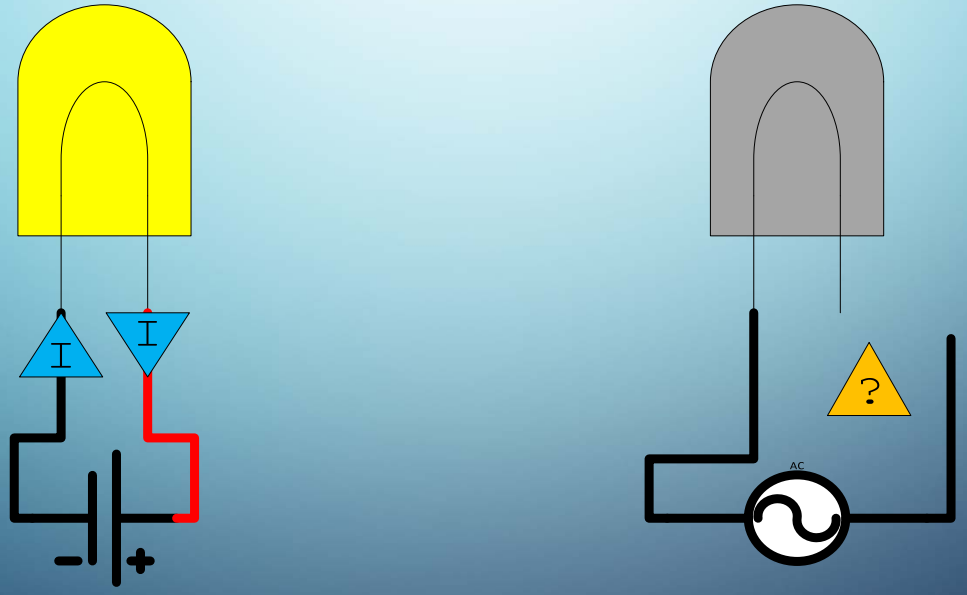
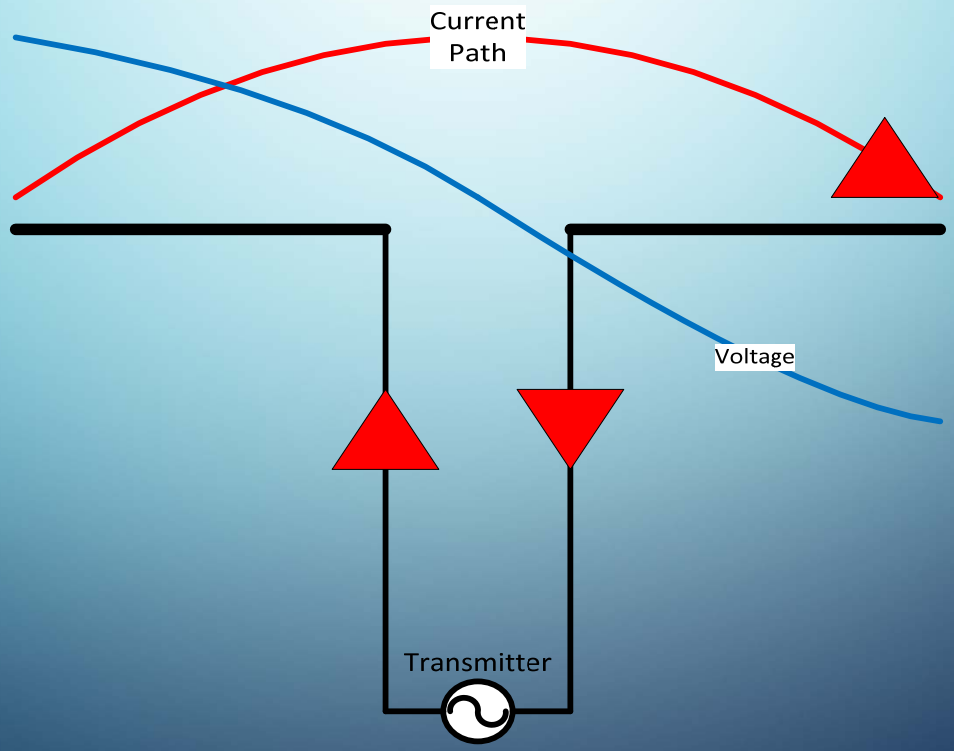
ANTENNA AND COUNTERPOISE BASICS

- R.F. TRANSMISSION/ANTENNA SYSTEMS HAVE SIMILAR QUALITIES TO COMPLETE PROPER A.C. & D.C. SUPPLY/LOAD CIRCUITS.
- KIRCHOFF'S LAW DICTATES THAT CURRENT FLOW OUT THROUGH A CIRCUIT MUST EQUAL CURRENT RETURNED. THUS THE R.F. CIRCUIT WANTS TO BE COMPLETE TOO.
- WITH PROPER TRANSMISSION LINE FEED AND ANTENNA CONSTRUCTION WE SHOULD HAVE CONTROL OF WHERE/HOW THE CURRENT RETURNS.
- IF WE DO NOT PROPERLY CONTROL THIS, STRAY R.F. RESULTS IN ATTEMPT TO COMPLETE THE RETURN PATH

AN ANTENNA WITHOUT A COUNTERPOISE IS LIKE A LAMP WITHOUT A COMPLETED CIRCUIT, EXCEPT THAT 'UNHAPPY' R.F. ENDS UP… *ANYWHERE*



BASIC HALF-WAVE DIPOLE: COMPLETE CIRCUIT EQUAL ¼-WAVE ELEMENTS



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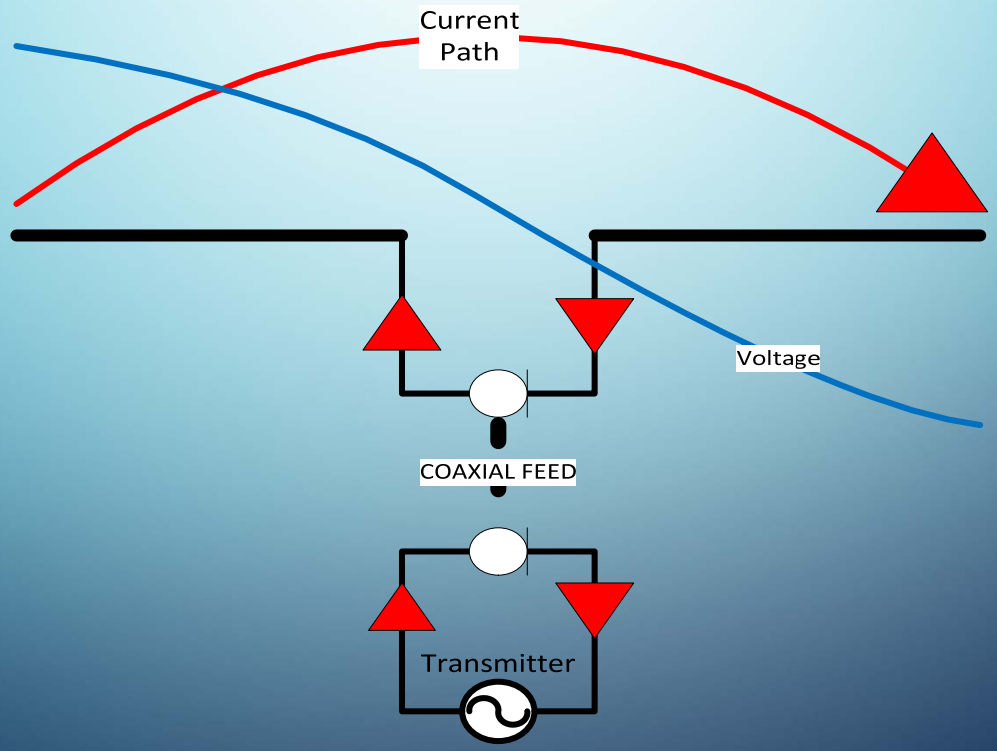

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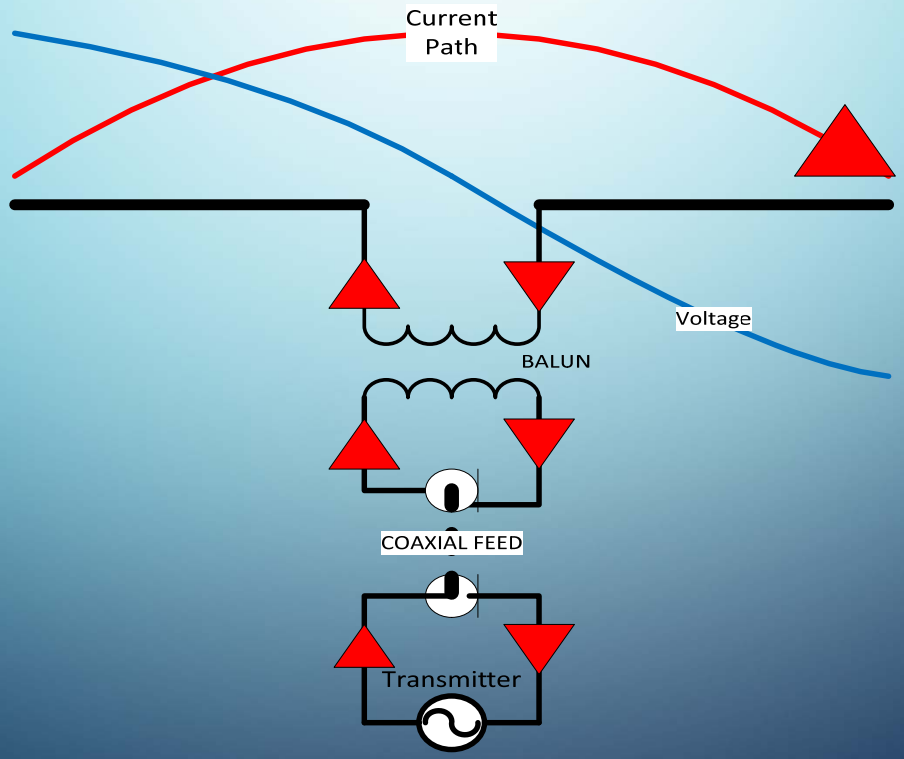
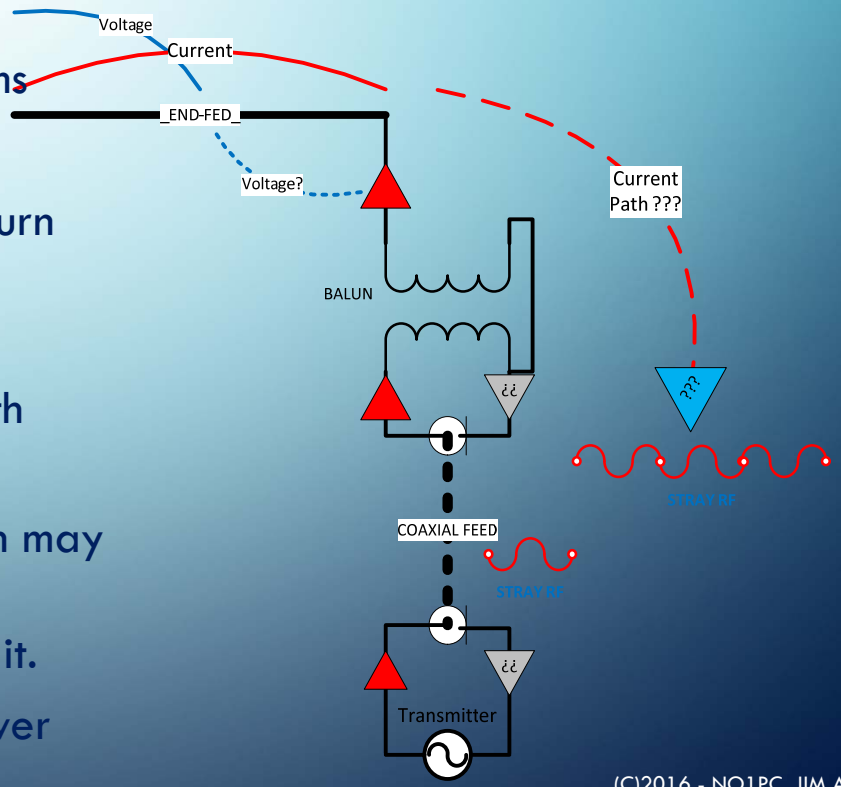


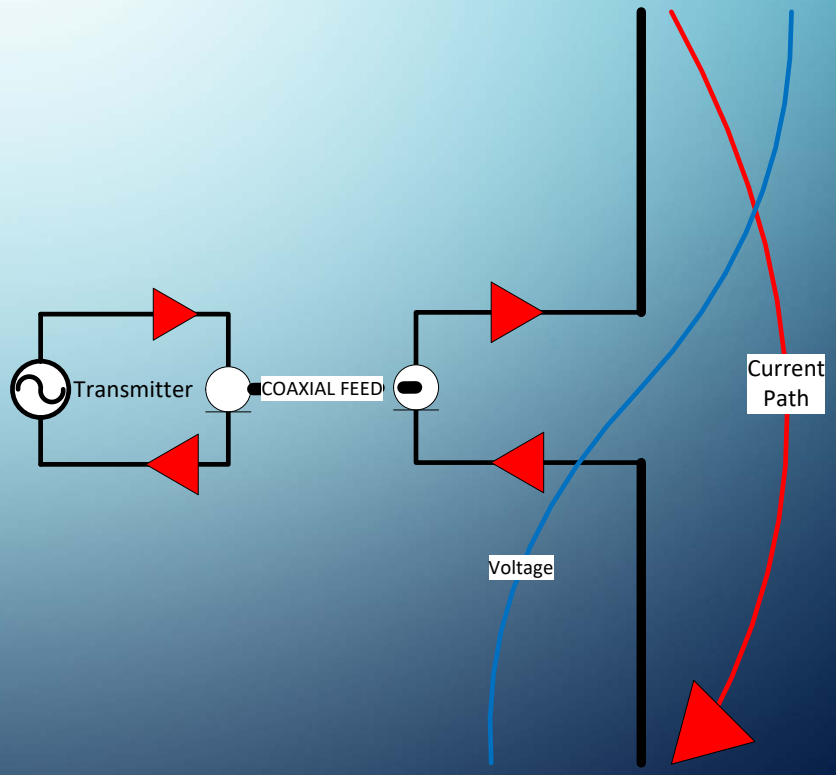
HALF-WAVE END-FED: IN-COMPLETE CIRCUIT UNEQUAL ELEMENTS / AMBIGUOUS PATH

- End-fed antennas typically HI-Z – 4-5k Ohms
- 9:1 matching element is common
- Lacking any deliberate counterpoise the return path IS the coax shield, which is an ambiguous/random element
- Recommendations are for a 0.05-wavelength radial tail (at frequency of use)
- Adding a choke to the feedline at the match may not help or prevents shield from being counterpoise. Choking at radio may protect it.
- Stray RF is less of of a problem at QRP power levels but become significant >50w



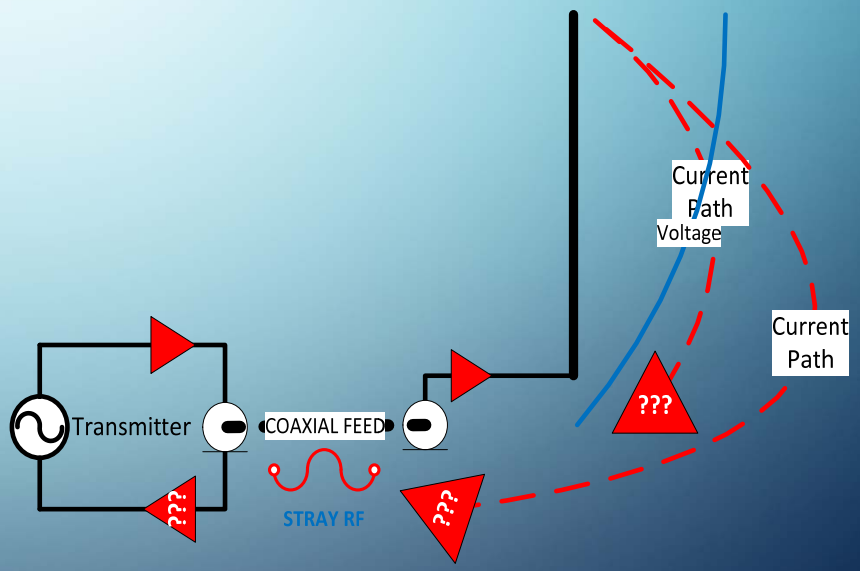
BASIC ½ WAVE VERTICAL DIPOLE: COMPLETE CIRCUIT
EQUAL ¼-WAVE ELEMENTS

- All of the same concepts and effects as the horizontal dipole.
- As we transition from dipole to end-fed vertical or ground-plane we have the same need to provide deliberate return current path.



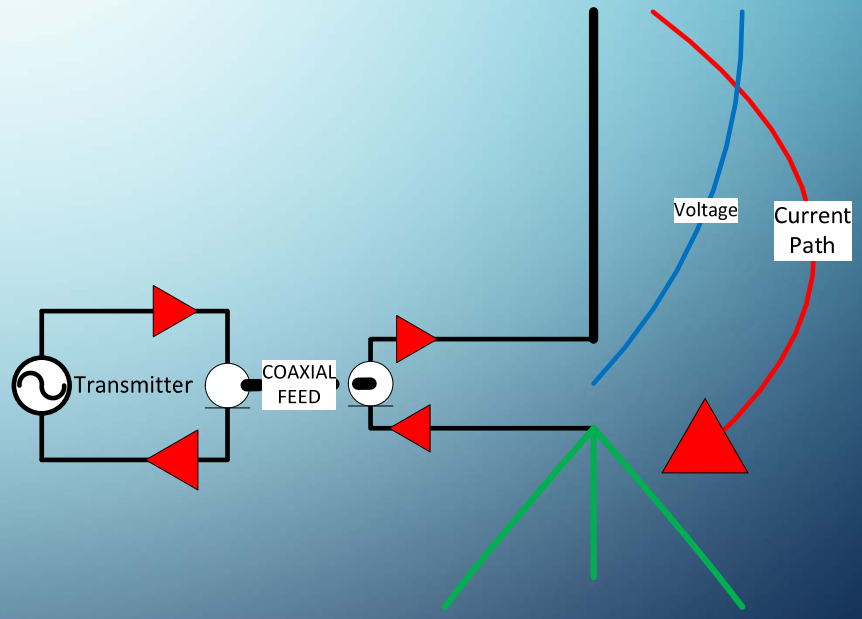
BASIC END-FED ¼ WAVE VERTICAL: IN-COMPLETE CIRCUIT NO EQUAL ¼-WAVE ELEMENTS

- All of the same concepts and effects as the horizontal and vertical dipole.
- Removing deliberate return current path (opposing ¼ wave element) leaves return path random.
- Coax shield likely to become the return path from 'stray' RF
- Choking the shield can deprive us of the available return path.
- The circuit needs a proper return = counterpoise/radials.



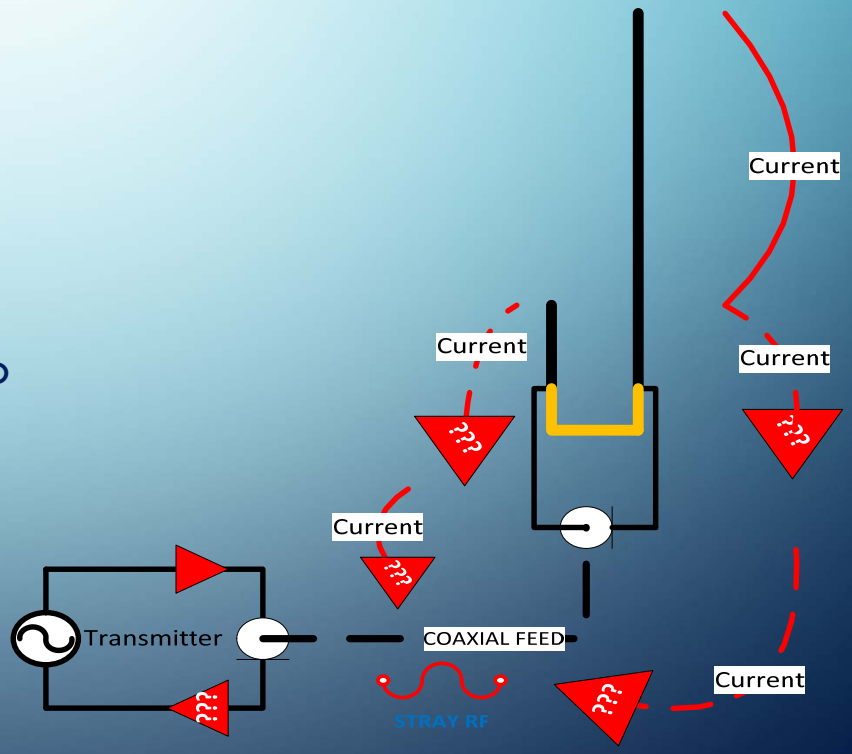
BASIC ¼ W VERT/GROUND PLANE: COMPLETE CIRCUIT EQUAL ¼-WAVE ELEMENT(S)

- The vertical needs at least one equal/opposite counterpoise to provide return path.
- The direction of the counterpoise sets the radiation pattern, thus we use at least 3-4 radials to draw the current to each to establish an omni-pattern.



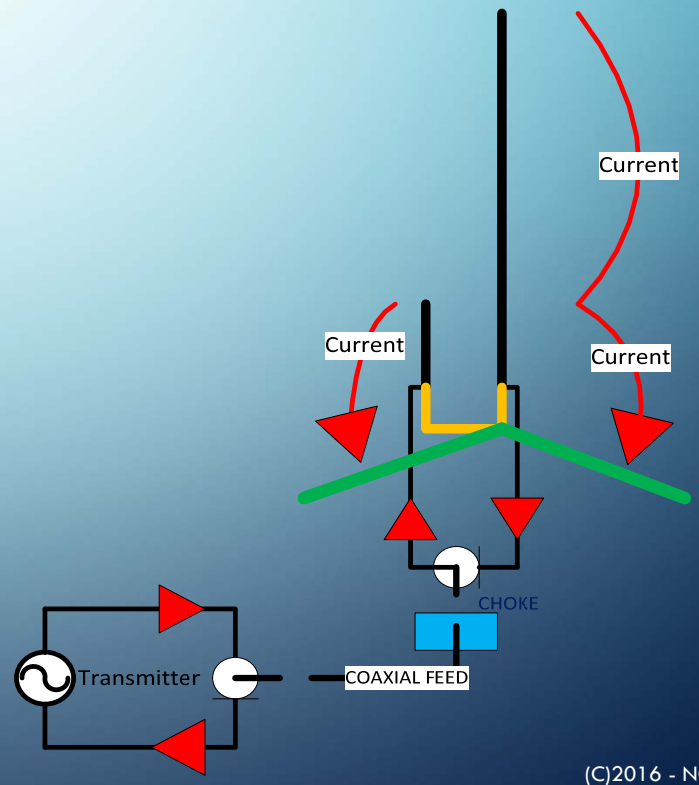
J-POLE VERTICAL: IN-COMPLETE CIRCUIT
NO RETURN ELEMENTS

- The j-pole is neither a ¼ w, ½ w or ¾ w.
- With the stub match the shield voltage is raised, thus 'hot' carrying RF thus stray RF. Increasing current from the top of the short element has no place to go.
- Either or both mast/grounding or choking the feed alter return and still force return to radiate to coax shield.
- This antenna is a stray RF nightmare, especially when many are used in fixed or field conditions.
- There is hope… fix it!



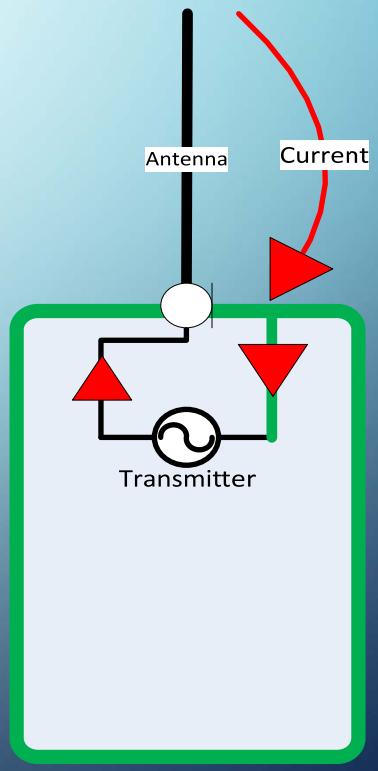
J-POLE VERTICAL: *PROVIDE* COMPLETE CIRCUIT *ADD* RETURN ELEMENTS

- Simply, provide the antenna with the critical missing piece – radials (in green…)
- See "Correcting the J-Pole Common Mode Problem" @ http://www.w8ji.com/end-fed_vertical.htm
- The technique bears some experimentation and alteration to suit the twin-lead variations.
- Given the benefit, or lack thereof, of the j-pole, simple true ¼ w or base loaded 5/8 w vertical ground planes are just as if not more effective, correct, less hassle.



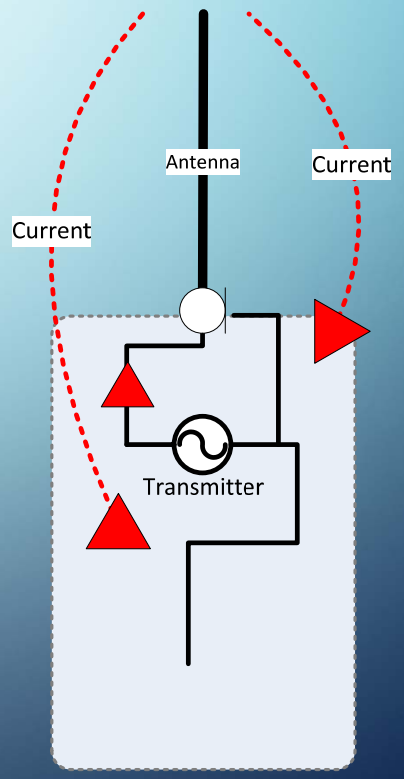
THE HAND-HELD RADIO ANTENNA DILEMMA – 1 –

- Small radio chassis present a specifically difficult challenge to shielding the electronics and providing adequate counterpoise.
- Internal construction and frame of higher-end commercial radios provided internal circuit shielding/isolation and significant metal frame structure (green outline.)



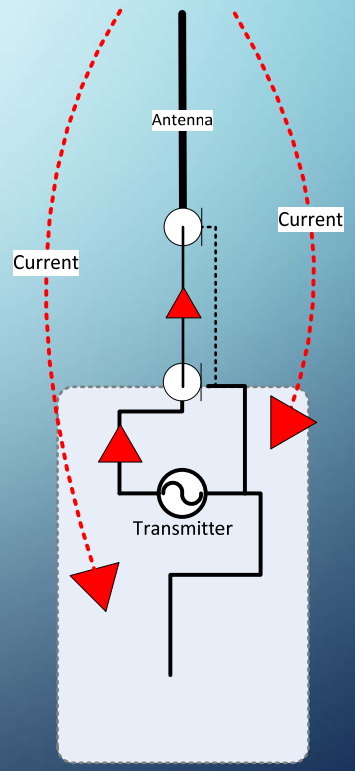
THE HAND-HELD RADIO ANTENNA DILEMMA – 2 –

- Lower-cost engineering and manufacturing do not provide any internal circuit shielding and often no chassis frame.
- This deprives the RF system of adequate counterpoise/controlled return current path, thus internal circuits and external items are exposed to stray RF
- The radiation pattern in such cases is ambiguous and not optimal.



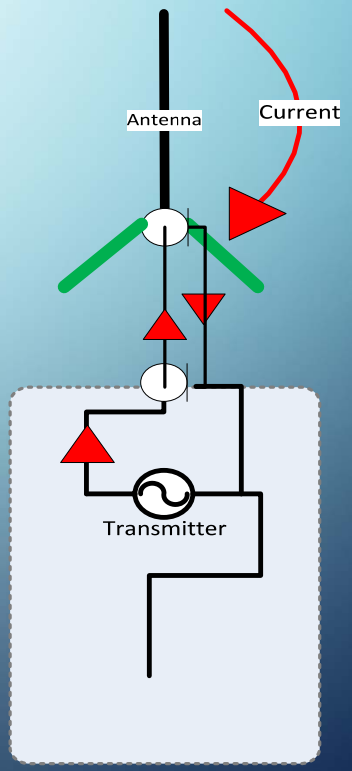
THE HAND-HELD RADIO ANTENNA DILEMMA – 3 –

- Extending just the antenna on a coax jumper, as is common in various ‘suitcase’ go-kits may make the stray RF problem even worse by increasing the stray RF surface area by coax shield.
- The radiation pattern in such cases is ambiguous and not optimal.



THE HAND-HELD RADIO ANTENNA DILEMMA – 4 –

- Adding appropriate lengths of radial material at the base of the antenna provides a ground plane for improved radiation pattern and counterpoise for known RF current return path.



SUMMARY

- RF systems, like A.C. and D.C. circuits, require a return current path.
- RF is unlike most AC/DC circuits in that without a known, determined, controlled path/counterpoise, RF *will* find/create its own return current path – randomly, uncontrolled, undesired.
- Only through engineering modeling systems and loosely translating to very rough illustration, imagination, visualization can we begin to appreciate this “RF aura” and either its desired or unacceptable effects.
- All antennas need a counterpoise. Better we create one than leave it to chance.