

Antennae make sure you have the optimum position.

Introduction

Now that you have built, bought or or are thinking about acquiring your own PilotAware Classic, it's time to consider where to position the unit and the various interfaces in your aircraft.

PilotAware is designed as 'carry on' equipment to be used as portable equipment or can be installed more permanently, if allowed by your aviation authority.

Whichever method you use, a simple understanding of the laws of physics will help you decide where to locate the PilotAware and, more importantly for this article, specifically where the antennae are located. So, this is a simple explanation, written for the majority of users to understand and help them position their PilotAware Classic units and antennae for maximum effect. More technical users with even better advice will hopefully post their advice on the PilotAware forum to help optimize the advice given here. Radio propagation, as the Buddha would say has many paths to perfection.

PilotAware uses the 868 MHz SRD Band (P3I) to transmit and receive signals between participating aircraft. This is how we can see and be seen. Where we position the antenna has a considerable effect on the performance of PilotAware both in its transmission and reception. In tests we have shown that with a correct type and a correctly positioned antenna, PilotAware has a range of 20Km, more than enough for a secondary conspicuity aid. So what stops PilotAware achieving this from any location in the aircraft?

Attenuation

Radio waves prefer what we call 'free space line of sight'. For our purpose we can assume that they they work best in cold dry air with nothing in the way. Unfortunately, this is best case and is virtually never achievable. Things do get in the way and the air can have variable density (due to temperature and humidity) all of which have an effect on performance. In the same way that a frosted glass window will disrupt light waves some things will totally block, partially block or distort radio waves. This is particularly so in the case of metal. If you want to prove this put a radio in a sealed biscuit tin and you will see that it doesn't work. Likewise if PilotAware is put into a sealed metal aircraft it will not work properly.

However, all metal aircraft are not sealed as they have doors and windows which let radio waves in. That's why your mobile phone sometimes works in the air, but it's not ideal. Also in most aircraft there is a huge mass of metal engine up front , or in the case of a micro-light weight shift or pusher aircraft, behind the pilot which will absorb a lot of the PilotAware Classic radio energy reducing the range. Get the idea? When radio waves go through metal they are significantly reduced, or attenuated as radio engineers say.

Attenuation also happens when radio waves go through water. To prove this put your radio in a bucket of water and again it will not work. Oh no! sorry, that's for a completely different reason, so don't try that at home.

So where is the water in a light aircraft, particularly with an air cooled engine. Well I'm sorry to have to say this but as far as physics is concerned, radio waves regard you, the pilot, and your passengers as a big bag(s) of water. Again that's how microwave oven work by heating up the water in the stuff you put in the microwave oven. Makes sense?

Therefore, you need to position your antenna such that it avoids metal and water.

Positioning the antenna

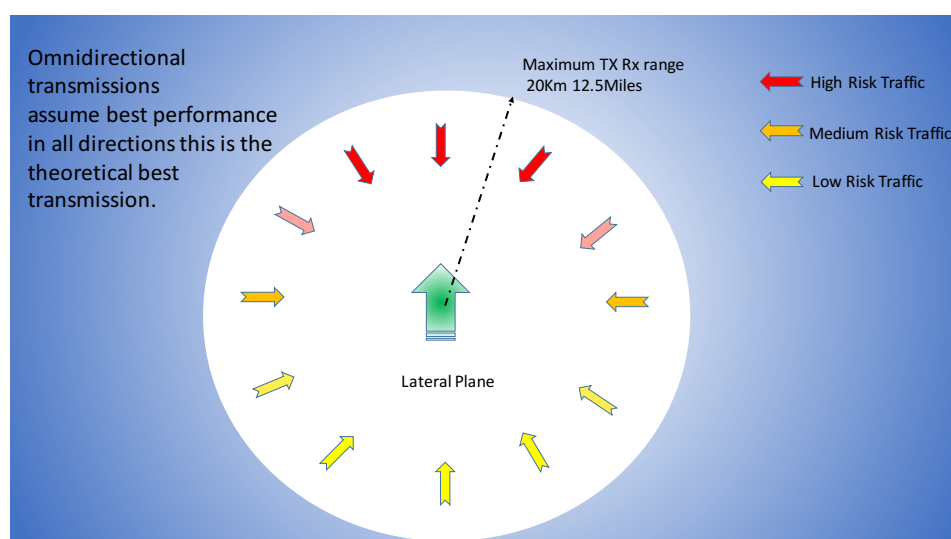
If you position the antenna directly behind a front mounted engine the the signal will be attenuated (lowered) going forwards. If you position the antenna in front of the pilot and passenger the signal will be attenuated (lowered) going backwards.

Therefore, for an internally mounted antenna, depending on your aircraft configuration you need to position the PilotAware where it transmits and receives with a clear view of the surrounding area without passing through metal or water, either to the front the back or side to side. If you don't it will still work but not as well!

If possible, it will always be better if an external antenna is used. This is why your transponder antenna and your air band radio antenna are both mounted externally for maximum efficiency.

For practical reasons the transmission of PilotAware Classic should be considered as omnidirectional. That is radiating out in all directions.

The diagram below (fig1) shows that the probable risk of collision is greatest in an 180° arc in front of the aircraft. The risk gets less as we move to the rear of this until a collision from directly behind is less probable.



Therefore, when positioning your antenna you should take the probability of the position of other aircraft into account along with the metal and water content of your aircraft that will be in the way of your omnidirectional transmissions.

For example, an antenna mounted on the coaming in front of the pilot and passenger will have a good range looking forwards and sideward but will be attenuated in a forwards and slightly downwards and rearward directions due to the engine and passengers respectively.

There is no need to look at all configurations as these will be different for each aircraft configuration and as time progresses the good folk on the PilotAware forum will no doubt give advice on all aircraft types.

Antennas mounted outside the aircraft are usually best as they put distance between them and the metal and the water but this may not be possible as seen later.

Monopole or Dipole

You may have heard of monopole and dipole antennas. What's this all about? Well without getting into detail all you need to know is that with a monopole antenna you need an earth plane with a dipole you don't. The PilotAware Classic comes complete with an end-fed dipole antenna as standard for P3I so you don't need an earth plane and is good to go. Centre fed dipoles are also available on an extension lead if this fits your installation better.

An earth plane is a metal base that the antenna sits on and to which the outside metal part of the antenna is connected. The bigger the better but a piece of aluminium about 1/16 to 1/4 inch thick by about 6 inches square or a similar size that fits the space you have will do.

Obviously to fit an antenna so that it is outside the aircraft will require drilling a hole in a metal, wooden or composite aircraft, including the pod on a trike, or fixing the antenna to an aluminium brace and cutting the fabric, on a tube and fabric aircraft such as a Eurofox or SkyRanger.

Usually 2 metres of extension cable is sufficient to facilitate the antenna extension and this has been shown to work well. Both the PilotAware P3I TxRx antenna and the ADSB Rx antenna will benefit from external mounting however as the ADSB-in is receive only and the 1090MHz transmissions from ADSB are much stronger this is usually less of a problem for up to a 20Km range. Extension cables and antennas, both monopole and dipole, will be available at pilotawarehardware.com.

Approval

If you do wish to install an external antenna, the manufacturer of your aircraft or importer, should be consulted as to the best practice to fit an external antenna for your type of aircraft. Also your licensing authority such as the CAA, LAA, BGA, BHGA or BMAA in the UK, will need to be consulted for the relevant approval. This

may require the granting of permission so to do, a fee and an inspection by an authorized inspector following the installation. As owner of the aircraft it is your responsibility to ensure that this is done correctly and in order. In other European countries the regulation process may differ and it is your responsibility to ensure that local regulations are adhered to.

In summary

It testing PilotAware Classic, the positioning of the antenna has been shown to be very important to get the best out of your PilotAware installation. No doubt, as more and more different types of aircraft are fitted with PilotAware units, advice will be forthcoming on the best place to fit the antenna and the route to approval for the various authorities. Keep an eye on the PilotAware Forum. forum.pilotaware.com

So, remember the basic physics when locating your antenna so that you have the best chance of seeing and being seen.

The PilotAware Team