

EME Dual Channel Receiver Rev.B
EME Single Channel Receiver Rev.B



User Manual

v.2.1

(19.11.2012)

LinkRF

INTRODUCTION

Congratulations for your new EME Dual Channel receiver rev.B. With your IQ+ you will increase your EME system performance. No more Faraday rotation problems or complex mechanical system to rotate your antenna, you will be able to copy more weak stations than any other lineal polarization system similar in size.

With the IQ+, in conjunction with MAP65 and/or Linrad, you will be able to "rotate" the polarization of your system by software and not any more by expensive HW systems. You will have always the right RX polarization angle and you will be able to work much more stations without take care anymore in which angle the RX signals are coming.

The IQ+ Rev.B is the latest evolution of my previous IQ+ Rev.A.

As a sub-part of your EME system the performance of your IQ+ Rev.B will depend on how your antenna system, preamplifiers and coax cables are deployed in conjunction.

In that way is important you follow every single recommendation from this user manual; taking special care about the topic "preamplifiers and noise-increment". Your IQ+ is designed considering the presence of an external preamplifier, this is the big difference with other SDR radios and super heterodyne commercial receivers and this is the reason why the IQ+ is a receiver created thinking in "Earth - Moon - Earth" communication. This is not a Wide band SDR receiver adapted to be use in EME; the IQ+ is a Narrow band receiver designed an optimized for EME.

The noise increment distribution is very important and you need to match some pre-conditions to exploit the maximum performance in your IQ+.

I hope you will enjoyed your new radio

73 de Alex, HB9DRI

TOPICS

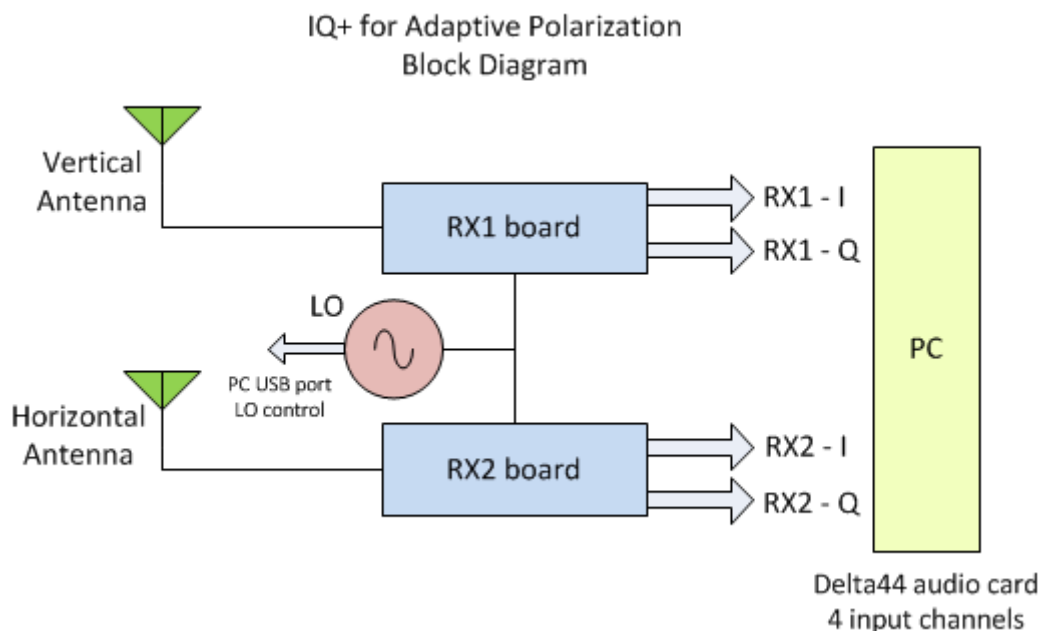
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3. Pre amplifiers and noise increment
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1. Architecture Description

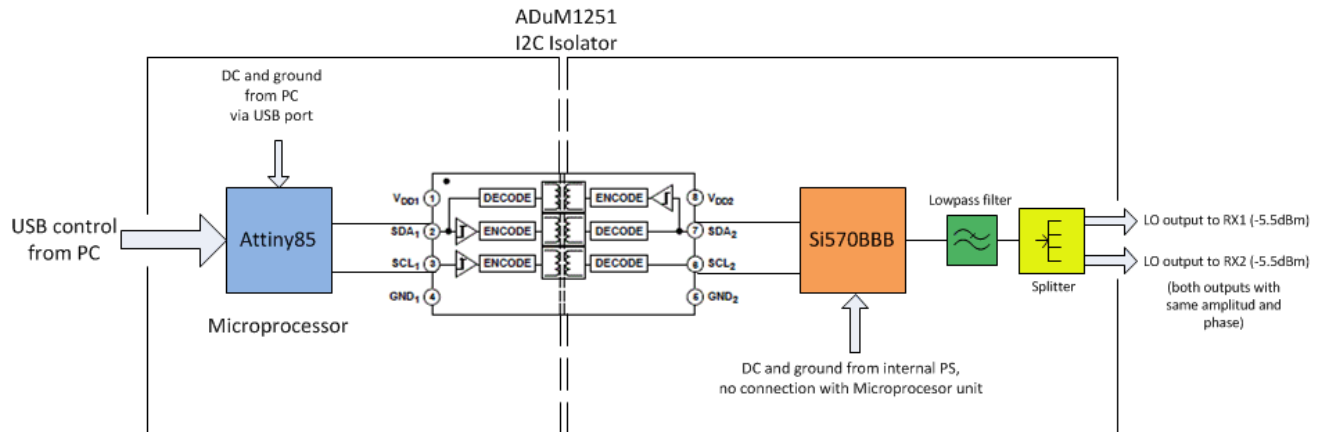
The IQ+ Rev.B is essentially 2 receptors in one, box RX channels share the same Local Oscillator as a pre-condition for Adaptive Polarization. The LO signal is filtered and divided in two identical signals with same amplitude and phase. The RX inputs pass to a Helical BPF and then the signal is amplified by a PHA-1+ mmic, the internal preamplifier output is filtered by a second helical BPF.

After the signal is amplified and filtered then is injected into the IQ demodulator LT5517 from Linear Technologies, the LT5517 receive the RX signal and the signal from the LO at two times the operative frequency (56MHz for 10m, 100MHz for 6m, 288 MHz for 2m and 864MHz for 70cm) The LO levels varies from -11dBm to -5dBm depending on your operative band.

The IQ demodulator produce 4 outputs, after filtered are send to a low noise Operational Amplifier (LT6231) working at 10VDC providing very low noise contribution. The output of both Operational amps produce the IQ pair corresponded to one channel, this configuration is duplicated in a second independent RX channel, having 2 IQ pairs the audio signal is injected into a DELTA44, MAYA44 PCI or PCIe or in a EMU1616 PCMCIA (for Laptop operation) or PCIe audio card to do the A/D conversion.



The LO is based on the chip Si570BBB from Silicon Labs and have a I2C isolator ADUM1251 to avoid spurious, birdies and artifacts coming from the PC Switching PS. The electric noises normally present on the USB DC connections have no path to the Microprocessor and to the Si570BBB chip.



The IQ+ Rev.B introduce a new feature in the LO, an USB auto reset circuit is added to avoid unplug and re-plug the cable if your IQ+ loss communication with your PC via the USB port

2. Requirements for Adaptive Polarization and Single Channel operation

To install properly your IQ+ Rev.B you need to provide two antenna systems with independent pre-amplifiers and with independent RX lines direct connected to the IQ+ Rev.B receiver. Do not split your RX signal with BNC tees or N tees, this absurd technique will only depredate your RX signals and will affect the IQ+ performance. If you want to have multiple receivers with the same antenna lines use professional splitters to guarantee the signal phase, depending on the attenuation you will need and intermediate preamplifier. If you have a IQ+ SC (single channel) the same rules apply but only to one RF channel, the antenna could be polarized Horizontal or Vertical.

The antennas for Adaptive polarization are normally cross yagis installed in "+" or "X" configuration, the polarization planes need to have 90 degrees difference. Depending on your HW facilities one configuration could be better than the other one and this will be an independent decision based on what you could install. To have the better results you need to have the lower antenna temperature as possible, a parameter most of the time forgotten by the EME operators, a noisy antenna design will destroy the performance of your IQ+ Rev.B (or any other receiver), well proved designs exist on internet and some commercial manufactures provide antennas with very low temperature. LDF antennas from InnovAntennas

(www.innovantennas.com) are very quiet and demonstrate extraordinary performance with his new cross yagis models for a very reasonable price.

Each antenna system need to have an independent preamplifier, is recommended to use the same preamp brand or design with the same gain and NF if possible.

In the same way the RX coaxial line from the pre amplifier output to the IQ+ input need to be the same brand and type with the same longitude both lines, if one line is longer or shorter than the other one you will introduce phase errors on your Adaptive polarization system.

In case your station is located near terrestrial stations you eventually could suffer some level of in band and out band interference, the use of a external pre amplifier increase dramatically the chances to suffer inter-modulation problems and in that case if the internal selectivity of the IQ+ is not enough adding cavity filters will improve your selectivity and solve the problem, this situation is common on RF polluted areas like big cities or when you have another EME or terrestrial station (VHF FM repeaters) working on the same band near your frequency and location.

3.Pre-amplifier and noise increment

Just few words about the preamp you plan to use, today existing several designs reaching incredible Noise figures, some ones reach even less than 0.2dB NF, keep in mind based on the fact the sky temperature in 144Mhz is very high you will not experiment any improvement if you move from a preamp with 0.5dB NF to a new one with 0.2dB NF, the S/N (signal to noise ratio) suffer a little variation for each 0.1dB NF you improve in 144Mhz and lower, has much more impact in 432Mhz and up where the sky temperature is much lower than in 2 and 6 meters bands.

Most of this ultra-extremely low NF preamps exhibit a very poor IIP3, the best ones are in the range of +1dB or maybe +2dB IIP3 and several has even negative values, having a preamp with a extremely low NF will not give any advantage (for the reason previously explained) specially if this device come with a very low IIP3, for sure your preamp with poor IIP3 would be the source of the major In-band, Out-Band and intermediation problems. A good preamp with at least +5dB IIP3 and NF in the range of 0.4dB would perform much better than a preamp with 0.1dB NF but poor IIP3.

The IQ+ Rev.B design consider the presence of an external preamplifier, most of the SDR radios and commercial Super heterodyne receivers are not design to work with and external preamp, the presence of this extra gain simple destroy the performance in most of the normal receivers.

The IQ+ with the IQ demodulator LT5517 is not free of this degradation, this is a physical fact. To compensate that; the noise increment is well distributed in the inter stages inside the IQ+ with the idea to mitigate the negative effects of the external pre amplifier presence and keep performance in an excellent level. Additional the

Rev.B incorporate better anti alias filtering to avoid send unnecessary frequencies to the IQ demodulator, in consequence less birdies and phantom signals are present now.

The noise increment in your BW is by design oriented to have the biggest increment when your pre-amplifier is ON.

The internal pre amp now is the PHA-1+ with almost 10dB better SFDR (Spurious Free Dynamic Range) compare with the GALI74 present on the IQ+ Rev.A, the IQ demodulator (LT5517), the Op amps (LT6231) and finally your A/D converter (audio card) all add noise to your RX path, the important condition here is ***the biggest noise floor increment need to be generated when the external preamp is ON and NOT in the inter stages inside the IQ+ ,*** that means the Noise contribution is dominated by your preamp.

For that reason you will need different pre amplifiers gain depending on your band, the next table resume the requirements in terms of gain for your preamplifier.

Assuming 1dB loss in your RX line after the preamplifier and with your antenna system pointing to the cold sky.

BAND	Pre amp. Gain	BW noise increment (+/- 1dB)
28 Mhz	22dB	16dB
50 MHz	23dB	16dB
144 MHz	25dB	16dB
432 MHz	21dB	13dB

You need to pay attention at 432 MHz, with a normal 21dB pre amplifier (single stage) the BW noise increment will be only 13dB or less, this level is not enough to keep your IQ+ running at best performance. The system will work but not at best performance.

The condition here is:

THE NOISE INCREMENT WHEN YOU TURN ON YOUR PREAMPLIFIERS NEED TO BE AT LEAST 14dB, IDEAL LEVEL is 16 to 18 dB AND MAXIMUM LEVEL WILL BE 20 dB, MORE THAN 20 dB YOU DECREASE DRAMATICLY YOUR DYNAMIC RANGE.

A good antenna system on 70cm will have at least 10dB less noise (higher the band less BW noise) compare with 144 MHz, for that reason a single stage pre amplifier

with aprox. 21dB gain will not be enough to reach your optimum performance; a dual stage pre amp will be a must on 70cm.

Most of the dual stage pre amplifiers on 70cm have gain level near 40dB, this level will be too high, with the idea to keep our precious dynamic range (don't care about dynamic range if you don't have other stations near you) maybe you will need to introduce coaxial attenuators until you reach the properly level. A simple rule will be: keep your noise increment in any band at least 14dB and no more than 20dB when your antenna system is pointing to the cold sky and you switch on/off your preamp, ideal 16dB.

All this recommendations are made using a DELTA44 audio card as an A/D converter configured in "consumer mode". The MAYA44 and EMU1616 works only in +4 or -10 dB mode, in those cards the recommendation will be to work on +4 mode. This will increase the Dynamic range by at least 3dB BUT will give you less noise increment when you turn ON your pre amplifiers.

To do the properly measurements you can use Linrad or MAP65.

One important progress today is with the latest MAP65 software you can interface direct your audio cards with MAP65 without using Linrad, Direct Input audio demonstrate a very good performance but in heavily noise places Linrad, as an input, could work better if you manage to calibrate properly the Noise Blanker, otherwise you will not have any additional benefit.

4. Installing the IQ+

Your radio is design for interior use, do not install outside for any circumstance. Water condensation will destroy the electronic parts. Avoid install in a room with less than 8 Celsius degrees or more than 35 degrees.

Avoid the installation near a window, floor, and door, heating system, air conditioner or power amplifier. Preferable install on a table without direct air circulation or direct sun light.

The IQ+ LO needs some minutes to become stable. The entire aluminum box needs to gain some temperature. With higher LO frequencies the drift is longer and longer the warm-up period. For IQ+ U the warm-up period is long but as soon the radio reach his working temperature is very stable

The IQ+ VL (50MHz) and IQ+ V (144MHz) need approximately 15 minutes to become stable. The IQ+ U (432MHz) needs 30 to 45 minutes under a room temperature of 22 Celsius degrees. Lower the room temperature longer the warm-up.

You will need 12VDC 750ma to feed your IQ+, avoid using any kind of switching power supplies, they will introduce a lot of birdies and artifacts in your pass band, better use a normal Linear regulated power supply.

A ground connection is very important, on the back panel exist one of the screws prepare for that, is and imbus screw, do not use other ones because they are

marked with paint to guarantee you did not open the radio if need to return to factory under guarantee.

The audio ground float in aprox 100ohms resistance respect to ground, do not attach any ground cable to the audio ground otherwise you will introduce heavy current return to the audio stages and you will increase the numbers of birdies, you could damage your audio stages if this happens the reparation could be expensive. (Refer to the section 4.3 Ground connection for more details)

4.1 Frontal panel



- a) ON/OFF switch: turns the LO and RX boards, the switch have a revers polarity protection.
- b) RED LED "Pwr RX" : turns ON indicating Radio in RX mode.
- c) GREEN LED "Mute" : Turns ON when Radio go to Mute after apply 12VDC into the Mute jack (back panel)

4.2 Back Panel



- a) 12VDC: Center pin(+), apply DC voltage from 12 to 16 VDC /750ma. 11.5VDC is the lower limit, after that some internal voltage regulators will not work properly.
- b) VFO Control USB PC: this is the USB port to control the VFO via Linrad or other software, use the cable provided with IQ+, do not extend that cable, you could compromise the microprocessor operation due the voltage drop.
- c) RX Mute: Apply +12VDC/20ma (central pin+) during TX to protect your LT5517 IQ demodulator. Frequently a considerable level of RF back to the station via the RX lines, the maximum level will be 0dBm. The time response is around 250us.
- d) Ant. RX1: This is the RX input for the first receptor; connect here your Horizontal Antenna.
- e) I-out / Q-out (RX1): this is the audio output for receptor 1 (horizontal antenna). The I-out is colored red and need to be connected to the "Input 1" on the Delta44 Break out Box. The Q-out is colored black and need to be connected to the "Input 2" on the Delta44 Break out Box.
- f) Ant. RX2: This is the RX input for the second receptor; connect here your Vertical Antenna.
- g) I-out / Q-out (RX2): this is the audio output for receptor 2 (vertical antenna). The I-out is colored red and need to be connected to the "Input 3" on the Delta44 Break out Box. The Q-out is colored black and need to be connected to the "Input 4" on the Delta44 Break out Box

4.3 Ground connection:

Install a ground connection cable from the IQ+ (on one of 4 screws in the back panel) to the PC chassis. DO NOT USE THE IQ+ IF THE GROUND CABLE TO THE PC IS NOT CONNECTED, your waterfall will be fully of birdies if you operate the IQ+ without ground connection. Your PC needs also a good ground connection.

For the DMX6Fire and EMU1616 audio cards install the IQ+ ground cable to the ground connections on the external audio box and from that point install a ground to your PC, the direct ground from the IQ+ to your PC works only for the internal PC cards like MAYA44 and delta44.

You don't need to install any other ground connection; the DC power supply and the antenna connectors provide the rest ground path.

The audio cables have their ground connection insulated from the IQ+ chassis but you can measure approx. 100 ohms from the audio ground respect to IQ+ chassis; this is totally normal. DO NOT ADD ANY ADDITIONAL GROUND CONNECTION FOR THE AUDIO CONNECTORS OTHERWISE YOU WILL INTRODUCE HUM NOISE INTO THE AUDIO CHANNELS.

Depending on how good is your ground system sometimes ground the IQ+ with the PC doesn't reach good ground path, unfortunate Ham radio stations has a lot of ground loops and this could affect how clean your pass band will be. Try to identified the best ground point just looking how nasty looks the central birdie on your waterfall, normally when a good ground point is reached, the central birdie is just as black deep line with one thin central line and two or 3 symmetrical lines in each side with aprox 200Hz wide, if multiple symmetrical birdies close to the central frequency exist and take more than 200Hz your ground path is not good enough and you will need to search and fix any ground loop in your ground system.

The Delta44 audio card have a design error on the input connector, please review the Linrad homepage how to modified the Delta44 ground input connector to reduce the central spur amplitude and avoid ground loops.

5. Setup LO driver under Win- XP / Win-7

Windows XP:

- a) Download the PE0FKO USB driver from <http://www.linkrf.ch/IQ+g.html>
- b) Create a folder on your root like C:\IQ+ and copy and unzip the PE0FKO driver in that location.
- c) Plug your IQ+ USB cable into the PC, the OS will tell you "Found new Hardware DG8SAQ-I2C", just point the Wizard to the C:\IQ+ folder and the driver will be installed.

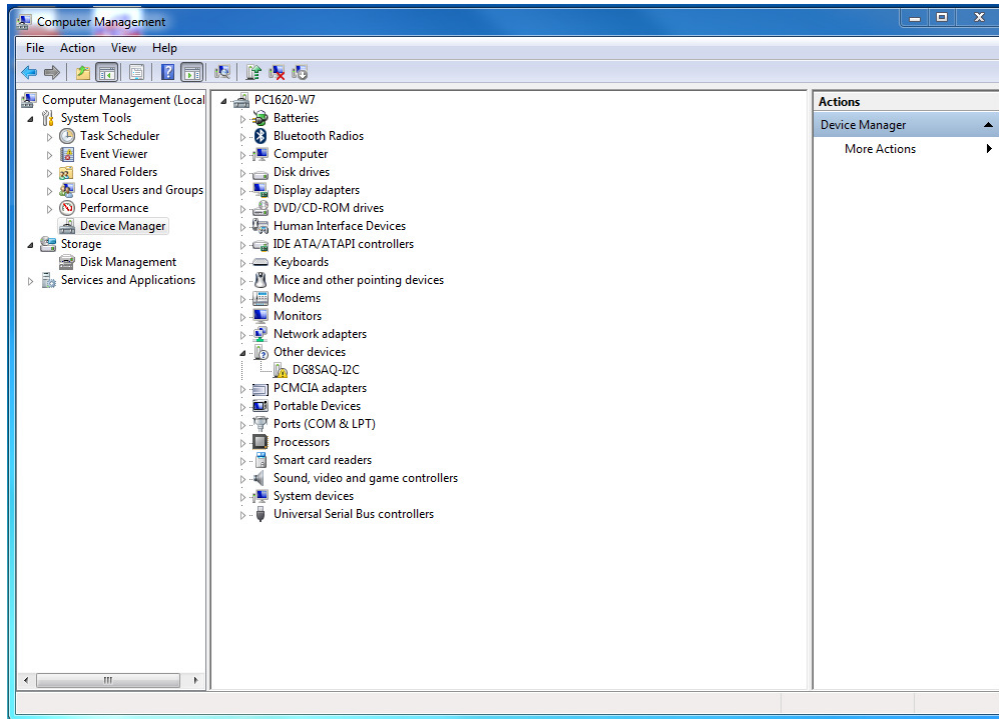
Windows 7:

- a) Download the PE0FKO USB driver from <http://www.linkrf.ch/IQ+g.html>

b) Create a folder on your root like C:\IQ+ and copy and unzip the PE0FKO driver in that location.

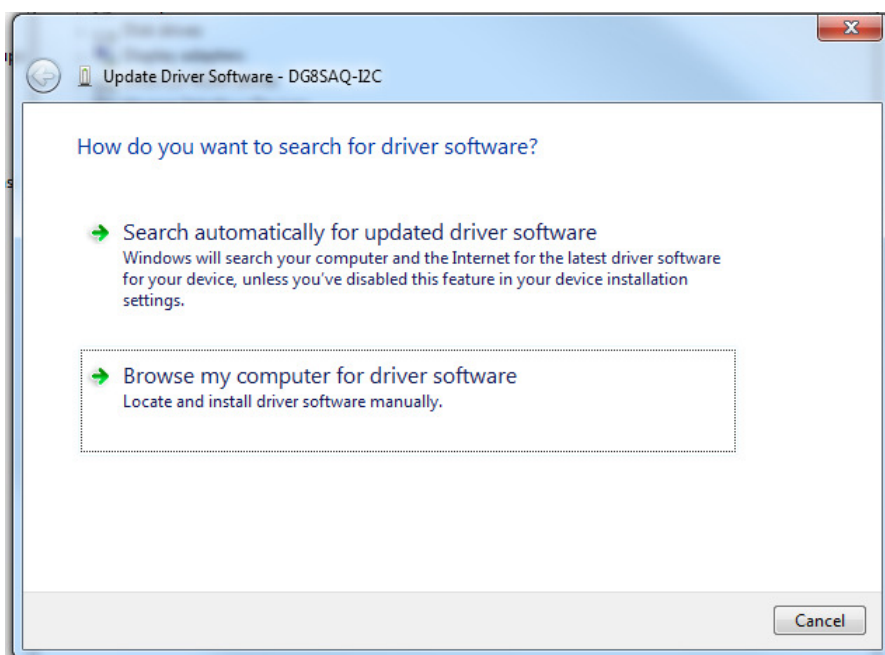
c) Plug your IQ+ USB cable into the PC, the OS will not found the properly driver.

d) Open the "Computer Management" console, just right click on Computer and then click on "Manage"



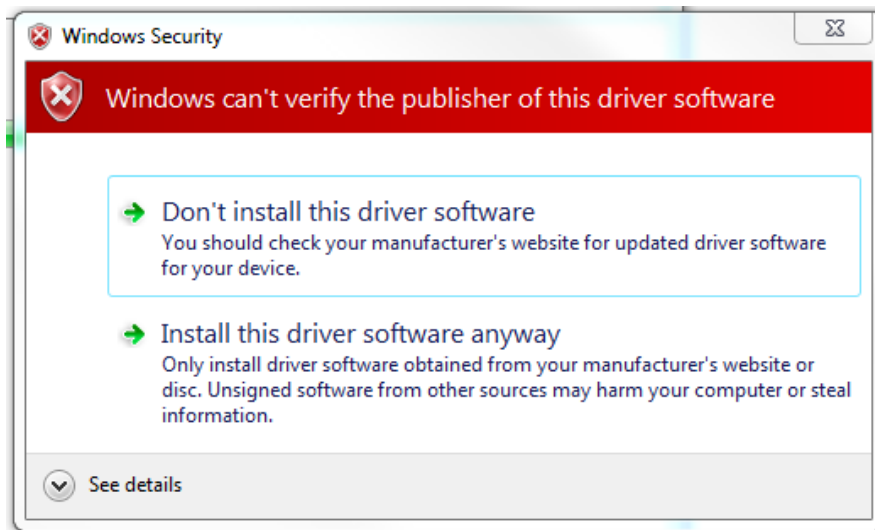
You will see DG8SAQ-I2C in yellow. Right click and press "Update Driver"

e) Select "Browse my computer for driver Software"

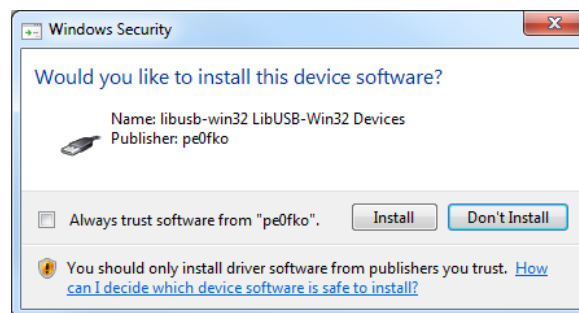


f) Select the folder C:\IQ+ and select "Include subfolders"

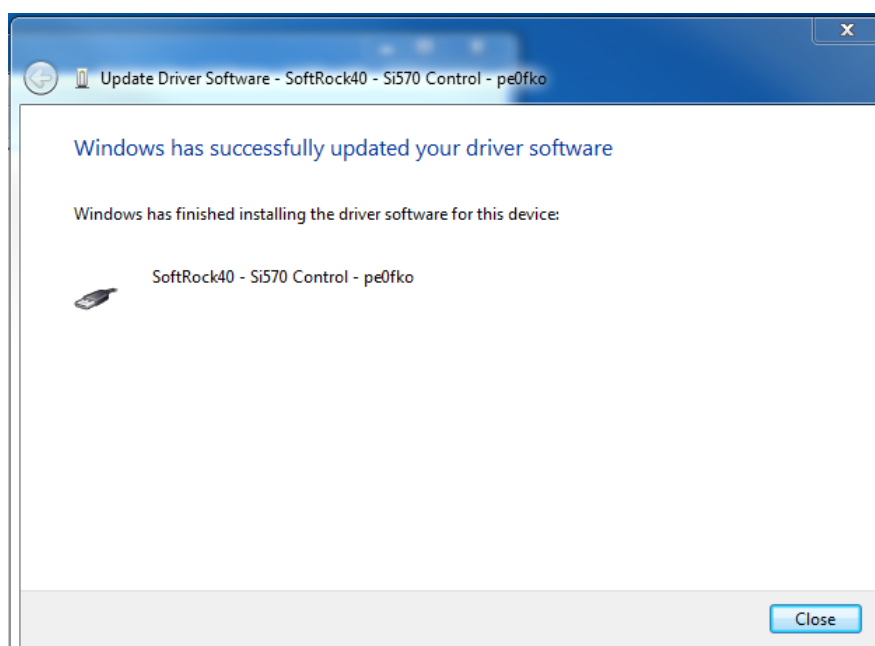
g) You will receive a Windows Security message; select "Install this driver software anyway"



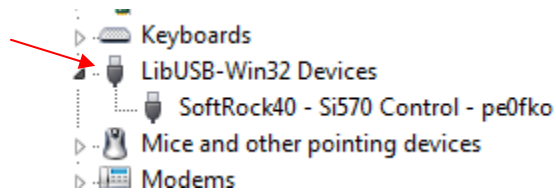
h) Confirm the installation pressing "Install"



i) You will receive the confirmation message:



For Windows XP and Windows 7 the Computer Manager will show you the device properly installed:



6. Define your audio input

Depending on what you plan to do with your IQ+ you need to define how you will manage your audio input. If you are interested in digital modes like MAP65 you have two options as an input:

- 1.- Linrad
- 2.- Direct Input audio (DIA) : MAP65 will open direct your audio device

Linrad offer a very strong Noise Blanker well proved for several years, MAP65 working under Direct Input Audio works really good but in some cases and depending on your Noise interference the NB will not perform same as Linrad. The advantage of DIA is the easy configuration. Linrad offer better Noise Blanker and in some conditions would be better to have as an input instead or working direct but you will need to define what's the best for your setup. The extraordinary NB in Linrad demand a more complex routines and a precise NB calibration otherwise will not perform properly. If your environment has not too much noise DIA would be ok for your setup or if you cannot master Linrad go for DIA

7. Install Linrad under Windows XP/ Windows 7 to use as an Input for MAP65

To run properly your IQ+ you will need an audio card with 4 channels (4 analog inputs). M-Audio produce the famous DELTA44, this card is "the fact" audio card for your IQ+. You can use another ones like MAYA44, DMX6Fire, EMU 1212 or 1616 (the setup with these cards will be covered in a separate Application -note "AN").

At the same time you run Linrad you will need to run MAP65, at the beginning we use separate computers to do that but today with the inexpensive price of RAM you can run both programs in one single computer. Because today most of the video cards come with "dual head" option installing a second monitor and extend your

desktop "is a must". With Linrad and MAP65 you will have a lot of information screens on your display and a second one will help a lot.

Unfortunate the DELTA44 drivers for Windows 7 are not good, you have a lot of glitches and interruptions, for that reason we are force to install our PC with Windows XP SP3 and use the Delta44 driver version 5.10.0.5047 otherwise your audio card will not work properly. The MAYA44, DMX6Fire (USB audio card) and the EMU1616 works very good under Windows 7

A Pentium Dual core processor with at least 2GB RAM is required to run both programs on the same computer. The new processors I3, I5 and I7 works great, just give enough RAM, especially for MAP65.

Linrad v3.26 Setup (apply for new versions also)

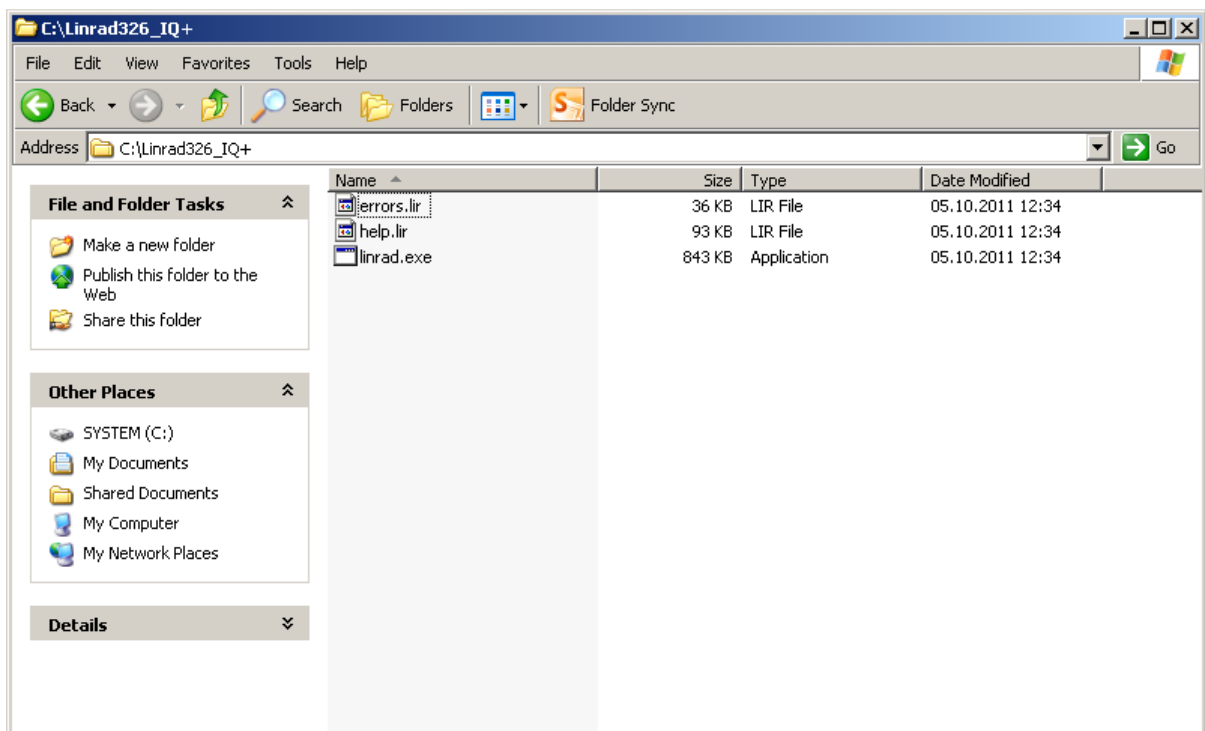
Step by step guide:

1. Download the Linrad DLL installer for Windows from the Linrad page:

<http://www.sm5bsz.com/linuxdsp/linrad.htm> and install, follow the GUI, is a very simple setup.

2. Create a directory call Linrad326_IQ+ on you drive C. you will see C:\Linrad326_IQ+

3. Download the Linrad installers for Windows and extract the content on the previous directory. You will have 3 files: errors.lir, help.lir and linrad.exe.



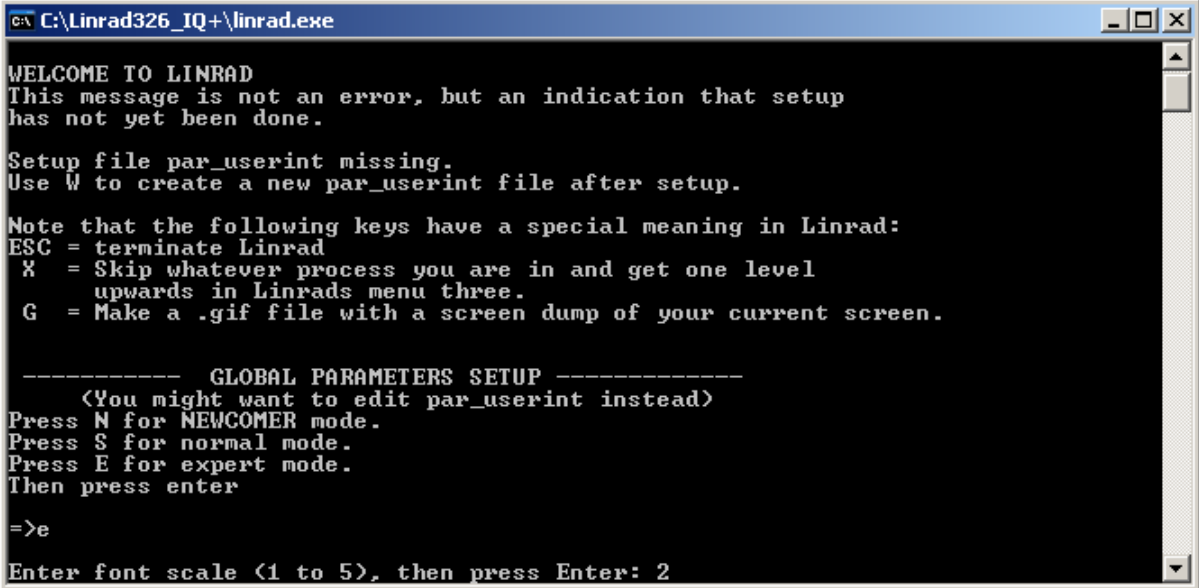
4. Your DELTA44 audio card need to be installed and the properly driver uploaded.

5. Double click on Linrad.exe and execute "Run" under the security Warning:



6. You will receive the "Welcome to Linrad" window, under global parameters setup just type "E" and then "enter"

7. Linrad ask for Font scale: just type "2" and press "enter"



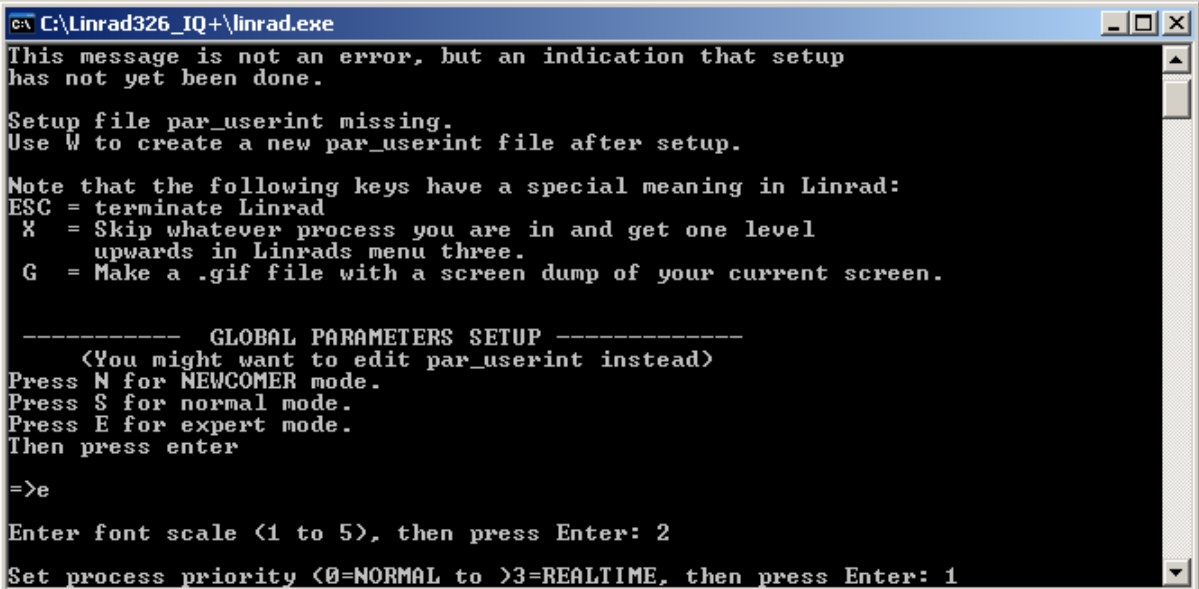
```
C:\Linrad326_IQ+\linrad.exe
WELCOME TO LINRAD
This message is not an error, but an indication that setup
has not yet been done.

Setup file par_userint missing.
Use W to create a new par_userint file after setup.

Note that the following keys have a special meaning in Linrad:
ESC = terminate Linrad
X = Skip whatever process you are in and get one level
upwards in Linrads menu three.
G = Make a .gif file with a screen dump of your current screen.

----- GLOBAL PARAMETERS SETUP -----
<You might want to edit par_userint instead>
Press N for NEWCOMER mode.
Press S for normal mode.
Press E for expert mode.
Then press enter
=>e
Enter font scale <1 to 5>, then press Enter: 2
```

8. Under "Set process priority" select "normal" for dual Core processors with less than 2GHz clock speed or enter "1" for I3 and I5 processors. If you have I7 processor can enter "2". I don't recommend "Real-time". Type the properly selection according to your hardware and the type "enter"



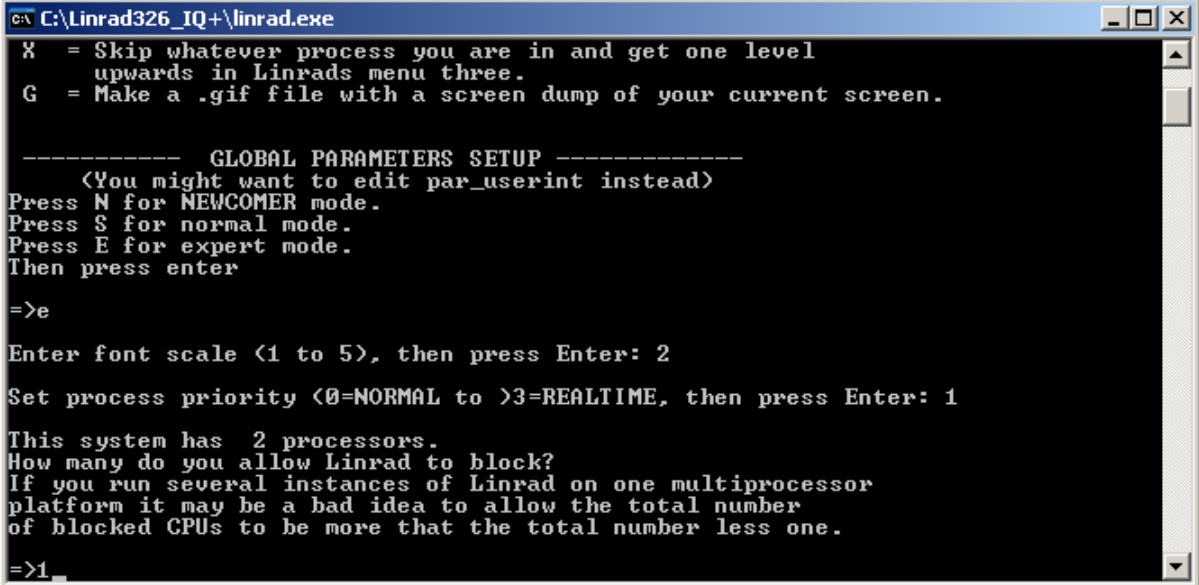
```
C:\Linrad326_IQ+\linrad.exe
This message is not an error, but an indication that setup
has not yet been done.

Setup file par_userint missing.
Use W to create a new par_userint file after setup.

Note that the following keys have a special meaning in Linrad:
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----- GLOBAL PARAMETERS SETUP -----
<You might want to edit par_userint instead>
Press N for NEWCOMER mode.
Press S for normal mode.
Press E for expert mode.
Then press enter
=>e
Enter font scale <1 to 5>, then press Enter: 2
Set process priority <0=NORMAL to >3=REALTIME, then press Enter: 1
```

9. Linrad will detect the number of processor you have, normally 2 or more, type "1" and the press "enter"



```
C:\Linrad326_IQ+\linrad.exe
X = Skip whatever process you are in and get one level
  upwards in Linrads menu three.
G = Make a .gif file with a screen dump of your current screen.

----- GLOBAL PARAMETERS SETUP -----
      <You might want to edit par_userint instead>
Press N for NEWCOMER mode.
Press S for normal mode.
Press E for expert mode.
Then press enter
=>e

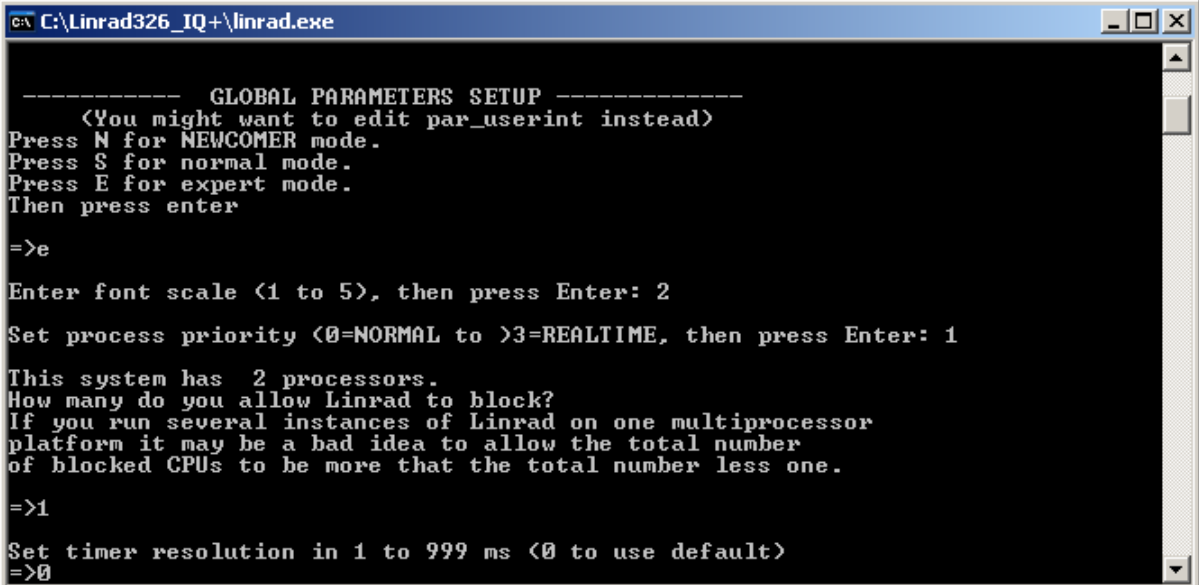
Enter font scale <1 to 5>, then press Enter: 2

Set process priority <0=NORMAL to >3=REALTIME, then press Enter: 1

This system has 2 processors.
How many do you allow Linrad to block?
If you run several instances of Linrad on one multiprocessor
platform it may be a bad idea to allow the total number
of blocked CPUs to be more that the total number less one.

=>1
```

10. Type "0" for the timer resolution and then press "enter" (consult Linrad homepage for more details about timing errors)



```
C:\Linrad326_IQ+\linrad.exe

----- GLOBAL PARAMETERS SETUP -----
      <You might want to edit par_userint instead>
Press N for NEWCOMER mode.
Press S for normal mode.
Press E for expert mode.
Then press enter
=>e

Enter font scale <1 to 5>, then press Enter: 2

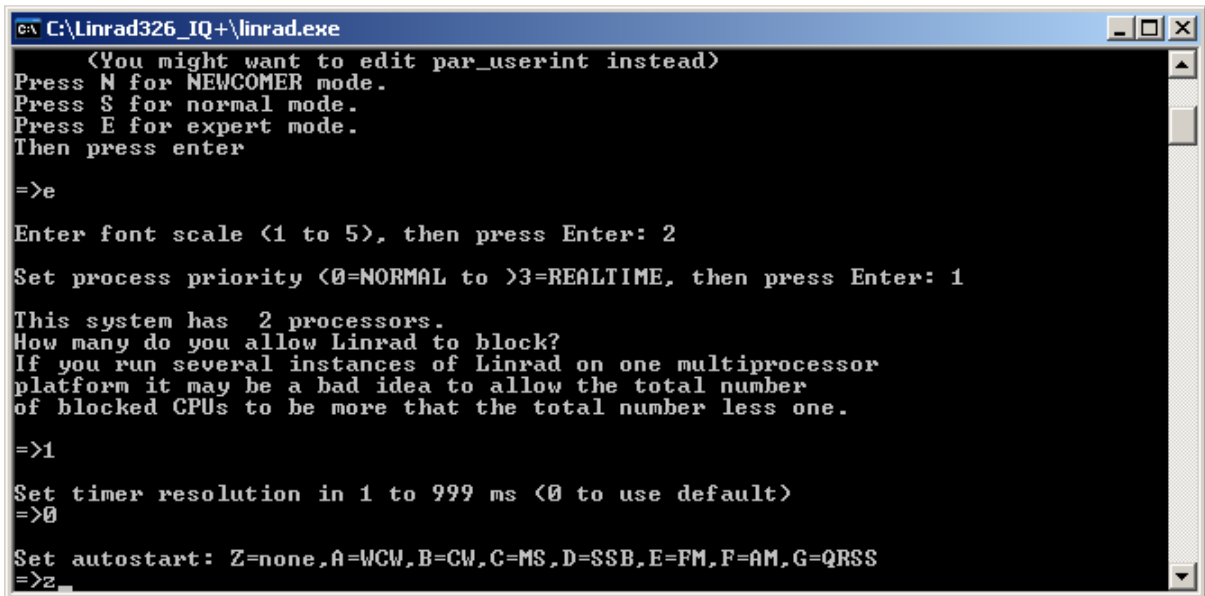
Set process priority <0=NORMAL to >3=REALTIME, then press Enter: 1

This system has 2 processors.
How many do you allow Linrad to block?
If you run several instances of Linrad on one multiprocessor
platform it may be a bad idea to allow the total number
of blocked CPUs to be more that the total number less one.

=>1

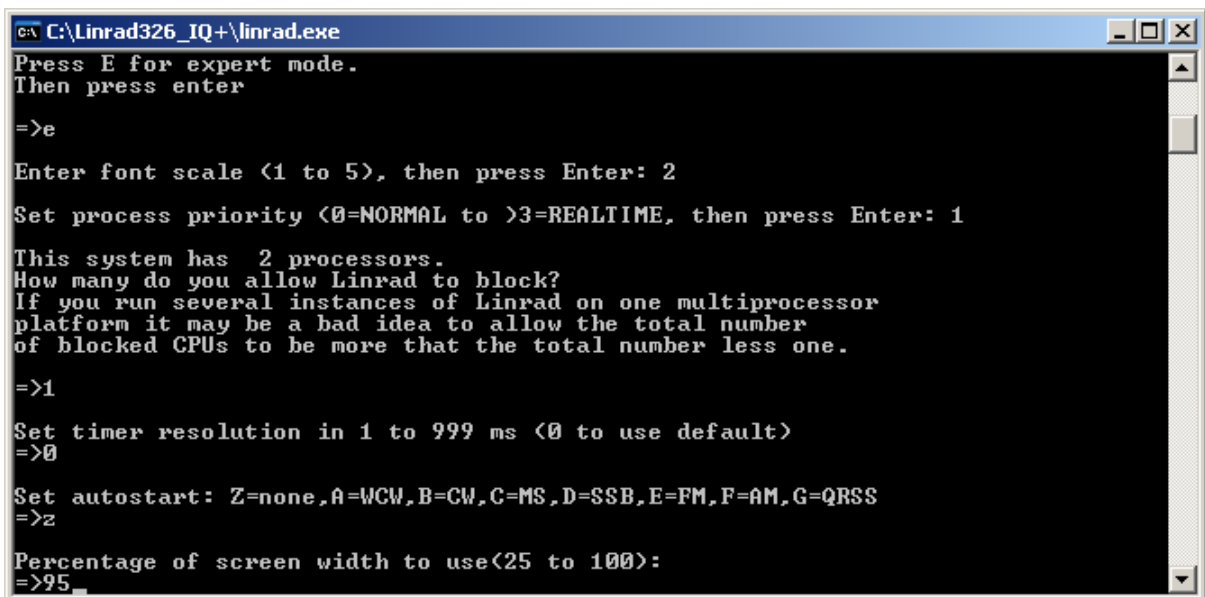
Set timer resolution in 1 to 999 ms <0 to use default>
=>0
```

11. Under set auto start type "Z" (none) and the press enter.



```
c:\Linrad326_IQ+\linrad.exe
<You might want to edit par_userint instead>
Press N for NEWCOMER mode.
Press S for normal mode.
Press E for expert mode.
Then press enter
=>e
Enter font scale <1 to 5>, then press Enter: 2
Set process priority <0=NORMAL to >3=REALTIME, then press Enter: 1
This system has 2 processors.
How many do you allow Linrad to block?
If you run several instances of Linrad on one multiprocessor
platform it may be a bad idea to allow the total number
of blocked CPUs to be more that the total number less one.
=>1
Set timer resolution in 1 to 999 ms <0 to use default>
=>0
Set autostart: Z=none,A=WCW,B=CW,C=MS,D=SSB,E=FM,F=AM,G=QRSS
=>z
```

12. Under percentage of screen width type "95" and press "enter". Retype "95" and press enter for "height".



```
c:\Linrad326_IQ+\linrad.exe
Press E for expert mode.
Then press enter
=>e
Enter font scale <1 to 5>, then press Enter: 2
Set process priority <0=NORMAL to >3=REALTIME, then press Enter: 1
This system has 2 processors.
How many do you allow Linrad to block?
If you run several instances of Linrad on one multiprocessor
platform it may be a bad idea to allow the total number
of blocked CPUs to be more that the total number less one.
=>1
Set timer resolution in 1 to 999 ms <0 to use default>
=>0
Set autostart: Z=none,A=WCW,B=CW,C=MS,D=SSB,E=FM,F=AM,G=QRSS
=>z
Percentage of screen width to use<25 to 100>:
=>95
```

13. The Linrad program will start and you will see the "cmd" box remembers you to press "W" to save the entire initial configuration you done. Minimize this screen, "don't close" otherwise Linrad will close to. Under the Linrad page press "W" and you will see:

```

Linrad-03.26
Linrad-03.26
expert mode

A=leak signal CW          1=Process first file named in 'adfile'
B=Normal CW              2=Process first file named in 'adwav'
C=Meteor scatter CW      3=Select file from 'adfile'
D=SSB                    4=Select file from 'adwav'
E=FM                     5=File converter .raw to .wav
F=AM                     T=Toggle network output
G=ORSS CW
H=TX TEST
I=SOUNDCARD TEST MODE
J=ANALOG HARDWARE TUNE
K=ADDA

M=Init moon tracking and EME database
N=Network set up
O=Global parms set up
P=A/D and D/A set up for RX
Q=TX mode set up
R=Save current parameters in par_userint
S=Emergency light
T or !=Show keyboard commands (HELP)

User interface setup saved  uga mode [12]
                          sha mode [0]
                          Screen width (%) [95]
                          Screen height (%) [95]
                          font scale [2]
                          mouse speed [8]
                          Max DMA rate [120]
                          Process priority [1]
                          Native ALSA [0]
                          RX input mode [-1]
                          RX rf channels [0]
                          RX ad channels [0]
                          RX ad speed [0]
                          RX ad device no [-1]
                          RX ad mode [0]
                          RX da mode [0]
                          RX da device no [-1]
                          RX min da speed [0]
                          RX max da speed [0]
                          RX max da channels [0]
                          RX max da bytes [0]
                          RX min da channels [0]
                          RX min da bytes [0]
                          Soundcard Radio [0]
                          Converter Hz [0]
                          Converter MHz [0]
                          network flag [0]
                          TX ad speed [0]
                          TX da speed [0]
                          TX ad device no [0]
                          TX da device no [-1]
                          TX da channels [0]
                          TX ad channels [0]
                          TX da bytes [0]
                          TX ad bytes [0]
                          TX enable [0]
                          TX pilot tone dB [0]
                          TX pilot microsec. [0]
                          Operator skill [3]
                          Max blocked CPUs [1]
                          Timer resolution [0]
                          Autostart [0]
                          RX ad latency [0]
                          RX da latency [0]
                          Sample shift [0]

```

14. Now we will do our A/D and D/A setup, press "U" and you will receive:

```

Linrad-03.26

CURRENT A/D and D/A SETUP FOR RX

Linrad RX input from:  SOUNDCARD NOT YET SELECTED: Select Menu Option A

Linrad RX output to:  NOT YET SELECTED (SHOULD BE EITHER SOUNDCARD OR DISABLED, AND/OR NETWORK)

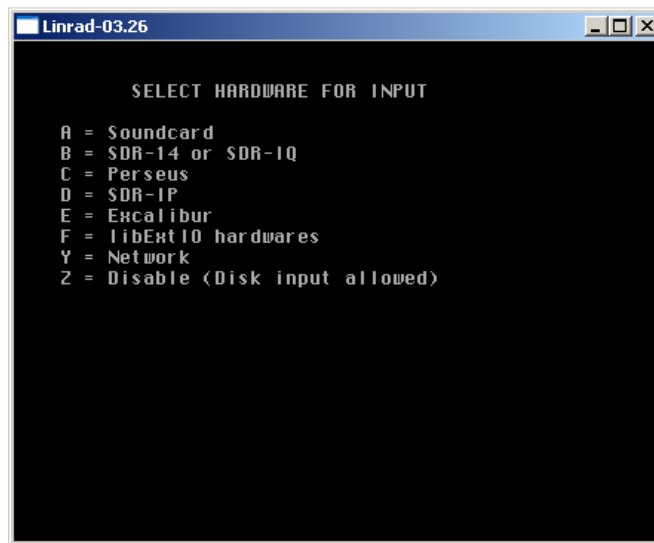
DMA rate  min=120  max=120

A = Change the input settings and reset the output soundcard settings if a soundcard is selected as input.
B = Change the output soundcard settings.
C = Change min/max dma rate.
E = Enable/Disable frequency converter and set shift.
Z = Disable the output soundcard.
X = To main menu.

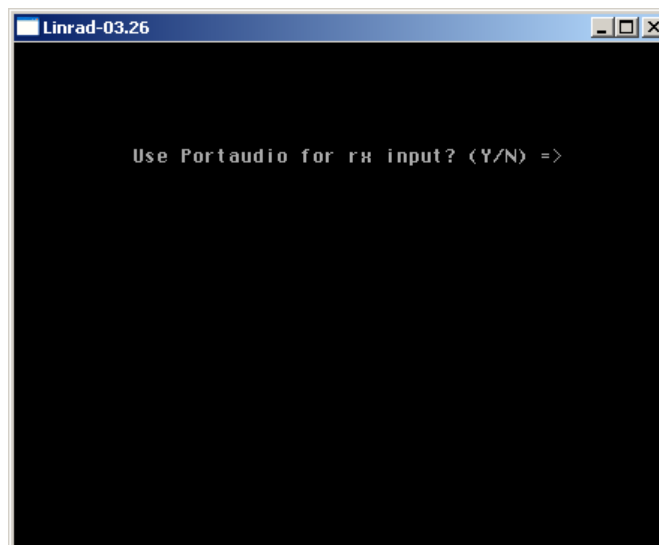
```

15. Press "A" to change Linrad input:

16. You need to specified your Hardware for input, type "A" (soundcard)



17. To the question if you use Port Audio answer "yes" typing "Y"



18. You will receive a list of audio devices in your PC, browse and identified the device "M-Audio Delta ASIO" and type the correspondent device number and press enter, in this case device "37". If you have any other audio card like MAYA44, DMX6Fire or EMU1616 browse for the properly ASIO drivers for your respective audio card, like MAYA44 ASIO or, or DMX6Fire ASIO or EMU ASIO,

```

Linrad-03.26
LIST OF VALID PORTAUDIO DEVICES FOR R# input :

ID      NAME                                HOST-API          SAMPLE RATE      CHANNELS         BYTES
-----  -----                                -
00  Microsoft Sound Mapper - Input      MME               8000/192000     1/ 2            1/4
01  C-Media USB Headphone Set           MME               8000/192000     1/ 2            1/4
02  Realtek HD Audio Input              MME               8000/192000     1/ 2            1/4
03  M-Audio Delta 44 Multi              MME               8000/192000     1/ 2            1/4
04  M-Audio Delta 44 1/2                MME               8000/192000     1/ 2            1/4
05  M-Audio Delta 44 3/4                MME               8000/192000     1/ 2            1/4
06  M-Audio Delta 44 Mon. Mixer         MME               8000/192000     1/ 2            1/4
07  Virtual Cable 1                     MME               8000/192000     1/ 2            1/4
08  Virtual Cable 2                     MME               8000/192000     1/ 2            1/4
09  USB Audio Device                    MME               8000/192000     1/ 2            1/4
18  Primary Sound Capture Driver        Windows DirectSound 8000/192000     1/ 1            1/4
19  C-Media USB Headphone Set           Windows DirectSound 8000/192000     1/ 1            1/4
20  Realtek HD Audio Input              Windows DirectSound 8000/192000     1/ 2            1/4
21  M-Audio Delta 44 Multi              Windows DirectSound 8000/192000     1/ 6            1/4
22  M-Audio Delta 44 1/2                Windows DirectSound 8000/192000     1/ 2            1/4
23  M-Audio Delta 44 3/4                Windows DirectSound 8000/192000     1/ 2            1/4
24  M-Audio Delta 44 Mon. Mixer         Windows DirectSound 8000/192000     1/ 2            1/4
25  Virtual Cable 1                     Windows DirectSound 8000/192000     1/ 8            1/4
26  Virtual Cable 2                     Windows DirectSound 8000/192000     1/ 8            1/4
27  USB Audio Device                    Windows DirectSound 8000/192000     1/ 1            1/4
36  ASIO4ALL v2                         ASIO              8000/ 96000     1/ 2            1/4
37  M-Audio Delta ASIO                  ASIO              32000/ 96000    1/ 6            1/4
38  Realtek HD Audio Input              Windows WDM-KS     8000/ 96000     1/ 2            1/4
40  M-Audio Delta 44 Multi              Windows WDM-KS     8000/ 96000     1/ 6            1/4
41  M-Audio Delta 44 1/2                Windows WDM-KS     8000/ 96000     1/ 2            1/4
42  M-Audio Delta 44 3/4                Windows WDM-KS     8000/ 96000     1/ 2            1/4
43  M-Audio Delta 44 Mon. Mixer         Windows WDM-KS     8000/ 96000     1/ 2            1/4
44  Virtual Cable 1                     Windows WDM-KS     8000/192000     1/ 8            1/4
45  Virtual Cable 2                     Windows WDM-KS     8000/192000     1/ 8            1/4
46  USB Audio Device                    Windows WDM-KS     8000/ 8000      1/ 1            1/4
47  USB Audio Device                    Windows WDM-KS     44100/ 48000    1/ 1            1/4

Select portaudio device ID for R# input from list > 37

```

19. You need to specified your sample speed in Hz; type 96000 and press "enter"

20. You need to specified Number of bits; type 32 and press "enter"

21. Now Linrad ask for the "Radio interface", select number "4" Two RF, four Audio channels (direct conversion, adaptive polarization)

```
Linrad-03.26

Select radio interface>

1: One RF, one audio channel (normal audio)
2: One RF, two audio channels (direct conversion)
3: Two RF, two audio channels (normal audio, adaptive polarization)
4: Two RF, four audio channels (direct conversion, adaptive polarization)

F1 for help/info
```

22. For latency factor type "1" and then press enter:

23. Now you need to select the receiver Hardware to use with soundcard. For IQ+ you will type "2" (Si570, this is the core oscillator inside IQ+), in the latest Linrad version the Si570 is in line 3. Take a look and select the properly

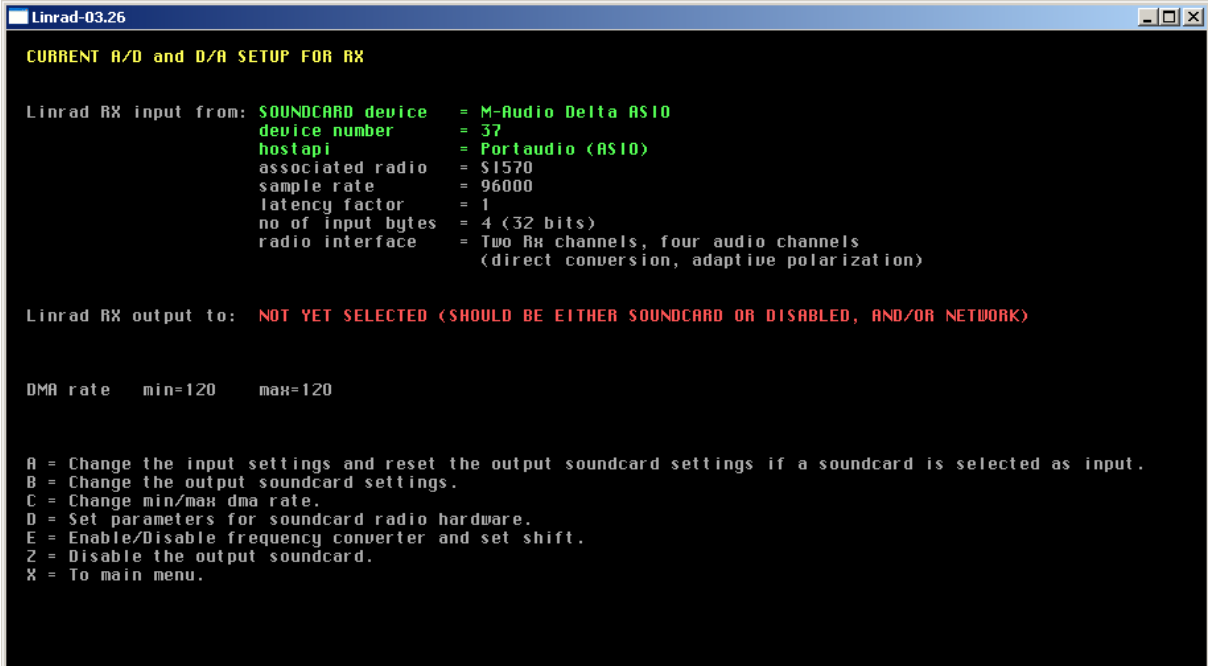
```
Linrad-03.26

Select receiver hardware to use with soundcard.

0 Undefined
1 USE
2 SI570
3 Soft66

Select by line number=> 2
```

24. Now your Input is configure, parameters appears in green, but audio output is not yet configure. Press "B"



```
Linrad-03.26
CURRENT A/D and D/A SETUP FOR RX

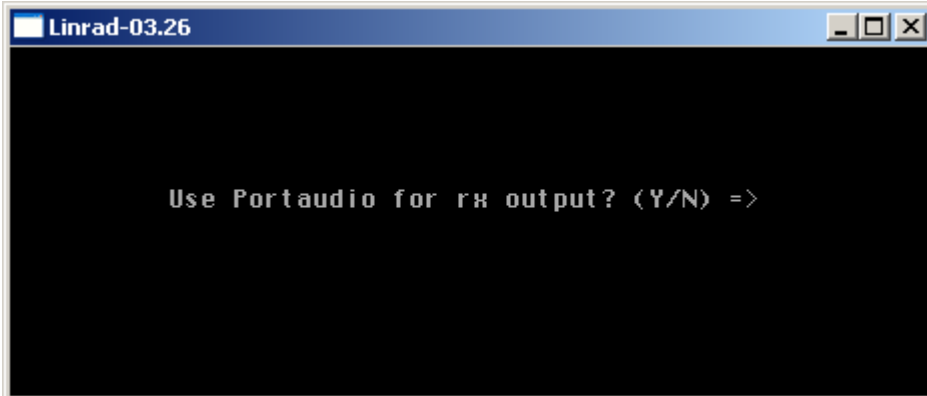
Linrad RX input from: SOUND CARD device = M-Audio Delta ASIO
                      device number    = 37
                      hostapi          = Portaudio (ASIO)
                      associated radio   = $1570
                      sample rate      = 96000
                      latency factor   = 1
                      no of input bytes = 4 (32 bits)
                      radio interface  = Two RX channels, four audio channels
                                      (direct conversion, adaptive polarization)

Linrad RX output to: NOT YET SELECTED (SHOULD BE EITHER SOUND CARD OR DISABLED, AND/OR NETWORK)

DMA rate  min=120  max=120

A = Change the input settings and reset the output soundcard settings if a soundcard is selected as input.
B = Change the output soundcard settings.
C = Change min/max dma rate.
D = Set parameters for soundcard radio hardware.
E = Enable/Disable frequency converter and set shift.
Z = Disable the output soundcard.
X = To main menu.
```

25. To the question if you use port audio for output select "N" (no)



```
Linrad-03.26

Use Portaudio for rx output? (Y/N) =>
```

26. You will receive a list of audio devices you can use, normally you will not need to specified and output audio device when you work JT65, is important for CW but never the less in that case select the audio device embedded in your main board or another audio card, DO NOT SELECT ANY DELTA44 OPTION. In that case type "0" and then press "enter" to use the "Realtek" device (this is my onboard audio device)


```
Linrad-03.26
Select SOUND CARD device for Rx output

0 Realtek HD Audio output
1 M-Audio Delta 44 Multi
2 M-Audio Delta 44 1/2
3 M-Audio Delta 44 3/4
4 Virtual Cable 1
5 Virtual Cable 2
6 C-Media USB Headphone Set

Select device for Rx output by line number> _
```

27. Now both; input and output are configure and appears in green. Press "D" to configure the IQ+ Local Oscillator.

```
Linrad-03.26
CURRENT A/D and D/A SETUP FOR RX

Linrad RX input from: SOUND CARD device = M-Audio Delta AS10
                      device number    = 37
                      hostapi           = Portaudio (ASIO)
                      associated radio   = S1570
                      sample rate       = 96000
                      latency factor     = 1
                      no of input bytes = 4 (32 bits)
                      radio interface    = Two RX channels, four audio channels
                                         (direct conversion, adaptive polarization)

Linrad RX output to: SOUND CARD device = Realtek HD Audio output
                      device number    = 0
                      hostapi           = Native MME
                      min da sample rate = 8000
                      max da sample rate = 96000
                      min da bytes      = 1
                      max da bytes      = 2
                      min da channels   = 1
                      max da channels   = 2

DMA rate  min=120  max=120

A = Change the input settings and reset the output soundcard settings if a soundcard is selected as input.
B = Change the output soundcard settings.
C = Change min/max dma rate.
D = Set parameters for soundcard radio hardware.
E = Enable/Disable frequency converter and set shift.
Z = Disable the output soundcard.
X = To main menu.
```

```

Linrad-03.26
CURRENT SETUP FOR 'SI570 USB DEVICE'

SI570 firmware-type           = DG8SAQ/PE0FKO firmware

USB serialID / Firmware version = Beta1.1 / Firmware version 14.0
USB device selection mode      = DYNAMIC ( => Linrad uses the first detected device )

SI570 min receive frequency (Khz) = 1800 Khz
SI570 max receive frequency (Khz) = 29700 Khz
SI570 passband increment (Khz)   = 45 Khz
SI570 passband direction        = 1

SI570 LO frequency multiplier   = 4.000000
SI570 LO frequency offset (Khz) = 0 Khz
SI570 resulting LO range (Mhz)  = from 7.200 to 118.800 Mhz

SELECT MENU OPTION TO CHANGE SETUP PARAMETERS OR TO EXIT:
A = Select a different SI570 firmware-type (DG8SAQ or FIF1-SDR).
B = Set selection-mode to DYNAMIC.
C = Set selection-mode to STATIC and select a 'predefined SI570 USB device'.
D = Change MIN RECEIVE frequency.
E = Change MAX RECEIVE frequency.
F = Change PASSBAND INCREMENT.
H = Change PASSBAND DIRECTION.
I = Change LO FREQUENCY MULTIPLIER.
J = Change LO FREQUENCY OFFSET.
K = RESTORE default parameters.
X = EXIT.

```

You will see the Si570 firmware recognize as "DG8SAQ/PE0FKO firmware"

We need to change the MIN and MAX frequency to allow our IQ+ local oscillator run at your properly band and change the multiplier. Press "E" to change your MAX frequency depending on your IQ+ model (see the next table) and then press enter.

IQ+ Model	Band Fc	Min receive Fc	Max receive Fc	LO Multiplier	LO range
SC IF	28 Mhz	28000	30000	2x	56.0 to 60.0 MHz
VL	50 Mhz	50000	52000	2x	100.0 to 104.0 MHz
V	144 MHz	144000	146000	2x	288.0 to 292.0 MHz
U	432 MHz	432000	434000	2x	864.0 to 868.0 MHz

```
Linrad-03.26
CURRENT SETUP FOR 'SI570 USB DEVICE'

SI570 firmware-type           = DG8SAQ/PEDFKO firmware

USB serialID / Firmware version = Beta1.1 / Firmware version 14.0
USB device selection mode     = DYNAMIC ( => Linrad uses the first detected device )

SI570 min receive frequency (Khz) = 1800 Khz
SI570 max receive frequency (Khz) = 145000 Khz
SI570 passband increment (Khz)  = 45 Khz
SI570 passband direction       = 1

SI570 LO frequency multiplier   = 4.000000
SI570 LO frequency offset (Khz) = 0 Khz
SI570 resulting LO range (Mhz)  = from 7.200 to 580.000 Mhz

                                Make sure your SI570 chip can handle frequencies > 210000 Khz !

SELECT MENU OPTION TO CHANGE SETUP PARAMETERS OR TO EXIT:
A = Select a different SI570 firmware-type (DG8SAQ or FiFi-SDR).
B = Set selection-mode to DYNAMIC.
C = Set selection-mode to STATIC and select a 'predefined SI570 USB device'.
D = Change MIN RECEIVE frequency.
E = Change MAX RECEIVE frequency.
F = Change PASSBAND INCREMENT.
H = Change PASSBAND DIRECTION.
I = Change LO FREQUENCY MULTIPLIER.
J = Change LO FREQUENCY OFFSET.
K = RESTORE default parameters.
X = EXIT.
```

You will see your MAX frequency changed to 145000 KHz for example. Now press "D" to change the MIN frequency and type 144000 and the press "enter".

28. Now you need to change the LO Frequency Multiplier, by default is 4 but IQ+ run with LO multiplier 2, type "I" and the type "2" and then press enter, then change the pass band increment typing "F" and then "1" (1KHz is the minimum Linrad allow you) See the previous table and select according your IQ+ model

29. You finish your IQ+ Local Oscillator configuration, review your screen with this information, you need to see same values otherwise back and repeat until you have all values listed in the next screen:

```
Linrad-03.26
CURRENT SETUP FOR 'SI570 USB DEVICE'

SI570 firmware-type           = DG8SAQ/PE0FK0 firmware

USB serialID / Firmware version = Beta1.1 / Firmware version 14.0
USB device selection mode      = DYNAMIC ( => Linrad uses the first detected device )

SI570 min receive frequency (Khz) = 144000 Khz
SI570 max receive frequency (Khz) = 145000 Khz
SI570 passband increment (Khz)   = 1 Khz
SI570 passband direction        = 1

SI570 LO frequency multiplier   = 2.000000
SI570 LO frequency offset (Khz) = 0 Khz
SI570 resulting LO range (Mhz)  = from 288.000 to 290.000 Mhz

                                Make sure your SI570 chip can handle frequencies > 210000 Khz !

SELECT MENU OPTION TO CHANGE SETUP PARAMETERS OR TO EXIT:

A = Select a different SI570 firmware-type (DG8SAQ or FIFi-SDR).
B = Set selection-mode to DYNAMIC.
C = Set selection-mode to STATIC and select a 'predefined SI570 USB device'.

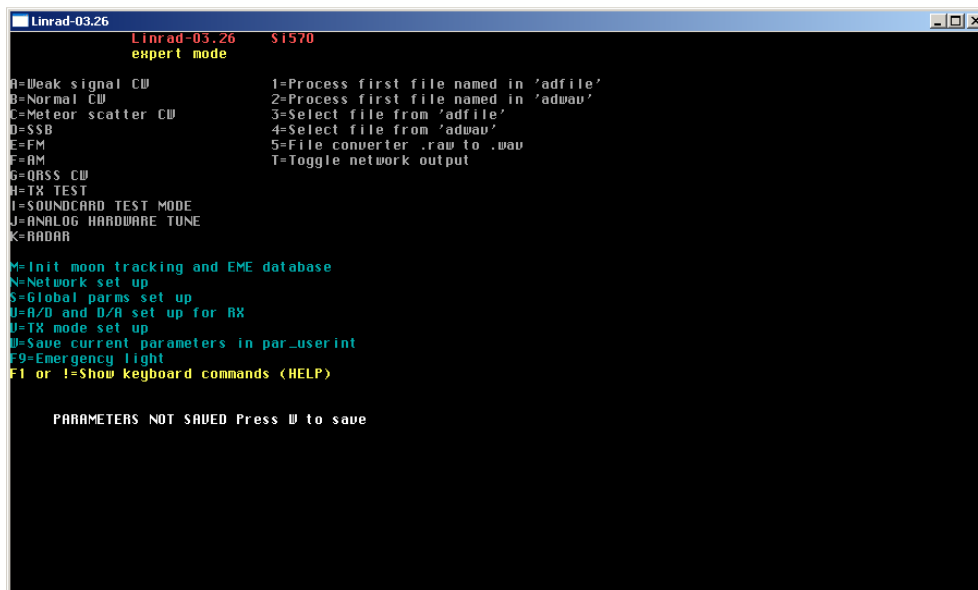
D = Change MIN RECEIVE frequency.
E = Change MAX RECEIVE frequency.
F = Change PASSBAND INCREMENT.
H = Change PASSBAND DIRECTION.

I = Change LO FREQUENCY MULTIPLIER.
J = Change LO FREQUENCY OFFSET.

K = RESTORE default parameters.

X = EXIT.
```

30. If values are ok just press "X" two times and then any key, you will back to:



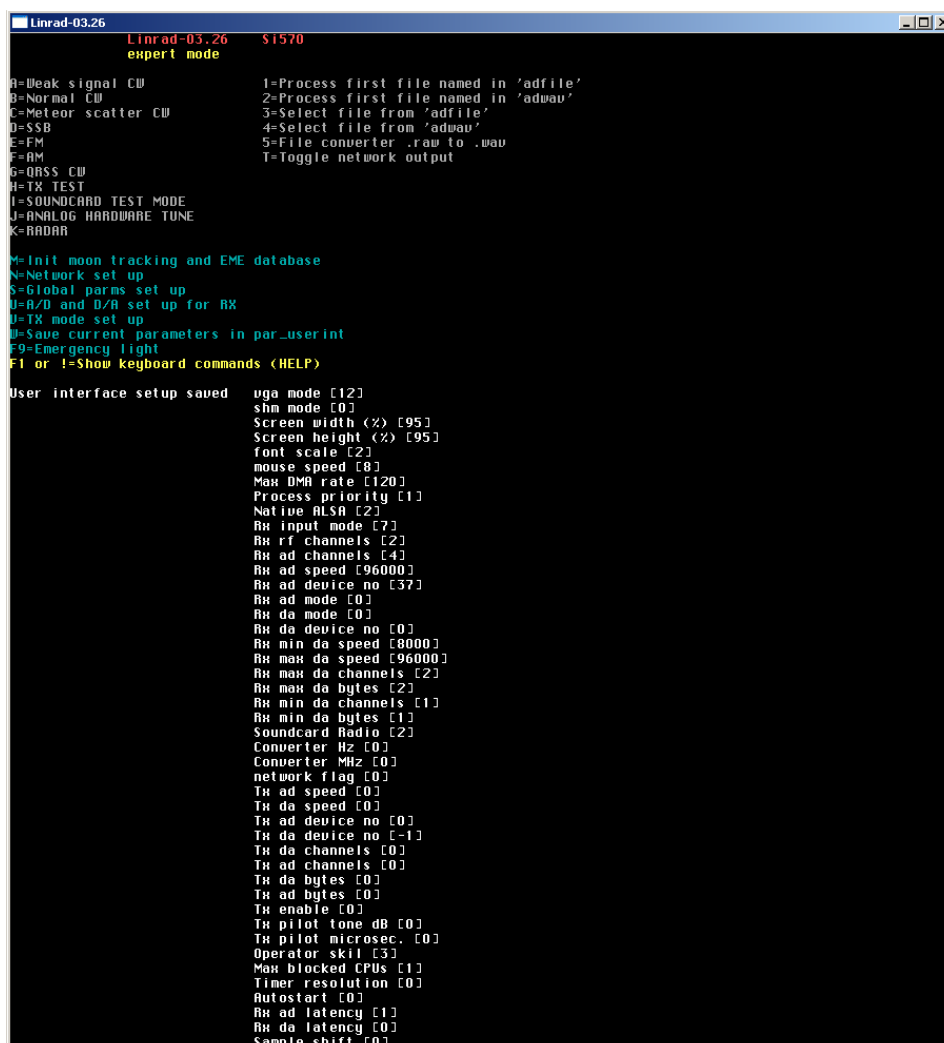
```
Linrad-03.26 Linrad-03.26 $1570
expert mode

A=Weak signal CW          1=Process first file named in 'adfile'
B=Normal CW              2=Process first file named in 'adwav'
C=Meteor scatter CW      3=Select file from 'adfile'
D=SSB                    4=Select file from 'adwav'
E=FM                      5=File converter .raw to .wav
F=AM                      T=Toggle network output
G=QSS CW
H=TX TEST
I=SOUNDCARD TEST MODE
J=ANALOG HARDWARE TUNE
K=RADAR

M=Init moon tracking and EME database
N=Network set up
S=Global parms set up
U=A/D and D/A set up for RX
U=TX mode set up
W=Save current parameters in par_userint
F9=Emergency light
F1 or !=Show keyboard commands (HELP)

PARAMETERS NOT SAVED Press W to save
```

31. But values are not saved, just press "W" and all values and configurations are saved, you will recognize because the screen list the values already saved:



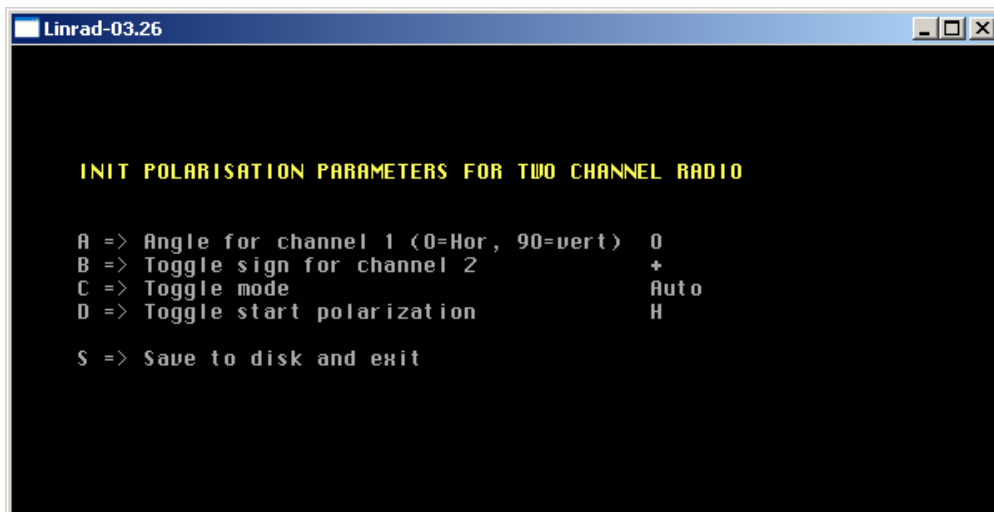
```
Linrad-03.26 Linrad-03.26 $1570
expert mode

A=Weak signal CW          1=Process first file named in 'adfile'
B=Normal CW              2=Process first file named in 'adwav'
C=Meteor scatter CW      3=Select file from 'adfile'
D=SSB                    4=Select file from 'adwav'
E=FM                      5=File converter .raw to .wav
F=AM                      T=Toggle network output
G=QSS CW
H=TX TEST
I=SOUNDCARD TEST MODE
J=ANALOG HARDWARE TUNE
K=RADAR

M=Init moon tracking and EME database
N=Network set up
S=Global parms set up
U=A/D and D/A set up for RX
U=TX mode set up
W=Save current parameters in par_userint
F9=Emergency light
F1 or !=Show keyboard commands (HELP)

User interface setup saved
uga mode [12]
shm mode [0]
Screen width (%) [95]
Screen height (%) [95]
font scale [2]
mouse speed [8]
Max DMA rate [120]
Process priority [1]
Native ALSA [2]
Rx input mode [7]
Rx rf channels [2]
Rx ad channels [4]
Rx ad speed [96000]
Rx ad device no [37]
Rx ad mode [0]
Rx da mode [0]
Rx da device no [0]
Rx min da speed [8000]
Rx max da speed [96000]
Rx max da channels [2]
Rx max da bytes [2]
Rx min da channels [1]
Rx min da bytes [1]
Soundcard Radio [2]
Converter Hz [0]
Converter MHz [0]
network flag [0]
Tx ad speed [0]
Tx da speed [0]
Tx ad device no [0]
Tx da device no [-1]
Tx da channels [0]
Tx ad channels [0]
Tx da bytes [0]
Tx enable [0]
Tx pilot tone dB [0]
Tx pilot microsec. [0]
Operator skill [3]
Max blocked CPUs [1]
Timer resolution [0]
Autostart [0]
Rx ad latency [1]
Rx da latency [0]
Sample shift [0]
```

32. Press "D" to start the SSB mode: you will see the parameters in Linrad, don't modified nothing, for now just press "enter" 3 times until you arrive to:



```
Linrad-03.26

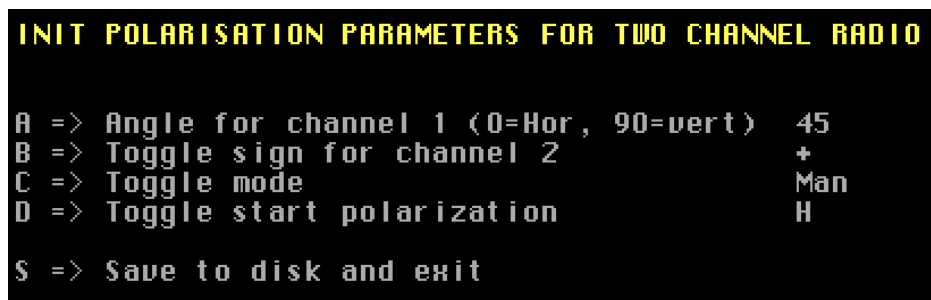
INIT POLARISATION PARAMETERS FOR TWO CHANNEL RADIO

A => Angle for channel 1 (0=Hor, 90=vert)  0
B => Toggle sign for channel 2             +
C => Toggle mode                           Auto
D => Toggle start polarization             H

S => Save to disk and exit
```

This screen is the typical configuration for antennas in "+" architecture.

33. If you have antennas in "X" architecture change the screen configuration to see like:



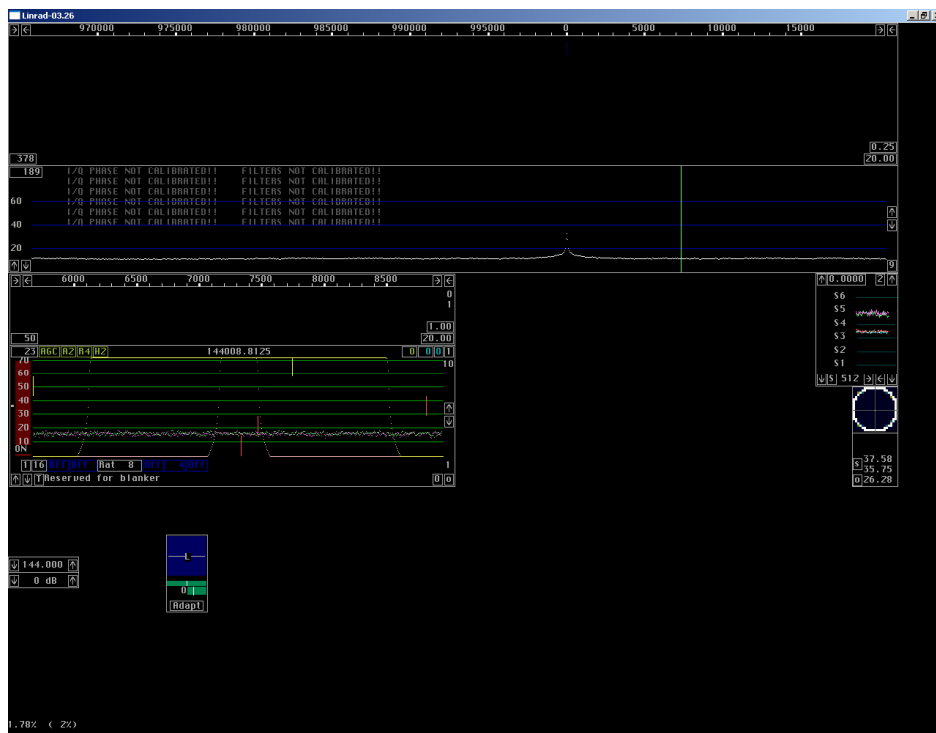
```
INIT POLARISATION PARAMETERS FOR TWO CHANNEL RADIO

A => Angle for channel 1 (0=Hor, 90=vert)  45
B => Toggle sign for channel 2             +
C => Toggle mode                           Man
D => Toggle start polarization             H

S => Save to disk and exit
```

and change "toggle mode" to "Auto" .

34. Press "S" to save data and you will see for first time your Linrad software running but not yet configure for adaptive polarization:



35. In Linrad Start up page press N to configure your network and instruct Linrad to send data to the same computer:

```

Linrad-03.45
Linrad-03.45 Soundcard
expert mode

A=Weak signal CW          1=Process first file named in 'adfile'
B=Normal CW              2=Process first file named in 'adwav'
C=Meteor scatter CW      3=Select file from 'adfile'
D=SSB                    4=Select file from 'adwav'
E=FM                     5=File converter .raw to .wav
F=AM                     T=Toggle network output
G=QRSS CW
H=TX TEST
I=SOUNDCARD TEST MODE
J=ANALOG HARDWARE TUNE
K=RADAR

M=Init moon tracking and EME database
N=Network set up
O=Global parms set up
P=A/D and D/A set up for RX
Q=TX mode set up
R=Save current parameters in par_userint
9=Emergency light
! or !=Show keyboard commands (HELP)

```

You will see:

```
Linrad-03.45

CURRENT NETWORK SETTINGS ARE:

1:      Base port = 50000
2:      SEND address = 239.255.0.0
3:      RECEIVE address = 239.255.0.0
4:      Send raw data in 16 bit format OFF
5:      Send raw data in 18 bit format OFF
6:      Send raw data in 24 bit format OFF
7:      Send FFT1 transforms OFF
8:      Send timf2 (blanker output) OFF
9:      Send FFT2 transforms OFF
10:     Send baseband (resampled,16 bit) OFF
11:     Send baseband raw (24 bit)OFF
12:     RX input from network -- (Raw data, 16 bit)
F1: Help

On exit from this routine network transmit will be OFF.
The screen shows what will become enabled when send
is enabled (with T on the main menu)
(Do not forget to save with W on the main menu)

Enter a line number to change, 0 to exit => _
```

36. Now press "8" to activate "Send timf2, the line will be in yellow and show the port 50004 :

```
Linrad-03.45

CURRENT NETWORK SETTINGS ARE:

1:      Base port = 50000
2:      SEND address = 239.255.0.0
3:      RECEIVE address = 239.255.0.0
4:      Send raw data in 16 bit format OFF
5:      Send raw data in 18 bit format OFF
6:      Send raw data in 24 bit format OFF
7:      Send FFT1 transforms OFF
8:      Send timf2 (blanker output) ON (port=50004)
9:      Send FFT2 transforms OFF
10:     Send baseband (resampled,16 bit) OFF
11:     Send baseband raw (24 bit)OFF
12:     RX input from network -- (Raw data, 16 bit)
F1: Help

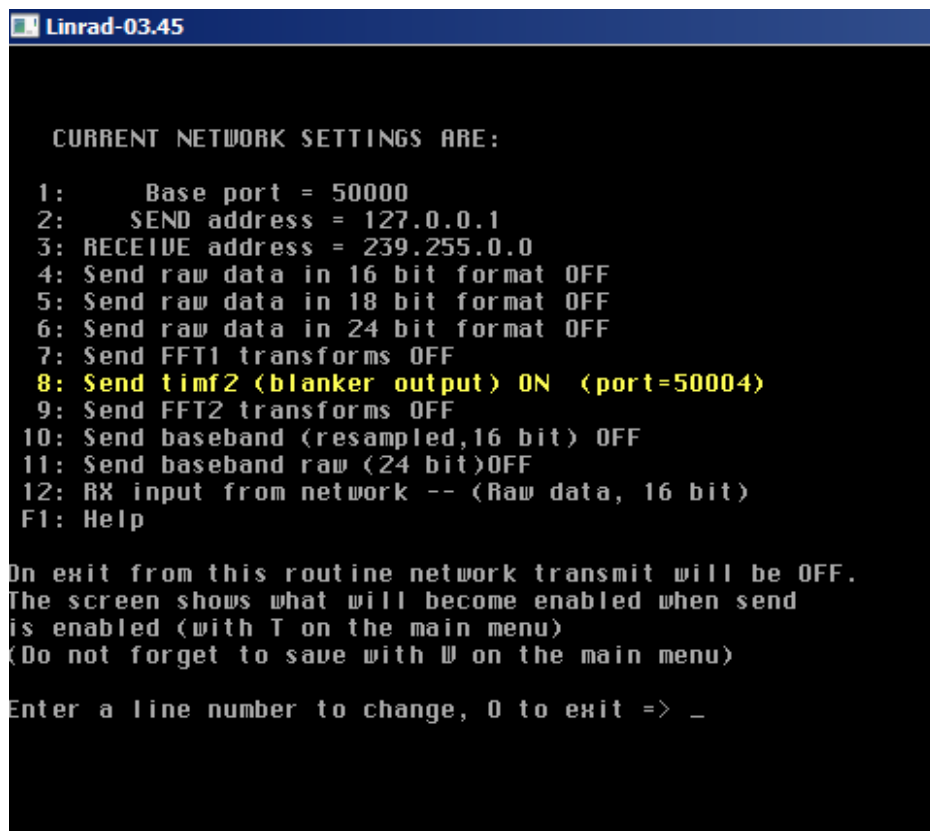
On exit from this routine network transmit will be OFF.
The screen shows what will become enabled when send
is enabled (with T on the main menu)
(Do not forget to save with W on the main menu)

Enter a line number to change, 0 to exit => _
```


37. Now press "2" to change SEND Address to 127.0.0.1, this is the local host IP address, with that you are telling Linrad to send the data to your same computer where MAP65 will run, in this case the same computer, if MAP65 will run in another PC you will specified here the IP address of that computer.

When you press 2 then type -1 and type 127.0.0.1 if MAP65 will run on the same computer with Linrad or the IP address of the PC where MAP65 will run (separate PC means different IP address)

The configuration will finish like that:



```
Linrad-03.45

CURRENT NETWORK SETTINGS ARE:

1:      Base port = 50000
2:      SEND address = 127.0.0.1
3: RECEIVE address = 239.255.0.0
4: Send raw data in 16 bit format OFF
5: Send raw data in 18 bit format OFF
6: Send raw data in 24 bit format OFF
7: Send FFT1 transforms OFF
8: Send timf2 (blanker output) ON (port=50004)
9: Send FFT2 transforms OFF
10: Send baseband (resampled,16 bit) OFF
11: Send baseband raw (24 bit)OFF
12: RX input from network -- (Raw data, 16 bit)
F1: Help

On exit from this routine network transmit will be OFF.
The screen shows what will become enabled when send
is enabled (with T on the main menu)
(Do not forget to save with W on the main menu)

Enter a line number to change, 0 to exit => _
```

Just press "0" and enter to back.

38. Now press D to enter in SSB, the X and select parameters and configure your parameters like the next list, this are just initial parameters, further reconfiguration probably will be needed:

```

par_ssb - Notepad
File Edit Format View Help
First FFT bandwidth (Hz) [100]
First FFT window (power of sin) [2]
First forward FFT version [0]
First FFT storage time (s) [1]
First FFT amplitude [1000]
Main waterfall saturate limit [0]
Enable correlation spectrum [0]
Timf2 storage time [2]
Enable second FFT [1]
First backward FFT version [0]
Sellim maxlevel [6000]
First backward FFT att. N [6]
Second FFT bandwidth factor in powers of 2 [2]
Second FFT window (power of sin) [2]
Second forward FFT version [0]
Second forward FFT att. N [7]
Second FFT storage time (s) [5]
Enable AFC/SPUR/DECODE (2=auto spur) [0]
AFC lock range Hz [150]
AFC max drift Hz/minute [100]
Enable Morse decoding [0]
Max no of spurs to cancel [0]
spur timeconstant (0.1sek) [5]
First mixer bandwidth reduction in powers of 2 [4]
First mixer no of channels [1]
Third FFT window (power of sin) [2]
Baseband storage time (s) [2]
output delay margin (ms) [400]
output sampling speed (Hz) [48000]
default output mode [1]
Audio expander exponent [3]
Baseband waterfall saturate limit [0]
A/D speed [96000]
Check [341]

Change only between brackets.
If file has errors, Linrad will ignore file and use defaults
or prompt for a complete set of new parameters

Linrad-03.45

```

To refine your parameters please follow the recommendations on the Linrad homepage.

39. Now on the Linrad initial screen type "T" to start sending data to MAP65, if the firewall warning appears "Allow" Linrad and don't block the data he is sending. You will see in the Left upper part a NETSEND in red, this indicate Linrad now is sending data to the network (i.e. MAP65.)

```

Linrad-03.45
NETSEND      Linrad-03.45      Soundcard
expert mode

A=Weak signal CW          1=Process first file named in 'adfile'
B=Normal CW              2=Process first file named in 'adwav'
C=Meteor scatter CW      3=Select file from 'adfile'
D=SSB                    4=Select file from 'adwav'
E=FM                     5=File converter .raw to .wav
F=AM                     T=Toggle network output
G=QRSS CW
H=TX TEST
I=$OUNDCARD TEST MODE
J=ANALOG HARDWARE TUNE
K=RADAR

M=Init moon tracking and EME database
N=Network set up
O=Global parms set up
P=A/D and D/A set up for RX
Q=TX mode set up
R=$ave current parameters in par_userint
9=Emergency light
F1 or !=Show keyboard commands (HELP)

PARAMETERS NOT SAVED Press W to save

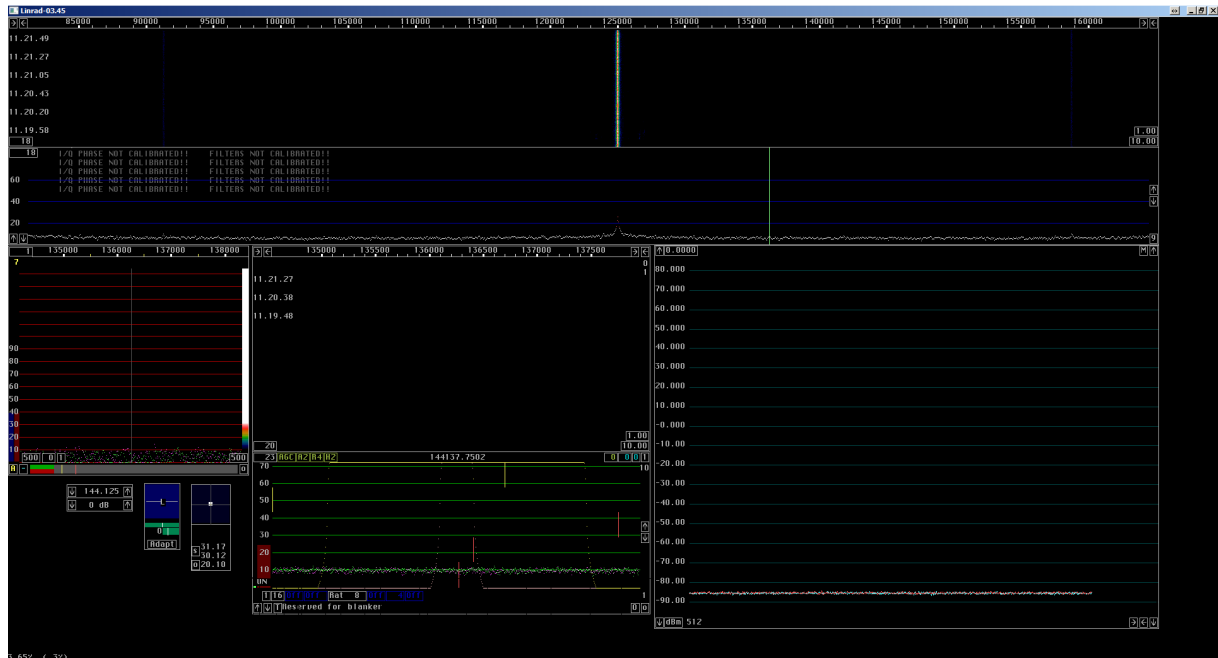
```

Now just press D and you will see you screen like:



If you have a "RX UNDERRUN_ERROR" you need to change your DMA parameters, press X two times to back to the main window and then press "U", then press "C" to change min/max DMA rate and type 20 for new min DMA and 300 for new max DMA, then you will back to the A/D D/A setup, just press X to back to the main menu and then press "W" to save parameters, you can press now D again and Linrad will start.

After resize the different windows Linrad look like that:



40. You can read on the main waterfall:

"I/Q PHASE NOT CALIBRATED" "FILTERS NOT CALIBRATED" your Linrad setup need to be calibrated, specially the I/Q PHASE AND AMPLITUDE (follow the next chapter)

8. Calibrate I/Q Phase and Amplitude for Linrad

In a Direct conversion receiver (with I and Q signals) your pass band will have an Image of the desired signal exact in the opposite side of your center frequency. If your center frequency is 144.100 MHz and you have a signal in 144.120 MHz you will see the "image" of this signal in 144.080 MHz. By default your IQ+ with Linrad exhibit the Image signal attenuated aprox. 35dB to 40dB. This value is not enough and Linrad need to be calibrated in Phase and Amplitude to increase this "Image Rejection".

For example if your signal have a level of -50dBm you will find the "Image" signal at -85dBm, this "Image" signal will be strong enough to appears in your pass band.

After Calibration you will have the "Image signal" attenuated almost 65dB. As soon you finish the calibration you can read up to -85dB attenuation but this high values don't remain for long time, typical values are from -65 to -78dB.

Step by Step Guide:

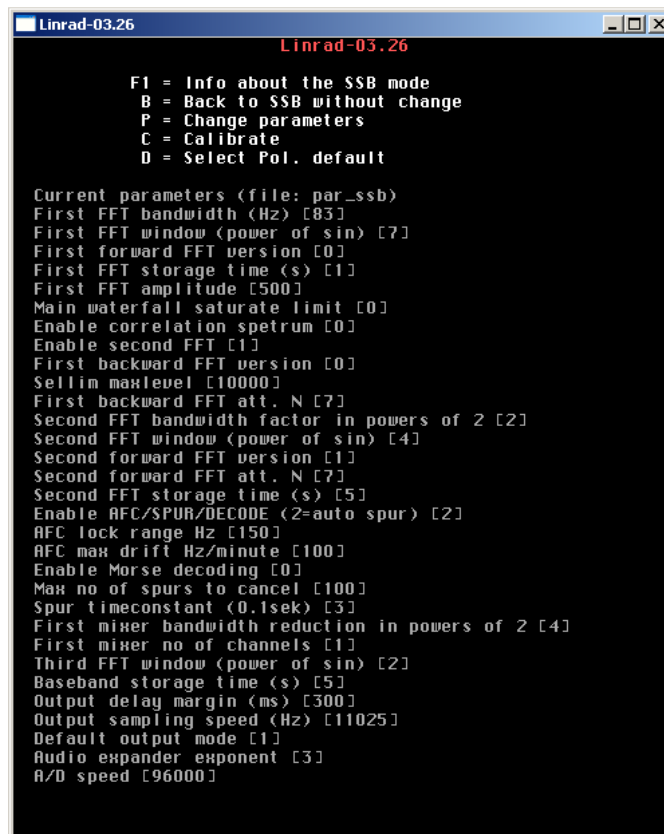
You will need:

- A signal generator with very stable signal (amplitude, phase and frequency) capable to deliver a signal in 144MHz with level aprox -30dBm
- Your Linrad software already setup with the spur removal deactivated.
- Your IQ+ up and running
- 2way 0(cero) degree splitter to split the signal in two and feed the 2 RX channels in IQ+ with the same level and same phase.

Prepare your devices: turn on your PC, IQ+ and Signal generator and keep running for 1 hour minimum before start calibration, do not attempt to do the calibration if your systems just start, they need to be warm and stable in frequency.

- 1.** Connect your 2 way splitter to IQ+ inputs and connect the splitter input to your signal generator.
- 2.** Change your center frequency in Linrad to 144.100 MHz an adjust your signal generator to have a signal in 144.120 MHz with -40dBm. Turn on your signal generator.

3. With Linrad running press "X"

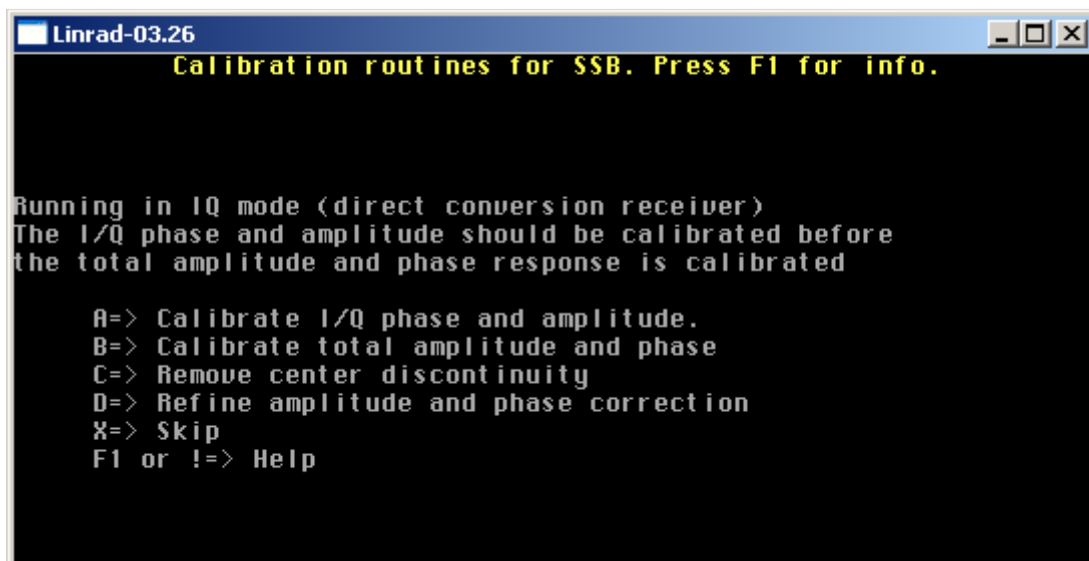


```
Linrad-03.26
Linrad-03.26

F1 = Info about the SSB mode
B = Back to SSB without change
P = Change parameters
C = Calibrate
D = Select Pol. default

Current parameters (file: par_ssb)
First FFT bandwidth (Hz) [83]
First FFT window (power of sin) [7]
First forward FFT version [0]
First FFT storage time (s) [1]
First FFT amplitude [500]
Main waterfall saturate limit [0]
Enable correlation spectrum [0]
Enable second FFT [1]
First backward FFT version [0]
Sellin maxlevel [10000]
First backward FFT att. N [7]
Second FFT bandwidth factor in powers of 2 [2]
Second FFT window (power of sin) [4]
Second forward FFT version [1]
Second forward FFT att. N [7]
Second FFT storage time (s) [5]
Enable AFC/SPUR/DECODE (2=auto spur) [2]
AFC lock range Hz [150]
AFC max drift Hz/minute [100]
Enable Morse decoding [0]
Max no of spurs to cancel [100]
Spur timeconstant (0.1sek) [3]
First mixer bandwidth reduction in powers of 2 [4]
First mixer no of channels [1]
Third FFT window (power of sin) [2]
Baseband storage time (s) [5]
Output delay margin (ms) [300]
Output sampling speed (Hz) [11025]
Default output mode [1]
Audio expander exponent [3]
A/D speed [96000]
```

4. Press "C" to calibrate and then select "A" "Calibrate I/Q phase and Amplitude".

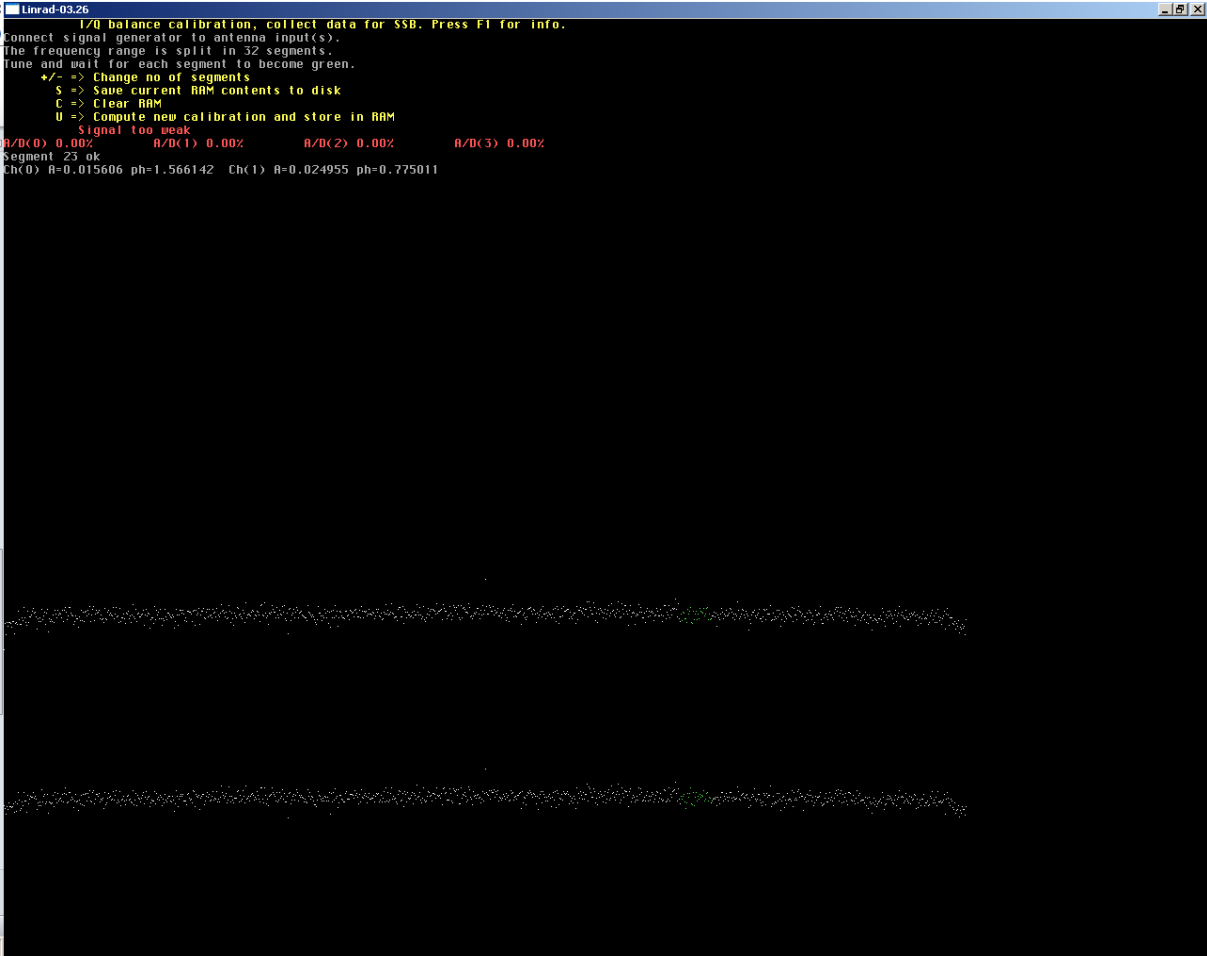


```
Linrad-03.26
Calibration routines for SSB. Press F1 for info.

Running in IQ mode (direct conversion receiver)
The I/Q phase and amplitude should be calibrated before
the total amplitude and phase response is calibrated

A=> Calibrate I/Q phase and amplitude.
B=> Calibrate total amplitude and phase
C=> Remove center discontinuity
D=> Refine amplitude and phase correction
X=> Skip
F1 or !=> Help
```

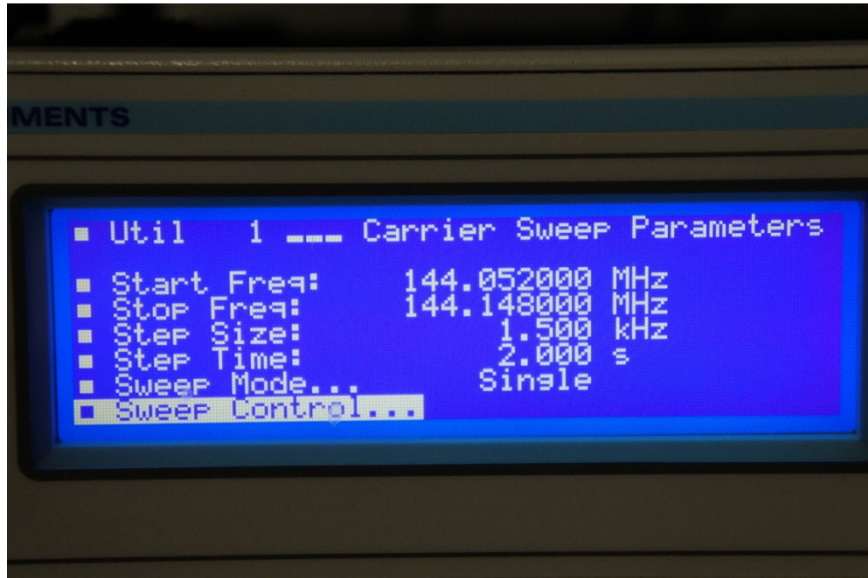
5. You will see both channels and you could see a carrier with green color on the base floor, the green color means for that frequency in particular Linrad already calculate the IQ correction, as soon you change the frequency and stop the base floor becomes "violet" and after 1.5 seconds will turn green, when is violet means for that position calculation is not yet finish. The idea is move thru the entire 96KHz in pre-define steps to allow Linrad do the calculation. You need to reach 50% level of A/D conversion. You can read this value for the 4 channels.



```
Linrad-03.26
I/Q balance calibration, collect data for SSB. Press F1 for info.
Connect signal generator to antenna input(s).
The frequency range is split in 32 segments.
Tune and wait for each segment to become green.
+/- -> Change no of segments
S -> Save current RAM contents to disk
C -> Clear RAM
U -> Compute new calibration and store in RAM
Signal too weak
A/D(0) 0.00%  A/D(1) 0.00%  A/D(2) 0.00%  A/D(3) 0.00%
Segment 23 ok
Ch(0) A=0.015606 ph=1.566142  Ch(1) A=0.024955 ph=0.775011
```

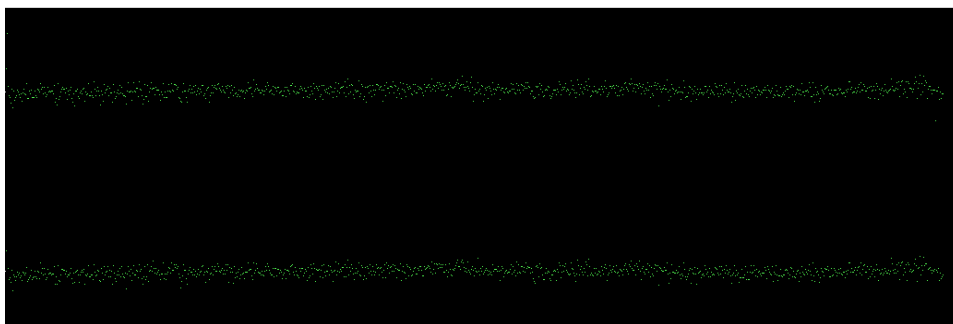
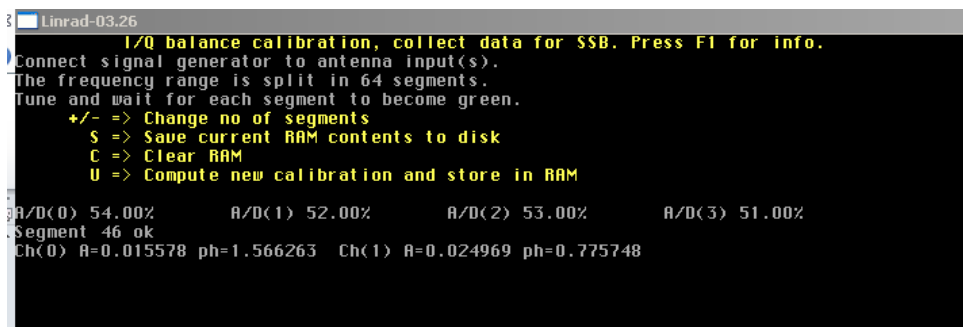
6. Now increase gradually the level on your signal generator, don't forget the splitter introduce some losses, in my case -3.4dB because have also a LPF embedded to avoid harmonics. Increase until you reach 50% A/D. Now using the + and - change the numbers of segments to 64, you can read that on the third upper line.

7. Prepare your Signal generator "to sweep" the entire band. Our pass band is 96KHz and we select 64 segments means $96/64= 1.5\text{KHz}$. This is the "step size". Allow at least 2 seconds interval to change to another segment, this will allow Linrad to compute the correct values and pass from violet to green on the base floor.



Your center frequency is 144.100 in consequence your limits are 144.052 and 144.148 for 96KHz bandwidth.

8. When the first iteration is finish the entire noise floor in our pass band will be green, remember violet is just a position start to be calculated and white is a position with no calibration yet, now press "U" to see the calibration graphic and store in RAM the values, the curves you see correspond to your specific HW, just press any key and you will back to the calibration screen.



9. Now press "S" to save the data. Linrad will create a file call "dsp_ssb_iqcorr". This file content the correction data for your particular Radio associated with your particular sound card. If you change Radio or Sound card you need to repeat this correction.

10. Now put your signal generator in 144.120 at -35dBm level, start Linrad and press "D" for SSB. Click on the carrier at 144.120 MHz and looking the high resolution map (screen with red horizontal lines) click exactly on the carrier and looks the average value you read on:



11. The average value for the signal is the lower number, in that case 112.9. Now look in 144.080 MHz, you will see a very weak signal, click on that signal in the big waterfall and using the high resolution screen click again to be on the middle and wait 30 seconds until the average give you a new value, now is:



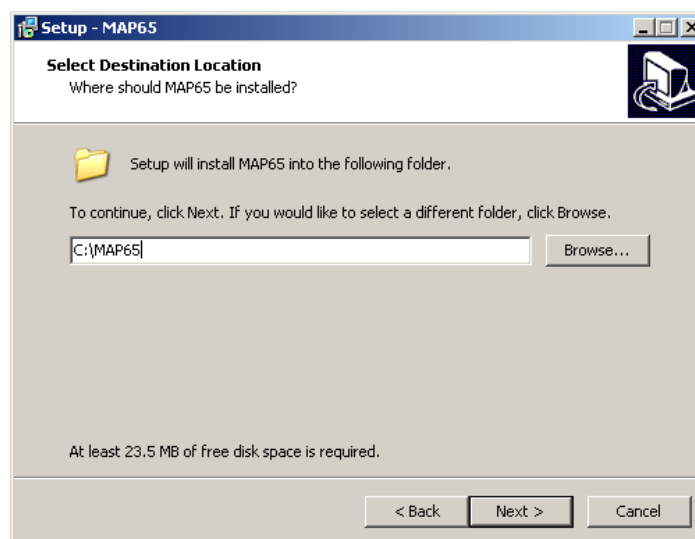
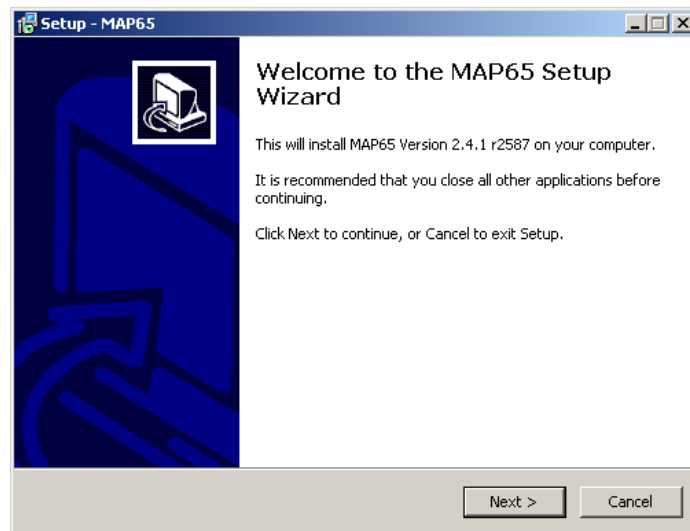
12. Just rest both numbers: $112.9 - 35.59 = 77.31\text{dB}$.This means your "Image" signal is 77.3dB attenuated respect to the main signal.

13. You will repeat the process 2 times more and you could reach -80dB or more, values higher than -85dB don't remain constant do the internal changes (temperature) in your audio card, PC and radio. The minimum value you need to reach is 60dB, lower values indicate a problem on your calibration routine, splitter, signal generator (signal not stable) Radio or audio card.

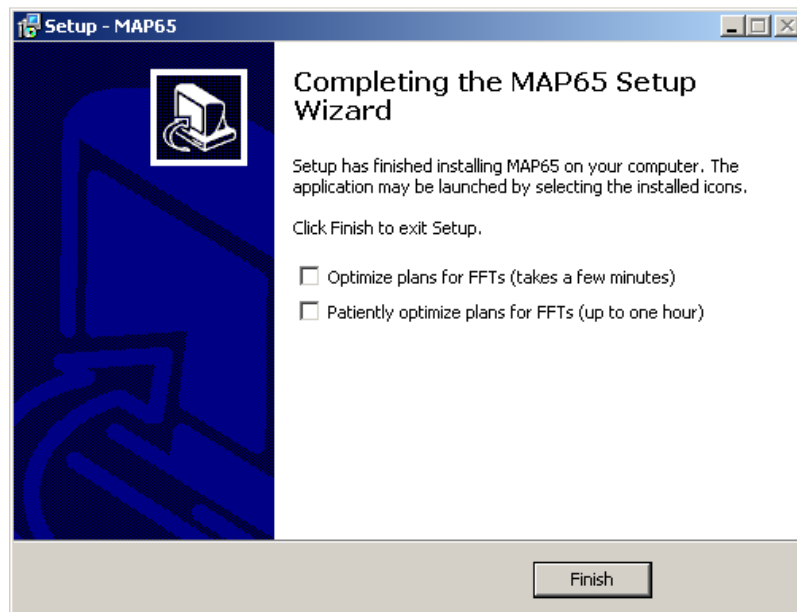
9. Install and configure MAP65 to use Linrad as an Input

At that point you have your IQ+ already installed and linked with Linrad as an input, at the same time Linrad is sending data to the network, could be to the same computer if MAP65 runs on the same computer as Linrad (if you select Send to 127.0.0.1 IP) or to another PC (IP address corresponding to the respective PC where MAP65 runs), now we will setup MAP65 and configure to receive data from Linrad.

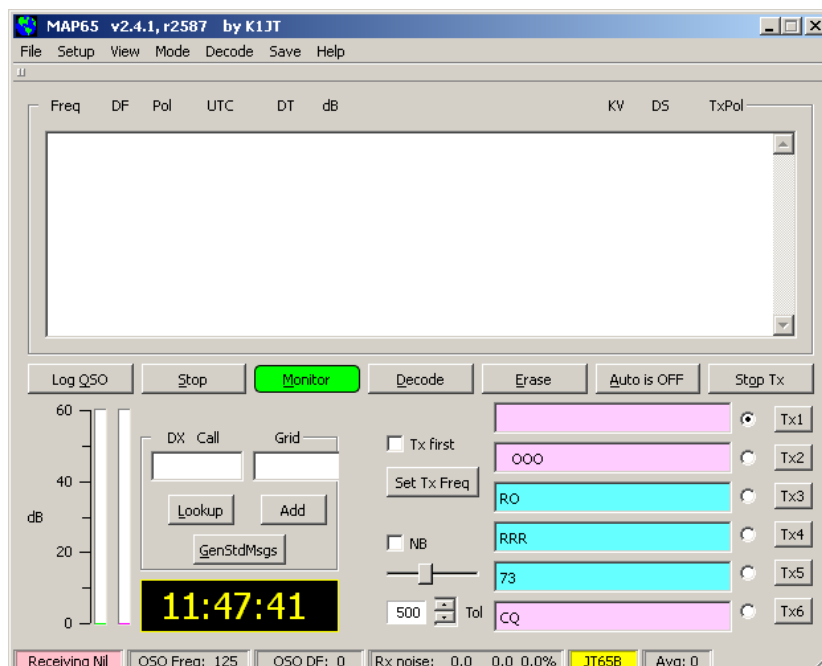
1. Download the latest MAP65 installers from the WSJT homepage.
2. Start the exe file and press "Next":



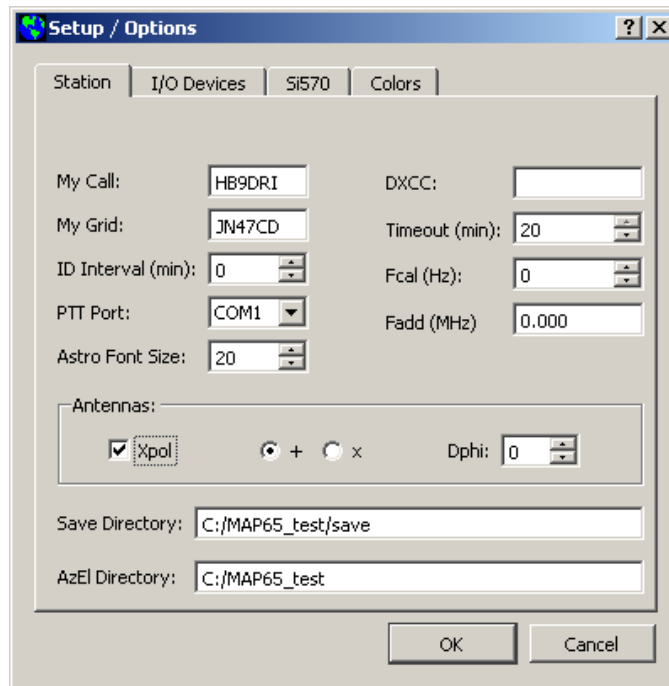
4. Accept the default path or select your path where you want to install MAP65, then press Next 2 times and then install.
5. After setup is finish deselect the option to optimized FFT's, we will do at the end both optimizations, just press finish.



6. Now start MAP65, an Icon is already created on your desktop:



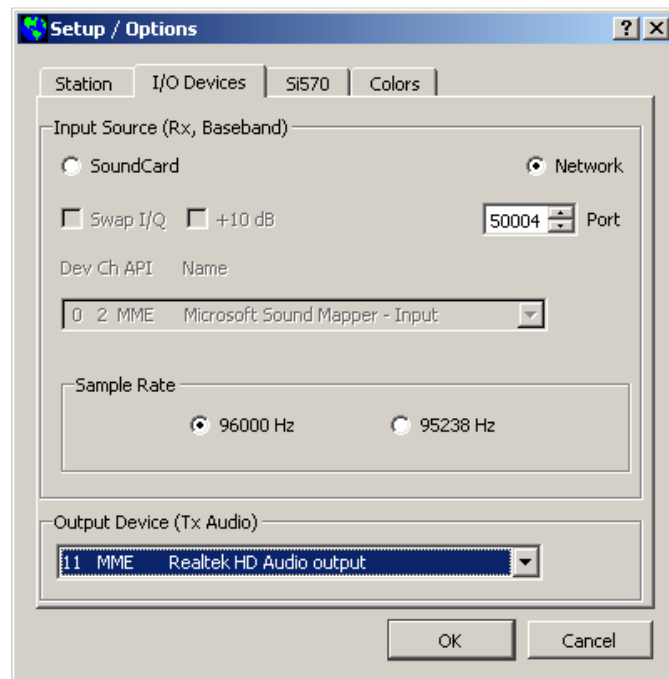
You can see left below the indication than MAP65 is not yet receiving, "Receiving Nil", just press "Setup" and select "options" :



Complete the necessary information: My Call and My Grid, under PTT port select the properly COM port to key your transmitter.

Under Antennas, select Xpol and the properly configuration "+" or "X", if you are running the IQ+ SC (single channel) do not select Xpol.

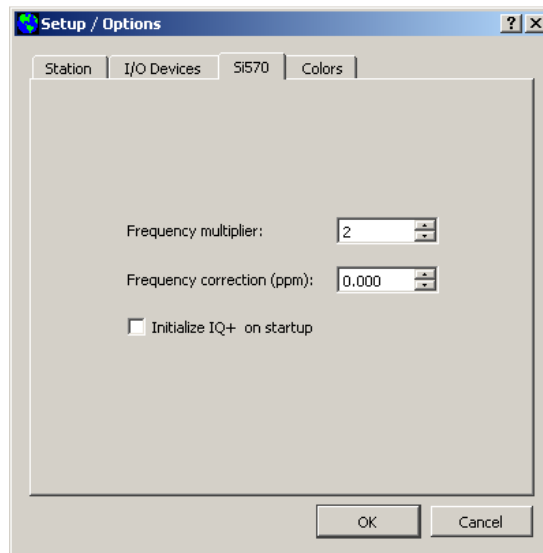
7. Change to I/O Devices and configure like that:



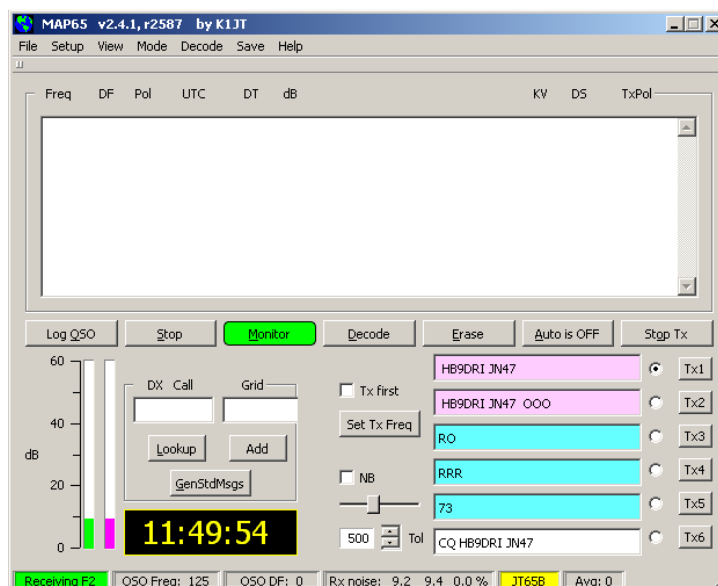
Select Network as an Input, the default port is selected (50004, same as in Linrad), the sample rate need to be 96000 Hz.

Under "Output Device (TX Audio) select the audio card you will use to generate and modulate the JT tones, normally is another audio card like the audio card embedded in your PC main board.

8. Change to the "Si570" label and verified than the selection to Initialized the IQ+ is deselected, Linrad is take care and already configure to manage the Local Oscillator, do not select initialized IQ+ on Start up otherwise you will create a conflict with Linrad Si570 routines:



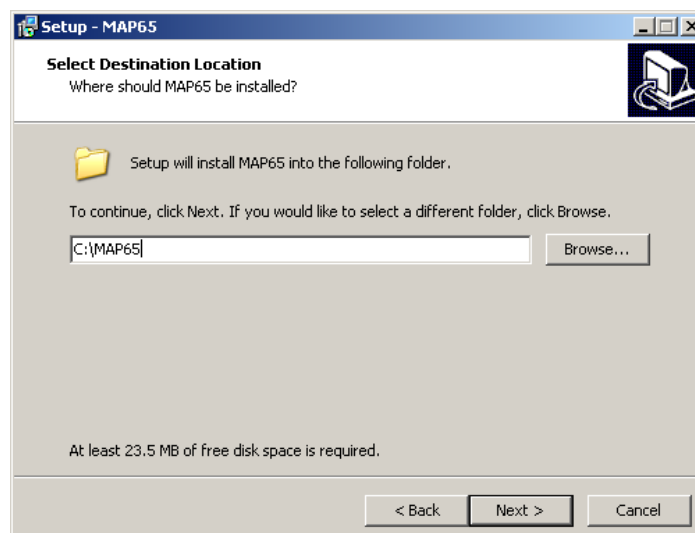
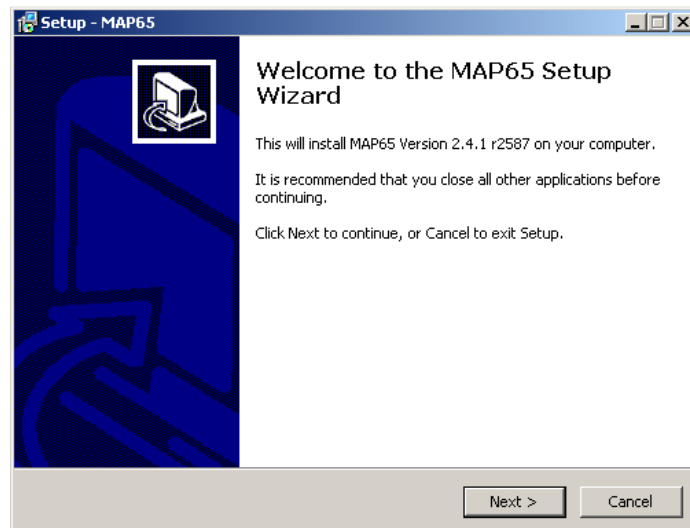
9. Now MAP65 is receiving the data coming from Linrad, Linrad need to be started and sending the data as was explain in the previous chapter, if everything is properly configure you will see in the main MAP65 screen on the Left lower the indication "Receiving F2" illuminated in green, additional you will see both channels (green is horizontal and pink Vertical) with increased noise level:



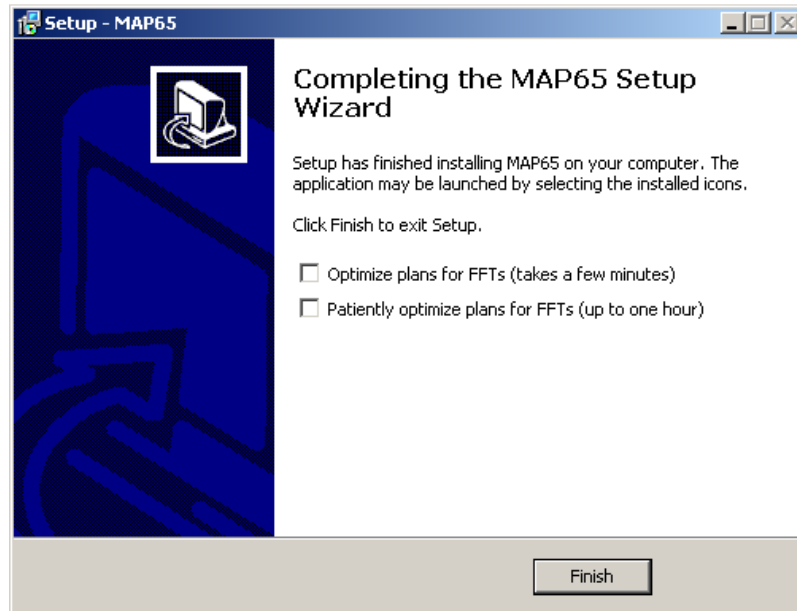
10. Install and configure MAP65 to use Direct Input Audio

The latest version of MAP65 allow to access the audio stream of your audio card directly without using Linrad, this reduce the complexity for setup and operation but never the less in some places using Linrad as an Input will give you the benefit of better noise filtering if Linrad is properly configure and the NB in Linrad is calibrated with a pulse generator. If Linrad is too complex for you, or if your interference level is not so high you can profit using MAP65 direct connected to your audio stream.

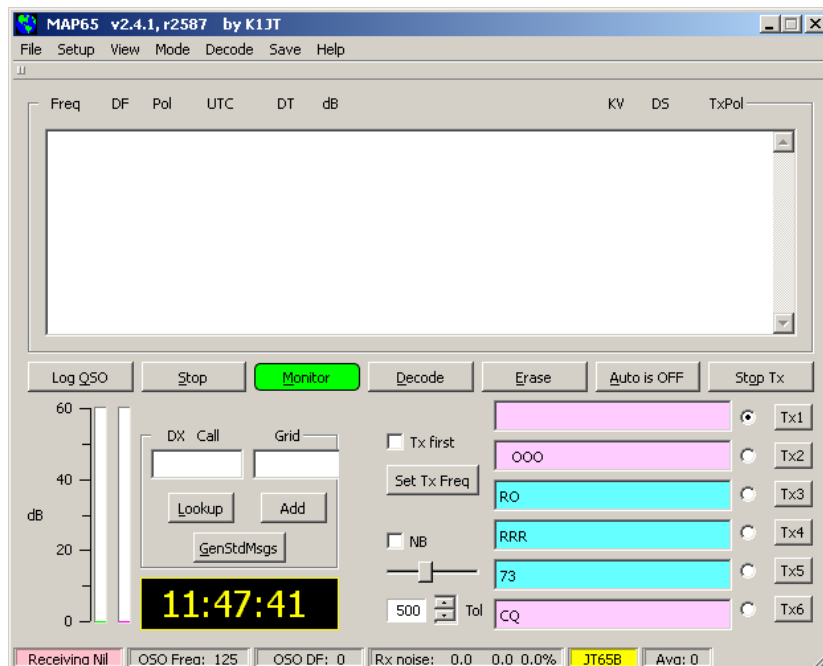
1. Download the latest MAP65 installers from the WSJT homepage.
2. Start the exe file and press "Next":



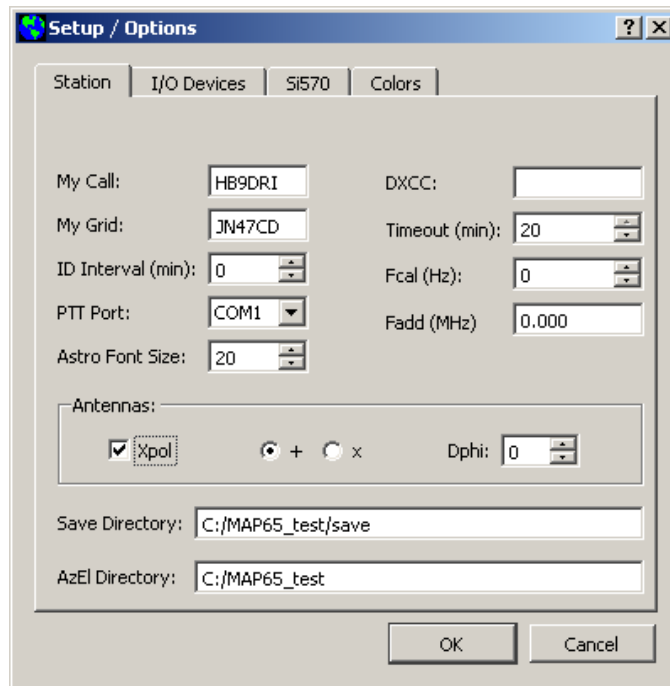
2. Accept the default path or select your path where you want to install MAP65, then press Next 2 times and then install.
3. After setup is finish deselect the option to optimized FFT's, we will do at the end both optimizations, just press Finish.



4. Now start MAP65, an Icon is already created on your desktop:



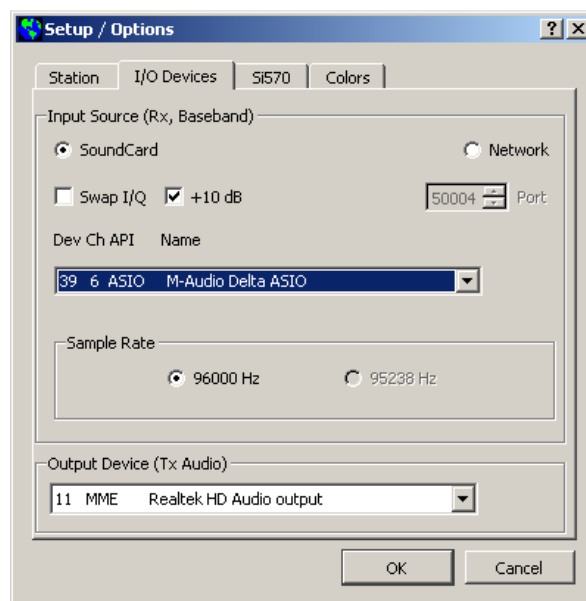
You can see left below the indication than MAP65 is not yet receiving, "Receiving Nil", just press "Setup" and select "options" :



Complete the necessary information: My Call and My Grid, under PTT port select the properly COM port to key your transmitter.

Under Antennas, select Xpol and the properly configuration "+" or "X", if you are running the IQ+ SC (single channel) do not select Xpol.

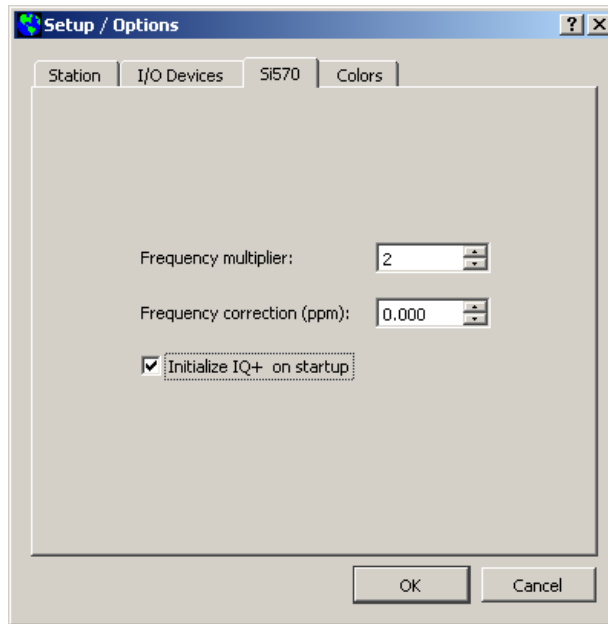
5. Change to I/O Devices and configure like that:



Select "SoundCard" as an Input, and search the ASIO driver for your audio card, the sample rate need to be 96000 Hz.

Under "Output Device (TX Audio)" select the audio card you will use to generate and modulate the JT tones, normally is another audio card like the audio card embedded in your PC main board.

- Change to the "Si570" label and verified than the selection to "Initialize IQ+ on startup" is selected, you are not using Linrad any more, means is MAP65 who needs to control your IQ+ LO

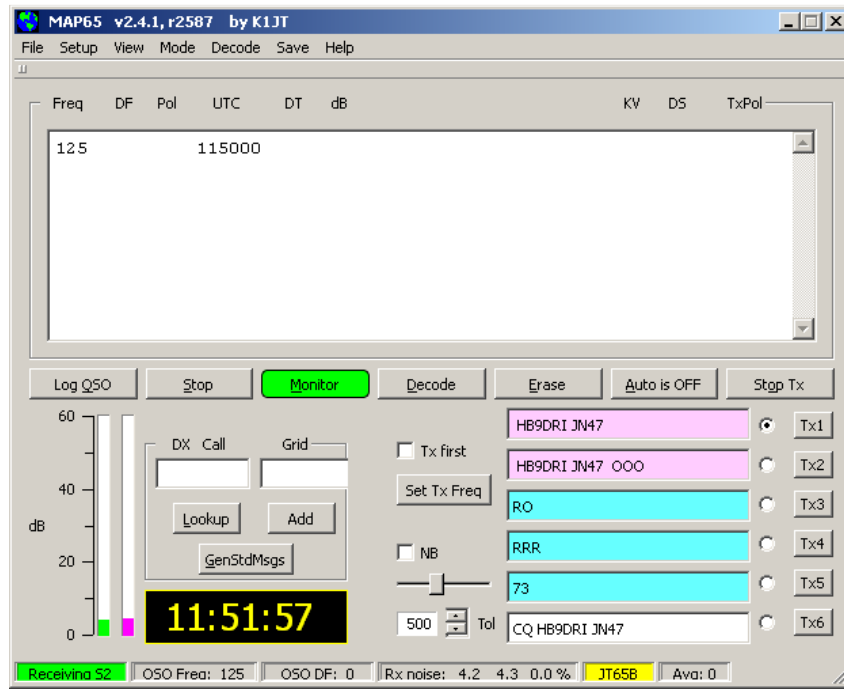


It's very important to select as Frequency Multiplier "2", any other number will not work, the IQ+ LO needs the LO frequency twice of your operative Frequency. The next table shows the different LO frequencies and ranges respect to each IQ+ model.

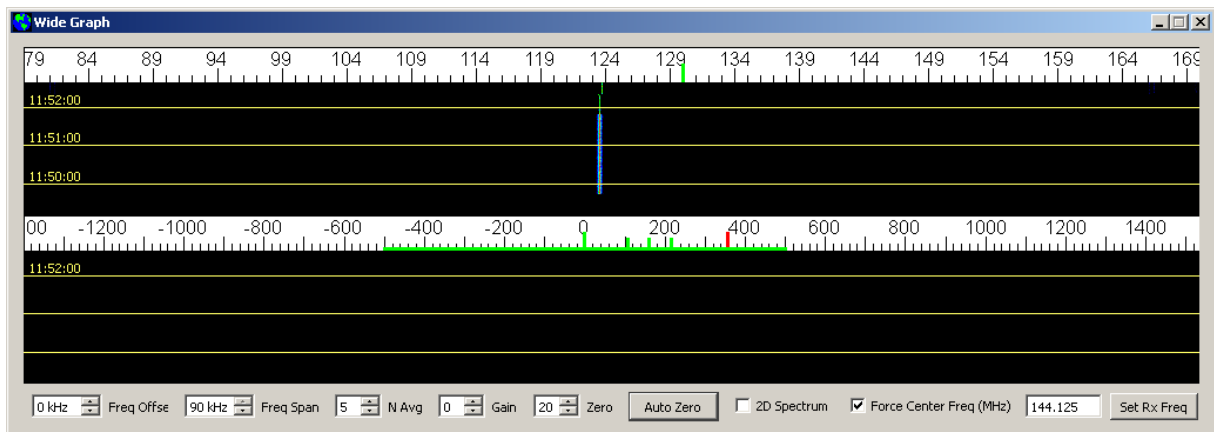
Under Frequency correction (ppm) you can calibrate the properly frequency, please follow the MAP65 manual to do that.

IQ+ Model	Band Fc	Min receive Fc	Max receive Fc	LO Multiplier	LO range
SC IF	28 Mhz	28000	30000	2x	56.0 to 60.0 MHz
VL	50 Mhz	50000	52000	2x	100.0 to 104.0 MHz
V	144 MHz	144000	146000	2x	288.0 to 292.0 MHz
U	432 MHz	432000	434000	2x	864.0 to 868.0 MHz

- Now MAP65 is receiving the data coming direct from the audio card, if everything is properly configure you will see in the main MAP65 screen on the Left lower the indication "Receiving S2" illuminated in green, additional you will see both channels (green is horizontal and pink Vertical) with increased noise level:



- Configure your waterfall parameters as:

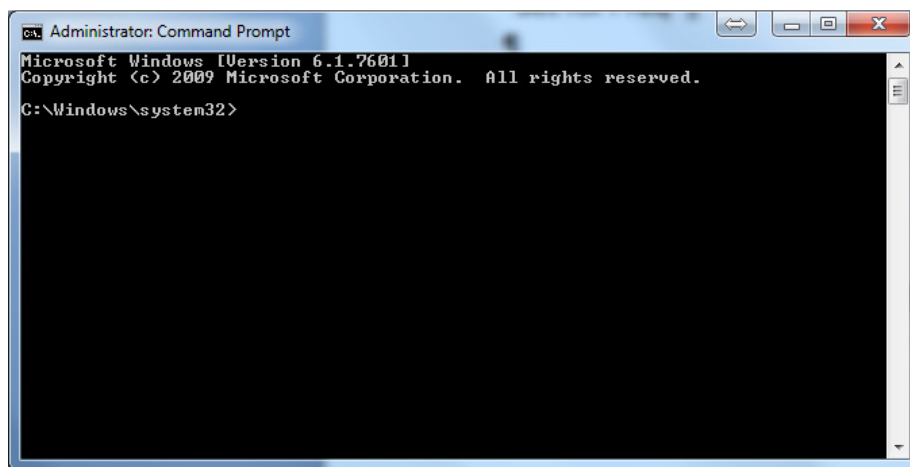


It's very important you select "Force Center Freq (MHz)" this will allow you to select the properly central frequency in any available band for the IQ+, to setup a new Center Frequency just type the new frequency on the right near box and press "Set Rx Freq"

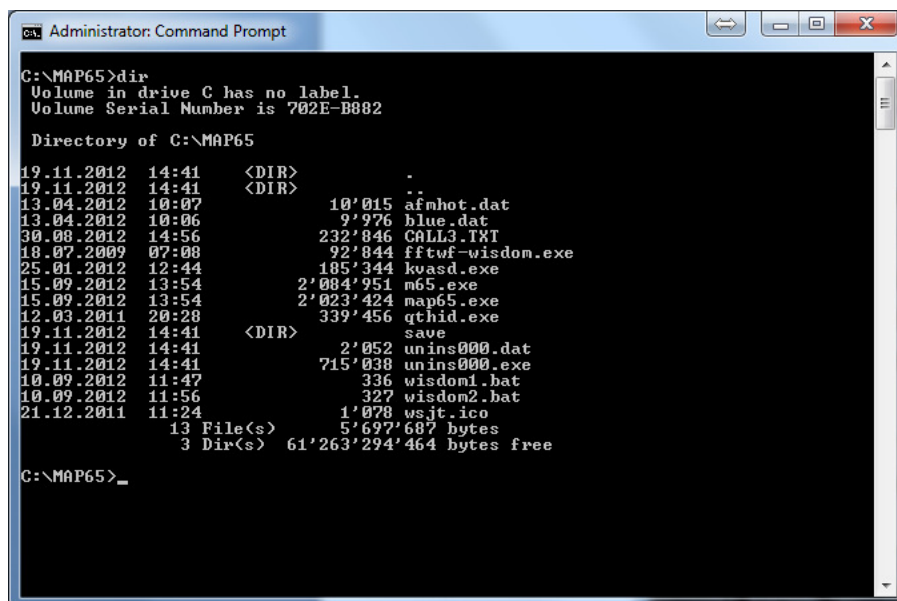
11. Optimize MAP65 FFT routines after setup

When we start MAP65 setup we skip the FFT optimization because take time and is better to do that at the end to avoid time delays and frustration, existing two optimization files need to be run, the first will take aprox 10min but the second optimization take from 30min to 1 hour to complete, how fast depend on your HW, this optimization is done just one single time.

1. Open your cmd console (if you are running windows 7 you need to run the cmd console "As Administrator").

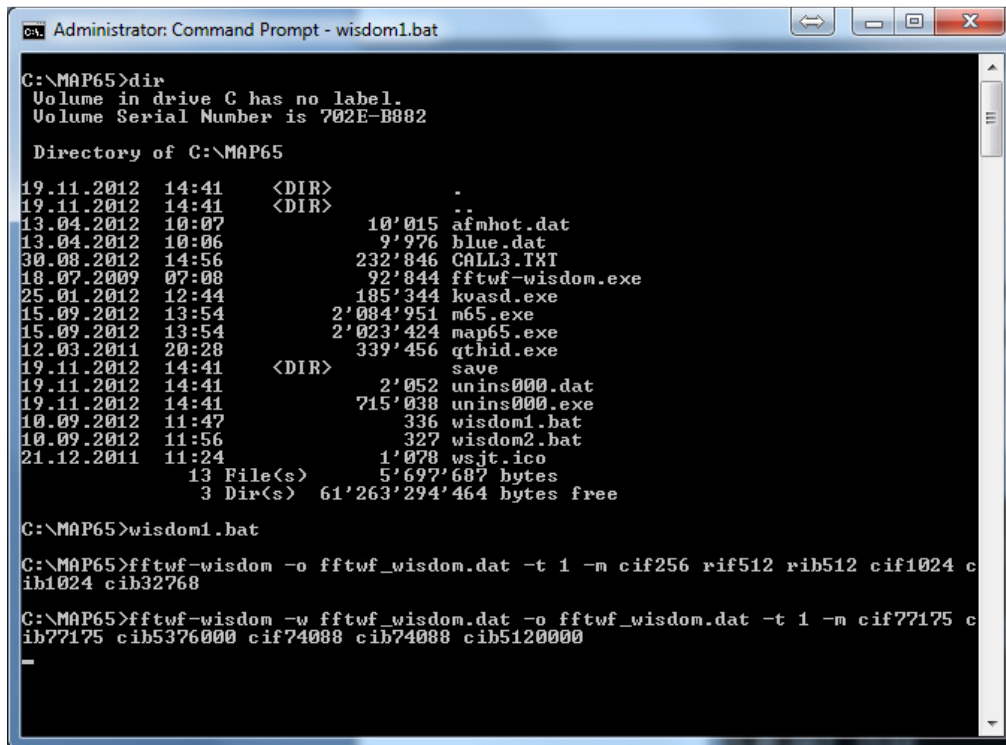


2. Move to the path where MAP65 is installed, in that case C:\MAP65 and type "dir" and press "enter":



Existing 2 files: "wisdom1.bat" and "wisdom2.bat"

3. Just type wisdom1.bat and press enter, the routine will start, wait until the prompt back to you, that means is finish, during the optimization the cursor blink on the lower left:



```
Administrator: Command Prompt - wisdom1.bat
C:\MAP65>dir
Volume in drive C has no label.
Volume Serial Number is 702E-B882

Directory of C:\MAP65

19.11.2012  14:41    <DIR>          .
19.11.2012  14:41    <DIR>          ..
13.04.2012  10:07                10'015  afmhot.dat
13.04.2012  10:06                9'976  blue.dat
30.08.2012  14:56                232'846 CALL3.TXT
18.07.2009  07:08                92'844  fftwf-wisdom.exe
25.01.2012  12:44                185'344  kvasd.exe
15.09.2012  13:54                2'084'951 m65.exe
15.09.2012  13:54                2'023'424 map65.exe
12.03.2011  20:28                339'456  qthid.exe
19.11.2012  14:41    <DIR>          save
19.11.2012  14:41                2'052  unins000.dat
19.11.2012  14:41                715'038 unins000.exe
10.09.2012  11:47                 336  wisdom1.bat
10.09.2012  11:56                 327  wisdom2.bat
21.12.2011  11:24                 1'078  wsjt.ico
           13 File(s)          5'697'687 bytes
           3 Dir(s)          61'263'294'464 bytes free

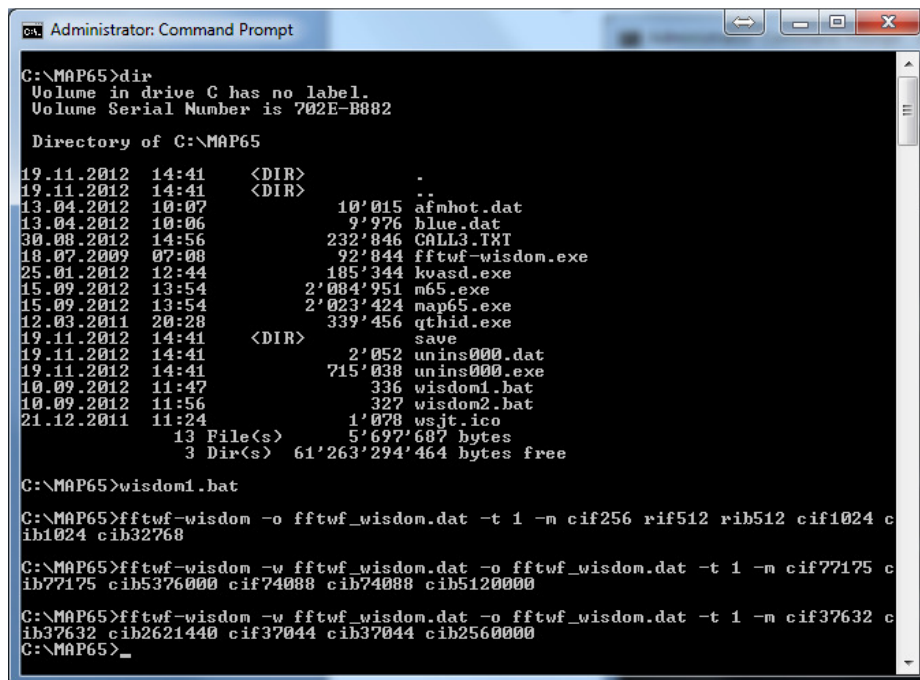
C:\MAP65>wisdom1.bat

C:\MAP65>fftwf-wisdom -o fftwf_wisdom.dat -t 1 -m cif256 rif512 rib512 cif1024 c
ib1024 cib32768

C:\MAP65>fftwf-wisdom -w fftwf_wisdom.dat -o fftwf_wisdom.dat -t 1 -m cif77175 c
ib77175 cib5376000 cif74088 cib74088 cib5120000

-
```

After is finish show like that:



```
Administrator: Command Prompt
C:\MAP65>dir
Volume in drive C has no label.
Volume Serial Number is 702E-B882

Directory of C:\MAP65

19.11.2012  14:41    <DIR>          .
19.11.2012  14:41    <DIR>          ..
13.04.2012  10:07                10'015  afmhot.dat
13.04.2012  10:06                9'976  blue.dat
30.08.2012  14:56                232'846 CALL3.TXT
18.07.2009  07:08                92'844  fftwf-wisdom.exe
25.01.2012  12:44                185'344  kvasd.exe
15.09.2012  13:54                2'084'951 m65.exe
15.09.2012  13:54                2'023'424 map65.exe
12.03.2011  20:28                339'456  qthid.exe
19.11.2012  14:41    <DIR>          save
19.11.2012  14:41                2'052  unins000.dat
19.11.2012  14:41                715'038 unins000.exe
10.09.2012  11:47                 336  wisdom1.bat
10.09.2012  11:56                 327  wisdom2.bat
21.12.2011  11:24                 1'078  wsjt.ico
           13 File(s)          5'697'687 bytes
           3 Dir(s)          61'263'294'464 bytes free

C:\MAP65>wisdom1.bat

C:\MAP65>fftwf-wisdom -o fftwf_wisdom.dat -t 1 -m cif256 rif512 rib512 cif1024 c
ib1024 cib32768

C:\MAP65>fftwf-wisdom -w fftwf_wisdom.dat -o fftwf_wisdom.dat -t 1 -m cif77175 c
ib77175 cib5376000 cif74088 cib74088 cib5120000

C:\MAP65>fftwf-wisdom -w fftwf_wisdom.dat -o fftwf_wisdom.dat -t 1 -m cif37632 c
ib37632 cib2621440 cif37044 cib37044 cib2560000
C:\MAP65>_
```

You can see now the cursor after the path C:\MAP65

4. Repeat the same but now type wisdom2.bat, the routine will start, this is a very long process, would take 30 min to 1 hour to complete. DO NOT INTERRUPT THE PROCESS, when the C:\MAP65 paths back to you just close the cmd window.

Your IQ+ is ready to use.