2024.04.10
JA5IUQ

# Consideration of end-fed antenna
# How to make a LC circuit impedance matching type end-fed antenna (50MHz band)

## 1. Introduction

I made an end-fed antenna that feeds power from one end of the antenna wire.

I measured the impedance (radiation impedance) characteristics when a 266cm antenna wire was installed perpendicular to the ground, and found that the resonance frequency (frequency where inductance = 0) is 51.0MHz, and the resistance component is 2500 to 3000Ω around that frequency. (Figure 1.1)

Based on this measurement, I set the radiation resistance to 3000Ω and designed a circuit that matches the output impedance of the transmitter to 50Ω using the impedance matching circuit shown in Figure 1.2.

As a result, it was found that L = 1.238μH, C = 8.255pF, and $f_R$ = 49.78MHz.

Therefore, based on this design result, I made the antenna shown in Photo 1.1 and obtained the data, which I will report here.

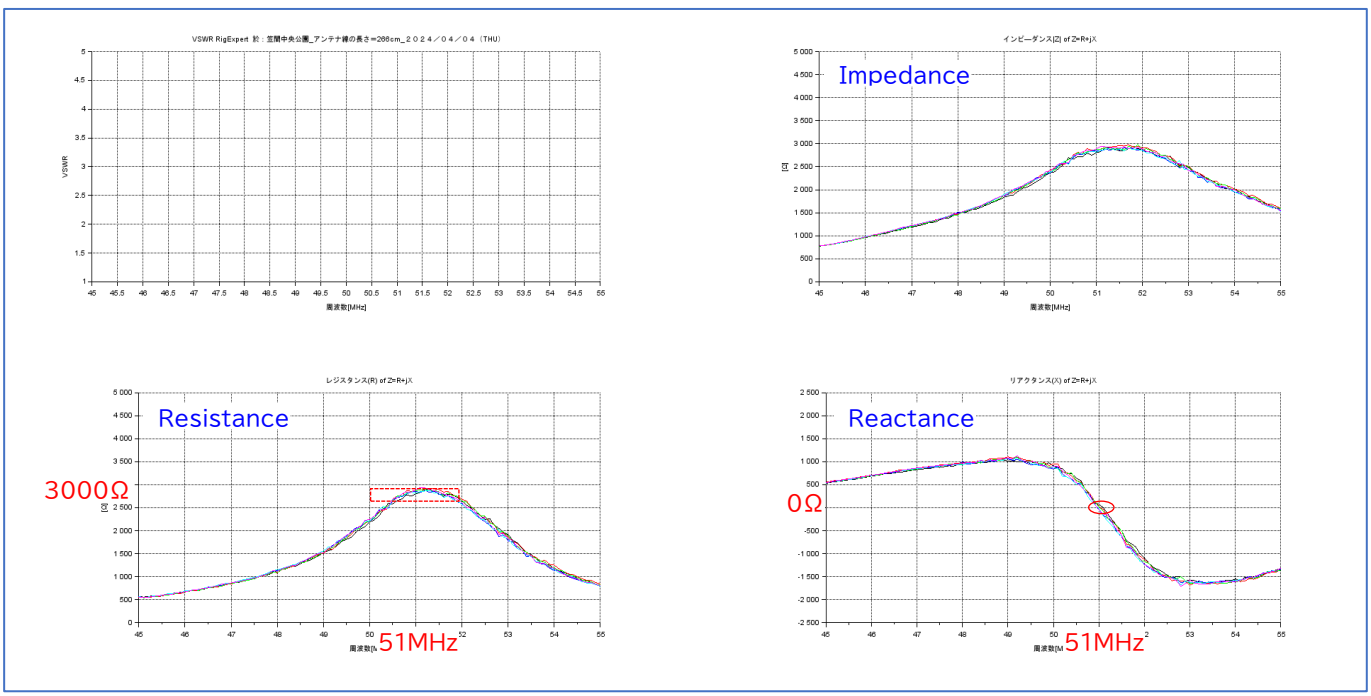



Fig 1.1 Radiation impedance characteristics of antenna wire

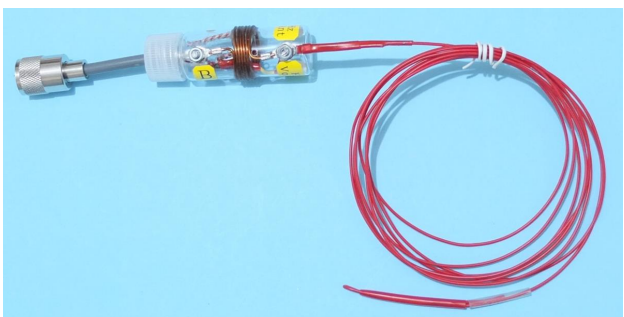


Photo1.1 this antenna

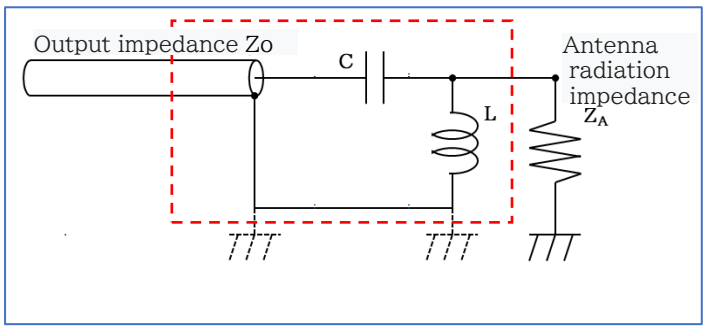



Fig1.2 impedance matching circuit

2. How to make a matching Circuit

(1) How to make a coil L

・coil material

・Coil bobbin: Spray bottle (20mL) (purchased at Seria)

・Coil wire material: $\phi$1.2mm polyurethane copper wire (purchased at Sengoku)

・Relationship between coil diameter (D), number of turns (n), winding width (w) and inductance (L)

・$L = k\,\mu s\,\pi^2 D^2 n^2 / w \times 10^{-7}$ (H): k: Nagaoka coefficient

μs: relative magnetic permeability (=1, air)

・$0.42 \times 1.0 \times \pi^2 \times (25.2 \times 10^{-3})^2 \times 6^2 / 8 \times 10^{-3} \times 10^{-7} = 1.185 \times 10^{-6}$ (H)

In other words, if I wrap a $\phi$1.2mm polyurethane wire around a $\phi$24mm spray bottle six times to a width of 8mm, I can expect an inductance of about 1.2$\mu$H.

Photo2.1 shows how the reactance of the coil is measured using the AA-55ZOOM.

As a result of calculation from the data, the inductance of the coil was 1.19$\mu$H at 50.2MHz.


Photo2.1 Inductance measurement status

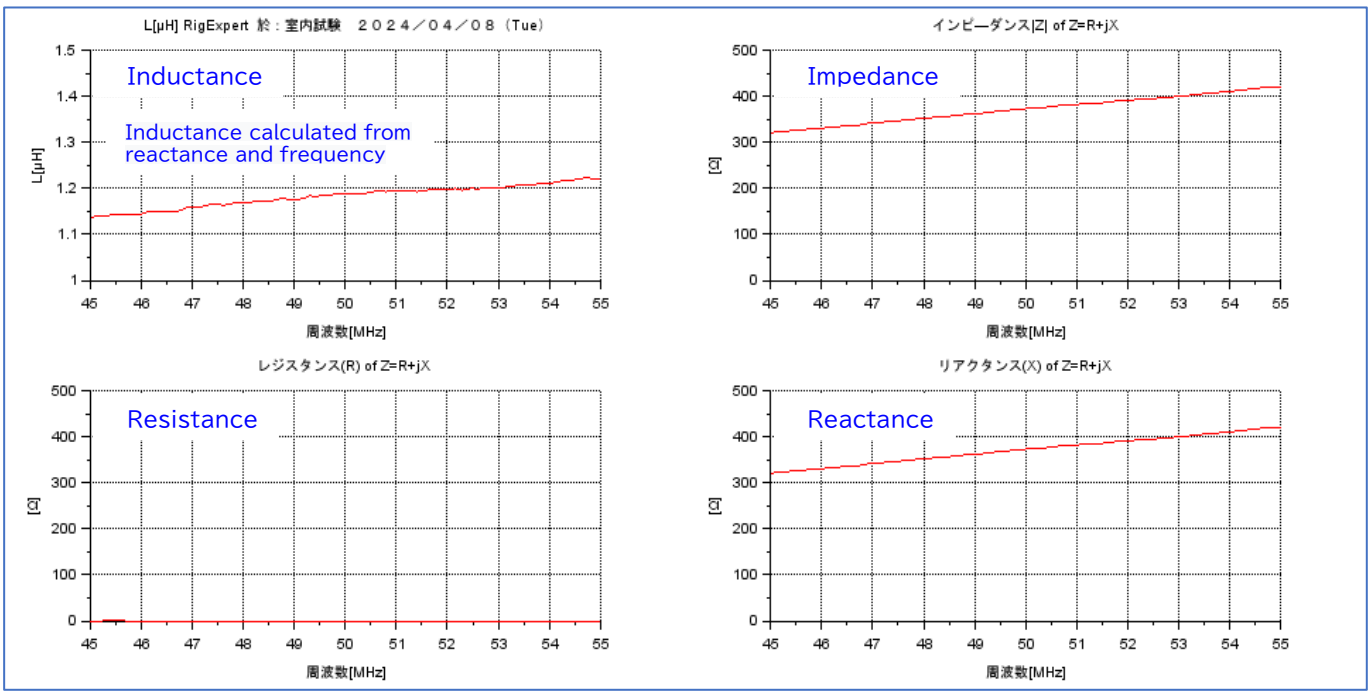



Fig 2.1 Inductance (reactance) measurement results

(2) How to make and adjust capacitor C

・capacitor material

・Wire: φ0.51mm Junflon wire (outer diameter 0.81mm) (ETFE) (purchased at Sengoku)

・shape

・Twisted pair and adjust capacity by cutting down

・adjastment

Rather than adjusting the capacitance of C, the resonant frequency of the LC circuit was adjusted to match the set value.

The resonant frequency of the LC circuit was adjusted to 49.8MHz using AA-55 ZOOM. (Photo 2.2)

It was also measured as a single unit, and it was 8.21pF at 50.2MHz.

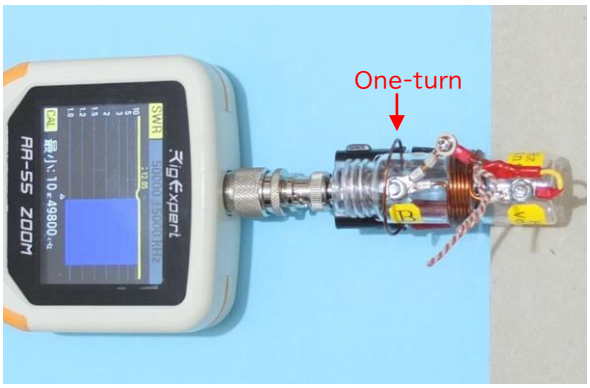



Photo2.2 Resonant frequency measurement status

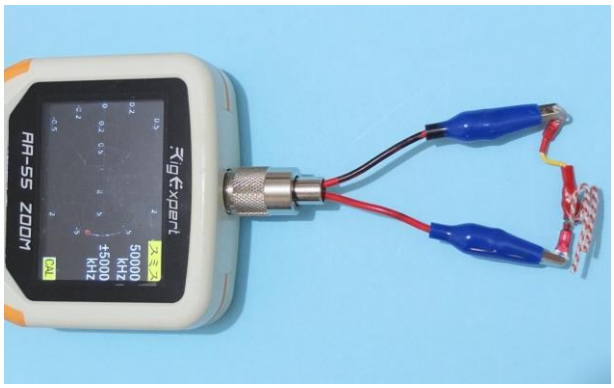



Photo2.3 Capacitance measurement status

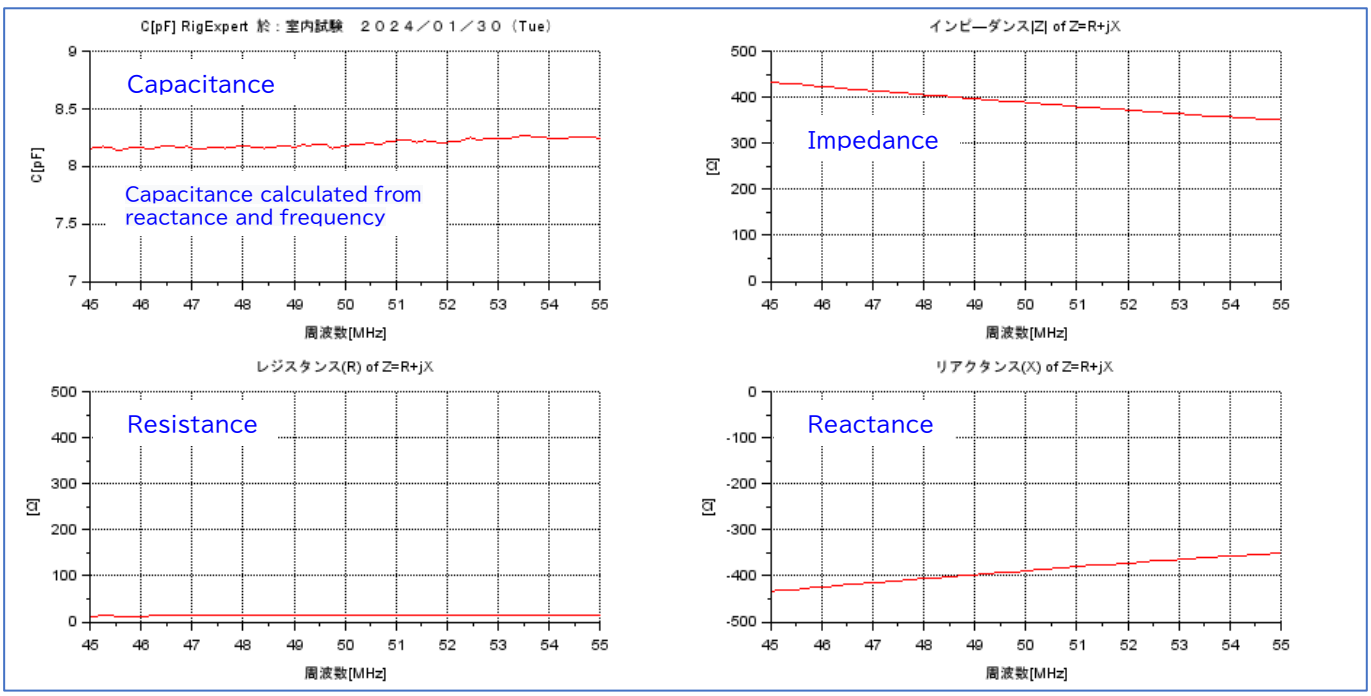



Fig 2.2 Capacitance (reactance) measurement results

3. Test results

(1) Indoor test results

Before conducting field tests, I conducted tests indoors (in the living room of an apartment) to confirm that it would function as an antenna. The data are shown in Figure 3.1 and Figure 3.2.

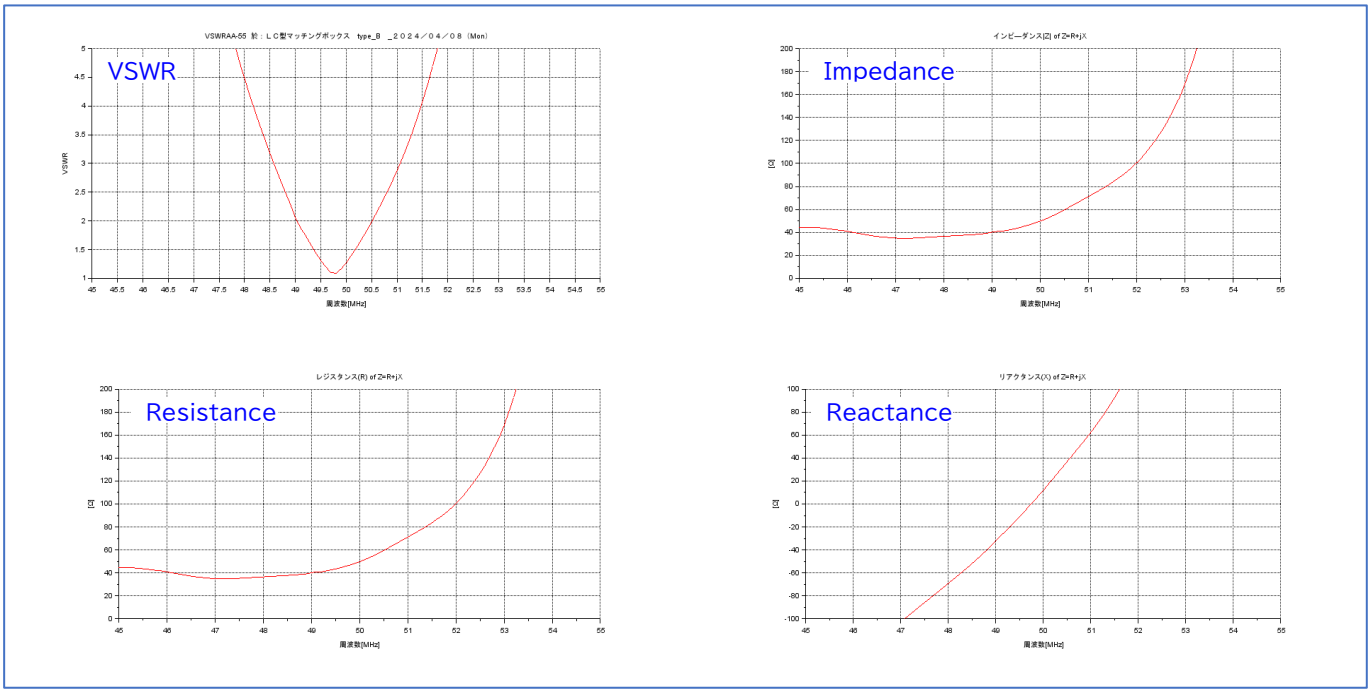



Fig.3.1 Indoor test results (VSWR, impedance, resistance, reactance)

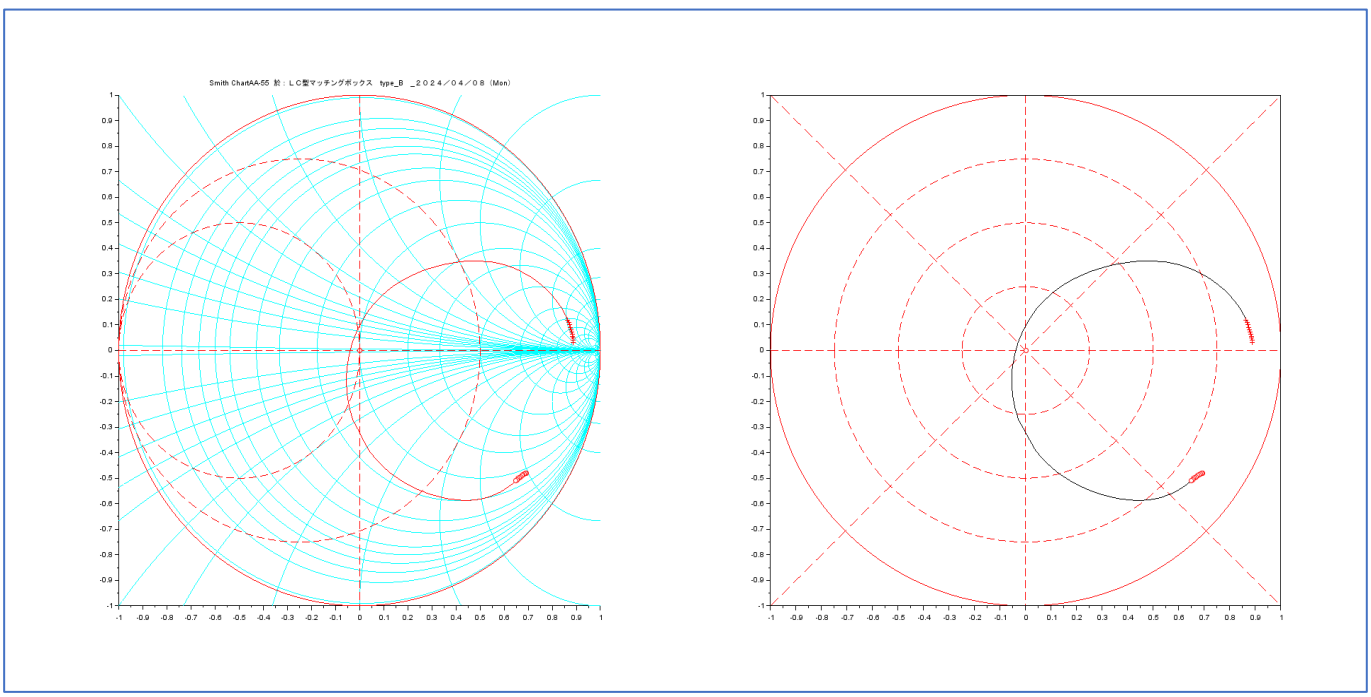


Fig.3.2 Indoor test results (Smith chart)

(2) Field test results

The field test data is shown in Figure 3.3 and Figure 3.4.

As a result of the test, the best value of VSWR was 1.20 near 50.4 MHz, and VSWR was 1.5 or less in the range of 50.0 MHz to 50.9 MHz, confirming that it is sufficiently practical as an antenna.

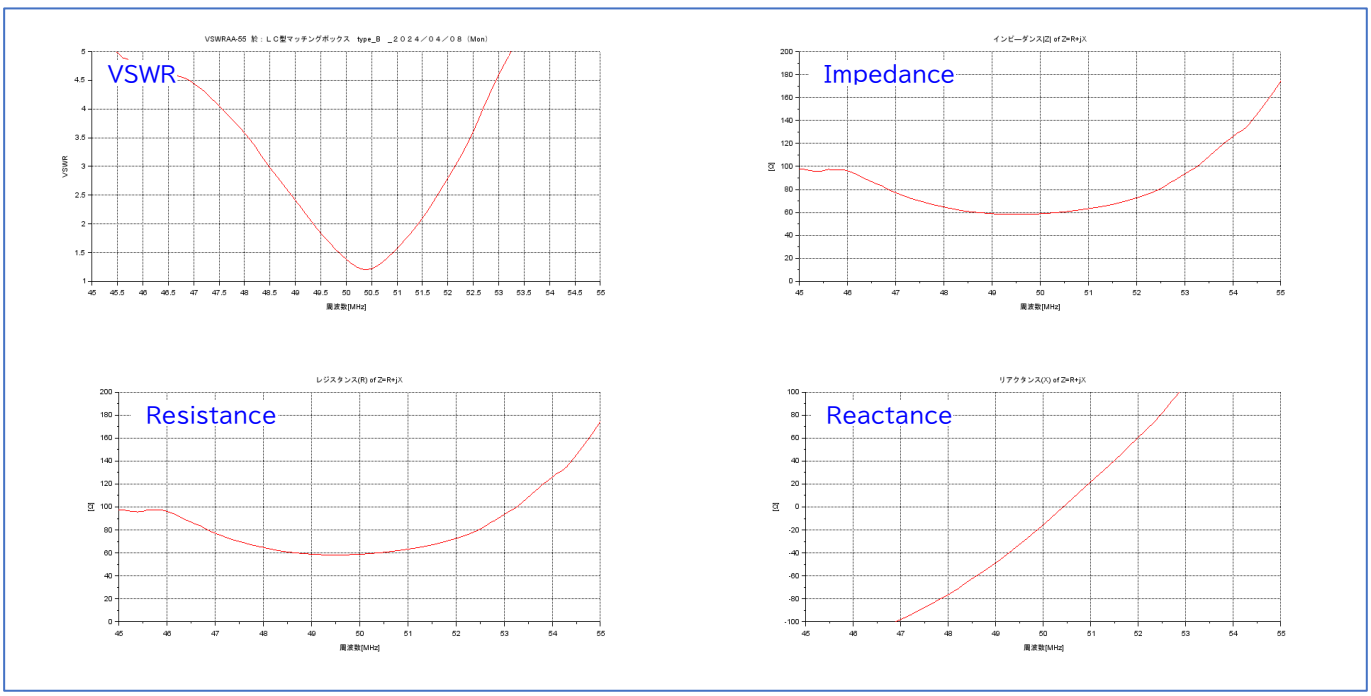



Fig.3.3 Field test results (VSWR, impedance, resistance, reactance)

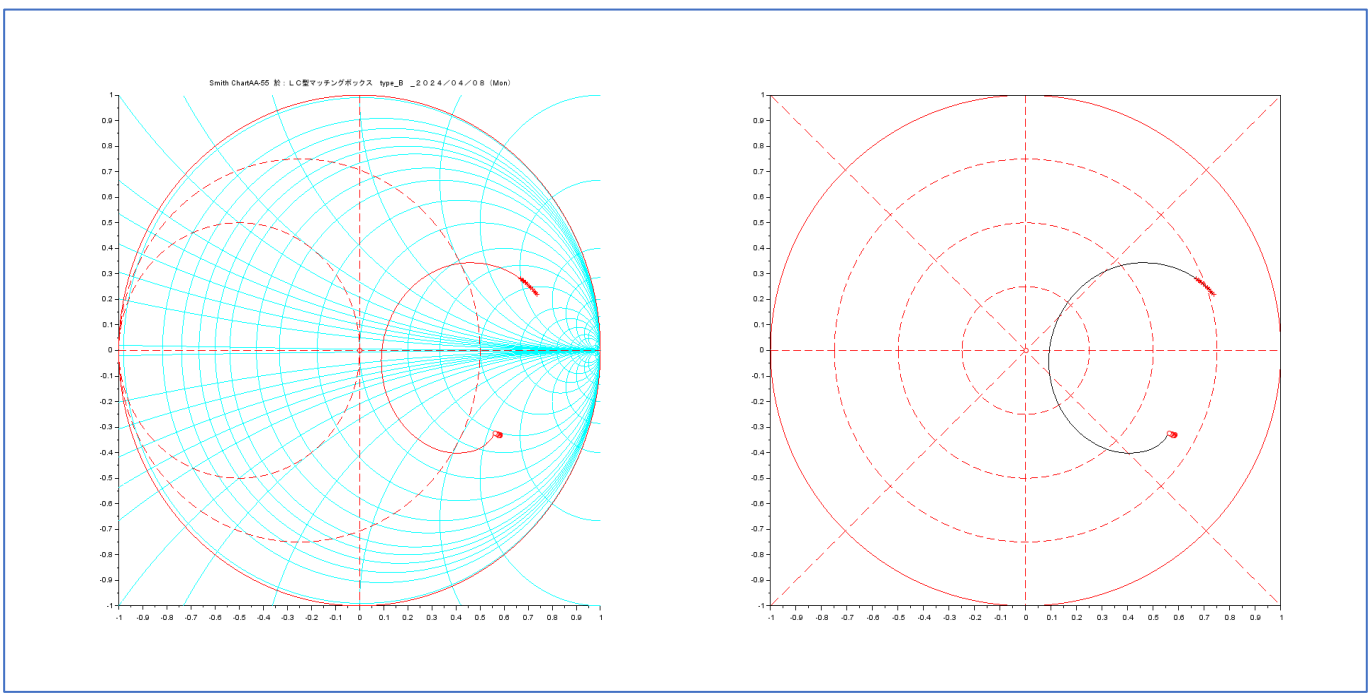


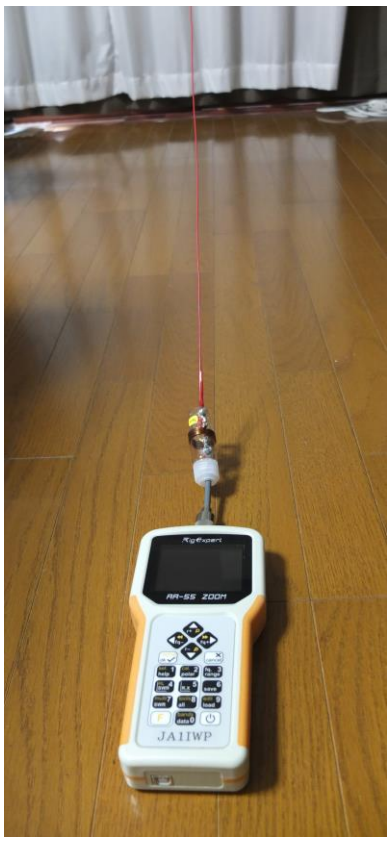
Fig.3.4 Field test results (Smith chart)

4. Afterword

Based on the radiation impedance data of the antenna wire, I created an LC circuit impedance matching type end-fed antenna.

Its VSWR characteristics showed good values (1.5 or less) at 50.0MHz to 50.9MHz.

Additionally, it worked without any problems in a 100W transmission test conducted at a later date, confirming that the hardware is sufficiently durable for practical use.




<Indoor test status>

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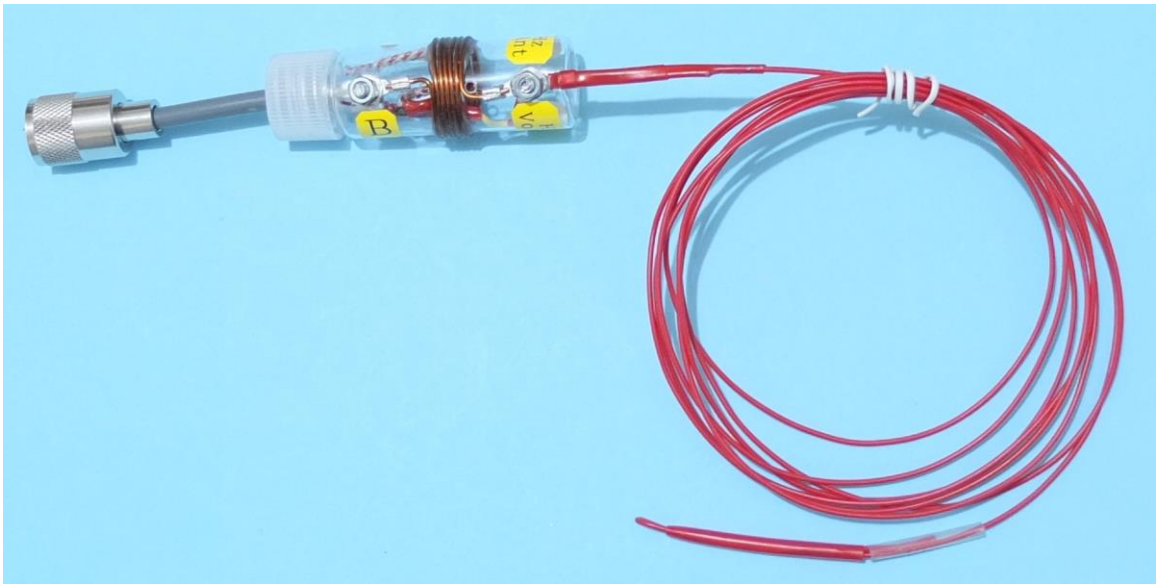

<Prototype antenna >