Quick Guide for the use of the filter settings of the TDR evaluation of the OWTS M28 / M60

This quick Guide is intended for OWTS users. Following will be a description of the functionalities and the background of the different filter settings which can be adjusted during the evaluation with the OWTS Explorer.
It is intended as guide line for the correct use of the different filter possibilities.

Data collection
Prior to the evaluation, a successful data collection is done. A high importance has in this sequence the setting of the adaptive quadrupole. The correct settings are important for the following data evaluation. The quadrupole offers some bandwidth adjustments, which are set in accordance with the cable lengths. For short cables less than 500 m the setting will be the high bandwidth up to 40 MHz. Resulting the lower Bandwidth of 3 MHz is typically used for longer cables. These settings are a result of the physical attenuation properties of the cable (low pass characteristics) and the optimized use of the amplifier range, to obtain a maximized accuracy of the measurement. These settings are typically done automatically by the system, but they can also be adjusted manually. Please refer to the manual for details.
As a consequence of these already bandwidth limited measuring value recordings, the values available for evaluation contain, (depending on the cable length), a higher or lower frequency spectrum for the final evaluation.

Band pass filtering
During the TDR analysis the band pass filtering has a default setting, as shown in the frame "Filter" in figure 1.
The slider "bandwidth" controls the band pass settings, where the lowest setting of the slider is equal to the highest Bandwidth. In simple terms, this setting varies the frequency window, which lets the frequency portions pass within this window, and which block resulting the frequency parts that are outside of the window. The effect of the band pass settings on the frequency spectrum is shown in figure 2.

Figure 1: example for a reflection in the tdr evaluation

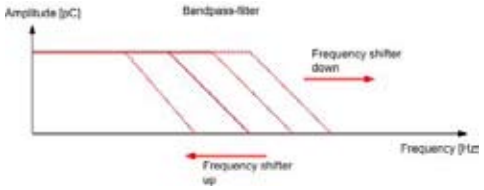

Figure 2: schematic view of the band pass in the signal level

Wavelet Filtering
The Wavelet filtering represents the second filter possibility, to be applied to the signal. In opposition to the band pass filter, the wave let filter permits an optimised possibility for noise reduction. The band pass filter permits only a fixed frequency window. The Wavelet filter can generate a set of different filters (multi section filter), which passes the correct signals or blocks them. A multi section filter is like a very high amount of band pass filters, see figure 3. Resulting this filter technology is much more complex than the band pass filter. With the settings "order" (slope steepness), "Level" (Amount of filters), "ignore" (Ignoring of passing signal frequencies) und the frequency slider (Threshold slider) the wavelet filtering can be optimised until the intended result is achieved. An ideal setting results in an almost noise free reflection diagram, see figure 4. But any real filter reaches certain levels. So for some specific types of the reflected signals the result may only be similar to the band pass filter.

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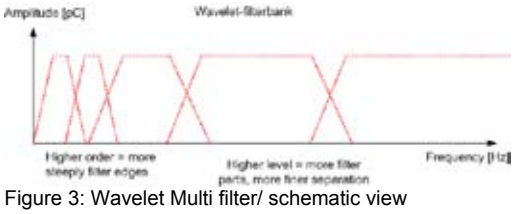

Figure 3: Wavelet Multi filter/ schematic view

Figure 4: Wavelet filter applied the the reflection of fig.1

FAQ's

Which filter should be used?
As a start, the default band pass filter settings should be maintained, since this permits a relatively fast operation. But also here, situations may occur, where it is important to focus on a specific reflection. Then the wavelet filter is the better solution.

How can I determine which frequency components are contained in my signal?
The steeper and edgy the signal appears, the more high frequency components are included. A simple test is, to move the Band pass slider from bottom to top, which reduces the passing frequencies. As a result it can be observed, how the signal shape changes to a rounder and wider appearance.

What advantages are achieved by the filtering?
The filtering permits to differentiate the partial discharge reflections better from the noise. This permits then a much better statement about the position of the PD Fault.

Are my filter settings depending on the cable lengths?
Basically the cable length has a direct effect on the bandwidth of the reflected signal.
Here we have a simple rule. The longer the cable, the higher is the attenuation of the high frequency components of the signal. Further, it must be distinguished between the cable types. A PILC cable has in a comparable length a higher attenuation than a similar XLPE cable. For the filter setting however, this has no direct influence.

What should I do for a correct filter adjustment?

- Select Band pass
- Move Band pass slider fully down (highest bandwidth)
- If the reflection is very noisy, (many small signals on the reflection) slide the bandwidth slider slowly up
- If a clear reflection becomes visible, then "accept", otherwise "skip" which deletes this reflection

What must be observed when I look for a PD Signal?
First, independent from the location of the fault spot, a reflection close to the trigger reflection (first pulse, marked "original" with blue triangle) indicates a fault closer to the far end of the cable. In this case, both pulses should have a similar shape and amplitude, since both had to travel a similar distance through the cables. Is the second reflection far from the trigger pulse, it indicates a PD fault at the near end of the cable. In this case, the amplitude of the second pulse will be significantly smaller that the Trigger pulse (how much smaller depends on the length of the cable and its attenuation) this effect can already be observed during the calibration. Due to the dispersion, the second reflection is also more rounded, since it has lost most of its higher frequencies during the passing through the cable.

Does it make a difference, if I look for a positive or negative pulse?
No. Rule is, the reflection must be equal to the trigger pulses, meaning: Trigger pulse positive --> Reflected pulse Positive and vice versa.

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