Using the Portable Fast Sampler

Jean-Luc Margot

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1 Software overview

`pfs_radar` main data taking program
`pfs_hist` computes histogram of data
`pfs_stats` computes statistics of data, including DC offsets
`pfs_unpack` unpacks data to four-byte floating point numbers
`pfs_fft` performs simple spectral analysis

Usage information can be obtained by specifying the program name followed by `-help` at the command prompt.

All programs require the `-m` argument which specifies the data taking mode. The sampling modes available with the EDT PCI CD-20 are listed in table 1.

mode	channels	bits	sampling rate	data rate
0	2	1	(N/A)	
1	2	2	5 - 40 MHz	2.5 - 20 MB/s
2	2	4	5 - 20 MHz	5 - 20 MB/s
3	2	8	5 - 10 MHz	10 - 20 MB/s
4	4	1	(N/A)	
5	4	2	5 - 20 MHz	5 - 20 MB/s
6	4	4	5 - 10 MHz	10 - 20 MB/s
7	4	8	(N/A)	

Table 1: Description of sampling modes

Source code and Makefile reside in /home/pfs/src/pfs. The executables are in /home/pfs/bin. Recompile with `make; make install`. The software is under RCS revision control. Please submit any changes or bug reports so that they can be incorporated in the main branch.

2 Required signals

- One second tick (1 pps), TTL level.
- Sampling clock (sinewave 5-40 MHz), +13 dBm (~3 Vpp into 50 Ohms).
- Data inputs (RCP I-Q, LCP I-Q), 1 Vpp into 50 Ohms.

The sampling clocks should be locked to the station reference (or appropriately drifted according to Doppler shift). The minimum value of the sampling clock is 5 MHz according to the specifications of the A/D converters. When sampling two channels, always use the RCP inputs, ie the rightmost BNC connectors.

3 Setting levels

The full-scale voltage range of the A/D converters is +-0.5 V. Levels outside the +-2.5 V range may destroy the A/D boards permanently. Please be careful and use appropriate attenuation. If in doubt, check levels on the oscilloscope *before* connecting to the sampler. Note that levels tend to rise significantly when switching to the load or during transmit cycles. Figure out what the worst-case situation is and set the attenuators accordingly.

4 Sampling data

The command to start the samplers is `pfs_radar`. The simplest way to run it is to go to the directory where data will be stored. Then specify a sampling mode by its numeric value and the duration in seconds:

`pfs_radar -dir . -m` mode `-secs` sec

Data taking will start after a key is pressed by the user. The actual data-taking start takes place on the second tick following the keyboard event + 2 seconds, giving enough time to allocate memory, open files, etc. Data taking can be interrupted prematurely by hitting CTRL-C.

It can be convenient to specify the UTC start time with the `-start` option, in the format `-start` yyyy,mm,dd,hh,mm,ss.

Other useful options are `-step` and `-cycles`, which allow the user to specify a number of recording cycles separated by step seconds.

The data filename is simply the timestamp of the data-taking start of each cycle in UTC, ie "datayyyymmddhhmmss".

The log file (radar.log by default) keeps a record of the sampling parameters.

The full list of options and their default values are listed below.

```
Usage: pfs_radar -m mode -dir d [-secs sec] [-step sec] [-cycles c]
                                [-start yyyy,mm,dd,hh,mm,ss]
  -m mode
         0: 2c1b (N/A)
         1: 2c2b
         2: 2c4b
         3: 2c8b
         4: 4c1b (N/A)
         5: 4c2b
         6: 4c4b
         7: 4c8b (N/A)

  -dir d      directory to use
  -secs sec   number of seconds of data to take (3600)
  -step sec   timestep between A/D cycles (0)
  -cycles c   number of repeat cycles (1)
  -start yyyy,mm,dd,hh,mm,ss  UTC start time

  -files f    total number of files to open (1)
  -rings r    number of input buffers to use (8)
  -bytes b    size of input ring buffer (1048576 bytes)
  -log l      log file name
```

5 Analyzing data

It is a good idea to display a histogram and statistics of the data with `pfs_hist` and `pfs_stats`. These programs read the first MB of data of the given filename and compute statistics. This is useful for adjusting levels and DC offsets.

Both programs print results on the standard output by default, or alternatively in a file specified with the `-o` option. The input filename is specified by the last argument on the command line.

```
Usage: pfs_hist -m mode [-o outfile] [infile]
Usage: pfs_stats -m mode [-o outfile] [infile]
```

`pfs_unpack` and `pfs_fft` have an additional option `-c (1 or 2)` to specify which channel to process. The default is 1 or RCP (rightmost BNCs), the other channel can be processed by specifying `-c 2`.

6 Other considerations

Data taking computer The PFS uses a rack-mount PC (Asus CUV4X motherboard with 800 MHz Pentium III) and runs the Debian GNU/Linux operating system.

Remote operation Once cabled properly, the PFS can be operated remotely.

Login The user name is `pfs`, the current password is `pfs0_pfs1!`

Programmable attenuators The PFS is equipped with adjustable attenuators which can be set with the program `pfs_levels`.

Network Time Protocol The control computer needs the ntp clients running to get its clock within a few milliseconds of the station clock. The actual data taking starts on the station 1 PPS signal.

Timezone Proper operation requires the data-taking computer to run on the UTC or GMT timezone.

`$Id: pfs_usage.tex,v 1.5 2000/11/18 22:14:10 margot Exp $`