

## The Icom PCR-1000 as a SDR RF Front End

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David Carr, KD5QGR

partially based on a document by

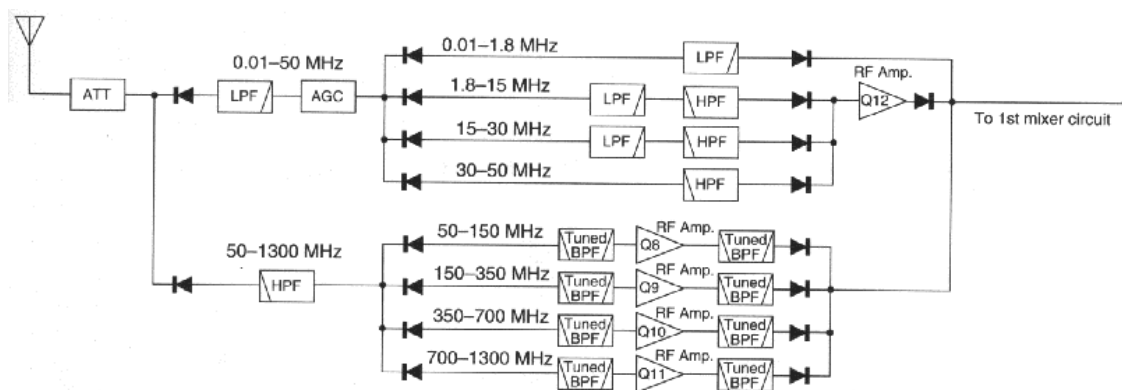
Edgar J. Kaiser, DF2MZ

### Purpose:

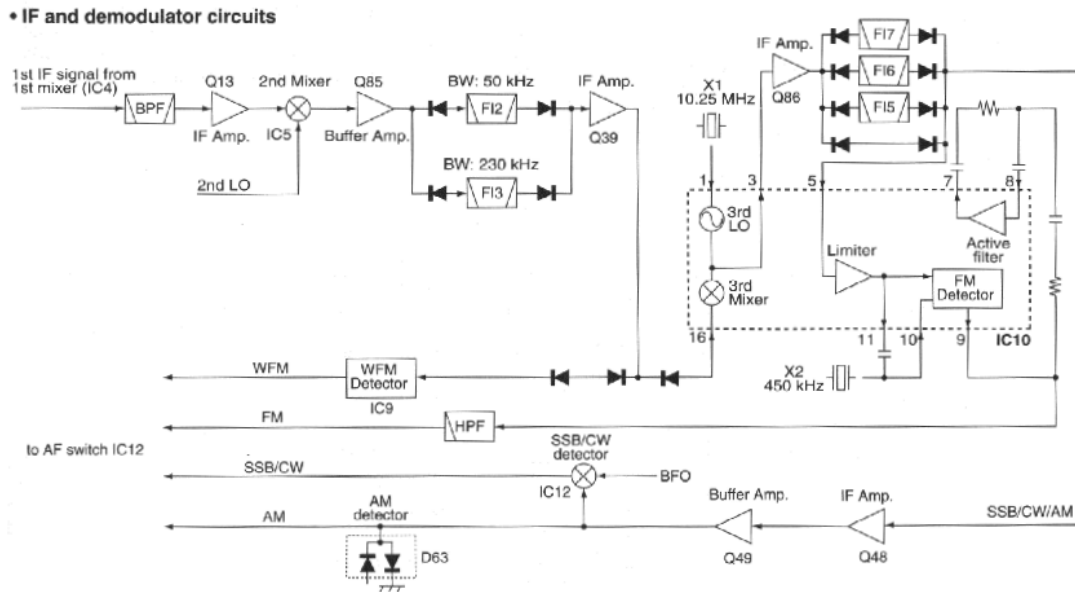
Many times when working in software defined radio some means is needed to convert a weak signal at a high frequency to a bandlimited high level signal at a much lower frequency to facilitate digitization. It has been my experience that suitable RF front ends for non-commercial software radio implementations are difficult to find. Existing commercial solutions are usually prohibitively expensive, and scratch built designs are rare and fairly complex. While looking for solutions to this problem I came across the PCR-1000 as capable alternative. The Icom PCR-1000 "PC-Receiver" is a relatively inexpensive readily available device that can be easily modified to serve as a medium-performance SDR RF front end. The features of the PCR that differentiate it from other radios in SDR applications are its wide tuning range, .1-1300Mhz, its built-in 3khz, 6khz, 15khz, 50khz and 230khz bandpass filters, and the relative ease of modifications required to produce an output suitable for direct digitization. This document attempts to detail the information necessary to implement a functional RF front end solution.

### Introduction:

The primary goal of our modifications to the PCR-1000 is to obtain a high level 450khz IF signal with a selectable bandwidth suitable for direct digitization. Additionally, we must be able to tune the front end so that the signals of interest are downconverted to this IF frequency. An explanation of the PCR basic structure follows to make the modifications more clear:



Signals from the antenna are first optionally passed through a 20db attenuator. Next, one of several sets of wideband preselection filters are applied and the signal is amplified.



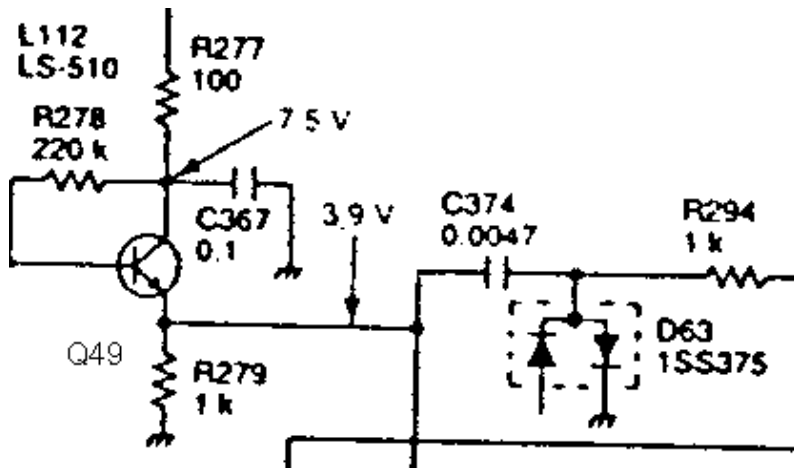
The signal is then mixed down to the first IF of 266Mhz, bandpass filtered and amplified and then mixed down to the second IF of 10.7Mhz. If wide-FM mode is engaged, the signal is then sent directly to the wide FM demodulator and the third IF of 450khz is disabled. This is not desirable for our purposes, so it is best to not select the wide-FM mode. If any other mode is selected, the signal is passed through either a 230khz or a 50khz bandpass filter before being mixed down to 450khz. At this point the signal can be filtered to 3khz, 6khz or 15khz bandwidth or not be filtered at all (to achieve 50khz or 230khz bandwidth). After the final set of filters, the signal is passed through several more gain stages before being sent to the various detectors. We will tap the 450khz third IF at the buffer amplifier labeled Q49 above.

Note: A 10.7Mhz signal with an estimated bandwidth of several megahertz is available at the output of buffer amplifier Q85 above.

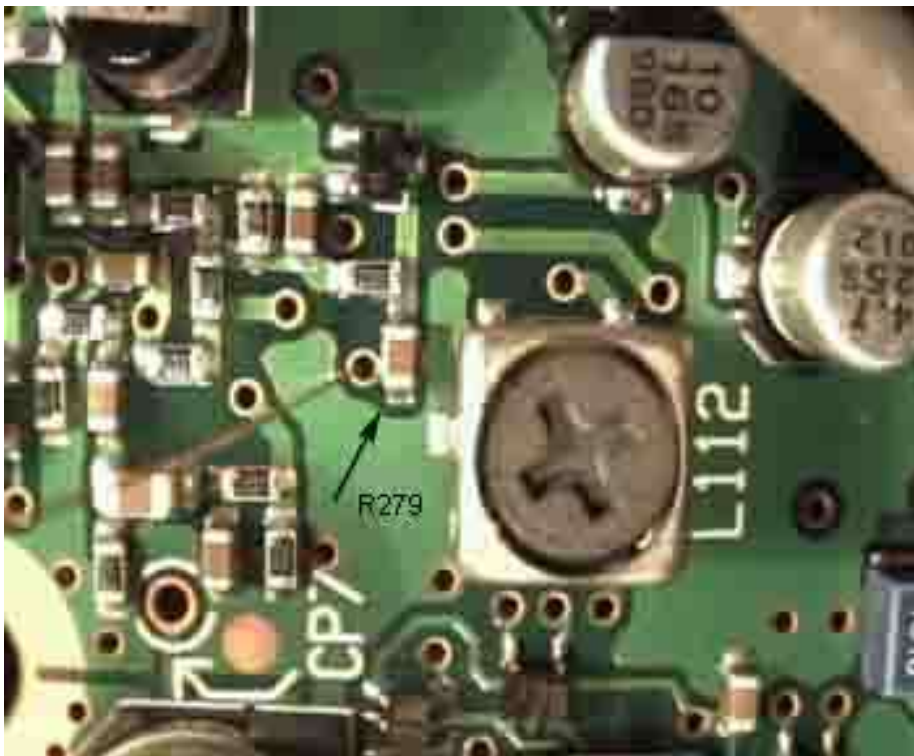
Hardware:

Due to the nature of the PCR's design, all that is necessary is to solder the center conductor of a spare piece of RG-174 coax to the output of Q49 (shown as the 3.9V point in the schematic below). This will provide us with a 450khz IF output with a large signal level. As the output of the transistor has a DC bias of about four volts, it is necessary to capacitively couple the tap. This is achieved by placing a 1.5nf capacitor in series with the center conductor. The tapping point is shown in the following pictures.

To find this point remove the PCR case and the inner metal shielding cover.



The below image shows R279, the connecting point. Its probably a good idea to have someone with surface mount soldering experience do the next step. Use a magnifier and a very fine soldering iron tip to attach the coax center conductor. Solder to the pad of R279 closest to the bottom of the image. You will also want to solder the shield of the coax to ground somewhere nearby. I used the side of inductor L112 but be careful not to apply to much heat to the components.



After you have attached the center conductor to the lower pad of R279 and the shield to ground, route your coax out of the inner box, parallel to the grey cable. You will then want to install some sort of connector on the outer case of the PCR. I used a panel mount BNC connector. Solder your coax shield to the outside of this connector and then solder a 1.5nf capacitor in series between your coax center conductor and the connector center conductor.

#### Software:

To control the front end some sort of software is required to communicate with the PCR. If you use a Microsoft OS, there are a variety of commercial packages available. Although I have not used it myself, TalkPCR gets good reviews. For linux, OSX and unix-like platforms there are several options. The 'qtPCR' program available at "<http://www.physics.purdue.edu/~teepanis/qtPCR/>" has a nice interface and works well for general use, however it does not support using the 230khz filter in any mode except for wide-FM. It is open source however so it could be modified to do so. Another open source project of interest is 'pcrd' ("<http://www.mv.net/ipusers/cdwalker/pcrd.html>"). 'pcrd' is a command line driven low level control interface for the PCR. It also supports control over a network using the telnet protocol. It allows full control over mode

selection including selecting the 230khz filter in any mode. Finally, if you'd prefer to brew your own, the PCR serial protocol is relatively simple and specifications are available at various sites including [OscarOnline.org](http://OscarOnline.org).