INVENTION DISCLOSURE

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TITLE

"Antenna VSWR Compensator Circuit"

INVENTORS

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BACKGROUND

This application is an addendum to Reference [1]

ABSTRACT

This invention covers a simplified version of the Hagerman Absorptive Bandpass Filter for use as an antenna VSWR compensator. The absorptive properties of the filter, when placed in series with an antenna, act to compensate for a poor VSWR caused by impedance mismatch at non-transmit frequencies. The result is a load seen by the transmitting amplifier which has greatly improved S11 characteristics, thereby offering improved stability, better harmonic rejection, improved performance for filters and combiners, and a reduction of broadband noise. In short, the invention converts a very difficult RF load into a very accommodating one by presenting a broadband impedance match.

BRIEF DESCRIPTION OF DRAWINGS

1) *Measured Response of Prototype VSWR Cancellation Circuit*
2) *Measured VSWR of 433MHz Quarter-Wave Dipole Antenna*
3) *Measured VSWR of Invention in Series with Antenna*
4) *Circuit Schematic of Preferred Embodiment*

PURPOSE

The purpose of this invention is to improve radio system performance by compensating for a very poor VSWR characteristic common to most antenna designs.

DETAILED DESCRIPTION

The proposed invention is a reduced form of the Hagerman Absorptive Bandpass Filter (Reference [1]) used in conjunction with an antenna. The filter comprises a minimal PI-section, which offers the lowest insertion loss in the passband, and yet still provides the necessary impedance match at all other frequencies. Rejection in the stop bands is not necessarily a required function.

For the preferred embodiment shown in Figure [4], only a single value of inductor and capacitor are used. The bandwidth of the bandpass region is roughly 50%. This circuit simplification results in reduced complexity and offers better manufacturing tolerance sensitivity for response tuning (using components in series and parallel results in optimal doubling and halving of effective values). Component values are calculated using the following formulas where f_0 is the center frequency:

$$L = \frac{R}{\pi \cdot f_0}$$

$$C = \frac{1}{2 \cdot \pi \cdot f_0 \cdot R}$$

Figure [1] shows the measured S11 and S22 response for a prototype VSWR Compensator. It has a bandpass centered at the desired transmission frequency (in this example 433MHz). The S11 and S22 are roughly -20dB or better across a wide frequency range. This is an intrinsically absorptive bandpass filter with a low passband insertion loss. Note, the rejection in the stop bands is minimal, and not a necessary function for VSWR cancellation.

Figure [2] is the measured VSWR of a properly mounted antenna. This is typical performance for a common quarter-wave dipole type. The VSWR is acceptably low at the carrier frequency, but rises rapidly on either side. A high VSWR represents a severe impedance mismatch (not 50 Ohms) and is manifested as reflected power.

Placing the proposed invention in series with the antenna compensates for the poor VSWR. The combined measured response is shown in Figure [3]. Performance is excellent, especially at the important second and third harmonic frequencies, thus proving the invention valid.

ADVANTAGES

Many RF system components are specified to operate acceptably without damage into loads with a VSWR up to 1.5. Thus, maintaining a VSWR below this value will offer system improvements in performance by allowing components to operate under the conditions they were designed for. High VSWR results in unwanted reflected power outside the transmission band, such as harmonics and broadband noise. This power is reflected by the antenna load back into the transmitting components. The invention eliminates this problem by absorbing the reflected power and converting it to heat.

The other benefits from impedance matching in a wireless system are detailed in Reference [2].

PRIOR ART

There are no known previous implementations for broadband antenna VSWR compensation.

REFERENCES

1. James G Hagerman, “Family of Intrinsically Absorptive Electronic Filters”, 2010.
2. Kevin A Miyashiro, “Ensuring Maximum Interference Rejection in the Real World”, 2011.

FIGURES

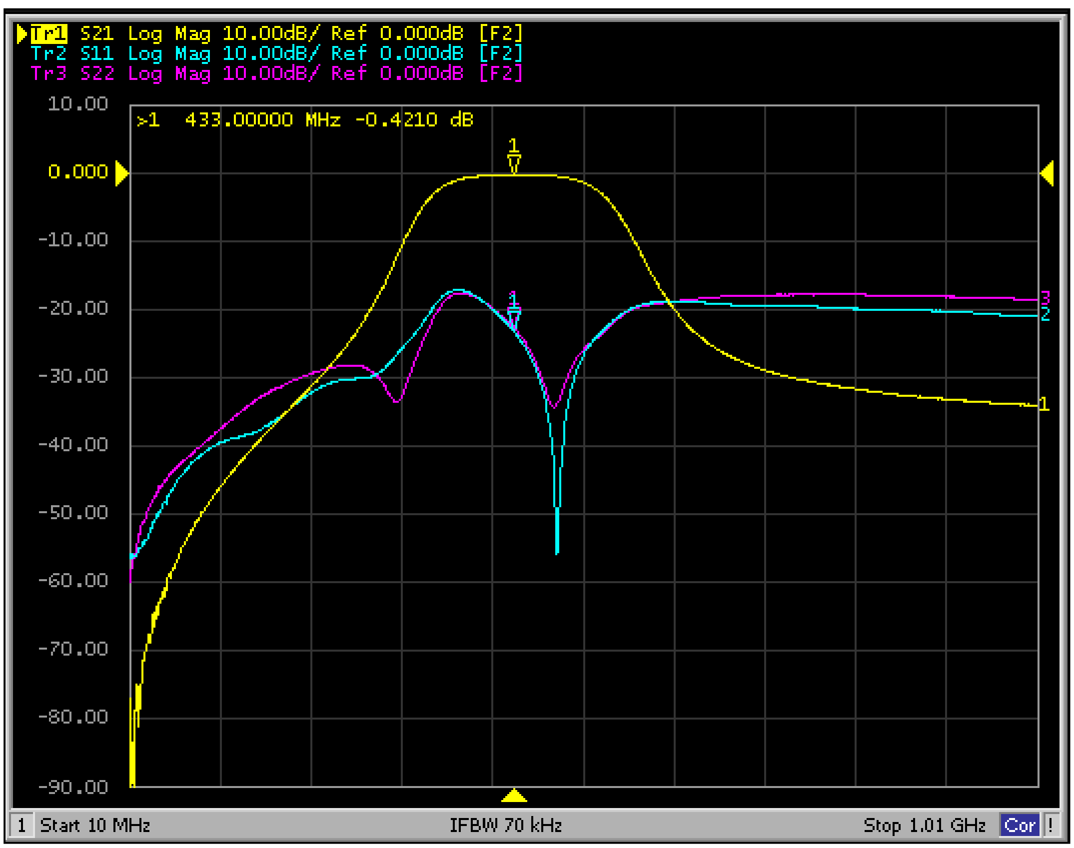

Figure 1 – Measured Response of Prototype VSWR Cancellation Circuit

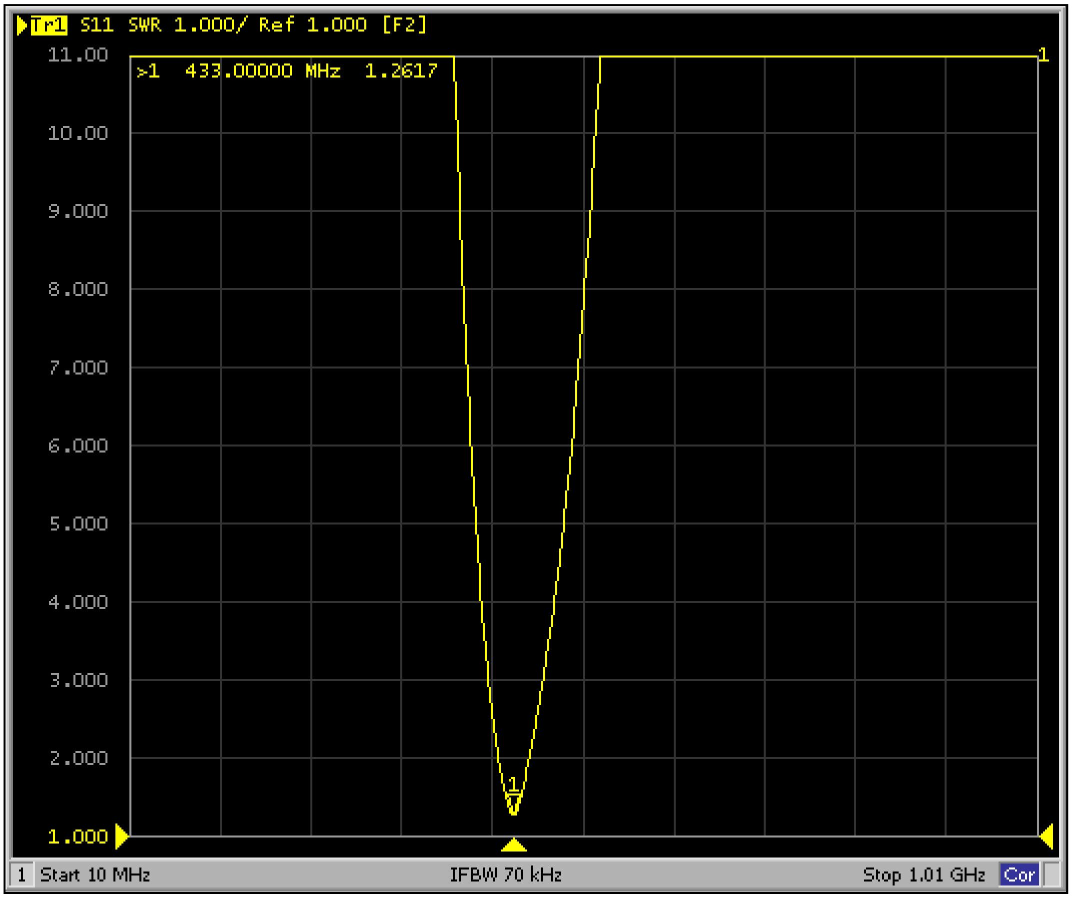

Figure 2 – Measured VSWR of 433MHz Quarter-Wave Dipole Antenna

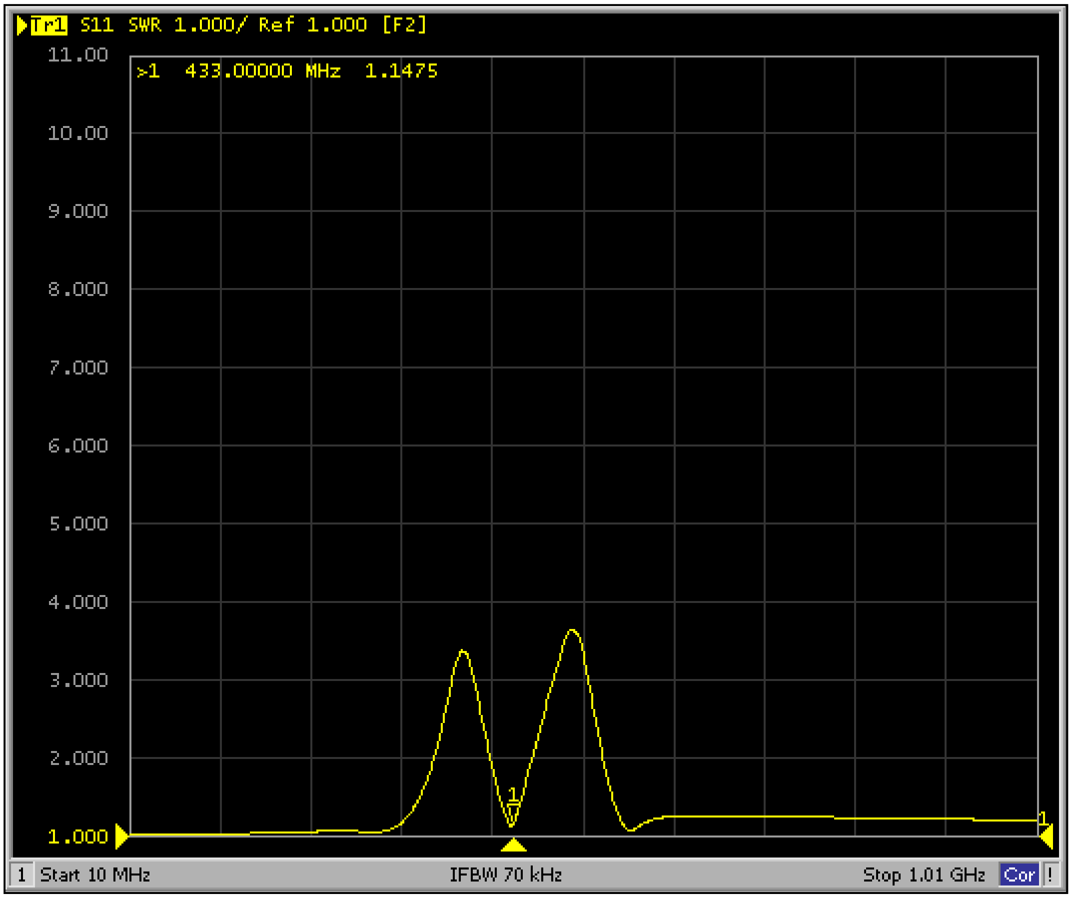

Figure 3 – Measured VSWR of Invention in Series with Antenna

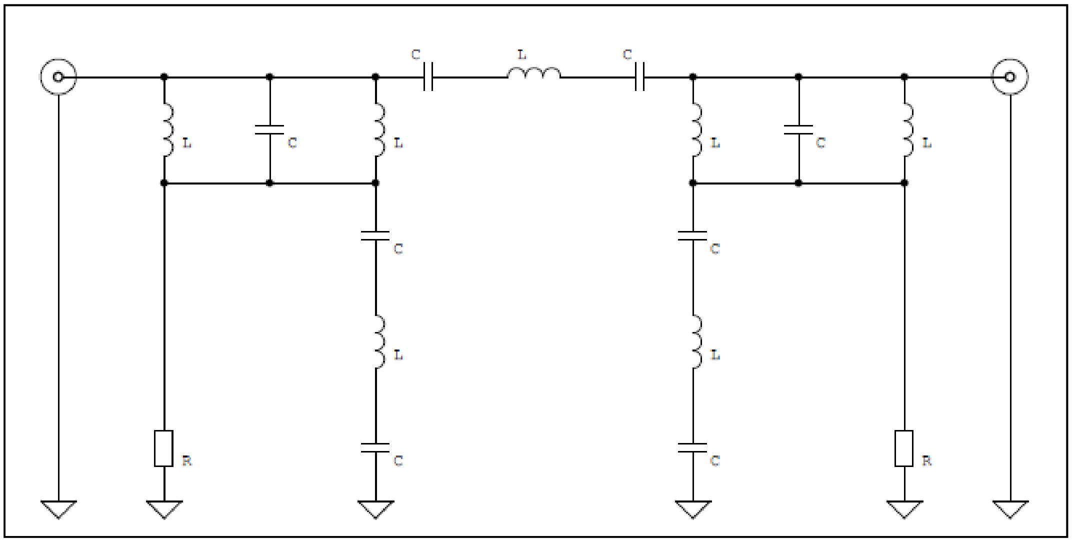

Figure 4 – Circuit Schematic of Preferred Embodiment