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Data Sheet

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4 Pages
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Micro RWD 125kHz Antenna Specification

The Micro RWD has been designed to interface to a simple low Q (10-20) antenna coil of around 750uH (micro Henry) inductance operating at a carrier frequency of 125 kHz. For maximum range and performance the following factors should be considered:

1) Maximum range and coupling between transponder and RWD is based on the ratio of their antenna diameters. Very approximately the RWD antenna loop diameter should be 2-3 times the diameter of the transponder coil. The basic method of communication is via magnetic flux linkage (like an air-cored transformer) so the more lines of flux that intersect the transponder coil, the better the overall performance. For ISO card transponders there is little benefit in using an RWD antenna larger than 10cm diameter. Circular antenna coils generally give a more uniform flux distribution.

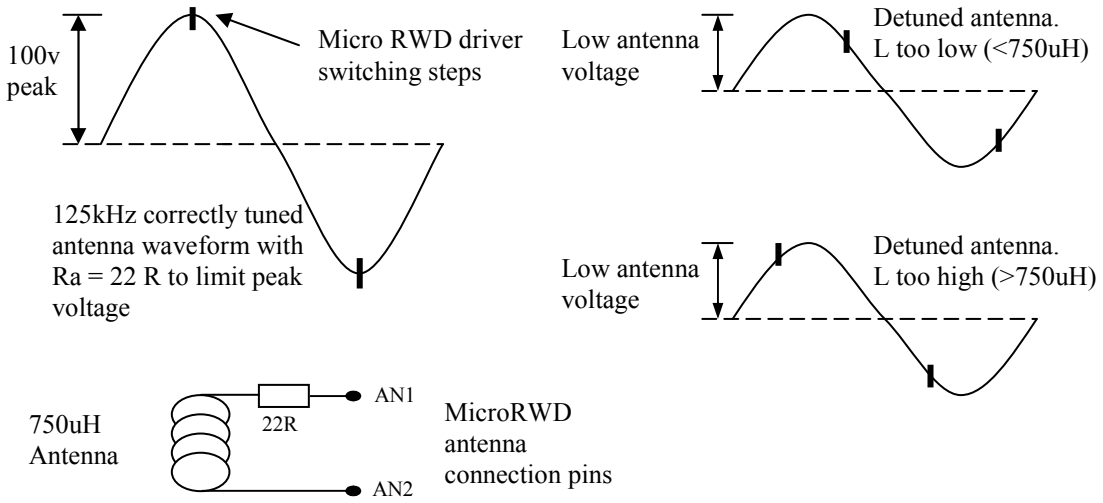
2) The Micro RWD is designed to give up to 400ma pulse current with a peak voltage of up to 200v. This can give a 20cm read/write range with HT2 ISO card transponders. Lower burst current can be achieved by inserting an additional series resistor in the antenna loop circuit (22R in series would typically reduce pulse current/voltage by about half using example antennas). **This is recommended in order to give the optimum signal-to-noise ratio and Q value.**

3) Sample antenna supplied is for demonstration only. The characteristics of an antenna for EMC/WT approval will vary according to shape of coil, type of wire used, style of winding, bobbin material, compaction of windings etc.

4) If the antenna is to be positioned remote to the Micro RWD a screened twisted pair cable can be used to connect them. The screen should be connected to the Antenna GND pin on the Micro RWD. Cable lengths up to 1.5 metres have been tested and perform well with no significant system degradation.

5) The capacitance and inductive effect of antenna cable and physical positioning of the antenna should be taken into account when designing the antenna coil and if necessary the inductance of the coil should be adjusted to compensate. The 125KHz tuned circuit is basically an RLC network with the C element fixed on the Micro RWD board. Tuning the antenna inductance (L) for optimum performance is quite simple, the positioned antenna system should be connected to the Micro RWD and power applied. An oscilloscope should be connected between the AN 2 pin and the GND pin. **Without** a transponder in the field a pulsed 125kHz sine wave will be seen with a peak voltage of up to +/-180v, with small switching “steps” visible near the peaks and troughs of the sine wave.

Optimum tuning and performance is achieved when these "steps" are seen exactly at the maximum and minimum points of the sine wave, the peak voltage will also be at its maximum value. The antenna series resistor (R) should be set to limit the peak voltage to 100v maximum in order to give the best Q value and optimum signal-to-noise ratio **(Voltages above 200 volts peak-to-peak will give reduced range)**.



6) For optimum performance the antenna Q should not exceed 20 and to achieve reliable tuning at 125kHz the antenna inductance should be around 750uH. Higher Q and inductance values will still function but with a reduced range and performance.
The formula for calculating Q = 2*π*fL / Rant = 549 / Rant

where f = Resonant frequency, 125 kHz, L = Antenna inductance, 750uH
Rant = Overall antenna resistance = Rdriver + Ra + (Rcu + Rrf)
π = 3.14159 etc

Rdriver = 3.5 R (from IC spec) and Ra = 22 R (series resistor in antenna loop)
Rcu = Resistance of Copper (coil and cable) and
Rrf = RF resistive component (eddy current losses etc)

By measurement at 125kHz, (Rcu + Rrf) = approx 6R
Therefore Rant = 3.5 + 22 + 6 = 31.5 Ohms, Q = 549 / 31.5 = 17

Max peak antenna current (with 22R series resistor),
Iant max = 4Vdd / π*Rant = 20 / π*31.5 = 200ma
Max peak antenna voltage, Uant max = Iant max . (2*π*fL) = 100v

7) **The Micro RWD has been designed to work at optimum performance with Rant = 31.5 (Ra = 22R), Uant max = 100v and Iant max = 200ma**.

When designing and winding antenna coils, the wire gauge and it's DC resistance must be considered to keep close to the design optimum. Significant differences in Ra will affect resilience to EMC and overall performance.

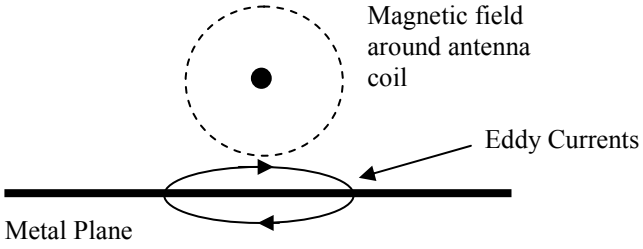
8) The strength of the magnetic (inductive) field of the antenna coil is proportional to the number of turns of wire used. Therefore, for maximum performance and range, the number of turns should be as high as possible and the gauge (thickness) of wire chosen to ensure the total Rant value (DC resistance) is kept around 31.5 ohms.

   Therefore, for antenna coils with DC resistance of 10 ohms, the series resistor should be 22 ohms.

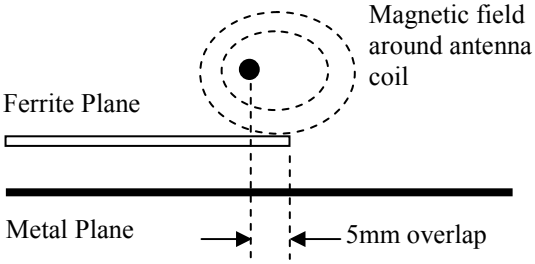
   For antenna coils with DC resistance of 20 ohms (better performance and range), the series resistor should be around 10 ohms.

9) <u>Ferrite Shielding</u>

When the RWD antenna coil is positioned close to metal objects such as the reader housing or even the PCB ground plane then the RF field induces eddy currents in the metal. This absorbs the RF field energy and has the effect of detuning the antenna (reducing the inductance). Both these factors can very significantly affect the performance of the RWD system. Therefore for operation in metallic environments it may be necessary to shield the antenna with ferrite. This shielding has the effect of concentrating the magnetic field lines close to the ferrite material, which introduces a fixed field component that detunes the antenna system (which can be accounted for in antenna design). Practically, there is a compromise between the shielding effect (reduction of eddy currents) and the concentration of the magnetic field (reduced range), so the ferrite plane should only slightly overlap the antenna coil. The optimum size of the ferrite plane, the distance from the coil and the degree of overlap are very hard to calculate and must be determined practically. Tests have shown that best performance is achieved when the antenna coil and ferrite plane overlap by around 5mm.



Eddy currents absorb energy and cause detuning of antenna



Optimum field distribution, fixed antenna detuning with minimum loss of energy

A useful formula is given below for calculating the approximate number of turns required to achieve a particular inductance.

$$N = (\text{approx}) \sqrt[1.9]{\frac{L}{2 \cdot A \cdot \ln(A / D)}} \qquad \text{or} \quad L = 2 \cdot A \cdot \ln(A / D) \cdot N^{1.9}$$

L = Required Inductance (nH) i.e H x 10^{-9}
A = Antenna Circumference (cm) ie. π x diameter (cm)
D = Wire Diameter (cm) e.g 0.0236 cm
N = Approx number of windings

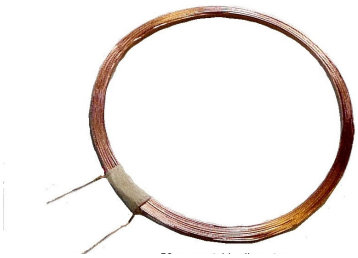
Example Antennas

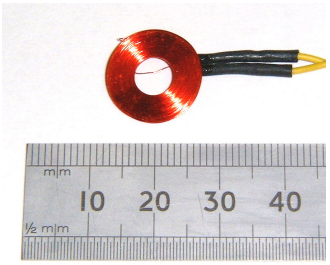
A)
0.236mm diameter (34 swg) Enamelled Cu wire.
Antenna 14.5cm internal diameter, 45 turns.
Approx 750uH
Maximum range: approx 20cm with HT2 card transponders

B)
0.236mm diameter (34 swg) Enamelled Cu wire.
Antenna 10cm internal diameter, 55 turns.
Approx 750uH
Maximum range: approx 15cm with HT2 card transponders

C)
0.236mm diameter (34 swg) Enamelled Cu wire.
Antenna 7cm internal diameter, 67 turns.
Approx 750uH
Maximum range: approx 10-15cm with HT2 card transponders

Examples of antenna (C) and a very small antenna for applications with limited space





More information on the Micro RWD and other products can be found at the Internet web site:

http://www.ibtechnology.co.uk

Or alternatively contact IB Technology by email at:

sales@ibtechnology.co.uk