

IQ+: The 46 most frequently asked questions

1.- ***How much I can improve my EME RX system with an IQ+ receiver?***

The IQ+ receiver is a dual channel radio specially designed for adaptive polarization, in that way having reception in both axis (H and V) will allow you to fight against Faraday rotation. From 50 MHz to 432 MHz sometimes the RX signal come in the wrong polarization angle and this cause several dB's of attenuation on the RX path. The IQ+, running with the properly software (Linrad and/or MAP65) will allow you to create a vectorial sum of both channels giving always the highest signal strength independent on witch angle the signal is arriving to your antenna system. If you have only single polarization antennas and you move to Adaptive polarization the improvement will be tremendous, especially when the RX polarization angle is lock in a inconvenient angle for your single polarity antenna system.

2.- ***But I have only single polarization yagis, the IQ+ will work?***

The IQ+ need and orthogonal antenna system (configured in + or X) if you have only one plane (horizontal or Vertical) the radio will work as a single channel receiver and you will not profit with Adaptive polarization.

3.- ***That means I will need two antenna systems?***

Yes, you will need an antenna system with dual polarization, the most common antenna system are the cross yagis.

4.- ***I can use only one preamp with my cross yagis?***

No, your antenna system (based on cross yagis) will need independent preamps with independent RX lines, each plane will be treated as a single antenna and each RX line will go down direct to your IQ+ receiver (the IQ+ has two Receptors, one per axis)

5.- ***What about the preamps, my ones has 0.2NF and 20dB gain, is that ok?***

The IQ+ was designed considering the presence of your antenna preamplifier; this is the big difference with commercial radios. Those radios are not designed to have and extra gain in front and the presence of an external LNA destroy their performance. The IQ+ needs an external preamp, the design is done to allow the preamp dominate the noise generation. Per design the IQ+ need a preamp with 26dB gain, this will create a noise floor increment of aprox 16dB when the preamp is on with

good antennas pointing to the cold sky. A 20dB gain preamp will produce only 10dB noise increment, in that situation the preamp will not dominate the noise generation and you will lose S/N, the radio will not have its maximum sensitivity.

6.- I install my IQ+ with a 26dB gain preamp but the noise increment is only 13dB, what's going wrong here?

Well, the 16dB noise increment happens considering 1dB losses on the RX line, if you have a long RX cable (medium quality) plus a filter and a splitter (because you want to monitor the band with different receivers) the sum of attenuation decreases your overall gain, in that case if you want to keep your IQ+ radio running at maximum sensitivity with 4 dB losses on your RX path you will need a preamp with 30dB gain, after the losses the IQ+ will see the 26dB's required.

7.- But 26dB gain is not frequent on 144Mhz, what can I do?

Existing several manufactures with preamps on that range. For many years the dominant gain was around 20dBs but not anymore.

8.- I have already my preamps but they have only 18dB gain, can I use that preamps?

Yes but you will lose sensitivity, you would be able to use your existing preamps in conjunction with a second stage preamp, **LinkRF** is working in a second stage preamp you can add to your existing preamp and you will have the possibility to regulate the gain and adapt the preamp to your particular antenna system. We are working at the same time in a dual stage preamp with an overall NF of 0.3dB and 36dB gain.

9.- But a second stage will increase the gain but also NF !!

Not really, if your preamp has 0.3dB NF 20dB gain and you add a second stage with 2dB NF 16dB gain the result cascading both preamps will be 0.32dB NF with 36dB gain (calculation done with AppCAD tool)

10.- But now the NF increase 0.02dB and in EME every fraction of dB count!!!

This is correct for 432 MHz and up, but not for 50 MHz and 144 MHz where the sky temperature is much higher.

The noise floor of any receiver (with the antenna pointing to the cold sky) is proportional to $(T_{sys}) + (T_{sky})$, the T_{sys} (system temperature) is the sum of all your losses expressed in Kelvin degrees. The T_{sky} in 50MHz is approx 3000 Kelvin degrees, in 144MHz is 200K and in 432MHz just 20K (values approx and not absolute)

In 144 Mhz any improve below 0.5dB on the NF have a very little impact on the S/N because the high Tsky in 144 Mhz dominate.

11.- *What would be the impact of the second stage preamp?*

Assuming your actual preamp has 0.3dB NF and 20dB gain, installing a second stage will give you 0.32dB NF and 36dB gain.

12.- *But the IQ+ need only 26dB gain, having now 36dB gain will decrease my Dynamic range by 10dB and this is also bad.!!!*

Yes, but 36dB gain will give you enough "dB budget" to compensate the losses you could have between the preamp output and the IQ+ input. If you have a long RX lines and/or if you want to install a Band pass filter and/or a splitter to use another receiver in parallel and compare performance the 36dB gain will give enough gain to manage all this attenuations, if after that you still having some dB's extra you could introduce 50ohms attenuators to have the properly noise floor increment on your IQ+. The idea is to have 26dB gain at the IQ+ input.

13.- *What is a properly noise increment when I switch on/off my preamps?*

Assuming your antenna is very good (low antenna temperature) pointing the antenna to the cold sky with 26dB gain preamps and 1dB losses from the preamp to the IQ+ you will see 15dB gain noise increment when you switch on/off the preamps, the lower limit is 13dB and the upper limits is 20dB.

14.- *I did that test but both channels show me unequal noise increment, what's wrong?*

In that case you could have preamps with unequal gain, or one preamp is oscillating or something in front of your preamps is causing the noise, several times is bad connectors or water inside your antenna combiners used to nest several yagis in one array, could be a problem on your antenna relays also.

15.- *Several things can go wrong, How can I test?*

A simple test is install on each preamp input a 50ohm dummy load instead of your antenna system, then the noise increment need to be the same in both channels (+/- 1dB) if both preamps are ok and have same gain, in the real practice the test with the 50ohm dummy load will give 1dB more than the value you will have with your antenna system connected and pointing the cold sky (Boltzmann constant).

16.- *When the second stage and dual stage preamps will be available?*

In June/July 2013

17.- *My IQ+ U has a long warm-up period, Why?*

The IQ+ LO (local oscillator) runs at double the desired frequency you want to use, for 432 MHz the LO runs at 864MHz. Is very difficult to have a low phase noise oscillator at that high frequency and reach stability very fast. Normally the IQ+ V (144 MHz) reach stability just in 10min, the IQ+ U needs 40 minutes for that.

18.- *Exist the possibility to "lock" the IQ+ LO with a 10Mhz external reference?*

No is not possible, never the less the SI570 chip used on the LO is a version with very good phase noise and thermal stability. Is much more expensive than the cheapest versions used on softrock and other SDR radios

19.- *But 40 min warm-up for my IQ+ U (432 MHz) is too much, exist any other possibility to improve that?*

Yes, a PTC 60 degrees glued on the surface of the SI570 chip reduce the warm-up just to 15 minutes at room temperature, from now every IQ+ U has this modification installed and for those who has the radios before March 2013 exist a kit "free of charge" available on request. The installation is very simple, never the less I can offer the installation in factory also for free.

20.- *I have the IQ+ V (144 MHz) I need this PTC kit?*

No, your really don't need because as soon the SI570 chip reach his working temperature the LO is extremely stable but you can install if you want, is a nice to have for 50 and 144 MHz

21.- *The IQ+ is dedicate for digital communications.*

No, this information is totally incorrect; the IQ+ is totally independent from the modulation you want to use. Is capable to do CW, SSB, FM and digital modes, in the same way MAP65 control the IQ+ LO via the USB port the software HSDR is the perfect suite for CW with absolute control over the IQ+ LO. Linrad has also full control over the IQ+.

22.- *What about the IQ+ SC (single channel) I heard some ones are using in microwave bands?*

Yes, some people install the IQ+ SC (28 Mhz or 144 Mhz) in parallel with the IF of their transverters, this allow a panoramic receiver up to 192Khz, specially appreciated for bands with high Doppler (23cm and UP)

23.- *But I don't have plans to install cross yagis, can I use the IQ+ SC.?*

Yes, several stations install the IQ+ SC and replace standard receivers with excellent results, the big advantage is you can profit of a big waterfall (96 or 192Khz) depending on the sample rate of your audio card.

24.- *What about the Dynamic range on the IQ+?*

In terms of numbers the IQ+ has a dynamic range above 100dB

25.- *This value is claim by you, what about and independent review about the IQ+ performance?*

I don't like to claim numbers, best is to ask IQ+ users about that, never the less a very extensive electronic review was done by Leif SM5BSZ. Everybody knows Leif about his technical skills and how rigorous is him with every HW landing in his Lab, I'm extremely satisfied with Leif report, just keep in mind this is a deep technical report and some parts will not be easy to understand by everybody or can be misinterpreted, you can read Leif's report on

<http://www.sm5bsz.com/linuxdsp/hware/iqplus/iqplus.htm>

26.- *Yes you are right, I don't understand complete the report done by Leif, exist another independent source about the IQ+ performance?*

I'm not allow to disclosure a complete list of IQ+ users but since two weeks ago independent reviews are publish by their own users on the eham.net portal, you can read direct. This homepage host thousands of report about amateur radio products.

I don't have any way to modified or bias the reports, the best is read what the IQ+ users actually think about the radio, and contact those users directly if you want more details. You can read the IQ+ users reviews here:

<http://www.eham.net/reviews/detail/10952>

27.- *I have several VHF stations near my area and they cause me always interference, How the IQ+ will perform in this situation?*

Will perform same or better than HF rigs with transverters, the main problem here could be you preamplifier. A wrong culture about "**lowest NF**" dominate today the way people "think" about the figure of merit of their preamps, just they think because has the lowest NF they has the best and this is totally wrong. Most of the time is your preamp who saturates first and in that common case having the best receptor with the highest Dynamic range will not help. The preamp is the first amplifier in your system, if the preamp saturate the rest devices cannot do anything.

28.- *How I can estimate is my preamp is good or not?*

Well, NF and gain are the most common values declared for a preamp, but what about IIP3 (input IP3)?, until today no body declare this value, the higher the IIP3 more immune your preamp is for saturation.

29.- *How can I know how much IIP3 my preamp has?*

Manufactures give for years only Gain and NF, now someone's start to give values in terms if IP3 , but this is very confusing because you don't know if is IIP3 (input IP3) or OIP3 (output IP3), by formula $OIP3 = Gain + IIP3$, if you have gain and OIP3 you can calculate how much is your IIP3, because the OIP3 is the sum of 2 values a well know trick is specified the OIP3 (and not the IIP3) and someone's publish this high level in dB's but just as a IP3 and not OIP3, this confuse people, the trick here is to write the higher number in dB's they can but without telling you this is OIP3, they just call IP3 and people "think" wowww IIP3 very high!!

Assuming a preamp declaration like:

NF: 0.3dB

Gain: 24dB

IP3: +26dB

Here the IP3 is presented as "extremely high IP3" but they don't tell you if is OIP3 or IIP3, you need to know the most common values for IIP3 in amateur preamps are in the range of -5dB to +12dB), the highest IIP3 value the saturation point is much higher, and normally quantitative OIP3 is always much higher the IIP3, because we know IIP3 values swing between a limited low value rapidly I assume the $IP3=+26dB$ could not be IIP3; definitive is OIP3, and they apply the formula:

$$OIP3 = Gain + IIP3$$

$$\text{then...} IIP3 = OIP3 - Gain$$

$$IIP3 = 26 - 24 = +2dB$$

THE REAL IIP3 FOR THAT PREAMP IS : +2dB and NOT +26

Now obviously, for marketing reasons, is better to declare $IP3 = +26dB$ than $IP3=+2dB$

30.- *High IIP3 values are difficult to achieve, what can I do to prevent the overload of my IQ+?*

I will reformulate this question: what can I do to prevent the overload of my preamp?

I'm sure, most of the times your preamp will saturate first than any radio at the end of your coax line. Try to have the highest IIP3, unfortunate the "NF culture" move people to think only in lowest NF values and most of this ultra-high-super LOW NF preamps come with very poor IIP3 and has tendency to oscillate.

31.- *My preamp has a high IIP3 and I still suffering from overloads on my system.*

In that case your EME facility is located in a inconvenient area, unfortunate this happens more and more, EME stations now can be installed in your back yard in the middle of big cities, the man made noise and saturated RF polluted areas are associated with high demographics areas and the presence of and external high gain preamp is not good in such areas.

A common practice for years was to install a Band Pass Filter after the preamp and before the radio, this work great for the IQ+ also, will not cure all your interference problems but plenty of time cure other ones, a 2 cavity helix BPF would give you a very good rejections for out band interference but if you have a "friend" doing tropo with 1KW RF just 1km away from your antenna you have no chance to eliminate such interference.

32.- *The IQ+ needs and audio card, any special?*

The important part here is the audio card needs 4 analog inputs (2 inputs per RX channel) and a sample speed of 96KHz and up, can work with less sample rate translated in a reduced bandwidth. The IQ+ was designed to work with the DELTA44 or similar.

33.- *But the DELTA44 won't work properly under Windows 7?*

Yes this is a fact, unfortunate the M-Audio drivers for Windows 7 are bad, the card works but if a strong signal enter on the radio the audio card generates glitches and pops. To avoid this problem you need to run the DELTA44 under Windows XP SP3.

34.- *But Windows XP is already discontinued, doesn't exist another alternatives?*

Yes off course, actually the main problem with the DELTA44 is not only doesn't run properly under Windows 7, the main problem is that card has a PCI architecture and now new computers doesn't come any more with PCI slots. The best card now working properly with the IQ+ is the MAYA44XTe (PCIe), this card is compatible with Windows 7 and 8. Exist another audio card the EMU1616 but is extremely expensive (more than 600.00 USD) and is very difficult to find. Other options are the DMX6Fire (a USB audio card by Terratec)

35.- *I want to use Adaptive Polarization but all the software setup is too much for my lower computing understanding. What can I do?*

If you have problems with the software setup (Linrad, MAP65, HSDR etc) extensive material is ready for download in <http://www.linkrf.ch>

If the manual, application notes and user guides are not enough I offer totally for free an "online support" for the IQ+ users. Using a remote connection with the software TeamViewer I will connect your PC in any part of the globe and I will configure your system in minutes, some additional test I can do remote with your assistance to debug any probably problem in your complete system (antenna, coax, preamp, IQ+, PC etc)

36.- *The IQ+ revB was announced during the EME conference 2012 in Cambridge, now you announce the IQ+ XT, this will replace the IQ+ revB?*

No, they are different products but complementary, the IQ+ XT is an exciter with limited power, is mainly a Software Define Radio Transmitter, the IQ+ revA and B are receptors.

Several IQ+ users ask for a transmitter, for that reason I decide to design the IQ+ XT, this is a complete new product but to keep lower prices I will use the local oscillator embedded on the IQ+ receivers to run the IQ+ XT

37.- *That means I cannot use the IQ+ XT separate from the IQ+ receiver?*

You can but for that you will need to provide the local oscillator frequency externally by your own LO or buy the IQ+ XT with an embedded LO.

38.- *Why tied the IQ+ XT to the IQ+ receiver?*

The IQ+ XT needs a LO (local oscillator), exact the same as the IQ+ receiver has, the LO is the most expensive part on the IQ+ receiver, duplicate the LO will result in elevated costs for the IQ+ XT, unnecessary when the IQ+ users already has a extremely good LO inside their receivers.

39.- *I want to know more about the IQ+ XT, can you tell more details?*

This will be a very long answer; the relevant part here is the IQ+ XT will not use the traditional way to generate RF (by audio shifting). The IQ+ XT will use "carrier shifting" to produce the cleanest signal produced by any software Define Radio transmitter. All you need to know about that is publish in a document on <http://www.linkrf.ch>

40.- *You mention to save cost, any idea how much will cost the IQ+ XT?*

Much less than a IQ+ receiver, probably 50% or even less.

41.- *You mention the IQ+ XT will have a RF output of +1.5dBm, this is too low?*

Yes is too low, several people wrote me emails asking for a little more power, for that reason I decide to increase the RF output to +20dBm, this will be enough power to feed a brick amplifier and reach 60 to 100 watts directly, then reach QRO power will be trivial.

42.- *What kind of software will be compatible with the IQ+ XT?*

For sure MAP65 will be the first software capable to Txing direct with the IQ+ XT, I already contact Joe Taylor K1JT and he accept to update MAP65 to support carrier shifting, as soon a functional prototype is finish he will receive one unit to reprogram his software. In the same way I already have contact with Leif SM5BSZ to extend TX support under Linrad (thinking mainly in CW users)

43.- *Ok, I understand now the differences between the IQ+ and the IQ+ XT but exist any plan to launch a IQ+ revC?*

No, the IQ+ receptor revB is the latest revision for the IQ+, no future plans to add or change something. The IQ+ revB, as it is, demonstrate excellent performance and dozens of satisfied customers confirm the good design. The only "new add" is done for the IQ+ U (432 Mhz) revA and B to decrease the warm-up period with the PTC kit. No reason to change nothing, I want to keep the radio functional without adding unnecessary gadgets (no space for nice to have here)

44.- *I can expect the IQ+ will work better than my HF rig with a transverters?*

Definitive yes, will not be fair (for a HF rig) to compare a single channel receiver with a dual channel receiver specially designed for Adaptive polarization. Having an adaptive polarization will allow you to copy stations you will never receive with a normal single channel receiver. In terms of overall performance the IQ+ outperform several commercial HF rigs from well known brands (please read Leif review).

One of the success on the IQ+ design was the noise distribution between all stages, every stage add noise, distribute the noise increment inside the IQ+ was very difficult and different amplification levels was selected very precise.

I doubt just installing a transverters in front of a HF rig will give you automatic the properly noise distribution, finally the real success on a weak signal receiver is based mainly on how this noise distribution happens.

45.- *The IQ+ was announced 2 years ago, I try to buy one but I was more than a year on the waiting list, what happens?*

Well unfortunate the demand exceed totally my capacity in the beginning, I was forced to industrialized most of the process, specially for the revB, on December 2012 I was able to "clean" all my waiting list, today you order the radio and shipping happens just 5 days after payment confirmation.

46.- *This is a long list of Q&A but I have other questions not solved here*

This Q&A is a collection of what people ask me via email, if you have any question not solved here just send me and email (info at linkrf dot ch) and I will answer you as soon as possible.

73 de Alex, HB9DRI

Mach, 2013