



# Halifax Amateur Radio Club

Basic Amateur Radio Licensing Course -  
2013

Saturday, November 3, 2012

*Establishing & Equipping  
an Amateur Station*



# Objectives

- **Students should be familiar with:**
  - **equipment necessary for various modes of operation**
  - **the basic operation of each piece of equipment**
  - **\*\* the necessary accessories in a station and their relative position in the transmission path\*\*.**



# Lesson Plan

- **VHF/UHF Station**
  - How to obtain equipment
  - Locating your station in the home
  - hand-held
  - mobile
  - all-mode
- **HF Station**
  - Phone (voice or SSB)
  - CW ?
  - Digital Station
- **Fun Stuff**
  - *Practical tips on setting up your first station*



# Obtaining Equipment

- **Dealers (new & used)**
  - No local dealers of amateur radio equipment
  - Nearest dealers
    - **Elkel** (Trois Rivieres Quebec)
    - **Radioworld** (Toronto ON)
    - **Durham** (Whitby ON)
    - **HRO** (New Hampshire) – possible warranty issues
  - **After-sales service is critical!!!**
- **Other Amateurs (used)**
  - **Flea Markets**
  - **Swap Shops**
  - **Try it out - make sure it works - get their call sign**



# Locating your Station VHF &/or HF

- **Separate room (ideally):**
  - ground floor or basement best
  - dedicated 120 VAC/15A
  - access for antenna transmission lines
  - proper grounding (see Ch. 16 - Safety)
  - computer with internet connection
  - telephone



# VHF/UHF Base Station

- **Transceiver Options**
  - **Handheld (FM) - with or without amplification**
  - **Mobile (FM)**
  - **All-mode Transceiver - base station (CW/FM/SSB)**
- **Power Supply - 13.8 VDC or Car Battery**
- **Antenna Options**
  - **Rubber ducky**
  - **Internal or External Vertical (1/4 5/8 full wave)**
  - **External Beam (directional antenna)**





# Handheld (handy talkie -HT)

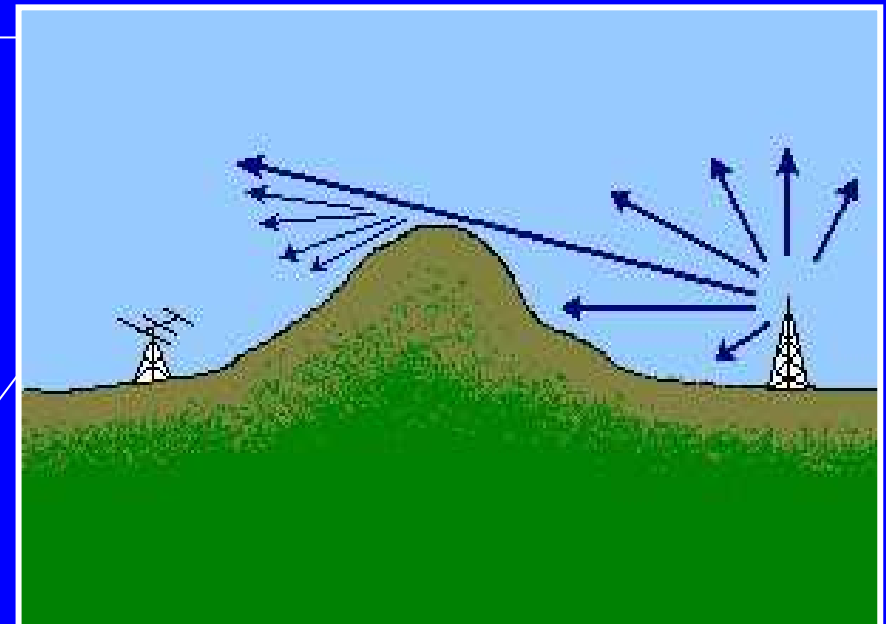
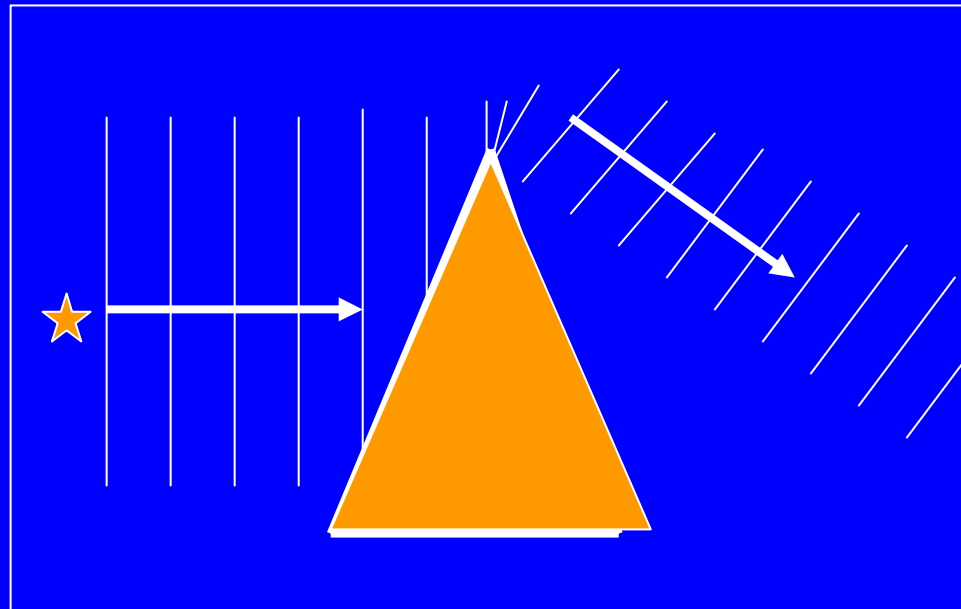
- **Ideal first radio**
  - VHF (2m) or UHF (70cm)
  - Dual-band (VHF / UHF)
  - Tri-band (VHF / UHF / 6m)
  - Flexibility (base station; mobile & portable)
  - Small & Simple
  - Low power (0.5 / 2.0 / 5.0 Watts)
  - RF amplifier (option for base station use)
- **Accessories**
  - Extra battery with charger and/or “gel cell” (sealed lead-acid)
  - Dry-cell battery case
  - Speaker microphone
  - Boom Microphone/Earphone set
  - External antenna





# Diffraction of Radio Waves

- **VHF/UHF is essentially “line of sight”**
- **Diffraction** - or bending of radio waves around a solid object; sharp edges are most effective at diffracting radio waves.







# Simplex or Repeater Operation

- **VHF/UHF** is “line of sight”
- **Simplex** - direct station to station on same frequency – not always possible, so:
- **Repeaters**
  - **Extend the coverage range** - “footprint”
  - **Most locations in Canada have 2m & 70cm repeater coverage**
  - **Input / Output / Offset** (+ or - 600 kHz)\*
  - **Auto patch** (links mobile to telephone)

*\*147MHz & above + offset / Below 147MHz -offset*



# HF Base Station

- **Operating restrictions** - Basic Honours or...?
- **What to buy** (used/new; tube type / hybrid / solid state)
- **How much to invest?**



Less than \$2k



More than \$12k



# HF Base Station

- **Station Power** - expressed as direct-current input power to the anode or collector circuit of the transmitter stage that supplies radio frequency energy to the antenna
  - **QRP - less than 10Watts**
  - **Low Power - up to 100 Watts**
  - **High Power - Linear Amplifier with more than 100 Watts**
    - up to 250 Watts (legal limit with Basic Honours or CW)
    - Up to 1000 Watts (legal limit with Advanced license)



# HF Accessories

- **Essential**
  - Low-pass Filter
  - SWR Bridge
  - Antenna (wire dipole or vertical)
  - Antenna Switch
  - Antenna Tuner \*
  - Dummy Load

\* if not part of transceiver

- **Non-essential**
- **Phone Patch**
  - Tower & Beam
  - Amplifier





## Low-pass (TVI) Filter

- reduces interference with other electronic equipment (TV / telephone etc.)
- eliminates spurious (unintended & unwanted) HF emissions above 36 MHz
- eliminates HF harmonics - whole number multiple of primary frequency
- offers low loss on HF frequencies below 30 MHz





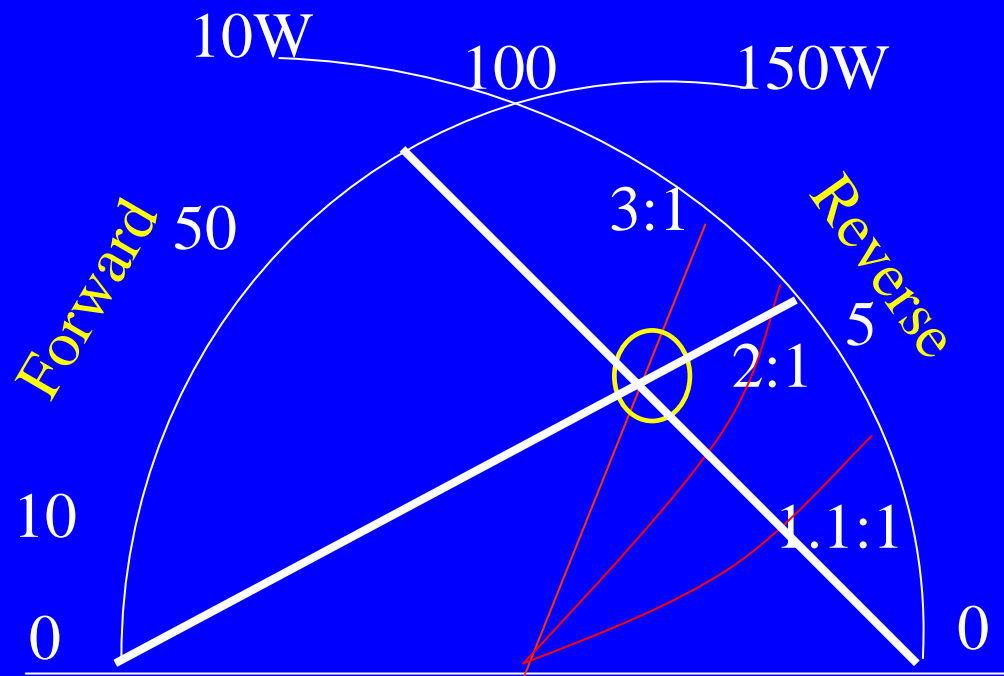
# SWR Bridge

- **Standing Wave Ratio Meter**
  - usually built into rig
  - indicates the state of match between transmitter (operating frequency) and antenna (resonance)
  - critical for modern radios with solid-state finals (most will automatically reduce output power if an antenna mismatch is identified)





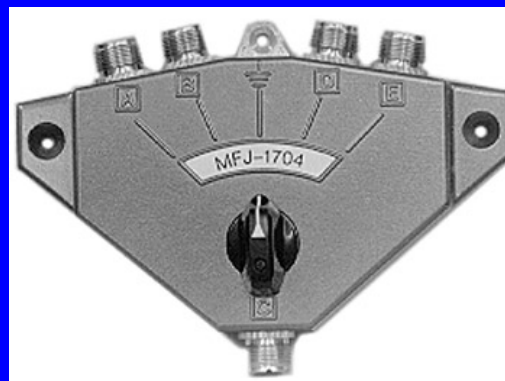
# SWR Meter





# Antenna Switch

- **Coaxial Switch**
  - allows multiple antennas to be accessible to the transceiver
    - dipole
    - vertical
    - beam
    - dummy load
  - **Remote multiple antenna switch**
    - Allows multiple antennas to be switched remotely and fed to the shack through one coax cable.







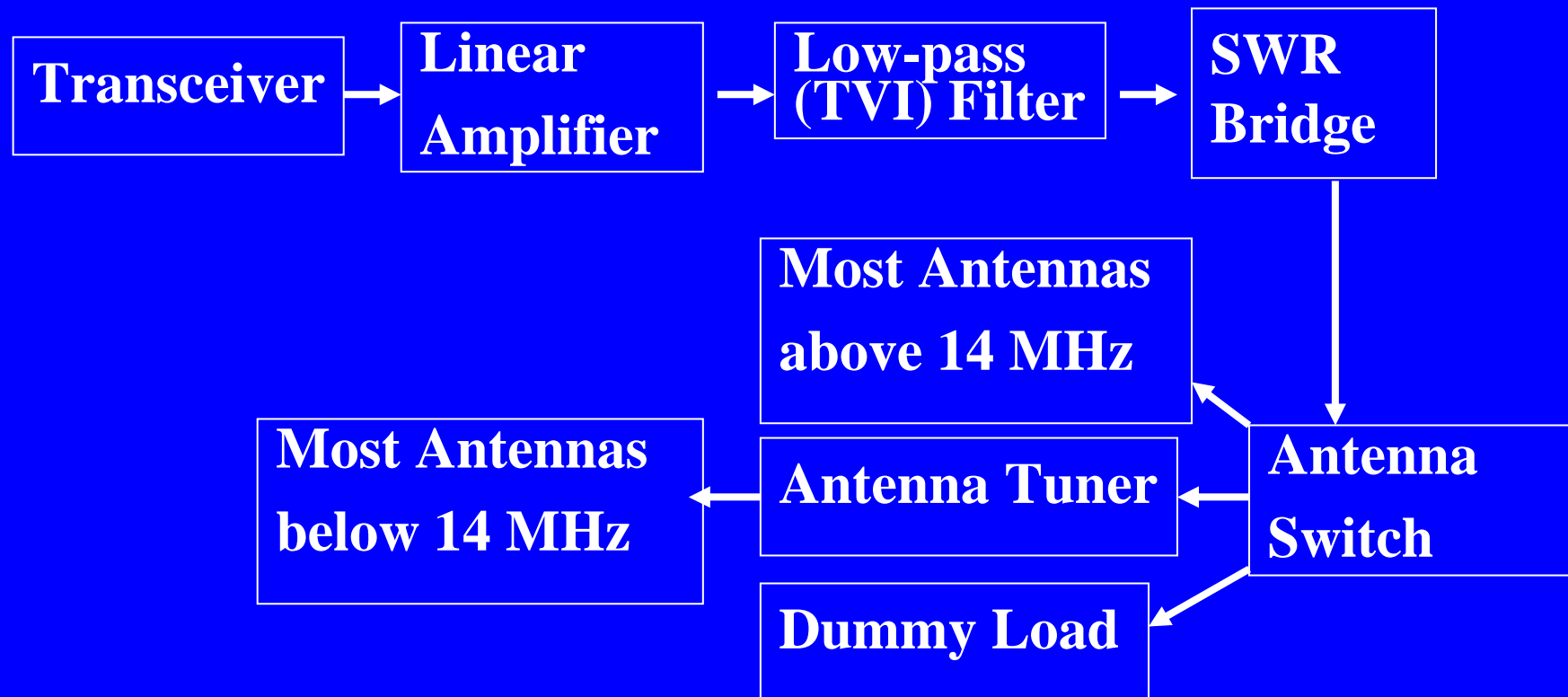
# Antenna Tuning Unit

- **Transmatch or Tuner**
  - matches impedance of transceiver to the antenna system (coax and antenna)
  - particularly important on lower HF bands (160 / 80 / 40 m)
  - most modern rigs have an on-board automatic tuner – **HOWEVER**, some antennas (backstay of sailboat) require a high-efficiency outboard tuner.





# Setting up the HF Station





# Operating HF Equipment

- **Complexity varies with rig type**
  - Solid state or tube-type
  - Mode of operation (CW; SSB; FM; AM)
  - Base or mobile rig





# Operating HF Equipment

- **Common Functions of solid-state rigs**
  - **Squelch** - blanks receive to weak signals
  - **Mic Gain** - adjusts audio output level to avoid “splatter” (i.e. transmitting outside the allotted band width)
  - **Automatic Level Control (ALC)** - prevents overdriving of transmitter (Over Modulation)
  - **Meter** - most have multiple selectable functions
    - **ALC / SWR / Power /**
  - **PTT** (push to talk) or **VOX** (voice-operated transmission)



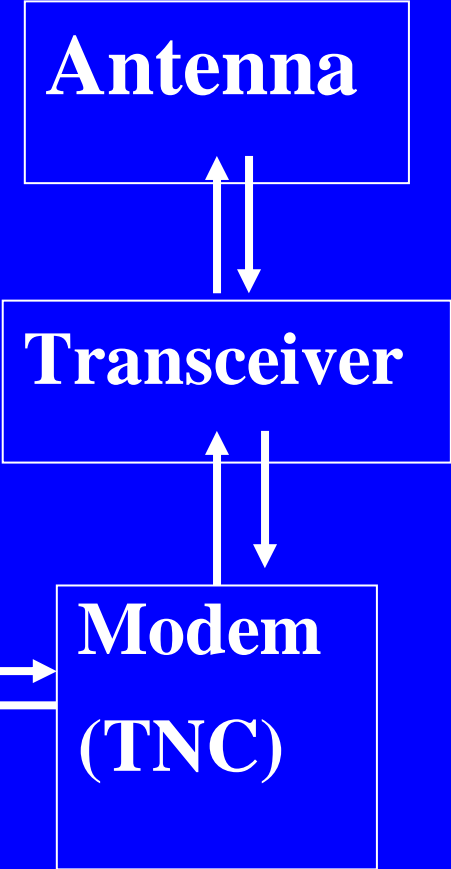
# Digital Modes

- Packet** - a form of packet switching technology used to transmit digital data via radio.
- RTTY** - radio teletype - keyboard to keyboard transmission
- APRS** - automatic position reporting system - GPS linked to radio
- PSK-31** - phase shift keying @ 31 baud

**I/O =  
Input/Output  
(Keyboard)**

**Computer**

**Modem  
(TNC)**



**Modem = modulator/demodulator**

**TNC = terminal node controller**



# Transducers

**converts sound  $\leftrightarrow$  electrical energy**

- **Frequency response (microphone & speaker)**
  - ideally cover range of human vocal production & hearing (what is that range?)
  - 20Hz > 20kHz
- **Sensitivity (microphone)**
  - level of energy required to effect a specific output voltage
- **Power rating - in Watts (speaker)**
- **Directional qualities (microphone)**
- **Impedance (microphone & speaker)**
  - matching between microphone (speaker) and transmitter is key to maximum efficiency



# Microphone Types

- **Crystal Microphone**
- **Dynamic Microphone & most Speakers (Speaker Mic)**
- **Electrostatic (Condenser or Capacitor) Microphone**





# Crystal Microphone



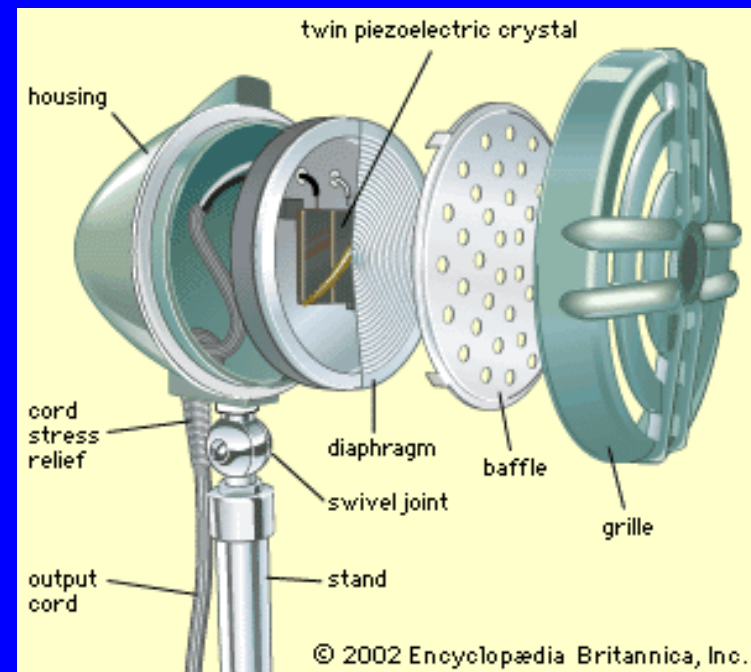
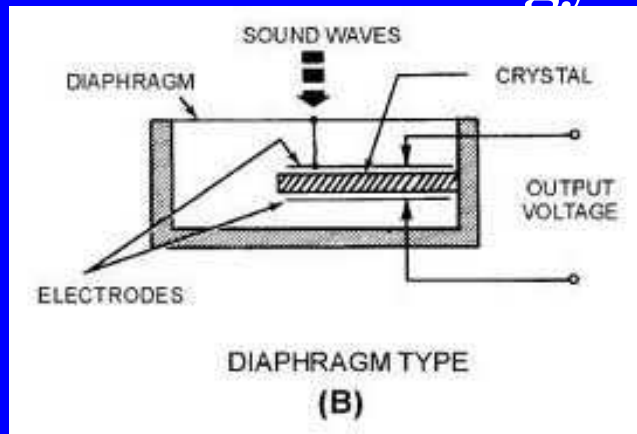
- **Piezoelectric effect**
  - deformation of crystal to produce a weak electrical current
- **Rochelle salt or potassium sodium tartrate:**
  - is popular for growing crystals because it results in easily grown single crystals.





# Crystal Microphone

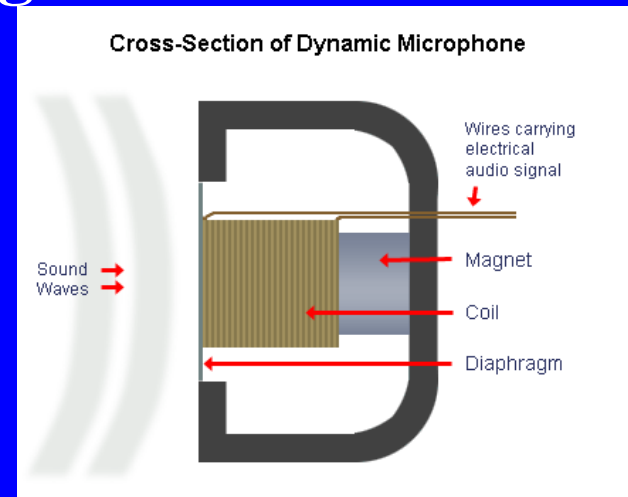
- Piezoelectric effect = deformation of crystal to produce a weak electrical current
- Metal plate attached to crystal
- Greater the deformation the more current flows
- Convert sound wave into electrical energy





# Dynamic Microphone

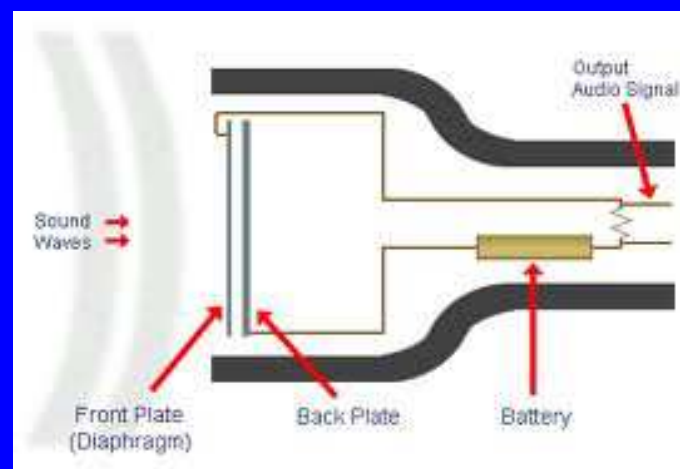
- **Dynamic Microphone & Most Speakers (Speaker Mic)**
  - electric current induced (*induction*) by moving conductor (voice coil attached to diaphragm) through magnetic field of a permanent magnet





# Electrostatic (Condenser or Capacitor) Microphone

- movable metal diaphragm forms one plate of air dielectric capacitor; the other plate is fixed
- capacitance changes with movement of diaphragm
- result is the flow of modulated electrical current





*The  
End*