Troubleshooting Beam Antennas

Solution

TROUBLESHOOTING BEAM ANTENNAS

General Information

Many factors can affect the performance of your antenna. Some of them are:

Corrosion, lightning, carbon tracking, tubing slippage, high power abuse, water, feed point connections, and bad construction. This article will address most of these causes. Current flow and its' failure is the main subject. Field patterns are not addressed, as this would require a separate article.

Corrosion affects all parts of the antenna in one way or another. Salt water near coastlines is probably the most severe form, as it affects most metals in the antenna, and some plastics. It can get into tubing, traps, and connection joints and prevent current flow.

Lightning usually results in a sudden failure of the antenna, but it can also be gradual.

Carbon tracking is a conduction path where an arc has occurred. The conduction path will be across an insulator. It may have a high or low resistance. With a high resistance, you may only see failure during high power usage. Normal locations affected will be a driven element insulator from the driven element to the boom, a trap where turns become shorted, driven element insulators, and baluns, where either conductor may short to ground.

Tubing Slippage usually results in a frequency shift, or a rise in swr. If severe enough, a tube may slip out. Outer tubes have been found on the ground and rooftops. If the slippage is minor, only a small shift in frequency will be seen. A normal beam antenna will be symmetrical, with both sides equal distance from the boom. Sometimes you can see the difference from the ground, using a field viewing glass.

High Power Abuse usually results from driving the antenna with more power than it is rated. This can result in explosions or fires in traps and baluns, and can leave carbon tracks behind.

Water can cause corrosion in tubing joints, traps, baluns, and even insulators. Salt water can leave conduction paths across insulators when it evaporates. Water in feed lines can cause strange swr readings. Water can freeze and expand joints.

Feed point connections may appear as a bad antenna. Loose wiring and hardware may show as intermittent problems. Solder lugs are used widely and need to be inspected and have solder reapplied as necessary. Cold solder joints may visually look fine, and tear loose if pulled or moved.

Bad construction can result in any number of problems. It can cause no frequencies to work, some to work, or all to work but with the wrong numbers. The numbers can change with loose hardware. The frequency can shift when the wind blows or the antenna is turned. If traps are backwards, or the wrong traps, the frequency will be off, but the swr good at that frequency, usually outside the ham band.

General Indications

For most multiple element, multiple band antennas, there are traps on the driven element, as well as reflector and director elements. Draw a swr curve to check all bands to see if any of them work, and which ones fail. This is very useful in finding the problem.

If you have access to a swr analyzer, this is a quick process. Due to the very low output power, you can touch the antenna with your hand with little or no danger. This should change the tuning on the antenna, which will show as a change on the swr analyzer. If you touch the antenna anywhere in the current flow path for a given band, the reading will change, for better or worse, but, it should change. If it does not change, the piece that is touched is not part of the current flow. This simple test works in many cases.

When power enters the antenna, current flows to a point where it cannot, and is then radiated. It is useful to use a dc current model for the first 90 degrees of flow. When the current reaches the end of flow, an antenna is created, both physically and electrically for all practical purposes. The higher frequencies use the same paths as the lower frequencies. If you had a way to isolate the frequencies in the radio, such as a diplexer, you could feed all bands of the antenna at the same time, and each frequency will find its' own path. Many vhf/uhf antennas function this way for full duplex operations.

When a driven element fails, the swr will be over 10:1, as it cannot oscillate. It is convenient to think of the driven element as an oscillator. This applies to single band and multiband antennas. Start with the highest band available, such as 10 meters. The current flows into the antenna from the feed line and balun, and is supposed to flow out to the 10 meter trap. Only three local things can cause failure of the first band:

The trap is bad, or off frequency.

The balun is bad. It may be open or shorted, with bad solder joints or lugs.

The center insulator is bad, and shorts the power to ground through the boom.

When a parasitic front or rear element trap fails, a swr meter will indicate slightly high, about 5:1 or so. It may range from slightly high up to around 8:1 depending on the antenna design. With a good antenna, the driven element oscillates, and has a good load from the parasitic elements. When the parasitic fails, the driven element still oscillates, and the parasitic element presents a bad load to the driven element, and results in a slightly higher swr, but not a complete failure. The current path flows from the boom or midpoint of the antenna, and out to the first stop point on the other passive elements, as it does with the driven element.

Tubing joints can be a failure cause. Sometimes burn marks can be seen where the mating tube surfaces contact. This can be caused by oxidation of the tubing, usually from salt air near coastlines. This can be prevented by using conductive grease such as Penetrox (HG p/n 878697), NoOx (CC p/n 244604), or even copper imbedded paste used to sweat copper pipes. The grease is gritty, and bites into each tube surface at the contact points. It also distributes rf current more evenly around the tubes.

Trap Inspection

Trap failure can result from extra high power, such as too much power and lightning, or mechanical causes. Lightning usually takes the outermost trap (radial distance from the mast), but any of them can be hit. Percentage wise, the reflector outer trap is the longest distance from the center of the antenna, and are the most likely to take a hit.

The first check for trap failure is to find if it is a total or partial failure. Partial failures may let the element outer bands appear to work but be off frequency. On a trap with an outer tube, there is usually a single screw which shorts out the inner and outer tube, on one end. The outer tube forms the capacitor section of the trap, and if the screw is loose or corroded, the capacitance is removed, and the rf band fails. Current can still flow through the inductor inside the trap and reach the outer traps and tubing. Inspect and repair the screw, and also the shorting strap which it holds. Look under the strap also. Next, remove the screw, and remove the outer tube of the trap. Some traps have dimples down the side of the outer tube, and may have to be removed. If the tube won't slide off, take a small drill bit and drill out each dimple as required. Now the tube should slide off.

The inner trap structure is simple, with only wire which is wound around a plastic coil form. The wire is attached to each end of the trap small tubes, with a screw. Remove the screws one at a time and clean all of the contact surfaces of the tubes and the wire. Replace the screw. Use stainless types.

Inspect the coil form for discoloration, swelling, and foreign objects. If charred, the trap will need to be replaced. Some parts are available separately for the trap assembly. Inspect the wiring for shorts between the turns. You should use a magnifying glass and bright light for the inspection. Wire which has been bent or exposed to very high currents can fracture or crystallize, and separate. The separation may extend away from the wire surface and contact the next turn on the coil, which shorts it out. This raises the frequency out of band. The separations are usually shiny, but very tiny, like spider silk. The bright light reflects from the separation. Use a sharp point or knife to remove the separation. Reassembly the trap and it should work again.

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