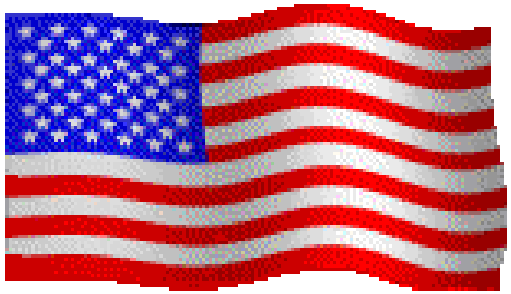


Repeater Components & Functions
Lesson Two

Bill Ragsdale K6KN

Berryessa Amateur Radio Klub

Dec. 17, 2024

What You Get

- Today we'll cover each component of a repeater.
- Including what it does and the characteristics important to a repeater operation.
- Next week we'll go into test equipment and measuring these key characteristics.
- Sessions: 45 min and 15 minutes Q&A.

This Week, Jan. 17, 2024

Mounting & Layout

Repeater, settings

Controller functions

Feed lines and cabling

Antennas

Filters, pass, notch and pass/notch.

Operating power, battery, solar.

And more

Sessions Summary

- Managing A Ham Repeater at
  YouTube.com channel: “K6KN Bill”
- Today: Repeater Components and Functions
- Jan 24: Repeater Tests & Test Equipment.
- Jan 31: Repeater Measurements & Adjustments.
- Feb 7: Repeater Diagnostics
- Optional: Hands on training.

Housekeeping

- I only know what I know. More?
- Questions at the end.
- For Slack access, register at barkradio.org/Training if you haven't already done so.
- **Be sure to change your Slack settings to receive notices.**
- PDF of slides will be posted on Slack.

Check-up

- Did you down-load and review the data sheet for a repeater cavity filter?

- Did you download and review the data sheet for a VHF antenna? Ground plane or folded dipole.

Key Terms

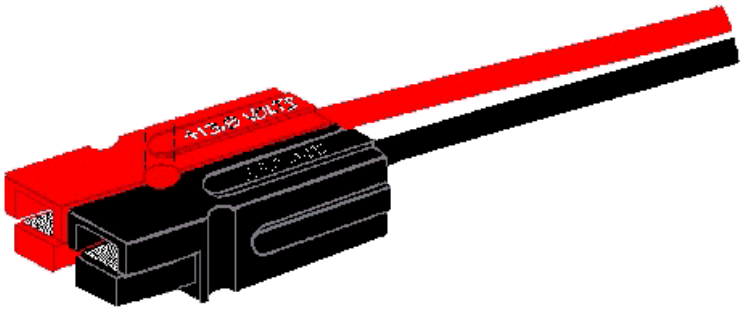
- COS Carrier Operated Squelch
- CTCSS Continuous Tone-Coded Squelch System, sometimes “PL” Motorola
- SINAD Signal Against Noise and Distortion.

Key Decisions

- Location: roof top, tower, 300 feet, 3,000 feet.
- One antenna or two.
- Remote control, integrated controller or separate,
- Coordination: Is your repeater coordinated?
- Web-site support.
- Huge check list at repeater-builder.com.

Technical Standards

- Power: Anderson PowerPole ARES standard

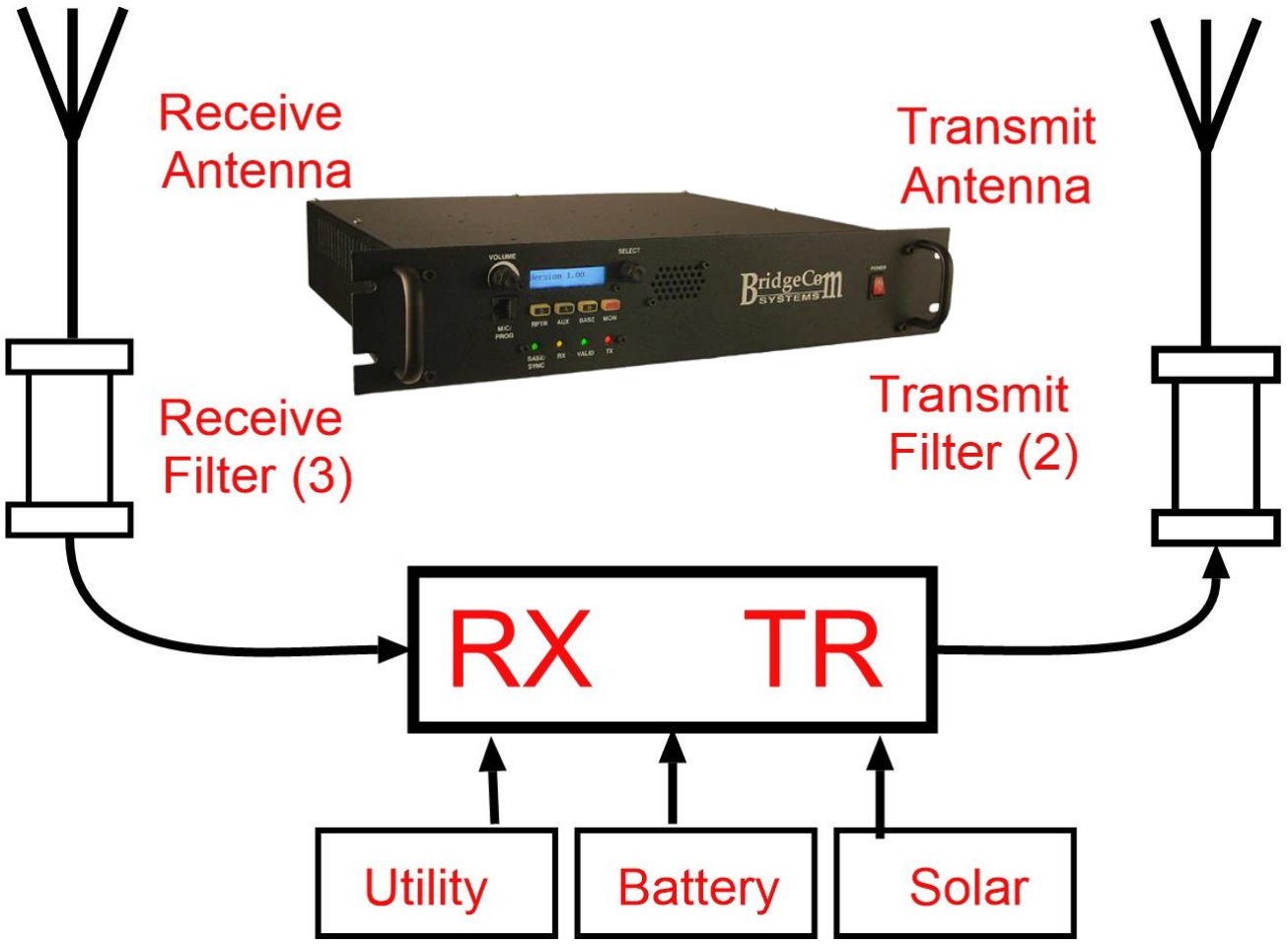


- RF Connector Material: silver plated not chrome or nickel. Avoid dissimilar metals.
- RF Connector Type: N connectors for Tx and Rx cable. N or BNC for test leads. The UHF connector is ‘dead’.

Technical Standards

- No adapters for a professional installation. BLM specifies no adapters.
- No foil/braid combination (unless insulation barrier between - LMR series).
- See also
- www.repeater-builder.com
- https://rfindustries.com/shop/

Station Layout



Mounting

- Rack mount: More difficult top and rear access. Dense.
- Tabletop, easy access but low space utilization.

Repeater

- A huge topic. We can only touch the top elements.
- Current practice is ‘black box’.
- No internal adjustments. No screwdrivers.
- Otherwise, return to factory.
- Most offer internal controller & external optional.

Setup Programming

- First generation: internal adjustments
  or code plug
- Next generation, LCD text display. Bridgecom.
- Currently: Color graphic touch display. Yaesu.
- Methods: Entry from front panel.
- Entry by computer link.
- Remote, over-the-air programming.
- With a wide range in capability. Check.

Design/Construction Level

- Ham grade: ICOM, Kenwood, Yaesu, Bridgecom, more.
- Industrial & Governmental: Motorola.
- Motorola equipment is usually repurposed from commercial service.

Settings

- Tx Rx Frequency, Power level … and ...
- Carrier Operated Squelch. COS.
- CTCSS always on receive. Sometimes sometimes on the transmitter output.
- Hang-time after carrier drops.
- ID at 8 to 10 minutes after the first transmission. Voice or CW.
- Bandwidth (deviation) by audio gain.

Controller

- The controller integrates COS , CTCSS, timeout and identification.
- Integrated or add on.
- Often with remote control via TouchTone; some by data link.
- Sometimes multi-port to integrate more that one repeater.

Cableing

- No braid/foil combination unless isolated by a foil layer.
- Want double shielded or Heliax
- “Hard Line” is very stiff copper tubing form.
- Needs specialized tools.
- Key value: attenuation per 100 feet.

Cabling

Andrew Heliax

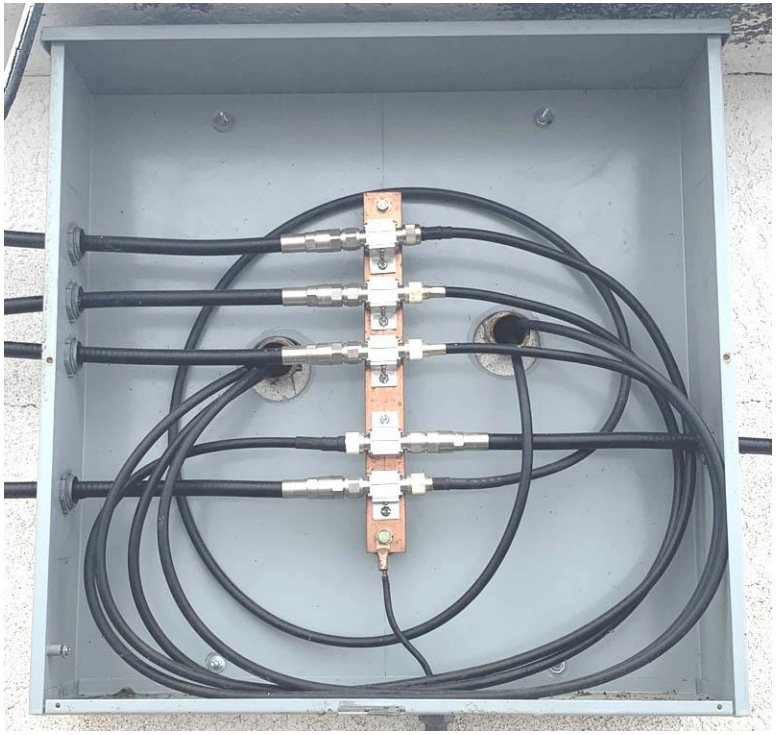
RG-214-U

RG-142-U

Cabling

- Outside Cable: Double shielded or Heliax.
- Example: Andrew/Commscope Heliax. Pasternack LMR-400-DB
- Interconnecting Cables: Andrew 1/4" Superflex preferred. Double-shielded coax. RG-214, RG-142, RG-393 or RG-400, LMR-400-DB (not LMR-400),
- Test leads RG-400 RG-214, double shielded.
- Don’t use Belden 9913, LMR-400, No foil/braid combination.

Transient Suppressors



- Won't cope with a direct lighting strike.
- Several technologies: gas tube, solid state.
- Mount on outside wall.
- Replaceable elements
- Air gap can complicate trouble shooting.

Antenna

- There are no magic answers. There are tradeoffs.
- One antenna vs. two. 10’ apart vertically is 35dB attenuation 2000:1.
- Mounting, pole, tall building, tower; guyed or unguyed.
- Favor the repeater receiving side as the transmitter power and antenna effectiveness far exceeds that of the users.

Antenna

<<Ground Plane

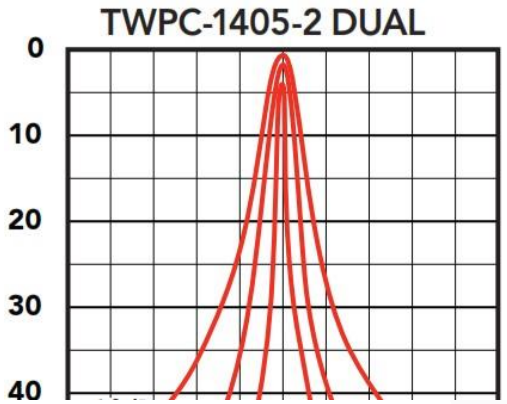
Folded Dipole>>

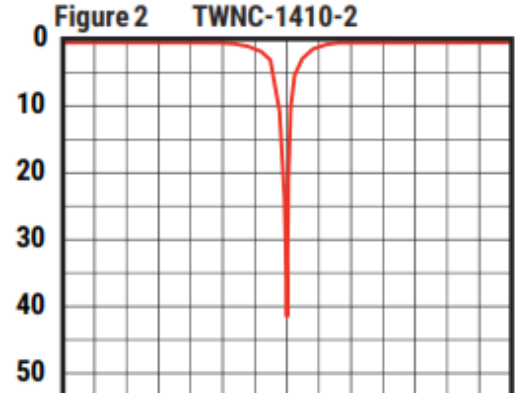
Antenna Gain: by length for ground plane; by elements for folded dipole.

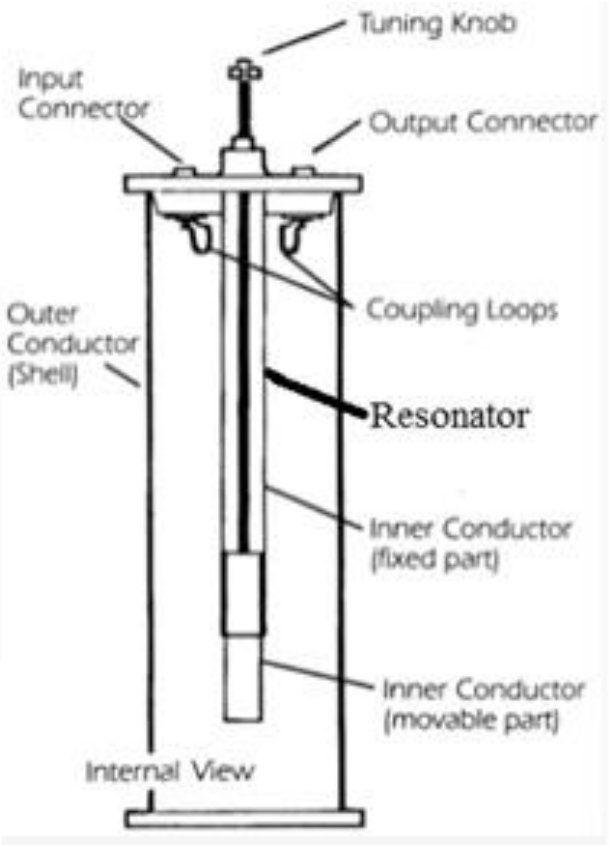
Antenna

- Ground plane vertical antennas are simple and economical. Less rugged.
- Folded dipole antennas are much more rugged but are noticeably more expensive and require slightly more mounting effort.
- The length or number of elements enhances trassmisison efficiency by directing more energy horizontally.
- This efficiency increase is the antenna's gain expressed dB. 3 dB is twice the efficiency.

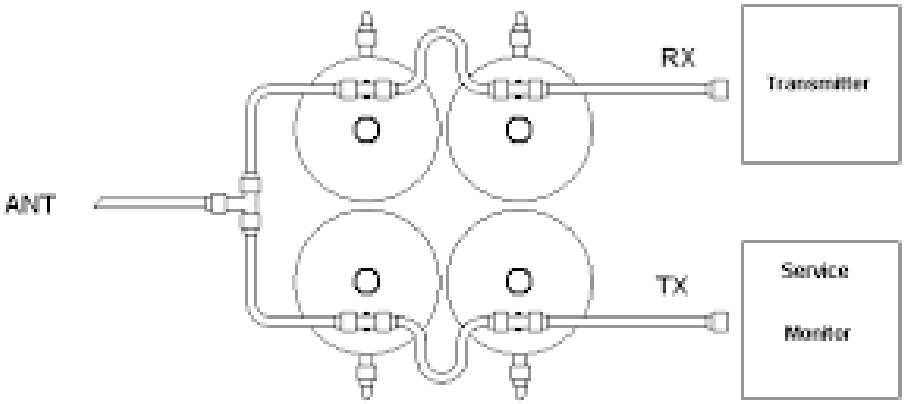
Cavity Filters

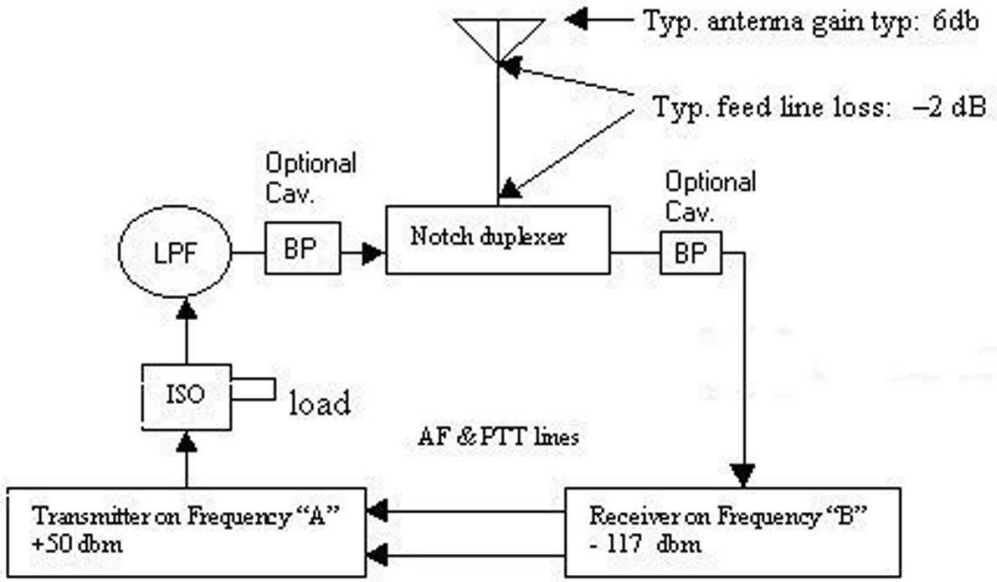






One Antenna Layout





Cavity Filters

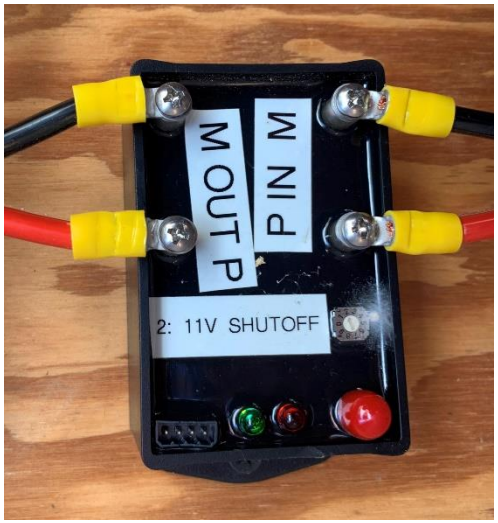
- Key parameters Q (bandwidth) and loss.
- Three major designs
  - Bandpass
  - Reject
  - Combined pass-reject.
- Commonly: 2 pass, 1 reject.
- Isolator (2 port) and circulator (3 port).
- See The ARRL Antenna Book. Ch. 17.

Operating Power

- AC Supply with meters
- Linear or switching.
- Battery, essential, 5 days
- Solar, desired
- Connectors: PowerPole, Molex is obsolete.
- EPIC PowerGate, brown-out protection.
- Grounding, a big topic. See The ARRL Handbook for Radio Communications Ch 28..


ON
OFF
AMPS
ASTRON
VOLTS
ASTRON
CORPORATION
ASTRON
CORPORATION


WEST MOUNTAIN
RADIO
Epic PWRgate
BATTERY
OUT
POWER


MOUT P
PIN M
2: 11V SHUTOFF

Power, Worst Case

- BARK story, PG&E down, 10 days and rainy.
- Estimated 5 days on battery boosted by limited solar to 9 days
- Down about 15 hours, then sunlight.
- Up in about 4 hours of sunlight.

Irritations and Discoveries

- You will discover your own.
- Yaesu DR-1X has no remote control or mute. Fan always runs. Early models would lockup.
- BridgeCom BCR-50V has a poor manual, limited remote control, has locked up twice, claims to have been fixed.

Irritations and Discoveries

- Our 1995 Maggiore repeater has been rock-solid for 28 years but out of business.
- Our favorite controller is CAT-250 but the company out of business.
- In general, industrial oriented firms stay in business longer than smaller ham-oriented businesses. MFJ is a notable exception.

Next Week, Jan. 24, 2024

Testing And Test Equipment

Record keeping

Must have test equipment

Should have test equipment

Repeater setup details, power and squelch.

Quick antenna tests

Power supplies.

Simple remote tests.

Assignment

- Find one or more power meters. Get the specs or a data sheet.
- Example: Bird Watt Meter Old Model 43 or the new Model 4410 Series and a 100 Watt VHF. plug-in element (slug).
- See the cost spread from $50 to $700.
- New or used. Try eBay.com.
- Review the full line at birdrf.com.

Evaluation

- An evaluation form will be posted at our support Slack site: ke6yuv.slack.com.
- Let me know how this class is working for you.

References

- Barkradio.org/training to register for Slack
- ke6yuv.slack.com. For PDFs, questions, discussion & YouTube links.
- YouTube.com channel: “K6KN Bill”
- www.repeater-builder.com
- The ARRL Handbook For Radio Communications.
- The ARRL Antenna Book.

Discussion

- Anyone wish to comment on the homework for this session?
- Cavity filters or antennas?
- Any repeater operator to review your station?
- Any comments or questions?

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