Short Topic: Bolometer DAQ Updates

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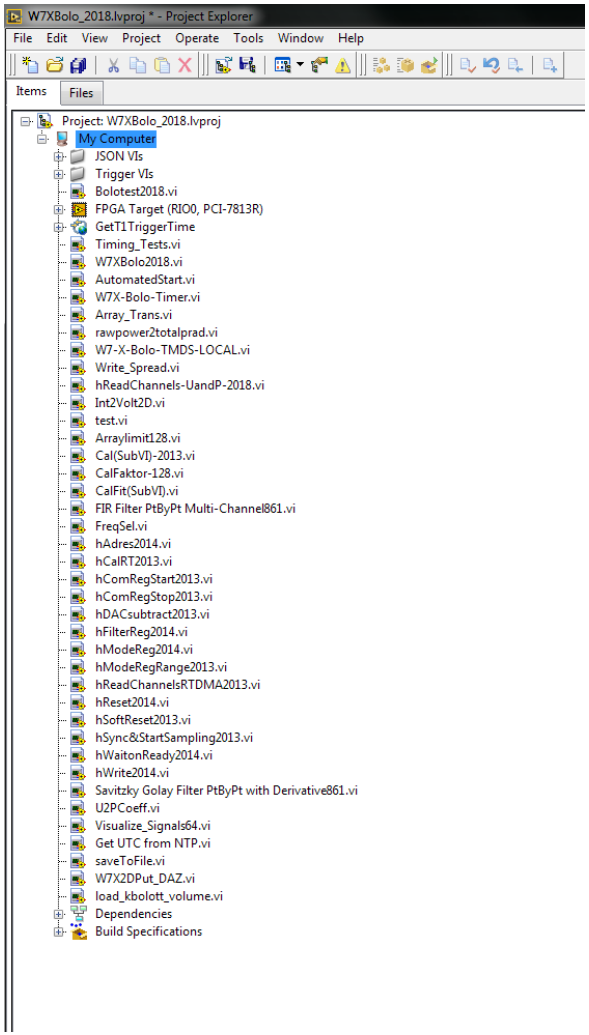
July 6, 2018

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No. 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

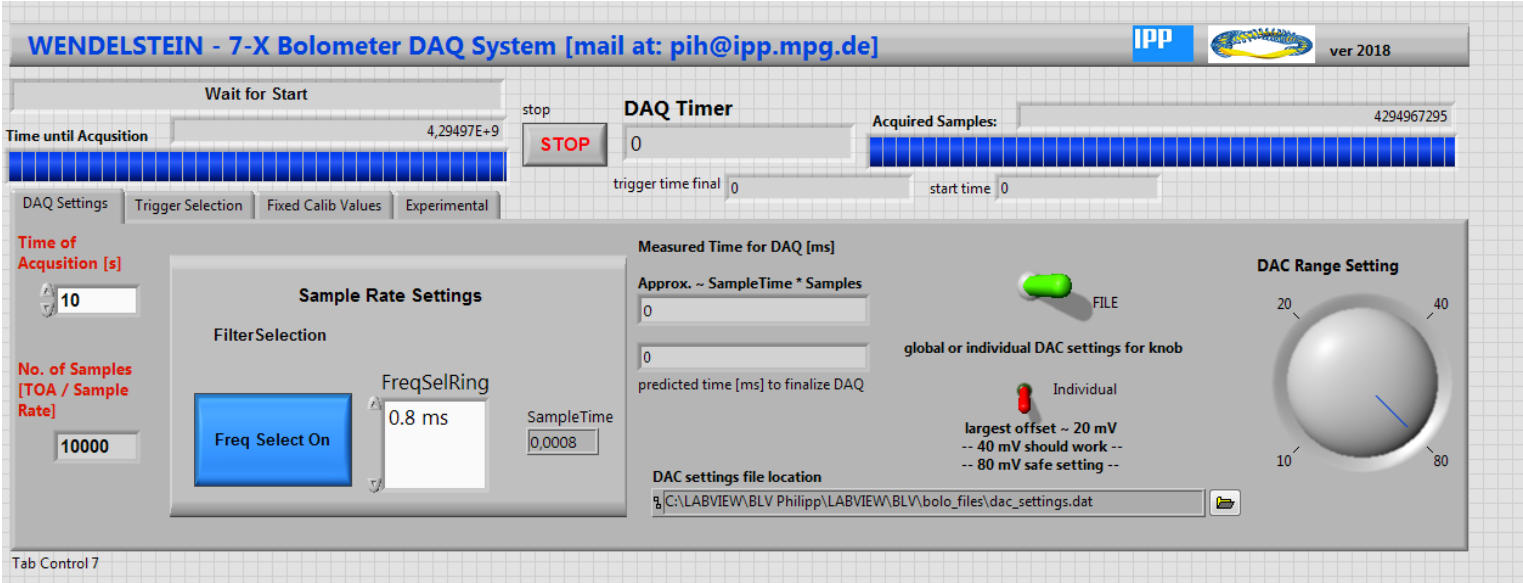
software versioning

- current and previous states of software development in git-controlled repository at `https://gitlab.mpcdf.mpg.de/pih/bolometer_labview`
- including documentation, software and hardware setup
- device manuals and supportfiles located in dedicated structures



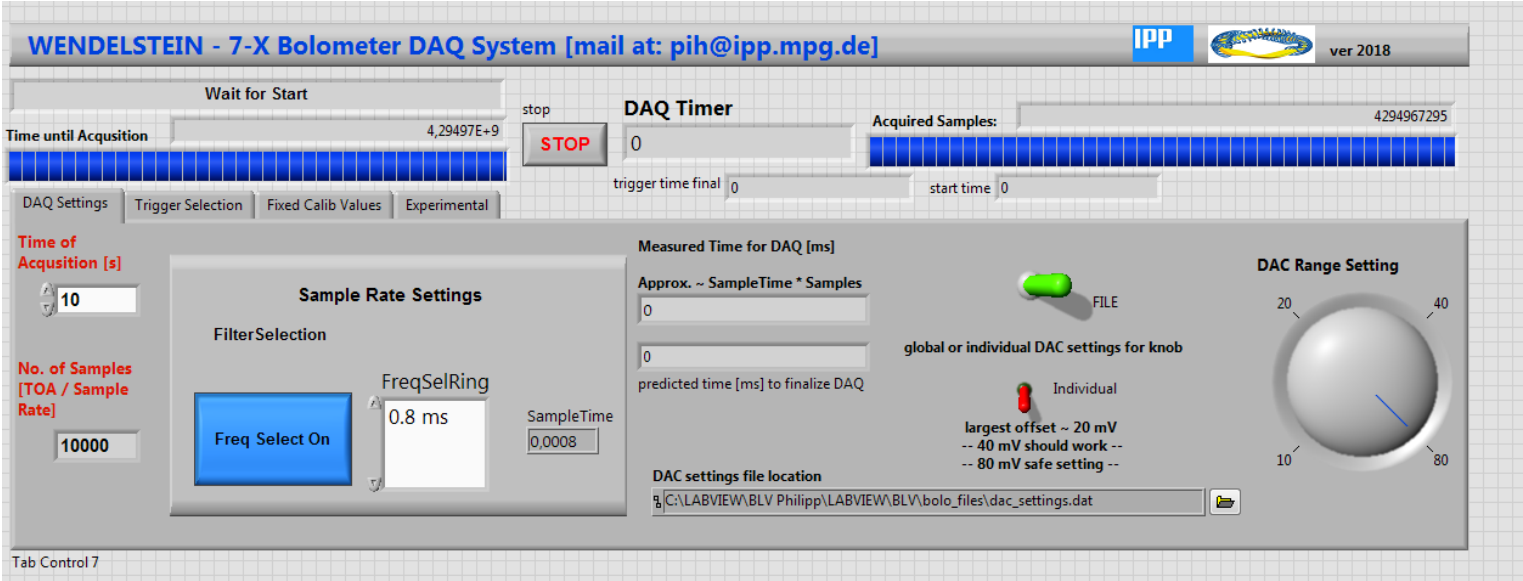
full software project with all dependencies; FPGA target with current build of executable and bit file, untouched (leave untouched!)

- important files are ‘AutomatedStart.vi’ & ‘W7XBolo2018.vi’
- latter is main VI in where calibration, acquisition and output are queued
- ’hReadChannels-UandP-2018.vi’ does measurement/estimation, ‘test.vi’ is a timing and reference test (disabled in the build)
- ‘rawpower2totalprad.vi’ calculates the final P_{rad} after acquisition



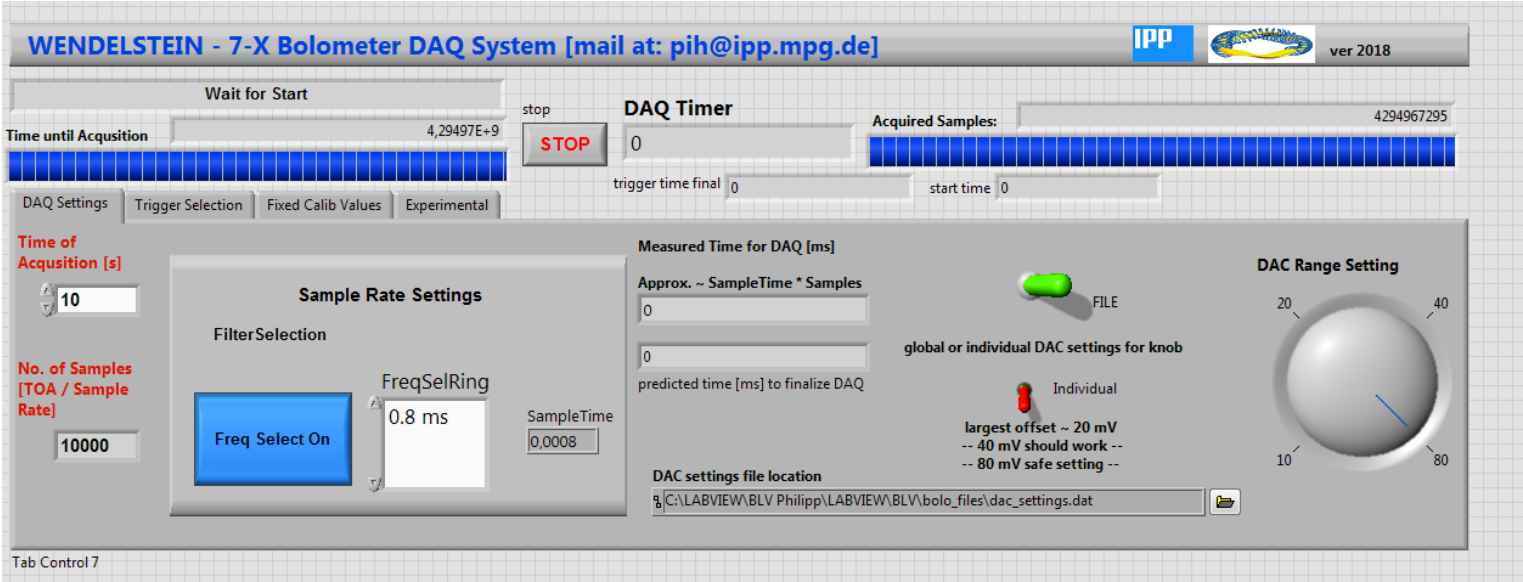
front panel: data acquisition and range settings for the voltage boundaries of the controller, e.g. turn/dial or file import of individual/global bits

- time of acq. defined in seconds (divide by sampling rate in ms yields number of samples)
- comparison of predicted DAQ duration and actual time passed acquiring samples (performance)



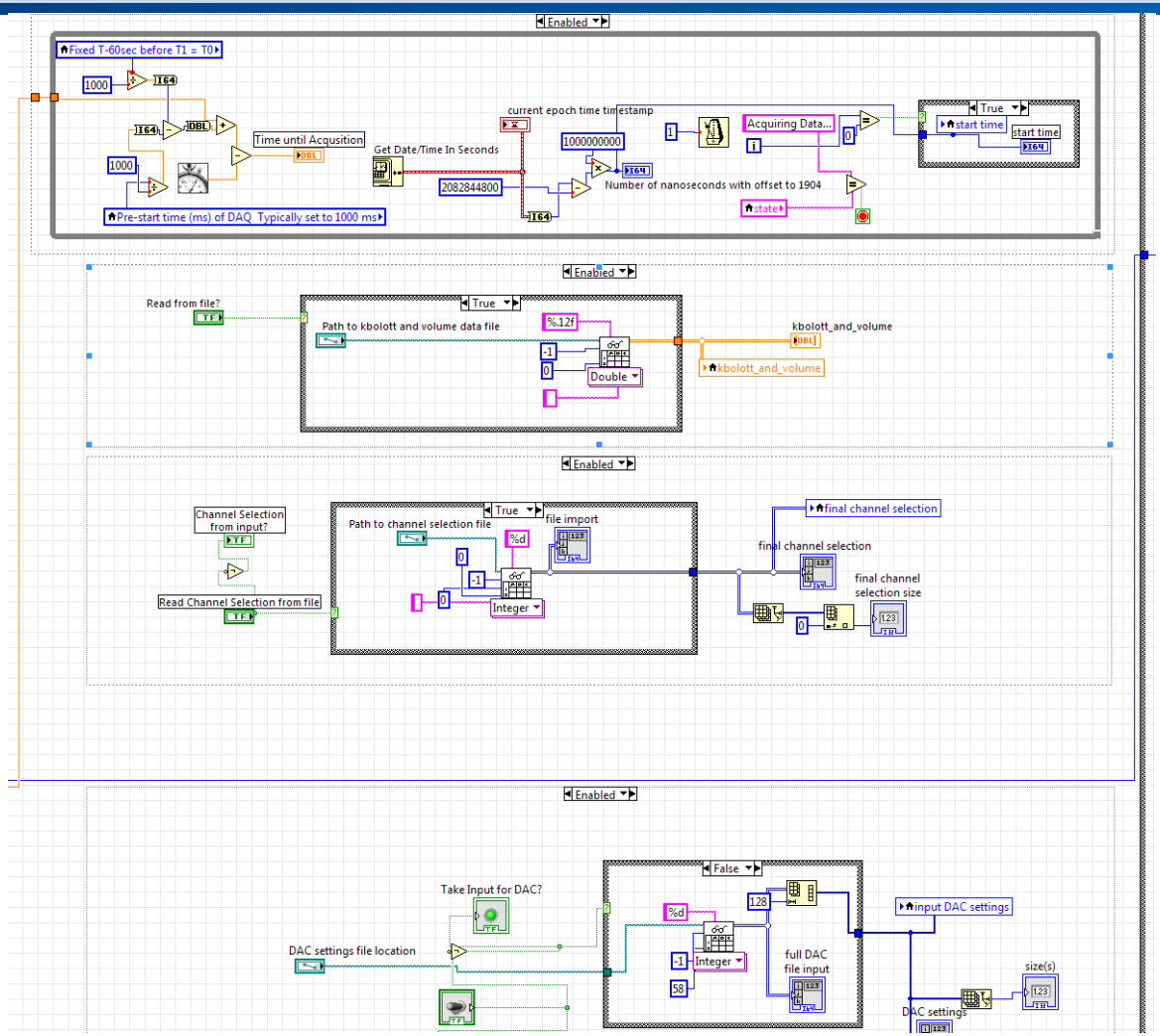
front panel: data acquisition and range settings for the voltage boundaries of the controller, e.g. turn/dial or file import of individual/global bits

- switch between global (all channels the same), individual bit settings for DAC ranges
- switch for input or file loaded settings of DAC ranges; individual input settings located in bottom ‘Test’ tab

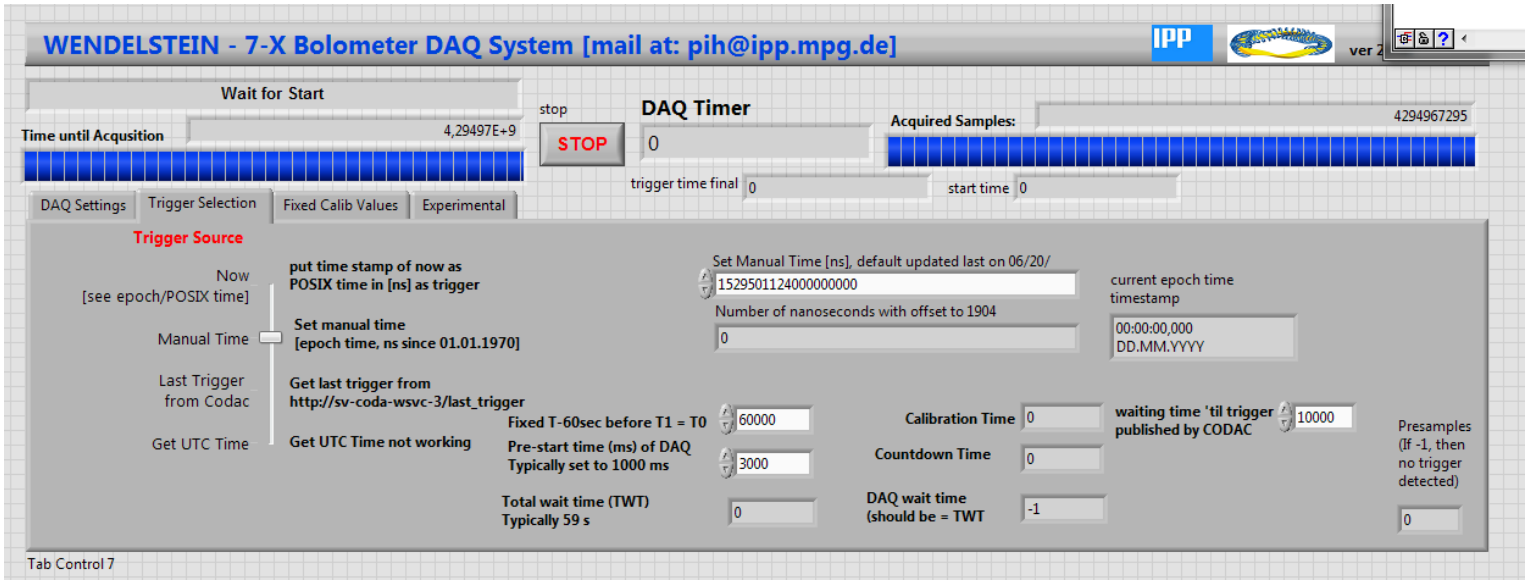


front panel: data acquisition and range settings for the voltage boundaries of the controller, e.g. turn/dial or file import of individual/global bits

- trigger and current epoch time displayed at top of VI
- countdown to start of data acquisition

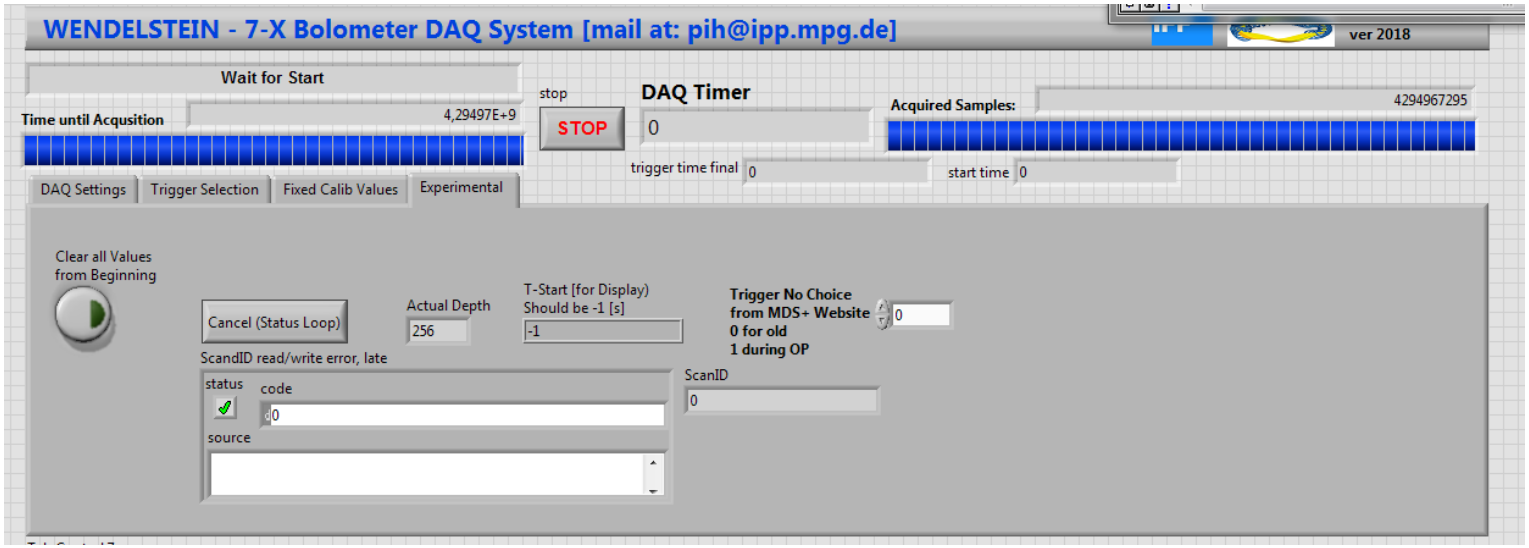


block diagram 'W7XBolo2018.vi': of previous front panel parts (top - timing, middle top - geometric factors import/input, middle bottom - channel selection, bottom - DAC range settings)

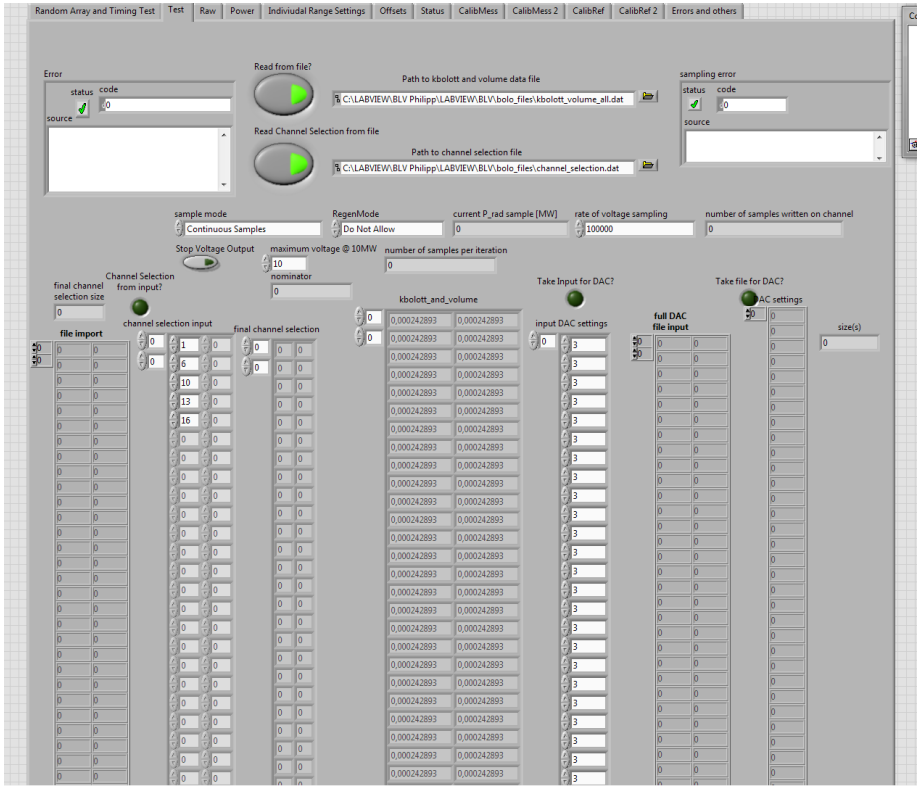


front panel: trigger source settings and timings; pre-start time before T0 (60s fixed after hardware trigger)

- time of acq. defined in seconds (divide by sampling rate in ms yields number of samples)
- comparison of predicted DAQ duration and actual time passed acquiring samples (performance)

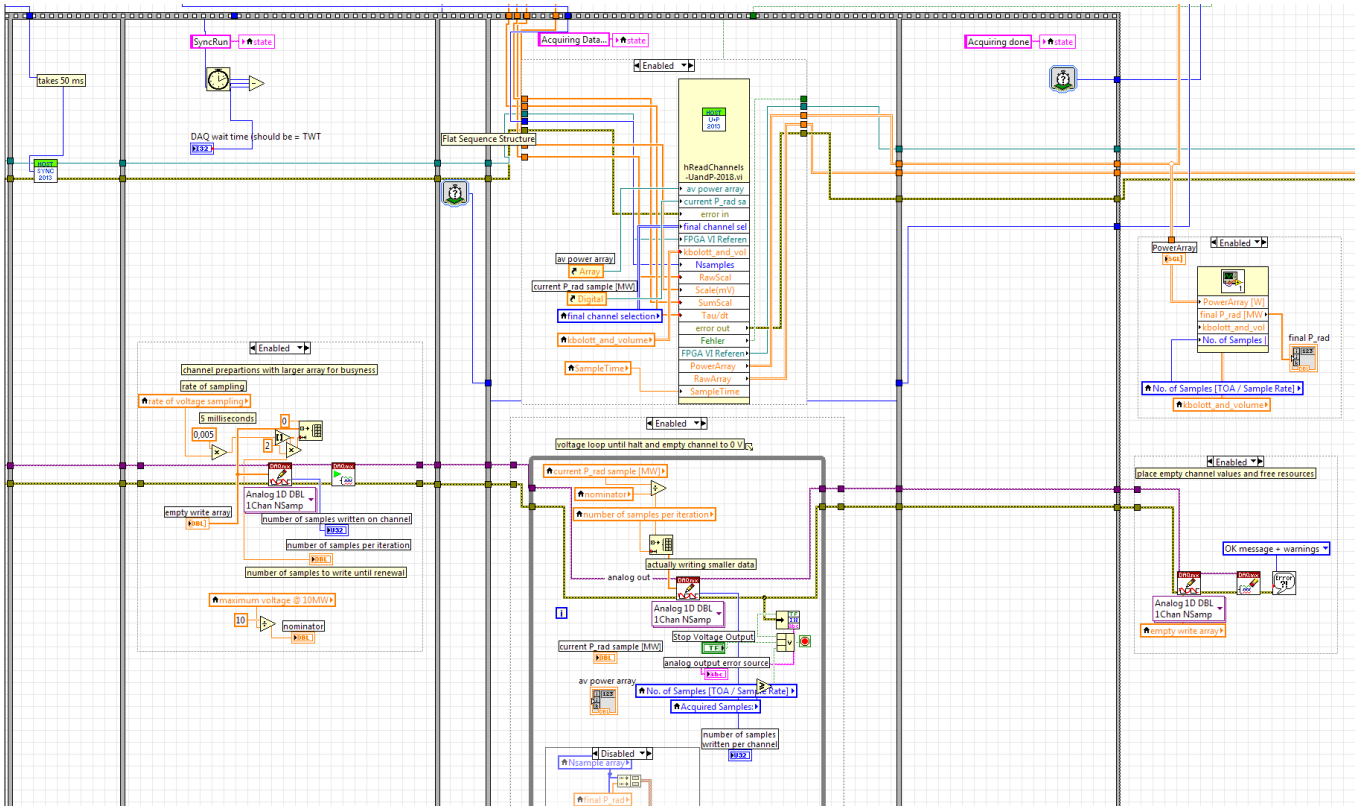


front panel: error top panel (first place to look at if something goes wrong/seems off) 'ScanID read/write error' refers to the stashed sample number on the FPGA target

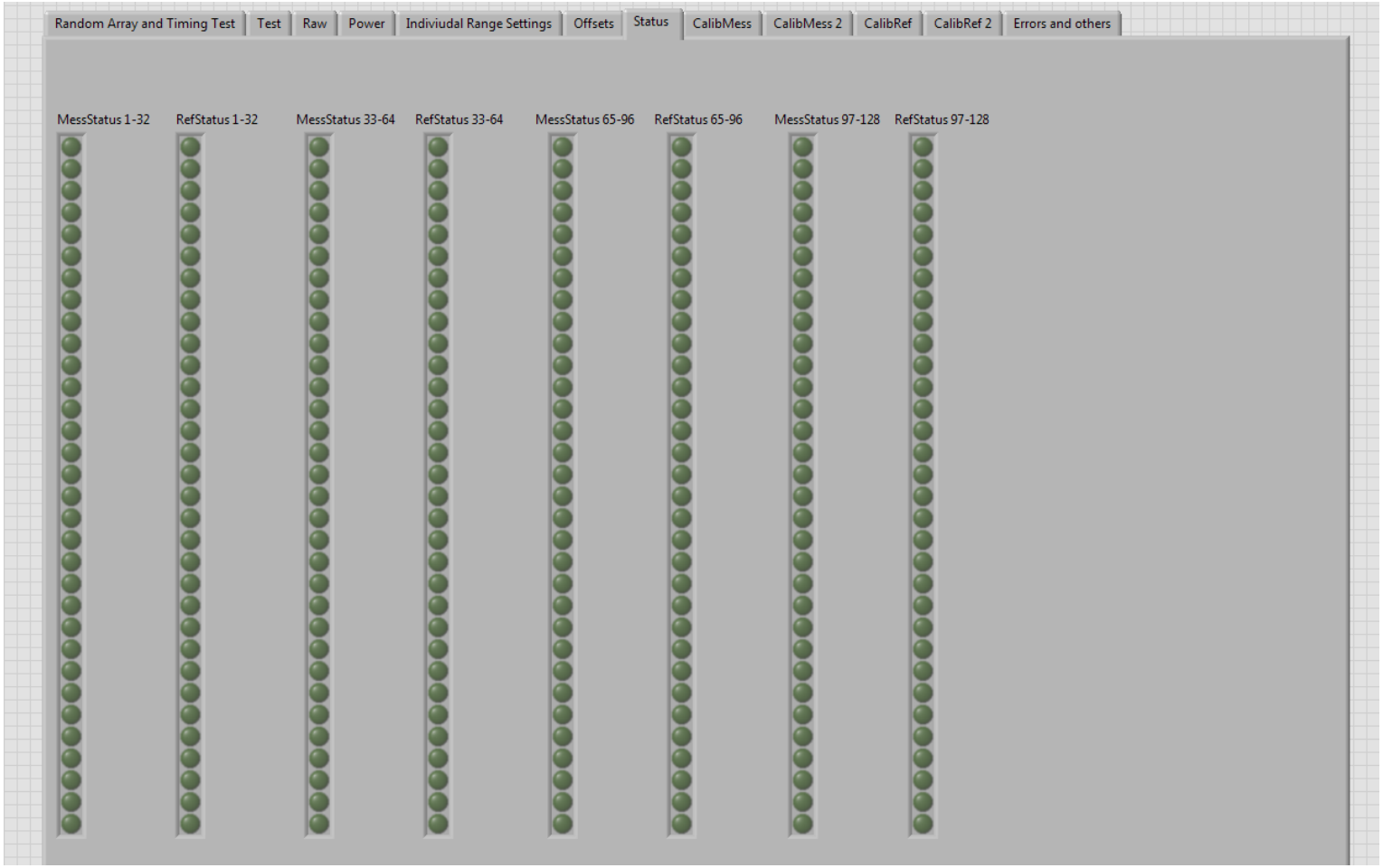


front panel: 'Test' tab; various DAC range import and and load settings; channel selection settings for P_{rad} estimation; array debugging and error codes

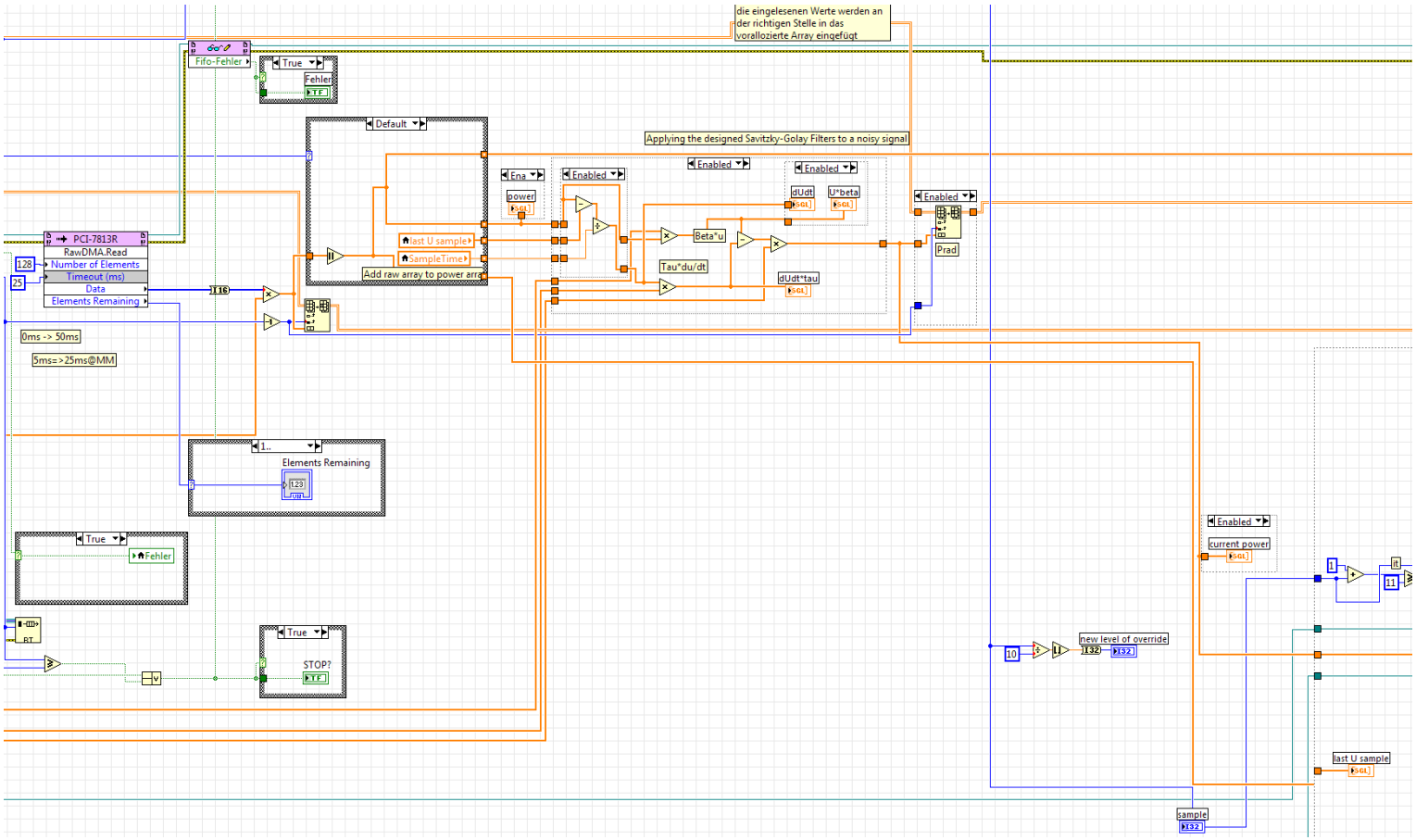
- top: switches on what to import for DAC range/channel selection
- below: sampling and frequency settings for voltage output of P_{rad} estimate, plus scaling voltage @ 10 MW
- bottom: debugging for arrays of imports/input



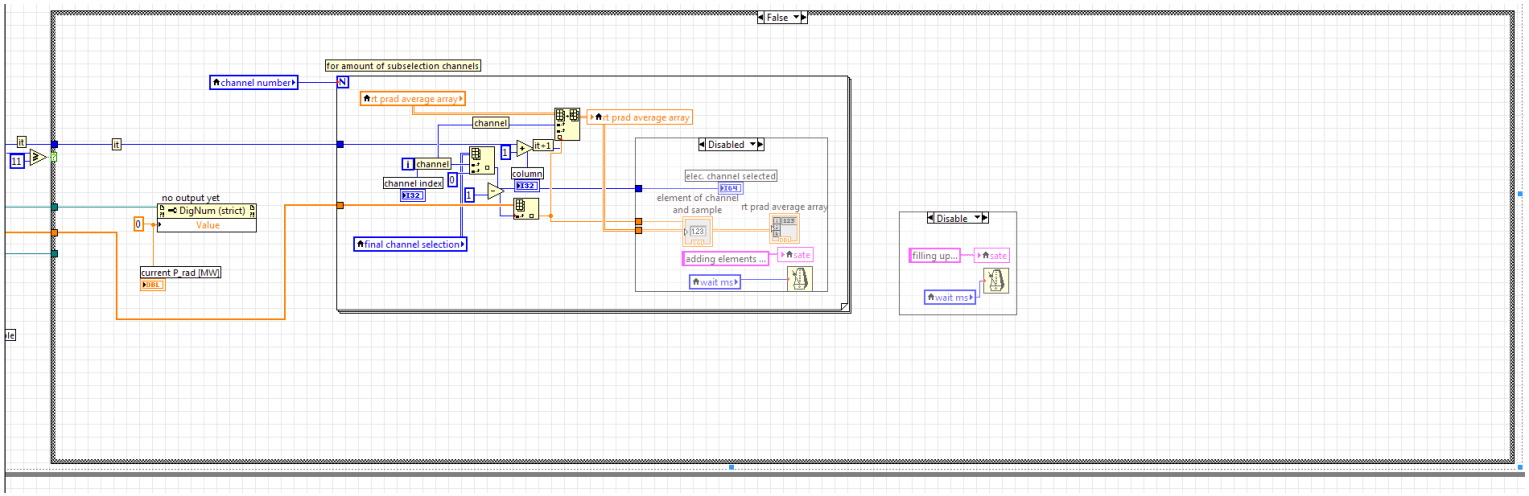
block diagram 'W7XBolo2018.vi': flat sequence of DAQ 'hReadChannels-UandP-2018.vi' with local variables inputs; bottom: channel set up for voltage and sampling on analog; right, outside: end of analog sampling and 'rawpower2totalprad.vi', where the channel power is used to calculate a 'full' P_{rad}



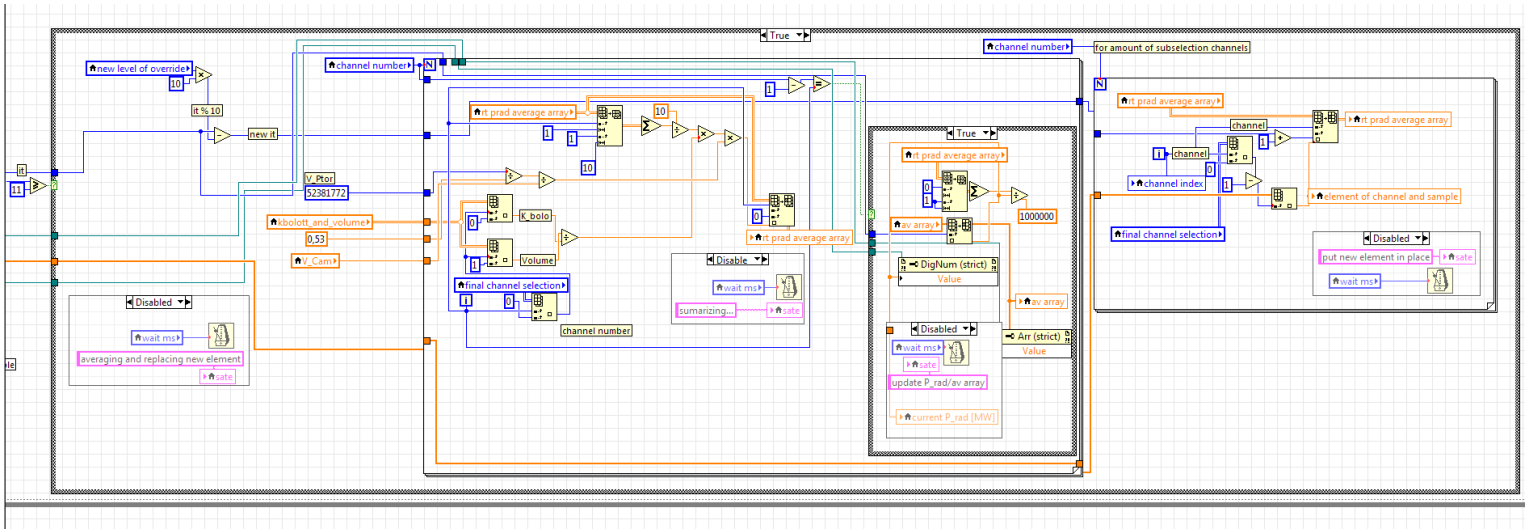
front panel: 'Status' panel tab; if calibration or reference values are off, this shows the channel status accordingly



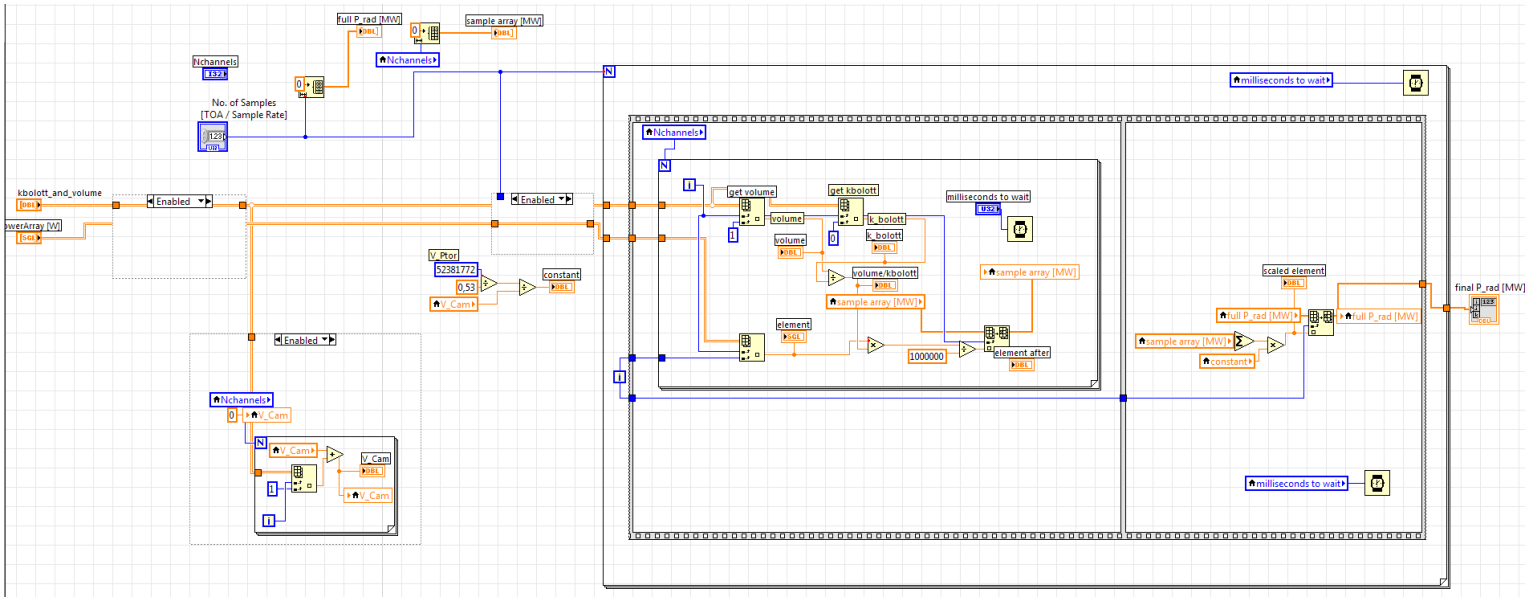
block diagram 'hReadChannels-UandP-2018.vi': conversion from raw voltage signal of channel and sample to power; bottom right: input for estimation routine and FIFO shifting



block diagram 'hReadChannels-UandP-2018.vi': first part of estimation - before 10th sample, filling up averaging FIFO array



block diagram 'hReadChannels-UandP-2018.vi': after 10th sample, averaging with geometry factors and scaling; then FIFO push the first sample out for new one (far right) and writing to the referenced properties for the top level 'W7XBolo2018.vi'



block diagram 'rawpower2totalprad.vi': processing routine calculating the 'full' P_{rad} after acquisition has finished, hence for all channels and samples the same calculation as in the previous subVI

Pros:

- performance good for channel selection of up to $\sim$10
- acquisition times for one sample actually improved due to some touch ups compared to old version
- technicality of imports, inputs and loading has been proven to not fail in previous (trigger-) tests
- stash of local files to load configuration, reproducibility
- calculation of estimate P_{rad} seems fine, tests to be made with comparison signal (manual/virtual)

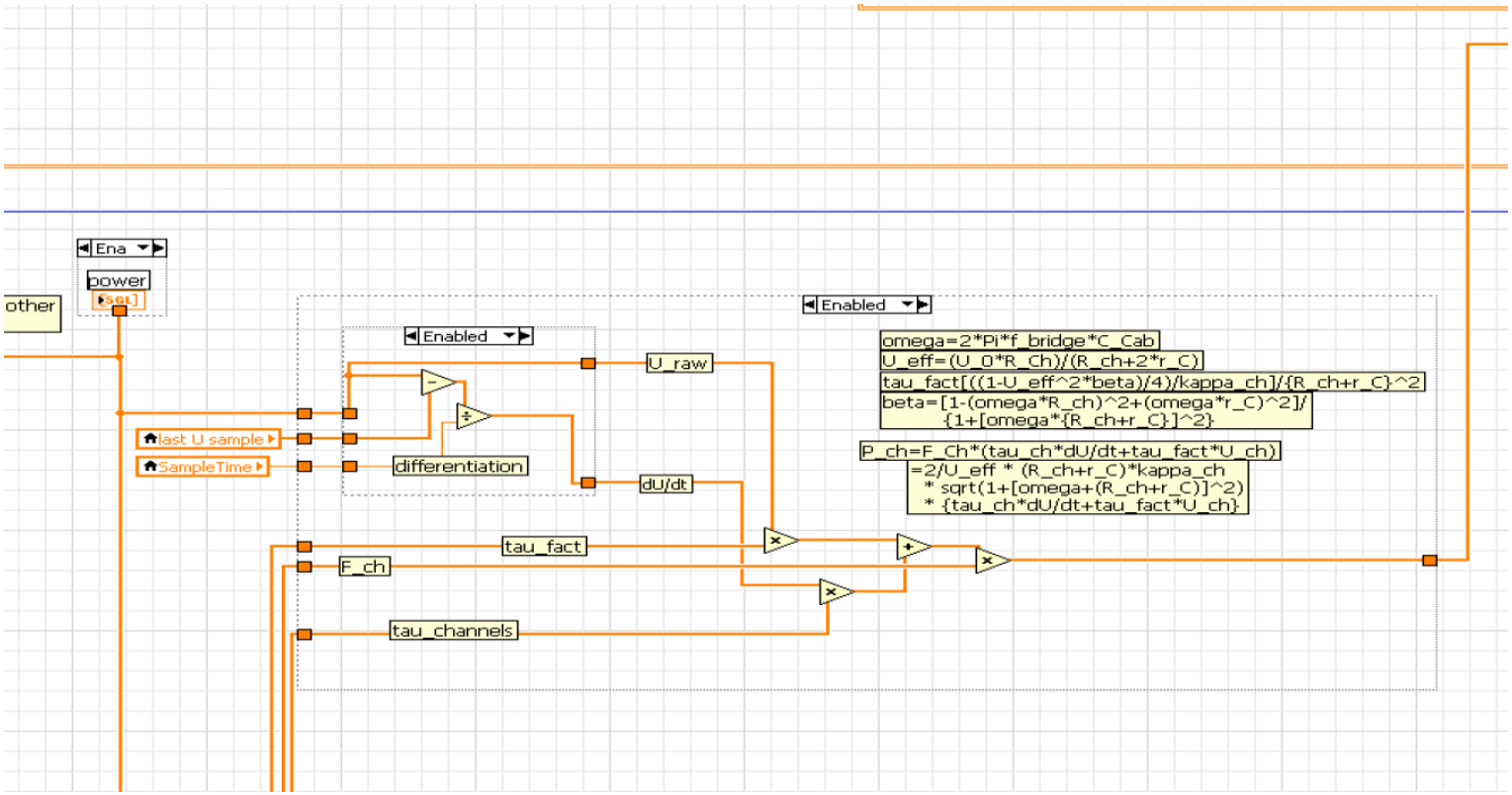
Cons:

- critical bug/feature in LabView's abort/stop function that does not clear FPGA targets local memory, hence e.g. samples acquired is stuck on a specific value
- hence, no proper measurement is possible directly after a failed software deployment/execution
- calculation inside 'rawpower2totalprad.vi' seem to be off by some orders of magnitude 10^x to no apparent reason (exactly the same calculation process as in 'hReadChannels-UandP-2018.vi')
- ?! to be proven: upload to archive broken ?!

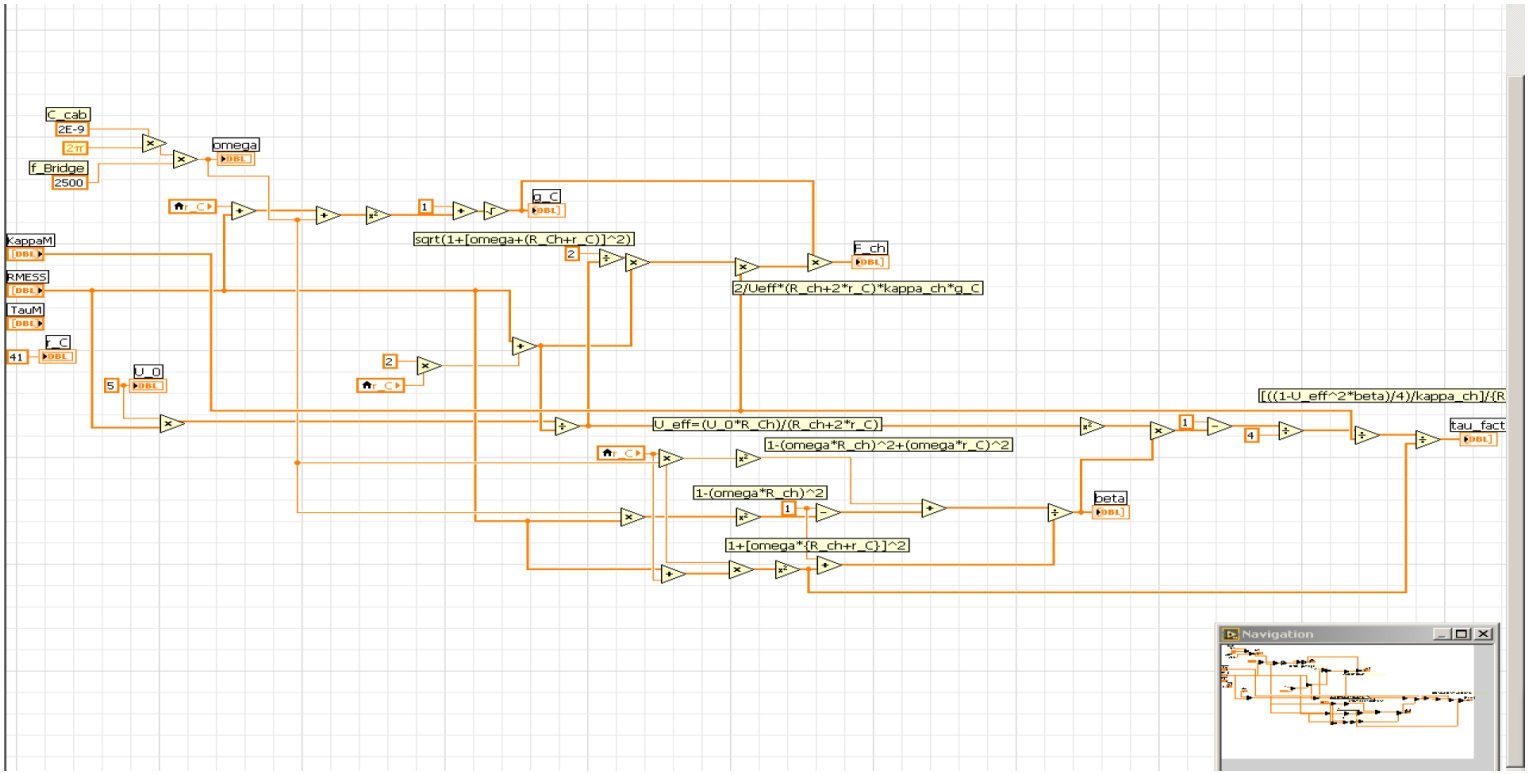
TODO:

- fix upload cycle and add the current configurations to it in the form of a JSON, add estimation time line to archive
- proof of calculations and estimation
- find possible fix for memory cache, local flashing routine of FPGA target in the start up phase of VI maybe
- fix full P_{rad} routine

Appendix


Ena
power
other
Enabled
Enabled
U_raw
dU/dt
differentiation
last U sample
SampleTime
tau_fact
F_ch
tau_channels
omega=2*Pi*f_bridge*C_Cab
U_eff=(U_0*R_Ch)/(R_ch+2*r_C)
tau_fact[((1-U_eff^2*beta)/4)/kappa_ch]/{R_ch+r_C}^2
beta=[1-(omega*R_ch)^2+(omega*r_C)^2]/
{1+[omega*{R_ch+r_C}]^2}
P_ch=F_Ch*(tau_ch*dU/dt+tau_fact*U_ch)
=2/U_eff * (R_ch+r_C)*kappa_ch
* sqrt(1+[omega+(R_ch+r_C)]^2)
* {tau_ch*dU/dt+tau_fact*U_ch}

Appendix


C_cab
2E-9
2π
omega
f_Bridge
2500
r_C
g_C
sqrt(1+[omega+(R_Ch+r_C)]^2)
F_ch
2/Ueff*(R_ch+2*r_C)*kappa_ch*g_C
KappaM
RMESS
TauM
r_C
41
U_0
5
2
r_C
U_eff=(U_0*R_Ch)/(R_ch+2*r_C)
1-(omega*R_ch)^2+(omega*r_C)^2
1-(omega*R_ch)^2
1+[omega*(R_ch+r_C)]^2
beta
[((1-U_eff^2*beta)/4)/kappa_ch]/(R
tau_fact
Navigation