

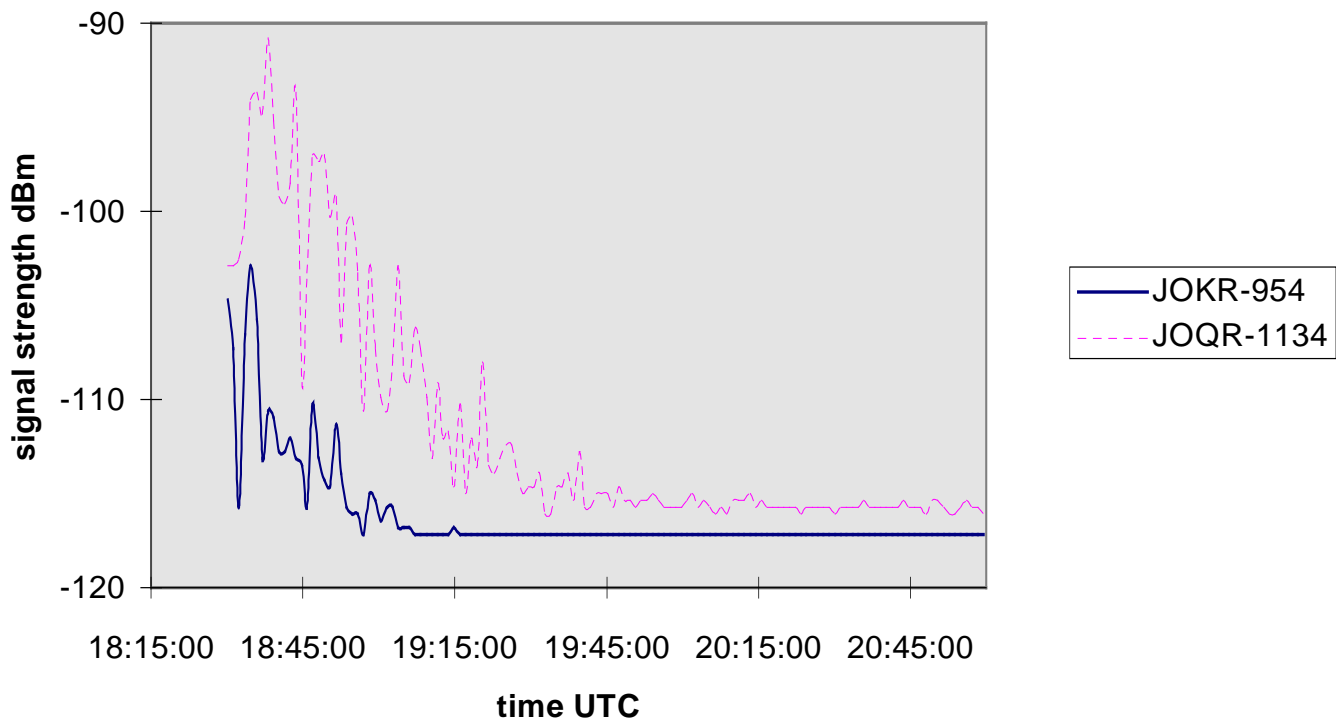
IRCA Technical Column

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Using a PC and a Communications Receiver for Advanced DXing

For the past couple of years I've been using a rather unusual communications receiver, the Dymek DR-333. It tunes from 10 to 29999 kHz, has quite respectable sensitivity and signal handling capabilities and has three Collins mechanical filters for IF selectivity. It is also about the size of a blockbuster paperback novel and has only an antenna input, a 12 volt power input, a couple of audio outputs and a DB-9 connector for RS-232 communications with an IBM compatible personal computer. A computer program which came with the radio allows receiver settings to be controlled from the keyboard and to be displayed on the PC screen along with the frequency readout. A detailed description and review of this receiver is found in the 1991 Proceedings from fine tuning publications.

One of my interests is the study of propagation of medium wave signals from the other side of the Pacific Ocean, but it's always been a problem recording the rise and fall in signal strength over time on even one channel, let alone several. A paper chart recorder will allow one to do this, but such items are not cheap or easily available. The DR-333 is capable of tuning in a signal and registering its signal strength in about 100 milliseconds, so it is possible to tune 10 channels in one second and record the signal strength on each one. You certainly can't tune this quickly using a keyboard, so I needed to write a program which would do it for me, as the program which came with the receiver wouldn't do it. The receiver manufacturer kindly provided me with the source code for the radio's control program, so I upgraded my programming skills in the "C" language, and eventually created a program which acts as a data logger, recording signal strengths on up to 120 channels at a time.



The data files can then be imported into a spreadsheet such as Excel which will create charts of each channel's signal strength over time. An example of a pair of Japanese medium wave stations fading-out as heard from 700 miles offshore in the north Pacific is shown above.

This was on March 1, 1996 and local sunrise was at 16:22 UTC . There are obviously some unanswered questions about how signals are propagating if you accept that a complete darkness path is necessary in order to hear MW stations 3700 miles away. I hope to expand on these and other observations in a later article.

The following description of the program will require some small knowledge of how a PC handles files and uses a serial port, but I hope that it won't deter those who are unfamiliar with the PC.

The program initially looks at various configuration files which establish receiver settings which will be used for the duration of the data logging, such as filter width, IF gain, AGC speed, communication port used, frequencies to be logged etc. These files can be modified by using a text editor, though except for the frequency list, the settings tend to remain the same; for example, the IF filter used for propagation studies is always the CW narrow filter. The radio is then set up by sending all parameters but the frequency list to it via the PC's serial port.

The program then creates a data file which includes a header of all the frequencies to be tuned. The radio is then tuned by the PC to each frequency in the frequency list. Each frequency is monitored for approximately 100 milliseconds, and its signal strength is placed in the PC memory. The list of frequencies is scanned over and over for 10 to 60 seconds ; the time is dependent on the number of frequencies being scanned--fewer frequencies scanned means faster updating. At this point, an average signal strength for the previous 10 to 60 seconds is generated and written to the data file along with a time stamp generated by the PC clock. The frequency scanning and signal strength recording continues until the user sends a "quit" command (Ctrl-Q) from the keyboard, or until a new hour starts. In the latter case, the last hour's data file is updated and closed, and a new file is started. Therefore, no data file is longer than one hour.

This program was first used on a ship in the North Pacific Ocean, hundreds of miles away from interfering domestic signals. Especially after sunrise, as in the above chart, the signal strengths recorded are pretty much accurate, but during the night, it was found that domestic sideband splatter could cause havoc with the recorded signal strength. A smoothed average of recorded signal strength on a given channel still gives a pretty accurate representation of relative signal strength, so you can see the DX fade in, vary, and fade out, but better results are obtained if a frequency one kilohertz away from each 9 kHz channel is also recorded (plus or minus depending on where the nearest 10 kHz channel is found). This is far enough away to be out of the filter passband, but near enough to have quite similar splatter characteristics. When the file is moved into the spreadsheet, this splatter signal strength can be subtracted from the signal strength found on the desired channel itself. Often, the resulting relative signal strength is quite similar overall to the uncorrected strength, just weaker.

An interesting variation of the above program was also written which displays signal strength for any or all of the 9 kHz channels on the PC monitor. The strength representation for each channel is a simple bar graph display using from one to eight ASCII arrows, e.g.

531 >>>>

All 9 kHz channels can be displayed on one screen this way, which makes it a very useful tool, especially on DXpeditions. It shows at a glance which channels have had above average signal strengths in the previous sampling period which can be up to two minutes, if the entire band is being sampled. Sometimes it's frustrating, as you tune in just as the signal fades down , but it does give a clear picture of where the hot spots are during an opening. Unfortunately, openings are when I would like to also record signal strengths for later analysis, so the next step is a program to record strengths as well as display them.

In this program, it was important to develop a splatter cancelling algorithm similar to that described above, otherwise channels like 1071 look as if New Zealand is always booming in. There are still occasional unexplained blips of high signal strength on random channels, but overall, the program now gives a good picture of where the action is on the band.

Either program could be modified to set off an alarm which could indicate when certain signals rose above a predetermined strength, thus indicating good DX conditions to an interesting part of the world. In western North America, for example, one could monitor channels such as 693 kHz which are only likely to have an Asiatic signal, or 612 kHz which is only likely to have an Australian signal. Most likely, they would all be monitored, and the program would indicate whether an Asian or Australian opening is in progress. Note that some form of wideband antenna is needed to allow the receiver to do all this scanning, though one can use a tuned loop if only one channel is being monitored.

The DR-333 was developed in the late eighties, and is no longer available, so is this program simply an historical curiosity? Not entirely, as since that time, several communications receivers have come on the market which have RS-232 interfaces. Unfortunately, I know of only two widely available receivers that have the interface which can also deliver signal strengths back to the PC: the JRC NRD-535 and the AOR AR-7030. (The NRD-525 probably could as well, but I'm not 100% sure. The RS-232 interface is an option on that radio). Other receivers with this capability may be in the future, but for propagation studies, it's best that the receiver in question have a high quality narrow IF filter, and it would be nice to have a fast enough AGC that one could scan signals at a rate greater than the present 10 Hertz.

For those who want to look at my source code in the hope of using it with another receiver, I can send it to you on a floppy for US\$1 to help cover the floppy and mailing, or it can be sent free via the Internet (I'm at nhp@ieee.org). The code was compiled using Borland Turbo C++ 2.0, but could be transferred to other compilers if you know what you're doing. (Experienced programmers witnessing the code: please keep your laughter to a dull roar!)