS-232 or USB 1.0 connection to computer or even PDA
- Codec for voice is AMBE® (Advanced Multi-Band Excitation)
- Unsure about voice input modes other than at handset

D-STAR?

- Voice is converted to digital modulation and transmitted at 4800 bps
- 2400 bits for voice
- 1200 bits for Forward Error Correction on voice
- 1200 bits for data (error correction usually in applications
- True narrowband digital signal
- Voice and data occupy one 6.25 KHz signal (versus 12.5 KHz FM voice, P25 and MotoTRBO)
- Can operate simplex, repeater or linked to other repeater(s)

D-STAR?

- Transmit or receive voice and 1200 baud data simultaneously on 2m, 440 and 1.2 GHz (no TNC required)
- 128 Kb data transmission on 1.2 GHz with Internet connectivity (Ethernet bridge to Internet with IP address)
- D-PRS (digital APRS) automatic position reporting simultaneous with voice with GPS
- Flexible repeater linking with Gateway and Internet connection
- Reflectors act as conference bridge for linking multiple repeaters (60+ DPLUS Reflectors now in operation worldwide)

D-STAR

Operational Implementation

- Radio-to-Radio (RF)
- Radio-to-Repeater (RF)
- Repeater-to-Repeater Gateway
- RF link
- Microwave link
- Internet
- Repeater to D-STAR zone with single Gateway

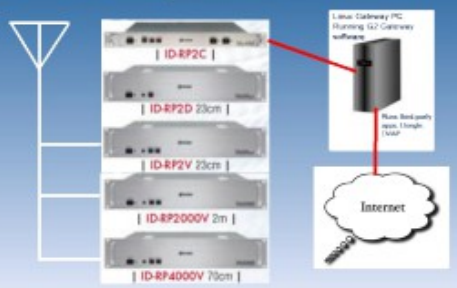
D-STAR

Unique D-STAR Features

- On initial transmission your call sign is registered and shared around the D-STAR system
- Call sign (and CQ message, if desired) incorporated in every transmission
- If the called station is not currently registered on the system, the call is routed to the last repeater on which the station was registered.
- Allows call sign squelch

D-STAR

Repeater Architecture



DRM?

- Questions

THE WORK OF THE ARRL LABORATORY

Bob Allison, WB1GCM
ARRL Laboratory Senior Test Engineer

Hello !

- Bob Allison, WB1GCM
- ARRL Test Engineer
- Coventry, CT
- Ham since 1974
- Coventry, CT
- Kathy, KA1RWY,
- (ARRL Staff Member)

Bob Allison, WB1GCM, WN1TDN in 1974

WB1GCM/KA1RWY

WB1GCM/KA1RWY


Lab Manager: Ed Hare, W1RFI
ARRL


Zack Lau
W1VT
Senior Lab
Engineer
ARRL


RFI Expert, Mike Gruber, W1MG


ARRL LAB February, 2011


The Evolution of Amateur Radio
Exhibit
ARRL


hallicrafters


ARRL

ARRL Laboratory's Mission:

Product Testing

Radio Frequency Interference

Spectrum Protection

Technical Information

ARRL Laboratory's Mission:

Product Testing

The Laboratory has an extensive suite of test equipment to perform product testing of amateur equipment. The results are used in QST "Product Review" and other ARRL Publications. Testing is also performed for advertising acceptance.

ARRL Laboratory's Mission:

Radio Frequency Interference

The ARRL has a comprehensive RFI program that helps members with RFI problems. We also work with industry standards organizations, helping to prevent RFI problems before they happen.

ARRL Laboratory's Mission:

Spectrum Protection

The Laboratory staff performs research and development to help ensure that amateurs have continued access to spectrum and protection from interference from non-amateur services.

ARRL Laboratory's Mission:

Technical Information

The ARRL Technical Information Service maintains the technical pages on our website and helps ARRL members with individual technical questions.

Product Testing

ARRL LAB'S MOST ASKED QUESTION:

WHAT RADIO SHOULD I BUY?

Sorry, I cannot tell you!

The Product Review process must be *un-biased*

You Must Decide!

(Don't worry, we'll help you!)

ARRL SCREEN ROOM

Faraday Cage, 100 dB of Isolation

W1AW: 7 Bands, 1 kW Each Band!

Product Review :

The Product Review Editor

Mark Wilson, K1RO

- Gathers ideas from ARRL members of what equipment to select for Product Review
- Locates and purchases *off the shelf*
- Schedules reviews, keeping the reviews varied
- Edits each Product Review

THE PRODUCT REVIEW PROCESS:

- Reviewer is selected
- Testing is done
- Retest anything questionable
- Assist manufacturer with any issues found
- Review is written and is edited by the editor
- Final review draft is sent to the manufacturer
- Review is published in QST
- Equipment is sold: The ARRL Auction!

What Do We Test ?

- HF Transceivers
- VHF/UHF Transceivers
- HF Amplifiers
- Antenna Tuners
- Test Equipment
- Receivers
- Accessories
- My Patience

The ARRL Does Not Test Antennas

We Don't Have an Antenna Range

The Top Receiver Tests

- Noise Floor (MDS)
- Blocking Gain Compression Dynamic Range
- Reciprocal Mixing Dynamic Range
- Two-Tone 2nd & 3rd Order IMD Dynamic Range

ARRL

Advice To Our Members:

The is NO need to purchase a high performance transceiver if you have simple wire antenna, such as a dipole or vertical.

Reason: there is not enough voltage at the antenna jack (received signals are not high enough).

ARRL

The Top Transmitter Tests

- Output Power
- Transmit Frequency
- Frequency Accuracy
- Spectral Purity
- Two-Tone Transmitted IMD
- CW Keying Waveform & Sidebands
- Phase Noise

ARRL

Advice To Our Members:

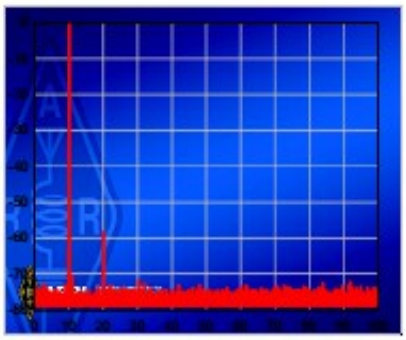
- *Invest in a good antenna system first (if possible) before buying a power amplifier!*

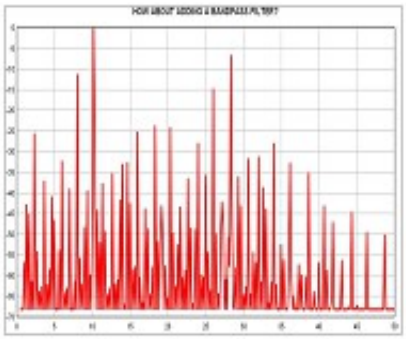
ARRL

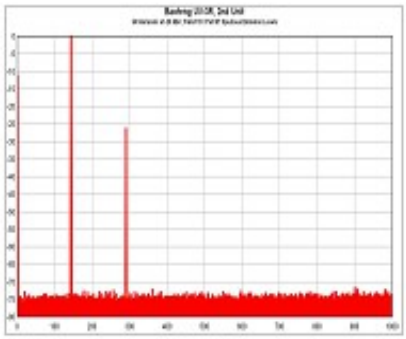
Does the Transmitter Comply With FCC Part 97 Emission Standards?

- 43 dB below fundamental below 30 MHz
- 60 dB below fundamental 30-225 MHz

ARRL







WE HELP THE MANUFACTURER!

- Many times the manufacturer is *unaware* of an issue.
- We share test methods and test results
- They correct the problem
- Everyone is happy, including our members who end up with a better product!

WHAT HAPPENS TO THE EQUIPMENT?

- Retained until the following fall (unless the Lab needs it!)
- Sold via the ARRL On-line Auction in October
- Descriptions are available on-line about two weeks before the auction opens.
- Some pay retail price for new transceivers reviewed by us!

WHAT DO ALL OF THOSE NUMBERS MEAN?

Product Testing:
Advertising Acceptance

Eight 50 Watt 800 Ohm Resistors!

RADIO FREQUENCY INTERFERENCE

RFI Identification: We Can Help!

ARRL

http://www.arrl.org/radio-frequency-interference-rfi

Sounds of RFI Web Page

Potential RFI Generators

- Arcing power line and related hardware
- Switch mode power supplies
- Non certificated LED light bulbs
- Other lighting devices (grow lights)
- Battery chargers
- Doorbell transformer

ARRL

It's Power Line Noise! or IS IT?

- Is noise present on all frequencies over a wide spectrum with no obvious pattern?
- While listening to a battery powered portable radio, does the noise go away when the main breaker is turned off?
- If yes to both, the noise source may be power line related.

ARRL

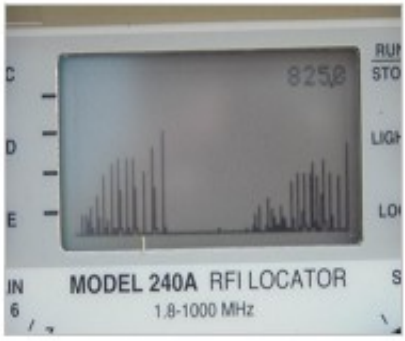
OK, IT IS Power Line Noise

- Try to determine the general direction of the noise source with a directional antenna. Use AM, if possible.
- A pole number is helpful.
- Call the power company, followed up by a written complaint, more than once, if needed.
- If power company is unresponsive, call ARRL.

ARRL

Radar Engineers, Model 240A

ARRL



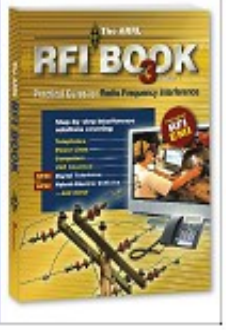
Consumer Devices: Bottom Line

- All consumer devices are prohibited from causing interference.
- Caveat: Burden falls on the device operator to fix the problem.
- It could be you, or your neighbor.

ARRL

Have RFI?

ARRL



Spectrum Protection

ARRL


A Look at QST Product Review
West Central Florida Section
Bob Allison, WB1GCM
ARRL Test Engineer

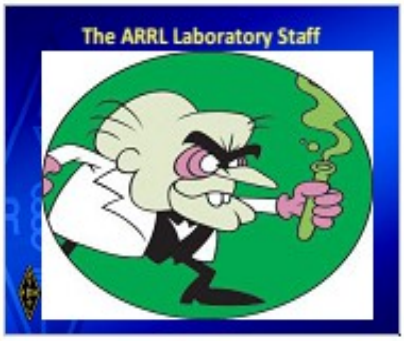

Hello !
Bob Allison, WB1GCM
ARRL Test Engineer
Coventry, CT
Ham since 1974
University of Hartford
28 years TV Engineer
At ARRL Lab April, 2008
Kathy, KA1RWY (LoTW)


WB1GCM/KA1RWY


WB1GCM/KA1RWY


ARRL Laboratory D-Star Repeaters

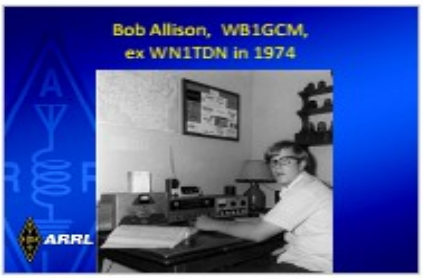

OSCAR 1


The ARRL Laboratory Staff


Lab Manager: Ed Hare, W1RFI


Zack Lau
W1VT
Senior Lab
Engineer

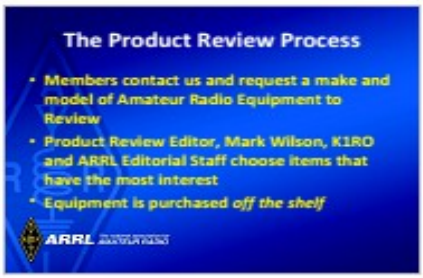

Mike Gruber,
W1MG
RFI Expert


Bob Allison, WB1GCM,
ex WN1TDN in 1974


Keiko Kaplan, KB1PFF &
Pete Turbide, W1PT


The Product Review Process……


The Product Review Process……
Starts with YOU!


The Product Review Process
Members contact us and request a make and model of Amateur Radio Equipment to Review
Product Review Editor, Mark Wilson, K1RO and ARRL Editorial Staff choose items that have the most interest
Equipment is purchased off the shelf

The Product Review Process

Testing

- Each Test follows the ARRL Procedure Manual
- Uniform and consistent testing allow us to directly compare one make and model to another
- Manufacturer is notified if there are issues

ARRL LABORATORY

The Product Review Process

When there are issues

- Manufacturer knows what's wrong, long before the review goes to the printer
- We report what was wrong, what modifications were made and how they will modify any units sold
- Manufacturer ends up with a better product!

ARRL LABORATORY

What We Test

- HF Transceivers
- VHF/UHF Transceivers
- HF Amplifiers
- Antenna Tuners
- Test Equipment
- Receivers
- Accessories

ARRL LABORATORY

We Don't Test Antennas

(but we do review them)

ARRL LABORATORY

WHAT RADIO IS **BEST** ???????????

??????

ARRL LABORATORY

You Decide!

- (Don't worry, we'll help you!)

ARRL LABORATORY

QST Product Reviews Help Radio Amateurs to Decide What to Buy Based On Their Requirements

- The Casual Operator
- The Contest & DX Operator
- The Mobile Operator
- The "Only Want the Best" Operator
- The "Tight Budget" Operator

ARRL LABORATORY

What Features Are Important ?

"Only Want the Best" Operator"

- Has the money!

"Tight Budget Operator"

- Needs to purchase older, used equipment
- Reads past QST Product Reviews
- (Available on the ARRL Website, to 1980)

ARRL LABORATORY

What Features Are Important ?

- Casual Operator
  Ergonomics. display, interference and noise rejection
- Contester or DXer
  Best possible performance, computer control, flexibility, dual receivers , roofing filters
- Mobile
  Small space, detachable control panel, noise rejection

ARRL LABORATORY

The Top Receiver Tests:

- Noise Floor (MDS)
- Blocking Gain Compression *Dynamic Range*
- Reciprocal Mixing *Dynamic Range*
- Two-Tone 2nd & 3rd Order IMD *Dynamic Range*

ARRL LABORATORY

Minimum Discernible Signal

- Known as Noise Floor
- CW, 500 Hz bandwidth
- An audio signal 3 dB above the background noise level
- Typically -120 to -140 dBm

ARRL LABORATORY

Minimum Discernible Signal

- Very Sensitive: Less than -140 dBm
- Good Sensitivity: -130 dBm
- Fair Sensitivity: -120 dBm
- -110 dBm.....could be better!

BUT.....

ARRL LABORATORY

Hook up an Antenna....

Minimum Discernible Signal

- With Antenna Connected:
- Receiver hears: Atmospheric Noise, Solar Noise and Man-Made Noise.
- Noise Floor is Raised
- Receiver with -120 dBm Sensitivity hears about as well as the receiver with the -140 dBm Sensitivity!

Blocking Dynamic Range

- A weak signal which is reduced by the presence of a nearby strong signal
- 1 dB reduction of audio level at 20, 5 and 2 KHz
- Noise Floor – adjacent signal = BDR
- (-140dBm – (-15dBm) = -125 dB (at 20KHz)
- We report this dynamic range as 125 dB

Blocking Dynamic Range

- A Top Receiver:
- 120 to 140 dB
- Some software defined receivers exhibit little or no blocking effects from strong adjacent signals up to the point of overload

Two-Tone Third-Order IMD Dynamic Range

- IMD: Inter-modulation Distortion
- Two strong, evenly spaced, adjacent signals mixing together which creates a *"phantom"* signals on the desired frequency
- Created in amplifier or mixing stages of a receiver
- 20 & 40 kHz, 5 & 10 kHz and 2 & 4 kHz away

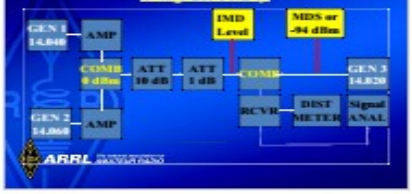
Two-Tone Third-Order IMD Dynamic Range

- Example:
- Receiver tuned to 14.020 MHz
- A strong signal at 14.040 and 14.060 MHz
- A 2nd harmonic of the 14.040 signal (28.080 MHz) is generated in the first IF mixer and beats with the 14.060 MHz signal at the mixer output.
- 28.080-14.060 = 14.020 MHz (desired frequency)
- A second order signal mixes with a first order signal, causing a third order signal

Two-Tone Third-Order IMD Dynamic Range

- Measurement: We use 3 signal generators
- The IMD and desired signals are observed using a signal analyzer. The IMD level is adjusted to equal the desired signal
- MDS – IMD level = IMD Dynamic Range
  Ex: -135 dBm – (-33 dBm) = 102 Db

Two-Tone Third-Order IMD Dynamic Range Hook-up



Two-Tone Third-Order IMD Dynamic Range

Top Receivers:

- 100 to 110 dB with 20 kHz spacing
- 100 dB with 2 kHz spacing

Reciprocal Mixing Dynamic Range

- A strong adjacent signal causes an increase of background noise
- 3 dB increase of noise with a strong signal 20, 5 and 2 kHz away from the desired frequency
- MDS + (adjacent signal level) = RM.
- Ex. -130 dBm + (-10 dBm) = -120 dBm
- We report this dynamic range as 120 dB

Reciprocal Mixing Dynamic Range

- Caused by the first LO sideband phase noise mixing with a strong adjacent incoming signal.
- Gets worse the closer the adjacent signal is
- Depends on receiver architecture
- Some software defined receivers exhibit no reciprocal mixing up the point of overload

Reciprocal Mixing Dynamic Range

- A Top Receiver:
- 120 dB at 20 kHz spacing
- 100 dB at 2 kHz spacing
- NOTE: Reciprocal mixing can be the most limiting dynamic range of the three dynamic ranges we measure.

ARRL LABORATORY

DO I NEED TOP PERFORMANCE?

- Only if you have a high performance antenna system (need all three dynamic ranges to be high), or
- If you have another transmitter near your location operating on the same Amateur band (Reciprocal Mixing and/or Blocking Gain Compression DR)

ARRL LABORATORY

"I ONLY HAVE A G5RV ANTENNA"

- There is no need for high performance since not enough signal voltage reaches the antenna jack. An entry level transceiver will perform just fine
- Exceptions: Close "Big Gun", or, Field Day setups operating different modes on the same band

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"ALL I HEAR IS NOISE AND SLOP!"

- Turn off the preamp
- Turn on the attenuator and adjust until the unwanted effect is reduced or eliminated

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Transmitter Testing

ARRL LABORATORY

A Good Antenna Helps !

- Perfect your antenna system before buying an RF amplifier

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Receiver Performance Has Improved; How About Transmitter Performance?

Not as much as we would like !

- Transmit IMD can be poor, causing splatter
- Keying Sidebands can be wide, taking up more spectrum
- High Phase Noise adds to background noise, masking weak signals

ARRL LABORATORY

The Top Transmitter Tests

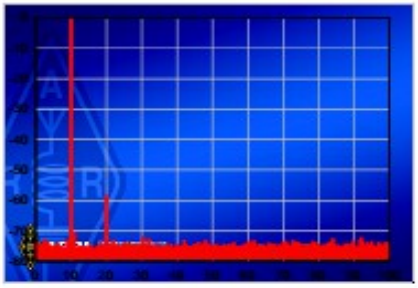
- Output Power
- Spectral Purity
- Transmit Two-tone IMD
- Keying Sidebands
- CW Keying Waveform
- Phase Noise

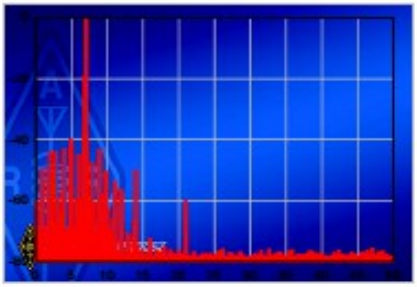
ARRL LABORATORY

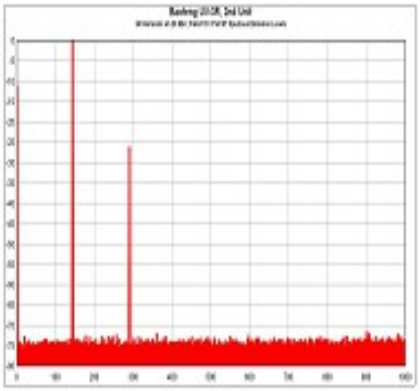
Spectral Purity

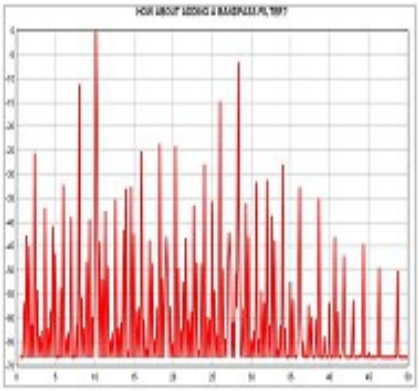
- The FCC requires minimum bandwidth necessary for information rate and emission type.
- Must not cause splatter or key clicks
- Spurious Emissions: After Jan 1, 2003
  - 43 dB below fundamental below 30 MHz
  - 60 dB below fundamental 30-225 MHz

ARRL LABORATORY









LEVEL OF HARMONIC RADIATION

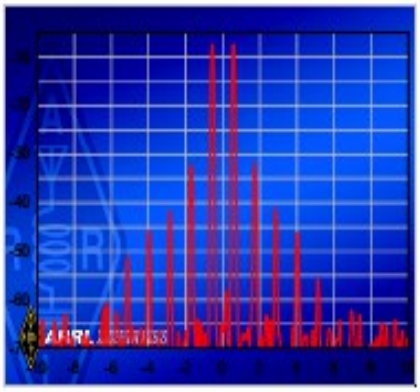
- 1500 Watt transmitter has -50 dBc harmonic.
- -10 dBc = 150 Watts
- -20 dBc = 15 Watts
- -30 dBc = 1.5 Watts
- -40 dBc = 150 mW
- -50 dBc = 15 mW
- You will be heard when the band is open!

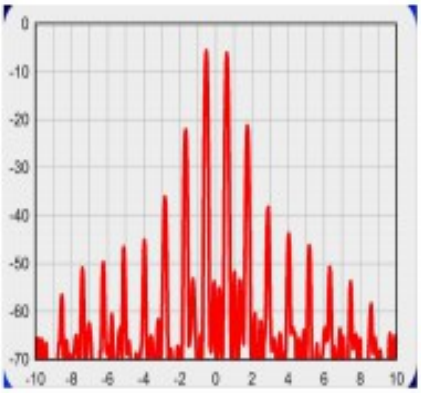
ARRL

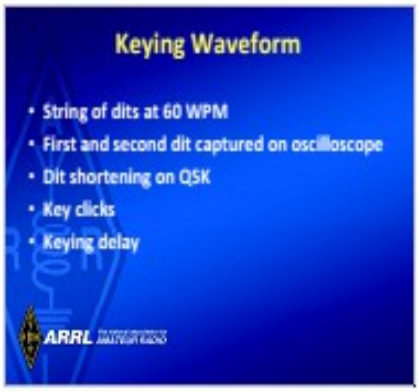
Two-Tone IMD

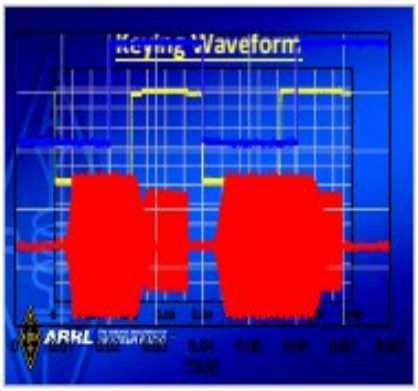
- Measures transmitted spurious output close to the desired transmitted audio
- Measured in SSB mode.
- Created by the audio stages or any amplification stage
- Made worse by the operator exceeding the ALC limit (too much mic & processor gain)

ARRL






Keying Waveform
• String of dits at 60 WPM
• First and second dit captured on oscilloscope
• Dit shortening on QSK
• Key clicks
• Keying delay
ARRL


Keying Waveform
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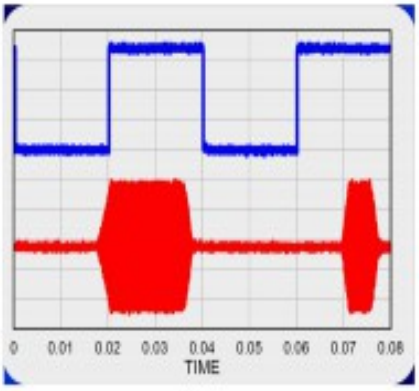
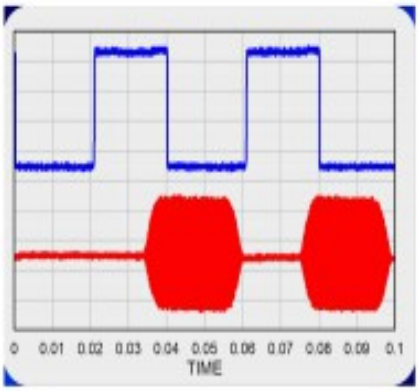

0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08
TIME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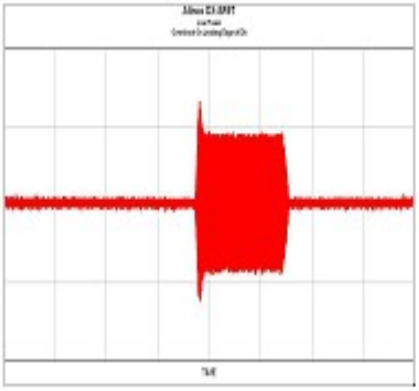
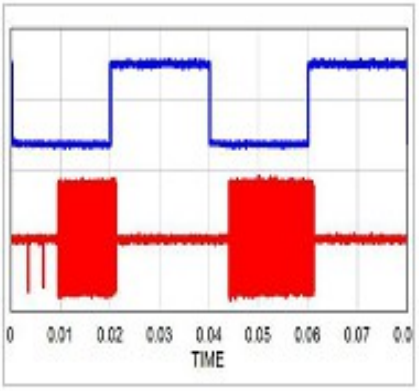
TIME




0 0.01 0.02 0.03 0.04 0.05 0.06 0.07
TIME

Keying Sidebands

- CW Dits at 60 WPM
- Spectrum Analyzer Bandwidth at 10 Hz
- Sweep Time at 30 Seconds
- Greater the CW Speed, the Greater the Bandwidth

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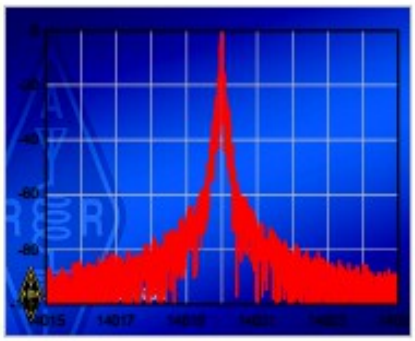

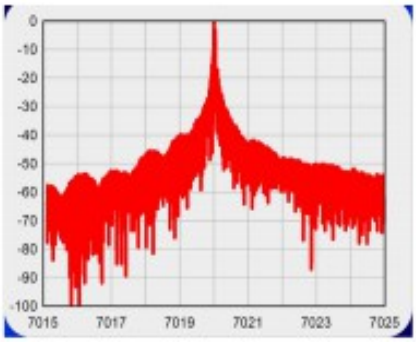

Phase Noise

- All oscillators exhibit phase noise adjacent to their carrier frequency
- Resulting noise is higher as the oscillator's carrier frequency is approached
- The effects from transmitted phase noise is a raised noise floor; weaker signals are masked
- The effect is cumulative on an Amateur band

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Rohde & Schwarz FSUP 26 Phase Noise and Signal Analyzer

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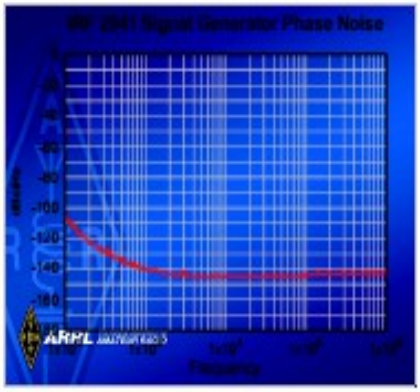
HP 3041 Signal Generator Phase Noise
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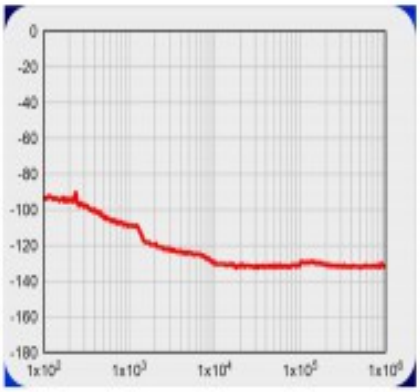
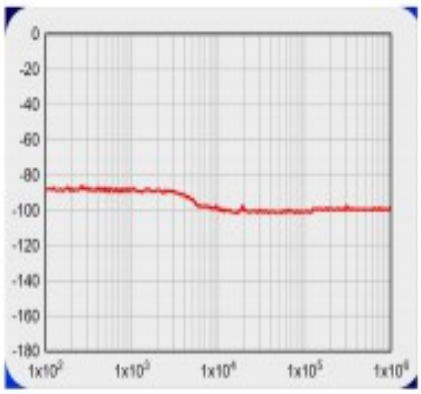

0
-20
-40
-60
-80
-100
-120
-140
-160
-180
1x10^2
1x10^3
1x10^4
1x10^5
1x10^6


0
-20
-40
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1x10^2
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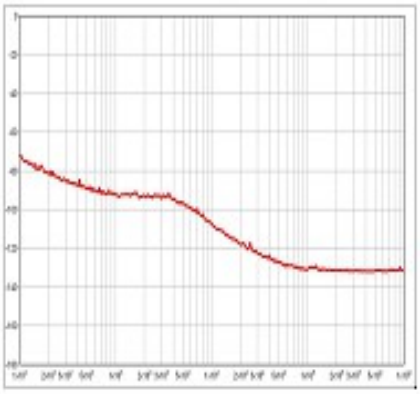
1x10^6




I'm Done Testing!
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Now What?

- The equipment goes to the reviewer
- Familiarity
- "Put it through its paces"
- Wide range of operating conditions
- Ergonomics

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Editing Process

- Typo & gramar coreckion
- Completeness
- Technical consistency
- Final editing
- Graphics, tables and text put together
- Publication

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WHAT HAPPENS TO THE EQUIPMENT?

- Retained until the following fall
- ARRL Auction in October
- Information and descriptions are available on line on-line about two weeks before the auction opens.
- Many pay retail price for new transceivers reviewed by us!

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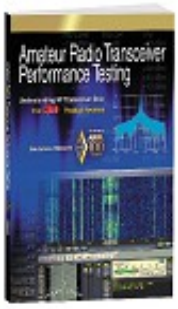
WHAT DO ALL OF THOSE NUMBERS MEAN?



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QUESTIONS?

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THANK-YOU & 73 de WB1GCM

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