Colorado Radio Collectors Antique Radio Club

The FLASH!

Colorado Radio Collectors Antique Radio Club

Volume 17, Issue 2 | ***January Meeting in Littleton - See Back Page*** | **March, April 2006**

Tuned Circuit Primer

by

David Boyle, CRC Member

Over the past several years we have discussed resistors, capacitors (condensers), and inductors. It is now time to put a few of these components together and find out what goes on. This article is intended for those CRC club members who are not schooled in radio/electronics theory but have a curiosity and desire to understand some radio operation fundamentals. There are some concepts and definitions that are the basis of tuned circuits and include the terms reactance, impedance, phase and resonance. But first, a little on the basics of ohms law:

Ohms' law - A ohm is a unit to measure opposition to the flow of current in a circuit and is expressed as the resistance. Hence, a ohm is a unit of resistance. The relationship of current in amperes (**I**), voltage in volts (**E**), and resistance in ohms (**R**) correspondingly in:

E=IR (or) **I=E/R** (or) **R=E/I**:

Power (watts) is a derivative of ohm's law and is a product of the current and voltage: **P=El**

Reactance - Both coils and condensers offer opposition to the flow of current. This is measured in ohms and is called the "reactance" of the coil or condenser. "Inductive" reactance is the term applied to the opposition of current through a coil (inductor) and is expressed as $\mathbf{X_L}$ and is given by the equation $\mathbf{X_L=2\pi fh}$ whereby π(pi)= 3.1416, as in the ratio of the diameter to circumference of a circle. **f** is the frequency in hertz (cycles per second) and **h** is the inductance in henrys. As can be seen by the equation as the frequency increases the inductive reactance increases.

The reactance of a condenser is given the equation $\mathbf{X_C=1/2\pi fc}$ whereby **c** equals capacitance in farads. This is just opposite of inductive reactance; capacitive reactance varies inversely with the frequency (decreases as the frequency increases).

Impedance - The total opposition to the flow of current in alternating current (AC) circuits, due to resistance and inductive and capacitive reactance, is called the impedance of that circuit, It is designated by the letter **Z**. The total impedance of a circuit cannot be calculated by adding the resistance and reactances for these do not act in the same directions. This is where it gets slightly complicated but simple algebra and simple vector analysis provide for some clear explanation:

In a circuit containing both $\mathbf{X_L}$ and $\mathbf{X_C}$, the effective reactance is found by subtracting the smaller quantity from the larger. The following equations give the impedance in any circuit containing **R**, $\mathbf{X_L}$ and $\mathbf{X_C}$:

Using a simple vector diagram resistance and

Only R and X_L; $Z = \sqrt{R^2 + X_L^2}$

Only R and Xc; $Z = \sqrt{R^2 + Xc^2}$

R, X_L, and Xc; $Z = \sqrt{R^2 + (X_L - Xc)^2}$

both XL and Xc are shown in the figure 1 below.

Mathematically $\mathbf{X_L}$ and $\mathbf{X_C}$ are combined by

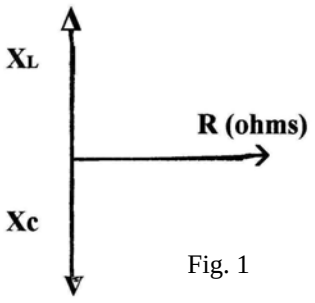

Fig. 1

subtraction and both are 90 degrees from R (more on that later when discussing "phase").

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COLORADO RADIO COLLECTORS ANTIQUE RADIO CLUB

Founded October 1988

Volume 17, Issue 2 **March/April 2006**

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MESSAGE FROM THE PRESIDENT

Hello to all CRC members.

It appears that the April Show is not going to happen this year. We do need to keep pursuing other concepts or possibilities so we don't let go of this.

If you are reading this then you paid your membership dues. If you know of anyone who did not get their Flash, then at least according to my records they didn't renew.

We decided to continue with the Flash as is, so we still need articles.

Well, it is close enough to spring to talk about spring cleaning, so bring all that stuff you don't want or need to the raffle, and someone else can take it home! Possibly this is a non productive activity in the big scheme of things, but it is a lot of fun! I am amazed at how many times the "basket case" ends up being someone's "prized" possession.

See you March 12th at the Bemis Library in Littleton.

Dennis

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CRC MEMBERSHIP

Annual membership in the CRC runs from **June to June**. Annual dues entitles members to a full year (6 issues) of the club publication "The Flash!", participation in club events such as the annual April Show, mid-summer picnic, October auction as well as our semi-monthly meetings and swap meets. Dues also entitle you to club officer elections and excellent discount prices on current hobby publications

Current annual dues are $12. New memberships will be prorated to the following June, i.e new members joining in May should submit $12, in December $5, etc.

CRC MEETINGS

Meetings are held on the 2nd Sunday of every other month starting in January (except 3rd Sunday of May) at 1:00pm. The meetings consist of business, "show & tell", raffles, swap meets, technical discussions and other subjects of interest.

Figure 2. graphically shows these relationships a little more in depth.

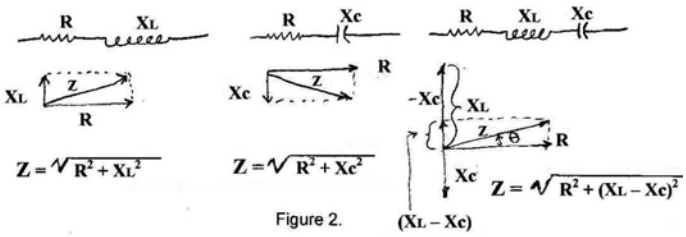


Figure 2.

These equations will be the foundation for discussion of most radio circuits especially for understanding basic tuned" circuits.

Phase - The angular relationship between voltage and current. In a pure inductive circuit the current lags the voltage by 90 degrees. In a pure capacitive circuit the voltage lags the current by 90 degrees. Put some resistance into either of the above circuits and the phase angle will be somewhere between 0 degrees and 90 degrees. The phase angle is calculated by the vector diagram as shown in figure 2. by computing the numerical value of the ratio of R to Z and becomes the cosine (always 1,000 or less). By using trigonometric tables the phase angle can then be found

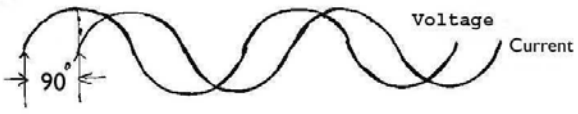


Figure 3. Phase angle in a "pure" inductance circuit

Understanding "phase" is not a concept necessary to fully understand tuned circuits but a benefit is to understand power or wattage in a AC circuit. Referring back to ohm's law - in a DC circuit power is calculated by **P=El**. In a AC circuit **P=EIcos θ**, where **θ** is the cosine of the phase angle. As one can derive from the math, available power is diminished as a function of the phase angle. For any combination of voltage and current, the least amount of phase difference produces the most power (efficiency). Many of us have heard the expression "power factor". Well, power factor and phase angle are essentially synonymous (cosineX100=P.F. in %).

Resonance - Resonant circuits are the basis of all transmitters, receivers and antenna operation. Simply stated: It is when the inductive reactance ($\mathbf{X_L}$) and capacitive reactance ($\mathbf{X_C}$) are in balance or equal each other.

This is now where it all comes together. Resonant circuits can be either series or parallel as shown in figure 4.

Figure 4.

Since resonance is a condition where $\mathbf{X_L = X_C}$, the formula is:

$$2\pi fL = 1/(2\pi fc) \qquad \text{Therefore} \qquad f = 0.159/\sqrt{LC}$$

Tuned circuit - An AC circuit consisting of inductance and capacitance which is constructed or can be adjusted for resonance at the desired frequency.

Radios, typically of the era that we collect, contain a number of tuned circuits, some are fixed and some are adjustable. Figure- 5. portrays a greatly simplified block diagram of a "All American Five" superheterodyne radio (1937 to 1960).

Tuned circuits are as designated:

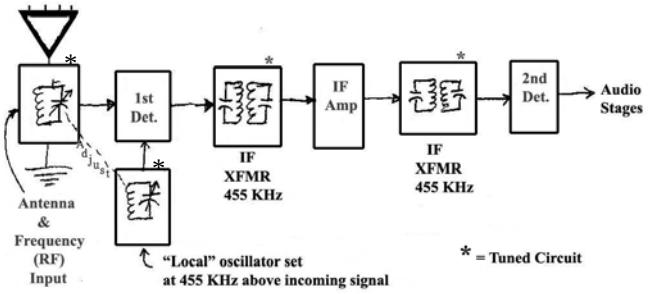
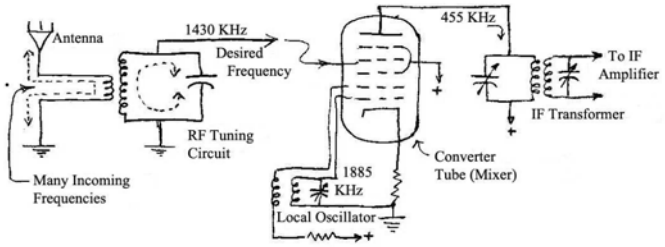


Figure 5.

What does this all mean to us radio collectors and part time amateur repair technicians? Referring to figure 5 and elaborating on several of the designated tuned circuits. Here's what's happening:

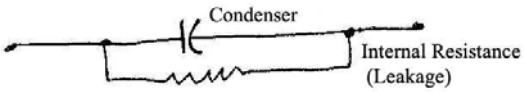


Converter tube combines incoming signal (1430kHz) with local oscillator set at 455kHz higher (1885 kHz) to produce a output of 455kHz called the intermediate frequency or IF.

Up to now we have been addressing "pure" inductive and capacitive reactance. In reality all inductances have an internal resistance due to the

electrical resistance of the coil winding wire. Schematically the equivalent circuit behaves like this:

The same is for capacitors but to a significantly lesser extent.



This internal resistance reduces the current available in the circuit, hence, reduces the "sensitivity" of the circuit. The second affect is a loss of "selectivity", which causes a station to spread over more space on the dial. For these reasons care should be used to keep resistance out of tuned circuits. Some of the more common causes of resistance in old radios are:

1. Poor or old solder joints
2. Poor or corroded connections to each side of the tuning condenser (capacitor)
3. Degraded insulation on coils and/or oxidized connections of the fine coil wire to the terminal lugs or parts.
4. Leaky capacitors

On superheterodyne radios there are several adjustments that can be made to possibly enhance reception and sensitivity without using a signal generator and output meter. These include "peaking" the intermediate frequency (IF) transformers and optimizing the compensation (sometimes referred to as padder or trimmer) condensers located on (or near) the tuning condenser. Let's go through some typical adjustments. Locate the IF transformers, usually a 1½ inch square or round aluminum can approximately 4 inches high that has 2 recessed adjustment screws located under holes on top. First tune in a clear but not too powerful station. Then using a small screwdriver "tweak" the screws on top of the first IF transformer for best sounding reception then go on to the second IF transformer and repeat this tweaking. Sometimes there is interaction between transformers, so go back and carefully repeat these adjustments. Some IF transformers use a combination of a nut and screw adjustment. Radios using miniature tubes use smaller IF transformers approximately 1 inch square and several inches high. These IF cans have one screwdriver or small adjustment on top and the second is underneath.

It's a little trickier to adjust the padder or trimmer condensers located on the tuning condenser. Tune the radio to a station at the upper end of the dial, try 1430 KEZW, there are adjustments on a 2 gang tuning condenser for the oscillator and antenna input circuit. On a 3 gang tuning condenser the third section is for the radio frequency (RF) circuit. Here again, carefully tweak for best reception. Sometimes compensation condensers are located remotely throughout the radio. Some radios will require referring to Riders or other schematics and instructions. Remember, DO NOT adjust these condensers too many turns from the original settings. Something else may be the problem and is beyond adjustment by ear.

Concurrent with release of this Flash issue I will provide a presentation on the above information at the next CRC meeting. Stay "tuned"

We would like to thank David Boyle for this article, and his past series of technical articles that he has provided the Flash. While this article contains several mathematical expressions, they are for demonstration and informational purposes only. It is not necessary to be able to use them to align a radio receiver. For those who never received, or lost the original technical articles on Capacitors and Inductors, they have been uploaded to our club web-site at http://www.radioace.com/.

-Flash publisher-.

Denver Post, Aug. 1928, Courtesy of Ray Kilkoyne

The Orkney Wireless Museum

by

Mark McKeown, CRC Member

Recently my wife Julie and I visited the Orkney Islands north of Scotland and had a chance to visit the Orkney Wireless Museum. The museum is well organized and has an excellent collection of civilian, commercial and WW II radios and memorabilia.

The museum operates an amateur radio station, periodically providing contacts and QSL cards for the worthy. They have a good website well worth a look at http://www.owm.org.uk/.

The museum is located in a small, substantial, building that is brim full of interesting radios and memorabilia

Display of WW II Allied military communications equipment. Note the BC-348.

The museum is small, but no space is wasted with every wall and available space on the floor used for displays

Spy radio designed for easy transport and use. Orkney and Shetland Islands to the north were jumping off points for the Norwegian underground

Vintage magazines are well displayed

WWII German submarine radio. The Orkney Islands had convoys between the USA and Europe and the German subs hunted them

(Continued on Page 9)

Jan/06 CRC Meeting

Bill Dial waxes nostalgic over the Knight "Space Spanner" radio kit that he constructed when he was just a kid.

Barney Wooters adjusts his Atwater Kent model 9.

Tom Puloit describes his RCA 128 cathedral, and a (believe it or not) home made replica of an early Audion tube. The glass envelope came from a "modern" Hytron tube.

Show N' Tell

Larry Snyder (left) show us his Crosley 1946 56TRL radio/phono combination that he restored. The radio was acquired at last year's CRC auction.

Dave Boyle (below) display his restorations of a Hotel Radio Corp. bedside radio, and a very fine Radiola 1924 AR-812 "catacomb" early superheterodyne.

Larry Weide (left) talks about his recent find of two classic RCA microphones, both designed in the early '30s. Left is a model 44 and the other is a model 77.

Collector Books for Sale

Special CRC prices. Order at club meetings. Mail order shipments: add $2.00 postage for each book ordered. Info/order: Charles Brett, 5980 Old Ranch Road, Colorado Springs 80908, (719) 495-8660, brett3729@aol.com. ***void all other listings***

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RADIOS, (GENUINE PLASTIC) OF THE MID CENTURY Jupp & Pina, hard bound, 219 pgs, 1998 PG, 450+ color pics	$39.95	$28.00
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GUIDE TO OLD RADIOS, POINTERS... - 2nd EDITION Johnson, 277 pgs, 1995-96 prices	$19.95	$15.00
ANTIQUE RADIO RESTORATION GUIDE - 2rd EDITION Johnson, 144 pgs, repairing, refinishing, cleaning	$14.95	$12.00
RADIO, EVOLUTION OF THE - VOLUME ONE 227 pgs, 118 in color, More than 800 radios pictured, 1992	$22.95	$18.00
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TRANSISTOR RADIOS, COLLECTOR'S GUIDE VOL II Bunis, 1996 prices, Full Color	$16.95	$13.00
ZENITH TRANSISTOR RADIOS, 1955-1965 Smith, 1998 PG, 160 pgs, 226 color pics, info, descr.	$29.95	$22.00
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ANTIQUE RADIOS 6TH EDITION John Slusser, 320 Pgs, 2004	$24.95	$19.50
OLD TIME RADIOS Joseph Carr, 256 Pgs, 1991	$19.95	$15.00

The Open Trunk

Member submitted advertisements

Submission of Sell/Want ads are always free to CRC members. Non-members may advertise in the Flash for $0.20 a word. Display advertising is available by contacting the CRC publisher for info and rates.

WANTED: Morse keys/bugs/paddles, Allied Radio/ Knight Kits, "heavy metal" communications gear (Hallicrafters, Hammarlund, etc). Also Icom R71-A accessories: EX257 FM PCB and FL-44A SSB filter.
Robert Baumann, (303) 988-2089
rgbdenver@worldnet.att.net **02/06**

WANTED: Good cabinet for Westinghouse "columnaire" deco grandfather clock radio. Working or restorable Zenith port hole television.
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WANTED: Interstage audio transformer for a Radiola 60. Looks like a small loaf of bread. Part number GW-42.
Mark McKeown, (303) 278-3908
mmckeown@direcway.com **02/06**

WANTED: A Triplett Model 1200-A VOM. If anyone has one they can part with, please contact;
Steve Touzalin, (303) 988-5394
stevet@champmail.com **12/05**

WANTED: Heathkit electronics of any type; the older the better. Also, Heathkit catalogs and flyers. Please contact **Bob Schineller, KA0RRX.**
schineller@comcast.net **12/05**

FOR SALE: Battery and early AC sets, transistor radios, test equipment and parts, and lots of tubes, including some fairly old ones. For more info;
Dick Craft, (970) 240-1387
montrosecraft@yahoo.com **02/06**

WANTED: Escutcheon for Stewart Warner model 900 series. This is a metal box type radio made in 1929.
Jerry Tynan, (303) 642-0553
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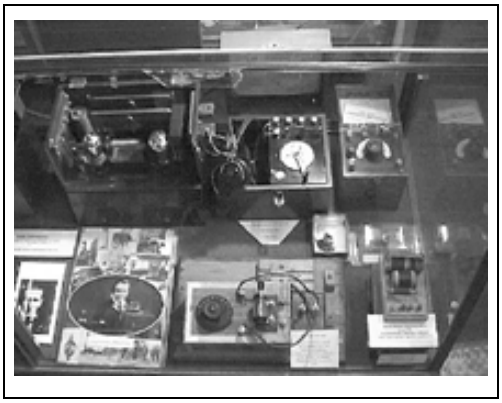
Fred Bantin, (303) 427-5431
bantin@sprynet.com **3/06**

Orkney Wireless Museum
Continued from page 5

Horn speakers and pre-war civilian radios

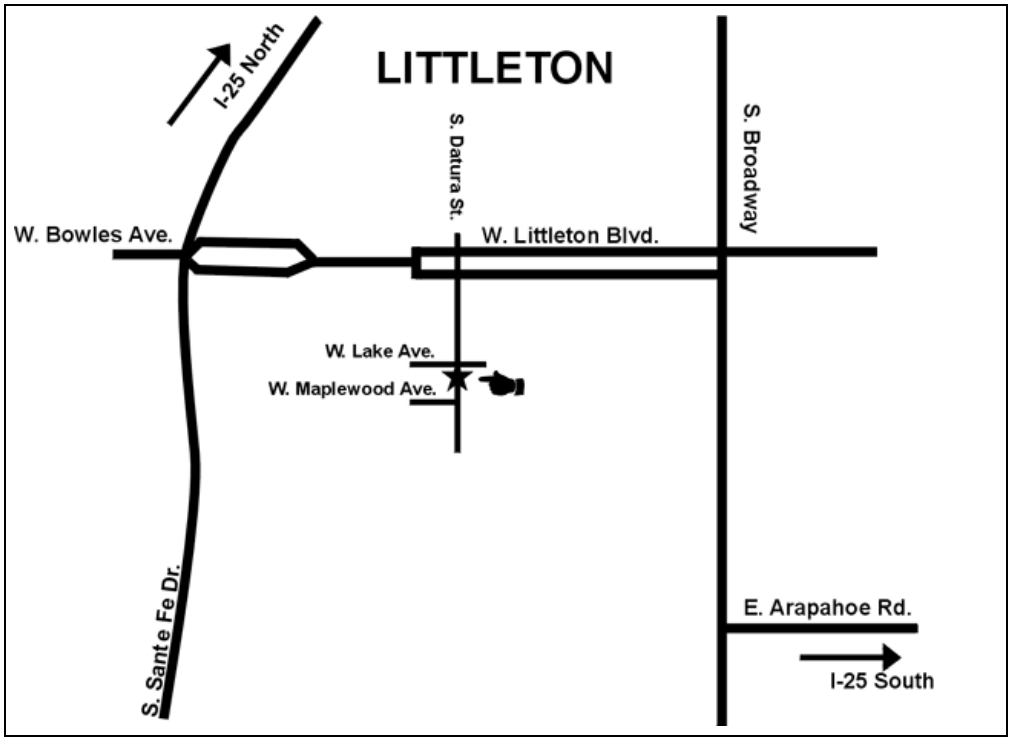


Crystal sets and early tube radios

Valves (tubes) from balloons to miniatures are nicely displayed. Some look familiar and some do not

For our March 12th, 1:00pm meeting ....

We will be meeting at the Bemis Public Library, Littleton



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