SWR Analyzer Tips For Antennas

Solution

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If the antenna is working, draw an swr curve for each band, for future reference. Put it near the owners' manual for the device under test. You may want to draw the swr curve with an analyzer, and also with an swr meter using power.

An analyzer, in most cases, is a transmitter and receiver in full duplex mode, so it hears itself, live in the case of MFJ types. It sends out a signal of known quality, and analyzes the return of the signal. It checks amplitude and phase shift against the source reference and calculates all of the readings which appear on the display, or computer screen. Some types of analyzers do not have any filtering in the receiver front end. This keeps the return signal in its' purest form for analysis.

When in doubt about a reading, compare against a power meter or swr meter using transmitter power. With most analyzers, if you connect it directly to your radio receiver, you will see a signal strength of around S9+40. Unfortunately, the analysis can be thrown off by outside influence. The analyzer only sees what is on the connector, not everything else which can influence what is attached to the connector. The analyzer can receive other things than the reference signal from other sources which can come into electrical or physical contact with the device under test. Other transmitters can generate rf signals which are received by the antenna, in most cases, but can also be received though coax leakage, or other nearby signal generators. Sometimes a filter can be used to eliminate some or all of the interference, such as a MFJ-731 Analyzer Filter, which can be tuned to cancel out the interference.

A common known interference problem is when an AM broadcast station around 1 MHz generates a strong modulated signal which mixes with the device under test.(antenna) The station is usually local, within a few miles, so the signal strength is very strong. It is not unusual for a station to be S9+20 or more. If an analyzer is connected directly to a radio receiver, it is typically S9+40 or so. In basic AC theory, signals will mix together if the weaker signal is about 10 % or more of the larger signal. A signal of S9+20 can easily mix with a signal of S9+40. The result is a change in the analysis of the return, which throws all of the derived calculations off, and gives a bad reading. The most common form is interference on 40 meters. I have seen the swr analyzer meter vary up and down greatly. It can look like an audio VU meter. I got curious, and tuned across the AM broadcast band. I found the station, and the meter will fluctuate in time with the voice or music at the time. This will also happen with ssb stations, and beat at the same rate, and the signal strength changes. With FM, you may see a constantly high swr reading. This happened to me when my friend started talking on his 2m ht nearby while I was taking a reading. This is called receiver desensing, or blanking.

Whether you are tuning an antenna or troubleshooting an antenna, see other articles here on the *Help Desk* for ideas and suggestions on how to reach an answer to your problem.

One interesting idea came from an antenna forum. Since an antenna analyzer is very low power, typically one tenth of a watt, you can touch a live circuit with no harm to yourself. You can modify it, tune it, or just test it. With the analyzer connected, you will read the conditions presented to the analyzer connector. By touching the device under test, the reading on the analyzer will change. It will get either better or worse, by the inductance and capacitance of your body, but it will change. If it does not change, then the area touched is not part of the active circuit. This can be very useful when troubleshooting.

On a single band antenna, the current goes all the way out to the tip of the antenna. So if you touch it anywhere, the swr analyzer reading will change. On a multiband antenna the current will stop when it reaches a switch, trap, or isolator/resonator. It does not travel the entire physical length. If you touch the device under test(DUT) the reading will change. If you touch it beyond the active area, it will not change. If you touch it on the active current area, and there is no change, that part of the circuit is inactive, and possibly defective. If there is a break in the current flow, you can run your finger along the active portion until the analyzer stops responding.

Treat antenna current like a dc circuit, and it makes finding a problem much easier. I find it helpful to visualize the current path for a given band. For each band in use, I draw a new representative dc circuit. Ask yourself which part is active and which is not.

Traps may be checked with an analyzer using the grid dip principal. With an MFJ-99 grid dip adapter, you can perform checks on some traps, but not others. With larger traps, you can place the adapter inside the coil of a trap to get a dip at resonance. Other positions around the trap may not give a reading. It depends on the trap design.

The analyzer was not designed to have a dip function. This was discovered later. The analyzer may not be very sensitive with some types of trap. The amount of the dip depends on the degree of coupling. The dip adapter works on a tranformer principal. The dip coil is your primary, which is supplied power by the analyzer. The circuit under test becomes the secondary. The coupling ability between the primary and secondary determines how much power can be drawn across the junction. Under and over coupling will affect the reading. At resonance, maximum power is drawn across the junction. From the analyzer viewpoint, it is losing more and more power forward, with less reflected. The calculations determine that more forward power is released, and not reflected. With a perfect coupling, where all power is lost as forward power, this will result in a 1:1 swr at resonance.

With many traps, only a loose coupling results, and a small dip will be seen. If too loose, it will not be seen at all. If you do not see a dip, you will have to use a smaller or larger coil for coupling. For example, if you were testing a tiny coil like you would see on a pc board, the coil would have to be tiny. You might even wind it around a pencil tip. At the other end of the scale, a very large coil would be needed for the tank circuit of a linear amplifier.

Another way to measure MFJ, Hy-gain, and Cushcraft style traps is to make a double loop about 4 inches in diameter, attached to a short coax, center only, and hold it around the trap while looking for a dip. You have to know the expected band area to prevent large searches.

Another way to measure a trap is to present a 50 ohm load to the analyzer, like a dummy load. If you put a 50 ohm resistor in series with the trap, you see a dip at resonance. At resonance, a trap will either act like a short, or it will act like an open circuit. In series, it effectively becomes a short, and looks like a piece of wire, leaving only the 50 ohm load to be seen by the analyzer. The opposite effect occurs if you put a 50 ohm resistor in parallel with the trap. At resonance, the trap becomes an open circuit, again leaving only the 50 ohm resistor to be seen by the analyzer, which results in a 1:1 dip.

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Article details

Article ID: 123
Company: Knowledgebase
Date added: 2017-11-10 12:12:45
Views: 2289

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