Avago Technologies IFPD Industrial Fiber

Relative Intensity Noise measurements

IEEE802.3bv Gigabit Ethernet over POF Task Force
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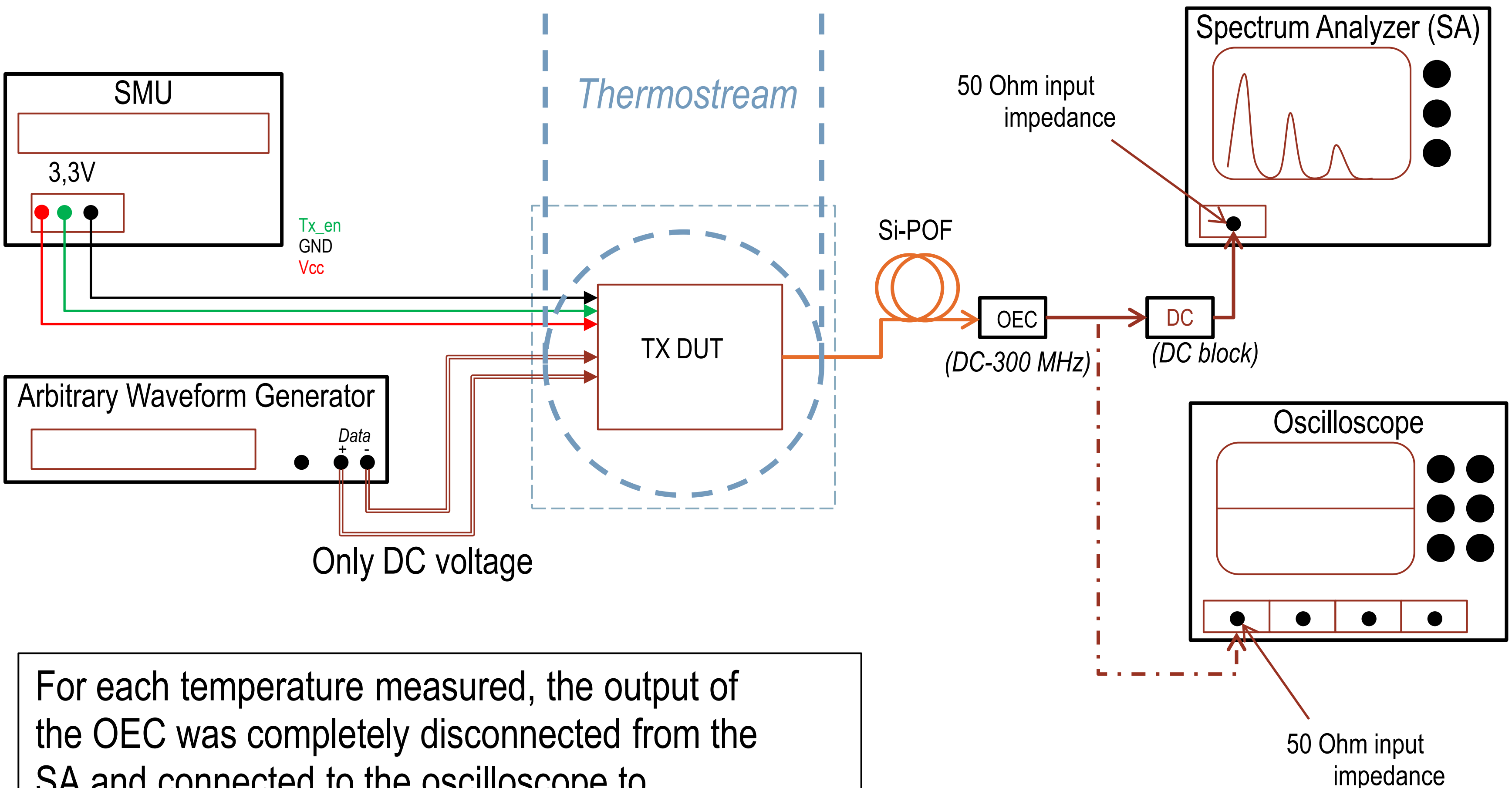
Purpose

- **Present the 802.3bv TF members a measurement methodology and results of relative intensity noise for a PMD transmitter**

Measurement conditions

- Temperature: -40 to 85 deg
- Sweeping frequency from 10 – 170 MHz
- The used optical-to-electrical converter (OEC) was a Femto DC...300MHz

Setup



For each temperature measured, the output of the OEC was completely disconnected from the SA and connected to the oscilloscope to measure the DC output voltage

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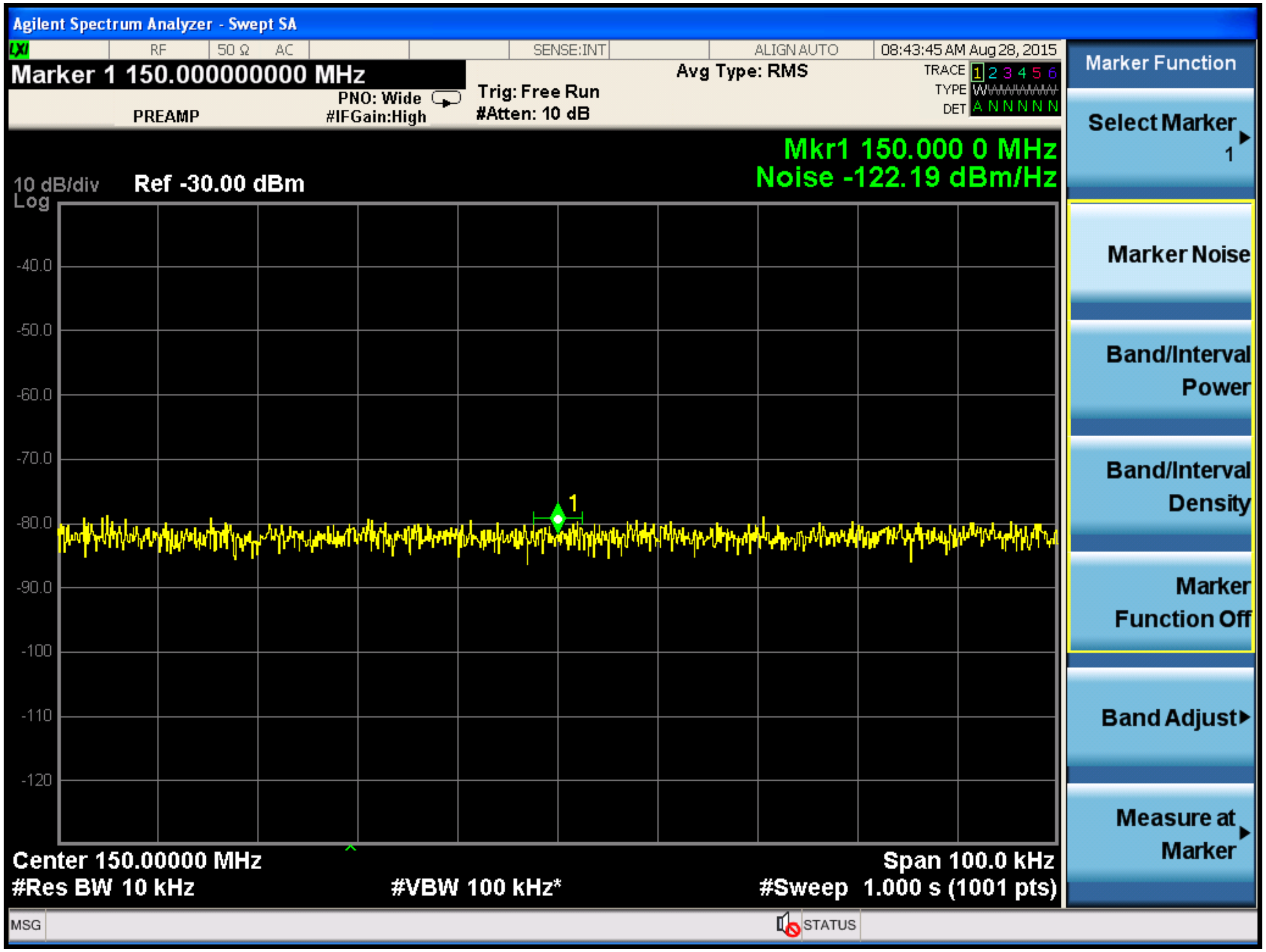
Spectrum Analyzer settings



SA settings at a glance:

- **Internal pre-amplifier enabled (noise level ~10 dB improved)**
- **ADC Dither function off (decreased linearity but also improved noise floor)**
- **High Swept IF Gain and FFT IF Gain for best noise level**
- **Low Resolution BW (10kHz) and low Video BW (100kHz)**
- **Long sweep time (1 second)**
- **Enabled noise marker**

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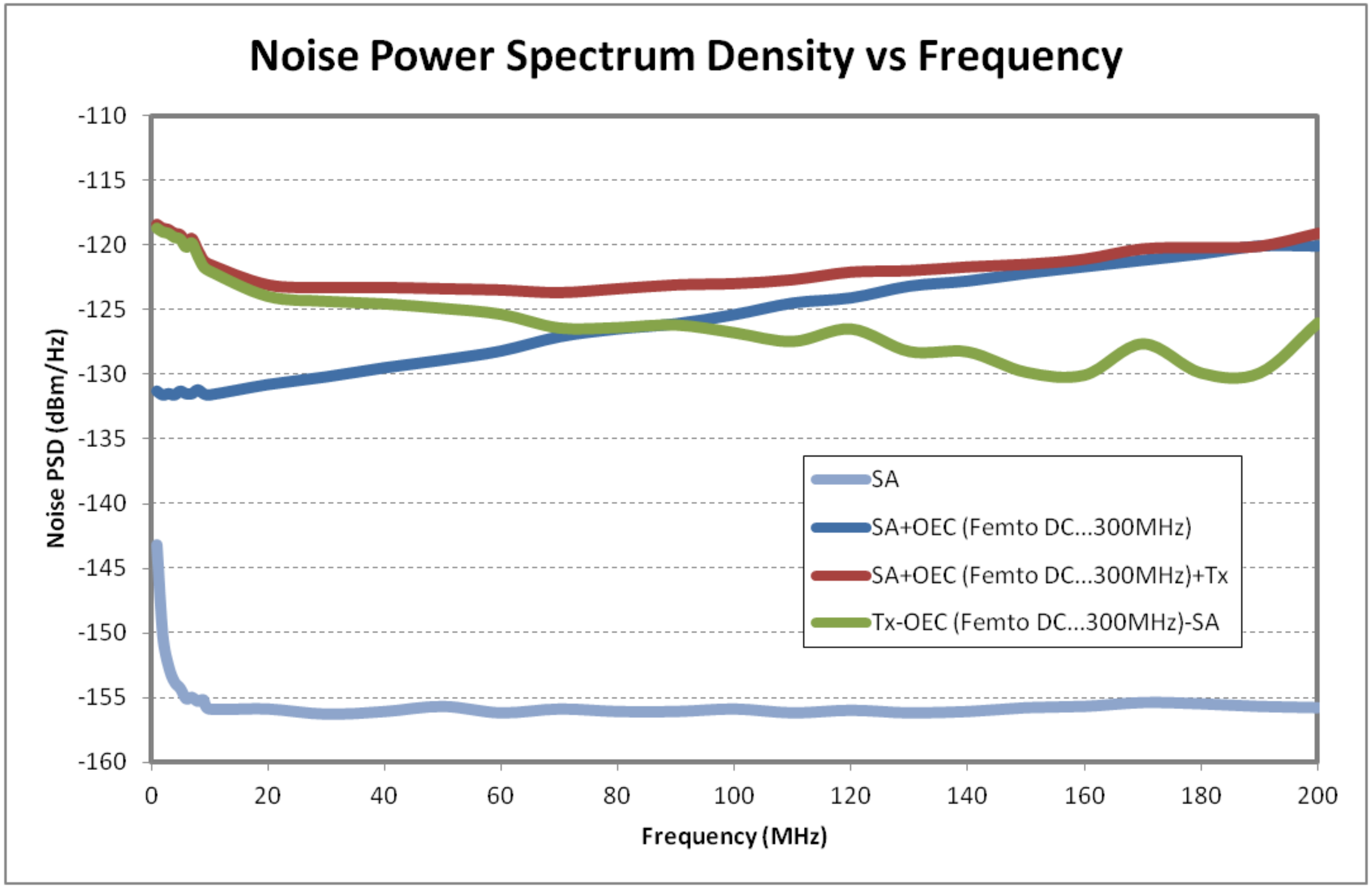
Measurement procedure



To get the noise PSD of a transmitter sample (green chart), the noise spectra of SA and OEC (blue chart) need to be substracted from the acquired measurement data (red chart)

Relative Intensity Noise calculation

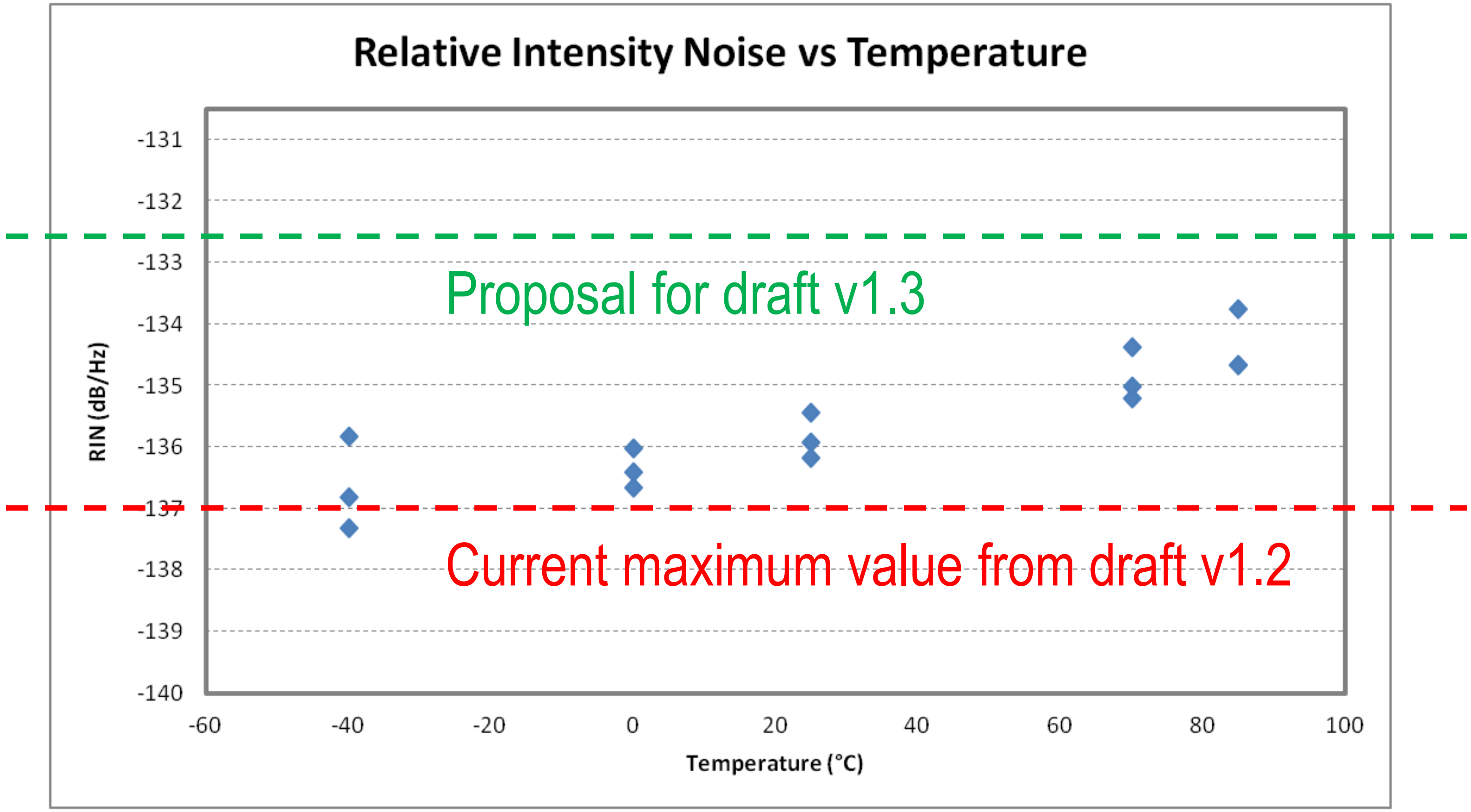
$$\mathrm{RIN} = 10\log_{10}\frac{P_\mathrm{N}}{BW \times I_{oe}^2 \times R} - G \ \ (\mathrm{dB/Hz})$$

where:

	RIN	is the relative intensity noise,
1.	P_N	is the electrical noise power in Watts with modulation off,
2.	BW	is the low-pass bandwidth of apparatus – high-pass bandwidth of apparatus due to DC blocking capacitor,
3.	I_{oe}	is the photocurrent of the optical to electrical converter,
4.	R	is the effective load impedance of the optical to electrical converter (for example, a 50 ohm detector load in parallel with a 50 ohm power meter would give R equal to 25),
5.	G	is the Gain in dB of any amplifier in the noise measurement path.

1. **PSD measured w/ SA, calculated in Watts**
2. **Signal bandwidth -> 162,5 MHz -> 170 MHz were taken for ease of use**
3. **Conversion gain of OECs output voltage need to be considered -> instead of I^2_{oe} x R**
   U^2_{oe} / R was taken
3. **Load impedance of OEC = 50 Ohm**
4. **Internal amplifier of SA (~ +10 dB) was neglected**

RIN measurement results



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Conclusions

- Considering the application case up to 85°C, the limit for RIN need to be increased to -132,5 dB/Hz
- For a differentiation between several use/application cases with other temperatures, more RIN limits can be taken into account

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Thank you