

Potential Impacts of 9-150 kHz Harmonic Emissions on Smart Grid Communications in the United States

Mark Halpin

Auburn University, USA

halpism@auburn.edu

Background

- Smart grid mostly means smart metering in USA
 - Costs covered by “American Re-Investment and Recovery Act” (late 2000s)
- Utilities in USA mostly use cellular radio technologies for “smart” communications
 - Only not used when conditions do not permit (terrain, environment, etc.)
- Many European countries use some type of PLC
 - This will be used in USA when radio is not viable

Overview of Work

- Numerous test results for European equipment and networks reported in WG8
 - No real contributions from USA (not a concern?)
- There is a need for information from USA
 - LV networks and systems are different
 - Equipment emissions could be different
 - Existing background levels could be different

Work Plan

- Measure existing disturbance levels on LV systems to establish baseline for comparison
 - Consider daily variations, weekly variations, holidays, etc.
- Measure emissions from specific equipment
 - CFL and LED lighting, Television/Displays, etc.
- Evaluate impact of typical LV networks and wiring on emission propagation from source to meter point

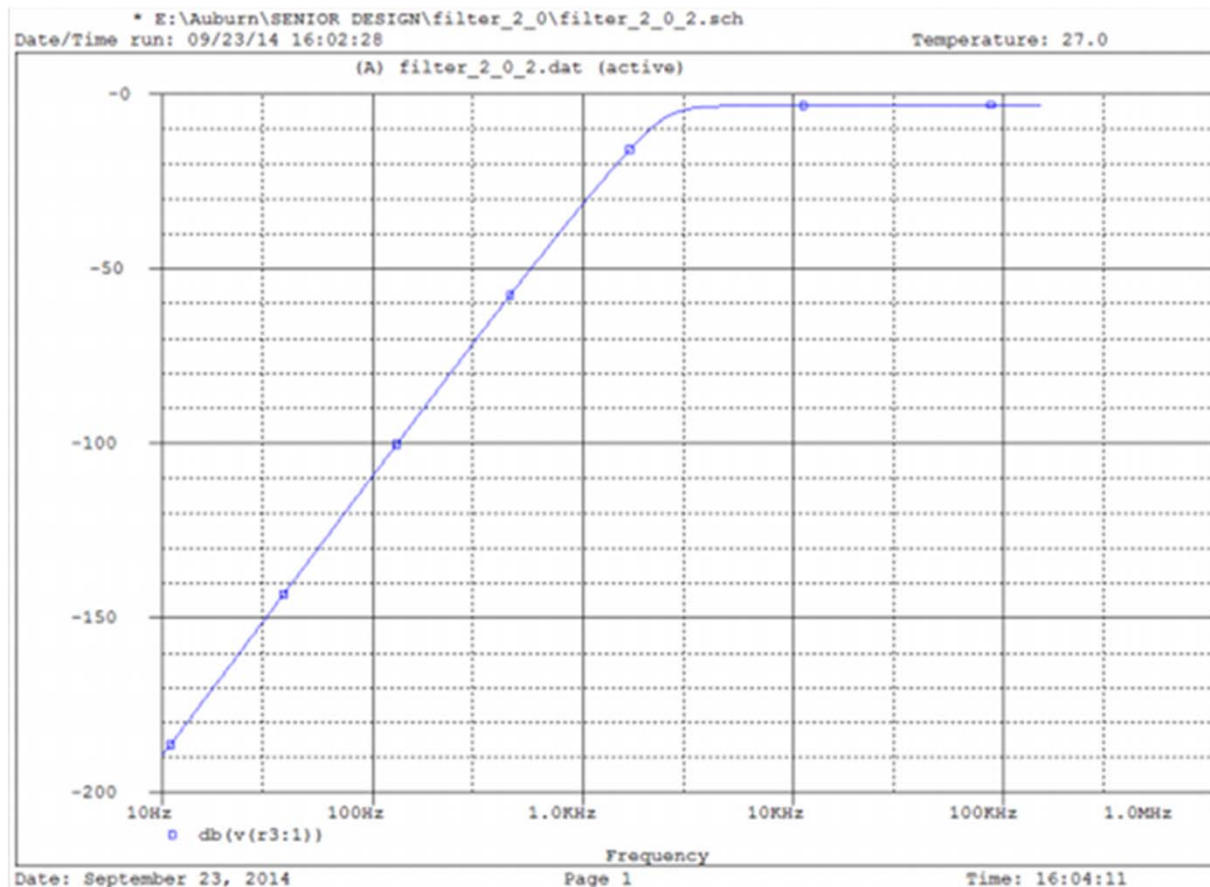
Measurement Approach



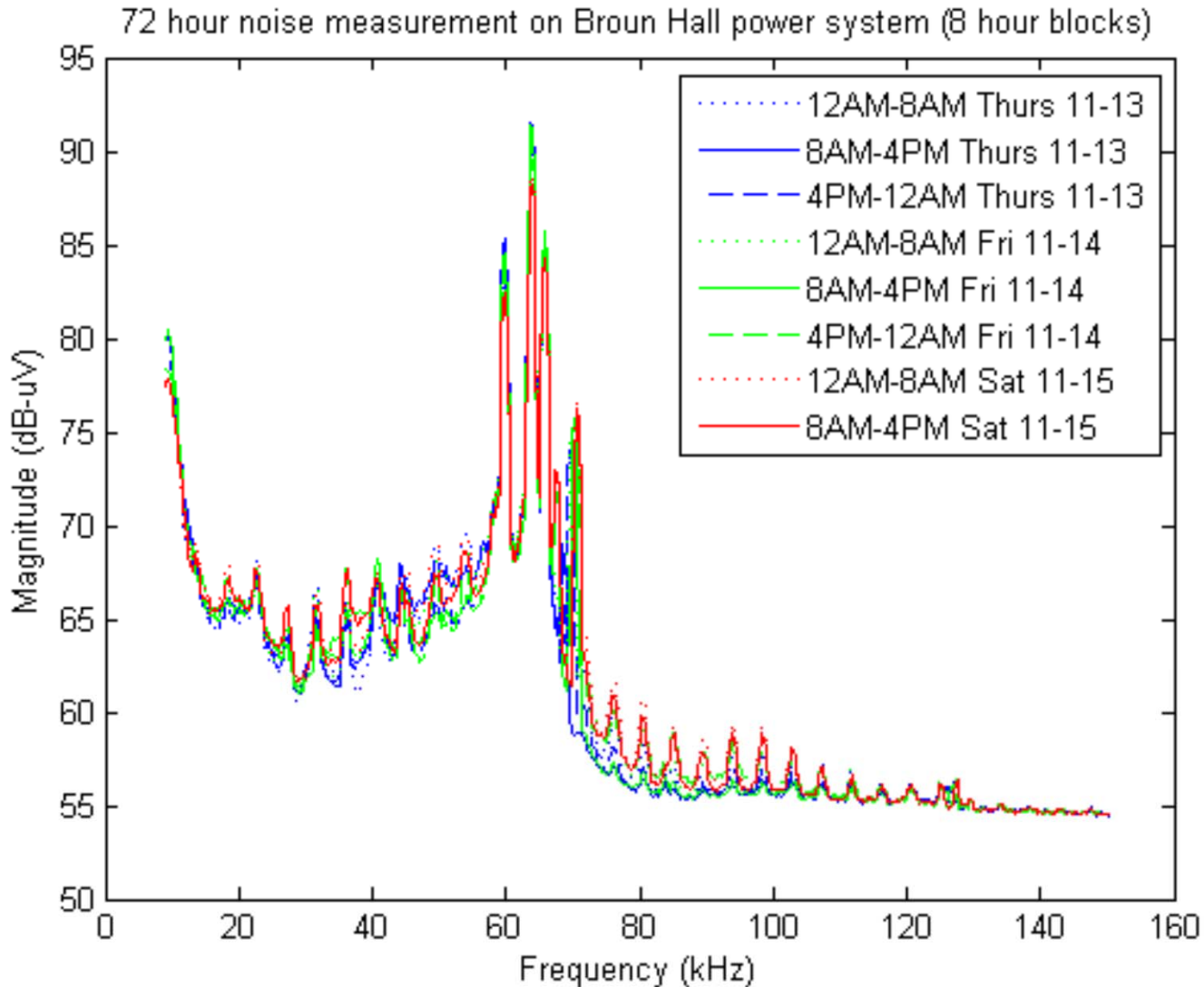
Measurements made at source end and load end of typical wiring/supply system with and without equipment in service

Interface Filter

- Custom filter designed and implemented to remove 60 Hz and low-frequency harmonics

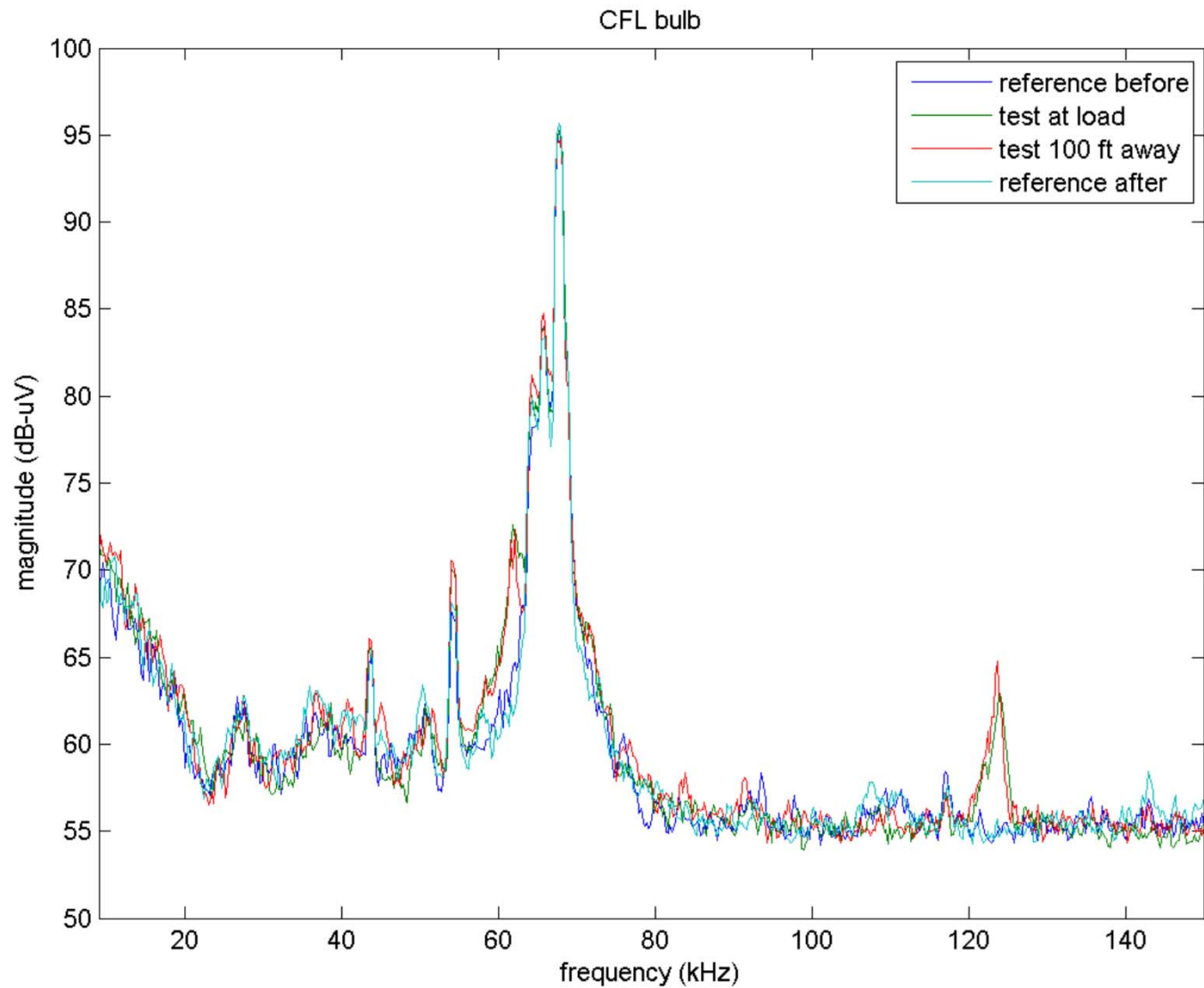


Measurement Results—Background

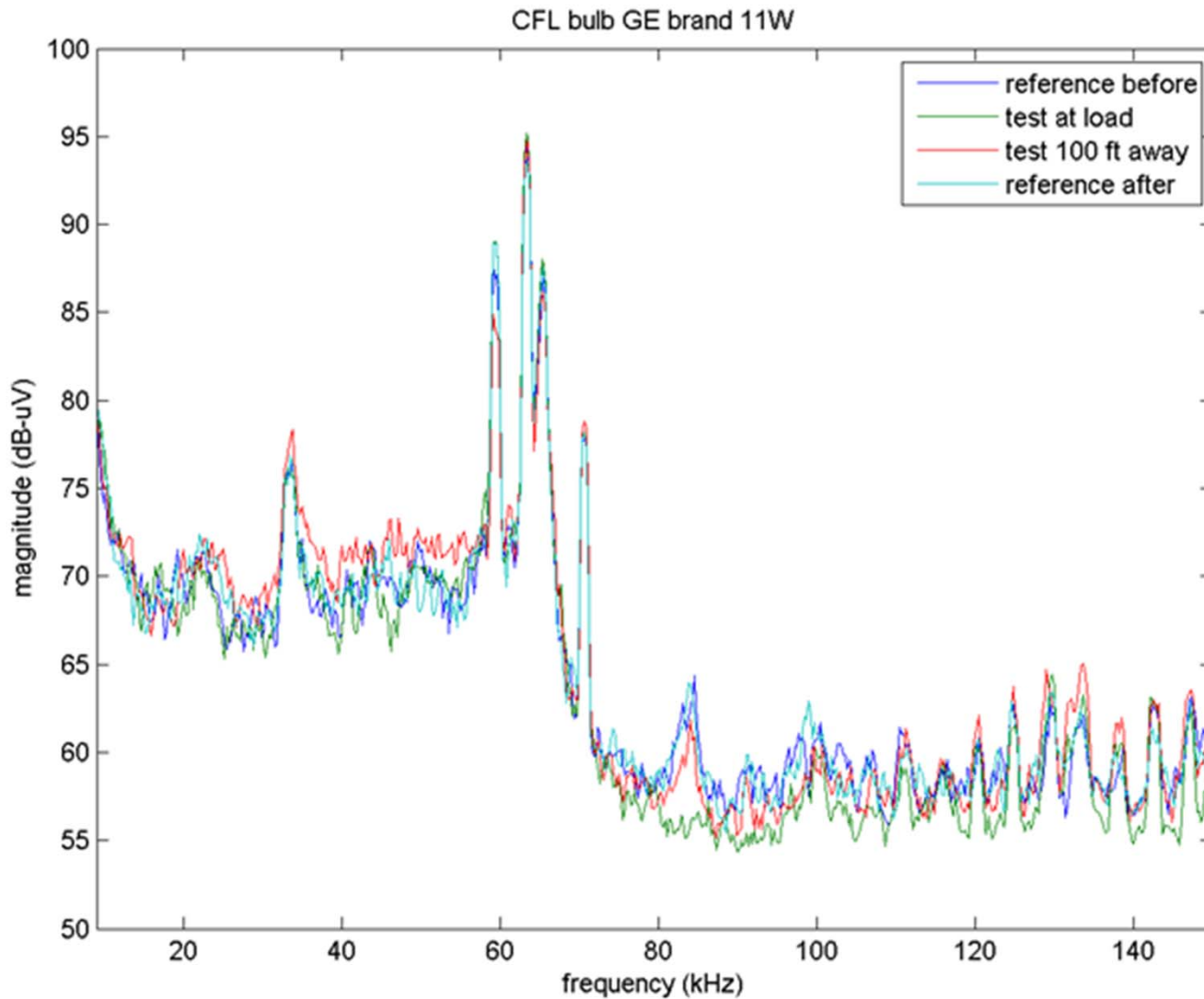


72 hour background disturbance levels already exceed proposed CLs

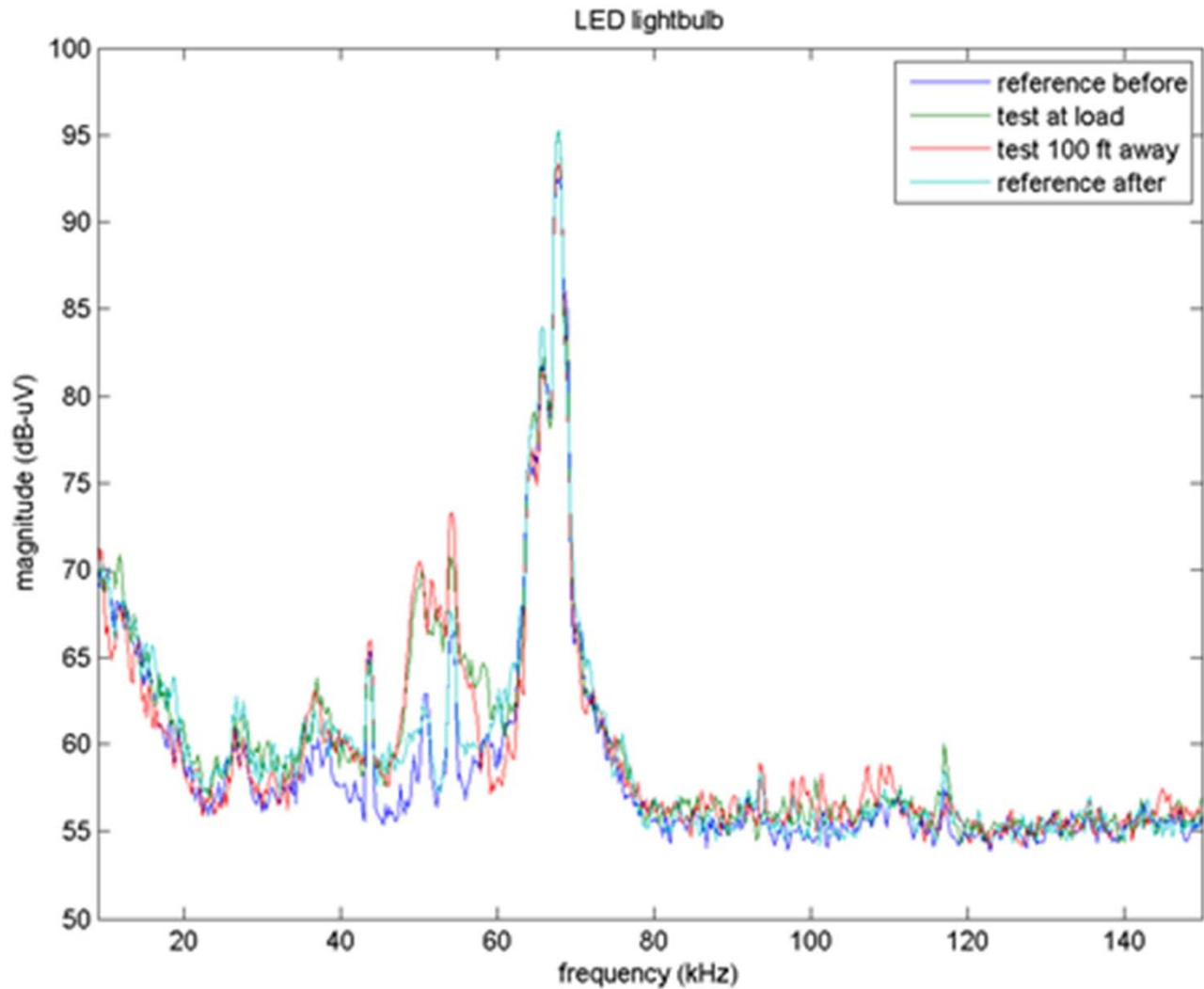
Measurement Results—13W CFL



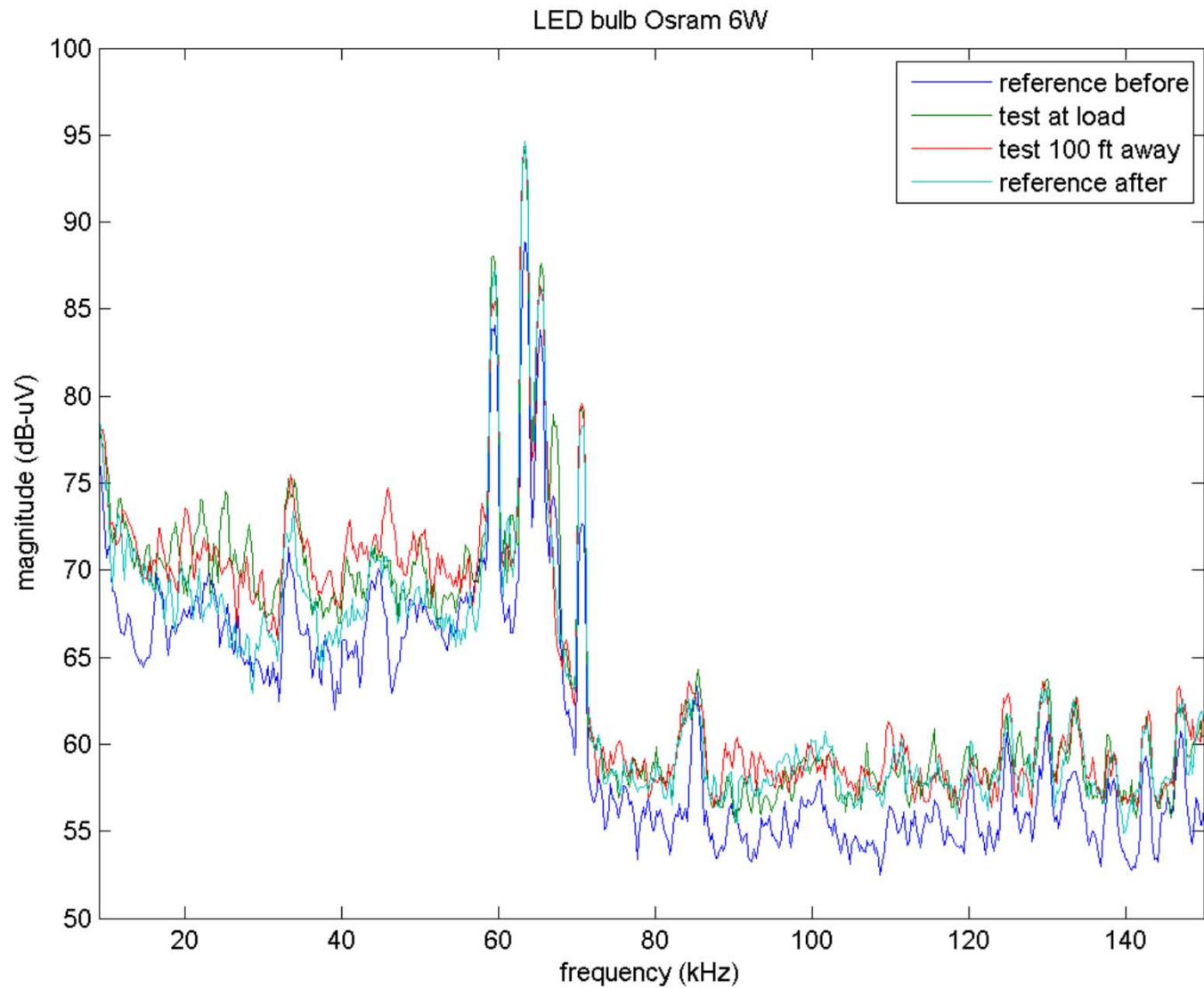
Measurement Results—11W CFL



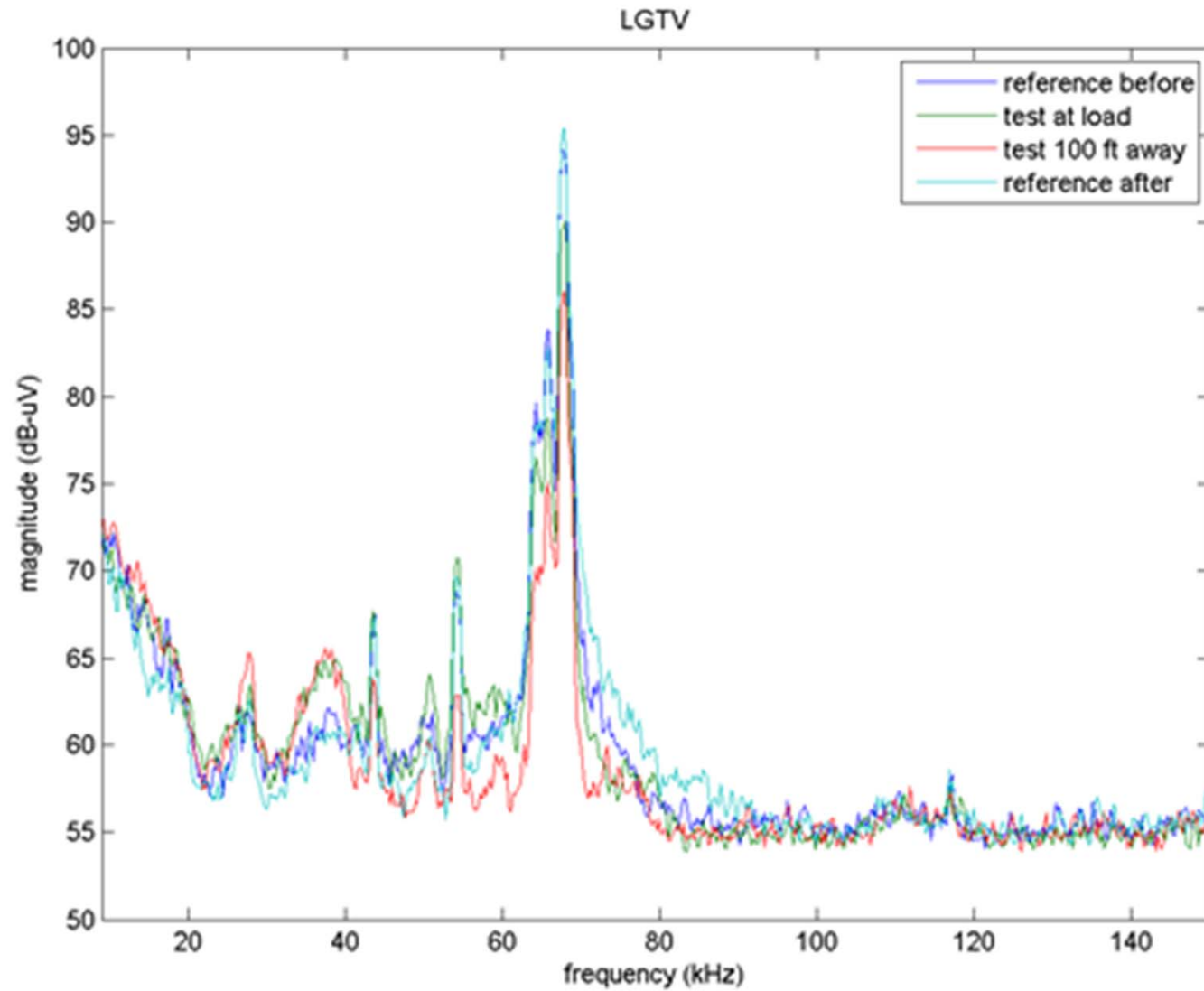
Measurement Results—9W LED



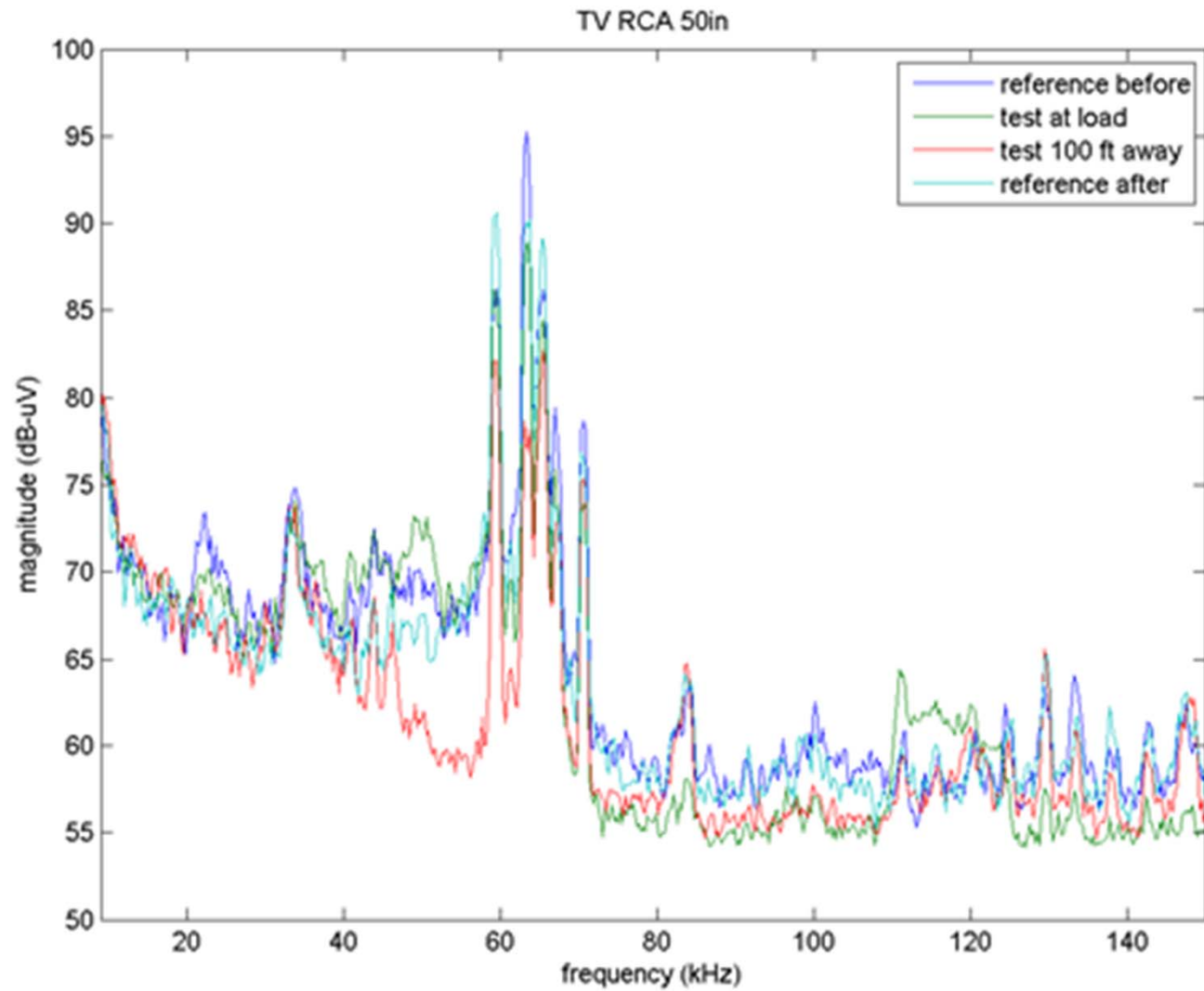
Measurement Results—6W LED



Measurement Results— TV1



Measurement Results— TV2



Conclusions

- Additional measurement results in paper
- Adding disturbing equipment can increase or decrease total disturbance level
 - No summation law exists at this time
- Effect of power cable between source and load has little impact on measurements
 - Disturbance levels at both source and load ends are similar with and without equipment in service
- Additional testing is obviously needed