Inductive compensation noise reduction

Wojciech Koczwara • Inductive compensation noise reduction | 13 Mar 23

Rockwell Automation

Contributors:

Galin Ivanov, Microchip

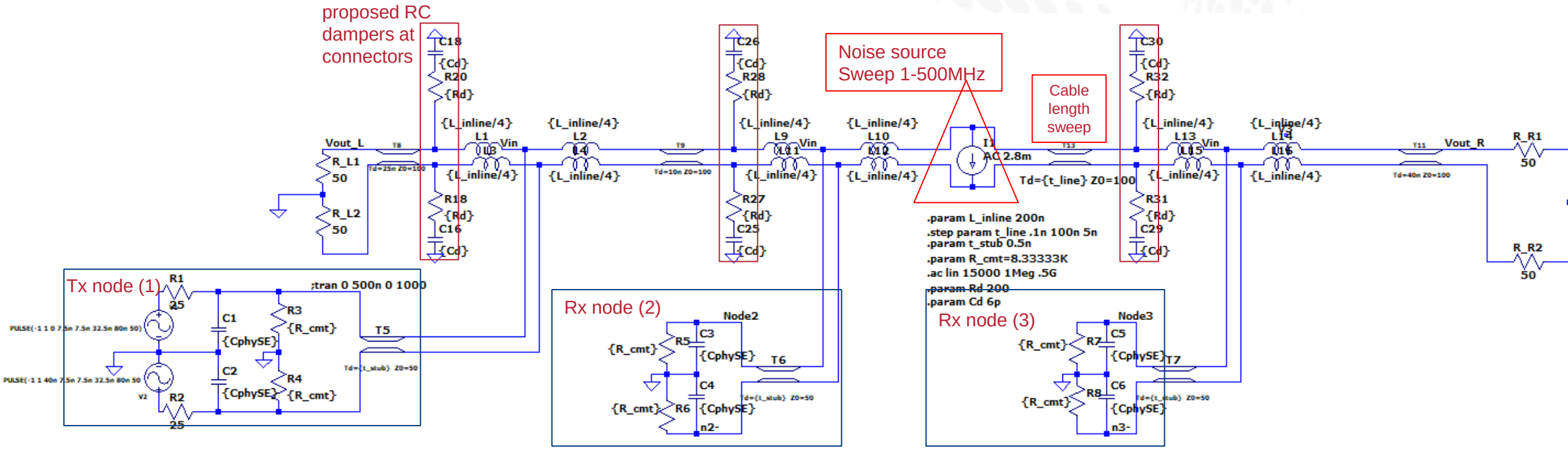
prof. Osami Wada, Kyoto University

Simulation setup – differential noise injection

I1 is the differential noise source

Simulations:

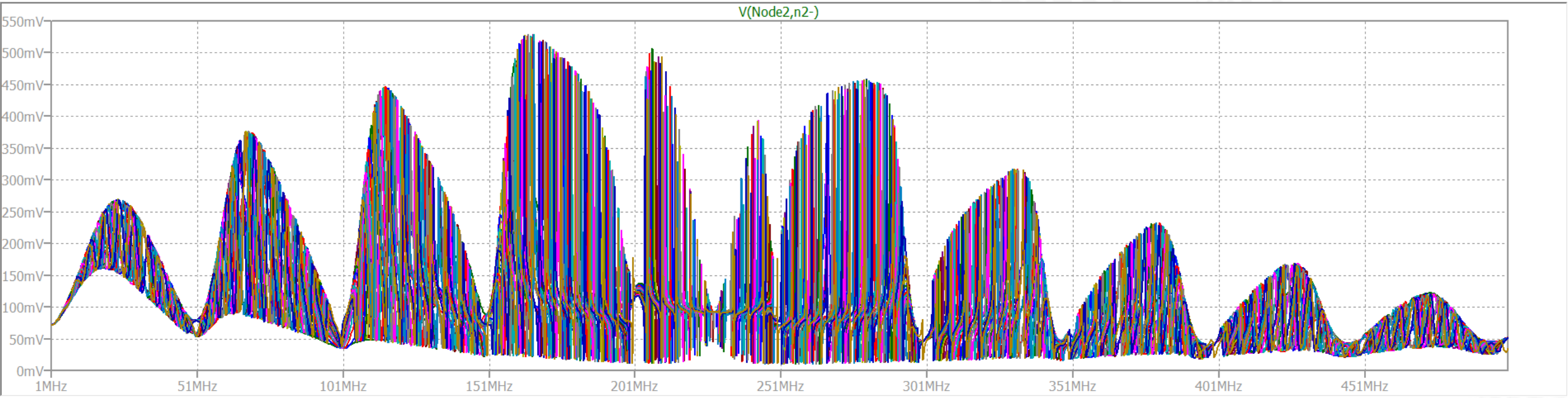
- **with/without impedance compensation**
- **with/without suggested RC dampers (400Ω/3pF differential)**



Differential noise without inductive compensation

Max differential noise:

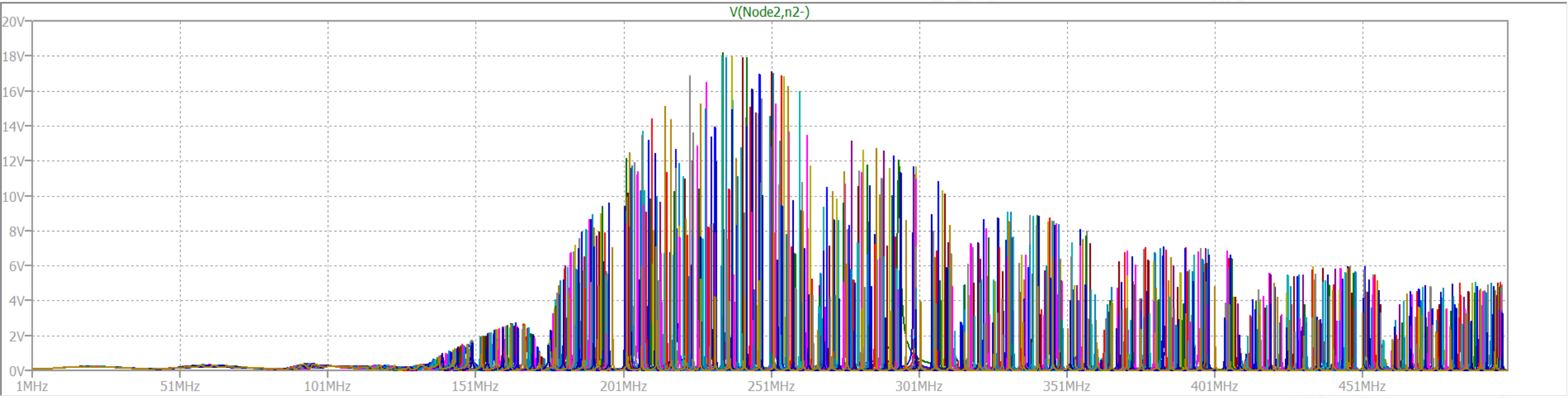
- **530mV (no impedance compensation)**



Differential noise with inductive compensation

Max differential noise:

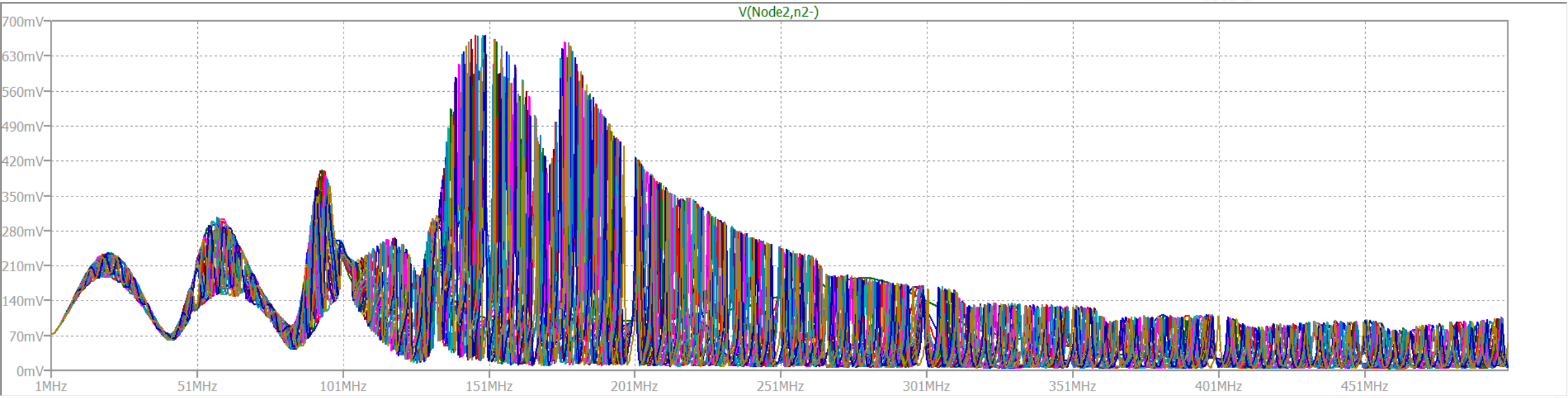
- **18.3 V (with impedance compensation [inductors only])**



Differential noise with inductive compensation and RC dampers

Max differential noise:

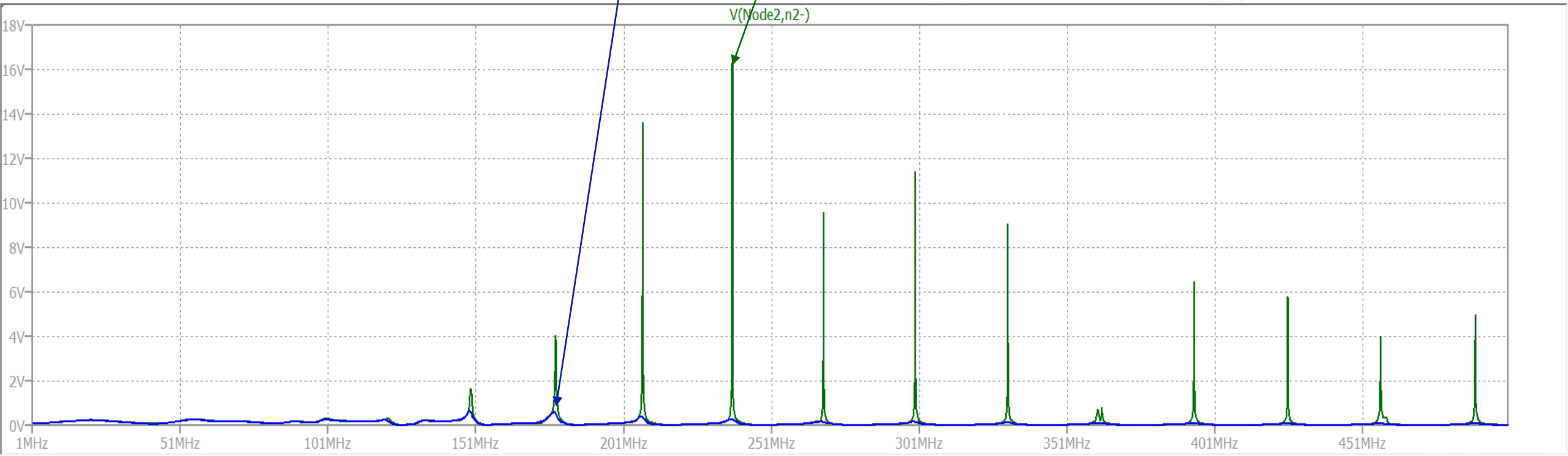
- **670mV (with impedance compensation and 400Ω / 3pF RC dampers), 27x noise reduction**



Effect of RC dampers for single cable length

Max differential noise:

- **16.3V (with impedance compensation, but no dampers)**
- **630mV (with impedance compensation and 400Ω / 3pF RC dampers)**



Conclusions and next steps

- Links using inductive compensation **and RC dampers** exhibit comparable noise coupling to links without inductive compensation
- Still using inductive compensation allows for a large number of nodes due to greatly reduced reflections
- Suggest to add Inductive compensation to the spec, including RC dampers
  - Suggested **Rdamp = 400Ω differential, Cdamp = 3pF differential**
  - RC damper capacitance needs compensation from the inline inductors (+30nH for Cdamp=3pF)
  - Cdamp can be implemented as parallel PCB planes (3mm x 3mm planes @ 4mils separation)

Thank you

www.rockwellautomation.com

Rockwell Automation