Sequencer for HAICU

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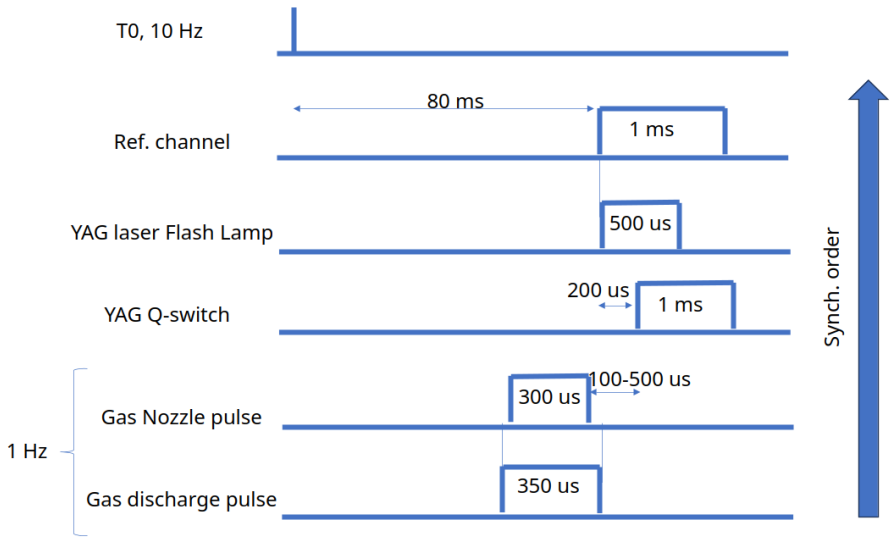
Requirements

Source sequence



Other sequence signals

- MLD 1-4 (separate?)
- EM bender
- "slow" trap magnets (quad, top gate, booster)
- Bottom gate
- DAQ trigger(s?)

Requirements

- Synchronize to laser trigger pulse (10Hz-50Hz)
- Produce sequence of pulses over hundreds of ms or more
- ~10 channels
- Accuracy/synchronization of order microseconds
- Gate inputs to prevent triggering partial system

PPG capabilities

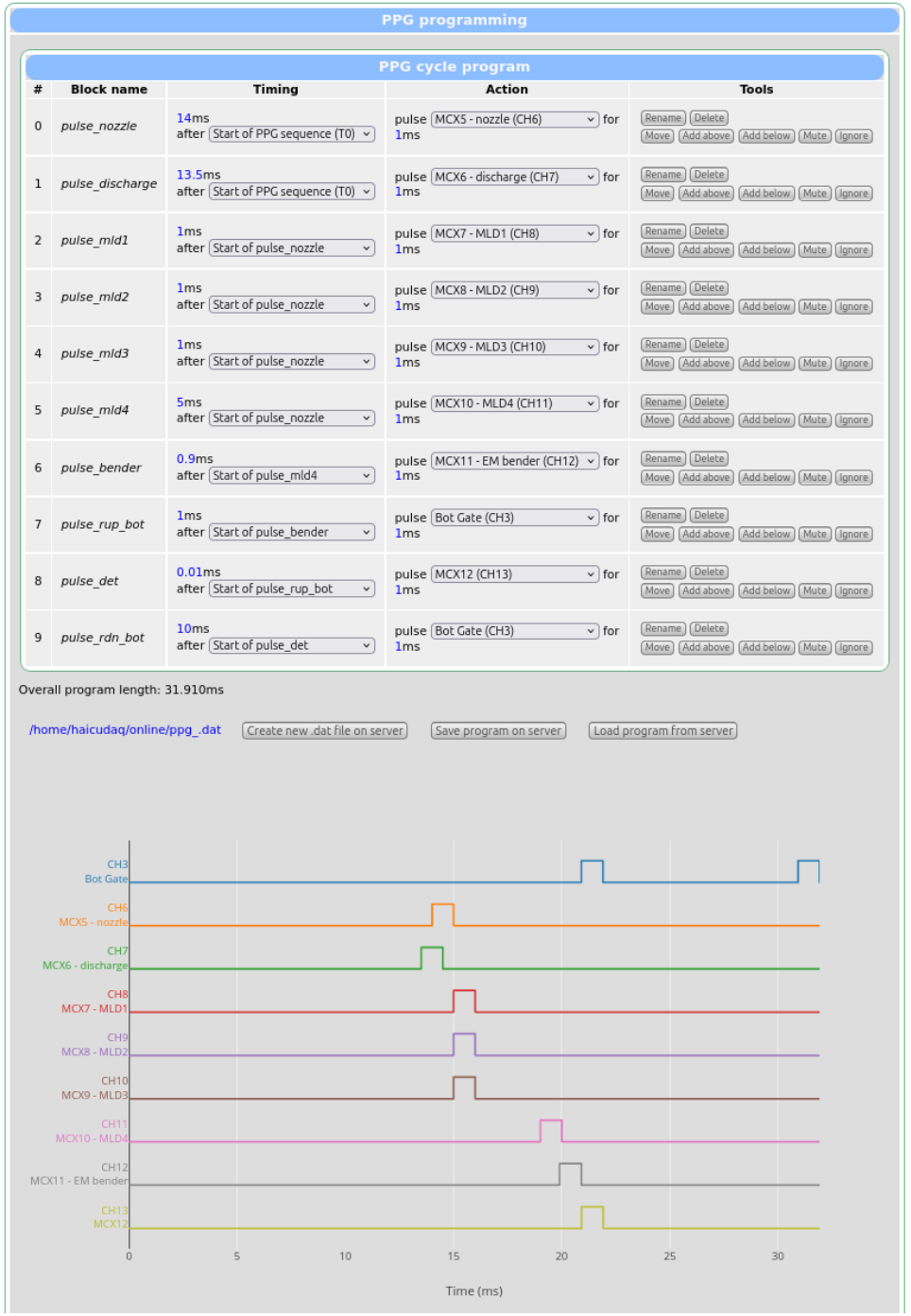
- FPGA based **P**rogrammable **P**ulse **G**enerator
- 100MHz clock, i.e. 10ns resolution
- Up to 32 independent outputs
- Up to 16 gate inputs and 16 veto inputs
- External trigger input
- Inputs and outputs can be freely mapped to ribbon connectors on back panel or coax connectors on front panel
- Coax in-/outputs can be switched between 3.3V and 5V

Design modified from https://daq00.triumf.ca/DaqWiki/index.php/VME-PPG32

User interface

- Sequences saved and loaded as hard-to read text file
- But convenient compiler with web-interface exists

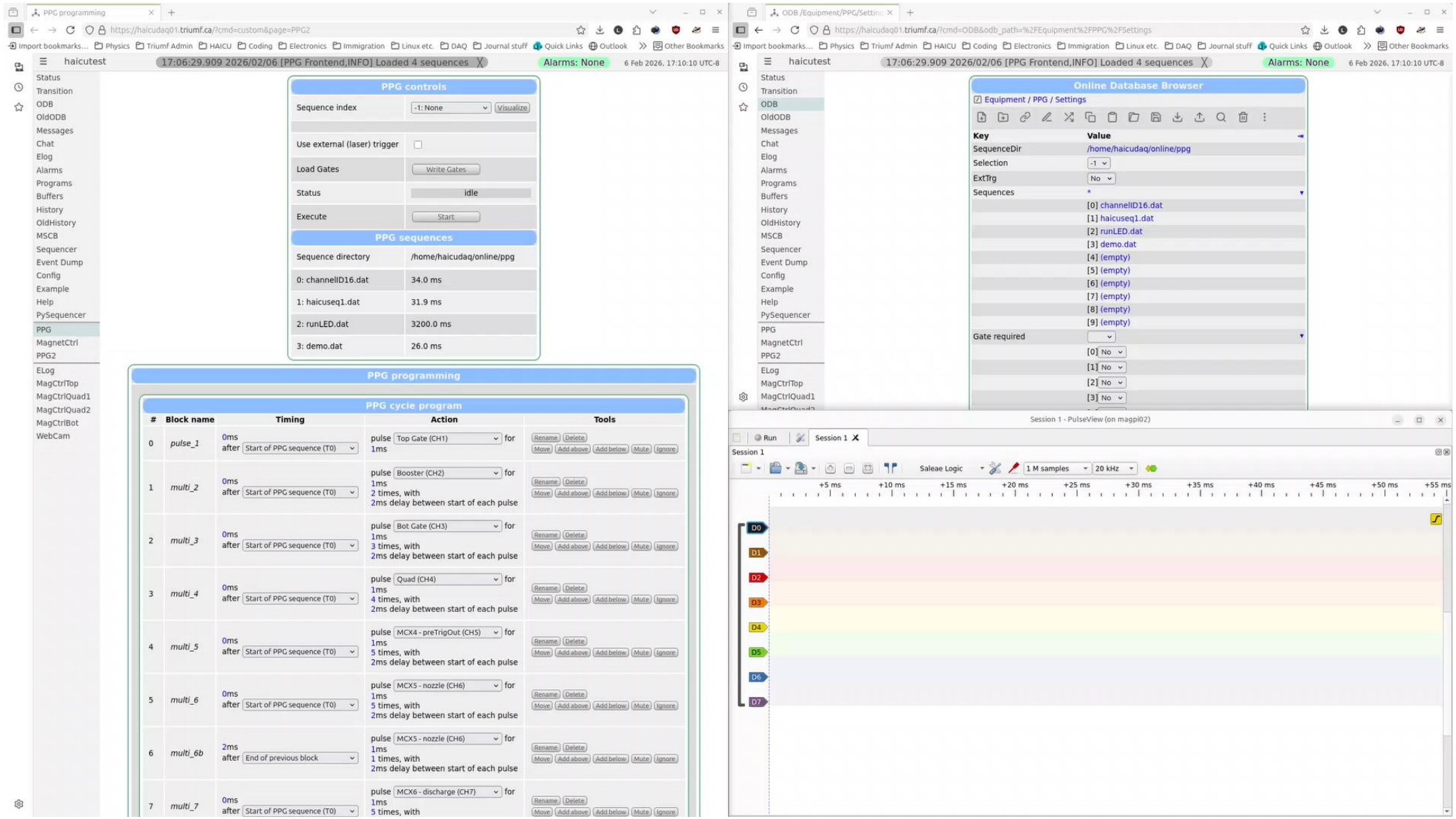
```
#Created by python PPG compiler
#Ins 0=halt 1=cont 2=loop 3=endloop
#Note: PC is decimal; bitpats,delay,ins/data are hex
#PC set bitpat clr bitpat      delay  ins/data
Num Instruction Lines = 016           # IDDDDD   set bitpattern: bits 31 to 0      loopname
000 0x00000000 0xffffffff  0x00000000 0x100000 # 00000000000000000000000000000000;
001 0x00000010 0xffffffef  0x000f423d 0x100000 # 00000000000000000000000000010000;
002 0x00000011 0xffffffee  0x0001869d 0x100000 # 00000000000000000000000000010001;
003 0x00000010 0xffffffef  0x00061a7d 0x100000 # 00000000000000000000000000010000;
004 0x00000012 0xffffffed  0x0001869d 0x100000 # 00000000000000000000000000010010;
005 0x00000010 0xffffffef  0x0033e13d 0x100000 # 00000000000000000000000000010000;
006 0x00000000 0xffffffff  0x00632e9d 0x100000 # 00000000000000000000000000000000;
007 0x00000004 0xfffffffb  0x0001869d 0x100000 # 00000000000000000000000000000100;
008 0x00000000 0xffffffff  0x017bf19d 0x100000 # 00000000000000000000000000000000;
009 0x00000004 0xfffffffb  0x0001869d 0x100000 # 00000000000000000000000000000100;
010 0x00000000 0xffffffff  0x001cfddd 0x100000 # 00000000000000000000000000000000;
011 0x00000002 0xfffffffd  0x0001869d 0x100000 # 00000000000000000000000000000010;
012 0x00000000 0xffffffff  0x001cfddd 0x100000 # 00000000000000000000000000000000;
013 0x00000001 0xfffffffe  0x0001869d 0x100000 # 00000000000000000000000000000001;
014 0x00000000 0xffffffff  0x00000000 0x100000 # 00000000000000000000000000000000;
015 0x00000000 0xffffffff  0x00000000 0x000000 # 00000000000000000000000000000000;
```



Demonstration

- https://haicudaq01.triumf.ca/?cmd=custom&page=PPG


PPG programming
PPG cycle program
Block name Timing Action Tools
0 pulse_1 0ms after Start of PPG sequence (T0) pulse Top Gate (CH1) for 2ms Rename Delete Move Add above Add below Mute Ignore
1 pulse_2 5ms after End of previous block pulse Booster (CH2) for 2ms Rename Delete Move Add above Add below Mute Ignore
2 pulse_3 7ms after Start of PPG sequence (T0) pulse MCX5 - nozzle (CH6) for 1ms Rename Delete Move Add above Add below Mute Ignore
Overall program length: 9.000ms
/home/haicudaq/online/ppg/channelID16.dat
Create new .dat file on server
Save program on server
Load program from server
CH1 Top Gate
CH2 Booster
CH6 MCX5 - nozzle
0 1 2 3 4 5 6 7 8 9
Time (ms)
Channel names
CH1 Top Gate CH2 Booster CH3 Bot Gate CH4 Quad
CH5 MCX4 - preTrigOut CH6 MCX5 - nozzle CH7 MCX6 - discharge CH8 MCX7 - MLD1
CH9 MCX8 - MLD2 CH10 MCX9 - MLD3 CH11 MCX10 - MLD4 CH12 MCX11 - EM bender


PPG programming
https://haicudaq01.triumf.ca/?cmd=custom&page=PPG2
haicutest
17:06:29.909 2026/02/06 [PPG Frontend,INFO] Loaded 4 sequences
Alarms: None
6 Feb 2026, 17:10:10 UTC-8
Status
Transition
ODB
OldODB
Messages
Chat
Elog
Alarms
Programs
Buffers
History
OldHistory
MSCB
Sequencer
Event Dump
Config
Example
Help
PySequencer
PPG
MagnetCtrl
PPG2
ELog
MagCtrlTop
MagCtrlQuad1
MagCtrlQuad2
MagCtrlBot
WebCam
PPG controls
Sequence index
-1: None
Visualize
Use external (laser) trigger
Load Gates
Write Gates
Status
idle
Execute
Start
PPG sequences
Sequence directory
/home/haicudaq/online/ppg
0: channelID16.dat
34.0 ms
1: haicuseq1.dat
31.9 ms
2: runLED.dat
3200.0 ms
3: demo.dat
26.0 ms
PPG programming
PPG cycle program
Block name Timing Action Tools
0 pulse_1 0ms after Start of PPG sequence (T0) pulse Top Gate (CH1) for 1ms
1 multi_2 0ms after Start of PPG sequence (T0) pulse Booster (CH2) for 1ms 2 times, with 2ms delay between start of each pulse
2 multi_3 0ms after Start of PPG sequence (T0) pulse Bot Gate (CH3) for 1ms 3 times, with 2ms delay between start of each pulse
3 multi_4 0ms after Start of PPG sequence (T0) pulse Quad (CH4) for 1ms 4 times, with 2ms delay between start of each pulse
4 multi_5 0ms after Start of PPG sequence (T0) pulse MCX4 - preTrigOut (CH5) for 1ms 5 times, with 2ms delay between start of each pulse
5 multi_6 0ms after Start of PPG sequence (T0) pulse MCX5 - nozzle (CH6) for 1ms 5 times, with 2ms delay between start of each pulse
6 multi_6b 2ms after End of previous block pulse MCX5 - nozzle (CH6) for 1ms 1 times, with 2ms delay between start of each pulse
7 multi_7 0ms after Start of PPG sequence (T0) pulse MCX6 - discharge (CH7) for 1ms 5 times, with
Rename Delete Move Add above Add below Mute Ignore
ODB /Equipment/PPG/Settings
https://haicudaq01.triumf.ca/?cmd=ODB&odb_path=%2FEquipment%2FPPG%2FSettings
Online Database Browser
Equipment / PPG / Settings
Key Value
SequenceDir /home/haicudaq/online/ppg
Selection -1
ExtTrg No
Sequences *
[0] channelID16.dat
[1] haicuseq1.dat
[2] runLED.dat
[3] demo.dat
[4] (empty)
[5] (empty)
[6] (empty)
[7] (empty)
[8] (empty)
[9] (empty)
Gate required
[0] No
[1] No
[2] No
[3] No
Session 1 - PulseView (on magpi02)
Run
Session 1
Saleae Logic
1 M samples
20 kHz
+5 ms +10 ms +15 ms +20 ms +25 ms +30 ms +35 ms +40 ms +45 ms +50 ms +55 ms
D0
D1
D2
D3
D4
D5
D6
D7

Future/Feedback

- Questions?
- Additional requirements?
- Problems or concerns?