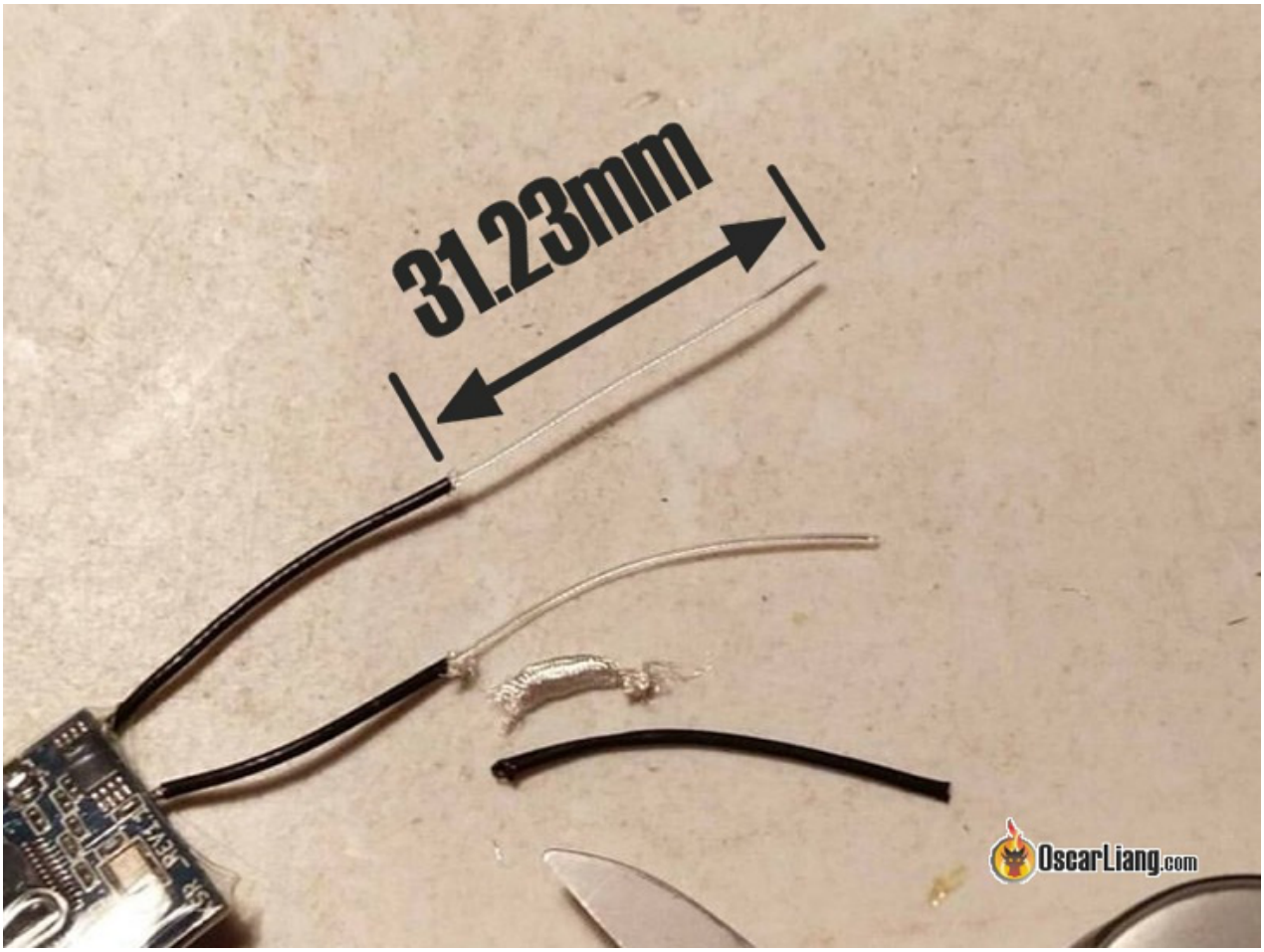
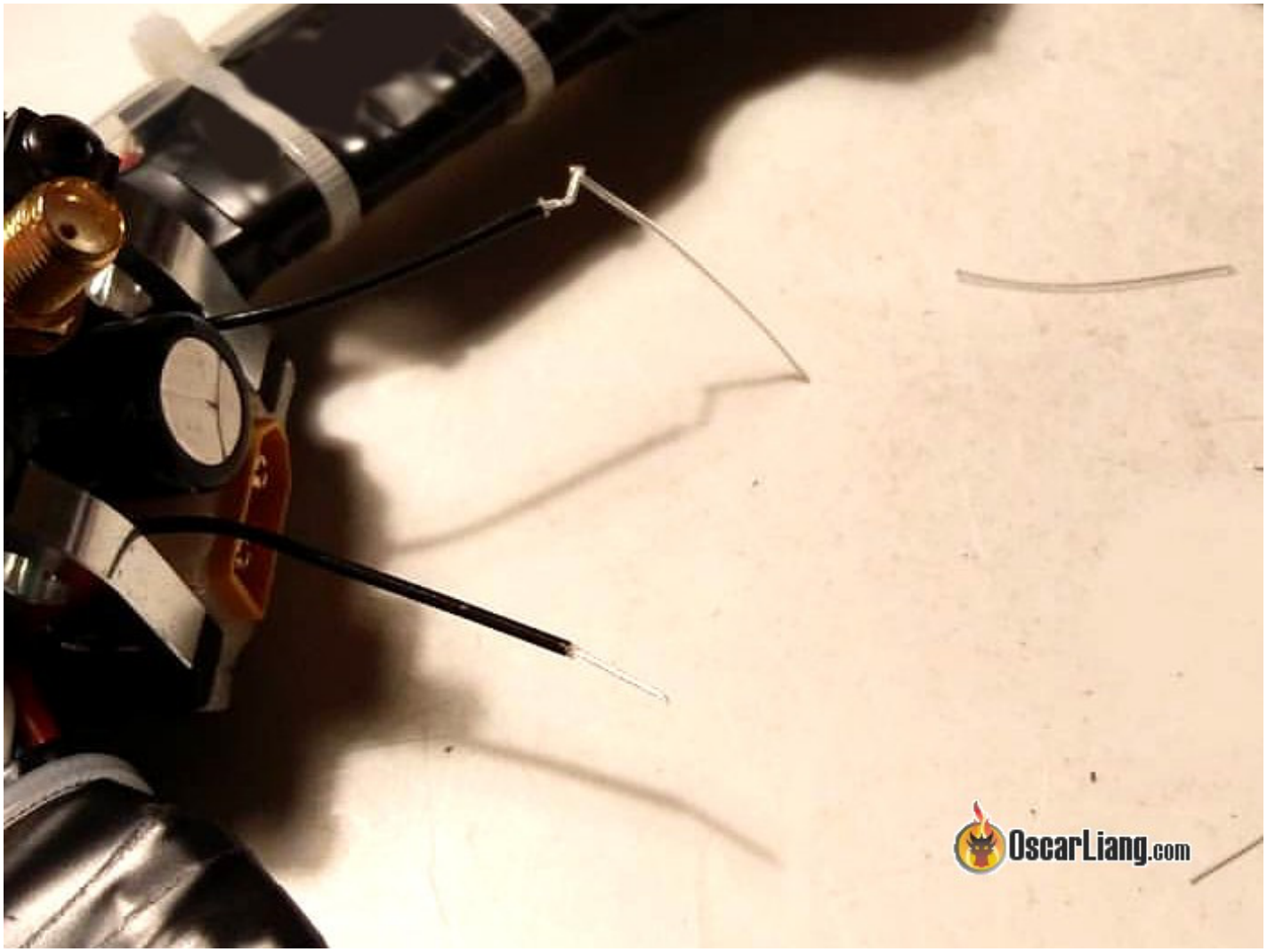
FIXING 2.4GHZ RADIO RECEIVER ANTENNA



If you accidentally damage your 2.4GHz receiver antenna in a crash or by spinning propellers, don't worry! You can easily fix it without buying a whole new receiver or replacement antenna. And there are considerations about the length of the antenna you should know about.

> ***Further Reading:** Learn about the basics of radio transmitter and receivers.*

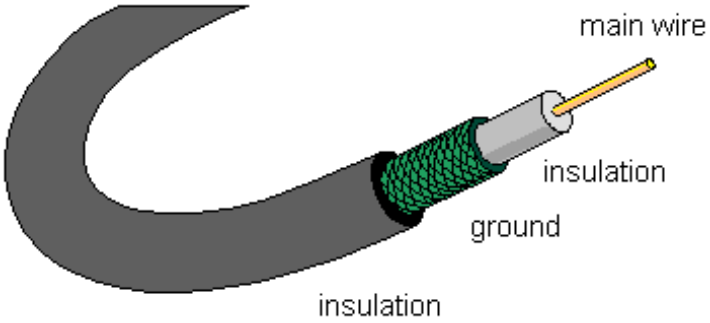


Understand The Construction of Receiver Antenna

A typical monopole antenna on an RX is simply made from a coaxial cable (coax).

From the outside to the inside, the first layer in a coaxial cable is plastic skin for physical protection. The next layer is grounded metal shielding that prevents noise getting in and signal getting out.

By removing the shielding reveals a thin insulated wire, which is the active element of your receiver antenna.



The construction of a coaxial cable

Calculate Antenna Length – 31.23mm

The length of the active element of a monopole antenna is determined by the wavelength of the radio wave. The resonant frequency happens to be a quarter of the signal wavelength, where the inductance and capacitance in the antenna are equal and cancel each other out. At this point the received signal of this frequency is the strongest.

With a shorter antenna we will have more capacitance. Or a longer antenna we will have more inductance. The additional capacitive or inductive reactance will result in antenna performance degrade.

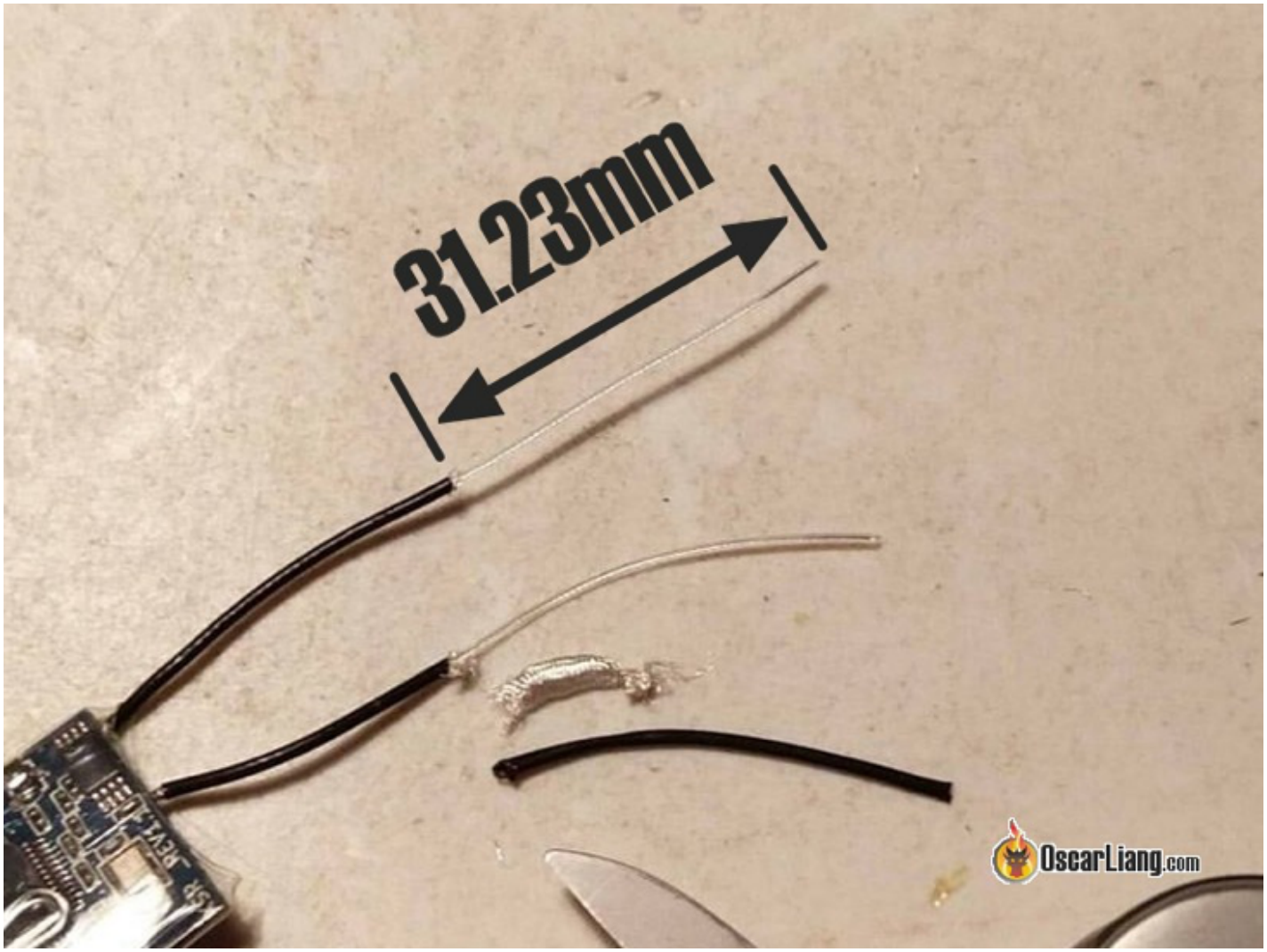
For 2.4GHz, the quarter wavelength antenna is about **31.23mm** long. (Enter this in google "**c / 2.4ghz / 4**")

Cutting Antenna and Stripping Shielding

The process of making or repairing 2.4Ghz receiver antenna is similar to what I described in our DIY 5.8Ghz monopole antenna tutorial.

- Take a clean cut at the end of a broken antenna
- Measure 31.23mm from the end, and carefully cut and remove the surface plastic layer and the shielding. only leaving the centre wire exposed
- It doesn't matter how long the whole antenna wire is, as long as there is only 31.23mm wire without shielding. It's okay for the exposed wire to be a tiny bit longer or shorter, your an-

tenna will still work, but the more accurate it is the better range



Why Some Receivers Come with Longer or Shorter Antennas? – Antenna Tuning!

The 1/4 wavelength of 2.4GHz is 31.23mm, so why do some receivers have different antenna length? For example we measured the antennas on a few different Frsky RX's to be:

- R-XSR – 23.5mm
- X4R-SB – 33.25mm
- XSR – 26mm
- XM+ – 23mm

It's suspected that Frsky is tuning the antennas in their receivers.

As mentioned, antenna that is too long or too short will change the capacitance and inductance in the antenna and shifts the resonant frequency. But in fact, we can **adjust the capacitance and inductance by adding inductor or capacitor** at the root, so theoretically we can tune the antenna to any length we want!

This might be why some receivers come with longer or shorter antennas than 31mm.

Therefore, my recommendation is, **follow the length of the original antenna that comes with the receiver**, because receivers are not always optimized for the 1/4 wavelength! Only experiment with different antenna length if you are getting really bad range.

Heatshrink / Tubes Changes Antenna Frequency?

Putting antennas in heatshrink or plastic tube for protection will “de-tune” its frequency slightly. It might reduce your signal strength very slightly, but it might not be enough to cause noticeable issues. We generally wouldn’t care about it too much, just a thing to be aware of.

Keep Active Element Straight

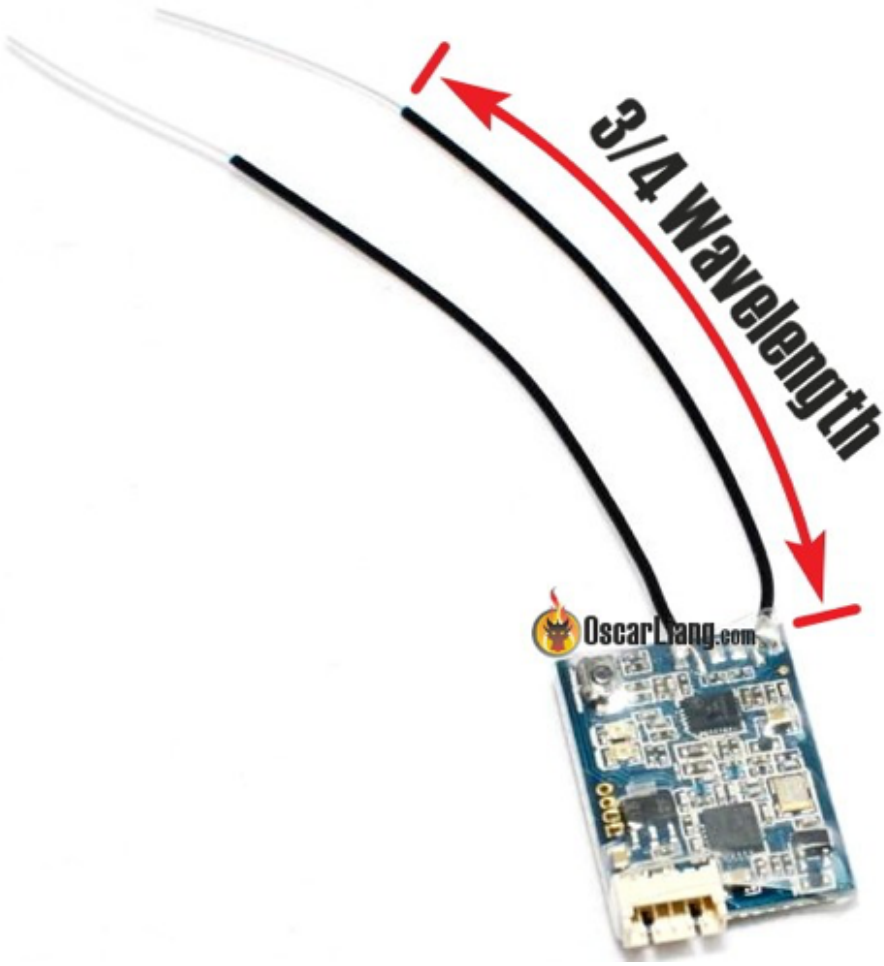
It’s extremely important to make sure the active element (the exposed wire) is kept straight. Any bending can reduce its performance.

Does the Length of the Shielded Wire Matter?

One interesting theory suggests that the length of the shielded part of the antenna might also affect the performance of the receiver antenna. I am not familiar with the concept but I am told that by keeping the shielded part of the antenna to a multiple quarter wavelength, you should get better antenna performance.

When fixing your RX antenna, you normally have to shorten the shielded wire to an odd length which can mess with the 1/4 wave antenna tuning and introduce unexpected problems. It’s interesting to note that the XSR receiver has 3/4 wavelength shielded wire, but it’s not the case on

other Frsky receivers. Maybe it has something to do with antenna tuning we just mentioned?



However, I have not verified this theory. The length of the shielded antenna doesn't seem to affect range noticeably from my experience. On one of my quads I even had the shielded wire shortened down to less than 2cm, shorter than the active element and it still seems to work pretty well within 800m (not getting signal warnings in LOS). Perhaps I wasn't pushing the range hard enough to notice the difference on a mini quad.

If you want to play safe, I think it's best to follow the length of the original antenna by modifying a brand new replacement antenna.

Replacement RX Antennas

I always try to fix any broken RX antennas first, but if I started to get signal issues such as failsafe or little range, I just simply replace that antenna and save the headaches.

Note that in the latest batch of Frsky receivers they've started using a smaller version of the IPEX connector, called "IPEX 4th Generation". Be extremely careful when shopping for replacement antennas for your Frsky receivers and don't get the wrong one.

Old IPEX Antennas (3mm)

- Banggood: http://bit.ly/frsky-2-4ghz-rx-antenna
- Amazon: http://amzn.to/2saMboK

New IPEX 4th Antennas (2mm)

- Amazon: http://amzn.to/2EVl6c0
- HorusRC: http://bit.ly/2H42gRy

Edit History

- Feb 2015 – Article created
- Jan 2018 – Updated article with sections talking about “why some receivers have longer or shorter antennas than 1/4 wavelength”, and “does the length of the shielded wire matter?”.
- Mar 2018 – Added warning about the new IPEX connector for the latest Frsky receivers

Related Articles

Make a simple whip antenna for 5.8Ghz- linear polorized FPV video

The Best FPV Antenna for Mini Quad 5.8Ghz

Best Antenna Positioning for 900MHz RC Systems - R9M/Crossfire

Posted in DIY and Hacks, Multicopter and tagged antenna, intermediate, rx on 8th March 2018 [https://oscarliang.-com/repair-2-4ghz-antenna-rx/] . 55 Replies

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55 thoughts on “Fixing 2.4GHz Radio Receiver Antenna”

Eric ziegel
19th August 2019 at 4:44 pm

I have a mini remote controller and there is a cable antenna soldered (only main wire and insulator) on it and no MMCX port; is it possible to connect a MMCX antenna directly on the card without port ? How ? Can I solder only the main wire of MMCX antenna to my card and let the ground without connexion ? Thanks if you can help because I really did not find any informations about it.

Slava Chrome
22nd July 2019 at 8:22 pm

Always used to put my antennas in double layer of heatshrink, after with ziptie third layer.

And now I have read that it can reduce range :(((

How to live

Protonus
7th June 2019 at 3:18 pm

Oscar I generally love your site, but there is a lot of bad info in this page. 31.23mm is simply the wrong length for an RX antenna! You cannot cut or extend your RX antenna without an antenna meter – that is the only way to know what a given antenna is tuned at! The 31.25mm antenna length is a MYTH because it makes several incorrect assumptions. The first is that your radio does NOT use 2.4 GHz, rather, it's a range of frequencies between 2.4 and 2.5 GHz, so most are actually tuned to 2.45GHz, which is a different length. The second is that that 31.25mm antenna length is the 1/4 wavelength for the frequency IN A VACUUM AT THE SPEED OF LIGHT. The wave slows down quite a lot in a wire, and even more in coax, and insulation slows it down too, as does capacitance. This is a very complex topic with a lot of variables which is why if you actually measure antennas for receivers you'll find they're all different lengths as y ou noted! This is because of differencex in antenna material! A good intro to this topic: youtube.com/watch?v=8iBoRNyrrPM

Oscar Post author
8th June 2019 at 11:02 am

it's a complicated subject, exactly.
most people in this hobby come from non-academic background and it's unlikely they would have a way to measure antennas.
as explained in this post, there are many factors that affects the length of the antenna.
31.2mm is just a general figure, or safe figure to try for 2.4GHz, if one doesn't have any idea what antenna length it should be.

Dennis Prickett
13th May 2019 at 12:00 am

I am trying to bring my 1/32 scale SUB back to life from drydock of 20 years on the shelf. My old radio (75 MHz FM) no longer works, so I bought a new 2.4 GHz radio; not good for SUB,s! What I'm hoping to do is run the antenna up the periscope and keep the top of the scope from going under water. My problem is that the antenna wire is too short. Can I lengthen it some how ?

FotoAmg
18th March 2019 at 6:09 pm

Hi!
As prop cut my FS-A8S antenna, I used replacement antennas but made a range test.
First I cut the replacement antenna element to about 26mm the original FS-A8S length, my failsafe triggered at 200meters range.
Then I put replacement 2.4Ghz antenna pigtail on it without cutting, about 33mm length (not measured perfectly) the failsafe triggered at 310meters range.
So my test resulted that we should use the full 2.4ghz sized antennas for better range, and not to cut them back.
At least with my FS-A8S this worked like this....
I also repeated the test again and got the same result.

Pete Barker
2nd December 2018 at 6:07 pm

Hi, I have just swapped over from RC aircraft to yachts using my FrySky 2.4 rx that has 2 aerials. Do I have to mount the rx in a plastic hull with the aerials protruding parallel up & out of the hull which will mean a water ingress problem. Thanks.

Oran
4th August 2018 at 8:31 am

Fresh first experience with R-XSR an hour ago. I flew at the same place as my previous XSR and at a bit longer distance than XSR (about 300-330m) and got a failsafe. Then I flew again now just 20m in front of me and got another failsafe!? Do you ever heard of R-XSR failsafe problem or range problem? I updated it to the latest FCC171009, SBUS, S.port if I don't missremember the version.

Oscar Post author
6th August 2018 at 6:22 pm

Check antennas are connected firmly? And they are not damaged?

Dale Stephenson
16th May 2018 at 2:20 pm

Hi Oscar,
I understand that the antenna should not be run along the carbon frame. What would be the best way to run it (up down, to each side)?
Thanks
Dale

Oscar Post author
17th May 2018 at 5:24 pm

The best position would be sticking out above the top plate like a letter "V".
I often mount them on the arms too if I don't have space, like this.
For short range flying that's totally fine.

Toby Burnett
8th May 2018 at 4:17 pm

Hi Oscar,

Love reading your pages.

Here is wee scrounging tip that might help someone.

If you happen to have lost an antenna with an ipex 3mm connector like I noticed mine had fallen off the satellite Rx on my 2" brushless quad last night. Just now I had an idea “ta dahh moment” … ” I know where I’ve seen those connectors before”

Digs out a very old broken laptop (you could get one at your local tip/ dump) and inside as re-membered are not one but two nice ipex connectors with a good 10+ cm of coax going to work an-tenna under screen. Just ship farthest away from the WiFi module and you’ve got two new antennas to construct as per your instructions.

Whilst I was at it I got 6 x18650 batteries that all hold charge well and will make a simple fpv goggle pack .

Greeting from up north (nr Oban)

Oscar Post author
9th May 2018 at 1:41 pm

good tip for emergency replacement :D but still easier to get a bunch of spare lol :D

Shivaprasad
3rd May 2018 at 4:37 pm

Can anyone tell me both covered and uncovers length of Fly sky R6B antenna length? I need length kept my manufacturer. So it will be tuned properly. please tell me if anyone having one

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ThomasTheDankEngine
8th March 2018 at 12:42 am

Mine came off at the solder joint. Any idea how i could fix that?

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celia cavasotto
20th February 2018 at 1:10 am

hi, i own a small drone with a 2.4 ghz wifi camera. about midway through the flight the transmission suddenly stops, as if the signal weren´t strong enough. i opened the drone and found that the antenna wasn´t a true 2.4 antenna (it was longer but did not reach the 1/2 wavelength). could the antenna make the transmission range shorter when the battery is lower than normal because it is not a true 2.4 antenna?

Oscar Post author
6th March 2018 at 5:28 pm

The length of the antenna can be tuned by adjusting the reactance in the circuit, so don't assume every 2.4Ghz receiver has to use antennas of the same length. Just stick with what you are given by the manufacturer you should be fine.

Mark
1st February 2018 at 11:49 pm

By "exposed", I'm assuming that you can cover the 31.23 mm in plastic antenna shielding, cocktail stirrer, etc.? it doesn't have to be open to air does it?

Oscar Post author
5th February 2018 at 2:38 pm

Yes, your can cover it with anything that is not RF shielding. Plastic should be fine.

Steve
26th October 2017 at 10:38 pm

Your calculation is based on a wavelength in free space and does not take into consideration the velocity factor for the coax you are using for the whip antenna. Therefor the length of the active part of the antenna will be between 69% to 95% of this length.

StogFly
30th August 2017 at 5:44 pm

I understand the antenna exposed at the desired length part etc but at the solder point of the antenna and the shielding to ground on the fc/pcb board, that part is also exposed at around 0.5mm? . Shouldn't that part be shielded somehow?

Neogen974
6th August 2017 at 5:37 am

Hi oscarliang the best.

Except error on my part.

About the calcul speed of light. Google rounded the value to 300 000 000 instead of 299 792 458 real value "wiki"

And c/2.4ghz/4=299 792 458/2.4ghz/4 = 11.29

With 300 000 000/2.4ghz/4 = 33.25

This is practically double. What do you think

Thanks

Your website is great

Neogen974

Oscar Post author

11th August 2017 at 3:57 pm

speed of flight slows down a bit in air.

But I think that's close enough anyway :)

Joelson José dos Santos

9th May 2018 at 2:44 pm

Esta conta está super errada.

R= 31.22 mm

Joyvel

4th August 2017 at 11:23 am

Hi, I always use FrSky receivers but I was flying a FlySky that comes with a different antenna, the one that seems to have a bullet shape and I broke one, can I attach any other antenna from my FrSky receivers? can I even use an antenna from a X8R receiver? Thank You

Oscar Post author
11th August 2017 at 3:46 pm

Yea the antenna should be interchangeable since they all operate at 2.4Ghz. just make sure the lengths of the active antenna are the same.

Mike
1st August 2017 at 9:20 pm

What about those of us that have the boda antenna ? Can you cut those out all together or could you re solder anything to them?

IflyHigh
27th October 2018 at 12:22 am

I know I am late to the party, but BODA can easy be fixed as long as you didn't lose the metal piece under the heat shrink. Cut the antenna as you would with a straight wire and then solder the shielding to metal sleeve and expose the center wire out of the top. If you lost the sleeve, no worries because the antenna will still work, but the concept of the sleeve is to reduce interference. That being said, you can make a BODA antenna on any receiver if you have the proper length sleeve.

Black
25th July 2017 at 11:06 am

Hi,

I see that the XM+ antennas do not come at the length you calculate. They come at 21 mm. Do you have any opinion about this?

Thanks

Oscar Post author
25th July 2017 at 1:37 pm

yea on some of the Frsky RX such as the XSR, antennas come at different length because they are using 1/5 wavelength..
Quite a lot of people complain to have range issue with that and they strip the shielding back to make it 1/4 wave... i.e. 31mm.
If you have this issue you could try this.

Ben
14th March 2017 at 10:16 pm

Hi Oscar,

I am currently in the process of waterproofing my multirotor.. it is hard to do that with my Stock Futaba Rxs coaxial antennae. My thought is to use a SMA to U.FL wall panel adapter mount and using a more traditional plastic 2.4 antenna instead. Is there any reason I can't do this or anything i need to take into consideration?

Thanks for your time.

Hamidreza
24th December 2016 at 11:05 am

Hi dear,

Last week i had rc airplane crash.

Till know i cut around 6cm of the reciever antenna because of crash.

The people there said that i crashed because the lenth of the main wire anttena is not long enough.

But i should mention that always i had 3 cm unshield anttena our of the rc airplan rather than the shieldet part.

The question is that the lenght of the antenna wire is important or just it is important that there be 3cm unshield of antenna wire?.

Thanks.

Oscar Post author

12th January 2017 at 9:41 am

yes only the length of the unshield part of the antenna matters, but I guess if the antenna is longer, the less probable signal gets blocked by aircraft material.

KWAD

16th November 2016 at 6:07 pm

Hi Oscar,

If I'm correct, the shielding on an antenna needs to be connectet to a ground? If so:

I just received an Devo-RX601 receiver for my devo 7 controller to use in a Quad, and noticed that the antennas are really short. I need them to be longer. I have several antennas that is made for Rc 2.4GHz receivers, so I know that they are correct for the purpose. However, the antennas that followed the receiver are so short, they are not shielded (or coaxed?). Therefore the receiver has no ground solder point for the shielding. Would it work if I connected it to another ground that is somewhat connected to my battery? Let's say the ground connecting to the receiver?

Thanks on beforehand!

Oscar Post author
22nd November 2016 at 1:27 pm

Hi, yes the shielding needs to be connected to ground.

Yes ground should be common on the receiver PCB, so any ground should do.

KWAD
3rd December 2016 at 10:57 pm

Thanks!

Only tested it indoors so far, but seemed to work great! This site is awesome ;)

Thumbs up!

Henk
5th June 2016 at 1:10 pm

This site helped me a lot, thanks!

Mark Ramsdale
31st March 2016 at 7:41 pm

Hi Oscar

I have a walkera runner 250 and a 250 advanced with gps. Not had much luck with the gps version

so far but the earlier model has been flying fine even after a few crashes and rebuilds. But I noticed on my earlier model both ariel wires wasn't stripped down at all. They had the full outer plastic casing all the way to the top but I was still flying using both my devo 7 and devo 12E well over half a mile with no issues. The other day I completely cut one of the wires off after a crash all the way down to the receiver unit so there was only 1 wire left. It still flew out over 1/4 of a mile before ran out of batteries. Anyway I have bought some replacement 2.7 wire to repair it and am I correct that I can completely remove the wire from the circuit board and just re solder my new wire to the larger of the 2 connections on the circuit board as this wire doesn't have the outer shielding so will only have 1 connection to the board instead of 2.

Oscar Post author
6th April 2016 at 3:43 pm

maybe the top end of the plastic casing has no shielding?

Fivedragon
8th March 2016 at 2:39 am

So I just get crashed and my exposed antenna wire is gone. So if I make that 31.23 mm shield cut on that broken antenna, its gonna make the total length of wire shorter on one side. Is that okay? Thank you.

Oscar Post author
9th March 2016 at 11:55 am

that's absolutely fine

Stan
8th February 2016 at 6:16 pm

Hi Oscar! I am new to the site and have an antenna question. Some back ground I am building a sailing craft and wish to keep the xr8 2.4 receiver inside the vessel's hull for waterproofing. I want to put a 2 meter extension on the antenna so it is well out of the water. Can you explain how this could be done. Also what are the implications of occasional spray contacting the exposed antenna?

Rafal
19th January 2016 at 9:18 pm

Hi Oscar … thank you for your blog.

Can I use an old 2.4 TX whip antenna (like from a Taranis Radio) without the surrounding plastic casing off course :) as an RX antenna?

I have one of those and I'm asking because from the tip of the weird bullet dome to the tip of the actual antenna core it's measuring 2.55cm not 3.123cm like you said.

Revomikey
7th December 2015 at 6:36 pm

Tell you what though Oscar, i have a thought….. (Dangerous :))

When the cable gets too short to facilitate 32mm whats to stop me unsoldering the coax completely and just adding a normal piece of single core antenna cable to the center core joint of the pcb and just trimming that back to 32mm, eliminating the outer core completely.

Would this work?

Oscar Post author
7th December 2015 at 11:44 pm

Yes that should work :)

Test it thoroughly before using it :)

RevoMikey
7th December 2015 at 12:54 pm

Hi Oscar, great page, thanks.

I never knew the active part of the antenna was just the “open” side, I now have my walkera runner 250 back in the skys.

Top man, many thanks.

Jake
16th November 2015 at 12:01 am

Thanks for all your posts and pages! Very helpful overall… So I cut my antenna the other day in a crash. If I understand correctly you can remove the plastic wrap as long as you leave the same amount exposed? My question is can I solder on a wire and then expose the very end of it to match the preferred length? I had a longer antenna and would like to replace it to the same length if possible. Thanks!

Oscar Post author
16th November 2015 at 10:02 am

i think so Jake that should work, after you done that just do a range test and make sure that's working reliably i guess

Travis
3rd March 2016 at 11:32 pm

It has to be a shielded coax antenna wire with the shield contacting the receiver's ground. Standard wire does not have a shield to ground.

Pakal
12th August 2015 at 4:51 am

So, basically the "working" part of the antenna is only the exposed wire ? Does it mean that I can hide the first part of the antenna under the frame and really just care to properly place those 31 mm of exposed wire ?

Oscar Post author
12th August 2015 at 5:02 pm

That's correct! yes you can!

Charles
27th March 2015 at 3:06 pm

Hi,

You have so many cool info. I'm a newbie

in the RC community. My question is,

can I tin the expose wire? What will happen if its tinned?

Thank you

Oscar Post author

29th March 2015 at 11:03 am

sorry why do you want to tin it? I don't think it would do anything really...

Jiri

27th February 2015 at 6:18 pm

Hi Oscar

You have one small mistake at last sentence. Longer antenna means lower resonant frequency ;)

In reality that´s not so critical, antenna will be OK within 1 to 2 mm tolerance.

Oscar Post author

28th February 2015 at 5:47 pm

you are absolutely right. updated now :)

thanks for pointing that out.

For prompt technical support, please use our forum IntoFPV.com. I check blog comments weekly.