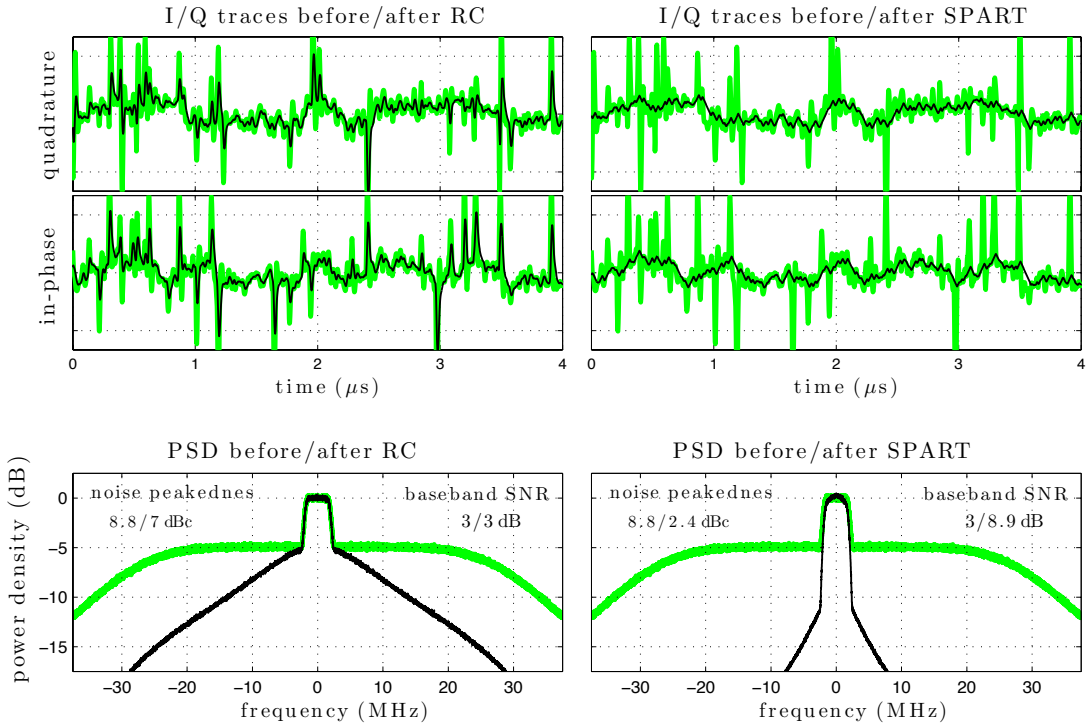
Horizon Analog's SPART filter improves quality of a communication channel affected by impulsive noise

If an appropriate SPART circuit is deployed early in the signal chain of a receiver channel affected by non-Gaussian impulsive noise, it can maximize signal-to-noise ratio and improve the quality of the channel. The simplified example shown in the figure below illustrates this statement.



In the figure, the green lines in all panels show the incoming signal-plus-noise mixture, for both time (separately for the in-phase and the quadrature traces I/Q) and frequency domains. The incoming signal represents a communication signal with the total bandwidth of 5 MHz, affected by a bandlimited mixture of a thermal (Gaussian) and white impulsive noises, with the total noise peakedness of 8.8 dBc.* The signal-to-noise ratio in the baseband is 3 dB, and the bandwidth of the noise is an order of magnitude greater than the channel bandwidth.

The incoming signal is filtered by (i) an RC integrator with the time constant $\tau = 16$ ns (3 dB frequency cutoff at 10 MHz; black lines in the left-hand panels), and (ii) a SPART circuit with the same τ and appropriately chosen rate parameter (black lines in the right-hand panels). Note that the RC integrator is just the SPART circuit in the limit of a large rate parameter.

As can be seen in the left-hand panels, the RC filter does not affect the baseband signal-to-noise ratio, as it only reduces the power of the noise outside of the channel. Also, since the time constant is small, the noise remains impulsive (7 dBc), as can be seen in the upper panels on the left showing the in-phase/quadrature (I/Q) time domain traces. On the other hand, the SPART circuit (the right-hand panels) improves the signal-to-noise ratio in the baseband by 5.9 dB, effectively suppressing the impulsive component of the noise and reducing the noise peakedness to 2.4 dBc. By comparing the black lines in the upper panels of the figure, for the RC and the SPART circuits, one can see how the SPART circuit removes the impulsive noise by "trimming" the outliers while following the narrower-bandwidth trend.

*The noise peakedness is measured as "excess-to-average power ratio," and expressed in units "dBc", or "decibels relative to constant."