

Daiwa CN901V N directional wattmeter

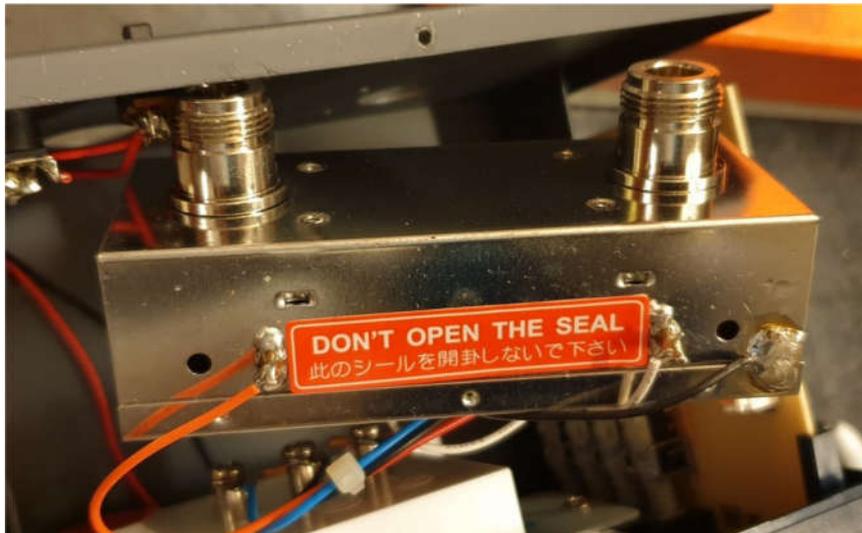
technical analysis

IKOBGG Jan. 2021

After having detected bad performances in terms of poor directivity of the CN901V N wattmeter, serial number 2007, I decided to disassemble it in order to understand how it has been designed and built.



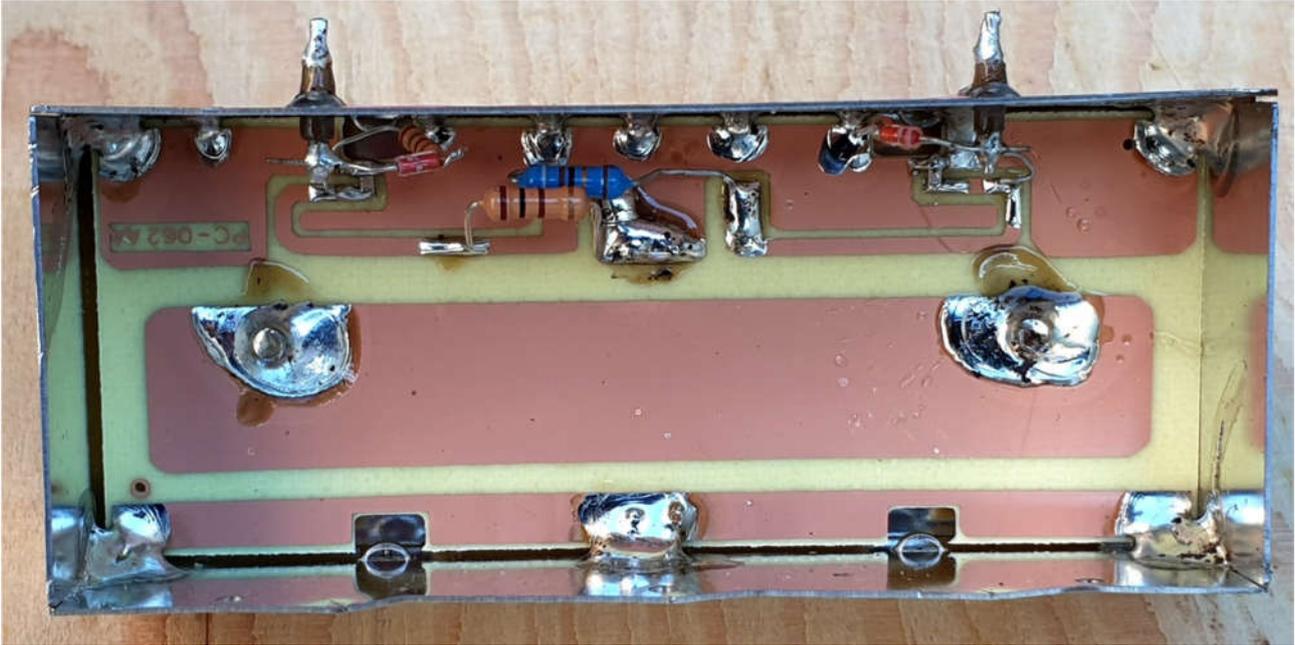
The heart of the instrument is the directional coupler I took out from the box:



The unit is hosted in a tinned steel box with a red seal label covering a long slot in the upper wall of the box. I left in place the label and removed the cover after having taken away the solder seal put on its right side.

Here is what the directional coupler looks like once the cover is removed:

- a suspended microstrip main transmission line links together the two N input and output connectors.
- two other microstrip transmission lines realize the directional couplers of the forward power (left) and the reflected power (right)



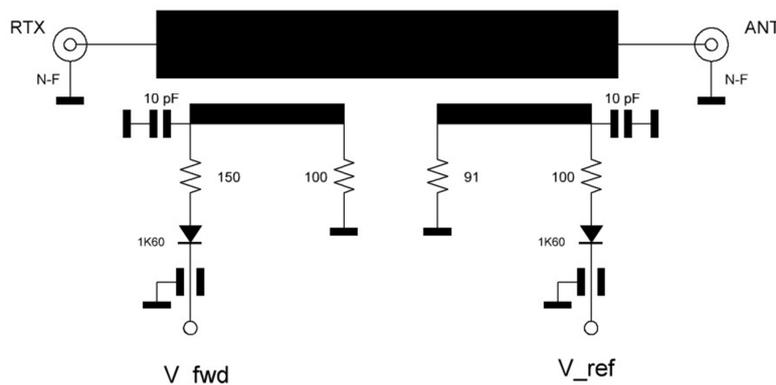
One may immediately notice the realization characterized by solder paste residues, excess tin, tiny little tin balls walking throughout the box.

At a first look one is impressed by the two couplers - that should be designed to operate up to over 500MHz - manufactured like an audio frequency circuit: the components are left with long leads.

There are long leads in order to make possible the calibration of the unit by changing the components' position by acting with a dielectric tool from the outside through the alignment slot. By moving the components one can obtain a power calibration but the consequence of the distorted coupler's topology and the lead's parasitic parameters is a very poor directivity, especially on the 430MHz band; as a result SWR readings are erratic.

Here is the schematic diagram of the unit.

Daiwa CN901V N VSWR coupler



Let's see into detail of how the forward power coupler is built.



The 100 ohm 0.5W resistor has long leads in order to be moved during the alignment process, the left lead is also connected to a weird place: it is soldered to the center of the microstrip instead of being connected to its land which, of course, has been left free.

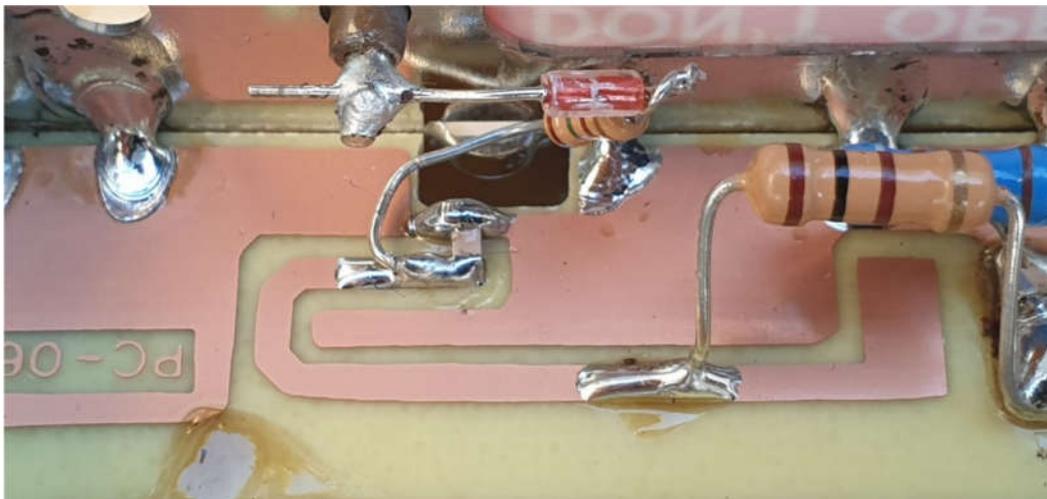
The 150 ohm resistor which is in series with the diode has an excessively long lead connected to the microstrip and it has been clearly moved when calibrating.

As for the reflected power coupler, the situation is as follows:



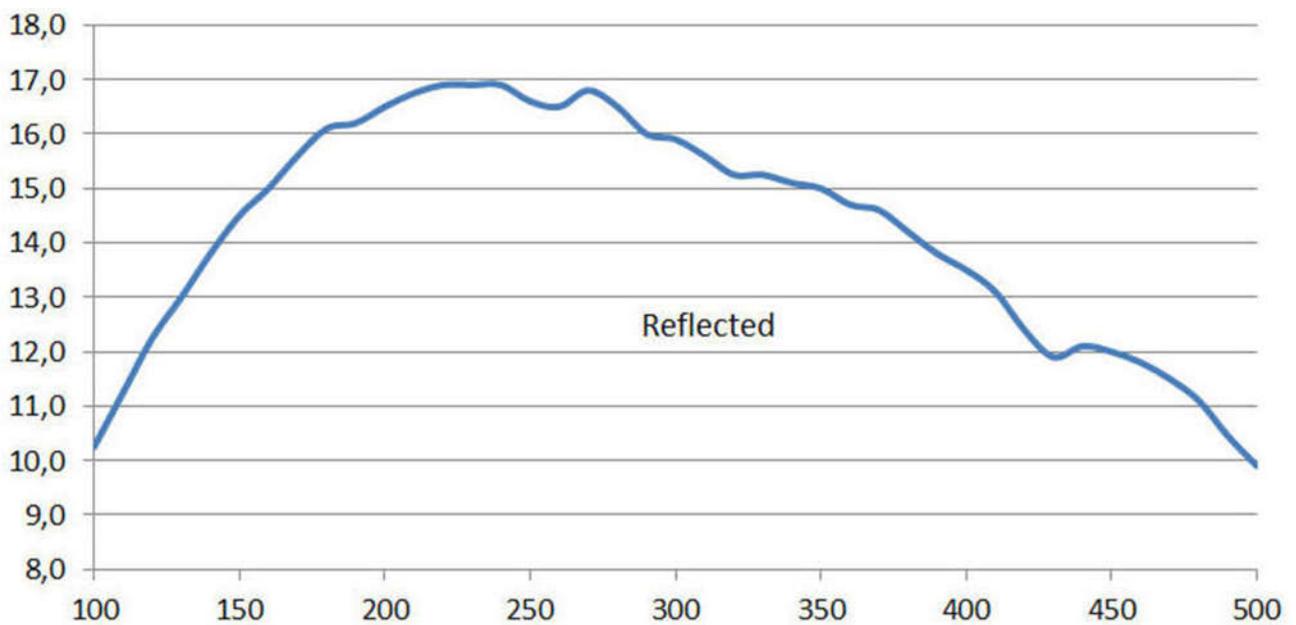
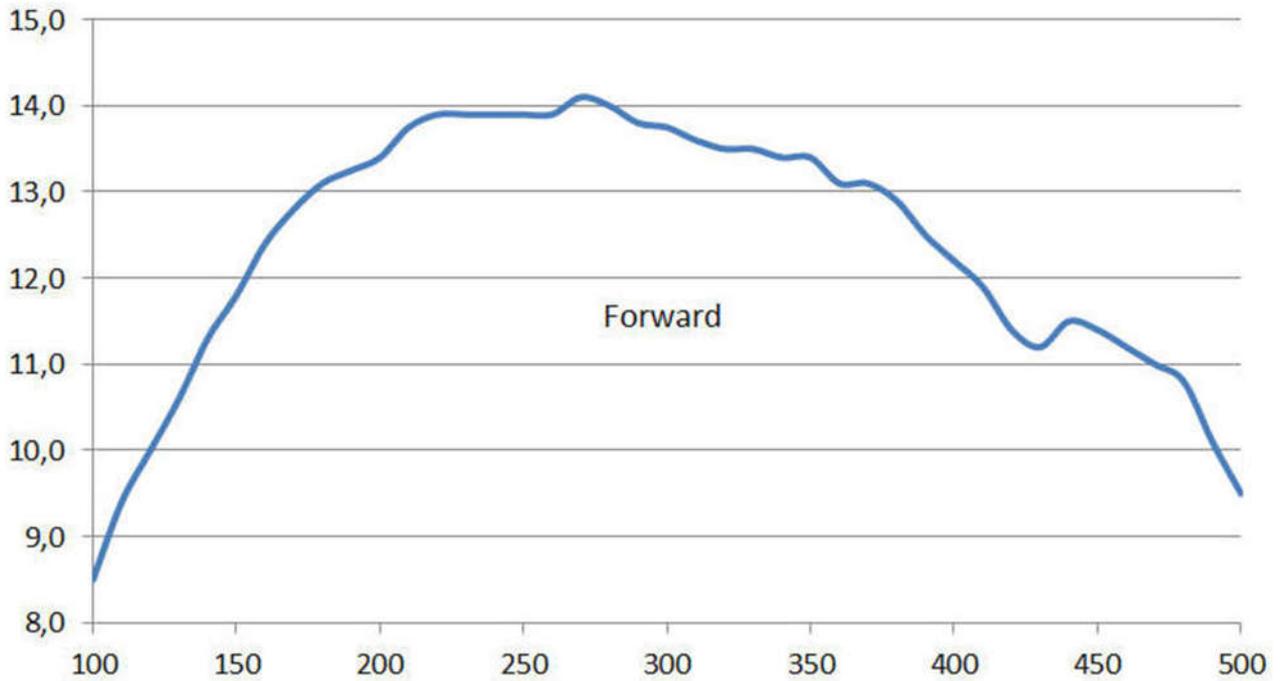
The 91 ohm 0.5W resistor (the blue one on the left side) has its right lead soldered to the right land (unlike the forward coupler one) but it is excessively long in order to move it while calibrating. The 100 ohm resistor (on the right and in series with the diode) has the lead connected to the microstrip that are very long and wandering. The welding of the pin of the coaxial antenna connector to the passing microstrip line is made with an excess of tin and with the solder paste and dirties that has not been removed; solder residues are interposed between the main line and the reflected power coupler's line.

By carefully watching the coupler's detail one can deduce that it seems to have been designed by hand drawing! In fact the coupler's line width is not constant and also the other traces have not been accurately drawn.



The coupler performances have been measured by feeding the unit with a signal generator and reading the output voltage, in relative units, as a function of the frequency; here are the forward and reflected power characteristics that have the same amplitude only in two points: 145 MHz and 435 MHz amateur bands.

Since the power is proportional to the square of the voltage, the accuracy of the power readings outside the above two amateur radio bands is completely out of specs.



The directivity is very poor but measurements are not shown in this report.

CONCLUSIONS

The directional coupler, the heart and the most critical component of the Daiwa directional wattmeter, has inadequate performance for a device that must operate up to over 500 MHz.

The components are left with long leads in order to change their position during calibration to achieve the desired frequency response of the wattmeter, the power calibration is reached only on the two ham radio bands and not on the entire specified frequency range.

A consequence of the distorted coupler's topology and parasitic parameters is a very poor directivity, especially on the 430MHz band, and so erratic VSWR readings.

A careful examination of the PCB traces shows that it seems to have been designed by hand drawing, in fact the coupler's line width is not constant and also the other traces have not been accurately drawn.

Due to this design and manufacturing of the directional coupler, the performances of the Daiwa CN901V N, s. n. 2007, are really poor and far from what is stated in the product's technical specifications.

It is under study a modification of the directional coupler in order to make the instrument work properly.