

FRA áttekintés

*X. Szigetelésdiagnosztikai Konferencia
Esztergom, 2010. 10. 20-22.*

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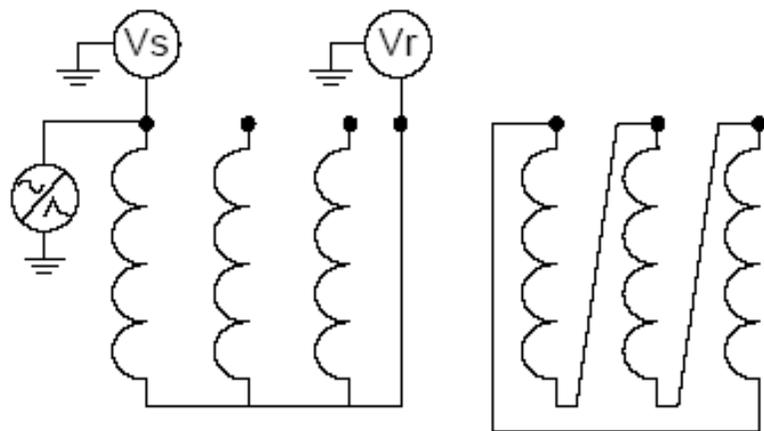
Cigré A2-26 munkabizottság

Célja:

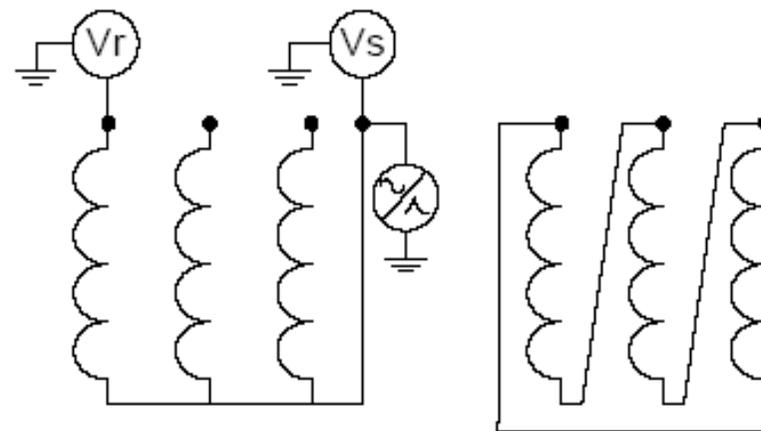
- *Az FRA mérés technika egységesítése*
- *A megbízható, ismételhető mérés feltételeinek kidolgozása*
- *A mérés értékelésének támogatása*
- *Modellalkotás az elmozdulások és az FRA görbék közötti összefüggések feltárására*



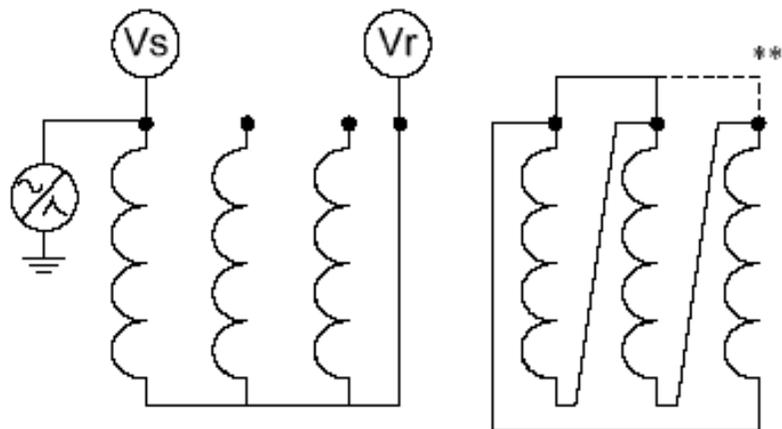
(a) End-to-end (source on phase terminal)*



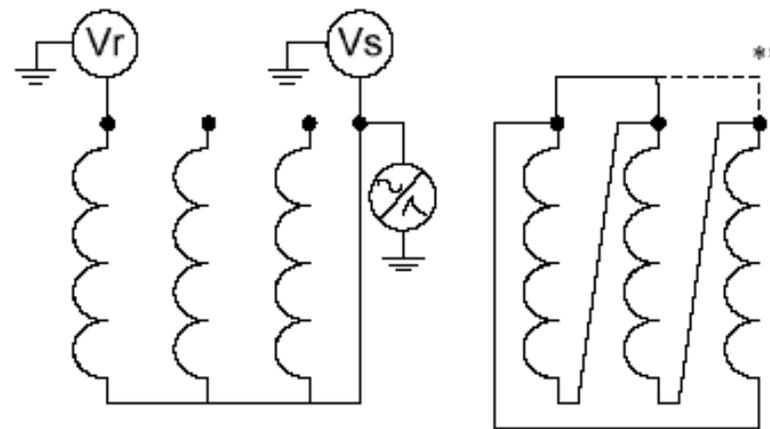
(b) End-to-end (source on neutral terminal)*

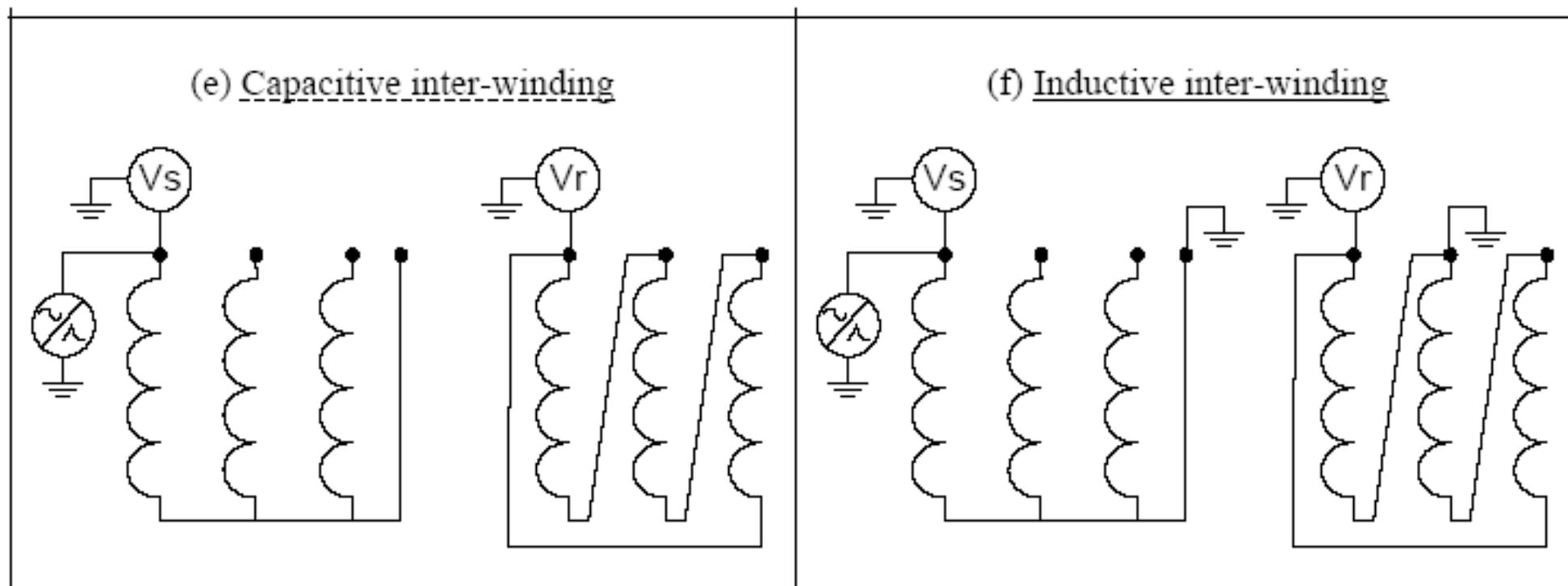


(c) End-to-end short-circuit (source on phase terminal)*



(d) End-to-end short-circuit (source on neutral terminal)*

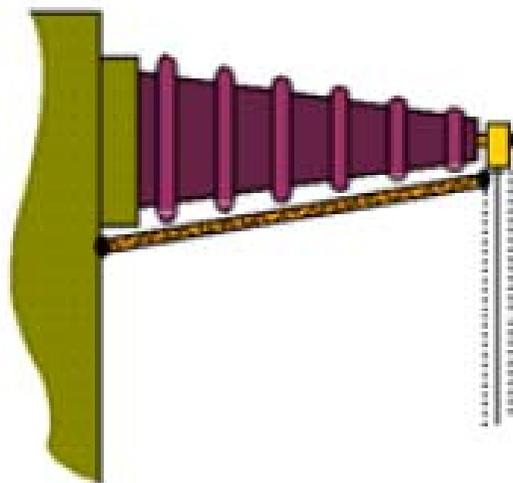




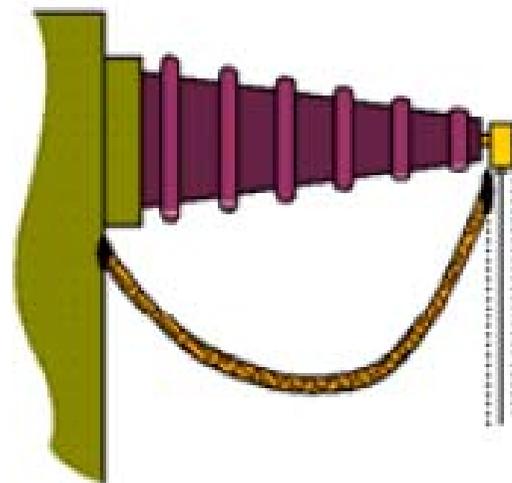
*End-to-end (open and short-circuit) tests can be performed in either direction, i.e. with the source applied on the phase terminal or on the neutral terminal.

** For three-phase transformers, there are two short-circuiting options, either per-phase or three-phase short-circuit.

Note: for auto-transformers, the end-to-end tests can be made across the series winding, the common winding or the series and common winding together.

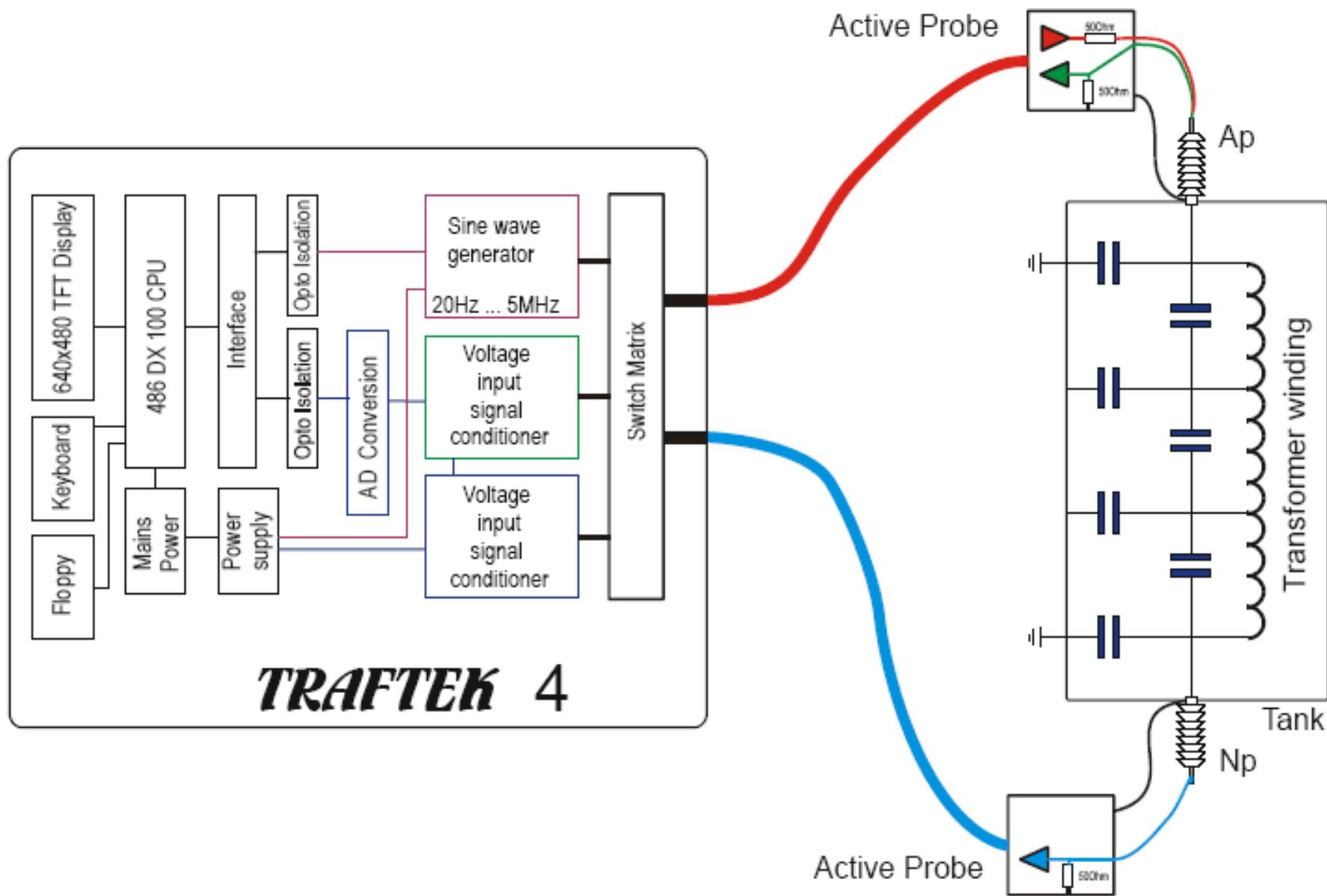


Recommended grounding practice



Bad grounding practice

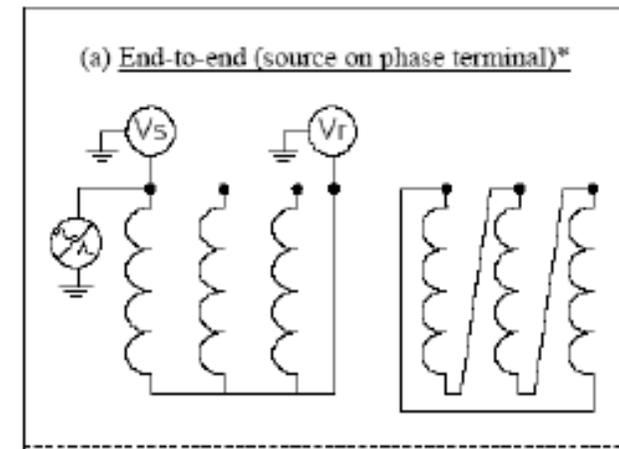
Figure 14: Recommendations for grounding the high-frequency cables.



END-TO-END OPEN WINDING MEASUREMENT

Tap position 1 and 5

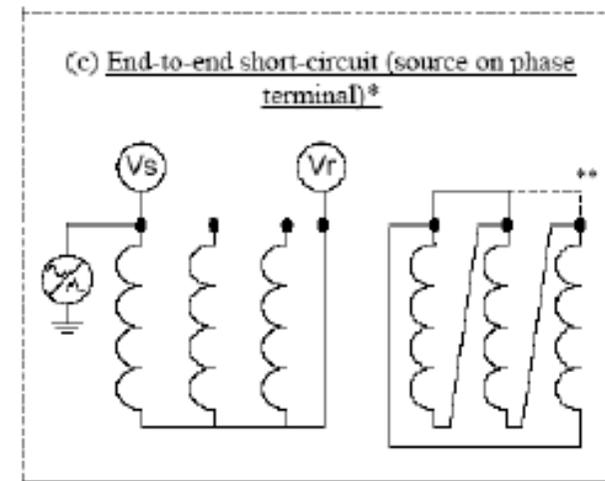
| Voltage output (Red clip) | Termination (Blue clip) | Other winding |
|------------------------------|----------------------------|---------------|
| 1U | 1N | Open |
| 1V | 1N | Open |
| 1W | 1N | Open |
| Tap position 1 | | |
| 2W | 2U | Open |
| 2U | 2V | Open |
| 2V | 2W | Open |



END-TO-END SHORT-CIRCUIT MEASUREMENT

Tap position 1 and 5

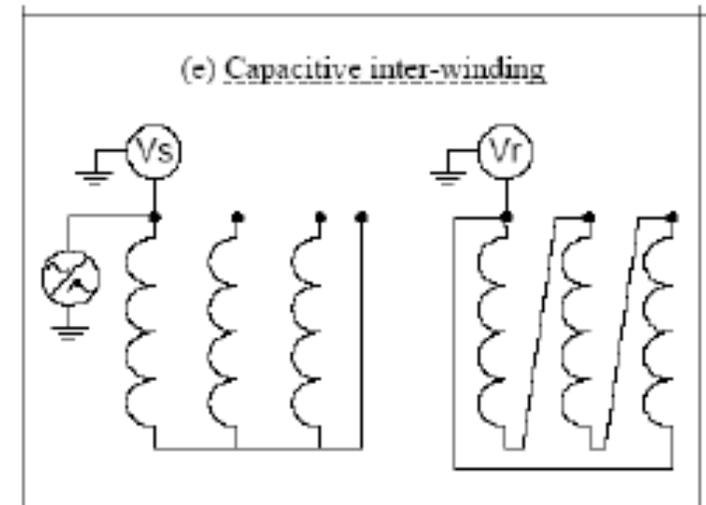
| Voltage output (Red clip) | Termination (Blue clip) | Other winding |
|------------------------------|----------------------------|---------------|
| 1U | 1N | Short+GND |
| 1V | 1N | Short+GND |
| 1W | 1N | Short+GND |



CAPACITIVE INTER-WINDING MEASUREMENT

Tap position 1

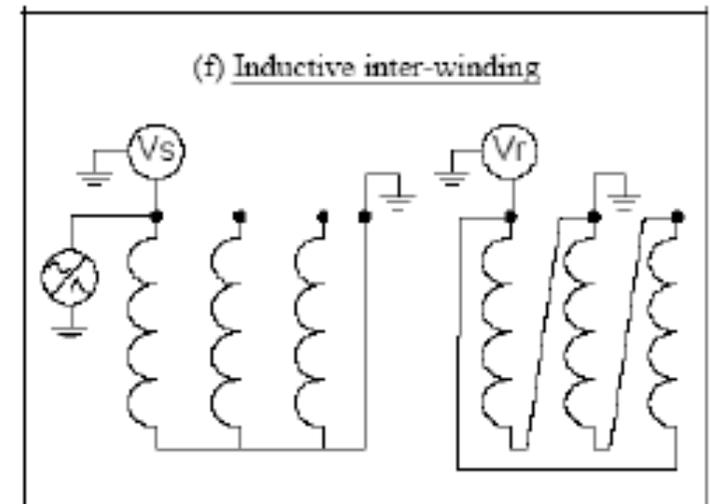
| Voltage output (Red clip) | Termination (Blue clip) | Other bushings |
|------------------------------|----------------------------|----------------|
| 1U | 2U | Open |
| 1V | 2V | Open |
| 1W | 2W | Open |



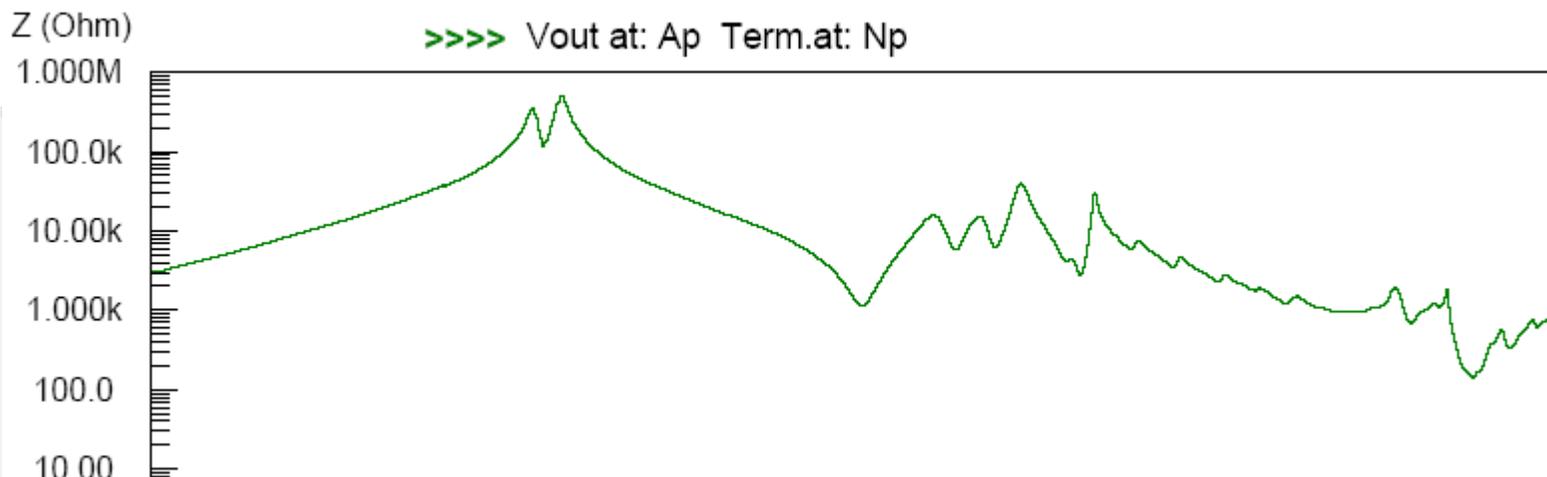
INDUCTIVE INTER-WINDING MEASUREMENT

Tap position 1

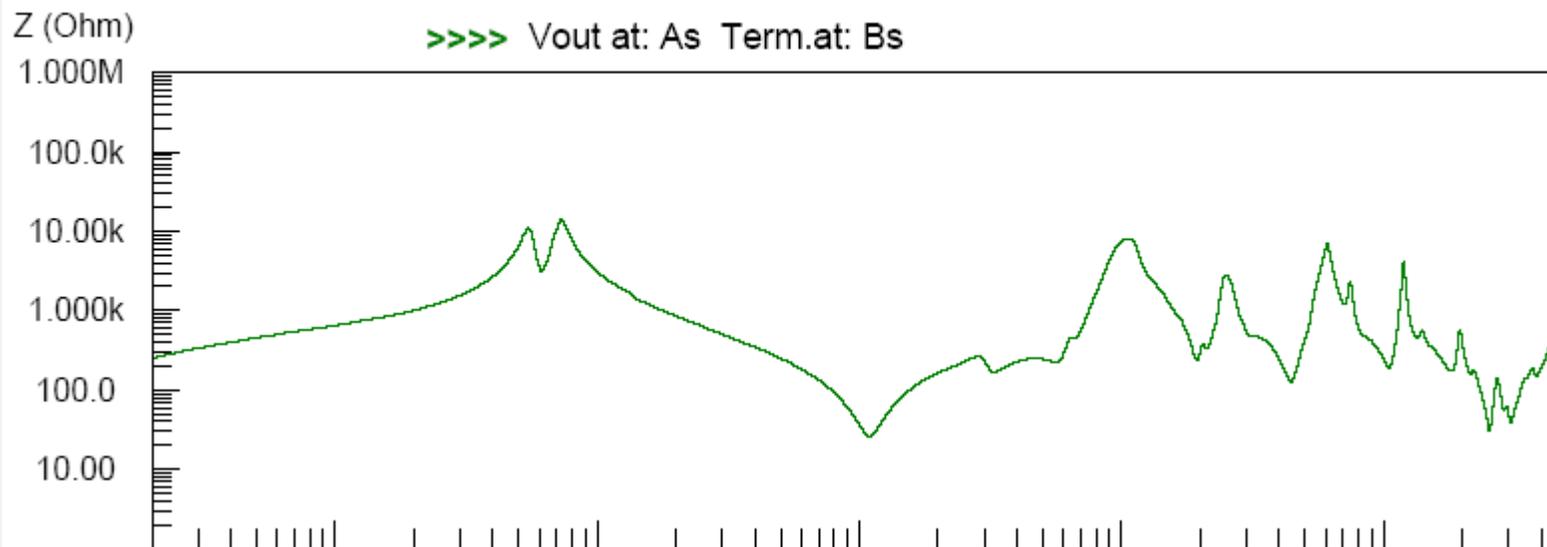
| Voltage output (Red clip) | Termination (Blue clip) | Other winding |
|------------------------------|----------------------------|----------------|
| 1U | 2U | 1N=GND, 2W=GND |
| 1V | 2V | 1N=GND, 2U=GND |
| 1W | 2W | 1N=GND, 2V=GND |



NLTC: 1 End-to-End Measurement Other winding: Open



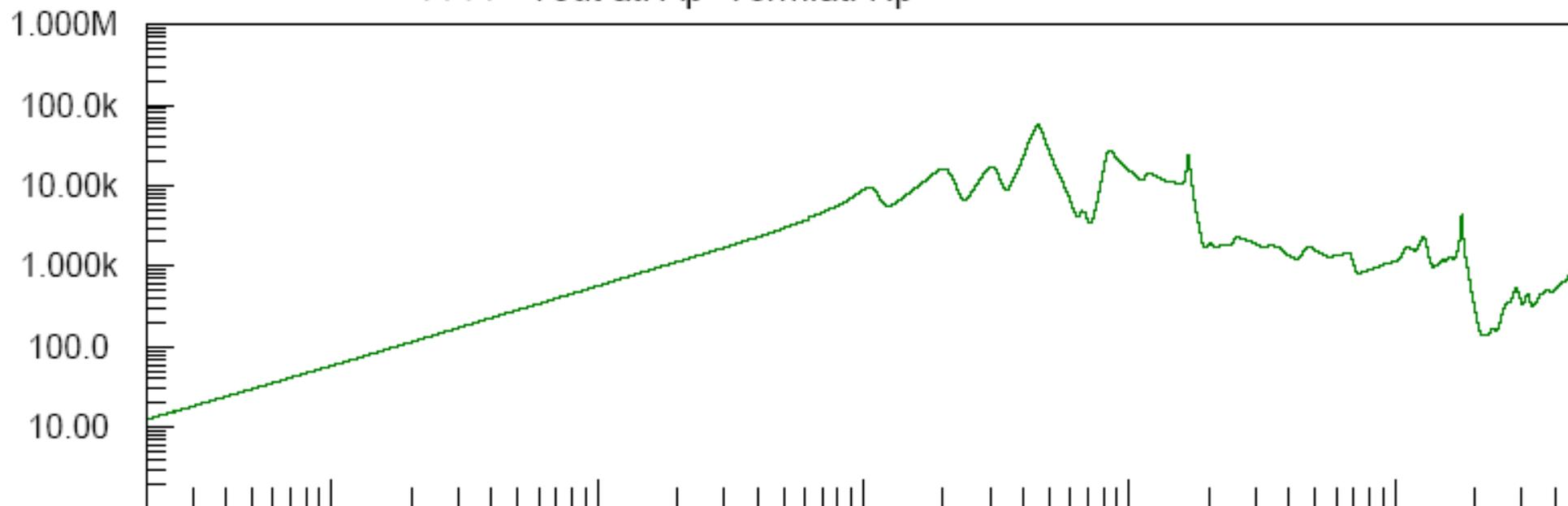
NLTC: 1 End-to-End Measurement Other winding: Open



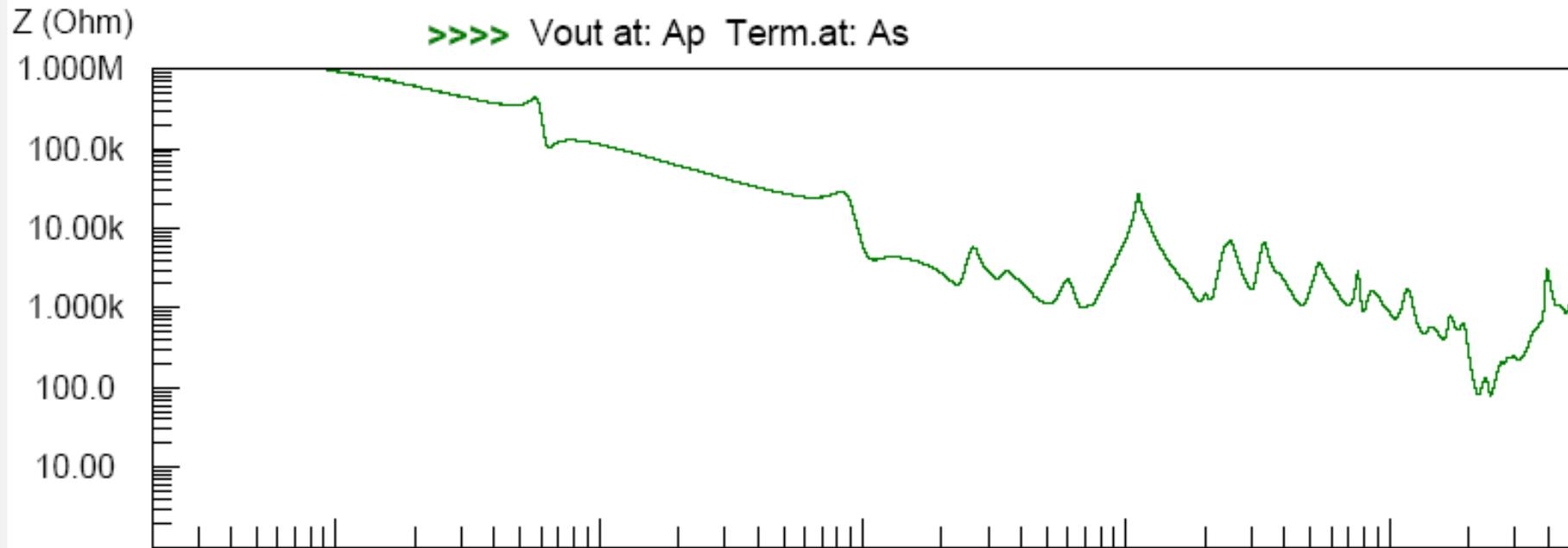
NLTC: 1 End-to-End Measurement Other winding: Short + GND

Z (Ohm)

>>>> Vout at: Ap Term.at: Np



NLTC: 1 Capacitive Inter-Winding Test Other winding: Open



NLTC: 1 Inductive Inter-Winding Test Other winding: 1N GND ; 2V GND

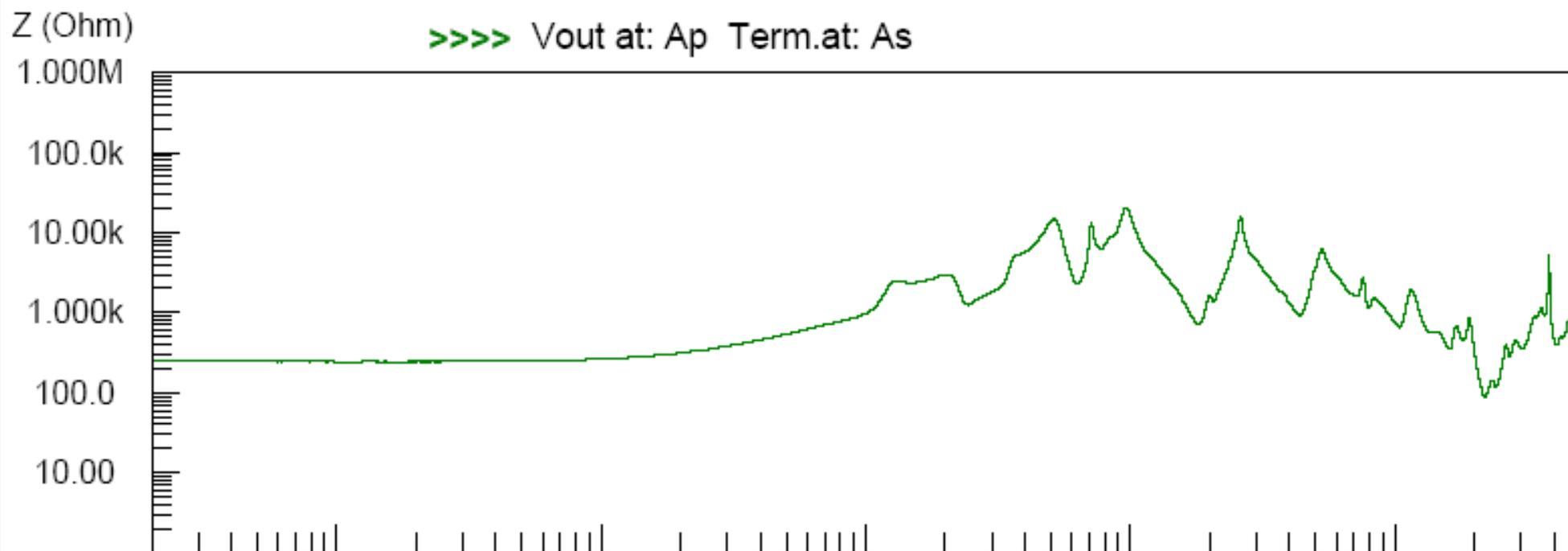
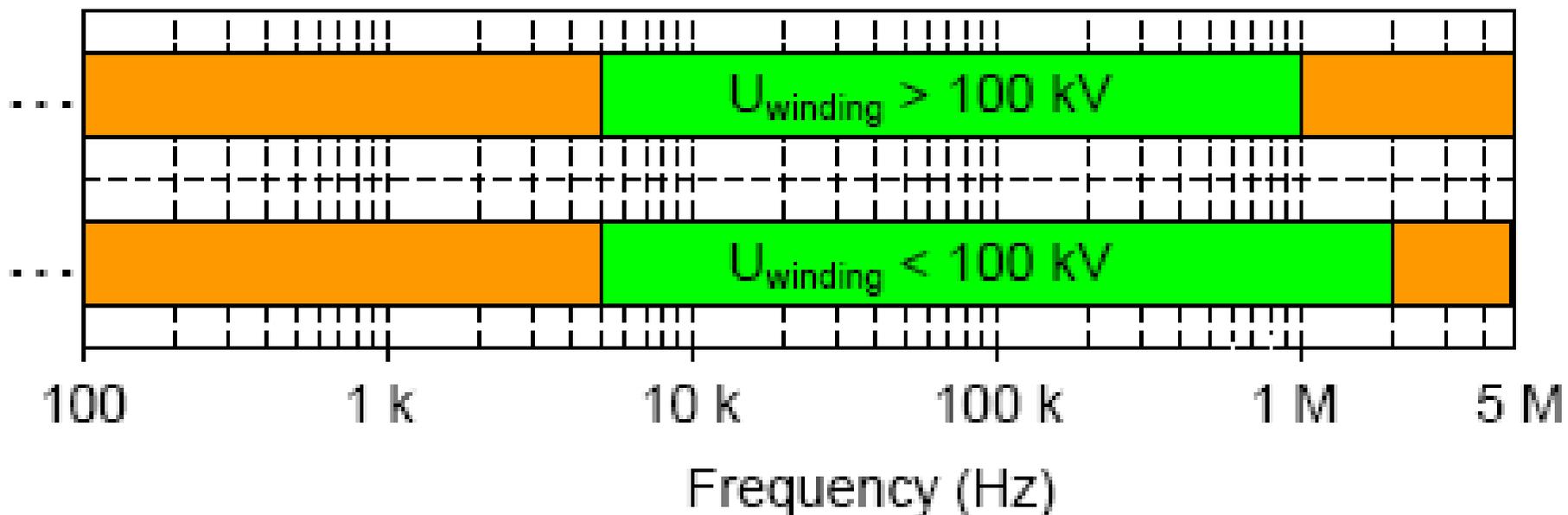


Table 2: Frequency range for natural frequencies of large transformer windings.

| Transformer component (> 100 MVA/limb) | Typical range for natural frequency | |
|---|-------------------------------------|------------|
| | start [kHz] | stop [kHz] |
| HV disk winding | 10 | 200 |
| LV layer winding | 10 | 1000 |
| Regulating winding | 100 | 1000 |

Table 3: Frequency range for natural frequencies of medium transformer windings.

| Transformer component (< 30 MVA/limb) | typical range for natural frequency | |
|--|-------------------------------------|------------|
| | start [kHz] | stop [kHz] |
| HV disk winding | 10 | 1000 |
| LV layer winding | 50 | 1500 |
| Regulating winding | 100 | 1500 |



Check:
Residual flux (LF)
Repeatability problem (HF)

Typical interpretation range

Figure 28: Typical FRA interpretation range.

*Köszönöm a
figyelmüket*
