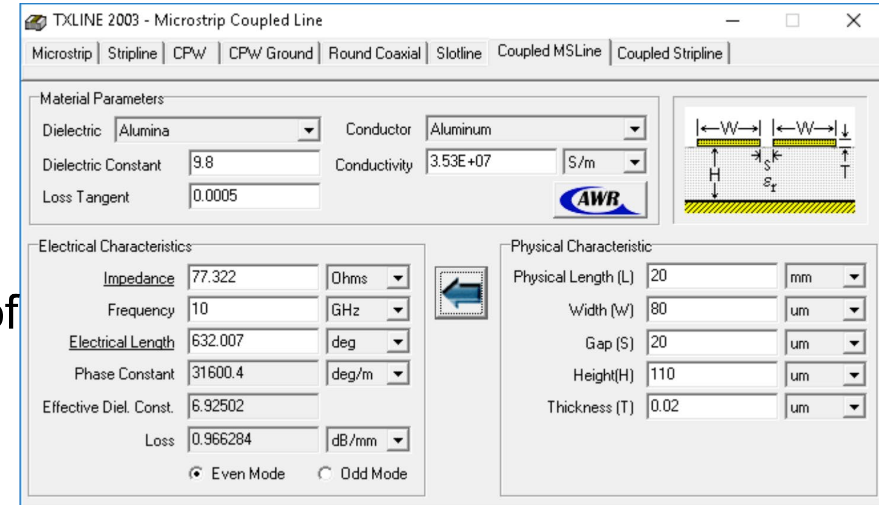
High strip resistivity and beam profile reconstruction
a case study from CLEAR's TB 28-31/03/2023

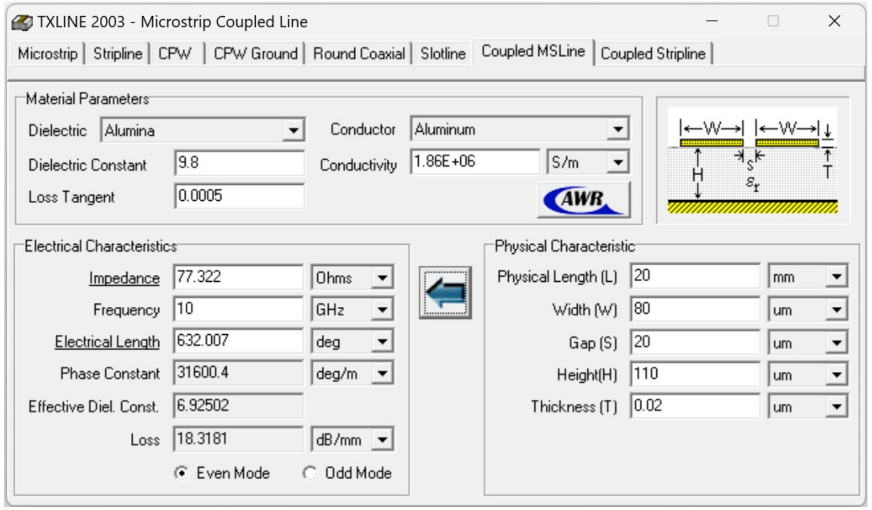
- Typical strip resistance (l=20mm) for **Tomsk** sensors is measured to be **6.7kΩ** for a strip, while **60Ω** for the **FBK** sensors.

- Typical strip even-mode impedance, assuming a signal rise time of 100ps, is approx. **77Ω** (93Ω) for the 110um-thick (150um) sensor.

- **Two key-points**
  1. high-strip resistivity implies signal attenuation (**loss**), whose intensity depends on the beam vertical position on the strip;
  2. lossy-line ($6.7k\Omega \gg 77\Omega$) means frequency-dependent termination: unproper matching and sig. **reflections.**

- **Case study:** signal from even/odd strips vs. beam pos. at CLEAR





Conclusions and open points

- **Conclusions**
  - High strip resistance – i.e., much bigger than strip impedance – should be **avoided**.
  - Quality check of strip metallization is important to ensure the layer thickness is uniform and resistivity within specifications.
  - Thicker metal layers are less affected by this issue.
    ► FBK sensors OK

- **Open points**
  - Early sapphire sensors (UniversityWafers-Inc. sapphire crystal + strip metallization by Tomsk-University) are affected by such issue.
  - Is it expected to have such high-resistance?
  - How well can the layer thickness be controlled in the manufacturing process?

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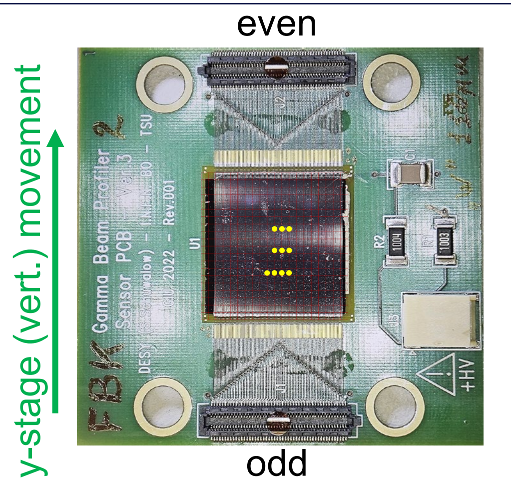

- The **test** consists in moving the beam along the strip and measure the effect looking at the asymmetry between the beam charge from the reconstructed beam profile (gaus+const fit) using either the even or the odd strips

$$asymA \equiv \frac{(A\sigma)_{even} - (A\sigma)_{odd}}{(A\sigma)_{even} + (A\sigma)_{odd}}$$

- The signal attenuation depends on the path length $e^{-loss\,\Delta y}$. Readout of even strips signals is from the top, while odd from the bottom.

- If $(A\sigma)_{odd} \propto e^{-\alpha\left(\frac{d}{2}+y\right)}$ and $(A\sigma)_{even} \propto e^{-\alpha\left(\frac{d}{2}-y\right)}$, we expect

$$asymA = \tanh(\alpha y) = \alpha y - \frac{(\alpha y)^3}{3} + O\left((\alpha y)^5\right)$$

a line with positive slope, as observed!
(notice we have $(\alpha y) \sim 10^{-2}$)