

# Bird 43 wattmeter

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## Purpose:

This paper describes the temperature dependency of the power reading of a Bird 43 wattmeter.

Absolute accuracy is measured as a second parameter as well as the accuracy and reproducibility of the measuring method.

## Material:

1. Bird 43 serial# 42870
2. Slug Coaxial Dynamics type 82006: 2-30MHz 250W
3. Dummy load 50 $\Omega$  Philco 160B-150FN serial# 1138
4. HF to DC peak detector , lab made
5. DC voltmeter APPA 65 & DVM part of THS730A
6. Variable RF power generator 2-14MHz 10-100W (IC751A)
7. Resistance measurement with TTi LCR400 and APPA65

Accuracy of the above (3) to (6) :

- Dummy load (3) was measured to be 50.0 ohm with the TTi LCR400 and APPA 65 which was checked/ calibrated against a certified standard of +/- 0.5%
- The lab made peak voltmeter(4) characteristics were measured and are discussed below.
- The DC voltmeter APPA 65 (5) was checked against a traceable standard.
- The power RF generator IC751A (6) was measured as having 2<sup>nd</sup> order harmonics of < -55dBc and 3-7th order < -60 to -80dBc

The HF to DC peak voltmeter consists of 3 x 1N4148 diodes in series and terminated with a mica C of 680pF and a parallel resistor of 680K, see fig1 below. It was checked that no significant output voltage ripple occurred at the chosen measuring frequency.

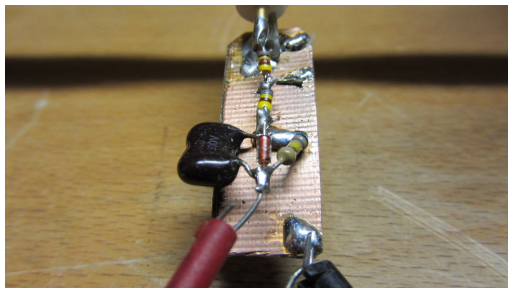


Fig1

## Test method:

The Bird 43 analogue built-in meter is stated to have a range of  $30\mu\text{A}$ . A variable PS of 0-30V was used in series with a resistor of  $1\text{M}\Omega$  to verify the stated range. This full scale mark was measured to be  $28.5\mu\text{A}$ , i.e. a deviation of 5%.

The temperature dependency in the range 12-25 °C of the meter without slug was measured to be negligible.

Fig2 below shows the setup. A T-connector is used to tap the RF signal to the peak detector. This setup shows negligible frequency dependency between 2-21MHz. The test frequency was set at 3550KHz which is well within a span where secondary parasitic effects are negligible.

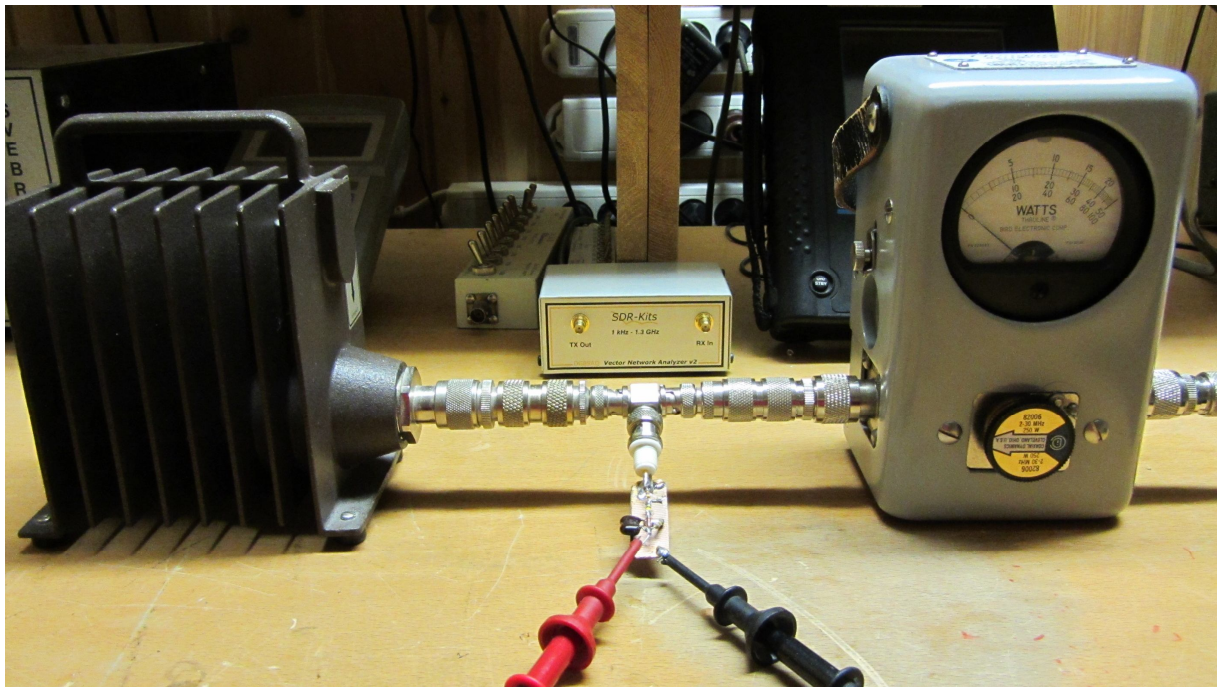


Fig2

The peak detector is used to measure the absolute power including the voltage loss over the 3 x 1N4148 diodes. Therefore the voltage loss was determined using DC current within the same range as the measuring setup. The diode voltage drop over the measuring range in the peak detector is plotted in Fig3 below.

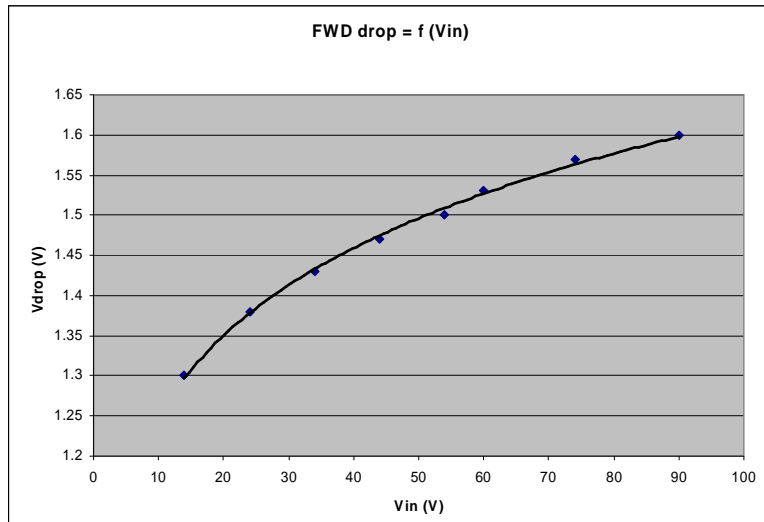


Fig3

The laboratory temperature during the tests was between 22.0-22.5°C. The slug temperature was varied between 15°C and room temperature.

Taking the diode voltage drop in account, the measured peak voltage is recalculated to an RMS voltage and towards power into the dummy load.

Fig4 below shows the measured vs Bird 43 power reading at 22°C (black) and 15 °C (red) and Fig5 the error in % of the reading.

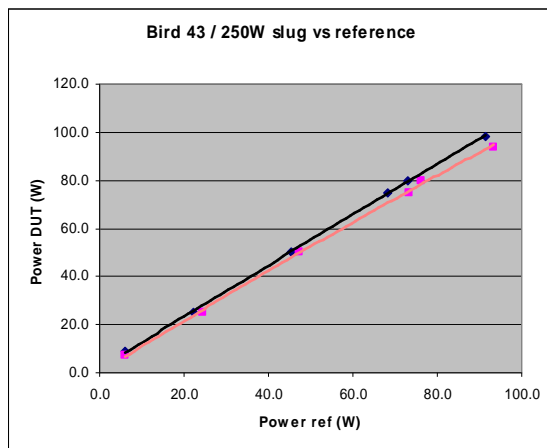


Fig4

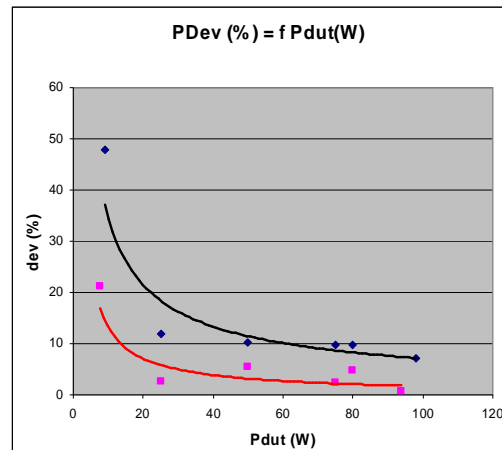


Fig5

A less reproducible test was done by cooling the slug to -15°C. Although it was not possible within this test to have a stable temperature in this range, it was clearly seen that the power reading was approx 20W lower compared to room temperature, increasing the error at mid scale to > 20%.

## **Conclusions/summary:**

The Bird 43 wattmeter is a rugged portable wattmeter with a practical way of changing frequency and power ranges. The slug is an analogue device where certain temperature dependency takes place for what is not compensated. For maximum reproducibility the Bird 43 must be handled within a very limited temperature environment.

### **Footnotes:**

The peak voltage test was chosen as accurate attenuators still have tolerances of  $\pm 0.1\text{dB}$  which equals to a power range of  $\sim 5\%$ . A peak voltage test transferred to power is only valid and calculable if the voltage is sinusoidal, therefore the source must have a high harmonic suppression. The frequency dependency of the peak detector is reasonable predictable by the internal capacitances of the diodes and T-connector. Verifying this with a frequency sweep is a solid method.

The analogue scale of the Bird 43 is compensated for the diode nonlinearity in the slug(s) but, as this is temperature dependent, a non compensable error will always exist in this analogue device.

## **References:**

[http://www.dxstore.com/download/Bird\\_43\\_Series\\_Manual.pdf](http://www.dxstore.com/download/Bird_43_Series_Manual.pdf)