

Group ADS-B test: 19 dongles

19 RTL-SDR dongle variations tested with identical Raspberry Pi 3 based ADS-B stations, sharing the same antenna and filtered preamp.

Disclosure

Post features my purchases and manufacturers' review samples, couldn't have done this comparison without support [<http://www.radioforeveryone.com/p/disclaimer.html>] - *many thanks!*

Links open in new tab, maker, main distributor, or Amazon affiliate links given to check at-door cost, do your research to save money.

Images go full screen when clicked or tapped, more info on testing environment [here](http://www.radioforeveryone.com/p/testing-diy-homebrew-ads-b-antennas-feb.html) [<http://www.radioforeveryone.com/p/testing-diy-homebrew-ads-b-antennas-feb.html>] , my approach in [Manifesto](http://www.radioforeveryone.com/p/manifesto.html) [<http://www.radioforeveryone.com/p/manifesto.html>] .

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Tested and works

Approximate prices for bundles as of August 2017, from left to right:



[http://2.bp.blogspot.com/-cl4pT_dSpnA/WaCG930geJI/AAAAAAAAANuo/YyRP_InHE_gl33xJ_VmHWK_rZpiwBLN1gCK4BGAYYCw/s1600/01%2BWorks.jpg]

1. **Nooelec Nano**: unavailable from Nooelec or Amazon, occasionally shows up on eBay.
2. **Nooelec Nano 2+ :** \$23, manufacturer [<http://www.noelec.com/store/sdr/sdr-receivers/nedr-nano2-plus.html>] , Amazon USA [<http://amzn.to/2t9HP1L>] .
3. **Nooelec Nano 3:** \$33, manufacturer [<http://www.noelec.com/store/nedr-nano-three-otg.html>] .
4. **Nooelec Nano-P:** \$24, Amazon USA [<http://amzn.to/2t9eAM4>] .
5. **Nooelec Mini:** \$19, manufacturer [<http://www.noelec.com/store/sdr/sdr-receivers/nedr-mini-rtl2832-r820t.html>] , Amazon USA [<http://amzn.to/2t9ficc>] .
6. **Nooelec Mini+ AI :** \$30, manufacturer [<http://www.noelec.com/store/sdr/sdr-receivers/nedr-mini-plus.html>] .
7. **Nooelec Mini 2:** \$19, manufacturer [<http://www.noelec.com/store/sdr/sdr-receivers/nedr-mini2-rtl2832u-r820t2.html>] , Amazon USA [<http://amzn.to/2tlKhcT>] .

8. **Generic R820T2:** \$10 or less from eBay, [don't pay more \[http://www.radioforeveryone.com/2016/02/avoid-rtl-dongle-rip-offs.html\]](http://www.radioforeveryone.com/2016/02/avoid-rtl-dongle-rip-offs.html) .
9. **Nooelec Mini 2+ :** \$23, [manufacturer \[http://www.nooelec.com/store/nesdr-mini-2-plus.html\]](http://www.nooelec.com/store/nesdr-mini-2-plus.html) , [Amazon USA \[http://amzn.to/2sFaE4G\]](http://amzn.to/2sFaE4G) .
10. **Nooelec Mini 2+ AI:** \$23, [manufacturer, \[http://www.nooelec.com/store/sdr/nesdr-mini-two-plus.html\]](http://www.nooelec.com/store/sdr/nesdr-mini-two-plus.html) [Amazon USA \[http://amzn.to/2sFaE4G\]](http://amzn.to/2sFaE4G) .
11. **Nooelec SMArt:** \$27, [manufacturer \[http://www.nooelec.com/store/sdr/sdr-receivers/nesdr-smart.html\]](http://www.nooelec.com/store/sdr/sdr-receivers/nesdr-smart.html) , [Amazon USA \[http://amzn.to/2sFeJ9g\]](http://amzn.to/2sFeJ9g) .
12. **rtl-sdr.com blog v3:** \$25, [manufacturer \[http://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/\]](http://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/) , [Amazon USA \[http://amzn.to/2t9NJA4\]](http://amzn.to/2t9NJA4) .
13. **FlightAware Pro Stick:** \$17 for receiver only at [Amazon USA \[http://amzn.to/2t9NJA4\]](http://amzn.to/2t9NJA4) .
14. **FlightAware Pro Stick Plus:** \$19 for receiver only at [Amazon USA \[http://amzn.to/2tJdvlj\]](http://amzn.to/2tJdvlj) or \$25 worldwide from [rtl-sdr.com store \[https://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/\]](https://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/) .

All dongles are used with the exception of Nano 3 and unmodded, exactly as you'd find them in the envelope.

Tested and doesn't work

Incapable of receiving 1090 MHz aircraft signals, no matter what:



Not for ADS-B

[<http://4.bp.blogspot.com/-LzNxEzpY8Vs/WaCDhwYSvCI/AAAAAAAAANuI/tYGXyeMbfj45G7EQ2J503eOjoIVJjXMKwCK4BGAYYCw/s1600/02%2Bnot%2Bfor%2B%2Badsb-b.jpg>]

E4000 chipsets: Nooelec [XTR+](http://www.nooelec.com/store/sdr/sdr-receivers/nedr-xtr-rtl2832u-e4000.html) , Outernet (*discontinued*), [SMARt XTR](http://www.nooelec.com/store/sdr/sdr-receivers/nedr-smart-xtr.html) and [SMARtee XTR](http://www.nooelec.com/store/sdr/sdr-receivers/nedr-smartee-xtr.html) . E4000s have a gap at 1090 MHz, this fact is clearly stated for new SMARt XTRs.

EzTV 645: refuses to cooperate due to [FC0013 chipset](http://www.nooelec.com/store/eztv645-dvb-t-usb-set-for-sdr.html) , no surprise there.

Testing rig

Two Raspberry Pi 3s from ModMyPi ([Starter Kit review \[http://www.radioforeveryone.com/p/review-modmypi-starter-kit-raspberry-pi.html\]](http://www.radioforeveryone.com/p/review-modmypi-starter-kit-raspberry-pi.html)), [shop \[https://www.modmypi.com/raspberry-pi/set-up-kits/rpi3-model-b-kits/starter-kit-including-raspberry-pi-3-model-b\]](https://www.modmypi.com/raspberry-pi/set-up-kits/rpi3-model-b-kits/starter-kit-including-raspberry-pi-3-model-b)), antenna splitter into Uputronics 1090 Mhz Filtered Preamp ([review \[http://www.radioforeveryone.com/p/review-uputronics-1090-mhz-filtered.html\]](http://www.radioforeveryone.com/p/review-uputronics-1090-mhz-filtered.html)), [Europe shop \[https://store.uputronics.com/index.php?route=product/category&path=59\]](https://store.uputronics.com/index.php?route=product/category&path=59) , [USA distributor \[http://airspy.us/#Other\]](http://airspy.us/#Other)) to get as much data as possible in the shortest time, 6 feet / 2m 50 Ohm RG-58 coax from a Nooelec SMARt bundle connected to a FlightAware antenna ([Amazon USA \[http://amzn.to/2r5JXGD\]](http://amzn.to/2r5JXGD)), [contributor comparison vs other pro antennas \[http://www.radioforeveryone.com/p/comparison-ads-b-antennas-under-50.html\]](http://www.radioforeveryone.com/p/comparison-ads-b-antennas-under-50.html)).

Data collection period at least 20 hours, performance judged by total position reports according to FlightAware, ranges and maps from planefinder. Guide [how to use both here \[http://www.radioforeveryone.com/p/besides-flightaware-ads-b-data.html\]](http://www.radioforeveryone.com/p/besides-flightaware-ads-b-data.html) .

Reliability was 100% with all components, unplug power, switch dongles, plug in power.

Personal comments dot the text *in italics*, as I love each and every dongle in the arsenal for one or two (3,4,5...) particular reason.

Results are relative

Update 1:

Two dongles tested on the same day to find out which one performs better. Consequently, Totals are only valid between two dongles, as they change due to traffic density day to day - see SMARt vs v.3 below as an example.

Calibrating

Establishing a baseline was necessary to check whether testing rig performs as it should.

Two rtl-sdr.com v.3 for four consecutive days to see day-to-day changes, 0.78%, 0.90%, 0.8%, then 0.57% difference in Totals.



[\http://1.bp.blogspot.com/-dQVd_dcQi_o/WaCEryN7a9I

[/AAAAAANuc/3veUtHsl-EA5hKijtwrigQp5TH8RDLgjuCK4BGAYYcw/s1600/03%2Bside%2Bby%2Bside.jpg\]](/AAAAAANuc/3veUtHsl-EA5hKijtwrigQp5TH8RDLgjuCK4BGAYYcw/s1600/03%2Bside%2Bby%2Bside.jpg)

Four Nooelec SMARts, one pair with 0.16 percent difference before commencing testing, retested other two SMARts midway, 0.65% between them.

Two R820T2 generics had 1.36% difference in Totals, 136 vs 140 nm maximum range.

Don't get too excited below 2%.

Perspective

At cruising altitude and speed, 5 miles more range means an extra 30-40 seconds capability, if that, to track a commercial flight at 33,000 feet doing 550 knots. **Furthermore**, maximum range primarily depends on antenna location, consequently I evaluate pairs based on Total received reports, but include maximums and maps if warranted. A higher Total always means better range, but only up to the point of geographical limitations.

Nano vs Nano-P

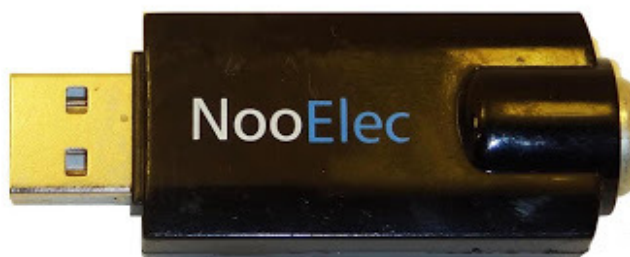
Same R820T chipset, -P denotes PAL connector standard:

Nooelec Nano



Total: 33,787

Nooelec Nano-P



Total: 47,794

[<http://1.bp.blogspot.com/--wKfoQrvPZo/WaCcKsVkMQI/AAAAAAAAANvA/2X4XvSxbXBwOYF-pzdCmnEKuVSbQq-igqCK4BGAYYCw/s1600/05%2BnanovsnanoP.jpg>]

Unsuitability of PAL for ADS-B pops up now and then on online forums, fortunately, this Nano-P can't read: 23.69% more Totals.

Mini vs Nano-P

Same R820T chipset, different size:

Nooelec Mini



Total: 32,626

Nooelec Nano-P



Total: 33,623

[http://3.bp.blogspot.com/-cJk49_YyEGo/WaCcTTUrC7I/AAAAAAAAANvI/xlqYdkXCdogtj9CnYwyTVwe7cZzNFO_IQCK4BGAYYCw/s1600/06%2Bmini%2Bvs%2BnanoP.jpg]

3.05 % more with Nano-P.

Nano 2+ vs SMART

Question asked for small-space applications:

Nooelec Nano 2+



Total: 33,643

Nooelec SMART



Total: 39,685

[<http://2.bp.blogspot.com/-wfUuuz5mtvM/WaR3bCn3fUI/AAAAAAAAANv8/quc4Vm3LxPECCkR99wNWJ5s1uO10WqNjwCK4BGAYYCw/s1600/nano%2Bplus%2Bvs%2Bsmart.jpg>]

17.95% more Totals.

Nano 3 vs SMARt

Latest and smallest Nano against its big brother, with and without heatsink:

Nooelec Nano 3

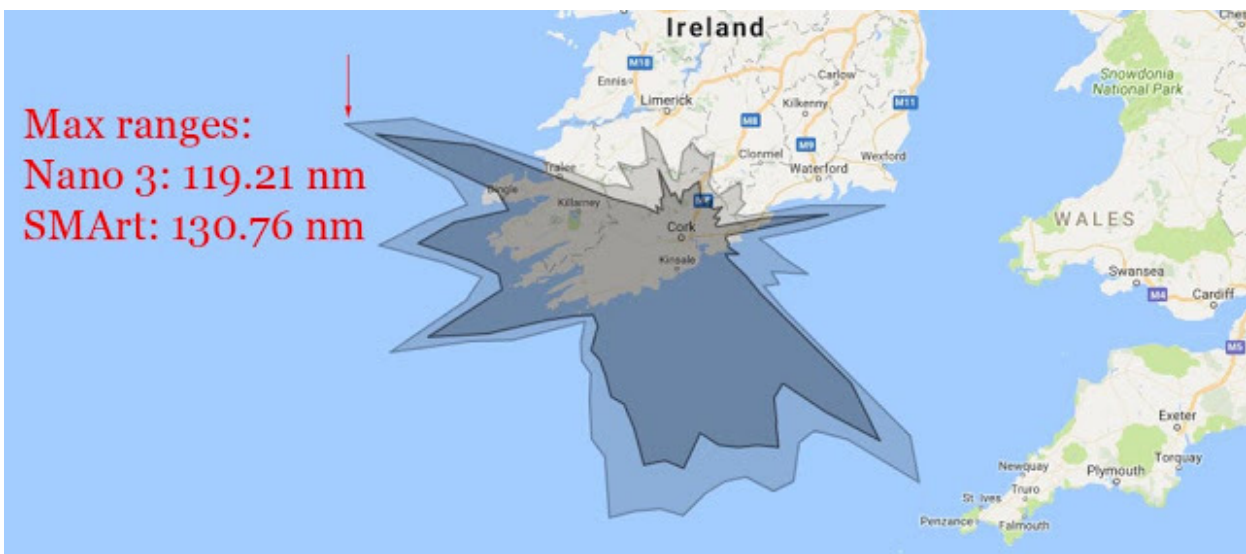


Nooelec SMARt



[\[http://4.bp.blogspot.com/-kDJDPgvzNsc/WaR4Lug7asI/AAAAAAAAANwI/Ly48zTSw1b42Yil-KhATB056SGgeG5MXgCK4BGAYYcw/s1600/10%2Bthree%2Bvs%2Bsmart.jpg\]](http://4.bp.blogspot.com/-kDJDPgvzNsc/WaR4Lug7asI/AAAAAAAAANwI/Ly48zTSw1b42Yil-KhATB056SGgeG5MXgCK4BGAYYcw/s1600/10%2Bthree%2Bvs%2Bsmart.jpg)

Two tests, without heatsink SMARt collected 49.70 % more data, attaching supplied heatsink lowered ratio to 43.69% and case temperature by approx. 4 degrees Celsius.



**43.69 % more Totals on map:
 Nano 3 (16,238, dark grey) vs
 SMARt (23,333, light grey) coverage**

[http://3.bp.blogspot.com/-nae_u4_8M-4/WaR5WP38KGI/AAAAAAAAANwQ/rmSxjWAbzNARol-3TUZ8NpntAcpRix1wgCK4BGAYYCw/s1600/smartv%2Bvs%2Bnano3.jpg]

Doubt anyone will improve FA ranking with a Nano 3, designed for an entirely different purpose.

Thoughts on Nano dongles

Nano-P is only a Nano in the name, twice the size of a thoroughbred. True Nanos are small, comparatively and absolutely:



Dongle size comparison

[<http://2.bp.blogspot.com/-MO0cksOIW8M/WaR7zBUbQ1I/AAAAAAAAANwc/nti64kl40wZ1ff8DI2-J6Yo7pLWv0tUwCK4BGAYYCw/s1600/dongle%2Bsize%2Bcomparison.jpg>]

PCB surface area contributes to heat dissipation, which becomes problematic beyond a point; in envelope heatsink is advantageous and highly recommended for Nano 3, the smallest RTL-SDR dongle ever.

Know that all Nanos as designed for, and marketed as the ideal solution for space-restricted applications, all perform extremely well for their intended purpose - I had a nailgun vs hammer analogy in mind, but you get the point anyway.

For maximum receive performance, full size dongles are a must, so onto big boys now.

R820T2 Generic vs Nooelec Mini 2

Bog-standard \$8 R820T2 off eBay against a seemingly identical Mini 2.

Generic



Total: 35,650

Nooelec Mini 2



Total: 36,106

[http://2.bp.blogspot.com/-hA4SbUsFyGM/WaR79M_XLUI/AAAAAAAAANwk/gs-KbEK4MGwF0vwNAFXK7R9X1r0nZgcACK4BGAYYCw/s1600/04%2Bgeneric%2Bvs%2Bmini%2B2%2Bed.jpg]

1.27% percent higher Totals with generic.

Mini AI+ vs Mini 2 AI+

Both with TCXO, both in metal case without thermal pads, chipset is the main difference:

Nooelec Mini+ AI



Total: 34,569

Nooelec Mini2+ AI



Total: 34,396

[<http://3.bp.blogspot.com/-VArmtlL7eSM/WaR8vzvZWgl/AAAAAAAAANww/7c9dQGYaEvUfBWilCKJMQ-Bc4ziSxHrFwCK4BGAYYCw/s1600/11%2Bals%2Btotals.jpg>]

0.44% after 23 hours is very close, safe to say both are of equal performance.

Nooelec Mini vs Mini 2

Chipset question revisited, some say the R820T2 in the Mini 2 is better for ADS-B.

Nooelec Mini



Total: 28,929

Nooelec Mini 2



Total: 28,113

[<http://2.bp.blogspot.com/-1YNzkCEv9bl/WaR-lkNpZul/AAAAAAAAANw8/RSf7vOPHfk8tRg4piVTwlrVVjFtEeBCZwCK4BGAYYCw/s1600/min%2Bvs%2Bmini%2B%2Btotals.jpg>]

2.90% more with R820T chipset.

Mini 2+ vs SMARt

Nooelec Mini 2+



Total: 35,900

Nooelec SMARt



Total: 38,700

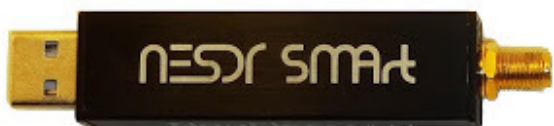
[http://1.bp.blogspot.com/-elsIW_vPx7E/WaSDg3Cv5-l/AAAAAAAAANxM/pk9lxTPGOT8EUWj373PgqOeLCJK-13uegCK4BGAYYCw/s1600/mini%2B2plus%2Bvs%2Bsmart.jpg]

7.79% more with SMARt. Despite being smaller, thermal pads for heat transfer do a good job.

SMARt vs rtl-sdr.com v.3

Top two premium general use dongles on the market.

Nooelec SMARt



rtl-sdr.com v.3



[<http://4.bp.blogspot.com/-w3aZbqENZ9U/WaSEzSOMCAI/AAAAAAAAANxY/sx8QHdsyTGAfaEUj7AvpgCmBd-bT9mpCwCK4BGAYYCw/s1600/smartv3.jpg>]

Two v.3s and four SMARts tested, and I mean extensively:

Day one: 12.91% more with v.3, was a scorching day, 25 degrees on the Emerald Isle results in people dropping on the street from heat exhaustion.

Day two: v.3 still 8.06% more Totals on a cooler day.

Day three: third SMARt against same v.3 used yesterday, ambient temperature 10 degrees less than two days ago, v.3 3.36% better.

Day four: 3.2 % more with v.3 again:



**3.20 % more Totals on map:
rtl-sdr.com v.3 (41,462, light grey) vs
Nooelec SMArt (40,175, dark grey) coverage**

[<http://3.bp.blogspot.com/-SOg6u1rNCA4/WaSE8NIMx-I/AAAAAAAAANxg/azR4K-skfd8IkOeosSFQaAx7MK7g1OROACK4BGAYYCw/s1600/Berealistic.jpg>]

Day-to-day differences: fourth SMArt and v.3 for three days:

Friday: 37846 / 35836, **5.60%**.

Saturday: 37121 / 34414, **7.86%**.

Sunday: 40262 / 37302, **7.93%**.

Rtl-sdr.com blog v.3 consistently more - why? From what I can see, larger surface area for sure - I've noted that there's a direct correlation in connection with comparative performance and ambient temperature, e.g. SMArt performs better on cooler days.

rtl-sdr.com v.3 vs FlightAware Pro Stick Plus

Frankly, I didn't expect this to work, cascading preamps and two 1090 MHz filters in the signal path, buy why not?

V.3

FlightAware Pro Stick Plus



Total: 34,637

Total: 40,202

[<http://3.bp.blogspot.com/-c2BTnjRcknk/WaSlpmkioYI/AAAAAAAAANyA/lhpm6lk97dkfA8scKv8WUVpekHM4E3TXgCK4BGAYYCw/s1600/vthree%2Bvspsp.jpg>]

Pro Stick Plus 16.06% more positions reported at 2145, *on an already amped and filtered rig.*

Reran this comparison to be on the safe side, 11.90% more over 23 hours with blue stick, map with max ranges:



Pro Stick Plus (light grey) vs v.3 (dark grey) coverage

[http://1.bp.blogspot.com/-Nzh61YW0rKM/WaSF2XOxL_I/AAAAAAAAANx0/7EGTynmJBLINF4HRNFPOzz0MGHdUhNiDQCK4BGAYYcw/s1600/psp%2Bv3%2Bcoverage.jpg]

Perfect day, experience being a snail humidity combined with massive fog, 213.93 nm range is best I ever got, haven't broken the 180 barrier before.

Had to triple-check, 68,908 vs 64,704, 6.49 % more with blue Pro Stick, slight advantage, but it's visible:



[http://1.bp.blogspot.com/-bvCBK2mrI9M/WaSJNixGatI/AAAAAAAAANYM/CcrruncylcUI_dHGOp1cU7uUJsoexz8ywCK4BGAYYCw/s1600/26th%2Bv3vspsps.jpg]

Why? Solve the following equation: $n1+x2+42+x4$ over traffic density equals what? Result = Pro Stick Plus dependably outperformed the best unamped dongle.

V.3 vs Pro Stick

v.3

FlightAware Pro Stick



Total: 31,591

Total: 36,950

[http://4.bp.blogspot.com/-wspTy_gTQ5w/WaSOEmoX-QI/AAAAAAAAANyc/s5CyjINmp2QZe7Fed0Tn3x2ZyFSMFjDdQCK4BGAYYCw/s1600/v3vsprostick.jpg]

16.91% more with orange Pro Stick. Did not pursue this any further, as earlier comparison showed the Plus is better on its own.

Conclusion and buying advice

Best value: \$8 generics from China. Build a Coketenna, be merry for less than \$10 - a \$150-dollar rig won't get you 15x more fun. Or 15x more data.

Best ADS-B receiver only: blue FlightAware Pro Stick Plus. On its own, or in this test, continues to amaze.

Best ADS-B receiver only with general use in mind: orange FlightAware Pro Stick. Onboard LNA for \$17 is priceless for weak data signals - if ADS-B, weather satellites, pagers etc are your game along with casual listening, get an orange FA Pro Stick.

Best plug-n-joy bundle: Nooelec SMArt. Longest supplied coax cable on the market, shortest of three supplied antennas good for ADS-B, quality in every detail - less than 1% between four dongles, need to say more? Thirty dollars for a SMArt bundle is an uncontested long-term investment in radio.

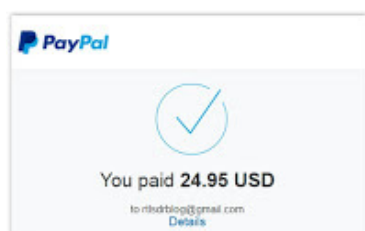
Advanced \$20 receiver-only: rtl-sdr.com v.3. Hands down the best performing dongle without onboard amplification, and the discerning ADS-B enthusiasts' choice due to bias-T: adding an antenna-mounted Uputronics LNA is easy.

Zombie dongles: Nooelec aftermarket case offers unparallelled physical protection, stock on Mini+ AI and Mini 2+ AI, fits all generics, dongle doubles as a short-range weapon against rabid dogs with two-year warranty. I always carry a Mini2+ AI when I go somewhere rough without no sit-down toilet in sight.

Small and performs: Nooelec SMArt receiver only. Nanos' size and inconvenient MCX or PAL connection standard are unwarranted when a SMArt is better in every aspect for terrestrial users.

Mobile / portable use: Nano 3. Any other dongle will run circles around it when and if numbers matter, but no other dongle attached to a mobile station or smartphone is so easy to use.

Which one would I spend my own money on?



[<http://3.bp.blogspot.com/-RmASbZ4zPEA/WaSFdjIGbEI/AAAAAAAAANxs/z-r0B7LEM1kboFI mA x-M9Bd0T9ldG2-gCK4BGAYYCw/s1600/paypal%2Bpayment%2Bfor%2Bpro%2Bstick%2Bplus.JPG>]

Put my money where's my mouth is, ordered a Pro Stick Plus before publishing, well in advance preempting "Out of Stock" misery. \$25 dollars / \$20 euros from rtl-sdr.com (lowest price I could find for Europe delivery) is money well spent.

End of a beginning

No stone was left unturned to find the best performing RTL-SDR dongle for 1090 MHz ADS-B use; however, results reflect my location, testing equipment, air traffic density, plus many factors.

FlightAware Pro Sticks, either one, were significantly better than the best unamped dongle, rtl-sdr.com's v.3 - onboard LNA matters a lot when the objective is eking out the last ounces of performance.

Look at the whole picture: neither FlightAware dongles come with any antenna nor cable, so any bundle will be better out of the box, as they will be usable right away.

Choice is yours: Premium dongle bundles come with bells and whistles for less than \$30, generic for \$8 rewards with best aircraft for money ratio after a three-week wait, any Nano is an engineering marvel, a Nano-P will pass a hard-eyed customs inspection in Burma, Plus models from Nooelec assure 2-years' restful nights, and so on.

Pros and contras exist for all dongles.

Point is: buy what you feel will be good for you. Undecided between this or that, go for both, or get any RTL-SDR dongle you can afford: performance ultimately matters little, as any dongle will put a smile on your face, and that's the most important thing, much, much more than percentage differences.