Supplementary Material

# Supplementary Data

Fig. 7 reports the spectrum measured at the signal port of the device. Therefore, the idler power here measured is a fraction of the idler power propagating in the multimode waveguide. In order to go back to the idler power actually coupled on the first TE mode (and thus involved in the FWM process) we considered the efficiency of the ADC and DC of the device and the coupling losses of the input and output facets of the device (6 dB per facet). Propagation losses are negligible thanks to the multimode waveguide.   
The DC at 1469 nm transmits the 49% and reflects the 51% of the power.   
The ADC at 1469 nm converts the 84% of the power into the 2TE waveguide mode.

We found that the idler power (1469 nm) measured at the signal port has to be multiplied by 4.4 to get the power on the first TE mode in the multimode waveguide.   
From Fig. 7 the off-chip CW idler at the signal port is 0.55 uW (-32.6 dBm). Therefore, the idler power on the 1TE in the multimode waveguide is 2.42 uW.   
To get the power of the generated signal at 1641 nm it has to be integrated the power over all its bandwidth, which is almost the same of the pump. By integrating over all the bandwidth and applying the duty cycle factor (23.98 dB), the off-chip peak power of the signal results 35 nW. Thus, rescaling by the coupling losses of the output facet, the on-chip signal peak power is 140 nW.

Finally, by calculating the conversion efficiency as the ratio between the on-chip signal peak power and the on-chip CW idler on the first TE mode we find 10\*Log(140 nW / 2.42 uW) = -12.4 dB.

A more conservative value for the efficiency can be calculated considering the total CW idler power circulating on-chip, not only the power coupled on the first TE mode. In this case the idler power measured at the signal port has to be multiplied by 9.2, finding 5.06 uW. The efficiency is thus 10\*Log(140 nW / 5.06 uW) = -15.6 dB.

In other terms, -15.6 dB is the actual efficiency of the considered device, while -12.4 dB is the maximum conversion efficiency attainable with all the components of the device (DC, ADCs) working with 100% efficiency.