

The G90's IQ connector on the back panel of the G90 seems to have not attracted much attention. Using a computer application to read and display the IQ contents can add a large capability to using and enjoying the transceiver.

The purpose of this document is to present an overview of how one makes use of the IQ signals. This is not an exhaustive 'how to' description but presents the major capabilities and steps to install it on your computer.

**What is an IQ signal?** Speaking in layman's terms .. the G90 IQ signals at the IQ output socket is a complex low-level waveform that represents the full spectrum of frequencies that the G90 is tuned to. The 'I' and 'Q' are the names for these two signal components that are derived from the G90's SDR processing. As the various frequencies in the spectrum change then the IQ output changes accordingly. The spectrum may contain many individual radio signals .. SSB, AM, FM, Data, etc. A computer program can sample this IQ signal and reconstruct all of the individual radio signals. Google SDR IQ Data and you will find loads of descriptions. One example is here: <http://whiteboard.ping.se/SDR/IQ>

**G90 IQ Signals.** The G90 SDR implementation provides the I and Q signals at the stereo socket on the back panel. This signal is on the order of just a few tens of millivolts. The G90 front panel spectrum displayed is plus and minus 24 KHZ on either side of the present tuned frequency. Behind the scenes the G90 SDR circuitry is producing something like plus and minus 100 KHZ about the tuned frequency and this is available at the IQ output pin. Being such a low level signal, IQ signals & cable may be prone to noise pickup from various sources. This may require extra attention in the form of shielding, ferrites and / or an inline ground loop isolator.

**Recovering IQ Spectrum Data.** There are just two components in recovering the IQ data in some useful form. 1. A fairly routine stereo computer sound card to sample the two channels: I and Q data. 2. A sophisticated computer program that processes the sampled data and mathematically reconstructs the various radio signals present in the data. The recovered data can be 'tuned' to any of the radio frequencies in the spectrum and apply the appropriate processing to decode LSB, AM, FM and other modulations in the original frequencies processed by the G90 SDR functions.

**Sound Card Requirements.** The computer sound card used may be one built into the computer or laptop in use. These days the sound card may well be in the form of a USB sound card plugged into a USB socket. The two key requirements are 1. It must be a stereo input, mic or line levels. 2. Most sound cards will be able to sample data at a rate in the 48 KHZ range. At this sample rate, the recovered spectrum data will be identical to what the G90 displays on its front panel. A faster sound card sample rate of 96 KHZ, for example, will be able to recover and process a 96 KHZ swath of spectrum. More expensive sound cards can sample at an even higher rate and thus present an even larger portion of spectrum.

**Example Sound Cards.** There are many many USB sound cards. However most are just 'mono' not stereo, and thus not usable. Here are two with a stereo input and appear to still be available:

- StarTech USB Sound Card w/ Stereo Mic – ICUSBAUDIO2D
- StarTech USB Sound Card w/ Stereo Line Input - ICUSBAUDIO7D)

**Of the two, only the StarTech ICUSBAUDIO2D supports 96 KHZ sampling .** The other model is limited to 48 KHZ. **96 KHZ is preferred for the displayed spectrum to be 96 KHZ wide.** See the advanced properties of your sound card to set the sample rate to be used.

**SDR IQ Processing / Display Programs.** There are literally dozens of computer programs that are capable of some level of sampling and processing an IQ data stream. These programs have been developed to run on the popular Windows PC's, Raspberry Pi's, and a few other platforms. We will focus on the four most popular and capable PC programs here. There are frequently versions of these four available for other computer platforms. Here are some general functions provided by these programs;

- Sample the IQ data stream or other SDR receiver and provide various processing functions. The sample rate can usually be set to various values.
- Basic data is displayed as the frequency spectrum and associated waterfall that is included in the IQ data stream. Usually you can use the computer cursor to 'tune' to any specific frequency in the spectrum .. just like tuning the radio.
- Provide various demodulation functions for frequencies in the spectrum. This would include AM, FM, LSB, USB, and more.
- Many other signal processing functions such as AGC action, digital signal processing, noise limiting and more. The user can configure all of these functions to improve the quality of the signal received.
- In addition to sampling data from a sound card, often they support some level of integration with other SDR radios and converters. Examples are the popular SDRPLAY RSP1A, and the RTL-SDR low cost SDR receiver dongle.
- The computer program may have computer control features to allow it to interact with the G90 so that one may tune the other and set a subset of the G90 CAT commands.

**SDRUNO.** This is an extremely sophisticated program that has capabilities that can probably meet any IQ processing desired. This power comes at a big cost of learning how to use it. It is free. So far, I have not found how to have SDRUNO sample the IQ data stream via a sound card. Go here for the download. <https://www.sdrplay.com/sdruno/>

**SDR-Console.** SDR-Console is a general purpose SDR program similar to other software like SDR#, HDSDR and SDRUno. SDR-Console V3 however sets itself apart by being one of the most feature rich packages with goodies like advanced DSP and NR options, frequency favorite lists, IQ recording and playback and much more. But, as with SDRUNO, this comes at cost of a steep learning curve. I also have not found how to have Console sample IQ data via a USB Sound card. Here is the link to SDR Console: <https://www.rtl-sdr.com/sdr-console-v3-beta-now-released-console-server-now-available/>

Both of the above programs work very well with my RSP1 receiver. Besides not being able to learn how to configure them to accept IQ data via a sound card I feel they are much too complex for more routine and initial usage with the G90's IQ signals.

Thus I will look at the HDSDR and SDR# (pronounced SDR Sharp) programs in more detail. They both are free and have similar capabilities and are much more approachable so far as installing and configuring for use.

**SDR#.** SDR# is the most popular free SDR software in use at the moment. It is relatively simple to use compared to other SDR software and has a simple set up procedure. It is a simple to use program that also has some advanced features. It has a useful modular plugin type architecture, and many plugins have already been developed by third party developers. The basic SDR# download without any third party plugins includes a standard FFT display and waterfall, a frequency manager, recording plugin and a digital noise reduction plugin. SDR# also decodes RDS signals from broadcast FM.

SDR# may be downloaded from: <https://airspy.com/download> **However, when I downloaded it from that site (which is the authors site) I get a virus warning and the download stops. I do have a prior copy and it runs fine. But because of the virus warning I do not recommend it at this time.** Perhaps the site will find this virus and eliminate it.

If you do manage a copy, configuring it for use with the G90 is simple. See the screen shot below.:

- Near the top left is the "IQ From Sound Card" drop down. This assumes that your sound card for the IQ use is installed and configured for the sample rate that you desire.
- Use the Radio drop down, note the modulation desired. Most important is to check the Swap I & Q box (else the audio is garbled).
- Not shown is the Audio drop box display. Here you select:
  - The sample rate desired
  - The name of the sound card to be used for input (Attached to the G90 IQ port)
  - The name of the sound card to be used for output .. select the Microsoft Sound Mapper to route the audio to your PC speakers
- Then click on the run arrow at the top left (it's a square as shown below) to start SDR# running.

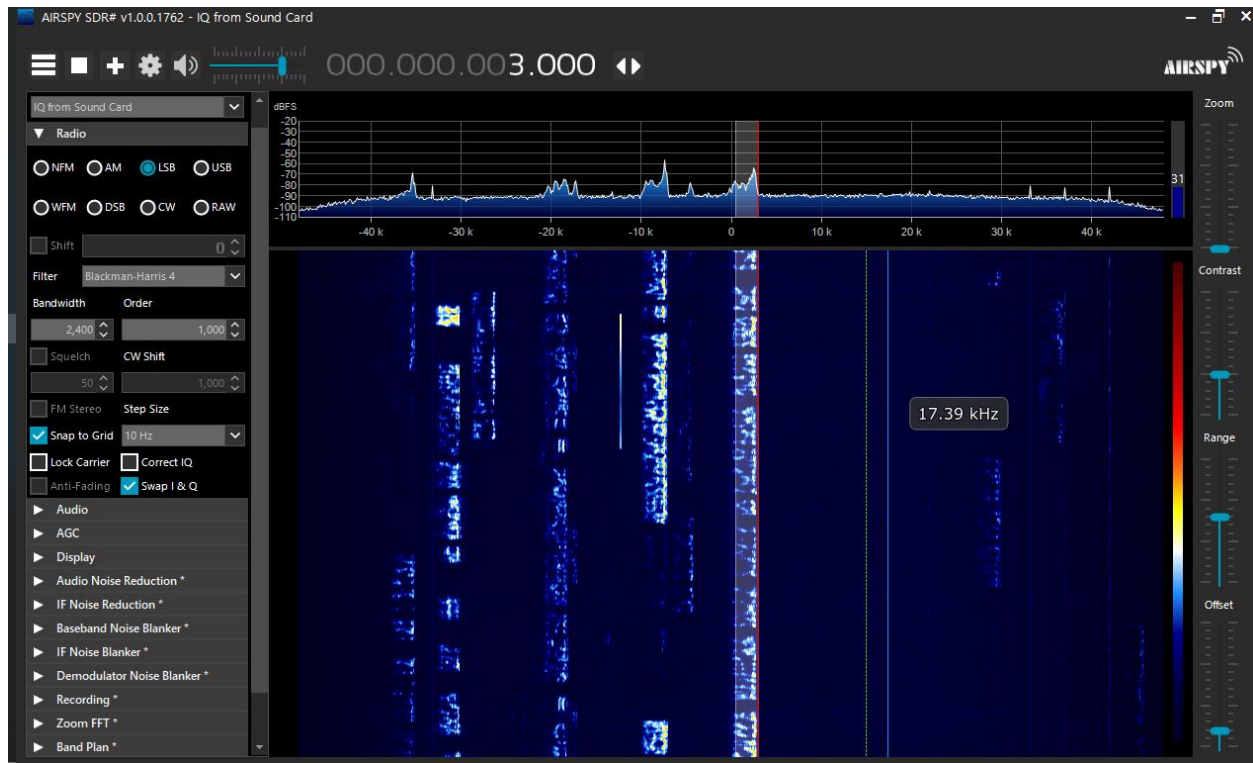
Comments when SDR# is running:

- The stock SDR# program does not have the ability to interact with the G90 via the CAT cable. So the frequency display is centered where the G90 is tuned to but that numeric frequency is not shown. Instead it displays the plus and minus KHZ major increments from that center. There is a plug in to enable Omnirig to be used with SDR# that I have not tested or used.
- Use the mouse to 'tune' around the displayed spectrum. Note the step size is settable. I prefer 1 KHZ.
- Note the spectrum shown is fixed and centered at what the G90 is tuned to. Retuning the G90 changes the spectrum displayed. This also means that you can monitor the station the G90 is tuned to while checking out the other stations shown on the SDR# spectrum displayed.
- The above means that you can leave SDR# running as a spectrum / panorama display while other digital modes software such as fldigi, WSJT-X, JS8Call, etc. are running and using the G90 CAT for frequency and mode control.

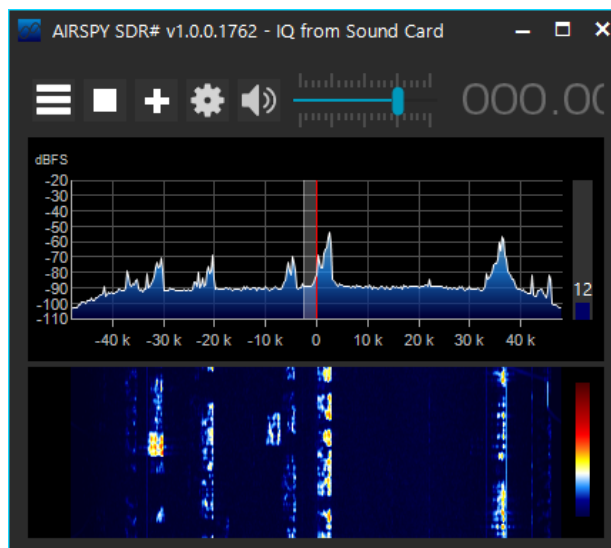
This web site provides some useful SDR# information.

<https://sites.google.com/site/g4zfqradio/connecting-soundcard-sdr-to-computer>

Here is a screen shot of the main SDR# display.



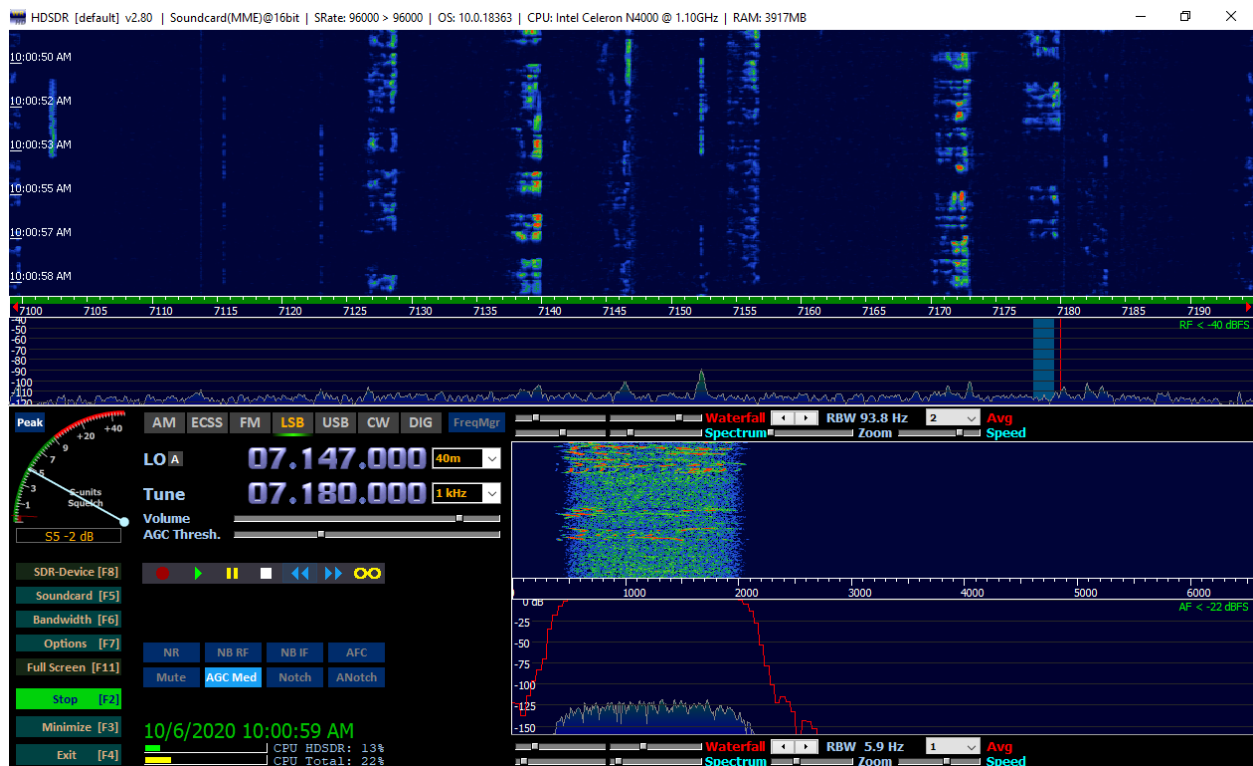
Below is an example of how the SDR# display can be made quite small. It could be left open on your computer display at all times as a G90 spectrum display.



**HDSDR** HDSDR is based on the old WinRAD SDR program. To install HDSDR, download the program from the link on the main HDSDR page <http://www.hdsdr.de/> . Along with a FFT display and waterfall, HDSDR has some extra advanced features. Users will also find an Audio FFT and waterfall display on the bottom of the screen. The output audio can also be bandpass filtered by dragging the filter borders on the display. Bandpass filtering the audio can really help clean up a noisy signal. The audio processing also supports placing of notch filters either manually or automatically. There are also noise reduction and noise blanker features and an automatic frequency centering algorithm which will automatically center the signal, so you don't need to click exactly in the center of a signal. Traditional ham radio users will also enjoy the S-units signal strength meter and the built in frequency manager. A good related how to: <https://sites.google.com/site/g4zfqradio/installing-and-using-hdsdr>

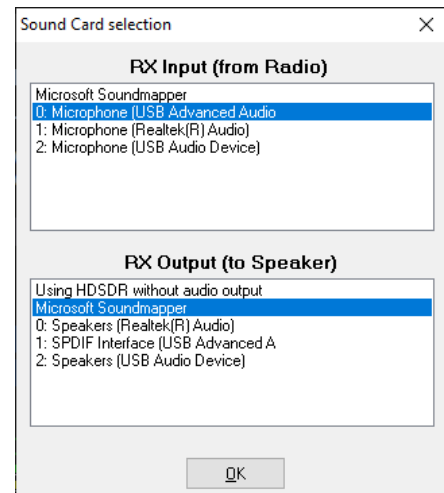
Once installed and assuming that the sound card to be used is installed and configured for the desired IQ sampling .. here is how to configure HDSDR for use:

Here is a screen shot of the basic HDSDR display.



Refer to the several dropdown boxes in the lower left corner:

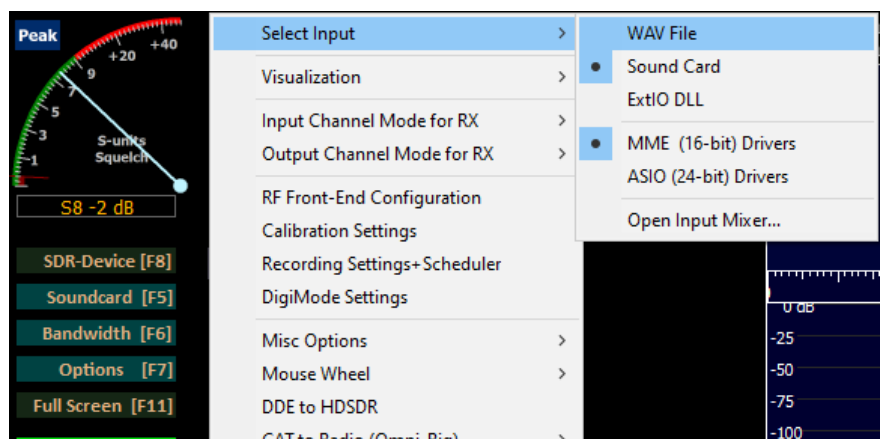
- Click on the Sound Card selection drop down and set it as shown where my Microphone (USB Advanced Audio) is my ICUSBAUDIO2D USB sound card.



- Click on the Bandwidth drop down box and select the desired input sample rate (from your sound card) and the output rate. My sound card can sample at 96 KHZ and that will yield the widest spectrum display (96 KHZ). Selection of a smaller sample rate will have the effect of zooming in on the spectrum. A sample rate of 48 KHZ will match the G90's displayed spectrum.

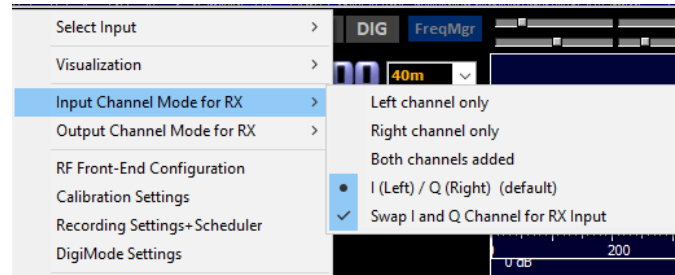
Sampling Rate [Hz]	
Input	Output
12000	12000
24000	24000
48000	48000
96000	96000
192000	192000
<hr/>	
11025	11025
22050	22050
44100	44100
88200	
176400	
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	4000
8000	8000
16000	16000
32000	32000

- Click on the Options drop down and then Select Input. Configure as shown here.

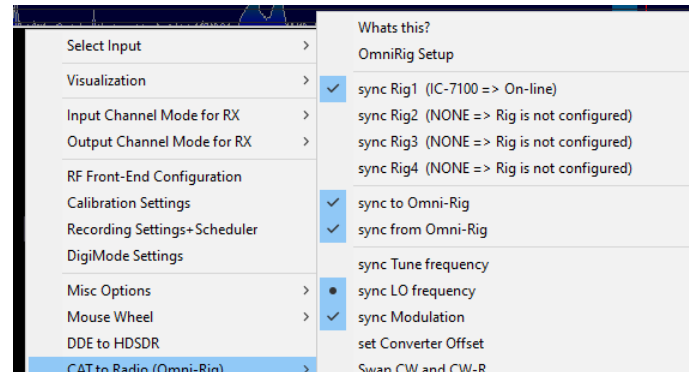




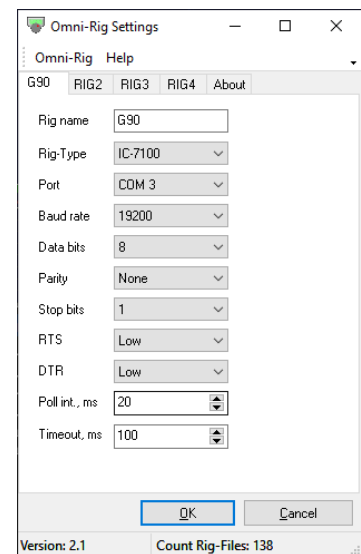
- Click on the Options drop down and then Input Channel Mode. Configure as shown here.



- Click on the Options drop down and then Cat to Radio (Omnirig). Configure as shown here. The 'Sync to LO frequency' means as you tune the G90 its frequency will be shown in the LO frequency. Also the A or B next to 'LO' allows selecting G90 VFO A or B.



- As you use your mouse to select a frequency in the HSDR display, the 'Tune' frequency will change but the G90 will not be tuned to that frequency.
- Selecting 'sync to Tune Frequency' will mean that the G90 tuning frequency is shown as the HSDR Tune frequency and they are both maintained to be the same value.
- Note the assumption is that Omnirig has been downloaded and configured as shown here. (Omnirig 2.1)



Then click on the Start button to begin HSDR operation. The various program options are too numerous to go over here. Further explore the HSDR page <http://www.hdsdr.de/> to learn more about it. When in doubt just hover over and click on the various 'controls' to see the impact.