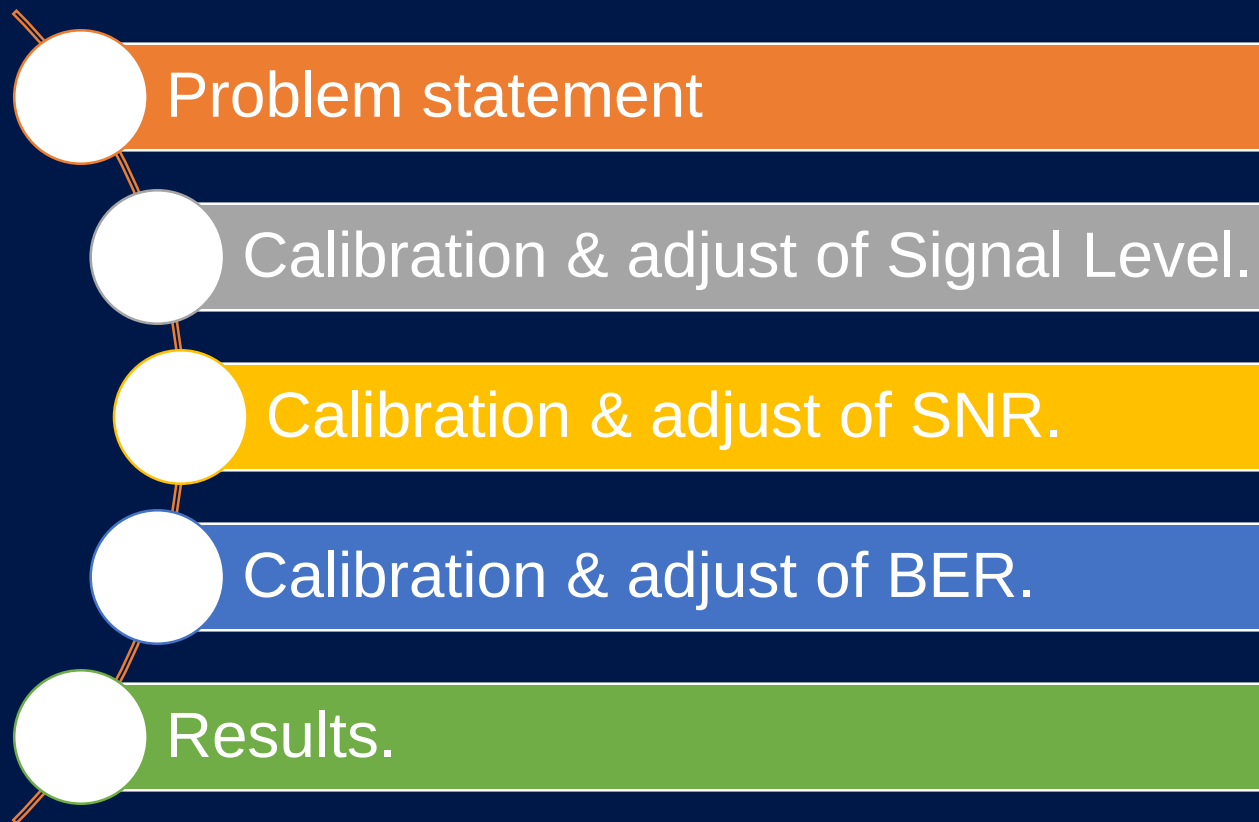


Calibration and adjustment of DTMB signal parameters on monitoring tool based on a commercial STB.

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Havana, November 2017

Outline



Precedents

- Digital Television deployment across the country.
- Broadcast services provider need for signal parameters monitoring.
- Development of DTMB signal monitoring tool based on commercial STB.

Tool's functionalities

- Retrieve DTMB mode used.
- Measure current values of Power, BER and SNR.
- Time statistics: extreme values and averages.
- Time variation graphs.
- Save data records at user's request.

Problem

The measurements obtained with the tool deviate from the lab-generated reference values and the functional relationship is unknown.



Goal

Calibrate and adjust the DTMB monitoring tool for Signal Level, SNR and BER measurements for:

- DTMB mode 6.
- Channels 7 to 51.



Calibration and adjustment of signal level.



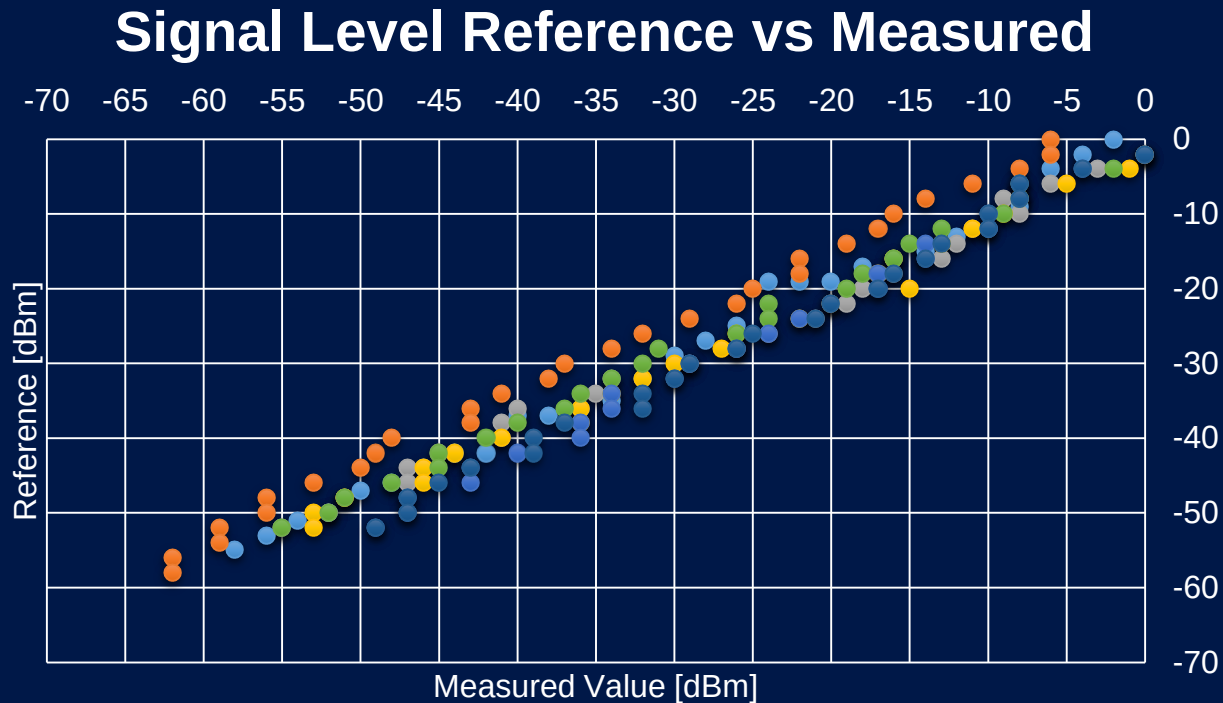
Calibration Test Set – Signal Level

- R&S BTC.
- Sweep levels from 0dBm to -56dBm
- 1dBm steps.



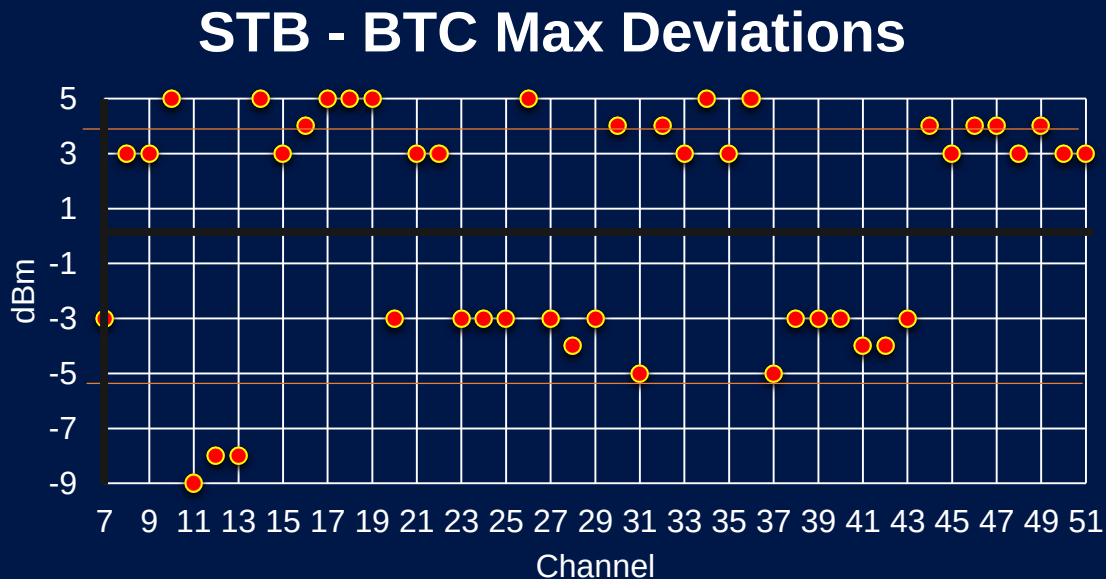
Tool calibration – Signal level

- About lineal.
- Variations in slopes and shifts



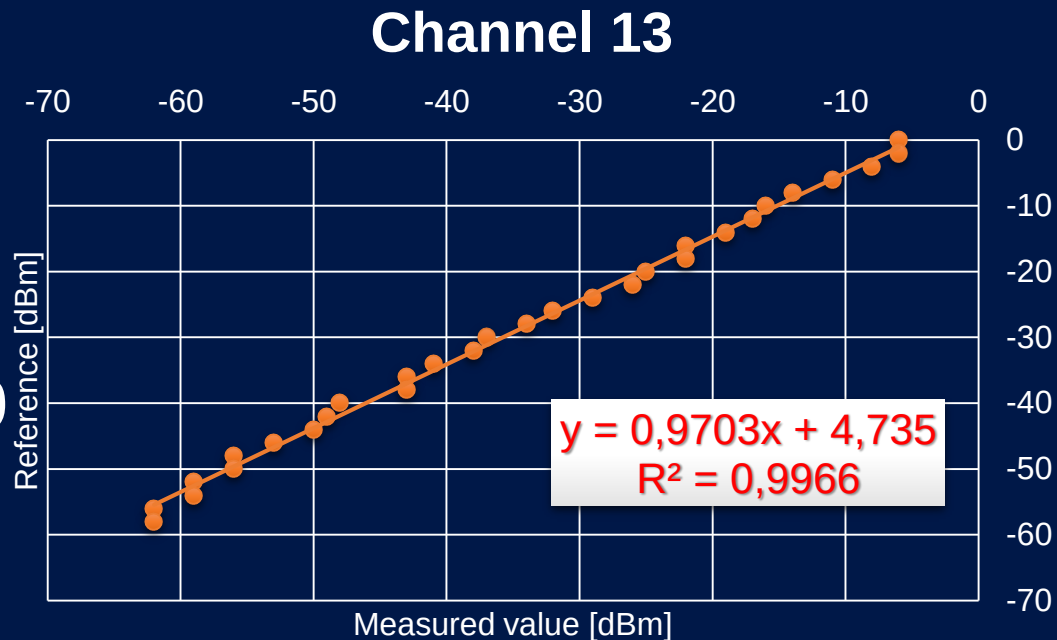
Maximum errors – Signal level

- Random errors per channel
- Maximum errors about $\pm 4\text{dBm}$.
- Peaks on 5dBm and -9dBm



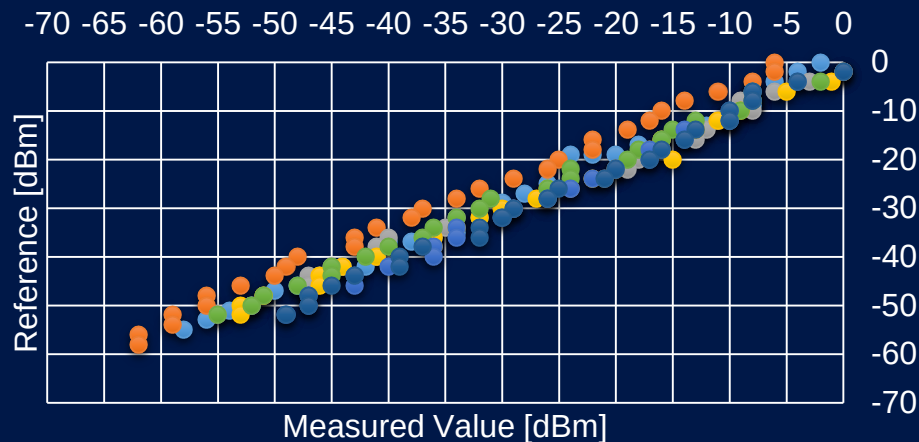
Tool adjustment – Signal level

- Proposed lineal fits.
- One fit per channel.
- Correlation above 0.99 for all channels.
- Fits are applied in the source code.

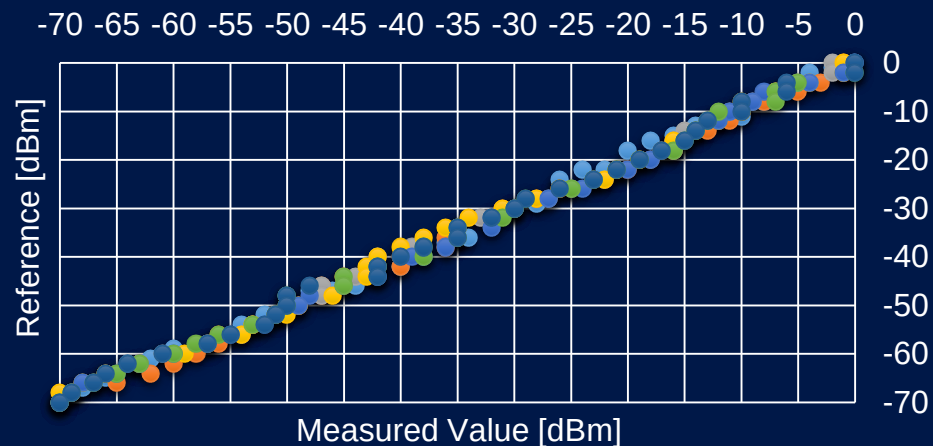


Validation – Pre and post adjustment

Pre-adjustment dispersion



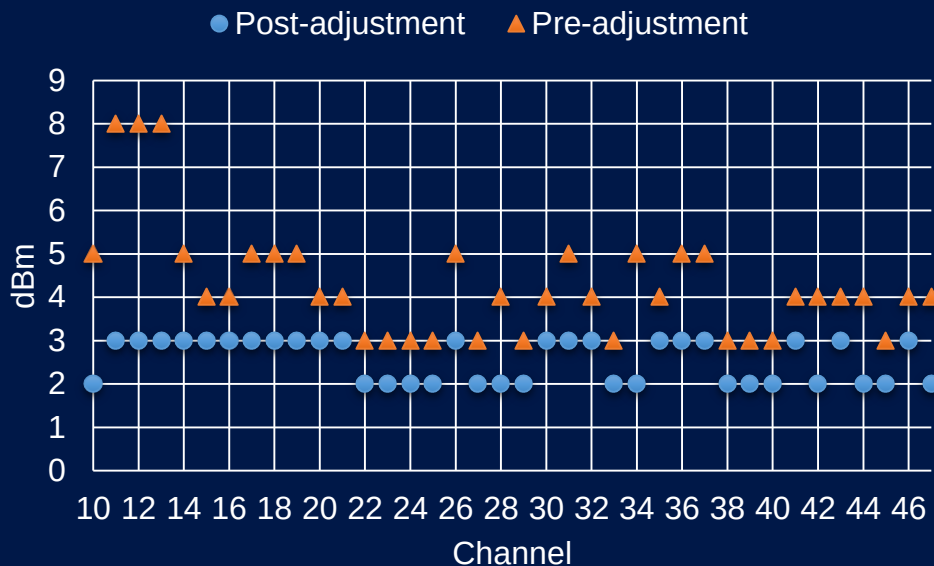
Post-adjustment dispersion



Validation – Peak errors

- Reduced errors on all channels.
- Maximum error of $\pm 3\text{dB}$ after adjustment.

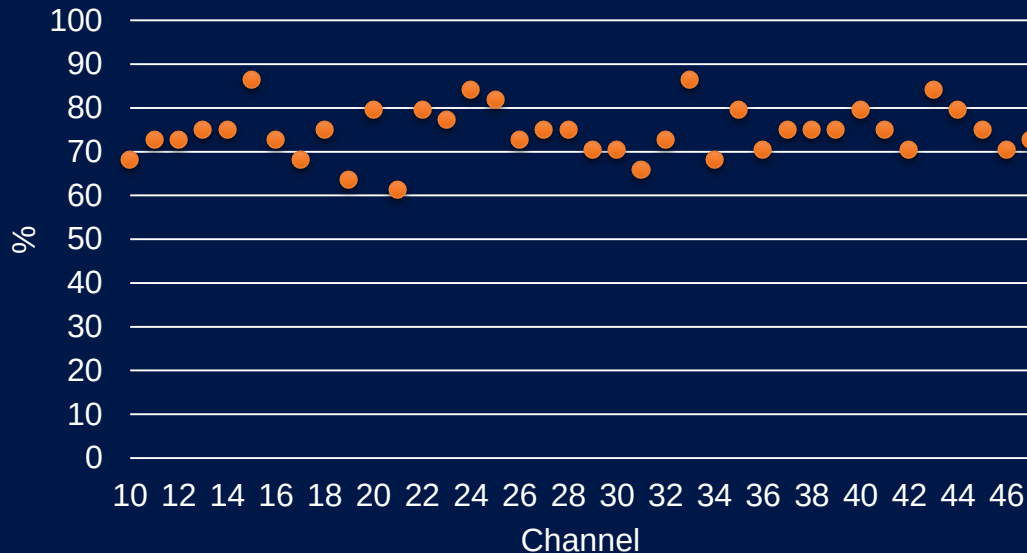
Maximum error



Validation – Spread of errors

More than 60% of deviations are between ± 1 dB.

Percentage of deviations between ± 1 dB

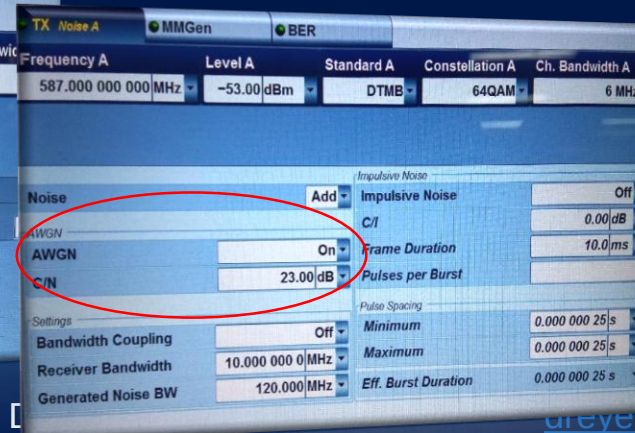
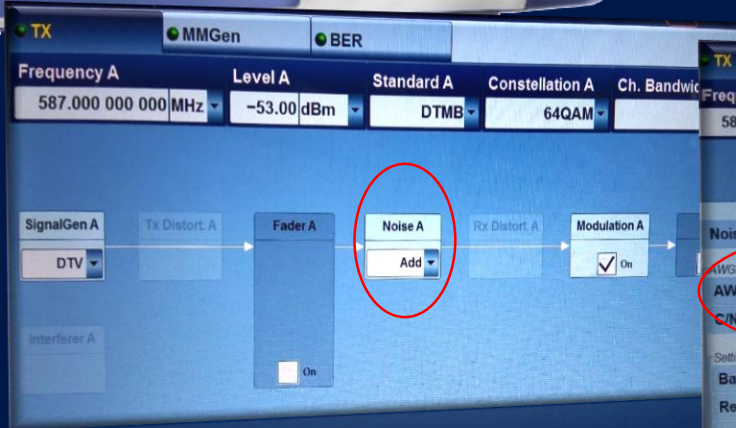


Calibration and adjustment of SNR.



Calibration Test Set – SNR

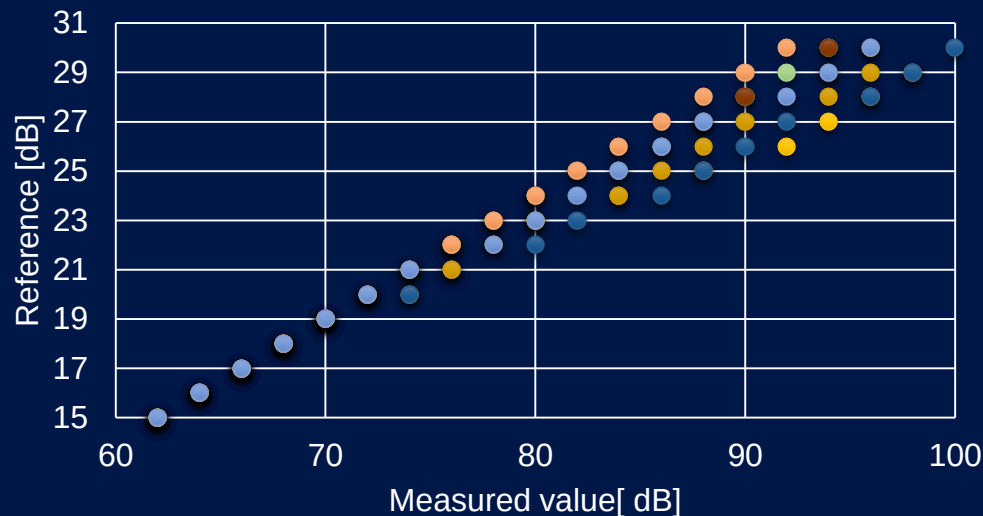
- R&S BTC.
- Level -53dBm.
- Add AWGN.
- $15\text{dB} \leq C/N \leq 30\text{dB}$.
- 1dB steps.



Tool calibration – SNR

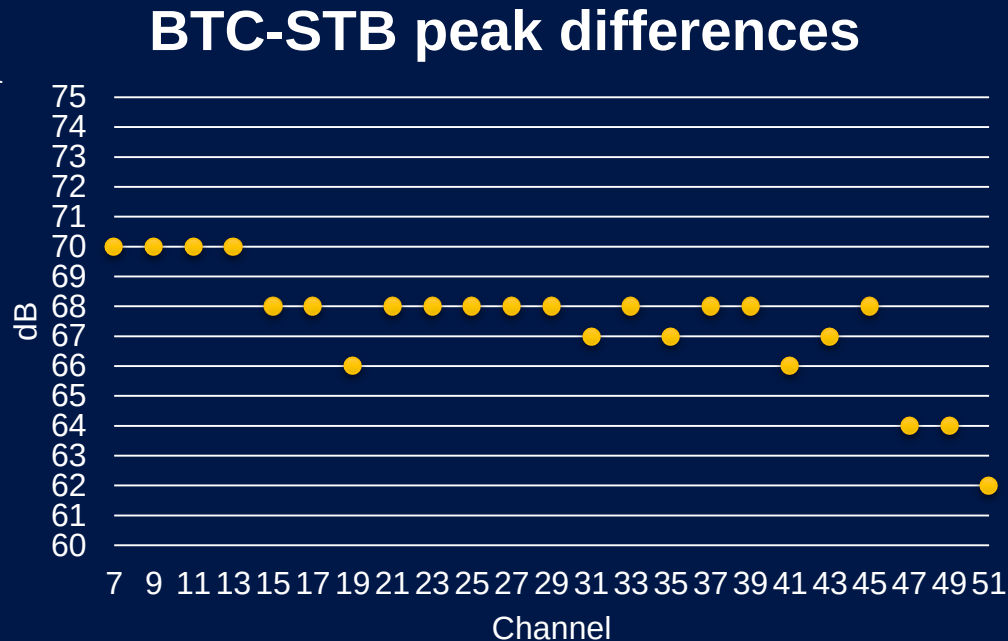
- Cuasi-linear response.
- Spread increases for higher SNR values.

SNR Reference vs Measured



Maximum errors – SNR

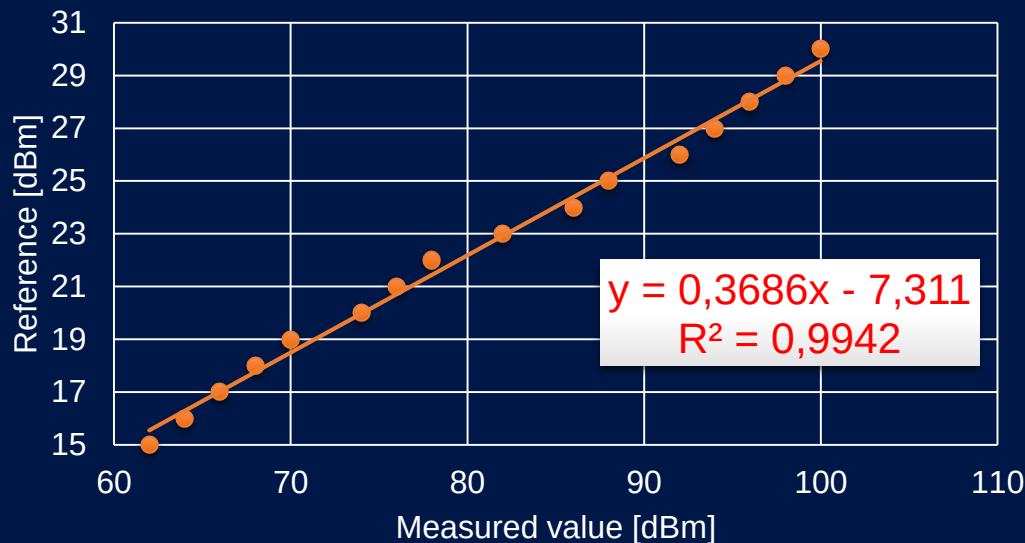
- Random values gathered around 67dB.
- Spreads between 62dB and 70dB.
- Max difference on 70dB.



Tool adjustment – SNR

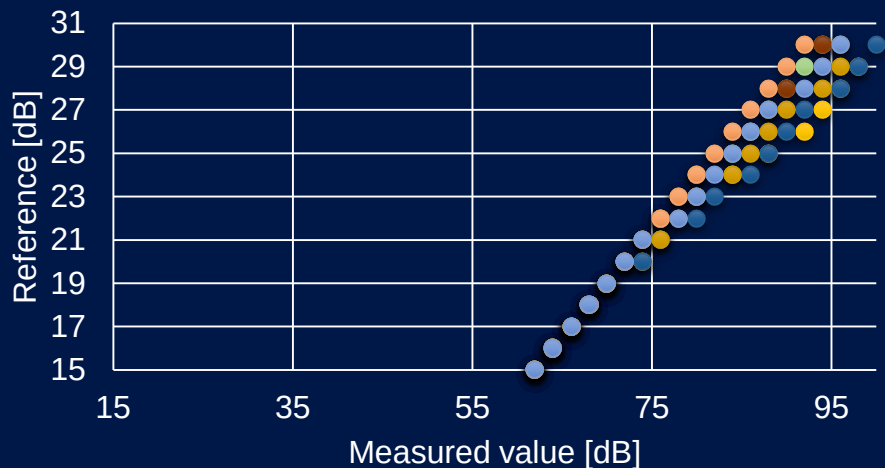
- Proposed lineal fits.
- One fit per channel.
- Correlation above 0.99 for all channels.
- Fits are applied in the source code.

Channel 7

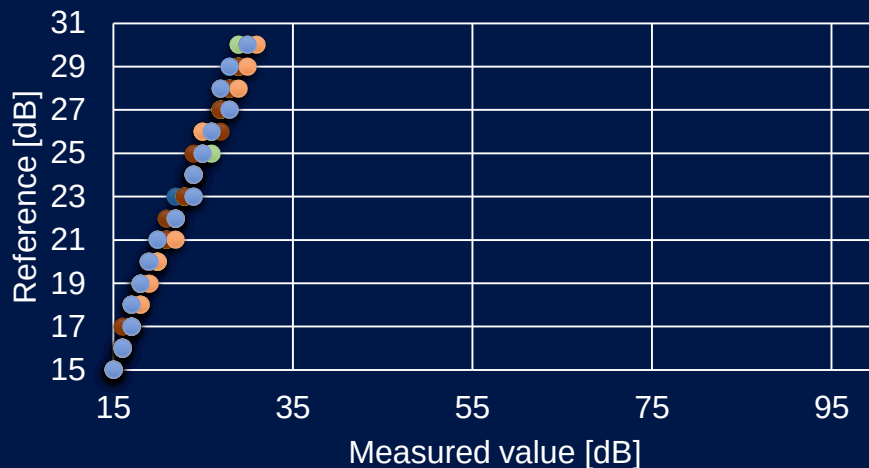


Validation – Pre and post adjustment

Pre-adjustment Dispersion

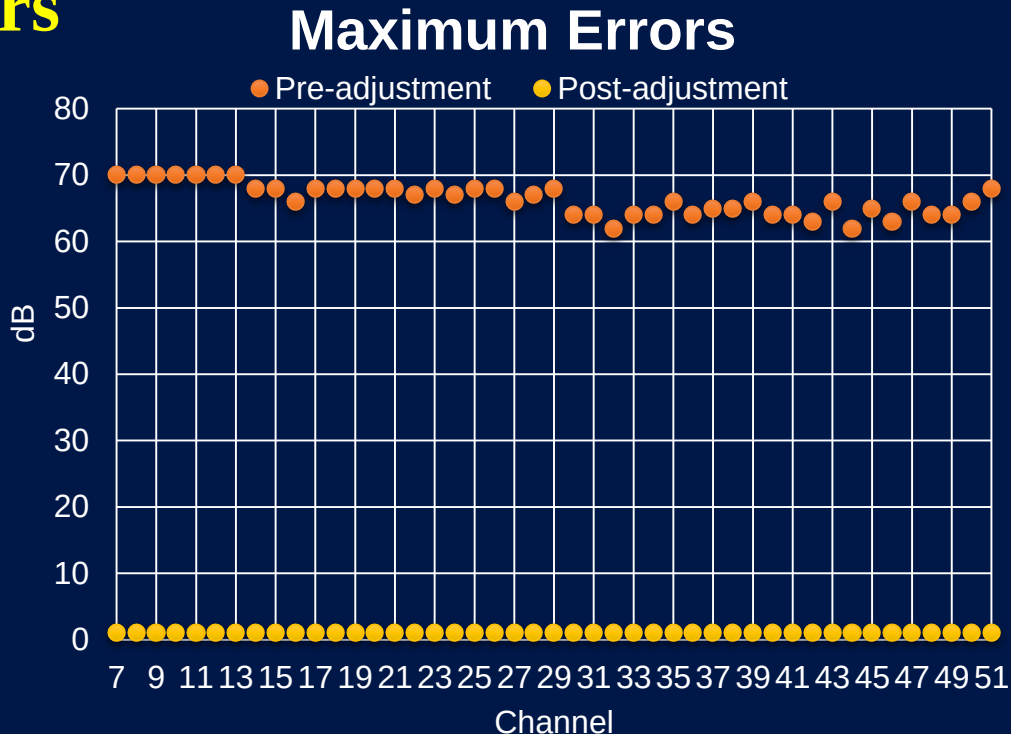


Pre-adjustment Dispersion



Validation – Peak errors

Maximum errors drop more than 60dB after adjustment.



Calibration and adjustment of BER.

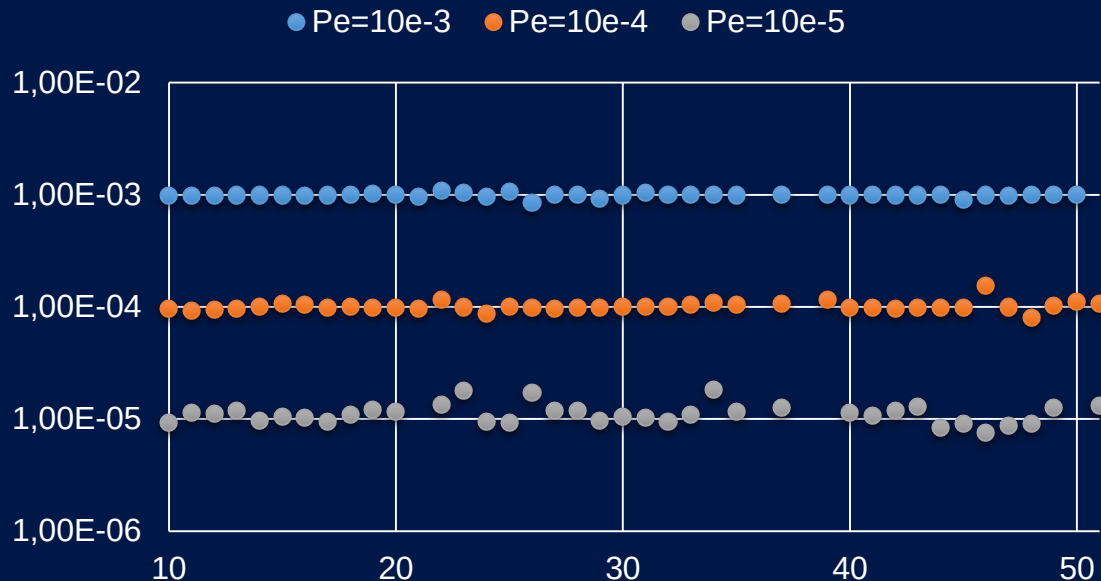


- Simulink DTMB Reference Model & Agilent E8267D PSG Vector Signal Generator.
- Generated test signals with known error probability.
- Level -53dBm.

Tool calibration – BER

- All measurements almost over its respective P_e line.
- Very low dispersions.

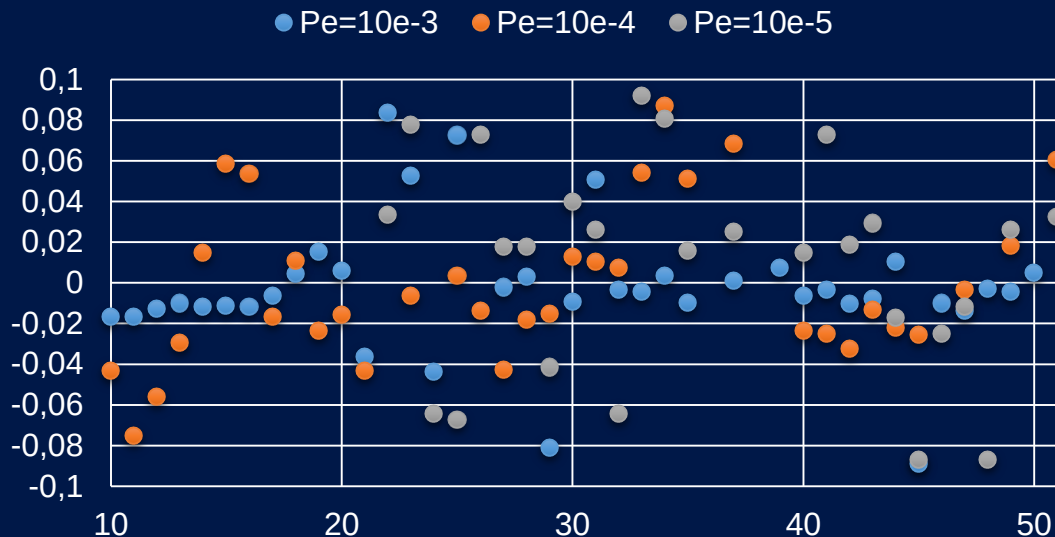
Measured BER vs P_e



Relative errors – BER

- All relative errors below 10% of reference P_e .
- No need for BER adjustment.

Relative errors



Results

- Calibrated and adjusted the signal level and SNR.
- Signal level adjusted for precision of $\pm 3\text{dBm}$, whereas SNR precision was taken to $\pm 1\text{dBm}$.
- Precision not far from commercially available field test handheld devices.
- Calibrated BER, no need for adjustment.



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