

Implementation of DIAMANT DSP

Numexo2 Workshop

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Overview

Shaping
DIAMANT
Signals

Data Frame

V6 Firmware
Versions

Acquisition
Software

Misc

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- A pole-zero compensated trapezoidal shaper's top.
- Our notation:
 - L –moving averaging window size. Equivalent of K in GANIL's notation.
 - G –delay in samples of differentiator for averages, as Gap. Equivalent to M in GANIL's notation.
- DIAMANT PACs have a longer decay time than Exogam2, $\alpha \approx 0.999920003$.
(for 125 μ s - the very exact value still needs to be measured or discovered by archeologists.)
- For testing purposes we use 512 (@100MHz) as both L and G. ($\sim 10\mu$ s peaking time is what we have)

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- Trapezoidal filter with L and G smaller than energy's (64 for testing purposes, a virtual peaking time would be $1.25\mu\text{s}$).
- Shorter trapeze top / longer trapeze top is a trait of particle type.
- This division will be offloaded:
 - The longer value is already present - it's the energy.
 - The shorter value can be calculated the same way as energy.
 - Division can be performed in-place, in acquisition chain.



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In the past analog electronics used a tripolar, digital electronics used a leading edge trigger.

- The constant fraction discriminator module is ready and suitable.
- A better resolution than 10ns is not needed.
- DIAMANT need not be a part of the GTS decisions - at least for the near future, GTS Leaf in V5 may not be bothered.



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- "Globals" (may still be implemented as per channel if possible):
 - L (K)
 - G (M)
 - ALPHA
- Per channel:
 - Trigger parameters (CFD: delay, threshold)
 - N
 - Q
 - Gain



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- All header fields are kept. (MFM)
- Agreed on with GANIL to be uniform with VAMOS by size.
- Statuses shrunk.
- Short top incorporated.

Meta Type	Frame Size [23..16]
Frame Size [15..0]	
SubSystem	Frame Type [15..8]
Frame Type [7..0]	Revision
Event Number [31..16]	
Event Number [15..0]	
Timestamp [47..32]	
Timestamp [31..16]	
Timestamp [15..0]	
Crystal ID	
Status 1	Status 2
Energy [31..16]	
Energy [15..0]	
Short Top [31..16]	
Short Top [15..0]	
Check Sum [15..0]	

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2 channels
16 channels
version

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- Based on Exploitation 5.72.
- In June a 2 channel version of DIAMANT DSP was created and tested.
- Due to quite large and periodic noise, we failed to produce a good trigger with CFD.
- A fast solution was developed during beam-time, a leading edge detector on the moving average of the shorter trapeze.
- The 16 bits cut out from the DSP result didn't incorporate the most significant bits for most values \Rightarrow analysis results were not good.



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Overview

Shaping
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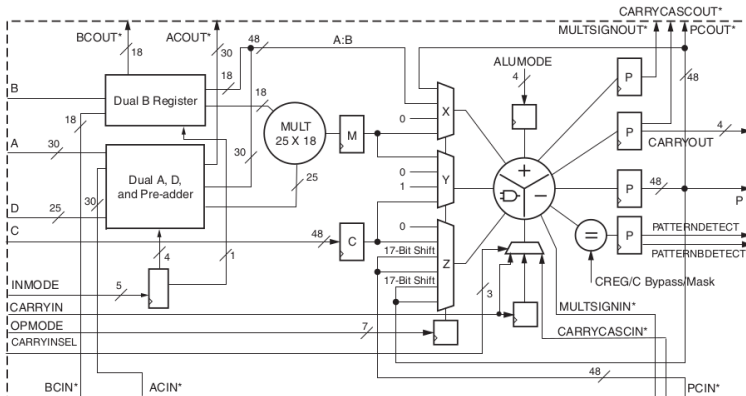
Data Frame

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16 channels
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- Based on version BASE 1.00 16ch (VAMOS 8.8).
- Generic by channel.
- Parametrized pretrigger filter (reusing N).
- Fails to route above 13 channels:

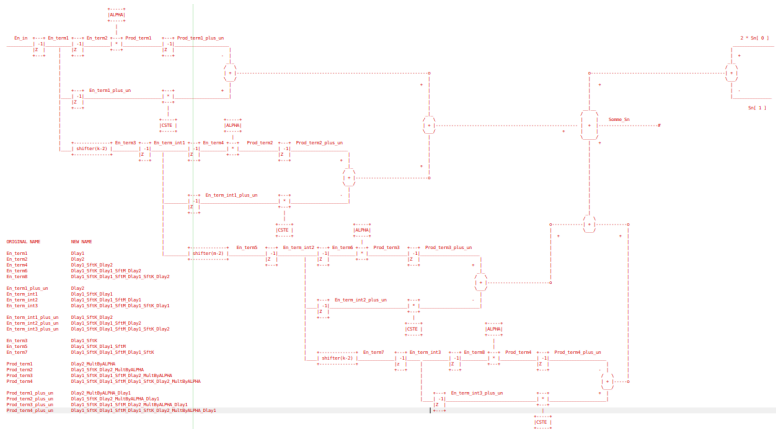
CHs	Occupied Slices	DSP48E1s	Not met
8	9,690 (48%)	141(29%)	0
12	12,754(63%)	177(36%)	0
13	13,424(67%)	186(38%)	0
14	14,195(70%)	195(40%)	1 (+41 ns)



*These signals are dedicated routing paths internal to the DSP48E1 column. They are not accessible via fabric routing resources.



$$F_{TPZ}(z) = \frac{(1 - \alpha \cdot z^{-1}) * (z^{-1} - z^{-(L+1)} - z^{-(L+1)} - z^{-(L+G+1)} - z^{-(2 \cdot L + G + 1)})}{1 - 2 \cdot z^{-1} - z^{-2}}$$



Not that well optimized version of trapezoidal shaper

Overview

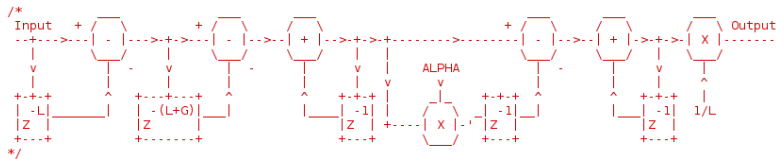
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$$F_{TPZ}(z) = (1 - z^{-L}) * (1 - z^{-(L+G)}) * \left(\frac{1 - \alpha \cdot z^{-1}}{1 - z^{-1}}\right) * \frac{z^{-1}}{1 - z^{-1}} * \frac{1}{L}$$



- Can be reordered to be able to use more than one function of DSP48E1.
- Have to be careful with vector lengths.

- Defining new configuration parameter sets (GECO_CORE.jar/BIBLI_REF/numexo2.xml)
- Adding the same in V6.
- Creating division offloading narval actor code.

If I have so much time and no questions

- DSP C++ (and corresponding VHDL) Library plans and progress.
- Documentation for exploitation 5.72 V6 firmware (outdated).
- Guide to build V6 Exogam2 Exploitation version 5.72.
- Guide to install an FPGA developer Virtual Machine for Numexo2.
- Installer script for GANIL software (outdated).

