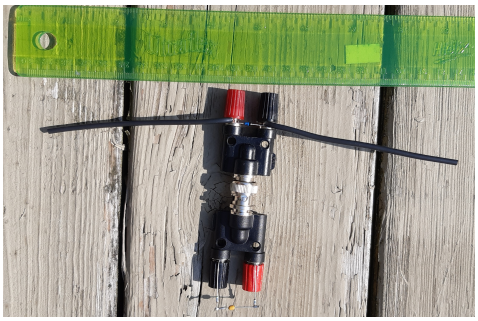
E-Probe for 20 m - 160 m Bands

Assembly and Calibration Guide



Revision	1
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Notice
Calibration is needed for field strength levels used and for different frequencies. Re-calibration has to be done if the probe was exposed to excessive radio frequency fields.

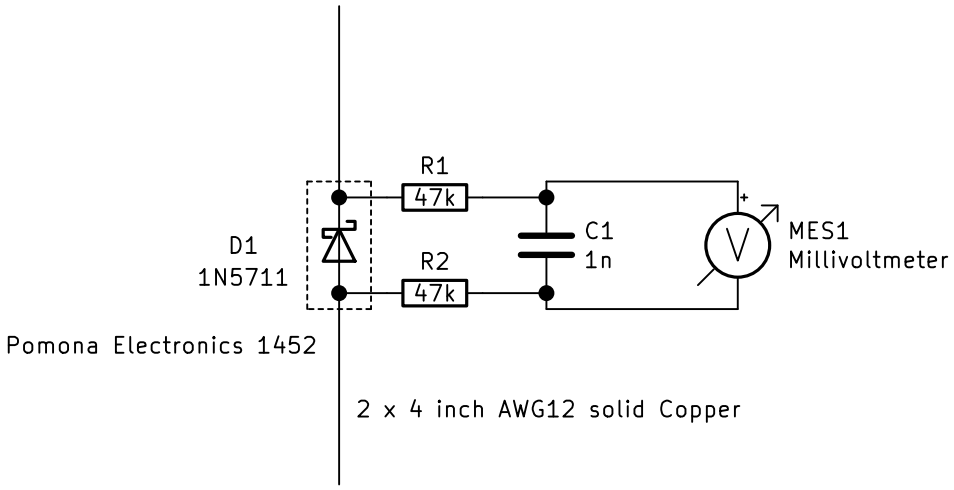

Figure 1: Circuit diagram of the probe uses Schottky diode D1 at center of electrically small dipole made from AWG12 solid Copper wire. Add 1/2 inch to wire length for connections. R1 and R2 isolate antenna from millivoltmeter and C1 filters the signal. Pomona Electronics 1296 and 1452 BNC-adapters are optional and circuit can be constructed on bread board too.

Calibration

The probe dipole is placed at 0.1 m distance from calibration dipole made from AWG12 solid Copper wire as shown in Fig. 2. The calibration antenna has impedance close to 50 Ω on bands used and provides good match to QRP transceiver like FT817 as seen from Fig. 3. Step attenuator (Elecraft AT1) is needed to measure power levels below 0.5 W with this transceiver.

Voltage at calibration dipole feed point is $U = \sqrt{P \cdot 50\Omega}$. Here P is power from transceiver. Self capacitance of dipole arm is about 1.4 pF. Displacement current flowing into dipole arm is negligible compared to current to 50 Ω load resistor. Thus dipole arm peaks at potential $\pm\sqrt{2} \cdot U/2$ to good approximation ($U = 0$ V at center of dipole). Electric field in wire direction at 0.1 m distance from excitation antenna along length of receiving dipole was estimated with FEMM 4.2 (David Meeker) electrostatic model using $U/2$ for one dipole arm. Fig. 4 shows measured voltage on bands 20 m - 160 m with different field strengths. Measured voltage has probably $\propto E_z^2$ dependence at field strengths below 1 V/m and $\propto E_z$ above 10 V/m (M. Kanda 1993).

Directivity can be tested by rotating the probe antenna by 90° to vertical plane.

Coupling to magnetic field is due to parasitic open loops in circuit construction. The induced voltages can be estimated from Faraday's law of induction.

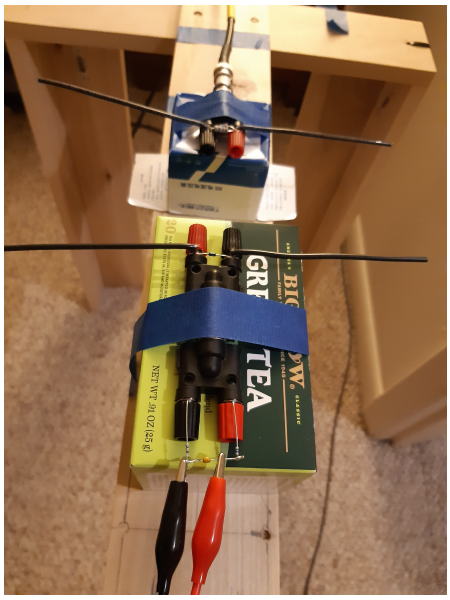

Figure 2: Probe at 4 inch (10 cm) distance from calibration antenna with two 100 ohm 2 W resistors in parallel at feed point.

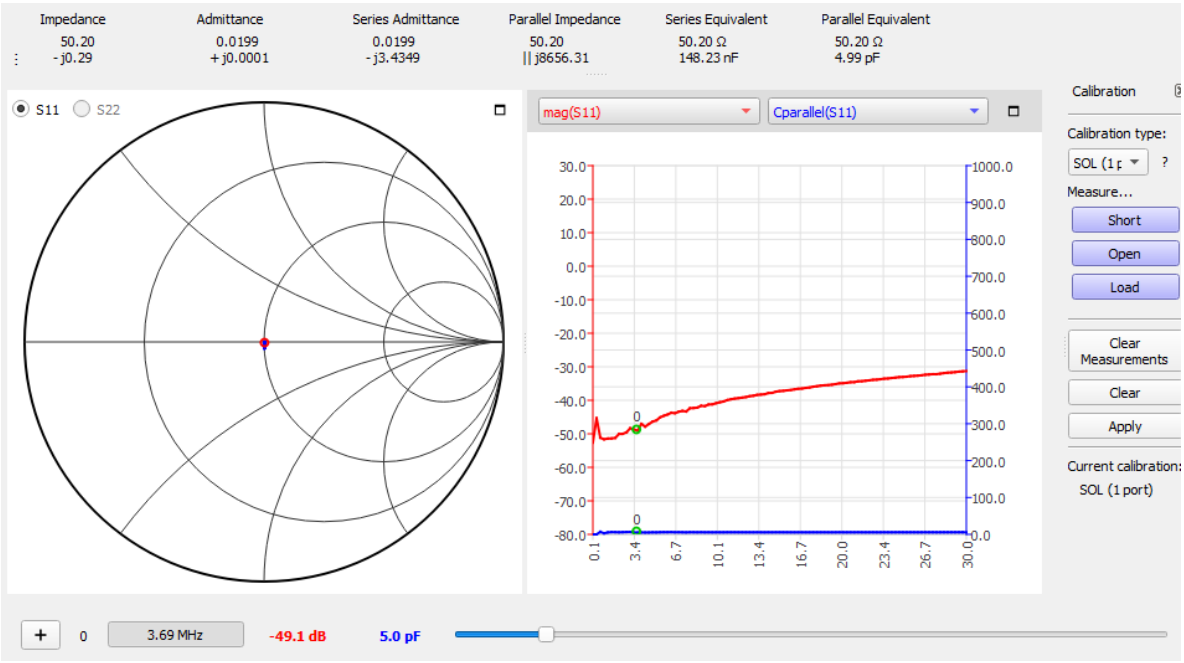

Figure 3: nanoVNA gives capacitance of 5 pF and resistance 50 Ω. Return loss is more than 30 dB below 30 MHz.

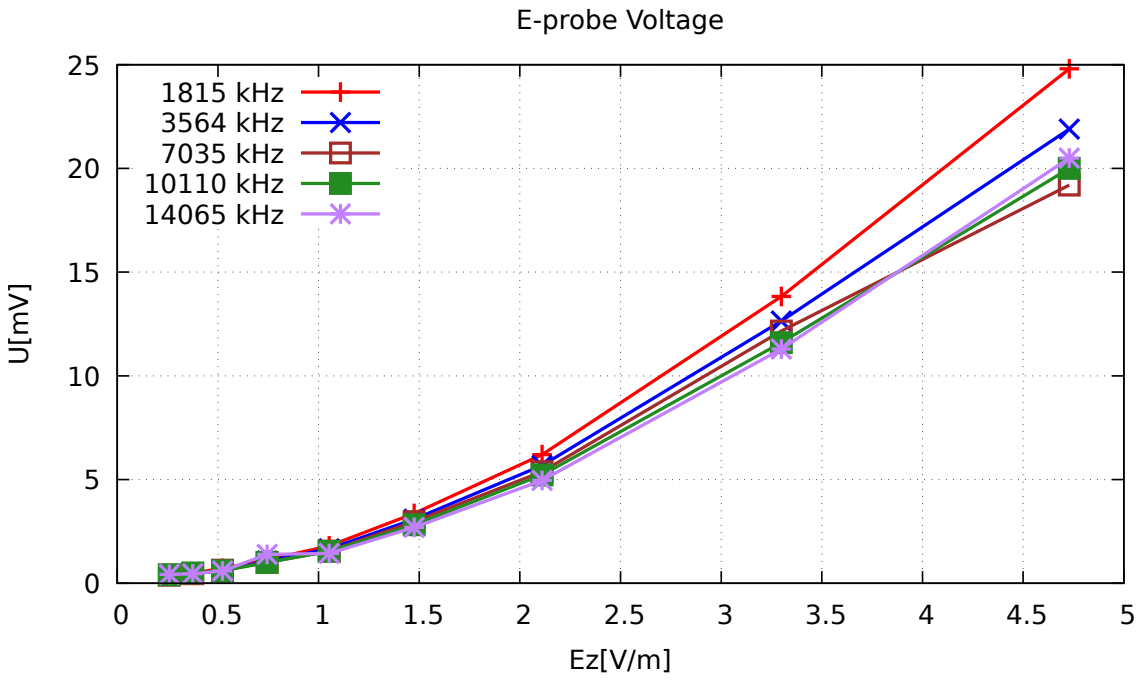

Figure 4: Typical Ez-field (in direction of dipole wire) response on bands 20 m - 160 m. Sensitivity seems to be almost same on all bands. Signal detection is maximum when calibration antenna and probe antenna are in parallel orientation.