

Crosstalk dependence on number of turns/inch for twisted pair versions of the endcap umbilical cable

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Introduction

The results of a previous study comparing coaxial and twisted pair versions of the endcap VPT/VFE umbilical connecting cable can be found in:

http://www.hep.ph.ic.ac.uk/~dmray/pdf/FILES/VPT_umbilical_studies.pdf

The twisted pair version clearly suffered from poorer crosstalk performance and it was suggested this might be improved if the twisted pairs were more tightly wound.

Figure 1 shows the end of the twisted pair cable as it enters the box where the mother card is mounted. To increase the twist density the cables were removed from the outer braided sheath, twisted more tightly and then re-inserted. Before tightening the number of turns/inch was found to be rather non-uniform, in the range 0.6 – 0.9. This was increased for all pairs to ~ 2 turns/inch.

Results

Figure 2 shows VFE channel 3 which has the blue led light pulse injected. The top graph is for the original cable and the bottom graph shows the picture after the twist density is increased. The red traces show the light signal, the blue shows the residual electrical interference if the fibre is removed from the VPT housing. The light pulse amplitude is approximately the same in each case.

Figures 3 – 6 show the pictures for the four channels which do not have the light pulse injected. The signal without the light pulse present is subtracted from the one with, to give the crosstalk signal in green. There are some differences between the looser and tighter twisted pair versions, but crosstalk is still evident.

Figure 7 shows the crosstalk traces only, for all four channels, in this case normalised to the maximum pulse height in the channel containing the light pulse. The vertical axis is expressed as a percentage, so for example for a channel which has a crosstalk waveform which peaks at 0.25% (roughly the case for the tighter twisted pair) a 100 GeV signal in one channel would result in a 25 MeV signal in the neighbouring channels. Figure 7 illustrates that the effect of increasing the density of twists results in a slightly reduced level of crosstalk, and also a more uniform distribution of the crosstalk between channels.

The led pulse signal is also shown in figure 7 to allow a comparison between its time development with that of the crosstalk. The peaks in the crosstalk signals occur during the rising edge of the light pulse.

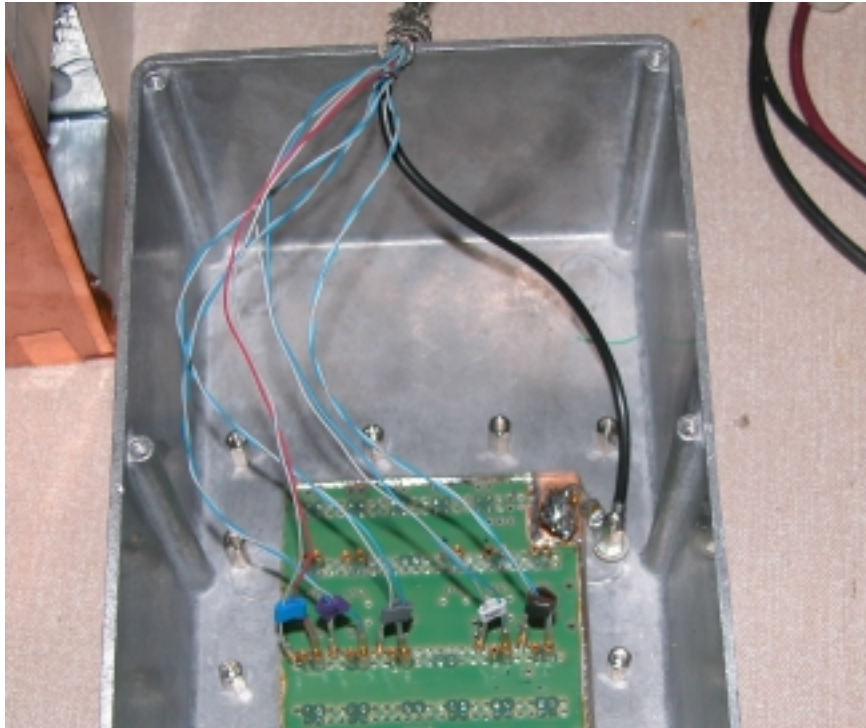


Figure 1. Twisted pair umbilical connection to motherboard

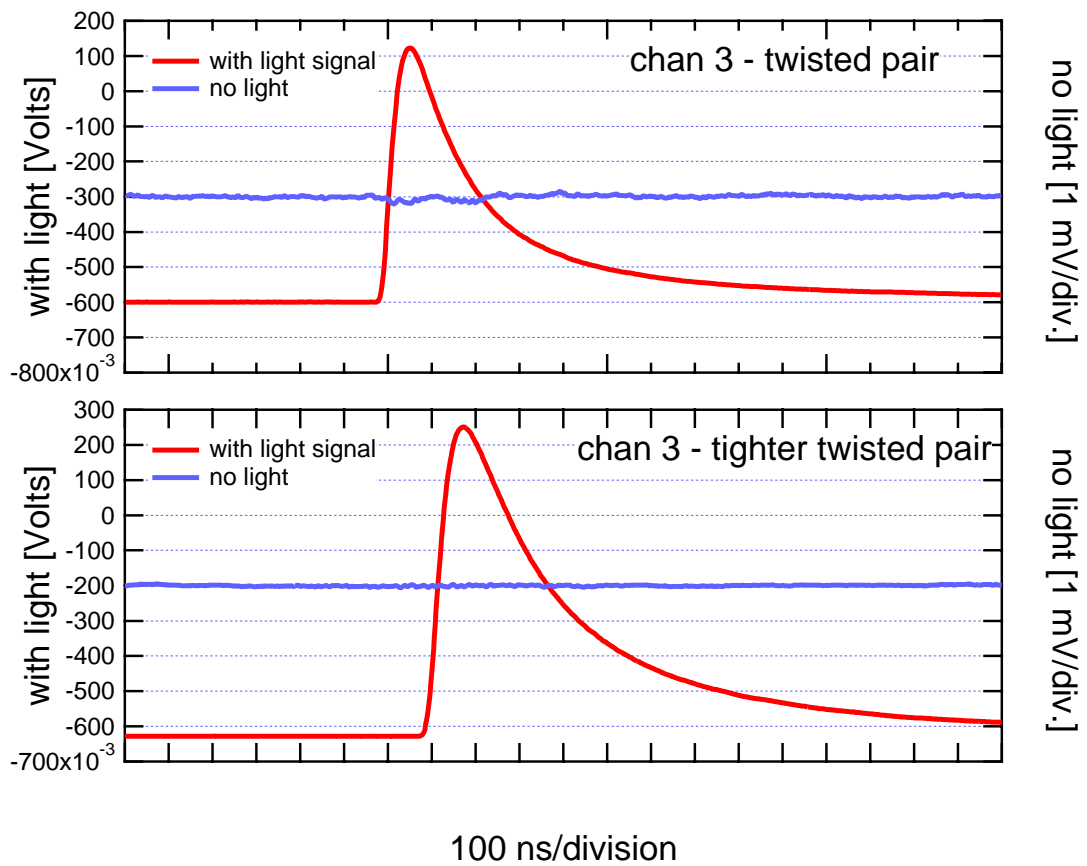


Figure 2. Light signal in VFE channel 3

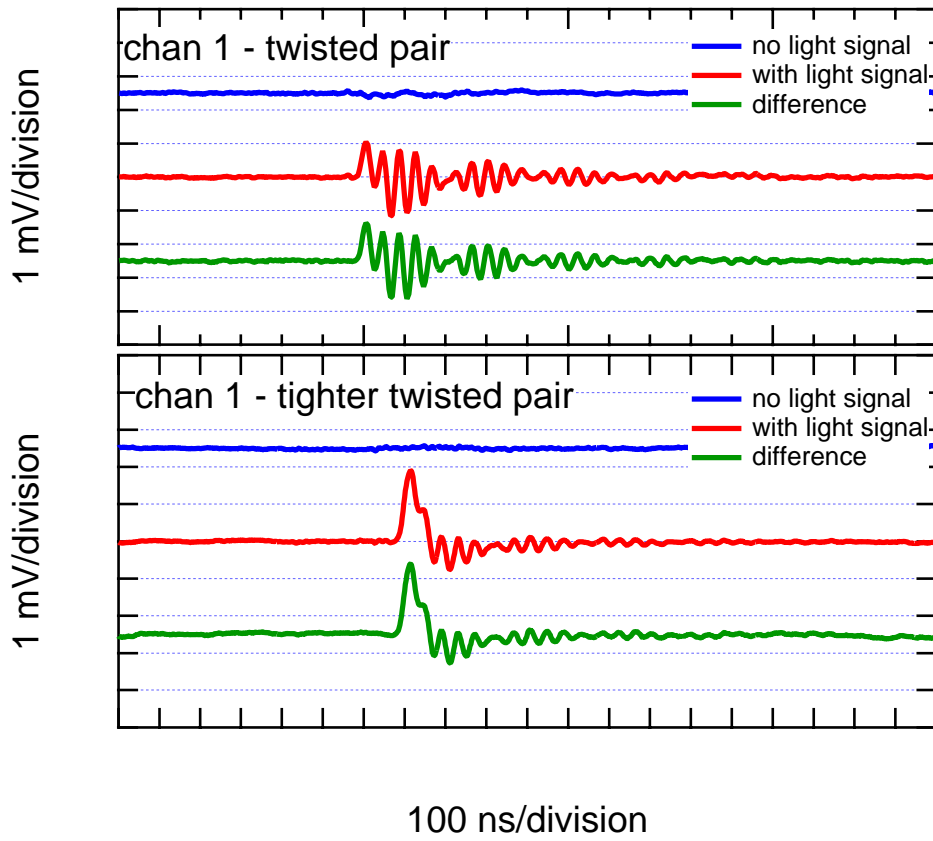


Figure 3. Crosstalk for VFE channel 1

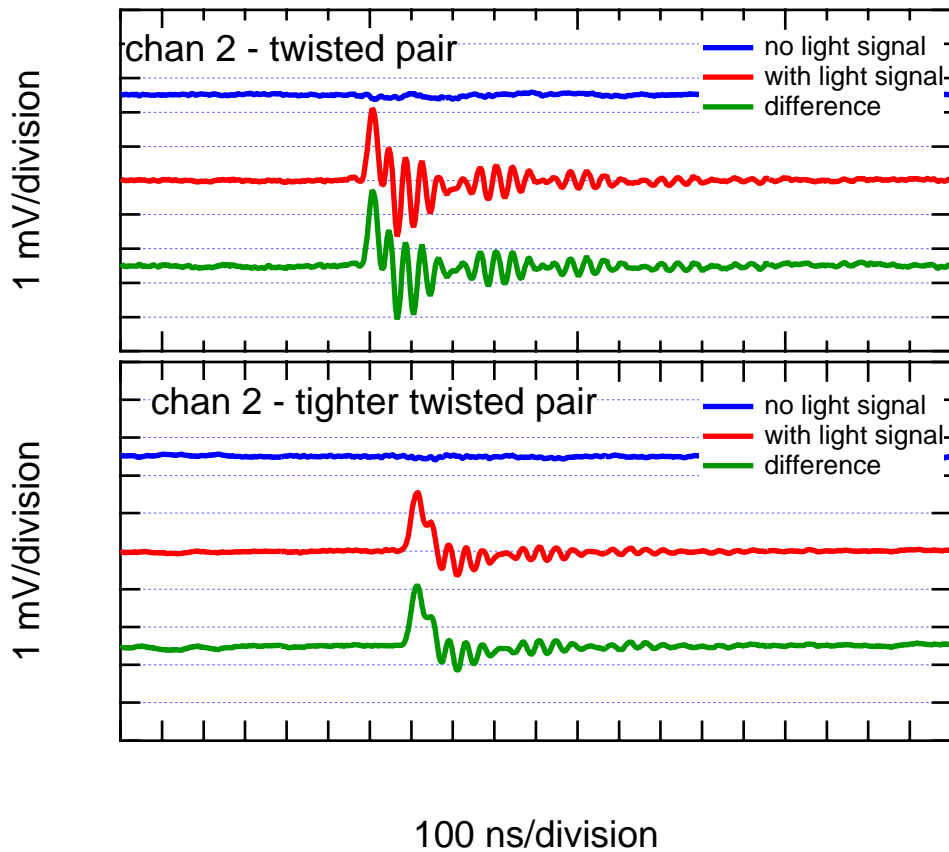


Figure 4. Crosstalk for VFE channel 2

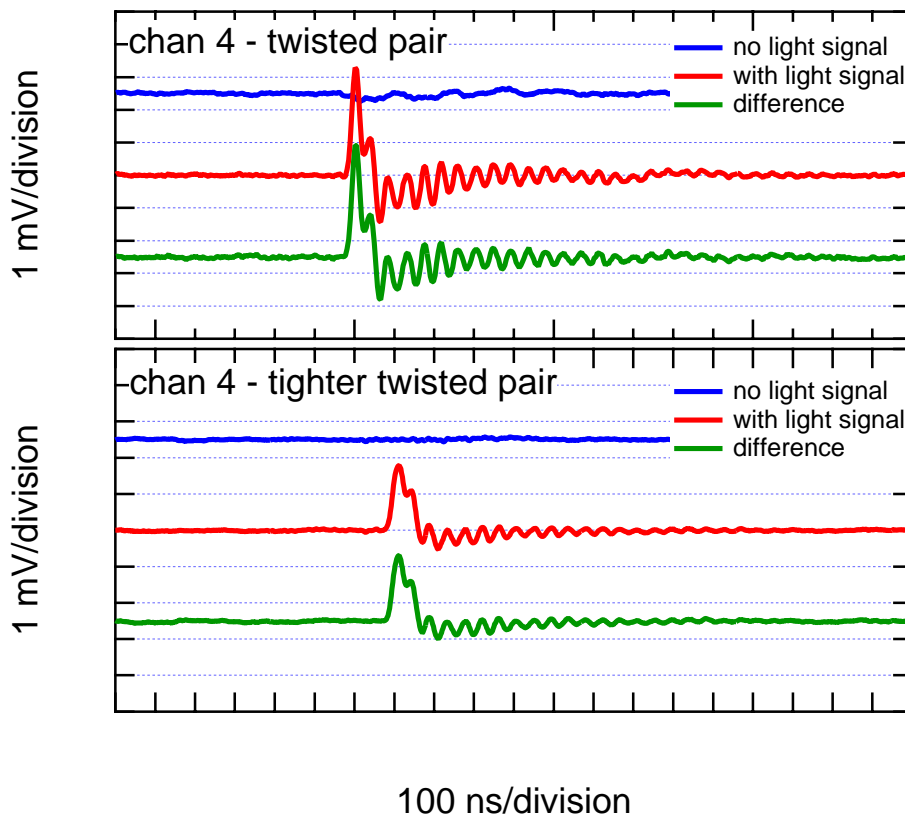


Figure 5. Crosstalk for VFE channel 4

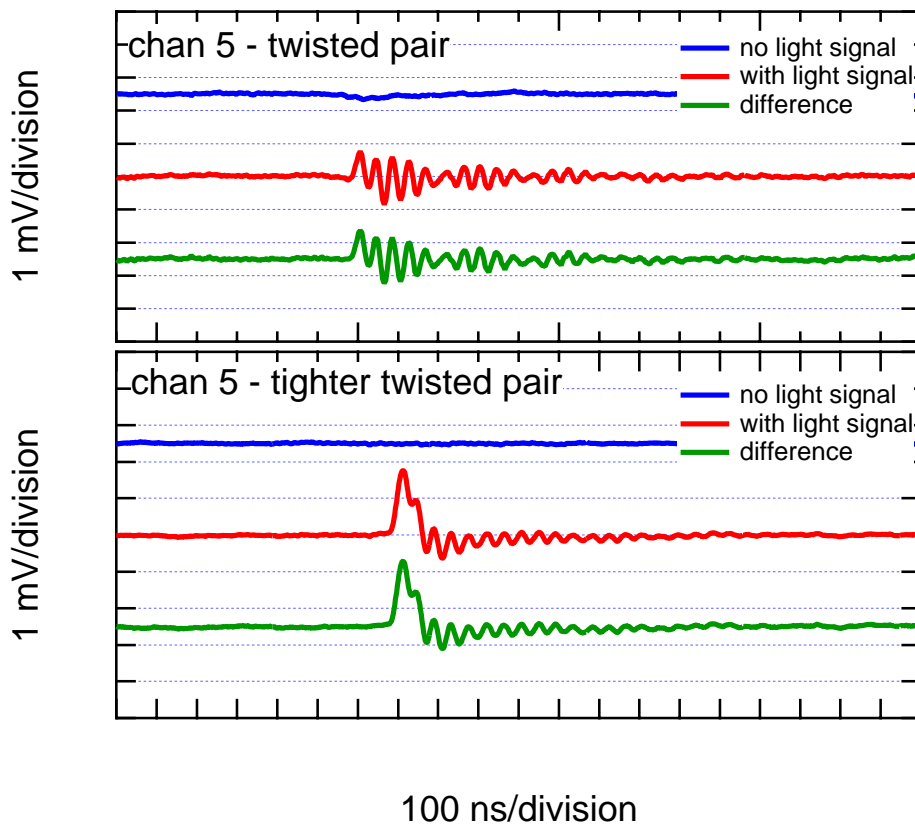
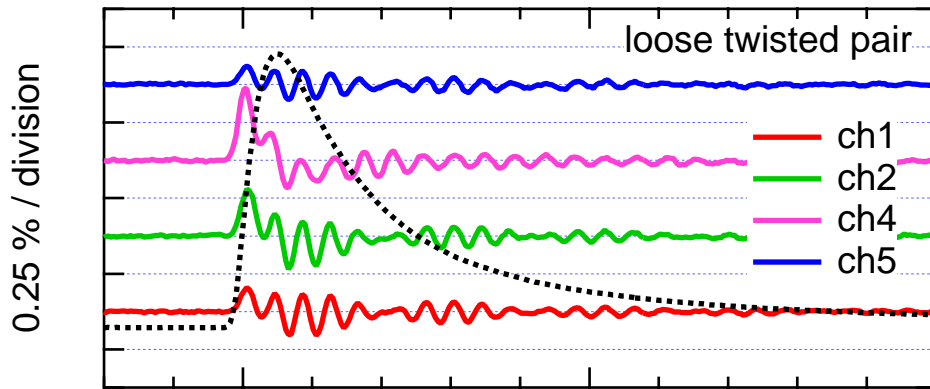
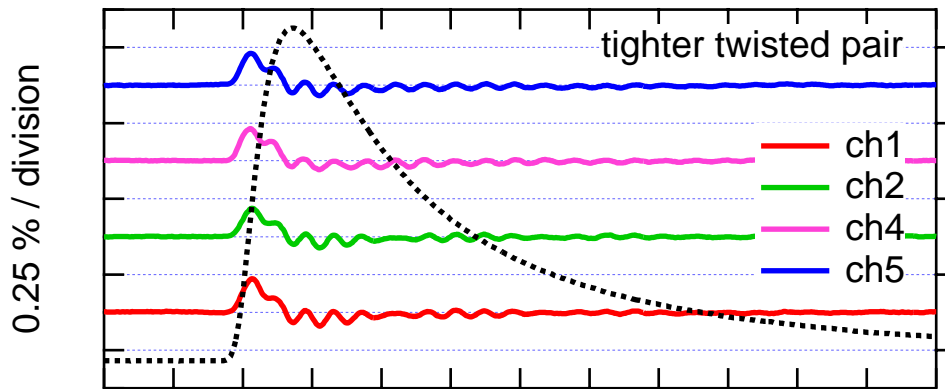


Figure 6. Crosstalk for VFE channel 5



100 ns/division



100 ns/division

Figure 7. Crosstalk signals normalised to maximum light signal pulse height (light signals in channel 3 also shown).