8CBC2flex hybrid: interference coupling through CF stiffener

for full story of measurements on AEMTEC hybrid see talk last time:

http://www.hep.ph.ic.ac.uk/~dmray/systems_talks/2016/8cbc2flex_effects.pdf

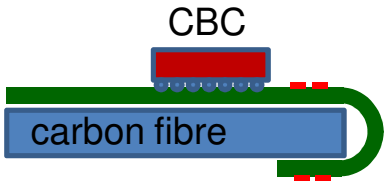
will recap briefly here

after meeting made new measurements on Valtronic hybrid

will present today for those who haven't already seen

Systems meeting, 7th June, 2016

the effects

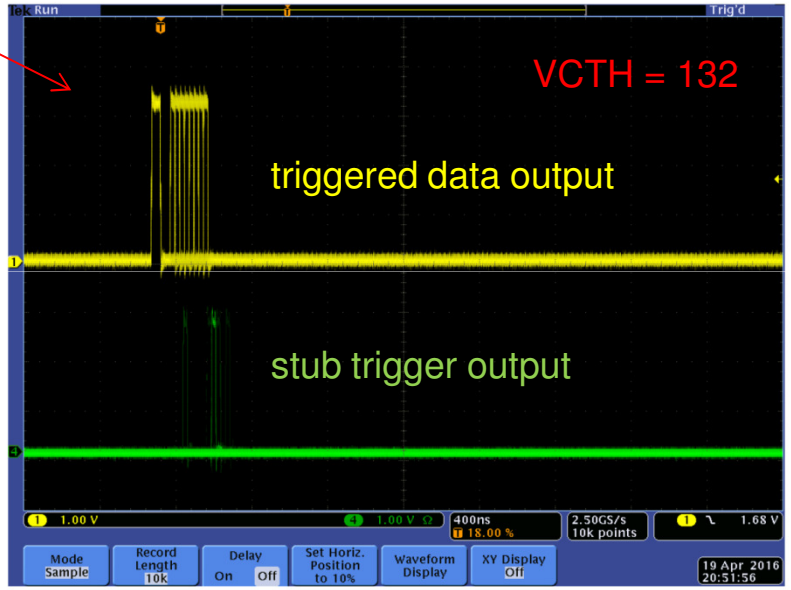


s-curve distortions appear when channels are unmasked from the correlation logic

worst affected channels are those that are tracked round the edge of the hybrid

with channels unmasked observe activity on the trigger line at around the same time as the digital header in the triggered data

triggering the chip at the digital header time (to see what has caused the trigger line to fire) shows big activity on every 4th channel, corresponding to the channels that are tracked furthest on the hybrid



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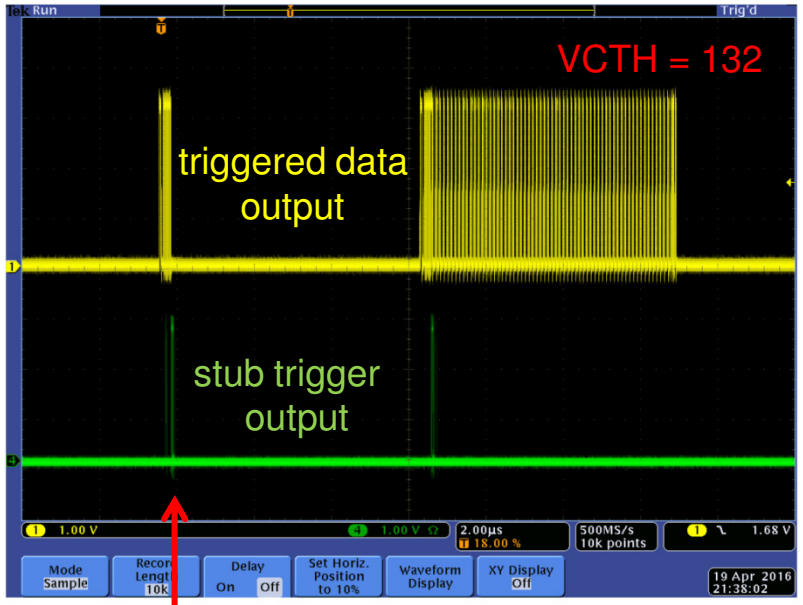

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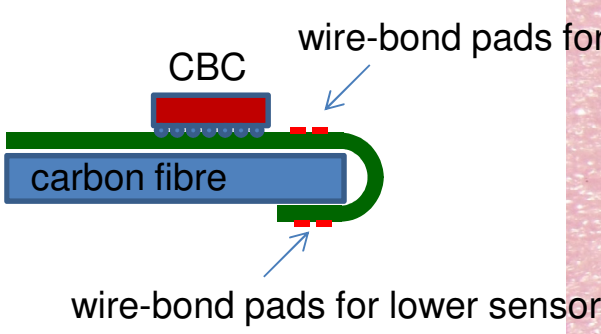
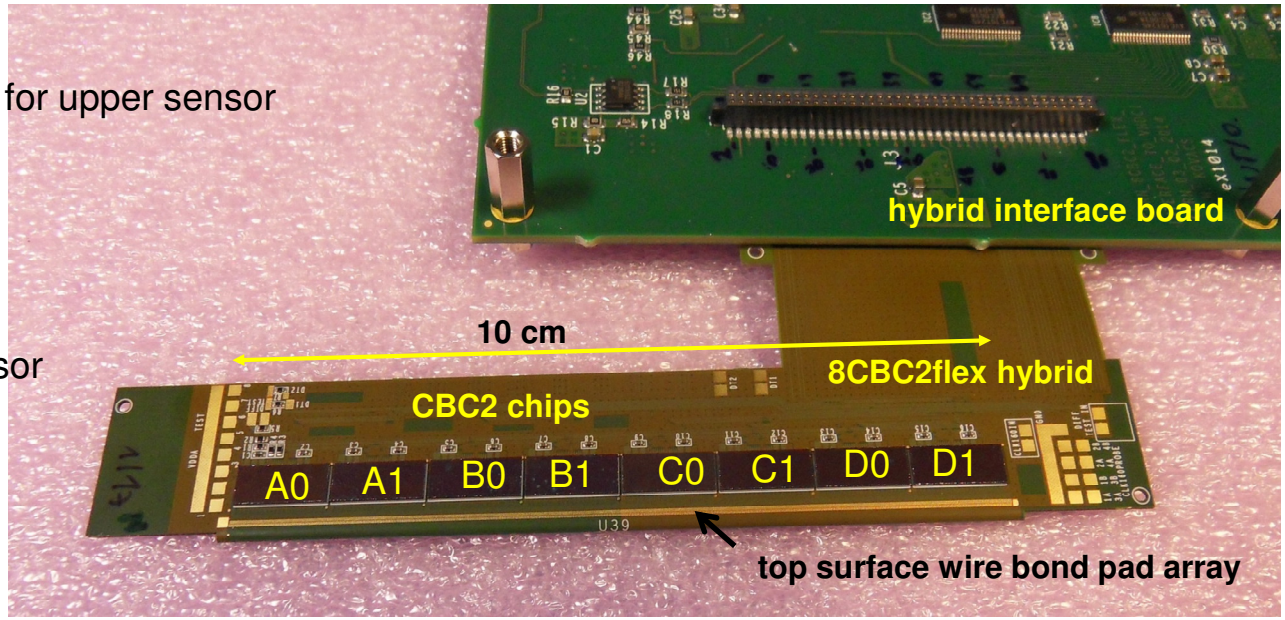
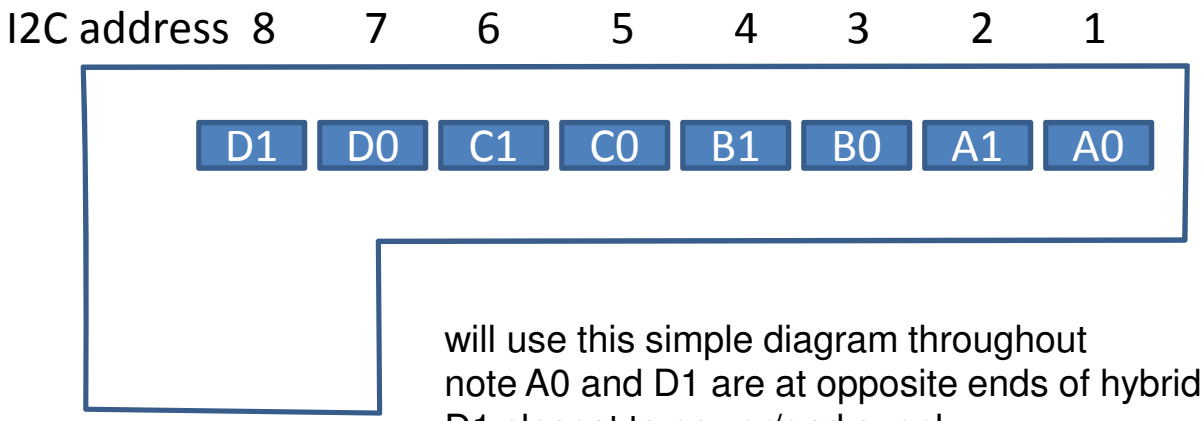
2nd trigger here

AEMTEC 8CBC2flex hybrid







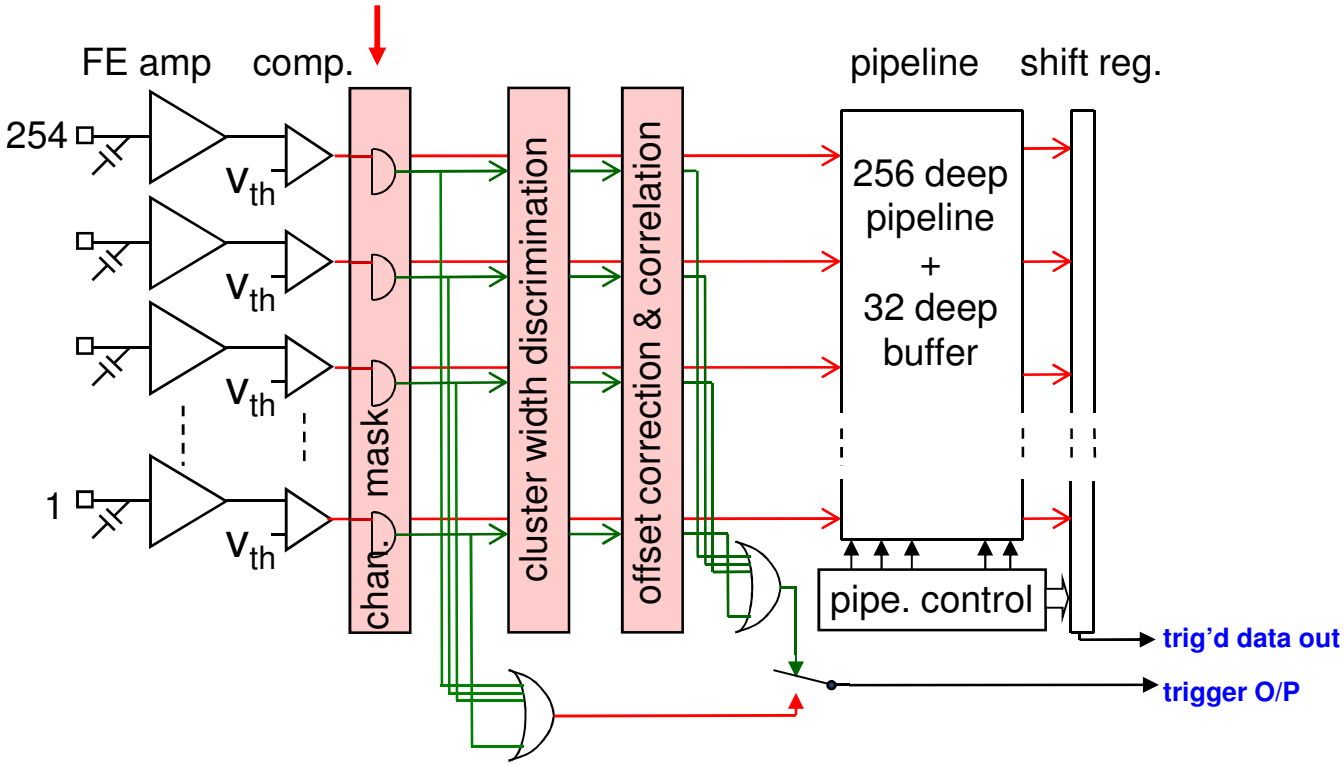
will use this simple diagram throughout
note A0 and D1 are at opposite ends of hybrid
D1 closest to power/gnd supply

measurement conditions

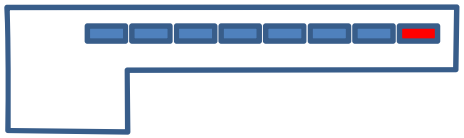
pedestals tuned to VCTH = 140 (decimal)

operation in electrons mode so **smaller** VCTH value => **higher** threshold

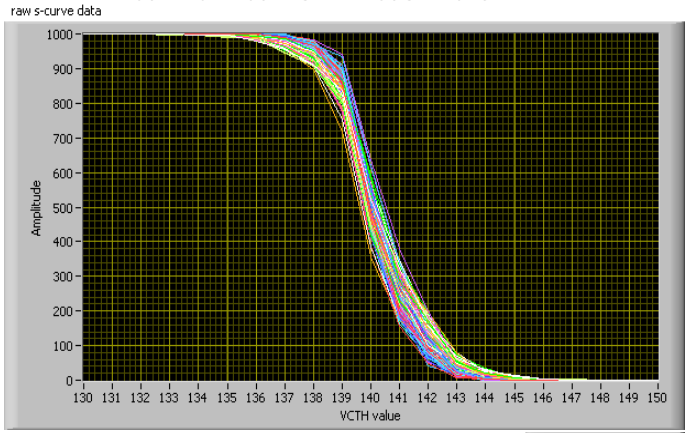
early on realised that observed s-curve effects depend on whether channels masked/unmasked from correlation logic

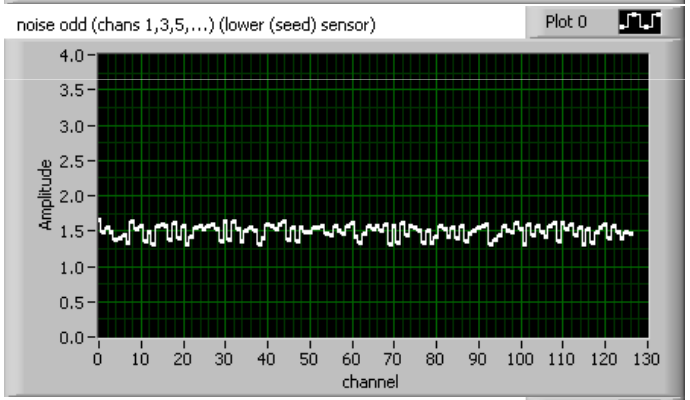


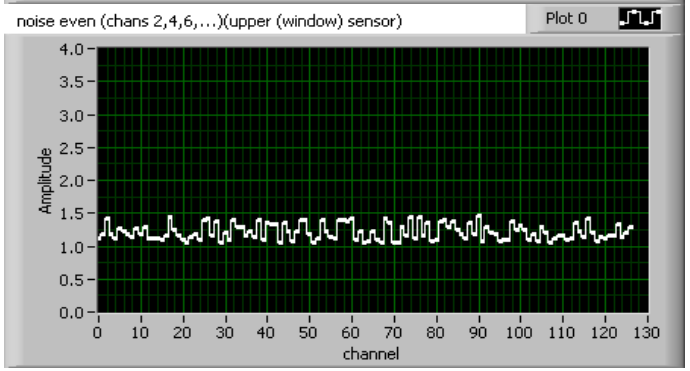
s-curves and noise



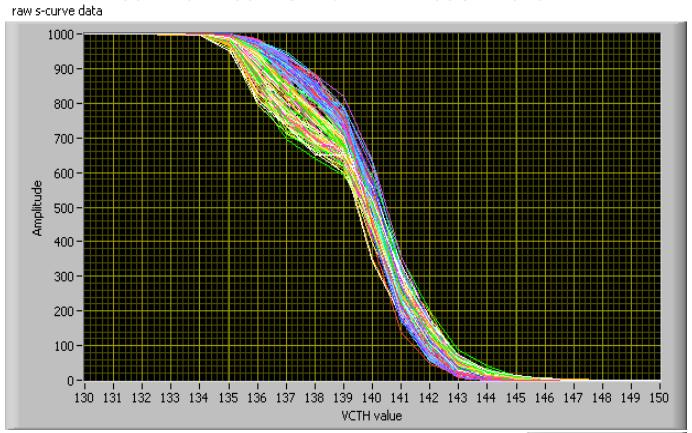
chip A0
all chans masked

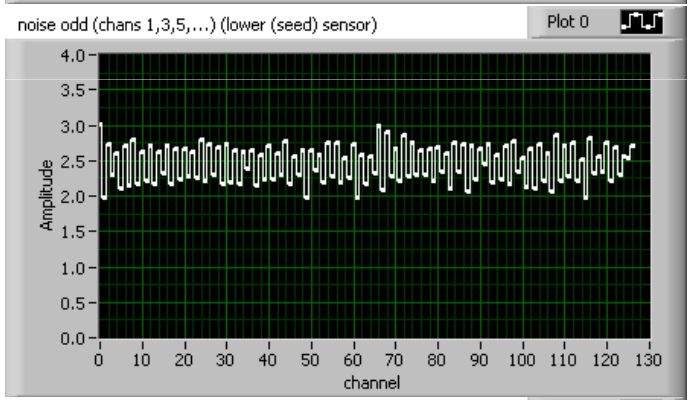


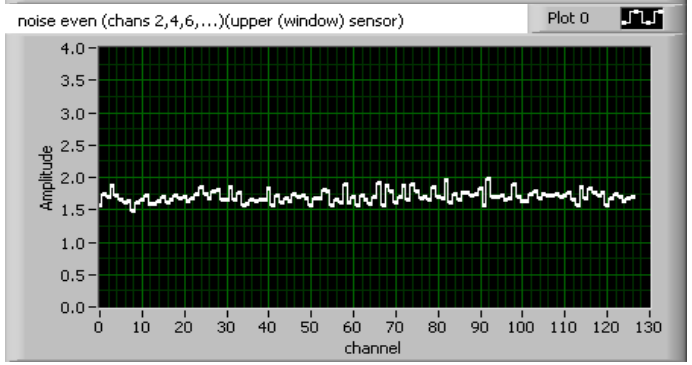




chip A0
all chans UNmasked



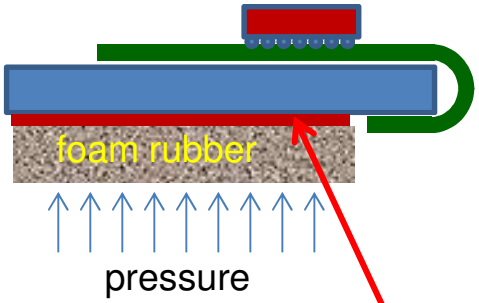




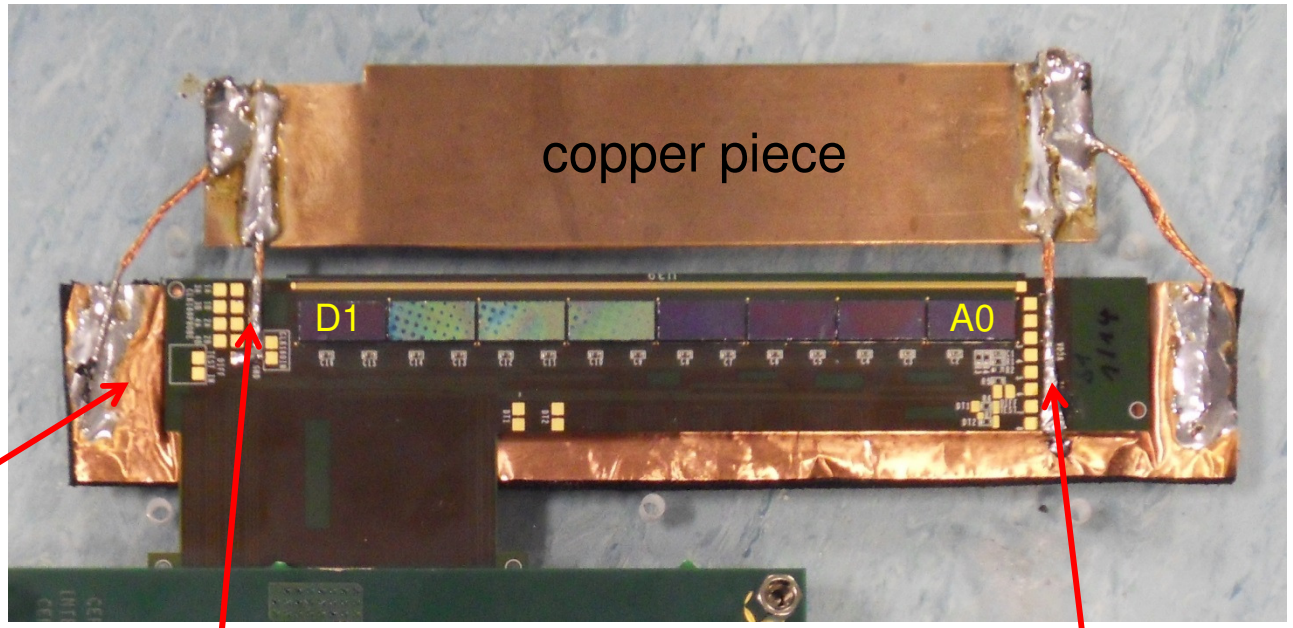
s-curve distortion when channels un-masked

alternating higher-lower effect in noise for lower sensor channels

some attempts to improve ground for AEMTEC hybrid



grounded Cu foil



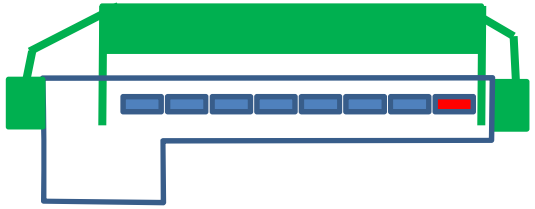
solder connection
to ground area
on hybrid

solder connection
to ground area
on hybrid

add low impedance connection between both ends of hybrid (copper piece)

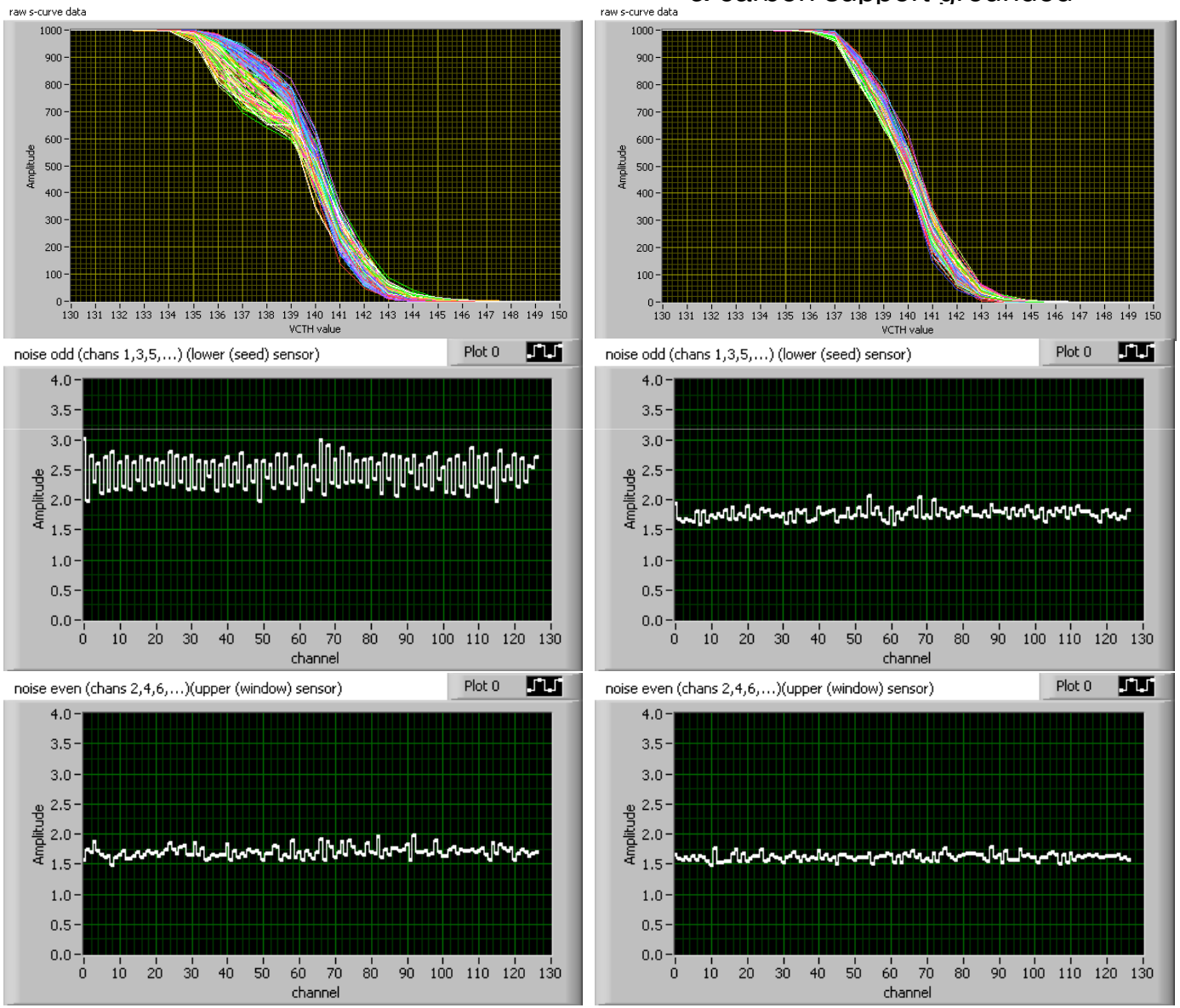
add Cu foil to underside of hybrid, using electrically conductive grease to try and achieve grounding of carbon fibre stiffener

s-curves and noise chip A0, all chans UNmasked



bare hybrid

added ground path
& carbon support grounded



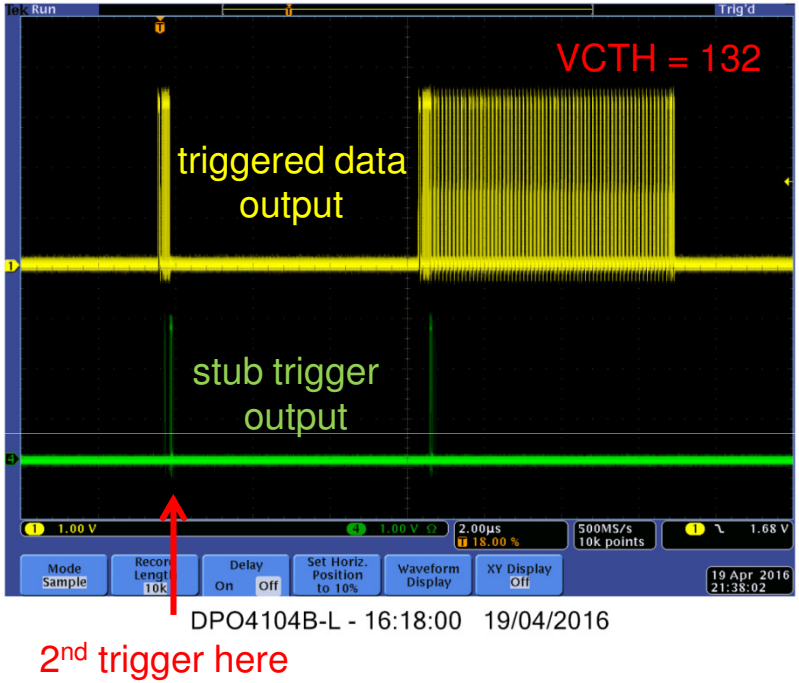
effect only appears when channels unmasked

effect barely visible for chips nearest power supply end of hybrid

strongest effect for chip A0, furthest from power end

effect significantly improved by added grounding of the CF stiffener

double trigger effect

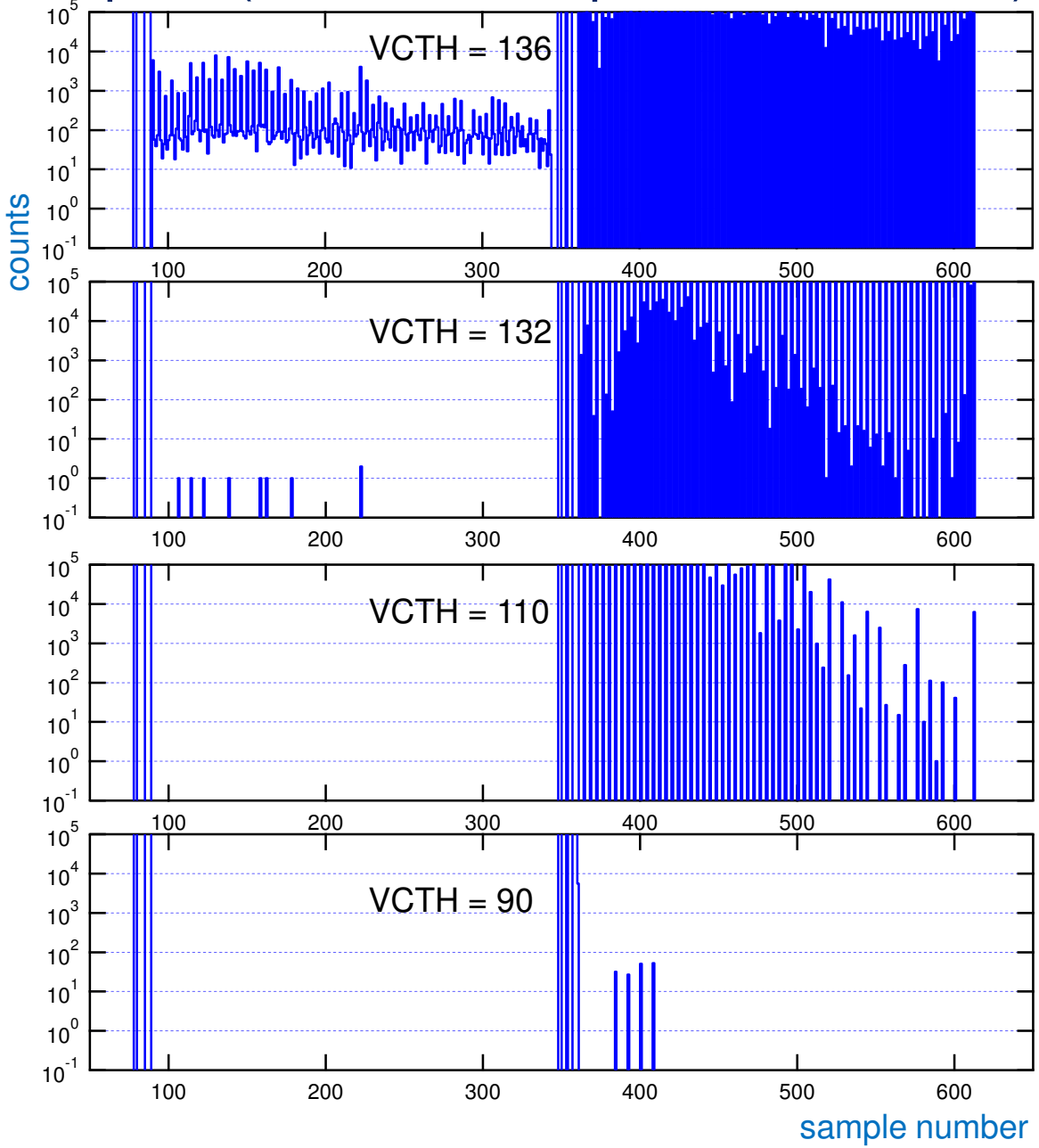


spotted while investigating s-curve distortions

not clear whether/how related

but appears to have same origin (interference coupling via carbon fibre stiffener)

chip A0 (furthest from power connector), no added grounding



for 100,000 double triggers count the no. of times a bit is set in the triggered output data for each sample time

for very low thresholds see significant activity in 1st data frame

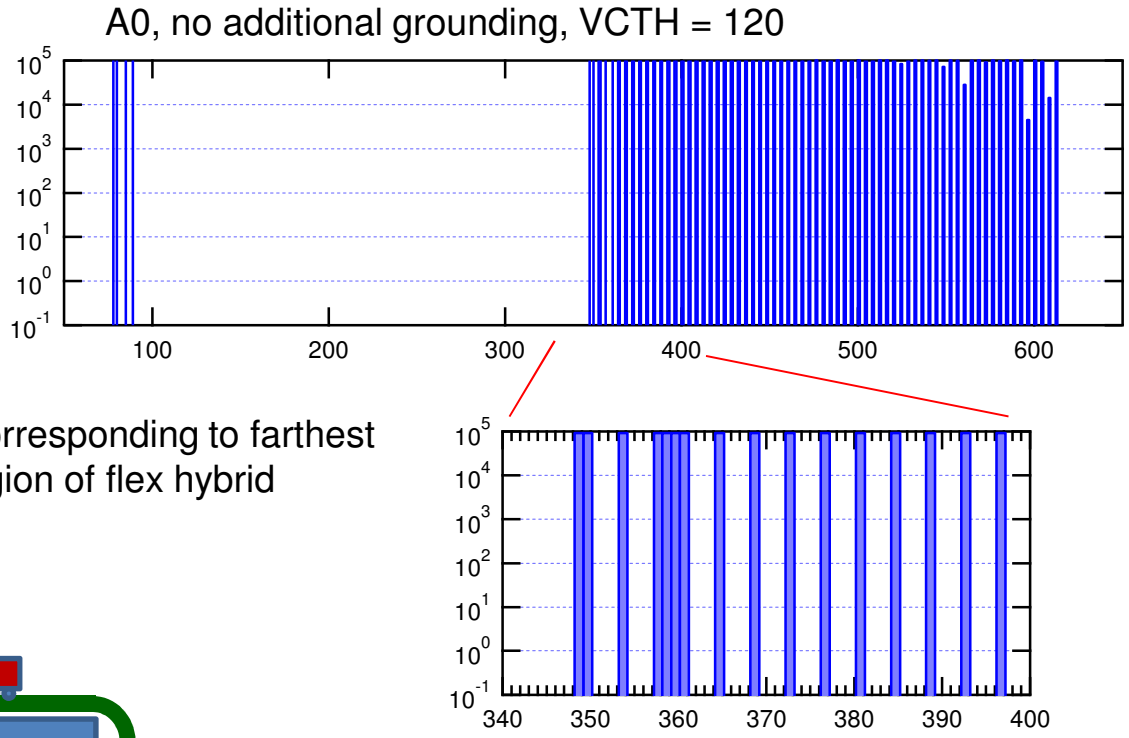
huge activity in second

as threshold increases (lower VCTH values) activity in 1st frame drops off but still a lot in 2nd

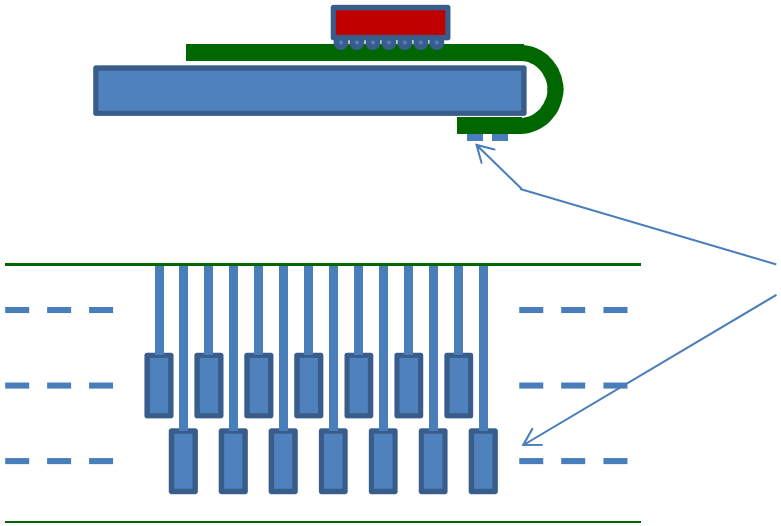
magnitude of effect can be judged from VCTH values

have to reach huge threshold values before activity in 2nd frame starts to fall off

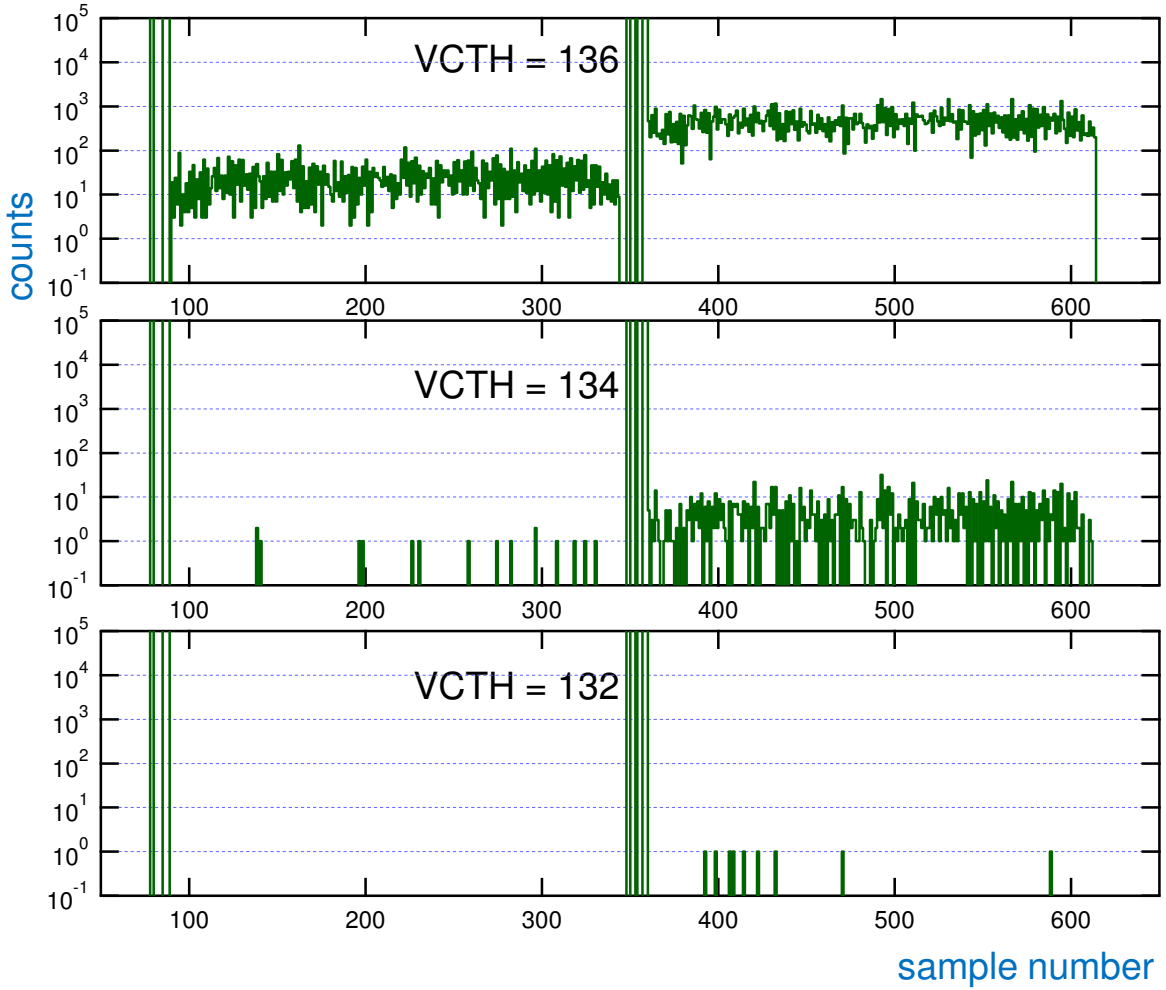
important observation

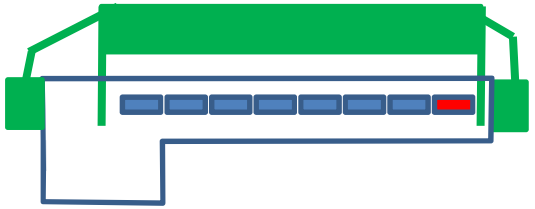


channels affected are every 4th , corresponding to farthest tracked channels on folded over region of flex hybrid



chip A0 with added grounding





clearly a huge improvement

effect appears almost completely eliminated

(some enhancement of the random activity in 2nd data frame, but negligible for reasonable thresholds)

conclusions from last time

1st effect

get s-curve distortions for chips furthest from power supply end of AEMTEC hybrid when channels are unmasked from correlation logic

significant improvement if add grounding to CF stiffener

2nd effect

if trigger and read out chip at header time corresponding to a previous trigger see lots of channels firing

VCTH threshold has to be increased enormously before it goes away

but extra grounding almost eliminates effect for A0

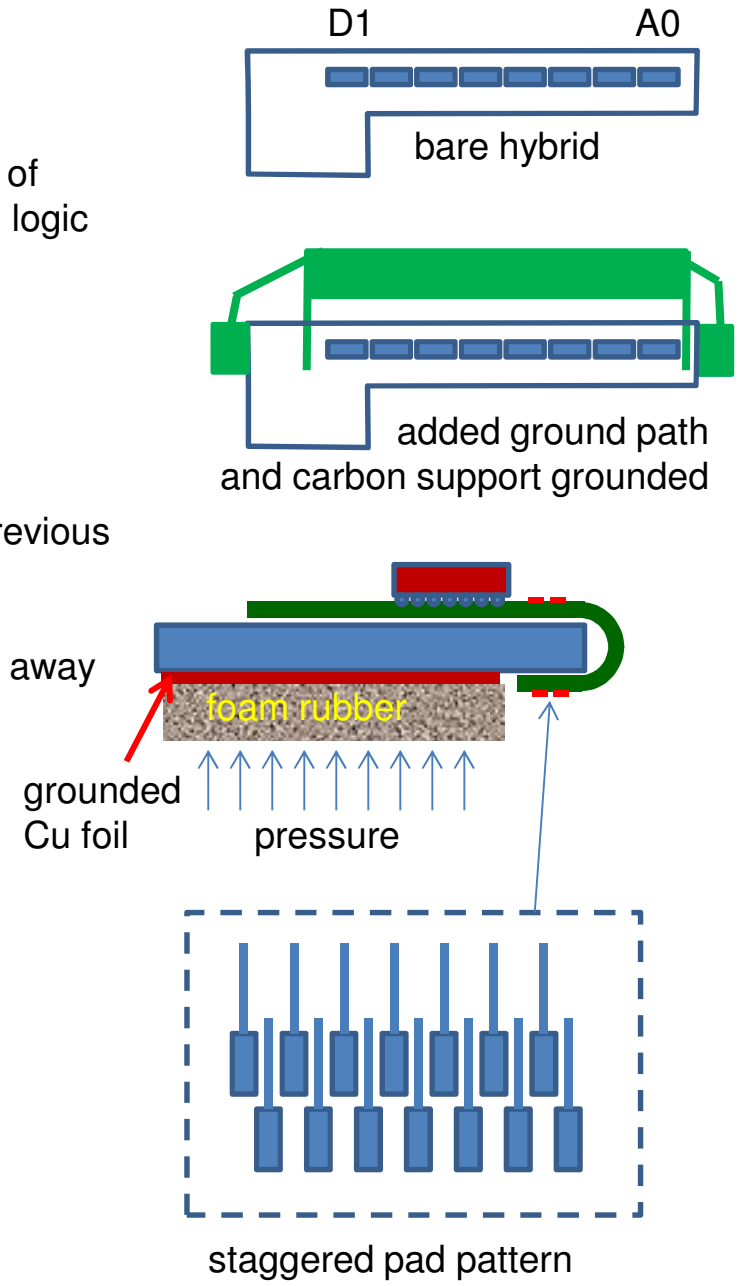
and completely eliminates for D1

most effective is ground contact to back surface of stiffener

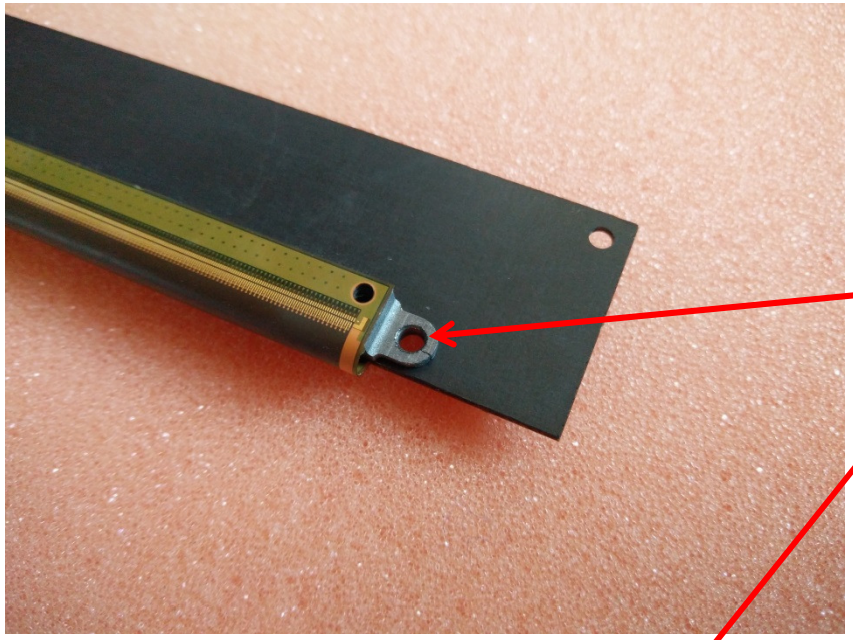
note: this effect does not require channels to be unmasked

final significant point to note:

effect does not appear on 2CBC2 hybrid



Valtronic hybrid results

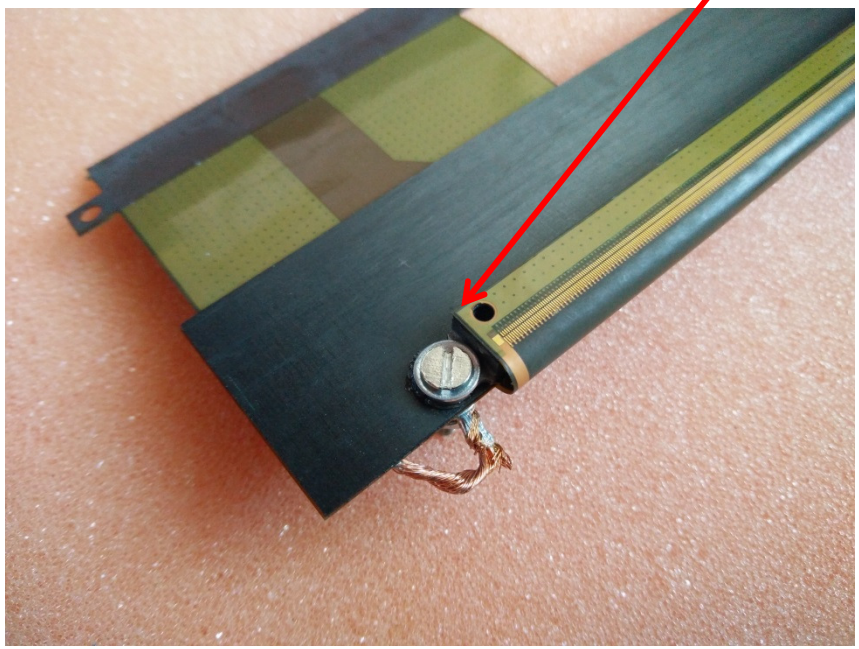


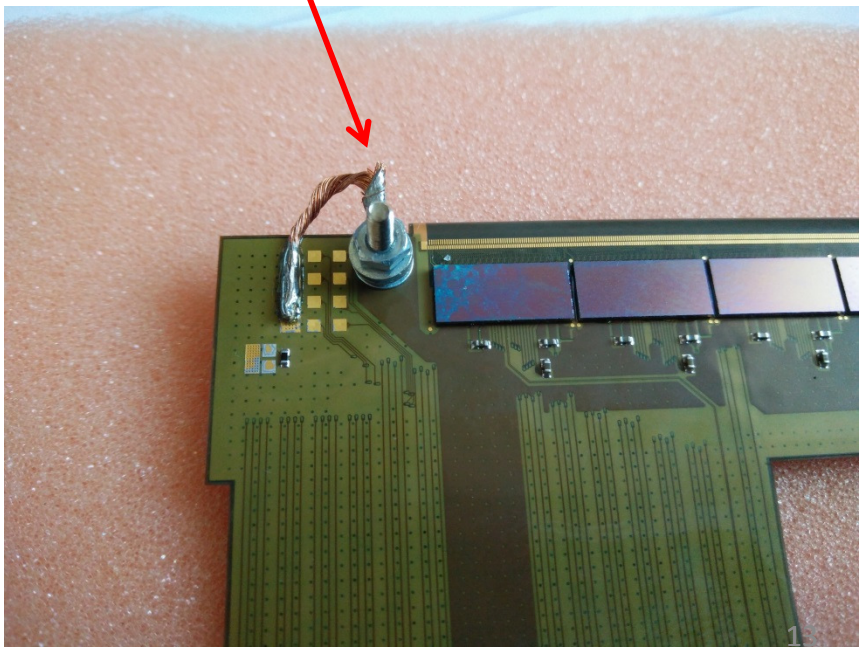
will compare bare hybrid performance with that obtained when ground contact made to carbon fibre piece that supports the foldover region of the hybrid

can make good electrical contact here

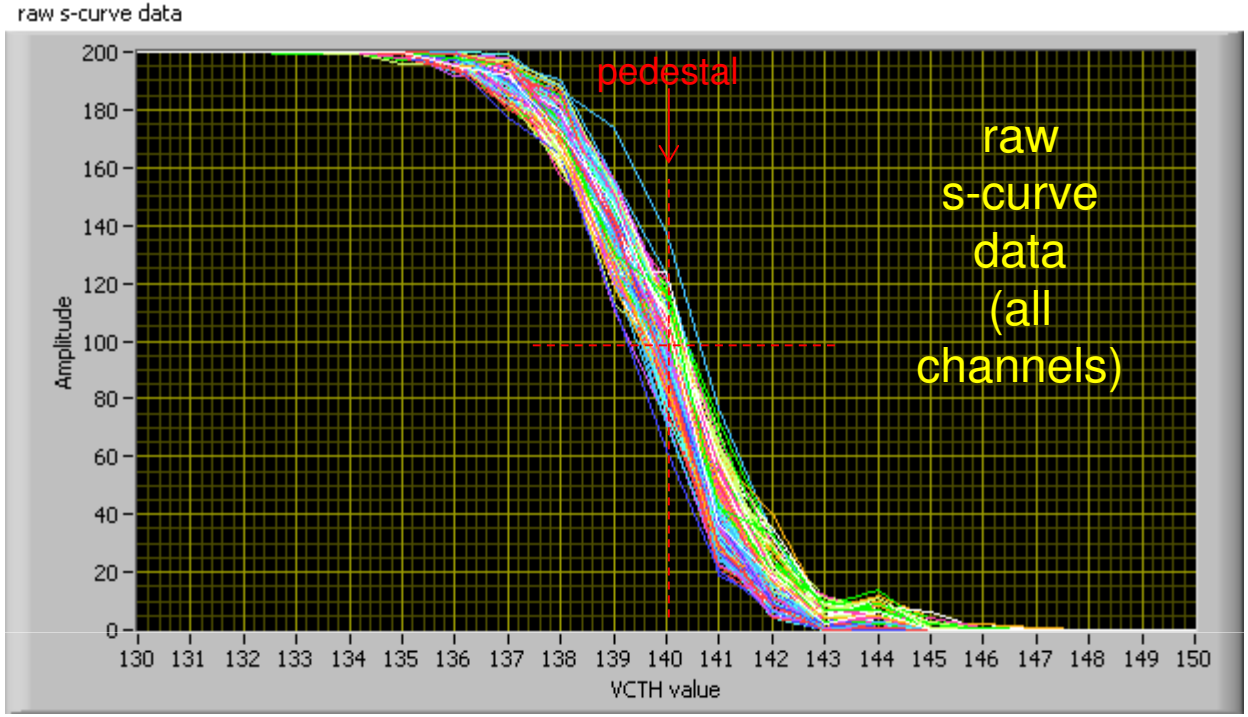
screw (+ washer) makes contact on underside of hybrid

solder tag connects screw to ground pad on hybrid (contact only made at one end only - the one nearest the power and signal cable)

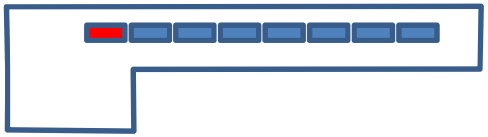


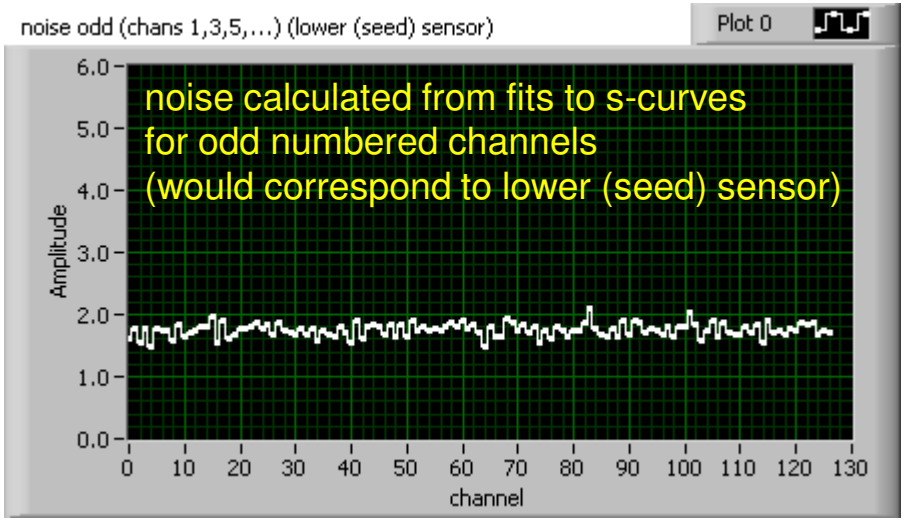


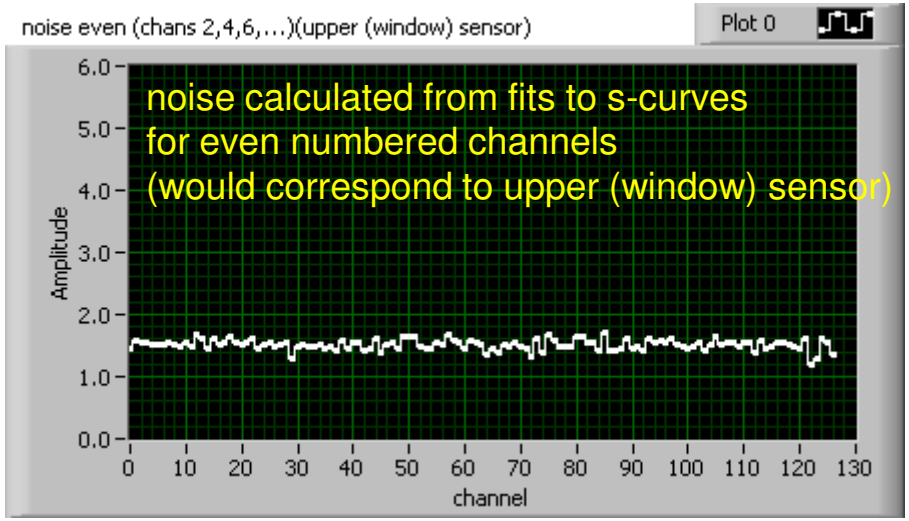
s-curves and noise



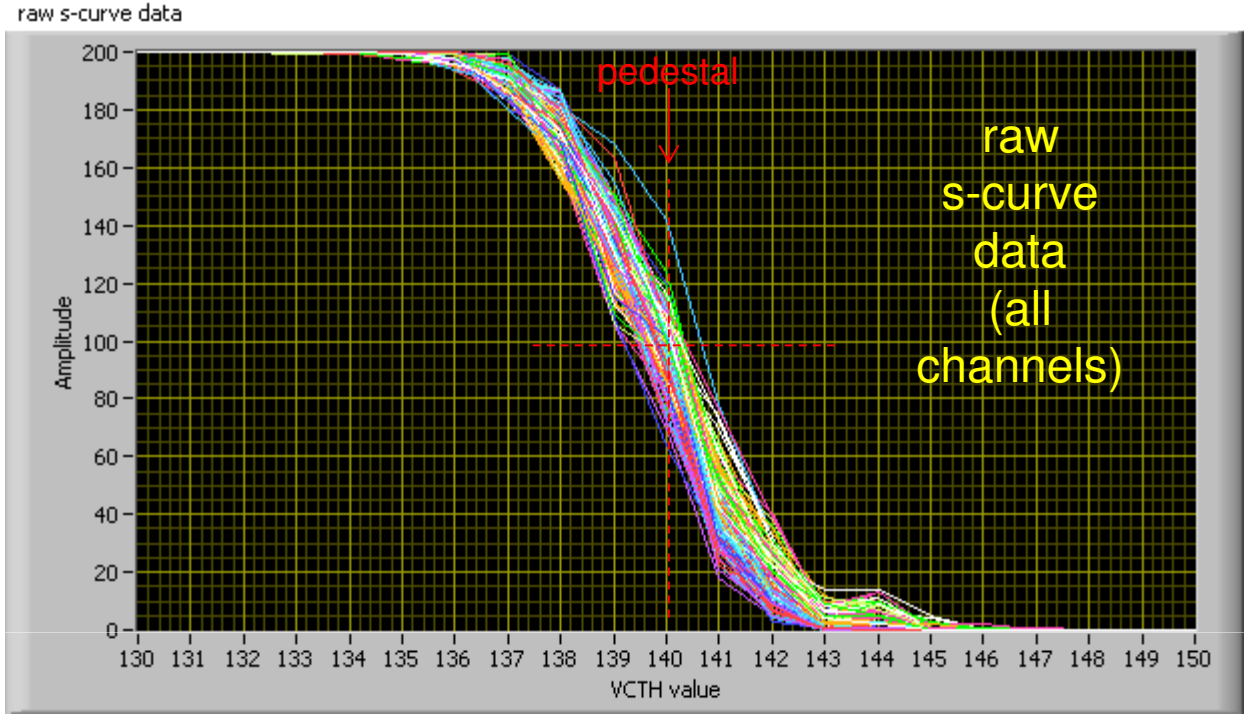
chip D1
all chans masked
bare hybrid



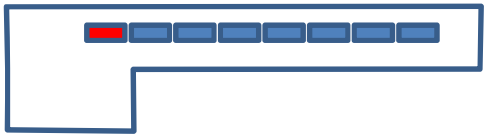




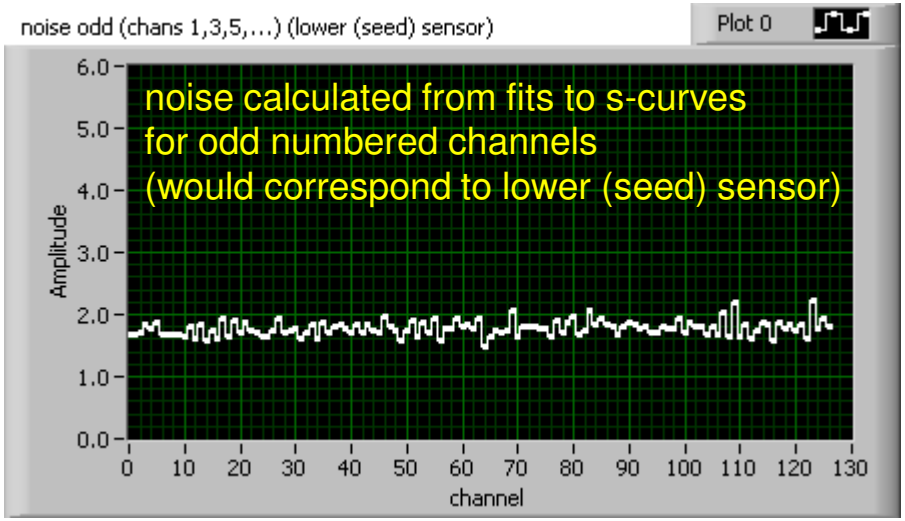
s-curves and noise

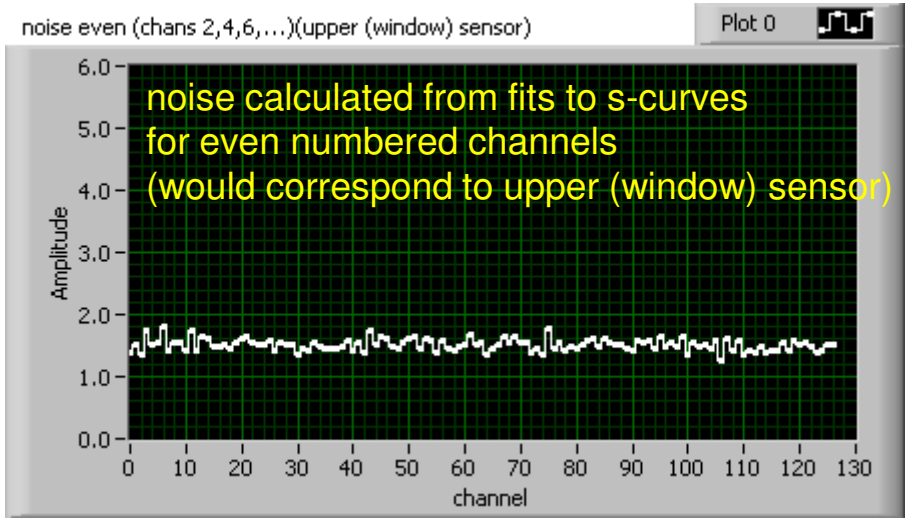


chip D1
all chans UNmasked
bare hybrid

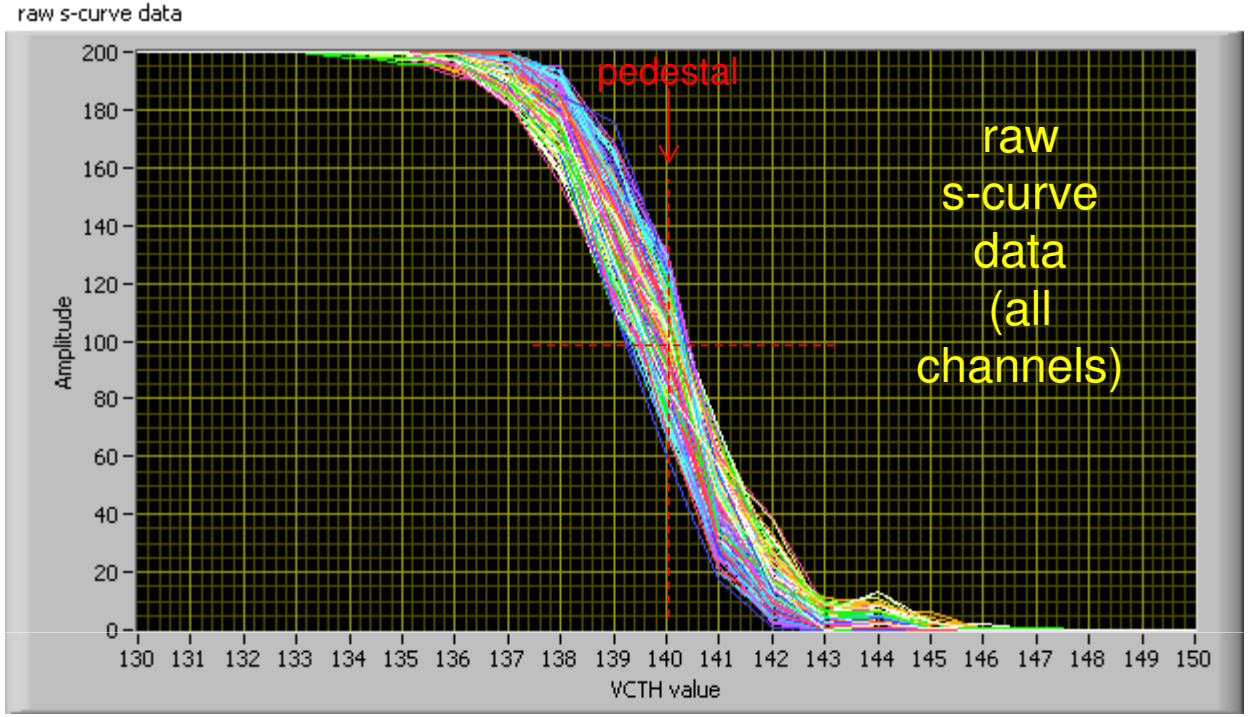


no significant difference

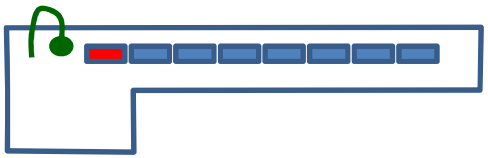




s-curves and noise

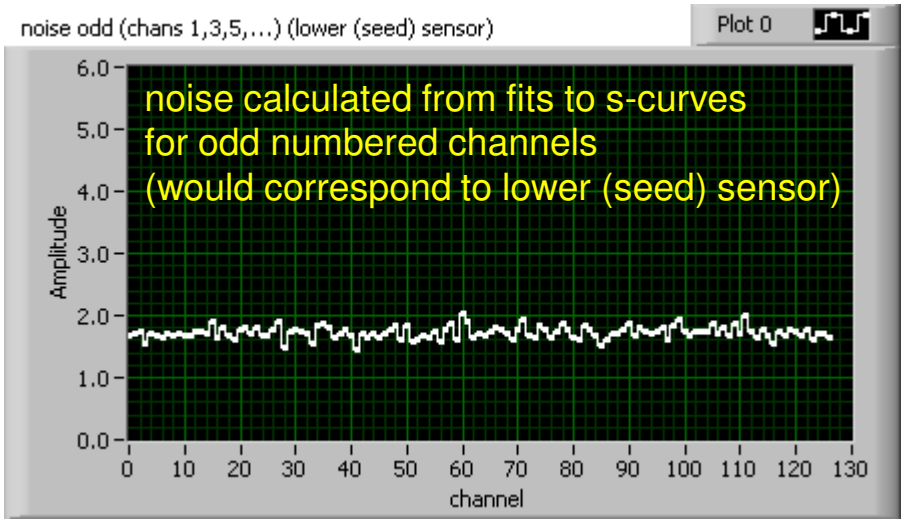


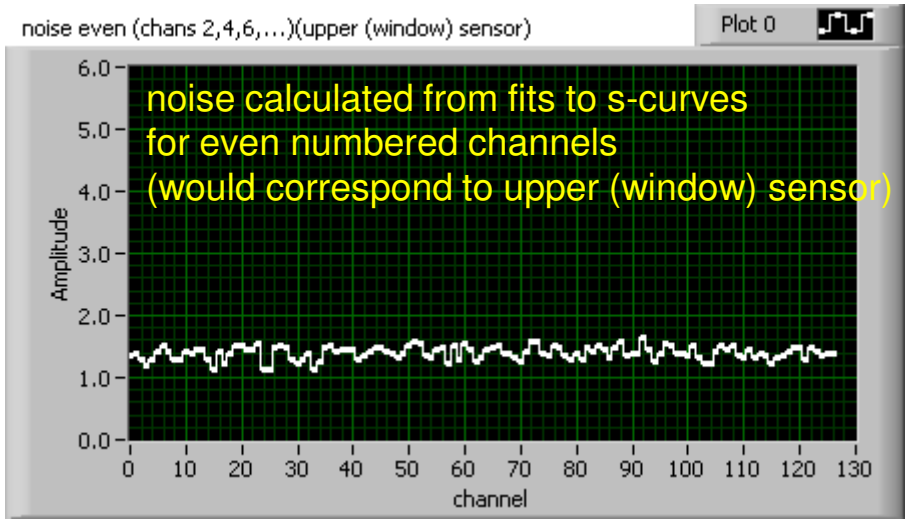
chip D1
all chans UNmasked
c.fibre piece grounded



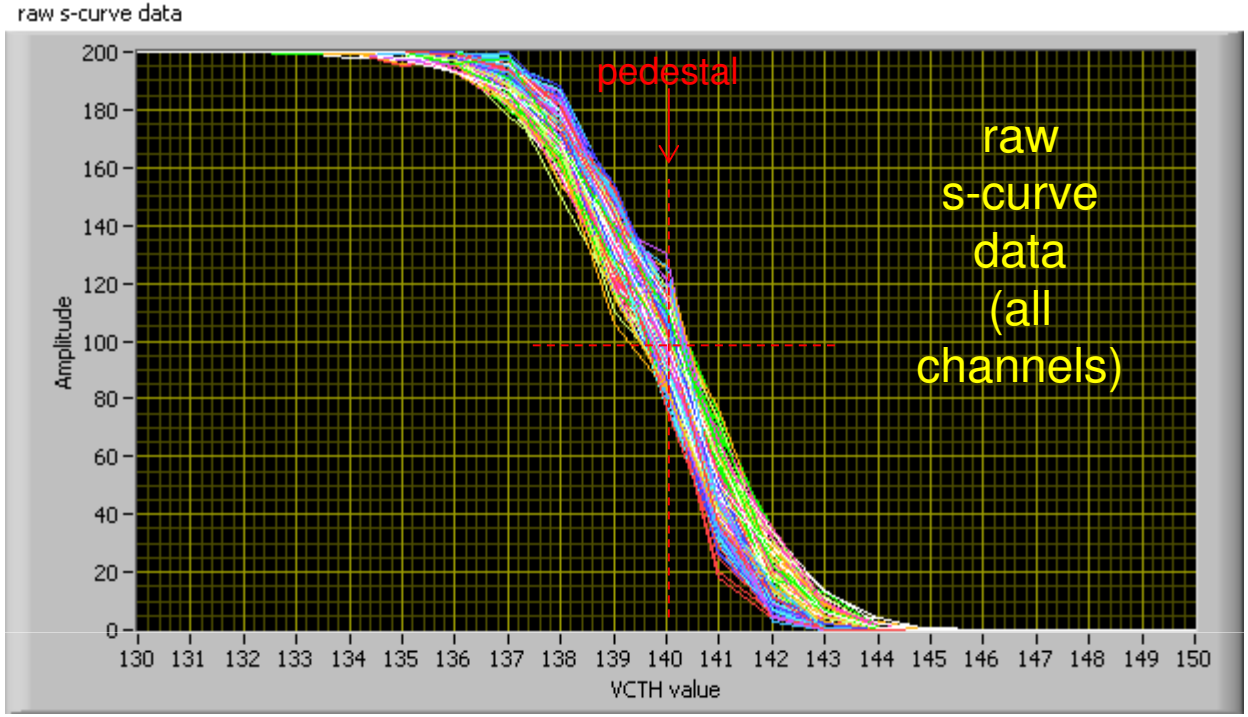
again no significant difference

grounding of carbon fibre piece has no observable effect

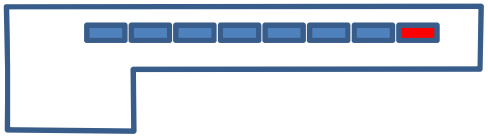


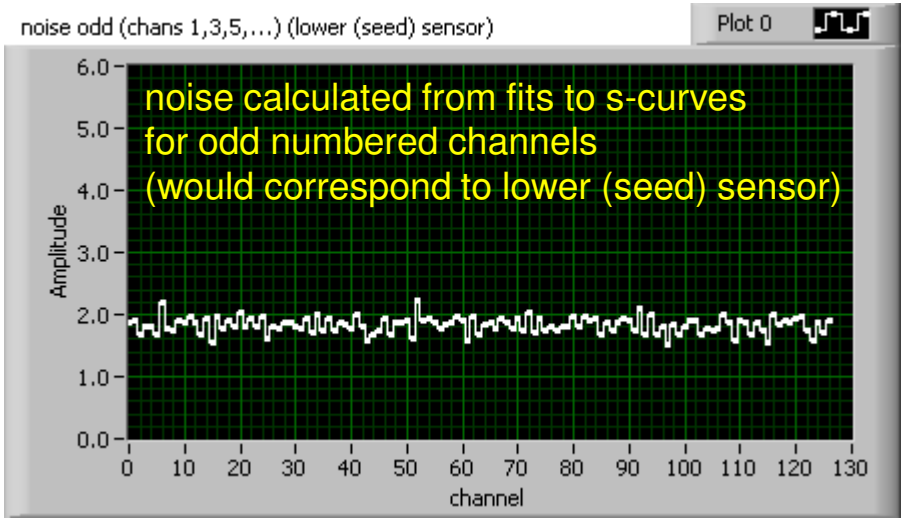


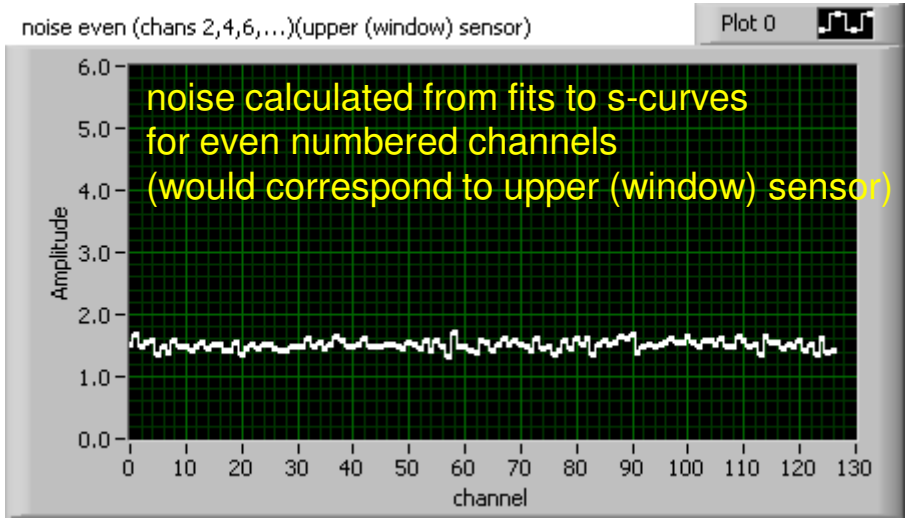
s-curves and noise



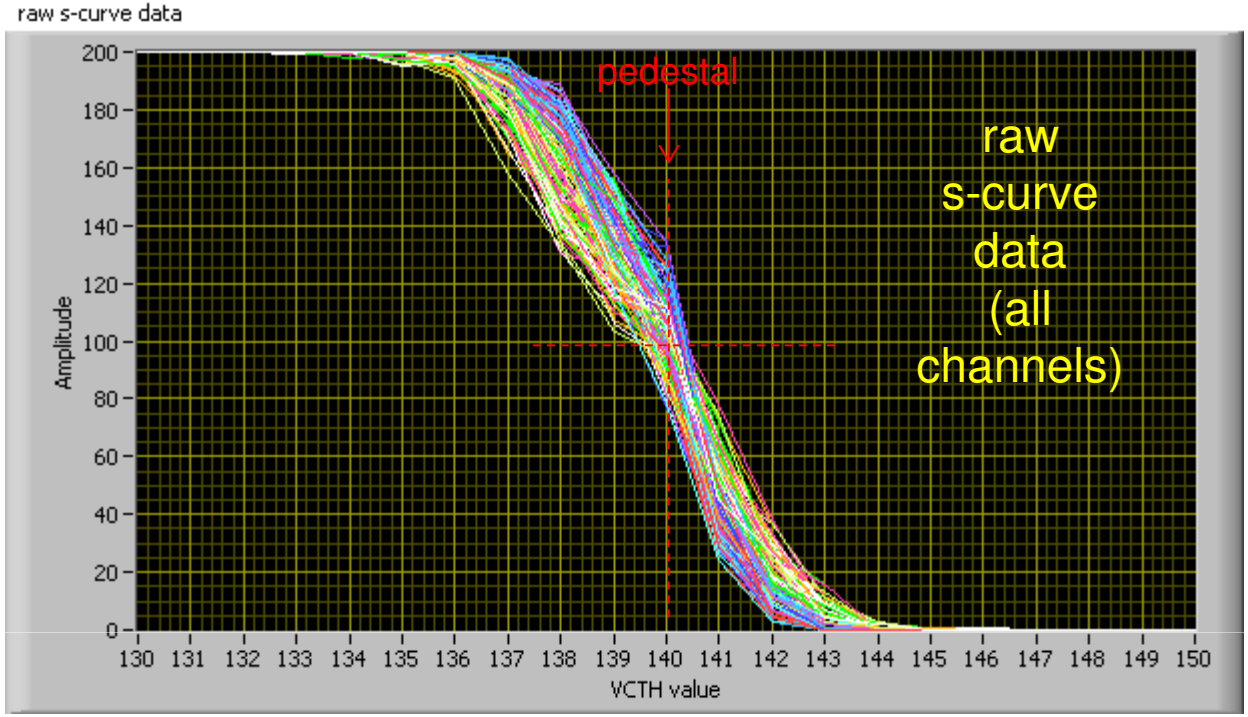
chip A0
all chans masked
bare hybrid



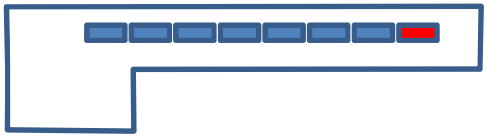




s-curves and noise



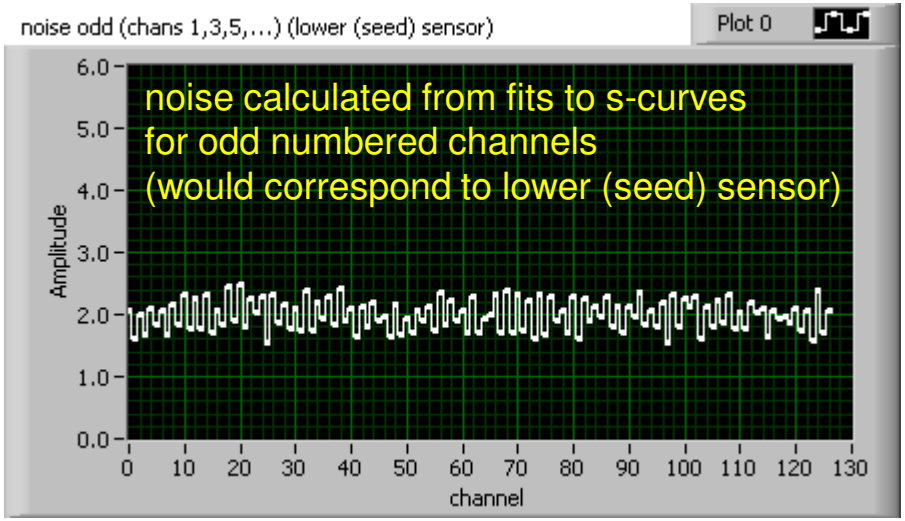
chip A0
all chans UNmasked
bare hybrid

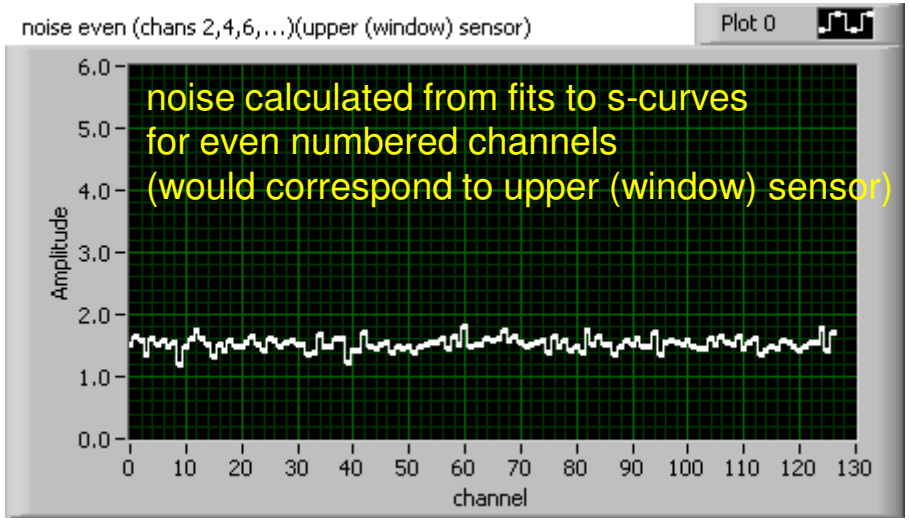


some visible s-curve distortion

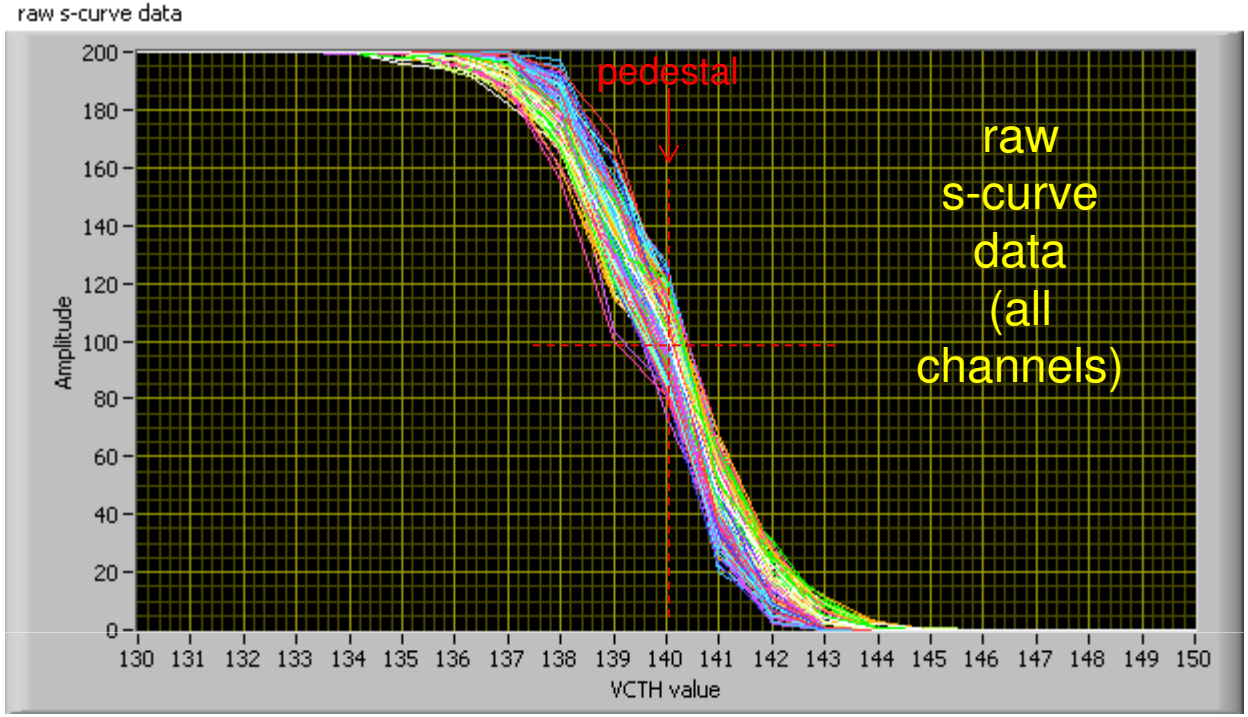
shows up in noise too for lower sensor channels

alternating channel effect

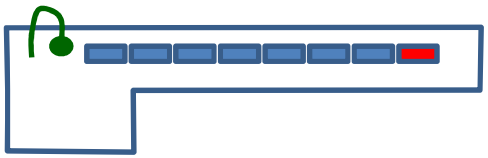




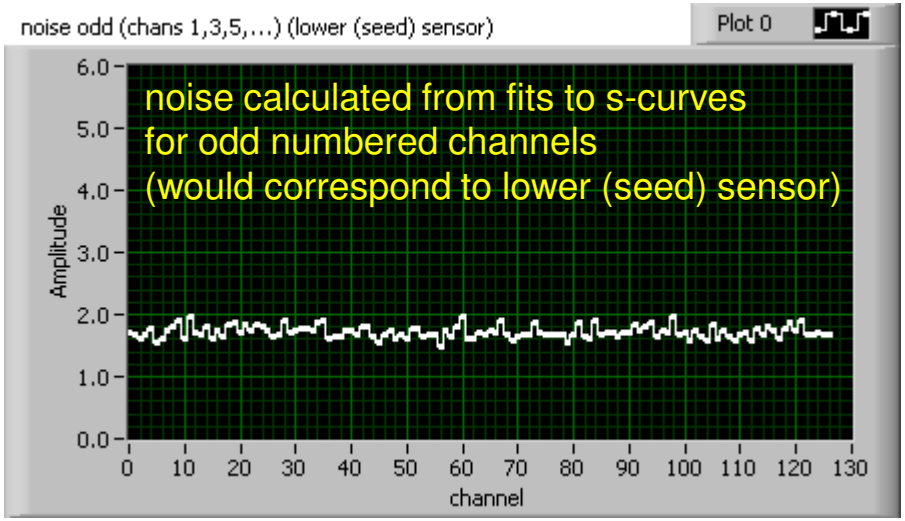
s-curves and noise

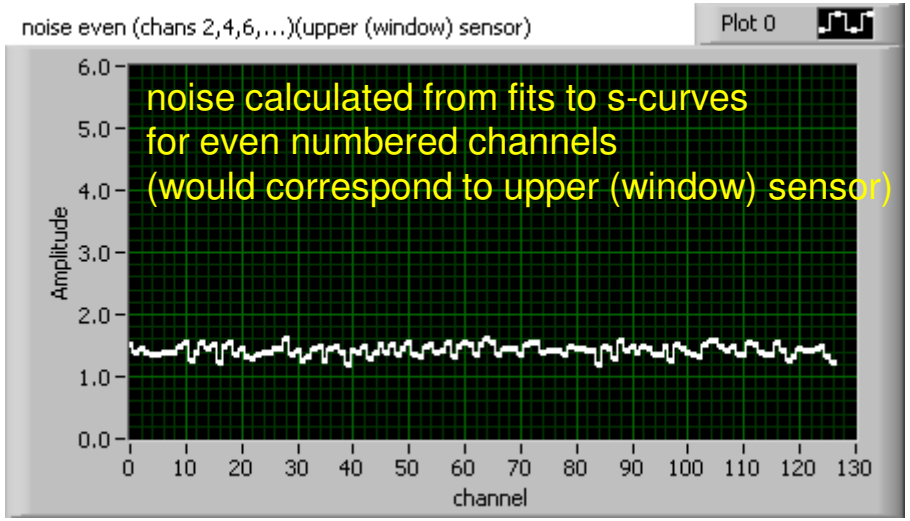


chip A0
all chans UNmasked
c.fibre piece grounded



additional ground connection
returns performance to what
it was with all channels masked





conclusions on s-curves and noise for Valtronic hybrid

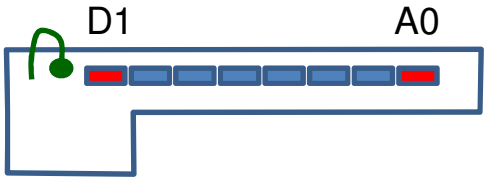
s-curve distortions when channels unmasked significantly less than observed for AEMTEC 8cbc2flex hybrid

chip D1

doesn't matter whether additional ground there or not

chip A0

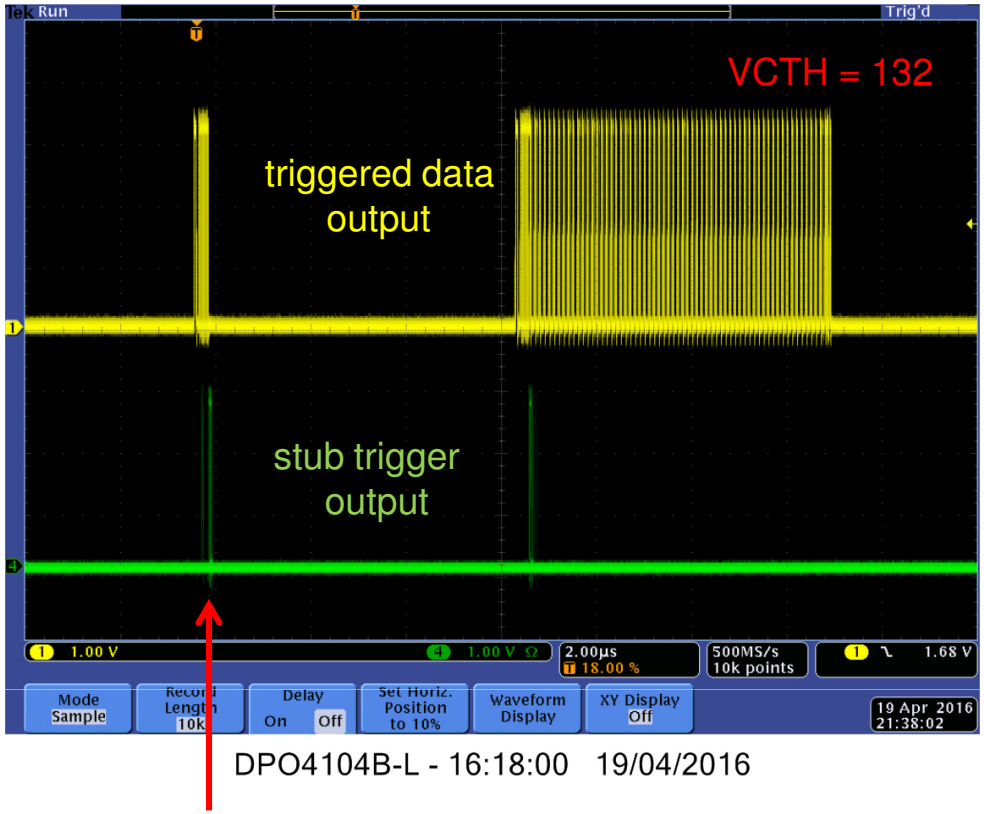
additional ground connection eliminates effect



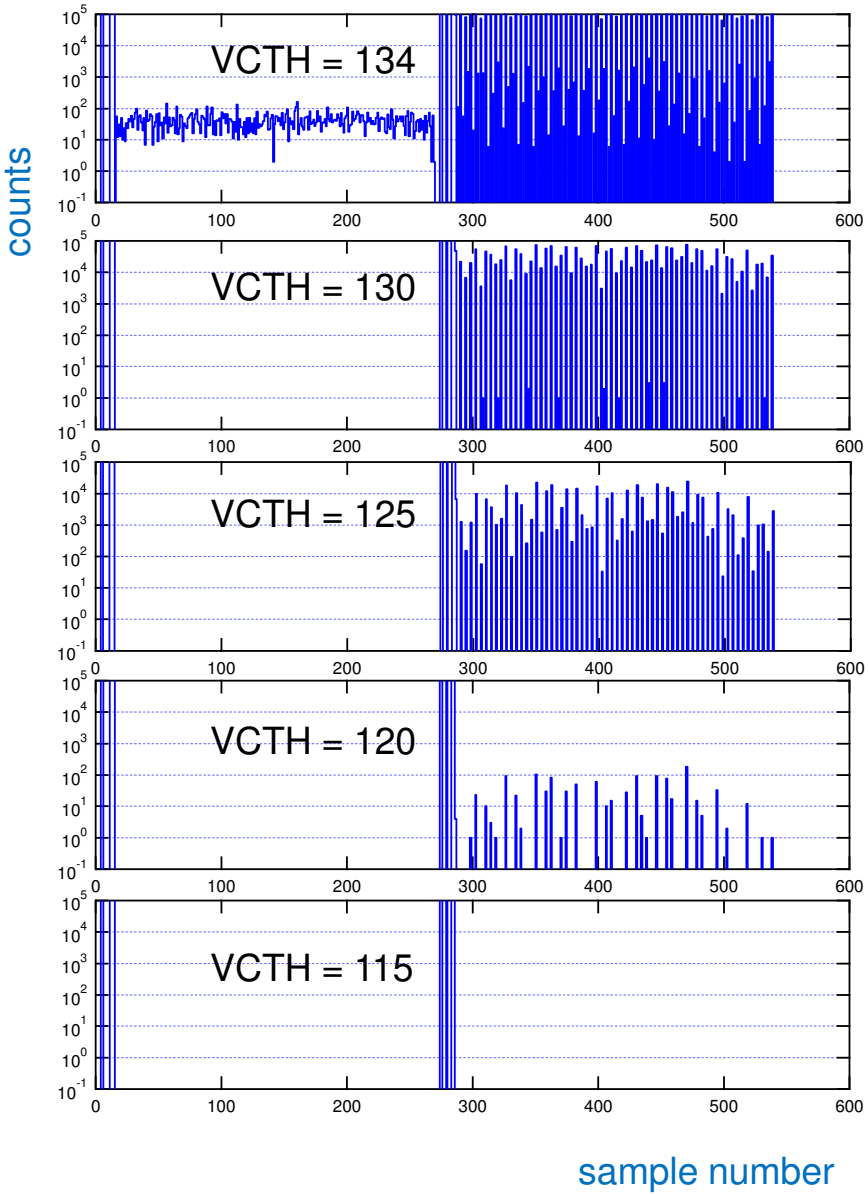
double trigger effect

this was the picture for the AEMTEC 8cbc2flex hybrid

following slides shows what is observed for the Valtronic hybrid



chip A0 (furthest from power connector), no added grounding

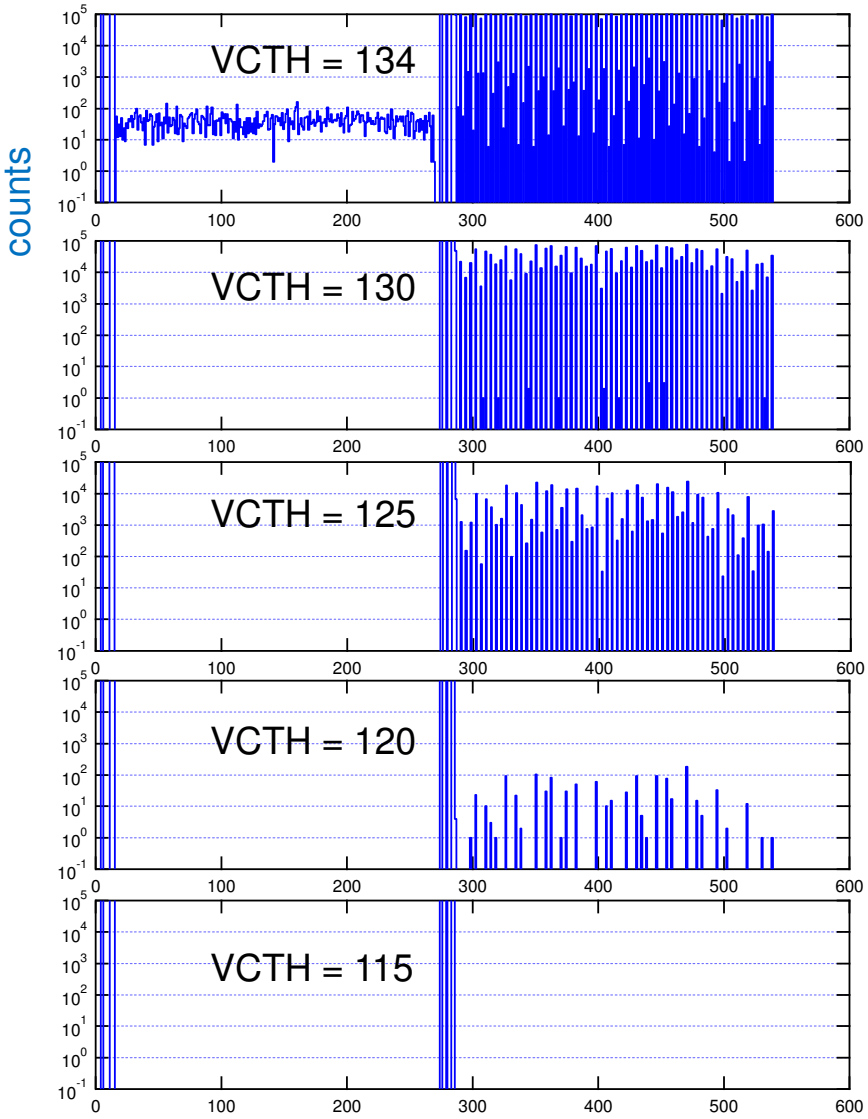


for the bare hybrid, without the additional ground connection, the effect is certainly there

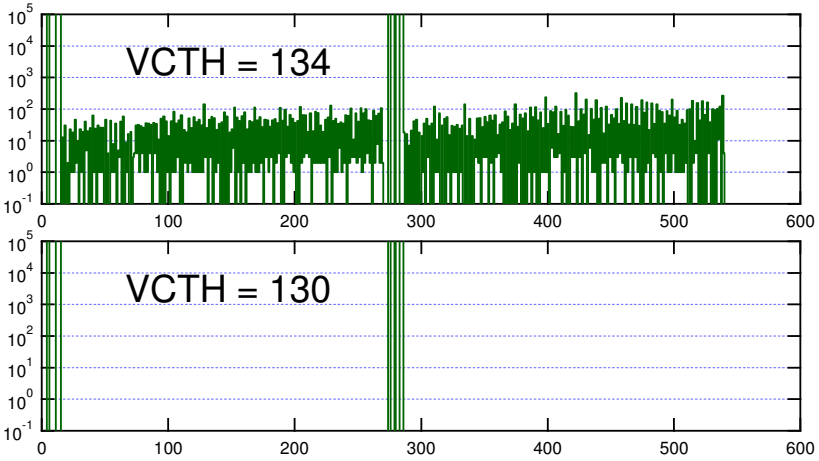
it is significantly less than what was observed for the original hybrid

but still much too big to live with

chip A0 (furthest from power connector)



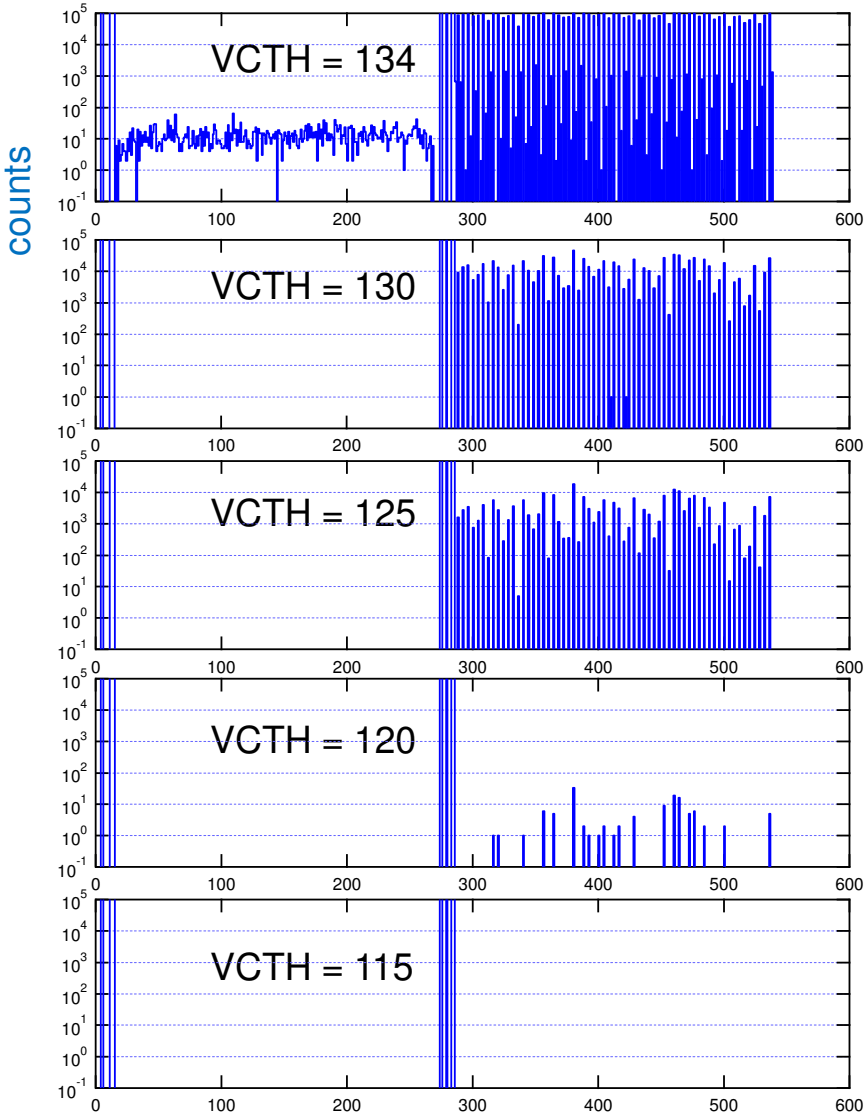
with added ground connection



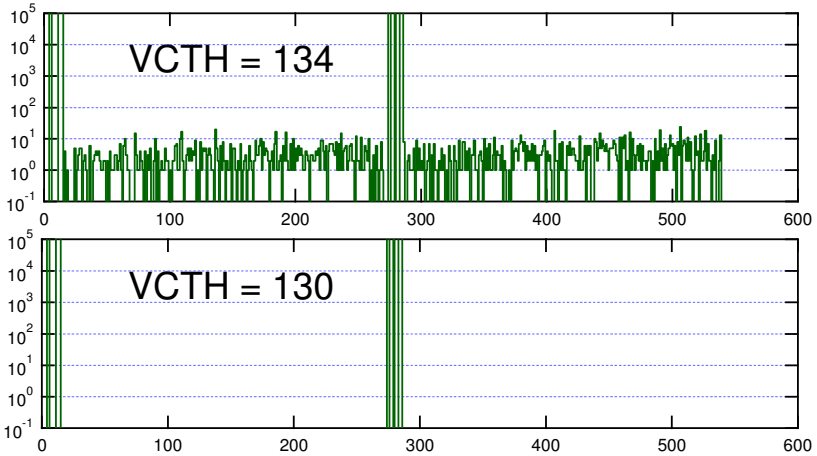
the additional ground connection completely eliminates the effect

chip D1 (closest to the power connector)

bare hybrid



with added ground connection



same conclusion for chip D1
(as you might expect)

overall conclusion

Valtronic hybrid performs better in terms of electrical coupling effects to the channels in the foldover region of the hybrid, even without any additional grounding

Nevertheless the double trigger measurement shows that still some action has to be taken

A single ground connection to the carbon fibre piece that supports the folded over portion of the hybrid appears to eliminate the problem